

# Monthly report

## Railway Field Laboratory

October 2023

**Client:** Swiss confederation; Federal Offices for the Environment (FOEN) and Transport (FOT), CH-3003 Bern  
The FOEN and the FOT are offices of the Federal Department of the Environment, Transport, Energy and Communications (DETEC).

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**Remarks:** This report was published on behalf the Swiss Federal Office for the Environment (FOEN) and Transport (FOT). The consultant is responsible for the content and all data displayed.

**Version:** V2  
Data basis: Database V3

**Date:** 26.2.2024

## 1. Status railway field laboratory

Construction work on the tracks:

- none

Downtimes of the measurement systems:

- none

Downtimes of the sensors:

- MQ 1\_1: a-mq11-2-rh (probably caused by parts of a train hanging down) 7.10.- 8.12.
- MQ 1\_2: a-mq12-4-rf (due to defect) 14.10. – 17.11
- MQ 1\_3: a-mq13-2-rh (probably caused by parts of a train hanging down) 7.10.- 8.12.
- MQ 2\_1: a-mq21-2-rh (probably caused by parts of a train hanging down) 7.10.- 8.12.
- MQ 2\_2: a-mq22-2-rh (probably caused by parts of a train hanging down) 7.10.- 8.12.
- MQ 2\_3: a-mq23-2-rh (probably caused by parts of a train hanging down) 7.10.- .
- REF: a-ref-2-rh (probably caused by parts of a train hanging down) 23.10.- 8.12.
- REF: a-ref-4-rh (probably caused by parts of a train hanging down) 23.10.- 8.12.

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

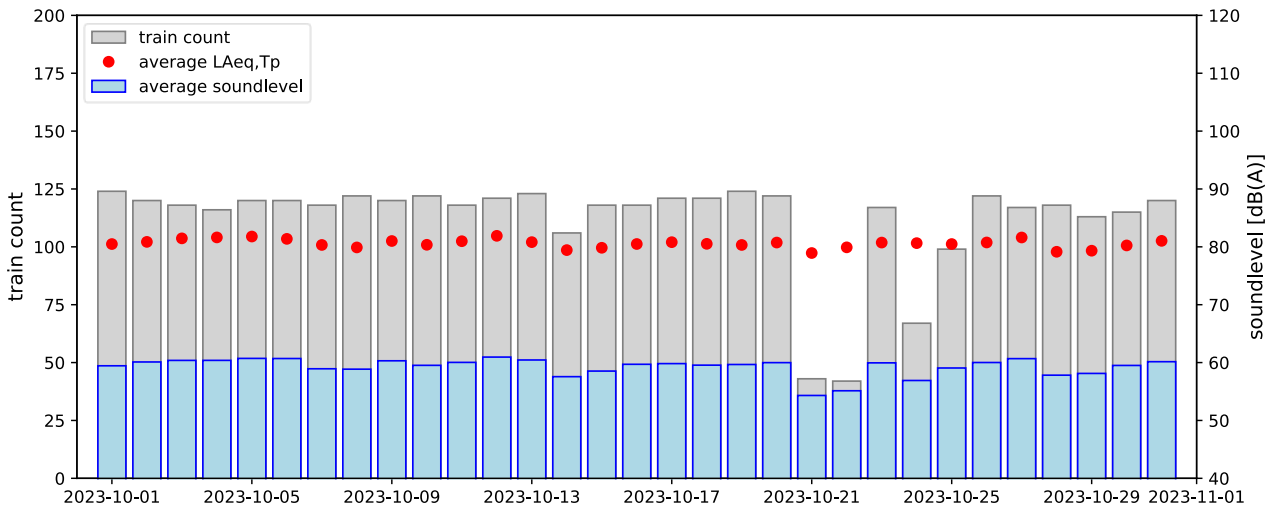
- none

Monthly data volume collected:

- 614 GB

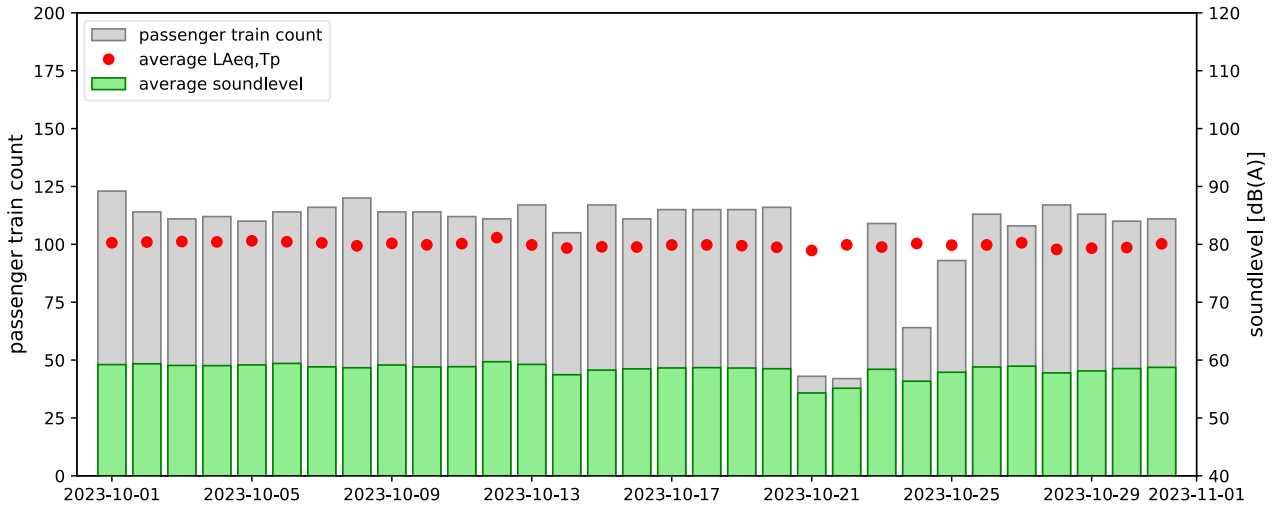
## 2. Measurement data

Daytime averages (24h) for all train passages at reference section (REF)



