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Federal Office for the Environment FOEN

CONSULTEST AG
Institut für Materialprüfung, Beratung und Qualitätssicherung im Bauwesen

G+P
INGENIEURE

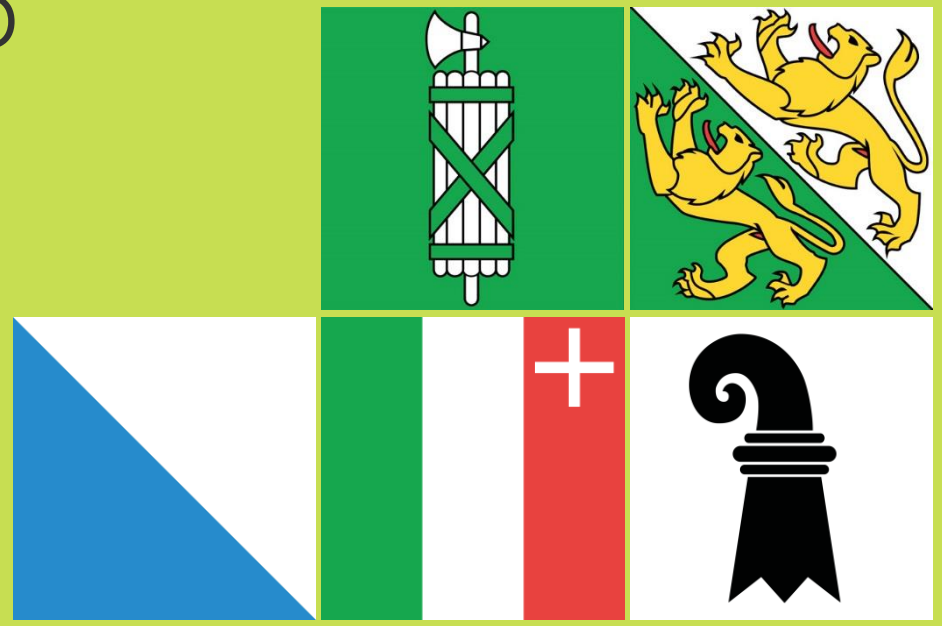
Recycling of SDA-RAP

Update Meeting

Peter Mikhailenko – G+P

Erik Bühlmann – G+P

Alain Tobler – Consultest AG



27.05.2025

Meeting agenda

1. **Introductions (10 min)**
2. **RESDA Project overview and plan (10 min)**
3. **SDA-RAP collection (15 min)**
4. **Laboratory program (15 min)**
5. **Additional partners? (5 min)**
6. **Upcoming work packages (10 min)**
7. **Questions and discussion**

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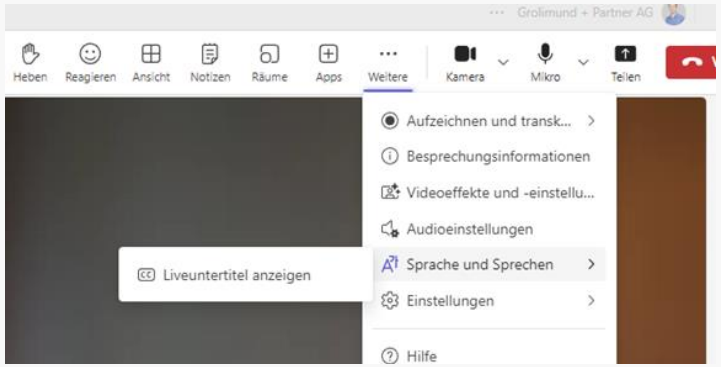
Introductions

- ✓ Speak in preferred language
- ✓ Signal if something was not understood

Introduction:

- Name,
- Organization
- Role

Live translation in Teams



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Why this project?

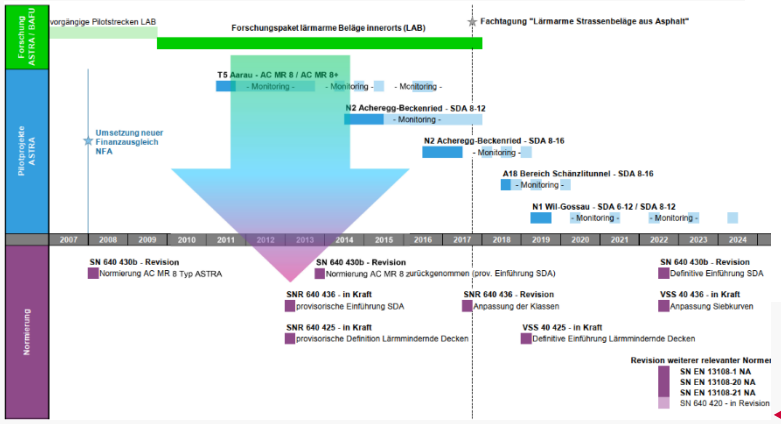
SDA-RAP in the context of the development of asphalt mixtures

