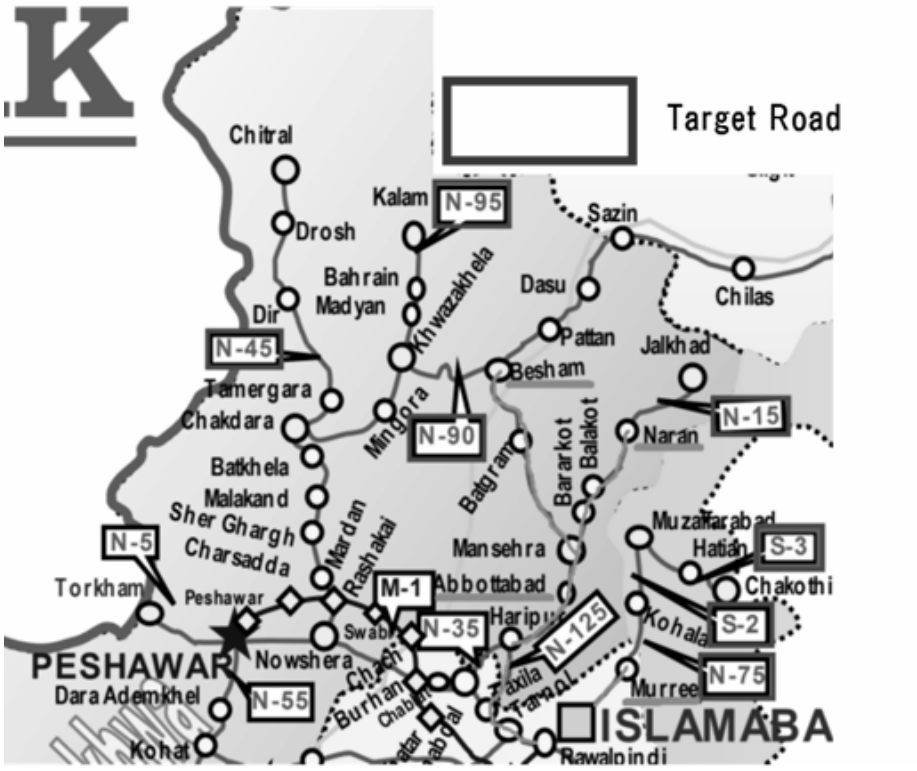
Appendix 6

Survey Result of Restricted Area

SLOPE FAILURE ANALYSIS ALONG THE MAJOR ROADS NETWORK IN NORTHERN PAKISTAN



Submitted to

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1. Summary

Northern Pakistan is witnessed to frequent and devastating geohazards, mainly including earthquakes and landslides. Mountain ranges in northern Pakistan including the Karakorum and Himalayas have the highest relief on Earth, highest rate of uplift, steep climatic gradient (from glacial to hyper-arid) and therefore hosting frequent and devastating geological and climatological hazards. Among these hazards, the most frequent and devastating are the different types of landslides which are frequently damaging the communication network and disrupting the traffic flow in the region. The frequent landsliding in the region can mainly be attributed to the abundance of unconsolidated, highly weathered and fractured rocks, well-developed rock discontinuities because of the active tectonics, frequent earthquakes, uncontrolled blasting for construction and repair of the roads, presence of the largest glaciers outside the polar regions, precarious locations of alluvial, lacustrine and morainal deposits; severe climatic conditions leading to rapid weathering, poor drainage conditions, scarcity of vegetation, high rates of erosion and anthropogenic activities on instable slopes. These factors suggest that slope movements in the area will continue to occur and posing high risk to the road network. Although the hazards associated with landslides cannot be completely eliminated, however, their devastating impacts can be minimized by assessment and evaluation of the prevailing hazards, understanding their triggering mechanism and accordingly develop and implement the mitigation measures.

The Kokusai Kogyo Co., Ltd, Japan with the financial support of Japan International Cooperation Agency (JICA) has initiated a study on landslide data collection survey along the major road network in the northern mountainous regions of Pakistan. In this regard, active landslides with high risk to the roads were selected by the experts from the Kokusai Kogyo Co., Ltd. The selected landslides located along the major road network in northern Pakistan, including N-35 (Karakorum Highway), N-15 (Naran-Chillas Road), N-75 (Murree-Muzaffarabad road), N-90 (Shangla-Swat Road), N-95 (Kalam Road) and N-45 (Dir-Chitral road) were sub-commissioned to a team of landslides experts from the different universities in Pakistan. The team was tasked to visit the selected landslides and collect the landslide data on a given slope chart, photographs and sketches of the landslides. The team has visited the proposed landslides along the road network and the required data is collected on the given template.

The selected roads in the study area are frequently affected by the landslide hazards. The selected roads are constructed in the mountainous topography and therefore the roads have weakened the shear strength of the slopes and triggering them to landslides. The active seismicity, fractured rocks, monsoonal climate, steep slopes and lack of effective landslide mitigation measures also contribute to frequent landsliding along the road and therefore these roads are often damaged and the traffic is disrupted leading to significant losses to the economy and human lives.

Each landslide was visited and the required information were collected on the provided slope charts, photographs and sketches was drawn on site. On most of the studied landslides, detached and hanging boulders were observed that pose serious threat to the traffic and road. Active erosion on the landslides leads to development of gullies in the landslides and debris flows. The lose debris comprised of boulders, gravels, sand and silt became an easy prey for sliding during a rainy season. The landslide mitigation measures are constructed on some of the landslides including mainly retaining walls, culverts, bridges, afforestation and check dams, however, due to lack of their regular maintenance, most of the constructed mitigation measures are not effective. Some of the studied landslides, specifically along the N-35 and N-15, are significantly large in size and very active and therefore effective mitigation measures needs to be designed and constructed to minimize the negative impacts of landslides. Among the studied roads, the N-35 as the main artery between the province of the Gilgit Baltistan and Pakistan and only land route between the China and Pakistan is facing significant and frequent problems of landsliding with damages to the human lives and economy. The collected landslide data along the selected road shall assist the agencies mainly the National Highway Authority (NHA) and Frontier Works Organization (FWO) to prioritize the landslides according to their magnitude of risk and accordingly design and implement the landslide mitigation measures.

2. Introduction

Landslides and associated hazards are frequently observed in the mountainous regions around the world. They have a devastating impacts on infrastructure and human lives (Regmi et al. 2010). It is estimated that, worldwide, around 1,000 deaths and economic losses of about 4 billion US$ occur due to landslides every year (Lee and Pradhan 2007). Landslide induced damages are increasing mainly due to increasing urbanization, unplanned development, deforestation and effects of climate change (Kanungo et al. 2008). The communication network including roads and railways in the mountains regions are often subjected to frequent disruption and damages by the landslides along the route.

The Karakoram and Himalaya mountain ranges in northern Pakistan are prone to frequent and devastating geohazards, mainly including earthquakes and landslides. High seismic hazard in Pakistan and adjacent Indian and Afghanistan regions is due to northward movement of the Indian tectonic plate at a rate of 31 mm/year (Bettinelli et al. 2006) which is subducting beneath the Eurasian continent. This collision of the Indian and Eurasian plates resulted in development of world highest mountain ranges i.e. Karakoram, Himalaya and Hindukush mountain ranges (Rao et al. 2006). These mountain ranges have the highest relief on earth, highest rate of uplift, steep climatic gradient (from glacial to hyper-arid) and therefore hosting frequent and devastating geological and climatological hazards. The region is severally and frequently affected by earthquakes, different types of landslides, excessive erosion, impacts of climate change and flash floods (Jones et al. 1983, Bishop et al. 1998, Derbyshire et al. 2001, Hewitt 2009, Hewitt 2009). Among these hazards, the most frequent and devastating are the different types of landslides which are frequently disrupting and damaging the communication network in the region (Derbyshire et al. 2001). The frequent land sliding in the region can mainly be attributed to the abundance of unconsolidated, highly weathered and fractured geology; well-developed rock discontinuities because of the active tectonics, frequent earthquakes, uncontrolled blasting for construction and repair of the roads, presence of the largest glaciers outside the polar regions, precarious locations of alluvial, lacustrine and morainal deposits; severe climatic conditions leading to rapid weathering, poor drainage conditions, scarcity of vegetation, high rates of erosion and anthropogenic activities on instable slopes (Derbyshire et al. 2001, Kamp et al. 2008, Panzera et al. 2015, Shafique et al. 2016). These factors suggest that slope movements in the area will

continue to occur and posing high risk to the road network. Moreover, the landslides often block the rivers/streams, resulting in natural dam such as the recent Attabad Lake, with devastating impacts on highway, geomorphic consequences and disturbing the entire river system of the region. Although the hazards associated with landslides cannot be completely eliminated, however, their devastating impacts can be minimized by assessment and evaluation of the prevailing hazards, understanding their triggering mechanism and accordingly develop and implement the mitigation measures.

The Kokusai Kogyo Co., Ltd with the financial support of the Japan International Cooperation Agency (JICA) initiated landslide data collection survey along the major road network in the mountainous regions of Pakistan. In this regard, landslides with high risk to the roads were selected by the group of experts from the Kokusai Kogyo Co., Ltd. The selected landslides located in the inaccessible sites along the N-35 (Karakorum Highway), N-15 (Naran-Chillas Road), N-75 (Murree-Muzaffarabad road), N-90 (Shangla-Swat Road), N-95 (Kalam Road) and N-45 (Dir-Chitral road) were sub-contracted to a team of landslides experts from the different Universities in Pakistan. The team were tasked to visit the selected landslides and collect the hazard and risk assessment data on a given template, photographs and sketches of the landslides. The brief information of the surveyed road network is given below.

3. Geological Background

3.1. Tectonics Setting

The geological setting of Pakistan, in the framework of the modern concept of plate tectonics, is rare and matchless in the world. Himalayan orogenic belt is the result of Tertiary Himalayan collision between the Eurasian and Indian plates. As a result of this collision Kohistan Island arc formed which was sandwiched between Indian and Eurasian plate followed by closing of Tethys ocean. This era of collision and formation of orogenic belt is named as Himalayan orogeny. Geologically the tectonostratigraphic units of Northern Pakistan is extremely complex. The aftermath of the events of the collosion of plates has brought disastrous effect on the stratigraphic sequences. The area is characterized by very complex structural features and fragile rocks. In general, project area is dominated by igneous, metamorphic and sedimentary rock units.

3.2. Regional Geological Description

3.2.1 Besham to Swat Section (N-90)

3.2.1.1 Besham Basement Rocks

In the Besham Complex assemblage of rocks of different origin have been folded togather, intricately mixed, involved or otherwise complicated. Stratigraphically, Besham Complex is divided into five units. The oldest is the Besham group. It is composed of heterogeneous gneisses and metasediments. Among the heterogenenous gneisses, sodic quartzofeldspathic gneisses of Besham group is considered as Lahore granite.

The second oldest rocks, are the mafic dykes, which intruded Besham group. These dykes have been metamorphosed to amphibolite grade. The third group of rocks includes cogenetic small granitic intrusions and associated pegmatites. The fourth unit in the Besham area is 'Karora group' which rests unconformably over the earlier three units. The fifth unit is leucogranite that intrudes both the Karora and Besham groups. The upper contact of Besham group with Karora group is unconformable.

3.2.1.2 Karora Group

The term Karora Formation is used to describe a sequence of marine metasediments which was deposited unconformably over the Besham group. The unconformity is marked by metaconglomerate, which grades upwards into a thick unit of graphitic phyllite and in turn, is overlain by a jointed siliceous dolomite.

3.2.2 Besham to Chillas Section (N-35)

3.2.2.1 Kohistan Island Arc (KIA)

Kohistan is an intra-ocean island arc bounded by indus Suture Zone (Main Mantle Thrust (MMT) to south and in north by Main Karakrum Thrust (MKT). The central part of the arc arranged is mainly composed of Kohistan Batholith which comprises mainly gabbro, diorite and grano-diorite which are intruded by younger dykes and sills of leuco granites.

The southern part of Kohistan is composed of thick sequence of mafic and ultramafic rocks. These rocks may be divided into three tectano-metamorphic complex, separated by major thrust zone. The KIA is mainly comprised of Jijal, Pattan and Chillas complexes.

3.2.2.2 Jijal Complex

This is the suture zone of Indian plate at Kohistan Island arc, or upthrust slice of mantle which has come forward along suture zone. This suture zone is known as MMT. The composition of Jijal complex is peridotite and pyroxinite dunite. This garnet granulite facies metamorphosed complex is made up of ultramafic base and gabbroic top, persumbaly representing cumulates in the roots of the Kohistan arc.

3.2.2.3 Pattan Complex

Jijal complex is overlain by Pattan complex. It is slightly metamorphosed. It consist of ultramafic and mafic rocks. Mafic rocks are gabbro, diorite and gabbro-norite. The ultramafic rock is pyroxinite. It consists predominantly of amphobolites and subordinately of hornblende gneisses, diorites, granitoids with minor pegmatites and metasediments.

3.2.2.4 Chillas Complex

Ultramafic and gabbronorite rocks of the Chillas complex are intrusive into the top of the Kamila amphibolite belt. Generally separating the granitic belt from the southern amphibolite belt, this complex extends E-W for about 300km and attains a breadth of up to 40 km. More than 85% of it is made up of meta-gabbronorities; other lithologies include hypersthene quartz diorites, anorthosite, chromite layer dunnite and peridotites and retrograde amphibolities.

3.2.3 Naran to Chillas Section (N-15)

The location of MMT in the SE Kohistan was known only at two places, i.e., Jijal and Babusar Pass. The Main Mantle Thrust is a premetamorphic or synmetamorphic fault that dates the time of obduction as pre-late Eocene and possibly as early as Late Cretaceous. Obduction along the Main Mantle thrust is associated with west-southwest-vergent folds on the Indian plate. Sharda group at Kaghan Valley is exposed on the roadside from Batal to Babusar. Calc-pelites, massive and thick band marble, politic gneisses, graphitic gneisses, garnetiferous calc-pelites, feldspathised prophyroblastic Gneiss, migmatites and granite gneiss, Gittidas granite gneiss, Babun granite gneiss are present in Kaghan Valley.

It is largely comprised of metapelitic, metagreywack gneisses followed by thick amphibolitic layers and diorite dykes.

3.2.4 Swat-Kalam section (N-95)

The area is covered by various types of plutonic and a Iesser quantity of sedimentary and volcanic rocks. Quartzites, siliceous schist, phyllite, siltstone, shale and limestone of the Kalam Group (Carboniferous to Siluro- Devonion) are exposed in Matiltan - Kalarn area. Norites, diorites, and the associated rocks of the Kohistan Basic Complex (Late Cretaceous) cover a large area to the south of Kalam. They form a northeast trending belt that extends to the east in Indus- Kohistan and to the west in Dir. To the northwest, the Kalam Group is overlain by a thick sequence of silicic to intermediate lavas, tuffs and agglomerates (the Utror Volcanic Rocks) of probable Creto-Eocene age.

3.2.5 Dir -Chitral Section (N-45)

3.2.5.1 Gahirat Marble (Chitral section)

The Gahirat Limestone is a thick complex of ash grey marble grey, massive and contains coarsely crystalline marble. The rock units of Chitral area are dominated by argillaceous succession and carbonate units of Ordovician to lower Cretaceous age.

3.2.6 Murree -Kohala Section (N-75)

3.2.6.1 Murree Formation

The Murree Formation is composed of red thinly laminated siltstone, shale, clay, with subordinate intraformational conglomerate. The sandstone is fine to medium grained, pale green to grey, maroon coloured, calcareous and greywacke in nature. The beds of sandstone, clay or shale alternate with each other. This pattern shows a cyclic deposition.

4. Landslide Data Collection

4.1 Karakorum Highway (N-35)

The Karakorum highway (N-35) traverses through Himalayan-Karakoram mountain ranges in northern Pakistan which are one of the most rapidly rising mountain ranges on earth with extreme topographic and climatic environment. The route also touches along the largest glaciers outside the Polar Regions and therefore is also prone to the glaciers associated hazards. A combined impact of geo-hazards including earthquakes, landslides, debris flows, glacial erosion, flash floods, river incision, periglacial action and an unpredictable input of monsoonal rains make it a region of very high geodynamic activity. The existing Karakoram Highway (KKH), which is an important component of the China Pakistan Economic Corridor (CPEC) in near future, has been frequently subjected to damages, human loss and disruption by rock fall, sliding of debris and rock, debris flow, mudflow and flash floods. Different types of mass movements along the KKH, are triggered by natural factors including the presence of well-developed rock discontinuities, extensive unconsolidated deposits, high relief, steep natural slopes, occurrence of torrential rains and seismically active nature of the region. The anthropogenic factors including uncontrolled blasting for roads and buildings construction on slopes also contribute to the landslides in the region. These factors suggest that slope movements in the area will continue to occur and high risk to the highway despite the remedial measures. Moreover, the landslides often block the rivers/streams, resulting in natural dam such as the recent Attabad Lake, with devastating impacts on highway, geomorphic consequences and disturbing the entire river system of the region (Delaney and Evans 2017). The various types of landslides that affect the KKH include rock falls, topples, plane failures, wedge failures, debris slides, debris flows and mud flows (Kibria and Masud 2006). Moreover, the development and settlements in northern Pakistan is also concentrated along the KKH and therefore the lives of the inhabitants are also at high landslide induced risk. Therefore, it is of significant importance to evaluate and characterize the spatial and temporal distribution of the landslides along the KKH and assist the concern agencies in developing and implementation of the landslide mitigation activities. The landslides along the KKH have been extensively studied by different researchers (Hewitt 1982, Hewitt 1999, Korup et al. 2007, Hewitt 2009, Hewitt 2009, Hewitt and Liu 2010, Bacha et al. 2018, Khan et al. in press). Although the hazards associated with slope movements cannot be completely eliminated, however, their devastating impacts can

be minimized by assessment and evaluation of the prevailing hazards, their demarcation and monitoring. As a part of the study, 27 landslides were selected along the KKH (Figure 1) for their detailed characterization on the given template given in the annexure 1. The proposed mitigation measures are presented in Table 1.

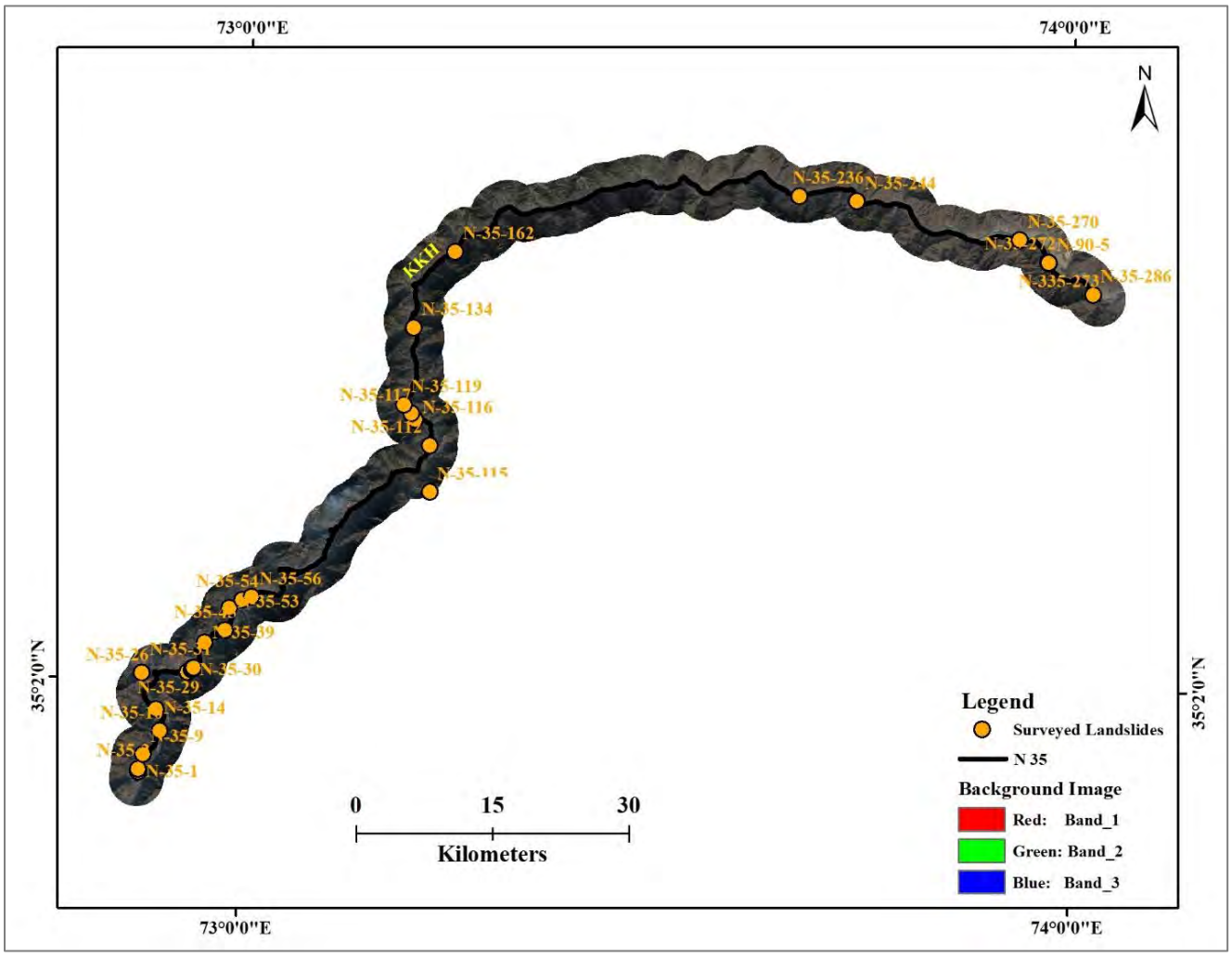

Figure 1: Location map of the surveyed landslides along the N-35

4.2. Murree-Muzaffarabad road (N-75)

The Murree-Muzaffarabad road **(**N-75) connects the Islamabad with Muzaffarabad and passes through the Murree and Abbottabad. The road is often damaged and disrupted due to frequent and damaging landslides. The geology of the region is mainly comprised of the loose and fractured Murree Formation which is mainly covered by mudstone, siltstone, sandstone and shales of Miocene age. The region is receiving abundant rains mainly during the monsoon season from July to September. The uncontrolled blasting during the road construction on fragile slopes has significantly reduced the shear strength of the slopes that ultimately leads to landslides during the rainfall. The road is used by the tourists aiming to the Murree and Galiyat which are the famous summer resorts. The road is also of significant importance as this is the preferred route to connect the Azad Jammu and Kashmir (AJK) with the rest of the country. The selected landslides along the route were mainly old that were triggered during the road construction. The slides become active mainly during the monsoon season. Due to the importance of the road, retaining walls are often constructed along the route to stabilize the slopes which are effective in some of the studied locations. Culverts and bridges are also constructed on streams passing through the road. Vegetation is also grown and check dams were constructed on two of the studies debris flows to stabilize the slopes and protect the road. However, the existing mitigation measures are not effective on the studied debris flows and therefore needs further attention from the concern agencies in designing and construction effective mitigation measures to minimize the negative impacts of debris flows. Monitoring and detailed characterizations of the selected landslides shall evaluate the prevailing risk and assist in forecasting the landslides. As a part of the study, 05 landslides were selected along the N-75 (Figure 2) for their detailed characterization on the given template given in the annexure 2. Proposed mitigation measures are presented in Table 2.

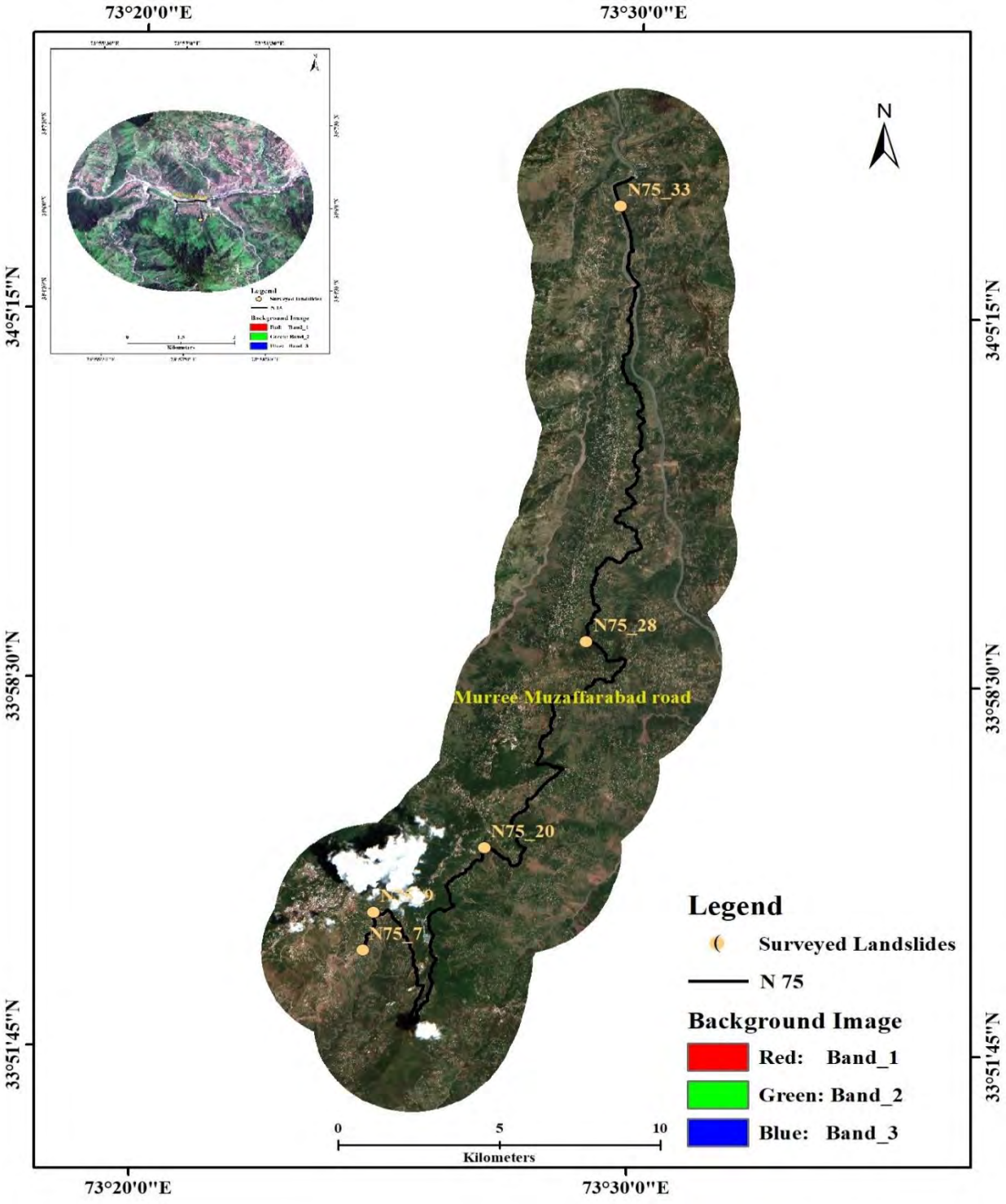

Figure 2: Location map of the surveyed landslides along the N-75

4.3.Naran-Chillas Road (N-15)

The Naran-Chillas road (N-15) connect the city of Balakot with the summer tourists resorts in Kaghan, Naran and Chillas. The region is frequently affected by landslides mainly due to active tectonics, high seismicity, fragile geology, and steep topography. The 2005 Kashmir earthquake also triggered many landslides along the N15, some of which are still active. Topographic features of the area are mainly mountainous, undulated terrain, and high relief. Shallow landslides on steep slopes are the common phenomena in the area (Basharat et al. 2016). Due to heavy snowfall in winter, the road is often closed during the winter season, however, heavy traffic mainly of tourists is present on the road during the summers. During the summer, the N15 is also utilized as a shortcut connection between the province of Gilgit-Baltistan and down country. The region is receiving abundant monsoon rains that also contribute in triggering the landslides. River cutting of the banks also trigger landslides in the area. Along the road, retaining walls are constructed on some of the landslides to protect the road from sliding, however, mitigation measures to stabilize the slopes are mostly lacking. As a part of the study, 11 landslides were selected along the N-15 (Figure 3) for their detailed characterization on the given template given in the annexure 3. Proposed mitigation measures are presented in Table 3.

Figure 3: Surveyed landslides along the N-15

4.4.Shangla-Swat Road (N-90)

The Shangla Swat road (N-90) connects the Besham and Swat. Active seismicity, monsoonal climate, rough topography and fragile geology contribute to frequent landsliding along the N-90. However, the landslides along the N-90 are mostly shallow in nature. Deep seated and old landslides were also observed along the road. An active debris flow is present along the road which is frequently obstructing the traffic and posing threats to the downstream community mainly during the monsoon season. Landslides along the N-90 are mostly slope failure with an active rock fall. Retaining walls were constructed to protect road from sliding, however, mitigation measures to stabilize the slide is lacking. As a part of the study, 05 landslides were selected along the N-90 (Figure 4) for their detailed characterization on the given template given in the annexure 4. Proposed mitigation measures are presented in Table 4.

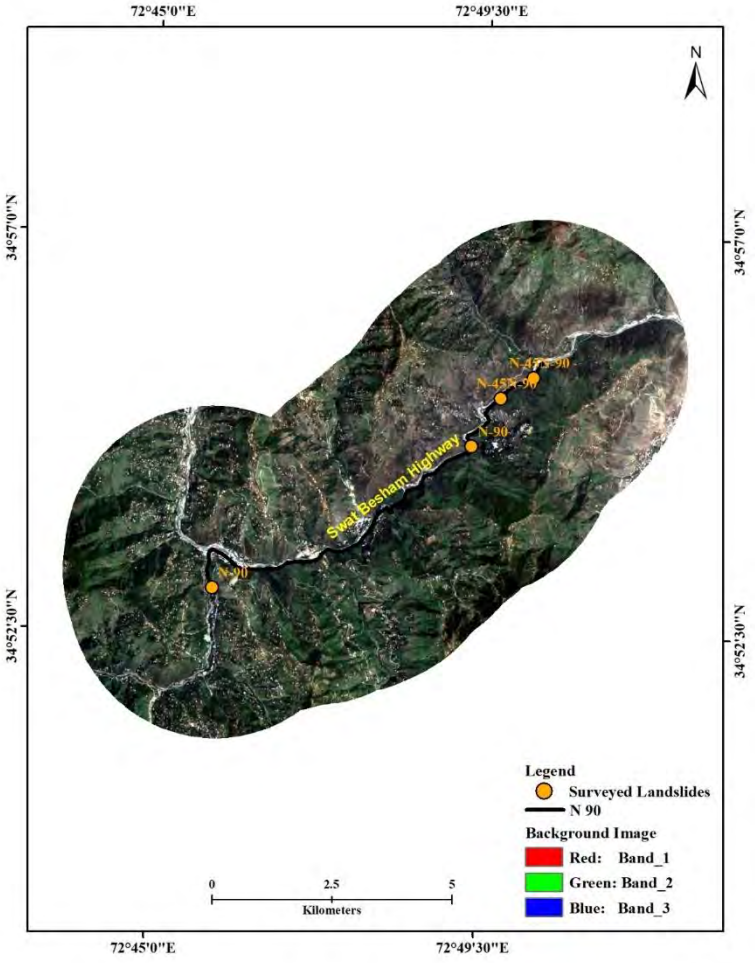

Figure 4: Surveyed landslides along the N-90

4.5. Kalam Road (N-95)

The Kalam road (N-95) connects the Khawzakhela town with the summer touristic sites of Kalam and Bahrain in the District Swat. The road was severally affected by the 2010 mega flood. Most of the road was swept away during the flood. Currently extensive repair work in underway to rebuild the road. Due to active tectonics, rough topography and anthropogenic activities on the steep slopes, the region is frequently affected by landslides. Active deforestation is triggering extensive surface erosion that eventually leads to landslides. Extensive scree slopes are present along the road that are slided to the road during the road repair and rainfall. Complex landslides were also present along the Kalam road comprising of rock fall at the slide crest and the detached debris act as a debris fall and flow during the rainy season. Retaining wall is built along the road to protect the road from river cutting, however, mitigation measures are lacking to stabilize the road or protect the road from landsliding. As a part of the study, 5 landslides were selected along the N-95 (Figure 5) for their detailed characterization on the given template given in the annexure 5. Proposed mitigation measures are presented in Table 5.

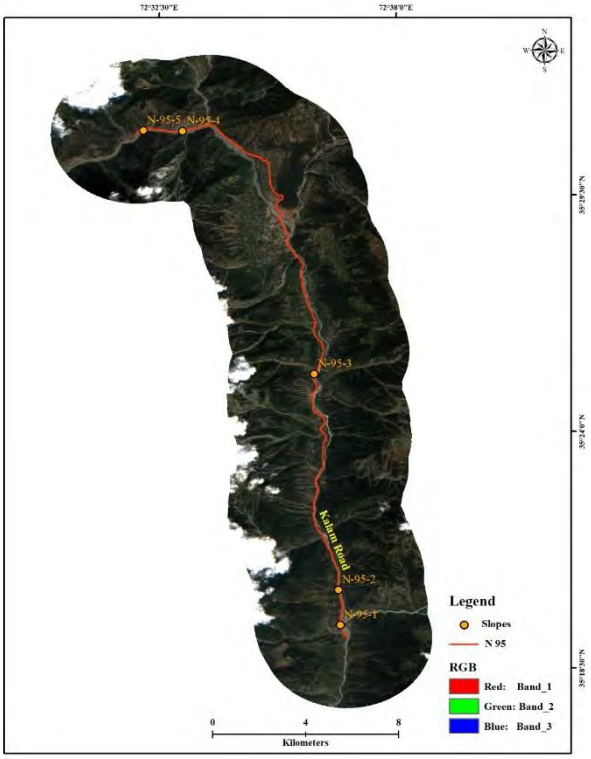

Figure 5: Surveyed landslides along the N-95

4.6. Dir-Chitral road (N-45)

The Dir-Chitral Road (N-45) connect the district of Chitral with the down country. Due to rough topography, active seismicity, fragile geology and anthropogenic activities on steep slopes, the region is witnessed to frequent landslides. Most of the landslides along the N-45 are shallow landslides which are mostly triggered during the rainy season.

As a part of the study, 5 landslides were selected along the N-45 (Figure 6) for their detailed characterization on the given template given in the annexure 6. Proposed mitigation measures are presented in Table 6.

