Supplemental File 2. Equations for the selected best models for each inland lake site. Models were used to predict *E. coli* concentrations from measurements of environmental and water-quality variables. Equations were generated using Virtual Beach software (1).

Alum Creek State Park

Gage rainfall data from USGS 03120500, Alum Creek at Africa; radar rainfall from 17, 4-km cells

Alum Campers

$Log_{10}(E.\ coli) = 0.552 - 0.006*(DayofYear) + 0.252*\ (Radarxcell\text{-}av\text{-}R_{d\text{-}2})^{0.5} + 0.149*(GageRw72) + 1.549*Log_{10}(Turbidity)$

Alum North

$Log_{10}(E.\ coli) = -1.397 + 0.092*(WaterTemp) + 0.347*\ (Radarxcell\text{-}av\text{-}R_{d\text{-}3})^{0.5} + 0.060*(Turbidity) + 0.181*(GageRw48)$

Alum Central

$Log_{10}(E.\ coli) = 0.372 + 0.001*(WaterTemp)^2 + 0.012*(Radarxcell\text{-}av\text{-}Rw72)^2 + 0.003*(Turbidity)^2 + 0.267*(GageR_{d\text{-}1})$

Atwood Lake Main Beach

Airport rainfall data from New Philadelphia, Harry Clever Field; radar rainfall from 10, 4-km cells

$Log_{10}(E.\ coli) = -0.742 + 0.002*(WaterTemp)^2 + 0.275*\ (Turbidity)^{0.5} + 0.133*(AirportRw48 + Radarxcell\text{-}av\text{-}Rw48) + 0.072*\ (Swim\_no)^{0.5}$

Buckeye Lake State Park

Lake level data from USGS 395417082314200, Buckeye Lk nr Millersport; airport rainfall and wind data from Newark Heath Airport; radar rainfall from 15, 4-km cells

Buckeye Brooks

$Log_{10}(E.\ coli) = -1{,}600 + 1.787*(LakeLevel) + 6.082*(LakeLevelChange) + 0.142*(WaterTemp)$

Buckeye Crystal

$Log_{10}(E.\ coli) = 1.922 + 0.035*(AirportWindA\_comp24) + 0.313*(AirportRw48) - 0.044*(AirportWindO\_comp24)$

(Beach orientation is 18.4 degrees)

Buckeye Fairfield

$Log_{10}(E.\ coli) = 1.204 - 0.076*(AirportWindA\_comp24) + 0.079*\ (Radarxcell\text{-}sum\text{-}Rw48)^{0.5} + 0.040*\ (Birds\_no)^{0.5} + 0.520*\ (WaveHt)^{0.5}$

(Beach orientation is -126.67 degrees)

Buck Creek State Park

Discharge data from USGS 03267900, Mad River at Paris Pike at Eagle City; airport rainfall and wind data from Cox Dayton International Airport; radar rainfall from 12, 4-km cells

Buck Creek North

$Log_{10}(E.\ coli) = 0.600 + 0.950*(Radarxcell\text{-}av\text{-}R_{d\text{-}1})^{0.5} + 171.03*[1/(DischR_{d\text{-}2})] + 0.036*(AirportWindSp*WindCode)$

Buck Creek South

$Log_{10}(E.\ coli) = 0.632 + 134.45*[1/(Disch48)] + 0.924*(AirportR_{d\text{-}1})^{0.5} + 0.032*(Birds\_no) + 0.033*(AirportWindSp*WindCode)$

Grand Lake St. Marys State Park

Airport wind data from Lima Allen County Airport; radar rainfall from 18, 4-km cells; gage rainfall from USGS 04180988, St. Marys River at Rockford

GLSM Campers

$Log_{10}(E.\ coli) = 2.317 + 0.054*(AirportWindSp*WindCode) - 0.00002*(DayofYear)^2 + 0.361*(GageRw72)^{0.5} + 0.000003*(Turbidity)^2$

GLSM West

$Log_{10}(E.\ coli) = 1.885 + 0.094*\ (AirportWindA\_comp\_Inst)^{0.5} + 0.947*(Radarxcell\text{-}av\text{-}R_{d\text{-}1}) + 0.624*(Radarxcell\text{-}av\text{-}R_{d\text{-}3}) + 1.668*(GageR_{d\text{-}3})^2$

(Beach orientation is 81.6 degrees)

GLSM East

$Log_{10}(E.\ coli) = 0.826 + 0.163*\ (AirportWindSp*WindCode)^{0.5} + 0.001*(WaterTemp)^2 + 1.402*(GageR_{d\text{-}3}) + 0.079*(Radarxcell\text{-}sum\text{-}R_{d\text{-}1})^{0.5}$

Tappan Lake Main Beach

Airport wind data from New Philadelphia, Harry Clever Field; radar rainfall from 12, 4-km cells

$Log_{10}(E.\ coli) = -1.210 + 0.050*(AirportWindO\_comp\_Inst) + 0.127*\ (Radarxcell\text{-}sum\text{-}Rw72)^{0.5} + 0.876*Log_{10}(Turbidity) + 0.064*(WaterTemp) - 0.082*(AirportWindA\_comp\_Inst)$

