Tire wear particles, tire leachates and road treatments: a Norwegian case study

Elisabeth Rødland, NIVA

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Statens vegvesen

NIVA

NIVAs tire research focus

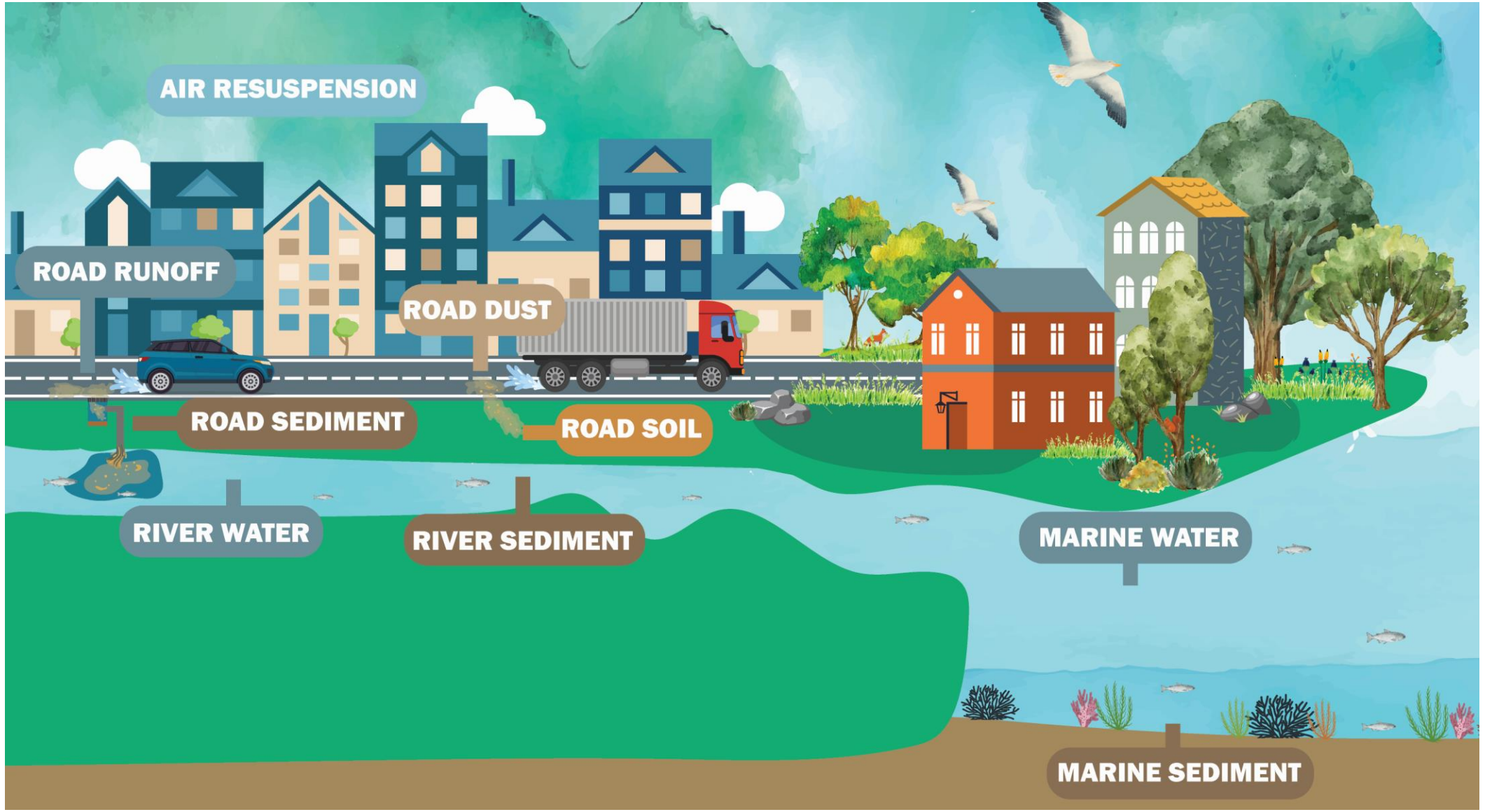


Illustration: Elisabeth Rødland (NIVA)

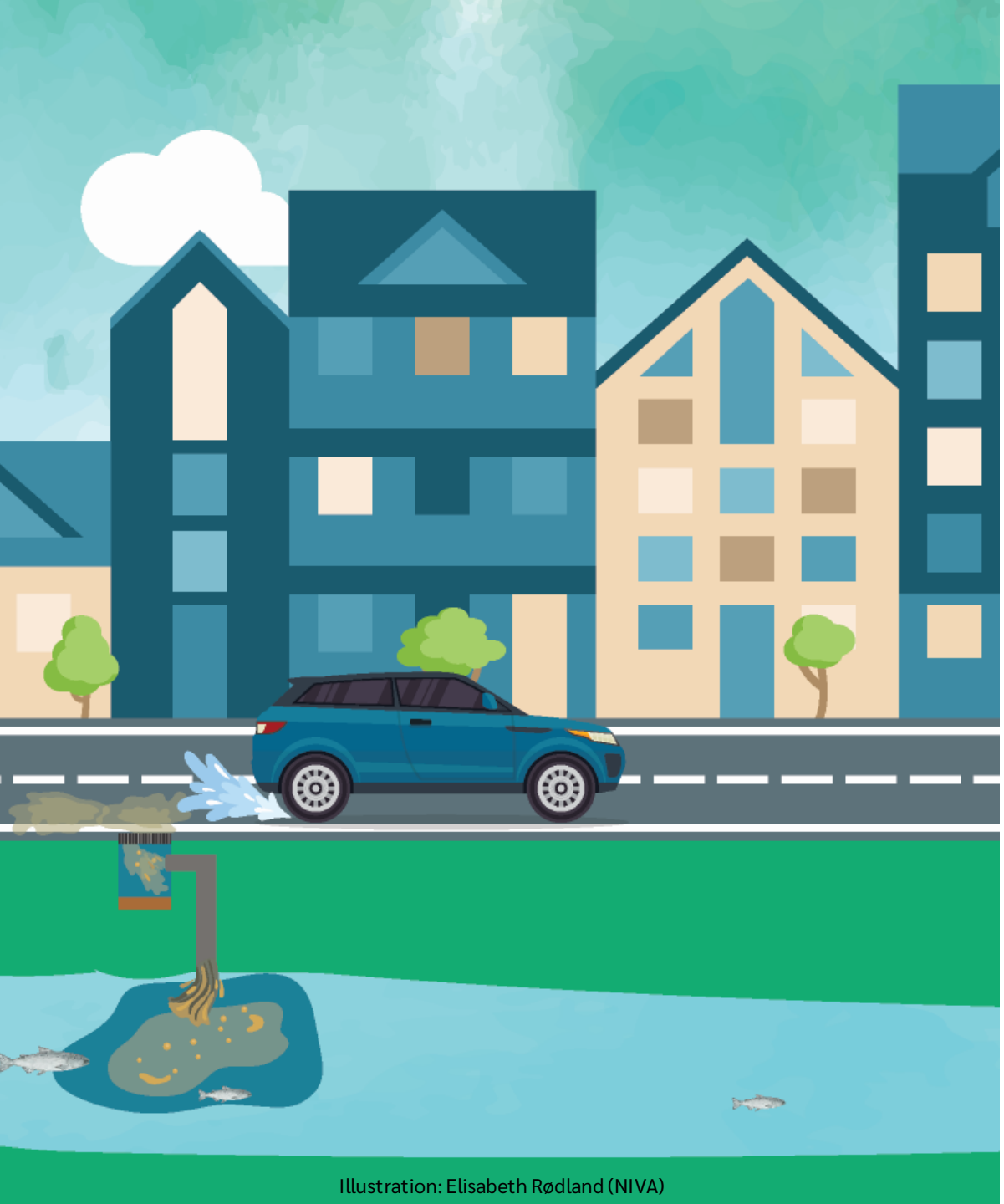


Illustration: Elisabeth Rødland (NIVA)

NIVAs tire research

Improving analysis of TRWP

PYR-GC/MS

Rødland et al., 2022. A novel method for the quantification of tire and polymer-modified bitumen particles in environmental samples by pyrolysis gas chromatography mass spectroscopy,
Journal of Hazardous Materials.

Tires
Different blends of SBR and BR rubber

Road asphalt
Polymer-modified bitumen containing styrene butadiene styrene rubber (SBS)

Markers
SBR+BR+SBS

SBR+BR

SBS

Apply tire data for TRWP prediction

Tire image: Elisabeth Rødland (NIVA)

PMB image: https://www.mrpavement.com/about-us/blog/general-information/how-pavement-reacts-temperature-changes/

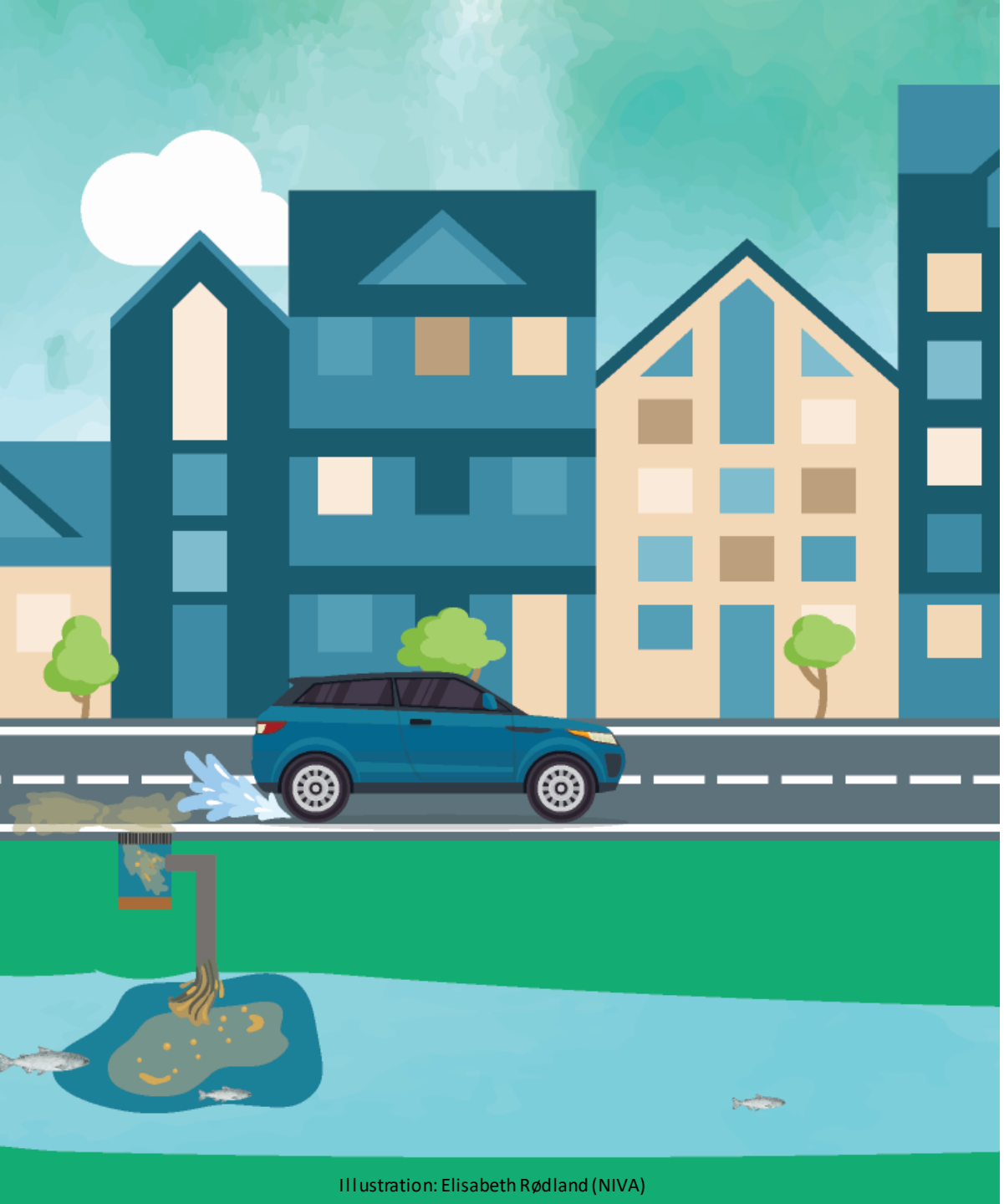


Illustration: Elisabeth Rødland (NIVA)

