The Dutch Practice

Soil investigation strategies

Tessa Verschoor
5 October 2020

Short introduction

- This is me
- Consultant Soil and Groundwater
- Program manager Soil & Groundwater TAUW NL
  - Vision
  - Strategy
  - Innovation
  - Quality
  - Knowledge

Content

- TAUW bv
- Purpose and Goal
- Exploratory soil research
- Questions

TAUW bv

Our history

Established in Haarlem on October 13, 1928

- Water is our source
- **T**echnisch **A**dviesbureau van de **U**nie van **W**aterschapsbonden
- 1960s; TAUW expanded and added engineering consultancy to its portfolio
- 1980s; Europe became our playground as we established branches in Germany, Belgium and France and later in Italy and Spain.
- In 2018, we proudly celebrated our 90th birthday

Today, TAUW is a proud employee-owned company

European environmental consultancy firm

Turnover (2019)

€ 137.989

Employees

1.108

Offices

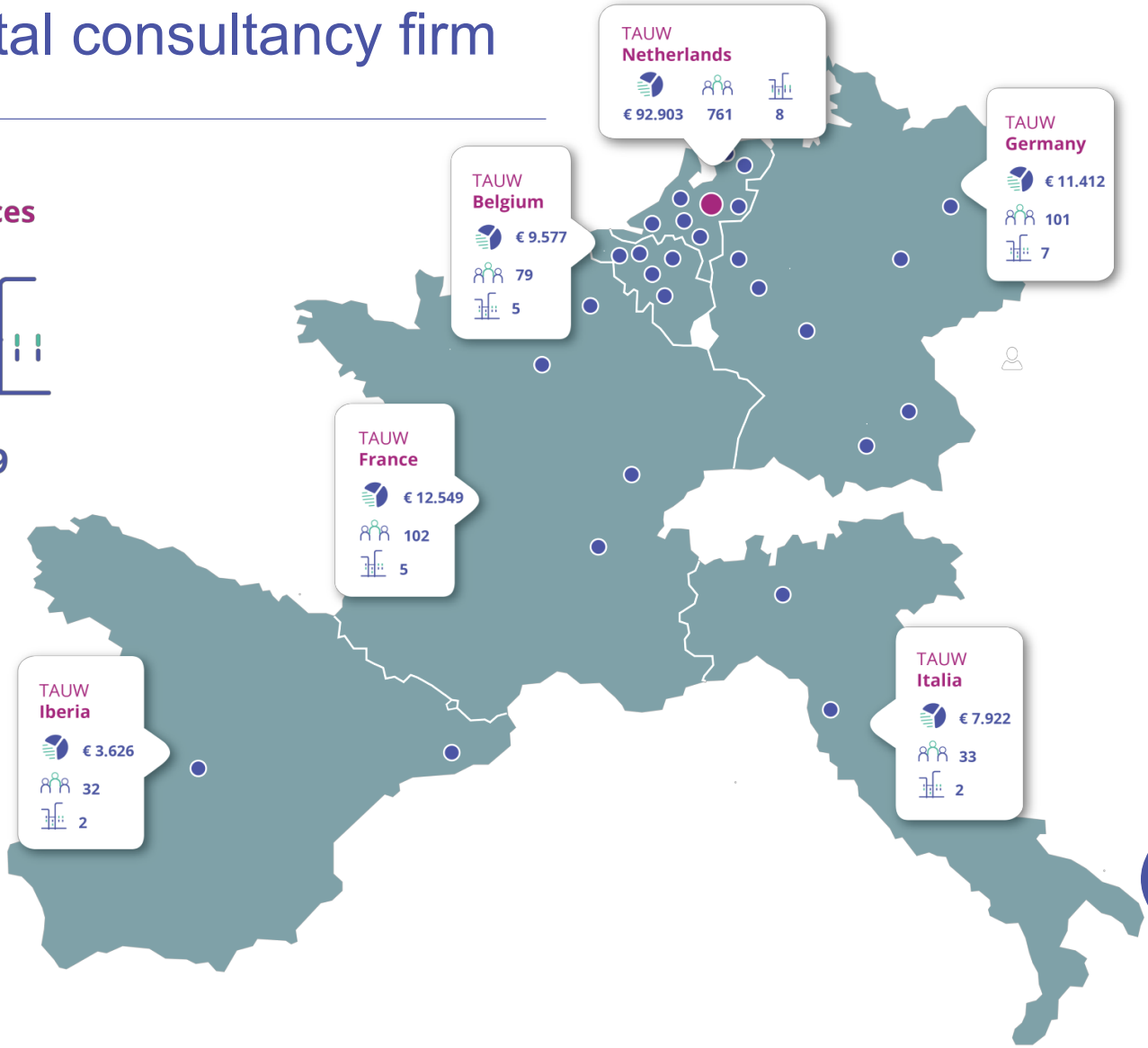
29

Employees Soil Netherlands

± 250

Employees Soil TAUW group

± 500



*Amounts 2019 in thousands

* FTE's December 2019

Our expertise

A selection of our main international expertises

- Compliance management
- Ecology
- Site development
- Environmental monitoring
- Infrastructure
- Soil & Groundwater
- Climate adaptation
- Transaction service
- Water treatment & safety

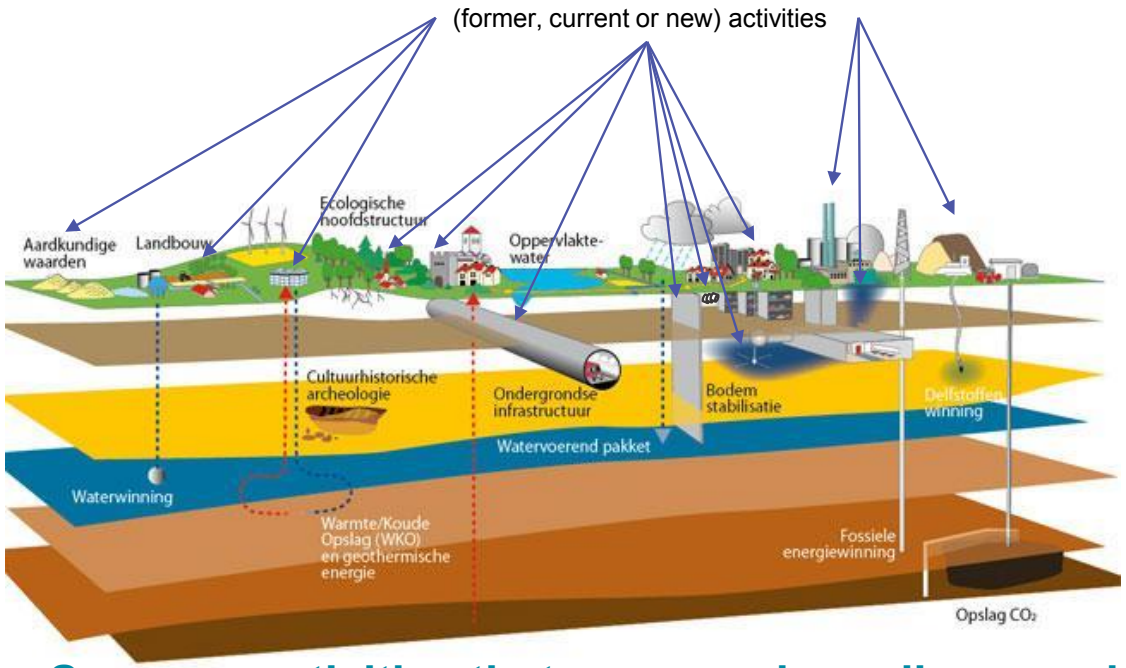
Purpose and Goal

Every investigation has a purpose and a goal

Why is investigation needed?

The purpose

Purpose	Policy
- Building permit - Order to investigate by the (local) government - Zoning plan - Underground cables and pipelines	Soil protection act
- Environmental permit	Environmental management act / Soil protection act
- A spill / leakage	Environmental management act / Soil protection act
- Soil movement	Soil quality decree
- Transaction	-



So many activities that may require soil research

No legal requirements because it's a private contract

What is it needed for?

The goal

Purpose	Goal	Remark
• Building permit • Order to investigate by the (local) government • Zoning plan • Underground cables and pipelines	• Licence to construct a building (house, factory, workshop, …) • determine whether soil contamination with environmental risks is present (spreading, human or ecological risk) • Assignment of a different zone (a rural area can be changed to a housing area) • Installation or maintenance works	According to a mandatory investigation protocol (focus of this presentation)
• Environmental permit	• Licence to operate	According to a mandatory investigation protocol (focus of this presentation)
• A spill / leakage	• Determine if a soil contamination is present (after basic remedial measures)	Expert judgement (not included in this presentation)
• Soil movement	• Legal agreement to apply soil for civil works	According to a mandatory investigation protocol • For application included in this presentation • Research for the formulation of policy is not included
• Transaction	• Determine liabilities	Expert judgement (depends on seller of buyer side) (not included)

