

**Project Report on Stabilization in 2019 of a approx. 4,65 km long forest way near Løten,  
municipality Hedmark / country Norway**

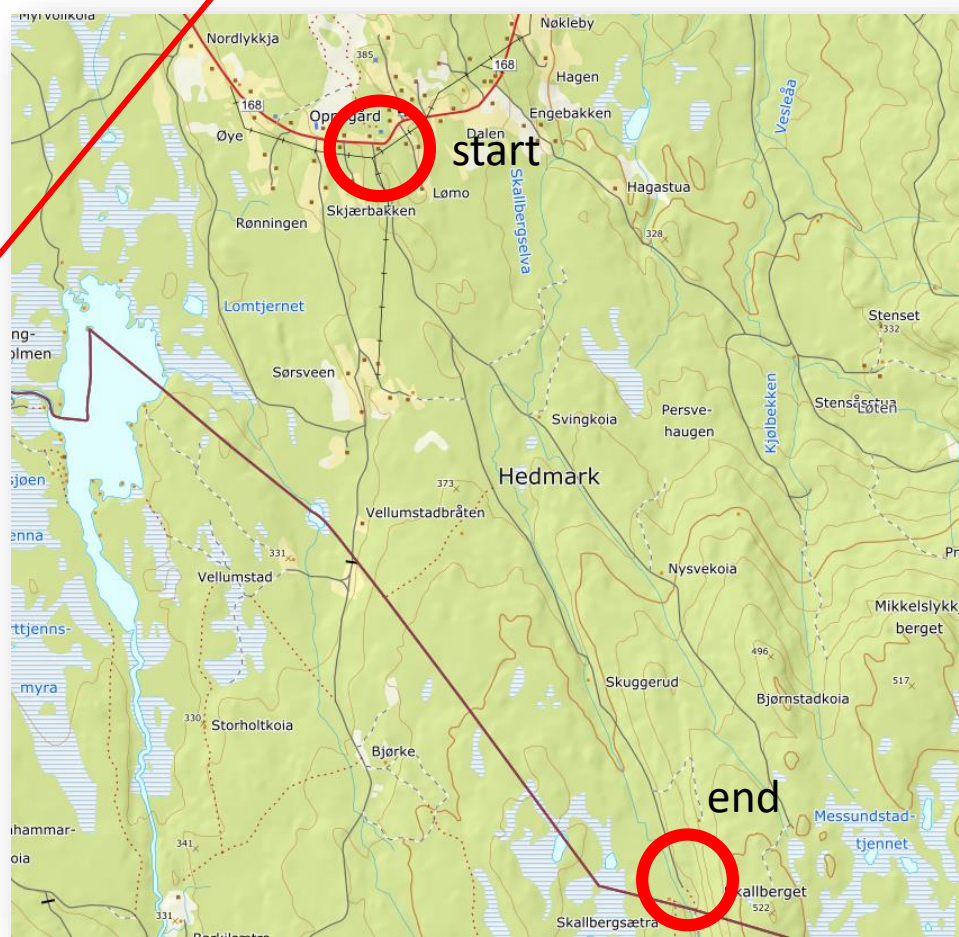


**application of GROUNDECO® SYSTEMTECHNOLOGY in June 2019: on 3<sup>th</sup> , 4<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup>**

