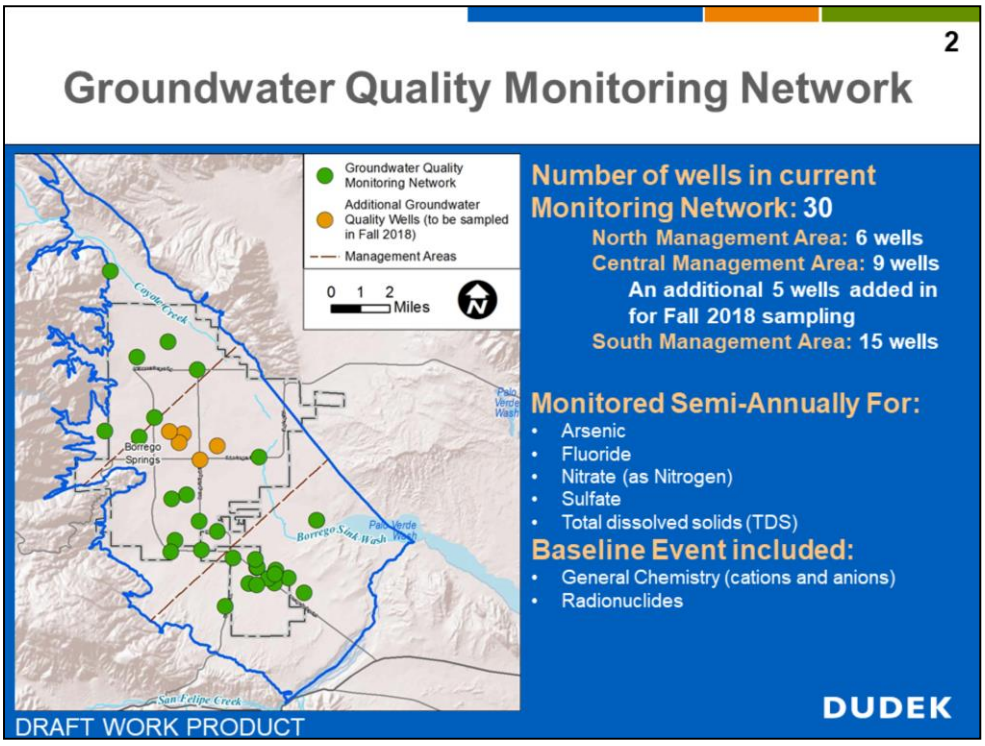
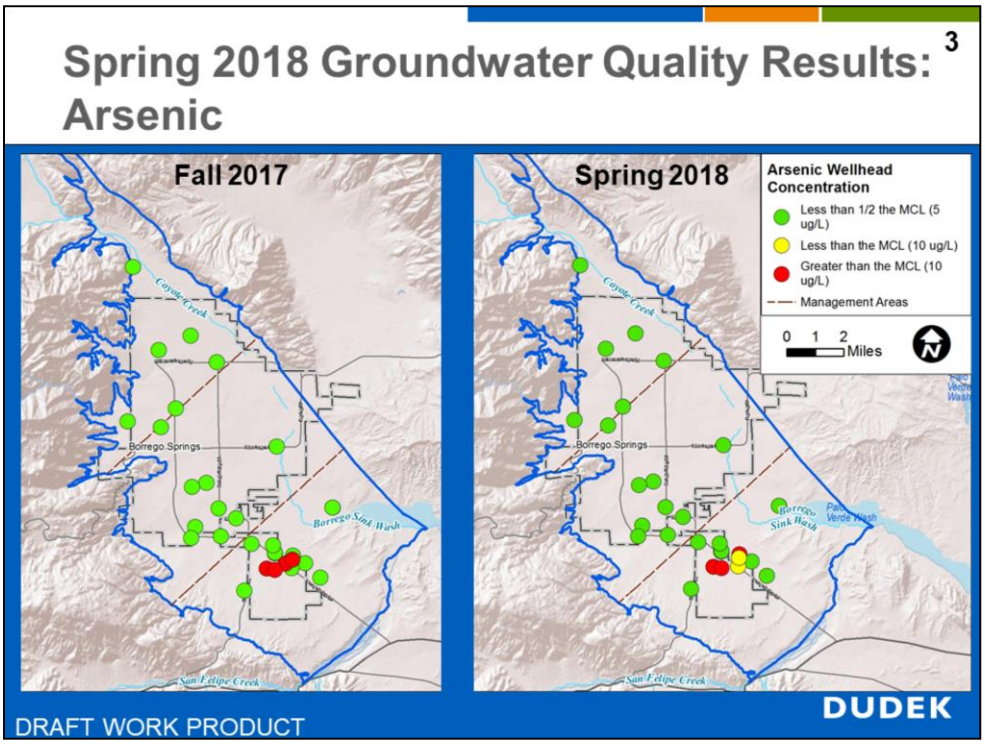
The Dudek team performed the spring 2018 groundwater monitoring event for the Borrego Springs Groundwater Subbasin (Subbasin), including measurement of groundwater elevations in 46 wells as compared to 37 wells in the fall 2017, and analysis of groundwater quality from 29 wells as compared to 30 wells in the fall 2017.[1] The spring 2017 monitoring event builds on the fall 2017 monitoring event to track changes in groundwater levels and groundwater quality in the Subbasin. The data collected will be compared to previous Groundwater Sustainability Agency (GSA) monitoring events and historical data to further refine understanding of Subbasin conditions for development of the Groundwater Sustainability Plan (GSP), and will also be used for tracking progress toward sustainability goals to be defined in the pending GSP. Data collected during the spring and fall 2017, and spring 2018 events have been incorporated into the GSA's Data Management System (DMS).[2] Results from measurement of groundwater levels and for water quality from the spring 2018 monitoring event were generally consistent with the spring and fall 2017 monitoring events and previous available historical data and trends.

