

**Action Taken Report  
Thorthormi Flood Incident 30 October 2023**



**Submitted by**

**Hydrology and Water Resources Services division  
National Centre for Hydrology and Meteorology  
Royal Government of Bhutan  
November 2023**



## **Action Taken Report Thorthormi Flood Incident 30 October 2023**

### **1. Background**

There are four lakes in the Lunana area. All four lakes (Luggye, Thorthormi, Rapstreng and Baytso) are identified as the potentially dangerous lake out of 9 potentially dangerous lakes in the head water of Phochhu.

GLOF EWS along the Punatsangchhu basin was installed in 2011 all four lakes water levels are monitored real time from the GLOF EWS Control Room Wangdi. Data is transmitted from the remote Automatic Water Level Station (AWLS) installed at the outlet of lakes through satellite communication (Iridium).

As a manual backup to Automatic GLOF EWS, the Flood Warning Office at Thanza, Lunana has two regular staff posted on a special duty, who monitor the lakes physically from time to time and inform HQ, and Control Room. Thanza Flood Warning Office is equipped with HF Wireless and Satellite phones beside the mobile.

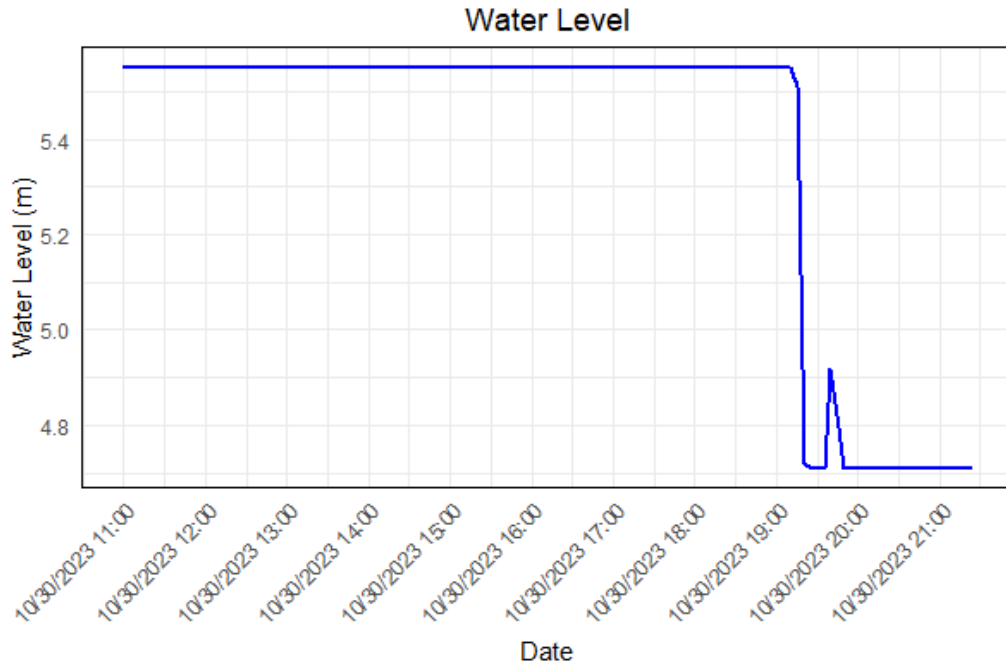
### **2. Thorthormi GLOF 30 October 2023**

#### **2.1 GLOF Detection**

On the evening of 30 October 2023 at around 19:45 p.m, a potential flood was reported from Lunana. The Automatic Water level Station (AWLS) on Thorthormi Lake detected a sudden fall in water level from 5.51 m at 19:15 hrs to 4.72 m at 19:20 hrs indicating breach of lakes. Downstream AWLS at Thanza/Toenchoe village recorded 6.78 m at around 19:45 hrs and the highest level of 6.8 m recorded at 20:00 hrs which is an increase of 0.38 cm from normal water level (6.42 m)