TEST PAVEMENTS

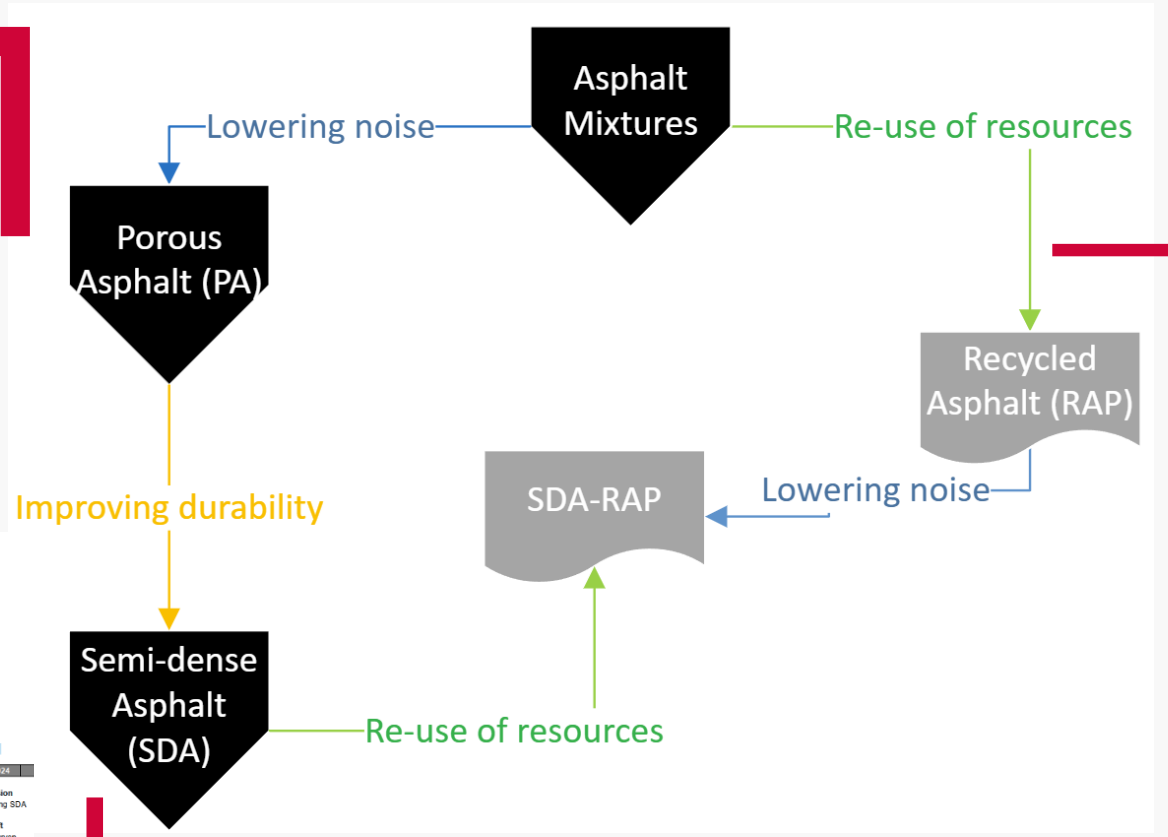
The research program now comprises 17 sections located on motorways, interurban, and urban roads with a section length between 150 m and 2.2 km. The oldest section was placed in 1979; the majority were constructed in 1985 and 1986. Reasons for choosing porous asphalt on these sections were general material testing, traffic safety, or traffic noise reduction. (A polymer-modified bitumen is generally used as a binder for the porous asphalt.) General data on the materials used are given in Figure 1 and as follows:

	Porous Asphalt (0/10)	*Porous Asphalt (0/16)*
Max. aggregate size (mm) (round sieve)	10	16
Layer thickness (mm)	28–42	43–50
Binder content (% by mass)	4.65–5.82	4.23–4.99
Void content (%) (Marshall specimens)	10.9–22.5	14.9–17.0
Void content (%) (cores)	14.6–21.1	14.6–19.6

