State of California
Natural Resources Agency
Department of Water Resources
Division of Integrated Regional Water Management
Northern Region Office

2017 GPS Survey of the Sacramento Valley Subsidence Network

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Technical Information Record (TIR) – NRO-2018-01

This Technical Information Record is primarily a working paper and is subject to revision or replacement. Its primary purpose is to summarize the equipment, procedures, processing, and results of the 2017 survey of the Sacramento Valley Subsidence Network installed in 2008.

Acknowledgements

This important survey project required many hours of field observation over more than 12 weeks using 4 to 10 observers per day. Without the outstanding support and assistance of many State, county, and local agencies, and private entities this project would not have been possible. The California Department of Water Resources would like to acknowledge and thank the following public and private entities for their assistance and support in making this project happen.

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- **Shasta County**
- **Sutter County**
- **Tehama County**
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- **Yolo County Flood Control and Water Conservation District**
- **Yuba County Water Agency**

Certification

I hereby state, all the work performed for this project was done by, or under the direct supervision of, a Licensed Land Surveyor. It is my opinion that the survey control, equipment, procedures, and techniques used for this survey are in conformance with accepted professional survey practice standards.

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This technical information record report has been prepared under my direction as the professional engineer in direct responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

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Acronyms and Abbreviations

CORS	Continuously Operating Reference Station
CSRC	California Spatial Reference Center
DIRWM	Division of Integrated Regional Water Management
DWR	California Department of Water Resources
GPS	Global Positioning System
ft.	feet
IRWM	Integrated Regional Water Management
InSAR	Interferometric Synthetic Aperture Radar
JPL	Jet Propulsion Laboratory
NAD83	North American Datum of 1983
NGS	National Geodetic Survey
NOAA	National Oceanic and Atmospheric Administration
NRO	Northern Region Office
OPUS	Online Positioning User Service
PDOP	Position Dilution of Precision
QR Code	Quick Response Code
RMS	Root Mean Square
Subsidence Network	Sacramento Valley GPS Subsidence Monitoring Network
TBC	Trimble Business Center
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey

Executive Summary

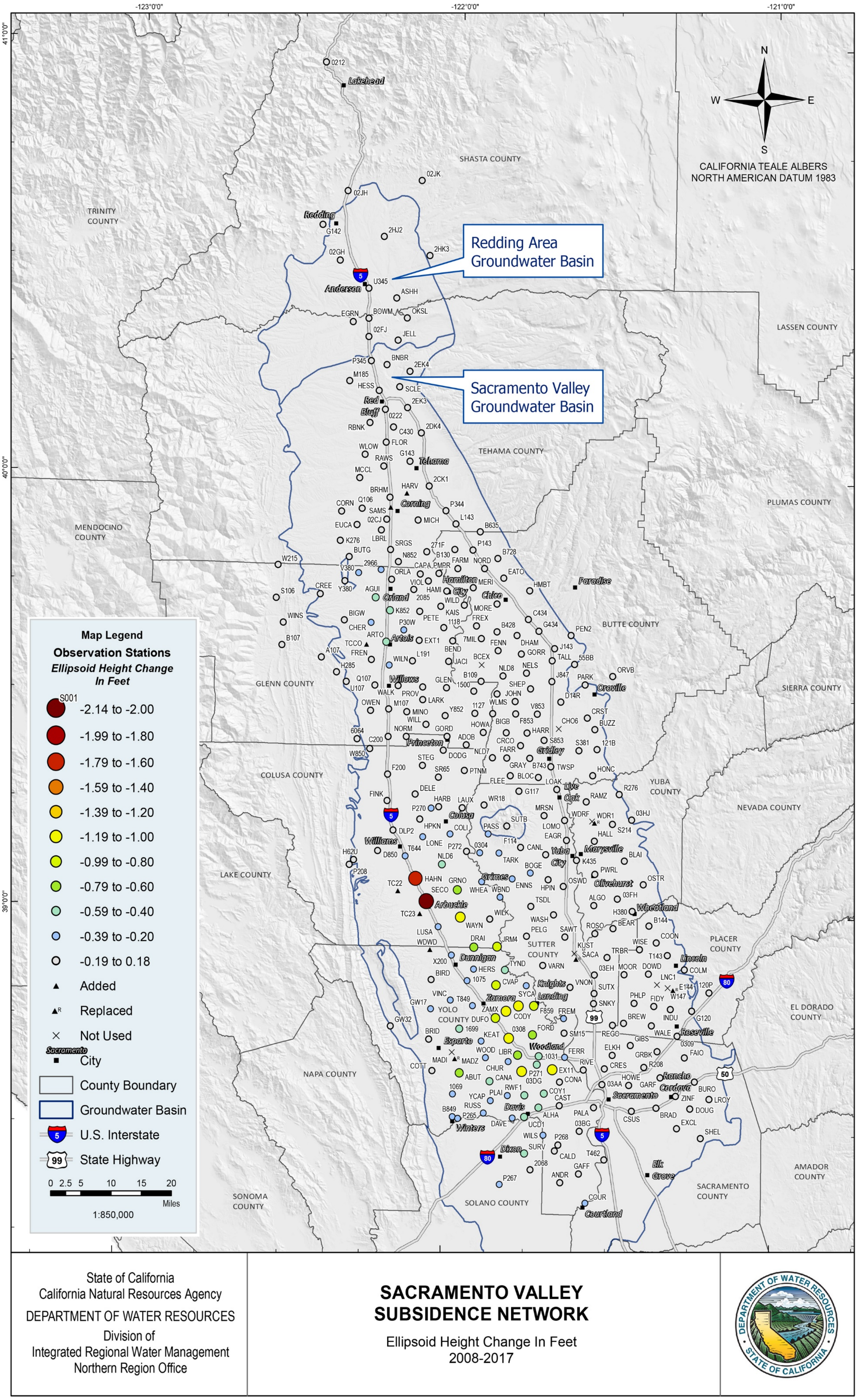
Land subsidence caused by groundwater extraction has occurred historically and continues to occur in portions of the Sacramento Valley. Over many years, the California Department of Water Resources (DWR) has established a subsidence monitoring program that includes field-based monitoring stations (11 extensometers and a Global Positioning System (GPS) network (further explained in this report) and more recently, remotely-sensed data (Interferometric Synthetic Aperture Radar [InSAR]) obtained from NASA and the Jet Propulsion Laboratory (JPL). In 2008, DWR developed a series of survey monuments in the Sacramento Valley to create a subsidence monitoring network. The network encompasses all or part of 11 counties, from Shasta County at the north end of the valley to Solano and Sacramento counties in the south. It includes over 300 benchmarks with an average spacing of 4.3 miles (7 kilometers). During the spring/summer of 2008, DWR along with 25 local, State, and federal partners performed an initial GPS survey of the network to establish a baseline measurement to compare against future surveys. The initial survey was done using National Geodetic Survey standards.

DWR resurveyed the monument network in 2017 with assistance from 19 State, county, and local agencies, and a private entity. The methodology and equipment used was similar to the 2008 survey. Analysis of the results was done to depict the change in height at each monument from 2008 to 2017.

The Arbuckle area (Colusa County) showed the most subsidence with a maximum change of -2.14 feet (ft.). Surrounding stations and InSAR data confirm this result with changes ranging from -0.49 to -1.00 ft. In eastern Yolo County (Zamora to Davis), the largest spatial extent of station declines was observed with several benchmarks showing changes between -0.3 and -1.1 ft. In Glenn County (Artois and Orland area), three stations, ARTO, K852, and AGUI showed changes of -0.59 ft., -0.46 ft., and -0.44 ft., respectively. An area on the south side of the Sutter Buttes showed changes ranging from -0.19 to -0.36 ft. The remainder of the valley shows little change overall. The results of the change between 2008 and 2017 are shown in Figure ES-1.

During the time of the 2017 survey, groundwater levels in the Sacramento Valley were recovering from the severe drought of 2012-16. During the drought, groundwater levels hit historic lows in most wells in the Sacramento Valley with maximum decreases in Glenn and Colusa Counties of 58 ft. and 43 ft., respectively, compared to 2011 pre-drought conditions. During the survey field work in 2017, groundwater levels had recovered about 7 ft. on average since 2015. The period between the two surveys was nine years, and it was not possible to determine when during that time frame the changes shown took place. However, it is likely that the subsidence occurred during the drought in 2012-16 when groundwater levels in many wells reached historic lows due to increased groundwater pumping. To better bracket when changes occur, surveys at a more frequent interval (3-5 years), are recommended. Integrating ground-based subsidence monitoring such as continuous GPS sites and extensometers and remote sensing data, such as InSAR, into the subsidence monitoring network is also recommended.

Figure ES-1 Height Change at Monuments between 2008 and 2017



1. Introduction/Background

It has long been known that pumping large quantities of groundwater in areas with compressible subsurface sediments in California's Central Valley lead to land subsidence (Borchers et al. 2014). DWR is interested in monitoring this phenomenon on a large spatial scale. To assist with this effort, in 2008 the Sacramento Valley GPS Subsidence Monitoring Network (Subsidence Network) was established and an initial survey was conducted (California Department of Water Resources 2008). In 2017, the Subsidence Network was resurveyed. This technical information record report summarizes the equipment, procedures, processing, and results of the 2017 resurvey. The purpose of the 2017 resurvey was to use GPS to resurvey the network to determine if any changes had occurred in the ground-surface elevation since the original survey was performed in 2008, and if so, to what magnitude. DWR's Division of Integrated Regional Water Management (DIRWM) Northern Region Office (NRO) staff led this work with the assistance of 19 State, county, and local agencies, and a private entity. The work was performed between February and December 2017 with funding from DWR's Sustainable Groundwater Management and Future Water Supply programs.

At the time of the 2017 survey, groundwater levels in the Sacramento Valley were recovering from the severe drought of 2012-16. During the drought, groundwater levels hit historic lows in most wells in the Sacramento Valley with maximum decreases in Glenn and Colusa counties of 58 ft. and 43 ft., respectively, compared to 2011 pre-drought conditions. During the survey field work in 2017, groundwater levels had recovered about 7 ft. on average since 2015.

The period between the two surveys was nine years, and it was not possible to determine when in that time frame the changes shown took place. However, it is likely that the subsidence occurred during the drought in 2012-16 when groundwater levels in many wells reached historic lows due to increased groundwater pumping.

1.2 Monitoring Network

In 2008, DWR contracted with Frame Surveying & Mapping to develop a series of survey monuments in the Sacramento Valley, to create a subsidence monitoring network, and to conduct a baseline GPS survey (California Department of Water Resources 2008). DWR resurveyed the monument network in 2017 with assistance from 19 state, county, and local agencies, and private entities to determine the change in elevation at each benchmark in the network.

The network encompasses all or part of 11 counties, from Shasta County at the north end of the valley to Solano and Sacramento Counties in the south. It includes over 300 benchmarks with an average spacing of 4.3 miles (7 kilometers).

Information gathered from the GPS subsidence network is used in conjunction with other sources including groundwater levels to assess the timing and location of land subsidence and help determine a correlation between the amount of groundwater extraction and the subsidence.

1.3 Equipment and Procedures

As with the 2008 network campaign, the procedures for this project followed the National Geodetic Survey (NGS) *Guidelines for Establishing GPS-Derived Ellipsoid Heights* NOAA Technical

Memorandum NOS NGS-58 using the 2-centimeter standards (National Geodetic Survey 1997). Although there are slight deviations from the network design standards for spacing, they are the same deviations that existed in 2008 and the design was accepted and approved by NGS at that time. Other variations from the Technical Memorandum include longer observation times than the minimum requirement and recording data at a higher epoch rate (recording interval). Each of these variations exceeded the guideline requirements. All GPS receivers and antennas used for the survey were dual-frequency, full-wavelength receivers that satisfied the requirements of NGS-58. All tripods used were fixed height, either 2-meter (6.562 ft.) or 1.8-meter (5.905 ft.). Prior to the first observations, the tripods and level bubbles were adjusted to plumb. Because all tripods had either a 3-bubble level plate or a rotating center pole bubble, there was an immediate indicator if the pole was not plumb. Any tripods that were found to be out of plumb during the survey were immediately removed from service until they were readjusted to plumb. A complete list of the equipment used is in Appendix A.

At the FERR station it was necessary to add a 2-foot extension to the tripod for a total of 8.562 ft. (2.61 meters) because the construction of a new water intake structure on the Sacramento River raised the ground surface nearly two feet, putting the monument below the surface by over 2.5 ft. (Figure 1-1).

Figure 1-1 FERR Monument with Tripod in Place

1.3 Training and Reconnaissance

After initial planning, two training sessions were held, one at DWR’s Northern Region Office on April 18, 2017, and one at DWR’s North Central Region Office on April 20, 2017. These sessions were designed to discuss safety and teach potential observers the process for locating the monuments, operating the survey equipment, and properly filling out the GPS Observation Log. Each observer was given the opportunity to complete a full scenario of setting up the equipment, recording data, and filling out the Observation Log. These sessions helped reduce errors during the survey campaign and revealed some unanticipated problems. One of the problems identified was that some observers had difficulty reaching the GPS receiver once it was placed atop the 2-meter tripod. To accommodate these situations, 1.8-meter tripods were sometimes used while some observers brought a stable platform, such as a step stool. Fieldwork began in March 2017. The first phase involved finding the monuments and marking them to make it easier for the observers to quickly identify them during the actual survey. It also allowed for identifying if monuments had been destroyed or if conditions such as vegetation growth prevented the monument from being surveyed directly with GPS.

During the first phase, it was discovered that five monuments had been destroyed: BC EXTN 2 (BCEX), Kuster (KUST), Madison (MADI), W1474 (W147), and Woodruff (WDRF). BCEX was in farmland and was damaged by disking equipment. KUST was located on a canal headwall which was removed by Caltrans for construction of a new alignment of Highway 99. MADI had been in farmland and was destroyed by land levelling during the planting of a new orchard. W147 was on a drainage channel headwall which was removed when the adjacent street was widened and improved. And WDRF, which was on an irrigation ditch headwall, was destroyed when the county realigned the road.

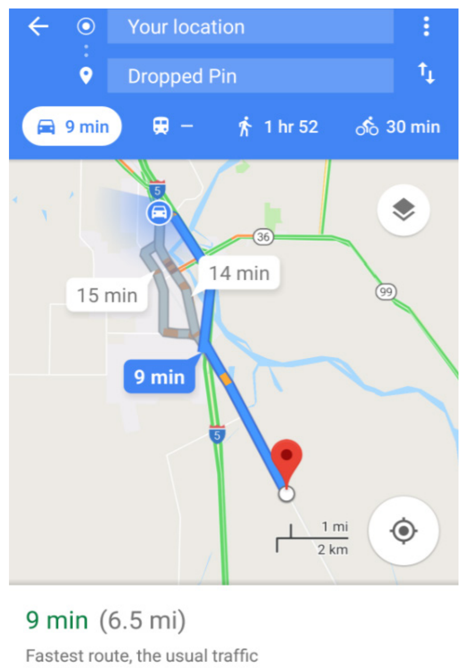
To meet the requirements for GPS network design station spacing, other existing monuments, if available, had to be recovered and marked, or new monuments had to be installed. Office and field research found existing monuments as replacements for W147, and MADI, stations E1446 (E144), and Madison Az Mk (MADZ), respectively. BCEX, KUST, and WDRF required that new stations be set. For BCEX, the existing metal rod was bent back into position and the name on the monument cap was changed to include “RESET”; although the original coordinates and elevation as published by NGS cannot still be considered valid, the elevation of the new monument is within a few hundredths of a foot of the original one. For KUST, a brass disk monument, Sacramento Ave (SACA) was set on a new headwall very near the original location of KUST. Unfortunately, there is no known data to relate the original elevation of KUST to the new SACA monument. Similarly, WDRF was also replaced with a new monument, Woodruff Replacement (WDR1), in a headwall; however, there is no data available to compare their elevations. The field location and marking also found that three stations were no longer suitable for GPS observations because of trees blocking the view of the sky; these stations are Gaffney (GAFF), Alhambra (ALHA), and Fremont (FREM). For these locations, temporary points were set for the GPS observations and differential levels were performed to tie the observed location back to the original network.

During the first phase, counties and other agencies were given an opportunity to add monuments to expand or densify the network. Tehama County set two new monuments, Harvest 2017 (HARV) and Samson 2107 (SAMS), to increase the network density in areas of potential subsidence. Glenn County added one monument, Tehama-Colusa Canal 0 (TCC0), to expand the network to the west; it is an existing brass cap monument on a Tehama-Colusa Canal check structure. Colusa County added three stations to the network to expand the network to the west as well. The southernmost monument, Wildwood Bridge (WDWD), is a new monument set on a bridge on Wildwood Road. The other two stations, Tehama-Colusa Canal 22 (TC22) and Tehama-Colusa Canal 23 (TC23), were existing monuments on Tehama-Colusa Canal check structures and their number designates the check structure numbers on the canal. Descriptions or sketches for the locations of all the new monuments are in Appendix B.

After the network points were found or re-set, one-page summary sheets including the location, description, and a map were created for each station. This was done to provide the observers with an easy to use reference to access each site. Previously, in 2008, NGS datasheets were used and they can consist of one to eight pages making them cumbersome and difficult to read. For the 2017 resurvey, a Quick Response (QR) Code was created to assist with locating the monuments. The QR Code leverages smartphone technology by quickly enabling the user to access a map and turn-by-turn instructions to the station (Figure 1-2). Although there were a few errors because of road locations relative to the monument, using the QR Code worked well by enabling the observer to quickly access station maps and location information and it reduced the time required to get from station to station.

After completing phase one of the project, monument locating and marking, a plan was developed for surveying the network (phase two of the project). This plan called for ten observers per day with eight-hour work days starting and ending within the vicinity of the network that was being observed that day. To allow for travel time between stations and a lunch break, the plan included four 50-minute surveying sessions per day with one hour of travel time between sessions. Thoughtful consideration of the daily surveying plan, including the number and location of the stations, was necessary to ensure that every observer would be able to conduct their daily surveying sessions without incident and that each station was surveyed in accordance with NGS standards.

Figure 1-2 QR Code and Smartphone Application Screenshot



1.4 Safety

As with all DWR projects, the safety of staff and the public is the highest priority. This project involved numerous hazards including: working along roadways, railroads, and airports, extreme weather conditions including record-breaking heat, biting and stinging insects, poison oak, and rattlesnakes (Figure 1-3). To minimize the risk to the station observers, several actions were taken. Prior to beginning observations each day, safety meetings were held with the observers to discuss the possible hazards and how to lessen the dangers. Because many of the stations are near roadways, traffic was a primary concern. An encroachment permit was obtained from Caltrans to allow work in the state right-of-way. This permit also provided roadside safety techniques. All observers were provided safety vests, hard hats, and traffic cones. Drinking water was made available to all observers at the beginning of each day.

Figure 1-3 Various Safety Concerns at Observation Sites

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2. Network Observation and Processing

This technical information record report summarizes the surveying results of observing the monuments in the Sacramento Valley to determine how much they have changed since 2008. The following section describes the observation work and the processing of the resulting data.

2.1 Local Network Observations

The Subsidence Network is comprised of two networks referred to as the Local Network and the Primary Base Station Network (Primary Network). The local network includes the stations with an average spacing of 4.3 miles (7 kilometers) (Figure 2-1). The primary network has 24 stations with much larger spacing of 24 miles (40 kilometers) (Figure 2-2). Local observations began on May 2, 2017. The goal was to have ten observers per day to complete the project in a timely manner. Unfortunately, it was not possible to recruit ten daily observers until the final day of observations. In fact, the number of observers changed from week to week, and sometimes from day to day. The average number of observers was seven with some days as few as four. This unplanned variability required the network observation schedule to be re-evaluated and significantly modified each week, which greatly increased the time required to complete the network observations. On June 28, 2017, it was necessary to modify the surveying schedule ad hoc because of a freeway closure due to a vehicle crash, which prevented the observers from reaching their stations. That day the observation schedule was reduced to three sessions. On five other days, the schedule was reduced to three sessions to accommodate for excessive travel times.

