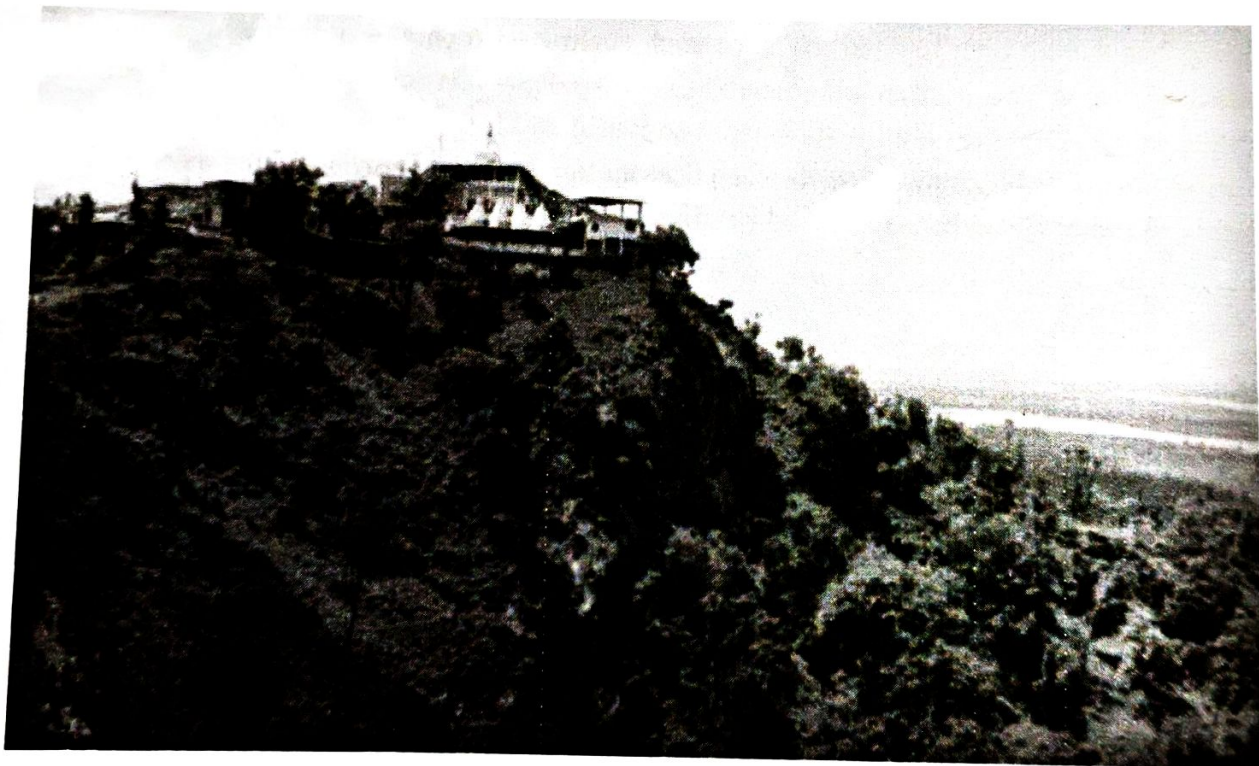


A

REPORT ON

**Geological Report on 23rd August landslip
activity in Chandi Devi hills**



Uttarakhand Landslide Mitigation and Management Center

SEPTEMBER 2023

Preamble :

A landslide event occur below the three shops located near the Chandi Devi Mandir in which a part of shops and retaining wall to support the structure got damaged. The event occurred during the heavy rainfall on 23.9.2023 at Chandi devi hills. Therefore, as per letter no 1141/USDMA/154672 dated 18 September 2023 putforth by USDMA, a team was visited the Chandi devi Mandir, Haridwar on 25th to 26th September with following members

- Dr Ruchika Tandon, Senior Geologist, ULMMC
- Tandrilla Sarkar, Geologist, USDMA
- Shri Prem Singh Negi, ULMMC
- Deepak Bhatt, Surveyor, ULMMC
- Pal Singh, Surveyor, ULMMC

1.0 Location of the area

The Haridwar township is a famous holy place located at the bank of river Ganga and bounded by Siwalik hills on its eastern and western flank. Towards the eastern side and the western side, the hills are known as Mansa Devi hills and Chandi devi hills respectively as after the name of temples having mythological importances, Thus, always occupied by crowd. Both the hills belongs to siwalik range of Outer Himalaya and can be approached by 3 -4 km trekking or by ropeway from the Main road.