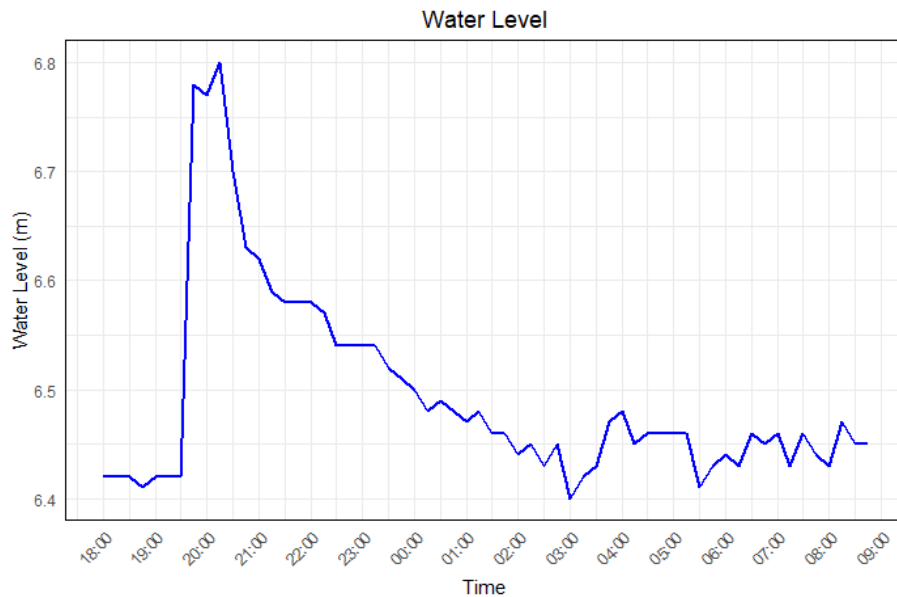


*Figure 1: Detection of GOLF by Thorthormi AWLS Station (Red Triangle)*



*Figure 2: Detection of fall of water level at Thorthomi AWLS Station*

The rise of water level was also detected by GLOF EWS monitoring station at Thanza, which is located approximately 4.60 km along the river channel downstream of Thorthomi lake. An increase in the water level of 6.78m from 6.42m was detected at Thanza station 15 minutes after the incident was reported at Thorthormi Lake outlet.



*Figure 3: Detection of the rise and fall of water level at Thanza Station*

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**2.2 Current GLOF EWS system Status**

As mentioned above, the GLOF EWS system for the Punatsangchhu basin is currently undergoing migration from old server to new server. The new server currently reported several HTTP web related issues due to the incomplete migration of the services. However, the system is operational at the back end whereby real time data is continuously pulled and processed by the new server.

2.2.1 Incident reported (7:50pm, 30/10/2023)

The status report of the Thothormi AWLS scenario at the above time was shared with the ICTA, NCHM, and an immediate need for the web interface of the new server was requested. Accordingly an emergency request was made to the team from SUTRON in order to look into the issue as early as possible.

2.2.2 Virtual meeting (8:10pm - 8:40pm)

The SUTRON team (Mr. Nickolas Ada & Mrs. Clara Patch) called an emergency meeting with the ICTA and were briefed about the incident. The prompt action taken by the experts from SUTRON helped NCHM to look into the issue on the new server and accordingly monitor the situation on the new server. The following shows the email loop & details on the status report shared by Mr. Nickolas.