Isenring, 1990



Würmli, 2023

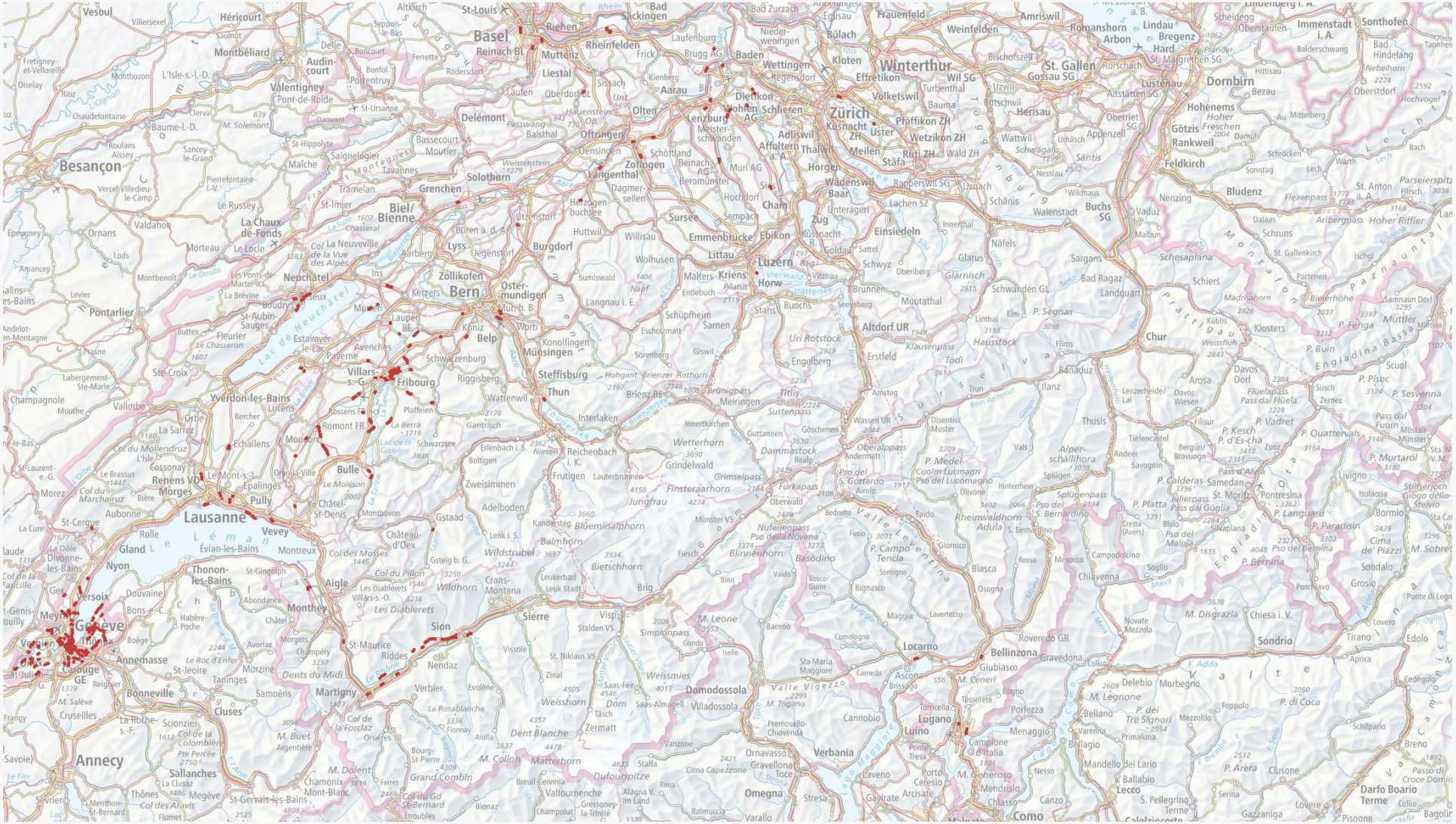


Schindler et al., 2024

	Szenario	ACMR 8	SDA 4	SDA 8	AC 8 H LA
Umweltbelastungspunkte (UBP'21) / km*a)	Bau und Rückbau	2.3E+07	4.5E+07	3.0E+07	2.3E+07
	Unterhalt	7.1E+06	7.1E+06	7.3E+06	7.2E+06
	Nutzung (exkl. Strassenlärm)	1.12E+09	1.09E+09	1.11E+09	1.12E+09
	Strassenlärm	8.2E+07	3.9E+07	7.2E+07	7.7E+07
	Total	**1.23E+09**	**1.18E+09**	**1.22E+09**	**1.23E+09**
Treibhausgaspotential (t CO2eq / km*a)	Bau und Rückbau	1.4E+01	2.7E+01	1.8E+01	1.4E+01
	Unterhalt	4.3E+00	4.4E+00	4.4E+00	4.4E+00
	Nutzung	8.23E+02	8.00E+02	8.16E+02	8.26E+02
	Total	**8.41E+02**	**8.32E+02**	**8.38E+02**	**8.44E+02**
Primärenergie (nePE) (GJ) / km*a)	Bau und Rückbau	2.9E+02	5.7E+02	3.8E+02	3.0E+02
	Unterhalt	9.2E+01	8.9E+01	9.1E+01	9.5E+01
	Nutzung	1.07E+04	1.04E+04	1.06E+04	1.07E+04
	Total	**1.11E+04**	**1.10E+04**	**1.10E+04**	**1.11E+04**
interne und externe Lebenszykluskosten (CHF / km*a)	interne Kosten Bau und Rückbau	2.3E+04	4.5E+04	3.0E+04	2.3E+04
	interne Kosten Unterhalt	1.0E+04	1.0E+04	1.0E+04	1.0E+04
	interne Kosten Nutzung	4.4E+05	4.3E+05	4.4E+05	4.4E+05
	externe Kosten Bau, Rückbau und Unterhalt	9.2E+03	1.6E+04	1.1E+04	9.3E+03
	externe Kosten Nutzung (exkl. Strassenlärm)	3.1E+05	3.0E+05	3.1E+05	3.1E+05
	externe Kosten Strassenlärm	2.3E+05	1.5E+05	2.1E+05	2.2E+05
	Total	**1.02E+06**	**9.59E+05**	**1.01E+06**	**1.02E+06**

SDA4 Situation in 2025

4 mm low-noise pavements ≥ 10 years old in 2025

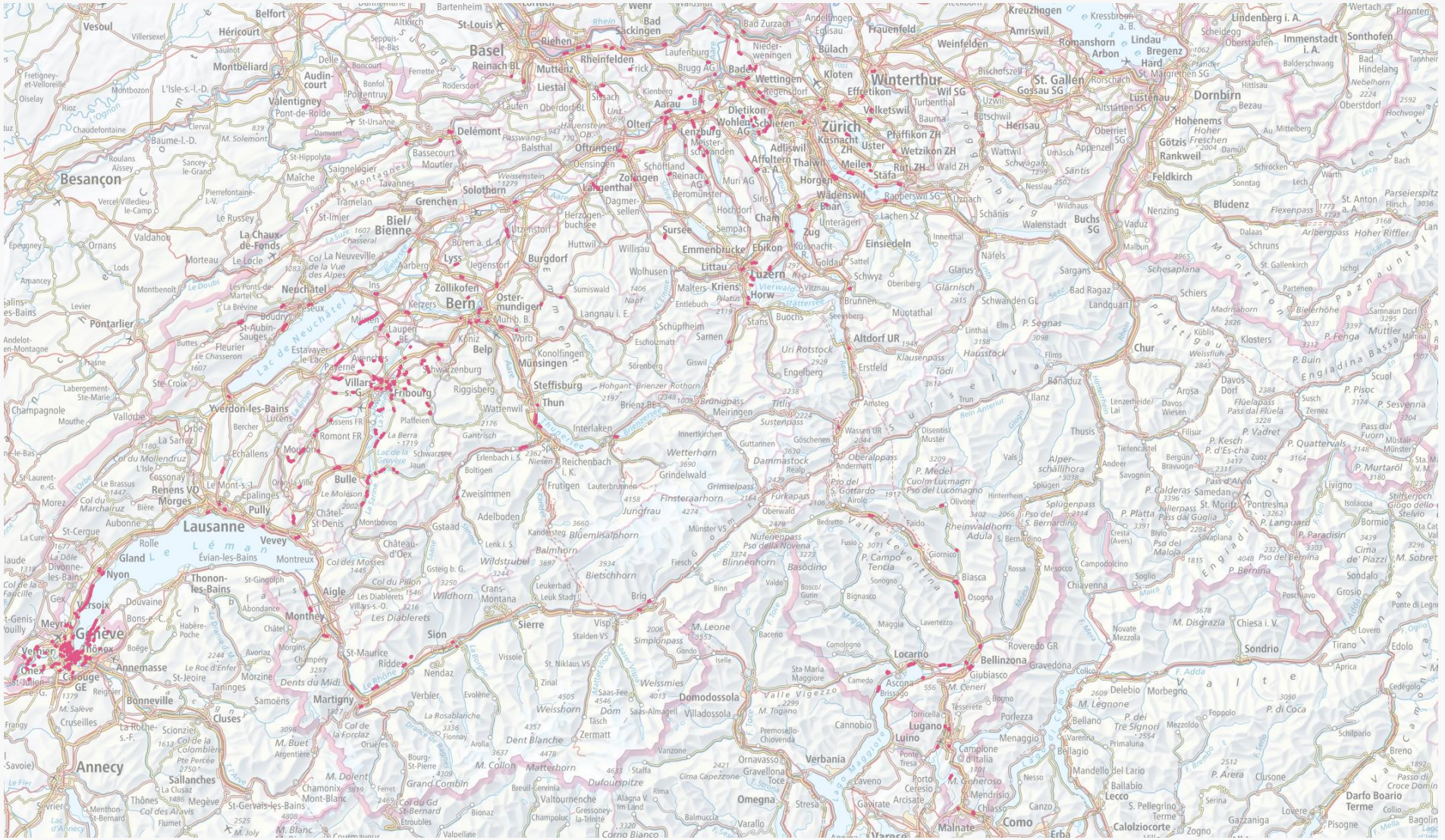


Canton	Total length	Approx. SDA-RAP
	km	tonnes
ZH	1.6	695
BE	9.2	4,061
LU	0.2	106
FR	36.2	15,950
BS	1.2	529
BL	1.6	701
AG	11.5	5,085
TG	0.6	251
TI	2.6	1,138
VD	11.4	5,032
VS	18.5	8,144
NE	4.5	1,995
GE	59.6	26,303
CH	**158.7**	**69,990**

