

# Monthly report

## Railway Field Laboratory

February 2024

**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:** V1  
Data basis: Database V3

**Date:** 8.7.2024

## 1. Status railway field laboratory

Construction work on the tracks:

- none

Downtimes of the measurement systems:

- none

Downtimes of the sensors:

- MQ 2\_3: a-mq23-2-rh (probably caused by parts of a train hanging down) 7.10.23- 10.4.24.

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

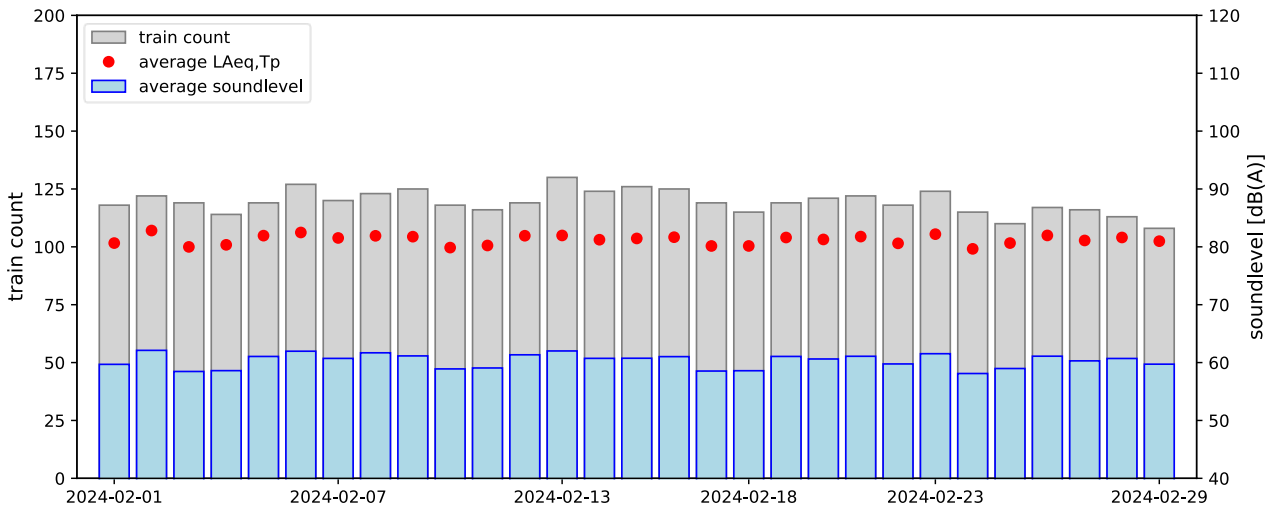
- none

Monthly data volume collected:

