

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LAHONTAN REGION**

**MEETING OF JANUARY 10, 2018  
APPLE VALLEY**

**ITEM 6**

**Status Update on Water Board's Perchlorate Investigation and Cleanup Project and the Status of City of Barstow's Nitrate Groundwater Contamination**

**CHRONOLOGY**

June 13, 1985	Water Board adopted Waste Discharge Requirements (WDRs), Board Order No. 6-85-60, allowing the City of Barstow (City) to use secondary treated effluent from their wastewater treatment plant for crop irrigation and disposal of effluent into percolation ponds.
February 10, 1994	Water Board adopted WDRs, Board Order No. 6-94-26, that required the City to begin groundwater monitoring in the vicinity of the authorized wastewater disposal sites.
July 27, 2004	Water Board adopted Cease and Desist Order (CDO) No. R6V-2004-0029 requiring the City to stop applying sewage biosolids to crop irrigation fields and upgrade its wastewater treatment system to comply with WDRs (i.e., stop polluting groundwater).
May 18, 2007	Water Board issued a 13267 Investigative Order requiring the City to submit an investigative work plan for remediating nitrate pollution, expand the monitoring well network for characterizing the nitrate plume, and propose a groundwater remediation action plan.
May 25, 2007	Water Board issued Cleanup and Abatement Order (CAO) No. R6V-2007-0017 requiring the City to begin quarterly sampling of private residential wells and provide replacement water to affected residents where private domestic wells have nitrate as nitrogen concentrations over 5 milligrams per liter (mg/L).
January 28, 2008	Water Board accepted the City's submitted investigative work plan and revised the compliance schedule for the 13267 Investigative Order (dated May 18, 2007).

<b>CHRONOLOGY</b>	
February 17, 2009	Water Board issued 13267 Investigative Order R6V-2009-0010 requesting the City install three additional groundwater monitoring wells within the Soapmine Road area.
March 13, 2009	Water Board revised the compliance schedule for the Investigative Order, issued May 18, 2007, for the City to submit a final remediation action plan for nitrate polluted groundwater.
May 20, 2009	Water Board staff conducted a public meeting to describe the extent of nitrate groundwater pollution in the Soapmine Road area and the City's planned cleanup efforts.
October 2009 through January 2010	The City conducted a small pilot-scale evaluation of a fluidized bed reactor system to treat nitrate-laden groundwater.
November 25, 2009	Based on the results from the pilot-scale study, the Water Board extended the compliance schedule for the Investigative Order, issued May 18, 2007, for the City to submit a revised final remediation action plan.
November 19, 2010	Water Board extended the compliance schedule of the 13267 Investigative Order, issued May 18, 2007, for the City to submit a revised final remediation action plan because the draft plan was deficient.
November 22, 2010	Perchlorate was discovered in the City of Barstow drinking water system.
April 24, 2012	Water Board staff conducted a second public meeting regarding the City's nitrate plume and the 2010 discovery of perchlorate in groundwater along the north side of the Mojave River, the possibility of perchlorate moving downgradient into Soapmine Road area residential wells, probable comingling of the perchlorate plume with the nitrate plume, actions taken by the City and Water Board, and future cleanup plans.
July 2, 2013	Water Board issued CAO No. R6V-2013-0045 requiring the City remediate nitrate polluted groundwater from the North Field and the Soapmine Road area.
July 10, 2013	Water Board issued CAO No. R6V-2013-0045-A1 extending all construction and start up deadlines for the City by 40 days.

<b>CHRONOLOGY</b>	
2012 - 2013	In late 2012 and early 2013, the United States Environmental Protection Agency (USEPA) conducted a removal action at the perchlorate source area. Approximately 1100 tons of perchlorate-impacted soil were removed.
December 19, 2014	Water Board issued CAO No. R6V-2013-0045-A2 extending all construction and start up deadlines by one year for the City. The extension was granted due to the presence of perchlorate in groundwater near the Soapmine Road area.
July 23, 2015	Water Board issued CAO No. R6V-2013-0045-A3 extending all construction and start up deadlines for the City by two years. The extra time was granted to allow the Water Board and City to find a long-term solution to cleanup nitrate and perchlorate groundwater pollution and obtain necessary funding.
February 16, 2016	Water Board staff conducted a third public meeting to discuss perchlorate and nitrate pollution in the Soapmine Road area. The public was presented with the size of perchlorate and nitrate plumes, fact sheets about the nitrate and perchlorate plumes, actions taken by the City and the Water Board, and the Water Board solicited stakeholder concerns and ideas for addressing both perchlorate and nitrate pollution in groundwater in the Soapmine Road area.
March 16, 2016	Water Board staff attended a neighborhood meeting hosted by a local resident and answered concerns and questions regarding perchlorate and nitrate as well as the feasibility of bringing a drinking water distribution system to the neighborhood.
December 2016	Water Board staff applied to the State Water Resources Control Board for Site Cleanup Sub Account Program Fund (Senate Bill 445 grant money) to obtain the funds to conduct a pilot-scale treatability study to clean up the perchlorate source area and the Lahontan Water Board was awarded \$2.67 million dollars.
April 24, 2017	Water Board issued CAO No. R6V-2013-0045-A4 extending all construction and start up deadlines by approximately three months to allow the City to install a pilot project instead of a full-scale nitrate remediation project.

## BACKGROUND

The effluent disposal practices from the City's wastewater treatment plant caused nitrate groundwater pollution, discovered after 1994, on the north side of the Mojave River, east of Interstate 15, in the Soapmine Road area that impacted drinking water wells. The Water Board adopted various enforcement orders from 2004 through 2017 requiring the City to take a number of actions to address nitrate groundwater pollution. As a result, the City modified its effluent disposal practices to eliminate land spreading of sewage biosolids and upgraded the wastewater treatment plant to reduce effluent total nitrogen.

In late 2010, perchlorate groundwater pollution was detected in a Golden State Water Company's supply well for the City of Barstow and Marine Corps Logistics Base, Nebo. This occurred as the City had begun preparing plans to clean up nitrate-polluted groundwater. Perchlorate pollution is now comingled with the nitrate plume. The City is responsible for the nitrate pollution but is not responsible for the perchlorate pollution. This situation delayed groundwater cleanup efforts as the City and Water Board staff searched for the money and means to conduct a cleanup that would address both constituents. Since November 2010, Water Board staff conducted numerous public meetings and provided Fact Sheets to inform the public of the cleanup efforts regarding both perchlorate and nitrate in groundwater.

Included with this item are the most recent Press Releases and Fact Sheets describing the cleanup status of the perchlorate and nitrate plumes (Enclosures 1-2). A current map of the comingled perchlorate and nitrate plumes is Enclosure 3.

## ISSUES

There is perchlorate and nitrate groundwater pollution in the Soapmine Road area near Barstow. Water Board staff has obtained a \$2.67 million grant to address cleanup at the perchlorate source area. Once the pilot-scale treatability study is complete, the Water Board will seek additional funding from the State Water Board for a long-term cleanup project to address the perchlorate source area as well as perchlorate groundwater pollution downgradient of its present location. To address nitrate and perchlorate in groundwater, BKT Consulting Engineers (BKT), in coordination with the City, applied for and received a \$1.7 million dollar grant from the California Energy Commission (CEC) to install a bio-filtration system for contaminant removal.

