ENVIRONMENTAL RISK ASSESSMENT A PRACTICAL APPROACH IN CASE OF SPECIFIC ACTIVITIES TO LOCOMOTIVES MAINTENANCE AND EXPLOITATION

Adriana Cuciureanu, Bogdan Stanescu, Lidia Kim, Gheorghe Batrinescu

National Research and Development Institute for Industrial Ecology ECOIND, Bucharest, Drumul Podu Dambovitei 71-73, district. 6, Postal code 060652; Romania, email: evmt@incdecoind.ro

Abstract

The paper shows a case study of environmental risk assessment generated in the area of development of specific activities to locomotives maintenance and exploitation. The analysis involves accumulating large volumes of information, processing, organizing and interpreting them in the context of the problems analyzed. The elements related to the nature and intensity of pollution, migration and transport pathways of specific pollutants are presented. As a result of investigations carried out on site soil / subsoil and groundwater have been able to identify and delimit areas of significant pollution. From the analysis the distribution maps of the THP contents, carried out on the analytical data obtained from characterization samples of soil, pollutant migration in a horizontal plane was highlighted

Keywords*: environmental risk, distribution maps of THP, locomotives maintenance*

1. Introduction

Environmental risk assessment generated from an activity starts in conditions of identifying nonconformities in quality environmental components studied area. The environmental risk assessment requires a complex analysis and has been conducted to source-pathway-receptor relationship [1]. It allows quantifying induced effects on the environmental components of the studied area.
The objective selected to case study is the area of development of specific activities to locomotives maintenance and exploitation. The elements that have led to impairment of the SOIL and GROUNDWATER environmental factors could be regarded: the long period of the activities in this area – aprox.100 years, the presences of some objectives with high level of wear which contains dangerous substances , the existence of visible areas affected due to the performance of work in not complying conditions.

Risk evaluation study try to explain:

- To what extent the significant pollution existence of the site **constitute a danger** to the soil / sub soil and groundwater quality
- Which are the **effects of this danger and its gravity**
- What are the **potential receptors and what risk can be registered**

For quantifying the risk has been used the following equation:

$$R = P \times C$$

Where: R- the risk
P- probability of occurrence
C- consequences (severity) effects on the environment

Quantifying probability of occurrence (P) is on a scale of 1 to 4:
1= unlikely
2= very small probability
3= moderate probability
4 = high probability

