

Case study from Ukraine

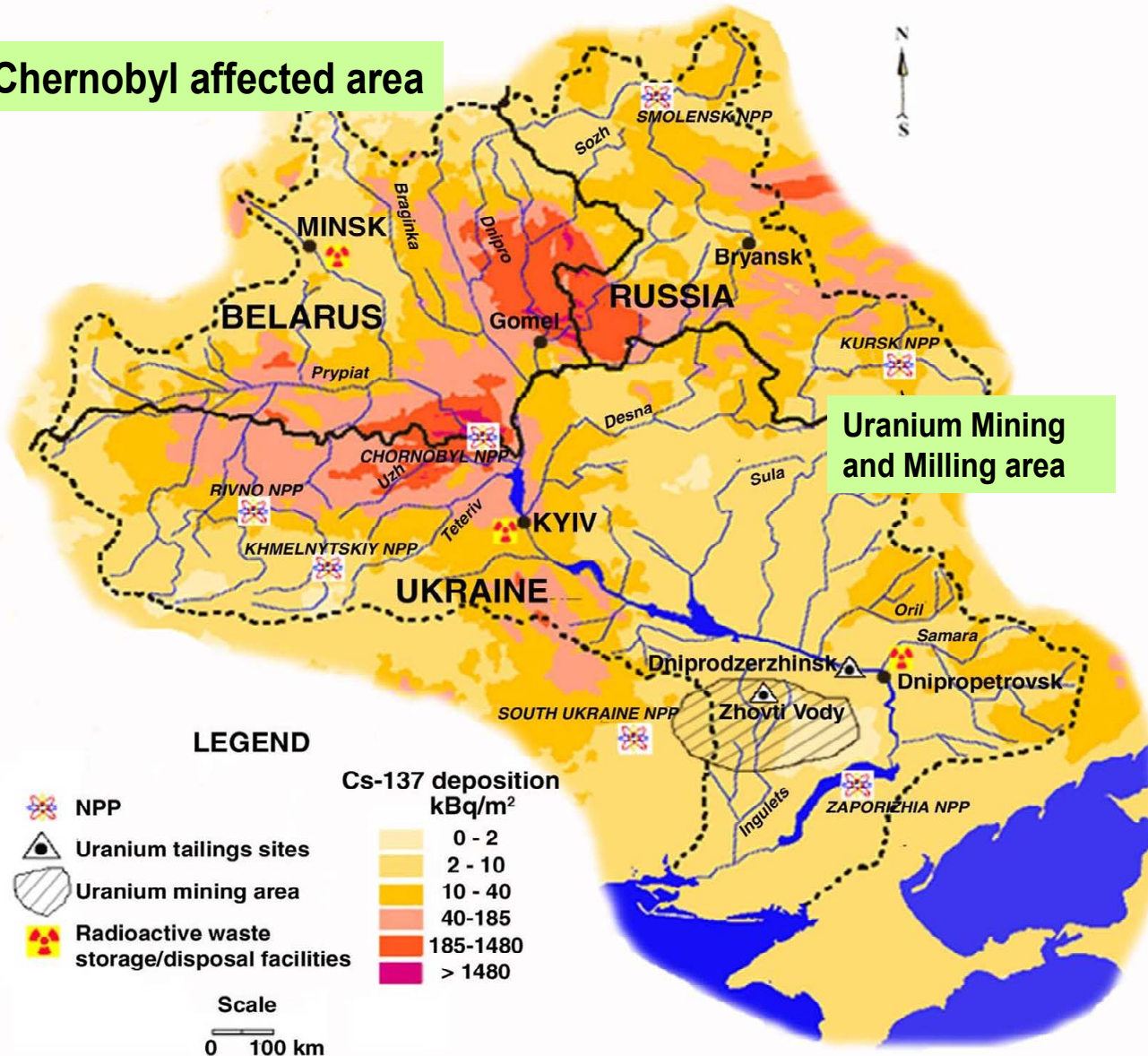
Uranium Mining Facilities at the Pridneprovsky Chemical
Plant

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Outline

- Overview of the situation
- Monitoring programs
- Examples of monitoring results
- Modelling work
- Examples of assessments

