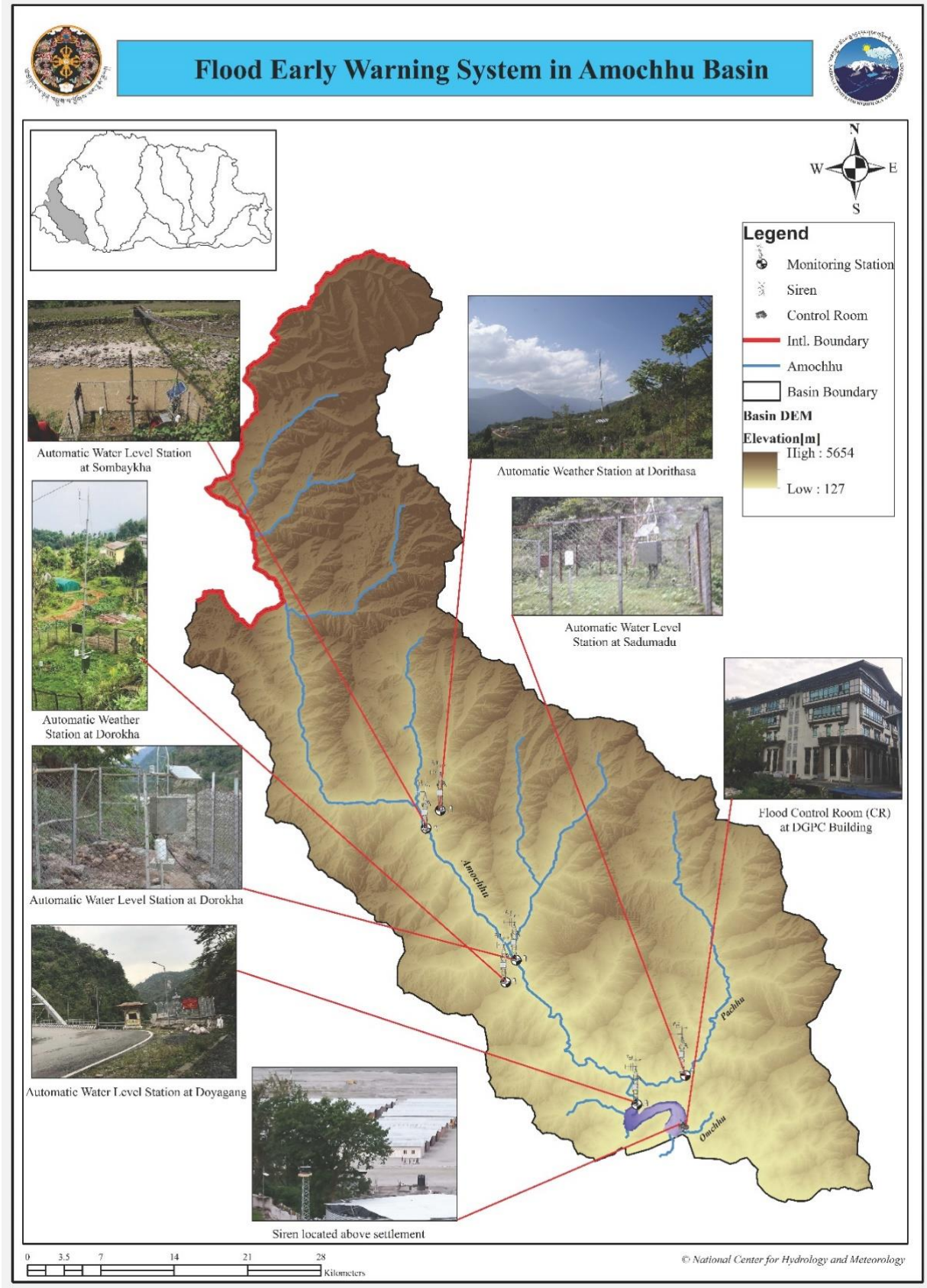
Final Report on
Installation of Interim Community Flood Early Warning System at Amochhu, Phuentsholing

National Center for Hydrology and Meteorology
Royal Government of Bhutan
Thimphu : Bhutan
May 2020

Target Area



(Amochhu Basin)

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Abbreviation

ADB	Asian Development Bank
AWLS	Automatic Water Level Station
AWS	Automatic Weather Station
CDCL	Construction Development Corporation Limited
CR	Flood Control Room
CST	College of Science and Technology
DCP	Data Collection Platform
DDM	Department of Disaster Management
DDMO	Dzongkhag Disaster Management Officer
DEM	Digital Elevation Model
DEOC	Dzongkhag Emergency Operation Center
DGPC	Druk Green Power Corporation
DOR	Department of Roads
EWS	Early Warning System
FCB	Food Cooperation of Bhutan
FEWS	Flood Early Warning System
FMCR	Flood Monitoring and Command Room
FWS	Flood Warning Station
GLOF	Glacial Lake Outburst Flood
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
HF Radio	High Frequency Radio
HQ	Head Quarter
LG	Local Government
MOHCA	Ministry of Home & Culture Affairs
NCHM	National Center for Hydrology and Meteorology
NDMA	National Disaster Management Authority
NEOC	National Emergency Operation Center
NWFWC	National Weather & Flood Warning Center
ORG	Ordinary Rain Gauge
PTDP	Phuentsholing Township Development Plan
RADAR	Radio Detection And Ranging
RBA	Royal Bhutan Army
RBP	Royal Bhutan Police
RH	Relative Humidity
RIGSS	Royal Institute for Governance and Strategic Studies
SAARC	South Asian Association for Regional Cooperation
SMS	Short Messaging Service
SOP	Standard Operating Procedure
STORM	Severe Thunderstorm Observation and Regional Modelling
UNISDR	United Nations International Strategy for Disaster Reduction
VHF	Very High Frequency
WFCR	Weather Forecasting Control Room
WFR	Weather Forecasting and Research model
YDF	Youth Development Fund

1. Background

The immediate installation of warning system for Amochhu settlement was commanded by His Majesty to High Level COVID-19 Task Force to warn community (evacuated from Jaigoan) of flood, who will be settled in the shelters under construction on the Amochhu river banks. The High Level COVID-19 Task Force directed NCHM to install the Flood Early Warning System (FEWS) as soon as possible. NCHM management started working instantly with preparation and planning to install the system with the available spares in stock and market. NCHM presented the design and plan for the FEWS to the High Level COVID19 Task Force on 23 April 2020 at RIGSS, Phuentsholing. NCHM constituted the following six Technical Teams to expedite the installation work-based on the NCHM Technical Team meeting held on 26 April 2020. The teams were immediately deputed to sites

a. Advisory Team
b. Planning and Design Team
c. Hydrological Survey, Modelling and Hazard Mapping Team
d. Flood Control Room (CR) and Communication Setup Team
e. Enhancement Observation Station Team
f. System Development Team

Figure 1: Temporary Shelter built at Amochhu bank, Phuentsholing

1.1 Amochhu Catchment

The River Toorsa, known as the Amochhu in its northern reaches, flows out of Tibet into the Chumbi Valley through western Bhutan before broadening near Phuentsholing and then flowing into India (Figure 2). The river has its source on Mount Pauhunri (7,128 m) in China. The catchment area at Doyagang Hydrological Station at Amochhu bridge (Phuentsholing-Samtse highway) is around 3304 km^2.

