Contaminated Sites with Risk-Based Approach: Turkish and Romanian Practice

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Contaminated Sites with Risk-Based Approach: Turkish and Romanian Practice

• A project was conducted by Turkish and Romanian researchers to investigate the scientific risk assessment processes applied in te management of contaminated sites in Romania and Turkey.

• The project included the steps of

- identifying the methodologies for assessment of risks to human health posed by the contaminated sites,
- conducting some case studies with the aim of understanding how to put into practice the concept of risk assessment and methods to minimize it,
- discussion of the uncertainties present in the risk assessment processes, and
- validation of the risk assessment model for the reduction of environmental pollution caused by the contaminated sites.

• The presentation includes a brief assessment of project findings and some discussions on the management of contaminated sites in Turkey.

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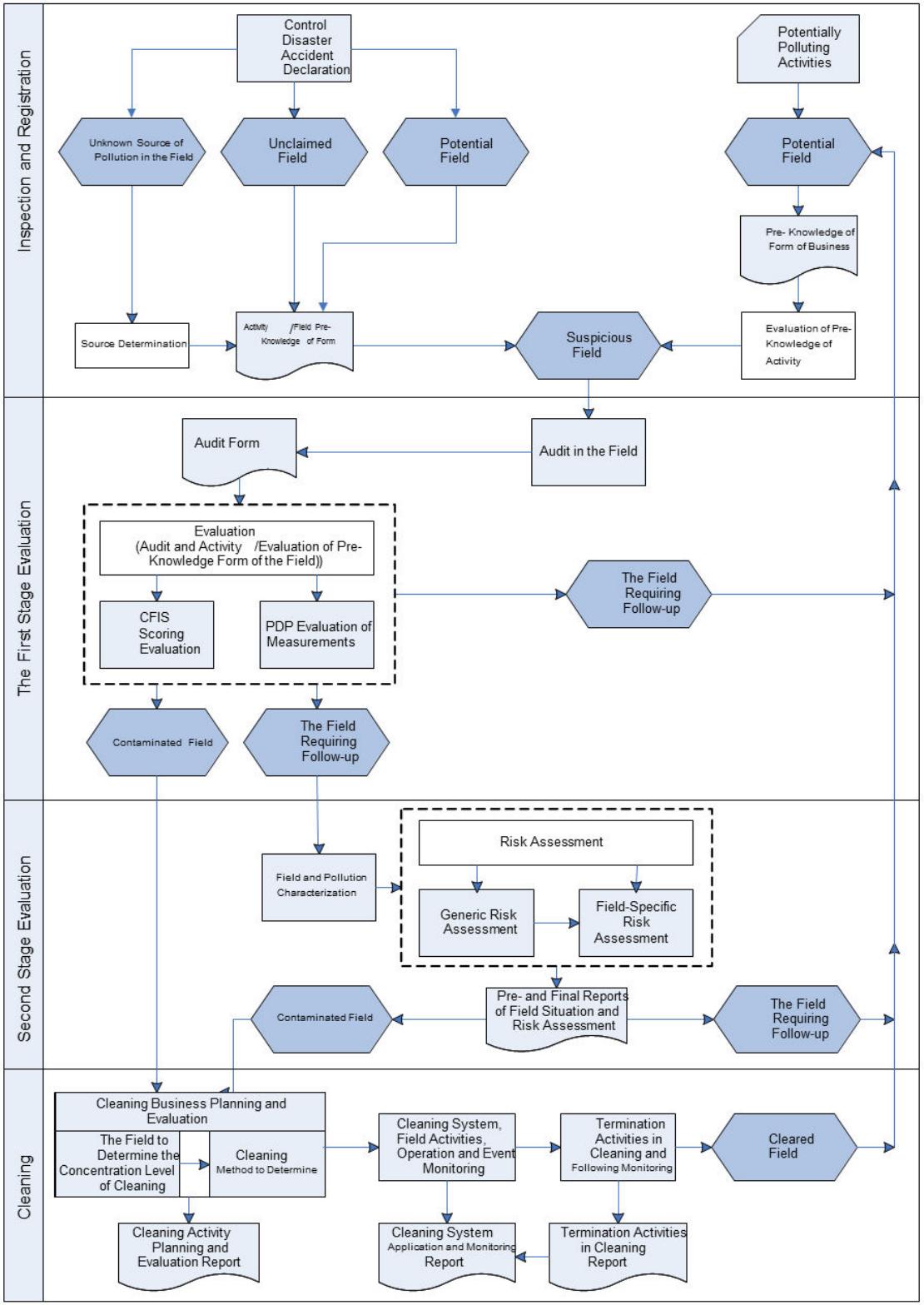
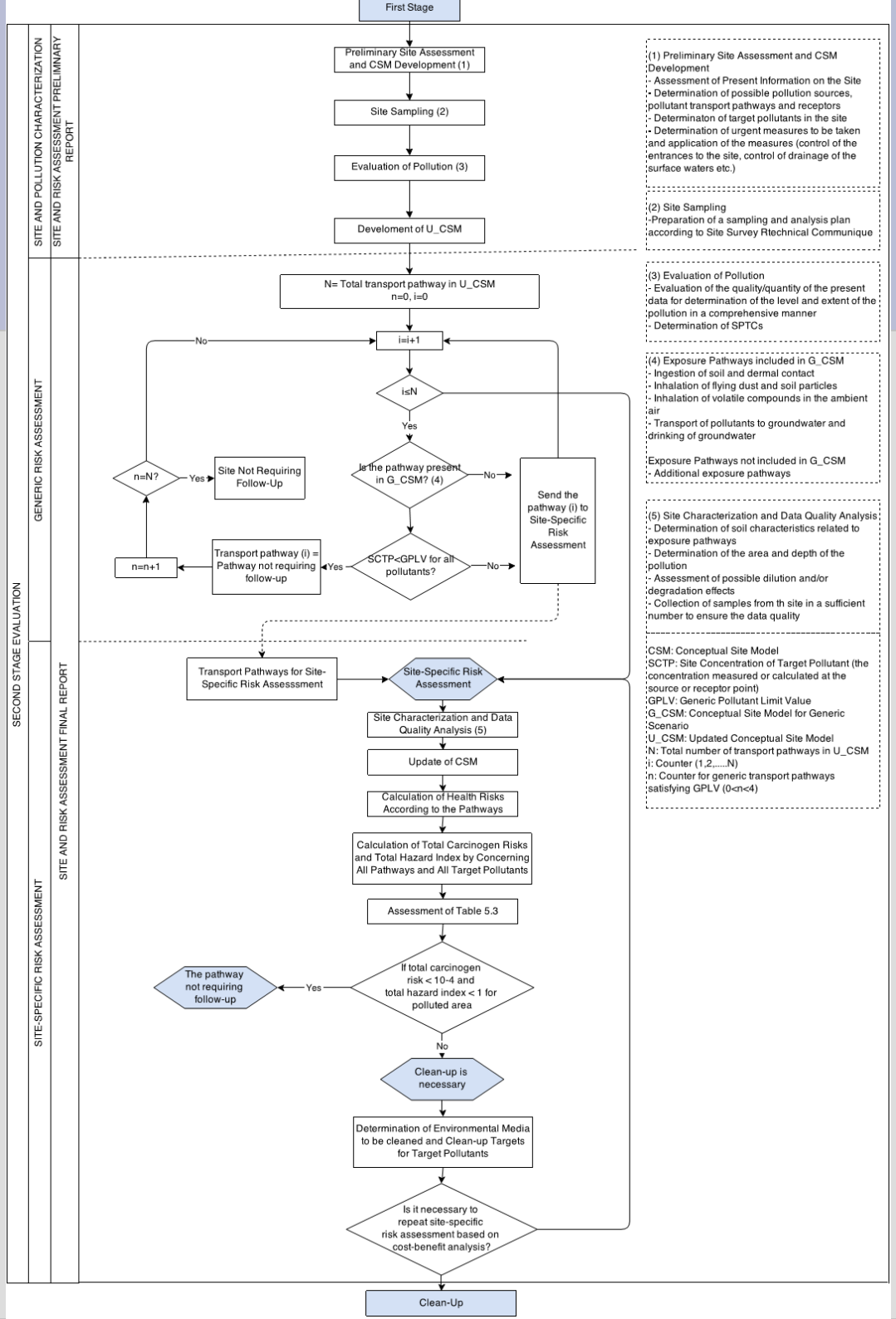
- Legal Procedure in Turkey

