SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND
BLENDING FACILITIES PROJECT

BASIS OF DESIGN TECHNICAL MEMORANDUM

June 2016

NV5

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June 2016

Prepared for:

Santa Nella County Water District
12931 South Highway 33
Santa Nella, CA 95322

Prepared by:

NV5, Inc.
1215 West Center Street, Suite 201
Manteca, CA 95337
(209) 239.9080 • (209) 239.4166 (Fax)

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June 2016

Santa Nella County Water District (SNCWD) has received funding under the State Drinking Water State Revolving Fund (SDWSRF) for water supply and system upgrades. The improvements are designed to: 1) increase water supply reliability; 2) achieve compliance with the California maximum contaminant level (MCL) for total trihalomethanes (TTHM); and 3) correct a storage capacity deficiency.

The proposed blending facility (Project) will include two storage tanks, a blending station, and a booster pump station. The Project will also include a new production well and 4.2 miles of 8-inch pipeline. The purpose of this Basis of Design Technical Memorandum (TM) is to establish design criteria for the Project.

1.0 WATER SYSTEM DESCRIPTION

SNCWD owns and operates the public water system in the unincorporated community of Santa Nella, on the west side of Merced County. The water system serves a population of approximately 1,500 persons through 609 service connections.

SNCWD utilizes two water sources: the California Aqueduct and Well 1. Water from the California Aqueduct is treated at the SNCWD Surface Water Treatment Plant (SWTP) before delivery to customers. The SWTP is located adjacent to the San Luis Canal component of the California Aqueduct, downstream of the O'Neill Forebay and adjacent to State Route (SR) 33. The SWTP includes the following major elements: 1) a raw water pumping station; 2) chemical storage and feed equipment; 3) two packaged conventional filtration units; 4) a filtered water pumping station; 5) a treated water storage tank; 6) wash water recovery ponds; and 7) sludge lagoons. The capacity of the SWTP is 0.91 million gallons per day (mgd), which represents the capacity with one packaged conventional filtration unit out of service for maintenance or repair [1]. The packaged units have been in service for more than 20 years, have developed leaks and control valve problems, and are generally in poor condition. Project facility locations are provided in Figure 1.

Well 1 satisfies demands for non-Central Valley Project (CVP) areas within SNCWD boundaries that are not allowed to receive water from the SWTP. Well 1 is equipped with a submersible pump, and was rehabilitated in 2011 to restore the capacity from failing conditions to the original 300 gallons per minute (gpm) (0.432 mgd) [2]. However, because of the well age and conditions, the pump will be operated at 200 gpm (0.288 mgd) or less. Well 1 total dissolved solids (TDS) concentrations are typically between 850 and 1,100 milligrams per liter (mg/L). For reference, the California "Recommended" and "Upper" secondary contaminant levels for TDS are 500 and 1,000 mg/L, respectively [3]. Water from Well 1 is chlorinated before delivery to consumers.

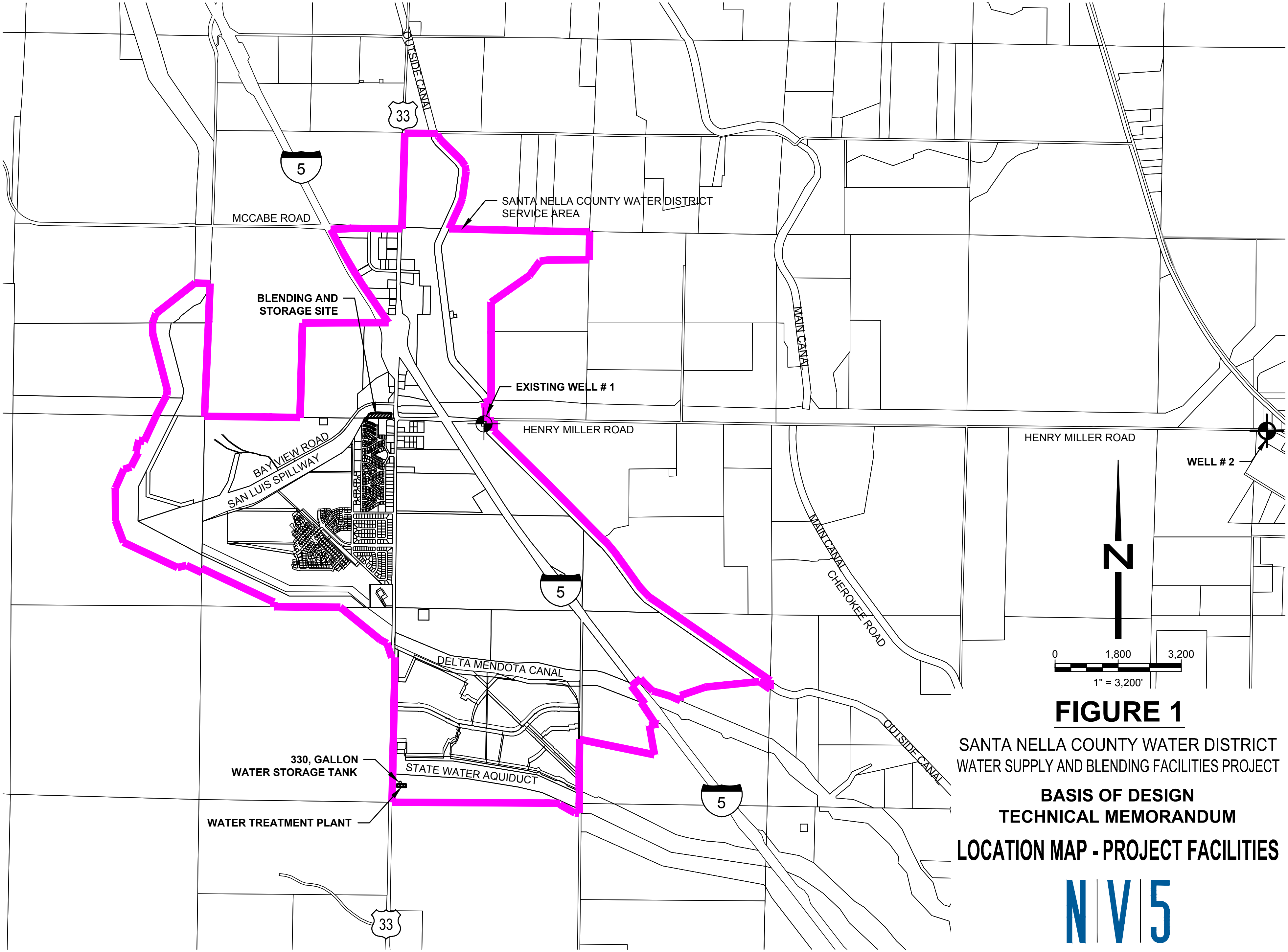

FIGURE 1

SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN
TECHNICAL MEMORANDUM

LOCATION MAP - PROJECT FACILITIES

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N:\226116-00132.03\Cadd\Exhibit\BOD TM\Figure 1-Location Map.dwg SD 6/20/2016

The distribution system consists of 4-inch to 30-inch water pipelines. In terms of storage, there are four tanks within the distribution system, including one inactive tank. A 330,000 gallon welded steel treated water storage tank is located at the SWTP, which provides disinfectant contact time and working pressure for the system. Water from Well 1 is stored in a 10,000 gallon storage tank located on SNCWD-owned property. In addition, a 15,000 gallon hydropneumatic tank located on SNCWD-owned property receives water from the SWTP through a booster pump station that was designed to deliver fire flows. The total capacity of SNCWD tanks in service is 355,000 gallons. Existing water facilities at the blending and storage tank site are provided in Figure 2.

2.0 WATER DEMANDS

A summary of existing SNCWD water demands are presented in Table 1 [4]. The maximum day demand (MDD) and peak hourly demand (PHD) are calculated based on criteria in the California Waterworks Standards [5].

