

**hoschung**

**hoschung**

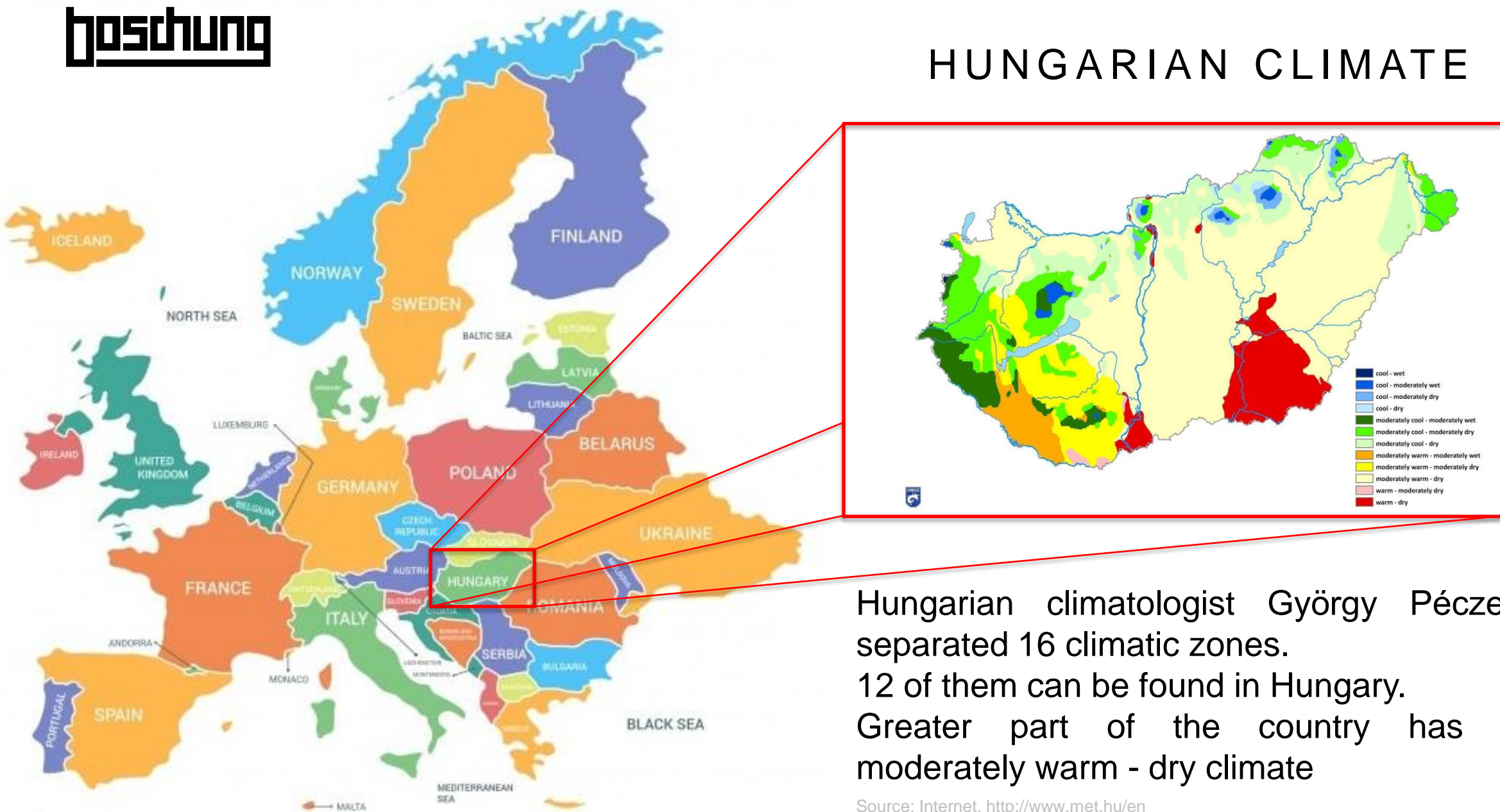
WINTER SEASON 2017 / 2018  
SELECTED WEATHER FACTS ON THE EXAMPLE OF  
A FIXED AUTOMATED SPRAYING SYSTEM  
IN PILISVÖRÖSVÁR (HUNGARY)



Smolenice, Slovakia  
May 29 – June 1, 2018

Jan Szczerbiński

## HUNGARIAN CLIMATE

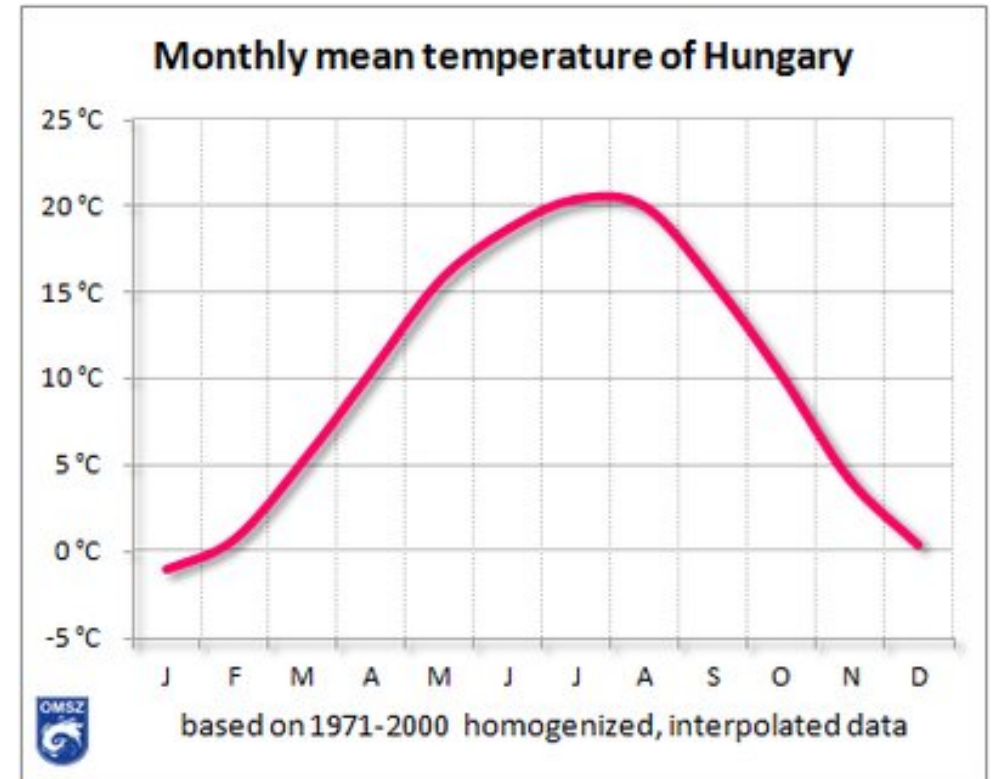


Hungarian climatologist György Péczeli separated 16 climatic zones. 12 of them can be found in Hungary. Greater part of the country has a moderately warm - dry climate

Most of the country can be described as typical European continental influenced climate with warm, dry summers and fairly cold winters.

January is the coldest month with daytime temperatures usually around 0°C.

The yearly average number of days with snow is less than 40.