Pavement Type	Total length	Approx. SDA-RAP
	km	tonnes
4mmSpec	6.2	2,714
ACMR4	0.5	220
Camaphone4	4.1	1,787
Griphone4	0.7	306
Mobiphone4	2.4	1,080
Nanosoft4	53.3	23,490
PA4	0.4	163
Perrphone4	6.6	2,897
Phono4	0.4	180
Sapa4dicht	1.1	470
Sapaphone4	43.6	19,207
SDA4	36.8	16,237
Tanaphone4	2.8	1,238

SDA4 Situation in 2030

4 mm low-noise pavements ≥ 10 years old in 2030 (paved after 2016)



Canton	Total length	Approx. SDA-RAP
	km	tonnes
ZH	12.8	5,667
BE	20.6	9,075
LU	5.5	2,430
UR	0.4	159
SZ	0.8	353
OW	0.3	146
NW	0.6	273
ZG	2.0	881
FR	57.7	25,435
SO	1.2	538
BL	3.9	1,701
SG	1.8	791
AG	43.6	19,210
TI	17.8	7,856
VD	11.0	4,853
VS	9.4	4,132
NE	4.5	1,990
GE	59.7	26,317
JU	3.2	1,402
LI	0.3	132
CH	**257.0**	**113,344**

Pavement Type	Total length	Approx. SDA-RAP
	km	tonnes
4mmSpec	5.9	2,624
Nanosoft4	35.5	15,655
Perrphone4	0.7	307
Sapaphone4	37.0	16,297
SDA4	167.1	73,701
Tanaphone4	10.5	4,633

Project Outline

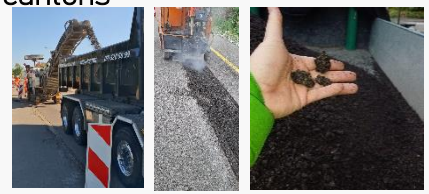
Current FOEN Project

Phase I — Phase II — Phase III

2024 | 2025 | 2026

Completed (for three cantons)

Collection of SDA4-RAP from cantons



Construction of SDA sections

Swiss-wide workshop

Completed with FOEN support

Project development

SDA4-RAP Evaluation

Next step

Performance evaluation of SDA sections

SDA4 mixture testing with different replacement levels: 10-40%

Planned at end of current project

With canton of Zurich

Long term planning, logistics and life cycle analysis (LCA)

Gantt Plan

Recycling of Semi-Dense Asphalt

ID	Work Package/Task	Type	Pre-Tasks	START DATE	END DATE
I	**Project organization, planning and administration**			**Apr 25**	**Jul 26**
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I-B	Meeting with partners and overseeing commission	Milestone	I-A	Mai 25	Mai 25
I-C	Planning with asphalt producers and constructors	Organization	I-A	Apr 25	Jun 25
II	**Demolition of SDA sections and collection of RAP**			**Apr 25**	**Jun 25**
II-A	Evaluation of SDA-RAP sources	Organization	I-A	Apr 25	Mai 25
II-B	Demolition of SDA pavements	Construction	I-C, II-A	Mai 25	Jun 25
II-C	RAP processing, shipment and storage	Construction	II-B	Mai 25	Jun 25
III	**Laboratory evaluation of SDA-RAP from different sources**			**Jun 25**	**Aug 25**
III-A	Evaluation of SDA RAP aggregate and bitumen properties	Testing	I-B, II-C	Jun 25	Aug 25
III-B	Meeting of project partners to discuss findings and plan	Milestone	III-A	Aug 25	Aug 25
IV	**Laboratory testing of SDA-RAP mixtures**			**Sep 25**	**Mär 26**
IV-A	Design of SDA mixtures with RAP	Testing	III-B	Sep 25	Nov 25
IV-B	Laboratory mechanical performance of SDA-RAP Mixtures	Testing	IV-A	Okt 25	Jan 26
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V-B	Research into alternative practices for SDA recycling	Analysis	I-C	Aug 25	Sep 25
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V-D	Cost analysis of SDA-RAP recycling scenarios and report	Analysis	V-A, V-B	Okt 25	Jan 26
VI	**Reporting and dissemination of findings**			**Feb 26**	**Jul 26**
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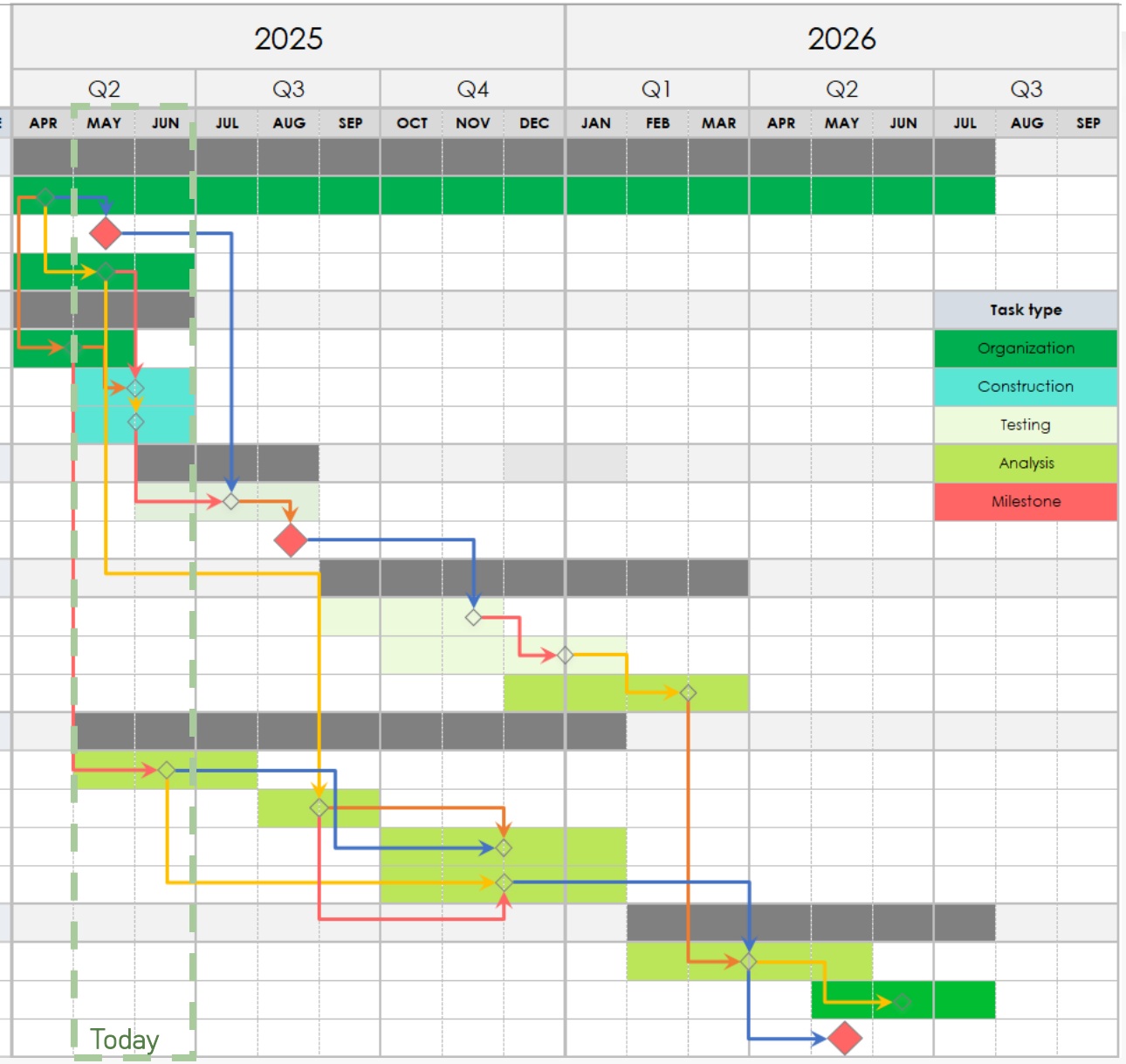

