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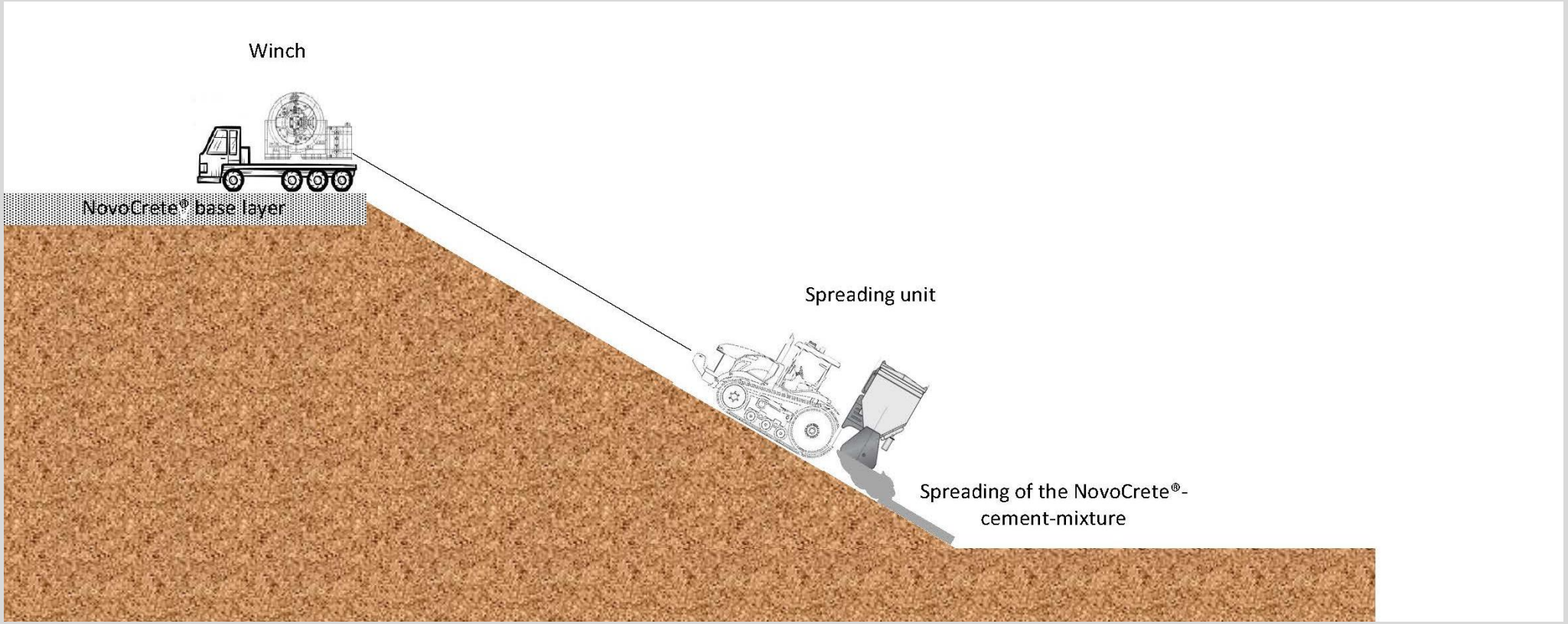
Erosion protection for water bodies by applying the NovoCrete technology

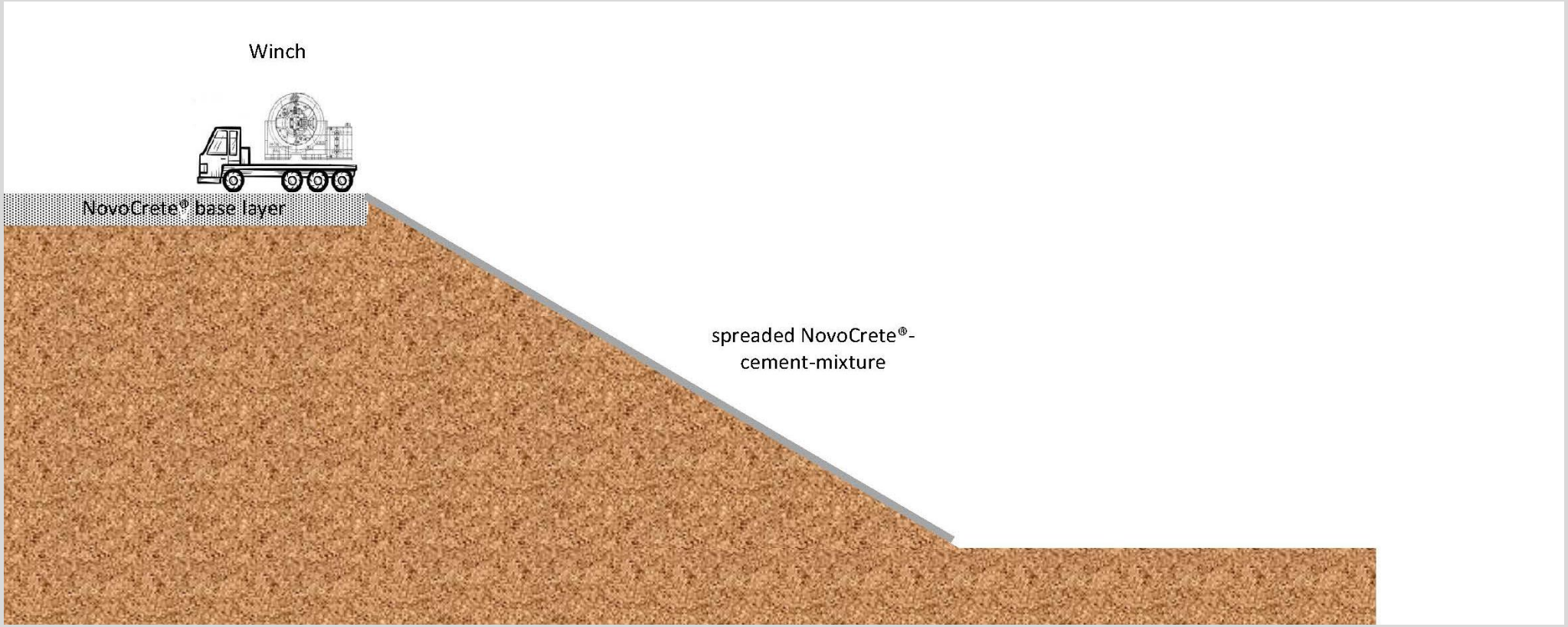
Option 1: stabilization by applying NovoCrete® technology

The spreading process:



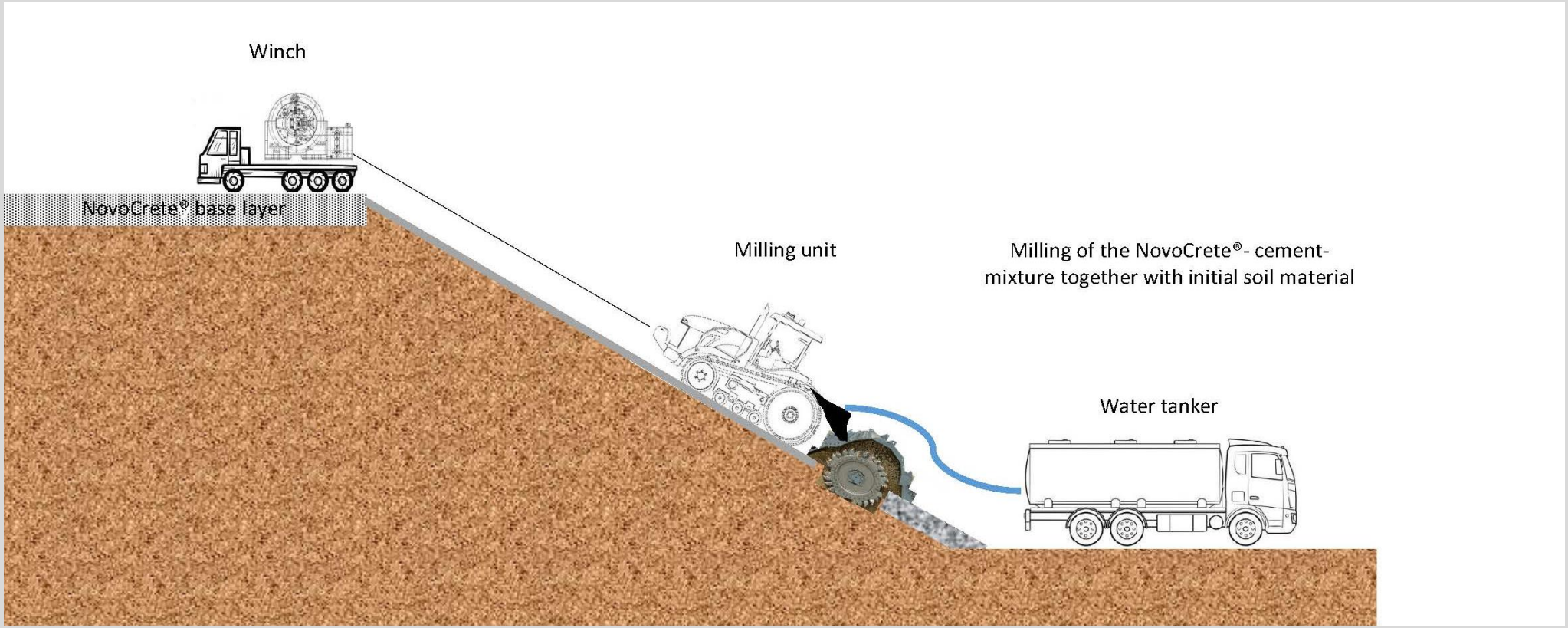
Option 1: stabilization by applying NovoCrete technology

The spreading process:



Option 1: stabilization by applying NovoCrete technology

The milling process:

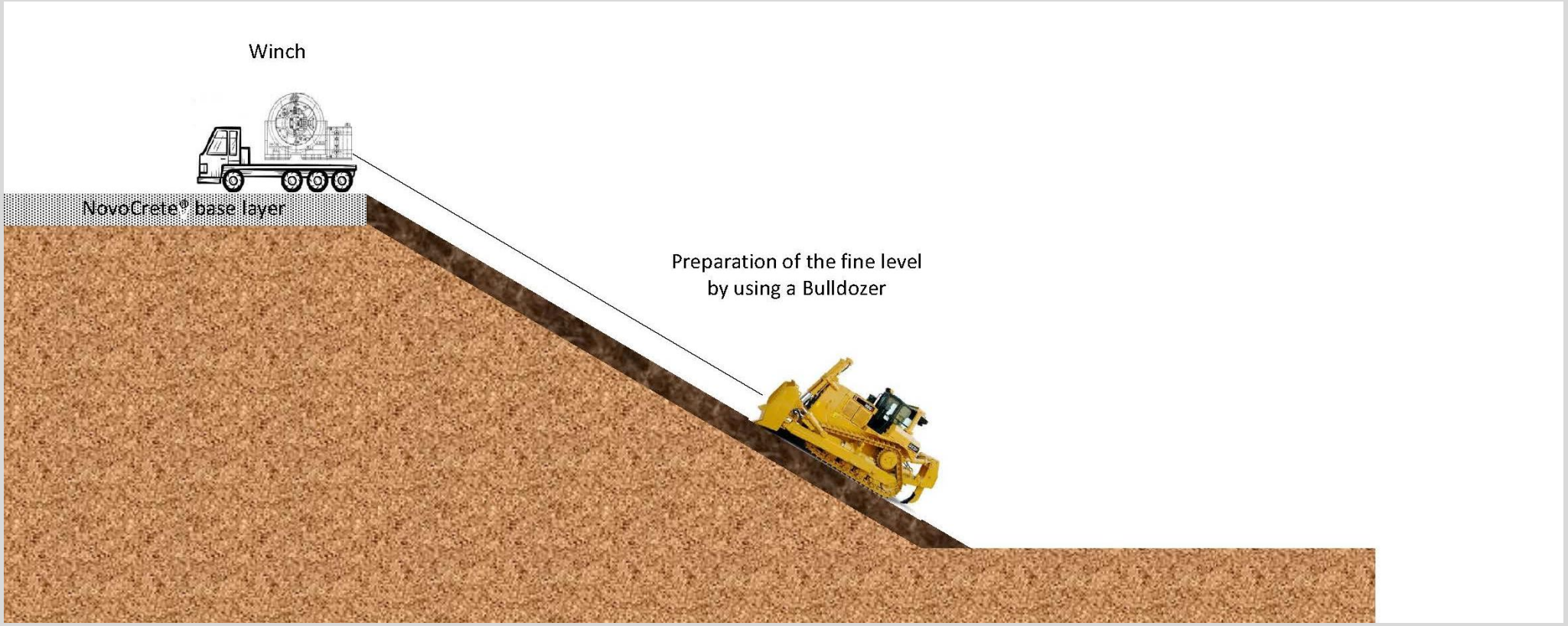


Option 1: stabilization by applying NovoCrete technology

The milling process:

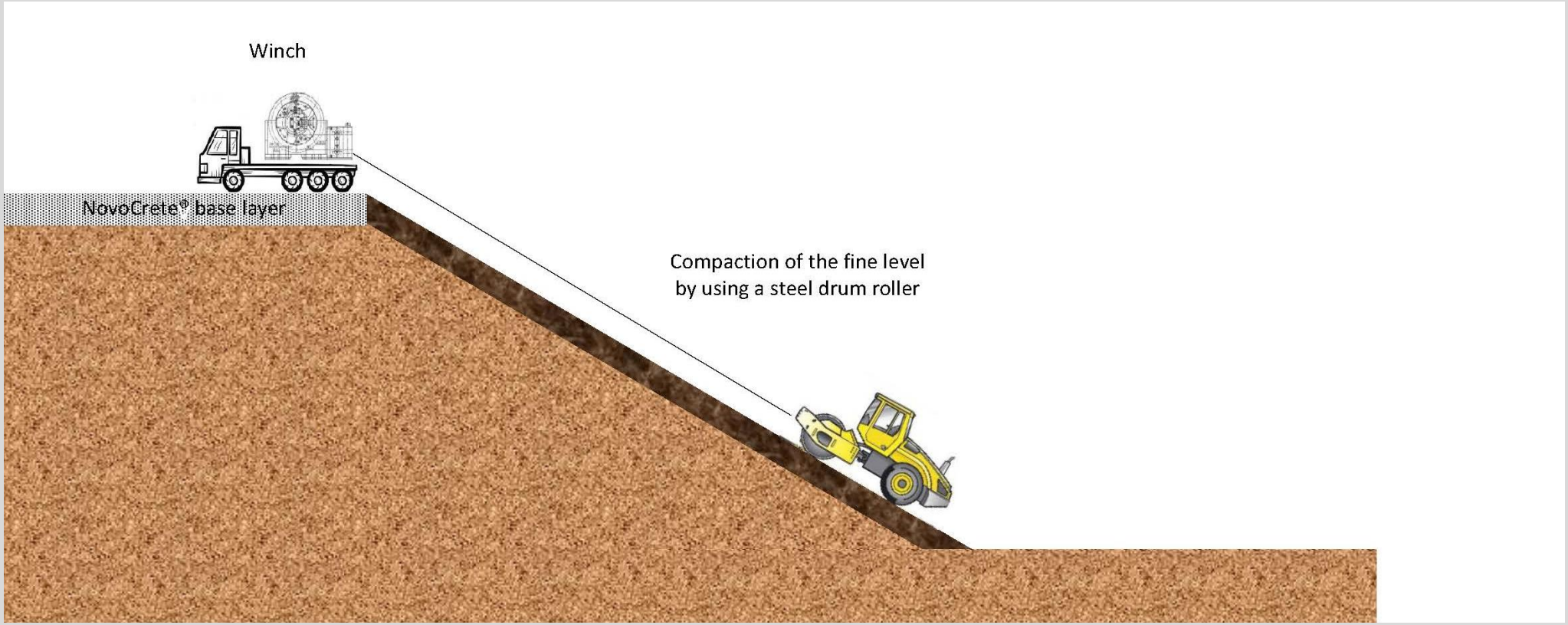
Option 1: stabilization by applying NovoCrete technology

The levelling process:



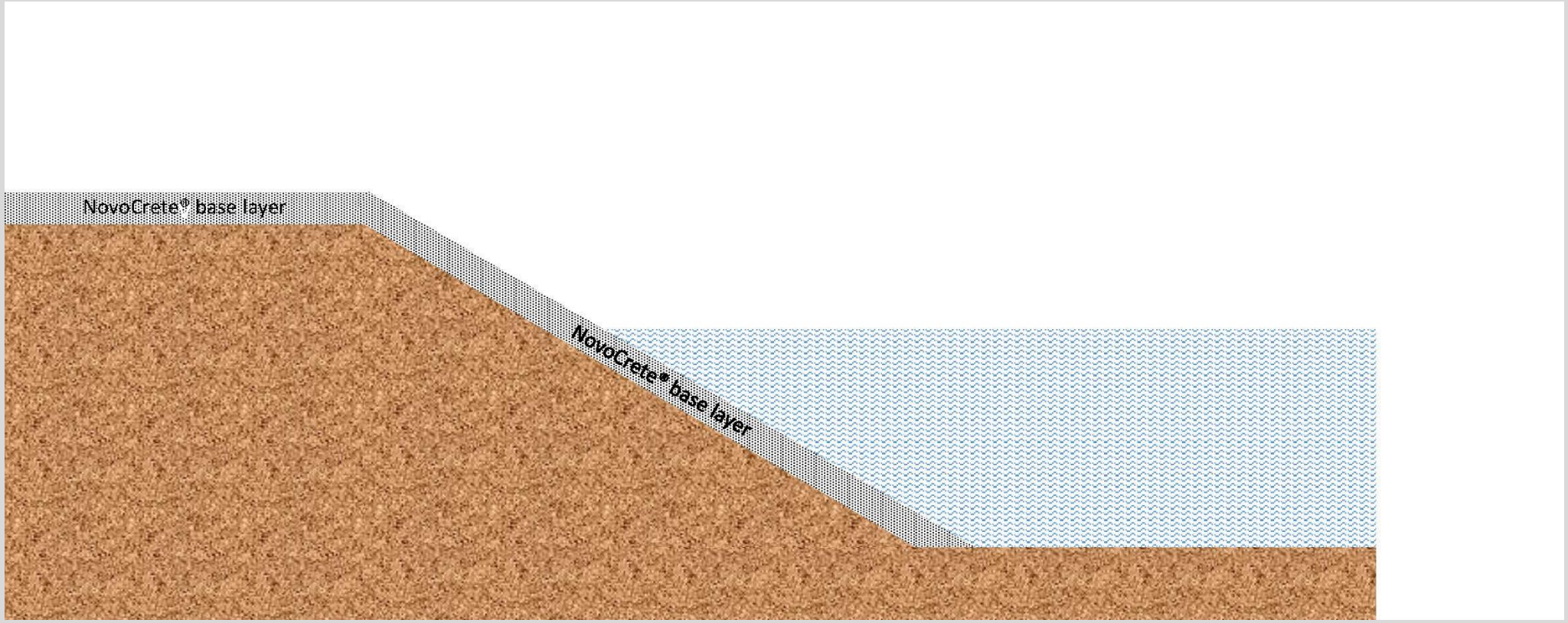
Option 1: stabilization by applying NovoCrete technology

The compaction process:



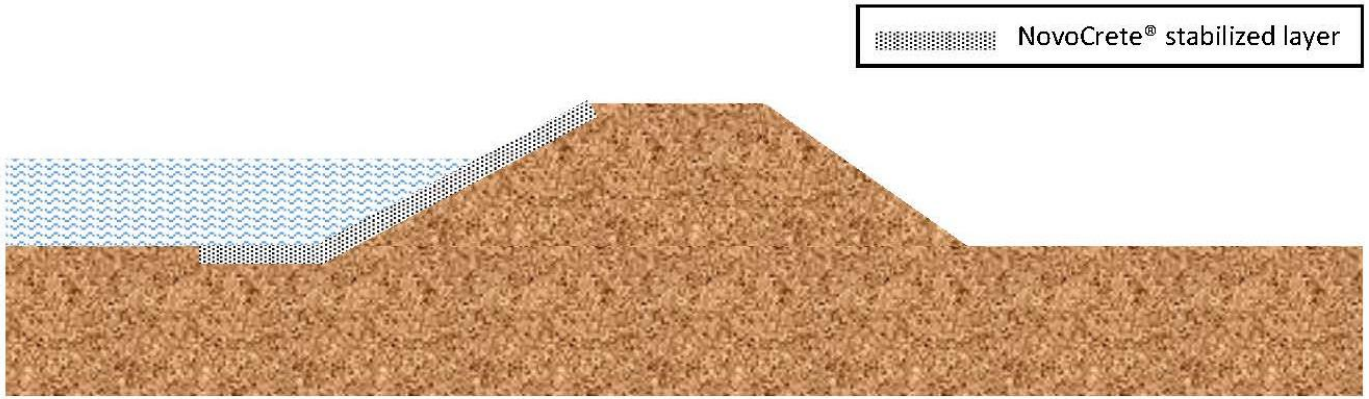
Option 1: stabilization by applying NovoCrete technology