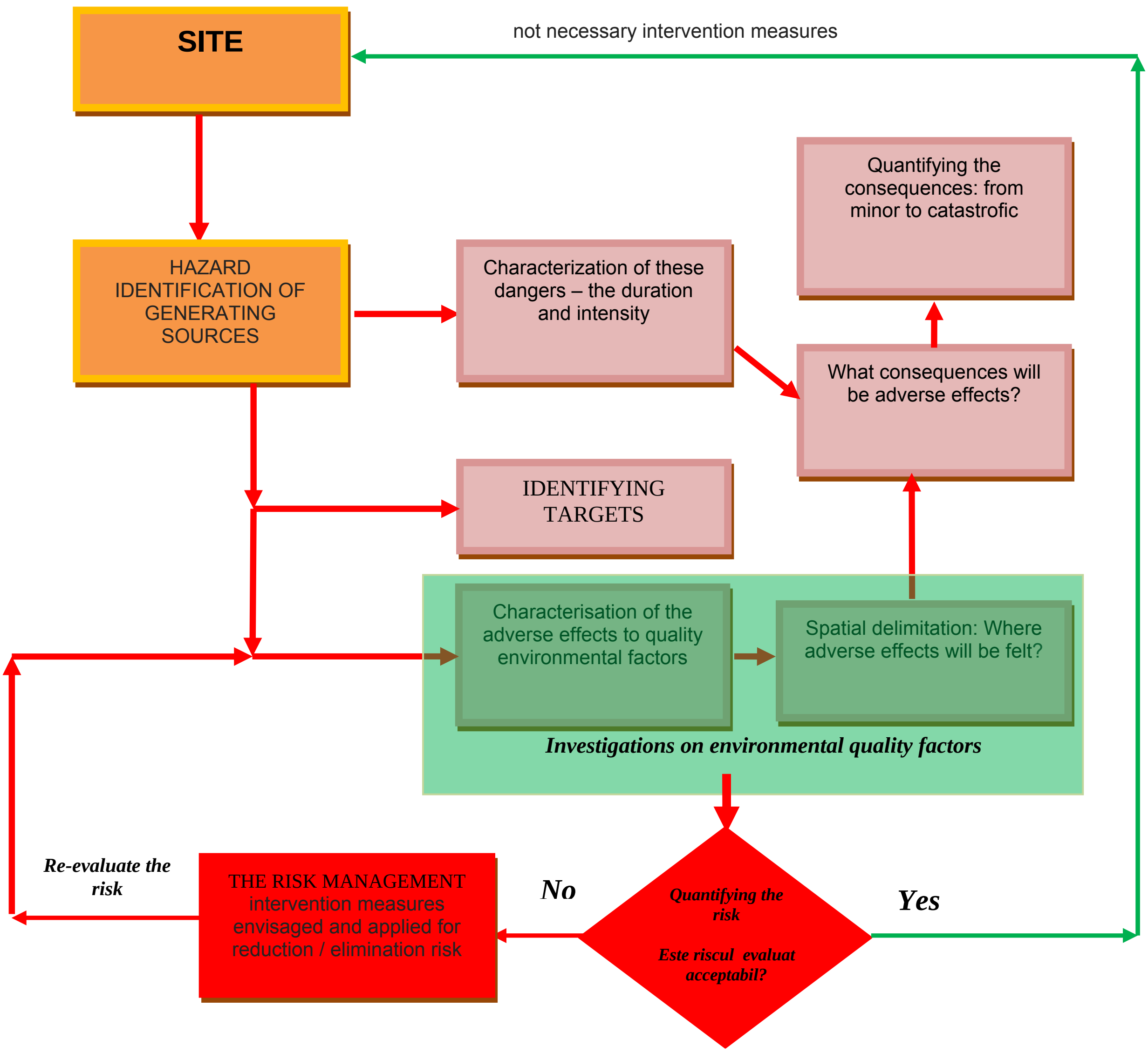
Quantifying the consequences (C) is on a scale of 1 to 4:
1= minor effects (local, with low risk to the environment)
2= moderate effects (presenting hazard to the environment)
3= serious effects (spills of toxic materials that poses a threat for environment)
4 = catastrophic effects (the environmental damage in all its components, with reduced neutralization and long recovery)

When R≥6 it is considered that the environmental impact is significantly [2].

The combination of the effects with probability for risk quantification is given below [3]:

		Efects			
		Catastrofic	Serious	Moderate	Minor
Probability	High	Very high risk	High risk	Moderate risk	Moderate/low risk
	Moderate	High risk	Moderate risk	Moderate/low risk	Low risk
	Very small	Moderate risk	Moderate/low risk	Low risk	Very low risk
	Unlikely	Moderate/low risk	Low risk	Very low risk	Minor risk
		RISK			

The schematically environmental risk analysis in the analyzed site it shows in fig.1.



Investigations carried out previously and visual observations emplacement shows the sources generating potential hazards: light liquid fuel tank, oil warehouse, clogged sections of the sewer storm water, the separator, corresponding areas of railroads damaged by oil spills.

2. Experimental

Adverse effects of the environmental components are emphasized by the performed investigations to SOIL and GROUNDWATER near the sources pollution generating.

- Were collected 24 soil samples from seven locations (Figure 2), different levels of depth (0-10 cm, 50 cm, 100 cm, 200 cm) for each location. Were used drilling equipment manual, all the samples were collected in glass containers, tightly closed. The samples were transported in proper conditions to laboratory. Soil samples taken were analyzed in the laboratory were applied standardized test methods (Table 1), using advanced analytical equipment and the modern technology [4]

Figure 2 *Location of sampling points*

Table 1 – Quality indicators and test methods

Nr.crt.	Quality indicators	Test methods
1	pH	ISO 10390/2005
2	Wet	SR ISO 11465/98
3	Total petroleum hydrocarbons (THP)	SR 7877/2:1995 ISO 14507:2003

- Were collected water samples from existing well using a manual sampler (bailer). The water samples were collected in glass container and were transported in proper conditions to laboratory. Water samples taken were analyzed in the laboratory were applied standardized test methods (Table 2), using advanced analytical equipment and the modern technology.

Table 2 - Quality indicators and test methods

Nr.crt.	Quality indicators	Test methods
1	pH	ISO 10523/12
2	Total petroleum hydrocarbons (THP)	SR 7877/2-95
3	COD	SR ISO 6060-96
4	HAP total	SR EN ISO 17993:04
5	BTEX	SR ISO 11423/1-00

3. Results and Discussion

- Analytical results revealed the characteristics of the soil samples (tab. 3).

