

# Legal Fuzziness

There's a good chance you spent some time at the coast this summer, and you probably walked along the beach. Cast your mind back for a moment and try to pinpoint the exact boundary between land and sea. It can't be done - the natural engine induced by tides and winds does not allow you to demarcate the exact frontier with a stick in the sand. The fluctuation of the sea washing back and forth over the sand creates a transition zone, where the shore can be classified both as partly land and partly sea.

Way back in the 1960s, soil scientists and other geoscientists succeeded in mathematising their understanding of physical processes taking place in the real world. They digitised the boundaries drawn on soil or geological maps and stored their models and data on computers. But their output was erroneous - not because of failures in micro-electronics but because the boundaries digitised from the maps were not exact, as their algorithms assumed. They indicated a transition zone similar to what you would have noticed while walking along the beach, asking yourself 'Where is the boundary?' The geoscientists found the solution in a new theory on sets developed by Zadeh and other researchers around 1965. In contrast to conventional set theory, in which membership to the class sea, for example, is expressed on a binary scale -that is a point along the shore belongs either to the class sea or to the class land - this extension to the conventional theory, called fuzzy set theory, allows a point on the beach to belong for 30% to the class sea and for 70% to the class land.

Soil scientists are not the only ones to be confronted with transition zones; so too does the cadastral surveyor who has to measure the boundary between grassland, owned by a farmer, and the adjacent ditch owned by the municipality. Since reeds and other vegetation cover the bank, the transition between the ditch and the grassland is not clear-cut, as it would be in the case of a stone building; instead, the boundary is fuzzy. The surveyor's equipment is able to determine points at millimetre precision, but reality does not allow the boundary to be defined with such precision. What he would like to conclude is: 'The bank may be partly owned by the farmer and partly by the municipality, and the closer you move to the ditch, the greater the percentage of ownership by the municipality until ownership reaches 100%.' But no legal system anywhere in the world allows for such fuzzy definitions of ownership; legal systems are based on clear-cut boundaries and conventional set theory.

This is what [Bennett and Van der Molen](#), though coming from another direction, point out when stating: "... idealisation precision, survey precision, reliability strips are normally wasted on judges." This article is a continuation of the dialogue on 'Towards Cadastre 2034' started in the July 2010 issue of GIM International and a 'must read' for cadastral surveyors.