Master in Water Engineerung
Geohydraulic and Geotechnical Design Criteria

Student Task 2019

Geohydraulic and geotechnical stability calculations for dike safety analysis

Given:

- Geometry and geotechnical investigation of an existing dike
- Suggestion for a dike reconstruction geometry
    - Homogeneous Dike Approach
    - Zoned Dike Apporach
- Soil parameters

Please determine the stability of the Dike reconstruction for relevant load case, use EC 7 partial safety concept

- Reconstructed homogeneous Dike:
  Load Case 1: Design Flood level, Land Slope, Uplift, Heave, Erosion (BS-P)
- Reconstructed zoned Dike:
  Load Case 1: Design Flood level, Land Slope, Uplift, Heave, Erosion (BS-P)

In detail you should:

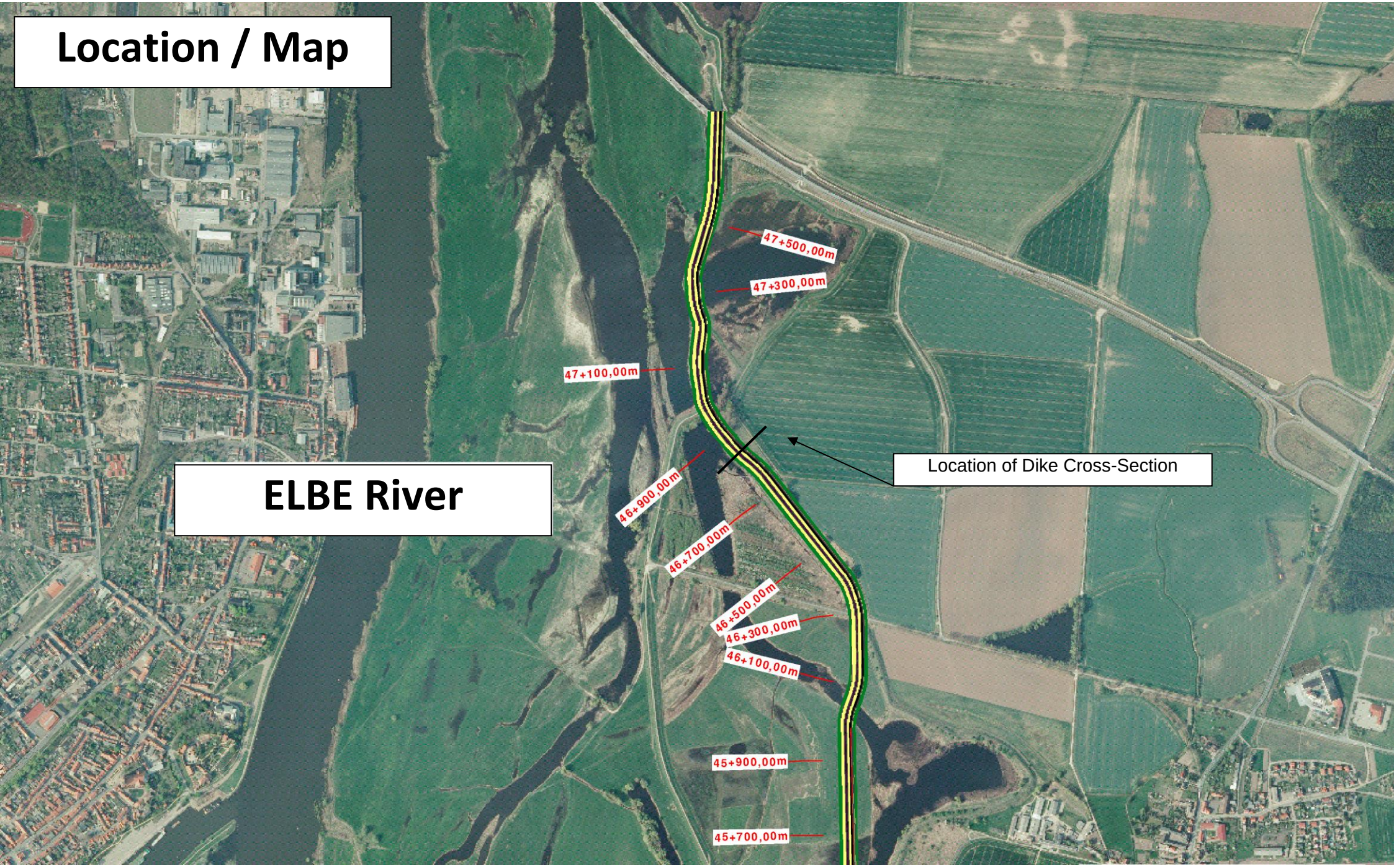
- Give a short description of the geotechnical and geohydraulic fundamentals for dike stability analyses.
- Describe the 2 design approaches for dike reconstruction applied here and give a first evaluation
- For both design approaches
    - Perform geohydraulic calculations and present results as potential contour lines and pore water pressures / hydraulic gradients at relevant locations
    - Determine Uplift / Hydraulic heave usability factor.
    - Determine slope stability (local / global) usability factor.
- Determine the need for additional means to achieve sufficient stability and perform necessary calculations to verify stability
    - geohydraulic calculations
    - Uplift / Hydraulic heave usability factor.
    - slope stability (local / global) usability factor.
    - Erosion resistance at relevant locations (Assume U = 10 for Sand grain size curve)
- Summary, conclusions, recommendations