Table 3

Nr. crt	Sample code/Depth level	pH	Wet (%)	THP (mg/kg d.s.)
1	P1 (0-10 cm)	7,84	16,54	**2660**
	P1 (50 cm)	7,56	19,6	**18408**
	P1 (100 cm)	7,32	39,35	**63974**
	P1 (200 cm)	7,23	17,22	**45482**
2	P2 (0-10 cm)	7,63	22,67	993
	P2 (50 cm)	7,72	12,26	57,84
	P2 (100 cm)	7,93	8,85	157
3	P3 (0-10 cm)	7,56	25,61	**6251**
	P3 (50 cm)	7,42	13,88	**3780**
	P3 (100 cm)	7,62	20,1	**2528**
4	P4 (0-10 cm)	7,52	16,87	**19818**
	P4 (50 cm)	7,33	14,96	*1987*
	P4 (100 cm)	7,12	12,34	**6959**
	P4 (200 cm)	7,08	15,1	247
5	P5 (0-10 cm)	7,21	11,8	**2757**
	P5 (50 cm)	7,31	14,8	**3509**
	P5 (100 cm)	7,46	16,6	**4494**
	P5 (200 cm)	7,13	13,9	100,5
6	P6 (0-10 cm)	7,89	10,9	**4587**
	P6 (50 cm)	6,17	20,8	241
	P6 (100 cm)	7,1	16,7	25
	P6 (200 cm)	6,91	14,6	410
7	P7 (0-10 cm)	6,72	24,2	**3149**
	P7 (50 cm)	7,03	18,6	**3365**
Reference values for soils with less sensitive use (according to Ord.756/1997 for aproving legislation on environmental pollution assessment) -mg/kg d.s.				
Normal value		-	-	<100
Alert threshold		-	-	*1000*
Intervention threshold		**-**	**-**	**2000**

The values determined in the samples compared with the limit values imposed by the Ord.756/1997 shows highlight pollution extended to surface and to the depth levels investigated. [5]

Distribution maps of the THP quality indicator are shown in fig. 3÷6.

The results presented to each level depth, were obtained applying Kriging method [6].

