Study 53

Effect of Subsidence on Channel Capacity

Final
2015 Monitoring and Analysis Plan

SAN JOAQUIN RIVER
RESTORATION PROGRAM

January 2015

1.0 Effect of Subsidence on Channel Capacity

Theme(s):

- Conveyance

Related Question(s):

Questions not developed for this theme to date.

1.1 Statement of Need

Topographic surveys completed prior to 2011 indicated that there was significant subsidence occurring within the San Joaquin River Restoration Program (SJRRP) Restoration Area. Continued subsidence is expected to change channel slopes which has the potential to affect the ability of levees and flow control structures to perform as designed, change sediment transport behavior, and reduce the long-term flow capacities of the flood and river system. Reclamation, as part of their development of design criteria for site specific projects, decided to account for subsidence. The goal of this study is to identify the potential impacts of subsidence on the channel capacity by developing hydraulic models to provide the SJRRP with a tool to inform the design and implementation of the projects to achieve the goals of the program.

1.2 Background

Subsidence, which is the downward shift or sinking of the ground, is known to have occurred throughout the San Joaquin Valley and to varying degrees along the San Joaquin River and flood bypass channels with the SJRRP Restoration Area. Various studies and mapping efforts that identify the extent and magnitude of subsidence have been completed by the United States Army Corps of Engineers (USACE), California Department of Water Resources (DWR), the Bureau of Reclamation (Reclamation), and the US Geological Survey (USGS). One of those studies within the project area is the Sacramento-San Joaquin Comprehensive Study completed by the USACE in 2002. This study highlighted the observed areas of subsidence, and provided historic rates based on previous surveys. The areas of greatest documented subsidence within the Restoration Area occur at the various control structures located along the river, including at Mendota Dam, Sack Dam, the Reach 4B1 Headworks and Sand Slough Control Structure (Reclamation, 2013).

The SJRRP has committed to maintaining Restoration Flows at or below estimates of then-existing channel capacities. Then-existing channel capacities in the Restoration Area correspond to flows that would not significantly increase flood risk from Restoration

Flows. Until adequate geotechnical data are available to apply the USACE criteria to the existing levees, the release of Restoration Flows would be limited to those that would remain in-channel (the water surface elevation in the river remains below the levees). The in-channel capacities currently established for the SJRRP are based hydraulic models that incorporate topographic from LiDAR collected in 2008 and bathymetry that was collected in 2010/2011. However, the significant subsidence that has occurred within the Restoration Area since 2008 has the potential to change the channel capacities and therefore potentially change how much Restoration Flow can be released.

In late 2012 and again in 2013, DWR completed surveys of the tops of approximately 65 miles of levees within the downstream portion of Reach 2A; the Eastside Bypass from its confluence with the Fresno River to the Eastside Bypass Control Structure; and the Mariposa Bypass. In addition to the above surveys, DWR also completed surveys in 2013 and 2014 of the levee and channel in the lower portion of Reach 3, Reach 4A, and the Middle Eastside Bypass. This study will use the topographic data to update the hydraulic models to consider subsidence, which can be used to determine channel capacity.

1.3 Anticipated Outcomes

The study will result in the following outcomes related to channel capacity, including:

- Estimated subsidence rates and trends within the Restoration Area
- Developed hydraulic modeling tools to assess channel capacity as a result of subsidence and Restoration flows
- Estimated in-channel capacity in Reach 3, Reach 4A and the Middle Eastside Bypass
- Inform other ongoing work, such as the geotechnical evaluations being completed as part of the SJLE Project, and the Verification and Monitoring of In-channel Capacity study

1.4 Methods

Type of Study: Combination of data collection and modeling

Reach(es): Reach 3, Reach 4A, and the Middle Eastside Bypasses

The following is a list of tasks necessary to achieve the goals and objectives of this study:

- **Data Collection**: Much of the data collection was completed 2013 and 2014 for this study, including collecting topographic data along the levees in Reach 3, Reach 4A and the Bypasses. The levee crowns were surveyed on an ATV on both the left and right levees recording points approximately every 100 feet. The

expected accuracy of distinct points is generally ±0.2 feet. In addition, several cross sections were surveyed to characterize those areas with 2010/2011 bathymetry.

- **Data Analysis**: The surveyed levee and cross section elevation data will be compared with elevations from the 2008 LiDAR terrain surface. The elevation comparison will be used to determine the magnitude of the elevation adjustments that should be made to the hydraulic model.

- **Model Development**: The elevations in the existing 1-D HEC-RAS models for Reach 3, Reach 4A, and the Middle Eastside Bypass will be adjusted to account for subsidence based on the results of the data analysis. It is possible that a different vertical adjustment will need to be applied to the in-channel and overbank portions of the cross sections because of different time frame the bathymetry and LiDAR were collected in.

- **In-channel Capacity Analysis:** The subsidence models for Reach 3, Reach 4A and the MEB that were adjusted for subsidence will be executed for a range of Restoration Flows. The outside ground elevation as defined in Tetra-Tech's Technical Memorandum, *San Joaquin River In-channel Capacity Analysis*, dated September 10, 2013 will be updated based on the topographic data collected and the updated models. The in-channel capacity will then be re-evaluated for each of those reaches and the three most critical areas identified.

1.5 Deliverables and Schedule

- **Data Collection:** All collected topographic point data including control points shall be delivered as a text file in (PENZD) point file format on California Coordinate System Zone 3 (US Survey Feet). (August 2014)

- **Model:** 1-D HEC-RAS hydraulic models adjusted for subsidence in a portion of Reach 3, Reach 4A, and the Middle Eastside Bypass based on topographic surveys conducted in 2013. (January 2015)

- **Capacity Analysis**: A technical memorandum that includes (1) a summary of the methodology used (2) water surface profiles for a range of Restoration Flows that show the outside ground elevations for the right and left levee, (3) recommended in-channel capacity, and (4) the three critical sites in each reach shown on a map. (February 2015)

1.6 Budget

The total cost estimate is $60,000 for 2015.

Table 1-1. Proposed 2015 Budget

Task	Cost*
Hydraulic Model Development for Reach 3, 4A, and MEB[1]	$20,000
Hydraulic Capacity Analysis	$40,000
Total	$60,000

Note:
[1] Models for Reach 4A and MEB are already complete and are not included in the cost.

1.7 Point of Contact / Agency Principal Investigator

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1.8 References

No applicable references.