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D5 Roads on Peat (in Ireland)

ROADEX Workshop in Ireland
Carrick-on-Shannon, 27 October 2011

Task D5: Roads on Peat

Lead persons: Haraldur Sigursteinsson & Ron Munro

Task description:

To demonstrate ROADEX technologies on planned road rehabilitation exercises on roads over peat.

To give practical support to local road improvement projects to use the new ROADEX road design methodology for low volume roads on their road networks.

NPP demonstration locations:

Ireland (2 projects)

Bog rampart, Ireland

D5 Roads on Peat

Demonstrating ROADEX methods

3 reports:

- ROADEX II Report, 2005
  "Dealing with Bearing Capacity Problems on LOw Volume Roads Constructed on Peat"

- ROADEX II Guidelines, 2005
  "Guidelines for the Management of Peat Slips on the Construction of Low Volume/Low Cost Roads over Peat"

- ROADEX III Executive Summary, 2006
  "Managing Peat Related Problems on Low Volume Roads"

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D5 Roads on Peat

Demonstrating ROADEX methods

The three phases:

- **Map the weak sections of road and FOCUS in on them**
- **Understand the processes causing the problems**
- **Innovate - find new 'fit for purpose' structures and treatments**

D5 Roads on Peat

Method:

DATA COLLECTION:

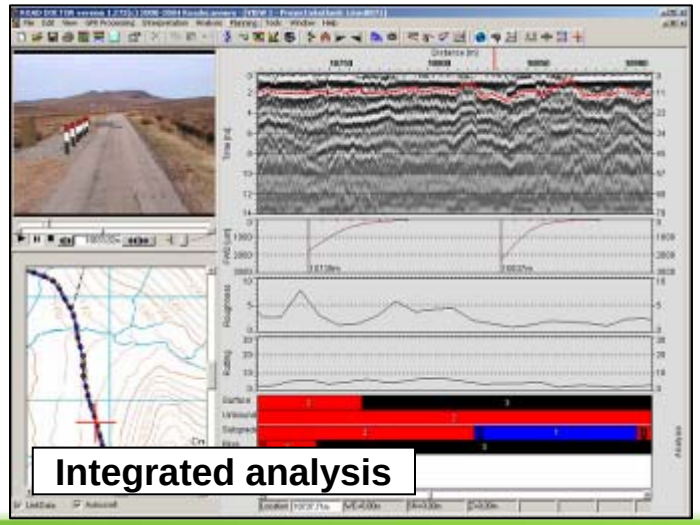
- **Falling Weight Deflectometer (FWD)**
  - bearing capacity of the road
- **Drill core data**
  - road structure verification & quality
- **Digital video**
  - pavement condition documentation
- **Scanner**
- **Ground Penetrating Radar**
  - road structures
  - subgrade soil quality
  - reasons for road defects

DATA PROCESSING AND ANALYSIS:

- **'Road Doctor' by Roadscanners Oy**
- **ArcView**


FWD & GPS

GPR, GPS & Video


Integrated analysis

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D5 Roads on Peat (Ireland) - outline

Project plan:

- **Initial visit** by HS to make working contact and get an understanding of Irish conditions. Preparation of preliminary report on Irish best practice. Discuss how sharing could happen;
- **Identify demonstration project locations**, preferably one strengthening project and one widening project;
- **Survey with ROADEX methods** (FWD, GPR, GPS, video, scanning, etc) to identify the problem areas and formulate solutions. Surveys and interpretation paid by Partners;
- **Strengthening & widening of road sections on peat**. Settlement is a major issue in strengthening and widening roads over peat - to be addressed in ROADEX for the first time. ROADEX to assist in design.
- **Carry out works** by Contractor. Report by ROADEX.

Links with other Tasks:

- Input into eLearning task and road widening research for projects involving peat.

D5 Roads on Peat (Ireland) – delivery

November 2010	DoT & NRA agree roads sections to be surveyed: • N56 Drumnaraw to Cashelmore, County Donegal • N59 Newport – Mulranny, County Mayo
March 2011	Survey of the road sections by PMS and Roadscanners
July 2011	Submission of the preliminary reports and "Road Doctor" project files:
August 2011	ROADEX workshop in Carrick-on-Shannon to discuss reports and give feedback Follow-up
March 2012	Report

ROADEX - demonstration projects in Ireland

a) N56 Drumnaraw – Cashelmore, Co Donegal, (10km)

b) N59 Newport – Mulranny, Co Mayo, (15km)

Surveys March 2011:

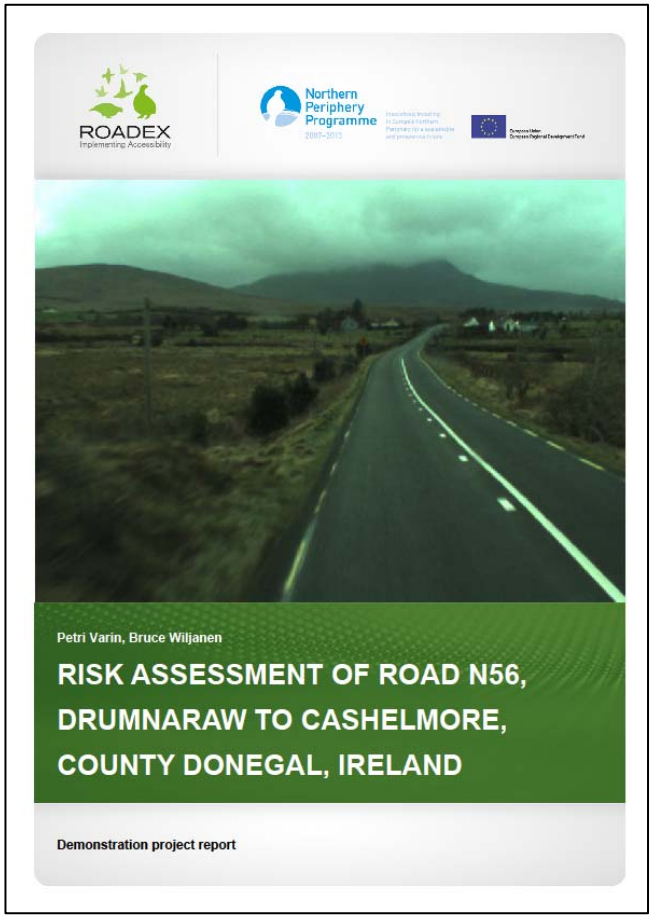
- standard GPR survey in both directions
- deep GPR survey for presence of peat in both directions
- GPR cross-sections at selected locations
- laser scanner survey in both directions
- FWD survey in one direction at 50m centres

GPR, GPS, laser scanner & video

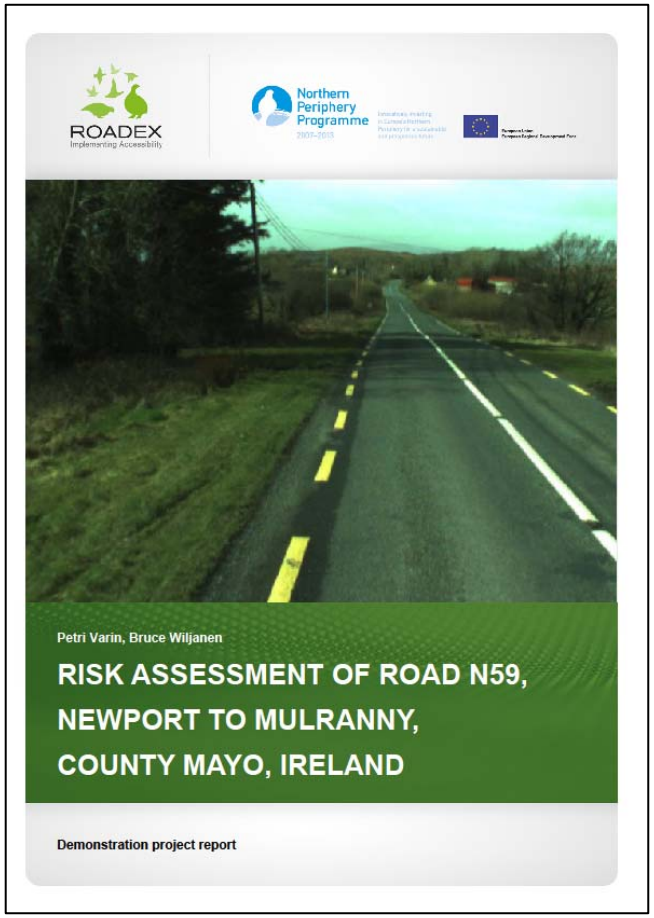
FWD testing

Roads on peat demonstrations in Ireland

Reports delivered 25 July 2011



N56 Drumnaraw to Cashelmore



N59 Newport to Mulranny

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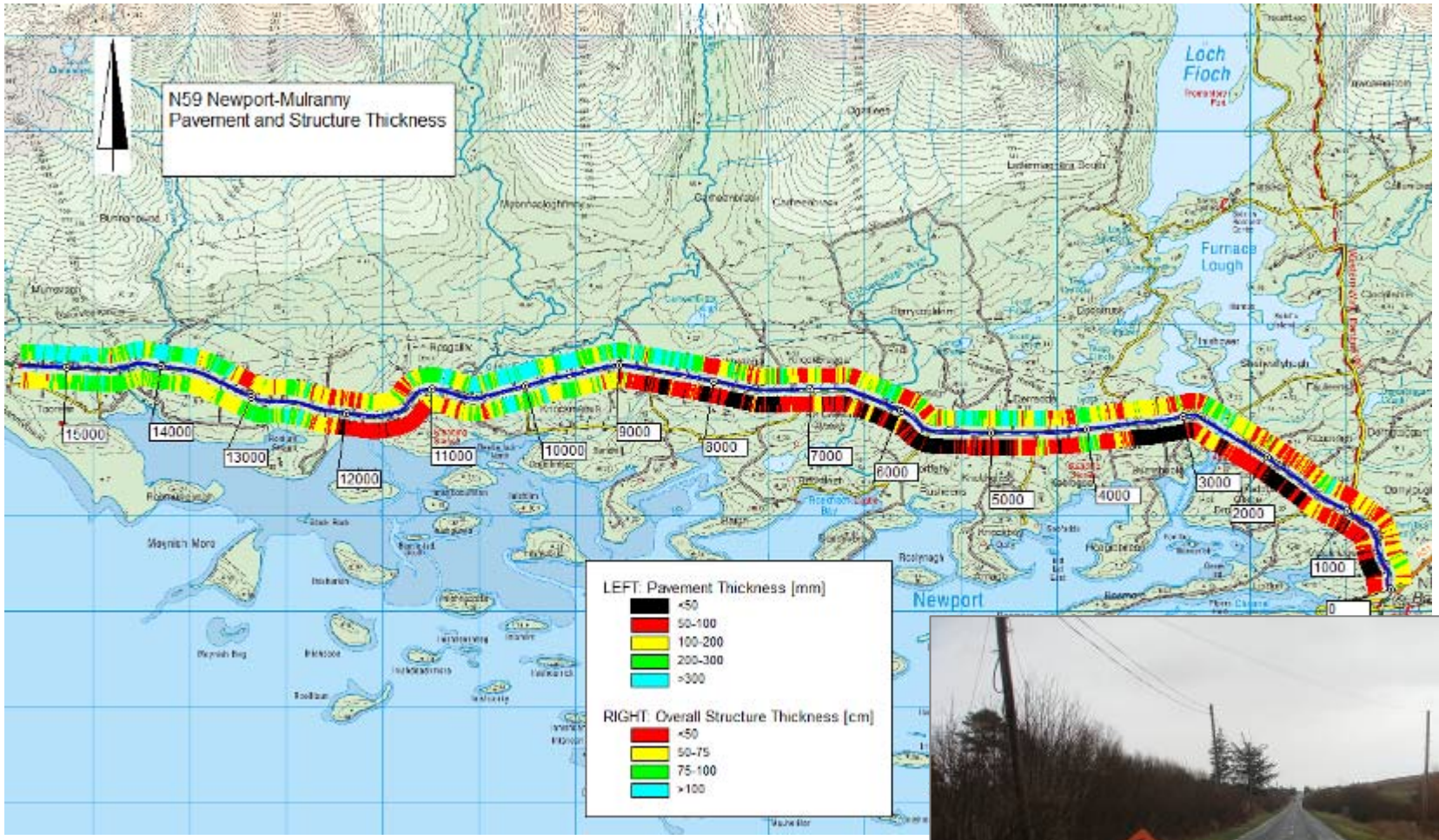
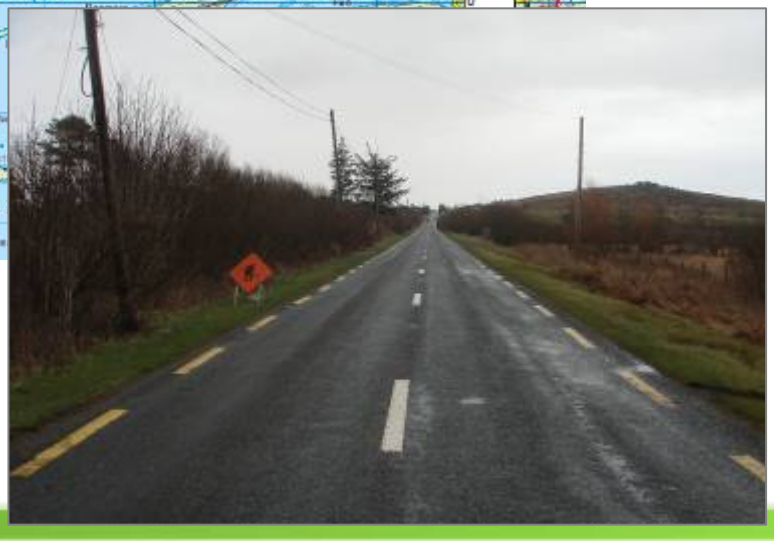
Example: N59 Newport – Mulranny





PAVEMENT AND STRUCTURE DEPTHS
N59 Newport to Mulranny
County Mayo

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Example: N59 Newport – Mulranny

GIS map of SOFT SUBGRADE areas
N59 Newport to Mulranny
County Mayo

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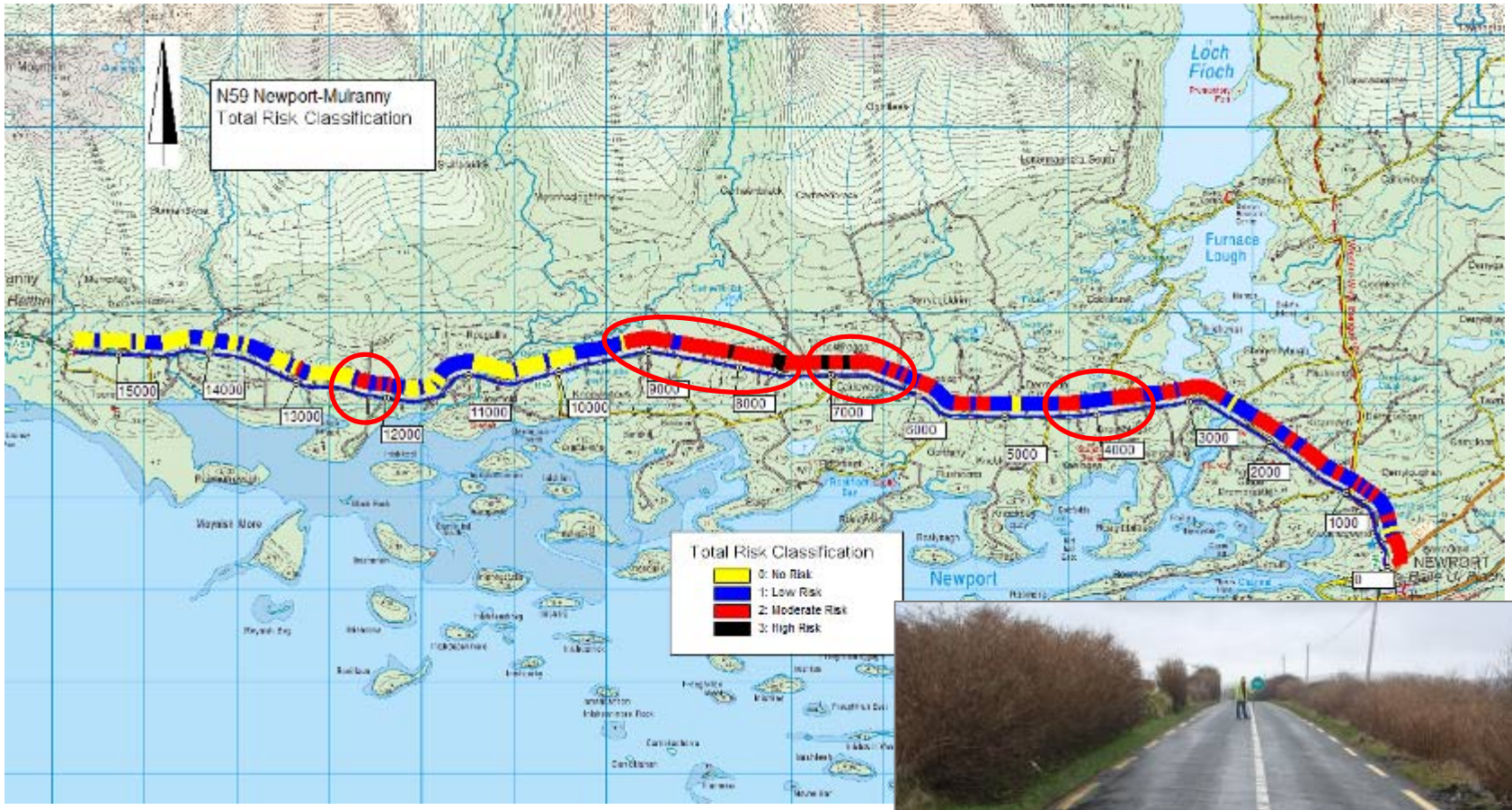
N59 Newport – Mulranny



