Connecticut Institute of Water Resources
The University of Connecticut

Annual Technical Report
2018

General Information

Products

Project 2018CT314B
Walker, S., Robbins, G., Helton, A. Lawrence, B. Quantifying road salt impacts on forested wetland structure and function. In prep.

Project 2018CT315B
R. Mendes, T.M. Vadas. Fe-C Coprecipitation & availability of C to denitrifiers. CT Conference on Natural Resources, March 2019. PP

R. Mendes, T.M. Vadas. Fe-OM Coprecipitation and its Effects on Bioavailability of Cu and OM to Denitrifiers. American Geophysical Union Fall Meeting, December 2018. PP

Project 2018CT317B
Brendan Noons. Nitrogen and Phosphorus Leaching from Compost-Amended Lawns. 2019 Connecticut Conference on Natural Resources, March 18, 2019. Storrs, CT.

Project2016CT297B
Q.C. Dong, Y.K. Huang, D.H. Song, H.X. Wu, F. Cao, Yu Lei. Rhodium Oxide nanofibers enabled dual sensor for both non-enzymatic glucose and solid-state pH sensing. 2018, Biosensors and Bioelectronics, 112, 136-142

Q.C. Dong, D.H. Song, Y.K. Huang, Z.H. Xu, J.H. Chapman, W.S. Willis, B.K. Li, Yu Lei. High-temperature annealing enabled iridium oxide nanofibers for both non-enzymatic glucose and solid-state pH sensing. 2018, Electrochimica Acta, 281, 117-126

Qiuchen Dong, Xuedong Wang, Haomin Liu, Heejeong Ryu, Jing Zhao, Baikun Li, Yu Lei. Heterogeneous Iridium Oxide/Gold Nanocluster for Non-enzymatic Glucose Sensing and pH Probing. 2019, Engineered Science, Accepted (DOI:10.30919/es8d512)

Project2016CT296B
Barclay, J.R., L.S. Keener-Eck, Z. Smiarowski, and A.T. Morzillo. A landscape-level assessment of water resources and communications in a “water-rich” state. In review

Information Transfer Program

Seminar Series Support: As part of the Department of Natural Resources and the Environment Seminar Series, CTIWR sponsors the "William C. Kennard Water Resources Lecture". This reporting year the speaker was Dr. William Hunt from North Carolina State University. Presentation title “(Water) Engineering for the People. Presented on Oct. 19, 2018.

Conference Support: CTIWR supports the annual Connecticut Conference on Natural Resources (CCNR) held each March at the University of Connecticut. The CCNR attracts over 300 individuals from throughout Connecticut who are involved in environmental research, developing policy, or otherwise interested in the natural resources of Connecticut. This conference serves as a venue for networking and sharing ideas regarding varied environmental resources in Connecticut. CTIWR contributed $250 to support the conference. CTIWR had an informational table that allowed us to provide general information about the Institute to the attending public.

Website: Our Institute maintains the CTIWR web site (http://ctiwr.uconn.ed), which we continually update. It includes information about the WRRI program, our Institute and its Advisory Board members, a listing of the current year's seminars, a list of sponsored projects, reports and publications, and access to electronic copies of our "Special Reports" series. We also use the web to announce special events and release of our 104B Program RFP, in addition to secure access to grant proposals, technical reviews and information for the CTIWR Advisory Board’s review.

Service and Liaison Work:
The CTIWR Director, Dr. Michael Dietz, is involved in the following:

• CT Source Water Collaborative (participant)
• CT Green Snow Pro workgroup (member)
• State Water Plan Implementation workgroup (member)
• Private well sub-workgroup of State Water Plan Implementation workgroup (chair)
• Road salt workgroup convened by CT DPH (participant)
• CT Council on Soil and Water Conservation (participant)
• Sodium chloride contamination of drinking water wells roundtable (member), called by CT Sen Saud Anwar

Student Support

104B Support

Undergraduate: 7

Graduate: 6

Post-Doc: 0

Notable Achievements and Awards

None to report

Projects

Evaluation of Created Thermal Refugia in Streams as a Climate Adaptation Strategy for Fish Populations Experiencing Thermal Stress

