CONTRIBUTION OF MAJOR SITES REMEDIATION ON THE TECHNICAL PRACTICES CONCERNING CONTAMINATED SOILS AND GROUNDWATER

Special session n° SpS20

I. REMEDIATION OF « TRAPÈZE » AND « SEGUIN ISLAND »: WHAT'S UP?

A.DEGRAEVE, G.POUILLE, E.REYNAUD (RENAULT)

I.1. Description

I.1.1. Situation

The RENAULT site "Trapèze and Seguin Island" is located in the middle of an urban zone, along the river Seine (*Fig.1*). It covers approximately 50 hectares.

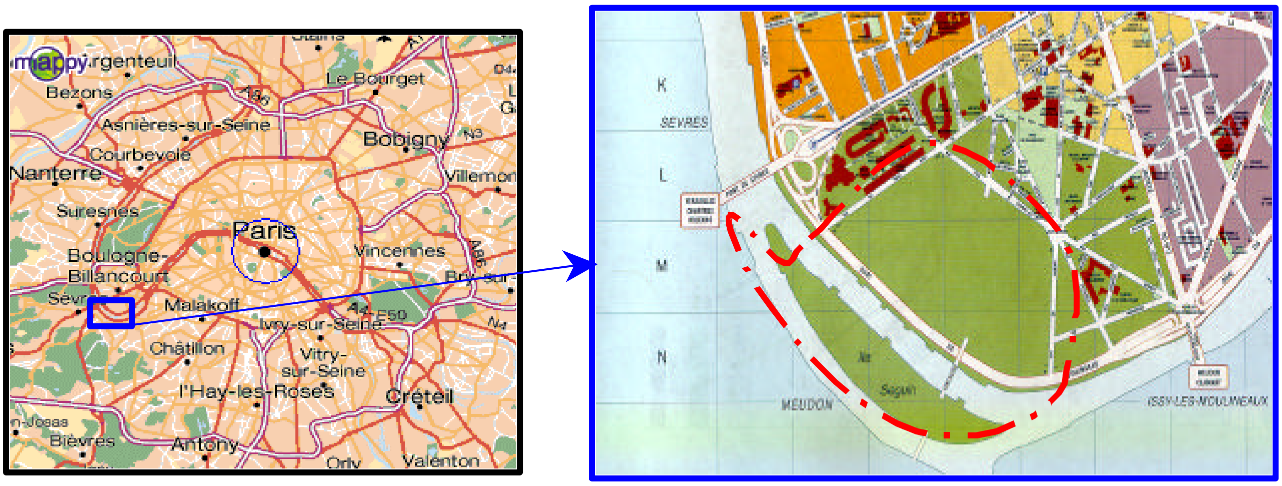

Fig.1: Situation near Paris, in an urban zone

I.1.2. Method

The industrial activities ceased in 1992. Since 1995, many studies have been performed in order to know as much as possible about soil conditions and groundwater quality.
RENAULT followed the French governmental methodological guide for polluted soils.
First of all, ANTEA realised historic studies on different parts of the site.
These historic studies permitted to target risk area for investigations (soil tests, monitoring well and soil gas tests) and in order to have a homogeneous coverage (*Fig.2*).

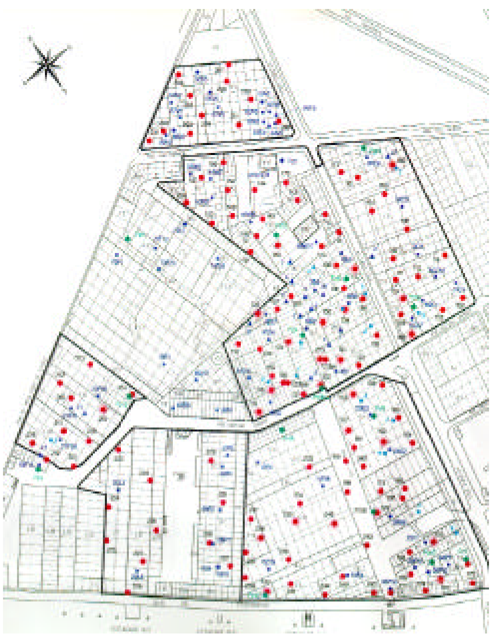

Fig.2: First investigations according to historic studies

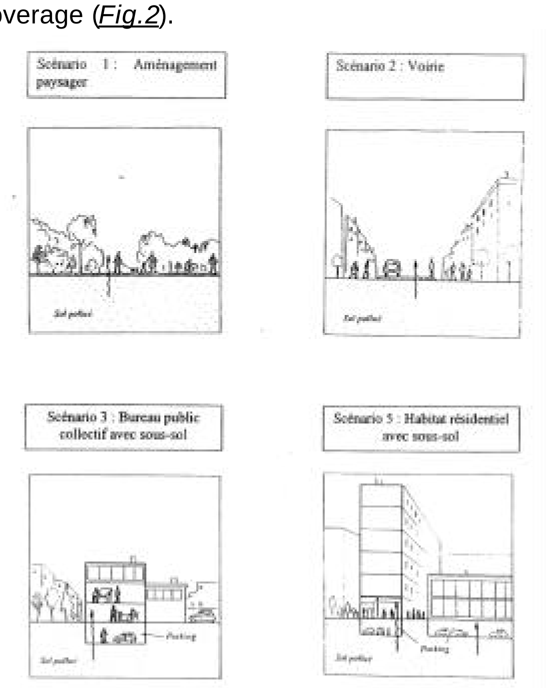

Fig.3: Four scenario for future urban site

The results of these diagnostics allowed us to realise DRAs (Detailed Risk Assessment) which took into account the four main scenarios considered for the development of the site (*Fig.3*).
These DRAs led to determine the clean-up level for the different substances potentially present on the site, which were then considered by the authorities as regulatory clean-up target. Subsequently, we obtained several “arrêté préfectoral” which imposed maximum pollution levels.

