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Kalıcı Organik Kirleticiler (KOK) ile Kirlenmiş Sahaların Tespiti ve iyileştirilmesi Projesi

International Best Practices: Case Study on PCB Contaminated Site

26 Ocak 2023

Robert Raschman

Contaminated Sites Management Expert

TÜRKİYE CUMHURİYETİ
ÇEVRE, ŞEHİRCİLİK VE İKLİM DEĞİŞİKLİĞİ BAKANLIĞI

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Contaminated Site Management

- Investigation
- Risk assessment
- Feasibility study
- Implementation design
- Remediation activities
- Post-Remediation monitoring

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Investigation

- Site reconnaissance (history, operations, ownership, surrounding areas etc.)
- Documentation review (maps, reports, authority decisions etc.)
- Geological and hydrogeological survey
- Identification of soil / groundwater contamination (priority contaminants, extend and level of contamination, source / plum zones)

Risk Assessment

- Identification of risk scenarios resulting from the real or potential negative impact of contamination on public health or on the environment
- Determination of adequate risk management measures (e,g, maximum acceptable soil and groundwater contamination levels - „Remediation limits“

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Feasibility Study & Implementation Design

Feasibility study on the site remediation

- Selection of the most suitable remediation approach
- Selection of the most suitable remediation method (technology)

Implementation design

- Detailed technical design of the selected remediation approach and method implementation (must respect the site-specific conditions, applicable legal requirements and technical standards, client´s requirements etc.)
- Approval of elaborated Implementation design
- Obtaining all permits, licences and approvals necessary for implementation of the designed activities in accordance with applicable legal requirements and decisions of local authorities

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Remediation

- Acquiring and mobilization of equipment and machinery and personnel
- Installation and commissioning of technological equipment
- Implementation of remediation activities in accordance with the approved Implementation design
- Remediation monitoring (environmental, quality, hygiene etc.)
- Project management and reporting
- Verification (validation) sampling
- Handover of the remediated site to the client

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Post-Remediation Monitoring

- Primarily concerned with residual contamination at a site
- Verification of long-term sustainability of implemented remediation measures
- Demonstrates that the objectives of the remedy are being met and that the risks to human health and the environment remain low and acceptable in the long term.
- Most often is associated with groundwater contamination ((because it is often impractical to completely remove contamination from groundwater)

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INCEL, Banja Luka, PCBs Detailed site assessment and Risk assessment of the PCB contaminated areas

Human Health and Environmental Risk Assessment

UNDP Project

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Site Location

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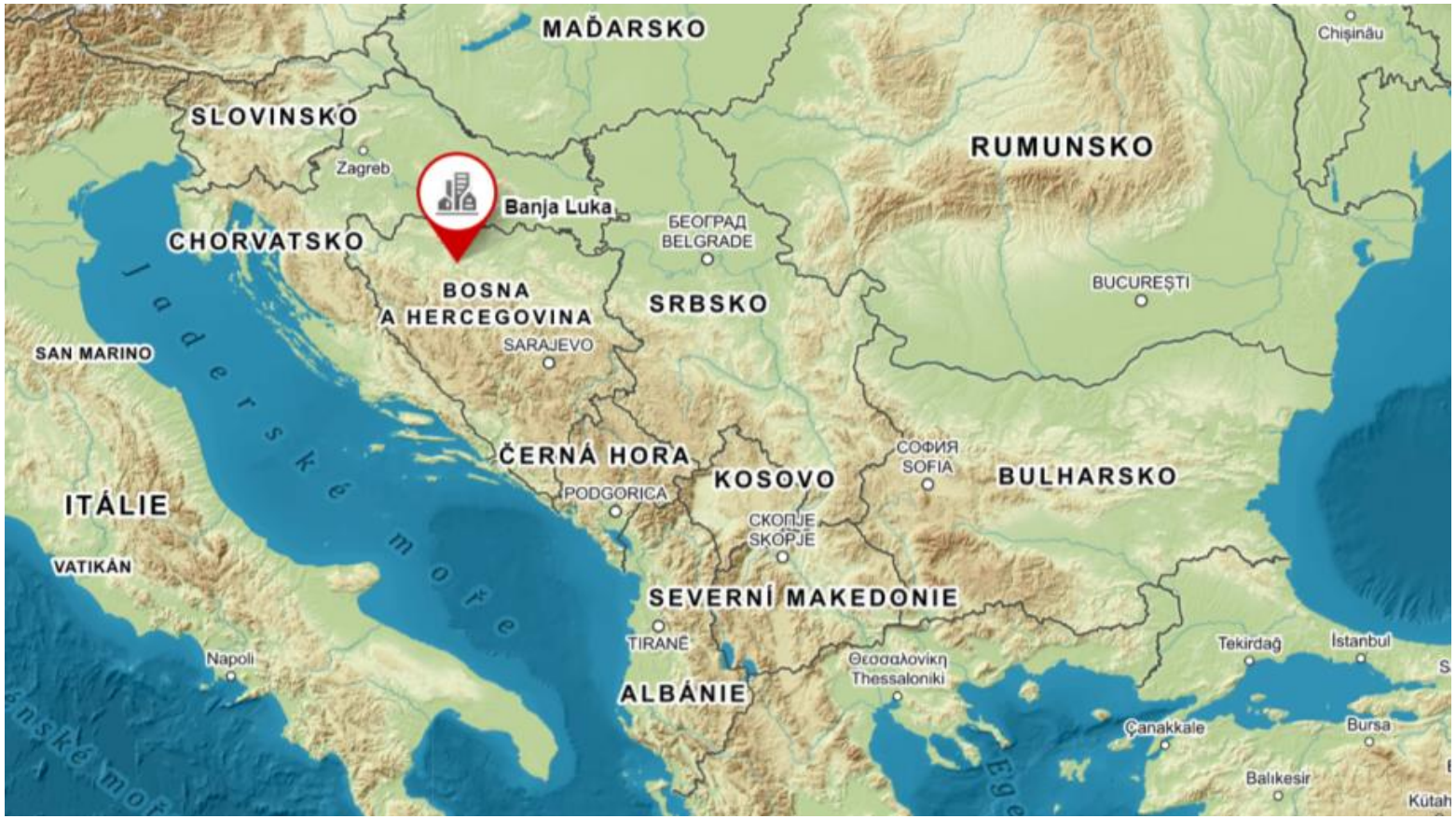

