

**Kern County Water Agency  
Improvement District 4  
Water Quality Laboratory  
Post Office Box 58  
Bakersfield, California 93302-0058**

# **Quality Assurance Manual**

November 2011

**Kern County Water Agency  
Improvement District 4  
Water Quality Laboratory**

# **Quality Assurance Manual**

This manual has been reviewed and determined to be appropriate for the scope, volume and range of analyses performed by the laboratory. This manual will be reviewed annually or more frequently as necessary. Periodic evaluations of laboratory operations will be conducted to insure that the quality control procedures and systems defined in the manual are fully implemented and adhered to at all times.

Paul Wagner  
Laboratory Supervisor

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# Quality Assurance Program Objectives

- Ensure that data produced by the Improvement District 4 Water Quality Laboratory is accurate and precise.
- Ensure that data produced by the Improvement District 4 Water Quality Laboratory is legally defensible.
- Ensure that the processes used by the Improvement District 4 Water Quality Laboratory to produce data are properly documented.
- Ensure that the Improvement District 4 Water Quality Laboratory is operating in accordance with federal, state and local regulations.

## Quality Assurance Terminology

Terminology and definitions for quality control samples and parameters are located in the internal quality control section.

### **Accuracy**

A combination of bias and precision of an analytical procedure which reflects the closeness of a measured value to a true value.

### **Bias**

A consistent deviation of measured value from the true value caused by systemic errors in a procedure.

### **Calibration Standard**

A solution containing a known concentration of method analytes, internal standard and surrogate analytes used to calibrate the instrument response with respect to the analyte concentrations in the standard.

### **Confidence Coefficient**

The probability (percent) that a measurement result will lie within the confidence interval or between the confidence limits.

### **Confidence Interval**

A set of possible values within which the true value will lie with a specified level of probability.

### **Confidence Limit**

One of the boundary values defining the confidence interval.

### **Detection Limits**

#### **Instrumental Detection Level**

The constituent concentration that produces a signal greater than five times the signal to noise ratio of the instrument. This is similar in many respects, to “Critical level” and “Criterion of detection.” The latter limit is stated as 1.645 times the standard deviation (SD) of blank analyses.

#### **Lower level of detection**

The constituent concentration in reagent water that produces a signal  $2 \times 1.645 \times SD$  above the mean of blank analyses. This sets both type I and type II errors at 5%. Other names for this limit are “detection limit” and “limit of detection (LOD).”

# Quality Assurance Terminology

## **Detection Limits (continued)**

### **Method Detection Level**

The constituent concentration that, when processed through the complete method, produces a signal with a 99% probability that it is different from the blank. For seven replicates of the sample, the mean must be  $3.14 \times \text{SD}$  above the blank where SD is the standard deviation of the seven replicates. The MDL will be larger than the LOD because of the few replications and the sample processing steps, and may vary with constituent and matrix.

### **Limit of Quantification**

The constituent concentration that produces a signal sufficiently greater than the blank that it can be detected within specified limits by good laboratory practices during routine operations. Typically, it is the concentration that produces a signal  $10 \times$  the SD above the reagent water blank signal.

## **Precision**

A measure of the degree of agreement among replicate analyses of a sample, usually expressed as the standard deviation.

## **Quality assessment**

A procedure for determining the quality of laboratory measurements by use of data from internal and external quality control measures.

## **Quality assurance**

A definitive plan for laboratory operations that specifies the measures used to produce data of known precision and bias.

## **Quality control**

A set of measures within a sample analysis methodology to assure that the process is in control.

## **Random error**

The deviation in any step in an analytical procedure that can be treated by standard statistical techniques.

## **Relative Standard Deviation**

Standard Deviation,  $\sigma$  / Average  $\times 100$

## **Standard curve**

A series of three or more standards or standard mixes containing the analyte(s) of interest. Each standard (mix) is run at different concentrations, from at or near the MDL to a higher level to bracket the expected concentration of the sample analyte. The resulting data generates a mathematical means for the quantification of the analyte in the samples.

## **Type I error**

The probability of deciding a constituent is present when it actually is absent. Type I errors are also known as alpha errors.

## **Type II error**

The probability of not detecting a constituent when it actually is present. Type II errors are also known as beta errors.

# Laboratory Personnel Qualifications

## Water Quality Laboratory Supervisor

1. Education and experience equivalent to a bachelor's degree in physical or natural sciences with coursework in analytical chemistry, microbiology, organic chemistry, and statistics.
2. A minimum of five years experience as a laboratory analyst in a water/wastewater laboratory.
3. Possession of a valid California Driver's license.
4. Possession of the CA/NV Section of the American Water Works Association (AWWA) Water Quality Analyst Grade 4 Certificate, or the ability to obtain the certification within 24 months.

## Water Quality Laboratory Analyst II

1. Possession of an AA or AS in chemistry, biology, physics, engineering or closely related field of equivalent course of study to provide the required knowledge, skills and abilities to perform the essential functions of the job.
2. Two years experience analyzing samples in a laboratory setting.
3. Possession of a valid California Driver's license.
4. Possession of the CA/NV Section of the American Water Works Association (AWWA) Water Quality Analyst Grade 2 certification.

## Water Quality Laboratory Analyst I

1. Possession of an AA or AS in chemistry, biology, physics, engineering or closely related field of equivalent course of study; or completion of two (2) years relevant course work and associated laboratory experience to provide the required knowledge, skills and abilities to perform the essential functions of the job.
2. One year of experience analyzing samples in a laboratory setting preferred.
3. Possession of a valid California Driver's license.
4. Possession of the CA/NV Section of the American Water Works Association (AWWA) Water Quality Analyst Grade 1 certification, or the ability to obtain one within 12 months of employment.

Resumes for the Water Quality Laboratory Supervisor and Water Quality Laboratory Analysts are appended. An organizational chart is also included in the appendix.

# Laboratory Personnel Responsibilities

## Water Quality Laboratory Supervisor

1. Ensure that data produced by the laboratory is accurate, precise and legally defensible.
2. Ensure that the processes used by the laboratory to produce data are properly documented.
3. Ensure that the laboratory is operated in accordance with federal, state and local regulations.
4. Plan, schedule and organize laboratory tasks.
5. Train and supervise laboratory technicians.
6. Institute additional analytical procedures as necessary.
7. Analyze inorganic, organic and physical samples using instrumentation and associated methods including, but not limited to, atomic absorption, gas chromatography, ion chromatography, ion selective electrodes, mass spectrometry (GC/MS), pH meter, total organic carbon analyzer, spectrophotometer and various bench and titration analyses.
8. Analyze microbiology samples using instruments and associated methods including, but not limited to, the autoclave, balances, colony counter, incubator bath, incubators, pH meter, stir/hot plate, tray sealer and UV sterilizer.
9. Perform sample preparation procedures including, but not limited to, the addition of preservation reagents, organic sample extractions and metal sample digestions.
10. Collect samples as needed from locations associated with, but not limited to, the Cross Valley Canal, distribution system, sanitary surveys, source water, treated water, treatment plant and wells.

# Laboratory Personnel Responsibilities

## Water Quality Laboratory Supervisor (continued)

11. Perform quality control procedures for, but not limited to, the autoclave, balances, conductivity meter, electrodes, microbiology control cultures and media, pH meter, reagents, titrants and turbidimeters.
12. Maintain all relevant quality control logs including, but not limited to, those associated with instrument temperature, reagent quality control and preparation, chain of custody, standard preparation, instrument maintenance, instrument performance checks and microbial procedures.
13. Prepare reagents, titrants, microbiology media, and other compounds, solutions and items as directed.
14. Prepare reports regarding, but not limited to, analysis summary, quality control samples, purveyor sample analysis and reports submitted for compliance purposes.
15. Maintain the inventory of all laboratory supplies and order as necessary.
16. Wash and clean laboratory bottles, containers, glassware and other items. Clean laboratory benches, cabinets, instruments, shelves, sinks and other items.
17. Perform duties relevant to water quality issues as directed.

## Water Quality Laboratory Analyst II

1. Analyze inorganic, organic and physical samples using instrumentation and associated methods including, but not limited to, atomic absorption, gas chromatography, ion chromatography, ion selective electrodes, mass spectrometry (GC/MS), pH meter, total organic carbon analyzer, spectrophotometer and various bench and titration analyses.
2. Analyze microbiology samples using instruments and associated methods including, but not limited to, the autoclave, balances, colony counter, incubator bath, incubators, pH meter, stir/hot plate, tray sealer and UV sterilizer.
3. Perform sample preparation procedures including, but not limited to, the addition of preservation reagents, organic sample extractions and metal sample digestions.
4. Collect samples as needed from locations associated with, but not limited to, the Cross Valley Canal, distribution system, sanitary surveys, source water, treated water, treatment plant and wells.
5. Perform quality control procedures for, but not limited to, the autoclave, balances, conductivity meter, electrodes, microbiology control cultures and media, pH meter, reagents, titrants and turbidimeters.
6. Maintain all relevant quality control logs including, but not limited to, those associated with instrument temperature, reagent quality control and preparation, chain of custody, standard preparation, instrument maintenance, instrument performance checks and microbial procedures.
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9. Maintain the inventory of all laboratory supplies and order as necessary.
10. Wash and clean laboratory bottles, containers, glassware and other items as directed. Clean laboratory benches, cabinets, instruments, shelves, sinks and other items as directed.
11. Perform duties relevant to water quality issues as directed.

# Laboratory Personnel Responsibilities

## Water Quality Analyst I

1. Analyze inorganic, organic and physical samples using instrumentation and associated methods including, but not limited to, atomic absorption, gas chromatography, ion chromatography, ion selective electrodes, pH meter, total organic carbon analyzer, spectrophotometer and various bench and titration analyses.
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10. Wash and clean laboratory bottles, containers, glassware and other items as directed. Clean laboratory benches, cabinets, instruments, shelves, sinks and other items as directed.
11. Perform duties relevant to water quality issues as directed.

# Laboratory Safety

## Safety Practices

- Concentrated acids and bases will only be handled in the fume hood.
- Safety glasses and chemical resistant gloves will be worn when handling acids, bases and reagents of any concentration.
- Chemicals from unlabeled or ambiguously labeled containers will not be used.
- Chemicals will not be tasted. Chemicals will only be smelled when absolutely necessary by cautiously wafting the vapor toward the nose while keeping the container away from the face.
- Analysts will not work alone when handling hazardous substances.
- Analysts will read the container warning label and MSDS of each chemical used in all analyses they perform.
- Hands and arms will be washed before leaving the work area and whenever a chemical contacts the skin. Hands will be sprayed with 70% ETOH after working with bacteria samples.
- Contact lenses will not be worn in the laboratory at any time.
- Long hair and loose fitting clothing will be restrained.
- Shorts, high-heeled shoes, open-toed shoes, sandals and shoes made of woven material will not be worn.
- Analysts will not eat, drink, smoke, take medication or apply cosmetics in chemical handling or storage areas.
- Analysts will not engage in horseplay, pranks and other acts of mischief in the laboratory.

## Inventory of Chemicals

Chemical volumes and concentrations will be ordered and maintained at the lowest practical level. Volumes and concentrations will be limited to minimize the amount of expired chemicals, exposure of personnel to hazardous chemicals and the potential of contamination.

## Storage of Chemicals

Acids, bases, and strong oxidizers will be isolated from each other and all other compounds in storage. Volatile organic solvents will be stored in the fume hood or explosion proof refrigerator. Organic and inorganic non-metal standards will also be stored in explosion proof refrigerators.