NIVAs tire research

Improving analysis of TRWP

Single tire testing
Leachate testing

PYR-GC/MS

LC-MS/MS

ICP-MS

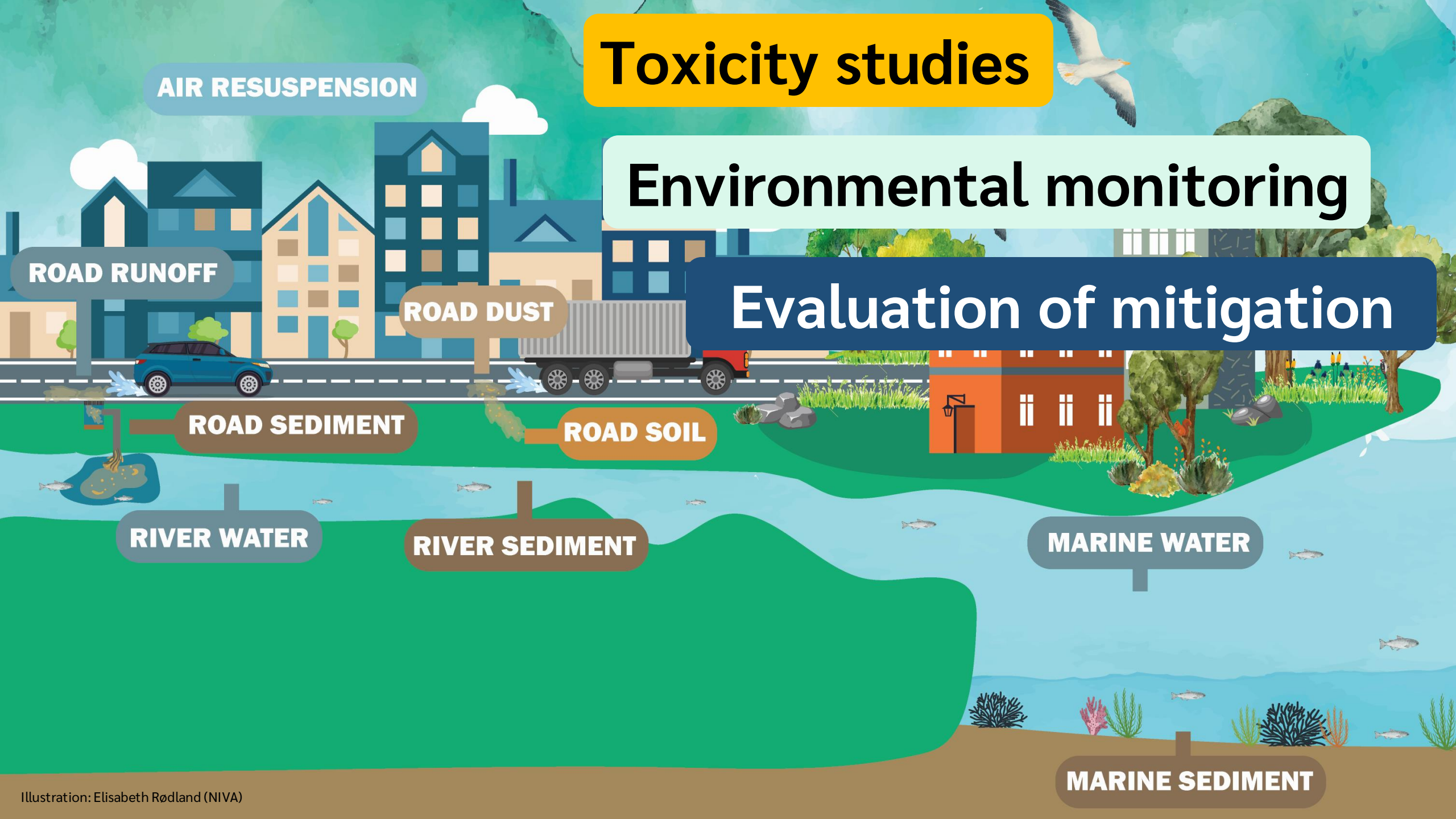
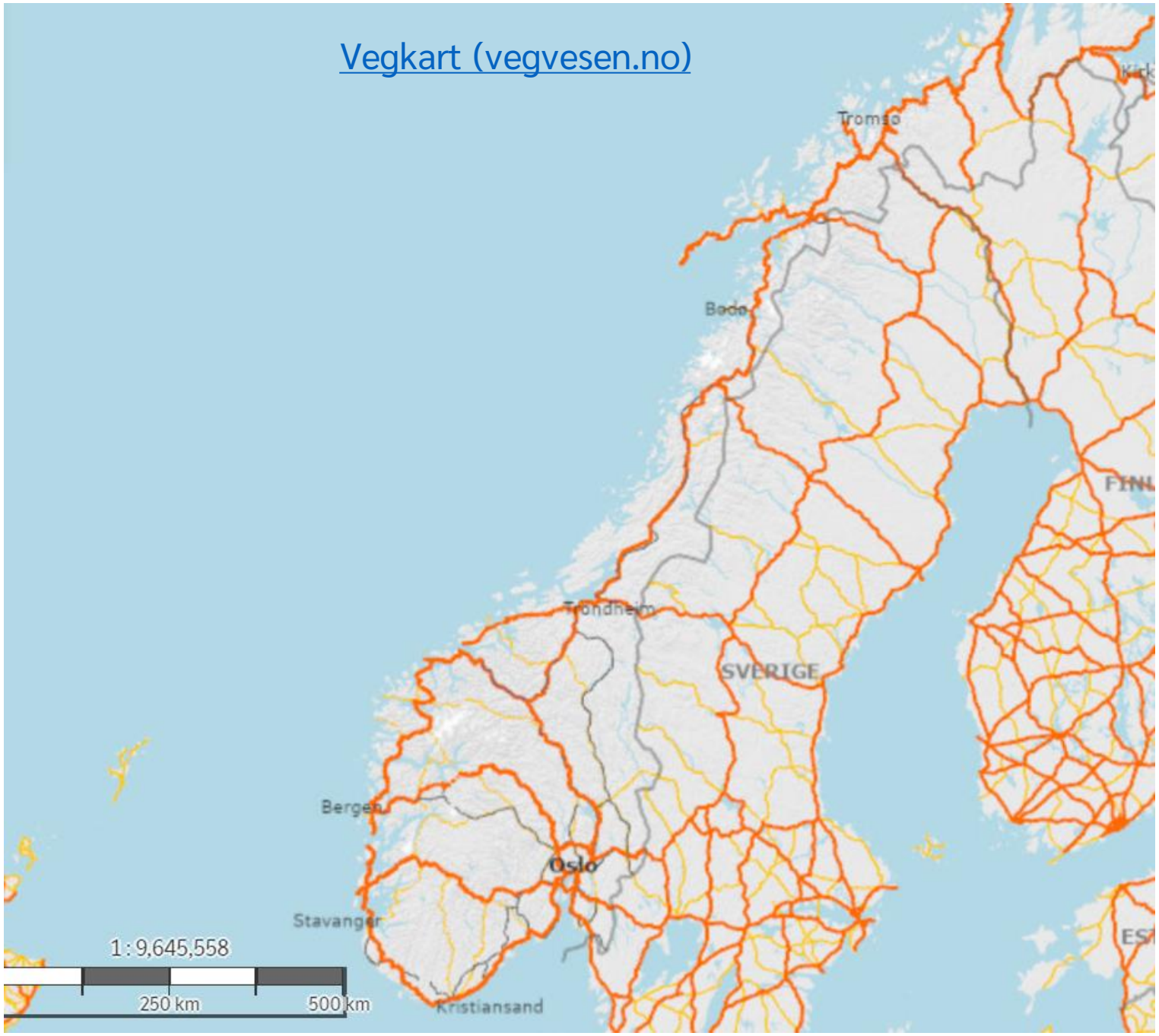


Illustration: Elisabeth Rødland (NIVA)

Norway and roads

>55 000 km and 1200 tunnels across national and county roads.

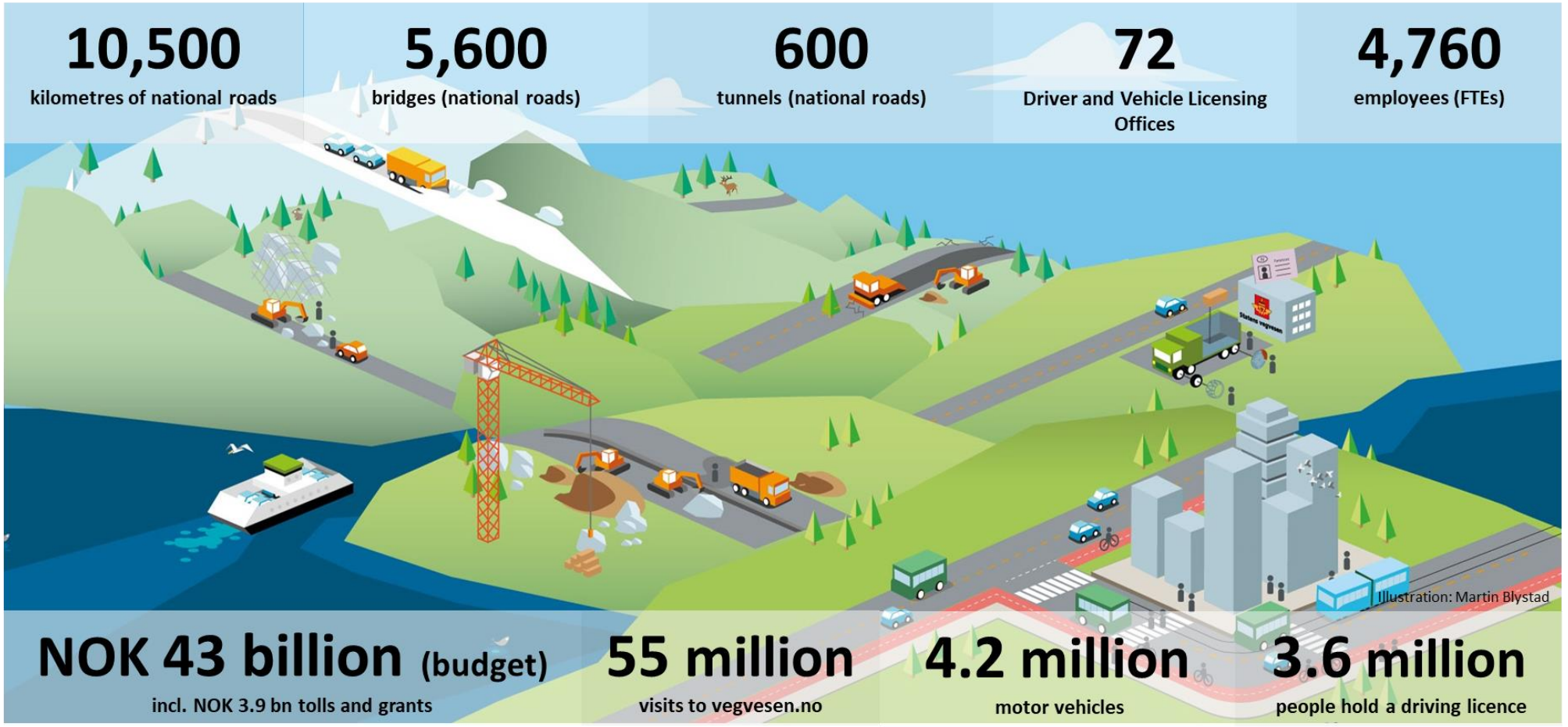


Norway and roads

Statens vegvesen

>55 000 km and 1200 tunnels across national and county roads.

