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RESEARCH ARTICLE

US A ENVIRONMENTAL DUE DILIGENCE PRACTICE CASE STUDY ON AN INDUSTRIAL SITE LOCATED IN CARAS-SEVER IN COUNTY ROMANIA

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ABSTRACT

This paper focuses on the application of the usual approach for the environmental assessment of sites which are the subject of a real estate transaction or which are brownfields. The existing Romanian legislation in this field must to be completed with other available regulations.In addition, the success of the approach is provided by a rich professional experience of the environmental assessors involved. The case study presented in this paper refers to the approach taken to investigate and quantify their potential historical pollution for a former industrial land with an area of 8840 m^2. In this respect, both the international and Romanian standards were applied.

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INTRODUCTION

In the last 10–15 years began to pay increasing importance of identifying historically contaminated sites, evaluate them and solve them using the most appropriate methods. Romanian environmental legislation has also been subject to several changes and additions in this period, but to solve the problems mentioned above there only a few titles. For example, it was approved the GD 1408/2007 on the methods of investigation and assessment of pollution of soil and subsoil, and then would have be publishedthe implementing rules.After nearly nine years they have not yet been published, so that environmental consultants who usually do these kinds of investigations are forced to use other countries' legislation and standards. This happens in a context where there is no EU legislation in this very bidder. Identification and quantification of historical pollution of land on which industrial activities were carried out is very importantespecially in two specific situations: through the procedure of identification and remediation brownfields sites; in the beginning of thecommercialreal estate transaction process. In this second case, the buyer of a subject property is the most interested to know all the details about a possible historical pollution. Ignorance in their timely, it can cost due to the fact that it will become the owner of land for decontamination which will have to pay. To achieve the necessary investigations to identify and quantify pollution to land, with or without ongoing activities, most environmental consultants resort to ASTM (American Society for Testing Materials) standards.Throughout its existence, ASTM was transformed from a simple American organization into an international one. ASTM International is a globally recognized leader in the development and delivery of voluntary consensus standards. Today, over 12,000 ASTM standards are used around the world to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence. According to ASTM standards and the international practice, the most usual approach for the full environmental site assessments requires going through successive following steps:

a) Phase I Environmental SiteAssessment: The purpose of this Phase I ESA is to identifythe environmental conditions in connection with the property and consists of four components (ASTM E1527-13):

- Site Description
- Records Review

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- Site Reconnaissance
- Interviews.

The final report shall include a conclusionssection that summarizes all recognized environmental conditionsconnected with the property and the impact of theserecognized environmental conditions on the property.

b) Phase II Environmental SiteAssessment: The main objective of conducting a

Phase II ESA is to evaluate the recognized environmentalconditions identified in the Phase I ESA or transaction screenprocess for the purpose of providing sufficient information regarding the nature and extent of contamination to assist inmaking informed business decisions about the property (ASTM E1903-11). The components of a Phase II ESA are as follows:

- Developing the scope of work (provide the rationale for planned sampling locations and testing parameters)
- Assessment activities
- Evaluation and presentation of data
- Presentation of findings and conclusions.

Phase IIIEnvironmental Site Assessment: The primary objective of a Phase III ESA (also known as Site Remedial Action Plan/Remediation Strategy Phase) is to investigate the nature and extent of adverse environmental impact identified by the Phase II ESA, to develop a Remedial Action Plan (RAP). Specific investigations of this phase include the calculation of the volume of impacted soil and/or groundwater, risk assessment, presentation of possible options for remediation, and sometimes site-specific pilot studies. At the end of this stage it is mandatory to notify the competent environmental authority which must approve the proposed remediation solution. An ASTM Standard for Phase III ESA does not exist because the type and variety of work performed under site clean-up actions is so variable. The necessary site characterization and remediation work must to use a multi-disciplinary approach to all characterization and remediation projects.

d) Phase IV Environmental Site Assessment: This phase (Remediation/clean-up or Remedial Action Plan Implementation) may involve the following components:

- Removal and disposal of existing contaminated area(s) through a variety of methods
- On site treatment of contaminated soils, groundwater, and waste streams
- Implementation of waste reduction plans, environmental management systems, and other at source remedial measures.
- No international standard exists for this ESA stage.

e) Phase V Environmental Site Assessment: This phase (also known as Completion/Validation Phase) must to demonstrate that RAP was implemented, providing evidence of actions undertaken. The Completion Report may include:

- Ground level surveys to demonstrate the depth of capping layer installed
- Photographic evidence of installed features
- Reassurance/verification sampling
- Laboratory results of imported soils
- Post completion monitoring etc.