## DISCUSSION

### Perchlorate Groundwater Pollution Discovery

In late November 2010, the Barstow Marine Corps Logistics Base reported that perchlorate was discovered in its drinking water supply. The State Water Board, Division of Drinking Water (DDW, then Department of Public Health) and the Water Board immediately began efforts to locate the source of perchlorate because the

drinking water supply for the whole City of Barstow was shut down. Golden State Water Company, a private firm, supplies water to both the City of Barstow and Nebo Marine Corps Logistics Base. While DDW staff worked with Golden State Water Company to locate the perchlorate source within the distribution system, Water Board staff sampled 26 private residential wells to establish the extent of perchlorate in groundwater.

A City fireman with years of experience recalled a former pyrotechnical company located near the Mojave River. Investigation determined that the company had closed, and the former owner (now deceased) had illegally disposed of excess perchlorate salts to the ground at his residence on Poplar Road, approximately 1.5 miles northwest of the Interstate 15 Mojave River bridge. A Golden State Water Company production well located along Soapmine Road was found to be supplying perchlorate into the drinking water distribution system. The impacted production well was taken out of service, and the water system was flushed and returned to service. Residents immediately downgradient of the perchlorate source continue to have high concentrations of perchlorate in their private wells.

Efforts to establish a viable responsible party for the perchlorate source failed as the former owner's descendants have no assets, and the resulting perchlorate groundwater plume is considered an orphan cleanup site. The City is the responsible party for the nitrate plume. Water Board staff has told the City it is not responsible for the perchlorate plume. The Water Board and the City are working together to address the treatment of both perchlorate and nitrate simultaneously because the perchlorate and nitrate groundwater plumes are now comingled in the Soapmine Road area along the north side of the Mojave River. The perchlorate plume is approximately 2-miles long by 1000-feet wide, and the nitrate plume is about 1.75-miles long and 2000-feet wide.

#### *Perchlorate Cleanup Actions*

The removal action conducted by the USEPA in late 2012 and early 2013 in the perchlorate source area removed an approximately three-foot thick layer of perchlorate salt from two areas of the residence where the illegal disposal occurred. The USEPA removed and properly disposed of approximately 1,100 tons of impacted soil, placed a plastic liner at the bottom of the excavation, and backfilled the excavation. Further soil cleanup is warranted based on soil samples, and perchlorate concentrations in the groundwater remain high in this area.

#### *Joint Nitrate and Perchlorate Cleanup Actions*

To address both perchlorate and nitrate in groundwater, BKT Consulting Engineers, in coordination with the City, applied for and received a \$1.7 million dollar grant from the California Energy Commission (CEC). This grant is paying for a pilot project to treat both perchlorate and nitrate from extracted groundwater along Webster Road where

the plumes are adjacent to each other and likely comingled. Extracting groundwater, as proposed, will pull perchlorate toward the extraction well.

The grant required that BKT Consulting Engineers provide the CEC with a report describing the energy efficiency of a bio-filtration technology. The pilot program will extract 175 to 350 gpm of groundwater; sequentially treat the extracted water for nitrate and then perchlorate. This pilot-scale project will operate for approximately 18 months after construction is complete. The report to the CEC will be provided six months after completing the pilot project; a copy of this report will also be submitted to the Water Board.

Water Board staff applied for and received a separate grant from the State Water Board for \$2.67 million from the Site Cleanup Sub Account Program Fund for a pilot project at the Poplar Road perchlorate source area. Those funds are transferred into the Department of General Services and will be administered by Lahontan Water Board staff. The project proposed by Water Board staff would construct a soil flushing unit and a system to capture, treat, and apply treated water to the perchlorate source area and flush perchlorate to groundwater for subsequent capture. However, the perchlorate plume downgradient of this treatment system will likely continue to migrate further into the Soapmine Road area.

#### *Historical Wastewater Effluent Disposal*

The City's wastewater treatment plant is located east of the City along the south bank of the Mojave River. It has a treatment capacity of 4.5 million gallons per day (mgd) and currently discharges about 2.3 mgd. The WDRs adopted by the Water Board in 1985 authorized application of treated effluent wastewater to two irrigation fields, one north (North Field) and one south (South Field) of the Mojave River; and authorized disposal of secondary treated effluent into eight percolation ponds along the south side of the Mojave River. The North Field is about 67 acres, and the South Field is about 72 acres. Until 2003, the City applied dried sewage biosolids from the wastewater treatment plant to both irrigation fields.

#### *Nitrate Groundwater Pollution Discovery*

Until 2009, the City's wastewater treatment plant produced effluent with total nitrogen concentrations of about 34 mg/L. Effluent and biosolids with high organic nitrogen concentrations were applied to the North and South fields causing the receiving groundwater nitrate concentrations to increase above the groundwater quality objective of 10 mg/L (drinking water maximum contaminant level [MCL]), thus creating a groundwater pollution. The permitted application of biosolids to both fields was first acknowledged in the 1994 (current) WDRs, but had begun earlier.

In 1994, the City was required to construct groundwater monitoring wells, both upgradient and downgradient of the irrigation fields and percolation ponds to assess the impact of wastewater plant discharges on the receiving groundwater. Samples

collected from the monitoring wells detected nitrate pollution had occurred as a result of waste disposal practices.

#### *Improved Wastewater Treatment and Disposal*

The City stopped application of biosolids in August 2003 to both fields because nitrate concentrations in groundwater monitoring wells were above the MCL of 10 mg/L. The City then took steps to immediately improve its wastewater treatment plant and was able to reduce effluent total nitrogen from 30 mg/L to 26 mg/L. During this time, nitrate as nitrogen concentrations in groundwater beneath and immediately downgradient of the North Field were detected at a high of 34 mg/L.

It was not until July 2004 that the Water Board prohibited the City from applying biosolids onto both irrigation fields, required effluent total nitrogen to remain below 26 mg/L (30 day average), and upgrade its treatment plant by July 2009 to ensure that effluent disposal would not further pollute groundwater. The City completed upgrades to its wastewater treatment plant by the imposed deadline. Since that time, the City has continued to make additional upgrades to the wastewater treatment plant. Currently, effluent nitrate concentrations average about 3.5 mg/L and total nitrogen concentrations average about 8.2 mg/L.

#### *Replacement Water to Residents Affected by Nitrate Pollution*

In May 2007 to address health risks associated with nitrate polluted groundwater, the Water Board ordered the City to provide uninterrupted replacement water to residences served by private domestic water wells within the Soapmine Road area. The criteria for supplying replacement water was to all residences for wells in which nitrate as nitrogen concentrations had been detected at or exceeding 5 mg/L. This concentration (one-half the drinking water MCL) was selected because nitrate concentration varied by as much as 5 mg/L from one sampling event to the next (quarterly sampling).

The Water Board also required the City to conduct quarterly sampling of all residential wells in the Soapmine Road area, to submit quarterly reports that included a list of all residences that receive uninterrupted replacement water, and to notify all residents in the Soapmine Road area that nitrate concentrations in the groundwater may exceed the drinking water standard of 10 mg/L. For many years the City provided bottled water to all residents downgradient of the North Field as a good public service, irrespective of the nitrate concentrations in residential wells.

However, since July 2016, the City began providing replacement water only to residents that have nitrate as nitrogen concentrations in their private domestic wells above 5 mg/L, as required in the Order. As of late 2017, the City provides bottled water to 11 residences. Only one residential well contains nitrate as nitrogen above the MCL. Nitrate concentrations in groundwater are declining overall due either to declining water table elevations or through natural attenuation.

