

**Virginia Water Resources Research Center
Virginia Polytechnic Institute and State University**

**Annual Technical Report
2019**

Virginia Water Resources Research Center
FY19 General Information
Prepared 30 March 30, 2021

Project Type: Annual Base Grant

Project ID: 2019VA267B

Products

Peer-Reviewed Research Publications (25):

Campbell, J.L., Rustad, L.E., Bailey, S.W., Bernhardt, E.S., Driscoll, C.T., Green, M.B., Groffman, P.M., Lovett, G.M., McDowell, W.H., **McGuire, K.J.** and Rosi, E.J., 2020. Watershed studies at the Hubbard Brook Experimental Forest: Building on a long legacy of research with new approaches and sources of data. *Hydrological Processes*, e14016, doi: 10.1002/hyp.14016.

Parker, E. A., Grant, S. B., Cao, Y., Rippy, M. A., **McGuire, K. J.**, Holden, P. A., Feraud M., Avasarala, S., Liu, H., Hung, W. C., Rugh, M., Jay, J., Peng, J., Shao, S., Li., D., 2020. Predicting solute transport through green stormwater infrastructure with unsteady transit time distribution theory. *Water Resources Research*, 56, e2020WR028579, doi: 10.1029/2020WR028579.

Fraser, O. L., Bailey, S. W., Ducey, M. J., **McGuire, K. J.**, 2020. Predictive modeling of bedrock outcrops and associated shallow soil in upland glaciated landscapes. *Geoderma*, 376, 11449, doi: 10.1016/j.geoderma.2020.114495.

Chen, J., **McGuire, K.J.**, Stewart, R.D., 2020. Effect of soil water-repellent layer depth on post-wildfire hydrological processes. *Hydrological Processes*, 34:270–283. doi: 10.1002/hyp.13583.

Juran, L., Adams, E. A., Prajapati, S., 2019. Purity, Pollution, and Space: Barriers to Latrine Adoption in Post-disaster India. *Environ Manage*, 64(4), 456-469. doi:10.1007/s00267-019-01202-6

Scott, V., **Juran, L.**, Ling, E.J., Benham, B., Spiller, A., 2020. Assessing strontium and vulnerability to strontium in private drinking water systems in Virginia. *Water* 12(4): doi:10.3390/w12041053.

Juran, L., 2020. Indian Ocean tsunamis, 2004. In *Natural hazards & disasters: from avalanches & climate change to water spouts & wildfires*, B.K. Paul (ed.), pp. 197-202. Broomfield: ABC-CLIO.

Clark, B., MacNaughton, I., **Juran, L.**, 2020. Bhola Cyclone, Bangladesh, 1970. In *Natural hazards & disasters: from avalanches & climate change to water spouts & wildfires*, B.K. Paul (ed.), pp. 14-18. Broomfield: ABC-CLIO.

Stevens, A., Compton, K., **Juran, L.**, 2020. BP Deepwater Horizon oil spill, United States, 2010. In *Natural hazards & disasters: from avalanches & climate change to water spouts & wildfires*, B.K. Paul (ed.), pp. 27-32. Broomfield: ABC-CLIO.

Aksha, S.K., Resler, L.M., **Juran, L.**, Carstensen, L.W., 2020. A geospatial analysis of multi-hazard risk in Dharan, Nepal. *Geomatics, Natural Hazards & Risk* 11(1): 88-111.

Read, D.C., Fisher, P.J., **Juran, L.**, 2020. How do women maximize the value of mentorship? Insights from mentees, mentors, and industry professionals. *Leadership & Organization Development Journal* 41(2): 165-175.

Oliver, R., Olson, E., **Juran, L.**, 2020. Bidding trepidation: Stockholm's uncertain relationship with the Olympic Games. In *Mega-events: place-making, regeneration & city-regional development*, G. Evans (ed.), pp. 127-139. London: Routledge

Diamond, J.S., Epstein, J., Cohen, M., **McLaughlin, D.L.**, Hsueh, Y., Keim, R., Duberstein, J., (2021, published online 2020). A little relief: ecological functions and autogenesis of wetland microtopography. *WIREs Water* 8: e1493, doi:10.1002/wat2.1493.

Cianciolo T.R., Diamond, J., **McLaughlin, D.L.**, Slesak, R., D'Amato, A, Palik, B., 2020. Hydrologic variability in black ash wetlands: implications for vulnerability to emerald ash borer. *Hydrological Processes*: doi:10.1002/hyp.14014.

Diamond, J.S., **McLaughlin, D.L.**, Slesak, R., Stovall, A., 2020. Microtopography is a fundamental organizing structure of vegetation and soil chemistry in black ash wetlands. *Biogeosciences* 17: 901-915, doi:10.5194/bg-17-901-2020.

