



STRATEGIC PLAN FOR RISK REDUCTION

Increasing resilience through effective

RESPONSE, RECOVERY, MITIGATION, & PREPAREDNESS

URBAN RISK HOTSPOT

HARIDWAR CITY

STATE LEVEL ENDORSEMENT

“The magnitude of hazards and frequency of extreme weather events in Uttarakhand has increased due to climate change. The traditional methods of disaster management need to be overhauled, earlier the traditional methods used to be relief, response and rehabilitation, but now the whole scenario has changed. We really have to upgrade our capacities and strengthen our people.”

Mr. Amit Singh Negi

Disaster Management Secretary, Govt. of Uttarakhand

(State Workshop on “Strengthening Resilience to Climate Change Related Disaster Risks” held in Dehradun on 21st July 2017)

Table of Contents

1	Introduction.....	1
1.1	Overview of Area.....	1
1.2	About this Strategic Plan	2
1.3	Area and Community Profile	4
1.4	Haridwar Risk Profile	10
1.5	Strategy Implementation, Monitoring, Evaluation.....	25
2	Strategies	27
2.1	Overarching Strategies.....	27
2.2	Specific Strategies for Earthquakes.....	35
2.3	Specific Strategies for Fluvial Floods.....	38
2.4	Specific Strategies for Landslides.....	42
3	Links to National and State Level Plans.....	46

1 INTRODUCTION

1.1 Overview of Area

The Haridwar Strategic Risk Mitigation Plan presented here is intended to provide key strategies and their priority with respect to mitigation of the identified risks associated with earthquakes (**High**) and flooding (**Moderate**) for the City. The strategies are for municipal leaders and planners, and are not technical. They are easy to understand, realistic, and they are all achievable. Successful implementation of the strategies will reduce the risk profile of this location.

Landslides in this location are a low risk, being ranked third to earthquakes and flooding as priority one and two respectively. Greater detail is provided in the Risk profile Section 1.3 below.

Over and above the threats these possible disasters pose to the estimated 400,000 residents of Haridwar City (a projected residential population of some 394, 900 people in 2018), the annual pilgrim population of over 5 million and over 60 million pilgrims for the Kumbha Mela - which is celebrated every 12 years - presents a set of challenges that far exceed anything else within the State.

The 2010 mela saw approximately 10 million people bathed in the Ganges River on the 14 April 2010, alone. By mid-April about 40 million people had bathed over the preceding three months (since 14 January 2010). Thought to be the largest religious gathering in the world, the Indian pilgrims are joined by many foreigners, both Hindu and as tourists.

This setting represents a unique situation, and at this scale, unlike any other for the State. It is addressed below in terms of the urban context in the first instance.

The pilgrimage context is addressed separately, but only in relation to local capacity as it presents a set of risks and the need for mitigation at a national, if not international level, and is outside the scope of this case study.



EARTHQUAKE

HIGH RISK

LANDSLIDES

VERY LOW RISK

FLASH FLOODS

NO RISK

FLOODS

MODERATE RISK

1.2 About this Strategic Plan

This document is an output of the Disaster Risk Assessment. It is one of 14 strategic plans produced under the study that aim to reduce risk in the selected locations and serve as case studies for other areas of risk in the State.

This Strategic Plan is built upon the hazard risk analysis undertaken by the project and formulated around key elements of the disaster risk management (DRM) framework embodied in the Sendia Framework.

The DRM process is sequential (cyclic) in order to allow adaptive improvement over time in order to build back better. It is also intended to incorporate a focus on pre-impact preparation through planning in order to mitigate risk associated with incidents before they occur.

This approach has been adopted at the National level.

While response and recovery are recognised as being reasonably short time frame processes (hours and days to months), Mitigation and Preparation are seen as much more strategic processes over longer time frames (months to years).

The National DRMP recognises three recovery periods after a disaster: a) Early – three to eighteen months, b) Medium – within five years and c) Long-term – within five to ten years. The concept of “build back better” points to continuous improvement in the mitigation and preparation process and its implementation, over all time frames as funds and resources come to hand, risk profiles change, and skills and mitigation outcomes are increased or realised. Continuous improvement represents a learning curve reflecting successes and failure – what has worked, what has not worked and how do we do better into the future?

By developing strategies around the separate phases of DRM and recognizing the opportunity for improvements over time it is possible to prioritize the actions that need to be taken. For each strategy presented here there is an initial list of key Actions include as the start of the process.

The strategies offered here are intended to aid the Municipality and its citizens, local authorities, businesses, private residents, and local NGOs, with the intent of driving a ground up approach within a State level top down policy context. The challenge is for all organizations and individuals to take upon themselves the responsibility of being prepared and being better able to offset the risks and manage the consequences of these disasters.

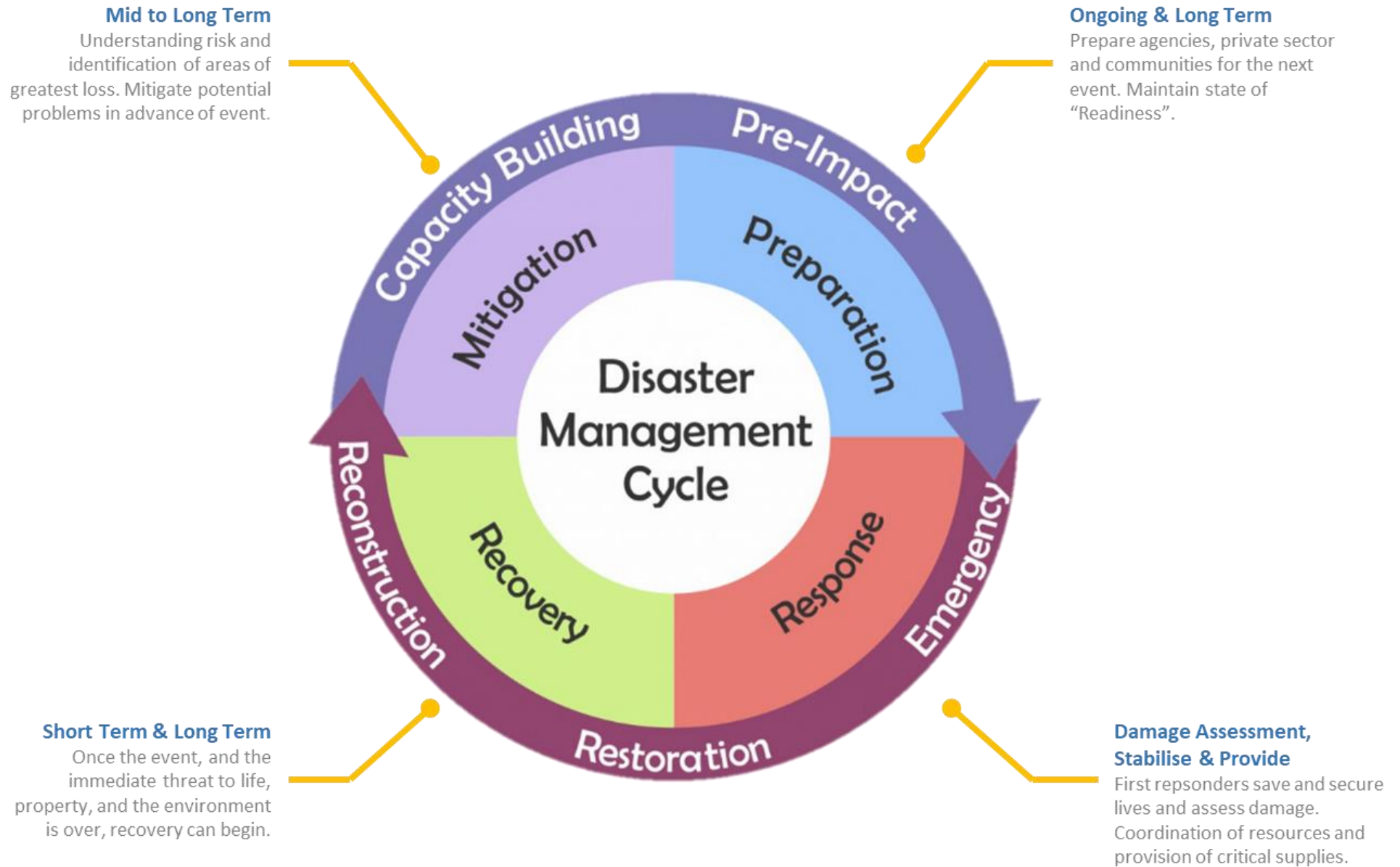
What is a Strategy?

“... a plan of action designed to achieve a long-term or overall aim.”

A strategy gives recognition to an overall goal and the way it might be achieved, taking into account the resource limitations and other constraints being faced.

What is an Action?

An Action is a key step to be taken in concert with other actions also needed for the strategy to succeed.



1.3 Area and Community Profile

1.3.1 Topography

Haridwar is situated in the plains of Uttarakhand along the banks of the Ganges at an elevation of 314 metres. The city lies in the Terai physiographic zone i.e. south of the Shivalik hills and north of the Indo-gangetic plains.

1.3.2 Climate

Haridwar experiences a moderate sub-tropical to humid climate with 3 distinct seasons namely summer (March-end till June-end), monsoon (June-end till mid-September) and winter (November to mid-March) with an average annual temperature of 23.6 °C. The monthly average temperatures vary from a minimum of 7.2 °C and a maximum of 39.1 °C. The annual rainfall is 1285mm with the bulk of the precipitation during the monsoons. The summers are windier than the winters with the monsoon rains bringing a lull in wind speeds.

1.3.3 Demographics

The Haridwar urban agglomeration has a population of 310,796 (as per Census 2011) with a literacy rate of 73.7% and a sex ratio of 873 females to 1000 males. According to a survey, the proportion of children and youth of age group: 0-24 is quite high (~62%) and the average household size is 5.7. However, since the survey data is for the entire district of Haridwar that includes Laksar and Roorkee as well, we can characterize the data as perhaps only indicative of the demographic breakup of the hotspot area considered. Further breakup is presented in Table 1.

Table 1: Age-wise distribution of Population -Haridwar district

Age Group	Percentage
0--4	9.5
5--14	29.5
15--24	23.4
25--29	5.6
30--44	18.7
45--59	8.7
60+	4.3

Workers constitute of 32.9% of the population whereas a high percentage of the population are non-workers (67%). Amongst the workers, the majority of the workers are employed in the 'others' category (95%) whereas the number of workers engaged in agriculture or the household industry are very low. The decadal growth rate of the Haridwar tehsil was 37.1% which is higher than that of Uttarakhand (18.8%) and India (17.64%) indicating a high

inflow of migrants (census 2011 vs 2001). Moreover, this is in line with the state decadal growth trends where urban areas have seen a growth of 40% whereas rural areas are growing at around 11%.

1.3.4 Economy

Since Haridwar is considered one of the holiest places in India, it attracts a large number of tourists - mostly religious - throughout the year. Currently, the city is amongst one of the most visited cities in Uttarakhand. Besides tourism, Haridwar also has significant industrial setups in the suburbs within designated estates. BHEL was one of the oldest large industries to setup in Haridwar but more recently the Haridwar industrial estate (a govt. SIDCUL initiative) was setup as an industrial cluster/special economic zone accommodating various companies and industries mostly related to the manufacturing sector. Haridwar also functions as a trading and distribution post of essential and non-essential goods for the hilly regions - especially the districts of Tehri-Garhwal and Pauri-Garhwal. Hence, Secondary and tertiary sectors are most dominant in the urban city of Haridwar.

1.3.5 Development History

In the 2010 Kumbh mela, more than 40 million people had bathed in the Ganges during the 3-and-a-half-month-long festival. The Kumbh mela which takes place every 12 years since centuries has necessitated the city to develop and become capable of handling the huge crowds that venture into the city during that time. In the 19th Century, the Ganga canal system was developed to improve usage of the river water. By the mid-20th century, sewage lines were laid in the city. Later in the century in 1988, Haridwar would become the headquarters of its own newly separated district. The city was connected by rail in the late 19th century and is presently well connected with direct trains to many important cities in India. There are plans in progress to extend the railway line beyond Rishikesh for easy movement of pilgrims for the Char Dham Yatra. Jolly Grant Airport serves as the nearest airport and operates daily flights from/to Delhi.

1.3.6 Regional Context

The area defined under the Haridwar hotspot stretches from Haripur Kalan to the north and encompasses the rapidly developing Ranipur to the east and beyond until Kota Murad Nagar. The area east of Ranipur is currently sparsely urbanized but the trends indicate that rapid urbanization would lead to an increasingly homogenous land spread connected to Haridwar. Since Haridwar is in the plains region, there are many roads of access to Haridwar prominent amongst which are National highway 334, which connects to Roorkee and national highway 34 which connects to Najibabad.

Haridwar lies to the south of Dehradun and Rishikesh, which are also very prominent urban centers. Any policies related to the disaster risk mitigation of the region should look at the city trio as a whole from a development perspective as any changes in one city could potentially have significant ramifications for the other.