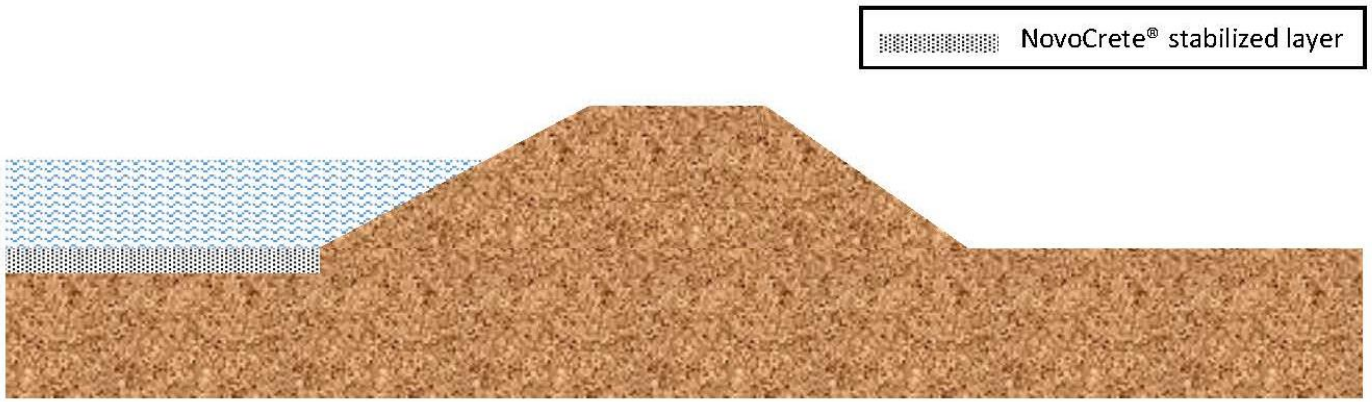
Final situation:



Option 1: stabilization by applying NovoCrete technology

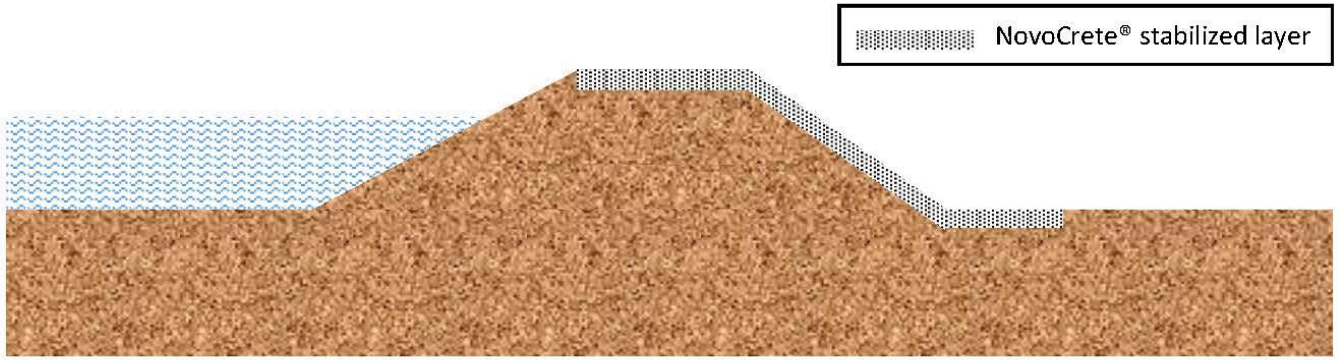
Final situation:

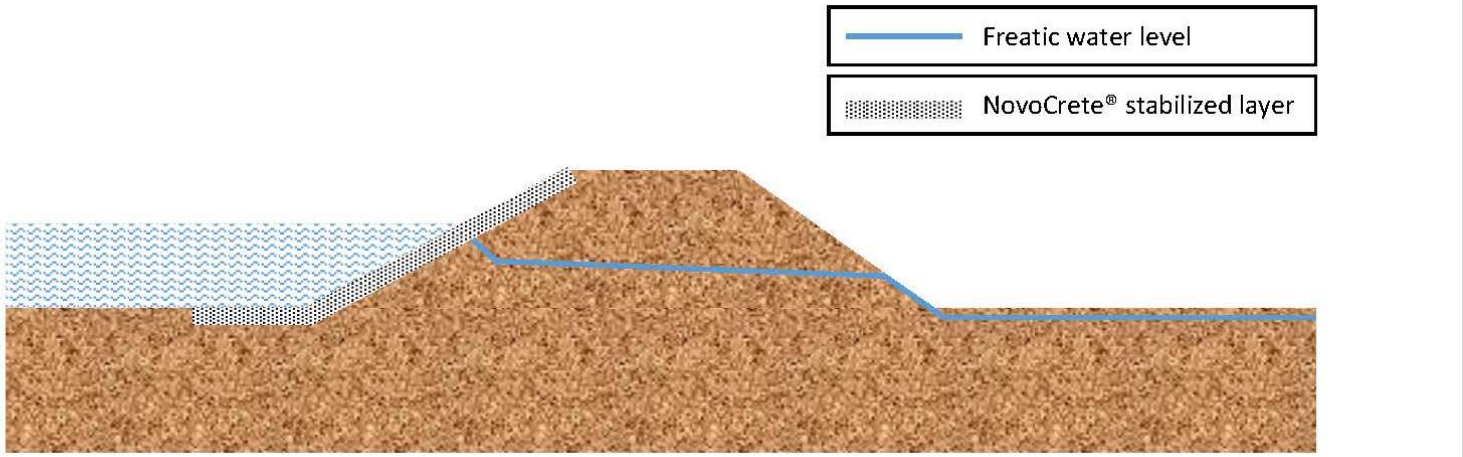




Option 1: stabilization by applying NovoCrete technology

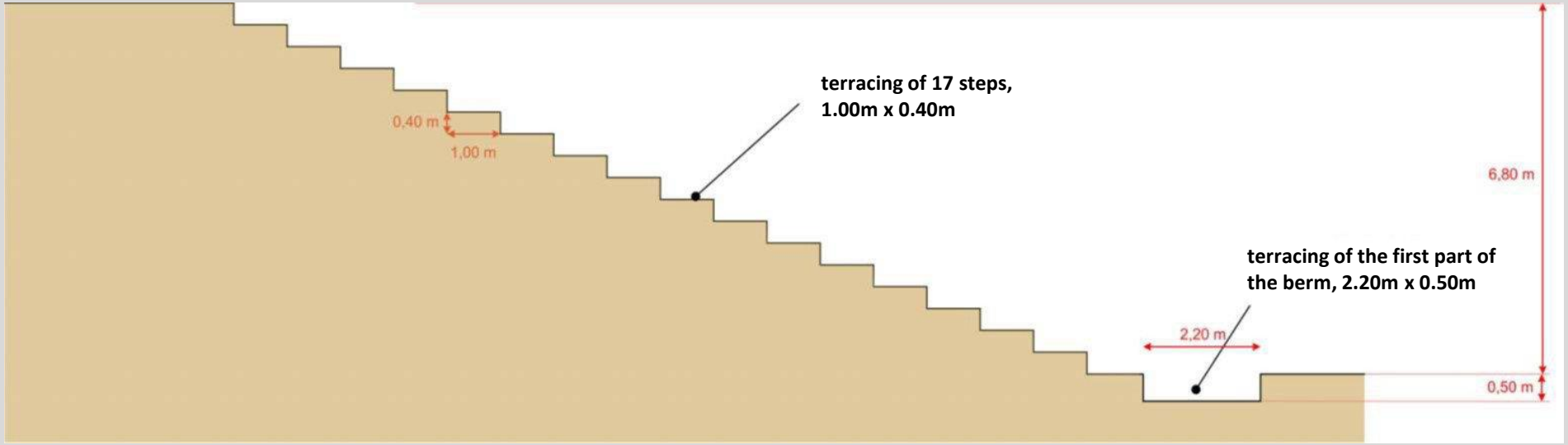
Final situation:





Option 2: stabilization process layer by layer

Construction methodology - Preparation:



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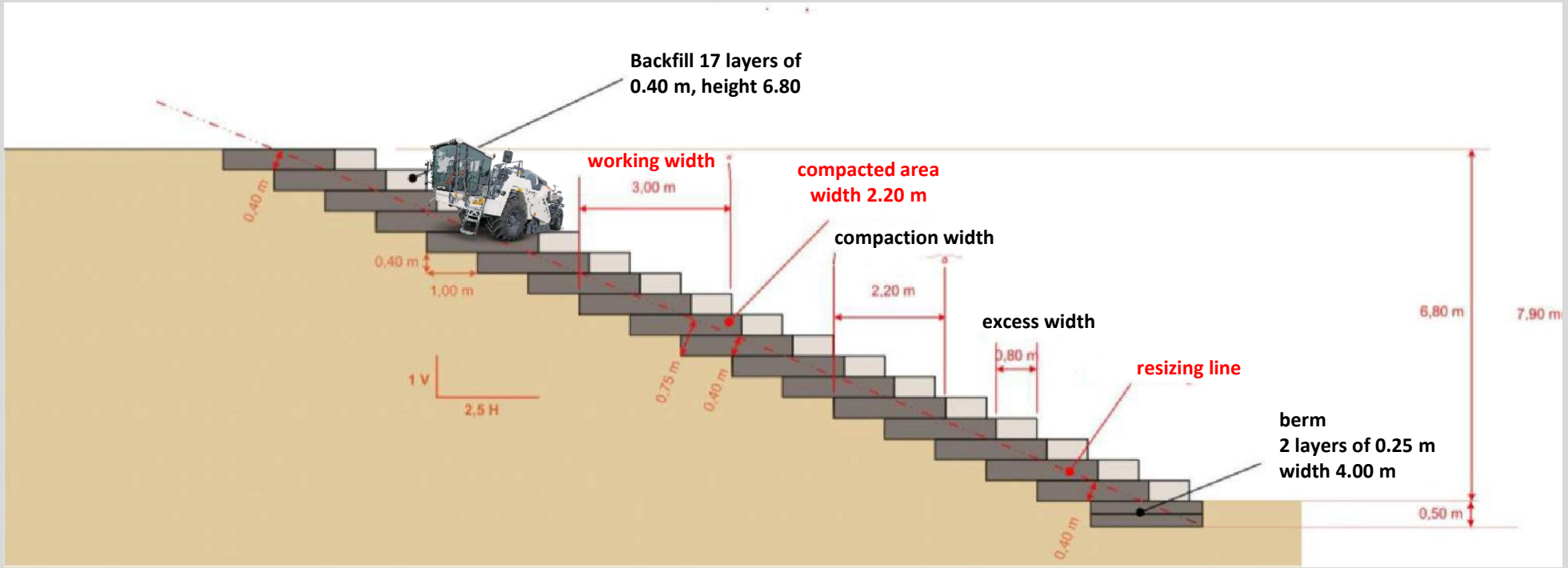
Option 2: stabilization process layer by layer