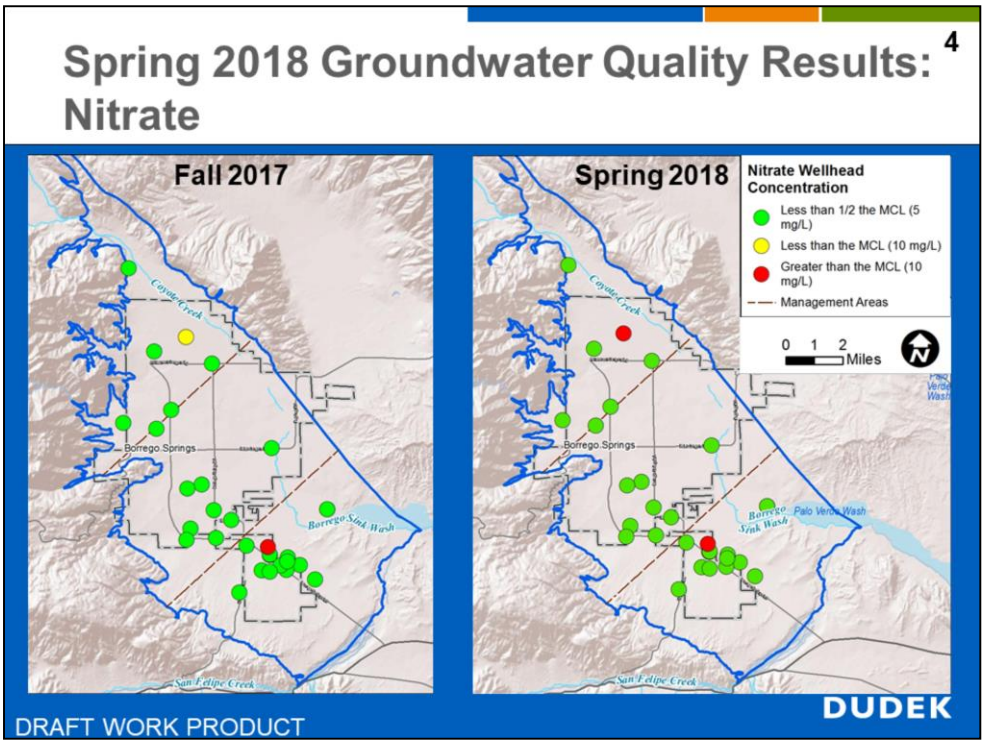
1. One well, RH-3, was not sampled due to a malfunctioning pump that has since been repaired.
2. For the spring 2017 monitoring event only groundwater levels were measured and no groundwater quality samples were collected.



In the fall of 2017, the Borrego Valley GSA performed groundwater quality sampling in order to establish baseline water quality and track water quality trends. Groundwater sampling will continue to occur semi-annually during Groundwater Sustainability Plan (GSP) preparation and is proposed to occur semi-annually during GSP implementation. Wells were monitored for potential constituents of concern (COCs) that were previously identified in part by the U.S. Geological Survey (USGS) and Department of Water Resources (DWR), and a review of the historical data by the GSA Consultant team. The COCs include arsenic, fluoride, nitrate, sulfate and total dissolved solids (TDS). Additionally in the fall of 2017 for the baseline event, general minerals were analyzed to establish baseline water quality and for comparison of water quality type for all wells monitored. Radionuclides were also analyzed to determine baseline conditions but are not currently considered a COC of concern. In the fall 2018, 5 wells are proposed to be added to the monitoring network for both groundwater levels and groundwater quality in the Central Management Area (orange dots) to better track trends in this area of the Subbasin. Additionally, the GSA continues to work with private landowners to expand the monitoring network and is currently in the process of negotiating access to additional existing wells. The fall 2017 and spring 2018 results of groundwater quality are presented in the following slides by constituent of concern.