# hoschung

## PILISVÖRÖSVÁR

~ 13 000 inhabitants

~ 9 km from Budapest borders

~ 190 km from Smolenice

National road No. 10

Railroad No. 72

2015 – new tunnel



Before construction





# hoschung

## PILISVÖRÖSVÁR

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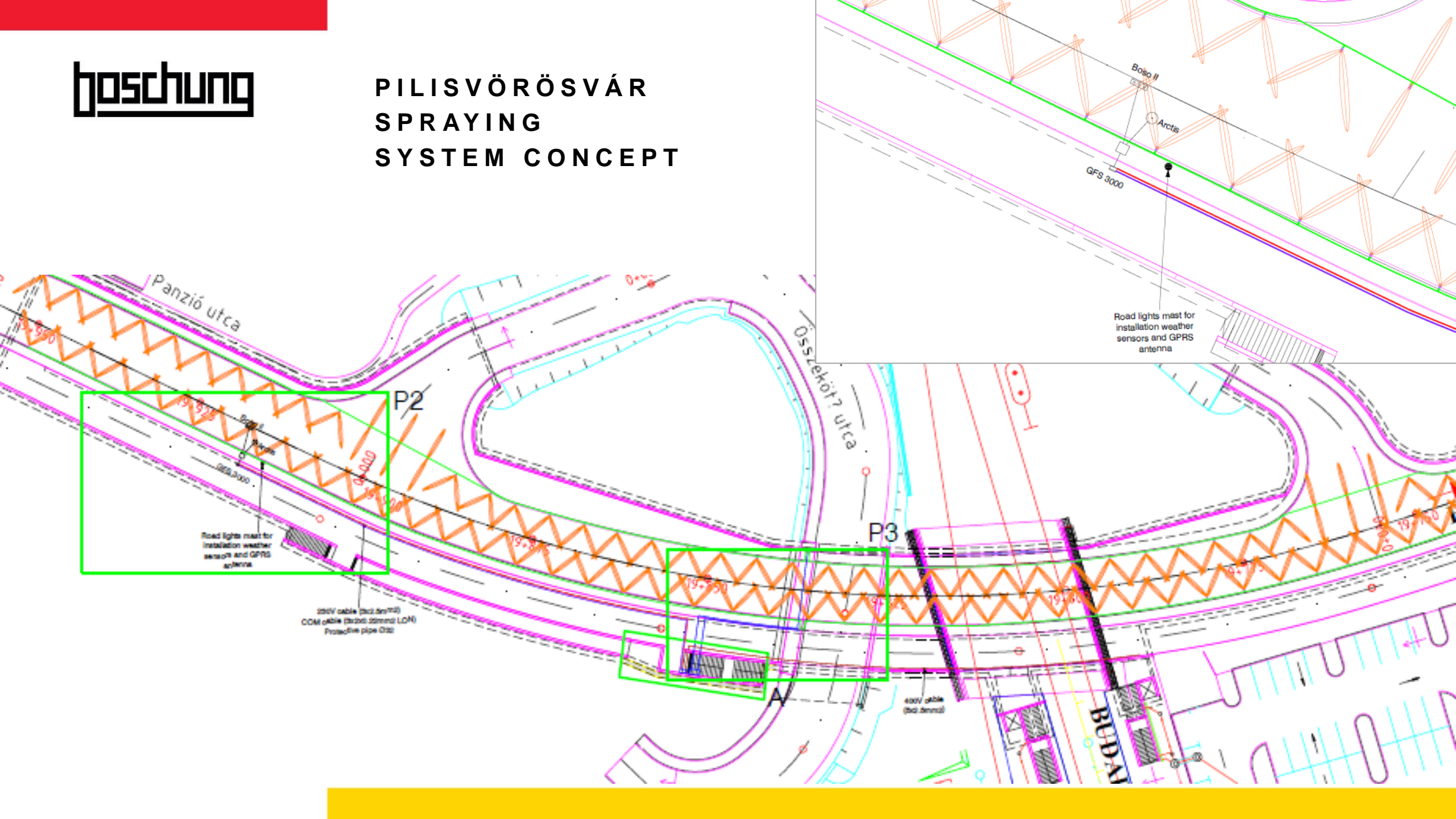
After construction



Road crossings and traffic lights in tunnel depression



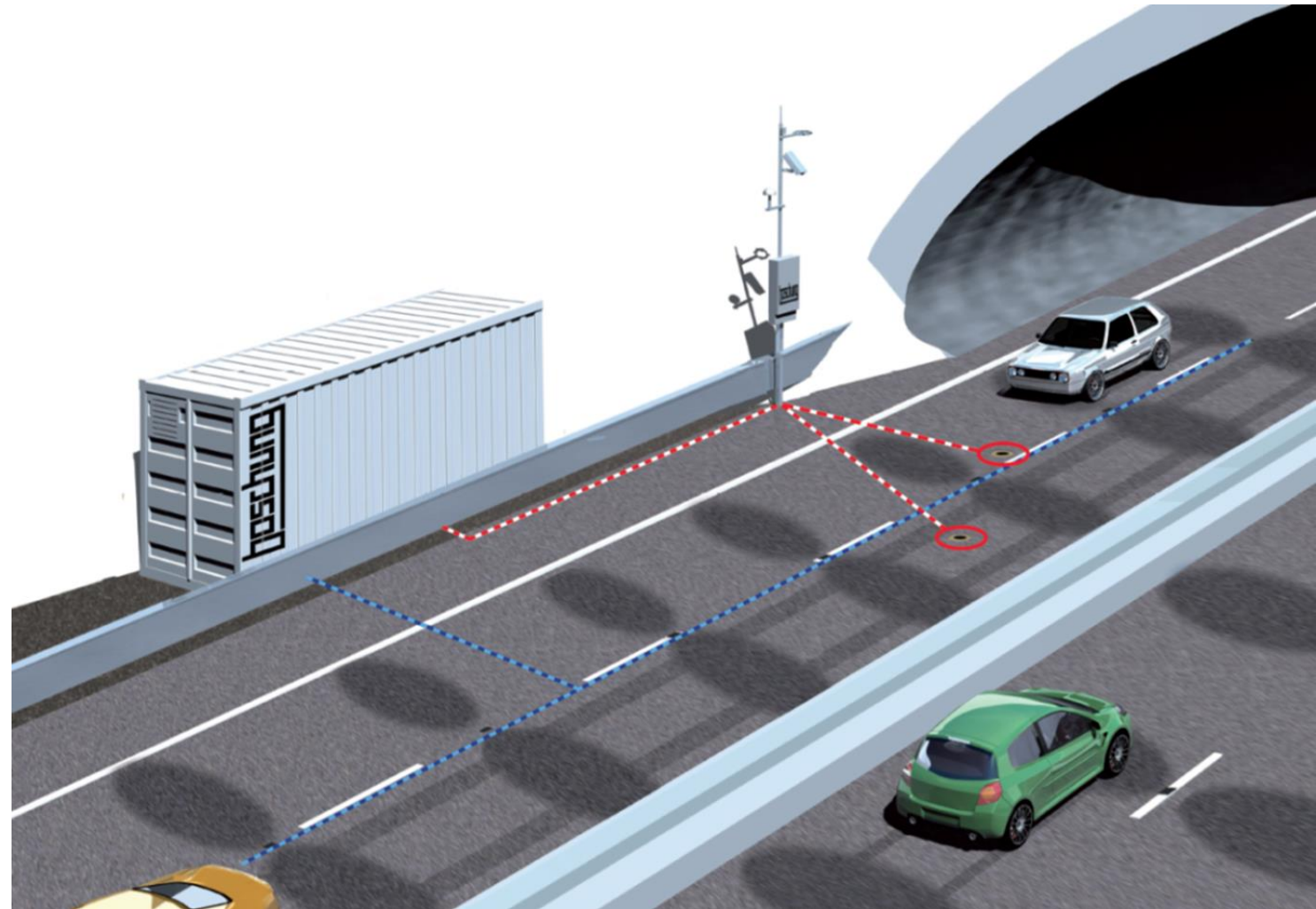
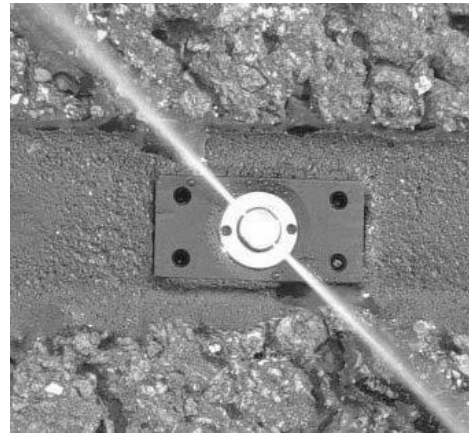
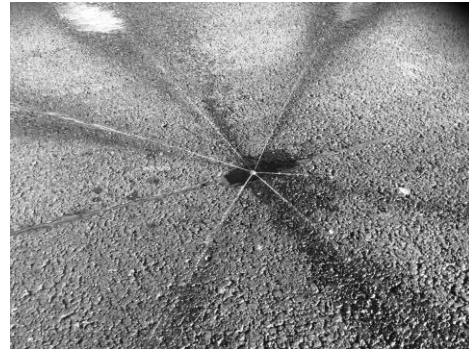
# PILISVÖRÖSVÁR SPRAYING SYSTEM CONCEPT