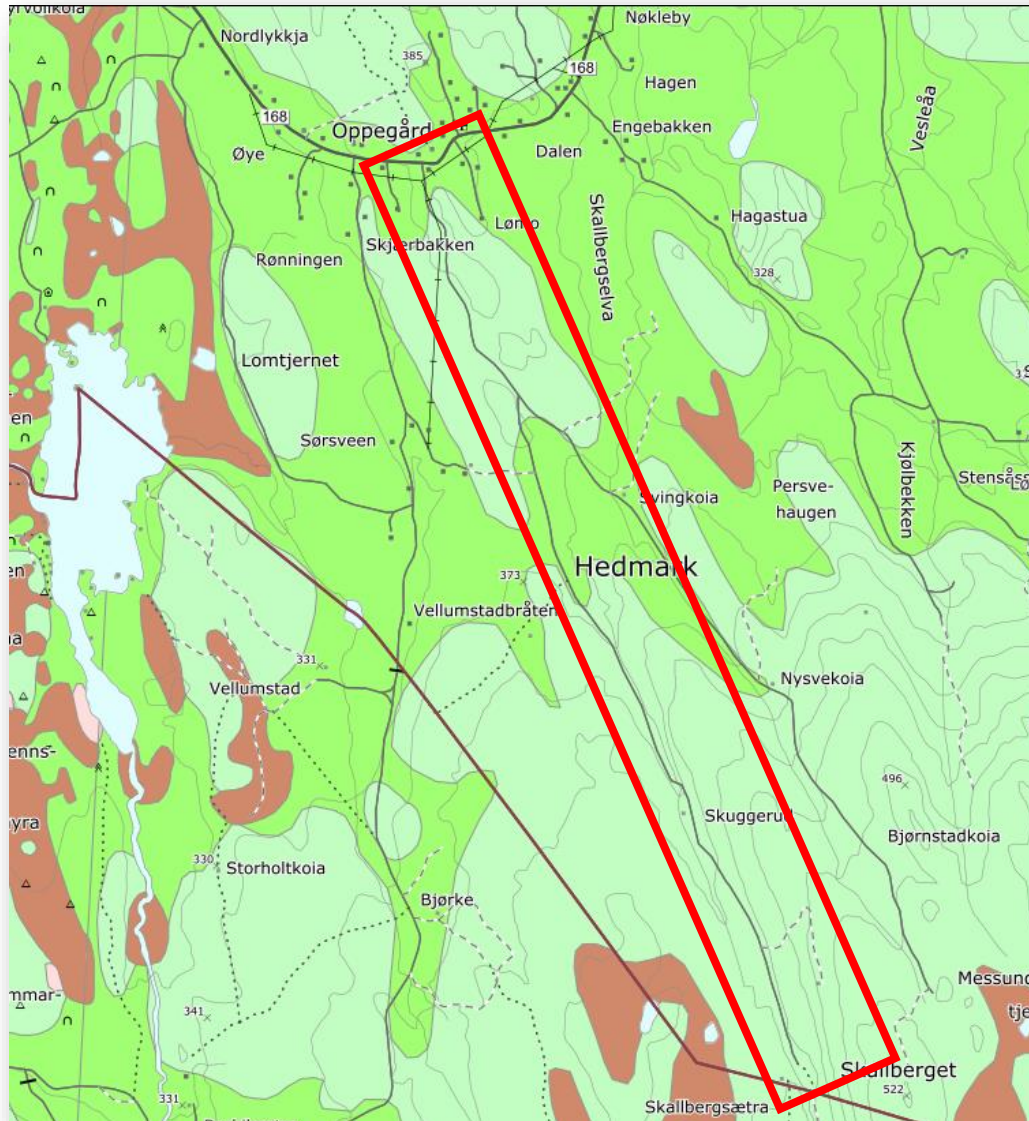


**location  
of site**

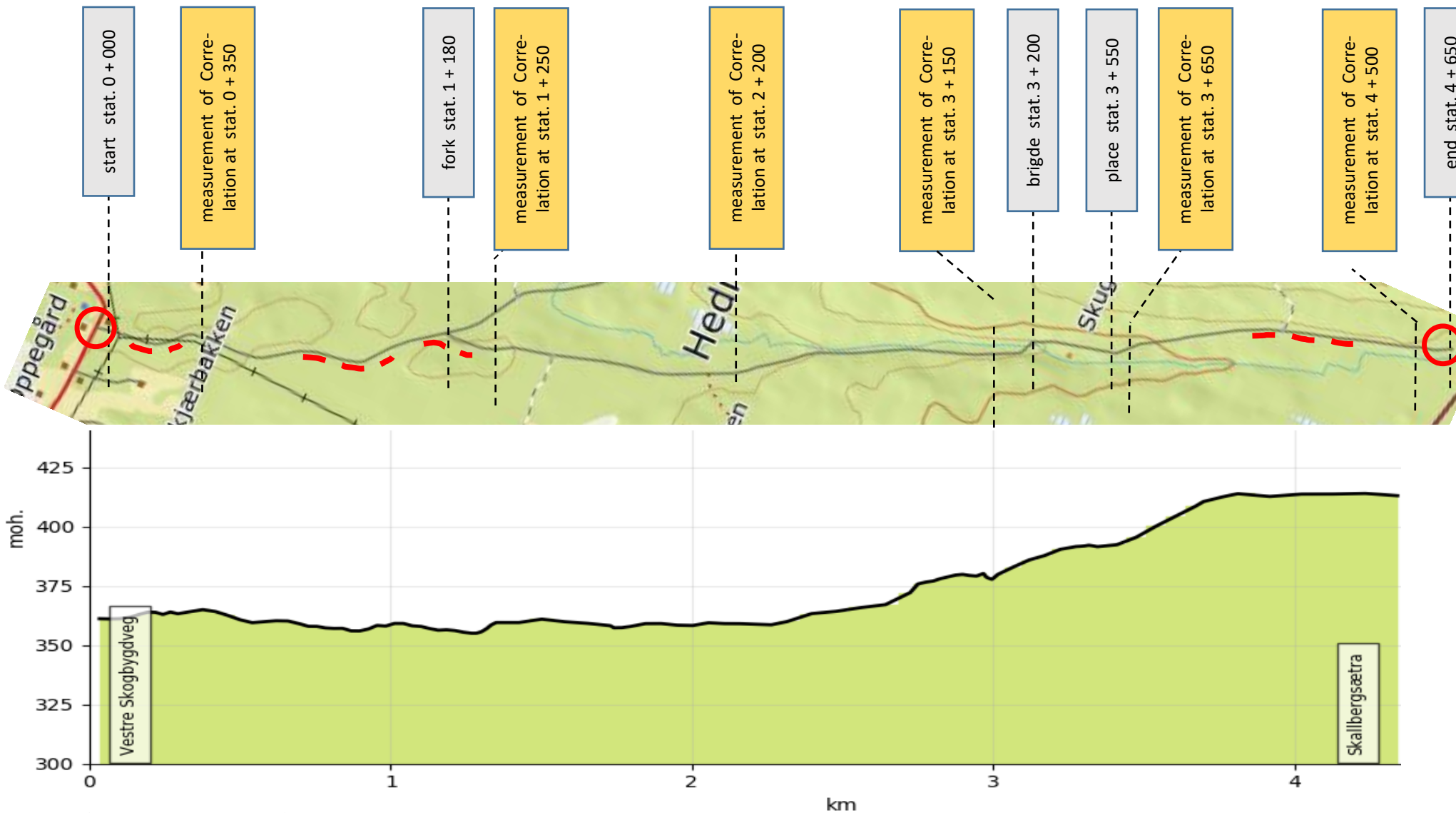
**Kommune Løten**



geological situation,  
 loose rocks on the surface



**Stationing + places of measurement of Correlation between „EV2“ and „EV dyn“ + height profile**



**views and building conditions from forest way at june 26<sup>th</sup> 2019**



stat. 1+250



stat. 1+900



stat. 3+150 ( look back to  
the start of construction )



stat. 3+500



stat. 4+350 (look back to  
the start of construction)



stat. 4+500 (look back to  
the start of construction)

Soil bearing capacity investigations using static and dynamic plate load tests before stabilization, calculation of correlations between "EV dyn", measured with 10 kg "Light Falling Weight Deflectometer" and "EV2", measured with "Static load plate test", creating a mining pit and soil sampling

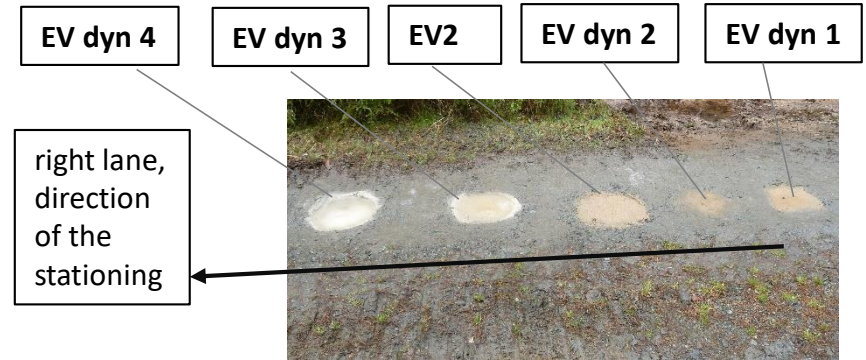
### basic procedure



measuring of  
"EV2" [ MPa ],  
using  
"Static load plate test"  
device



measuring of  
"EV dyn" [ MPa ],  
using 10 kg  
"Light Falling Weight  
Deflectometer"