TABLE 1
SANTA NELLA COUNTY WATER DISTRICT WATER SYSTEM
SUMMARY OF EXISTING WATER DEMANDS

Parameter	Value	Notes
Average day demand (ADD), million gallons per day (MGD)	0.48	Combined (Well 1 and SWTP) total monthly water production from 2010-2012
Maximum month demand, million gallons (MG)	21.7	Maximum month from 2010-2012 occurred in September 2011.
MDD, MGD	1.08	MDD calculated by multiplying the average daily usage in the maximum month by a peaking factor of 1.5
PHD, gpm	1,125	PHD is calculated by multiplying the MDD by a minimum peaking factor of 1.5

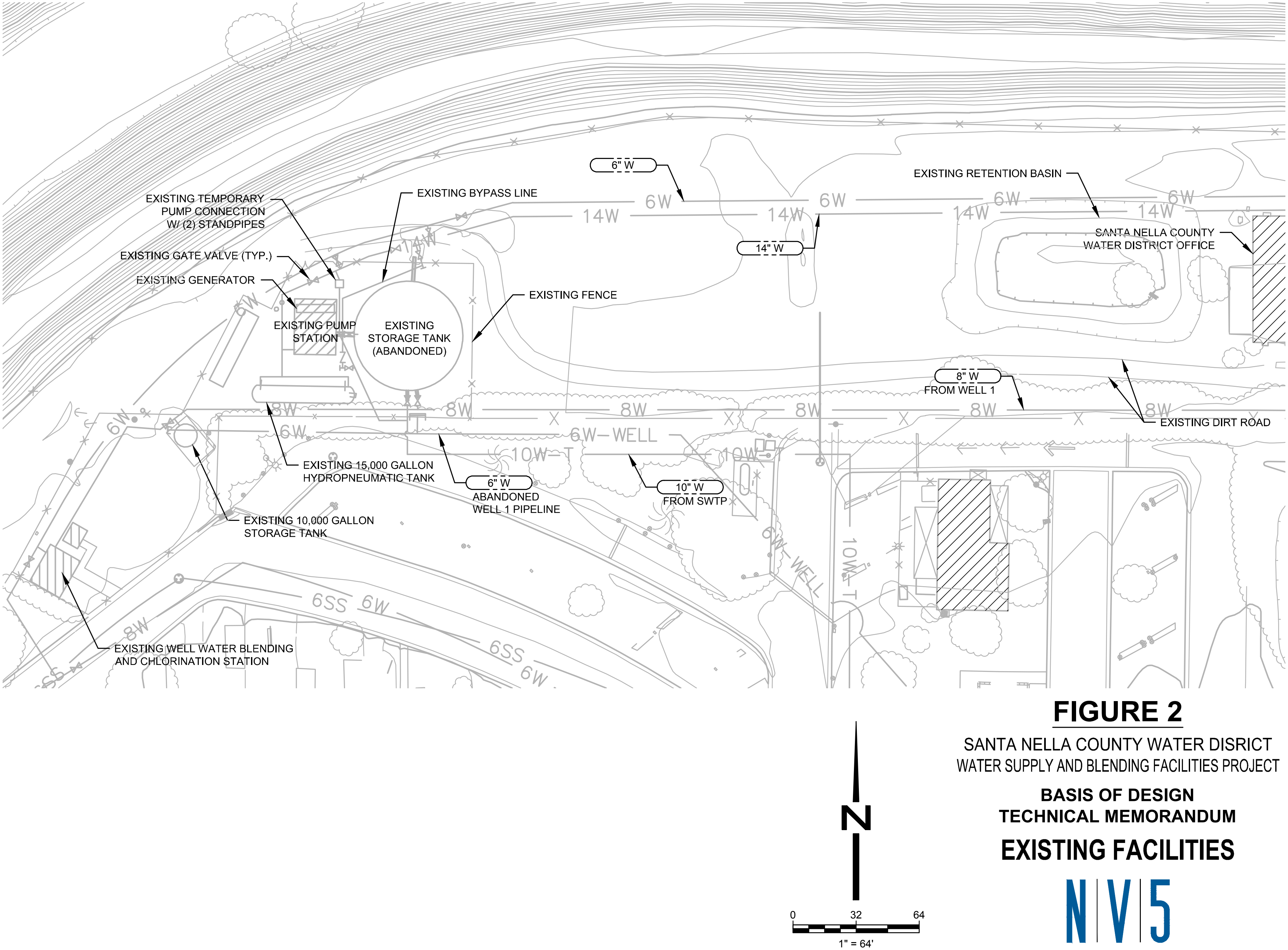

FIGURE 2

SANTA NELLA COUNTY WATER DISRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN TECHNICAL MEMORANDUM

EXISTING FACILITIES

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N:\226116-00132.03\Cadd\Exhibit\BOD TM\Figure 2-Existing Utilities.dwg SD 6/20/2016

3.0 DESIGN CRITERIA

Design criteria for the Project are presented in the sections to follow.

3.1 Pipeline and Distribution System Requirements

Pipeline and distribution system design criteria are as follows:

1. Minimum pipeline diameters of 6-inches.
2. C900 PVC required for pipe material (AWWA C900).
3. Distribution system pressures of 40-75 pounds per square inch (psi) at PHD.
4. Fire flow of 3,000 gpm for three hours with minimum residual pressure of 25 psi.
5. Maximum head loss in distribution system of 10 ft per 1,000 ft.
6. Maximum pipeline velocity of 8 feet per second (fps).
7. Maximum pipeline velocity of 12 fps for short durations.
8. Booster pumps with redundant capacity for operation with one unit out of service.

3.2 Distribution Booster Pumping System Requirements

Booster pumps will be designed to meet PHD with redundant capacity for operation with one unit out of service.

3.3 Storage Requirements

According to the California Waterworks Standards [5], the storage capacity within a water system with less than 1,000 service connections shall be equal to or greater than the MDD (1.08 mgd per Table 1). In addition, 540,000 gallons should be available for fighting fires (3,000 gpm for three hour duration) [6, 7]. Total required storage is the sum of these values, or 1.62 MG. To satisfy this requirement, SNCWD needs approximately 1.5 MG additional storage capacity. A summary of the system water storage requirements and existing tankage is provided in Table 2.

TABLE 2
SANTA NELLA COUNTY WATER DISTRICT WATER SYSTEM
SUMMARY OF WATER STORAGE REQUIREMENTS

Parameter	Value	
MDD	1,080,000	Gallons
Fire protection (3,000 gal for 3 hours)	540,000	Gallons
Total Capacity Needed	**1,620,000**	**Gallons**
Existing well 10,000 gal tank – needed for well control and pre-blending supplies	0	
Existing hydropneumatic tank – 15,000 gallons, 1/3 available	5,000	Gallons
Existing 330,000 WTP tank – 215,000 gallons needed for backwash head and capacity	115,000	Gallons
Available Capacity	**120,000**	**Gallons**
Net new capacity needed	**1,500,000**	**Gallons**

4.0 PROJECT COMPONENTS AND PRELIMINARY DESIGN

Project components include a production well, pipeline, blending facilities, storage tanks, and booster pump station. Each component is described below. A process flow schematic showing project components is shown on Figure 3.

4.1 Production Well

Well water is needed to blend with surface water from the WTP to assure compliance with the drinking water disinfection byproducts regulations. A test well (TH-3) was successfully drilled on Henry Miller Road in Volta (see Figure 4). A Hydrogeologist report describes the well and provides water quality information (see TM No. 6 located in Appendix A). The water quality sampling and testing at two different times showed no exceedances of primary MCLs including the constituent of concern in that area which is hexavalent chromium. Table 2 in Appendix A shows the metals analyzed results and Table 3 shows the non-metals analysis. Table 4 shows the analytic results for TTHM and haloacetic acid formation potential. There were no secondary standards exceedances other than boron which was tested later from the samples and was 1,200 parts per billion (ppb) for the shallow zone and 1,300 ppb for the intermediate/deep zone as compare to a notification requirement for Boron of 1,000 ppb.

Limited pump testing was performed in the 6-inch test well. However, based on the aquifer characteristics and the minimal drawdown observed, the Hydrogeologist was able to conclude that a production well utilizing the lower two zones would meet or exceed the 600 gpm design demand with 60 ft or less of drawdown.

