



If you want to test an idea

– the Danish Soil Partnership is here to help you move forward in the process ...

Contact:

Danish Soil Partnership
www.danishsoil.org

Christian Andersen
E: can@regioner.dk
T: +45 3529 8175



For the development and demonstration of methods for the investigation and remediation of contaminated soil and groundwater





National network of test sites

→ For the development and demonstration of methods for the investigation and remediation of contaminated soil and groundwater

Single point of entry

A major obstacle to the development of techniques for the investigation and remediation of soil contamination is the lack of opportunity to test the techniques on existing contaminants.



Most of the five Danish regions either own or have access to one or more well-documented, heavily contaminated sites which are used for the development and demonstration of new environmental technology. The sites represent different geology, different groundwater conditions, and their contaminants have different chemical compositions. Seen as a whole, the sites therefore represent a wide range of contamination issues, and thus complement one another in the development and demonstration of new techniques for the investigation and remediation of pollution.

The main players are the regions, which have the rights or the possibility of negotiating the rights of access to the sites, but the intention is to make the sites widely available to environmental technology companies, contractors and consultants as well as research and educational institutions.

The aim is furthermore to establish an international showcase for Danish soil contamination solutions.

The regions have a unique opportunity to bring together multiple stakeholders – public adminis-

trations and private companies – to collaborate, and thus expand the opportunities for Public-Private Partnership (PPP) and Public-Private Innovation (PPI).

The national network of test sites has been established to encourage and facilitate the development, demonstration and maturation of new techniques for the investigation and remediation of soil and groundwater contamination – with a particular focus on competitive and cost and resource-efficient solutions. There may also be concurrent projects and on-site workplaces.

The test site facilities are made available through Danish Soil Partnership, which serves as a single point of entry for environmental technology companies, contractors and consultants as well as research and educational institutions involved with the development of new methods and new technology.

Through its collaboration with public and private partners, Danish Soil Partnership aims to promote the development of technology and know-how with market potential, promote the development of new products and showcase Danish solutions abroad.



FACTS AND BASIC DATA



SITE	HORSENS GASWORKS	RINGE TAR AND ASPHALT FACTORY	MIDDELFARTVEJ FORMER DRY CLEANER	ESKELUND LOSSEPLADS FORMER WASTE DISPOSAL SITE	INNOVATION GARAGE FORMER DRY CLEANER
ADDRESS	Gasvej 21 DK-8700 Horsens	Villavej 17-23 DK-5750 Ringe	Middelfarvej 126 DK-5000 Odense	Eskelundvej 13 DK-8260 Aarhus	Skovlunde Byvej 96A DK-2740 Skovlunde
REGION	Central Denmark Region	Region of Southern Denmark	Region of Southern Denmark	Central Denmark Region	Capital Region of Denmark
OWNER	The Danish Museum of Industry	Region of Southern Denmark	Region of Southern Denmark	Aarhus Municipality	Capital Region of Denmark
BACKGROUND	Gasworks, tar and asphalt roofing factory	Tar and asphalt factory	Dry cleaning	Waste disposal site	Dry cleaning
AVAILABILITY/ ACCESS	Good	Good	Good	Good	Good
GEOLOGY	Fill / glacial till	Glacial till/meltwater sand	Glacial till/meltwater sand	Fill/peat/organic silt/glacial till	Glacial till/meltwater sand
IN-DEPTH SURVEY*	Yes, >40 drillings	Yes	Yes	Yes	Yes
CONTAMINATION	PAH + phenol, cyanide, heavy metal	PAH + BTEX	Chlorinated solvents	All	Chlorinated solvents
PRIORITISED ACTION	Further studies regarding surface water	Yes (Ringe VV)	Monitoring	Yes	Yes
OTHER	Local geological and hydrological model set up (Leapfrog Hydro) – not site specific	Both a geological and a hydrological model have been set up for the site (available digitally)	A local geological and hydrological model has been set up. The Danish Nature Agency has also surveyed the groundwater in the area	Groundwater model set up. (hydrogeosphere), remedial pumping under review	Purchased as test site

* Understanding of the local geology and contamination, not necessarily electronic geological and/or conceptual models.



The location of the five test sites

To date, the Capital Region, the Region of Southern Denmark and Central Denmark Region have acquired and currently operate test sites, but both Region Zealand and North Denmark Region are in the process of looking for locations suitable for testing purposes.

<p>HORSENS GASWORKS Gasvej 21 8700 Horsens</p>	<p>RINGE FORMER TAR AND ASPHALT FACTORY Villavej 17-23 DK-5750 Ringe</p>	<p>MIDDELFARTVEJ FORMER DRY CLEANER Middelfartvej 126 DK-5000 Odense</p>	<p>ESKELUND LOSSEPLADS FORMER WASTE DISPOSAL SITE Eskelundvej 13 DK-8260 Aarhus</p>	<p>INNOVATION GARAGE FORMER DRY CLEANER Skovlunde Byvej 96A DK-2740 Skovlunde</p>
---	---	---	--	--



Horsens Gasworks

Geology


- 0,5 – 2,5 m fill
- 1,5 – 3,5 m sand
- 0,5 – 2 m silt
- Sand
- Clay
- Sand


History

- **1860–1969**
Gasworks, tar and asphalt roofing factory
- **1988** preliminary investigation
- **1990's** supplementary investigations
- **1996** remediation – dig and dump
- Monitoring

Source characteristics / Contamination situation

- Heavy contamination of soil 5-7 m bgl
- Heavy contamination of local groundwater with dissolved tar components
- Pollution plume in top aquifer
- Flux calculations show an annual leaching of 12,8 kg xylenol to the harbor basin

