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Twentynine Palms Water District Groundwater Monitoring Implementation Plan

27 December 2017

Prepared for

Twentynine Palms Water District
72401 Hatch Road
Twentynine Palms, CA 92277

K/J Project No. 1744007*00

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Section 1: Introduction

1.1 Purpose and Background

The Twentynine Palms Water District (District) prepared a Salt and Nutrient Management Plan (SNMP) in June 2014 with the primary purpose of developing a strategy for the District, along with the City of Twentynine Palms (City) to monitor and protect the groundwater resources in the Twentynine Palms area. The SNMP recognizes and addresses the increased need to assess potential groundwater quality impacts from salt and nutrient sources that are derived primarily from regional septic tanks.

The purpose of this Groundwater Monitoring Implementation Plan is to develop an implementation plan to provide a detailed monitoring plan and time schedule for the proposed groundwater monitoring activities in accordance with the SNMP.

This Implementation Plan has four phases:

- Phase 1 – Increase Sampling Frequency of the District's Existing Production Wells
    - Action – The District has already implemented this phase of the monitoring plan, and collects water quality data annually instead of every three years.
- Phase 2 – Establish a Water Quality Monitoring Well Network Using Existing Wells
    - Action – The Implementation Plan will identify existing wells to sample; provide sampling operation (sample documentation, water level measurement, sampling and packaging); recommended analytical procedures; quality assurance procedures; and summary and reporting protocols.
- Phase 3 – Installation of New Monitoring Wells
    - Action – Pending the results from Phase 2 and Phase 4 and available funding opportunities, monitoring well locations will be identified, and installed to further assess the vertical mixing within the aquifer.
- Phase 4 – Conduct a One-Time Existing Conditions Sampling Event
    - Action – Pending funding, the District will develop an outreach program, including the production of a public information sheet that describes the monitoring purpose. This information will be utilized to access, collect and sample as many private groundwater wells as possible.

Section 2: Physical Setting

2.1 Service Area Characteristics

The District service area encompasses approximately 87 square miles and includes the City of Twentynine Palms (City) (see Figure 1). The District is located in the high desert of southern California, approximately 72 miles due east of the City of San Bernardino and 35 miles northeast of the City of Palm Springs. Groundwater is the primary source of water for the District.

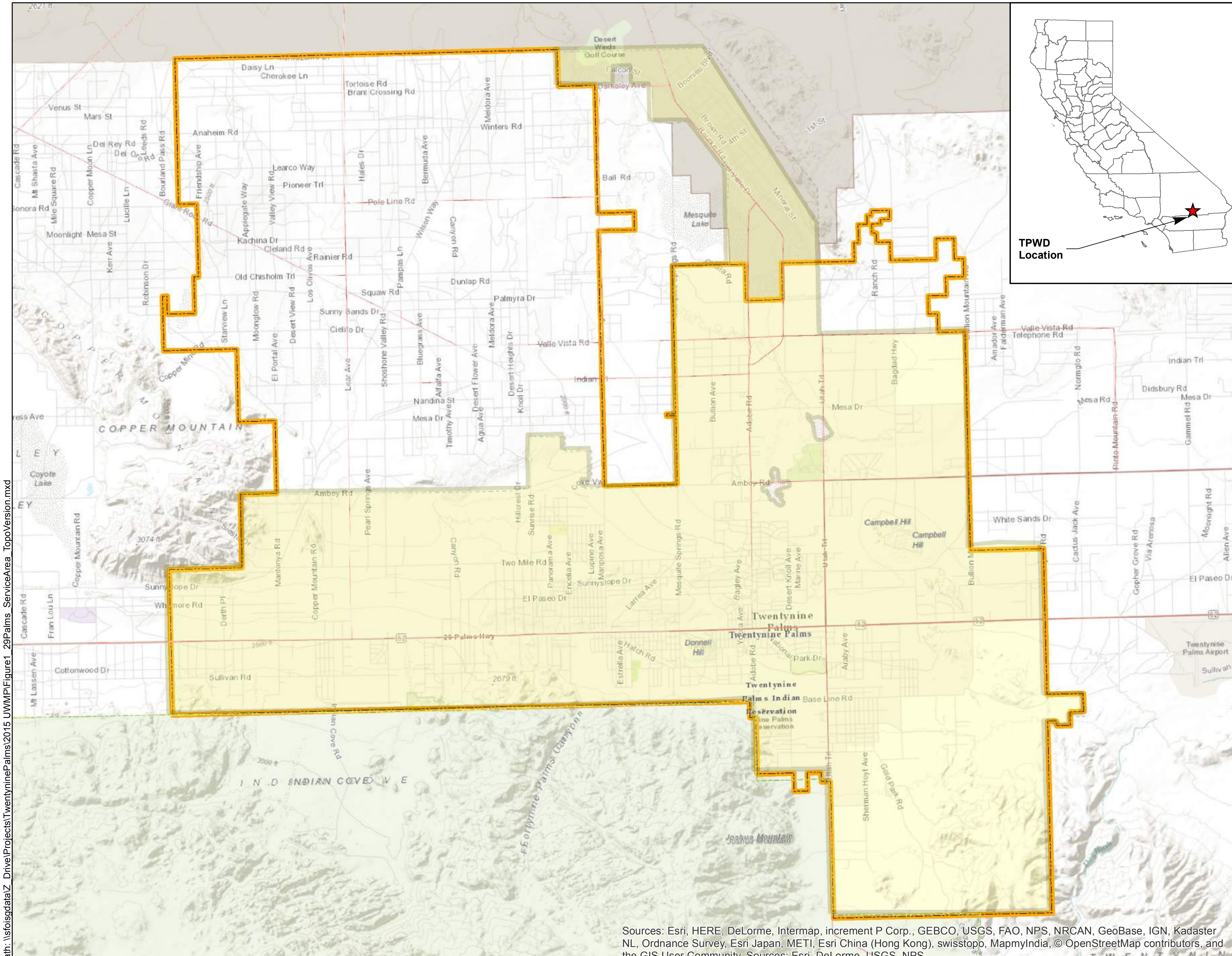
The District's mission is to provide a safe and adequate supply of water at the lowest feasible cost to the people of the district and to preserve and protect the water resources within the established boundaries of the District.

2.1.1 Demographics

Residential development is currently the single largest land use within the District. Approximately 80% of residential development is single-family homes. The remaining 20% of the District's land use is made up of some multi-family residential units, commercial properties, and minor light industry. The current population that the District serves is approximately 15,000 (based on 2010 census data). As of 2014, 100% of the District's service area is considered disadvantaged, based on the State's definition of a disadvantaged community having an income of 80% less than the State's Median Household Income (MHI). Using American Community Survey data for the years 2009-2013, 80% of the Statewide MHI is $48, 875. There is no community sewage system and wastewater is disposed of through individual septic tank and tile field disposal systems.

Potable water is limited in the District for several reasons:

- Due to drought conditions the area has recently received far less than the historical average of approximately five inches of annual rainfall.
- There is negligible infiltration of direct precipitation in areas where alluvial deposits are thick.
- A substantial amount of available runoff is lost to evaporation after flowing into the basin.
- Some of the local groundwater is unsuitable for drinking water purposes due to naturally occurring soluble minerals, such as fluoride, in addition to hexavalent chromium and arsenic.



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Legend

- City of Twentynine Palms
- Twentynine Palms Water District Boundary

N

0 3,500 7,000
Feet

Kennedy/Jenks Consultants

Twentynine Palms Water District
Groundwater Implementation Plan
Twentynine Palms, CA

Twentynine Palms Water District
Service Area Boundary

KJ 1744007.00
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Figure 1

2.1.2 Population

The District currently (2015) serves 6,759 active connections, all of which are metered accounts and mostly (greater than 90%) residential. Commercial connections account for approximately 4%, and landscape irrigation and fire protection/non-potable connections account for less than 1% of the District's total connections.

Population projections for the City of Twentynine Palms were derived from the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP). Populations for 2020 and 2035 were interpolated and extrapolated to derive populations for 2025, 2030 and 2040. The District's service area compromises approximately 92.5% of the City of Twentynine Palms. Therefore, Table 2-1 reflects both the City of Twentynine Palms and the District's population projections.

TABLE 2-1: PROJECTED POPULATION ESTIMATES

	2020	2025	2030	2035	2040
City of Twentynine Palms[(a)]	26,300	29,633	32,967	36,300	39,633
Twentynine Palms Water District[(b)]	24,328	27,411	30,494	33,578	36,661

Notes:
(a) SCAG 2012 RTP for the City of Twentynine Palms.
(b) Assumes 92.5 % of the District service area comprises the City of Twentynine Palms.

