

WATER WELL LEVELS MEASUREMENT PROCEDURE

~~April 19, 2012~~

April 20, 2016

The following procedure is utilized for measuring water well levels in Lake County. The Lake County Watershed Protection District (District) measures water levels in 85 wells on a semi-annual basis (April and October) in 7 separate groundwater basins in Lake County and 14 wells on a monthly basis in Big Valley (a subset of the 85 wells). The semi-annual wells have been monitored since the early 1960's (in most cases) in cooperation with the California Department of Water Resources (CaDWR). Some wells were previously monitored by CaDWR, while some wells have been added at a later date to supplement and/or replace previously measured wells.

Field data for the wells is kept in three binders, two black binders for the semiannual wells and a white binder for the monthly wells. When conducting the semi-annual measurements, the data for the 14 monthly wells are recorded in the black binders. The binders contain a map of the well locations by groundwater basin and well data sheets in the order of which the wells are to be read. With the semiannual measurements, order of groundwater basins measured may be varied as schedules require.

Well Data sheet¹: The Well Data sheet contains information on each individual well, including owner's name, property address, well number, well location including latitude and longitude, elevations, reference point description, information on the well (much of this data is out of date), location maps and photographs to assist in locating the well and reference point.

Field Well Data Sheet²: The Field Well Data Sheet is where actual well water level measurements are recorded. At the top of the sheet are the well numbers, the reference point (RP) elevation, and the average spring and fall water level measurements. Also at the top are the no measurement (NM) and questionable measurement (QM) codes. Data is recorded in the space below. Also record whether the well was measured with an electronic sounder (ES) or a steel tape (ST) (There is currently no field, so note in comments).

Measurement Procedure: The District utilizes two methods for determining the water level, steel tape or electronic tape.

Steel Tape: Measurements are taken in accordance with USGS Office of Ground Water, Stand Alone Procedure Document, Water Level Measurement Using Graduated Steel Tape, No. GWPD 1³.

- The tape is wiped clean and dry with a clean cloth.

¹ Well Data sheets and Location Exhibits are stored in the Access database located at w:\flood\welldata\well data.mdb.

² Field Well Data Sheets are stored as w:\flood\welldata\fieldshts\field sheet master.xls

³ This document is stored as w:\flood\welldata\USGS_GWL Using an Steel Tape.pdf

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- The date of the well measurement is recorded. Records are recorded in pencil.
- The tape is lowered into the well casing through a hole or slot, depending on the well, to a depth which is slightly deeper than the groundwater level (the previous month's reading and/or the average seasonal groundwater level help estimating this depth). This distance is recorded as the *Tape Reading at RP*.
- The tape is carefully drawn back out of the well and the wetted length of the tape is recorded. This measurement is recorded as the *Tape Reading at WS* (WS: water surface).
- The difference between these two readings is recorded as the *RP to WS*.
- The groundwater level, *Elev of WS*, is the RP elevation minus the *RP to WS*. This data is not required to be recorded on the Field Well Data Sheet, as the database automatically calculates the water surface elevation.
- The observer notes his/her initials in the remarks field.
- If conditions warrant, the QM and NM codes should be denoted and comments added as necessary.
- The tape is wiped clean and dry with a clean cloth.

Electronic Tape: Measurements are taken in accordance with USGS Office of Ground Water, Stand Alone Procedure Document, Water Level Measurement Using an Electric Tape, No. GWPD 4⁴.

- Before leaving the office, verify the electric tape is working properly by dipping in water to ensuring the red light and audible beep are triggered. Replace the battery as necessary.
- The tape is wiped clean and dry with a clean cloth.
- The date of the well measurement is recorded. Records are recorded in pencil.
- The tape is lowered into the well casing through a hole or slot, depending on the well, gradually until the device signals water is reached (both a red light and audible "beep"). The depth is read off the electric tape. This distance is recorded as the *RP to WS*.
- The groundwater level, *Elev of WS*, is the RP elevation minus the *RP to WS*. This data is not required to be recorded on the Field Well Data Sheet, as the database automatically calculates the water surface elevation.
- The observer notes his/her initials in the remarks field.
- If conditions warrant, the QM and NM codes should be denoted and comments added as necessary.
- The tape is wiped clean and dry with a clean cloth.
- Spare water sensors are maintained and may be used to replace the water sensor on the tape. Care must be taken to ensure the length of the tape is unchanged.

Data Entry⁵: Well water levels are maintained in a Microsoft Access database. The file location is w:\flood\welldata\well data.mdb. When the database is opened, the main switchboard is opened. From this switchboard, there are five options.

⁴ This document is stored as w:\flood\welldata\USGS_GWL Using an Electric Tape.pdf.

