उत्तराखण्ड सरकार

Overview of construction works at 4 candidate sites

The Project for
Natural Disaster Management
in Forest Areas in Uttarakhand

Outline of the Project

In June 2013, as an aftereffect of heavy rains in the Himalayan region, the unexpected large-scale destruction due to floods and landslides caused tremendous loss to human life and property in Uttarakhand. This was one of the largest natural calamities in India.

Responding to this, the disaster management component of the Yen Loan project, "Uttarakhand Forest Resource Management Project" (UFRMP) and the technical cooperation project, "Project for Natural Disaster Management in Forest Areas in Uttarakhand" (hereafter referred to as the Project) have been commenced to enhance the capacity of Uttarakhand Forest Department (UKFD) and to improve the preparedness of the people in Uttarakhand against sediment-related disasters in future.

At the first Joint Coordinating Committee (JCC) of the Project held in August 2017, three (3) sites, i.e., Nirgad, Jawadi and Padli were decided as model sites for implementing the reconstruction work with maximizing exhibition effect and showcasing the maximum techniques.

Furthermore, at the third JCC held in February 2019, it was decided that the Project would treat other several sites too as candidate sites. Through the activities and experiences in model sites, technology for erosion control work has widely adopted in the Project to some extent. Therefore, the activity shall be carried forward on UKFD's initiative in four sites additionally, i.e., Raipur, Jokla, Malla and Lakhanpur sites.

Objective of the Project

1. Overall Goal

   (1) Erosion control works for slope disaster management in forest area are appropriately implemented in Uttarakhand.

   (2) Knowledge and technology for erosion control works are disseminated to other Himalayan states.

2. Project Purpose

   System to appropriately implement erosion control works for slope disaster management in forest area is established in Uttarakhand.

3. Outputs

   (1) Technology for erosion control which is adapted in Uttarakhand is developed.

   (2) Knowledge and skills on erosion control of staff in UKFD and another related organization are improved.

   (3) Appropriate technology developed for erosion control in forest area is shared in the state and with other Himalayan states.

   (4) Collaboration with UFRMP for implementing the interventions under the erosion control and sediment disaster mitigation component is achieved.

Project period

Five (5) years from 26 March 2017 originally

Extended for two (2) years till 25 March 2024

Concept of Chisan

Chisan is the Japanese term which means forest restoration through erosion prevention works in forest areas. The objective of Chisan is to prevent and mitigate disasters and to contribute to water conservation through appropriate construction of erosion control facilities and maintenance of forests.

Location of 4 candidate sites in Uttarakhand

Raipur and **Jokla** sites in Dehradun District, **Malla** site in Uttarkashi District and **Lakhanpur** site in Pithoragarh District.

Contractor

In December 2022, Project Management Unit of UFRMP and M/s Hindustan Developers and Builders entered into the contract for the construction of candidate sites. The contractor proposed construction periods of 24 months, 30 months, 24 months, and 27 months for Raipur, Jokla, Malla, and Lakhanpur sites respectively, accepted by the project.