Figure 3 *– Distribution map of THP at 0-10cm level depth*

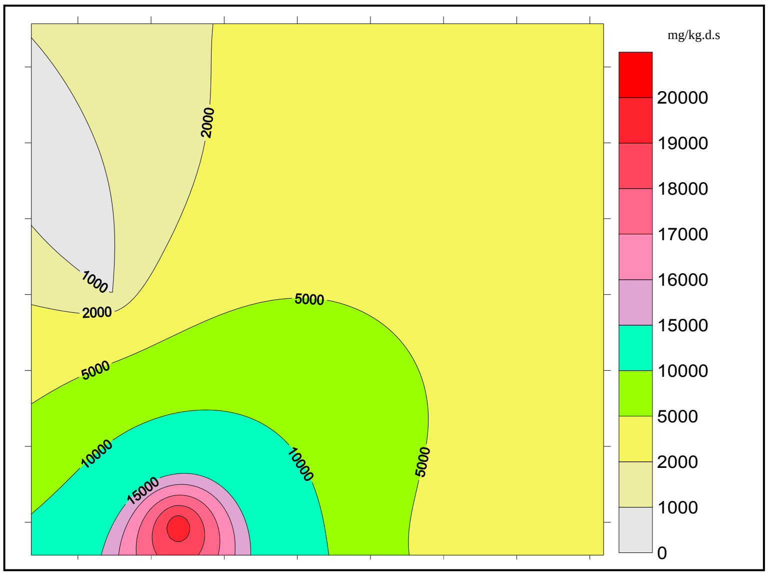


Figure 4 *– Distribution map of THP at 50cm level depth*

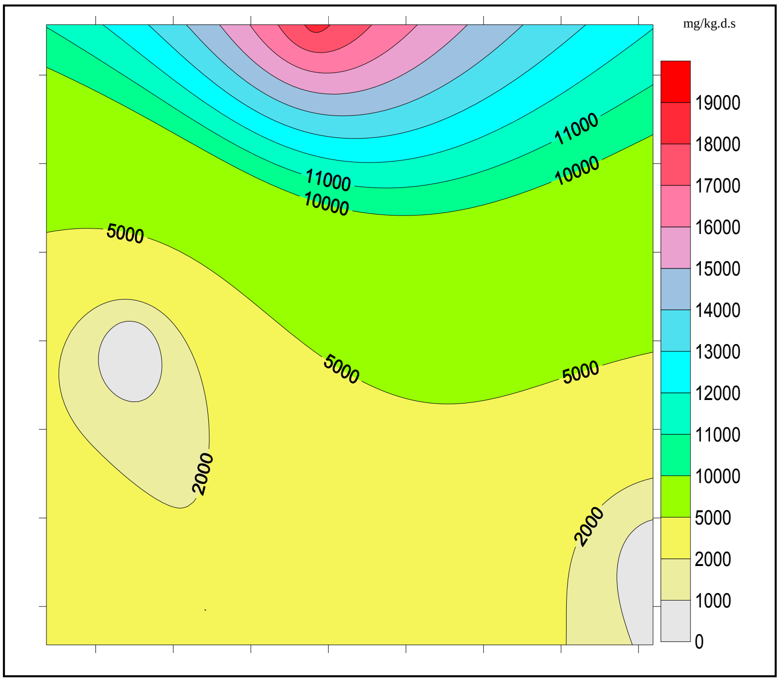


***Figure 5** – Distribution map of THP at 100cm level depth*

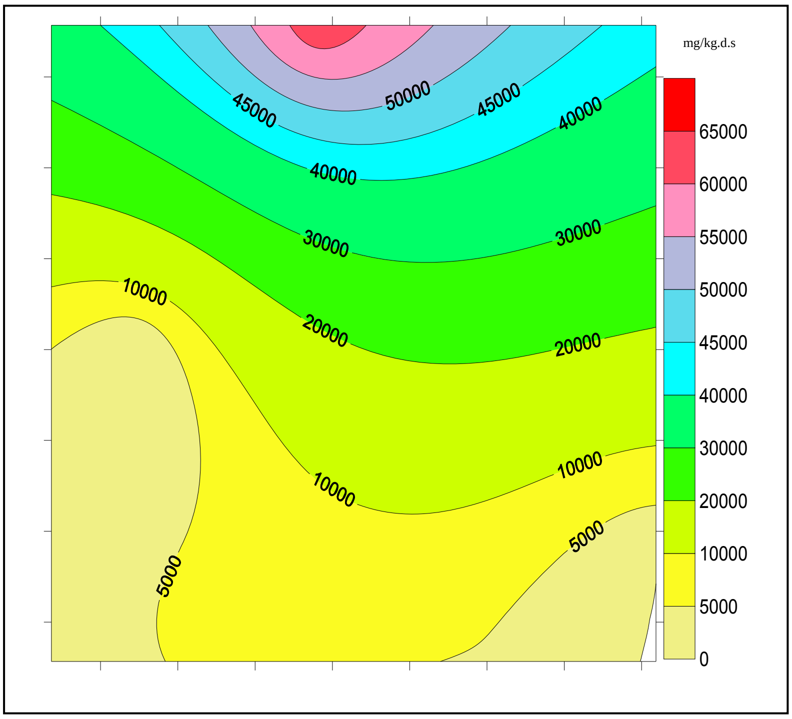
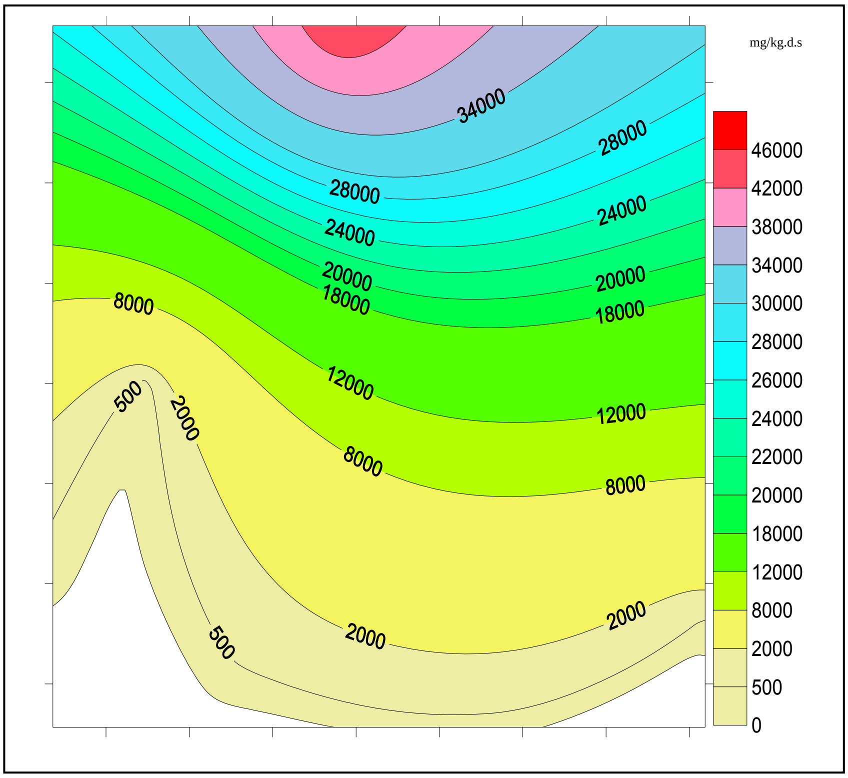