Chernobyl affected area

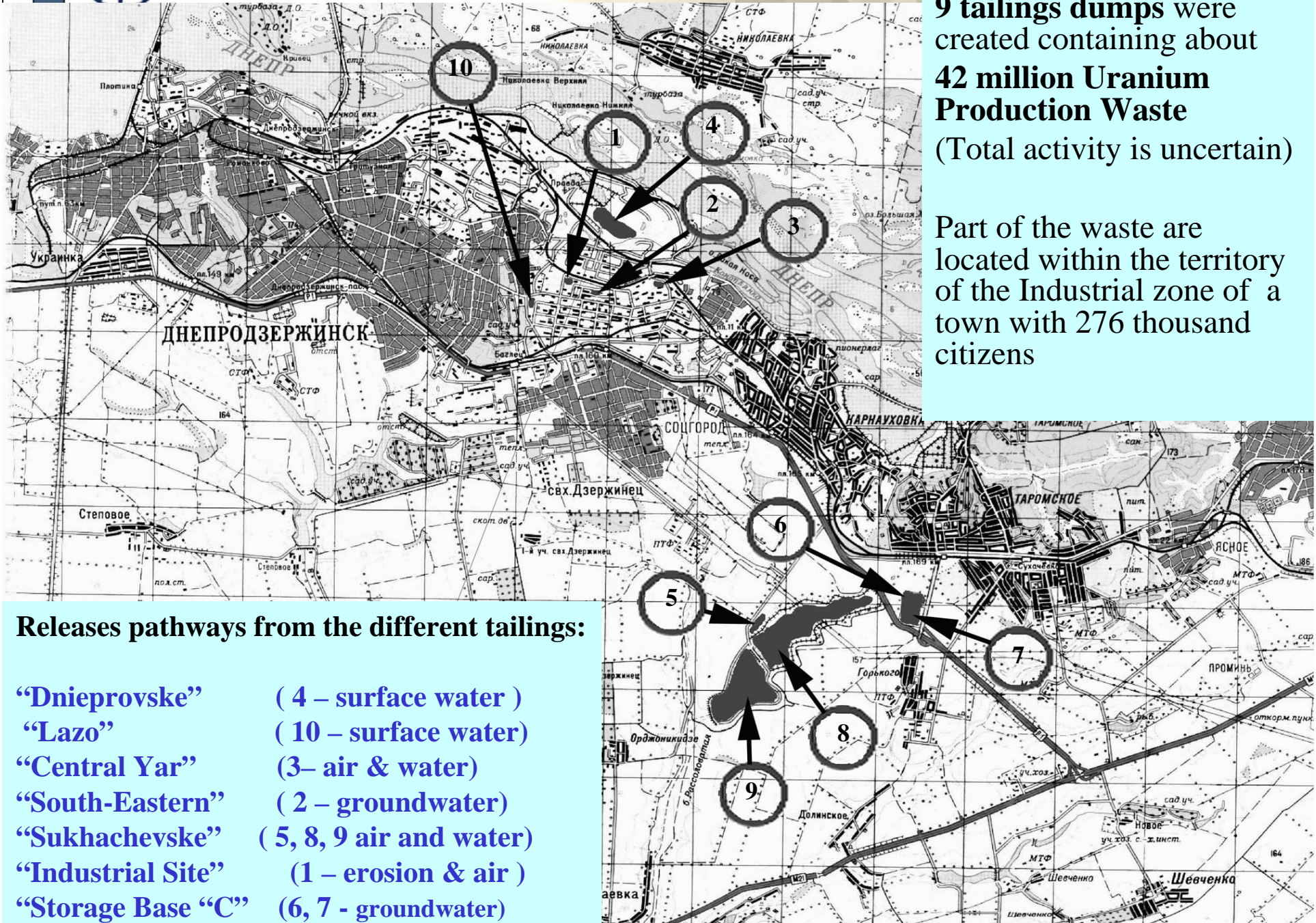


The Uranium Milling facility “Pridneprovski Chemical Plant” in Dniprodzerzhinsk was in operation from 1948 till 1991. It was closed down After the collapse of the Soviet Union.

Remediation of the plant and Uranium tailings located on its territory started in 1991

9 tailings dumps were created containing about **42 million Uranium Production Waste** (Total activity is uncertain)

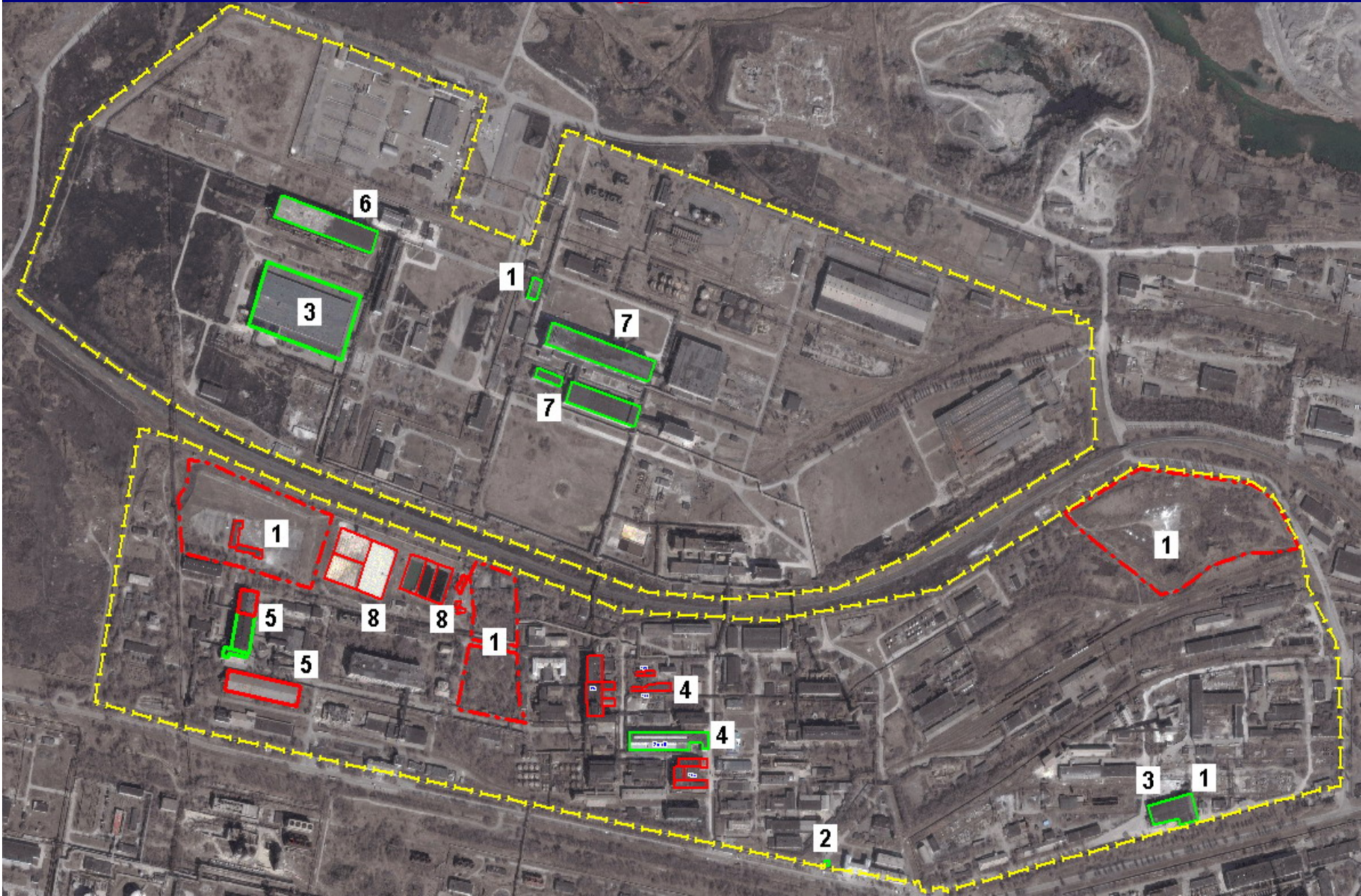
Part of the waste are located within the territory of the Industrial zone of a town with 276 thousand citizens



Releases pathways from the different tailings:

- “Dnieprovske” (4 – surface water)
- “Lazo” (10 – surface water)
- “Central Yar” (3– air & water)
- “South-Eastern” (2 – groundwater)
- “Sukhachevske” (5, 8, 9 air and water)
- “Industrial Site” (1 – erosion & air)
- “Storage Base “C” (6, 7 - groundwater)

Legacy Site and former Uranium Facilities





There are currently 20 enterprises in operation at the territory of the Legacy Site, which are not related to the former Uranium Production



