

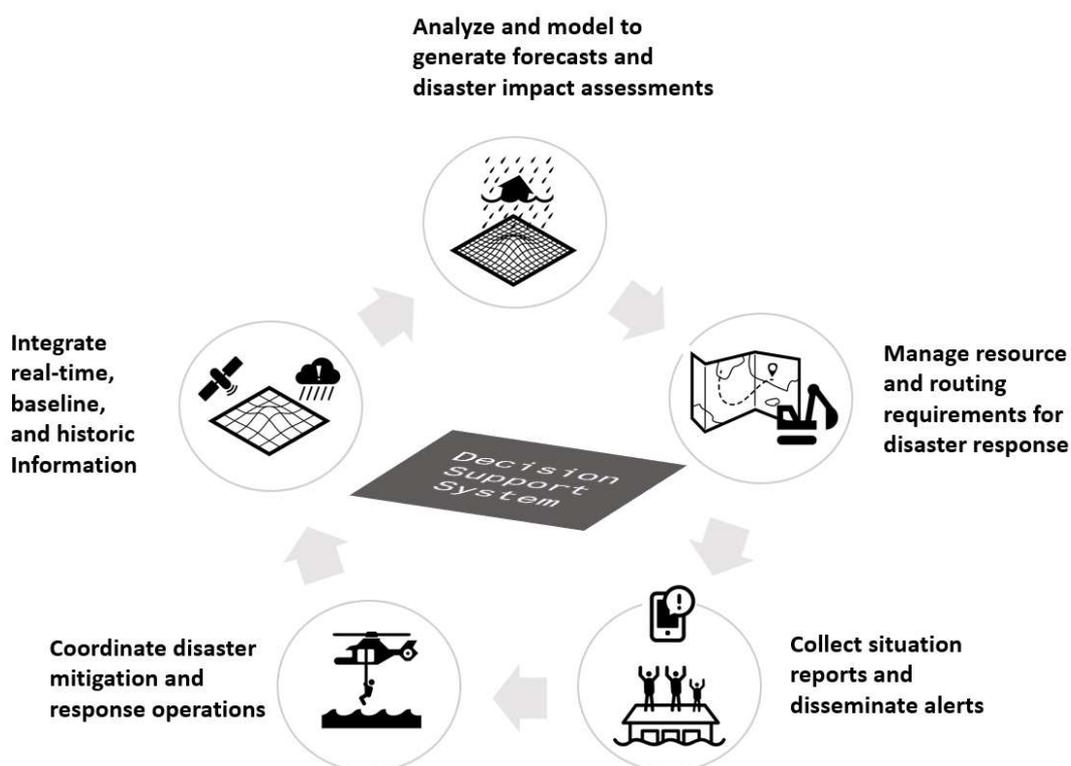
## Annexure-A

### Selection of Consulting Firm for Design, Development, and Operation of Modular Decision Support System for Disaster Risk Management under Uttarakhand Disaster Recovery Project (UDRP)

#### 1. Vision and Objectives

The State of Uttarakhand and several parts of the higher reaches of Himalayas received extremely heavy rainfall during the period June 15 to 17, 2013. The resulting flash flood and landslides caused heavy loss of lives and damage to infrastructure and property. Following the request of the Government of India, the World Bank is financing the Uttarakhand Disaster Recovery Project (UDRP), which has six components including Technical Assistance and Capacity Building for Disaster Risk Management. One of the subcomponents focuses on establishment of a Decision Support System (DSS) for disaster risk management and risk-informed development planning, with specific focus on enhancing hazard monitoring and early warning, disaster preparedness and response, and recovery planning.

#### 1.1 Vision



The envisioned Modular Decision Support System (DSS) is expected to integrate real-time, historic, and baseline information from various sources to offer a common platform to the GoUK decision makers for situation awareness, disaster forecasts, impact assessments, incident reports, emergency routing, and other actionable information. The DSS will facilitate coordination and collaboration in effectively deploying resources, manpower, and expertise

for risk mitigation (before disasters), response (during and after disasters), and post-disaster recovery planning in view of the state’s high vulnerability to flash floods, floods, landslides, and earthquakes. The modular design of the DSS will also allow to monitor and manage the state’s response to accidents and forest fires in close coordination with the responsible line departments.

The DSS will be operated and used by the Uttarakhand State Disaster Management Authority (USDMA) and District Level Disaster Management Authorities. The use of the system will extend to various other departments and agencies involved in disaster risk management and relief such as the State Disaster Response Force (SDRF), Public Works, Irrigation, Forest, Police and Tourism Departments. The DSS will integrate the existing Forest Fire Monitoring System at the Forest Department.

