SFD Lite Report

Dehradun
Uttarakhand, India

This SFD Lite Report was prepared by
Sanitation Capacity Building Platform (SCBP),
National Institute of Urban Affairs (NIUA).

Date of production/ last update: 31/08/2022

1 The SFD Graphic

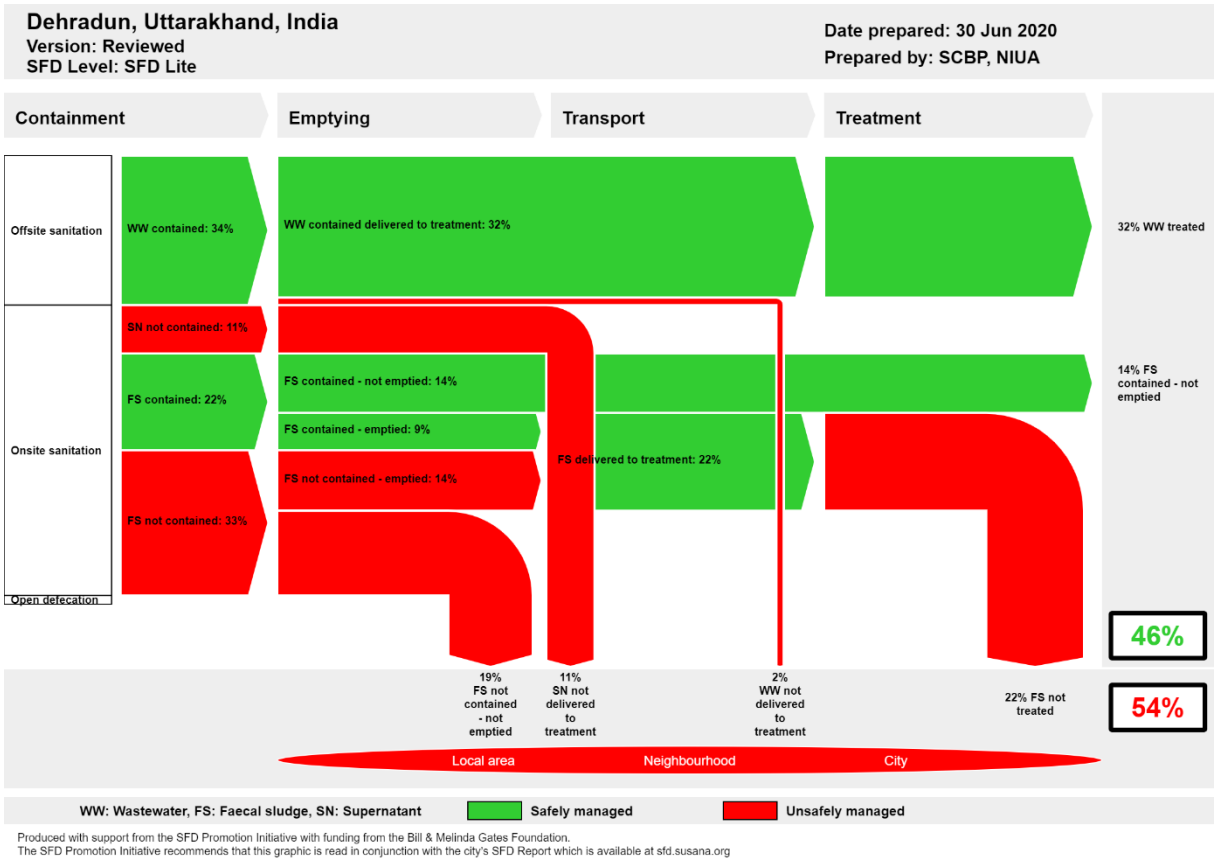

Figure 1: SFD Graphic for Dehradun.