In this way it confirms that remediation targets have been achieved. In this context, this paper presents a study case related to the environmental investigations developed on a Romanian brownfield in order to identify and quantify the existing historical pollution, required by a potential investor interested in land acquisition.

MATERIALS AND METHODS

The subject property of the study case is located in the town of Moldova Noua, Caras-Severin County and occupies 8,840 m^2 of land (which consist of two plots of land – Plot 1 of 5,000 m^2 and Plot 2 of 3,840 m^2, respectively). The site is located in an industrial area within the Moldova Noua industrial harbour, in the westernmost part of the town, along the Danube River. The property is bordered by the Danube River (to the West), industrial area (to the South), residential area (to the East) and by a public property (to the North).

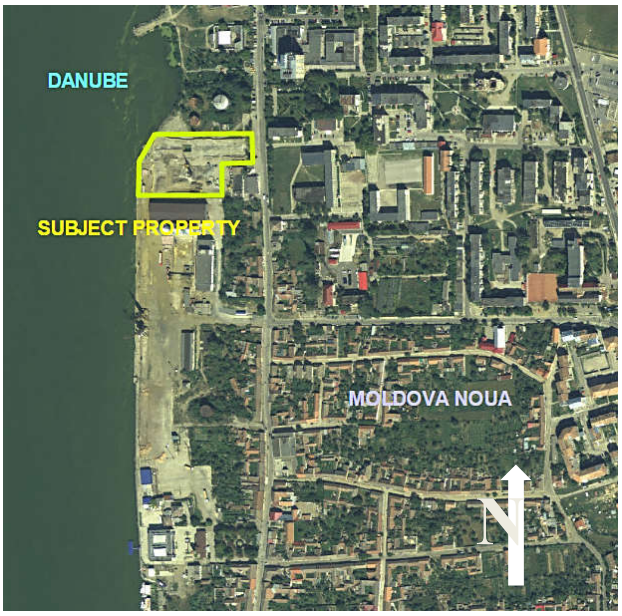


Figure 1. Site map location

For location above was made that an environmental assessment aimed at identifying and quantifying geological environment pollution. To this end, they have been completed phases I, II and III of the environmental assessment procedure set out above. Also they have taken into consideration the applicable Romanian legislation included in the Ministry Order no. 184/1997 on approving the Environmental Site Assessment Procedure (with subsequent additions and modifications).

To interpret the results of measurements were taken on the provisions:

- Ministry Order no. 756/1997 approving the Regulation on the environmental pollution assessment (with subsequent additions and modifications);
- Low no. 458/2002 related on the quality of drinking water (modified by L311/2004);
- Dutch Standard related to the groundwater target values and soil and groundwater intervention values.

RESULTS AND DISCUSSION

Phase I ESA: Based on desk study and on site visit information, the following environmental findings could where reported on the subject property:

- The presence of potential contamination sources associated with fuel pumping and loading activities.
- The existence of three aboveground storage tanks (AST) located in the close North vicinity of the subject property, at approximately 20-50 m from its boundary; no official information could be found on past incidents related to potential leaks or inappropriate operation of the tanks.
- The presence of a metallic hall with three compartments, located south of the subject property, hosting various uncontrolled solid waste.

