Preliminary Design Report for the Chino Creek Wellfield and Chino II Expansion Wellfield Chino Desalter Phase 3 Project

DRAFT

Prepared For:

WESTERN MUNICIPAL WATER DISTRICT

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CITY OF ONTARIO CALIF. BALANCED COMMUNITY INCORPORATED 1891

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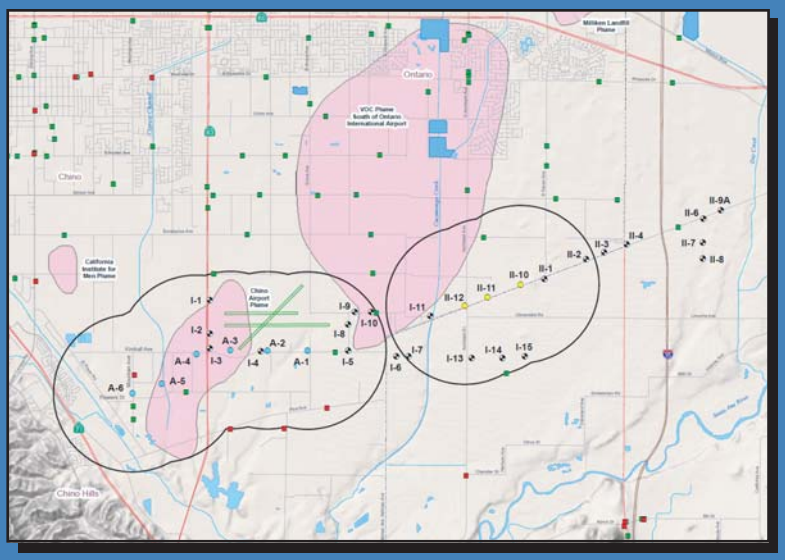

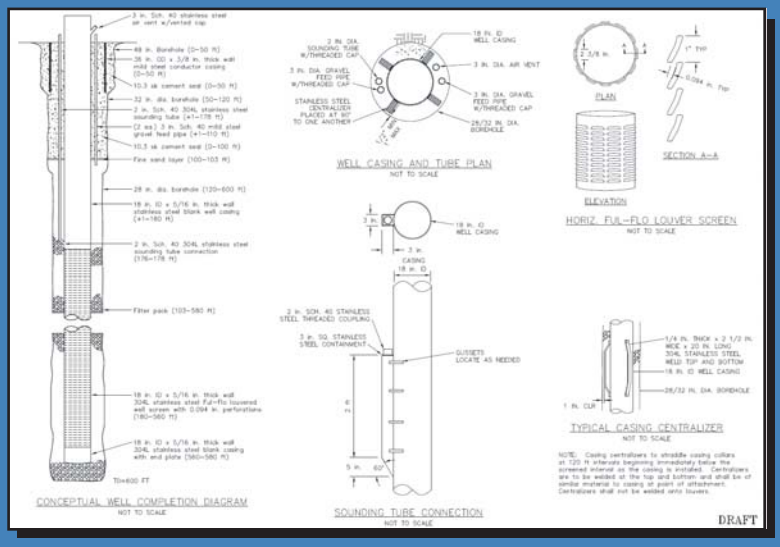

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WESTERN MUNICIPAL WATER DISTRICT
PRELIMINARY DESIGN REPORT
FOR THE CHINO CREEK WELLFIELD AND CHINO II EXPANSION WELLFIELD
CHINO DESALTER PHASE 3 PROJECT

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WESTERN MUNICIPAL WATER DISTRICT
PRELIMINARY DESIGN REPORT
FOR THE CHINO CREEK WELLFIELD AND CHINO II EXPANSION WELLFIELD
CHINO DESALTER PHASE 3 PROJECT

1.0 INTRODUCTION

1.1 Background

The Chino Desalter Phase 3 Project was developed by Western Municipal Water District (WMWD), Jurupa Community Services District (JCSD), and the City of Ontario (Ontario) to provide for expansion of the Chino Desalter System. Part of the Chino Desalter Phase 3 Project includes development of a new wellfield in the Chino Creek area of Chino Basin, expansion of production from the existing Chino II Desalter wellfield, and evaluation of potential well sites for future expansion of the Chino II Desalter wellfield (see Figure 1). The additional pumping from the Chino Creek and Chino II Desalter wellfields will be used to gain hydraulic control of the basin and to provide raw water to the Chino Desalter system.

The Chino Creek wellfield will consist of six (6) full-scale production wells (see Figure 2). The first stage of construction will include two (2) test production wells that will be designed to operate as full-scale production wells, and two (2) companion monitoring wells. The two companion monitoring wells will be located in close proximity to the first two production wells and will be used to measure ground water level interference data during testing of the production wells. Data collected from the monitoring wells will be used to accurately assess aquifer parameters such as transmissivity and storativity that will be used to refine the existing ground water flow model in the vicinity of the Chino Creek wellfield. Additionally, the companion monitoring wells may be useful for purposes of monitoring and mitigation.

The Chino Creek production wells will supply between 5,000 and 7,700 acre-ft/year in order to achieve hydraulic control of Chino Basin in that area. Pumping from the existing Chino I Desalter wells will be reduced accordingly in order to maintain the 16,140 acre-ft per year raw water capacity of the Chino Desalter I facility (Carollo, 2007). Pumping from the existing Chino II Desalter wellfield (see Figure 1) will be increased by 12,040 acre-ft per year to 23,860 acre-ft per year. Additionally, existing Chino I Expansion Wells I-13, I-14, and I-15 (see Figure 3) will be interconnected with the Chino II wellfield, thus allowing those wells to provide a portion of the required 12,040 acre-ft per year Chino II expansion. The interconnect will also allow the Chino II wellfield to supply water to Chino I as necessary.