 Gasvej 21
8700 Horsens

 **CONTACT PERSON:**
Rolf Johnsen
E: rolf.johnsen@ru.rm.dk
T: 7841 1933

→ RINGE

Former tar and asphalt factory

Geology

- 1–6 m bgl Glacial till, heavily fractured
- 6-10 m bgl Glacial till with sandy deposits

(secondary aquifers)

- 10-14 m bgl Increasing dominance of sandy deposits
- Below this is an extensive cover of sand (primary aquifer)

Source characteristics / Contamination situation

- Heavily contaminated with tar
- Source area: Phenols up to 45,700 µg/l and NSO compounds up to 917 µg/l
- Free phase tar in the primary aquifer
- Heavy contamination of local groundwater with dissolved tar components
- Narrow pollution plume with very high concentration of tar in the primary aquifer

History

- **1930–1968**
Tar and asphalt factory
- **1969–c.1985**
Garage
- **1986**
First surveyed
- **2007 >**
Passive ventilation of the unsaturated zone and monitoring



Villavej 17-23
DK-5750 Ringe



CONTACT PERSON

Lone Dissing
E: lone.dissing@rsyd.dk
T: +45 7663 1937

→ MIDDELFARTVEJ

Former dry cleaner

Geology

- 2–10 m thick cover of glacial till
- Below this, meltwater sand, 2–5 m thick
- Below this, glacial till
- It is thought that the sand aquifer may be connected to the upper primary aquifer in the area.

Source characteristics / Contamination situation

- Soil contamination from 2.5 – 7 m bgl
- Residual contamination in soil approx. 32 kg
- Groundwater contamination present from 10–20 m bgl in the sand aquifer
- Residual contamination in groundwater approx. 3 kg in hotspot and 1 kg in plume
- Primarily PCE and to some extent TCE, low content of cis-DCE, small quantity of VC
- Dehalococoides present – but too low to quantify

History

- **1964–1989**
Dry cleaning
- **1965–2002**
Garage
- **1993–1994**
First surveyed
- Groundwater contamination currently monitored
- The site is empty, buildings demolished



Middelfartvej 126
DK-5000 Odense



CONTACT PERSON

Kristian Dragsbæk Raun
E: Kristian.Raun@rsyd.dk
T: +45 7663 1934

→ ESKELUND Former waste disposal site

Investigations conducted

- Monitoring over > 20 years
- Methane measurements and flux estimation
- Pump tests
- Geophysical measurements and method development (IP)
- Borehole logs
- Age dating
- Hydrogeological model and groundwater model
- Modelling of climate change impact

Source characteristics / Contamination situation

- Landfill up to 4 metres
- Typical landfill characteristics: high conductivity and salts, also the discovery of BTEX, pesticides, cyanides, phenols, etc.
- Contamination of groundwater under the site
- Significant amounts of methane

History

- Municipal waste disposal site
- Construction waste, domestic waste and industrial waste
- More than 2,000,000 m³ waste
- Disposal in meadow areas near the river Aarhus Å
- Close to the abstraction wells of public water works
- Remediation and monitoring over 20 years
- Many projects completed



Eskelundvej 13
DK-8260 Aarhus



CONTACT PERSON

Tom Birch Hansen
E: Tom.Birch-Hansen@RU.RM.DK
T: +45 7841 1946

→ SKOVLUNDE Innovation Garage

Geology

- 0–8 m bgl – Saturated zone, (glacial) till
- 8–16 m bgl – Unsaturated zone, sand
- 16–27 m bgl – Saturated zone, meltwater sand
- Approx. 27 m bgl, limestone
- The limestone is in direct contact with the overlying layers of sand, and the saturated sand is therefore regarded as part of the primary aquifer

Source characteristics / Contamination situation

Soil and groundwater very heavily contaminated with chlorinated solvents at the property Skovlunde Byvej 96a and the surrounding properties. The contamination is thought to originate from the spillage of cleaning fluid when the property housed a dry cleaners from 1960–1987.

A substance assessment shows there to be approximately 1,850 kg of PCE in the area.

In the hot spot, high concentrations have been found as far down as 8.5 m bgl, while the overall picture outside the hot spot is vertical diffusion from 2.5 to 4 m bgl.

PCE is by far the most dominant component in the soil. Only small and insignificant quantities of decomposition products, total hydrocarbons and BTEX have been found in the soil, compared to the PCE concentrations.

In the secondary groundwater from 2–5 m bgl, extensive contamination by PCE, TCE, decomposition components and total hydrocarbons have been found. The very high content of decomposition components in relation to PCE in the groundwater is considered evidence of a high degree of natural decomposition in the unsaturated and saturated zone.

Flux calculations show an annual leaching of between 4.6 and 18.4 kg PCE to the unsaturated zone and the lower sand aquifer.

The primary aquifer is affected, but horizontally only.

History

- **1960–1987**
Dry cleaning
- **1987–2013**
Carpentry firm
- **1993**
Registered as a waste disposal site
- **1997–1999**
Further investigation and remediation programme
- **1999–2013**
Remediation system with passive ventilation and drainage
- **2006 and 2011–2012W**
Re-evaluation of existing remediation; additional investigation as well as new risk assessment
- **2013**
The Capital Region of Denmark acquires the site for testing
- **2013 >**
Remediation of groundwater contamination by a groundwater remediation system with carbon filtration



Skovlunde Byvej 96A
DK-2740 Skovlunde



CONTACT PERSON

Mads Terkelsen
E: mads.terkelsen@regionh.dk
T: +45 3866 5615