Phase II ESA: Based on the data and information obtained during the Phase I ESA, intrusive investigations were recommended to be performed on site. These investigations were to consist of drilling works allowing sampling and analysis of soil and groundwatersamples, to identify some potential historical pollution. Potentially contaminated areas were identified in the northern part of the subject property, near the exiting ASTs located at approximately 20 and 50 m from the boundary. It is most likely that the ASTs formerly contained fuel that was pumped through the pump room to the tank trailer loading platform, both located on site. The survey focused on a good coverage of the site surface, in order to give a relatively accurate and comprehensive view of the extent of the potential contamination, as well as of its chemical nature. Soil and groundwater sampling was performed according to the applicable Romanianregulations (Ministry Order no. 184/1997 on approving the Environmental Site Assessment Procedure). Six boreholes were drilled to a maximum depth of 20 m bgl, one of which was equipped as monitoring well to a depth of 10 m. The Subject Property layout and drilling locations map are enclosed in Figure 2.

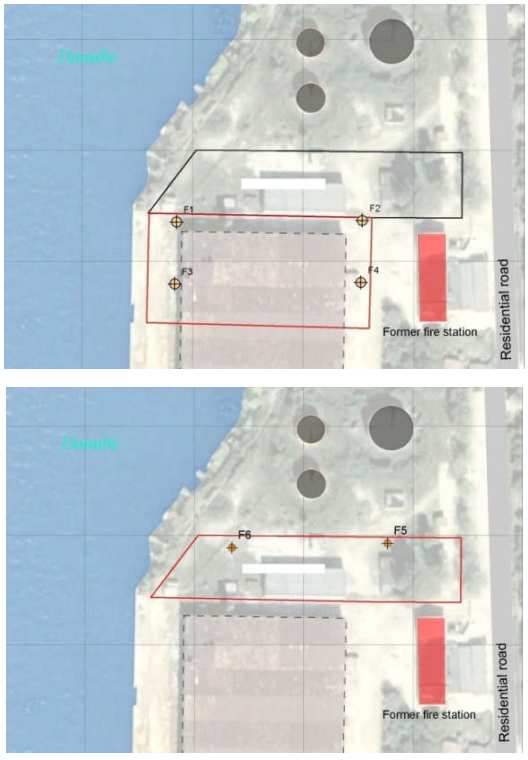


Figure 2. Phase II ESA - Drilling locations map

A total of 24 soil samples and 4 groundwater samples were recovered in order to be analysed in the analytical laboratory. Samples were stored in pre-cleaned glass containers; the sampled quantities were decided according to the type of analysis and the laboratory requirements. The sample containers were labelled with a unique sample identification numberand transported to the analytical lab (certified according ISO 17025:2001) by aconsultant representative. An example from the drilling operations is shown in Figure 3.

The analysed parameters were selected as to:

- Represent all the potential pollutants for this particular site; the identification of potential sources of contamination was done by relating the nature of past activities on site to visual observations;
- Provide relevant data taking into account any possible remedial actions that may be conducted as a result of significant contamination.
- Also, the selection of the parameters to be analysed for the soil samples (ph, total petroleum hydrocarbon, cd, cu, total cr, ni, pb, zn and chlorides) was made based on mo no. 184/1997 provisions.

Figure 3. Drilling of borehole F1

In order to interpreted the analytical results, the Ministry Order no. 756/1997 approving the Regulation on the environmental pollution assessment (with subsequent additions and modifications) defines the significance of and sets down the provisions on the alert threshold and the intervention threshold for air, and water pollutants and soil contaminants:

Alert threshold – pollutant concentrations in air, water, soil or in emissions/discharges, which have the role of warning the competent authorities on a potential environmental impact and which determine the start-up of supplementary monitoring