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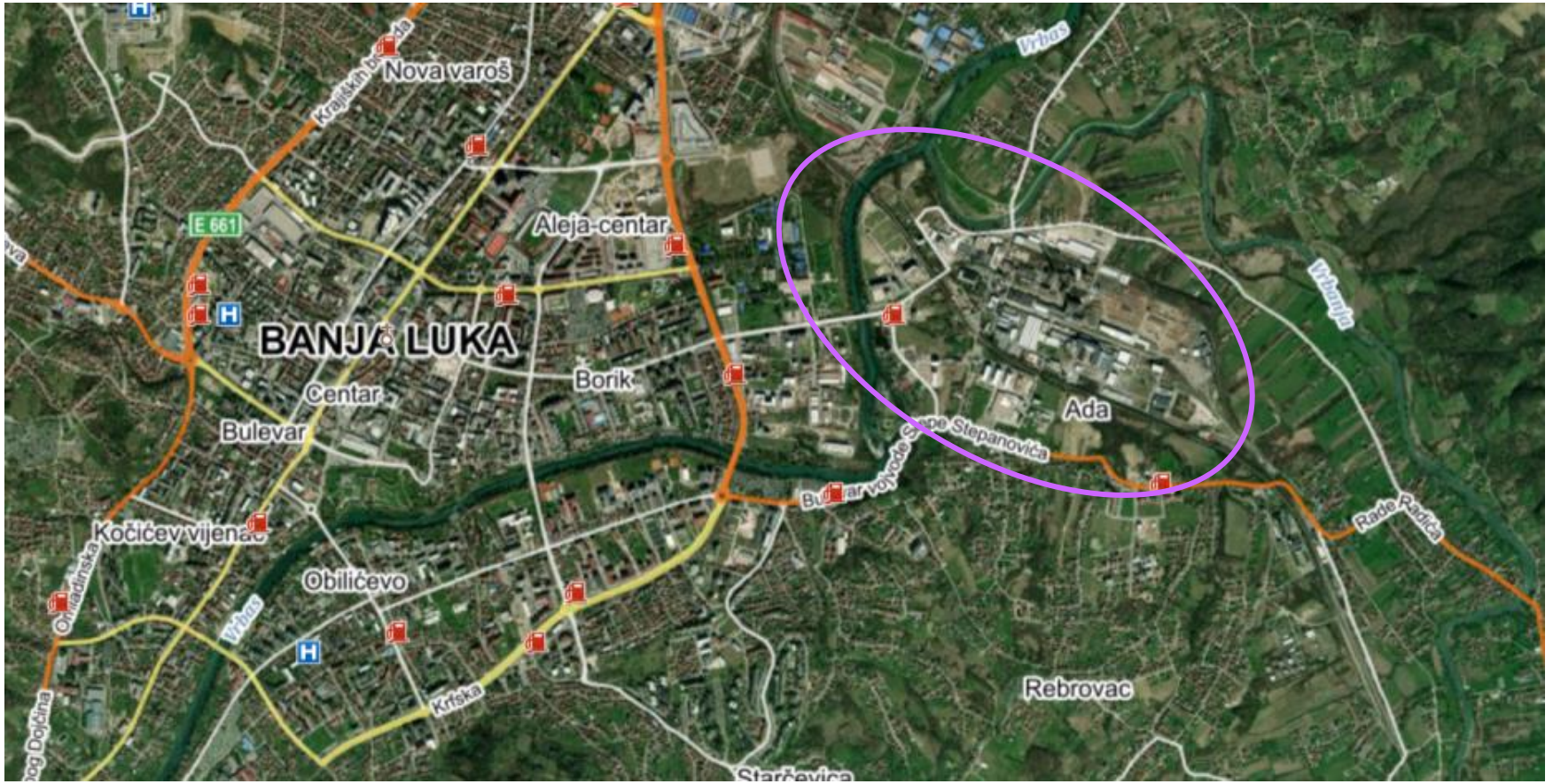
- City of Banja Luka, app. at 3 km distance from the city centre



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Site History

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- Former industrial complex INCEL Banja Luka Cellulose Factory producing cellulose, viscose, and paper products
- Established in 1954 and become the major regional industry, center with up to 6,500 workers
- Production declined in the 1980s
- Abandoned and deteriorated during the war in Bosnia and Herzegovina in the 1990s
- Gradually rebuilt after the war. Premises leased or sold and redeveloped as offices, warehouses, and facilities for light industry (scrap metal processing, wood processing, car repair, etc.); there are still remnants of old installations at the sitee (former power plant etc.)
- At present: 1,500 permanent employees and 1,500 daily visitors and temporary workers at the site
- Plans for redevelopment of the entire area as Business Zone, however, it requires high investments and thus the future development of the area is expected to be slow.


SHP Celex
Incel / CELEX
Filira sp
Lepinjara Dujaković
Pekarstvi
DKC Incel
Pjeskarenje
Banja Luka
Incel
LANACO
Paintball
klub "Borac"
Elgrad
PC Info d.o.o
Prodej elektroniky
Asocijacija
Samostalnih...
AUTO DE-MI
Digiteh
Prodej elektroniky
Konoba SKADARLIJA
Cafe bar PIDO
IEE Incel