**measurements for correlation EV2 / EV dyn , and digger pit at station 0 + 350 on 20190626**



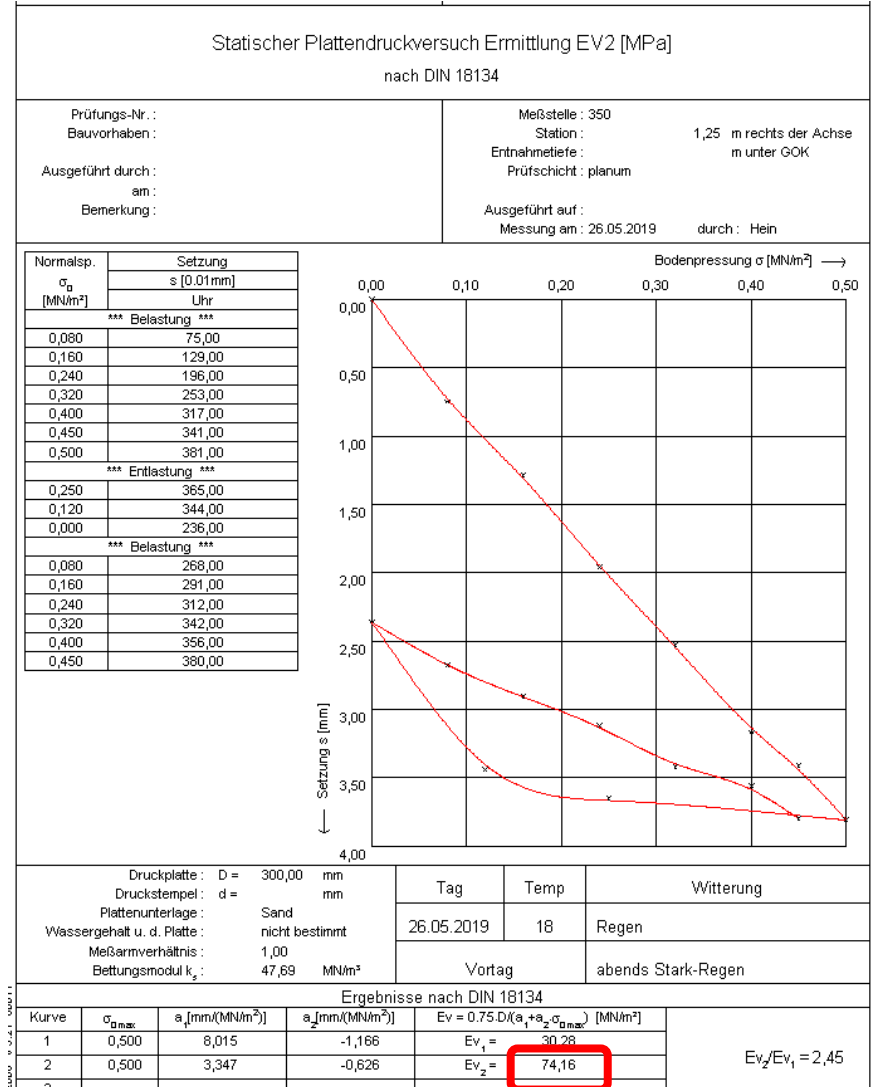
result of “static plate bearing test”:  
 EV2 = 74,16 MPa;

EV dyn 1 = 25,0MPa  
 EV dyn 2 = 25,8 MPa  
 EV dyn 3 = 22,9 MPa  
 EV dyn 4 = 23,1 MPa  
 average of EV dyn =  
 24,2 MPa



correlation:  
 EV2 [MPa] =  
**3,06 \* EV dyn [MPa]**

**the correlation calculation is falsified by the extremely high water content in the surface, not in depth, because of the current large amount of rain, a general use of this calculated value is not possible**



**measurements for correlation EV2 / EV dyn , and digger pit at station 1 + 250 on 20190626**

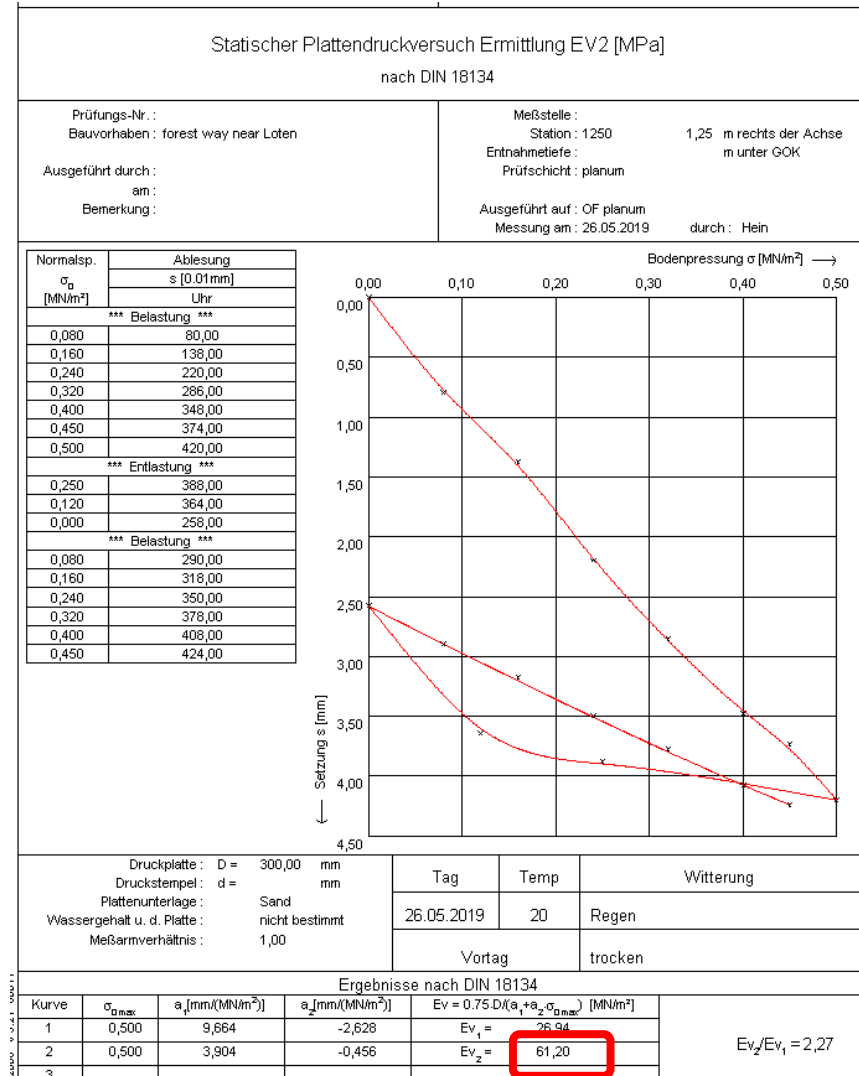


result of “static plate bearing test”:  
 EV2 = 61,2 MPa;

EV dyn 1 = 26,5 MPa  
 EV dyn 2 = 32,4 MPa  
 EV dyn 3 = 34,4 MPa  
 EV dyn 4 = 33,3 MPa  
 average of EV dyn =  
 31,65 MPa