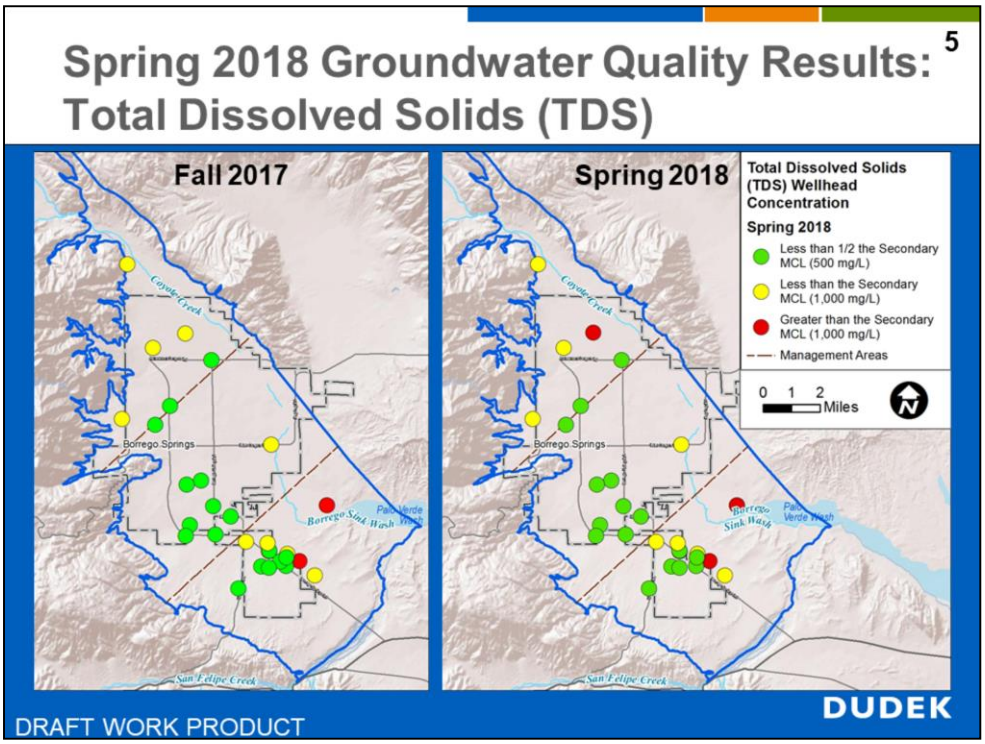
Groundwater quality results are color coded by concentration relative to their respective California drinking water maximum contaminant level (MCL). Green dots represent concentrations less than one-half the MCL. Yellow dots represent concentrations less than the MCL and red dots indicate concentrations above the MCL. The primary MCL for arsenic is 10 micrograms per liter (µg/L). Fall 2017 results are shown on the left figure and Spring 2018 results are shown on the right figure. Arsenic concentrations from the 29 wells sampled in the spring 2018 were all less than one-half the drinking water MCL, except for 5 wells located in the SMA of the Subbasin. The 5 wells with elevated arsenic are non-potable wells that provide water supply to the Rams Hill Golf Course (RHGC). The wells are predominately screened in the Lower Aquifer. In the spring 2018, the arsenic concentration of one of the wells (RH-4) declined to less than the MCL, and increased slightly to over ½ the MCL in another well (RH-2) as noted by the two yellow dots. Elevated arsenic was detected in the Rams Hill wells when they were originally drilled. Analysis of the four samples collected from 2015 to 2018 for the RHGC wells indicate there are no statistically significant trends in arsenic concentrations for any of the RHGC wells using the Mann-Kendall test at a confidence level of 95% (0.05 significance level). RHGC voluntarily monitors their wells on a semi-annual basis at their own expense.



Nitrate concentrations from the 29 wells sampled in the spring 2018 were all less than one-half the drinking water maximum contaminant level (MCL), except for one well in the North Management Area (NMA) and one well in the South Management Area (SMA). The primary MCL for nitrate as nitrogen (as N) is 10 milligrams per liter (mg/L). Potential sources of nitrate include septic recharge, fertilizer applications and/or leaching of natural nitrogen deposition in desert soils.

One well sampled in the NMA exceeded the nitrate MCL during the spring 2018 event. In fall 2017, the well tested below the MCL but historical nitrate results for this well indicate previous exceedances of the MCL. Additional wells screened in the upper aquifer of the NMA are required to determine nitrate concentrations in the upper aquifer underlying areas of historical agricultural fertilizer applications.

The source of elevated nitrate detected in the SMA is likely the adjacent percolation ponds for the Rams Hill Wastewater Treatment Facility (WWTF). Review of the effluent data for the WWTF indicates total nitrogen effluent concentrations ranging from 4.2 mg/L to 48.0 mg/L. Dissolved concentrations of nitrate may increase at the percolation ponds as result of evaporation. To date, nitrate concentrations in the SMA detected above the nitrate drinking water MCL have only occurred at the WWTP monitoring well.