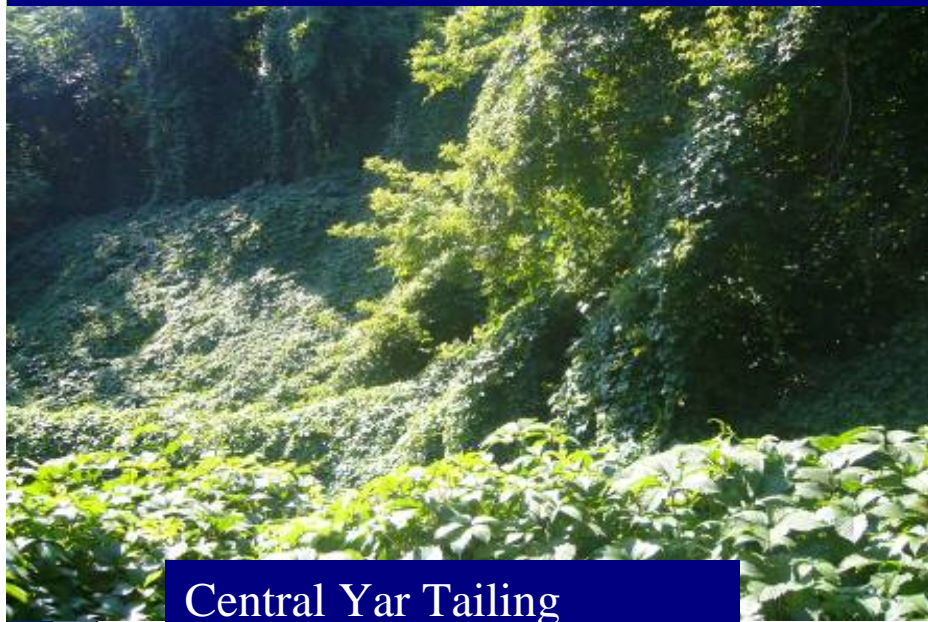
Former Hydrometallurgical Facility



“SMOLY” Enterprise is in operation



Some tailings are covered by trees with deep roots



Central Yar Tailing

The covers of the tailings is not sufficient

Tailing materials have been released to the surface by burrowing animals.

Tailing materials mixed with soil have high Ra-226 levels (100-200 Bq/g), Rn-exhalation 2-5 Bq/m²s



High exhalation of Rn-222, 5,5 Bq M² s



The monitoring programme (1)

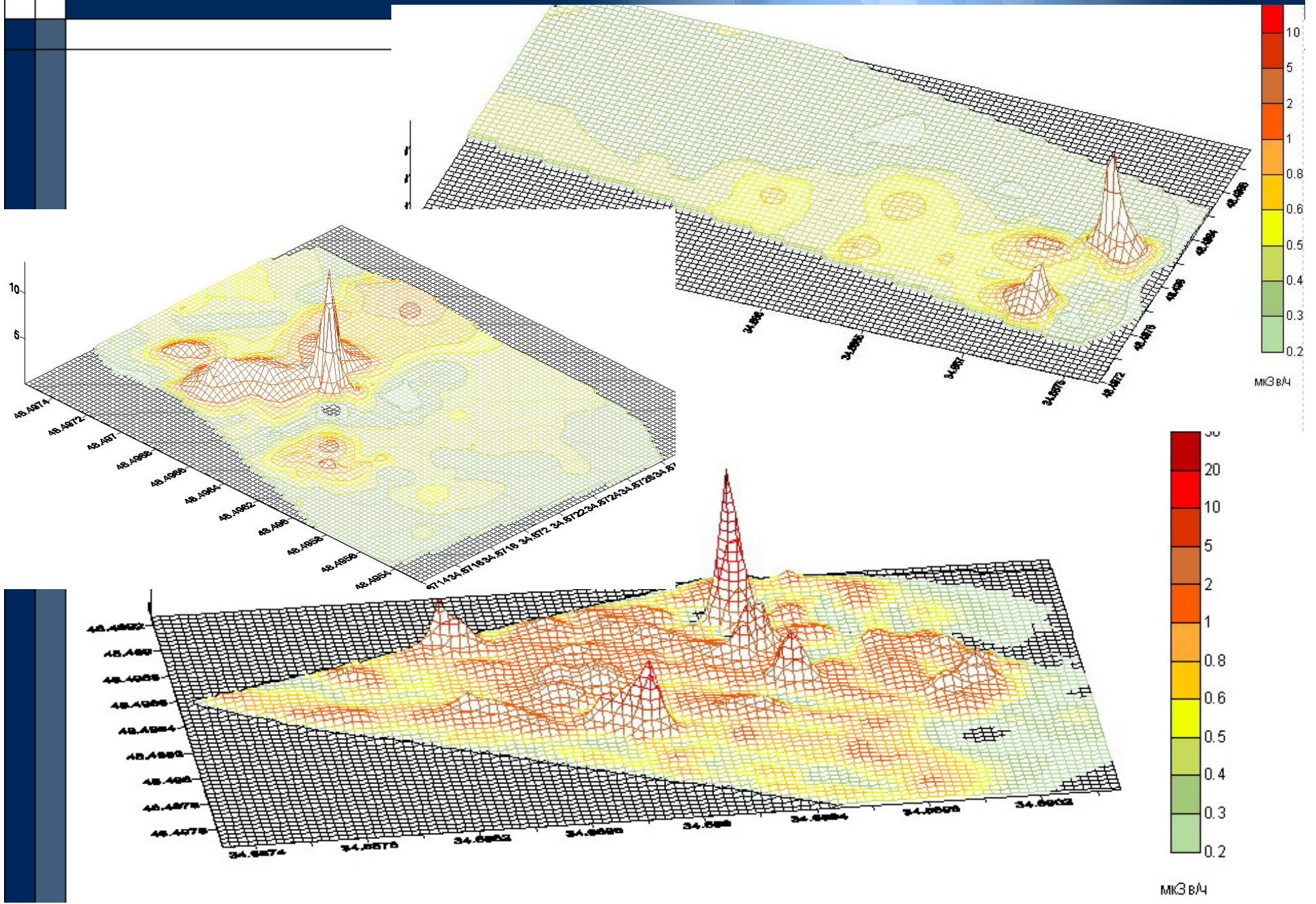
- The program started in 2005. Substantial work was done during 2008-2009.
- The goal is to provide data for evaluation of radiological risks and evaluation of remediation options.
- Several Ukrainian institutions have been involved. Analytical services have been provided by the Hydrometeorological institute.
- A database with monitoring data has been developed