**correlation:**  
**EV2 [MPa] =**  
**1,93 \* EV dyn [MPa]**

**extremely thin, well-**  
**compacted top layer**  
**with fines, which has**  
**drained the previous**  
**rainwater sideways**  
**across the cross slope**





**measurements for correlation EV2 / EV dyn , and digger pit at station 2 + 200 on 20190627**



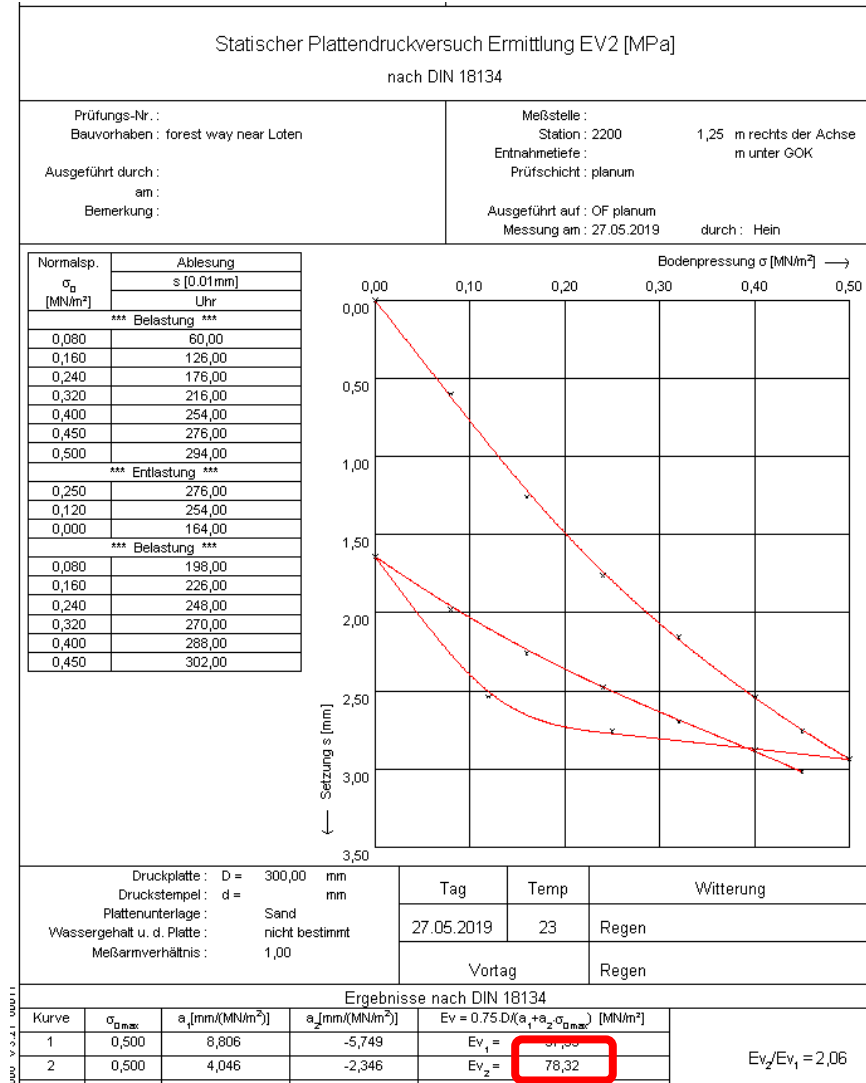
result of “static plate bearing test”:

EV2 = 78,32 MPa;

EV dyn 1 = 33,9 MPa  
 EV dyn 2 = 25,9 MPa  
 EV dyn 3 = 14,5 MPa  
 EV dyn 4 = 17,1 MPa  
 average of EV dyn = 22,85 MPa

correlation:  
**EV2 [MPa] = 3,4 \* EV dyn [MPa]**

**Disturbance in the subsoil through a boulder lying directly below the planum, the correlation calculation is falsified by the extremely high water content in the surface, not in depth, Correlation is limited**



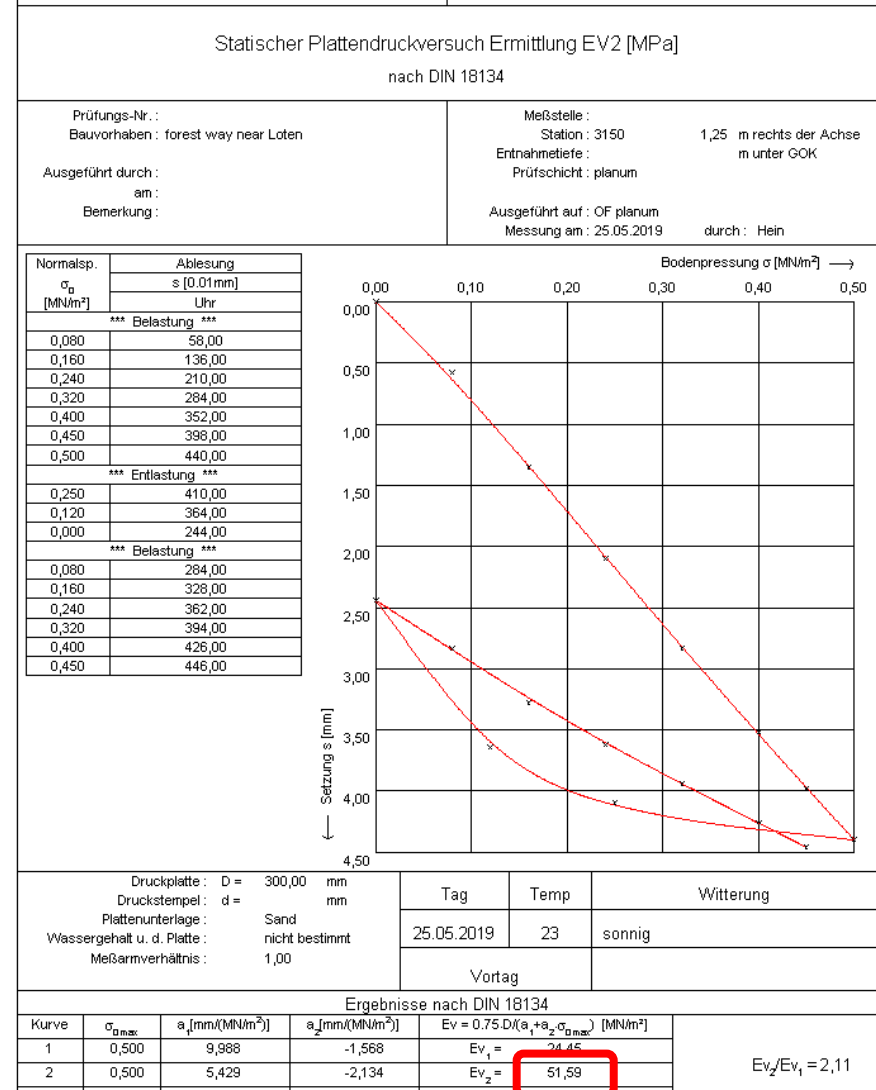
measurements for correlation EV2 / EV dyn , and digger pit at station 3 + 150 on 20190625



result of “static plate bearing test”:  
 EV2 = 51,59 MPa;