During the observation period for the local network, all staff met between 7:00 and 8:00 AM each morning (depending on location) to discuss and plan the day's activities and to distribute survey equipment, observer binders, and safety items as well as to do a safety briefing. At the end of each day, staff met again to collect the equipment and discuss any problems that may have occurred. Each night the files collected in the GPS receiver during the daily observation sessions were downloaded and checked. A complete listing of the observation schedule is provided in Appendix C.

Despite the limited amount of surveying experience of the observers, phase two was completed successfully, and the observers were able to complete their tasks of traveling to the station and locating the monuments, setting up and operating the equipment, and filling out the GPS Observation Logs. As previously stated, individuals from multiple agencies participated in this effort. A complete list of observers is shown in (Appendix D) and without the support of staff from the cooperating agencies, this project could not have been completed. Figure 2-3 shows a couple of the observers set up on stations.

Figure 2-1 **Local Network Map**

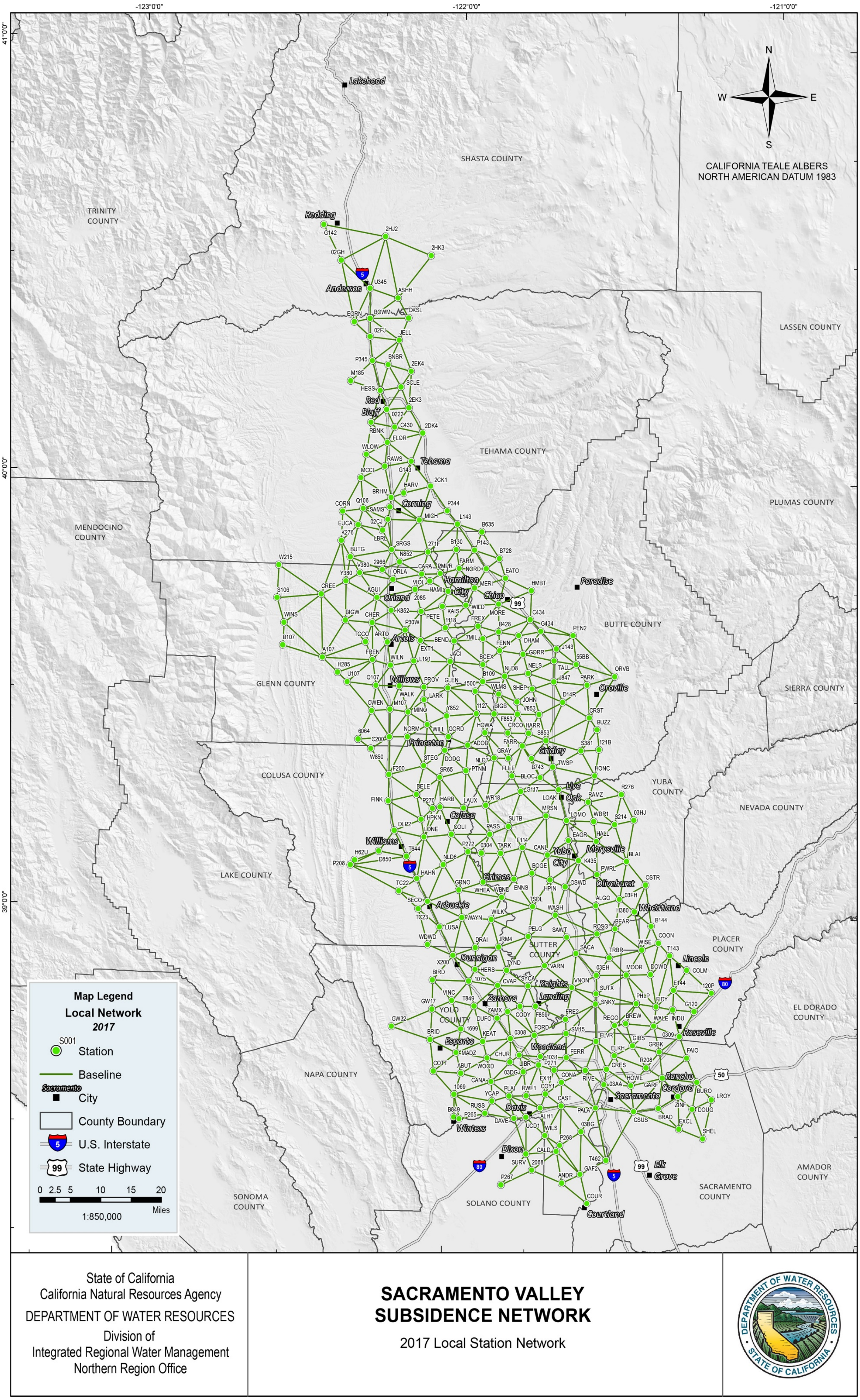

Figure 2-2 **Primary Network Map**

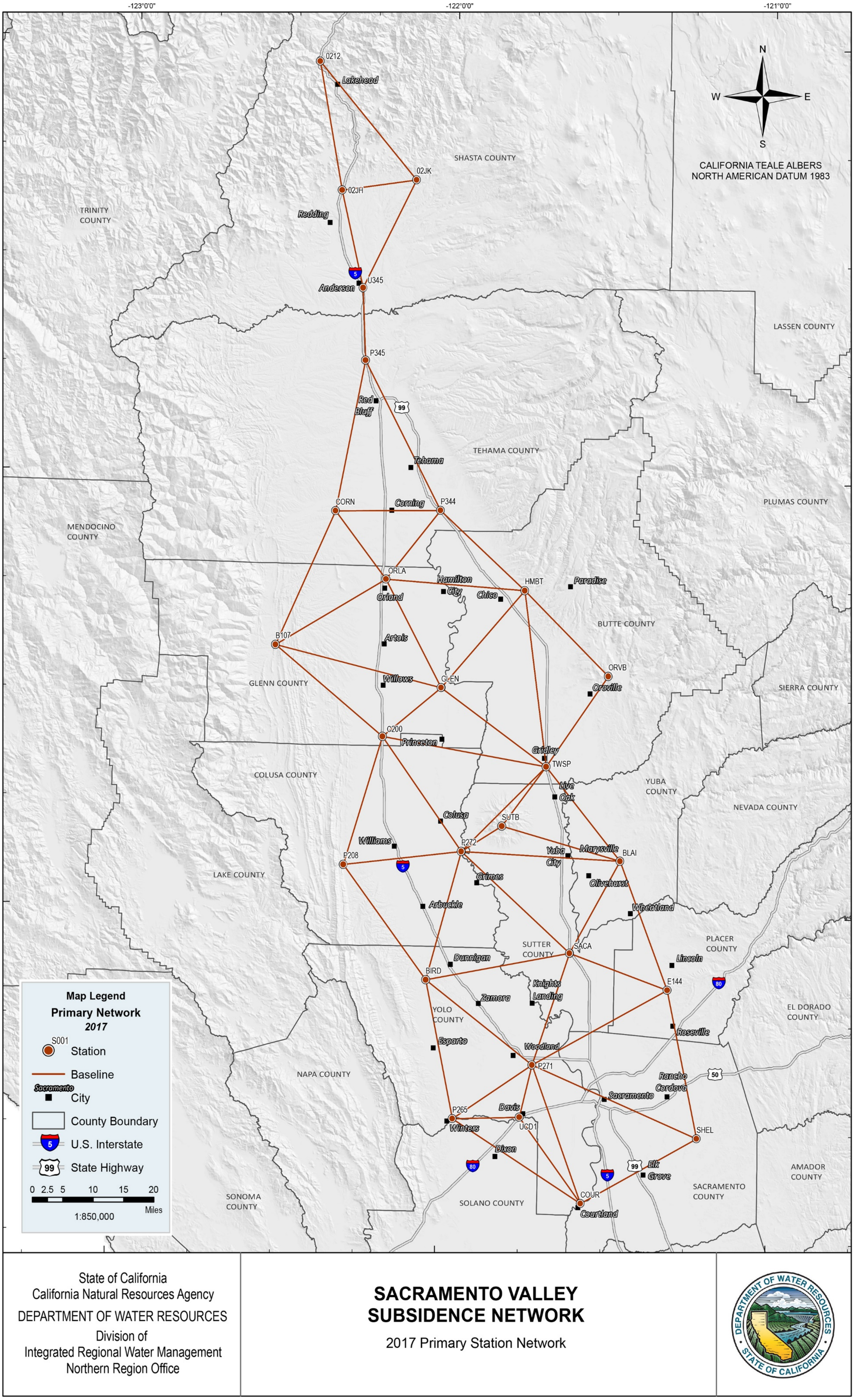

Figure 2-3 Hether Ward (Glenn County) at Station Peter and Jerry Peatross (Placer County Water Agency) at Station Hallwood

2.2 Primary Network Observations

Primary network observations began on August 8, 2017. As with the local network, the monitoring plan included ten observers per day, however the actual number of daily observers was less than ten. This shortage changed the observation plan of the primary network from two sections (northern area and southern area) to three sections; increasing the observation schedule from two weeks to three weeks. For the northern third of the network, staff met at the beginning and end of each day and checked out/in the surveying equipment. Data files were also downloaded and checked nightly. For the other two-thirds of the primary network it was not feasible to meet daily due to increased travel times required to cover the monitoring grid in the central and southern Sacramento Valley. Observers in these areas met at the beginning and end of each week, and the data was downloaded at the end of the week.

During the primary network observations, it was discovered that at station HPGN CA 0212 (0212) a nearby tree had grown large enough to affect the quality of the survey data. Future surveys will require that at station HPGN CA 0212 an offset point with a clear view of the sky be set and differential levels performed.

2.3 Baseline Processing

The third phase of assessing land subsidence with GPS involves processing and analysis of the GPS data, typically referred to as “baseline processing”. A baseline is the measured vector between two GPS receiver antennas. Each baseline for the 2017 survey was processed using Trimble Business Center (TBC) software (version 3.7).

Initially, the processing was accomplished using the broadcast ephemeris. The broadcast ephemeris contains information pertaining to the expected positions of the GPS satellites. After approximately ten days, the precise ephemeris was published and the baseline processing was done again. The precise ephemeris contains information about the actual locations of the GPS satellites. Generally, the baselines were processed using a 15-degree elevation mask for the satellites; however, some variations were made to account for obstructions at some stations. For this survey, the NGS absolute antenna calibration model was used, as opposed to the relative antenna calibration model used in 2008. The relative antenna model could not be used for this survey because some of the GPS receivers were not calibrated by NGS using the relative model and mixing of antenna models within a survey can lead to significant differences. Although it is known that there is some difference in the computed ellipsoid height difference due to the different antenna calibration models, when NGS was contacted they said the amount of difference cannot be quantified.

For the 2008 campaign, Trimble Geomatics Office software was used to process the baselines. Because of differences between the processing software, including the tropospheric model used during processing, there is a chance that systematic errors or differences can occur between the two sets of data. However, these differences, if they do exist, should be minor and not have a significant effect on the final results.

As per the NGS standards, each baseline within the local network was measured twice under different satellite configurations and atmospheric conditions and after processing using the precise ephemeris, duplicate baselines were compared to make sure they met the 2-centimeter ellipsoid height difference criteria. Additionally, the root-mean-square (RMS) value for each computed baseline must not exceed 1.5 centimeters (0.05 ft.). Only 4.2 percent of the baselines failed the criteria and required re-observation. The schedule for the re-observation is combined with the observation schedule in Appendix C.

The requirements for the primary network are different than those for the local network. Because of the much greater spacing between stations in the primary network, the required observation time is five hours and there are three redundant baselines between stations. And in this case, the ellipsoid height difference for the baselines cannot exceed 5.0 centimeters (0.16 ft.).

One baseline, between stations B1079 (B107) and Glenn (GLEN), slightly exceeded this criterion, however, because baselines processed to adjoining stations from each of these stations did meet the standards, the baseline was accepted. During the primary network adjustment, discussed later, this baseline was a significant outlier and was removed. Although the loss of this baseline is a deviation from the recommended standards, the results of the network adjustment are such that it was not deemed to be a substantial issue. The complete baseline processing report contains over 10,000 pages and is not included in this report but can be made available upon request.

To supplement the bench marks used, any Continuously Operating Reference Station (CORS) in the valley are included in this study and the 2008 study. CORS are fixed locations that continually collect position data, and it is available online. During processing, it was discovered that two CORS used in the 2008 survey could not be used for this 2017 survey. One station, Chico 6 CORS ARP (CHO6), had been decommissioned by the United States Coast Guard and the other station, Lincoln 1 CORS ARP (LNC1), had problems functioning for the majority of 2017. This loss of stations required observations of eleven additional baselines to meet the network requirements. Some of these additional baselines were added as observations during the local network observation schedule and the rest were completed during the re-observation schedule of baselines that did not meet the 2-centimeter criteria.

During processing, it was also discovered that the wrong monument had been measured at station Winslow (WINS). This error occurred because the wrong monument was flagged and marked during phase one. Specifically, the monument for Winslow RM1 had been marked; it is approximately 50 ft. from the WINS monument. To account for this error, differential levelling was performed from Winslow RM1 to WINS to update the elevation for the correct station.

2.4 Network Adjustment

The primary and local network adjustments were performed individually. The adjustments were performed with TBC using a least squares adjustment method; using this method, the sum of the squares of all the weighted residuals is minimized. For the primary network, a minimally constrained adjustment was performed first using station Sutter Buttes CORS Point (SUTB) as the fixed position both horizontally and vertically. This station was held fixed because it is near the center of the network and is very stable. The adjustment statistics showed a network reference factor of 1.00 and an A Priori scalar of 1.49 at the 95% confidence level. From the adjustment, there were only four outliers and two of these were baseline measurements to station 0212, which is understandable given the poor observation conditions that exist at that station due to the overgrown tree. A complete listing of the results of this adjustment are available upon request from NRO. They are not included in this report due to the size of the document. Overall, these statistics indicate there are no significant issues or large errors in the measurements and that the observations form a cohesive network.

Similarly, the local network was first adjusted in the same manner holding SUTB fixed horizontally and vertically. This adjustment produced a network reference factor of 1.00 and a scalar of 1.09 with three outliers. In this case, all the outliers occurred at station Oswald (OSWD) during one observation. Although it is possible that the satellite measurements were the source of the difference, analysis of the three outliers strongly indicate that the tripod was not plumb and was leaning northeasterly. Regardless, these differences were in the ellipsoid distance and azimuth and have little to no effect on the ellipsoid heights which is the focus of this survey. Again, these results indicate a cohesive network with no large errors. The complete results of this minimally constrained adjustment of the local network are available upon request from NRO.

To begin establishing control for the primary network, the five-hour observations from the primary network survey were processed using the NGS program “Online Positioning User Service” (OPUS). OPUS is a program that allows users to upload a GPS file from dual frequency survey grade receivers (like those used in this project) and then computes a position based on three CORS receivers. The computed position is an average of three independent baseline solutions generally, but not always, from the closest CORS. For each passive station in the primary network, the CORS solutions from the three sessions were then averaged for a final value. The solutions provided by the CORS processing are provided in reference to the most current NGS realization of the North American Datum of 1983 (NAD83) which is known as NAD83 (2011).

To keep the end results of the 2017 survey consistent and comparable with the previous survey referencing NAD83 (2007), the OPUS-produced ellipsoid heights were compared to the previously published NAD83 (2011) heights and the difference was then applied to the ellipsoid heights from the 2007 reference. The results for all the stations were then used as constraints in a least-squares adjustment with the measured baselines produced from the primary network survey. The results showed several significant outliers with the measured baselines indicating that all the CORS solutions could not be correct, or there was a problem with the baselines themselves.

Because the minimally constrained adjustment proved the network to be cohesive, the problem was in some of the positions from the OPUS solutions. To help determine which positions might be in question, at least one session from each primary station was processed to a minimum of three CORS using the July 2, 2017 ellipsoid heights published by the California Spatial Reference Center (CSRC) as constraints. Unlike the OPUS solutions, the CORS selected for processing were chosen to provide strong geometry to the measured station location. These results were then compared to those from the OPUS solutions. Generally, the results from each method should be comparable at about 0.08 ft. (2.4 centimeters). If the results for the computed ellipsoid heights were not within 0.10 ft. (3.0 centimeters) of each other, the OPUS solution was not considered reliable and that station’s height was not held fixed. Because of the loss of CORS LNC1 and passive station KUST, their replacement stations E144 and SACA were not held fixed since there was no previous ellipsoid heights available for reference. The results of this process generated the following stations as vertical constraints for the primary network adjustment: 02JK, BIRD, BLAI, COUR, GLEN, ORVB, P208, P265, P271, P345, SHEL, SUTB, TWSP, and U345. For the CORS stations held fixed (ORVB, P208, P265, P271, P345, and SUTB), the ellipsoid height used was computed by taking the difference between the CSRC 2017 NAD83 (2011) ellipsoid values and the 2008 NAD83 (2011) values and then applying that difference to the NAD83 (2007) ellipsoid height.

Because the purpose of this survey was not to produce new horizontal coordinates, only SUTB and U345 were used for horizontal constraints. The results from the fully constrained primary network adjustment yielded good results with a reference factor of 1.00 and an A Priori scalar of 2.44. Of the 162 baselines, there were only two outliers and one of those was to station 0212 which was discussed earlier. The other was a baseline which, although it met the 5-centimeter criteria, had a large difference compared to the other two baselines measured between stations P345 and CORN.

The fixed and adjusted heights from the primary network were then used as constraints for the local network. The fixed adjustment process was a series of iterations of adding points as constraints and then analyzing the results to be sure they fit properly within the structure of the network. From this process, a discrepancy was discovered in the southeast portion of the local network (this is the area where primary stations LNC1 and KUST were lost). When the height of primary station E144 was added as a constraint, it showed an increase in height of the nearest stations and created some outlier observations. Although most of the changes were within the 0.17-foot level of statistical significance, the decision was made to find another source of height control in this area. When the network was first created for the 2008 survey, it was intentionally designed to tie into stable monuments outside the area susceptible to subsidence. Consequently, station G120 on the eastern edge of the network was chosen to provide vertical control for this area and its ellipsoid height was held fixed. This station is set in a rock outcrop and has a stability level A per the NGS which means it is considered “most reliable and expected to hold position/elevation well.” With the addition of this station as a final constraint, the local network was then adjusted using the least-squares method.

The final combined network consists of 321 stations, 1,357 occupations (including CORS), and 1,728 baselines. The overall network reference factor is 1.00 with an A Priori Scalar of 1.18. Of the 1,728 baseline measurements, there are only seven outliers (at the 95% confidence level). Of these, only four were in the ellipsoid height difference. Again, these results show that there are no large errors and as such, the remaining errors are small and random and were properly distributed by the least-squares adjustment. The complete results of the fully constrained adjustment can be found in Appendix E.

Appendix F contains a table of the adjusted ellipsoid heights for all stations in the survey. For existing stations, the record 2008 latitude and longitude is shown; for new and replacement stations, the computed latitude and longitude from the network adjustment is shown.

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3. Survey Data Analysis

The final adjusted ellipsoid heights from the 2017 survey were compared with the computed ellipsoid heights from the 2008 survey. Ellipsoid heights, not orthometric heights (elevations), were used to negate the errors introduced when ellipsoid heights are converted to orthometric heights using a geoid model. The geoid model represents the equipotential surface of the Earth's gravity field. Over time, additional measurements further refine the model and there have been four new models created since the 2008 survey. The use of ellipsoid heights removes the question of which geoid model to use as well as eliminating the errors contained within the model.