The monitoring programme (2)

- Gamma dose rates at the territory of industrial sites, U-tailings and also outside and inside of buildings.
- Radionuclide concentrations in aerosols (5 points), soils and tailing materials.
- Radon concentrations at the territory and also outside and inside buildings (radiometers, track detectors and LLS),
- Radon exhalation surveys
- Radionuclide concentrations in ground and surface water and locally growth food products.
- Background levels were measured at the vicinity and areas that have not been affected by the uranium tailings
- Baseline monitoring information (meteorology, hydrology, hydrogeology)
- Chemistry of ground and surface waters

Typical ranges of environmental contamination with radionuclides from ^{238}U series

Type of samples	Units	^{238}U	^{230}Th	^{226}Ra	^{210}Pb	^{210}Po
Soils at the inhabitant areas	Bq kg ⁻¹	20-30	50-70	20-40	50 -90	40-70
Soils at the Industrial site	Bq kg ⁻¹	10 ² -10 ³	10 ² -10 ³	10-10 ²	10 ² -10 ³	10 ² -10 ³
Soils and tailing material at the Uranium residue dump sites,	Bq kg ⁻¹	10 ³ -10 ⁴	10 ³ -10 ⁴	10 ⁴ -10 ⁵	10 ⁴ -10 ⁵	10 ⁴ -10 ⁵
Groundwater (pore water) in the aquifer at the tailing site	Bq m ⁻³	10 ² -10 ⁵		10-10 ³	10-10 ³	15-300
Surface water in the drainage systems inlet to the Dnieper River	Bq m ⁻³	200-500		15-30	15-20	5-10
Aerosols at the tailings and nearby contaminated buildings	10 ⁻⁶ Bq m ⁻³	50-300		100-150	600-1100	150-400
Aerosols at the inhabitant area nearby of industrial sites	10 ⁻⁶ Bq m ⁻³	15-20		10-30	50-200	15-40



Groundwater

About 50 wells at the territory

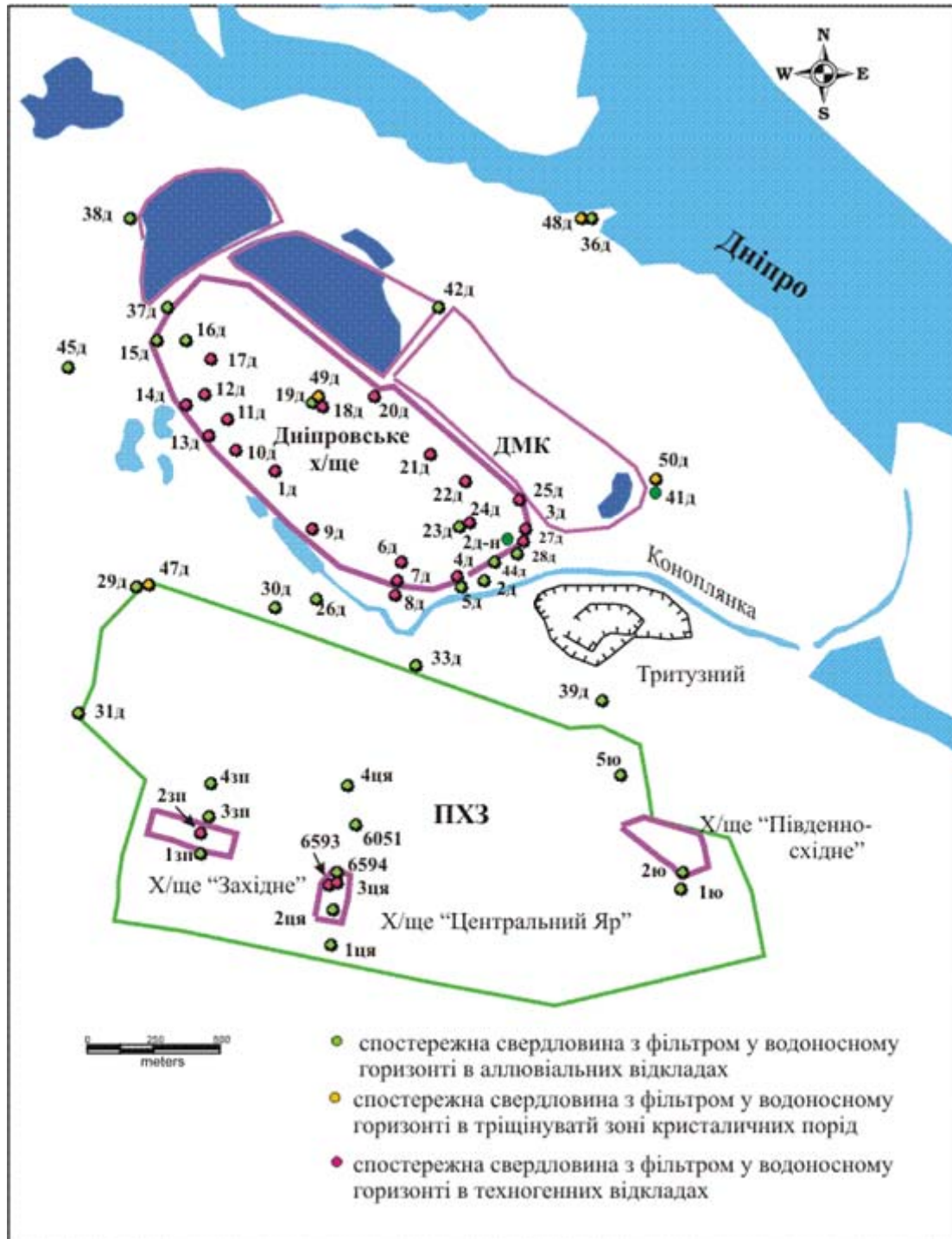
Sampling 1-2 times per year at 10-15 wells

Maximal levels of $^{238+234}\text{U}$ in pore water (100-500 Bq/l)

