

**South Dakota Water Resources Research Institute
Agricultural Experiment Station**

**Annual Technical Report
2018**

General Information

Products

Presentations:

- Kringen, D. (2018) Cover Crops for Water and Nutrient Management. Oral presentation at the Ag Horizons Conference, Pierre, SD. November 28, 2018.
- Punsal, J., Stone, J.J., Sieverding, H., Rhoades, C., Kenner, S., Fegel, T. The impact of mountain pine beetle infestation on surface water quality within the upper Rapid Creek watershed of the Black Hills National Forest. Presented at the 2018 Western South Dakota Hydrology Conference, Rapid City SD.
- Mardani, S., R. McDaniel, B. Bleakley. (2019). The effect of edge-of-field management practices on transporting E. coli in subsurface drainage systems. Poster Presentation at the 74th Soil and Water Conservation Society International Annual Conference. Pittsburgh, PA.
- McDaniel, R. (2019). E. coli in stream sediments. Oral Presentation at the Wyoming Association of Conservation Districts Wyoming Watershed Conference, Casper, WY.
- McDaniel, R., B. Bleakley, S. Salam, and L. Amegbletor. (2019). Streambed sediment and E. coli variability, attachment, and the impact of riparian area management. Oral Presentation at the 2019 Universities Council on Water Resources – National Institutes for Water Resources Annual Conference, Snowbird, UT.
- McDaniel, R., S. Mardani, and B. Bleakley. (2019). Microbial Communities in Bioreactors. Oral Presentation at the Agricultural Drainage Management System Annual Meeting, Moorhead, MN.
- McDaniel, R. (2019). Saturated Buffers in South Dakota. Oral Presentation at the June East Dakota Water Development District Board Meeting, Brookings, SD.
- McDaniel, R., S. Mardani, and B. Bleakley. (2018). Bacteria Transport and Fate in Bioreactor Systems. Oral presentation at the 2018 Drainage Research Forum, Owatonna, MN.
- McDaniel, R., S. Salam*, L. Amegbletor, B. Bleakley, Z. Gu, and M. Hummel. (2018). Microbial contamination: Sediment sources, attachment, and development of a source tracking biosensor. Poster presentation at the National Nonpoint Source Training Workshop, Colorado Springs, CO.
- Mardani, S., R. McDaniel, B. Bleakley. (2018). The effect of bioreactors on transporting E. coli in subsurface drainage systems under different media (Laboratory study). Poster presentation at the Eastern South Dakota Water Conference, Brookings, SD.
- Salam, S., R. McDaniel, and B. Bleakley. (2018). Monitoring the seasonal variability of E. coli levels in streambed sediment and the evaluation of the effect of Seasonal Riparian Area Management (SRAM). Poster presentation at the Eastern South Dakota Water Conference, Brookings, SD.
- McMaine, J. T. (Lead Author and Presenter), Vogel, J., Belden, J., Schnelle, M., Brown, G., Annual International Meeting, "Evaluating Effectiveness of Constructed Wetlands for Pollutant Removal from Nursery and Greenhouse Runoff," ASABE, Detroit, MI, United States. (July 30, 2018)
- McMaine, J. T. (Lead Author and Presenter), Vogel, J., McLemore, A., Brown, G., Annual International Meeting, "A Simple Procedure for Optimized Selection of Low Impact Development Practices and Area Treated at the Watershed Scale Based on User-Defined Criteria," ASABE, Detroit, MI, United States. (July 31, 2018)
- McMaine, J. T., Dakota Fest, "Controlled Drainage for Weather Resilience and Water Quality Improvement," Dakota Fest, Mitchell, SD, United States. (August 22, 2018)
- Trooien, T. P., Huq, S., McMaine, J. T., Kringen, D. E., Mathiowetz, A. (2018). State of the Aquifer: South Dakota and Rosebud Sioux Tribe. Ogallala Water CAP. <http://ogallalawater.org/ogallala-summit-white-papers/>
- McMaine, J. T., Water in South Dakota, Stakeholder Guided Strategies for Moving Forward. 2018 Eastern South Dakota Water Conference, Brookings, SD. October 17, 2018.
- McMaine, J. T., Rainwater Harvesting for Greenhouses. 2018 Local Foods Conference, Brookings, SD. November 2, 2018.
- McMaine, J. T., Partnerships and Sharing Skills for Engaged Homeowners to Implement Stormwater BMPs. One Water Action Forum, Indianapolis, IN. December 11-12, 2018. Poster Presentation.
- McMaine, J. T., Nutrient Loss and the Nutrient Loss Calculator. July 11, 2019. Agricultural Drainage + Future of Water Quality Workshop. Marshall, MN.
- Sieverding, H., Vargas-Castano, A., Hottebrock, H., Fenster, C., Stone, J.J. Using green stormwater infrastructure to create urban biodiversity corridors. Presented at the 2019 Western South Dakota Hydrology Conference, Rapid City SD, April 2019.