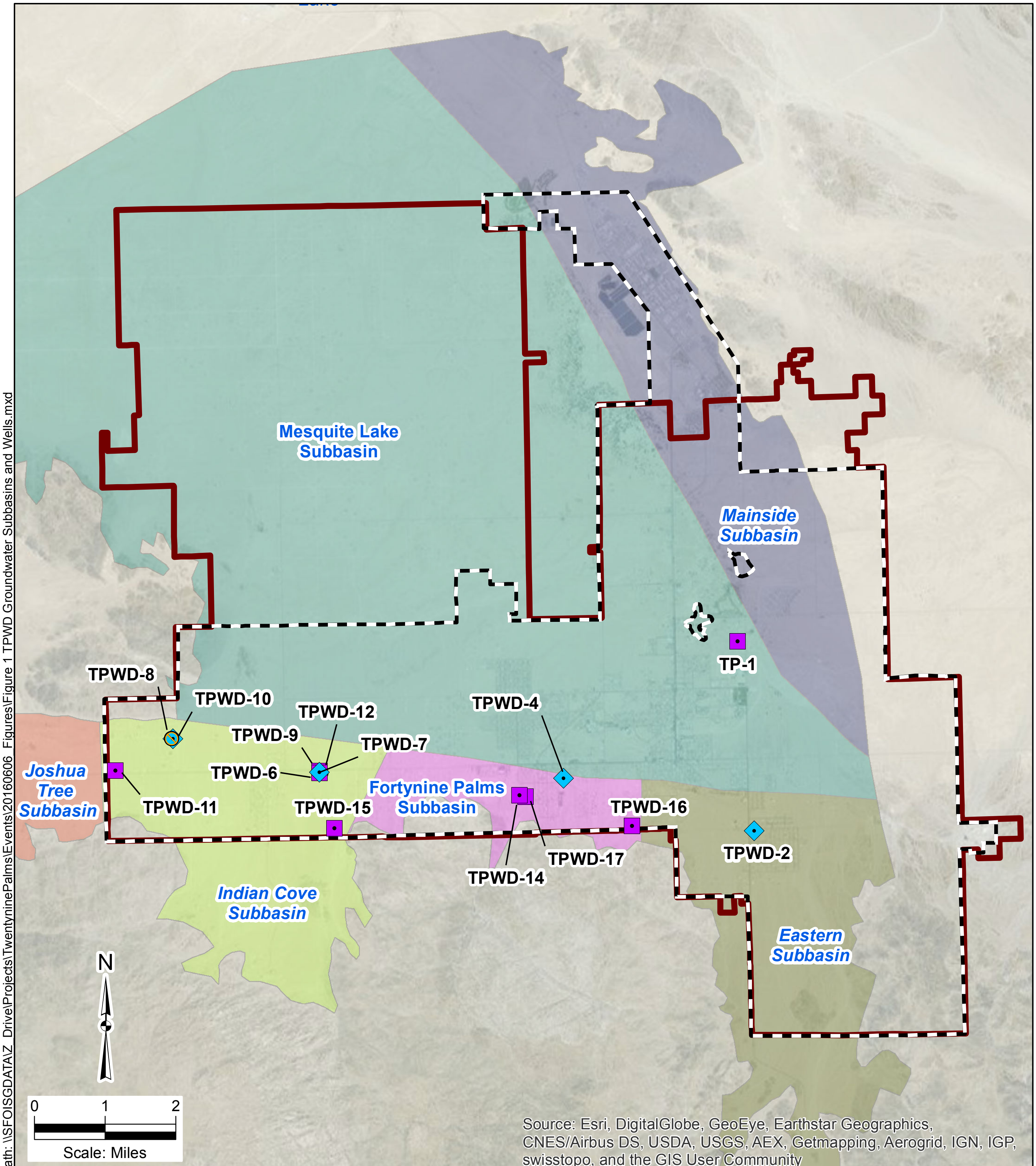
2.2 Groundwater Use

The District currently relies solely on local groundwater as its source. The District overlies two non-adjudicated groundwater basins, the Twentynine Palms Valley Basin and the Joshua Tree Basin. Within the Twentynine Palms Valley Basin are the Mesquite Lake and Mainside subbasins. Within the Joshua Tree Basin are three subbasins, the Indian Cove, Fortynine Palms, and Eastern subbasins. The District also overlies a portion of the Dale Valley Basin, but there is little to no pumping or historical data from this basin and the District has no production wells in this basin. The location of the subbasins and the District wells are shown on Figure 2.

Water provided by the District is derived solely from groundwater pumped from supply wells located along the southern limit of the service area. The District had eighteen total groundwater production wells in its history. As of 2014, the District has eight (8) active production wells. The remaining wells are inactive and/or used for groundwater monitoring. Available information indicates that more than 400 private wells have also been constructed within the District's service area. Most of these wells are not currently operated. The District collects groundwater level, water quality and water production data for use in groundwater management and other reporting purposes.

Geology and groundwater characteristics of the subbasins are similar, as they are contiguous. However, there are some differentiating characteristics among the subbasins. More data are available on Indian Cove subbasin than the others, as many of the District's existing production wells are located within this subbasin.

Path: \\SFOISGDATA\Z_Drive\Projects\TwentyninePalms\Events\20160606_Figures\Figure 1 TPWD Groundwater Subbasins and Wells.mxd



Legend

Show, Status

- TPWD Active Water Supply Well
- TPWD Inactive Water Supply Well
- TPWD Abandoned Well
- City Limit
- Water District Boundary

Kennedy/Jenks Consultants

Potable Water Hexavalent Chromium Compliance Plan
Twentynine Palms Water District

TPWD Groundwater Subbasins and Wells

K/J 1644403*00
June 2016

Figure 2

2.2.1 Water Demand Projections

Kennedy/Jenks Consultants assisted the District with development of its 2015 Urban Water Master Plan (UWMP) (May 2016). The UWMP assessed projected demands on the groundwater supply in 2020, 2030 and 2040 to be 4,333, 5,431 and 6,530 Acre-feet (AF), respectively (not including projected losses of about 250 AF). Under normal hydrologic year conditions, these demands are projected to be less than the Department of Water Resources (DWR) recommended pumping limit of 6,995 AF. However, in single-dry and multiple-dry year hydrologic conditions, the District may have to exceed the pumping limit temporarily in order to meet demands. Hence, the District needs to protect its local groundwater from constituents that may impact the reliability of the supply (i.e. Cr VI impacted sources) to meet future water demand.

2.2.2 Historical Groundwater Pumping

At the time of the District's formation in the 1950s, groundwater pumping ranged from 500 to 1,000 AFY. By the 1990s, groundwater pumping had increased and ranged from approximately 2,730 to 3,145 AFY, with an average daily delivery per service connection slightly under 400 gallons. Groundwater pumping eventually peaked in 2002 and again in 2008. Since then, groundwater pumping has returned back to levels similar to the early 1990s. Table 2-2 provides a summary of the District's historical water production.

TABLE 2-1: HISTORICAL WATER PRODUCTION

Year	AF
1990	2,788
1991	2,728
1992	2,961
1993	3,013
1994	3,132
1995	3,013
1996	3,144
1997	2,983
1998	3,030
1999	3,077
2000	3,248
2001	3,105
2002	3,416
2003	3,200
2004	3,203
2005	3,152
2006	3,340
2007	3,328
2008	3,416
2009	3,123
2010	3,001
2011	3,005

Year	AF
2012	2,929
2013	2,842
2014	2,737
2015	2,221

Source:
District water production records.

Historical groundwater pumping by basin for 2011 to 2015 is presented in Table 2-3. Current pumping is limited to DWR's recommendations to prevent overdraft in the Indian Cove and Fortynine Palms subbasins (KJC 2014a).

TABLE 2-2: HISTORICAL AMOUNT OF GROUNDWATER PUMPED (AFY)

Basin Name	2011	2012	2013	2014	2015
Mesquite Lakes Basin	1,127	1,167	1,133	1,110	913
Joshua Tree Basin					
Fortynine Palms Subbasin	1,102	1,011	1,006	987	784
Eastern Subbasin	329	310	292	258	228
Indian Cove Subbasin	447	441	411	382	296
Total	**3,005**	**2,929**	**2,842**	**2,737**	**2,221**
% of Total Water Supply	**100%**	**100%**	**100%**	**100%**	**100%**

2.2.3 Projected Groundwater Pumping

The District has a total pumping capacity of approximately 5,210 gallons per minute (gpm) (8,400 AFY). In order to prevent overdrafting of the subbasins, DWR has recommended pumping limits at 4,340 gpm (6,995 AF). Table 2-5 provides a breakdown of the pumping capacity by subbasin (KJC 2014a). Current pumping (2015) represents approximately 26% of the total current pumping capacity.

TABLE 2-5: GROUNDWATER PUMPING CAPACITY

Basin Name	Total Pumping Capacity[(a)] (gpm)	Total Pumping Capacity[(a)] (AFY)	Limited Pumping Capacity[(b)] (gpm)	Limited Pumping Capacity[(b)] (AFY)
Mesquite Lake Basin	2,100	3,395	2,100	3,395
Joshua Tree Basin				
Fortynine Palms Subbasin	1,500	2,420	870	1,400
Eastern Subbasin	500	800	500	800
Indian Cove Subbasin	1,110	1,785	870	1,400
Total	**5,210**	**8,400**	**4,340**	**6,995**

Notes:
(a) From TPWD 2014 Groundwater Management Plan, (KJC 2014a).
(b) DWR recommended pumping limit to prevent overdraft.

Table 2-6 presents projections of groundwater pumping through the end of the 25-year planning period. District groundwater resources are anticipated to be available at the same levels during average/normal, single-dry, and multiple-dry years.

TABLE 2-6: PROJECTED GROUNDWATER PUMPING (AFY)

Basin Name	2020	2025	2030	2035	2040
Mesquite Lake Basin	1,779	2,004	2,229	2,455	2,681
Joshua Tree Basin					
Fortynine Palms Subbasin	1,530	1,724	1,918	2,112	2,306
Eastern Subbasin	446	502	559	615	672
Indian Cove Subbasin	578	652	725	798	872
Total	**4,333**	**4,882**	**5,431**	**5,980**	**6,530**
% of Total Water Supply	**100%**	**100%**	**100%**	**100%**	**100%**

2.2.4 Groundwater Quality Trends

Groundwater quality in the region is quite variable. Minerals are added to the groundwater as it flows through the aquifer; water that spends more time in the aquifer tends to have higher concentrations of chemical constituents than does water with a low residence time. Water near the mountain fronts, which has been recharged relatively recently, tends to be of high quality, with low concentrations of chemical constituents. This is the case in the Indian Cove, Fortynine Palms, and Eastern Subbasins, where groundwater is close to its source area. In the Mesquite Lake Subbasin, groundwater has had a longer residence time and, therefore, tends to have higher concentrations of minerals. A general summary of the spatial trends in groundwater quality are summarized below:

- The groundwater in the Mesquite Lake Subbasin is predominantly sodium sulfate character. Locally elevated levels of TDS can be found associated with the playas, but is not present in high concentrations in the District's water supply wells. TDS content ranges from about 300 to 1,300 milligrams per liter (mg/L), but reaches 3,100 mg/L (DWR, 1984). Some wells in the basin exceed the recommended levels for drinking water in fluoride, arsenic and sulfate concentrations. Thermal waters or hot springs are also known to occur in this basin (DWR, 1984).

- The groundwater in the Indian Cove, Fortynine Palms and Eastern Subbasins is predominantly sodium bicarbonate in character (DWR, 1984) or sodium calcium bicarbonate in character (Krieger and Stewart, 1996). TDS content ranged from 139 to 164 mg/L for water in production wells in 1994 (Krieger and Stewart, 1996). Data from 14 public supply wells show an average TDS content of 159 mg/L and a range of 117 to 185 mg/L. Fluoride concentration in water from some wells has reached 9.0 mg/L, exceeding recommended maximum concentration levels of 2.0 mg/L (DWR, 1984).

Water may take thousands of years to migrate from the recharge area to its discharge point. Nishikawa *et al*. (2004) used carbon-14 dating methods to determine that groundwater in the Copper Mountain Subbasin is likely to have been in the aquifer for approximately 10,000 years. This relationship can be complicated by the environment within the aquifer; groundwater that experiences elevated temperatures dissolves aquifer minerals more readily, and additional chemicals can be added from other aquifers or the ground surface. The minerals in groundwater may also be concentrated by evaporation when the water table is close to the ground surface. Water quality is described here only for the subbasins within the boundary of TPWD.

2.3 District Water Treatment

The District has been historically pumping from the Indian Cove, Fortynine Palms and Eastern Subbasins in the south because of the generally good water quality in these areas. However, the District does have to treat water from certain wells for naturally-occurring constituents including fluoride and arsenic.