Implementation of the Phase 3 project will result in expansion of the total raw water pumping for both desalters from 27,960 acre-ft per year to 40,000 acre-ft per year.

1.2 Purpose and Scope

The purpose of this report is to provide preliminary designs, design criteria, ground water production estimates, and estimates of anticipated geohydrologic conditions for the proposed Chino Creek and Chino II expansion wellfields.

The scope of work to achieve the objective included:

1. Field reconnaissance of two proposed Chino Creek well sites (A-4 and A-6),
2. Review of existing wells in the vicinity of the proposed wellfields,
3. Evaluation of well production data,
4. Evaluation of ground water quality data, and
5. Evaluation of potential sources of ground water contamination.

A prior version of this report entitled *Preliminary Design Report for the Chino Creek Wellfield and Chino II Expansion Wellfield - Chino Desalter Phase 3 Project* was issued by GEOSCIENCE Support Services, Inc., (GEOSCIENCE) on May 18, 2009. That report was

submitted to Chino Basin Watermaster and their engineering consultant, Wildermuth Environmental, Inc., (Wildermuth) for technical review and comment prior to issuance of a final version. Technical comments were received from Chino Basin Watermaster in a July 8, 2009 letter entitled *Review of the Preliminary Design Report for the Chino Creek Wellfield and Chino II Expansion Wellfield Chino Desalter Phase 3 Project* (see Appendix A). Responses to those comments have been incorporated into this version of the report.

1.3 Location of Potential Well Sites

1.3.1 Chino Creek Wellfield

The six wells that comprise the Chino Creek wellfield (designated A-1 through A-6) will be located to the south and southwest of Chino Airport (Figures 1 and 2). Wells A-4 and A-6 have been designated as full-scale "test" production wells and will be constructed prior to the other four Chino Creek wells. Well A-4 is to be located at one of two potential sites on the grounds of the Chino I Desalter facility at 6905 Kimball Avenue in the City of Chino (see Figure 4). Well A-6 is to be located at the northeast corner of the RP-5 solids handling facility at the intersection of Mountain Avenue and Flowers Street in the City of Chino (see Figure 5). Companion monitoring wells (designated MW A-4 and MW A-6) will be installed approximately 100 ft from wells A-4 and A-6 (see Figures 4 and 5).

1.3.2 Chino II Expansion Wellfield

Five potential well sites were originally selected for expansion of the Chino II Desalter wellfield based on the results of recent ground water modeling (GEOSCIENCE, 2008; see Figure 1). Three of those five potential well sites (designated II-10, II-11, and II-12) were selected as favorable for installation of production wells. This selection was based on evaluation of several criteria such as anticipated geohydrologic conditions, potential for ground water level interference, and proximity to the Chino II Desalter facility. The three selected well sites are

located north of the existing Chino I expansion wells and west of the existing Chino II wellfield along the boundary between San Bernardino and Riverside Counties (see Figure 3).

1.4 Sources of Data

Data used for this analysis were obtained from multiple sources. The primary sources and types of data are summarized as follows:

- Wildermuth Environmental Inc. (2007): Chino Basin Management Program: State of the Basin Report – 2006. Prepared for Chino Basin Watermaster, July 2007. Basin cross-sections, contaminant plumes, existing well locations.

- Chino Basin Watermaster (2009): Ground water level data, water quality data, well locations, extraction data, and well construction details.

- GEOSCIENCE (2008). Chino Desalter Ground Water Flow Model Update. Prepared for Chino Basin Desalter Authority, September 15, 2008. Pumping scenarios, nearby well locations, historical ground water levels, aquifer test data.

- California State Water Resources Control Board (2008): Point sources of contamination.

- Well driller's logs.

2.0 GEOHYDROLOGY

2.1 Geologic Setting

The proposed well sites are located in the southern portion of the Chino Basin in Southern California. The Chino Basin is a structural depression located between the San Gabriel Mountains to the north, the Chino Hills to the southwest, La Sierra Hills to the south, and Jurupa Mountains to the east. The San Gabriel Mountains are part of the Transverse Ranges geomorphic province. The Chino and La Sierra Hills are part of the Peninsular Ranges geomorphic province.

2.2 Stratigraphic Units

2.2.1 Bedrock

The south and southwestern boundaries of the Chino Basin consist of relatively impermeable bedrock. The southern portion, which includes the Jurupa Mountains, Pedley Hills and La Sierra Hills, consists of granitic and metasedimentary bedrock. The Chino Hills are composed primarily of Tertiary sedimentary rocks of the Puente Formation. The type of bedrock in the northern portion of the Chino Basin has not been characterized but is likely composed of granitic and metamorphic rocks similar to those of the San Gabriel Mountains.

Bedrock in the vicinity of Chino Creek wellfield is expected to consist of shale and siltstone of the Puente formation (Fox, 1994) and is known not to yield appreciable amounts of ground water to wells (DWR, 1970). Bedrock encountered in the vicinity of the Chino II expansion wells consists of crystalline granitic bedrock. The depth to bedrock within the Chino Basin ranges from greater than 1,500 feet below ground surface (bgs) in the Chino and Ontario areas to less than 50 feet bgs in the Santa Ana River Channel near Riverside Narrows.