Table 1. Phase II ESA - Soil analytical results

Sample Identification		Depth [m]	pH	TPH (IR)	Cadmium (Cd)	Copper (Cu)	Total Chromium (Cr)	Nickel (Ni)	Lead (Pb)	Zinc (Zn)	Chlorides
F1/1.00 m		1.0	7.93	26.2	<0.5	90.4	14.2	20.4	14.8	68.1	52.16
F1/2.00 m		2.0	8.34	2,779.0	<0.5	87.3	20.0	40.7	21.9	73.0	65.03
F1/3.00 m		3.0	8.41	3,792.0	<0.5	115.0	15.4	21.0	16.6	82.8	24.85
F1/4.00 m		4.0	8.26	41.1	<0.5	126.7	13.7	21.0	15.2	74.8	33.40
F2/1.00 m		1.0	8.39	29.7	<0.5	82.1	20.1	23.9	39.5	75.5	43.57
F2/2.00 m		2.0	8.38	28.1	<0.5	126.0	21.0	24.5	20.4	84.6	63.11
F2/3.00 m		3.0	8.49	37.1	<0.5	452.0	15.3	21.2	61.3	194.0	63.69
F2/4.00 m		4.0	8.36	30.7	<0.5	55.0	34.8	39.0	23.9	110.0	27.19
F3/1.00 m		1.0	8.25	<25.0	<0.5	79.5	17.2	22.2	23.2	71.5	49.71
F3/2.00 m		2.0	8.43	<25.0	<0.5	100.0	13.7	21.2	16.2	103.0	64.05
F3/3.00 m		3.0	8.42	<25.0	<0.5	96.7	16.2	21.3	16.7	76.3	20.65
F3/4.00 m		4.0	8.37	27.2	<0.5	153.0	13.9	22.3	18.5	98.9	29.37
F4/1.00 m		1.0	8.46	289.0	<0.5	165.0	15.9	18.6	26.7	89.6	75.62
F4/2.00 m		2.0	8.48	38.8	<0.5	55.9	27.6	29.7	11.0	84.5	40.28
F4/3.00 m		3.0	8.34	38.3	0.9	854.0	14.5	22.5	46.2	305.0	73.01
F4/4.00 m		4.0	8.30	<25.0	<0.5	31.9	31.0	35.0	13.4	70.3	31.41
F5/1.00 m		1.0	8.64	28.1	<0.5	174	20.0	24.4	96.4	103.8	60.46
F5/2.00 m		2.0	8.62	<25.0	<0.5	148	22.8	24.9	26.0	91.1	54.08
F5/3.00 m		3.0	8.69	<25.0	<0.5	209	25.8	28.7	30.4	111.0	48.35
F5/4.00 m		4.0	8.65	35.1	<0.5	132	19.2	18.8	22.5	84.0	41.38
F6/1.00 m		1.0	8.62	34.2	<0.5	174	21.5	22.3	33.2	118.0	61.88
F6/2.00 m		2.0	8.69	<25.0	<0.5	113	21.9	22.2	26.4	87.8	55.96
F6/3.00 m		3.0	8.67	2,237.0	<0.5	133	22.5	22.4	18.6	87.1	37.29
F6/4.00 m		4.0	8.66	79.8	<0.5	108	14.3	16.4	16.3	76.1	37.14
Measurement unit			*pH units*				*mg/kg dry matter*				
Less sensitive use of land	*Normal value*		*6.5÷7.5*	*<100*	*1*	*20*	*30*	*20*	*20*	*100*	*≤180*
	Alert threshold		-	*1,000*	*5*	*250*	*300*	*200*	*250*	*700*	-
	Intervention threshold		-	*2,000*	*10*	*500*	*600*	*500*	*1,000*	*1,500*	-

Table 2.Phase II ESA – Groundwater analytical results

Sample id.	Depth [m]	pH [pH units]	Parameters [mg/dm^3]				
			CCO-Mn	Turbidity	Total hardness	Ammonium	TPH
F1	3.0	7.44	5.76	9	6.3	1.82	0.32
F2	3.0	6.78	3.20	6	59.4	1.36	<0.05
F4	3.0	6.89	2.40	19	63.6	0.73	<0.05
F6	3.0	6.80	13.75	10	56.6	0.91	2.99
Maximum allowableconcentration	*L 458/2002*	*6.5÷9.5*	*5*	*≤5*	*5*	*0.50*	-
	Dutch Standards	-	-	-	-	-	*0.60*

