Domestic Well Needs Assessment Workshop: Presentation Summaries/Abstracts

January 18th, 2019, 10:00 am-4:00 pm

Klamath Meeting Room
California EPA Building, 2nd Floor
1001 I Street, Sacramento, CA

GAMA Program Projects and Studies Regarding Domestic Well Users in California

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The State Water Resources Control Board (State Board) Groundwater Ambient Monitoring and Assessment (GAMA) Program is a statewide comprehensive groundwater quality monitoring program that also studies groundwater issues like domestic well use and extent, develops data tools to improve public knowledge of groundwater issues, and improves groundwater data availability.

Through the GAMA Shallow Aquifer Assessment Study, the State Board and US Geological Survey assesses the quality of raw drinking water quality in the aquifers used for small system and domestic supply. The study analyzes for hundreds of constituents, some at very low levels, and engages the well owners in groundwater quality in the process. The areas to study are developed from groundwater units, defined from the previously completed work on understanding the location and population of domestic well users in the state.[1]

In this study, geographic information system analysis derives an estimate of domestic well users in the state through two methods: digitizing a statistically-representative sample of well completion reports per section in California, and using 1990 US Census data. Through this work, an estimate of 789,219 to 1,580,320 people use domestic well water as their drinking water source.

The GAMA Program has collected and continues to collect large numbers of groundwater data, and has provided a website to query this data against other organizations' data, and provide the export capabilities for extended analyses. New data tools are available on the GAMA Online Tools website that allow users to learn about groundwater issues, determine their proximity to impacted wells, and assess groundwater vulnerability.

As the GAMA Program continues to grow, its support of the Human Right to Water strengthens its mission to assess groundwater throughout California, and inform the public about groundwater quality.

[1] Johnson, Tyler and Belitz, Ken, Identifying the location and population served by domestic users in California, Journal of Hydrology, V 3, March 2015

CV-SALTS Technical Approaches for Salt and Nitrate Characterization of Central Valley Groundwater

Vicki Kretsinger Grabert*, Luhdorff & Scalmanini, Consulting Engineers*

Luhdorff & Scalmanini, Consulting Engineers (LSCE), independently as well as part of other teams, has been actively involved in and completed projects for the Central Valley Salinity Coalition for the Central Valley Salinity Alternatives for Long-Term Sustainability program (CV-SALTS) since 2009. A multi-phase project was conducted to analyze water, salt, and nitrate balances for the entire Central Valley floor to provide the technical basis for the Central Valley Salt and Nitrate Management Plan (SNMP) (December 2016). These technical studies also served as resources for the development of the Amendments to the Water Quality Control Plans for the Sacramento River and San Joaquin River Basins and Tulare Lake Basin (Basin Plans) to Incorporate a Central Valley-wide Salt and Nitrate Control Program (Central Valley Regional Water Quality Control Board, 2018). During the SNMP studies, a large-scale conceptual model analysis performed on the Central Valley Floor revealed that a higher resolution analysis would be more robust and useful as a management tool for determining sources, sinks, and movement of water, salt, and nitrate. Using a higher resolution analysis instead of an aggregated analysis allows data gaps and data distribution needs within larger areas to be addressed. In 2015-2016, a higher resolution analysis (LSCE and LWA, 2016[2]) of groundwater quality conditions was conducted with respect to salt and nitrate for the Region 5 area (not solely the Valley floor). This analysis included:

- Updating the CV-SALTS groundwater quality database with linkage to the State Water Resources Control Board's Division of Drinking Water (DDW) database that includes well information (i.e., well depth and, where available, the depth of well screened intervals, as well as accurate x-y coordinate data).
- Organizing publicly available groundwater quality data (nitrate and TDS data) with respect to the groundwater system to better communicate groundwater quality conditions and trends to develop long-term salt and nitrate management strategies.
- GIS maps and tables summarizing the groundwater data (nitrate and TDS) in terms of availability for determining ambient groundwater quality, assimilative capacity, prediction of future groundwater quality based on historical observations, and trends for the Upper and Lower Zones within the Central Valley Floor.

Highlights relating to the datasets, approach for linking groundwater quality data to the Central Valley groundwater system, and valley-wide results stemming from the high-resolution analysis are discussed to provide information on existing work that may be useful to the implementation of the State Board's drinking water needs assessment. A local example is also provided for the Kings subbasin to illustrate the nitrate mapping results from the high-resolution analyses.

[2] LSCE and LWA. 2016. Updated Groundwater Quality Analysis and High Resolution Mapping for Central Valley Salt and Nitrate Management Plan

Potential Impact of Legacy Well Constructions on Water Quality in Supply Wells

R. M. Gailey*, P.G., C.HG., R.M. Gailey Consulting Hydrogeologist PC*

Contaminant migration through inactive supply wells can affect groundwater quality and the large number of wells in many basins poses a challenge for protecting groundwater from nonpoint source pollution. Approaches are needed to estimate the potential extent of impact and help focus limited resources on investigations as well as corrective measures where appropriate. This is especially true 1) for sole-source groundwater supplies in rural and disadvantaged communities and 2) given the advent of the Sustainable Groundwater Management Act. Recent advances in the availability of pertinent data make it possible to evaluate the geographic distribution of well construction details and hydrogeologic conditions in order to determine if conduit migration is likely in particular areas. Results of a survey-level analysis using this approach are presented for a geographically extensive area in the southern Central Valley of California where the Corcoran Clay acts as a regional aquitard. The number of wells that appear to act as conduits for migration of nitrate and total dissolved solids is potentially significant when estimates of contaminant fluxes are considered along with needs to control nonpoint source pollution and improve drinking water quality for rural residents. Addressing a limited number of areas where contaminant fluxes are high may achieve significant groundwater quality protection/improvement and may allow some undesirable water quality results to be avoided.

