PREPARATION OF THE DRADENAU LOGISTICS SITE

USE OF METHAMATERIAL FOR LAND RECLAMATION

HPA
Hamburg Port Authority

IAPH Sustainability Awards 2023

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Location of the former interim storage facility for dredge spoils 25

- The Dradenau harbour at the end of the Köhlfleet – a channel of the river Elbe
- From 1993: interim storage facility for dredge spoils
- Central location in the west of the port
- Close to large container terminals
- From January 2000
  - Restructuring of the port
  - Growing need for logistic sites
  - Closure of the storage facility and reclamation planned

Approval management

2004 - We‘re restructuring the port

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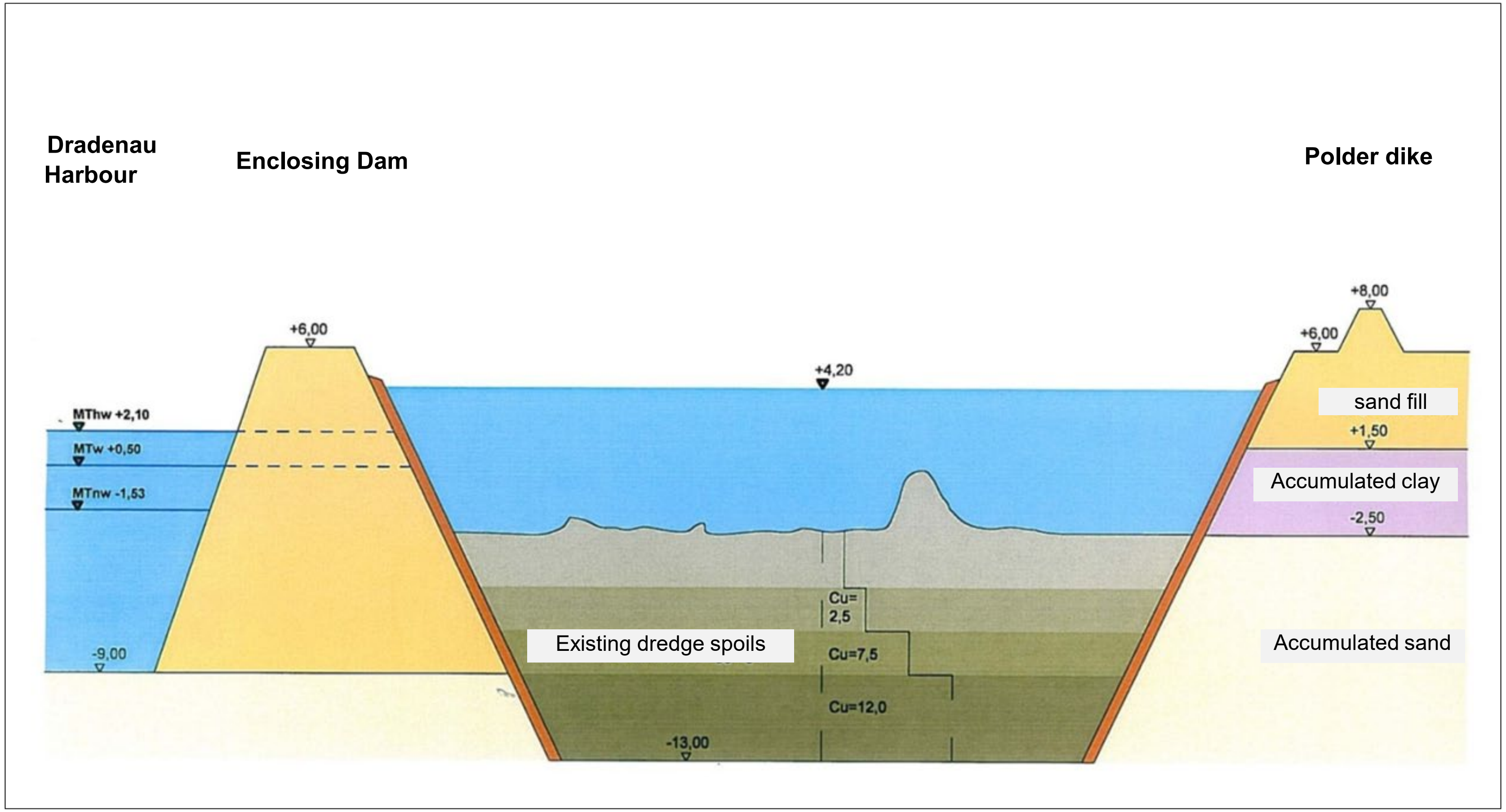