National roads → The Norwegian Public Rods Administration (NPRA)



NIVA

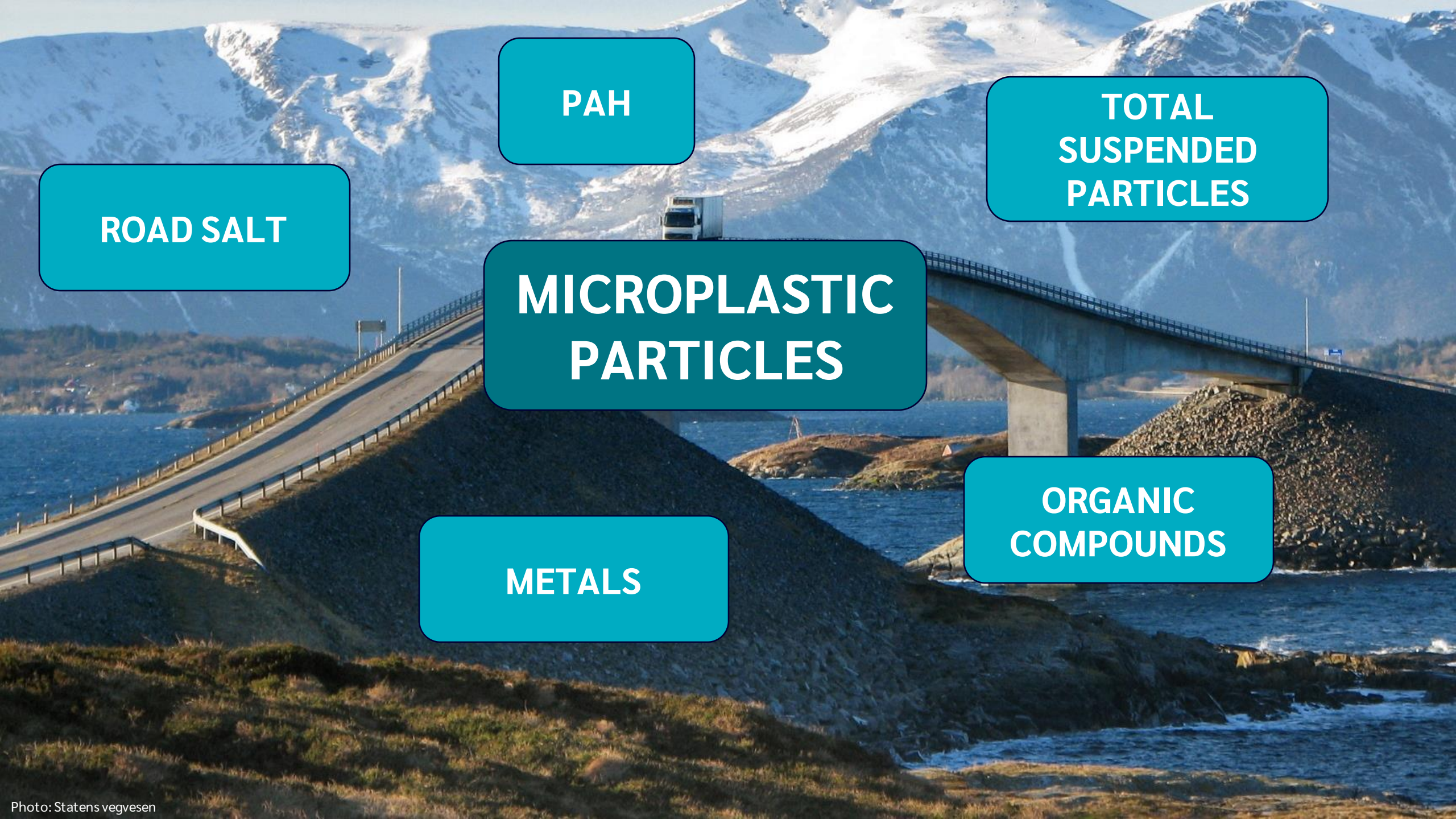


Photo: Statens vegvesen

Norway and roads

National roads → The Norwegian Public Rods Administration (NPRA)

Statens vegvesen

National Transport Plan

→Need to reduce plastic pollution from transport sector

→Increase knowledge about environmental impact from TRWP and tire-associated chemicals

Norwegian Transport Strategy

→Traffic pollution to the local environment is one of the main challenges for the transport sector.

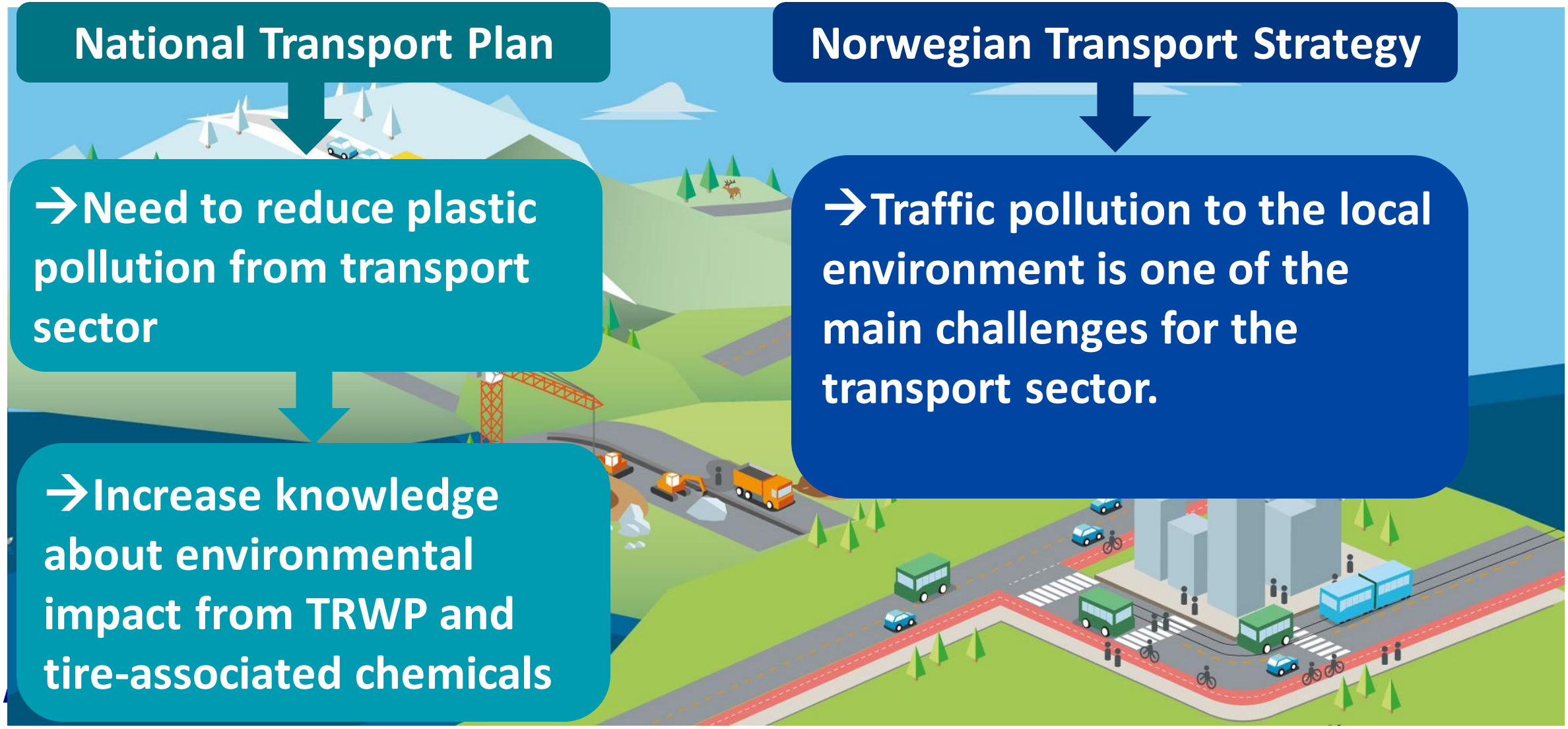


Illustration: Martin Blystad

Tunnel wash water – high priority

Image: Vegkart

Photo: Statens vegvesen

Tunnel wash water

Photo: Statens vegvesen

Road tunnels in Norway

- Tunnels are washed regularly
- More than 80% without treatment
- High levels of TSS, metals, PAH, organic contaminants
- Many compounds above environmental quality standard (EQS)
- Potentially high environmental impact in vulnerable recipients

