

# Monthly report

## Railway Field Laboratory

July 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:** V3  
Data basis: Database V3

**Date:** 26.2.2024

## **1. Status railway field laboratory**

Construction work on the tracks:

- tamping of the measuring cross-sections MQ 2\_3 and the reference cross-section between 13.7.2023 and 18.7.2023

Downtimes of the measurement systems:

- Stations have been out of operation due to track tamping from 13.7.2023 0:00 till 18.7.2023 24:00.

Downtimes of the sensors:

- MQ 1\_2: a-mq12-4-rf (due to defect) 25.7. – 9.8.

Maintenance and sensor exchange:

- none

Modifications to the data, database, or analysis:

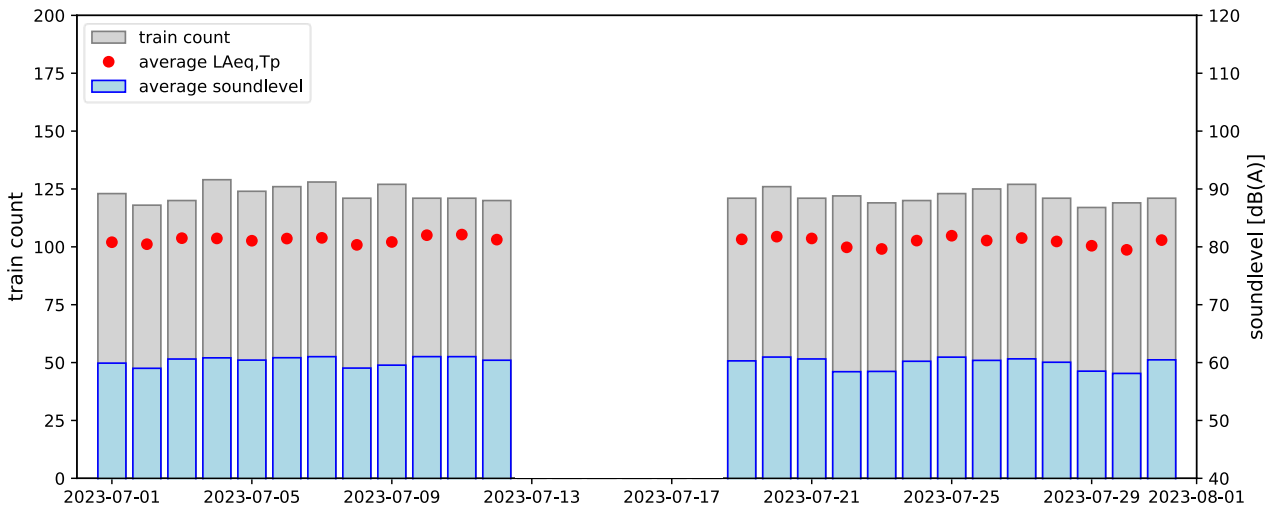
- none

Monthly data volume collected:

- 546 GB

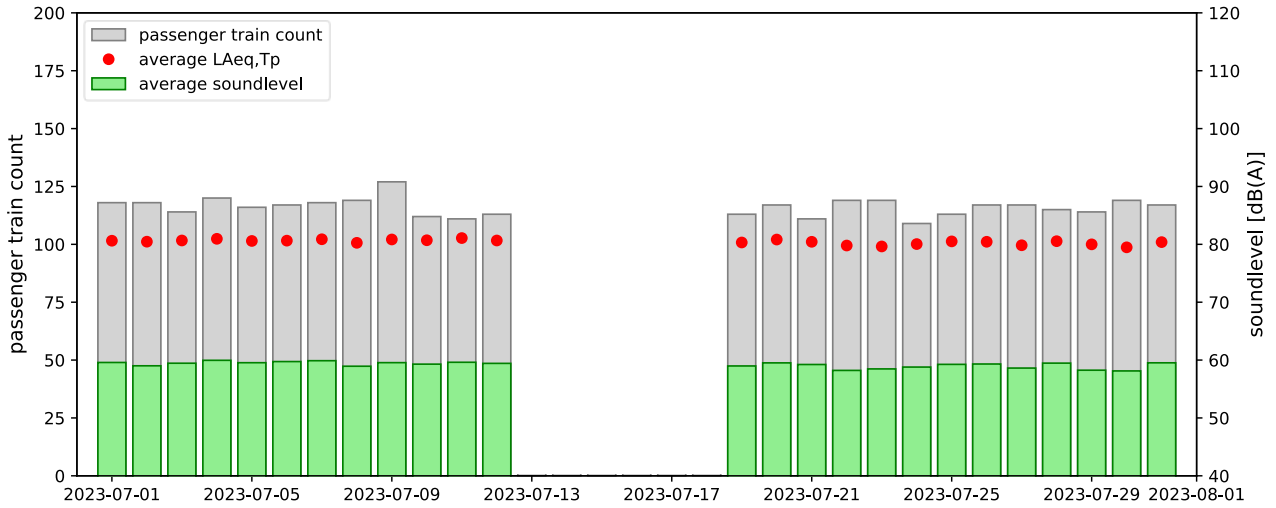
## 2. Measurement data

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



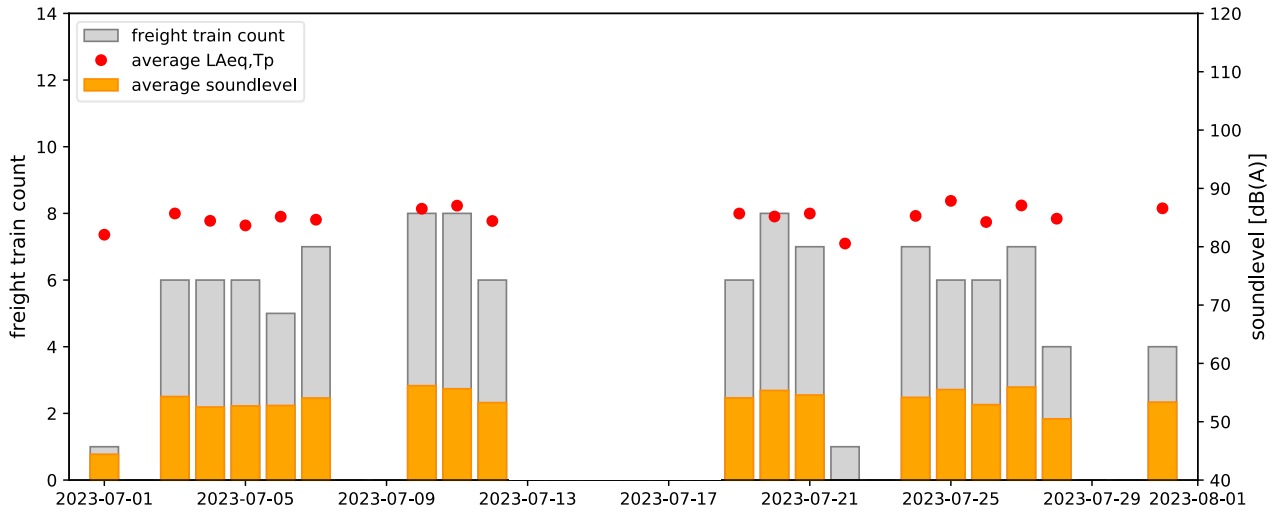
date	location	train count	passenger train count	freight train count	service train count	average LAeqTp	average soundlevel
01.07.2023	REF	123	118	1	4	80,8	59,9
02.07.2023	REF	118	118	0	0	80,5	59
03.07.2023	REF	120	114	6	0	81,5	60,6
04.07.2023	REF	129	120	6	3	81,5	60,8
05.07.2023	REF	124	116	6	2	81,1	60,4
06.07.2023	REF	126	117	5	4	81,4	60,8
07.07.2023	REF	128	118	7	3	81,6	61
08.07.2023	REF	121	119	0	2	80,3	59
09.07.2023	REF	127	127	0	0	80,8	59,6
10.07.2023	REF	121	112	8	1	82	61
11.07.2023	REF	121	111	8	2	82,1	61
12.07.2023	REF	120	113	6	1	81,2	60,4
13.07.2023	REF	0	0	0	0	0	0
14.07.2023	REF	0	0	0	0	0	0
15.07.2023	REF	0	0	0	0	0	0
16.07.2023	REF	0	0	0	0	0	0
17.07.2023	REF	0	0	0	0	0	0
18.07.2023	REF	0	0	0	0	0	0
19.07.2023	REF	121	113	6	2	81,3	60,3
20.07.2023	REF	126	117	8	1	81,8	61
21.07.2023	REF	121	111	7	3	81,4	60,6
22.07.2023	REF	122	119	1	2	79,9	58,4
23.07.2023	REF	119	119	0	0	79,6	58,5
24.07.2023	REF	120	109	7	4	81,1	60,2
25.07.2023	REF	123	113	6	4	81,9	60,9
26.07.2023	REF	125	117	6	2	81,1	60,4
27.07.2023	REF	127	117	7	3	81,5	60,6
28.07.2023	REF	121	115	4	2	80,9	60,1
29.07.2023	REF	117	114	0	3	80,2	58,5
30.07.2023	REF	119	119	0	0	79,5	58,1
31.07.2023	REF	121	117	4	0	81,2	60,5
<b>month</b>	<b>REF</b>	<b>3060</b>	<b>2903</b>	<b>109</b>	<b>48</b>	<b>81,1</b>	<b>60,2</b>