Approval management

2004 - We‘re restructuring the port

2008 - It‘s taking too long

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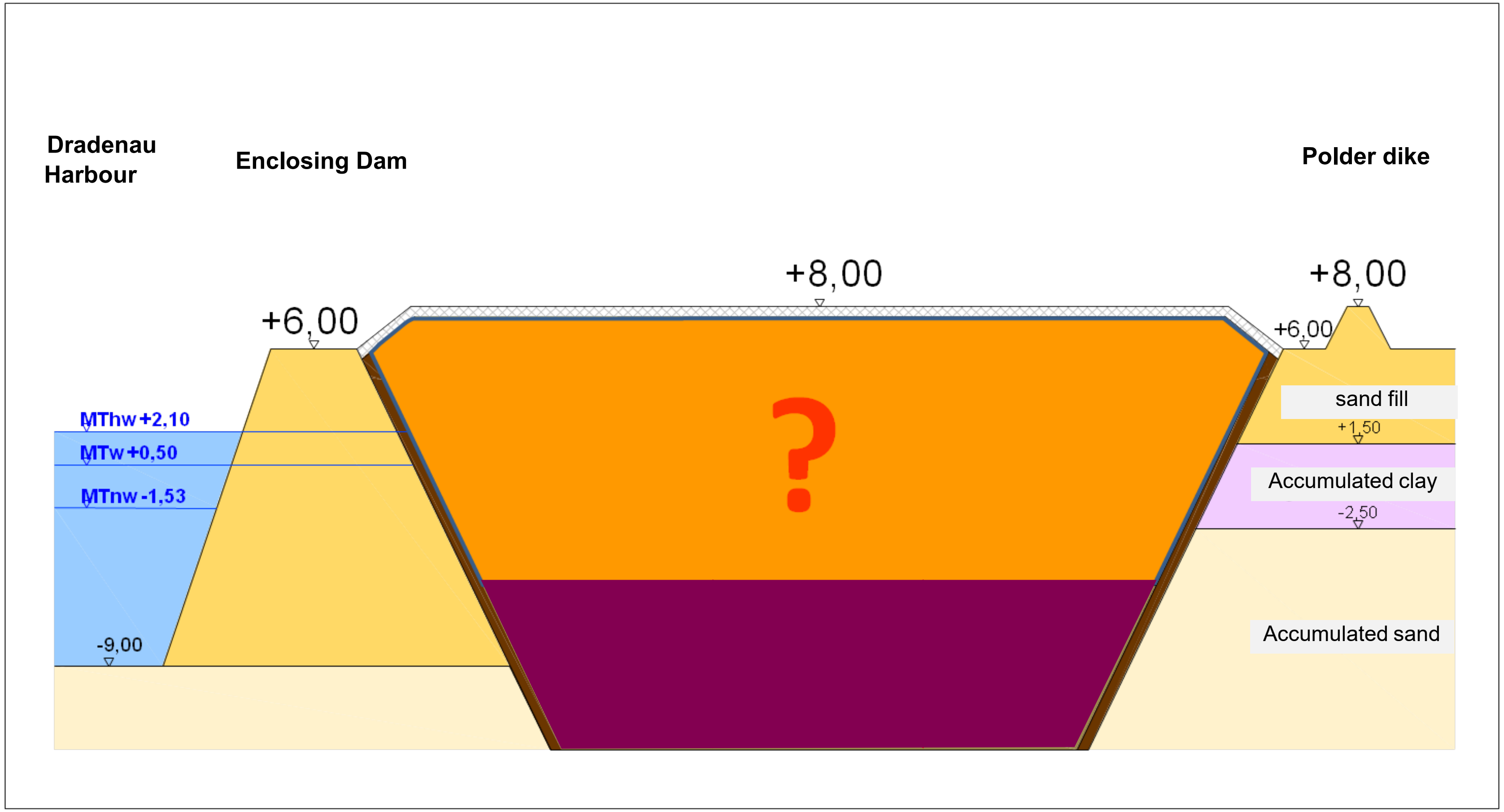

Approval management

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2004 - We‘re restructuring the port

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2009 - Nobody‘s there anymore