Exploratory soil research

Preliminary soil research and investigation strategies

Strategy for conducting exploratory soil research (NEN 5740)

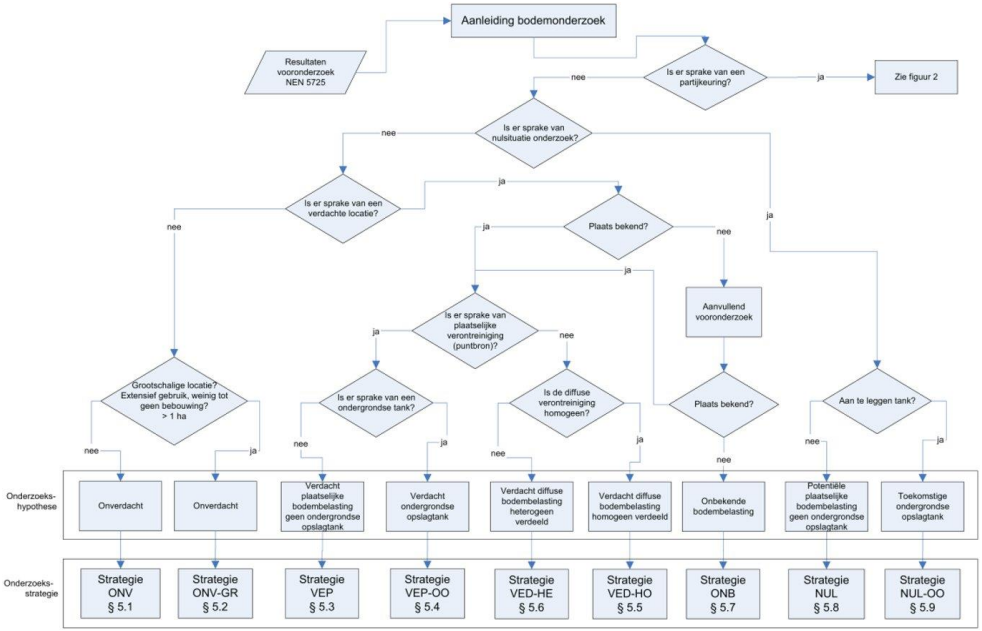
Research into the environmental quality of soil and groundwater

This standard describes the **method** for drawing up the **research strategy** for exploratory soil research into the (**possible) presence of soil contamination and the method** for determining the **environmental quality of the soil** (referred to as 'soil' in the rest of the document) and possibly from this released soil. The standard **applies to** exploratory soil investigation of **both unsuspected and suspicious locations**. The standard consists of a collection of research strategies, each with a specific area of application.

NEN 5740:2009+A1:2016 nl

The strategies

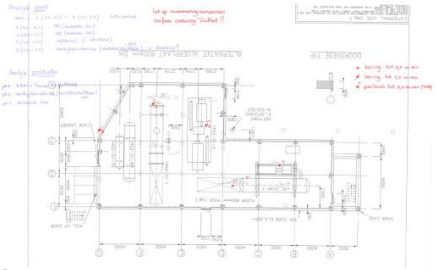
- The exploratory soil investigation must be preceded by a preliminary investigation (desk study) in accordance with NEN 5725. Based on the information from the preliminary investigation, a research hypothesis is formulated whereby a distinction is made between:
  - exploratory soil research into the current soil quality;
  - exploratory soil investigation for a future potential soil pollution.

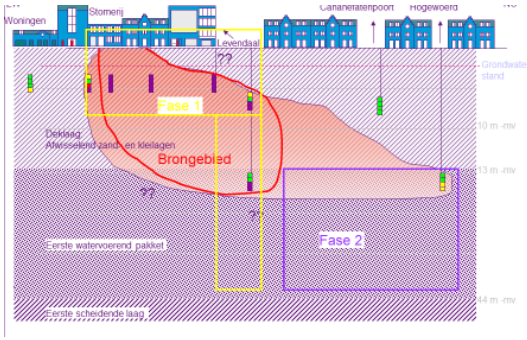


Preliminary research

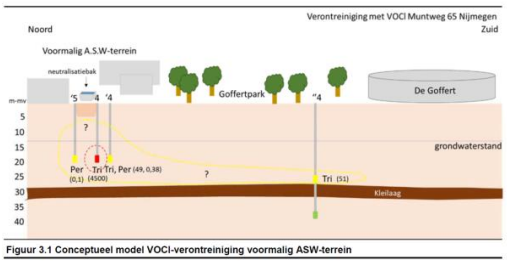
The basis for soil research is good preliminary research and a CSM