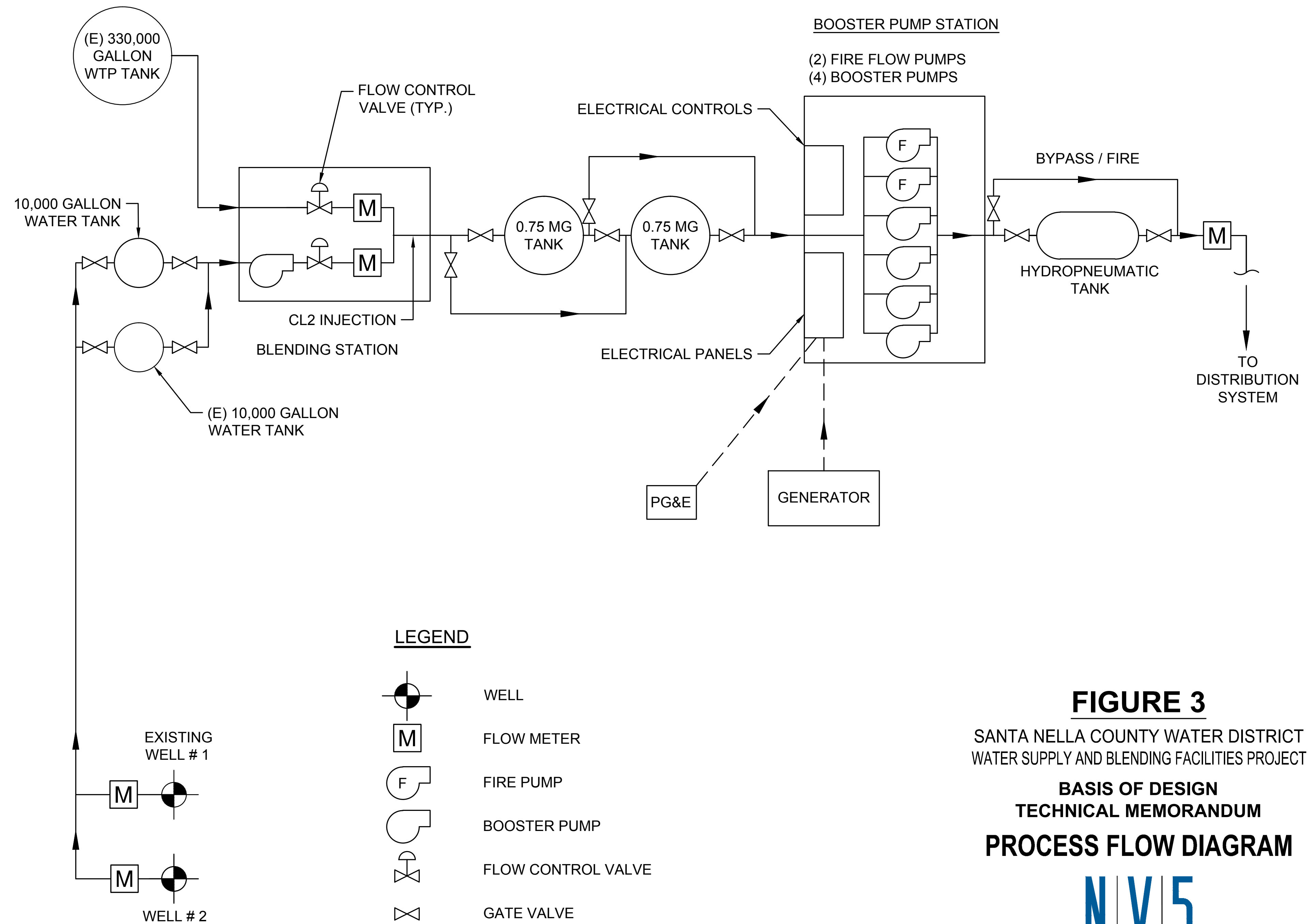

FIGURE 3

SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN
TECHNICAL MEMORANDUM

PROCESS FLOW DIAGRAM

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N:\226116-00132.03\Cadd\Exhibit\BOD TM\Figure 3-FlowDiagram.dwg SD 6/22/2016

FIGURE 4

SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN TECHNICAL MEMORANDUM

WELL #2 LOCATION MAP

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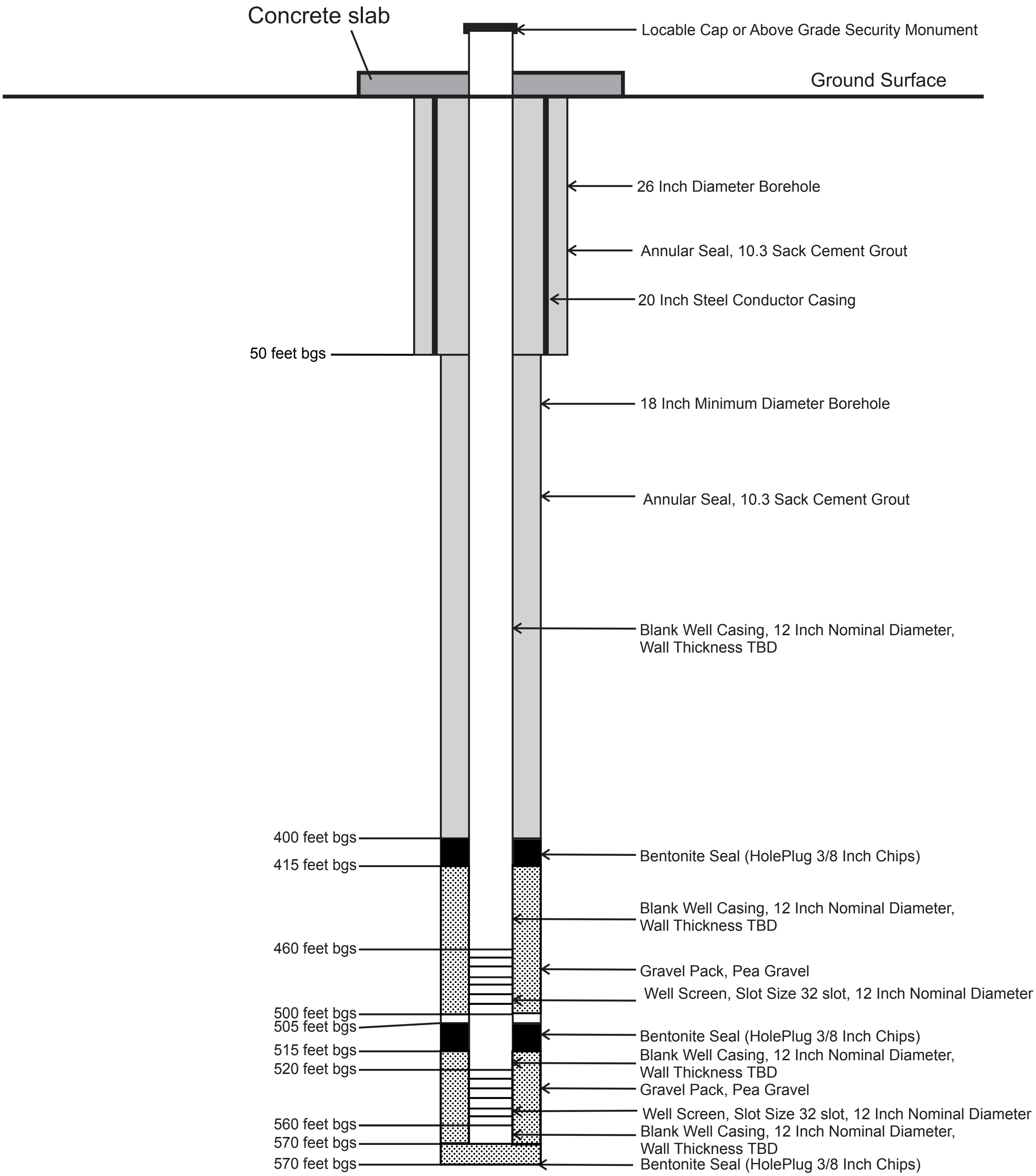
The proposed production well (Well 2) will be designed and equipped in accordance with the test well findings. See Figure 5 for a preliminary production well design schematic. In addition, the well and well head features will satisfy Merced County requirements, the California Water Works Standards [3], and the California Well Standards. The proposed production well site layout is shown on Figure 6.

The capacity of Well 2 will be designed to satisfy the MDD in conjunction with Well 1 with the SWTP out of service. As described in the *Well 1 Pump Improvements – Completion Report*, Well 1 is old and has a capacity of approximately 150 gpm [2]. Therefore, the design capacity of Well 2 will need to be approximately 600 gpm to meet the MDD of 750 gpm (1.08 mgd per Table 1).

Equipment and accessories at the proposed Well 2 site will include the following: 1) pump and motor; 2) piping and valves to allow pumping to waste; 3) sample taps; 4) check valve and butterfly valve; 5) level transducer; 6) flow meter; 7) air release/vacuum relief valve; 8) pressure gauges; and 9) provisions for installing and connecting chlorination equipment if needed. Because well water will be pumped directly to the blending facility, no chlorination is needed at the well site, but provisions for installing chlorination equipment will be included for future or emergency use.

The blending/well water tank will be operated to provide consistently acceptable water quality and would be an effective buffer for variations in well production or surface water concentrations. The proposed location for the blending/well water tank is near the existing 10,000 gallon storage tank site near the existing well water blending/chlorination facilities where the waterlines from Well 1 connect to the existing tank. A new 10,000 gallon HDPE tank will be added to increase the blending water capacity to 20,000 gallons and will also improve the well operation efficiency.