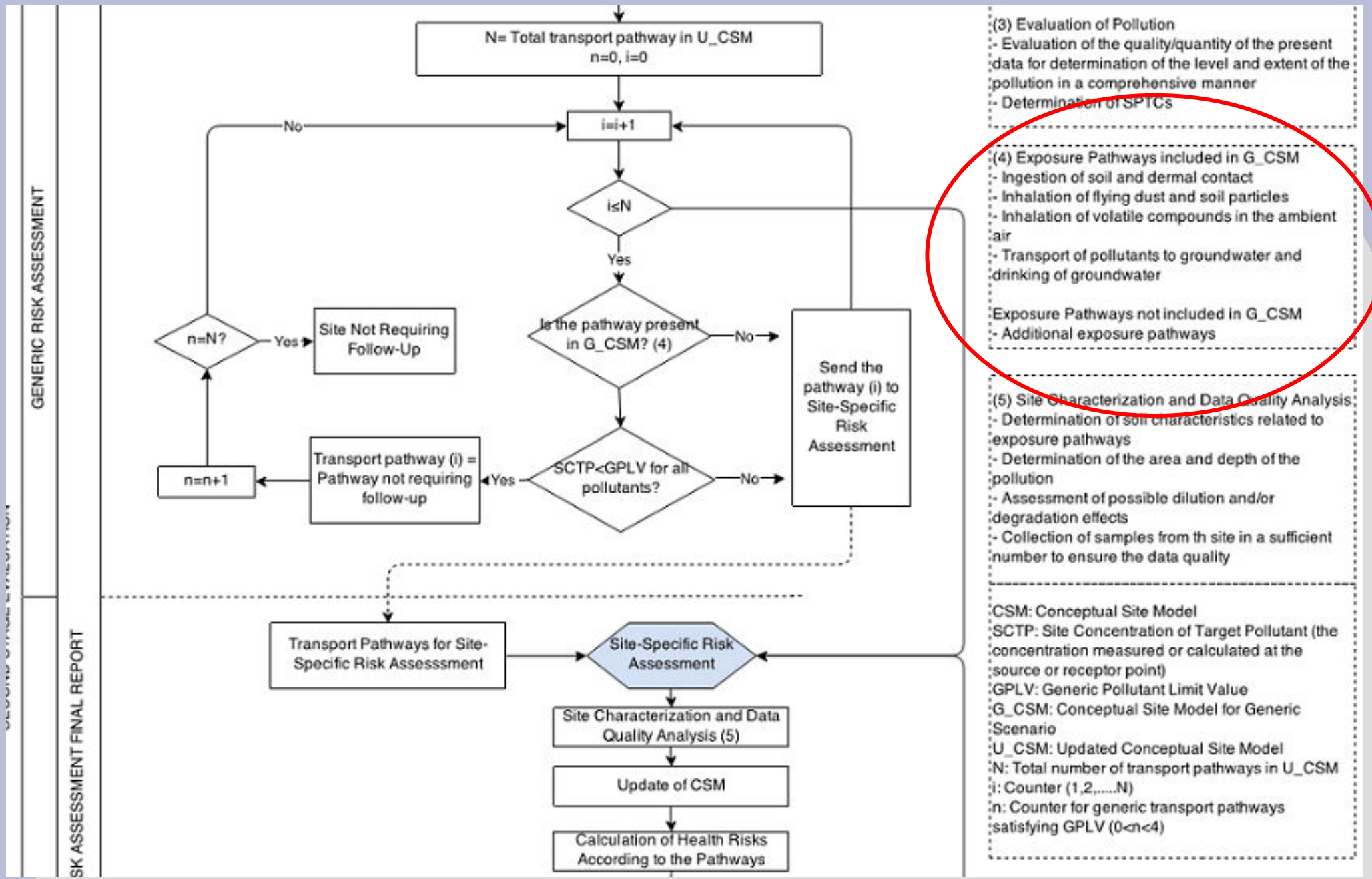
Soil Pollution Control and Point-Source-Contaminated Sites Regulation (will be active in 2015)

Contaminated Sites Identification and Registration System (CSIRS)
Contaminated Sites Evaluation System (CSES)
Contaminated Sites Cleaun-Up System (CSCS)

At the present, no inventory of contaminated sites.