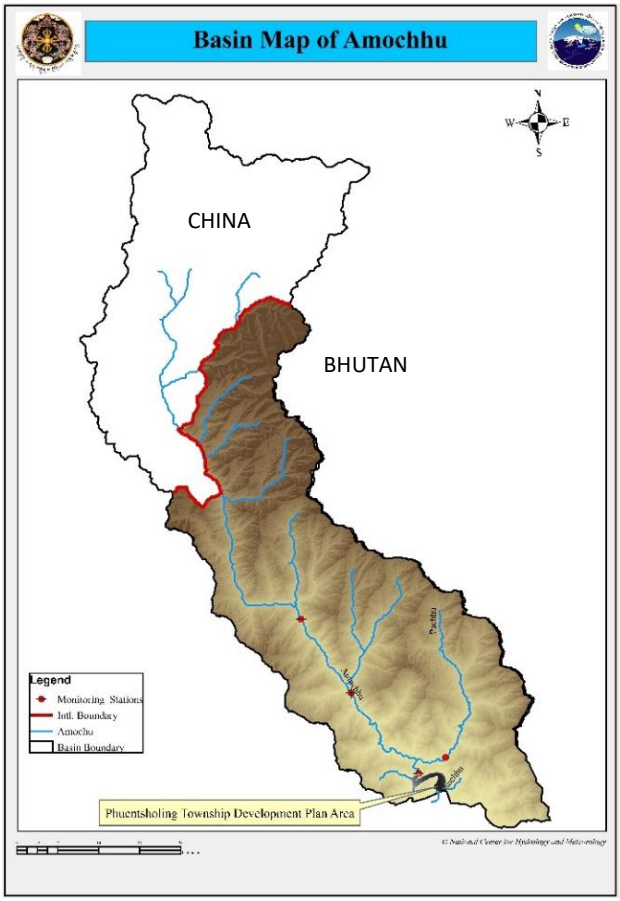


Figure 2: Amochhu river catchment area

1.2 Flooding Problem

Flooding in southern Bhutan are regular phenomena during the monsoon due to heavy precipitation and fragile geology. Major past flooding in Phuentsholing area occurred due to incessant rainfall in June 1990, Omchhu flood due to heavy rainfall on 2-5 July 1991, Omchhu and Barsachhu flood in August 2000, Cyclone Aila flood in May 2009 and heavy rainfall flood in July 2016. Flooding caused damages to infrastructure and industrial area as most of the settlements, infrastructure and industries are located in the flood plains.

The average annual rainfall is about 4000 mm at Phuentsholing. The annual rainfall decreases with the increase of the catchment elevation. The high amount of annual rainfall over the southern foothills causes numerous hydro-meteorological disasters due to flash flood and landslides.

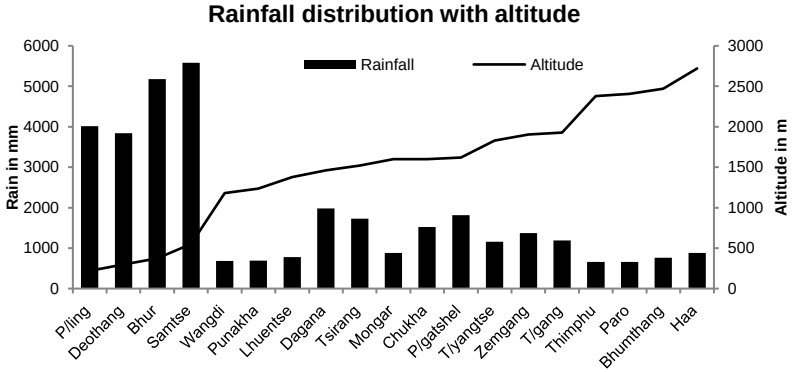


Figure 3: Annual rainfall distribution with altitude

2. Planning and Designing of Flood EWS

Planning and design of the of FEWS was done in close coordination with DDM, Phuentsholing Township Development Plan (PTDP), CDCL and Phuentsholing Thromde.

Work plan of NCHM for installation of Interim Community based Flood Early Warning System (FEWS) for Amochhu Settlement was presented to High Level COVID-19 Task Force on 23 April 2020, RIGSS.

Table 1: NCHM Work plan for installation of Flood EWS at Amochhu

Sl. No	Activities	Apr-2020		May-2020		
		3rd Wk	4th Wk	1st Wk	2nd Wk	3rd Wk
1	Aerial field survey and hazard mapping and analysis maps					
2	Installation of communication system (HF) at CR, Doygang Station and Dorokha)					
3	Set up facilities for Flood Control Room at DGPC building with basic communication system with upstream (Dorokha and Doyagang stations operational					
4	Testing and commissioning of Flood EWS + Warning sirens					
5	Training of CR operator					
6	Formulation of SOP					
7	Education and awareness for LG and vulnerable communities by NCHM, DDM and LG on Flood EWS	This will be done after settlement				

3. Components of Flood EWS

The interim FEWS at Amochhu consists of 4 important components of the Early Warning System (UNISDR, 2006 checklist) as follows;

a. Hazard and Risk Knowledge
b. Monitoring and Warning Services
c. Communication and Dissemination
d. Response capability (In coordination with DDM)

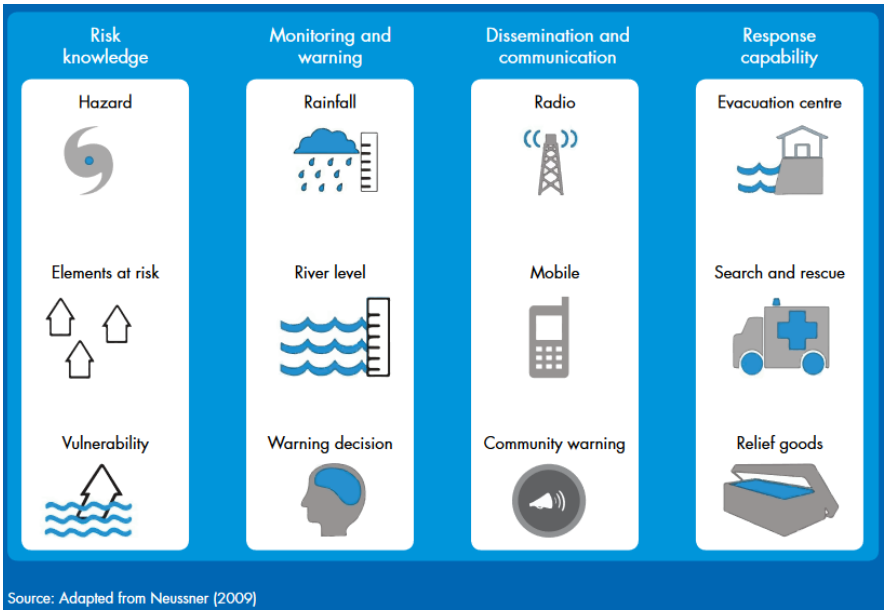


Figure 4: Components of monitoring and warning services

4. Hazard Mapping and Risk Knowledge

One of the main components of the FEWS is the hazard mapping. The hazard mapping of the Amochhu settlement area included the following activities.

4.1 Area Survey

Hydrological Survey, Modelling and Hazard Mapping Team carried out the aerial survey of Amochhu river banks from 22-23 April 2020 by using drone from downstream international border (India-Bhutan border) to upstream Doyagang Hydrological Station located at Phuentsholing-Samtse Highway bridge. The aerial survey of Omchhu (Dhotikhola) is also carried out for hazard mapping. The images are processed for generation of DEM and to create flood hazard maps based on the flood frequency analysis for different flood return periods to set up the threshold value (Alert and Alarm) at Doyagang station.