I.1.3. Complete diagnostic

To obtain a better knowledge of the soil conditions, RENAULT decided to complete soil testing by carrying out borings every 100 m² (*Fig.4*).
This investigation network allows the remediation companies to be more precise in the prevision of excavation plans and quantities of polluted soils. But the main reason for that extensive investigation (more than 5000 borings) is a better knowledge of soil conditions to avoid litigation in the future. This large database will permit to chose the best location for different sensitive uses (hospital, nursery, school…) and also simplify the work of master planners and builders.

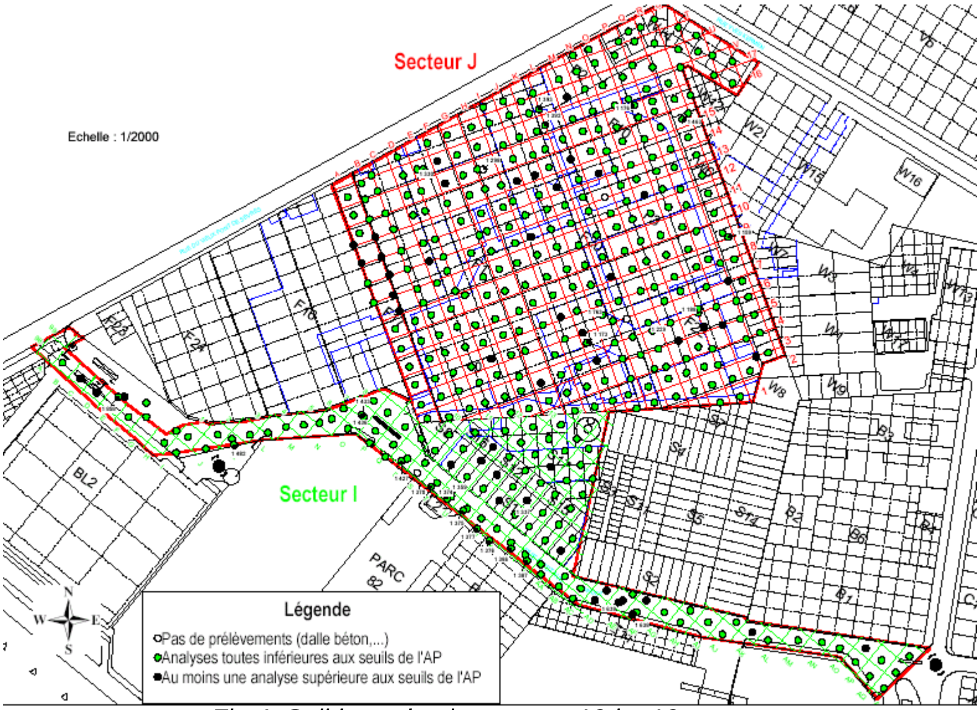

Fig.4: Soil investigations every 10 by 10 meters

In total, almost 5 000 borings have been performed on the site.

I.1.4. Remediation characteristics

The main method of remediation is excavation and off-site treatment, because its efficiency and fiability are higher. But in situ and on site remediation are also carried out where access was difficult.

The table below represents all soil moved during the remediation period:

Surface	Duration	Quantities	
20 hectares	2 years	Excavation	Evacuation
		353 000 tons	145 000 tons

I.2. Difficulties in dealing with big sites

I.2.1. Complex and iterative studies

Due to the size of site and the schedule of demolition, the site was cut into several zones. This breakdown explains the numerous studies that had to be done on this site. These studies or DRAs led to the obtaining of four “arrêté préfectoral” for the Trapèze and one for Seguin Island.

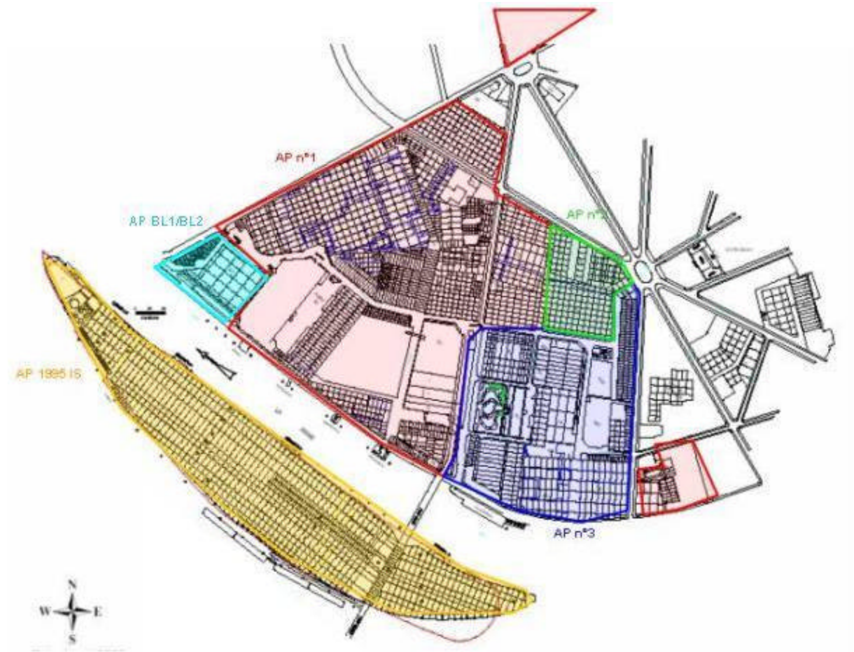

Fig.5: Several “arrêté préfectoral” covering the entire site

The surface covered by the first “arrêté préfectoral” obtained on the Trapèze (2002) was so important that it had been divided into six zones according to the schedule of demolition and liberation. For each zone, when remediation is achieved, the local authority delivers for each zone an official notification what leads to multiply administrative procedures.