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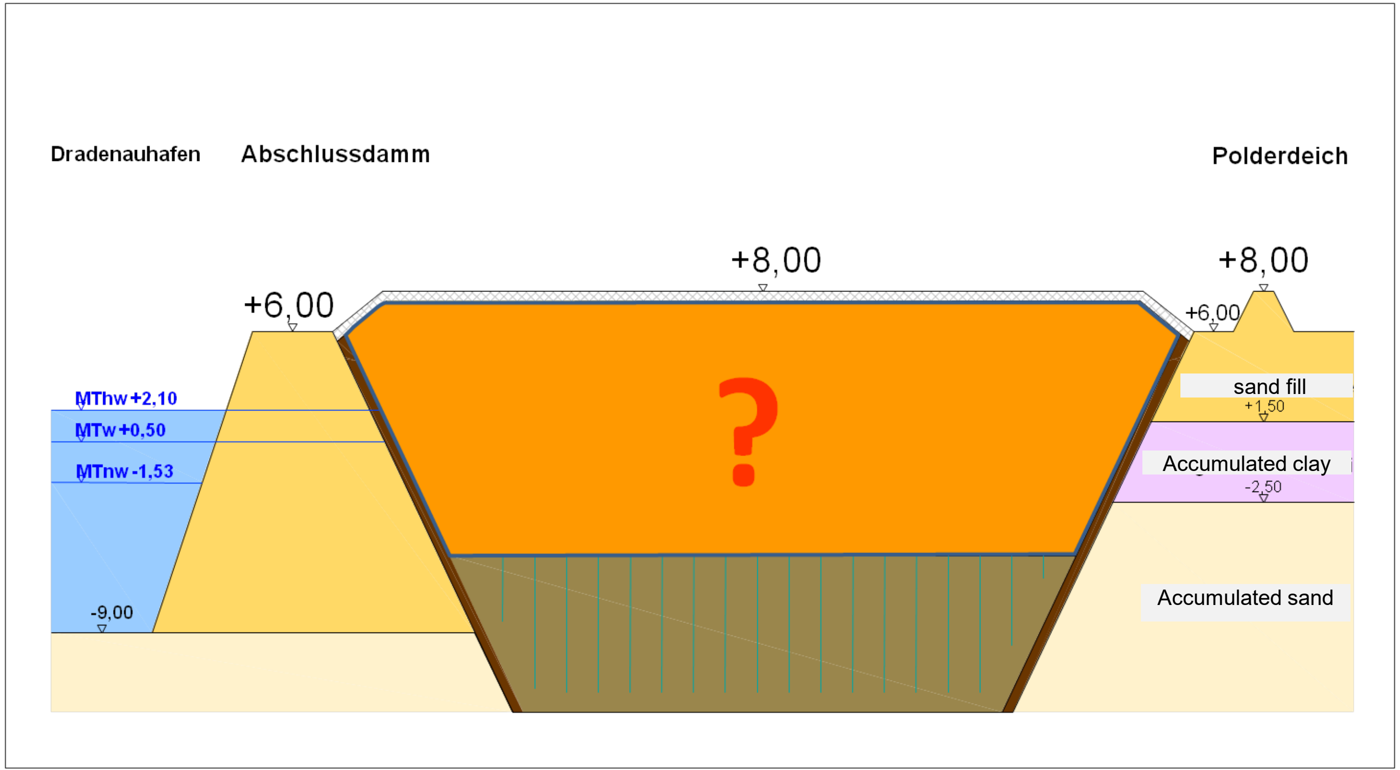
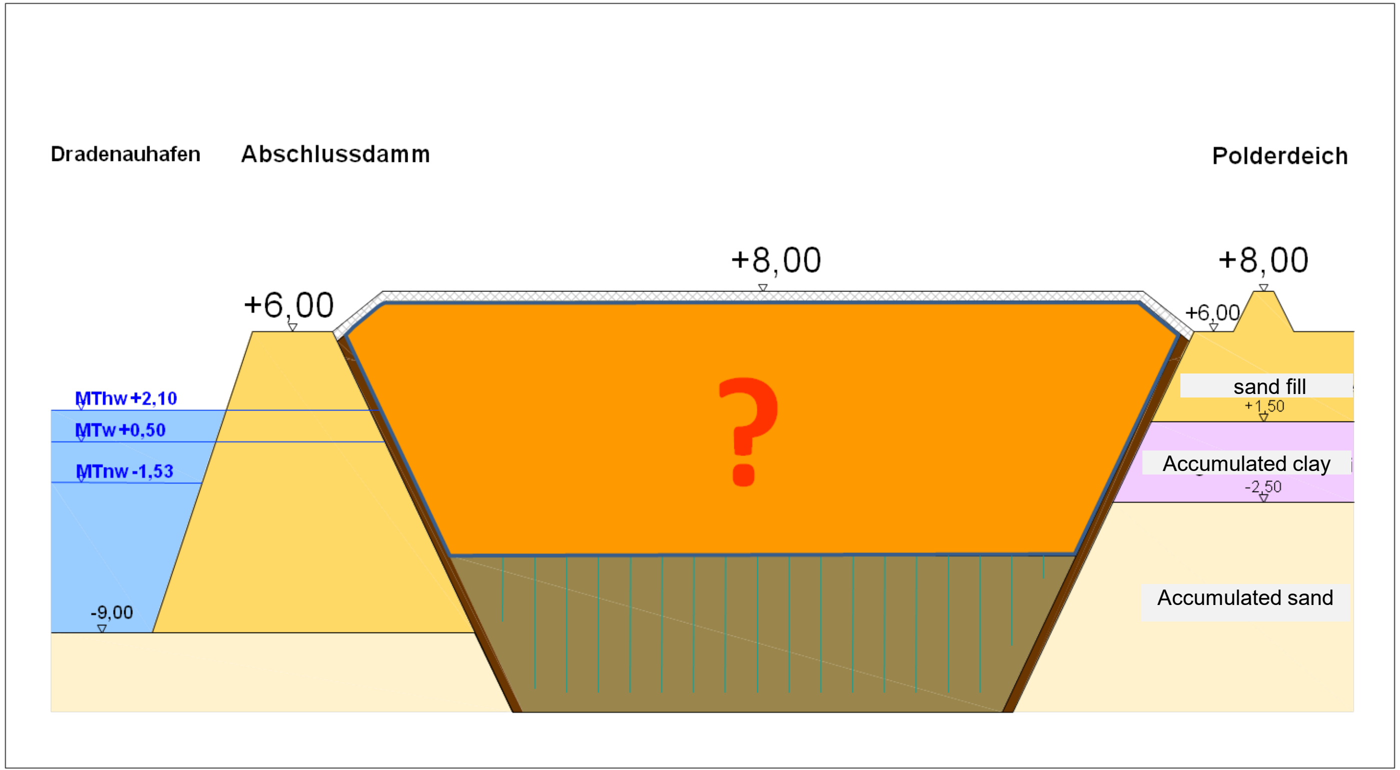


- Financial crisis leads to changing needs
- Landfill resources for dredge spoils are limited
- Decision
  - Stop further extraction
  - Develop a new backfill concept
  - New planning procedure

2010 – Making new things possible, together



- Planning premises
- Conservation of landfill volume by:
  - refraining from further silt removal
  - including METHA material
- Sand volume savings
- Recycling of waste
- Transferabilit to other port expansion measures
- Creation of a planning team consisting of engineers, environmental planners and legal experts