***Figure 6** – Distribution map of THP at 200cm level depth*



- The result of the quality indicators of the groundwater samples analyzed are presented in table 4.

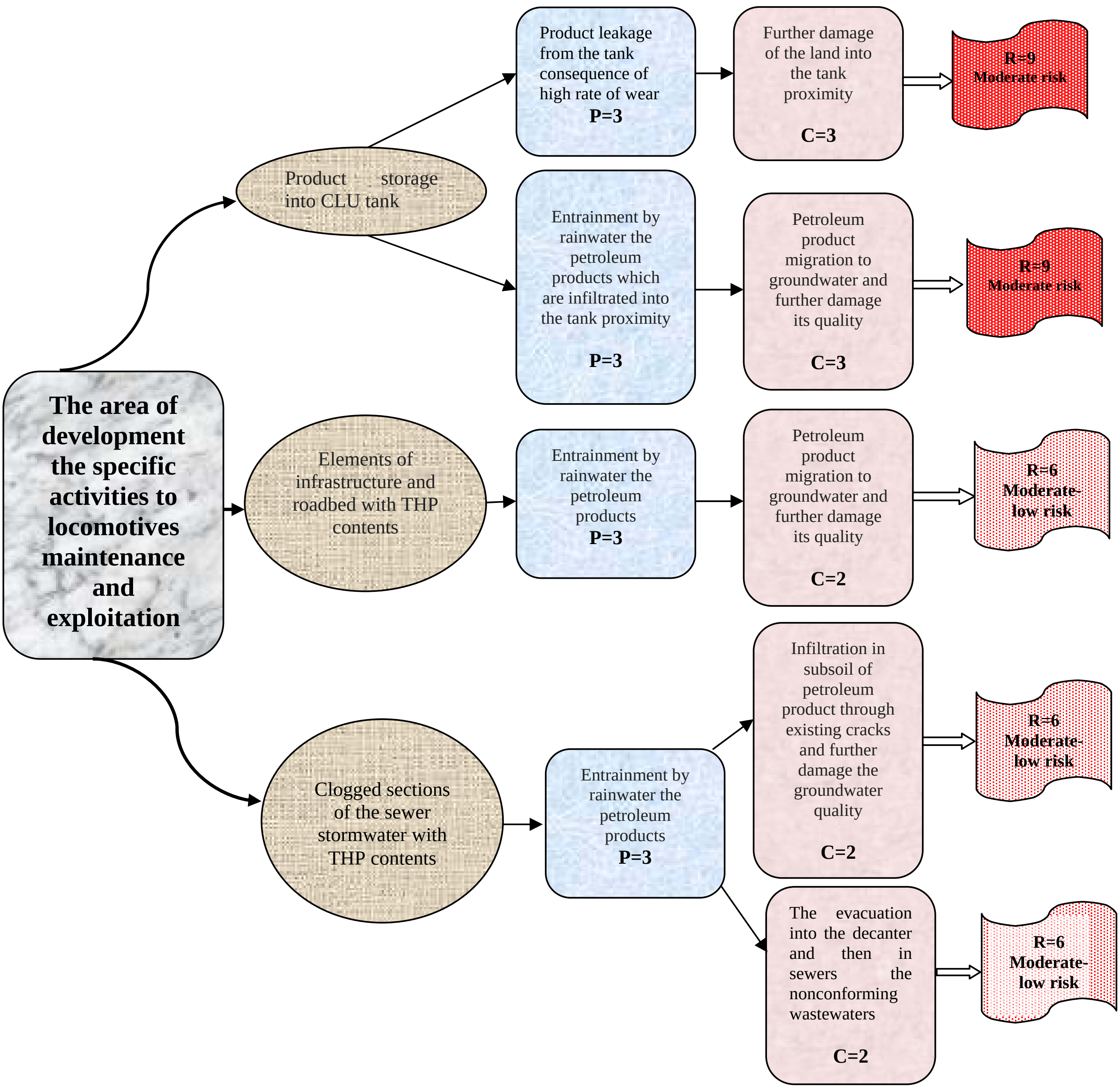
Table 4

Nr. crt	Quality indicators	UM	Sample code F (2013)	Sample code F (2014)	Values according to HG 449/2013 and Dutch list
1	pH	unit pH	7,69	7,17	-
2	THP	mg/l	**0,92**	**17**	0,6
3	COD	mg O_2/l	-	520	-
4	**HAP total**	µg/l	<0.005*	0.589	81,9
	Anthracene	µg/l	<0.005*	<0.005*	5
	Benz(a)anthracene	µg/l	<0.005*	<0.005*	0,5
	Benzfluorantene	µg/l	<0.005*	0.070	-
	Benz- k fluorantene	µg/l	<0.005*	0.009	0,05
	Benz(ghi)perylene	µg/l	<0.001*	0.031	0,05
	Benz(a)pyrene	µg/l	<0.002*	**0.054**	0,05
	Chrisen	µg/l	<0.005*	**0.349**	0,2
	Florantene	µg/l	<0.005*	<0.005*	1
	Indenol(1,2,3cd)pyrene	µg/l	<0.001*	0.011	0,05
	Naphtalene	µg/l	<0.005*	<0.005*	70
	Phenanthrene	µg/l	<0.005*	0.007	-
	Pyrene	µg/l	<0.005*	0.058	-
5	**BTEX**	µg/l	-	<0,05*	-
	Benzene	µg/l	-	<0,05*	50
	Toluene	µg/l	-	<0,05*	1000
	Ethylbenzene	µg/l	-	<0,05*	300
	Xylene	µg/l	-	<0,05*	500

The THP values determined in the samples which are compared with the limit values shows an extended highlight pollution. The pollution by oil products is exhibited to an increasing trend. This is due to solubilization of petroleum products while stationed in the unsaturated zone, also additional contribution due to presence on the studied area of the sources of pollution.

The investigation results presented above have allowed quantification of risk induced by oil products presence in soil/sub soil and groundwater environmental factors. This quantification is represented schematically in Figure 7.

Figure 7 – The risk quantification



4. Conclusions