Fig.6: The six zones composing the first “arrêté préfectoral”

I.2.2. Quality control

A specific procedure for quality control has been put in place, including on site laboratory. That's mean dedicated competences on chemical analyses which allow more flexibility and shorter notice decision.

Fig.7: Procedure of quality control

I.2.3. Air and water monitoring

Atmospheric tests are carried out by an independent specialist. It consists of taking samples of air from different points in the zone (*Fig.8*), of analysing and comparing them to an initial base line and to toxicological reference values.

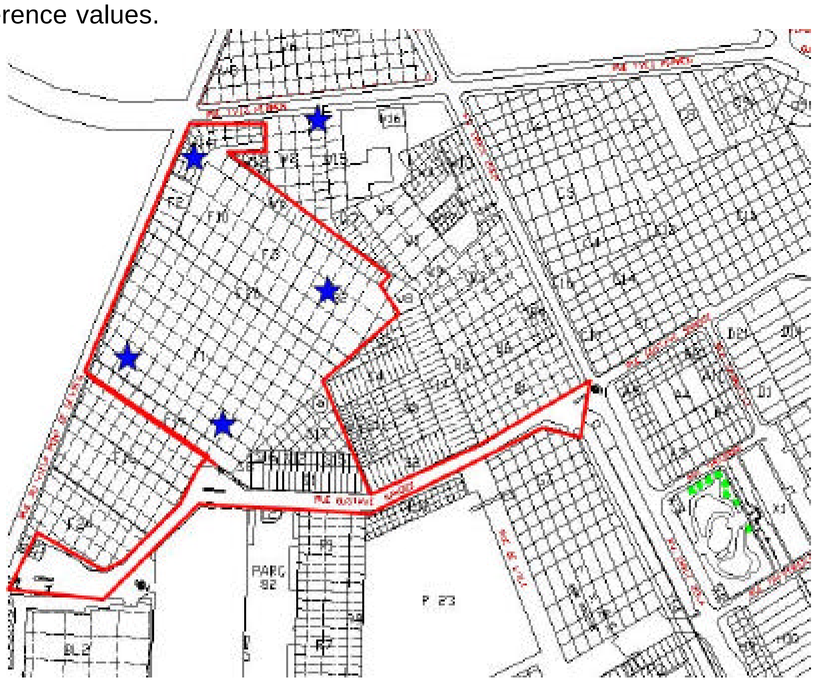

Fig.8: Air surveillance on a remediation zone

The groundwater is also regularly monitored, during excavation works but also on the entire site. Indeed, several surveillance networks exist on the site. The duration of the remediation works allow the realization of a over time diagnosis on top of a special one, which permits us to use average measures that are more representative of sub-chronic risks evaluation and of the real condition of the groundwater.

Fig.9: The administrative water surveillance

The results of all these monitoring are transmitted to the local authority at regular frequencies.

I.2.4. Traceability and data management

As this is a large operation which covers a significant period of time (approximatively 15 years for demolition-remediation), a large quantity of data has to be gathered and stored.

ANTEA realized a data base of all data collected on the site: soil tests, monitoring well, soil gas tests…According to this data base, ANTEA manage to create map of pollution presence by substance and depth.

RENAULT has also created a documentary data base (*Fig.10*). It includes all technical notes, studies, maps, correspondence, reports, administrative documents, etc… emitted by every different person involved in the project. Traceability of facts and data is a key issue for such large project involving high liability over time.

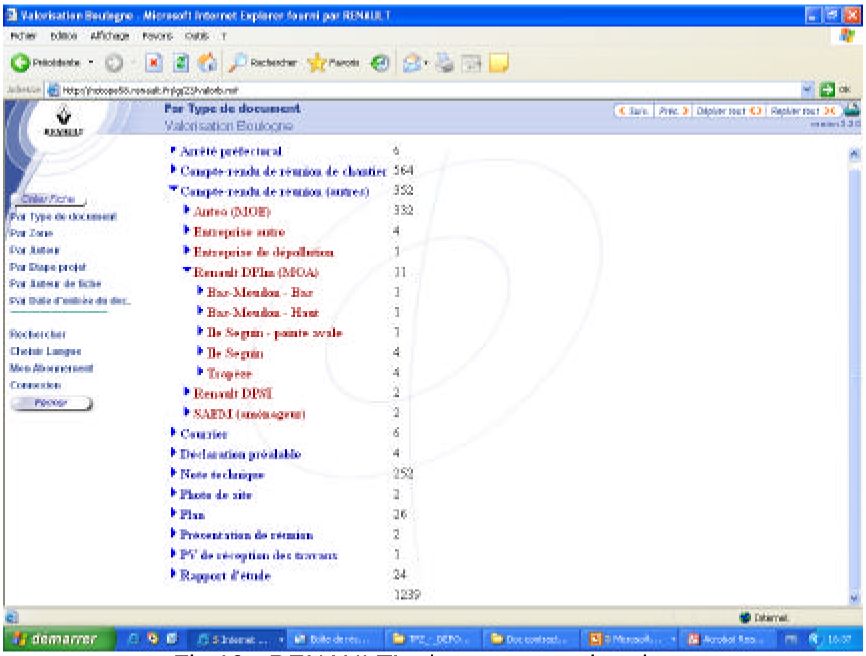

Fig.10 : RENAULT's documentary data base

I.2.5. Communication

This large operation involves many stockholders: ex-workers and employees of RENAULT, neighbours and local residents… Indeed, communication around the project is very important, as much internally to RENAULT as externally.