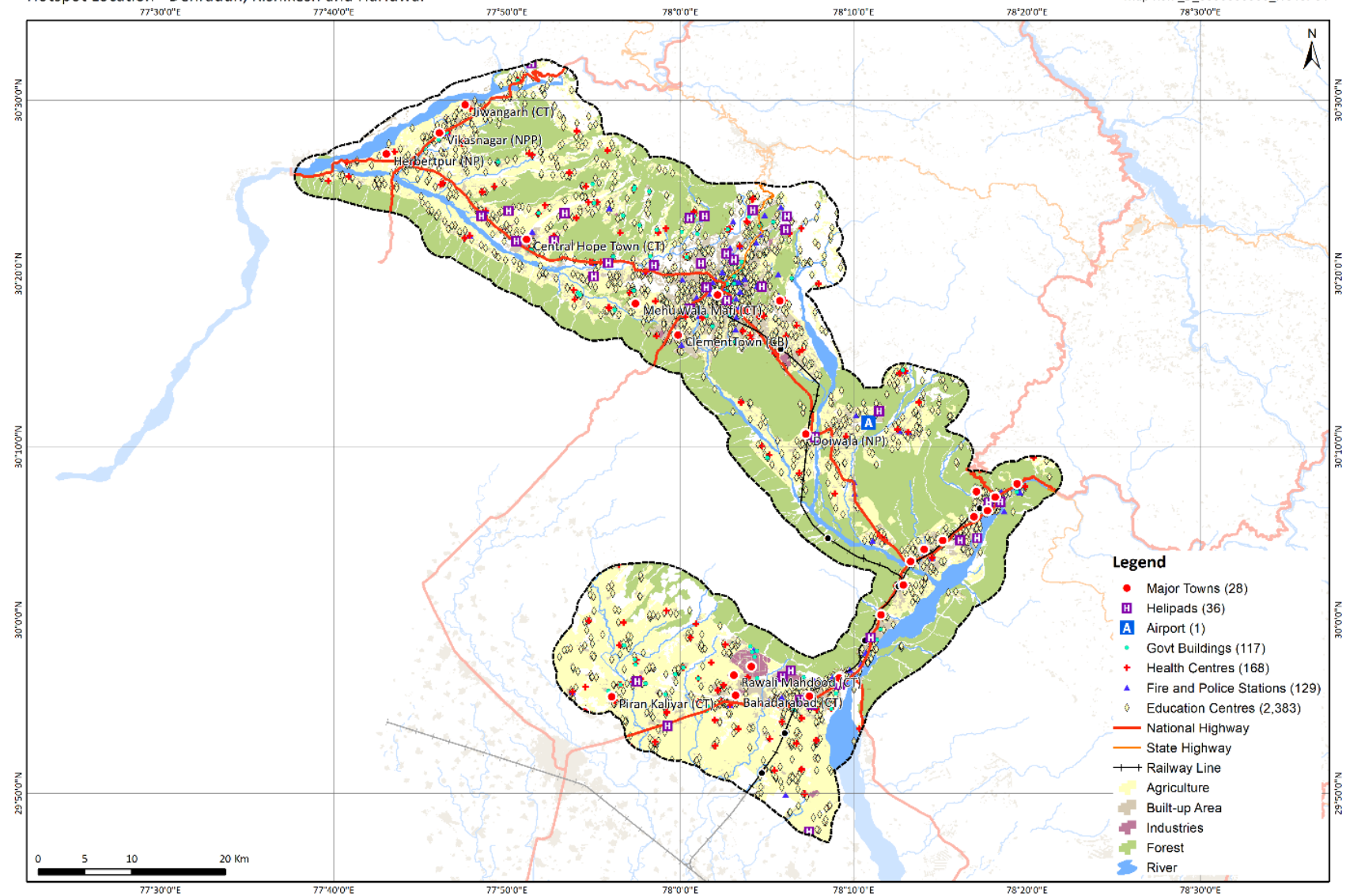
Hence, we present the case studies of Haridwar, Rishikesh and Dehradun as Urban Cluster – 1 for the purpose of a consolidated view (See Map 1).

Urban Cluster 1 (Dehradun, Rishikesh and Haridwar)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Dehradun, Rishikesh and Haridwar

Map Ref: _B_0000000000_HOTSPOT



Map 1: Urban Cluster 1: Haridwar, Rishikesh and Dehradun

1.3.7 Administrative Units

The Haridwar hotspot is broadly a mixture of rural, urban and forest areas. The administrations governing the hotspot are diverse and this presents a significant challenge to effective coordination of planning (short and long-term) for DRM; especially mitigation and preparation activities in the longer term. Some of the disaster risk management strategies may require efforts that cut across administrative boundaries. Below is a general view of the different administrations involved in the Haridwar hotspot:

Table 2 List of the different administrative areas within Haridwar hotspot

Urban		Rural	
		Block	Tehsil
Haridwar (NPP)	Jagjeetpur (CT)	Bahadarabad	Haridwar
BHEL Ranipur (ITS)	Rawali Mahdood (CT)		
Bahadarabad (CT)	Piran Kaliyar (CT)		

1.3.8 Critical Facilities/Infrastructure

Haridwar is connected by air to the rest of India and beyond via the Jolly Grant airport that sits between the three cities on the plain to the north of the Shivalik hills. Access and Egress via road is limited to a single highway of variable capacity and is in a state of repair that is presently being upgraded.

To the north it connects with Rishikesh and as such is the pilgrimage route up the Ganges. For significant periods of the year it is a constant jam of very slow-moving traffic. The road is elevated above the flood plain by some 3-4 meters and in a case of flood will be the only secure high ground into and out of the city and surrounds. Below is a snapshot of lifeline buildings and helipads, which are important from the disaster risk management perspective:

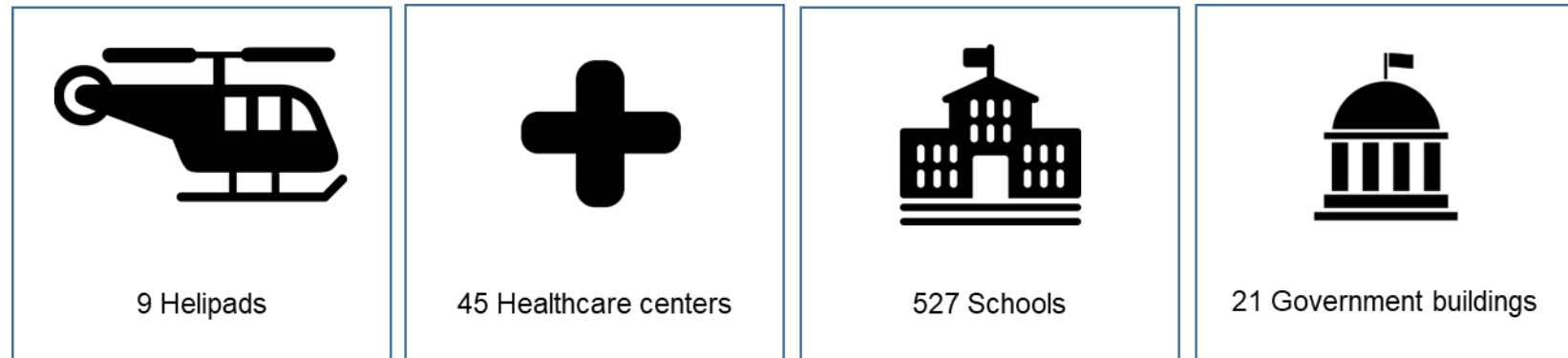
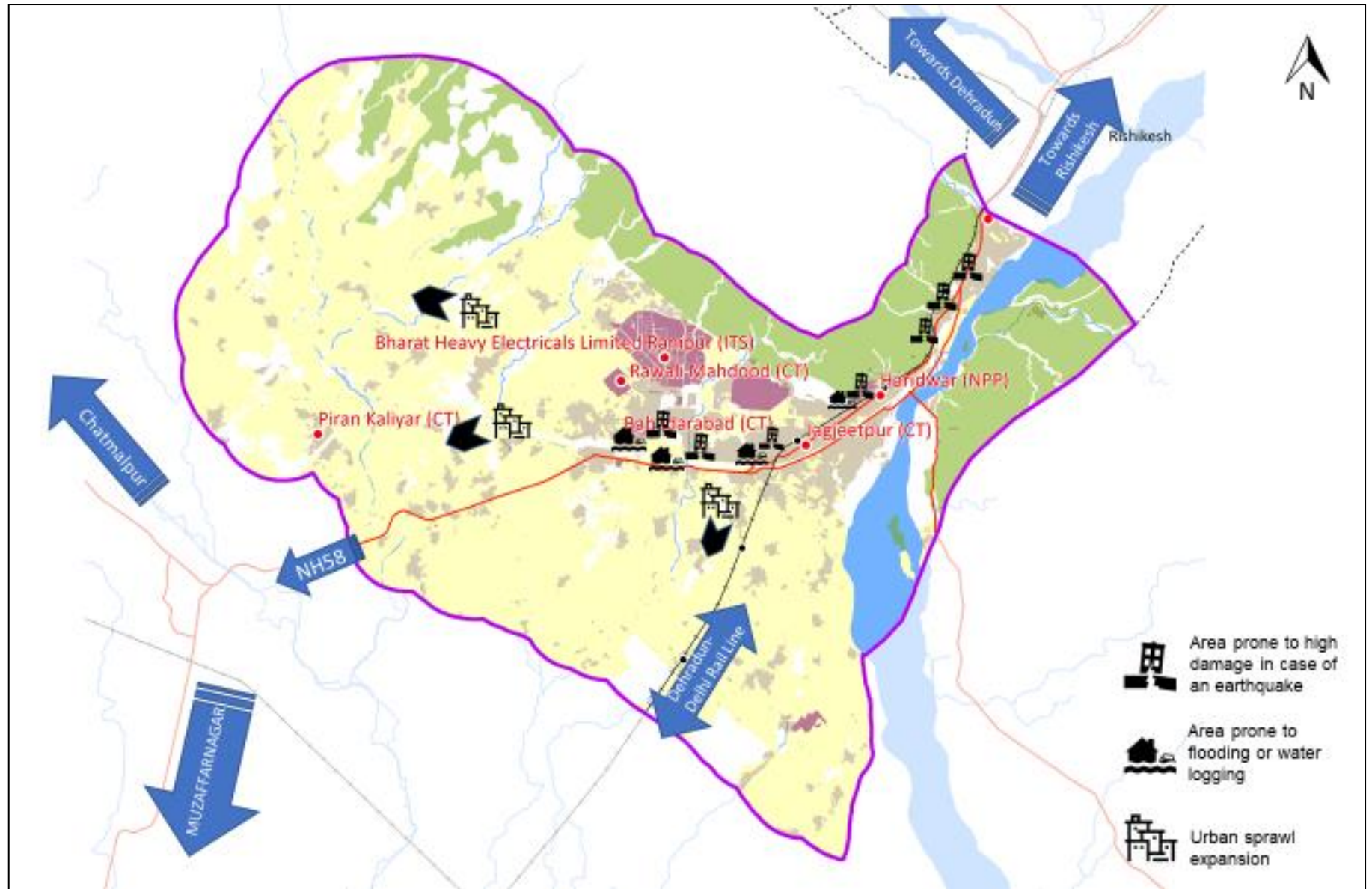


Figure 1: Critical Infrastructure in the Haridwar Hotspot

Thirty-two of the 45 healthcare centers are sub-centers whereas the rest include 10 PHC's and 3 hospitals. The total lifeline buildings in the Haridwar hotspot are 561.

In the city of Haridwar, the sewage management is a mixture of piped systems and unorganized on-site sanitation systems. The water supply is mostly piped in urban areas with some rural areas relying on water table extraction with hand pumps or motor pumps. For cooking fuel, the urban areas mostly use LPG cylinders whereas in some rural areas firewood and cow dung is still used.



Map 2: Context Map of the Haridwar Hotspot

1.4 Haridwar Risk Profile

1.4.1 Social Vulnerability

The social vulnerability has been ascertained by analyzing a combination of indicators that define certain characteristics or qualities (such as socio-economic and demographic attributes) within social systems that create the potential for loss or harm. According to this study, the vulnerability of the Haripur Kalan town, which is upstream, the river Ganges is ascertained as “very high”.

Certain pockets near Bahadarabad to the west and near Dhanpura to the south are also of “very high” vulnerability. Additionally, pockets in the north-west of the hotspot near the Mohand forest range are of “moderate to high” vulnerability.

However, The Haripur Kalan town area is of particular concern since the area is exposed to flood risk as well whereas the other vulnerable areas are only prone to earthquake hazard. Also, the Haripur Kalan area is densely populated which increases the number of vulnerable persons.

Maps 3-8 illustrate the social vulnerability and population density of the key areas of Haridwar.

1.4.2 Earthquakes



HIGH RISK

Haridwar city and its surrounds are classified as “High Risk” with respect to earthquakes. It is important to note that the traditional market areas in Haridwar have high population density hence increasing the exposure to an earthquake event.

The buildings are not adequately built to withstand earthquakes and the narrow roads in these areas are likely to impede response efforts. A particularly worrying trend in key commercial areas is the creation of shopfront facades that are not being effectively tied back to buildings hence having a high risk of detachment during an earthquake.

Maps 9 – 11 illustrate the earthquake hazard in the key areas of Haridwar for the 100yr, 475yr, and 1000yr return period probabilities.

1.4.3 Floods



MODERATE RISK

Flood Risk for Haridwar is Moderate. Whilst the city suffers from annual urban drainage problems (outside the scope of DRM), the potential for catastrophic floods is deemed moderate for the city as a whole.

The assessment of risk is largely a result of the works undertaken to control the flow of the Ganges with respect to pilgrimage activities during the annual and 12 yearly melas (pilgrim gatherings).

It was recorded that there are still river training issues due to sand mining activities and there is a lack of an overall assessment of how this should be implemented on a scientific basis to optimize the run off characteristics of the river at this point.

To reiterate, the chronic flooding problem in Haridwar is due to the blocking of drains leading to water logging issue, which is arising due to the filling of natural drains for increasing the built-up area inside the city. The monsoon rainfall runoff water is unable to drain properly through proper channels and creates water-logging issues every year affecting the daily life of millions living in the city in turn creating unhygienic environments in these areas.

Maps 12 – 14 highlight the flood risk in the key areas of Haridwar.

Fluvial vs. Flash Floods vs. Pluvial Floods

Fluvial Floods, or riverine flooding, occurs when excessive rainfall over an extended period causes a river to overflow its banks and to spread out over a wide area. The damage from a fluvial flood can be widespread.

Flash floods are intense, high velocity torrents of water that occur in an existing river channel with little notice. Flash floods are very destructive because of the force of the water and the debris they carry.