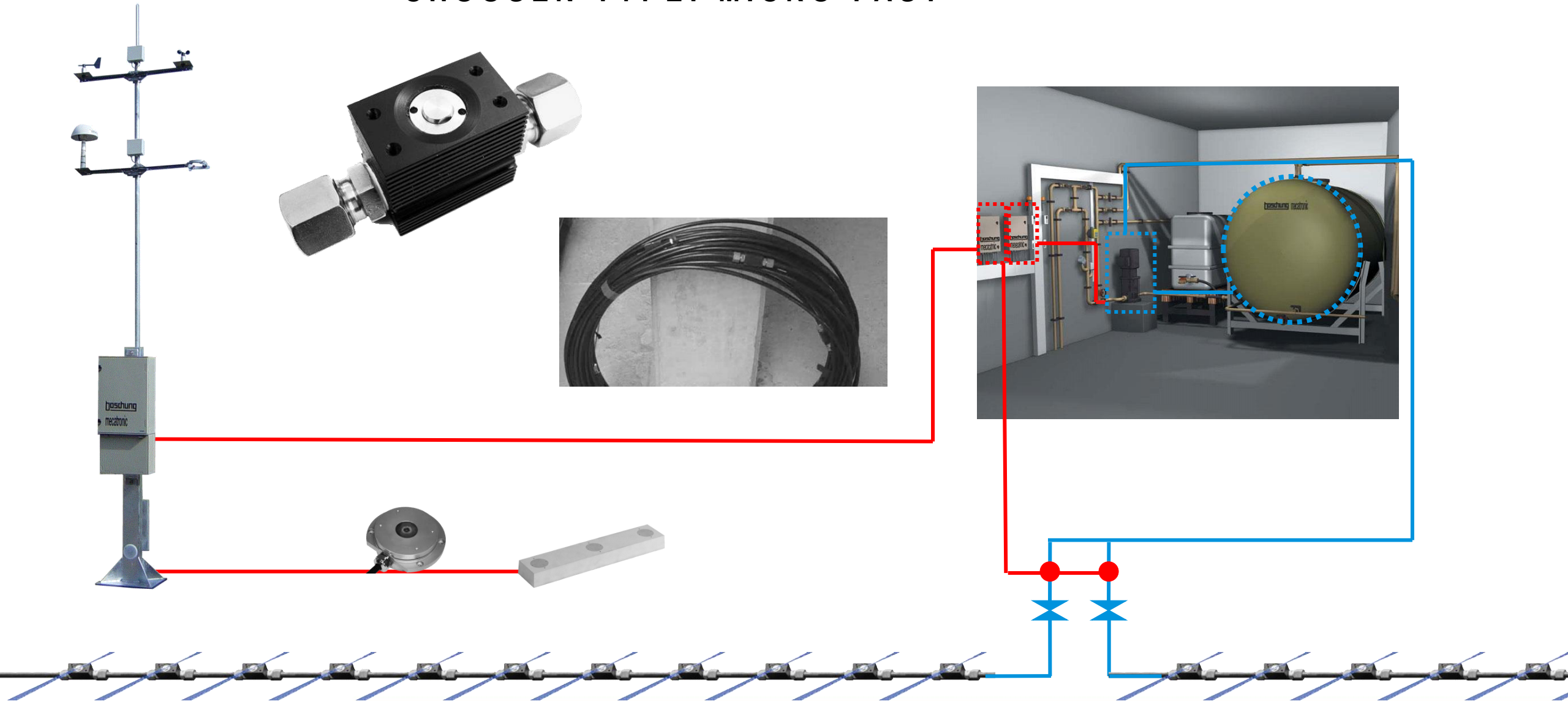
FIXED AUTOMATED SPRAY TECHNOLOGY  
CHOOSEN TYPE: MICRO-FAST





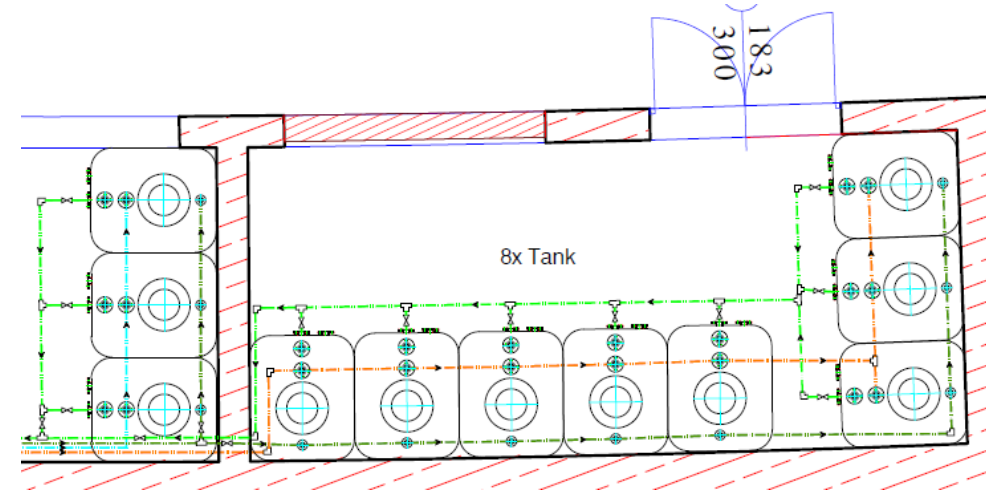


# FIXED AUTOMATED SPRAY TECHNOLOGY CHOOSEN TYPE: MICRO-FAST





# FIXED AUTOMATED SPRAY TECHNOLOGY CHOOSEN TYPE: MICRO-FAST



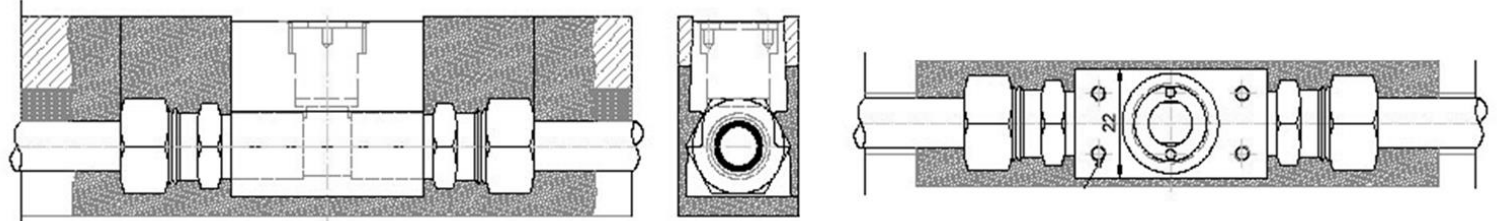
Tanks:  
3m<sup>3</sup> of water  
8m<sup>3</sup> of brine