## Labeling Chemical Containers

All chemical containers will be clearly labeled. Reagents prepared in the laboratory will be stored in containers labeled with the chemical name, concentration and preparation date.

## Material Safety Data Sheets

Material safety data sheets (MSDS) will be maintained for each chemical used. The material safety data sheets will be stored in three ring loose-leaf binders in the laboratory. Information on the properties of chemicals can also be found on the Internet.

## Safety Meetings

Safety meetings involving all treatment plant personnel will be held every two weeks. The meetings will focus on a wide range of safety topics related to the laboratory and treatment plant. A record of the meetings shall be kept in a three ring loose-leaf binder by the treatment plant safety officer.

## Sampling Procedures

All samples shall be collected as specified in the following inorganic, organic, and miscellaneous sample collection and storage requirement tables.

### Inorganic Sample Collection and Storage Requirements

Analyte	Container	Volume, mL	Preservative	Storage Time
alkalinity	P, G	200	None, 4°C	14 days
aluminum	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
ammonia	P, G	500	H <sub>2</sub> SO <sub>4</sub> , < 2, 4°C	28 days
antimony	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
arsenic	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
barium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
beryllium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
bicarbonate	P, G	500	none, 4°C	6 months
boron	P, PTFE cap	1000	none	6 months
bromide	P, G	100	none	28 days
cadmium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
calcium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
carbonate	P, G	500	none, 4°C	6 months
chloride	P, G	50	none	28 days
chlorine	P, G	500	none	15 minutes
chromium VI	P, G	1000	none, 4°C	24 hours
chromium, total	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
cobalt	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
color	P, G	1000	none, 4°C	48 hours
conductivity	P, G	500	none, 4°C	28 days
copper	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
cyanide, total	P, G	1000	NaOH, pH > 12, 4°C	14 days, 24 hours if sulfide present
fluoride	P	100	none	28 days
hardness	P, G	100	HNO <sub>3</sub> , pH < 2	6 months
iron	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
lead	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
magnesium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
manganese	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
mercury	P, G	1000	HNO <sub>3</sub> , pH < 2	28 days
molybdenum	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
nickel	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
nitrate	P, G	100	none, 4°C	48 hours, 28 days if chlorinated
nitrite	P, G	200	none, 4°C	48 hours
odor	G	500	none, 4°C	6 hours
oxygen, dissolved	G, BOD bottle	300	none	8 hours
perchlorate	P, G	250	none, 4°C	28 days
pH	P, G	50	none	15 minutes
phosphate, ortho	G (A)	100	none, 4°C	48 hours
potassium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
selenium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
silica	P, PTFE cap	200	none, 4°C	28 days
silver	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
sodium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
solids	P, G	200	none, 4°C	7 days
sulfate	P, G	100	none, 4°C	28 days
surfactants (MBAS)	P, G	250	none, 4°C	6 months
temperature	P, G	none	none, 4°C	15 minutes
turbidity	P, G	100	none, 4°C	24 hours
thallium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
vanadium	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months
zinc	P, G	1000	HNO <sub>3</sub> , pH < 2	6 months

# Sampling Procedures

## Organic Sample Collection and Storage Requirements

Analyte	Container	Volume, mL	Preservative	Storage Time
EPA 502.2	G	2 X 40 VOC	25 mg ascorbic acid if chlorinated, HCl, pH < 2, 4°C	14 days
EPA 504	G	2 X 250	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	28 days
EPA 505	G	1000	none, 4°C	7 days
EPA 507	G	1000	none, 4°C	7 days
EPA 508	G	1000	none, 4°C	7 days
EPA 515.1	G	1000	none, 4°C	7 days
EPA 524.2	G	2 X 40 VOC	25 mg ascorbic acid if chlorinated, HCl, pH < 2, 4°C	14 days
EPA 525	G	1000	none, 4°C	7 days
EPA 531	G, amber	250	chloroacetic buffer/Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	7 days
EPA 547	G, amber	250	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	7 days
EPA 548.1	G	1000	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	7 days
EPA 549	P, amber	1000	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	7 days
EPA 550.1	G	1000	none, 4°C	7 days
EPA 551	G	4 X 40 VOC	0.1 mL NH <sub>4</sub> Cl, HCl, pH 4.5, 4°C	14 days
EPA 552	G	250	0.25 mL NH <sub>4</sub> Cl, 4°C	28 days
EPA 632	G	1000	none, 4°C	7 days
carbon, total organic	G, amber	2 X 40 VOC	H <sub>2</sub> SO <sub>4</sub> , pH < 2, 4°C	28 days
dioxin	P, G	2 X 1000	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	30 days
oil and grease	G(wide), amber	1000	H <sub>2</sub> SO <sub>4</sub> , pH < 2, 4°C	28 days
phenols	P, G PTFE cap	500	H <sub>2</sub> SO <sub>4</sub> , pH < 2, 4°C	28 days

## Asbestos, Bacteriological, and Radionuclide Sample Collection and Storage Requirements

Analyte	Container	Volume, mL	Preservative	Storage Time
asbestos	P, G	1000	none, 4°C	48 hours
bacteriological	P, G sterile	100	Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> , 4°C	8 hours
radionuclides	P	1000/analyte	none, 4°C	6 months

## Sample Containers

Bacteriological:	Clean, sterile, 125 mL wide mouth polypropylene bottles
Metals:	Clean, acid-rinsed, amber, borosilicate or polypropylene containers with TFE closures.
Mineral and Physical:	Clean, amber, borosilicate glass or polypropylene bottles with TFE closures.
Purgeable VOC's:	40 mL amber, borosilicate vials with new TFE faced silicon septa
Non-purgeable Organics:	Clean, amber, glass containers with new TFE closures.

## Sampling Quality Control Procedures

Field reagent blanks will accompany all volatile organic chemical samples collected in the field and will be carried through the entire sampling, storage, and laboratory procedure for all analyses. All sample preservatives will be added to the field reagent blanks prior to sample collection.

Duplicate samples will be collected and analyzed to determine the precision associated with sample collection, preservation, storage and laboratory procedure.

# Sampling Procedures

## Chain of Custody

All sample containers will be numbered and the number will correspond to specific locations as listed in the site-sampling plan. When samples are collected from locations other than those listed in the site-sampling plan, the container will be numbered and labeled with the following information:

Sample location – address or location at which the sample is taken.

Sample source – source water description.

Time and date sample is collected.

Name of the sample collector.

The chain of custody will receive a laboratory number that will be recorded in the chain of custody logbook along with the date and time the samples were received by the laboratory. A copy of the results will be attached to the chain of custody and the chain of custody will be filed in chronological order.

## Analytical Procedures

### Methods

The Kern County Water Agency (KCWA), Improvement District 4 (ID4), Water Quality Laboratory primarily utilizes analytical methods published in *Standard Methods, 20<sup>th</sup> edition* (SM) and by the Environmental Protection Agency (EPA). All samples analyzed for compliance purposes will utilize methods approved by the Environmental Laboratory Accreditation Program. The analytes and associated analysis methods are listed in the tables below.

### Inorganic Nonmetallic Methods

Analyte	Method
Alkalinity	SM 2320 B
Ammonia	SM 4500-NH3 F
Bromide	EPA 300.0
Chlorate	EPA 300.0
Chloride	EPA 300.0
Chlorite	EPA 300.0
Chlorine	SM 4500-Cl G
Dissolved oxygen	SM 4500-O G
Fluoride	SM 4110 B, SM 4500-F C
Hardness	SM 2340 C
Nitrate	EPA 300.0
Nitrite	EPA 300.0
Phosphate	EPA 300.0
Silica	SM 4500-Si D
Sulfate	EPA 300.0

# Analytical Procedures

## Metal Methods

Analyte	Method
Aluminum	EPA 200.9
Antimony	SM 3113 B
Arsenic	SM 3113 B
Barium	SM 3113 B
Beryllium	SM 3113 B
Cadmium	SM 3113 B
Calcium	SM 3111 D
Chromium	SM 3113 B
Copper	SM 3111 B
Iron	SM 3111 B
Lead	SM 3113 B
Magnesium	SM 3111 B
Manganese	SM 3111 B
Mercury	SM 3112 B
Nickel	SM 3113 B
Potassium	SM 3111 B
Selenium	SM 3113 B
Silver	SM 3113 B
Sodium	SM 3111 B
Thallium	EPA 200.9
Zinc	SM 3111 B

## Microbiological Methods

Analysis	Method
Total coliform	SM 9221 A, B, C SM 9222 A, B, C SM 9223
Fecal coliform	SM 9221 A, B, E SM 9222 D
<i>Escherichia coli</i>	SM 9221 A, B, C SM 9222 A, B, C SM 9223
Heterotrophic bacteria	SM 9215 B
Biochemical identification	API 20E

## Organic Methods

Analyte	Method
DBCP/EDB	EPA 504.1
Haloacetic acids	EPA 552.3
Organohalide Pesticides & PCBs	EPA 505
Trihalomethanes	EPA 524.2
Total organic carbon	SM 5310 C
Dissolved organic carbon	SM 5310 C
UV254	SM 5910 B
Volatile organic chemicals	EPA 524.2

# Analytical Procedures

## Physical Properties Methods

Analyte	Method
Color	SM 2120 B
Conductivity	SM 2510 B
Corrosivity	SM 2330 B
Odor	SM 2150 B
pH	SM 4500-H <sup>+</sup> B
Temperature	SM 2550 B
Suspended solids	SM 2540 D
Total dissolved solids	SM 2540 C
Total solids	SM 2540 B
Turbidity	SM 2130 B

Samples requiring analyses not performed by the KCWA ID4 Water Quality Laboratory will be contracted out to laboratories certified by the California Department of Public Health (CDPH).

## Instrumentation

### General Chemistry

Equipment	Manufacturer	Model
balance – analytical	Mettler	AE 260
balance – top loading	Mettler	BB2440
stir plate	Corning	PC 210
stir plate with light	Thermolyne	7200
water bath	Blue	WB1120A

### Inorganic Nonmetallic

Equipment	Manufacturer	Model
ion chromatograph	Dionex	DX600
pH/ion selective meter	Orion	720A
spectrophotometer – chlorine	Hach	Pocket Colorimeter
spectrophotometer – UV/Vis	Hach	DR4000U

### Metals

Equipment	Manufacturer	Model
atomic absorption spectrometer	Perkin – Elmer	AAAnalyst800
flow injection mercury system	Perkin – Elmer	FIMS 400
water bath	Blue	WB1120A

# Instrumentation

## Microbiology

Equipment	Manufacturer	Model
autoclave	Market Forge	Sterilmatic
colony counter	Darkfield Quebec	3325
hot/stir plate	Corning	PC 520
hot/stir plate	VWR	630 Standard
incubator – fecal coliform	Thermolyne	37900
incubator – total coliform	VWR	3015
microscope – binocular	Spencer	-
microscope – dissecting	Spencer	-
oven – hot air sterilizing	VWR	1325F
sealer – Quantitray	IDEXX	2X
sterilizer – UV	Millipore	-
UV lamp	Spectroline	EA160
water bath	Precision Scientific	66885

## Organics

Equipment	Manufacturer	Model
auto sampler – GC/MS	Varian	Archon
auto sampler – GC/MS	CTC Analytics	CombiPal
gas chromatograph	Varian	3800
mass spectrometer	Varian	Saturn 2000
sample concentrator – GC/MS	Tekmar Dohrman	3100
total organic carbon analyzer	Tekmar Dohrman	Phoenix 8000
muffle furnace	Thermolyne	1400

## Physical Properties

Equipment	Manufacturer	Model
conductivity meter	Orion	153A
color comparator	Hellige	611-A
turbidimeter	Hach	2100AN

## Personnel Training

Laboratory staff will be trained on each instrument by the installer. Additional training at the manufacturer's school will be provided on some instruments to staff who will then train other laboratory employees.

