

# Measures for stabilization and reduced erosion on slopes along roads and railways in Norway: Stakeholder experience and research needs

**INTRODUCTION:** Development of transport infrastructure, lead by The Norwegian Public Road Administration (SVV) and Norwegian Rail (Bane NOR) are the main intervention in the natural landscape, including slopes. The National Transport Plan 2014 - 2023 (June 2013), states the need to limit the environmental impact of the transport infrastructure.

The Nature Diversity Act (2009) requires that restoration after intervention in nature should be based on indigenous species. The importance of vegetation to prevent soil erosion and landslide has so far received little attention in Norway.

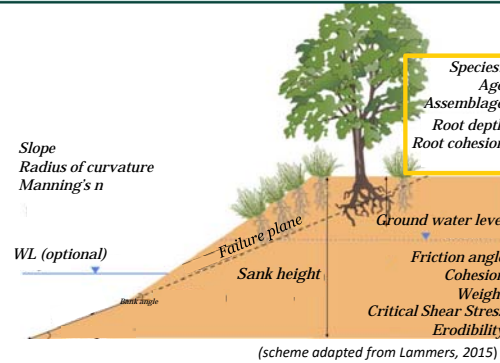
**OBJECTIVES:**

Map the common practices and trends in Norway based on information from project leaders from the road and railway sector, as well as from the Norwegian Water and Energy directorate (NVE), and identify the knowledge gaps and direction of future research in Norwegian conditions.

**METHODS:**

- Literature review & summary of the relevant research in Norway
- Questioners concerning geographic locations, climate, slope, timing and sustainability of implemented measures.

**KNOWLEDGE GAP**



- Lack of research on typical Norwegian species concerning e.g.:
  - Root cohesion (depending on plant age, soil conditions, etc)
  - Root development (depending on soil type, layering, weather conditions, etc)
- Lack of practical (successful) examples in Norwegian conditions

**CONCLUSIONS**

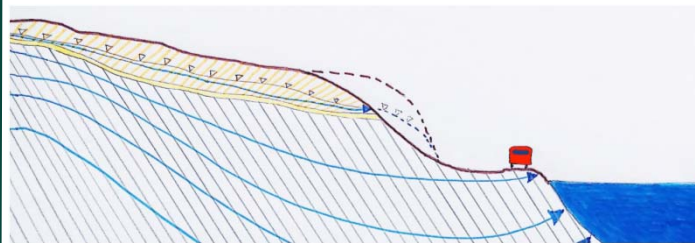
- **Until recently**, the most common measure for securing erosion-exposed slopes along roads, railways and waterways was to sow imported grass seed mixes, followed by the use of pesticides. Grass and short shrubs, forests and perennial bush vegetation may constitute the original vegetation. While the Nature Diversity Act (2009) requires that restoration after intervention in nature should be based on indigenous species.
- It looks like **transition period** from prioritizing conservative practices into opening for new solutions (enhanced by Nature Diversity Act).

There is a **need for more research**.

*"Vegetation is an important stabilizing element in terms of both water regulation and soil reinforcement. Where grass and wood species (trees and shrubs) are satisfactory as protective measures, this should be used for ecological and landscape reasons rather than in combination with mechanical measures."* (SVV, 2014)

**RESULTS OF LITERATURE STUDY AND STAKEHOLDERS FEEDBACKS**

**- Typical situation in Norway:**



**Figure 1.** Imaginary cross section of the large intersection (from Aavatsmark, 2014).  
Brown line - current topography;  
Dotted brown line - assumed topography before road construction;  
Thin black line (in orange shaded field) - current groundwater level;  
Dotted blue line - presumed groundwater level before road construction;  
Shaded orange area - layer of well-sorted relatively fine sand (river deposits);  
Yellow field - thin layer of silt; Shaded gray field - thick layer of clay;  
Blue arrows - groundwater flow.

**- Common measures:**



**Figure 2.** Narvik 2014 (BaneNOR)



**Figure 3.** E6 Frya- Sjøa, 2013 – 2016 (SVV)

The coconuts mat layer on the bare soil, before the application of topsoil and sowing. In addition to grass, groups of shrubs were planted on the slope.

**- Remaining questions (from BaneNOR & SVV):**

- Has the coconuts mats rotted and has the vegetation managed to establish itself?
- How is/would be the condition of the vegetation within 5 years after establishment?
- How does it work, in practice, according to stability and erosion protection?

**Relevant research areas:**

- Preventing landslides with slope reforestation
  - promising results when using ALM (*ulmus glabra*) in Kotsøy, Gauldalen (BaneNOR)
- Stream bank stability monitoring and modeling under different vegetation cover (grass, shrubs, tress)
  - RECARE (FP7, EU 2015-2018)
  - BUFFERKLIMA (LDB, 2017-2019)



**Figure 4.** ALM tree (wikipedia.com)

**REFERENCE:**

Aavatsmark E. 2014. Survey of stability conditions and hydrogeology in ravine landscape along new railway track north of Eidsvoll Station. NMBU Norway, MS.  
Krzeminska D, Kerkhof T, Skaalsveena K, Stolte J. 2019. Effect of riparian vegetation on stream bank stability in small agricultural catchments. CATENA 172:87-96  
Lammers W. 2015. Uncertainty and Sensitivity in the Bank Stability Model: Implications for Estimating Phosphorus Loading. Colorado State University, Fort Collins, Colorado.  
SVV, 2014. Grunnforsterkning, fyllinger og skråninger. Håndbok V221