Publications:

- Vik., E., Sieverding, H., Punsal, J., Kenner, S., Kunza, L., Stone, J.J. 2017. Timing of organic carbon release from mountain pine beetle impacted ponderosa pine Forests. *Water Environment Research*. 31 (3), 375-379. <http://dx.doi.org/10.1111/wej.12253>
- Mardani, Sara, Rachel McDaniel, Bruce Bleakley, and Trinity Hamilton. (In Review). The effect of woodchip bioreactors on microbes and antibiotic resistance in subsurface drainage water.

Theses:

- Amegbletor, Louis. 2018. Evaluating E. coli particle attachment and the impact on transport during high flows. Master's Thesis, South Dakota State University.
- Sharma, Abhinav. 2018. Application of drainage water management and saturated buffers for conservation drainage in South Dakota. Master's Thesis, South Dakota State University.

University News Releases/WRI Newsletter articles:

- Delfanian, C. Saturated buffers remove nitrates from tile drainage water. Posted April 23, 2019. <https://www.sdstate.edu/news/2019/04/saturated-buffers-remove-nitrates-tile-drainage-water>
- Delfanian, C. Encapsulated fertilizer improves nutrient release, protects water quality. Posted April 23, 2019. <https://www.sdstate.edu/news/2019/04/encapsulated-fertilizer-improves-nutrient-release-protects-water-quality>
- Delfanian, C. Rain gardens reduce urban runoff, protect environment. Posted March 25, 2019. <https://www.sdstate.edu/news/2019/03/rain-gardens-reduce-urban-runoff-protect-environment>
- Delfanian, C. Understanding E. coli behavior important for improving water quality. Posted March 4, 2019. <https://www.sdstate.edu/news/2019/03/understanding-e-coli-behavior-important-improving-water-quality>
- Winter manure application can improve soil health. Posted March 4, 2019. <https://www.sdstate.edu/news/2019/03/winter-manure-application-can-improve-soil-health>
- White paper documents challenges, sets research priorities. Posted March 4, 2019. <https://www.sdstate.edu/news/2019/03/white-paper-documents-challenges-sets-research-priorities>
- Delfanian, C. Researchers developing sensor to quickly detect viral DNA. Posted April 25, 2019. <https://www.sdstate.edu/news/2019/04/researchers-developing-sensor-quickly-detect-viral-dna>

Extension Articles:

- Kringen, D. (2018) Mitigating Harmful Algal Blooms Across the Midwest and Beyond. Posted September 10, 2018.
- Kringen, D., J. McMaine (2019) Managing Flooding Around Home Structures. Posted March 15, 2019. <https://extension.sdstate.edu/managing-flooding-around-home-structures>
- Kringen, D., T. Erickson (2019) Dealing with Emergency Manure Runoff. Posted March 22, 2019. <https://extension.sdstate.edu/dealing-emergency-manure-runoff>
- Kringen, D., J. McMaine (2019) Checking & Treating Domestic Water Supplies After a Flood, Posted March 22, 2019. <https://extension.sdstate.edu/checking-and-treating-domestic-water-supplies-after-flood>
- Kringen, D., J. McMaine (2019) Septic Systems and Flooding. Posted March 27, 2019. <https://extension.sdstate.edu/septic-systems-and-flooding>

