Development Alternatives

HEINRICH BÖLL STIFTUNG
INDIA

UNDERSTANDING WATER FLOWS IN Dehradun

STATUS AND POTENTIAL

The **Understanding Water Flows in Dehradun** report is jointly published by the Heinrich Boll Foundation, Berlin, Germany and Development Alternatives, New Delhi, India

About Heinrich Böll Foundation

HEINRICH BÖLL STIFTUNG
INDIA

The Heinrich Böll Stiftung/ Heinrich Boell Foundation is a German foundation and part of the Green political movement that has developed worldwide as a response to the traditional politics of socialism, liberalism, and conservatism. We are a green think-tank and an international policy network, our main tenets are ecology and sustainability, democracy and human rights, self-determination and justice. We place particular emphasis on gender democracy, meaning social emancipation and equal rights for women and men. We are also committed to equal rights for cultural and ethnic minorities. Finally, we promote non-violence and proactive peace policies. To achieve our goals, we seek strategic partnerships with others who share our values.

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For more information please contact us:
Heinrich Böll Foundation, India Office
C-20, 1st floor, Qutub Institutional Area
New Delhi 110016, India
phone +91-11-2685 4405, +91-11-2651 6695
fax +91-11-2696 2840
mail: info@in.boell.org
web: www.in.boell.org

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Development Alternatives

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Status of Water Flows in Dehradun

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Understanding Water Flows in Dehradun

STATUS AND POTENTIAL

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HEINRICH BÖLL STIFTUNG

CORE PROJECT TEAM

DEVELOPMENT ALTERNATIVES

Shruti Issar, Manager, Policy Research
Aishwarya Varadharajan, Fellow

We are grateful for the support and guidance of our Advisory Panel members.

ADVISORY PANEL

DEVELOPMENT ALTERNATIVES

Zeenat Niazi, Vice President
Gitika Goswami, Programme Director

EXPERT CONTRIBUTORS

Our special thanks go to the many experts from academia, government, non-profits, and research organisations who provided invaluable perspectives and expertise throughout the project.

Uttarakhand PeyJal Nigam

V C Purohit, Chief Engineer
Y K Mishra, Chief Engineer Gharwal
Narendra Bisht, Chief General Manager, Construction Wing
S C Pant, Superintendent Engineer
L M Karnatak, Superintendent Engineer
G P Singh, AMRUT Nodal Officer (Drainage a& Sewerage), Central Store Division
Meenakshi Mittal, Assistant Engineer, (Doon Division – Dehradun)
Jaspreet Singh, Executive Engineer, Mechanical Division
Namita Tripathi, Executive Engineer

Uttarakhand Jal Sansthan

S K Sharma, Chief General Manager
Neelima Garg, General Manager
L K Adlakha, Officer Special Duty
Subodh Kumar, Superintendent Engineer
Manish Semwal, Executive Engineer–Water works (South division)
Yashbir Mall, Executive Engineer–Water works (North division)

Dehradun Nagar Nigam

Rachna Payal, Executive Engineer
Ashish Kathait, Nodal Officer- AMRUT
Dinesh Khanna

Uttarakhand Environmental Protection & Pollution Control Board
S P Subudhi, Member Secretary

Department of Irrigation, Uttarakhand
Subhash Chandra Pandey, Superintendent Engineer

Gati Foundation
Anoop Nautiyal, Director

Uttarakhand Science Education & Research Centre
Dr Durgesh Pant

Col. H R S Rana, Ex. C. O. Eco Task Force, Uttarakhand

LIST OF ACRONYMS

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
ATM	Automated Teller Machine
BPL	Below Poverty Line
BWS	Baseline Water Stress
CDP	City Development Plan
CSP	City Sanitation Plan
CWR	Clear Water Reservoir
DI	Ductile Iron
DNN	Dehradun Nagar Nigam
DoDW	Department of Drinking Water
DPR	Detailed Project Report
GIS	Geographical Information System
GOI	Government of India
GoU	Government of Uttarakhand
JNNURM	Jawaharlal Nehru Urban Renewal Mission
KL	Kilo-Liter
Km	Kilometer
kWh	Kilo watt per hour
LPCD	Litres per Capita Day
MLD	Million Liter per Day
MoHUA	Ministry of Housing & Urban Affairs
MoUD	Ministry of Urban Development
NRW	Non-Revenue Water
O&M	Operations and Management
OHT	Over-Head Tank
PVC	Poly Vinyl Chloride
SAAP	State Action Annual Plan
SBR	Sequence Batch Reactor
SDG	Sustainable Development Goals
STP	Sewage Treatment Plant
TAC	Technical Advisory Committee
UJS	Uttarakhand Jal Sansthan
ULB	Urban Local Bodies
UN	United Nations
UPJN	Uttarakhand Pey Jal Nigam
WTP	Water Treatment Plant

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About the Project

Cities are the epicenters of growth; however the rising urbanization phenomenon has directly given rise to unchecked resources exploitation. Contamination of fresh water and scarcity of water resources are the first and foremost issues that occur as a result of over-exploitation and mismanagement of the city's water resources and has led to resource overuse and resource use conflict between various users.

With support from Heinrich Böll Foundation (HBF), this study is undertaken to explore and understand water resource flows in urban areas and accordingly draw lessons for more efficient urban water planning and management. The study attempts to enable a more holistic understanding of not only sources of water into a city and its use in the city, but also the quantity of resource and the different processes through which it flows before its final consumption, treatment and disposal. The key objective of the study is to highlight the need for viewing urban water management systems through the circular metabolism perspective and to identify areas where interventions can be made to ensure-efficient water management.

Raw water, drinking water, waste water and urban eco-systems in the urban environments are often managed in isolation rather than as an integrated system. As a result, there is a gap in the methodology that can enable urban planners in designing water sufficient and efficient cities or retrofit existing cities in terms of infrastructure, water governance and water education. An urban water resource flow methodology is likely to provide tools for sustainable solutions to address the growing water demand and efficient water management in cities.

An understanding of urban water resource flows, integrating the principles of resource circularity into planning would add significant value to designing sustainable and resilient cities. The study would additionally support policy makers in developing strategies and actions for integrated water management for resource(water) security and resilience.

This report is the glimpse of the baseline scenario prevailing in the city of Dehradun. Following are the key aspects of the nature of water flows in Dehradun:

CHARACTERISTICS OF DEHRADUN'S WATER SOURCES

The Dehradun city is primarily dependent on the ground water sources to meet its water needs. Around 90% of the water supplied is sourced from the ground water source, indicating the need to reassess the dependency on ground water for the sustainable resource management in the future. Increasing the optimum usage of the surface water within the region by developing gravity dams and reservoirs to meet the water needs of the city would support in reducing the dependency on ground sources.

Fig: STP at Kargi

POTENTIAL OF WASTE WATER AS A RESOURCE

Currently, there are 4 Sewage Treatment Plants (STP) that are operational in the city, with an installed capacity of 89 MLD, however, only 18 MLD of waste water is treated at these plants. An additional 4 STP are under construction with an installed capacity of 29 MLD. The waste water which is treated at the STP is directly let out into the water bodies or open fields, indicating the huge unutilized resource with a potential of reducing the dependency on fresh water, if treated waste water is brought to reuse.

NATURE OF GOVERNANCE IN WATER MANAGEMENT

Unlike many other cities, the municipal bodies are responsible for management of water resource within the city; the water resource management in Dehradun is mainly carried by a set of institutions under the Department of Drinking Water (DoDW), Government of Uttarakhand (GoU). The water supply of Dehradun is operated and maintained by Uttarakhand Jal Sansthan (UJS), an institution working under DoDW, also responsible for constructing small works. However, the large capital works and overall planning is carried out by Uttarakhand Pey Jal Nigam (UPJN) also working under DoDW. Dehradun Nagar Nigam (DNN) is not involved in the planning, design, construction, operation, maintenance and service delivery of this important Urban Infrastructure.

