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Subsurface Transport of Phosphorus in Alluvial Floodplains

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Abstract:

For phosphorus transport from upland areas to surface water systems, the primary transport mechanism is typically considered to be surface runoff with subsurface transport assumed negligible. However, certain local conditions can lead to an environment where subsurface transport may be significant. The objective of this research was to determine the potential of subsurface transport of phosphorus along streams characterized by cherty or gravelly subsoils. At a field site along the Barren Fork Creek in northeastern Oklahoma, a trench was installed with the bottom of the trench at the topsoil/alluvial gravel interface, and several piezometers were installed at various locations surrounding the trench. Water was pumped into the trench to maintain a constant head, and a conservative tracer (Rhodamine WT) and potassium phosphate solution were injected into the trench. Rhodamine WT and phosphorus were detected in some piezometers at equivalent concentrations as measured in the trench, suggesting the presence of preferential flow pathways. Electrical resistivity equipment was used to create three-dimensional maps of the subsurface electrical properties near the trench. Since soil resistivity is dependant on particle size, as well as other soil properties, the preferential flow pathways were located in the resistivity data. Electrical resistivity surveys were also performed throughout the riparian floodplain to document the size and extent of the preferential flow paths. Currently, an additional piezometer field is being installed in order to quantify the activity of the preferential flow pathways and to estimate the subsurface phosphorus load to streams. Water levels in the piezometers will be monitored real-time using pressure transducers. Also, phosphorus samples will periodically be obtained from the piezometers and in the stream to document concentration gradients over time. The potential for nutrient subsurface transport shown by this alluvial system has implications regarding management of similar riparian floodplain systems.

Impact Statement:

This research reports that subsurface movement of phosphorus can be an important transport mechanism, especially in areas such as riparian floodplains which possess hydraulic conditions conducive to the rapid transport of phosphorus. The movement of water and contaminants in riparian floodplains, even those classified as non-structured, coarse gravel, is not homogeneous and can be impacted by the presence of preferential flow pathways.

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