TOTAL RISK CLASSIFICATION
N59 Newport to Mulranny
County Mayo

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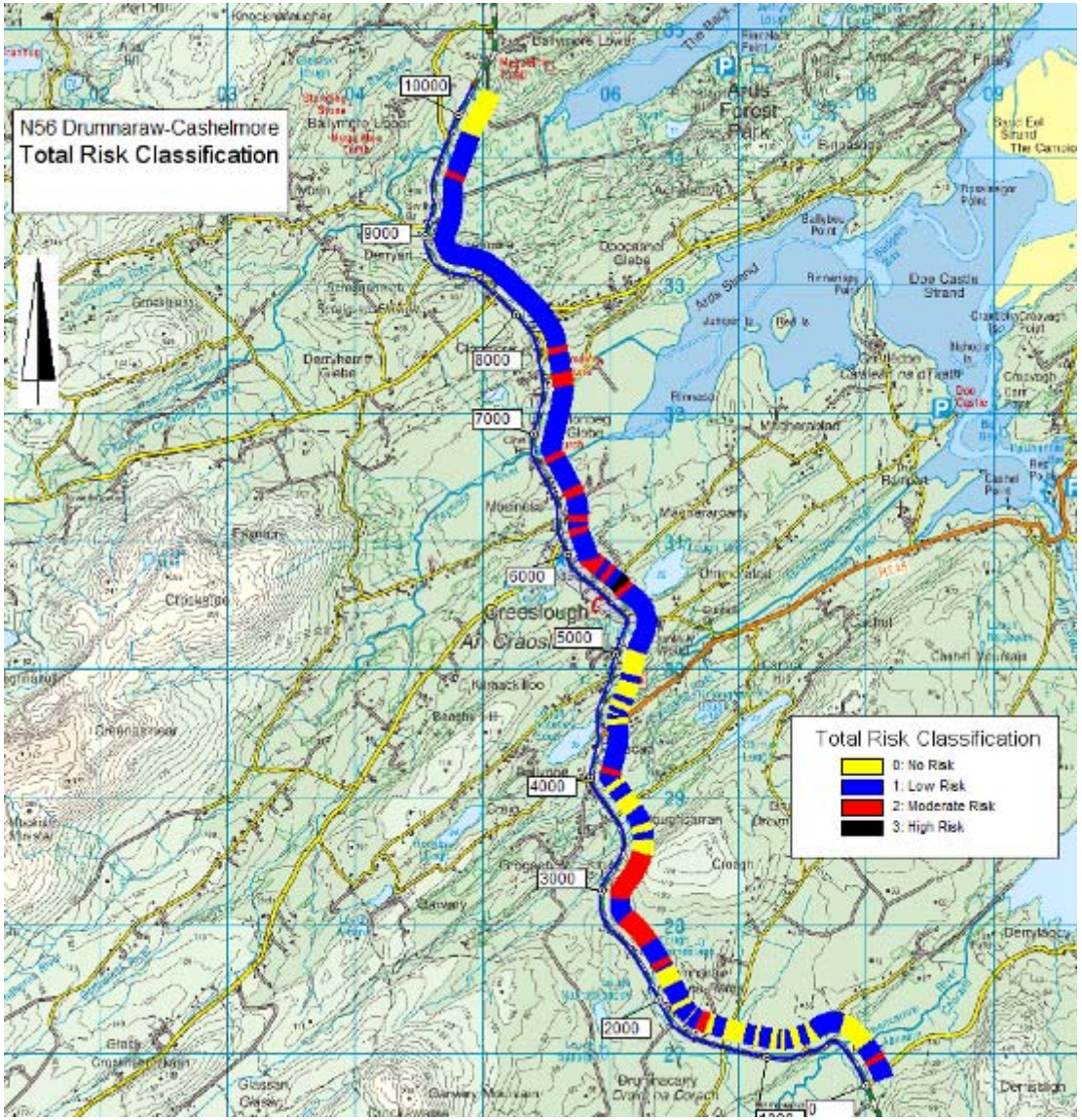
N56 Drumnaraw to Cashelmore

TOTAL RISK CLASSIFICATION
N56 Drumnaraw to Cashelmore
County Donegal



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Today:

ROADEX workshop 27 October 2011

- Presentation of survey results
- Discussion
- Agree a way forward
- Report

Haraldur

D5 Roads on Peat

ROADEX workshop,

27 October 2011,

The Landmark Hotel, Carrick-on-Shannon

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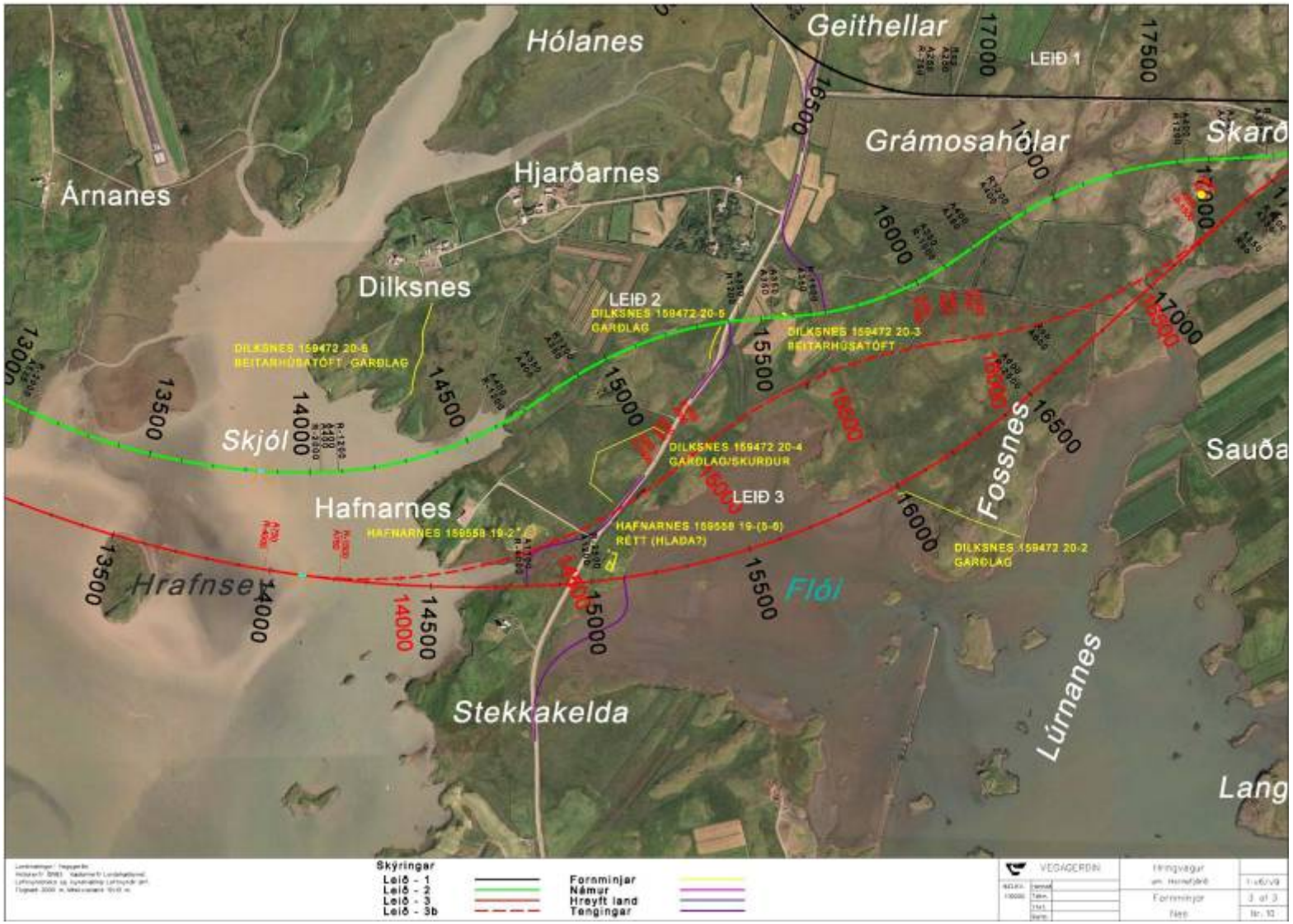
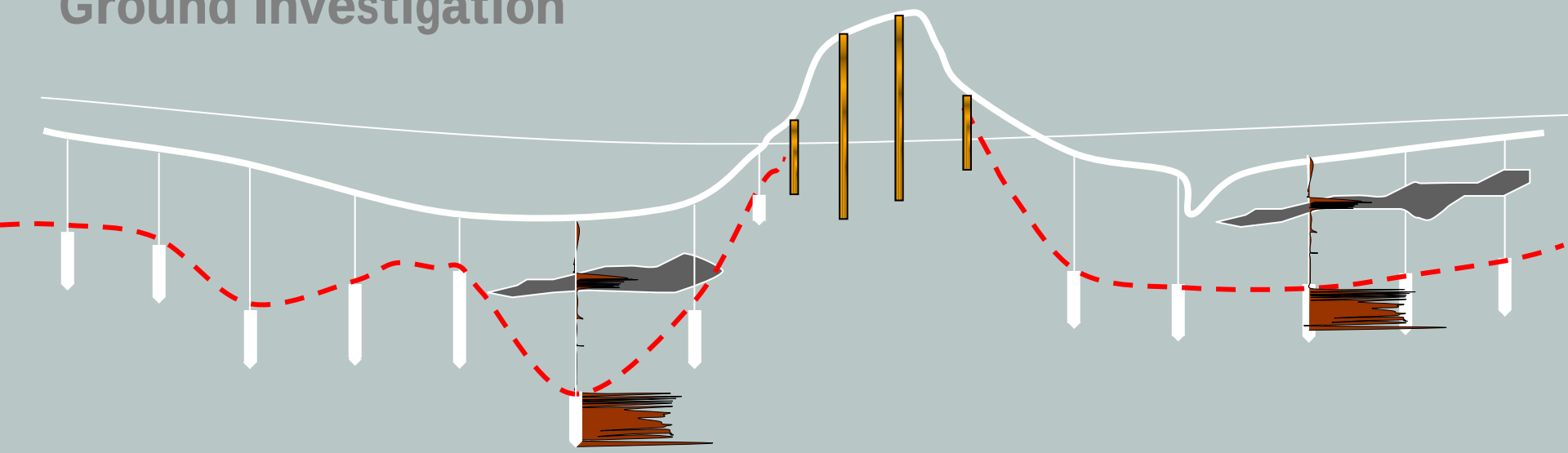
Site investigation



Site investigation

Roads on Peat:

Ground Investigation

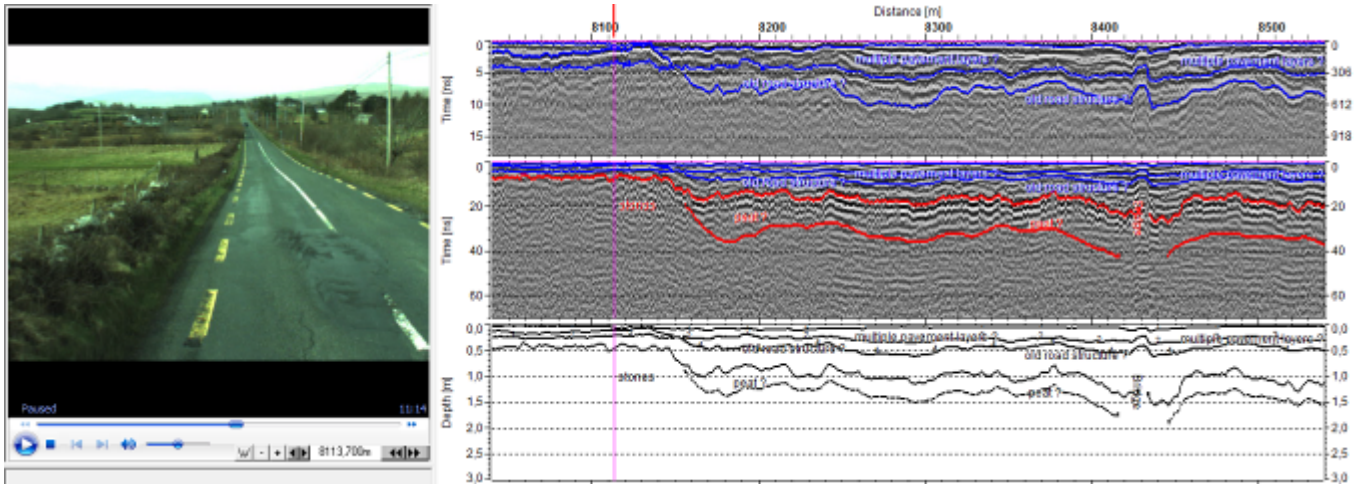


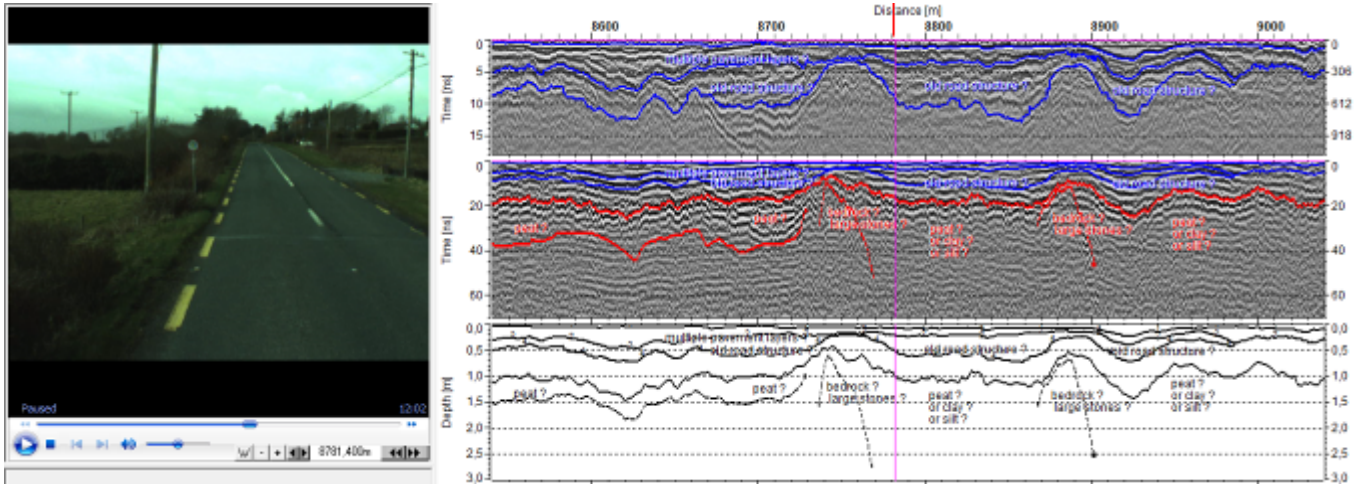
Boreholes are normaly driven at 20 m intervals in peat areas

Drilling carried out using rotation and penetration at constant speed.

The force needed to push the probe down is logged.

