



STRATEGIC PLAN FOR RISK REDUCTION

Increasing resilience through effective

RESPONSE, RECOVERY, MITIGATION, & PREPAREDNESS

TOURISM RISK HOTSPOT

JOSHIMATH & BADRINATH

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)

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1 INTRODUCTION

1.1 Overview of Location

This is one of a series of case studies developed for “hotspots” in the Indian State of Uttarakhand and is one of four relating to disaster risk management issues and strategies to address tourism concerns in the State. As such the strategic focus is entirely on tourism. Other case studies deal with the strategies to address earthquakes, flooding and landslides in both urban and rural settings within the State. These documents should be consulted with respect to non-tourism-based strategies.

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. Promotion of effective disaster preparedness in tourism destinations is a governmental function yet requires the participation of all at the destinations.

It is important to recognise that tourism from the DRM point of view needs to be considered in terms of individual destinations and the way people travel to and from these. Even so, leadership in this regard has to come from Government, the industry is a key stakeholder but is not likely to undertake a holistic systemic approach to the management of the problem. Moreover, policy and regulations may need to be enforced as it has been demonstrated elsewhere that short term commercial imperatives will frequently assume prominence over long term benefits to the whole economy and society at large.

The Joshimath City & Badrinath Strategic Risk Mitigation strategies presented here are intended to provide key strategies and their priority with respect to mitigation of identified risks to tourist and the tourism industry associated with earthquakes (**Extreme**), flooding (None), flash flooding (**High**) and landslides (**Moderate**). Greater detail is provided in the Risk profile below.

Disaster management needs to be systematic and positive in approach DMP should promote collaboration between public, private and community stakeholders and seek proactive responses to perceived threats. Adopting strategies that are positive, integrating and adaptable to change due to changing circumstances is important.

Not only is Joshimath a major tourist center within the Chamoli district, it is the gateway to Badrinath, Auli, and Valley of Flowers etc. Areas of particular focus for tourism are: the main city, Vishnuprayag area, Govindghat, Ghangharia and Hanuman Chatti area. Badrinath is a holy town and a nagar panchayat being the most



important of the four sites in India's Char Dham pilgrimage. Winter recreation is catered for by the ski resort of Auli and there is also a growing focus on adventure tourism.

Map 1 gives the extent of the hotspot within the block. Although we do not deal with the whole block in this instance, the strategies are applicable to locations outside the designated risk hotspot.

Tourism features as a prime element in the Uttarakhand Vision 2022¹. The two goals are:

- Promote the state as a global tourist destination by highlighting its spiritual, cultural and adventure tourism.
- Target 5 lakh international tourists by 2022.

Inflow of foreign tourists into the state increased from 1.01 lakh in 2014-15 to 1.05 lakh in 2015-16. 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.

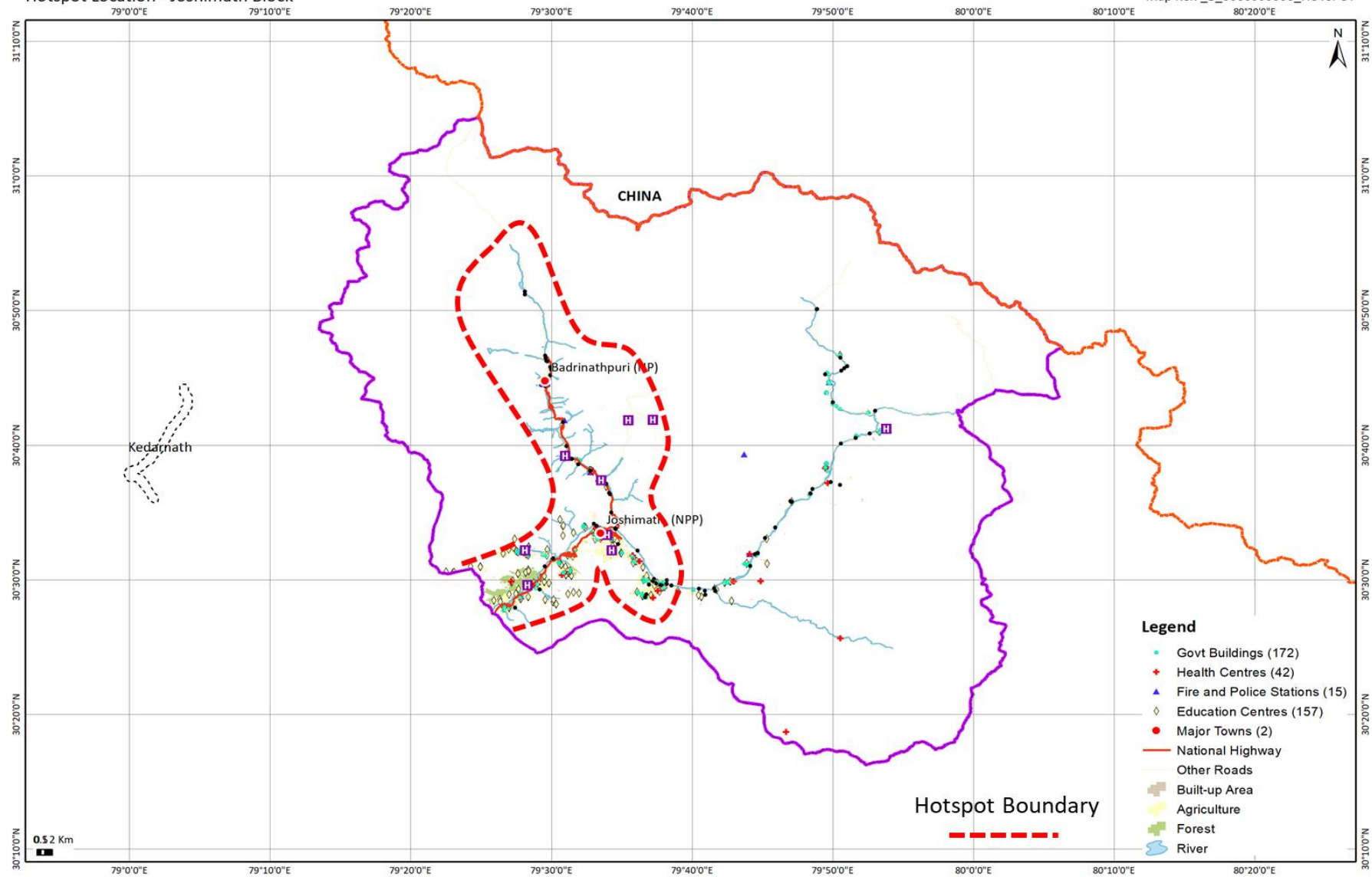
¹ IBEF Brief Uttarakhand May 2017 www.ibef.org

Tourism Hotspot Plan

Hotspot Location - Joshimath Block

Disaster Risk Assessment of Uttarakhand (2016-2018)

Map Ref: _B_0000000000_HOTSPOT



Map 1: Hotspot Boundary for Strategic Planning

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, Plan, Action?

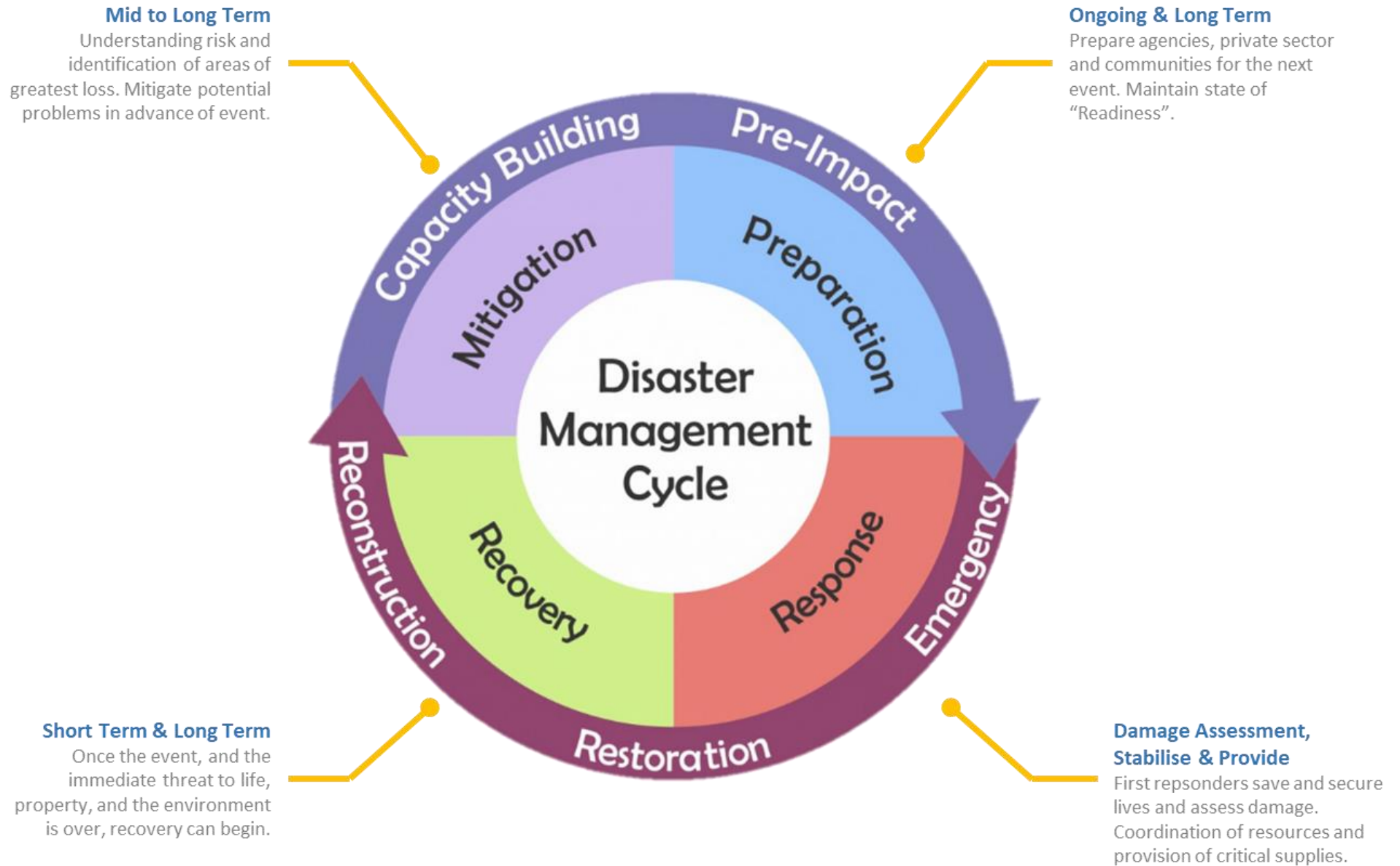
“... a plan of action designed to achieve a long-term or overall aim.”