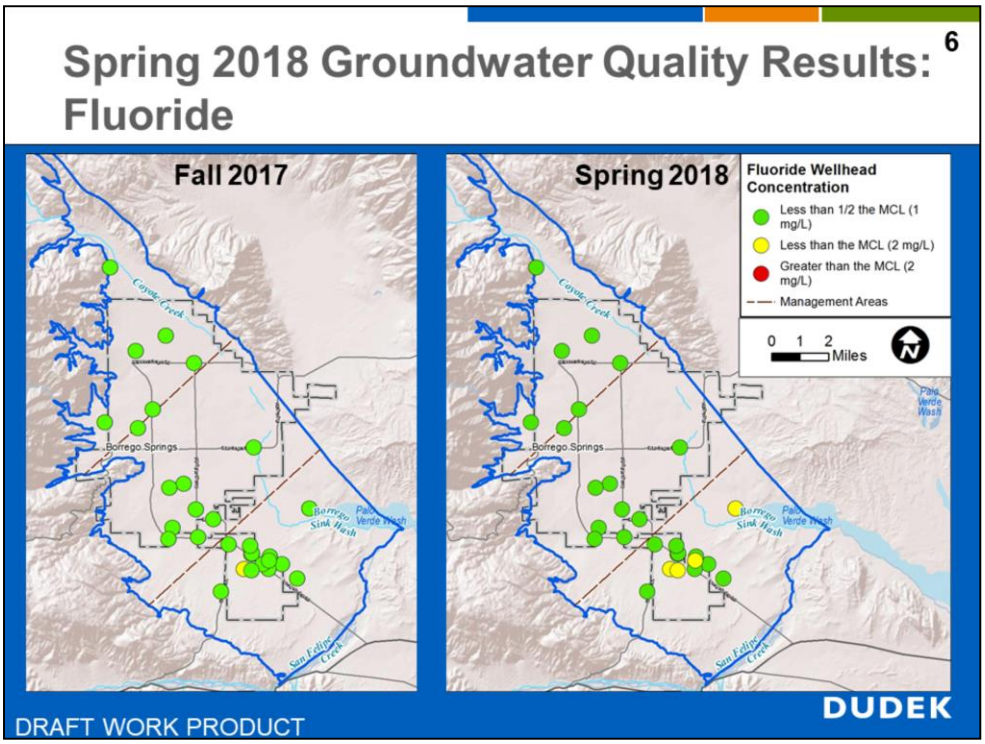
Total dissolved solids (TDS) concentrations from the 29 wells sampled in the spring 2018 were all less than one-half the drinking water upper maximum contaminant level (MCL), except four wells in the NMA, one well in the CMA and five wells in the SMA.[1] The fall 2017 and spring 2018 TDS results are similar except for an increase in one well in the NMA.

The wells with slightly elevated TDS concentrations appear to be correlated with wells completed in the Lower Aquifer at the western edge of the Subbasin and potentially with wells completed in the Upper Aquifer that have been impacted by irrigation return flow.

Elevated TDS also appears to be correlated with poorer water quality near the Borrego Sink likely due to concentration of dissolved solids as a result of evaporation of water in the Borrego Sink and later leaching of evaporites (sediments formed by the evaporation of water).

Slightly elevated TDS is also apparent in the Lower Aquifer of the South Management Area. This is likely due to the longer residence time of this water in the aquifer as previously described.

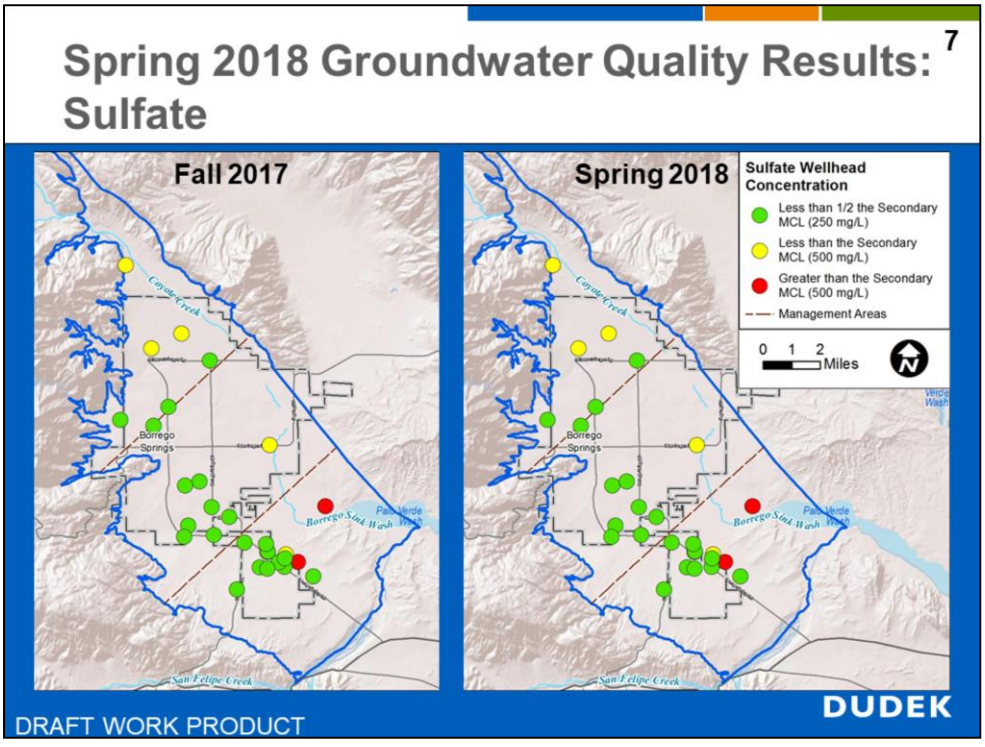
[1.] Total Dissolved Solids (TDS) has a secondary MCL ranges of recommended (500 mg/L), upper (1,000 mg/L) and short-term.(1,500 mg/L).