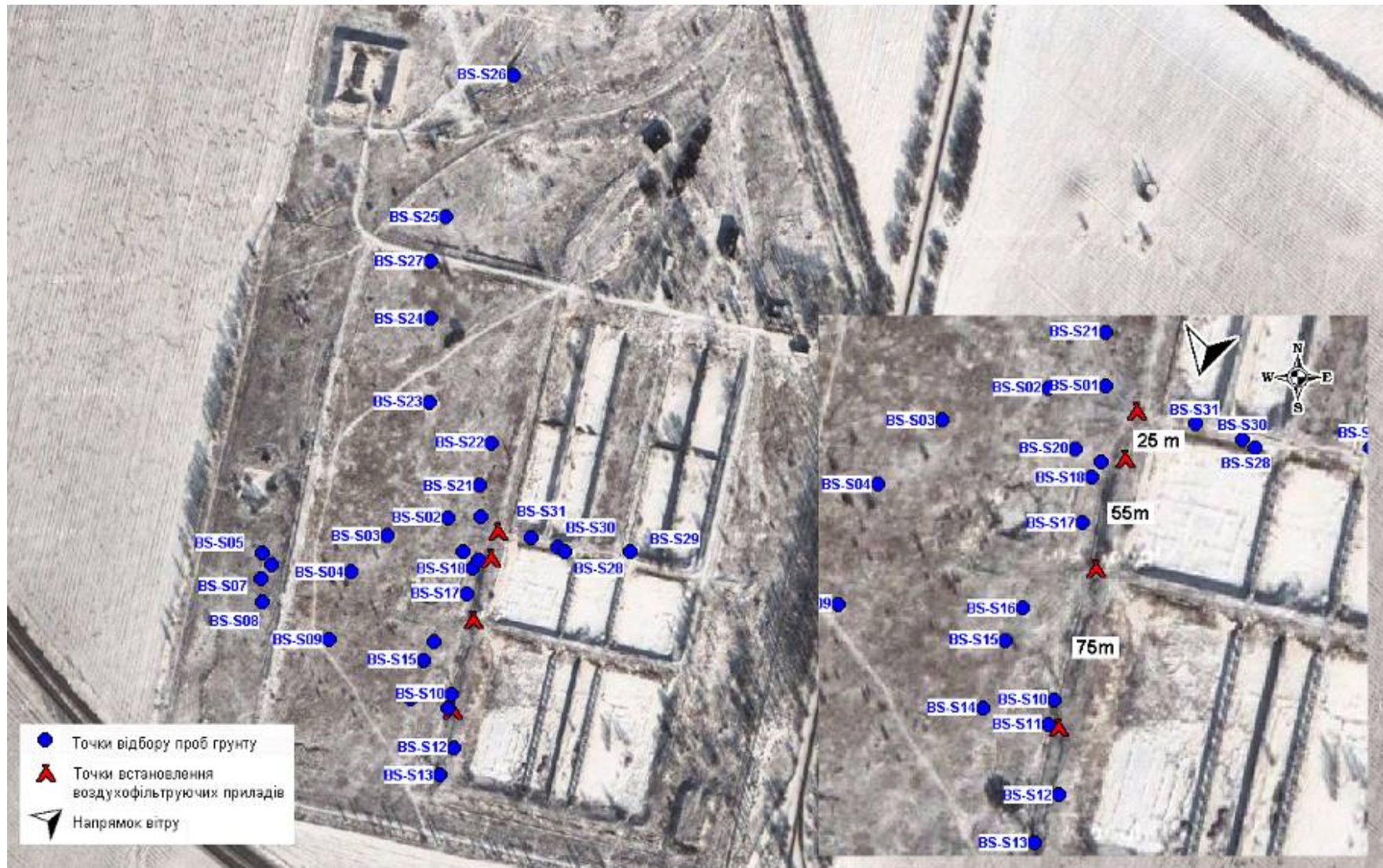
Drainage water has high mineralisation (Sulphates and Chlorides ions)

Groundwaters discharges to the Dnieper reservoir

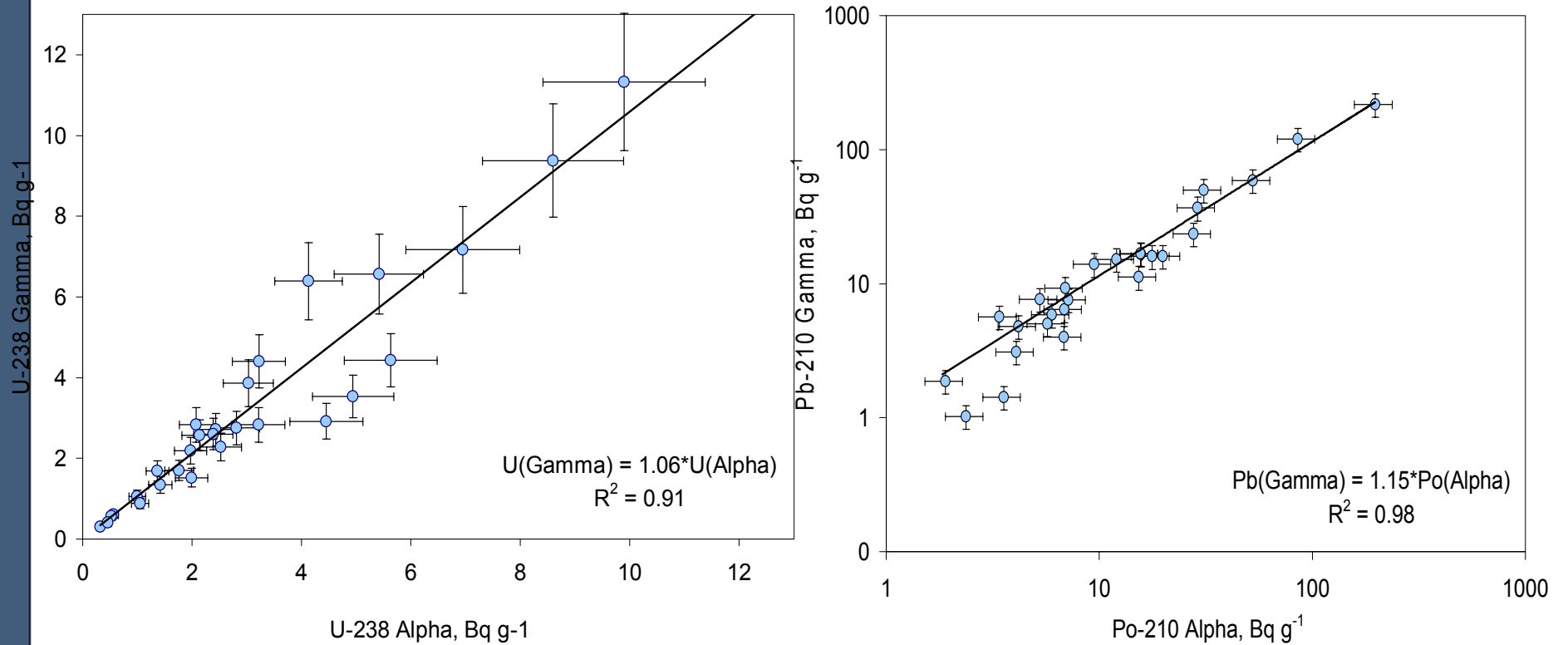
High concentrations of Uranium in neighboring villages in the drinking wells