2.2.2 Alluvium

Weathering of the mountains surrounding the Chino Basin has resulted in the deposition of alluvial sediments that have filled the basin. Alluvial sediments in the vicinity of the proposed well sites are generally divided into recent alluvial units and an older alluvial unit. The older alluvial unit consists of Pleistocene fan and terrace deposits from weathering of bedrock in the Puente Hills and Santa Ana Mountains (Durham and Yerkes, 1964). Where these sediments are saturated in the subsurface they form the basin's aquifers. Recent (Holocene) alluvium is found primarily in drainage channels in the Chino Hills and as wind-blown sand and fan deposits on the Chino Plain. Evaluation of driller's and geophysical borehole logs indicate that the subsurface alluvial sediments consist of alternating layers of sand, gravel, silt and clay in varying proportions.

2.3 Geologic Structure

The Chino Basin was formed as a result of tectonic activity along major faults that generally run along the base of the surrounding mountain ranges. These include the Cucamonga and Red Hill fault zones at the base of the San Gabriel Mountains and the Chino Fault at the base of the Chino Hills. The Red Hill fault zone serves as a ground water barrier, however, the Chino fault does not. The Central Avenue Fault runs parallel to the Chino Fault and is significant to the Chino Creek Wellfield in that it is very near to the proposed location of Chino Creek Well A-6 (see Figure 1). The existence and location of the Central Avenue Fault has been postulated based on ground water level and lithologic differences along either side of the inferred fault trace, but there has been no evidence of Late Quaternary activity. Although this fault may act as a ground water flow barrier, its effect on ground water is generally unknown.

2.4 Ground Water

2.4.1 Aquifer Systems

As with all alluvial basins, complex water-bearing zones consisting of inter-layered sands, gravels, silts and clays comprise the aquifer system of the Chino Basin. The water-bearing zones have been grouped into two general aquifer systems: an upper system that is generally unconfined to semi-confined and a lower system that is generally semi-confined to confined.

2.4.2 Aquifer Yield

Specific capacity is defined as the amount of drawdown measured within a well pumping at a known rate and is expressed as the pumping rate divided by the drawdown. Generally, the specific capacity of a well is a measure of its ability to yield water and can be used to estimate the potential yield of an aquifer.

Specific capacities and instantaneous discharge rates in the vicinity of the proposed Chino Creek wellfield are generally low due to the prevalence of low permeability sediments in that portion of the Chino Basin. Chino Desalter Authority (CDA) Wells I-1 through I-4 have specific capacities ranging from approximately 1 to 8 gallons per minute per foot of drawdown (gpm/ft) with an average of 4 gpm/ft (see Table 1). Instantaneous discharge rates have ranged from approximately 200 to 500 gpm (see Table 1). Well driller's logs for nearby wells 02S07W-29J01 and 02S07W-29M01 report specific capacities of 24 and 67 gpm/ft, and instantaneous discharges rates of 1,400 and 2,350 gpm, respectively (see Figure 2 and Appendix B).

In the vicinity of the Chino II expansion wellfield, specific capacity values generally increase from west to east and are higher than those found in the vicinity of the Chino Creek wellfield. The specific capacity of CDA Wells I-5 through I-11, located immediately west of the proposed Chino II expansion wells, have had specific capacities ranging from 4 to 55 gpm/ft with an average of approximately 24 gpm/ft (see Table 1). The instantaneous discharge rates for the

abovementioned wells have historically ranged from approximately 200 to 2,700 gpm (see Table 1). CDA Wells II-1, II-2, and II-3 are located immediately to the east of the proposed Chino II expansion wells and have had specific capacities ranging from approximately 99 to 113 gpm/ft, with instantaneous discharge rates of approximately 1,900 to 2,000 gpm (see Table 1).

2.4.3 Ground Water Occurrence and Movement

Ground water in the Chino Basin generally flows in a southerly direction from the San Jose and Red Hill faults at the base of the San Gabriel Mountains towards the Prado Flood Control Basin. Ground water elevation contours prepared by Wildermuth for the fall seasons of 2000, 2003 and 2006 all show that ground water flows from northeast to southwest in the vicinity of the two proposed wellfields. During those periods, the hydraulic gradient ranged from approximately 14 to 17 ft/mile (0.002 to 0.003 ft/ft).

2.4.4 Historical Ground Water Elevations

Hydrographs for selected wells in the vicinity of the Chino Creek wellfield are shown on Figure 6. Historical records indicate that ground water levels in the area have remained fairly stable from 2000 to the present. Figure 7 shows ground water level elevations for selected wells in the vicinity of the Chino II expansion wellfield. The hydrographs indicate that ground water levels have been considerably more variable than those in the vicinity of the Chino Creek wellfield. However, given the limitations of the data, no specific trend is evident.

2.4.5 Ground Water Quality

2.4.5.1 Non-Point Sources of Contamination

Ground water in the southwestern portion of the Chino Basin is commonly known to have elevated concentrations of total dissolved solids (TDS) and nitrate. Between January 2001 and June 2006, 359 wells in the Chino Basin exceeded the California Department of Public Health

(CDPH) maximum contaminant level (MCL) for TDS and 452 wells exceeded the MCL for nitrate (Wildermuth, 2007). The primary source of non-point source ground water contamination in this area is from deep percolation of nitrogen-based fertilizers applied to crops, and manure from cattle feed lots.