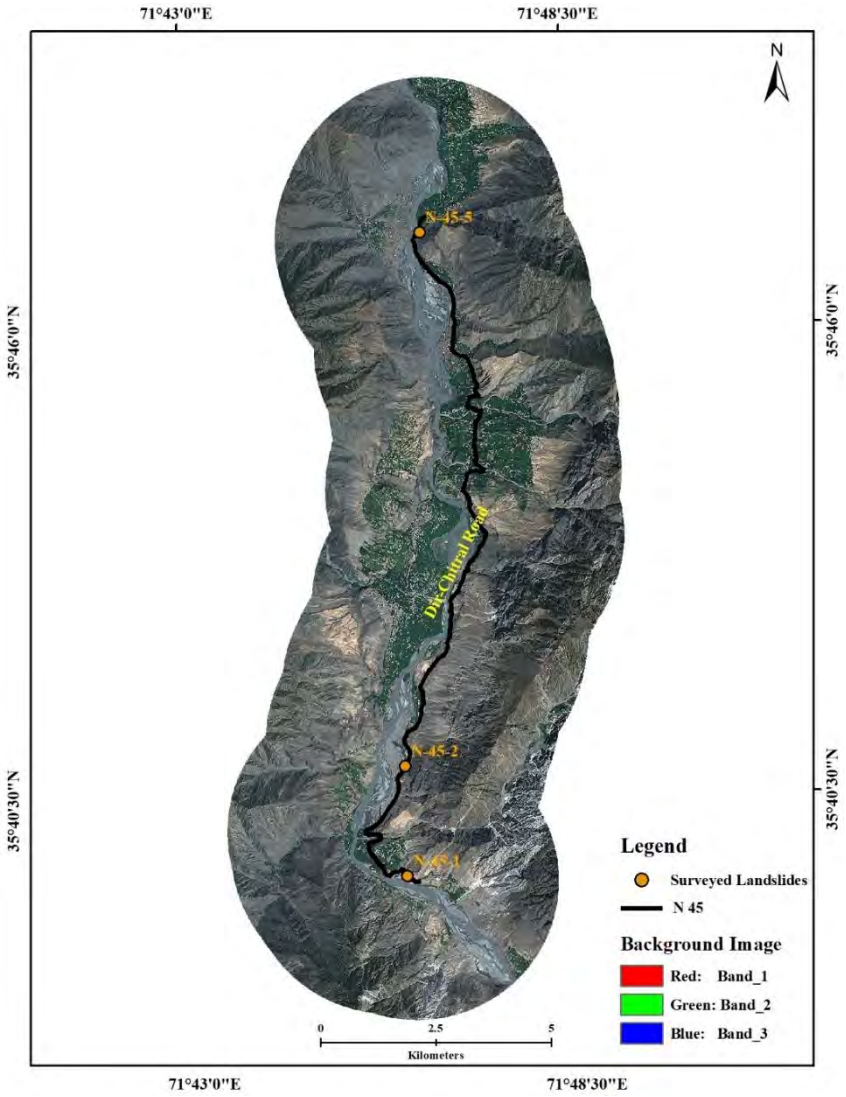

Figure 6: Surveyed landslides along the N-45

5. Recommendations

1. A detailed study of the high risk landslides for their geotechnical and geophysical characterization and long term monitoring is strongly recommended. The study shall assist to evaluate and understand their deformation pattern and triggering mechanism. The study shall also assist to establish the triggering precursors for the landslide activity to assist the government agencies in predicting the landslides. Based on the derived results, a team of relevant experts comprising of earth scientist, geologists, engineering geologist, and civil engineer shall survey the high risk landslides and suggest mitigation measures.
2. A monitoring team of relevant experts shall be designed to regularly monitor the high risk landslides and monitor the prevailing condition and existing mitigation measures and accordingly suggest the repair of existing measures of suggest new mitigation measures.
3. A scientific research teams shall be established in the NHA and FWO for the landslides induced hazards, vulnerability and risk evaluation along the major road network in the country. The team shall establish a close liaison with the relevant academia in the country to utilize their expertise and resources in understanding the nature, causative factors and triggering mechanism of landslides in different parts of the country.
4. The historic record of the landslides activity along the road network shall be established and regularly updated. Such record shall assist the correlate the temporal landsliding activity with the weather and technic records to assist in landslides hazard assessment.
5. The road construction, extensions and repair in the landslides prone regions, shall be executed under the supervision of the landslides experts to minimize the negative impacts of landslides.
6. Public awareness campaign shall be launched in the landslide prone regions. Through local language pamphlets, print and electronic media the devastating impacts of landslides, the causative and triggering factors and possible mitigation measures shall be shared with the public. The afforestation shall be encouraged and deforestation shall be strongly discouraged. A close liaison shall be established between the local community and the concern agencies to share the information of the changing behavior or active deformation of the landslides. The community shall be warned of possible landslides prior to a rainfall event or rainy season to minimize the damages to the infrastructure and human lives.

7. Regular regional scale landslide monitoring/inventories shall be established with the relevant academic institutions mainly through satellite or air borne remote sensing data. Recently the European Space Agency (ESA) has launched the free satellite data from the Sentinel-II mission with 10 m spatial resolution and 5 days temporal resolution. Such data resource can be effectively utilized to regularly monitor the dynamics in the landslides from local to regional scale. For detailed characterization and mapping the Unmanned Survey Vehicles (UAV) shall be utilized in high risk landslides.

Table 1: Proposed Mitigation measures for studied slopes along N-35 (Besham to Chillas)

S#	ID	Location	Type	Proposed Mitigation Measures	Description	Priority
01	**N-35-01**	34°56'26.6" 72°52'40.3"	Slope Failure	Retaining Wall	This slope failure is actually cut slope due to the excavation for N-35 and link road above the scarp. Meta-sedimentry sequence of besham basement group is exposed along the cut slope. The rock is highly jointed and cracked. Three gullies has marked towards the valley side. Erosion along these gullies is endangering the stability of N35. Retaining wall is partially damaged.	Medium
02	**N-35-02**	34° 56' 36.1" 72° 52' 40.6"	Debris Flow	Construction of culvert, Construction of check dams on upstream	A seasonal stream crosses the highway at this location. Small catchment area with debris fall/rock fall material are present on the upstream. Small landslide was also observed along the stream which contribute in the debris volume. Granite is exposed along the stream. Various boulders of granite size more than 1 m3 has also been observed. The culvert has been blocked due to debris material along this channel.	Medium
03	**N-35-09**	34°57'28.1" 72°53'1.8"	Slope Failure	Development of Drainage Channels and Construction of Retaining Wall	The landslide is located on N35. This is an old landslide that was triggered during the road construction. The landslide has active surface erosion mainly induced by the rain water and therefore gullies are present on the landslide body. On the slide, detached boulders are present that are prone to slide during a rainfall and can damage the road and traffic. The landslide is void of any trees. The slide scarp is visible. A culvert was constructed to drain the rain water from the slide, however, it is buried by the sliding debris. Tensions cracks were visible on the slide. The rainwater from the slide is flowing on the road and therefore damaging the road. The rain water needs to be properly drain out to protect to road. No mitigation measures are constructed to stabilize the landslide.	Medium

04	**N-35-10**	34° 58' 53.2" 72° 54' 11.3"	Debris Flow	Construction of culvert, Construction of check dams on upstream	The debris flow is located on N35. It is a historically active debris flow with continuous flowing water. The water seeps beneath the road and through could lead to potential disaster and significant damages to the road. The source area of the DF is void of any vegetation except some shrubs and bushes with steep gradient of 30-40 degrees. Detached boulders, gravels, sand and silt was present at the toe of the DF above the road. During the rainy season it become active and often leads to damages to road and disruption of the traffic. Part of the DF is also prone to rock fall and slope failure. The source of the DF is a V shaped valley. No mitigation measures is constructed to protect the road from the flowing debris. Bedrock of the DF is granitic. Cracks were present on the road and therefore need effective mitigation measures to protect the road from damages.	Medium
05	**N-35-14**	35°00' 11.9" 72°53' 53.90"	Slope Failure	Construction of retaining wall	This rotational landslide is located on N35. It is historically active slope failure. The slide was mainly triggered during the 2005 earthquake and also reactivated during the torrential and prolonged monsoonal rains of 2010. The slide also become active during the rainy seasons. The scarp and upper parts of the slope is partially stable with thick vegetation. However, the portion of the landslide close to the road is still active and prone to frequent sliding and rock fall and therefore posing threats to the road. Many detached boulders and gravels are hanging on the slope posing threat to the road and traffic. No mitigation measures are constructed to protect the road from the fallen rocks or debris. Bedrock of the slide is fractured and weathered granitic rocks. Water erosion leads to development of gullies on the slide.	High

06	**N-35-26**	34° 02' 19.4" 72° 52' 49.3"	Rock Fall/Slope Failure	Retaining Wall/ Rock bolting, Wire mesh	The slide is active rock fall and cut slope posing great and frequent risk to road. Bedrock of the slide is highly fractured and weathered pyroxinite. The slide has hanging boulders and gravels posing threats to road and traffic. Some sections of the slide are very steep with slope of around 60 degrees. Slide is void of vegetation. During the rainy season the slide is also prone to debris flow comprising of boulders, gravels, sand and silt. Rock fall is planar in nature. Water seepages is observed on the right flank of the slide. Intersecting joints leads to wedge failure. Drainage is developed on the slope and at the stream outlets fan shaped talus are developed. No effective mitigation measures are constructed for the rock fall.	Medium
07	**N-35-28**	35° 02' 25.7" 72° 56' 6.8"	Slope Failure	Construction of shed/ Drainage diversion	This is an active slope failure and rock fall. The failure has historically affected the road. The wedge shape failure is found on the slide. Detached boulders and gravels are hanging on the slide that combine with the sand and silt leads to debris flow during the rainy season. The slide is void of vegetation. Bedrock is highly fractured and jointed pyroxinitic rocks. Drainage is developed on the slide and active weathering and erosion leads to development of gullies on the slide. Retaining wall is constructed to stabilize the slide, however, the right side of the retaining wall is already damaged. Rainfall is the major trigger for the slide and therefore leads to road damages and disruption of traffic during the rainy season. One of the trigger of the slide is also the freeze and thaw phenomenon. Since this slide is frequently damaging and disrupting the slide and therefore needs quick and comprehensive mitigation measures to minimize its impact on road.	High

08	**N-35-29**	35° 02' 34.9" 72° 56' 23.7"	Rock Fall	Retaining Wall, Rock bolting	The slide is an active rock fall. The exposed bedrock is comprised of exposed pyroxinite rock. The bedrock is highly deformed and jointed. Tension cracks were visible on the slide. Boulders and gravels were detached and hanging on the slide and therefore posing threats to the road and traffic. Rainy water induced surface erosion leads to development of gullies on the slide. Intersecting joints leads to wedge failure. Talus is visible at the slide toe. No mitigation measures is adopted to stabilize the slide. However, retaining wall is constructed to protect the road from sliding.	Medium
09	**N-35-30**	35° 02' 42.2" 72° 56' 27.1"	Rock Fall	Retaining Wall/ Rock bolting, Wire mesh	The slide is an active rock fall/slope failure. Gullies were observed on the slide. Talus deposits were noted at the end of the developed gullies. Wedge failure is observed on the slide. Detached and hanging boulders and gravels were observed on the slide that are prone to fall during rainy season or moving cattle and posing threat to road and traffic. Many vehicle were reportedly damaged due to fallen rocks. No mitigation measures is adopted to stabilize the slide or protect the road/traffic from falling rocks. A retaining wall is constructed to support the road. The pyroxinitic bedrock is exposed and therefore void of any vegetation.	Medium
10	**N-35-31**	35° 02' 42.2" 72° 56' 33"	Slope Failure	Retaining Wall	This is a deep seated multiple rotational landslide. The main body of the slide is consolidated with shrubs and grass. However, the toe of the slide which is close to the road is active due to road cutting. On the slide, detached boulders are present posing threats to the road and traffic. Active erosion on the landslide debris leads to development of gullies. Bedrock of the slide is proxininite. The slide is frequently affecting the road, however, no mitigation measures are built to stabilize the slope or the road. On the slide body benching are made by the local people mainly for the agriculture purposes. Dip direction is NW and dip angle is 40-50 degress. The slide is void of thick vegetation.	Medium

11	**N-35-39**	35^{O} 04' 13" 72^{O} 57' 19.6"	Debris Flow	Construction of culvert, Construction of check dams, Construction of retaining wall	This is an active DF with well develop erosion channels. The DF has huge source area. The lying debris of the DF are consists of boulders, gravels, sand and silt. The accumulated poorly sorted debris in the erosion channels are already failed and still prone to slope failure. The DF has continuous flowing water, however, the water seeps beneath the road and appears again on the valley side of the road and therefore the road is prone to a disaster. No trees are present in the source area of the DF, however, shrubs and bushes are sparsely present. Boulders are mainly of Dunite and Amphibolite. The DF is frequently affecting the road, mainly during the rainy season. However, no mitigation measures are adopted to drain the water and protect the road from flowing debris. A retaining wall is constructed on the valley side of the road which is also partly damaged. Part of the source area of the DF is also prone to rock fall with detached and fragmented boulders that could also reach to the road and therefore also posing threat to road and traffic.	Medium
12	**N-35-45**	35^{O} 04' 57.3" 72^{O} 58' 45.7"	Slope Failure	Construction of retaining wall	This is an active slope failure of lose debris comprising of boulders, gravels, sand and silt. The scarp of the slope failure is clearly visible and still prone to rock failure due to presence of detached, weathered and jointed rocks. Presence of the loose debris in the upstream of slide also cause debris flow during heavy rains. Shrubs and grasses are present on the debris however, no trees are present. Active erosion and weathering on the slide leads to development of gullies. Detached boulders are present on the loose debris that often reach to the road and therefore posing threat to the road and traffic. The landslide is frequently affecting the road, mainly during the rainy season, however, no mitigation measures is constructed to stabilize the slope or protect the road from flowing and falling debris. Bed rock is composed of fragmented and jointed Dunite. Loose talus deposits are present on above and below the road.	Medium

13	**N-35-53**	35^{O} 06' 17.7" 72^{O} 59' 3.6"	Slope Failure	Construction of retaining wall	This is a deep seated multiple rotations landslide. The main body of the landslide is consolidated with presence of grasses, however, the left and right flanks of the landslide is activated mainly due to the road cutting. The debris of the slide is mainly comprised of boulder, gravels, silt and sand. Active erosion on the slide debris leads to development of well-developed gullies. Hanging boulder are also present in the debris that pose threats to the road and traffic. The slide is mainly activated during the rainy season and the loose debris can also leads to debris flow. Despite the continuous damages of the road and disruption of the traffic due to falling debris and rocks, not mitigation measures are adopted to stabilize the slide. A retaining wall is constructed to protect the road, however, it is also buried by the falling debris. A house is located on the ridge of the slide. Tension cracks and open joint are present on the slide. Talus is present on the upper and lower side of the road. Slide is void of any thick vegetation.	Medium
14	**N-35-54**	35^{O} 06' 48.3" 72^{O} 59 ' 59.7"	Slope Failure	Retaining Wall, Wire Mesh, Rock Bolting	This is a complex landslide comprising of rock fall, debris flow and slope failure. Active erosion on the loose material leads to development of deep gullies that often leads to debris flow during rainy season. The exposed bed rock on the left flank of the slide has detached, fractured and jointed boulders that are prone to rock fall and therefore posing threats to the road and traffic. Three roads are passing through the slide at different heights. However, no mitigation measures are constructed to stabilize the slide. A retaining wall is constructed on the valley side of all the three roads. Tension cracks were present on the slide and it is void of thick vegetation. Talus is present above and below the road.	Low

15	**N-35-56**	35° 06' 59" 73° 00' 39.8"	Slope Failure/ Rock Fall	Retaining Wall, Wire Mesh, Rock Bolting	An active rotational complex landslide comprising of slope failure, Debris flow and rock fall. Weather, jointed and fractured overhanging bed rock are posing threats to the road and traffic. Active weathering and erosion leads to development of gullies. Debris flow induced erosion tracks are well developed. Talus material comprised on boulders, gravels and sand is present. Bed rock is comprised of Amphibolite. Although it is posing threats to the road, however, no mitigation measures are adopted. This LS needs quick attention from the concern authorities as on the valley side a medical hospital is built which is also prone from the rock fall.	Medium
16	**N-35-112**	35° 16' 12.3" 73° 13' 23.6"	Rock Fall	Wire Mesh, Rock Bolting	An old rock fall however no signs of fresh rock fall. A steep cliff with jointed, fractured and detached boulders. Intersecting joints leads to wedge. Cracks are open. Bed rock is amphibolite. No mitigation measures are adopted. Houses are located on the top of the ridge. A hospital is located at the valley side of the slide and therefore needs quick attention from the concern authorities.	Low
17	**N-35-115**	35° 13' 26.1" 73° 13' 25.2"	Slope Failure/ Rock Fall	Retaining Wall, Terracing	An active slope failure and rock fall. Originally a rock fall, however, talus of 16 m is accumulated at the rock fall toe that is prone to slope failure now. Active weathering and erosion on this talus deposits leads to development of gullies. On the rockfall cliff there are many jointed and detached boulder that poses threats to road and traffic. Wedge cutting is observed. Weathering becomes active during the rains and affecting the road. However, no mitigation measures are constructed. A retaining wall is built at the left flank of the slide, however, it is also not enough to stabilize the slide	Medium
18	**N-35-116**	35° 17' 42.9" 73° 12' 15.5"	Slope Failure	Tunnel	The site (Chochang) has a history of road blockade in past. It is a historical landslide, which is reactivated many times. Initially it was rockfall but now it is slope failure in debris/talus deposit. Deposit comprises of some boulders of size >6 m^3. Geology of the site is characterized by presence of Kamila Jal Shear zone on backside, which results in intense fragmentation of Kamila Amphibolite.	High

19	**N-35-117**	35° 18' 5.4" 73° 11' 58.6"	Slope Failure	Retaining Wall, Culvert, Terracing	An active debris fall from an old lake deposits. The talus cone is present in the valley. Active erosion on the talus leads to development of gullies. Water is flowing through the talus and also seeps in the debris. Hanging boulder are present in the debris. The slide is active during the rainy season and can also leads to a debris flow. It is damaging the road, however, no mitigation measures are adopted to protect the road. Trenches are made on the talus to stabilize the debris.	Medium
20	**N-35-119**	35° 18' 35.8" 73° 11' 26.8"	Rock Fall	Construction of shed	It is impression of old rockfall. Lithology at this site is Kamila amphibolite, which is highly jointed and sheared due to closeness to KJS. Uncontrolled blasting for road excavation triggered this site. In addition to it, river is eroding the valley side of the road resulting in over steepening of the slope towards valley side. There is retaining wall towards valley side for road protection. No countermeasures for rockfall has been constructed.	Medium
21	**N-35-134**	35° 23' 12.3" 73° 12' 2.3"	Rock Fall/Slope Failure	Retaining wall, Rock bolting	Uncontrolled blasting for road excavation triggered this slope. Lithology is Granulite, which is highly sheared and fragmented rockmass. Slope is collecting a lot of surface runoff due to large catchment area, further leading into gully erosion.	Medium
22	**N-35-162**	35° 27' 46.4" 73° 14' 56.9"	Rock Fall/Slope Failure	Retaining wall, Drainage Control	The site is characterized by highly jointed Gabbro and talus deposit on slope. This talus deposit contains some boulders of size equal or greater than three m^3. Slope failure mostly occurs during rainfall when rainwater is infiltrated into deposit. Gully erosion is prominent in debris/talus.	Medium
23	**N-35-236**	35° 31' 23.8" 73° 39' 59.5"	Slope Failure	Construction of retaining wall, Development of benching, Plantation	Large Talus slope with multiple scarps within the main slope failure. Small bushes can be seen on the talus deposit. During rainfall, the talus slope failure makes this site vulnerable for the continuity and safety of N-35. Due to this surface runoff, gully erosion are visible and prone to debris flow. Retaining wall about 4 feet high was built to minimize the risk but it has been damaged due to recent activity.	High

24	**N-35-244**	35° 31' 8" 73° 44' 9.3"	Rock Fall/Slope Failure	Construction of Retaining Wall, Culvert	Boulders of 2m^3 at toe indicates rockfall upslope. Small channel passing through slope bringing debris material hence making the gully on the slope. Gabbro of Kohistan batholith is exposed which is crushed and jointed. This crushing and jointing alongwith the blasting for N-35 are the main triggering factors of this slope.	Low
25	**N-35-270**	35° 28' 55.5" 73° 56' 03.1"	Debris Flow	Construction of culverts, Construction of retaining walls	Mouth of channel is very wide near road forming a fan shaped structure containing boulders of different sizes and some of size 2-3m^3. Channel divides into two near the road: a) Eastern channel having culvert box b) Western Channel without protection Sides of channel are steep having overhangs.	Medium
26	**N-35-272**	35° 27' 38.1" 73° 58' 9.4"	Debris Flow	Construction of Culvert / Construction of Bridge	Two channels with large catchment area. The 272 contains small quantity of debris as compare to 273. The 273 contains considerable amount of debris containing some boulders of size 0.5 m3, which can threaten stability of the highway. Further, valley side of channels is very steep due to river erosion. Paved drainage path on valley side is protecting from erosion on valley side.	Medium
27	**N-35-273**	35° 27' 33.5" 73° 58' 11.2"	Debris Flow			
28	**N-35-286**	35° 25' 43.1" 74° 01' 25.5"	Rock Fall	Rock Bolting, Wire Mesh	The site is characterized by jointed gabbro. Three joint sets with average joint spacing 1-2 meters exists leading to wedging failure. Furthermore, the presence of overhangs is increasing vulnerability of the site. Talus deposit is present in gully and is flooded on the road during or after rainfall	Medium

Table 2: Proposed Mitigation measures for studied slopes along N-75 (Murree to Kohala)

Sr. No	ID	Location	Type	Proposed Mitigation Measures	Remarks	Priority
01	**N-75-07**	33° 53' 34.5" 73° 24' 38.0"	Landslide	Continuous monitoring of landslide displacement and establishment of early warning system	The N-75-7 passing through a very big old landslide which comprises almost 3 km^2 area. Lithology of the site is characterized by claystone, siltstone and sandstone of Miocene Murree Formation. The scarp of the landslide clearly indicates that it is an old landslide. This landslide has been reactivated many times in the past, consequently, small landslides were also observed within the landslide. The upper part of the slide is stable, however, at the toe the landslide material has been reactivated and there is potential for future landslide. A small landslide on the right side has been reactivated and consider as a potential threat to the road in future. Although, the retaining walls were built to protect the road. However, the displacement upto 4 cm has been observed in the retaining wall.	Low
02	**N-75-09**	33° 54'15.9" 73° 24' 51"	Debris Flow	Redesigning and construction of existing culvert, construction of check dams on the upstream, Development of proper drainage control network.	A seasonal stream crosses the highway at this location. Stream brings huge volume of debris every year. During 2007, the debris flow damaged the road completely. Big catchment area with debris fall/rock fall material are present on the upstream. Small landslides were also observed along the stream which contribute in the debris volume and have potential to damage the road in future. Sandstone bed along the left side of the stream is dipping towards the channel. Various sandstone boulders of size more than 2 m3 has also been observed. The bridge and culvert has been damaged in the past due to debris flow along this channel.	Medium
03	**N-75-20**	33° 55' 28.9" 73° 27' 3.5"	Debris Flow	Construction of culvert, Development of proper drainage control network.	The site is marked by the presence of landslide and debris flow. Geology of the site is characterized by active fault and highly jointed claystone and sandstone. Due to erosion along two gullies debris material has been found in the stream bed. Beside, debris flow, there is also a potential landslide. Large open crack on the top indicates its future potential failure. The debris flow and landslide are in dangering the stability of the road. Small retaining walls has been constructed to protect the road. Along the stream small benching were made to minimize erosional effects.	Medium

04	**N75-28**	33° 59' 16.6" 73° 29' 2.7"	Debris Flow	Construction of check dams on the upstream	The site is located on a seasonal stream, where road has very sharp bend. Sides of the upstream are bounded by alternative beds of sandstone and claystone. Some boulders of size greater than 3 m3. The culvert has been constructed for the debris outflow. Vegetation is also present on both sides of the stream. As a countermeasure benching on upstream side was made which is partially damaged. Downstream side retaining walls are also present. No historic debris flow and blockage of road has been found	Low
05	**N75-33**	34° 7' 14.9" 73° 29' 35.4"	Slope Failure	Shed has been already constructed , Development of benching, Plantation of deep rooted species	Landslide was initially triggered during 1992 flood. In March 2012, landslide was reactivated during the heavy rainfall. The landslide completely destroyed 200 meter road. The continuity of traffic along this road was disrupted more than one week during March 2012. This section is cut slope consisting of sandstone and shale . The slide is still active. There are large number of open cracks and boulders. As a countermeasure NHA has constructed the shed to protect the road from debris material.	Low

Table 3: Proposed Mitigation measures for studied slopes along N-15 (Naran to Chillas)

Sr. No	ID	Location	Type	Proposed Mitigation Measures	Remarks	Priority
01	**N-15-04**	34º 55′ 43.4″ 73º 40′ 51.4″	Landslide	Retaining Wall	This landslide is located along N-15, about 3 km away from the Naran town. It is an old rotational landslide which has been reactivated due to road construction and rainfall. The upper part of the landslide is stable with vegetation cover, however, the landslide is active at the toe. Thick forest is also present on the left side of the slide. Due to re-activation of this slide about 100 meters road has been affected. Above the road the landslide scarp is clearly visible. Many detached boulders are hanging on the landslide scarp that can damage the road and the continuity of traffic. The boulders comprising of granite and schist ranges between 1-3 m3 size was present. A retaining wall above 2 m height has been constructed to protect the road from the slide material. However, the central part of this retaining wall has been damaged due to the reactivation of the slide material. Presently, there is no high risk to damage the road, however, in the future if the whole mass of the landslide body will move, lead to the damage and block the road for the continuity of traffic. For mitigation purpose, a retaining wall with a height of 5 meters has been suggested with proper drainage control.	**High**
02	**N-15-08**	34º 56′ 17.8″ 73º 40′ 51.4″	Debris Flow	Culvert	This is an active debris flow with large catchment area. The debris flow origin appears from the glacier valley. The debris material mainly comprises boulders, cobble, gravel, sand and silt. The size of the boulders ranges upto 5 m^3. The debris flow has a large amount of water in the channel posing great and frequent risk to road. Very huge material is present on both the sides of the erosional channel. The gabion wall has seen at the mouth of the channel to control the debris, however, no culvert has been constructed for the outlet of the water and debris flow material. Therefore, this debris flow posing a significant threat for the continuity of traffic on the road, particularly during heavy rainfall. According to the local inhabitants a very serious debris flow disaster occurred after every five years at the site. For the mitigation measures it has been suggested to construct the culvert for the outlet of the water flow and develop the erosional channel properly.	**Medium**
03	**N-15-09**	34º 56′ 22.4″ 73º 42′ 45.6″	Debris Flow	Culvert	The debris material might be active during the rainfall and can also lead to a debris flow disaster in future. Presently, the water is flowing through a narrow channel and along the road it is diverted through channel to reduce its impact on road damage. The loose debris comprises boulder, cobble, gravel, sand and silt. It is likely that future debris flow will continue along the slope. A retaining wall is constructed to protect the	**Medium**

					road which is also partly damaged. However, no countermeasures have been taken to drain the water and protect the road from the debris material. The debris flow posing risk of road damage in future.	
04	**N-15-24**	34º 56′ 19.9″ 73º 50′ 59.7″	Slope Failure	Develop the drainage control system	This slope failure is located about 100 meters away from the N-15. It is an active slope failure of loose material composed of boulder, cobble, gravel, sand and silt. On the back of the slope failure steep cliff is comprised of metamorphic rocks. Any impact to damage the road from the slope failure has not been observed. On the right side of the slope failure man made terraces has been formed. Active erosion on the slope leads to the development of the gullies. A retaining wall is built to protect the road, however, no mitigation measures have been taken to stabilize the slope failure. The slope failure is not being considered to endanger the road.	**Low**
05	**N-15-34**	34º 58′ 15.8″ 73º 55′ 37.1″	Debris Flow	Construction of Bridge	This is an active debris flow with large catchment area and flowing great amount of water. The debris is being mainly comprised of large boulders up to 5 m^3 size. The loose material is present on both sides of the erosional channel. About 60 meters road has been damaged due to this debris flow. The debris flow has continuous water flowing on the road. A retaining wall is constructed to protect the road, however, no mitigation measures have been taken for the outflow of the water. To protect the road from this debris flow in the future, the construction of the bridge has been suggested for the outflow of debris material.	**High**
06	**N-15-53**	35^0 4′ 28.0″ 73^0 56′ 17.9″	Landslide	Retaining Wall	This is an old rock avalanche which triggered due to any tectonic activity in the ancient time. It is presumed the rock avalanche has blocked the stream and created a lake which is known as Lalusar Lake. A channel has been constructed for the outflow of the water from the lake. The rock avalanche material is mainly composed of granite and granite gneisses. The huge boulders are present at the site up to more than 10 m^3 sizes. Presently, this rock avalanche has no impact on the road, however, in future if rock avalanche material will be remoblized it may block the water channel and disrupt the road. A retaining wall has been constructed to protect the road.	**High**
07	**N-15-61**	34^0 05′ 46.6″ 73^0 57′ 17.0″	Debris Flow	Culvert	This is an active debris flow located at the sharp bend along N-15. Presently, the erosional channel is covered with glacier and road has been severely damaged. The debris flow has very large surface run off with steep gradient. The water seeps beneath the road and boulders ranges between 1-3 m^3 are present in the channel towards valley side. Due to this steep gradient debris flow posing serious debris flow disaster which cause to damage the road and discontinuity of the traffic. A culvert is constructed for the out flow of the water, however, it does not fulfill the requirement. The active landslides were also observed both side of	**High**

					the river bed along the road posing risk to damage the road. A retaining wall is constructed to protect the road which has been damaged due to the debris flow. For the mitigation purpose, a culvert for the outflow of the water and debris material should be redesign and constructed.	
08	**N-15-72**	35^0 11′ 2.3″ 74^0 02′ 38.1″	Debris Flow	Depth of Channel Should be increased	The debris flow is located along N-15 with large surface runoff. The debris flow origin appears from the top of the Babusar (13700 feet asl). This debris flow has very large catchment area and long run-out. It is a permanent stream with flowing water through out the year. The main source of water in the stream is glacier and springs. The shallow channel has been observed. A culvert has been constructed for the out let of the water, however, according to the local inhabitant during the heavy rain fall the water is following on the road. Man made terraces at the side of the stream has been developed. No damage of the road has been observed at the site. The width of the river bed is about 50 meters. The size of the boulders in the stream ranges between 1-5m^3. Retaining wall has been constructed to protect the road. For the mitigation purposes depth of the channel should be increased for the outflow of the debris material.	**Medium**
09	**N-15-75-1**	35^0 15′ 36.0″ 74^0 05′ 28.1″	Debris Flow	Construction of Shed	This is an active debris flow along N-15. The debris flow event occurred in July 2017 due to a very heavy rainfall in the area. The debris flow origin from the cliff and lead to a serious debris flow disaster. According to the local inhabitant, three vehicles and local irrigation system have been damaged and road has been blocked more than a week. After one week the material has been removed from the road for the continuity of the traffic. The debris flow has very long run-out and transported a huge debris material which covered the entire road section. Still huge material is deposited along the road site. Large size of the boulders ranges between 1-5m3 are present at the site. The boulders are comprised gabbro diorite and granitic rocks. It has been observed the debris flow is drained by the seasonal water. The gradient of the erosional channel is very steep and lead to potential in future disaster and significant damage of the road. The area is still very unstable and there is a high potential for more events occur. In future, there is possibility this debris flow block the Thak Nala and create a landslide dam. A retaining wall is constructed to protect the road which has been damaged due to this debris flow. For the mitigation purpose the construction of shed has been suggested to protect the road in the future.	**High**
10	**N-15-75-2**	35^0 15′ 40.2″ 74^0 05′ 28.2″	Debris Flow	Construction of Shed	This active debris flow also occurred in July 2017 during heavy rainfall at the 100 meters away from the previous location. The debris flow leads to similar disaster as N-15-75-1. Due to this debris flow about 60 meters road has been partially damaged. The source of the debris flow	**High**

					has very steep cliff. The debris flow comprises two water channel, however, both channels have been drained by seasonal water. The erosional channel has a very steep gradient. Detached boulders of the size range between 1-5m3 was present in the channel and large number of boulders are still hanging along the road that lead to further disaster. The area is still very unstable and there is a high potential for more events occur. Due to the recent debris flow no mitigation measures have been taken to protect the road. Therefore, construction of shed is suggested to protect the road in the future.	
11	**N-15-78**	35^0 21′ 18.8″ 74^0 08′ 18.8″	Debris Flow	Culvert	This debris flow is located on N-15. It is an old debris flow with large catchment area. The unconsolidated debris material is present both sides of the erosional channel. A temporary house is constructed in the middle of the stream and is prone to disaster. No countermeasures have been taken to avoid the debris material on the road. Therefore the road has been damaged due to this debris flow. Presently water is not flowing in the stream, therefore, the stream has been drained by seasonal water. It is likely that future debris flow will continue on the road. For the mitigation purpose construction of the bridge or a culvert has been suggested for the smooth outflow of the water and the debris material	**Medium**

Table 4: Proposed Mitigation measures for studied slopes along N-90 (Besham to Shangla)

S#	ID	Location	Type	Proposed Mitigation Measures	Description	Priority
01	**N-90-01**	34° 52' 59.2" 72° 45' 0.17"	Rock Fall/Slope Failure	Retaining Wall/ Rock bolting, Wire mesh	This is a cut slope mainly triggered due to road construction. Active erosion is present leading to water gullies. Eroded talus is present along the road. Detached boulders are present on the slide. Part of the slide is prone to debris flow and also rock fall. Tension cracks are also observed. Two roads passes through the slide. Loose debris is present on the slide. It is disrupting the road traffic mainly during the rainy season. No mitigation measures are present.	**Low**
02	**N-90-02**	34° 54' 38.3" 72° 49' 20.7"	Slope Failure	Construction of retaining wall	A rotation landslide is mainly triggered during the road construction. The slide is mainly active along the road. Active soil erosion is present leading to development of water gullies. The check dams are developed along the gullies to minimize the erosion. Hanging debris is also present on the slide. The slide is obstructing the traffic mainly during the rainfall. Detached and hanging boulders are also present. Bedrock is impermeable. Shrubs and grass is present on the slide. Talus is present mainly with the road. Spring water is present. No counter measures to protect the slide.	**Low**
03	**N-90-03**	34° 55' 25.6" 72° 50' 10.4"	Rock Fall/Slope Failure	Construction of retaining wall	This is a cut slope located on the N90. The landslides is a slope failure triggered due to construction of the road. With the Schist and granite as a bed rock of the slide, part of the slide is also prone to rock fall with detached and hanging boulders. Active soil erosion mainly during the rain, is present on the slide leading to presence of talus is present along the road and gullies on the slide. Spring water is present in the slide. No effective counter measures are present. A culvert is built to drain out the channel water. A retaining wall is built to protect the landslide.	**Medium**
04	**N-90-04**	34° 55' 11.3" 72° 49' 43.8"	Slope Failure	Construction of retaining wall	This is an old landslide which is retriggered during the construction of road. Detached boulder are present on the slide. Loose debris on the bedrock are prone to sliding. Active soil erosion on the slide leads to the development of gullies. Shrubs are present on the slide with no trees. No counter measures are present to protect the slide.	**Medium**
05	**N-90-05**	35° 27' 33.5" 73° 58' 11.2"	Debris Flow	Construction of Culvert and diversion of drainage	A very active debris flow mainly triggered during the intense monsoon rainfall of 2010 blocking the road for 3 weeks. The debris flow is active mainly during the rainy season blocking the road and obstructing the traffic. A channel is develop to drain the debris flow. Spring water is percolating in the slide debris. Active erosion leads to the development of gullies. Hanging boulders are also present on the slide. Two roads are passes through the slide.	**High**

