

Landfill Mining at Skaarup Landfill

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Technologies for material recovery from landfills and mining residues”

22.-23. September 2016

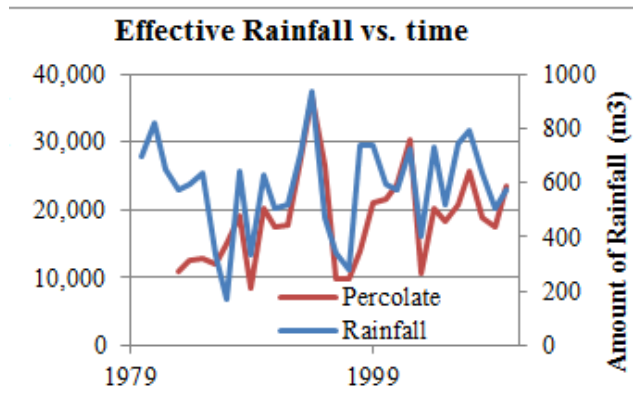
University of Novi Sad

Novi Sad, Serbia

Skårup Landfill



- Owned by RenoSyd I/S, municipal Waste Company
- Operation 1979- on going
- 8.1 ha landfill
- Stage 1 (1979-81), MSW, bulky waste, slagg, C&D, sludge etc.



- <http://85.191.98.168/control/userimage.html>

Good preliminary study

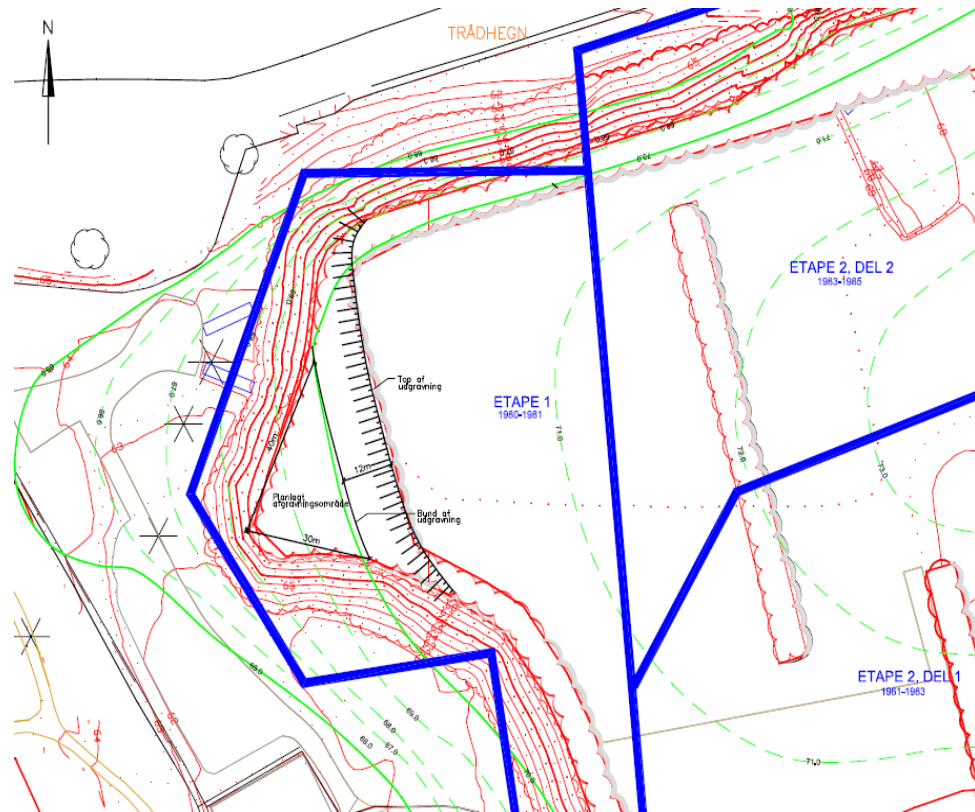
- Looking through the archives (1000 documents and drawings)
- Estimation based on a historic desktop study:
 - 40 % soil (2000-2500 tonnes of soil)
 - 25-30 % MSW for incineration
 - 20-25 % C&D waste
 - 1-2 % Metals (50-100 tonnes)
 - 5-15 % Fines (slag, ashes and sludge etc.)

Application for LFM

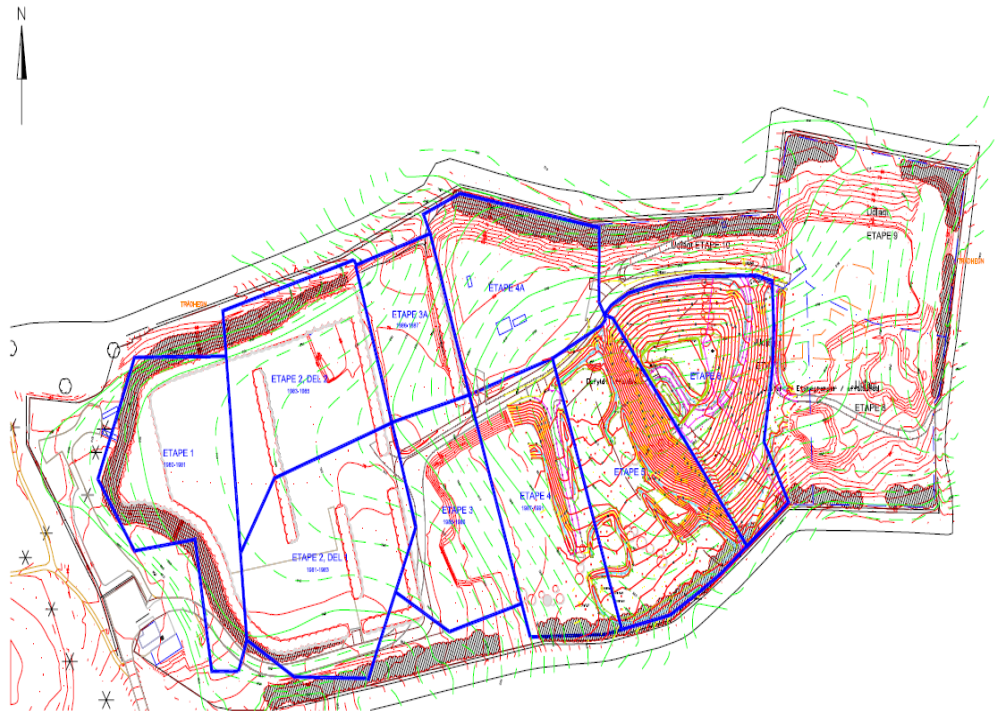
- Project was approved for funding by the Danish EPA (MUDP) - 1/12/2015
- Environmental application was sent to authorities 14/12/2015 and consisted of excavation of 5000 tonnes of waste from Stage 1
- Follow Up Meeting with Danish EPA 2/3/2016
- Revised application was sent 7/3/2016
- Accepted by Danish EPA on 23/5/2016.