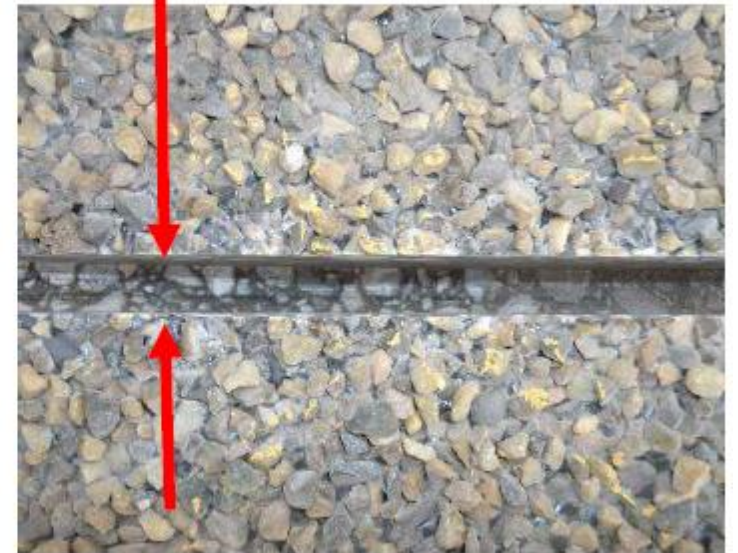


FIXED AUTOMATED SPRAY TECHNOLOGY  
CHOSEN TYPE: MICRO-FAST



48 mm

11 mm







**FIXED AUTOMATED SPRAY TECHNOLOGY  
CHOOSEN TYPE: MICRO-FAST**







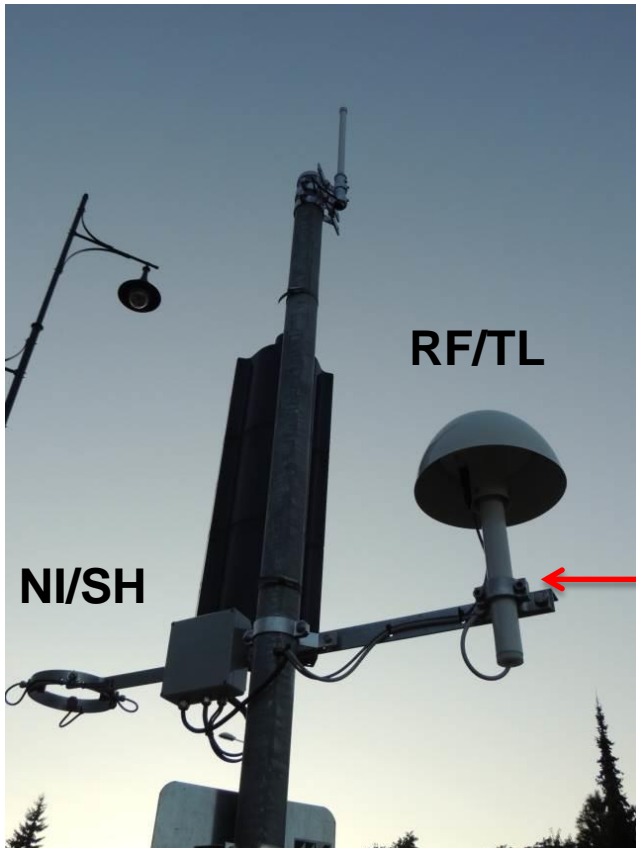
**FIXED AUTOMATED SPRAY TECHNOLOGY  
CHOSEN TYPE: MICRO-FAST**



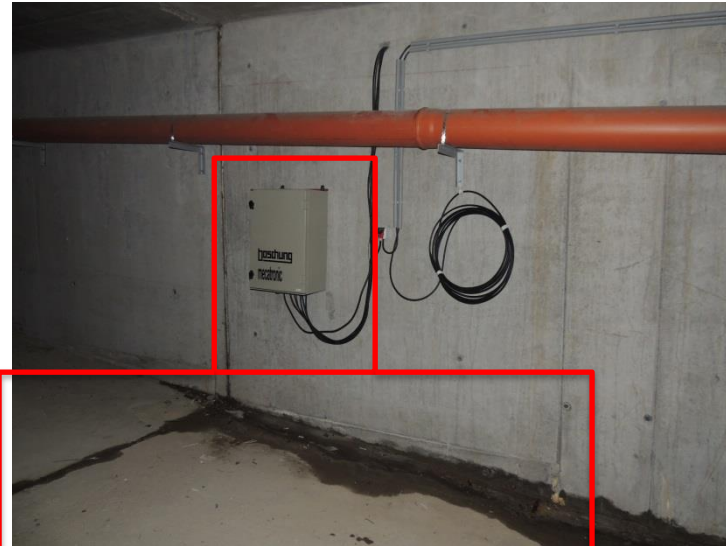


**FIXED AUTOMATED SPRAY TECHNOLOGY  
CHOOSEN TYPE: MICRO-FAST**

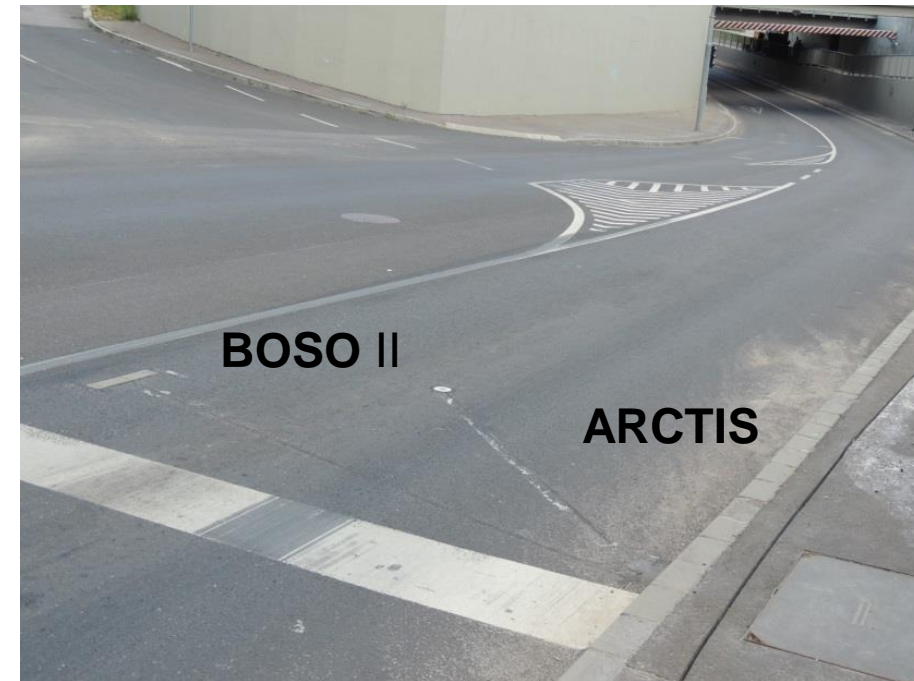