### 1.2 Objectives

The objective of the consulting firm assignment is to **design, develop, and operate** the envisioned DSS that should:

 <p>Integrated hazard monitoring</p>	<ul style="list-style-type: none"> <li>● Integrate baseline data, real-time and historic, from various sources, including crowdsourcing, on a geospatial platform</li> <li>● Integrate real-time hydromet and seismic data feeds and create alerts</li> <li>● Pull real-time data into models to generate forecasts, advisories and impact assessments for extreme rainfall, flash floods, floods, and landslides</li> <li>● Pull real-time data into models to generate alerts and impact assessments for earthquakes</li> <li>● Provide data services to develop and operate modules and applications</li> </ul>
 <p>Disaster Preparedness and Planning</p>	<ul style="list-style-type: none"> <li>● Generate ‘What-If’ scenarios to study impact of extreme rainfall, flash floods, floods, landslides, and earthquakes on communities, infrastructure and service delivery.</li> <li>● Enable users to send reports of compliance of directives and executive orders directly to the system</li> <li>● Enable deployment of disaster preparedness infrastructure, human resources and machinery.</li> </ul>
 <p>Situation awareness</p>	<ul style="list-style-type: none"> <li>● Collect and display incident reports on the map-based view</li> <li>● Generate disaster warnings and impact assessments on a geospatial view, and identify suitable sites for evacuation and relocation</li> <li>● Help monitor and track tourist movement on the Char Dham Yatra and other important routes</li> <li>● Generate near real time situational reports of stocks, mechanical and human resources</li> </ul>

 <p>Early warning and advisory</p>	<ul style="list-style-type: none"> <li>● Automatically send forecasts and alerts over SMS, cell broadcasting and social media channels to specified user groups</li> <li>● Enable users in the field to enter incident reports and status of resources</li> </ul>
 <p>Relief, Response and SAR Coordination</p>	<ul style="list-style-type: none"> <li>● Direct relief, response and search and rescue operations during and after disasters and emergencies.</li> <li>● Estimate resource requirements and optimal routes based on impact assessments</li> <li>● Enable users to add and track temporary disaster relief infrastructure such as camps and helipads on the map-based view</li> </ul>

Refer to the sections below for details on the DSS requirements.

## 2. Existing Groundwork at Uttarakhand

There are several existing and ongoing initiatives underway at Uttarakhand that will lay a substantial foundation of data, studies, and analytical tools that can be leveraged for the development of the DSS. Some of the key initiatives to note:

### 2.1 Uttarakhand Disaster Risk Assessment

As part of the Risk Assessment work the following are being prepared for the state, district, and block levels:

- Input datasets (spatial and temporal) for hazard assessment
- Exposure, capacity, and vulnerability datasets
- Hazard layers for earthquake, floods, landslides, flash floods, and industrial hazards
- Probabilistic and deterministic risk analysis for earthquake, floods, landslides, flash floods, and industrial hazards
- Report detailing datasets, methodology, and models used for the analysis
- A “Digital Risk Database” of all spatial and non-spatial data from the assessment

### 2.2 River Morphological Analysis

As part of the Morphological Analysis work, the following are being prepared for important river stretches in the state:

- GIS layers for land use, forest area, roads, railways, lakes, major wetlands, basins, river, streams, areas of sedimentation deposits, landslides, high elevation points, vulnerable areas and settlements with history of floods
- Cross sectional data for vulnerable points in river basins
- Output rasters of digital elevation model (DEM)
- Rain-runoff modeling outputs, including snowmelt
- 1-D Hydrodynamic modeling output including dam break simulation with GLOF (Glacial Lake Outburst Flood)

- 2D Morphological Modeling Outputs
- Inundation Modeling Outputs
- “Uttarakhand River Morphological Information System (URMIS)” GIS database to interact with the modeling information

### 2.3 UDRP Management Information System

This MIS (<http://ukdisasterrecovery.in/mis/>) tracks the reconstruction work undertaken in the state after 2013 floods, and has several pertinent datasets to leverage, including:

- Major road, rail, rivers, and administrative boundaries
- Search and rescue equipment availability, requirement, and map
- Location and status of reconstruction work including bridges, roads, public buildings, water supply, helipads
- Data visualization and reporting tools for monitoring and evaluation.

In addition to these, the “Disaster Mitigation and Management Center” for the state has over time developed a strong database of GIS information and applications for disaster risk management in the state, including:

- Critical infrastructure: Healthcare, police, road, civic aviation, civic supplies, buildings
- Seismic vulnerability assessment
- Landslide hazard assessment
- Flood inundation mapping for Tehri and Pipalkoti dams

### 3. Requirements

To translate the Modular DSS vision to reality the following components should be designed, developed, and deployed by the consulting firm. The consulting firm is also required to maintain and operate these over **two years** - and also build capacity in the government for operation and maintenance of the system.

The core database, modules, and applications need to be designed for both **online** and **offline** use (*offline use should be available at the Dehradun and District Headquarter locations*) - as internet connectivity can be disrupted in real-life disaster scenarios.

