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Combining sub-field scale soil sampling and GIS interpolation techniques for mapping nutrient hotspots

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The EU Water Framework Directive (WFD) aims to target prevalent poor water quality status. Of the various contributing sources agriculture is particularly important due to the high loading rates of sediment and nutrient losses associated with fertilisation, sowing, and cropping regimes. Understanding soil nutrient status and the potential pathways for nutrient loss either through point or diffuse sources is an important step to improve water quality from an agricultural perspective. Research has demonstrated extensive in-field variability in soil nutrient status. A sampling regime that explores this variability at a sub-field scale is necessary. Traditional soil sampling consists of taking 20-30 cores per field in a W-shaped formation to produce a single bulked core, however, it generally fails to locate nutrient hotspots at finer resolutions. Inappropriate generalised fertilisation and management recommendations can be made in which nutrient hotspots or deficient zones are overlooked. Gridded soil sampling can reveal the full degree of in-field variability in nutrient status to inform more precise and site-specific nutrient applications. High soil phosphorus levels and the concept of legacy nutrient accumulation due to long-term over-application of phosphorus fertiliser in addition to animal slurry is a problem across the island of Ireland.

This research aims to locate and quantify the presence of soil nutrient hotspots at several field-scale locations in the cross-border Blackwater catchment in Northern Ireland / Republic of Ireland. Based on 35 m sampling grids, the nutrient content at unsampled locations in each field was determined using GIS interpolation techniques. Particular attention was paid to phosphorus, given its role in eutrophication. Gridded soil sampling enables the identification of nutrient hotspots within fields and when combined with an analysis of their location in relation to in-field landscape characteristics and knowledge of current management regimes, the risk of nutrient or sediment loss potential may be defined. This research concluded that traditional W soil sampling of producing one average value per field is not appropriate to uncover the degree of spatial variability in nutrient status and is inappropriate for catchment management of agricultural systems for controlling nutrient losses. Soil sampling at multiple locations per field is deemed to be cost-prohibitive for many farmers. However, sub-field scale soil sampling and appropriate

geostatistical interpolation techniques can reveal the degree of variability and suggest an appropriate resolution for field-scale nutrient management that may be necessary to achieve measurable improvements in water quality.