EV dyn 1 = 20,7 MPa  
 EV dyn 2 = 24,2 MPa  
 EV dyn 3 = 20,2 MPa  
 EV dyn 4 = 27,9 MPa  
 average of EV dyn =  
 23,25 MPa

correlation:  
 EV2 [MPa] =  
 2,21 \* EV dyn [MPa]



**measurements for correlation EV2 / EV dyn , and digger pit at station 3 + 650 on 20190625**



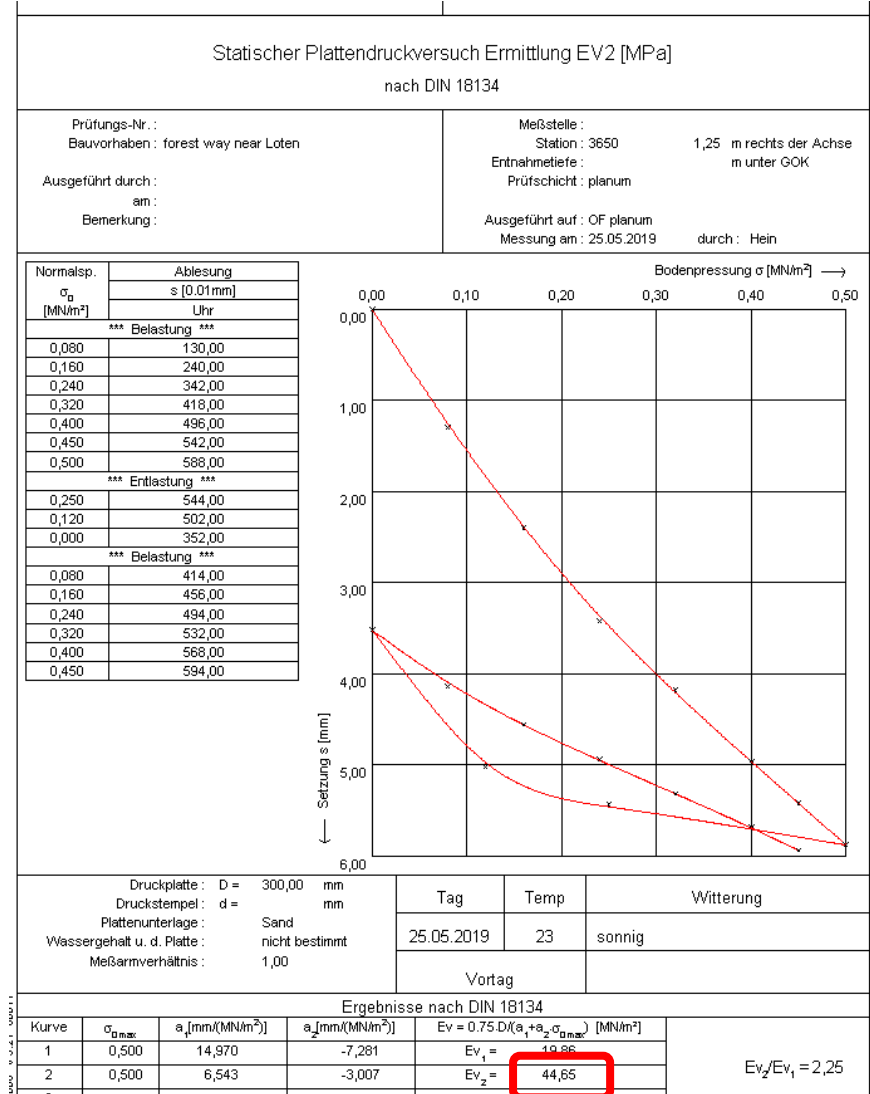
result of "static plate bearing test":  
 EV2 = 44,65 MPa;

EV dyn 1 = 11,6 MPa  
 EV dyn 2 = 12,1 MPa  
 EV dyn 3 = 14,0 MPa  
 EV dyn 4 = 12,5 MPa  
 average of EV dyn = 12,55 MPa

correlation:  
 EV2 [MPa] =  
 3,6 \* EV dyn [MPa]



the correlation calculation is falsified by the extremely high water content in the subsoil, over the entire depth !  
 Correlation is limited !