Construction methodology - implementation of the first part of the berm and 17 layers of backfill:




Spreading cement + NovoCrete


Milling of cement + NovoCrete


Compaction

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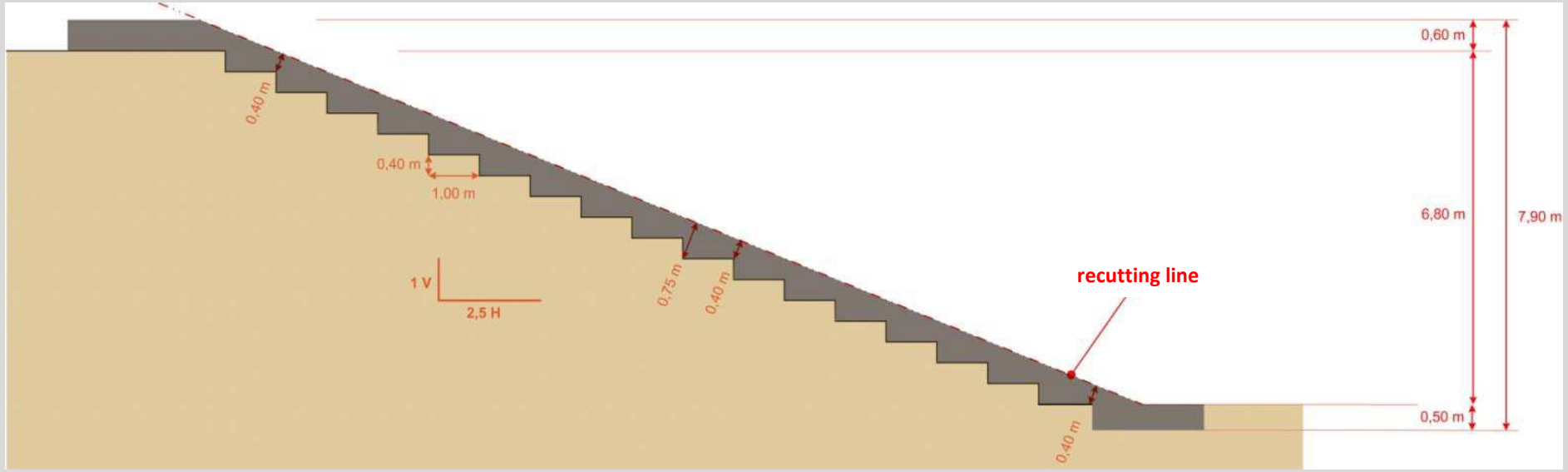
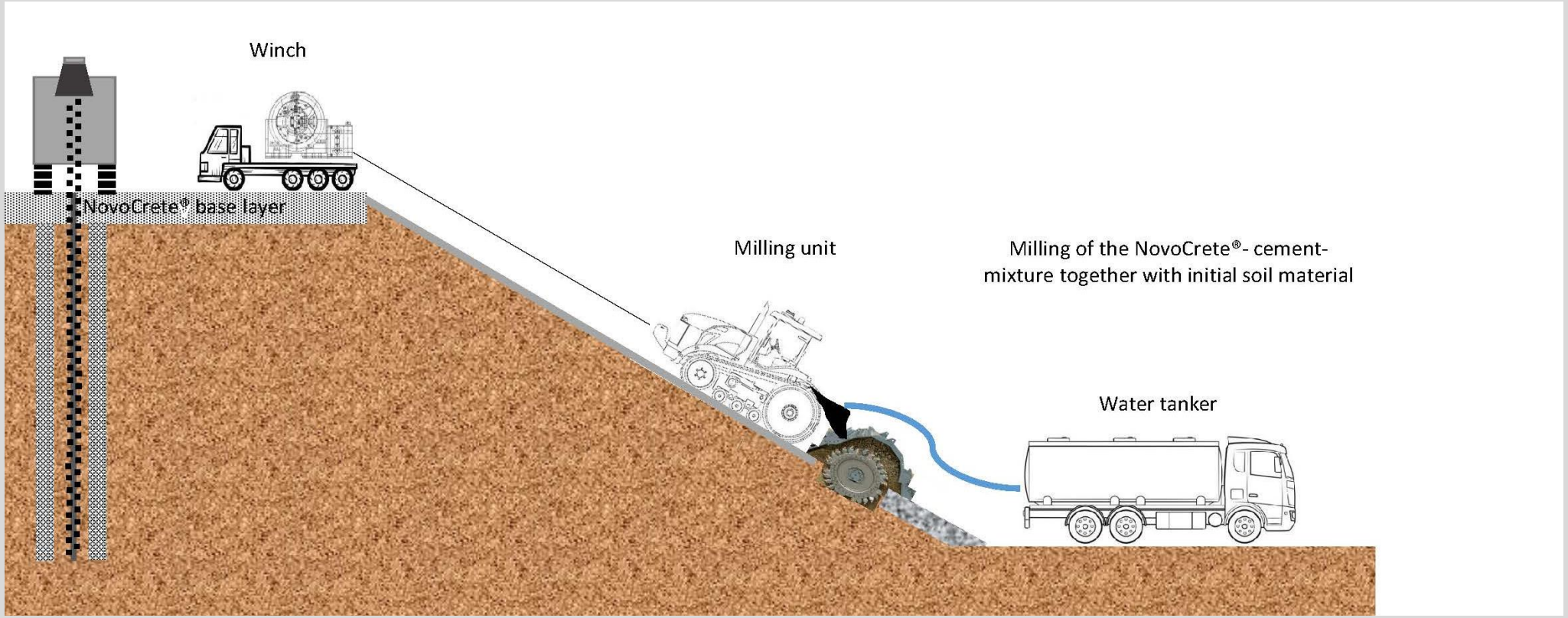
Option 2: stabilization process layer by layer

Construction methodology - recutting of the embankment:



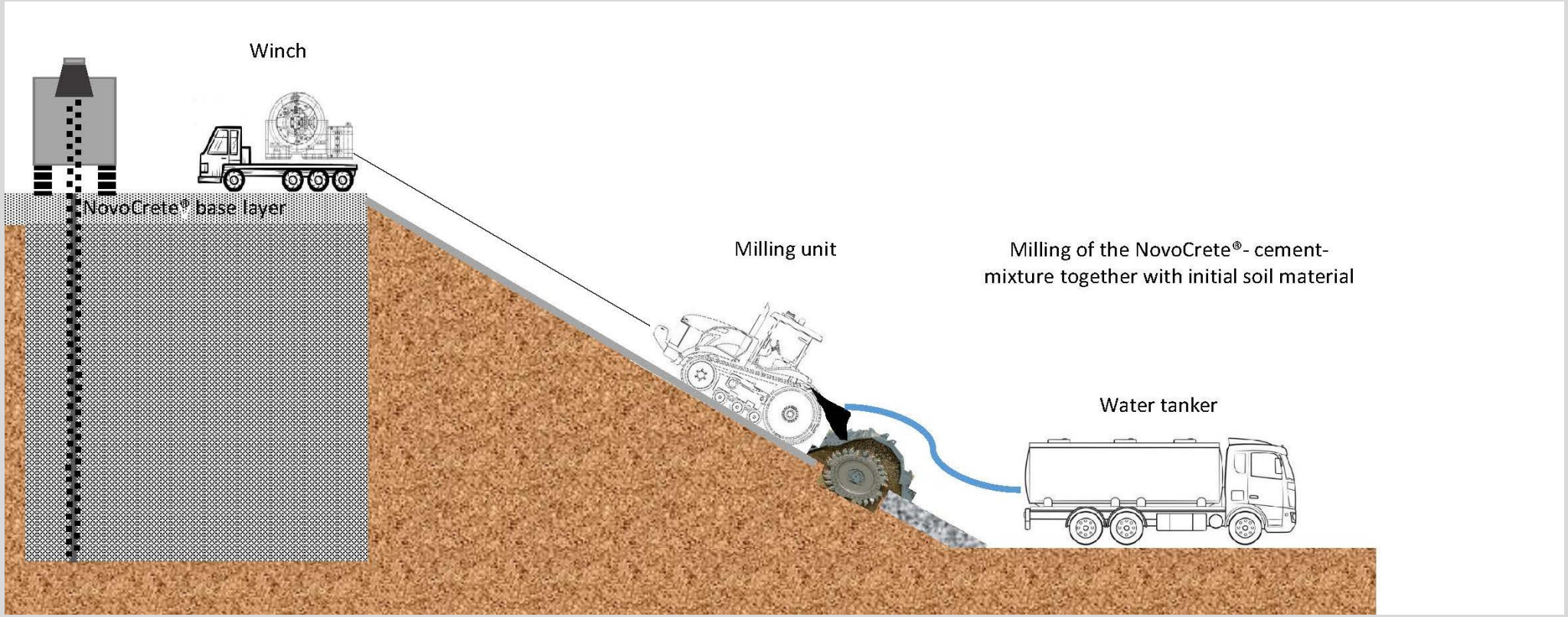
Option 3: stabilization process + MMI technology

Combination with milling-mixing-technology (MMI):