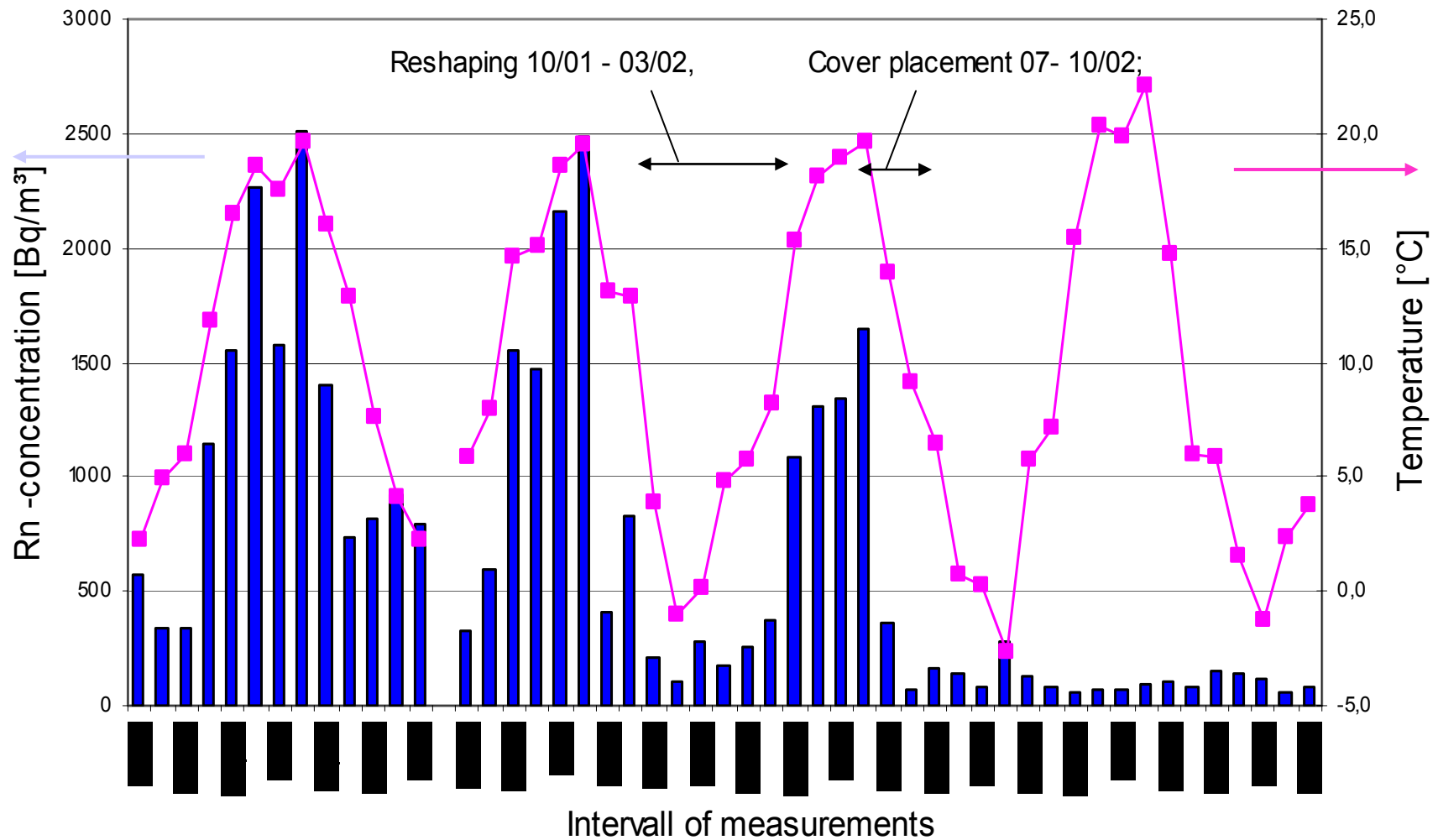
Soils and aerosols



Comparison of results for U-238 i Pb-210 obtained by gamma and alpha spectrometry