Tunnel wash water – Projects with NIVA

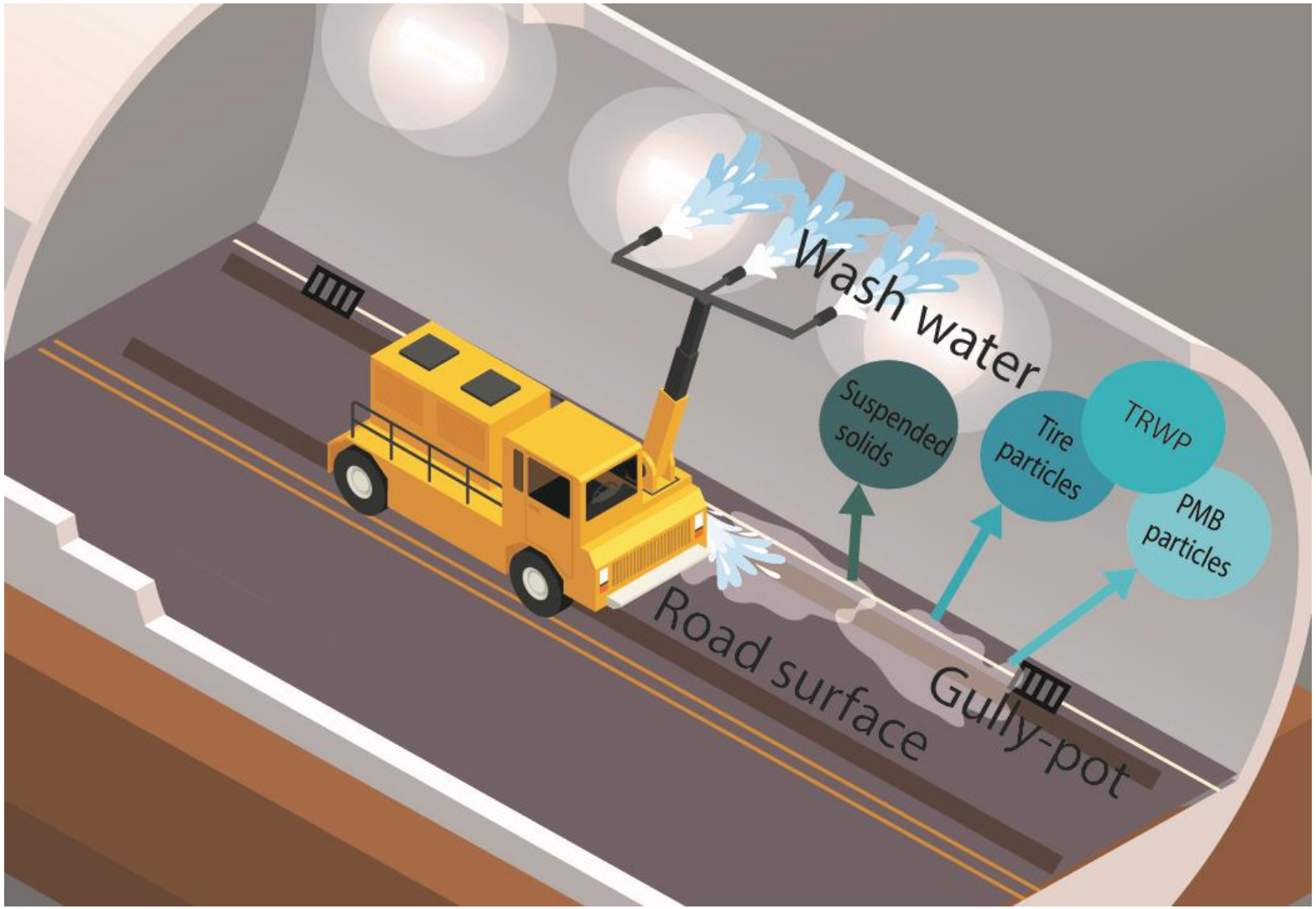


Illustration: Elisabeth Rødland (NIVA)

- TRWP
- TIRE-ASSOCIATED CHEMICALS
- METALS
- PMB

SMESTAD TUNNEL

ONE DIRECTION PER TUBE
22 000 V/D
70 KM/H

PYR-GC/MS

Image: Elisabeth Rødland (NIVA)

ROAD DUST

WET DUST SAMPLER

Image: Elisabeth Rødland (NIVA)

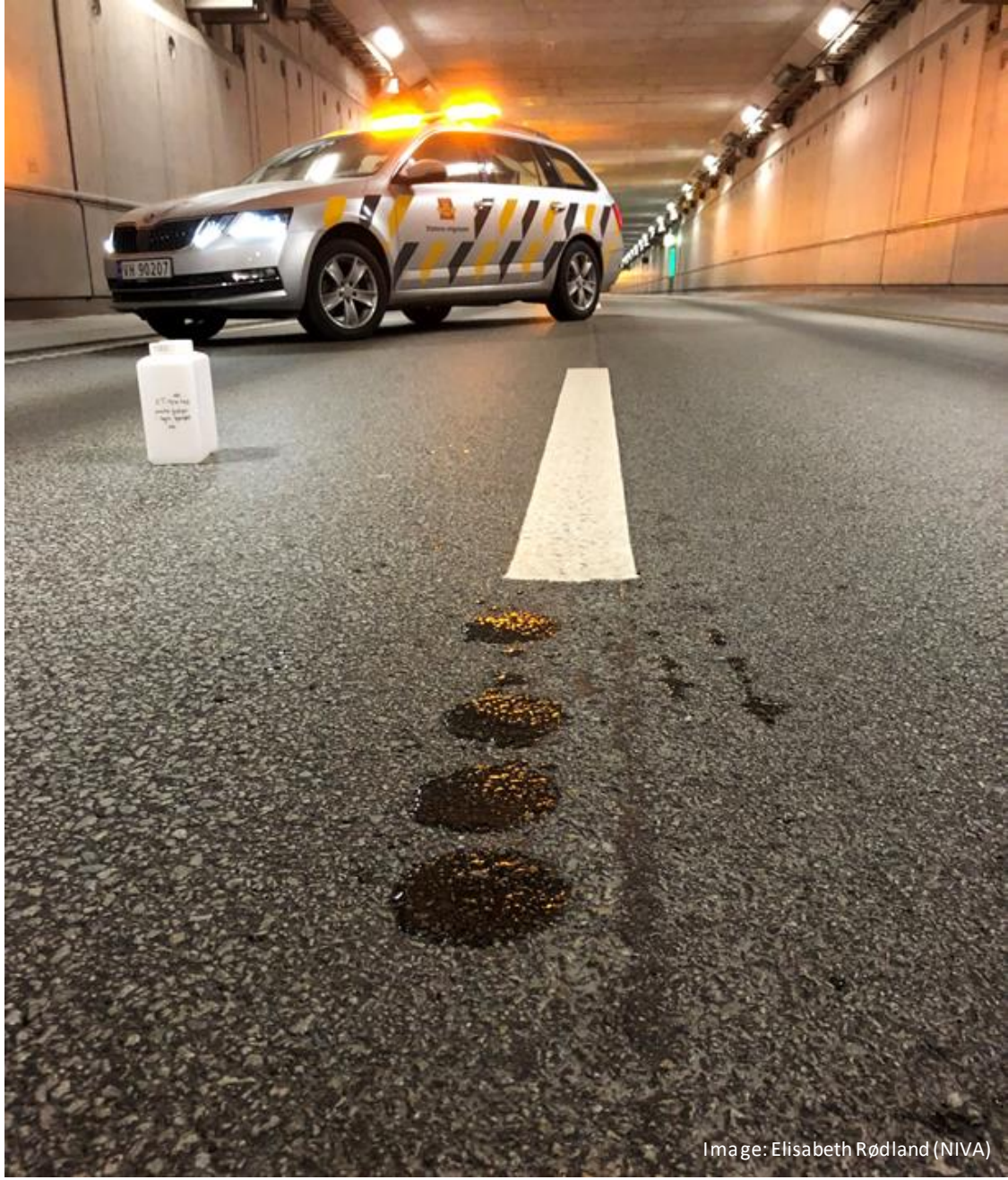


Image: Elisabeth Rødland (NIVA)

***Rødland et al., 2022. Characterization of tire and road wear microplastic particle contamination in a road tunnel: From surface to release**

ROAD DUST

Road surface*

- Highest values in the bank area and in the outlet of the tunnel: 0.835 and 373 mg/g (57.2 ± 99.1 mg/g)
- Higher than previously reported in road dust


Image: Elisabeth Rødland (NIVA)

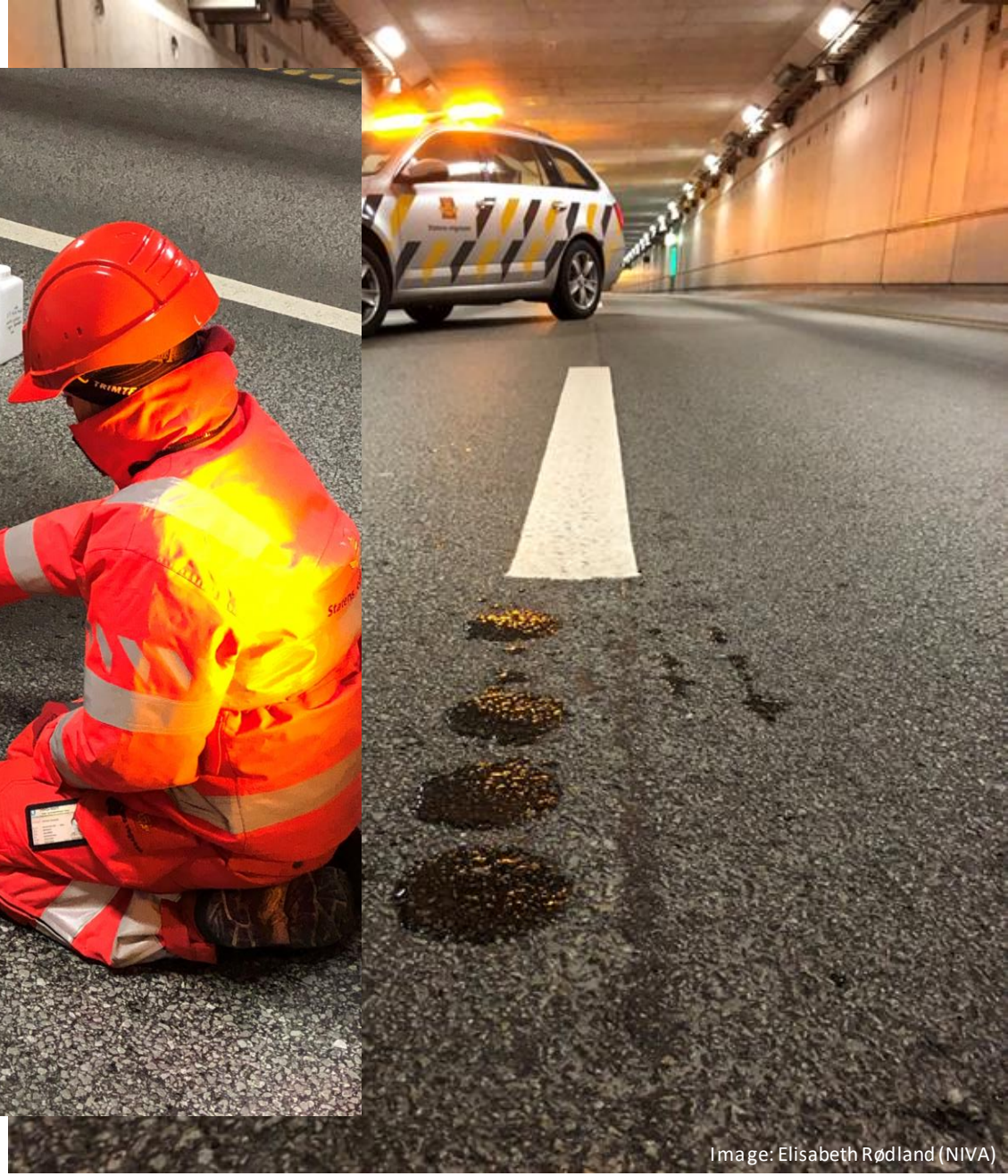


Image: Elisabeth Rødland (NIVA)

*Rødland et al., 2022. Characterization of tire and road wear microplastic particle contamination in a road tunnel: From surface to release

ROAD SEDIMENT

Gully-pots*

- **Highest concentration close to inlet**
  53.1 ± 1.33 mg/g

*Rødland et al., 2022. Characterization of tire and road wear microplastic particle contamination in a road tunnel: From surface to release

TUNNEL WASH WATER

Tunnel wash*

- **Large variation in TWP levels during the wash and during release f treat**
- **Inlet: 14.5 - 47.8 mg/L (3**
- **Outlet: 6.78 to 29.4 mg/**
- **63% retention**

Treatment efficiciency and design?