Table 3. Phase III ESA – Description of recovered soil samples

Sample Identification	Sampling depth (m)	Field observations
SP1	1 – 3	Heterogeneous filling material with coarse gravel and sand; dark coloured layers with smell of hydrocarbons at 1 and 2 m bgl, noticeable smell of hydrocarbons at 3 m bgl and traces of hydrocarbons on the groundwater surface.
SP2	1 – 3	Coarse filling material with sand and gravel; thick, dark coloured layer with noticeable smell of hydrocarbons between 1 and 3 m bgl, traces of hydrocarbons on the groundwater surface.
SP3	1 – 3	Coarse filling material with sand and gravel; dark coloured layer with smell of hydrocarbons at 3 m bgl.
SP4	1 – 3	Coarse filling material with sand and gravel; dark coloured layer with noticeable smell of hydrocarbons at 3 m bgl.
SP5	1 – 3	Heterogeneous filling material with sand and gravel; dark coloured layer with smell of hydrocarbons at 3 m bgl.
SP6	1 – 3	Filling material with sand and gravel, light smell of hydrocarbons at depths below 2 m.
SP7	1 – 3	Coarse mixture of sand and gravel; thin dark coloured layer at 2 m bgl, no noticeable smell of hydrocarbons.
SP8	1 – 3	Heterogeneous filling material, no smell or traces of hydrocarbons
SP9	1 – 3	Filling material with coarse sand and gravel; thick, dark coloured layer with heavy smell of hydrocarbons and traces on the groundwater surface.
SP10	1 – 3	20 cm thick layer of concrete, coarse filling material with sand and gravel; thin, dark coloured, shallow layer with light smell of hydrocarbons at 1 m bgl.
SP11	1 – 3	20 cm thick layer of concrete, coarse filling material with sand and gravel.
SP12	1 – 3	20 cm thick layer of concrete, coarse filling material with sand and gravel.
SPx (off-site)	1 – 3	Coarse filling material with sand and gravel; dark coloured layer with noticeable smell of hydrocarbons over the 2 - 3 m depth interval.

or/and mitigation of pollutant concentrations in emissions/discharges;

Intervention threshold – pollutant concentrations in air, water, soil or in emissions/discharges for which the competent authorities will require risk assessment studies to be performed and pollutant concentrations to be mitigated.

The current regulations on soil contamination refer both to the sensitive and less sensitive use of land, described as follows:

- The sensitive use of land is the use of land for residential and recreational areas, for agricultural purposes, as protected or sanitary areas under a restrictive regime, as well as parcels of land foreseen to be used in the future as described above;
- The less sensitive use of land includes all the existing industrial and commercial uses, as well as parcels of land foreseen to be used in the future as described above.

The results of the analyses run on the recovered soil samples were compared to the maximum allowable levels imposed for the less-sensitive use of land, taking into account the fact that there is no known intent for a change of land use, other than industrial or commercial, relative to the subject property. Soil analytical results for the F1-F6 boreholes are presented in Table 1 and samples with exceedances of thresholds values are highlighted in red (for intervention threshold) or blue (for alert threshold). The soil analytical results revealed some significant concentrations for the chosen parameters, as follows:

- Three samples, two collected from the borehole F1, at depths of 2 and 3 meters, and one collected from borehole F6, at a depth of 3 m, revealed concentrations of total petroleum hydrocarbons (TPH) above the intervention threshold;
- One sample collected from the F4 borehole, at the depth of 3 m, revealed a concentration of copper above the intervention threshold;
- One sample collected from the F2 borehole, at the depth of 3 m, revealed a concentration of copper above the alert threshold.

No exceedances of the threshold concentrations were recorded for the other samples. According to the applicable legislation (MO no. 756/1997), the exceedance of the intervention threshold indicates a significant soil pollution, in which case it is necessary to implement soil remediation measures. The analytical results of the groundwater chemical parameters are presented in Table 2. The measurements values were compared to the applicable Romanian standard as L no. 458/2002 regarding the quality of drinking water (modified by L no. 311/2004). Samples with exceedances of thresholds values are highlighted in red (for intervention threshold) or blue (for alert threshold).