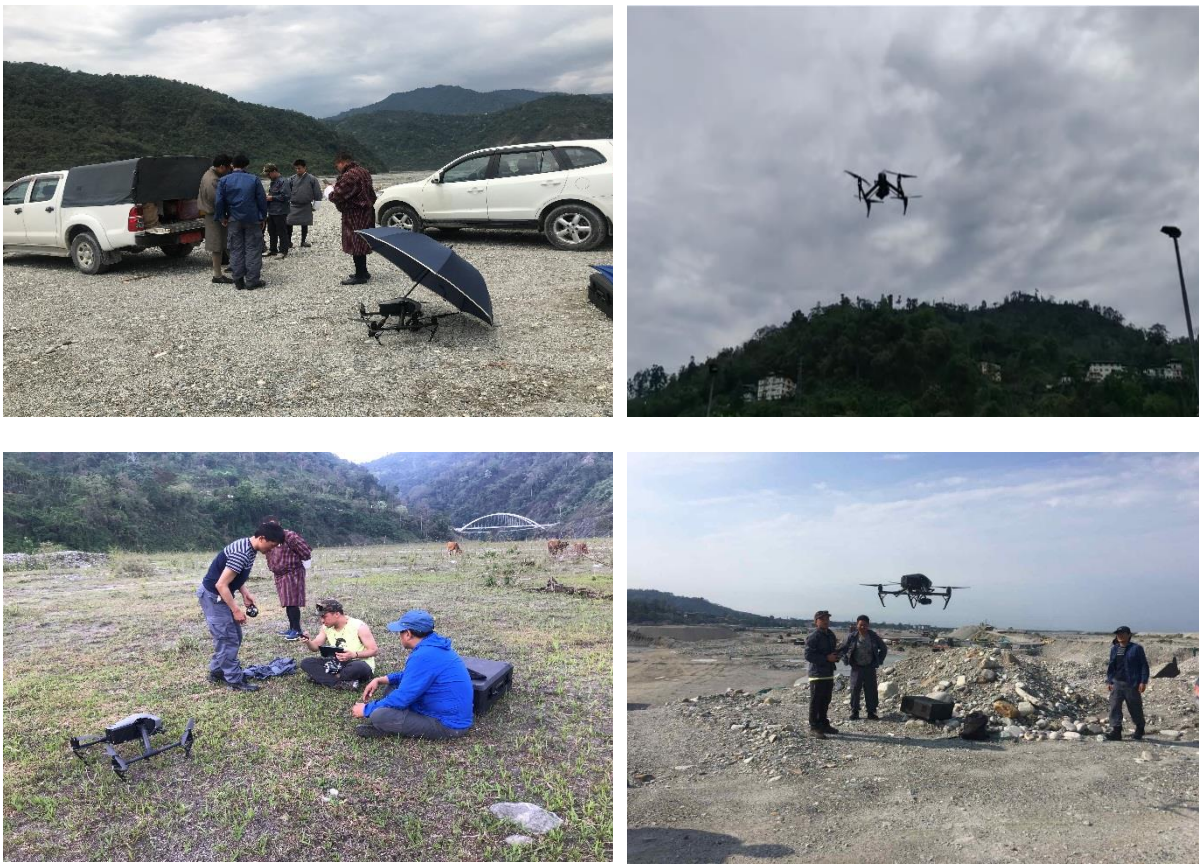


Figure 5: Survey team carrying out the aerial survey using drone

4.2 Hydrological Modelling and Hazard Mapping

The images collected from the aerial survey are processed using the Agisoft tool. The Digital Elevation Model was generated from the aerial image. Hydrological model HEC-HMS was used for inundations map based on flood frequency analysis of different return period and past flood events.

The flood frequency analysis was done for 2,5,10 and 20 years at the Doyagang station on Amochhu at Amochhu bridge. Accordingly, the thresholds, Alert and Alarm was set at 5 meters and 7 meters respectively at Doyagang station.

For the observation and viability , the water level marks with threshold of Alert and Alarm were painted yellow and red respectively at the abutment of the Doyagang bridge of Phuentsholing – Samtse highway.

Table 2: Water level based on the flood event and hazard map at Doyagang monitoring station

Return period (Years)	Flow (m3/s)	Water level (flood model)
2	1055	4.91
5	1556	5.82
10	1886	6.38
20	2204	6.87
50	2557	7.29

Table 3: Thresholds of ALERT and ALARM at Doyagang Station defined as of May 2020

Station	Alert Level	Alarm Level
Doyagang	**5.0 m**	**7.0 m**

Note: The above thresholds are subject to change depending on the physical changes at the monitoring station**.**

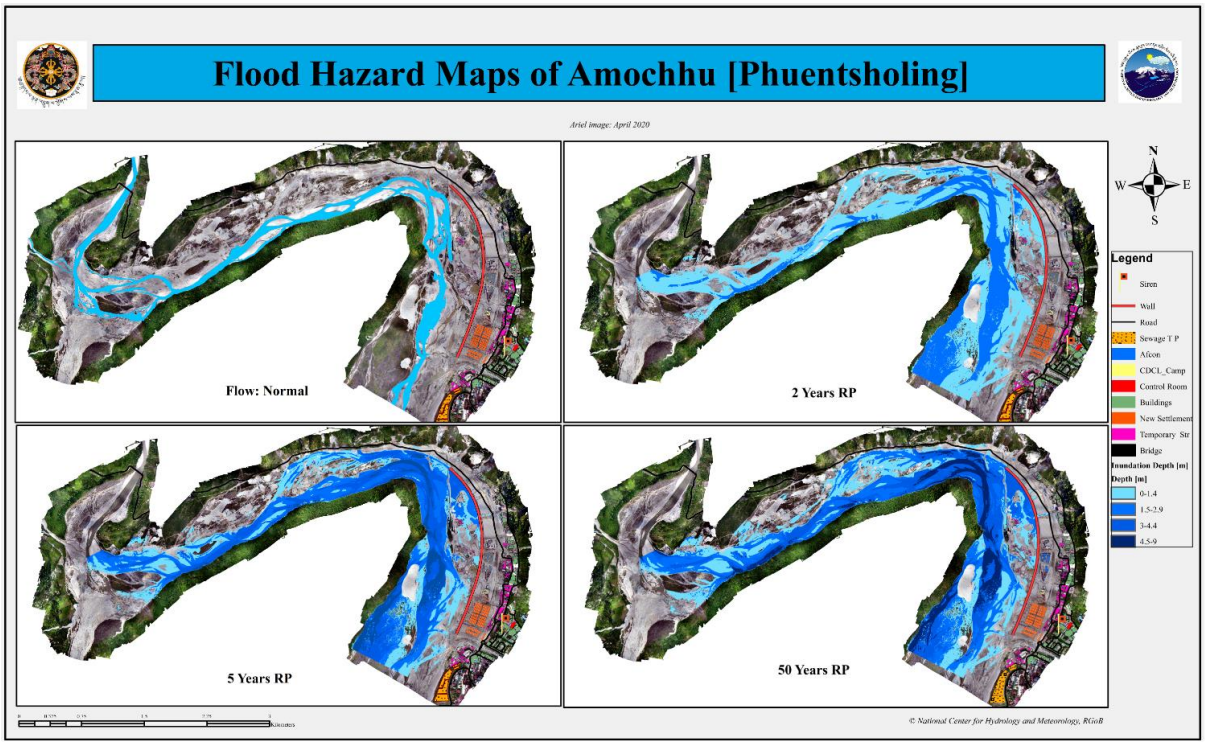


Figure 6: Flood hazard map of Phuentsholing Township Development Plan for 2, 5 and 50 years return period

4.3 Omchhu river hazard mapping

The Amochhu settlement area has a history flooding in the past due to swollen and overflowing Omchhu river due to heavy precipitation. Therefore, the aerial survey was also carried out along the Omchhu river for hazard mapping. Since there was no gauge station located in the Omchhu river, the rainfall events from the past that caused flooding from Omchhu river were considered to generate the hazard map (Figure 7).