2 SFD Lite information

Produced by:

- Sanitation Capacity Building Platform (SCBP), National Institute of Urban Affairs (NIUA), New Delhi, India
- This report was prepared as part of the support to Uttarakhand State for Scale up of Faecal Sludge and Septage Management solutions.
- We would like to thank Mr. Yashreor Mal, EE (Executive Engineer), Jal Sansthan North Division, Mr. Maneesh Semwal, EE (Executive Engineer), Jal Sansthan South Division, Mr. Ashish Kathait, Nodal Officer, AMRUT, Dehradun Nagar Nigam, Dr. Kailash Joshi, Senior Municipal Health Officer, Dehradun Nagar Nigam, Ms. Meenakshi Mittal, A.E (Assistant Engineer), Dehradun Jal Nigam, Mr. Sumit Anand, EE (Executive Engineer), Mr. Ramesh Lingwal, Senior Accountant, Urban Development Directorate (UDD), Mr. Ankit Bhandari, Consultant AMRUT, Urban Development Directorate (UDD).
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Collaborating partners:

- Dehradun Nagar Nigam

Date of production: 30/06/2020

3 General city information

Dehradun Nagar Nigam area[1] is 100 km^2. and has 100 wards with a population of 804,379[2] (as of 2018). There are 167,577 households (HHs) (after municipal boundary expansion in 2018) within municipal boundary; this suggests the average household size in the city to be 5.

Dehradun lies at 30.3164° N, 78.0321° E. It is part of the Garhwal region and lies along NH7 with the distance of 236 kilometres north of India's capital New Delhi, 168 km from Chandigarh and is served by Dehradun railway station and Jolly Grant Airport, Doiwala. It is one of the counter magnets of the National Capital Region (NCR) Delhi which is being developed as an alternative centre of growth to help ease the migration and population explosion and also establish a smart city at Dehradun (Figure 2).

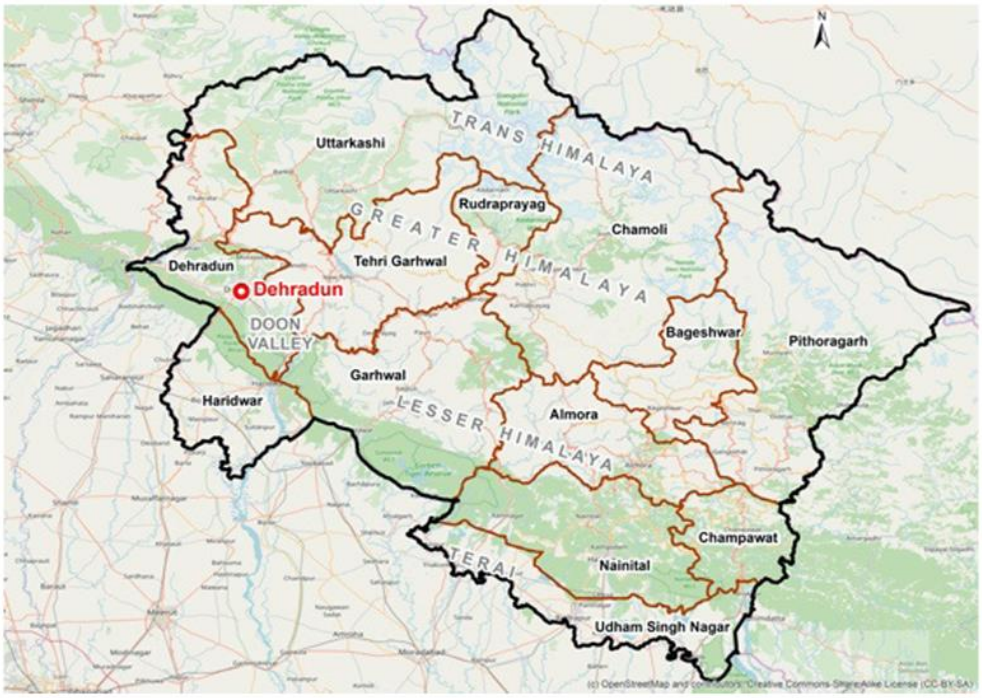

Figure 2: Dehradun, Uttarakhand (Source: SCBP/NIUA/2021).

The city of Dehradun mainly lies in Doon Valley. Doon Valley has the Himalayas to its north, the Shivalik range to its south, the sacred Ganga River to its east and the Yamuna River to its west. The city of Dehradun is surrounded by Song River on the east, Tons River on the west, Himalaya ranges on the north and Sal forests in the south. The Doon Valley is situated between the two most important rivers of India. i.e., Ganga and Yamuna, located in a picturesque setting. Dehradun is surrounded by dense forest all around and number of streams and canals dissect the city in the north-south direction. It lies 674 m above mean sea level.