## Manufacturer's Manuals

The manufacturer's manuals will be used for training and reference, and will be kept in the laboratory library.

## Instrument Inspection, Calibration and Service

Instrument	Inspection	Calibration*	Service Frequency
atomic absorption spectrometer	each use	each use	as needed
autoclave	each use	each use	as needed
balance – analytical	each use	quarterly	annually
balance – top loading	each use	quarterly	annually
gas chromatograph	each use	each use	as needed
incubators	daily	twice daily	as needed
ion chromatograph	each use	each use	as needed
mass spectrometer	each use	each use	as needed
ovens	each use	quarterly	as needed
pH/ion selective meter	each use	each use	monthly
spectrophotometer – UV/Vis	each use	each use	as needed
total organic carbon analyzer	each use	each use	as needed

\*Continuing calibration checks (CCCs) will be analyzed to determine if an instrument requires recalibration.

### Calibration Procedures

#### Atomic Absorption Spectrometer

The direct concentration calibration method will be used whenever possible. Standard addition calibration will be used for some graphite furnace analyses when matrix effects or background indicate a need. All calibration curves will consist of three to five standards, depending on the analysis method requirement. The calibration standards will bracket the expected analyte concentration. If the sample concentration is below the detection limit, the lowest calibration standard should be at the DLR.

#### Gas Chromatograph

Internal and external standard calibration methods with three to five standards will be used, depending upon the analysis method requirement. The lowest standard must approach the method detection limit.

#### Gas Chromatograph/Mass Spectrometer with Purge and Trap

The internal standard calibration method with five standards will be used. The instrument must pass the BFB tuning procedure before the analysis of the calibration standards can begin. The lowest standard must approach the method detection limit.

#### UV/Vis Spectrophotometer

The direct concentration method with three to five standards bracketing the expected analyte concentration will be used, depending on the analysis method requirement. The spectrophotometer will be zeroed before the first calibration standard and a procedural blank will be analyzed periodically to confirm the instrument is zeroed.

#### UV/persulfate TOC analyzer

The direct concentration method with five standards bracketing the expected analyte concentration will be used. The lowest standard must approach the method detection limit. The analyzer priming and cleaning procedure will be performed prior to instrument zeroing and analysis of the first calibration standard.

# **Instrument Inspection, Calibration and Service**

## **Calibration Frequencies**

Instruments will be recalibrated if the calibration verification standard recovery deviates from the known concentration in excess of the analysis method recovery requirement. Calibration verification standards will be analyzed prior to the analysis of samples, after every ten or twenty samples (depending upon the analysis method) and at the end of the analysis run. The concentration of the calibration verification standards will be no greater than one half of the highest calibration curve standard.

## **Absorbance Monitoring**

Absorbance values from atomic absorption and UV/Vis spectrophotometer analyses will be monitored at each calibration. Trends in the absorbance values of the low calibration standard for each analyte will be monitored as a check on instrument performance.

## **Instrument Service and Preventative Maintenance**

Minor repairs and routine instrument maintenance will be performed by laboratory personnel in accordance with the manufacturers' instructions. Manuals specifying service procedures are available for every instrument. Service technicians will perform repairs laboratory personnel are not capable of performing. A replacement parts inventory will be maintained for each instrument in order to minimize instrument downtime.

# **Internal Quality Control**

## **Quality Control Samples and Parameters**

The quality control requirements of each analysis method are specified in their respective SOPs. The terminology and associated definitions used to describe the method quality control requirements are listed below.

### **Initial Calibration Check**

A solution containing a known concentration of method analytes used to evaluate the performance of an instrument relative to a defined set of method criteria. The initial calibration check should be analyzed immediately following instrument calibration.

### **Continuing Calibration Check**

A calibration standard containing the method analytes, internal standard(s) and surrogate standard(s) which is analyzed periodically to verify the accuracy of the existing calibration for the method analytes.

### **Continuing Calibration Blank**

An aliquot of reagent water prepared in exactly the same manner as the reagent water used for the preparation of the calibration standards. The continuing calibration blank is used as a zero standard and to auto-zero the instrument, or to determine if analyte carryover is occurring.

### **Quality Control Sample**

A laboratory reagent blank or sample matrix fortified with a solution of method analytes of known concentrations. The quality control sample (QCS) must be prepared from an external laboratory source not used for the preparation of calibration standards. The purpose of the QCS is to verify laboratory performance relative to externally prepared standards and solutions.

# Internal Quality Control

## Quality Control Samples and Parameters

(continued)

### **Detection Limit for Purposes of Reporting**

A calibration standard prepared at the concentration of the lowest calibration standard. The purpose of the detection limit for purposes of reporting (DLR) is to verify the accuracy of the calibration curve at the minimum reporting limit. The DLR must contain all method analytes, internal standard(s) and surrogate standard(s).

### **Field Reagent Blank**

An aliquot of reagent water or other blank matrix that is treated exactly as a sample including shipment to the sampling site, exposure to sampling site conditions, storage, preservation and all analytical procedures. The purpose of the field reagent blank is to determine if method analytes or other interferences are present in the field environment.

### **Laboratory Reagent Blank**

An aliquot of reagent water or other blank matrix that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards and surrogates that are used in the preparation and analysis of samples. The purpose of the laboratory reagent blank is to determine if method analytes or other interferences are present in the laboratory environment, reagents or apparatus.

### **Laboratory Fortified Blank**

An aliquot of reagent water or other blank matrix to which known concentrations of the method analytes are added in the laboratory. The laboratory fortified blank must be analyzed exactly like a sample and its purpose is to determine if the methodology is in control and whether the laboratory is capable of making accurate and precise measurements.

### **Matrix Spike**

An aliquot of an environmental sample to which known concentrations of the method analytes are added in the laboratory. The matrix spike (MS) must be analyzed in exactly the same manner as the samples. The purpose of the MS is to determine if the sample matrix contributes bias to the analytical results.

### **Matrix Spike Duplicate**

Two aliquots of the same environmental sample to which known concentrations of the method analytes are added in the laboratory. The matrix spike duplicate (MSD) must be analyzed in exactly the same manner as the samples. The purpose of the MSD is to determine if the sample matrix contributes bias to the analytical results and to assess method precision and accuracy.

### **Duplicate Sample**

Two aliquots of the same sample collected in the laboratory or field and analyzed separately using an identical analysis method. The purpose of the duplicate sample is to assess the precision of the laboratory analysis procedure.

### **Surrogate Standard**

A pure analyte added to a sample prior to extraction or other processing for the purpose of monitoring method performance with each sample. A known concentration of the surrogate standard (SS) must be added to each sample and the SS must not be a method analyte.

# Internal Quality Control

## Quality Control Samples and Parameters

(continued)

### Internal Standard

A pure analyte added to a sample, extract or standard solution for the purpose of measuring the relative responses of the other analytes and surrogates that are components of the same sample or solution. A known concentration of the internal standard (IS) must be added to each solution and the IS must not be a method analyte.

### Control Charts

Control charts for every analyte will be maintained for continuing calibration check, duplicate sample, detection limit for purposes of reporting, laboratory fortified matrix and quality control samples. The control charts will specify mean recovery, upper control limits, and lower control limits. Upper and lower control limits for external reference samples may be the same criteria recommended by the supplier of the reference sample.

### Anion-Cation Balance

An anion-cation balance will be calculated quarterly on the major ionic species for source and treated water. The typical criteria for acceptance are listed below.

Anion Sum, meq/L	Acceptable Difference
0 – 3.0	+/- 0.2
3.0 – 10.0	+/- 2%
10.0 - 800	5%

### Conductivity

A logbook will be maintained for weekly checks of specific conductivity. The conductivity meter will be calibrated prior to measuring the conductivity of samples. Three KCl standard solutions will be prepared. The conductivity meter will be calibrated on the middle conductivity standard and correction factors will be calculated for the high and low standards. The middle conductivity standard will approach the expected conductivity of the samples.

### Ion Specific Electrodes

The slope of the ion specific electrode will be recorded on every analysis batch summary sheet. The acceptance criteria for the electrode slope will be 57 mV +/- 3 mV.

### Microbiology

#### Control Cultures

An ATCC registered control culture will be maintained for the following cultures:

*Escherichia coli* (positive for TC, FC, *E. coli*)

*Klebsiella pneumonia* (negative for FC)

*Enterobacter aerogenes* (negative for FC)

*Pseudomonas aeruginosa* (negative for TC)

*Staphylococcus aureus* (negative for TC)

The control cultures will be transferred monthly to new plate count agar slant tubes. The control culture species shall be verified quarterly using API 20E identification tests.

# Internal Quality Control

## Microbiology

(continued)

### Incubators

All incubator temperatures will be recorded twice each day. The temperatures shall not vary by more than +/- 0.5 °C from the method specified temperatures.

### Media Preparation

All media will be prepared in strict adherence to the manufacturers' instructions. The pH of the media will be taken after sterilization and recorded in the media logbook along with the preparation details. Expiration dates and dates opened will be marked on all media containers and recorded in the media logbook.

The sterility of every batch of media shall be verified by incubating an aliquot of the media for the required period and examining it for growth. Every batch of media will also be inoculated with control cultures to ensure the media produces the appropriate response. The positive and negative controls for each media type are specified in the table below.

### Media Control Cultures

Media	Positive Control	Negative Control
brilliant green bile broth	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>
Colilert	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>
EC medium with MUG	<i>Escherichia coli</i>	<i>Enterobacter aerogenes</i>
m endo agar LES	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>
m FC agar	<i>Escherichia coli</i>	<i>Klebsiella pneumonia</i>
lauryl tryptose broth	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>
nutrient agar with MUG	<i>Escherichia coli</i>	<i>Klebsiella pneumonia</i>
plate count agar	<i>Escherichia coli</i>	<i>Pseudomonas aeruginosa</i>
tryptic soy broth	<i>Escherichia coli</i>	N/A

### Methods

#### Enzyme Substrate Test

The enzyme substrate test will be the principal method used in the analysis of all treated and source water samples. Enzyme substrate analyses will be performed using Colilert media and vessels purchased from IDEXX. Each lot of Colilert will be inoculated with *Escherichia coli*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa* to verify the media produces the appropriate response.

#### Heterotrophic Plate Counts

The bacterial density should be no greater than 300 bacteria per plate. A media blank plate and an air control plate will be analyzed in each batch of samples. The air control plate will remain uncovered and exposed for 15 minutes. The number of colony forming units must not exceed 15. A dilution water plate will be analyzed if samples are diluted. All plate count samples will be analyzed in duplicate.

# Internal Quality Control

## Microbiology

(continued)

### Membrane Filtration

The membrane filtration method will be used to analyze treated and source water in the event the enzyme substrate method cannot be performed. The membrane bacterial density should be no greater than 80 coliform bacteria or 200 colonies of all types. Ten mL of dilution water will be added to the filter apparatus prior to filtering samples of 10 mL or less. The filter apparatus will be disinfected in the UV box after the filtration of each sample. A dilution water blank will be analyzed every 10 samples. All membrane filtration samples will be analyzed in duplicate.

### Multiple Tube Fermentation

The multiple tube fermentation method will be used to analyze source water in the event the enzyme substrate method cannot be performed. Source water samples will be analyzed using 3 sets of 5 tubes containing 10mL, 1 mL, and 0.1 mL of media respectively. Positive and negative control cultures will be incubated with every batch of samples analyzed in EC with MUG media.