A **Strategy** is a planning tool developed with a long-term perspective. It provides a common vision and includes certain guiding principles and priorities. It needs to incorporate certain flexibility and periodic evaluation mechanisms to adjust course, evolve and adapt to changing circumstances, while continuing to provide guidance.

A **Plan** provides the operational orientation for implementing the strategy. It defines specific goals to reduce ... risk together with priority actions and activities to achieve these goals. It goes into needed detail as it assigns roles and responsibilities, mobilizes resources and allocates budget. It also sets timelines, indicators, and mechanisms for monitoring progress.

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

Abstracted in the main from: Implementation guide for local disaster risk reduction and resilience strategies, UNDSIR 2018



1.3 Area and Community Profile

1.3.1 Topography

Joshimath and Badrinath lie in the Great Himalaya physiographic zone and also in the Alaknanda basin. This is a mountainous zone consisting of ridges and slopes formed by valleys of Alaknanda river and its tributaries. The topography consists of crests of ridges, falls, springs, rocky knobs, deep valleys with steep gradient formation of rocks: These steep rocks are mostly hard but at some places are soft which makes these areas a landslide prone zone. Above the height of 3000 metres, glaciated topography is seen. The height of region varies between 1200 & 4000 metres from the mean sea level. Joshimath is at an elevation of 1890 metres above sea level whereas Badrinath is at 3300 metres above sea level.

1.3.2 Climate

Joshimath block enjoys a cool and pleasant summer season from April until July when the monsoon begins. The winters are cold with temperatures breaching the sub-zero mark occasionally and lasts from October until April.

1.3.3 Demographics

Joshimath and Badrinath have a combined population of 19,147 with low sex ratios at 673 and 187 respectively due to the large proportion of migrant male workers in the population of these towns. The main workers form the bulk of the population at Badrinath i.e. 81%. At Joshimath, the non-workers are higher at 56% with main workers at 42%. Amongst the working population a majority are engaged in the "others" category whereas cultivators form 14% & 10% of the workers in Joshimath and Badrinath respectively. The Household industry is significantly big in Badrinath where 38% of the workers are engaged in it. It is important to note that civilian presence beyond Hanuman Chatti is allowed only for the six months of the tourist season. The transient population of these twin towns assume a higher significance in the context of disaster risk mitigation. Since Badrinath is accessible by a motorable road, it has been the most frequented of the 4 pilgrimages. Up till the 2013 disaster Badrinath was clocking over 9 lakh pilgrims annually. There was a lull in the number of pilgrims from 2013 – 2015. However, the number has been steadily increasing since 2016 with 2018 expected to receive the highest number of visitors ever. The daily overnight capacity at Badrinath is at around 12,000 – 14,000 and Badrinath operates at full capacity on many days during the peak season.

The transient population also has to take into account the many tourists who would be travelling to this hotspot for secular tourism (Valley of Flowers and Auli) or Hemkund Sahib. A majority of the transient tourist populations are domestic tourists and they largely travel in groups of families, friends, work colleagues etc. Groups of tourists often stay for 10-12 days in Badrinath where they spend their time attending religious lectures, spiritual initiations etc.

1.3.4 Economy

Tourism is the most significant sector of the economy in both towns as Badrinath is one of the 4 important pilgrimages of the state and Joshimath is the popular halting place enroute. Also, a majority of the population is dependent on tourism for earning their livelihoods. A survey of four towns preceding Joshimath (Ratura, Gauchar, Nandprayag and Chamoli) which are also on the Badrinath route found that 57.5% of the households were engaged in tourism services with 37.5% amongst these exclusively engaged in tourism services (the rest were partially or fully engaged in agriculture). Also, those engaged in tourism services were able to earn higher incomes than those engaged in agriculture (Sati, 2015). These data are indicative of the scenario in the towns from Joshimath to Badrinath where the economic dependence on tourism is in fact higher.

As a result of this, there is immense financial incentive to build more infrastructure for the tourist season. We gather that most of the infrastructure is not earthquake resistant due to reduced costs and lack of enforcement measures. Driven by tourism businesses, some infrastructure has been built in the dangerous floodplains of the region despite the risk of flooding.

1.3.5 Development History

The Joshimath - Badrinath corridor was hit badly by the 2013 floods. Notably, Pandukeshwar and Govindghat faced severe casualties. Govindghat was almost entirely destroyed by the floods and there were significant losses of property and life in Pandukeshwar as well.

The Char Dham Expressway National Highway project was flagged off in late 2016 and is currently underway. This project plans to connect the four dhams to Rishikesh with a four lane (two in each direction) road with a minimum width of 10 metres. It will enable visitors a smooth access into Joshimath and is likely to pave the way for more tourism infrastructure development in the corridor.

1.3.6 Regional Context

The area defined under this hotspot stretches from Badrinathpuri town and village Mana in the north to Joshimath town in the south including areas enroute such as Govindghat and Pandukeshwar. Joshimath being the block headquarter is an important halting place enroute Badrinath. Govindghat is another junction for tourists heading towards Sri Hemkunt Sahib and the Valley of Flowers national park. The transient population in this tourist hotspot are to some extent homogenously spread across the hotspot area. Joshimath is connected by National Highway 7.

1.3.7 Critical Facilities/Infrastructure

Joshimath has a significant presence of military establishments in close proximity such as the ITBP, BRO and the army. Military establishments have known to be very helpful during disaster relief and recovery efforts with their local knowledge, expertise and resources. The Vishnuprayag hydroelectric project reservoir is situated near Hanuman Chatti north of Pandukeshwar. Below is a snapshot of critical infrastructure which are important from the disaster risk management perspective:

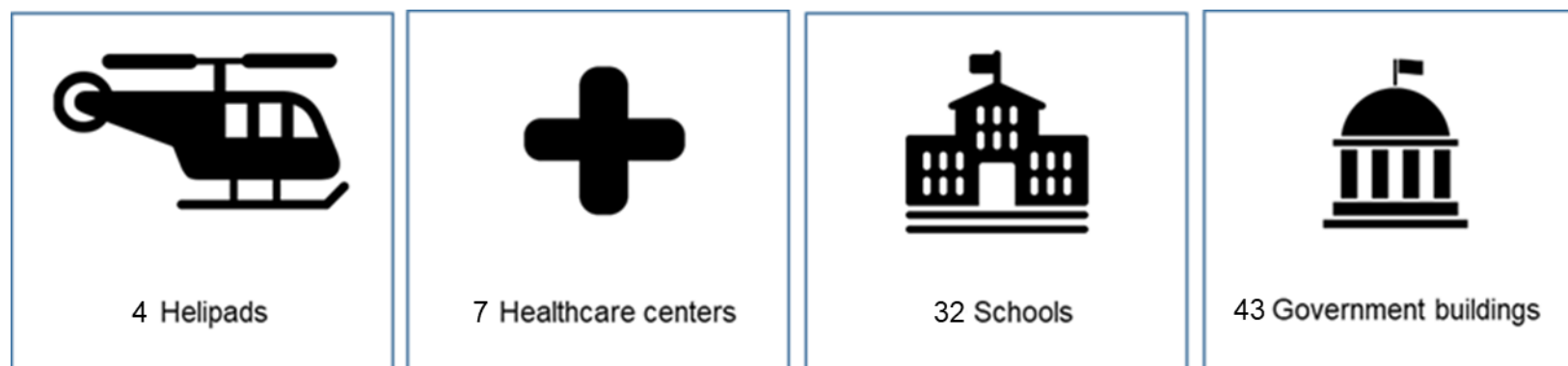


Figure 1: Snapshot of Critical Facilities in the Hotspot

Three of the 7 healthcare centers are sub-centers whereas the rest include 1 CHC and 3 hospitals. The total lifeline buildings in this hotspot are approximately 79. Besides this, there is a big parking area near the municipality office which is also used for organizing shelter and supplies during relief efforts post-disaster.

Sewage management in the Joshimath-Badrinath corridor is rudimentary with many buildings using on-site sanitation systems or draining untreated sewage into the Alaknanda river. However, under the clean Ganga mission, several of these direct drains have been identified and STP's are to be built. For water, most people rely on hand/motor pumps or bore wells to extract water from the water table, however the water table supply is often not adequate in hilly areas causing regular shortages of water for the people of the area. For cooking gas, there are LPG services in Joshimath town and Badrinathpuri as well, however many rural parts of the corridors especially the remote hill villages still use traditional cooking fuels such as firewood and cow dung.