With GPS, as with any type of measurement, there is some amount of error. For GPS measurements, the primary sources of error come from signal delays caused by the troposphere and ionosphere, poor satellite geometry (known as Position Dilution of Precision or PDOP), and multi-path where the signals from the satellites reflect off an object before reaching the GPS receiver. Additional errors may occur from clock timing and clock synchronization errors. These errors or "noise," creates an error of uncertainty of approximately 0.17 ft. (5.2 centimeters). Therefore, any change less than 0.17 ft. is not considered statistically significant. The results of the differences for stations that have previously measured ellipsoid heights can be seen in Appendix G and graphically in Figure 3-1.

To validate the results of this survey, additional checks were made to other sources of data. First, a comparison was made to the results of a DWR subsidence survey for Colusa County that was completed in 2016. That network was a small portion of the Subsidence Network and therefore used different stations for constraints (control). Of greatest concern for comparison were stations SECO and HAHN in the Arbuckle area that showed major changes of -2.14 and -1.69 ft., respectively. Also of importance for comparison were two stations that were added for the 2016 Colusa County Survey, TC22 and TC23. Although the surveys were done a year apart and the method of control was different, the comparison showed a difference of only -0.062 ft. for station SECO and -0.049 ft. for station HAHN. The computed ellipsoid heights for stations TC22 and TC23 differed in each survey by only 0.016 ft. and 0.019 ft., respectively. The observation that significant subsidence has occurred in this area is reinforced by the knowledge that a number of nearby wells have suffered collapse or damage in recent years.

Next, a comparison was made to CORS that were not held fixed as part of the primary network adjustment. For these stations, two different comparisons were made. The first was to the height difference as discussed in the primary network portion of the Network Adjustment section. The second was to the height difference computed by the CORS. Each CORS measures its current position several times per day and computes the daily change from its reference height. CORS then publishes the daily average height change as well as the standard deviation for the measurement. For a variety of reasons, the standard deviation may exceed the single day change shown. For this reason, the 30-day average encompassing the observation dates in both 2008 and 2017 were used to determine the change. The results are shown in Tables 3-1 and 3-2.

Figure 3-1 Height Change at Stations between 2008 and 2017

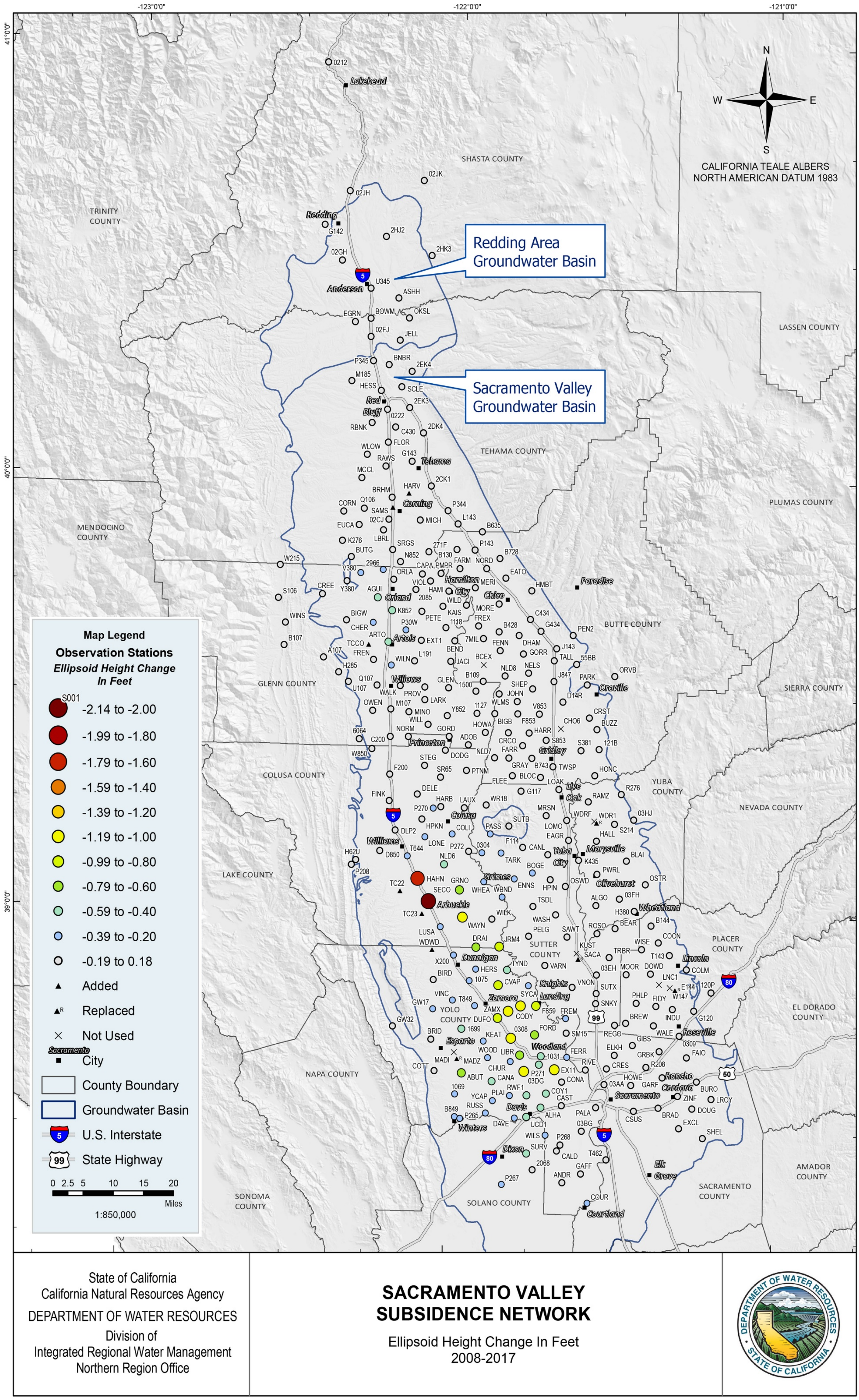


Table 3-1 Published and Network Ellipsoid Height of CORS

4-CH ID	Published 2017 Ellipsoid Height (ft.)	2017 Network Ellipsoid Height (ft.)	Difference (ft.)
267	-55.612	-55.787	0.175
P268	-76.875	-76.887	0.012
P272	-38.101	-38.042	-0.059
P344	164.733	164.748	-0.015
UCD1	-0.142	-0.046	-0.096

Table 3-2 30-Day Average CORS Ellipsoid Height

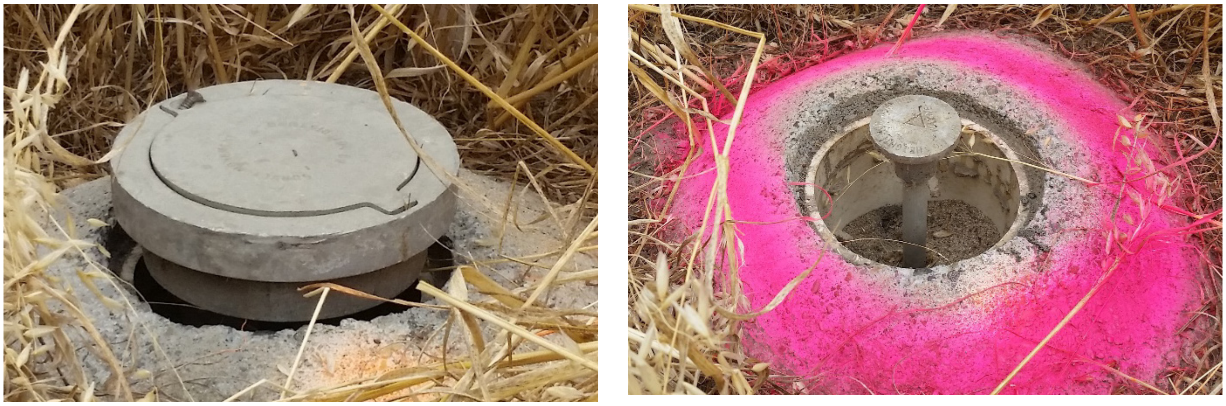
	30-Day Average in mm (2008)		30 Day Average in mm (2017)		Change 17-08 (mm)	Change 17-08 (ft.)	Measurement change (ft.)	Difference Station-Measurement (ft.)
Station	Measurement	SD	Measurement	SD				
P268	-17.627	5.036	-42.386	5.181	-24.759	-0.081	-0.125	0.044
P272	-16.278	4.698	-29.557	5.378	-13.279	-0.044	-0.129	0.085
UCD1	-71.491	7.836	-191.970	7.907	-120.479	-0.395	-0.558	0.163
P270	-4.281	4.790	-24.685	4.498	-20.404	-0.067	-0.258	0.191
P344	-7.313	5.630	-17.810	5.487	-10.497	-0.034	-0.032	-0.002

Notes:
ft.= feet, mm= millimeter, SD= Standard Deviation
Original data published in millimeters.

Within the Sacramento Valley, the stations SECO and HAHN, in the Arbuckle area, showed the greatest height changes at -2.14 ft. and -1.69 ft. respectively. Three stations immediately to the east and southeast of these also showed declines ranging -0.49 ft. to -1.00 ft. In Yolo County, several stations show a decrease between -0.3 and -1.1 ft. and Yolo County shows the largest spatial extent of stations showing decline. In Glenn County, in the Artois and Orland area, three stations, ARTO, K852, and AGUI show changes of -0.59 ft., -0.46 ft., and -0.44 ft., respectively. There is also an area on the south side of the Sutter Buttes showing a decrease in elevation ranging from -0.19 to -0.36 ft. Only one station showed an increase greater than or equal to the level of statistical significance; station J143 showed an increase in elevation of 0.18 ft. Initially this change was troublesome since the NGS datasheet states this monument has a stability "A" and is in a bedrock outcropping. However, after further investigation it was determined that it is not a bedrock outcropping but rather a pyroclastic rock boulder approximately 2 ft. x 6 ft. in size.

While it is not the purpose of this survey to determine new horizontal coordinates for the monuments, the measured positions were compared to those from the 2008 survey for Quality Assurance/Quality Control (QA/QC) purposes. With only one exception, all the monuments were very near their previous horizontal geographic positions. The one exception was station WAYN, where the horizontal position changed by 0.69 ft. Station WAYN is located on the east levee of the Colusa drain approximately 5.6 miles southeast of Arbuckle. Per the NGS datasheet, this monument is on an aluminum alloy rod that was driven into the ground nearly 20 ft. and originally the monument cap was 0.2 ft. below the monument cover. Today, the monument has lifted the cover off its concrete collar and with the cover removed, is protruding more than 0.25 ft. (Figure 3-2). The measurements and visual inspection indicate that the levee is most likely sloughing and pushing the monument and aluminum alloy rod to the northeast.

Figure 3-2 Station WAYN with and without Cover



4. Future Considerations

Based on the work of the 2017 survey, several lessons were learned and should be considered for the future:

- Monitoring of all types, including GPS, involves looking for spatial and temporal trends in the data. Although the 2008 survey provided a baseline for comparison, there have only been two surveys and thus, only two datasets. As such, it is difficult to say that any trends are occurring since a difference at any location may just be an anomaly in either one of the surveys. The resurveying of the network should occur more frequently to develop a better record from which trends can be determined.
- Because of the spacing of the stations, the loss of even one station creates a large spatial gap. Even if a GPS survey is not performed, the stations should be visited more frequently to make sure the protective markers are still in place. Although they initially had signs indicating to contact the NGS if the monument had to be disturbed, it would be beneficial to have a notice indicating to contact DWR. If DWR is contacted, DWR would have the opportunity to perform differential leveling from the station before it is destroyed so that the relative elevation could be perpetuated for comparison in future surveys.
- To avoid spending unnecessary time during planning, have a firm commitment of the number of observers available before developing an observation schedule.
- The observation data from the 2008 baseline survey, this survey, and subsequent surveys should be kept in a centralized location. Then, the data could all be re-processed using the same baseline processor and adjustment software to eliminate the errors that can be introduced by using different software applications.
- The NGS has an on-line program called OPUS Shared. Just like the OPUS Program, it allows users to submit a survey-grade GPS file for processing with the additional requirement of submitting photographs of the monument and equipment set-up. The solution produced from the OPUS processing is then shared on-line. This site should be monitored on a regular basis for solutions published for monuments that are part of the Sacramento Valley Subsidence Network. Although there is no guarantee that the solution provided properly reflects the equipment used (correct tripod height, for example), the combination of data could be used to find trends indicating potential subsidence and help promote further study in a focused area.

Another part of the OPUS Shared Program is OPUS Projects. This program adds additional visualization and management tools. DWR might want to consider creating a project specific to the monuments within the Subsidence Network. Through outreach and coordination with State and local agencies (Caltrans, county survey offices, and groundwater sustainability agencies for example), a great deal of data could be collected for review and analysis without a large expenditure of time, resources, and money for any one agency.

References

Borchers JW, Grabert VK, Carpenter M, Dalgish B, and Cannon D. 2014. *Land Subsidence from Groundwater Use in California*. Sacramento (CA): California Water Foundation. 193 pp. Viewed online at: https://water.ca.gov/LegacyFiles/waterplan/docs/cwpu2013/Final/vol4/groundwater/13Land_Subsidence_Groundwater_Use.pdf.

California Department of Water Resources. 2008. *Project Report: 2008 California Department of Water Resources and U.S. Bureau of Reclamation, Sacramento Valley GPS Subsidence Project*. Sacramento (CA): California Department of Water Resources. Prepared by Jim Frame and Don D'Onofrio. 49 pp. Viewed online at: https://water.ca.gov/LegacyFiles/groundwater/docs/DWR_USBR_Sacramento_Valley_Subsidence_Report_2008.pdf

National Geodetic Survey. 1997. *Guidelines for Establishing GPS-Derived Ellipsoid Heights*: NOAA Technical Memorandum NOS NGS-58. Silver Spring (MD) NOAA. Viewed online at: https://www.ngs.noaa.gov/PUBS_LIB/NGS-58.html.

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

Appendix A: Survey Equipment List

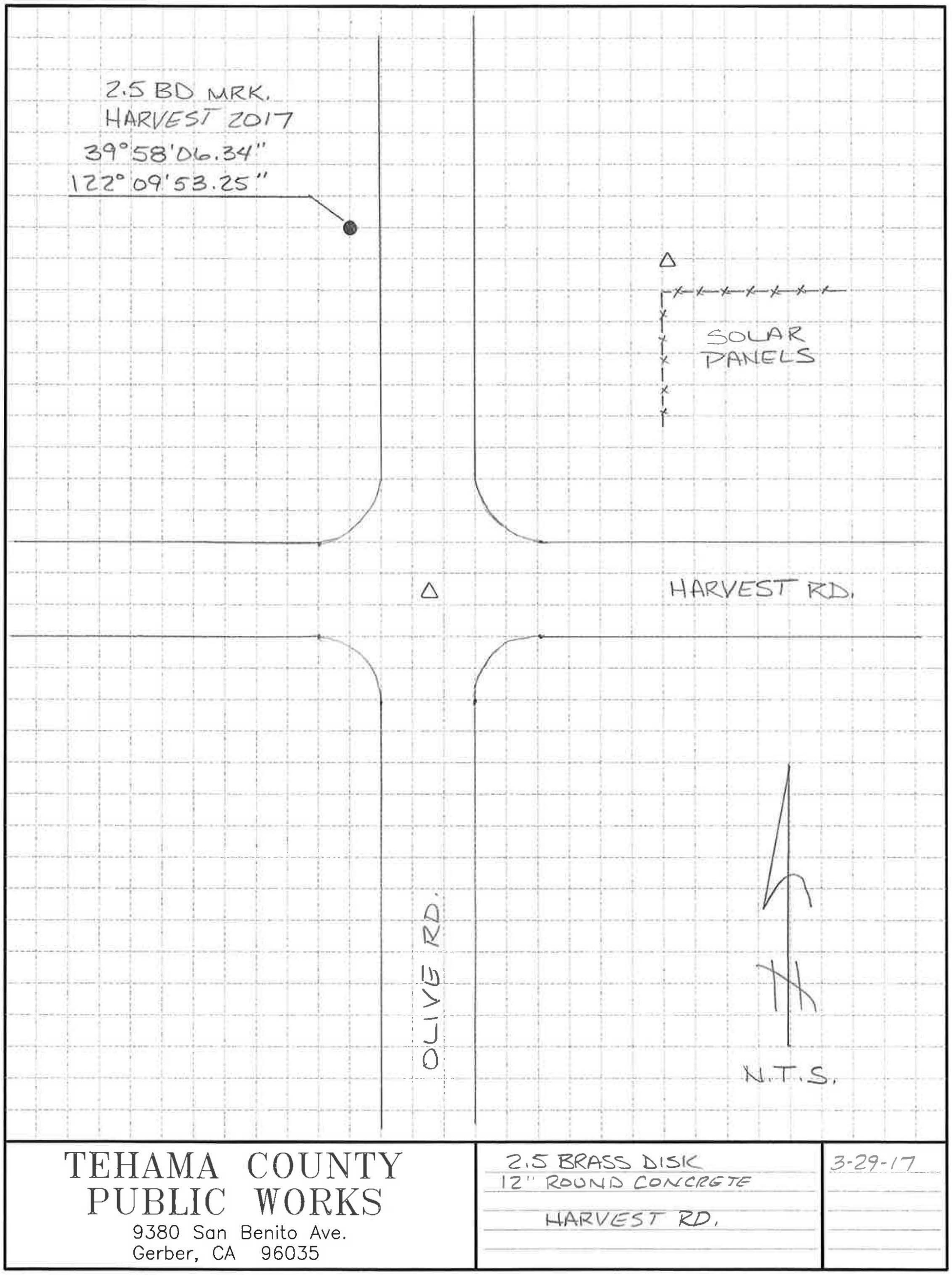
See next page

Subsidence Monitoring Equipment List

Make	Model	Serial Number
Trimble	R8-3	5203481821
Trimble	R8-3	5203481320
Trimble	R8-3	5201480882
Trimble	R8	4602105531
Trimble	R8	4550103919
Trimble	R8	4602105544
Trimble	5800	4347129130
Trimble	4700	0220203616
Trimble	Compact L1/L2 Antenna	0 220003263
Trimble	4700	0220202606
Trimble	Micro-Centered L1/L2 Antenna	0220200693
Trimble	R10	5337443297

Appendix B: New Monument Descriptions

See next page



2.5 BD MRK.
HARVEST 2017
39°58'06.34"
122°09'53.25"
SOLAR PANELS
HARVEST RD.
OLIVE RD.
N
N.T.S.
TEHAMA COUNTY PUBLIC WORKS
9380 San Benito Ave.
Gerber, CA 96035
2.5 BRASS DISK
12" ROUND CONCRETE
HARVEST RD.
3-29-17