Table 5: Proposed Mitigation measures for studied slopes along N-95 (Swat to Kalam)

S#	ID	Location	Type	Proposed Mitigation Measures	Description	Priority
01	**N-95-01**	35° 19' 29.9" 72° 36' 41.9"	Slope Failure	Retaining Wall	A deep seated translational landslide. Loose debris of the slide is comprised of boulders, gravels sand and silt. The slide is also prone to debris flow mainly during the rainy season. Active soil erosion on the slide leads to development of gullies on the slide. Around 15 meter of slide scarp is prone to rock fall that often reach to the road. Two road are present in the slide, one the middle of the slide and second at the slide toe. The slide has the potential to damage the road and disrupt the traffic mainly during the rainy season. No countermeasure are constructed to stabilize the slide.	**High**
02	**N-95-02**	35° 20' 18.9" 72° 36' 39.0"	Debris Flow	Culvert	This is an active debris flow. Channel of the DF is well developed with detached boulders and gravels. The DF is drained by the spring water. Source of the DF is steep scrap with detached and jointed boulders. Eroded talus is present. The slide is mainly triggered during the rainy season. The DF can affect the road and disrupt the traffic. No mitigation measures are constructed to stabilize the slide.	**Medium**
03	**N-95-03**	35° 25' 19.6" 72° 36' 5.6"	Debris Flow	Culvert	An active debris flow. Water is coming in the slide from the upstream glaciers. Upstream of the debris flow is also prone to rock fall. Detached boulders are present in the DF channel. The DF can be activated during the rainfall. No counter measures are constructed to stabilize the slide.	**Medium**
04	**N-95-04**	35° 30' 58.7" 72° 33' 2.0"	Rock Fall/Slope Failure	Retaining Wall	It is a complex slide comprising of rock fall and debris flow. Debris is comprised of boulders, gravels, sand and silt. Source of debris is from steep outcrop with fractured and jointed rocks. Hanging and detached boulders are lying on the debris that are prone to sliding during the rainfall. Soil erosion leads to development of water channels in the slide. The loose material on the slide is prone to debris flow during the rainy season. Excavation of the loose debris for construction material also trigger the slide. A small retaining wall is built, however, it is also damaged due to falling rocks and not effective to stabilize the slide.	**High**
05	**N-95-05**	35° 30' 59.8" 72° 32' 7.5"	Debris Flow	Culvert and Retaining Wall	This is an old debris flow and the road is built in the debris. Debris is comprised of boulder, gravels, sand and silt. Detached boulders are lying on the debris that are prone to slide to the road. Active erosion leads to development of gullies. Scarp of the slide is prone to rock fall. Eroded talus is present along the road. Excavation of the loose debris for construction material also trigger the slide. The slide is frequently damaging the road and obstructing the traffic, however, no mitigation measures are constructed to stabilize the slide.	**Medium**

Table 6: Proposed Mitigation measures for studied slopes along N-45

Sr. No	ID	Location	Type	Proposed Mitigation Measures	Remarks	Priority
01	**N-45-01**	35° 39' 37.3" 71° 45' 58.9"	Rock Fall	Rock Bolting	This cut slope is generated during excavation for N-45. Marble and quartzite is exposed in this section which is jointed and cracked with a risk of over hang blocks. Clayey material is found on both sides of the rock fall. Drainage is also found on the right side of the rock fall.	**Low**
02	**N-45-02**	35° 40' 54.8" 71° 45' 59.6"	Rock Fall	Rock Bolting	This cut slope is generated during excavation for N-45. Marble is exposed in this section which is cracked and some open cracks are also observed with a risk of overhang blocks. Drainage is also found on the both sides of the rock fall. Highly weathered.	**Low**
03	**N-45-03**	34° 55' 25.6" 72° 50' 10.4"	Slope Failure	Retaining Wall and Develop Drainage System	Rounded to sub rounded boulders, gravels, pebbles and cobbles with sandy, silty clayey matrix. About 0.5 to 1m thick sand layers are also observed at different lavels along the slope. Few boulders at the top and mid of the slope failure which threaten the road and traffic. This 300 to 400 m wide road section was highly susceptible to erosion. Minor scarps are also observed. 1 feet wide drainage (damaged) is also observed at the toe of slope failure. Gullies are observed at different intervals along the slope failure.	**Medium**
04	**N45-04**	34° 55' 11.2" 72° 49' 43.9"	Slope Failure	Retaining Wall and Develop Drainage System	Rounded to sub rounded, angular to sub angular boulders, gravels, pebbles and cobbles with sandy, silty clayey matrix. About 0.5 to 1m thick sand layers are also observed at different lavels along the slope. This 300 to 400 m wide road section was highly susceptible to erosion. Gullies are observed at different intervals along the slope failure. Drainage is bounded on both sides of the slope failures. Road is often blocked during rainy seasons due to material overflow on the road.	**Medium**
05	**N45-05**	35° 47' 9.9" 71° 46' 24.7"	Slope Failure	Retaining Wall	Schist is exposed along this slope failure. 4-5 m thick alluvial deposit is also observed along the slope failure. Highly fractured rock along the slope failure. Minor scarps are also observed. 1 feet wide drainage (damaged) is also observed at the toe of slope failure. Gullies are observed at different intervals along the slope failure. Water channel for local supplies is also found at the top of the slope failure.	**Medium**

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Code no.	N 3 5 _ 0 1
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	34°56'26.6"
	Longitude	72°52'40.3"
Road name		Km

Date	12/1/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score	Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences	√
			2 correspondences	
			1 correspondences	
			no correspondence	
Geological conditions	Soil	susceptible to erosion less strength with water	marked	
			a little marked	√
			None	
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked	
			a little marked	√
			None	
	Structure	dip slope of bedding plane	It corresponds.	
			None	√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked	√
			a little marked	
			None	
Surface codition	Topsoil, detached rock and unsteady rock		instability	√
			a little unstable	
			stability	
	Spring water		notable spring waster	
			seepage	
			none	√
	Surface condition		bare land with minor vegetation	√
			intermediate (bare・grass・tree)	
			mainly structure, mainly tree	
Profile	Height (H), dip (i)		height H≧50m	
			height 30≦H<50m	√
			height 15≦H<30m	
			height H<15m	
			dip i≧70°	
			dip 45°≦i<70°	√
			dip i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity	√
			certain・unclarity	
			none	

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	

Effectiveness of existing countermeasures	Check
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	√
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 73.6 m, W= 145 m, D 1 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

This slope failure is actually cut slope due to the excavation for N-35 and link road above the scarp. Metasedimentry sequence of besham basement group is exposed along the cut slope. The rock is highly jointed and cracked. Three gullies has marked towards the valley side. Erosion along these gullies is endangering the stability of N35. Retaining wall is partially damaged.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

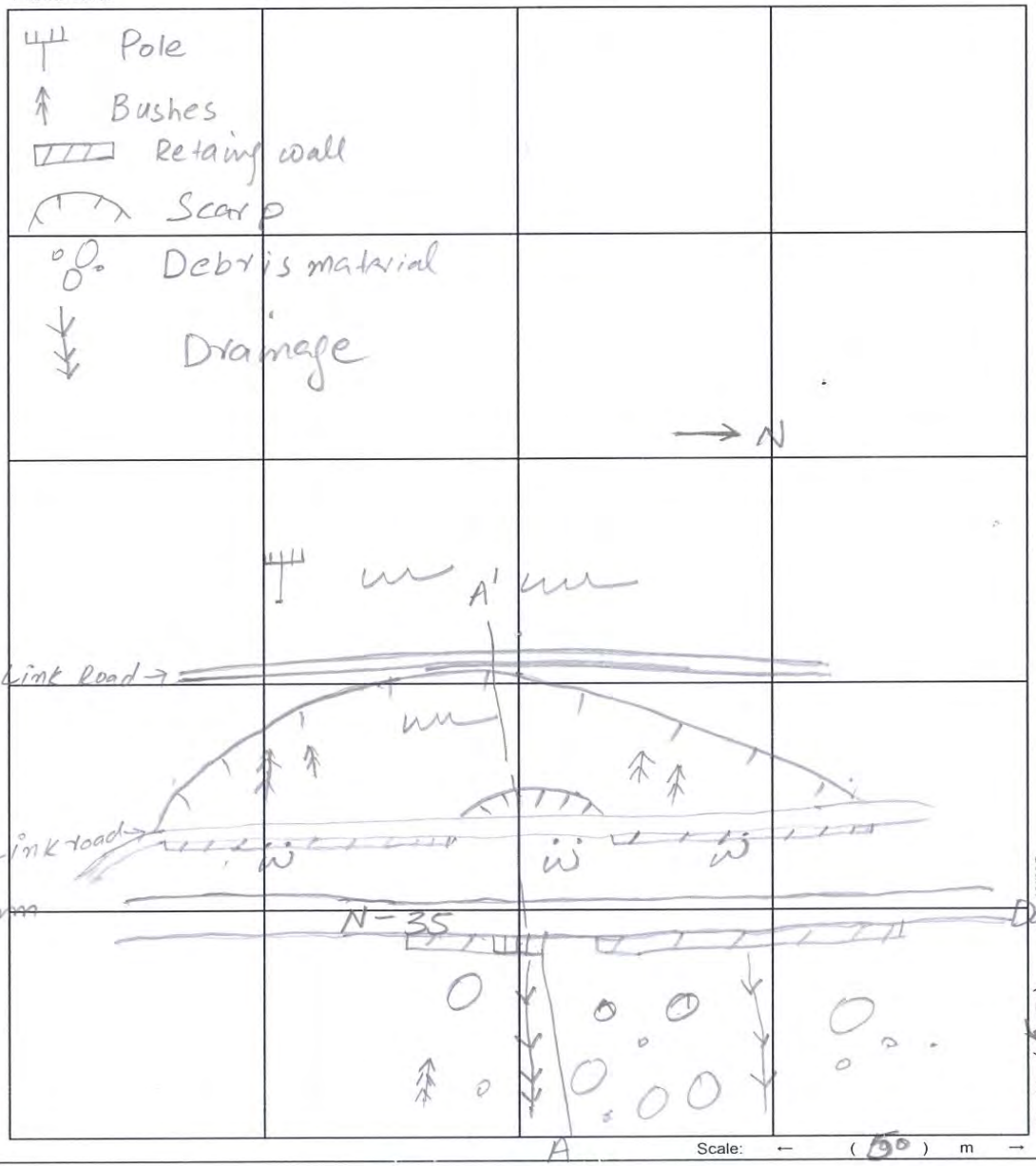
Code no.	N 3 5 _ 0 1
Region Office	
Maintenance Unit	

Sketch sheet

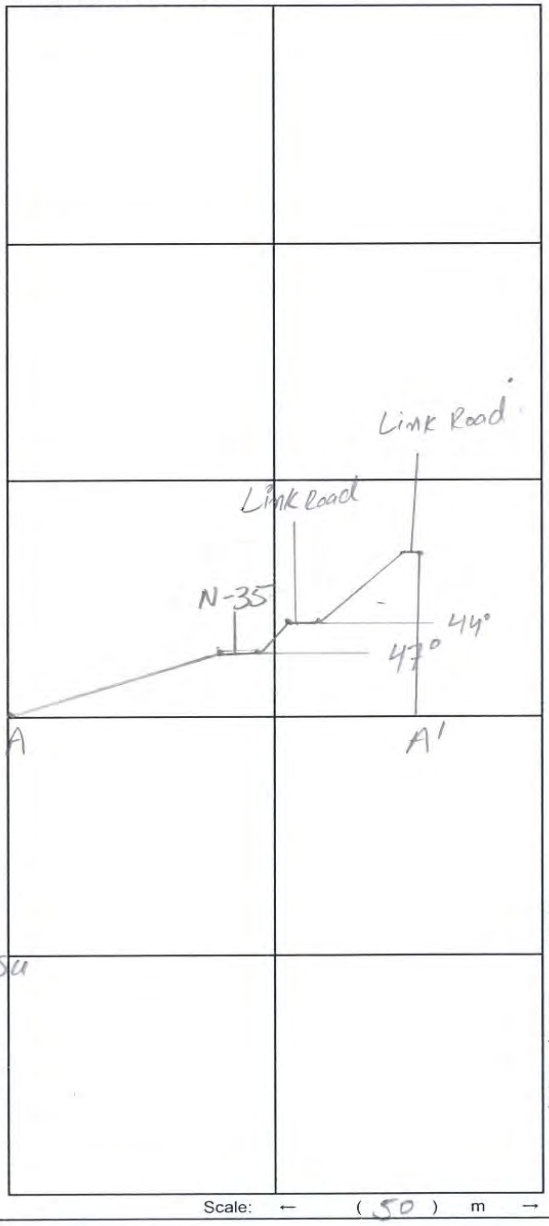
Coordinates	Latitude	34° 56' 26.6"
	Longitude	72° 59' 40.3"
Road Name	N - 35	Km 0 1

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5	_	0	1				
Region Office										
Maintenance Unit										

Photo sheet

Coordinates	Latitude	34°56'26.6"
	Longitude	72°52'40.3"
Road name		Km

Date	12/1/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of Culvert outlet as counter measure and retaining wall for N-35

View of new slope failures withn the N-35-1

Evaluation sheet (debris flow)

Code no.	N 3 5 0 2
Region Office	
Maintenance Unit	

Coordinates	Latitude	34º 56' 36.1"
	Longitude	72º 52' 40.6"
Road Name		Km

Date	12/2/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	
		0.15km^2 - 0.50km^2	
		less than 0.15km^2	√
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	√
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	√
		none	
	new crack and/or slope failure in stream	certain	√
		none	
	traces of large slope failure in stream	certain	
		none	√

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or No bridge / box culvert	√
	1m - 2m	
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	
There is a history about debris flow though there is no obstacle to traffic.	√
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 1000 m, W=15 m, D= 2 m

[Countermeasure]

Type of countermeasure		Check
Retaining walls has been constructed to protect the road. Box Culvert has also been made for the out flow of the debris but the inlet has blocked by the debris		
Effect of existing countermesure	none・low	
	moderate	√
	high	
	enough	

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

A seasonal stream crosses the highway at this location. Small catachment area with debris fall/rock fall material are present on the upstream. Small landslide was also observed along the stream which contribute in the debris volume. Granite is exposed along the stream. Various boulders of granite size more than 1 m^3 has also been observed. The culvert has been blocked due to debris material along this channel.

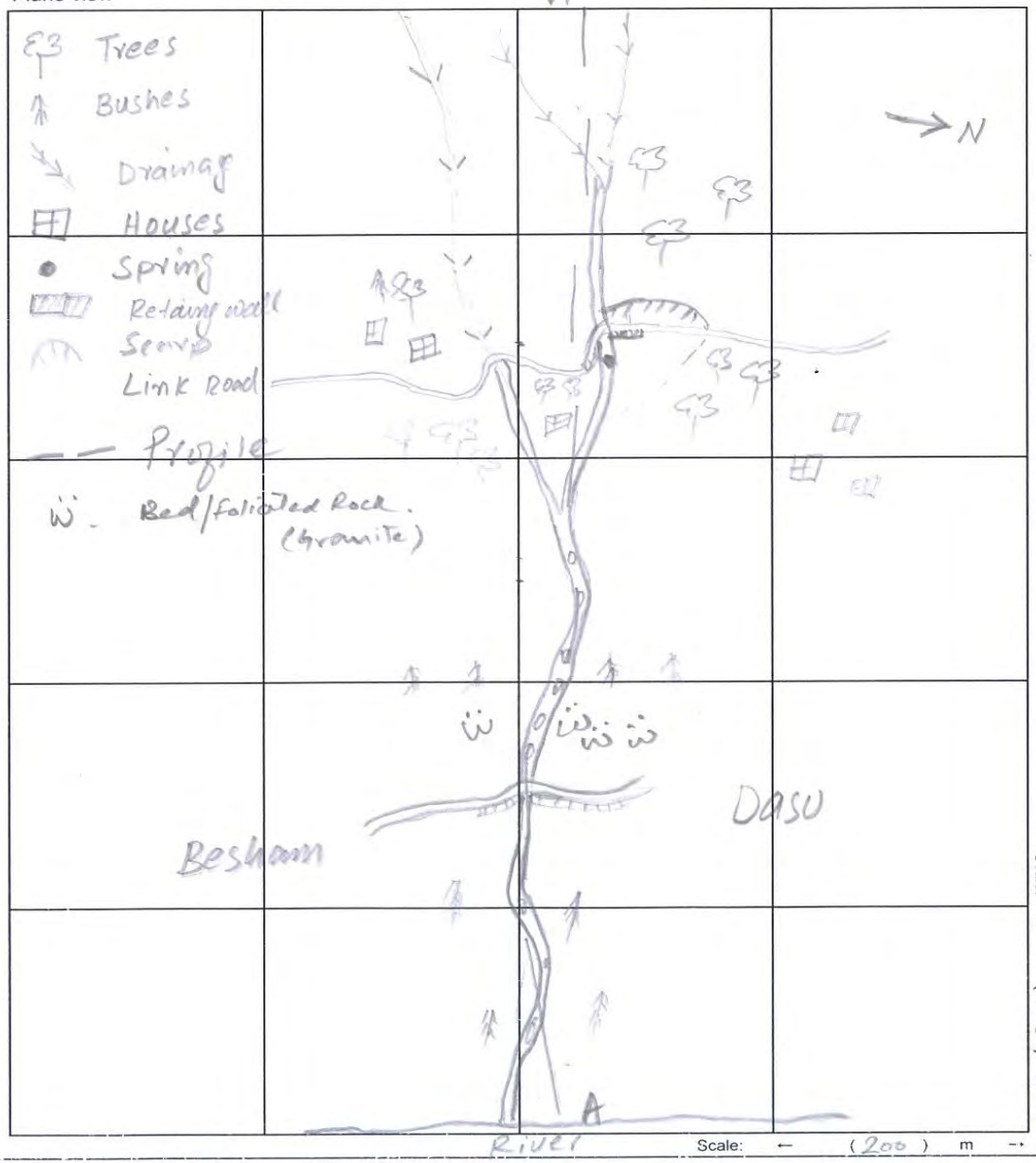
Sketch sheet

Code no.	N 3 5 0 2
Region Office	
Maintenance Unit	

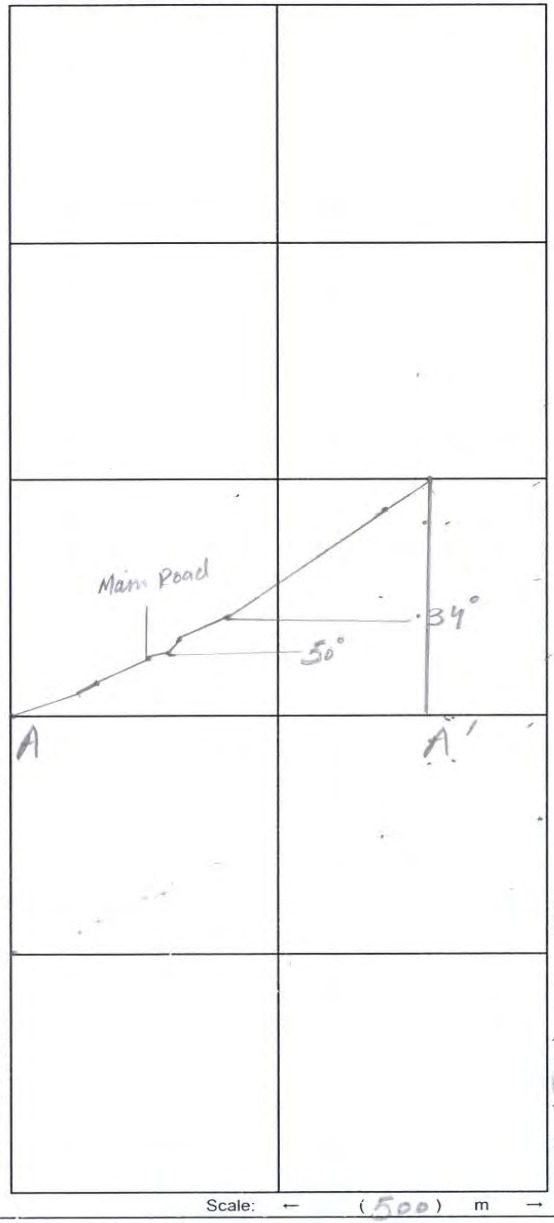
Coordinates	Latitude	34° 56' 36.1"
	Longitude	72° 52' 40.6"
Road Name	3 5	Km 0 2

Date	
Inspector	

Plane view



Cross sectional view

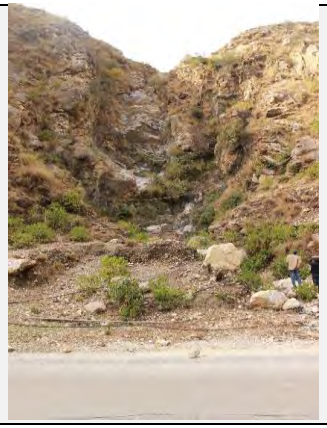


Code no.	N	-	3	5				0	2
Region Office									
Maintenance Unit									

Photo sheet

Coordinates	Latitude	34° 56' 36.1"
	Longitude	72° 52' 40.6"
Road Name		Km

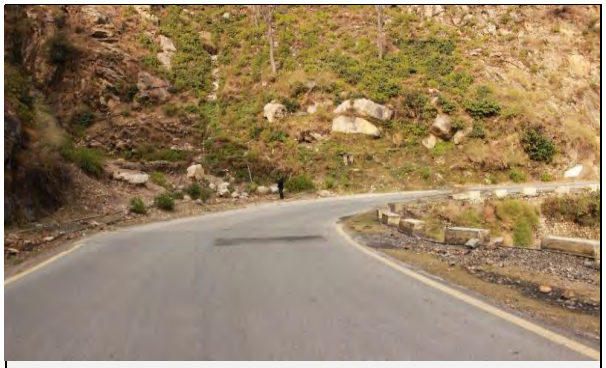
Date	12/2/2017
Inspector	Yasir, Sajid, Shafique, Basharat



Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow



The patch work on the road has been observed

Existing countermeasures / anomalies: Inlet of the culvert is chocked by the debris.

Existing countermeasures / anomalies: Culvert outlet has been constructed at the toe of the debris flow

Evaluation sheet (Slope failure/Rockfall)

Code no.	N35_09
Region Office	
Maintenance Unit	

Coordinates	Latitude	34°57'28.1"
	Longitude	72°53'1.8"
Road name	Km	

Date	3-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		
			None		√
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	
				i<45°	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 184 m, W= 90 m, D = 3 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	3
Low risk	2	3	(4)

[Description]

The landslide is located on N35. This is an old landslide that was triggered during the road construction. The landslide has active surface erosion mainly induced by the rain water and therefore gullies are present on the landslide body. On the slide, detached boulders are present that are prone to slide during a rainfall and can damage the road and traffic. The landslide is void of any trees. No mitigation measures are constructed to stabilize the landslide.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

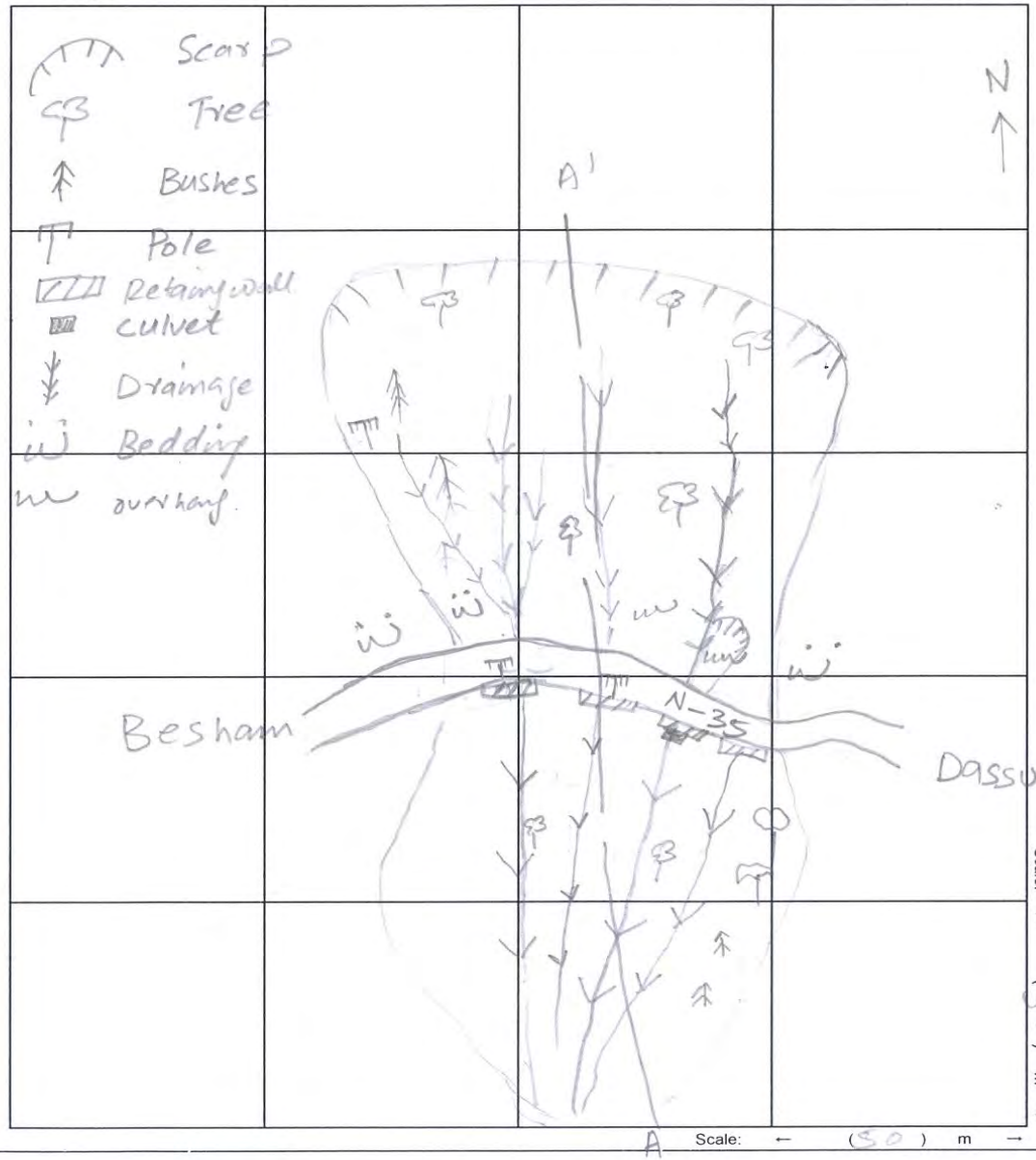
Sketch sheet

Code no.	N 3 5 _ 0 9
Region Office	
Maintenance Unit	

Coordinates	Latitude	34° 57' 28.1"
	Longitude	72° 53' 1.8"
Road Name	N-35	Km 0 9

Date	
Inspector	

Plane view



Cross sectional view

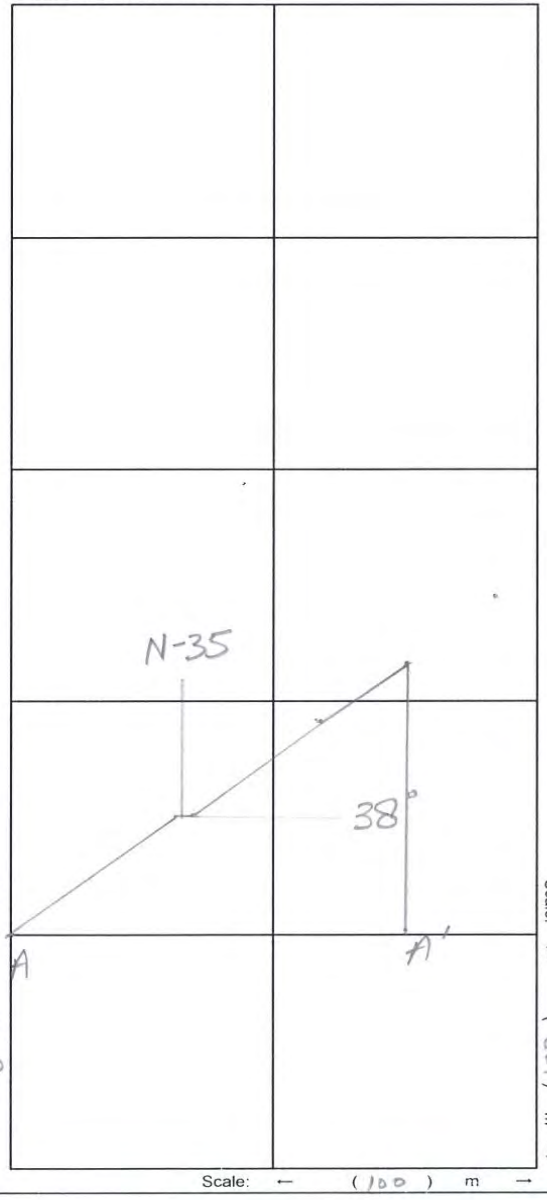


Photo sheet

Code no.	N	3	5	_	0	9				
Region Office										
Maintenance Unit										

Coordinates	Latitude	34°57'28.1"
	Longitude	72°53'1.8"
Road name		Km

Date	12/3/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point with sloping wall at the toe of slope failure

Existing countermeasures / anomalies: View of Culvert as counter measure and retainin wall

Close View of slope falure

Evaluation sheet (debris flow)

Code no.	N35 10
Region Office	
Maintenance Unit	

Coordinates	Latitude	34º 58' 53.2"
	Longitude	72º 54' 11.3"
Road Name	Km	

Date	12/4/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	
		0.15km^2 - 0.50km^2	√
		less than 0.15km^2	
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	√
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	√
		none	
	new crack and/or slope failure in stream	certain	
		none	√
	traces of large slope failure in stream	certain	
		none	√

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or	
	No bridge / box culvert	√
	1m - 2m	
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	√
There is a history about debris flow though there is no obstacle to traffic.	
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 1000 m, W=23.50 m, D= 1-2 m

[Countermeasure]

Type of countermeasure		Check
Retaining walls has been constructed to protect the road (N-35)		
Effect of existing countermesure	none・low	
	moderate	√
	high	
	enough	

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	(3)
Low risk	2	3	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

A seasonal stream crosses the highway at this location. Small catachment area with debris fall/rock fall material are present on the upstream. It is a historically active debris flow with continuous flowing water. The water seeps beneath the road and through could lead to potential disaster and significant damages to the road. . Detached boulders, gravels, sand and silt was present at the toe of the DF above the road. During the rainy season it become active and often leads to damages to road and disruption of the traffic. Part of the DF is also prone to rock fall and slope failure.

