Environmental impacts of the Krasny Bor toxic waste landfill – EnviTox

Environmental risk assessment in the EnviTox project

Latest studies in water contamination, ecotoxicology and transport of hazardous substances – new views for environmental risk assessment in Finland and in Russia
Webinar 13.9.2021

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Environmental impacts of the Krasny Bor toxic waste landfill – EnviTox

- Main objectives:
  - To develop recommendations and tools to **ensure good quality environment in the area around Krasny Bor hazardous waste landfill**
  - **To provide up-to-date information on the state of the environment** in the area

- Project partners:
  - State Geological Unitary Company Mineral (SC Mineral)
  - Institute of Limnology, Russian Academy of Sciences (IL RAS)
  - Institute of Precambrian Geology and Geochronology, Russian Academy of Science (IPGG RAS)
  - Geological Survey of Finland (GTK)
  - South-Eastern Finland University of Applied Sciences (Xamk)

- Duration of the project: 3/2019 – 2/2022 (3 years)

- The project is co-funded by the South-East Finland – Russia Cross-border Cooperation Programme (CBC Programme 2014-2020) with the financing from the European Union, the Russian Federation and the Republic of Finland. Total budget 931 016 €

Main activities in the EnviTox project

- State of the art studies
- Preparatory actions and training
- 3 sampling stages
  - Field work
  - Analytical research
  - Quality control
  - Results interpretation
- Surface water monitoring
- Surface water modelling
- Vulnerability and risk assessment
- Recommendations for risk management measures
- Sharing experiences of methods and best practices
- GIS portal
- Stakeholder communication

Photo: Galina Savenkova

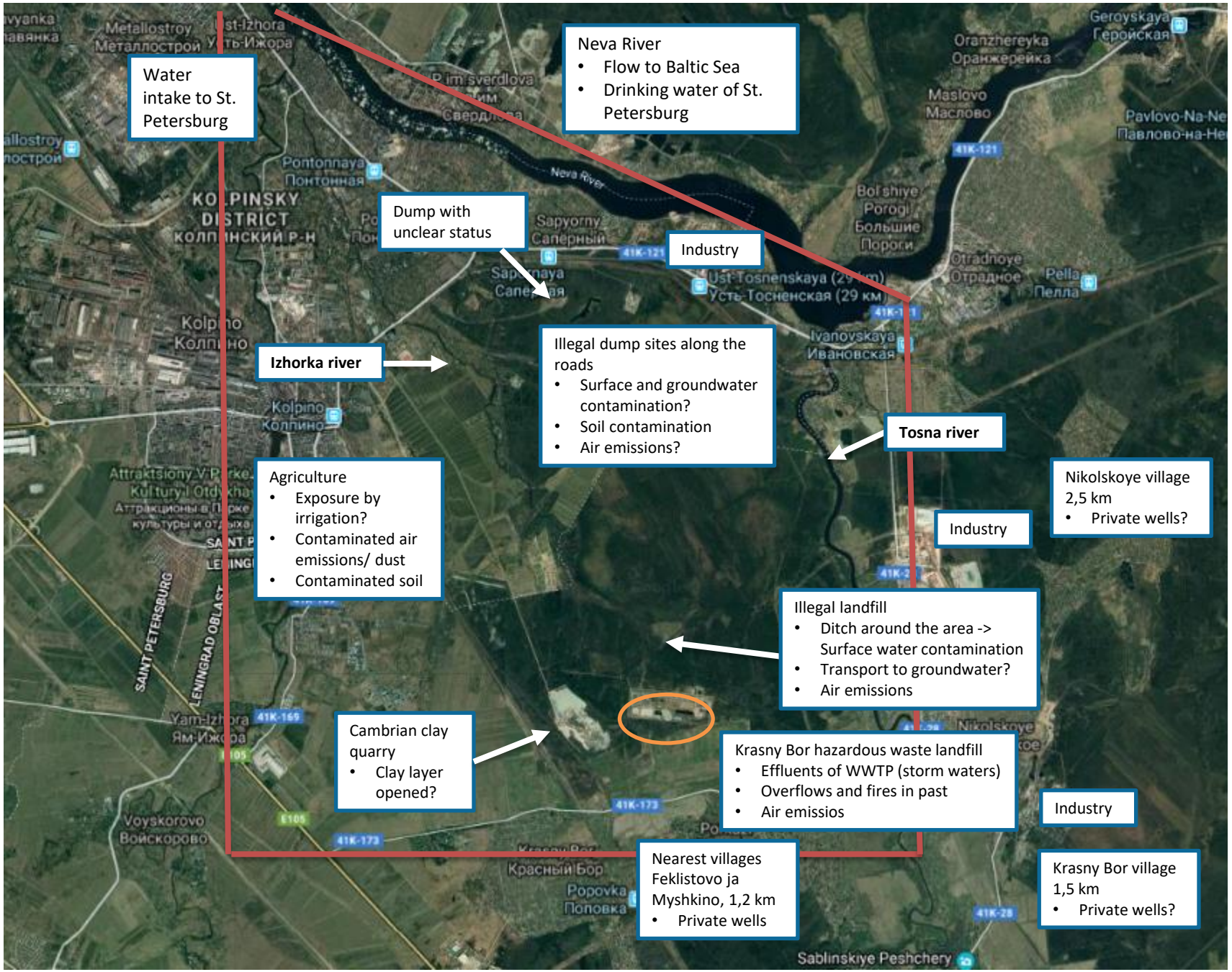
Krasny Bor hazardous waste landfill and the EnviTox study area