Elevated fluoride concentrations above the maximum contaminant level (MCL) are widespread across the District's service area. In 1993, the District was granted a variance from the California Primary MCL for fluoride, which states "the District shall not serve water containing fluoride levels in excess of 3.0 milligrams per liter (mg/L) or 75 percent of the U.S. Environmental Protection Agency (USEPA) Primary Drinking Water Standard (currently at 4.0 mg/L), whichever is higher." The District made its request for the variance based on provisions outlined in SB 694 and AB 2681 which provide for the granting of a variance from the Primary Drinking Water Standard for fluoride by the DDW for a period of up to 30 years, provided that a review of the variance status is conducted every five years. The DDW finds that there is no need for a comprehensive fluorosis study based on present levels of fluoride being served. The variance is set to expire in 2023.

Fluoride concentrations in the Indian Cove, Fortynine Palms and Eastern Subbasins generally averages below 2 mg/L, but several wells, especially in the Eastern Subbasin, average above 3 mg/L. Several older wells with high fluoride concentrations were taken out of operation in the 1990s and replaced by newer wells located in areas with lower fluoride concentrations. Because of the variance, groundwater from these wells has been allowed for use without treatment for fluoride.

Because the fluoride concentrations in the Mesquite Lake Subbasin are generally well above 3 mg/L, groundwater from these subbasins cannot comply with the variance without treatment. In 2003, the District began pumping from the Mesquite Lake Subbasin; however, groundwater has high levels of fluoride. Water pumped from the Mesquite Lake Subbasin is treated to reduce fluoride before being distributed into the pipeline system using the Twentynine Palms Fluoride Removal Water Treatment Plant in the Twentynine Palms Valley Basin. The plant is designed to reduce fluoride concentrations in the groundwater to levels below the State MCL of 2 mg/L allowed by the DDW for fluoride. The treatment plant is currently producing approximately 1.2 mgd and has a maximum capacity of 3 mgd. With the operation of the treatment plant, it is the District's long-term goal to maintain fluoride levels of not more than 2 mg/L.

In 2008, the DDW lowered the MCL for arsenic from 50 μg/L to 10 μg/L. Arsenic concentrations from all of the District's wells complied with the earlier MCL, but several wells, especially in the Indian Cove Subbasin, have arsenic concentrations that exceed the new 10 μg/L MCL. Therefore, the District has been required to install an arsenic treatment system for compliance with the new MCL.

As of 2013, the District met the federal and state total chromium MCL of 0.05 mg/L with an average detection of 0.019 mg/L and a maximum of 0.026 mg/L in 2013. Following adoption of the more stringent MCL in July of 2014, and in response to the hexavalent chromium concentrations present in the wells, the District shut down three of its eight production wells, reducing overall water production capacity by 15 percent. The wells are not operating, but two of the wells are still physically connected to the distribution system.

Wellhead treatment systems (or other alternatives such as blending) to reduce concentrations of hexavalent chromium in the water supply are necessary to return these wells to service and restore the water production capacity. Further, Senate Bill 385, passed in September 2015, requires the development of an action plan to comply with the MCL by June 2016, with full compliance by January 1, 2020. However, in May 2017, the Superior Court of California, Sacramento County, issued an order requiring the California SWRCB to withdraw the current MCL for hexavalent chromium of 0.01 mg/L and establish a new MCL. Until the new MCL is established, it is unclear whether the District will need to move forward with hexavalent chromium treatment, or if there will still be a need to comply with SB 385.

2.4 Wastewater Management

There is no community sewage system within the District service area and wastewater is disposed through individual septic tank and tile field disposal systems. There are two major categories of onsite wastewater treatment systems in the Twentynine Palms area – residential and non-residential. Single family and multifamily households all fall under the residential category. A variety of commercial (e.g., restaurants and hotels) and institutional (e.g., school) establishments and facilities fall into the non-residential wastewater category.

The District recently (October 28, 2016) adopted the Wastewater Master Plan in coordination with multiple stakeholders. Efforts are also currently underway to expand and improve on the groundwater monitoring in the Basin. Future SNMP updates will incorporate; report on and utilize existing and future data sets to monitoring the basins and ultimately improve the water quality in our region. These actions demonstrate the intent of the District and the City to address wastewater practices to reduce salt and nutrient impacts to the groundwater resources in their region.

Section 3: SNMP Groundwater Monitoring Plan

3.1 Summary of SNMP Groundwater Monitoring Plan

This groundwater monitoring plan is designed as part of the SNMP to provide water quality data to help determine, in part, if a sewer system would be required to protect public health and water quality in the District. This may also reduce the significant hardship that residents would have to face given the prohibitive cost associated with design, financing, and constructing a sanitary sewer system.

The proposed monitoring plan recognizes the time required to collect sufficient data and analysis based on scientific evidence if groundwater pollution and degradation in the area are caused by septic tanks. This monitoring plan provides an adaptive approach for data collection efforts needed to make more informed decisions on the effects of septic tanks on groundwater supply.

The monitoring locations will focus on high-density areas with potentially greater impact on potable water supply wells. Existing wells will be used for sampling when the well is known to be in good condition and sufficient information on well construction and depth of perforations is available. If adequate existing wells are not available, installation of new monitoring wells may be warranted, in key areas.

In general, groundwater conditions in the basins are stable and are not subject to significant seasonal variations. Therefore, once sufficient sampling has been conducted to establish the conditions in a well, the frequency of long-term groundwater quality monitoring should not need to account for seasonality.

Annual reports will summarize the monitoring data each year along with a brief data assessment to described groundwater conditions in each of the subbasins. The annual reports will note any issues regarding the effectiveness of the monitoring plan. Revisions to the plan will be reported to the Colorado River Regional Water Quality Control Board (RWQCB) as needed to adequately characterize the groundwater quality conditions in the basins.

3.2 Proposed 2018 Monitoring Plan Objectives and General Approach

A recommendation for the SNMP is to conduct long-term groundwater quality monitoring to establish the spatial distribution and temporal trends of COCs, primarily nitrates and salts, by regular sampling over a number of years. From the Basin Plan water quality objectives, detailed study is needed before establishing specific groundwater quality objectives for a particular basin. Accordingly, a groundwater monitoring program will be necessary to demonstrate that the City and District intend to fully understand groundwater quality conditions and trends.

The SNMP proposes to collect groundwater quality data to evaluate if the existing septic tank systems are degrading groundwater quality in the area and quantify the nature and extent of any COCs found. The results of the proposed monitoring data and evaluation will help in making more informed decisions with respect to wastewater management, and will provide the site-specific data needed to establish the technical basis for management criteria in a Tier 2 Local Agency Management Program of the Twentynine Palms area.

3.3 Constituents of Concerns

The primary COCs related to septic system discharge are nitrate and salts which are related to sewage. Salts can be monitored as individual constituents and as total dissolved solids (TDS) and general minerals. Other COCs are included that will help identify potential septic system influences from residential and commercial/industrial areas. The District's current production wells are to be sampled for the COCs listed on Table 3-1. Current wells not being used for production will be sampled for electrical conductivity (EC), TDS and nitrate, in addition to general minerals and physical constituents. The general mineral constituents to be analyzed may include: calcium, magnesium, sodium, potassium, carbonate, bicarbonate, hydroxide, chloride, sulfate, nitrate, nitrite, MBAS, TDS, pH, copper, iron manganese, zinc, conductivity, hardness, fluoride, color, odor, and turbidity. Below is an overview of the key COCs.

3.3.1 Nitrates

Anthropogenic groundwater nitrate sources can come from a number of sources but are typically related to agriculture and wastewater. DDW has set the MCL for nitrate in drinking water at 45 mg/l for nitrate as nitrate (as NO3) or 10 mg/l for nitrate as nitrogen (as N). These values are stoichiometrically equivalent. Nitrate concentrations in public drinking water supplies exceeding the MCL require water system actions to provide safe drinking water.

3.3.2 General Mineral Analysis

The general mineral analysis provides a means of characterizing the groundwater within each production zone and comparing the groundwater in each of the production zones in which a particular well is screened. The data gained in this analysis can also be used to compare wells and infer whether the study wells are producing water from the same subbasins.

3.3.3 Coliforms

Total coliform is a measurement of general coliform bacteria, the presence of which indicates that the water has had contact with plant or animal life. General coliforms are universally present and can be found in soil, animals, insects, etc. At high levels, coliforms indicate the presence of some type of waste which could include pathogens. Fecal coliforms indicate that the water has had contact with mammal or bird feces. The presence of total and fecal coliforms is an indication of human or animal waste; however, this does not conclusively indicate infiltration from septic tanks. For the purposes of this study, the presence of coliforms could indicate septic influence on the groundwater.

3.3.4 Natural Constituents

Fluoride (F) naturally occurs in the local groundwater and is a constituent of concern for the water delivery system in the District's service area. The DDW-mandated MCL for fluoride in drinking water is 2.0 mg/L. Fluoride is relatively low in the Indian Cove, Fortynine Palms, and Eastern Subbasins, but several samples have exceeded the MCL for drinking water. Average fluoride concentrations range from 0.4 to 2.3 mg/l, but some older wells did have higher fluoride levels. Groundwater in the Mesquite Lake Subbasin has a different chemical character with substantially higher fluoride concentrations. Fluoride has been measured in WTP-1 in the

Mesquite Lake Subbasin, hovering around 6.0 mg/L in only two samples, above the 2.0 mg/L MCL. Samples reported by DWR (1984) throughout the Mesquite Lake Subbasin varied between 3.0 and 22.0 mg/L. Concentrations in the area of the Mesquite Dry Lake are mostly around 11 mg/L.

Arsenic (As) is a naturally occurring element in groundwater that forms from the erosion and breakdown of geologic deposits; however, arsenic is less commonly associated with contaminant plumes. The primary MCL for arsenic is 10 micrograms per liter (µg/L). The occurrence of arsenic in the Twentynine Palms area is from natural sources. Arsenic has been detected in concentrations up to 31 µg/L; however, the average arsenic concentration is below 10 µg/L in most of the District's wells. Arsenic above the MCL is most prevalent in the Indian Cove Subbasin and Well #3B in the Fortynine Palms Subbasin. Arsenic is below the MCL in the Eastern and Mesquite Lake Subbasins as well as the other Fortynine Palms Subbasin wells. The elevated arsenic concentrations require treatment at some of the District wells.