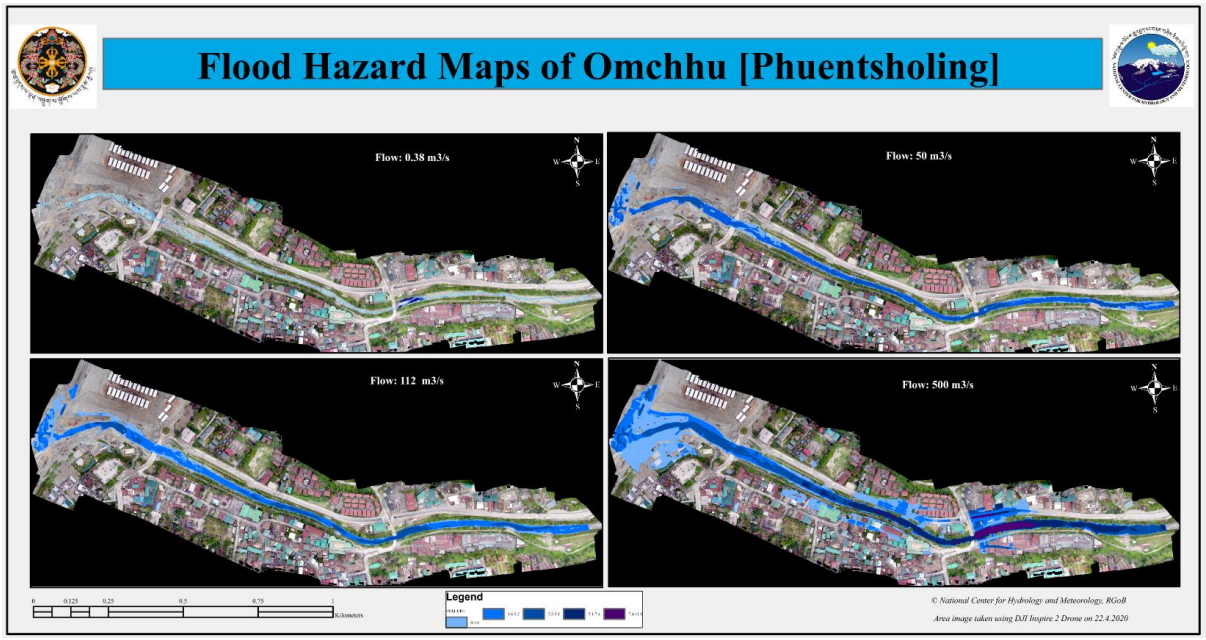


Figure 7: Omchhu flood hazard map based on different flow simulation

5. Monitoring and Warning System

One of the main components of the FEWS is the monitoring station, control room operation and warning system. Following activities were carried to enhance the monitoring station, set up control room and communication system at Amochhu.

5.1 Enhancement of Hydro-met monitoring Stations

As an interim FEWS, NCHM used the existing monitoring stations from Amochhu Basin. There are 6-existing hydro-met stations located within upstream of Amochhu, which are operational and linked for the flood warning purposes. Detail of the stations that are used for monitoring network is shown in the table below:

Table 4: List of Hydro-met stations to be used for flood EWS

Sl. No.	Station Name	Dungkhag/Dzongkhag	Parameter to used	Remarks
A	**Meteorological Station**			
1	Dorithasa AWS, Sombaykha	Sombaykha/Haa	Rainfall, temperature, humidity	Automatic Weather Station (AWS)
2	Dorokha AWS	Dorokha/Samtse	Rainfall, temperature, humidity	Automatic Weather Station (AWS)
B	**Hydrological Station**			
3	Sombaykha AWLS on Amochhu	Sombaykha/Haa	Water level, rainfall, temperature.	Automatic Water Level Station (AWLS)
4	Dorokha Flood Warning Station/AWLS	Dorokha/Samtse	Water level, rainfall, temperature	Manual Flood Warning Station New AWLS installed
5	Sadumadu AWLS on Pachhu	Phuentsholing/ Chhukha	Water level, rainfall, temperature	Automatic Water Level Station (AWLS)
6	Doyagang Principal Hydrological Station with AWLS	Phuentsholing/ Chhukha	Water level, flow, rainfall, temperature	Manual/Automatic

Rehabilitation and major maintenance of all the monitoring stations were carried out to be used for EWS. New AWLS were installed at Dorokha and Doyagang Hydrological Station that transmit real time data to Control Room.

The monitoring stations transmit data to National Weather and Flood Warning Center (NWFWC), Thimphu via GSM/GPRS. From NWFWC, Thimphu to the Flood Control Room, Phuentsholing data are exchanged via internet.

The detail activities carried out to enhance the monitoring stations are as follows;

5.1.1 AWLS at Dorokha

AWLS station at Dorokha had problem to communicate with the server at NWFWC, Thimphu. Therefore, a new AWLS was installed at Dorokha about 600 m upstream from the old Flood Warning Station. The AWLS is installed at new location due to river diversion work carried out. Details of station location is given below.

- Altitude 500 meter above sea level,
- Latitude 27° 1’ 9.99” N
- Longitude 89° 13’ 4.89” E

Figure 8: Location of Dorokha, Old and new monitoring station site and FWS office.

The new site selection was done based on the following criteria;

1. Single channel and river bed were stable.
2. Smooth river flow for about 100 m upstream
3. Easy access for sub-daily reading and maintenance work.
4. Access to network connectivity (GSM/GPRS).

New AWLS at Dorokha

Dorokha HF Communication Room

Summer Manual Gauge

AWLS and Manual Winter Gauge

Figure 9: Dorokha monitoring station and FWS site office pictures

5.1.2 New AWLS Radar at Doyagang

A new AWLS Radar type was installed on Amochhu Bridge at Doyagang. With prior approval from the Department of Roads (DoR), a communication system was set up on the concrete base left bank of Amochhu bridge. A radar sensor was installed on the bridge about 56 meters away from the station.

Location details:

- Altitude 508 meter above sea level,
- Latitude 26° 53’ 9.54” N
- Longitude 89° 20’8.78” E

Figure 10: Location of Doyagang Station

New AWLS on Amochhu Bridge

Radar sensor facing water placed on Amochhu Bridge

Concrete base near bridge for ALWS setup

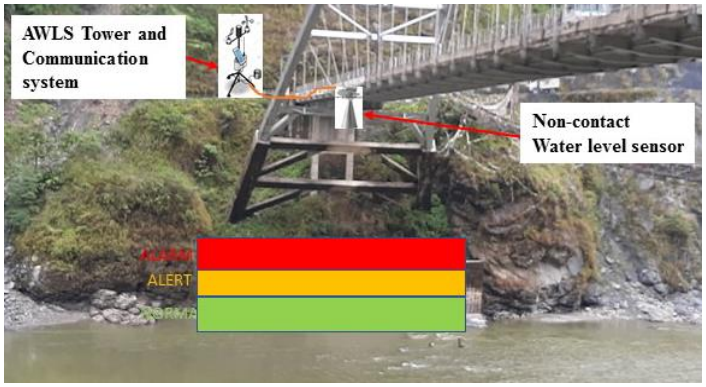
Field work for installation of AWLS at Doyagang

Figure 11: Doyagang AWLS radar location and manual flood gauge

5.1.3 Manual Flood Gauge Painting at Doyagang Bridge

Based on the threshold defined for Alert and Alarm water level from the Flood Hazard Map, the flood gauge was painted at the abutment located of the left bank of the Amochhu bridge at Doyagang. Three colour band was painted, Green, Yellow and Red for Normal, Alert and Alarm respectively.