Approval management

2004 - We‘re restructuring the port

2008 - It‘s taking too long

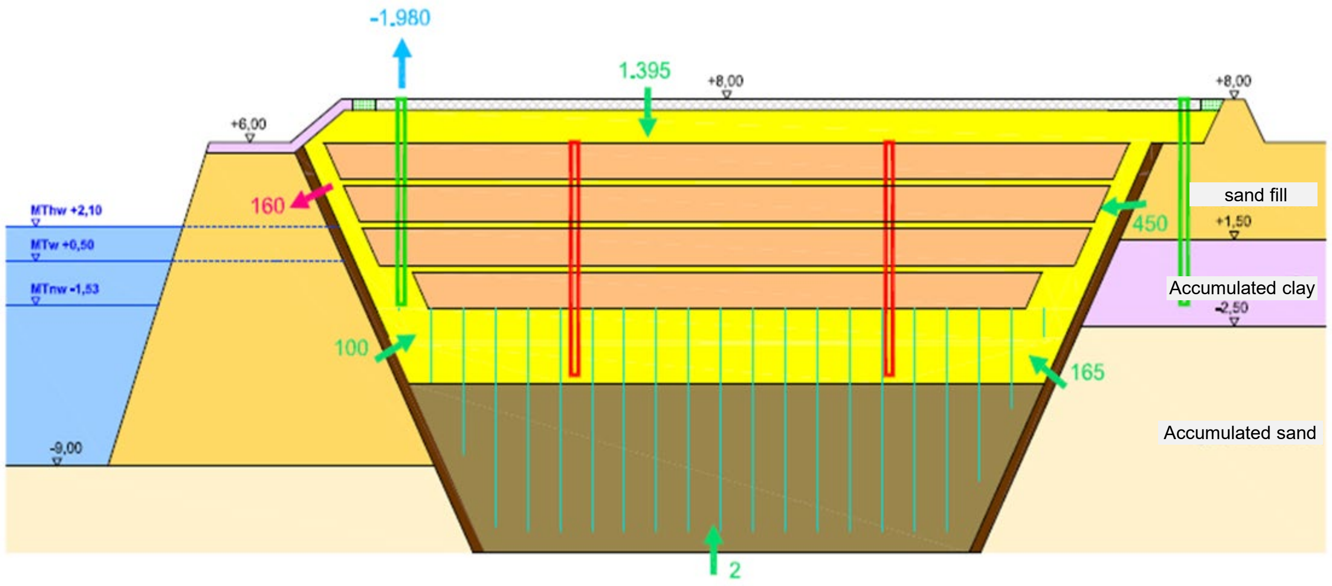
2009 - Nobody‘s there anymore

2013 - Change of mindset

2017 - Innovation prevails

2013 - 2017 – Sediments as the basis for modern logistics

Approval situation



- Environmental impact of the project
  - Water, as a protected resource, is most affected
    - High ammonium-input
    - Avoidance of groundwater runoff
  - Production of climate-changing methane gas resulting from existing organic components
  - Controlled drainage and biological treatment
  - Impact on other protected resources classified as low
- Suitability of the site for logistics purposes

Construction phase 1: wet installation

- Remaining silt at an elevation of between 13.00 metres below sea level (BSL) and an average of 2.5 metres BSL.
- Depositing of around 160,000 m³ of sand to achieve an average elevation of approx. 1.5 metres above sea level.
- Specific requirements :
  - Layers of uniform density with a thickness of just a few decimetres
  - Targeted placement of sand volumes not allowed
  - Precise control and positioning of installatoin machinery
    Continuous comparison of flush volume and traverse speed
  - Performance: 2,000 m³/day

Construction phase 1: wet installation

- Precision positional control of the spreader, using a 200 metre long pontoon as a guide.
- Precisely positioned using four winches at four anchor points on the edge of the basin
- GPS positioning in conjunction with continuous speed and flow measurement

Construction phase 2: water management

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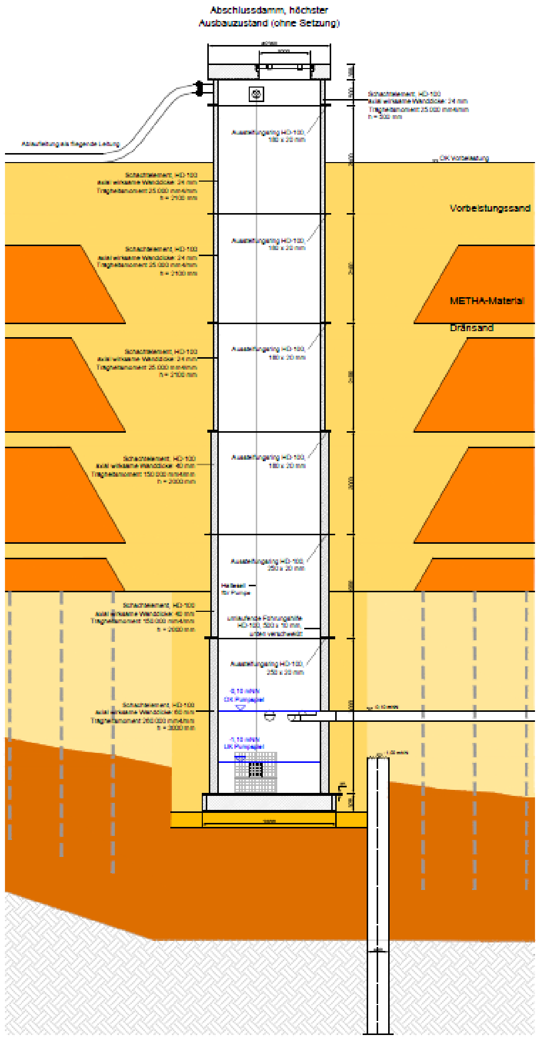
- Construction of vertical drains
  - Inserted into the stored dredge spoils to accelerate consolidation
  - Installation of approx. 26,800 strip drains with a settling depth of between 2 and 12 metres.
  - Total length of all drains installed: approx. 190 km