Roads on Peat

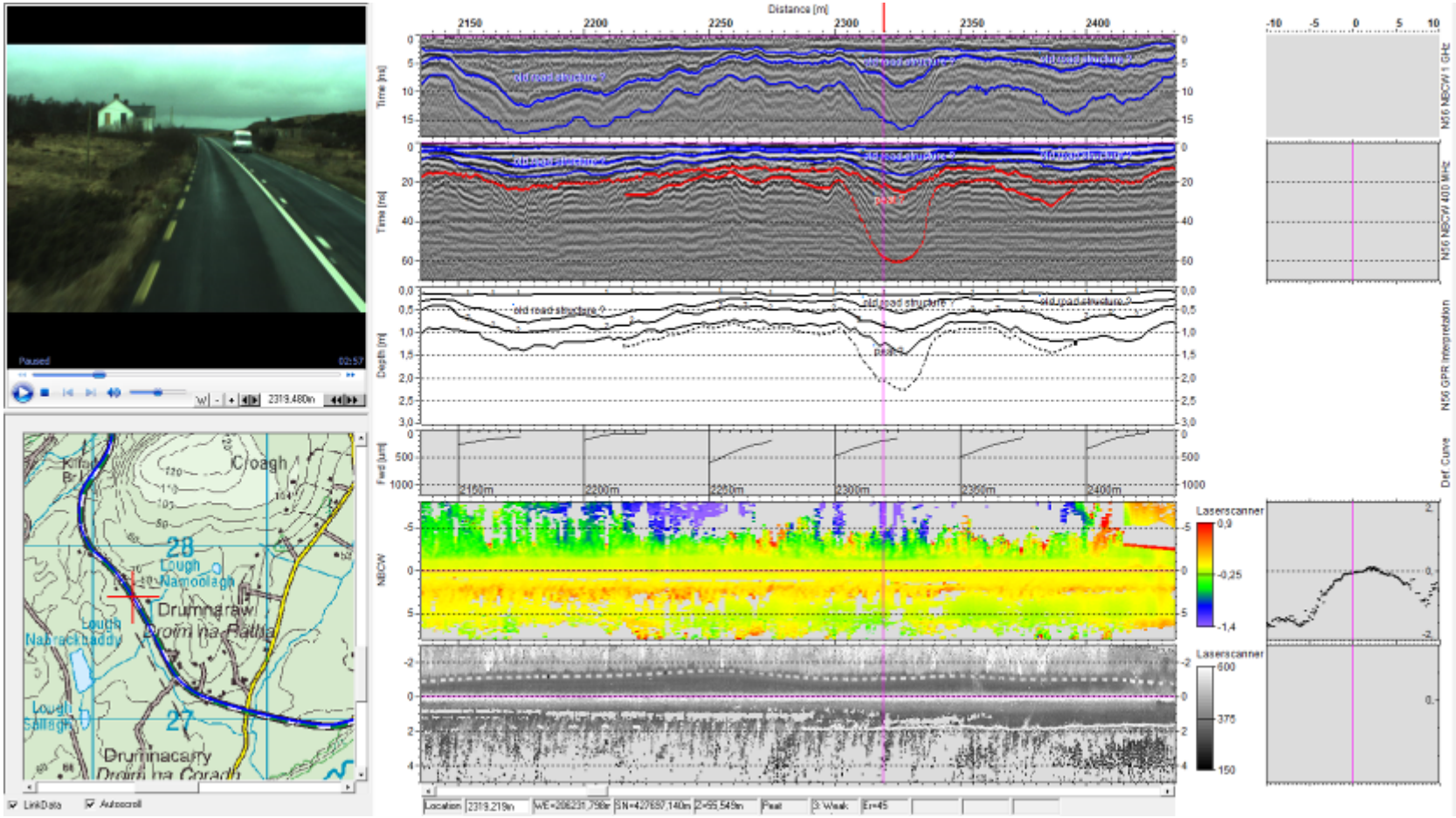




N59 Mayo, 700m section of road on peat from 8150 to 8730

in the field

Roads on Peat

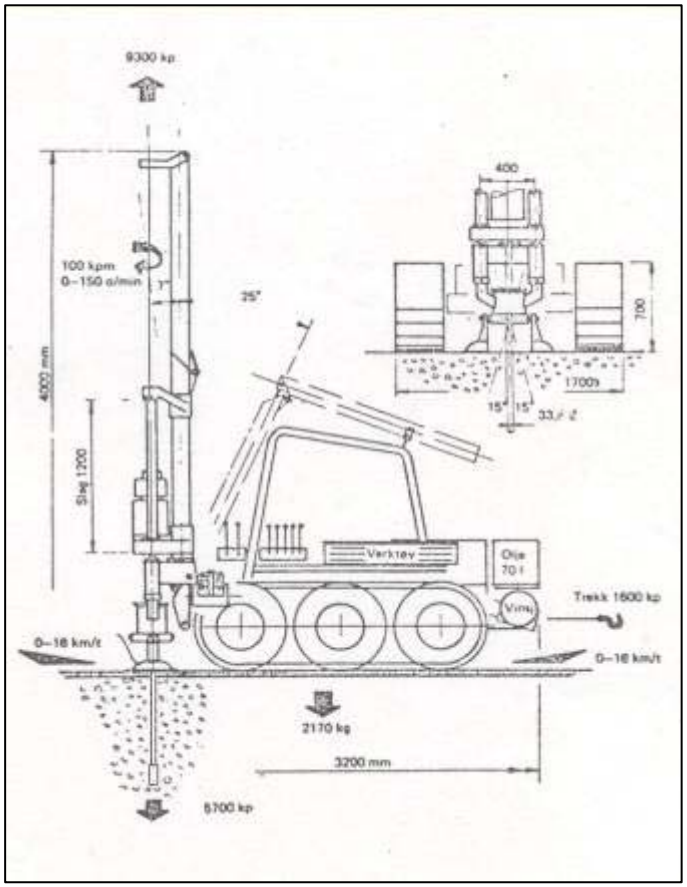


N56 Donegal, pocket of peat at Drumnaraw

and more, much more of something

Roads on Peat:

Ground Investigation - survey vehicle



3m/min

25revs/ min

New Geothnical drillrig

Tenders documents were opened 25th of Oktober

New Geothnical drillrig

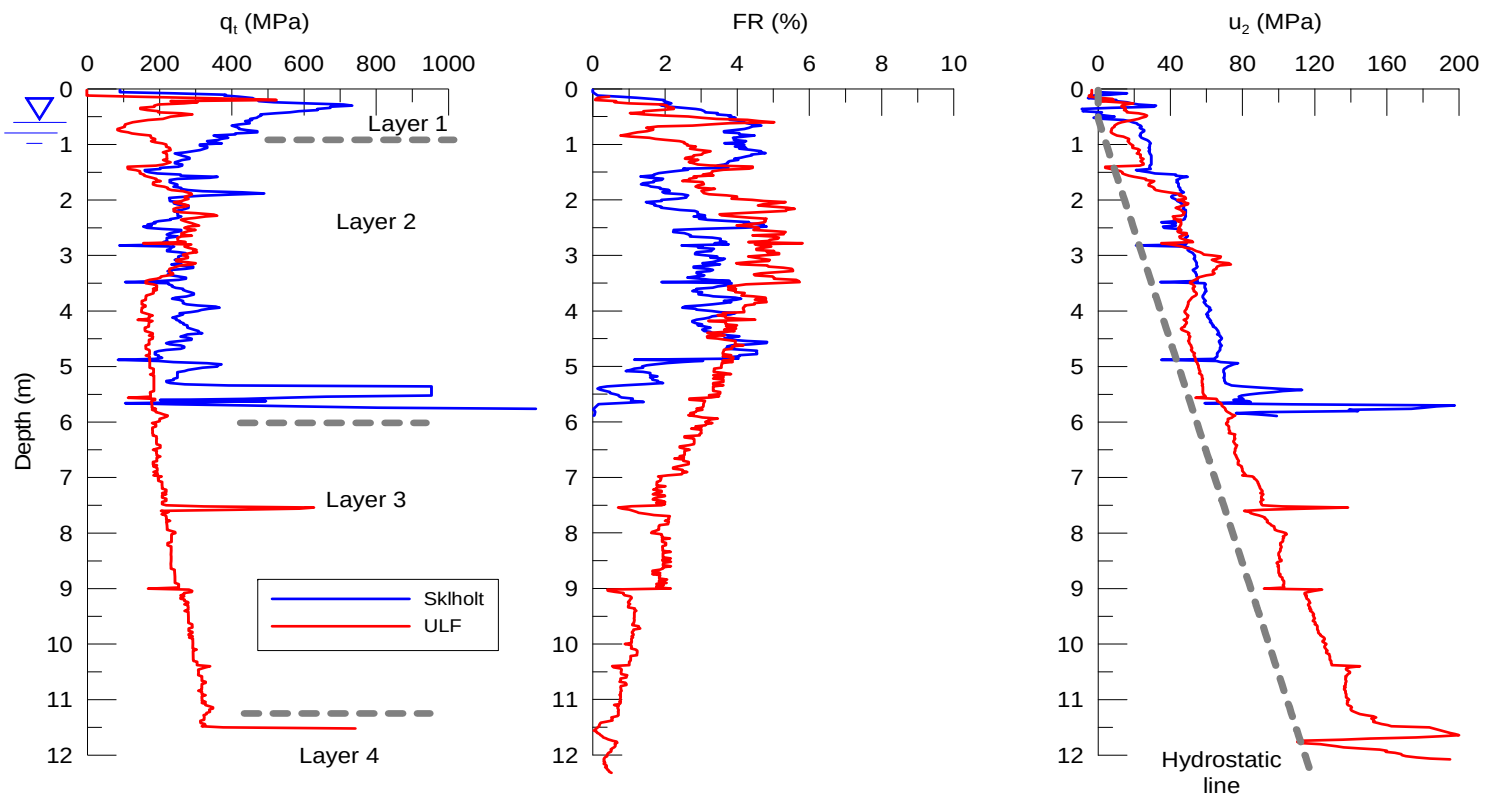
New Geothnical drillrig

The drillrig shall have at least 3 tons capacity with maximum weight 6 tons. The following reasearchs and drilling methods shall be performable by the drillrig:

- Rotary/pressure drilling in soft soil (n. Dreietrykksondering).
- Cone Penetration Testing CPT
- Sampling with 54 og 76 mm Piston samplers
- Dynamik sounding (Swedish standard)
- Georock drilling, (n. Geosondering)
- Total soil/rock drilling, (n. Totalsondering), combinations drilling in soft soil and hard rock.

CPT drilling

CPT in Peat- result



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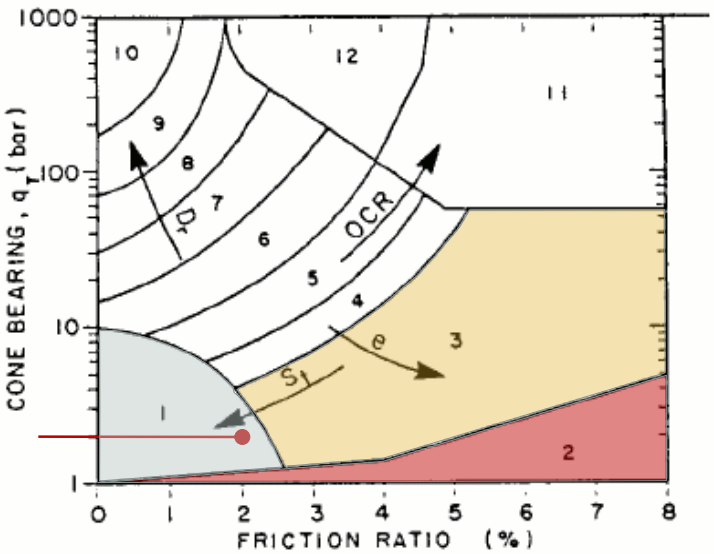
CPT – soil classification

$$q_t = q_c + u_2(1-a)$$

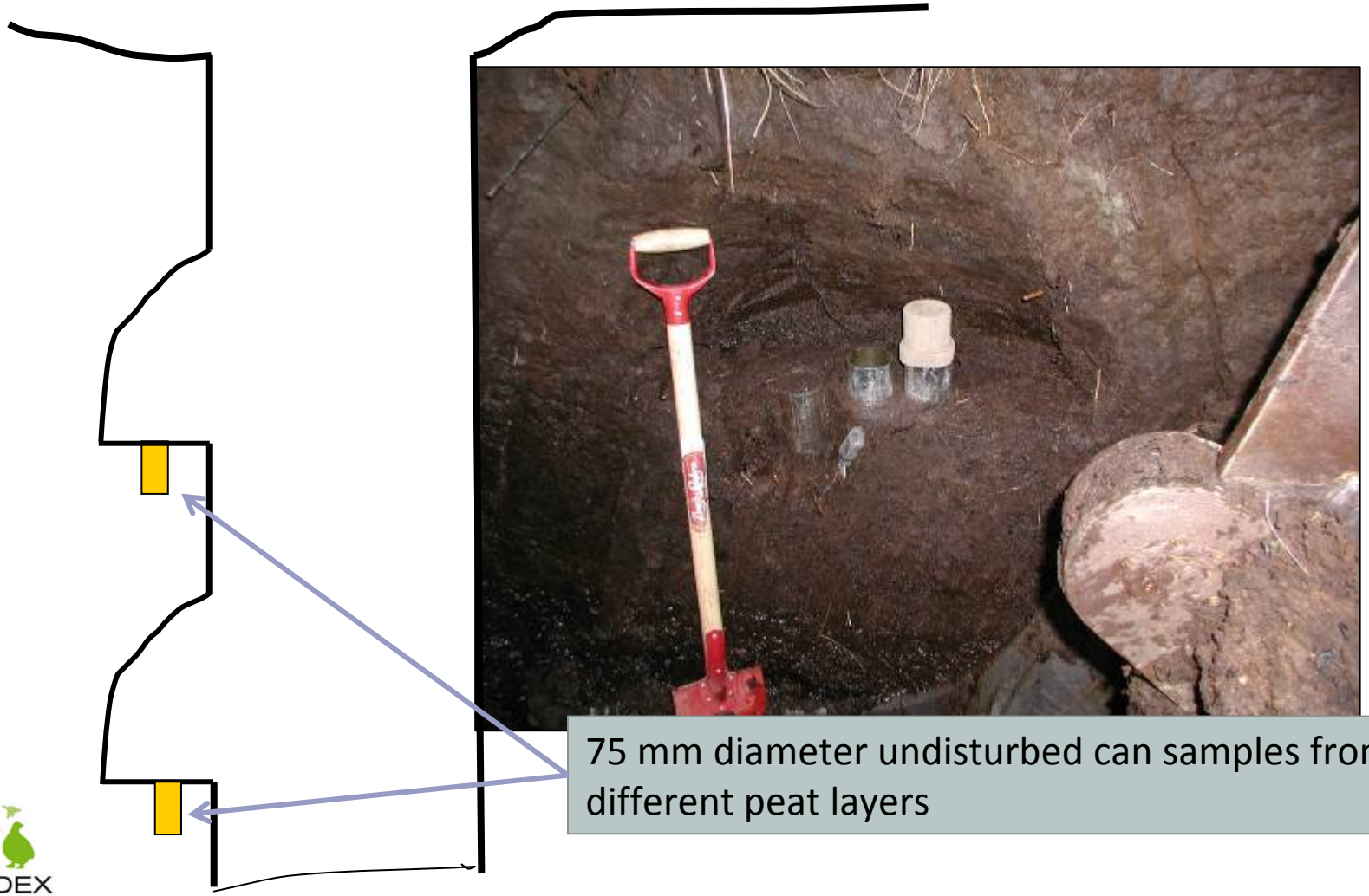


Flokkað út frá friction við borhulsu.