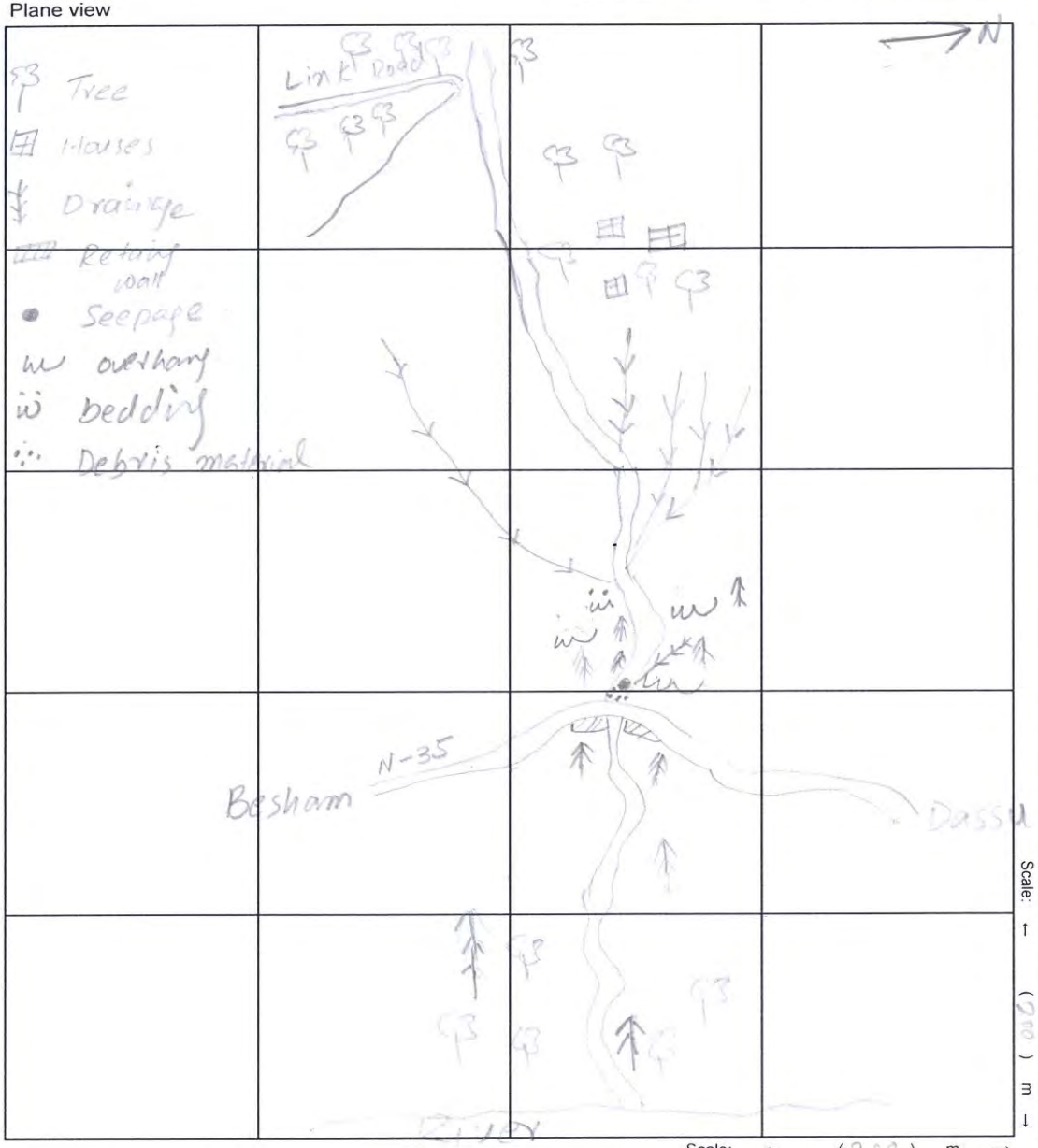
Sketch sheet

Code no.	N 3 5 1 0
Region Office	
Maintenance Unit	

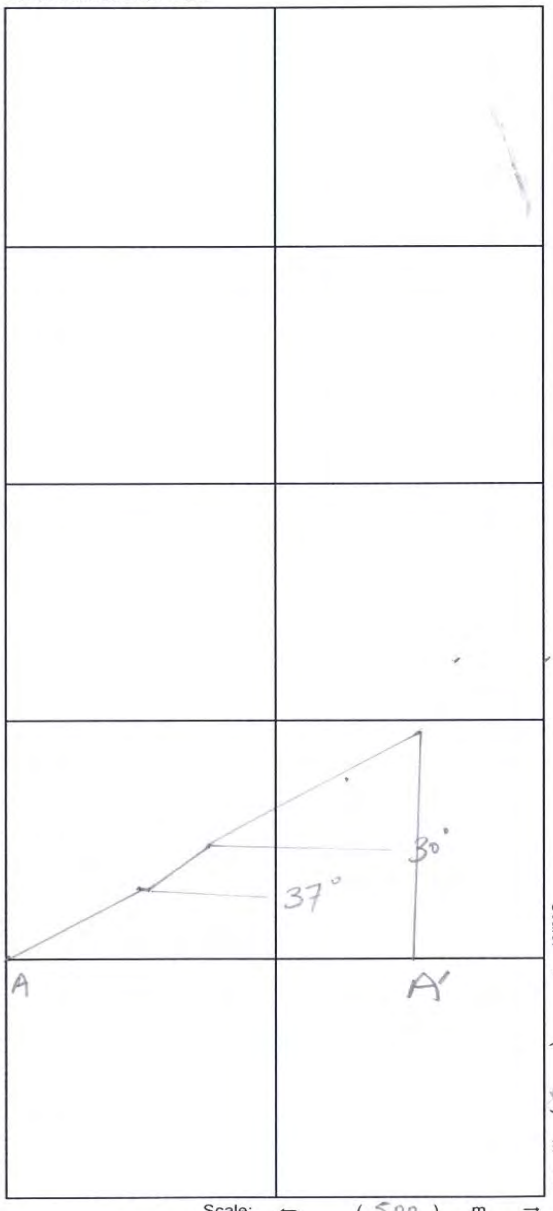
Coordinates	Latitude	34° 58' 53.2"
	Longitude	72° 54' 11.3"
Road Name	N-35	Km 10

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5					1	0
Region Office									
Maintenance Unit									

Photo sheet

Coordinates	Latitude	34° 58' 53.2"
	Longitude	72° 54' 11.3"
Road Name		Km

Date	12/4/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow

The crack on road has been observed

Road condition

Existing countermeasures / anomalies: Retaining wall has been constructed at the toe of the slope failure

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 1 4
Region Office	
Maintenance Unit	

Coordinates	Latitude	35°00' 11.9"
	Longitude	72°53' 53.9"
Road name	Km	

Date	12/5/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		
			intermediate (bare・grass・tree)		√
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	
				30≦H<50m	
				15≦H<30m	√
				H<15m	
			dip	i≧70°	
				45°≦i<70°	
				i<45°	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	
Natural slope	√

[Countermeasure]

Type of countermeasures	
Retaining wall for N-35 has been built for road support towards valley side	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 850 m, W= 300 m, D = 10 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	(2)	3
Medium risk	1	2	3
Low risk	2	3	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

[Description]

This rotational landslide is located on N35. It is historically active slope failure. The slide was mainly triggered during the 2005 earthquake and also reactivated during the torrential and prolonged monsoonal rains of 2010. The slide also become active during the rainy seasons. The scarp and upper parts of the slope is partially stable with thick vegetation. However, the portion of the landslide close to the road is still active and prone to frequent sliding and rock fall and therefore posing threats to the road.

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

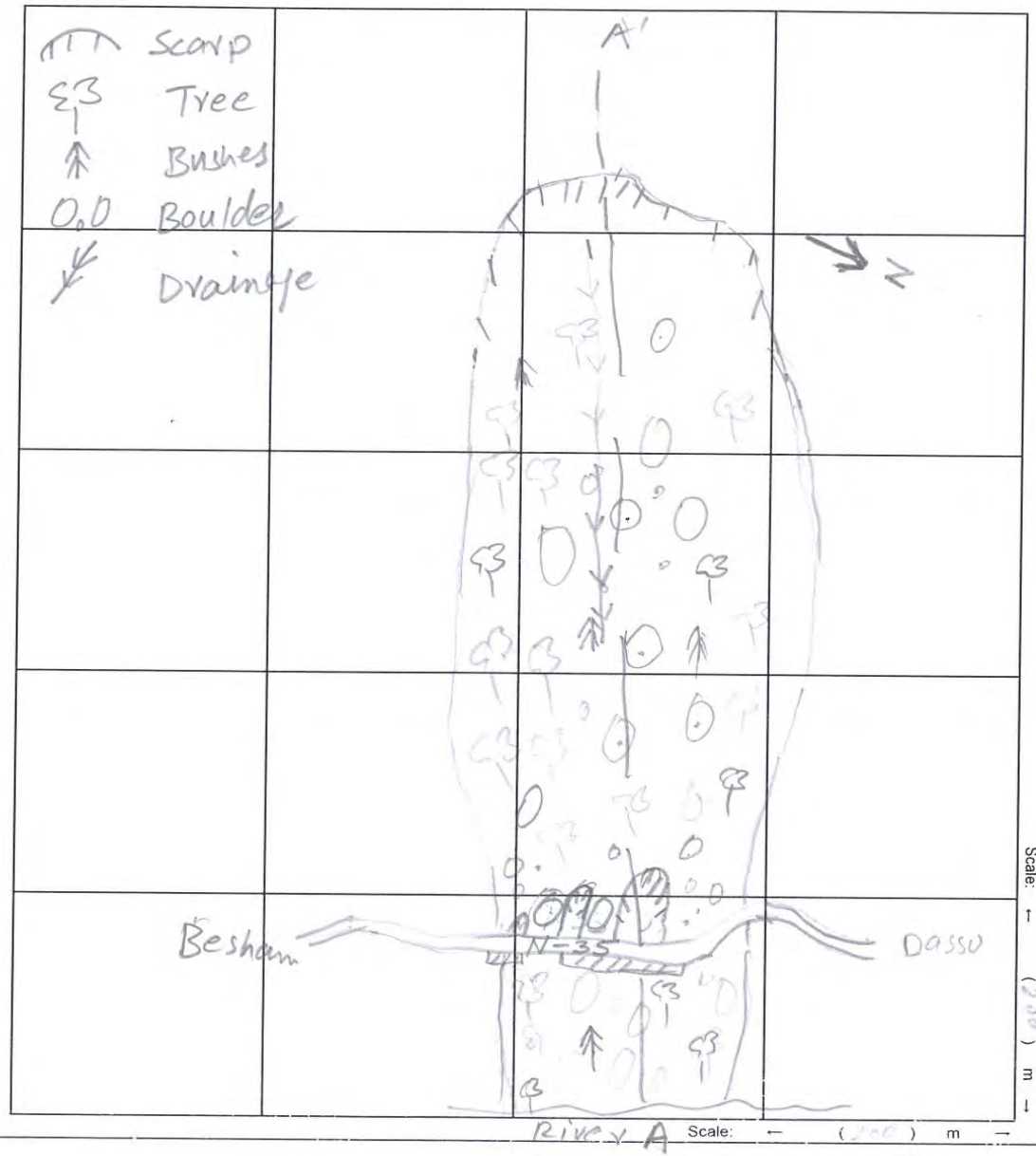
Code no.	N	3	5		1	4		
Region Office								
Maintenance Unit								

Sketch sheet

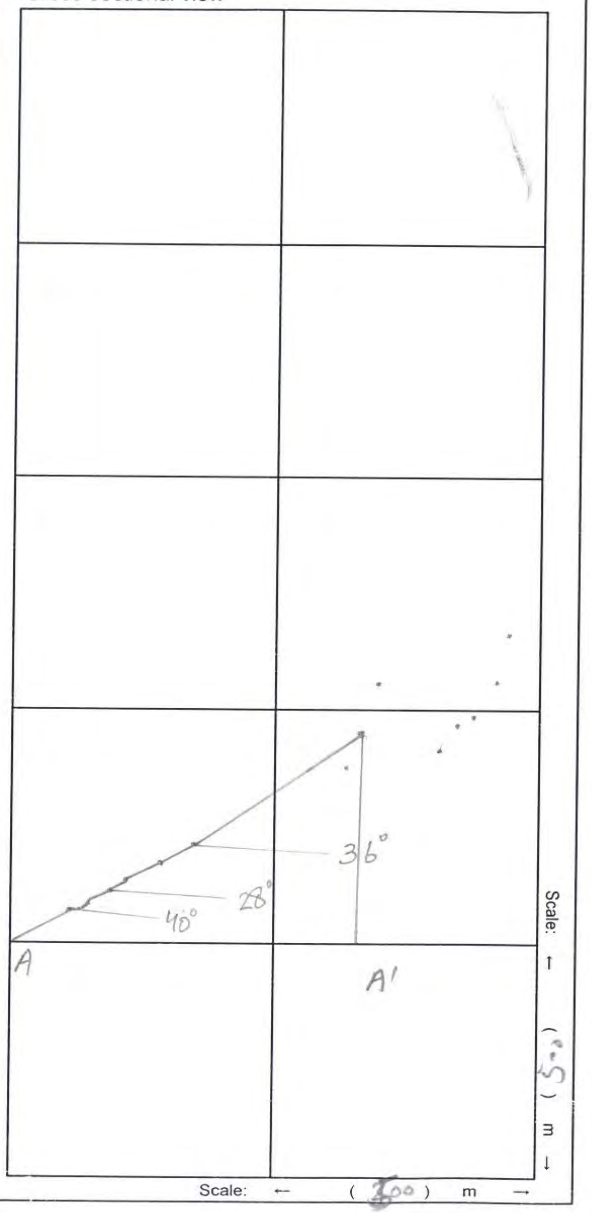
Coordinates	Latitude	35°00' 11.9"
	Longitude	72°53' 53.9"
Road Name	N-3-3 5	Km 1 4

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		1	4		
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35°00'11.9"
	Longitude	72°53' 53.9"
Road name		Km

Date	12/5/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies

View of fallen blocks on road

Code no.	N 3 5 _ 2 6				
Region Office					
Maintenance Unit					

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	34° 02' 19.4"
	Longitude	72° 52' 49.3"
Road name		Km

Date	6-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	
				i<45°	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 200 m, W= 150 m, D = 1 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	3
Low risk	2	3	4

[Description]

The slide is active rock fall and cut slope posing great and frequent risk to road. Bedrock of the slide is highly fractured and weathered pyroxinite. The slide has hanging boulders and gravels posing threats to road and traffic. Some sections of the slide are very steep with slope of around 60 degrees. During the rainy season the slide is also prone to debris flow comprising of boulders, gravels, sand and silt. Rock fall is planar in nature. Water seepages is observed on the right flank of the slide. Intersecting joints leads to wedge failure.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

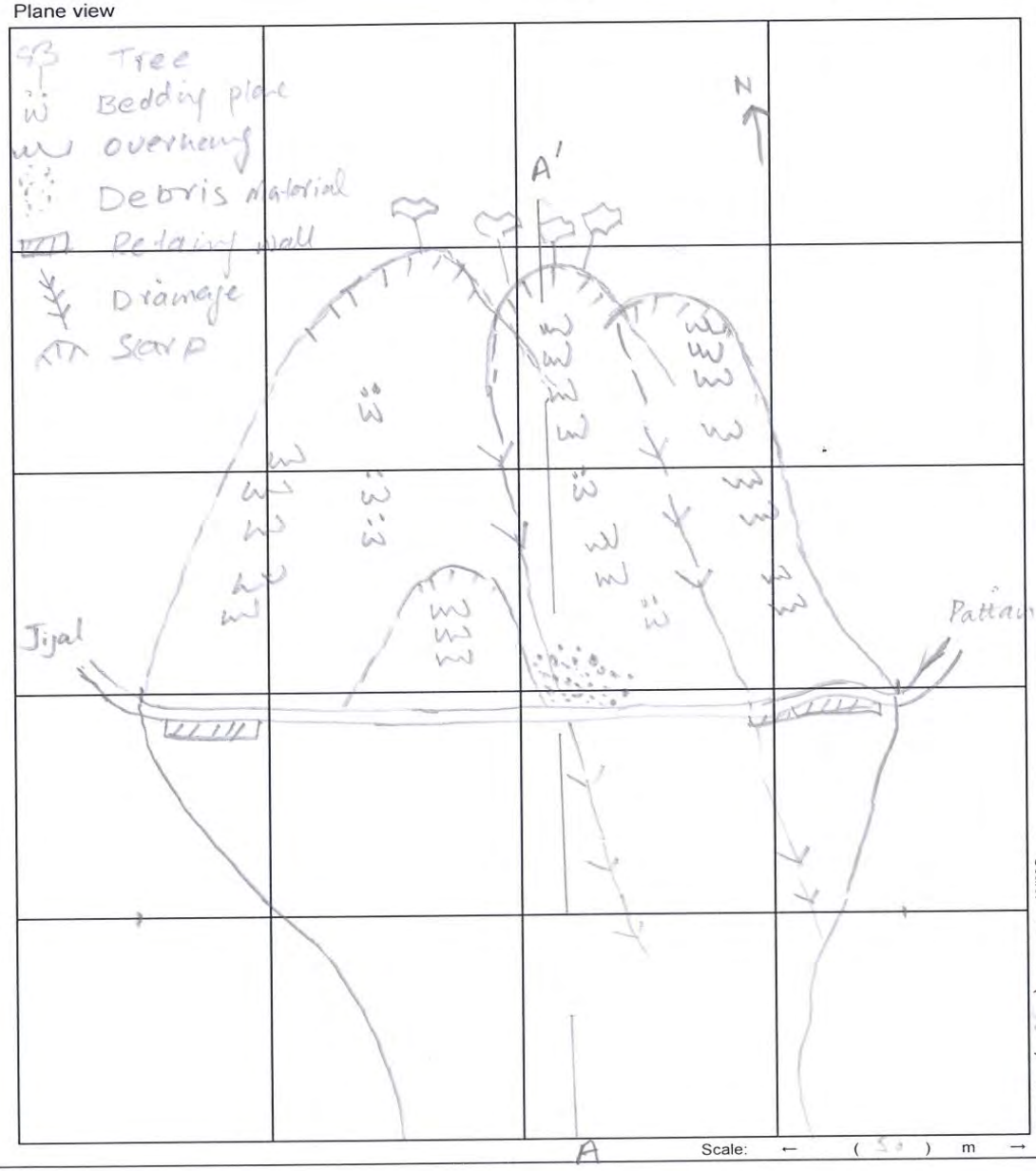
Sketch sheet

Code no.	N 3 5 _ 2 6
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 02' 19.4"
	Longitude	72° 55' 49.3"
Road Name	N 3 5	Km 2 6

Date	
Inspector	

Plane view



Cross sectional view

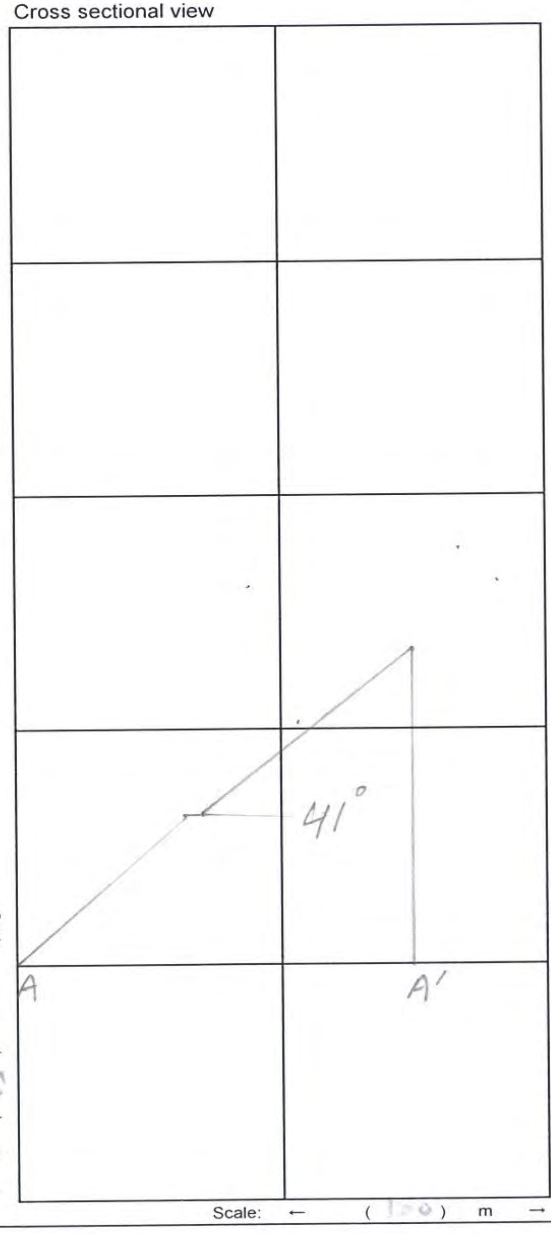


Photo sheet

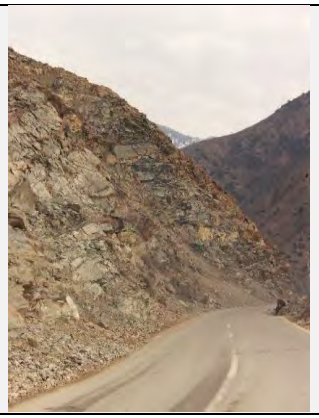
Code no.	N 3 5 _ 2 6
Region Office	
Maintenance Unit	

Coordinates	Latitude	34° 02' 19.4"
	Longitude	72° 52' 49.3"
Road name		Km

Date	12/6/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:



Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of Retaining wall for N-35 as counter measure

View of fallen blocks along the slope failure which threaten the household at the toe of the slide

Code no.	N 3 5 2 8
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 02' 25.7"
	Longitude	72° 56' 6.8"
Road name	Km	

Date	12/7/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H<50m	height	
			15≦H<30m	height	
			H<15m	height	
			i≧70°	dip	
			45°≦i<70°	dip	
			i<45°	dip	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Retaning wall for slope failures towards mountain side	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L=900m, W= 210m, D= 1-2m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	3
Low risk	2	3	4

[Description]

This is an active slope failure and rock fall. The failure has historically affected the road. The wedge shape failure is found on the slide. Detached boulders and gravels are hanging on the slide that combine with the sand and silt leads to debris flow during the rainy season. Bedrock is highly fractured and jointed pyroxinite. Drainage is developed on the slide and active weathering and erosion leads to development of gullies on the slide. Retaining wall is constructed to stabilize the slide, however, the right side of the retaining wall is already damaged.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

Sketch sheet

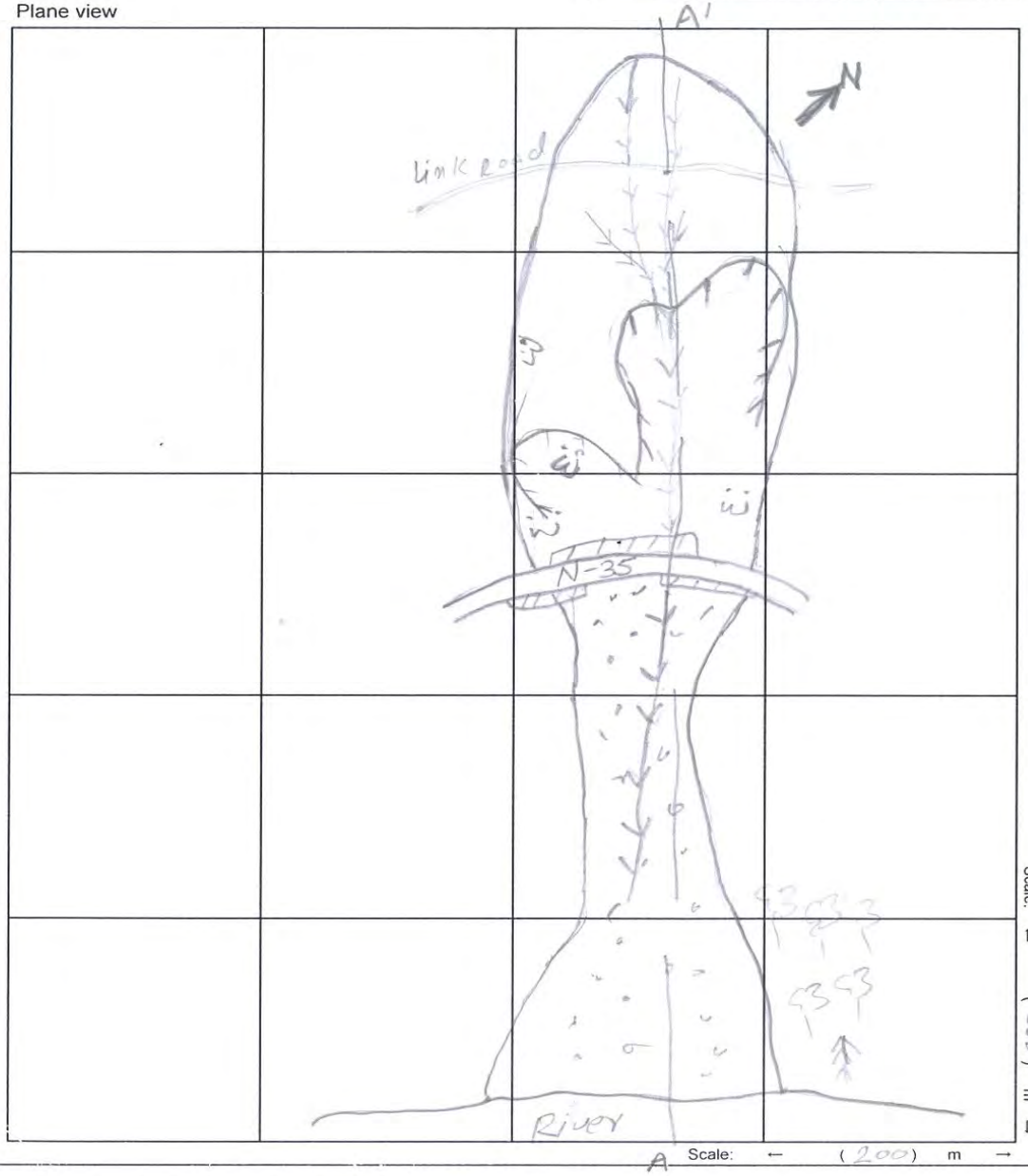
Code no.	N	3	5		2	8	
Region Office							
Maintenance Unit							

Coordinates	Latitude	35° 02' 25.7"
	Longitude	72° 56' 6.8"
Road Name	N-35	Km 28

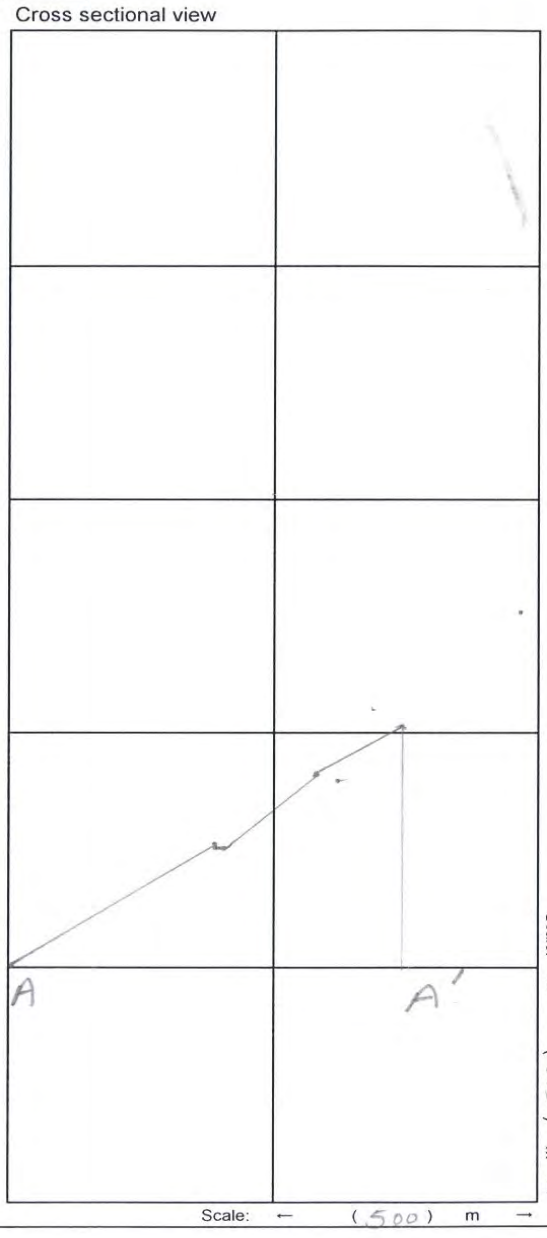
Date	
Inspector	

895 at Road

Plane view



Cross sectional view



Code no.	N	3	5		2	8	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 02' 25.7"
	Longitude	72° 56' 6.8"
Road name		Km

Date	12/7/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

Anomalies in retaining wall for N-35_28

Code no.	N 3 5 2 9
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 02' 34.9"
	Longitude	72° 56' 23.7"
Road name		Km

Date	12/8/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	
				30≦H<50m	√
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	√
				i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Retaining wall for N-35 protection towards valley side	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 150 m, W= 90 m, D = 1 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

The slide is an active rock fall. The exposed bedrock is comprised of exposed pyroxinite. The bedrock is highly deformed and jointed. Tension cracks were visible on the slide. Boulders and gravels were detached and hanging on the slide and therefore posing threats to the road and traffic. . Intersecting joints leads to wedge failure. Talus is visible at the slide toe. No mitigation measures is adopted to stabilize the slide. However, retaining wall is constructed to protect the road from sliding.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

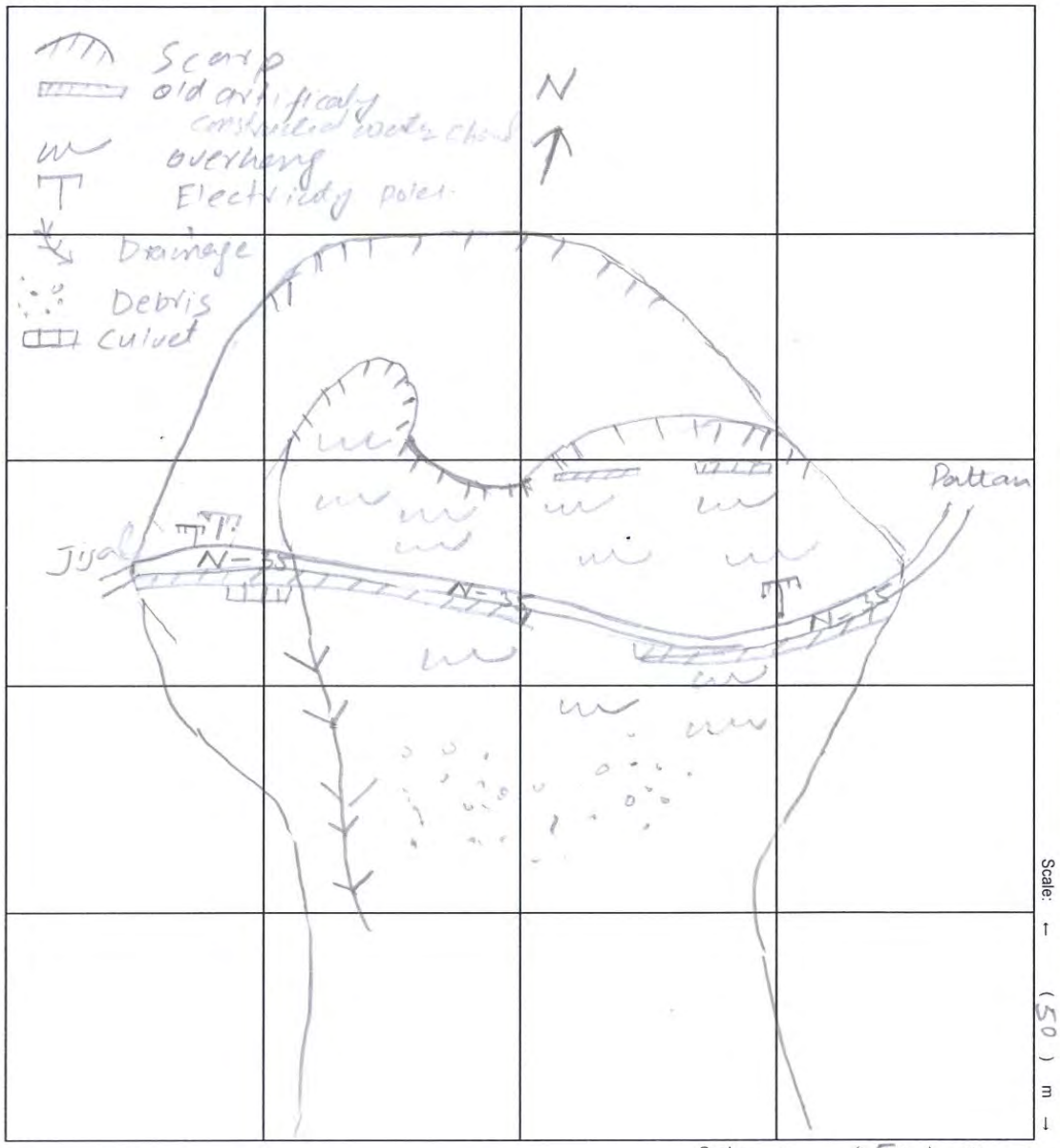
Code no.	N	3	5		2	9	
Region Office							
Maintenance Unit							

Sketch sheet

Coordinates	Latitude	35° 02' 34.9"
	Longitude	72° 56' 23.7"
Road Name	N-35	Km 29

Date	
Inspector	

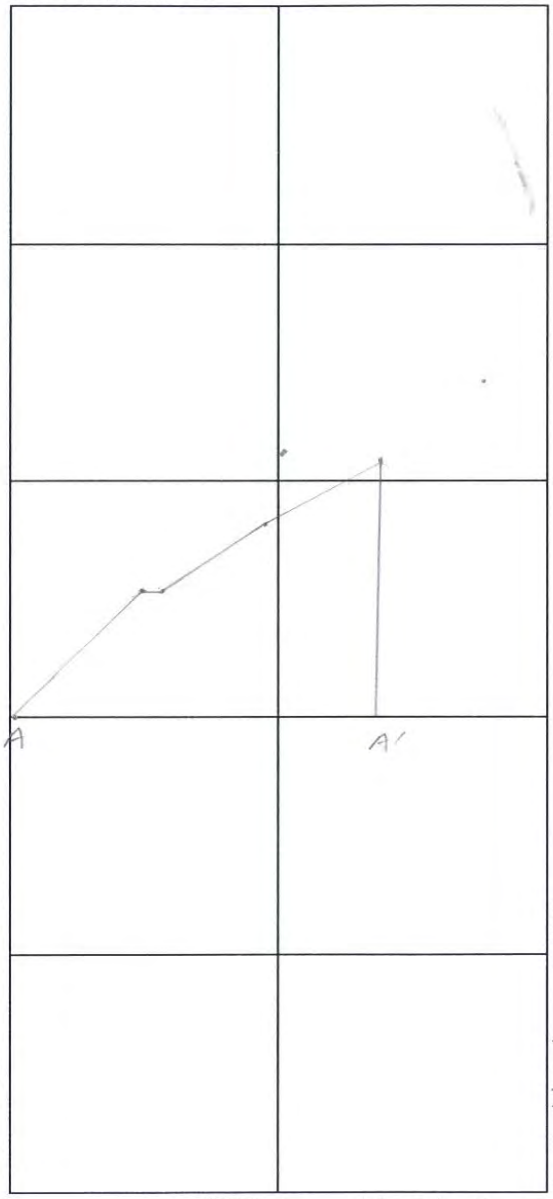
Plane view



Scale: ← (50) m →

Scale: ↑ (50) m ↓

Cross sectional view



Scale: ← (100) m →

Scale: ↑ (100) m ↓

Code no.	N	3	5		2	9	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 02' 34.9"
	Longitude	72° 56' 23.7"
Road name		Km

Date	12/8/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

View of fallen blocks on Shed

Code no.	N 35 30
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 02' 42.2"
	Longitude	72° 56' 27.1"
Road name		Km

Date	12/9/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare･grass･tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H＜50m		
			15≦H＜30m		
			H＜15m		
			i≧70°	dip	
			45°≦i＜70°		√
			i＜45°		
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences･clarity		√
			certain･unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Retaining wall is about 07 feet high for slope protection (Mountain side) and also for N35 on valley side.	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 110 m, W= 106 m, D = 1 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	(3)
Low risk	2	3	4

[Description]

The slide is an active rock fall/slope failure. Gullies were observed on the slide. Talus deposits were noted at the end of the developed gullies. Wedge failure is observed on the slide. Detached and hanging boulders and gravels were observed on the slide that are prone to fall during rainy season or moving cattle and posing threat to road and traffic. Many vehicle were reportedly damaged due to fallen rocks. No mitigation measures is adopted to stabilize the slide or protect the road/traffic from falling rocks.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