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DATE: 06/16/2016
SCALE: NOT TO SCALE
PROJECT NO: 226116-00132.03
DRAWN: CT
CHECKED:
FIGURE 5

PRODUCTION WELL
PROPOSED CONSTRUCTION
SNCWD
MERCED COUNTY, CALIFORNIA

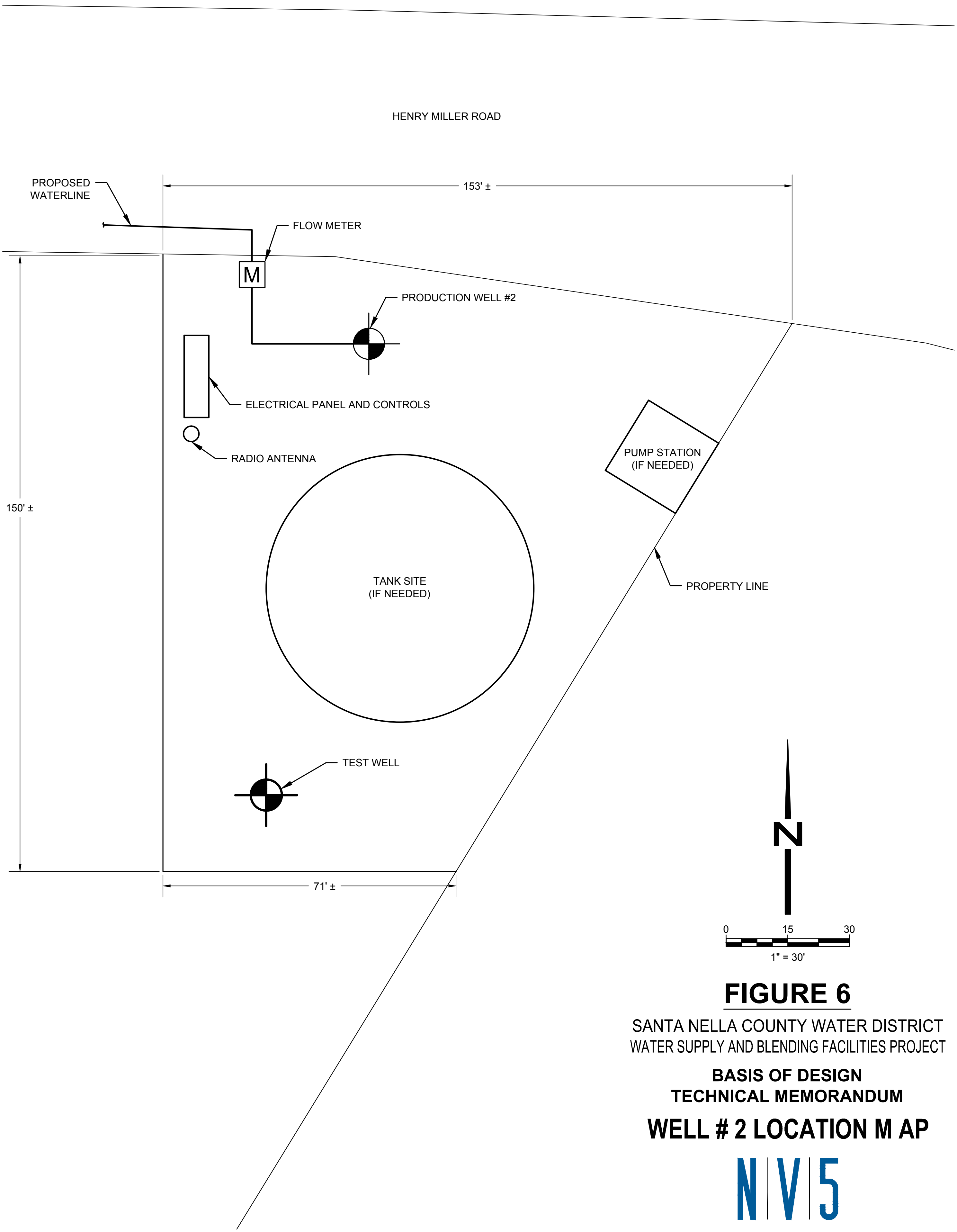

FIGURE 6

SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN TECHNICAL MEMORANDUM

WELL # 2 LOCATION M AP

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4.2 Pipeline

A transmission pipeline will be constructed to convey water from Well 2 to the new blending and storage facilities and facilitate blending of well water with water from the SWTP. Approximately 21,900 ft of 8-inch waterline will be constructed to connect to an existing 6-inch waterline near Well 1. An 8-inch waterline was selected to reduce the pumping head and electricity costs. Hydraulic line loss calculations for 6-inch and 8-inch waterlines are included in Appendix B. At 600 gpm, approximately 529 ft of pumping head and 120 horsepower is saved by installing an 8-inch pipeline.

4.3 Blending Station

Well water is needed to be blended into the treated surface water to assure compliance with the disinfection byproducts rules. The issued compliance order states that the disinfectants/ Disinfection Byproducts (D/DBP) rule requires MCLs in drinking water for TTHM at 0.080 mg/L and for five haloacetic acids (HAA5) at 0.060 mg/L.

Flows of water into the blending tanks (and the blend ratio) shall be controlled using rate of flow control valves and a solenoid operated shutoff valve. Additionally, the well water pump on signal will be activated when water from the treatment plant is flowing into the blending station. Well water and surface water will be routed to the blending facility in two separate pipelines and joined together with a tee and static mixer. The flow in each pipeline will be monitored with electromagnetic flow meters.

4.4 Blended Water Storage Tanks

Two 750,000 gallon bolted steel water storage tanks will be constructed near the existing booster pump station to provide the needed storage capacity. The storage tanks will be interconnected with bypass options to allow for routine maintenance, repairs, and unexpected failures.

To correct the existing storage capacity deficiency and provide blending of well water and surface water, storage tanks and a booster pumping station will be constructed. The proposed storage tanks will have a combined design capacity of 1.5 MG to meet storage capacity requirements. Tank dimensions with seismic considerations will be calculated based on ANSI/AWWA D100-11 standards. The proposed booster pumping station will transfer water from the storage tanks into the distribution system, and will be designed to provide adequate flow and pressure for domestic use and firefighting. Booster pumps will be sized to accomplish the following: 1) satisfy projected PHD while maintaining distribution system pressures of 40-75 psi, and 2) provide a minimum fire flow of at least 3,000 gpm while maintaining a residual pressure of 25 psi.

A chlorination facility is needed for the well water at the blending facility.

4.5 Distribution Booster Pumping System

The proposed distribution booster pumping station will transfer water from the two 0.75 MG tanks into the distribution system, and will be designed to provide adequate flow and pressure for domestic use. The booster pumping system will be designed for a PHD of approximately 1,125 gpm at a total dynamic head (TDH) of 180 feet (approximately 80 psi). To satisfy these design conditions, the booster pumping system will include the following components:

1. Four distribution booster pumps
2. Hydropneumatic tank
3. Isolation valves on the suction and discharge piping for each pump
4. Check valves on the discharge side of each pump
5. Electrical control panels, with pump control based upon pressure within the distribution system
6. Variable frequency drives (VFDs) for each pump

For this installation, a hydropneumatic tank is required to reduce the number of pump starts per hour. This is accomplished by providing a reserve of pressurized water to meet varying system demands and by assuring minimum pump run times to recharge the tank to full volume. The two largest pumps will be rated at a capacity of 1,500 gpm each; a three-minute pump run time would supply a volume of 4,500 gallons to the hydropneumatic tank and reduce the risk of motor overheating due to frequent starts. Based on the 4,500 gallon drawdown volume and a cutoff pressure of 75 psi, a 10,000 gallon hydropneumatic tank will be required. As an additional benefit, the air cushion within the hydropneumatic tank would protect the distribution system facilities from damage due to pressure surge.

A preliminary design layout of the blending, storage, and pumping facilities is shown on Figure 7.

4.6 Fire Pumping System

The fire pumping system will be designed to meet a fire flow of 3,000 gpm with two VFD drive fire pumps.

4.7 System Capacity vs. Demand

The water system upgrades will allow SNCWD to have several different operational scenarios to meet the MDD (1.08 mgd). The SWTP will have the capacity (1.08 mgd with one filter unit out of service) to meet the MDD if Well 1 and Well 2 were offline, as would Well 1 and Well 2 combined (1.15 mgd) if the SWTP was offline.