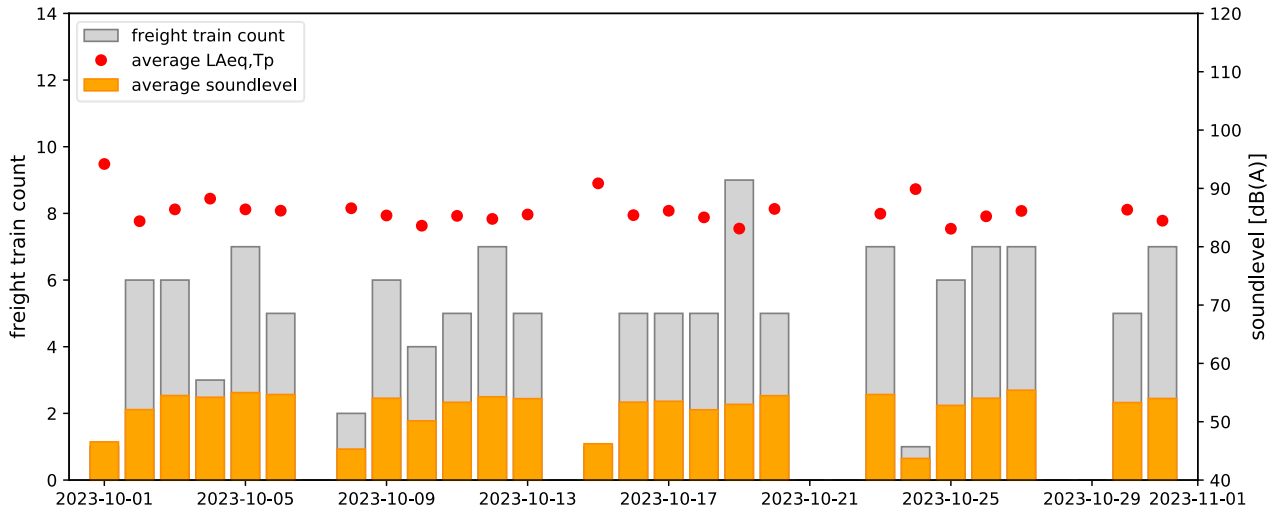
date	location	train count	passenger train count	freight train count	service train count	average LAeq,Tp	average soundlevel
01.10.2023	REF	124	123	1	0	80,5	59,4
02.10.2023	REF	120	114	6	0	80,9	60,1
03.10.2023	REF	118	111	6	1	81,5	60,4
04.10.2023	REF	116	112	3	1	81,6	60,4
05.10.2023	REF	120	110	7	3	81,8	60,7
06.10.2023	REF	120	114	5	1	81,4	60,7
07.10.2023	REF	118	116	0	2	80,3	58,9
08.10.2023	REF	122	120	2	0	79,9	58,9
09.10.2023	REF	120	114	6	0	81	60,3
10.10.2023	REF	122	114	4	4	80,4	59,5
11.10.2023	REF	118	112	5	1	81	60
12.10.2023	REF	121	111	7	3	81,9	61
13.10.2023	REF	123	117	5	1	80,8	60,4
14.10.2023	REF	106	105	0	1	79,4	57,6
15.10.2023	REF	118	117	1	0	79,8	58,5
16.10.2023	REF	118	111	5	2	80,5	59,7
17.10.2023	REF	121	115	5	1	80,8	59,8
18.10.2023	REF	121	115	5	1	80,5	59,6
19.10.2023	REF	124	115	9	0	80,3	59,7
20.10.2023	REF	122	116	5	1	80,7	60
21.10.2023	REF	43	43	0	0	78,9	54,3
22.10.2023	REF	42	42	0	0	79,9	55,1
23.10.2023	REF	117	109	7	1	80,7	60
24.10.2023	REF	67	64	1	2	80,6	56,9
25.10.2023	REF	99	93	6	0	80,5	59,1
26.10.2023	REF	122	113	7	2	80,8	60
27.10.2023	REF	117	108	7	2	81,6	60,7
28.10.2023	REF	118	117	0	1	79,1	57,8
29.10.2023	REF	113	113	0	0	79,3	58,1
30.10.2023	REF	115	110	5	0	80,2	59,5
31.10.2023	REF	120	111	7	2	81	60,2
<b>month</b>	<b>REF</b>	<b>3465</b>	<b>3305</b>	<b>127</b>	<b>33</b>	<b>80,7</b>	<b>59,5</b>

Daytime averages (24h) for all passenger train passages at reference section (REF)