This hotspot is a mixture of urban and rural areas. Some of the DRM strategies may require efforts that cut across administrative boundaries. Joshimath (NPP) and Badrinathpuri (NP) are the urban towns and Joshimath is the block and tehsil headquarter for the rural administration.

1.3.8 Tourism Attractions in this Hotspot

Joshimath, Badrinath and Mana

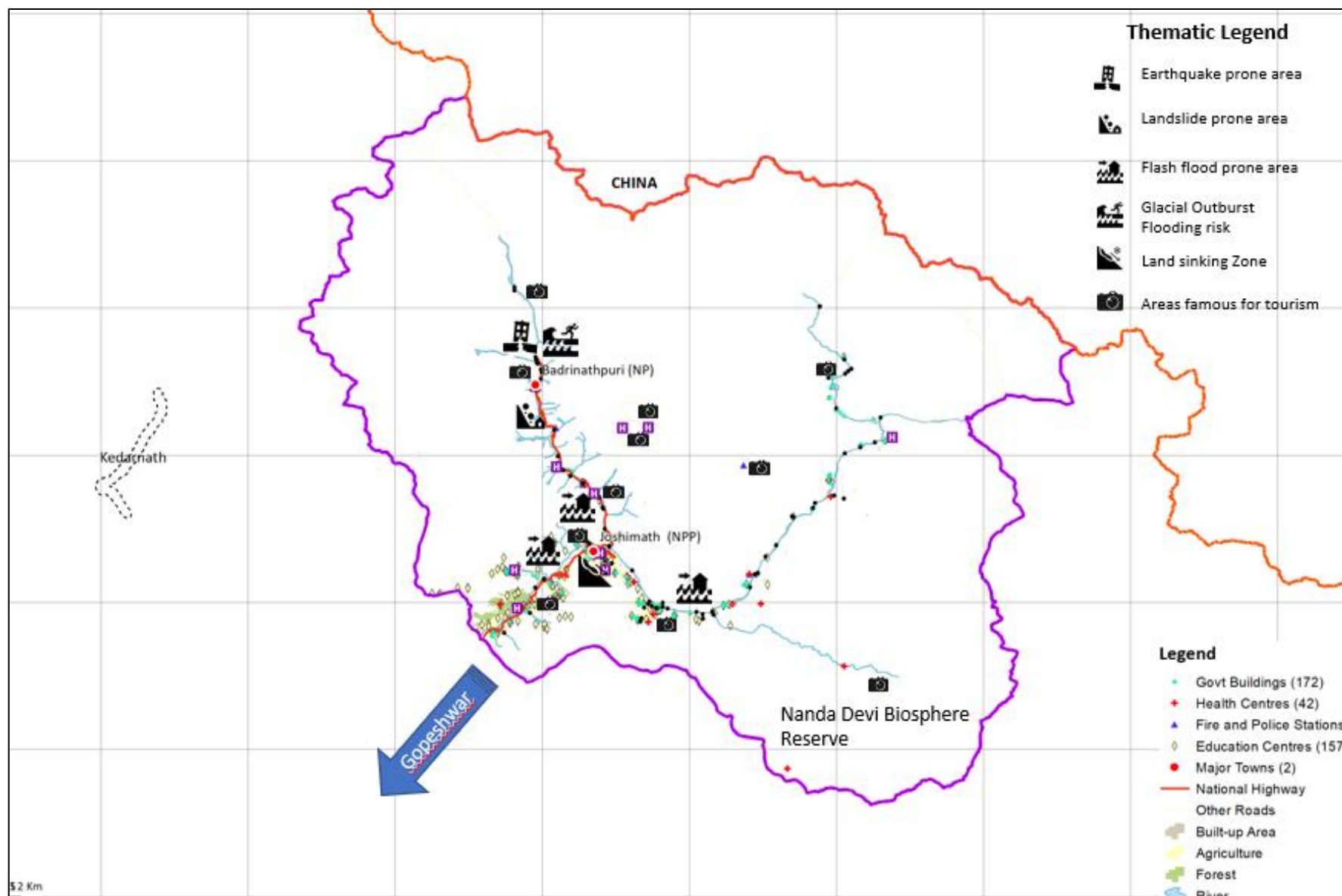
All three have significant pilgrims and an increasing number of non-pilgrim visitors throughout the summer period. Earthquakes represent the greatest risk followed by landslides. Congestion around the temples is paramount in Joshimath and Badrinath while it is less so in Mana, but the latter has always been and still is a local village. The effect on all three is most prominent with respect to parking. Space is limited and is becoming increasingly inadequate as the volume of private cars, buses and even trucks increases. The net effect is congestion not only of people but also of vehicles. It is probably prudent to assume that during a major earthquake or landslide there will be limited ability to get people out or into these towns and the village.

Auli ski resort and slopes

Sking is a growing winter recreational activity in India. Above Joshimath at an elevation of 2,500 metres (8,200 ft) is the small ski resort area of Auli, which is one of the top three in the country. Surrounded by coniferous and oak forests, with a panoramic view of the peaks of the Himalayas both the township which is essentially accommodation and the ski areas being expanded. The slopes are intended for both professional skiers and novices. The Garhwal Mandal Vikas Nigam Limited (GMVNL) a state government agency which takes care of this resort, and Uttarakhand Tourism Department conduct winter sports competitions at Auli to encourage skiing in India. It has a 4 kilometres (2.5 mi) cable car, a chairlift from the township up to the slopes and a ski lift from Joshimath, along with a maintained trek route. Auli ski resort is accessed through a road that deteriorates in its condition as it climbs up from Joshimath. Typically, in ski resorts, tourists aren't well prepared for any disaster eventuality. In this case, it becomes important that the support staff in Auli is adequately prepared to assume the role of the 1st responder. Auli happens to be very close to a military establishment who are often most effective responders.

Valley of Flowers and Hemkund sahib

From Govindghat, there is a trek route for Hemkund sahib and the Valley of flowers. The former is a religious place for Sikhs and the latter is a nature lover's attraction. The trek is about 17 kms long. Many of the vehicles headed towards these places including two wheelers and four wheelers park themselves near Govindghat which causes massive traffic jams during the peak season due to limited available space. This is also because Govindghat is enroute to Badrinath and there is no slowing down of traffic on this route during the tourist season.

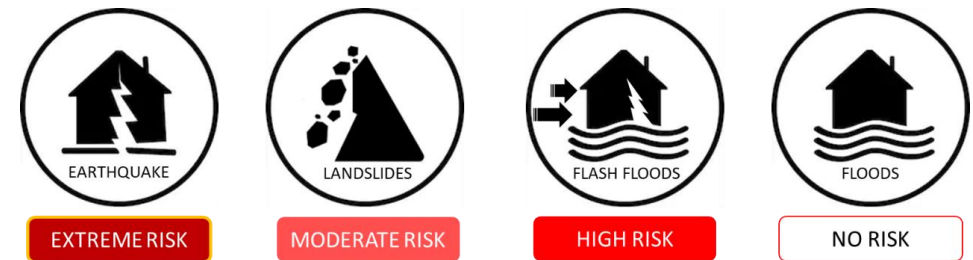


Map 2: Thematic Map of Joshimath Block Indicating Routes of Egress and Areas of Exposure and Risk

1.4 Joshimath City & Badrinath 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, this hotspot is highly vulnerable with Joshimath, Badrinath, Govindghat and Pandukeshwar as the key vulnerable areas. Joshimath and Badrinath are also densely populated although Badrinath is inhabited only for half of the year during the tourist season. Maps 3 and 4 illustrate the social vulnerability and population density of the Joshimath hotspot.



1.4.2 Earthquakes

Joshimath City & Badrinath block is classified as being Extreme Risk with respect to earthquakes. The built up area in Joshimath is dense and congested in certain parts with many buildings built without earthquake resistance. Maps 5 to 7 depict the earthquake intensities experienced under different return periods in the hotspot.

1.4.3 Fluvial Floods

There is no fluvial flood risk associated with Joshimath City & Badrinath.

1.4.4 Flash Floods

Flash flooding is assessed as high risk in Joshimath City & Badrinath. Map 8 depicts the flash flood hazard and exposure for this hotspot.