Painting of Manual Flood Gauge



Location of AWLS and Flood Gauge at Doyagang bridge

Figure 12: Manual Flood Gauge at Amochhu Bridge

Location details:

- Altitude 508 meter above sea level,
- Latitude 26° 53’ 9.54” N
- Longitude 89° 20’8.78” E

The flood gauge threshold set at Doyagang bridge are as follows;

Station	Normal	Alert Level	Alarm Level
Doyagang	**<5.0m**	**5.0 m**	**7.0 m**

Note: The above thresholds are subject to change depending on the physical changes at the monitoring station**.**

5.1.4 Manual Flood Gauge Painting at Omchhu Bridge

The aerial survey was carried out for the Omchhu river and flood hazard map was generated based on the historical flood event and rainfall intensity. Accordingly, the water level threshold was calculated for setting up the manual flood gauge at Omchhu bridge.

Location details:

- Altitude 195 meter above sea level,
- Latitude 26° 51' 58.46" N
- Longitude 89° 22' 34.02" E

The gauges were fixed by carrying out the river cross-section. The gauge height graduation and marking were done on the bridge foundation wall and threshold levelling was marked with different colour viz: **GREEN** for **Normal**, **YELLOW** for **Alert** and **RED** for **Alarm.**

Station	Normal	Alert Level	Alarm Level
Omchhu Bridge	**<3.5m**	**3.5 m**	**5.0 m**

Figure 13: Location of Manual Flood Gauge at Omchhu

5.1.5 Maintenance of AWLS and Manual Gauge station at Sadumadu

Sadumadu is located at the upstream of the Pachhu and is one of the monitoring stations for FEWS for Amochhu

The Technical Team visited the Sadumadu AWLS and manual gauge station for rehabilitation It was observed the bubbler heads were exposed due to the diversion of the river flow to construct access road for the loggings. There was no data transmission from AWLS to server, HQ, Thimphu.

Location details:

- Altitude 360 meter above sea level,
- Latitude 26° 54' 28.20"N
- Longitude 89° 22' 37.59"E

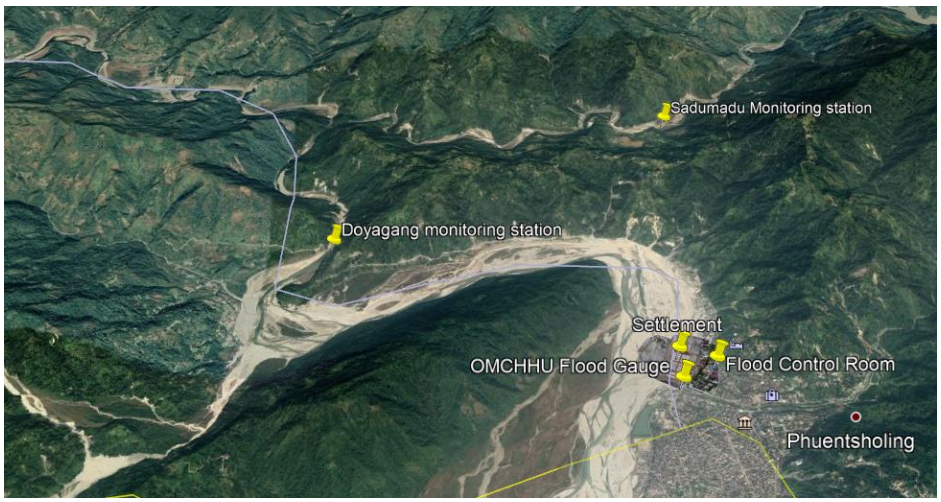


Figure 14: Location of Sadumadu monitoring station at Pachhu

Following activities were carried out at Sadumadu monitoring station;

a. New Manual Gauge post was installed, painted and marked the graduation readings with gauge plates.

b. The bubbler heads were cleaned and shifted to the suitable site.

c. The overgrown vegetation around the station were cleared and equipment were cleaned.

d. The data transmission problem was solved and the data reporting to the server, HQ.

Figure 15:AWLS and new manual gauge station installation at Sadumadu

5.1.6 Installation of Class C station at Doyagang

New manual Class C station was installed near the Doyagang Site Office. The meteorological station will be monitored by the Doyagang staff who will be working 24/7 in shift. The basic weather variable includes rainfall and temperature observation. The data will be used for the validation of the hydrological model and also to validate the new AWLS data installed near the Amochhu bridge.

Location details:

- Altitude 285 meter above sea level,
- Latitude 26° 53' 10.76"N
- Longitude 89° 19' 58.15"E

Figure 16: Location of Manual Class C station at Doyagang

Field works carried out for Class C Met station at Doyagang;

a. Earth excavation works and concreting for the foundation of the screen box stand and ordinary rain gauge (ORG) and.

b. Installed screen box (thermometer) and ORG.

c. Trained Doyagang field staff for taking manual observation, recording in daily log book and basic maintenance work.

Figure 17: Installation of Class C station work and training site staff at Doyagang

5.1.7 Maintenance of Rinchending AWS station

Automatic Weather Station (AWS) located at premises of College of Science and Technology (CST), Rinchending, Phuentsholing was installed under the SAARC STORM Program in 2014 but found that data are not reporting New AWS additional sensors and data logger of MICROSTEP was installed on the old AWS tower. Currently, the data is reported from the Rinchending AWS.

Location details:

- Altitude 418 meter above sea level,
- Latitude 26° 51' 3.06"N
- Longitude 89° 23' 30.95"E