### *Additional Monitoring Wells Demonstrate Connected Nitrate Plumes*

In January 2008 and February 2009, the Water Board ordered construction of additional shallow, intermediate, and deep-zone groundwater monitoring wells to evaluate nitrate concentrations in those water bearing units or zones. These additional monitoring wells were required within the Soapmine Road area to fully delineate the lateral extent of nitrate concentrations downgradient of the North Field. The data collected from these wells allowed several stand-alone nitrate plumes to be connected. The concentrations of nitrate as nitrogen above the drinking water standard have moved downgradient beyond the furthest eastern groundwater monitoring well, and the nitrate plume remains undefined towards the Nebo Marine Corps Logistics Base. The nearest downgradient drinking water wells are at the Marine Corps Logistics Base, Barstow, Nebo Annex. The Nebo Annex receives their drinking water from Golden State Water Company due to historically detected base-related groundwater contamination. One of the base production wells (BPW-3) is currently used for landscape irrigation at the golf course. The other wells are no longer used.

### *Nitrate Pollution Cleanup Actions*

From July 2004 to July 2009, the City upgraded its wastewater treatment plant to meet requirements of the CDO. Since 2009, the City has been continuously improving this treatment system, and it now attains an effluent total nitrogen concentration of about 8.2 mg/L. Additionally, in 2006, the City sold the North Field to a private entity, Pacific Holt, which intended to develop the site into private residences. As a result of the economic downturn in 2008, the land remains vacant. The City continues to irrigate alfalfa crops on the South Field using secondary non-disinfected, nitrogen-reduced effluent, but does not apply biosolids.

Between October 2009 and January 2010, the City conducted a pilot program to determine if a fluidized bed reactor treatment method would reduce the levels of nitrate in pumped groundwater to less than the MCL prior to disposal. The test demonstrated that this technology is suitable and able to reduce nitrate as nitrogen concentrations to less than 10 mg/L.

Following this pilot test, in January 2012, the City conducted an aquifer pumping test along Webster Road to determine how the groundwater table would respond to an extraction well pump and treat program. The test results indicated the water table in the Soapmine Road area near an extraction well could be lowered by 1.5 to 3 feet. The City estimated that installing a full-scale pump and treat system would lower the overall water table in the Soapmine Road area by about 3 feet.

Between 2008 and 2013, the City submitted several remediation plans to clean up the groundwater. The Water Board accepted the third revised cleanup plan submitted in April 2013, which was incorporated into the July 2013 CAO. The City's cleanup plan was to:



- Construct four extraction wells on Webster Road and three extraction wells along Clay River Road;
- Extract and treat 1,000 gallons per minute (gpm) of groundwater using a fluidized bed reactor; and
- Discharge treated water into three existing City percolation ponds located on the south side of the Mojave River.

Since that time, the Water Board has issued three revisions of the CAO to extended compliance dates, most recently due to the comingling of perchlorate and nitrate plumes. Water Board staff believes that the cleanup for both constituents should be addressed simultaneously. The City also agrees that cleanup for both constituents should be addressed. To date, no active groundwater nitrate pollution cleanup has occurred.

#### **PUBLIC OUTREACH/INPUT**

Three public meetings and one neighborhood meeting were held in the Soapmine Road area between May 2009 and March 2016 in which much public concern was voiced. Water Board staff answered public concerns based on the best information available at the time. Future public meetings may be scheduled to provide information related to the Water Board's perchlorate source area cleanup project and BKT's and the City's bio-filtration groundwater remediation system project.

#### **PRESENTERS**

Alonzo Poach will present the status of perchlorate along the Mojave River and Ghasem Pour-ghasemi will present the status of nitrate within the Soapmine Road area (Enclosure 4).

#### **RECOMMENDATION**

This is an informational item only and the Water Board will not be asked to take any action, though the Water Board may provide comments to staff during item discussion.

<b>ENCLOSURE</b>	<b>ITEM</b>	<b>BATES NUMBER</b>
<b>1</b>	Fact Sheet, February 2016 – Barstow Groundwater Perchlorate Contamination	<b>6 - 13</b>
<b>2</b>	Fact Sheet, February 2016 – Barstow Groundwater Nitrate Contamination	<b>6 - 17</b>
<b>3</b>	Latest map of the extent of perchlorate and nitrate plumes in groundwater for residential and monitoring wells in Barstow	<b>6 - 21</b>
<b>4</b>	Staff Presentation	<b>6 - 25</b>



# **ENCLOSURE 1**



## FACT SHEET



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Una versión en español de datos acerca de la contaminación de perclorato en las aguas subterráneas está disponible en la página electrónica [www.waterboards.ca.gov/lahontan](http://www.waterboards.ca.gov/lahontan). Esta página provee la manera de comunicarse con el personal de la junta de Control de Calidad de Agua – Región Lahontan (Junta de Agua).

 **California  
Environmental  
Protection Agency**

## California Regional Water Quality Control Board, Lahontan Region

### Barstow Groundwater Perchlorate Pollution Update

#### Background

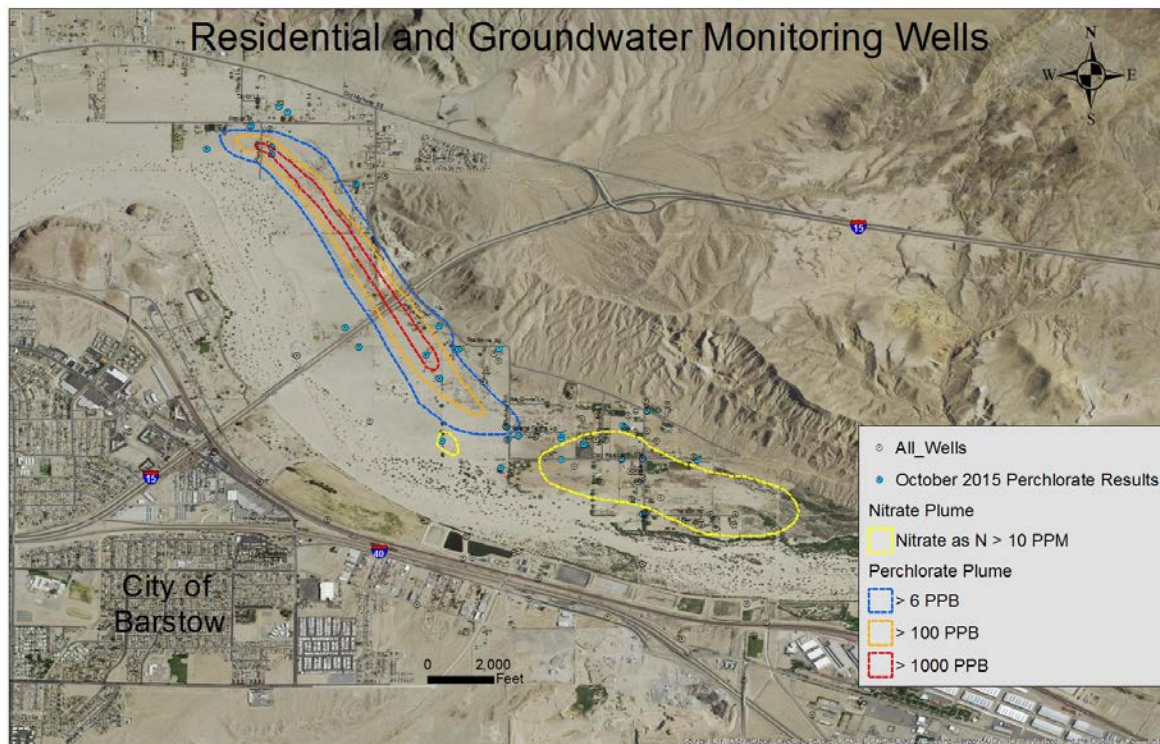
In 2010, perchlorate, a chemical used to make rocket fuel, fireworks, flares, and explosives, was found near Barstow in wells used by Golden State Water Company. Within days of the discovery, Golden State Water Company had cleaned the distribution system and contaminated water is not being distributed in the municipal supply. Perchlorate was detected in the groundwater during a site investigation by the U.S. Environmental Protection Agency (USEPA) at 30433 Poplar Street, Barstow, CA. This site is considered the perchlorate contamination source area.