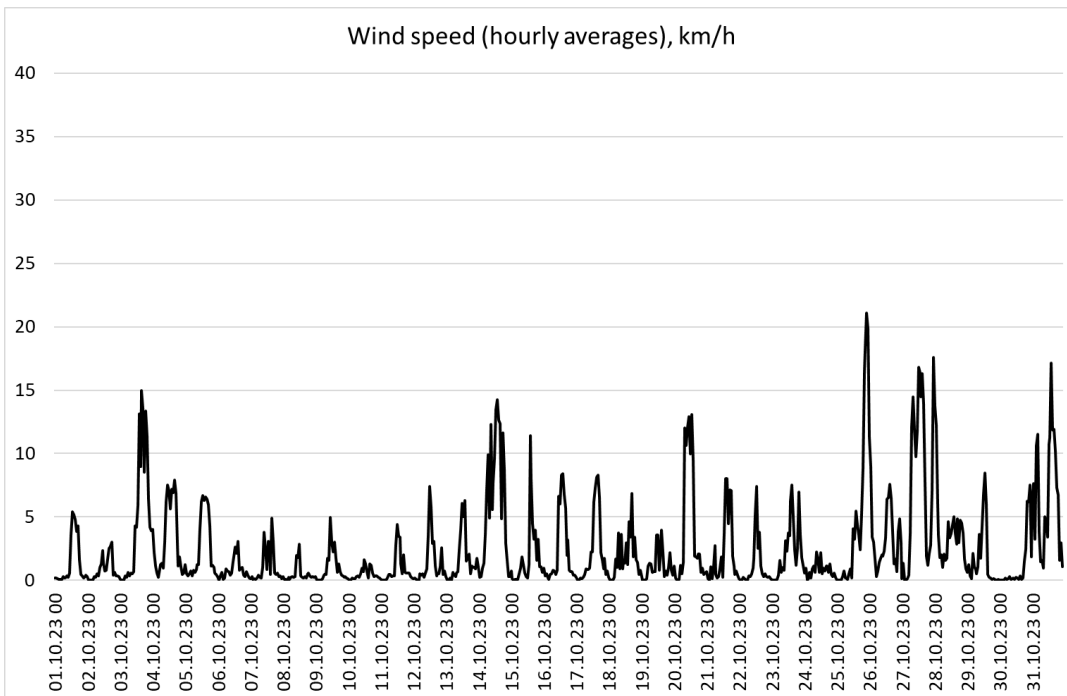
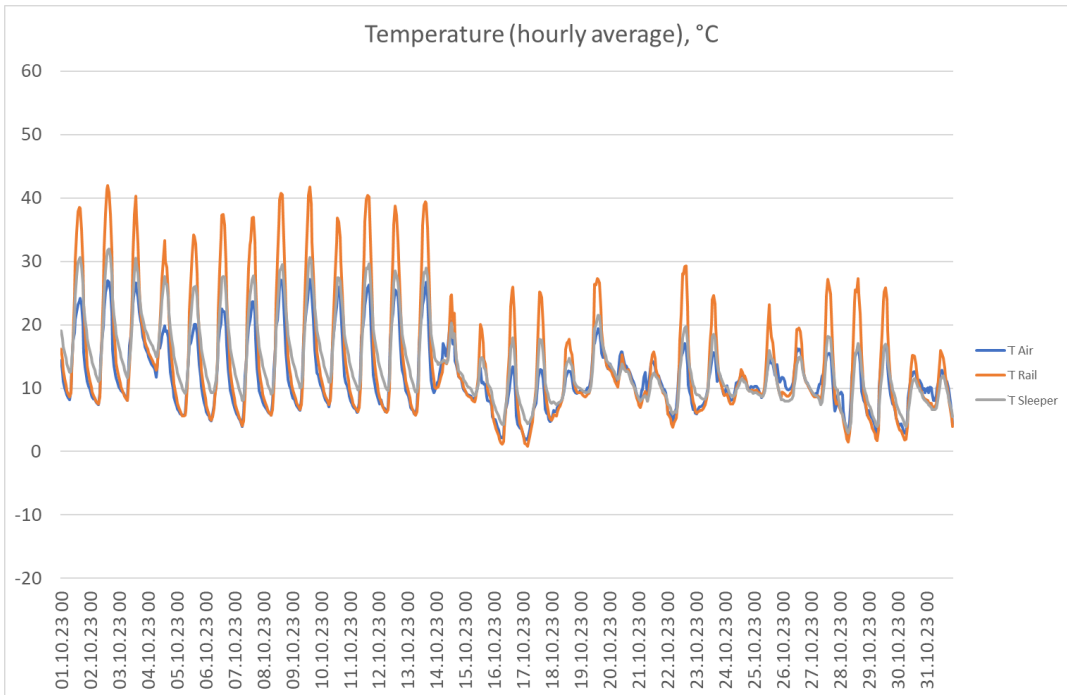
date	location	passenger train count	average speed	average length	average axlecount	average LAeqTp	average soundlevel
01.10.2023	REF	123	111,6	150,3	21,6	80,3	59,2
02.10.2023	REF	114	111,3	168,3	24,2	80,4	59,4
03.10.2023	REF	111	112,4	159,1	23	80,5	59,1
04.10.2023	REF	112	111,1	155,7	22,7	80,4	59
05.10.2023	REF	110	113,6	160,5	23,2	80,6	59,2
06.10.2023	REF	114	112,8	168,6	24,2	80,5	59,4
07.10.2023	REF	116	111,8	149,2	21,4	80,3	58,8
08.10.2023	REF	120	111,4	153,3	22,2	79,7	58,7
09.10.2023	REF	114	112,6	166,3	23,9	80,2	59,1
10.10.2023	REF	114	109,5	157,4	22,8	79,9	58,8
11.10.2023	REF	112	112,7	162,7	23,5	80,1	58,9
12.10.2023	REF	111	114,2	160,3	23,2	81,2	59,7
13.10.2023	REF	117	109,8	170,4	24,4	79,9	59,3
14.10.2023	REF	105	111,8	146,7	20,9	79,4	57,5
15.10.2023	REF	117	110,8	148,4	21,3	79,6	58,3
16.10.2023	REF	111	111,1	168,2	24,2	79,5	58,5
17.10.2023	REF	115	112,2	159,2	23	79,9	58,6
18.10.2023	REF	115	111,4	158,4	23	79,9	58,7
19.10.2023	REF	115	111,8	161,2	23,3	79,8	58,6
20.10.2023	REF	116	112,9	168,5	24,2	79,5	58,5
21.10.2023	REF	43	90	148	20,3	78,9	54,3
22.10.2023	REF	42	91,4	146,4	20	79,9	55,1
23.10.2023	REF	109	111,8	170,2	24,3	79,5	58,4
24.10.2023	REF	64	115,3	164	23,8	80,1	56,4
25.10.2023	REF	93	111,1	161,5	23,4	79,9	57,9
26.10.2023	REF	113	111,7	163,6	23,8	79,9	58,8
27.10.2023	REF	108	112,5	164,6	23,7	80,3	58,9
28.10.2023	REF	117	112,6	149,4	21,2	79,1	57,8
29.10.2023	REF	113	109,8	152	21,9	79,3	58,1
30.10.2023	REF	110	110,5	170,5	24,6	79,4	58,5
31.10.2023	REF	111	112,2	160,1	23,3	80,1	58,7
<b>month</b>	<b>REF</b>	<b>3305</b>	<b>111,3</b>	<b>159,8</b>	<b>23</b>	<b>80</b>	<b>58,5</b>

