A case study of methane emission and methane oxidation at a large scale Swedish landfill

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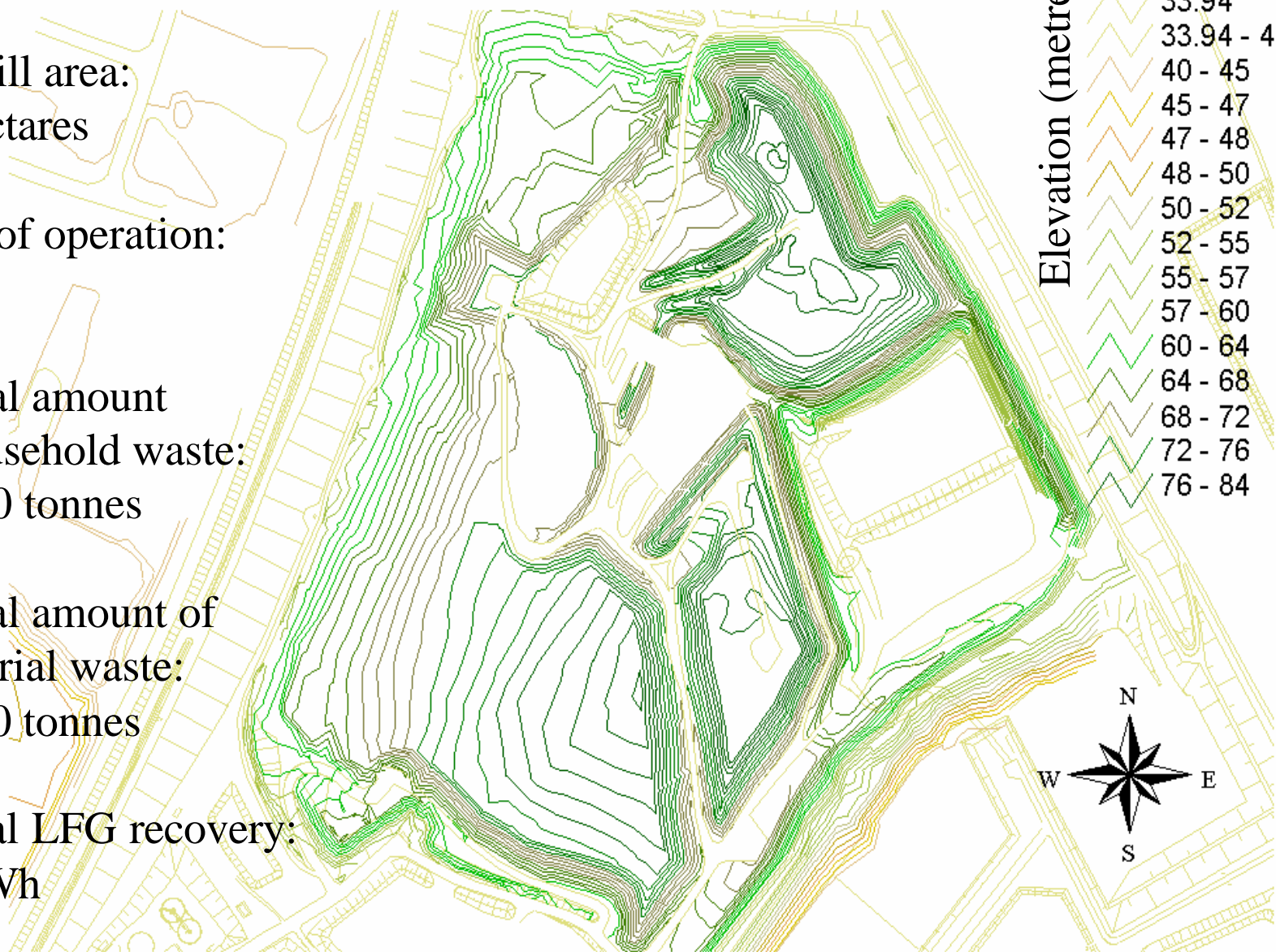# Overview of the Filborna landfill

Landfill area:
38 hectares

Time of operation:
1970-

Annual amount
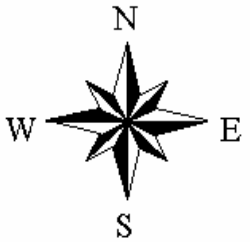of household waste:
60 000 tonnes