Project Type: Annual Base Grant **Project ID:** 2017CT305B

Project Impact: The goal of this project was to assess the effectiveness of potential engineered thermal refugia as a climate-change adaption strategy by pumping nearby alluvial aquifer groundwater at a controlled rate into the stream channel during a peak temperature period. The extent of the thermal anomaly created was assessed using a combination of temperature sensing, visual dye, and hydrodynamic methods. The objectives of this study were to: 1) Characterize effective created cold water plume volume by exploring the relationships between ambient warm surface water flow and facilitated discharge by pumping in controlled volumes of shallow floodplain groundwater across a natural gradient of in-channel flow rates. 2) Assess the effectiveness of an engineered baffle to limit local mixing of surface water with groundwater, potentially enhancing the size of the created cold water pocket. After assessing the extent of the cold water plume created while pumping at a rate of 0.41 L/s in the Fenton River, it was determined that a successful cold-water habitat would be best suited to low flow areas in a stream reach because at high flow (65 ft3/s) there was not a viable cold-water plume detected by the FO-DTS or the thermal infrared imaging, and at medium flow there was a small thermal anomaly created and detected by the infrared and the fiber optic cable. The lack of a cold water pocket present at high flow and the limited amount present at medium flow could also be due to the absence of vertical movement of the cold water as it entered the stream reach. The dye revealed the cold water was not rapidly mixing with the surface water as it dissipated downstream, but as the temperature difference was not picked up by the fiber optic or the infrared images, the cold water must have been highly vertically constrained. In conclusion, there was a trace of a thermal anomaly showing the potential for creating an effective cold water pocket under lower flow conditions. The recommendation for future studies would be to incorporate these thermal assessments on a plume injected in a slower flowing area of a stream, along the banks or out of the main channel flow path. This could result in a more significant temperature difference that would be able to be utilized by cold-water adapted fish species attempting to thermoregulate during extreme temperatures.

Fe-OM Coprecipitation and Its Effects on Bioavailability of Cu and OM to Denitrifiers

Project Type: Annual Base Grant **Project ID:** 2018CT315B

Project Impact: This project aims to better understand wetland biogeochemical processes under the conditions seen in developed systems with natural or replacement wetlands and will inform design or management to make them more functional and efficient. Specifically the inputs of Fe, Cu and OM are examined for their role in controlling the forms and aqueous speciation of Cu and OM in the porewater, two components that are critical for optimal denitrification of the nitrate entering the system. Using the sampling times and concentrations of N2O at each time step, a linear regression was performed to calculate the rate of N2O as ppm per min. The linear regression was only performed on data sets where the values continued to increase. When data showed a decrease, only the values prior to that decrease were used for regression. In some cases, only 2 points could be used but in general a minimum of 3 points was utilized to calculate the value. It is expected that treatment 13 (Fe, HA, G, Cu, NO3) should show lower yields as Cu and carbon are most available compared to other treatments. It is also expected that Treatment 10 (Fe, HA, G, NO3) would have one of the highest yields due to limited copper availability. If shown to be accurate, then the control of copper on denitrification is proven. The rate data allows an analysis of the production of N2O but does not indicate the yield or total denitrification. The current data shows that Treatment 8 (Fe, G, NO3) has the highest rate of N2O production. In looking at comparing treatments with a glucose amendment versus a humic acid amendment, the rate of N2O is lower in all cases with humic acid. Based on these yield calculations, it is expected that if carbon and copper are acting as a control on denitrification that in scenarios where Cu and C are available the yield will be lower and total denitrification will favor N2. The treatment with the highest total denitrification was treatment 10. Treatment 10 (Fe, HA, G, NO3) had no additional Cu in it and therefore it was expected that while denitrification would still occur due to the plentiful carbon and nitrate source that the lack of Cu may encourage more incomplete denitrification.

