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Project Summary

Measurement of Fugitive Emissions at a Region I Landfill

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The report discusses a field study to measure methane and hazardous air pollutant emissions from a superfund site in Somersworth, NH. The results will help determine whether active controls will be required at the site. Concentrations of each compound were measured, and fluxes (determined as the rate of flow per unit time through a unit area) were calculated for each compound detected. The study used an open-path Fourier transform infrared spectrometer and optical remote sensing-radial plume mapping. Measured surface methane concentrations ranged from 0 to 3.06 ppm above the global background methane concentration of 1.75 ppm, and hot spots with methane emissions up to 6.5 ppm average above the global background were located. The methane flux from the entire site was estimated to be 5.8 g/s. No hazardous air pollutants were detected.

This Project Summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Background

A field study was performed during September and October, 2002 by ARCADIS and the U.S. EPA to measure emissions from a superfund site in Somersworth, NH using an open-path Fourier transform infrared (OP-FTIR) spectrometer. The study involved a technique, developed through research funded by the EPA's National Risk Management Research Laboratory (NRMRL), that uses optical remote sensing-radial plume mapping (ORS-RPM) to evaluate fugitive emissions.

The focus of the study was to characterize the emissions of methane and hazardous air pollutants to assess landfill gas emissions from the site. The results will help determine whether active controls will be required at the site. Concentrations of each compound were measured, and fluxes (determined as the rate of flow per unit time, through a unit area) were calculated for each compound detected.

Site Information

The 26-acre Somersworth Sanitary Landfill, shown in Figure 1, is located in a predominantly residential area approximately 1 mile southwest of downtown Somersworth. Forest Glade Park, which was reclaimed as a recreational park in 1978, sits atop the easternmost 10 acres of the site. An apartment building for senior citizens, a fire station, and a National Guard Armory abut the property to the east, and an elementary school is located approximately 2,300 feet northeast.

The Somersworth site was divided into five rectangular survey subareas (A-E). Figure 1 presents the overall layout of the Somersworth Superfund Site, detailing the geographic location of each survey region. Additionally, the figure shows the location of the vertical scanning configuration, which was used to gather data in order to calculate emission fluxes for the entire site.