### Sterilization

The sterilization times and maximum temperature shall be recorded for every autoclave run. A maximum temperature thermometer will be used to measure the temperature.

Vessels containing microbiological analysis media will be autoclaved for 15 minutes at 121°C and 15 psi. The sterilization process will be confirmed whenever media is prepared (or monthly if multiple media batches are prepared during the month) by autoclaving a vial containing *Bacillus stearothermophilus* with the media and incubating it at 55 +/- 0.5°C for 48 hours. Sterilization is confirmed if the vial does not change color or exhibit growth.

All sample bottles for microbiological analyses will be autoclaved for 15 minutes at 121°C and 15 psi. The bottles will contain sodium thiosulfate prior to sterilization.

Waste will be autoclaved for a minimum of 30 minutes at 121°C and 15 psi.

### Sterility Verification

The sterility of every lot of each item, media batch or dilution water must be verified. The sterility verification procedures are listed in the table below. The absence of growth in the tryptic soy broth following incubation indicates that the item or dilution water is sterile. The sterilization of microbiological media is confirmed if the *Bacillus stearothermophilus* vial does not change color or exhibit growth following incubation.

Item	Procedure	Incubation
bacteria sample bottle	add 50 mL TSB x 1 to bottle	≥ 24 hours at 35 +/- 0.5°C
dilution water	remove 50 mL of 100 mL dH <sub>2</sub> O in bottle add 50 mL TSB x 2 to remaining 50 mL dH <sub>2</sub> O in bottle	≥ 24 hours at 35 +/- 0.5°C
membrane filter & pads	place item in sterile bottle add 100 mL TSB x 1 to sterile bottle containing filter	≥ 24 hours at 35 +/- 0.5°C
microbiological media	autoclave <i>Bacillus stearothermophilus</i> vial with media	≥ 48 hours at 55 +/- 0.5°C
Petri dish	add 5 mL TSB x 1 to Petri dish	≥ 24 hours at 35 +/- 0.5°C
pipette and pipette tips	induct TSB x 1 to capacity of pipette or tip discharge TSB in pipette or tip into sterile Petri dish	≥ 24 hours at 35 +/- 0.5°C
Quantitray	add 100 mL TSB x 1 to quantitray	≥ 24 hours at 35 +/- 0.5°C

# Internal Quality Control

## Microbiology (continued)

### Water Suitability and Inhibitory Residue Tests

The Water Suitability test and Inhibitory Residue test will be performed once each year as specified by *Standard Methods*, 20<sup>th</sup> edition.

### pH Electrodes

A logbook will be maintained for pH electrode calibrations. The acceptance criteria for the electrode slope will be 100 +/- 10% (or as recommended by the manufacturer) for a two-point calibration consisting of pH 7.0 and pH 10.0 buffer solutions.

### Pipettes – Adjustable

A logbook will be maintained for the monthly adjustable pipette calibration check. Each adjustable pipette will be tested at its lowest, middle and top operating range. Appropriate aliquots of dH<sub>2</sub>O will be used to determine if the pipettes are in calibration. Pipettes determined to be out of calibration will be recalibrated following manufacturer's instructions.

### Thermometers

A logbook will be maintained for the annual thermometer calibration check. Each thermometer will be checked against a certified NIST calibrated thermometer. A correction factor will be calculated for each thermometer if necessary. The correction factor will be recorded in the logbook and also affixed to the thermometer.

### Turbidimeters

A logbook will be maintained for the weekly turbidimeters calibration check using 2 Gelex secondary standards. The acceptance criteria will be +/- 5% of the value of the secondary standards as measured immediately after the monthly calibration of the turbidimeters. The turbidimeters will be calibrated more frequently if the calibration check falls outside the acceptance criteria.

## Apparatus and Reagent Quality Control Monitoring Schedule

### Each Use

pH meter calibration

### Weekly

conductivity meter accuracy check  
eye wash station flush  
reagent preparation  
turbidimeter accuracy check

# Internal Quality Control

## Apparatus and Reagent Quality Control Monitoring Schedule (continued)

### Monthly

autoclave sterility check  
balance accuracy check  
chloride electrode calibration (operations laboratory)  
control culture transfer  
pipette accuracy check  
quantitray sealer  
water quality check (dH<sub>2</sub>O & RO)  
titrant accuracy check  
turbidimeter calibration

### Quarterly

autoclave timer check

### Biannually

control culture rehydration  
control culture API 20E identification

### Annually

thermometer accuracy check

### Logbooks

The following logbooks will be maintained to record instrument parameters, standard preparation, reagent preparation and reagent quality control.

1. Instrument Temperature Log:
  - incubator (total coliform)
  - incubator (fecal coliform)
  - refrigerator
  - autoclave
  - sterilization oven
  - fecal coliform waterbath
2. Instrument and Reagent Quality Control Log:
  - alkalinity
  - chloride
  - hardness
  - DI/RO system
  - gas inventory
  - hood velocity
  - autoclave timer
  - balances
  - thermometers
  - spectrophotometer (standard absorbance test)

# Internal Quality Control

## Logbooks

(continued)

3. Instrument Calibration Log:
  - conductivity meter
  - pH electrode
  - turbidimeter calibration check
  - turbidimeter calibration
4. Instrument Maintenance Logs
5. Microbiological Quality Control Log:
  - Colilert reagent
  - sterility (dilution water and vessels)
  - autofluorescence
  - quantitray sealer
  - media preparation
  - control cultures
6. Reagent Preparation Log
7. Metal Sample Digestion Log
8. Haloacetic Acid Sample Digestion Log
9. Atomic Absorption Standard Preparation Log
10. Colorimetric and Selective Ion Electrode Standard Preparation Log
11. Ion Chromatography Standard Preparation Log
12. Organic Standard Preparation Log

## Data Reduction and Validation

### Significant Figures

All digits in a reported result are expected to be known definitely, except for the last digit, which may be in doubt. If more than a single doubtful digit is carried, the extra digit(s) is not significant.

Reported figures will be determined by the accuracy of the work. Digits that are not significant or known definitely will be dropped. If the digit 6, 7, 8, or 9 is dropped, the preceding digit will increase by one unit. If the digit 0, 1, 2, 3, or 4 is dropped, the preceding digit is not altered. If the digit 5 is dropped, the preceding digit is rounded off to the nearest even number. The digit 0 may record a measured value or it may serve as a spacer to locate a decimal point.

# Data Reduction and Validation

## Units

The International System of Units (SI) will be used to report most results. However, terms such as ppm and acre-feet will occasionally be used. Concentration units will be expressed as indicated in the table below.

Referent	Abbreviation
grams per liter	% or g/L
milligram per liter	mg/L
microgram per liter	µg/L
nanogram per liter	ng/L
Nephelometer turbidity units	NTU
colony forming units	cfu
part per million	ppm
part per billion	ppb
part per billion	ppt

## Data Reduction

Data generated by the mass spectrometer, gas chromatograph, total organic carbon analyzer, high-pressure liquid chromatograph and atomic absorption spectrometer will be acquired and reduced by the instrument's software. The software will be capable of accounting for diluted samples. Data generated by the UV/Vis spectrometer and pH/ion electrode will be recorded by hand and processed using software programs such as Curve and CCPro. The data systems will be able to generate the following data:

- Response/Calibration Factors
- Correlation Coefficient
- Variance
- Linear and quadratic best fit
- Maximum, minimum, and average
- Control charts

**Raw data** includes: handwritten and printed measured values, dilution and concentration factors, sample treatment and calculations.

**Finished data** includes: chromatograms, calibration curves, and computerized or handwritten analysis summary reports. All pertinent raw data will be attached to the corresponding finished report.

## Data Validation

All analytical results will be reviewed prior to reporting. The review process will include but not be limited to: condition of sample, adherence to established standard operating procedures, verification of calculations and comparison of the new quality control data against established control charts.

## Reporting

Final reports will be submitted only when all relevant data has been reduced, reviewed and validated. All reports submitted for compliance with CDPH regulations will be completed and submitted by the tenth day following the end of the monitoring period. Completion of compliance monitoring reports will take priority over all other reports.

## **Report and Record Archival**

Records of all verbal and written water quality and system water outage complaints received will be retained for a period of five years. The records will also include any corrective action taken.

Records of all bacteriological analyses will be retained for a minimum of the most recent five years.

Records for all chemical analyses will be retained for a minimum of the most recent ten years.

All records will contain the following information:

- Sample date, place, and time
- Sample collector
- Sample identification (include sample type for bacteria samples)
- Date of report
- Name of the laboratory
- Name of the analyst or laboratory director
- Analytical technique or method
- Analysis results

Records and resultant corrective actions will be retained for a minimum of three years following the final action taken to correct a particular violation.

Records of any type relating to sanitary surveys of the system conducted by the water supplier, a private consultant, or any local, state or federal agency will be retained for a minimum of ten years following completion of the sanitary survey involved.

Variations or exemptions granted to the laboratory will be retained for a minimum of five years following the expiration of the variance or exemption.

## **Performance and System Audits**

### **Laboratory Check Samples**

Laboratory check samples purchased from vendors such as ERA and NSI will be analyzed quarterly. The analyte recovery will be within the acceptance range specified by the manufacturer. The check samples shall consist of regulated and unregulated analytes representative of the following classes of constituents:

1. inorganic metallics
2. inorganic non-metallics
3. purgeable organics
4. non-purgeable organics

### **Laboratory Intercomparison Samples**

The laboratory will analyze performance evaluation samples annually as required by the Environmental Laboratory Accreditation Program. The samples will consist of metals, non-metals, organics and bacteria. The samples will encompass every method the laboratory is certified to perform.

### **Compliance Audits**

The collection, storage and analysis of specific analytes and methods will be periodically observed to verify adherence to the appropriate SOP.

## **Performance and System Audits**

### **Laboratory Quality Systems Audits**

Internal quality systems audits will be conducted annually to assess the quality assurance process. The internal audit will examine the entire spectrum of procedures and policies associated with sample processing, sample analysis, data reduction and reporting. Environmental Laboratory Accreditation Program inspectors will conduct audits to assess the quality assurance process every other year.

### **Corrective Actions**

Corrective actions will be implemented as soon as possible after the discovery of a deficiency. SOPs and policies will be updated and discussed with laboratory and treatment plant staff as necessary. Corrective action responses will be submitted to the Environmental Laboratory Accreditation Program as required.

### **Quality Assurance Reports**

Quality assurance reports will include but not be limited to quality control charts, standard operating procedures and corrective action responses. Quality control charts will be updated and reviewed periodically. All quality control charts will be available for inspection by authorized personnel. Written standard operating procedures (SOPs) will be maintained for every method performed by the laboratory. The SOPs will be periodically reviewed and revised if deficiencies are discovered. Corrective action responses will be compiled addressing deficiencies discovered by the Environmental Laboratory Accreditation Program (ELAP) inspectors. The corrective action responses will be forwarded to ELAP and Agency management for review.

### **Traceability**

All measurements will be made utilizing calibration standards and calibration check standards prepared in accordance with National Institute of Standards and Technology guidelines. The certificate of analysis for each calibration standard and calibration check standard will be kept on file for the duration of the measurement archival period. Standard preparation logbooks will be maintained listing the log number, concentration, expiration date and required dilutions for each analysis batch. The standard preparation logbooks will also be kept on file for the duration of the measurement archival period. All reagents used will be of American Chemical Society grade or better.

### **Procurement**

All purchases of instrumentation and operating supplies will be made in accordance with the Kern County Water Agency's Purchasing Policies Interpretation and Procedures Manual.