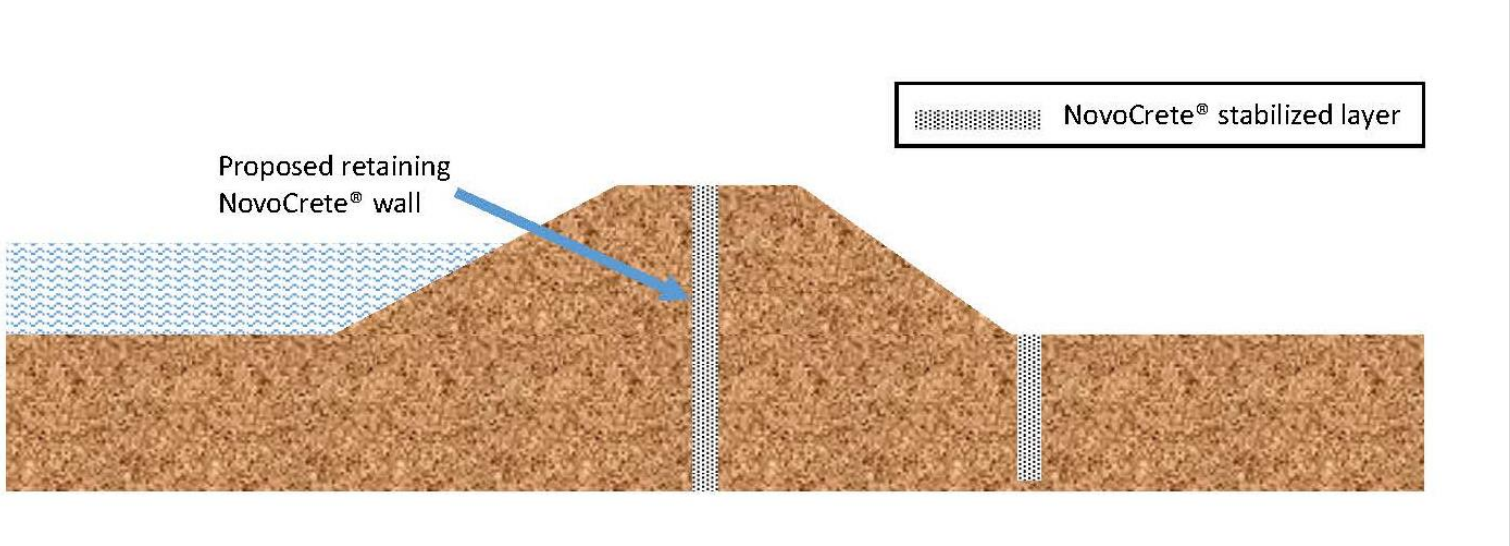
Option 3: stabilization process + MMI technology

Combination with milling-mixing-technology (MMI):



Option 3: stabilization process + MMI technology

Final situation:



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About MMI technology

Background:

The milling-mixing-injection process used in depth soil solidification

The milling-mixing-injection process (MMI process) is an economical and environmentally friendly technology in special civil-engineering, in which the soil is intensively mixed with a binding agent suspension. The mixing takes place in-situ, without an open construction pit, with a specially developed soil milling machine. A homogeneous, water-impermeable, frost-proof and joint-free „earth concrete“ body is created.

Due to the intensive mixing of the different types of soil during the mixing process, organic layers can also be improved.

Fields of application:

- In-depth soil improvement for traffic route engineering
- In-depth soil stabilisation of railway embankments
- Protection of road shoulders
- Construction of cut-off walls in dike construction
- Immobilisation of harmful substances

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About MMI technology

Process description:

In depth soil solidification using the milling-mixing-injection process (MMI process)

The milling-mixing-injection process is an "in situ" soil solidification. In this process, the existing soil is milled in one operation and evenly mixed with a binding agent suspension to create "earth concrete". At no point an open pit arises. The binder is added at the lowest point of the cutting blade, so that even mixing from bottom to top is enforced. Defects in the cut-off wall are therefore excluded.

With the newly designed MMI milling machine, the soil can be soldified up to a depth of 15 m. The milling widths can vary here (minimum 50 cm).

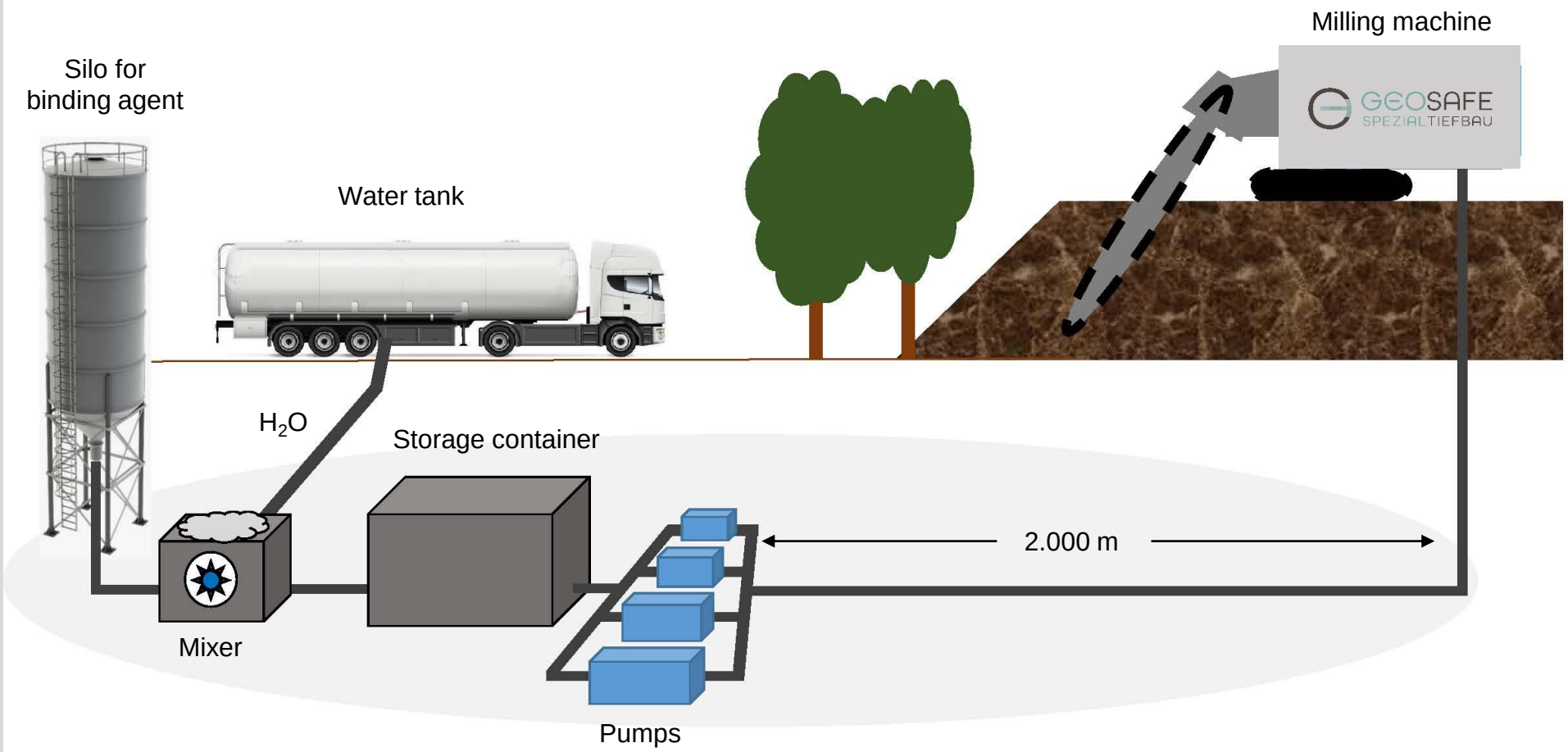
In the run-up to the construction of the cut-off wall, an excavator is used to create a feed trench which absorbs the excess masses caused by the process and thus protects the surrounding area from contamination with binder suspension.

The binding agent suspension is produced in an external mixing system and fed to the cut-off wall milling machine via pump systems and hose lines. The maximum conveying capacity is approx. 2 km, so that in the ideal case, with the central positioning of the mixing plant, a distance of approx. 4 km can be processed without transpositioning the working equipment. The process proves to be particularly low in vibration and noise. The impact on people and nature is thus reduced to a minimum.

Before starting work, suitability tests must be carried out to determine the recipe. In the suitability tests, the optimal amount of binding agent and the type of binding agent to comply with the required parameters (e.g. compressive strength, water permeability coefficient) are determined with the existing soil.

Schematic Diagram/Equipment

Required space for the entire equipment: 300 m²



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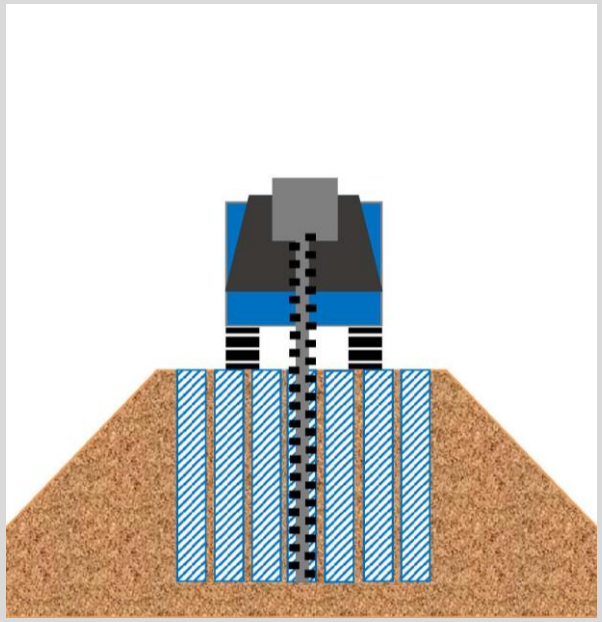
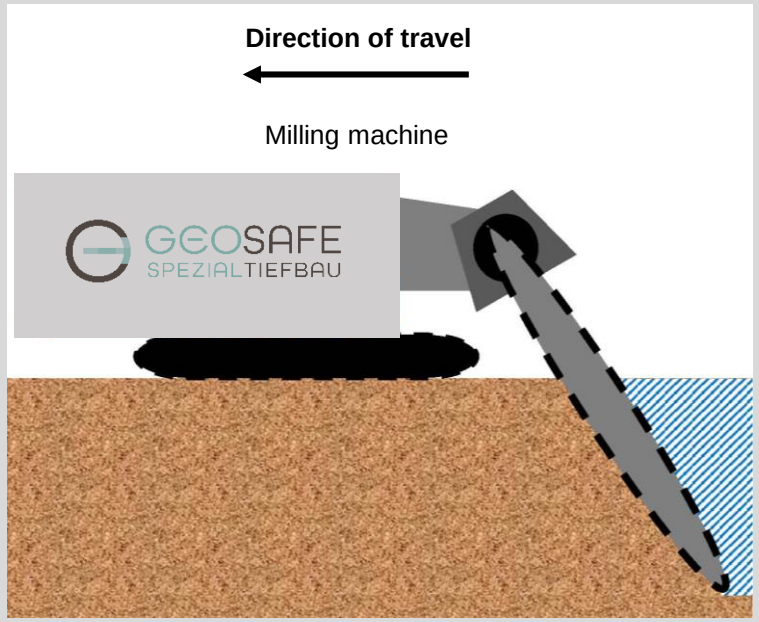
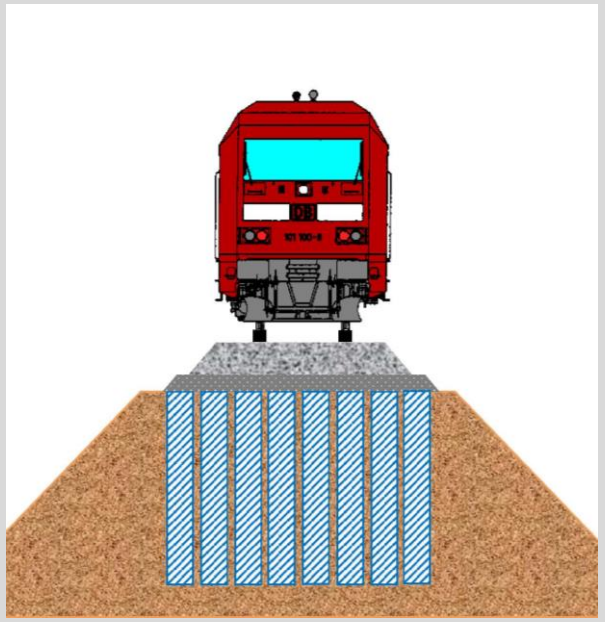
Ground improvement on railway embankments