The chandi devi hills occupies of lat N 29.934009 and long E 78.18107. At the base, a road connecting haridwar to Nainital is passes through whereas at the top Chandi devi mandir is located at an elevation of m.

2.0 Geology of the area

Geologically, the area is composed of alternate sequence of sandstone and claystone beds belong to dhokpathan and nagri formations of middle siwalik subgroup of upper to lower Pliocene age. The sandstone is buff to grey in colour and medium grained with thickness of beds varies from 20 cm to 3 m. At the base of the chandi hills, the sandstone beds is well exposed with RBM material on top of sandstone bed whereas at the top of the hill, most of the area is covered with sandy soil. The general trend of these beds is NW-SE dipping towards NE with an dip amount less than 20 and into the hills. the lithology of the area is mainly represented by middle shiwalik consisting of thickly bedded medium to fine grained sandstone intercalated with thin beds of claystone. Three sets of joint planes are observed where sandstone beds are exposed near the base of chandi hills. The sandstone is of grey colour, fine to medium grained and having micaceous content whereas claystone is reddish brown in colour and present as minor intercalation and are highly friable in nature. River borne material is also present with rounded

pebbles. The presence of RBM material on top of sandstone beds near roads side exhibits the upliftment of the area by tectonic activity. Rest of the slope is covered with dense forest towards northern and eastern side and falls under Rajaji national park

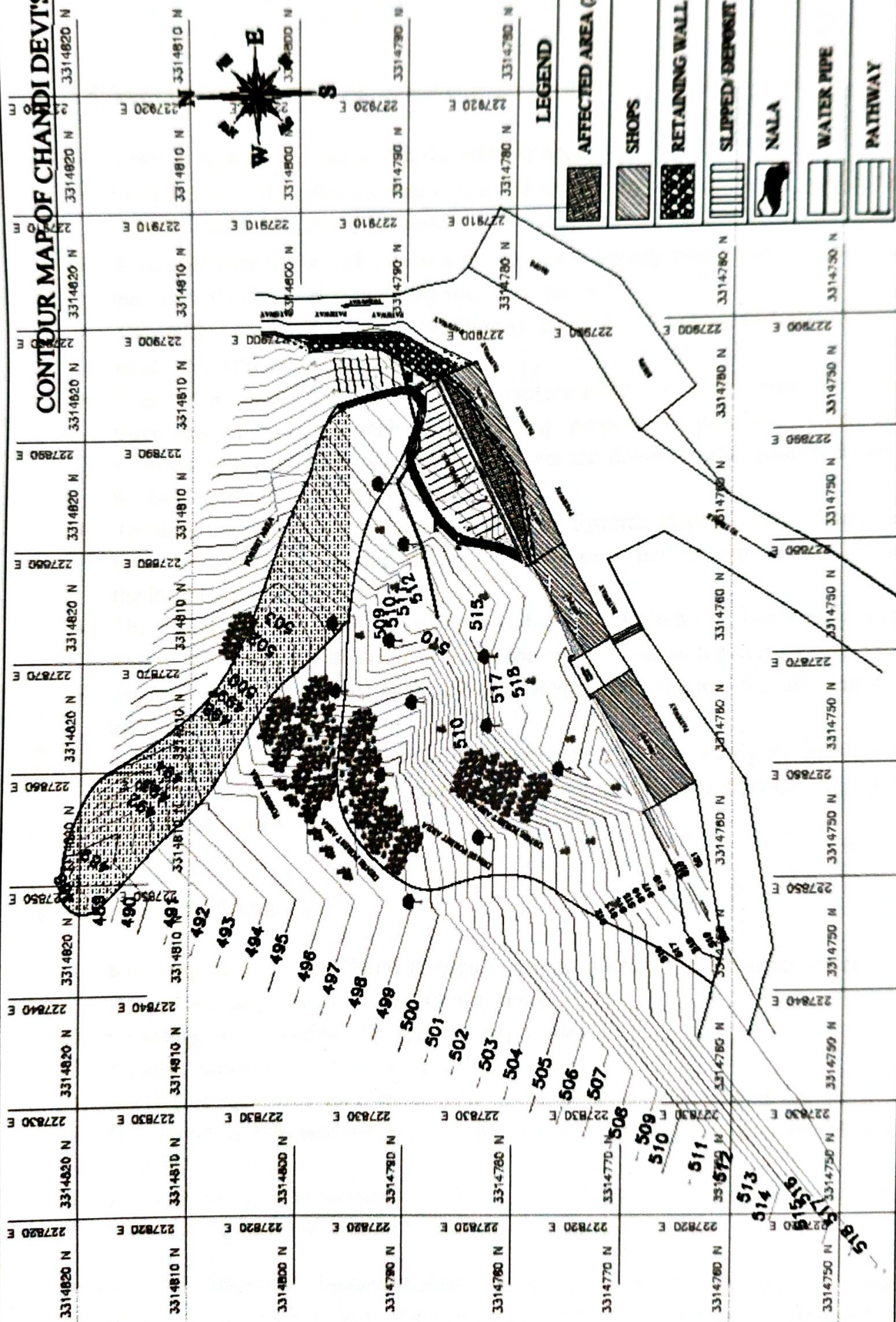
Geomorphologically, the relief of the valley is ~180 m. The slopes in the area are generally moderately steep ($>45^\circ$) and curvilinear to straight and covered with thick vegetation. Landslide in the form of rock fall (boulder size less than 25 cm), debris fall and mud flow are active phenomena on the slopes.