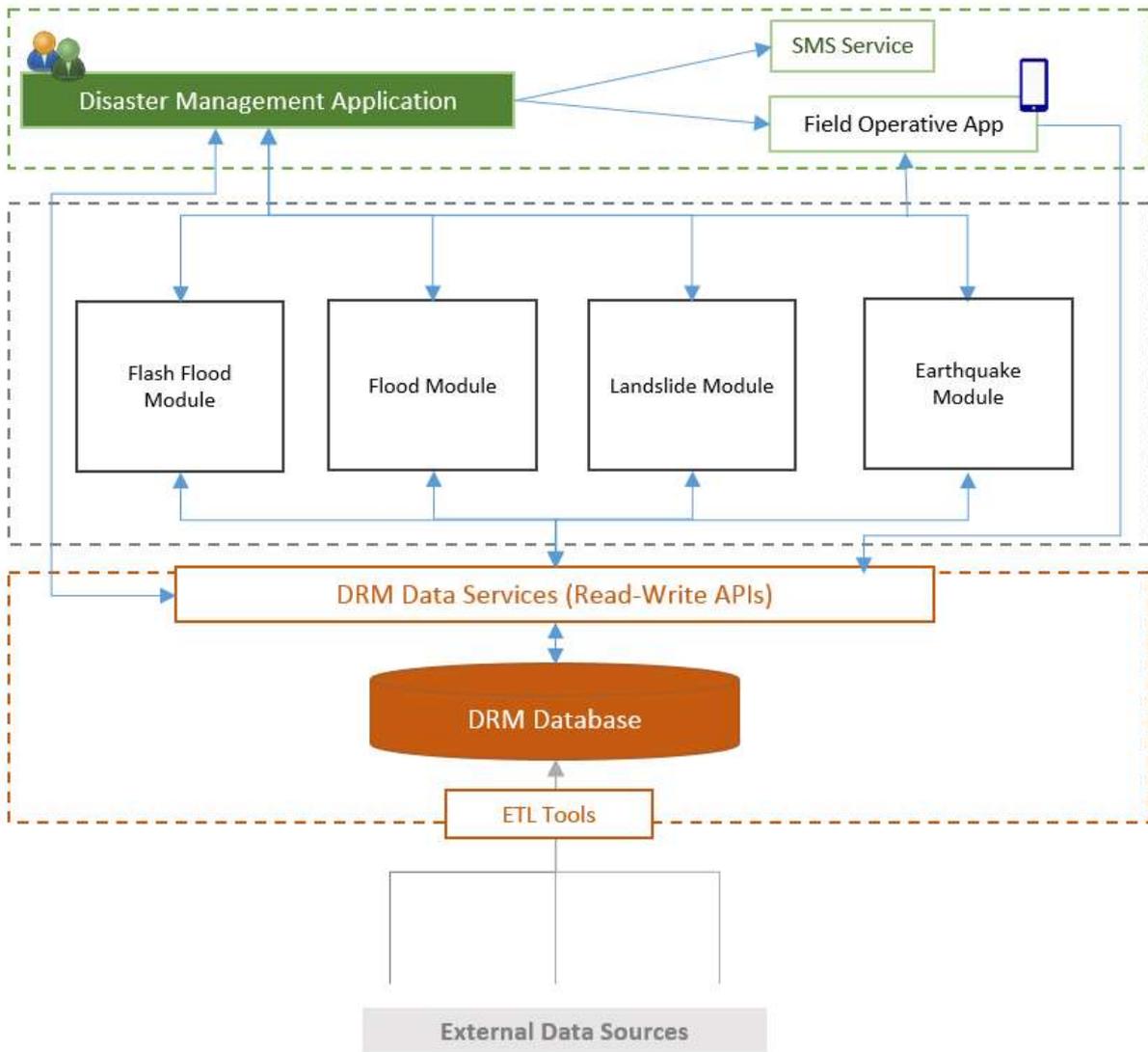
<ul style="list-style-type: none"> <li>● <b>Database</b> <ul style="list-style-type: none"> <li>○ Extract-Transform-Load (ETL) tools</li> <li>○ Disaster Risk Management Database</li> <li>○ Read-Write Application Programming Interfaces (APIs)</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● <b>Analytical Modules</b> <ul style="list-style-type: none"> <li>○ Flash Flood Module</li> <li>○ Flood Module</li> <li>○ Heavy rainfall monitoring</li> </ul> </li> </ul>

- Landslide Module
- Earthquake Module

- **End User Applications**

- Char Dham Tracking
- Disaster Management
- Field Operative Mobile App
- SMS/Cell broadcasting Service

A schematic representation of some of these components is given below. The selected consulting firm can consider and refine the architecture in consultation with stakeholders - keeping in mind that data services and modularity is a key component of the technical requirements to calibrate and expand the system over time with expanding data and user feedback. The firm will also develop the interface for linking the Forest Fire Monitoring System and logging in accidents (fire, road, industrial) and other emergencies under USDMA's purview.