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



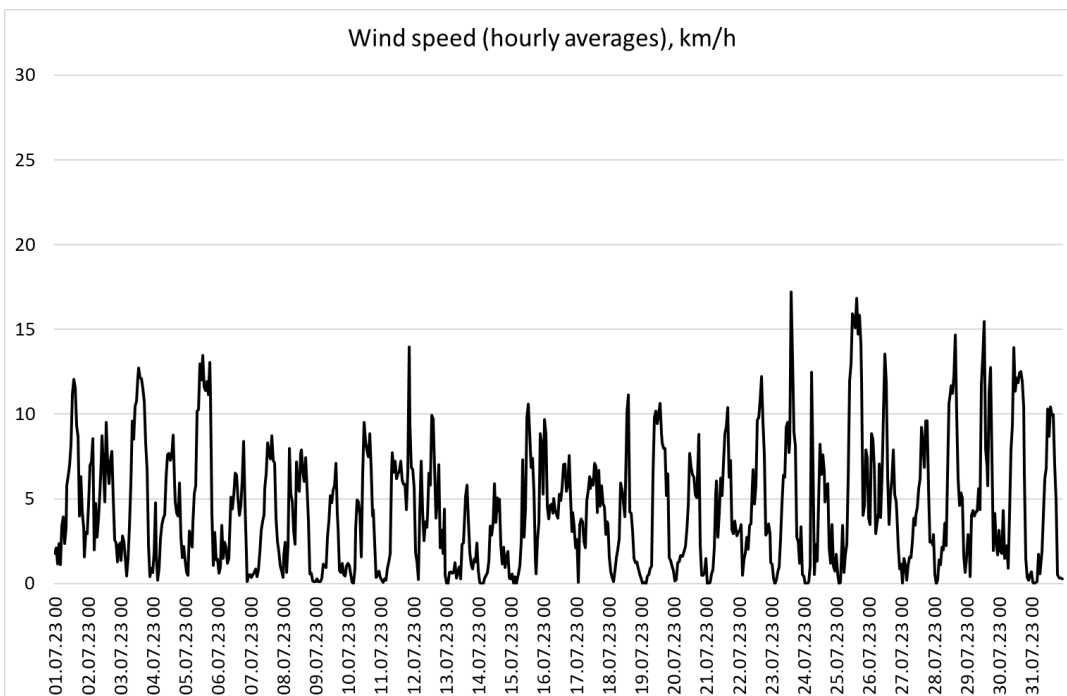
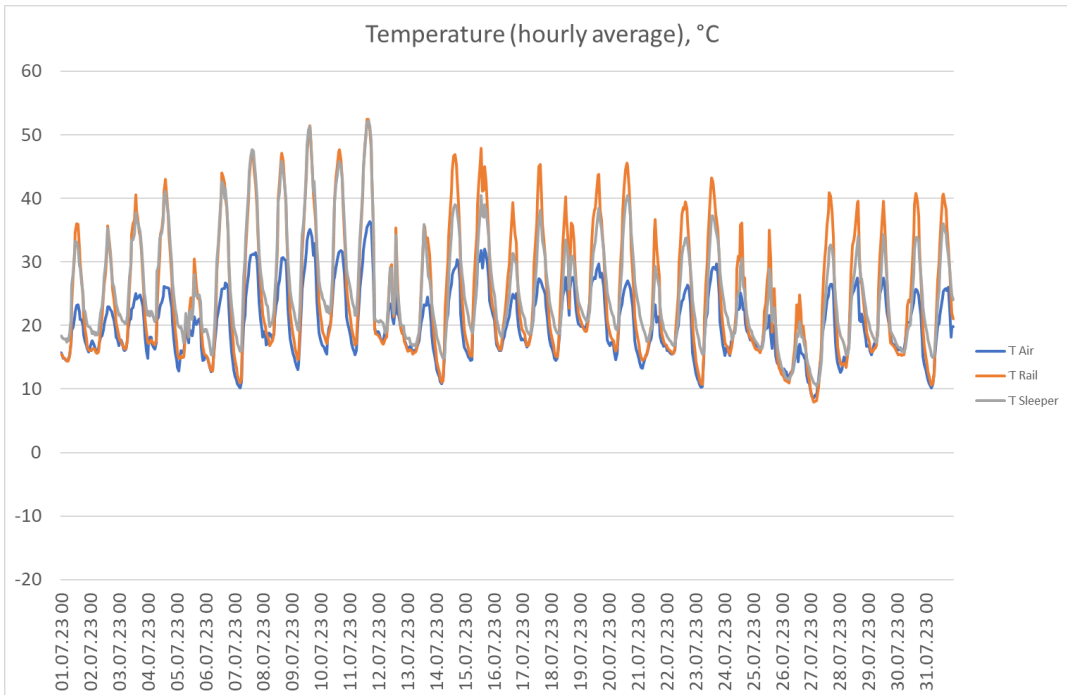
date	location	passenger train count	average speed	average length	average axlecount	average LAeqTp	average soundlevel
01.07.2023	REF	118	112,7	163,2	23,4	80,6	59,6
02.07.2023	REF	118	111,8	144,3	21,1	80,5	59
03.07.2023	REF	114	113,1	160,2	23,2	80,7	59,5
04.07.2023	REF	120	112,4	161,2	23,5	81	60
05.07.2023	REF	116	112,2	162,9	23,7	80,6	59,5
06.07.2023	REF	117	110,5	162,2	23,6	80,6	59,7
07.07.2023	REF	118	112,7	166,5	24,2	80,9	59,9
08.07.2023	REF	119	110,9	144,4	20,8	80,3	58,9
09.07.2023	REF	127	111,4	139,2	20,2	80,8	59,6
10.07.2023	REF	112	112,5	157,1	22,8	80,7	59,3
11.07.2023	REF	111	111,3	154,2	22,5	81,1	59,6
12.07.2023	REF	113	111,6	158,7	23,2	80,7	59,4
13.07.2023	REF						
14.07.2023	REF						
15.07.2023	REF						
16.07.2023	REF						
17.07.2023	REF						
18.07.2023	REF						
19.07.2023	REF	113	110,6	154,1	22,4	80,3	59
20.07.2023	REF	117	111,4	150,6	22,1	80,8	59,5
21.07.2023	REF	111	113,1	167,1	24,3	80,4	59,2
22.07.2023	REF	119	111,9	138,2	20	79,8	58,2
23.07.2023	REF	119	109,3	149,3	21,8	79,6	58,5
24.07.2023	REF	109	109,7	158,2	23,1	80	58,8
25.07.2023	REF	113	111	155,7	22,7	80,5	59,3
26.07.2023	REF	117	111,2	156	22,8	80,4	59,3
27.07.2023	REF	117	111,4	154,3	22,6	79,8	58,6
28.07.2023	REF	115	112,8	165,7	24,1	80,5	59,5
29.07.2023	REF	114	112,7	141,9	20,5	80	58,2
30.07.2023	REF	119	109,8	142,9	20,9	79,5	58,1
