Yolo Bypass Widening into the Elkhorn Basin: A Multi-Benefit Opportunity for Flood Control, Floodplain Habitat and Fish Passage

Jai Singh, cbec eco engineering, j.singh@cbecoeng.com
Chris Bowles, cbec eco engineering, c.bowles@cbecoeng.com
Chris Campbell, cbec eco engineering, c.campbell@cbecoeng.com

Large scale projects addressing flood control, seasonal floodplain habitat and fish passage needs are critical for the survival of threatened salmonids in the face of climate change and a growing California population. Local agencies in the Sacramento region and the State of California are collaborating on a feasibility study of widening the Yolo Bypass into the Elkhorn Basin. The Elkhorn Basin is bordered by the Sacramento River to its north and east, the Yolo Bypass to its west, and the Sacramento Weir bypass to its south. Given its location and existing topography, the Elkhorn Basin presents a significant opportunity for flood relief, increasing floodplain habitat and enhancing fish passage. Initial hydraulic analyses demonstrate that degrading and setting back existing levees in the Elkhorn Basin could generate as much as 1,830 acres of floodplain habitat inundated for at least 2 weeks every 2 of 3 years between December 1st and May 15th. In addition to providing habitat for juvenile salmonids in winter and spring months, this additional floodplain area could provide a seasonal habitat for waterfowl and a net primary production export to the Delta via the Yolo Bypass. A preliminary 2-D hydrodynamic modeling of a coupled Elkhorn Basin and Yolo Bypass system has been developed to assess floodplain inundation and habitat conditions, flood attenuation, and agricultural impacts. Finding a solution that maximizes ecological benefits while also meeting flood relief goals, agricultural needs, and economic constraints will require creative collaboration among agency staff, landowners, non-profits and engineering firms to determine specific project objectives, site design, an operation regime, and compensation schemes for farmers creating fish habitat.

While it is shown that the ecological benefits are clearly substantial, gaining stakeholder buy-in is critical given the agricultural, economic and flood protection consequences of the considered project and this process is outlined.

Keywords: Yolo Bypass, Flood Control, Fish Passage, Fish Habitat, Ecology, Hydraulics
Session Title: Flood Management
Session Time: Thursday 1:00PM – 2:40PM Room 314

An Integrative Approach to Modeling Effects of Reactivation of River Migration on Aquatic and Floodplain Habitats

Glen Leverich, Stillwater Sciences, glen@stillwatersci.com
Noah Hume, Stillwater Sciences, noah@stillwatersci.com
Rafael Real de Asua, Stillwater Sciences, raf@stillwatersci.com
Eric Larsen, Department of Human Ecology, UC Davis, ewlarsen@ucdavis.edu
Ray McDowell, Floodway Ecosystem Sustainability Branch, FloodSAFE Environmental Stewardship and Statewide Resources Office, DWR, Ray.McDowell@water.ca.gov
Adam Henderson, Northern Region Office and FloodSAFE Environmental Stewardship and Statewide Resources Office, DWR, Adam.Henderson@water.ca.gov
Stacy Cepello, Floodway Ecosystem Sustainability Branch, FloodSAFE Environmental Stewardship and Statewide Resources Office, DWR, Stacy.Cepello@water.ca.gov

As part of implementing the Central Valley Flood Protection Plan, the Department of Water Resources seeks to enhance natural dynamic geomorphic processes in the flood management system to increase flood conveyance, thereby reducing downstream flood risks. One possible strategy is expansion of floodway corridors, which would ideally have ancillary benefits to aquatic and terrestrial habitats of listed species, particularly rearing habitat for juvenile salmonids. We modeled the potential effects of reactivated river migration associated with hypothetical revetment removal and levee setbacks along the middle Sacramento River on habitat suitability of Chinook salmon and Central Valley steelhead. For the sites considered (each approximately 3 river-miles in length), meander migration processes were initially modeled to forecast likely future channel positions following the hypothetical management action. We then employed the Standard Assessment Methodology (SAM) to assess potential changes in near-shore and floodplain aquatic habitat for the special-status fish species resulting from the forecasted river migration. The SAM, originally developed by Stillwater Sciences for the U.S. Army Corps of Engineers, evaluates habitat suitability based on the fish species' understood sensitivities to six habitat parameters: bank slope, floodplain availability, bank substrate size, instream wood, aquatic vegetation, and riparian shade. The analysis required enhanced approaches in order to incorporate the one-dimensional meander-migration results and interpret associated riverine processes, including change in channel position and profile, point-bar development, riparian forest succession, and woody material recruitment. Our results generally reflect large increases in habitat value due to more suitable bank-cover conditions (i.e., habitat quality) and greater channel dimensions (i.e., habitat quantity) associated with the predicted reactivated channel migration. The analysis thus demonstrates the use of a new framework within which future SAM analyses of a dynamic channel state may reasonably follow, and provides initial confirmation that expansion of the river floodway will potentially improve aquatic habitat conditions.