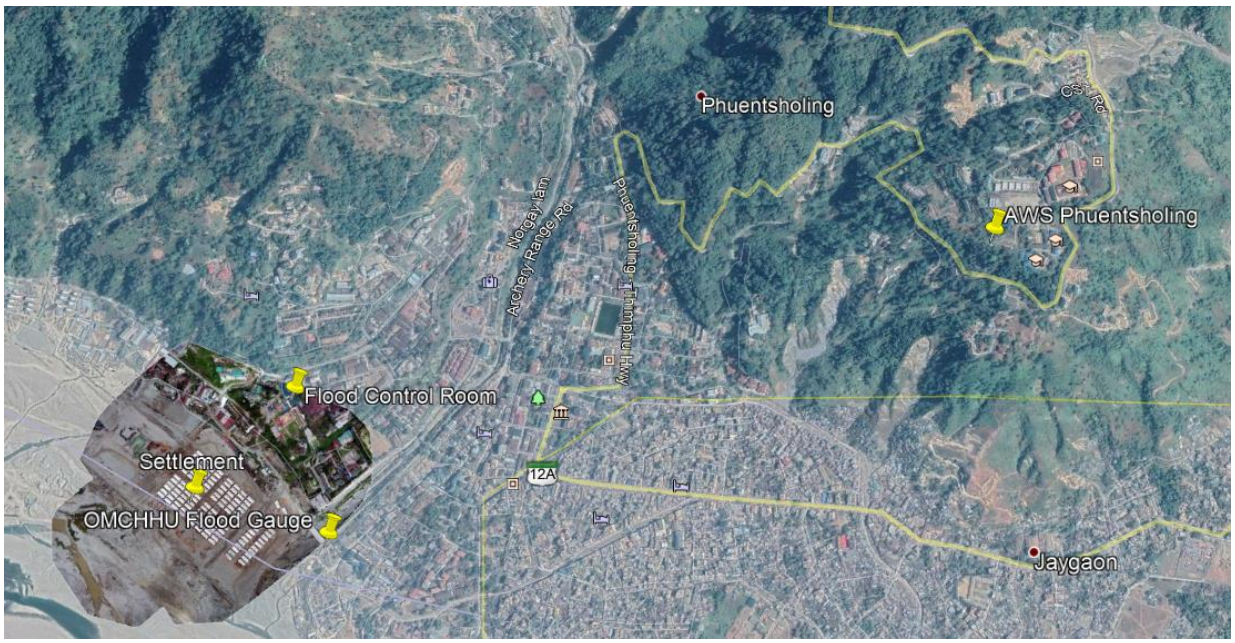


Figure 18: Location of AWS at Rinchending, Phuentsholing

Field works carried out at Rinchending AWS;

a. Wind Sensor arm, ARTH/Solar radiation sensors arm and clamps for DCP box were fabricated to mount MicroStep MIS on existing AWS tower.
b. Sensors, data logger and other accessories were installed.
c. Sensors and communication were tested and verified.

Figure 19: AWS at Rinchending with additional sensors and accessories from MICROSTEP

5.1.8 Maintenance of AWS at Dorithasa

The AWS located at Dorithasa was maintained and made operational. The relative humidity sensor was changed and rectify the problem. Team also cleared overgrown vegetation surrounding of the station and maintained AWS equipment (Sensors, solar panel, DCP, battery checking etc.,).

Location details:

- Altitude 1760 meter above sea level,
- Latitude 27° 8' 39.96"N
- Longitude 89° 9' 6.75"E

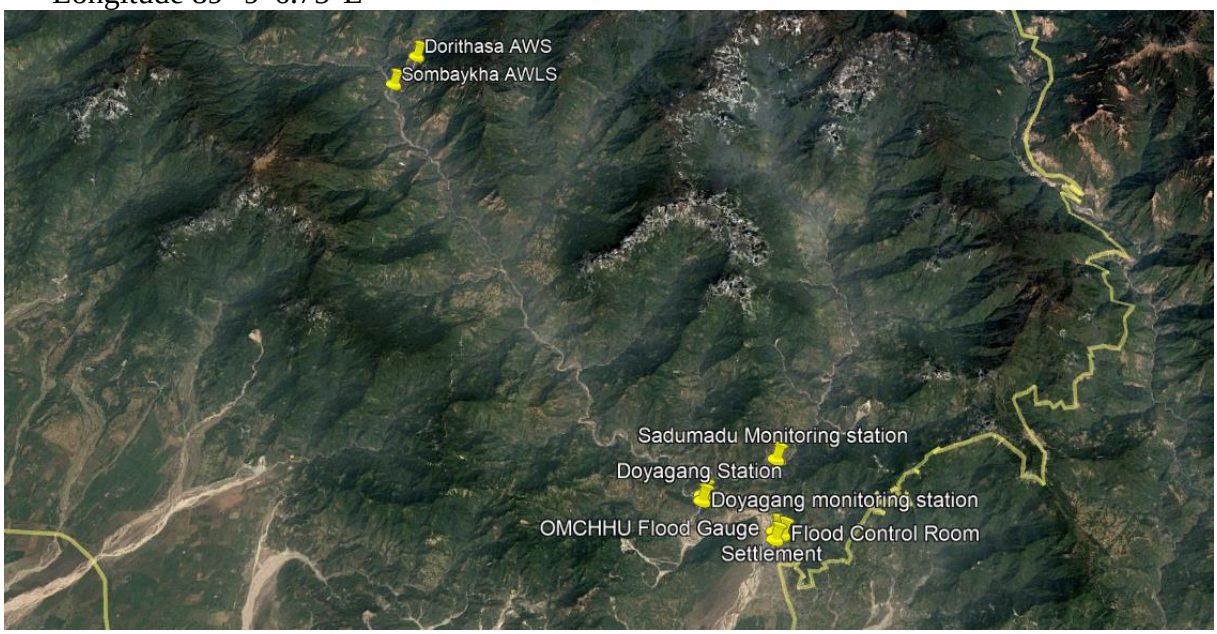


Figure 20: Location of Dorithasa AWS and Sombaykha AWLS station

Figure 21: AWS located at Dhorithasa

5.1.9 Maintenance of AWLS at Sombaykha

The AWLS station was not transmitting data. The Technical Team visited the site and rectified the problem . All the sensors were replaced and the whole system was configured and made functional.

Location details:

- Altitude 825 meter above sea level,
- Latitude 27° 7'52.28"N
- Longitude 89° 8'12.76"E

Following were the activities carried out at Sombaykha site;

a) Replaced the data logger, modem & RADAR sensor and configured the whole system.

b) Cleared the overgrown bushes, grasses around the stations and cleaned the all the equipment

c) Repainted the manual gauge posts

d) Re-calibrated water level reading of AWLS with that of manual gauge

e) The station was configured and threshold levels was setup.

Figure 22: AWLS location and maintenance work at Sombaykha

The station has started transmitting the data to the server. SMS Alert will be automatically send to Control room when the water level has exceeded 4 meter (alarm level).

5.1.10 Flood Control Room and Communication Set up

NCHM team completed the setting up of Control Room with basic communication within the deadline. As an interim Flood Control Room (CR) for operation and flood monitoring with dedicated communication facilities was established at newly constructed Druk Green Power Corporation (DGPC) building near the FCB Auction Yard. The use of space in the DGPC building was requested by COVID-19 Task Force. CR is operated 24/7 with staff on shift duty. The CR would serve as data and information exchange between upstream monitoring stations in the basin, National Weather and Flood Warning Center (NWFWC), Thimphu, Local Government (Chhukha Dzongkha, Phuentsholing Thromde) and vulnerable communities.

The CR receives data manually or automatically from all monitoring data including stations status. The data status will be recorded and displayed on the monitoring screen on regular interval. The CR shall be in operation 24/7 during the monsoon (May to October).

Figure 23: Flood Monitoring Control Room located at DGPC Building, Phuentsholing

CR is equipped with various modes of communication facilities (HF radio, VHF handset, fixed phone line, mobile phone) to enable CR to communicate with flood monitoring stations, NWFWC, Thimphu and Dzongkhag/Thromde (community) for flood information and emergency operation. CR will also operate the warning sirens during the emergency for evacuation.