- The toxic waste landfill Krasny Bor (73 hectares) is located about 30 km from the centre of St. Petersburg
- From 1969, altogether 2 million tons of toxic waste was accumulated into 70 ponds excavated in the Cambrian clay. The landfill stopped accepting toxic waste in 2014.
- The thermal facilities of waste neutralization are the main sources of air emissions at the site
- There have been landfill fires and overflows of the toxic waste ponds in the area.
- Since 2016, the measures to eliminate the accumulated environmental damage have been carried out. Ponds have been mainly covered and there is wastewater treatment plant for storm waters in the landfill.
- The Baltic Marine Environment Protection Commission (HELCOM) has identified the Krasny Bor toxic waste landfill as a major hot spot of the Baltic Sea Region from 1993 to the present.
- The main part of the environmental activities is concentrated on the territory of landfill and its sanitary protection zone. Environmental assessment outside this area has not systematically been provided.

EnviTox project provides up-to-date information on the state of the environment **in the area around the Krasny Bor landfill**

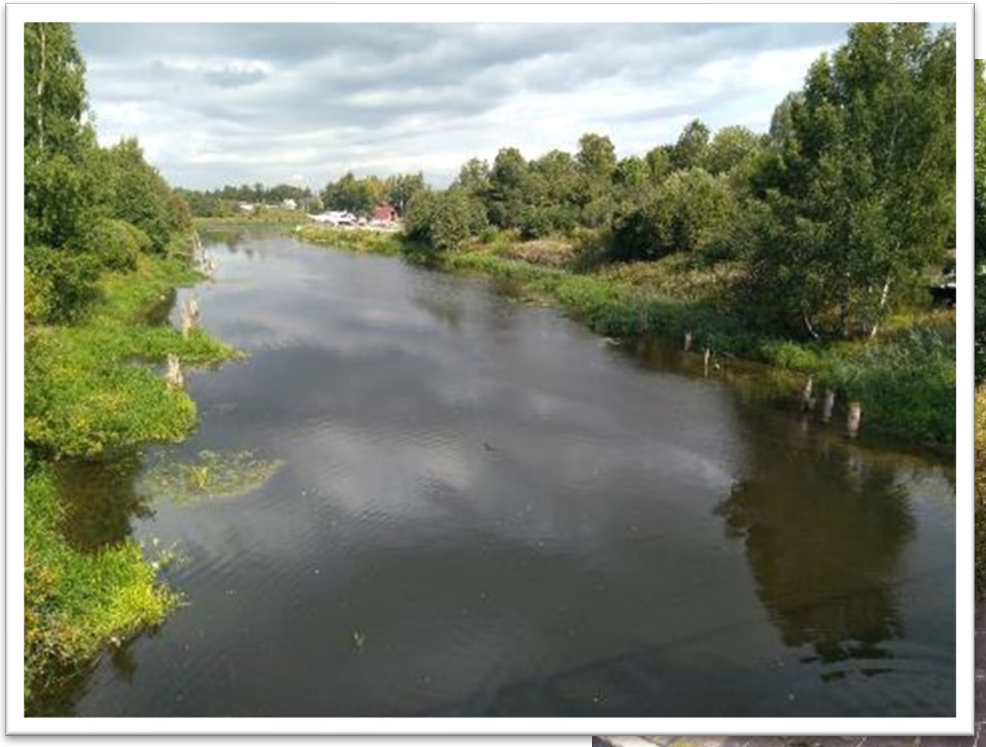
EnviTox study area

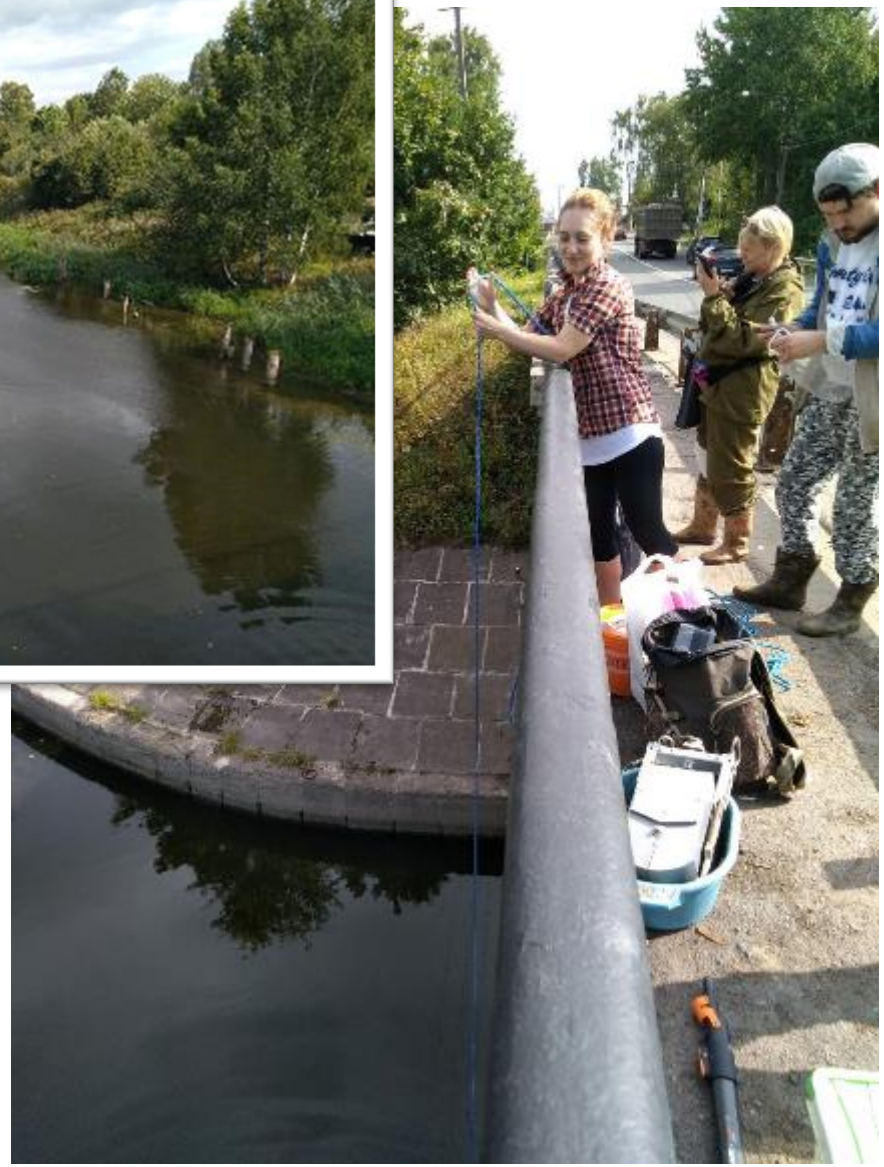
- The EnviTox study area locates between Izhora and Tosna rivers and its size is 65 km^2.
- In addition to Krasny Bor landfill, there are many other human acitivities / contamination sources: industry, agriculture, cemetery, commercial garden
- Illegal/ unauthorized landfills



Main canal from landfill in August 2019 and in April 2021.