Image: Elisabeth Rødland (NIVA)


Image: Elisabeth Rødland (NIVA)

***Rødland et al., 2022. Characterization of tire and road wear microplastic particle contamination in a road tunnel: From surface to release**

Image: Elisabeth Rødland (NIVA)

VÅLERENG TUNNEL OSLO

ONE DIRECTION PER TUBE
32 000 V/D
70 KM/H

FOCUSED ON TUNNEL WASH WATER TREATMENT

PUMPHOUSE INLET BEFORE TREATMENT

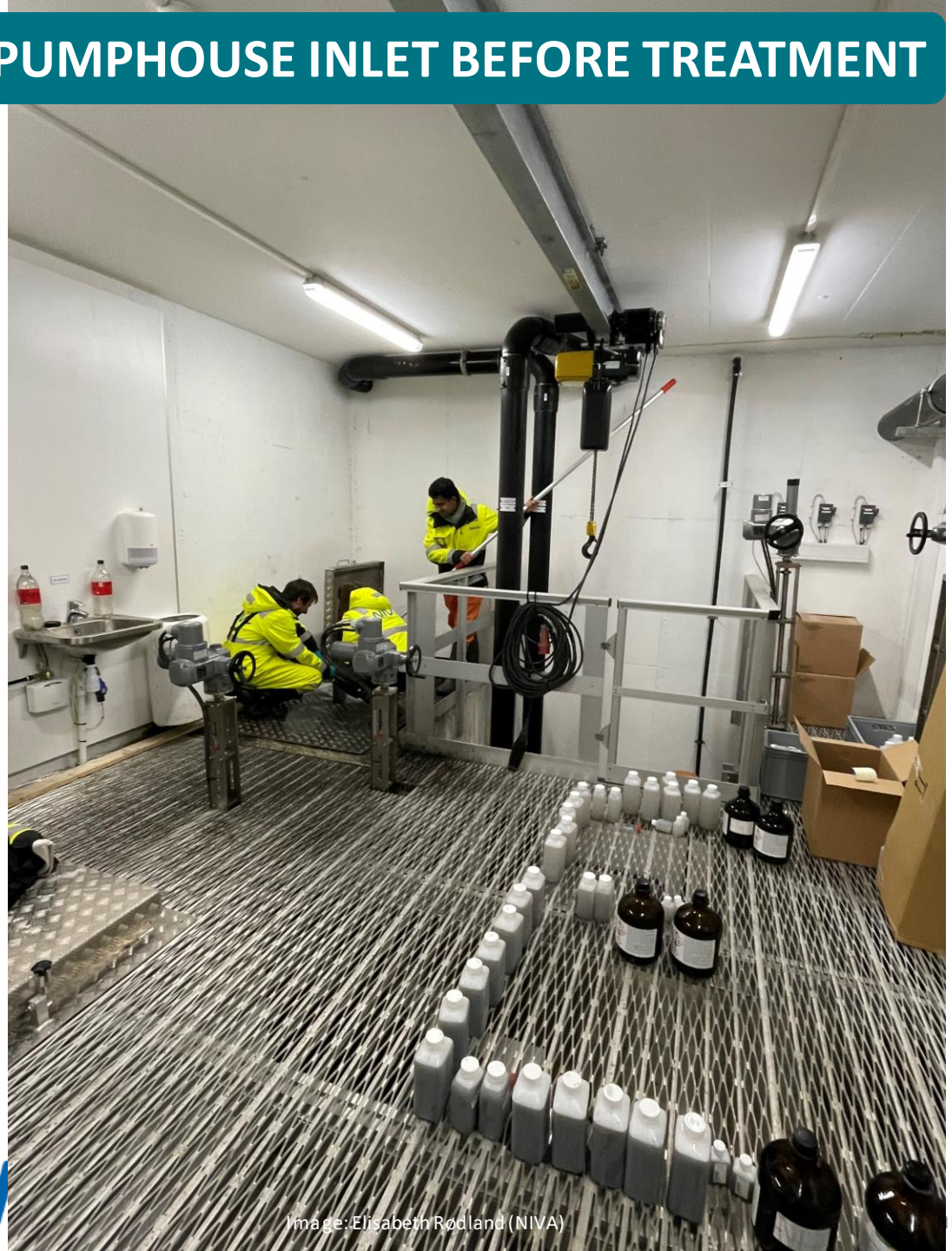


Image: Elisabeth Rødland (NIVA)

WATER INLET TO TREATMENT BASIN

Image: Elisabeth Rødland (NIVA)

Image: Elisabeth Rødland (NIVA)

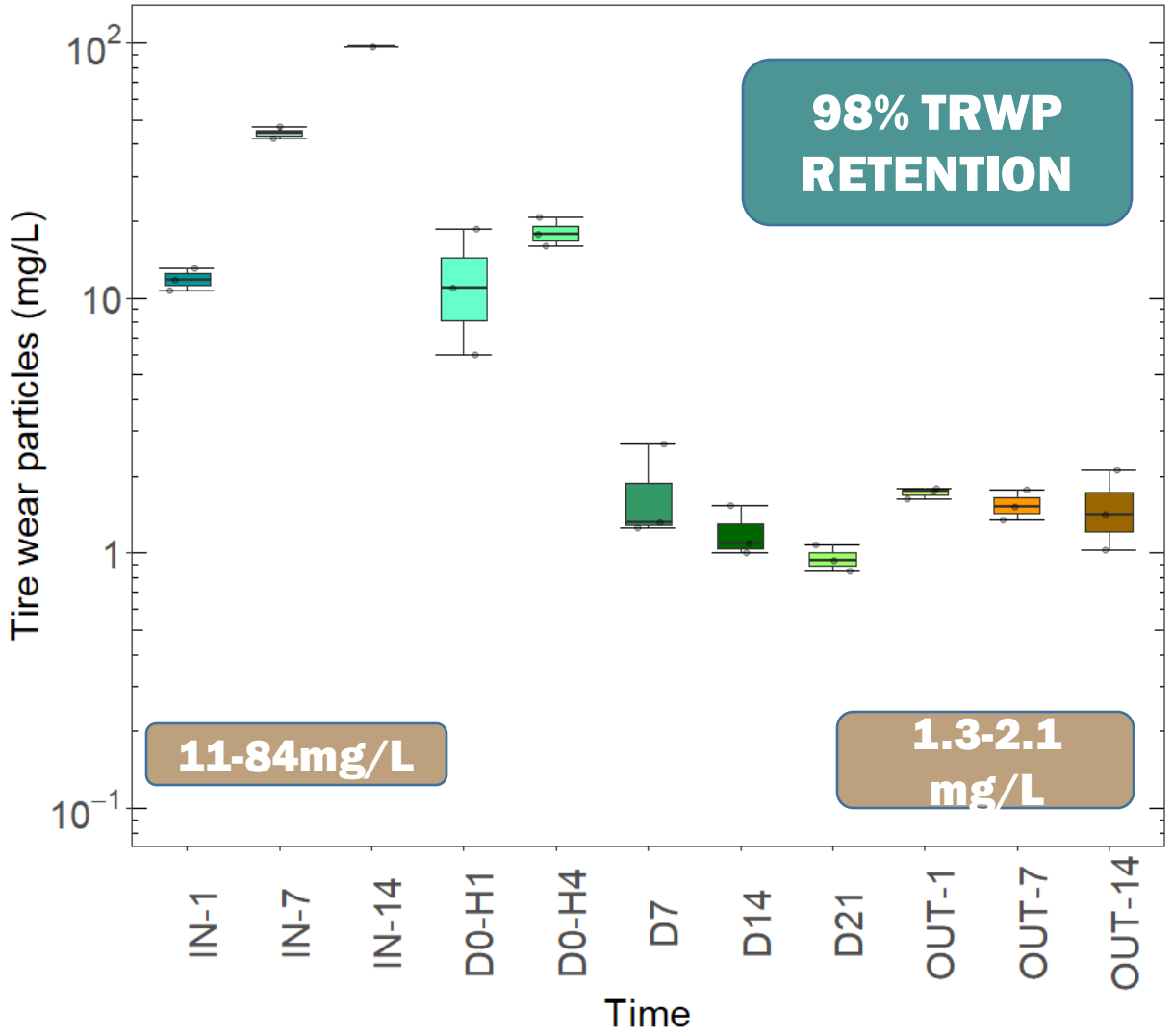
TWP AND TAC LEVELS IN TOTAL SAMPLE (>1.6 µm)

TWP LEVELS IN SIZE FRACTIONS

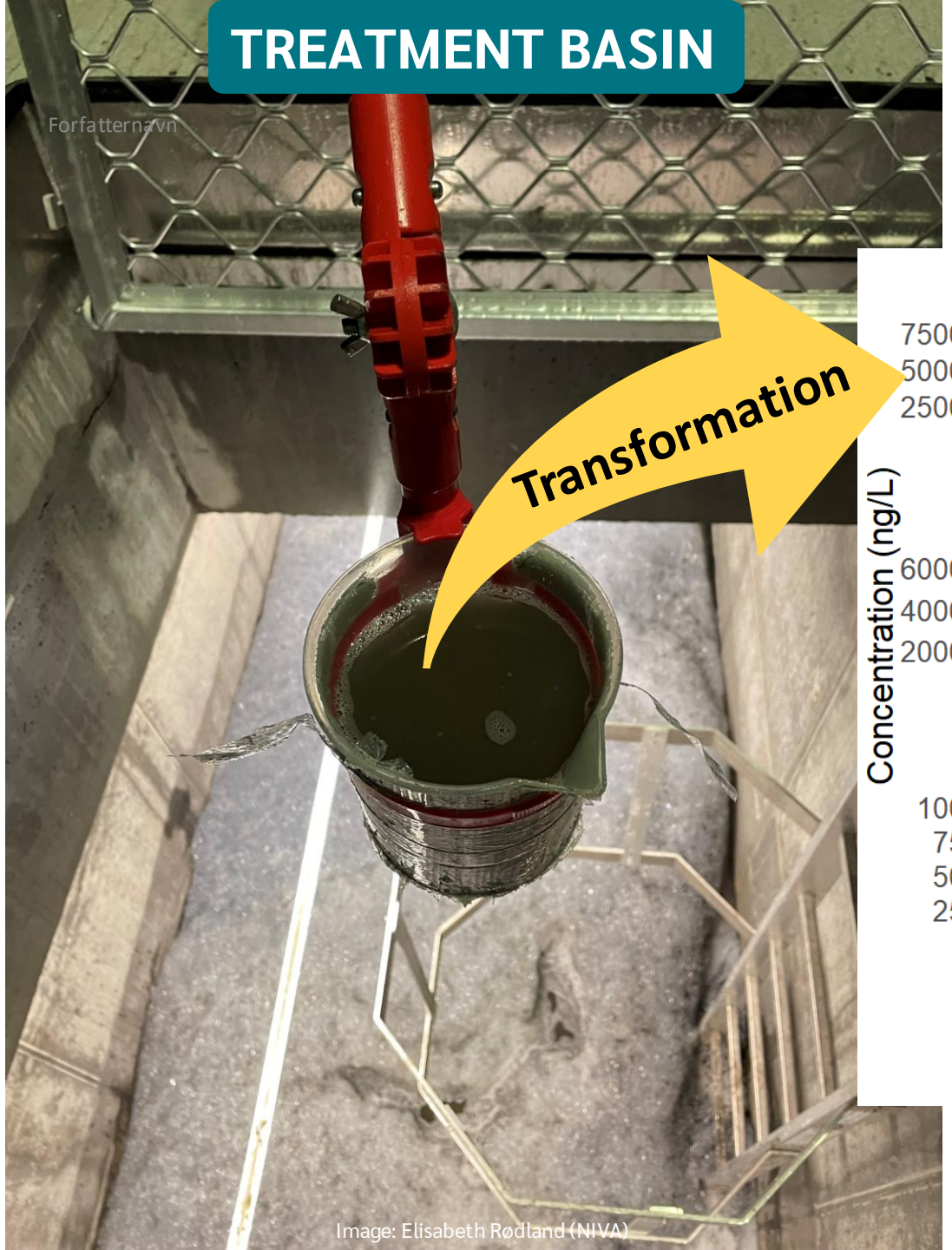
- PYR-GC/MS
- SEM-EDX

Image: Elisabeth Rødland (NIVA)