Application for LFM

- Removal of topsoil/cover
- App. 30 x 40 meters
- App. 12 m of waste
- Sorting on top of the membrane area



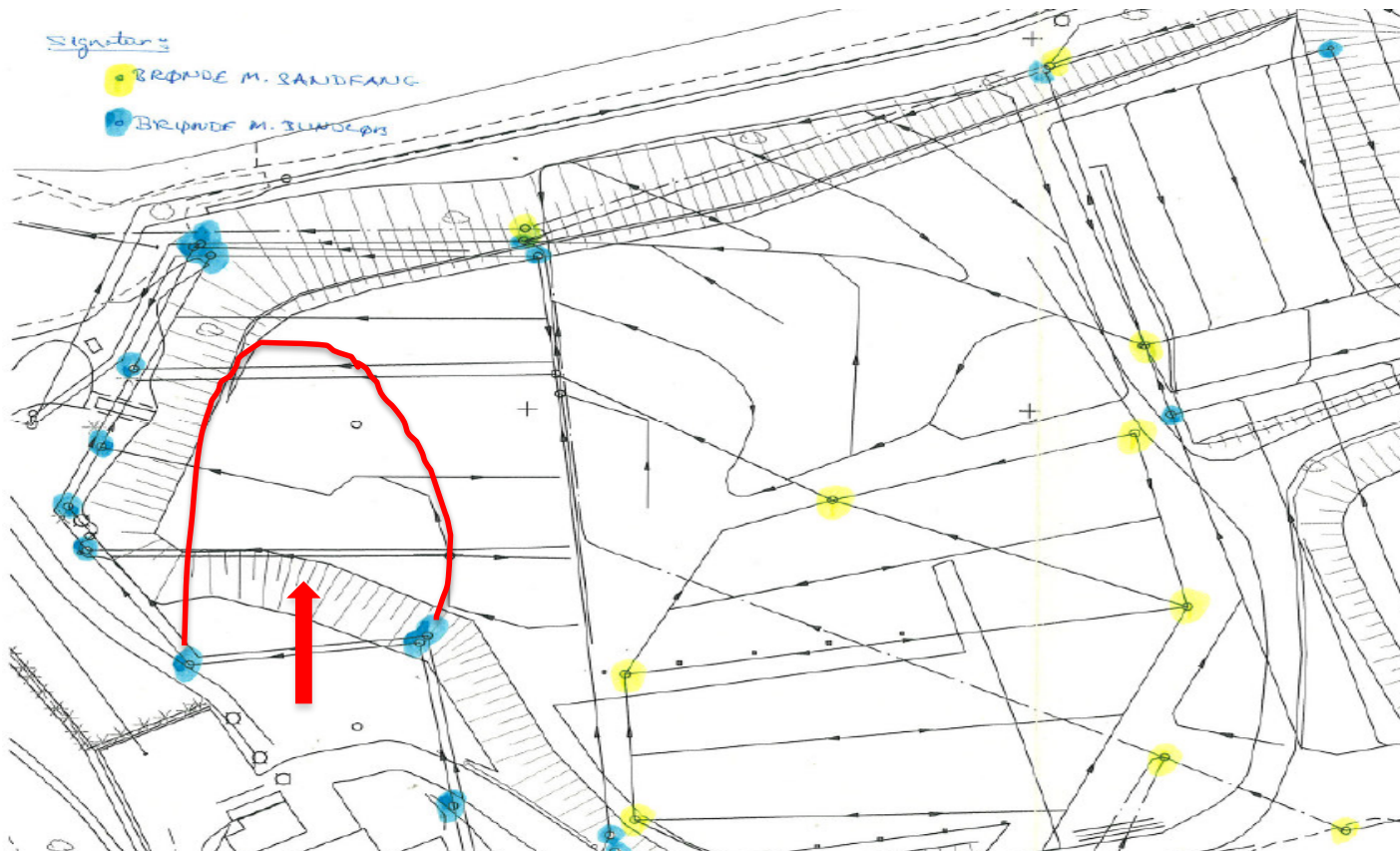
Application for LFM



- Soil hotel - Cell 2 and 4
 - Bricks, small - Cell 4A
 - Concrete, Lg - Cell Etape 9
 - Re-landfiling - Cell 6
-
- Re-landfill - Clean soil and Contaminated soil, Cell 1, if drainage system is working ok