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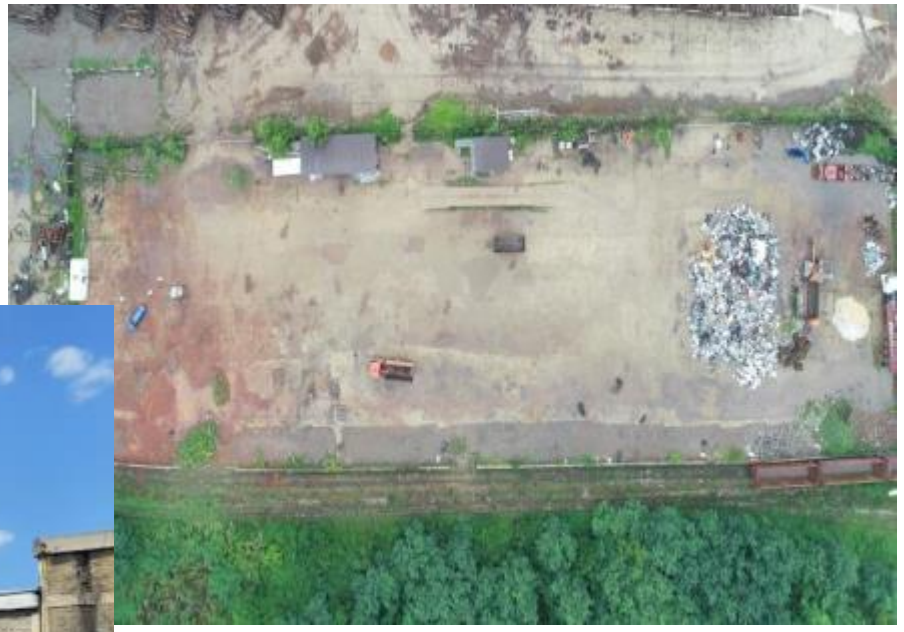

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Investigation of PCB hotspots areas at the Incel site

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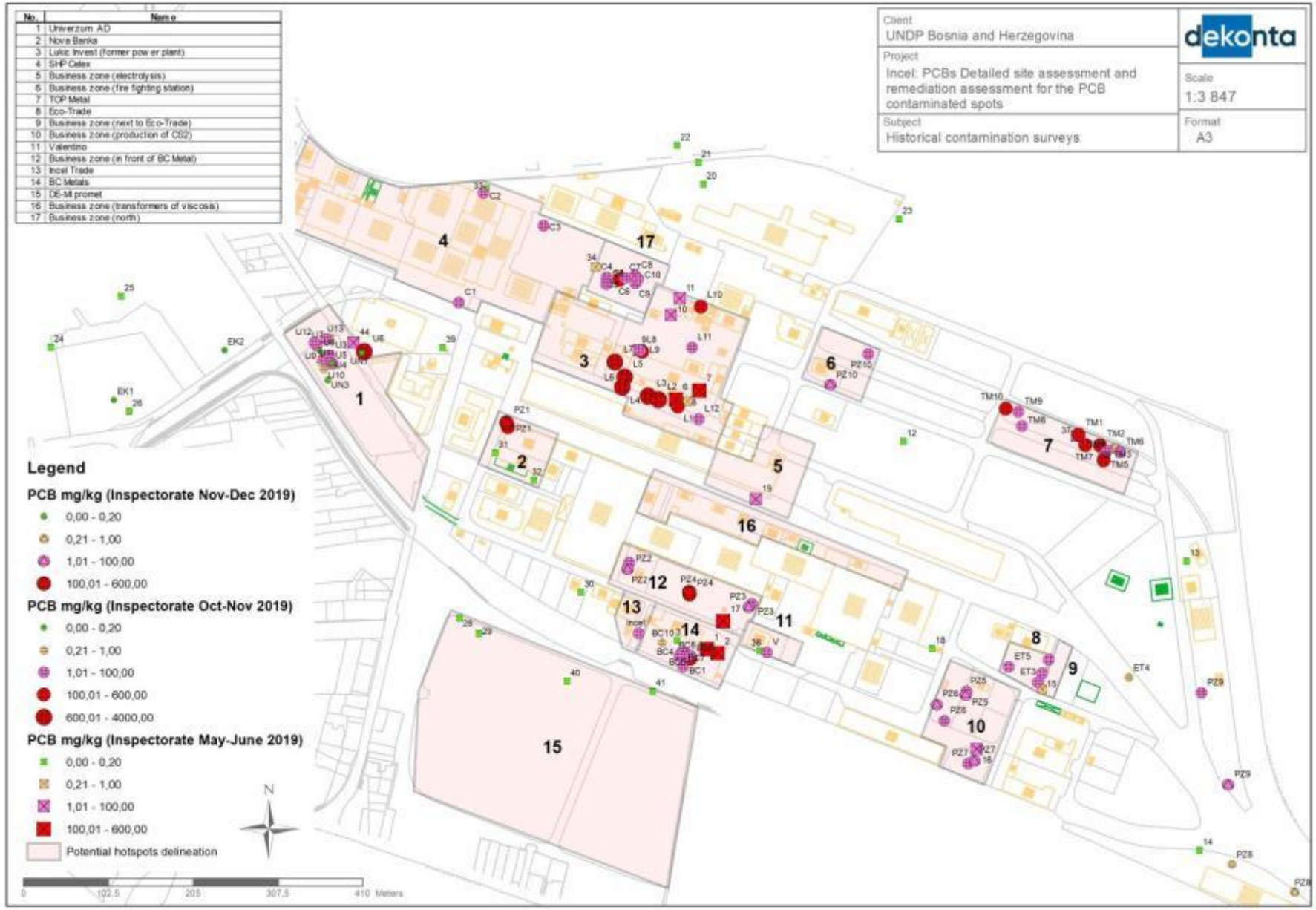
Overview of Previous PCBs Investigations

- 2005 – 2018: Sampling and analytical work of various organizations
- 2019 - Department for Inspection Affairs City of Banja Luka + Institute for Protection, Ecology and Informatics, Banja Luka - different types of sampling work during the year, identified 17 PCB hotspots in the INCEL area
- 2019 – TAUW: Phase 1 of the sustainable management of the INCEL industrial zone
  - Identification of soil contamination sources
  - Delineation of hotspots in the INCEL area and recommendation for further detail investigation

PCB investigation results – TAUW, 2019



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2020 – DEKONTA: PCBs Detailed site assessment and remediation assessment for the PCB contaminated s

Samples	Quantity
Topsoil inside Incel	95
Topsoil outside Incel	4
Soil probes	62
Groundwater inside Incel	14
Groundwater outside Incel	3
Sediments	3
Construction materials	21

Used PCBs **reference concentrations** :