## R. L. BASSETT, Ph.D.

### Tetra Tech

3801 Automation Way, Suite 100  
Fort Collins, CO 80525  
970-206-4254

### Academic Background

BAYLOR UNIVERSITY	B.S. (1971)	Geology, Chemistry (minor)
TEXAS TECH UNIVERSITY	M.S. (1973)	Geochemistry
STANFORD UNIVERSITY	Ph.D. (1977)	Environmental Geochemistry
U.C. BERKELEY	(1974)	Doctoral Exchange Geochemistry Course work

### Professional Work Experience

- **PRINCIPAL GEOCHEMIST**, Tetra Tech, Fort Collins, CO. March 2011 to present.
- **PRESIDENT**, Geochemical Technologies Corp. in Wheat Ridge, Colorado, 1999 to March 2011; **PRESIDENT**, TENECO Energy, LLC; and **ADJUNCT PROFESSOR**, Department of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona (2000 - present); **Faculty Director** of the Isotope Laboratory in the Department of Hydrology and Water Resources, University of Arizona
- **PROFESSOR**, Department of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona (1993 - 2000); **PROFESSOR** Geosciences Department, (Joint Appointment, until July, 2000), **Faculty Director** of the Isotope Laboratory in the Department of Hydrology and Water Resources, University of Arizona
- **ASSOCIATE PROFESSOR**, Department of Hydrology and Water Resources, The University of Arizona, Tucson, Arizona (1987 - 1993)
- **PRESIDENT**, GeoSystems Research Corp., Wheat Ridge, CO (1985 to 1994)
- **EXPLORATION MANAGER**, Stauffer Oil and Gas Exploration, Subsidiary of Stauffer Chemical Co., Denver, Colorado (March 1982 - December 1985)
- **RESEARCH SCIENTIST**, The University of Texas at Austin, Bureau of Economic Geology, (September 1979 - March 1982)
- **RESEARCH SCIENTIST**, U.S. Geological Survey, Water Resources Division, Regional Research Center, Denver, Colorado (January 1977 - September 1979)

## **Areas of Expertise**

Brine Geochemistry	Chemical Modeling
Contaminant Chemistry	Groundwater and Vadose Zone Geochemistry
Isotope Geochemistry	Project Management
Radioactive Waste Disposal Issues	3D Geologic Computer Visualization
Oil, Gas and Mining Contamination	Flow and Transport Modeling

## **Professional Societies (Active and Past Member)**

American Association of Petroleum Geologists  
American Chemical Society  
- Colloid and Surface Chemistry Section  
- Geochemistry Section  
American Geophysical Union  
Association of Groundwater Scientists and Engineers  
Baylor Geological Society  
Clay Mineral Society  
Geochemical Society  
Geological Society of America  
International Association of Geochemistry and Cosmochemistry  
National Ground Water Association  
New York Academy of Science  
Rocky Mountain Association of Geologists  
Society for Environmental Geochemistry and Health  
Texas Academy of Science

## **Awards, Honors, and Honorary Societies**

Sigma Xi  
Omicron Delta Kappa  
Sigma Gamma Epsilon  
Texaco Scholarship (Geology), Baylor University [2 years]  
USGS Graduate Fellowship (Geochemistry), Stanford University [2 years]  
Henri Darcy Distinguished Lecturer: (Twenty University Tour) Selected by the National Ground Water Association [1989-90]  
Nomination to The University of Arizona Honors Program Five Star Faculty Award for excellence in teaching [1988, 1989]  
Cited by the College of Engineering and Mines, University of Arizona, as a nominee for the Burlington Award for teaching [1994]  
National Academy of Sciences Committee on Low Level Radioactive Waste [1993-96]  
Argonne National Laboratory Radioactive Waste Review Panel [1986-1989]  
NSF Joint U.S./Japan Workshop: "Collaborative Research Topics on Emerging

Hydrologic Hazard and Water Resources Engineering Issues."  
Professor of the Year (1996) Selected by the Tau Beta Pi Honorary Engineering Society  
Awarded the Certificate of Recognition for Excellence at the Student Interface, 1996, 1998, College of  
Engineering and Mines, University of Arizona

### **Editorial and Society Boards and Advisory Committees**

Board of Directors of the National Ground Water Association, Association of Ground  
Water Scientists and Engineers, the largest association of ground water professionals with more  
than 24,000 members  
Waterloo Centre for Groundwater Research, University of Waterloo, Ontario, Advisory Committee  
[1995-1996]  
Associate Editor for the journal *Water Resources Research* [1989 - 1994]  
Associate Editor for the journal *Ground Water* [1996 - 2003]  
Associate Editor for the journal *Applied Geochemistry* [1998 - 2003]  
Ground Water/Vadose Zone Expert Panel appointed by U.S/ Department of Energy for the Hanford  
Washington Site [1998-2001]  
External Review Team, Idaho National Engineering and Environmental Laboratory, WAG 10  
Groundwater Model and Long Term Stewardship [May, 2004]

### **Intramural Service**

Lectured in the University of Arizona Chemistry Department, Geoscience Department, School of  
Natural and Renewal Resources.  
Substitute lecturer for other faculty within the Department of Hydrology and Water  
Resources  
Departmental Committees: [Space, Graduate, Admissions, Computer, Instrumentation,  
Field Camp]  
Taught Summer Field Camp [1988-1992]  
Faculty Search Committees:  
- *Chairman and Head*, Department of Hydrology,  
- *Hydrogeologist* Faculty Position, Dept. of Hydrology and Water Resources,  
- *Vadose Zone Hydrologist* Faculty Position, Dept. of Hydrology and Water Resources,  
- *Geoenvironmental* Faculty Position, Civil Engineering Department,  
- *Vice President for Research*, University of Arizona.  
Organized 3 National Workshops: Evans Conferences - "Unsaturated Flow and Transport"  
sponsored by the United States Nuclear Regulatory Commission, and the University of  
Arizona. [1991, 1993, 1995].  
Began a Water Chemistry Colloquium series, in which graduate students have an opportunity to  
present the results of their research.  
Member of Graduate Council, and Executive Committee of the Council for the University of  
Arizona [1992-97]

## **Extramural Service**

Lecturer: Sunnyside High School, Tucson, AZ. Expanding Horizons Series [1988].  
Co-organizer: National Conference for the American Chemical Society on Chemical Modeling[1988], "Chemical Modeling in Aqueous Systems II."  
Reviewed numerous technical journal articles for leading journals in the field of hydrology and geochemistry (*Water Resources Research, Applied Geochemistry, Geochimica et Cosmochimica Acta, Limnology and Oceanography*).  
Reviewed numerous proposals for funding agencies (National Science Foundation, United States Geological Survey, American Chemical Society).  
Served as Session Chairman for National Conferences (American Geophysical Union, American Chemical Society, Waste Management Conference).  
Reviewed numerous books on isotope geochemistry, aqueous geochemistry and environmental hydrology.  
Numerous Short Courses for the USGS, National Training Center in Denver, CO.  
Short Courses sponsored by the EPA Dallas and Austin, Texas.  
Guest lecturer in Geochemistry classes (Univ. Colorado; Colorado School of Mines and Geology; Univ. Texas at Austin).  
Review Team Member for External Review of the Department of Geology and Atmospheric Sciences at Iowa State University [1992].  
Training Session Instructor, Arizona United States Geological Survey District Conference, Carefree Arizona, May 20, 1998.

## **Scientific Publications: Refereed Journal Articles, Conference Proceedings, Book Chapters, Monographs, etc.**

Guay Bradley, Eastoe Christopher J., Bassett R.L., and Long Austin (2004) Sources of Surface and Ground Water Adjoining the Lower Colorado River Inferred by  $\delta^{18}\text{O}$ ,  $\delta\text{D}$  and  $^3\text{H}$ , (accepted for publication in August *Hydrogeology Journal*).

Haschke, John M. and Bassett, R.L. (2002) Control of plutonium dioxide solubility by amorphous tetrahydroxide: a critical review of the model. *Radiochem. Acta*, **90**, 1-5.

Carty D.J., Whittemore D.O., and Bassett R.L. (2000) Identifying Environmentally Detrimental Saltwater in Oilfields Using Boron Isotopes and Anion Ratios. Proceedings 6<sup>th</sup> Annual International Petroleum Environmental Conference, November 1999, Houston, TX, The Integrated Petroleum Environmental Consortium(IPEC), The University of Tulsa, Tulsa, OK, 34p.

Ball J. W. and Bassett R.L. (2000) Ion exchange separation of chromium from natural water matrix for stable isotope mass spectrometric analysis. *Chemical Geology, Isotope Geoscience* **168** (1-2) 123-134.

Brown J. G., Bassett R. L., and Glynn P. D. (2000) Reactive transport of metal contaminants in alluvium – model comparison and column simulation. *Applied Geochemistry* **15**, 35-49.

Duane M.J. and Bassett R.L. (1999) Modern & ancient sabkha environments – boron isotopes as discriminators of environments and applications to mineral exploration *in* Stanley et al. (editors) Mineral Deposits, Processes to Processing, Proceedings of the 5<sup>th</sup> Biennial SGA Meeting and 10<sup>th</sup> Quadrennial IAGO Symposium, London, UK, 22-25<sup>th</sup> August, Published in book form, BNalkema, Rotterdam, 1225-1227.

Woodhouse E. G., Bassett R. L., and Shuttleworth W. J. (1998) Infiltration measurements from a water budget at Apache Leap Research Site, Arizona. (*WM'98, March 1-5, 1998*).

Davidson G.R., Bassett R. L., Hardin E. L., and Thompson D. L. (1998) Isotopic and geochemical evidence of fracture flow in unsaturated tuff at the Apache Leap Research Site. *Applied Geochemistry* **13**, 185-195.

Quanrud David, Arnold Robert, Massaro Mike, Wilson Gray, Lansey Kevin, Karpiscak Martin, Seodel Georgetta, Bassett Randy, and Gerba Charles. (1998) Soil-aquifer treatment research at the University of Arizona: a review. Proceedings of the Annual UC Water Reuse Research Conference, Monterey, CA, June 4-5, 16 p.

Cunningham, E., Long A., Eastoe C., and Bassett R. L. (1998) Migration of recharge waters downgradient from the Santa Catalina mountains into the Tucson Basin Aquifer. *Hydrogeology* **6**, 94-103.

Leenhouts J.M., Bassett R. L. and Maddock T. M. III. (1998) Utilization of boron isotopes as co-migrating tracers for identifying nitrate contamination sources. *GROUND WATER* **36**, 240-250.

Brown J.G., Bassett R. L., and Glynn P. D. (1997) Characterization and simulation of reactive transport of metal contaminants in ground water in Pinal Creek basin, Arizona. *Journal of Hydrology* , **209**, 225-250.

Hardin E. L., Bassett R. L. and Murrell M. T. (1997) Rate limited isotopic exchange involving natural uranium in the Apache Leap Tuff. *Waste Management '97*, Mar. 2-6, 1997.

Broermann J., Bassett R. L., Weeks E. P., and Borgstrom M. (1997) Estimation of  $\lambda$ , velocity,  $K_d$  and confidence limits from tracer injection test data. *GROUND WATER* **35**, 1066-1076.

Bassett, R. L. (1997) Chemical modeling on the bare rock or forested watershed scale. In: *Water quality trends and geochemical mass balance* (eds. N.E. Peters, O. P. Bricker and M. M. Kennedy) Advances in Hydrological Processes, pp. 285-308. Wiley. [Reprinted selected journal articles for the book].

National Research Council Committee to Review New York State's Siting and Methodology Selection for Low-Level Radioactive Waste Disposal (R.L. Bassett, member) (1996), Review of New York State low-level radioactive waste siting process: National Academy Press, Washington, D.C., 286 p.