Application for LFM

- Drainage system/wells



Application for LFM

- **Safety (Develop a plan for Safety and Health)**
- Plan for safety and health,
- Gas measurement
- Explosion and risk of fire
- Collapse of excavation
- Handling of hazardous waste (chemicals/asbestos)

- **Extern environment**
- Noise and vibrations
- Landfill gas and minimization of dust
- Soil and groundwater risk (recipients)
- Neighbours

Application for LFM

- Close by Neighbours 200 m
- Recipient 70m

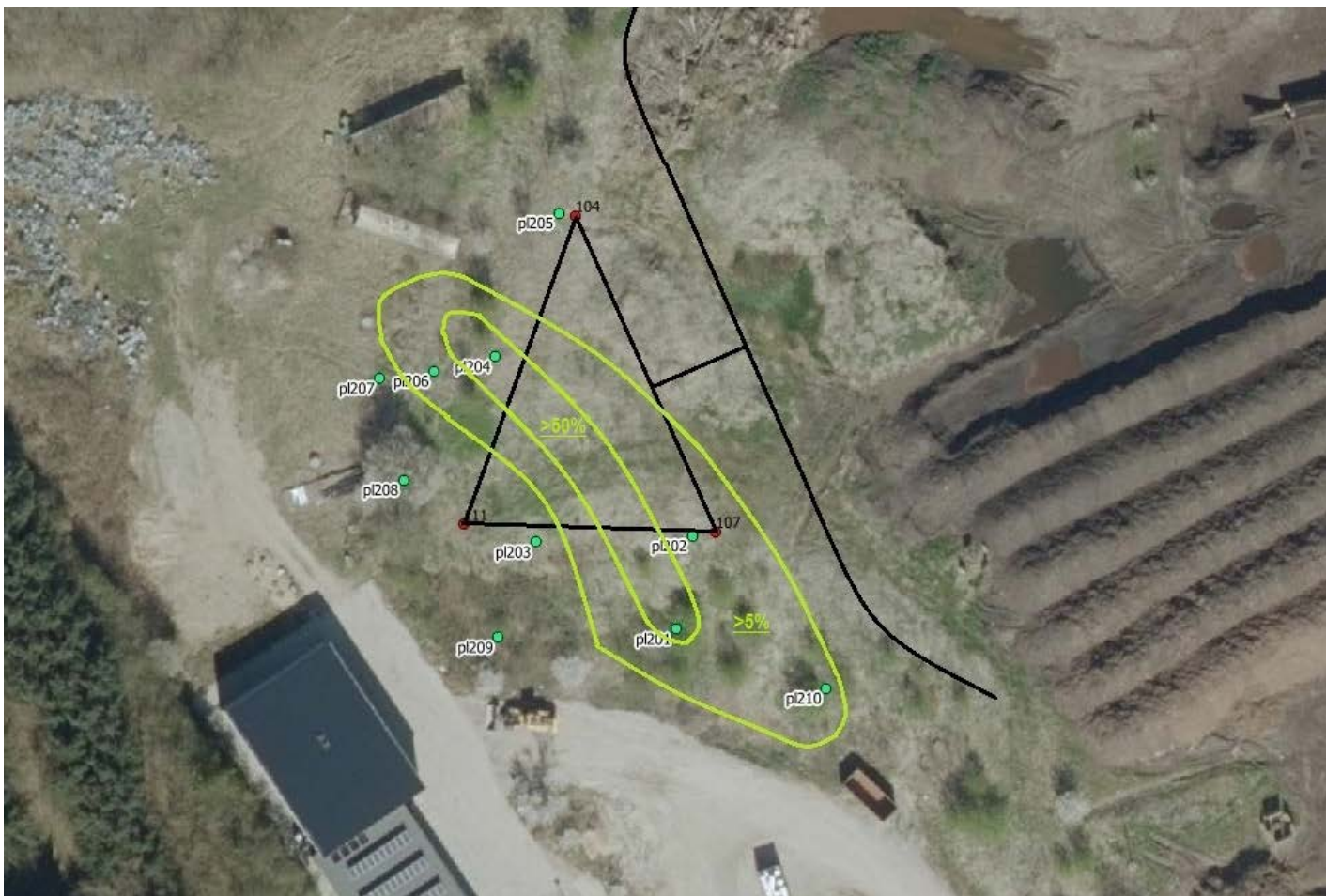


Total fugitive Emission measurement -2014



© Google & Aerodata International Survey

Gas, safety and odour



Gas, safety and odour



- GPS
- Gas measurements

Gas, safety and odour



Gas, safety and odour

- Preliminary gasdetection/measurment
- Safety Instructions
- Gasdetector (CO_2 , CH_4 , H_2S and CO)
- Gasmeasurment during excavation
- Small excavation "Ventilation" and control before excavation
- Gasalarms in cabin (2 alarms so far)

Handling of soil

- Fine fraction
- 1 test per 120 tonnes of soil
- Analysis: Hydrocarbons C_6 - C_{35} , PAH og heavy metals