- 517 GB

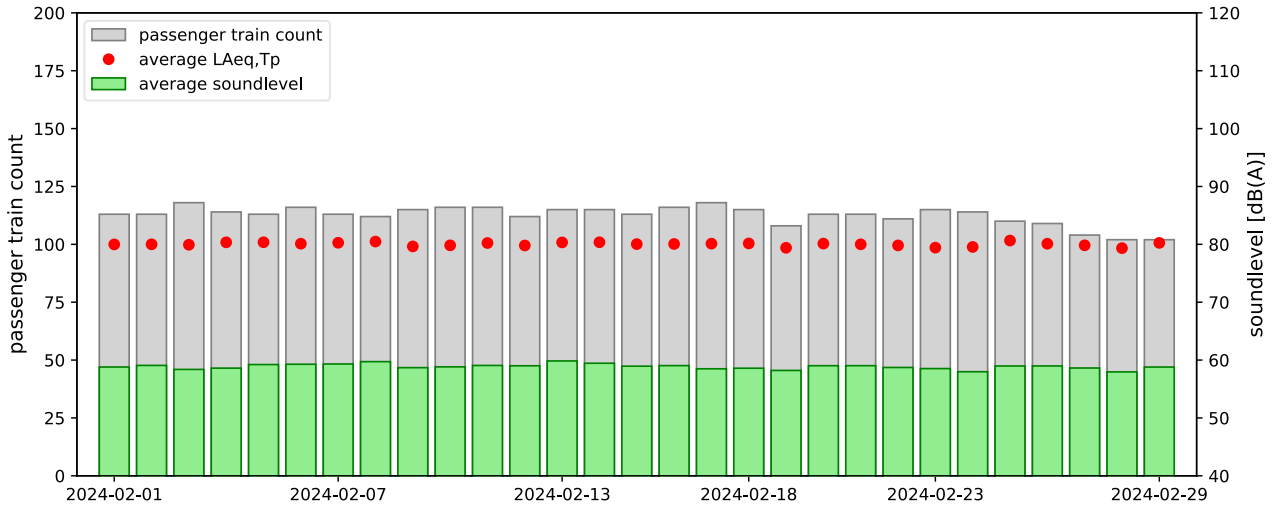
## 2. Measurement data

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



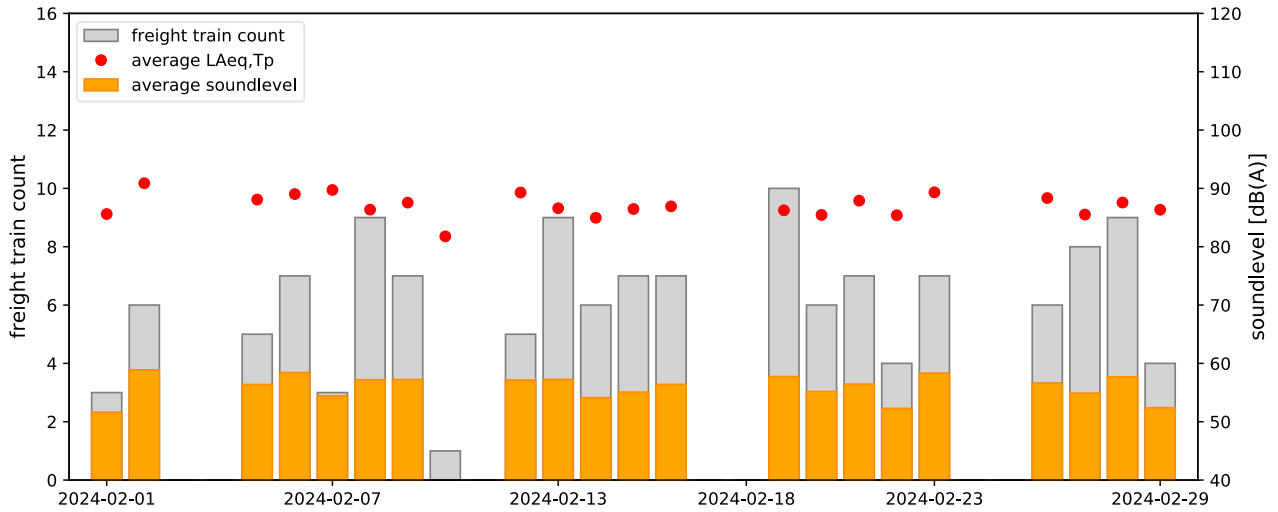
date	location	train count	passenger train count	freight train count	service train count	average LAeqTp	average soundlevel
01.02.2024	REF	118	113	3	2	80,7	59,7
02.02.2024	REF	122	113	6	3	82,8	62,1
03.02.2024	REF	119	118	0	1	80,0	58,5
04.02.2024	REF	114	114	0	0	80,3	58,6
05.02.2024	REF	119	113	5	1	81,9	61,1
06.02.2024	REF	127	116	7	4	82,5	62,0
07.02.2024	REF	120	113	3	4	81,5	60,7
08.02.2024	REF	123	112	9	2	81,9	61,7
09.02.2024	REF	125	115	7	3	81,8	61,2
10.02.2024	REF	118	116	1	1	79,9	58,9
11.02.2024	REF	116	116	0	0	80,2	59,1
12.02.2024	REF	119	112	5	2	81,9	61,3
13.02.2024	REF	130	115	9	6	82,0	62,0
14.02.2024	REF	124	115	6	3	81,2	60,7
15.02.2024	REF	126	113	7	6	81,4	60,8
16.02.2024	REF	125	116	7	2	81,7	61,0
17.02.2024	REF	119	118	0	1	80,1	58,5
18.02.2024	REF	115	115	0	0	80,2	58,6
19.02.2024	REF	119	108	10	1	81,6	61,1
20.02.2024	REF	121	113	6	2	81,3	60,6
21.02.2024	REF	122	113	7	2	81,8	61,1
22.02.2024	REF	118	111	4	3	80,6	59,8
23.02.2024	REF	124	115	7	2	82,2	61,5
24.02.2024	REF	115	114	0	1	79,7	58,1
25.02.2024	REF	110	110	0	0	80,7	59,0
26.02.2024	REF	117	109	6	2	82,0	61,1
27.02.2024	REF	116	104	8	4	81,1	60,3
28.02.2024	REF	113	102	9	2	81,6	60,7
29.02.2024	REF	108	102	4	2	81,0	59,7
<b>month</b>	<b>REF</b>	<b>3462</b>	<b>3264</b>	<b>136</b>	<b>62</b>	<b>81,4</b>	<b>60,5</b>