Vålerenga tunnel Oslo 2023*

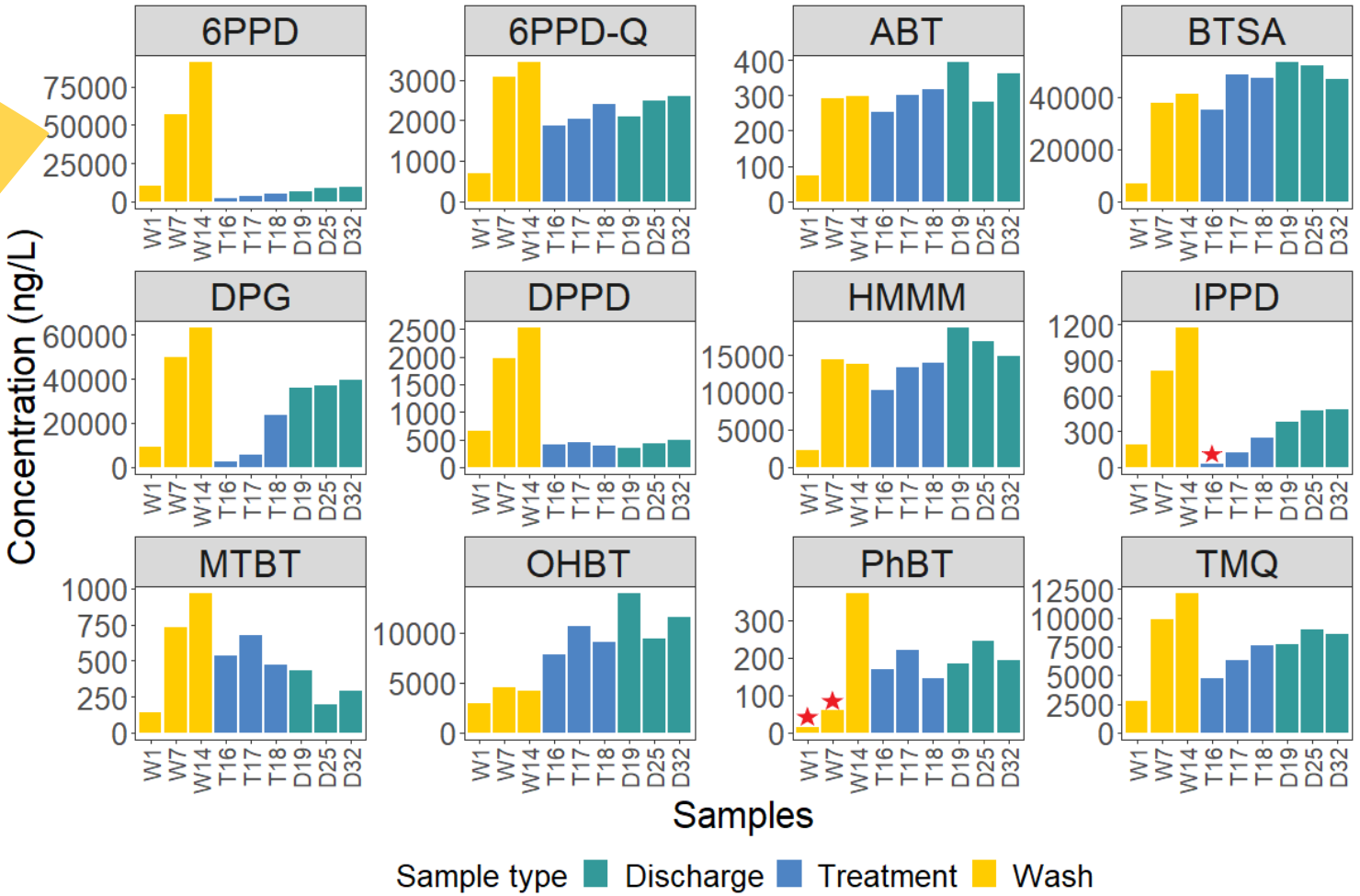


*Meland et al. 2023: Screening of Tire-Derived Chemicals and Tire Wear Particles in a Road Tunnel Wash Water Treatment Basin



Treatment of tire-related chemicals?

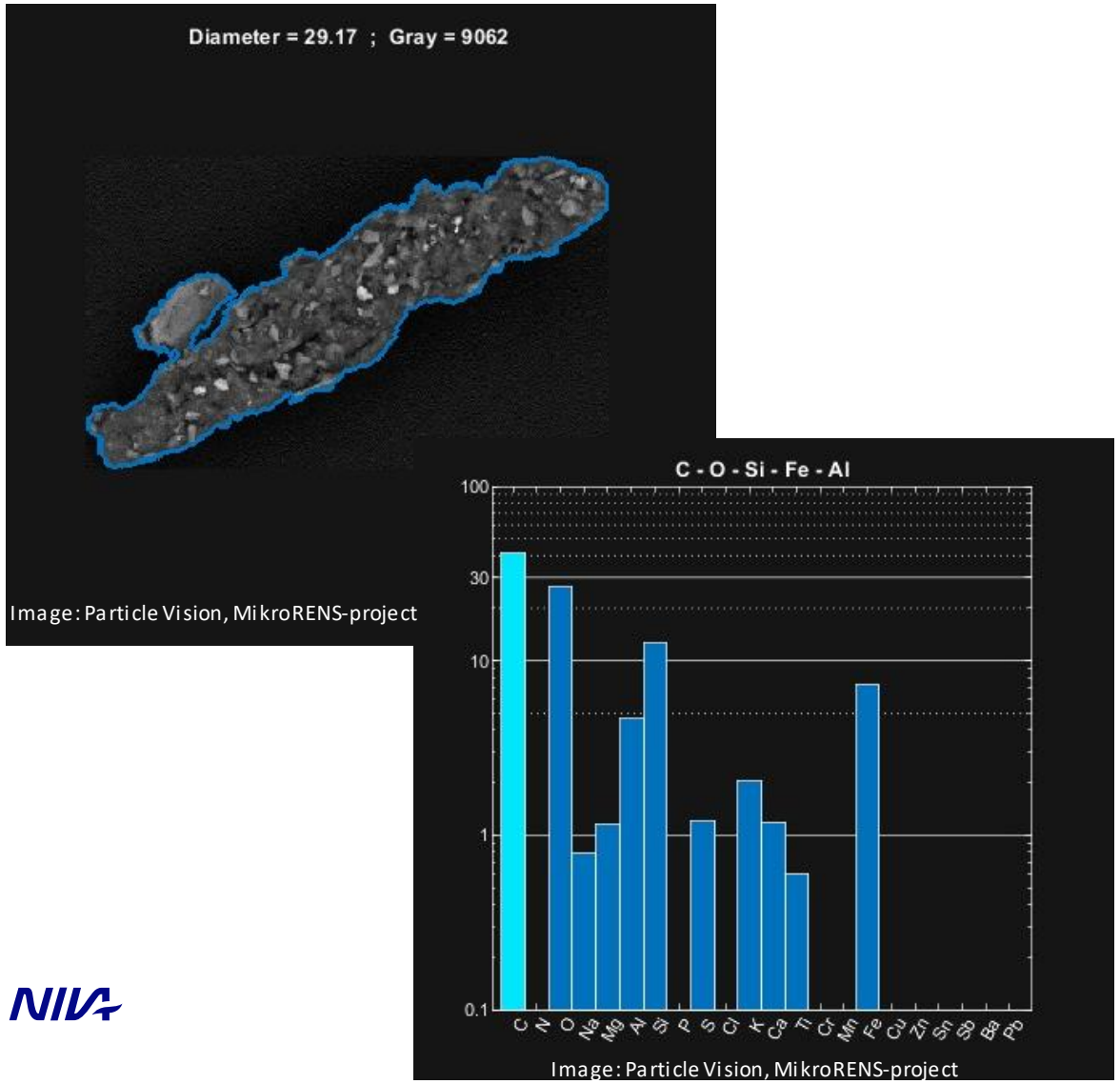
Discharge levels higher than inlet water

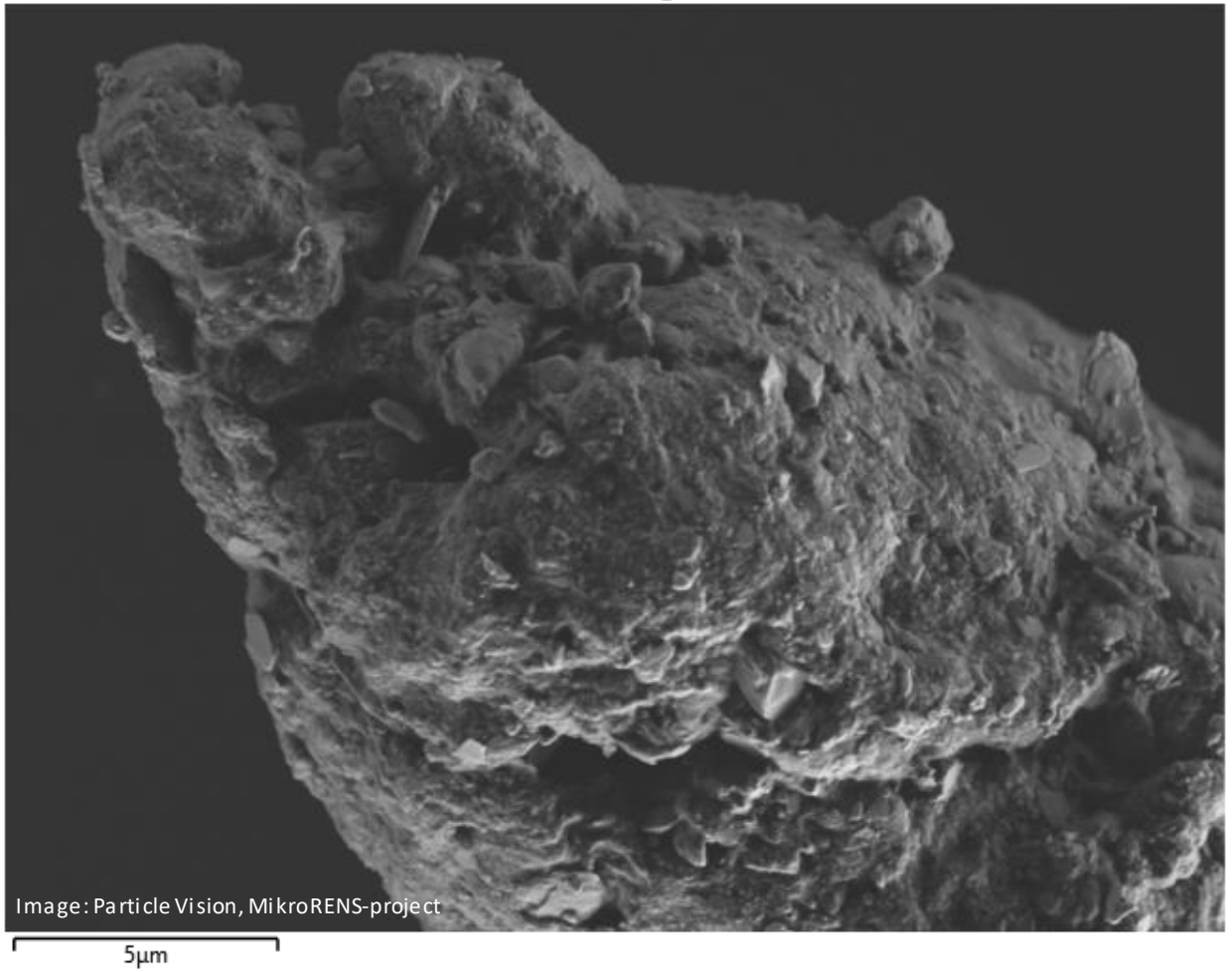


*Meland et al. 2023: Screening of Tire-Derived Chemicals and Tire Wear Particles in a Road Tunnel Wash Water Treatment Basin