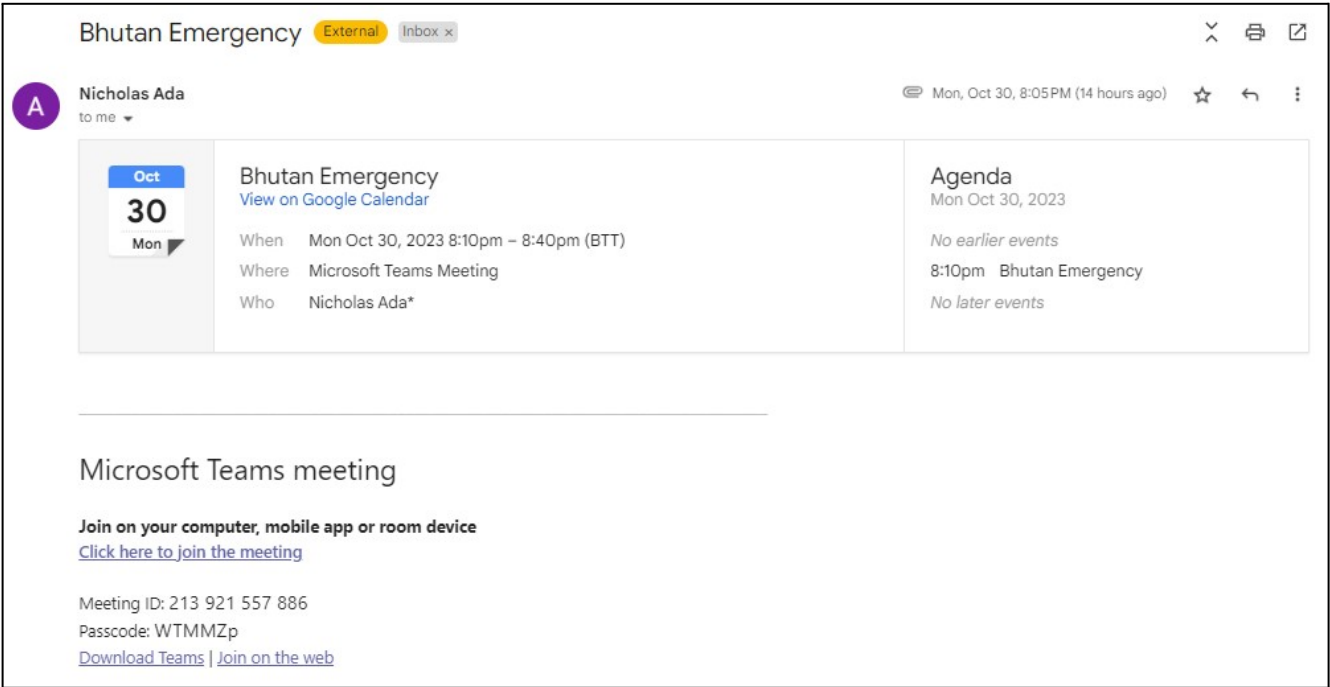


Figure 4: Emergency virtual meeting between ICTA & Sutron team



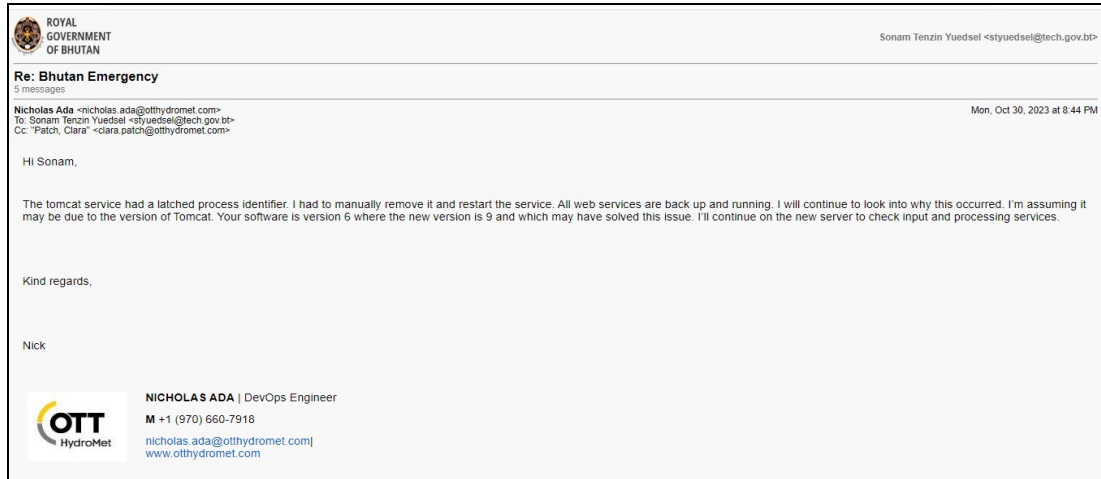


Figure 5: Diagnosis & resolution report

### 2.2.3. New server Web service status (8:40pm)

The web services were back online once Mr. Nickolas was able to resolve the issue on the new server. His speculations suggest that the new system with its software versions might have caused a few bugs and compatibility issues which had potentially caused the web based issue. This is to be taken into consideration especially during the migration phase so as to avoid such downtime in the future.

### 2.2.4. Siren Controller status (8:50pm)

After the new server had come back online, virtual mirroring of the new server's Interface was activated on ICTA's workstation and a siren controller was launched to enable real time access to the siren if the situation worsens. Since then, the workstation was used on standby, waiting for command from the FMCR.