The average annual temperature in the city is 21.8 °C, June being the warmest month has an average temperature of 29.4 °C and with an average's temperature of 12.6 °C January is the coldest month. Dehradun receives an average rainfall of around 1,896 mm per year, the driest month is April with 16 mm of precipitation and with an average of 567 mm, August receives

[1] Key Informant Interview, Urban Development Directorate, Dehradun
[2] Key Informant Interview, Urban Development Directorate, Dehradun

the highest rainfall in the city[3]. Average water level across city is greater than 15 mbgl[4] (metres below ground level).

Dehradun city is divided into four divisions namely, North Division, South Division, Raipur Division and Pithuwala Division for drinking water supply. North Division receives water from Gilogi River and Masifall River, it goes to two different Water Treatment Plants (WTPs) Purkul Treatment plant with a capacity of 15 Million Litres per day (MLD) and Sahansai Ashram Treatment plant with a capacity of 14 MLD, respectively. Water is directly supplied to households after treatment which include softening and chlorination. 95% of households in this division have Jal Sansthan water supply connections. Average water supply in this division is 135 lpcd (litres per capita per day).

In South Division sources of water are Bandal River, Bijapur Canal and tube wells. There is one water treatment plant namely Dilaram WTP with a capacity of 27.5 MLD in this division. Bandal River is situated 14 km from Dilaram WTP. The discharge of this river is approximately 15 MLD and 8 MLD in winter and summer, respectively. Water is transported to the Dilaram WTP from Bandal River through gravity and after filtration processes water is stored and supplied to consumers. The distance between Bijapur Canal to Dilaram WTP is around 10 km. Discharge of this river is around 8 MLD and 6 MLD in winter and summer, respectively. Filtration processes are done in the Dilaram WTP and water is then stored and supplied to the consumers. Approximately 27 MLD water demand is met through these two rivers and 173 MLD water is supplied through tube-wells after chlorination. 95% of households in this division have Jal Sansthan water supply connections. Average water supply in this division is 135 lpcd.

Raipur division receives water from Maldevta River, it goes to Kessarwala WTP with a capacity of 3.6 MLD which is the only WTP of this division. Remaining water is extracted from tube-wells which is supplied to the households after primary treatment and chlorination. 80% of households in this division have Jal Sansthan water supply connections. Average water supply in this division is 100 lpcd.

Pithuwala division does not have any WTPs. The source of water supply here is tube-wells. Water is supplied to the households after primary treatment and chlorination. 80% of households in this division have Jal Sansthan water supply connections. Average water supply in this division is 100 lpcd.

[3] https://en.climate-data.org/asia/india/uttarakhand/dehradun-3679/
[4] Central ground water board, 2015-16

4 Service outcomes

Dehradun, Uttarakhand, India, 30 Jun 2020. SFD Level: SFD Lite
Population: 808879
Proportion of tanks: septic tanks: 50%, fully lined tanks: 50%, lined, open bottom tanks: 50%

Containment								
System type	Population	WW transport	WW treatment	FS emptying	FS transport	FS treatment	SN transport	SN treatment
	Pop	W4a	W5a	F3	F4	F5	S4e	S5e
System label and description	Proportion of population using this type of system (p)	Proportion of wastewater in sewer system, which is delivered to centralised treatment plants	Proportion of wastewater delivered to centralised treatment plants, which is treated	Proportion of this type of system from which faecal sludge is emptied	Proportion of faecal sludge emptied, which is delivered to treatment plants	Proportion of faecal sludge delivered to treatment plants, which is treated	Proportion of supernatant in open drain or storm sewer system, which is delivered to treatment plants	Proportion of supernatant in open drain or storm sewer system that is delivered to treatment plants, which is treated
T1A1C2 Toilet discharges directly to a centralised foul/separate sewer	34.0	95.0	100.0					
T1A2C5 Septic tank connected to soak pit	12.0			100.0	100.0	0.0		
T1A2C6 Septic tank connected to open drain or storm sewer	11.0			100.0	100.0	0.0	0.0	0.0
T1A5C10 Lined pit with semi-permeable walls and open bottom, no outlet or overflow	10.0			50.0	100.0	0.0		
T1B10C10 Containment (fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - with no outlet or overflow	10.0			50.0	100.0	0.0		
T1B10C5 Containment (septic tanks, fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - connected to soak pits	12.0			50.0	100.0	0.0		
T1B10C6 Containment (septic tanks, fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - connected to open drain or storm sewer	11.0			50.0	100.0	0.0	0.0	0.0

Table 1: SFD Matrix for Dehradun, Uttarakhand (Source: Sachin/NIUA/2022).

Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were conducted with the key stakeholders responsible for providing services on water and sanitation, in accordance to SFD Manual. Municipal boundary is considered for the current study.

The output of the SFD graphic represents that 46% of the human excreta flow is attributed to be safely managed and the remaining 54% is unsafely managed (Figure 1). The unsafely managed excreta of 54% are contributed by offsite sanitation as well as onsite sanitation. Under offsite component, Wastewater (WW) not delivered to treatment due to leakages and transportation inefficiency is attributed by 2% of the population. Under the onsite components, Faecal Sludge (FS) not contained i.e., FS from septic tanks system connected to open drains; Containment systems (septic tanks, fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - connected to soak pits, to open drain or storm sewer and with no outlet or overflow together constitutes 33%. FS not contained – not emptied (19%) represents portion of FS, which remains in tanks and infiltrate into the ground. Faecal Sludge (FS) emptied, delivered to treatment but not treated is decanted into the Sewage Treatment Plants (STPs) is attributed by 22% of the population. Supernatant (SN) generated from systems (septic tanks connected to open drains + Containment (septic tanks, fully lined tanks, partially lined tanks and pits, and unlined pits) failed, damaged, collapsed or flooded - connected to open drain or storm sewer) to open drains (i.e., 50% proportion of the content in

the tank is FS and 50% is SN) largely gets SN discharged into open drains and not delivered to treatment facility is attributed by 11% of the population.

Overview on technologies and methods used for different sanitation systems through the sanitation service chain are as follows:

4.1 Off-site Sanitation Systems

Dehradun has six sewerage zones, namely, Kargi zone, Rispana zone, Indra nagar zone, Vijay colony zone, Salawala zone and Doon vihar zone. Currently, these zones are partially served with sewerage network covering 57,173 households having toilets discharging directly to a sewer (T1A1C2) which is 34% of the total households in the city.

The volume of wastewater generation is estimated to be 87 MLD and the faecal sludge generation is 320 KLD. There are seven STPs in the city, their design capacity and utilized capacity are mentioned in Table 2:

Table 2: Sewage Treatment Plants in Dehradun (Source: Jal Sansthan/Uttarakhand/2020).

Sl. No.	STP	Design Capacity (MLD)	Utilized Capacity as of March 2020
1	Kargi	68	16% (23.53 MLD)
2	Motharawala-I	20	60% (12 MLD)
3	Motharawala-II	20	25% (5 MLD)
4	Indranagar	5	20% (1 MLD)
5	Jakhan doon Vihar	1	30% (0.3 MLD)
6	Salawala	0.71	42.25% (0.29 MLD)
7	Vijay Colony	0.42	71.43% (0.3 MLD)

All the STPs mentioned in Table 2 are based on Sequential Batch Reactor (SBR) technology. Kargi STP receives 25-30 trucks of septage daily and the trucks discharge septage at a designated decanting station within the STP premises. Currently, there is no properly designed co-treatment infrastructure nor any treatment of septage with sewage. However, the performance evaluation of the STPs' treated wastewater outfall discharge is within the national discharge standards.

4.2 Onsite Sanitation Systems

Containment: Through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with municipal officials, masons and emptiers, the number of households dependent on different types of onsite sanitation systems are estimated: 12% of HHs are dependent on septic tanks connected to soak pits (T1A2C5), 11% of HHs are dependent on septic tanks connected with open drains (T1A2C6), 10% of HHs are dependent on lined tanks with semi-permeable walls and open bottom (T1A5C10), 10% of HHs are dependent on containment failed, damaged, collapsed or flooded - with no outlet or overflow (T1B10C10), 12% of HHs are dependent on containment failed, damaged, collapsed or flooded – connected to soak pit (T1B10C5) and 11% of HHs are dependent on containment failed, damaged, collapsed or flooded – connected to open drains or storm sewers (T1B10C6).

***Emptying**:* Predominant method of emptying is by private cesspool operators. There are around 25 to 30 cesspool vehicles plying in the city. The average desludging frequency of the containments is around 5-8 years. For properly designed septic tanks (open drains + soak pits), the desludging frequency was around 4 years, hence emptying (F3) was considered 100% (T1A2C5 and T1A2C6), whereas for other systems, emptying (F3) it was 50% (T1A5C10, T1B10C5, T1B10C6 and T1B10C10), as these containments were made of irregular sizes with an emptying frequency over 4 years.