Pluvial Floods (Urban Flooding) flooding occurs when an extremely heavy downpour of rain saturates drainage systems and the excess water cannot be absorbed. It is a common nuisance in Haridwar, Dehradun, Haldwani, and other larger towns during the monsoon. The water quickly disappears when the rain stops. Integrated urban drainage systems are an appropriate solution, and pluvial flooding is not under the scope of this risk management strategy.

1.4.4 Flash Floods



NO RISK

Flash flooding is not seen as a risk in Haridwar and has been ranked as being of No Risk status. As a result, there is no need to develop strategies with respect to this Hazard.

The urban drainage issues faced by the city do not constitute flash flooding of the magnitude expected to cause a catastrophe.

1.4.5 Landslide Hazard



VERY LOW RISK

Landslides are not a significant risk in Haridwar and landslides have been ranked under the DRA as being very Low Risk status. As a result, there is no need to develop strategies with respect to this Hazard.

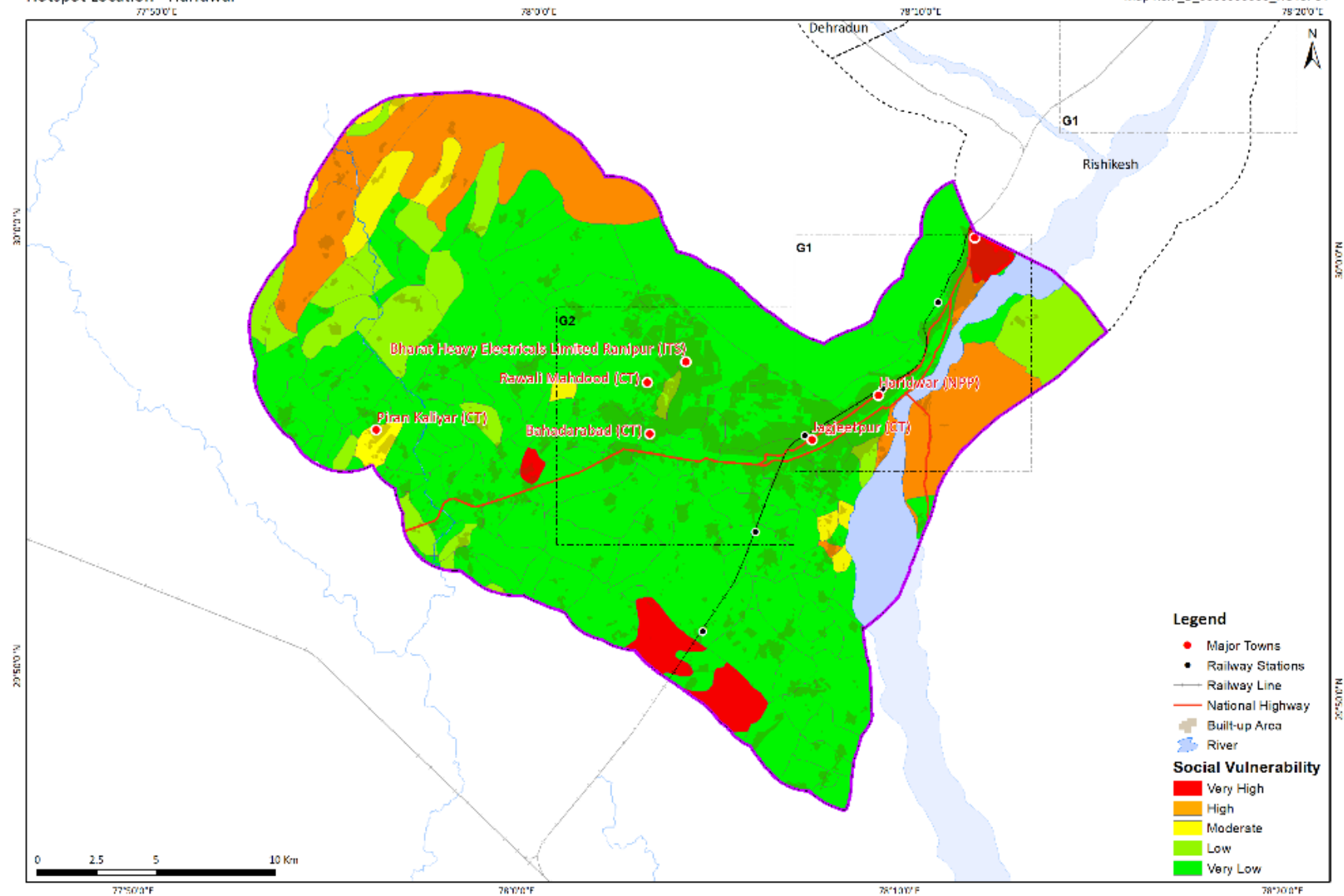
Notwithstanding this, the District Authority is advised to ensure good building practices on potentially unstable slopes proximate the Mata Mansa Devi Mandir temple.

Urban Hotspot Plan (Social Vulnerability)

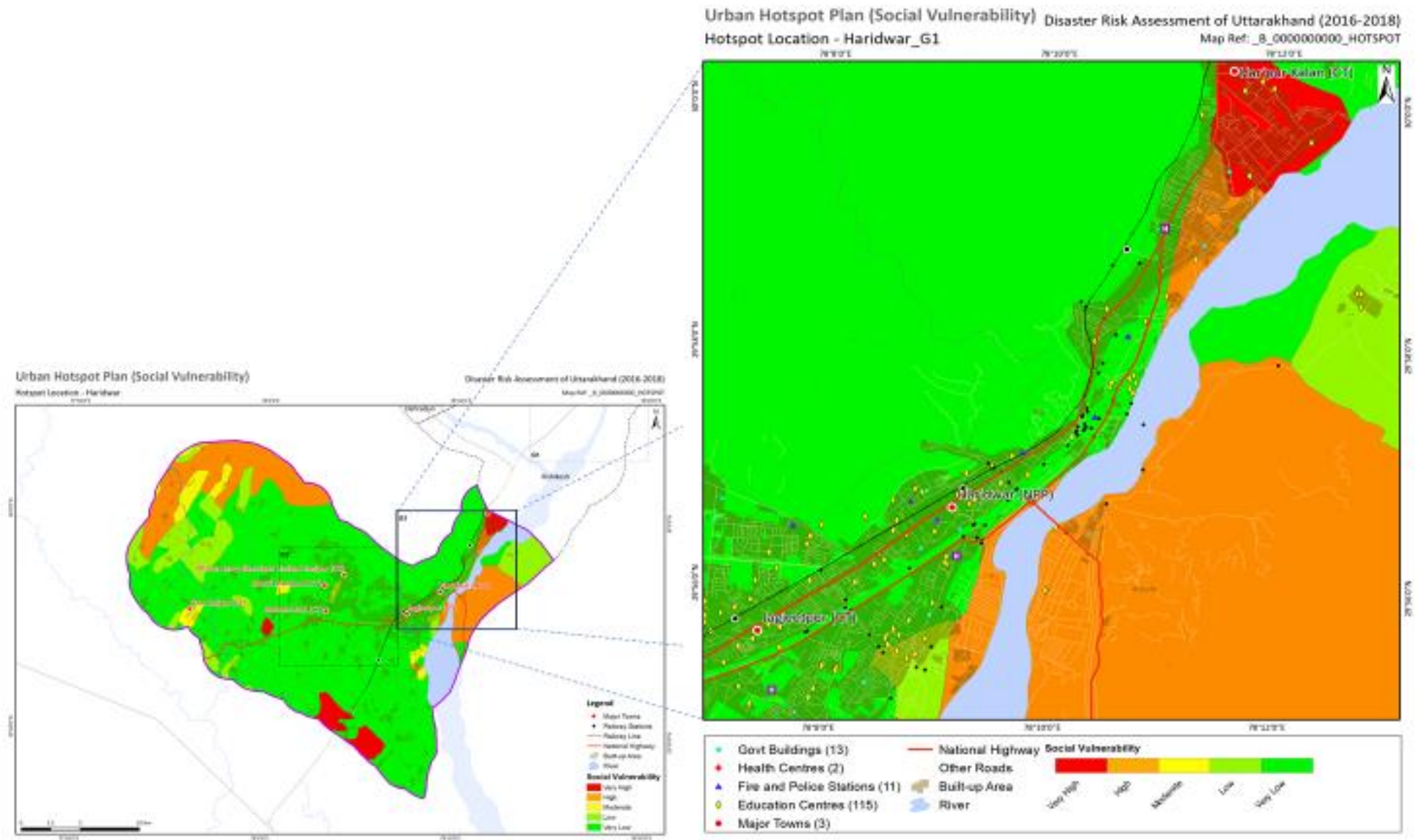
Hotspot Location - Haridwar

Disaster Risk Assessment of Uttarakhand (2016-2018)

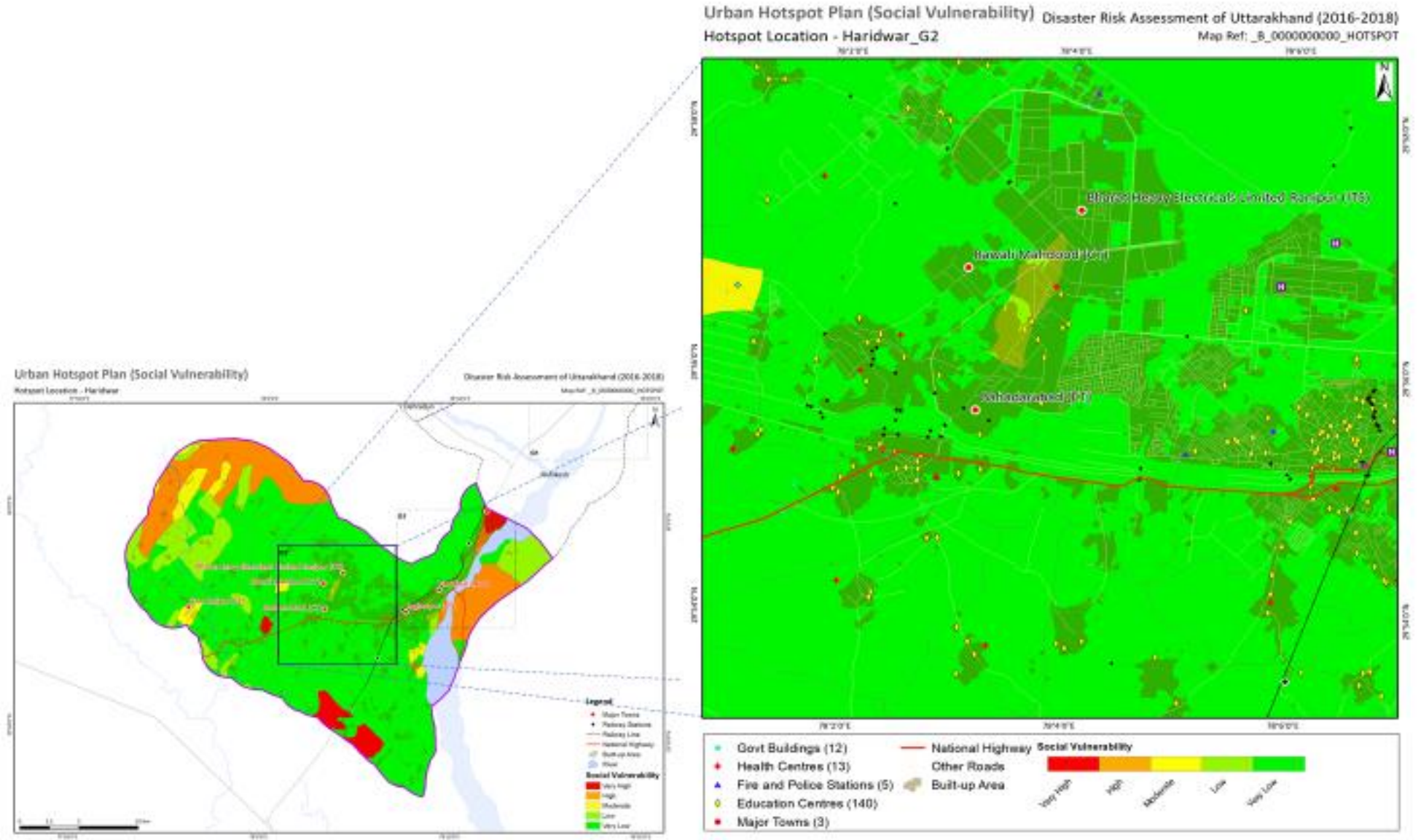
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Map 3: Integrated social vulnerability Index Haridwar hotspot area