While the consulting firm is expected to conduct a thorough needs analysis to define the tasks that will be available in various module, here is the initial set of requirements to iterate upon.

### 3.1 Design of the Modular DSS

In this phase, the consulting firm is expected to elucidate, assess, and analyze the needs and the available resources for the Modular DSS to lay out the plan, architecture, and requirements for the development of the system. This will be a consultative and iterative process for the firm to understand and appreciate the USDMA context and to provide USDMA with a comprehensible birds-eye-view of the project plan, system design, and deliverables. Note that the firm is expected to follow an agile methodology in this project

To accomplish this, the firm is expected to:

- Use participatory design to elaborate and prioritize the expected usage scenarios of the platform in (1) Providing forecasts and impact assessments (2) Managing resources

and routing (3) Collecting reports and disseminating alerts (4) Coordinating disaster preparedness and response (5) Integrating data and alerts from various sources

- Conduct in-depth consultation with USDMA, Disaster Mitigation and Management Center (DMMC), and Uttarakhand Space Application Center (USAC) to create an inventory of existing and expected data sources, datasets, data types, periodicity (and other metadata) that can be incorporated in the platform
- Conduct a thorough analysis of technologies and databases in use by USDMA, DMMC, and USAC - and importantly the databases and applications being developed through other components of the UDRP project mentioned above in Section 2, and explore cross-links and complementarity of systems and database.
- Conduct an analysis of network connectivity options, and device accessibility for the proposed users of this system (especially in remote areas)

### 3.1.1 Deliverables

- A comprehensive Project Inception Report that includes:
  - Project plan
  - Product roadmap and release plan
  - High-level system architecture and conceptual model
  - User profiles and personas, including their roles and tasks
  - High-level schematic of the assets, resources, and protocols involved
  - Key usage scenarios and associated low fidelity wireframes
  - Catalog of existing and proposed datasets for the system, data gaps
  - Data center and hardware requirement, and bill of material
  - Forecasting models to be used
  - Software requirements, and bill of material

### 3.2 Design and Development of Database

The consulting firm will design, develop, and operate a scalable and extensible database that will integrate **spatial** (GIS) and **non-spatial** data from multiple sources and will offer associated data services (read-write APIs) to be used by other modules and applications. It is critical to note that the database is expected to be scalable and extensible, in order to accommodate newer spatial / non-spatial data as it becomes available. In addition, the database needs to provide high-availability.

**Data sources** may include:

- Institutional sources of weather and disaster risk data, such as: IMD, NASA, ISRO, IITs, Forest department (Forest Fire Monitoring), etc.
- Institutional sources of hydro-meteorological and early warning data such as: Central Water Commission (CWC), Tehri Hydro Development Corporation (THDC), NASA Tropical Rainfall Measuring Mission (TRMM), etc

- Real-time weather data from Automated Weather Stations, Automated Rain Gauges, Snow Gauges, Doppler radars, Human Weather Operating Systems
- Real-time water discharge and high flood level data from river gauges installed by CWC, THDC and Irrigation Department
- Uttarakhand River Morphological Information System (URMIS)
- Uttarakhand Digital Risk Database (DRDB)
- UDRP Management Information System (MIS)
- Data from Uttarakhand Space Applications Center (USAC), National Remote Sensing Center (NRSC), IIRS, and BHUVAN
- Private Satellite Imagery providers
- Existing GIS layers and topographical data available with govt. departments
- Model outputs and results from the Risk Assessment and Morphology Analysis
- Mobile apps for field data collection
- LIDAR data and Digital Elevation Models (DEM) data
- Openstreetmap
- Incident reports from state and district level Emergency Operation Centers
- Disaster Helpline and Whatsapp
- Social Media
- UAV and CCTV data
- Traffic and transit data
- GPS tracker data

### 3.2.1. Deliverables

The consulting firm will deliver the following:

#### Design

- Requirement analysis and conceptual design of the database and data services
- Design of data model, logical design, physical design, and infrastructure design for the database and associated data center
- Development of data model for field data collection (including for resources, assets, facilities, and incident reports)

#### Development

- Development of ETL (Extract, Transform, Load) tools for datasets, as required
- Development and setup of the database
- Collation and integration of various datasets into the database
- Clearly documented metadata, and metadata management interface
- Deployment and setup of the hardware for the associated data center
- Development of APIs (Application Programming Interfaces)
- Development of administrative interface enabling users to upload new data, connect to data from online sources, manage and update metadata
- Integration of data services with analytical modules and applications

- Definition of the business continuity plan (BCP) for the database/data services
- Setup of the backup and recovery mechanisms per the BCP
- Detailed technical documentation of the database for system administrators
- Detailed technical documentation of the API for system developers
- Detailed training material for USDMA and line department staff in Uttarakhand