Tørstof	83	%	0.2	DS 204 mod.
Metaller				
Bly (Pb)	26	mg/kg ts.	1	SM 3120 ICP-OES
Cadmium (Cd)	0.42	mg/kg ts.	0.02	SM 3120 ICP-OES
Chrom (Cr)	14	mg/kg ts.	1	SM 3120 ICP-OES
Kobber (Cu)	71	mg/kg ts.	1	SM 3120 ICP-OES
Nikkel (Ni)	12	mg/kg ts.	0.5	SM 3120 ICP-OES
Zink (Zn)	160	mg/kg ts.	1	SM 3120 ICP-OES
Kulbrinter (pentan-ekstraherbare)				
Benzen-C10 (florisil)	< 2	mg/kg ts.	2	REFLAB metode 1 mod. GC-FID
C10-C15 (florisil)	9.6	mg/kg ts.	5	REFLAB metode 1 mod. GC-FID
C15-C20 (florisil)	20	mg/kg ts.	5	REFLAB metode 1 mod. GC-FID
C20-C35 (florisil)	240	mg/kg ts.	20	REFLAB metode 1 mod. GC-FID
Sum C10-C20 (florisil)	30	mg/kg ts.		REFLAB metode 1 mod. GC-FID
Sum Benzen-C35 (florisil)	270	mg/kg ts.		REFLAB metode 1 mod. GC-FID
C6H6-C10	2.3	mg/kg ts.	2	REFLAB metode 1:2010 GC-FID
C10-C15	14	mg/kg ts.	5	REFLAB metode 1:2010 GC-FID
C15-C20	40	mg/kg ts.	5	REFLAB metode 1:2010 GC-FID
C20-C35	520	mg/kg ts.	20	REFLAB metode 1:2010 GC-FID
Sum (C10-C20)	54	mg/kg ts.		REFLAB metode 1:2010 GC-FID
Sum (C6H6-C35)	580	mg/kg ts.		REFLAB metode 1:2010 GC-FID
PAH-forbindelser				
Fluoranthen	1.2	mg/kg ts.	0.005	REFLAB metode 4 GC-MS
Benzo(b+j+k)fluoranthen	0.88	mg/kg ts.	0.005	REFLAB metode 4 GC-MS
Benzo(a)pyren	0.47	mg/kg ts.	0.005	REFLAB metode 4 GC-MS
Indeno(1,2,3-cd)pyren	0.28	mg/kg ts.	0.005	REFLAB metode 4 GC-MS
Dibenzo(a,h)anthracen	0.048	mg/kg ts.	0.005	REFLAB metode 4 GC-MS
Sum af 7 PAHer	2.9	mg/kg ts.		REFLAB metode 4 GC-MS
Oplysninger fra rekvirent				
Prøvedybde	0-1.5	m		*

Soil

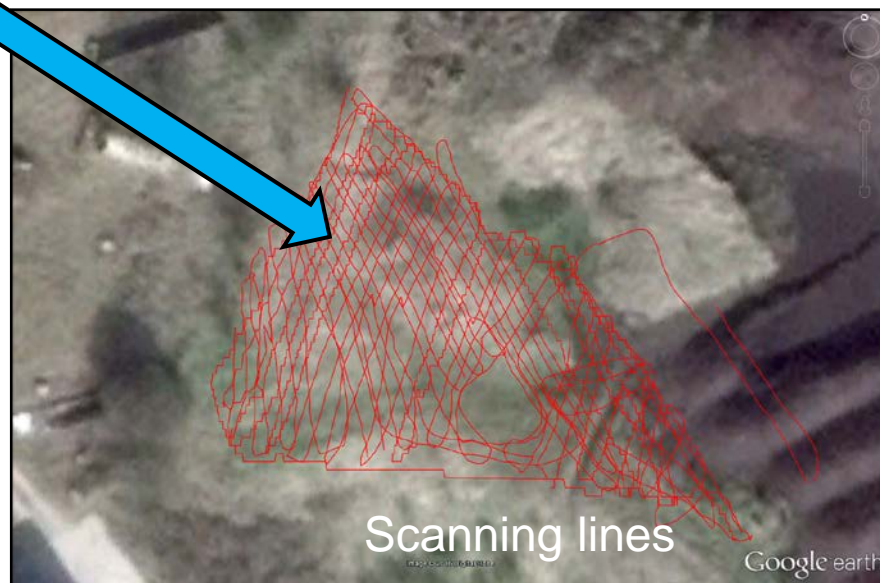
- Re-use of clean and contaminated soil etc.
Hydrocarbons < 300 mg/kg TS (C₆-C₃₅).
- High TOC content from household waste sludge and garden waste.
- Florisil-cleaning of soil samples
- Cleaning removes natural organic hydrocarbons from the hydrocarbons

