

Groundwater And Soil Pollutants (GRASP): a city-scale screening tool using soil geochemical data to assess threats to shallow groundwater quality

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Groundwater is a key pathway for pollutants moving from soils and the shallow subsurface to surface water and ecological receptors, as well as a receptor in its own right. Integrated protection of the water environment and related ecosystem quality is a key aspect of the EU Water Framework Directive and other environmental legislation. However, although urban areas are often where groundwater and the wider water environment are most need of protection, data on threats to groundwater quality are frequently lacking. Most studies of urban soil and groundwater contamination are detailed but site-specific; city-wide overviews are generally lacking.

The British Geological Survey's (BGS) Clyde Urban Super-Project (CUSP) is developing a range of multi-disciplinary geoscience products for Glasgow, UK. Among these is a GIS-based prioritisation tool – GRASP (GRoundwater And Soil Pollutants) – which provides a broad-scale assessment of threats to groundwater quality across the city. GRASP identifies areas where shallow groundwater quality is at greatest threat from the leaching of potentially harmful metal contaminants in the soil, which derive from the city's industrial past.

GRASP builds on an existing BS–ISO methodology for determining the leaching potential of 11 metals from soils (Al, Fe, Cd, Co, Cr, Cu, Hg, Ni, Mn, Pb and Zn). GRASP is innovative in combining assessments of soil leaching potential with soil metal content data to highlight threats to shallow groundwater quality. The input parameters required (soil pH, clay, organic matter, sesquioxide and metal content) are derived from a systematic geochemical dataset of 1600 soils (4 per km²) collected across Glasgow as part of BGS's Geochemical Baseline Survey of the Environment (G-BASE). These are combined with assessments of climate, groundwater levels, and the leaching potential of unsaturated Quaternary deposits, to produce maps prioritising likely threats to shallow groundwater quality. Data processing is carried out in five steps using Visual Basic® programming language and ArcGIS® software. GRASP is in the process of development; however, the rationale and initial derivation of the methodology will be presented.

GRASP can help us to understand groundwater pollution sources, migration and attenuation, particularly when combined with further hydrogeological information, such as the 3D geometry of shallow aquifers. It can support both groundwater quality modelling and assessments of the ecological health of surface water environments. GRASP could also be used to highlight areas at greatest threat of metal leaching from increased water infiltration, either as a result of sustainable urban drainage systems (SUDS) or of changing climate. Therefore, it could have important application as part of screening tools for developing SUDS on a city-wide scale.