The California Regional Water Quality Control Board, Lahontan Region (Water Board) completed an investigation of the perchlorate-contaminated groundwater down gradient of the source area in 2012. The Water Board also samples residential wells and City of Barstow (City) monitoring wells on a regular basis to track the movement of the plume.

#### Activities, 2011-2014

- In 2011 and 2012, USEPA conducted site investigations and cleaned up shallow soils at the source area
  - Over 1,100 tons of contaminated soil was removed from the site
  - A plastic liner was installed in the excavated area before being backfilled to prevent water from getting into the soil which still contains perchlorate at depth
  - To protect the plastic liner from being damaged, Land Use Restrictions against digging in the liner area (deed restrictions) were put on the site in 2014
- In 2011, the Water Board investigated groundwater downgradient of the source area. Investigation results showed the presence of a high concentration plume of perchlorate in groundwater from the source area and extending to the southeast.

**Figure 1 – Nitrate and Perchlorate Plume**



## Current Activities

With permission of well owners, the Water Board continues to sample groundwater, from City-owned groundwater monitoring wells and from domestic supply wells in the area. Results from the October 2015 sampling event show the following:

- High concentrations of perchlorate near the source area (up to 2,400 µg/L) and in two private domestic supply wells in the area northwest of Interstate 15 (I-15).
- The perchlorate contamination is moving in groundwater south and east beyond I-15 at concentrations above the maximum contaminant level (MCL) of 6 micrograms per liter (µg/L).
- The perchlorate plume greater than the MCL appears to extend more than 1.8 miles southeast from the source area.
- The lateral and vertical distribution of perchlorate is still not well known. At its most eastern point the perchlorate plume has mixed in with a nitrate plume in groundwater (caused by the City's treated sewage discharge site). See reverse side for an updated plume map showing both the perchlorate and nitrate plumes in groundwater. A separate Fact Sheet describing the status of the nitrate plume can be found at [http://www.waterboards.ca.gov/lahtontan/water\\_issues/programs/nitrate/index.shtml](http://www.waterboards.ca.gov/lahtontan/water_issues/programs/nitrate/index.shtml)

## Perchlorate and Drinking Water Standards

While the federal government has not yet set an MCL for perchlorate, California has established the MCL (the drinking water limit) for perchlorate at 6 micrograms per liter (µg/L, also known as parts per billion or ppb). MCLs are set for drinking water purposes only. It is important not to drink or prepare food with water that exceeds an MCL of 6 µg/L for Perchlorate. Boiling the water will not remove perchlorate and may actually concentrate it in the water. However, water that exceeds an MCL can be used for other purposes such as washing dishes, washing clothes, and general cleaning. MCLs are for humans. No standards exist for consumption by animals or for irrigation purposes. Persons wishing to better understand the health effects related to perchlorate are encouraged to contact the San Bernardino County Environmental Health Services, Safe Drinking Water Section or the State Water Resources Control Board, Division of Drinking Water.

## Next Steps

- The Water Board is continuing to work with other state agencies to determine the next steps for additional groundwater investigation and remediation, and possible funding sources.
- The California Rural Water Association has been awarded a planning grant to look at forming a legal entity in the area that could receive grant monies to provide a safe and reliable source of drinking water for each household. The planning grant will be considering a variety of alternatives. Community members are encouraged to participate in the process.

## Reference/Resource

Barstow Perchlorate

*Mojave River Pyrotechnics Assessment Report*, dated October 2011 and *Perchlorate Groundwater Investigation Report*, 30433 Poplar Street, Barstow, California

[http://www.waterboards.ca.gov/lahtontan/water\\_issues/programs/perchlorlate/index.shtml](http://www.waterboards.ca.gov/lahtontan/water_issues/programs/perchlorlate/index.shtml)

## Health Related Resource

San Bernardino County, Department of Health Services, 172 W. 3rd Street, 1st Floor,  
San Bernardino, CA 92415

(800) 442-2283

[http://www.sbcounty.gov/dph/dehs/Depts/EnvironmentalHealth/BusinessServices/safe\\_drinking\\_water.aspx](http://www.sbcounty.gov/dph/dehs/Depts/EnvironmentalHealth/BusinessServices/safe_drinking_water.aspx)

## **ENCLOSURE 2**





# California Regional Water Quality Control Board, Lahontan Region

## Barstow Groundwater Nitrate Pollution Update



### FACT SHEET

February 2016

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Lahontan Region**

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Una versión en español de datos acerca de la contaminación de nitrato en las aguas subterráneas está disponible en la página electrónica [www.waterboards.ca.gov/lahontan](http://www.waterboards.ca.gov/lahontan). Esta página provee la manera de comunicarse con el personal de la junta de Control de Calidad de Agua – Región Lahontan (Junta de Agua).

### Introduction

This fact sheet describes the status of groundwater nitrate pollution investigation and cleanup activities in the Soapmine Road area east of Barstow along the Mojave River. Since 2004, the Water Board has required the city of Barstow (City) to evaluate nitrate concentrations in groundwater, ensure that no one is drinking water with nitrate above drinking water standards, eliminate pollution sources, and clean up groundwater to either background levels or to what is feasible, but in no case greater than drinking water standards.

### Nitrate Found Above Drinking Water Standards

Nitrate concentrations in some areas between the Soapmine Road and the Mojave River (Soapmine Road area) are at, or above, levels greater than the state standard for drinking water. The Water Board required the City to investigate this problem because the predominant source of pollution is the City's historic wastewater disposal on fields north of the Mojave River and northwest of the wastewater treatment plant. Other potential nitrate sources include septic tank discharges and agricultural fertilizers (see Figure 1).

