

## COMPLETION NOTICE

**SA ¶4(k) Pilot test Virtual Beach model for beach notification and advisories/closures (P23).**

**SA ¶4(l) Refine and validate existing water quality models for freshwater beach notification and advisories/closures (P24).**

**SA ¶4(m) Refine and validate other existing water quality models for marine beach notification and advisories/closures (P25).**

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### Summary of the Study

The study refined and evaluated the Virtual Beach software tool which is designed to build multiple linear regression (MLR) models that can predict fecal indicator bacteria (FIB) densities measured by culturable and quantitative polymerase chain reaction (qPCR) techniques in both freshwater and marine settings. EPA developed and pilot tested the initial version of Virtual Beach (Virtual Beach 1.0) using existing data from the Great Lakes. Virtual Beach 1.0 included *Model Builder* to construct beach-specific models, and *Beach Advisor* as a user-friendly tool for acquiring and inputting data to refine beach-specific models and for data visualization. In 2008 other modeling approaches (SAS, Minitab, and R) were evaluated using site-specific data (e.g., UV attenuation, spectral, and DOC measurements, and microbial, meteorological, water quality, UV, and current data) from South Shore Beach WI, La Monserrate Beach PR and Hobie Beach FL. In 2009, by collecting modeling data from Boqueron Beach PR and Surfside Beach SC, site-specific modeling predictions were evaluated and Virtual Beach 1.0 was redesigned to become Virtual Beach 2.0. This refinement involved an updating of its programming language, including all functionality of Virtual Beach 1.0 *Model Builder* and *Beach Adviser*, as well as additional modeling, visualization and statistical capabilities. The updated version, Virtual Beach 2.0, was further evaluated and modified using data from EPA epidemiological studies (from Huntington Beach OH, Silver Beach MI, Washington Park Beach IN, West Beach IN, Fairhope Beach AL, Goddard Beach RI, and Edgewater Beach MS). The current version, VB 2.1, facilitates the use of multiple approaches for evaluating model performance (e.g., comparing observed versus predicted FIB densities and/or examining correctly-predicted exceedances and non-exceedances of FIB criteria).

### Summary of Findings

The summary of results from this study is:

- Taking into account time lags and time windows can significantly improve MLR model results.
- Model predictions of observed FIB densities were generally more accurate for the freshwater beaches than for the marine beaches.
- Models developed using VB 2.0 more closely predicted FIB densities measured by culture methods than densities measured by qPCR techniques.
- Turbidity and antecedent rainfall were among the most influential variables for prediction of culture at both freshwater and marine beaches.
- The number of swimmers at both freshwater and marine beaches was another influential variable, especially at sites and times where large numbers of people were present.
- The effectiveness of environmental variables for prediction of FIB levels was dependent on factors such as the method used to measure the FIBs and site specific factors.

- Chlorophyll was most influential for cultured data but UV absorption coefficient was most influential for qPCR.
- Chlorophyll and dissolved oxygen were most influential for freshwaters but turbidity, salinity, UV absorption coefficients and bird abundance were the most influential for marine beaches.

**This study has been completed as of December 15, 2010**