Keywords: Sacramento River, aquatic habitats, ecosystem restoration, flood management, modeling
Session Title: Flood Management
Session Time: Thursday 1:00PM – 2:40PM Room 314

Background Quality of Delta Island Soil and Ground Water and the Implications for Reusing Dredged Sediments

Steven Michelson, Applied Water Resources, smichelson@awrcorp.net
Robert Northup, PhD, Applied Water Resources, rnorthup@awrcorp.net

Annual maintenance dredging of the deep water ship channels produces 100+ thousand cubic yards of sediment each year, the proposed deepening of the Sacramento and Stockton channels could produce 50+ million cubic yards, and the twin tunnel project is likely to produce several 10s of millions of cubic yards. Dredged sediments are a public asset, yet, there are several regulatory and administrative impediments to beneficially and cost effectively reuse these sediments and the potential impacts of placing dredged sediments on the Delta Islands are poorly understand. Furthermore, the Water Board considers dredged sediment to be a waste and incorrect assumptions about the quality and impact of dredged sediments persist. We have performed several studies that characterize the quality of dredged sediment and provide a reasonable understanding of the background geochemical quality of three Delta Islands - Sherman, Twitchell, and Brannan Andrus. This information allows the potential effects of reusing dredged sediments to be put into proper perspective with the background quality of these three Delta Islands. In short, the data show that, overall, dredged sediments reused in an upland environment pose little to no risk to the quality of soil and ground water, and are more likely to improve the overall quality. In addition, this talk will identify some important regulatory, permit, administrative, and bureaucratic inefficiencies to reusing dredged sediment along with potential solutions.

Keywords: Sediment Groundwater Reuse Dredge
Session Title: Flood Management
Session Time: Thursday 1:00PM – 2:40PM Room 314

Post-Cyclic Behavior of Sherman Island Peat

Ali Shafiee*, UCLA, ashafiee@ucla.edu
Scott J. Brandenberg, UCLA, sjbrandenberg@ucla.edu
Jonathan P. Stewart, UCLA, jstewart@seas.ucla.edu

Seismic risk is a significant issue for the Sacramento / San Joaquin Delta because levees are composed of saturated, often liquefiable soils that rest atop soft compressible peaty organic soil. A moderate earthquake on one of the faults in or near the Delta is anticipated to cause multiple simultaneous levee breaches, resulting in inundation of multiple islands and intrusion of saline water. Liquefaction of levee fill soil is a well understood problem and a significant driver of seismic risk in the Delta. Much less is currently understood about the engineering properties of the peat soils that underlie many levees. Our hypothesis is that peat soils may contribute to levee settlement, and we have performed a laboratory investigation of the peat soils to study this behavior. A direct simple shear device at UCLA has imposed cyclic straining on peat samples gathered from the subsurface at Sherman Island, and development of excess water pressure in the peat and the post-cyclic settlement of the peat has been measured. Test results reveal that excess pore water pressure builds up and post-cyclic volume change develops when shear strain amplitude is greater than 1%. This is important since shear strains higher than this level would be anticipated for a moderate magnitude earthquake in the Delta. In addition to settlement associated with expulsion of excess water pressure, peat exhibits continued settlement over time called secondary compression. Our study has identified that the secondary compression clock is partially or even completely reset by cyclic straining, which would translate to an increase in the rate of settlement of levees that survive strong shaking during an earthquake, potentially resulting in loss of freeboard. We anticipate that our results will provide more realistic seismic risk assessments in the future, and will help guide policy decisions in the Delta.

Keywords: Levees, Sherman Island Peat, Earthquake, Settlement
Session Title: Flood Management
Session Time: Thursday 1:00PM – 2:40PM Room 314

Subsidence and Levee Movement in the Sacramento-San Joaquin Delta: Application of Radar Imaging to a Region-Wide Levee Assessment

Cathleen Jones, Jet Propulsion Laboratory/California Institute of Technology, cathleen.e.jones@jpl.nasa.gov
Priyanka Sharma, Jet Propulsion Laboratory/California Institute of Technology, priyanka.sharma@jpl.nasa.gov
Joel Dudas, Ca. Dept. of Water Resources, jdudas@water.ca.gov
Gerald Bawden, U.S. Geological Survey, gbawden@usgs.gov
Steven Deverel, HydroFocus, Inc., sdeverel@hydrofocus.com

Land subsidence in the Sacramento-San Joaquin Delta poses a serious challenge to maintaining the local ecosystem and the integrity of the state's water supply. Subsidence in and near the levees reduces levee freeboard, increases hydrostatic load on the levees, and can induce various problems that could cause levee failure. In the Delta, a complex host of causes drive sub-island-scale subsidence, including aerobic oxidation, consolidation, shrinkage, anaerobic decomposition, wind erosion, resource withdrawal, and dissolution of soil organic matter. The variety of subsidence mechanisms and the hetereogenity of Delta soils make it difficult to uniquely characterize levee-scale deformation across this dynamic landscape. Here we report on an ongoing study to determine current-day subsidence rates across the Sacramento-San Joaquin Delta using data from NASA's UAVSAR L-band radar platform acquired at ~6 week intervals during 2009-2014. In this presentation, we focus specifically on the levees, using high resolution (~7 m ground resolution) radar remote sensing to resolve the levees from the surrounding area. We report preliminary analyses that suggest various specific spatial patterns of subsidence can be identified and quantified: We found that there is increased land subsidence and surface deformation on and near levee segments subsequent to repairs; general differential levee subsidence that affects sections of levees and island interiors that have not undergone recent repair; and specific other land-side and water-side slope instabilities. We observe that consolidation from material addition causes compaction to be the main contributor following levee repair in some, but not all, areas. We also found that general subsidence can induce changes to the levees and, conversely, levee repair can induce subsidence a substantial distance inland from the directly loaded section. This information is of value to both risk management associated with levee maintenance and to long-term plans for providing a more reliable water supply for California.

Keywords: Sacramento-San Joaquin Delta, levees, subsidence, radar remote sensing, UAVSAR
Session Title: Flood Management
Session Time: Thursday 1:00PM – 2:40PM Room 314