Bassett R.L. (1997) Chemical modeling on the bare-rock or forested watershed scale. *Hydrological Processes* **11**, 695-717.

Woodhouse E.G. and Bassett R. L. (1996) Mechanisms for the formation of a perched water zone in fractured tuff: a natural analog study, Scientific Basis for Nuclear Waste Management. *Proceedings of the Materials Research Society*, Dec., 1996, Boston, MA.

Hardin E. L., Bassett R. L., and Murrell M. T. (1996)  $^{234}\text{U}/^{238}\text{U}$  fractionation in vadose zone pore waters of the Apache Leap Tuff. In *Waste Management '96, Proceedings on Waste Management at Tucson, AZ.*, Feb. 25-29, 1996.

Davidson G.R., Hardin E. L., and Bassett R. L. (1996) Extraction of  $^{14}\text{C}$  from pore water in unsaturated rock using vacuum distillation. *Radiocarbon* **37**, 861-874.

Bassett R.L., Buszka, P., Davidson G.R. and Diaz-Chong D. (1995) The identification of groundwater sources using boron isotopic composition. *Environmental Science and Technology* **29**, 2915-22.

Miller, William R., Bassett, R.L., McHugh, John, and Ficklin, W.H. (1995) Behavior of trace metals draining natural acid sulfate weathering in an alpine watershed: *Society of Exploration Geochemistry Reviews in Economic Geology* **6A**.

Bassett, R.L., Miller, William R., McHugh, John, and Catts, John G. (1992) Simulation of natural acid sulfate weathering in an alpine watershed: *Water Resources Research* **28**, 2197-2209.

Davidson, Gregg R. and Bassett R.L. (1993) Application of Boron Isotopes for Identifying Contaminants such as Fly Ash Leachate in Ground Waters: *Environmental Science and Technology* **27**, 192-196.

Wallin, Robert, Bassett, R.L., and Eychaner, James (1991) Groundwater transport of polycyclic aromatic hydrocarbons in association with humic substances in Pinal Creek Basin, Globe, Arizona: *USGS Water-Resources Investigations Report* 91-4034, 511-515.

Bassett, R.L. (1990) A critical evaluation of the available measurements for the stable isotopes of boron: *Applied Geochemistry* **5**, 541-554.

Reese, Ronald S. and R.L. Bassett (1990) Characterization of organic contamination of ground water in a mining area, Globe, Arizona: *NWWA/AGWSE Groundwater Geochemistry Conference, Proceedings*, Kansas City, Missouri, 221-235

Ward, N.E., and R.L. Bassett (1990) Adsorption of hexavalent chromium on kaolinite and illite: *Trace Substances and Environmental Health*, **24**, 193-206.

Melchior, D.A., and Bassett, R.L. (eds.) (1989) *Chemical Modeling in Aqueous Systems II*. American Chemical Society, **416**, 556 p.

Bassett, R.L. and Dan Melchior (1989) Chemical modeling of aqueous systems: an overview: *ACS Symposium Series* 416, 1-14.

Bassett, R.L., and Bentley, M.E. (1983) Deep brine aquifers in the Palo Duro Basin: Regional flow and geochemical constraints: The University of Texas at Austin, Bureau of Economic Geology *Report of Investigation* No. 130, 59 p.

Bassett, R.L., and Bentley, M.E. (1982) Geochemistry and hydrodynamics of deep Formation brines in the Palo Duro and Dalhart Basins, Texas: *Journal of Hydrology* **59**, 331-372.

Handford, C.R., and R.L. Bassett (1982) Permian facies sequences and evaporite depositional styles, Texas Panhandle: *SEPM Core Workshop No.3*, p. 210-237.

Gustavson, T.C., Bassett, R.L., (and others), Geology and geohydrology of the Palo Duro Basin, Texas Panhandle: a report on the progress of nuclear waste isolation feasibility studies (1982); The University of Texas at Austin, Bureau of Economic Geology *Geological Circular* 83-4.

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Roedder, Edwin, and Bassett, R.L. (1981) Problems in the determination of the water content of rock salt samples and its significance in nuclear-waste storage siting: *Geology* **9**, 525-530.

Bassett, R.L., Bentley, M.E., Duncan, E.A., and Griffin, J.A. (1981) Predicting the reaction state of brines in proposed regions of nuclear waste isolation: Chapter 3, p. 27-34, In J.G. Moore (ed.). *Scientific basis for nuclear waste management*, Plenum Press, New York, **3**.

Bassett, R.L. (1980) A computer model for aqueous organic complexes in natural systems and physiologic fluids: *Trace Substances in Environmental Health* **13**, 189-197.

Bassett, R.L. (1980) A critical evaluation of the thermodynamic data for boron ions, ion pairs, complexes, and polyanions, aqueous solution at 298.5 K and 1 bar: *Geochimica et Cosmochimica Acta* **44**, 1151-1160.

Wood, W.W., and Bassett, R.L. (1975) Water quality changes related to the development of anaerobic conditions during artificial recharge: *Water Resources Research* **11**, 553-558.

Gustavson, T.C., Bassett, R.L., Finley, R.J., Goldstein, A.G., Handford, C.R., McGowen, J.H., Presley, M.W., Baumgardner, R.W., Bentley, M.E. Dutton, S.P., Hoadley, A.D., McGookey, D.A., McGillis, K.A., Ramondetta, P., and Simpkins, W.W., 1981, Geology and geohydrology of the Palo Duro Basin, Texas Panhandle, a report on the progress of nuclear waste isolation feasibility studies (1980): The University of Texas at Austin, Bureau of Economic Geology *Geological Circular* 81-3.

Nordstrom, D.K., Plummer, L.N., Wigley, T.M.L., Jenne, E.A., Wolery, T.J., Bassett, R.L., Crerar, D.A., Fritz, B., Hoffman, M., Holdren, G.R., Lafon, G.M., Mattigod, S., Reddy, M.M., Thraikill, J. (1978) Computer programs for the calculation of chemical equilibrium in aqueous solutions: *American Chemical Society Symposium Series 93*, Chap. 38, p. 857-894.

Bassett, R.L., Kharaka, Y.K., and Langmuir, D. (1978) Critical review of the Equilibrium constants for kaolinite and sepiolite: Chemical modeling --speciation, sorption, solubility, and kinetics in aqueous systems: *American Chemical Society Symposium Series 93*, Chap. 19,389-400.

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Jones, D.L., and Bassett, R.L. (1975) Alteration of sediments in lower part of hole 286 in Andrews, J.E., and Parkham, G., eds., *Initial reports of the deep sea drilling projects*: U.S. Government Printing Office. **3**, 483-488.

### **Other Publications: Research Reports and Contract Reports**

Arnold Robert, Lansey Kevin, Bassett Randy, Gerba Charles, Amy Gary, Yanko William, Baird Rodger, Reinhard Martin, Houston Sandra, and Drews Joerg. (1998) Soil aquifer treatment for sustainable water reuse. Progress Report 4, 7/1/98 – 10/31/98, 159 p.

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Bassett, R.L., S.P. Neuman, P.J. Wierenga, G.R. Davidson, G. Chen, A.M. Geddis, D.M. Stephens, and D.L. Thompson, 1996, Field experimental plan for the Apache Leap Research Site, NUREG/CR-6497.

Bassett, R.L., S.P. Neuman, P.J. Wierenga, G.R. Davidson, A.M. Geddis, A.G. -Guzman, E.L. Hardin, D.L. Thompson, E.G. Woodhouse, 1996, Validation studies for assessing unsaturated flow and transport through unsaturated fractured rock, NUREG/CR-6459.

Rhodes, S.C., L.G. Wilson, T.C. Rasmussen, and R.L. Bassett, 1996, Moisture characteristic curves for Apache Leap Tuff, NUREG/CR-6458.

Geddis, A.M., Amado G.-Guzman, and R.L. Bassett, 1996, Rapid estimate of solid volume in large tuff cores using a gas pycnometer, NUREG/CR-6457.

Woodhouse, E.G., R.L. Bassett, T.W. Orr, and D.L. Thompson, 1995, Apache Leap Research Site Weather Data Feb. 1, 1994 through July 31, 1994, UA Data Report 95-001.

Hardin, E.L. and R.L. Bassett, 1995, Summary of geophysical studies at the Apache Leap Research Site, UA Data Report 95-002.

Davidson, G.R. and R.L. Bassett, 1995, X-ray Diffraction patterns of fracture coatings and matrix rock samples from borehole USW-UZP-4 core, UA Data Report 95-003.

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Bassett, R.L., Neuman, S.P., Rasmussen, T.C., Guzman, A., Davidson, G.R., and Lohrstorfer, C.F., 1994, Validation studies for assessing unsaturated flow and transport through fractured rock, NUREG/CR-6203, U.S. Nuclear Regulatory Commission, Washington, D.C.

Bassett, R. L. , Sully M. J., and Rasmussen, T.C., 1992, Validation studies for assessing unsaturated flow and transport through unsaturated fractured rock: Contract Report, August, Nuclear Regulatory Commission.

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Bassett, R.L., Lyons E., Eastoe J., Lohrstorfer C., Burns A. and Booth, T., 1991, Task 4: Geochemical studies: Contract Report, July, Nuclear Regulatory Commission.

Bassett, R.L., 1987, An interim report on the results of the geochemical investigation of brine injection at Mont Belvieu, Texas: Report prepared for the city of Mont Belvieu, Texas,

Bassett, R.L., 1987, A final report to International Technologies on the geochemistry and isotopic composition of ground water at the Panoche Waste Disposal site, Martinez, California: Report prepared for IT Corporation.

Bassett, R.L., 1987, A report to the state of Texas on brine leaks in Canadian potash mines and the analogy to the Palo Duro Basin, Texas, which potentially contains sites for the storage of nuclear waste: a report prepared for the state of Texas.

Paddock, R.A., Lerman, A., Bassett, R.L., Was, G.S., Macdonald, D.D., Harrison, W., Hambley, D.F., Frape, S.K., Fischer, L.E., and J.C. Burton, 1986, Radioactive waste isolation in salt: U.S. DOE Report, Prepared for Argonne National Lab.

Bassett, R.L., 1986, Clay mineralogy of granite wash section: Report prepared for the Underground Resources Management Corporation.

Bassett, R.L. (with others), 1986, Evaluation and stabilization of in place remediation for the uranium tailings site at Riverton, Wyoming: Report prepared for the State of Wyoming, Dept. Env. Quality Division.

Bassett, R.L. (with others), 1983, Trona solution mining study: prepared for Stauffer Chemical Company.

Bassett, R.L. (with others), 1982, Geochemical aspects of industrial waste injection systems: Prepared for EPA with Underground Resources Management Corporation.

Gustavson, T.C., Bassett, R.L., Baumgardner, R.W., Jr., Bentley, M.E., Dutton, S.P., Goldstein, A.G., McGowen, J.H., and Presley, M.W., 1980, Nuclear waste isolation studies of the Palo Duro and Dalhart Basins, F 1980: U.S. Department of Energy, Office of Nuclear Waste Isolation, Proceedings, Annual Meeting, p. 269-272.

Bassett, R.L., Weeks, E.P., Ceazan, M.L., Perkins, S.G., Signor, D., Reddinger, D.L., Malcolm, R.L., Aiken, C.R., Thurman, E.M., Avery, P.A, Wood, W.W., Thompson, G.M., Stiles, G.K., 1981, Preliminary data from a series of artificial recharge experiments at Stanton, Texas: U.S. Geological Survey Open-File Report 81-149, 235 p.