### 3.3 Design and Development of Analytical Modules

#### 3.3.1 Flash Flood, Flood, and Landslides Modules

##### Forecasting Component

- The firm should develop the most appropriate and calibrated forecasting models to process real-time meteorological, hydrological, and satellite data in conjunction with historical and baseline information to generate automated **flash flood forecasts, flood forecasts, and landslide forecasts for Uttarakhand**. The models should:
  - Provide reliable forecasts with sufficient lead time;
  - Have a reasonable degree of accuracy;
  - Meet data requirements within available data and financial means, both for calibration and for operational use;
  - Be simple enough to be operated by operational staff with moderate training
- The forecasts generated by the module should be classified based on their confidence levels, severity, and lead time
- The flood forecasts should include inundation areas, inundation depths, flood levels, arrival time, flood duration to be displayed spatially
- The forecast for landslide movement should include runoff area, probability of impact on habitation and infrastructure.
- The classified forecasts should be pushed and displayed in the *Disaster Management Application*
- The forecasts should serve as input to generate impact assessments

##### Impact Modeling Component

- This consulting firm should develop appropriate hydrological, hydraulic, environment, and economic models to assess impact of flash flood, flood, and landslide forecasts. These should be calibrated with historic data.
- The models should be automated to run and produce impact assessments for the alerts generated by the forecasting component
- The impact assessment should generate reliable spatial visualizations and estimates of the impact of emergent forecasts - including evacuation needs, building damage, loss to essential facilities, shelter needs, road closures, repair costs etc.
- The impact visualizations and reports should be pushed and displayed on the *Disaster Management Application*

### **‘What-If’ Component**

- In addition, the modules should enable users to run ‘what-if’ scenarios to estimate impact of flash flood, flood, and landslide situations for disaster preparedness

### **3.3.2 Earthquake Module**

#### Monitoring Component

- The consulting firm should develop tools to process near real-time earthquake feeds from USGS and IMD to generate geo-referenced earthquake alerts and reports
- The consultant firm should develop tools to process real-time or near real time earthquake feeds from earthquake early warning sensors installed by IIT, Wadia Institute to generate geo-referenced earthquake alerts
- The alerts should be classified based on intensity, recency, and proximity to habitations - and should include epicenter, magnitude, depth, ground motion, and intensity data
- The alerts should be pushed and displayed in the *Disaster Management Module*

#### Impact Modeling Component

- The consulting firm should develop tools to integrate the output of DRDB models to assess impact of earthquake alerts including: casualties, debris, building damage, loss to essential facilities, shelter needs, road closures, cost of building repair, economic impact, etc
- The models should be automated to run and produce impact assessments for the alerts generated by the monitoring component
- The impact visualizations and reports should be spatially visualized in the *Disaster Management Module*

### **‘What-If’ Component**

- In addition, these models should enable users to run ‘what-if’ estimates of earthquake impact for disaster preparedness

### **3.3.3 Deliverables**

For the Flash Flood, Flood, Landslide, and Earthquake modules:

#### Design

- Analysis report of available data, risk assessment, and existing early warning systems for selection of appropriate modeling methodologies and proposed lead times for various forecasts and impact assessment
- High-level and detailed architecture design - including data flows and interfaces
- Detailed documentation of the datasets, models, and methodology deployed
- List of models and tools being used and associated licensing requirements

#### Development

- Development and deployment of all modules listed above - including the models

- Development of integration interfaces / tools for the module to automatically pull input data from the *Disaster Management APIs* and push output data to other parts of the system
- Test cases, testing, and test results to ensure model verification and quality of forecasts
- Detailed technical documentation for developers
- Detailed operation and maintenance manual for end users
- Implementation guidelines for system administration
- Detailed training material for UDRP administrative staff in Uttarakhand

### 3.4 Design and Development of End-User Applications

#### 3.4.1 Disaster Management Application

This application will be the primary user interface for the operational needs of managing response and recovery from ongoing or impending disasters. This application may consist of multiple dashboards / screens providing a common operational picture and workflow to all departments and agencies involved in disaster response and recovery.

The consulting firm is expected to develop the application, which will include:

#### Weather and Char Dham Monitoring

- Base map providing pertinent risk, vulnerability, hazard, exposure, geographical, resources, infrastructure, elevation, and other pertinent layers
- Display real-time weather, precipitation, and forest fire data available from IMD, NASA, and Automated Weather Stations
- Display latest available satellite imagery for the disaster hit areas
- Provide satellite-based emergency mapping tools to users
- Enable users to import crowdsourced map data on to the base map
- Display latest hydro-meteorological data (for instance: water level, discharge, sediment flow) available from CWC and THDC
- Display latest earthquake feeds from USGS
- For the Char-Dham route, display location-specific CCTV feeds
- For the Char Dham route, display latest geo-tagged tourist population numbers
- Display latest traffic data from publically available sources, such as Google
- Display current location of specific *Field Operative App* users