- Basic CSM needed for exploratory investigation (to establish a hypothesis)
  - Sentence
  - Table
  - Drawing by hand
  - Drawing digitally
- More advanced CSM needed if contamination is present:
  - To fill in all (or as much as possible) knowledge gaps (risk based)
  - Remedial investigations or design

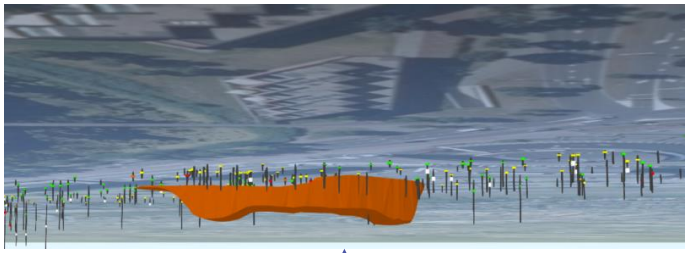




- ISO 21365:2019(en)



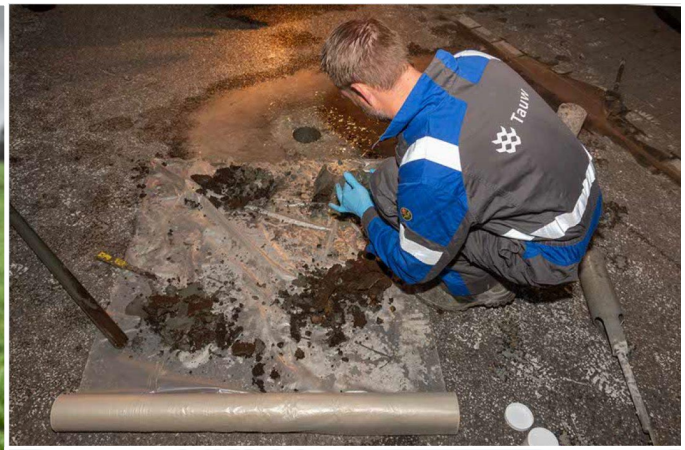
Figuur 3.1 Conceptueel model VOCl-verontreiniging voormalig ASW-terrein



Click the picture. It is a link to a 3D CSM Demo available on our website

The strategies

- No expectation for soil contamination
  - Small and medium size sites (ONV)
  - Large areas (ONV-GR)
- Contamination expected
  - Local (VEP)
  - Underground tank related (VEP-OO)
  - Homogenic diffuse (VED-HO)
  - Heterogenic diffuse (VED-HE)
- Unknown soil impact (ONB)
- Baseline study (NUL)
- Baseline study underground tank (NUL-OO)
- In situ soil quality examination (TOETS-S;
  proof of the soil quality before excavation and application of soil elsewhere)



The strategies

	Field				Analysis			
	0-0,5 m bgl	Up to ground-water	Other soil depth investigation obligation	Monitoring well	Soil sample 0-0,5 m bgl	Soil sample 0,5-2 m bgl	Other soil sample obligation	Ground-water sample
ONV (>1 ha)	✓	✓		✓	✓	✓		✓
ONV-GR (>5 ha)	✓	✓		✓	✓	✓		✓
VEP			✓	✓			✓	✓
VEP-OO			✓	✓			✓	✓
VED-HO			✓	✓			✓	✓
VED-HE			✓	✓			✓	✓
ONB	Referred to other investigation protocol (NTA 5755)							
NUL	✓	✓		✓			✓	✓
NUL-OO			✓	✓			✓	✓
TOETS-S + GR			✓				✓	

The strategies

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	0-0,5 m bgl	Up to ground-water	Other soil depth investigation obligation	Monitoring well	Soil sample 0-0,5 m bgl	Soil sample 0,5-2 m bgl	Other soil sample obligation	Ground-water sample
ONV (>1 ha)	✓	✓						✓
ONV-GR (>5 ha)	✓	✓		✓	✓	✓		✓
VEP			✓	✓			✓	✓
VEP-OO							✓	✓
VED-HO							✓	✓
VED-HE							✓	✓
ONB								
NUL	✓	✓					✓	✓
NUL-OO							✓	✓
TOETS-S + GR							✓	

Also line elements are included

Example

VEP (locally soil quality is influenced)