The results, recommendations and summary should be presented in a short report (~10 pages max.).

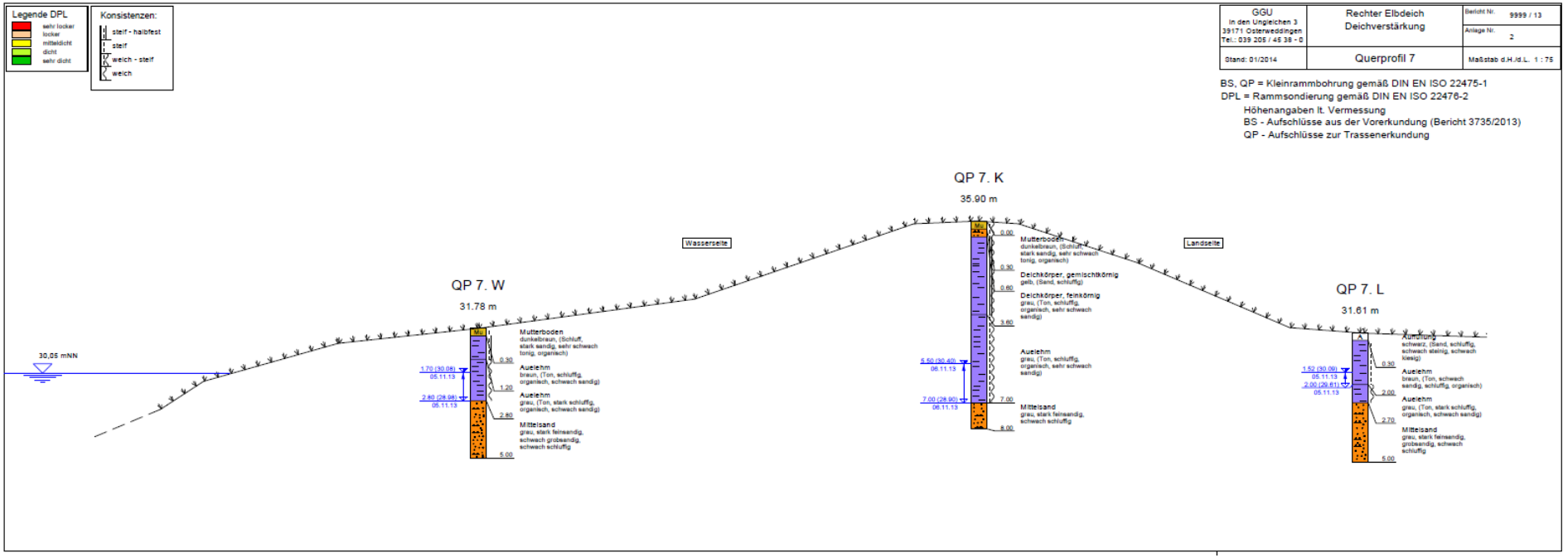
The student task can be prepared in groups of ~4 Students.