**Weather sensors**



**GFS 3000**



**Pavement sensors**





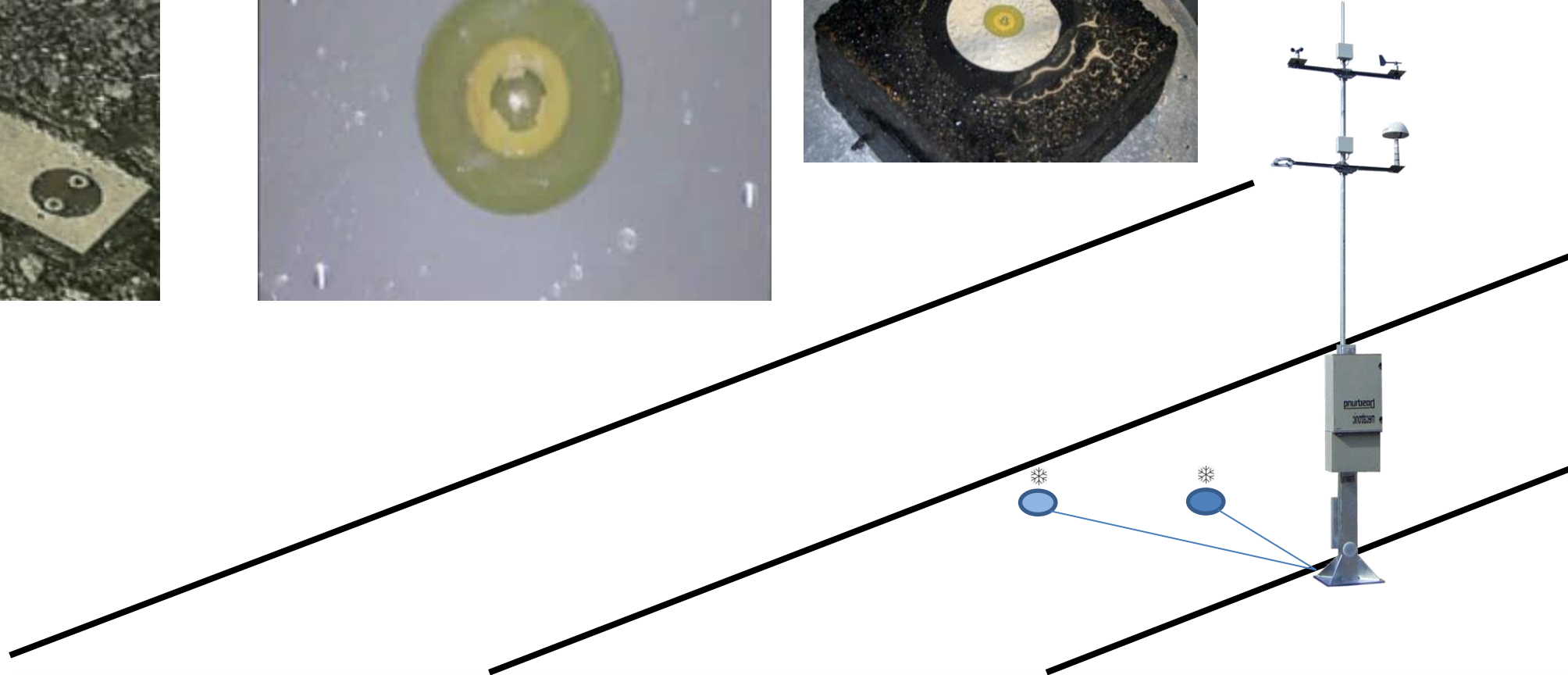
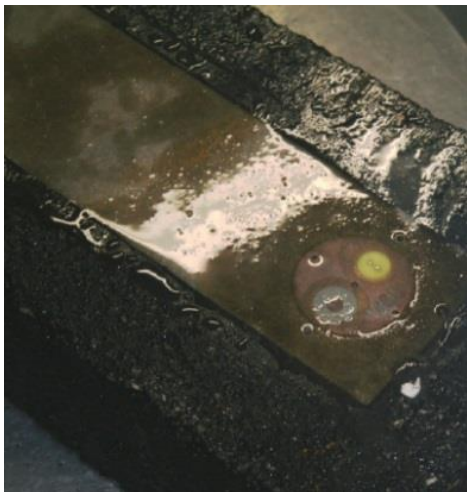
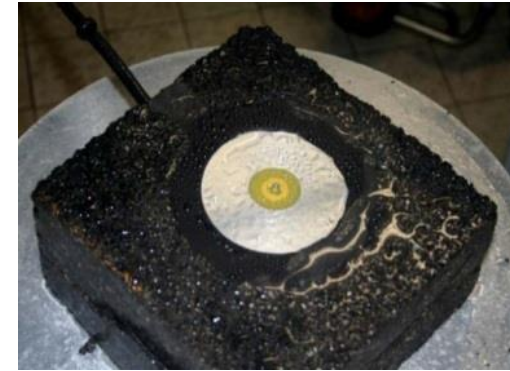
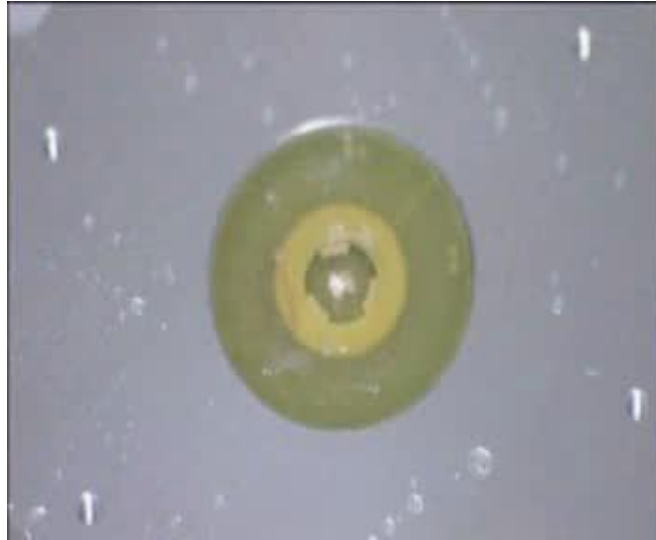


# ACTIVE-ACTIVE MEASUREMENT HIGH ACURACY ALARMS & REACTION

BOSO II



ARCTIS

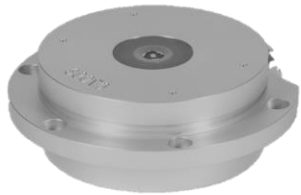




## ACTIVE-ACTIVE MEASUREMENT HIGH ACURACY ALARMS & REACTION

### ARCTIS

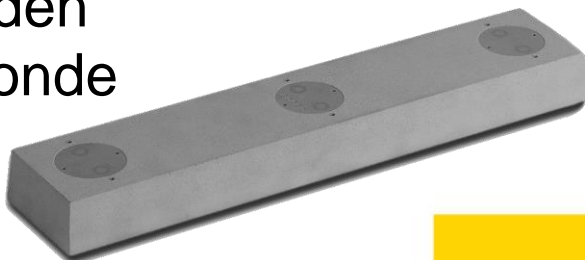
Active  
Road/Runway  
Condition  
Temperature of  
Ice formation  
Sensor