Transportation: There are no cesspool vehicles owned by government yet. The emptying charge is approximately Rs.1,500-2,200[5] (US$ 18.75-27.50) per service depending on the distance of the household from the STP. A tipping fee of Rs. 400 (US$ 5) is charged by Kargi STP operator from the desludging operators for letting the decanting of faecal sludge and septage at STP. Hence 100% (F4) transportation of faecal sludge was considered for all the systems.

Figure 3: STP with circular SBR tank: Motharawala STP 20 MLD Dehradun (Source: Laila/NIUA/2020).

Figure 4: Sewer jetting cum suction machine (Source: Laila/NIUA/2022).

Disposal: The treated wastewater is tested for its quality which has been consistently found to be within the Central Pollution Control Board (CPCB) prescribed discharge standards. The treated wastewater is let off into the rivers or streams and the treated sludge is used as soil conditioner for gardening within the STP premises as well as for farming in the nearby villages.

Open Defecation: Open defecation is not practised in the Dehradun city.

[5] 1 $ = 79.72 Indian Rupee, 2022

5 Context-Adapted SFD Graphic

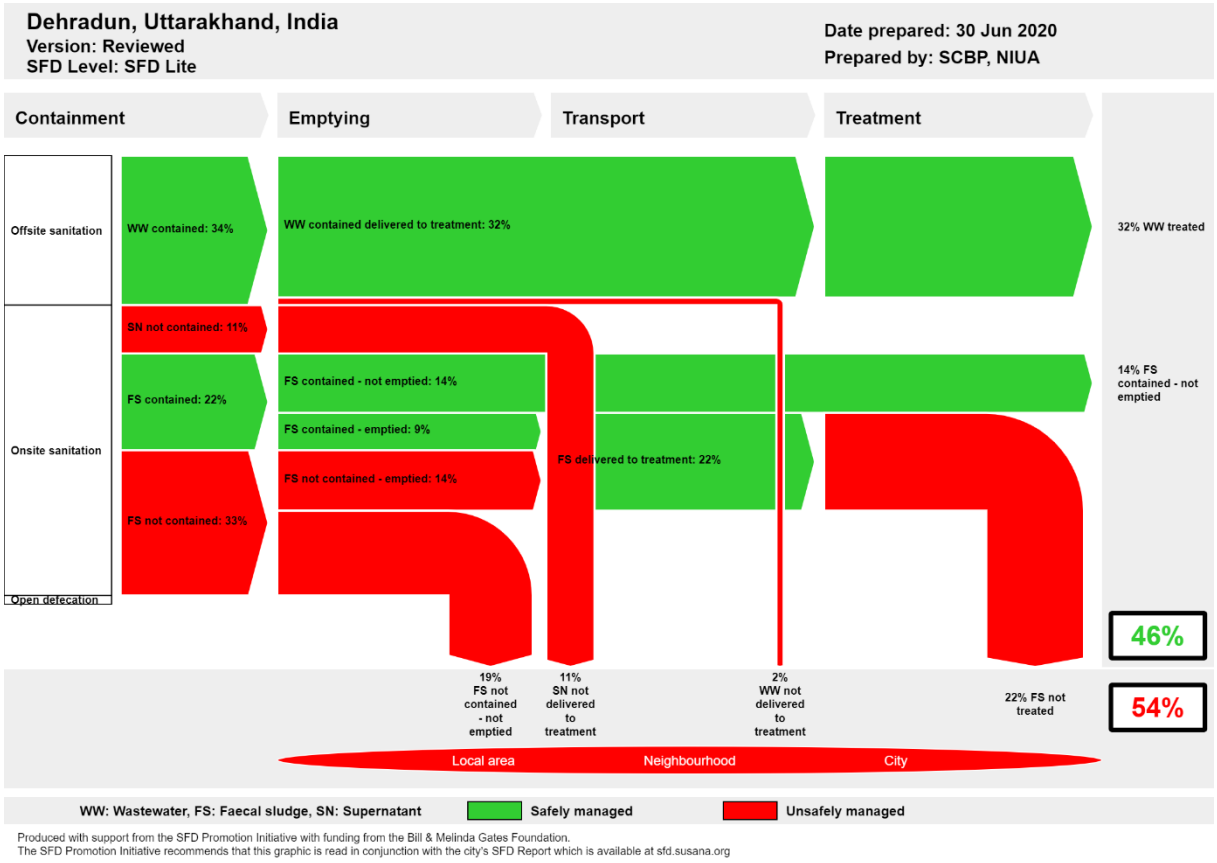

Figure 3: Context-Adapted SFD for Dehradun (Source: Sachin/NIUA/2022).

