Outline

- GAMA Priority Basin Project (GAMA-PBP) Design
- Status of groundwater quality in the Northern San Joaquin Basin study unit.
- Factors affecting groundwater quality
- Other GAMA-PBP work
Goals of GAMA-PBP

- Comprehensive assessment of statewide groundwater quality in primary aquifer systems.
- Focus on identifying and understanding risks to groundwater and increasing the availability of that information to the public.
- GAMA-PBP assesses groundwater quality through direct sampling of groundwater using a statistically reliable sampling approach.
- Goal is to produce three types of assessments in each study units.

1. **Status**: assessment of current quality of groundwater resource
2. **Understanding**: identification of the natural and human factors affecting groundwater quality and explanation of relations between water quality and selected explanatory factors
3. **Trends**: detection of changes in groundwater quality.
35 STUDY UNITS
Sampled from May 2004 – Dec. 2011
Over 2,500 wells sampled statewide
Northern San Joaquin Study Unit
- Study unit divided into 4 study areas

Study areas primarily based on DWR groundwater basin boundaries with the exception of the Uplands (QPC).
- Study areas were divided into equal areas cells.
- One well per cell was sampled (randomly selected).
- CDPH data was used to supplement empty cells or wells that were missing data.
Constituents sampled:

- Numerous organic compounds including volatile organic compounds (VOCs) and pesticide and pesticide degradates
- Waste-water indicators
- Nutrients and dissolved organic carbon
- Major and minor ions
- Trace elements
- Microbial constituents
- Radioactive constituents (radon, radium, gross-alpha and beta)
- Tracers of age and source
  - Tritium, carbon-14, noble gases, stable isotopes of water

*Not all constituents were sampled at all wells.
Benchmarks for evaluating groundwater quality

GAMA-PBP used benchmarks for drinking water to provide context to results.

Benchmarks included Federal and California regulatory thresholds as well as non-regulatory health-based and aesthetic-based benchmarks.

- High = greater than benchmark.
- Moderate = greater than one-tenth of benchmark for organic constituents and greater than one-half of benchmark for inorganic constituents.
Status assessment overview

Health-based benchmarks (HBB)

Any organic constituent
- High
- Moderate
- Low

Organic constituents at high concentrations:
- DBCP
- PCE
- Vinyl Chloride

Any inorganic constituent
- High
- Moderate
- Low

Inorganic constituents at high concentrations:
- Arsenic
- Boron
- Nitrate

Aesthetic benchmarks

Any inorganic constituent
- High
- Moderate
- Low

Constituents at high and moderate concentrations:
- Iron
- Manganese
- Chloride
- Sulfate
- Total dissolved solids
Fumigants by study area

DBCP at high and moderate concentrations in both study areas.
Inorganic constituents classes (HBB)

Trace Elements
- High: 13
- Moderate: 25
- Low: 62

Radioactive Constituents
- High: 2
- Moderate: 98
- Low: 89

Nitrate
- High: 2
- Moderate: 9
- Low: 89

Trace elements at high and moderate concentrations:
- Arsenic
- Boron
- Vanadium
In each study area if a constituent was detected at a high concentration it was also detected at moderate concentrations as well.
Inorganics with SMCLs by study area

Eastern San Joaquin
- High – Mn: 2
- Moderate – Mn: 6
- High – Cl, Fe, Mn, SO₄, TDS: 64
- Moderate – Cl, Fe, Mn, SO₄, TDS: 18

Cosumnes
- High – Mn: 3
- Moderate – Mn: 5

Tracy
- High – Mn: 6
- Moderate – Mn: 18
- High – Cl, Fe, Mn, SO₄, TDS: 92
- Moderate – Cl, Fe, Mn, SO₄, TDS: 18

Uplands
- High – Fe, Mn: 9
- Moderate – Fe, Mn: 9
- High – Mn: 3
- Moderate – Mn: 5

TDS
Potential explanatory factors assigned to wells.

Water quality information is compared to the explanatory factors.