Available ground water quality data for selected wells in the vicinity of the Chino Creek wellfield show that TDS concentrations have ranged from 176 to 1,350 milligrams per liter (mg/L; Chino Basin Watermaster, 2009; see Figure 8). TDS concentrations in the shallow aquifers (less than approximately 150 ft bgs) are significantly higher than TDS concentrations in the deep aquifer (greater than approximately 320 ft bgs). Recent water quality data show TDS concentrations ranging from 178 to 1,220 mg/L. Since 2006, nitrate concentrations have ranged from 0.4 to 27 mg/L as nitrogen (Chino Basin Watermaster, 2009; see Figure 9). As with TDS, nitrate concentrations in the shallow aquifers are significantly higher than those within the deeper aquifers. Silica concentrations have ranged from 17 to 34 mg/L since 2006 (Chino Basin Watermaster, 2009; see Figure 10) and the most recent data show silica concentrations of 19 mg/L. Since 2006, chloride concentrations in the Chino Creek wellfield area have ranged from 5 to 97 mg/L with the greatest concentrations occurring within the shallow aquifers (Chino Basin Watermaster, 2009; see Figure 11). The following table presents a summary of recent TDS, nitrate, silica, and chloride concentrations for selected wells in the vicinity of the Chino Creek wellfield:

**Summary of Recent Ground Water Quality Data (November 2008)
for Selected Wells in the Vicinity of the Chino Creek Wellfield**

Well	Nitrate as N MCL = 10 mg/L [mg/L]	TDS MCL = 500 mg/L [mg/L]	Silica no MCL [mg/L]	Chloride No MCL [mg/L]
CDA I-2	3.2	350	19	16
CDA I-3	7.2	342	19	42
MW HCMP 1/1	0.5	178	-	88
MW HCMP 1/2	1.0	210	-	6.2
MW HCMP 1/3	27.0	1,220	-	6.3

Source: Chino Basin Watermaster, 2009

Available ground water quality data for selected wells in the vicinity of the Chino II expansion wellfield show that TDS concentrations have ranged from 440 to 850 mg/L (Chino Basin Watermaster, 2009; see Figure 12). Since 2006, nitrate concentrations have ranged from 16 to 38 mg/L as nitrogen and silica concentrations have ranged from 28 to 38 mg/L (Chino Basin Watermaster, 2009; see Figures 13 and 14). Concentrations of chloride have ranged from 48 to 81 mg/L, with the greatest concentrations occurring in wells screened within the shallow aquifer system (Chino Basin Watermaster, 2009; see Figure 15). The following table presents a summary of recent TDS, nitrate, silica, and chloride concentrations for selected wells in the vicinity of the Chino II expansion wellfield:

**Summary of Recent Ground Water Quality Data (November 2008)
for Selected Wells in the Vicinity of the Chino II Expansion Wellfield**

Well	Nitrate as N MCL = 10 mg/L [mg/L]	TDS MCL = 500 mg/L [mg/L]	Silica no MCL [mg/L]	Chloride No MCL [mg/L]
I-11	33.8	800	35	81
I-13	33.19	743	34	62
II-1	19.6	610	37	66

Source: Chino Basin Watermaster, 2009

2.4.5.2 Point Sources of Contamination

Point sources of contamination are specific sites or locations where contaminants have been, or have the potential to be, released to the subsurface via localized spills at or below ground surface (Figure 16). Locations of point sources of contamination were obtained from the Regional Water Quality Control Board's (RWQCB) GeoTracker database (http:/geotracker.swrcb.ca.gov) and from Wildermuth (2007).

Common point sources include specific sites where contaminants have been released to the subsurface from leaking underground storage tanks (LUST) or localized surface spills. Within a one-mile radius of the Chino Creek wellfield there are three open LUST sites (Figure 16). There are no open LUST sites within a one-mile radius of the Chino II expansion wellfield. Because the leaks reported at these sites are generally shallow, the potential for contaminants associated with these facilities to reach the regional ground water table is minimal. This assumes that no cross contamination occurs through wells perforated in both shallow and deep aquifers and that the aquitards separating the shallow contamination from the deep regional aquifer form effective ground water barriers.

There are several non-leaking underground storage tanks (UST) in the vicinity of both proposed wellfields. A summary of LUST and UST facilities within one mile of the proposed Chino Creek and Chino II expansion wellfields are provided in the table below and are shown on Figure 16.

Summary of UST and LUST Sites
Within 1 Mile of the Proposed Chino Creek and Chino II Expansion Wellfields

Type	Site Name	Status	Address	City
Chino Creek Wellfield				
UST	AG-KOOPAL, S	None	16050 MOUNTAIN AVE	CHINO
UST	AG-MURRAY, DONALD L.	None	7000 MERRILL AVE	CHINO
UST	AG-TEUNE'S DAIRY	None	8749 MERRILL AVE	CHINO
UST	AG-V HOLSTEIN'S DAIRY	None	6841 BICKMORE AVE	CHINO
UST	AG-VEIGA & SONS DAIRY	None	16195 MOUNTAIN AVE	CHINO
UST	CO-CHINO FUEL SERVICE	None	7000 MERRILL AVE	CHINO
UST	CO-SAN BDNO/CHINO AIRPORT	None	7000 MERRILL AVE	CHINO
UST	JET EXECUTIVE TRANSPORTATION	None	8352 KIMBALL AVE	CHINO
UST	UCO AVIATION	None	7000 MERRILL AVE	CHINO
LUST	STUEVE BROS. FARMS	OPEN	8300 PINE AVE	CHINO
LUST	VAN HOFWEGEN DAIRY	OPEN	15913 S MOUNTAIN AVE	CHINO
LUST	ROCHA PROPERTY	OPEN	7311 PINE AVE	CHINO
Chino II Expansion Wellfield				
UST	AG-LAUREN DUHALDE DAIRY	None	9859 EUCALYPTUS AVE	CHINO
UST	KNEVELBAARD DAIRIES	None	6880 HARRISON AVE	CORONA