1. Raipur Site in Dehradun district

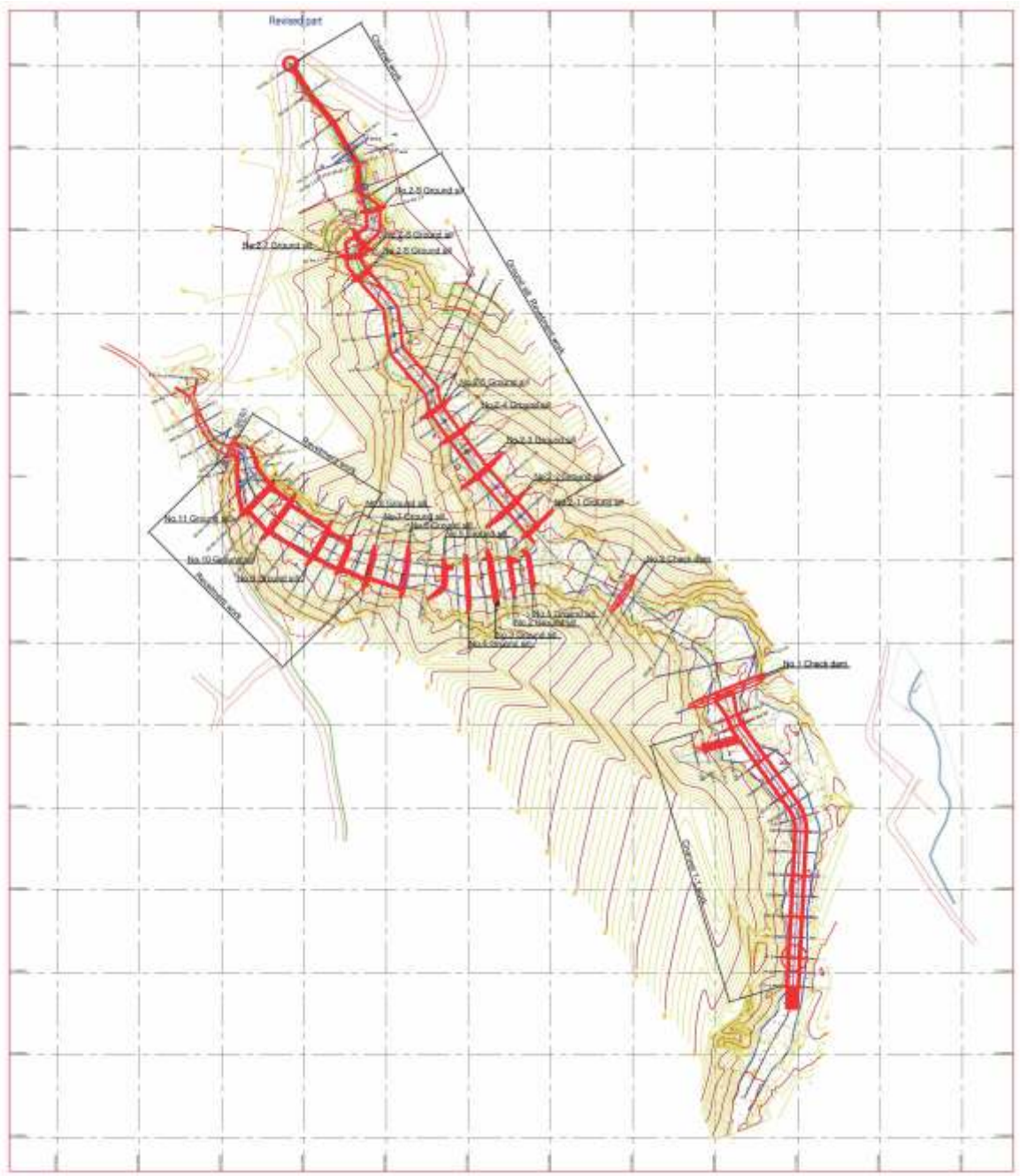
This is a debris flow type disaster site, located at the stream in the forest near Dehradun city.

During rainy season, large amount of water flows in the tributaries.

This causes the erosion of the stream bed and stream bank thereby triggering flow of the small and big stones and boulders to the downstream area.

Countermeasures for this site will reduce the risk of disturbance to the cultivation area and village in the downstream area.

Work Plan Map



The site consists of a devastated mountain stream with 17 Ha catchment area, out of which 1.2 Ha area is to be treated, treatment plan involves torrent works and hillside works.

As countermeasures, 2 concrete check dams work, 20 groundsill work, channel work, revetment work as torrent works, and cut slope work, erosion control mat work as hillside works are to carry out.

Concrete check dam work

Gravity dam is the most popular and has high stability and durability. If the ground has stable foundation and sufficient sedimentation area behind, this concrete type of dam is generally planned.

Concrete channel work

Water collected runs on the slope with high velocity which causes sediment discharge and debris flow. Channel work can collect water and drain the same out of the area safely.