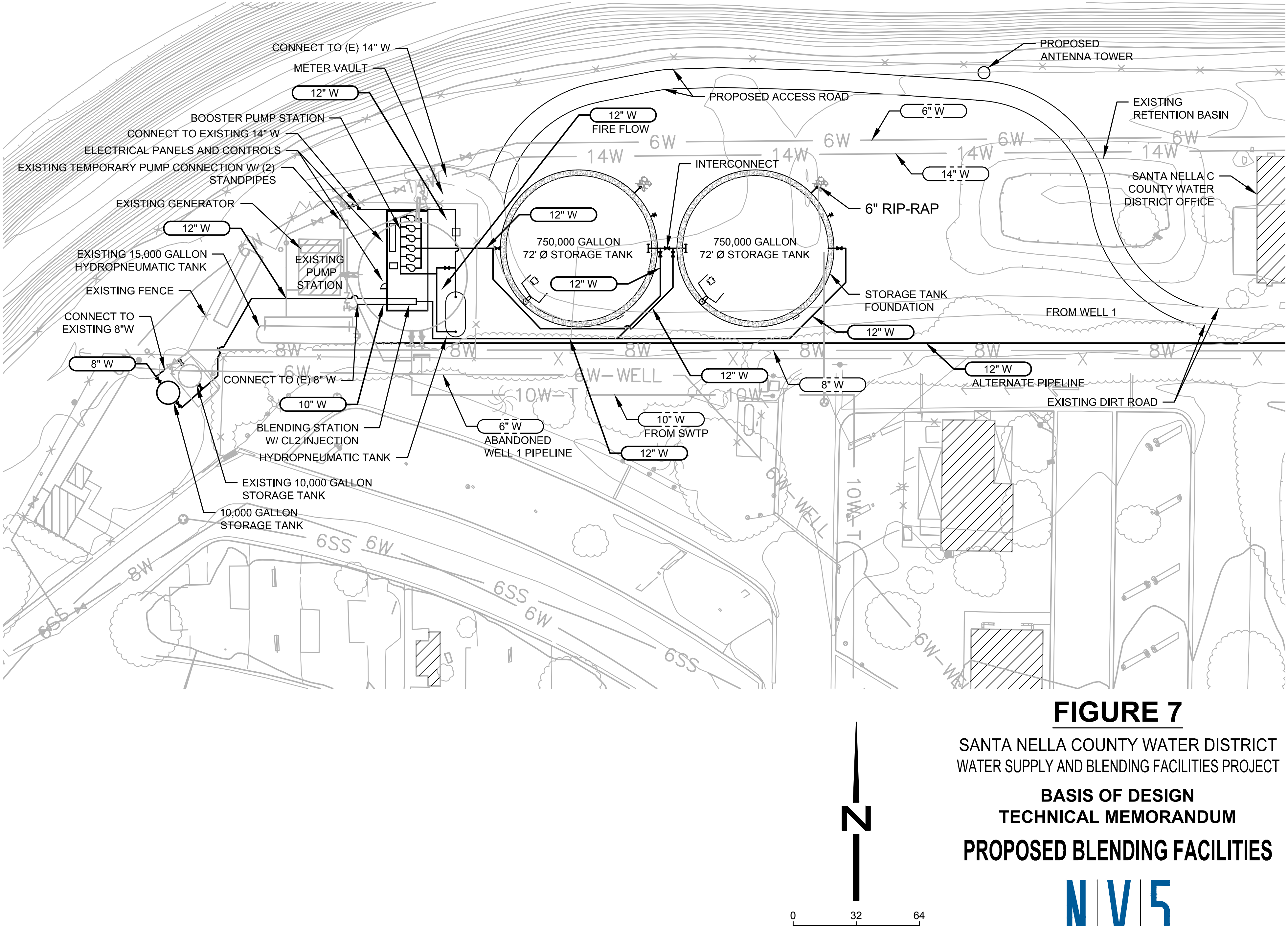

FIGURE 7

SANTA NELLA COUNTY WATER DISTRICT
WATER SUPPLY AND BLENDING FACILITIES PROJECT

BASIS OF DESIGN TECHNICAL MEMORANDUM

PROPOSED BLENDING FACILITIES

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N:\226116-00132.03\Cadd\Exhibit\BOD TM\Figure 7-SitePlan.dwg SD 6/20/2016

5.0 ANTICIPATED USEFUL LIFE

The major components of the Project consist of a well, tank, pumps, treatment units, and pipelines. The anticipated useful life of these items, with regular maintenance, is as follows:

1. Water wells 30-40 years
2. Storage tank 40 years
3. Pumps 10 years
4. Treatment units 20 years
5. Pipelines 40-50 years

6.0 INSTRUMENTATION AND CONTROLS

The following provides information on the instruction and controls for the system.

6.1 Well Water Supply

The wells will pump into well water equalization tanks at the blending station site. The wells will be operated by an on/off level sensor in the tank. A controller will be required to select either Well 1, Well 2, or both to run. The tank also requires high-water and low-water level sensors connected to an alarm.

The well sites require a flowmeter and meter head with local display and signal output transmitting the flow rate and cumulative production to a SCADA unit.

6.2 Blending Station

The water from the water treatment plant to the blending station is conveyed by elevation head from the 330,000 gallon tank. Treated surface water will flow through the blending station to the blended water storage tanks whenever the valve is open. The valve on the treated waterline will be operated by a solenoid activated by a controller and a water level sensor in the storage tanks.

The well waterline into the blending station will be controlled by a normally closed solenoid operated valve that will open on a signal from the flow sensor on the treated surface waterline. A controller will also turn on the blending pump from the well water tank when a signal is received from the flow sensor in the treated waterline. The well waterline will have an adjustable flow control valve and VFD drive on the pump to adjust the well water flow to the desired blending ratio.

Both waterlines in the blending station will have water meters that will measure and transmit the flow rates and cumulative production. Each of the two water source flows through the blending station will be monitored and recorded electronically.

6.3 Booster Pump Station

The booster pumps will be controlled by on/off signals from a pressure sensor/control unit on the new hydropneumatic tank. The booster pump station will be equipped with large pumps to supply fire protection demands and four distribution pumps of different sizes to meet varying and seasonal demands. The pumps will have VFD controls to adjust pump flows to meet current demand. As system pressure drops, the smallest pump will turn on; if system pressure continues to drop, the VFD will ramp up to its maximum capacity. If the pressure continues to drop with the smallest pump at full speed, the next larger pump will be brought online. If the pressure increases, the smaller pump will be shut off. With different sized pumps operating under VFD control, the distribution system demands can be met and pressures maintained within the established operating range.

A meter downstream of the hydropneumatic tank will measure and record flow rates and cumulate water system usage. This will provide an accurate record of the varying water system usage and peak demands as a basis for future water supply and water system upgrades.

6.4 Electrical

The following provides information related to the electrical components of the system.

6.4.1 Blending and Booster Pump

A new PG&E service will be provided for the proposed booster pump station and tank site with a feed to the existing booster pump station; therefore, a single PG&E meter and billing record will apply to the site.

The proposed booster pump station will include a new emergency generator with automatic transfer switch to maintain the distribution system and fire flow delivery during an emergency.

All pumps will be supplied with VFDs.

6.4.2 Well 2

Well 2 is a new well site and will require a new PG& service and meter. The electrical panel will be equipped with a receptacle and manual switch for a portable emergency generator, if necessary.

6.5 Communications/SCADA

A radio system with antenna is required for instrumentation and control communication between the Well 2, Well 1, the water treatment plant, the proposed booster pump station and storage tanks, and the SNCWD office. An antenna tower will be constructed near the new blended water storage tanks.

Duplicate/redundant SCADA interface terminals will be installed in the proposed booster station and at the SNCWD office.

7.0 REFERENCES

[1] *Santa Nella County Water District Surface Water Treatment Plant Wash Water and Sludge Facilities – Technical Report*, prepared by NV5, Inc., August 2010.

[2] *Santa Nella County Water District Well 1 Pump Improvements Completion Report*, prepared by NV5, Inc., August 2011.

[3] *Secondary Drinking Water Standards*, California Code of Regulations, Title 22, Section 64449.

[4] *Santa Nella County Water District Water Supply and System Improvement Project*, prepared by NV5, Inc., September 2012.

[5] *California Water Works Standards,* New and Existing Source Capacity, California Code of Regulations, Title 22, Section 64554. September 7, 2012.

[6] *Santa Nella County Water District Surface Water Treatment Plant Predesign Report*, prepared by Boyle Engineering Corporation, January 2007.

[7] *2001 California Fire Code,* California Code of Regulations, Title 24, Part 9.