Photos V. Malk and M. Gorelenko





Right: Sampling from river Bolshaya Izhorka

Left: Tosna river

Photos V. Malk

Forest / northern side of the landfill.

Photos Vuokko Malk

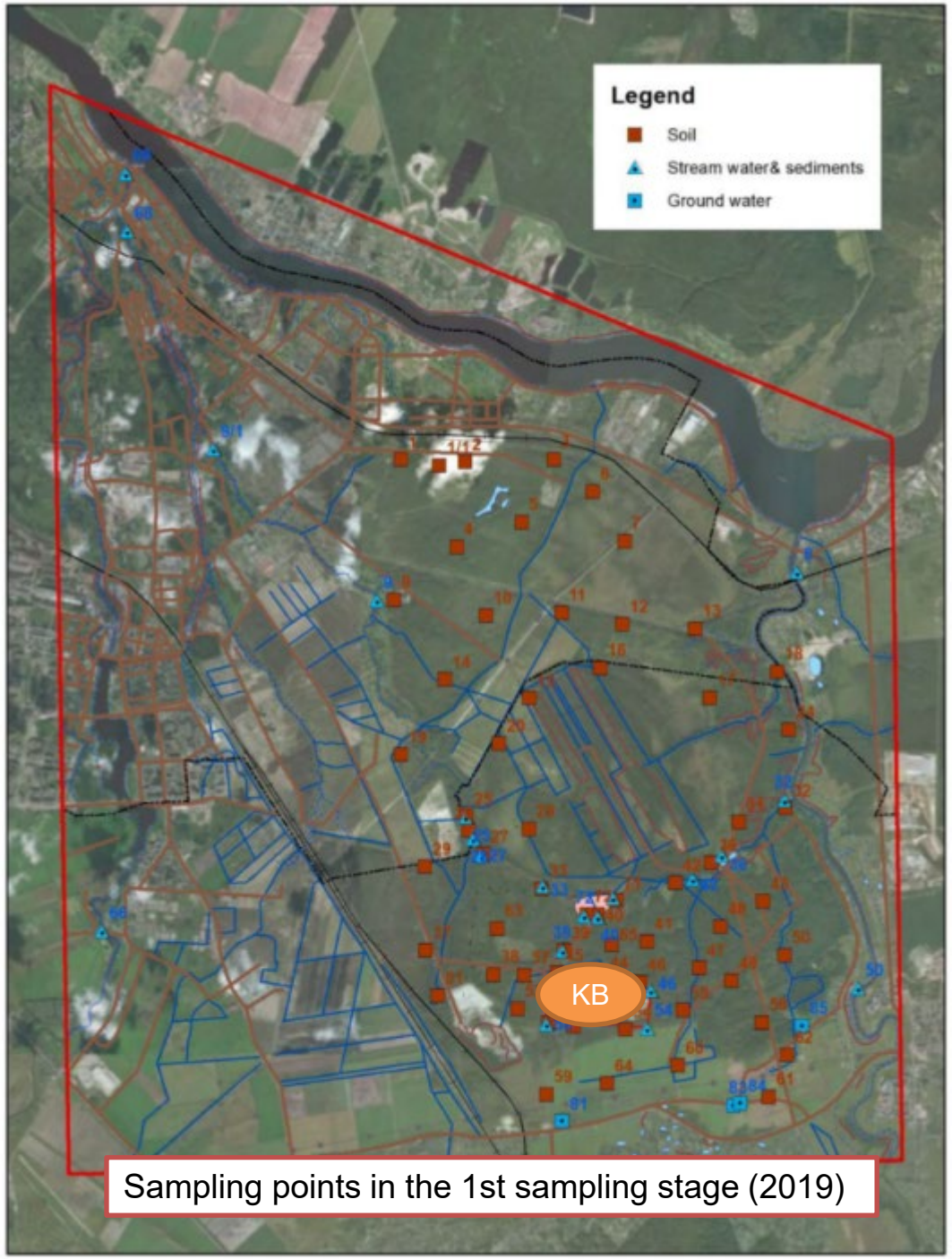
Location of the Unauthorized Disposal Site 6.4 km Northwesterly of the Krasny Bor Landfill (Romanov et al. 2021)