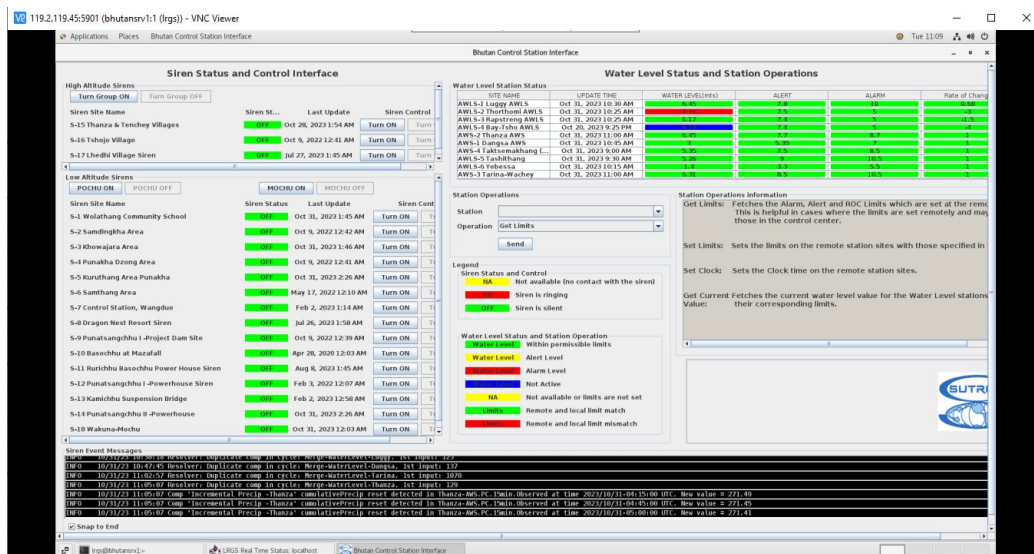


Figure 6: Virtual Mirrored session of new server with siren control panel

## 2.3 Emergency Meeting

As per the Standard Operating Procedure (SOP) of the GLOF EWS installed along the Punakha-Wangdue Valley, an Emergency Meeting was called for by HWRSD, Offtg Chief. The following members of NCHM management group gathered at the Flood Monitoring and Command Room of NWFWC by 19:30 hours and Dasho Karma Tshering, Secretary, MoENR also joined the Group to oversee and monitor the situation.

1. Mr. Karma Dupchu, Director, NCHM
2. Mr. Karma, Specialist, (chief, CSD), NCHM
3. Mr. Singay Dorji, Specialist, (chief, MSD), NCHM
4. Mr. Jamyang Phuntshok, Specialist, (Offgt. chief, HWRSD), NCHM
5. Mr. Sangay Tenzin, Engineer, HWRSD
6. Ms. Yeshe Choki, Hydromet Officer, HWRSD
7. Mr. Wangdi, Technician, FMCR, HWRSD



*Figure 7: Emergency meeting at FMCR*

## 2. 4 Information Sharing

### 2.4.1. Flood Monitoring and Command Room (FMCR), Thimphu

According to the Standard Operation Protocol, the situation was informed to relevant stakeholders like the Department of Disaster Management (DDM), Ministry of Home and Cultural Affairs (MoHCA) and Dasho Dzongdas of Punakha and Wangdue Phodrang dzongkhag. The information was shared to alert the relevant people and stakeholders of the situation.

### 2.4.2 Wangdue Control Room

Wangdue Control Room also informed agencies and the relevant stakeholders in line such as the DDMO (Wangdue Phodrang and Punakha), Punatsangchu Hydroelectric Project Authorities (PHPA I&II), Basochu Hydropower Plant(BHPA) and FMCR, Thimphu as per the standard operating procedure.