EFFICIENT WATER DISTRIBUTION SYSTEM

Like many other cities, the Dehradun city is also facing the problem of distribution loss. Despite having sufficient water from both ground and surface water, due to 38% distribution loss,[1] considerable amount of water is lost before it reaches the consumer, indicating the urgent need for efficient management of the water distribution system.

1 The distribution loss of 38% has been derived after consultation with the UttarakhandPeyJal Nigam

Dehradun

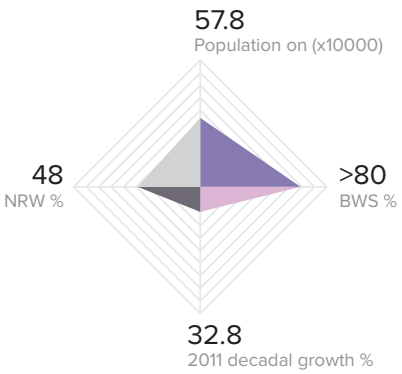


Figure 1: Status of Dehradun

Dehradun is the administrative center and the interim capital of the state of Uttarakhand. Dehradun was declared the provisional capital of newly created state Uttaranchal (Now Uttarakhand) in November 2000. The city is situated at the Himalayan foothills in the fertile Doon Valley. Dehradun city has two main rivers, Bindal and Rispana which flows through the city. The city of Dehradun is surrounded by river Song on the east, river Tons on the west, Himalaya ranges on the north and Sal forests in the south. Song River is a medium Himalayan tributary of River Ganga and creates a boundary of Dehradun and Tehri-Garhwal up to village Maldevta.

According to the Dehradun Master Plan- 2025, 27% of the area is under urban land and 73% of the area is under rural land, i.e. 96.99sq km is under city area and about 261.68 sq km is under rural area. Within the urban areas, 31% is residential; 8.4% under commercial, industrial and offices; 4.8% under Forest Research Institute; almost 31.5% of the area undefined; and the remaining under garden, forest etc.

The Census 2011 estimated the population of the city as 5,78,420. Dehradun has served as a state headquarters for over 17 years which has resulted in mass migration from hills, huge floating population and high tourist footfall. The arial extent of the city is about 64.88 sq.km. The water supply system was introduced in Dehradun in 1885. Pipelines were laid from a natural spring at Kolukhet situated 25 km from Dehradun. The water supply system was re modelled and underwent major augmentation between 1936 and 1937.

CITY'S PRIORITIES

The city authorities of Dehradun have identified and prioritized the need for efficient water management system in the city due to the high rate of growth of population; a sustainable water system is essential. Goal 1 of the Smart City Proposal of Dehradun focuses on infrastructural development in the sectors of water supply, sewerage, storm water drainage, smart water meters and water ATMs along with a 24*7 water supply. However, the issue of equitable distribution, sufficient resource availability and the efficient resource management receives limited attention.

The city experiences Baseline Water Stress (BWS) greater than 80% and the Non-Revenue Water (NRW) is about 48%. There is a lack of sufficient ground water recharge to meet the requirement of depleting ground water tables. Water losses in the distribution system due to old and poor quality pipes made of PVC and illegal connections of water is one of major issues the city faces. Further, with the decadal growth rate of 32%, the stress on the water system of the city is forecasted to increase over time.

Population
5,78,420

Density
1900 ppkm²

Growth Rate
32.48%

Climate and Topography
Humid Subtropical

Area (sq.km)
96.99 sq.km

Freshwater Source

Demand

Total water demand
147 MLD

Total water available for consumption (From Sankey findings)
92 MLD

Slum Population (%)
27%

Major Industries
Floriculture & Horticulture, Food processing industry, Biotechnology industry, Information and communication technology, eco- tourism

Baseline Water Stress
>80%

Precipitation
3000 mm

MoUD Scheme/ Programmes

204.23 Cr funds allocated by ULB for water supply,800 Cr for drainage; 416.85 Cr for sewerage and septage management. (SAAP)

Supply

Total water supply (freshwater and ground water sources)
150-155 MLD

% BPL households having in house water supply connection
63.3%

% households having in-house water supply connection
Approx. 90%

Avg annual rainfall
2187 mm

Avg water supply/person
155 lpcd

NRW
48%

CURRENT SITUATION OF THE URBAN WATER CYCLE

INSTITUTIONAL SET-UP

Unlike many other cities where the municipal bodies are responsible for the management of water resources within the city; the water resource management in Dehradun is mainly driven by a set of institutions under the DoDW, GoU. The responsibility for operation and maintenance of water supply in Dehradun lies with Uttarakhand Jal Sansthan (UJS), an institution working under DoDW. However, the large capital works and overall planning are carried out by Uttarakhand Pey Jal Nigam (UPJN) also working under DoDW. Dehradun Nagar Nigam (DNN) is not involved in the planning, design, construction, operation, maintenance and service delivery of this important Urban Infrastructure.

For an effective management, the city is divided into 51 zones; 5 zones are water sufficient with a water supply of 135 lpcd and 46 zones do not receive sufficient water. Therefore for effective water supply to these 46 zones, 23 zones are managed under the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and executed by the Peyjal Nigam (Dehradun division) and the remaining 23 zones are managed by the Asian Development Bank (ADB)