Annual amount of
industrial waste:
50 000 tonnes
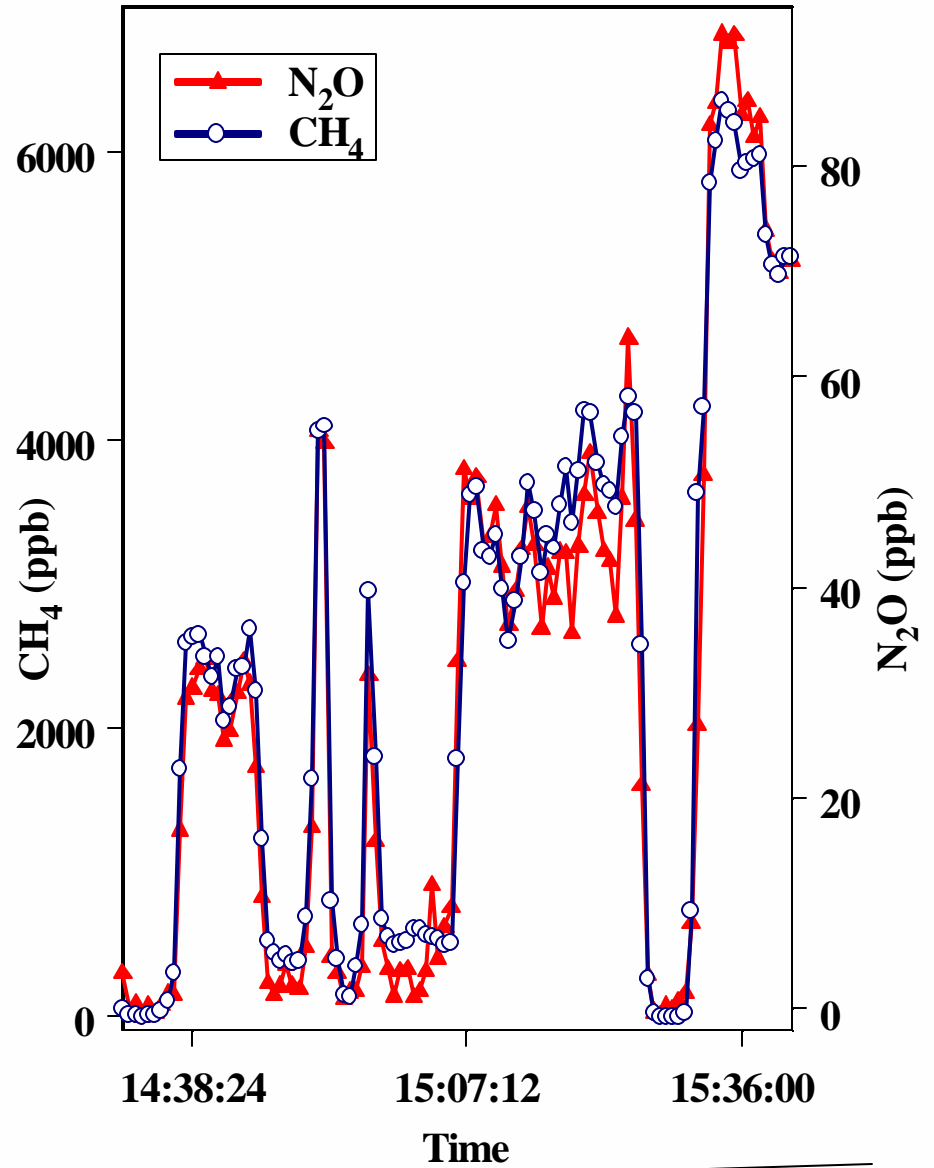
Annual LFG recovery:
72 GWh