Internal communication consists of:

- exhibition of explicative panels on the site,
- distribution of explaining comic strip,
- information in CHSCT (Hygiene, Security and Work conditions Committee) and social partners.

As regards to external communication, we can distinguish two types:
Administrative:

- Presentation of DRAs in CDH (Hygiene Departmental Comity) in order to obtain prefectoral orders
- Meeting with Prefecture, Associations, Public authorities… every year.

Public communication:

- Interview with journalists (articles, photos, film…)
- Professional communication for forums and seminars
- Internet site with explaining cartoons

www.developpement-durable.renault.fr

⇨ Les sites ⇨ Politique Environnement ⇨ Les sols

Les sols : une animation pédagogique
pour comprendre la démarche
et mieux appréhender les deux cas
concrets de Dacia et du Trapèze.
Cliquez ici pour accéder à l'animation

Le site de Dacia (Roumanie) :
mise en sécurité d'un site industriel en activité.
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Le site du Trapèze (Boulogne -Billancourt, France) :
reconversion d'un site industriel en zone résidentielle.
Cliquez ici pour accéder à l'animation

II. METHODOLOGY FOR THE CHOICE OF TRV

R.PECCI, L.ROUVREAU (ANTEA), E.REYNAUD (RENAULT)

II.1. Context

The Toxicological Reference Values (TRVs) used for the Detailed Risk Assessments (DRAs) have been established by internationally acknowledged organisms such as the US-EPA (Environmental Protection Agency), the ATSDR (Agency for Toxic Substances and Disease Registry) or the WHO (World Health Organisation). These values are based on the results of experimental or epidemiological studies. Hence, the TRVs are bound to be regularly challenged with the most recent results of toxicological research, which generally lead to more conservative value.

It should be noted that the TRVs are essential to the DRA studies : in fact, risks associated with the exposure to a given substance are directly linked with the concentrations at the exposure area (calculated or measured), and the TRVs.

For toxic substances, the hazard ratio (HR) can be expressed as the following :

$$HR = \frac{C_{EA}}{TRV}$$

where : C_{EA} is the concentration at the exposure area of the considered substance (mg/m^3),
TRV is the toxicological reference value (for the toxic aspect) of the considered substance (mg/m^3).

For carcinogenic substances, the individual excess risk (IER) is expressed as the following :

$$IER = C_{EA} \cdot TRV$$

where : C_{EA} is the concentration at the exposure area of the considered substance (mg/m^3),
TRV is the toxicological reference value (for the carcinogenic aspect) of the considered substance (mg/m^3).

A remediation site such as the “Trapèze” in Boulogne-Billancourt (92) extends on a large time-scale : remediation has started in 2002 and is expected to continue until 2007. Remediation targets have been established zone by zone, according to the accessibility of each zone and the results of the various DRAs (on the basis of the available toxicological data at the time of the study). When dealing with such a site, the issue of TRVs evolving with time becomes crucial.

II.2. Selected approach

The approach that has been selected in the context of the Trapèze remediation site is the following:

- constantly monitoring the evolution of the various TRVs for all substances identified on the site, on the basis of the six databases proposed by the INERIS toxicological worksheets, i.e. : US-EPA, ATSDR, OMS, RIVM (Rijksinstituut voor Volksgezondheid en Milieu), Health Canada and OEHHA (Office of Environmental Health Hazard Assessment) (the first three databases being the most important, and the three others being consulted if there is no TRVs on the first three),
- undertaking a first approach study in order to estimate the pertinence of the new TRV (in respect of the ministerial methodological guide) with regards to the previously available TRVs and particularly the TRVs used in the previous DRAs,
- selecting the most pertinent TRVs for the next DRAs by a motivated choice.

The first approach study compares, for the currently available TRVs, the following aspects:

- date of the study ;
- whether the study concerns human beings (epidemiological study) or animals ;
- exposure duration ;
- considered adverse effect ;
- seriousness of the considered adverse effect ;
- establishment of a NOAEL (No Observed Adverse Effect Level) or a LOAEL (Lowest Observed Adverse Effect Level).

This approach is explained here below for two substances that have been identified on site and that are usually encountered on polluted sites: benzene and xylenes.

II.2.1. Benzene

During the first DRA undertaken at the site in 2000, no TRV for the toxicological aspect was available for benzene. As a conservative approach, the available value had been derived from the RBCA database (Risk Based Corrective Action), given for ingestion.

Subsequently, a TRV for inhalation was published by the US-EPA in 2003, which has led to considering this new value instead. The RBCA database is not one of the references proposed by the INERIS toxicological worksheets. Besides, the US-EPA value has been established for inhalation, which is the pathway selected in the conceptual model of the site.

II.2.2. Xylenes

The TRVs currently available for xylenes are presented in **Table 1** (inhalation).