- ***From preliminary research:***
  - Spill in 1985 at a former tank location
  - Parameters: mineral oil, volatile aromatic hydrocarbons, volatile oil
  - Area to be investigated 12 m^2

- ***Investigation strategy and analysis***
  - 3 boreholes up to 0,5 m below contaminated layer
  - 1 monitoring well
  - 1 soil sample
    - Mixed soil sample for analysis on mineral oil
    - 1 undisturbed sample for analysis on volatile aromatic hydrocarbons, volatile oil
  - 1 groundwater sample for analysis on mineral oil, volatile aromatic hydrocarbons, volatile oil

VED-HE (diffuse contamination; heterogenic distributed in terms of sampling effort)

- ***From preliminary research:***
  - A 1.2 meter thick sediment layer is applied in the fifties
  - Parameters: PAH, heavy metals, heavy mineral oil
  - Area to be investigated 17,000 m^2

- ***Investigation strategy and analysis***
  - 24 boreholes in the contaminated layer
  - 5 boreholes to bottom of the contaminated layer
  - 3 monitoring wells
  - 5 soil (mixed) samples for analysis on PAH, heavy metals and mineral oil
  - 3 groundwater sample for analysis on PAH, heavy metals and mineral oil

The strategies

	Field measurement	Possibility to mixed up soil samples (in lab) with a maximum of	Analysis	Remarks
ONV (>1 ha)	pH, Ec Groundwater level, NTU	10	Standard set of parameters is analysed	Including line elements (cables);
ONV-GR (>5 ha)	pH, Ec Groundwater level, NTU	10	Standard set of parameters is analysed	Similar and extensive use, little or no development
VEP	pH, Ec Groundwater level, NTU (if suspected for LNAPL, LNAPL measurement in monitoring wells)	5	only activity related parameters are analysed	Small areas; samples from the contaminated layer
VEP-OO	pH, Ec Groundwater level, NTU (if suspected for LNAPL, LNAPL measurement in monitoring wells)	3	only activity related parameters are analysed	Near tank, filling point, fuel pipelines
VED-HO	pH, Ec Groundwater level, NTU	4	analysis on the expected parameters	Boreholes equally distributed; samples for analysis from suspected layer;
VED-HE	pH, Ec Groundwater level, NTU	4	analysis on the expected parameters	Higher intensity
ONB	pH, Ec Groundwater level, NTU	Not inquired	At least a standard set of parameters is analysed	Expert judgement
NUL	pH, Ec Groundwater level, NTU	Not preferred	Only future + current activity related substances are investigated	
NUL-OO	pH, Ec Groundwater level, NTU	no	Only future activity related substances are investigated	
TOETS-S + GR	-	2 buckets; 50 grasps of 150gr each	At least a standard set of parameters is analysed	

The strategies

Asbestos

Exploratory soil investigation
(only if no severe contamination is expected from preliminary research)

- Visual inspection of investigation area for material that could be (containing) asbestos, note locations and weight
- Digging small pits (30*30*30cm)
- Sieving
- Collect asbestos suspicious material
- Collect sand sample for analysis
- Result of plate and soil analysis < 50 mg/kg dm; no expectation for asbestos heavily contaminated soil
- Result of plate and soil analysis > 50 mg/kg dm; indication that Asbestos could be a problem; advanced research is strongly advised

- APPLICABLE FOR DIFFERENT STRATEGIES PARALLEL TO CHEMICAL CONTAMINATION FOR EXPLORATY REASEARCH

The strategies

Asbestos

Advanced soil investigation

- Visual inspection of investigation area for material that could be (containing) asbestos, note locations and weight
- Digging 5trenches of 200*35cm per 1,000 m^2
- Sieving
- Collect asbestos suspicious material
- Collect at least 10 kg material from one area of 1,000 m^2
- Analysis
    - if expected for small fibres also SEM
    - If results indicate small fibres could be present; SEM
- Result of plate and soil analysis > 100 mg/kg dm → heavily contaminated → remediation needed at some point
- Result of plate and soil analysis < 100 mg/kg dm → not further action needed

Reflection

- Well thought strategies
- Works for all different types of chemical contaminations
- Structured and uniform
- No discussion about the approach
  - Not from the authorities
  - Not from the client
- Tailor made strategies are still possible
- Little room for expert judgement
- Focus on intrusive techniques
- Innovation is not quickly adopted

TAUW

Questions

TAUW | a living ambition

Tessa Verschoor

+31 6 22974820

tessa.verschoor@tauw.com

www.tauw.com