Bassett, R.L., Perkins, S. G., and Waddell, R.K., 1979, Preliminary data describing the distribution of fluoride and silica in the Ogallala aquifer on the Southern High Plains of Texas: U.S. Geological Survey Open-File Report 8-349, 19 p.

### **Media:**

Videotape - Keynote lecture, Annual Meeting of the National Ground Water Association, 1989.

Videotape - "Report of Research at the Apache Leap Research Site," by R.L. Bassett and Ralph Nye, 1994, Copyright University of Arizona.

### **Professional Society Meetings and Conferences:**

More than 50 presentations, most with published abstracts, at national professional meetings, federal labs, regulatory agencies and professional conferences [American Geophysical Union, Arizona Hydrological Society, Geological Society of America, American Association of Petroleum Geologists, International Association of Geochemistry and Cosmochemistry, Society of Environmental Geochemistry and Health, Texas Academy of Science, Center for Nuclear Waste Regulatory Analysis].

### **Distinguished Lectureship:**

Henri Darcy Distinguished Lecturer [1989, 1990] - 20 lectures at universities, conferences, and research labs, sponsored by the National Ground Water Association/Association of Ground Water Scientists and Engineers.

### **Keynote Speaker:**

Annual Meeting of Arizona Post Secondary Chemistry Teachers [1990]

- Phoenix Chapter of the Arizona Hydrological Society, [1990,1992]
- Rocky Mountain Association of Ground Water Scientists, Salt Lake City, Utah, [1989]
- National Meeting, National Ground Water Association/AWGSE, Houston, Texas, [1989]

### **Other Significant Invited Presentations:**

- INVITED SPEAKER: AGU Spring Annual Meeting, 1997, Baltimore, MD
- INVITED SPEAKER: GSA Annual Meeting Fall 1996, Denver, CO
- Presentation to the Yucca Mountain Licensing Group, U.S. Nuclear Regulatory Commission, Rockville, MD, Nov. 20, 1996.
- Presentation to the Advisory Committee on Nuclear Waste (ACNW), Las Vegas, Nevada, September, 26, 1996.

- Presentation to the Advisory Committee on Nuclear Waste (ACNW), US Nuclear Regulatory Commission Headquarters, Rockville, MD, September, 20, 1995.
- High Level Waste (HLW) Hydrology Program Briefing, US Nuclear Regulatory Commission, Rockville, MD, Sept. 19, 1995.
- Field Presentation to the Waste Subcommittee of the Nuclear Safety Research Review Committee of the Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission, at the Apache Leap Research Site, January 20, 1995.
- Presentation for the US NRC/US DOE Technical Exchange on Groundwater Flow, Denver, CO, November 30, 1994.
- Round Table Discussion, Panel on Structural Geology & Geoengineering and Hydrogeology & Geochemistry, Nuclear Waste Technical Review Board (NWTRB), Washington, DC, Nov. 18, 1994.
- Presentation to US Nuclear Regulatory Commission Management and Technical Staff, Rockville, MD, June 28, 1994.
- Presentation to the Nuclear Safety Research Review Committee of the Office of Nuclear Regulatory Research, US Nuclear Regulatory Commission, at the Center for Nuclear Waste Regulatory Analyses, San Antonio, Texas, December 16, 1993.
- Presentation to US Nuclear Regulatory Commission Management and Technical Staff, Rockville, MD, January 23, 1992.
- Presentation to the INTRAVAL Working Group I Meeting, Lawrence Berkeley Laboratory, Berkeley, CA, December 10, 1991.

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## Thomas C. Haslebacher

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### Summary of Qualifications

- Twenty-six years experience as geologist in groundwater, petroleum, and mining.
- Proven written and communication skills.
- Seven years experience of supervising staff.
- Leadership roles and participation in groundwater banking committees.
- Provide hydrogeologic and database services for various local, state and federal agencies.

### EXPERIENCE

#### **Kern County Water Agency (KCWA) - Geologist IV**

5/88 Present

- Supervise staff in groundwater level/quality monitoring programs, GIS mapping, database management, report generation.
- Budget development for KCWA, Improvement District 3 (Kelso Creek Flood Control Dist.), Kern Fan Monitoring Committee.
- Secretary for Kern Fan Monitoring Committee.
- KCWA representative for Indian Wells Valley Technical Advisory Committee, IWV WD AB303 Committee, Kern Fan Monitoring Committee-Technical Subcommittee, Semitropic Groundwater Banking Program Technical Subcommittee, Association of California Water Agencies - Groundwater Committee, and Association of Ground Water Agencies.
- Hydrogeologic and database services to Indian Wells Valley Cooperative Groundwater Management Committee, Kern County Environmental Health Services Department, Kern Water Bank Authority, CA Dept. of Water Resources, CA Dept. of Health Services, CA Regional Water Quality Control Board, U.S. EPA, U.S. Army Corps of Engineers.
- Responsible for groundwater maps, hydrologic balance, text and figures for KCWA annual reports, Kern Fan Monitoring Committee Annual Report, Improvement District 4 (urban Bakersfield water district) annual report.

#### **Union Oil Company of California - Geologic Technician**

2/84 TO 5/88

- Well site geologist.
- Interface between oil field development geology staff, reservoir engineering staff and mainframe/PC computer system.
- Geophysical database management, computer generated mapping, and reservoir modeling.

#### **Sierra Exploration Drilling Company - Geologist**

12/80 TO 7/82

- Well site geologist.
- Water well design and construction.
- Mud logging, electric log interpretation, mud engineering, air/mud rotary drilling rig operation.

### EDUCATION

#### **West Virginia University, Morgantown, West Virginia**

5/78

Bachelor of Science: Geology

#### **Santa Barbara City College, Santa Barbara, California**

5/82

Certificate of Geoscience Technology

### SPECIAL TRAINING

California State University: Advanced Hydrogeology

Bakersfield Community College: Water Distribution and Water Treatment Technology, Hazardous Materials Technology, Incident Management

GDMS, Lancaster, CA: Auto Desk Land Development (graphics and GIS software)

GDMS, Lancaster, CA: ArcView (GIS software)

### CERTIFICATES/MEMBERSHIPS

Registered Geologist, California-No. 4739

3/90

Certified Hydrogeologist, California-No. 446

6/96

Water Treatment Plant Operator, Grade 2, No. 18649

12/93

Groundwater Resources Association of CA, San Joaquin Valley Chapter - Vice President

2002 to present

# Michelle Casterline

4101 Brittany Ct. Apt 210  
Bakersfield, CA 93312  
(661) 368-2347  
mcasterline93@gmail.com

## Objective

Position as a Geologist

## Education

California State University, Bakersfield  
Bachelor of Arts in Geology; minor in Biology

## Certifications

Professional Geologist CA #8898

## Relevant Experience

6/07 to Present

### **Kern County Water Agency**

#### *Hydrogeologist*

Responsible for the collection, analysis, and writing of reports using groundwater, hydrological, surface water, water quality data, geographic information systems (GIS) and engineering applications. Provide technical information to Agency personnel, engineers and the public. Responsible for project execution including preparation of plans and specifications related to groundwater projects. Preparation of technical reports, motions, and resolutions for the Board of Directors and various committees. Analyzes water management plans involving local and imported water sources of a variety of agricultural, municipal, and industrial uses, including operations, costs and budgets.

9/06 to 6/07

### **California State University, Bakersfield**

#### *Teaching Assistant*

Conduct laboratory demonstrations; Instruct students on lab assignments; Work with lecture instructors and associate Teaching Assistants to organize lab assignments for the year; Grade lab assignments and assign final lab grades.

6/06 to 9/06

### **Kern County Water Agency**

#### *Water Resource Intern*

Responsible for gathering, organizing, and analyzing water supply data; Responsible for writing the 2001-2005 Water Supply Report; Collected and entered stream data from field stations.

8/05 to 6/06

### **California State University, Bakersfield**

#### *Research Assistant*

Gathered and scanned 1700 shallow oil and water well electric logs; Digitized and imported several hundred electric logs; Constructed geologic cross-sections using digitized electric logs; Taught undergraduate and graduate students how to scan and digitize electric logs, construct cross-sections, and enter data into Geographix™.

## Computer Skills

Knowledge of Microsoft Office Suite/IMAC/Neuralog™/ Geographix™/ Environmental Visualization Software (EVS) PRO

## References

Available Upon Request

# RENEE E. MORQUECHO, Ph.D., P.E.

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## EMPLOYMENT

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- ◆ **Chief Engineer/District Engineer** 6/06-present  
Indian Wells Valley Water District, Ridgecrest, CA  
  
*Responsibilities:* Manager of the Engineering Department including engineering; chemical, bacteriological and biological reviews; construction management; regulatory compliance; and related technical and administrative assignments. When assigned by the General Manager, assist and support the General Manager, including acting as General Manager. Additional responsibilities include maintaining District engineering standards and reviewing plans for compliance with District standards, and preparing engineering plans and specification for District projects.
  
- ◆ **Assistant Engineer** 10/05-6/06  
Indian Wells Valley Water District, Ridgecrest, CA  
  
*Responsibilities:* Water distribution mapping and hydraulic analysis using AutoCAD and H<sub>2</sub>O MAP, overseeing biological permitting and liaison with California Department of Fish and Game, gathering of data and development of comprehensive database for water quality results, and development of yearly Consumer Confidence Report. In addition, responsibilities include interacting with and evaluating the needs of customers through phone calls and office visits.
  
- ◆ **Research Assistant** 8/01-8/05  
Department of Civil and Environmental Engineering, University of Alabama  
  
*Responsibilities:* Dissertation-level research on metals association with particulate matter in stormwater runoff. Project Research Assistant on two EPA-funded projects: “*Methods for Detection of Inappropriate Discharges from Storm Drainage Systems*” and “*Evaluation of NPDES MS4 Stormwater Monitoring Data*”. Trained students in the use of laboratory equipment and supervised up to five Master’s Degree students. Taught class sessions in Water Resources Engineering.
  
- ◆ **Environmental Health Specialist II** 11/96-08/99  
Benton-Franklin Health District, Kennewick, WA  
  
*Responsibilities:* Initiated a new and innovative water quality education program for the local community in order to raise awareness of the potential public health problem caused by local groundwater contamination by nitrates. Duties involved development of educational material in both English and Spanish (brochures, fact sheets, school curricula, newspaper articles, and radio public service announcements). Educational materials were designed to explain health effects of nitrates, local on-site sewage rules and regulations, importance of well maintenance and testing of drinking water, and the benefits of recycling of household hazardous waste. Community outreach involved numerous school and community presentations, participation in local health fairs and other events and interviews with local television and radio stations. Additional responsibilities involved listening to and evaluating phone calls and office visits from the general public related to on-site sewage and land use regulations.