Knowledge before excavation

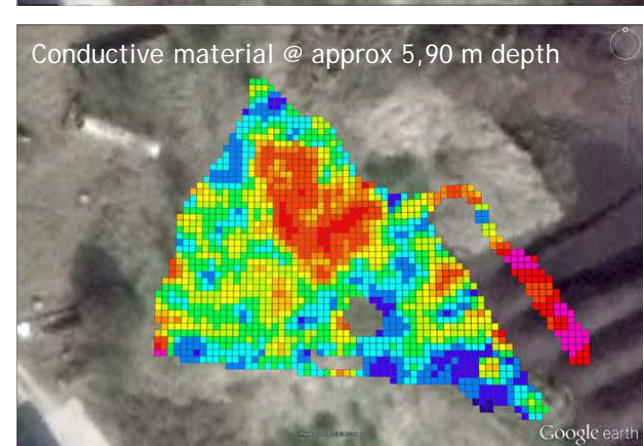
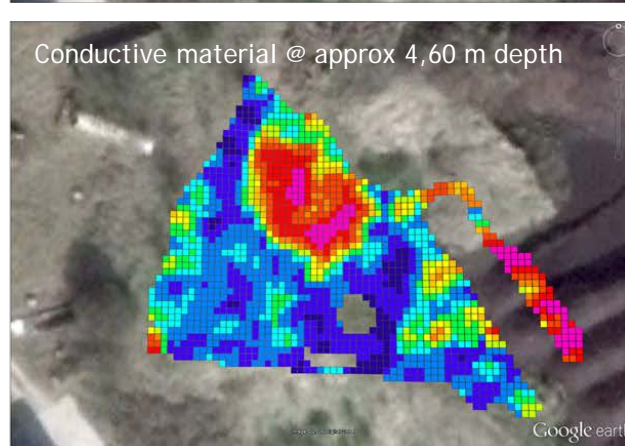
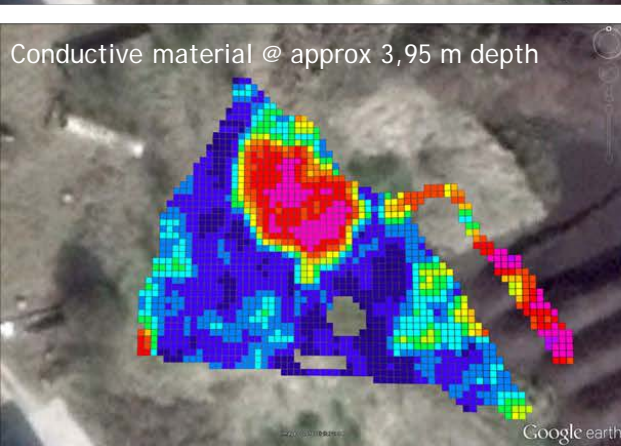
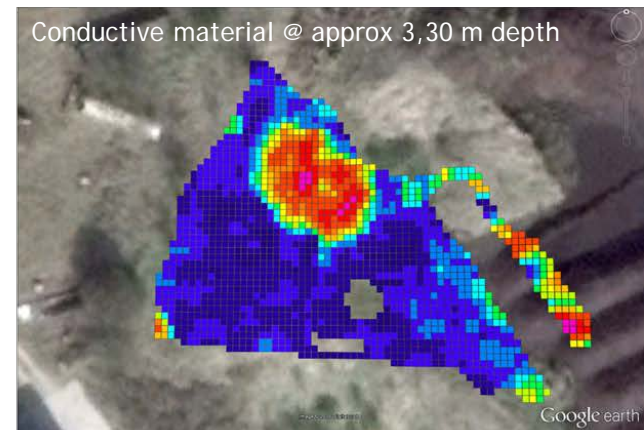
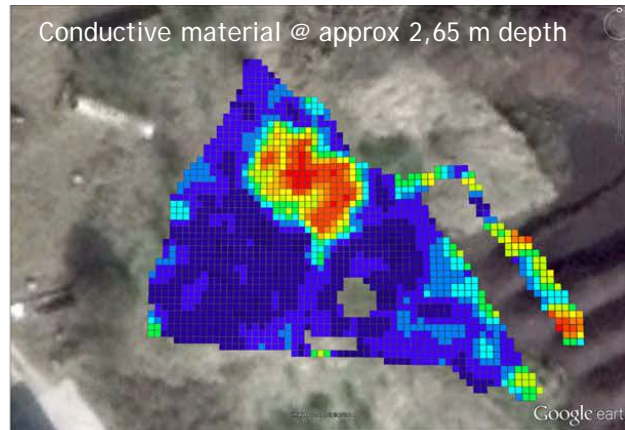
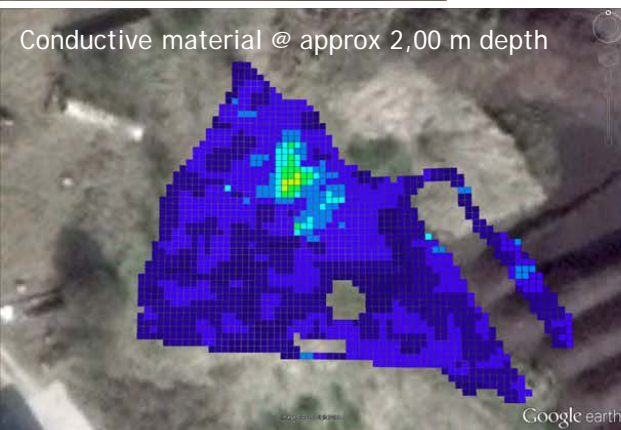
- Test drilling
- Test Excavations
- Non-invasive
 - No penetration into the soil
 - Georadar (GPR)
 - GPR/Tracer screening
 - Interpretation is essential
 - Metodology is the under development