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



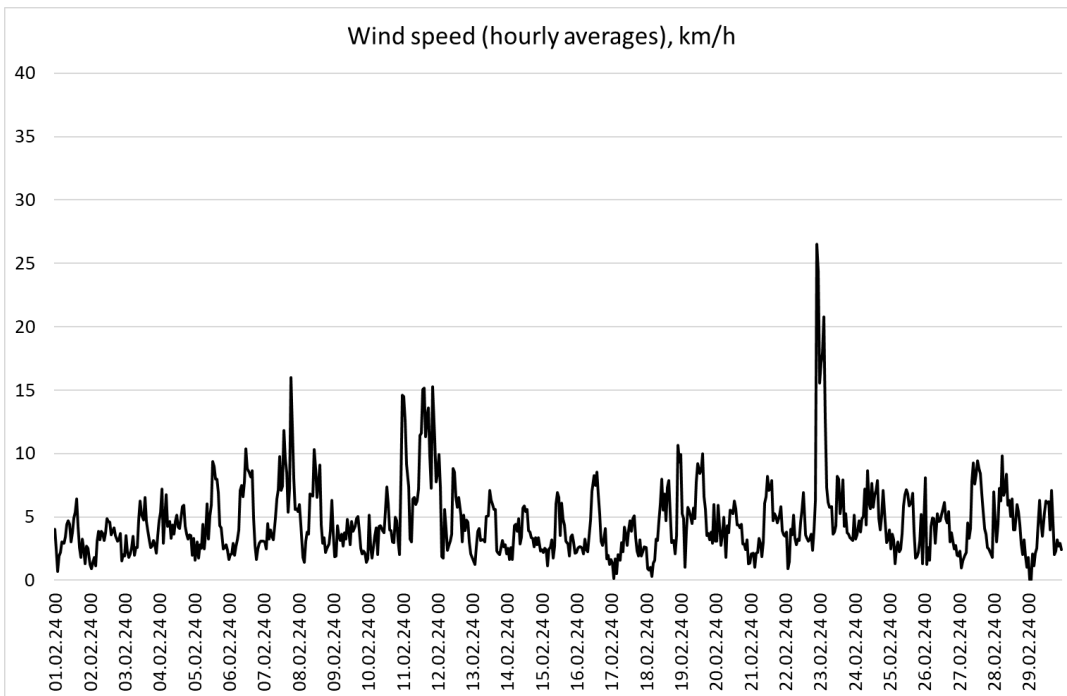
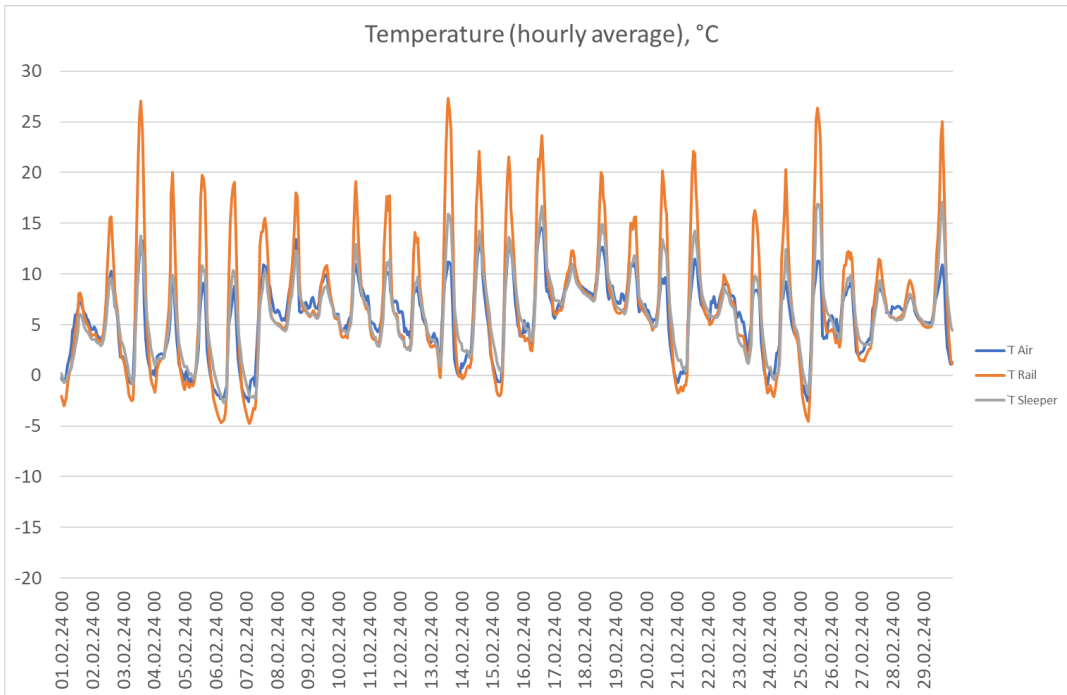
date	location	passenger train count	average speed	average length	average axlecount	average LAeqTp	average soundlevel
01.02.2024	REF	113	112,4	164,1	24,1	80,0	58,8
02.02.2024	REF	113	111,4	172,7	25,3	80,0	59,1
03.02.2024	REF	118	111,3	140,0	20,2	79,9	58,4
04.02.2024	REF	114	111,8	144,3	20,9	80,3	58,6
05.02.2024	REF	113	110,6	165,8	24,4	80,4	59,2
06.02.2024	REF	116	108,6	168,5	24,8	80,1	59,3
07.02.2024	REF	113	110,0	170,4	25,1	80,3	59,3
08.02.2024	REF	112	110,5	180,5	26,5	80,5	59,7
09.02.2024	REF	115	111,9	168,7	24,8	79,6	58,7
10.02.2024	REF	116	111,1	167,9	24,5	79,8	58,8
11.02.2024	REF	116	111,9	158,8	22,9	80,2	59,1
12.02.2024	REF	112	111,8	181,6	26,7	79,8	59,0
13.02.2024	REF	115	109,0	183,4	27,1	80,3	59,9
14.02.2024	REF	115	111,8	170,1	25,0	80,4	59,5
15.02.2024	REF	113	113,3	169,9	24,9	80,0	58,9
16.02.2024	REF	116	112,8	169,0	24,8	80,1	59,0
17.02.2024	REF	118	112,3	142,6	20,7	80,1	58,5
18.02.2024	REF	115	112,6	146,0	21,3	80,2	58,6
19.02.2024	REF	108	108,2	163,2	24,0	79,4	58,2
20.02.2024	REF	113	110,2	165,7	24,3	80,1	59,0
21.02.2024	REF	113	111,0	170,1	25,0	80,0	59,0
22.02.2024	REF	111	111,5	170,4	25,0	79,8	58,7
23.02.2024	REF	115	111,0	170,9	25,1	79,4	58,5
24.02.2024	REF	114	112,7	147,4	21,5	79,5	58,0
25.02.2024	REF	110	111,6	149,1	21,7	80,7	59,0
26.02.2024	REF	109	112,8	172,6	25,5	80,1	59,0
27.02.2024	REF	104	113,9	172,0	25,3	79,8	58,6
28.02.2024	REF	102	112,5	173,1	25,5	79,3	58,0
29.02.2024	REF	102	113,2	173,1	25,6	80,3	58,8