Extension News Releases:

- Learn How to Build Rain Gardens. Posted July 17, 2018
- Tours & Equipment Demonstrations at the 2018 North American Manure Expo. Posted July 30, 2018.
- SDSU Extension Teams Up to Mitigate Harmful Algal Blooms Across the Midwest and Beyond. Posted December 17, 2018. <https://extension.sdstate.edu/news/sdsu-extension-teams-mitigate-harmful-algal-blooms-across-midwest-and-beyond>
- Register for 2018 Eastern South Dakota Water Conference Today. Posted September 24, 2018.
- 2019 SD Soil Health Coalition Soil Health Conference & Annual Meeting. Posted January 14, 2019. <https://extension.sdstate.edu/news/2019-sd-soil-health-coalition-soil-health-conference-annual-meeting>
- Outlook Shows Increased Chance of Flooding Spring 2019. Posted March 11, 2019. <https://extension.sdstate.edu/news/outlook-shows-increased-chance-flooding-spring-2019>

Extension Publications/Impact Reports/Open Prairie:

- SDSU Extension 2018 Impact: Agriculture & Natural Resources. North American Manure Expo. Posted March 8, 2019. <https://extension.sdstate.edu/sites/default/files/2019-02/MC-00310.pdf>
- Growing South Dakota Magazine, Winter 2019. SDSU Extension and Partners Hosted the 2018 North American

Manure Expo, page 76. https://openprairie.sdstate.edu/coabs_grow/26/

Radio:

- iGrow Radio - North American Manure Expo comes to SD, August 3, 2018
- KCountry 102.3, Brookings - North American Manure Expo interview, August 10, 2018
- WNAX Radio, Yankton - North American Manure Expo interview, August 15, 2018
- Red River Farm Network – 2019 Spring Flooding Outlook interview, March 15, 2019.

Information Transfer Program

The Information Transfer Program included public outreach, participation in the annual Dakotafest Farm Show, annual Ag PHD field day, Chairing the 2018 North American Manure Expo, serving on the steering committee and participation in the Big Sioux Water Festival, interactions with extension specialists, local, state and federal agencies, participation and presentations at regional and national conferences, youth education, adult education, and university student training and education. The SDWRI hosted the 2018 Eastern South Dakota Water Conference. This conveyed information and research of regional significance to the public, state agencies, and other stakeholders.

Outreach activities included communication using the Institute's website. Due to new requirement for those individuals who are visually impaired, project reports, newsletters, and other information are now being archived and converted to a format that can be read by text reading software. The Institute uses the WRI Twitter account to communicate with stakeholders. The account was started in March, 2019 and has 72 followers.

Publications, (pamphlets, educational materials, reports, peer-reviewed journal articles) are being disseminated in electronic formats through the WRI website, Twitter account, and iGrow. The Institute also promoted its activities and impacts through its biannual newsletter, as well as presentations at conferences and meetings.

WRI personnel continue to work with local, state and federal agencies/entities to develop management solutions to water-related problems in South Dakota. Institute personnel continue our strong collaboration with the USDA Natural Resources Conservation Service to analyze and interpret information from ongoing research by the WRI and others to develop conservation practice standards.

Student Support

Undergraduates: 5

Graduate Students: 2

Post-Doc: 0

Notable Achievements and Awards

None.

Projects

Evaluating and predicting the risk of algal blooms in South Dakota lakes using remote sensing.