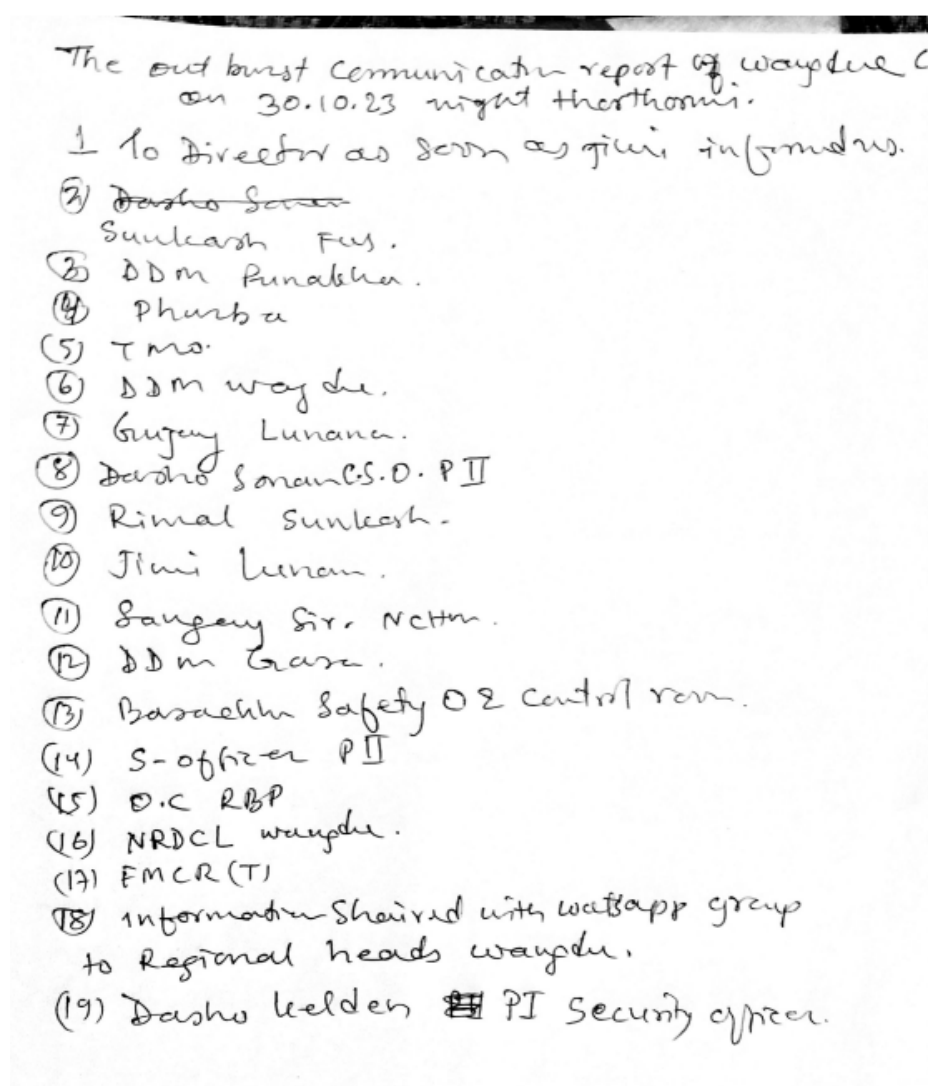


Figure 8: Information sharing log book at Wangdue CR

### 2.4.3 Thanza(Lunana) Site Staff

Two site staff of NCHM stationed at Thanza(Lunana) informed about the breach of subsidiary lake II of Thorthormi glacier lake to concern people and agencies. As mandated, the information was shared to control rooms at Wangdue and Thimphu, Director and the Chiefs of NCHM, Gup of Lunana Gewog and Principal of Lunana Primary School, Member of Parliament(Lunana).



## 2.5 GLOF Monitoring and Follow-up Updates

### 2.5.1 Flood Monitoring and Command Room (FMCR), Thimphu

Since the detection of the rise in water level at Thorthormi AWLS, FMCR as the Control Room in Head Quarter which is operated 24/7 intensified the monitoring. The site staff at Thanza were contacted and asked for immediate field verification through manual gauge reading and reported that the water level had risen.

The information regarding the Thorthormi lake breach was updated to the relevant stakeholder through email, facebook and whatsapp group. An update to the situation was provided after the field verification at Thorthormi lake was carried out by the field staff and the intensive monitoring will be continued until the situation stabilizes back to normal.

Since the events occurred at night, the team couldnt ascertain the potential risk it possessed so the people at the vulnerable location were asked to stay at a safer place and to be vigilant.

A team from the center was formed and deployed the next morning to visit Thorthormi and carry out the detailed assessment of the situation.



*Figure 9: Team preparing for the site visit*

### 2.5.2 Wangdue Control Room

Punatsangchu basin control room at Wangdue also intensified the monitoring. Staff kept in contact with the Thanza site staff for field updates and reported to FMCR. Necessary information was duly shared as per SOP. A small meeting was called for by the in-charge asking for continued vigilance and monitoring.

### 2.5.3 Thanza (Lunana) Site Staff

The field staff stationed at Thanza were deputed for field verification soon after detection. Despite harsh weather conditions, the two site staff immediately initiated the action. One stayed at Thanza AWLS reporting the situation while the other continued to monitor the Thorthormi Lake. At 22:17 PM, the field staff after doing the field verification informed FMCR that there are very abrupt changes of the Thorthormi lake. From the visual observation, it was reported that there is a huge displacement of icebergs and new erosion on the Morian walls of subsidiary lakes I and II.



*Figure 10: Site staff at the lake site showing the situation at the site*

Since then, they manually monitored the site at Thorthormi and regularly updated the control room about the situation out there. It was reported by the field staff that the automatic water level sensors were damaged and are not functioning currently so the station was monitored manually. The team from the HQ will assess the AWLS damages and try to repair.

### 3. 31 October 2023

#### 3.1 NCHM Technical Team to Lunana

A three-member expert team from the National Centre for Hydrology and Meteorology (NCHM) led by Mr. Karma Toeb, Specialist/Glaciologist, Mr. Phuntsho Tshering, Glaciologist and Mr. Sangay Tenzin, EWS Engineer left for Lunana on 31 Oct 2023 morning at around 08:30 AM from Lungtenphug Helipad for Rapid assessment of risks of Thorthormi lake after the 30 October 2023 GLOF incident.

NCHM Lunana staff along with other friends in Lunana spent the whole night at Thorthormi lake site monitoring the status. Thorthormi Automatic Water Level Water Sensors (AWLS) are reported damaged by yesterday GLOF incident.