Other known point sources of contamination in the vicinity of the Chino Creek and Chino II expansion wellfields include three contaminant plumes. A large plume of volatile organic compounds (VOC) has been delineated extending south from Ontario International Airport. This plume extends approximately 4 miles southward from State Route 60 to Kimball Avenue. At its widest point it measures approximately 2.5 miles across. Ground water within the plume is primarily contaminated with trichloroethylene (TCE) from industries associated with the airport. The Chino Airport Plume is elongate and extends approximately 2.4 miles to the southwest from the western portion of Chino Airport. It has likely resulted from the use of various chemicals and organic solvents at Chino Airport since the early 1940s. The primary contaminant within the plume is TCE. The westernmost plume is associated with the California Institution for Men (CIM) and extends approximately 3,350 ft south of Eucalyptus Avenue. The primary contaminants within this plume are TCE and tetrachloroethylene (PCE).

3.0 EXPECTED GEOHYDROLOGIC CONDITIONS

3.1 Production Capacity

The total annual production capacity required from the proposed Chino Creek wellfield is between 5,000 and 7,700 acre-ft/year. As discussed in Section 2.4.2, instantaneous production rates of existing wells in the vicinity of the proposed Chino Creek wellfield and the existing Chino II wellfield have ranged from approximately 200 to 2,350 gpm, and 200 to 2,700 gpm, respectively. As such, based on the available data, it is expected that instantaneous production rates of the proposed Chino Creek wells will range from approximately 200 to 1,500 gpm. It is expected that instantaneous production rates in the vicinity of the proposed Chino II expansion wells will be somewhat higher, ranging from approximately 1,000 to 2,700 gpm.

It should be noted that well yield will likely vary due to spatial variations in aquifer characteristics and proximity to possible ground water barriers such as the Central Avenue Fault. In general, aquifer yield within the southern portion of the Chino Basin decreases from east to west due to an increasing proportion of sediments such as silt and clay within the aquifer system.

3.2 Water Quality

As discussed in Section 2.4.5.1, concentrations of TDS, nitrate, and chloride are significantly higher for wells screened within the shallow aquifer system of the southern Chino Basin. As such, depth-specific ground water quality data will be critical for preparation of well designs resulting in acceptable ground water quality for the Chino desalter system. This data will be acquired during isolated aquifer zone testing at each of the proposed well sites.

3.3 Potential Sources of Contamination

There are three open-case LUST sites and six UST sites identified within one mile of the proposed Chino Creek wellfield (see Figure 16). One of the open-case LUST sites (former Van Hofwegan Brother's Dairy – UST Case No. 083603756T) is located approximately 1,300 ft

north of proposed Chino Creek Well A-6. This LUST site was first identified in 1999 at which time it was discovered that hydrocarbons associated with gasoline and gasoline additives had impacted the vadose zone and ground water. The constituents of concern include petroleum hydrocarbons (TPH), benzene, methyl tert-butyl ether (MTBE), and to a lesser degree tert-amyl methyl ether (TAME) and tert-butyl alcohol (TBA). The impacted area is believed to occur within a general area of approximately 150 x 150 ft. To date, there is still free product present floating upon the ground water surface. Other than a passive skimmer system to remove free product, there is no remediation taking place.

There are no reported open-case LUST sites within one mile of the proposed Chino II expansion wellfield (see Figure 16). However, there is one UST site located approximately 4,000 ft north of proposed Chino II expansion well II-11.

The Chino Airport Plume and the VOC plume associated with the Ontario International Airport present the greatest potential for impacting the proposed Chino Creek wellfield. Wells A-3, A-4 and A-5 are located within the current delineated plume boundary of the Chino Airport Plume, and Wells A-2 and A-6 are located approximately 1,250 ft from the plume boundary (see Figure 16). Well A-1 is located approximately 3,100 ft downgradient and to the southwest of the VOC plume associated with the Ontario International Airport and approximately 3,850 ft east of the Chino Airport Plume. As such, it is possible that long-term pumping of the Chino Creek wellfield will result in the wells being impacted by dissolved VOCs within the ground water.

The proposed Chino II expansion wells are located cross-gradient and to the east of the VOC plume associated with the Ontario International Airport. Proposed wells II-10 and II-11 are within ½-mile of the plume boundary and have the greatest potential for being impacted by contaminants associated with this plume.

3.4 Interference Issues

Recent ground water modeling conducted by GEOSCIENCE (2008) predicted that an additional 29 to 91 ft of drawdown (i.e. interference) may occur within the existing Chino I and II Desalter wells as a result of the additional pumping from the proposed Chino Creek and Chino II expansion wellfields. It is expected that the magnitude of interference will be greater in the vicinity of the proposed Chino Creek wells and the existing Chino I Desalter wells primarily due to the relatively low permeability of sediments in that area. The model assumes that the existing production rate of 16,140 acre-ft per year is maintained at the proposed Chino Creek and existing Chino I Desalter wells and that an additional 12,040 acre-ft per year is extracted from the proposed and existing Chino II Desalter wells. The model predictive period ranged from 2007 to 2017 with the additional pumping from the proposed extraction wells beginning in 2011. This additional ground water level interference may result in reduced yield from wells, necessitate lowering of existing well pumps, and will likely result in increased energy costs associated with additional pumping lift.