3.0 Field Scenarios and Photographs

After the heavy rainfall on 23rd August 2023 , a part of the land at the top of the hill is washed away causing damage to four shops and the retaining structures , picture of which is depicting below. Since the landslide movement is of smaller scale therefore there is no damage occur to people however shops are at risk. Below are the pictures depicting the site scenarios and the topographic map is attached as fig 2.



CONTOUR MAP OF CHANDI DEVIS



LEGEND

	AFFECTED AREA (28.42 M²)
	SHOPS
	RETAINING WALL
	SLIPPED/DEPOSIT SOIL
	NALA
	WATER PIPE
	PATHWAY

UTTARAKHAND LANDSLIDE
MITIGATION AND
MANAGEMENT CENTER

DATE: 20/09/2023

DRAFT BY:
ARVIND BORA
(AUTOCAD EXPERT)

SURVEY BY:
PAL SINGH, DEEPAK
BHATT (SURVEYOR)

TITLE: CONTOUR MAP OF CHANDI
DEVIS LANDSLIDE AREA

OFFICE USE ONLY

4.0 Observations

- There is no rock bed exposed at the affected site.
- Geologically , the affected area consist of coarse grained sandy soil which have least organic content and prone to erosion
- A part adjacent to the left side of affected area is already washed away few weeks back and construction of new retaining wall is going on.
- The fallen/ damaged retaining structure is about 4 to 5 m high and placed on the loose sandy soil without deeper foundation.
- There is no heavy load or concrete structure build above the sandy soil except the placement of the water tank for drinking purpose for pilgrims, behind which the continuous flow of water is observed, however the flowing water quantity is low but can be problematic in the longer run.
- Towards the right side of the slope (if facing towards slope), a small landslide scarp occur which has also develop during this monsoon as per the information collected from the localites.
- The sandy soil have least cohesion and high permeability therefore susceptible to erosion when mixed with water which is the main reason of the current landslip event
- There is no damage occur in the Chandi Devi temple site and the affected site is far away.
- There is no proper maintenance of retaining structure and dwelling the grounds near and below retaining structures by monkeys is common that may provide site for water to collect and ingress into slope.

Recommendations:

1. Retaining structure may build in such a way to distribute the load at wider space. The stepped retaining structure may provide safety.
2. Retaining wall should have proper drainage holes
3. Regular maintenance of retaining wall is required
4. Shifting of water tank may be consider or the proper arrangement of water flowing away from retaining structure may keep so that minimize the water ingress into slope or below retaining structures .
5. Towards the right side of landslip affected area, drain may be build for proper dispose of water during monsoon in order to avoid further erosion.

Further, An Automatic Weather station was installed near the premises of Chandi devi mandir but not in working state. Such weather station must be regularly checked, maintain along with providing basic training to concern person on its working. It is important in order

to establish threshold value of rainfall and related instability in the area which is prone to erosion and will be helpful to develop Early warning System in similar geological sites.