*Figure 11: NCHM Technical Team landed in Lunana on 31 Oct 2023.*

### 3.2 Observation of Flood Downstream

At around 8:00 hours, the site staff at Samdingkha started noticing a slight change in the water color and from 09:19 hrs, the water color completely changed its color but did not observe any change in the water level.

Similarly, as per the site staff at Wangdue, they noticed the change of water color at 0920 hrs on 31 October 2023 but no apparent increase in water level was recorded. A drastic change in the water color was observed from 14:10 hrs.

### 3.Flood travel time observed downstream

Place/Station	Date/Time	Water Level	Remarks
Samdingkha Hydrological Station on Phochhu	31 Oct 2023/08:00 AM	Water color changes observed at 08:00 AM but no increase in water level	Flood water arrived after more than 13 hours at Samdingkha (13 and half hours)
Wangdi Flood Warning Station/Bridge	31 Oct 2023/09:20 AM	Water color changes observed at 09:20 AM but no increase in water level	Flood water arrived after more than 14 hours at Wangdi bridge





Samadingkha Hydrological Station, Phochhu



Punakha Phochhu-Mochhu Confluence



Above Wangdiphodrang Bridge

*Figure 12: Observation of flood at the downstream*

#### **4. Update on Thorthomi Situation,**

##### **4.1 Update on 31 Oct 2023**

The Technical Team from Lunana sent the following Observation and recommendations updates on 31 Oct 2023 evening.

##### **Observations**

1. No major blockage at the outlet of the main Thorthomi Lake by icebergs.
2. No major mass movement was observed on the Thorthomi Rabstreng barrier except for a few small fresh landslide scars. The fresh landslide scars are observed on the Thorthomi side only and are not a very major one.

3. Due to the 30th October night incident, there are various erosion marks on the existing channel between SL-I and SL-II. The erosional marks are approximately measuring up to 40 to 50 centimeters of down cutting.
4. At the frontal (outlet) part of the Thorthomi lake, no major iceberg concentrations are observed. All the ice masses are found to be concentrated at the upper side of the lake.

Recommendation/Advisory:

1. Since no detailed investigation was carried out, the team recommended continuing with High Alert for the vulnerable community of the Lunana region. However, it's recommended to be Vigilant for the downstream region.
2. No manual 24/7 observer at the lake site, but both Automatic and Manual observation of Thanza Station shall continue. Manual Observation data shall be transmitted half hourly (every 30 minutes) in addition to 15 minutes transmission by AWLS of GOLF EWS.
3. At Thanza station the observer shall carry on manual observation and the data shall be transmitted half hourly (30 min) during night hours (7 PM to 6:00 AM).

#### **4.2 Update on 1<sup>st</sup> Nov 2023**

The Technical Team from Lunana shared the following observations and recommendations on 1 November 2023 evening.

Observations:

1. No major blockage at the outlet of the main Thorthomi Lake by icebergs.
2. No major mass movement was observed on the Thorthomi Rabstreng barrier except for a few small fresh landslide scars. The fresh landslide scars are observed on the Thorthomi side only and are not a very major one.
3. Due to the 30th October night incident, there are various erosion marks on the existing channel between SL-I and SL-II. The erosional marks are approximately measuring up to 40 to 50 centimeters of down cutting.
4. At the frontal (outlet) part of the Thorthomi lake, no major iceberg concentrations are observed. All the ice masses are found to be concentrated at the upper side of the lake.
5. It was observed that water level in the main Thorthormi lake has lowered by about 46 centimeters due to the 29th October event.
6. Outlet channel between the main lake and previous subsidiary Lake II indicates active erosion both on sides and on water channel bed level. Similar active erosions are also observed at the terminal outlet (previous SL-II outlet).
7. The Automated Real Time water level monitoring station on Thorthomi has been damaged by the 29th Oct 2023 event. The bubbler pipe and termination blocks were damaged.
8. The footpath bridge crossing Thorthomi outlet leading to Luggye Tsho was completely washed away and there is no alternative access to Luggye Tsho.



#### Recommendation/Advisory:

1. Based on today's assessment, we recommend continuing with High Alert for the vulnerable community of the Lunana region for the next few days. However, it's recommended to be Vigilant for the downstream region.
2. No manual 24/7 observer at the lake site, however, it is recommended that the observer stationed at Thanza shall conduct visual inspection of Thorthomi lake at least 3 times in a week and as and when there is abnormal observation at Thanza station.
3. At Thanza station the observer shall carry on manual observation and the data shall be transmitted half hourly (30 min) during night hours (7 PM to 6:00 AM).
4. In addition, the control room at Wangdue and Thimphu shall continue to monitor intensively and for any abnormal data from automated EWS.