Adult values (mg/m^3)	Child values (mg/m^3)	Uncertainty factor	Target organ (studied target)	Year	Study based on NOAEL/LOAEL	Exposure duration	Information source
0.1	0.1	300	Loss of coordination (rat)	2003	NOAEL	6 months	US-EPA database : IRIS
0.434	0.434	100	Multiple (worker)	1995	LOAEL	7 years	ATSDR
0.87	0.87	1000	Neurotoxicity (animal)	1997	LOAEL	20 days	World Health Organisation (WHO)

Table 1 : Presentation of the currently available TRVs and their characteristics for xylenes

The TRV that was selected for the first DRA (which has led to the remediation targets) was the most conservative at the time of the study, i.e. that from the ATSDR (0,434 mg/m^3). The publication of a new TRV by the US-EPA in 2003 has induced a first approach study.

For the next DRAs undertaken at the site, the US-EPA TRV has been selected for the following reasons :

- ➢ most recent toxicological value,
- ➢ only value based on a NOAEL (which is the base of the TRV assessment, before the LOAEL),
- ➢ non-specificity of the ATSDR study (based on the observation of an effect induced by simultaneous exposure to xylenes and other substances),
- ➢ study of the effects of xylenes alone.

II.3. Conclusion

The continuous evolution of scientifical knowledge implies the definition of a pragmatic approach for risk assessment studies, particularly when these studies concern large remediation works, which take place over a large period of time.

In the present case, the approach includes monitoring new publications and assessing the validity and pertinence of the new TRVs with regards to the previously selected ones : about 57 % of TRVS have changed since the first study.

Hence, the new TRVs are selected where appropriate for the next DRAs, particularly for the “sensitive” scenarios, when these were not accounted for in the first DRA.

III. METHODOLOGY OF ACCOUNTING FOR DETECTION LIMITS IN DRAS

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III.1. Introduction – problematics

As part of the remediation of a former industrial site where initial site investigations have shown the presence of volatile contaminants, detailed site investigations and risk assessment are required. In this case, the implemented Detailed Risk Assessment (DRA) must account for *human exposure via inhalation*.

Environmental data of the site may be collected through investigation of three potential media :

- groundwater,
- soil,
- soil air.

The first one (*groundwater*) provides information on the saturated zone, whilst the latters (*soil and soil air*) characterise the unsaturated zone.

As part of a detailed risk assessment, conservative risk calculations are generally undertaken by considering, for each substance, the most unfavourable pathway. This is equivalent to calculating the concentrations at the exposure area of each medium, then considering that the target is exposed to the highest of the three concentrations.

This approach becomes limited for a given pathway/medium and a given substance where no concentration at least equal to the detection limit has been measured, whilst its presence is strongly suspected by the site history.

In this case, one of the aspects to be considered is whether undertaking risk calculations is relevant :

- either by considering, for this pathway, the laboratory detection limit of the substance,
- or by removing this substance, for this pathway, from the risk calculations (which is equivalent to considering its absence from the given medium).

But, in the first case (considering the laboratory detection limit of the substance), the calculated risk may be strong, and either not acceptable (especially for toxically volatile substance as vinyl chloride). In this case, the management of the polluted site becomes difficult.

The decision of maintaining or not the detection limit for risk calculations (for each substance and each pathway) is related to the impossibility of assessing the absence of a substance in the ground with certainty when :

- historical review show that its presence is probable,
- investigations results cannot definitely conclude on this matter (the laboratory of analyses gives a result in terms of exceedance of a threshold, which is named detection limit and defined as different from zero ; however this threshold can vary from one laboratory to another).

III.2. Suggested approach

III.2.1. General approach

As a first stage, it can be distinguished between :

- the "saturated" zone, whose environmental state can only be characterised via analyses on groundwater samples. This medium will therefore always be considered in risk calculations.

- the “unsaturated” zone, which will be characterised via the medium (i.e. soil or soil air) deemed as the most relevant with regards to detection limits.

The choice of the pathway (in relation with the detection limits) and the decision to account (or not) for the detection limits, or possibly decrease their “weight” in the risk calculations is comprised in the following methodology :

- ✓ calculate the concentrations, in the soil medium, equivalent to each soil air detection limit,
- ✓ compare (for each substance) the equivalent concentration in the soil with the measured soil air concentration (both pathways characterising the unsaturated zone),
- ✓ compare (for each substance) the representative pathways to be investigated,
- ✓ consider the possibility of decreasing some laboratory detection limits,
- ✓ decide whether to account for the detection limits in the risk calculations for each pathway, or not.

III.2.2. Examples of application of this methodology

EQUIVALENT CONCENTRATIONS AND ASSESSMENT OF THE DL RELEVANCE

As an example, Table 2 shows the equivalent concentration in soil air calculated with the detection limit of vinyl chloride. The equivalent concentration is calculated with the equation describing the balance between the three phases in the ground (classic soil characteristics have been selected).

Substance	**Soils**	**Soil air**
Laboratory detection limit	**0,05 mg/kg-DM**	**0,1 mg/m3**
Equivalent concentration of vinyl chloride (mg/m^3)	126,8	0,1

Table 2 : Equivalent concentrations calculated in soil air –example for vinyl chloride

Hence, at the same depth and for given soil characteristics, the detection limit of vinyl chloride in soils (expressed as the equivalent concentration in soil air) is approximately 1250 times above the laboratory detection limit in soil air. This implies that the risk calculation based on the detection limit for soils leads to a 1250 times higher risk in comparison with that based on the detection limit for soil air… which can be extremely unfavourable for some exposure scenarios, even though the presence of the substance at such concentrations has not been demonstrated.