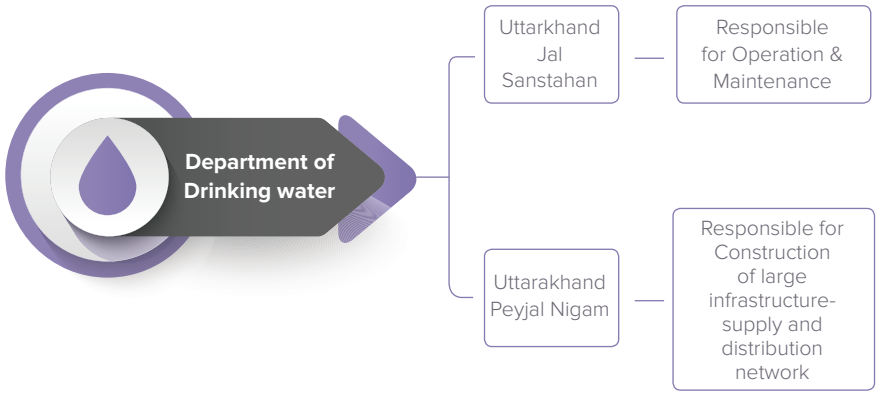


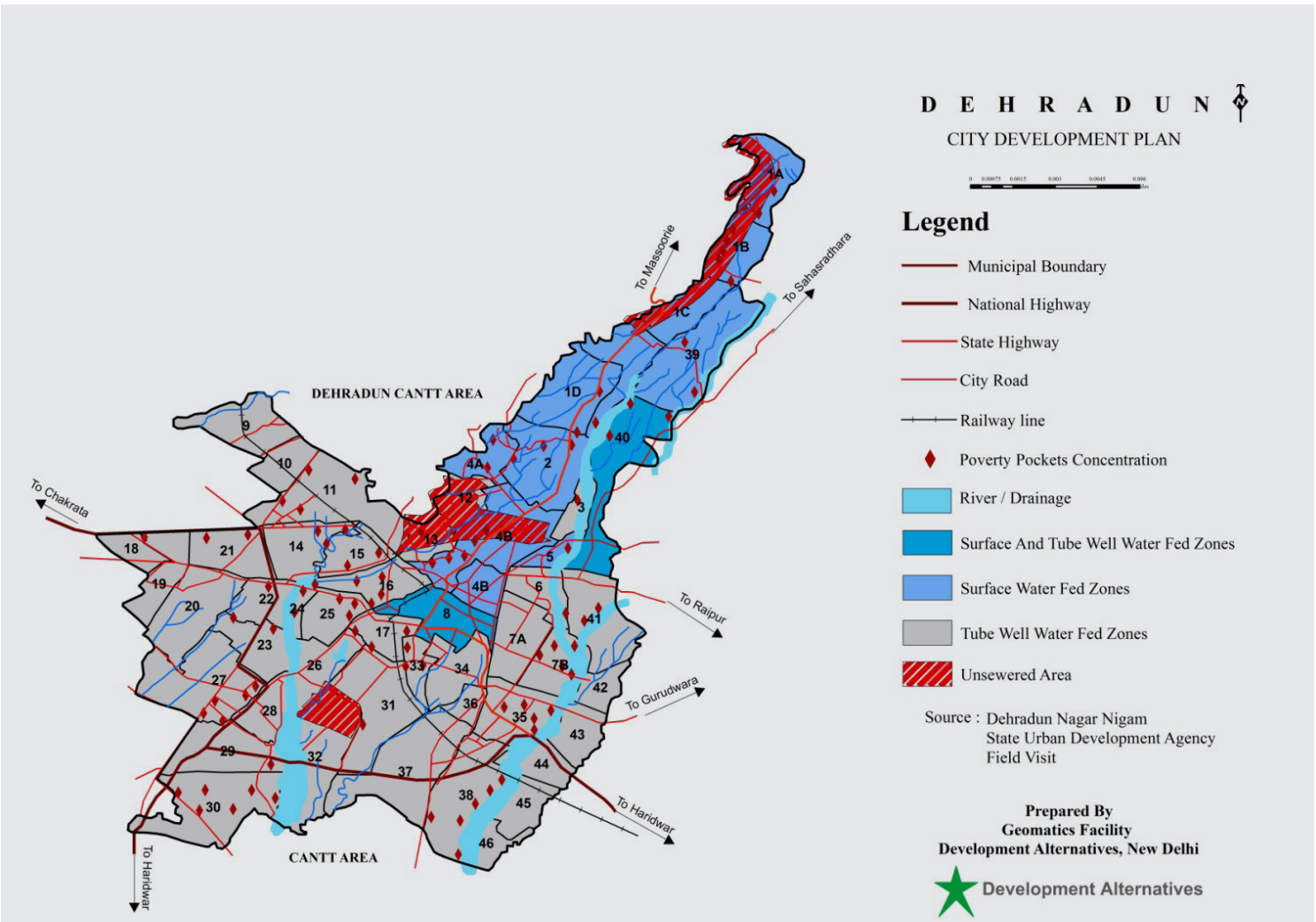
Figure 2: Institutional Set-up

TYPE OF FLOW

Based on the type of flow, Dehradun is broadly divided into three water supply zones; gravity flow zone, pumping flow zone and mixed flow zone. The northern part of the town mainly Rajpur Road and localities around it fall under the gravity flow zone and therefore receives only surface water, while the southern part of the town including the old city area receives water through ground water sources. The third zone is in between these two zones and can be called as the mixed flow zone where water is supplied from ground water as well as from surface water sources.

The overall current water situation of the city to meet its water supply needs with respect to the different sources including tubewells, surface water and mixed zone is represented in Map 1. Unsewered areas in the map provide an estimation of the areas which are not connected to the existing STP's.

Map 1:
Depiction of un-sewered areas and poverty pockets across the different water fed zones



THE WATER FLOWS SITUATION IN DEHRADUN

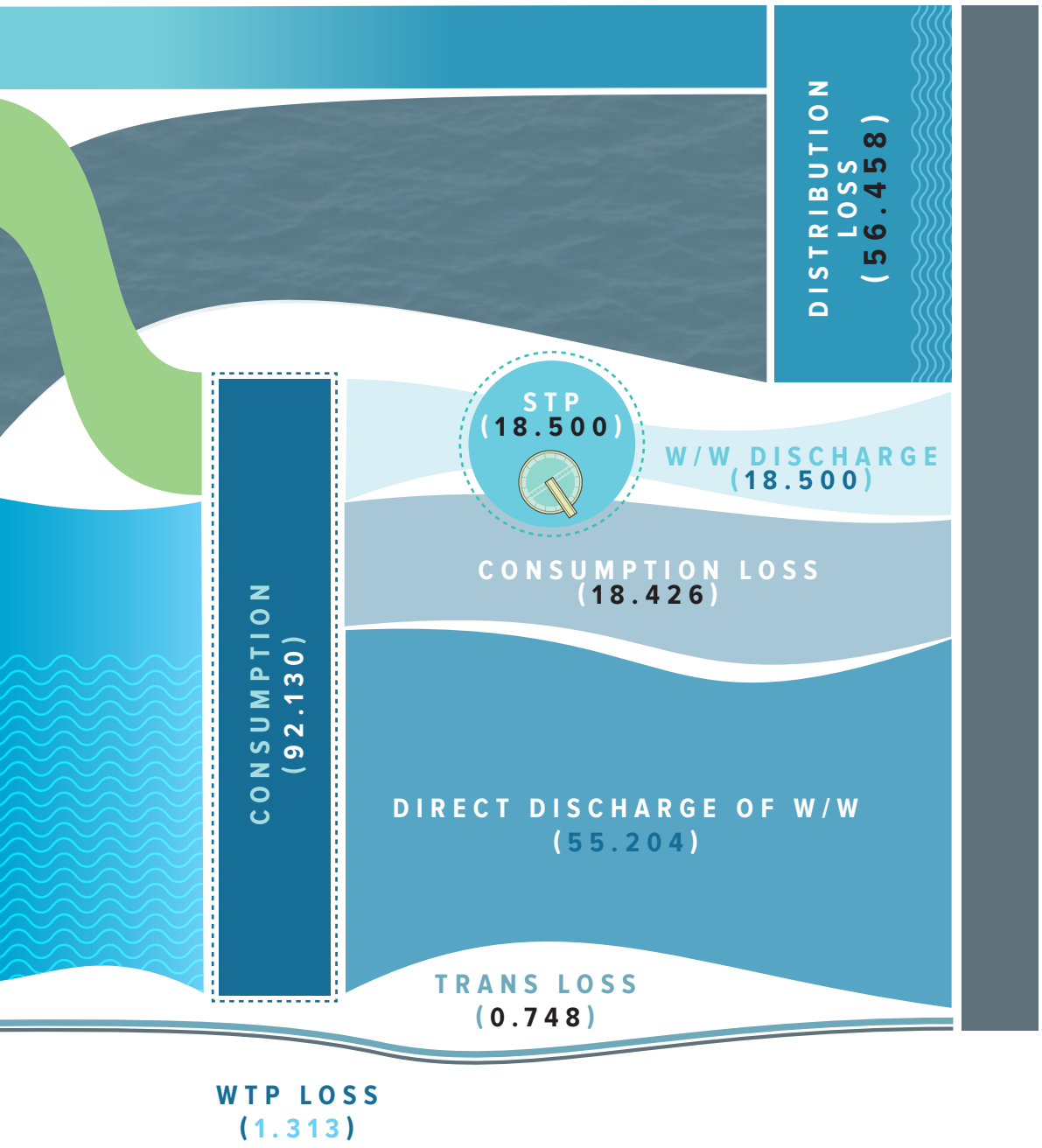
The sources of extraction as depicted in the sankey diagram for the Dehradun city are surface water and ground water. Around 90% of the water supplied is sourced from the ground water source. The sankey depicts that around:

- 25.86 MLD of surface water and 124.8 MLD of ground water is extracted for consumption in the urban city.
- A small quantity of ground water(0.4 MLD) along with all the surface water is transported to the Water treatment plant. The remaining groundwater 124.4.MLD is let out for direct pumping.
- Considering 5% loss of water at the WTP and a transmission loss of 3%, 24.19 MLD of water from the WTP reaches the OHT & Reservoir where it is stored.
- Around 75% of ground water let out for direct pumping is sent to the OHT & Reservoir and the remaining 25% which is sent for direct distribution across the city. The volume of water present in the OHT & Reservoir is around 117.5 MLD which is pumped and sent for distribution across the city.