Appendix A

Test Hole 3 (Volta) Hydrogeologist Report Technical Memorandum No. 6

TO:	**Amy Montgomery – Santa Nella County Water District** **Reid Johnson - NV5**
FROM:	Cassie Tremblay, GIT and Tyler Randall – NV5 Patrick F. Dunn, P.G., C.Hg. – NV5
DATE:	May 2, 2016
PROJECT NO.:	**State SRF2410018-001P and NV5 –** 226116-00132.03 (Previous MTB018105)
RE:	**Technical Memorandum No. 6 –** Test Hole (TH-3 - Volta) Resampling and Limited Test Pump Results for Santa Nella County Water District

1. BACKGROUND

NV5 (previously Dunn Environmental or DE) provided oversight assistance for resampling from a third test boring for a possible production well site located in Volta Area for Santa Nella County Water District (SNCWD) in Merced County. Funding was provided by the State Water Resources Control Board (SWRCB) Division of Drinking Water. An area wide hydrogeological conceptual model was developed and first presented in Tech Memo No. 1[1]. One test hole (TH-1) was completed during April 2013, one isolation zone sample was collected and drilling and analytical findings were summarized in Tech Memo No. 2[2]. During October 2013, a second test hole (TH-2) was drilled and encountered formations were not favorable for isolation zone sampling. Findings from the drilling program were summarized in Tech Memo No. 3[3]. Tech Memo No. 4[4] provided details for the rationale of expanding the test hole drilling program to the east towards Volta as well as proposed drilling locations. Tech Memo

[1] Dunn Environmental, Technical Memorandum No. 1 – Target Depth and Well Design Technical Memo, Santa Nella County Water District, Revision 2, October 1, 2012.

[2] Dunn Environmental, Technical Memorandum No. 2 – Test Hole Investigation, Isolation Zone Sampling and Analytical Results for Santa Nella County Water District, CDPH Test Hole No. 1, Revision 0, June 19, 2013.

[3] Dunn Environmental, Technical Memorandum No. 3 – Test Hole No. 2 Investigation and Future Recommendations for Santa Nella County Water District, Revision 0, December 6, 2013.

[4] Dunn Environmental, Technical Memorandum No. 4 – Evaluation of Increased Ground Water Supplies Near SNCWD, Revision 0, June 10, 2014.

No. 5[5] provided details for the drilling, installation, development and isolation zone sampling from the third test hole (TH-3) as well as a summary of previous investigation efforts and findings. This Technical Memo No. 6 (TM-6) documents the pump testing and resampling effort was completed and confirmed favorable capacity and water quality identified during the isolation zone sampling completed in the past. Test hole TH-3 location is suitable for future production well design. Refer to Figure 1 for the location.

SNCWD receives its surface water from California Aqueduct which is then treated by SNCWD and their surface water treatment plant (SWTP). The SNCWD also has one groundwater well used by blending with water from the SWTP. Facilities used to distribute treated water include one surface water storage tank, water transmission pipeline and a fire booster pump station. SNCWD is looking to augment their ground water supply. TH-3 well completion will meet Title 22 water quality standards without treatment.

Refer to the previous Technical Memorandums Numbered 1 and 5 for discussion of the hydrogeologic setting, area hydrogeology, area water quality and descriptions of 2013 drilling investigation efforts.

2014 TH-3 DRILLING PROJECT – NEAR VOLTA

Based on area knowledge and the data compilation effort referenced and documented thoroughly in the *Technical Memorandum No. 4 – Evaluation of Increased Ground Water Supplies Near SNCWD*, DE developed an approach toward the completion of a new well as the area of interest was expanded east toward Volta. The project approach was phased and included the refinement of the conceptual hydrogeologic model during the test hole and geophysical investigation to determine target depths for potential zones for production well development. The target depths were sampled discretely with selected well screen intervals.

TH-3 was drilled and installed in September and October 2014. TH-3 geology was dominated by sands and clays and, based on the geologic logging and geophysics, three target depth zones, 200 to 240 feet, 460 to 500 feet and 520 to 560 feet, were identified for isolation zone sampling. For TH-3 construction, the three screened intervals were included on one casing string and separated on the outside of the casing using bentonite seals. Isolation within the casing was achieved with the use of a packer system. Water quality samples were collected in late October 2014 and indicated good water quality with no primary MCL exceedances and one secondary MCL exceedance

[5] Dunn Environmental, Technical Memorandum No. 5 – Test Hole (TH-3) Investigation, Isolation Zone Sampling and Analytical Results for Volta & Santa Nella County Water District, Revision 0, November 25, 2014.

for manganese noted from the deep zone. Concerns regarding hexavalent chromium and the potential of contamination in the shallow zone resulted in a preliminary recommendation to develop the lower two zones for a production well and a request for the additional testing to confirm analytical results.

2. TH-3 2016 TESTING

Prior to moving forward for the completion of a production well, a second round, or resampling, of the well was requested to confirm the favorable water quality results. During this effort, NV5 also collected water level information to determine specific capacity results for the sampled zones to help for design capacity of a production well.

Test hole TH-3 pumping and resampling was completed on March 28th and 29th, 2016. In order to confirm water quality, a composite sample of the intermediate and deep zones and a second sample of the shallow zone only would be collected and compared to the previous results. A pump and packer assembly was used to isolate the intermediate and deep zones from the shallow zone for the first sample. In order to measure water level drawdown below the packer, a bubbler system was used. The bubbler system consisted of a nitrogen cylinder connected to a ¼″ diameter tubing placed below the packer. The pressure was read off of a gauge at the surface and converted to a drawdown to determine specific capacity of the lower two zones.

For the testing completed on March 28th, a packer was set at 250 feet and the pump was set below the packer. For the two lower zones combined, two short-term step tests were completed at 50 and 80 gpm. The duration of the steps was based on observed water level stabilization of the zones that was observed with the bubbler method. The steps were run for a minimum of 30 minutes and up to a maximum of two hours. Water levels stabilized within one foot of drawdown within fifteen minutes of the start of the test; so the lengths of the tests were cut short to 30 minutes. Water level data is provided on Table 1. Maximum observed drawdown was 1.15 feet for both tests. A water quality grab sample was collected prior to shutting down the pump while the packer was inflated. Refer to Tables 2 through 4 for the water quality results.

Once the pump was shut down, full recovery and stabilization was observed after 14 minutes. It should be noted that due to the poor accuracy of the water level measurement using the bubbler system, the calculated value for total observed drawdown could be greater. However, it was observed that these lower zones had a higher static water level demonstrating confined conditions with higher specific capacity.

On March 29th, the packer was reinstalled with the pump above the packer. Two short-term step tests were completed at 50 and 80 gpm for the shallow zone only. Water level drawdown during these pump tests was measured using a water level meter. More than seven feet of drawdown was observed. A water quality grab sample was collected prior to shutting down the pump. Refer to Table 2 through 4 for the water quality results. After the pump was shut off, recovery stabilization was observed after 26 minutes.

Two more short-term step tests were completed at 50 and 100 gpm for the combined entire well interval on March 29th. A water level meter was used to measure water level drawdown during these tests. The 50 gpm test was run for 40 minutes and the 100 gpm test was run for 45 minutes before stabilization of the water level was observed. The maximum observed drawdown was 4.50 and 9.46 feet for the 50 and 100 gpm tests, respectively.

Once the pump was shut off, stabilization of the static water level was observed after 26 minutes.

3. PUMP TESTS AND WATER QUALITY RESULTS

PUMP TESTS AND SPECIFIC CAPACITIES

Results from the limited pump test for total drawdown and specific capacity can be found in Table 1.

The ranges in Specific Capacity for TH-3 were as follows;

1) The shallow zone exhibited a total drawdown of 7.46 feet at a maximum pump rate of 80 gpm, producing a calculated specific capacity of 10.74 gpm/ft;
2) The intermediate and deep zones exhibited a total drawdown of 1.15 feet at a maximum pump rate of 82.2 gpm, producing a calculated specific capacity over 60 gpm/ft which is erroneously high; and
3) The combined, three screen, well capacity was reported at the conservative 10 gpm/ft

Based on the performance of the conservative range in specific capacity of this well, the anticipated demand of 600 gpm will be met or exceeded by the lower two zones.

More accurate specific capacities can be calculated based on both the performance of the shallow zone and the combined system allowing possible conclusions on the expected performance of the intermediate and deep zone.

WATER QUALITY ANALYTICAL RESULTS

Samples were submitted to CLS of Rancho Cordova, CA, ELAP No. 1233 for analysis. Analytical results metal parameters are presented on Table 2. Results of non-metal parameters are shown on Table 3. Results of radiological and Haloacetic Acid

Formation Potential (HAA) are can be found on Table 4. The resampling list was approved by the State Water Resources Control Board and can be found in Attachment A.