1.4.5 Landslide Hazard

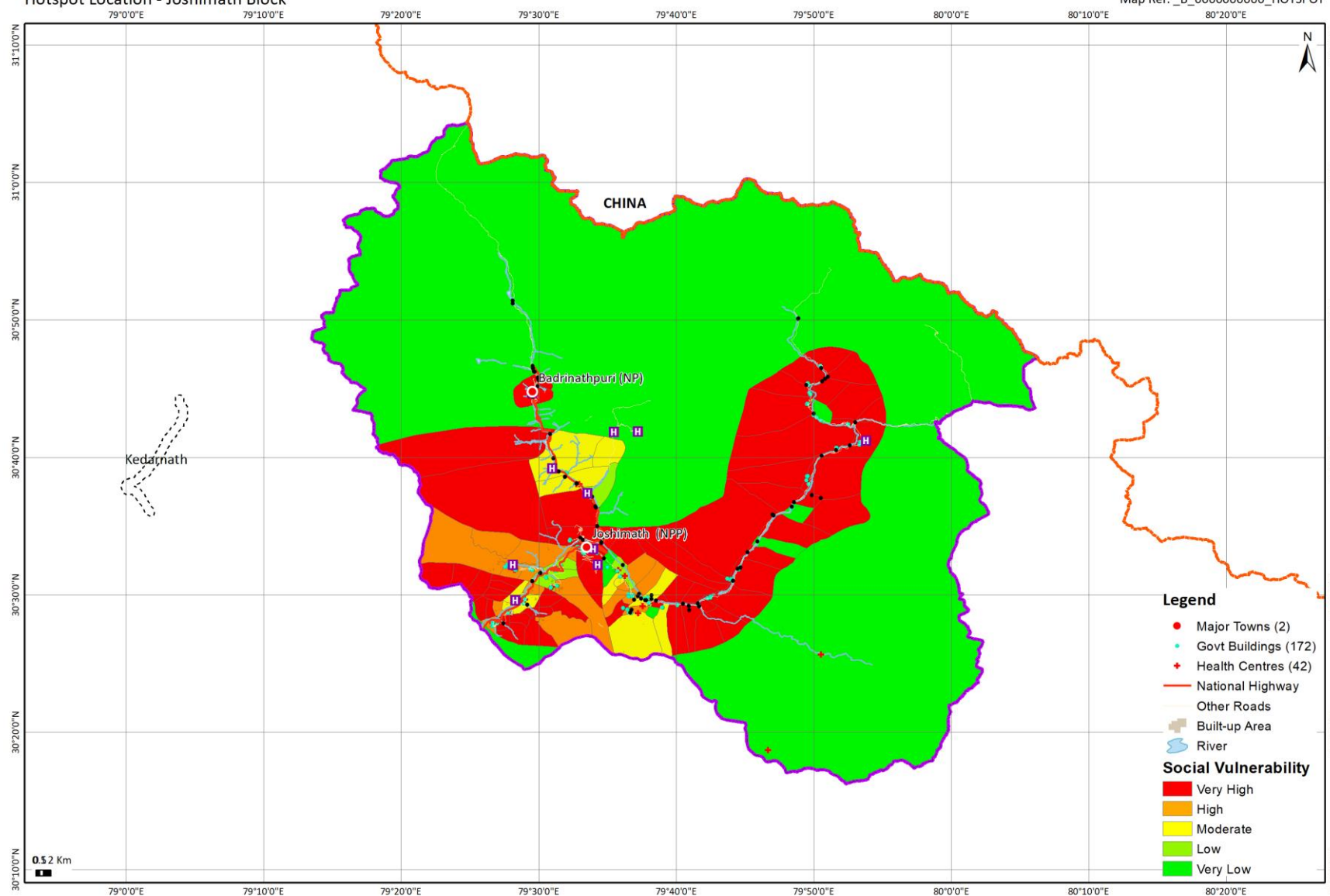
Landslides have been assessed as a low-moderate risk hazard in the Joshimath City & Badrinath corridor. Hazard. Map 9 indicates the negligible areas of exposure to severe landslides.

Tourism Hotspot Plan (Social Vulnerability)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



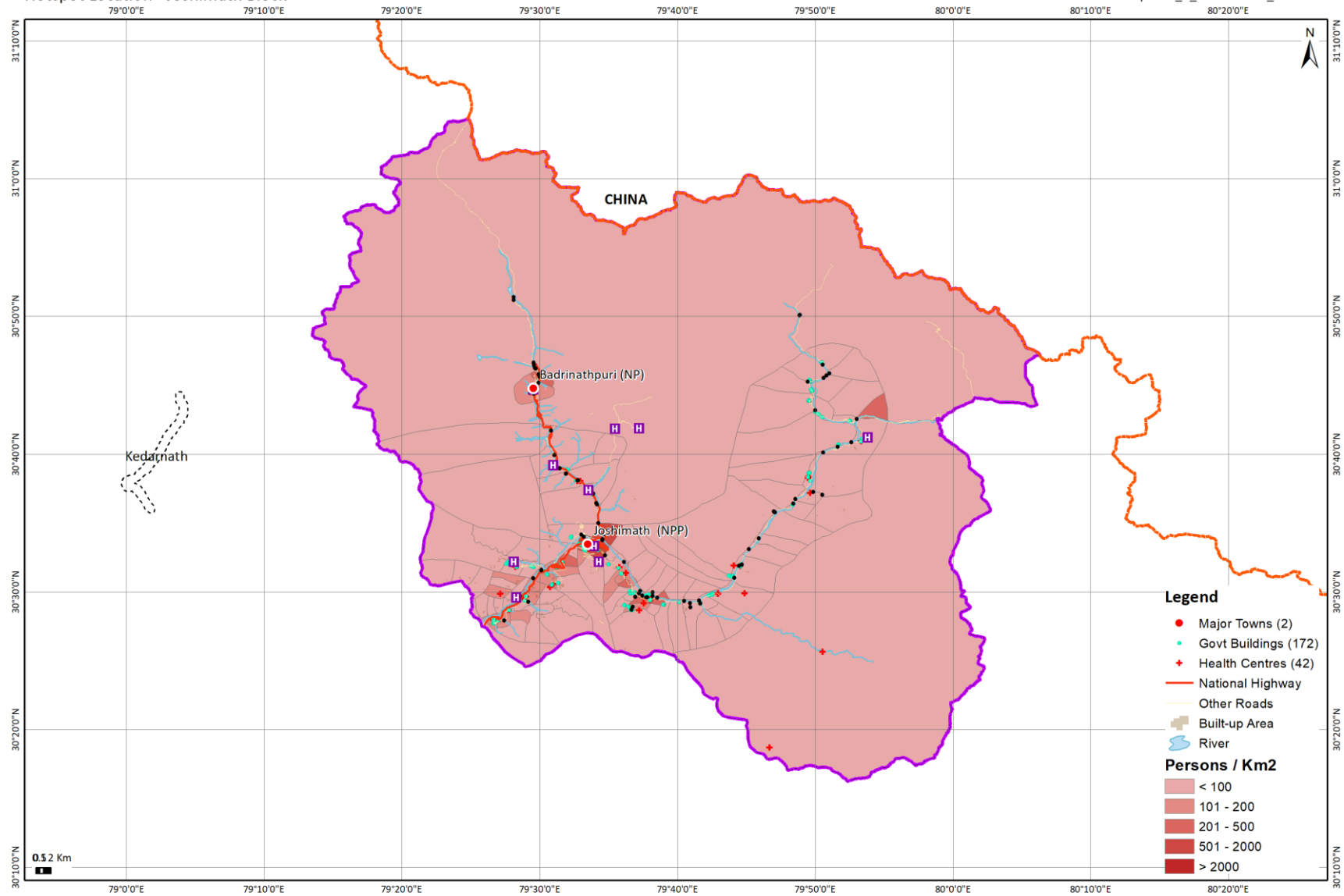
Map 3: Social Vulnerability map – Joshimath Block

Tourism Hotspot Plan (Population Density 2011)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



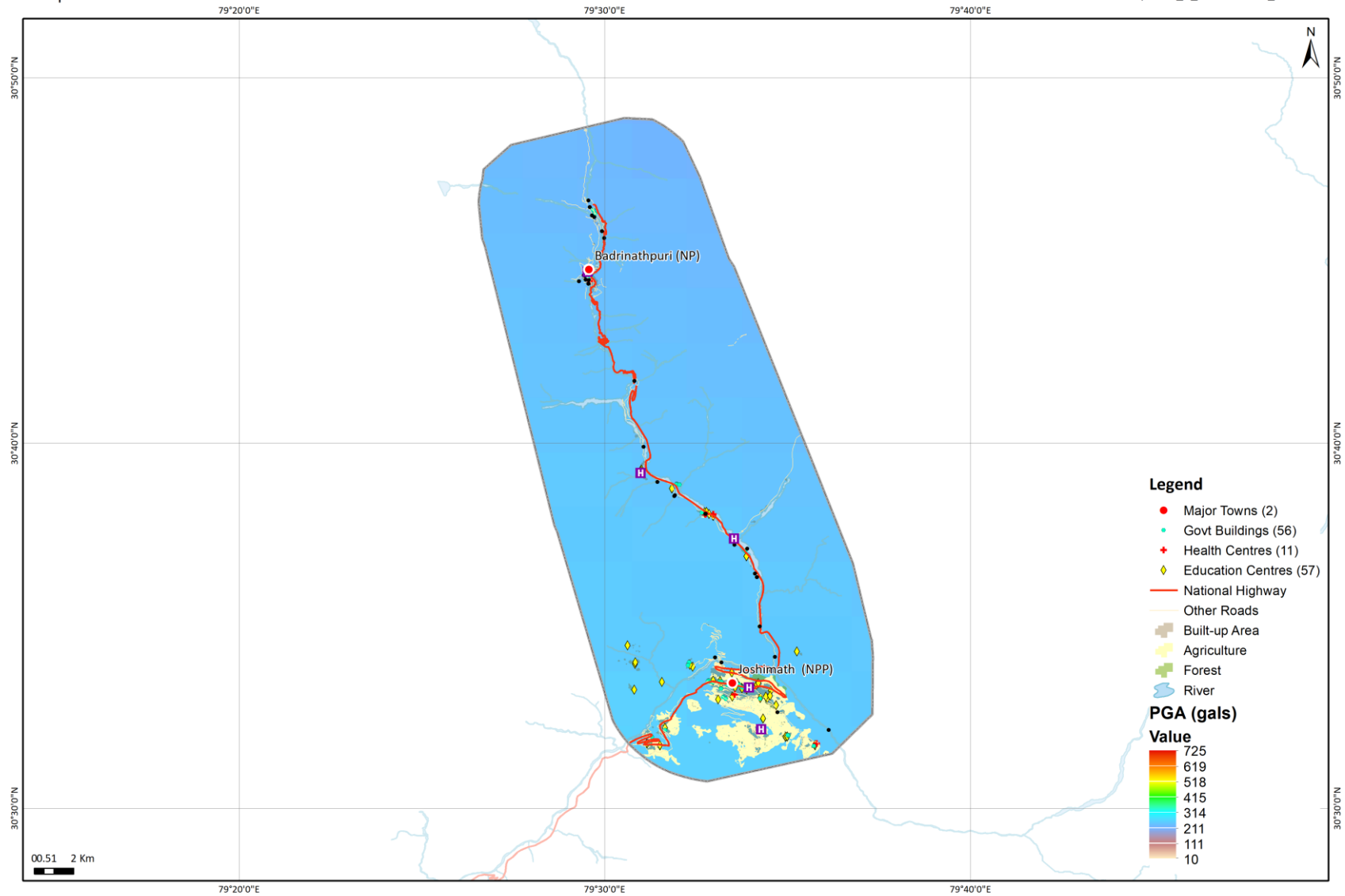
Map 4: Joshimath Block Population Density Maps