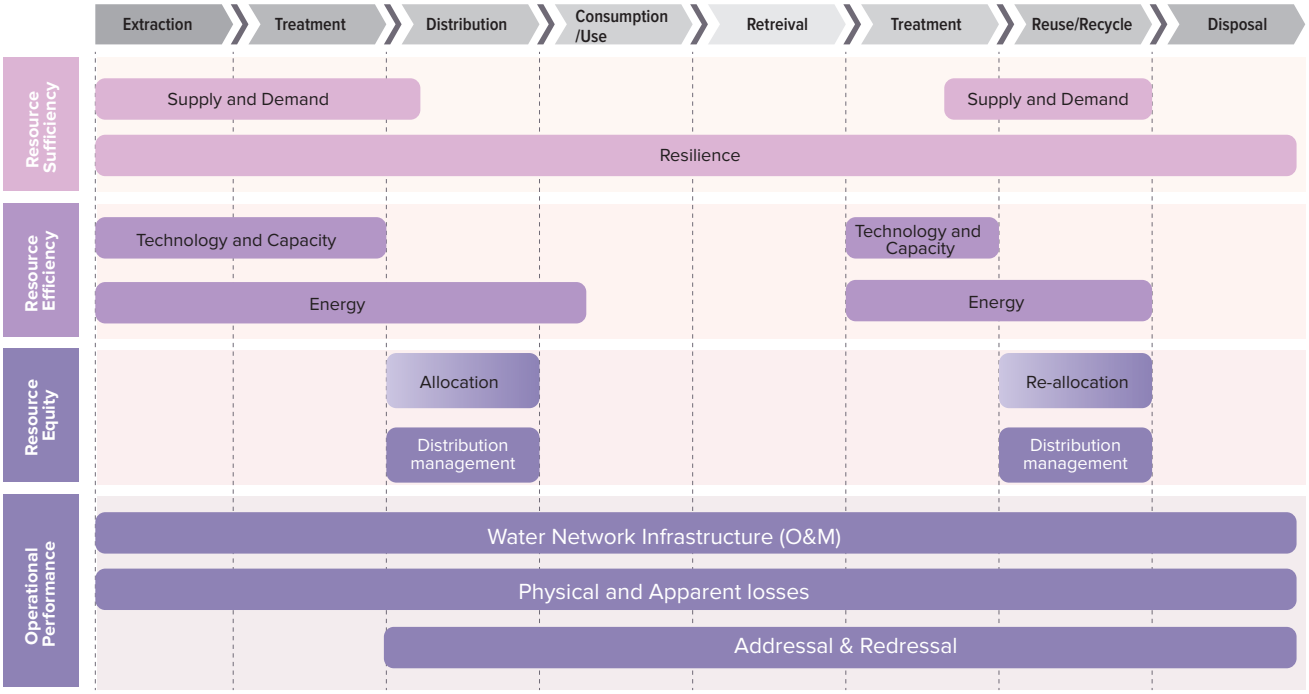
Figure 3: Sankey diagram: Water flows situation in Dehradun

- Considering high distribution losses (38%) for each of the distribution pathways, the total water available for consumption is 92.13 MLD.
- Assuming that 80% of the water consumed is let out as waste water, and with current working capacity of all the STP's in Dehradun at 18 MLD, out of 73.7 MLD, 18.5MLD is sent for treatment and the remaining wastewater which Is 55.2MLD is directly discharged into water bodies/open fields.
- Since the treated water at the STP is not brought to reuse, the entire treated water (18 MLD) is also directly discharged into water bodies/open fields.

The current urban water system in Dehradun clearly indicates the huge potential for efficient water management with strategic focus on the potential for reuse of treated waste water; efficient distribution system; and optimum utilization practice.



ANALYSIS FRAME



For an effective sustainable urban water system, the natural and anthropological parts of the urban water system have been explored from the lens of resource resilience and efficiency. Four domains have been identified to act as a lens to understand the urban water system. The four lenses through which the water flows in the Dehradun city is looked upon includes:

- **Resource Sufficiency:** This refers to the ability of ensuring continuity in consumption without constraints on the supply. The main drivers of increased self-sufficiency are identified as shortage of available water, constrained infrastructure, high quality water demands and commercial and institutional pressures. Research studies have demonstrated that increases in self sufficiency ratios can be achieved upto 80% with contributions from recycled water, sea water desalination and rain water collection.
- **Operational performance:** This refers to the performance which is measured against standard or prescribed indicators of effectiveness, efficiency, and environmental responsibility such as cycle time, productivity, waste reduction and regulatory compliance.
- **Resource Efficiency:** Resource efficiency is defined as 'the ratio of resource inputs on one hand to economic outputs and social benefits on the other'. It is an innovative approach to resource consumption by reducing the total environmental impact of the production and consumption from raw material extraction to final use and disposal. It plays a pivotal role in introducing sustainable production and consumption patterns to residents of the city as well as municipal governments on the opportunity to improve resource efficiency, decrease CO2 emissions, reduce environmental risks and safeguard ecosystems.
- **Resource Equity:** This refers to ensuring equitable access to water, and to the benefits from water use, between women and men, rich people and poor, across different social and economic groups which involves issues of entitlement, access and control.

These lenses are used to understand the nature of water management in the city and identify key areas of intervention to support sustainable urban water system. This would further contribute towards achieving Sustainable Development Goal- Six (SDG-6) on clean water and sanitation for all. The progress on each of these lenses would contribute to specific indicators under SDG6 and targets laid under Ministry of Housing and Urban Affair's (MoHUA) programme- Smart Cities Mission. Thekey SDG indicators include –

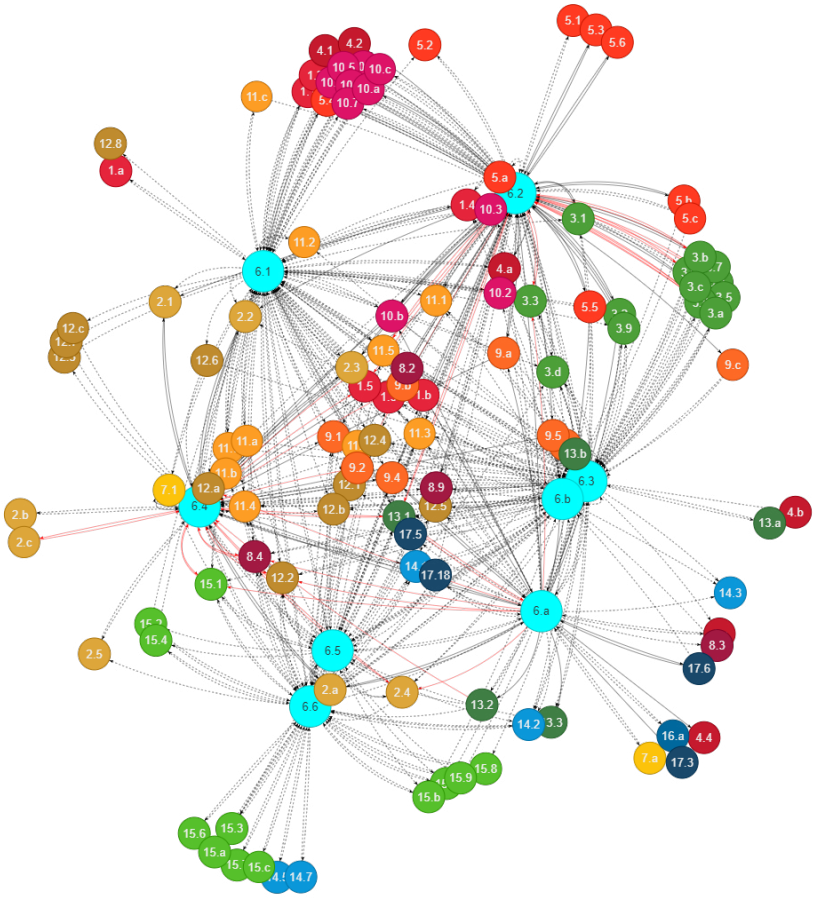
- **Target 6.1.1:** Proportion of population using safely managed drinking water services
- **Target 6.3.1:** Proportion of safely treated wastewater, for which India is yet to define some standards
- **Target 6.4.2:** Level of water stress (referred as BWS in this report) i.e. freshwater withdrawal as a proportion of available freshwater resources.