Map 4: Integrated social vulnerability index – Haridwar G1



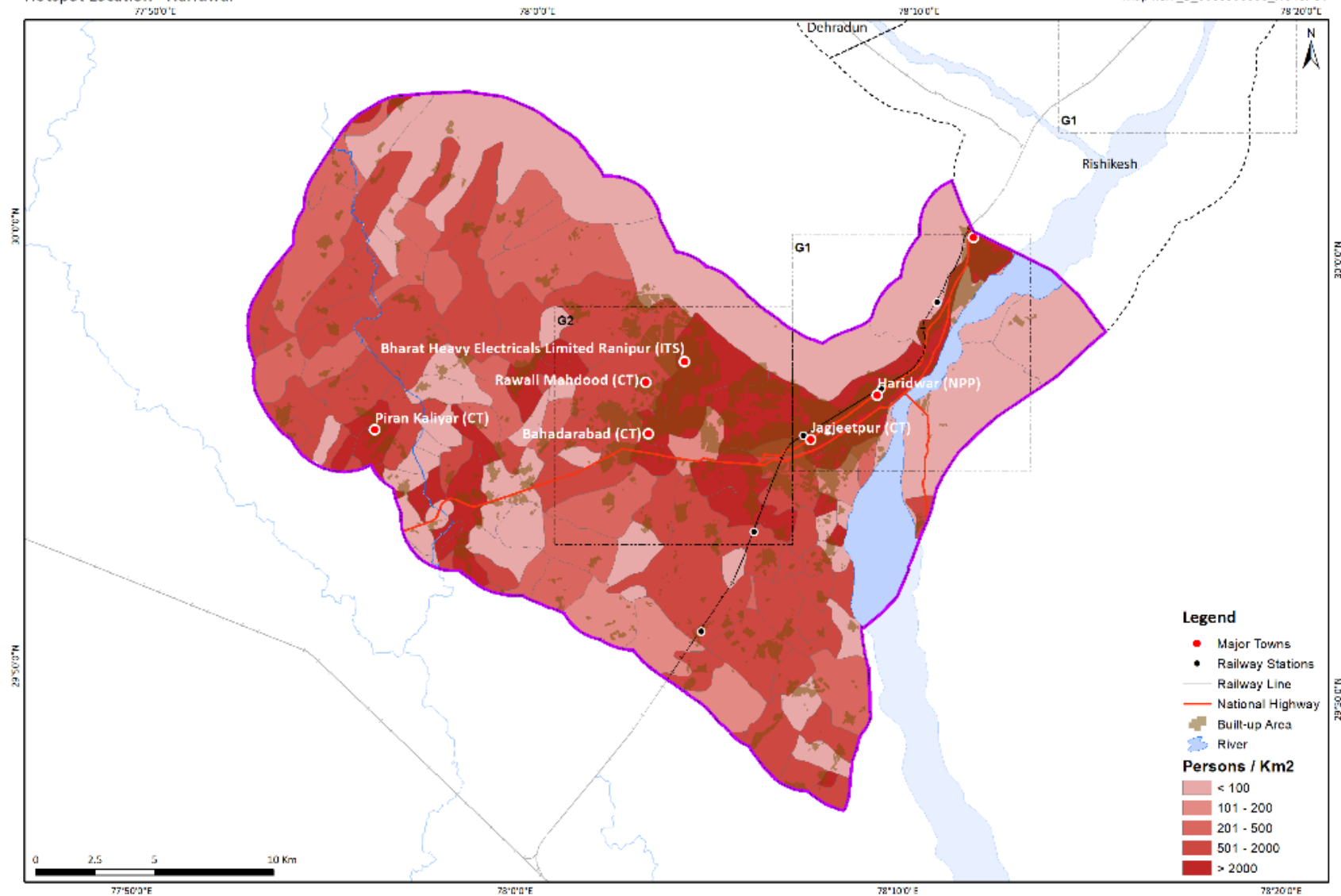
Map 5: Integrated social vulnerability index – Haridwar G2

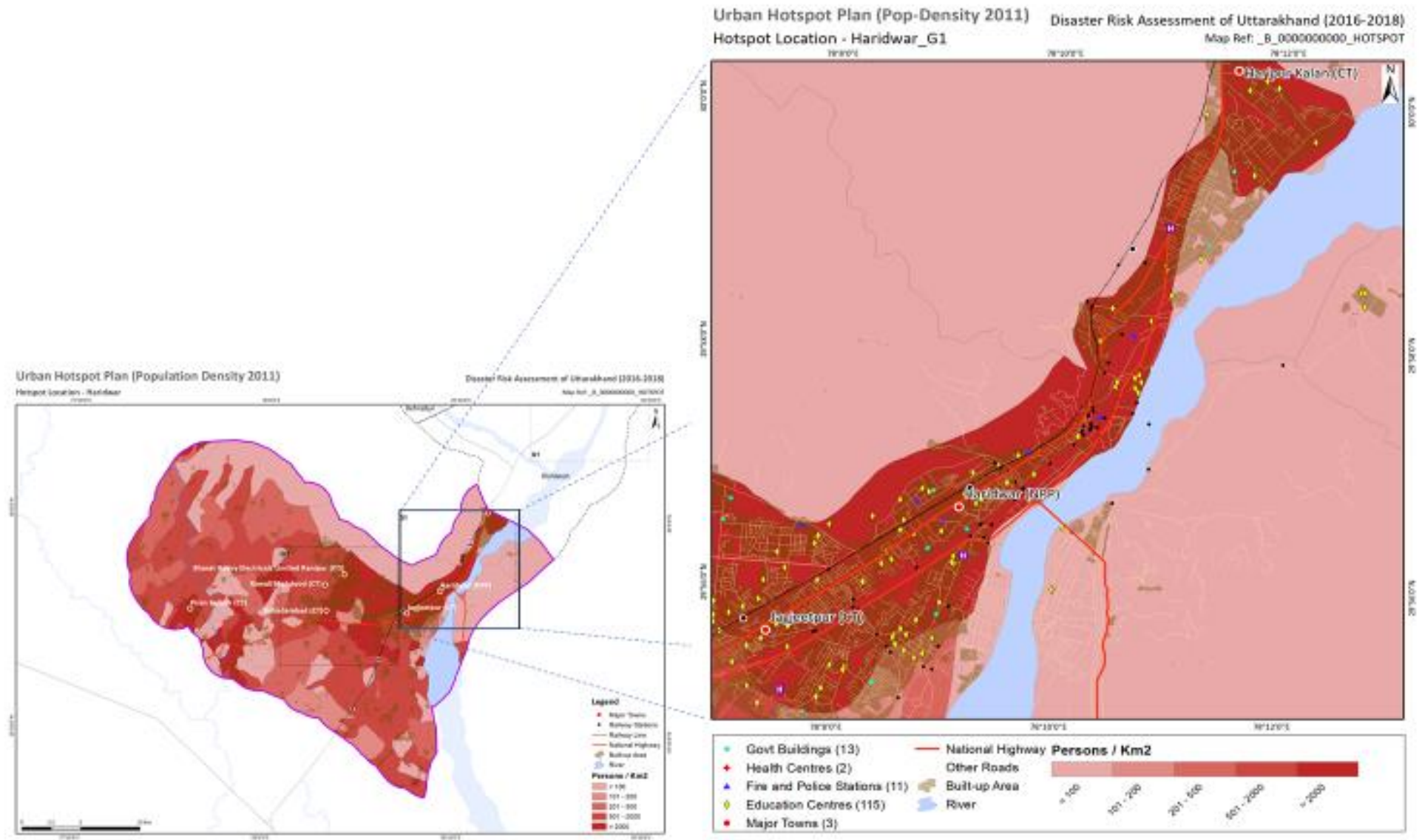
Urban Hotspot Plan (Population Density 2011)

Disaster Risk Assessment of Uttarakhand (2016-2018)

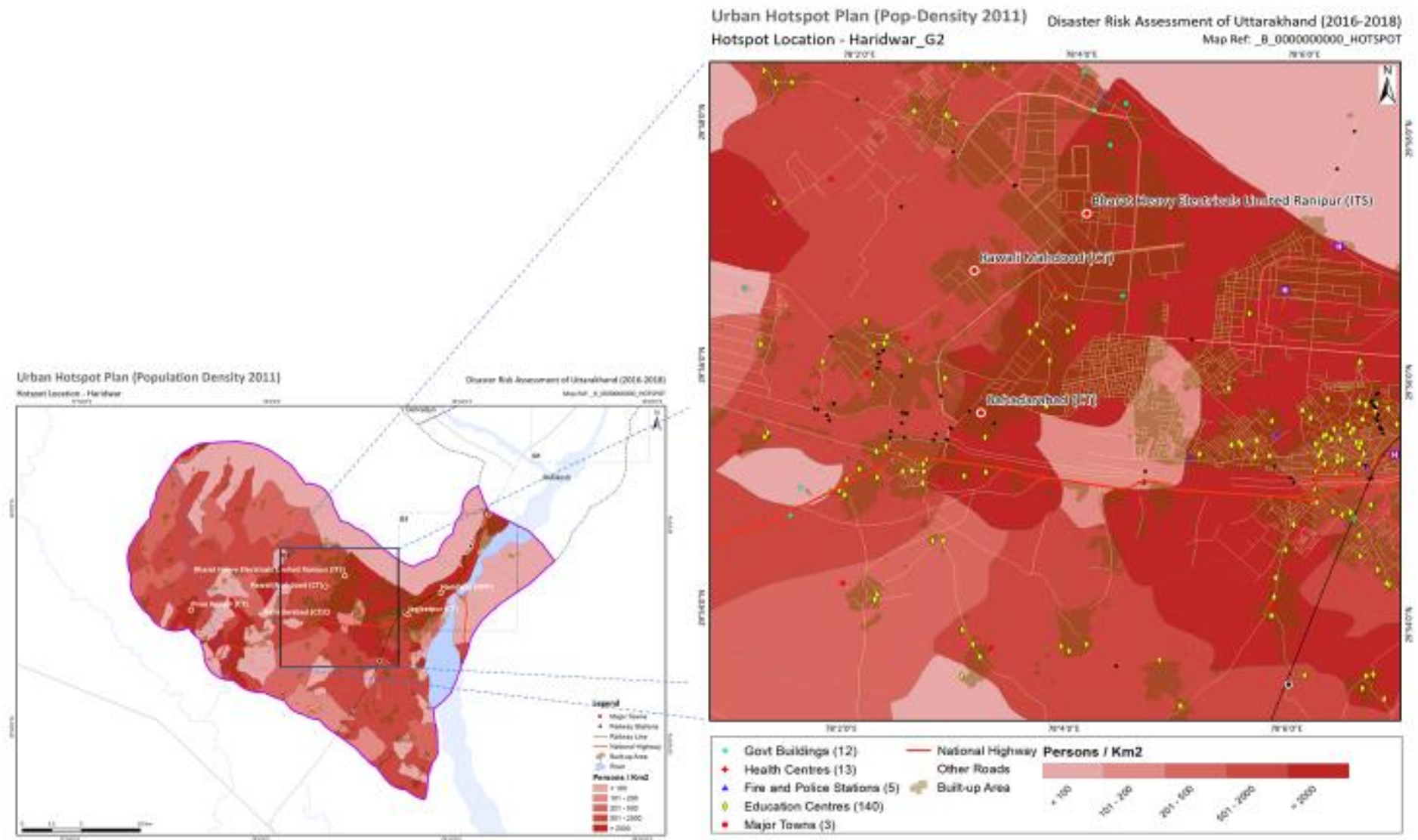
Hotspot Location - Haridwar

Map Ref: _B_0000000000_HOTSPOT





Map 7: Population density - Haridwar G1



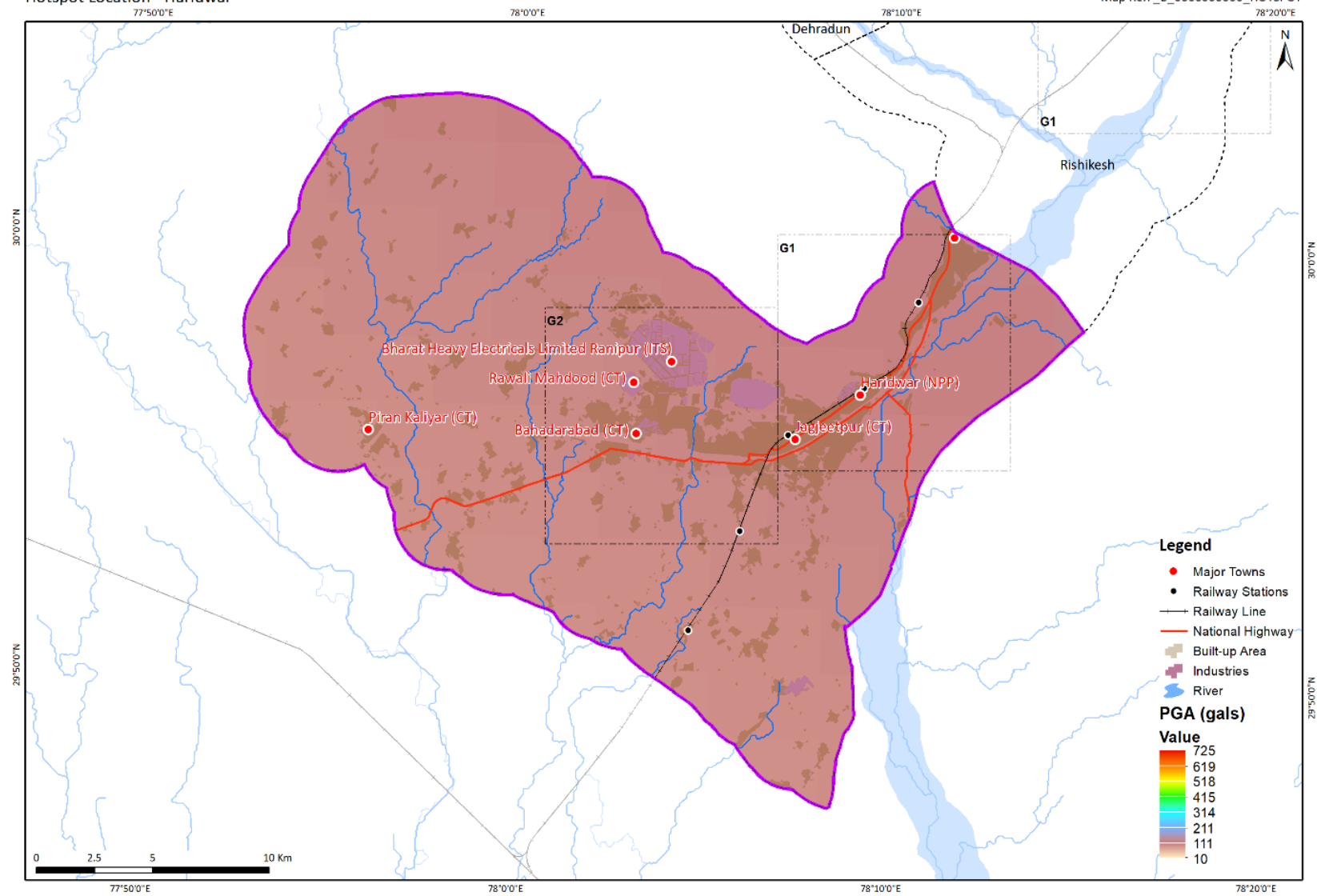
Map 8: Population density - Haridwar G2

Urban Hotspot Plan (Earthquake: 100 year return period)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Haridwar