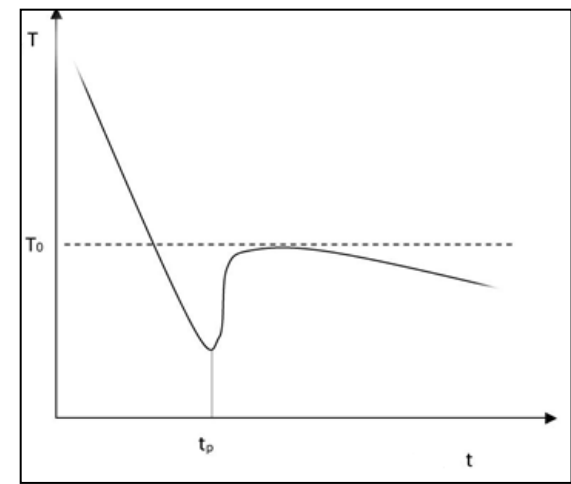
- Measurement of Freezing point temperature

- Measurement independent of deicing agent

### BOSO Boden Sonde



- High acuracy 0,5 °C



EN 15518-3:2011 (E)

Table 1 (continued)

	Parameters	Requirements
B	Freezing point temperature	<b>Measured:</b> Measuring range: - 30 °C to 0 °C Resolution: 0,1 °C <b>Accuracy: 0 °C to - 15 °C, (± 0,5 °C)</b> - 15 °C to - 30 °C, (± 1,5 °C) <b>This requirement is independent of the de-icing agent being used.</b> These accuracies are obtained under the following conditions: <ul style="list-style-type: none"><li>- Aqueous solution film thickness: 0,05 mm to 0,5 mm;</li><li>- Measured from <math>\leq 4</math> °C pavement surface temperature.</li></ul> <b>Calculated</b> Measuring range : - 30 °C to 0 °C Resolution : 0,1 °C Accuracy : 0 °C to - 2,5 °C, (± 0,5 °C) - 2,5 °C to - 30 °C, (± 20 %) This requirement depends on the de-icing agent being used. These accuracies are obtained under the following conditions: <ul style="list-style-type: none"><li>- Aqueous solution film thickness: 0,05 mm to 0,5 mm;</li><li>- Under defined and constant de-icing agent;</li><li>- Measured from <math>\leq 4</math> °C pavement surface temperature.</li></ul>



### Alarm GFS

#### Alarm 1

Roadway or air temperature below 32°F (0°C) and humid

--> **Weather condition / Information**

#### Alarm 2

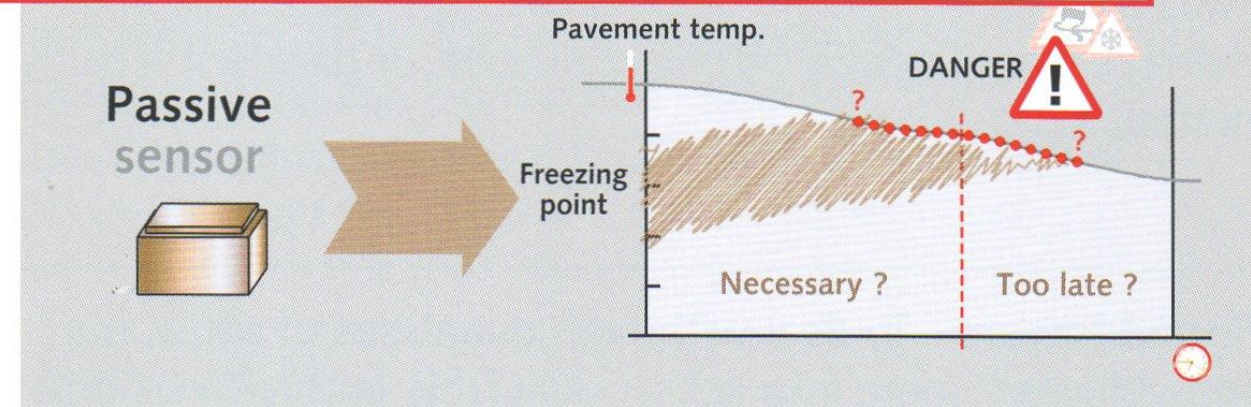
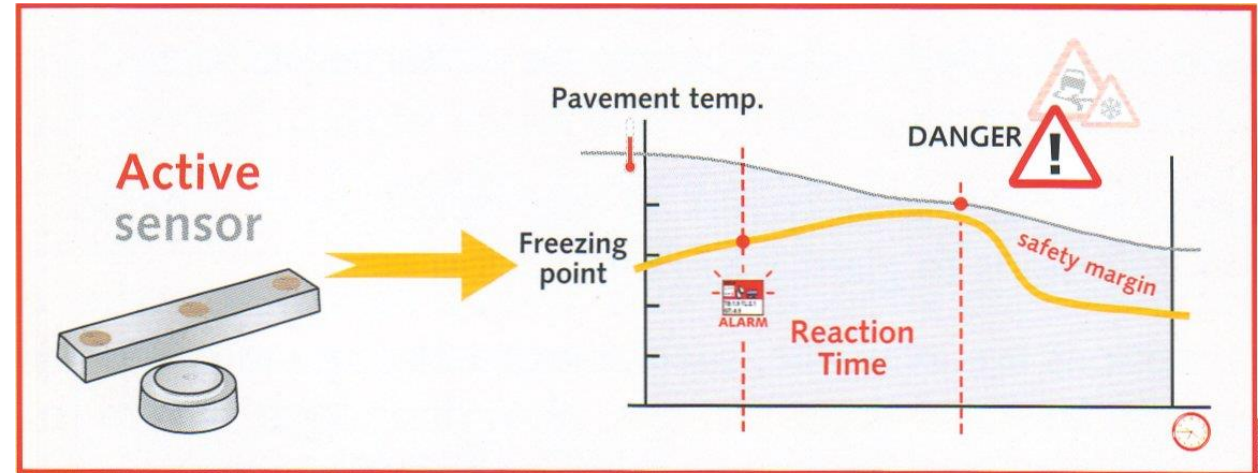
Formation of ice, observed during BOSO sensor cooling