Investigation of Bedrock Well Contamination by Uranium, Radium and Radon Resulting from Deicing Salt Exchange

Project Type: Annual Base Grant **Project ID:** 2017CT304B

Project Impact: The goal of this project was to evaluate whether salt contamination of fractured bedrock has caused elevated levels of uranium, radium and radon in wells. The broader goal of the project was to further the understanding of the risks associated with de-icing salt contamination in the state's supply of subsurface drinking water. Due to a laboratory error, no analysis of Ca, Na, Mg or Ca was performed for samples from the Brookfield sites and several of the UConn sites (-SOB, -GB5, -BHK, -BHF). However, all samples were analyzed for EC and Rn. Regression analysis indicated a significant positive relationship between EC and Rn (R2=0.95) for the bedrock wells, however the regression only contained five data points. Only one sample had a concentration of Rn above the 4,000 pCi/L action level. A separate project and recent analysis of shallow wells in Storrs, CT indicated a weak but statistically significant negative relationship between conductivity and Rn. Shallow groundwater has more potential to lose Rn in gaseous form to the atmosphere. Water drawn from deep bedrock wells would likely have higher dissolved radon, because it has cannot readily escape in gaseous form. No discernible relationship was evident for the samples from shallow groundwater sites in the current study. Radium concentrations in the bedrock wells sampled were generally low, with only one site having a detectable concentration. Uranium was detected in all of the bedrock wells sampled, but all samples were below the 30 ?g/L drinking water standard. A significant positive relationship was found between conductivity and U. Uranium concentrations were generally low or not detected (61%) in shallow groundwater samples. The concentration of radium in all of the shallow groundwater samples taken from the UConn campus was above the drinking water standard. This does not pose a direct health concern, because the shallow groundwater in this area is not currently being used as a drinking water source. A weak negative relationship between Na and Ra was found.

Nitrogen and Phosphorus Leaching from Compost-Amended Lawns

Project Type: Annual Base Grant **Project ID:** 2018CT317B

Project Impact: The objectives of this project are to 1: determine if a relationship exists between soil tests (labile N and extractable P) and leaching concentrations and losses of N and P from lawn turf receiving varying rates of compost, and 2: if relationships are determined, propose environmental critical levels of soil labile N and extractable P for compost-amended lawns to guide compost application rates. Soil test P concentrations increased with increasing compost additions. At the three highest application rates, modified-Morgan soil test extractable P approach or exceed the agronomic and environmental critical levels (40 and 80 lbs P2O5 per acre, respectively) that have been set for agricultural production fields. Soil test values for Solvita CO2-Burst and SLAN tests significantly (P 0.5 mg L-1. Concentrations of (NO2+NO3)-N at times exceeded the drinking water standard of 10 mg L-1, whereas concentrations of PO4-P were generally less than 0.05 mg L-1, but several samples were between 0.1 to 0.5 mg L-1. Approximately 70% of the TP concentrations were > 0.1 mg L-1. Concentrations of TP tended to be higher with increasing rates of compost. Robust regression (M-estimation) analysis of PO4-P concentrations show a significant (P

Quantifying Road Salt Impacts on Forested Wetland Structure and Function in Eastern Connecticut

Project Type: Annual Base Grant **Project ID:** 2018CT314B

Project Impact: The goal of this project was to examine the impact of road salt pollution on the structure (i.e., vegetation composition and abundance) and function (i.e., water quality, carbon cycling) of eastern Connecticut forested wetlands. To achieve this, field observations of wetland hydrology were coupled with controlled greenhouse experiments, and laboratory assays to address the following objectives: 1) Characterize forested wetland hydrology and water quality in eastern Connecticut. 2) Test how variable hydroperiods and salinity levels alter forested wetland seedling emergence 3) Examine how elevated salinity in roadside RM swamps alters the stability of stored soil carbon The project results suggest that even in exurban areas with low impervious surface cover, road deicing salt application affects water chemistry of forested wetlands months after active road salt application, highlighting road salt legacy effects. However, the conductivity measurements we made in the field during 2018 and 2019 were relatively low (max