**measurements for correlation EV2 / EV dyn , and digger pit at station 4 + 500 on 20190625**

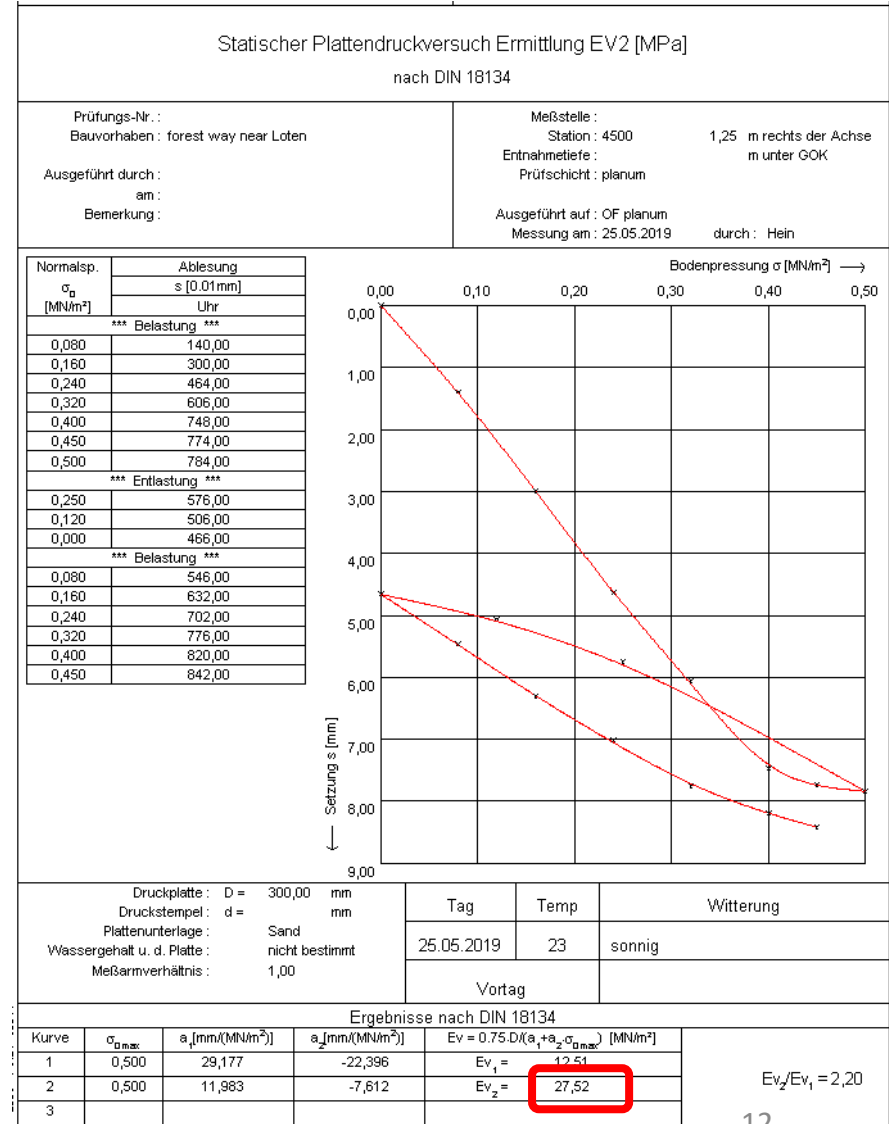


result of “static plate bearing test”:  
 EV2 = 27,52 MPa;

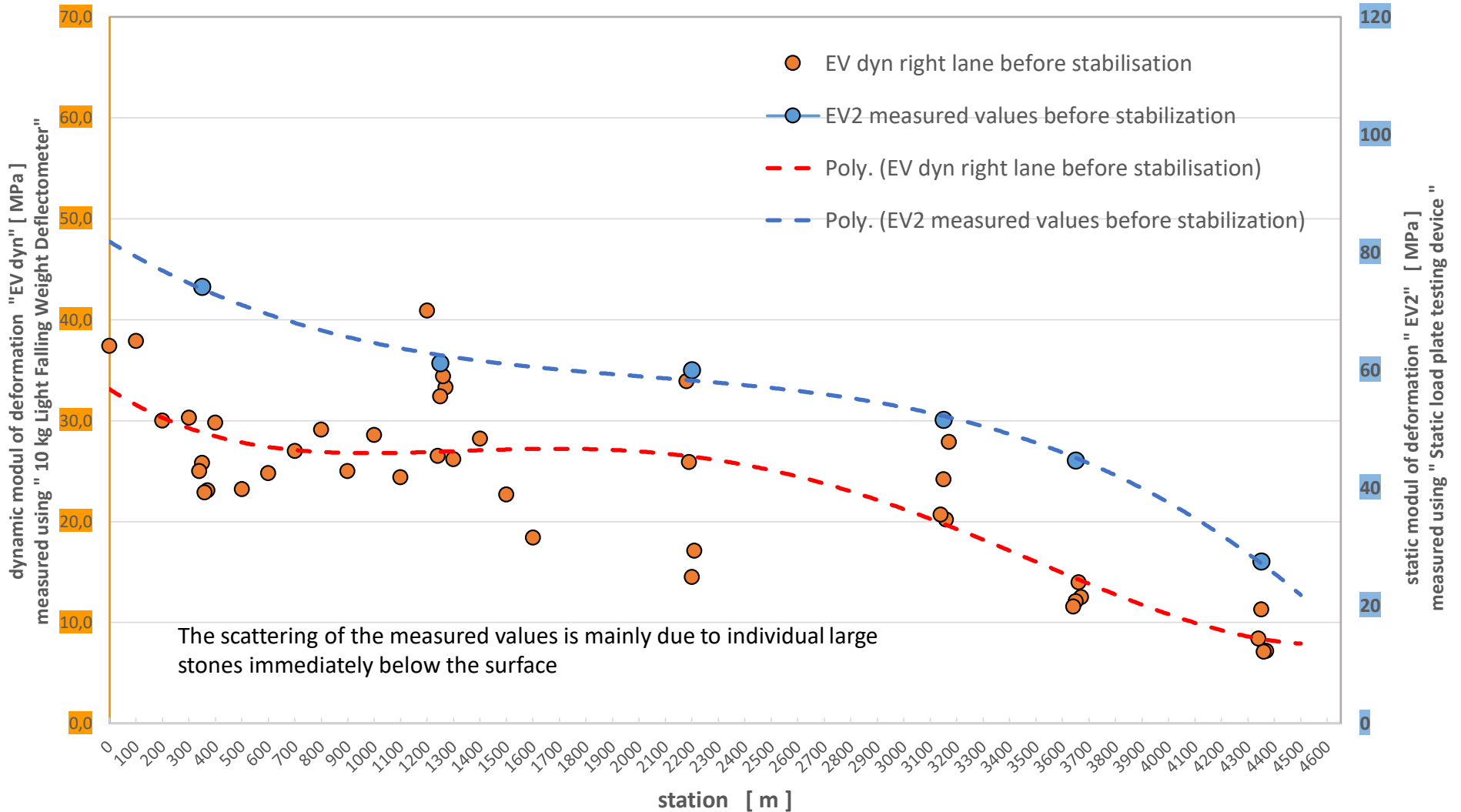
EV dyn 1 = 8,4 MPa  
 EV dyn 2 = 11,3 MPa  
 EV dyn 3 = 7,1 MPa  
 EV dyn 4 = 7,2 MPa  
 average of EV dyn = 8,5 MPa

correlation:  
 EV2 [MPa] =  
 3,23\* EV dyn [MPa]