--> **Ice warning / Situation to be analyzed**

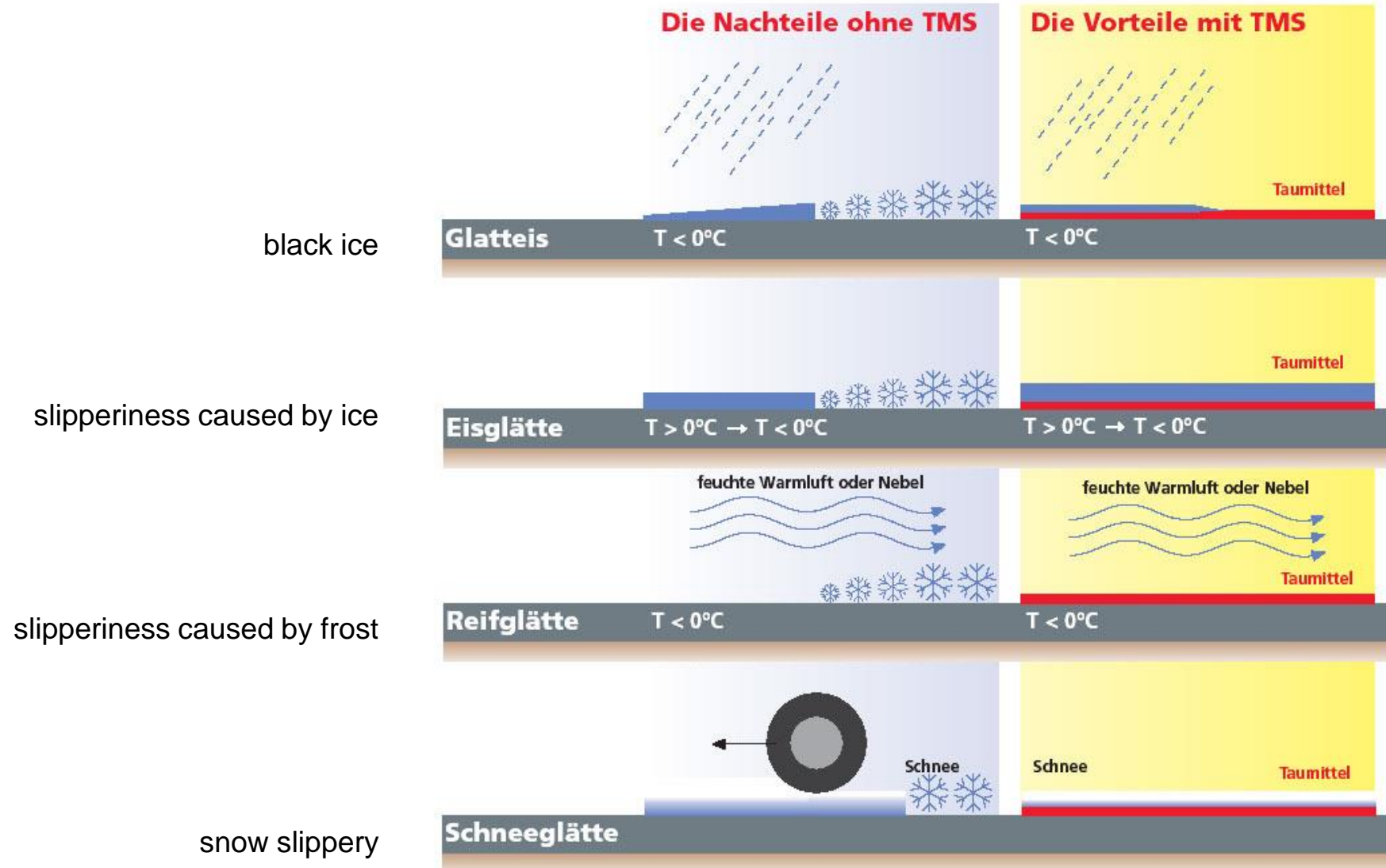
#### Alarm 3

Physical state phase modification, observed during BOSO sensor warming, snow or during rain with roadway temperature below 32°F (0°C)

--> **Ice message / Salt to be sprinkled ASAP**



## ACTIVE-ACTIVE MEASUREMENT HIGH ACURACY ALARMS & REACTION







## WINTER SPRAY CONDITIONS

- To prevent slippery danger
- Alarm(s) from active sensors
- Ground temperature between  $-15^{\circ}\text{C}$  and  $0,2^{\circ}\text{C}$







## SUMMER SPRAY CONDITIONS

- To keep installation clean
- Each 72 h, wet conditions
- If no wet conditions each 5 days



## MICRO-FAST SPRAY CONDITIONS



- multiple map layers
- easy interface
- simple graphic icons

**PUBLIC STATIONS (1,458)**

Station Name	Current Temp	Forecast Temp	Humidity	Other Data
Reichergasse	0.8 °C	1.6 °C	N/A	97.7 %
Leebrücke	-2.4 °C	-1.1 °C	N/A	100.0 %
Haschhof	-0.4 °C	0.3 °C	N/A	100.0 %
Bernser Kirchweg	N/A	N/A	N/A	N/A
Lutterberg	N/A	N/A	N/A	N/A
Aachtalbruecke	N/A	N/A	N/A	N/A
Aarebrücke	1.5 °C	-0.0 °C	N/A	91.6 %
Aarebrücke 1	5.1 °C	-0.2 °C	N/A	N/A

**PVV 01**

AT: -0.8 °C GT: 0.6 °C  
FPT: -0.3 °C RH: 99.9 %

**PVV 01**

AT: -0.9 °C GT: -0.1 °C  
FPT: -0.2 °C RH: 100.0 %

**PVV 01** 036026001001 (159 m)

AL: 1 2 3 Please hover over alarms for more information  
PT: \* 2/3  
WF: 3/4  
AT: -1.0 °C  
GT: -0.2 °C  
FPT: -0.2 °C  
RH: 100.0 %





# BORRMA - ON LINE DATA MANGEMNT SYSTEM

HISTORIC  
EXAMPLE

Ground  
temperature

Freezing point  
temperature

Spraying  
cycles






# BORRMA - ON LINE DATA MANGEMNT SYSTEM

**LIVE**  
and  
**HISTORIC**

File View Help



 **HISTORIC**

PVV 01 (36.26.1.1)

Station meteo data:

Times & dates Δ	AT [°C]	GT [°C]	FPT [°C]	RH [%]	DP [°C]	PTMS [-]	TANK_TMS [%]
13.01.2018-22:31	-0.8	-0.1	-1.1	100.0	-0.8	4	49
13.01.2018-22:37	-0.8	-0.1	-1.1	100.0			
13.01.2018-22:43	-0.9	-0.1	-0.7	100.0			
13.01.2018-22:49	-0.8	-0.0	-0.7	100.0			
13.01.2018-22:55	-0.9	0.2	-0.2	100.0			
13.01.2018-23:01	-0.9	0.3	-0.2	100.0			
13.01.2018-23:07	-0.8	0.0	-0.2	100.0			
13.01.2018-23:13	-0.9	-0.2	-0.2	100.0			
13.01.2018-23:18	-0.9	-0.1	-0.2	100.0			
13.01.2018-23:24	-1.0	-0.2	-0.2	100.0			
13.01.2018-23:30	-0.9	-0.1	-0.4	100.0			
13.01.2018-23:36	-1.0	-0.1	-0.3	100.0			
13.01.2018-23:42	-1.0	0.2	-0.3	100.0			
13.01.2018-23:48	-0.9	0.2	-0.2	100.0			
13.01.2018-23:54	-0.9	0.2	-0.2	100.0			
14.01.2018-00:00	-1.0	0.1	-0.1	100.0			
14.01.2018-00:06	-0.9	0.0	-0.1	100.0			
14.01.2018-00:12	-0.9	-0.1	-0.4	100.0			
14.01.2018-00:18	-0.9	-0.2	-0.4	100.0			
14.01.2018-00:24	-1.0	-0.2	-0.4	100.0			
14.01.2018-00:31	-1.0	-0.3	-0.8	100.0			
14.01.2018-00:37	-1.0	-0.6	-0.8	100.0			
14.01.2018-00:43	-1.1	-0.5	-0.6	100.0			
14.01.2018-00:49	-0.9	-0.3	-0.6	100.0			
14.01.2018-00:55	-1.0	-0.3	-0.2	100.0			
14.01.2018-01:01	-1.0	-0.3	-0.2	100.0			
14.01.2018-01:07	-1.0	-0.3	-0.4	100.0			
14.01.2018-01:13	-1.0	-0.2	-0.2	100.0			
14.01.2018-01:19	-1.0	-0.2	-0.2	100.0			
14.01.2018-01:25	-1.1	-0.2	-0.1	100.0			
14.01.2018-01:31	-1.1	-0.2	-0.1	100.0			
14.01.2018-01:37	-1.0	-0.2	-0.1	100.0			
14.01.2018-01:43	-1.1	-1.0	-0.1	100.0			
14.01.2018-01:48	-1.1	-1.0	-0.6	100.0			
14.01.2018-01:54	-1.1	-0.7	-0.6	100.0			
14.01.2018-02:00	-1.2	-0.7	-0.5	100.0			
14.01.2018-02:06	-1.1	-1.3	-0.5	100.0			
14.01.2018-02:12	-1.1	-1.5	-0.5	100.0			
14.01.2018-02:18	-1.1	-1.3	-1.1	100.0			