Areas with BWS above 20 percent may already begin to experience risks from stress to the environment[1] and a threshold of 40% signifies severely water-stressed conditions.[2] According to the UN Statistics India's national average of BWS was 44.53% in 2014.

Accordingly, this analysis framework would help identify the key points for intervention in the city water management practice and would contribute towards establishing efficient and resilient water management system in the city.

Figure 4:
SDG6 inter-linkages with other SDGs

Source: Institute for Global Environmental Strategies, 2018



1 Although several groups have attempted to set minimum environmental ow requirements for healthy freshwater ecosystems, differences in eco- systems and hydrological regimes around the world hinder the creation of a meaningful global standard.

2 Vörösmarty et al., "Global Water Resources: Vulnerability from Climate Change and Population Growth."

RESOURCE SUFFICIENCY

SUPPLY

90%

% households having in-house water supply connection

63.3%

% BPL households having in house water supply connection

155.6 MLD

Total availability of water (freshwater and groundwater sources)

56.5 MLD

Freshwater treatment and supply capacity of the city

92.13 MLD

Freshwater treatment and supply capacity of the city

DEMAND

5,78,420

Population (2011 Census)

9,48,648

Population by 2022

92.13 MLD

Total water consumption of the city (MLD)

115 MLD

Total water demand of the city (MLD)

78 MLD

Total water demand of the city

147.28 MLD

Demand by 2021

RESILIENCE

84.7 MLD

Total storage capacity (city infrastructure)

SUPPLY AND DEMAND

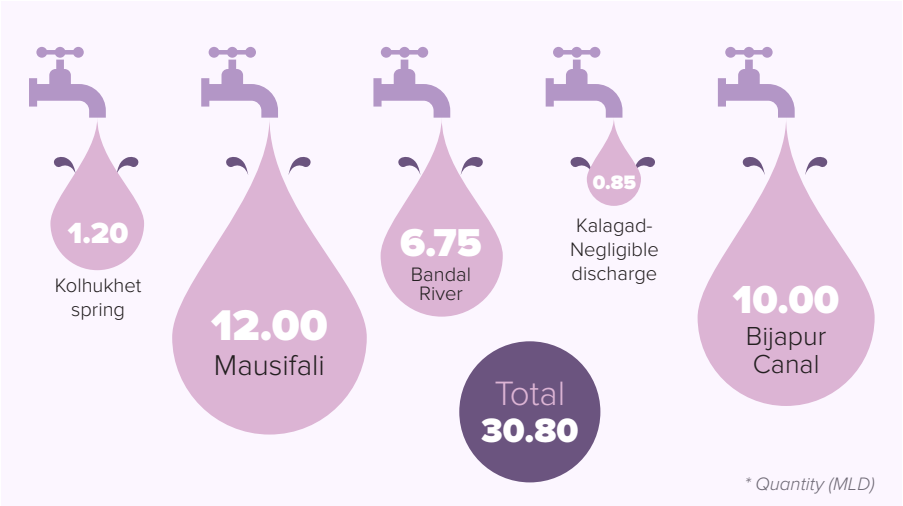
The Dehradun city authority receives water from two primary sources- surface water and ground water to meet its supply needs. The city authorities are currently able to sufficiently supply water to the consumers beyond the total water demand; however, with the rising population, the demand would increase and the authority would require additional quantities of water to meet those rising demands.

According to the recent government estimates, the total water demand in the city by 2012 will be 147.28 MLD against the total water supplied at 155.60 MLD, indicating the surplus 8.32 MLD water available for supply in the city. However, considering the high distribution losses at 38%, total water available for actual consumption is 92.13 MLD, (as against the 155 MLD of supply and 147 MLD of demand)- indicating lack of sufficient resource availability.

SURFACE WATER

30.80 MLD water is collectively sourced from 5 different sources of surface water including Kolhukhet spring; Mausifali; Bandalriver; Kalagad-Negligible discharge; and Bijapur canal.

The following are the surface water sources along with the quantities extracted from each of them.



GROUND WATER

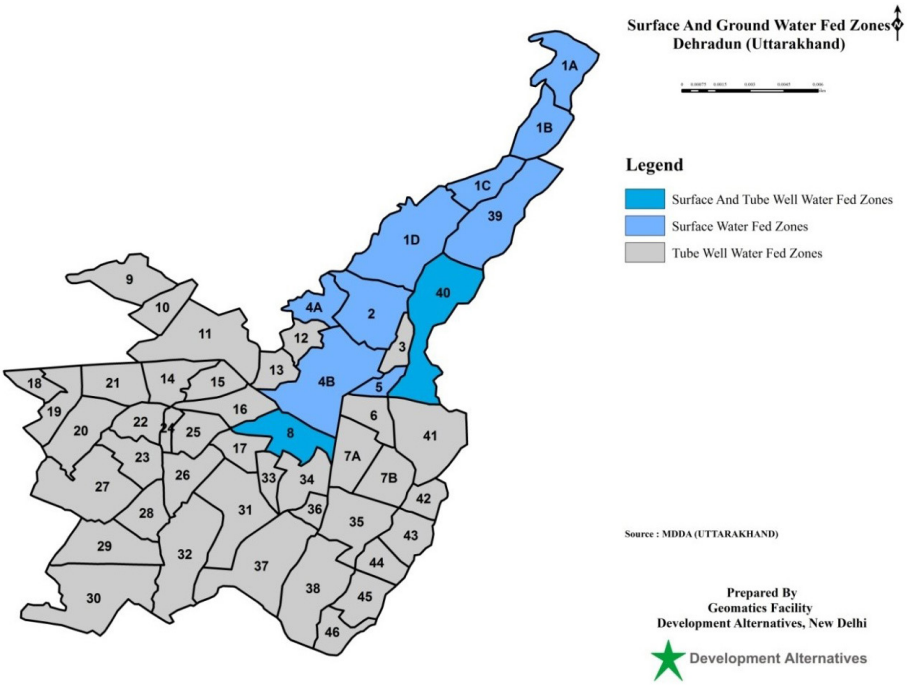
The city currently sources 90% of its water supply from ground water. There are 178 major and mini tubewells managed by UJS, 14 by Uttrakhand Jalnigam, and about 40 more under other establishments. The combined installed capacity of these tube wells is 226.88 MLD for the urban city.

However, only 25.86 MLD of surface water and **124.8 MLD** of ground water is extracted for consumption in Dehradun. Small quantity of ground water **(0.4 MLD)** along with all the surface water **(25.86 MLD)** is transported to the Water Treatment Plant **124.4 MLD** is let out for direct pumping.

STORAGE

There are 90 OHTs and CWRs under the UJS, 13 under the UPJN and about 60 more in other establishments. There are several other rural schemes serving the water supply system located at various water supply zones of the distribution system throughout the city and since many of these are newly constructed, they are operating really well.