COMPARISON STUDY BETWEEN PYR-GC/MS AND SEM-EDX

Vålerenga tunnel Oslo 2023**



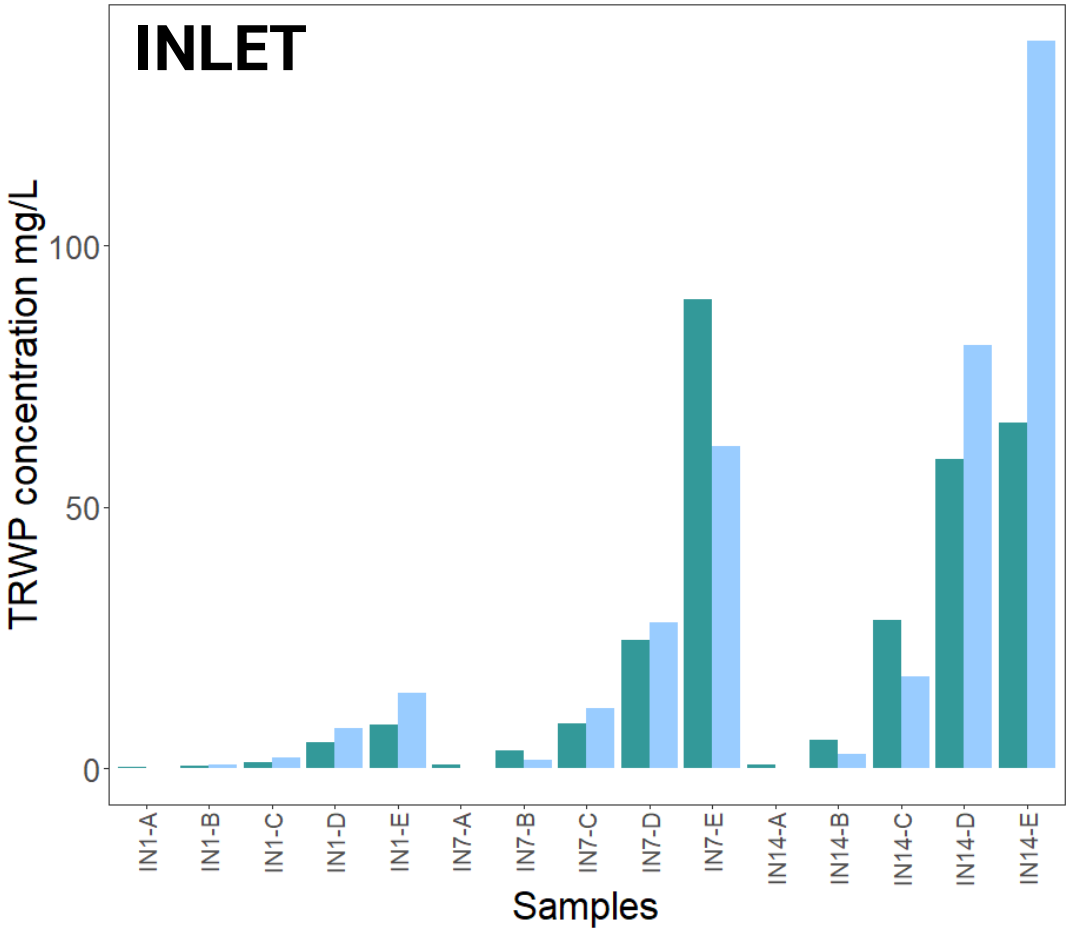


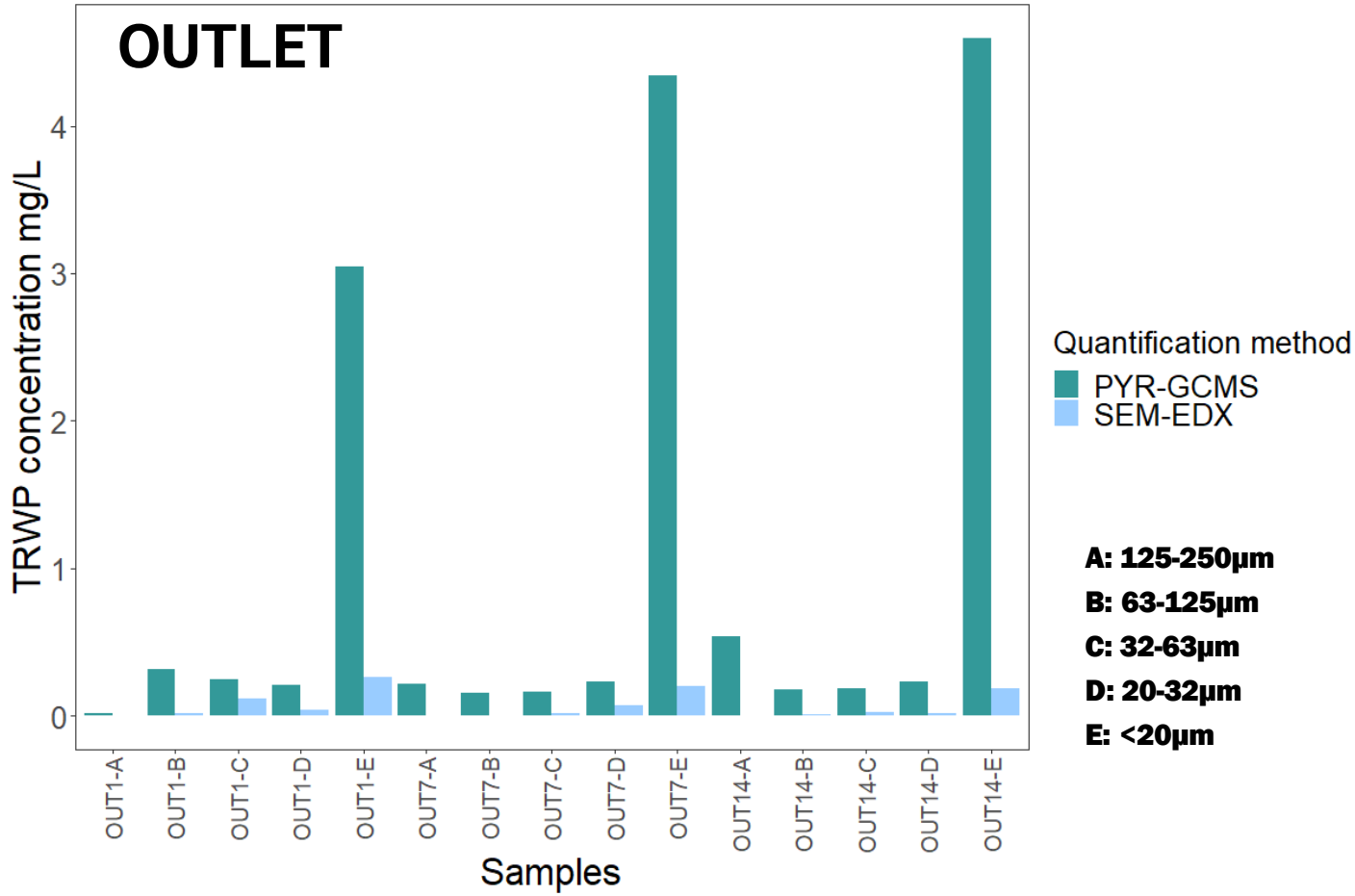
**Rødland & Particle Vision, In prep.

COMPARISON STUDY BETWEEN PYR-GC/MS AND SEM-EDX

SEM-EDX → difficult to distinguish TRWP and RWP <10µm?

PYR-GC/MS: Influence on markers in out samples?