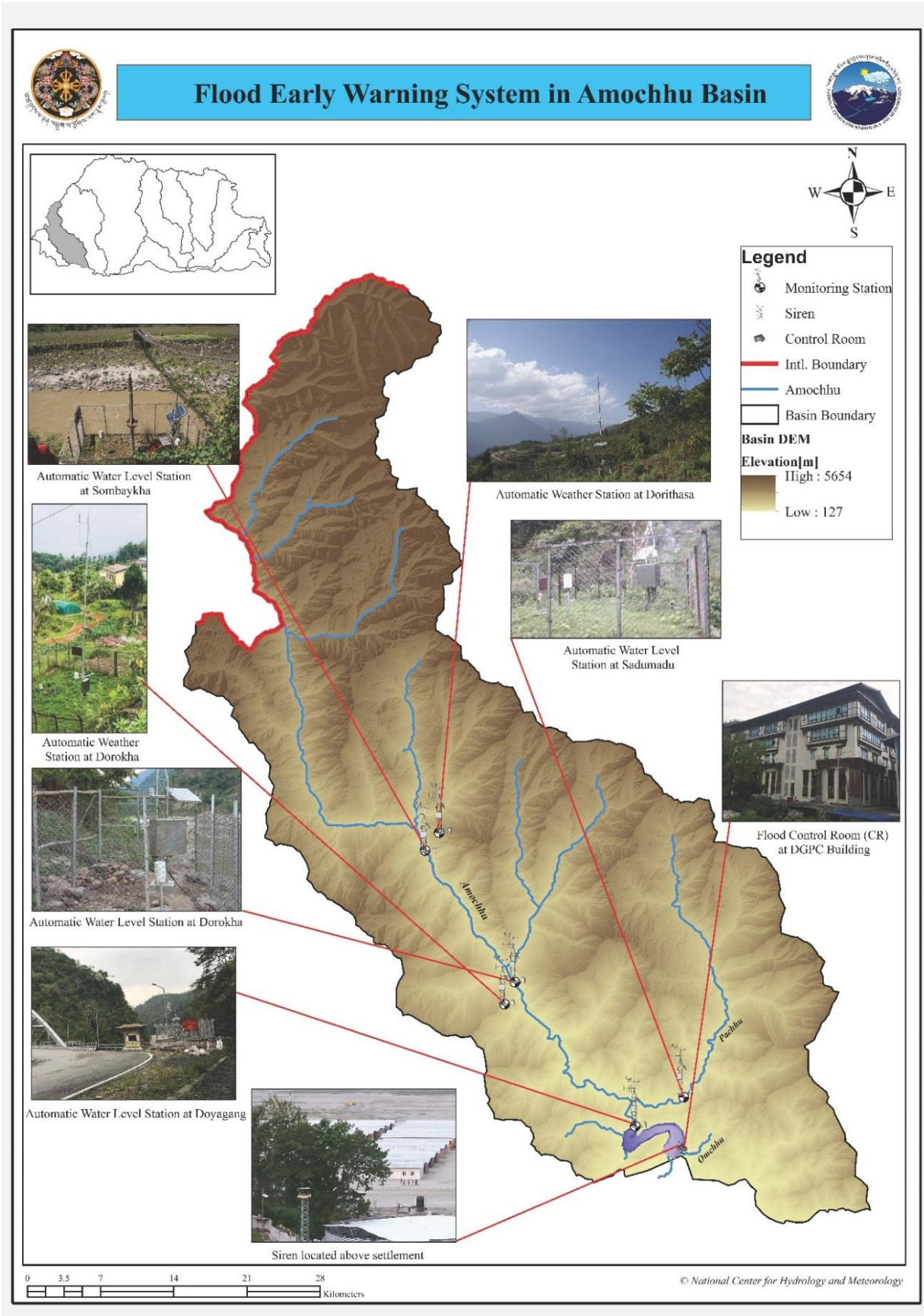


Figure 24: Location of the Flood EWS monitoring stations, CR and Siren in Amochhu river

5.1.11 *Lhapsang Thrusel* of Flood Control Room

Coinciding with good *Zakar*, NCHM conducted a simple *Lhapsang and Thruesel ceremony* of the newly set up Flood Control Room, Phuentsholing in the early morning on 10 May 2020.

Figure 25: Inaugural of the new Flood Control Room at Phuentsholing

6. Communication and Dissemination

Communication is the backbone for any Early Warning System. Therefore, FEWS at Amochhu is equipped with dedicated fixed telephone line, internet leased line, mobile phone and HF radio communication.

The scheduled data transmission from automatic monitoring stations are done via GSM/GPRS network to NWFWC, NCHM, Thimphu that can be visualized at the CR via internet.

The dedicated HF radio backup communication system would be used to communicate between CR and upstream monitoring station at Dorokha and Doyagang. VHF radio handset would be used to communicate with Thromde disaster focal point, CDCL and RBP post.

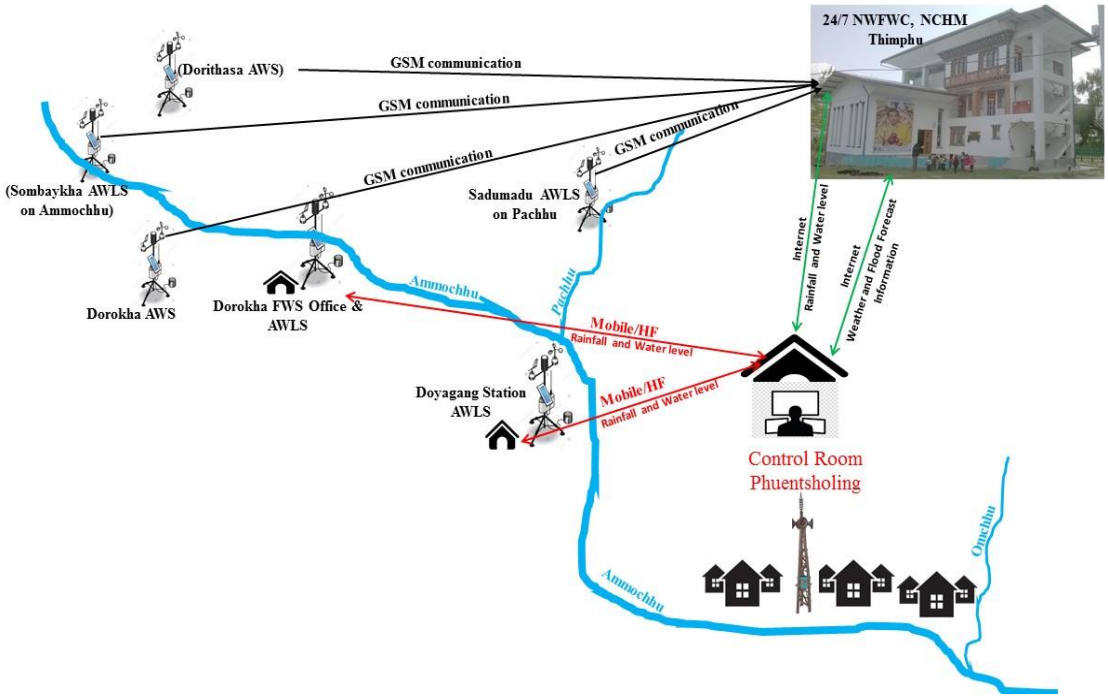


Figure 26: Systematic diagram of the monitoring stations and mode of communication used for data transmission

6.1 Siren for information dissemination

A manually operated outdoor siren was installed in front of DGCP building facing Amochhu settlement area for flood warning. The voice broadcasting system (trumpet horn) was also installed in the settlement area for further dissemination of information and warning.

Siren will be manually activated when the water level reaches to **ALARM** level.

Figure 27: Siren installed for dissemination of flood warning information.

6.2 Flood arrival time

The flood arrival time is a lead time for the residents to evacuate to the safer area. Flood arrival time was estimated based on flood simulation result using hydrological model.