Table 4. Phase III ESA – Analytical results

Sample Identification	Sampling depth (m)	Analysed parameter					
		TPH (mg/kg dry matter)	Fraction (%) C10-C14	C14-C20	C20-C26	C26-C34	C34-C40
SP1/1 m	1	4,562.00	35	55	10	<5	<5
SP1/2 m	2	5,525.00	35	55	10	<5	<5
SP1/3 m	3	8,066.00	35	55	10	<5	<5
SP2/1 m	1	7,112.00	20	55	25	<5	<5
SP2/2 m	2	1,379.00	45	45	10	<5	<5
SP2/3 m	3	2,350.00	45	45	10	<5	<5
SP3/1 m	1	36.23	50	50	<5	<5	<5
SP3/2 m	2	471.00	25	45	30	<5	<5
SP3/3 m	3	1,442.00	30	55	15	<5	<5
SP4/1 m	1	37.18	<5	100	<5	<5	<5
SP4/2 m	2	75.23	<5	90	10	<5	<5
SP4/3 m	3	3,494.00	30	65	5	<5	<5
SP5/1 m	1	140.00	10	70	20	<5	<5
SP5/2 m	2	56.39	<5	90	10	<5	<5
SP5/3 m	3	1,687.00	25	60	15	<5	<5
SP6/1 m	1	51.24	20	75	5	<5	<5
SP6/2 m	2	2,737.00	15	75	10	<5	<5
SP6/3 m	3	6,804.00	15	75	10	<5	<5
SP7/1 m	1	59.73	<5	90	10	<5	<5
SP7/2 m	2	43.18	<5	100	<5	<5	<5
SP7/3 m	3	359.00	15	80	5	<5	<5
SP8/1 m	1	127.00	<5	100	<5	<5	<5
SP8/2 m	2	174.00	5	95	<5	<5	<5
SP8/3 m	3	129.00	5	90	5	<5	<5
SP9/1 m	1	<25.00	<5	<5	<5	<5	<5
SP9/2 m	2	30.29	<5	100	<5	<5	<5
SP9/3 m	3	6,699.00	45	50	5	<5	<5
SP10/1 m	1	540.00	10	80	10	<5	<5
SP10/2 m	2	161.00	10	85	5	<5	<5
SP10/3 m	3	88.73	<5	95	5	<5	<5
SP11/1 m	1	27.87	<5	95	5	<5	<5
SP11/2 m	2	99.75	<5	95	5	<5	<5
SP11/3 m	3	245.00	<5	95	5	<5	<5
SP12/1 m	1	96.41	5	90	5	<5	<5
SP12/2 m	2	<25	<5	<5	<5	<5	<5
SP12/3 m	3	<25	<5	<5	<5	<5	<5
SPx/1 m	1	133.00	25	65	10	<5	<5
SPx/2 m	2	8,476.00	20	55	25	<5	<5
SPx/3 m	3	4,921.00	20	55	25	<5	<5
Normal value		*<100*	-	-	-	-	-
Alert threshold		*1,000*	-	-	-	-	-
Intervention threshold		*2,000*	-	-	-	-	-

The analytical results for groundwater revealed exceedances of the maximum allowable concentrations for the some of the chosen parameters, as follows:

- The maximum allowable concentration for chemical oxygen demand (CCO-Mn) was exceeded in 2 samples;
- The maximum allowable level for turbidity, and total hardness, and ammonium were exceeded in all samples;
- The maximum allowable concentrationfor TPH, as compared with the Dutch standards, was exceeded in F6.
- Several conclusions can be drawn as regards the analytical results for the groundwater samples:
- The exceedances of the limits for CCO-Mn and Ammonium, which further reflect into the turbidity values, reveal high concentrations of organic matter in the first
- Aquifer, which may be a consequence of the inappropriate waste water in the nearby residential area;
- The values for total hardness indicate the high presence of calcium and magnesium ions; however, compared to the Romanian standard for water aggressiveness, the concentrations of magnesium lower than 200 mg/l reveal the fact that water in the three monitoring wells are very low aggressive over concrete;
- The Romanian regulation for the quality of drinking water Lno. 458/2002 does not stipulate a maximum allowed concentration for petroleum hydrocarbons, therefore any presence of this chemical parameter is considered to be a contamination of the aquifer; according to the Dutch standards, the TPH concentration exceeds the maximum allowed limit of 0.6 mg/l.