TABLE 3-1: SAMPLING AND ANALYSIS PLAN – LIST OF PARAMETERS FOR ACTIVE PRODUCTION WELLS ONLY

Analyte	Units	EPA Test Method	Typical Lab PQL
General Minerals, Cautions, and Anions:			
Boron	mg/L	200.7	0.3
Calcium	mg/L	200.7	0.3
Total Iron	mg/L	200.7	0.05
Manganese	mg/L	200.7	0.1
Potassium	mg/L	200.7	0.2
Total Alkalinity	mg/L	310.1	0.3
Bicarbonate	mg/L	310.1	10
Carbonate	mg/L	310.1	10
Hydroxide	mg/L	310.1	10
Bromide	mg/L	300	10
Chloride	mg/L	300	1
Fluoride	mg/L	340.2	50
Nitrate	mg/L	300	0.1
Nitrite	mg/L	354.1	0.1
Orthophosphate	mg/L	365.2	0.01
pH	s.u.	150.1	0.2
Sodium	mg/L	200.7	0.01
Specific Conductivity	µmhos/cm	120.1	1
Sulfate	mg/L	300	1
TDS	mg/L	160.1	50
Total organic carbon	mg/L		40
Field Sampling:			
Dissolved Oxygen	mg/L	Field Probe 1	
Temperature	F	Field Probe	
Microbiological Analysis:			
Total Coliform	MPN/100 ml	SM9223B	2
Fecal Coliform	MPN/100 ml	SM9223B	2

Analyte	Units	EPA Test Method	Typical Lab PQL
Anthropogenic Analytes:			
Sucralose	µg/L	Non-standard	0.01
Caffeine	µg/L	8270M/SIMS	0.01
17B-estradiol	µg/L	Non-standard	0.001
NDMA	µg/L	Non-standard	0.002
Triclosan	µg/L	Non-standard	0.05
DEET	µg/L	Non-standard	0.05

3.4 Phased Approach to Monitoring Plan

To methodically assess and potentially develop additional monitoring information, a phased approach is recommended. This approach will optimize the use of the District's existing groundwater quality data, validate the opportunity to capitalize on other local groundwater production well information, and quantify the need for new monitoring wells and facilities. It will also provide an opportunity to seek grant funding for the recommended monitoring program. A discussion of the phased approach follows.

3.4.1 Phase 1 – Increasing Sampling Frequency of Existing District Production Wells

The District has collected water quality samples from the active groundwater production wells at least every three years as required by DDW. These samples provide the extent of the data on water quality in the Twentynine Palms area. It is recommended that the sampling frequency for the analytes listed in Table 3-1 be increased to annually for all active and inactive District owned production wells.

The District has been historically monitoring groundwater levels and quality within the groundwater basins underlying the District's service area. Table 3-2 lists the current monitoring activities from the water supply and monitoring wells. The ten water supply wells are monitored for water levels on a monthly basis and water quality at various sampling schedule. Inactive wells listed are not currently monitored.

The District currently conducts water quality monitoring from supply wells per DDW standards which is sufficient for the purpose of tracking changes in groundwater quality in the basins. In order to provide and maintain the highest standard of healthful drinking water possible, the District employs a stringent testing schedule for all local water sources, based upon state and federal monitoring and quality regulations. This testing is conducted weekly for bacteria and fluoride, annually for radioactivity, and every three years for pesticides, minerals, inorganic substances, clarity, taste and odor. There is no known contamination in the District although there are concerns about high levels of fluoride, arsenic, and TDS in certain areas of the District. Historical nitrate data from the water supply wells show no evidence of water quality exceeding the water quality objectives of the Basin Plan.

TABLE 3-2: EXISTING GROUNDWATER MONITORING BY TWENTYNINE PLAMS WATER DISTRICT

Well Name	Well Type	Water Levels	Water Quality – Other Constituents	Proposed SNMP Sampling Plan
4	Inactive	Monthly	Every 3 years	Annually
6	Inactive	Monthly	Every 3 years	Annually
7	Destroyed	Monthly	Not Sampled	Annually
8	Inactive	Monthly	Every 3 years	Annually
9	Inactive	Monthly	Every 3 years	Annually
10	Inactive	Monthly	Every 3 years	Annually
11	Destroyed	Monthly	Every 3 years	Annually
12	Active water supply	Monthly	Every 3 years	Annually
14	Active water supply	Monthly	Every 3 years	Annually
15	Active water supply	Monthly	Every 3 years	Annually
16	Active water supply	Monthly	Every 3 years	Annually
17	Active water supply	Monthly	Every 3 years; quarterly for VOCs	Annually
WTP-1	Active water supply	Monthly	Every 3 years	Annually

3.4.2 Phase 2 – Establishing a Water Quality Monitoring Well Network

Phase 2 of the groundwater monitoring program consists of establishing a network of existing monitoring locations throughout the Twentynine Palms area with appropriate spatial distribution to be able to define the nature and extent of COCs related to septic systems discharges. The purpose is to define existing conditions and to collect long-term monitoring data to assess the potential future impacts to the beneficial use of groundwater. The objectives of the monitoring well network include the following:

- Establish background conditions for COCs. The monitoring network should include sufficient wells upgradient of Twentynine Palms to establish COC concentrations relatively unaffected by higher density septic density areas.
- Monitor COC concentrations in high-density areas. The monitoring network should include sufficient wells to establish concentrations for the high-density areas.
- Define downgradient concentrations especially for high-density areas. The monitoring network should include sufficient wells to establish downgradient COC concentrations especially for the high-density areas.

Each of the different groundwater subbasins have separate well networks that can be used to establish the distribution of COCs.

The groundwater monitoring network should preferably consist of wells that have either a sufficient well construction record or have a long-term monitoring history. Currently, groundwater level monitoring is currently performed by the United States Geological Survey

(USGS) primarily associated with the Marine Base but includes several wells in the Twentynine Palms area. Using wells with a history of groundwater level measurements is highly desirable, as measurements from these facilities provide a means to evaluate water quality in context with overall groundwater basin conditions. Of the recently monitored (within last five years) USGS wells, three are in the Indian Cove Subbasin, one is in the Fortynine Palms Subbasin, eight are in the Eastern Subbasin, nineteen are in the Mesquite Lake subbasin, and three are in the Dale Basin. Available information indicates that more than 400 private wells have also been constructed within the District's service area. The District has located and inspected about 250 private wells. See Figure 3 for a schematic of the wells in the Twentynine Palms area. Figure 4 shows potential groundwater monitoring locations.

It is recommended that water quality samples be collected from a representative number of these wells in the appropriate areas. Coordination with the USGS and private well owners will be required to access these wells for this study.

3.4.3 Phase 3 – Installing New Monitoring Wells

Phase 3 consists of a more focused monitoring network located in a limited number of areas where elevated nitrates have been detected. The purpose of Phase 3 is to define the vertical extent of nitrates and how the local geology and vertical mixing within the aquifer may affect COC concentrations. It is also recommended to install a cluster of monitoring wells in key areas where elevated concentrations of COCs have been detected. The purpose of these monitoring well clusters is to provide more detailed geology, groundwater and water quality data in these areas.

This data will be used to support additional analysis of the influence of the geology and other factors on the movement and attenuation of COCs in the Twentynine Palms area. For example, the underlying geology includes former lake deposits that may form barriers to vertical flow through the vadose zone and the presence of organics and other constituents may lead to denitrification and losses that may potentially limit the transport of COCs to the groundwater. This could also create stratification within the aquifer so that COCs may be found in the shallow groundwater but not be able to reach deeper portions of the groundwater aquifer. The objective is to collect data to improve our understanding of the fate and transport of COCs through the vadose zone and groundwater aquifers.

Four areas have been identified for further assessment as shown in Figure 4. These include the following:

- Luckie Park is located along Utah Trail in the eastern part of Twentynine Palms. Existing shallow monitoring wells show elevated COC concentrations. This area is located near the former Shortz Playa and may have elevated naturally occurring TDS. The purpose is to evaluate vertical and horizontal mixing and possible influence of geologic layering. Two monitoring well locations are planned with one near the Luckie Park well and another about 1,000 feet downgradient.

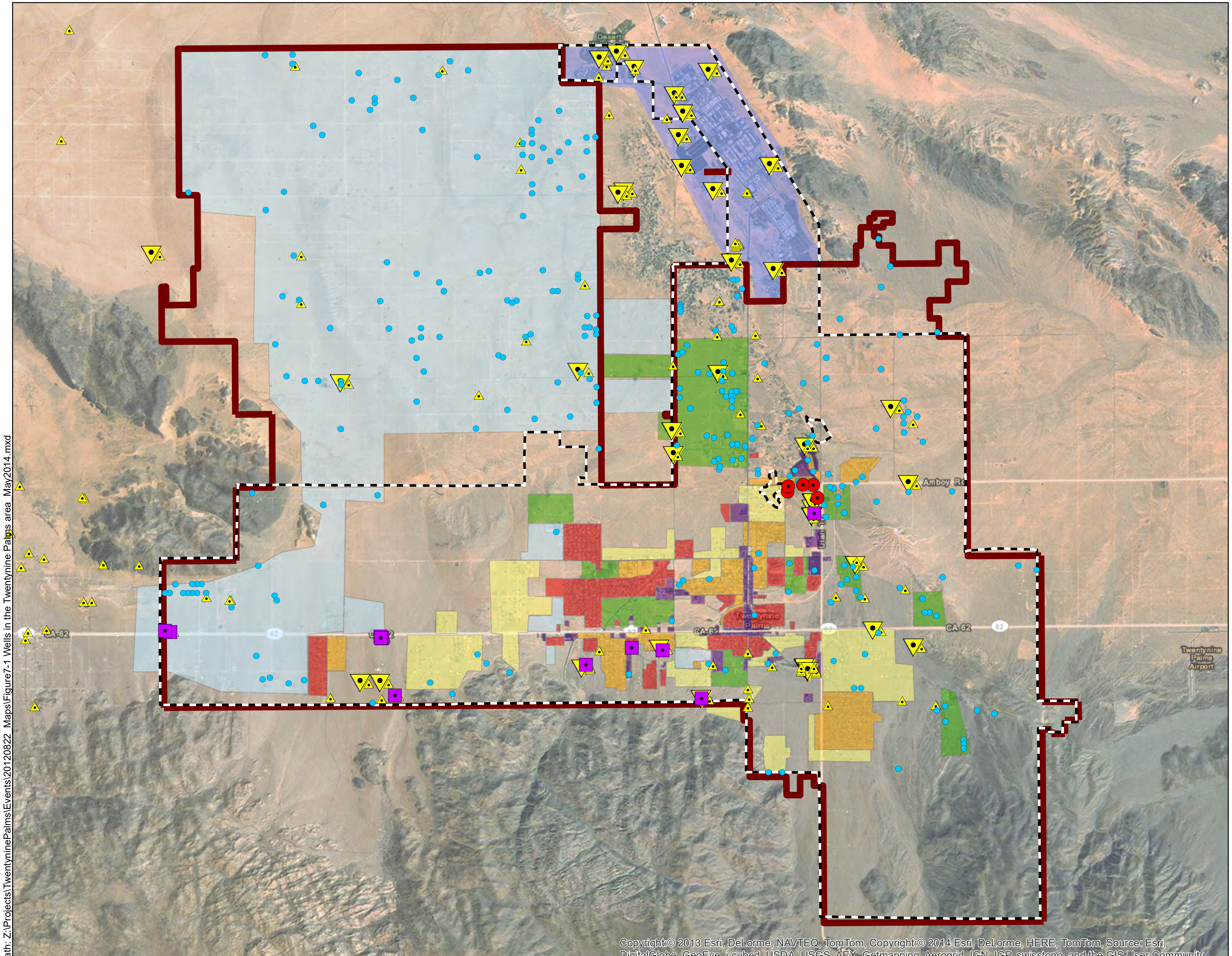
- Saddlehorn Drive area is located along Utah Trail near the golf course. Elevated COC concentrations in a single well were attributed to poor well construction. This area is also near the former Shortz Playa. The purpose is to evaluate vertical and horizontal distribution of COCs and possible influence of geologic layering from lake deposits. A single well cluster is planned.