Tourism Hotspot Plan (Earthquake: 100yr RP or 40% chance in next 50 yrs)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



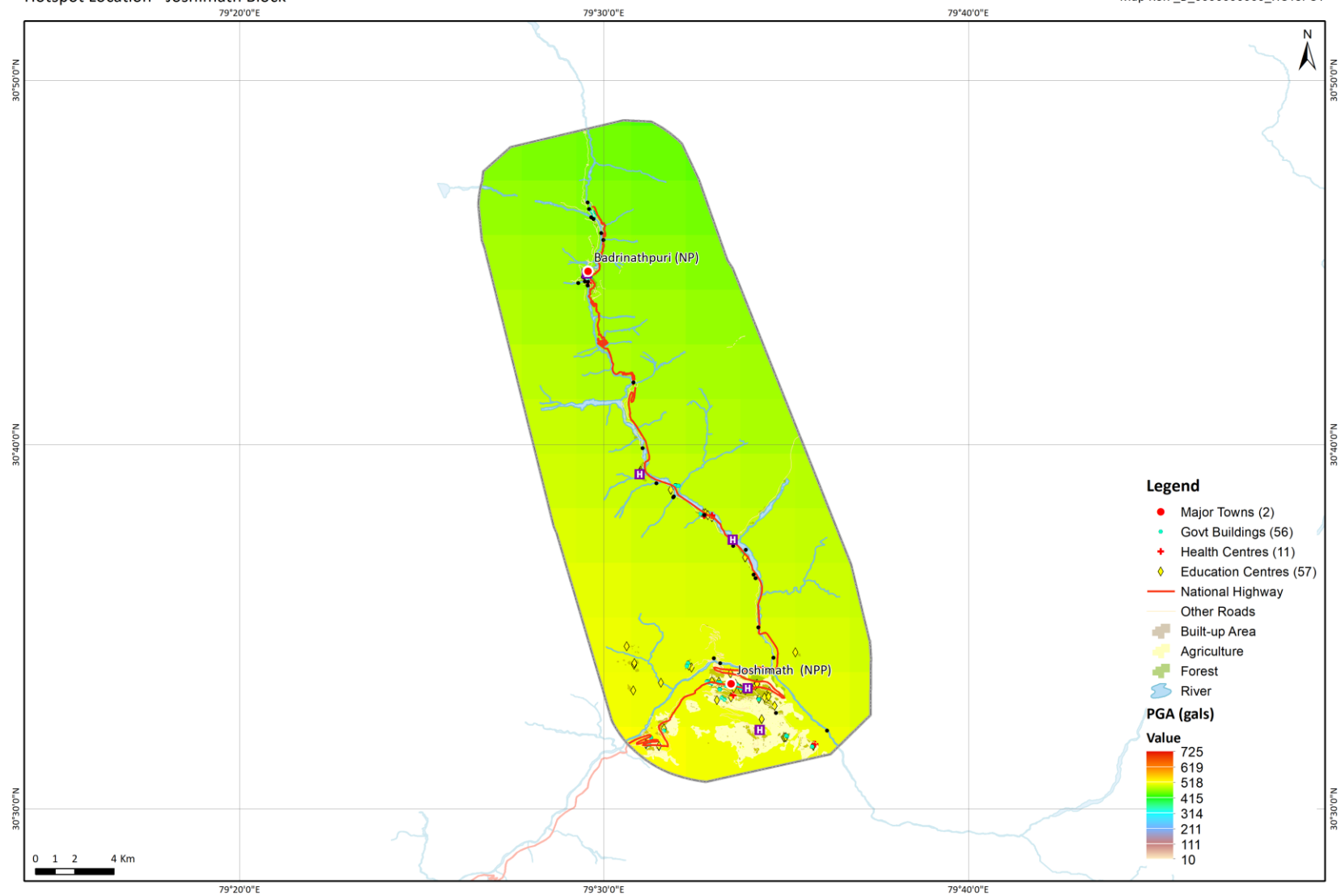
Map 5: Predicted Earthquake Intensity for 100yr Return Period for Joshimath Hotspot Location

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

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT

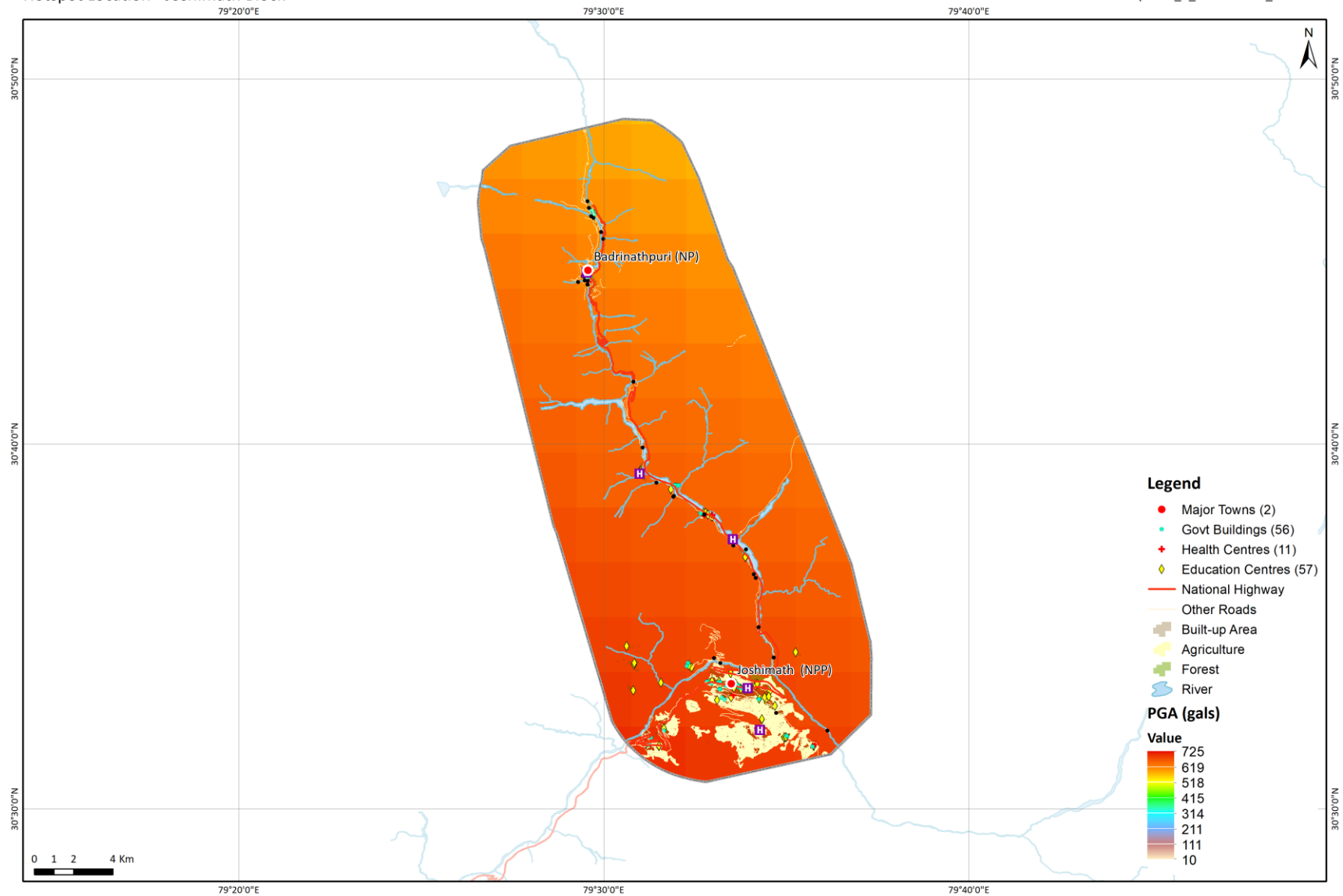


Tourism Rural Hotspot Plan (Earthquake: 1,000 yr RP or 5% chance in next 50yrs)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