Looking South

Harvest Monument

Station SACA

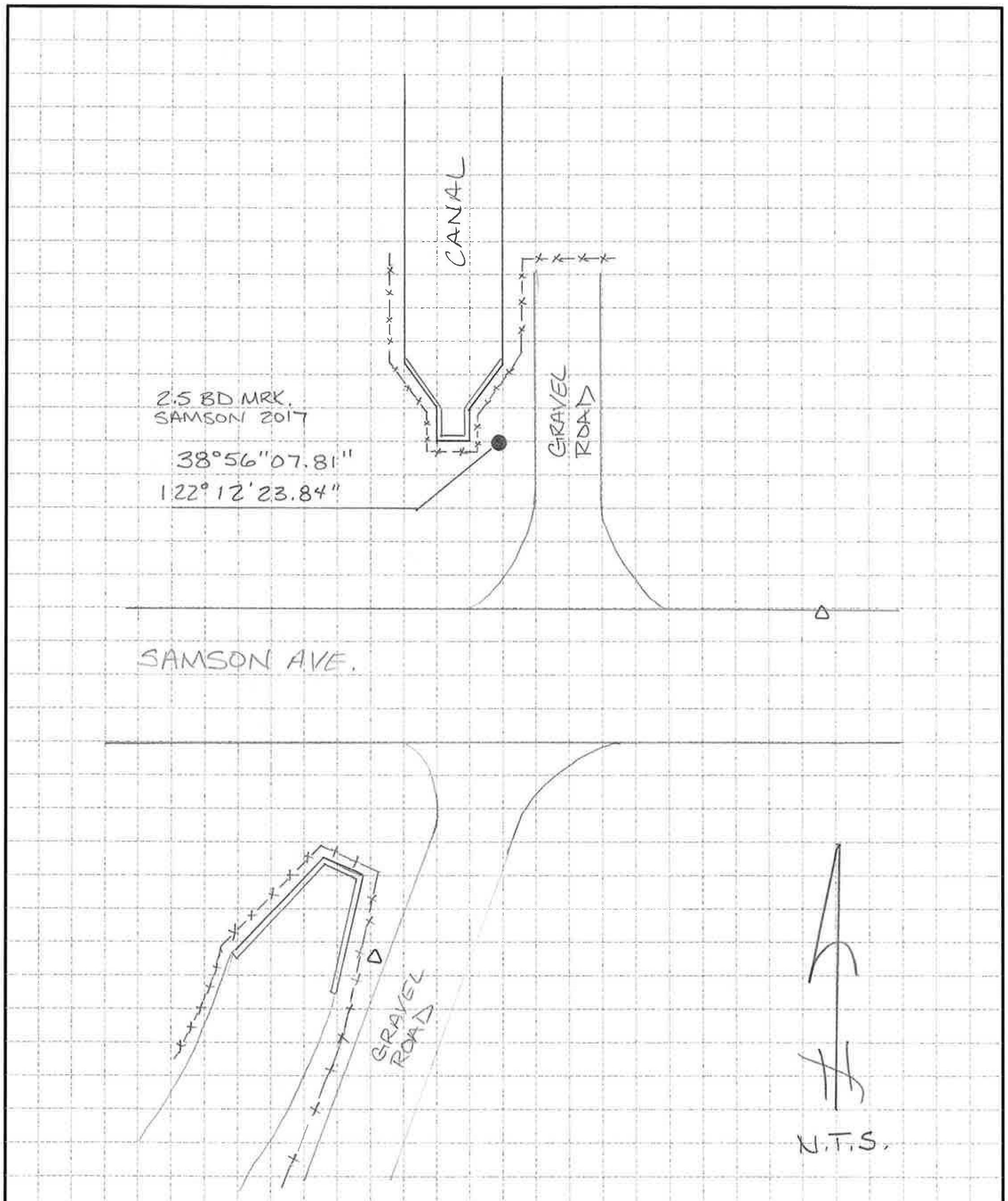
Sacramento Avenue

Station SACA is in Sutter County approximately 15.5 miles south of Yuba City and 1.7 miles northwest of Nicolaus. The station is located at the southwest corner of the intersection of Highway 99 and Sacramento Avenue approximately 61 feet south of the centerline of Sacramento Avenue and 103 feet west of the centerline of Highway 99. The station is a standard brass disk in the top of the south end of a concrete headwall of an irrigation canal which is south of, and parallel to, Sacramento Avenue where the canal crosses under Highway 99. The brass disk is stamped “SACA 2017”.

Looking Southeast

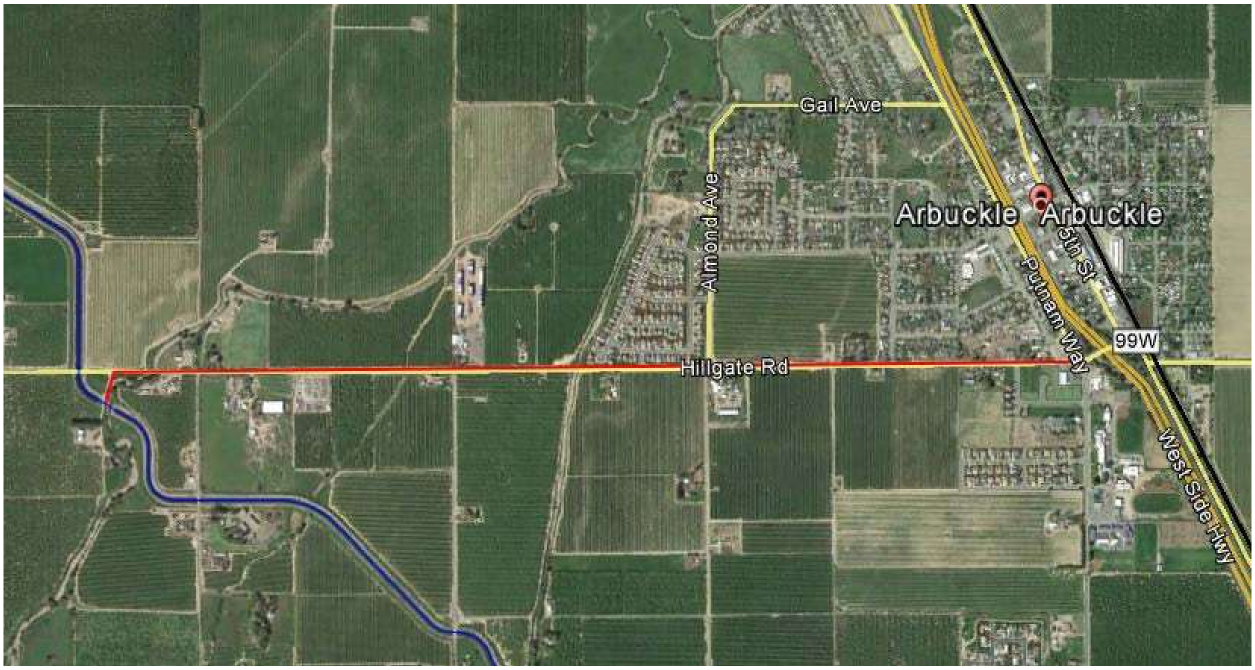
Looking West

Looking Northwest



TEHAMA COUNTY PUBLIC WORKS 9380 San Benito Ave. Gerber, CA 96035	2.5 BRASS DISK 12" ROUND CONCRETE SAMSON AVE.	3-29-17

From the intersection of I-5 and Hahn Road, head west on Hahn Road 3.0 miles to a T-intersection with Cortina School Road. Turn left and head south on Cortina School Road 0.4 miles to a dirt road on right (TCC access road). Turn right and head west on the dirt road 0.5 miles to the station on left. The station is a 4-inch brass disk on the southwest corner of the hoist deck on check structure 22 on the Tehama-Colusa Canal. The disk is stamped "US Department of Interior BM". The 4-digit designation will be "**TC22**"



From the intersection of Putnam Way and Hillgate Road in Arbuckle, head west on Hillgate Road 1.92 miles to a dirt road on left. Turn left and head south for 300 feet to the station on right. The station is a 4-inch brass disk on the southwest corner of the hoist deck on check structure 23 on the Tehama-Colusa Canal. The disk is stamped "US Department of Interior BM". The 4-digit designation will be "**TC23**"

Station TCC0

Take exit 610 off of I-5 from either north or south directions and head west on County Road 33 towards the Glenn County Landfill Site 5700 County Rd 33 Artois, CA 95913. Approximately 1 mile after the intersection of County Road D and 33 continuing west a bridge crosses the Tehama-Colusa Canal (TCC). The TCC monument is located in the center of the check structure which is south of the bridge. TCC staff will need to be contacted prior to the surveying of this monument to gain gate access.

Don Babb,
dbabb@tccanal.com
(530) 570-8578

Station WDR1

Woodruff

Replacement

Station WDR1 is located in Yuba County approximately 5.4 miles north of Marysville and 6.7 miles southeast of Live Oak. To reach the station from the intersection of Highway 70 (Oroville Hwy.) and Woodruff Lane, head east on Woodruff Lane 2.3 miles to a sharp curve in the road to the south, and the station is on the right. The station is located in the southwest quadrant of the curve approximately 25 feet south of the centerline. The station is a standard brass disk in the top of the northeast corner of a concrete headwall of an irrigation canal where the canal crosses under Woodruff Lane.

Looking West

WDR1 Monument

Wildwood Bridge Monument – WDWD

Colusa County
WDWD1
SGMA
Monuments
Installed May 2017

THE STATION IS LOCATED IN COLUSA COUNTY APPROXIMATELY 6.03 MILES SOUTH OF THE TOWN OF ARBUCKLE. TO REACH THE STATION FROM INTERSTATE 5, TAKE THE COUNTY LINE ROAD EXIT, APPROXIMATELY 7 MILES SOUTH OF ARBUCKLE AND APPROXIMATELY 3.08 MILES NORTH OF DUNNIGAN. HEAD WEST ON COUNTY LINE ROAD FOR APPROXIMATELY 3.25 MILES TO A STOP SIGN AT WILDWOOD ROAD. AT WILDWOOD ROAD TURN RIGHT (NORTH) AND PROCEED APPROXIMATELY .26 MILES TO REACH THE MONUMENT LOCATION. THE MONUMENT IS LOCATED ON THE NORTH-WEST PORTION OF THE BRIDGE.

Wildwood Bridge, northwest corner, looking west

Wildwood Bridge, looking south

Wildwood Bridge, looking north

Wildwood Bridge, looking west

Wildwood Bridge monument

Appendix C: Observation Schedule

See next page

Local Network Observation Schedule

Tuesday, May 02, 2017

DAY 1	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	RBNK	HESS	02FJ	U345
OBSERVER 2	0222	BNBR	OKSL	ASHH
OBSERVER 3	2EK3	SCLE	JELL	BOWM
OBSERVER 4	HESS	M185	BNBR	EGRN
OBSERVER 5	SCLE	2EK4	2EK4	02FJ

Wednesday, May 03, 2017

DAY 2	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	02FJ	U345	RBNK	HESS
OBSERVER 2	OKSL	ASHH	0222	BNBR
OBSERVER 3	JELL	BOWM	2EK3	SCLE
OBSERVER 4	BNBR	EGRN	HESS	M185
OBSERVER 5	2EK4	02FJ	SCLE	2EK4

Thursday, May 04, 2017

DAY 3	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	2EK4	2EK3	2DK4	G143
OBSERVER 2	2EK3	2DK4	G143	2CK1
OBSERVER 3	0222	C430	FLOR	RAWS
OBSERVER 4	RBNK	RBNK	WLOW	MCCL
OBSERVER 5	C430	FLOR	RAWS	HARV
OBSERVER 6	FLOR	WLOW	MCCL	BRHM

Monday, May 15, 2017

DAY 4	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	02GH	G142	2HJ2	BOWM
OBSERVER 2	EGRN	02GH	U345	OKSL
OBSERVER 3	BOWM	2HJ2	2HK3	ASHH
OBSERVER 4	02FJ	U345	ASHH	JELL

Monday, May 08, 2017

DAY 5	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	2DK4	G143	2EK4	2EK3
OBSERVER 2	G143	2CK1	2EK3	2DK4
OBSERVER 3	FLOR	RAWS	0222	C430
OBSERVER 4	WLOW	MCCL	RBNK	RBNK
OBSERVER 5	RAWS	HARV	C430	FLOR
OBSERVER 6	MCCL	BRHM	FLOR	WLOW
OBSERVER 7	OKSL	OKSL	EGRN	
OBSERVER 8	BOWM	ASHH	02GH	

Tuesday, May 09, 2017

DAY 6	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	MCCL	CORN	BUTG	AGUI
OBSERVER 2	CORN	K276	V380	V380
OBSERVER 3	Q106	BUTG	N852	N852
OBSERVER 4	SAMS	EUCA	2966	2966
OBSERVER 5	BRHM	Q106	MICH	CAPA
OBSERVER 6	02CJ	SRGS	271F	2085
OBSERVER 7	MICH	LBRL	SRGS	ORLA
OBSERVER 8	2CK1	02CJ	L143	271F

Wednesday, May 10, 2017

DAY 7	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	BUTG	AGUI	MCCL	CORN
OBSERVER 2	V380	V380	CORN	K276
OBSERVER 3	N852	N852	Q106	BUTG
OBSERVER 4	2966	2966	SAMS	EUCA
OBSERVER 5	MICH	CAPA	BRHM	Q106
OBSERVER 6	271F	2085	02CJ	SRGS
OBSERVER 7	SRGS	ORLA	MICH	LBRL
OBSERVER 8	L143	271F	2CK1	02CJ

Thursday, May 11, 2017

DAY 8	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	K852	CAPA	FARM	1118
OBSERVER 2	PETE	PMPR	NORD	FREX
OBSERVER 3	2085	271F	P143	HMBT
OBSERVER 4	CAPA	L143	L143	MERI
OBSERVER 5	VIOL	VIOL	B130	WILD
OBSERVER 6	HAMI	B130	B635	EATO
OBSERVER 7	KAIS	FARM	B728	MORE
OBSERVER 8	1118	HAMI	MERI	B428
OBSERVER 9	WILD	MERI	EATO	C434

Friday, May 12, 2017

Shasta and Tehama Counties

DAY 9	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	2HJ2	BOWM	02GH	G142
OBSERVER 2	U345	OKSL	EGRN	02GH
OBSERVER 3	2HK3	ASHH	BOWM	2HJ2
OBSERVER 4	ASHH	JELL	02FJ	U345

Friday, May 12, 2017

Glenn and Butte Counties

DAY 9	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	WILD	MORE	KAIS	HAMI
OBSERVER 2	1118	B428	1118	K852
OBSERVER 3	FREX	FREX	PETE	PETE
OBSERVER 4	MERI	C434	WILD	2085

Monday, May 15, 2017

DAY 10	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	L143	NORD	HAMI	NORD
OBSERVER 2	B635	B728	MERI	MERI
OBSERVER 3	B130	EATO	EATO	P143
OBSERVER 4	P143	HMBT	MORE	EATO
OBSERVER 5	B728	C434	WILD	HAMI
OBSERVER 6	NORD	MORE	KAIS	FARM

Tuesday, May 16, 2017

DAY 11	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	AGUI	AGUI	K276
OBSERVER 2	V380	BUTG	W215
OBSERVER 3	CHER	BIGW	BIGW
OBSERVER 4	Y380	Y380	CREE
OBSERVER 5	ARTO	CHER	Y380
OBSERVER 6	FREN	A107	S106
OBSERVER 7	WILN	FREN	WINS
OBSERVER 8	P30W	TCC0	B107

TCC0 is a new point added by Glenn County, there is no datasheet.

Sharla Stockton is familiar with the station and needs to be the observer.

Wednesday, May 17, 2017

DAY 12	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	AGUI	K276	AGUI
OBSERVER 2	BUTG	W215	V380
OBSERVER 3	BIGW	BIGW	CHER
OBSERVER 4	Y380	CREE	Y380
OBSERVER 5	CHER	Y380	ARTO
OBSERVER 6	A107	S106	FREN
OBSERVER 7	FREN	WINS	WILN
OBSERVER 8	TCC0	B107	P30W

TCC0 is a new point added by Glenn County, there is no datasheet.

Sharla Stockton is familiar with the station and needs to be the observer.

Thursday, May 18, 2017

DAY 13	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	AGUI	P30W	Q107	B107
OBSERVER 2	K852	EXT1	WALK	WINS
OBSERVER 3	PETE	L191	L191	Q107
OBSERVER 4	P30W	WILN	PROV	A107
OBSERVER 5	EXT1	WALK	M107	H285
OBSERVER 6	1118	JACI	MINO	U107
OBSERVER 7	BEND	BEND	JACI	FREN
OBSERVER 8				CREE

The next session, Day 14, will have the longest drive in the morning. Be sure to tell everyone it is important to be on time for the Day 14 morning meeting.

Monday, May 22, 2017

DAY 14	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	B107	Q107	P30W	AGUI
OBSERVER 2	WINS	WALK	EXT1	K852
OBSERVER 3	Q107	L191	L191	PETE
OBSERVER 4	A107	PROV	WILN	P30W
OBSERVER 5	H285	M107	WALK	EXT1
OBSERVER 6	U107	MINO	JACI	1118
OBSERVER 7	FREN	JACI	BEND	BEND
OBSERVER 8	CREE			

Reverse order of Day 13. The longest drive will be for session 1.

Tuesday, May 23, 2017

DAY 15	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	BEND	DHAM	NELS	NELS
OBSERVER 2	FREX	FENN	NLD8	NLD8
OBSERVER 3	B428	C434	TALL	TALL
OBSERVER 4	7MIL	G434	55BB	55BB
OBSERVER 5	BCEX	GORR	GORR	SHEP
OBSERVER 6	FENN	J143	J143	J847
OBSERVER 7	DHAM	PEN2	PEN2	PARK

Station Gorrill requires a 2153 key.