Gabion groundsill (GS) work

Gabion GSs are identical to the wire crate barriers constructed widely in India, with the only difference of stepped construction. Step GS prevents the unstable soil flowing down, reduces the flow velocity, and separates rocks and water, thus erosion on stream bed is

Cover work/ Mat work

(Laying erosion control mat)

After making the slope gentle, cover work is carried out on the cut slope area, by laying the erosion control mat. This will keep the area in good condition for germination and let the native vegetation invade on the slope after the work completes.

COLUMN 1

Importance of Culvert and its connecting Channel

Prior to the main construction work at the Raipur site, existing culvert and channel which is located in the most upstream area of the site is to be reconstructed with the increased size.

Since the water flows from top to bottom, it is important to study how much water flows into/ through the area to be treated, so as to design a smooth water flow to downstream without disturbing the site.

Temporary road constructed will be demolished once in the main area culvert is completed. Size of the culvert is increased to connect with upstream existing channel.

Original road is demolished for the construction of culvert. The road will be restored after the culvert work completes.

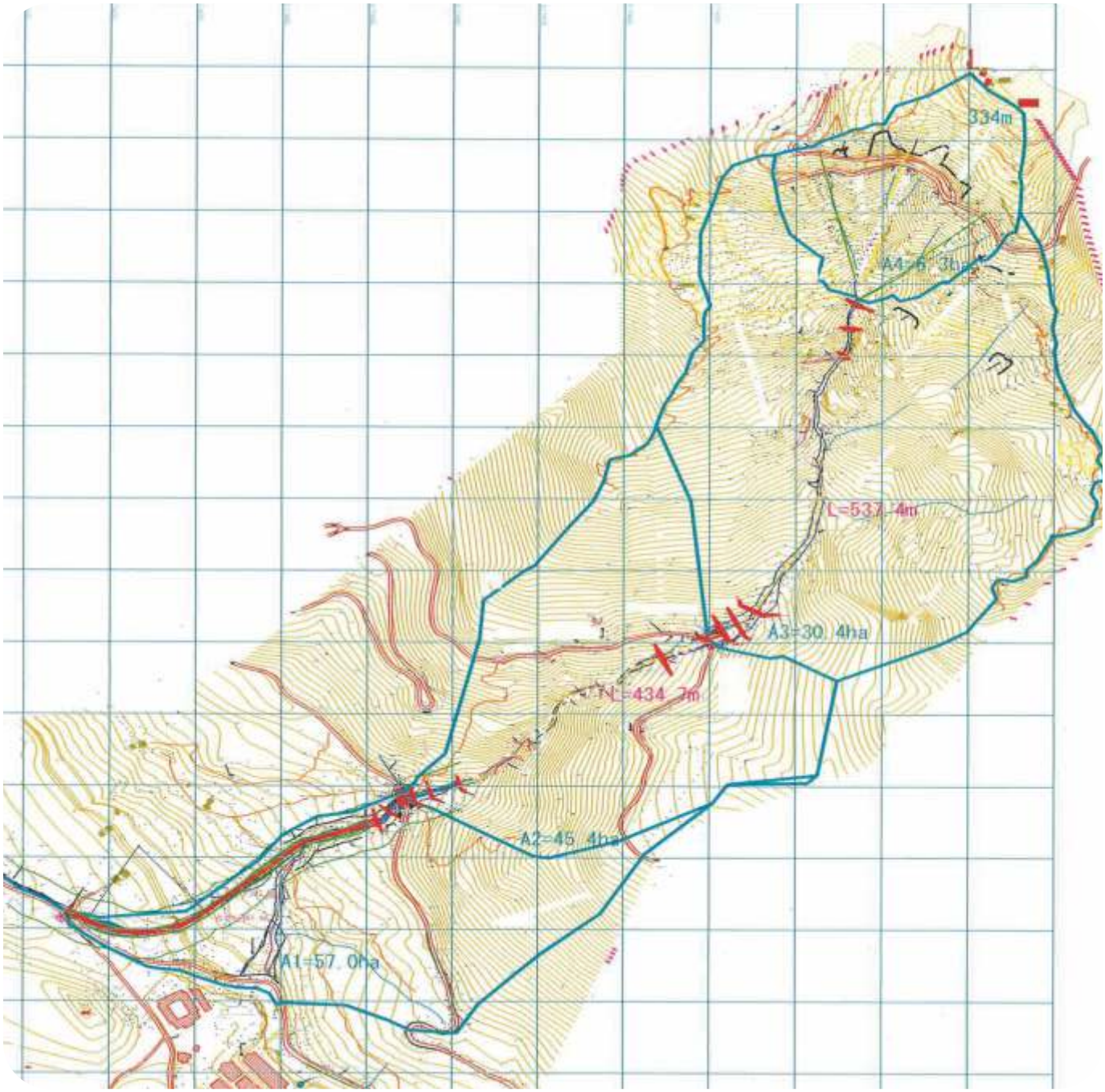
The size of the culvert is designed so as to easily carry the water even in the maximum rainfall on the site and high-water level. Since there is an existing road over the culvert, the road will be realigned first to secure the traffic before commencing the culvert construction.