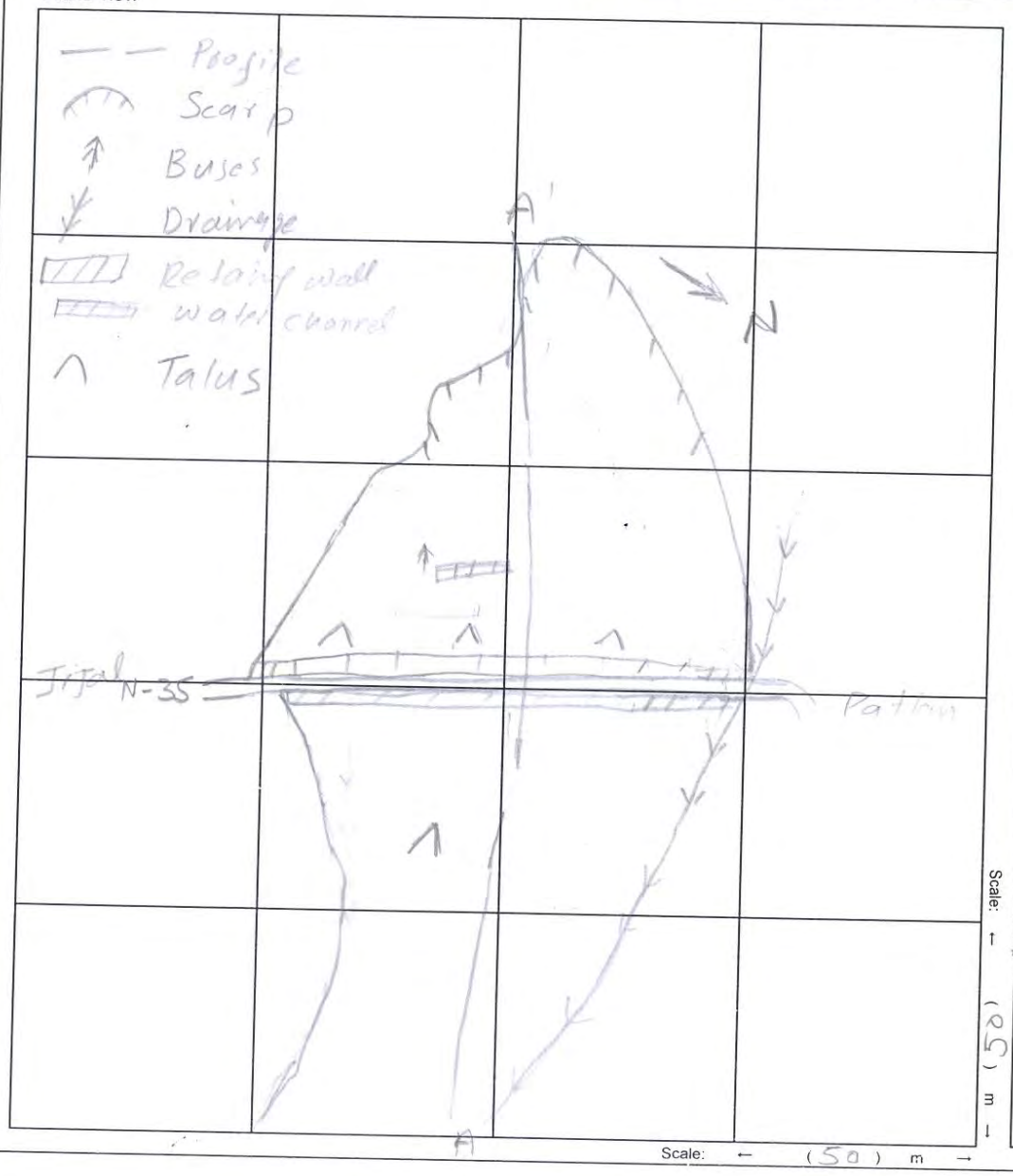
Code no.	N	3	5		3	0	
Region Office							
Maintenance Unit							

Sketch sheet

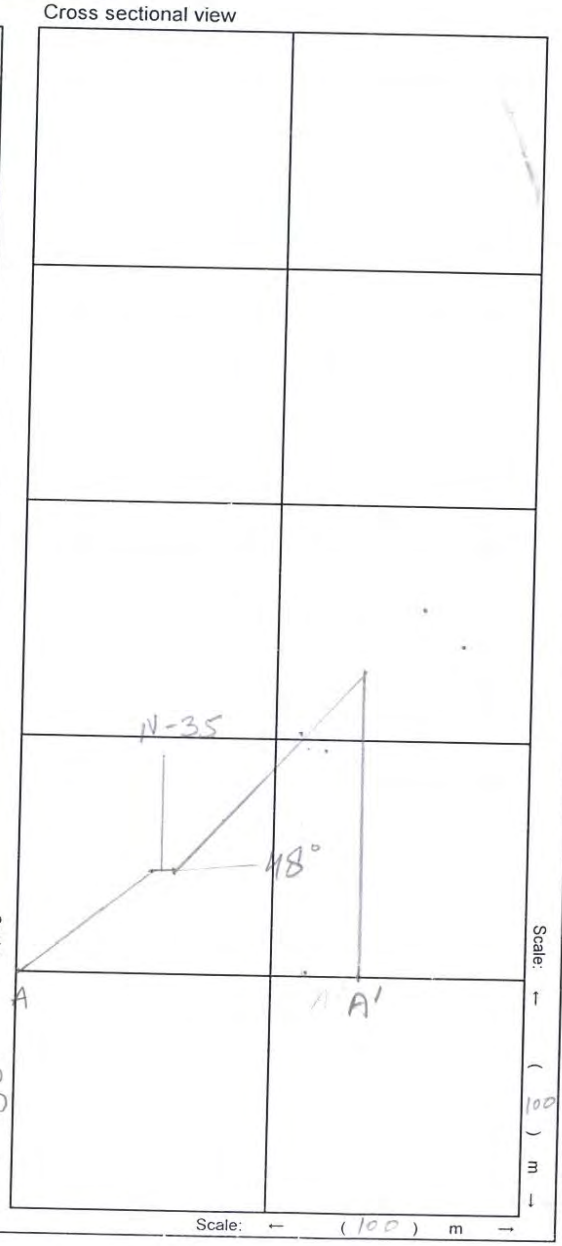
Coordinates	Latitude	35° 02' 42.2"
	Longitude	72° 56' 27.1"
Road Name	N - 35	Km 30

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		3	0	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 02' 42.2"
	Longitude	72° 56' 27.1"
Road name		Km

Date	12/9/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies:

Code no.	N 3 5 3 1
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 02' 42.2"
	Longitude	72° 56' 33"
Road name		Km

Date	12/10/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score	Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope, overhang, water catchment slope	3 or more correspondences	√
			2 correspondences	
			1 correspondences	
			no correspondence	
Geological conditions	Soil	susceptible to erosion less strength with water	marked	√
			a little marked	
			None	
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked	√
			a little marked	
			None	
	Structure	dip slope of bedding plane	It corresponds.	
			None	√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked	√
			a little marked	
			None	
Surface codition	Topsoil, detached rock and unsteady rock		instability	√
			a little unstable	
			stability	
	Spring water		notable spring waster	
			seepage	
			none	√
	Surface condition		bare land with minor vegetation	√
			intermediate (bare・grass・tree)	
			mainly structure, mainly tree	
Profile	Height (H), dip (i)		height H≧50m	√
			height 30≦H<50m	
			height 15≦H<30m	
			height H<15m	
			dip i≧70°	
			dip 45°≦i<70°	√
			dip i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity	√
			certain・unclarity	
			none	

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	√

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 380 m, W= 208 m, D = 2 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

This is a deep seated multiple rotational landslide. The main body of the slide is consolidated with shrubs and grass. However, the toe of the slide which is close to the road is active due to road cutting. On the slide, detached boulders are present posing threats to the road and traffic. Active erosion on the landslide debris leads to development of gullies. Bedrock of the slide is proxininite. The slide is frequently affecting the road, however, no mitigation measures are built to stabilize the slope or the road. On the slide body benching are made by the local people mainly for the agriculture purposes. Dip direction is NW and dip angle is 40-50 degress. The slide is void of thick vegetation

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

897m

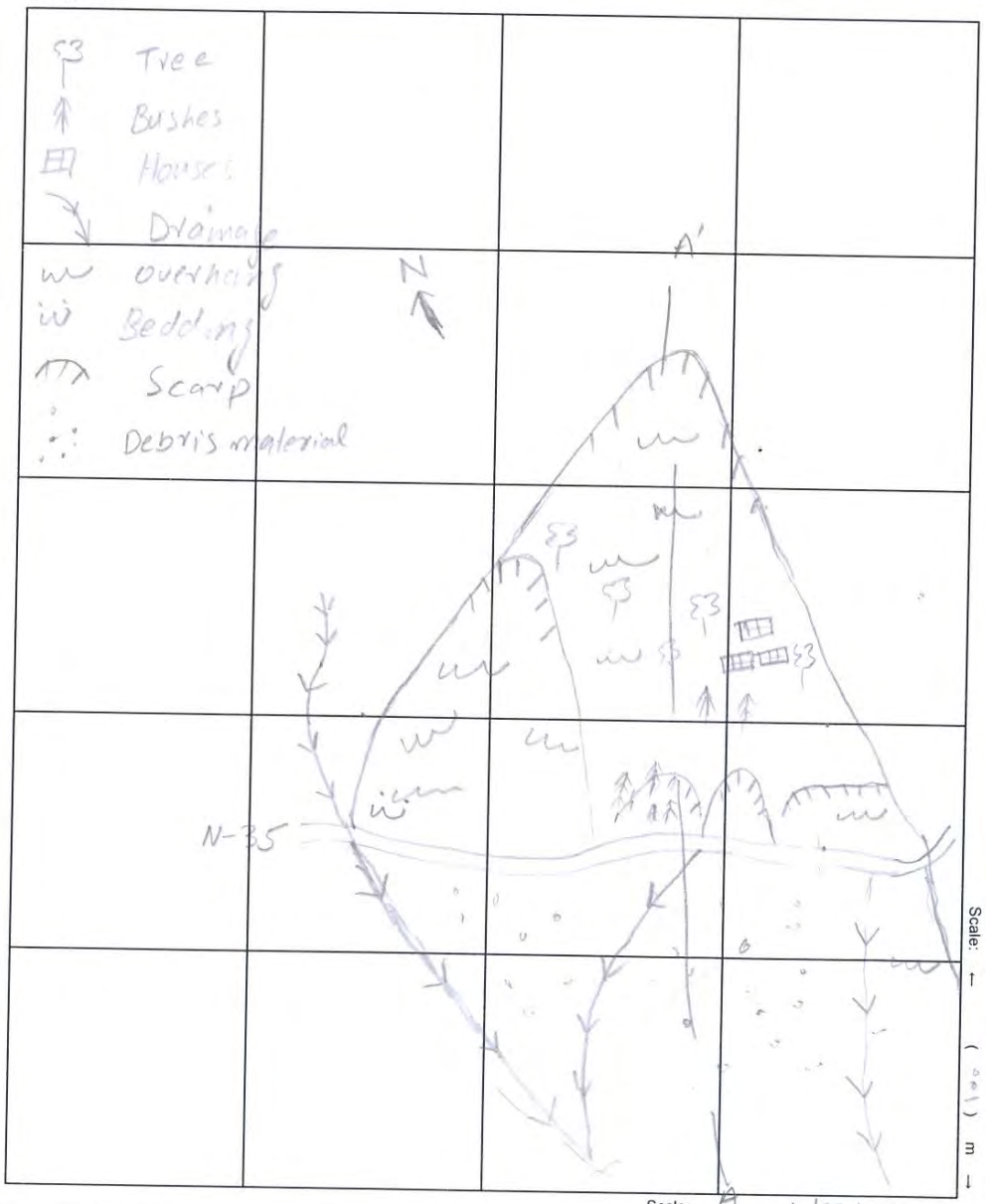
Code no.	N	3	5		3	1	
Region Office							
Maintenance Unit							

Sketch sheet

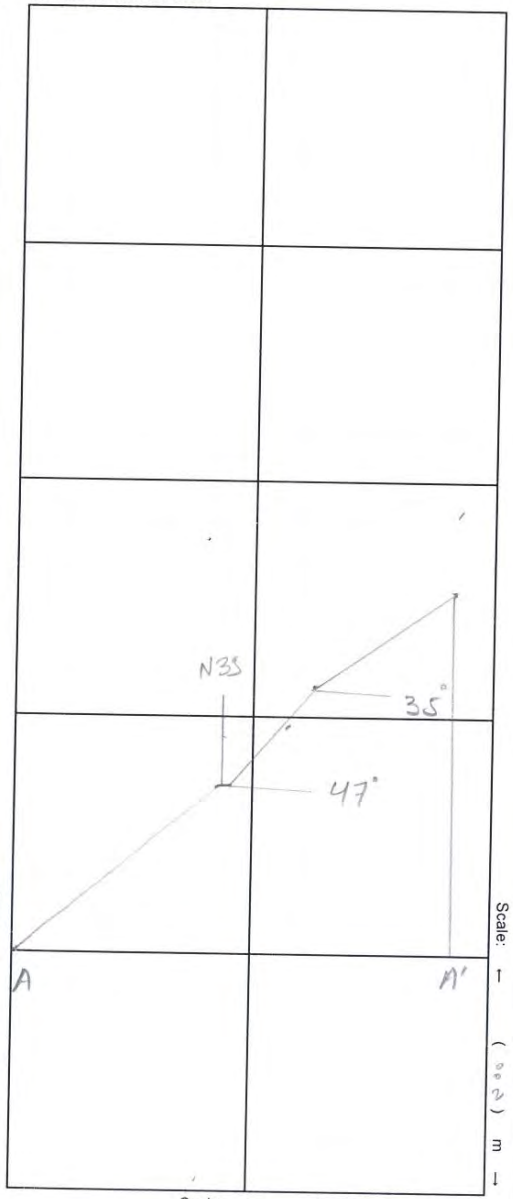
Coordinates	Latitude	35° 12' 42"
	Longitude	72° 56' 33"
Road Name	N - 35	Km 31

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		3	1	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 02' 42.2"
	Longitude	72° 56' 33"
Road name		Km

Date	12/10/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of retaining wall for N-35 as counter measure

View of Large blocks fallen and talus deposit at the toe of Slaope Failure

Evaluation sheet (debris flow)

Code no.	N35 39
Region Office	
Maintenance Unit	

Coordinates	Latitude	35º 04' 13"
	Longitude	72º 57' 19.6"
Road Name	N35	Km 39

Date	12/11/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	√
		0.15km^2 - 0.50km^2	
		less than 0.15km^2	
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	√
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	
		none	√
	new crack and/or slope failure in stream	certain	√
		none	
	traces of large slope failure in stream	certain	√
		none	

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or No bridge / box culvert	√
	1m - 2m	
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	√
There is a history about debris flow though there is no obstacle to traffic.	
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 1500 m, W=13 m, D= 1-2 m

[Countermeasure]

Type of countermeasure		Check
Stepped and inclined Retaining wall has been constructed to protect along the valley side of road (N-35). Also a 2 feet high and 15 feet long protection wall at the mouth of the right bank of the stream		
Effect of existing countermesure	none・low	√
	moderate	
	high	
	enough	

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

This is an active DF with well develop erosion channels. The DF has huge source area. The lying debris of the DF are consists of boulders, gravels, sand and silt. The accumulated poorly sorted debris in the erosion channels are already failed and still prone to slope failure. The DF has continuous flowing water, however, the water seeps beneath the road and appears again on the valley side of the road and therefore the road is prone to a disaster. No trees are present in the source area of the DF, however, shrubs and bushes are sparsely present. Boulders are mainly of Dunite and Amphibolite. The DF is frequently affecting the road, mainly during the rainy season. However, no mitigation measures are adopted to drain the water and protect the road from flowing debris. A retaining wall is constructed on the valley side of the road which is also partly damaged. Part of the source area of the DF is also prone to rock fall with detached and fragmented boulders that could also reach to the road and therefore also posing threat to road and traffic.

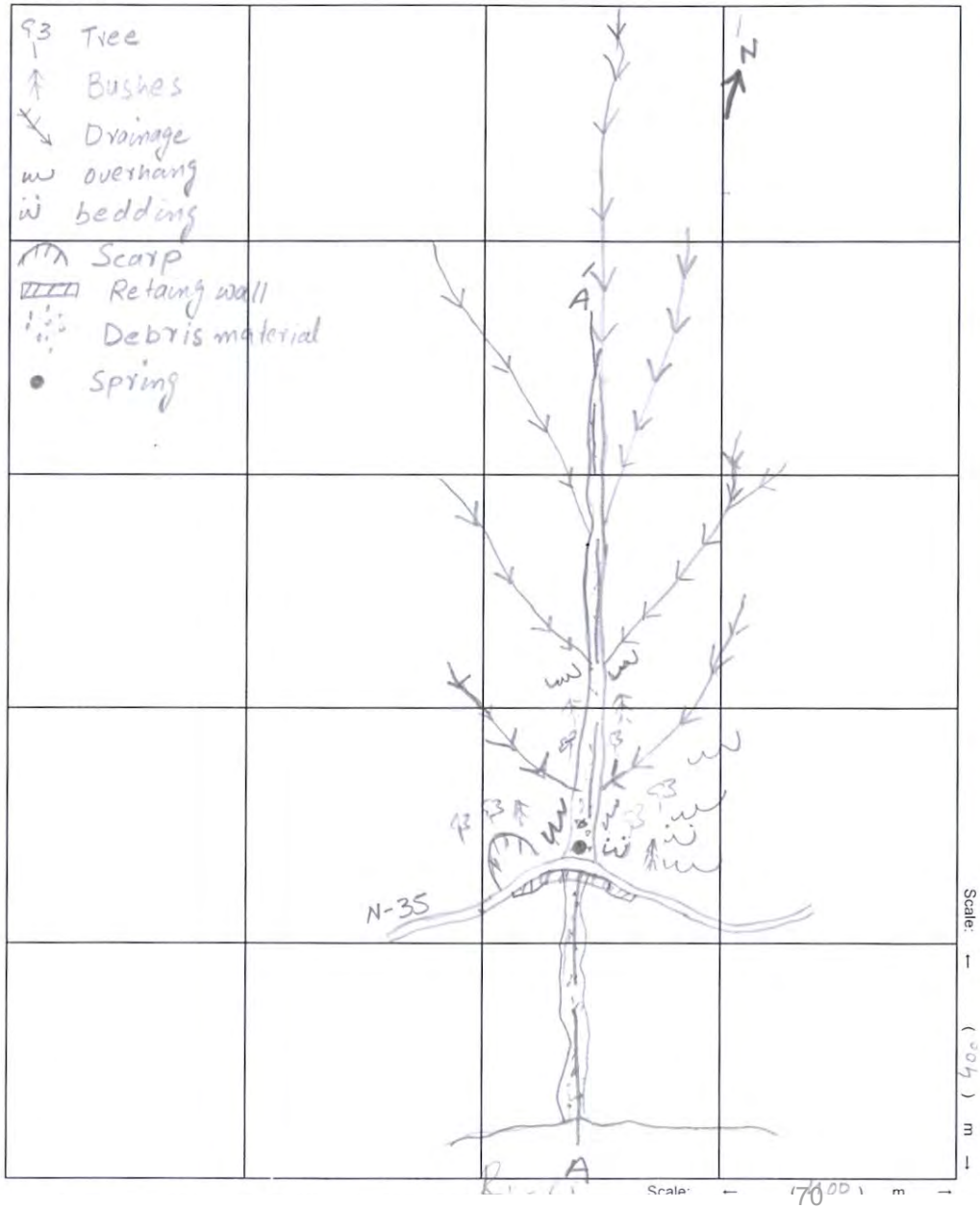
Code no.	N _ 3 5			3 9
Region Office				
Maintenance Unit				

Sketch sheet

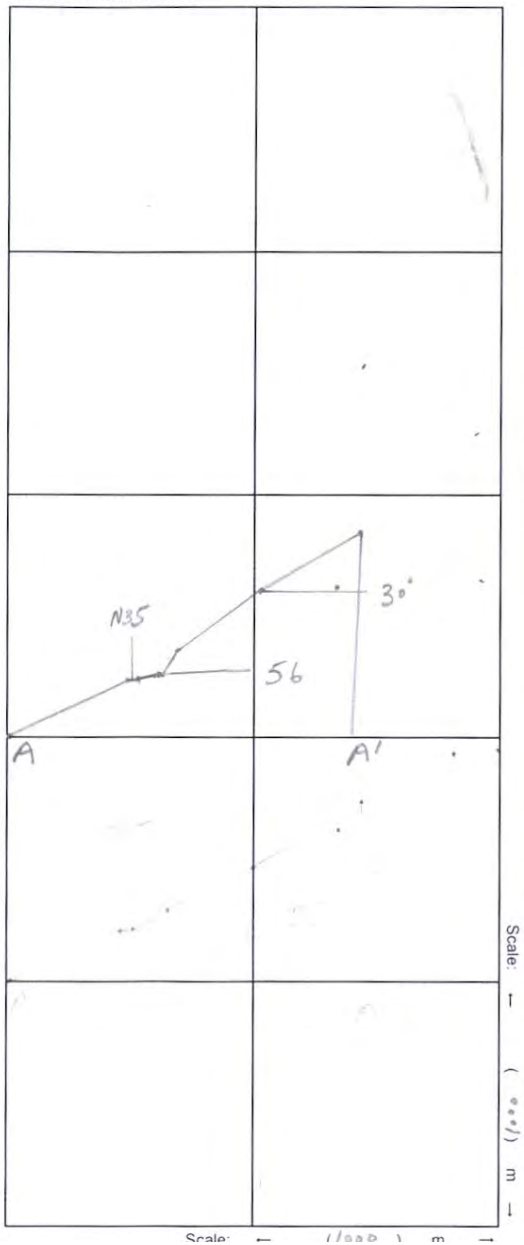
Coordinates	Latitude	35°04'13.0"
	Longitude	72 57 19.6
Road Name	N - 35	Km 39

Date	
Inspector	

Plane view



Cross sectional view



Scale: ↑ ( ) m →

Code no.	N	_	3	5			3	9
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 04' 13"
	Longitude	72° 57' 19.6"
Road Name		Km

Date	12/11/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow

Existing countermeasures / anomalies: Sloped Retaining wall has been constructed for Debris material

Road condition

Existing countermeasures / anomalies: Retaining wall has been constructed for N-35

Code no.	N 3 5 4 5
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35°04'57.3"
	Longitude	72°58'45.7"
Road name	Km	

Date	12/12/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H＜50m	height	
			15≦H＜30m	height	
			H＜15m	height	
			i≧70°	dip	
			45°≦i＜70°	dip	
			i＜45°	dip	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	
Natural slope	√

[Countermeasure]

Type of countermeasures	
There is no countermeasure	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	√

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 184 m, W= 93 m, D = 3 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

This is an active slope failure of lose debris comprising of boulders, gravels, sand and silt. The scarp of the landslide is clearly visible and still prone to rock failure due to presence of detached, weathered and jointed rocks. Presence of the loose debris in the upstream of slide also cause debris flow during heavy rains. Shrubs and grasses are present on the debris however, no trees are present. Active erosion and weathering on the slide leads to development of gullies. Detached boulders are present on the loose debris that often reach to the road and therefore posing threat to the road and traffic. The landslide is frequently affecting the road, mainly during the rainy season, however, no mitigation measures is constructed to stabilize the slope or protect the road from flowing and falling debris. Bed rock is composed of fragmented and jointed Dunite. Loose talus deposits are present on above and below the road.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

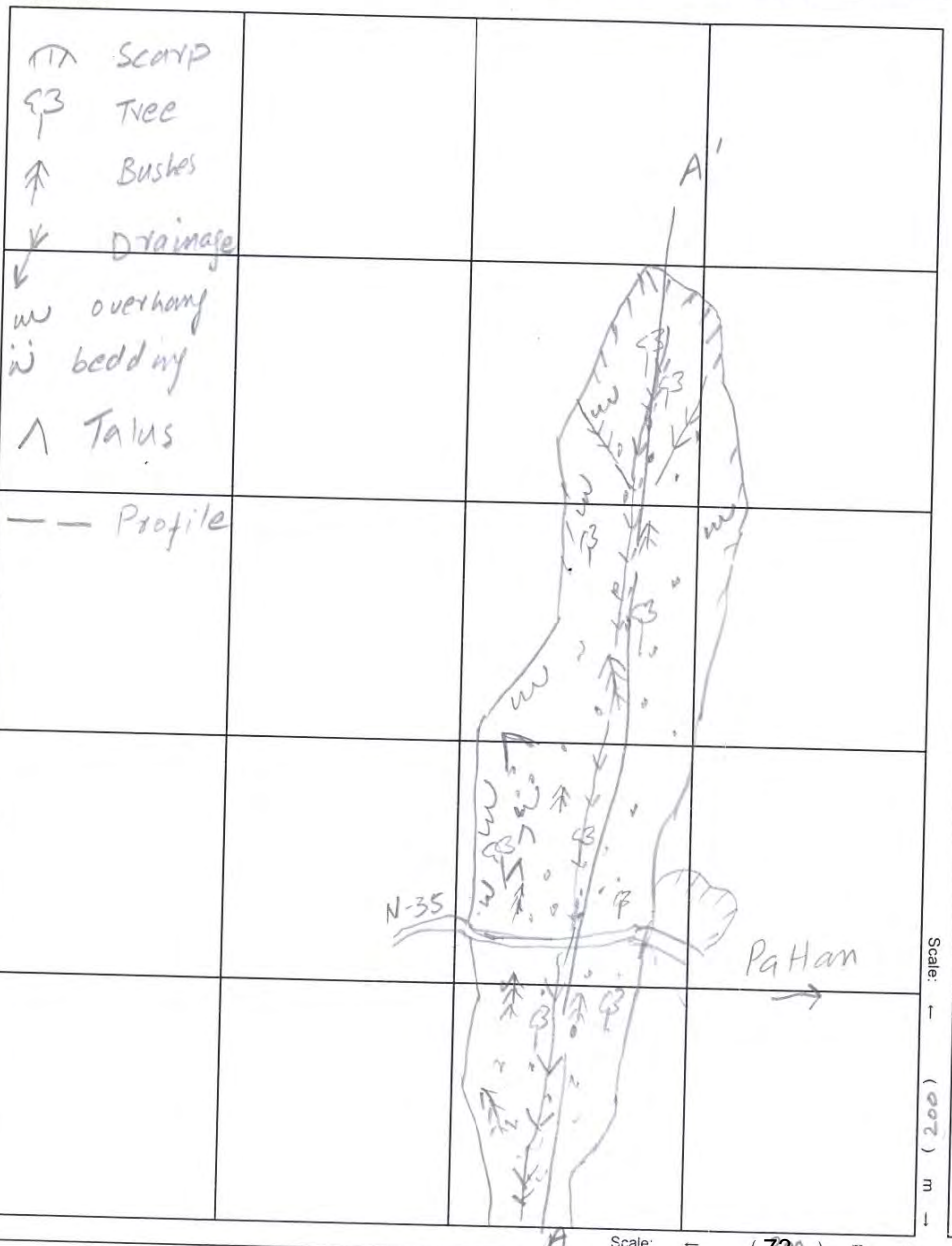
-Low risk: no road closure

Code no.	N	3	5		4	5	
Region Office							
Maintenance Unit							

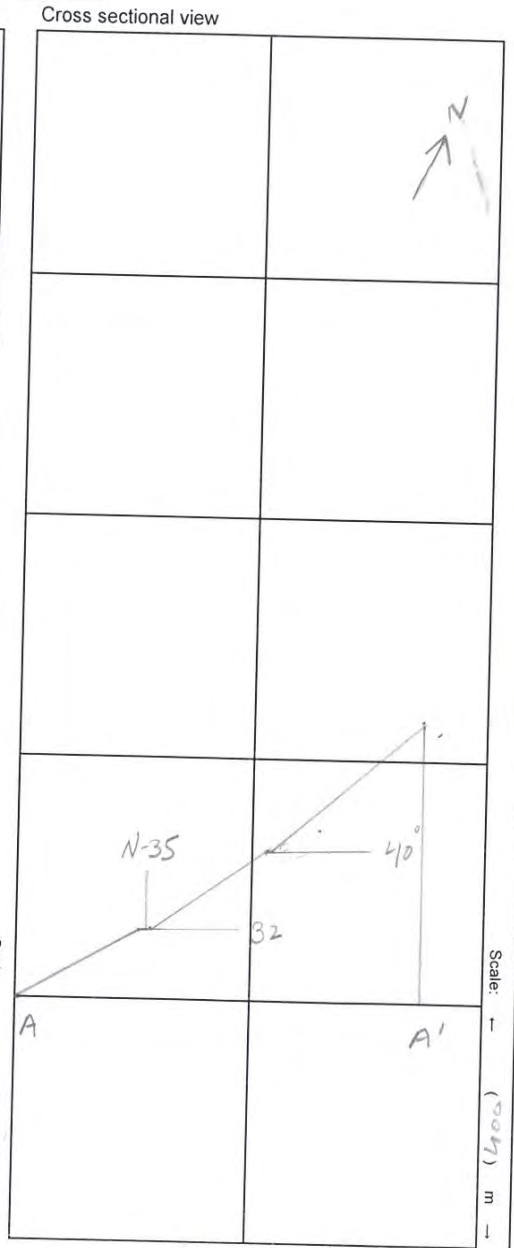
Sketch sheet

Coordinates	Latitude	35°04'57.3"	Date	
	Longitude	72°58'45.7"	Inspector	
Road Name	N-35	Km 45		

Plane view



Cross sectional view



Code no.	N	3	5		4	5	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35°04'57.3"
	Longitude	72°58'45.7"
Road name		Km

Date	12/12/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: No counter measures

View of fallen blocks

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 5 3
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 06' 17.7"
	Longitude	72° 59' 3.6"
Road name	Km	

Date	12/13/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H＜50m		
			15≦H＜30m		
			H＜15m		
			i≧70°	dip	
			45°≦i＜70°		√
			i＜45°		
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	
Natural slope	√

[Countermeasure]

Type of countermeasures	
Retaining wall has been constructed for N-35 on valley side.	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 138.4 m, W= 261.5 m, D = 4-5 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

This is a deep seated multiple rotations landslide. The main body of the landslide is consolidated with presence of grasses, however, the left and right flanks of the landslide is activated mainly due to the road cutting. The debris of the slide is mainly comprised of boulder, gravels, silt and sand. Active erosion on the slide debris leads to development of well-developed gullies. Hanging boulder are also present in the debris that pose threats to the road and traffic. The slide is mainly activated during the rainy season and the loose debris can also leads to debris flow. Despite the continuous damages of the road and disruption of the traffic due to falling debris and rocks, not mitigation measures are adopted to stabilize the slide. A retaining wall is constructed to protect the road, however, it is also buried by the falling debris. A house is located on the ridge of the slide. Tension cracks and open joint are present on the slide. Talus is present on the upper and lower side of the road. Slide is void of any thick vegetation.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

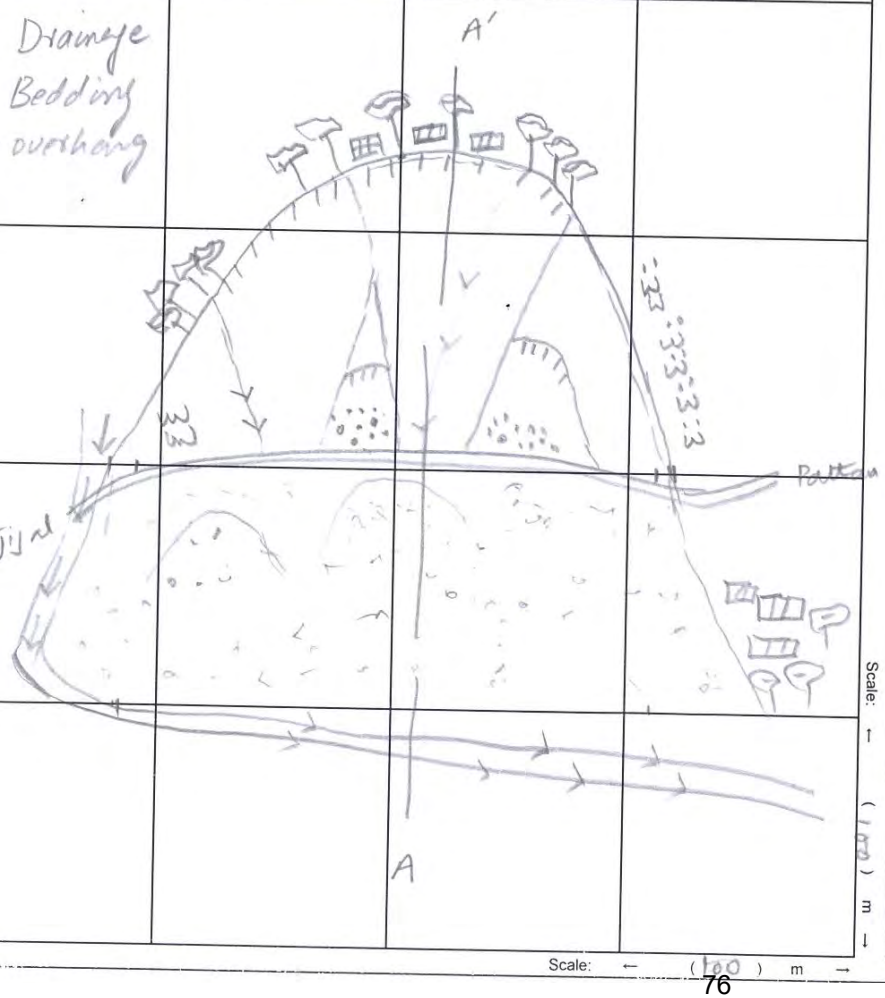
Code no.	N	3	5		5	3	
Region Office							
Maintenance Unit							

Sketch sheet

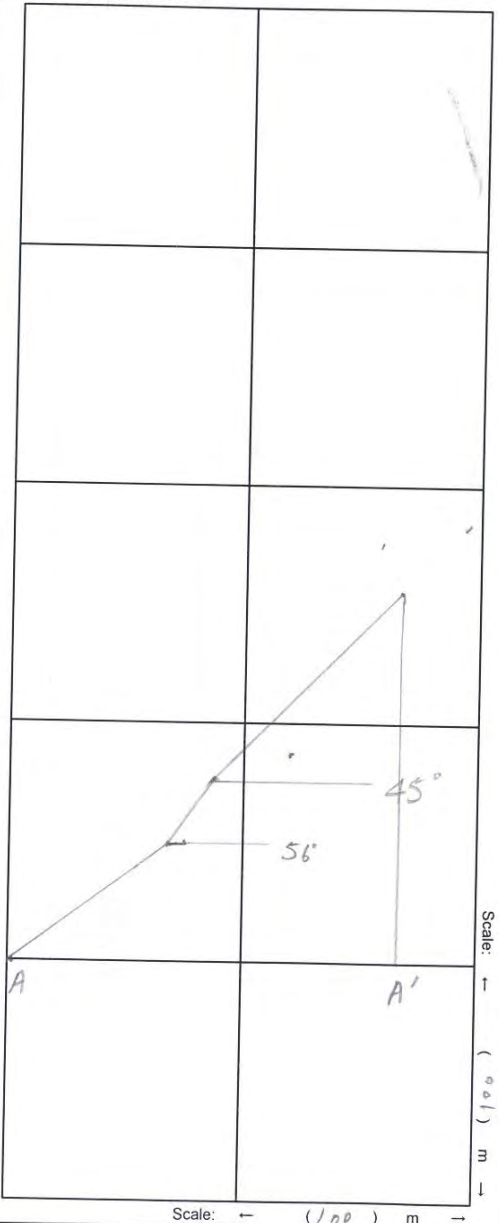
Coordinates	Latitude	35° 06' 17.7"	Date	
	Longitude	72° 59' 3.6"	Inspector	
Road Name	N - 35	Km	53	