Map 2:
Surface water, ground water and mixed fed zone map



OPERATIONAL PERFORMANCE

LOSSES

48%

Current NRW%

Approx. 90%%

% households dependent on ground water

50-60 yrs (renovation is ongoing by ADB)

Age of distribution system

159.85 km

Length of distribution system

ADDRESSAL AND REDRESSAL

No. of people assigned for this job

Efficiency in redressal of complaints

INFRASTRUCTURE MANAGEMENT

1 STP of 20MLD

Number and capacity of STPs

6 monthly

Frequency of operation and maintenance procedures within the supply network

11,370 lakhs

Cost of repair and maintenance

While the city authorities are facing difficultly in supplying sufficient water to the people; the poor infrastructure/ water distribution network, significant amount of supplied water is lost before it reaches the consumer. Assuming 5% loss of water at the WTP and a transmission loss of 3%, **24.19 MLD** of water from the WTP reaches the OHT and reservoirs; around 75% (**93.3 MLD**) of ground water let out for OHT. Accordingly, **117.49 MLD** is pumped for distribution from OHT and reservoirs and 25% (**31.1 MLD**) of ground water is sent for direct distribution across the city. Further, assuming 80% of water consumed is let out as waste water, **73.7 MLD** of water is let out as waste water

While the functions on water management are divided across different departments under the DoDW; there is lack of clarity and knowledge on the actual number of human resource specifically assigned for the operation and maintenance of the water supply system, resulting into inefficient water management.

While the government has identified this concern and with support from Asian Development Bank (ADB), the Smart water management shall be implemented in ADB managed area at the cost of INR 20 Crore with the objective to implement viable information system for water management. This includes under-Instrumentation System, Automation Systems, Supervisory System- Operational Technology, and Information System- Information Technology. In fact, a major portion of the water distribution system is being renovated to ensure more durability of the pipes and the PVC pipes have been replaced by DI pipes in many locations.

Additionally, while, there are 4 Sewage Treatment Plants (STP) that are operational in the city, with an installed capacity of 89 MLD, however, only 18 MLD of waste water is treated at these plants and remaining 55.2 MLD is directly discharged into the water bodies, **indicating lack of effective operations**. All the STPs except the one situated in Kargi have been built by UPJN, under Jawaharlal Nehru Urban Renewal Mission (JNNURM). The STP at Kargi has been built under ADB and currently run by UJS.

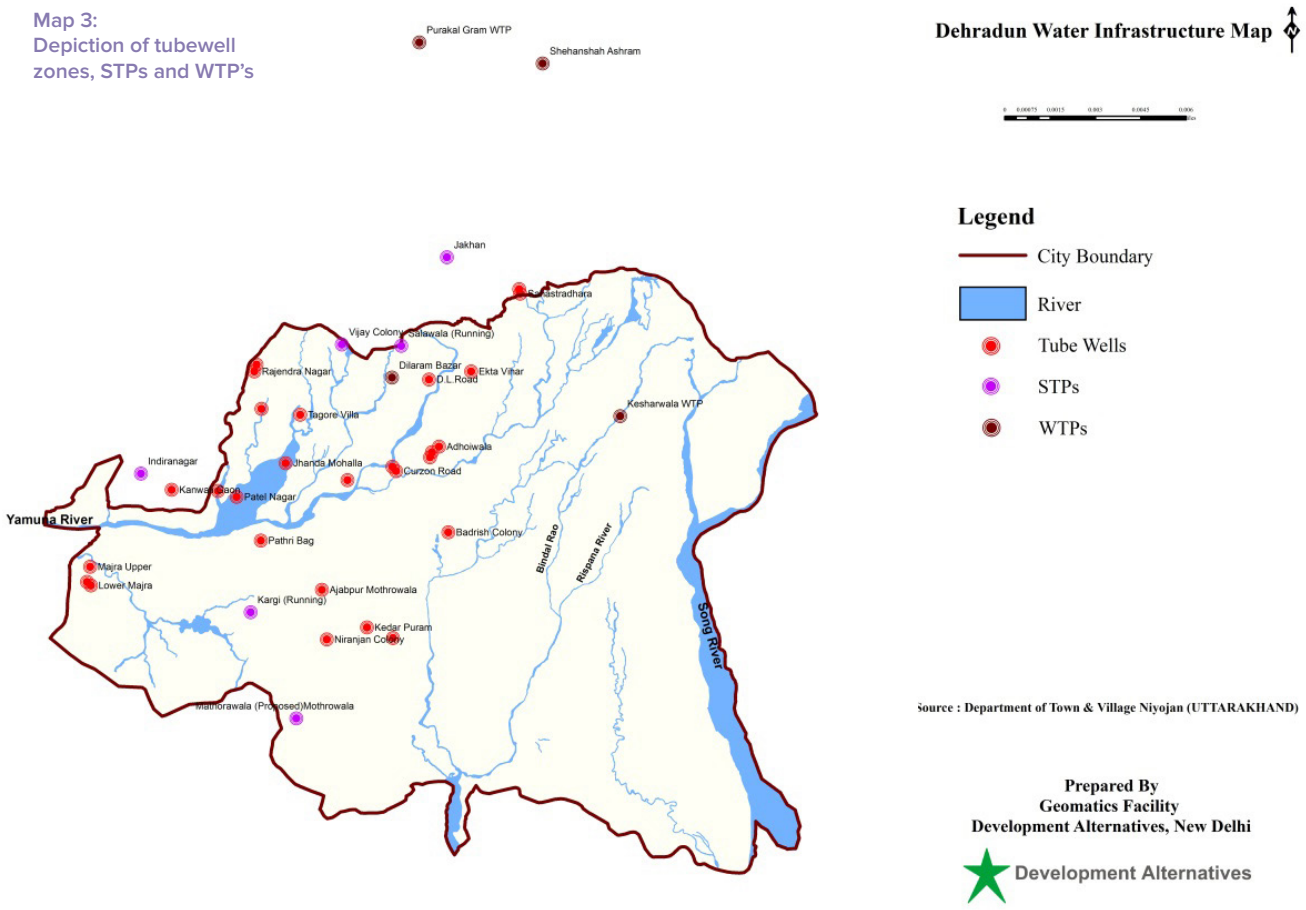
Table 1: Sewage Treatment Plants in Dehradun

Sl No.	City/Town	STP location	Status (Operational/Non Operational/under construction	STP installed capacity	Technology	Working Capacity
1	Dehradun	**Indira Nagar**	Operational	5.00	SBR	0.20
2	Dehradun	**Mothorowala**	Operational	20.00	SBR	10.00
3	Dehradun	**Jakhan**	Operation and Maintenance	1.00	SBR	0.30
4	Dehradun	**Vijay colony**	Operational	0.42	SBR	0.20
5	Dehradun	**Salawala**	Operational	0.71	SBR	0.30
6	Dehradun	**Mothorowala-II**	Operational	20.00	SBR	0.00
7	Dehradun	**Kaulagarh**	Funds available however it has been proposed under AMRUT	3.00	SBR	0.00
By ADB						
8	Dehradun	**Kargi**	Operational	68.00	SBR	7.50

Table 2: Water Treatment Plants in Dehradun

Sl. No.	Location	Existing capacity mld.	Added cap mld. In ADB project	Total cap. Mld.
1	Dilaram Water Works	20.00	7.50	27.50
2	Purkul water works	0.00	15.00	15.00
3	Shahanshahi water works	14.00	0.00	14.00
	Total	**34.00**	**22.50**	**56.50**

Map 3:
Depiction of tubewell zones, STPs and WTP's



The city authorities are responsible for efficient water management, however like any other process, urban water management process also involves a huge expenditure to be borne by the government. The government of Uttarakhand spent approximately INR 42742.87 lakhs in last one year to facilitate water supply to the consumers, but failed to generate the similar amount of revenue and accordingly contributed to its deficit which further contributes to poor maintenance and continuous distributional losses. Thus, while government is spending, but for economically sustainable water management system, effective measures to overcome deficits have to be put in place in order to optimize the resource management practice. However, the city is currently practicing a flat increase of 15% in the tariffs in order to overcome the deficits and facilitate efficient water management system.