Special advantages of the MMI process:

- Resource-saving minimization of mass transports in in contrast to soil exchange methods
- Vibration-free implementation of the process in contrast to soil compaction processes
- No longitudinal track shoring between construction tracks and operating track
- Implementation during continuous rail operation (alternating side single track)
- Strengthening of subbases with organic layers
- no in-house approval required
- No dismantling of the contact line is necessary due to the low device height
- Environmental aspects of existing vegetation on embankments can be met
- Short construction time

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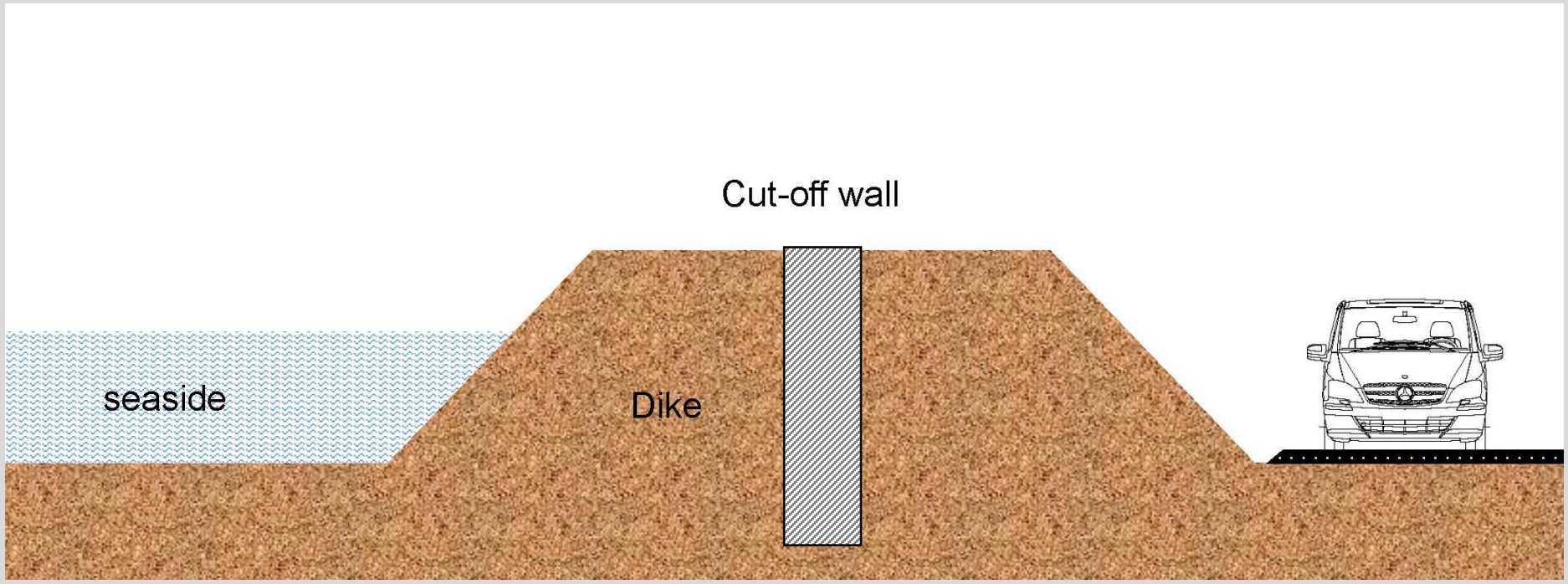
Construction of cut-off walls using MMI process

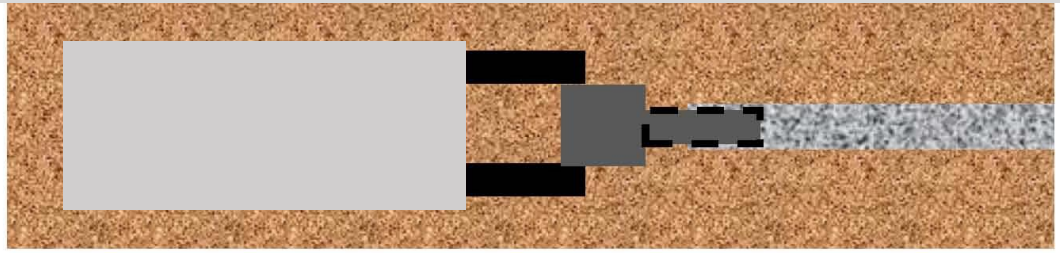


Special advantages of the MMI process:

By using the NovoInject process cut-off walls are created without replacing the soil by milling binding agents deep into the existing subsoil. The cut-off wall manufactured using the MMI process is a particularly effective solution for flood protection.

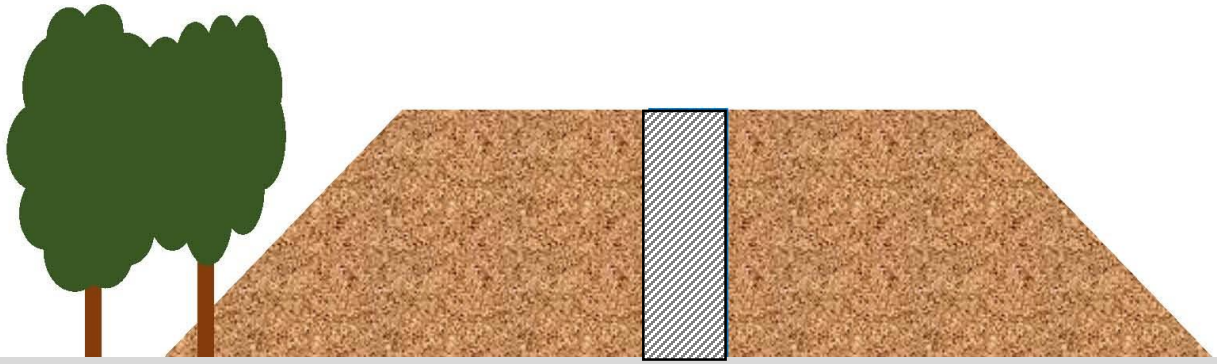
- Resource-saving by minimizing mass transports and using less raw materials
- vibration-free implementation of the procedure
- great resistance to natural influences
- great resistance to chemical attack
- close distance to existing structures possible
- short construction time