Soil: 0.94 mg/kg - US EPA screening levels for industrial soil

Groundwater: 0.01 µg/l - Dutch intervention limit values for groundwater

Sediments: 0.02 mg/kg according to the *"Decree on limit values for pollutants in surface and groundwater and sediment and deadlines for reaching them"*, Official Gazette of Republic of Serbia' (50/2012)

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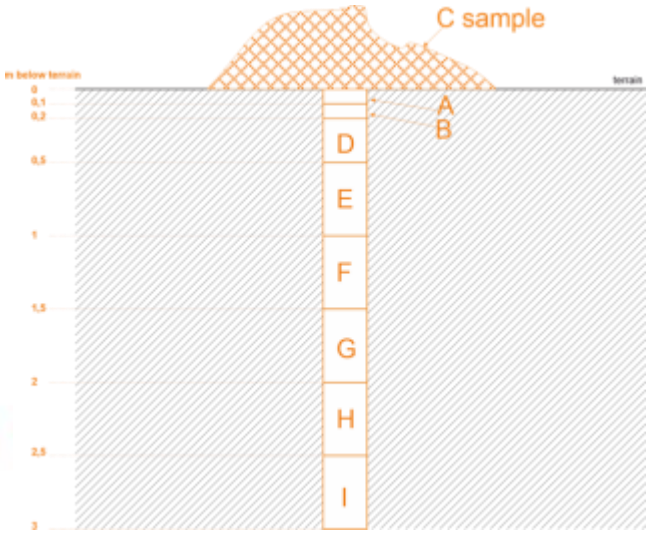
2021 Investigation - overview

2 levels of spatial investigation at each hotspot
- 0-0.1 m bellow terrain
- 0.1–0.2 m bellow terrain

Drilling at 3 hotspots
- Lukic (max. depth 3 m)
- Univerzum (max. depth 2 m)
- Business zone (in front of BCMetal) (max. depth 3 m)



IN TOTAL
503 soil samples
92 construction debris samples

Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir.

Main 2020 results - PCBs:
Topsoil: 15 samples out of 91 over limit 0,94 mg/kg of dry matter

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Main 2020 results - PCBs:

- **Soil:** Only topsoil samples exceeded 0.94 mg/kg
- **Groundwater:** Univerzum and Lukic hotspots with exceeding limit 0.01 ug/L
- **Sediment:** Samples collected at the sewage canal and downstream of the canal in the Vrbas river exceeding 0.02 mg/kg
- **Construction material:** Exceed the limit value 0.94 mg/kg at Lukić Invest, Business Zone (Eectrolysis) and SHP Celex
- PCB pollution migration by air outside the INCEL – not confirmed
- PCB pollution migration through the rainwater wash-off and trough the sewer system – **confirmed**
- PCB pollution migration by groundwater – not relevant

Bu proje Avrupa Birliği ve Türkiye Cumhuriyeti tarafından finanse edilmektedir.

Other contaminants found:

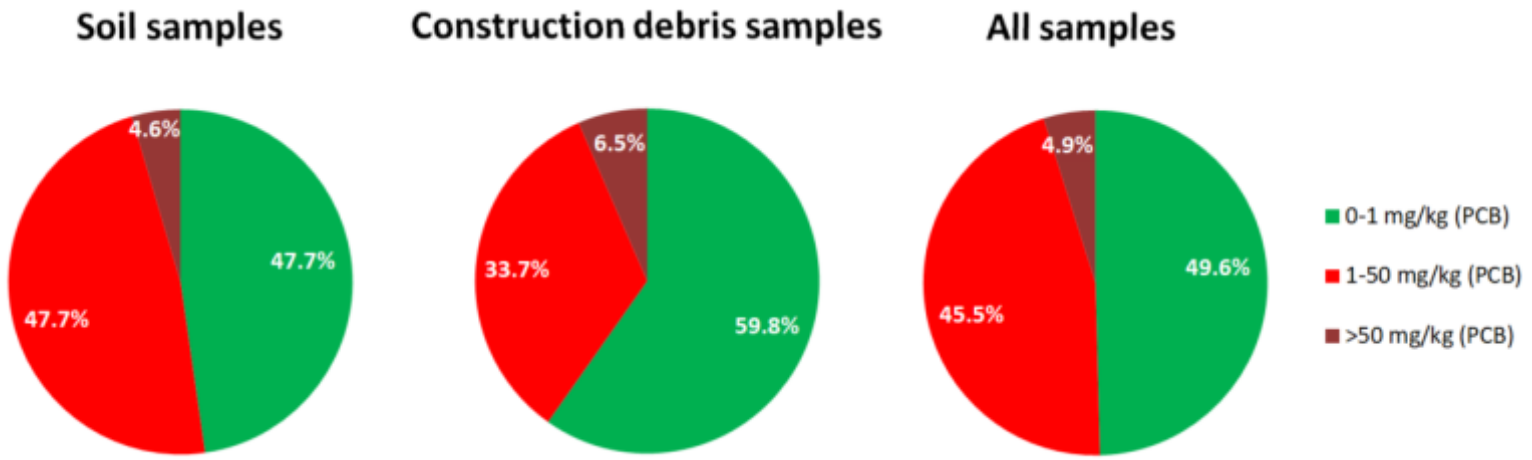
- Lukic – heavy metals + petroleum hydrocarbons in construction material, heavy metals + asbestos in topsoil/construction debris
- Business zone (electrolysis) – heavy metals + petroleum hydrocarbons in construction material
- Business zone in front of BC Metal – heavy metals in topsoil
- BC Metal – heavy metals in topsoil
- Univerzum – heavy metals + PAHs in topsoil
- TOP Metal – heavy metals in topsoil
- Sediments – heavy metals + petroleum hydrocarbons

Results of detail PCBs investigation at 7 hotspots at the Incel sitel

Name of location	Employees, visitors
Univerzum A.D.	Up to 10 employees and up to 10 visitors daily
Lukić Invest (former power plant)	Trespassing to gain valuable materials, exact number unknown, but low in general.
Business zone (north)	
SHP CELEX (concrete platform)	Max. 1 employee who visits the site once per a week, no visitors
Top Metal d.o.o.	1 employee who visits the site once per a week, no visitors
Business zone (in front of BC Metal)	Up to 100 employees (mostly men) and up to 100 daily visitors in the surrounding areas