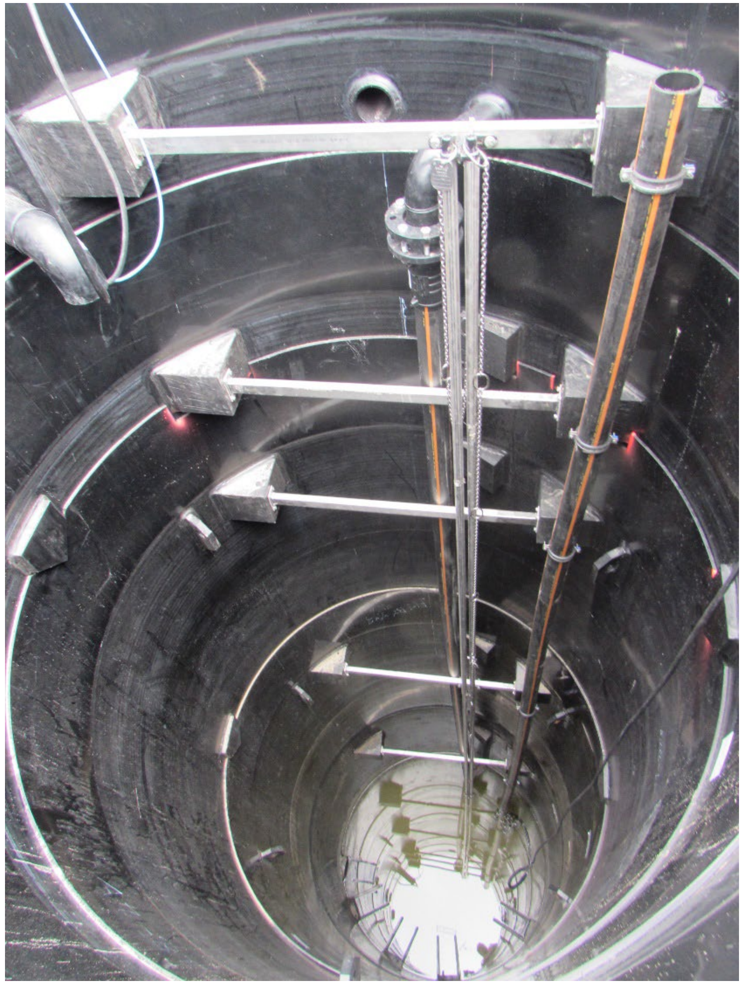
Construction phase 2: water management

- Construction of horizontal drains
  - Permit management: No ammonium should drift into the surrounding groundwater
  - Horizontal drains distributed across the entire site
  - Aligned with two pumping areas and four inspection shaft, all located at the site boundary.

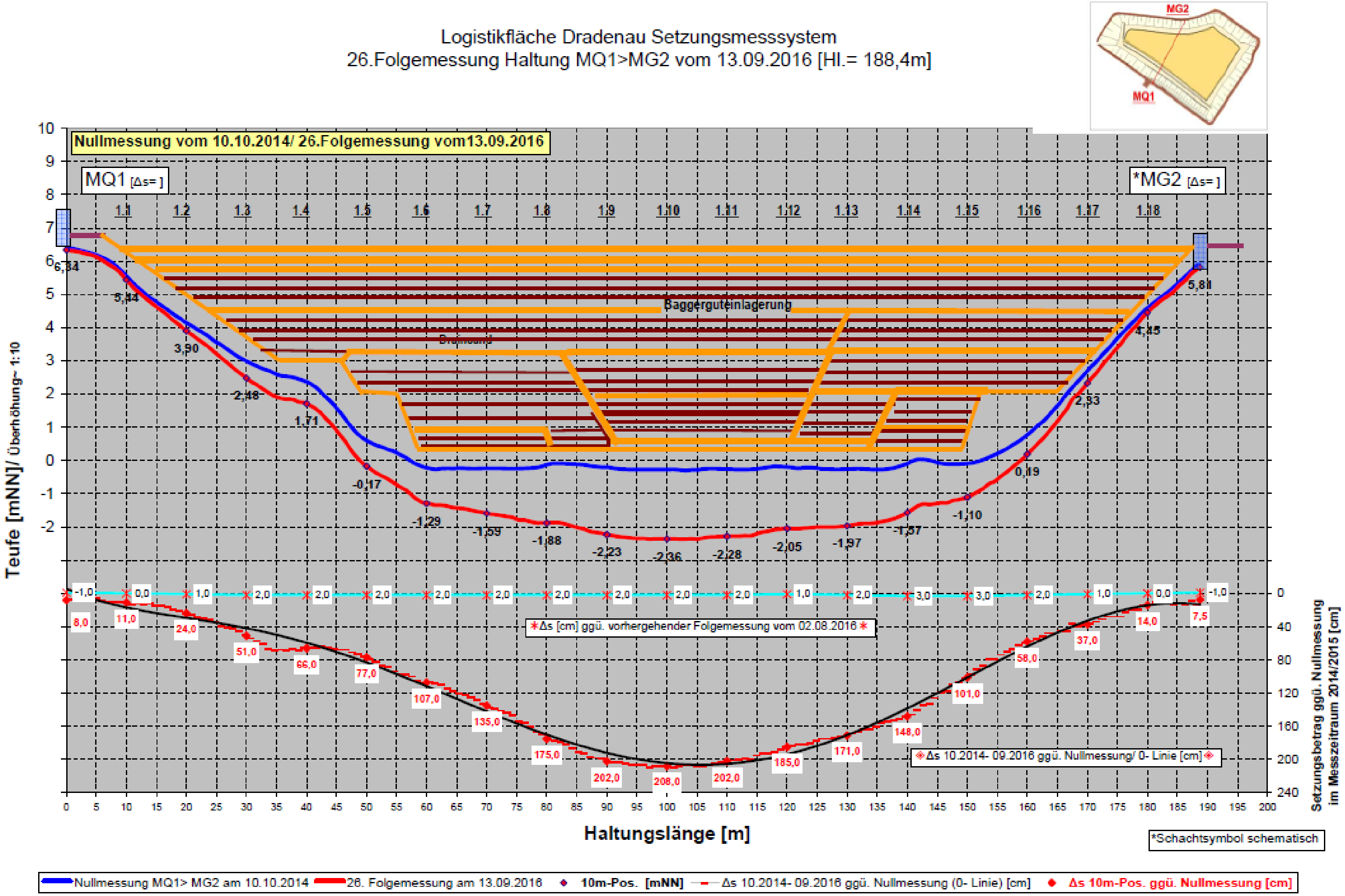
Construction phase 2: water management



- Construction of the management system
  - Ensure permanent groundwater management
  - Positioned at sea level in the ground- / impounded water
  - Two PE shafts (DN 2000) used to pump off the impounded water