## CERTIFICATIONS

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- ◆ Licensed Professional Civil Engineer, State of California, Certificate No. 79344
- ◆ Grade D2 Water Distribution Operator, State of California Department of Public Health. Operator # 34708

## EDUCATION

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- ◆ **University of Alabama**, Tuscaloosa, AL  
Ph.D. in Civil Engineering, August 2005  
Department of Civil and Environmental Engineering. Minors: Urban Wet Weather Flows and Public Health.
- ◆ **University of Alabama at Birmingham**, Birmingham, AL  
M.S. in Civil Engineering, August 2001  
M.S. in Public Health, August 1996
- ◆ **University of Puget Sound**, Tacoma, WA  
Bachelor of Science in Biology, May 1993

## RESEARCH

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- ◆ **Doctor of Philosophy, Dissertation:** *Pollutant Associations with Particulates in Stormwater.* Sequential extraction experiments examining the characteristics of the filterable portion of stormwater heavy metals utilizing a Chelex-100 ion -exchange resin, ultraviolet light exposure, and Anodic Stripping Voltammetry to measure the chemical forms of the heavy metals.
- ◆ **Master's of Science in Civil Engineering, Non-Thesis Research Project:** *Sequential Extraction and Particle Size Associations of Stormwater Pollutants.* Part of a larger project funded by the Water Environment Research Foundation titled: *Innovative Metals Removal Technologies for Urban Stormwater.* A joint project between the University of Alabama at Birmingham and the University of Alabama.
- ◆ **Master's in Public Health, Thesis:** *Body Composition, Resting Metabolic Rate and Energy Requirements of Short- and Normal-Stature, Low-Income Guatemalan Children.* Guatemala City, Guatemala. February-April, 1996. Established new collaboration between the University of Alabama at Birmingham, School of Public Health and the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) in Guatemala City, Guatemala.
- ◆ **Bachelor of Science Senior Thesis:** *Locating the Gene Encoding the Resistance-Related Protein RP-6 from Barley, Hordeum vulgare, Using the cDNA Probe.* Initiated and organized independent research project involving plant molecular biology techniques. May 1991-May 1993

## PUBLICATIONS AND PRESENTATIONS

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- ◆ Author of 10 journal articles and published proceedings.
- ◆ Co-author of 14 published proceedings and 2 chapters in books.
- ◆ Presenter of 14 papers at local and national conferences.

# MAEGAN ALLEN

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## EMPLOYMENT

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### WATER RESOURCES PLANNER II

2008-PRESENT

*Kern County Water Agency  
Bakersfield, CA*

Develop and implement water quality sampling schedule and water level measurement schedule. Developed water quality monitoring plan merging plans from four different banking facilities (M&I and Agricultural) into one sampling program to be compliant with DWR and CA Department of Public Health. Represent Agency as Water Quality Representative at conferences and meetings. Developed QA protocol to ensure that water level measurement devices and water quality equipment are calibrated. Developed Water Quality SOPs for field staff use. Responsible for property management (including different leases, permits, etc.) of groundwater banking facilities. Compile reports on the cumulative operations of the alluvial fan groundwater banking region for the regional monitoring committee. Provide statistical and graphical water quality analyses as needed. Comment on projects and operations that may impact groundwater quality in the region. Enter water quality data into the database. Lead role on amendments to grants and progress reports on state grants. Prepare budget for the department, consisting of multiple funds and cost centers. Work with little supervision. Supervised summer intern.

### LABORATORY WATER QUALITY ANALYST II

2005-2008

*Kern County Water Agency – Improvement District No. 4  
Bakersfield, CA*

Perform chemical and biological water quality testing on source waters (including groundwater and surface waters) and treated drinking water. Provide reports for the Laboratory Supervisor and for the state Write-On database. Help ensure drinking water values are within established limits. Perform weekly, monthly, quarterly, and annual sampling and analysis as required. Perform weekly, monthly, and quarterly quality control procedures.

### ANALYST I

2003-2005

*BC Laboratories, Inc.  
Bakersfield, CA*

Performed EPA 8015M (Luft, Total Petroleum Hydrocarbons) method on extracts from water, soil and oil matrices. Performed this analysis utilizing both Hewlett-Packard and Perkin-Elmer Gas Chromatography instruments. Performed regular maintenance and

troubleshooting on instruments to remedy problems. Differentiated fuels based on chromatographic results. Developed an 8015b Direct-Inject method and SOP.

#### QUALITY CONTROL CHEMIST I

2000-2003

*Chemron, Corporation  
Paso Robles, CA*

Performed a variety of different wet chemistry tests on products made for the personal hygiene and oilfield industries. Ensured that products met different specifications and made additions to them to ensure quality completion. Prepared and signed off on Certificates of Analyses. Worked with little to no supervision.

### EDUCATION

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#### B. S. ECOLOGY AND SYSTEMATIC BIOLOGY

1997-2000, 2008

*California Polytechnic State University*

*San Luis Obispo, CA*

Concentration of Microbial Ecology. Extensive chemistry and biology classes. Transcripts available. GPA 3.11

#### GENERAL EDUCATION

1995-1997

*Bakersfield College*

*Bakersfield, CA*

Dean's List student five times. General education classes and prerequisites for transfer to Cal Poly.

### CERTIFICATIONS

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- AWWA, California-Nevada Section, **Water Quality Laboratory Analyst Grade 2**, Certification No. 020117, Expires 05/31/2013

### SKILLS

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- High level of responsibility, dependability, and personal pride in work
- Work well with little to no supervision
- Highly adaptable, gain understanding of new concepts quickly and accurately

# GLENN W HARRIS

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## EMPLOYMENT

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### **Natural Resources Specialist**

**1989 to present**

United States Department of Interior, Bureau of Land Management  
Ridgecrest Field Office, Ridgecrest, California

Serves as program lead for the Soil, Water, Air and Botany programs for the BLM field office. The program lead is responsible for monitoring the conditions of the 1.8 million acres of land in the field office and evaluating proposed projects for potential impacts to the resources. A portion of work involves reviewing large renewable energy projects and preparing and/or reviewing associated environmental documents. Many of these documents are joint EIS/EIR documents. In the area of ground water, work has involved reviewing proposed projects for impacts to ground water, development of stipulations, mitigations and monitoring plans. Additional work has included project inspector on well drilling contracts, ground water sampling, inventories of abandoned wells, development of security for abandoned wells, and served as chairman of the Technical Advisory Committee for the Indian Wells Valley Cooperative Ground Water Management Group. Also served as an instructor for a number of classes at the BLM National Training Center.

### **Lead Rangeland Management Specialist**

**1974 to 1989**

Provide overall administration for grazing use in the area. Work included supervision of other employees in the administration of the program including authorizations and billings, compliance, conducting monitoring studies, development of management plans and designing and directing construction of numerous range projects.

## EDUCATION

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### **Bachelor of Science in Rangelands Management**

Humboldt State College (CSU Humboldt)  
School of Natural Resources  
Minor in Geology  
Extensive graduate work in Wildland Hydrology.

Riverside City College  
Administration of Justice

# WILLIAM D FOSTER

801 CHARLES COURT  
RIDGECREST, CA 93555  
WD40.FOSTER@GMAIL.COM  
(760) 793-9991

## EDUCATION

**Associates in Science Degree**  
**Cerro Coso Community College**  
GPA 3.15

August 2003 – December 2005

## NATURAL RESOURCES EXPERIENCE

I have assisted Bob Robinson, the watershed coordinator in Kern River Valley in community outreach and area statistics for reports and projects that educate about water restoration. I have previous experience in the Boy Scouts and NRCS in gathering and organizing volunteers who are interested in assisting with various projects. I also have extensive experience from my work with the DMRC&D and NRCS in documenting and reporting on projects since extensive documentation is always required in government assisted or grant funded projects. I am currently working in the Indian Wells Valley and Searles Valley on watershed projects and coordinating with many local groups to secure grant funds and make a successful watershed plan.

## WORK EXPERIENCE

**Watershed Coordinator, Indian Wells & Searles Valleys**      October 2011 – Present  
**CSU Stanislaus, Turlock, California**

My primary responsibility is to coordinate with and provide technical support and other assistance to help the IWVCGMG and partners with watershed related objectives. This is a full time position based in the Ridgecrest CA area. Skills and duties include: interpersonal communication skills and an understanding of “social” context in order to work effectively with a wide diversity of stakeholders, administrative skills to manage any and all aspects of projects including grant writing, budget development and tracking, reporting, and coordinating subcontractors.

**Soil Conservation Technician, NRCS**      May 2007 – June 2011  
**Natural Resources Conservation Service, Ridgecrest, California**

I updated, and maintained site pages for desertmountainrcandd.org, using CSS, HTML, Ajax, and Dreamweaver. Created map overlays and supporting documentation for reports using ARC GIS 9.2. Additional duties included project multi-tasking, public interaction, and meeting organization. I have 4 years of experience in graphic design creating publications with Adobe Indesign, Illustrator and Microsoft Publisher. I have a fairly extensive portfolio upon request.

**Conservation Aid III, NDOW**      May 2006 – Aug 2006  
**Nevada Department of Wildlife, Las Vegas, Nevada**

I worked as a Conservation Aide III, conducting native fish fieldwork mostly on the Muddy and Virgin rivers. I also helped out with game fish projects on Lake Mead. My fieldwork included the setting of hoop nets, river seining, trawling at night for shad, and dive counts. I have been trained in procedures of fish hatcheries and helped design and build the native fish room at the Lake Mead Fish Hatchery. I was also on the team involved with the maintenance planning and management of the Devils Hole pup-fish refugia below Hoover dam.

### Skills

Dreamweaver  
Photoshop  
Illustrator  
Indesign  
ArcGIS  
MS Office Suite

### Operating Systems

Windows  
XP/Vista/7

**Field Biologist Technician, SSRS**  
**Southern Sierra Research Station, Weldon, California**

May 2005 – August 2005

During my internship, I was required to recognize and identify a variety of target birds by sight and sound. I am proficient with Willow Flycatcher survey protocol and nest searching procedures. I have gained hands on experience with fledgling banding and resighting of both Willow Flycatchers and Black Phoebes. I am familiar with GIS and have used Garmin GPS units to take points and record survey data and locations of re-sighted birds. I participated on the MAPS program, a continent-wide banding program monitoring avian productivity and survivorship. My experiences also involved the non-native removal project of plant species such as Purple Loosestrife, Salt Cedar, and Russian Olive.

**Conservation Aid II, NDOW**  
**Nevada Department of Wildlife, Reno, Nevada**

May 2004 – August 2004

I was hired by the fisheries department as a Conservation Aide II. I conducted creel censuses, requiring fishermen to be individually interviewed in the field about their fishing success, the bait or technique used, the water conditions, and the weather. Other duties included electroshocking streams for spawning or eradication purposes and hatchery fin clipping. I assisted with the Lahontan cutthroat trout project, which is reintroducing the Lahontan cutthroat trout into the Truckee River. The project involved surgically inserted radio transmitters, tracking the fish in the field with radio telemetry equipment and recovering the transmitters.

## **ACTIVITIES & AWARDS**

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**Maturango Museum** 1999-Present. Volunteer docent for the Maturango Museum leading museum tours and presenting natural history programs to the public and elementary schools K-5<sup>th</sup>. During the Museum's annual wildflower show, I collect plant specimens from the surrounding area, assisting with their identification and display in the museum.

**BLM** 1999-Present. Volunteer for the BLM, assisting with their community supported (S.E.E.P.), Sand Canyon Environmental Education Program for 5<sup>th</sup> graders in the valley.

**Boy Scouts of America** 1997-2005. In 2004 I achieved the rank of Eagle Scout, the highest rank in Scouting.

**Ridgecrest Public Library** 1997-2004. When working as a volunteer Departmental Aide at the library, I became proficient with assisting patrons, locating reference materials, and shelving materials using the Dewey decimal system or the Library of Congress system. Organized and ran many of the summer reading programs for the library with assistance of my recruited friends and family including the READ group and Harry Potter Days.

## **References**

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Donna Thomas (EKCRCD) (760) 977-7967  
Hudson Minshew (Natural Resources Conservation Service) (661) 303-4120  
Carolyn Lofreso (Natural Resources Conservation Service) (775) 688-1882  
Phil Leitner (Endangered species recovery program) (925) 253-8400  
Terri Middlemiss (Audubon) (760) 377-5192  
Dan Johnson (CCCC Network Admin) (760) 793-2776