Session 6: Conveyance: Subsidence, Sediment, and Seepage

Subsidence Impacts on Channel Capacity along the SJR and Bypass

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From 1926 to 1970, groundwater pumping caused land subsidence up to 28 feet near the city of Mendota in Fresno County. Recently it has been determined that extreme subsidence rates up to nearly 1 foot per year are occurring in a new area centered near the town of El Nido and including areas of the San Joaquin River and flood bypass channels within Madera and Merced Counties. With the potential impact on channel conveyance and improvements of the San Joaquin River Restoration Program (SJRRP), the Department of Water Resources (DWR), Reclamation, and other agencies have performed surveys to understand the limit and rate of the subsidence.

The SJRRP uses hydraulic models for various studies under existing and future project conditions including evaluating channel capacity, fish passage in channels and at structures, and spawning and rearing habitat for fisheries. The model results may also be used to provide input to other modeling applications in evaluating sediment transport, temperature effects, levee underseepage and stability, growth and mortality of riparian vegetation and surface water/groundwater linkages.

Hydraulic models developed to support the SJRRP incorporate 2008 LiDAR survey data and use water surface profile data collected from 2009 to 2011 for model calibration. Some of the model reaches, specifically in those areas that have experienced a great amount of subsidence no longer reflect the capacity and hydraulic conditions characterized by the 2008 models and therefore require update. To do this, DWR completed additional topographic surveys in select reaches and updated the models in those reaches that are critical to understanding the channel capacity to support the release of Restoration Flows.

The presentation will provide a brief overview of the subsidence that is occurring with the Restoration Area, DWR and other data collection efforts, the methods used to update the models, as well as the resulting changes in flow capacity and water surface elevations.

Reach 2A channel and sediment monitoring: implications to future flood capacity and downstream sediment supply

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The California Department of Water Resources (DWR) and Tetra Tech have engaged in a monitoring program in Reach 2A of the San Joaquin River to assess the aggradation/degradation, bed material gradation, and sediment transport response to restoration flows and other high-flow releases. This study provides information to assess both short- and long-term trends in the flood carrying capacity and channel stability in the study reach, and the implications of those trends to sediment supply to Reach 2B and the Chowchilla Bypass. Important, related questions are whether the restoration flows will cause sedimentation that could adversely affect operation of the Chowchilla Bypass Bifurcation Structure, and whether the bed material in the reach will eventually coarsen sufficiently due to higher flows and lack of upstream sediment supply to limit the sediment supply to downstream reaches, with attendant effects on channel stability.

The field monitoring consists of 27 cross sections in the downstream approximately 2.7 miles of the reach, and a series of 11 sites where detailed topography has been collected in 50-foot to 75-foot long patches that extend across the active channel width. The cross sections were originally surveyed in November 2010, and re-surveyed in November 2011 and June 2012 to assess the ongoing effects of the interim flow releases and the 2011 high-flow releases. The “patch” surveys were originally conducted in July 2009 and repeated in February and August 2011. Systematic bed material sampling was also conducted in conjunction with the patch surveys. The data from both the cross section and patch surveys indicate a general degradation trend throughout the period, although parts of the reach degraded most significantly during the 2011 high flows and then partially backfilled during the subsequent low-flow periods and interim restoration releases. The data also indicate that the area just upstream from the Bifurcation Structure tends to aggrade during low- to intermediate-flow periods, but then scours during higher flows. An initial hydraulic analysis indicates that the changes that occurred during the monitoring period have not had a substantive effect on channel capacity. The bed material data at the patch-survey sites indicates a general coarsening trend in the upstream part of the reach, but no discernable trend in the downstream portion. At sites where the coarsening was detected, there appears to be a cyclic response, with general coarsening during the 2011 high flows, followed by fining during the subsequent lower flows.

The DWR/Tetra Tech Team intend to continue the monitoring efforts as the Program transitions from interim to full restoration releases, with the intent of capturing responses to higher flows, and will use the resulting data to build our understanding of long-term trends in the reach and the effects on sediment supply to downstream portions of the restoration reach and bypass system.