#### 4.3 Intensified Monitoring by Control Rooms

Based on the recommendation of the Technical Team, the GLOf EWS Control Room, Wangdi and Flood Monitoring and Command Room (FMCR), NWFWC, Thimphu intensified monitoring. Since the Early Warning System (EWS) was not stable due to the migration, the staff were instructed to oversee the EWS status through the WIMES system.

During the incident, the sensor was displaced, causing it to record a constant water level of 4.71m starting from 19:20 on October 30, 2023. However, at 14:30 on November 1, 2023, a sudden rise in the water level was reported. Upon communicating with the field staff, we learned that the sensor had been repositioned, but they indicated the need for maintenance and calibration in the upcoming days.

The water level data from both the manual and automatic stations at Thanza are being monitored continuously.

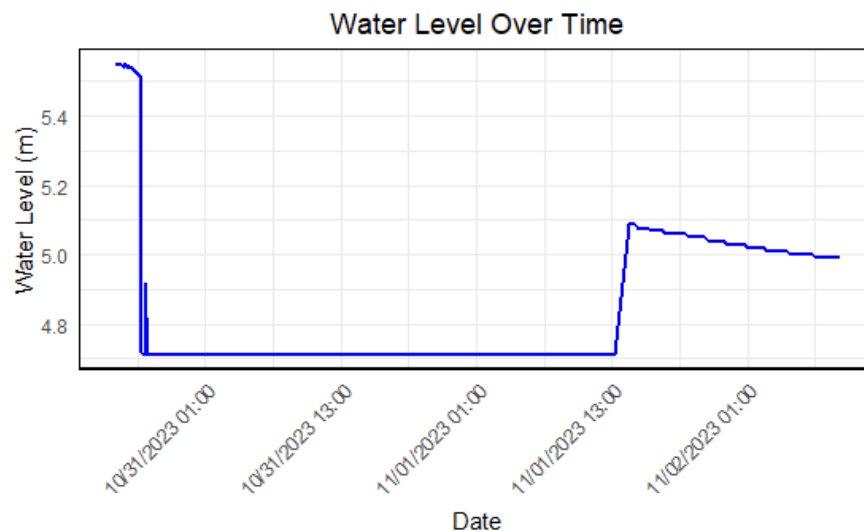


Figure 13: Thanza water level status

## **5.0 Rapid Assessment by Technical Team**

The NCHM team carried out the rapid assessment of lakes and surroundings on 31 October 2023, 1 Nov 2023 and 2 November 2023.

Mr. Karma, Specialist (Glaciologist) and Mr. Phuntsho Tshering, Principal Glaciologist, returned on 3 November 2023. Rapid Assessment results and observations were presented by Mr. Karma, Specialist/ Glaciologist, Cryosphere Services Division (CSD), NCHM.

Mr. Sangay Tenzin stayed back in Lunana for physically monitoring the lakes and working to restore AWLS of Thorthormi Lake damaged by the incident.

## **6. Presentation of Technical Team Assessment Outcomes and Findings to the Secretaries of MoENR, MoHA and OGZ (HMS) on 6 Nov 2023 at 11:00**

A presentation on the findings and outcomes from the rapid assessment of the Thorthormi lake by the technical team was made to the head of the relevant agencies on 6th November 2023. The session was attended by:

- a. Dasho Karma Tshering, Secretary, Ministry of Energy and Natural Resources
- b. Dasho Sonam Wangyel, Secretary, Ministry of Home and Affairs
- c. Dasho Namgay Rinchen, Zimpon Wongma, OGZ, HMS
- d. Mr. Kado Zangpo, Director, Department of Local Government and Disaster Management
- e. Mr. Karma Dupchu, Director, and Division Heads from NCHM

## **7. Media Briefing on Statue of Thorthormi Lake on 6 November 2023 at 15:00 hours**

A media briefing was organized at 15:00 hrs in November 2023 to update the media on the current status of Thorthormi lake. The briefing included a concise presentation on the findings and outcomes for the GLOF event which occurred on 30th October, followed by an interactive discussion and a question-and-answer session. Media representatives from the following organizations were in attendance:

- a. Gyalchi Selshog
- b. Business Bhutan
- c. Bhutan Broadcasting Services
- d. Bhutan Today



## 8. Temporary Restoration of damaged Thorthori Lake AWLS, 6 Nov 2023

Mr. Sangay Tenzin and Team carried out the emergency maintenance of Thorthomi AWLS station damaged by GLOF. The team temporarily restored the terminal block, changed the bubbler pipe, and refixed the conduit pipe. Besides, the team also conducted basic maintenance on the station. AWLS was made functional after maintenance started transmitting data around 16:50 PM on 6 November 2023. The GLOF EWS Control Room Wangdue was also instructed to change the Alarm Level to 3.5 m.