Klammer, H., Quintero, C., Jawitz, J., **McLaughlin, D.L.**, Cohen, M., 2020. Local storage dynamics of individual wetlands predict wetlandscape discharge. *Water Resources Research*: doi:10.1029/2020WR027581.

Acharya, S., **McLaughlin, D.L.**, Kaplan, D., Cohen, M., 2020. A proposed method for estimating interception from near-surface soil moisture response. *Hydrology and Earth System Sciences* 24: 1859-1870, doi:10.5194/hess-24-1859-2020.

Hensley, R., Decker, C., **McLaughlin, D.**, Schilling, E., Cohen, M., 2020. Fertilization has negligible effects on nutrient export and stream biota in two North Florida forested watersheds. *Forest Ecology and Management* 465: 118096, doi:10.1016/j.foreco.2020.118096.

Harrington, T.B., Slesak, R.A., Dollins, J.P. **Schoenholtz, S.H.**, Peter, D.H., 2020. Logging-debris and vegetation-control treatments influence competitive relationships to limit 15-year

productivity of coast Douglas-fir in western Washington and Oregon. *Forest Ecology and Management* 473: 118288. <https://doi.org/10.1016/j.foreco.2020.118288>

Cienciolo, T.R. **McLaughlin, D.L.**, Zipper, C.E., Timpano, A.J., Soucek, D.J., **Schoenholtz, S.H.**, 2020. Impact to water quality and biota persist in mining-influenced Appalachian streams. *Science of the Total Environment* 717: 137216. <https://doi.org/10.1016/j.scitotenv.2020.137216>

Cienciolo, T.R., **McLaughlin, D.L.**, Zipper, C.E., Timpano, A.J., Soucek, D.J., Whitmore, K.M., **Schoenholtz, S.H.**, 2020. Selenium bioaccumulation across trophic levels and along a longitudinal gradient in headwater streams. *Environmental Toxicology and Chemistry* 39(3): 692-704. <https://doi.org/10.1002/etc.4660>.

Drover, D.R., **Schoenholtz, S.H.**, Soucek, D.J., Zipper C.E., 2020. Multiple stressors influence benthic macroinvertebrate communities in central Appalachian coalfield streams. *Hydrobiologia* 847(1):191-205. <https://doi.org/10.1007/s10750-019-04081-4>

Peer-Reviewed Research Publications from VWRRC Seed Grant Program (4):

Lee*, R. M., McGuire, K. J., Strahm, B. D., Knoepp, J. D., Jackson, C. R., Stewart, R. D., 2020. Revisiting the Hewlett and Hibbert (1963) hillslope drainage experiment and modeling effects of decadal pedogenic processes and leaky soil boundary conditions. *Water Resources Research*, 56, doi: 10.1029/2019WR025090.

Lofton*, M. E., Leach, T. H., Beisner, B. E., Carey, C. C., 2020. Relative importance of top-down vs. bottom-up control of lake phytoplankton vertical distributions varies among fluorescence-based spectral groups. *Limnology and Oceanography*. doi:10.1002/lno.11465

Krueger*, K. M., Vavrus, C. E., **Lofton*, M. E.**, McClure, R. P., Gantzer, P., Carey, C. C., Schreiber, M. E., 2020. Iron and manganese fluxes across the sediment-water interface in a drinking water reservoir. *Water Res*, 182, 116003. doi:10.1016/j.watres.2020.116003

Doubek*, J. P., Campbell, K. L., **Lofton*, M. E.**, McClure, R. P., Carey, C. C., 2019. Hypolimnetic Hypoxia Increases the Biomass Variability and Compositional Variability of Crustacean Zooplankton Communities. *Water*, 11(10). doi:10.3390/w11102179

Bold*: VWRRC seed grant recipient

Information Transfer Program

The VWRRC supports timely dissemination of science-based information to policy- and decision-making entities and to citizens. The VWRRC used a portion of its USGS 104b funds to support expert personnel with responsibilities related to administration of the VWRRC and production of the VWRRC's outreach and collaborative programs. During the reporting period, the USGS 104b funds were used for:

1. Partial support for administration of the USGS 104b funds, including preparation of 104b proposals and reports and managing 104g proposal submissions.
2. Partial administrative support for the Virginia Water Monitoring Council.
3. Partial support for production and management of the VWRRC webpage (<https://www.vwrcc.vt.edu/>), VWRRC Facebook, VWRRC Twitter, and *Virginia Water Radio*.
4. Preparation and electronic publication of the *Virginia Water Central* Water News Grouper containing annotated links to articles and references relevant to Virginia's water resources. The Water News Grouper is accessed via the VWRRC webpage (<http://vawatercentralnewsgrouper.wordpress.com>).
5. Preparation and electronic publication of the 2020 annual inventory of Virginia General Assembly water-related bills (<https://www.vwrcc.vt.edu/wp-content/uploads/2021/01/VaWaterBills2020.pdf>)
6. Preparation and electronic publication of 'Did You Know' website information feature.
7. Management of Virginia Water Photograph contest.
8. Coordination of water studies