Project Organization

Overall support

Schweizerische Eidgenossenschaft
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Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Office for the Environment FOEN

Research team

G+P INGENIEURE

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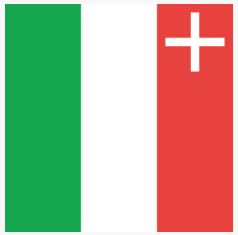
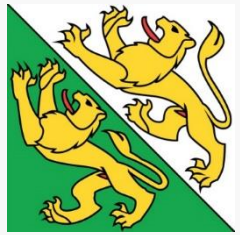
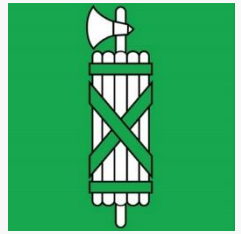
Cantons providing SDA-RAP

Neuchatel, Thurgau, Basel-City

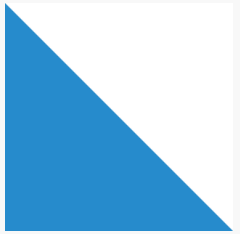




Cantons providing additional support

St. Gallen (financial support for lab study)



Zurich (Logistics/ LCA study)



Research Team

Grolimund + Partner

Peter Mikhailenko
Project Leader

Erik Bühlmann
Head of R&D

FOEN Support

Simon Steiner
Road Noise

Clara-Marine Pellet
Materials Cycles

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Federal Office for the Environment FOEN

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Empa

Fabian Traber
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Philip Bürgisser
Basel-Landschaft

Olga Paperna
Aargau

Samuel Probst
Weibel AG

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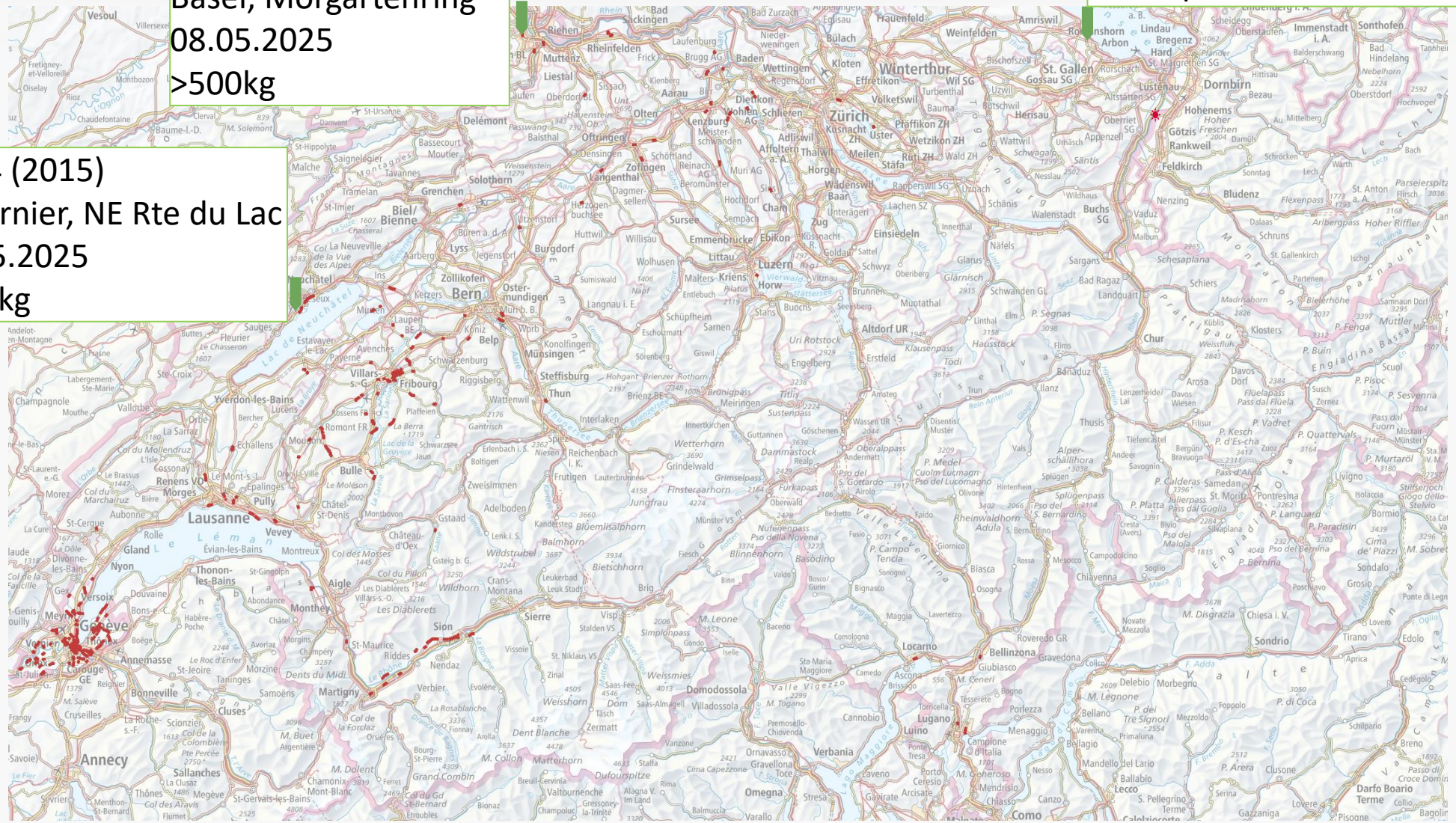
SDA-RAP Collection Sites