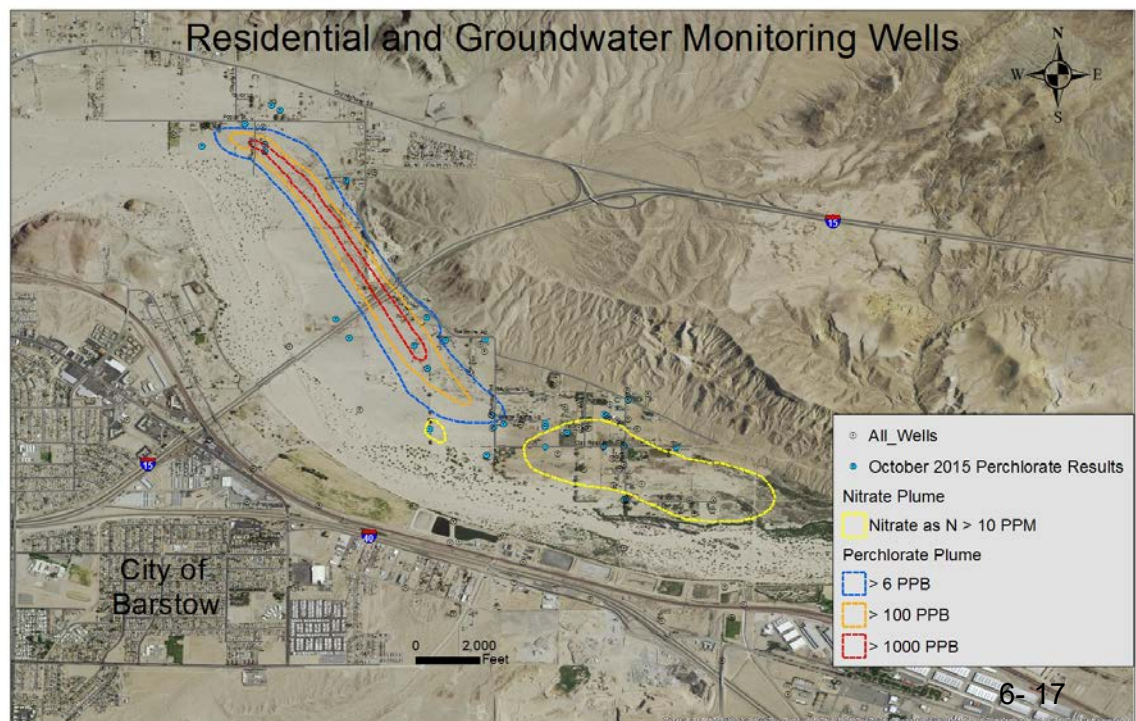
### Health Effects from Nitrate

Total nitrogen is comprised of organic nitrogen, ammonia, nitrate, and nitrite. Nitrate nitrogen is the most highly oxidized form of nitrogen found in wastewater. The California drinking water standard for "nitrate as nitrate" ( $\text{NO}_3$ ) is 45 milligrams per liter (equivalent to parts per million or ppm). Nitrate is also reported as "nitrate as nitrogen" (N) and 10 ppm nitrate as N equals 45 ppm nitrate as  $\text{NO}_3$ . Water with nitrate in this amount or higher is a serious health concern for infants and pregnant women. For the purposes of this fact sheet, all nitrate concentrations will be reported as nitrate as N so that concentrations can be compared to the 10 ppm value. Boiling, freezing, most types of filtering, and/or letting water stand does not reduce or remove nitrate levels. Boiling actually increases the concentration of nitrate in the water.

### Nitrate Sources

Nitrate is a type of salt containing nitrogen. Low levels of nitrate occur naturally in water. Nitrate levels that exceed water quality standards are most often due to inappropriate disposal of animal waste and human sewage, or the inappropriate application of nitrogen-based fertilizers that leach to groundwater. While these materials can safely and effectively be used on farms, they can result in nitrate pollution of ground and surface waters if they are over-applied, especially in sandy soils. Septic systems can pollute groundwater with nitrate.

Figure 1 – Nitrate and Perchlorate Plume



## FACT SHEET

### Completed/Ongoing Activities

- Treatment Plant Upgrades - The Water Board directed the City to upgrade its wastewater treatment facility to decrease the concentration of nitrogen in their treated wastewater by July 2009. The City completed this upgrade and improved its wastewater treatment facility between 2014 and 2015. A December 2015 report indicates the average concentration in the wastewater treatment plant effluent for the last 12 months is 3.47 mg/L for nitrate as nitrogen (N) and 7.02 mg/l for total nitrogen.
- Residential Well Sampling – Nitrogen leaching from sludge and treated wastewater applied to irrigation fields and percolation ponds has contaminated the groundwater. The Water Board ordered the City to perform quarterly sampling of all residential wells that may be affected in addition to sampling the City's monitoring wells. As of the fourth quarter 2015, nitrate in two residential drinking water wells was over the drinking water limit.
- Replacement Water - The Water Board required the City to provide bottled water to the residents within the affected area that have nitrate as N concentrations above 5 ppm. As of the fourth quarter 2015, there were eight residential wells with nitrate as N concentrations greater than 5 ppm. Although the drinking water standard for nitrate as N is 10 ppm, the Water Board required the City to provide replacement bottled water to all residents with wells showing nitrate as N concentrations greater than 5 ppm because variation between sampling events could allow the drinking water standard to be exceeded in the meantime.
- Pilot Treatment Test - The City conducted a pilot program between October 2009 and January 2010 to determine if a fluidized bed reactor treatment method would reduce the levels of nitrate in groundwater pumped from the plume prior to disposal. In this process, a biomass growth is maintained by using methanol or ethanol as a food source for bacteria to reduce nitrate by conversion to nitrogen and carbon dioxide gases and additional biomass. The test demonstrated that this technology is suitable to reduce nitrate as N concentrations to less than the drinking water standard of 10 ppm nitrate as N and a pilot test target level of 5 ppm nitrate as N.

### Recent Activities

- The Water Board directed the City to evaluate and propose a groundwater cleanup strategy. The City submitted an initial groundwater cleanup plan in June 2010 that did not consider multiple scenarios. In January 2011, the City provided a revised plan evaluating different scenarios. In June 2011, Water Board staff told the City that the computer groundwater model was not calibrated properly, and requested revised computer models and an aquifer pump test to evaluate the pumping radius of influence and draw down effect.
- In January 2012, the City conducted an aquifer test along Webster Rd. that determined how the groundwater will respond to an extraction well pump and treat program. The test results indicated the water table in the Soapmine Road area near an extraction well could be lowered by 1.5 to 3 feet. Therefore, a pump and treat cleanup system may cause the water table to drop during the cleanup.
- In February 2012, the City submitted a revised cleanup plan that would pump from four extraction wells along Webster Road and one well along Clay River Road, treat extracted water using a fluidized bed reactor, and dispose of treated water in ponds along the south side of the Mojave River.
- In April 2013, after further negotiation with the Water Board, the City submitted a third revised cleanup plan that would pump from four extraction wells along Webster Road and three wells along Clay River Road. The Executive Officer approved this plan when issuing Clean Up and Abatement Order R6V-2013-0045-A1. However, due to perchlorate groundwater pollution upgradient of the proposed extraction system and the mixing of nitrate and perchlorate, Water Board staff and the City agreed that both constituents should be addressed simultaneously.
- In August 2014, the City submitted another revised cleanup plan to address both nitrate and perchlorate. That plan was too expensive so Water Board staff and the City are discussing a less expensive plan. In 2015, the City applied for a grant from the State Board to address the perchlorate portion of the cleanup cost.

### Next Steps

- The City's final Remedial Action Plan is not complete at this time. The Executive Officer directed the City to (1) obtain funding and provide a new construction design by May 2016, (2) complete a final design report by May 2017, and (3) start extraction and treatment by November 2017.

### Health Related Resource

San Bernardino County, Department of Health Services,  
72 W. 3rd St., 1st Floor, San Bernardino, CA 92415  
(800) 442-2283

[http://www.sbcounty.gov/dph/dehs/Depts/EnvironmentalHealth/BusinessServices/safe\\_drinking\\_water.aspx](http://www.sbcounty.gov/dph/dehs/Depts/EnvironmentalHealth/BusinessServices/safe_drinking_water.aspx)

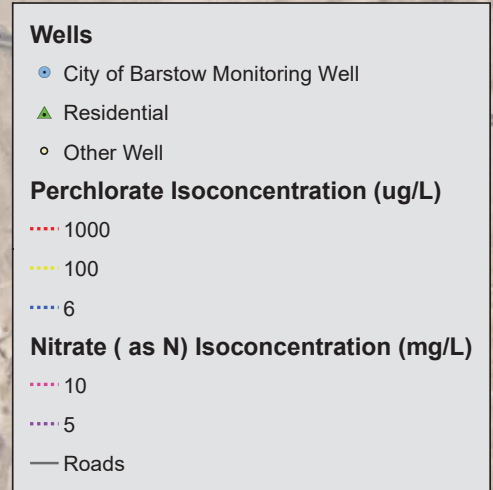
## **ENCLOSURE 3**





# Enclosure 3

## Extent of Nitrate and Perchlorate in Groundwater Residential and Monitoring Wells Barstow, CA 2nd Quarter 2017



City of  
Barstow

Note: Nitrate Plume digitized from Figure 7, 2nd Quarter 2017 Groundwater Monitoring Report prepared by Atlas Environmental Engineering, Inc. on behalf of the City of Barstow.