2021 Investigation – Analytical results

Soil samples	Quantity	Construction debris samples	Quantity	All samples	Quantity
0-1 mg/kg d.m. (PCBs)	240	0-1 mg/kg d.m. (PCBs)	55	0-1 mg/kg d.m. (PCBs)	295
1-50 mg/kg d.m. (PCBs)	240	1-50 mg/kg d.m. (PCBs)	31	1-50 mg/kg d.m. (PCBs)	271
≥50 mg/kg d.m. (PCBs)	23	≥50 mg/kg d.m. (PCBs)	6	≥50 mg/kg d.m. (PCBs)	29
Total	503	Total	92	Total	595



2021 Investigation – Heavy metals + TPH

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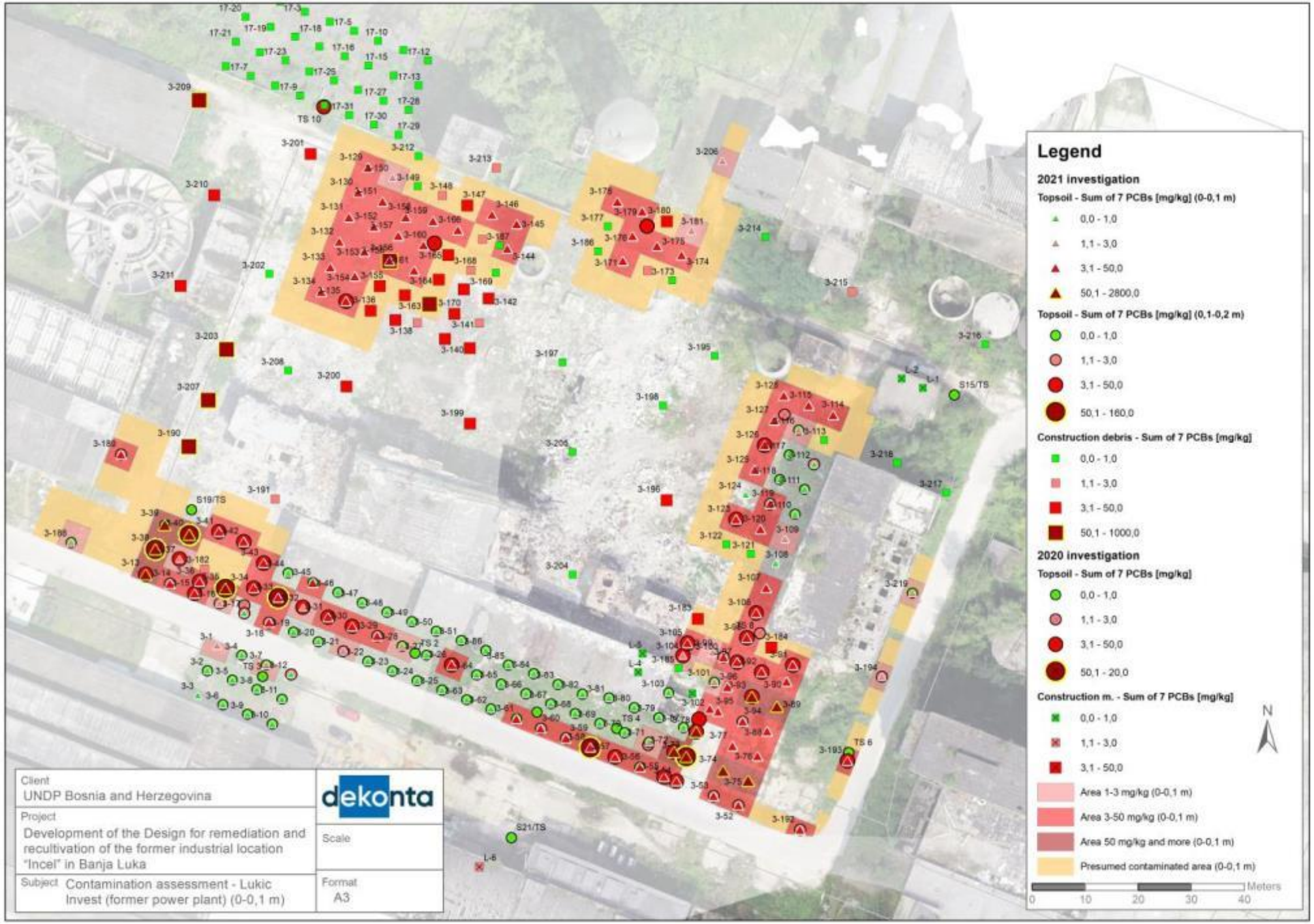
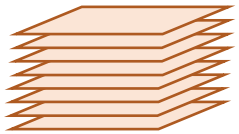
- RULEBOOK ON LIMIT AND REMEDIATION VALUES OF POLLUTANTS, HARMFUL AND HAZARDOUS SUBSTANCES IN SOIL ("Official Gazette of RS", No. 82/2021)
- Petroleum hydrocarbons – no limit exceeding
- Top Metal - slightly exceeding the limit for Zinc (865 mg/kg, 1.2 x)
- Lukic – slightly exceeding the limit for Mercury (10.9 mg/kg, 1.1 x)
- Business zone (electrolysis) – highly increased concentration of Mercury (maximum 195 mg/kg, 19.5 x)
- Leaching tests according to the EU landfill legislation (Council Directive 1999/31/EC) – all samples are below the non-hazardous landfill limit
- Ecotoxicity – all samples pass for ecotoxicity tests, except the sample from the Business zone (electrolysis), which corresponds to mercury occurrence



2020 Investigation - GIS output

Example:
Lukic Invest (former power plant)
topsoil sampling



8 layers
8 GIS levels

8x
- spatial distribution of cotamination
- contamination areas → volumes

Total volume for excavation
- Soil
- Construction deb.