2. Jokla Site in Dehradun district

The site consists of a devastated mountain stream with 17 Ha catchment area, out of which 1.2 Ha area is to be treated. Treatment plan involves torrent works and hillside works.

As countermeasures, 2 concrete check dams work, 20 groundsill work, channel work, revetment work as torrent works, and cut slope work, erosion control mat work as hillside works are to carry out.

Work Plan Map



The site consists of a devastated mountain stream with 56 Ha catchment area, out of which 8.1 Ha area is to be treated, where torrent works and hillside works have been planned.

12 concrete check dams, channel work as torrent works, and hillside works viz. cut slope work, anchor bolting, hydroseeding, rock-netting are to be carried out.

Series of concrete check dams

Rather than completely holding up earth, sand, and rock masses on the spot, multiple relatively small dams are placed in series to reduce the dynamic energy of water and earth to drain the water, which stops big boulders that are prone to roll down.

Wire netting work

In spraying work, wire netting work is often applied in combination for the purpose of dispersing cracks that occur in hardened cement and preventing delamination.

Hydroseeding work (Seed spraying work)

When a steep slope has poor soil conditions, and quick greening in a large area is required, the mechanical spraying work is planned. Here, soil and organic materials are used as base materials to which seeds, fertilizers are mixed as required and sprayed to the ground by a mortar sprayer. It is applied on the steep slope that has hard earth and sand, or rocks.

COLUMN 2

Series of check dam

Installation of series of check dams is one of the contermeasure against debris flow among erosion control work in forest areas. There are two types regarding the space treatment on the upstream side of the dam: One is to leave a pocket-like space on the upstream side of the dam to trap debris when a debris flow occurs, and the other is to backfill the upstream part of the dam with earth and sand during construction of the dam. The energy of a debris flow is proportional to the angle of the mountain stream and the amount of sediment generated. By installing a type of dam that backfills its upstream side with earth and sand, the slope of the mountain stream is gradually eased, the force of the mountain stream and the amount of sediment flowing down are suppressed. As a result, debris flow is mitigated. The height and direction of the dam to be installed are determined according to the material of the dam, the nature of the expected debris flow, or the target of conservation.

Construction of dams should be effective and economical.

Concrete dam is usually adopted because it is relatively cheaper, robust, and easy to construct. Constructing one high dam is not always cheaper than constructing two low dams.