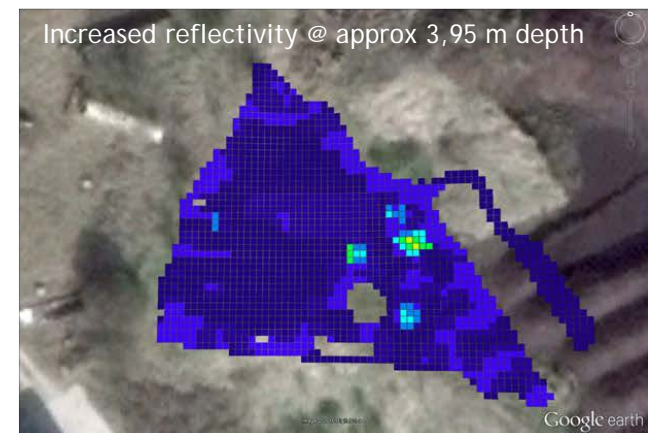
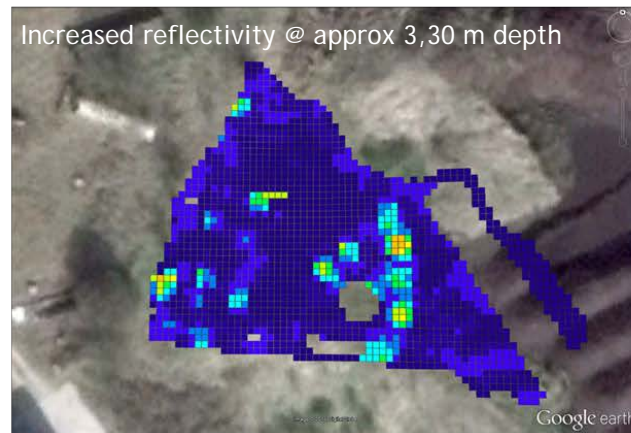
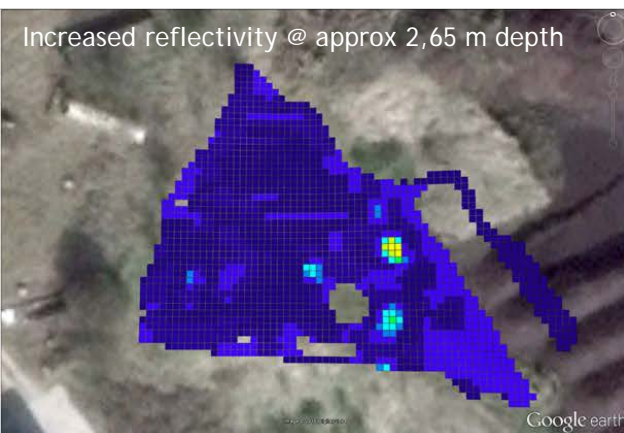
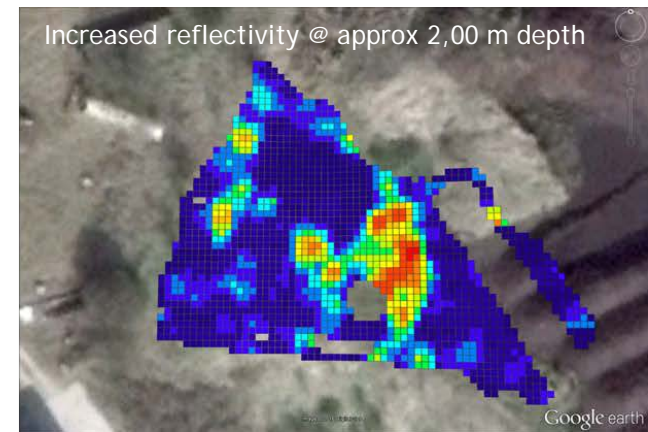
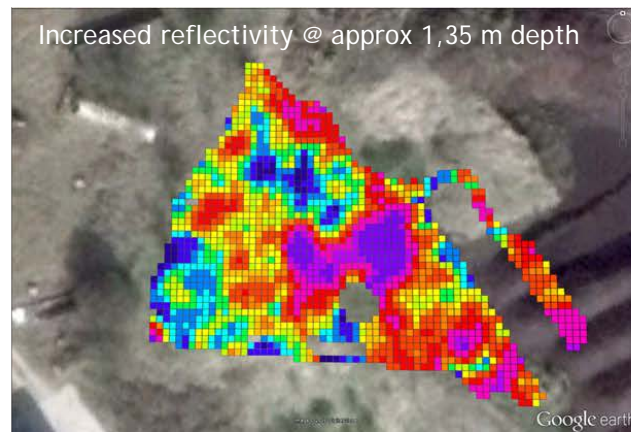
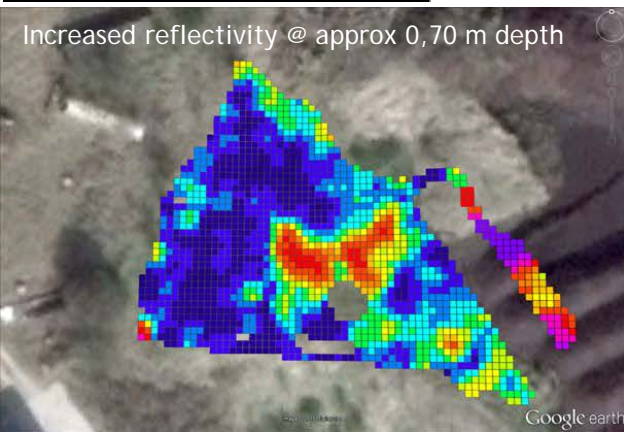
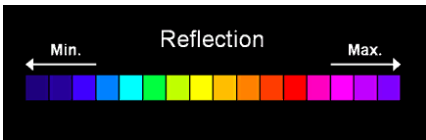
Field Study