- The District Well #4 has had elevated COC concentrations relative to other District wells. It is unclear if this is a regional or well specific issue. The purpose is to evaluate vertical and horizontal distribution of COCs near Well #4. A single well cluster is planned.

- The high-density residential area located near 2 Mile Road and Mesquite Springs Road is located in an area of thick vadose zone and potentially thin saturated interval of alluvial sediments. The purpose is to evaluate the potential for attenuation of COCs in these areas. Two monitoring well locations are needed, one near the edge of the residential area and a second about 1,000 feet downgradient.

Monitoring will require one or more wells at each of the targeted areas. An initial deep pilot borehole will be drilled that will be geologically logged by a California licensed geologist and have a suite of borehole geophysical logs run to provide detailed geologic data for each of these locations. Based on this information, the number of potential monitoring wells in the cluster at each location will be determined. A downgradient monitoring well cluster will be added as appropriate. Downgradient locations are anticipated for the Luckie Park and the 2 Mile Road and Mesquite Springs Road locations. The monitoring wells will be constructed in a manner consistent with obtaining regular high-quality water quality data. The Sampling Plan detailed in Section 4 for this phase will be implemented once funding is approved for this phase.

When funding opportunities are available (see section 6 for more details), efforts will be made to acquire access, implement the design, installation and testing of at these proposed locations.



Path: Z:\Projects\TwentyninePalms\Events\20120822_Maps\Figure7-1 Wells in the Twentynine Palms area_May2014.mxd

LEGEND

- TPWD Monitoring Well
- TPWD Production Well
- Private Well
- USGS Monitored Well
- Current USGS Monitored Well
- City Limit
- Water District Boundary

Current Land Use

- Zone A
- Zone B
- Zone C
- Zone D
- Zone E
- Commercial Area
- Military Base

Zone A = High Density Residential (> 2 du/acre)
Zone B = High Density Residential (1 - 2 du/acre)
Zone C = Moderate Density Residential (0.5 - 1 du/acre)
Zone D = Low Density Residential (0.1 - 0.5 de/acre)
Zone E = Low Density Residential (< 0.1 du/acre)

Note: Data compiled from 2012 air photo anaysis

N

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Miles

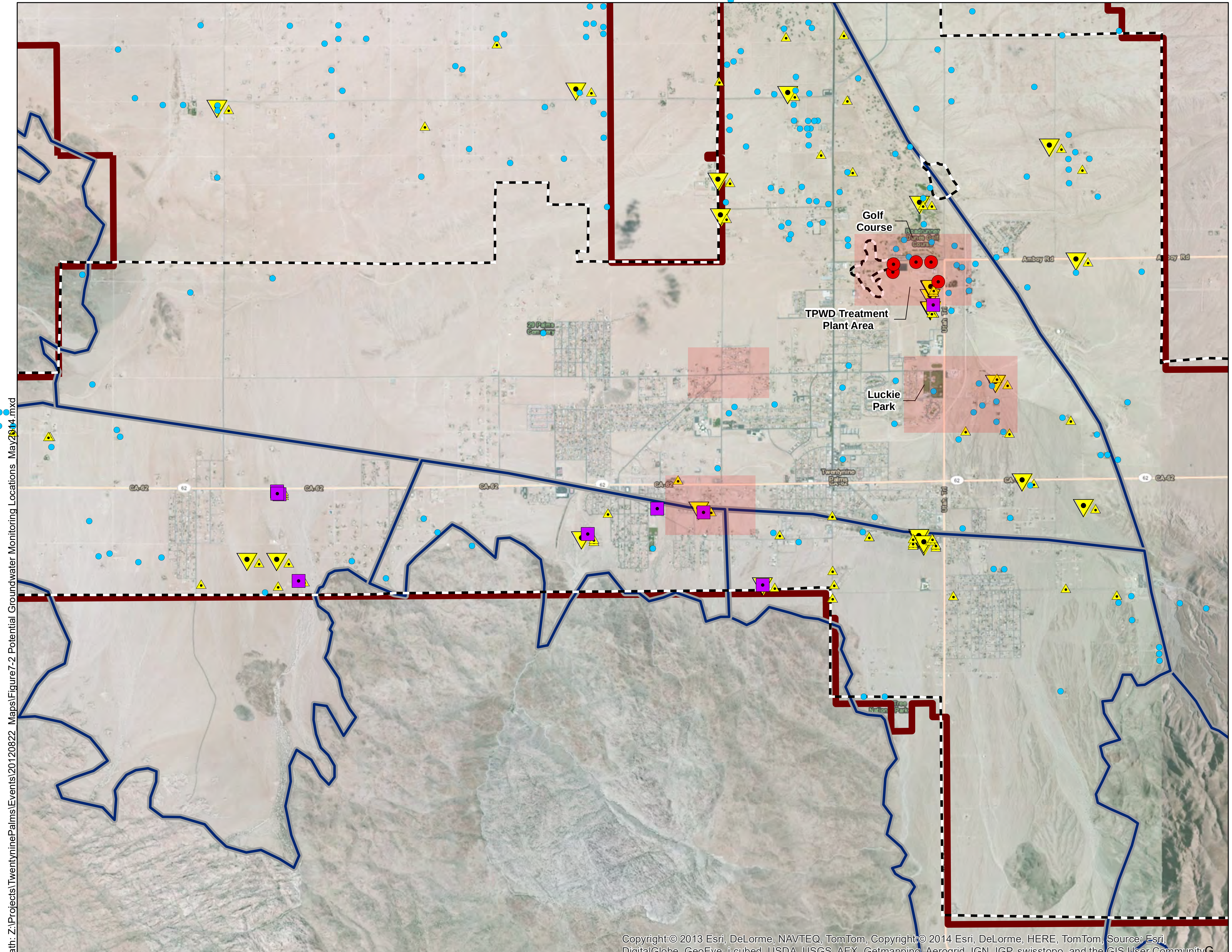
Kennedy/Jenks Consultants

Groundwater Implementation Plan
Twentynine Palms, California

Wells in the Twentynine Palms Area

K/J 1744007*00
Oct 2017

Figure 3



LEGEND

- TPWD Monitoring Well
- TPWD Production Well
- Private Well
- USGS Monitored Well
- Current USGS Monitored Well
- City Limit
- Groundwater Basin Boundary
- Water District Boundary
- Proposed Monitoring Well Locations

Kennedy/Jenks Consultants

Groundwater Implementation Plan
Twentynine Palms, California

Potential Groundwater Monitoring Locations

K/J 1744007*00
Oct 2017

Figure 4

Path: Z:\Projects\TwentyninePalms\Events\20120822_Maps\Figure7-2 Potential Groundwater Monitoring Locations_May2014.mxd

3.4.4 Phase 4 – Conducting a One-Time Existing Conditions Sampling Event

Collecting a one-time sample for COCs from as many existing domestic wells as possible will require coordination and outreach to local property owners to obtain water quality samples. It is recommended that a single event sampling program be conducted that will obtain data from a large number of private wells from various parts of the study area to establish what is the areal extent of COCs and potential impact to beneficial uses. The purpose of this is to collect a onetime sample for COCs from as many existing domestic wells as possible to establish the areal extent of COCs and assess the potential impact to beneficial uses.

This will require coordination and outreach to local property owners to obtain water quality samples. It is requested that the District facilitate the procurement of these data, based on local knowledge and receptivity of private land owners to allow their wells to be inspected and sampled for water quality.

In addition, this outreach program would provide a mechanism to evaluate the condition and construction of existing wells. This provides a means to evaluate whether wells are acting as vertical conduits that may allow septage to flow down the well annulus due to poor well construction, causing areas of locally high nitrate and TDS concentrations.

In 2016 the District began working with the Mojave Water Agency Integrated Regional Water Management Plan group to access funding made available by the Department of Water Resources (DWR) for water related projects to assist disadvantaged communities. In 2017 the Mojave IRWM Region submitted an application through the Colorado River Funding Area which has been awarded $2,636,488. Of that amount approximately $50,000 will be provided to the District to assist specifically with this Phase 4 of this Groundwater Implementation Plan.
It is anticipated that the Phase 4 activities would occur beginning Spring of 2018 and ending Spring of 2019.

Section 4: 2018 Groundwater Monitoring Implementation Plan Strategy

4.1 Monitoring Design

For this implementation plan, a preliminary subset of wells has been identified by the District as shown in Tables 4-2 through 4-6. It is recommended that wells selected for this monitoring program be sampled on an annual basis. All results of the monitoring will be submitted to the District for inclusion into their current water quality database. The District will be the responsible party for collecting samples, compiling the results in tabular form, updating/revising the Monitoring Plan and submitting it to the RWQCB.

4.2 Monitoring Program Goals

The groundwater level and water quality monitoring program for this effort is designed to accomplish the following:

1) Document groundwater level and groundwater quality trends through time;
2) Identify salt and nutrient constituents of concern;
3) Identify potential sources of salts and nutrients;
4) Identify existing monitoring well locations that will be used to track potential changes in water quality over time; and
5) Conduct fate/transport evaluations of the constituents of concern.

4.3 Water Quality Parameters

4.3.1 Primary Parameters

The recommended parameters to be monitored for SNMP purposes include EC, TDS and nitrate, in addition to general minerals and physical constituents. The general mineral constituents to be analyzed may include: calcium, magnesium, sodium, potassium, carbonate, bicarbonate, hydroxide, chloride, sulfate, nitrate, nitrite, MBAS, TDS, pH, copper, iron manganese, zinc, conductivity, hardness, fluoride, color, odor, and turbidity. Additional parameters may be monitored as determined by baseline sampling results. The SNMP monitoring plan does not include a recommendation for monitoring COCs (discussed in Section 3.3). Future monitoring of COCs will be incorporated, as applicable, through the SNMP process and under the direction of the State Water Board

4.4 Monitoring Sampling Frequency

Each well will be sampled on an annual basis or until such time the data provides sufficient evidence to extend or reduce the sampling frequency. Rationale to decrease sampling frequency may include repeated constituent levels well below MCL's, while rationale to increase the sampling frequency may include a constituent continuing to exceed MCL's and its proximity to public supply wells and/or domestic wells. No temporal or seasonal changes in groundwater quality are expected because very little, if any, precipitation infiltrates the ground surface and percolates to the top of the shallow aquifer, much less the deep aquifer(s), where the SNMP sampling points are located.