Inspection and Registration
Control Disaster Accident Declaration
Potentially Polluting Activities
Unknown Source of Pollution in the Field
Unclaimed Field
Potential Field
Potential Field
Pre- Knowledge of Form of Business
Source Determination
Activity /Field Pre-Knowledge of Form
Suspicious Field
Evaluation of Pre-Knowledge of Activity
The First Stage Evaluation
Audit Form
Audit in the Field
Evaluation (Audit and Activity /Evaluation of Pre-Knowledge Form of the Field))
CFIS Scoring Evaluation
PDP Evaluation of Measurements
The Field Requiring Follow-up
Contaminated Field
The Field Requiring Follow-up
Second Stage Evaluation
Field and Pollution Characterization
Risk Assessment
Generic Risk Assessment
Field-Specific Risk Assessment
Contaminated Field
Pre- and Final Reports of Field Situation and Risk Assessment
The Field Requiring Follow-up
Cleaning
Cleaning Business Planning and Evaluation
The Field to Determine the Concentration Level of Cleaning
Cleaning Method to Determine
Cleaning System, Field Activities, Operation and Event Monitoring
Termination Activities in Cleaning and Following Monitoring
Cleared Field
Cleaning Activity Planning and Evaluation Report
Cleaning System Application and Monitoring Report
Termination Activities in Cleaning Report


First Stage
SECOND STAGE EVALUATION
SITE AND POLLUTION CHARACTERIZATION
SITE AND RISK ASSESSMENT PRELIMINARY REPORT
GENERIC RISK ASSESSMENT
SITE-SPECIFIC RISK ASSESSMENT
SITE AND RISK ASSESSMENT FINAL REPORT
Preliminary Site Assessment and CSM Development (1)
Site Sampling (2)
Evaluation of Pollution (3)
Develoment of U_CSM
N= Total transport pathway in U_CSM
n=0, i=0
i=i+1
No
i≤N
Yes
Is the pathway present in G_CSM? (4)
No
Send the pathway (i) to Site-Specific Risk Assessment
Yes
n=N?
Yes
Site Not Requiring Follow-Up
n=n+1
Transport pathway (i) = Pathway not requiring follow-up
Yes
SCTP<GPLV for all pollutants?
No
Transport Pathways for Site-Specific Risk Assesssment
Site-Specific Risk Assessment
Site Characterization and Data Quality Analysis (5)
Update of CSM
Calculation of Health Risks According to the Pathways
Calculation of Total Carcinogen Risks and Total Hazard Index by Concerning All Pathways and All Target Pollutants
Assessment of Table 5.3
If total carcinogen risk < 10-4 and total hazard index < 1 for polluted area
Yes
The pathway not requiring follow-up
No
Clean-up is necessary
Determination of Environmental Media to be cleaned and Clean-up Targets for Target Pollutants
Is it necessary to repeat site-specific risk assessment based on cost-benefit analysis?
Clean-Up
(1) Preliminary Site Assessment and CSM Development
- Assessment of Present Information on the Site
- Determination of possible pollution sources, pollutant transport pathways and receptors
- Determinaton of target pollutants in the site
- Determination of urgent measures to be taken and application of the measures (control of the entrances to the site, control of drainage of the surface waters etc.)
(2) Site Sampling
-Preparation of a sampling and analysis plan according to Site Survey Rtechnical Communique
(3) Evaluation of Pollution
- Evaluation of the quality/quantity of the present data for determination of the level and extent of the pollution in a comprehensive manner
- Determination of SPTCs
(4) Exposure Pathways included in G_CSM
- Ingestion of soil and dermal contact
- Inhalation of flying dust and soil particles
- Inhalation of volatile compounds in the ambient air
- Transport of pollutants to groundwater and drinking of groundwater
Exposure Pathways not included in G_CSM
- Additional exposure pathways
(5) Site Characterization and Data Quality Analysis
- Determination of soil characteristics related to exposure pathways
- Determination of the area and depth of the pollution
- Assessment of possible dilution and/or degradation effects
- Collection of samples from th site in a sufficient number to ensure the data quality
CSM: Conceptual Site Model
SCTP: Site Concentration of Target Pollutant (the concentration measured or calculated at the source or receptor point)
GPLV: Generic Pollutant Limit Value
G_CSM: Conceptual Site Model for Generic Scenario
U_CSM: Updated Conceptual Site Model
N: Total number of transport pathways in U_CSM
i: Counter (1,2,.....N)
n: Counter for generic transport pathways satisfying GPLV (0<n<4)