Wednesday, May 24, 2017

DAY 16	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	NELS	NELS	BEND	DHAM
OBSERVER 2	NLD8	NLD8	FREX	FENN
OBSERVER 3	TALL	TALL	B428	C434
OBSERVER 4	55BB	55BB	7MIL	G434
OBSERVER 5	GORR	SHEP	BCEX	GORR
OBSERVER 6	J143	J847	FENN	J143
OBSERVER 7	PEN2	PARK	DHAM	PEN2

Thursday, May 25, 2017

DAY 17	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	JACI	WILL	DODG	BIGB
OBSERVER 2	PROV	GORD	GORD	1500
OBSERVER 3	GLEN	GLEN	HOWA	NLD8
OBSERVER 4	LARK	LARK	1127	BCEX
OBSERVER 5	BCEX	1500	CRCO	WLMS
OBSERVER 6	B109	1127	ADOB	B109
OBSERVER 7	1500	Y852	BIGB	FENN

Colusa County

Friday, May 26, 2017

DAY 18	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	DODG	BIGB	JACI	WILL
OBSERVER 2	GORD	1500	PROV	GORD
OBSERVER 3	HOWA	NLD8	GLEN	GLEN
OBSERVER 4	1127	BCEX	LARK	LARK
OBSERVER 5	CRCO	WLMS	BCEX	1500
OBSERVER 6	ADOB	B109	B109	1127
OBSERVER 7	BIGB	FENN	1500	Y852

Colusa County

Tuesday, May 30, 2017

DAY 19	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	WLMS	HOWA	FARR	HARR
OBSERVER 2	SHEP	HARR	BUZZ	PARK
OBSERVER 3	BIGB	NLD7	TWSP	S853
OBSERVER 4	JOHN	CRCO	B743	V853
OBSERVER 5	CRCO	FLEE	S381	S381
OBSERVER 6	HARR	BLOC	HONC	BUZZ
OBSERVER 7	F853	FARR	121B	CRST
OBSERVER 8	V853	GRAY	S853	D14R

Wednesday, May 31, 2017

DAY 20	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	FARR	HARR	WLMS	HOWA
OBSERVER 2	BUZZ	PARK	SHEP	HARR
OBSERVER 3	TWSP	S853	BIGB	NLD7
OBSERVER 4	B743	V853	JOHN	CRCO
OBSERVER 5	S381	S381	CRCO	FLEE
OBSERVER 6	HONC	BUZZ	HARR	BLOC
OBSERVER 7	121B	CRST	F853	FARR
OBSERVER 8	S853	D14R	V853	GRAY

Thursday, June 01, 2017

DAY 21	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	B743	LOMO	LOMO	G117
OBSERVER 2	BLOC	RAMZ	MRSN	FLEE
OBSERVER 3	TWSP	S214	EAGR	BLOC
OBSERVER 4	HONC	R276	LOAK	LOAK
OBSERVER 5	LOAK	WDRF	CANL	WR18
OBSERVER 6	LOMO	BLAI	K435	F114
OBSERVER 7	RAMZ	HALL	HALL	CANL
OBSERVER 8	R276	03HJ	WDRF	MRSN

WDRF has been reset on the opposite side of the road

Friday, June 02, 2017

DAY 22	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	LOMO	G117	B743	LOMO
OBSERVER 2	MRSN	FLEE	BLOC	RAMZ
OBSERVER 3	EAGR	BLOC	TWSP	S214
OBSERVER 4	LOAK	LOAK	HONC	R276
OBSERVER 5	CANL	WR18	LOAK	WDRF
OBSERVER 6	K435	F114	LOMO	BLAI
OBSERVER 7	HALL	CANL	RAMZ	HALL
OBSERVER 8	WDRF	MRSN	R276	03HJ

WDRF has been reset on the opposite side of the road

Monday, June 05, 2017

DAY 23	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	HALL	03FH	03EH	PELG
OBSERVER 2	K435	WASH	KUST	K435
OBSERVER 3	OSWD	SAWT	VARN	HPIN
OBSERVER 4	PWRL	ALGO	VNON	OSWD
OBSERVER 5	BLAI	BLAI	BEAR	KUST
OBSERVER 6	03FH	OSTR	TRBR	WASH
OBSERVER 7	ALGO	ROSO	ROSO	SAWT

Station KUST has been replaced with Station SACA

Tuesday, June 06, 2017

DAY 24	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	03EH	PELG	HALL	03FH
OBSERVER 2	KUST	K435	K435	WASH
OBSERVER 3	VARN	HPIN	OSWD	SAWT
OBSERVER 4	VNON	OSWD	PWRL	ALGO
OBSERVER 5	BEAR	KUST	BLAI	BLAI
OBSERVER 6	TRBR	WASH	03FH	OSTR
OBSERVER 7	ROSO	SAWT	ALGO	ROSO

Station KUST has been replaced with Station SACA

Wednesday, June 07, 2017

DAY 25	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	TSDL	TSDL	ENNS	TARK
OBSERVER 2	PELG	ENNS	0304	HARB
OBSERVER 3	WILK	WBND	WBND	0304
OBSERVER 4	WASH	CANL	WHEA	PASS
OBSERVER 5	OSWL	BOGE	TARK	LAUX
OBSERVER 6	HPIN	HPIN	F114	WR18
OBSERVER 7	BOGE	F114	GRNO	COLI

TSDL - SEND 2153 KEY

Thursday, June 08, 2017

DAY 26	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	ENNS	TARK	TSDL	TSDL
OBSERVER 2	0304	HARB	PELG	ENNS
OBSERVER 3	WBND	0304	WILK	WBND
OBSERVER 4	WHEA	PASS	WASH	CANL
OBSERVER 5	TARK	LAUX	OSWL	BOGE
OBSERVER 6	F114	WR18	HPIN	HPIN
OBSERVER 7	GRNO	COLI	BOGE	F114

TSDL - SEND 2153 KEY

LAUX to OSWD 42 minutes

Monday, June 12, 2017

DAY 27	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	U107	6064	F200	FINK
OBSERVER 2	Q107	C200	SR65	COLI
OBSERVER 3	OWEN	W850	DELE	LONE
OBSERVER 4	M107	NORM	NORM	DELE
OBSERVER 5	MINO	MINO	DODG	HARB
OBSERVER 6	WILN	LARK	WILL	SR65
OBSERVER 7	6064	F200	FINK	DLP2
OBSERVER 8	C200	WILL	STEG	HPKN

Tuesday, June 13, 2017

DAY 28	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	F200	FINK	U107	6064
OBSERVER 2	SR65	COLI	Q107	C200
OBSERVER 3	DELE	LONE	OWEN	W850
OBSERVER 4	NORM	DELE	M107	NORM
OBSERVER 5	DODG	HARB	MINO	MINO
OBSERVER 6	WILL	SR65	WILN	LARK
OBSERVER 7	FINK	DLP2	6064	F200
OBSERVER 8	STEG	HPKN	C200	WILL

Observer 2, drive time from session 2 to 3 is 37 minutes.

Wednesday, June 14, 2017

DAY 29	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	DODG	T644	TC22
OBSERVER 2	ADOB	DLP2	TC23
OBSERVER 3	SR65	D850	NLD6
OBSERVER 4	PTNM	HAUN	SECO
OBSERVER 5	NLD7	LONE	COLI
OBSERVER 6	LAUX	H62U	HAUN
OBSERVER 7	WR18	NLD6	GRNO

TCC KEYS

LONE IS A DEEP WELL MONUMENT, NEED TO USE GREEN 2-METER TRIPOD.

Thursday, June 15, 2017

DAY 30	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	TC22	DODG	T644
OBSERVER 2	TC23	ADOB	DLP2
OBSERVER 3	NLD6	SR65	D850
OBSERVER 4	SECO	PTNM	HAUN
OBSERVER 5	COLI	NLD7	LONE
OBSERVER 6	HAUN	LAUX	H62U
OBSERVER 7	GRNO	WR18	NLD6

TCC KEYS

LONE IS A DEEP WELL MONUMENT, NEED TO USE GREEN 2-METER TRIPOD.

Friday, June 16, 2017

DAY 31	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	WILK	JRM4	SYCA	ZAMX
OBSERVER 2	TC23	X200	1075	VINC
OBSERVER 3	WDWD	WDWD	BIRD	GW17
OBSERVER 4	SECO	LUSA	X200	BIRD
OBSERVER 5	LUSA	HERS	HERS	DUFO
OBSERVER 6	GRNO	WAYN	JRM4	1075
OBSERVER 7	WAYN	DRAI	CVAP	CVAP
OBSERVER 8	WBND	WILK	TYND	T849

TCC KEYS

HERS- ACCESS FROM NORTH, GATE SHOULD BE OPEN

WAYN- ACCESS FROM NORTH, GATE SHOULD BE OPEN

CVAP- LOOK AT DATASHEET, GATE ON LEVEE ROAD FROM SOUTHEAST MAY BE LOCKED

WBND- FOLLOW DATASHEET DIRECTIONS FOR TURN OFF OF WILSON BEND ROAD

Monday, June 19, 2017

DAY 32	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	SYCA	ZAMX	WILK	JRM4
OBSERVER 2	1075	VINC	TC23	X200
OBSERVER 3	BIRD	GW17	WDWD	WILD
OBSERVER 4	X200	BIRD	SECO	LUSA
OBSERVER 5	HERS	DUFO	LUSA	HERS
OBSERVER 6	JRM4	1075	GRNO	WAYN
OBSERVER 7	CVAP	CVAP	WAYN	DRAI
OBSERVER 8	TYND	T849	WBND	WILK

TCC KEYS

HERS- ACCESS FROM NORTH, GATE SHOULD BE OPEN

WAYN- ACCESS FROM NORTH, GATE SHOULD BE OPEN

OBSERVER 8- SESSION 2 TO 3 DRIVE TIME IS 38 MINUTES

CVAP- LOOK AT DATASHEET, GATE ON LEVEE ROAD FROM SOUTHEAST MAY BE LOCKED

WBND- FOLLOW DATASHEET DIRECTIONS FOR TURN OFF OF WILSON BEND ROAD

Tuesday, June 20, 2017

DAY 33	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	GW32	BRID	CHUR	DUFO
OBSERVER 2	GW17	COTT	WOOD	CODY
OBSERVER 3	VINC	MADZ	0308	SYCA
OBSERVER 4	T849	KEAT	FORD	CVAP
OBSERVER 5	BRID	1069	03DG	FORD
OBSERVER 6	1699	ABUT	CANA	KEAT
OBSERVER 7	MADZ	CANA	1031	F859
OBSERVER 8	KEAT	WOOD	LIBR	ZAMX

Wednesday, June 21, 2017

DAY 34	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	CHUR	DUFO	GW32	BRID
OBSERVER 2	WOOD	CODY	GW17	COTT
OBSERVER 3	0308	SYCA	VINC	MADZ
OBSERVER 4	FORD	CVAP	T849	KEAT
OBSERVER 5	03DG	FORD	BRID	1069
OBSERVER 6	CANA	KEAT	1699	ABUT
OBSERVER 7	1031	F859	MADZ	CANA
OBSERVER 8	LIBR	ZAMX	KEAT	WOOD

Thursday, June 22, 2017

DAY 35	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	SAWT	VNON	EX11
OBSERVER 2	PELG	SUTX	CONA
OBSERVER 3	JRM4	FORD	PLAI
OBSERVER 4	TYND	1031	RFW1
OBSERVER 5	VARN	F859	03DG
OBSERVER 6	SYCA	SM15	ALHA
OBSERVER 7	VNON	SNKY	CAST
OBSERVER 8	F859	FREM	COY1
OBSERVER 9	ROSO		

Session 1- Drive time to VNON is 30 minutes.

Station FREM has an offset station FRE2

SUTX-Be sure to check datasheet for access directions

Sac Levee Key

CONA- Check in at office

EX11-Check in at office or sign binder

COY1-Check in at office

ALHA- Offset point is PK nail and shiner (ALH1) in curb 75 feet west of ALHA (no datasheet for ALH1)

At the end of the day meet at 2033 Trade Court in Woodland behind the Jack in the Box resturant at County Road 102 and East Main Street

Friday, June 23, 2017

DAY 36	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	VNON	EX11	SAWT
OBSERVER 2	SUTX	CONA	PELG
OBSERVER 3	FORD	PLAI	JRM4
OBSERVER 4	1031	RFW1	TYND
OBSERVER 5	F859	03DG	VARN
OBSERVER 6	SM15	ALHA	SYCA
OBSERVER 7	SNKY	CAST	VNON
OBSERVER 8	FREM	COY1	F859

Station FREM has an offset station FRE2

SUTX-Be sure to check datasheet for access directions

Sac Levee Key

CONA- Check in at office

EX11-Check in at office or sign binder

COY1-Check in at office

ALHA- Offset point is PK nail and shiner (ALH1) in curb 75 feet west of ALHA (no datasheet for ALH1)

Monday, June 26, 2017

DAY 37	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	OSTR	T143	PHLP	COLM
OBSERVER 2	03FH	WISE	SUTX	FIDY
OBSERVER 3	ALGO	TRBR	SNKY	WALE
OBSERVER 4	H380	DOWD	FIDY	120P
OBSERVER 5	BEAR	SUTX	BREW	E144
OBSERVER 6	B144	MOOR	WALE	G120
OBSERVER 7	WISE	03EH	REGO	INDU
OBSERVER 8	COON	COON	MOOR	T143

E1446 replaced W1474, there is no QR code

ADAPTER

Private property - DWR to verify that contact has been made

Tuesday, June 27, 2017

DAY 38	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	PHLP	COLM	OSTR	T143
OBSERVER 2	SUTX	FIDY	03FH	WISE
OBSERVER 3	SNKY	WALE	ALGO	TRBR
OBSERVER 4	FIDY	120P	H380	DOWD
OBSERVER 5	BREW	E144	BEAR	SUTX
OBSERVER 6	WALE	G120	B144	MOOR
OBSERVER 7	REGO	INDU	WISE	03EH
OBSERVER 8	MOOR	T143	COON	COON

E1446 replaced W1474, there is no QR code - adapter needed

Private property - DWR to verify that contact has been made

Adapter needed

No information

Wednesday, June 28, 2017

DAY 39	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	SM15	ELVR	0309	~~GRBK~~
OBSERVER 2	1031	ELKH	GRBK	~~R208~~
OBSERVER 3	EX11	03AA	BREW	~~CRES~~
OBSERVER 4	FERR	REGO	INDU	~~GIBS~~
OBSERVER 5	CONA	RIVE	GIBS	~~HOWE~~
OBSERVER 6	RIVE	GIBS	G120	~~FAIO~~
OBSERVER 7	ELVR	SNKY	WALE	~~ELKH~~
OBSERVER 8	PALA	CRES	FAIO	~~GARF~~

SM15- Requires Sac Levee Key

EX11- Check in at office or sign binder

CONA- Check in at office or sign binder

FERR-Meet with contractor and use tripod extension (8.562feet)

ELVR replaced ELVT (ELVT shown on maps)

CRES- Contact Doug Henry at least one day prior for access (916-769-1720)

Thursday, June 29, 2017

DAY 40	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	ELVR	0309	SM15
OBSERVER 2	ELKH	GRBK	1031
OBSERVER 3	03AA	BREW	EX11
OBSERVER 4	REGO	INDU	FERR
OBSERVER 5	RIVE	GIBS	CONA
OBSERVER 6	GIBS	G120	RIVE
OBSERVER 7	SNKY	WALE	ELVR
OBSERVER 8	CRES	FAIO	PALA
OBSERVER 9	HOWE		

SM15- Requires Sac Levee Key

EX11- Check in at office or sign binder

CONA- Check in at office or sign binder

FERR-Meet with contractor and use tripod extension (8.562feet)

ELVR replaced ELVT (ELVT shown on maps)

CRES- Contact Doug Henry at leaset one day prior (916-769-1720)

Wednesday, July 05, 2017

DAY 41	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	CSUS	ELKH	ALH1	SURV
OBSERVER 2	BRAD	R208	03BG	GAF2
OBSERVER 3	GARF	GIBS	CAST	2068
OBSERVER 4	ZINF	GRBK	PALA	WILS
OBSERVER 5	BURO	0309	03AA	CALD
OBSERVER 6	LROY	BURO	CSUS	03BG
OBSERVER 7	DOUG	FAIO	HOWE	T462
OBSERVER 8	EXCL	HOWE	WILS	ANDR
OBSERVER 9	SHEL	GARF	T462	COUR

BURO HAS BEEN FOUND AND MARKED

ALH1 REPLACES ALHA. ALH1 IS NAIL IN CURB 75 FEET NORTHWEST OF ALHA

GAF2 REPLACES GAFF. GAF2 IS 46 FEET NORTHWEST OF GAFF

Thursday, July 06, 2017

DAY 42	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	ELKH	ALH1	CSUS
OBSERVER 2	R208	03BG	BRAD
OBSERVER 3	GIBS	CAST	GARF
OBSERVER 4	GRBK	PALA	ZINF
OBSERVER 5	0309	03AA	BURO
OBSERVER 6	BURO	CSUS	LROY
OBSERVER 7	FAIO	HOWE	DOUG
OBSERVER 8	HOWE	WILS	EXCL
OBSERVER 9	GARF	T462	SHEL

BURO HAS BEEN FOUND AND MARKED

ALH1 REPLACES ALHA. ALH1 IS NAIL IN CURB 75 FEET NORTHWEST OF ALHA

Friday, July 07, 2017

DAY 43	SESSION 1	SESSION 2	Receiver
OBSERVER 1	COUR	F859	9130
OBSERVER 2	T462	PLAI	3919
OBSERVER 3	GAFF	DAVE	0882
OBSERVER 4	ANDR	SURV	4700 #1
OBSERVER 5	03BG	CANA	Sac. Co.
OBSERVER 6	CALD	YCAP	5544
OBSERVER 7	2068	RUSS	1821
OBSERVER 8	WILS	1069	1320
OBSERVER 9	SURV	B849	4700 #2
OBSERVER 10		CODY	5531

DAVE - Needs adapter

YCAP - Read blue sheet. Check in with Gary. Need escort. Inform Gary about Monday plan and time.

RUSS - Needs adapter. Read blue sheet. Check in with Israel.

Monday, July 10, 2017

DAY 44	SESSION 1	Receiver
OBSERVER 1	F859	9130
OBSERVER 2	PLAI	3919
OBSERVER 3	DAVE	0882
OBSERVER 4	SURV	4700 #1
OBSERVER 5	CANA	Sac. Co.
OBSERVER 6	YCAP	5544
OBSERVER 7	RUSS	1821
OBSERVER 8	1069	1320
OBSERVER 9	B849	4700 #2
OBSERVER 10	CODY	5531

DAVE - Needs adapter

YCAP - Read blue sheet. Check in with Gary. Need escort. Inform Gary about Monday plan and time.

RUSS - Read blue sheet. Check in with Israel.

Tuesday, July 25, 2017

DAY 44 X	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	WILN	P30W	PMPR	CAPA
OBSERVER 2	L191	L191	HAMI	PMPR
OBSERVER 3	EXT1	VIOL	VIOL	

DAY 44 X	SESSION 5
OBSERVER 1	K852
OBSERVER 2	CHER
OBSERVER 3	

Tuesday, October 10, 2017

DAY 45	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	PTNM	TARK	JRM4
OBSERVER 2	NLD7	PASS	ENNS
OBSERVER 3	WR18	WHEA	PELG
OBSERVER 4	G117	ENNS	TSDL
OBSERVER 5	FLEE	F114	WILK

Locked gate, but able to walk around, no posted signs.

Reference point next to power pole is not the monument.

Can use Hageman Rd. 1.5 miles west of monument, then east on S. Butte Rd. to avoid parking on Highway 20.

Park at levee gate and station is located ~80 feet north of gate.

Have to cross barbed wire fence.

Team 1 Wednesday, October 11, 2017

DAY 46	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	RIVE	CRES	BRAD
OBSERVER 2	O3AA	HOWE	EXCL
OBSERVER 3	TC22		CSUS

No witness post. Blue sheet gives suggestion for parking, but do what feels the safest.

We will have called in advance, but if gate is not open there are two phone numbers on the blue sheet. If gate is open, then drive in and follow instructions.

Park where safe. Roadway shoulder is widest under the overpass.

Survey after 0900

Team 2 Wednesday, October 11, 2017

DAY 46	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	2966	2085	BIGW	CHER
OBSERVER 2	ORLA	VIOL	AGUI	K852

DAY 46	SESSION 5
OBSERVER 1	H285
OBSERVER 2	FREN

No witness post.

Contact office (530) 865-1403 prior.

Need to cross barbed wire fence.

Team 1 Thursday, October 12, 2017

DAY 47	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	2DK4	JELL	EGRN	02GH
OBSERVER 2	2EK3	BOWM	O2GH	2HJ2

Team 2 Thursday, October 12, 2017

DAY 47	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	D850	SECO	WAYN
OBSERVER 2	T644	NLD6	X200

Tuesday, October 17, 2017

DAY 48	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	271F	MRSN	WHEA	ENNS
OBSERVER 2	PMPR	F114	WBND	WHEA
OBSERVER 3	B130	F853	DOWD	SUTX
OBSERVER 4	FARM	HARR	FIDY	PHLP

No witness post

6 inches below grade

Need to cross over barbed wire fence

Narrow shoulder, bring extra cones or reflectors.

Wednesday, October 18, 2017

DAY 49	SESSION 1	SESSION 2	SESSION 3	SESSION 4
OBSERVER 1	DOWD	ELKH	ANDR	ROSO
OBSERVER 2	FIDY	REGO	CALD	SAWT
OBSERVER 3	BRID	MADZ	ABUT	03DG
OBSERVER 4	1699	WOOD	CANA	RWF1

Narrow shoulder, bring extra cones or reflectors.