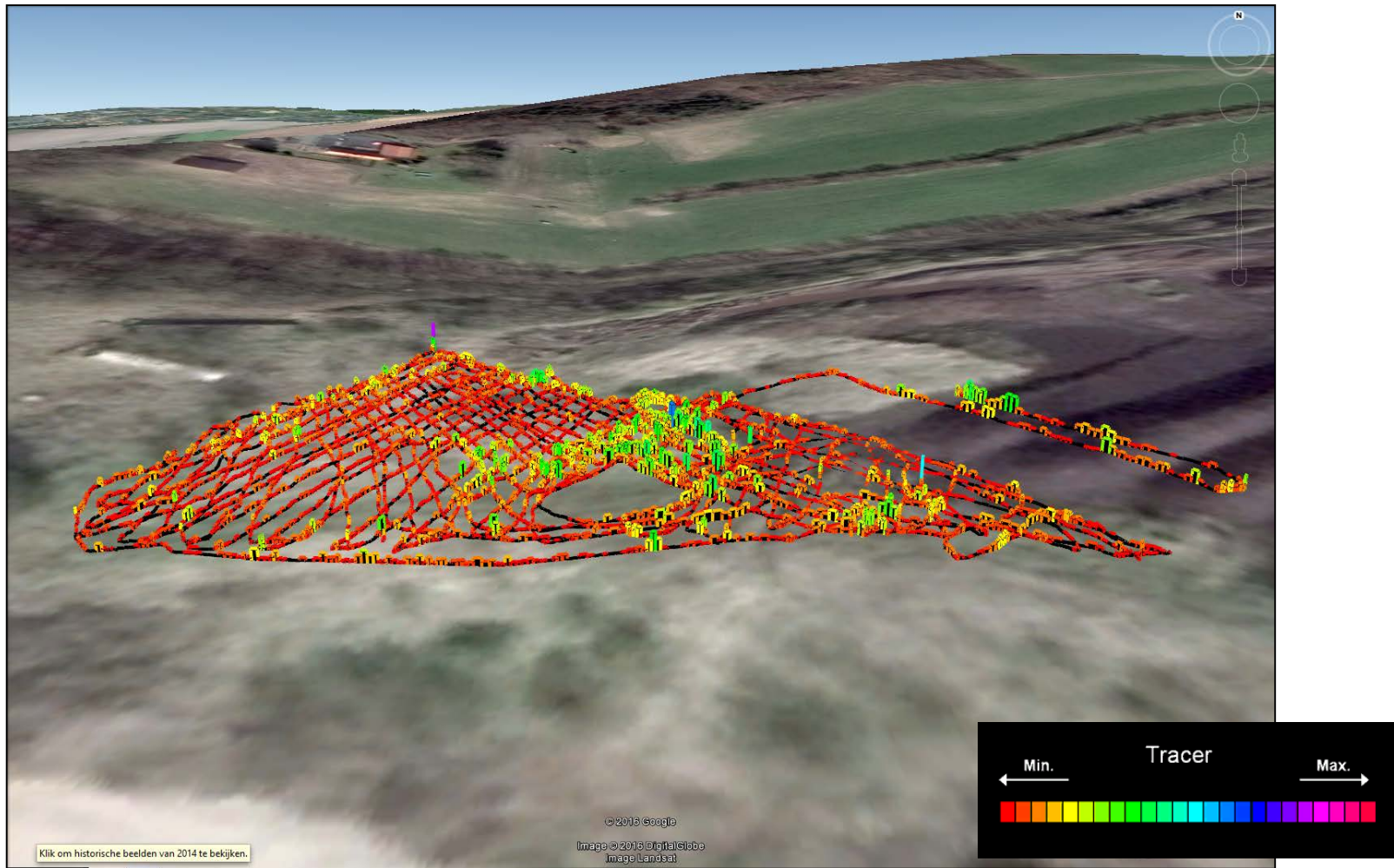
Output from dimming'-module



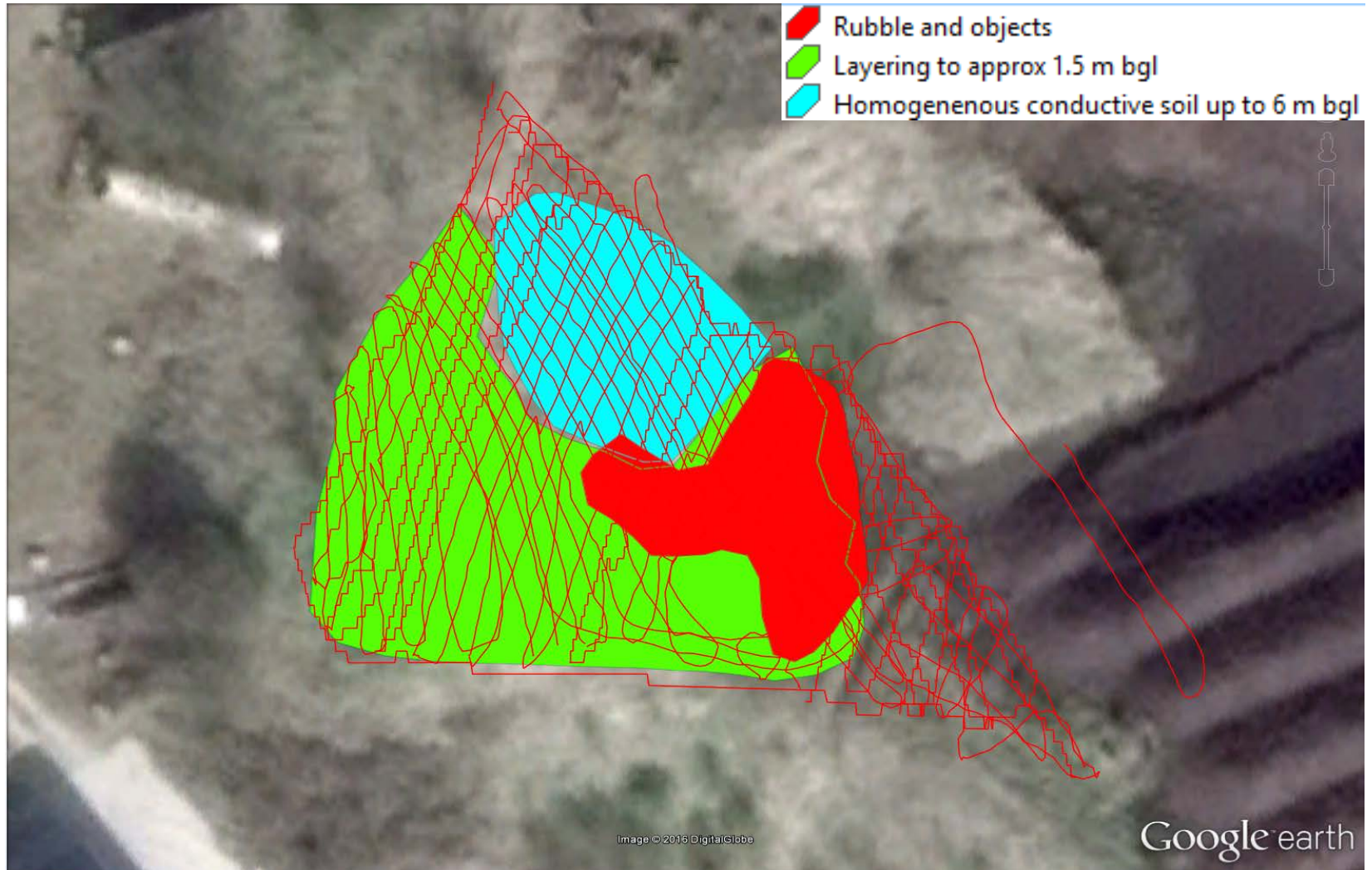
Output from 'reflection'-module



‘Tracer’ results “gps”



Preliminary Results



Excavation and sorting

- Excavation and sorting with excavator and sorting grab
- Large Bricks and stones, large metal pieces, Tyres, large plastfoil, textiles and accumulators etc.
- **Sorting with** Keestrack 175 vibration and screening



Excavation and sorting

- Coarse Screening: Heavy Duty Finger screen 51mm
- Punched plate & full Hardox top deck 40 mm
- 2 Magnet-belts on midsize fraction og coarse fraction
- Plastfoil-sucktion on the coarse fraction



LFM Fractions

- Fine fraction: Soil
- Mid size fraction: App. 50 % soil, plast, stones (need x-tra sorting - after drying)