Dissolved metal samples were collected to reduce the influence of elevated sample turbidity and potential false positive detections or exceedances. As depicted on Table 1, neither primary nor secondary MCL exceedances were observed. Parameters ranged as follows: arsenic from 0.0021 to 0.0022 mg/L, calcium ranged from 52 to 57 mg/L, hexavalent chromium ranged from 0.0058 to 0.0065 mg/L, magnesium ranged from 27 to 30 mg/L, potassium ranged from 2.3 to 2.5 mg/L, and sodium ranged from 150 to 160 mg/L.

VOC parameter toluene was reported as 2.2 μg/L in the shallow zone and non-detect in the intermediate and deep zone. Other VOCs and 1,2,3-trichloropropane were reported as non-detect.

Non-metal parameters were reported as follows: total hardness as $CaCO_3$ was ranged from 240 to 260 mg/L, bicarbonate alkalinity ranged from 240 to 250 mg/L, total dissolved solids ranged from 680 to 750 mg/L, chloride ranged from 190 to 200 mg/L, fluoride ranged from 0.26 to 0.29 mg/L, nitrate as NO_3 ranged from 31.9 to 32.8 mg/L, sulfate ranged from 93 to 97 mg/L and total alkalinity ranged from 240 to 250 mg/L. Parameters carbonate alkalinity, hydroxide alkalinity, perchlorate, and nitrite as nitrogen were reported as non-detect for both zones. No primary or secondary MCL exceedances were observed for non-metal parameters.

Analysis for TTHM formation potential was completed and the result was reported as non-detect. Refer to Table 4 for summary of analytical results.

Sample results were very similar to the previous sampling event.

4. CONCLUSIONS AND RECOMMENDATIONS

The additional round of water quality sampling was conducted to verify the analytical results from the previously collected samples that resulted in similar water quality between all three zones tested; and specifically the isolated intermediate and deep zones for this round of sampling. Based on the similar results from the two sampling events, it can be concluded that they represent the favorable water quality of the well system. Pump testing was completed for the intermediate and deep zones, shallow zone and combined three zones for specific capacity information to determine probable water production of a production well.

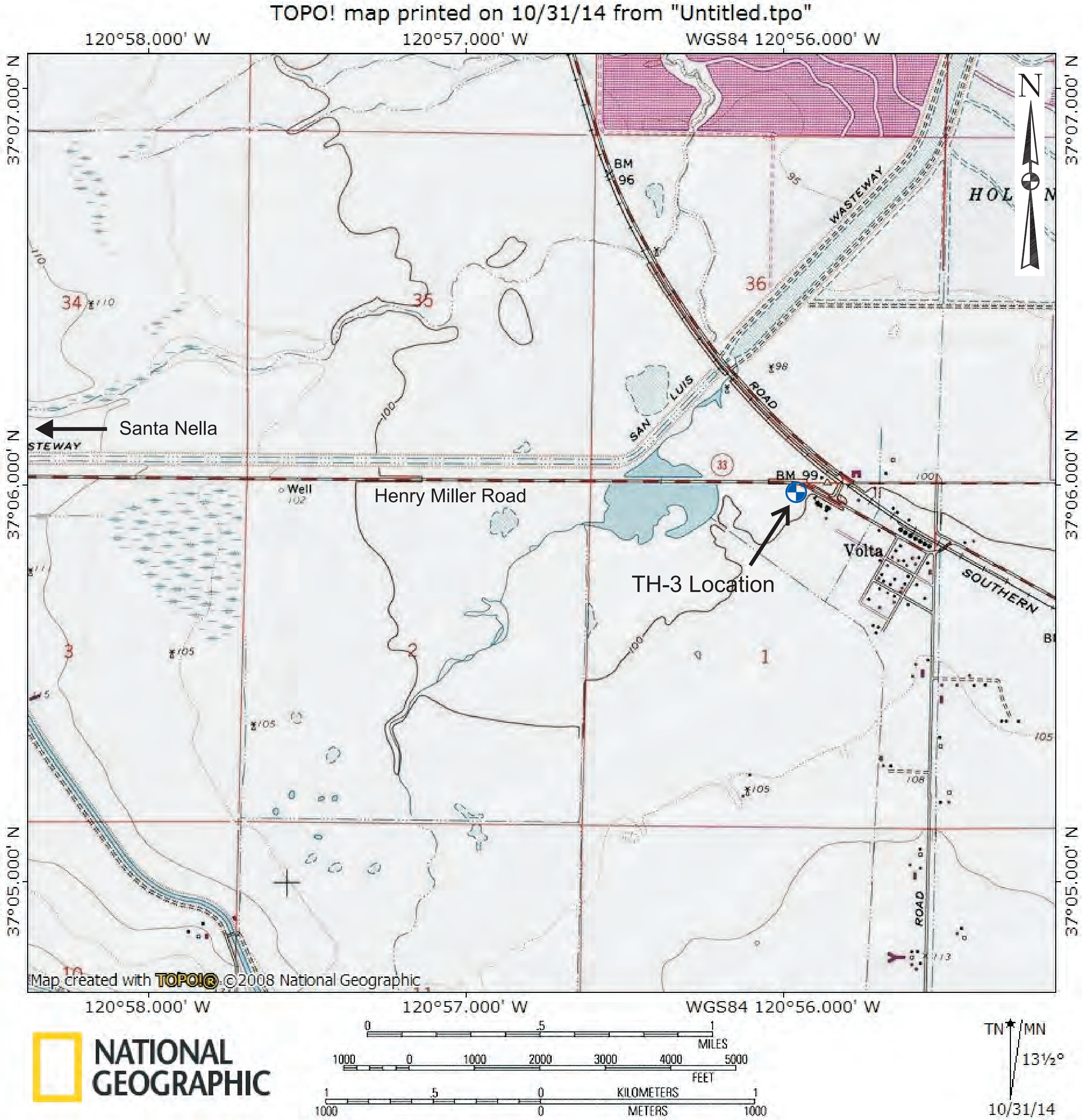
Analytical results indicate that no primary or secondary MCL exceedances were observed in either the shallow or the intermediate and deep zones.

Based on the minimal drawdown from the aquifer observed during the limited pump test, a production well at this location, targeting the intermediate and deep zones, will meet or exceed the 600 gpm demand for SNCWD. The more conservative specific capacity of 10 gpm/ft will only result in 60 feet of anticipated drawdown for these lower two zones.

The referenced production well at this location should include the two lower zones from 460 to 500 and 520 to 560 feet bgs as they are less susceptible to shallow ground water impacts and will facilitate the desired demand. The recommendation of the use of the lower zones for a production well has been confirmed.

<u>Attachments</u>

Figure 1 – Location Map
Table 1 - Water Level Operations during Step Test with Packer On & Off
Table 2 – Metal Results
Table 3 –Non-Metal Results
Table 4 – Trihalomethane and Haloacetic Acid Formation Potential
Attachment A – Approved Resampling Parameter List, Pump Test Field Data Sheets, Resampling Field Data Sheets
Attachment B – Analytical Reports



LEGEND

TEST BORING LOCATION

Dunn Environmental, Inc.
An NV5 Company

DATE: 10/31/2014	TH-3 LOCATION MAP SNCWD MERCED COUNTY, CALIFORNIA
SCALE: AS SHOWN	
PROJECT NO: MTB018105	
DRAWN: CT	
CHECKED: PFD	
FIGURE: 1	

Table 1

Water Level Operations During Step Test with Packer On & Off

Santa Nella County Water District

Test **		Test Duration (min)	Max Pump Rate (gpm)	Total Drawdown (ft)	Specific Capacity (gpm/ft)	Packer Used
Shallow Zone	Pump Test	30 @ 50 gpm; 30 @ 80 gpm	80.1	7.46	10.74	Yes
	Recovery	14; stable @ 1	--	7.46	10.74	Yes
	Composite Recovery	16; stable @ 6	--	4.99	16.05	No
Intermediate & Deep Zone	Pump Test	55 @ 50 gpm 80 @ 80 gpm	82.2	1.15*	71.48*	Yes
	Recovery	26; stable @ 22	--	1.15*	71.48*	Yes
	Composite Recovery	22; stable @18	--	0.96	80.73*	No
Composite	Pump Test	40 @ 50 gpm; 45 @ 100 gpm	99.2	9.46	10.49	No
	Recovery	26; stable @ 13	--	8.65	11.47	No

* calculated value may not reflect actual specific capacity due to imprecise measurement of water level using the bubbler system and inability to determine total drawdown.