SDA4-20 (2012)
Basel, Morgartenring
08.05.2025
>500kg

SDA4-12 (2019)
Egnach, TG Bahnhofstrasse
29.04.2025
Entire pavement

SDA4 (2015)
Auvernier, NE Rte du Lac
08.05.2025
>500kg



SDA-RAP Egnach

SDA4-12 (2019)

Egnach, TG Bahnhofstrasse 29.04.2025

Asphalt Producer: MOAG

Contractor: Alder-Zani AG

Field Air Voids%: 13.3

SDA Thickness (mm): 34

- Removal in single pass for entire lane
- 30 tons stored at MOAG for 2026 *

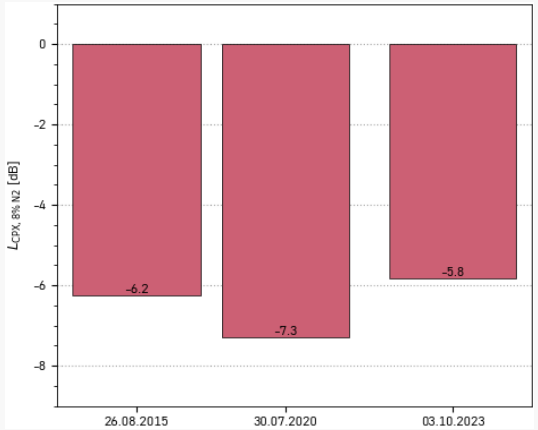
SDA-RAP Neuchâtel

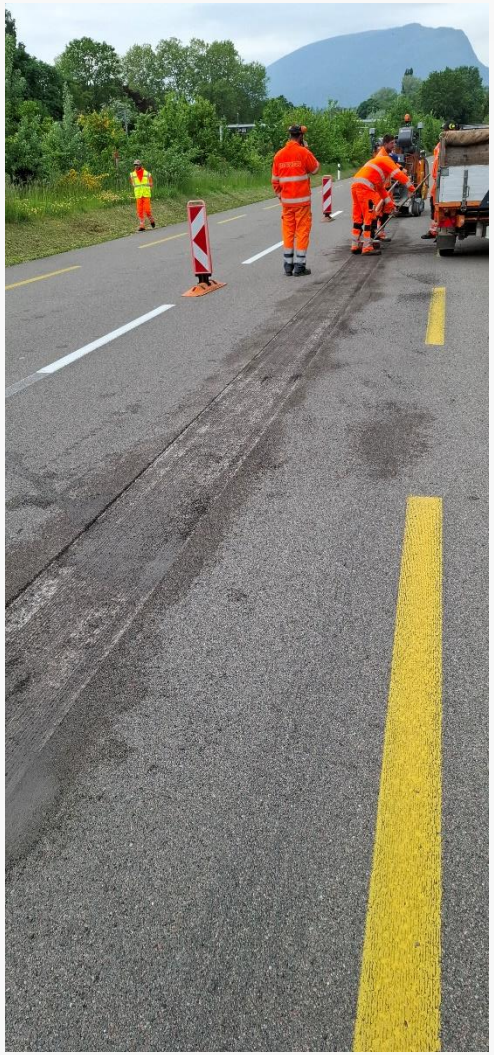
SDA4/ Facchiphone4 (2015)

Auvernier, NE Rte du Lac 08.05.2025

Asphalt Producer: Facchinetti SA

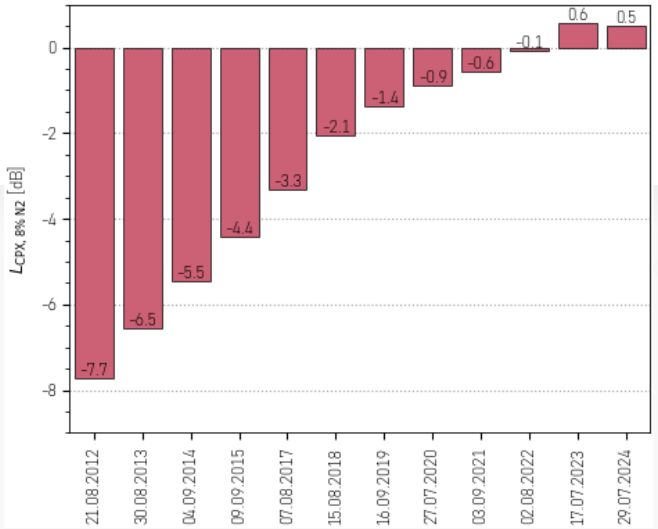
Contractor: Framix





- Removal of half ton in 2 passes (2x 15 mm)

SDA-RAP Basel-City



SDA4-20 (2012)