Map Ref: _B_0000000000_HOTSPOT



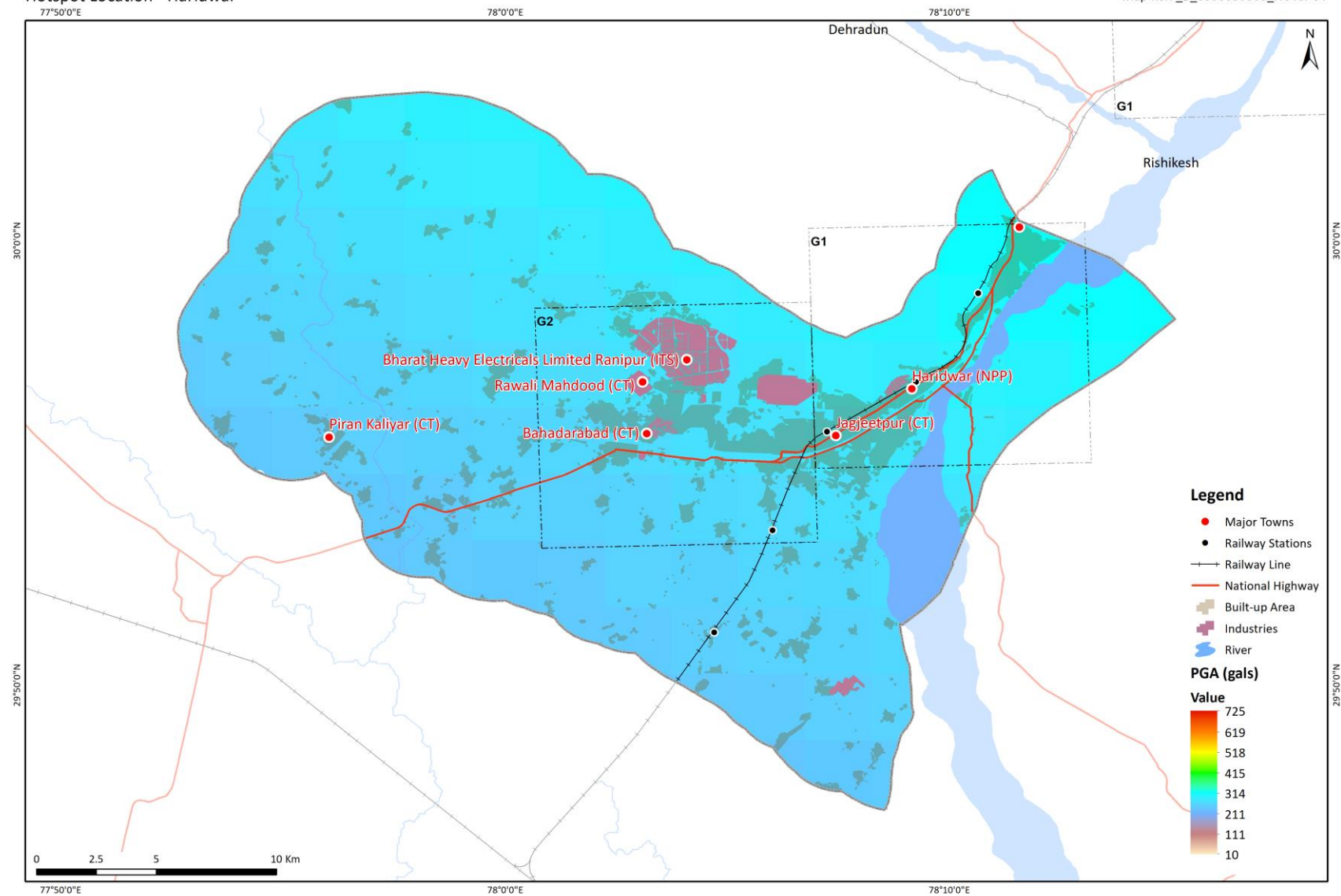
Map 9: Earthquake Hazard Map (100 yr RP) - Haridwar Hotspot Area

Urban Hotspot Plan (Earthquake: 475 yr RP or 10% chance in next 50yrs)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Haridwar

Map Ref: _B_000000000_HOTSPOT



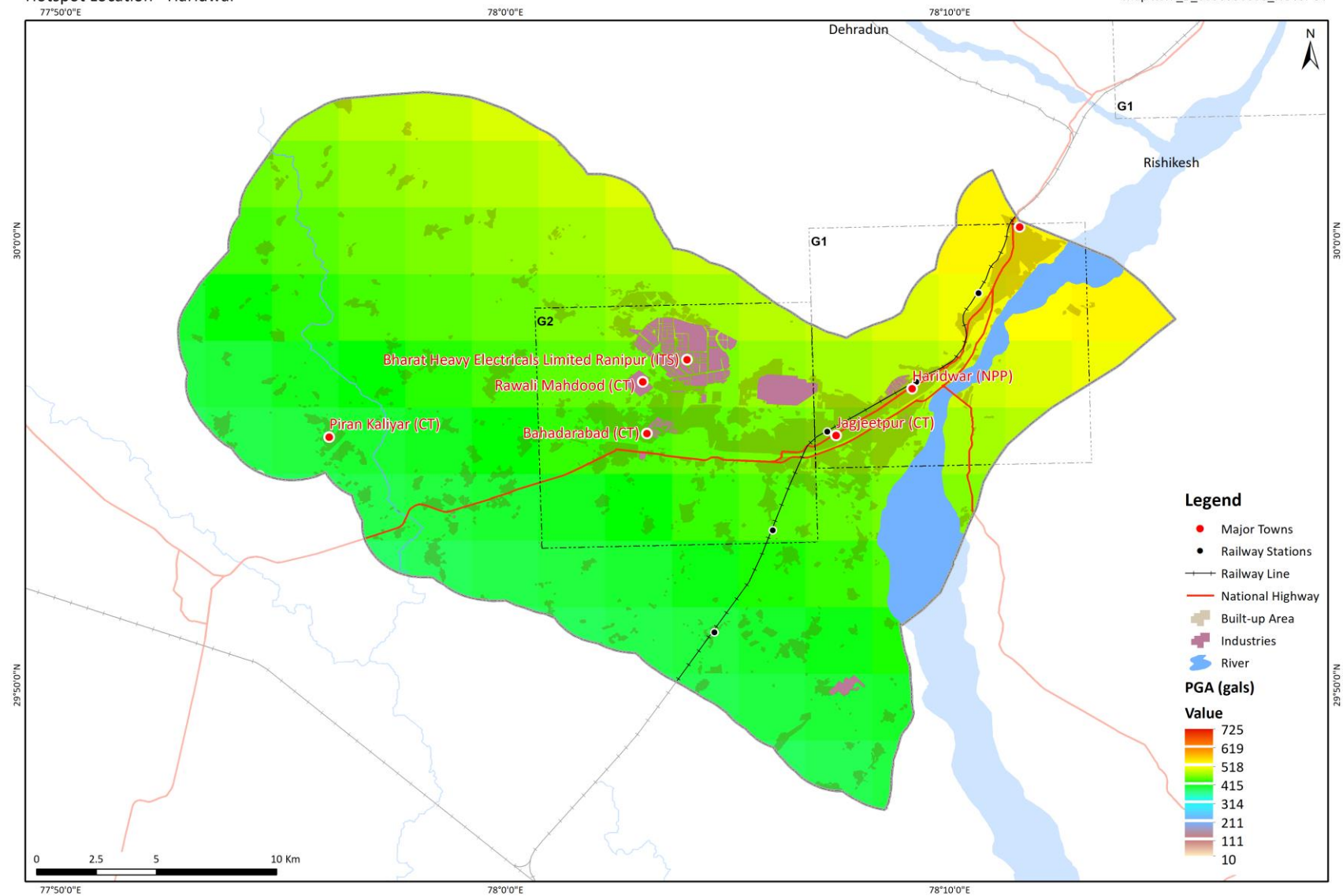
Map 10: Earthquake Hazard Map (475yr RP) - Haridwar Hotspot Area

Urban Hotspot Plan (Earthquake: 1,000 yr RP or 5% chance in next 50yrs)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Haridwar

Map Ref: _B_0000000000_HOTSPOT



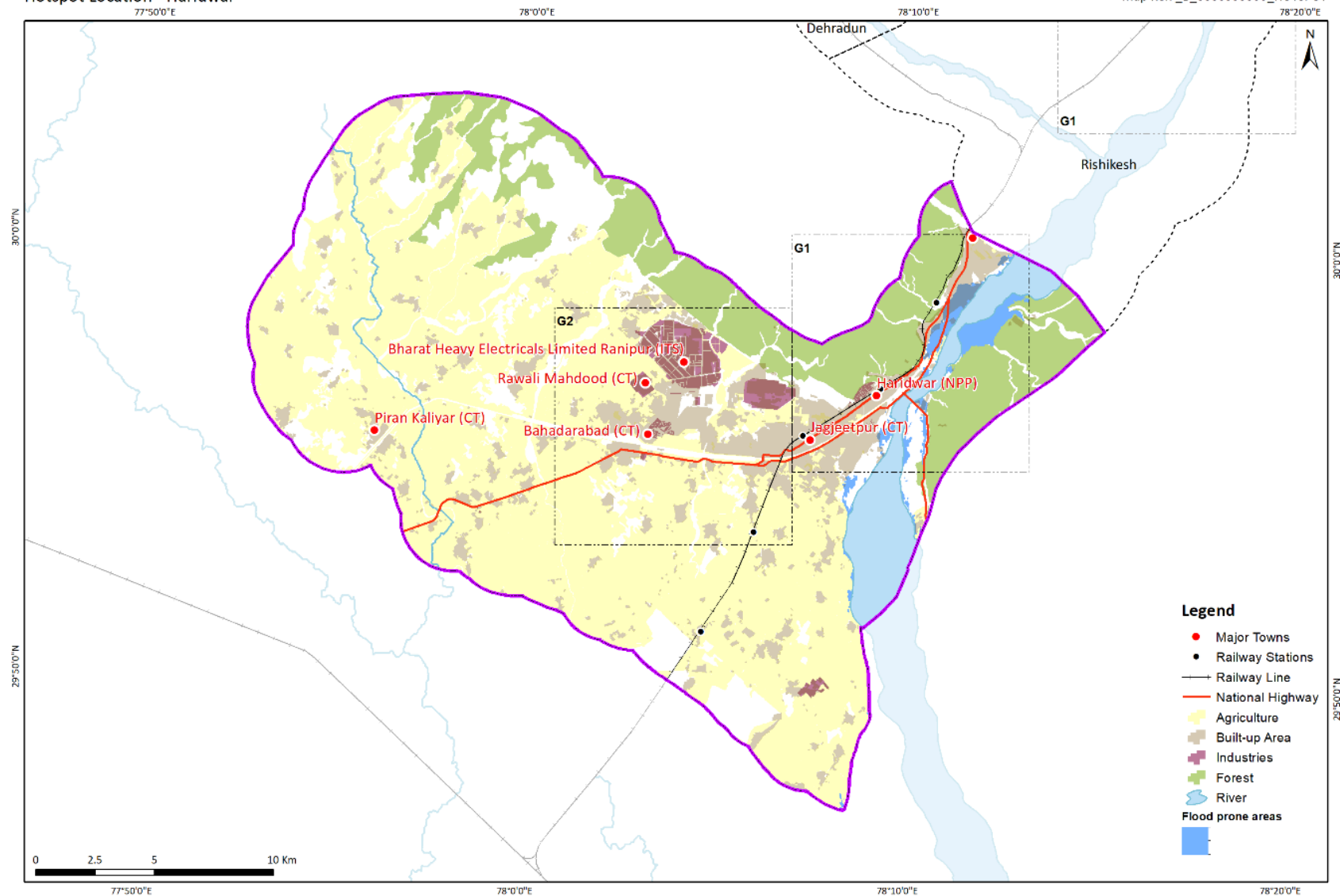
Map 11: Earthquake Hazard Map (475yr RP) - Haridwar Hotspot Area

Urban Hotspot Plan (Flood Prone Areas)

