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Soil-related geohazard assessments for maintaining the UK's minor road network

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The minor road network of the UK (United Kingdom) encompasses 98% of the overall road network. In recent years the UK's roads have been deteriorating, currently rated 26th in the world and considered at risk and declining by the Institution of Civil Engineers (ICE). Many factors contribute to the degradation and ultimately, to the failure of particular road sections.
However, several UK local authorities have identified that during drought conditions, road sections founded upon clay soils which are susceptible to volumetric shrinkage and swelling undergo significant deterioration compared to those sections on non-susceptible soils. Droughts in East Anglia recently resulted in estimated damages of £26 million, leading several local authorities to apply to Central Government for emergency funding. The minor or evolved road network is most at risk due to them having often little, if any, structural foundations.

This paper addresses the use of soil-related geohazard assessments and GIS (Geographical Information Systems) in helping to provide a soil-informed maintenance strategy for the asset management of the important (both socially and commercially) local road network of the UK. Furthermore, to establish future subsidence risk, UKCP09 climate projections have been used to model the likely potential soil moisture deficit (PSMD) for baseline (1961-1990), 2030 (2020-2049) and 2050 (2040-2069) scenarios. The incorporation of probabilistic PSMD data into clay-related subsidence models has allowed an assessment of potential subsidence risk, with a range of uncertainties, for these scenarios. Intersection of road networks with future projections of subsidence risk has enabled metrics of potential vulnerability to be established. This will aid prioritisation of areas which require further maintenance to make them more climate resilient, avoiding emergency funding situations. Subsequently, this approach can then be extrapolated to the entire UK minor road network, on a local authority level, to provide a series of regional risk assessments.

Case studies are drawn from the UK administrative counties of Lincolnshire and Worcestershire. Data from observed road assessments, obtained from the respective local authorities have been analysed and intersected with clay-related subsidence risk. Lincolnshire County Council have already implemented this research to prioritise approximately £600,000 of road maintenance fund to their minor road network. Further appreciation of the spatial distribution and understanding of soil-related hazards has also led Lincolnshire County Council to trial new resurfacing strategies; these new techniques helping to reduce carbon outputs in the form of materials and transport. A reduction in the amount of potential hazardous (bituminous) waste to landfill is also being achieved through re-inclusion of waste material back into the road foundation where areas are particularly prone to soil shrinkage.

Our research shows that soil-related geohazard assessments have a part to play in the asset management of the UK's local highways network. The study supports the ICE's recommendation for a regime which moves towards planned, preventative maintenance and achieving Defra's (Department for Environment, Food and Rural Affairs) aim of a climate resilient UK infrastructure. The methodology introduced here also has applicability to other countries, where appropriate soils and infrastructure data are available.