Monday, November 13, 2017

DAY 50	SESSION 1	SESSION 2
OBSERVER 1	LIBR	KEAT
OBSERVER 2	FORD	308

Thursday, November 16, 2017

DAY 51	SESSION 1	SESSION 2	SESSION 3
OBSERVER 1	TARK	NLD6	FREN
OBSERVER 2		SECO	H285

Primary Network Observation Schedule

Tuesday, August 08, 2017

DAY 1

OBSERVER	STATION
OBSERVER 1	0212
OBSERVER 2	02JH
OBSERVER 3	02JK
OBSERVER 4	U345
OBSERVER 5	CORN
OBSERVER 6	B107
OBSERVER 7	ORLA

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Wednesday, August 09, 2017

DAY 2

OBSERVER	STATION
OBSERVER 1	0212
OBSERVER 2	02JH
OBSERVER 3	02JK
OBSERVER 4	U345
OBSERVER 5	CORN
OBSERVER 6	B107
OBSERVER 7	ORLA

START TIME	1130 (11:30 AM)
STOP TIME	1630 (4:30 PM)

Thursday, August 10, 2017

DAY 3

OBSERVER	STATION
OBSERVER 1	0212
OBSERVER 2	02JH
OBSERVER 3	02JK
OBSERVER 4	U345
OBSERVER 5	CORN
OBSERVER 6	B107
OBSERVER 7	ORLA

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Tuesday, September 12, 2017

DAY 4

OBSERVER#	STATION
OBSERVER 1	BLAI
OBSERVER 2	B107
OBSERVER 3	ORLA
OBSERVER 4	GLEN
OBSERVER 5	HMBT
OBSERVER 6	C200
OBSERVER 7	TWSP

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Wednesday, September 13, 2017

DAY 5

OBSERVER#	STATION
OBSERVER 1	BLAI
OBSERVER 2	B107
OBSERVER 3	ORLA
OBSERVER 4	GLEN
OBSERVER 5	HMBT
OBSERVER 6	C200
OBSERVER 7	TWSP

START TIME	1130 (11:30 AM)
STOP TIME	1630 (4:30 PM)

Thursday, September 14, 2017

DAY 6

OBSERVER#	STATION
OBSERVER 1	BLAI
OBSERVER 2	B107
OBSERVER 3	ORLA
OBSERVER 4	GLEN
OBSERVER 5	HMBT
OBSERVER 6	C200
OBSERVER 7	TWSP

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Tuesday, September 19, 2017

DAY 7

OBSERVER#	STATION
OBSERVER 1	BIRD
OBSERVER 2	BLAI
OBSERVER 3	E144
OBSERVER 4	COUR
OBSERVER 5	SHEL
OBSERVER 6	SACA/KUST

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Wednesday, September 20, 2017

DAY 8

OBSERVER#	STATION
OBSERVER 1	BIRD
OBSERVER 2	BLAI
OBSERVER 3	E144
OBSERVER 4	COUR
OBSERVER 5	SHEL
OBSERVER 6	SACA/KUST

START TIME	1130 (11:30 AM)
STOP TIME	1630 (4:30 PM)

Thursday, September 21, 2017

DAY 9

OBSERVER#	STATION
OBSERVER 1	BIRD
OBSERVER 2	BLAI
OBSERVER 3	E144
OBSERVER 4	COUR
OBSERVER 5	SHEL
OBSERVER 6	SACA/KUST

START TIME	0900 (9:00 AM)
STOP TIME	1400 (2:00 PM)

Appendix D: List of Observers

See next page

Subsidence Monitoring Network Observers List

City of Roseville
- Mike Mercurio
- Thomas Cooney

City of Sacramento
- David Veasey
- Vinnie Nguyen

Butte County
- Kevin Anderson
- Amanda Erling
- Patrick Wickham

Colusa County
- Tim Gomes
- Shane Hodges
- Oscar Vaca

Glenn County
- Hether Ward
- Sharla Stockton

Placer County
- Brandon Thurber

Sacramento County
- Doug Bean
- Aya Kamil
- Carson Sperber

Shasta County
- Eric Wedemeyer
- Senecca Nunez
- Dennis Zeimet

Sutter County
- Jerry Orr
- Nick Ramos
- David Tomm

Tehama County

- Robert Brownfield
- Greg Latourell
- Brandon Konicke

Department of Water Resources – Northern Region Office

- Jessica Boyt
- Glen Gordon
- Scott Kennedy
- Debbie Spangler
- Jonathan Stephan
- Jim West

Glenn Colusa Irrigation District

- Tomás Loera

Natomas Central Mutual Water Company

- Floyd McLaughlin

Placer County Water Agency

- Jerry Peatross

Reclamation District 108

- Justin Correa

Sacramento Central Groundwater Authority

- Ramon Roybal
- Bob Steeg

University of California Cooperative Extension

- Allan Fulton

Yolo County Flood Control and Water Conservation District

- Jennifer Reed

Yuba County Water Agency

- Caleb Boyle
- Alyson Zoellin

Appendix E: Combined Fully Constrained Network Adjustment

Because of the large size and page count of Appendix E, it is available for download here: https://d3.water.ca.gov/owncloud/index.php/s/HbFMMbe8zzCi8dN.

Appendix F: Adjusted Ellipsoid Heights for all Stations

See next page

Stations Adjusted Ellipsoid Heights

4-CH ID	LATITUDE	LONGITUDE	ELLIP HT Ft	NAME
0212	40 57 25.62137	-122 26 05.71155	1320.532	HPGN CA 02 12
0222	40 09 35.65554	-122 13 26.31267	219.066	HPGN CA 02 22
0304	39 08 35.79003	-121 54 06.27002	-55.098	HPGN CA 03 04
0308	38 43 01.99970	-121 48 07.54307	-23.882	HPGN CA 03 08
0309	38 43 40.44969	-121 17 10.61549	72.444	HPGN CA 03 09
1031	38 40 38.14620	-121 42 34.07956	-67.584	P 1031
1069	38 35 10.00158	-121 58 17.45711	77.010	T 1069
1075	38 50 51.29688	-121 56 00.25902	-51.141	P 1075
1118	39 39 34.81961	-122 01 36.97599	55.648	MI 11.18
1127	39 27 50.60647	-121 55 31.40372	-6.403	11 227 CADH
1500	39 30 54.05238	-121 55 48.13085	4.855	1500
1699	38 44 12.69774	-121 57 15.85827	70.863	169
2068	38 24 54.17949	-121 43 48.53771	-63.350	RD2068
2085	39 44 47.88889	-122 07 21.69250	118.440	208.56 USBR
2966	39 47 25.23145	-122 13 33.09204	204.286	296.66 USBR
6064	39 23 58.70746	-122 17 16.91803	118.786	60.64
02CJ	39 54 23.48872	-122 12 41.99254	198.314	HPGN D CA 02 CJ
02FJ	40 19 36.36794	-122 16 48.62611	480.293	HPGN D CA 02 FJ
02GH	40 30 04.45170	-122 22 34.14721	387.517	HPGN D CA 02 GH
02JH	40 39 42.34403	-122 21 24.42911	587.569	HPGN D CA 02 JH
02JK	40 41 20.86922	-122 07 26.10097	991.250	HPGN D CA 02 JK
03AA	38 36 52.10500	-121 30 52.07644	-81.247	HPGN D CA 03 AA
03BG	38 30 20.00995	-121 34 55.09363	-69.675	HPGN D CA 03 BG
03DG	38 38 27.43871	-121 45 39.59772	-23.453	HPGN D CA 03 DG
03EH	38 51 59.61388	-121 32 32.95866	-63.803	HPGN D CA 03 EH
03FH	39 02 32.12158	-121 28 33.65961	-21.844	HPGN D CA 03 FH
03HJ	39 13 28.63373	-121 26 07.89645	101.790	HPGN D CA 03 HJ
120P	38 49 43.37051	-121 11 25.70317	322.187	P 1200
121B	39 23 07.67821	-121 32 43.05896	31.379	121 BB USGS
271F	39 50 02.09813	-122 05 06.37738	81.574	FWS 271
2CK1	39 59 08.54832	-122 04 55.26451	112.602	99 TEH 9.22
2DK4	40 06 26.67915	-122 06 34.30664	150.931	99 TEH 17.88
2EK3	40 09 54.04229	-122 09 16.26597	178.076	99 TEH 22.63
2EK4	40 14 55.50552	-122 08 57.52221	527.917	36 TEH 48.89
2HJ2	40 33 28.91645	-122 14 22.18029	373.165	44 SHA 6.94
2HK3	40 31 00.04768	-122 05 41.25218	927.144	44 SHA 15.59

55BB	39 34 51.75177	-121 37 10.10251	177.780	2655 BB
7MIL	39 38 10.70086	-121 54 35.88676	32.162	7 MILE
A107	39 35 08.29767	-122 24 17.70413	399.381	A 1079
ABUT	38 38 05.70806	-121 57 06.70412	71.446	ABUT
ADOB	39 23 26.70034	-121 57 00.54639	-22.956	ADOBE
AGUI	39 43 33.88344	-122 14 26.10120	179.313	AGUIAR
ALGO	39 01 34.25609	-121 32 52.74429	-48.753	ALGONDON
ALHA	38 33 31.09911	-121 42 26.68991	-60.108	ALHAMBRA
ANDR	38 23 12.17817	-121 38 18.72218	-91.629	ANDREW
ARTO	39 37 27.53430	-122 12 17.01222	98.440	ARTOIS
ASHH	40 25 01.37465	-122 11 46.07066	288.475	ASH
B107	39 36 40.90399	-122 31 42.87306	611.030	B 1079
B109	39 32 16.89132	-121 54 29.95102	10.393	BC 1090
B130	39 50 25.86208	-121 59 50.95987	79.297	BC 1305
B144	38 58 51.60386	-121 22 38.16061	12.529	B 1446
B428	39 39 10.19358	-121 51 41.88938	53.326	BC 428
B635	39 52 56.09953	-121 55 09.50364	195.061	BC 635
B728	39 49 19.23517	-121 51 47.29794	201.166	BC 728
B743	39 21 45.99884	-121 45 12.07658	-12.323	BC 743
B849	38 32 01.29302	-121 58 15.18500	27.333	B 849
BCEX	39 34 37.37225	-121 54 29.29833	16.051	BC EXTN 2
BEAR	38 58 25.68355	-121 29 15.58212	-29.863	BEAR
BEND	39 37 47.54948	-121 59 53.81418	29.103	ORDBEND
BIGB	39 27 51.24644	-121 52 13.93680	-6.892	BIG BUTTE
BIGW	39 40 21.14716	-122 20 10.15790	362.007	BIG W
BIRD	38 50 54.73696	-122 02 37.47800	208.842	BIRD
BLAI	39 07 45.76995	-121 27 19.47241	-11.968	BLAIR
BLOC	39 19 08.21655	-121 43 29.67814	-7.650	BLOCK
BNBR	40 15 47.33630	-122 13 16.55246	225.714	BEND BRIDGE
BOGE	39 05 54.18224	-121 44 43.12530	-53.203	BOGUE
BOWM	40 22 08.87224	-122 16 55.59009	320.343	BOWMAN
BRAD	38 33 42.05715	-121 20 53.68273	-42.564	BRADSHAW
BREW	38 45 23.02115	-121 27 04.05356	-41.242	BREWER
BRHM	39 57 25.74497	-122 12 10.79866	201.965	BARHAM
BRID	38 42 41.39741	-122 02 50.18491	109.616	BRIDGE
BURO	38 37 22.92193	-121 13 52.96988	36.426	BUREAU
BUTG	39 49 05.64042	-122 19 32.23341	292.161	BUTTE GAGE
BUZZ	39 25 52.64256	-121 33 10.73535	60.533	BUZ
C200	39 24 22.66481	-122 11 32.19690	-2.253	C 200
C430	40 07 10.61731	-122 11 50.06925	190.548	C 1430
C434	39 40 57.28699	-121 45 52.54818	116.914	C 1434

CALD	38 27 33.51387	-121 39 24.21540	-85.358	CALDWELL
CANA	38 37 02.05610	-121 51 30.11758	-4.747	CANAL AI5054
CANL	39 08 28.88981	-121 41 54.56938	-42.518	CANAL KS1836
CAPA	39 46 56.79115	-122 06 14.48559	106.659	CAPAY
CAST	38 33 50.77665	-121 38 37.80523	-84.633	CASTRO AZ MK RESET
CHER	39 40 05.35080	-122 15 11.41771	134.803	CHEROKEE
CHUR	38 39 48.00698	-121 48 09.05972	-22.526	CHURCH
CODY	38 47 30.59910	-121 46 29.02194	-58.838	CODY
COLI	39 11 06.44950	-121 59 40.52447	-48.300	COLIND
COLM	38 52 51.57383	-121 15 59.68957	114.410	CITY OF LINC MON 109
CONA	38 37 05.49590	-121 38 40.43050	-76.094	CONAWAY
COON	38 56 33.44240	-121 21 13.73614	67.797	COON
CORN	39 55 22.12420	-122 21 10.25652	368.266	CORNBUTTE
COTT	38 38 20.24654	-122 02 08.12336	198.907	COTTON
COUR	38 20 24.76001	-121 33 40.05319	-77.110	COURTLAND
COY1	38 35 28.05256	-121 41 31.83645	-74.146	COY DUMP
CRCO	39 25 14.34566	-121 49 38.66101	-16.595	CARRICO
CREE	39 43 53.37497	-122 24 47.93597	421.991	CREEK
CRES	38 39 02.32925	-121 30 26.67590	-85.216	CAPITOL RESERVOIR
CRST	39 27 29.40210	-121 34 37.33912	169.207	CREST RM 2
CSUS	38 33 14.57195	-121 25 23.72489	-57.346	HPGN D CA CSUS
CVAP	38 50 19.76530	-121 50 39.17763	-73.845	CVAP 02
D14R	39 29 37.19895	-121 39 36.31648	68.700	D 146 RESET
D850	39 08 33.63125	-122 13 02.10462	23.571	D 850 RESET 1971
DAVE	38 31 59.46614	-121 47 14.17833	-39.511	DAVEPORT
DELE	39 16 30.61577	-122 06 18.73989	-35.915	DELEVAN
DHAM	39 38 42.83605	-121 47 56.98190	71.488	DURHAM
DLP2	39 11 28.05229	-122 10 16.52852	-20.316	DELPHOS RM 2
DODG	39 22 38.58760	-122 01 14.53249	-15.921	DODGE
DOUG	38 33 39.66443	-121 14 40.07544	47.529	DOUGLAS
DOWD	38 52 12.97794	-121 22 37.59339	3.218	DOWD
DRAI	38 55 31.04662	-121 54 52.46326	-56.844	DRAIN
DUFO	38 45 48.09758	-121 50 39.06980	-34.703	DUFOUR
E144	38 50 02.53699	-121 18 24.42143	32.823	E 1446
EAGR	39 10 30.16195	-121 38 05.30991	-33.951	EAGER
EATO	39 46 35.87075	-121 50 38.46180	107.274	EATON
EGRN	40 21 37.05238	-122 19 51.32354	355.116	EVERGREEN
ELKH	38 40 54.09781	-121 29 03.49658	-65.377	ELKHORN
ELVR	38 42 51.94225	-121 32 27.05671	-53.461	ELVERTA RESET
ENNS	39 05 04.16171	-121 48 01.24256	-58.338	ENNIS
EUCA	39 53 34.68604	-122 18 13.65574	323.587	EUCALYPTUS

EX11	38 38 46.41083	-121 40 03.02693	-76.301	EX 1
EXCL	38 30 54.64180	-121 17 03.89418	23.352	EXCELSIOR
EXT1	39 37 46.82661	-122 06 07.91037	57.397	EXT1
F114	39 09 25.19376	-121 46 36.67526	-35.736	F 114
F200	39 19 09.12298	-122 11 29.55051	-11.143	F 200
F853	39 27 52.11254	-121 47 57.49852	-1.749	F 853
F859	38 47 34.20221	-121 43 36.01912	-53.774	F 859 RESET
FAIO	38 40 43.39475	-121 15 47.08830	70.605	FAIR
FARM	39 47 48.63828	-121 59 14.55179	58.809	FARMLAND
FARR	39 23 30.67958	-121 46 54.96082	-13.792	FARRIS
FENN	39 36 34.94804	-121 51 26.37613	32.812	FENN
FERR	38 40 32.00848	-121 37 49.18232	-61.139	FERRY
FIDY	38 47 44.65788	-121 21 31.46217	8.898	NEWFIDDY
FINK	39 15 29.80425	-122 11 29.32285	-4.540	FINKS
FLEE	39 19 19.51428	-121 48 45.29233	-23.348	FAIRLEE
FLOR	40 05 02.95397	-122 13 08.47394	197.529	FLORES
FORD	38 43 33.23689	-121 43 47.39391	-43.453	FORD RM 2
FREM	38 45 52.89499	-121 38 08.00736	-58.878	FREMONT
FREN	39 34 56.74098	-122 14 58.85488	68.238	FRENCH
FREX	39 39 55.81754	-121 55 31.30193	34.596	FARWELL
G117	39 17 12.36614	-121 47 04.01869	-1.985	G 1175
G120	38 47 09.87507	-121 14 32.09716	155.554	G 1200
G142	40 34 56.64305	-122 25 57.29320	626.891	G 1429
G143	40 02 29.98167	-122 08 34.41325	133.424	G 1430
G434	39 39 22.25673	-121 43 54.05926	92.445	G 1434
GAFF	38 24 25.68519	-121 34 56.13811	-99.822	GAFFNEY
GARF	38 37 54.87928	-121 20 13.16472	5.032	GARFIELD
GIBS	38 42 19.17563	-121 25 46.48242	-28.018	GIBSON
GLEN	39 31 17.92813	-122 00 53.29298	3.482	GLENN
GORD	39 24 34.42661	-122 00 35.87886	-8.822	GORDON
GORR	39 36 09.58714	-121 47 05.11298	43.143	GORRILL
GRAY	39 21 44.26672	-121 49 27.53604	-22.846	GRAY
GRBK	38 41 31.13614	-121 20 47.91838	52.865	GREENBACK
GRNO	39 03 24.21931	-121 58 08.69127	-65.586	GRAINO
GW17	38 46 52.25991	-122 02 38.10877	177.659	GWM 17
GW32	38 44 21.97313	-122 09 59.02870	269.121	GWM 32
H285	39 33 07.29911	-122 21 26.02222	247.490	H 285 USGS
H380	39 00 49.80193	-121 25 46.20418	-14.714	H 380
H62U	39 07 14.13848	-122 17 27.38962	127.356	H 62
HAHN	39 04 50.45360	-122 05 54.15159	-11.275	HAHN
HALL	39 10 28.68832	-121 32 57.31597	-3.317	HALLWOOD