Notifications to Virginia Water Monitoring Council

The VWRRC provides administrative support to the Virginia Water Monitoring Council (VWMC). The VWMC was formed in 1999 to promote and facilitate coordination of water monitoring programs throughout the Commonwealth of Virginia. Membership in the VWMC is open to any person or organization with responsibility for or interest in water monitoring in Virginia. Weekly water-related announcements via list server are provided to 700 members (representing more than 275 different organizations) of the VWMC. Announcements include information about conferences, workshops, public water meetings in Virginia, job openings, newly published reports, information posted on Web sites, and other pertinent information.

1. Distributed 54 sets of general announcements (>1,100 individual announcements) as e-mail messages to the VWMC membership; each message contained at least a dozen informational announcements, including: calls for papers, conference announcements, job openings, training opportunities, recently published reports, information posted on websites, total maximum daily load (TMDL) public meetings in Virginia, and other pertinent information.
2. Maintained current content on VWMC website.

3. Weekly announcements are posted on the VWRRC (<https://www.vwmc.vwrrc.vt.edu/>) and VWMC (www.VirginiaWMC.org) websites.

VWRRC Website

(www.vwrrc.vt.edu)

The VWRRC website is updated at least weekly and supports a *Water News Grouper* blog page, which is updated typically each week. During the reporting cycle there were approximately 178 posts listed on the *Water News Grouper* blog page and approximately 2,880 page views (~5/day). The VWRRC website also serves as the portal for three other information-transfer websites that the VWRRC manages:

1. Virginia Water Monitoring Council (<http://www.vwmc.vwrrc.vt.edu/>)
2. Virginia Department of Environmental Quality Stormwater BMP Clearinghouse (<https://www.swbmp.vwrrc.vt.edu/>)
3. Virginia Water Educators (<https://www.vwrrc.vt.edu/virginia-water-educators/>)

VWRRC is on **Twitter** at <http://twitter.com/VaWaterCenter> and **Facebook** (<http://www.facebook.com/pages/Blacksburg-VA/Virginia-Water-Resources-Research-Center/186479556264?v=wall>)

Virginia Water Radio

(www.virginiawaterradio.org)

The VWRRC produces and hosts a weekly 5-minute radio show featuring summaries of recent water news, upcoming water events, and water-related sounds or music. The radio show also includes relevance to specific Virginia science and social studies standards of learning for Virginia public schools for each episode. *Virginia Water Radio* is broadcast on two campus stations: WECH at Emory & Henry College and WVRU at Radford University. During the reporting period, 80 weekly episodes were produced and the Water Radio Web site had approximately 4,245 page views (~8/day).

Inventory of Virginia General Assembly Water-related Bills

The most-recent final inventory of water-related bills considered in the 2020 session by the Virginia General Assembly was posted in January 2021 online at <https://www.vwrrc.vt.edu/wp-content/uploads/2021/01/VaWaterBills2020.pdf>

'Did You Know' Water Information Series

The VWRRC's 'Did You Know' series was initiated during the reporting period as a bi-weekly online publication that brings diverse Virginia water stories to the public. Eight articles were published during the reporting period. (<https://www.vwrcc.vt.edu/did-you-know/>).

Virginia Water Photos Contest

During the reporting period the VWRRC established its first Virginia Waters Photo Contest open to all Virginia college and university students to submit photos featuring water in Virginia. Thirty seven entries were received from students at four Virginia colleges and universities. (<https://www.vwrcc.vt.edu/virginia-waters-photo-contest/>)

Coordination of Studies

The VWRRC chaired the *Water Quality Academic Advisory Committee*, which serves an advisory role for the Virginia Department of Environmental Quality to establish and evaluate water-quality criteria and standards for freshwater resources in the Commonwealth of Virginia. During the reporting period, the VWRRC coordinated a study of classification of Class VII swampwaters in Virginia by determining aquatic life use assessment protocols, including habitat and geomorphological variables that best indicate water bodies for which pH, dissolved oxygen, and biological assemblage criteria for free-flowing streams are not appropriate. The VWRRC also coordinated a study of dissolved oxygen assessment protocols for lakes and reservoirs.