(Beach orientation is -177.05 degrees)

Key to acronyms and variables

nr, near
USGS, U.S. Geological Survey
USACE, U.S. Army Corps of Engineers

Field observations or measurements

E. coli: concentration of *Escherichia coli*, in most-probable number per 100 milliliters
Swim_no: the number of swimmers in the water at the time of sampling
Turbidity: turbidity of the sample, in nephelometric turbidity ratio units
WaterTemp: water temperature at time of sampling, in degrees Celsius
WaveHt: wave height as measured with a graduated rod, in feet
Birds_no: the number of birds on the beach at the time of sampling
Dayofyear: the number representing the date beginning with 1 for January 1 and 365 or 366 for December 31 (the latter being a leap year)

Rainfall from USGS gage ("Gage") or National Weather Service nearest airport site ("Airport")

R_{d-1}: the total rainfall, in inches, for the 24-h period before sampling
R_{d-2}: the total rainfall, in inches, for the 24-h period 2 days before sampling
R_{d-3}: the total rainfall, in inches, for the 24-h period 3 days before sampling
Rw48: the amount of rainfall, in inches, for the 48-h period before sampling, with the most recent rainfall receiving the most weight. Calculated as $(2*R_{d-1})+R_{d-2}$
Rw72: the amount of rainfall, in inches, for the 72-h period before sampling, with the most recent rainfall receiving the most weight. Calculated as $(3*R_{d-1}) + (2*R_{d-2}) + R_{d-3}$

Wind direction and speed from the National Weather Service nearest airport site

WindA_comp: a measure of the component of the wind velocity moving parallel to the shoreline, for the instantaneous (INST) value near 8 a.m. or a 24-hr vector up to 8 a.m. (24), calculated as:

Wind A = -wind speed * cosine ((wind direction – beach orientation) * π/180)

A positive value indicates winds are moving from right to left across the beach when looking toward the water from the shoreline (U.S. Environmental Protection Agency, 2012).

WindO_comp: a measure of the component of the wind velocity moving perpendicular to the shoreline, the instantaneous (INST) value near 8 a.m. or a 24-hr vector up to 8 a.m. (24), calculated as:

Wind O = wind speed * sine ((wind direction – beach orientation) * π/180)

A positive value indicates winds are moving from the water toward shore (U.S. Environmental Protection Agency, 2012).

WindCode: site-specific wind code calculated by assigning the most weight to the range of wind directions associated with the highest *E. coli* concentrations.

WindSp: wind speed, in miles per hour

Radar rainfall from National Weather Service

Radarxcell-av-R_{d-1}: hourly maximum radar rainfall among multiple cells divided by the number of cells for the 24-h period before sampling

Radarxcell-av-R_{d-2}: hourly maximum radar rainfall among multiple cells divided by the number of cells for the 24-h period 2 days before sampling

Radarxcell-av-R_{d-3}: hourly maximum among multiple cells divided by the number of cells for the 24-h period 3 days before sampling

Radarxcell-av-Rw48: hourly maximum radar rainfall among multiple cells divided by the number of cells for the 24-h periods 1 and 2 days before sampling. The most recent rainfall receives the most weight. Calculated as: (2*Radarxcell-av-R_{d-1}) + Radarxcell-av-R_{d-2}

Radarxcell-av-Rw72: hourly maximum radar rainfall among multiple cells divided by the number of cells for the 24-h periods 1, 2 and 3 days before sampling. The most recent rainfall receives the most weight. Calculated as: (3*Radarxcell-av-R_{d-1}) + (2*Radarxcell-av-R_{d-2}) + Radarxcell-av-R_{d-3}

Radarxcell-sum-R_{d-1}: the sum from multiple cells for the 24-h period before sampling

Radarxcell-sum-Rw48: the sum from multiple cells for the 24-h periods 1 and 2 days before sampling. The most recent rainfall receives the most weight. Calculated as: (2*Radarxcell-sum-R_{d-1}) + Radarxcell-sum-R_{d-2}

Radarxcell-sum-Rw72: the sum from multiple cells for the 24-h periods 1, 2 and 3 days before sampling. The most recent rainfall receives the most weight. Calculated as: (3*Radarxcell-sum-R_{d-1}) + (2*Radarxcell-sum-R_{d-2}) + Radarxcell-sum-R_{d-3}

Stream discharge and water surface elevation from a nearby USGS or USACE gage

DischR_{d-1}: the mean discharge, in cubic feet per second, for the 24-h period 2 days before sampling

LakeLevel: lake level at 8 a.m., in feet

LakeLevelChange: change in lake level (today – yesterday) at 8 a.m., in feet

References

1. **U.S. Environmental Protection Agency**. 2012. Exposure Assessment Models—Virtual Beach. Center for Exposure Assessment Modeling, U.S. Environmental Protection Agency, Athens, GA. http://www.epa.gov/ceampubl/swater/vb2/index.html.