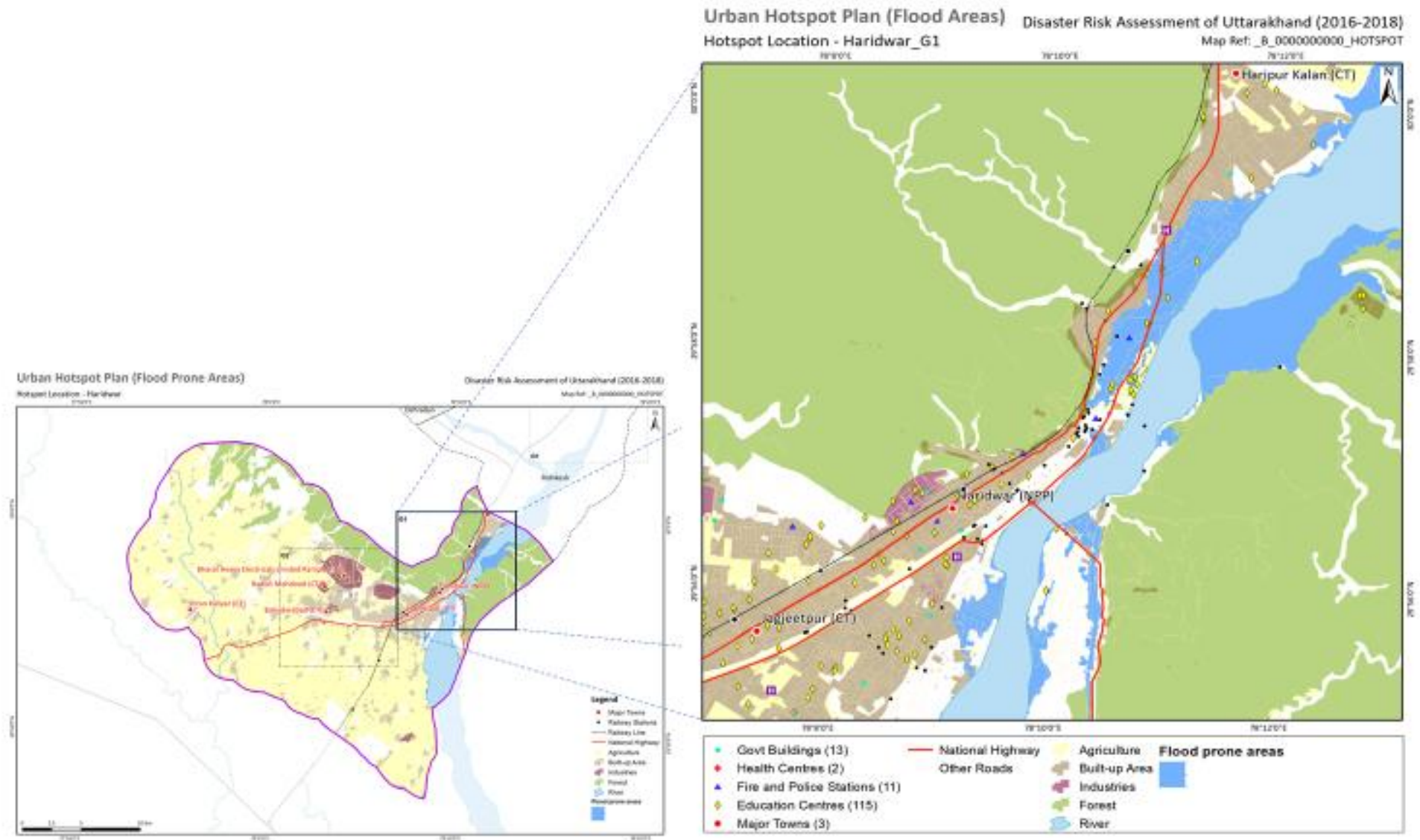
Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Haridwar

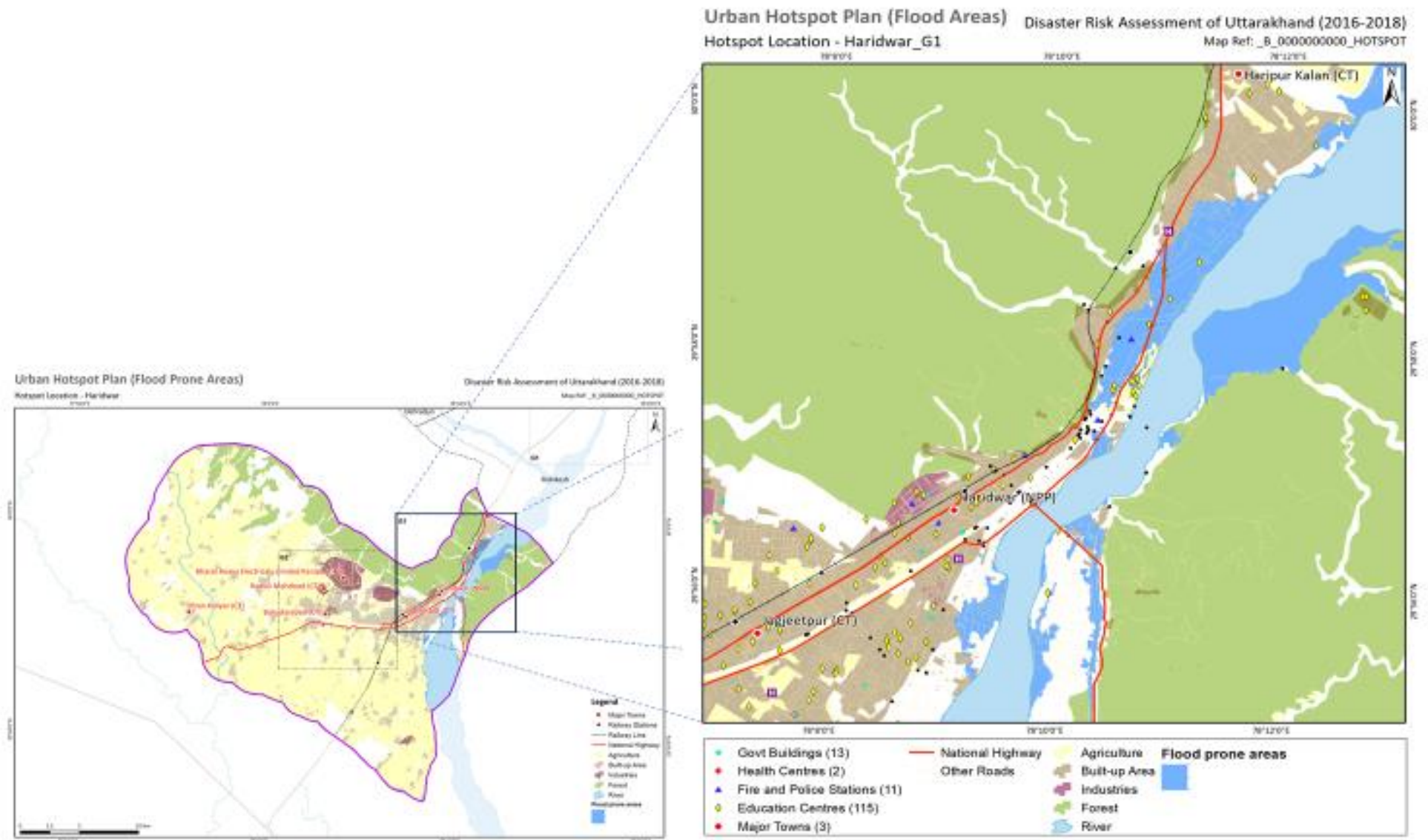
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Map 12: Flood Prone Areas in Haridwar City



Map 13: Haridwar Fluvial flood map - G1



Map 14 Haridwar Fluvial Flood map - G2

1.5 Strategy Implementation, Monitoring, Evaluation

1.5.1 Challenges in Implementation

Three challenges have been identified with respect to DRM in Haridwar and surrounds. In brief, these are:

Finance - Section 40(2) of the DM Act 2005 stipulates that every department of the State, while preparing the DM plan shall make the provisions for financing the activities proposed therein.

The marginal cost involved in mainstreaming DRR in existing programs, activities and projects of the department are not very sizable and the departments may not find it difficult to arrange such funds. However, funds for disaster prevention and mitigation may not be available so easily unless the departments are able to negotiate such projects with the planning and finance departments with proper Cost Benefit Analysis (CBA).

Technical – the way data and other information are acquired and transferred is still essentially dependent on manual processes. As a result, planning and awareness are both compromised, as is an ability to take an effective overview and achieve a ‘whole of government’ capacity to integrated strategic planning. Best practice statutory planning and regulation (including enforcement) is now done at this level using a spatial approach with a GIS and data sets available with all departments. It is time for the city to enter the digital age in this respect. First steps are related to recruiting young graduate qualified spatial planners and engineers to deliver access to the requisite GIS data sets and facilitate planning and regulation.

Integrated mitigation, planning and preparation - An integrated approach across Government, the private sector and the community is required to ensure fully effective DRM. A simple example, is the need to pay much attention to Police & Fire, health specialisations; i.e. how to evacuate disabled, sick people or evacuation during fire/ smoke etc, During the development of any evacuation plan whether for city or rural, these specialisations need to be considered.

1.5.2 Proposed Management and Governance Structure

It is proposed that a Haridwar Hazard Mitigation Working Group is established by the Mayor/ or the Chairman of the Municipal Corporation as they can constitute a CDMC any time and then seek endorsement by the DDMA. The Municipal Commissioner/ or MNA (Mukhya Nagar Adhikari) should be the Secretary, with some Municipal Councilors, the city Chief of Police plus Head of relevant line Departments. City Trade Association, NGOs, CVOs, Civil Defense also need to be considered as possible members (not more than 20 people). This CDMC will take care & report to the District Disaster Management Authority (DDMA).

Once established the Group is to become responsible for coordinating implementation of the DRM Plan and its associated strategies and undertake the recommended annual review and reporting process. In order to develop momentum for plan implementation, the Group needs to establish an appropriate timeframe for the meeting schedule as plan implementation begins, meeting quarterly, half yearly or annually, depending upon the hazard profile of the City.

The HMWG will meet annually to identify funding needs for the implementation of mitigation strategies, evaluate the effectiveness of the plan, and develop new mitigation strategies to reduce loss from natural hazards. The HMWG must have core level of funding to facilitate their own activities as well as giving effect to key recommendations at the municipal level. Reporting to the State on all such Expenditure is also an annual obligation.

1.5.3 Monitoring and Evaluation

The National DMP calls for all DMPs to be updated annually through a process of stakeholder review and revision. It is proposed here that Uttarakhand State, the Districts and Sub-Districts undertake an annual assessment and adopt a reporting process on the status and progress made in implementing the strategies adopted in taking the respective DMPs forwards. If formulated as a report card then this can be used as both a governmental and Institutional device to drive mitigation, planning and preparation processes and yielding political and funding benefits to support the continuation of the process.

For each strategy, there is the need to determining an indicator of progress and success. It is international best practice for all strategies to have a monitoring and evaluation component so that progress and can be measured and reported upon. Such a key performance indicator (KPI) needs to be defined using realistic time periods and a quantitative rather than a qualitative measure.

For each strategy presented here a Key Performance Indicator (KPI) has also been provided is a measurable value that demonstrates how effectively the strategy is being achieved. These KPIs are indicative and need to be agreed and adopted as part of the implementation process by the relevant stakeholders.

2 STRATEGIES

2.1 Overarching Strategies

Overarching strategies are intended to apply to all disaster types and provide the backbone to a strong disaster risk management approach to mainstream administration, and in the case of Haridwar, and other important pilgrimage centers, are fundamental to strengthening the existing management planning of the observances and movement of many millions of pilgrims.

2.1.1 Mitigation

Mitigation			
STRATEGY	DRIVER	OUTCOMES	KPI
Constitute a City Disaster Management Committee (CDMC).	The key to effective cross organization collaboration is to make it top down with designated tasks to be reported upwards, and then run a process of participatory engagement.	A CDMC with responsibility to ensure all DMP are formulated, understood and implemented with an obligation to report to the respective city/ward and state government.	A committee established, and appropriate TOR agreed and signed off on within 6 months.
Development & updating of Disaster Management Plans at all levels within the Cities jurisdictions and across its departments.	At city level, DM Plans have not yet been developed.	DM Plans developed for all sectors of the City.	DM Plans developed within 12 months.
Ensure the City DM Plan/ Evacuation Plan (CDMP) is widely distributed and understood.	The DMP not only needs to be up-to-date but it needs to be part of mainstream administration of the city.	A well prepared and tested DMP that is regularly reviewed, amended and distributed.	Development of the DMP within 12 months followed by regular annual reviews. / Annual review of the DMP awareness of relevant agencies/officials and annual reviews of its relevance.

Development and implementation testing of Hospital/ Mass Casualty Plans.	DMP needs to be a mainstream component for both hospital and medical administrators as well as front line medical and support staff, including pharmacy and medical supply lines.	Demonstrated response capability within the medical and para medical support system of the city.	Development of the Hospital/Mass casualty plans in DMP within 12 months followed by regular annual reviews.
Development of school DMPs with appropriate simulations and debriefings.	School children not only need to be protected but are also a strong mechanism for dissemination of DRM thinking within families and the broader community.	Greater resilience at schools and school children equipped with demonstrated response capability.	Development of the school reach out and school DMP within 12 months followed by regular annual reviews.
Undertake an audit of the structural and lifeline support capability of all lifeline buildings to ensure that all are assessed and that the results of the comprehensive assessments are reported ¹ .	The National Institute of Disaster Management makes clear that preparedness and mitigation measures should include retrofitting of life-line buildings not only for saving lives of the vulnerable people, but also to ensure prompt and efficient response to disasters. Lack of information on this is an issue facing each hotspot and it needs to be a strategic priority so that appropriate works can be planned and budgeted for.	A report on the results of a comprehensive assessments of the structural resilience and life line support capability of all lifeline buildings so that appropriate works can be planned and budgeted for.	Twenty percent (20%) of all lifeline buildings assessed annually and a comprehensive report provided to government.

¹ There are now web based assessments available specifically designed for this task. See for example, <http://www.retrota.com/>

2.1.2 Planning and preparation

Planning and preparation			
STRATEGY	DRIVER	OUTCOMES	KPI
Increase public awareness, understanding, support & demand for hazard mitigation through the development of a citywide sales and marketing strategy and campaign focused on private sector, community groups, industry, city agencies, pilgrims and tourists.	As noted above planning for risk management and response is still to be undertaken. Community awareness, preparedness and response capability is predicated on risk awareness and right response behavior. This process needs to be fast tracked and focused on. A brand awareness needs to be built along with a "need to know" desire using professional education and publicity expertise which is focused on a complete DRM cycle approach within key "market" sectors: schools and youth.	A risk management capable community/stakeholder lessening the level of probable loss of life and assets.	A public awareness campaign designed and sponsored within 12 months.
Sensitization meetings at municipal ward level/ awareness camps.	To generate awareness about various types of disasters and associated vulnerabilities amongst community, making them better prepared.	A well awakened and enabled community to make effective decisions about reducing loss from various hazards.	Sensitization and awareness camps on regular basis.
Sensitization of NGO/CVO & other civil organizations to disaster risk mitigation, planning and preparation.	NGOs, CVOs and other civil organizations have a vital role to play in disaster mitigation, planning and preparation. Frequently they have expertise and funding that strongly compliments the government capacity and capability and they also have strong international connections that can provide rapid response support and additional capability.	Trained volunteers of social organizations can be a good resource for District & State Govt. for all DM related activities.	Interaction and meetings with these organizations on regular basis.
Training of school staff, hospital staff, municipal councilors, officials, community members, city/ municipal ward level ERTs, students and teachers.	Training and testing of training through simulations and post-simulation debriefing/review sessions is critical for a deep response capacity within organizations and institutions.	A well trained and capable response capacity within and across key organizations and institutions.	Annual training and simulation testing developed within 12 months with annual testing and review.

