Title: Post Fire/Debris Flow Sediment Delivery and Systems Response. Using science to better manage sediment accumulation/redistribution in Santa Barbara County Coastal Watersheds

Client/Proposer: South Coast Habitat Restoration, Carpinteria, CA
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Objectives:

1. Develop sediment delivery response curve for creeks located in South Coast Santa Barbara County Watersheds post-fire and/or debris flow using environmental parameters and metrics
2. Identify and evaluate environmental and socioeconomic costs and benefits to status quo sediments management strategies
3. Explore and present alternative sediment management recommendations that consider tradeoffs between sediment management actions, land use planning, and public policy

Significance:
During December 2017, the Thomas Fire ravaged Southern California and certain Santa Barbara County watersheds. Driven by persistent Santa Ana winds and exacerbated by severe lack of rainfall, the Thomas fire burned 281,893 acres in Santa Barbara and Ventura counties resulting in an estimated $2.2 billion in damages. Immediately following the Thomas Fire, an intense rainstorm battered charred Santa Barbara mountainsides, triggering deadly debris flows in Montecito killing 23 community members. Not only did the fire/debris flows directly impact public safety, sensitive species/habitats and natural landscapes; the catastrophic event had major impacts to the local economy, human health, and the communities' capacity to address other needs within the region.

In response to that event, environmental managers made tough decisions about how to manage the deposited sediment sources from the 2018 debris flows and many actions taken to manage the sediment were contentious among public stakeholders. With time of the essence, management decisions were made that presented tradeoffs among various operational efficiencies, environmental impacts, public safety, and socioeconomic elements. In any scenario that presents tradeoffs, hindsight grants an opportunity to understand the magnitude of the tradeoffs and if there are management alternatives that could present increase utility and reduce adverse impacts/costs.

While it is important to note wildfire is a natural phenomenon in California, it's no secret wildfires in California are becoming more severe and frequent due to anthropogenic influences and shifts in climate. Unfortunately, even though the fires and debris flows of the winter of 2017 and 2018 were extreme natural disasters, they may represent the new normal. So, with more regular recurrence, a better understanding of the sediment delivery processes during post-fire recovery is necessary. This will allow environmental managers, policy decision makers, and other jurisdictional agencies to make more informed decisions about sediment management, its costs, and benefits.

This project will demonstrate how communities in flash flood and fire prone Southern California can use science, public/private partnerships and collaboration to understand natural post-fire sediment delivery processes. Moreover, this study will occur in tandem of proposed County infrastructure improvements that aim to "work with", as oppose to "against", sediment delivery processes to yield the highest level of environmental and socioeconomic benefits for the region. Timing for this project is unique in the fact that many diverse community partners are working together to strengthen restoration efforts and create ecologically informed sediment management techniques and infrastructure for the region.

Background:
Southern California coastal watersheds are long steeped in fire and flooding recurrence cycles. A natural process in which fires leave burnt hillslopes, with hydrophobic soils more susceptible to mass wasting events such as landslides or, more predominantly, debris flows. Such historic fire/debris flow events have led environmental managers (i.e. Army Corp of Engineers) in the 1960's, to install debris catchment basin facilities at the foothills in many steep coastal range watersheds. Strategically placed downstream of steep sloped wildlands, the facilities are located where the longitudinal slope profile of the creek generally eases from the mountains, yet are positioned upstream from the majority of the built environment on the Santa Barbara coastal plains.

The purpose of these facilities is to catch and accumulate debris before hazardous/dangerous debris entrenched in a debris flow/flood avulses the creek bank to cause any sort of endangerment of human life or destruction to property.

Post-fire event, varying fluxes of sediment enter the debris basins from rainfall events throughout time. The debris basins are excavated and redistributed to several locations throughout Santa Barbara County as needed. This process presents capital costs associated with excavation, transportation and redistribution of sediment to SB County Flood Control Protection District (SBCFCPD), in addition to unquantified environmental costs (i.e. GHG Emissions, degradation of downstream habitats for federally endangered Southern Steelhead Trout, lack of beach nourishment, etc..). These costs wildly vary between extreme events (i.e. 2017 debris flows) and lower magnitude post-fire rainfalls.

A major factor for consideration is the magnitude of sediment delivery in post fire event in South County watersheds. While debris flows (i.e. extreme events) are known to occur and can cause severe adverse impacts, rainfall scenarios that don't trigger debris flows still undoubtedly augment sediment delivery. These events have the potential to "fill in" the debris basin facilities diminishing their retention capacities, and thus rendering the facility less effective for sediment storage and capture for future rainfall events. SBCFCPD excavates and re-distributes sediment to offsite locations. This activity allows for the maximized retention of material should an extreme event occur.

So, while it is known that sediment delivery increases in waterways post-fire events, what is not known is the predictability of such delivery given varying environmental factors such as precipitation, slope, fire intensity/severity, vegetation cover, hillslope stability, sediment grain size, etc. However, with the debris basins serving as a "stopping" point for sediment in the creek, sediment can be quantified based on the excavation records when digging out the facilities for increased retention. Using this information, local environmental managers would benefit from understanding sediment delivery with more predictability. This would allow for the preparation of capital costs and fiscal budgeting, proactive outreach to first responders and the public, and more predictably guide environmental restoration efforts.