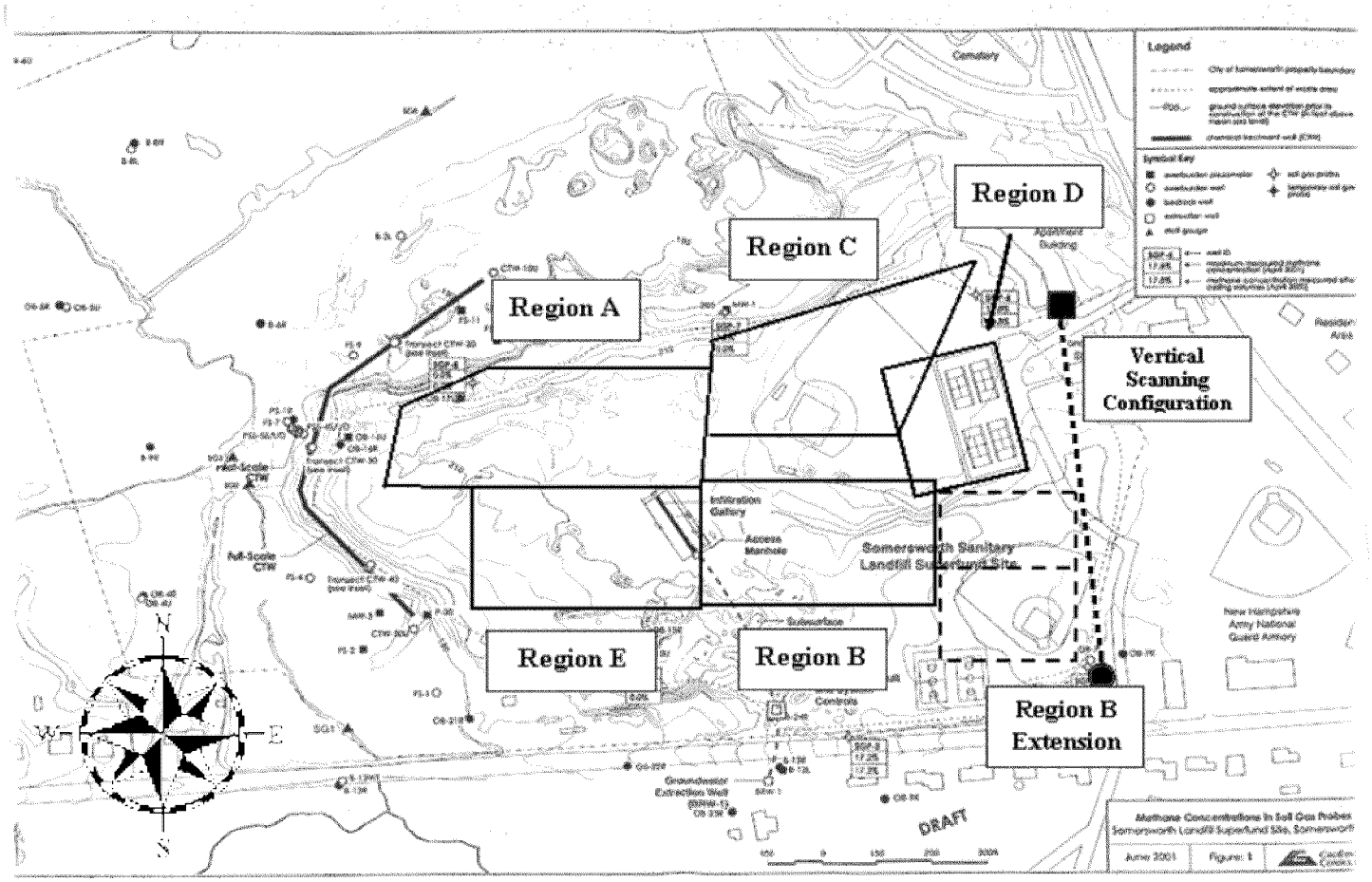

Figure 1. Map of the Somersworth Superfund Landfill showing the survey subareas.

Measurements

The ORS-RPM techniques used in the present study were designed to characterize the emissions of fugitive gases from area sources. Detailed spatial information is obtained from path-integrated ORS measurements by the use of optimization algorithms. The method involves the use of an innovative configuration of non-overlapping radial beam geometry to map the concentration distributions in a plane. This RPM method can also be applied to a vertical plane downwind from an area emission source to map the crosswind and vertical profiles of a plume. By incorporating wind information, the flux through the plane is calculated, which leads to an emission rate of the upwind area source.

Surface RPM

Surface scanning was performed in each of the five survey subareas shown in Figure 1 to search for emission hot spots. Area A is located in the northwestern section of the landfill site; Area B is located in the southeastern section of the site and includes a baseball field and basketball courts; Area C is located in the northern section of the site and includes a baseball field; Area D is located inside the chain-link fence of four tennis courts in the northeastern corner of the site; and Area E is located in the southwestern section of the site.

Vertical Scanning

Vertical scanning was done to determine the emission flux for each compound detected. The Vertical scan configuration was set up along the eastern boundary of the landfill site. This location was chosen because it was optimum for determining a flux that would be representative of the entire site under the given wind conditions. Figure 1 shows the location of the vertical scanning configuration. The dashed line shows the location of the vertical plane, the large dot shows the location of the OP-FTIR instrument, and the large square shows the location of the scissors jack.

Results

An emissions contour map of the entire site and identification of three emission hot spots was obtained from radial plume mapping. Vertical scanning enabled an estimate of the methane flux from the entire site to be made.

Surface RPM Results

Table 1 shows a range of the area-averaged methane concentrations in the five subareas. The measured surface methane concentrations ranged from 0 to 3.06 ppm above the global background methane concentration of 1.75 ppm. The average methane concentration was 1.03 ppm above global background.

