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Subject: **Quantifying Potential Groundwater Recharge Benefit of the Blodgett Dam**

Summary

This proposal details the objectives, scope and process for quantifying the potential groundwater recharge benefit of the Blodgett Dam (RM 22.5) located in the Cosumnes River basin, California, USA. The approach combines fieldwork, stakeholder engagement, and geostatistical (TPROGS) and groundwater flow models (MODFLOW) to conduct the analysis and will be done in collaboration between Larry Walker Associates (LWA) and UC Davis.

Background

Flashboards installed on the Blodgett Dam are primarily used to increase the depth of water stored behind the dam during periods of drought. Previous work in four dams along the river was conducted to improve flow passage conditions to support salmon spawning and migration during low flow conditions. However, the ongoing maintenance necessary to keep the dams functional is both time consuming and costly.

Groundwater levels in the Cosumnes River Basin have significantly declined over the past 70+ years, and recharge potential is important to consider in the design and cost of Blodgett Dam maintenance. In the first case mentioned above, the presence of the dam and installation of flashboards for several months of the year may be advantageous for recharge by increasing the head. Alternatively, recharge potential could increase with a larger wetted area resulting from dam removal.

UC Davis researchers with LWA support developed a groundwater flow model of the lower Cosumnes River and surrounding area to investigate impacts of managed aquifer recharge and levee removal on groundwater recharge. This model can be used to explore effects of Blodgett Dam redesign on groundwater recharge.

Objective

The objective of this project is to explore the potential recharge benefit of the Blodgett Dam under alterative design parameters via model simulation with geostatistical and groundwater flow models.

Scope of Work

From September 1, 2020 to December 15, 2020, LWA and UC Davis researchers will conduct field work, stakeholder engagement, modeling, and data analysis to address the project objective. Additional components, as outlined below, will be added to the previously developed geostatistical and groundwater flow models. The functionality of the Blodgett Dam will be evaluated to develop three locally relevant scenarios for model simulation. Scenarios will likely explore the impacts of adjusting maximum dam height and area of flooding.

Process

Field work (1 week +)

1. Conduct initial survey of flashboard dam to measure dimensions and understand effects
2. Conduct detailed survey of flashboard dam and surrounding streambed to quantify recharge area associated with a water depth [from Frontier Precision]
    - Trimble SX10 Scanning Total Station with Controller - $600 per day
    - Trimble Real Works Advanced (TRW) Software - $100 per day

Stakeholder Engagement (1 week +)

1. Determine scenarios for model simulation

Field and GIS-based Calculations (1 week)

1. Calculate maximum, minimum, and mean water depths upstream of the flashboard dam based on field measurements
2. Calculate corresponding maximum, minimum and mean wetted perimeter based on cross sectional survey or DEM with geospatial software

Geostatistical (TPROGS) and Groundwater Flow Modeling (MODFLOW) and Analysis (8 weeks)

1. Incorporate TPROGS into MODFLOW model (2 weeks)
    - Adjust Layer Property Flow package to increase the number of layers and varied hydraulic properties, and account for deep volcanic geology
    - Adjust boundary conditions to include more layers
    - Adjust UZF to account for more layers
2. Improve streambed geometry of Stream Flow Routing (SFR) Package (1 week)
    - Update streambed cross sections based on new field measurements
    - Update streambed profile based on new field measurements

3. Set new boundary conditions (1 week)
    - Change inputs to SFR package to account for max, min and mean stream depths
4. Conduct sensitivity analysis (1 weeks)
    - Test streambed cross-section, profile, hydraulic conductivity
    - Test aquifer hydraulic conductivity
5. Calibrate MODFLOW model (2 weeks)
6. Simulate scenarios and calculate potential recharge estimates (1 week)

Deliverable

1. Interpret results and write a final report or research paper (2 weeks)

Budget

We expect to complete the proposed work with a budget not to exceed 35,000$ (including field work and eventually data collection).

Work Schedule

Month	**October**				**November**				**December**		
Week	1	2	3	4	1	2	3	4	1	2	
Task											
Field Work											
Public Outreach											
Field/GIS Calcs											
Modeling											
Report assimilation											

We appreciate the opportunity to assist Omochumne - Hartnell Water District on this project. If you have any questions, please do not hesitate to contact me.

Sincerely,

Laura Foglia
Associate Engineer