While there were multiple watersheds affected by the Thomas Fire and subsequent debris flows, the most devastating impacts occurred on Montecito Creek, San Ysidro Creek and Romero Canyon Creek. These areas will be considered the study area a with a potential reference site along Gobernador Creek in the Carpinteria Creek Watershed. Moreover, SBCFCPD has a myriad of projects slated to improve their debris basin infrastructure in these watersheds with anticipation that implementation will improve sediment retention capacities and enhance habitat connectivity.

Equity:

SCHR is committed to diversity, equity, and inclusion in all aspects of our work. While it does not look like there is a direct link to Disadvantaged Communities (DAC Mapper), sediment management options that are explored may present less costly management alternatives, in which, tax payer dollars may be saved from status quo operations and savings re-allocated to other environmental equity needs throughout Santa Barbara County.

Available Data:

There are a multitude of data repositories available for use. They Include:

- Inundation, flow dynamics, and damage in the 9 January 2018 Montecito Debris-Flow Event—USGS
- Vegetation Regrowth Plots—Montecito Fire Protection District
- Sediment Haul-Off Quantities and Costs—SBCFCD
- Photogrammetric Debris Basin Imagery--SBCFCD
- Landsat Remote Sensing Data—Vegetation Regrowth (NDVI)
- Historical Debris Flow Data—Project for Resilient Communities (Larry Gurolla, Ph.D.)
- Forest Service Region 5 Fire Severity Geodatabases—United States Forest Service BAER Reporting
- Precipitation Data—PRISM

Possible Approaches:

- Use flood control records of quantified basin excavation data (Cubic yards/per excavation event through time), develop a multivariant regression model for sediment delivery using environmental data such as vegetation recovery plots, rainfall, fire severity extents, slope, NDVI, etc. that allows for predictability of sediment delivery given x, y, z, parameters.
- Perform cost benefit analysis that examines capital costs of status quo sediment management techniques and explore alternatives for bypassing sediment distribution or alternative methods of sediment management
- Geospatially locate candidate receiver sites for sediment distribution that mitigate direct/indirect environmental and socioeconomic costs

Deliverables:

- Predicative Sediment Delivery Response Curve—Interactive Calculator Tool that predicts sediment delivery based on selectable parameters
- Alternative Sediment Management Recommendations
- Present Findings to Local Stakeholder Group

January 22, 2021

Group Project Committee
Bren School of Environmental Science and Management
2400 Bren Hall,
University California, Santa Barbara CA 93106-5131

RE: Group Project Proposal—Post Fire/Debris Flow Sediment Delivery and Systems Response: Using science to better manage sediment accumulation/redistribution in Santa Barbara County Coastal Watersheds

I am writing to express my full support and commitment to the Group Project Proposal: *Post Fire/Debris Flow Sediment Delivery and Systems Response: Using science to better manage sediment accumulation/redistribution in Santa Barbara County Coastal Watersheds*. As a former Bren School student and graduate (2018), I understand what it takes for a project to be the valuable to the learning experience Bren prides itself on, but also feasible and successful. I believe this project presents a real-world challenge, data to explore solutions, and the true potential that any recommendations resulting from this project will be considered for implementation. Moreover, I think that the project will afford students with different interests to work interdisciplinary on technical skills, management skills, and collaboration skills as this project entails data wrangling and the opportunity to meet and work with real-world practitioners. Another benefit of this project is the local nature. SCHR is located in Carpinteria and our project partners (i.e. Santa Barbara County Flood Control Protection District, and Project for Resilient Communities) are also local. This gives students increased access to interfacing with SCHR as the client and other partners involved in the Project.

Internships: SCHR will be able to host two paid internships during the summer of 2021 to facilitate the continuance of the group project efforts in addition to providing interns with outside experience in creek restoration efforts throughout the county. During summer 2021, SCHR will be employing 2-5 major implementation projects that will enhance habitat for federally endangered southern steelhead trout. Interns will have exposure to on the ground restoration efforts with engineers and construction contractors, access to working with private and public project partnerships (i.e. private landowners, USFS, CDFW, Coastal Conservancy, National Fish and Wildlife Foundation, and more), and obtain experience in grant funding and project management. SCHR has a budget of $10,000 for each student that will cover their services and any costs or materials for summer 2021.

Funding: SCHR does not foresee there being any need to augment funding for any reason throughout the duration of the group project. Additionally, SCHR has set aside funds to internally support the students request for information, stakeholder meetings, and other needs as necessary. With that, SCHR plans to be fully engaged throughout the duration of the Group Project and an active client.

Data: As currently proposed, the project plans to use mostly publicly available data. Other data will be sourced from our project partners (i.e. Santa Barbara County flood Control Protection District & Project for

Resilient Communities). We don't anticipate any restrictions of use and can assist the students in their efforts to find additional data they may find useful.
SCHR is excited about the proposal put forth herein and truly believes the findings of this GP will be considered for real world application. Its locality and importance to the community will afford students to feel like their work really matters and will beneficially impact local natural resources with positive legacy effects. SCHR urges the Bren School to support this proposal.

Sincerely,

Jason White, MESM
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