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GIS for Health and Human Services

Spatial Analysis Gives Insight into Source of Legionnaires' Disease

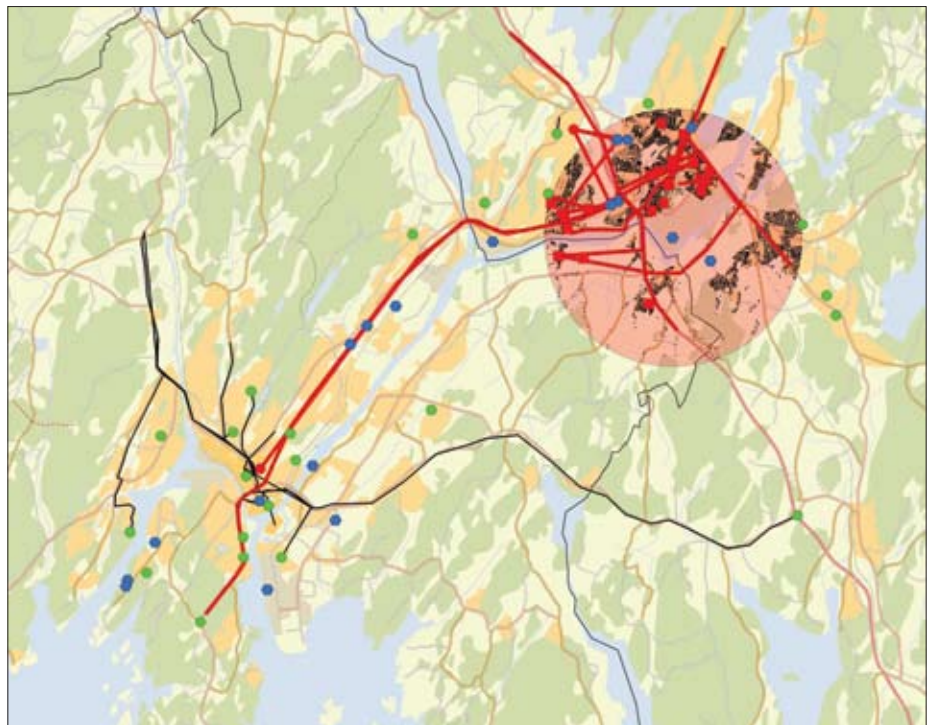
By Arleen Engeset, Key Account Manager, Geodata AS, and Tore Jensen, Technical Specialist, Geodata AS

When a hospital in Norway alerted national health authorities about an outbreak of Legionnaires' disease, authorities reacted quickly to find the disease source. They used geographic information system (GIS) technology tools for data mapping, time series analysis, and visualization to analyze more than 50 cases of the infection. Although infected patients were scattered over a large area with no places visited in common, the tools provided by ESRI's ArcGIS software helped reveal a unique and unusual source of dispersal for the bacteria—a commercial air scrubber that released infected water droplets into the air. Geodata AS, ESRI's distributor in Norway, provided consulting services for mapping and finding the probable source of the outbreak based on GIS analysis.

Legionnaires' disease is a severe form of pneumonia caused by the *Legionella pneumophila* bacterium. The bacterium is most commonly transmitted by airborne droplets from contaminated water sources, such as cooling towers used in industrial systems, and is not readily transmitted from one person to another.

The Legionella epidemic took place in May 2005 in the neighboring municipalities of Fredrikstad and Sarpsborg. Together, the two cities form the fifth-largest urban area in Norway, with a total population of about 121,000. The outbreak was one of the biggest health crisis situations that Norwegian municipalities had dealt with in recent years.

Time was of the essence to prevent more cases, but multiple and complex questions



An analysis of a three-kilometer buffer from the air scrubber (blue symbol in the middle) shows Legionella patients residing within the buffer (red boxes) and infected patients who live outside the buffer (red dots) and traveled through (red line) the buffer zone. Green dots show infected patients who live outside the buffer zone and have not traveled through it.

needed to be answered before the contaminated source could be identified. How many people were infected? Where did they live, travel, or work, and what were the most likely sources of infection? Control of the situation depended on the speed at which these and other questions could be answered, mapped, and analyzed.

Data collection methods conducted by health department personnel included interviews with infected patients and investigation of potential sources including 23 companies with cooling towers. Data collected for mapping in ArcGIS

ArcInfo included

- Infected patients' places of residence
- Locations of cooling towers and other possible sources of infection
- Infected patients' movements over a 12-day period (280 routes)
- Wind and weather conditions

"GIS was helpful for this task, because digital mapping presents large data volumes in a simple and well-ordered manner, which is critical for the actual analysis itself," explains Øivind Werner-Johansen, director of health for the city and municipality of Sarpsborg.