Elevation (metres)
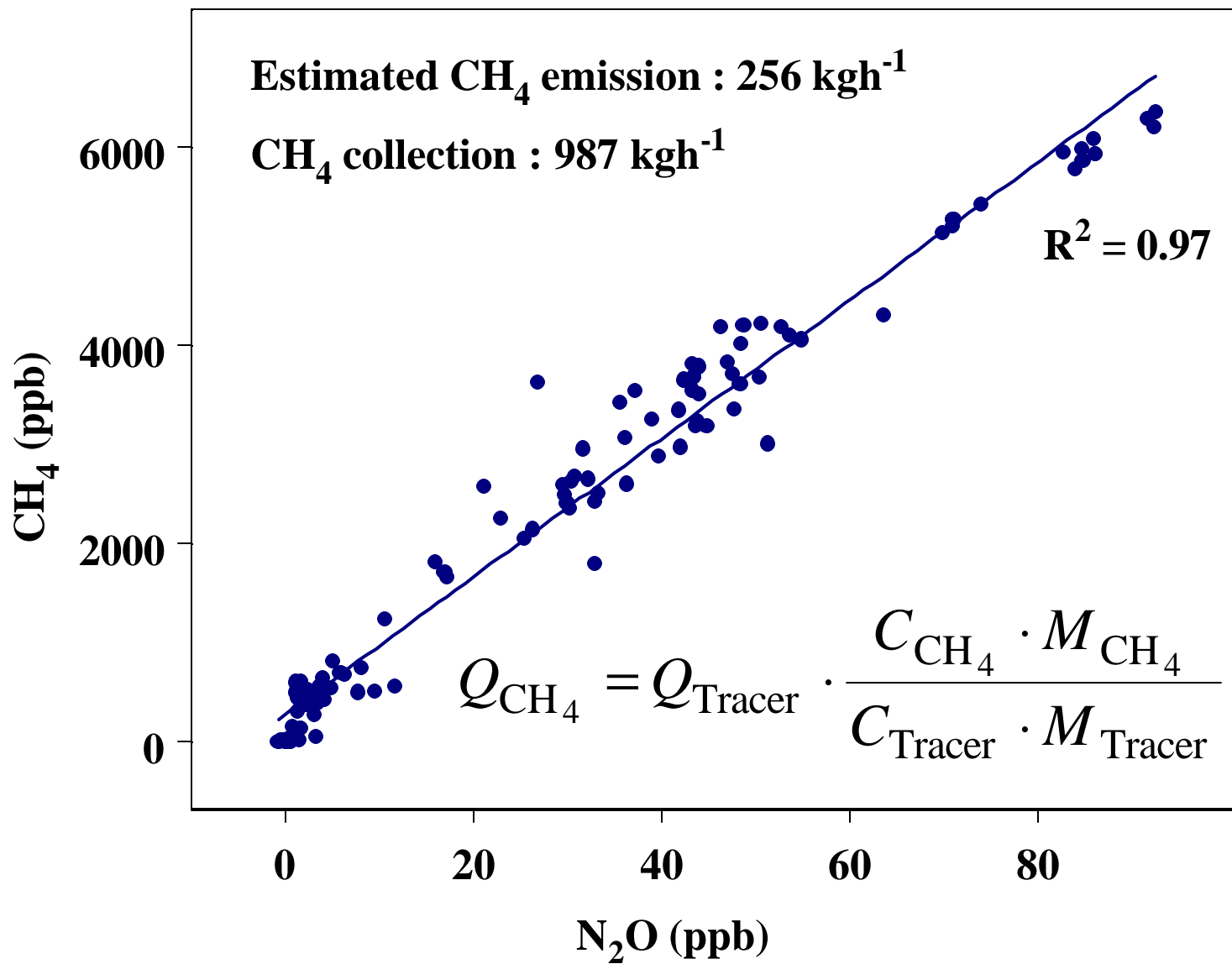
Filborna.shp
33.94
33.94 - 40
40 - 45
45 - 47
47 - 48
48 - 50
50 - 52
52 - 55
55 - 57
57 - 60
60 - 64
64 - 68
68 - 72
72 - 76
76 - 84

Measurement distance
1-3 km from landfill

● Source of
   tracer gas (N_2O)

N
W — E
S

Wind direction

Estimated CH_4 emission : 256 kgh^{-1}

CH_4 collection : 987 kgh^{-1}

$R^2 = 0.97$

$$Q_{CH_4} = Q_{Tracer} \cdot \frac{C_{CH_4} \cdot M_{CH_4}}{C_{Tracer} \cdot M_{Tracer}}$$

CH$_4$ (ppb)

N$_2$O (ppb)

Date	Gas collection kg CH_4 h^{-1}	Emission to atmosphere kg CH_4 h^{-1}	R^2-value atm. emission	Methane oxidation estimate %	Total CH_4 production kg CH_4 h^{-1}	Atmospheric emission part of total CH_4 production %
4th Apr 01	852	308	0.94	12[*]	1202	25.6
16th Nov 01	832	385	0.94	12.20	1270	30.3
23rd Nov 01	820	441	0.82	10.30	1312	33.6
29th Nov 01	718[**]	547[**]	0.89	7.60	1310	41.8[**]
6th Dec 01	987	256	0.97	4.60	1255	20.4
7th Dec 01	1006	361	0.92	4.60	1384	26.1
2nd Jul 02	806	346	0.8	20[*]	1239	27.9

[*] Marked methane oxidation rates assumed or still not processed

[**] Gas collection system partly in start-up after some days of service stop

Calculation of the fraction of the degradable organic carbon that is converted to landfill gas, DOC_F - and comparison with model value