Table 3: Economics of water management in Dehradun

Particulars	Values
Energy cost (Electricity)	INR 1982.87 lakhs
Repair and Maintenance	INR 11370 lakhs
Operation (man power & raw material)	INR 26799 lakhs
Miscellaneous cost (cost of major replacement)	INR 2591 lakhs
Total cost	INR 42742.87 lakhs
Annual water pumped to city (estimated)	12742 KL
Water cost (excluding the operation, repair, maintenance, and misc cost)	INR 3.35/ KL

RESOURCE EFFICIENCY

WATER STRESS

80%

Current Baseline Water Stress % (6.4.2)

22.66 MLD

Current total withdrawal from freshwater sources

30.80 MLD

Current total production from fresh water sources

QUALITATIVE ALLOCATION
(Use, Reuse, Recycle)

0%

Current % of treated water reused

18.5 MLD

Proportion of safely treated wastewater (6.3.1)

ENERGY USED

City's overall energy consumption

12,425,372 kWh

Energy required at the pumping stations

Energy required at the WTPs & STPs

18.5 MLD

Energy used by distribution system

The GoU is implementing series of projects on ensuring efficient water supply within the Dehradun city under JNNURM and ADB funding. These projects are mainly focused on reorganizing and restructuring the water supply distribution system within the city along with installations of some new tube wells/ creation of reservoirs, GIS mapping and other distribution improvement works.

However, a focused approach on reducing the dependency on ground water source is currently a missing link. There is a clear need to reassess the dependency on ground water for the future. Intervention towards decreasing this dependency and increasing the optimum usage of the surface water within the region requires more attention.

While the government is thinking towards constructing a gravity dam across the Song River to ensure the creation of a sustainable source of raw water for a long term, effective low hanging solutions are overlooked. The irrigation department has prepared a Detailed Project Report for developing a gravity dam. The reservoir so created shall have the capacity to supply256 MLD water which will be sufficient to cater to the population of Dehradun up to 2051, however the measures to enhance optimum resource management with respect to use and reuse needs a push. The Song river project is a State funded Project (INR 935 Cr) which would enable water distribution through gravity alone. This development would further lead to closing of most tube wells.

According to the Investment grade energy audit report of Dehradun, the energy costs account for about 40% to 60% of cost for water supply in urban areas and energy efficiency interventions can reduce this cost by 20 %to 40 %, depending on the type and age of pump sets being used for Public Water Works and Sewerage Systems (PWW&SS).

Additionally, the waste water which is treated at the STP is directly let out into the water bodies or open fields, indicating the huge unutilized resource with a potential of reducing the dependency on fresh water, if treated waste water is brought to reuse. Thus efficient resource management requires a push towards optimum resource utilization of fresh water and treated water.

RESOURCE EQUITY

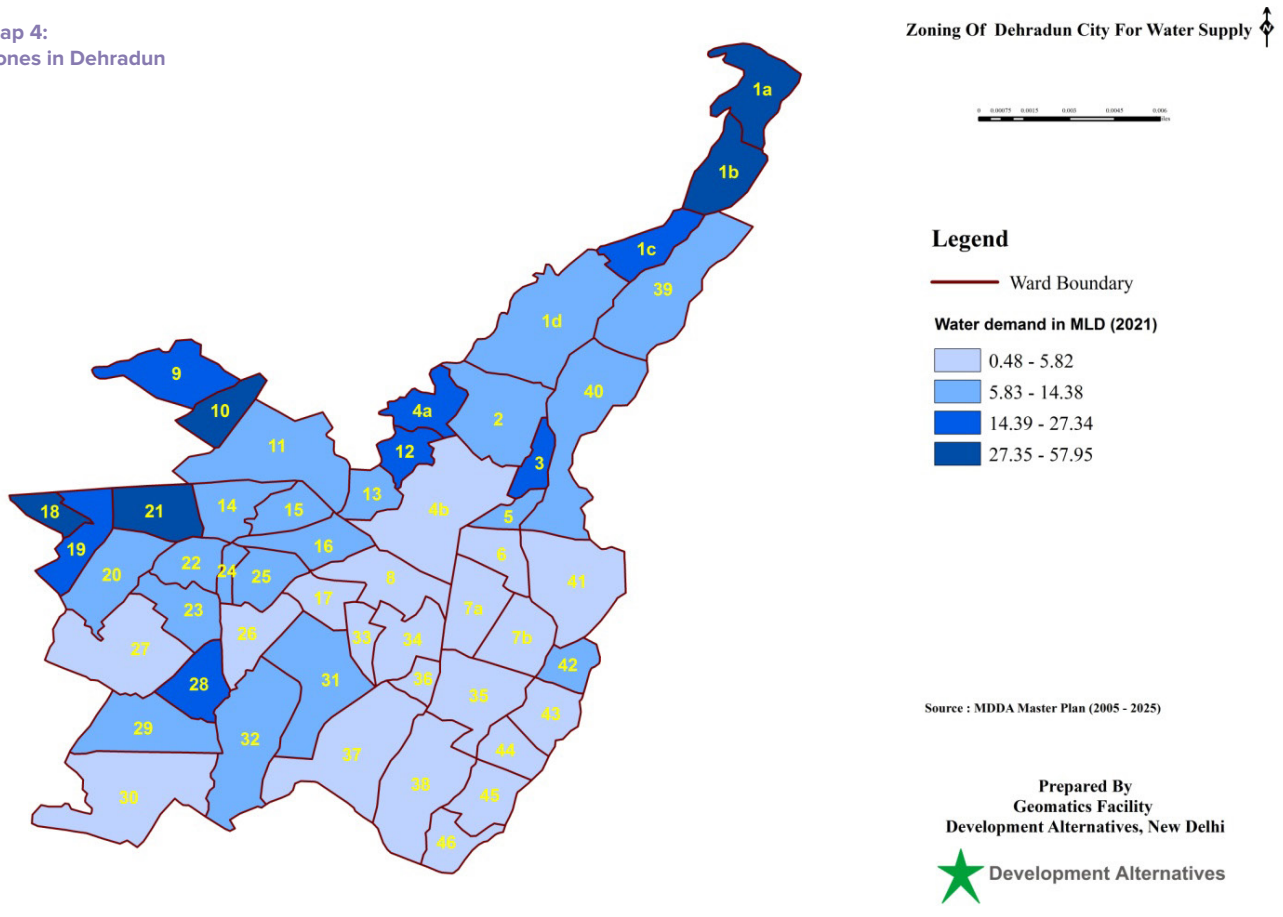
The city is sufficiently supplying water resource in the urban areas however, it is equally essential to ensure equitable resource distribution. However, in the presence of inadequate information on the actual water distributed across four divisions, the extent of equity practiced in the distribution stays ambiguous.

However, in the light of available data, one could easily identify that since the total population and thereby the water demand in the south division continues to stay highest amongst all the divisions followed by north division, Pithuwala and Raipur, it would be necessary to ensure the similar share of water supply in the respective divisions in order to ensure resource equity.

Table 4: Status of water demand in Dehradun[1]

Divisions	No. of zones	Total Population (expected in 2021)	Total water demand in 2021 (MLD)
North	11	211602	32.85
South	25	563190	87.44
Pithuwala	10	131204	20.37
Raipur	5	42653	6.62

Map 4:
Zones in Dehradun



1 Number of zones have been considered according to the Uttarakhand PeyJal Nigam

NEW GOVERNMENT INITIATIVES

The GoU is actively intervening towards effective water supply. There are series of initiatives directed towards improving the water supply, storm water drains, and sewerage systems under the AMRUT Mission planned for the year 2017- 2018. However, the lack of holistic approach towards sustainable, inclusive and efficient urban water system requires traction.