As a consequence of the recent incident there is a drastic change in the morphological condition of Thorthormi lake and surrounding areas of AWLS, it is recommended to shift the AWLS from subsidiary lake I to the main lake.

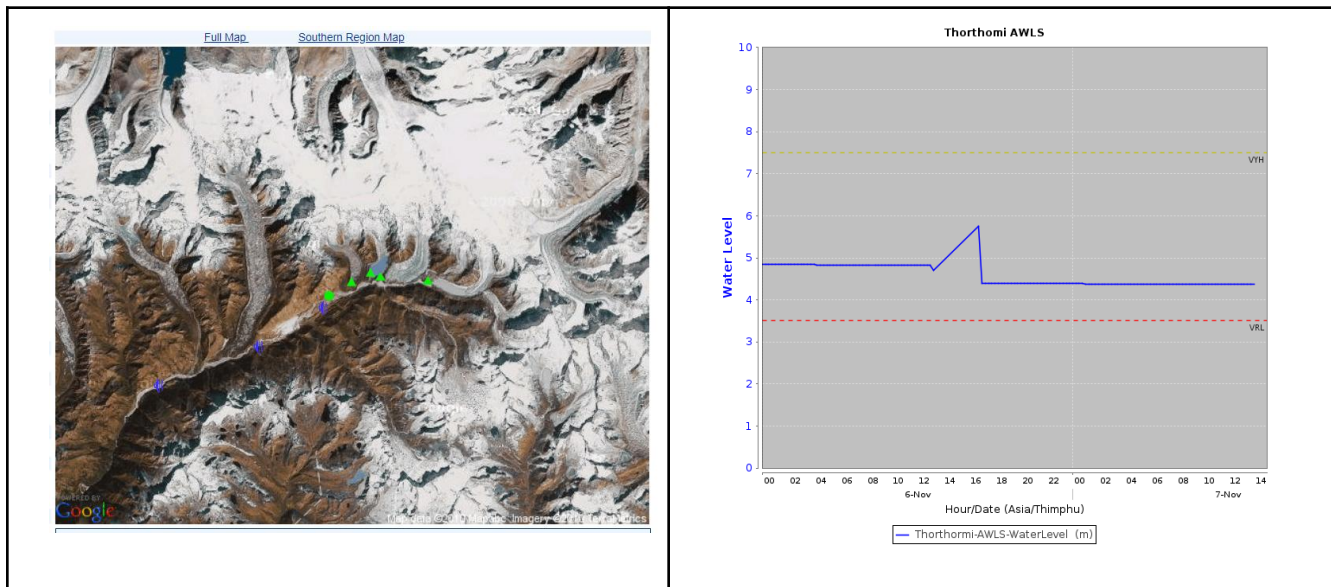


Figure 14: Thorthomi station after restoration

## **9. Assessment Outcomes and Findings Presentation to the Cabinet on 7 November 2023 at 15:30**

A presentation on the findings and outcomes from the rapid assessment of the Thorthormi lake by the technical team was made to the Interim Government (IG) Advisor at PMO Office on 7th November 2023.

## **10. Emergency fund Request**

As per the Operation Guideline Disaster Financing 2017, NCHM submitted "Emergency Fund for Shifting and Restoration of Automatic Water Level Station ( AWLS) in Thorthormi Lake damaged by 30 October 2023" on 10 Nov 2023.

## **11. Submission of Report**

Final Report on Rapid Assessment of GLOF Event from Thorthormi, 30 October 2023" was submitted to the following Authorities on December 4, 2023 (both in soft and hard copy)

- a. Cabinet Secretary, Cabinet Secretariat, Royal Government of Bhutan
- b. The Secretary, Ministry of Energy and Natural Resources
- c. The Secretary, Ministry of Home Affairs
- d. Dasho Zimpon, Office of Gyalpoi Zimpon, His Majesty's Secretariat, Thimphu
- e. The Director, Department of Local Governance and Disaster Management, MoHA
- f. Dasho Dzongda Dzongkhag, Administration Gasa/Punakha/Wangdue Phodrang

## **12. Recommendations**

The following are a few observations and recommendations.

1. Update the Standard Operating Procedure for GLOF EWS in Puna-Wangdue valley,
2. Upgradation and enhancement of GLOF EWS as it has become old (Operated for more than 12 years) and
3. Monitoring of temperature trends