Fluoride concentrations from the 29 wells sampled in the spring 2018 were all less than one-half the drinking water maximum contaminant level (MCL) except four wells in the SMA. The California drinking water MCL for fluoride is 2 mg/L.

The wells with slightly elevated fluoride concentrations appear to be correlated with wells completed in the Lower Aquifer or with poorer water quality near the Borrego Sink likely due to concentration of dissolved solids as a result of evaporation of water in the Borrego Sink and later leaching of evaporites (sediments formed by the evaporation of water).

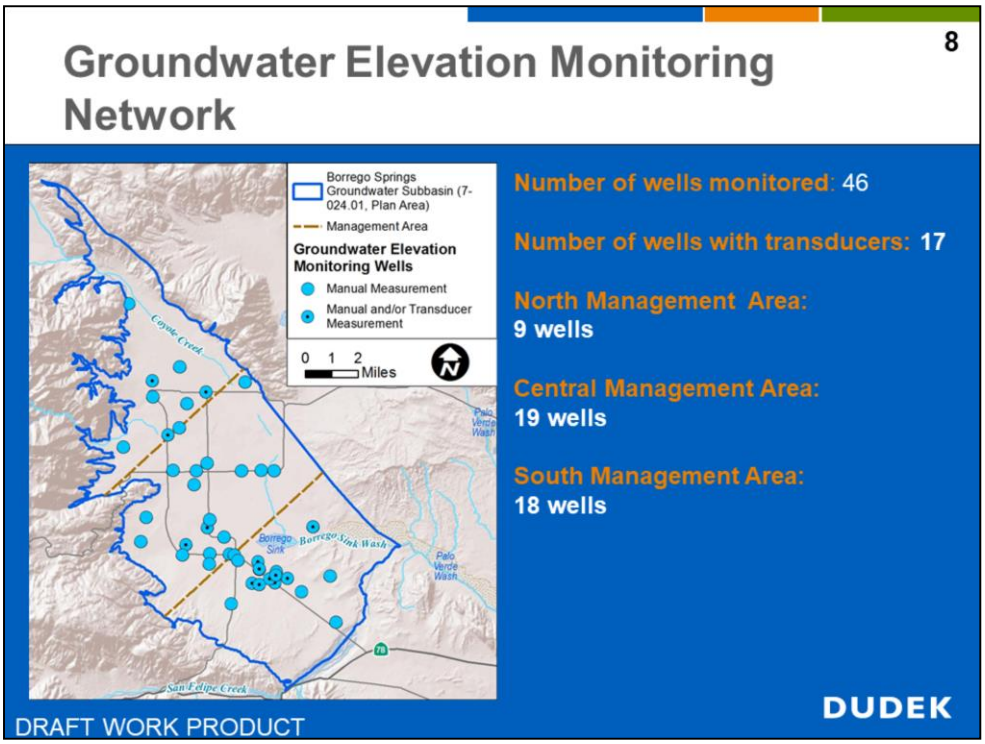
Slightly elevated fluoride in the Lower Aquifer of the SMA is likely due to the longer residence time of this water in the aquifer as previously described.