Basel, Morgartenring 08.05.2025

Asphalt Producer: Tozzo

Contractor: Rotomill AG

Marshall Air Voids%: 17.1

Field Air Voids%: 15.1

SDA Thickness (mm): 41.0

- Removal of one ton in single pass from parking spot

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RAP Evaluation

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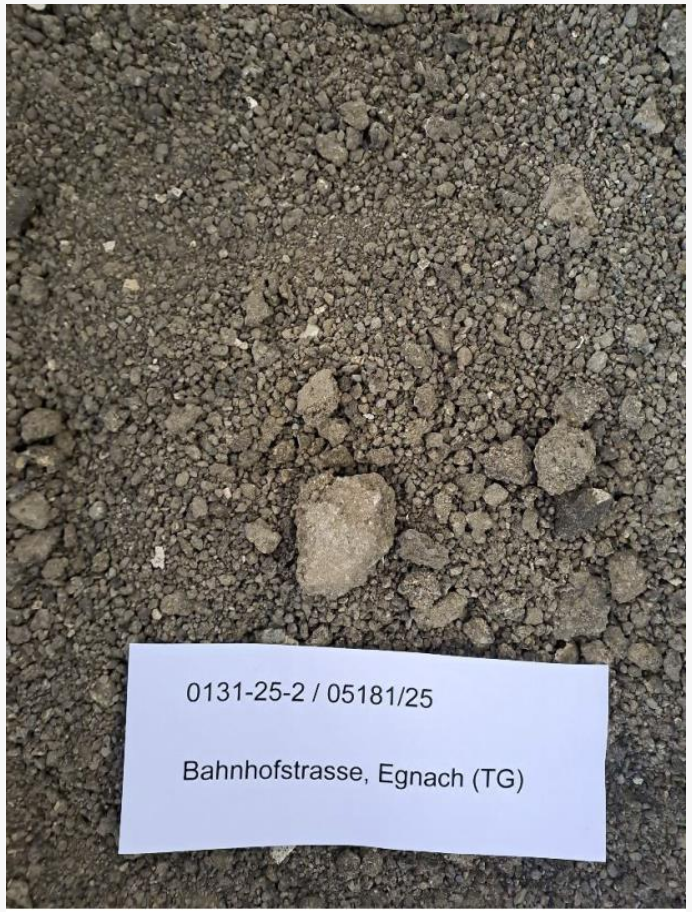
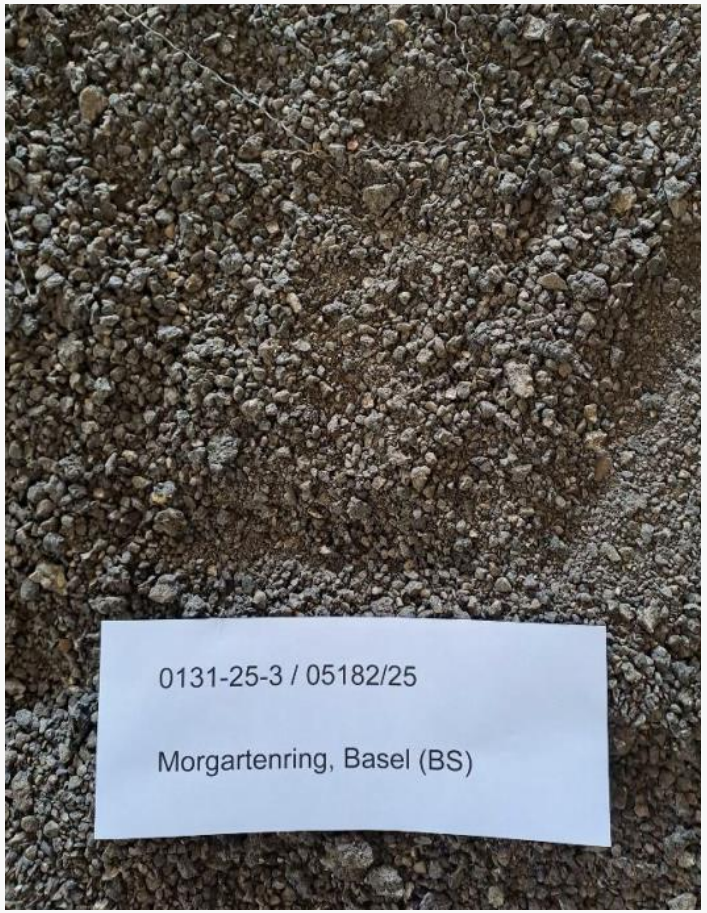
Institut für Materialprüfung, Beratung und Qualitätssicherung im Bauwesen





SDA-RAP evaluation

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WPIII: SDA-RAP Evaluation

- Gradation of aggregates before and after bitumen extraction
- Testing of recovered bitumen % (extraction+recovery)

Recovered Bitumen:

- Penetration + softening point
- BTSV (with DSR)
- Fraass for low temperature

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Additional partners for SDA-RAP?

Obtaining SDA-RAP samples from different cantons:

- Selection of paving company/ asphalt producer
- Demolition of all or small part of SDA section (2 options)

Option 1: **Smaller** amount of SDA-RAP for lab testing (approx. 500 kg – 1.5 m)

Option 2: **Full** amount of SDA-RAP needed for laboratory testing and testing sections (500 kg, the rest is stored until needed for test section)

- Transportation/storage of SDA-RAP
- Collection of data from demolition, transport and storage (LCA)

