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Incorporating Emerging Sensor Technologies Into Existing Near-Real-Time Water-Quality Monitoring Stations

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INCORPORATING EMERGING SENSOR TECHNOLOGIES INTO EXISTING NEAR-REAL-TIME WATER-QUALITY MONITORING STATIONS

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Concern about the security of civilian and military water supplies has accelerated the development of new sensors for monitoring contaminants in water. Water suppliers and Federal, State, and local agencies interested in water security are seeking to take advantage of emerging sensor technologies. Successful use of new sensors requires that their deployment be accomplished in a manner that provides valid information about the system being monitored. Advance field-testing is recommended as a means to assess sensor performance under actual operating conditions. Near-real-time gaging stations (Figure 1) that collect continuous water-quality data could serve as convenient platforms for advance field-testing and subsequent deployment of new sensors.

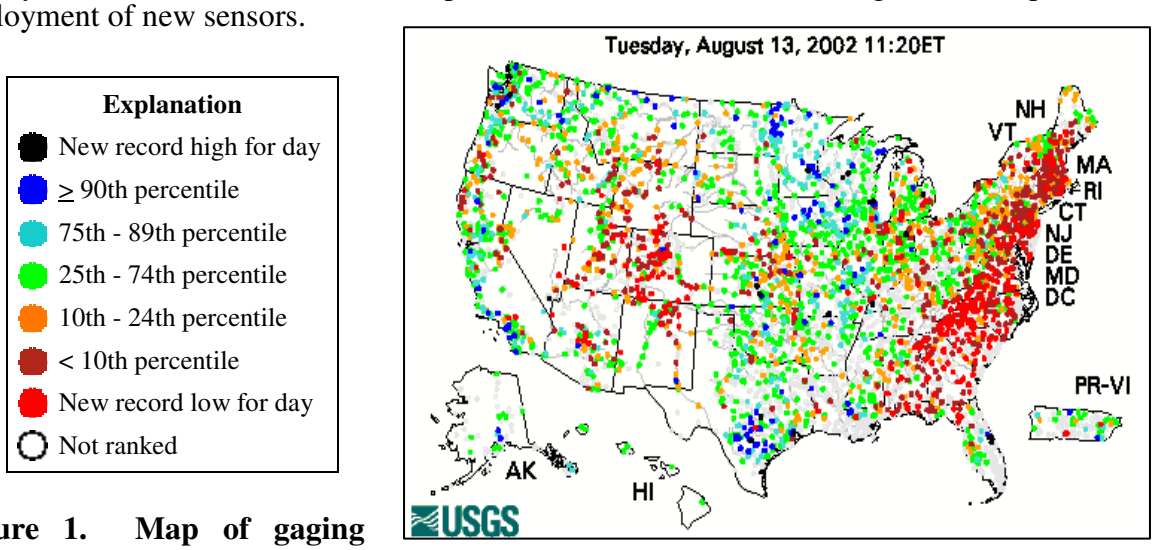

Figure 1. Map of gaging stations maintained by the U.S. Geological Survey as part of the near-real-time data network.

The colored dots on this map depict streamflow conditions as percentiles, which are computed from the period of record for the current day of the year. Only stations with at least 30 years of record are used.

The **gray circles** indicate other stations that were not ranked in percentiles either because they have fewer than 30 years of record or because they report parameters other than streamflow. For example, some stations measure stage only.
[Map obtained from http://waterdata.usgs.gov/nwis/rt on August 13, 2002.]