Reports for these two efforts have been edited and published by the VWRRC:

Carey, C.C. and W.M. Woelmer. 2020. *Water Quality Assessment Procedures for Virginia: Dissolved Oxygen Assessment of Lakes and Reservoirs*. SR64-2020. June 2020. VWRRC, Blacksburg, VA. 40 pp.

Garey, A.L. 2020. *Development of Aquatic Life Use Assessment Protocols for Class VII Waters in Virginia: 2020 Report of the Academic Advisory Committee for Virginia Department of Environmental Quality*. SR65-2020. July 2020. VWRRC, Blacksburg, VA. 22 pp.

International Outreach Activities

1. VWRRC Faculty serve as referees for numerous international journals.

2. Associate Director McGuire serves as Associate Editor of *Hydrological Processes*, *Water Resources Research*, and Special Chief Editor of *Frontiers in Forests and Global Change*, Forest Hydrology section, which publish international research.
3. Director Schoenholtz serves as sub-editor of *Current Forestry Reports*, editorial board member of *Forests*, and as Associate Editor of *Journal of American Water Resources Association*, which publish international research.
4. Associate Professor McLaughlin serves as Associate Editor of *Frontiers in Forests and Global Change* and Associate Editor of *Forests*, which publish international research.

Student Support

The VWRRC supports training opportunities through assistantships, fellowships, seed grants, internships, and hourly-wage positions for undergraduate and graduate students. During the reporting period the VWRRC used a portion of its USGS 104b funds to support students.

Undergraduate Students: 11

Graduate Students: 10 (2 M.S. 8 Ph.D.)

Post-docs: 1

Notable Achievements and Awards

During the reporting period, the VWRRC was recognized by the USGS as one of 12 Outstanding water institutes/centers among the 54 water institutes/centers supported by the USGS 104b annual base grant program for the FY2011-2015 reporting period. Twenty-five papers were published in refereed journals, as chapters, and in encyclopedias, including 4 papers published by students supported by the VWRRC student seed grant program. VWRRC faculty taught 10 courses and presented three invited talks at professional meetings. Two new outreach programs were successfully established – a biweekly water information column (“Did You Know?”) featured on the VWRRC website and a Virginia Water Photo contest for university and college students across the Commonwealth.

Virginia Water Resources Research Center Student Seed-Grant Research Proposals 2019

Project Type: Annual Base Grant

Project ID: 2019VA267B

Project Impact:

During the FY19 reporting period, two student seed grants were awarded. One was completed (summarized below) and the second currently has an approved no-cost extension because of COVID limitations.

Samantha Fortin (Virginia Institute of Marine Science)
VWRRRC Final Report

Microplastic Biofilms are Hotspots of Nitrogen Cycling

Microplastics are a major concern in many aquatic ecosystems as they are introduced to waterways through runoff, poor waste management, and wastewater treatment plants. They fall into two major categories based on their composition, the petroleum based plastics and the biodegradable bioplastics. The negative effects of microplastics on organisms, as well as their ability to leach or sorb toxic chemicals, has been investigated in numerous studies but the role of the microplastic biofilm communities has not been widely studied in the marine environment. We used genomic tools to sequence the genomes of biofilm communities on four types of microplastics deployed to the York River, and tracked the changes in their metabolism over a three week period.

Two biopolymers (polyhydroxyalkanoate, PHA, and polylactic acid, PLA) and two petroleum-based polymers (polyethylene, PE, and polyvinylchloride, PVC) were deployed in the water column of the York River, a major tributary of Chesapeake Bay, and collected after 1, 2, and 3 weeks. Overall, the biofilm communities were dominated by Proteobacteria and Firmicutes, especially Bacilli, though changes in community structure were observed between the plastic types and over the three week deployment period at lower taxonomic levels. Microbes in the microplastic biofilms have the genetic capacity to use different types of nitrogen substrates for their growth. Genes for denitrification, the stepwise reduction of nitrate to N₂ gas, were present in the biofilms of all plastic types, though were highest in the PVC biofilms, and generally increased throughout the three week period. Denitrification is normally a sediment process, since it is an anoxic process; however, microplastic biofilms appear to provide an anoxic habitat for these microbes to be active in the water column. Furthermore, genes that have been previously linked to microbial hydrocarbon degradation were found in the biofilms of all the plastic types, showing that these microbes may be degrading the plastics they live on and using the carbon as an energy source.

Overall, this project provided one of the first snapshots of the metabolic potential of microplastic biofilms. The potential for a water column based anoxic nitrogen hotspot, in the form of these microplastic biofilms, provides new information to understand how microplastics are impacting our waterways while the possible hydrocarbon degrading microbes show how the microbial community is adapting to this new carbon source.