Daytime averages (24h) for all freight train passages at reference section (REF)



date	location	freight train count	average speed	average length	average axle count	average LAeqTp	average soundlevel
01.10.2023	REF	1	98	39,3	9	94,2	46,5
02.10.2023	REF	6	81,2	166,9	33,8	84,4	52,1
03.10.2023	REF	6	87,7	220,7	51,7	86,4	54,5
04.10.2023	REF	3	90,7	277,7	75,3	88,2	54,2
05.10.2023	REF	7	87,8	211,2	49,1	86,4	55
06.10.2023	REF	5	81,9	251,7	63,2	86,2	54,7
07.10.2023	REF	0					0
08.10.2023	REF	2	74,9	60,7	10	86,6	45,3
09.10.2023	REF	6	85,1	240,1	56	85,4	54
10.10.2023	REF	4	72,4	187,8	44	83,6	50,1
11.10.2023	REF	5	83,7	240,8	50,4	85,3	53,3
12.10.2023	REF	7	85,6	253	57,7	84,8	54,3
13.10.2023	REF	5	87	279,8	65,6	85,5	54
14.10.2023	REF	0					0
15.10.2023	REF	1	96,7	78,7	20	90,9	46,2
16.10.2023	REF	5	72,5	230	52,8	85,4	53,4
17.10.2023	REF	5	94,6	227,1	47,6	86,2	53,5
18.10.2023	REF	5	90,1	208,3	42,4	85	52
19.10.2023	REF	9	75,8	186,7	41,3	83,1	53
20.10.2023	REF	5	90,7	260,4	63,6	86,5	54,5
21.10.2023	REF	0					0
22.10.2023	REF	0					0
23.10.2023	REF	7	89,9	238,8	53,4	85,7	54,7
24.10.2023	REF	1	90,5	56,8	10	89,9	43,7
25.10.2023	REF	6	74,3	261,9	59,3	83,1	52,8
26.10.2023	REF	7	80,4	195,6	40,7	85,2	54
27.10.2023	REF	7	86,8	243,7	53,7	86,1	55,4
28.10.2023	REF	0					0
29.10.2023	REF	0					0
30.10.2023	REF	5	88,6	213,4	40,5	86,3	53,3
31.10.2023	REF	7	81,4	235,3	54,3	84,5	54
<b>month</b>	<b>REF</b>	<b>127</b>	<b>84,1</b>	<b>221,5</b>	<b>50</b>	<b>85,5</b>	<b>52,2</b>