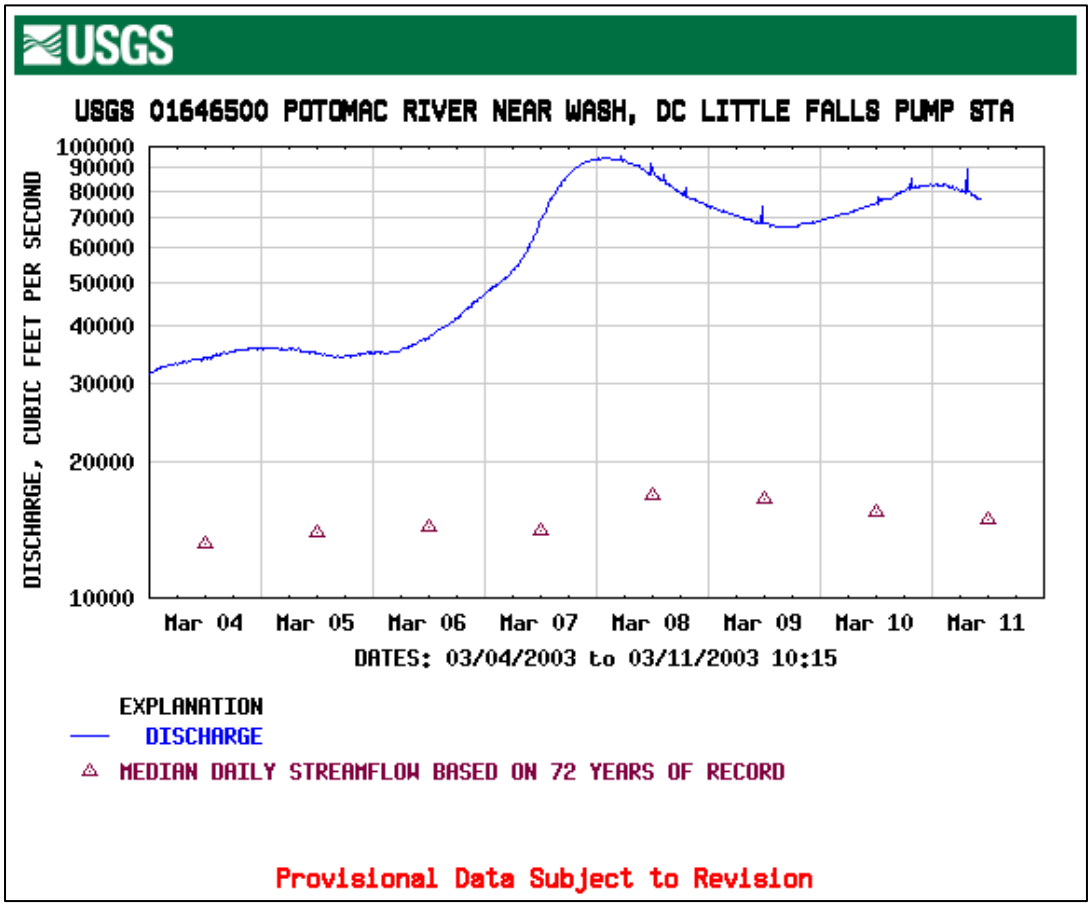

Figure 2. Example of near-real-time stream discharge data available through NWISWeb. [Plot obtained from http://waterdata.usgs.gov/md/nwis/uv?01646500 on March 11, 2003.]

The U.S. Geological Survey (USGS) currently maintains a national near-real-time data network (Figure 1) that includes over 5,000 gaging stations, several hundred of which measure two or more water-quality parameters. Nearly all of these stations measure stream discharge (Figure 2), which is necessary to understand flow conditions and to calculate contaminant loads. Water-quality parameters that most commonly are measured at near-real-time gaging stations include specific conductance (Figure 3), water temperature, pH, dissolved oxygen, and turbidity. Some stations measure additional parameters, including salinity, oxidation-reduction potential, fluorescence, ultraviolet (UV) absorbance, selected individual ions (for example, chloride, ammonium, and nitrate), and weather conditions, such as wind speed, air temperature, and precipitation. Data typically are recorded at 15-60 minute intervals, stored onsite, and then transmitted to USGS offices every 4 hours. Data are available to the public through NWISWeb, at URL http://waterdata.usgs.gov/nwis/rt.

Advantages of deploying new sensors at currently operating near-real-time stations include the availability of data logging and transmission equipment, shelter to protect sensitive instrumentation (Figure 4), a power source (electricity or battery), and for some stations, an autosampler to archive water samples for analysis. An additional advantage is the potential use of near-real-time data from proven technologies to supplement and support the interpretation of