When a flood peak is detected at the Sombaykha station, it is estimated that flood may arrive at Amochhu settlements, Phuentsholing after 146 minutes. Similarly, the flood travel time from Dorokha to Amochhu settlement is approximately 96 minutes. The flood travel time from Doyagang station to settlement area is approximately 21 minutes.

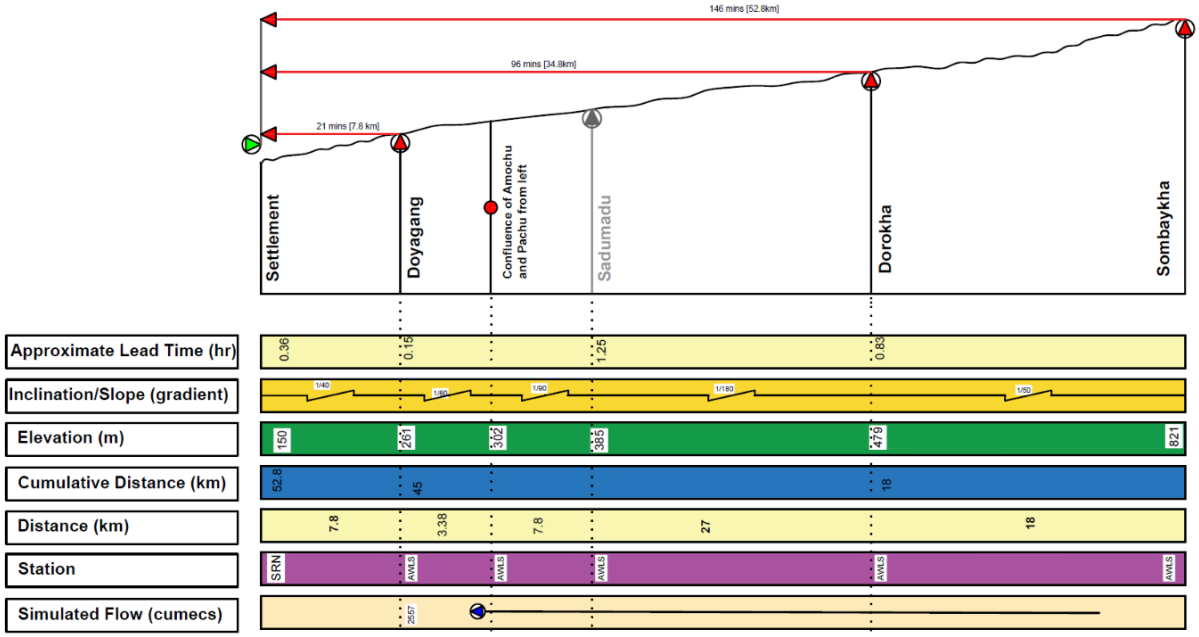
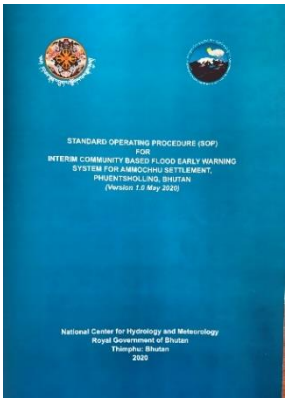


Figure 28: Distance and flood arrival time in Amochhu basin

6.3 Standard Operating Procedure (SOP)



The Standard Operating Procedure (SOP) has been developed for the FEWS at Amochhu, Phuentsholing. This SOP document contains detail information on the installed communication system, information flow during the flood event and contacts details of the stakeholders for information dissemination.

The SOP document is published and shared with stakeholders.

6.4 Demonstration of Flood EWS

The High Level COVID-19 Task Force members, Local Government and higher officials has visited the Flood Control Room at Amochhu, Phuentsholing. The demonstration and poster presentation were made during their visit.

Flood Hazard Maps poster for Amochhu and Omchhu are printed and displayed at the Flood Control Room. The education and awareness program will be done in coordination with the Department of Disaster Management, MOHCA and Local Government (Phuentsholing Thromde), after the settlement has moved in the house.

7. Recommendation

Overall, the installation of interim Flood EWS with basic communication to Control Room was completed. Following are some of the recommendations for further follow up:

a. NCHM would collaborate with local government and DDM to conduct education and awareness and conduct mock drills once people have moved in shelters.

b. Evacuation zone has to be marked and trail route to be identified in collaboration with DDM and Local Government.

c. For the long term a full-scale flood EWS has to set up for Amochhu basin. The Phuentsholing Township Development Plan, CDCL project implemented under ADB financing will provide necessary funding.

d. Currently, the Flood Control Room is located at newly constructed DGPC building as a temporary measure. NCHM need to follow up with the Phuentsholing Thromde for shifting the CR at the YDF building which is found to be most suitable location for CR.

e. Phuentsholing Thromde has to allocate land for the construction of permanent flood Early Warning Control and its facilities at appropriation location as requested by NCHM.

8. Annexure

8.1 Team members for installation of interim flood EWS at Amochhu

Sl. No.	Name of Team/Members	Remarks
1	**Advisory Team:** a. Director b. Chiefs of Division	- Coordination with line agencies/COVID19 Task Force - Facilitate seeking fund/budget - Facilitate procurements
2	**Planning and design Team:** a. Mr. Karma Dupchu, Director b. Mr. Tayba Buddha Tamang, Chief HWRSD c. Mr. Sangay Tenzin, Engineer EWS, HWRSD	- Write proposal and design of FEWS - Formulate SOP
3	**Hydrological Survey, modelling and hazard mapping Aerial Survey Team** a. Mr. Tandin Wangchuk, Team Leader/Pilot Drone b. Sangay Tenzin, Enginner, HWRSD c. Mr. Jamyang Zangpo, Engineer, HWRSD d. Mr. Wangdi, Technician **Hydrological modelling and hazard mapping Team:** a. Mr. Tandin Wangchuk, Team Leader/Pilot Drone b. Mr. Jamyang Zangpo, Engineer c. Mr. Chimi Namgyal, Statistician d. Mr. Yeshi Choki, Engineer	- Aerial drone survey of Amochhu bank - Flood assessment and hazard mapping, - Flood Frequency analysis, - Determined different waning levels (Normal/Alert/Alarm), - Printing of flood hazard maps - Installation of manual flood gauges near shelters - Education and awareness of vulnerable communities
4	**Control Room (CR) and Communication Setup Team:** a. Mr. Sangay Tenzin, HWRSD, Team Leader b. Mr. Tshering Tashi, CSD c. Mr. Kunzang, FWS	- Setup CR office - Installation of monitoring and communication equipment and accessories - Training of CR Operators and Site staff. - Education and awareness of vulnerable communities
5	**Enhancement Observation Station Team:** a. Mr. Trashi Namgay, HOID b. Mr. Kunzang, FWS, HOID c. Mr. Jangchub Chhophel, HOID	- Installation new AWLS at Dorokha and Doyagang Station on Amochhu - Enhancement of other AWS and AWLS stations located within Amochhu basin and periphery including communication. - Installation of Manual Flood gauges near shelters
6	**System Development Team** a. Mr. Kunzang Dorji, ICT b. Mr. Trashi Namgay, HOID **c.** Mr. Jangchub Chhophel, HOID	- Develop monitoring display for CR - Monitor reporting of AWLS and AWS - Start QC of AWLS and AWS of Amochhu basin
7	**CR Operator** a. Mr. Wangdi, FMCR, NWFWC, HQ, Thimphu b. Two on temporary (Diploma/TTI Engineering)	Mr. Wangdi to be Temporary Transfer to CR, P/ling