Monitoring of Rn-222 to evaluate the effectiveness of rehabilitation methods

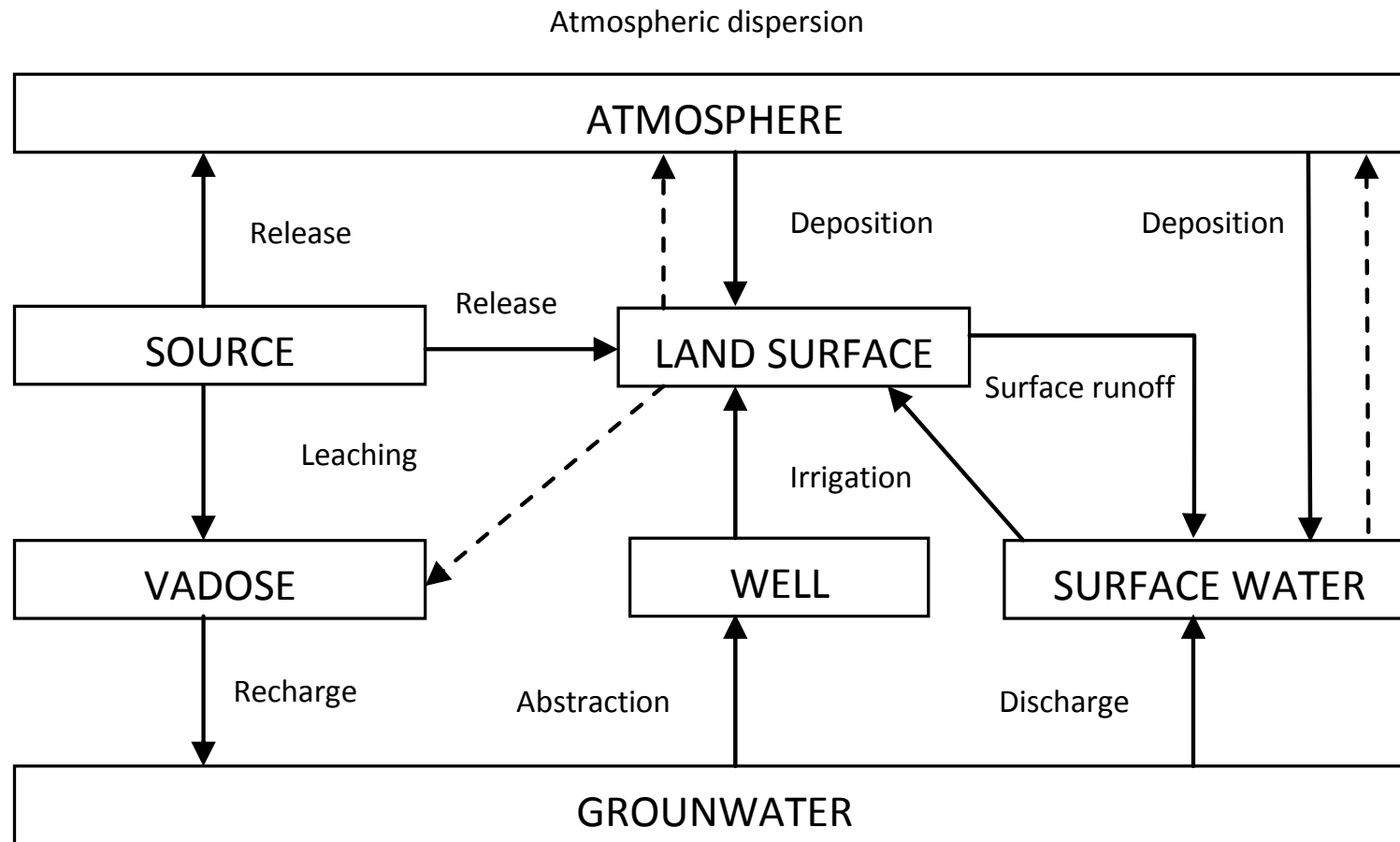


Modelling work (1)

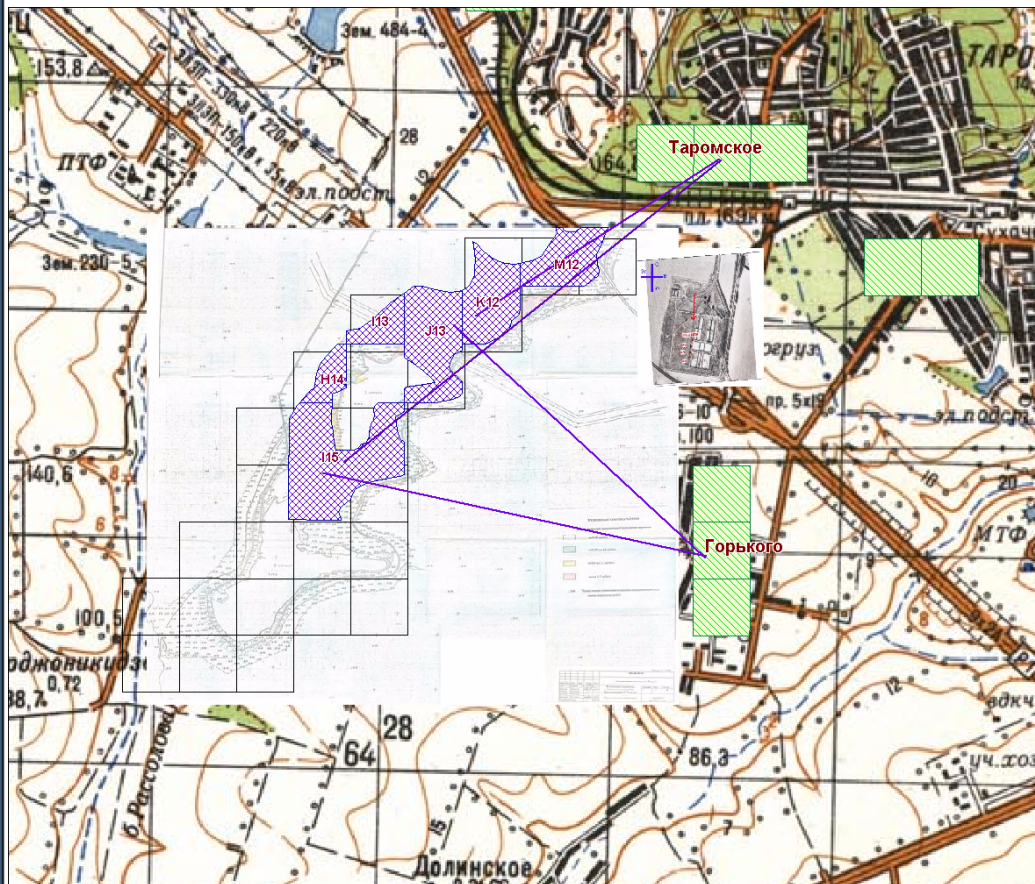
The main objectives are:

- Estimate exposure of workers and the public for the current situation,
- Perform risk and safety assessments in support to decision making for remediation of the site

Modelling work (2)