1. Sensitive fine-grained soil
2. Organic soil
3. Clay
4. Silty clay to clay
5. Clayey silt to silty clay
6. Sandy silt to clayey silt
7. Silty sand to sandy silt
8. Sand to silty sand
9. Sand
10. Sand to gravelly sand
11. Very stiff fine-grained soil
12. Overconsolidated or cemented sand to clayey sand

Roads on Peat:

Ground Investigation - Undisturbed peat sampling



75 mm diameter undisturbed can samples from different peat layers

Roads on peat:

Estimation of settlement – Janbu method

Settlement calculated as an elastic material, during the preconsolidation stage , Pc, as following:

$$\delta c = \int_0^H \varepsilon dz \qquad \varepsilon = \int_{P_0}^{P_0+\Delta P} \frac{\overline{\sigma}}{M} = \frac{\Delta P}{M}$$

When dealing with a virgin area:

$$\delta c \int_0^H \varepsilon dz \qquad \varepsilon = \int_{P_0}^{P_0+\Delta P} \frac{\overline{\sigma}}{m * \overline{\sigma}} = \frac{1}{m} * \ln \frac{P_0 + \Delta P}{P_0}$$

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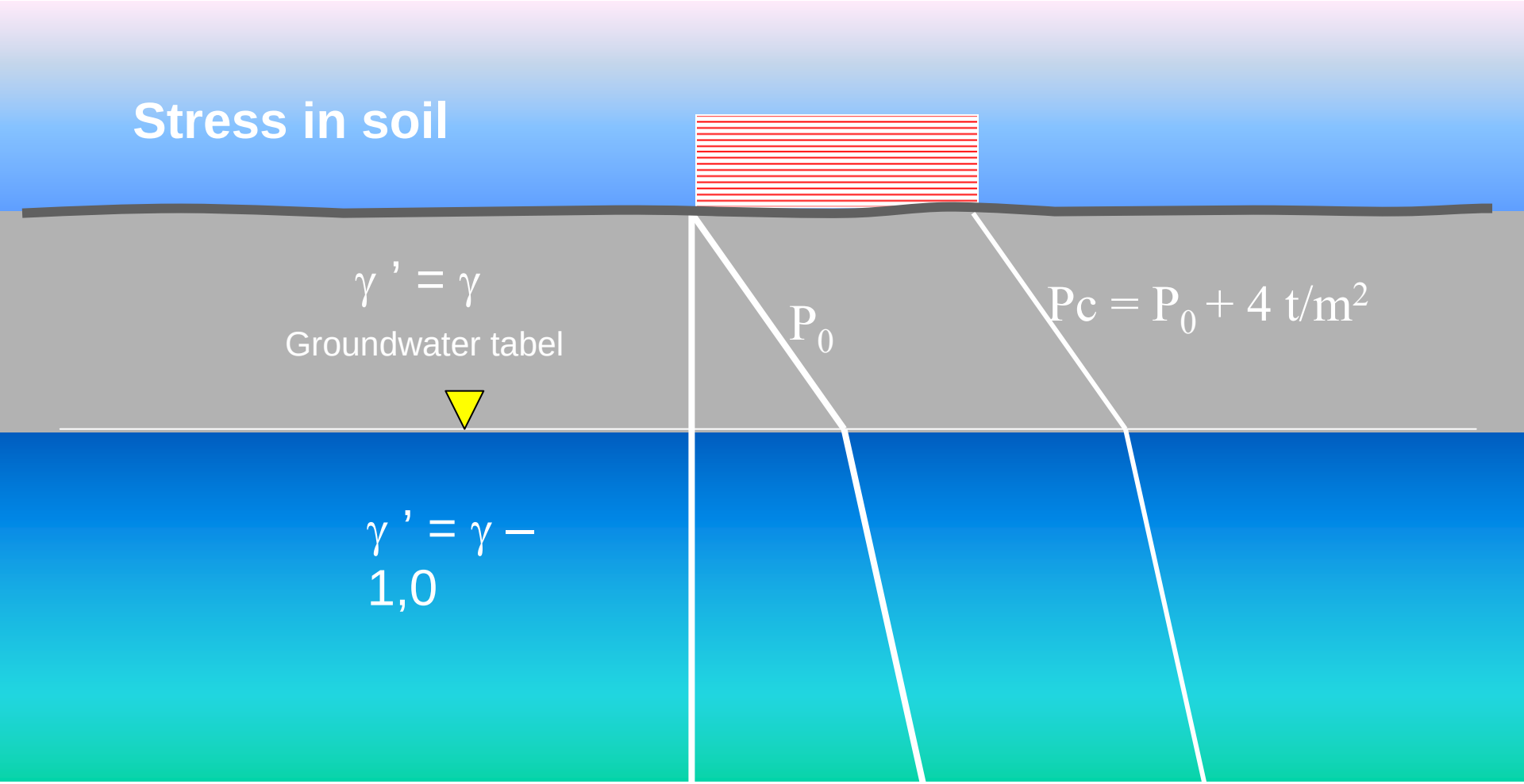
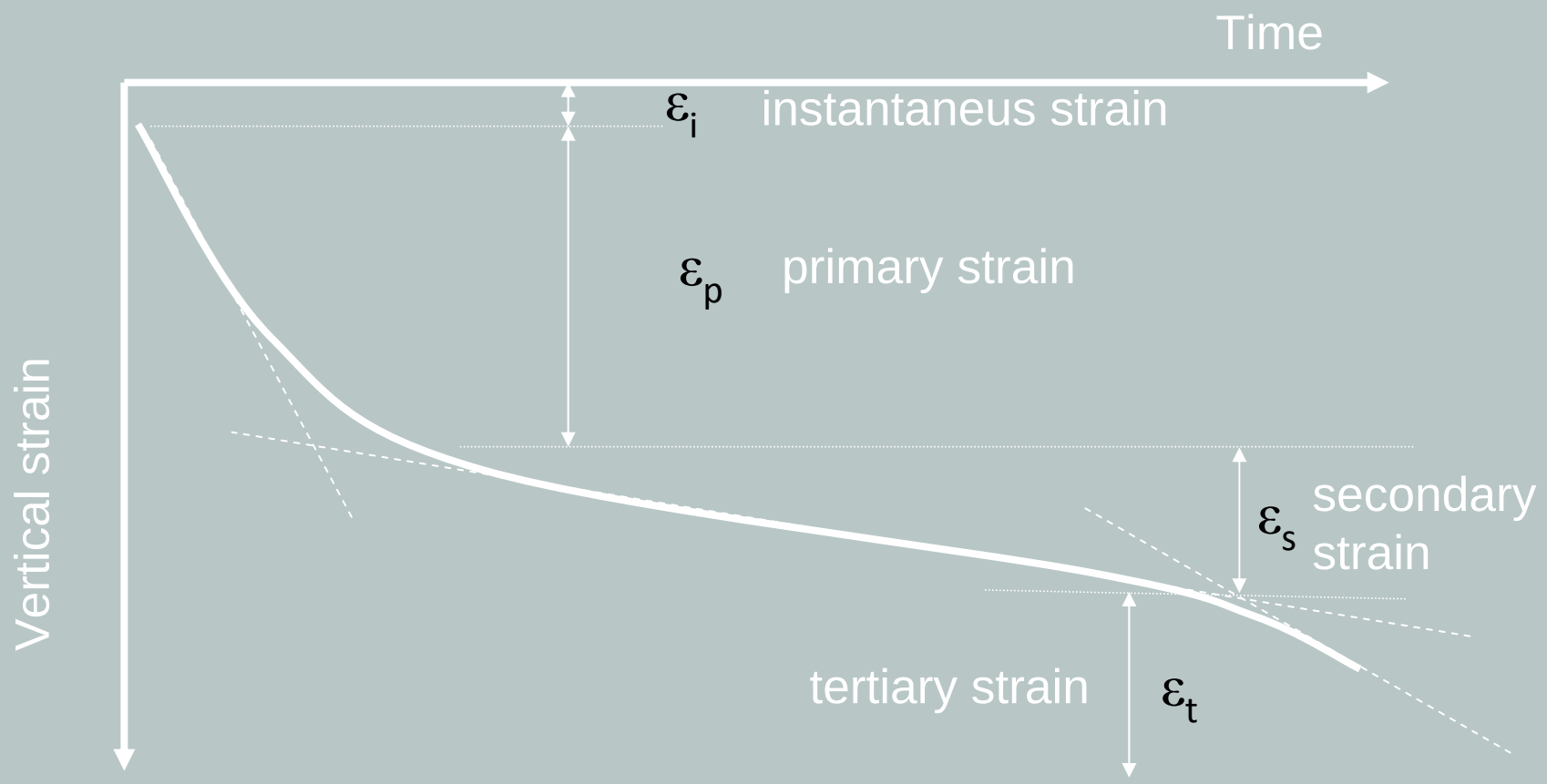
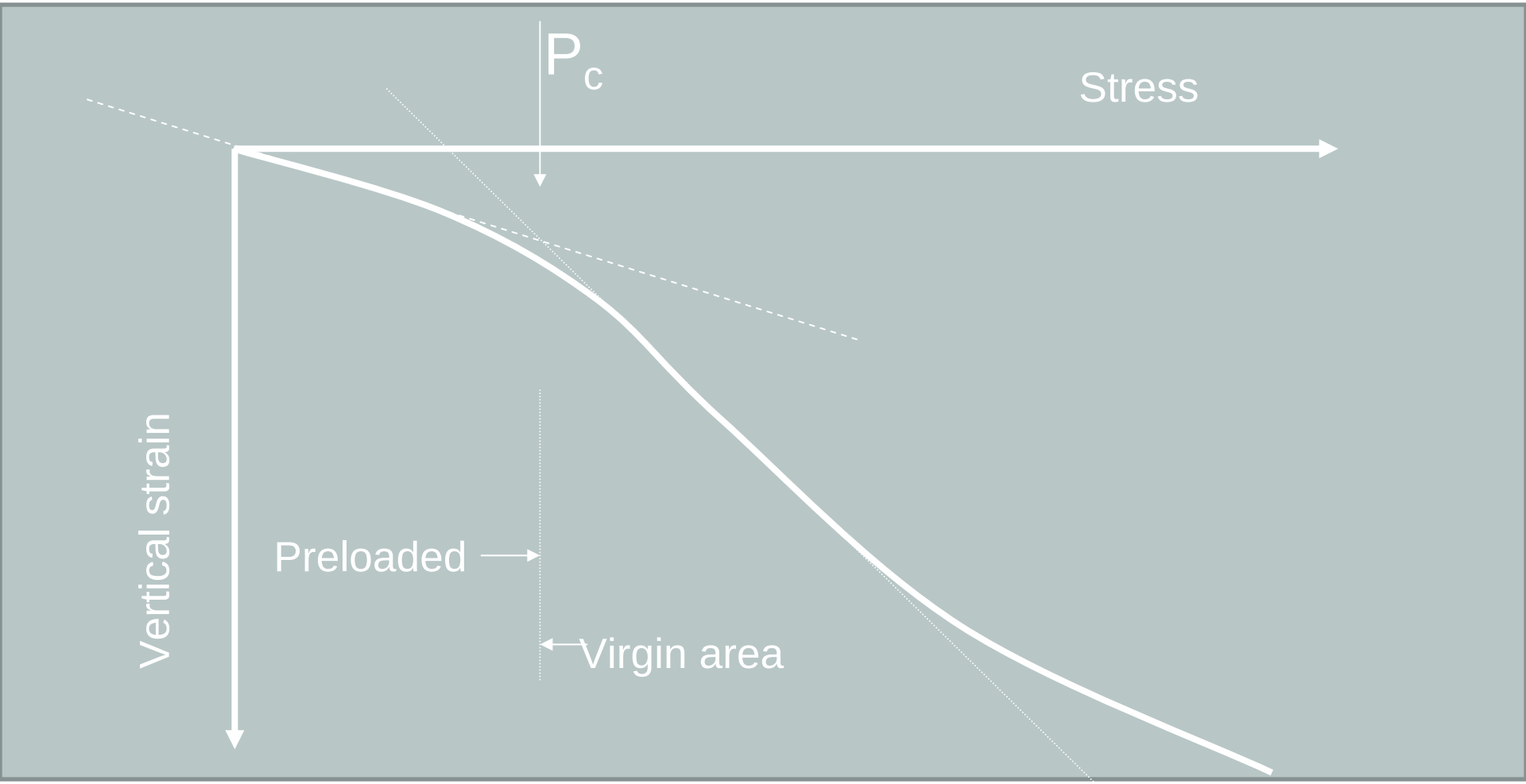
Soil properties



Consolidation Behavior of Peat

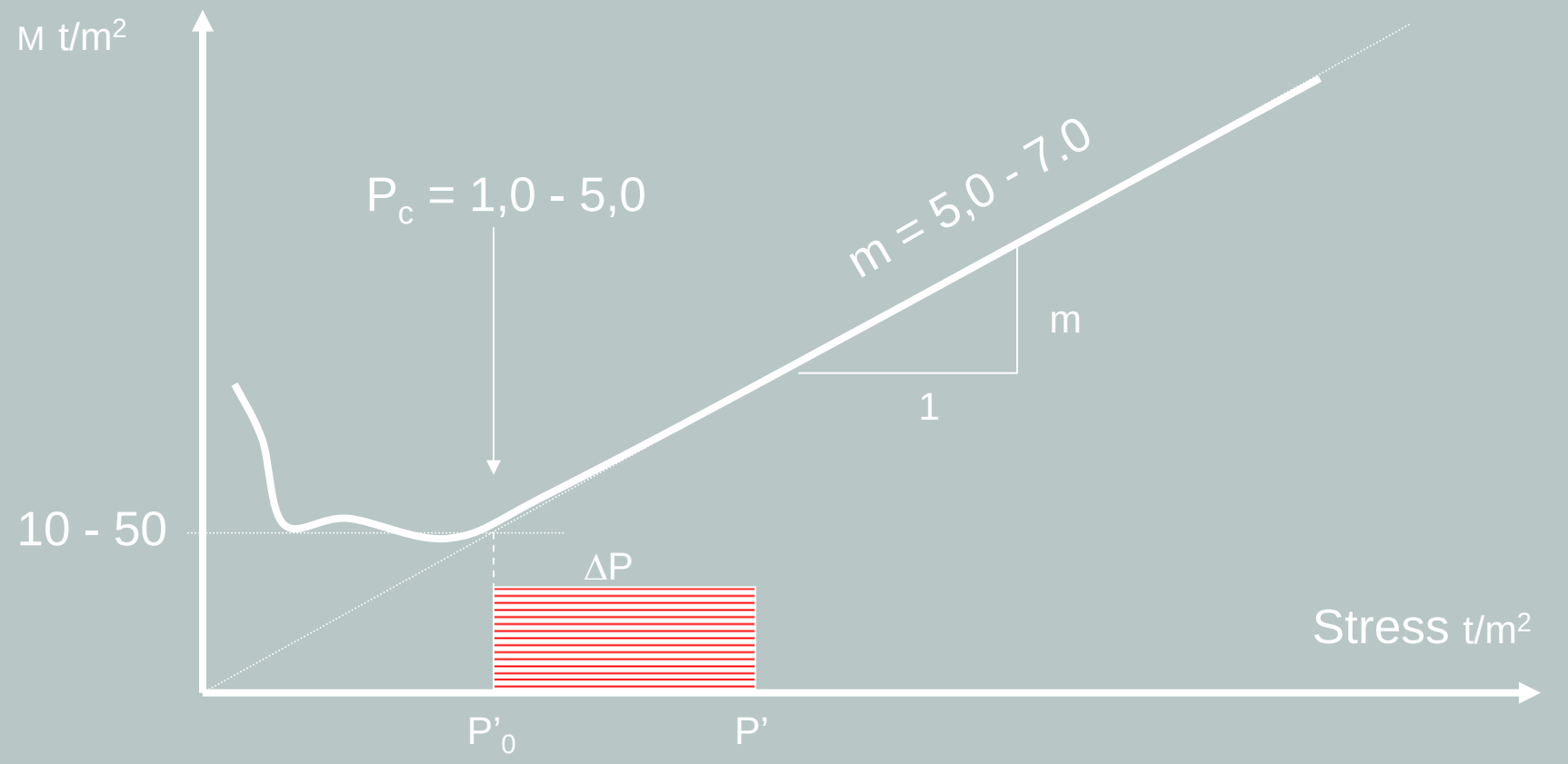


Stress – strain path



Roads on Peat:

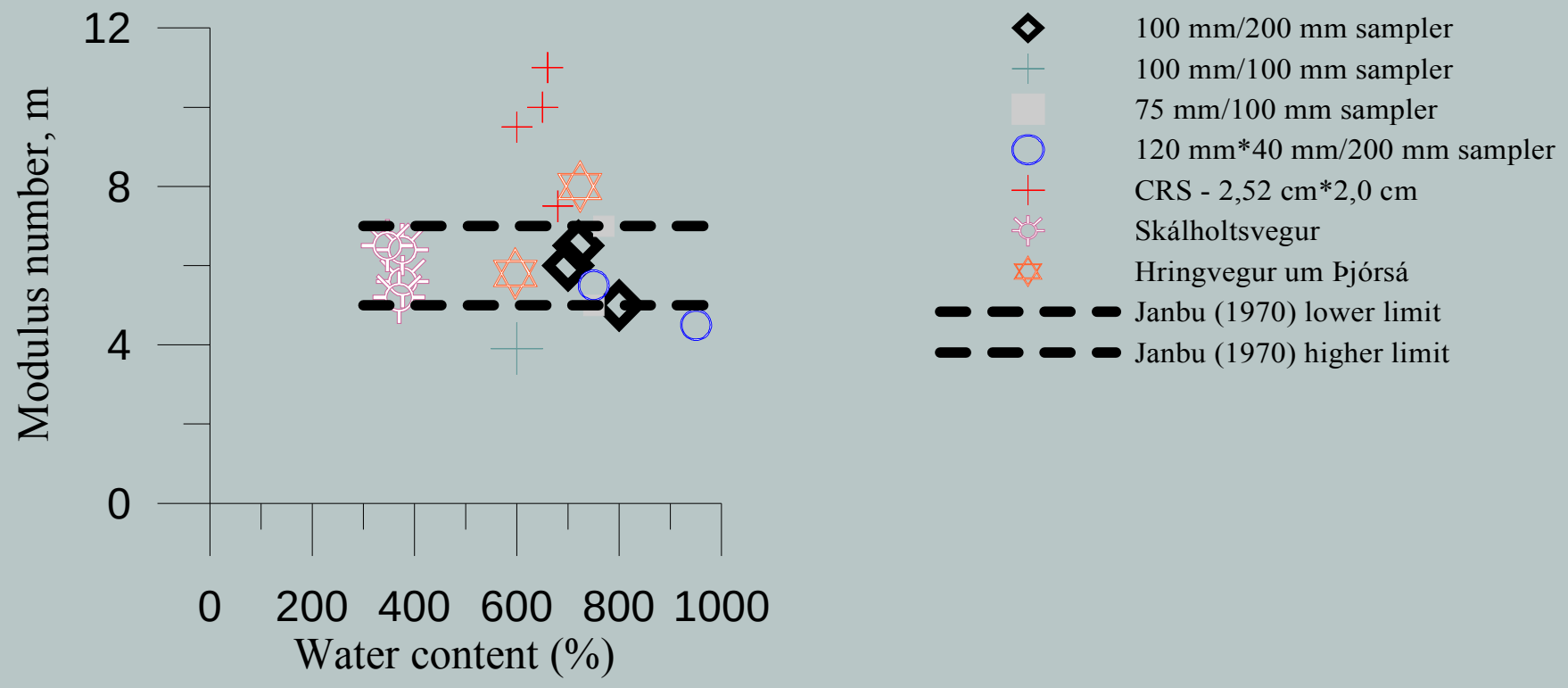
Estimation of settlement – Janbu method



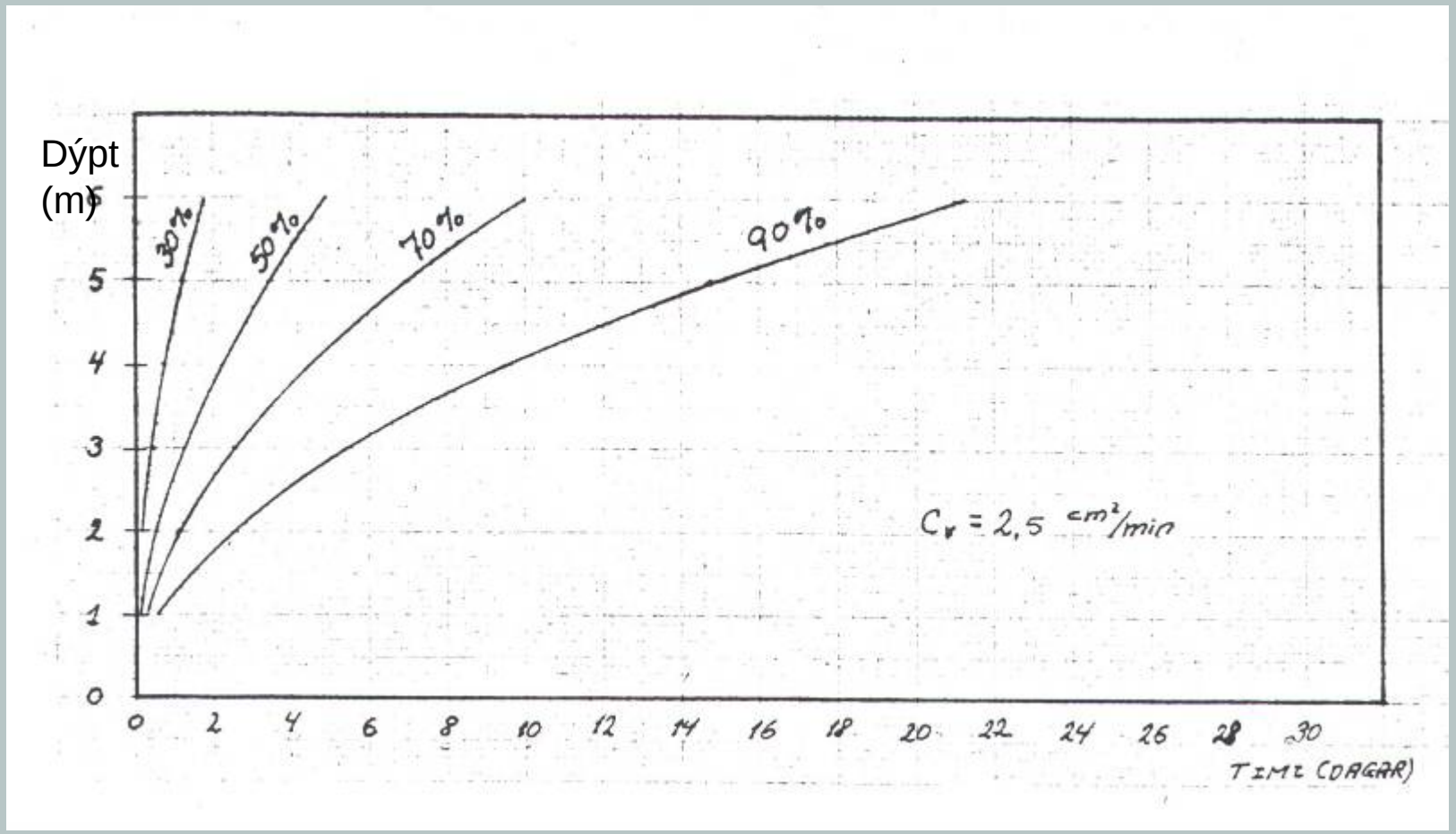
$M = d\sigma / d\varepsilon$ = Constrained modulus

m = Coefficient of volume change

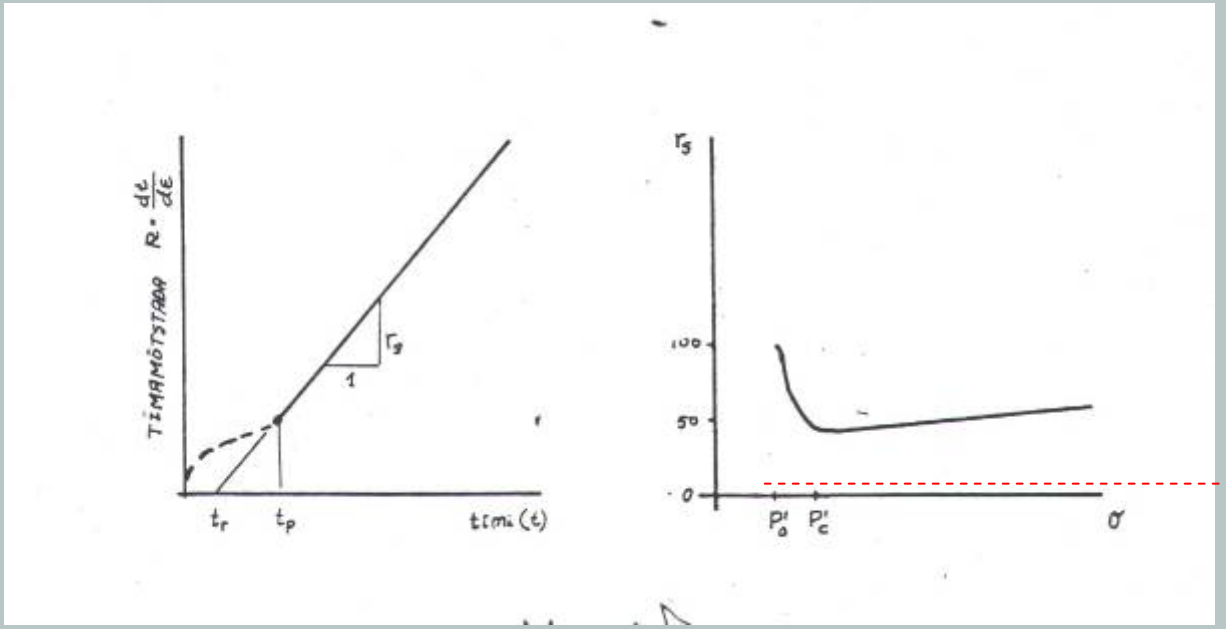
Comparison of Icelandic and Irish peat



Calculation of settelment time



Settelment – time resistant



Forsenda reikninganna er tímamótsstaðan R, sem fall af tíma.

Tímamótstöðutalan r_s breytist línulega en lítið eftir að álagið er komið yfir á jómfrúarsvæðið og því er valin ein tala fyrir langtímasigið.

Calculation of settelment time

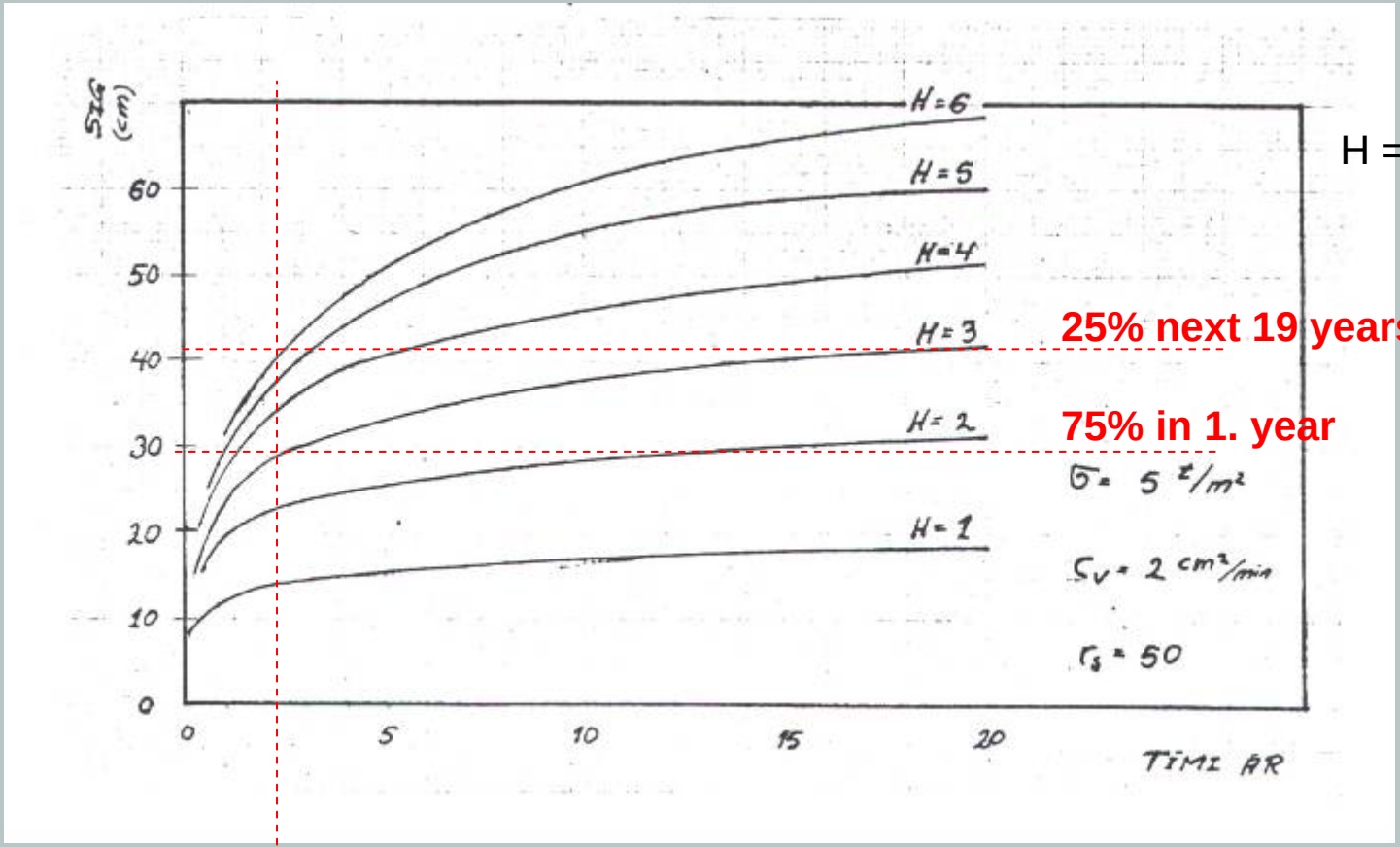
Sigtíminn ákvarðast af lekt, lektarleið og spennuástandi mýrarinnar. Lekt mýrarinnar er ákveðin með mælingum í ödometer og konsolideringstíminn, t_k, síðan reiknaður þannig:

$$t_k = T_p * \frac{D^2}{C_v} \qquad U_p = \frac{\delta_t}{\delta_{t100}}$$

Up = konsolideringsgráðan gefur sigið á einhverjum ákveðnum tíma, ***t***, í hlutfalli við sigið fyrir tímann t_{100}

Í sigreikningum er yfirleitt reiknaður tíminn fyrir 30 - 50 - 70 og 90% af skammtímasiginu.

Secondary settelment

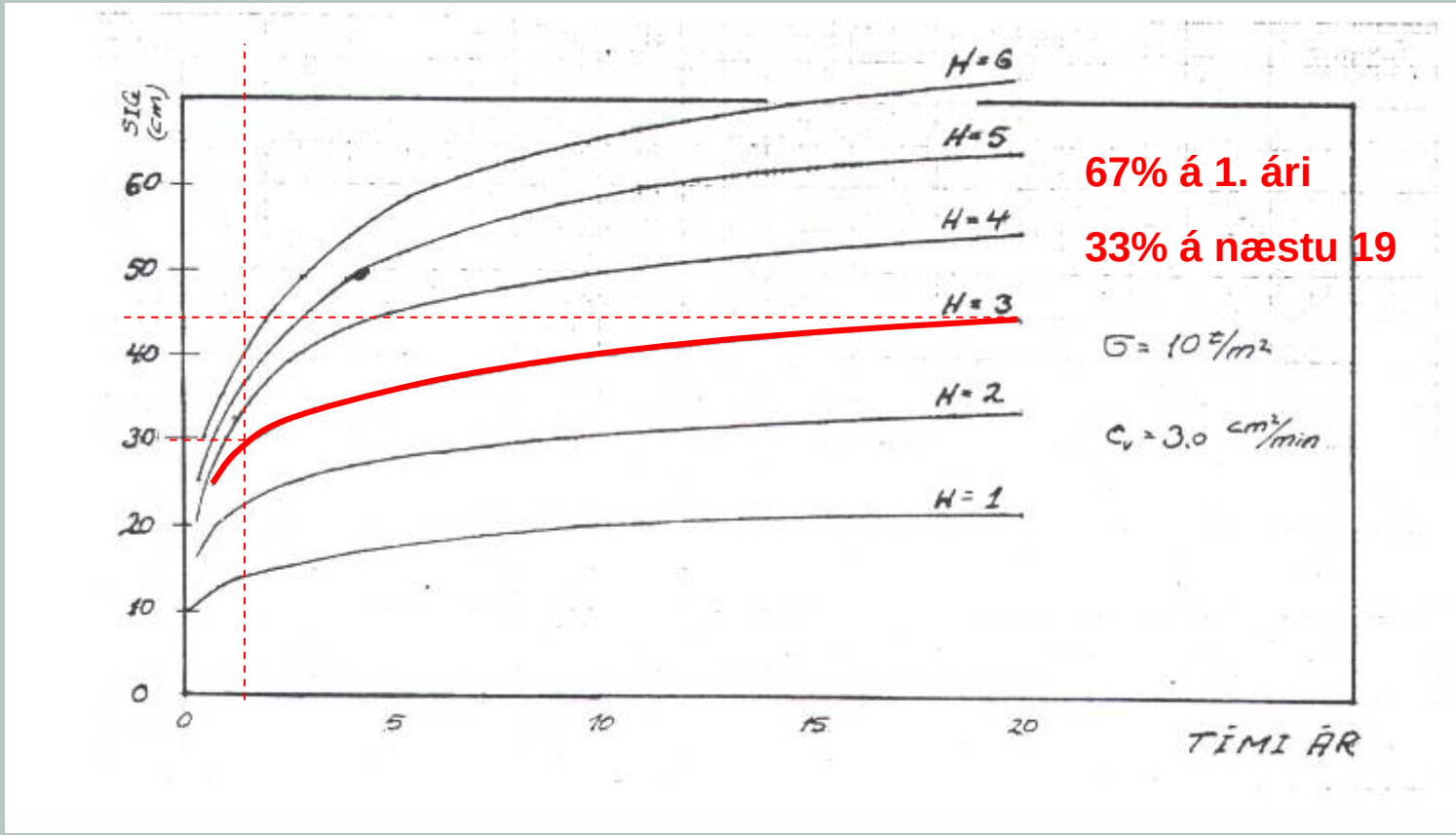


H = mýrardýpt

25% next 19 years

75% in 1. year

Secondary settelment



Sig vegfyllingar - tími

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Roads on Peat:

Predicted settlement summary table

Road section

510-01 Borgarfjarðarbraut to Vatnshamraleið

Section M	Fill depth m	Peat depth m	Primary consolid m	Secondary compress m	Total settlement m	Preload m	Area m2	Volume m3	Cosolidation time in days 30%	50%	70%	90%	width increase m	Length of hose
9100	0.98	0.80	0.11	0.11	0.22	0.11	1.87	37.49	0.0	0.1	0.2	0.4	0.08	9.4
9120	2.32	1.40	0.40	0.15	0.55	0.20	6.02	120.41	0.1	0.3	0.5	1.2	0.30	13.5
9140	3.27	1.70	0.59	0.16	0.74	0.25	9.56	191.16	0.1	0.4	0.8	1.7	0.44	16.3
9160	2.77	1.50	0.47	0.15	0.62	0.21	7.40	148.06	0.1	0.3	0.6	1.3	0.35	14.8
9180	2.02	1.50	0.40	0.16	0.56	0.21	5.82	116.36	0.1	0.3	0.6	1.3	0.30	12.6
9200	2.02	1.20	0.31	0.13	0.45	0.17	4.67	93.37	0.1	0.2	0.4	0.9	0.23	12.6
9220	1.64	1.60	0.37	0.17	0.55	0.21	5.32	106.38	0.1	0.4	0.7	1.5	0.28	11.4
9240	1.69	2.90	0.77	0.26	1.03	0.36	10.12	202.35	0.4	1.2	2.3	5.0	0.58	11.6
9260	1.75	1.70	0.42	0.18	0.60	0.23	5.90	117.99	0.1	0.4	0.8	1.7	0.32	11.7
9280	1.05	0.50	0.07	0.08	0.15	0.08	1.26	25.17	0.0	0.0	0.1	0.1	0.05	9.7
9300	2.68	2.50	0.82	0.21	1.03	0.33	12.12	242.33	0.3	0.9	1.7	3.7	0.62	14.5
9320	1.42	2.90	0.70	0.27	0.97	0.36	9.00	180.00	0.4	1.2	2.3	5.0	0.53	10.8
9340	1.52	2.60	0.64	0.25	0.89	0.33	8.39	167.82	0.3	0.9	1.9	4.0	0.48	11.1
9360	1.43	2.90	0.70	0.27	0.97	0.36	9.04	180.85	0.4	1.2	2.3	5.0	0.53	10.8
9380	1.33	2.40	0.54	0.24	0.78	0.30	7.05	141.01	0.3	0.8	1.6	3.4	0.41	10.5
9400	1.56	2.40	0.59	0.23	0.82	0.30	7.88	157.52	0.3	0.8	1.6	3.4	0.44	11.2
					0.66			6450.98						

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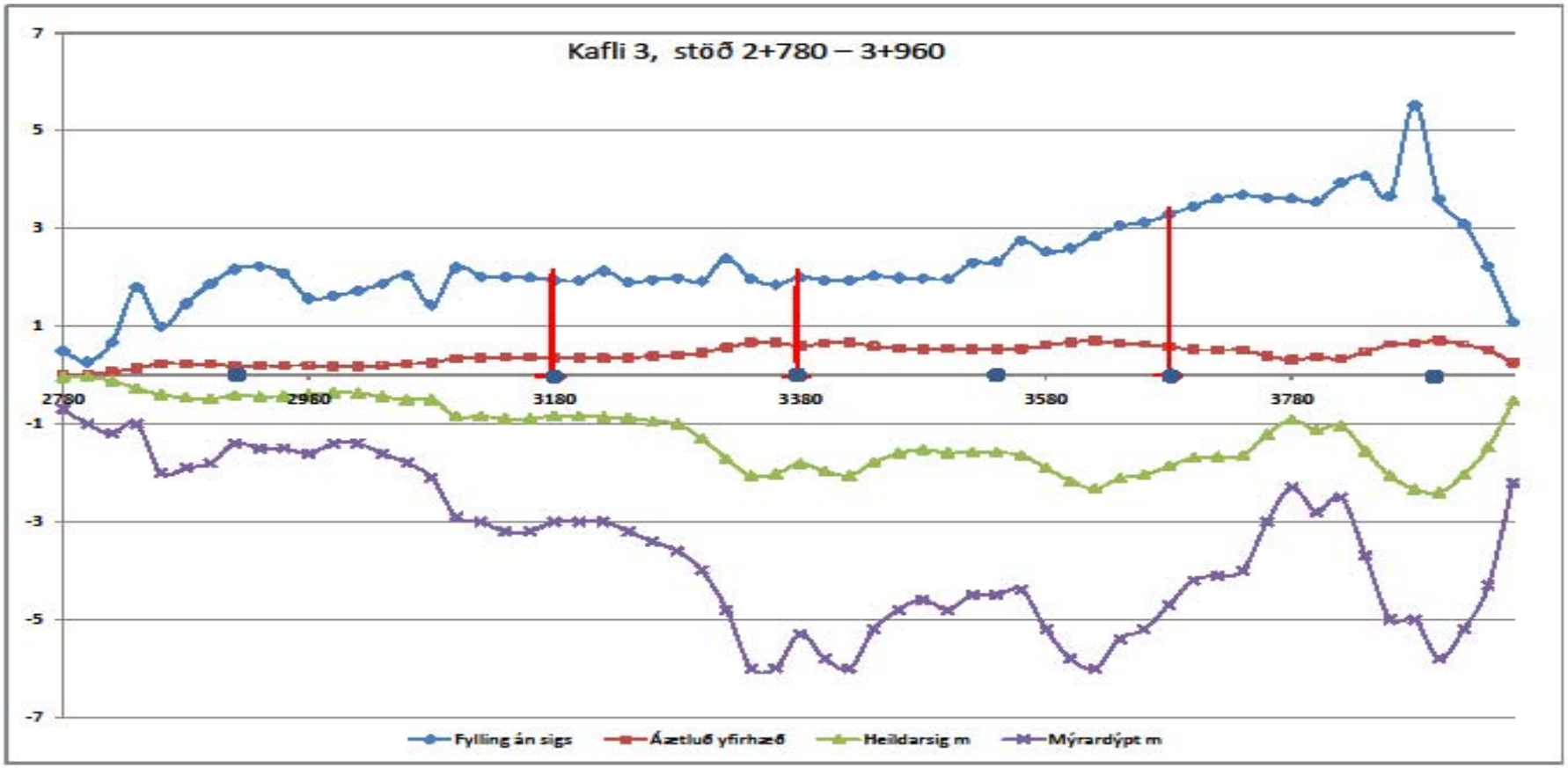
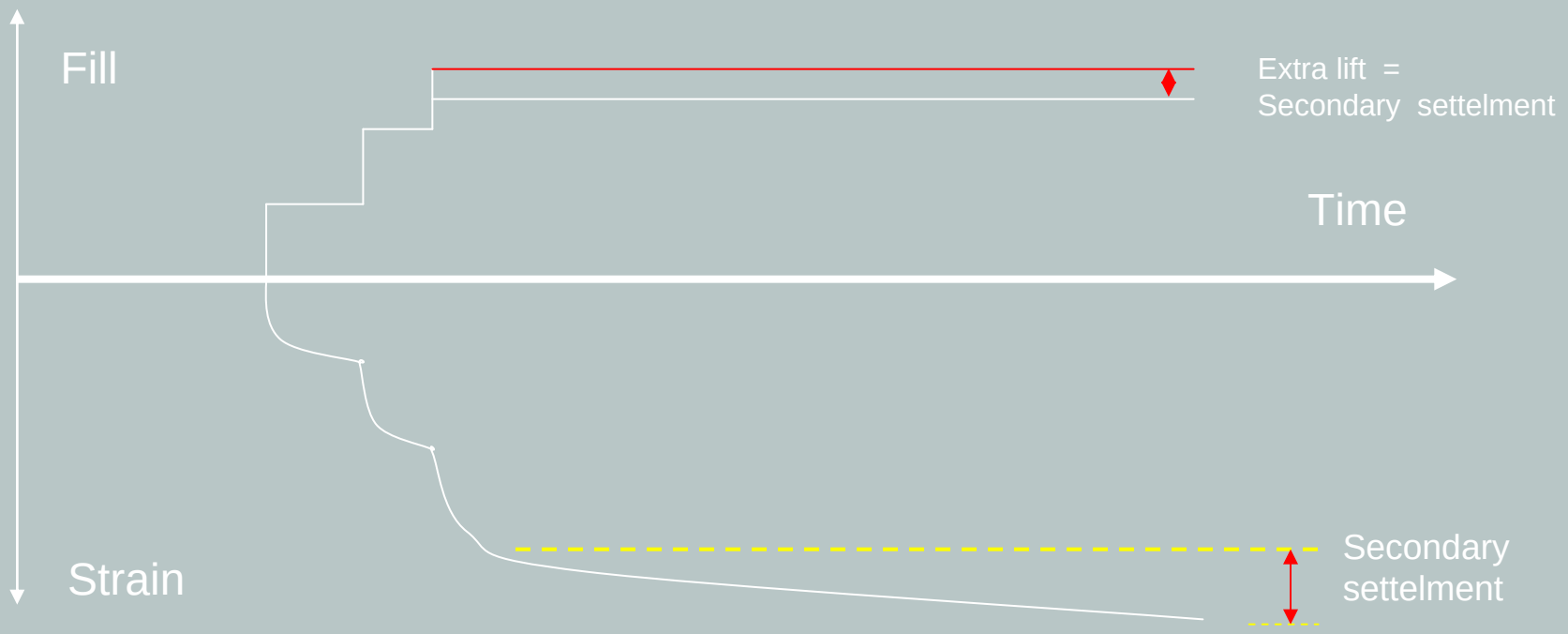
Roads on Peat:
Predicted settlement

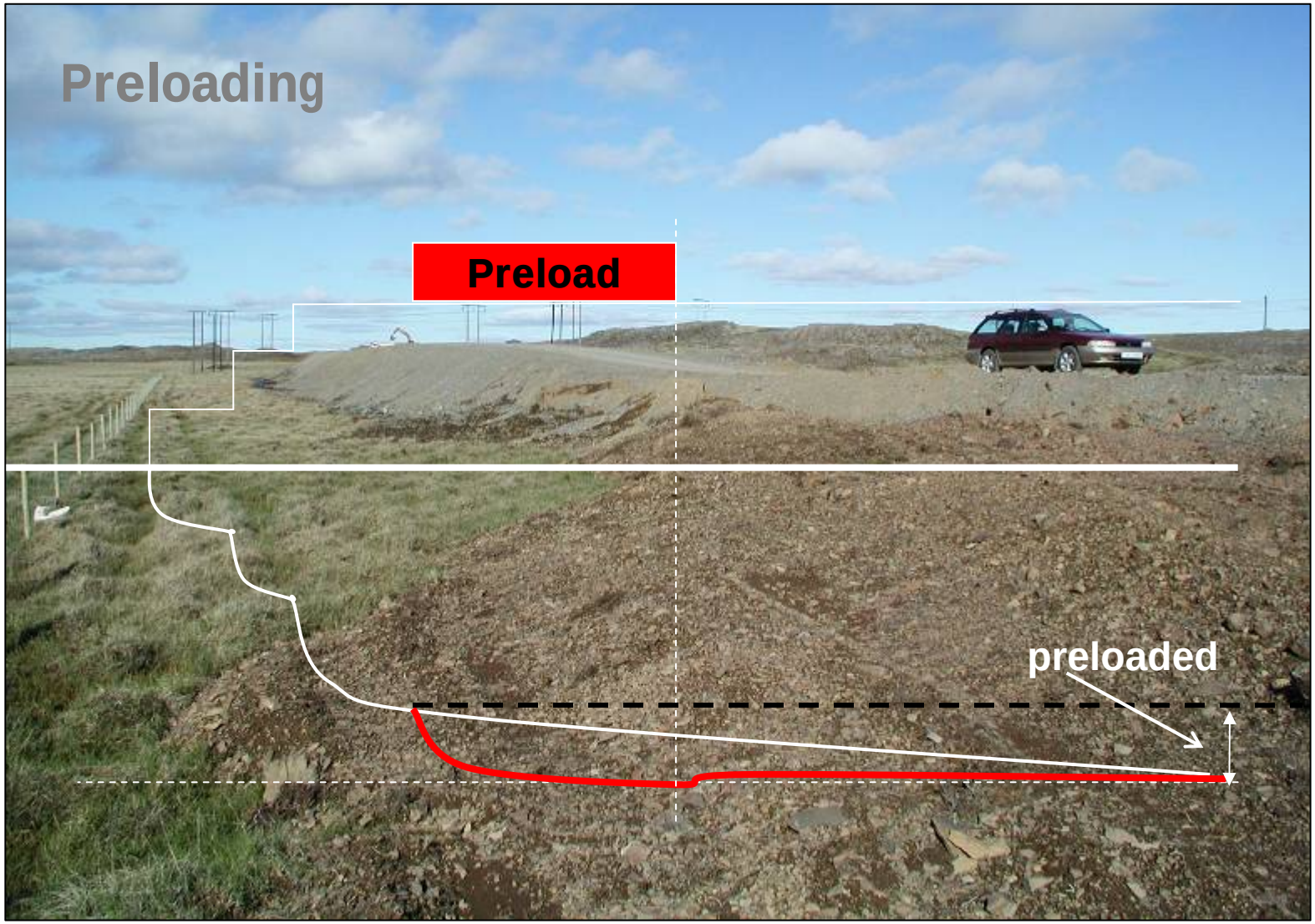


Extra lift of fill material

Due to settlement expected after the constructions period the hight of fill material should be higher than designed level. This can be equal to the secondary settelement and even also partly from the consolidations settlement.



Roads on Peat:



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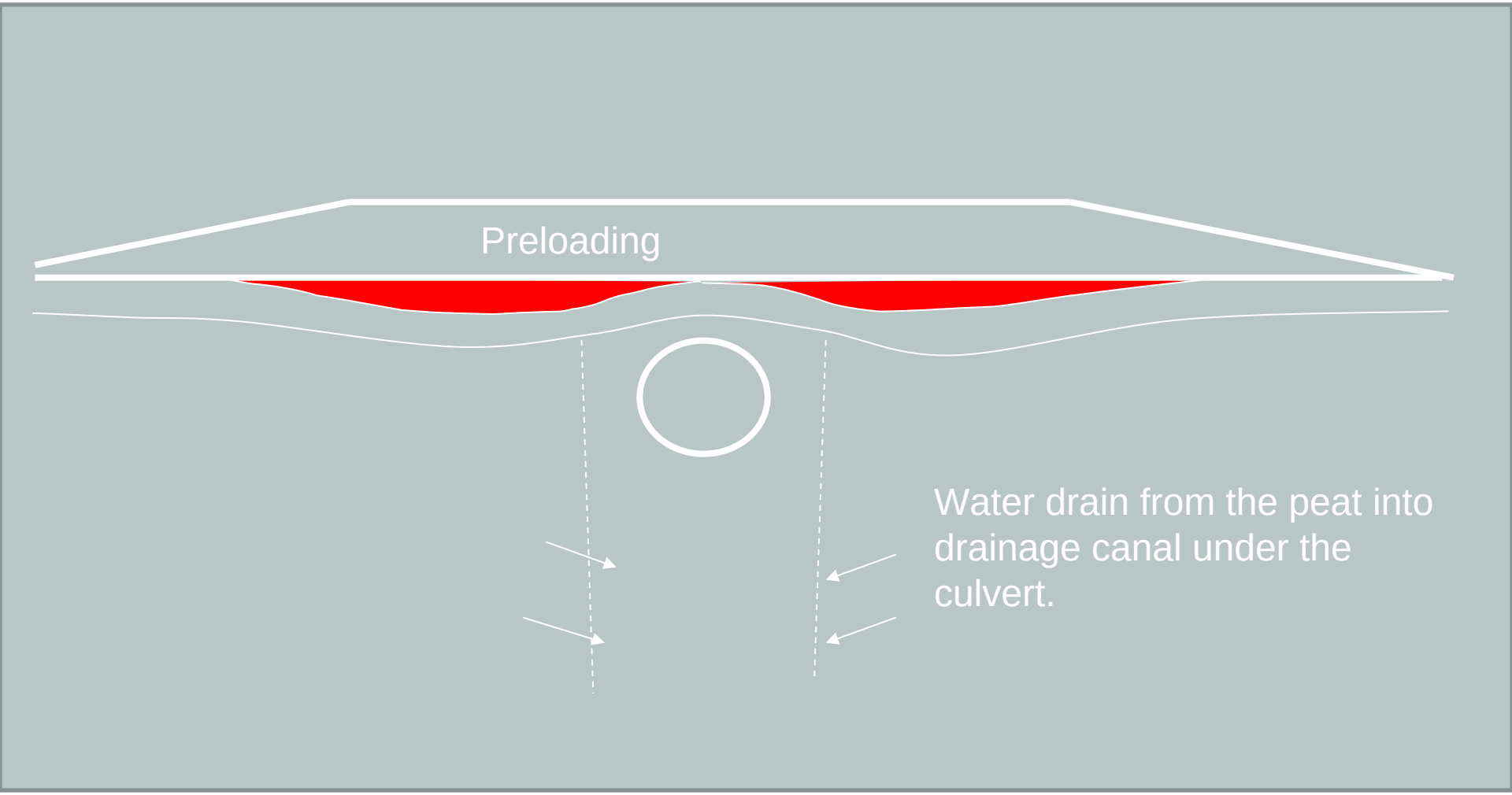
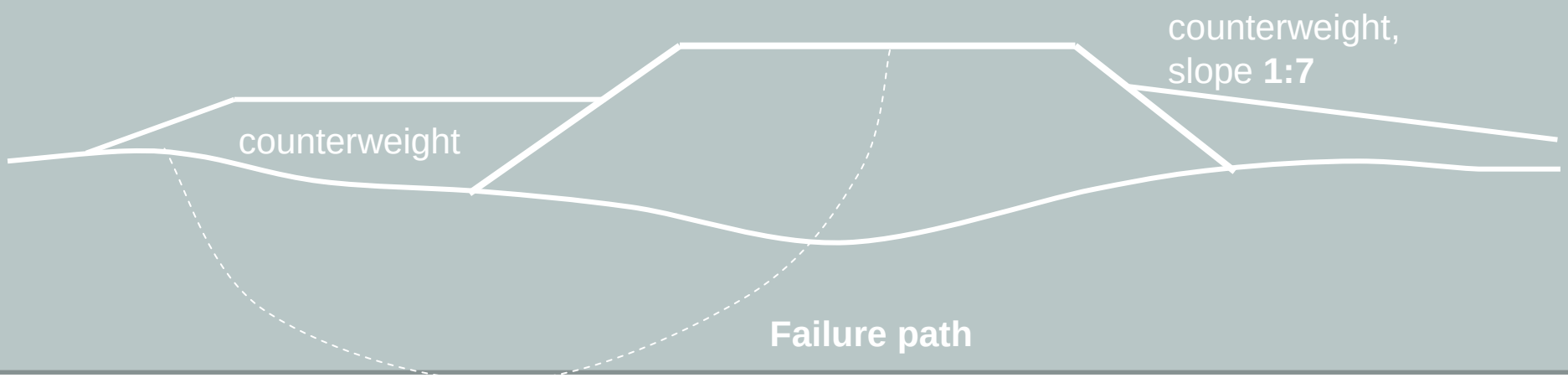
Preloading – culvert – avoid bumbing