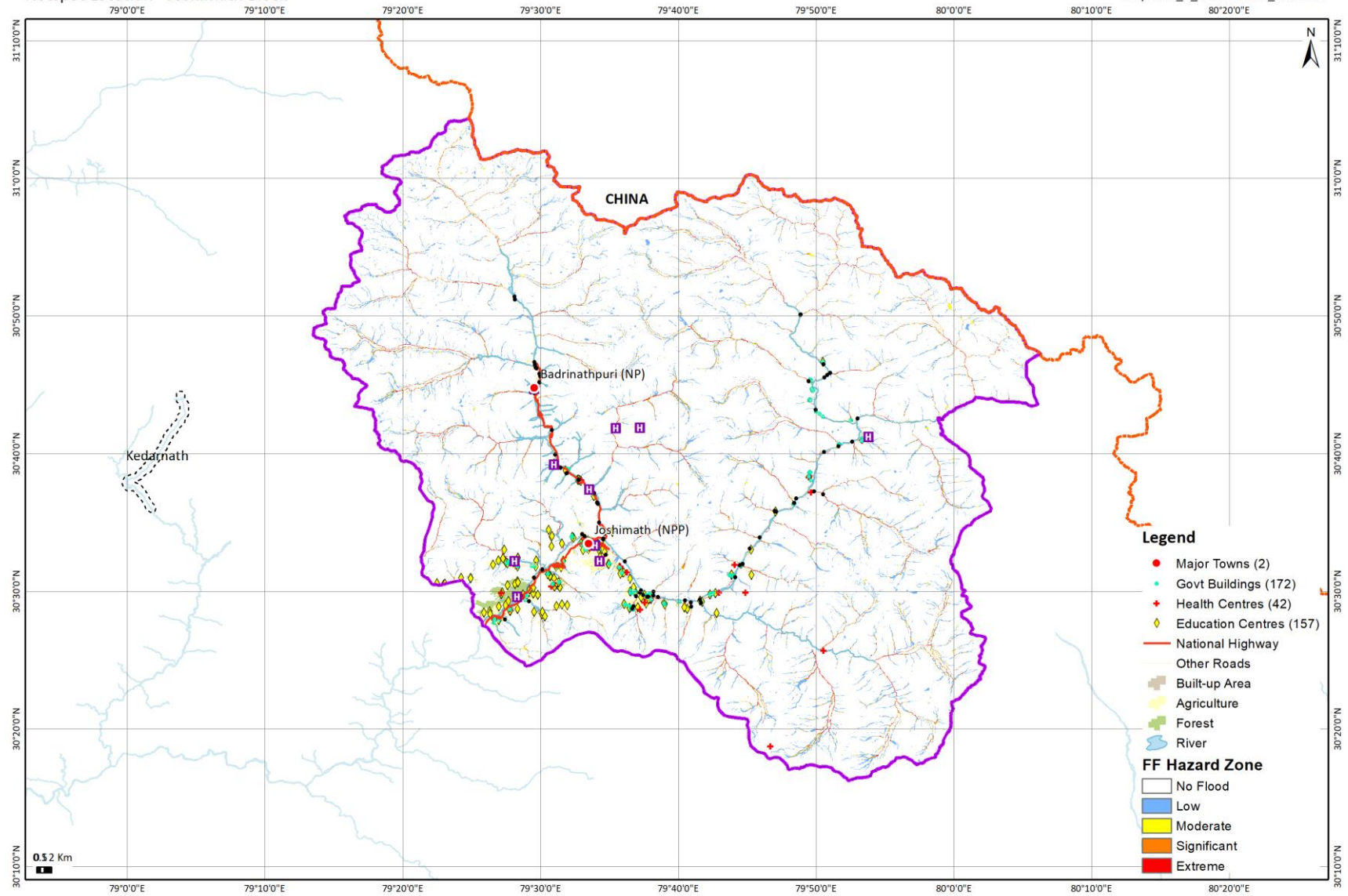
Map 7: Predicted Earthquake Intensity for 1000yr Return Period for Joshimath Hotspot Location

Tourish Hotspot Plan (Flash Flood)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



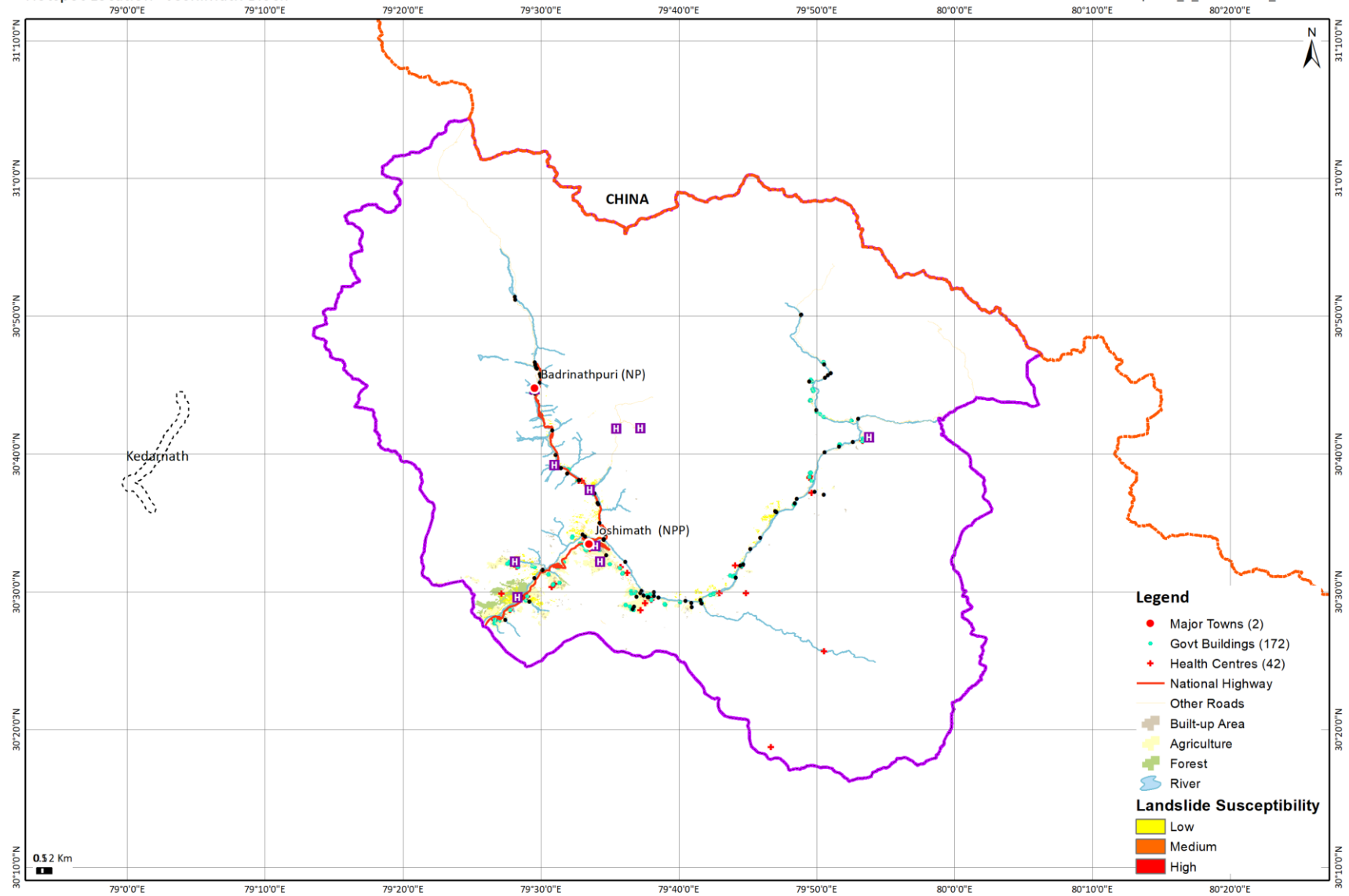
Map 8: Flash Flood Hazard and Exposure for Joshimath Block

Tourism Hotspot Plan (Landslide Susceptibility)

Disaster Risk Assessment of Uttarakhand (2016-2018)

Hotspot Location - Joshimath Block

Map Ref: _B_0000000000_HOTSPOT



Map 9: Landslide Susceptibility and Exposure for Joshimath Block

1.5 Strategy Implementation, Monitoring, Evaluation

1.5.1 Challenges in Implementation

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

Finance & HR - 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).

The relevant departments are also seen to be understaffed to enforce building compliance and other risk mitigation measures as a majority of officials are stressed with other operational works related to managing the massive tourist season in the region.

Technical – the way data and other information are acquired and transferred is still essentially dependent on manual processes especially in rural blocks such as Joshimath. 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 specialisation viz; 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 specialisation need to be considered.

As with all the cases studies there are several issues that need to be addressed no matter where the location.

- Preparation & updating of Hazard Zonation map of the City, which includes: update & maintain current map of areas within the City that are subject to be sensitive/ vulnerable to the EQ; identify the location & extent of hazard areas.
- Enforce the most current Building Codes Standards to protect the built environment in the City.
- Enforce Earthquake Safe Construction Technology in the City.
- Retrofitting existing public facilities & services of the City to contemporary standards.
- Seek to reduce non-structural hazards in homes, schools, business centers & offices of the City.

1.5.2 Proposed Management and Governance Structure

It is proposed that a Joshimath City & Badrinath Hazard Mitigation Working Group (HMWG) is established by the appropriate municipality. The Group is seen as being responsible for coordinating implementation of plan's strategies and undertaking an annual review process. In order to develop momentum for plan implementation, the Group will establish an appropriate timeframe for the meeting schedule as plan implementation begins.

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 District/Block, Gram Panchayat 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 DRMPs 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 determine an indicator of progress and success. It is international best practice for all strategies to have a monitoring and evaluation component so that progress 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 as a measurable value that demonstrates how effectively the strategy is being achieved. These KPIs are indicative and need to be agreed and adopted as implementation part of the implementation process by the relevant stakeholders.