Location of the Unauthorized Disposal Site 850 m to the North of the Krasny Bor Landfill Territory (Romanov et al. 2021)

Photo Jaana Jarva

EnviTox data for risk assessment

- 1st sampling stage (August 2019):
  - 122 soil samples, 22 surface water samples, 22 sediment samples, 5 groundwater samples
- 2nd sampling stage (November 2020):
  - 12 soil samples, 22 surface water samples, 15 sediment samples
- 3rd sampling stage
  - Original plan was to take snow samples to measure atmospheric deposition. Due to weather conditions, the plan was changed.
  - Melting waters (April 2021)
  - Water samples for ecotoxicity tests (*Paramecium caudatum,* infusoria*)* (August 2021)
- Surface water monitoring
  - August 2019, October 2019, November 2020, April 2021, August 2021



Sampling points in the 1st sampling stage (2019)

Analysed substances

- Analyses were based on earlier studies in the Krasny Bor landfill area and available methods.
- Samples were analysed in Russian accredited laboratories according to Russian standard methods.
  - Metals
  - Oil products
  - Phenols
  - PAH
  - PCB
  - Halogenated organic pesticides
  - Dioxines (from few soil and sediment samples)
  - Surface active anionic substances (from water samples)
  - Volatile halogenated hydrocarbons (from water samples)
  - Formaldehyde (from water)
  - Inorganic substances (major ions, from water)

- Other properties
  - Soil/sediment samples: water content, LOI, pH, grain size distribution
  - Water samples: COD, BOD, evaporated residue, suspended substances, organic carbon, DOC.
  - Field measurements: pH, electric conductivity, oxygen, redox potential

Preliminary results & observations

- The results interpretation is still in progress and all the laboratory analyses are not yet ready.
- Russian limit values have exceeded in several soil, sediment and surface water samples
  - High concentrations were observed especially in the vicinity of unauthorized disposal sites
  - Concentrations of mercury, nickel, lead, iron and manganese exceeded Russian limit values; emission sources have not been unambiguously identified
  - Concentrations of phenols, anionic surfactants, chloroform and PAHs in stream water above the limit values may come from the Krasny Bor hazardous waste landfill and illegal landfills
  - In sediment samples, the highest concentrations of harmful substances were found in the south-western corner of the Krasny Bor hazardous waste landfill, in the vicinity of the illegal landfill and in the stream flowing into Izhorka, northwest of Krasny Bor.

- There is variation in results between 1st and 2nd sampling stage and the reason is not known. Different laboratories were used in 1st and 2nd stages.