Data Entry:

- Press the button and you are given the option of entering monthly or semi-annual well measurements.
- Select the appropriate option, and permit the appending of records. Blank records with the well numbers and RP elevations are appended to the existing data table (Wellinfo), and the database backs up to near the first record⁶.
- At the first blank record, begin entering the data in the order following groundwater basin order: Scotts Valley, Upper Lake Valley, Big Valley 1, Big Valley 2, Collayomi Valley, Coyote Valley, Burns Valley and High Valley. Wells in the database are in the same order as the notebooks. Data entered are: *Sample Date*, *Measurement (ft) (RP to WS)*, *Measurement Code*⁷, *QM Code*, *NM Code*, *Measurement Method* and *Comments*. The database automatically calculates the *Water Level*.
- Go to the next record and repeat until completed. All data should be entered in one data entry session. If you must leave a session, reenter by opening the form "Data Entry" and proceeding to the first blank record. If you enter through the Main Switchboard, a new set of blank records is added, resulting in multiple blank records when the data entry is complete.

Individual Well Data (Tabular): This displays all the data for wells in a tabular form. Both active and inactive wells are included. Using the "Find" button, you can display data for any well in the database.

Individual Well Data (Charts): This displays all the data for wells in a hydrograph format (chart). Both active and inactive wells are included. Using the "Find" button, you can display data for any well in the database. A recently observed glitch in the database does not allow the dates to be displayed on the hydrographs (the X-axis is not labeled).

Seasonal Average Water Levels: This displays the average water level for each well in a tabular form. Averages are displayed for each month that at least one data point exists. Both active and inactive wells are included. Using the "Find" button, you can display data for any well in the database.

Reports: This creates a report of water levels for the selected groundwater basin in a format for submittal to CaDWR. Printed reports are no longer submitted to CaDWR, and an Excel spreadsheet created from the *Query Export to DWR* is submitted directly to CaDWR for importation to their database. In the Design View of the query, the desired

⁵ All data kept in the database utilizes the 1929 NGVD vertical datum. CASGEM wells are required to be reported in 1988 NAVD. Elevations are converted in queries by adding 2.9 feet to the NGVD elevation.

⁶ The database was created in an earlier version of Access and the upgrade did not work 100%, leaving us unable to modify the number of records, the database "goes back" to find the first blank record.

⁷ Measurement Codes indicate the month and year for which the measurement was taken. The format myy is utilized, except for the spring and fall measurements, in which "S" and "F" are used to substitute for the month. For instance, a year of codes is represented as: 111, 211, 311, S11, 511, 611, 711, 811, 911, F11, 1111, 1211. This format must be used for the database queries to properly function.

measurement season is entered in the Criteria line in the field *MSMTCODE*. The current recipient of the email is April Scholzen (april@water.ca.gov).

CASGEM Submittals: In 2009, the State established the California Statewide Groundwater Elevation Monitoring System (CASGEM) which required monitoring entities submit groundwater data to CaDWR for all groundwater basins identified in Bulletin 118, California's Groundwater. The District submitted a monitoring plan and was approved as the monitoring entity for Scotts Valley, Upper Lake Valley, High Valley, Burns Valley, Coyote Valley, Collayomi Valley and Big Valley. The query *CASGEM Export* is used to export the data to a spreadsheet, where it is copied into the *CASGEM Elevation Data Template 12022011.xls*, which is batch uploaded to the CASGEM website. In the Design View of the query, the desired measurement season is entered in the Criteria line in the field *MSMTCODE*.

A few items when pasting in the data to the template:

- Do not copy the calculated fields (GSE and GS to WS), as these fields are locked.
- When numbers are exported from Access to Excel, sometimes the exact number is changed, say from 3.2 to 3.1999997. You may have to type in the correct number, 3.2.
- If you have No Measurement (NM) codes, be sure to delete the Measurement Accuracy (MA) entry for that well.

Upload the file, log to the CASGEM website

(<http://www.water.ca.gov/groundwater/casgem/>) as a Monitoring Entity (link on page). The log-in is currently tom.smythe@lakecountycal.gov and the password is H2oh2oh2o. The "Administrator" will have to be changed to the appropriate personnel and my name deleted and a new login created. The file is uploaded by clicking on "Groundwater Measurements" under the "Manage Wells" tab.

Other Functions: Additional queries have been created for specific purposes, such as "Export Data: Specific Well". This is frequently used to export data to Excel for additional analysis or preparation of presentation quality hydrographs.

Datum Establishment: For groundwater data to be meaningful, the elevation of the reference point needs to be determined. Most of the wells have been measured since the early to mid-1960's. Information, including elevations, was provided by CaDWR when the District took on the responsibility of monitoring the wells. The source of these elevations is likely to be interpretation from USGS topographic maps⁸.

The District has added two wells to the well network in the past 20 years. Elevations were surveyed in using standard survey practices with a level loop from a point of known elevation. Level loops from known elevations, or the use of survey grade GPS, will be utilized for elevation determinations for new wells. As an alternative, the FEMA provided Lidar from 2016 may be used to establish a ground elevation at the well site.