3.5 Potential for Land Subsidence

Land subsidence (due to non recoverable compaction in aquifer systems) has been identified in portions of the southwest Chino Basin since the late 1960s and has resulted in ground fissuring which has been observed in the vicinity of the California Institution for Men. Land subsidence is typically associated with ground water withdrawals and long term lowering of ground water levels in areas where aquifers are confined, little or no pre consolidation has occurred, and a significant portion of the subsurface lithology consists predominantly of fine-grained sediments. The Chino Basin Watermaster is currently monitoring and performing tests to better understand the factors and causes of subsidence in the southwest Chino Basin.

Wells within the Chino Creek wellfield will be designed to produce water primarily from the unconfined shallow aquifer system. However, there may be some potential for land subsidence due to the likelihood of significant ground water level drawdown in an area known to have a high percentage of fine-grained sediments in the subsurface.

4.0 CONSTRUCTION LOGISTICS AND PRELIMINARY WELL DESIGN FOR THE CHINO CREEK WELLFIELD

4.1 Expected Lithology

Based on the available literature and lithologic logs from nearby wells, the subsurface alluvial sediments in the southwestern portion of the Chino Basin are expected to include alternating layers of sand, gravel, silt and clay in varying proportions. Bedrock is expected to consist of consolidated sedimentary rock and is expected to occur at depths ranging from 555 to 650 ft bgs as summarized in the following table:

Summary of Expected Bedrock and Ground Water Depths
Proposed Chino Creek Production Wells

Chino Creek Well	Elevation [ft amsl]	Expected Depth to Bedrock [ft]	Expected Depth to Ground Water [ft]
A-1	618	650	70
A-2	608	650	60
A-3	598	640	50
A-4	592	620	40
A-5	571	580	35
A-6	565	555	30

Source: Wildermuth, 2007

The expected depth to ground water for each of the proposed Chino Creek wells ranges from 30 to 70 ft bgs as summarized in the table above. These estimates are based on water levels recorded in Fall 2006 and show that ground water levels become more shallow from east to west.

4.2 Recommended Well Drilling Method

The proposed Chino Creek wells will be drilled in two passes (i.e. pilot borehole and reamed borehole) using the reverse circulation rotary drilling method with installation of a gravel

envelope to stabilize the formation. The 17.5-inch pilot boreholes will be drilled to estimated total depths ranging from 600 ft bgs (Wells A-4, A-5, and A-6) to 700 ft bgs (Wells A-1, A-2 and A-3).

Once each 17.5-inch pilot borehole has been drilled to total depth, a suite of geophysical logs will be conducted within the open borehole. Isolated aquifer zone testing will then be performed, the results of which will be used to quantify aquifer yield and ground water quality prior to preparing the final well design. Upon preparation of the final well design, the 17.5-inch borehole will be reamed to the final recommended diameters of 28 to 32 inches.

The drilling method for the two companion monitoring wells will also be reverse circulation rotary. The boreholes for these wells will be drilled in a single pass of 17.5-inch diameter to the same total depths as Wells A-4 and A-6.

4.3 Preliminary Well Design and Construction Materials

4.3.1 Production Wells

4.3.1.1 Casing Material

Chloride concentrations in the vicinity of the Chino Creek wellfield area have historically been less than 100 mg/L. As such, Type 304L stainless steel casing and screen material will provide suitable resistance to corrosion and is recommended for construction of the full-scale production wells. In the long term, this material is considered more cost effective than lower grade steels when taking into account life expectancy and well rehabilitation costs.

4.3.1.2 Expected Depth and Diameter of Well Casing

The inside diameter (ID) of the casing and screen is anticipated to be 18-inch with a wall thickness of 5/16-inch. The anticipated well screen will consist of louvered style 0.094-inch horizontal slots. The final recommended diameter and wall thickness of the casing and screen

may be modified based on the results of drilling and isolated aquifer zone testing. The anticipated total length of louvered well screen will be 510 ft (A-1, A-2, and A-3), 410 ft (A-5), and 380 ft (A-4 and A-6). It should be recognized that the conceptual designs for each of these wells is for preliminary design purposes only and that the final design will be based upon review of actual borehole lithologic samples, geophysical logs, and isolated aquifer zone testing.

Prior to implementing the final well designs, it is recommended that meetings be held between interested parties (i.e., GEOSCIENCE, WMWD, JCSD, Ontario, Carollo Engineers, and Wildermuth) to discuss and reach consensus on the details of the well designs. Once all parties are in agreement, the final well designs will be issued to the drilling contractor for implementation in the field.

4.3.1.3 Preliminary Conceptual Well Designs

Figure 17 and the table below summarize the preliminary conceptual design of Wells A-4 and A-6.

Chino Creek Well A-4 and A-6
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 110	annulus	3	Sch. 40	-	2 x Gravel Feed Pipe (Mild Steel)
+1 – 178	annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 100	32	-	-	-	Sanitary Seal (10.3 Sack Cement Slurry)
100 – 103	32	-	-	-	Fine Sand Layer
103 – 600	32 (50-120) 28 (120-600)	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 180	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
180 – 560	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
560 – 580	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
580 – 600	28	-	-	-	Filter Pack Below Casing

Figure 18 and the table below summarize the preliminary conceptual design of Well A-5.