4.5 Quality Assurance/Quality Control

4.5.1 Data Reliability

Anomalous results from sampling may be a result of well construction problems, faulty monitoring equipment or localized groundwater contamination. Data obtained from wells should be scrutinized to determine if the data is representative of groundwater levels or water quality conditions of the area. This can be done by repeat measurement (water levels) to make sure that obstructions or cascading water in the well is not giving false readings. Groundwater quality sampling should include travel blanks and spikes to ensure that contamination of the sample or mishandling by the laboratory has not occurred.

4.5.2 Field Equipment Calibration

Water quality parameters (pH, specific conductance, and temperature) will be monitored while groundwater is purged via a flow-through cell. The water will pass through the cell, and measurements will be made with probes installed in the cell. Equipment used to measure these parameters will be calibrated according to manufacturer instructions. Each probe will be calibrated at the beginning of each day of sample collection. The pH probe will be calibrated to bracket pH values of 7.4-10.4. While the temperature probe has an internal electronic calibration, the specific conductance probe is not calibrated and rather checked against a standard (the meter cannot be adjusted).

4.5.3 Field Duplicate Samples

Field duplicate samples (laboratory quality check) are two samples collected at the same time, by the same method, from the same source, and submitted as separate samples for analysis. Duplicate samples for this plan will be collected at a frequency of 10 percent. Each duplicate will be analyzed for the same parameters as the real sample. All duplicate samples will be collected, numbered, packaged, and sealed in the same manner as the real samples.

4.6 Field Sampling Plan and Procedures

The field sampling procedures are outlined in Table 4-1.

TABLE 4-1: PROPOSED FIELD SAMPLING PROCEDURES BY TWENTYNINE PLAMS WATER DISTRICT

Method	Description	Minimum Requirements	Comments
Bailing	Removing water with a bailer	Remove 3 to 5 well volumes or until pH, conductivity and temperature stabilize	
Submersible Pump	Removal of water with a submersible pump	Same as above	
Air-Lifting	Displacing volume of water with compressed air	Same as above	
Micro-purge	Slow removal of water with pump set within the screened interval	Remove water that is contained within the casing from pump depth to surface	Depth limitations due to pump capacity

4.6.1 Record Keeping

Each time that a water level or water quality sample is collected from a monitoring program well, the water level and/or the water quality analysis results will be recorded into the District's database. Currently, water level readings are recorded into a bound field notebook and then transferred into the database maintained by the District. In the future, all data transferred into the District's database.

Each time a well is sampled for water quality, the field notes should specify analysis methods, how and when the well was purged and sampled, amount of water removed during the purging, and general field comments. This field data and all the analytical results should be archived in the database.

4.6.2 Groundwater Sampling Protocol and Best Management Practices

Groundwater samples collected as part of the SNMP should be collected using the following guidelines:

1) Prior to sampling, a water level measurement will be obtained from each well. Water levels will be used to construct a water elevation contour map and to determine volume of water in the well.

2) Wells shall be purged with a submersible pump until 3-5 well volumes of water (not including development) were removed or until consecutive readings of conductivity, temperature, pH, and dissolved oxygen were within 10% of the previous two readings. Readings shall be collected every 5 to 10 minutes dependent on the discharge rate. At least 5 consecutive readings should be collected regardless of field parameters.

Readings shall be collected by passing water through a flow-through cell connected to a meter.

3) Samples shall be filtered in the field (where possible) with a disposable in-line 0.45-micron filter prior to being placed in the sample container.

4) Samples for water quality analysis shall be collected in containers appropriate for the analysis intended.

5) Each sample container shall be labeled with the well number/location, date/time of sample collection, and sampler's name. The samples shall be delivered to the laboratory under chain-of-custody.

4.6.3 Sample Analysis

Field parameters of conductivity, pH, temperature and dissolved oxygen shall be monitored during purging. Samples shall be filtered and preserved as specified for each analyte (TDS/nitrate/etc.) and shipped to the appropriate laboratories for analysis.

4.7 Water Quality Data Management

All data collected and analyzed for this sampling program will be compatible with the existing database utilized by District. Responsibility for data input will be decided as part of the Monitoring Plan and will depend on personnel availability, computer (hardware and software) capabilities, and schedules.

4.8 Sampling and Monitoring Areas

Five areas of the District's service area (53 wells total) have been selected to be the focus of this implementation sampling program. The five areas include:

- Indian Cove Subbasin
- Fortynine Palms Subbasin
- Eastern Subbasin
- Mesquite Subbasin, and
- Mainside Subbasin

4.9 Coordination Activities and Sampling Plan Well Types

A combination of monitoring wells, domestic wells, and public supply wells will eventually be in the sampling program well network. Currently Phase I and 2 implementation efforts are being implemented for District wells and USGS sites which are known to be accessible. All wells incorporated into this Phase I and Phase 2 sampling well network have completed well construction records including known perforated intervals to allow evaluation of both vertical and horizontal components of the aquifer system(s) and the knowledge of which water-bearing zone is being sampled and analyzed.

4.9.1 Indian Cove Subbasin Groundwater Monitoring Locations

The Indian Cove Subbasin is located between the Joshua Tree Subbasin on the west and the Fortynine Palms Subbasin on the east. The basin is floored by bedrock, which generally slopes northward with depth to bedrock ranging from 100 to 1,200 feet below ground surface (bgs) (Kennedy/Jenks, 2014a).

In the Indian Cove Subbasin, pumping records go back to 1957, and varied from about 30 AFY initially to a peak of 2,075 AFY in 1985. In 2012, total pumping in the subbasin was 442 AFY. The current production capacity for wells located within this subbasin is 1,785 AFY (Table 2-5). The greatest annual pumping from a single well in the basin was about 620 AFY, from Well #10 in 1976.

The groundwater levels vary more widely in the Indian Cove Subbasin than the other subbasins in the area. The groundwater elevations in the northern part of the subbasin have declined between 1.5 and 2.5 feet per year from the 1960s to the 2000s. Groundwater elevation dropped most quickly from about 1970 to 1990 before decreasing more slowly to the present time. Over the past 10 years, water levels in most of these wells generally increased at the rate of about 0.5 to 1.5 feet per year.

Wells south of the Pinto Fault did not experience similar declines in the groundwater levels. The water levels in the southern group wells range from about 2,210 to 2,440 feet above MSL.

Seven groundwater wells will be used for sampling purposes in this area as shown in Table 4-2.

TABLE 4-2: INDIAN COVE SUBBASIN MONITORING INFORMATION

Well Name	Well Type	Pump Installed	Owner	Total Depth
TPWD-6	Muni	Yes	TPWD	403’
TPWD-8	Muni	Yes	TPWD	785’
TPWD-9	Muni	Yes	TPWD	530’
TPWD-10	Muni	Yes	TPWD	400’
TPWD-11	Muni	Yes	TPWD	400’
TPWD-12	Muni	Yes	TPWD	410’
TPWD-15	Muni	Yes	TPWD	352’

4.9.2 Fortynine Palms Subbasin Groundwater Monitoring Locations

The Fortynine Palms Subbasin is located directly east of the Indian Cove Subbasin. The known depth to bedrock in the subbasin is between 170 and 430 feet bgs making this the shallowest among the subbasins in the area (Kennedy/Jenks, 2010). The Pinto Fault also traverses the southern part of this basin; however, there are no wells exist south of the fault to verify whether or not the fault is a barrier to flow. No other significant faults are known within this subbasin.

In the Fortynine Palms Subbasin, pumping records go back to 1952. Since then, pumping has varied from about 260 AFY in 1953 to a peak of 1,620 AFY in 2002. In 2012, total pumping in the subbasin was 1,012 AFY. The current production capacity for wells located within this subbasin is 2,420 AFY. The greatest discharge from a single well in the subbasin was about 920 AFY, from TPWD-14 in 2007.

From the 1940s to about 1970, groundwater levels declined by about 1 foot per year before leveling off about 1990, coinciding with a pumping decline in this basin. Starting around 1990, water levels declined as pumping again increased in the subbasin; until 2003, when pumping was reduced, and water levels again leveled off. Water levels in TPWD-13 and TPWD-14, in the southwestern part of the subbasin, have experienced a much steadier decline than other District wells in the subbasin. Measured groundwater elevations have decreased 150 feet from the 1940s, including about 100 feet since 1980.

Seven groundwater wells will be used for sampling purposes in this area as shown in in Table 4-3.

TABLE 4-3: FORTYNINE PALMS SUBBASIN MONITORING INFORMATION

Well Name	Well Type	Pump Installed	Owner	Total Depth
TPWD-3	Muni	Yes	TPWD	340’
TPWD-3B	Muni	Yes	TPWD	398’
TPWD-4	Muni	Yes	TPWD	283’
TPWD-5	Muni	Yes	TPWD	TBD
TPWD-13	Muni	Yes	TPWD	337’
TPWD-14	Muni	Yes	TPWD	430’
TPWD-17	Muni	Yes	TPWD	TBD

4.9.3 Eastern Subbasin Groundwater Monitoring Locations

The Eastern Subbasin is located immediately to the east of the Fortynine Palms Subbasin. Woodward-Clyde (1985) noted that groundwater supplies in the Eastern Subbasin appear limited due to most of the flow being confined to a shallow zone above or in the bedrock. The depth to bedrock varies from 160 to 750 feet bgs (Kennedy/Jenks, 2008, 2010). Test wells drilled in 1987 near the large housing tract encountered bedrock at depths ranging from 327 to 415 feet bgs, and the water table was inferred at depths ranging from160 to 170 feet bgs (BCI, 1988).

In the Eastern Subbasin, pumping records go back to 1952. Since then, pumping has varied from about 200 AFY in 1953 to a peak of 829 AFY in 2002. In 2012, total pumping in the subbasin was 311 AFY. The current production capacity for wells located within this subbasin is 800 AFY. The greatest discharge from a single well in the subbasin was 580 AFY from TPWD-16 in 2002.

Groundwater elevations for wells with at least 20 years of record have mostly declined between 0.2 and 0.8 feet per year. Measured groundwater elevations have decreased 70 feet from the 1940s, including about 50 feet since 1990.

Three groundwater wells will be used for sampling purposes in this area as shown in Table 4-4.