Quantifying the adverse effects of the environmental components and the potential hazards generated on the area of development the specific activities to locomotives maintenance and exploitation have shown significant risks induced on soil/sub soil and groundwater environmental factors. The THP stationed in the unsaturated zone migrates into the depth to the groundwater (saturated zone).

The distribution maps of the THP contents, carried out on the analytical data obtained from characterization samples of soil, pollutant migration in a horizontal plane was highlighted.

Values obtained for risk, respectively $R \geq 6$ emphasize that environmental impact is significant.

Environmental risk management measures to decrease pollution aimed to eliminating the causes of the danger.

References

[1] *** Ministry of Waters, Forests and Environmental Protection, Order no. 184/1997 approving the regulation on environmental pollution assessment, the Official Journal of Romania no. 303bis from 6 November 1997

[2] G. W. Suter II, B.E. Sample, et all - Approach and Strategy for Performing Ecological Risk Assessments, 1995 – Revision

[3] S. Wilson, S. Oliver, H. Mallett, H. Hutchings, G. Card - Assessing risk posed by hazardous ground gases to builidings, CIRIA C665, London, 2007

[4] B. Stanescu, G. Batrinescu, A. Cuciureanu, L. Kim, D. Scradeanu, M. Scradeanu – Practical aspects of hydrogeological investigations and assessment of the environmental components pollution in urban areas. Case study, Journal of Environmental Protection and Ecology 15, no.3, 870-877, 2014

[5] *** Ministry of Waters, Forests and Environmental Protection, Order no. 756/1997 approving the regulation on environmental pollution assessment, the Official Journal of Romania no. 303bis from 6 November 1997

[6] spatial-analyst.net/how_to_use-kriging.htm