This example shows that, for one same substance, the choice of the investigated medium and its related detection limit can strongly influence risk calculations. It then becomes relevant, if the substance has not been detected in one of the media (at concentrations at least equal to the detection limit), to try and find it in the other medium. This will allow :

- either the confirmation that the substance is absent from the unsaturated zone, or a better quantitation of this substance (if it is present), for instance by soil air measurements,
- or, finally, if the laboratory may provide with this possibility, to account for this substance but at a lower (and therefore less unfavourable detection limit with regards to the risk calculations).

HELP GUIDE TO THE CHOICE OF MEDIA AND WHEN ACCOUNTING FOR DETECTION LIMITS

Following further detailed investigations, during the Detailed Risk Assessment, the decision to account for the detection limit may be based on the elements indicated in Table 3.

<table>
<tr><th colspan="3">Site data – Presence of the substance in the various media</th><th colspan="3">Concentrations selected for the risk calculations for each pathway</th></tr>
<tr><th>Ground water</th><th>Soil</th><th>Gas</th><th>Groundwater</th><th>Soil</th><th>Gas</th></tr>
<tr><td>Value</td><td>Value</td><td>Value</td><td rowspan="2">Gas concentration calculated from the groundwater value</td><td rowspan="3">Gas concentration calculated from the soil value</td><td>Measured gas concentration</td></tr>
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DL : detection limit

Table 3 : Methodology for the selection of detection limits in risk calculations

IV. MAJOR BROWNFIELDS: DEVELOPMENT OF A GUIDE LINE FOR THE HEALTH RISK ASSESSMENT ON LOCAL POPULATIONS DURING THE ACTUAL REMEDIATION OPERATIONS

B.HAZEBROUCK (INERIS), V.GROSSHENNY (COLAS)

IV.1. Introduction

The health risk assessment on local populations during the actual remediation of brownfields is key to a responsible management and to the acceptance of that site management by the surrounding populations. Although the responsibility for actual health impacts on the population is clearly covered by the French regulation, there are, currently no technical guidelines available in France or in Europe for that assessment:, the involved parties to the cleanup have to develop their own approach, which does not necessarily fit in their core competencies.

COLAS Environnement et Recyclage, which has been active in brownfield cleanup for many years, and the INERIS Institute, specialized in risk assessment and mitigation of industrial activities, launched a joint R&D project aiming at developing a guideline for such assessments.

We briefly present here the current state of this ongoing study and of its preliminary results. This presentation will be introduced by the case of the former Renault auto plant cleanup in Boulogne Billancourt; this project was carried out independently from and mostly prior to the COLAS-INERIS R&D project: in the absence of relevant guidelines, this relatively advanced experience of monitoring and management of the impacts of the cleanup operations illustrates well the questions and difficulties that may arise.

IV.2. Case of the cleanup of the Renault former auto plant in Boulogne Billancourt

The cleanup of the Renault former factory in Boulogne Billancourt takes place in a very urban area, in a time frame of about 10 years. The INERIS is involved in the cleanup as a critical reviewer on the environmental aspects of the cleanup. COLAS Environnement et Recyclage is marginally involved in the Renault site, and not at all in its monitoring. In its cleanup consent order ("Arrêté Préfectoral"), the local arm of the national administration prescribed the following for the protection of the neighboring population:

- "In the areas susceptible of emitting toxic, odorous, noxious, or inflammable substances during cleanup operations, a monitoring of the atmosphere shall be implemented."
- "It is forbidden to emit fumes, steam, soot, dust, odorous, toxic or corrosive gazes which can inconvenience the neighborhood and harm the Public's health or safety, and the environment. (...).
- In the case of detection of substances at dangerous concentrations in the atmosphere, the operations are immediately stopped and the necessary measures are applied (...)."

No other precision is given in the consent order, for example on the phrase "dangerous concentrations", nor in any guide in France.

As a general prevention measure, Renault favored an off-site treatment of the excavated contaminated materials, so as to limit their handling on the site.

The air monitoring was organized at the various locations of the huge Renault site (several hundred acres) where cleanup activities were conducted. Communication with the neighboring population was organized through a quite formal "Local Information and Monitoring Committee" (*Comité Local d'Information et de Suivi*: CLIS) which meets about twice a year under the authority of the county executive ("Sous-Préfet").

The two firms in charge of the sampling and of the analyses controlled occupational employees' exposure, with procedures and detection limits based on the regulatory occupational exposure limits. These limits however (typically around 0,1 to 1 mg/m^3 for metals such as nickel, arsenic or lead), are much too high for a conclusive assessment of the impacts of the cleanup operations on air quality and on human health for the general population, with background concentrations and toxicological reference concentrations[1] lower than 1 µg/m^3. Therefore, the two firms' mission had to be reorganized: the documentation of the sampling was extended and the sampling time and laboratory testing were adjusted so as to reach detection limits under 1 µg/m^3. At those levels, artifacts may occur more easily in the measurement process, for example, due to contamination of filters or of laboratory material with metals. In the Renault cleanup monitoring, the two firms did not reassess nor correct anomalously high results which were sometimes obtained (probably mostly artifacts), as far as they did not exceed the occupational exposure limits: the results transmitted to Renault would have required more detailed quality control and data treatment, before allowing a conclusive assessment of the impacts of the cleanup ongoing operations on air quality and on human health for the general population.

It thus appears that a new culture and an experience of accurate monitoring has to be developed among engineering firms in order to allow an adequate independent control of the actual cleanup impact on a routine basis.