TABLE 4-4: EASTERN SUBBASIN MONITORING INFORMATION

Well Name	Well Type	Pump Installed	Owner	Total Depth
TPWD-1	Muni	Yes	TPWD	TBD
TPWD-2	Muni	Yes	TPWD	275'
TPWD-16	Muni	Yes	TPWD	320'

4.9.4 Mesquite Lake Subbasin Groundwater Monitoring Locations

The District has one high-capacity supply well (WTP-1) in this subbasin. WTP-1 came on line in 2003 and has a discharge capacity of 3,395 AFY. The well has pumped between 610 and 1,168 AFY since then. Otherwise, groundwater pumping in this subbasin is limited due to naturally-occurring water quality issues. There are private irrigation wells for the Roadrunner Dunes Golf Course and Luckie Park that have been estimated to pump as much as 580 AFY.

The static water level in WTP-1 has dropped by about 6 feet over the 10-year period of record. A significant amount of historical data is available from the USGS. Most water level measurements through the past 60 years are from the eastern and southern parts of the subbasin, with limited data from the western half of the subbasin. Most wells with long records show relatively steady water levels over time with total variations in groundwater levels ranging within 5 feet.

27 groundwater wells will be used for sampling purposes in this area as shown in in Table 4-5.

TABLE 4-5: MESQUITE LAKE SUBBASIN MONITORING INFORMATION

Well Name	Well Type	Pump Installed	Owner	Total Depth
WTP-1	Muni	Yes	TPWD	1,010
TPWD-18	Muni	Yes	TPWD	TBD
MW-1	Mon	No	TPWD	TBD
MW-2	Mon	No	TPWD	TBD
MW-3	Mon	No	TPWD	TBD
MW-4	Mon	No	TPWD	TBD
MW-5	Mon	No	TPWD	TBD
N1	Mon	No	TPWD	TBD
N2	Mon	No	TPWD	TBD
N3	Mon	No	TPWD	TBD
N4	Mon	No	TPWD	TBD
N5	Mon	No	TPWD	TBD
N6	Mon	No	TPWD	TBD
S1	Mon	No	TPWD	TBD
S2	Mon	No	TPWD	TBD
S3	Mon	No	TPWD	TBD
S4	Mon	No	TPWD	TBD
S5	Mon	No	TPWD	TBD
09L1	Mon	No	USGS	TBD
12G1	Mon	No	USGS	TBD
16H4	Mon	No	USGS	TBD
17E1	Mon	No	USGS	TBD

Well Name	Well Type	Pump Installed	Owner	Total Depth
21H4	Mon	No	USGS	TBD
27C1	Mon	No	USGS	TBD
32A1	Mon	No	USGS	TBD
35F1	Mon	No	USGS	TBD
24H1	Mon	No	USGS	TBD

4.9.5 Mainside Subbasin Groundwater Monitoring Locations

The District does not have production or monitoring wells in the Mainside Subbasin. Estimated pumping from the Marine Base golf course well in not measured but has been estimated between 50 and 540 AFY from the Mainside Subbasin. Groundwater levels have increased by 0 to 0.7 feet per year in the eight wells for which the USGS has collected data, although most of the increases are due to single or few anomalously low water levels at the beginnings of the periods of record. Water levels within this basin have been basically stable since about 1990.

Eight groundwater wells will be used for sampling purposes in this area as shown in Table 4-6.

TABLE 4-6: MAINSIDE SUBBASIN MONITORING INFORMATION

Well Name	Well Type	Pump Installed	Owner	Total Depth
04C1	Mon	No	USGS	UNK
11N2	Mon	No	USGS	UNK
23D1	Mon	No	USGS	UNK
19F1	Mon	No	USGS	UNK
20M2	Mon	No	USGS	UNK
29M2	Mon	No	USGS	UNK
29R1	Mon	No	USGS	UNK
32R2	Mon	No	USGS	UNK

4.10 Data Evaluation, Reporting and Periodic Review of SNMP and the Groundwater Implementation Plan

4.10.1 Groundwater Quality Sampling Report

The goal of the SNMP monitoring program is to provide the data required to calculate ambient TDS and nitrate concentration with the same methodology used in the 2014 SNMP. An interim technical memorandum will be provided after each annual sampling event to document the field sampling activities. This will be a concise report to document field procedures performed during the event, provide field data sheets to verify stabilization parameters and other key sampling parameters, and provide the laboratory results.

4.10.2 Annual Report

This task includes preparation of a draft technical report to document the work completed during Phase I and Phase 2 efforts. The report will also include consolidated findings and any recommended actions in response to the water quality risk assessment and proposed work scope for Phase 3 and Phase 4 implementation

4.10.2.1 Groundwater Review

After sufficient new data are collected, a comprehensive groundwater study will be conducted to evaluate the findings from the monitoring program. This would include more detailed hydrogeological evaluation and modeling to assess the potential impacts of COCs on the beneficial use of groundwater in the Twentynine Palms area. The District will maintain an electronic library of the report, mapping, shape-files and groundwater model data input and output sets for use by interested parties moving forward.

4.10.2.2 Peer Review

District staff and interested participating stakeholders will be involved at key milestones as the project proceeds including both public meetings and stakeholder workshops. This effort will provide for a broad level of peer review and stakeholder input improving the overall quality of the concepts, assumptions, findings and ultimately the conclusions of this project.

4.10.3 Adaptive Management Plan

Adaptive management involves implementing a management strategy where goals, objectives and/or actions may be further developed, modified, or replaced based on monitoring and collection of new information in response to changing physical conditions or reduction in uncertainty. In this way, groundwater managers simultaneously apply management practices and learn from those management practices.

Adaptive management is typically broken into several general steps:

1. Assess/reassess current groundwater conditions and develop hydrogeologic conceptual model.
2. Design/modify management and monitoring plan.
3. Implement the management/monitoring plan.
4. Evaluate monitoring results and use to revise the hydrogeologic model and management plan.

Based on the monitoring program requirements of annual sampling and analysis, adaptive management will involve reviewing the monitoring results on an annual basis and determining whether results are in the anticipated range of analytical results expected based on the hydrogeologic conceptual model and predictive modeling of the Basin. If analytical results are significantly different than anticipated, the need for reassessing the hydrogeologic model and management and monitoring plan will be assessed and modified if appropriate. This would include assessing the potential need for additional BMPs if warranted to protect water quality objectives and SNMP goals.

4.10.4 Performance Measures

The following are performance measures to be used to assess whether the goals and objective of the SNMP are being met:

- Monitor for salinity and plot trends and review the actions outlined in the approach to meet the objectives were obtained.

- Assess whether sufficient information was obtained to better understand the relationship between overdraft and the increasing trend in salinity in the basin to assist in managing the basin moving forward.

- Conduct basin-wide salinity mass balance during future groundwater resources related project implementation and compare to fate and transport model projects and new simulations.

- Determine if sufficient characterization data was collected to better understand and inform future actions and decisions in managing the basin moving forward.

4.11 Implementation Schedule

The SNMP monitoring program will be implemented according to the following schedule:

- Finalize agreements with RWQCB for implementation by March 2018.

- Perform groundwater sampling within 1 year of the RWQCB approval of implementation plan.

- Deliver first annual report on the status of monitoring associated with Phase I and Phase 2 efforts by March 2019.

- Annual Report will include at a minimum: a summary of monitoring and data collection efforts performed, table and charts of monitoring results, and any recommended changes to the monitoring program including the implementation of Phase 3 and Phase 4 monitoring efforts, scheduled to occur between Spring of 2018 and Spring 2019.

It is anticipated that this SNMP could be incorporated into a GSP under development in the future and that updates will happen through adaptive management of the potential future GSP. The timing of an update is not tied to a scheduled reoccurrence interval; however, an update could be triggered by the following:

- Major changes in land use or land management practices

- New information from the groundwater monitoring program

- Changes in basin management

4.12 Conclusions

In accordance with the Recycled Water Policy, this monitoring implementation plan for the District's SNMP will be developed through a collaborative process involving regional stakeholders. This implementation plan was developed to access TDS, chloride and nitrate which were determined in the SNMP to be indicator compounds for salts and nutrients. 53 current wells are being proposed for sampling and reporting as part of this program. The

District will be responsible for collecting samples from proposed wells on an annual basis and submitting this data to the RWQCB.

Based on results from this program, the SNMP Implementation Monitoring Plan will be updated as necessary. Additionally, as funding sources are secured, Phase 3 and Phase 4 of the monitoring program will be implemented. This implementation will require updates as necessary to this plan.

Section 5: Public Participation and Educational Outreach

5.1 Outreach, Communication and Facilitation

Successful implementation of a Groundwater Implementation Plan will depend on efficient outreach, communication, and facilitation between the District and locals/stakeholders. Stakeholder engagement is defined as efforts made to understand and involve stakeholders and their concerns in the activities and decision-making of an organization or group. The idea is that those impacted by a decision have a right to be involved in the decision-making process; stakeholder acceptance of projects and management actions included in the Implementation Plan will forestall the potential for lawsuits and will aid in achieving basin sustainability.

DWR has published guidelines regarding communication and outreach specific to the SGMA process; which is similar to the Groundwater Implementation Plan process given its focus on groundwater management, and monitoring.

Recognizing DWR's goals for proactive outreach for the SGMA process, the following goals have been established for the District's Groundwater Implementation Plan outreach:

- Engage public participation in the groundwater plan implementation
- Maintain cooperation between the RWQCB and other agencies and stakeholders
- Educate stakeholders, water users, and citizens on groundwater monitoring requirements and water management sustainability objectives, as well as the role and responsibility of each party.
- Provide easy access to informative materials, data, and reports
- Report on progress and accomplishments in implementing and provide transparency about the District's implementation activities.

Additionally, regardless of how stakeholders are engaged, it is important to consider whether or not the groundwater monitoring activities have the support of all necessary parties, is the proposed plan is flexible enough to include new potential agencies and stakeholders in the future, and what formal mechanisms exist for facilitating participation of beneficial users.

During the plan implementation, roundtables and/or other traditional meetings will be conducted to facilitate communication with more active and easily reached stakeholders. For those who face more barriers to participation, alternative opportunities for participation will be provided.

Evening meetings, translation, and targeted outreach and communication take more work to conduct but are ultimately more successful at including these stakeholders. Regional public stakeholder workshops will be held to obtain stakeholder input. Interviews of select stakeholders will be held to gain further understanding of input from previous workshops. Web-based surveys and data requests may be employed to obtain input from stakeholders on specific topics not covered during in-person workshops. When appropriate, web-based meetings such as webcasts and webinars may be used to disseminate information related to draft documents or other project information. Existing conferences and meetings can be used to present progress and results.