#### Disaster Monitoring Features

- Display latest geo-tagged forecasts for flash floods, floods, and landslides generated by the corresponding modules
- Display latest geo-tagged alerts for earthquakes from the *Earthquake Module*
- Display latest disaster incident reports provided via the *Field Operatives App*
- Display latest user entered disaster incident reports (received from various sources, including Disaster Helpline, Wireless, Whatsapp, SMS, etc)

### **Disaster Assessment Features**

- For each forecast or alert for flash floods, floods, landslides, and earthquakes - enable users to view the results of the associated impact model on the map
- Enable users to run ‘what if’ scenarios to assess impact of flash floods, floods, landslides, and earthquakes

### **Resource Planning Features**

- Automatically suggest sites for evacuation / relocation for disaster impacted areas (based on impact assessment results)
- Enable users to run routing and resource analysis for impacted areas to plan rescue and relief efforts
- Automatically update status of mobilized resources, stocks and other inventories as well as status of remaining resources, stocks and inventories for decision making
- Enable user to issue directives and executive orders to the field staff online with digital signature of authority concern

### **Incident Reporting Features**

- Enable users to add and update geo-tagged incident reports on the base map. Users may receive these Incident reports may be via Disaster Helpline / Whatsapp / Wireless / SMS / e-mail
- Enable users to manually add road closures and alternative routes on the map
- Enable users to search and monitor geo-referenced social media feeds (Facebook / Twitter) and Google Crisis Maps in case of disaster situations
- Enable users to manually add tourist numbers along locations on Char Dham route

### **Relief Coordination Features**

- Enable users to analyze the demand and supply status or disaster relief equipment and resources
- Enable users to add features on the map representing temporary disaster relief infrastructure including: staging area, helibase, command post, helipads, relief camps, field hospitals, alternative routes etc.
- Enable users to update the status and location of resources / facilities
- Enable user to assign roles and tasks to specific personnel or teams, and track status
- Enable users to update the number of affected citizens at impacted locations and the status of their evacuation or relocation

### **Communication Features**

- Enable users to view and maintain contact details and locations of personnel involved in disaster management and relief / rescue efforts
- Enable users to push alerts or task assignments to specific personnel or groups of personnel via SMS and notifications of the *Field Operative Application*
- Enable users to view and respond to status reports coming in through the *Field Operative Application*

### 3.4.2 Field Operative Mobile Application

This Android and iOS based mobile application will offer critical features and tools to users in the field to send and receive critical information. The application should:

- Display latest geo-tagged disaster forecasts and alerts
- Display task assignments, and allow user to update their status
- Display location and status of critical disaster response facilities
- Enable user to send geo-tagged incident reports including text and images
- Identify critical evacuation points and routes in user's nearby areas
- Enable user to update status of disaster response resources
- Store and share the GIS track of the user for particular periods
- Enable user to stream the device's current GPS location

### 3.4.3 SMS/Cell broadcasting Services

- This component should enable the dissemination of forecasts and disaster alerts through SMS and cell broadcasting messages

### 3.4.4 Deliverables

#### Design

- Detailed requirement analysis for all end-user applications mentioned above
- Detailed user analysis - including personas and scenarios for all end-user applications mentioned above
- Detailed User Experience Design - including all use cases and screens across devices (desktop and mobile)
- High-level and detailed system architecture design all end-user applications mentioned above
- Technical specifications including interface details with other applications
- List of 3rd party tools being used and licenses

#### Development

- Development and deployment of all end-user applications mentioned above
- User acceptance test cases, testing, and test results for all end-user applications
- Quality assurance testing
- Detailed technical documentation for developers
- Detailed user documentation for end users
- Detailed operation manual for system administration
- Implementation guidelines and roll-out manual

### 3.5 Operation of the Modular Decision Support System

After completing development, deployment, and integration of all the components of the Modular DSS mentioned in this section - the consulting firm will be required to operate and maintain the decision support system for two years. This is a critical component as the USDMA recognizes that:

- A forecasting and modeling system of this nature will need iterative calibration and updates based on verification of the forecast and impact assessments against actual observations
- In real-life disaster scenarios - expert support may be needed to interpret forecasts and assessments in context of the available information at the time
- The user feedback of the DSS use in real-life disaster scenarios will need to be addressed over time to make the system more tuned to the needs of the state
- More datasets and data sources will be available overtime to improve the system, and the existing ETL tools may need to be fine-tuned
- The in-house capacity in USDMA to operate and maintain the system will need to be built up over time given the needs

### 3.5.1 Deliverables

#### Operational Plan

- Detailed operational plan describing service standards and plan for operations

#### Operation of the Database, ETL tools, and Data Services

- Ongoing maintenance and operation of the database, ETL tools, and APIs
- Updates to the database and APIs - including addition of new datasets
- Delivery of training, capacity building, and assessment of USDMA administrators
- Handover of database, ETL tools, and API operation to USDMA administrators