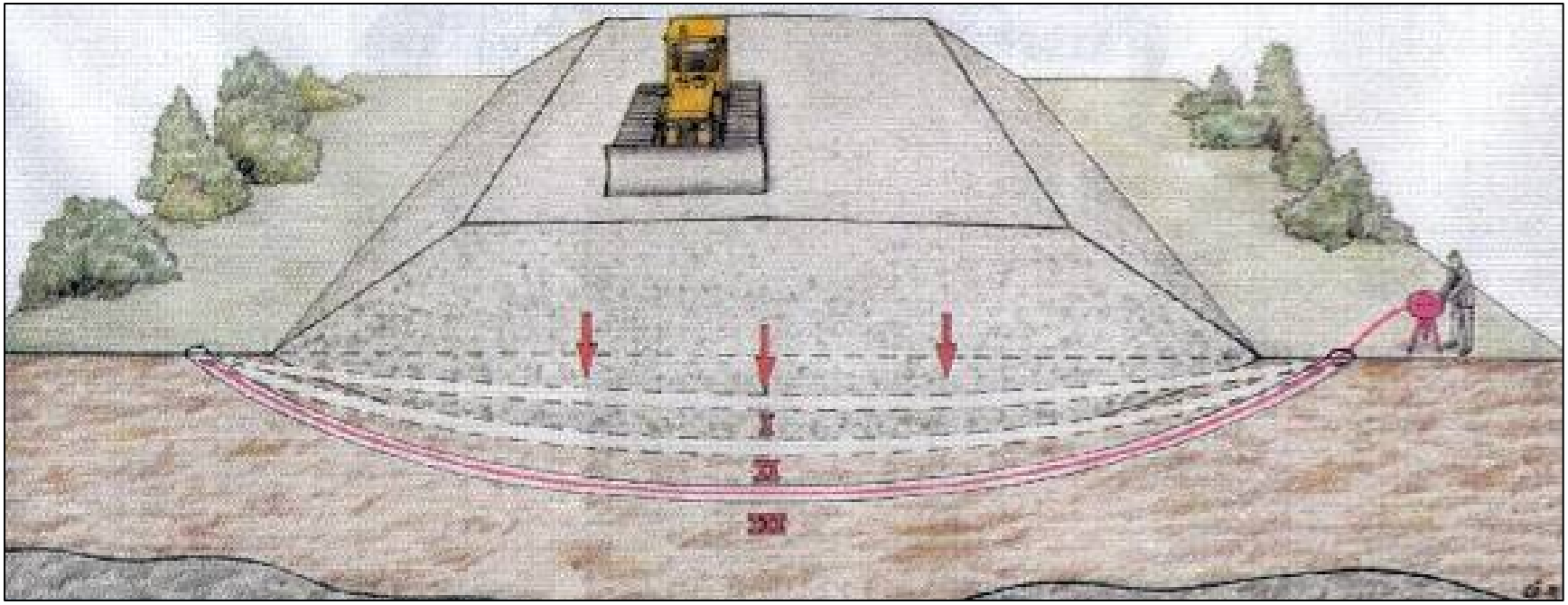
Fill on peat- counterweight

It is common that counterweight is needed to avoid failure crack in the peat.



on Peat:

Measurement of settlement by pressure sensor



CONSOIL Hydrostatic Profiler

- polyethylene tube with a portable pull-through sensor

on Peat:
Tube installation

on Peat:

Referencing tube on peat surface

on Peat:

Referencing settlement rod

on Peat:

settlement tube, no crushed rock around the tube

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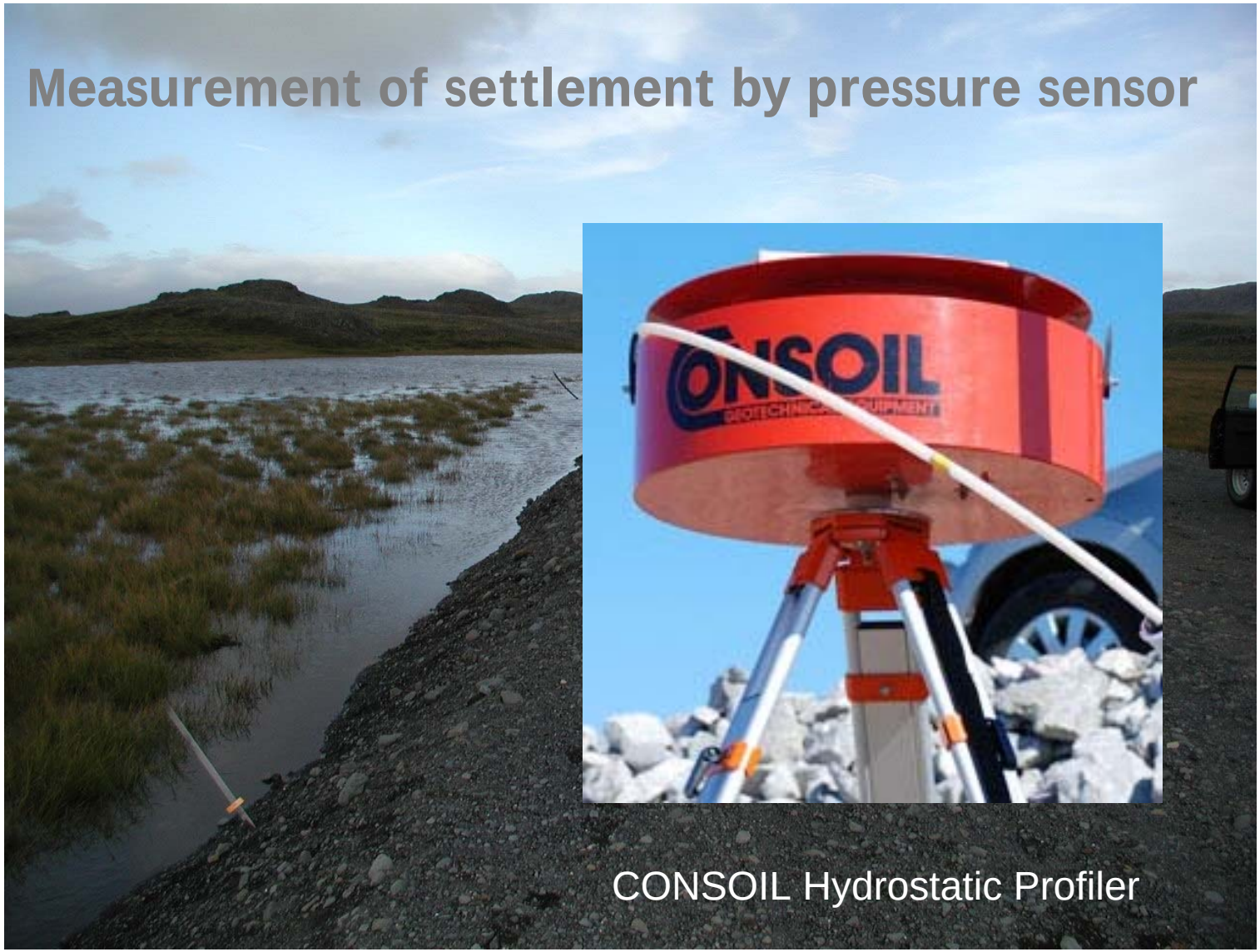
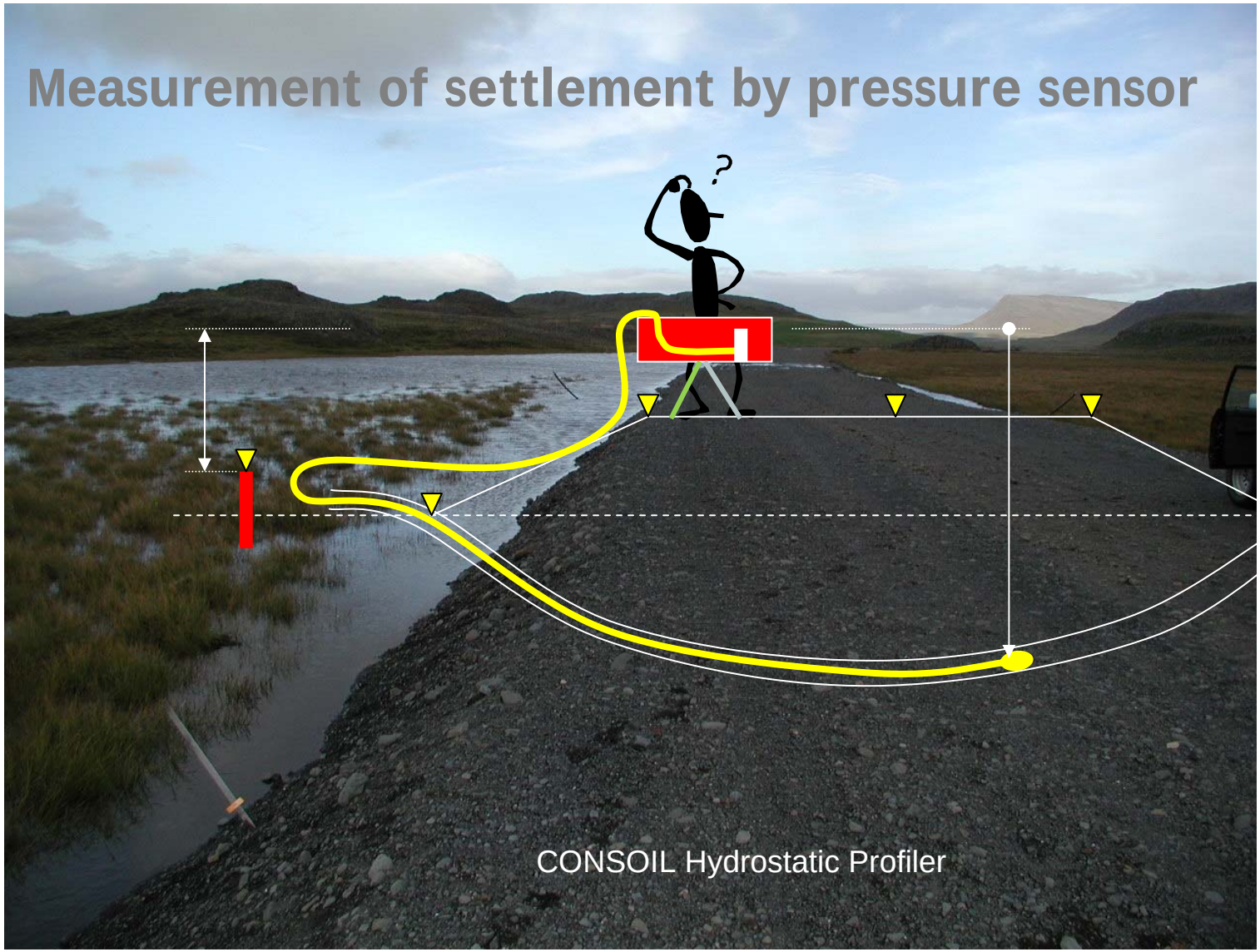
on Peat:

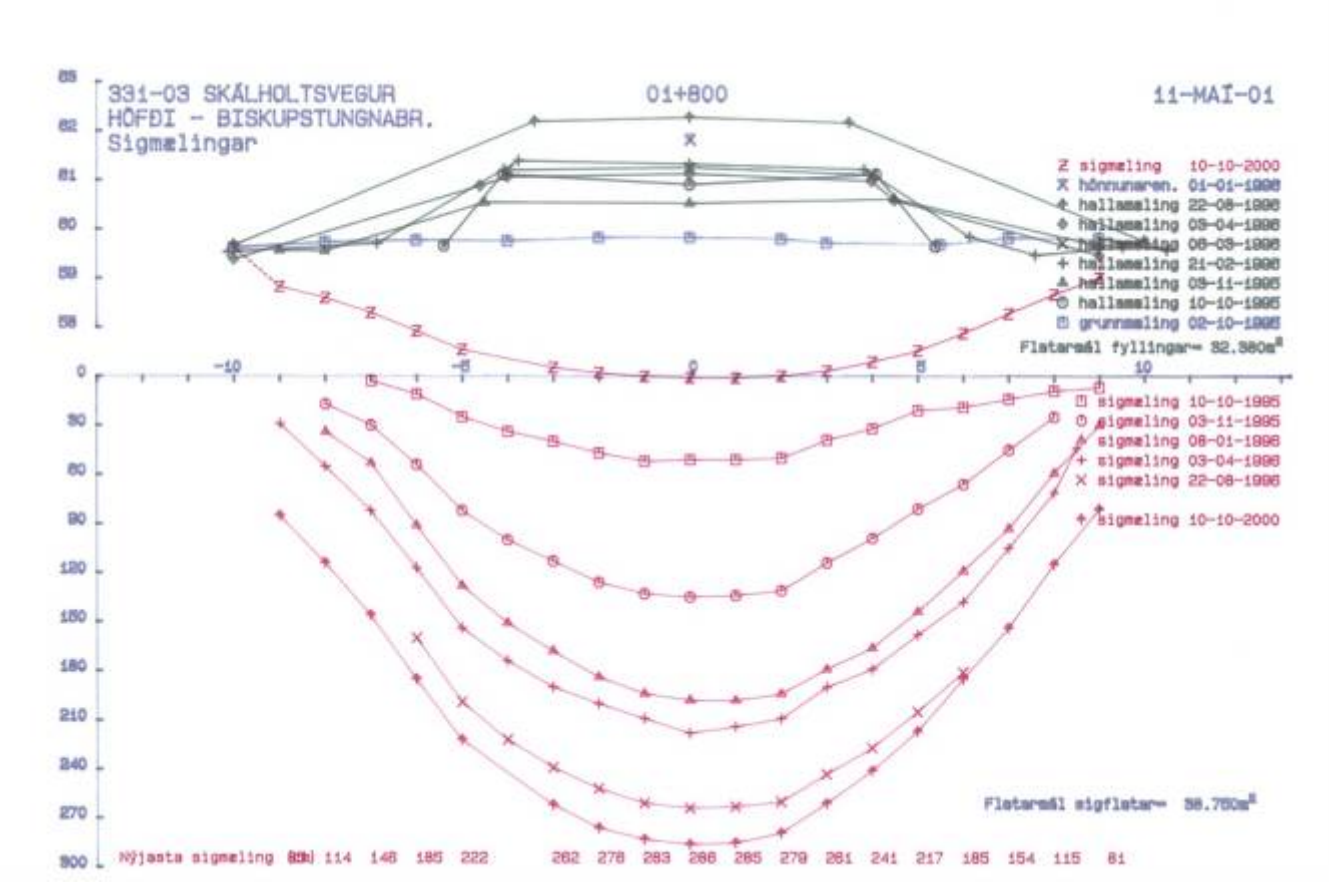

Measurement of settlement by pressure sensor
CONSOIL
CONSOIL Hydrostatic Profiler

on Peat:


Measurement of settlement by pressure sensor
CONSOIL Hydrostatic Profiler

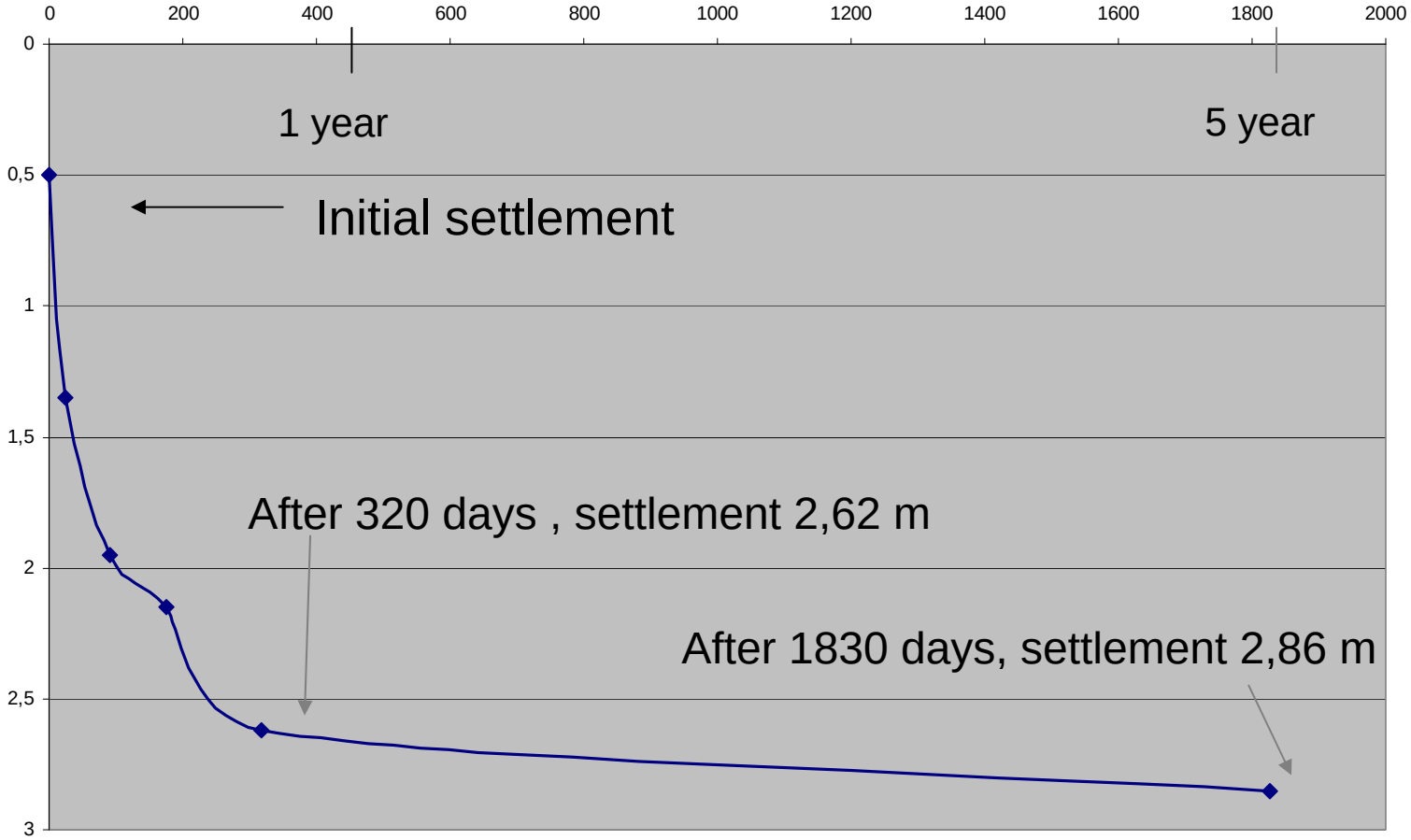
on Peat:

Time - settlement records



on Peat:

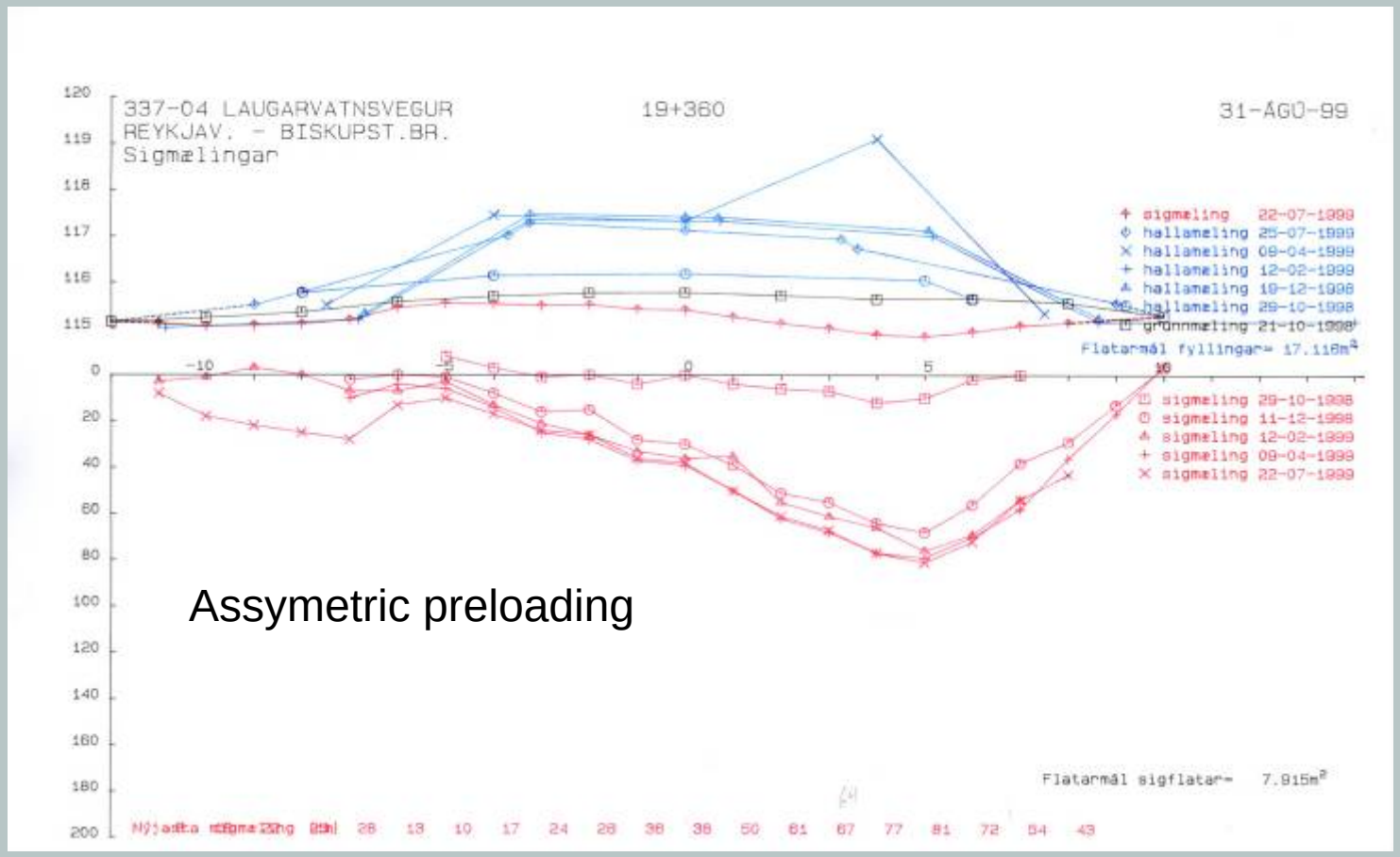
Time - settlement records



ROADEX
Implementing Accessibility

on Peat:

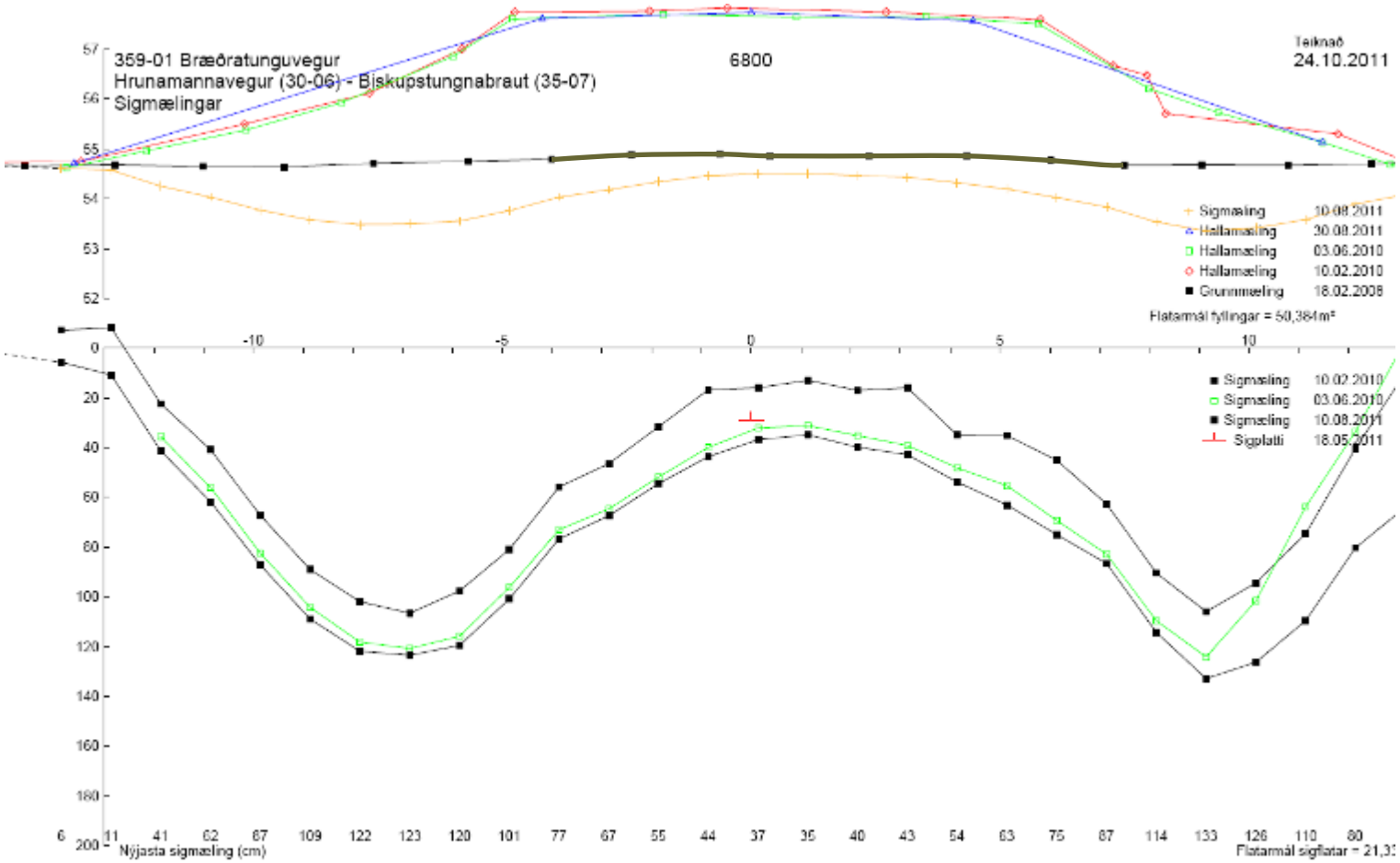
Settlement records



Assymetric preloading

on Peat:

Settlement records



on Peat:

First the material are placed on the widening part

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07/10/2009

on Peat:

on Peat in Ireland:

escavation and refill with crushed material

ROADEX
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on Peat:

ROADEX
Implementing Accessibility

on Peat:

on Peat:

ROADEX
Implementing Accessibility

On Peat, thin layer on geotextile, failure

Supporting layer from trees

on Peat:

on Peat:

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on Peat:

and some cracks which we don´t have

in our work we meet lot of people

Takk fyrir

ROADEX workshop,
27 October 2011,
The Landmark Hotel,
Carrick-on-Shannon

ROADEX
Implementing Accessibility

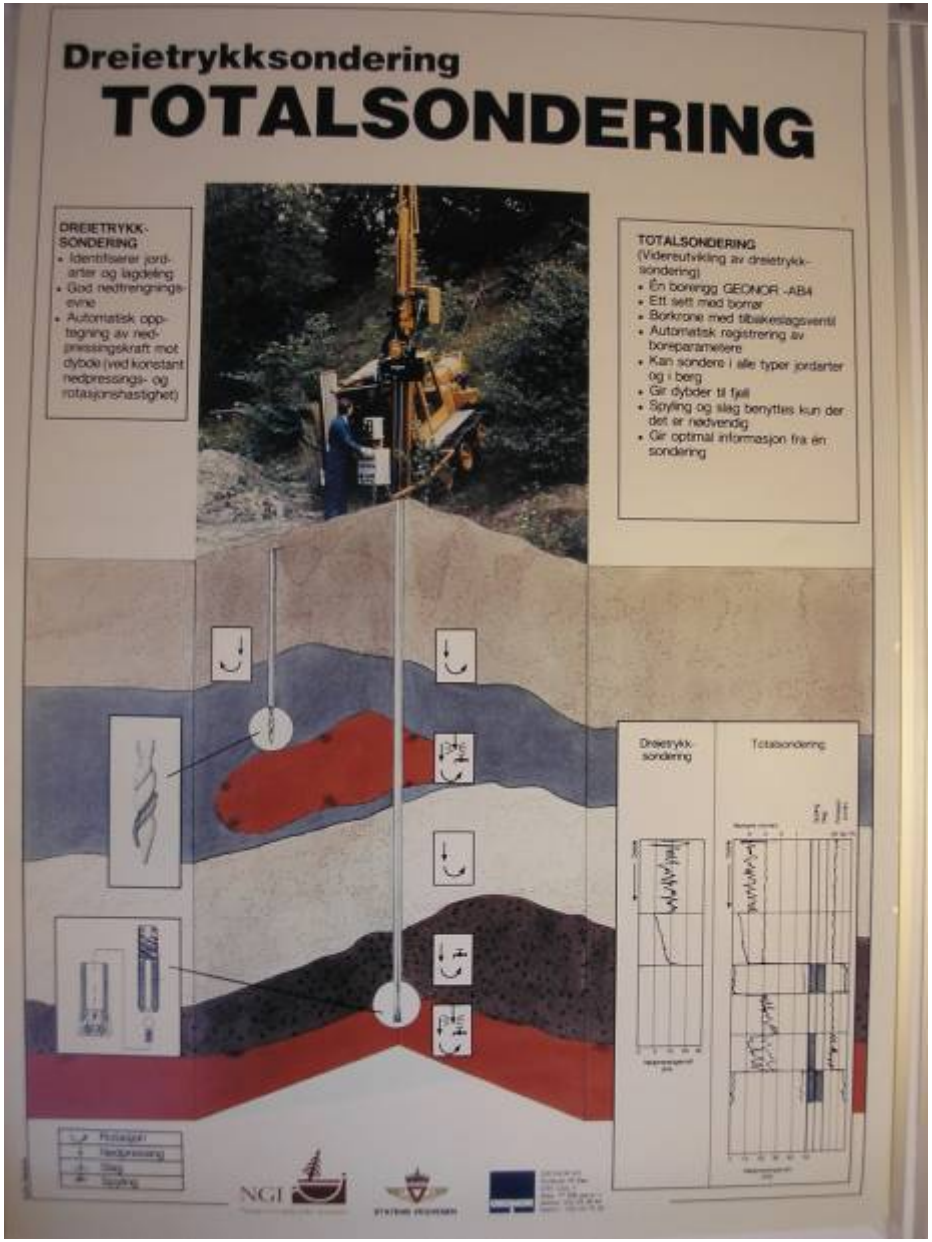
D5 Roads on Peat

ROADEX workshop,

Roadbuilding on Peat practice in Iceland

ROADEX
Implementing Accessibility

ROADEX
Implementing Accessibility


Dreietrykksondering
TOTALSONDERING
DREIETRYKK-SONDERING
• Identifiserer jordarter og lagdeling
• God nedtrengningsevne
• Automatisk opptegning av nedpressingskraft mot dybde (ved konstant nedpressings- og rotasjonshastighet)
TOTALSONDERING
(Videreutvikling av dreietrykksondering)
• Ên boreingg GEONOR -AB4
• Ett sett med borrør
• Borkrone med tilbakeslagsventil
• Automatisk registrering av boreparametere
• Kan sondere i alle typer jordarter og i berg
• Gir dybder til fjell
• Spyling og slag benyttes kun der det er nødvendig
• Gir optimal informasjon fra én sondering
Dreietrykk-sondering
Totalsondering
NGI

N56 Creeslough, Donegal (John Mclaughlin, Director)

Local contact Brian Burke

- Typical structures outside towns:
  - - 40mm SMA to Clause 942, 60mm of 20mm dbm
  - - 3-10cm surface dressing, 10-30cm clause 804 crushed rock, subbase
- Typical structure inside towns is 20mm DBM
- Road structure is likely to change along the road from HRA, SD, SMA, DBM, etc

- Water cannot escape from the carriageway due to the verges. If there is water sensitive material under the road this will lead to a loss in bearing capacity