Chino Creek Well A-5
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 148	annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 600	28	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1– 150	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
150 – 560	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
560 – 580	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
580 – 600	28	-	-	-	Filter Pack Below Casing

Figure 19 and the table below summarize the preliminary conceptual design of Wells A-1, A-2, and A-3.

Chino Creek Wells A-1, A-2 and A-3
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 148	annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 700	28	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1– 150	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
150 – 660	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
660 – 680	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
680 – 700	28	-	-	-	Filter Pack Below Casing

4.3.1.4 Sounding Tube and Gravel Feed Pipe Design

As Wells A-4 and A-6 are to be located at treatment facilities, it is anticipated that they will be the only wells in the Chino Creek wellfield that will require annular cement seals. It is anticipated that CDPH will require deep annular seals as a condition of permitting. Each annular cement seal will consist of 10.3-sack sand-cement grout and will be placed from approximately 100 ft bgs to ground surface. Two (2) 3-inch schedule 40 mild steel gravel feed pipes will be installed in each well for the purpose of adding filter pack material during development and as needed in the future.

All of the Chino Creek production wells will be fitted with one (1) 2-inch, schedule 40 304L stainless steel sounding tube.

4.3.2 Monitoring Wells

4.3.2.1 Casing Material

The recommended casing and screen material for the companion monitoring wells (designated MW A-4 and MW A-6) is Certa-Lok™ SDR 17 PVC.

4.3.2.2 Expected Depth and Diameter of Well Casing

The ID of the casing and screen is anticipated to be 4.2-inch with a wall thickness of 0.305-inch. The anticipated well screen will consist of mill-slotted 0.090-inch vertical openings. The final recommended design for monitoring wells MW A-4 and MW A-6 is intended to duplicate that of Wells A-4 and A-6 and may be modified based on the results of drilling and testing at Well A-4 and A-6.

Figure 20 and the table below summarize the preliminary conceptual design for monitoring wells MW A-4 and MW A-6:

Chino Creek Monitoring Wells MW A-4 and MW A-6
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Type of Material
0 – 35	30	20 OD	1/4	-	Conductor Casing with Cemented Annulus (ASTM A139 Grade B Steel)
0 – 20	-	-	-	-	Annular Bentonite Seal (Baroid Hole Plug)
20 – 580	Annulus	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 180	17.5	nominal 4.5	SDR 17	-	Blank Casing (SDR 17 Certa-Lok PVC)
180 – 560	17.5	nominal 4.5	SDR 17	0.090	Vertically Slotted Screen (SDR 17 Certa-Lok PVC)
560 – 570	17.5	nominal 4.5	SDR 17	-	Blank Casing w/Bottom Cap (SDR 17 Certa-Lok PVC)
570 – 580	17.5	-	-	-	Gravel-filled Borehole Below Casing and Bottom Cap

4.3.3 Filter Pack Gradation

Conceptually, it is anticipated that the filter pack gradation for the Chino Creek production wells and monitoring wells will be a ¼ in. x 16 custom blend. Mechanical grading analysis (i.e. sieve analysis) will be performed on formation samples from a minimum of eight different intervals per well. Based on the results of these sieve analyses, the recommended filter pack gradations will be determined. The filter pack design for the wells shall have a Uniformity Coefficient (defined as the ratio of the 60% passing size to the 10% passing size) of approximately 2 to control sand production, and will meet Terzaghi's permeability and migration criteria. The anticipated filter pack design is summarized in the table below.

Anticipated Filter Pack Design – ¼ in. x 16 Custom Blend

U.S. Standard Sieve No.	Sieve Opening [in.]	Sieve Opening [mm]	Cumulative Percent Passing
3/8”	0.375	9.53	100
1/4”	0.250	6.35	90
4	0.187	4.75	70
8	0.094	2.38	17
10	0.079	2.00	10
12	0.066	1.68	7
16	0.047	1.19	2
20	0.033	0.84	0.1

4.4 Sequence of Drilling Operations

Operations at each of the proposed Chino Creek production well sites will involve the following:

1- Mobilizing a fluid reverse circulation rotary drilling rig and its associated equipment to the well site including sound barriers for noise control, reservoirs for fluid containment, solids control equipment, and a working geolograph.

2- Drilling, installing and cementing a 36-inch OD conductor casing to a depth of 50 ft within a 48-inch diameter borehole.

3- Drilling and sampling the 17 ½ -inch diameter pilot borehole to total depth with deviation surveys being performed every 100 ft.

4- Conditioning and cleaning the borehole, if necessary, prior to running the specified geophysical borehole logs.

5- Performing isolated aquifer zone testing within the pilot borehole.

6- Destroying the borehole in accordance with County of San Bernardino requirements if unsuitable as a production well. If suitable, the following steps will be completed:

7- Enlarging the pilot borehole from 17 ½ inches to 28 and 32 inches in diameter to total depth.

8- Performing a caliper survey on the enlarged borehole less than six hours prior to the installation of the casing and screen.

9- Installing 18-inch ID casing and louvered well screen within the reamed borehole, with centralizers, sounding tube, and two (2) gravel feed pipes as necessary.

10- Installing an artificial filter pack in the annular space between the casing and/or screen and the borehole wall, and install surface seal as necessary.

11- Performing initial development by airlifting and swabbing from between packers.

12- Cleaning out the blank casing below the screened interval.