31.07.2023	REF	117	109,7	163,7	23,9	80,4	59,5
<b>month</b>	<b>REF</b>	<b>2903</b>	<b>111,5</b>	<b>154,7</b>	<b>22,5</b>	<b>80,5</b>	<b>59,2</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
01.07.2023	REF	1	87,8	351,8	84	82,1	44,4
02.07.2023	REF	0					0
03.07.2023	REF	6	86,9	248,5	51	85,7	54,3
04.07.2023	REF	6	80,7	195,5	46,3	84,4	52,5
05.07.2023	REF	6	78,6	239,8	50	83,7	52,7
06.07.2023	REF	5	84,9	233	59,2	85,2	52,8
07.07.2023	REF	7	78,9	232,4	53,1	84,6	54,1
08.07.2023	REF	0					0
09.07.2023	REF	0					0
10.07.2023	REF	8	80	216,6	48,8	86,5	56,2
11.07.2023	REF	8	86,8	191,3	40,9	87	55,6
12.07.2023	REF	6	78,6	234,3	54	84,4	53,3
13.07.2023	REF						
14.07.2023	REF						
15.07.2023	REF						
16.07.2023	REF						
17.07.2023	REF						
18.07.2023	REF						
19.07.2023	REF	6	86,9	220,7	44	85,7	54,1
20.07.2023	REF	8	84,4	256,3	57,8	85,2	55,4
21.07.2023	REF	7	88,3	225,8	51,1	85,7	54,6
22.07.2023	REF	1	58,8	85,1	18	80,6	38,9
23.07.2023	REF	0					0
24.07.2023	REF	7	90,2	231,5	52,6	85,3	54,2
25.07.2023	REF	6	84,3	196,4	44,7	87,9	55,5
26.07.2023	REF	6	78,2	216,8	49,7	84,2	52,9
27.07.2023	REF	7	88,9	235,2	54,9	87,1	55,9
28.07.2023	REF	4	83,1	182,8	37	84,8	50,5
29.07.2023	REF	0					0
30.07.2023	REF	0					0
31.07.2023	REF	4	91,2	261,1	57	86,6	53,4
<b>month</b>	<b>REF</b>	<b>109</b>	<b>83,9</b>	<b>224,9</b>	<b>50,3</b>	<b>85,6</b>	<b>52,6</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

$A1 = 10 \cdot \log_{10}(n \cdot 24 \cdot 3600)$  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