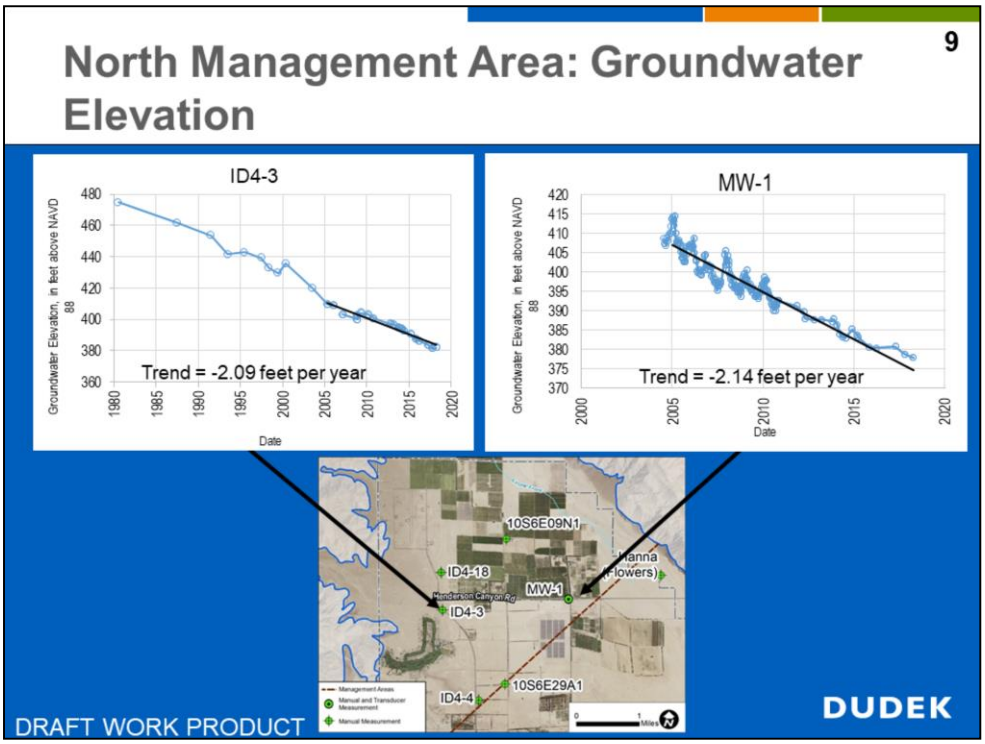
Sulfate concentrations from the 29 wells sampled in the spring 2018 were all less than one-half the drinking water upper maximum contaminant level (MCL) except for 3 wells sampled in the NMA, 1 well in the CMA that were less than one-half the secondary upper drinking water maximum contaminant level (MCL).[1] Two wells in the SMA were above the sulfate upper MCL of 500 milligrams per liter (mg/L). Sulfate concentrations in the spring 2018 were similar to concentrations in the fall 2017.

The elevated source of sulfate is unknown but may coincide with variable groundwater quality at the edge of the Subbasin near the contact of unconsolidated sediments with metamorphic and igneous fractured rock in the NMA. Elevated sulfate also appears to be associated with poorer water quality near the Borrego Sink likely due to concentration of dissolved solids as a result of evaporation of water in the Borrego Sink and later leaching of evaporites (sediments formed by the evaporation of water).

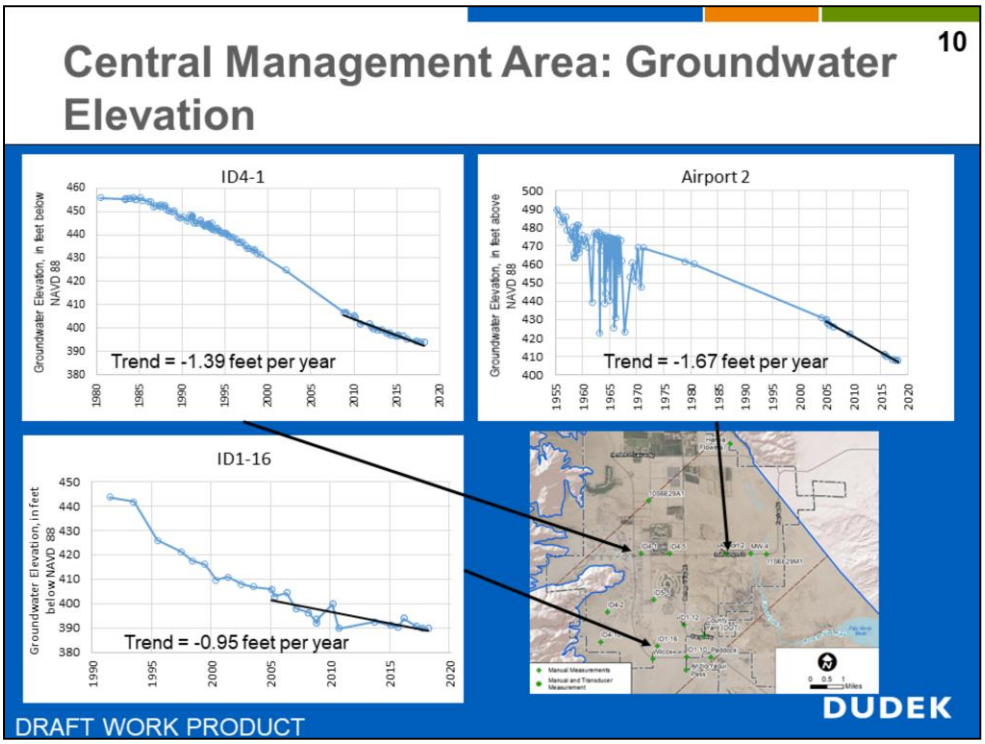
[1.] Sulfate has a secondary MCL ranges of recommended (250 mg/L), upper (500 mg/L) and a short term limit of 600 mg/L.



