Village Blue: Real-time water quality monitoring and providing water quality information to the Baltimore Community

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Kevin Oshima

Office of Research and Development
Notice: Although this work was reviewed by EPA and approved for presentation, it may not necessarily reflect official Agency policy.
• How to more fully realize the potential of using real-time water sensors to understand processes that influence water quality in watersheds

• Seek innovative approaches for informing partners and communities on the status/challenges with water quality

• A demonstration project would be helpful to address these issues
EPA and the US Geological Survey (USGS) have initiated the “Village Blue” research project to provide real-time water quality monitoring data to the Baltimore community and increase public awareness about local water quality in Baltimore Harbor and the Chesapeake Bay.

The Village Blue demonstration project complements work that a number of state and local organizations are doing to make Baltimore Harbor “swimmable and fishable” by 2020.

USGS has set up a new real-time monitoring site upstream of the Waterfront Partnership of Baltimore Inner Harbor Water Wheel.
Village Blue Demonstration Project: Goals

• Characterize the performance of water sensors (quality assurance, robustness, maintenance)

• Use the sensor platform (sonde) to test new sensors and low-cost water sensors

• Analyze real-time water quality and weather data to develop models for community outreach and to inform basic understanding for important water quality parameters using statistical and process models

• Explore approaches to use sensor data to increase public awareness of the impacts of water quality on human and ecosystem health (community outreach)

• Create an EPA website that provides additional visualization tools for sensor and weather data and background interpretive information on sensors, and a how to guide so other communities across the US could install their own Village Blue stations

• Develop communication outreach documents on how to develop similar projects in other communities
Village Blue Team

• USGS Sensor
  – Deployment and maintenance

• EPA Office of Research and Development
  – Microbiologists, engineers, modelers, community outreach, communications

• EPA Region 3
  – Communications and outreach

• Blue Water Baltimore
  – Sample collection and analysis for fecal indicator bacteria

• Outreach activities
  – Baltimore Aquarium, Baltimore Science Center, Baltimore Waterfront Partnership, Blue Water Baltimore, Baltimore Urban Waters Partnership, City of Baltimore
**Overview of the Village Blue Project**

**Main Components**

1. Set up a new real-time monitoring site upstream of the Waterfront Partnership of Baltimore Inner Harbor Water Wheel

2. Develop new Village Blue mobile friendly website focused on data visualization and modeling of water quality

3. Develop community outreach opportunities of real-time sensor and weather data

4. Evaluate the impact of community outreach activities
Multiple Parameters

Real-time monitoring data on the Jones Falls River (sonde was deployed and maintained by the USGS)

- Conductivity, Dissolved Oxygen, Nitrate, pH, Temperature, Turbidity, Tidal Height, and flow direction/velocity
  - Data posted to the USGS National Water Information System (NWIS) every 5 minutes

- Chlorophyll and Phycocyanin

- NOAA Meteorological Data (precipitation and radar)
Floating platform keeps instruments 8 inches below water surface, measuring Jones Falls

Platform 2 x 3 x 1 ft.
• Custom electronics board and program
• Data from 5 platforms collected and transmitted to national database (NWIS)
• 5-minute data, publicly viewable

Powered by 10, 12v 48A batteries
Jones Falls Link:
https://waterdata.usgs.gov/md/nwis/uv?site_no=01589485
Jones Falls

Mr. Trash Wheel

Stream velocity sensor

Upper Probe

Jones Falls River Water (Fresh)

Lower Probe

Inner Harbor Water (Salt)

Halocline

Not to scale
Conductivity measurements confirm that the two sets of sensors are collecting brackish river water (upper) and inner harbor water (lower).
Peaks in turbidity are present in the river water (upper) and not the inner harbor water (lower).
Relationships between turbidity and nitrate in the fresh water layer
Preliminary Data – Jones Falls River

Provisional Data

Velocity
Conductivity Upper
Conductivity Lower
Precipitation (daily)
Rain Event and Effect on Sensor Readings

Precipitation *100 (Cyan), NO3 Upper *1000 (Black), JFR_Turbidity_Upper (Brown)
Focus Areas for Research

Water Sensors

- Water sensors are a relatively new technology; need for developing quality assurance/quality control (QA/QC) approaches, management of data, and characterizing the robustness of the deployed sensors in marine and freshwater environments.

- Application of software tools to model water quality parameters using sensor data; use EPA modeling tools such as CANARY and Virtual Beach to model sensor performance, microbial water quality, sources of fecal contamination, dissolved oxygen, nutrients, algae etc..