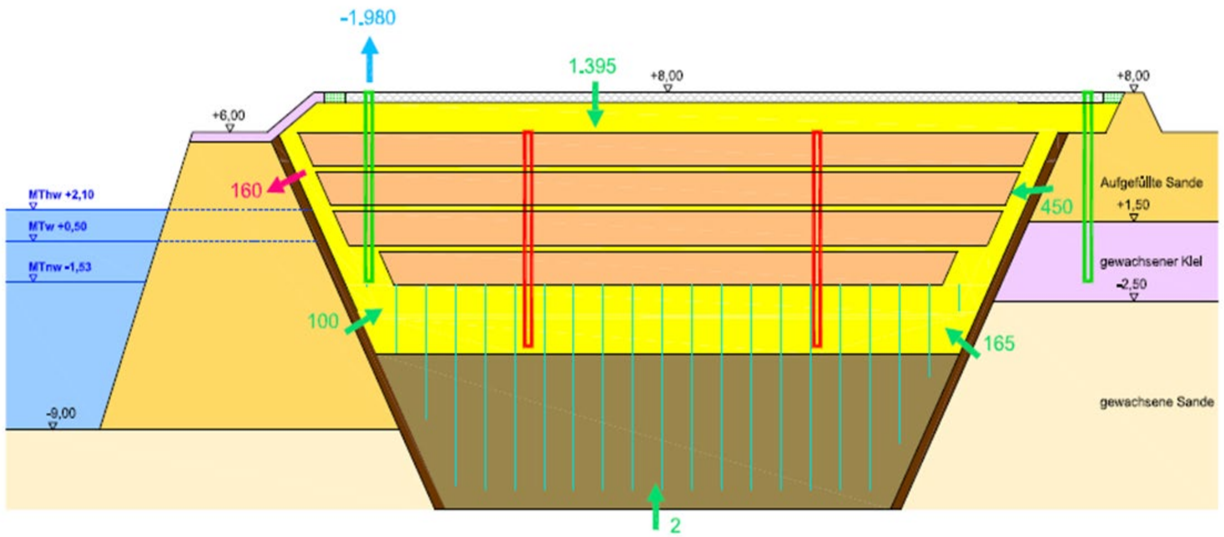
Construction phase 2: settlement measuring system



- Construction and operation of the settlement measuring system
  - Due to the soft layers, settlement of up to 3.0 metres can be expected in the central area.
  - 4 line measurement strands of up to 380 m in length
  - Regular measurement of hydrostatic settlement
  - Continuous improvement of the model-based settlement prognosis
  - Repeated adjustment of the required preloading (sand preload) during construction

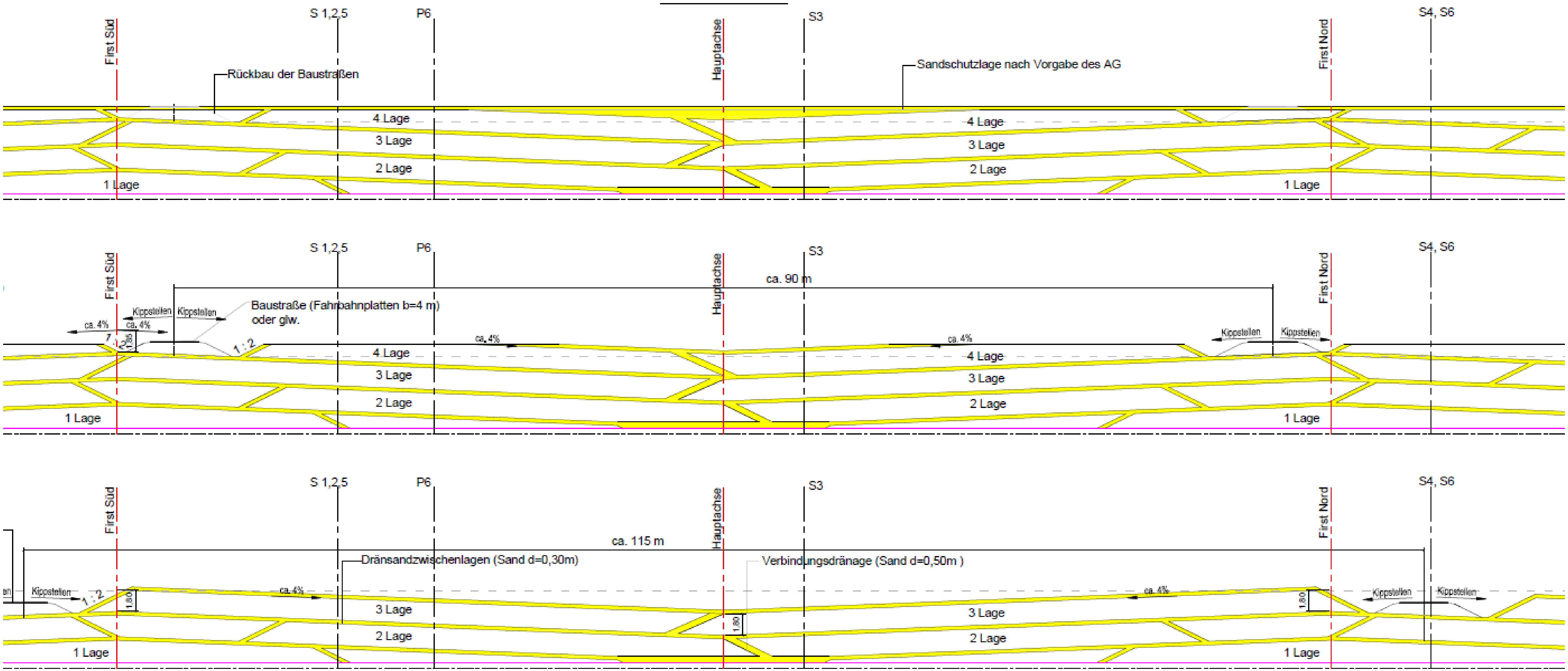
Construction phase 3: installation of METHA material and sand