2 STRATEGIES

2.1 Overarching Strategies for Tourism

Like all DRM planning, Tourism DRM is undertaken as five basic and sequential steps:

- 1 *Identifying hazard risks:* analyzing hazards resulting from a natural or manmade event, along with an understanding of the full range of probable effects and consequences.
- 2 *Assessing a community's vulnerability to the risk:* a community's vulnerability may be measured in terms of its size, geographic location, economic status, level of organization, and available resources; infrastructure, and response capability, among other factors. Its vulnerability will therefore depend upon the level of exposure and its capacity to adapt, respond to or recover from the hazard.
- 3 *Developing a preparedness and mitigation plan:* a plan will be required to address any institutional or systemic weaknesses, which could limit the destination or community's ability to mitigate disaster risks.
- 4 *Implementing the plan:* implementation may be simulated to ensure that the plan is workable during real disaster conditions. It is also important to document the lessons learned from the exercises in order to assemble a databank of learning, experience and information.
- 5 *Monitoring, evaluating, revising and updating the plan:* the information assembled provides essential learning for revising and updating the plan, correcting any areas of weakness or ineffectiveness, reallocating resources

These elements are not static but revolve around a continuous cycle of activity and interaction among the responsible and collaborating agencies. For such groups a common objective to reduce the probability for disaster occurrence is important. This is the framework used here in developing strategies for the hot spots.

For DRM in tourist hotspots, there needs to be very specific data internalized to the process. For example, when managing tourism disaster risks, the tourism value chain must be central to the planning and organization process. This needs to be understood so that all aspects of the DM plan can build the necessary links to the other relevant sectors and the broader community.

In the case of the Uttarakhand hotspots and elsewhere there is more than one tourism type and as a result there is more than one value chain that needs to be considered.

DRM needs to be adopted as a continuous cycle of activity and interlocation among the responsible and collaborating agencies, united by a common objective to reduce the probability for disaster occurrence.

In preparing a Tourism DM plan for individual locations the following key strategies need to be adopted:

2.1.1 Mitigation

STRATEGY	DRIVER	OUTCOMES	KPI
Establish a Tourism Disaster Management Committee (TDMC).	The TMDC needs to be led by the appropriate municipality and include representation from relevant government agencies, police, fire, govt. healthcare, the Army, highway construction, Dam construction, hotel association, tourist operators, restaurants, All India Radio, Met office, Water Commission, Gram Panchayat and community tourism representatives.	A TDMC with responsibility to ensure a TDMP is 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.
Develop a Hazard identification Prioritisation and Tourism Risk (HIPTR) assessment by mapping of hazard areas against tourist areas, activities and movements (vulnerable populations), to derive a level of exposure and value chain for each of the tourist categories ²	The development of a knowledge management system which is regularly updated is an important first step. The DRMA data portal is a prime source for some but not all of the required data. A series of surveys will be required. Risk mitigation and management options need to be derived.	A risk assessment of which tourist, where and when they are exposed, as well as the exposure of the relevant service industries and secondary suppliers.	HIPTR to be drafted within 6 months of the TOR being finalized.
Establish a TDMC funding arrangement and resourcing to undertake technical aspects of the work.	The formulation of the HIPTR is going to be a specialized set of tasks that will require skills not already available in administration i.e. GIS, community consultation, undertaking a range of survey and economic evaluations. Specialist training may be required.	A funded and resourced task team to undertake key elements of data collection, analysis and plan preparation.	A five-year funding plan to be established within 6 months of TDMC inception. Recruitment/contracting of key personnel within 3 months of TOR being signed

² There is a need to understand the risk profile in terms of loss of life and assets but also any additional risks including risks to tourism resources (e.g. biodiversity, water supply), plant and infrastructure (e.g. coastal resorts), business risks (e.g. supply disruptions, changes in insurance coverage), or market risks (e.g. changes in competitiveness through increased transportation costs).

Develop a Tourism Disaster Management Plans (TDMP) at all levels of jurisdictions, across departments, the industry and communities.	A TDMP is the basis on which all forward planning for mitigation and preparation is based. Risk mitigation and management options need to be assessed and adopted.	A well prepared and tested DMP that is regularly reviewed, amended and distributed.	DM Plans developed within 6 months of the drafted HIPTR, followed by annual reviews.
As part of the TDMP, increase public awareness, understanding, support & demand for hazard mitigation through the development of a city-wide sales and marketing strategy and campaign focused on building awareness and a "need to know" desire focused on key participants in the tourism sector.	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 well-informed tourism sector capable of planning for and responding to disasters at a level that will significantly diminish probable loss of life and assets.	A public awareness campaign designed and sponsored within 12 months.
An effective Pilgrim Control & Regulatory Body may be constituted for management & control of tourists/pilgrims.	Pilgrim management requires strengthening across the state, but especially in these hotspot locations. This regulatory body would oversee the programme of improvement for pilgrim management.	Pilgrims safer and risk reduced during high tourism season.	Body to be established and mandated within 18 months.
While planning for tourism related developmental activities, besides environmental & social-cultural issues, carrying capacity of tourism sites should also be kept in mind.	Often ancillary infrastructure such as parking, public spaces etc. are inadequate compared to the residential accommodation of the tourist locations.	A properly planned tourist infrastructure that has adequate infrastructure related to accommodation, parking and adequate public spaces.	Assessment of max carrying capacity to be completed within 18 months. Effective regulation and controls in place within 36 months.
In disaster prone areas like Badrinath, tourists contribute a major portion of floating population, therefore there should be an effective pilgrim management system.	Pilgrims are vulnerable, exposed, and displaced. An effective Pilgrim Management System for these hotspot areas would allow for more effective planning, communication, response and immediate recovery.	Pilgrims are informed, risk aware, locatable, and managed in the event of a major disaster.	Pilgrim Management System in place within 24 months.

2.1.2 Planning and Preparation

STRATEGY	DRIVER	OUTCOMES	KPI
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Establish an integrated Hazard Emergency Warning System and awareness education for all tourists on arrival.	The warning or alarm elements of a EWS need to be simple in its approach and easy to understand so that public awareness is not compromised due to complexity.	A readily understood EWS notification system integrated to include all hazards and an indication of level of response needed.	EWS established within 12 months, awareness training and education material created and distributed as soon as W EWS activated.
Develop a Tourist DM Evacuation Plan (TDMEP) and ensure it is widely distributed and understood.	The TDMEP not only needs to be part of the mainstream processes of the city but tailored to the site characteristics associated with the tourism type. Signage (international/Multilanguage) and other awareness programmes to be developed.	A well prepared and tested TDMEP that is regularly reviewed, amended and distributed.	Development of the DMP within 12 months followed by regular annual reviews.
Emergency response testing (closing the gap).	Experience elsewhere shows that education and awareness does not guarantee the right responses nor in a timely manner. Response testing with tourists is not normally possible in terms of a training exercise but can be checked through questionnaires to assess understanding and to improve awareness. Such questionnaires can be used to also gain valuable feedback data on tourism processes.	An effective awareness programme tested against regular measures of understanding and response.	Annual survey reports based on awareness and response testing.
Develop damage assessment competency as part of the HIPTR process	As with all DMPs an understanding the damage the sector has suffered as a result of a disaster is fundamental to planning for future recovery and mitigation. In this case socio economic data are critical as is the need to present a realistic picture of the level of damage and functionality to tourist.	Competent assessors able to undertake evaluations with respect to infrastructure, socio-economic conditions, supply chain functionality.	Annual assessments as part of the overall TDM plan and assessment review
Seek out mechanisms to introduce both microfinance and micro-insurance opportunities	Both micro-finance and micro-insurance needs a lot of efforts to put in place such as onboarding authorities, re-insurers, local insurers and banks	A reduced dependency on post event State funding for compensation of loss to life, property, livelihood etc.	Annual assessment of share of people/buildings insured.

relating to the tourism supply chain as a way to build resilience in the sector.	with their distribution channels. This takes time and effort but both have been shown to make a positive contribution in disaster situations towards improving livelihoods and building resilience as a result of readily available funding to help people and businesses get back on their feet.		
Develop a specific Hazard identification Prioritisation and Pilgrimage Risk (HIPTR) assessment to deal with large numbers involved and the need for crowd control during response and initial recovery post an event.	There is a fundamental issue with pilgrims that comes out of the sheer numbers involved. Mass movement is a critical issue. Panic will be a major issue should a large hazard event occur and crowd control will be paramount as a first response capability in this situation. Focus needs to be on understanding temple capacity, inclusive of all waiting areas and develop plans to deal with this. Consider reasonable waiting time - compare with requirement and assess faster turnaround. Escape routes and safe places to be clearly identified.	An analysis focused on the temples and waiting areas and a plan to manage congestion, choke points and potential solutions.	HIPPR to be drafted within 6 months of the TOR being finalized.
Limited points of entry and exit for proper Implementation of the biometric registration of each pilgrim headed to Badrinath and Hemkund sahib.	Currently there is an informal count recorded of the pilgrims that visit the region. However, this manually collected data may not be completely reliable. Also, a biometric system captures information in greater detail than a head count.	A fool proof biometric registration gives the administration a real-time view of the count and details of pilgrims inside the Joshimath hotspot. This will cover pilgrims at Badrinath and Hemkund sahib. The data will also be immensely useful for future tourism studies.	Pilgrim Registration and Management System in place within 24 months.