Plane view

Tree
Houses
Scarp
Debris material
Drainage
Bedding
overhang



Cross sectional view



Code no.	N	3	5		5	3	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 06' 17.7"
	Longitude	72° 59' 3.6"
Road name		Km

Date	12/13/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of Retaining wall as counter measure for N-35

View of fallen blocks

Code no.	N 3 5 _ 5 4
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 06' 48.3"
	Longitude	72° 59 ' 59.7"
Road name		Km

Date	14-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		√
			none		
	Surface condition		bare land with minor vegetation		√
			intermediate (bare･grass･tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H＜50m	
				15≦H＜30m	
				H＜15m	
			dip	i≧70°	
				45°≦i＜70°	√
				i＜45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences･clarity		√
			certain･unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L= 184 m, W= 90 m, D = 3 m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

This is a complex landslide comprising of rock fall, debris flow and slope failure. Active erosion on the loose material leads to development of deep gullies that often leads to debris flow during rainy season. The exposed bed rock on the left flank of the slide has detached, fractured and jointed boulders that are prone to rock fall and therefore posing threats to the road and traffic. Three roads are passing through the slide at different heights. However, no mitigation measures are constructed to stabilize the slide. A retaining wall is constructed on the valley side of all the three roads. Tension cracks were present on the slide and it is void of thick vegetation. Talus is present above and below the road.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

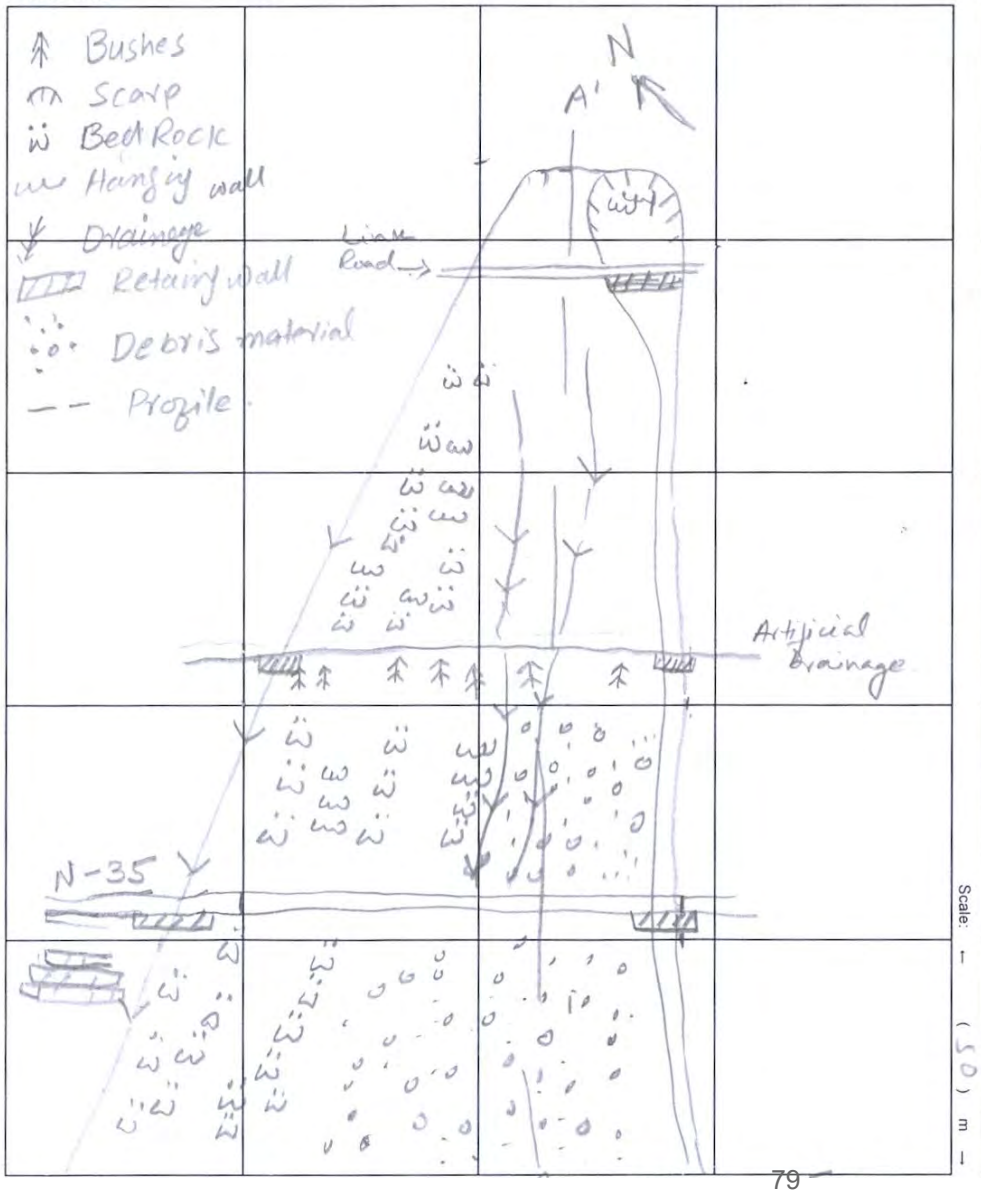
Code no.	N 3 5 _ 5 4
Region Office	
Maintenance Unit	

Sketch sheet

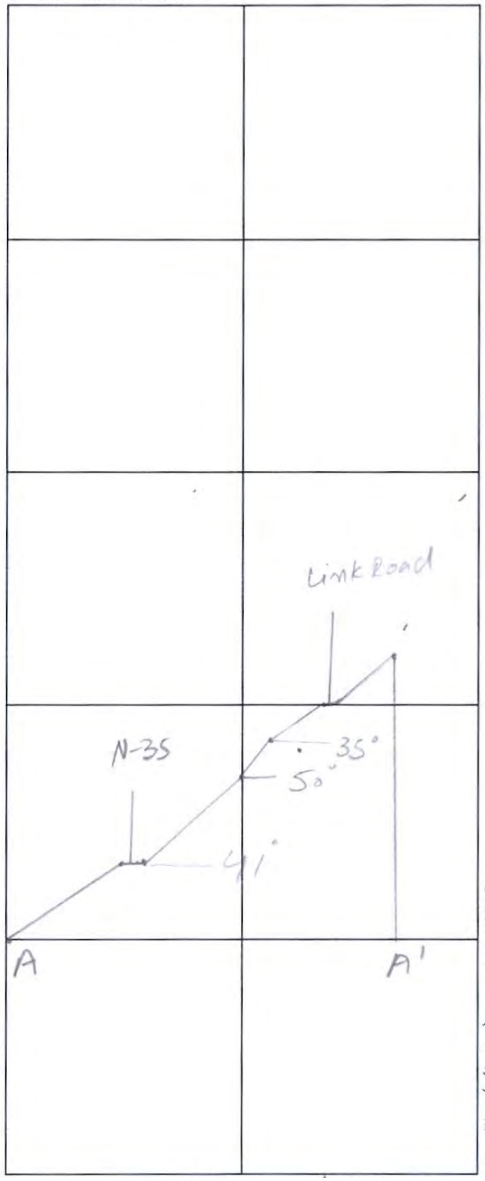
Coordinates	Latitude	35° 06' 48.3"
	Longitude	73° 59' 39.7"
Road Name	N - 35	Km 54

Date	
Inspector	

Plane view



Cross sectional view



) m

Code no.	N	3	5	_	5	4	
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 06' 48.3"
	Longitude	72° 59 ' 59.7"
Road name		Km

Date	12/14/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of Retaining wall and benching as counter measure

View of fallen blocks on road

Code no.	N 35 _ 56
Region Office	
Maintenance Unit	

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 06' 59"
	Longitude	73° 00' 39.8"
Road name		Km

Date	15-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	
			30≦H<50m	height	√
			15≦H<30m	height	
			H<15m	height	
			i≧70°	dip	
			45°≦i<70°	dip	√
			i<45°	dip	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L=520m, W=180m, D=1-2m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

An active rotational complex landslide comprising of slope failure, Debris flow and rock fall. Weather, jointed and fractured overhanging bed rock are posing threats to the road and traffic. Active weathering and erosion leads to development of gullies. Debris flow induced erosion tracks are well developed. Talus material comprised on boulders, gravels and sand is present. Bed rock is comprised of Amphibolite. Although it is posing threats to the road, however, no mitigation measures are adopted. This LS needs quick attention from the concern authorities as on the valley side a medical hospital is built which is also prone from the rock fall.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

Sketch sheet

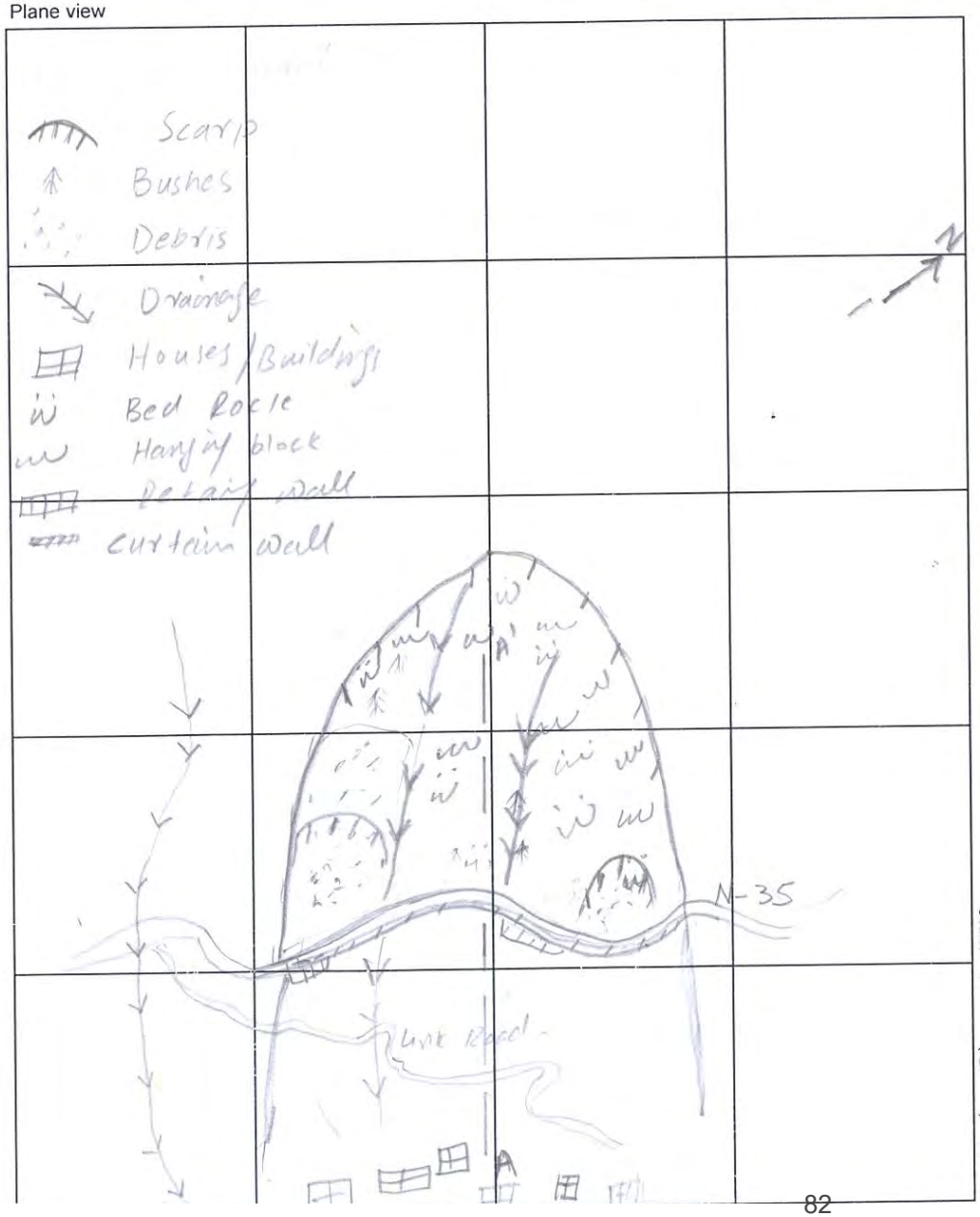
Code no.	N 3 5 _ 5 6
Region Office	
Maintenance Unit	

Coordinates	Latitude	35°06'59"
	Longitude	73°00'39.8"
Road Name	N-35	Km 56

Date	
Inspector	

Plane view

Cross sectional view



Scale: 1 ( ) m

Photo sheet

Code no.	N	3	5	_	5	6				
Region Office										
Maintenance Unit										

Coordinates	Latitude	35° 06' 59"
	Longitude	73° 00' 39.8"

Road name					Km					

Date	12/15/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

View of Overhang blocks on road

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 1 1 2
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 16' 12.3"
	Longitude	73° 13' 23.6"
Road name		Km

Date	12/16/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		
			2 correspondences		√
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		
			a little marked		
			None		√
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		
			a little marked		
			None		√
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		
			a little unstable		√
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	√
				i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	
There is no countermeasure, or there is not effective even if countermeasures are not performed.	√

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 182m, L= 38.5m, D=?

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	(3)
Low risk	2	3	4

[Description]

An old rock fall however no signs of fresh rock fall. A steep cliff with jointed, fractured and detached boulders. Intersecting joints leads to wedge. Cracks are open. Bed rock is amphibolite. No mitigation measures are adopted. Houses are located on the top of the ridge. A hospital is located at the valley side of the slide and therefore needs quick attention from the concern authorities.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

..uto' 7258

Code no.	N	3	5		1	1	2
Region Office							
Maintenance Unit							

Sketch sheet

Coordinates	Latitude	35° 16' 12.3"	Date: 17-12-2017
	Longitude	73° 13' 23.6"	Inspector:
Road Name	N - 35	Km 1 1 2	

Tree
Communication Tower
Houses
Scarp
Bedrock
Hanging block
Debris
Retaining wall

Plane view

Cross sectional view

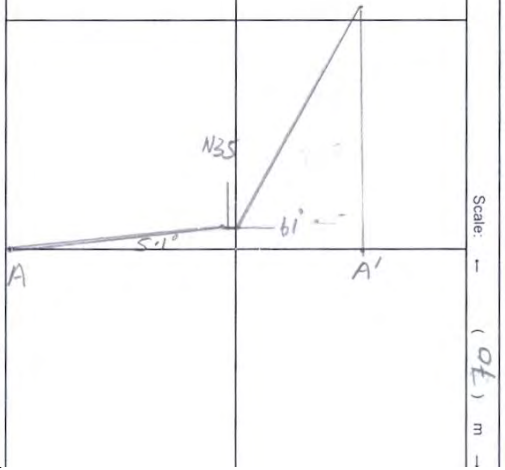


Photo sheet

Code no.	N	3	5					1	1	2
Region Office										
Maintenance Unit										

Coordinates	Latitude	35° 16' 12.3"
	Longitude	73° 13' 23.6"

Road name		Km	

Date	12/16/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of retaining wall as counter measure

View of fallen blocks

Code no.	N 3 5 _ 1 1 5									
Region Office										
Maintenance Unit										

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 13' 26.1"
	Longitude	73° 13' 25.2"
Road name		Km

Date	17-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H<50m		
			15≦H<30m		
			H<15m		
			i≧70°	dip	
			45°≦i<70°		√
			i<45°		
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

L=230m, W=200m, D=1-2m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

An active slope failure and rock fall. Originally a rock fall, however, talus of 16 m is accumulated at the rock fall toe that is prone to slope failure now. Active weathering and erosion on this talus deposits leads to development of gullies. On the rockfall cliff there are many jointed and detached boulder that poses threats to road and traffic. Wedge cutting is observed. Weathering becomes active during the rains and affecting the road. However, no mitigation measures are constructed. A retaining wall is built at the left flank of the slide, however, it is also not enough to stabilize the slide

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

Sketch sheet

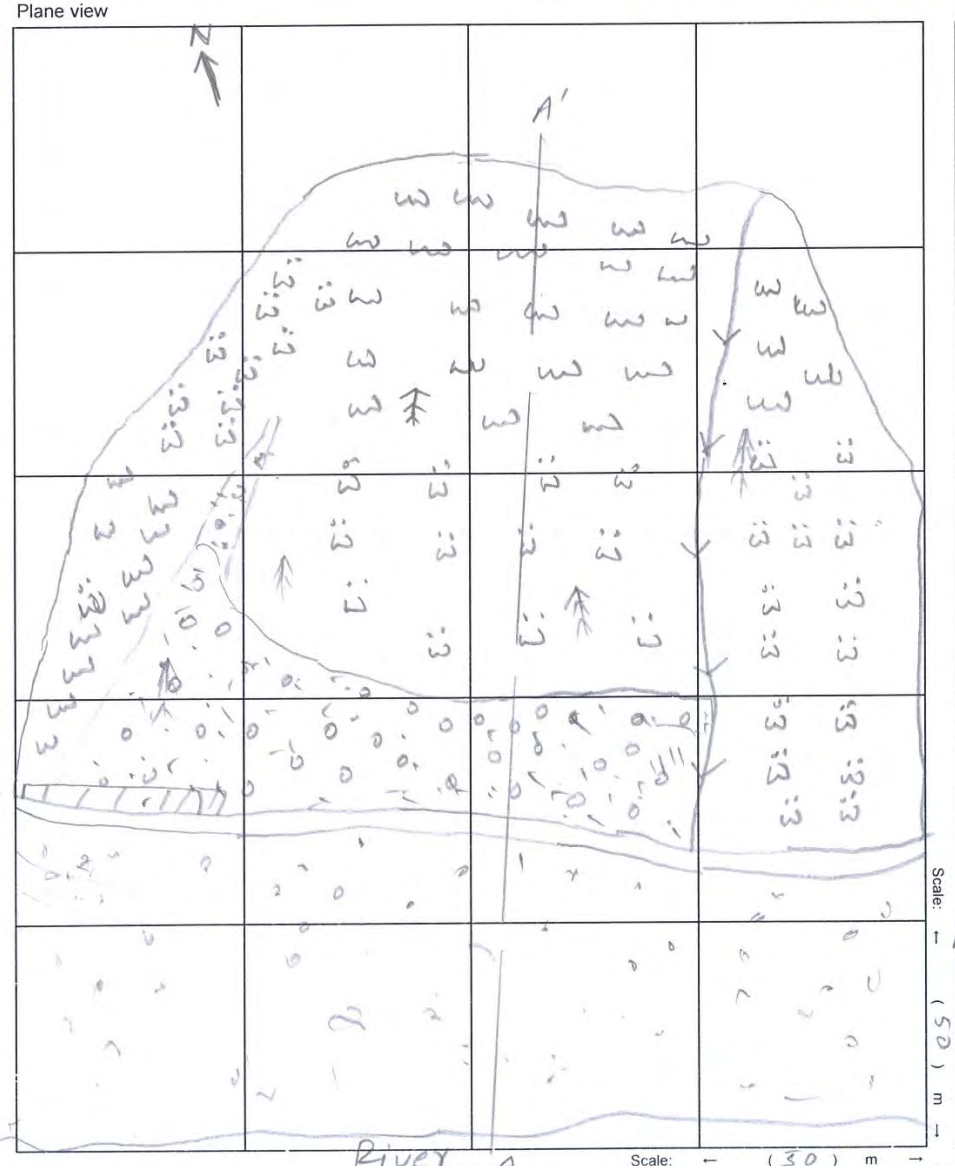
Code no.	N 3 5 _ 1 1 5
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 17' 26.1"
	Longitude	73° 13' 25.2"
Road Name	N - 35	Km 1 1 5

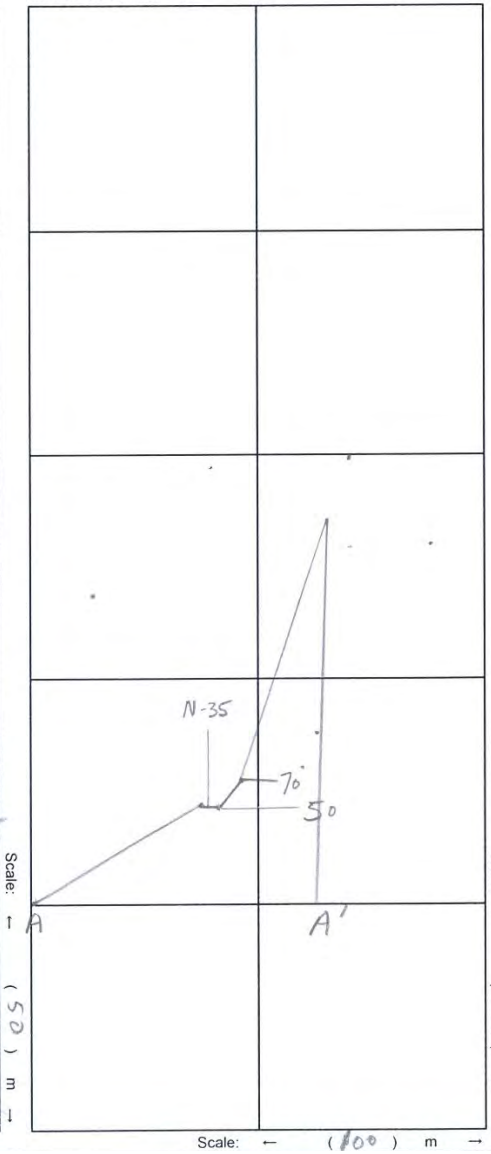
Date	
Inspector	

Retaining wall
overhang
Bedding
Bushes
Debris
Drainage

Plane view



Cross sectional view



Scale: ← (50) m →

Scale:

Photo sheet

Code no.	N 3 5 _ 1 1 5
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 13' 26.1"
	Longitude	73° 13' 25.2"
Road name		Km

Date	12/17/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of retaining wall as counter measure

View of Gully erosion along the slope failure

Code no.	N 3 5 _ 1 1 6									
Region Office										
Maintenance Unit										

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 17' 42.9"
	Longitude	73° 12' 15.5"
Road name		Km

Date	18-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H＜50m	
				15≦H＜30m	
				H＜15m	
			dip	i≧70°	
				45°≦i＜70°	√
				i＜45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Retaining wall for N-35	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W=370, L= 307m, D= 7m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	(2)	3
Medium risk	1	2	3
Low risk	2	3	4

[Description]

The site (Chochang) has a history of road blockade in past. It is a historical landslide, which is reactivated many times. Initially it was rockfall but now it is slope failure in debris/talus deposit. Deposit comprises of some boulders of size >6 m3.
Geology of the site is characterized by presence of Kamila Jal Shear zone on backside, which results in intense fragmentation of Kamila Amphibolite.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

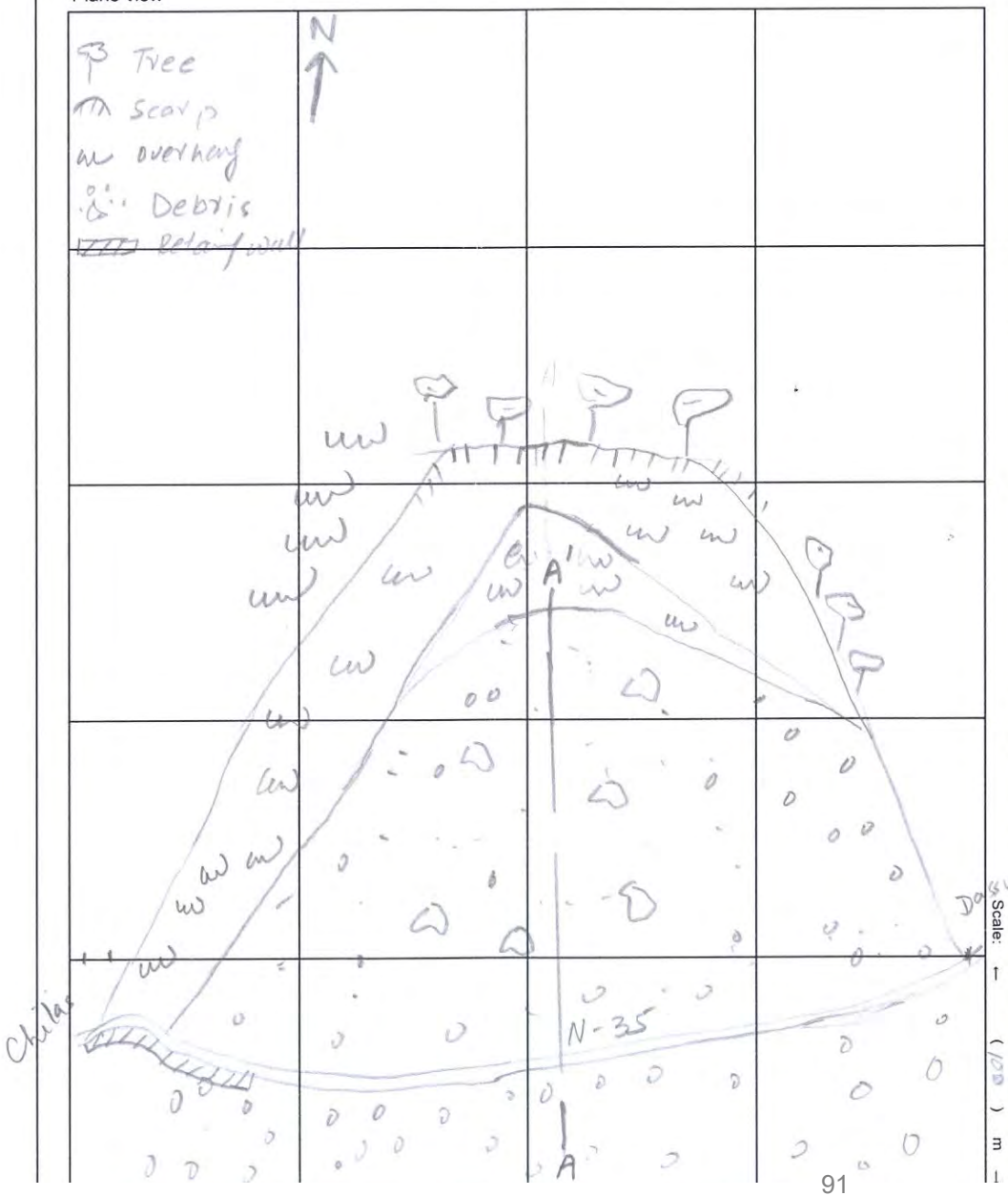
Sketch sheet

Code no.	N 3 5 _ 1 1 6
Region Office	
Maintenance Unit	

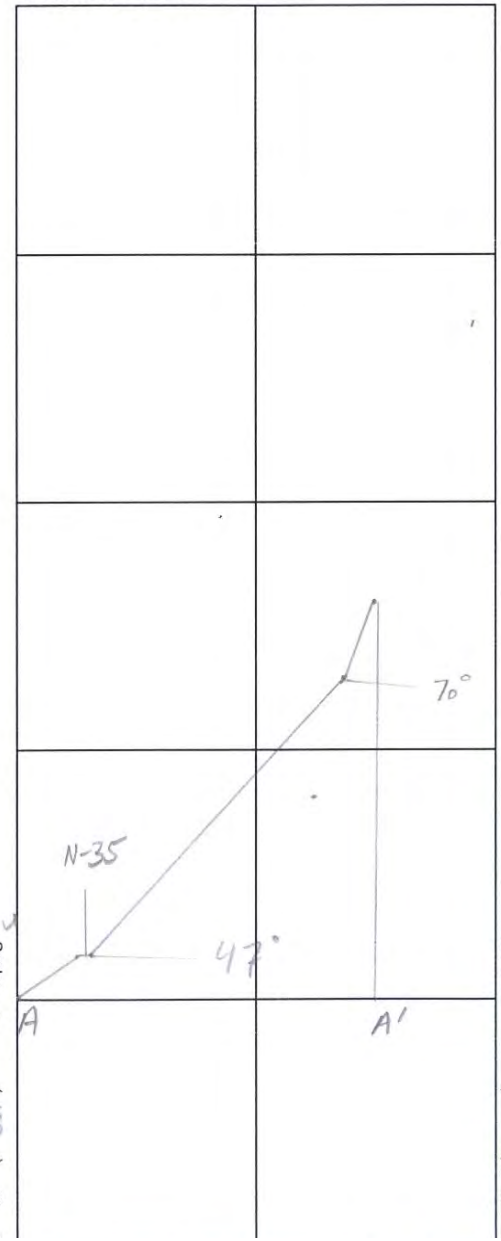
Coordinates	Latitude	35°17' 42.9"
	Longitude	73°12' 15.5"
Road Name	N-35	Km 1 1 6

Date	
Inspector	

Plane view



Cross sectional view



Scale: ( ) m

Code no.	N	3	5	_	1	1	6
Region Office							
Maintenance Unit							

Photo sheet

Coordinates	Latitude	35° 17' 42.9"
	Longitude	73° 12' 15.5"
Road name		Km

Date	12/18/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of retaining wall as counter measure

View of fallen block

Code no.	N 3 5 _ 1 1 7								
Region Office									
Maintenance Unit									

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 18' 5.4"
	Longitude	73° 11' 58.6"
Road name		Km

Date	19-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		√
			none		
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H＜50m		
			15≦H＜30m		
			H＜15m		
			i≧70°	dip	
			45°≦i＜70°		√
			i＜45°		
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Benching and terracing on the debris to stabilize the slope	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 200m, L=380m, D=2-3m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

An active debris fall from an old lake deposits. The talus cone is present in the valley. Active erosion on the talus leads to development of gullies. Water is flowing through the talus and also seeps in the debris. Hanging boulder are present in the debris. The slide is active during the rainy season and can also leads to a debris flow. It is damaging the road, however, no mitigation measures are adopted to protect the road. Trenches are made on the talus to stabilize the debris.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

7323

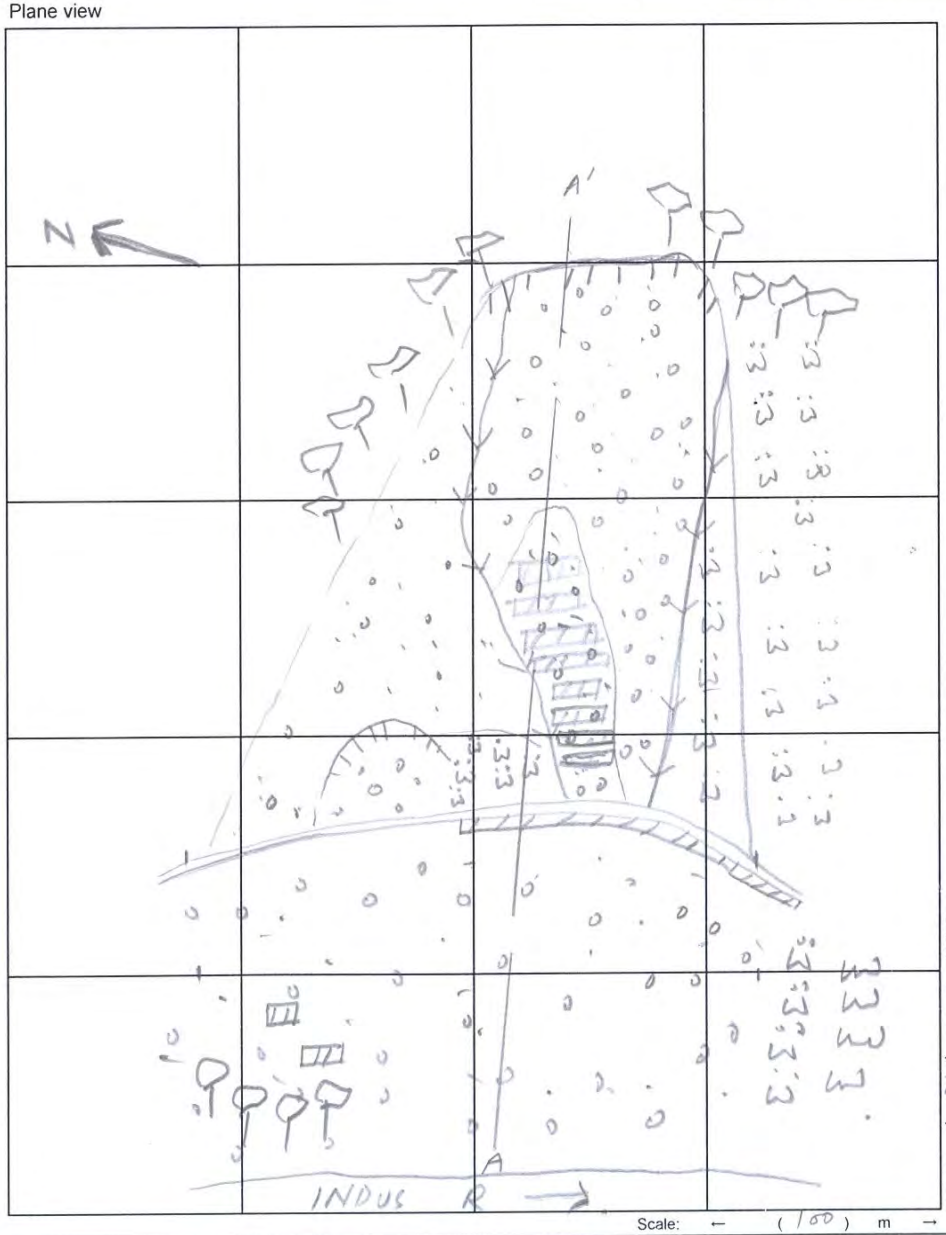
Code no.	N	3	5	_	1	1	7			
Region Office										
Maintenance Unit										

Sketch sheet

Coordinates	Latitude	35° 18' 5.4"									
	Longitude	73° 11' 58.6"									
Road Name	N - 3 5	Km	1	1	7						