- Installation of METHA materials and drainage sand
  - Layer-by-layer fillling of METHA material as a layered package
  - 4 layers with a maximum of 3 intermediate layers of 60 to 65 cm
  - Average thickness of the METHA material layer approx. 1.85 m



- Drainage sand with a thickness of 0.30 metres between the layers

Construction phase 3: Installation of METHA material and sand



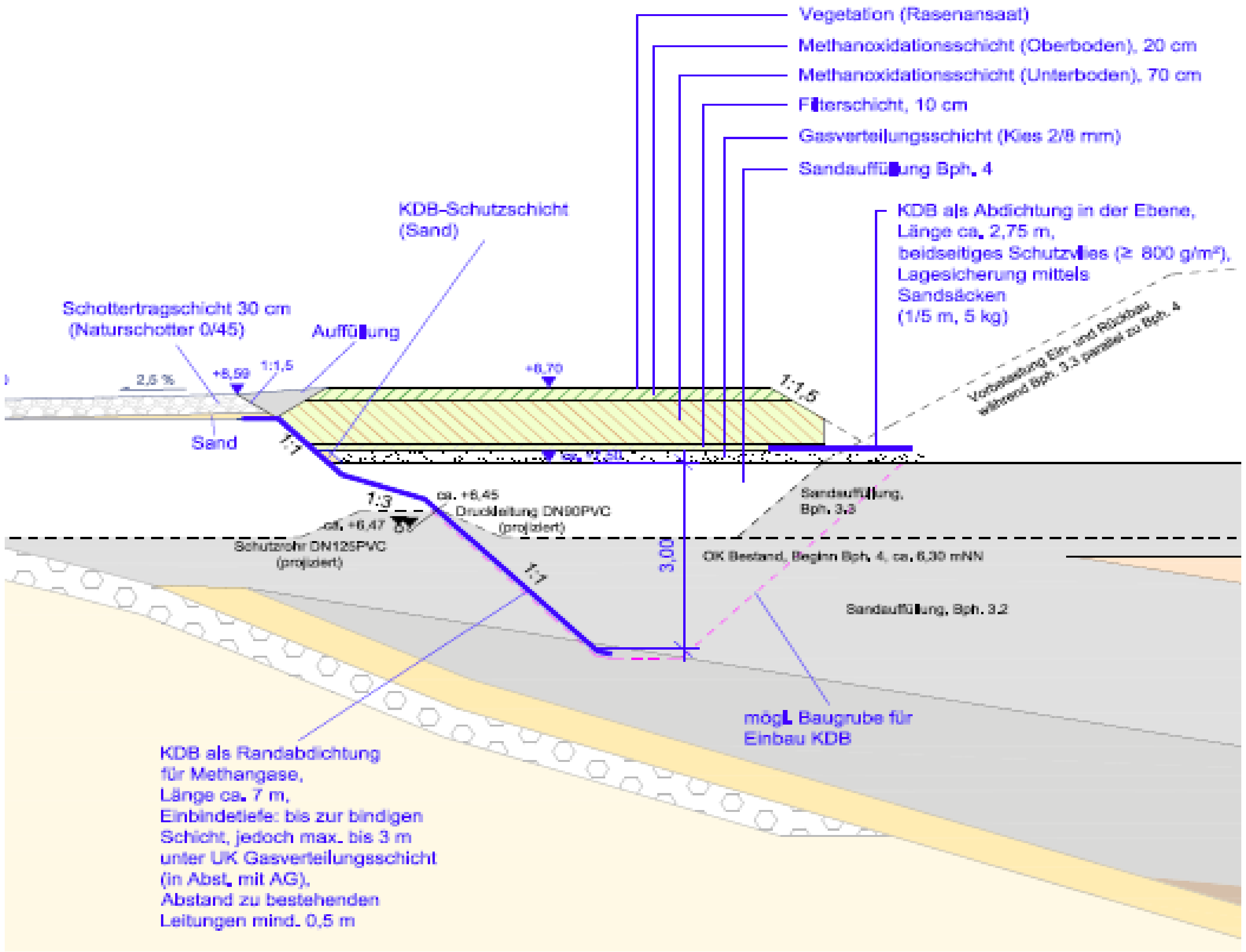
Construction phase 3: Installation of METHA material and sand

- Installation and removal of preloading layer
  - Expect initial settlement period of 6 months
  - Ongoing refinement of model-based settlement forecast
  - Geometry of preloading layer adjusted several times during construction
  - Preloading layer comprise of approx. 150,000 m³
  - Around 50,000 m³ relocated on construction area
    100,000 m³ of sand removed
    50,000 m³ remain to compensate for settlement and for use in surface layer and embankment

→ Maximum secondary settlement of 20 cm fulfilled with a superimposed area load of 30 KN/m²

