Session E3: Real-time Surrogates

Room B117-119
10:30 am – 12:00 pm

0040
E3-1

Use of Real-Time Monitoring to Predict Concentrations of Select Constituents in the Menomonee River Watershed, Milwaukee, Wisconsin

Austin Baldwin[1], Dave Graczyk[1], Christopher Magruder<sup>2<sup>, Dale Robertson[1] and David Saad[1]

[1]*US Geological Survey, Middleton, Wis., USA,* [2]*Milwaukee Metropolitan Sewerage District, Milwaukee, Wis., USA*

The Menomonee River Watershed in southeast Wisconsin will undergo a number of changes in the coming years, including channel restorations, flood management projects, and urbanization of the headwater basins. In 2008 the US Geological Survey and the Milwaukee Metropolitan Sewerage District initiated a study in the watershed to develop regression models as a way to estimate real-time water-quality concentrations, loads, and exceedances. Real-time water-quality sensors and automated samplers were installed at six sites in the watershed. The sensors continuously measured the explanatory variables: water temperature, specific conductance, dissolved oxygen, and turbidity. Automated samplers collected between 39 and 101 discrete samples per site over a one-year period, which were analyzed for the response variables: chloride, suspended solids, total phosphorus, *E. coli*, and fecal coliform. Simple and multiple linear regression models were developed to estimate the response variables based on the explanatory variables. The resulting models are used to calculate continuous estimates of the response variables suitable for evaluating exceedance criteria in the sampled streams. Managers will use the models to identify problem areas and help prioritize improvement projects, protect the public and aquatic fauna from potential health threats, and establish TMDLs. Over the long term, managers may be able to use these data to measure trends and evaluate the effects of improvement projects on water quality.

0091
E3-2

Continuous Monitoring of Total Phosphorus in the Reedy River through Implementation of Empirical Regression Equations

Benjamin Hammond[1], Judy Wortkoetter<sup>2<sup> and James Riddle[1]

[1]*Woolpert, Inc., Columbia, S.C., USA,* [2]*Greenville County Public Works, Greenville, S.C., USA*

The determination of the health of a waterbody has historically been based on random, grab sampling programs implemented by regulatory agencies. Fiscal and personnel resource limitations often restrict these agencies from collecting data as frequently as is necessary to accurately characterize water quality constituent concentrations, concentration fluxes, and potential sources. In addition, stream flow and hydrologic conditions are often not included in field notes making it difficult to distinguish between dry weather and wet weather results. Despite these limitations in water quality data, regulatory agencies are generally forced to take a one-size-fits-all approach in the application of this data for NPDES permitting, 303(d) listings, and the development of TMDLs. A more comprehensive approach to reliable water quality monitoring is the use of continuous monitoring instrumentation which includes water quality and hydrological metering devices.

In the spring of 2008, Greenville County, SC instituted a continuous monitoring program, utilizing YSI 6600 datasondes (outfitted with temperature, turbidity, pH, dissolved oxygen, specific conductivity, and ammonium sensors) and Hydrological Services tipping bucket rain gauges. While continuous water quality data proved useful for assessing general trends and fluxes during varying hydrologic conditions, the County lacked the ability to continuously monitor the pollutants named in various developing TMDLs. In response to a pending TMDL for total phosphorus (TP) in the Reedy River, the County began an effort to develop surrogate-based regression equations that would allow the County to estimate TP (and other pollutants) concentrations using other continuous parameters.

Site-specific regression equations (selected using the PRESS statistic, RMSEs: 0.039-0.053) were developed from more than twenty-four months of paired continuous and traditional grab sampling data collected at six continuous monitoring stations located along the Reedy River. The result of the County's efforts is a highly frequent characterization of TP concentrations at critical locations along the Reedy River. The regression approach will yield much more accurate annual TP loads than traditional sampling methods and/or watershed-scale pollutant load models and should greatly assist in the assessment of potential sources along the Reedy River.

0150
E3-3

Applications of Fluorescence Spectroscopy to Predict Wastewater in an Urban Stream

Jami Goldman[1,2], Stewart Rounds[1] and Joseph Needoba[2]

[1]US Geological Survey Water Science Center, Portland Oreg., USA, [2]Oregon Health and Science Univ., Beaverton Oreg., USA

In an urban watershed, anthropogenic influences can cause detrimental effects on the region's rivers and streams and lead to negative impacts on water quality. Determining the water quality and health of these aquatic ecosystems requires identification of natural and anthropogenic influences and an understanding of the seasonal hydrologic cycle. Dissolved organic carbon (DOC) represents a significant carbon reservoir in all ecosystems and can be used as a means to measure the characteristics and sources of organic matter in aquatic environments. Fluorescence spectroscopy can be used to quantify and characterize a subset of the DOC pool, the colored dissolved organic matter (CDOM), which can absorb and re-emit energy as fluorescence. This study utilizes fluorescence spectroscopy to characterize organic carbon in the Portland, Oregon urban watershed temporally and spatially and traces the anthropogenic signature found in wastewater effluent associated with treatment plants. Samples were collected from multiple sites within and outside the urban area and from effluent of two different wastewater treatment plants. Several statistical approaches were used to develop a model to predict the amount of wastewater present in a stream sample: end-member mixing experiments were conducted to demonstrate the linearity of fluorescence; principle component analysis was used to distinguish sources and characteristics of the organic matter; and a multivariate linear regression model was built using three key fluorescence peaks to characterize the organic matter. The model was tested with independent data and predicts the percentage of wastewater in a sample within 80% confidence. The model results can be used to develop *in situ* instrumentation, inform monitoring programs, and develop additional water quality indicators for aquatic systems.

0420
E3-4

Real-Time Monitoring to Estimate Bacteria Concentrations in Midwest Urban Streams Providing the Public with Continuous Water Quality Information

Gary Welker[1], Jeff Robichaud[1], Laura Webb[1], Shawn Henderson[1] and Jejung Lee[2]

[1]US Environmental Protection Agency, Kansas City, Kans., USA, [2]Univ. of Missouri - Kansas City, Kansas City, Mo., USA

The US Environmental Protection Agency (USEPA) in Kansas City has deployed real-time satellite telemetry units on nine urban streams in the greater Kansas City area to estimate in-stream bacteria levels and provide the public with real-time data via the internet on KCWaters.org. In-stream water YSI sondes have been installed that measure continuous turbidity along with temperature, conductivity and stream levels. Multiple co-located bacteria and turbidity samples have been taken at each stream site under a gradient of stream flow conditions. Co-located bacteria and turbidity data are used to develop regression equations for bacteria-turbidity relationships for each stream site location. Using this relationship, continuous in-stream turbidity measurements are converted to estimated bacteria using data acquisition software. The data acquisition software (Wiski) retrieves data from the National Oceanic and Atmospheric Administration's (NOAA) geostationary operational environmental satellites (GOES) network, stores the data in a time series optimized relational database and calculates estimated bacteria concentrations. Estimated bacteria levels are provided to the public at real-time speed in a simple, easy to understand format on our website at KCWater.org located at the University of Missouri–Kansas City.