2.1.3 Response

STRATEGY	DRIVER	OUTCOMES	KPI
Develop local warden skills in tourist guides or comparable staff in hotels, medical and police forces.	Language and cultural differences can vary amongst all tourists. Such traits are exacerbated under stress. As a result there is a need for designated wardens trained in suitable communications and cultural behaviors/understanding during emergency evacuation and response situations.	A well recognised and trained Warden task force capable of bridging both language and cultural gaps under emergency situations.	Evaluation of effectiveness under annual DM training programs.
Development of an international, national language and cultural aid database.	All countries are tied to international tourism with respect to their own citizens as a result of their proactive use of travel advisors and aid in time of crises. Understanding how to take advantage of both and to seek support in times of crises is an important resource for the management of the tourism sector and the region's perception in the market.	A resources database and communications process relating to foreign country tourists facilitating access to interpreter skills and travel advisory content.	An annual review of a database accessible through the TDM process.
Organize ward-level volunteer groups for disaster response in Joshimath town under each ward councilor.	The first respondents are the town residents who are a huge support to the response effort. However, this is currently unorganized and spontaneous with scope for better optimization of this crucial resource.	Organizing volunteers at the ward level gives the disaster response efforts an effective chain of command for the completion of various tasks such as preparation of shelter sites, proper flow of information, managing relief supplies etc.	Volunteer groups to be formed as soon as possible or after ward councilors are elected in the coming municipality elections.
Before entry to disaster prone/ high altitude area like Badrinath, tourists/ pilgrims should be clearly warned about the weather conditions. They must also be provided basic "Dos & Don'ts" & latest information on weather.	Tourists are often unaware of the extreme weather conditions and disaster related "Dos and Don'ts".	A well-informed tourist takes adequate precautions and is more aware of next steps in the event of a disaster.	Implementation of the communication program within an immediate time frame or latest by the start of the next tourist season.
There should be alternate routes for emergency evacuation wherever possible & these routes must be pre-identified & maintained by State Govt.	Currently evacuation routes aren't entirely pre-planned and are often a result of post-disaster improvisation.	pre-identified evacuation routes equip the administration and affected populations to perform better in response to a disaster.	evacuation routes to be identified and documented within an immediate timeframe.

	This leads wastage of crucial time and usage of potentially sub-optimal evacuation routes.		
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2.1.4 Recovery

STRATEGY	DRIVER	OUTCOMES	KPI
Undertake tourism sector damage assessment as part of the DM response process.	An understanding of the damage the sector has suffered is fundamental to planning for future recovery and mitigation. Including the need to present a realistic picture of the level of damage and functionality to tourism within the market in order to minimize losses.	Competent assessment of the status and actions needed with respect to infrastructure, socio-economic conditions and supply chain functionality.	An immediate assessments as part of the overall DM response and recovery process with the first 6 months.
Establish a Sector recovery plan including advertisement of status of national and international perceptions.	A sector recovery plan serves 2 functions. One is to ensure that the hardships associated post recovery are minimized and the sector reestablishes its functionality as soon as possible. The second is to advise the market of the real status of the sector as opposed to what is frequently reported in the media and in travel advisory's.	A well planned recovery minimizing socioeconomic losses and human hardship. A well informed national and international market as to the unfolding realities.	Number of returning tourist and the reestablishment of the supply chain on an initial 6 an then 12 monthly basis.

2.2 Specific Strategies for Earthquakes

2.2.1 Earthquake - 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 Dehradun 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 - 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 Joshimath hotspot area.	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, raising resilience and reducing impacts of a disaster as a result of people responding in a well informed and disciplined manner. Significant research ³ shows that “shock” from traumatic situations can be very debilitating but can be overcome through awareness and training.	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.

³ See for example: Laurence Gonzales, *Deep Survival*, 2017.

Increase the community resilience by expanding the number of Community Emergency Response Teams (CERT) in the Joshimath hotspot area.	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.

2.2.3 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/	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.

	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.		
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.
Develop specific DMPs for high density areas such as the markets and older parts of the city	There is an urgent need to deal with high density poorly developed areas of the city such as the key market areas and associated surrounds. Commercial facades present a specific problem as does narrow roads, passage ways and poor response capability to earthquakes as a primary hazard and fires as secondary hazard	Structural and none structurally driven DMPs for high priority areas of the city.	Identification and planning for the development of DMPs to be a high priority within the first 12 months of the CDMC activity
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	Appropriate mechanism for compliance & review of all construction designs submitted to ULBs/ Development Authorities/ construction agencies.	Ongoing process

	of Indian Standards & further included in the NBC.		
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

2.3 Specific Strategies for Flash Floods

Flash flood events can be very unpredictable and of extreme magnitude: impacts are nearly-impossible to mitigate in many cases. The focus should be on minimizing human losses with economic (asset) losses being secondary.

For mitigation of the frequent events (<100Y), entrainment walls and structural mitigation are good solutions. Flood zone delineation should help to reduce or reverse exposure – ideally a 500Y event risk profile could be used to identify high risk areas.

Early warning systems using simple upstream indicators are now both feasible and effective – see Box. The warning does not necessarily need to rely on real-time hydrological modelling. Hydrological analysis could be used to define trigger levels of rainfall intensity that could potentially lead to either direct flash flood or landslide that might subsequently to dam break type of flooding. The system needs to be integrated with local knowledge and communities involved in the development and operation. Forecasting if feasible should be prioritized and should rely primarily on high temporal and spatial resolution rainfall data.

With respect to tourists and locals alike early warnings and evacuation routes need to be clearly defined and emergency response communicated to the public through education, leaflet, signs, and locals or in transit.

Building community capacity for flash flood risk management.

The flood warning instruments installed by the project provided communities with early warning of flash flood waves on six occasions between August 2010 and August 2011. In each of these flood events, the flood alarms woke villagers during the night or early morning drawing their attention to the rising water level. The villagers remained alert and disseminated the flood information to downstream areas using mobile phones. As a result, the downstream communities had lead time of one to one-and-a-half hours to move people and valuables to safe areas.

Source: Partha J Das in Shrestha, AB; Bajracharya, SR (eds) (2013) Case studies on flash flood risk management in the Himalayas: In support of specific flash flood policies. Kathmandu: ICIMOD

Risk transfer through micro-insurance could be established for flash floods and thereby transfer the emphasis from Government based compensation to more effective and quicker process of recovery and economic independence.

2.4 Specific Strategies for Rural Adventure and Trekking Tourism

Adventure tourism such as mountain climbing, white water rafting, mountain biking and summer trekking are all growing in popularity worldwide. This is well recognised by Uttarakhand State (Vision 2022) and Government of India (GOI). The Ministry of Tourism, GOI, has published a *BASIC MINIMUM STANDARDS FOR MOUNTAINEERING* which covers, for tour operators, both the required certification and the essentials to be covered in an operating SOP. The Standard applies to such activities as mountain climbing, trekking, zip wires and high ropes courses, rock climbing artificial wall climbing and abseiling, all-terrain vehicle (ATV), horse safaris, skiing/snowboarding, mountain biking, parasailing, skydiving, hang gliding/paragliding, hot air balloon, water sports, rafting and river cruising. For each activity there are specifics with respect to the requirements for dealing with Emergencies and Risk Mitigation.

On the premise that the SOPs and other requirements are met the instructors and guides are well trained in emergency response and first aid as well as appropriate evacuation methods.

Adventure travel involves exploration or travel to remote exotic areas. Adventure tourism is rapidly growing in popularity as a tourist seeks different kinds of vacations. Any constructive activity which tests the endurance of both a person and his equipment to its extreme limit is termed as Adventure.



Ministry of Tourism Government of India

STRATEGY	DRIVER	OUTCOMES	KPI
Enforce the basic minimum standards for mountaineering published by the minister of tourism.	Adventure sports activities in Uttarakhand are often carried out without 100% compliance to the standards laid out which exposes tourists and service providers alike to risks which can be avoided.	Minimisation of risk in these activities with 100% compliance to best standards with respect to usage of equipment and validation of support staff.	Reduced number of unauthorized, inadequately resourced operators within stipulated time frames.
Incorporate DRM planning into these adventure activities such as evacuation routes planning, SOP's for support staff in the event of a disaster.	Currently the standards for mountaineering published by ministry of tourism does not include DRM.	A response capable eco-system where post disaster tragedies can be minimized.	DRM policy on adventure tourism in Uttarakhand to be drafted and enforced within stipulated time frame.

2.5 Specific Strategies for Landslides

2.5.1 Landslide - Introduction

Landslides (including rock falls) are a common geohazard and although frequently considered a secondary consequence of earth quakes co-seismic landslides are not uncommon and can be of great consequence. They are also caused by flooding, heavy rain and hydraulic soil changes, land clearing and infrastructure development such as dams and roads landslides. 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/endpovertyinsouthasia/minimizing-risks-caused-geohazards-south-asia>)

2.5.2 Landslides - Mitigation Strategies

Landslides - Mitigation			
STRATEGY	DRIVER	OUTCOMES	KPI
Identify the location & extent of landslide hazard areas in the Joshimath hotspot.	Preparation & updating of Hazard Zonation maps of the City is required, which includes updating & maintenance of current maps of areas within the City that are subject to mass movements;	A basic tool for development planning.	Mapping exercise within 24 months.

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.	No further development in high risk zones. Zero encroachment.
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.

2.5.3 Landslides - Planning and Preparation

Landslides - Planning and Preparation			
STRATEGY	DRIVER	OUTCOMES	KPI
Develop emergency response procedures as part of the Joshimath block 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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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:

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PROJECT PROGRAMME

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