However, comparing the analytical results with specific maximum allowable concentrations of drinking water is slightly forced, given that it is expected that water from aquifers is not drinking water. Soil remediation measures are required to decrease the concentration of TPH below the intervention threshold stipulated by the Romanian legislation. There was no question of continuing soil investigations and decreasing the concentration of Copper, taking into account that in the interested area could be presented higher concentrations of Copper than normal due to prolonged use of the harbour for loading/unloading ore.

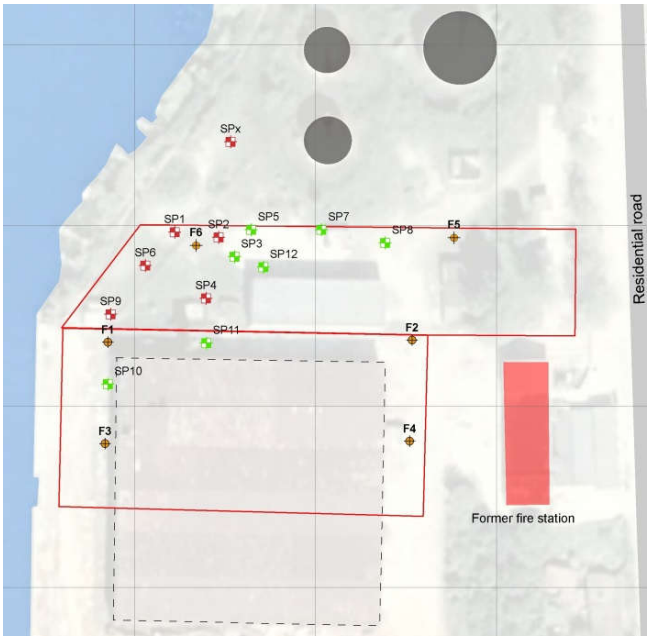


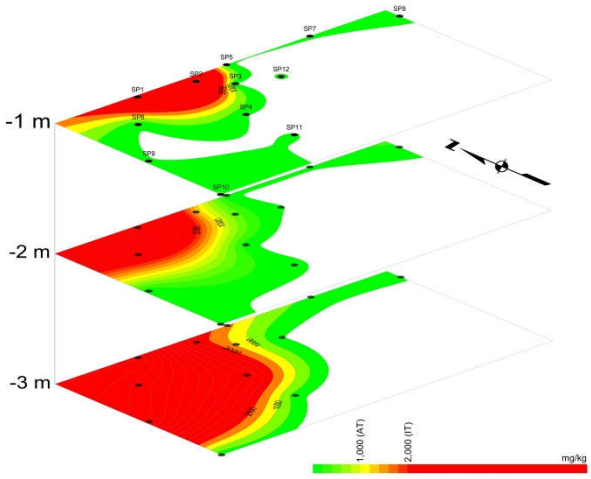
Figure 4. Sampling pits locations map

Phase III ESA: The previous step of the environmental assessment revealed a contaminated area in the north-western corner of Plot no. 1 and the south-western corner of Plot no. 2, at depths ranging from 2 to 3 m. Additional soil investigations were recommended as Phase III ESA. No additional depth for soil quality investigations were proposed because of the presence of groundwater at 3 m bgl. A Sampling Plan was proposed and consisted of recovering additional soil samples from the surfaces already identified as contaminated (in the vicinity of F1 and F6). In this respect, some sampling pits were conducted in order to give a more accurate view of the spatial extent and volume of contaminated soil. Soil samples would be collected at 1 m intervals to the depth of the groundwater table, in order to perform the proposed additional analyses. The recovered samples were analysed in order to confirm the nature and the intensity of the contamination identified during the Phase II EDD and to suggest the most suitable remediation method. Therefore, 12 on-site sampling pits were executed by an excavator to a maximum depth of 3 m, in order to obtain the necessary material for chemical analysis (Figure 4 and Figure 5). An additional excavation (SPx) was performed in the close northern vicinity of Plot no. 2, in order help to identify more accurate the source of contamination on the subject property. Soil samples were collected, recovery, preparation and labelling tasks were ensured by the consultant qualified personnel.