GENERIC RISK ASSESSMENT
SK ASSESSMENT FINAL REPORT
N= Total transport pathway in U_CSM
n=0, i=0
i=i+1
No
i≤N
Yes
Is the pathway present in G_CSM? (4)
No
Send the pathway (i) to Site-Specific Risk Assessment
n=N?
Yes
Site Not Requiring Follow-Up
SCTP<GPLV for all pollutants?
Yes
No
Transport pathway (i) = Pathway not requiring follow-up
n=n+1
Transport Pathways for Site-Specific Risk Assesssment
Site-Specific Risk Assessment
Site Characterization and Data Quality Analysis (5)
Update of CSM
Calculation of Health Risks According to the Pathways
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- Legal Procedure in Romania

National Strategy and National Action Plan for the Management of Contaminated Sites in Romania was completed and published in August 2013.

Contaminated sites management system includes four steps: 1. identification and registration; 2. preliminary assessment, 3. detailed assessment and 4. remediation.

Detalied assessment of contaminated sites requires the following steps:

- Site characterization and its contamination.
- Generic Risk Assessment. Concentrations of contaminants measured is compared with the soil quality standard in order to define the transfer pathways, and the generic scenario will include the inhalation of fugitive dust, inhalation of volatiles, groundwater ingestion, dermal absorption. If standard values are exceeded, it will begin the risk assessment for all potential open pathways. Also, all transfer pathways will be identified.
- Detailed Risk Assessment (site-specific)

Contaminated Sites with Risk-Based Approach: Turkish and Romanian Practice

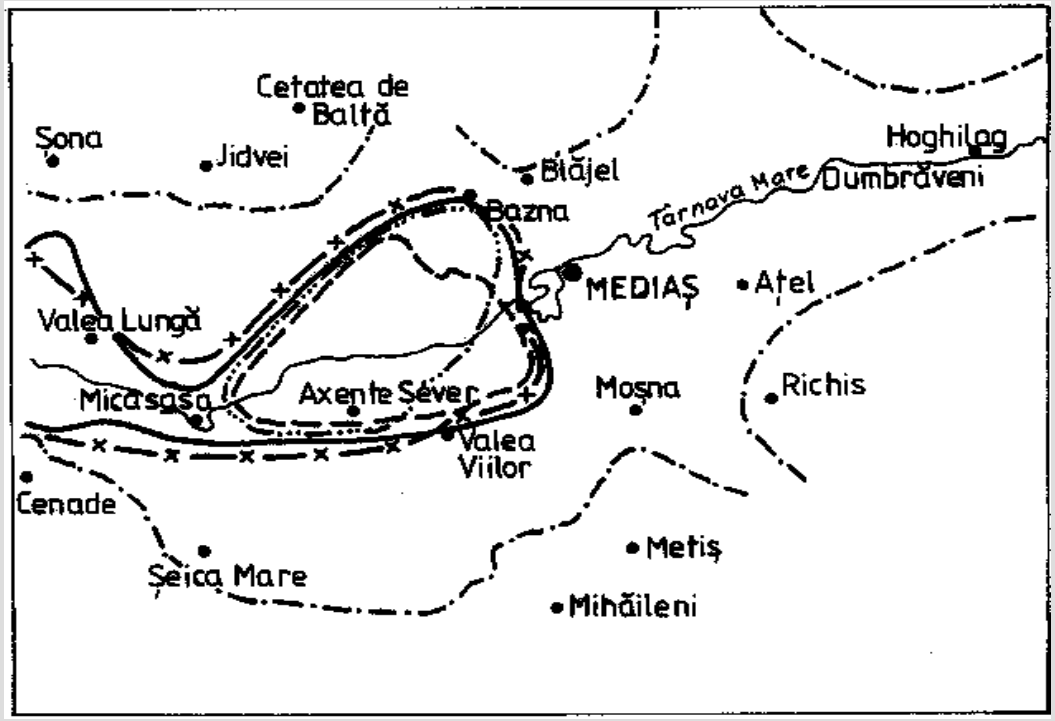
During the study, contaminated sites from both Romania and Turkey were selected for application of generic and site-specific risk assessment scenarios.