### 3. Weather data



## Appendix: measurement quantities

### Transit Exposure Level *TEL*

A-weighted sound pressure level of a single train pass-by as energetic average over the entire exposure duration  $T$  and averaged over the pass-by duration  $T_p$ .

$$TEL = 10 \log \left( \frac{1}{T_p} \int_0^T \frac{p_A^2(t)}{p_0^2} dt \right) \quad (1)$$

Where

$p_A(t)$  = the A-weighted sound pressure, [Pa]

$p_0 = 20 \mu Pa$  (reference pressure), [Pa]

$T_p = T_2 - T_1$  = pass-by duration of the train, time interval during which a train is within the measurement cross-section and which starts with the entry time  $T_1$  into the measurement cross-section and ends with the exit time  $T_2$ , [s]

$T$  = time interval which starts when the smoothed sound pressure level (sound pressure level smoothed as a function of time with the frequency weighting A and a time weighting F („fast“ or averaging over a duration period of time, e.g. 100 ms) is for the last time 10 dB below that prevailing at the time of entering the measurement cross-section and which ends when the smoothed sound pressure level is for the first time 10 dB below the one at the time of leaving the measurement cross-section. [s]

### A-weighted equivalent sound pressure level of the train pass-by $L_{Aeq,Tp}$

The A-weighted equivalent sound pressure level equals the (energetic) average of the sound pressure level over the train pass-by time  $T_p$  according to the following equation:

$$L_{Aeq,Tp} = 10 \log \left( \frac{1}{T_p} \int_{T_1}^{T_2} \frac{p_A^2(t)}{p_0^2} dt \right) \quad (2)$$

where

$p_A(t)$  = the A-weighted sound pressure, [Pa]

$p_0 = 20 \mu Pa$  (reference sound pressure), [Pa]

$T_p = T_2 - T_1$  = pass-by duration of the train, [s]



### Sound Exposure Level **SEL**

The sound exposure level *SEL* references the acoustic energy of the entire pass-by event to one second. The *SEL* is used in calculating average sound level contributions from trains over longer periods of time (i.e. days/months/year). The *SEL* is related to the transit exposure level *TEL* through:

$$SEL = TEL - 10 \log (T_0 / T_p) \quad (3)$$

where

$$T_0 = 1 \text{ [s]}$$

$T_p$  = pass-by duration of the train, [s]

### Average sound level (period)

Average (energetic) A-weighted sound pressure level measured over a given period of time.

For the average sound level contributions from train pass-byes this equals the sum (energetic) of all sound exposure levels during the period for a given measurement position:

$$average \ soundlevel = 10 \cdot \log_{10} \left( \sum 10^{\frac{SEL}{10}} \right) - A1 \quad (4)$$

where

$$A1 = 10 \cdot \log_{10}(n \cdot 24 \cdot 3600) \text{ for a 24-hour period}$$

*SEL* (see equation 3) taken from measurement data

$n$  = number of days being averaged over

### Average $L_{Aeq,Tp}$

Average (energetic) sound level of all the A-weighted sound pressure levels from the individual equivalent sound level of all train pass-byes in a given period of time (day/month/year).

Calculated per train category and per period day/night, month, year, etc. and per measurement location:

$$average \ L_{Aeq,Tp} = 10 \cdot \log_{10} \left( \sum T_p \cdot 10^{\frac{L_{Aeq,Tp}}{10}} \right) + 10 \cdot \log_{10} \left( \frac{1}{\sum T_p} \right) \quad (5)$$

where

$T_p$  = pass-by duration of the train [s]

$L_{Aeq,Tp}$  (see equation 2) is calculated directly from the measurement data