The Borrego Valley Groundwater Sustainability Agency (GSA) groundwater elevation monitoring network currently consists of 46 wells in the Borrego Springs Subbasin. An additional 2 wells are monitored for groundwater levels in the Ocotillo Wells Subbasin. These results are focused on the Borrego Springs Subbasin. Of the 46 wells monitored, 17 of the wells have pressure transducers installed that record groundwater levels at a frequency of every 15 to 30 minutes (pressure transducer wells noted by black dots inside well identifier). The distribution of wells by management area are 9 wells in the NMA, 19 wells in the CMA, and 18 wells in the SMA. As the Borrego Water District (BWD) has included all of their production wells into the GSA network and they predominantly pump from the CMA, there are more wells located in the CMA. 10 wells were added to the monitoring network and 5 pressure transducers between the fall 2017 and spring 2018 monitoring events. The Borrego Valley GSA monitored groundwater elevations in the spring and fall of 2017 and spring 2018. Historical groundwater level data were previously collected by the U.S. Geological Survey (USGS), Department of Water Resources (DWR), BWD and County of San Diego (County). Results of groundwater elevation monitoring are presented in the following slides by Subbasin management area, which includes the North Management Area (NMA), Central Management Area (CMA) and South Management Area (SMA).



Historical groundwater levels in wells ID4-3 and MW-1 indicate a declining trend of about 2 feet per year in the NMA since 2005. Each well hydrograph has a distinct period of record and number of data points based on when the well was originally drilled, lifespan of the well and frequency of data collection. (*The Borrego Valley GSA considers the longevity of well infrastructure among several other criteria when selecting wells for the monitoring network. For instance, a well drilled in 1950 is likely not a good candidate for the monitoring network as it is unlikely to be useable throughout the GSP period trough 2040 and beyond)*. For trend analysis, we will be focusing on 21st century trend starting in about 2005 for this review. Proximity of groundwater elevation monitoring wells to pumping centers located in the area of agricultural and recreation irrigation will influence overall trend of groundwater level elevations (i.e. pumping vs. static groundwater levels. Thus, groundwater elevations should be monitored at multiple wells during Groundwater Sustainability Plan (GSP) preparation and implementation to track trends and progress toward GSP goals.

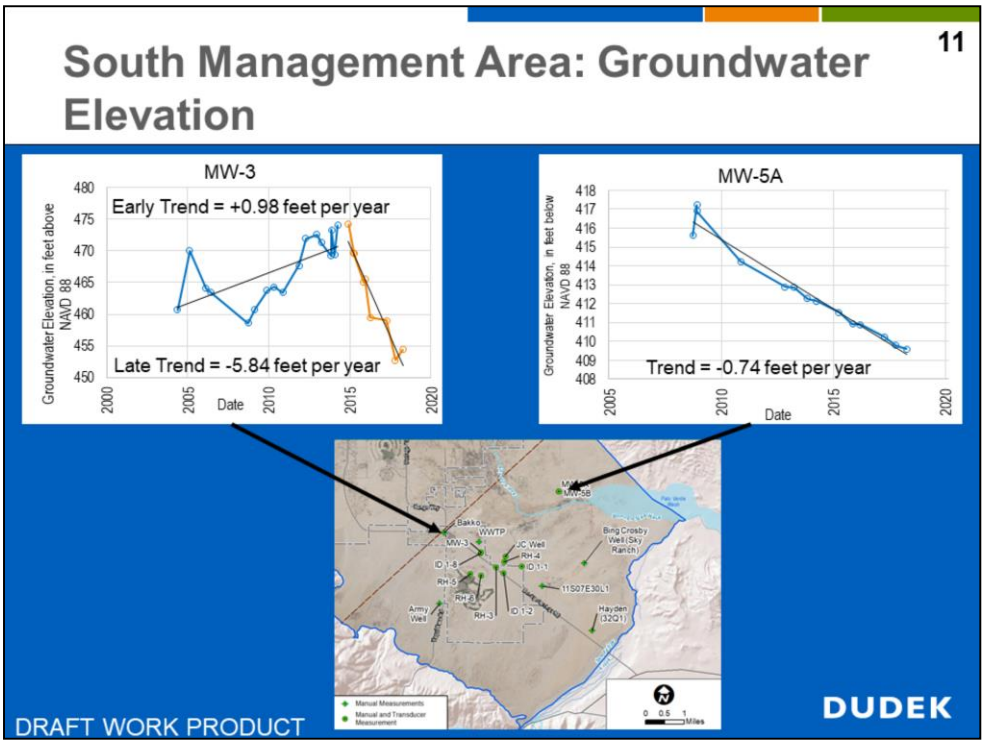


Historical groundwater levels in wells ID4-1, ID1-16 and Airport 2 indicate a declining trend of 1 to 1.7 feet per year in the in the CMA since about 2005.