HAMI	39 44 39.73466	-122 01 14.04402	65.169	HAMILTON
HARB	39 14 50.41718	-122 01 52.59714	-38.327	HARBISON
HARR	39 25 15.84127	-121 45 47.49633	-5.711	HARRIS
HARV	39 58 06.32553	-122 09 53.18586	163.600	HARVEST 2017
HERS	38 52 28.84909	-121 54 51.96639	-53.806	HERSHEY
HESS	40 12 10.19826	-122 14 38.93611	224.916	HESS
HMBT	39 44 56.68116	-121 45 44.95410	465.656	HUMBOLT ROAD
HONC	39 19 30.36058	-121 33 25.38614	-1.337	HONCUT
HOWA	39 25 12.40945	-121 53 52.38446	-19.154	HOWARD
HOWE	38 36 47.57477	-121 25 57.72002	-52.480	HOWE
HPIN	39 05 02.23246	-121 41 22.49100	-51.123	HOPPIN
HPKN	39 13 03.73219	-122 05 19.78451	-41.224	HOPKINS
INDU	38 47 22.39967	-121 18 30.17528	39.648	INDUSTRIAL
J143	39 36 58.45551	-121 40 55.09816	115.018	J 1434
J847	39 32 26.40350	-121 41 19.92260	41.775	J 847
JACI	39 34 56.70124	-122 00 36.01176	18.634	JACINTO
JELL	40 19 10.76990	-122 11 18.93506	251.359	JELLYS
JOHN	39 29 34.87206	-121 48 03.91638	4.346	JOHNSON
JRM4	38 55 39.86301	-121 50 35.87584	-58.823	JIMENO RM 4
K276	39 51 20.08360	-122 21 17.65317	407.644	K 276
K435	39 07 48.26172	-121 36 10.80926	-34.465	K 1435
K852	39 41 48.97337	-122 11 42.87273	135.978	K 852
KAIS	39 42 33.01150	-122 02 14.80490	67.017	KAISER
KEAT	38 42 33.52452	-121 53 11.08433	16.077	KEATON
L143	39 53 58.26074	-121 59 43.71714	117.185	L 1430
L191	39 34 55.29570	-122 07 20.25672	43.158	L191
LARK	39 29 33.92962	-122 05 15.35311	7.036	LARKINS
LAUX	39 14 43.76124	-121 57 31.83708	-37.977	LAUX
LBRL	39 52 54.51303	-122 13 40.87823	193.780	LIBERAL
LIBR	38 40 44.18607	-121 46 28.10236	-36.486	LIBRARY
LOAK	39 17 32.29397	-121 40 03.10997	-14.005	LIVE OAK
LOMO	39 13 16.45060	-121 38 30.20256	-27.317	LOMO
LONE	39 10 37.25553	-122 04 42.66480	-44.693	LONESTAR
LROY	38 34 59.56034	-121 11 09.85571	153.699	LEROY
LUSA	38 58 14.53878	-122 01 33.18195	53.372	LUSA RM 2
M107	39 28 11.23448	-122 11 34.20352	14.211	M 1078
M185	40 13 26.68599	-122 20 15.38537	361.531	M 185
MADZ	38 40 54.92522	-121 58 02.26312	49.712	MADISON AZIMUTH MARK
MCCL	40 00 03.40639	-122 17 54.82304	291.870	MCCLURE
MERI	39 45 11.55704	-121 56 18.44913	49.155	MERIDIAN
MICH	39 54 23.62219	-122 06 51.25847	123.046	MICHIGAN

MINO	39 27 51.90718	-122 08 11.90330	5.025	MINOR
MOOR	38 52 05.63457	-121 27 06.12051	-34.206	MOORE
MORE	39 43 01.15264	-121 51 47.73302	85.967	MOREHEAD
MRSN	39 13 53.91179	-121 42 20.39927	-24.564	MORRISON
N852	39 48 34.53046	-122 10 21.16414	153.380	N 852
NELS	39 33 32.16917	-121 46 02.48688	30.535	NELSON
NLD6	39 06 51.82343	-122 01 05.76961	-59.468	NLD 126
NLD7	39 21 43.64417	-121 52 04.89131	-20.764	NLD 127
NLD8	39 33 05.70989	-121 50 25.56267	24.224	NLD 128
NORD	39 47 52.36582	-121 54 12.94550	90.079	NORD
NORM	39 24 27.02222	-122 08 10.64987	-16.812	NORMAN RM 1
OKSL	40 22 19.00059	-122 09 39.72897	294.030	OAK SLOUGH
ORLA	39 46 06.53462	-122 11 32.38478	173.422	ORLAND SOUTH BASE
ORVB	39 33 16.64409	-121 30 00.99384	1117.216	OROVILLE DAM GRM
OSTR	39 04 32.48480	-121 23 47.56973	26.813	OSTROM
OSWD	39 04 08.45087	-121 38 35.20804	-54.360	OSWALD
OWEN	39 27 56.35589	-122 14 56.20739	49.158	OWENS
P143	39 50 25.16278	-121 56 26.97801	101.589	P 1430
P208	39 06 33.47268	-122 18 13.87415	245.280	P208
P265	38 31 48.65374	-121 57 15.04705	27.926	P265
P267	38 22 49.19327	-121 49 23.59067	-55.787	DIXONAVIATCN2005 GRP
P268	38 28 24.67978	-121 38 47.02681	-76.887	FINCHFARMSCN2005 GRP
P270	39 14 37.55614	-122 03 18.70996	-38.992	HOPKINSLGHCN2005
P271	38 39 26.44614	-121 42 52.32300	-58.453	WOODLAND1_CN2004 GRP
P272	39 08 43.72026	-121 56 34.97076	-38.042	P272
P30W	39 39 09.86008	-122 09 04.27114	85.170	P30W
P344	39 55 44.82920	-122 01 40.64284	164.748	VINAHELITKCN2006 GRP
P345	40 16 16.42993	-122 16 14.84758	441.331	HOOKERDOMECN2005 GRP
PALA	38 33 38.01494	-121 32 19.52261	-59.006	PALA
PARK	39 32 03.17236	-121 35 08.27986	160.013	PARK
PASS	39 11 12.89064	-121 52 39.51125	5.823	PASSBUTTE
PELG	38 57 10.44580	-121 45 11.56267	-69.374	PELGER
PEN2	39 38 50.12755	-121 37 52.46715	225.870	PENTZ RM 2
PETE	39 41 44.95431	-122 06 10.75254	88.260	PETER
PHLP	38 48 08.88420	-121 25 08.97910	-20.197	PHILLIP
PLAI	38 35 05.49911	-121 48 11.62330	-37.135	PLAINFIELD
PMPR	39 47 03.48797	-122 02 45.63131	70.264	PUMP RESET
PROV	39 31 18.60693	-122 05 18.95541	4.013	PROVIDENT
PTNM	39 19 54.55238	-121 57 16.32585	-32.214	PUTNAM
PWRL	39 05 53.12684	-121 32 45.09647	-31.535	POWER LINE
Q106	39 55 50.45225	-122 17 19.39254	280.699	Q 1065

Q107	39 31 27.18416	-122 14 14.24917	53.136	Q 1078
R208	38 39 18.54363	-121 23 14.17953	-23.779	CONTROL MONUMENT LR 208
R276	39 16 59.75551	-121 28 28.71311	54.752	R276
RAMZ	39 15 52.80382	-121 34 32.91113	-12.507	RAMIREZ
RAWS	40 01 44.82989	-122 13 30.24357	216.754	RAWSON
RBNK	40 07 43.98752	-122 16 16.23696	248.603	REDBANK
REGO	38 45 05.19081	-121 29 05.75197	-53.330	RIEGO RM 4
RIVE	38 38 50.46233	-121 34 20.06447	-61.660	RIVER
ROSO	38 57 41.12263	-121 32 35.74876	-55.173	RIO OSO
RUSS	38 32 38.06691	-121 52 33.83961	-6.705	RUSSELL RANCH 2
RWF1	38 35 10.00001	-121 45 05.10254	-54.471	RWF1
S106	39 43 11.19917	-122 32 58.14288	810.606	S 1067
S214	39 12 51.33924	-121 29 39.08934	-0.353	S 214
S381	39 22 57.18253	-121 36 05.92597	9.647	S 381
S853	39 24 18.45481	-121 42 35.21934	-0.166	S 853
SACA	38 54 58.47627	-121 36 21.81928	-60.936	SACRAMENTO AVENUE
SAMS	39 56 07.79841	-122 12 23.77870	202.944	SAMSON 2017
SAWT	38 57 08.19851	-121 38 05.25899	-62.378	SAWTELLE
SCLE	40 12 45.99522	-122 10 47.96284	317.739	SCALE
SECO	39 01 43.79941	-122 03 50.15192	27.237	SECO
SHEL	38 29 36.45481	-121 12 38.99171	96.380	SHELDON
SHEP	39 31 21.89548	-121 45 14.73264	21.676	SHEPPARD
SM15	38 43 51.60561	-121 37 59.39391	-76.308	SM NO 15
SNKY	38 48 00.00896	-121 32 38.49240	-74.314	SANKEY
SR65	39 18 55.05166	-122 02 02.41282	-22.714	SR 65
SRGS	39 50 13.21292	-122 11 51.22413	179.202	SOUR GRASS
STEG	39 20 29.35392	-122 05 03.27414	-30.977	STEGEMAN
SURV	38 27 08.54514	-121 44 56.17415	-59.777	SURVEYOR
SUTB	39 12 20.99590	-121 49 14.10315	2024.405	SUTTER BUTTES CORS POINT
SUTX	38 49 24.26976	-121 32 34.91383	-66.256	SUTEXTN
SYCA	38 50 19.12449	-121 45 06.39099	-74.058	SYCAMORE
T143	38 54 48.09360	-121 19 08.98950	49.138	T 1435
T462	38 26 25.99276	-121 30 17.76416	-72.188	T 462
T644	39 07 54.60446	-122 07 55.53110	-8.514	T 644
T849	38 47 24.93437	-121 54 56.34591	18.124	T 849
TALL	39 35 18.57012	-121 41 18.48668	83.413	TALLOW
TARK	39 08 35.48327	-121 50 33.52742	-35.012	TARKE
TC22	39 03 08.09485	-122 09 08.47318	94.236	TEHAMA-COLUSA CANAL 22
TC23	39 00 42.17233	-122 05 33.18456	89.604	TEHAMA-COLUSA CANAL 23
TCCO	39 37 25.17367	-122 16 21.02344	129.556	TEHAMA-COLUSA CANAL 0
TRBR	38 54 26.11180	-121 30 16.30656	-46.438	TROWBRIDGE

TSDL	39 01 17.19989	-121 44 28.51168	-40.862	TISDALE
TWSP	39 20 39.15175	-121 41 14.03761	-1.693	TOWNSHIP
TYND	38 52 26.17842	-121 49 03.81328	-69.461	TYNDALL
U107	39 31 51.03564	-122 19 34.37147	212.188	U 1078
U345	40 26 17.61362	-122 17 00.50606	367.229	U 345
UCD1	38 32 10.44918	-121 45 04.37936	-0.046	UCD1 GEODETIC REF MK
V380	39 46 56.35924	-122 17 41.94348	275.274	V 380 RESET 1967
V853	39 27 52.90377	-121 43 54.95275	11.091	V 853
VARN	38 53 09.54121	-121 42 06.92253	-74.606	VARNEY
VINC	38 48 08.12088	-121 59 00.32326	57.999	VINCOR
VIOL	39 45 58.92989	-122 04 39.34848	92.807	VIOLICH
VNON	38 50 11.64870	-121 37 00.84434	-74.619	VERNON
W215	39 47 44.85242	-122 32 47.50320	583.901	W 215 AZ MK
W850	39 22 39.76584	-122 14 52.83333	17.467	W 850
WALE	38 45 05.63004	-121 21 54.75058	16.662	BASEWALE
WALK	39 31 27.11587	-122 09 53.88080	31.129	WALKER
WASH	39 00 10.76062	-121 40 17.31543	-57.355	WASHINGTON
WAYN	38 59 37.07181	-121 57 29.53946	-52.984	WAYNE
WBND	39 02 30.73423	-121 50 12.69748	-36.290	WILSON BEND
WDR1	39 13 12.45297	-121 33 30.51991	-17.665	WOODRUFF REPLACEMENT
WDWD	38 55 46.44916	-122 03 40.00935	204.434	WILDWOOD BRIDGE
WHEA	39 04 35.82764	-121 53 39.35614	-30.122	WHEAT
WILD	39 42 45.69824	-121 57 52.89683	43.201	WILDLIFE
WILK	38 59 26.08013	-121 52 01.52546	-68.371	WILKENS
WILL	39 26 09.36329	-122 04 34.02839	-11.584	WILLOW
WILN	39 34 15.04128	-122 11 37.65205	48.713	WILSON
WILS	38 29 41.85229	-121 41 31.51629	-71.598	WILSON
WINS	39 39 48.63648	-122 31 33.45902	560.511	WINSLOW
WISE	38 55 34.68214	-121 24 18.47150	-6.360	WISE
WLMS	39 30 34.22274	-121 51 27.13135	5.608	WILLIAMS
WLOW	40 03 18.10460	-122 17 00.85803	275.447	WILLOW
WOOD	38 40 17.76321	-121 52 20.38261	28.552	WOODPORT
WR18	39 15 10.74753	-121 53 30.00190	-21.778	DWR18
X200	38 54 20.73299	-121 58 59.79249	-1.547	X 200 RESET
Y380	39 45 45.77974	-122 20 14.55455	367.309	Y 380
Y852	39 27 25.84590	-122 01 03.38339	-4.683	Y 852
YCAP	38 34 20.34610	-121 51 18.37479	-5.591	YOLO COUNTY AIRPORT BASELINE POINT 6
ZAMX	38 46 45.78648	-121 48 44.63159	-58.234	ZAMX
ZINF	38 35 23.60764	-121 17 18.80311	0.266	ZINFANDEL

Appendix G: Station Ellipsoid Height Changes from 2008 to 2017

See next page

Station Differences in Ellipsoid Height from 2008 to 2017

4-CH ID	LATITUDE	LONGITUDE	ELLIP HT CHANGE Ft	NAME
0212	40 57 25.62137	-122 26 05.71155	0.000	HPGN CA 02 12
0222	40 09 35.65554	-122 13 26.31267	-0.051	HPGN CA 02 22
0304	39 08 35.79003	-121 54 06.27002	-0.203	HPGN CA 03 04
0308	38 43 01.99970	-121 48 07.54307	-1.110	HPGN CA 03 08
0309	38 43 40.44969	-121 17 10.61549	-0.007	HPGN CA 03 09
1031	38 40 38.14620	-121 42 34.07956	-0.412	P 1031
1069	38 35 10.00158	-121 58 17.45711	-0.293	T 1069
1075	38 50 51.29688	-121 56 00.25902	-0.298	P 1075
1118	39 39 34.81961	-122 01 36.97599	-0.024	MI 11.18
1127	39 27 50.60647	-121 55 31.40372	-0.028	11 227 CADH
1500	39 30 54.05238	-121 55 48.13085	-0.040	1500
1699	38 44 12.69774	-121 57 15.85827	-0.462	169
2068	38 24 54.17949	-121 43 48.53771	-0.197	RD2068
2085	39 44 47.88889	-122 07 21.69250	-0.113	208.56 USBR
2966	39 47 25.23145	-122 13 33.09204	-0.290	296.66 USBR
6064	39 23 58.70746	-122 17 16.91803	-0.059	60.64
02CJ	39 54 23.48872	-122 12 41.99254	-0.025	HPGN D CA 02 CJ
02FJ	40 19 36.36794	-122 16 48.62611	-0.073	HPGN D CA 02 FJ
02GH	40 30 04.45170	-122 22 34.14721	-0.097	HPGN D CA 02 GH
02JH	40 39 42.34403	-122 21 24.42911	-0.081	HPGN D CA 02 JH
02JK	40 41 20.86922	-122 07 26.10097	-0.067	HPGN D CA 02 JK
03AA	38 36 52.10500	-121 30 52.07644	-0.119	HPGN D CA 03 AA
03BG	38 30 20.00995	-121 34 55.09363	-0.151	HPGN D CA 03 BG
03DG	38 38 27.43871	-121 45 39.59772	-1.081	HPGN D CA 03 DG
03EH	38 51 59.61388	-121 32 32.95866	-0.106	HPGN D CA 03 EH
03FH	39 02 32.12158	-121 28 33.65961	-0.063	HPGN D CA 03 FH
03HJ	39 13 28.63373	-121 26 07.89645	-0.090	HPGN D CA 03 HJ
120P	38 49 43.37051	-121 11 25.70317	0.091	P 1200
121B	39 23 07.67821	-121 32 43.05896	0.001	121 BB USGS
271F	39 50 02.09813	-122 05 06.37738	-0.014	FWS 271
2CK1	39 59 08.54832	-122 04 55.26451	0.001	99 TEH 9.22
2DK4	40 06 26.67915	-122 06 34.30664	0.016	99 TEH 17.88
2EK3	40 09 54.04229	-122 09 16.26597	-0.021	99 TEH 22.63
2EK4	40 14 55.50552	-122 08 57.52221	-0.022	36 TEH 48.89
2HJ2	40 33 28.91645	-122 14 22.18029	-0.092	44 SHA 6.94
2HK3	40 31 00.04768	-122 05 41.25218	-0.023	44 SHA 15.59
55BB	39 34 51.75177	-121 37 10.10251	0.070	2655 BB

7MIL	39 38 10.70086	-121 54 35.88676	-0.020	7 MILE
A107	39 35 08.29767	-122 24 17.70413	-0.070	A 1079
ABUT	38 38 05.70806	-121 57 06.70412	-0.604	ABUT
ADOB	39 23 26.70034	-121 57 00.54639	-0.033	ADOBE
AGUI	39 43 33.88344	-122 14 26.10120	-0.444	AGUIAR
ALGO	39 01 34.25609	-121 32 52.74429	-0.128	ALGONDON
ALHA	38 33 31.09911	-121 42 26.68991	-0.495	ALHAMBRA
ANDR	38 23 12.17817	-121 38 18.72218	-0.120	ANDREW
ARTO	39 37 27.53430	-122 12 17.01222	-0.589	ARTOIS
ASHH	40 25 01.37465	-122 11 46.07066	-0.117	ASH
B107	39 36 40.90399	-122 31 42.87306	-0.117	B 1079
B109	39 32 16.89132	-121 54 29.95102	-0.056	BC 1090
B130	39 50 25.86208	-121 59 50.95987	0.026	BC 1305
B144	38 58 51.60386	-121 22 38.16061	-0.056	B 1446
B428	39 39 10.19358	-121 51 41.88938	-0.033	BC 428
B635	39 52 56.09953	-121 55 09.50364	0.022	BC 635
B728	39 49 19.23517	-121 51 47.29794	0.002	BC 728
B743	39 21 45.99884	-121 45 12.07658	-0.036	BC 743
B849	38 32 01.29302	-121 58 15.18500	-0.226	B 849
BEAR	38 58 25.68355	-121 29 15.58212	-0.096	BEAR
BEND	39 37 47.54948	-121 59 53.81418	-0.047	ORDBEND
BIGB	39 27 51.24644	-121 52 13.93680	0.054	BIG BUTTE
BIGW	39 40 21.14716	-122 20 10.15790	-0.079	BIG W
BIRD	38 50 54.73696	-122 02 37.47800	-0.121	BIRD
BLAI	39 07 45.76995	-121 27 19.47241	-0.091	BLAIR
BLOC	39 19 08.21655	-121 43 29.67814	-0.065	BLOCK
BNBR	40 15 47.33630	-122 13 16.55246	-0.053	BEND BRIDGE
BOGE	39 05 54.18224	-121 44 43.12530	-0.227	BOGUE
BOWM	40 22 08.87224	-122 16 55.59009	-0.129	BOWMAN
BRAD	38 33 42.05715	-121 20 53.68273	-0.094	BRADSHAW
BREW	38 45 23.02115	-121 27 04.05356	-0.094	BREWER
BRHM	39 57 25.74497	-122 12 10.79866	-0.020	BARHAM
BRID	38 42 41.39741	-122 02 50.18491	-0.111	BRIDGE
BURO	38 37 22.92193	-121 13 52.96988	-0.080	BUREAU
BUTG	39 49 05.64042	-122 19 32.23341	-0.037	BUTTE GAGE
BUZZ	39 25 52.64256	-121 33 10.73535	0.038	BUZ
C200	39 24 22.66481	-122 11 32.19690	-0.084	C 200
C430	40 07 10.61731	-122 11 50.06925	-0.072	C 1430
C434	39 40 57.28699	-121 45 52.54818	-0.018	C 1434
CALD	38 27 33.51387	-121 39 24.21540	-0.129	CALDWELL
CANA	38 37 02.05610	-121 51 30.11758	-0.436	CANAL AI5054

