# Final dissertation: Master of Science in Environmental Geotechnologies

## A.Y. 2021/2022

## 6th March 2023

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Environmental Health Risk Analysis according to Italian Legislative Decree no. 152/06 and Italian Ministerial Decree no. 31/2015 of a former abandoned fuel sales point.

Internship at Montana SpA

Risk Analysis is currently the most advanced support tool in the management of contaminated sites which allows for the quantitative assessment of the risks for human health and for the protection of water resources associated with the presence of pollutants in environmental matrices.

The first point for a correct application of the Risk Analysis is the development of the Conceptual Model of the Site (MCS) based on the identification of the three main elements:

- The contamination's source
- Migration paths of pollutants through environmental matrices
- The targets or receptors of contamination on or around the site.

A necessary condition for the application of the Risk Analysis is the exceeding of the Contamination Threshold Concentrations (CSC) set out in Annex 5 to Title V part IV of Legislative Decree 152/06, following which the site is defined as potentially contaminated. The final goal of the Risk Analysis will be the calculation of the remediation objectives, i.e. the Risk Threshold Concentrations (CSR).

This document constitutes the specific site Risk Analysis, pursuant to Legislative Decree 152/06 and Ministerial Decree 31/15, of a former abandoned fuel sales point, on which an environmental proceeding was active.

On 16/04/2014, in correspondence with the excavation carried out for the extraction of the tank farm, a situation of potential contamination was found due to the exceeding of the CSC pursuant to Legislative Decree 152/06 and a notification was therefore sent to the Competent Public Authorities ("PP.AA.").

Subsequent environmental investigations carried out for the characterization of the site (surveys, piezometers and soil gas probes) confirmed the presence of exceedances of the reference CSC relating to the soil samples taken on site. Specifically, the presence of Aromatic Hydrocarbons (Ethylbenzene, Toluene and Xylenes), Aromatic Organic Summation, Light Hydrocarbons C≤12, Heavy Hydrocarbons C>12, Lead, MtBE and EtBE emerged.

The results of the periodic monitoring of groundwater have shown exceeding of the reference CSC for the parameters Aromatic hydrocarbons (Benzene, Ethylbenzene, Toluene, Styrene and p-Xylene), total hydrocarbons expressed as n-hexane and MtBE. Following this evidence, emergency safety measures (MISE) were activated from September 2018, initially through low-flow forced manual purges from all the wells, and subsequently carrying out this activity from the wells identified as PoC (Points of Conformity) starting from January 2019, with a fortnightly frequency, in order to contain and mitigate the contamination detected. In November 2019, a remediation project was proposed which provides for the execution of a supplementary survey, the construction of a pumping and treatment plant for groundwater in the public sewer (Pump&Treat) and the introduction into the groundwater at the PZ6 compliance point of slow oxygen release compounds ("ORC").

The supplementary investigations and the periodic monitoring of the groundwater confirmed the presence of exceedances of the reference CSC for the soils in both the deep soil compartment and in the groundwater.

In this regard, the Site Risk Analysis was drafted - specification that will be described in the following document in order to update the Conceptual Model of the Site (MCS) and implement a Phase 2 Remediation Project. The Risk Analysis has highlighted that the Site is "contaminated" pursuant to current legislation in relation to the groundwater sector of the POCs and for this reason the safety measures will continue until the implementation of the phase 2 Remediation Project.

**Dr. Antonio Carafa**

Specific site health risk analysis according to Italian Legislative Decree no. 152/06 of an industrial plant under redevelopment
Internship at Ramboll Italy s.r.l.

This document represents a Risk Analysis pursuant to Legislative Decree 152/06 and subsequent amendments for the surface soil and deep soil matrices for an industrial plant under redevelopment.

The area under examination, has been the subject of environmental proceedings since 2011. A site-specific (HHRA)had already been approved by the authorities in 2013, which highlighted the absence of health and environmental criticalities for the site's environmental matrices.

The results of the previous studies and investigations, as well as the supplementary investigations carried out by Ramboll Italy as part of the site characterization preliminary to an environmental Due Diligence activity, made it possible to define the state of the environmental matrices in the area under examination, as well as to define the site-specific parameters necessary for the definition of a reliable conceptual model of the site. The results of these activities found potential contamination of the surface soil and deep soil matrices, with exceedances of the reference CSCs for the parameters: Light Hydrocarbons C<12, Heavy Hydrocarbons C>12 and Zinc.