A Human Health Risk Assessment (HRA) of the impact of the cleanup operations was not a goal of the monitoring (and has not been performed so far): low detection limits were wished just in case such an assessment would be needed afterwards. The question of the human health impact on the surrounding population was only raised once, within the local committee, following the detection of odors. In this particular case, the accuracy of the air monitoring of organic compounds allowed a satisfactory answer in regard with the current state of the art.

Another difficulty for an accurate and fully conclusive monitoring of the cleanup's impact on the air quality is the time and space variability of the background atmospheric concentrations in an active urban area like Boulogne Billancourt bordering the Paris city limits. Is a recorded peak in the monitoring actually representative of a peak in the site's emissions or due to a traffic increase or to a change in wind direction?
A fully comprehensive air monitoring strategy, taking into account all the objectives (the workers, the general Public, and the outdoor air in general) as well as the identified difficulties, was developed in 2004 based on the site return on experience of the first two years. It is currently in an implementation phase.

All the work done on monitoring protocols, on analytical data review, on detection limits, and on the monitoring strategy in general, places the experience of the air monitoring of the actual cleanup phase on Renault's Boulogne Billancourt site among the most advanced in France.

The impacts of the cleanup operations do not involve only the air, but for instance also the groundwater, *e.g.* due to excavations in contaminated soils and/or removal of impermeable covers. This was reminded of during the Renault site cleanup: an extensive network of groundwater monitoring wells had been implemented throughout the site, and a local high groundwater contamination with chromium VI was observed in an area during the cleanup operations[2]. The impact was directly suppressed by the immediate cleanup of the spot (pump and treat).

IV.3. Presentation of the R&D project of Colas & INERIS

COLAS Environnement et Recyclage has been a cleanup contractor of contaminated sites for many years.
In Amponville, about 100 miles South of Paris, at a former sand quarry where drums of chlorophenols had been buried, the cleanup was conducted under a depressurized tent which allowed a full control of the atmospheric impact on the neighborhood. In the cleanup of a nearby site (Vernou) contaminated with hexachlorocyclohexane, other biocides and PAH, an attempt with the INERIS to asses the cleanup operation's health impact on the local general Public was hindered by such questions as too high detection limits and as the extrapolation over the distance of measured air concentrations. Those questions are not new: the problems in the site assessment merely underlined the need for a foregoing overview and thorough and detailed preparation of the assessment as a whole.

[1] derived for a 10-5 individual excess of risk (treshold usually considered in France).
[2] Actually, it is not known whether the contamination already existed before the cleanup or resulted from the cleanup operations.

COLAS Environnement et Recyclage came to the conclusion that currently cleanup contractors and their clients have to develop their own approach for the protection of the local population, which was not fully satisfactorily: such developments do not belong to their core competencies. INERIS, on the contrary, is specialized in such developments, but not directly active in cleanup projects. This is the reason why COLAS and INERIS launched a joint R&D project aiming at developing a guideline for the health risk assessment on local populations during the actual remediation phase. The project was organized in three steps:

1. State of the art of the theoretical rules and of the praxis in France and in the world;
2. Proposal for a method and for the associated guideline;
3. Test and illustration on a case study.

The project is currently (may 2005) in state 2. It is regularly reviewed by a committee gathering the points of view of the local sanitary administration, of the Ministry of the Environment, of industrials (Renault included) and environmental engineering firms.

IV.4. Synthesis of the results of the state of the art

The state of the art was searched among academical literature, public documents and personal contacts in France, the Netherlands, Germany, the USA, Canada, and in European Institutions and working groups.

The evaluation of the state of the art collected led us to distinguish two types of HRA for the general population potentially affected by cleanup operations:

- Predictive HRA based on modeling, before the start of the project, which can help adjust the cleanup concept and organization, including its monitoring strategy;
- "Monitoring HRA" based on monitoring data, which may require very short-term responses.

Besides, it was concluded that the psychological impact had to be incorporated in the thinking, if not in quantitative terms. Together with the search for efficiency, this implies that impact assessment should be pursued towards dialogue and reduction of the impact when needed: the exercise can not end up on solely identifying and describing problems, it absolutely must allow designing solutions.

Except in the USA, and to a lesser extent in Canada and in France (MATE, 1999), the cleanup operations themselves are not incorporated in the official regulations and guidelines for brownfield management, which focus on the pre-cleanup assessment and on the post-cleanup verification. The question of the human risks associated with the actual cleanup phase is mentioned in general and mostly qualitative terms. In the USA, numerous guidelines give not only the principles, but also most of the technical tools needed.

The praxis of predictive HRA for cleanup operations appeared very poor: only pieces of experiments could be reported on real sites. In France, there is a general recommendation given by a 1999 Instruction that the risks linked to the cleanup operations be assessed before deciding the cleanup action, but it is not actually implemented. Besides, the necessary technical tools (*e.g.* particulate emission factors, or VOC emission model for a <u>surface</u> source) are not always those used for brownfield detailed risk assessments commonly performed in France for cleanup decisions (*e.g.* model for VOC emission from an <u>underground</u> source): the needed tools still need to be acquired by site assessment professionals.

More practical experience could be found on "monitoring HRAs", but they seemed mostly to underline the difficulties mentioned above for the cases of Renault in Boulogne Billancourt or of COLAS in Vernou.

Furthermore, not all methods or tools used in other countries would be suitable in the French context: the need for detailed justification seems more developed in France than in many other countries, where "expert judgment", or generic emission or immission threshold values seem to be more readily accepted.

Finally, predictive HRA for cleanup operations is also hindered by the general current problems of HRA, such as the modeling of pollutant transfer to plants, or the choice of toxicological reference values.