The sites selected for the risk assessment studies:

- Copşa Mică in Romania
- TEDAŞ Gölbaşı Transformer Repair and Maintenance Area in Turkey.

CONTAMINATED SITE IN ROMANIA

Copşa Mică is a town in Sibiu County, Romania. Copşa Mică (and its surroundings) is known in the recent past as the most polluted town in Europe; especially with heavy metals - iron and steel industry.



areal poluat puternic cu:
Cd (——), Cu (—··—),
Pb (×—), Zn (— — ·)

—·—·— limita arealelor cu polluare minimă spre medie

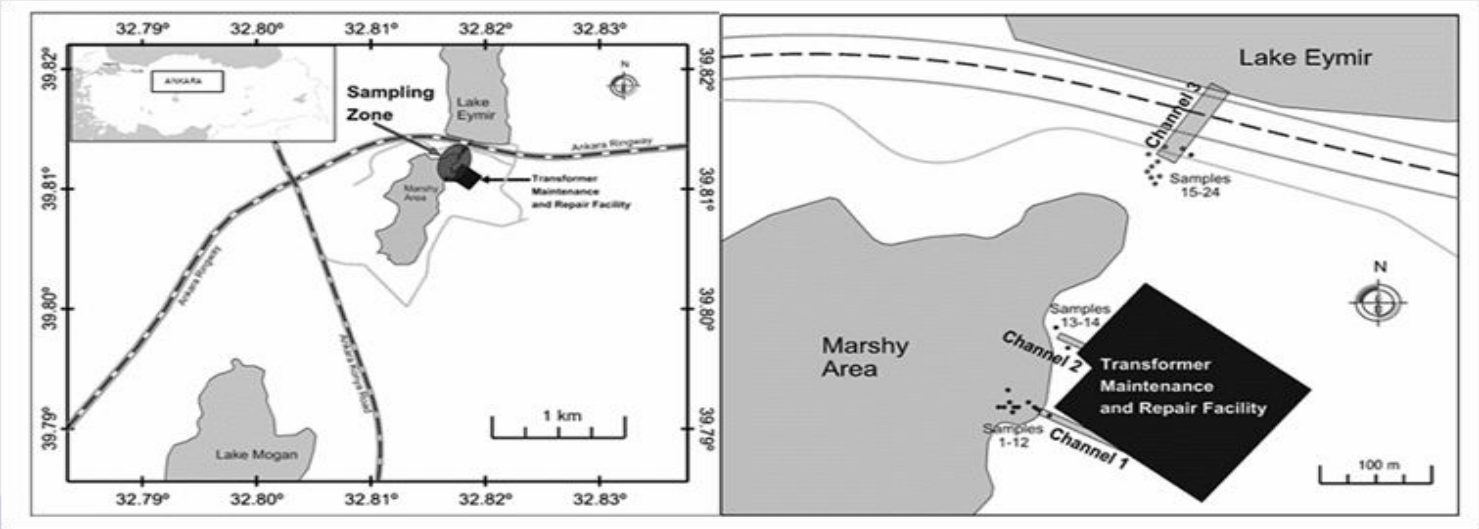
CONTAMINATED SITE IN ROMANIA

Dynamics of the total content of heavy metals (mg / kg) in arable horizon (0-20 cm) of the polluted soils from Copşa Mică

Chemical compund	1990			1993			1995		
	min	max.	med.	min.	max.	med.	min.	max.	med.
Cd	1,5	31,5	8,7	2,5	28,0	7,7	1,8	15,1	4,3
Cu	20	370	75	30	110	51	25	92	37
Pb	25	805	228	85	735	243	35	584	165
Zn	110	765	465	190	1640	514	134	1350	407

CONTAMINATED SITE IN TURKEY

Site Holder	Location	Activity/Use	Contamination Type	Background/Description/Status
TEDAS	Golbasi District (20 km S of Ankara)	Transformer repair and maintenance	PCBs	Located adjacent to a marsh declared environmental protection area and 300m of Lake Eymir Facility operated as a main repair/maintenance operation from 1978-1995. Extensive evidence of PCB contamination in adjacent water, sediments including hot spots>50 ppm. . Limited on site soil contamination data available (464 PPM)