Please submit results to: Dr. Peter Grubert, p.grubert@ggu.de,

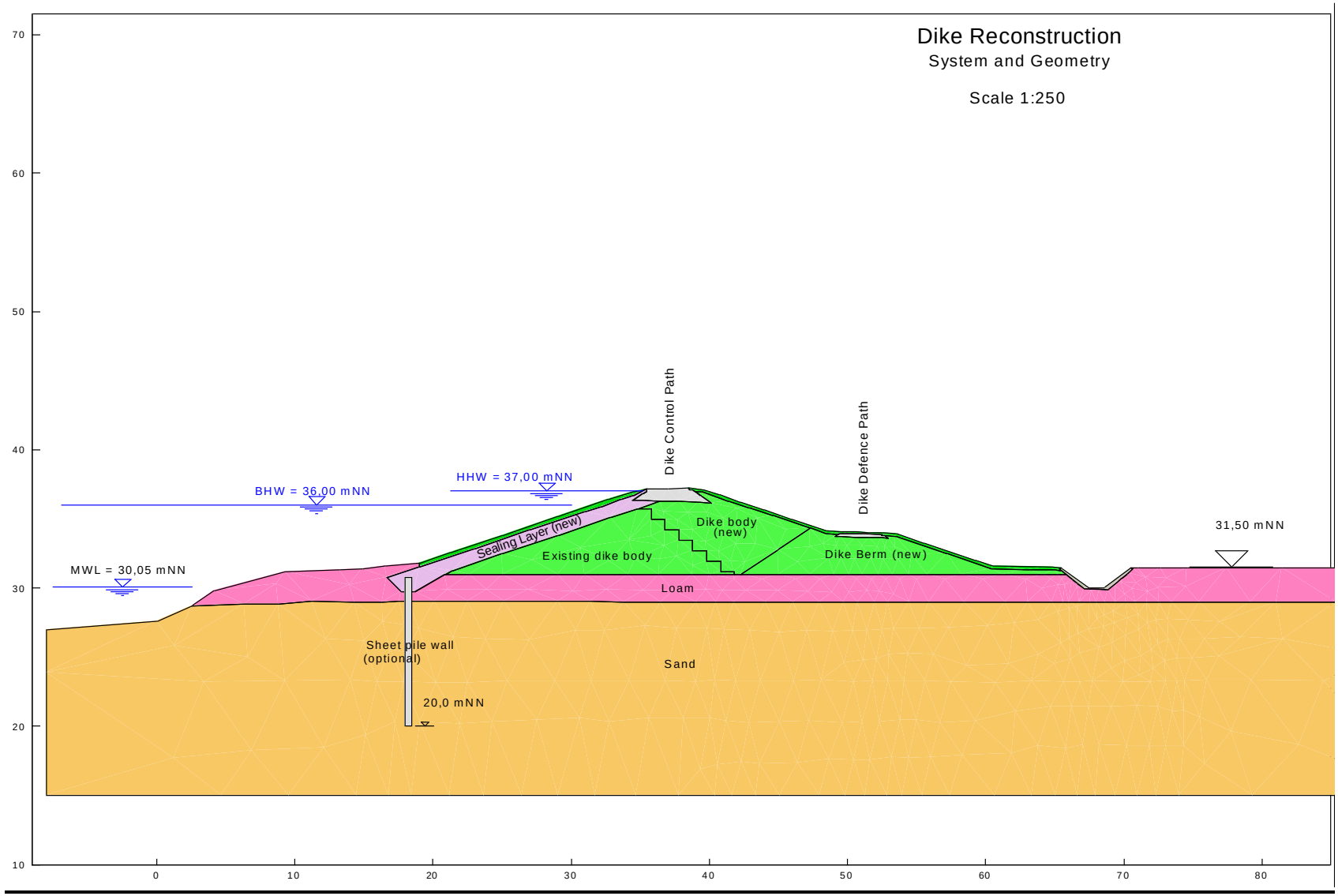
May, 2019


Location / Map
ELBE River
47+500,00m
47+300,00m
47+100,00m
46+900,00m
46+700,00m
46+500,00m
46+300,00m
46+100,00m
45+900,00m
45+700,00m
Location of Dike Cross-Section