Document Path: R:\RB6\RB6\Victorville\SharedUnits\Barstow Perchlorate\Barstow Perchlorate Plume\Perchlorate PDF's\GIS MAPS\2017\_April\_perc\_nitrate\_map.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



## **ENCLOSURE 4**





Enclosure 4

## Agenda Item 6

### Perchlorate and Nitrate Pollution in Groundwater Barstow, CA

Alonzo Poach, Engineering Geologist  
and  
Ghasem Pour-Ghasemi, Water Resource Control Engineer

Lahontan Regional Water Quality Control Board  
January 10, 2018  
Apple Valley, California



V:\units\cm unit\Barstow Perchlorate\public meeting\barstow public meeting ppt1-2016

## Purpose

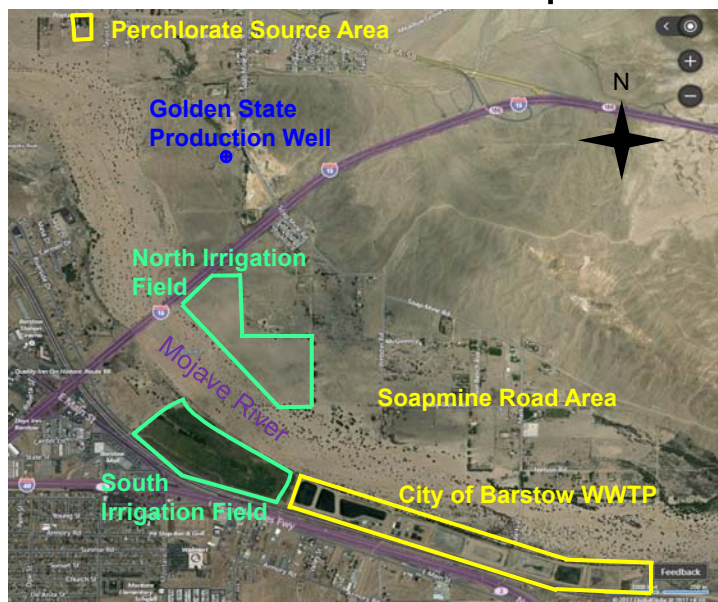
- Discuss perchlorate and nitrate in groundwater near Soapmine Road, in Barstow
  - Sources and background
  - Response actions
  - Current status
- Status update to inform the Board and the public

## Groundwater Pollution Near Soapmine Road

- Primary Contaminants of Concern
  - Perchlorate Plume - source at Bray property located west of I-15 Freeway
  - Nitrate Plume - source from City wastewater treatment plant disposal site located east of I-15 Freeway

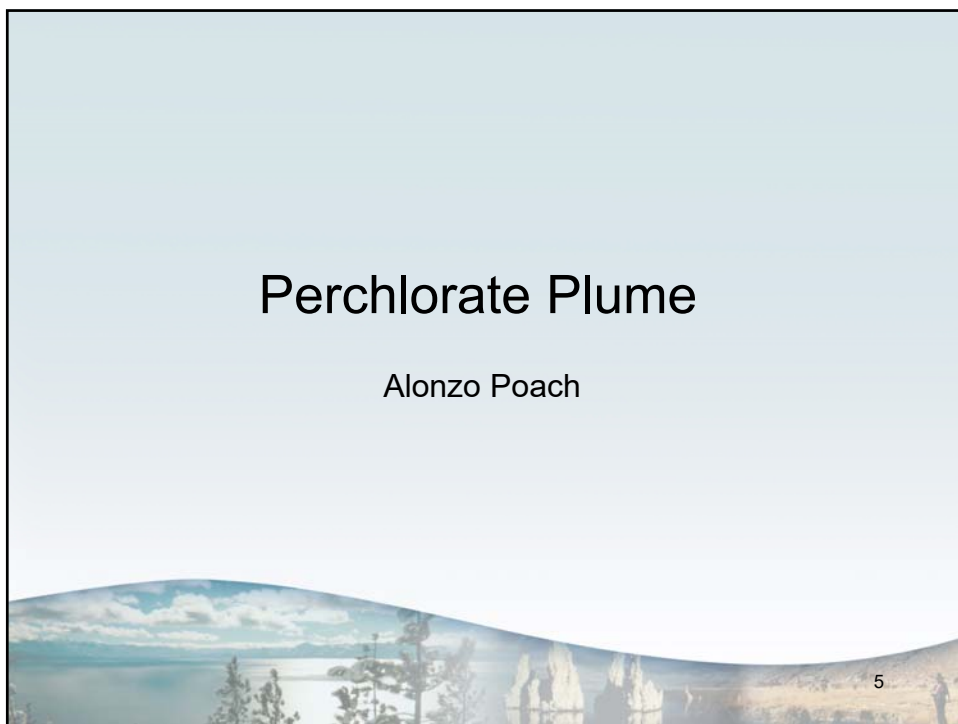


## Barstow Area Map



# Perchlorate Plume

Alonzo Poach



## Perchlorate Source Area and History



## History

- Perchlorate detected in Golden State Water Company's Soapmine Road Well in November 2010
- USEPA and Water Board investigated and determined the source to be located at a residence on Poplar Street
- Investigation determined illegal disposal of perchlorate occurred in mid 1980s



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## History (Continued)

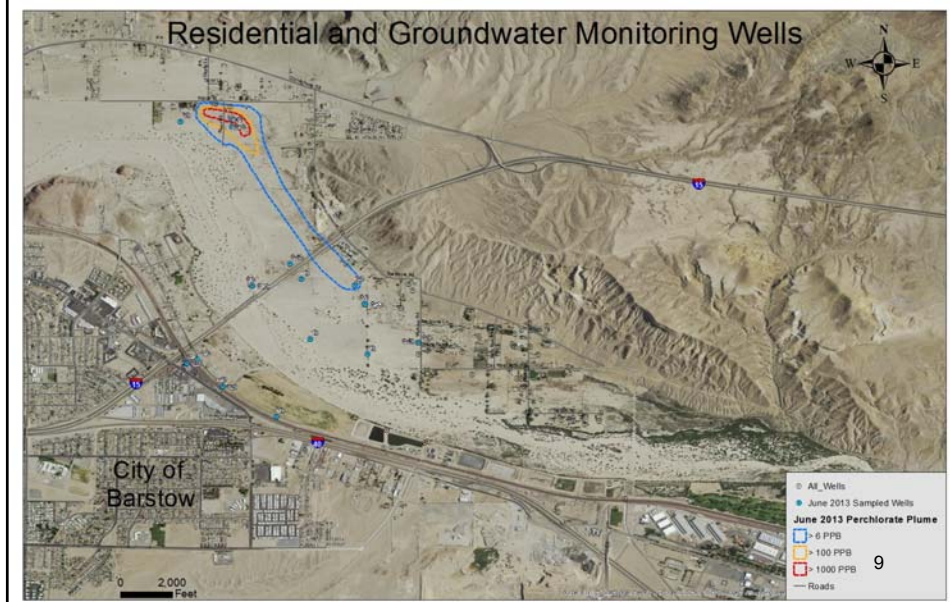
- Water Board conducted a groundwater investigation January 2012 to determine the extent of perchlorate in the shallow part of the aquifer
  - Detected perchlorate concentrations up to 13,000 micrograms per liter (ug/L) near the source