Results of simulations of atmospheric transport of dust



SR-19 and more advance models are being used

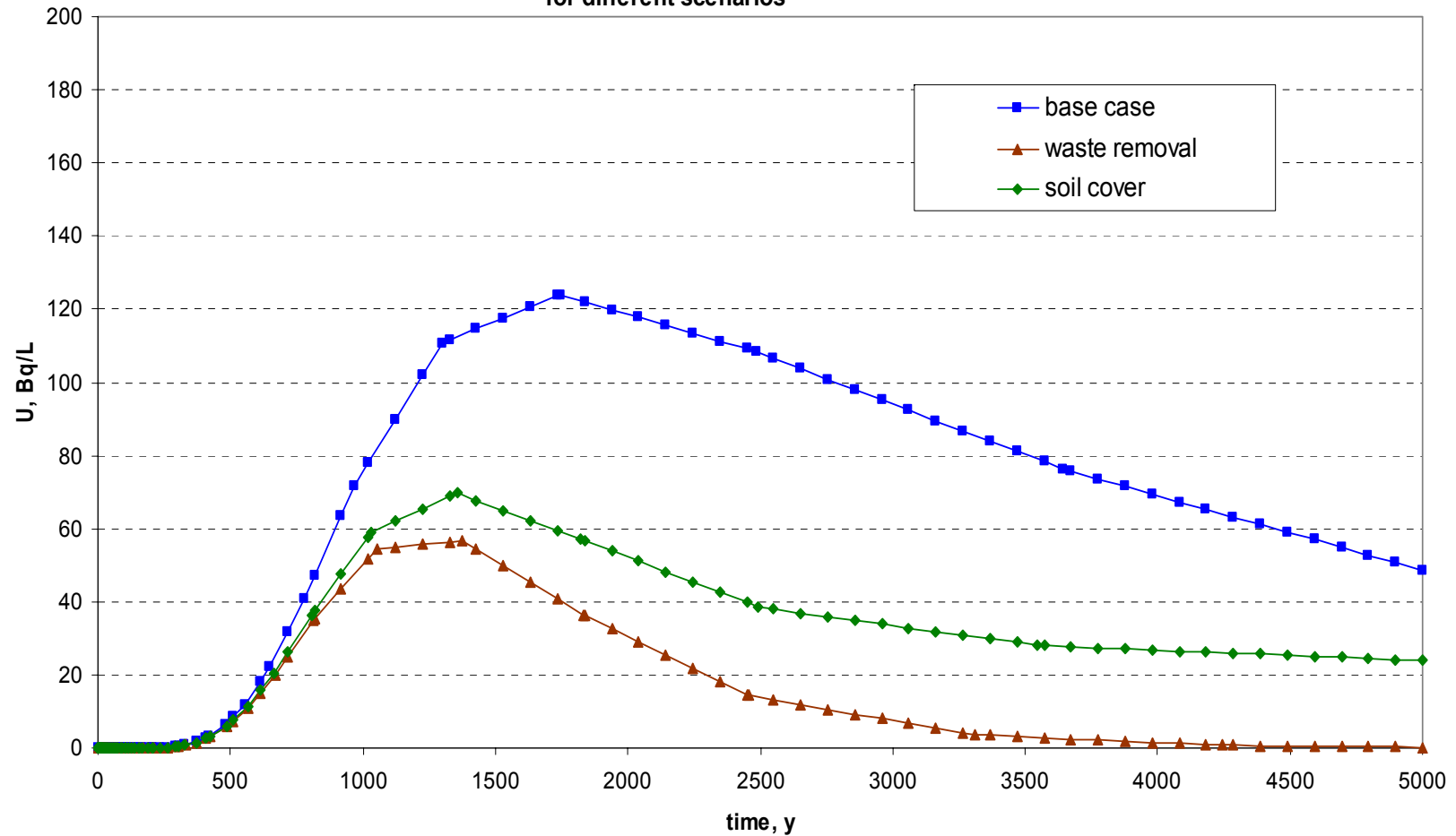
Example:
Study of the impact on nearby town of dust releases in a situation with dry weather and high wind speed (12 m/s)

Estimated doses 80-100 μSv

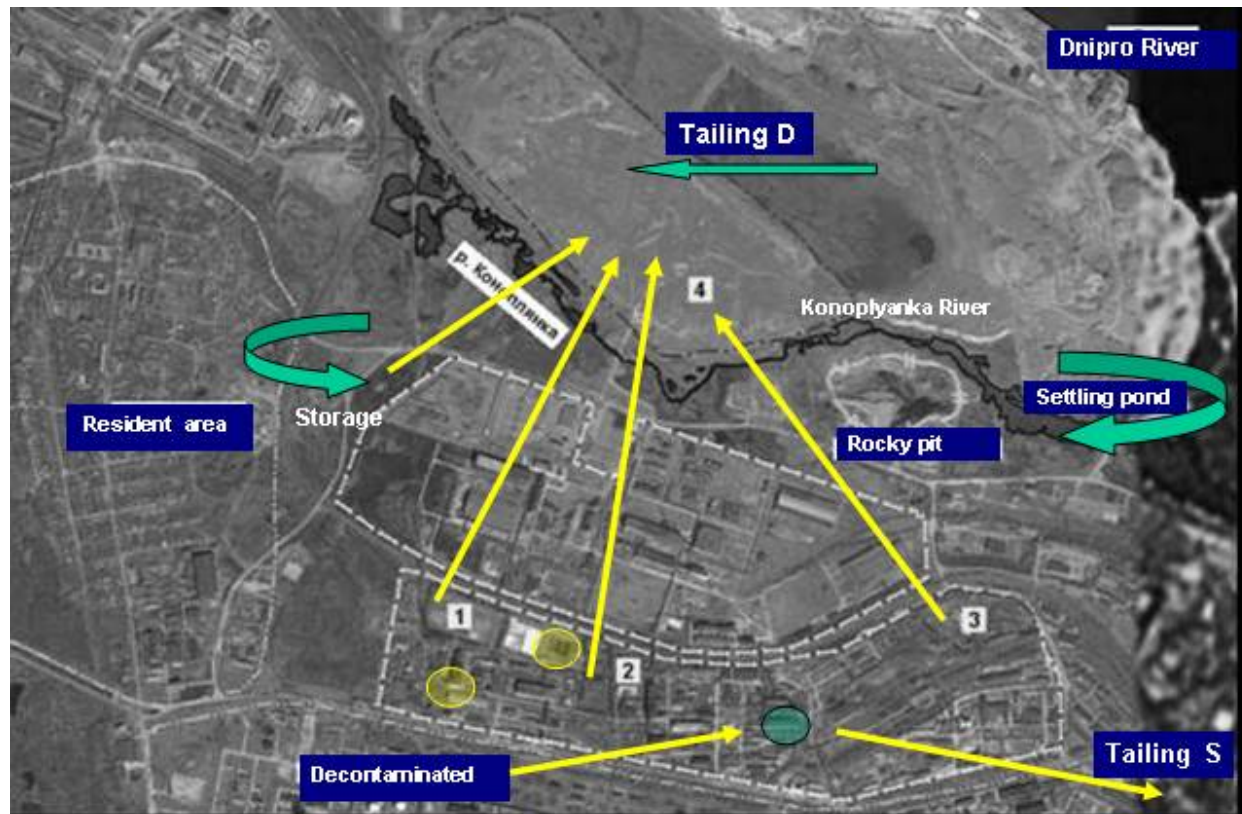
Near the source the concentrations are one order of magnitude higher

Examples of simulations with the groundwater transport model

U concentration in the aquifer at site boundary
for different scenarios



Preliminary Remediation Options



The focus of the work in 2009-2010 will be on evaluation of the alternative remedial options