Disaster Mitigation and Management Centre
Uttarakhand Secretariat, Dehradun

Geological Note on Baderkhila landslip, Menagad nala area at Gyansu village in Uttarkashi, Uttarakhand

May, 2012

DEPARTMENT OF DISASTER MANAGEMENT
GOVERNMENT OF UTTARAKHAND

1. Abstract

Geologically instability of the Himalayan region together with high atmospheric precipitation is responsible widespread landslide occurrences in the region. The rocks of the region are characterized by multiple structural discontinuities and the relationship of these with the slope often make conditions favourable for landslides to occur. Landslides cannot be completely prevented but with proper planning intensity of its impact can certainly be reduced.

The present investigations in the vicinity of Uttarkashi town were undertaken by Shri Sushil Khanduri in compliance of office order No. 64/DMMC/IXV&287(2008) dated 26th April, 2012. During the course of the investigations Shri Devendra Singh Patwal, Disaster Management Officer, DDMA, Uttarkasi and Shri Kailash Nautiyal, Forester were present in the field.

2. General geology, geomorphology, and physiography

Uttarkashi valley exhibits characteristic rugged topography of the Lesser Himalayan terrain. The ground elevations generally vary between 1150 to 2000 meters above msl. The hill slopes in the area are generally observed to comprise of rocky outcrops, rocky cliffs and mantle of colluviums. The hill slopes in the area is generally moderately steep (25°- 35°) to steep (36°- 45°) while few escarpments or cliffs (> 50°) are also present.

Uttarkashi town is located in the Lesser Himalayan geotectonic block and it is bound by two major Thrust fault i.e. Main Centre Thrust (MCT) and Srinagar Thrust (ST). The MCT can be traced to the northeast of Uttarkashi while the Srinagar Thrust lies in the southwest. Phyllite, metabasic and quartzite of Garhwal Group are exposed around the area. The geological setup of area is as given below.

Table 1: General Stratigraphic Succession of the study area.

Formations	Lithology
NORTH	
Berinag Formation	Quartzite with / without penecontemporeneous mafic metavolcanic intruded by epidiorite
---------- Thrust ----------	
Rautgara Formation	Quartzite with penecontemporeneous mafic metavolcanic intruded by epidiorite.
---------- Fault ----------	
Berinag Formation	Quartzite with / without penecontemporeneous mafic metavolcanic intruded by epidiorite.
SOUTH	

The area has sub - tropical climate and experiences a high monsoonal rainfall. This region is prone to landslides due to high relief, presence of overburden and high precipitation. Rock falls are related to steep slopes and mainly controlled by rock discontinuities. The rocks in the area at most of the places are highly weathered and have low cohesive strength.

3. Seismicity

Uttarkashi lies in Zone IV of the Seismic Zoning Map of India. Earthquake of 1803 had devastated the old township of Uttarkashi, then known as Barahat. This was followed by 20th October 1991 Uttarkashi Earthquake that took a toll of 768 human lives, besides inducing numerous rock slides, ground fissures and changes in hot spring chemistry (GSI, 1992). The epicentral tract occupying an area of 20 sq km around Maneri in Bhagirathi valley recorded an intensity of IX on MSK-64 scale. The main shock was followed by a series of over 2000 aftershocks in a period of two months.

4. Landslip in Baderkhila area, Uttarkashi

4.1 Introduction

The Baderkhila landslip area is located on about 4.5 km north of Gyansu village and about 4.0 km northwest of Varunavat hill and can be approached by a footpath. The area is bounded by Menagad nala, a seasonal stream, that flows in SW direction. Traverses were taken around the site and upslope to examine the geological setup. Pine was observed to dominate the vegetation of the area.

4.2 Geology of the study area

The area is located on hill and presence of rock outcrops as well as overburden was observed. The overburden was generally observed to be less than 2.0 meters in thickness but at places the overburden thickness, including weathered rock, was observed to be around 5.0 meters. The overburden material comprised of soil, hill wash and debris and mainly consisted of brown and grayish, fine grained silty matrix with angular fragments of metabasics.

The rock of Garhwal Group comprising of metabasics and phyllites were observed to be exposed around the area. The rock was largely observed to be moderately weathered but at places highly weathered rocks were also encountered. These were observed to be moderately to highly jointed, thinly to medium bedded and dipping towards northeast at moderate to steep angles. The rock mass was observed to have slumped due to fractured and jointed nature of rocks and underground water / seepage. Most rock types in the area were observed to belong to Rautgara, Deoban and Berinagh formations.

5. Reconnaissance geotechnical assessment

The Baderkhila landslip area has surface slope steeper than 45° and metabasics, phyllites and quartzites comprise the dominant rock types present in the area. The rocks largely dip towards N 20° E to N 40° E at 35°– 40°. These dip towards hillside at steep dip angles. The critical joint present in the area dips towards S 60° E at 45°. The joint plane thus dips towards the slope direction.

At Baderkhila the landslip has taken place in weathered metabasics and thin soil, mainly along a smooth and concave weathered surface of metabasics that dips at about 35° oblique to the slope. The vertical height and width of the landslip is 60 to 70 meters and 40 to 50 meters respectively.

Around 3.0 – 6.0 meters of subsidence has at the crown of the landslip. The subsided material lying on steep slope has developed tension cracks that are up to 20 cm wide and 30 cm deep indicating active soil movement.

Saturation by rainwater led to increased pore pressure in the overlying overburden mass and lubrication of the underlying jointed and fractured weathered rock mass that reduced the shear resistance of the slope forming materials. This ultimately triggered the landslip.

During the monsoon season Baderkhila landslip debris is likely to flow down together with the rainwater along Menagad nala. This might pose threat to Gyansu village located along its course.

The original course of Menagad nala at Gyansu village area has been modified due to developmental activities and the same has been rendered very narrow and even blocked. This might further aggravate the situation.

6. Recommendations

Based on above surface geological - geotechnical observations and considering the terrain in the area adequate precautions are required to be taken. The area is geologically in a critical state and the following remedial measures are recommended:

- In order to minimize the percolation of water into the slide zone lined drains are recommended in the upslope portion of the Baderkhila landslip towards the depression in the northeast side.
- It is recommended that the existing pine trees around crown and detached / subsided parts of landslip be remove immediately before the onset of monsoon season.
- Installation of wire crates with iron sticks is recommended in the landslip area. This would help in beholding the critical mass.
- Construction of wire crate check dams is recommended along the course of Menagad nala together with installation of deep rooted girders at specific intervals across the nala above Gyansu village area. This would retard the flow of transported material / large boulders.
- It is recommended that damaged retaining walls / stone masonry walls on both flanks of Menagad nala, near Gyansu village area be repaired.
- It is recommended that the transported debris lying on Menagad nala bed near Gyansu village area be removed as it results in debris coming down to the village area in a huge quantity.
- It is recommended that the exit of Menagad nala be extended up to Bhagirathi river. This would avoid traffic disruption on Rishikesh-Gangotri National Highway by the debris brought down by the nala.
- It is recommended that all encroachments on Menagad nala bed area be immediately removed.
- It is recommended that the threat posed by Menagad nala be communicated to the masses so as to ensure that they avoid Menagad nala area during monsoon season.

In order to be effective, all the slope stability related measures must be planned, and designed carefully under the supervision of experienced geotechnical engineer / civil engineer.