Table 5: Details of government initiatives in Dehradun

SL No	Schemes	Project cost (Cr)	Notes
Sewerage system			
1.	Work corresponding to sewer system	15	The DPR is in progress
Water supply system			
1.	19 out of 23 zones to be provided with drinking water supply (PeyJal Nigam)	52.03	Tender document work in progress
2.	Planning of Dehradun drinking water supply scheme	5.97	The DPR is in progress
Storm water drain schemes			
1.	Work on Indira Gandhi marg near Saharanpur road	2.64	DPR prepared and sent to TAC (Technical Advisory Committee)
2.	Bhandaaribaag drainage work	1.55	DPR prepared and sent to TAC (Technical Advisory Committee)
3.	Le Rajeev JuyaalMarg, Bhramanwaala	3.63	DPR prepared and sent to TAC (Technical Advisory Committee)
4.	Green park, Saharanpur road next to Chamanpuri	0.41	DPR prepared and sent to TAC (Technical Advisory Committee)
5.	Drainage laid near Ballupur Masjid	0.18	

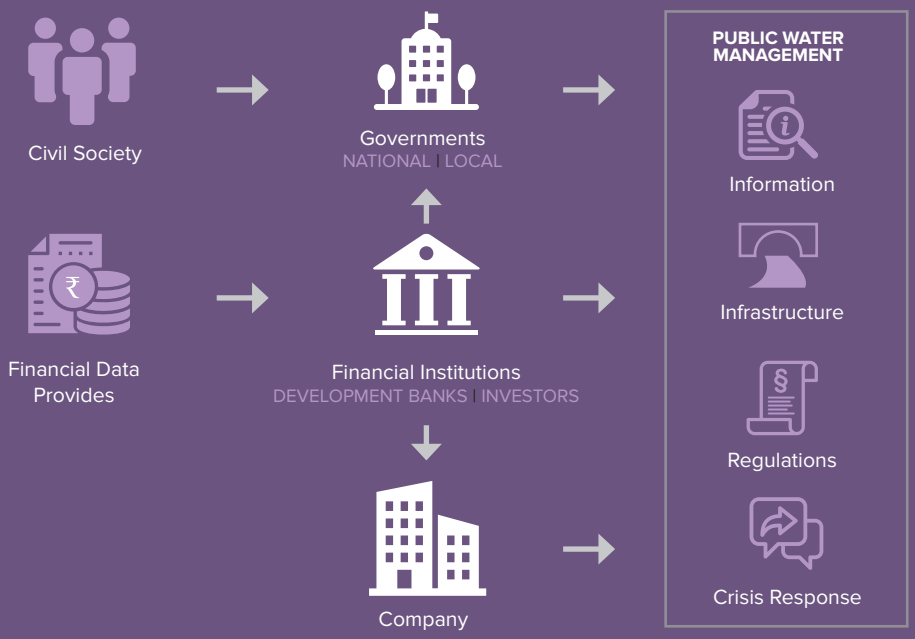
WAY FORWARD

Collaborative perspective building on sustainable urban water systems is the need for the day. Accordingly, the importance of resource resilience and their associated benefits related to economic development, waste utilization, natural resource saving and climate through consultations and multi-stakeholder dialogues involving policy makers and civil society has to be highlighted. There exists lack of information and database required for analysis and effective decision making with respect to policy, legislative and market ecosystem.

In the given situation, a framework for the integrated role of policy, business and civil society can potentially contribute to the sustainable development of the country in general and achieving targets listed under SDG6 in particular. The theory of change that would mainstream effective and efficient water management system require being holistic, one that gives balanced weight to economic prosperity, equitable opportunity, a healthy and productive environment and participatory governance to move towards the vision of well-being for people, planet and profit.

Further, the data providers and civil society would drive a variety of users including government, financial institutions supporting infrastructure projects and industries to influence and improve public water management on a local or utility level. Rather than offer a fixed set of activities that actors could take, the transition would require an ecosystem of actors at play as this would together lead to better water management driven by sufficient information, required infrastructure, effective regulations and crisis response mechanism.

Figure 5: Theory of Change



Source: Adapted from WRI Environment Democracy Index (Worker and de Silva 2015)

With an overarching view of addressing diverse policy and practice issues, challenges, and transitions required for mainstreaming effective and efficient water management system in Dehradun, Development Alternatives with support from Heinrich Böll Foundation initiated a workshop on 'Understanding Water Flows in Dehradun' on Thursday, 25th October, 2018 at Hotel Madhuban, Dehradun. The workshops focused on identifying issues and need for efficient water management in Dehradun.

The consultation provided a platform and brought together various stakeholders from the government, civil society and academia to create multi-stakeholder dialogue to highlight the importance of efficient water management and its associated benefits. The environmental impacts of the current water management systems and lifecycle practices and the potential to mitigate these impacts through an inclusive strategy that supports economic growth needed to fuel development in the city was deliberated in the consultation.

The consultation sought to assess and determine coherence in policies pertaining to water management for the betterment of people and nature - vital to the new security agenda. While, favorable policy ecosystem will provide the necessary impetus for business and industry to approach this strategic transition more seriously. However, both resource efficiency and responsive consumption will be primarily driven by innovation and awareness. Alongside this, business, industry and academia need to partner together to research not just pioneering resource efficient technologies, but also the social ramifications of this transition. Following are the key subjects identified at the workshop for efficient and effective water management system:

- **Development of an integrated data portal:** Currently, there are multiple departments responsible for water management in Dehradun, an integrated system to manage all the database related to water management to avoid any discrepancies or overlapping in data gathering. A robust database or a city level water dash board system will then effectively contribute to effective analysis and solutions.
- **Formation of a committee on water management**- a consortium of agencies/ committee of key stakeholders working on the subject of water management will bring more impactful results as a multi-stakeholder approach will maximise the opportunities for sustainable future since there is a potential role of each stakeholder including government, civil society, government and academia. Policy makers will need to engage more coherently with the concept of resource management; civil society sectors needs to broadly disseminate the principles of sustainability, change existing consumer attitudes, and sensitise them to the responsible consumption; international communities can also play an important parallel role, not just in facilitating technology transfer, but in financing innovation and in implementing key pilot initiatives; and business, industry and academia need to partner together to research not just pioneering resource efficient practices.
- **Rejuvenation of rivers**- With the rising population of Dehradun, the demand for water is continuously increasing and in the given scenario, while has already taken initiatives towards reviving Rispana and Kosi rivers to meet the growing demand of water in the city; a continuous push will always be required for associating the common man with the cause of saving and reviving the rivers.
- **Strengthening the capacities of consumers through communication and outreach**- popularising water management practices; changing existing consumer preferences towards optimal utilization; generating awareness about

the prevailing water crisis is significant to bring significant impacts. Awareness generation and media are strong components that would create a large impact on communication and behavior change towards best water management practices. Online knowledge portals, competitions, nomination of celebrities as goodwill ambassadors of sustainability etc. are few instruments to bring the transition.

- **Adoption of economically feasible and socially viable decentralization technologies**- As the 2016 waste management rules pushes city authorities to look at decentralization, suggestions were given for the city to adopt decentralization measures for treatment of wastewater. Even with a set of alternatives i.e. the innovative resource efficient technological solutions available; the challenge to up-scale the use of these alternatives continues to exist. The innovation to take them to the market, or incubate these products on ground needs more action. Business, industry and academia can potentially partner together to research in pioneering such solutions.

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B-32, Tara Crescent,
Qutub Institutional Area
New Delhi -110016.
India.
Email: mail@devalt.org
Website: www.devalt.org
Ph: 011-2654-4100, 011-2654-4200