<b>month</b>	<b>REF</b>	<b>3264</b>	<b>111,5</b>	<b>165,0</b>	<b>24,2</b>	<b>80,0</b>	<b>58,9</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
01.02.2024	REF	3	78,0	231,1	68,0	85,6	51,6
02.02.2024	REF	6	91,2	222,7	55,0	90,9	58,9
03.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
04.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
05.02.2024	REF	5	85,3	266,0	58,0	88,1	56,4
06.02.2024	REF	7	88,3	255,3	61,4	89,0	58,4
07.02.2024	REF	3	83,7	192,8	45,3	89,7	54,5
08.02.2024	REF	9	81,3	233,4	58,9	86,4	57,2
09.02.2024	REF	7	81,7	245,6	60,9	87,6	57,2
10.02.2024	REF	1	77,6	85,1	18,0	81,8	38,7
11.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
12.02.2024	REF	5	88,1	248,2	58,8	89,3	57,1
13.02.2024	REF	9	78,9	225,2	52,2	86,6	57,3
14.02.2024	REF	6	77,3	222,2	45,0	85,0	54,1
15.02.2024	REF	7	86,4	207,8	48,0	86,5	55,1
16.02.2024	REF	7	84,6	249,1	64,3	86,9	56,4
17.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
18.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
19.02.2024	REF	10	85,3	272,1	67,4	86,2	57,7
20.02.2024	REF	6	75,5	275,5	67,7	85,5	55,2
21.02.2024	REF	7	87,2	214,6	52,3	87,9	56,5
22.02.2024	REF	4	89,0	244,4	57,0	85,4	52,3
23.02.2024	REF	7	95,1	251,1	63,7	89,3	58,3
24.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
25.02.2024	REF	0	0,0	0,0	0,0	0,0	0,0
26.02.2024	REF	6	84,1	228,6	53,7	88,3	56,6
27.02.2024	REF	8	87,5	211,9	48,3	85,5	54,9
28.02.2024	REF	9	83,8	215,8	55,5	87,6	57,7
29.02.2024	REF	4	80,9	190,3	45,5	86,3	52,4
<b>month</b>	<b>REF</b>	<b>136</b>	<b>84,5</b>	<b>234,0</b>	<b>56,6</b>	<b>87,4</b>	<b>55,0</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