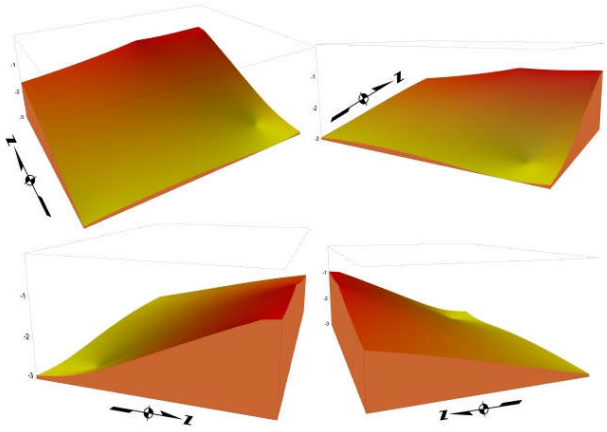
Figure 5. Digging of SP4

These activities were performed by observing the specific requirements of the national and international standards and by complying with the appropriate QA/QC measures. The bulk of the excavator was carefully cleaned after the execution of the each sampling pit. The preservation of the samples in adequate

conditions (paying more attention to cleaning of the excavator's bucketafter the execution of each sampling pit) and their transportation to the laboratory were also ensured by consultants. The main field observations on collected samples are presented in the Table 3. It can be seen that since the time of sampling, for most samples was felt the smell of hydrocarbons. Later, it was confirmed by the results obtained in the analytical laboratory. Samples were analysed using the gas chromatography (GC) method, in order to highlight the percentages of different fractions of hydrocarbons in the recovered samples. The analytical results are presented in the next table. Samples with exceedances of thresholds values are highlighted in red (for intervention threshold) or blue (for alert threshold). The analytical results for the samples recovered during Phase III ESA were graphically interpolated for a relatively accurate view of the spatial extent and volume of contaminated material (see Figures 6).



A. Horizontal cross sections of TPH contamination extent over the 1-3 m depth range



B. 3D perspectives of the extent of TPH contamination over the 1-3 m depth range

Figure 6. Horizontal cross section of TPH contamination (2D and 3D perspectives)

The analytical results based on intrusive soil investigation during Phase III ESA revealed exceedances of the legal thresholds, as follows:

- Concentrations in 11 samples, recovered from 6 of the sampling pits (SP1, SP2, SP4, SP6, SP9 and SPx) exceeded the intervention threshold for TPH, the depth of contamination being more than 3 m;
- Three 3 samples collected from 3 of the sampling pits (SP2, SP3, SP5) revealed exceedances of the AT for TPH;
- The bulk test pits (8 of 13), hydrocarbons concentration increases with depth;
- The identified fractions of hydrocarbons range from C10-C14 to C14-C20 and C20-C26, with the highest weight in the C14-C20 fraction. Given the results, it can be deduced that the contamination consists of high concentrations of diesel fuel.

Conclusion

After three successive stages, the environmental assessment for a former industrial site located in Moldova Noua town confirmed the presence of an historical pollution with petroleum hydrocarbon. The contaminated area is situated in western side of Plot no. 2 and in the north-western corner of Plot no. 1. As the samples collected from the off-site sampling pit, located in the close northern vicinity of Plot no. 2, revealed high exceedances of the IT for TPH, it was confirmed that the source of contamination were the 3 nearby ASTs. Based on analytical results, the estimated volume of contaminated soil with hydrocarbons is of approximately 1,500 m^3, over a depth ranging from 1 to 3 m, on a total surface of approximately 700 m^2. Moreover, the groundwater table was affected through progressive infiltration of the contaminant. Soil and groundwater remediation works are required on the subject property, so the environmental assessment must be continued with Phase IV and Phase V.

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