Construction phase 4: site borders and methane oxidation areas

- Permit requirement (Methane!):
  - reduce climate impact
- Installation of a plastic geomembrane sealing layer
- Methane emerging from the surface is captured and fed to the methane oxidation
- Microbial oxidation of the environmentally harmful methane
- Methane oxidation layer runs along outer edges of the site and is 7.0 m wide, with an area of 8,000 m²

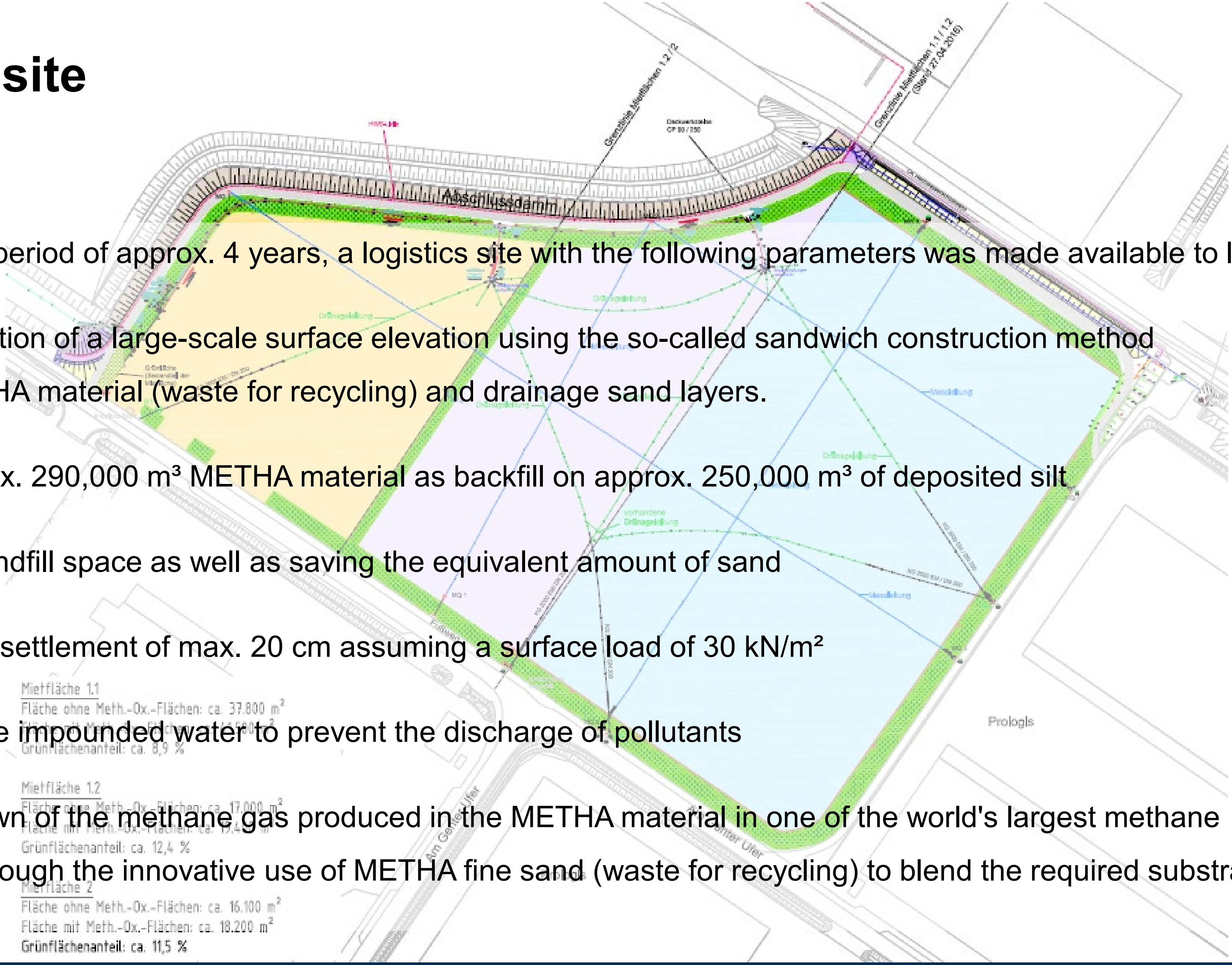


Construction phase 4: site borders and methane oxidation areas

- Subsoil layer mixed on site from 2 different soil materials
  - Base material 1: on-site sand
  - Base material 2: so-called METHA fine sand (by-product of the production of sealant silt for landfills)
- Special briefing of the machine operators on site
  - Mixing to form a homogeneous soil material
  - Allow soil to glide over the excavator shovel, ensuring the highest possible volume of air voids
- Target value: 80 % DPr degree of compaction
  - Water permeability approx. 1.0 x 10-5 m/s
  - Useable field capacity (uFC) approx. 16.0 mm/dm
  - Air capacity approx. 17 vol.%
- Topsoil mixture of base material 1 (sand) and a certified compost to protect the subsoil and as a suitable substrate for greening the surface

New logistics site

- After a construction period of approx. 4 years, a logistics site with the following parameters was made available to let:
  - First-time construction of a large-scale surface elevation using the so-called sandwich construction method consisting of METHA material (waste for recycling) and drainage sand layers.
  - Recycling of approx. 290,000 m³ METHA material as backfill on approx. 250,000 m³ of deposited silt
  - Conservation of landfill space as well as saving the equivalent amount of sand
  - Predicted residual settlement of max. 20 cm assuming a surface load of 30 kN/m²
  - Management of the impounded water to prevent the discharge of pollutants
  - Microbial breakdown of the methane gas produced in the METHA material in one of the world's largest methane oxidation areas through the innovative use of METHA fine sand (waste for recycling) to blend the required substrate.



You need a good team to make a project work

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