The only difference suggested in the context-adapted SFD is at the containment stage for correctly designed septic tanks connected to open drains. Although, these systems are considered to be a safe practice, but to represent that those containment systems are correctly designed and properly functioning with regular emptying, hence a revised SFD context-adapted graphic is created manually for advocacy purposes. According to the assumption, 50% of the proportion of the content of the septic tank is solid Faecal Sludge (FS), which remains in the septic tanks. The FS collected in the septic tank is considered to be contained in the context-specific of local conditions, hence for overall SFD graphic 28% of FS is contained and 14% is emptied (represented green in colour at the containment stage) and the remaining 14% is FS still contained - not emptied, since a small portion of FS remains in the septic tank even after the desludging process. Overall, the excreta of 46% of the population is safely managed according to the context-adapted SFD graphic.

6 Data and assumptions

Following are the assumptions considered while preparing the SFD for Dehradun city:

1. **Population:** As per KII with the Dehradun Nagar Palika, the city receives 4,500 tourists on an average per day as floating population every year. Thus, the total population of the city becomes 808,879 (804,379+4,500).

2. **Wastewater:** Water supply in the city is 135 lpcd. Based on the water supply, assuming total waste water generated is 80% of total water supply, it is coming out to be 108 lpcd.

3. **Containment, emptying and treatment:** Maximum emptying frequency for septic tank has been considered to be four years, and one year for fully lined tank and for lined pit with semi-permeable walls and open bottom, thus containment system emptying beyond stipulated duration are considered under containment damaged or collapsed category. Based on the study, it was found that about 23% of septic tanks and 10% of lined pit with semi-permeable walls and open bottom systems are being emptied beyond their stipulated time and hence such systems have been considered under category of 'containment damaged or collapsed' in the SFD graphic.

4. **Risk of groundwater:** Average water level across city is greater than 15 mbgl. Considering soil type to be fine sand, silt and clay, vulnerability of the aquifers was found to be at low risk, less than 25% sanitation facilities are located <10m from ground water sources and greater than 25% of sanitation facilities are located uphill of ground water sources causing significant risk to lateral separation, less than 25% drinking water is produced from groundwater sources and protected boreholes, dug wells and springs with adequate sanitary facilities in place are used for production of drinking water.

   Thus, overall risk to groundwater contamination is estimated to be low in Dehradun.

7 List of Data Sources

Reports and Literature

- District Ground Water Brochure[6] of Dehradun, Uttarakhand.
- Ground Water Year Book of Uttarakhand, CGWB, 2015-2016.
- Service Level Benchmarks, Dehradun 2018-19
- Swachh Survekshan 2020, Dehradun
- SBM City Profile 2020, Dehradun

Key Informant Interviews (KIIs)

- KII-1, 2020; Interview with Mr. Ashish Kathait, AMRUT Nodal Officer, Dehradun Nagar Nigam.
- KII-2, 2020; Interview with Dr. Kailash Joshi, Senior Municipal Health Officer, Dehradun Nagar Nigam
- KII-3, 2020; Mr. Yashreor Mal, Executive Engineer (E.E), Jal Sansthan North Division.
- KII-4, 2020; Mr. Maneesh Semwal, Executive Engineer (EE), Jal Sansthan South Division.
- KII-5, 2020; Ms. Meenakshi Mittal, Assistant Engineer (AE), Jal Nigam, Dehradun.
- KII-6, 2020; Mr. Sumit Anand, Executive Engineer (EE), Jal Nigam, Dehradun.

Focus Group Discussions (FGDs)

- FGD-1, 2020; Focus Group Discussion with Sanitation Workers.
- FGD-2, 2020; Focus Group Discussion with Local People, Masons.

Field Observations

- Covering households - Slums, Lower Income Groups (LIG), Middle Income Groups (MIG) and Higher Income Groups (HIG) spread throughout the city.
- Survey of Public Toilet (1 No.).

[6] https://en.climate-data.org/asia/india/uttarakhand/dehradun-3679

Dehradun, India 2020

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