2021 Investigation – GIS processing, contaminated volume calculation

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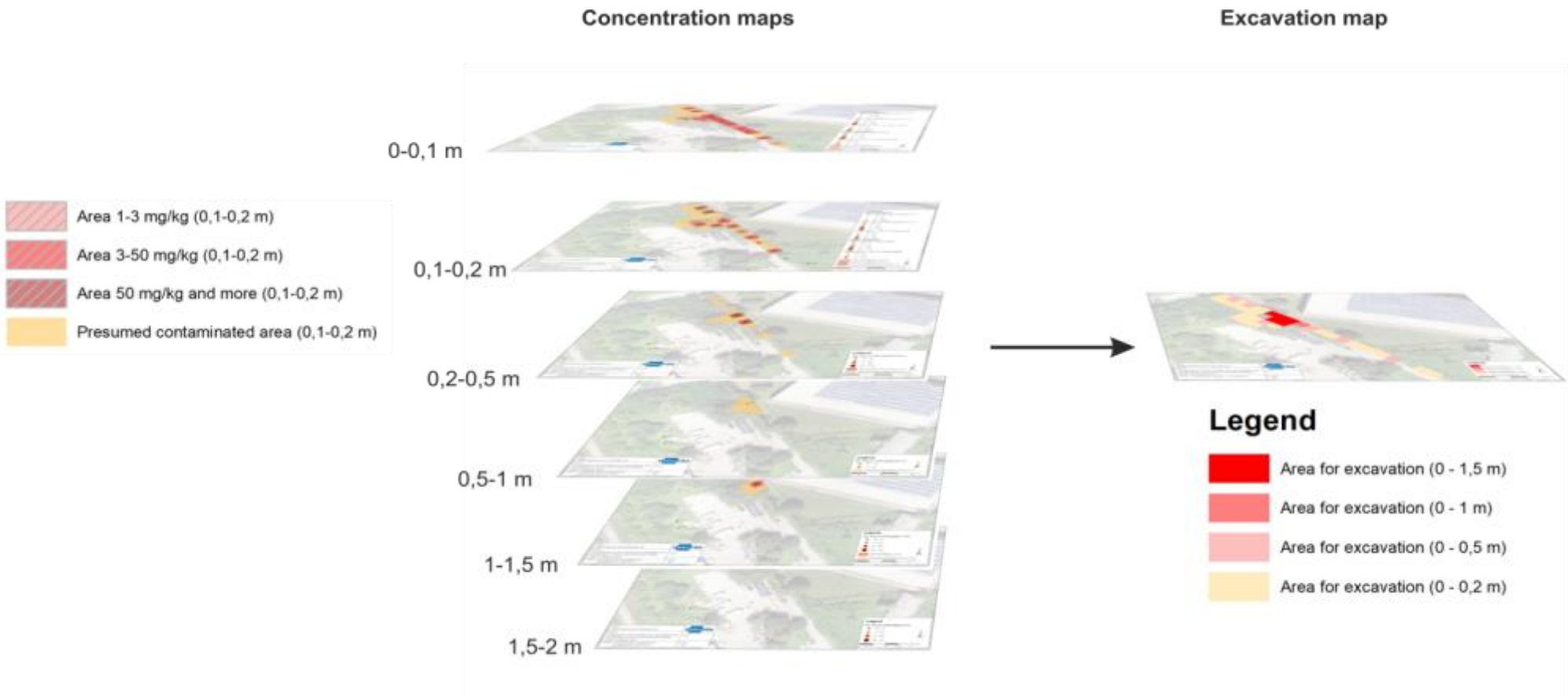

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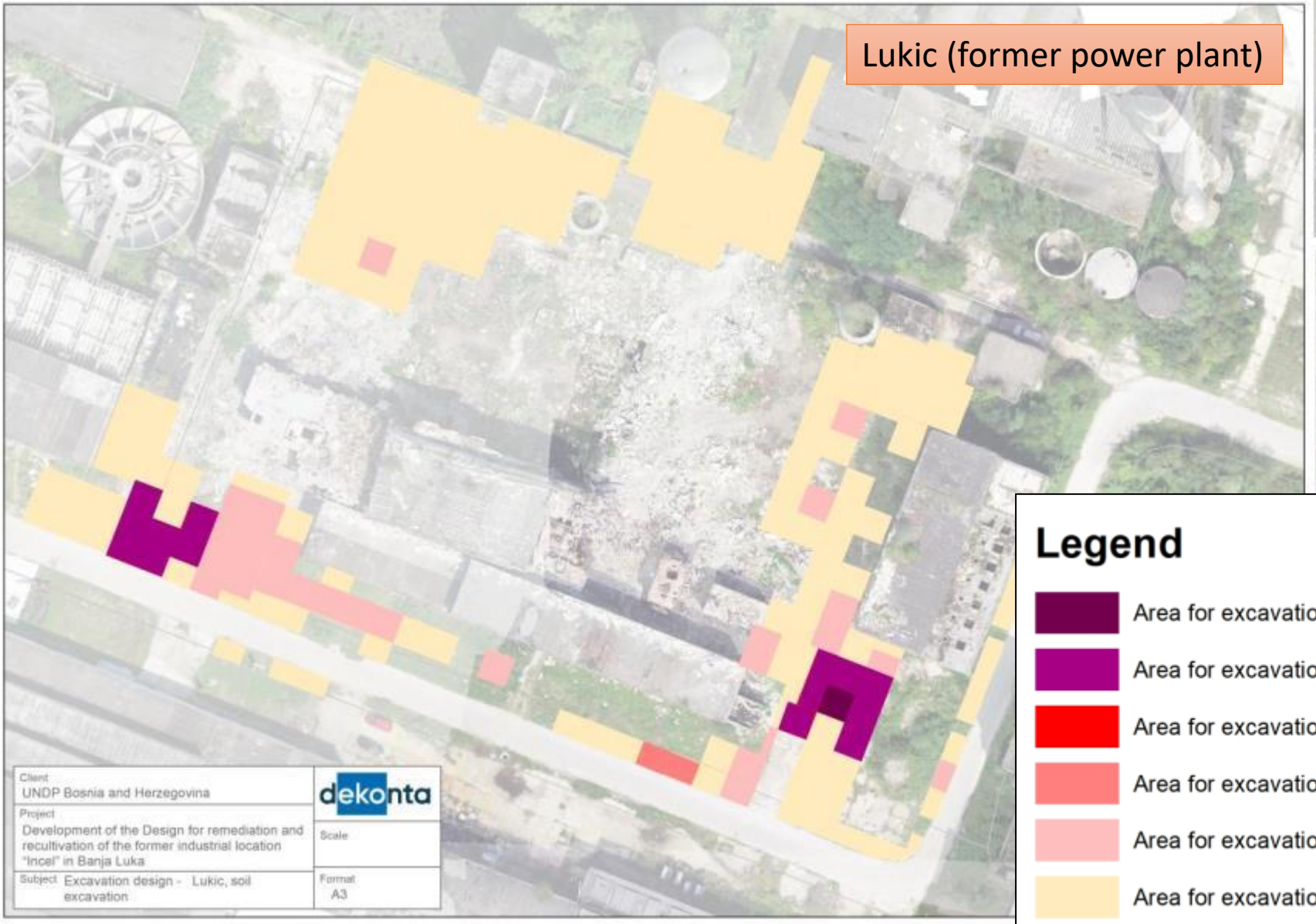
Hotspot	Average PCBs (mg/kg d.m.)	Maximum PCBs (mg/kg d.m.)	Volume for excavation (m^3)
Univerzum AD	13.9	113	392
Lukić Invest (former power plant)	Soil: 3.7 - soil construction w. - 25.2	soil: 2,800 construction w.: 546	4,281
SHP CELEX AD	3.9	72.8	65
Business zone (electrolysis)	1.7	12	11
Top Metal	0.5	1.08	2
Business zone (in front of BC Metal)	1.8	15.2	102
Business zone (north)	0.22	<5.02	38
Total			4,890