- Coarse fraction: Stone, C&D, heavy foil, wood, textiles etc. (need x-tra sorting)
- Metal fraction
- Plastfoil

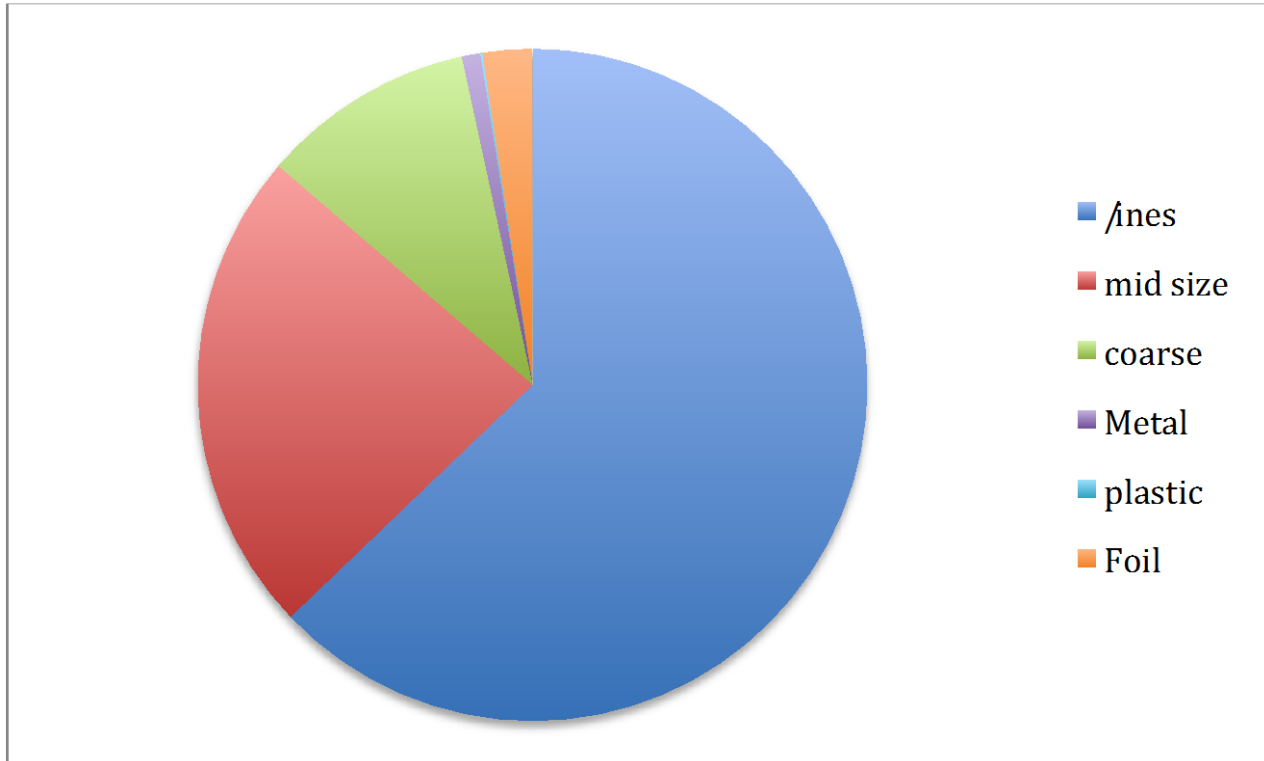


LFM – fractions



Preliminary results

Fine Fraction (tonnes)	Mid size fraction (tonnes)	Coarse Fraction (tonnes)	Metals (tonnes)	Plastic (tonnes)	Lg. Foil (tonnes)
1181,7	441,5	193,8	17,8	2,1	46
62,8 %	23,4 %	10,3 %	0,9 %	0,1 %	2,4 %



Still remains

- X-tra sorting (14 Days)
- Re-develop the landfill (1 week)
- Cost-benefit analysis and foot-print
- Final report by the end of the year
- Despite poor fractions we are quite happy and a lot of lessons learnt

Thanks for the Attention



Danish Waste Solutions
Waste - Resources - Environment

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