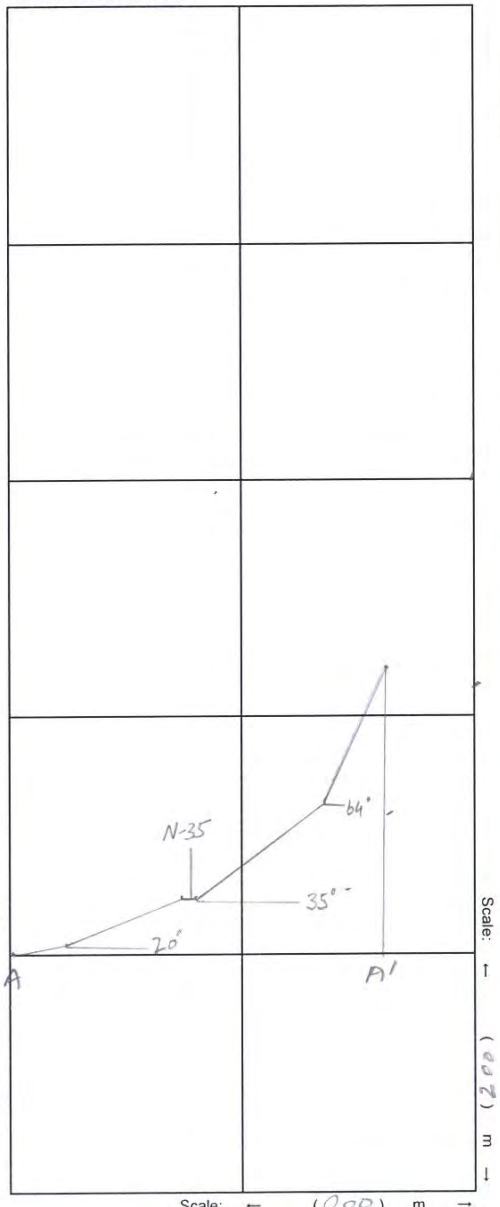
Date	
Inspector	

Plane view



Scale: ← (100) m →

Cross sectional view



Scale: ↑ (200) m ↓

93 Tree
Drainage
Retaing wall
Debris
Scarp
Houses
overhang
Bedding

Code no.	N	3	5	_	1	1	7	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 18' 5.4"
	Longitude	73° 11' 58.6"
Road name		Km

Date	12/19/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of benching as counter measure

View of fallen blocks along slope failure

Code no.	N	3	5		1	1	9			
Region Office										
Maintenance Unit										

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 18' 35.8"
	Longitude	73° 11' 26.8"
Road name		Km

Date	12/20/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		
			a little marked		√
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H＜50m	
				15≦H＜30m	
				H＜15m	
			dip	i≧70°	
				45°≦i＜70°	√
				i＜45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic ~~after construction of recent measures.~~	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 349m, L= 240m, D= 1m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

It is impression of old rockfall. Lithology at this site is Kamila amphibolite, which is highly jointed and sheared due to closeness to KJS. Uncontrolled blasting for road excavation triggered this site. In addition to it, river is eroding the valley side of the road resulting in over steepening of the slope towards valley side. There is retaining wall towards valley side for road protection. No countermeasures for rockfall has been constructed.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

Sketch sheet

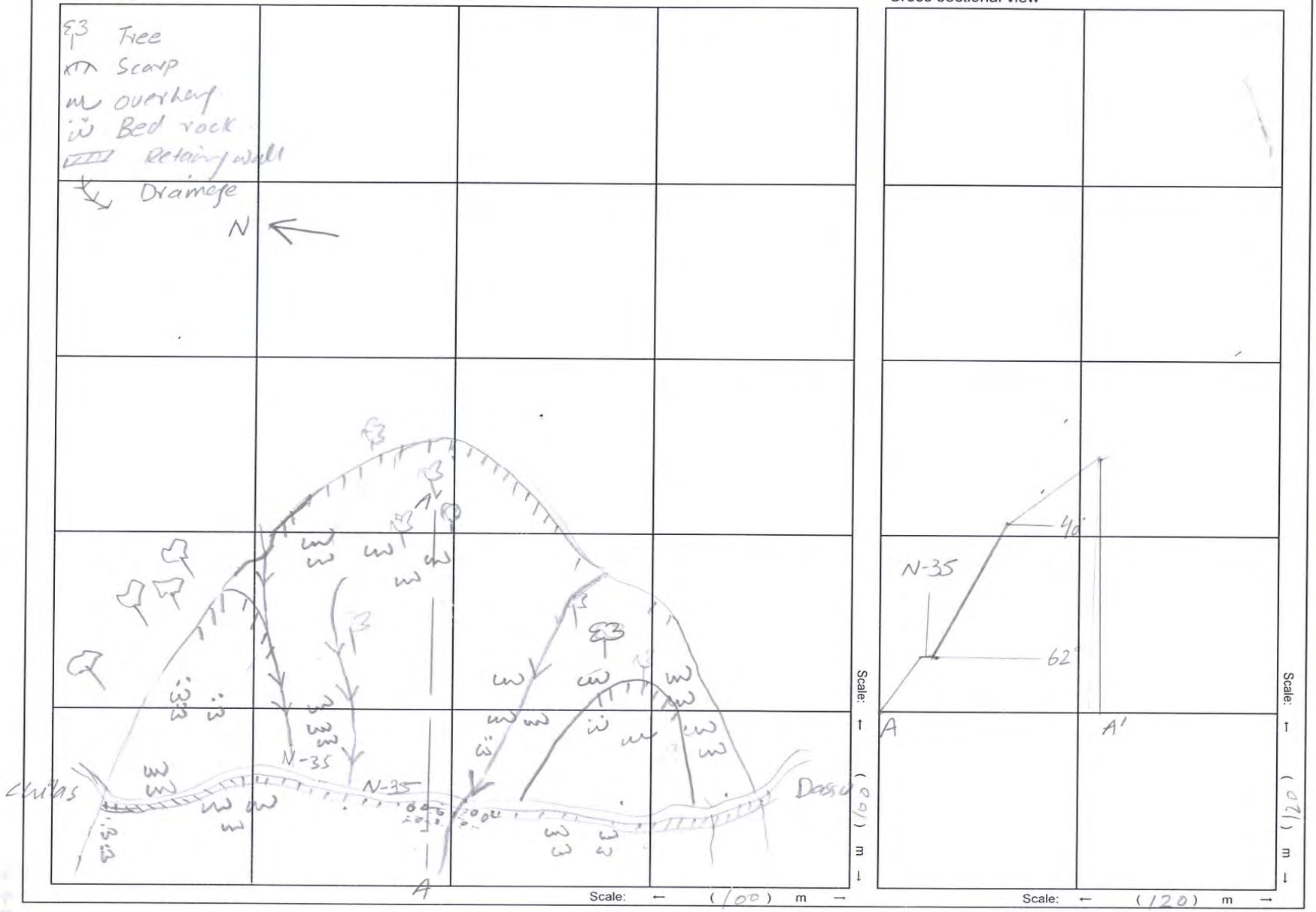
Code no.	N 3 5 1 1 9
Region Office	
Maintenance Unit	

Coordinates	Latitude	35°18'35.8"
	Longitude	73°11'26.8"
Road Name	N-35	Km 1 1 9

Date	
Inspector	

Plane view

Cross sectional view



Code no.	N	3	5		1	1	9	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 18' 35.8"
	Longitude	73° 11' 26.8"
Road name		Km

Date	12/20/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

View of fallen blocks

Code no.	N 3 5	1 3 4
Region Office		
Maintenance Unit		

Evaluation sheet (Slope failure/Rockfall)

Coordinates	Latitude	35° 23' 12.3"
	Longitude	73° 12' 2.3"
Road name		Km

Date	12/21/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	√
				i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 264m, L= 270m, D= 1-2m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	(2)	3
Medium risk	1	2	3
Low risk	2	3	4

[Description]

Uncontrolled blasting for road excavation triggered this slope. Lithology is Granulite, which is highly sheared and fragmented rockmass. Gullies upslope contain a large quantity of scree/talus/debris. Due to low infilteration in hard rocks and large catchment area, seasonal rainfalls result into debris slide.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

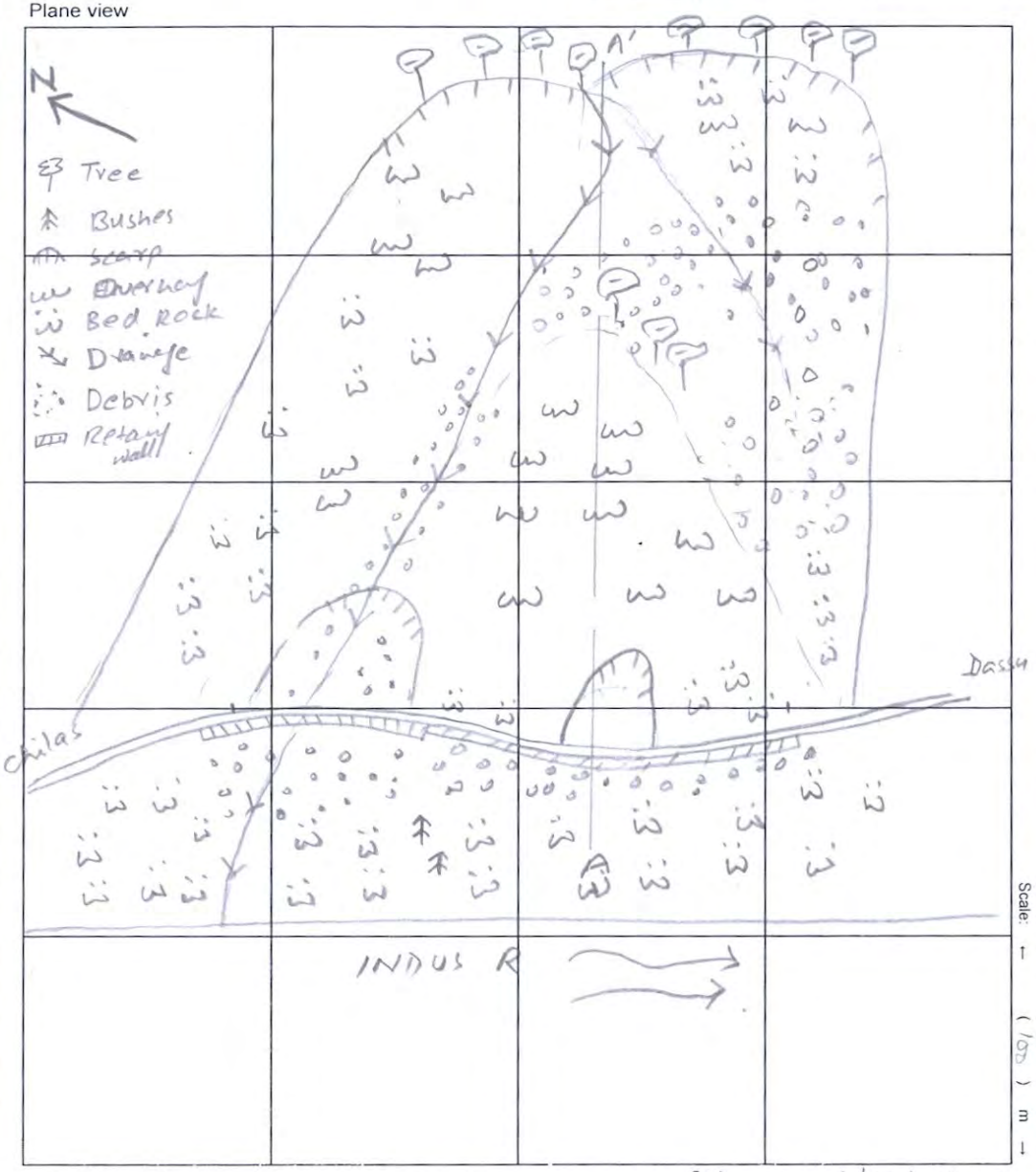
Code no.	N	3	5		1	3	4			
Region Office										
Maintenance Unit										

Sketch sheet

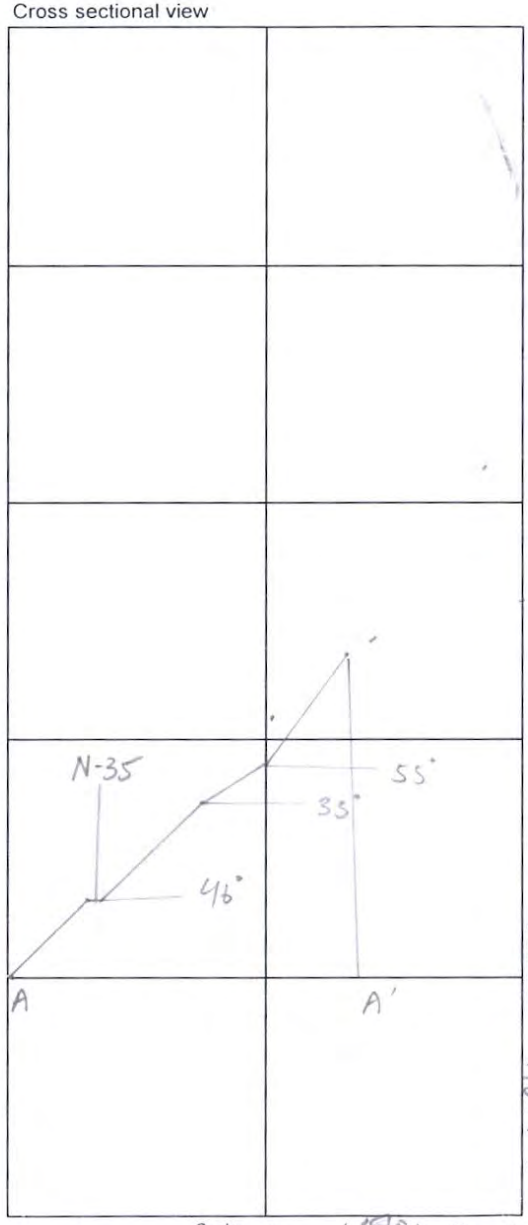
Coordinates	Latitude	35°23'12·3"
	Longitude	73°12' 02·35"
Road Name	N - 35	Km 134

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		1	3	4	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 23' 12.3"
	Longitude	73° 12' 2.3"
Road name		Km

Date	12/21/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

View of fallen blocks

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 1 6 2
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 27' 46.4"
	Longitude	73° 14' 56.9"
Road name	Km	

Date	12/22/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H<50m		
			15≦H<30m		
			H<15m		
			i≧70°	dip	
			45°≦i<70°		√
			i<45°		
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Perforated Retaining wall for talus slope about 3.5m high. Stepped Retaining wall for road N-35.	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 165m, L= 376m, D= 4-5m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	(2)	3
Medium risk	1	2	3
Low risk	2	3	4

[Description]

Due to closeness with active Kamila Fault, the site is characterized by highly jointed Gabbro and talus deposit on slope. This talus deposit contains some boulders of size equal or greater than three m3. Rockfall upslope has resulted in accumulation of scree/talus deposit. This deposit is highly susceptible to failure during

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

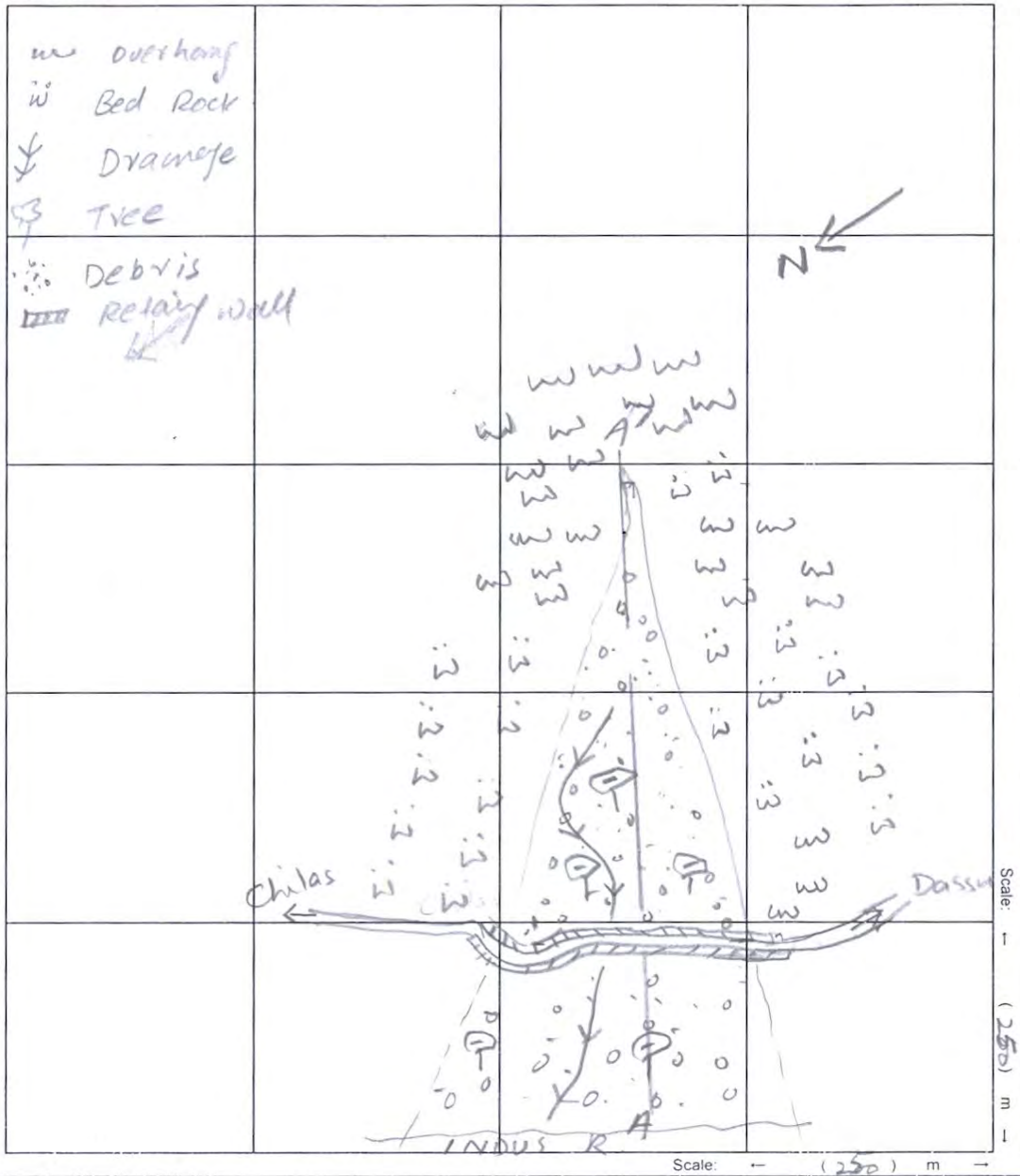
Code no.	N	3	5		1	6	2			
Region Office										
Maintenance Unit										

Sketch sheet

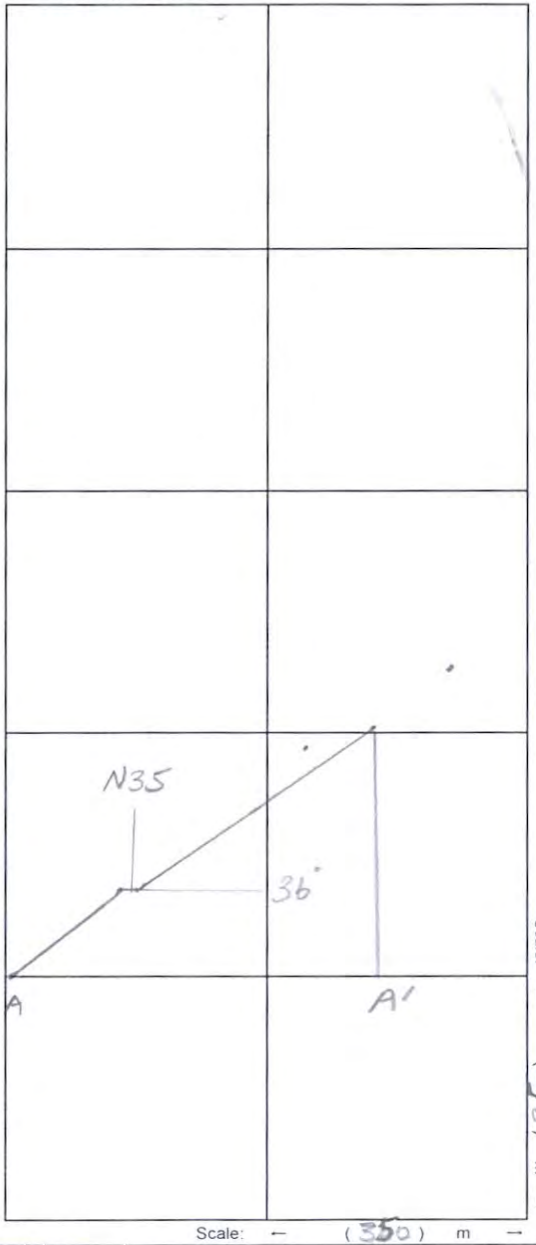
Coordinates	Latitude	35° 2' 46.4"
	Longitude	73° 14' 56.5"
Road Name	N - 35	Km 162

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		1	6	2			
Region Office										
Maintenance Unit										

Photo sheet

Coordinates	Latitude	35O 27' 46.4"
	Longitude	73O 14' 56.9"
Road name		Km

Date	12/22/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of retaining wall as counter measure for slope failure

View of fallen blocks

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 2 3 6
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 31' 23.8"
	Longitude	73° 39' 59.5"
Road name	Km	

Date	12/23/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane.	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		√
			a little marked		
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		H≧50m	height	√
			30≦H＜50m	height	
			15≦H＜30m	height	
			H＜15m	height	
			i≧70°	dip	
			45°≦i＜70°	dip	
			i＜45°	dip	√
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	
Slope failure	√

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
Retaining wall for talus slope about 1m high	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	√
There is no countermeasure, or there is not effective even if countermeasures are not performed.	

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 515m, L= 453m, D= 4-5m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

It is an old landslide deposit (Harbon Avalanch II), which dammed Indus River in past. This deposit is highly susceptible to erosion. During rainfall, slope failure, gully erosion and debris flow within this deposit makes this site vulnerable.
Retaining wall about 4 feet high was built to minimize the risk but it has been damaged due to recent landslide activity.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

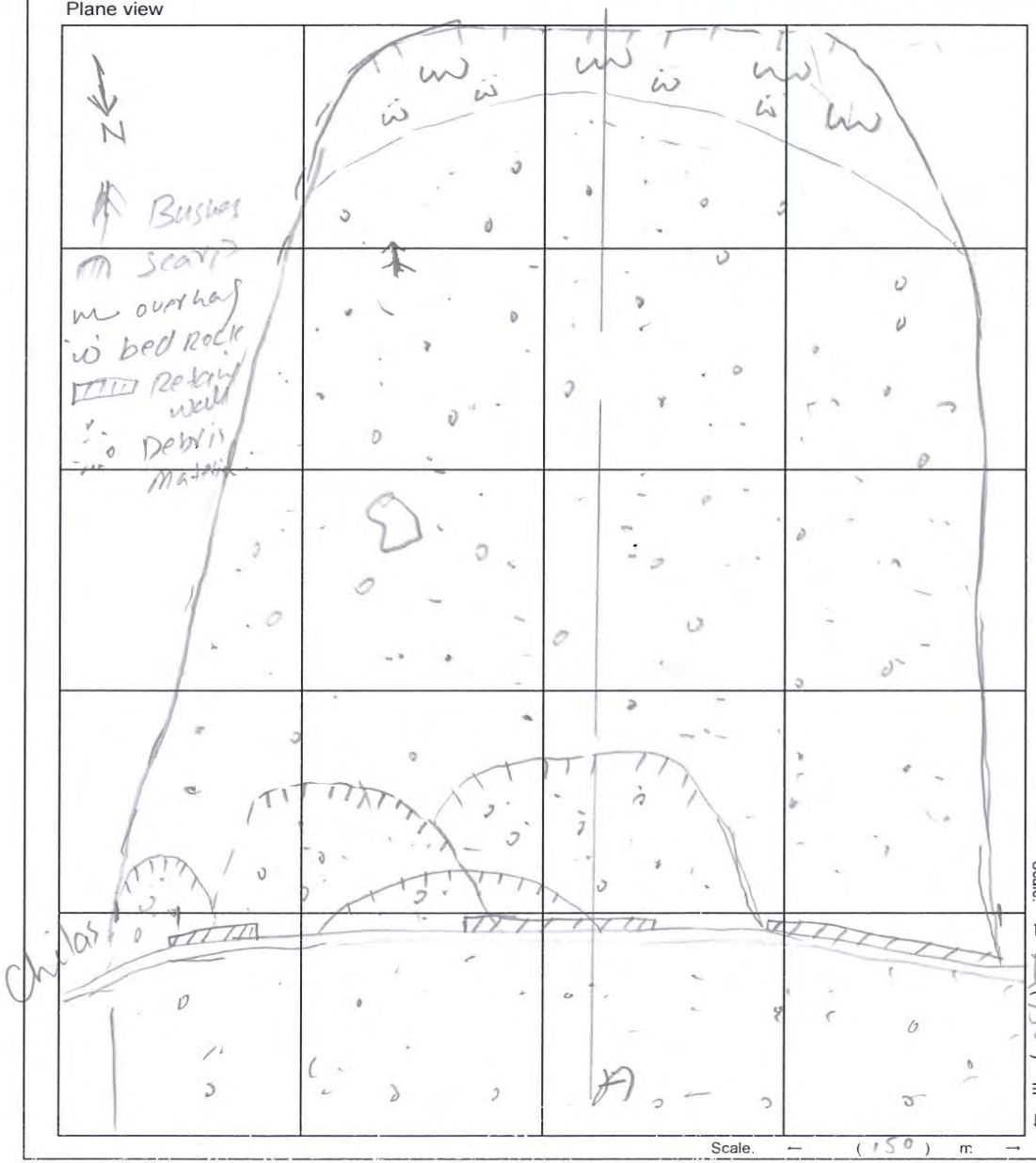
Code no.	N	3	5		2	3	6	
Region Office								
Maintenance Unit								

Sketch sheet

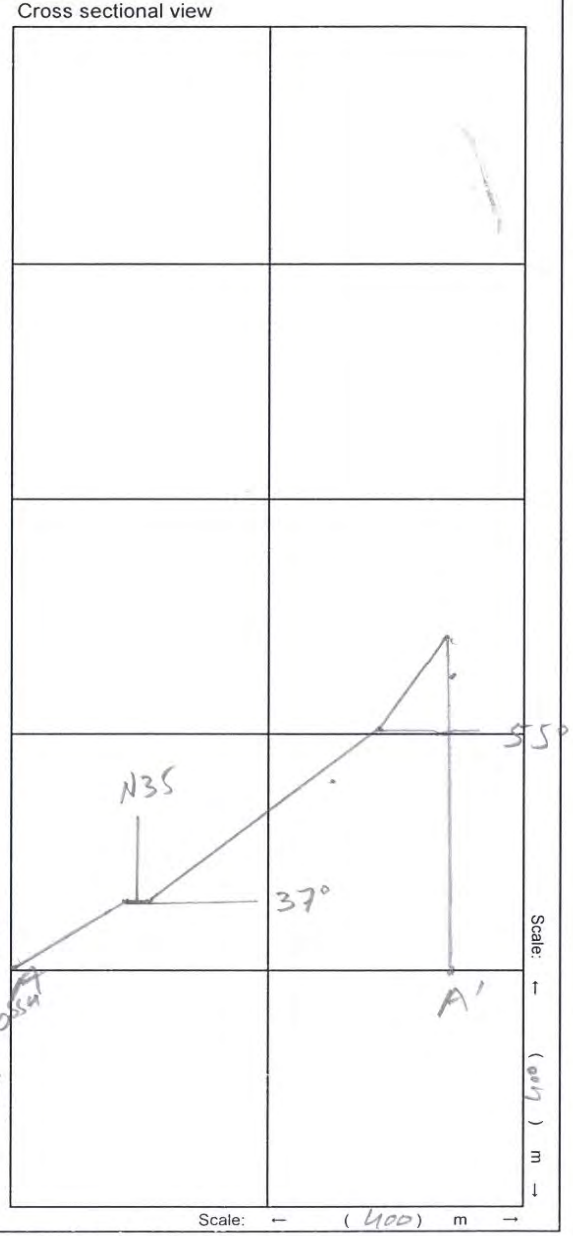
Coordinates	Latitude	35°31'23.8"
	Longitude	73°39'59.5"
Road Name	N-35	Km 236

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5		2	3	6	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 31' 23.8"
	Longitude	73° 39' 59.5"
Road name		Km

Date	12/23/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: View of shed as counter measure

View of Multiple slope failure in the talus deposits

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 _ 2 4 4
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 31' 8"
	Longitude	73° 44' 09.3"
Road name		Km

Date	24-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		
			a little marked		
			None		√
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		
			a little marked		√
			None		
	Structure	dip slope of bedding plane. Joint Planes	It corresponds.		√
			None		
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	√
				i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	?

[Main check object]

Cut slope	√
Natural slope	

[Countermeasure]

Type of countermeasures	
No countermeasures for slope failure. Retaining wall for N-35	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	
There is no countermeasure, ~~or there is not effective even if countermeasures are not performed.~~	√

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 35m, L= 160m , D= 1-2m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

Its 900 meters long steep slope having scree/talus deposit. Boulders of 2m^3 at toe indicates rockfall upslope. Small channel passing through slope bringing debris material hence making the gully on the slope. Gabbro of Kohistan batholith is exposed which is crushed and jointed. This crushing and jointing alongwith the blasting for N35 are the main triggering factors of this slope.

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

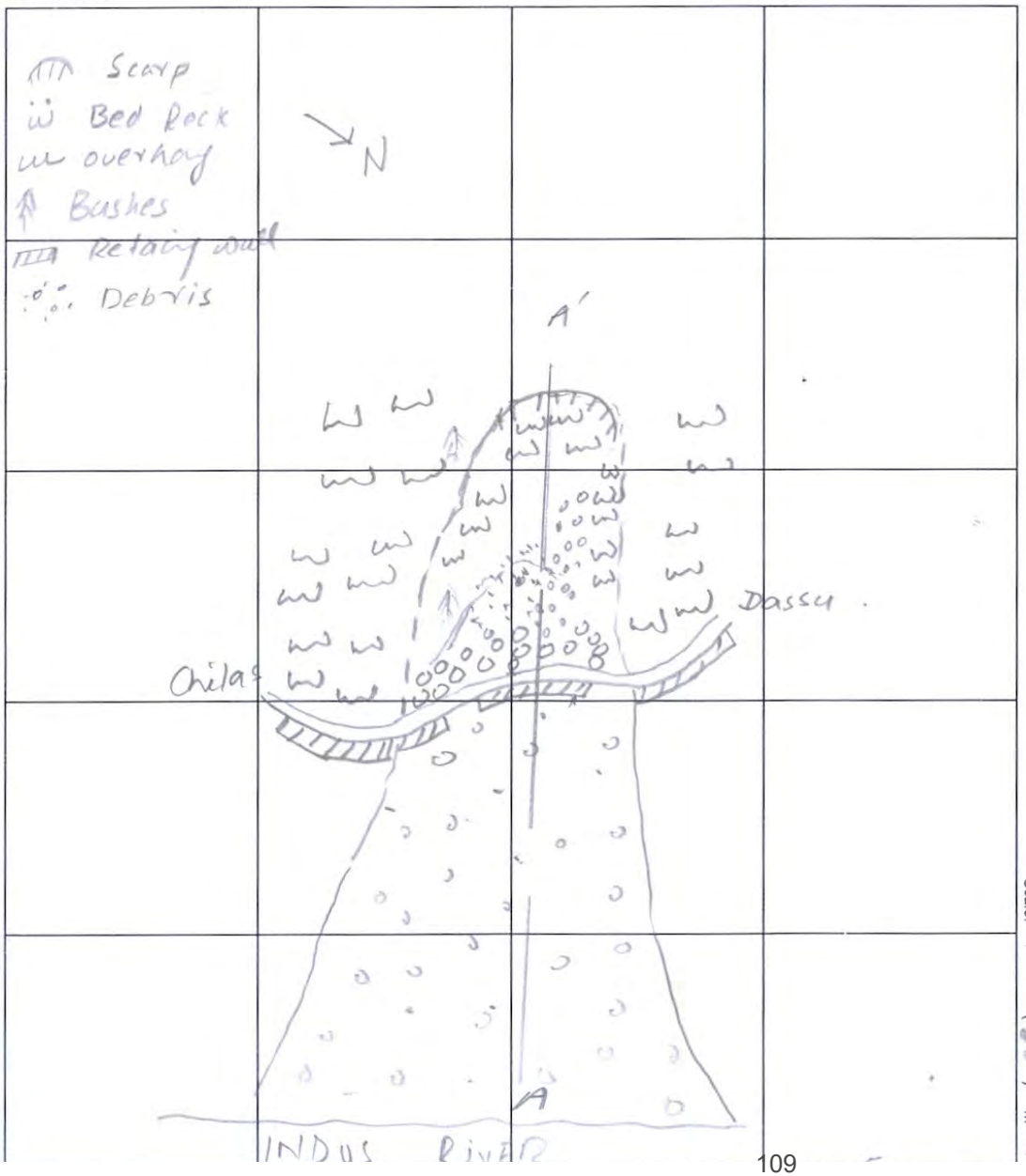
Sketch sheet

Code no.	N	3	5	_	2	4	4			
Region Office										
Maintenance Unit										

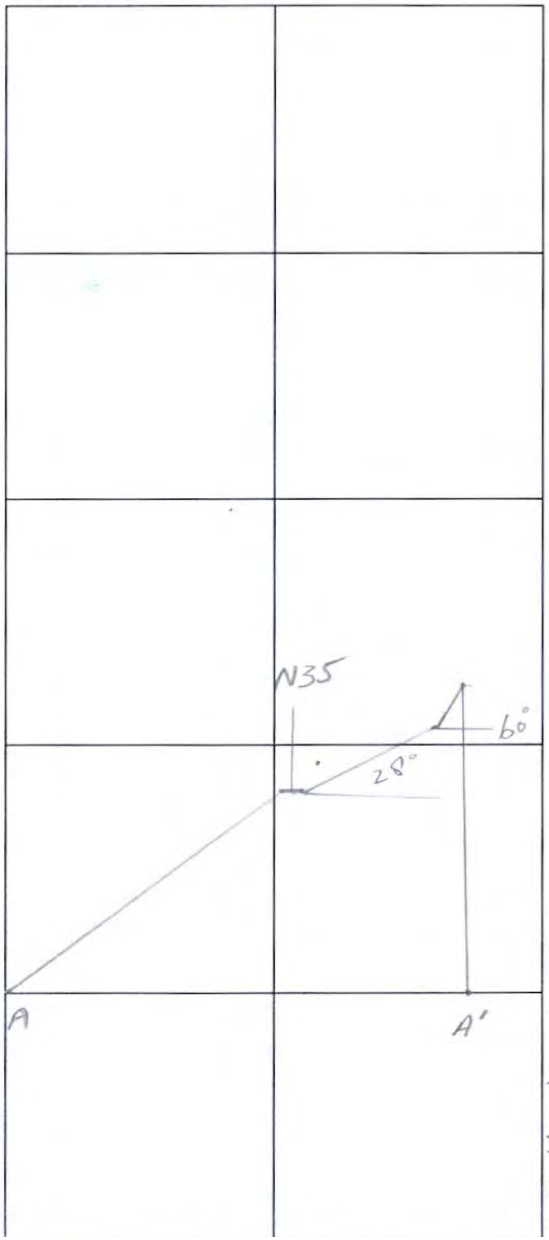
Coordinates	Latitude	35° 31' 8.0"
	Longitude	73° 04' 9.3"
Road Name	N - 35	Km 244

Date	19-12-2017
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5	_	2	4	4	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 31' 8"
	Longitude	73° 44' 09.3"
Road name		Km

Date	12/24/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies:No Counter Measure

View of fallen blocks on road

Evaluation sheet (debris flow)

Code no.	N35 270
Region Office	
Maintenance Unit	

Coordinates	Latitude	34° 28' 55.5"
	Longitude	73° 56' 03.1"
Road Name		Km

Date	12/25/2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	
		0.15km^2 - 0.50km^2	√
		less than 0.15km^2	
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	
		none	√
	new crack and/or slope failure in stream	certain	
		none	√
	traces of large slope failure in stream	certain	
		none	√

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or No bridge / box culvert	
	1m - 2m	√
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	√
There is a history about debris flow though there is no obstacle to traffic.	
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 1300 m, W=25 m, D= 2-3 m

[Countermeasure]

Type of countermeasure		Check
Culvert with opening 1x1 m		
Effect of existing countermesure	none・low	
	moderate	√
	high	
	enough	

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

Mouth of channel is very wide near road forming a fan shaped structure containing boulders of different sizes and some of size 2-3m3. Channel divides into two near the road:
a) Eastern channel having culvert box
b) Western Channel without protection
Sides of channel are steep having overhangs.