Construction of cut-off walls using MMI process



Top view

Long profile



Cross profile

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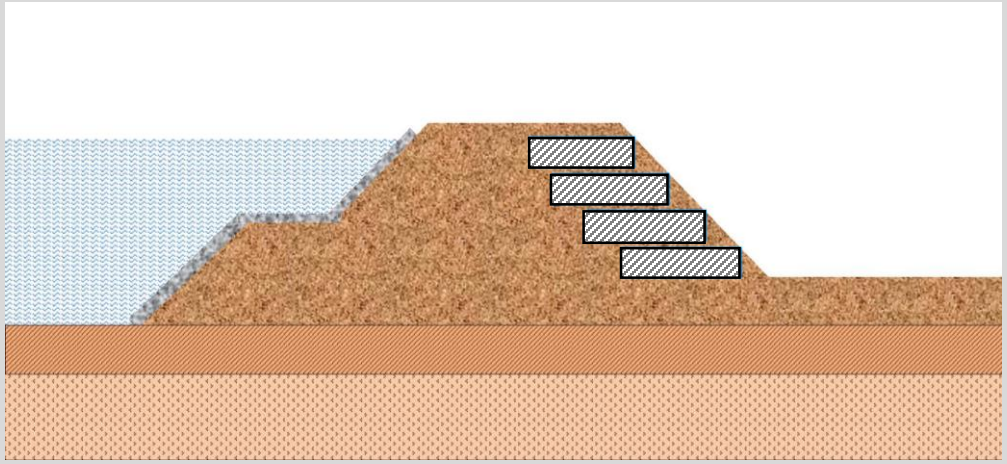
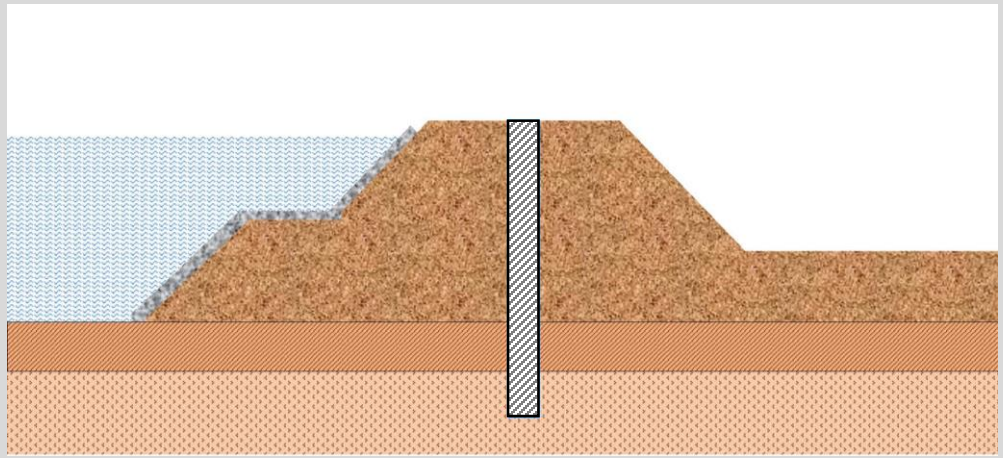
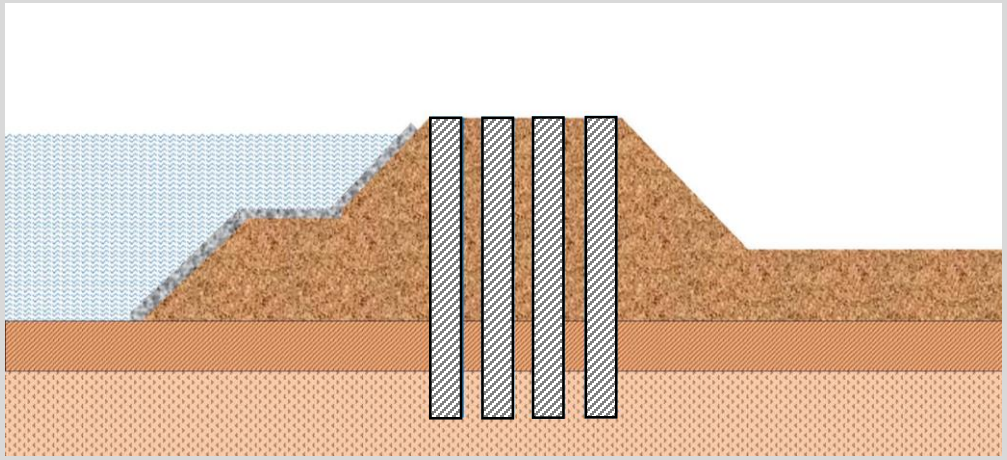
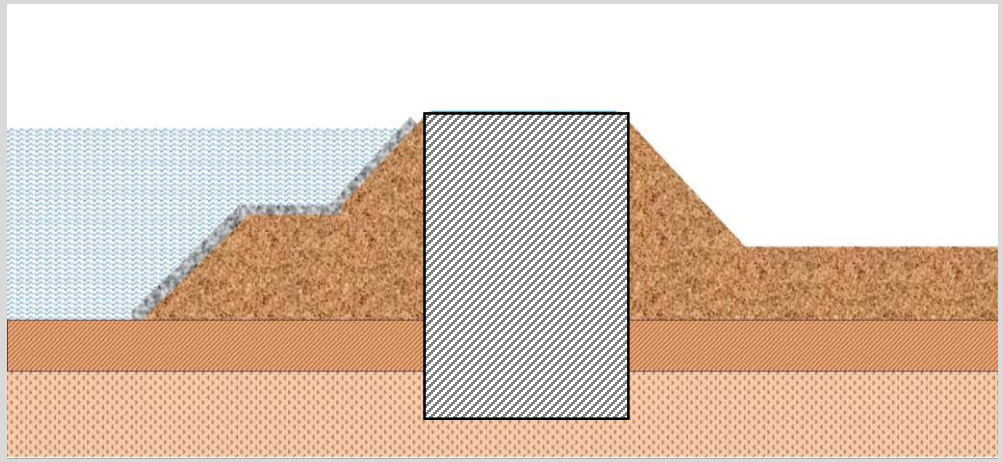
Macro stability









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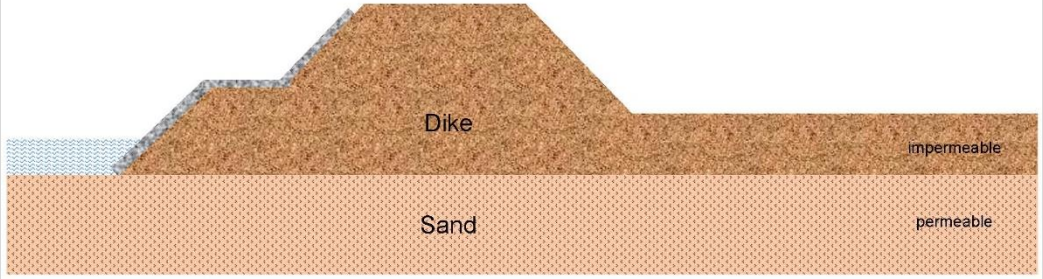
Problem: Undermining of dikes (1)

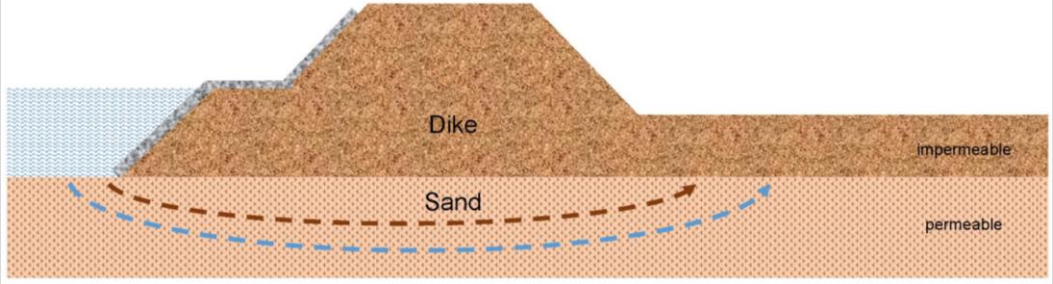
1

Regular
water level



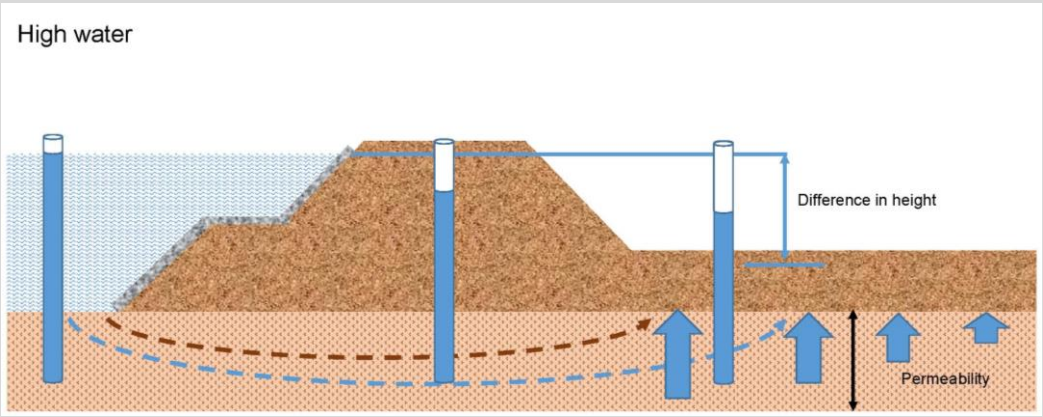
2

Increasing water level,
water undermines the dike,
soil material is being taken
away



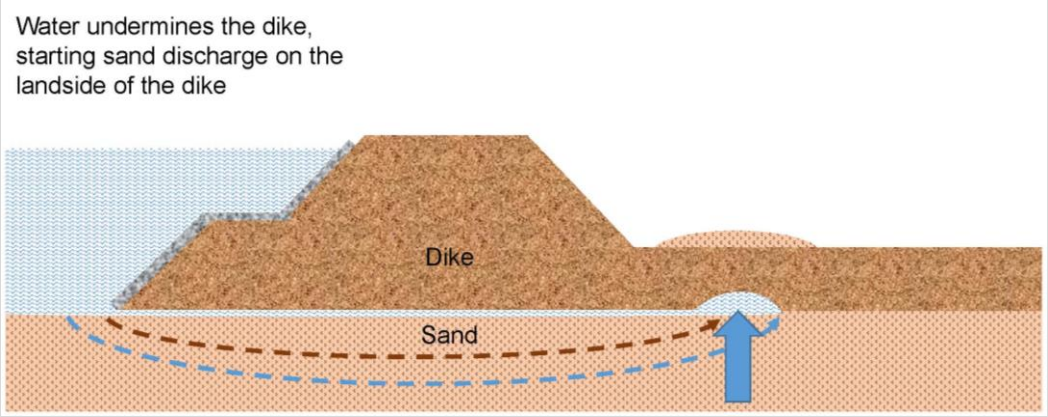
3

High water



4

Water undermines the dike,
starting sand discharge on the
landside of the dike



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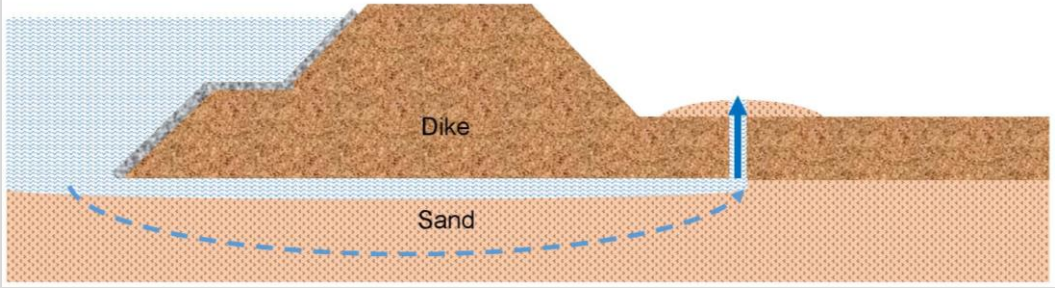
Problem: Undermining of dikes (2)

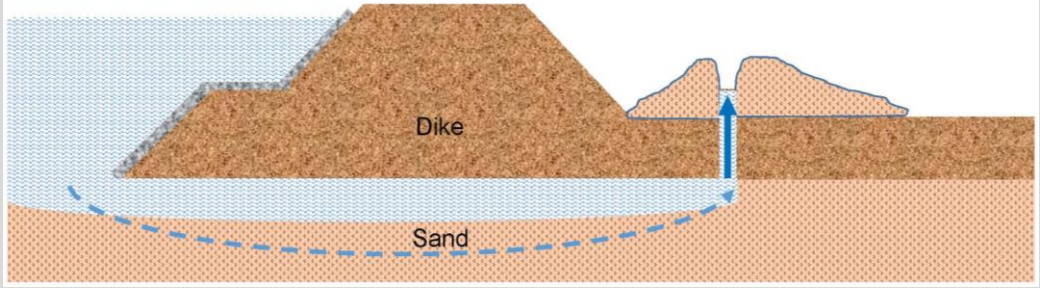
5

The dike is completely undermined by water, water discharge on the landside of the dike