Collaborative models and decision-support tools take existing or newly developed data or models and guides stakeholders through a wide array of scenarios and options. The District understands that this method is helpful at building a shared understanding and providing stakeholders with a forum where they can test their concerns and preferences with others. In conclusion, to obtain buy-in and build good will, it is vital that all aspects of the plan and implementation truly consider and respond in more meaningful way to stakeholder concerns and needs.

The more opportunities for assessment, feedback, alteration, and improvement that the District pursues, more effective stakeholder engagement will be.

5.2 Public Outreach Implementation Plan and Schedule

Specific tactical approaches that may be utilized to deliver activities, messages, and any recommendations to the public will be developed after the first 2018 draft report has been prepared. Outreach activities will be developed in an efficient and cost savings way. This strategy will allow consistency of messaging and reduce confusion for stakeholders. The following are suggested options for communication and outreach coordination.

- Website
- Branded informational Flyers, Templates, PowerPoint Presentations
- Periodic newsletter
- SNMP related mailing lists
- Public workshops
- Press releases and guest editorials
- Existing group venues
- Outreach documentation

Section 6: Funding Opportunities

There are multiple funding options available for implementing the Groundwater Implementation Plan, including activities such as monitoring, data collection and analysis, and associated outreach, as well as long-term activities such as funding for SNMP updates, tool development and project/program implementation. A significant source of available outside funding Statewide for water resources planning efforts and project implementation is Proposition 1 (Prop 1), also referred to as the Water Quality, Supply, and Infrastructure Improvement Act of 2014. California voters passed Prop 1 in 2014 which authorized $7.5B in general obligation bonds for state water supply infrastructure projects which is allocated to various funding programs administered by multiple agencies.

The primary administering agencies include DWR and the California State Water Resources Control Board (SWRCB). Funding opportunities that would be applicable include the Water Recycling Funding Program (WRFP) / Clean Water State Revolving Fund (CWSRF) Program, Drinking Water State Revolving Fund (DWSRF) Program, the Groundwater Sustainability Program, the Integrated Regional Water Management (IRWM) Program, and the Sustainable Groundwater Planning Grants. These are described in more detail in the following sections.

6.1 Applicable Funding Opportunities

Funding options would be for activities such as conducting groundwater monitoring, collecting and analyzing data (including development of data management systems and/or groundwater flow models), and performing SNMP-related outreach. Other funding avenues would include regulatory fees and/or assessments that would be assessed per California Water Code Section 10730 and federal funding opportunities and agreements such as USGS Grants and cooperative agreements, also described below.

6.1.1 Integrated Regional Water Management Grant Program

DWR administers the Integrated Regional Water Management (IRWM) Grant Program, providing planning and implementation grants for the preparation and updates of IRWM Plans, and for construction and implementation of water resources-related projects, respectively. Under Prop 1, DWR has released one round of IRWM planning grant funding, and is anticipated to be releasing two rounds of IRWM implementation grant funding. Prop 1 allocated $510M to the IRWM program. Of the overall $510M, $367.3M has been allocated for IRWM implementation grants. Details regarding release of the implementation grant funding are as follows:

- Anticipated timing of future implementation grant solicitations
  - FY17/18: Implementation Round 1
  - FY19/20: Implementation Round 2
- Prop 1 requires a 50% outside funding match for the entire proposal (which typically includes multiple projects).

- For a project to receive IRWM grant funding, it must be included in an IRWM Region's IRWM Plan. Funding match waivers can sometimes be obtained for projects that directly benefit Disadvantage Communities (DACs) or Economically Distressed Areas (EDAs).

- To be eligible for funding, IRWM Plans must comply with new Proposition 1 Guidelines and Plan Standards in order to be eligible for implementation grant funding. Thus, Regions will be updating their IRWM Plans in the next couple of years.

IRWM implementation grant funding can be used to fund a wide variety of water-related projects including distribution/collection system upgrades, ecosystem restoration, stormwater projects and groundwater projects.

6.1.2 IRWM Disadvantaged Community Grant Program

DWR administers a grant program specific to providing outreach and education to DACs and/or EDAs within an eligible IRWM Funding Region. In 2016 the Mojave IRWM Region submitted an application through the Colorado River Funding Area which has been awarded $2,636,488. Of that amount approximately $50,000 will be provided to the District to assist specifically with Phase 4 of this Groundwater Implementation Plan.

6.1.3 Groundwater Sustainability Grant Program

As previously noted, Proposition 1 provided $800M for projects that prevent or cleanup contamination of groundwater that serves or has served as a source of drinking water. Administered by the SWRCB, the $800M to be awarded through the Grant Program includes $160M for DACs and EDAs, and at least $80M for severely DACs. In order to be eligible for this funding, a project must achieve at least one of the following:

- Prevent the spread of contamination (both natural and human made) in an aquifer that serves or has served as a source of drinking water.

- Accelerate the cleanup of contamination in an aquifer that serves or has served as a source of drinking water.

- Protect an aquifer that serve as a source of drinking water.

- Provide clean drinking water to DACs or EDAs.

- Be identified as a high priority by the applicable State or federal regulatory agencies (e.g. RWQCB, SWRCB, Department of Toxic Substances Control, USEPA).

- Have adequate funding match (50%) and applicant must have capability to pay O&M costs.

- Have a useful life of at least 20 years.

Eligible project types for this funding program include planning projects such as site assessment and characterizations, groundwater modeling, feasibility studies, remedial investigations, monitoring and reporting plans, and preliminary engineering design. Implementation projects that can be funded by this program include wellhead treatment, installation of extraction wells combined with treatment systems, centralized groundwater treatment systems, groundwater recharge projects to prevent or reduce contamination of municipal or domestic wells and groundwater injection projects to prevent seawater intrusion.

6.1.4 USGS Cooperative Agreements

The USGS participates in cooperative agreements with public organizations (such as cities, water districts and irrigation districts) to support efforts for research and data collection. Under this program, the USGS provides support and research for data collection and examination of the geological structure, water, mineral, and biological resources, and include efforts such as well installation and monitoring and groundwater modeling. Awards are typically supported by funding from internal projects and programs, and funds are not separately budgeted or reserved for external projects or proposals under this entry.

6.1.5 Clean Water State Revolving Fund Program

SWRCB administers the Clean Water State Revolving Fund (CWSRF) Program offering, low-interest loans to eligible applicants for construction of publicly-owned facilities including wastewater treatment, local sewers, sewer interceptors, water reclamation facilities, and stormwater treatment; expanded use projects (including implementation of nonpoint source projects or programs); and development and implementation of estuary comprehensive conservation and management plan. The Water Recycling Funding Program (WRFP) is a subprogram that falls under the purview of the CWSRF Program and promotes beneficial use of treated municipal wastewater (water recycling) in order to augment fresh water supplies in California by providing technical and financial assistance to agencies in support of water recycling projects and research. In addition to the approximately $200 to $300M of available funding through the CWSRF Program, Proposition 1 provides $625M for planning and construction of water recycling projects. Other CWSRF key points are as follows:

- CWSRF loans typically have a lower interest rate than bonds, at half of the General Obligation bond (typically 2.5% to 3%, currently 1.6%) at the time of the financing agreement.
- Loans are paid back over 20 or 30 years. Repayment begins one year after construction is complete.
- Historically, SWRCB has offered principal forgiveness (i.e. grants) to applicants if the project directly benefits a small, disadvantaged community.
- The application process can take up to a year or more to complete.

6.1.6 Drinking Water State Revolving Fund Program

The Drinking Water (DWSRF) Program is also administered by the SWRCB and provides drinking water grants and low-interest loans for public water system infrastructure improvements and related actions to meet safe drinking water standards and to ensure affordable drinking water. The application process for the DWSRF program similar to that for the CWSRF Program. Key points relating to this program are as follows:

- Eligible projects include water treatment systems, water distribution systems, interconnections, and consolidations, pipeline extensions, water sources, water meters, and water storage.

- Maximum loan amount based on borrowing capability of applicant.

- Interest rate is half the General Obligation bond (typically 2.5% to 3%, currently 1.6%) at the time of the financing agreement. A 0% interest rate may be available to public water systems serving small DACs.

- Loans are repaid over 20 or 30 years, or the useful life of the project for water systems serving DACs. Repayment begins one year after project completion.

- Principal forgiveness may be available to publicly owned water systems or non-profit mutual water companies serving DACs.

- Application review and financing agreement execution can take over a year or more.

The District has submitted an application to the DWSRF Program requesting approximately $2.1 million for planning and design of treatment systems associated with fluoride and hexavalent chromium (pending the outcome of the remanded MCL). The project is listed on the SWRCB's DWSRF Intended Use Plan's Comprehensive List and is currently being reviewed by SWRCB staff and District counsel.

6.1.7 Infrastructure State Revolving Fund Program

The Infrastructure SRF Program is a program administered by the California Infrastructure and Economic Development Bank (I-Bank) to provide financing for public infrastructure projects. Eligible projects include, but are not limited to, drainage, water supply and flood control, environmental mitigation measures, sewage collection and treatment, and water treatment and distribution. Similar to the DWSRF and CWSRF program, funding of amounts in the range of $50,000 - $25M are available for up to a 30-year term. Because the ISRF program is a state-run program, compliance with CEQA (rather than CEAQ-Plus) is required.

6.1.8 Small Community Wastewater Grant Program

Another SWRCB funding program is the CWSRF Small Community Grant Fund. This program provides financial assistance to small (i.e., with a population of 20,000 persons, or less) communities for planning, design, and construction of publicly-owned wastewater treatment and collection facilities. Eligible entities include public agencies, non-profits, and tribes. At present, $260M is available through Prop 1. Similar to the CWSRF program, this program provides both design and construction grants. Applications for this program are submitted via the SWRCB FAAST system.

6.1.9 Bureau of Reclamation WaterSMART Grant Program

The WaterSMART (Sustain and Manage American Resources for Tomorrow) funding program is a funding program operated by the U.S. Bureau of Reclamation (USBR). WaterSMART grants provide funding for the following types of projects: Water and Energy Efficiency Grants, System Optimization Review Grants, Advanced Water Treatment and Pilot and Demonstration Project

Grants, and Grants to Develop Climate Analysis Tools. Projects are selected through a competitive process and the focus is on projects that can be completed within 24 months that will help sustainable water supplies in the western United States. Funding awards range from $300,000 to $1M, depending on the WaterSMART subprogram, and require a 50% local cost share. Projects funded under these programs should seek to conserve and use water more efficiently, increase the use of renewable energy, protect endangered species, or facilitate water markets. The timing and availability of funding is set annually by the USBR and varies based on project and funding availability.

6.2 Funding Recommendations

On at least a quarterly basis, it is recommended that Groundwater Implementation Plan activities be aligned with applicable funding opportunities and summarized in a matrix. Action items such as initiating contact with funding agency staff and preparation of applications will be identified and implemented as appropriate.

Section 7: References

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