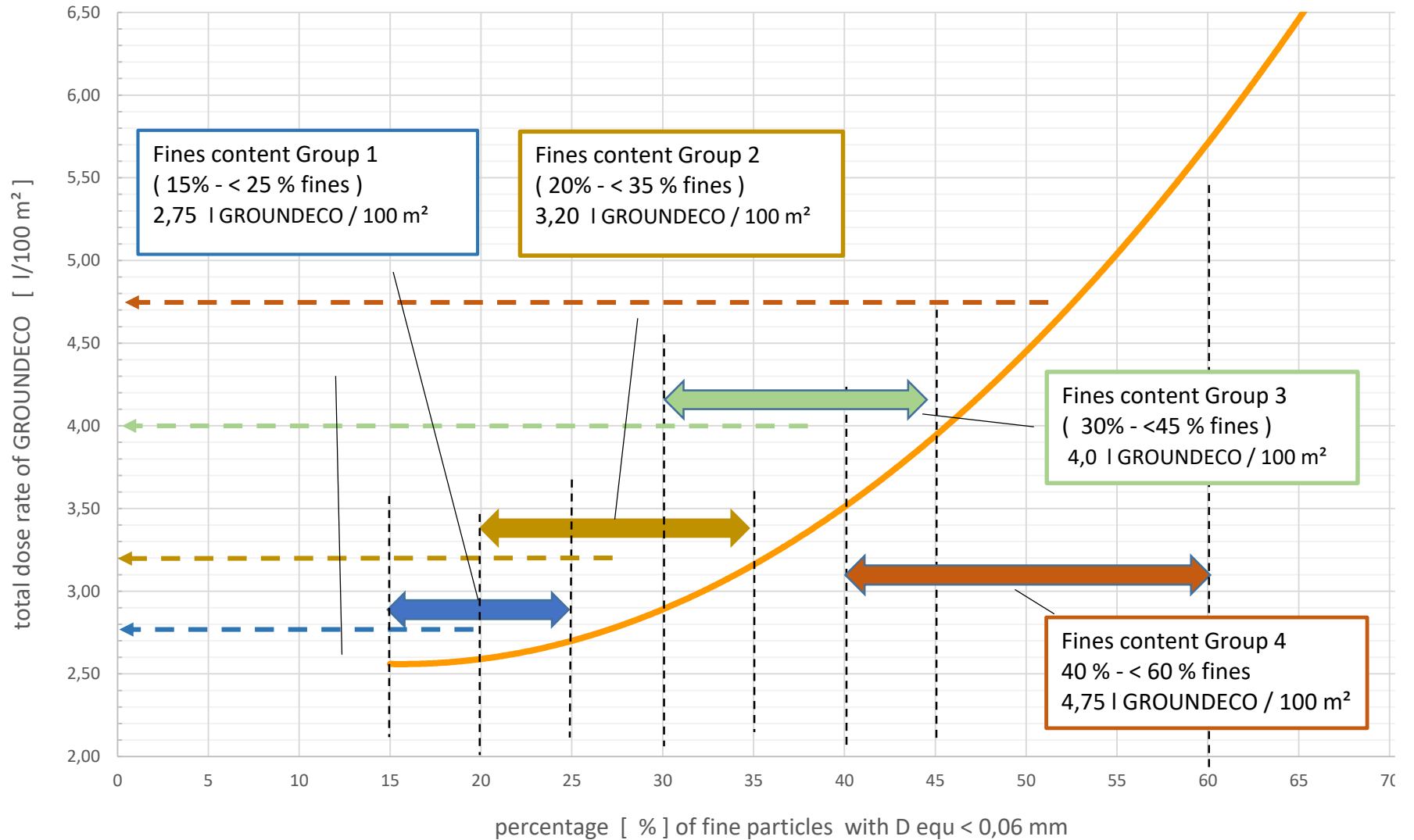
**the correlation calculation is falsified by the extremely high water content in the subsoil, over the entire depth !  
 Correlation is limited !**



forest way near Løten, load bearing capacity before start of soil stabilization



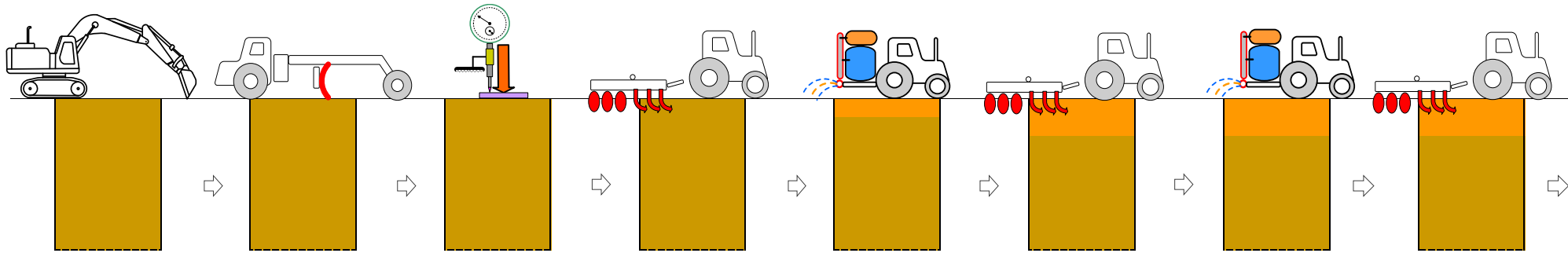
total dose rate of GROUNDECO, depending on the percentage [%] of fine particles with  $D_{eq} < 0,06$  mm



**Soil characteristics and evaluation of suitability of the existing ground  
 for application of GROUNDECO-SYSTEMTECHNOLOGY**

soil characteristics	manufacturer's parameterization for successful application of GROUNDECO	in laboratory determined values	evaluation of suitability of the existing ground for GROUNDECO-technology
share of fine particles with Diam < 0,06 mm, related to dry weight [ % ]	> 15 weight - %	In the laboratory rough and roughly determined proportion of fines: approx. from 25 mass-% up to 40 mass-% share of fine particles with Diam < 0,06 mm	well suited
according to the specifications of the manufacturer (chart "total dose rate"), the sections of the path are assigned as follows:			
<b>station 0+000 to 1+900: Fines Content Group 2: total dose rate GROUNDECO = 3,2 liter GROUNDECO / 100 m<sup>2</sup> = 1,9 km</b> <b>station 1+900 to 3+200: Fines Content Group 3: total dose rate GROUNDECO = 4,0 liter GROUNDECO / 100 m<sup>2</sup> = 1,3 km</b> <b>station 3+200 to 3+500: Fines Content Group 2: total dose rate GROUNDECO = 3,2 liter GROUNDECO / 100 m<sup>2</sup> = 0,3 km</b> <b>station 3+500 to 4+650: Fines Content Group 3: total dose rate GROUNDECO = 4,0 liter GROUNDECO / 100 m<sup>2</sup> = 1,15 km</b>			
pH-value	pH > 6	pH > 6,5	well suited
share of organic impurities related to dry weight [ % ]	< 4 weight-%	no indication of organic impurities	well suited