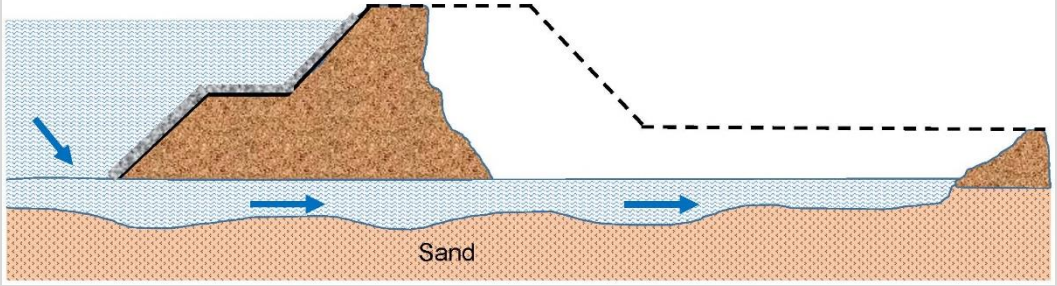
6

The dike is undermined by water, continuing sand discharge on the landside of the dike



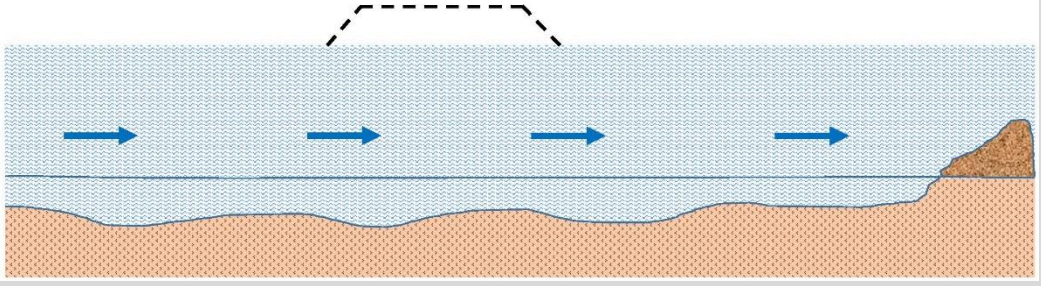
7

The dike body sinks on the landside as a result of the undermining



8

Final situation – the dike has disappeared completely



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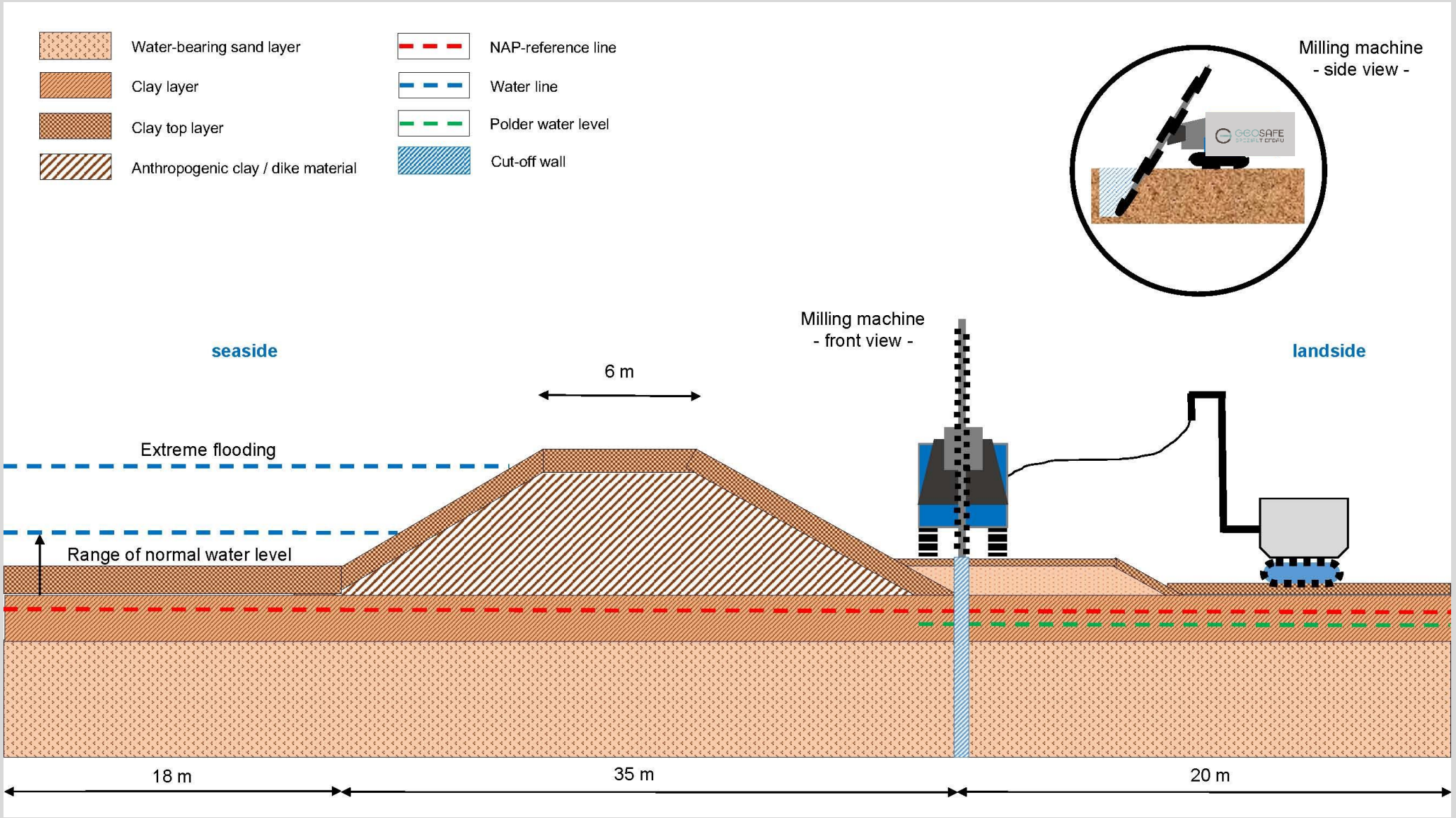
Flood prevention using the MMI process



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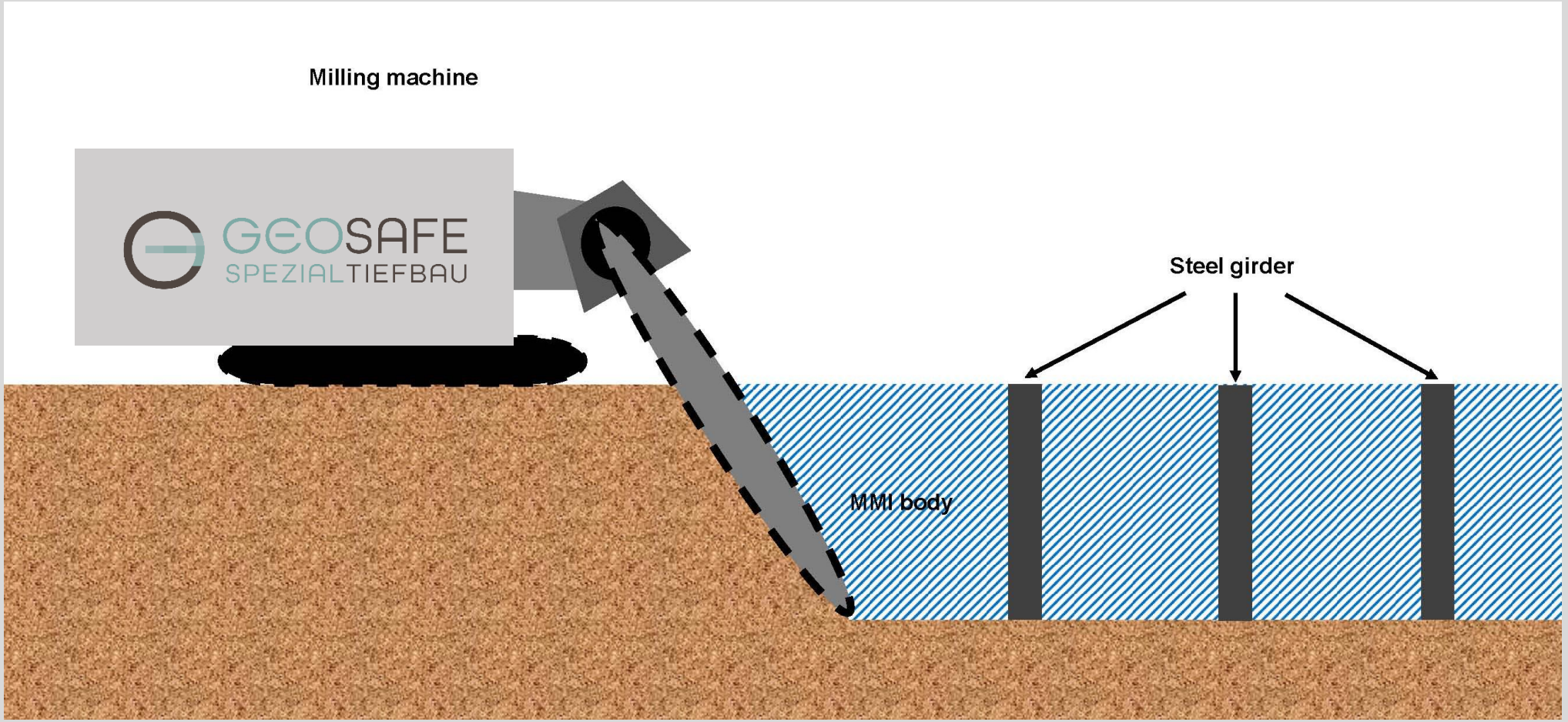
In depth soil soilidification for high loads



The combination of the MMI process with the use of steel girders at a statically required spacing enables extremely high loads. Occuring bending moments can be absorbed perfectly.

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Thank you for your attention!

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