- Depth
- Geology
- Ground-Water Age
- Land Use
- Lateral Position
- Redox
• DBCP concentrations were also significantly negatively correlated with depth.
Organic constituent detection frequency and groundwater age

- All organic constituent class concentrations higher in water classified as young as compared to old.
Lateral position as an explanatory factor
Arsenic versus lateral position

- Arsenic concentrations significantly negatively correlated with lateral position.
TDS versus lateral position
Other GAMA projects in the area

GAMA Trends

**Triennial trend wells**
- Sampled twice since 2005
- Upcoming GAMA-PBP report covers trends statewide.

**Decadal trend wells**
- First decadal samples collected early March, 2014
- Decadal wells include previously selected wells in the triennial network.
• High concentrations of uranium in the Central Valley are due to the mobilization of naturally-occurring uranium by downward-moving, bicarbonate-rich irrigation return flows. Elevated bicarbonate is a result of plant productivity. In the future, an increasing number of public supply wells are expected to be affected by high concentrations of uranium. [Jurgens and others, Groundwater, 2010]

• High concentrations of vanadium are associated with sediment derived from mafic, igneous source rock and alkaline conditions. [Wright and Belitz, Groundwater, 2010]

• Perchlorate can occur naturally in deep groundwater at low concentrations (0.1 to 0.5 μg/L) under a range of climatic conditions (arid to humid). Concentrations above 4.0 μg/L are unlikely to be natural. [Fram and Belitz, ES&T, 2011]

• Lateral position and depth to the water table are predictive of redox condition in the Central Eastside. San Joaquin Valley. Depth of well screen is not as predictive. [Landon and others, Hydrogeology Journal, 2011]
GAMA-PBP Shallow Aquifer Assessment - ongoing

- Northern San Francisco Bay and Monterey and Salinas area completed between 2012-2013
- Currently sampling in the Madera and Kings Basins.

- Northern San Francisco Bay (completed)
- Monterey and Salinas (completed)
- Madera and Kings GW basins (ongoing)
- Kaweah, Tule, Tulare GW basins (upcoming, Fall 2014)
In cooperation with the California State Water Resources Control Board

California GAMA Program: Ground-Water Quality Data in the Northern San Joaquin Basin Study Unit, 2005

Data Series 156

Ground-Water Ambient Monitoring and Assessment (GAMA) Program

http://ca.water.usgs.gov/gama/

In cooperation with the California State Water Resources Control Board

A product of the California Groundwater Ambient Monitoring and Assessment (GAMA) Program

Status and Understanding of Groundwater Quality in the Northern San Joaquin Basin, 2005: California GAMA Priority Basin Project

Scientific Investigations Report 2016–5175

U.S. Department of the Interior
U.S. Geological Survey

Groundwater Quality in the Northern San Joaquin Valley, California

The Northern San Joaquin (NSJ) study unit is located in California’s San Joaquin Valley and includes the Claresmont, eastern San Joaquin, and Tracy groundwater sub-basins (California Department of Water Resources, 2011). The LSPIG program’s study unit was divided into four study zones: Claresmont, eastern San Joaquin, Tracy, and Calaveras (Particulates unassessed compliance). The NSJ study unit has hot and dry summers and cool, moist winters. Average annual rainfall ranges from 11 to 17 inches. Most rain and intense flooding across the study unit drain into the San Joaquin River, which flows northwest into the Sacramento-San Joaquin Delta and San Francisco Bay estuary.

The study unit is underlain by fractured crystalline silicate rocks, sand, and clay deposits. During the study period, the study unit extended from the Central Valley to the Sierra Nevada Mountains. The primary aquifer is the NSJ study unit can range from 0 to 10 feet below land surface (DBA). The water within the study area may range from 0 to 10 feet below land surface (DBA). The water within the study area may range from 0 to 10 feet below land surface (DBA). The water within the study area may range from 0 to 10 feet below land surface (DBA). The water within the study area may range from 0 to 10 feet below land surface (DBA). The water within the study area may range from 0 to 10 feet below land surface (DBA).

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GAMA’s Priority Basin Project evaluates the quality of imported groundwater. However, the current, benchmarks established for drinking water quality are used for comparison. Benchmark, and definition of high, moderate, and low concentration, are discussed in the text below.

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