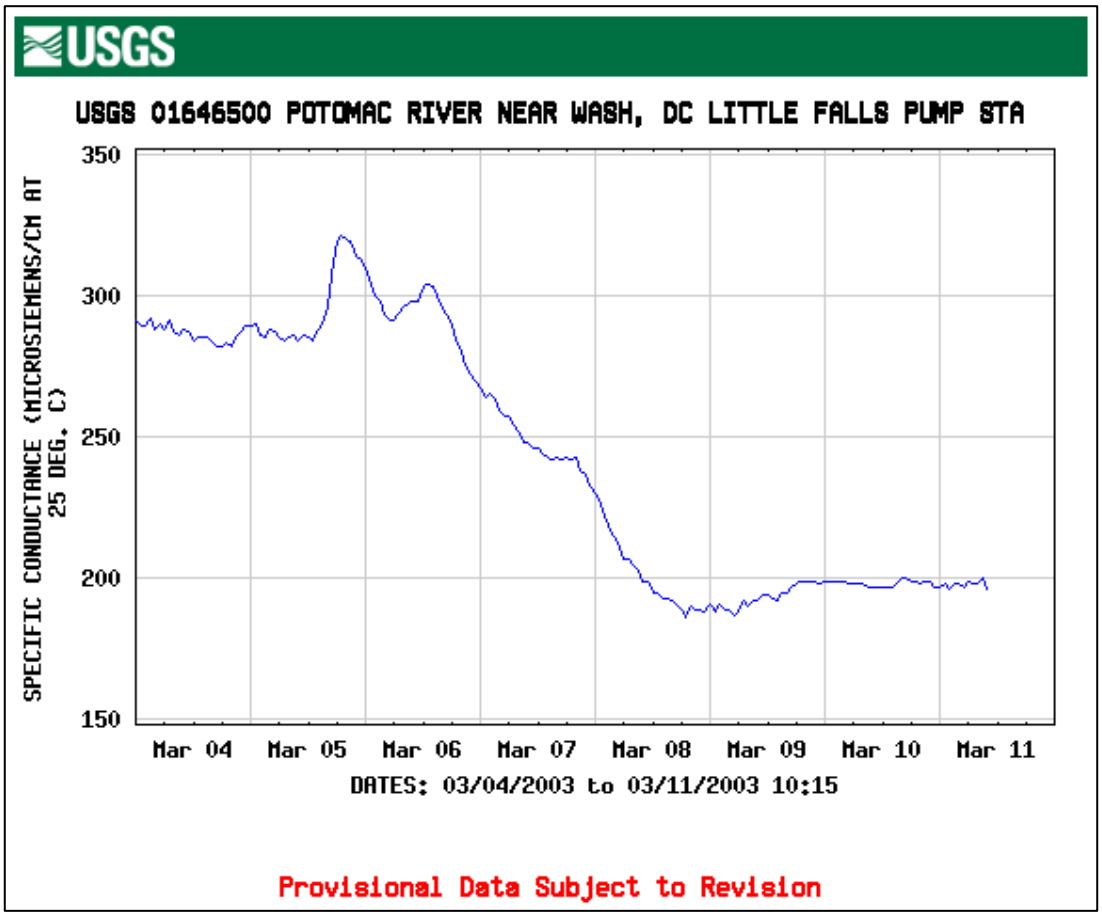

Figure 3. Example of near-real-time specific conductance data available through NWISWeb. [Plot obtained from http://waterdata.usgs.gov/md/nwis/uv?01646500 on March 11, 2003.]

data obtained from new sensors. For example, parameters that are now routinely measured (such as specific conductance or turbidity) would likely correlate with some of the parameters that would be monitored with new technologies, and the ability to identify digressions from such correlations would be useful in the determination of which water conditions notably affect sensor performance. "Indicator parameters" also potentially could be identified and used to (1) provide early warning of a change in water conditions, (2) trigger a system to archive a water sample for later analysis, or (3) increase the frequency of measurement.

Technical considerations for testing new sensors include determining current background levels of the target analytes, quantifying natural variability associated with diurnal patterns, seasonality, or precipitation events, and anticipating conditions that can interfere with sensor performance. Following successful field-testing, deployment of new sensors in conjunction with current water-quality monitoring technologies at near-real-time stations would allow for timely water-quality data transmission. This would enable a prompt response to critical events, such as an accidental or intentional release of a contaminant. With sufficient funding and support, a comprehensive network of near-real-time water-quality monitoring stations could be developed to support the needs of National and local emergency preparedness programs.

Figure 4. Example of a U.S. Geological Survey gaging station (USGS 01598500 NORTH BRANCH POTOMAC RIVER AT LUKE, MD)

[Photograph obtained from http://waterdata.usgs.gov/wv/nwis/uv?01598500 on March 11, 2003.]

REFERENCES

NWISWeb Real-Time Data for the Nation, most recently accessed on March 11, 2003, at URL http://waterdata.usgs.gov/nwis/rt.

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