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V-D	Cost analysis of SDA-RAP recycling scenarios and report	Analysis	V-A, V-B	Okt 25	Jan 26
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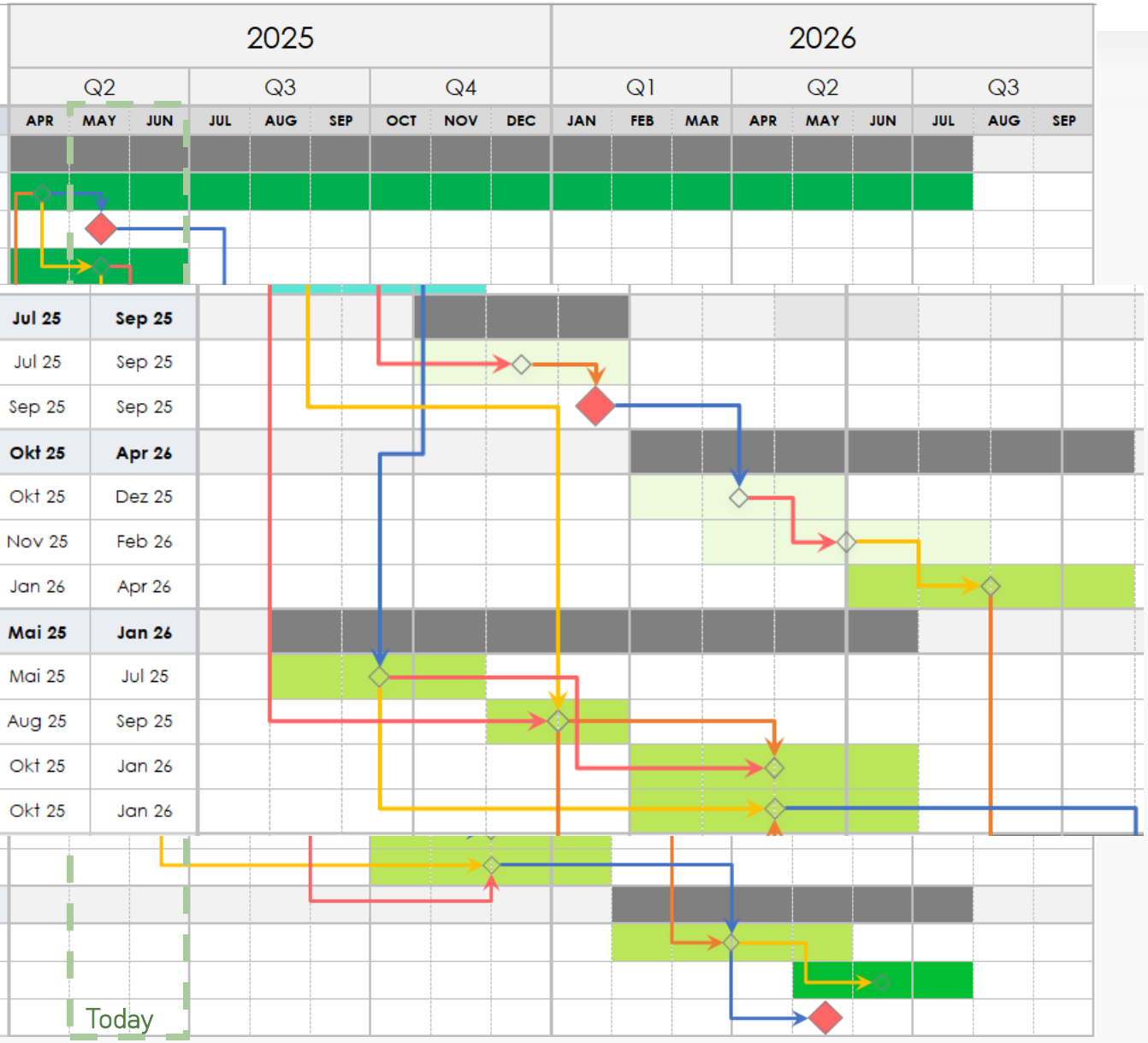


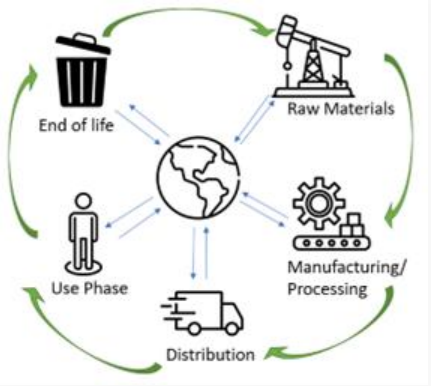
Long term planning, logistics and life cycle analysis

Long term planning and practical considerations

- Calculate SDA-RAP quantity to be expected in future

- Examine data on consumption of alternative disposals methods

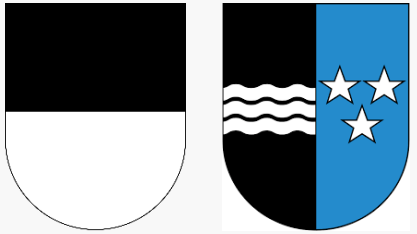
With canton of Zurich



Logistics

- Develop separation and storage strategy

- Additional studies?



LCA/LCCA

- Gather information from demolition, recycling and construction process (transport, energy, acoustic properties, consumption of non-renewable materials)

- Cost/ Savings calculation

Employing SDA RAP in new SDA	Downcycling to base layer	Burning off bitumen	Export
+Potentially best value -Performance risks at higher contents	+Least performance requirements -Challenges with smaller fractions	+Recovery of quality aggregates -(Controlled) air pollution	+Waste exported to area with infrastructure to handle it -export of quality aggregate resources

Laboratory mixture study

CONSULTEST AG
Institut für Materialprüfung, Beratung und Qualitätssicherung im Bauwesen

WPIV. Laboratory Research Program

- Select 2 RAP sources (hardest and softest variant from WP I)
- Select reference SDA4 with corresponding virgin aggregate source
- Investigate effect of 3 RAP replacement levels of 10, 20, 40% on aggregate loss
- 7 mixtures in total (1 control, 6 RAP)

- Marshall mix design combined based on initial AMT Tool baseline mixture designs

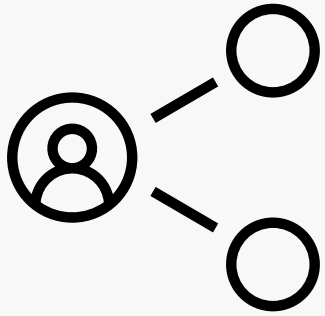
- Water sensitivity for durability
- Rutting resistance (wheel tracking)
- Low temperature cracking test (TSRST)
- Raveling test

1. Introductions (10 min)
2. RESDA Project overview and plan (10 min)
3. SDA-RAP collection (15 min)
4. Laboratory program (15 min)
5. Additional partners? (5 min)
6. Upcoming work packages (10 min)
7. **Questions and discussion**

What needs to be done?

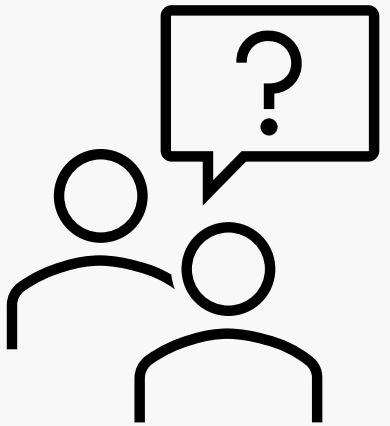
- Next Meeting (decide parameters for laboratory study and Milestone 1)

End of August or September?



- Share folder: Teams

Questions? Comments?



Thank you for your participation!! ☺