- Effectiveness of community outreach based on sensor applications.
Evaluating new sensors

Water Sensors

- This sensor emplacement (sonde) provides an excellent testbed for comparative studies of new sensors that have been previously tested in the laboratory.

- New technologies are being developed through challenge grants and other pathways, and these may be commercially ready and suitable for field deployment in a test and demonstration platform such as Village Blue.

- Novel techniques for data quality assurance may be implemented.
EPA and USGS display the real-time data on the National Water Information System and Village Blue website. The Village Blue website includes:

- The landing page that provides additional context about Village Blue, interpreting sensor data and a link to the Village Blue application (web address is pending)

- Application provides additional visualization of the sensor data that helps users interpret sensor data (will be available by the end of 2017)
Tour of:

– Landing Page
– Application
Outreach Activities

- **Objectives:**
  - Working with stakeholders, develop outreach opportunities to highlight how sensor data can be used to inform Inner Harbor water quality
    - Baltimore National Aquarium
    - Baltimore Science Center
    - Baltimore Waterfront Partnership
    - Blue Water Baltimore
    - Baltimore Urban Waters Partnership
  - Examples of outreach activities being pursued
    - Characterization of rain events on water quality in the Inner Harbor (dissolved oxygen, turbidity, microbial water quality, nitrogen etc)
    - Impact of river outfall on inner harbor water quality
    - Education on sensor technology
    - Modeling of water quality to environmental conditions
  - Provide documents to help other communities/stakeholders develop sensor-based outreach activities
Impact of Outreach Initiatives

Water Quality Information

• Assessing the Value and Impact of Delivering Water Quality Monitoring Data to the Public - A Pilot in Baltimore Harbor

• Questions being addressed:
  • Is data being delivered as information the public can absorb, and resonates and educates at the appropriate level?
  • Does water quality information stimulate public action, participation, or the interest to obtain additional information?
  • Are there ways to measure and document success in any of the above?

• Outreach from Village Blue will be assessed for impact to stakeholders
• Quality assurance and maintenance of sensors
• Performance characteristics of new sensors
• Web access of visualization of Village Blue sensors
• Implementation of outreach to increase awareness and understanding of water quality in the inner harbor and the application of water sensor information more broadly
• Assessment of the effectiveness of outreach
• Documentation to assist other stakeholders on the utilization of water sensors
• Website goes live by the end of 2017
  • The landing page and application will continue to evolve even after they are rolled out

• Evaluate and procure new sensors

• Continue to work with partners to support outreach activities FY18

• Measure impact of outreach activities FY17-18

• Research products
  • Findings of QA/QC, robustness of the deployed sensors in marine and freshwater environments
  • Application of software tools to model water quality parameters; evaluate sensor data vs. batch (more limited) environmental data on model performance; applies to scientific and outreach needs
  • Effectiveness of community outreach based on sensor applications
Feedback

– Is there interest in similar programs in other locations?
– Opportunities for collaboration?
– Suggestions for outreach or partnerships?
– When the website does go live, we welcome comments and suggestions
Kevin Oshima
– Project Contact
– Oshima.Kevin@epa.gov

Emily Smith
– Media Contact
– Smith.Emily@epa.gov

EPA's Village Blue: A Real-Time Water Quality Monitoring Project
supporting ongoing efforts to understand and improve water quality
in Baltimore Harbor

What is Village Blue?
EPA and the U.S. Geological Survey (USGS) established the Village Blue
research project to provide real-time water quality monitoring across
the Baltimore community and increase public awareness about local water
quality in Baltimore Harbor and the Chesapeake Bay. The Village Blue
demonstration project complements work that a number of state and
local organizations are doing to enhance the Blue Water Enterprise.

Why are the partners?
EPA and USGS are collaborating on this project and establishing
partnerships with state and local organizations in Maryland.

Where is the Village Blue project taking place?
EPA and USGS staff are using a new monitoring site in the Jones
Point area in Baltimore to test,
develop and deploy next-generation
collecting real-time water quality
data. Three sensors are located
near the Jones Point Pharmaceutical
of Baltimore in lower harbor where
people know it and it
reaches the harbor
without entering theessel.
USGS established the new
monitoring site.

How does it work?
EPA installed sensors near the
Jones Point area to gather real-time
water quality monitoring data
that will be displayed on the
Village Blue site, and will
complement the data that number
of state and local organizations
are doing to enhance water quality
data available to the public.