CANL	39 08 28.88981	-121 41 54.56938	-0.139	CANAL KS1836
CAPA	39 46 56.79115	-122 06 14.48559	-0.060	CAPAY
CAST	38 33 50.77665	-121 38 37.80523	-0.119	CASTRO AZ MK RESET
CHER	39 40 05.35080	-122 15 11.41771	-0.266	CHEROKEE
CHUR	38 39 48.00698	-121 48 09.05972	-0.334	CHURCH
CODY	38 47 30.59910	-121 46 29.02194	-1.049	CODY
COLI	39 11 06.44950	-121 59 40.52447	-0.200	COLIND
COLM	38 52 51.57383	-121 15 59.68957	-0.104	CITY OF LINC MON 109
CONA	38 37 05.49590	-121 38 40.43050	-0.123	CONAWAY
COON	38 56 33.44240	-121 21 13.73614	-0.008	COON
CORN	39 55 22.12420	-122 21 10.25652	0.015	CORNBUTTE
COTT	38 38 20.24654	-122 02 08.12336	0.052	COTTON
COUR	38 20 24.76001	-121 33 40.05319	-0.230	COURTLAND
COY1	38 35 28.05256	-121 41 31.83645	-0.475	COY DUMP
CRCO	39 25 14.34566	-121 49 38.66101	-0.040	CARRICO
CREE	39 43 53.37497	-122 24 47.93597	-0.046	CREEK
CRES	38 39 02.32925	-121 30 26.67590	-0.088	CAPITOL RESERVOIR
CRST	39 27 29.40210	-121 34 37.33912	0.028	CREST RM 2
CSUS	38 33 14.57195	-121 25 23.72489	-0.105	HPGN D CA CSUS
CVAP	38 50 19.76530	-121 50 39.17763	-0.810	CVAP 02
D14R	39 29 37.19895	-121 39 36.31648	-0.007	D 146 RESET
D850	39 08 33.63125	-122 13 02.10462	-0.172	D 850 RESET 1971
DAVE	38 31 59.46614	-121 47 14.17833	-0.325	DAVEPORT
DELE	39 16 30.61577	-122 06 18.73989	-0.118	DELEVAN
DHAM	39 38 42.83605	-121 47 56.98190	-0.008	DURHAM
DLP2	39 11 28.05229	-122 10 16.52852	-0.142	DELPHOS RM 2
DODG	39 22 38.58760	-122 01 14.53249	0.011	DODGE
DOUG	38 33 39.66443	-121 14 40.07544	-0.086	DOUGLAS
DOWD	38 52 12.97794	-121 22 37.59339	-0.073	DOWD
DRAI	38 55 31.04662	-121 54 52.46326	-0.656	DRAIN
DUFO	38 45 48.09758	-121 50 39.06980	-0.907	DUFOUR
EAGR	39 10 30.16195	-121 38 05.30991	-0.109	EAGER
EATO	39 46 35.87075	-121 50 38.46180	0.040	EATON
EGRN	40 21 37.05238	-122 19 51.32354	-0.103	EVERGREEN
ELKH	38 40 54.09781	-121 29 03.49658	-0.118	ELKHORN
ENNS	39 05 04.16171	-121 48 01.24256	-0.231	ENNIS
EUCA	39 53 34.68604	-122 18 13.65574	-0.031	EUCALYPTUS
EX11	38 38 46.41083	-121 40 03.02693	-1.052	EX 1
EXCL	38 30 54.64180	-121 17 03.89418	-0.178	EXCELSIOR
EXT1	39 37 46.82661	-122 06 07.91037	-0.152	EXT1
F114	39 09 25.19376	-121 46 36.67526	-0.188	F 114

F200	39 19 09.12298	-122 11 29.55051	-0.083	F 200
F853	39 27 52.11254	-121 47 57.49852	-0.030	F 853
F859	38 47 34.20221	-121 43 36.01912	-0.913	F 859 RESET
FAIO	38 40 43.39475	-121 15 47.08830	-0.041	FAIR
FARM	39 47 48.63828	-121 59 14.55179	-0.023	FARMLAND
FARR	39 23 30.67958	-121 46 54.96082	-0.045	FARRIS
FENN	39 36 34.94804	-121 51 26.37613	-0.016	FENN
FERR	38 40 32.00848	-121 37 49.18232	-0.207	FERRY
FIDY	38 47 44.65788	-121 21 31.46217	-0.052	NEWFIDDY
FINK	39 15 29.80425	-122 11 29.32285	-0.094	FINKS
FLEE	39 19 19.51428	-121 48 45.29233	-0.015	FAIRLEE
FLOR	40 05 02.95397	-122 13 08.47394	-0.095	FLORES
FORD	38 43 33.23689	-121 43 47.39391	-0.668	FORD RM 2
FREM	38 45 52.89499	-121 38 08.00736	-0.204	FREMONT
FREN	39 34 56.74098	-122 14 58.85488	-0.194	FRENCH
FREX	39 39 55.81754	-121 55 31.30193	-0.040	FARWELL
G117	39 17 12.36614	-121 47 04.01869	-0.046	G 1175
G120	38 47 09.87507	-121 14 32.09716	0.000	G 1200
G142	40 34 56.64305	-122 25 57.29320	-0.011	G 1429
G143	40 02 29.98167	-122 08 34.41325	-0.027	G 1430
G434	39 39 22.25673	-121 43 54.05926	0.027	G 1434
GAFF	38 24 25.68519	-121 34 56.13811	-0.193	GAFFNEY
GARF	38 37 54.87928	-121 20 13.16472	-0.089	GARFIELD
GIBS	38 42 19.17563	-121 25 46.48242	-0.088	GIBSON
GLEN	39 31 17.92813	-122 00 53.29298	-0.111	GLENN
GORD	39 24 34.42661	-122 00 35.87886	-0.092	GORDON
GORR	39 36 09.58714	-121 47 05.11298	0.016	GORRILL
GRAY	39 21 44.26672	-121 49 27.53604	0.008	GRAY
GRBK	38 41 31.13614	-121 20 47.91838	-0.012	GREENBACK
GRNO	39 03 24.21931	-121 58 08.69127	-0.603	GRAINO
GW17	38 46 52.25991	-122 02 38.10877	-0.218	GWM 17
GW32	38 44 21.97313	-122 09 59.02870	-0.153	GWM 32
H285	39 33 07.29911	-122 21 26.02222	-0.049	H 285 USGS
H380	39 00 49.80193	-121 25 46.20418	-0.085	H 380
H62U	39 07 14.13848	-122 17 27.38962	-0.081	H 62
HAHN	39 04 50.45360	-122 05 54.15159	-1.692	HAHN
HALL	39 10 28.68832	-121 32 57.31597	-0.102	HALLWOOD
HAMI	39 44 39.73466	-122 01 14.04402	-0.074	HAMILTON
HARB	39 14 50.41718	-122 01 52.59714	-0.181	HARBISON
HARR	39 25 15.84127	-121 45 47.49633	-0.012	HARRIS
HERS	38 52 28.84909	-121 54 51.96639	-0.365	HERSHEY

HESS	40 12 10.19826	-122 14 38.93611	-0.074	HESS
HMBT	39 44 56.68116	-121 45 44.95410	0.004	HUMBOLT ROAD
HONC	39 19 30.36058	-121 33 25.38614	-0.025	HONCUT
HOWA	39 25 12.40945	-121 53 52.38446	-0.053	HOWARD
HOWE	38 36 47.57477	-121 25 57.72002	-0.092	HOWE
HPIN	39 05 02.23246	-121 41 22.49100	-0.185	HOPPIN
HPKN	39 13 03.73219	-122 05 19.78451	-0.164	HOPKINS
INDU	38 47 22.39967	-121 18 30.17528	0.016	INDUSTRIAL
J143	39 36 58.45551	-121 40 55.09816	0.176	J 1434
J847	39 32 26.40350	-121 41 19.92260	-0.046	J 847
JACI	39 34 56.70124	-122 00 36.01176	-0.050	JACINTO
JELL	40 19 10.76990	-122 11 18.93506	-0.084	JELLYS
JOHN	39 29 34.87206	-121 48 03.91638	-0.008	JOHNSON
JRM4	38 55 39.86301	-121 50 35.87584	-0.920	JIMENO RM 4
K276	39 51 20.08360	-122 21 17.65317	-0.023	K 276
K435	39 07 48.26172	-121 36 10.80926	-0.131	K 1435
K852	39 41 48.97337	-122 11 42.87273	-0.455	K 852
KAIS	39 42 33.01150	-122 02 14.80490	-0.063	KAISER
KEAT	38 42 33.52452	-121 53 11.08433	-0.380	KEATON
L143	39 53 58.26074	-121 59 43.71714	0.033	L 1430
L191	39 34 55.29570	-122 07 20.25672	-0.146	L191
LARK	39 29 33.92962	-122 05 15.35311	-0.106	LARKINS
LAUX	39 14 43.76124	-121 57 31.83708	-0.100	LAUX
LBRL	39 52 54.51303	-122 13 40.87823	-0.016	LIBERAL
LIBR	38 40 44.18607	-121 46 28.10236	-0.777	LIBRARY
LOAK	39 17 32.29397	-121 40 03.10997	-0.078	LIVE OAK
LOMO	39 13 16.45060	-121 38 30.20256	-0.089	LOMO
LONE	39 10 37.25553	-122 04 42.66480	-0.284	LONESTAR
LROY	38 34 59.56034	-121 11 09.85571	-0.028	LEROY
LUSA	38 58 14.53878	-122 01 33.18195	-0.358	LUSA RM 2
M107	39 28 11.23448	-122 11 34.20352	-0.097	M 1078
M185	40 13 26.68599	-122 20 15.38537	-0.089	M 185
MCCL	40 00 03.40639	-122 17 54.82304	-0.036	MCCLURE
MERI	39 45 11.55704	-121 56 18.44913	-0.074	MERIDIAN
MICH	39 54 23.62219	-122 06 51.25847	-0.005	MICHIGAN
MINO	39 27 51.90718	-122 08 11.90330	-0.067	MINOR
MOOR	38 52 05.63457	-121 27 06.12051	-0.105	MOORE
MORE	39 43 01.15264	-121 51 47.73302	-0.083	MOREHEAD
MRSN	39 13 53.91179	-121 42 20.39927	-0.112	MORRISON
N852	39 48 34.53046	-122 10 21.16414	-0.117	N 852
NELS	39 33 32.16917	-121 46 02.48688	-0.003	NELSON

NLD6	39 06 51.82343	-122 01 05.76961	-0.488	NLD 126
NLD7	39 21 43.64417	-121 52 04.89131	-0.013	NLD 127
NLD8	39 33 05.70989	-121 50 25.56267	-0.005	NLD 128
NORD	39 47 52.36582	-121 54 12.94550	-0.019	NORD
NORM	39 24 27.02222	-122 08 10.64987	-0.165	NORMAN RM 1
OKSL	40 22 19.00059	-122 09 39.72897	-0.120	OAK SLOUGH
ORLA	39 46 06.53462	-122 11 32.38478	-0.147	ORLAND SOUTH BASE
ORVB	39 33 16.64409	-121 30 00.99384	0.020	OROVILLE DAM GRM
OSTR	39 04 32.48480	-121 23 47.56973	-0.041	OSTROM
OSWD	39 04 08.45087	-121 38 35.20804	-0.148	OSWALD
OWEN	39 27 56.35589	-122 14 56.20739	-0.094	OWENS
P143	39 50 25.16278	-121 56 26.97801	0.041	P 1430
P208	39 06 33.47268	-122 18 13.87415	-0.113	P208
P265	38 31 48.65374	-121 57 15.04705	-0.263	P265
P267	38 22 49.19327	-121 49 23.59067	-0.282	DIXONAVIATCN2005 GRP
P268	38 28 24.67978	-121 38 47.02681	-0.125	FINCHFARMSCN2005 GRP
P270	39 14 37.55614	-122 03 18.70996	-0.258	HOPKINSLGHCN2005
P271	38 39 26.44614	-121 42 52.32300	-0.431	WOODLAND1_CN2004 GRP
P272	39 08 43.72026	-121 56 34.97076	-0.129	P272
P30W	39 39 09.86008	-122 09 04.27114	-0.224	P30W
P344	39 55 44.82920	-122 01 40.64284	-0.032	VINAHELITKCN2006 GRP
P345	40 16 16.42993	-122 16 14.84758	-0.049	HOOKERDOMECN2005 GRP
PALA	38 33 38.01494	-121 32 19.52261	-0.128	PALA
PARK	39 32 03.17236	-121 35 08.27986	0.030	PARK
PASS	39 11 12.89064	-121 52 39.51125	-0.220	PASSBUTTE
PELG	38 57 10.44580	-121 45 11.56267	-0.168	PELGER
PEN2	39 38 50.12755	-121 37 52.46715	0.004	PENTZ RM 2
PETE	39 41 44.95431	-122 06 10.75254	-0.155	PETER
PHLP	38 48 08.88420	-121 25 08.97910	-0.053	PHILLIP
PLAI	38 35 05.49911	-121 48 11.62330	-0.367	PLAINFIELD
PMPR	39 47 03.48797	-122 02 45.63131	-0.077	PUMP RESET
PROV	39 31 18.60693	-122 05 18.95541	-0.180	PROVIDENT
PTNM	39 19 54.55238	-121 57 16.32585	-0.062	PUTNAM
PWRL	39 05 53.12684	-121 32 45.09647	-0.160	POWER LINE
Q106	39 55 50.45225	-122 17 19.39254	-0.035	Q 1065
Q107	39 31 27.18416	-122 14 14.24917	-0.187	Q 1078
R208	38 39 18.54363	-121 23 14.17953	-0.187	CONTROL MONUMENT LR 208
R276	39 16 59.75551	-121 28 28.71311	-0.015	R276
RAMZ	39 15 52.80382	-121 34 32.91113	-0.079	RAMIREZ
RAWS	40 01 44.82989	-122 13 30.24357	-0.060	RAWSON
RBNK	40 07 43.98752	-122 16 16.23696	-0.064	REDBANK

REGO	38 45 05.19081	-121 29 05.75197	-0.177	RIEGO RM 4
RIVE	38 38 50.46233	-121 34 20.06447	-0.184	RIVER
ROSO	38 57 41.12263	-121 32 35.74876	-0.085	RIO OSO
RUSS	38 32 38.06691	-121 52 33.83961	-0.209	RUSSELL RANCH 2
RWF1	38 35 10.00001	-121 45 05.10254	-0.400	RWF1
S106	39 43 11.19917	-122 32 58.14288	-0.029	S 1067
S214	39 12 51.33924	-121 29 39.08934	-0.068	S 214
S381	39 22 57.18253	-121 36 05.92597	-0.015	S 381
S853	39 24 18.45481	-121 42 35.21934	-0.025	S 853
SAWT	38 57 08.19851	-121 38 05.25899	-0.098	SAWTELLE
SCLE	40 12 45.99522	-122 10 47.96284	-0.016	SCALE
SECO	39 01 43.79941	-122 03 50.15192	-2.143	SECO
SHEL	38 29 36.45481	-121 12 38.99171	-0.099	SHELDON
SHEP	39 31 21.89548	-121 45 14.73264	0.006	SHEPPARD
SM15	38 43 51.60561	-121 37 59.39391	-0.104	SM NO 15
SNKY	38 48 00.00896	-121 32 38.49240	-0.128	SANKEY
SR65	39 18 55.05166	-122 02 02.41282	-0.165	SR 65
SRGS	39 50 13.21292	-122 11 51.22413	-0.082	SOUR GRASS
STEG	39 20 29.35392	-122 05 03.27414	-0.108	STEGEMAN
SURV	38 27 08.54514	-121 44 56.17415	-0.407	SURVEYOR
SUTB	39 12 20.99590	-121 49 14.10315	-0.014	SUTTER BUTTES CORS POINT
SUTX	38 49 24.26976	-121 32 34.91383	-0.134	SUTEXTN
SYCA	38 50 19.12449	-121 45 06.39099	-0.236	SYCAMORE
T143	38 54 48.09360	-121 19 08.98950	0.017	T 1435
T462	38 26 25.99276	-121 30 17.76416	-0.167	T 462
T644	39 07 54.60446	-122 07 55.53110	-0.305	T 644
T849	38 47 24.93437	-121 54 56.34591	-0.318	T 849
TALL	39 35 18.57012	-121 41 18.48668	0.113	TALLOW
TARK	39 08 35.48327	-121 50 33.52742	-0.334	TARKE
TRBR	38 54 26.11180	-121 30 16.30656	-0.086	TROWBRIDGE
TSDL	39 01 17.19989	-121 44 28.51168	-0.196	TISDALE
TWSP	39 20 39.15175	-121 41 14.03761	-0.030	TOWNSHIP
TYND	38 52 26.17842	-121 49 03.81328	-0.501	TYNDALL
U107	39 31 51.03564	-122 19 34.37147	-0.016	U 1078
U345	40 26 17.61362	-122 17 00.50606	-0.132	U 345
UCD1	38 32 10.44918	-121 45 04.37936	-0.558	UCD1 GEODETIC REF MK
V380	39 46 56.35924	-122 17 41.94348	-0.264	V 380 RESET 1967
V853	39 27 52.90377	-121 43 54.95275	-0.031	V 853
VARN	38 53 09.54121	-121 42 06.92253	-0.118	VARNEY
VINC	38 48 08.12088	-121 59 00.32326	-0.200	VINCOR
VIOL	39 45 58.92989	-122 04 39.34848	-0.087	VIOLICH

VNON	38 50 11.64870	-121 37 00.84434	-0.105	VERNON
W215	39 47 44.85242	-122 32 47.50320	-0.143	W 215 AZ MK
W850	39 22 39.76584	-122 14 52.83333	-0.138	W 850
WALE	38 45 05.63004	-121 21 54.75058	-0.054	BASEWALE
WALK	39 31 27.11587	-122 09 53.88080	-0.170	WALKER
WASH	39 00 10.76062	-121 40 17.31543	-0.137	WASHINGTON
WAYN	38 59 37.07181	-121 57 29.53946	-1.006	WAYNE
WBND	39 02 30.73423	-121 50 12.69748	-0.217	WILSON BEND
WHEA	39 04 35.82764	-121 53 39.35614	-0.365	WHEAT
WILD	39 42 45.69824	-121 57 52.89683	-0.122	WILDLIFE
WILK	38 59 26.08013	-121 52 01.52546	-0.169	WILKENS
WILL	39 26 09.36329	-122 04 34.02839	-0.095	WILLOW
WILN	39 34 15.04128	-122 11 37.65205	-0.257	WILSON
WILS	38 29 41.85229	-121 41 31.51629	-0.260	WILSON
WINS	39 39 48.63648	-122 31 33.45902	-0.029	WINSLOW
WISE	38 55 34.68214	-121 24 18.47150	-0.074	WISE
WLMS	39 30 34.22274	-121 51 27.13135	-0.022	WILLIAMS
WLOW	40 03 18.10460	-122 17 00.85803	-0.054	WILLOW
WOOD	38 40 17.76321	-121 52 20.38261	-0.332	WOODPORT
WR18	39 15 10.74753	-121 53 30.00190	-0.082	DWR18
X200	38 54 20.73299	-121 58 59.79249	-0.290	X 200 RESET
Y380	39 45 45.77974	-122 20 14.55455	-0.013	Y 380
Y852	39 27 25.84590	-122 01 03.38339	-0.123	Y 852
YCAP	38 34 20.34610	-121 51 18.37479	-0.217	YOLO COUNTY AIRPORT BASELINE POINT 6
ZAMX	38 46 45.78648	-121 48 44.63159	-1.082	ZAMX
ZINF	38 35 23.60764	-121 17 18.80311	-0.124	ZINFANDEL