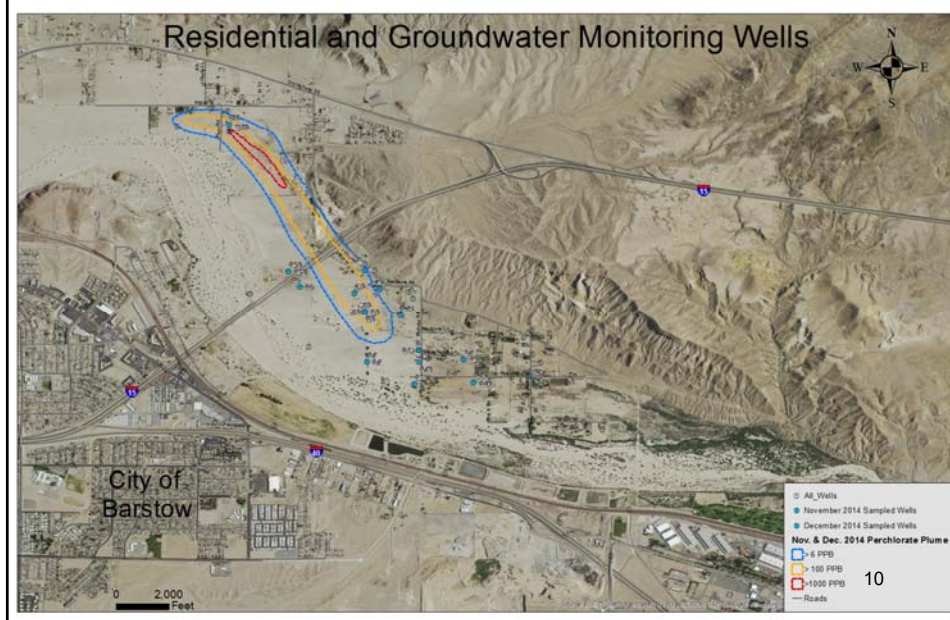
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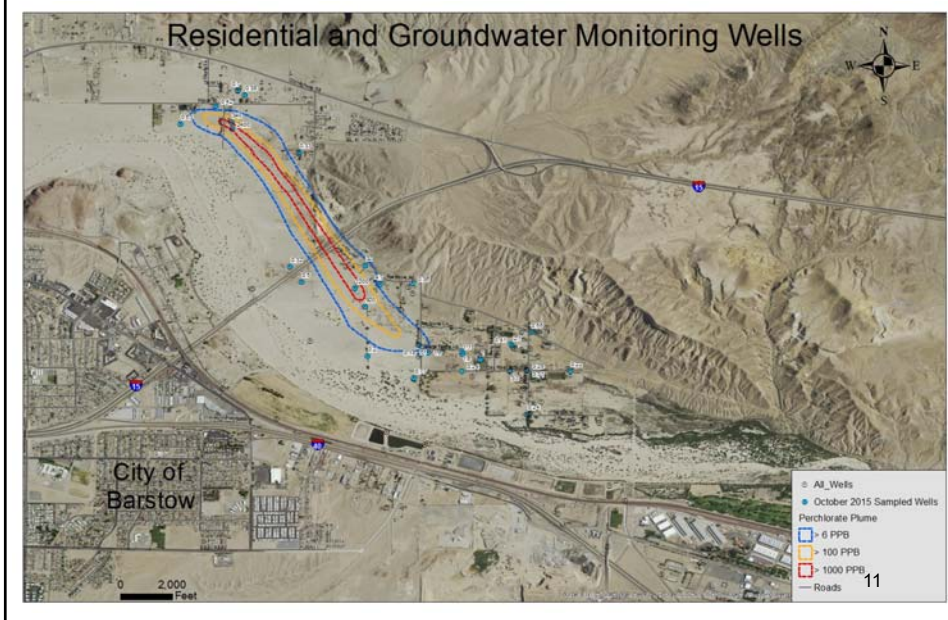
## Perchlorate Plume – June 2013



## Perchlorate Plume – December 2014



## Perchlorate Plume – October 2015



## Perchlorate Plume – October 2016





## Perchlorate Plume – October 2017



## Current Conditions

- Private residential wells and City of Barstow monitoring wells periodically sampled by Water Board staff since discovery of perchlorate in the Soapmine Road well in 2010
- Plume extends south and east from the source area to beyond I-15, with a total length of approximately 2.0 miles
- Plume is moving about 1.0 to 1.5 feet per day



## Current Conditions (Continued)

- Leading edge of the plume, as defined by the maximum contaminant level (MCL) 6 ug/L, is now just east of Irwin Bench Lane, north of Clay River Road
- Residential wells perchlorate concentrations vary from trace values to 1600 ug/L, with an historical maximum of 2600 ug/L
- Perchlorate plume commingled with City of Barstow nitrate plume south and east of I-15



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## Current Conditions (Continued)

- Water Board providing bottled water to 8 residents with perchlorate-impacted wells
- Currently awaiting contractor award to perform removal action in the source area (funded by SB 445 law)
  - Contractor has been selected through Department of General Services



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# Nitrate Plume

Ghasem Pour-Ghasemi

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# Nitrate Plume

Barstow City Wastewater Treatment Plant Board  
Order 6-85-60 authorized disposal of:

- Biosolids and effluent to:
  - North irrigation field
  - South irrigation field
- Effluent to:
  - Percolation ponds

Elevated effluent total nitrogen and biosolids  
leached nitrate to shallow groundwater causing  
pollution, detected after 1994