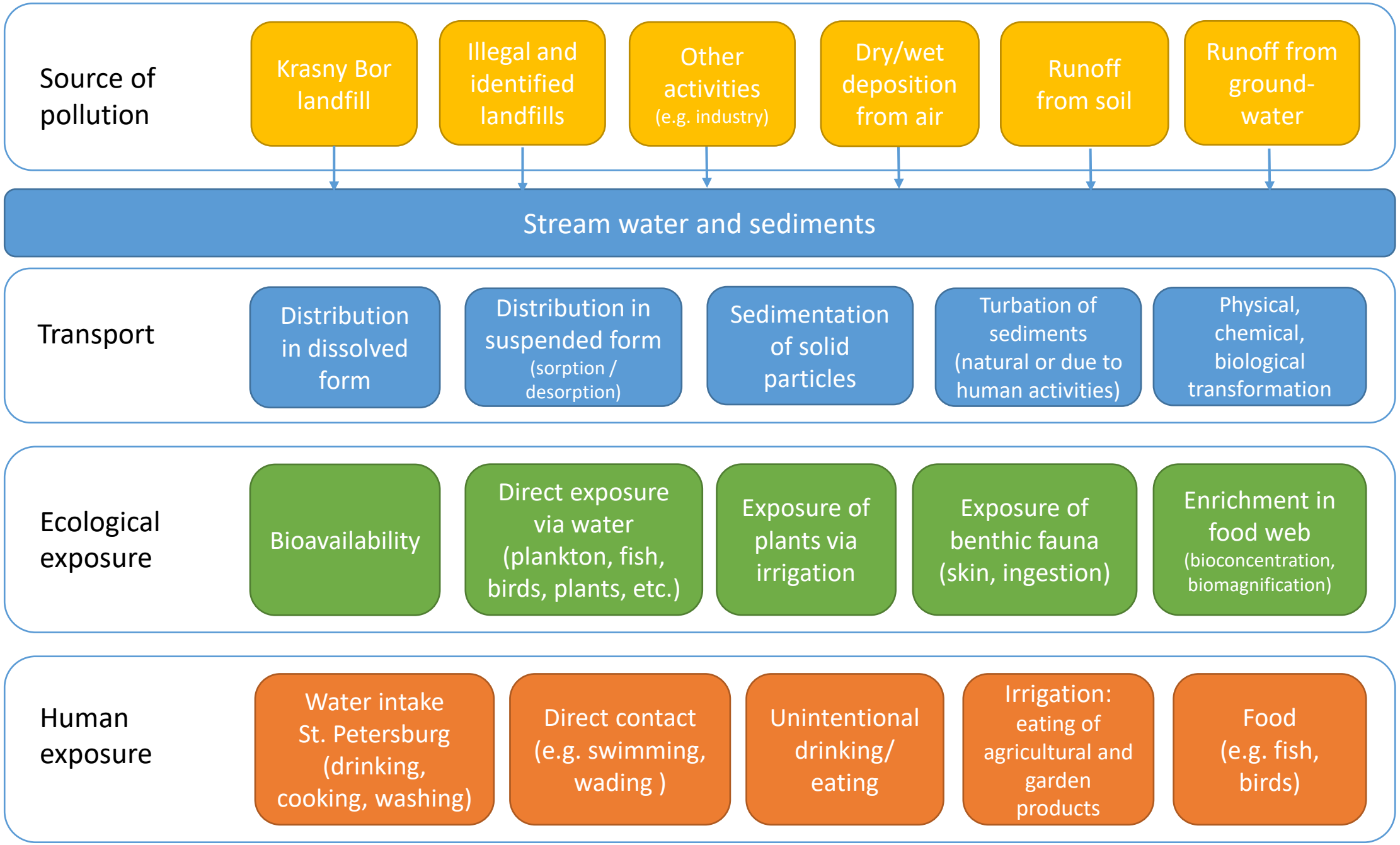
Risk assessment in the EnviTox project

- Transport risks, ecological risks (and health risks) are assessed qualitatively
  - In risk assessment, the study area is divided into smaller areas
  - Focus on hot spot areas and the main key pollutants

- The risk assessment is based on data produced in the project, literature data and background information from the study area.

- The transport and exposure routes are described, and the most important ones are identified. Conceptual model is created.

EXAMPLE: TRANSPORT AND EXPOSURE ROUTES VIA STREAM WATER AND SEDIMENTS. DRAFT.



Risk assessment in the EnviTox project

- Concentration data has been compared to reference values already at the results interpretation phase
  - In addition to the reference value analysis, **site-specific conditions** (e.g. organic matter, pH analyses and field observations) and **substance-specific properties** (based on literature data) and **their effect on bioavailability** are taken into account

- Uncertainty analysis
  - The challenge of risk assessment is e.g. variability and uncertainties observed in the analytical results. There can be also contaminants in the area, which are not analysed.
    - For quality control, parallel laboratory analysis in different laboratories would be recommended
  - The study area is wide, so despite the large number of samples and analyzes taken, the coverage and representativeness of the sampling is not fully complete.
  - There are no research results on the interactions and effects of contaminants on organisms in the area

- Recommendations for future studies

Thank you!

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