2021 Investigation – Areas proposed for excavation

Lukic (former power plant)



Legend

- Area for excavation (0 - 2,5 m)
- Area for excavation (0 - 2 m)
- Area for excavation (0 - 1,5 m)
- Area for excavation (0 - 1 m)
- Area for excavation (0 - 0,5 m)
- Area for excavation (0 - 0,2 m)

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Human health and Environmental Risk Analysis - Incel site

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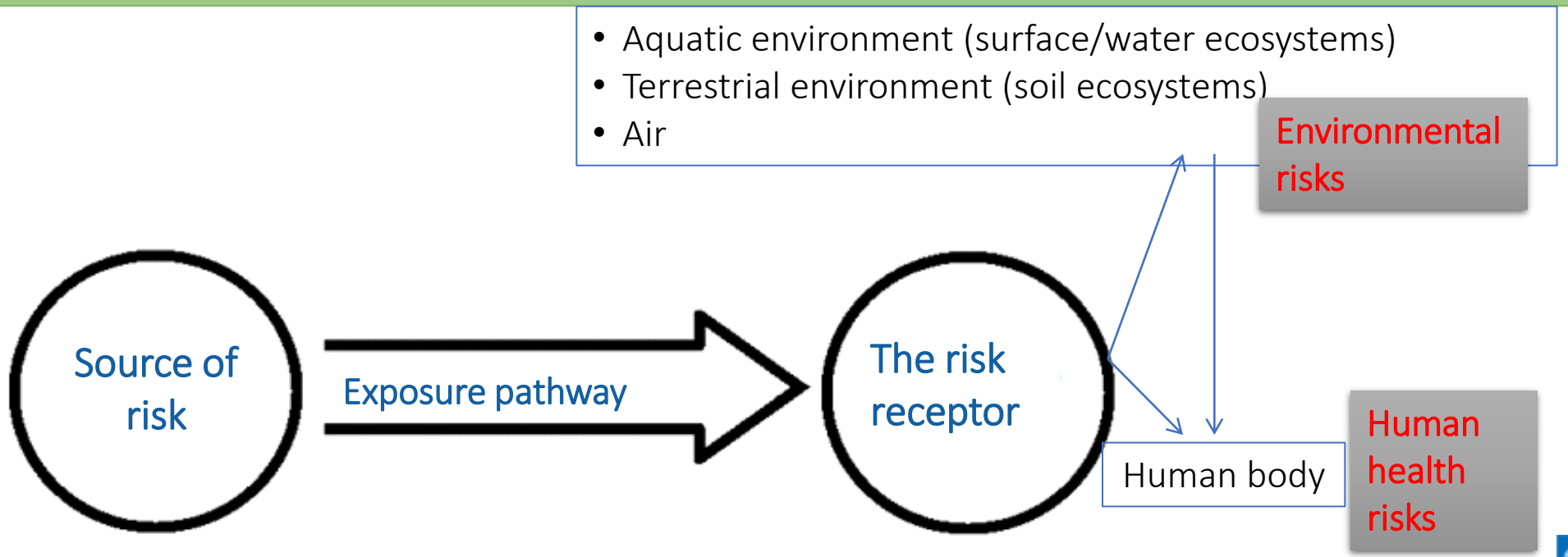
Risk Analysis is the basic tool for decision making about

- necessity/urgency
- character/nature/concept
- parameters of remedial measures to reduce the health and environmental risks of contamination



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Risk Assessment

Hazard Identification

- Identification of potential hotspots and priority pollutants
- Basic characteristics of risk recipients at the potential hotspots
- Overview of potential exposure scenarios – Conceptual Model

Exposure Assessment

- Exposure of employees and visitors working at the non-contaminated areas
- Exposure of employees working at the contaminated areas
- Exposure of workers during demolition and soil excavation works
- Exposure of inhabitants in the site surrounding areas

… Other Exposure scenarios?

