Water Quality Data Require Context for Regulatory Decisions (Newsletter)*

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It is common to read statements like this: "... EPA found that 20 percent of 331 wells tested had nitrate levels above federal drinking water standards ..." Such statements contain no useful information because they lack context.

To put this statement in context we need much more information. For example: where are these 20% located in relation to all 331 wells, what time of year were these high nitrate concentrations observed, and how frequently did they occur? This would be a start, yet still not complete enough to support sound regulatory or judicial decisions.

Most water discharge permits specify compliance monitoring at specific locations and times; if either (or both) are changed by the regulator this limits long term analyses and the opportunity to determine causation.

All ecosystems constantly change, but on different time scales. Aquatic ecosystems are more variable than terrestrial ecosystems, and surface waters are more variable than ground waters. In all ecosystems variability is both spatial and temporal; unformed decisions are likely outcomes unless both spatial and temporal variability are included in analyses. Decisions made on incomplete analyses can be costly to permit holders, hinder resolution of the perceived problem, and prevent determining the cause(s) of the issue being addressed.

There are statistical spatio-temporal models that produce robust analyses of point data (e.g., ground water monitoring wells) and areal data (e.g., land use and cover, geology, and soil map units). To discover the cause of a variable of interest requires collecting data on potential explanatory variables (e.g., physical and biological, geographic, anthropogenic activity) at the same time and location as data on the response variable of interest.

Few monitored areas have sufficiently-well designed sample locations. For example, if the concern is leakage of metals or non-volatile organic compounds into soils and ground water under a closed landfill, then a single up-gradient "control" monitoring well is insufficient. Even when the hydrogeologists map ground water flow under the landfill a single well cannot determine what might be flowing under the landfill and detected at multiple down-gradient monitoring wells. The landfill's responsible party might be held accountable for undesired chemicals (or concentrations) down-gradient from the site that actually originated up-gradient.

Another example seen in a draft proposal for total maximum daily loads (TMDLs) for a river's main stem, with fecal coliform bacteria colony counts as one component to be limited. The regulator assumed that agricultural lands in a large tributary were the source of the bacteria. Their data consisted of a few samples in the mainstem of the river, downstream from the tributary's confluence. There were no data presented from anywhere in the tributary network nor upstream from the confluence along the main stem of the river. Proposing restrictive regulations based on such data is neither technically sound nor legally defensible.

Fines, penalties, and costly remedial actions result from incidents where an aquatic chemical constituent exceeded a maximum concentration level. The regulator is not required to document that this actually harmed any specific beneficial use; the exceedence itself is sufficient. The operator is assumed to be responsible without robust investigation using an adequate amount of data and robust, appropriate analytical models. Regulatory science can be improved using the tools and knowledge acquired over the past few decades. There is no justification for applying 1970 approaches to Clean Water Act compliance in the 21st century.

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