⁸ Ehorn, Bill, CaDWR, email dated July 13, 2011

All data kept in the database utilizes the 1929 NGVD vertical datum. CASGEM wells are required to be reported in 1988 NAVD. For CASGEM, elevations are converted in queries by adding 2.9 feet to the NGVD elevation.

Website: The Lake County website has hydrographs and maps under the Groundwater Data page.

Hydrographs are generated for the monitored wells. Hydrographs are stored in Excel spreadsheets in w:\flood\welldata\hydrographs. Update the spreadsheets by copying and pasting information from the Access database. I use the following procedure:

- Open the Excel spreadsheet for the hydrograph to be updated.
- Open the *Well Data.mdb* database. Open the Query *Export Data: Specific Well* in design view. Delete the entry in Criteria under *StateNo* so all well data is shown.
- Search for the well you wish to update (for ease, copy the *StateNo* from the spreadsheet into the Find box).
- With the *StateNo* of the desired well highlighted, use the Records-Filter-Filter by Selection feature to show the data for only the desired well. The data should be in chronological order.
- Using the arrows in the bottom of the Query window, go to the last record. Highlight the record(s) to bring the file up to date and copy, then paste into the spreadsheet.
- Delete the header row and make sure the chart is showing the new data (you may have to extend the chart's data range or scale).
- Save the chart as a PDF file in a subfolder for the appropriate season (create if necessary).
- Do this for all wells, then send all hydrographs to a "zip" file for uploading to the website. Name the file something like *Hydrographs S16.zip*.
- Open the web editor in the browser⁹ and log-in.
- Open the Digital Assets Manager under the System tab.
- Using the Manage Folders button, create a subfolder with a name like *Hydrographs S16* under Water Resources –Groundwater Management.
- Use the Add Multiple Assets button and upload the zip file to the folder *Water Resources –Groundwater Management-Hydrographs S16*. Click Add then click Save.
- Verify the files are in the appropriate folder.
- When the files have been uploaded, go to the *Well Hydrographs* page, and in the edit mode, select the folder with the current digital assets, *Hydrographs S16*.
- If this is correct, you can delete the old hydrographs and folder using the following procedure. Open Digital Assets Manager, select Manage Folders, select the parent folder of the folder to delete, i.e. *Water Resources – Groundwater Management*. Check the delete box for the folder to be deleted, i.e. *Hydrographs F15*. Click Save.

⁹ I am currently using an old version of Firefox as the web editing software is not compatible with newer versions of Microsoft Outlook.

Groundwater Basin Maps: Groundwater levels are presented on maps of the groundwater basin, showing the Average Spring water level, Average Fall water level and the particular season's water level. Use the following procedure to generate the maps:

- In the *Welldata.mdb* Access database, after all data has been input, open the Query *Compare to Average*.
- Select the season of concern by opening Design View, then changing the *MSMTCODE* criteria to the desired season, i.e. S16.
- Reopen the Datasheet View and confirm the Query is functioning properly. Save the Query, then export (File-Export) it to an Excel spreadsheet in the GIS folder c:\GIS\Projects\Groundwater and Save it as *Compare to Average S16*.
- Open the GIS project c:\GIS\projects\Groundwater\Seasonal Comparison SnF. Remove the Join to the shapefile *Wells Measured*.
- Update the file *Wells Measured* by adding or subtracting wells to reflect the current wells being read.
- Join *Wells Measured* to the spreadsheet , i.e. *Compare to Average S16*, using the fields *State_ID* and *StateNo*. Confirm the join functioned properly.
- PDF maps can be generated through the Layout View. Bookmarks are established for the separate groundwater basin maps and title blocks have been created for each map. When generating the maps, make sure the appropriate groundwater basin(s) are checked on, the scale is correct, and the title block is correct. Export the maps to an appropriate folder with appropriate titles, i.e. *S16 Big Valley.pdf*.
- A summary report of the findings can be created. The reports are stored in w:\flood\welldata\hydrographs as Word documents. It is easiest to copy the previous report and edit the findings accordingly.
- Create a PDF of the summary report and upload it to the website using the Digital Assets Manager to *Water Resources-Groundwater Management*.
- When all maps are created, in file Explorer select all maps and Send To a compressed (zip) file. Name the file something like *Maps S16*.
- Using the Manage Folders button, create a subfolder with a name like *Maps S16* under *Water Resources –Groundwater Management*.
- Use the Add Multiple Assets button and upload the zip file to the folder *Water Resources –Groundwater Management-Maps S16*. Click Add then click Save.
- Verify the files are in the appropriate folder.
- Create a new Digital Asset Gallery page under *Water Resources Groundwater Management* for the particular season, i.e. *Spring 2016*. Copy the text from another page, i.e. *Fall 2015*, into the page. Update the link to the summary report by deleting the old link, then use Insert Digital Asset. Provide the appropriate link to folder containing the new maps.