GENERIC SCENARIO FOR COPŞA MICA

Limit values for generic scenario

Pollutant	Soil ingestion and dermal adsorption (mg / kg dry soi)	Inhalation of fly ashes (mg / kg dry soil)	Transfer of pollutants to groundwater (mg/kg dry soil) Dilution Factor (DF) = 10	DF = 1
Arsenic	0,4	471	3	0,3
Berilium	0,1	843	0,1	0,01
Cadmium	70	1124	27	3
Chrome (VI)	235	24	10	1
Lead	400	-	135	14
Nickel	1564	-	13	1

If the the distance to the aquifer is less than 3 m, the aquifer crack or karstic, or pollution source area is greater than 10 hectares, dilution factor (DF) must be considered “1”. DF must be considered “10” in other cases.

GENERIC SCENARIO FOR COPŞA MICA

- Is site-specific risk assessment necessary?

Pollutant	**Soil ingestion and dermal adsorption**	**Inhalation of fly ashes**	**Transfer of pollutants to groundwater**
Arsenic	**Yes**	No	**Yes**
Berilium	**Yes**	No	**Yes**
Cadmium	No	No	**Yes**
Chrome (VI)	No	No	**Yes**
Lead	No	No	**Yes**
Nickel	**Yes**	No	**Yes**

GENERIC SCENARIO FOR TEDAŞ

Limit values for generic scenario

Pollutant	Soil ingestion and dermal adsorption (mg / kg dry soi)	Inhalation of fly ashes (mg / kg dry soil)	Transfer of pollutants to groundwater (mg/kg dry soil) Dilution Factor (DF) = 10	DF = 1
PCB 2	0,2		0,03	0,003
PCB 3	6		0,9	0,09

2 For all mixtures excluding Arochlor 1016

3 For Arochlor 1016 mixtures.

Aroclor 1016 contains mono- through hexachlorinated homologs with an average chlorine content of 41%.

GENERIC SCENARIO FOR TEDAŞ

Soil PCB contamination in TEDAŞ (Karakaş et al., 2013)

Pollutant	**Surface Soil (h < 20 cm) (mg/kg)**	**Deep Soil (h > 20 cm) (mg/kg)**
PCB (Arochlor 1016)	0,014	0,019
PCB (Arochlor 1260)	0,065	0,07

Is site-specific risk assessment necessary?

Pollutant	**Soil ingestion and dermal adsorption**	**Inhalation of fly ashes**	**Transfer of pollutants to groundwater**
PCB (Arochlor 1016)	No	No	No
PCB (Arochlor 1260)	No	No	No

SITE-SPECIFIC SCENARIO FOR TEDAŞ

- Performed by Recoland v1.0 (developed by Romanian team)

Carcinogen risk for only PCB 118 (2,3,4,4',5-pentachlorobiphenyl)

- Computations were made for 5 receptor points and risk was taken as average.
- Average risk 1.51 x 10 -2 is higher than the acceptable risk of 1 x 10 -6

Receptor points	**PCB 118**
1	1.53E-02
2	1.15E-02
3	2.60E-02
4	3.48E-04
5	2.22E-02
Average risk	**1.51E-02**

RESULTS

- There is a critical need for expertise for the determination of the exposure pathways related to a contaminated site.
- Decision on the generic or site-specific risk assessment may lead to different risk estimation results.
- For the carcinogenic pollutants (especially the carcinogenic POPs), application of site-specific risk assessment is vvery important.
- The consequences and assessments related to te generic risk assessment procedures are generally similar for both Turkey and Romania, while site-specific risk assessments performed through different exposure and modeling methodologies may produce different results and assessments for same contaminated site.
- The necessity for a parameter standardization and validation of models used in the risk assessment for setting a reliable risk-based contaminated site management is emphasized.

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The project (112Y226) was supported by the cooperation of TÜBİTAK (The Scientific and Technological Research Council of Turkey) and ANCS (Autoritatea Naţională pentru Cercetare Ştiinţifică şi Inovare). Authors thank to these institutions for financial support.

THANKS FOR YOUR ATTENDANCE