Project Type: Annual Base Grant **Project ID:** 2018SD268B

Project Impact: The algal bloom risk project has three stages: (1) data collection, (2) estimate chlorophyll-a concentrations using remotely sensed data and a developed model, and (3) use chlorophyll-a concentrations to estimate algal bloom risk. Two students have been recruited for this project: one master's student and one doctoral student in the Agricultural and Biosystems Engineering Department at South Dakota State University (SDSU). The team at SDSU has collected chlorophyll-a data from public databases (e.g. Water Quality Portal) and local databases (e.g. City of Mitchell) for use as algal bloom calibration data. We have partnered with the Water Resources Center at the University of Minnesota to estimate lake chlorophyll-a concentrations in South Dakota using satellite imagery. Remote images from the Sentinel satellites were used in combination with the collected data to generate an initial model to predict chlorophyll-a concentrations in Lake Mitchell, SD for 2017-2019. While there is limited observed data collected on the dates when the satellites passed, the signal response is proportional to surface water chlorophyll ($R^2=0.83$). Two steps are planned to improve model performance and provide more confidence in modeled results. First, the team will collect additional chlorophyll-a data on the dates the Sentinel satellites pass over the region. The second step is to include additional South Dakota lakes for a broader range of conditions as well as an expanded dataset. Simultaneous to the development of the chlorophyll-a predictions, data is being collected for the risk assessment such as precipitation, temperature, and surrounding land use and topography.

Evaluation of Nitrate Removal Rates of Denitrification Bioreactors Using Agricultural Residue Media (Year 2)

Project Type: Annual Base Grant **Project ID:** 2018SD267B

Project Impact: Agricultural subsurface drainage can transport large quantities of nitrate from soils to surface waters. Denitrification bioreactors have emerged as an important edge-of-field treatment technology to reduce nitrate loads from agricultural subsurface drainage. These bioreactors typically utilize an organic carbon medium such as woodchips to support the growth of denitrifying bacteria which reduce nitrate to nitrogen gas. The objective of this project was to evaluate the performance of agricultural residues as alternative organic carbon sources for denitrification bioreactors. Three agricultural residues were chosen for this study including corn cobs, corn stover and barley straw. Woodchips were also used to compare the denitrification performance with agricultural residues. Laboratory column reactors filled with the selected four materials were used to treat simulated subsurface drainage under controlled conditions. The results of the six-month column experiments showed that the average nitrate removal capacities of different materials followed the order of corn cobs > corn stover > barley straw > woodchips. The same order also applies to the phosphate removal efficiencies. Agricultural residues, especially barley straw showed high rates of decline in nitrate and phosphate removal over time, whereas woodchips maintained relatively stable performance during the six month period. The results of this study suggest that agricultural residues are viable options as organic carbon sources for denitrification bioreactors.

Stormwater management and ecosystem health: The complementary role of green infrastructure in urban environments.

Project Type: Annual Base Grant **Project ID:** 2018SD269B

Project Impact: Cities themselves present both the problems and solutions to sustainability challenges of an increasingly urbanized world. By removing vegetation and topsoil and creating impervious structures, urbanization damages natural biodiversity, hydrological processes, and ecosystem services provision. But urbanization can be designed to support and minimize impact to ecosystem services through landscaping and multi-purpose infrastructure, such as rain gardens. Well-planned green stormwater control infrastructure (e.g. rain gardens, green roofs, hellstrip gardens) can serve to meet regulatory mandates while restoring connectivity. Careful placement and design of green stormwater infrastructure can provide ecological niches and habitat corridors to larger natural areas.

Pollinators have a functional role inside an ecosystem and can serve as biodiversity indicators. Three rain gardens in Rapid City, SD were surveyed for pollinator habitat. Trait-based plant models were created to link urban pollinators, plant health, and water resources. Over 70 species of insects were identified within the stormwater structures. Soil moisture, which is representative of water availability, had a significant positive effect (LRT: $\chi^2_{21DF} = 41.48$, p