Training of officials on damage & need assessment.	Training to undertake a damage and needs assessment across the entire city is critical to undertaking a successful assessment as a first step in building back better.	The assessment lays down the foundation for a fresh start in City's development efforts.	Designed training for 12 months. Annually tested.
Development of Standard Operating Procedure (SOPs) for DM within line departments, including delineated responsibilities down to individual level, resource inventories and training.	It is a first principal in organizational OH&S that SOPs are developed for disaster response with simple and clear directions as to how to respond and who has what responsibilities. This needs to include recovery planning such as the establishment of relief camps at identified safe zones and how these will be serviced.	A well-trained and capable response capacity within and across organizations.	Development of organizational SOPs and lines of responsibility within 12 months; semiannual simulations and assessments undertaken and reported on the organizations executive management.
Capacity building & orientation of NGO/CVO & other civil organizations to disaster risk mitigation, planning and preparation.	NGOs, CVOs and other civil organizations have a vital role to play in disaster mitigation, planning and preparation. Frequently they have expertise and funding that strongly compliments the government capacity and capability and they also have strong international connections that can provide rapid response support and additional capability.	Trained volunteers of social organizations can be a good resource for District & State Govt. for all DM related activities.	Interaction and meetings with these organizations on regular basis.
Building on the development of Standard Operating Procedure (SOPs) for DM within line departments, undertake a program of evacuation planning, training and practice within the City Public Safety Agencies such as Police & Fire, Health and the private sector.	Evacuation planning, training and practice within key response agencies such as Police & Fire, Health and the private sector and hotels is seen as a critical element in the planning and preparation process, particularly where multi-agency coordination is a vital component in response efficiency.	A well-planned and trained response capability for all disasters that spreads across the City's Public Safety Agencies and the private sector.	It should be conducted on regular basis.
Development of Early Warning Systems and assessing their effectiveness within the city and surrounds.	Having effective and tested EWS capability is an important element of response planning and preparation as even several seconds warning may lead to the saving of many lives. Such systems should be graded so that if there is a level of early warning this can lead to better	A well founded, tested and serviced EWS for all critical response agencies and the community.	It should be established within 12 months and can be tested during regular mock exercises.

	short-term preparation by all agencies and citizens.		
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2.1.3 Response

Response			
STRATEGY	DRIVER	OUTCOMES	KPI
Establishment/ Activation of City level Emergency Operation Center (EOC).	A EOC is a combination of various line departments of Govt./ or other agencies whose services are generally required during incident response. At District level, EOCs are well established, however, at City level, this still needs to be done. Consideration should be given to incorporating EOC capacity into the existing processes for managing pilgrimage movements.	A well-established EOC directs the operations at the disaster site and coordinates at all levels to meet the conflicting demand at the time of disaster.	Establishment and functioning of EOC within 12 months.
Establishment of Incident Response Mechanism (IRS) at the city level.	In the State of Uttarakhand, all districts have adopted & established IRS. However, it has not been initiated at a city level. Effective response to emergency situation requires a high degree of coordination amongst various departments and agencies within and outside Government at different levels for performing multiple tasks in an integrated and time bound manner for achieving specific results.	NDMA has developed an IRS as an effective mechanism for performing various tasks of disaster response and issued comprehensive guidelines for the same. In the State of Uttarakhand, all districts have adopted & established IRS. However, it has not been initiated at a city level. A city level IRS will be able to focus on issues at a city level and allow the district IRS to focus on pan-district operations in coordination with the city IRS. .	Establishment and functioning of IRS at City level within 12 months.
Establishment of Emergency Support Functions (ESF).	Disaster response is a multi-agency function. The Department of Disaster management is the Nodal Agency that will be responsible for managing/ coordinating all the functions of disaster response, while other agencies will	In order that these functions are performed in smooth, effective and fail proof manner.	In specific context of Uttarakhand, important ESF should be identified with 12 months.

	provide necessary support and assistance in managing emergency situations.		
Deployment of ERTs.	Emergency response to be performed during disaster shall depend on the level of disaster. At local level, the emergency response teams, consisting volunteers from Wards, NGOs, CVOs & other organizations can be deployed.	A smooth & effective response by trained ERTs.	Performance/ level of readiness should always be checked on regular basis.
Development of regular set of simulation exercises around a designated disaster and area within the city.	Based on the given disaster scenario, the simulation or mock exercises can be performed at school, offices, market and ward level to check the level of preparedness & readiness of various ERTS and community.	Simulation or mock drills reduces the gaps in preparedness & increases the level of response.	The City DMG can develop a simulation exercise calendar annually.

2.1.4 Recovery (Short-term)

Recovery (Short-term)			
STRATEGY	DRIVER	OUTCOMES	KPI
Conduct damage & need assessment just after disaster as the basis to planning the restoration & improved disaster resilient housing, government buildings & cultural heritage in city.	A damage and needs assessment across the entire city that includes all structures and infrastructure support as well as non-structural attributes is the first step in building back better.	Foundation is laid for a fresh start in an area's development efforts as well as to reconstruct the damaged areas & contribute to the long-term development plan.	Assessments should be undertaken within 24 hours of disaster.
Provide community safety and effective management of victims through the establishment of relief camps at identified safe zones.	Based on pre-disaster planning adequate numbers of buildings/ open space shall be identified where relief camps can be set up during an emergency. This will be guided by the minimum standards of relief as laid down by the NDMA & the SDMA in terms of Section 12 & 19 respectively of DM Act.	The affected community must be provided all assistance so as to ensure that they are able to live with dignity.	Members of ERTs can be designated to monitor the RF functioning.

Restoration of essential services: road connectivity, electricity supply, water supply etc.	Disruption in essential services hamper recovery efforts and are a cause of distress for the affected people.	Actions are taken swiftly with resolve in order to retain community confidence & minimize economic disruption.	Recovery plan should be developed, tested annually.
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2.1.5 Recovery (Long-term)

Recovery (Long-term)			
STRATEGY	DRIVER	OUTCOMES	KPI
Strengthen the capacity of people and communities to reduce the risks and vulnerability & enhance social cohesion through a Post Disaster Recovery Framework.	There is not at present a Post Disaster Recovery Framework (PDRF) for the State, however, all responsible agencies, the community and the private sector need to plan not for the inevitable disasters that will occur but also for recovery. The proposed City Disaster Management Committee (CDMC) needs to take the lead as part of its obligations.	A Post Disaster Recovery Framework that links to specific hazard responses, recovery Plans and the agencies responsible for pilgrim activities; as well as strategic growth strategies for the city and surrounds.	A first draft within three years.
Develop sector (e.g. defence, industry, tourism, agriculture, NGO etc) plans to restore & improve access to services & improve environmental resilience in rebuilding communities and community cohesion.	Sector specific plans should be used to guide, plan & estimate resource requirements for recovery & reconstruction at the sector level. Sector plans should also be developed into tools to monitor progress against targets on an ongoing basis. Similarly, social sectors which include education, shelter, food & nutrition, health also frequently are neglected, so social sector planning is very essential. The scope of the sectoral plans include both the development deficit & the needs/ damage emerging out of the recent disaster.	To quantify the needs for each of the sectors to enable a convergent and coordinated recovery process wherein Govt., NGOs & corporate sectors could bring in their respective capacities & capabilities to implement the plan.	Each plan should be developed within 12 months. Updated annually.
Restore & improve disaster resilient housing, government buildings & cultural heritage in City.	Disaster Resilient Housing (multi-resistant) is a key priority in building back, whereby the owners will be responsible for and will manage their own reconstruction, make their own choices & mobilize	The development of multi-hazard resistant housing as a fundamental rebuilding block for the city and surrounds.	Initiate once response & relief phase is over. Monitoring through team of experts. Guidelines for owners should

	their own resources i.e. in other words an Owner driven Reconstruction of Houses (ODRC). After the June 2013 disaster, this exercise was carried out by the State Govt., where more than 2500 houses were reconstructed across the State under ODRC.		be developed within 12 months.
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2.2 Specific Strategies for Earthquakes

2.2.1 Introduction

Earthquakes of any magnitude in highly urbanized areas bring a particular challenge that means many people and much property is at risk as result of the high population and building density. Many - although not all - parts of Haridwar are definitely in a category where serious loss to life and property damage demands full attention to both structural and non-structural solutions in reducing risk and improving resilience.

2.2.2 Earthquakes - Mitigation

Earthquakes - Mitigation			
STRATEGY	DRIVER	OUTCOMES	KPI
Strengthen planning, management and regulation of EQ risks on infrastructure through improved understanding of existing and future risk (data) to private and public infrastructure, transport and communications.	Several State & National level Institutes/ Organizations in the State, are engaged in the researches concerning hazard zonation & risk/vulnerability assessment of the State, however the recommendations/ results of the studies are not commonly available to the concern authorities. Mapping should be done on a priority area basis focused on high density or vulnerability areas first.	Preparation & updating of Hazard Zonation maps of the City as the basis to planning and preparation procedures and training simulations.	Complete within a three year period mapping of all areas in the City with annual reporting of progress against an agreed plan of priority areas.
Review current building standard compliance and develop mechanisms to strengthen levels of compliance.	Enforcement of the most current Building Codes Standards to protect the built environment in the City is required as is retrofitting. The State has amended building by-laws and the Town & Country Planning Act, however due to non-compliance/ or lack of enforcement by the concerned authorities, the habitation of unsafe/high risk areas is expanding.	Effective compliance to building codes and statutory planning zonation and codes for the City and surrounds,	Ongoing process. Review every 6 months by State Govt.

In line with the overarching strategy to audit lifeline buildings, formulate a policy for retrofitting of existing public facilities & services according to contemporary standards.	The seismic safety of all lifeline buildings must be assessed in a time bound manner. A approach should be to selectively retrofit lifeline structures and buildings on the basis of priorities to be fixed by the Govt.	A detailed & comprehensive safety assessment of buildings/ structures to determine type of retrofit technique.	Assessment should be completed within 3 years.
Enforce Earthquake Safe Construction Technology in the City and incentivize with insurance benefits and/ or utility access.	All departments/ agencies must ensure that construction undertaken by their depts. and agencies under their control strictly comply with the standards & specifications prescribed by the Bureau of Indian Standards & further included in the NBC.	Appropriate mechanism for compliance & review of all construction designs submitted to ULBs/ Development Authorities/ construction agencies.	Ongoing process.
As part of the overall awareness campaign, emphasize reduction of non-structural hazards in homes, schools, business centers & offices of the city.	Significant harm can occur to people in situations where non-structural hazards fall onto them during an earthquake. Awareness and subsequent repositioning/fastening etc. can significantly reduce the risks of damage.	Improved resilience to harm and likely damage as a result of awareness and small amounts of preparation/investment.	Ongoing process.

2.2.3 Earthquakes - Planning and Preparation

Earthquakes - Planning and Preparation			
STRATEGY	DRIVER	OUTCOMES	KPI
Design & develop public education campaign for emergency preparedness & hazard mitigation for those who live & work in Haridwar city and surrounds.	Just as DM needs to become mainstream in the thinking and actions of Government institutions so should Disaster response awareness in businesses and the community generally be integral to their daily lives. This awareness will then play a key part in reducing vulnerability,	Create community resilience through emergency preparedness & hazard mitigation awareness programs via communication channels such as TV, print, pamphlets, street plays etc.	An awareness campaign plan should be developed for 12 months.

	raising resilience and reducing impacts of a disaster as a result of people responding in a well informed and disciplined manner. Significant research ² shows that “shock” from traumatic situations can be very debilitating but can be overcome through awareness and training.		
Increase the community resilience by expanding the number of Community Emergency Response Teams (CERT) in Haridwar City and surrounds.	CERTS are seen as excellent first responders as they are first on-site, have in-depth knowledge of resources and victim location likelihood, strongly motivated and effective networks. Funding remains an issue. As per the guidelines of GOI, 10% of State Disaster Response Fund (SDRF) can be spent on Training & capacity Building programs; Every DDMA needs a yearly allocation out of SDRF for this purpose.	Increased community resilience through first response capability by community members.	Formation of CERTS within 6 months & their training. follow-up trainings every 3 months.
Modify evacuation plans to incorporate City Public Safety Agencies such as Police & Fire, Health departments.	Evacuation plans need to be developed hazard specific & in consultation/collaboration with the specialized agencies.	A well updated & documented evacuation plan can reduce the life loss.	Ongoing process.
Train employees & practice City Facility Evacuation Plans.	The evacuation plans need to be well disseminated amongst community, business community, schools, city facility centers, offices.	Increases community resilience	Ongoing process. Practice every 3 months.

2.2.4 Earthquakes – Response

See strategies listed in Overarching Strategies above

2.2.5 Earthquakes - Recovery

See strategies listed in Overarching Strategies above

² See for example: Laurence Gonzales, *Deep Survival*, 2017;

2.3 Specific Strategies for Fluvial Floods

2.3.1 Introduction

Flood strategies in general are discussed in the Preface to the Hotspot case studies and in the case of Haridwar flooding within the city is seen as a short term issue associated with the adequacy of the drainage system to cope and the need for structural improvements as well as non- structural changes.