Scenario evaluation with data-drive hydrologic tool for restoration flow release planning

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The San Joaquin River Restoration Program (SJRRP) is a long-term effort to restore fish populations to the river. An important component of the SJRRP is the role of the Restoration Administrator (RA), who is tasked with recommending releases from Friant Dam to achieve the fish restoration goal. Determining how best to manage water volumes allocated to the river under the terms of the Settlement Agreement requires real-time understanding of key data on system hydrology. We have developed an interactive Flow Management Tool (FMT) for flow recommendation scenario planning and evaluation to facilitate use by the RA and expand access to resource agencies and stakeholders. The FMT integrates 1) real-time flow and water temperature data, 2) runoff forecasts, and 3) historical and modeled flow magnitude, flow routing, and water temperatures throughout the SJRRP area. Key benefits of the tool include automatic updating of gage data, flexibility in runoff forecast input data, an intuitive user interface allowing tracking of remaining restoration flow allocations, and a graphical display of downstream flows and water temperatures. The TAC has developed draft “Template Hydrographs” for a wide range of flow allocations that provide more detailed release schedules than the Settlement Exhibit B hydrographs. These hydrographs will be used to illustrate both the functionality of the flow tool and the ability to rapidly evaluate the sensitivity of flow and temperature response to changes in recommended flows.

San Joaquin River Restoration Program : groundwater monitoring program overview

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The San Joaquin River Restoration Program (SJRRP) monitors groundwater levels in over 200 wells located near the San Joaquin River in Fresno, Madera, and Merced Counties, CA. The groundwater level data is used to inform water management decisions regarding the timing and magnitude of restoration flow releases to the San Joaquin River authorized by the San Joaquin River Restoration Settlement Act (Public Law 111-11). The SJRRP monitor well network is designed to measure the response of the near-surface alluvial aquifer to the release of restoration flows in the San Joaquin River and contribute to an overall understanding of groundwater levels under various hydrologic, river flow, and local irrigation conditions. The goals of the groundwater monitoring program are (1) to protect agricultural crops near the river from damage due to seepage in accordance with the SJRRP Seepage Management Plan, (2) provide high quality data to inform the design seepage control measures, (3) provide data to inform estimates of seepage losses associated with SJRRP restoration flows. Groundwater level data are collected at frequencies ranging from weekly to hourly and are available to the public online at www.restoresjr.net and by request from the SJRRP. This talk will present trends and analysis of groundwater response to Interim and Restoration Flows and irrigation events, shallow to deep acquifer interactions, effects of interceptor lines, and overall groundwater trends across the SJRRP area.

Electrical Resistivity Investigation of Fluvial Geomorphology to Evaluate Potential Seepage Conduits to Agricultural Lands along the San Joaquin River, Merced County, California, 2012–13

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Increased flows in the San Joaquin River, part of the San Joaquin River Restoration Program, are designed to help restore fish populations. However, increased seepage losses could result from these higher restoration flows, which could exacerbate existing drainage problems in neighboring agricultural lands and potentially damage crops. Channel deposits of abandoned river meanders that are hydraulically connected to the river could act as seepage conduits, allowing rapid and widespread water-table rise during restoration flows. There is a need to identify the geometry and properties of these channel deposits to assess their role in potential increased seepage effects, and to evaluate management alternatives for reducing seepage. Electrical and electromagnetic surface geophysical methods have provided a reliable proxy for lithology in studies of fluvial and hyporheic systems where a sufficient electrical contrast exists between deposits of differing grain size. In this study, direct-current (DC) resistivity was used to measure subsurface resistivity to identify channel deposits and to map their subsurface geometry. The efficacy of this method was assessed by using DC resistivity surveys collected along a reach of the San Joaquin River in Merced County, California, during the summers of 2012 and 2013, in conjunction with borings and associated measurements from a hydraulic profiling tool. Modeled DC resistivity data corresponded with data from cores, hand-auger samples, a hydraulic profiling tool, and aerial photographs, confirming that DC resistivity is effective for differentiating between silt and sand deposits in this setting. Modeled DC resistivity data provided detailed two-dimensional cross-sectional resistivity profiles to a depth of about 20 meters. The distribution of high-resistivity units in these profiles was used as a proxy for identifying areas of high hydraulic conductivity. These data were used subsequently to guide the location and depth of wells installed onsite for monitoring flow in the channel deposits. Estimates of the cross-sectional area of channel deposits from DC resistivity pseudosections can provide critical input for groundwater-flow models designed to simulate river seepage and evaluate seepage-management alternatives.