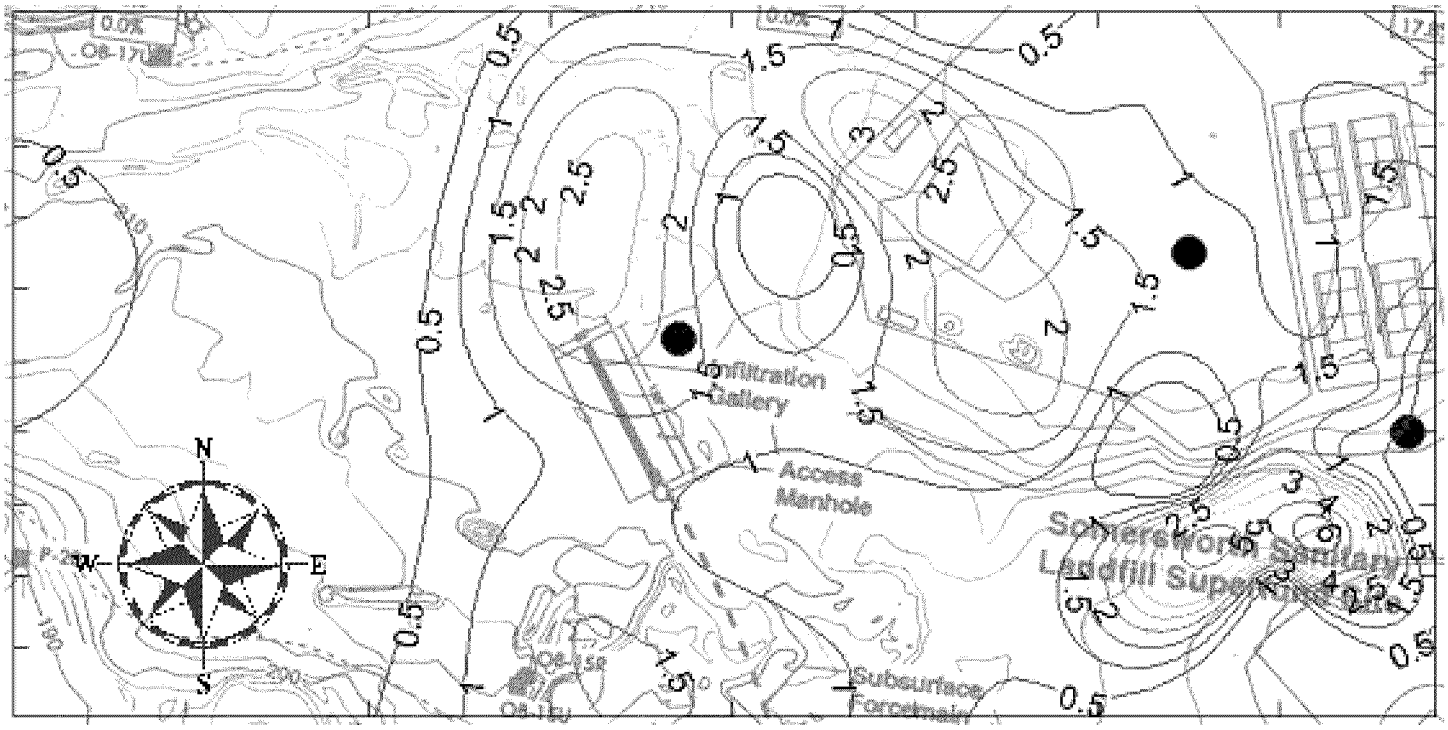

Figure 2. OP-FTIR RPM methane concentration contours overlaid on the map of the Somersworth Superfund Landfill.

Table 1. Range of mean methane concentrations above global background found in each survey subarea.

Area	Methane Concentration Range, ppm
A	0.00 to 2.69
B	0.56 to 1.83
C	0.00 to 3.06
D	0.00 to 1.91
E	0.00 to 1.44

Figure 2 shows the RPM-determined methane concentration contours overlaid on a map of the Somersworth site. The determination of this concentration map is based solely on the mean path-integrated measurements made in each survey sub-area and on six auxiliary path-integrated measurements made by an additional OP-FTIR instrument. Figure 2 shows methane hot spots in Area A (2.5 ppm above ambient), in the northwest corner of Area C (3.0 ppm above ambient), and in a small valley that lies north of the baseball field in Area B (6.5 ppm above ambient, the most intense). The Area B hot spot was identified in sub-area B, so an additional OP-FTIR instrument was set up in the valley and made six auxiliary measurements. Including these six measurements provided the detail showing the sharp concentration gradients shown in Figure 2. Strong methane emissions were located near an uncapped vent on the south slope of the valley adjacent to Area B.

Vertical Scanning Results

Vertical scanning was done on the eastern boundary of the landfill to determine a methane flux from the entire site, which was estimated to be 5.8 g/s. The methane flux from the hot spots found during the surface scanning survey was estimated to be 3.3 g/s, which represents 57% of the entire landfill emission.

Hazardous Air Pollutants

All data collected at the site (including data from surface and vertical scanning surveys) were analyzed for any chemicals that are not normally found in the atmosphere, and the analysis did not detect any of these chemicals at the site. This result is not surprising considering that the maximum methane concentration measured at the landfill was 6.5 ppm. The minor constituents (neglecting aliphatic hydrocarbons) occur in landfills at levels that are typically much less than 10^{-4} times the methane levels. Thus, the minor constituents of the landfill gases would be expected to be present at levels much lower than the detection limits of the OP-FTIR instrument.

Conclusions

The study employed OP-FTIR sensors to determine chemical concentrations over the entire area of the Superfund landfill in Somersworth, NH. The spatial information was extracted from path-integrated OP-FTIR measurements using the RPM method. A complete methane concentration contour map of the entire landfill was developed from these measurements, and methane emission hot spots (up to 6.5 ppm average above the global background) were located. In addition, the vertical scanning technique provided an estimate for the methane emission from the entire landfill of 5.8 g/s. The methane emission rate from the hot spots in the valley was determined to be 3.3 g/s, which is estimated to be 57% of the emission from the entire landfill.

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***Susan A. Thorneloe** is the EPA Project Officer (see below).*
The complete report, entitled "Measurement of Fugitive Emissions at a Region I Landfill," is available at http://www.epa.gov/appcdwww/apb/EPA-600-R-04-001.pdf or as Order No. PB2004-103034; Cost: $31.50, subject to change from:
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