The historical rate of decline is the CMA is less than the NMA. This is likely because less overall groundwater extraction occurs in the CMA. However, groundwater levels will likely continue to decline in the CMA at the current rate of groundwater extraction regardless of future agricultural land fallowing in the NMA.

Thus, declining groundwater levels are not limited to areas where agricultural extraction is predominantly occurring (i.e. NMA).[1] Reduction in groundwater extraction will likely also need to occur in the CMA in order to reach Subbasin sustainability.

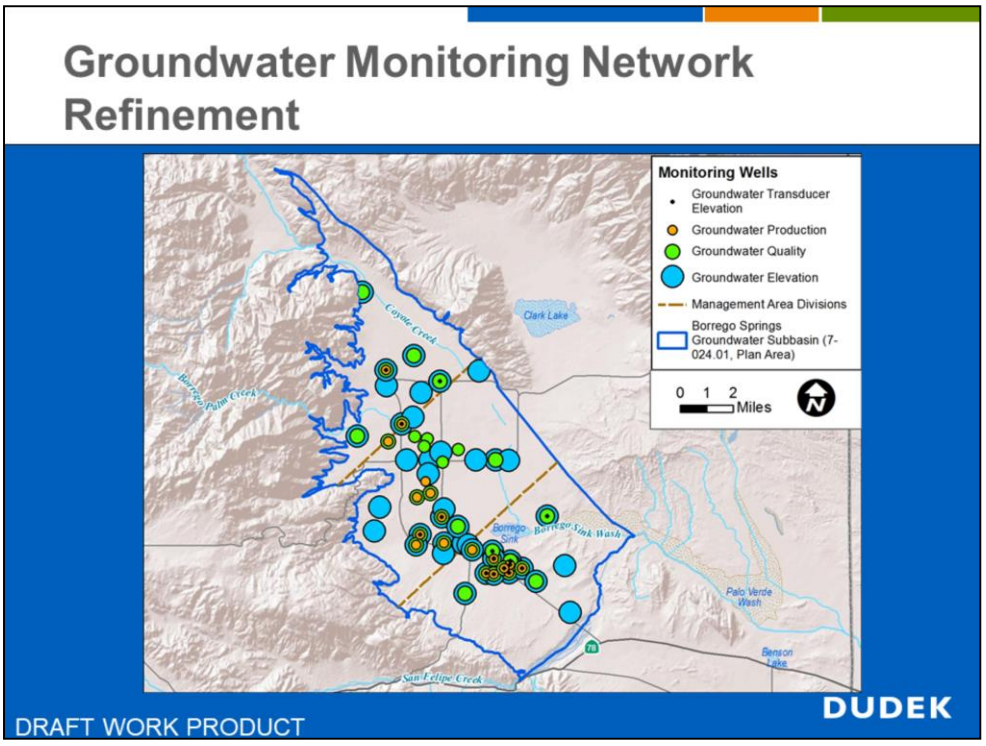
1. Recreation pumping also occurs in the NMA for the De Anza Country Club.



Well MW-5A located in the Borrego Sink in the SMA indicates a declining groundwater trend of 0.74 feet per year since 2008 when the well was drilled and completed. This well is located far from large pumping centers and likely provides .

The groundwater trend at Well MW-3 in the SMA reflects the change in water supply for the Rams Hill Golf Course. Prior to 2013 the Rams Hill Golf Course was predominantly supplied from wells located in the CMA. Groundwater levels are observed to be recovering at a rate of 0.98 feet per year in well MW-3 over the 10-year period from 2004 to 2014. This likely was a result of recharge from applied irrigation water at the Rams Hill Golf Course and lack of appreciable groundwater pumping in the SMA during this timeframe.

When the Rams Hill Golf Course reopened in 2014/2015, the water supply was provided by new wells primarily located in the SMA. Pumping from Rams Hill wells in combination with some Borrego Water District (BWD) pumping from well ID1-8 has resulted in a declining groundwater level trend of 5.84 feet per year over the period from 2015 to 2018. Reduction in groundwater extraction will likely need to occur in the SMA in order to reach Subbasin sustainability.



The Groundwater Sustainability Agency (GSA) continues to refine the groundwater monitoring network. The GSA has obtained funding from Proposition 1 to drill a new well that will be added into the monitoring network. The GSA intends to submit an application to Department of Water Resources' (DWR) Technical Support Services (TSS) to install a new monitoring well using potentially available grant funds. The GSA is coordinating with DWR to complete the application. The TSS grant for is limited to monitoring wells for this particular application.

The GSA has recently inspected several private wells to determine potential to include into the monitoring network. The GSA is working with the private property owners to gain access for long-term monitoring. Several Subbasin stakeholders have been assisting the GSA with obtaining access to private wells. As a result, 5 wells have been added to the monitoring network starting with the fall 2018 monitoring event (5 green dots in the CMA as depicted on the map).

The GSA will continue to adapt the monitoring network in order to fill identified data gaps and provide best science to inform development and implementation of the GSP.


Questions and Discussion