United States Department of the Interior

BUREAU OF RECLAMATION
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, CA 95825-1898

IN REPLY REFER TO:

MP-220
PRJ-1.10

AUG 2 1 2012

MEMORANDUM

To: San Joaquin River Restoration Project
Attn: MP-170 (DMooney)

From: Ani Bhattacharyya
FOR Regional Engineer

Subject: Central Valley Subsidence Investigation - Data Update

Attached are various exhibits and data files representing historic subsidence monitoring data provided by others and current data collected by the Bureau of Reclamation, Mid-Pacific Region, Division of Design and Construction, Surveys and Mapping Branch (MP-220). I have listed each attached file by name below, explaining the origin of the data represented and any other pertinent information. No conclusions have been drawn to date due to the limited dataset available at this time. To provide a more complete study of the project area, monitoring surveys of the Arroyo and TSR canals are planned to continue through July 2013, with re-surveys of the San Joaquin River Restoration Project (SJRRP) Geodetic Control Network planned for December 2012 and July 2013.

SJR-Subsidence Maps-data from other: These exhibits were prepared to represent actual and expected annual subsidence rates in the project area.

- Page 2 of 5 is based upon the SJRRP Geodetic Control Network performed by MP-220 using static GPS methods in December 2011. This survey data was compared to published NGS elevations and elevations shown on RBF's Record of Survey Vol. 48, Pg. 30 (Merced County) to calculate shown annual subsidence rates.
- Page 3 of 5 is based upon GPS surveys performed by RBF Consulting (RBF) in 2008 and 2010 under contract with California Department of Water Resources (CA DWR). Data was provided by CA DWR and RBF. Annual rates shown were calculated by dividing elevation changes by 2 years, as actual precise dates of survey are not available.
- Page 4 of 5 is based upon the U.S. Army Corps of Engineers (USACE) comprehensive study information paper "Subsidence in the Central Valley", Figure 2 dated December 2002. The annual subsidence rates shown were calculated by comparing record benchmark elevations to elevations determined by USACE in a 2001 survey.
- Page 5 of 5 is based upon U.S. Geological Survey (USGS) interferogram data collected between January 2008 and January 2010.

- Page 1 of 5 is a compilation of all datasets in this document, with the exception of the USGS interferogram data. This data was not incorporated due to the difficulty correlating its non point related data to the other datasets.

CalTrans Hwy152Subsidence – editGTD: This document is mostly provided as prepared by the California Department of Transportation. Columns highlighted in yellow have been added by MP-220 to provide for easier comparison to annual subsidence rates presented in other attached documents. Slightly higher annual rates shown in the 1988-2004 survey data supports the theory that subsidence rates in the project area have accelerated in the last two decades. Of note is the fact that that maximum observed subsidence rates and locations shown on this survey, Reclamation surveys, and survey data provided by other agencies are all in substantial agreement.

ARROYO canal monitoring 07302012: This document reports the results of MP-220's monitoring activities along the Arroyo canal from May 15, 2012 to July 30, 2012. These surveys were performed using a digital level and first order leveling techniques. Elevation changes shown on this report are relative, as the elevation of station 375USE has been held fixed for these surveys. To correctly interpret the results of these surveys, this must be kept in mind because the subsidence appears are "lift" at the end of the level runs. The actual localized subsidence that has occurred between stations CHECK2 and 375USE as of July 30, 2012 is 0.058', with station 375USE subsiding as CHECK2 leveled in at 0.058' higher in elevation than the baseline survey. Of note is the acceleration of subsidence between the July 11 and July 30 monitoring events.

TEMPLE canal monitoring 08012012: This document reports the results of MP-220's monitoring activities along the Temple - Santa Rita (TSR) canal from June 12, 2012, to August 1, 2012. These surveys were performed using a digital level and first order leveling techniques. Elevation changes shown on this report are relative, as the elevation of station CHECK 1 has been held fixed for these surveys (based upon it's elevation from the ARROYO survey dated June 6, 2012). The same method of reporting is used for these surveys as explained above for the Arroyo canal surveys. The TSR surveys also exhibit an acceleration of subsidence between the July 11 and August 1 events.

ARROYO-TSR Survey Points: This shows the horizontal location of Arroyo and TSR monitoring stations. These stations were surveyed by MP-220 using RTK GPS methods based upon the July 2012 values of the SJRRP Geodetic Control Network. Stations G990 and William3 are shown for orientation only, and are not a part of either monitoring system.

SJRRP network comparison dec2011-jul2012: This spreadsheet shows the elevation differences observed during the July 2012 observation of the SJRRP Geodetic Control Network by MP-220. These surveys were both performed using static GPS methods; with post processing and least squares adjustments performed using Trimble Business Center v.2.7. Bolded elevations in the 12/2011 column were provided by RBF, and were not a part of the original SJRRP Geodetic Control Network. They were added here to provide a more complete representation of the network densification provided by the July 2012 re-survey.

SJRRP-Subsidence Mapping-network comparison: This exhibit is a graphic representation of annual subsidence rates derived from the observed actual rates shown on the above mentioned spreadsheet. This exhibit also incorporates the Arroyo and TSR canal monitoring stations for further densification in the project area. An ArcGIS map package has been provided of this dataset to enable interested parties to overlay their service areas, infrastructure, etc as needed.

If you have any questions regarding this data and analysis, please contact Gerald Davis, PLS at 916-978-5538, GDavis@USBR.Gov or Mark Morberg, PLS, Chief - Surveys and Mapping Branch, at 916-978-5306.

Attachments – 7 (Listed below)

1 - SJR-Subsidence Maps-data from other.pdf
2 - CalTrans Hwy152Subsidence – editGTD.pdf
3 - ARROYO canal monitoring 07302012.pdf
4 - TEMPLE canal monitoring 08012012.pdf
5 - ARROYO-TSR Survey Points.pdf
6 - SJRRP network comparison dec2011-jul2012.pdf
7 - SJRRP-Subsidence Mapping-network comparison.pdf
SJRRP-Subsidence Mapping-network comparison.mpk (Electronic File Only)