A: 125-250µm
B: 63-125µm
C: 32-63µm
D: 20-32µm
E: <20µm

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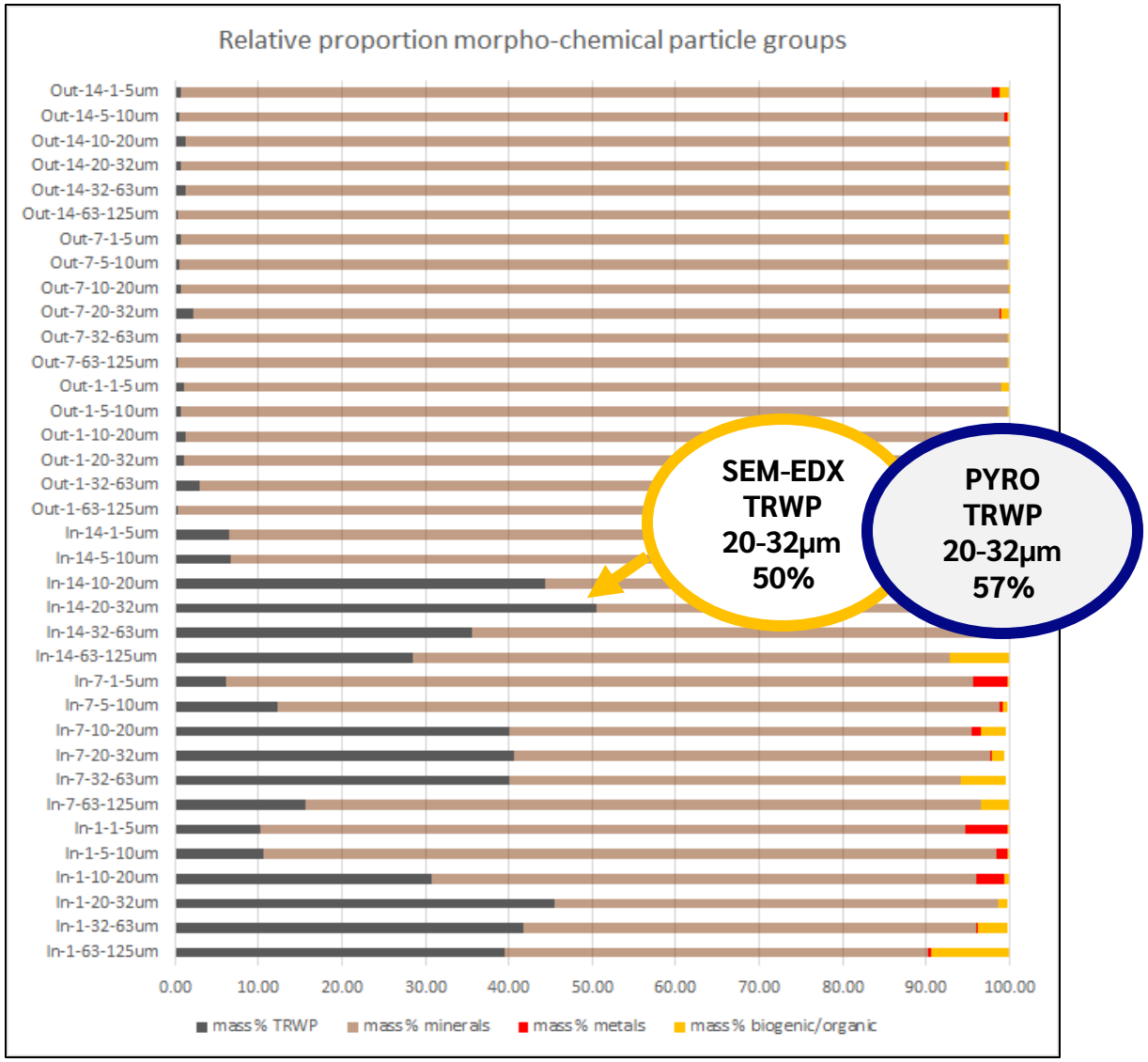
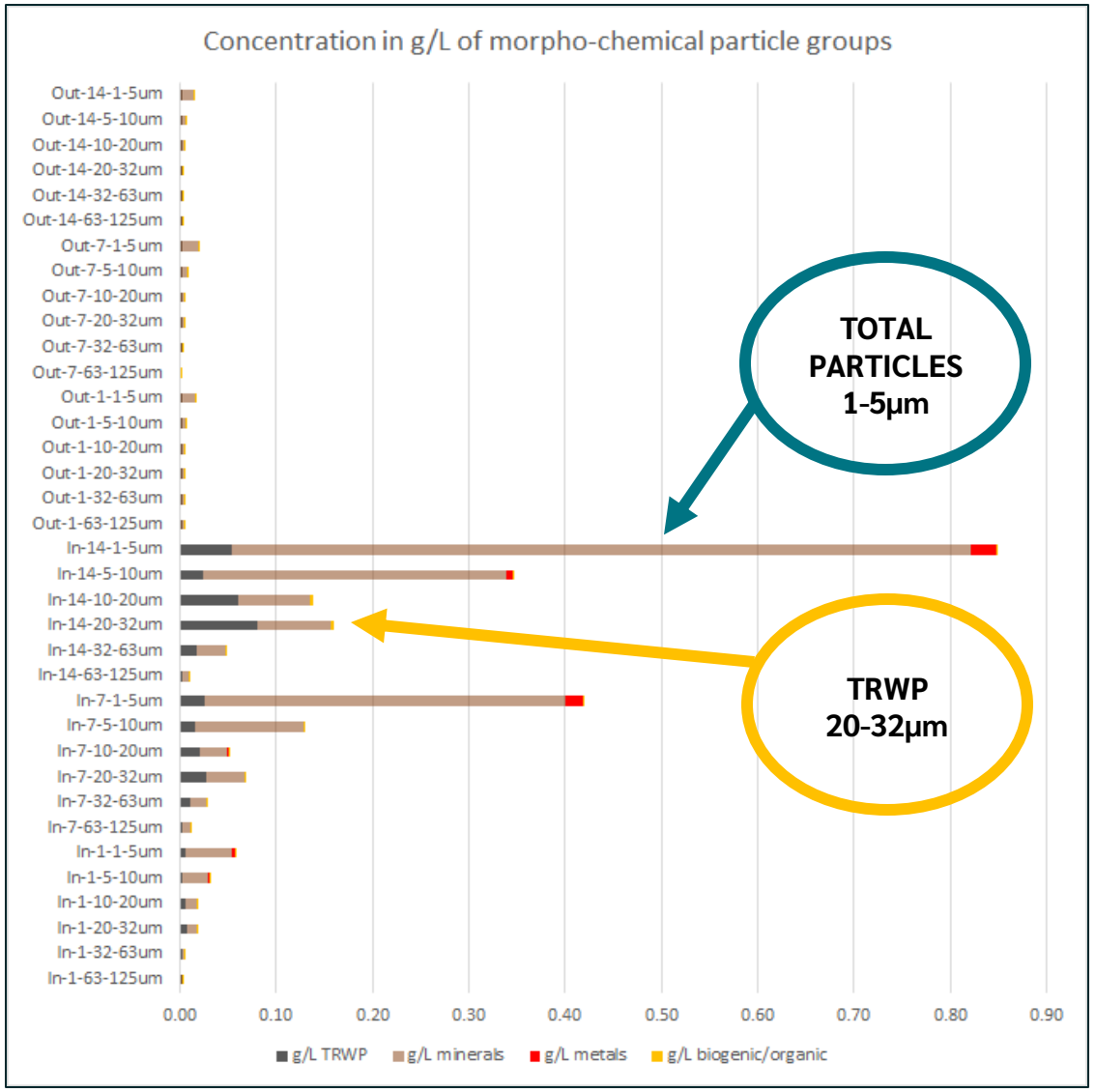
COMPARISON STUDY BETWEEN PYR-GC/MS AND SEM-EDX





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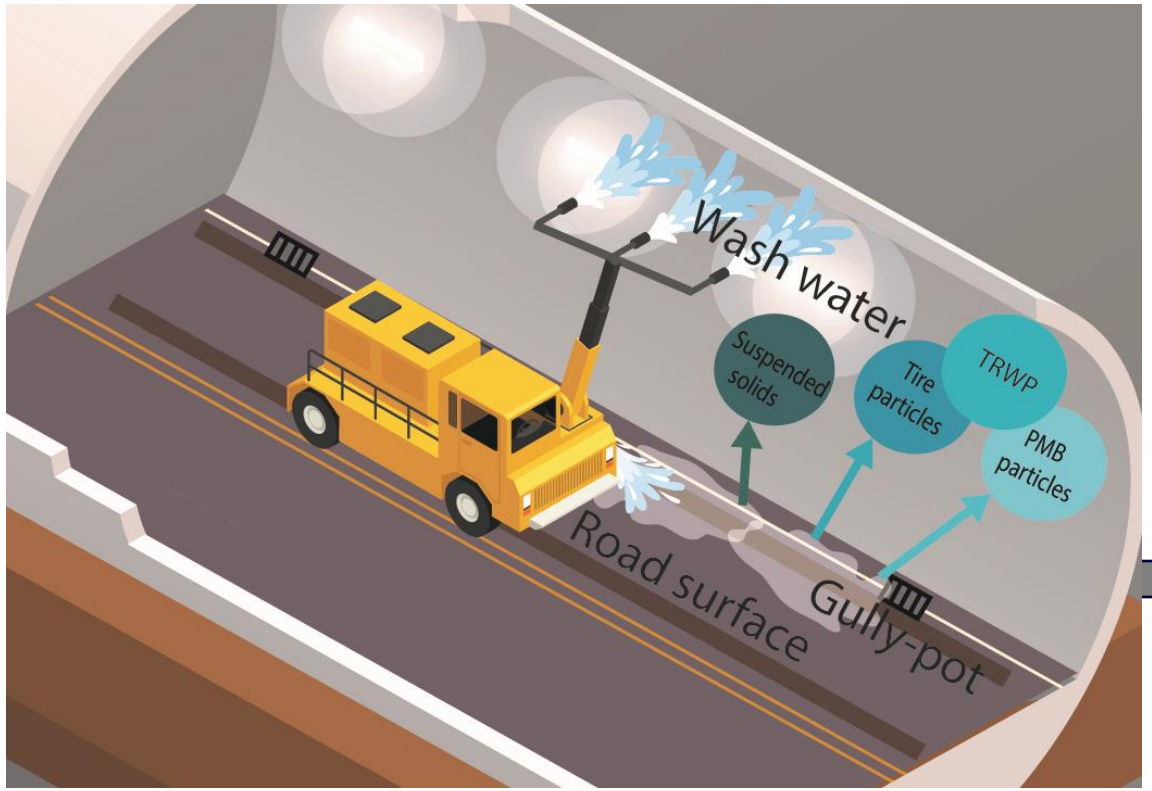
NEW ONGOING PROJECTS

PROJECT TREAT: IMPROVED REMOVAL OF TRWP AND TAC USING TWO-STEP TREATMENT



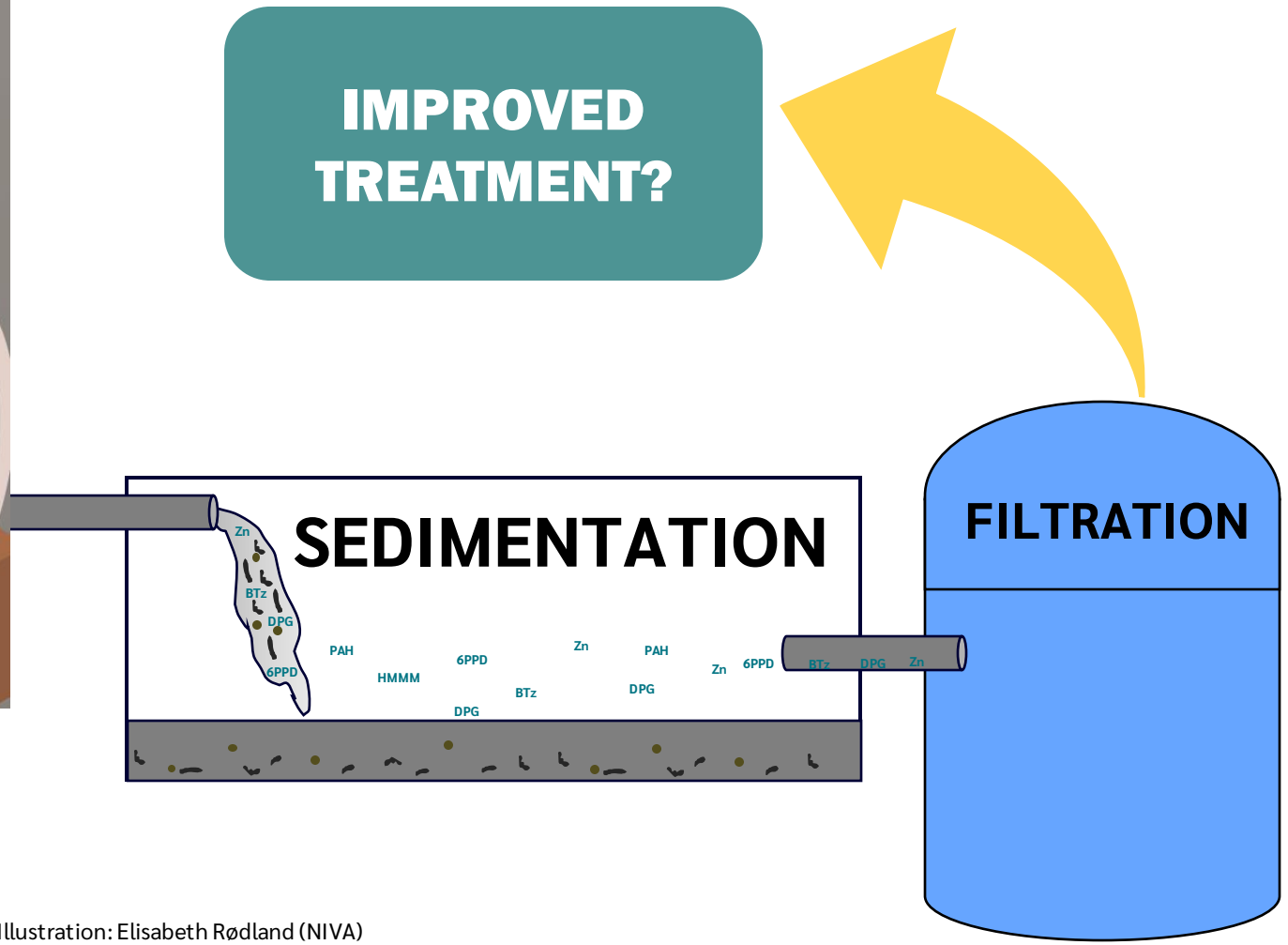


Illustration: Elisabeth Rødland (NIVA)

Thank you for the attention!

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Statens vegvesen

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