#### Operation of the Flash Flood, Flood Landslide, and Earthquake Modules

- Running models as required to meet decision support requests of USDMA to deal with active or emergent disaster scenarios
- Continuous calibration of the models with verification of forecasts and availability of additional datasets
- Ongoing maintenance and updates of the modules
- Delivery of training, capacity building, and assessment to enable USDMA staff to operate and maintain the models
- Handover of the operation of the modules to USDMA administrators

#### Operation of the Disaster Management Application, Field Operative Application, and SMS Services

- Ongoing maintenance and updates to the applications
- Continuous calibration of the applications with user feedback
- Capacity building of USDMA staff to operate and maintain the applications
- Handover of the operation of the applications to USDMA staff

## 4. Timeline

- The duration of this consultancy is **4 years**



- The design, development, and deployment of the DRM Database, Analytical Modules, and End-User Applications as part of the integrated Decision Support System should be accomplished in **24 months** after thorough testing. Here is a suggested timeline:

Modular Component	DSS	Deliverables	Period in Months (from contract signing date)
• High-level design		Refer section: 3.1.1	3 months
• DRM Database		Refer section: 3.2.1	6 months
• Flash Flood Module • Flood Module • Landslide Module • Earthquake Module		Refer section: 3.3.3	15 months
• Disaster Management Application • Field Operative Mobile App • SMS Services		Refer section: 3.4.4	24 months

- The operation services by the consulting firm will cover **two more years** after the deployment that will also include the knowledge transfer. Refer to section 3.5.1 for deliverables.

## 5. Technical Requirements

- Interoperability of data is a critical need for the platform - data formats and models should follow established international standards such as OGC standards for geo-data, allowing other developers to connect to data sources
- The Geospatial solution used must allow easy integration with Open Street Map and enable Satellite-Based Emergency Mapping
- As far as possible, the technology stack used in the development of the platform should be open source, and should allow future development and deployments with minimal proprietary software/architecture and licensing issues
- The platform should enable offline use at Dehradun and the District Level Disaster Management Authorities in case of loss of internet connectivity
- The consulting firm should recommend hardware sizing and configuration, networking specifications taking into account the number of concurrent users, desired response time, database sizes etc. This includes definition of back end servers, data

storage/volumes, network equipment, connectivity, and physical security requirements.

- The consulting firm should define the hosting needs along with connectivity options for high availability of the system and networking and bandwidth requirements.
- Since this platform will support critical, emergency services - the consulting firm should define the Business Continuity Planning requirements and constraints to ensure constant availability of the platform
- Software development activities should be conducted following industry best practices in secure code development as outlined in the OWASP Secure Coding Practices
- Consulting firm should provide for quality assurance and security testing of deliverables including providing evidence thereof to USDMA providing opportunity and dedicated environment for USDMA to complete their own QA & security testing as desired prior to acceptance of delivery.

## **6. Usability Considerations**

- As disaster and risk management are high-stress situations with large volumes of information adding to the cognitive load of the disaster managers/responders who need to make quick decisions – the user experience design for the user-facing application should be carefully considered for effectiveness in real crisis situation.
- The firm should develop a suite of data visualization tools for efficient analysis and reporting, and for issuing user-friendly public alerts for a range of hazards and emergencies.
- The design of the platform should consider the support for Hindi to ensure its usability - especially for users in the field

## **7. Knowledge Transfer**

- It is mandatory for the consulting firm to transfer the knowledge to the identified USDMA staff and officers with respect to the operation and maintenance of the Decision Support System.
- Prepare detailed training and capacity building plan for the users, implementation agencies, etc.:
  - Training plan: Develop training plan based on assessment of skill-gap analysis of USDMA/SEOC/DEOC staff (during requirement gather stage). Requirement for training will be assessed with the focus on end-user services and responsiveness
  - Training modules: Develop curriculum and courseware for variety of training modes like web based video libraries, self-learning, instructor led training etc. consultant should also list out the mode and associated infrastructure needs for successfully delivering the trainings for trainers, ICT staff, data entry agency, help desk and users,

- Manuals: Develop operations manuals including implementation and rollout plan, user manuals, training manuals and aids, etc. This will also include comprehensive process guidelines for rollout by third party implementers
- All source code and artifacts produced as part of this assignment should be provided to USDMA - which would have the right to re-deploy these as needed
- The USDMA shall have exclusive rights over all IP products and database generated under this consultancy assignment
- In every three month consultant will conduct training related to DRM Database Flash Flood, Flood, Landslide, and Earthquake Modules, End-user applications and Integrated DSS system.
- The number of participant in these trainings are 25-30 including USDMA staff ,SEOC/DEOC staff, Irrigation Engineering Staff and PWD staff.