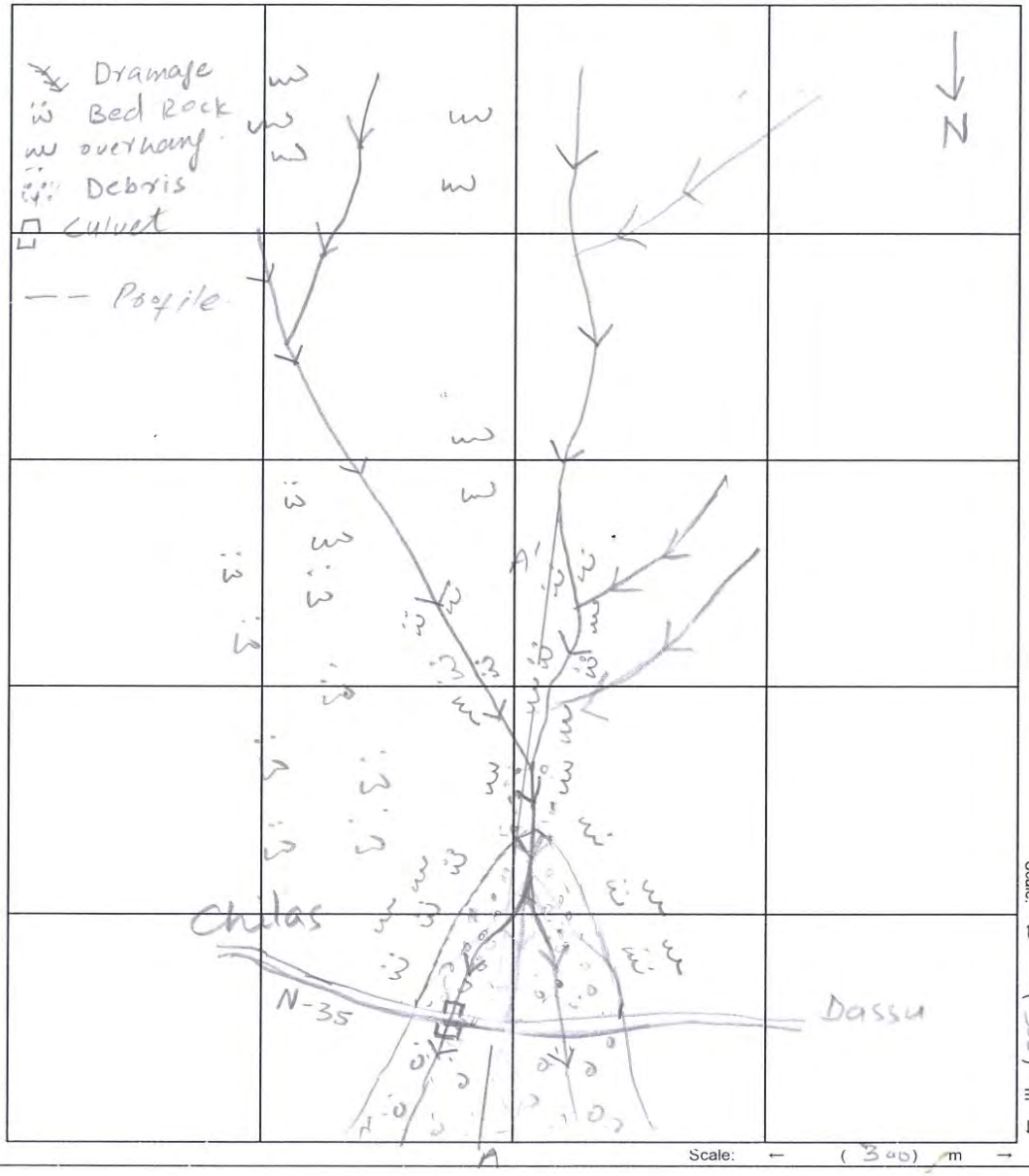
Sketch sheet

Code no.	N 35 270
Region Office	
Maintenance Unit	

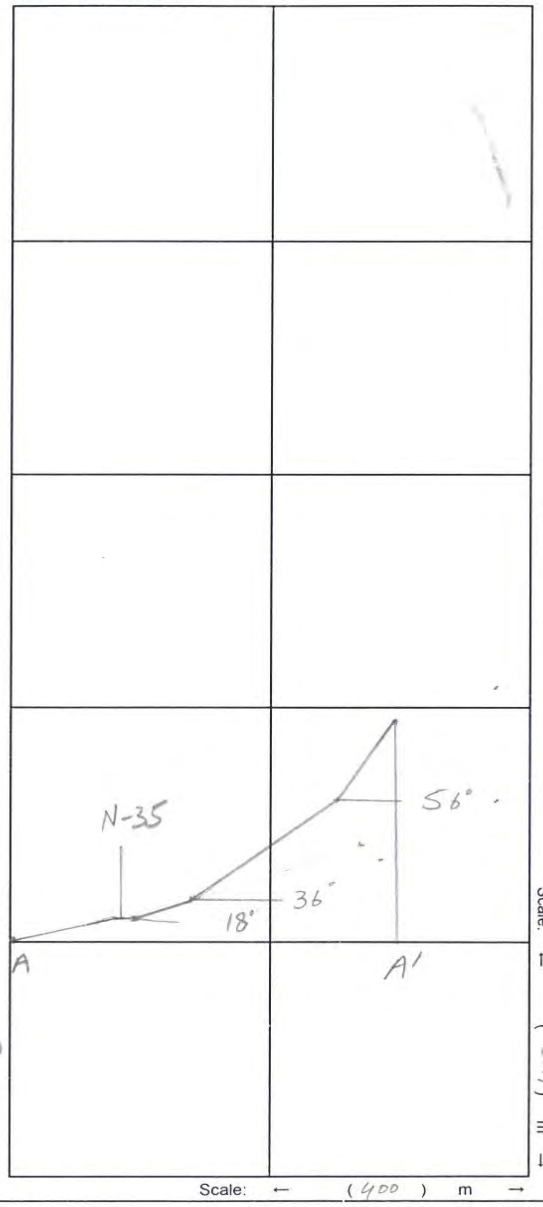
Coordinates	Latitude	35° 28′ 55.5″
	Longitude	73° 56′ 03.1″
Road Name	N-35	Km 270

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N - 35	270
Region Office		
Maintenance Unit		

Photo sheet

Coordinates	Latitude	34° 28' 55.5"
	Longitude	73° 56' 03.1"
Road Name		Km

Date	12/25/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow

Inlet of the culvert for the debris flow

Road condition

Existing countermeasures / anomalies: Culvert outlet view

Evaluation sheet (debris flow)

Code no.	N35_272
Region Office	
Maintenance Unit	

Coordinates	Latitude	35º 27' 38.1"
	Longitude	73º 58' 9.4"
Road Name		Km

Date	26-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	
		0.15km^2 - 0.50km^2	
		less than 0.15km^2	√
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	
		none	√
	new crack and/or slope failure in stream	certain	
		none	√
	traces of large slope failure in stream	certain	
		none	√

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or	
	No bridge / box culvert	√
	1m - 2m	
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	
There is a history about debris flow though there is no obstacle to traffic.	√
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 2000 m, W=11.20 m, D= 0.3 m

[Countermeasure]

Type of countermeasure		Check
Paved drainage path towards valley side		
Effect of existing countermesure	none・low	√
	moderate	
	high	
	enough	

[Evaluation Rank]

Scale of disaster / Risk	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	3
Low risk	2	(3)	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

A seasonal stream crosses the highway at this location. Two channels with large catchment area.
The 272 contains small quantity of debris as compare to 273. The 273 contains considerable amount of debris containing some boulders of size 0.5 m3, which can threaten stability of the highway. Further, valley side of channels is very steep due to river erosion. Paved drainage path on valley side is protecting from erosion on valley side.

Sketch sheet

Code no.	N35_272
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 27' 38.1"
	Longitude	73° 58' 9.4"
Road Name	N-35	Km 272-273

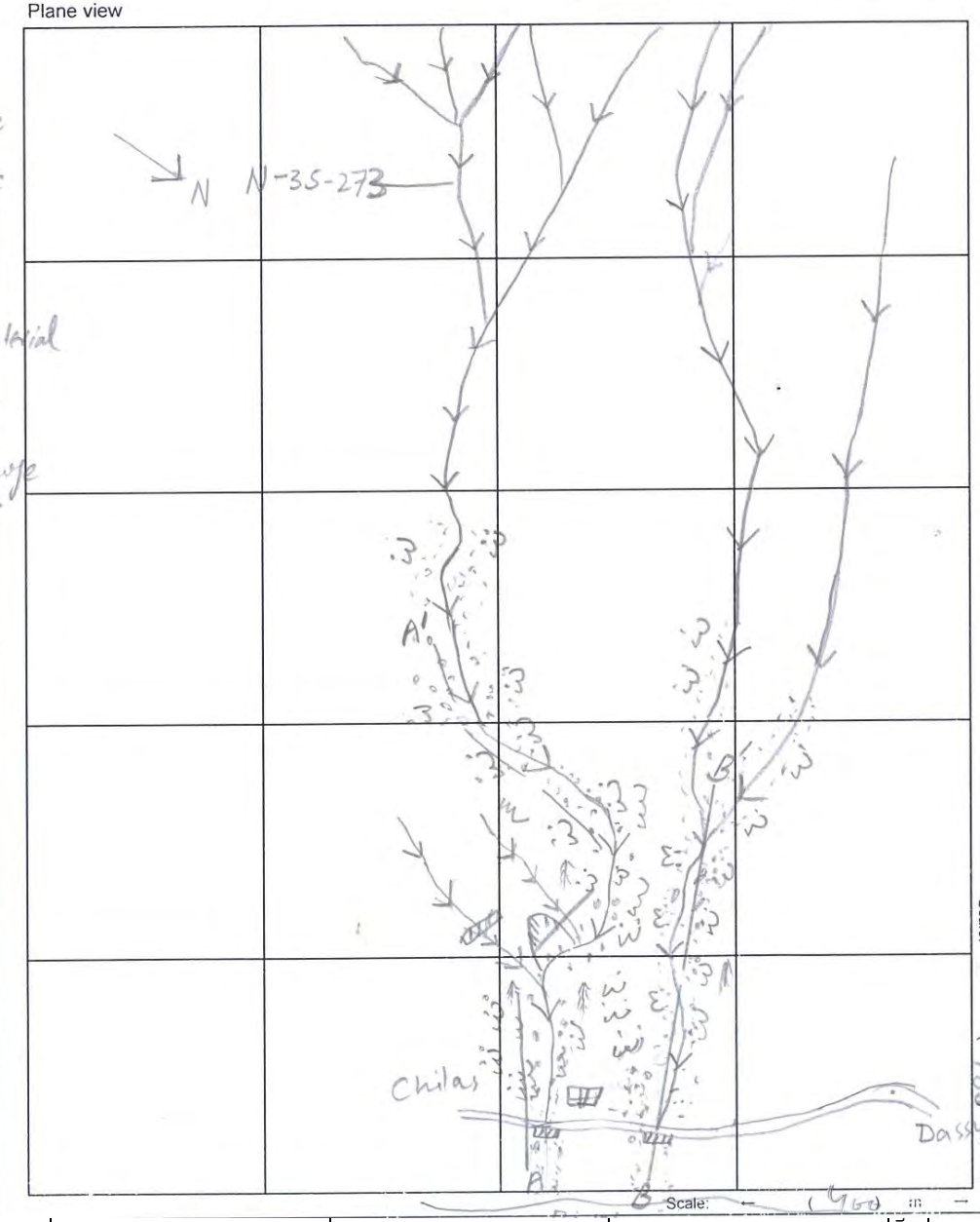
Date	
Inspector	

(273) to 8569

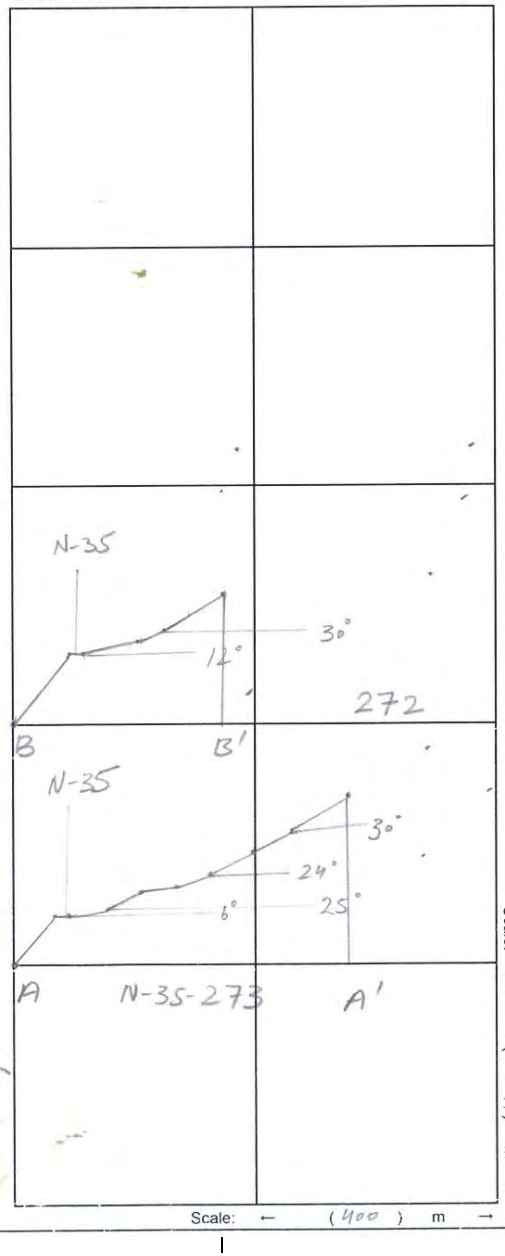
8585(2) 272

Drainage
Bed Rock
overhang
Bushes
Debris material
Building
Paved Drainage Path

Plane view



Cross sectional view



Code no.	N	-	3	5			2	7	2
Region Office									
Maintenance Unit									

Photo sheet

Coordinates	Latitude	35° 27' 38.1"
	Longitude	73° 58' 9.4"
Road Name		Km

Date	12/26/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow

The crack on road has been observed

Road condition

Existing countermeasures / anomalies: Retaining wall has been constructed at the toe of the Debris Flow

Evaluation sheet (debris flow)

Code no.	N35_273
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 27' 33.5"
	Longitude	73° 58' 11.2"
Road Name		Km

Date	27-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

item	factor	category	Check
Property of river	areas that river bed is 15°or more in watershed area	0.50km^2 or more	
		0.15km^2 - 0.50km^2	√
		less than 0.15km^2	
	steepest slope of river bed	40°or more	√
		30° - 40°	
		less than 30°	
Property of slope	area that slope gradient is 30° or more in watershed area	0.20km^2 or more	
		0.08km^2 - 0.20km^2	
		less than 0.08km^2	
	area that meadow and shrub (less than 10m height) occupy in watershed area	0.20km^2 or more	
		0.02km^2 - 20km^2	
		less than 0.02km^2	√
	artificial works that cause negative effects	certain	
		none	√
	new crack and/or slope failure in stream	certain	
		none	√
	traces of large slope failure in stream	certain	
		none	√

[Road structure]

structure	category of score	Check
River width	10m or more	√
	5m - 10m	
	3m - 5m	
	less than 3m	
Beam height	less than 1m or	
	No bridge / box culvert	√
	1m - 2m	
	2m - 3m	
	3m - 5m	
	5m or more	

[History]

category of score	Check
There is a history about debris flow that were obstacles to the road traffic after construction of recent measures.	
There is a history about debris flow though there is no obstacle to traffic.	√
There is no history of debris flow	

[Potencial disaster mode]

	Check
Damage of bridge/culvert	
Outflow of embankment	
Debris flooding on the road	√

[Expected size of disaster] (width, length, depth, etc.)

L= 1950 m, W=12.30 m, D= 0.6 m

[Countermeasure]

Type of countermeasure		Check
Paved drainage path towards valley side		
Effect of existing countermesure	none・low	√
	moderate	
	high	
	enough	

[Evaluation Rank]

Scale of disaster / Risk	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	2	3
Low risk	2	(3)	4

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

[Description/comments]

A seasonal stream crosses the highway at this location. Small catachment area with debris fall/rock fall material are present on the upstream.Two channels with large catchment area.
The 273 contains considerable amount of debris containing some boulders of size 0.5 m3, which can threaten stability of the highway. Further, valley side of channels is very steep due to river erosion. Paved drainage path on valley side is protecting from erosion on valley side.

Sketch sheet

Code no.	N 3 5 _ 2 7 3
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 27' 33.5"
	Longitude	73° 58' 11.2"
Road Name	N - 35	Km 272 - 273

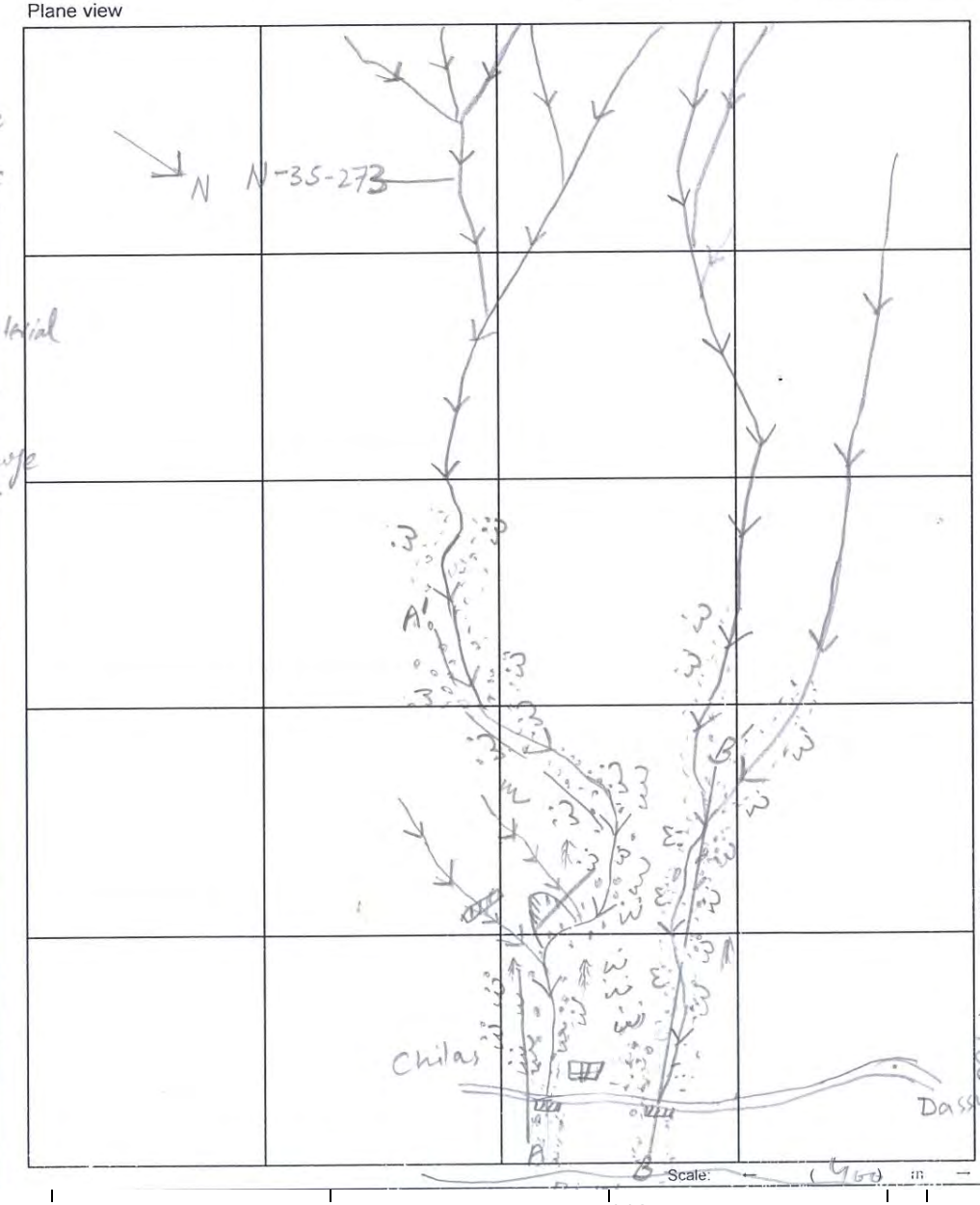
Date	
Inspector	

(273) to 8569

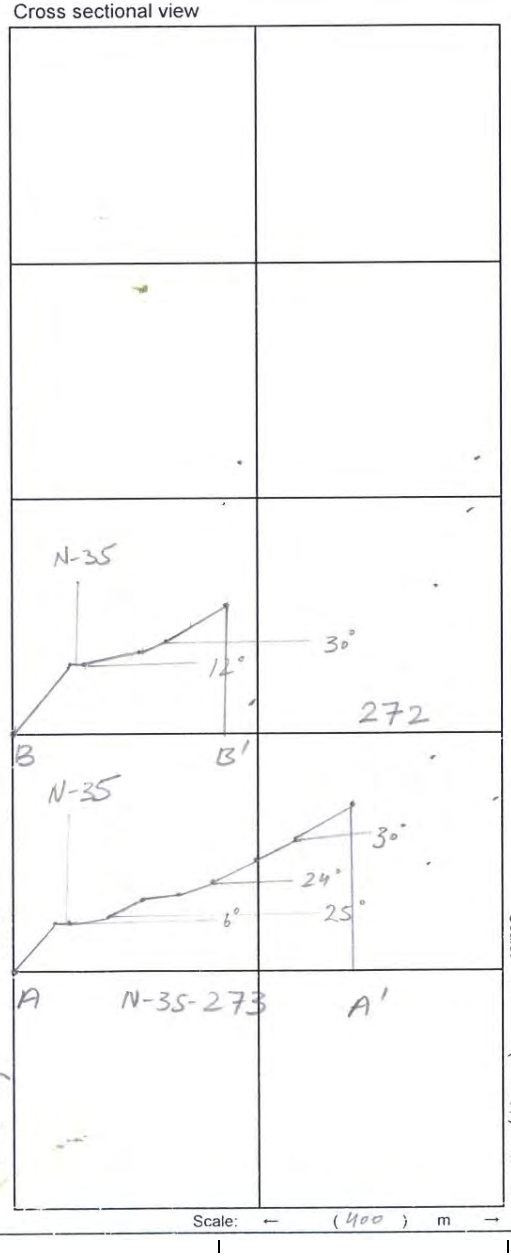
8585(2)272

Drainage
Bed Rock
overhang
Bushes
Debris material
Building
Paved Drainage Path

Plane view



Cross sectional view



Code no.	N	-	3	5			2	7	3
Region Office									
Maintenance Unit									

Photo sheet

Coordinates	Latitude	35° 27' 33.5"
	Longitude	73° 58' 11.2"
Road Name		Km

Date	12/27/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Mountain side view of the debris flow

Valley side view of the debris flow

Front view of the debris flow

Road condition

Boulders and Blocks along the Debris flo

Existing countermeasures / anomalies: Retaining wall has been constructed at the toe of the Debris Flow

Evaluation sheet (Slope failure/Rockfall)

Code no.	N 3 5 _ 2 8 6
Region Office	
Maintenance Unit	

Coordinates	Latitude	35° 25' 43.1"
	Longitude	74° 01' 25.5"
Road name		Km

Date	28-Dec-2017
Inspector	Yasir, Sajid, Shafique, Basharat

[Causes]

Item		factor	category of score		Check
topography	Collapsed factor	talus slope, clear convex break of slope, eroded toe of slope , overhang, water catchment slope	3 or more correspondences		√
			2 correspondences		
			1 correspondences		
			no correspondence		
Geological conditions	Soil	susceptible to erosion less strength with water	marked		√
			a little marked		
			None		
	Rock	high density of cracks and a weak layers, susceptible to erosion, fast weathering	marked		√
			a little marked		
			None		
	Structure	dip slope of bedding plane.	It corresponds.		
			None		√
		debris on impermeability bedrock, the upper part is a hard /the toe of slope is weak.	marked		
			a little marked		√
			None		
Surface codition	Topsoil, detached rock and unsteady rock		instability		√
			a little unstable		
			stability		
	Spring water		notable spring waster		
			seepage		
			none		√
	Surface condition		bare land with minor vegetation		√
			intermediate (bare・grass・tree)		
			mainly structure, mainly tree		
Profile	Height (H), dip (i)		height	H≧50m	√
				30≦H<50m	
				15≦H<30m	
				H<15m	
			dip	i≧70°	
				45°≦i<70°	√
				i<45°	
Anomaly	Surface collapse, small fallen rock, gully, erosion, piping hole, subsidence, heaving, bending of tree root, fallen tree, crack, open crack, anomaly of countermeasure		2 or more correspondences・clarity		√
			certain・unclarity		
			none		

[Disaster type]

Rock fall	√
Slope failure	

[Main check object]

Cut slope	
Natural slope	√

[Countermeasure]

Type of countermeasures	
No countermeasures	
Effectiveness of existing countermeasures	**Check**
Potential slope failure are prevented enough, or, it is defended enough when it is generated.	
Potential slope failure are considerably prevented, or it is considerably defended when it is generated.	
Potential slope failure are partly prevented, or it is partly defended when it is generated. However, it is not enough for the remaining factors.	
There is no countermeasure, ~~or there is not effective even if countermeasures are not performed.~~	√

[History]

Level of disaster history	Check
There is a history about large fallen rocks and slope failures that were obstacles to the road traffic after construction of recent measures.	√
There is a history about large fallen rocks and slope failures that gets to the road though there is no obstacle to traffic.	
There is a history about small fallen rocks and slope failures that did not get to the road.	
No disaster records	

[Expected size of disaster](width, length, depth, etc.)

W= 222m, L= 258m, D= 2-3m

[Evaluation Rank]

Risk \ Scale of disaster	Big	Medium	Small
Great risk	1	2	3
Medium risk	1	(2)	3
Low risk	2	3	4

[Description]

The site is characterized by jointed gabbro. Three joint sets with average joint spacing 1-2 meters exists leading to wedging failure. Furthermore, the presence of overhangs is increasing vulnerability of the site. Talus deposit is present in gully and is flooded on the road during or after rainfall

Organization responsible for countermeasure works according to the scale of the disaster

-Big: Grant aid

-Medium: Major contractor in Pakistan

-Small: Local contractor

Influence on the traffice when potential disaster

-Great risk: road closed for 2 days or more

-Medium risk: road closed for 1 day or less

-Low risk: no road closure

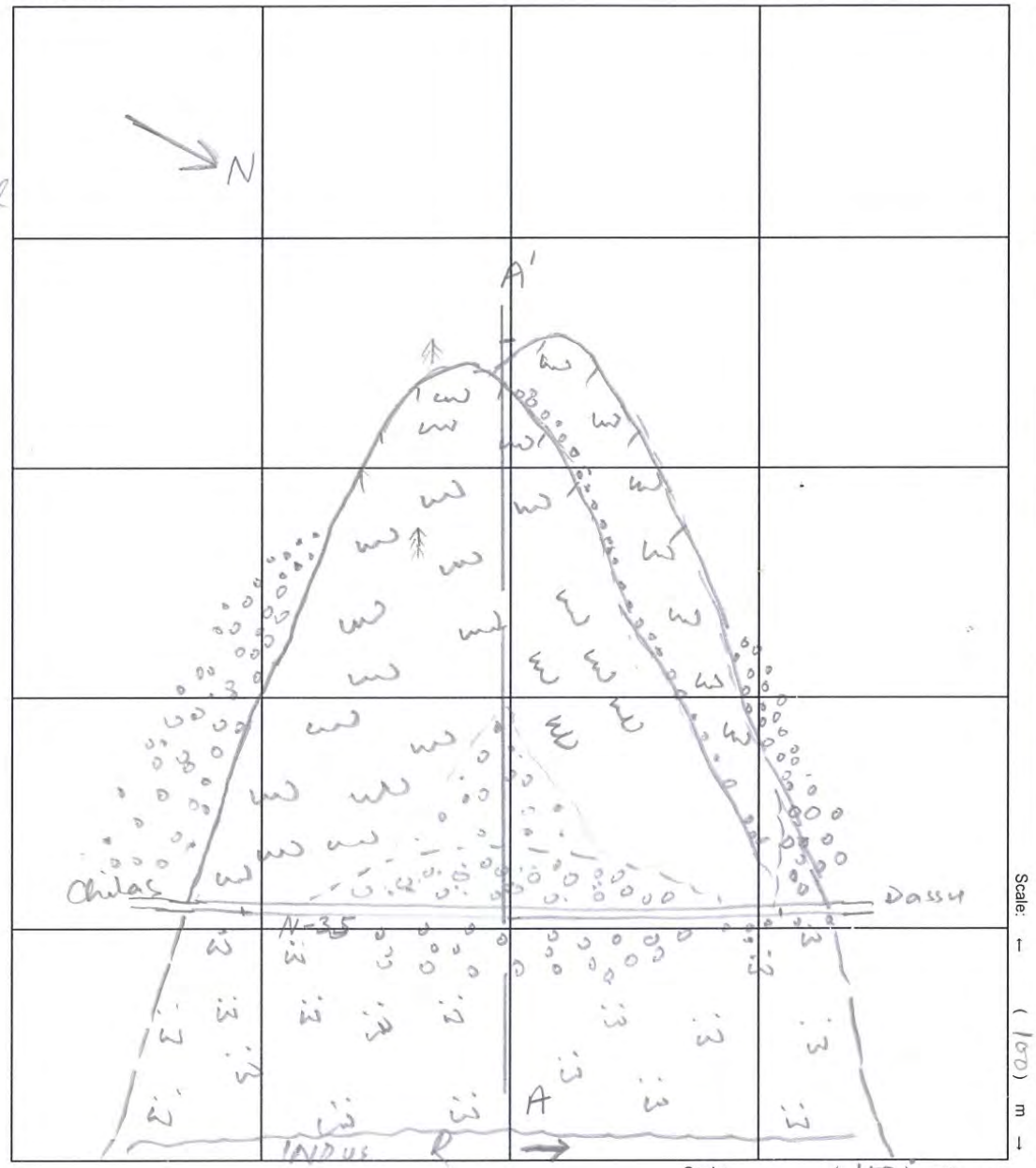
Code no.	N	3	5	_	2	8	6			
Region Office										
Maintenance Unit										

Sketch sheet

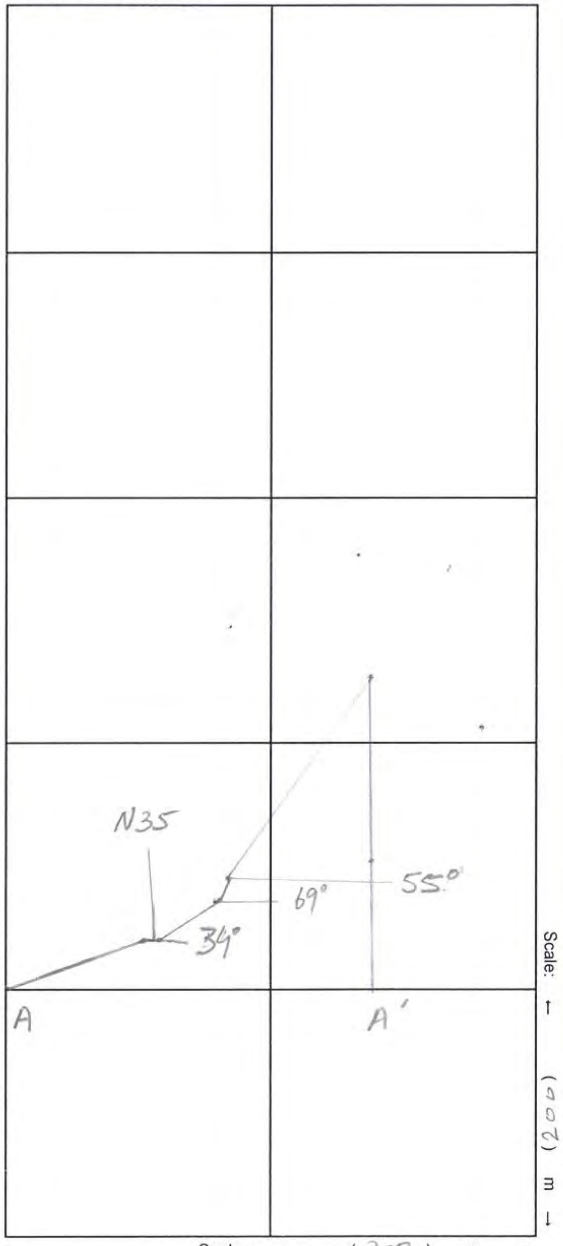
Coordinates	Latitude	35° 25' 43.0"
	Longitude	74° 01' 25.5"
Road Name	N-35	Km 286

Date	
Inspector	

Plane view



Cross sectional view



Code no.	N	3	5	_	2	8	6	
Region Office								
Maintenance Unit								

Photo sheet

Coordinates	Latitude	35° 25' 43.1"
	Longitude	74° 01' 25.5"
Road name		Km

Date	12/28/2017
Inspector	Yasir, Sajid, Shafique, Basharat

Full view of the landslide

View of landslide on Valley side:

Road condition:Cut slope at the start point

View of the slope failure at the middle point

Existing countermeasures / anomalies: No counter measure

View of fallen blocks along the slope failure