Industrial waste DOC

Householdwaste DOC

Tonnes DOC vs **Year** (1996, 1997, 1998, 1999, 2000, 2001/2002)
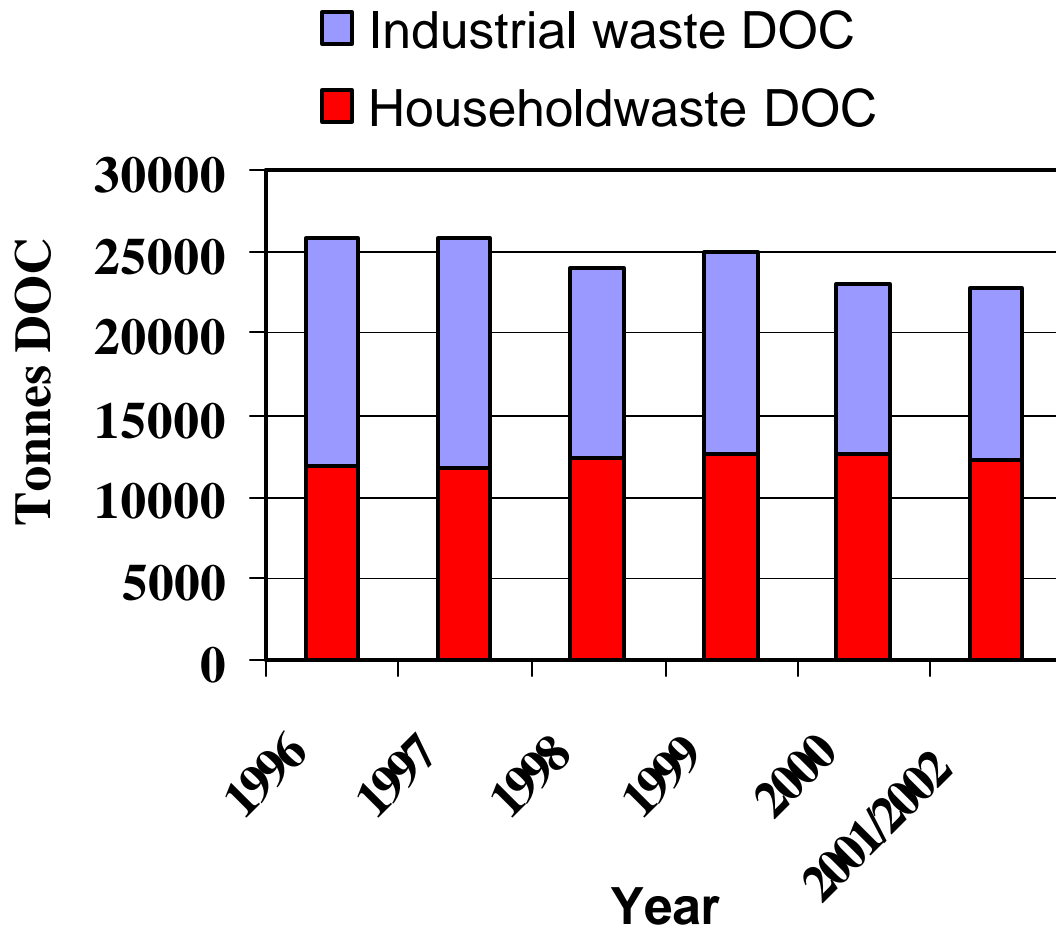
In case of a steady state situation the input of DOC should be stable and balanced by the total LFG production

Total CH$_4$ production, 7 measurements: **1282 kgh^{-1} ± 4.6%**

Extrapolated production Nov01-Jun02: **7444 tonnes CH$_4$**

$$CH_4 \ produced = \frac{CH_4 \ emitted \ to \ atmosphere}{1 - part \ oxidised} + CH_4 \ collected$$

$$DOC_F = \frac{CH_4 \ produced}{(DOC \ landfilled) \times (CH_4 \ content \ in \ LFG) \times (M_{CH4} / M_C)}$$

Methane content in the landfill gas, 7 measurements: **57.6 ± 5.9 %**

Total DOC landfilled Nov01-Jun02, based on
10 waste analyses (8 industrial, 2 household) by
the landfill operator: **14777 tonnes DOC**

Recommended value of the DOC_F factor for Sweden: **0.7**

DOC_F value obtained from the Filborna data: **0.66**

Outlook:

Short term variability in atmospheric CH_4 emission and influence of air pressure fluctuations (no clear tendency seen in the presented measurements, with air pressure ranging from 1001 to 1040 hPa, and gradients from -1.1 to 0.77 hPa h^{-1})

Final results of methane oxidation rates