### **8. Services and Facilities to be provided by USDMA**

The following support will be extended by the USDMA to achieve outcomes of the assignment:

- Appropriate production hardware for setup and deployment of system
- Facilitate data collection from government agencies in timely manner
- Appropriate open source software for setup and deployment of the production system . If the development not done in open source environment than consultant should provide life time licenses with upgrading facility to run the DSS module.
- Facilitate coordination with other government agencies for sourcing datasets, and provide access to existing systems and datasets available within USDMA
- Facilitate the availability of key staff/project team for discussions when needed and organize workshops to facilitate structured consultations.
- Facilitation of interaction and exchange of information with key stakeholders and ensuring linkages with other DRM components of the project as well as Government of Uttarakhand initiatives
- Office facilities, telephone, internet, computers, etc for installation and commissioning of the Modular DSS Decision Support System
- Hardware and space for the Data Center based on specifications provided by the consulting firm

### **9. Vendor Requirements**

- The consulting firm should have successful track record of designing, developing and operation of Flood Early Warning Systems / Decision Support Systems for Disaster Management / GIS systems for Disaster Management for three similar assignments in India or abroad in past five years.
- The consulting firm should have proven expertise of working with hydrometeorological data and forecasting models for floods for two similar assignments
- Vendors should include tentative bill of material for their proposed technical solution in their response to the RFP

- The consulting firm should have staff capacity to provide onsite operation and maintenance support at Dehradun for all components of the Decision Support System
- The key staff to be provided by the consulting for design and development are shown below.

Poistion	Man-Month	Qualification/ Experience
Team Lead	● 48	<ul style="list-style-type: none"> <li>● M.Tech/MCA/MBA from a premier institute.</li> <li>● 10 + years of experience in planning, designing, and managing Decision Support Systems / Early Warning Systems</li> <li>● Extensive knowledge of modeling tools and methodologies used for flood / earthquake / landslide</li> <li>● Experience in leading and managing application development projects</li> <li>● Demonstrable experience working on disaster risk reduction related projects in India</li> </ul>
Meteorologist	● 40	<ul style="list-style-type: none"> <li>● Advanced degree in Meteorology / Atmospheric Sciences or related disciplines</li> <li>● 5+ years of experience in developing and implementing weather models that use real-time data for forecasts and nowcasts</li> <li>● Experience of incorporating weather data from surface stations, satellites, and other real-time sources into weather models</li> </ul>
Flood Forecasting Expert	● 40	<ul style="list-style-type: none"> <li>● Advanced degree in hydrology / hydraulics / water management or related disciplines</li> <li>● 5+ years of experience in flood modeling and early warning system / GIS use</li> <li>● Extensive knowledge of hydrological and hydrodynamic modeling tools</li> <li>● Experience in statistical analysis of model performance and data quality control</li> </ul>
Seismologist	● 40	<ul style="list-style-type: none"> <li>● Advanced degree in geology / geophysics or related disciplines</li> <li>● 5+ years of experience in design and development of earthquake risk assessments</li> <li>● Extensive seismic research experience and familiarity with , and assessment of</li> </ul>

		remote sensing images
GIS Expert	<ul style="list-style-type: none"> <li>• 40</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced degree in GIS/Geology/IT or related disciplines</li> <li>• 3+ years of experience in design and development of GIS datasets and systems</li> <li>• Demonstrable experience of working with satellite data</li> <li>• Direct experience in development of hydrological applications, including flood inundation mapping</li> </ul>
User Experience Designer	<ul style="list-style-type: none"> <li>• 40</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced degree or certification in User Experience Design / Usability and related disciplines</li> <li>• 3+ years of experience in research and User Interface design for GIS based applications</li> <li>• Demonstrable experience in planning and conducting participatory design sessions</li> <li>• Demonstrable experience in designing mobile applications</li> </ul>
Database Expert (2 Nos.)	<ul style="list-style-type: none"> <li>• 80</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced degree in computer science / computer engineering or related disciplines</li> <li>• 5+ years of experience in database design and development - with a focus on Hydromet and GIS databases</li> <li>• Demonstrable experience in API development and management</li> <li>• Experience in integrating real-time data with decision support systems</li> </ul>
Application Developer(s) (2 Nos.)	<ul style="list-style-type: none"> <li>• 80</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced degree in computer science / computer engineering or related disciplines</li> <li>• 5+ years of experience in developing GIS based decision support applications - for desktop and mobile devices</li> <li>• Demonstrated experience in developing and managing Application Programming Interfaces</li> </ul>
Training and Documentation Expert	<ul style="list-style-type: none"> <li>• 40</li> </ul>	<ul style="list-style-type: none"> <li>• MBA or advanced degree in knowledge Management.</li> <li>• 5+ years of experience in designing, developing and delivering training for technical products/software</li> </ul>

		<ul style="list-style-type: none"><li>● Experience in using rapid e-learning tools to develop learning modules</li><li>● Demonstrated capability in developing technical documentation for complex technical products</li><li>● Capacity to deliver classroom training in English and Hindi</li></ul>
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