A hybrid boosted regression tree model to predict and visualize nitrate concentration throughout the Central Valley aquifer, California

Katherine M. Ransom, *Postdoctoral Researcher, UC Davis Dept. of Land, Air, and Water Resources*

Authors: Katherine M. Ransom, Bernard T. Nolan, Jonathan A. Traum, Claudia C. Faunt, Andrew M. Bell, Jo Ann M. Gronberg, David C. Wheeler, Celia Z. Rosecrans, Bryant Jurgens, Gregory E. Schwarz, Kenneth Belitz, Sandra M. Eberts, George Kourakos, Thomas Harter

We developed a hybrid machine learning model with the boosted regression tree (BRT) method to assess the risk of nitrate contamination of groundwater in the Central Valley aquifer at depths up to approximately 500 m below ground surface. The hybrid approach included as predictor variables, outputs from existing physically based models of the Central Valley. A database of 145 predictor variables representing well characteristics, historical and current field and landscape-scale nitrogen mass balances, historical and current land use, oxidation/reduction conditions, groundwater flow, climate, soil characteristics, depth to groundwater, and groundwater age were assigned to over 6,000 private supply and public supply wells measured previously for nitrate and located throughout the study area. Cross validation was performed in order to select the optimal BRT tuning parameters. The BRT method was used to rank variables on their importance to nitrate concentration in the study wells in order to decrease the number of variables in the final model. Twenty-five variables were selected for the final model for log-transformed nitrate, which was used to predict nitrate concentration in the aquifer at 17 depth zones. The most important predictor variables included two oxidation/reduction variables and two nitrogen input variables. In general, increasing probability of anoxic conditions had a corresponding decrease in nitrate concentration predictions. Conversely, increasing nitrogen inputs had an increasing relative impact on nitrate predictions. Three-dimensional visualization of predicted nitrate generally indicated a decrease in concentrations with increasing groundwater age. A bootstrapping routine was used to assess prediction uncertainty and the widths of prediction intervals were mapped at average depths of private and public supply wells. Prediction interval widths were generally greater in the alluvial fans subregion for both depths likely due to the higher variance of bootstrap samples in that region.

An Overview of Domestic Well Data in California's Central Valley: Opportunities for Informed Risk Assessment

Rich Pauloo, ***PhD Candidate in Hydrogeology at the University of California Davis***

The Online State Well Completion Report Database (OSWCR) contains nearly one million well completion reports (WCR) and counting. Well location, construction, and hydrogeologic information within the database holds the potential to inform urgent questions about California's sustainable groundwater future, but missing, incomplete, and otherwise "bad" data prevents its application towards solving these problems. After meticulously cleaning this data, this study presents what are perhaps the most up-to-date estimates of active domestic well count and distribution in the state of California, and in the Central Valley—values critical towards the aim of estimating the cost of implementing SB 623. Next, we demonstrate a case study of how this cleaned data may be used in models to predict regional-scale well failure. We show that a future extended drought of 4 years following the 2012-2016 drought results in nearly twice the amount of domestic well failures, due to already-low groundwater levels. This cleaned data, along with the scripts used to programmatically clean it, are made available online, along with an interactive spatial database query tool—already in use by researchers and consultants—which allows a user to download a clean version of the OSWCR database. This talk concludes by demonstrating the key elements within OSCWR that may be used in conjunction with existing spatial datasets of contaminant distribution and sociodemographic variables to inform the assessment of domestic well water quality contamination in California's Central Valley.

A drinking water vulnerability screening tool for domestic well communities

Clare Pace, ***MPH, PhD (UC Berkeley)***
Carolina Balazs, ***PhD (Office of Environmental Health Hazard Assessment (OEHHA))***

Industrial and agricultural activities in California have resulted in elevated levels of chemical contaminants in drinking water such as nitrate, arsenic, pesticides, and chromium. Among small, rural, and socioeconomically disadvantaged communities, degraded infrastructure and a lack of resources to treat contamination problems result in drinking water that does not meet regulatory standards for health and safety. Residents served by water systems with fewer than five service connections and those using private wells face even greater challenges, as these systems are not regulated under existing drinking water laws and little monitoring exists to evaluate contamination problems. The fact that communities with elevated concentrations of contaminants in their drinking water are largely low income and disproportionately Latino raises environmental justice concerns.

Water Equity Science Shop (WESS) of the UC Berkeley Superfund Research Program will address these water equity challenges by assessing the needs, priorities and concerns of community-based nongovernmental organizations (NGOs) working to address water quality concerns in disadvantaged communities. The overall approach of the WESS draws on community-based participatory research methods as a model that advances sustainable and socially-just strategies to improve drinking water quality by engaging community-based organizations throughout the research process– from the identification of research questions, to the implementation of study protocols, and the interpretation and dissemination of results.

In partnership with the NGO Community Water Center, the WESS is creating a Domestic Well Screening Tool that will use secondary data to locate domestic well communities, estimate their water quality, and identify populations that may be particularly vulnerable based on sociodemographic characteristics. This project aims to fill key knowledge gaps regarding drinking water quality and contribute to efforts to address challenges facing California's water supplies.

Tulare Lake Basin GIS Collaborative

Michael Hickey, ***GIS Analyst, Tulare County Information/Communication/Technology***

This talk will focus on providing the GSAs of TLB a common data set to stimulate two-way data sharing. A key component is to develop a consolidated database of well points with hyperlinks to well logs, to enable the GSAs (with much better "local knowledge") to edit the data attributes and well location, in a way that will allow all members of the TLB G Collaborative to benefit from this knowledge sharing. It is anticipated that the GSAs may have local data that they are willing to share - or knowledge of other published data that was unknown to Tulare County GIS.