File Group Help

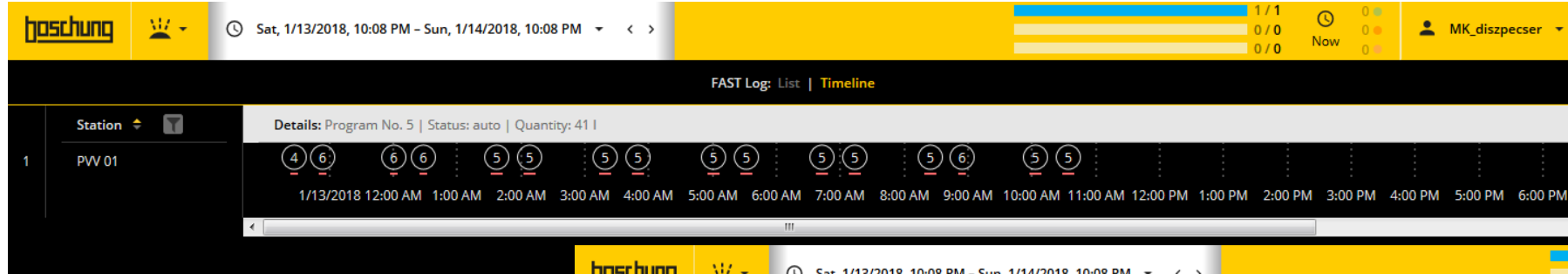
  HU

Num.	Station	Date/Time		Prg.	Quantity			Tank		Type/State		Status
Nb	Name (Nb)	Start	Duration [min s]	Nb	Spr. [l]	d[%]	d[l]	[Liter]	[%]	Type	State	Message
0	PVV 01 (036026001001)	26.04.2018-00:01	5'51"	17	24	14.0	3.0			U	M	STATUS : Valve(s) : 001 002 003 004 005 006 007
1	PVV 01 (036026001001)	27.04.2018-10:30	9'27"	17	50	-7.0	-4.0			U	M	STATUS : Valve(s) : 001 002 003 004 005 006 007
2	PVV 01 (036026001001)	01.05.2018-00:01	5'51"	17	29	38.0	8.0			U	M	STATUS : Loss[Pressure](no spraying),Valve(s) : 001 002 003 004
3	PVV 01 (036026001001)	03.05.2018-15:23	0'0"	17	0	0.0	0.0			U	M	STATUS : Locking,
4	PVV 01 (036026001001)	08.05.2018-14:51	0'0"	17	0	0.0	0.0			U	R	
5	PVV 01 (036026001001)	11.05.2018-11:16	10'39"	17	60	11.0	6.0			U	M	STATUS : Valve(s) : 001 002 005 007 008
6	PVV 01 (036026001001)	13.05.2018-11:26	0'18"	17	60	11.0	6.0			U	M	STATUS : Valve(s) : 001 002 005 007 008
7	PVV 01 (036026001001)	15.05.2018-04:31	5'42"	17	29	38.0	8.0			U	M	STATUS : Loss[Pressure](no spraying),Valve(s) : 001 002 003 004
8	PVV 01 (036026001001)	16.05.2018-06:08	0'0"	17	0	0.0	0.0			U	M	STATUS : Locking,
9	PVV 01 (036026001001)	16.05.2018-21:32	0'0"	17	0	0.0	0.0			U	M	STATUS : Locking,
10	PVV 01 (036026001001)	17.05.2018-09:25	0'0"	17	0	0.0	0.0			U	R	
11	PVV 01 (036026001001)	17.05.2018-11:21	0'0"	17	0	0.0	0.0			U	M	STATUS : Locking,
12	PVV 01 (036026001001)	17.05.2018-20:35	0'0"	17	0	0.0	0.0			U	M	STATUS : Serial line,
13	PVV 01 (036026001001)	18.05.2018-10:02	0'0"	17	0	0.0	0.0			U	R	
14	PVV 01 (036026001001)	18.05.2018-10:05	10'39"	17	60	11.0	6.0			U	M	STATUS : Valve(s) : 002 003 004 005 007 008
15	PVV 01 (036026001001)	18.05.2018-10:27	0'0"	17	0	0.0	0.0			U	R	
16	PVV 01 (036026001001)	18.05.2018-10:30	10'21"	17	51	-6.0	-3.0			U	M	STATUS : Valve(s) : 002 004 005 006
17	PVV 01 (036026001001)	22.05.2018-13:01	7'49"	2	14	-33.0	-7.0			M	U	STATUS : Spraying nozzle to clean, Valve(s) : 006





# BORRMA - ON LINE DATA MANGEMNT SYSTEM



	Station	Start time	Duration	Prg	Quantity	Tank	Status	Messages
1	PWV 01	Sun, 1/14/2018 10:28 AM	117"	5	41 l		auto	
2	PWV 01	Sun, 1/14/2018 9:57 AM	117"	5	41 l		auto	
3	PWV 01	Sun, 1/14/2018 8:50 AM	7:22"	6	20 l		auto	
4	PWV 01	Sun, 1/14/2018 8:19 AM	117"	5	41 l		auto	
5	PWV 01	Sun, 1/14/2018 7:08 AM	117"	5	41 l		auto	
6	PWV 01	Sun, 1/14/2018 6:37 AM	117"	5	41 l		auto	
7	PWV 01	Sun, 1/14/2018 5:26 AM	117"	5	41 l		auto	
8	PWV 01	Sun, 1/14/2018 4:55 AM	117"	5	41 l		auto	
9	PWV 01	Sun, 1/14/2018 3:44 AM	117"	5	41 l		auto	
10	PWV 01	Sun, 1/14/2018 3:13 AM	11:16"	5	41 l		auto	
11	PWV 01	Sun, 1/14/2018 2:02 AM	11:16"	5	41 l		auto	
12	PWV 01	Sun, 1/14/2018 1:31 AM	117"	5	42 l		auto	
13	PWV 01	Sun, 1/14/2018 12:24 AM	7:22"	6	21 l		auto	
14	PWV 01	Sat, 1/13/2018 11:57 PM	7:22"	6	21 l		auto	
15	PWV 01	Sat, 1/13/2018 10:50 PM	7:22"	6	21 l		auto	
16	PWV 01	Sat, 1/13/2018 10:23 PM	7:22"	4	23 l		auto	

FAST log

&

Timeline



## WINTER SEASON 2017 / 2018 STATISTICS

from 31<sup>st</sup> of October 2017 till 28<sup>th</sup> of March 2018

Description	Value	Unit
The air temperature has reached or dropped below 0°C	95	times
The pavement temperature has reached or dropped below 0°C	91	times
<b>The freezing point temperature reached or dropped below pavement temperature when road was wet</b>	<b>45</b>	<b>times</b>
Days when weather station reported weather alarms (different types)	90	days
Days with presence of precipitation (different types and durations)	55	days
Days with presence of snow precipitation	29	days
<b>Key days of most often alarming and spraying</b>	<b>38</b>	<b>days</b>
Brine used in total (calculated from % of tanks)	9120	liters
Spray programs triggered in total	298	times
Spray programs triggered because of weather conditions	251	times
Spray programs triggered for self-cleaning (maintenance spraying)	47	times
<b>The average amount of liquid used for one spray (calculated from % of tanks and number of spray programs)</b>	<b>30,60</b>	<b>liters</b>
Average time of spraying for one nozzle	40	seconds
Number of nozzles	100	pieces
Average quantity of de-icer sprayed by one nozzle	306	ml

















**boschung**

**boschung**

THANK YOU



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