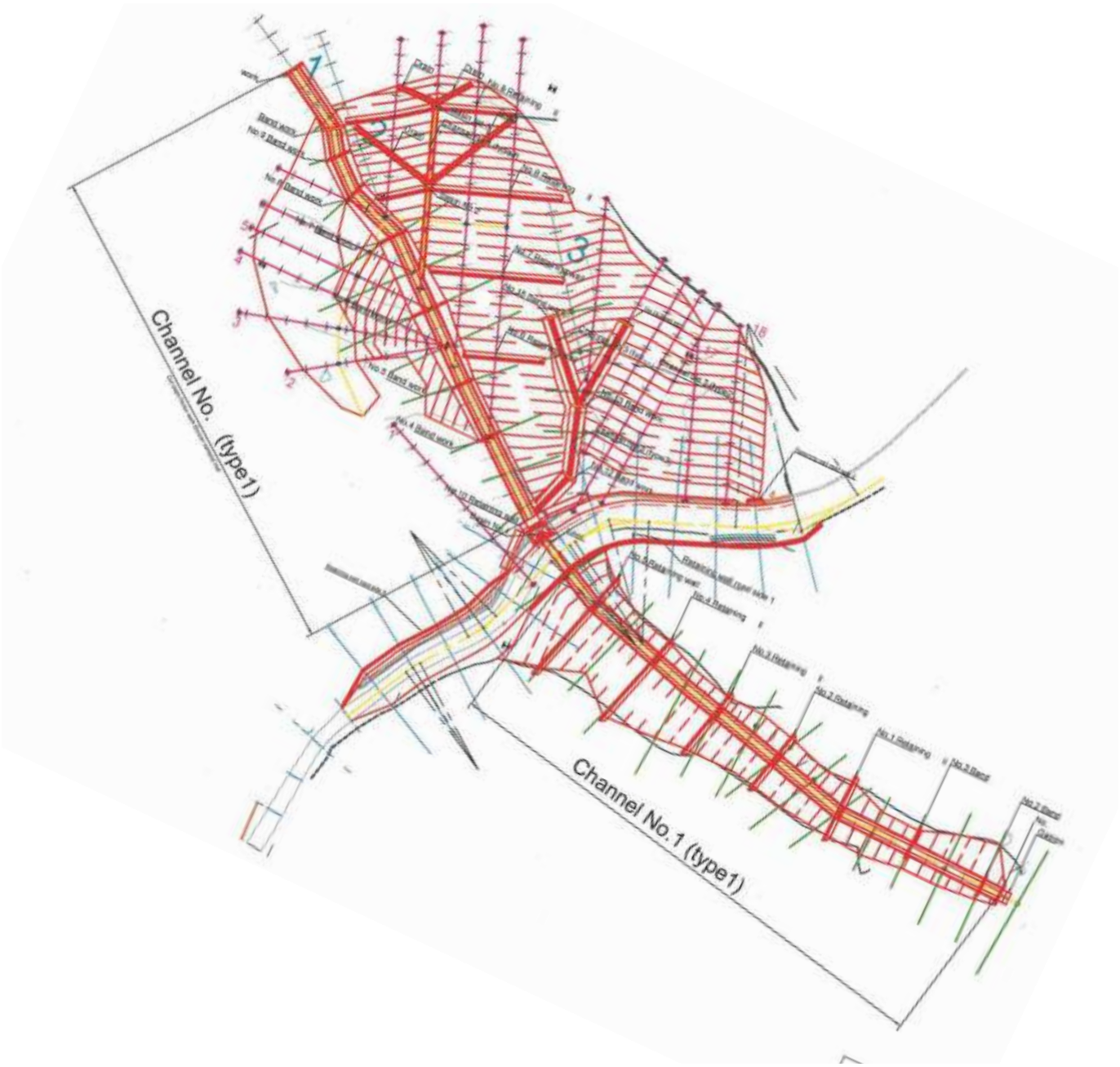
Since the cross section of the dam is trapezoidal, and the valley is an inverted triangle, a dam that extends over a valley requires more concrete as they get higher in height. That is why installing multiple low dams may be more economical than installing a single large/high dam.

