

CASFM Research Proposal

Experiments of floodplain cover and implications for hydrogeomorphic channel response

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Introduction

Floodplains provide critical ecosystem services including: flood attenuation, nutrient retention, habitat for wildlife, and access to nature in urban areas. The importance of functioning floodplains has been widely recognized in Colorado in recent years as managers attempt to reconnect rivers to floodplains through restoration of impaired reaches and improvements of lateral hydrologic connectivity. The design basis for river restoration projects is often limited to bankfull flow with little regard to the effects of floods and the hydraulic conditions in the floodplain. The omission of floodplain flow in hydraulic river restoration design can be attributed to the complexity of flow through vegetation and poorly understood interactions with the active channel.

Research Proposal

We are currently conducting physical flume modeling experiments in a meandering compound channel with a range of floodplain vegetation densities at Colorado State University's Engineering Research Center. This proposal is to conduct additional experiments of various flood depths likely to occur during overbank flooding. If awarded, this work would contribute to an impressive dataset describing the nature of flow and geomorphic channel response to a range of floodplain vegetation densities and flood depths. Specifically, this study will improve our knowledge of floodplain processes and meet the grant criteria by:

- Investigating the momentum transfer of floodplain-to-active channel flow with varied vegetation density and resulting flood attenuation at a range of flow depths. This will inform practitioners of best practices for floodplain vegetation planting. Improved understanding of flood attenuation through planting best practices advances the protection of human life and property.
- Highly detailed hydraulic measurements shed insight into turbulent nutrient mixing and retention processes which will inform management practices and lead improved water quality.
- We are collaborating with the Coalition for the Poudre River Watershed and other northern Colorado community groups like Trout Unlimited to disseminate the knowledge gained through these flume experiments and educate the public about the importance of functioning floodplains.

- There are many active stream restoration projects throughout Colorado. We work with or communicate often with individuals from reputable consulting design firms including: Stillwater Sciences, Stantec, and RiverRestoration. Beyond the additional experimental process, this grant will allow us to meet with and discuss the results of this work with these firms that will improve practices throughout the state.
- This project is currently being partially funded by an NSF award 1916780. As described above, additional \$2500 in funding would allow us to expand upon the data that have been collected, and more purposefully connect with individuals in the community including practitioners and local watershed groups.

Thank you for your consideration and we hope to share our passion of healthy floodplains with the assistance of this CAFSM grant.

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Quantifying the Increase in Stormwater Storage on Residential Properties after Rain Garden Installation

The most common type of Stormwater Control Measure in Colorado is the Extended Detention Basin, which requires a large amount of space to manage stormwater and flooding in residential areas. Rain gardens are green infrastructure features which promote stormwater infiltration, mitigate flooding and subsequent property damage, improve surface and groundwater quality, and enhance native plant biodiversity. The goal of this project is to determine if rain gardens can be utilized at the residential scale to mitigate flooding and to reduce the total amount of stormwater that needs to be treated and managed by stormwater control measures. This project seeks to quantify the change in stormwater storage capacity of residential properties' landscapes after installing rain gardens in six cities along the Colorado Front Range.

This proposed research will be in collaboration with the Colorado Stormwater Center's, "Expanding Residential Rain Gardens in Front Range Communities" (Rain Gardens) project that has requested \$180,600 in funding from the Colorado Water Conservation Board. The Rain Gardens project seeks to remove barriers to installing residential rain gardens by providing rain garden planting layouts, the creation of a Certified Rain Garden Installer Training, planting 19 demonstration rain gardens, and providing monitoring with the Mile High Flood District (MHFD) stormwater App. The Rain Gardens project centers on language justice and will provide all resources in English and Spanish. By incorporating the proposed research, we will extend the Rain Gardens project's scope to emphasize the efficacy of rain gardens in residential sites and potential for rain gardens to benefit the state of Colorado.

Over a period of two years, we will monitor and evaluate 6 of the 19 demonstration rain gardens from the Rain Gardens project and track our data using the MHFD App. Locations may include: Fort Collins, Greeley, Boulder, Loveland, Centennial, and Denver. In each simulation, we will pour water through the downspout above the rain garden and calculate the time it takes for runoff to reach the street. The first simulation will determine a baseline measurement of the yard's storage capacity, thus enabling us to compare the storage capacity of yards before and after rain garden planting. We will collaborate with the property owner to ensure the garden is planted in a practical location and includes their desired design elements. We will conduct six simulations at each site:

- Simulation 1: Prior to rain garden planting in approximately early May 2022
- Simulation 2: Post-planting at the end of May 2022
- Simulation 3: July 2022
- Simulation 4: September 2022
- Simulation 5: May 2023
- Simulation 6: July 2023

The \$2500 will be used to purchase a Soil Moisture Meter to enable the calculation of the runoff coefficient, an Orbit Single Hose Outlet Timer to ensure a standard flow volume into the rain garden, and the staff time needed to conduct the proposed research. We hope to find that these rain gardens increase the storage capacity of stormwater.