** Test Descriptions

Pump Test	Performed step test at 50 gpm and 80 gpm, ran pump until water level stabilization was observed.
Recovery	Turned off pump and recorded water level change over time until stabilization was achieved.
Composite Recovery	Repeated recovery test with the pack deflated allowing all zones to influence water level.

Table 2
Metals Ground Water Analytical Results
Santa Nella County Water District

			10/24/2014	10/24/2014	10/27/2014	3/28/2016	3/29/2016		
Analyte Name	Method Code	Units	TH-3 Shallow	TH-3 Intermediate	TH-3 Deep	TH-3 Int + Deep	TH-3 Shallow	CA EPA Primary MCL	CA EPA Secondary MCL
Aluminum, dissolved	EPA-200.7	mg/L	<0.050	<0.050	<0.050	NA	NA	1	0.2
Antimony, dissolved	EPA-200.8	mg/L	<0.006	<0.006	<0.004	NA	NA	0.006	
Arsenic, dissolved	EPA-200.8	mg/L	0.0027	0.0022	0.0022	0.0021	0.0022	0.01	
Barium, dissolved	EPA-200.7	mg/L	0.15	0.15	0.15	NA	NA	1	
Beryllium, dissolved	EPA-200.8	mg/L	<0.005	<0.005	<0.001	NA	NA	0.004	
Cadmium, dissolved	EPA-200.8	mg/L	<0.010	<0.010	<0.001	NA	NA	0.005	
Calcium, dissolved	EPA-200.7	mg/L	61	60	62	57	52		
Chromium, dissolved	EPA-200.7	mg/L	<0.010	<0.010	<0.010	NA	NA	0.05	
Hexavalent Chromium, dissolved	EPA 218.6	mg/L	0.0057	0.0015	<0.001	0.0058	0.0065	0.01	
Copper, dissolved	EPA-200.7	mg/L	<0.010	<0.010	<0.050	NA	NA	1.3	1
Cyanide, dissolved	SM500	mg/L	<0.0050	<0.0050	<0.0050	NA	NA	0.15	
Iron, dissolved	EPA-200.7	mg/L	<0.1	0.19	0.1	NA	NA		0.3
Lead, dissolved	EPA-200.8	mg/L	<0.005	<0.005	<0.005	NA	NA	0.015	
Magnesium, dissolved	EPA-200.7	mg/L	32	31	30	30	27		
Manganese, dissolved	EPA-200.7	mg/L	<0.020	<0.020	0.098	NA	NA		0.05
Mercury, dissolved	EPA-200.8	mg/L	<0.00020	<0.00020	<0.00020	NA	NA	0.002	
Nickel, dissolved	EPA-200.7	mg/L	<0.020	<0.020	<0.010	NA	NA	0.1	
Potassium, dissolved	EPA-200.7	mg/L				2.5	2.3		
Selenium, dissolved	EPA-200.8	mg/L	<0.005	<0.005	<0.005	NA	NA	0.05	
Silver, dissolved	EPA-200.7	mg/L	<0.010	<0.010	<0.010	NA	NA		0.1
Sodium, dissolved	EPA-200.7	mg/L	150	150	160	160	150		
Thallium, dissolved	EPA-200.8	mg/L	<0.001	<0.001	<0.001	NA	NA	0.002	
Zinc, dissolved	EPA-200.7	mg/L	0.094	0.11	0.11	NA	NA		5

BOLD indicates exceedance of primary or secondary standard

Table 3
Ground Water Analytical Results - Non-Metal Parameters
Santa Nella County Water District

Analyte Name	Units	10/24/2014 TH-3 Shallow	10/24/2014 TH-3 Intermediate	10/27/2014 TH-3 Deep	3/28/2016 TH-3 Int + Deep	3/29/2016 TH-3 Shallow	CA EPA Primary MCL	CA EPA Secondary MCL
General Physical								
pH (field)	pH Units	7.75	7.60	7.66				
Turbidity (field, not filtered)	NT Units	2.34	0.71	80.07				5
Electrical Conductivity @ 25 C (field)	µS/cm	1,296	1,272	1,267				1600*
Total Hardness as CaCO3	mg/L	280	280	280	260	240		
Color	Color Unit	<1	<1	<1	NA	NA		15
Threshold Odor Number	T.O.N.	<1	<1	<1	NA	NA		3
Alkalinity as CO3 - Carbonate	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0		
Alkalinity as CO3 - Hydroxide	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0		
Alkalinity as HCO3 - Bicarbonate	mg/L	270	270	270	250	240		
Total Dissolved Solids (TDS)	mg/L	710	710	730	750	680		1,000*
Chloride	mg/L	200	190	190	190	200		500*
Fluoride	mg/L	0.18	0.18	0.19	0.26	0.29	2	
Nitrate as NO3	mg/L	32	31	32	32.8 (7.4)	31.9 (7.2)	45 / (10)	
Sulfate	mg/L	89	84	89	97	93		500*
Total Alkalinity	mg/L	270	270	270	250	240		
Perchlorate	µg/L	<4.0	<4.0	<4.0	<4.0	<4.0	6	
Nitrite as N	mg/L	<0.10	<0.10	<0.10	<0.40	<0.40	1	
Radiological								
Gross Alpha	pCi/L	2.54 ± 2.34	4.93 ± 3.42	2.10 ± 2.34	NA	NA	15	
Radium 226	pCi/L	0.000 ± 0.155	0.000 ± 0.180	0.000 ± 0.155	NA	NA	5 pCi/L	
Radium 228	pCi/L	0.000 ± 1.65	0.000 ± 1.65	0.147 ± 0.747	NA	NA	Combined	
Uranium	pCi/L	0.614 ± 0.620	1.14 ± 0.750	1.08 ± 0.672	NA	NA	20	
Purgeable Organic Compounds								
Toluene	µg/L	3.8	4.3	7.1	NA	2.2	150	
Remaining non-detect	µg/L	ND	ND	ND	NA	ND		
Semi-Volatile Organic Compounds								
Alachlor	µg/L	<1.0	<1.0	<1.0	NA	NA	2	
Atrazine	µg/L	<0.50	<0.50	<0.50	NA	NA	1	
1,2-Dibromo-3-chloropropane	µg/L	<0.010	<0.010	<0.010	NA	NA	0.2	
Ethylene Dibromide	µg/L	0.041	<0.020	<0.020	NA	NA	0.05	
Simazine	µg/L	<1.0	<1.0	<1.0	NA	NA	4	
1,2,3-Trichloropropane								
1,2,3-Trichloropropane	µg/L	<0.0050	<0.0050	<0.0050	NA	<0.50		
Methylene blue active substances								
MBAS	mg/L	<0.10	<0.10	<0.10	NA	NA		0.5

* Use upper secondary MCL where available; March 2016 nitrate report as N, converted to NO3 with nitrate as N in parentheses

Table 4

Ground Water Analytical Results - Trihalomethane and Haloacetic Acid Formation Potential

Santa Nella County Water District

		10/24/2014	10/24/2014	10/27/2014	3/28/2016	3/29/2016		
Analyte Name	Units	TH-3 Shallow	TH-3 Intermediate	TH-3 Deep	TH-3 Int + Deep	TH-3 Shallow	CA EPA Primary MCL	CA EPA Secondary MCL
Total Potential HAA	µg/L	6.1	5.4	4	NA	NA		
Bromochloroacetic Acid*	µg/L	2.4	2.6	1.5	NA	NA		
Dichloroacetic acid	µg/L	1.4	1.6	<1.0	NA	NA	60	
Monobromoacetic acid	µg/L	<1.0	<1.0	<1.0	NA	NA		
Dibromoacetic acid	µg/L	4.7	3.8	4	NA	NA	60	
Monochloroacetic acid	µg/L	<1.0	<1.0	<1.0	NA	NA	60	
Trichloroacetic acid	µg/L	<1.0	<1.0	<1.0	NA	NA	60	
Total Potential THM	µg/L	16.2	23.2	20.6	<0.50	<0.50		
Bromodichloromethane	µg/L	2.1	3.8	3.5	<0.50	<0.50	80	
Bromoform	µg/L	7.4	9.3	7.8	<0.50	<0.50	80	
Chloroform	µg/L	0.64	1.2	1.3	<0.50	<0.50	80	
Dibromochloromethane	µg/L	6.1	8.9	8	<0.50	<0.50	80	

*Bromochloroacetic Acid is analyzed during the THAA process, but was not included in the total potential HAA value