In addition, by suppressing the momentum of debris flows at multiple dams and extending the life of each dam, it is possible that the dam functions can be maintained for a longer period of time and economic efficiency can be improved. Erosion control dams in concrete are costly to construct, so it is important to design them so that the benefits exceed the costs

3. Malla Site in Uttarkashi district

This is a slope failure type disaster site. The site is located at about 26 km from Uttarkashi city on the Uttarkashi – Gangotri Road (National Highway 34). A huge soil mass at the top of the slope had failed and became very vulnerable. Rocks and loose debris had erupted after the slope failure was affected by the subsurface water. The current primary cause of sediment runoff is erosion by surface water during rainfall.

Work Plan Map



Total devastated hillside area for the site is 9.7 Ha with slope gradient of 40 degree, out of which 1 Ha is to be treated, where hillside work such as cut slope work, mat work, retaining wall work, channel work, fence work is planned.

Treatment work shall be carried out at 70 m above the Highway. Prior to the construction of the slope, the road widening work is to be carried out for smooth traffic flow.

Fence work and laying of erosion control mat (ECM)

Fence work and application of erosion control mat are carried out together to stabilize the loose soil. The gradient of the slope is made gentle before the work.

** Condition after installing fence work with ECM

After some time after installation of fence with ECM, the area will become green. Since the area was stabilized and the slope gradient was made gentle, the germination of plants become easy to happen

Road realignment work

Road realignment work is carried out involving road widening, when rockfall may happen during construction on mountain side of the road. The purpose of the work is to secure installation space for protection fence on the road and ensure traffic safety.

COLUMN 3

Wire netting work and hydroseeding work

On slopes, during heavy rains, freezing and thawing, water rapidly permeates the ground surface, loosen the consistency of sediment, resulting in sediment runoff. By growing vegetation/ installing wire nets for covering the slopes, the rapid infiltration of water and temperature changes in the soil will be moderated. This is like covering injured skin with a bandage.