Risk Characterization

HOTSPOTS CHARACTERIZATION (example)

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Hotspot or group of hotspots	Activities	Employees, visitors	Future activities
Univerzum a.d.	Truck repair, scrap metal and other secondary raw materials storage and selling	Up to 10 employees and up to 10 visitors daily	Development of the area is not likely
Lukić Invest (former power plant);	Abandoned area, ruins of old buildings and installations	Trespassers collecting valuable materials	Expected substantial reconstruction of the sites
Top Metal d.o.o.	Parking trucks and storing equipment at a paved area	1 employee who visits the site once per a week, no visitors	No information is available
Business zone (in front of BC Metal)	Green area, in its vicinity recycling of batteries, workrooms, storages, ironmongery	Up to 100 employees (mostly men) and up to 100 daily visitors in the surrounding areas	Development of the area is likely

CONCEPTUAL SITE MODEL

Conceptual Site Model shows the biological, physical and chemical processes that determine the ways how contaminants move from sources through the environmental media to environmental receptors

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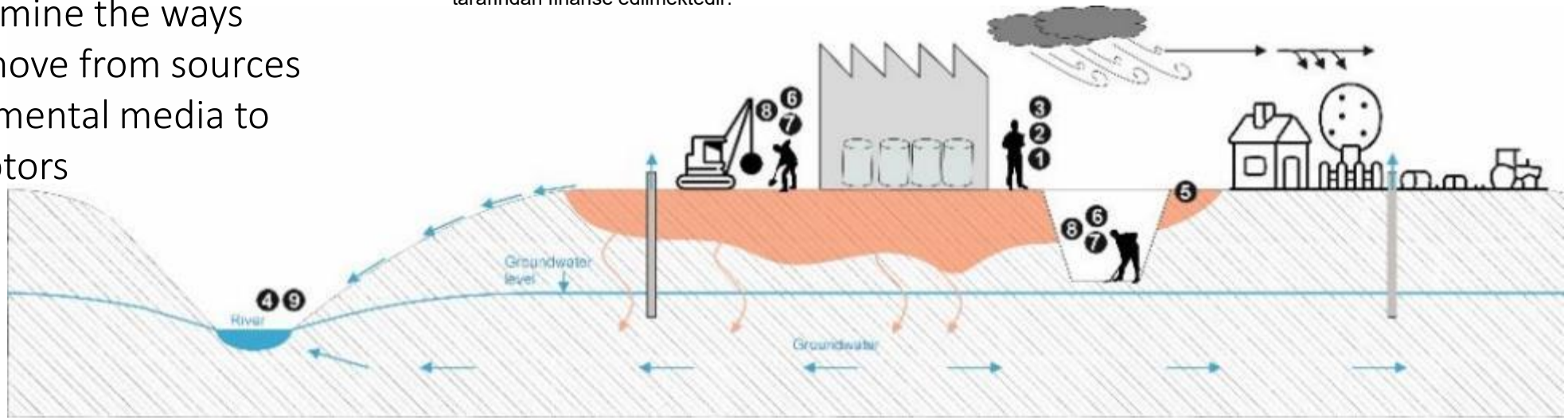

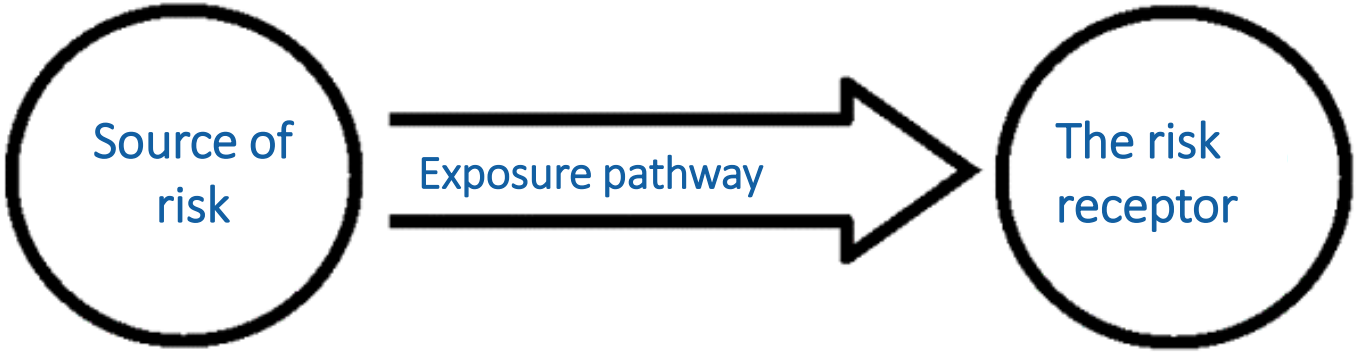

Medium	Transport way	Risk receptor	Way of exposure (scenario)	Risk relevancy
Surface soil	Direct contact with surface soil and dust	Local current/future workers, trespassers, and visitors	Dermal contact Accidental ingestion	**YES** PCB contamination found in surface soil
	Surface soil → Ambient air	Local current/future workers, trespassers, and visitors	Inhalation of dust	**YES** PCB contamination found in surface soil
	Surface soil → Ambient air → Surrounding land	Inhabitants of the surrounding land	Accidental ingestion Dermal contact Crops consumption	NOT RELEVANT No PCB contamination was found in soil outside the site
	Surface soil → Ambient air → Surrounding land	Ecosystems of the surrounding land	Deposition of dust particles by wind	NOT RELEVANT No PCB contamination found in soil outside the site
	Surface soil → surface waters and river sediments	Aquatic ecosystem of Vrbas river	Surface water run-off	**YES** PCB contamination found in the sewer outlet to Vrbas river and in the river sediment

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Medium	Transport way	Risk receptor	Way of exposure (scenario)	Risk relevancy
Surface Soil	Direct contact with surface soil	Terrestrial ecosystem	Direct contact	
Con-structi-on m.	Direct contact with construction materials	Trespassers and construction workers (demolition / rebuild works)	Dermal contact	
			Accidental ingestion	
			Inhalation of dust	
Unsatu-rated zone	Direct contact with soil	Construction workers (earthworks / remedial works)	Dermal contact	
			Accidental ingestion	
			Inhalation of soil particles	

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Medium	Transport way	Risk receptor	Way of exposure (scenario)	Risk relevancy
Groundwater	Soil and construction materials → Groundwater	Local workers	Dermal contact	
		Residents	Dermal contact	
			Ingestion	
			Consumption of crops (crops watering)	
	Groundwater → Surface water and sediment	Vrbas river and their ecosystems	Groundwater drainage into surface waters	