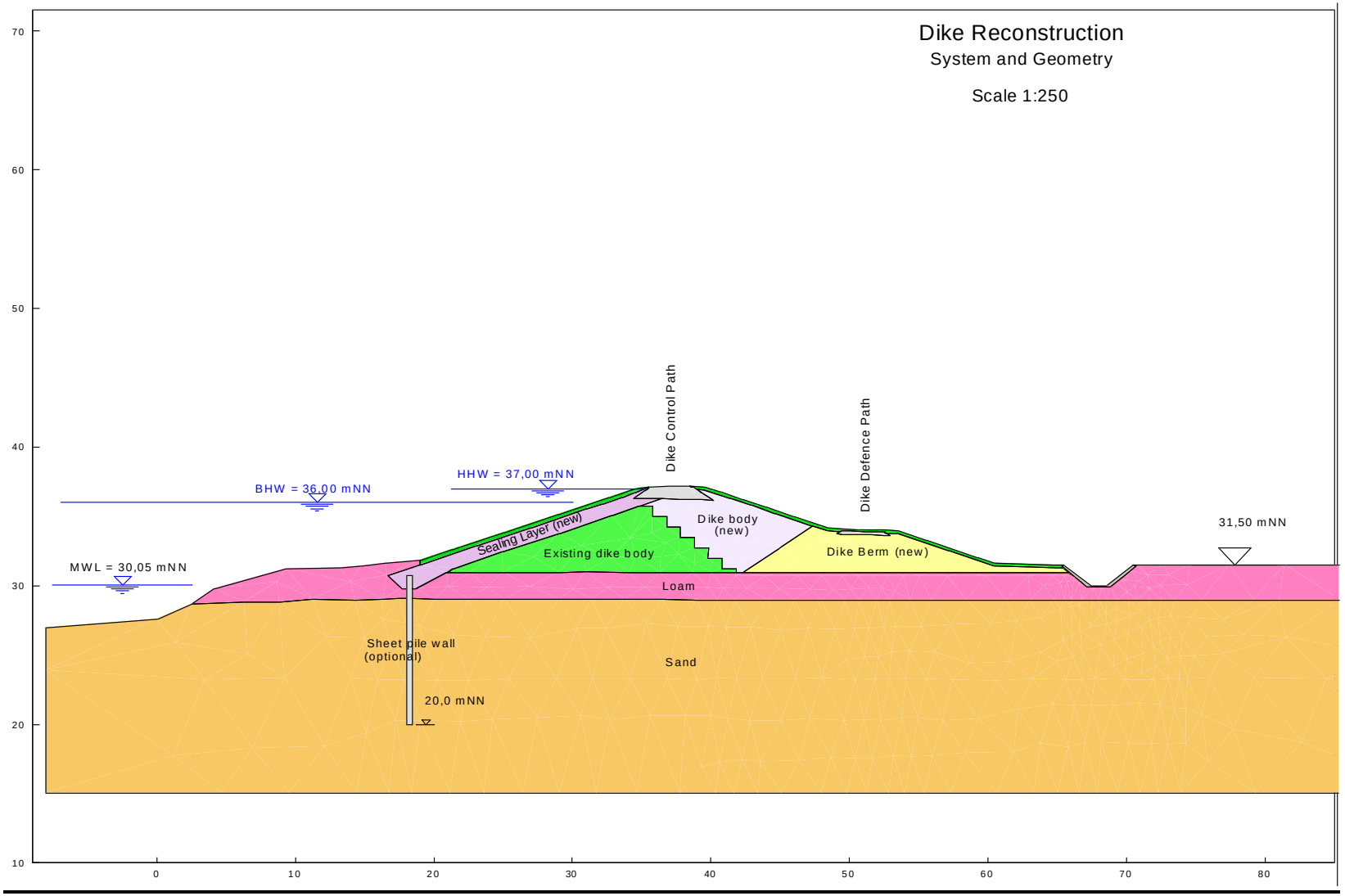
Results of Soil investigation



Reconstruction Approach Homogeneous Dike



Reconstruction Approach Zoned Dike



Soil Parameters

Layer / Bodenschicht	Wichte Density γ/γ' [kN/m³]	Reibungs-winkel Friction φ'k[°]	Kohäsion Cohesion c'k [kN/m²]	Durchlässigkeit Permeability k [m³/s]
Layer 0, Oberboden / Topsoil				
Layer 2 Auelehm / Loam	21,0/12,0	20,0°	3,0	10^{-7}
Layer 3 Sand	18,0/10,0	30,0°		10^{-4}
Existing Dike Body	19,0/11,0	22,5°	2,0	10^{-6}
Tondichtung / Sealing Layer (new)	21,0/12,0	25,0°	10,0	10^{-9}
Design Approach Homogeneous Dike				
Deichkörper / Dike Body (new)	20,0/11,0	25°	5,0	10^{-7}
Berme / Dike Berm (new)	20,0/11,0	25°	5,0	10^{-7}
Design Approach Zoned Dike				
Deichkörper / Dike Body (new)	19,0/11,0	30,0°		10^{-5}
Berme / Dike Berm (new)	18,0/8,0	30,0°		10^{-3}

Calculations (Overview)

	Load Case			Load	Load	Erosion	Slope Stability	Uplift/Heave	**Remarks**
		Water Level Elbe	Water Level Land	Crest	Berm	Potential	Usability	Usability	
		mNN	mNN	kN/m²	kN/m²		[1]	[1]	
Calculation Dike Reconstruction EASY									
Load Case 1	BS-P	BHW 36.00 mNN	Terrain Level	10,00	16,67	-			Slope Land side
Calculation Dike Reconstruction Zones									
Load Case 2	BS-P	BHW 36.00 mNN	Terrain Level	10,00	16,67	-			Slope Land side
Calculation Dike Reconstruction Zones									
Load Case 2	BS-P	BHW 36.00 mNN	Terrain Level	10,00	16,67				Slope Land side