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## Water Board Actions

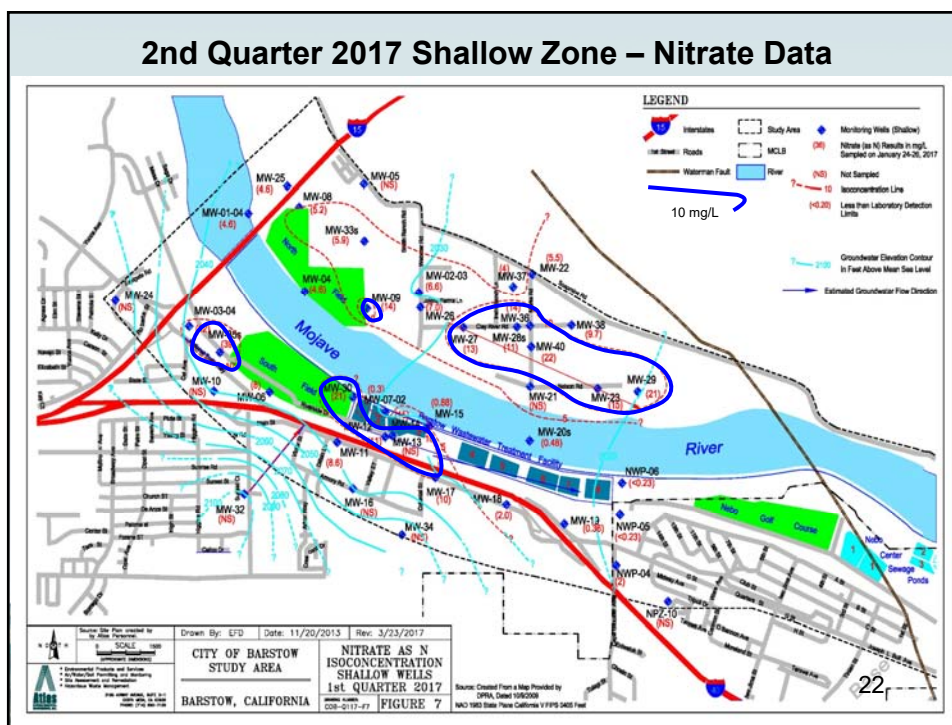
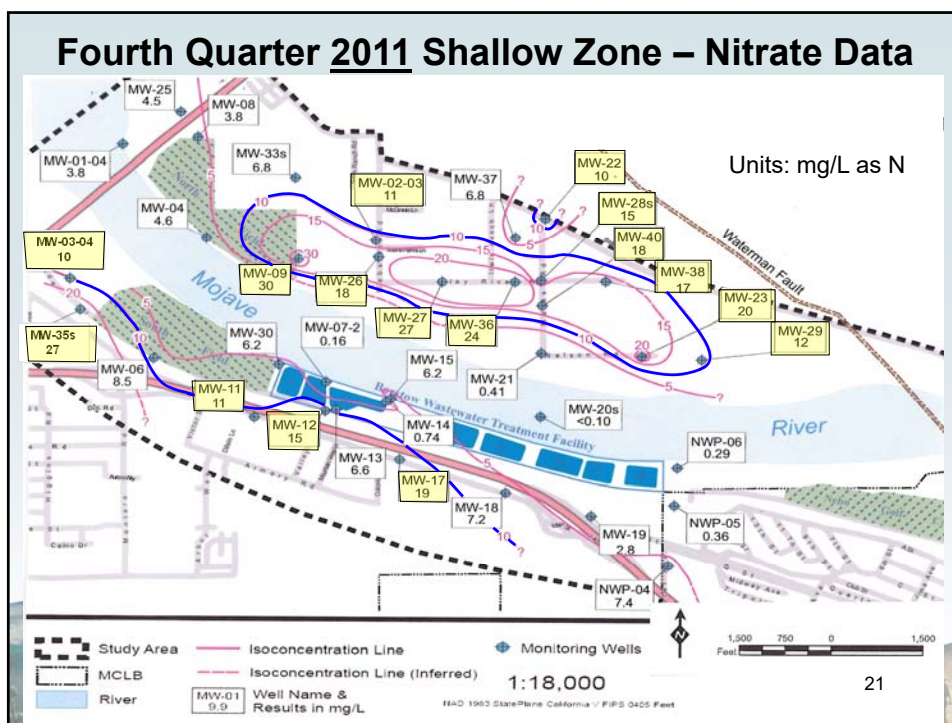
Year	Action	Requirement
2004	Cease & Desist Order	<ul style="list-style-type: none"> <li>• Stop applying biosolids</li> <li>• Upgrade wastewater treatment</li> </ul>
2007	Investigative Order	<ul style="list-style-type: none"> <li>• Characterize nitrate plume</li> <li>• Propose cleanup</li> </ul>
2007	Cleanup & Abatement Order	<ul style="list-style-type: none"> <li>• Sample residential wells</li> <li>• Supply replacement water</li> </ul>
2013	Cleanup & Abatement Order	<ul style="list-style-type: none"> <li>• Remediate nitrate polluted groundwater</li> <li>• (Four amendments extending time schedule)</li> </ul>

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## Water Board Public Outreach

Year	Action
2009	Public Meeting discussing extent of nitrate groundwater pollution and City's planned actions
2012	Public Meeting discussing extent of nitrate groundwater pollution, discovery of perchlorate, and Water Board and City actions
2016	Public Meeting discussing co-mingling of perchlorate and nitrate plumes, solicited public concerns and ideas for addressing both
2016	Neighborhood Meeting answering local resident concerns and feasibility of neighborhood drinking water system
	Numerous Fact Sheets distributed to the public and posted on Water Board web site

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## City's Actions to Address Nitrate

Year	Action
1994	<ul style="list-style-type: none"> <li>Groundwater monitoring wells first installed, quarterly monitoring, about 40 wells installed</li> </ul>
2003	<ul style="list-style-type: none"> <li>Field application of biosolids stopped, now hauled offsite</li> <li>Effluent total nitrogen reduced from 30 to 26 mg/L</li> </ul>
2007	<ul style="list-style-type: none"> <li>Ongoing sampling of private residential wells in Soapmine Road area</li> <li>Replacement water provided to residences with concentrations &gt; 5 mg/L</li> </ul>
2009	<ul style="list-style-type: none"> <li>Completed pilot test of fluidized bed reactor for nitrate removal</li> </ul>
2010	<ul style="list-style-type: none"> <li>Initial groundwater cleanup plan submitted, four total, not yet implemented</li> </ul>
2012	<ul style="list-style-type: none"> <li>Completed aquifer pump test</li> </ul>
2014	<ul style="list-style-type: none"> <li>Completed wastewater treatment plant upgrades reducing effluent total nitrogen, in 2016 about 8.2 mg/L</li> </ul>

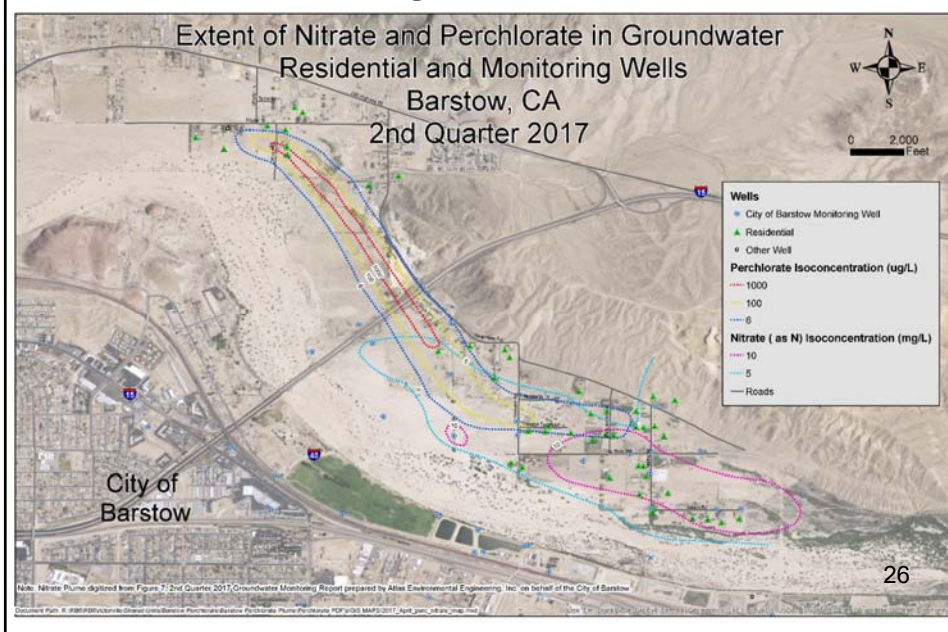
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## Next Steps

- Continue monitoring of both perchlorate and nitrate (Water Board and City)
- Pilot test using fluidized bed bioreactor system installed on Webster Road
- Perchlorate source area treatment
  - Install/operate perchlorate source area treatment system with SB 445 funds
- Additional discussions with community

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# Comingled Plume



Questions / Comments