Flooding from the Ganga is also not a significant concern for the city but potentially a concern in the areas on the flood plains where pilgrims and also itinerant and other low income peoples are likely to be housed. With fluvial flooding and the slower onset of events, traditional flood forecasting is useful. Warning, education, communication and evacuation routes need to be communicated particularly to the most vulnerable communities living in the most exposed areas and transient tourists -> Preparation and response are critical for those population groups.

On the larger floodplains areas to the east water level variations between event return periods are lesser than in the mountains. However, higher quality DEM data would help increase the accuracy of zoning. Higher rainfall accuracy is less important (law of large numbers: larger catchment implies that the error will get averaged across space) than terrain accuracy.

Structural solutions such as walls and other large structural measures should be used with caution as structures can fail. Localized flood proofing of buildings is required in flood prone zone (regardless of whether protected by wall or not).

Risk transfer: it is recognised that flood risk transfer mechanisms need pooling with many other regions and states to be potentially viable, but it needs to be explored.

2.3.2 Floods – Mitigation

FLOODS - MITIGATION			
STRATEGY	DRIVER	OUTCOMES	KPI
Improve the understanding (and access to data) of flood risk ³ as the basis to strengthening planning, management and regulation of flooding impacts.	Limited access to critical information including a detailed flood assessment base on accurate survey data results in poor planning and management, including sand extraction (mining).	A scientifically accurate assessment of flood levels and likelihood as well as testing of mitigation strategies as the basis to formulation of flood management policies within the city.	Flood assessment completed within 12 months.
Haridwar City to develop a Municipality Flood Risk Mitigation Strategy which includes funding mechanisms, KPIs and auditing and reporting processes.	NDMA has issued guidelines for management of floods, but there is no adoption of these guidelines/ regulations in Haridwar.	Strategy formulated and implemented. Formulation and adoption of flood management policies within the City.	Flood risk strategy drafted in 12 months, finalized in 18 months following the completion of the flood risk assessment.
Develop compliance policies for the Municipality and associated regulations that provide realistic incentives supported by regular auditing and reporting of compliance to the State Parliament.	The Municipality via the State is responsible to incorporate NDMA guidelines/ provisions into the Building by-laws & to implement. As yet this has not happened in Haridwar.	A regulatory process and auditing program of compliance.	A total number of agreed sites audited each year for compliance. Follow up where non-compliances recorded, including imposition of fines.
Develop a City - Insurance Sector - Private sector dialogue around flood mitigation and risk management incentives through premium structures and assessment payout adjustments for proven compliance.	Positive incentives are required to encourage community engagement in adopting flood risk policies and complying with regulations.	A measured reduction in non-compliance as designated in the Municipality flood risk management strategy targets.	Increase of properties (target % rate of increase to be determined by State Govt) taking out flood risk insurance policies annually.

³ Note that UDRP for flood risk was undertaken at a Block level with no access to suitable high resolution and accurate elevation and drainage data (the Cartosat satellite imagery used has an accuracy is 8m vertical). The flood maps produced cannot capture some of the localized effects (particularly for rainfall ponding) that are critical in flood modelling and the level of detail needed for drainage planning at the city level. The state government has procured for a LIDAR data covering from Haridwar to Kedarnath – it should be available in a few month time. Ideally the flood modelling should be advised to be re-done in high exposure areas (e.g. Srinagar, Rishikesh, Haridwar) if possible using a 2D models for the larger floodplains (Rishikesh, Haridwar) and using accurate elevation of embankments and detailed operation rules of the barrages and other structures. The UDRP has provided discharge return periods (mean, std. dev) for 120 locations across the state that should be valuable for any other studies downstream. Gauging records can help confirm those results in more locations but will take time to acquire (basically 30+ years of data are required for proper extreme statistics).

Develop a trans-institutional legal framework for flood management at the State and Municipality level.	In developing a Strategy there is the need to consider trans-jurisdictional boundaries across departments and state agencies, noting that the State of Uttarakhand does not have a legal framework. However, even more so, the framework when developed needs to be clear as to institutional responsibilities and ensure an easily understood and simple set of approval and regulatory processes.	An easily understood and simple set of approval and regulatory processes bound in law that can operate at the municipality level.	A draft set of Laws within 12 months. A final set of ratified laws with 24 months. A set of policies and regulations drafted and ratified in parallel.
Encourage River Bed Mining (RBM)	Developmental activities coupled with accelerated forest degradation & deforestation have led to increase in erosion & thus adding more sediments to rivers, ultimately leading to reduction in water carrying capacity of rivers.	Removal of excess sediment from river beds through river bed mining helps in increasing the water carrying capacity of rivers.	area-specific river bed mining to be assessed and implemented within a stipulated time frame.

2.3.3 Floods - Planning and Preparation

FLOODS - PLANNING AND PREPARATION			
STRATEGY	DRIVER	OUTCOMES	KPI
Develop a municipality wide Flood Risk Mitigation Strategy which includes funding mechanisms and KPIs with auditing and reporting processes.	A lack of funds and a strategic approach to addressing flood risk is still an issue in Haridwar. The lack of scientifically based data and risk analysis at the fine scale (see above in Overarching Strategies) is part of the reason but there is still a need to develop a strategy to underpin funding and the planning of response strategies based on the scale of the floods and the desirable levels of early warning.	A well thought out strategy for funding and delivering on risk reduction associated with flood mitigation and response.	The Flood Risk Mitigation Strategy drafted with 12 months and enacted within 24 months.

Develop public-private partnerships for addressing Flood Risk Mitigation Strategy issues that include funding mechanisms, awareness and the implementation of mitigation projects.	There is a lack of funds and CSR driven partnerships in addressing flood risk.	Corporate Social Responsibility (CSR) activities from the Corporates/ Industries and funds from many bigger NGO's or CVO's will be harnessed for future mitigation projects.	The Flood Risk Mitigation Strategy drafted with 12 months and enacted within 24 months. CSR partnership agreements drafted with three large Companies and three local NGOS within 18 months.
Develop policies and programs intended to increase the number and preparedness of CERTS at a ward level.	At municipal ward level, there is an opportunity for CERTs to be formed comprising community members. This should be done as part of the Flood DRM Plan.	An increase in the number and preparedness of CERTS at a Ward level lowering the risk of loss of life and property during incidents.	Six (6) certification programs run per 12 months period with a 80% or greater accreditation.
Test and revise evacuation plans across the city through a process of mock disaster drills and a city wide review workshop following each drill focused on gleaning strengths, limitations, opportunities to improve and risks if these are not realised.	Mock drills are a critical element of DRM planning and training. With the help of local NGOs/CVOs, local residents mock drills can be conducted on regular basis to check the evacuation plans.	An increase in the number and preparedness of all participants in an incident thereby lowering the risk of loss of life and property during incidents.	A mock drill run in every ward every 12 months. A citywide drill run every 2 years.
Development & updating of Disaster Management Plans at all levels within the Cities jurisdictions and across its departments.	At City Level, DM Plans have not yet been developed.	Flood DM Plans developed for all sectors of the city.	Flood DM Plans developed within 12 months.

2.3.4 Floods – Response

See strategies listed in Overarching Strategies above.

2.3.5 Floods – Recovery

See strategies listed in Overarching Strategies above.

2.4 Specific Strategies for Landslides

2.4.1 Introduction

While landslides (including rock falls) are not considered to be a high risk in Haridwar they are a common geohazard in areas where steep slopes prevail and while frequently considered a secondary consequence of earth quakes co-seismic landslides are not uncommon and can be of great consequence, particularly in association with road construction (see box). They are also caused by flooding, heavy rain and hydraulic soil changes, land clearing and infrastructure development such as dams. Apart from directly threatening life and property, in road systems they can cause frequent long periods of obstruction with all the direct and indirect consequences experienced by what are frequently poor or already marginalized communities. Landslide dams can lead to upstream flooding, downstream flash flooding when breached, bank erosion and silting of dams. Note that “landslide” is generic term for a range of slope failure processes including rock falls, slides, slumps, flows and a combination of failures leading composite or complex movements. As such requires considerable skill to map and propose mitigation strategies in high risk areas.

Note that “landslide” is generic term for a range of slope failure processes including rock falls, slides, slumps, flows and a combination of failures leading composite or complex movements. As such it requires considerable skill and technical support to map high risk areas and propose mitigation strategies. Particular reference with respect to a broad understanding of landslides should be made to Parkash Surya (2012). Training Module on Comprehensive Landslides Risk Management. National Institute of Disaster Management, New Delhi - 110002, Pages 282.

....In Nepal, there was a six-fold increase in landslide fatalities (from 20 to 120 on average per year, the average for the last five years is 152 deaths per year) between 1978 and 2005. A primary driver of this increased mortality has been a deadly combination of an increase in poorly constructed roads with more intense monsoon rains due to climate change.

(see: <http://blogs.worldbank.org/endo-overtysouthasia/minimizing-risks-caused-geohazards-south-asia>)

2.4.2 Landslides - Mitigation

Landslides - Mitigation			
STRATEGY	DRIVER	OUTCOMES	KPI
Identify the location & extent of landslide hazard areas in the city and surrounds.	Preparation & updating of Hazard Zonation maps of the City is required, which includes updating & maintenance of current maps of areas	A basic tool for development planning.	Mapping exercise within 24 months.

	within the City that are subject to mass movements;		
Determine the level of risk presented by the existing development in landslide prone areas and develop a landslide Risk Management Plan.	Protect existing development in landslide prone area, which includes:- Provide information to residents on landslide prevention, retain & restore existing vegetation, avoid certain activities by private owner on landslide prone properties and construct debris flow diversion to protect existing properties.	Risk management strategies to protect property and life including advising all owners and relevant City and Government agencies.	Avoid construction for next 5 years.
Establish an assessment and approval process for all structures approved for construction in landslide zones.	Stringent planning and design requirements in landslide-prone and unstable areas need to be imposed.	Significant reduction in life and property loss as well as costs and social trauma associated with landslides.	Ongoing process.
Within the landslide Management Plan there is a need to assess and manage hydraulic drivers for landslides.	Maintenance of public & private drainage system is a critical part of landslide prevention. This includes: ensure that culverts, nalahs are inspected & cleared prior to rainy season each year; encourage pervious, and minimize impervious surfaces to reduce storm water runoff.	Increased resilience to land slide risk as a result of knowledge, planning and information transfer as well as active management of hydraulic structures.	Ongoing process.

2.4.3 Landslides - Planning and Preparation

Landslides - Planning and Preparation			
STRATEGY	DRIVER	OUTCOMES	KPI
Develop emergency response procedures as part of the City and surrounds Landslide Managements Plan.	Having understood areas of highest risk it becomes critical to then generate emergency response scenarios and plan for suitable responses.	An increased level of awareness leading to mitigation and improved preparation for response to landslides.	Establishment of response structure, tested annually.

Design & develop public education campaign for emergency preparedness & hazard mitigation for those who live & work in affected areas.	By creating awareness amongst exposed populations there may be a mitigation effect and also an improved resilience as a result of people understanding what has happened and how to respond.	An improved resilience as a result of people understanding what has happened and how to respond.	Ongoing process.
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2.4.4 Landslides – Response

There is no significant landslide risk assessed in Haridwar and present response mechanisms in place at State Level are adequate. No specific strategies for improvement are, therefore, put forward in this regard in this location.

2.4.5 Landslides – Recovery

There is no significant landslide risk assessed in Haridwar and present recovery mechanisms in place at State Level are adequate. No specific strategies for improvement are, therefore, put forward in this regard in this location.

3 LINKS TO NATIONAL AND STATE LEVEL PLANS

Sendai Framework

www.unisdr.org/we/coordinate/sendai-framework



National Disaster Management Plan

www.ndma.gov.in/en/national-plan.html



Uttarakhand State Disaster Management Authority

www.usdma.uk.gov.in



Uttarakhand State Disaster Management Plan

www.dmmc.uk.gov.in/files/pdf/complete_sdmap.pdf

Disaster Risk Assessment of Uttarakhand

Project Information Sheet

OVERVIEW

With support from the World Bank, the Uttarakhand State Government has engaged experts to complete a disaster risk assessment of the entire state so that it can understand the threat from natural hazards and the exposure of communities and critical infrastructure. This is the first attempt to develop an integrated disaster risk inventory for the state and is viewed as an important step to support the recovery efforts and to underpin future decision-making and planning.

This report is one of the outputs from the risk assessment and presents risk mitigation strategies for a location of high risk in the state. It serves as a case study for similar locations throughout Uttarakhand.

WHAT RISKS HAVE BEEN ASSESSED AND HOW?

This project assessed the threat and potential consequences of **flooding** (both fluvial and flash floods), **earthquakes**, **landslides**, and **industrial hazards** in Uttarakhand. It developed a comprehensive inventory of data for hazards and assessed the likelihood and consequence of these hazards in the future.

This hazard assessment adopted proven tools preferred by the World Bank for assessing risks, and the team collated existing data and completed field surveys to build up a strong profile of vulnerability and exposure across the state.



One of the tools is CAPRA. It is a software suite that is a free, modular, open-source, and multi-hazard tool for risk assessment. CAPRA provides a risk calculation platform integrating exposure databases and physical vulnerability functions under a probabilistic approach. CAPRA evaluates risk in terms of physical damage and estimates direct economic and human losses.

HOW WILL THE PROJECT BENEFIT UTTARAKHAND?

The outcomes from this project will help Uttarakhand to develop its resilience to natural and industrial hazards. The information will be used by the State Disaster Management Authority to support recovery efforts and future master planning. It will help them prioritise activities and investments in infrastructure.

The system deployed for is easy to maintain and manage and will add value for the State Government and communities. The team looks forward to engaging with local experts and stakeholders to understand the vulnerabilities and exposure of communities across the state.

THE TEAM

The project was completed by technical implementation experts from the following partner organisations:



www.dhigroup.com



www.ern.com.mx



www.ait.ac.th



www.earthobservatory.sg



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Track the project activity at:

www.facebook.com/UttarakhandDRA



PROJECT PROGRAMME

The project started in May 2016 and concluded at the end of October 2018.