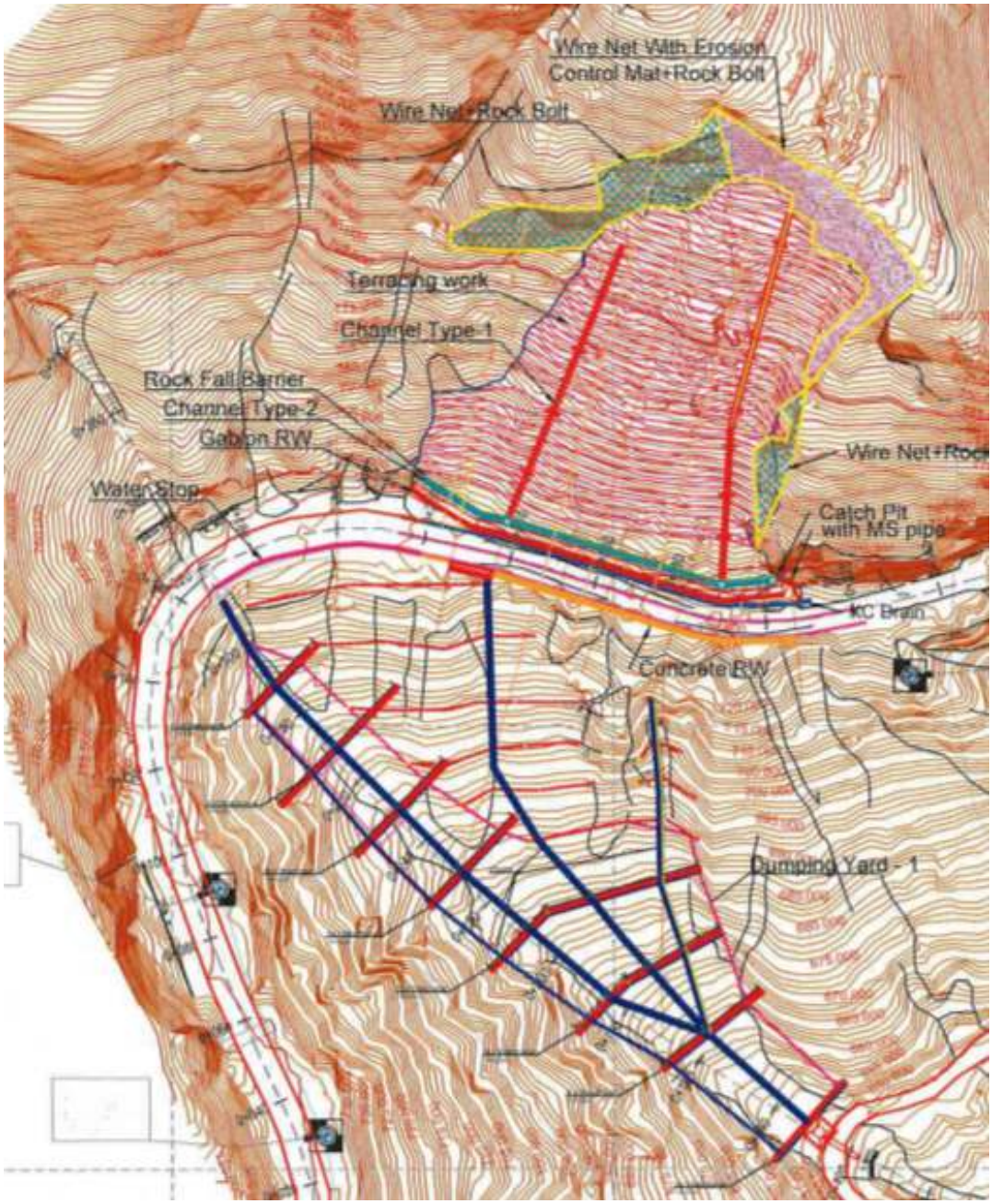
The root system of plants grown from seeds can penetrate rock cracks and hold the soil more strongly, so it is more effective in suppressing slope failure than planting seedlings to restore vegetation. However, slopes formed by bedrock do not have sufficient foundation for vegetation to settle, and are more susceptible to weather effects such as dryness and temperature changes. Therefore, we sometimes adopt a method of artificially creating a topsoil layer by covering the slope with a wire net, fixing the soil to the bedrock, and then spraying a mixture of soil, fertilizer, and sometimes seeds on top of it.

Since the spray work for greening aims to restore vegetation, there is a proper time for the work. In general, it is ideal to conduct the work at a time when sufficient temperature and rainfall can be secured for a certain period of time for germination, and to complete the work before the rainy season.

4. Lakhanpur Site in Pithoragarh district

This is a slope failure type disaster site. The site locates near northwest border of Uttarakhand about 60 kms from Pithoragarh city on Delhi - Dhaarchulha Highway. A huge soil mass at the top of the slope failed and has become very vulnerable. Rocks and loose debris had erupted after the slope failure was affected by the subsurface water. The current primary cause of sediment runoff is erosion by surface water during rainfall.

Work Plan Map



Total devastated hillside area for the site is 11 Ha with maximum slope gradient of 60 degree. Out of which, 2 Ha will be treated where hillside work such as cut slope work, wire netting with rock bolting, retaining wall work, mat work, channel work, fence works are planned.

The devasted slope locates 100 m above the Highway so prior to the construction, the road widening work is to be carried out for smooth traffic.

Fence work

The work is carried out to make the gradient of the slope gentler and to stabilize the surface soil so that water flow velocity is reduced and water flow is dispersed. Thus, the vegetation base will be secured.

Rock fall protection fence (Rockfall barrier)

During construction of hillside work including its preparation work, a lot of rockfall is prone to occur. To prevent any damage to the traffic on the road, the rockfall protection fence is necessarily planned/ provided.

Wire rope net covering work

The work covers the slope with wire rope net, which is fixed to the slope by wire clips, etc. Auxiliary wires/ nets of required strength can be used together to prevent boulders from falling out of gaps in the rope net.

**** Wire rope net covering work in detail**

Memo

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