IV.5. Outlines of the proposed guideline

Two types of instruments are proposed for the health risk assessment on local populations of cleanup operations:

- General methodological and organizational tools: logigrams are proposed for predictive HRA, monitoring HRA, dialogue with the local community and the overall site management.
- Technical tools, presented with a "user manual". The tools were selected based on their relevance for the question and on a critical review of their content. Those tools may concern "hard" technical issues like the particulate emission factors (US EPA, 1995) and the modeling of VOC emissions from a surface source (US EPA, 1996), but also "hard" technical issues such as the organization of a public meeting.

Proportionality is an essential principle to consider before developing a HRA or the public debate for the cleanup of a given brownfield. The study proposes criteria for assessing the issue and deciding the best degree of impact management.

IV.6. Conclusion

The study presented here will not propose a press-button method for the health risk assessment on local populations during the actual cleanup phases, and certainly not answer all future questions: a lesson of the state of the art is precisely the high part of site-specificity, especially when dialogue with the population is involved: spontaneous communication, direct dialogue and reactivity appear then as important ingredients of success. The study should nevertheless help cleanup contractants analyze the issues, with an appropriate and operational tool box.

V. LEGAL RISKS MANAGEMENT IN THE EXECUTION OF BIG SITES REMEDIATION

Vincent SOL (WINSTON & STRAWN)

The big sites remediation can be divided into two categories as they limit themselves either only to the property of the owner or that they concern third party property.

In the first case, the main questions concerned the management of the nuisances with the neighbourhood.
In the second case, new problems can themselves be added to the previous one (risk of media crisis, contrary owners, demand of private individual treatment, damages management).

From precise examples, the statement will show how a global management based on a meticulous preparation and a third relay strategy might minimize the risks.

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- Bardos P., Vik E., 2001. A framework for selecting remediation technologies for contaminated sites. Clarinet Final Conference. Sustainable Management of Contaminated Land. Proceedings. http://www.clarinet.at.
- E. J. Bonano, G. E. Apostolakis, P. F. Salter, A. Ghassemi and S. Jennings, 2000. Application of risk assessment and decision analysis to the evaluation, ranking and selection of environmental remediation alternatives. Journal of Hazardous Materials. Volume 71, Issues 1-3, 7 January 2000, Pages 35-57. PII: S0304-3894(99)00071-0. Elsevier Science B.V.
- CCME, 1997. Document d'orientation sur la gestion des lieux contaminés au Canada. Chapitres 8.4 et 8.5. Avril 1997.
- CLARINET, 2000. CLARINET problem catalogue. Draft. October 2000. Venice. Prepared by the Federal Environment Agency – Austria.
- COLAS, 2000: Dépollution du site d'Amponville. Novartis. COLAS Environnement et Recyclage. Cederom. 2000.
- COLAS, 2002: Réhabilitation du site: Le Moulin de Nanchon. Syngenta. COLAS Environnement et Recyclage. Cederom. 2002.
- Ferguson, C., 1999. Assessing Risks from Contaminated Sites: policies and Practice in 16 European Countries. Land Contamination & Reclamation, 1999 EPP Publications.
- INERIS, 2003. REFERENTIEL. Evaluation des risques sanitaires liés aux substances chimiques dans l'étude d'Impact des Installations Classées pour la Protection de l'Environnement. Version Projet 3.0. 30 novembre 2001. sur www.ineris.fr.
- InVS (2000). Guide pour l'analyse du volet sanitaire des études d'impact Février 2000. www.ivs.fr
- MATE, 1999. Ministère Français de l'Environnement. Circulaire du Ministère chargé de l'Environnement du 10/12/1999. Sites et sols pollués. Principes de fixation des objectifs de réhabilitation.
- MATE, 2001. Ministère Français de l'Environnement. Gestion des sites pollués : Diagnostic approfondi – Evaluation détaillée des risques. Version 0. DPPR, INERIS, BRGM. BRGM Editions. Juin 2001
- NICOLE, 1997. Nicole Opinion on Contaminated Land research. August 1997. Edité par Dr. D.A. LAIDLER.
- US EPA, 1991b. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual (Part C, Risk Evaluation of Remedial Alternatives). Interim. Office of Emergency and Remedial Response. US EPA/540/R/003. October 1991.
- US EPA, 1990a. Air/Superfund National Technical Guidance Study Series: Development of Example Procedures for Evaluating the Air Impacts of Soil Excavation Associated with Superfund Remedial Actions. US EPA-450/4-90-014. Jul. 1990 (NTIS PB90-255662/AS)
- US EPA, 1991. Air/Superfund National Technical Guidance Study Series: Emission Factors for Superfund Remediation Technologies. US EPA-450/1-91-001. Mar. 1991. (NTIS PB91-190-975)
- US EPA, 1992b. Air/Superfund National Technical Guidance Study Series: Estimation of Air Impacts for the Excavation of Contaminated Soil. US EPA-450/1-92-004. Mar. 1992 (NTIS PB92-171925)
- US EPA, 1993a. Air/Superfund National Technical Guidance Study Series: Volume III - Estimation of Air emissions from cleanup activities at Superfund sites US EPA-450/1-89-003. Jan. 1989. (NTIS PB90-180061/AS).
- US EPA, 1995. AP-42: Compilation of Air Pollution Emission Factors, fifth Edition. January 1995.
- US EPA, 1996. Soil Screening Guidance: Technical Background Document. 9355.4-17A, Washington, DC: Office of Emergency and Remedial Response, 1-168.

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