Based on the results of the investigations conducted on the site, this Risk Analysis was implemented to identify the values of the Threshold Risk Concentrations (CSR) for the potential contaminants detected in the shallow soil and deep soil matrices. The future scenario was also considered, which foresees a redevelopment of the (currently disused) plant for new industrial activities.

The study was developed in accordance with the indications defined in “Criteri generali per l’analisi di Rischio sanitario ambientale sito-specifica”, Annex 1 to Title V of Part Four of Legislative Decree 152/06. Reference was also mainly made to what is reported in the ISPRA document "Criteri metodologici per l'applicazione dell'analisi assoluta di rischio ai siti contaminati" (March 2008 - Rev. 2), to the APAT document "Documento di riferimento per la determinazione e la validazione dei parametri sito-specifici utilizzati nell’applicazione dell’analisi di rischio ai sensi del D.Lgs 152/06".

The study under examination included the following operational phases

- definition of conceptual model of the site;
- definition of the geometry of the contamination source and estimation of the site-specific parameters;
- identification of the indicator pollutants and the corresponding chemical-physical and toxicological properties;
- estimation of exposure parameters;
- application of the Risk-net calculation model, version 3.1.1pro, at level 2;
- verification of outputs, analysis and commentary of results.

**Dr. Isabella Faragò**

Environmental characterization plan of decommissioned quarry area

Internship at TERRA & OPERE S.R.L. Società d'Ingegneria

The environmental legislation about polluted sites is ruled by D.Lgs 152/06.

The technical-amministrative process to value the contamination phenomenals of “potentally” polluted sites, begins, after having established the presence of heavy metals in environmental matrices in concentrations higher than Csc from Tab.1 and 2 All. 5 Part IV from D.Lgs 152/06, with the drafting of the “Charaterization Plan”.

The Characterization Plan is only the first of three projectual steps about an environmental remediation process, which is identified in all the activities which allow the reconstruction of contamination phenomena charged to environmental matrices, with the purpose to obtain information for the possible environmental safety and/or the final environmental remediation.

It is a preparatory study activity, performed on site, with a data collection about pollution phenoma, which is followed by the elaboration of a Final Conceptual Model, like a tool used for drafting the operating environmental remediation project.

The drafting of a Charaterization Plan is the object of this paper, carried out during the training internship period at “Terra& Opere S.rl.”, under the guidance of Dott. Gabriele Paolini.

During this period, I had the opportunity to appreciate the environmental consulting, through the realization of a disused quarry area’s Characterization Plan, which has become after many years an illegal landfill, with all kinds of waste.

The first phases of this work have enclosed the historic reconstruction of the activities conducted on the site, by preliminary investigations analysis; subsequently Conceptual Model has been developed and environmental investigations plan has been arranged, with the goal of characterizing the waste found and investigating the environmental status of soil, subsoil, surface and ground waters.

The first step of the Characterization Plan finished with the presentation of the results to the competent authorities.

The environmental remediation is required if the environmental matrices contamination, is higher than CSC, identified with the preliminary investigations plan and if the contaminants concentration will exceed the CSR, rated with the application of risk analysis procedures.

**Dr. Roberto Villani**

Technical report updating the prevention and safety measures - former fuel sales point

Internship at GOLDER ASSOCIATES

This paper reports the results of groundwater monitoring activities for the year 2022 of a former fuel sales point. The past activity of the Site was the distribution of petroleum products for transport, with temporary storage of fuel inside underground tanks (this activity ended in 2004). The chemical analysis on soils and groundwater have highlighted exceedances of CSCs for hydrocarbons, PAHs, SOAs, ethers and metals, with the presence of supernatant product. It was therefore necessary to adopt prevention and safety measures that are still active. These measures consist of a "P&T" pumping system downstream of the hydrogeological site, recovery of supernatant product and groundwater monitoring. The results of the monitoring activities show over the years a stable contamination situation and that the P&T system has managed to contain the contamination of the Site; this consideration is also valid for the results of the year 2022 monitoring.

The Site is waiting for the Authorities to approve the Single Reclamation Project prepared by Golder.

The potential technologies considered for the remediation of the Site are the injection of reagents, specifically the use of a reagent based on activated sodium persulfate and calcium peroxide with manual recovery of the product. The P&T system would be temporarily deactivated, being incompatible with the injection of reagents, and could be reactivated if the remediation targets were not met.