**GROUNDECO® SYSTEMTECHNOLOGY adapted to specific conditions**



Clean and open road ditches, lay pipes at low points to cross the road for water drainage

produce the rough planning, with longitudinal and transverse slopes

Measuring the carrying capacity on the earth planum

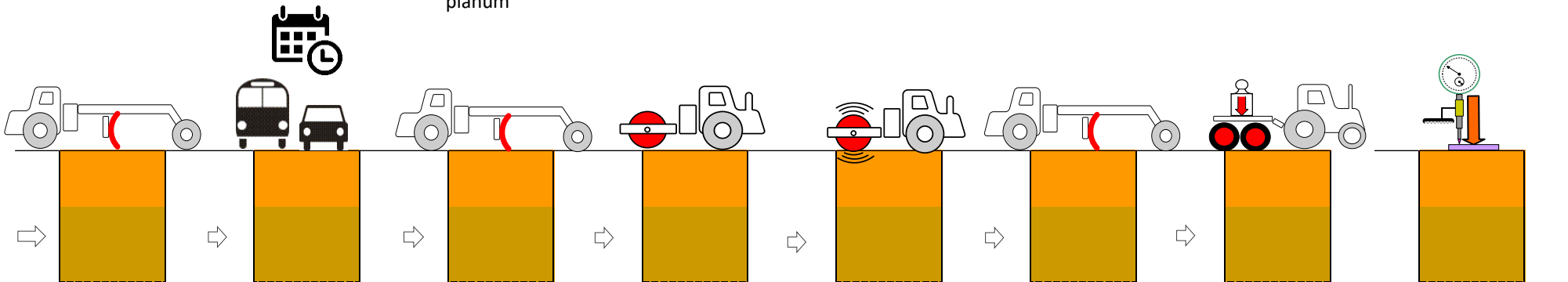
Tearing and roughening the subgrade

spraying 1st mix consisting of **GROUNDECO** + water on to surface

mixing and drying the soil using e.g. a disc harrow

spraying 2nd mix consisting of **GROUNDECO** + water on to surface

mixing and drying the soil using e.g. a disc harrow



restore Planum

leave the soil and let GROUNDECO work no shut-off required, normal traffic is permitted

restore Planum, placing back soil into the preloaded lanes

control water content, compaction with smooth roller, not vibration

compaction with smooth roller + vibration

restore Planum

Compaction with heavy rubber wheel roller, especially the borders and the middle of the way

Measuring the carrying capacity on the earth planum



required travel speed of the discharge unit depending on the pump capacity of the water pump and the width of the application = 5,0 m  
 Assignment depending on the proportion of fines in the soil: **Fines Content Group 2 = total dose rate 3,2 liter GROUNDECO / 100 m<sup>2</sup> planum**

### Application of GROUNDECO® - SYSTEM TECHNOLOGY in road construction

Application of the mixture prepared in the tank GROUNDECO + water via pump and distributor pipe  
**required travel speed of the discharge unit depending on the pump capacity of the water pump and the width of the application**

total effort of GROUNDECO®, divided into 2 application rates =		3,2	l / 100 m <sup>2</sup> =	0,032	l / m <sup>2</sup>		input values
share of dose rate of GROUNDECO®		for 1st application rate =	1/2	for 2nd application rate =	1/2		output values
amount of water for dilution		for 1st application rate =	0,8	l / m <sup>2</sup>			
mixing ratio of GROUNDECO® to water		for 1st application rate =	0,020	=	2,00	%	
amount of water for dilution		for 2nd application rate =	0,8	l / m <sup>2</sup>			
mixing ratio of GROUNDECO® to water		for 2nd application rate =	0,020	=	2,00	%	

pump power	200	l / min	required driving speed [m/min] =	
width of distribution	5,00	m	= pump power [l / min] / required distribution rate per meter path length [l / m]	

1st partial rate GROUNDECO®	dilution 1 part GROUNDECO® to x* Teile Wasser	amount water	1st application rate GROUNDECO® + water	pump power	width of distribution	distribution area per m path length	distribution rate per m path length	required speed of dispensing unit m/min	required speed of dispensing unit km/h
l/m <sup>2</sup>	x=	l/m <sup>2</sup>	l/m <sup>2</sup>	l/min	m	m <sup>2</sup> /m	l/m		
0,016	0,020	0,8	0,816	200,00	5,00	5,00	4,08	49,0	2,94

2nd partial rate GROUNDECO®	dilution 1 part GROUNDECO® to x* Teile Wasser	amount water	1st application rate GROUNDECO® + water	pump power	width of distribution	distribution area per m path length	distribution rate per m path length	required speed of dispensing unit m/min	required speed of dispensing unit km/h
l/m <sup>2</sup>	x=	l/m <sup>2</sup>	l/m <sup>2</sup>	l/min	m	m <sup>2</sup> /m	l/m		
0,016	0,020	0,8	0,816	200,00	5,00	5,00	4,08	49,0	2,94

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required travel speed of the discharge unit depending on the pump capacity of the water pump and the width of the application = 5,0 m  
 Assignment depending on the proportion of fines in the soil: **Fines Content Group 3 = total dose rate 4,0 liter GROUNDECO / 100 m<sup>2</sup> planum**

Application of GROUNDECO® - SYSTEM TECHNOLOGY in road construction									
Application of the mixture, prepared in the tank, GROUNDECO + water via pump and distributor pipe									
required travel speed of the discharge unit depending on the pump capacity of the water pump and the width of the application									
total effort of GROUNDECO®, divided into 2 application rates =	4	l / 100 m <sup>2</sup> =	0,04	l / m <sup>2</sup>					input values
share of dose rate of GROUNDECO®	for 1st application rate = 1/2	for 2nd application rate = 1/2							output values
amount of water for dilution	for 1st application rate =	1,0	l / m <sup>2</sup>						
mixing ratio of GROUNDECO® to water	for 1st application rate =	0,020	=	2,00	%				
amount of water for dilution	for 2nd application rate =	1,0	l / m <sup>2</sup>						
mixing ratio of GROUNDECO® to water	for 2nd application rate =	0,020	=	2,00	%				
pump power	200	l / min							required driving speed [m/min] =
width of distribution	5,00	m							=pump power [l / min] / required distribution rate per meter path length [l / m]
1st partial rate GROUNDECO®	dilution 1 part GROUNDECO® to x* Teile Wasser	amount water	1st application rate GROUNDECO® + water	pump power	width of distribution	distribution area per m path length	distribution rate per m path length	required speed of dispensing unit	required speed of dispensing unit
l/m <sup>2</sup>	x=	l/m <sup>2</sup>	l/m <sup>2</sup>	l/min	m	m <sup>2</sup> /m	l/m	m/min	km/h
0,020	0,020	1,0	1,020	200,00	5,00	5,00	5,10	39,2	2,35
2nd partial rate GROUNDECO®	dilution 1 part GROUNDECO® to x* Teile Wasser	amount water	1st application rate GROUNDECO® + water	pump power	width of distribution	distribution area per m path length	distribution rate per m path length	required speed of dispensing unit	required speed of dispensing unit
l/m <sup>2</sup>	x=	l/m <sup>2</sup>	l/m <sup>2</sup>	l/min	m	m <sup>2</sup> /m	l/m	m/min	km/h
0,020	0,020	1,0	1,020	200,00	5,00	5,00	5,10	39,2	2,35

**Selected work steps in the construction period from 03th June to 07th June 2019**



spraying a mix consisting of **GROUNDECO** + water on to surface



mixing and drying the soil using a disc harrow



Filling GROUNDDECO into the tanks by pump and counter



Filling water into the tanks by pump