13- Demobilizing the drilling rig and associated drilling equipment.

14- Mobilizing the test pump and support equipment.

15- Installing a deep well turbine test pump with a variable speed engine.

16- Performing final development using a deep well turbine test pump.

17- Performing well and aquifer tests (including step drawdown, constant rate and recovery tests).

18- Collecting water quality samples for Title 22 (California Code of Regulations) and other selected analyses.

19- Performing a spinner (flowmeter) survey prior to the end of the constant rate pumping test.

20- Removing the test pump from the well.

21- Performing a gyroscopic alignment survey of the well.

22- Bailing the well to remove sediments, which have accumulated during test pumping.

23- Performing a dual-cam video survey of the well.

24- Disinfecting the well using a sodium hypochlorite solution and securing the well against entry.

25- Demobilizing all equipment, including site clean up, restoration and wellhead completion.

5.0 CONSTRUCTION LOGISTICS AND PRELIMINARY WELL DESIGN FOR THE CHINO II EXPANSION WELLFIELD

5.1 Expected Lithology

Based on available literature and lithologic logs from nearby wells, the subsurface alluvial sediments in the vicinity of the Chino II wellfield are expected to consist of alternating layers of sand, gravel, silt and clay in varying proportions. Sand and gravel are expected to be the predominant lithologies. Bedrock is anticipated to consist of granite and is expected to occur at depths ranging from approximately 490 to 650 ft bgs as summarized in the following table:

Summary of Expected Bedrock and Ground Water Depths
Proposed Chino II Expansion Wells

Well Designation	Elevation [ft amsl]	Expected Depth to Bedrock [ft]	Expected Depth to Ground Water [ft]
II-10	672	490	140
II-11	652	530	120
II-12	646	650	100

Source: Wildermuth, 2007 and GEOSCIENCE, 2008.

The expected depth to ground water for each of the proposed Chino II expansion wells ranges from approximately 100 to 140 ft bgs as summarized in the table above.

5.2 Recommended Well Drilling Method

The proposed Chino II expansion wells will be drilled in two passes (i.e. pilot borehole and reamed borehole) using the reverse circulation drilling method with installation of a gravel envelope to stabilize the formation. The 17.5-inch pilot boreholes will be drilled to estimated total depths of approximately 530 ft bgs (Well II-10), 570 ft bgs (Well II-11), and 690 ft bgs (Well II-12).

Once each 17.5-inch pilot borehole has been drilled to total depth, a suite of geophysical logs will be conducted within the open borehole. Isolated aquifer zone testing will then be performed, the results of which will be used to quantify aquifer yield and ground water quality prior to preparing the final well design. Upon preparation of the final well design, the 17.5-inch borehole will be reamed to the final recommended diameter of 28 inches.

5.3 Preliminary Well Design and Construction Materials

5.3.1 Casing Material

Chloride concentrations in the vicinity of the Chino II wellfield area have historically been less than 100 mg/L. As such, Type 304L stainless steel casing and screen material will provide suitable resistance to corrosion and is recommended for construction of the full-scale production wells. In the long term, this material is considered more cost effective than lower grade steels when taking into account life expectancy and well rehabilitation costs.

5.3.2 Expected Depth and Diameter of Well Casing

The ID of the casing and screen is anticipated to be 18-inch with a wall thickness of 5/16-inch. The anticipated well screen will consist of louvered style 0.094-inch horizontal slots. The final recommended diameter and wall thickness of the casing and screen may be modified based on the results of drilling and isolated aquifer zone testing. The anticipated total length of louvered well screen will be 340 ft (Well II-10), 380 ft (Well II-11), and 500 ft (Well II-12). It should be recognized that the conceptual designs for each of these wells is for preliminary design purposes only and that the final design will be based upon review of actual borehole lithologic samples, geophysical logs, and isolated aquifer zone testing.

Prior to implementing the final well designs, it is recommended that meetings be held between interested parties (i.e., GEOSCIENCE, WMWD, JCSD, Ontario, Carollo Engineers, and Wildermuth) to discuss and reach consensus on the details of the well designs. Once all parties

are in agreement, the final well designs will be issued to the drilling contractor for implementation in the field.

All of the Chino II expansion wells will be fitted with one (1) 2-inch, schedule 40 304L stainless steel sounding tube.

Figures 21 through 23, and the table below summarize the preliminary conceptual designs of the Chino II expansion wells:

Chino II Expansion Well II-10
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 148	Annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 530	28	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 150	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
150 – 490	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
490 – 510	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
510 – 530	28	-	-	-	Filter Pack Below Casing

Chino II Expansion Well II-11
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 148	Annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 570	28	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 150	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
150 – 530	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
530 – 550	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
550 – 570	28	-	-	-	Filter Pack Below Casing

Chino II Expansion Well II-12
Conceptual Design of Casing and Screen

Interval [ft bgs]	Borehole Diameter [in.]	Casing Diameter [in.]	Wall Thickness [in.]	Screen Slot Size [in.]	Material Type
0 – 50	48	36 OD	3/8	-	Conductor Casing (ASTM A139 Grade B Steel)
+1 – 148	Annulus	2	Sch. 40	-	Sounding Tube (304L Stainless Steel)
0 – 690	28	-	-	-	¼ in. x 16 Custom Blend Filter Pack Material
+1 – 150	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing (304L Stainless Steel)
150 – 650	28	18 5/8 OD (18 ID)	5/16	0.094 (3/32 in.)	Ful-Flo Louvered Screen (304L Stainless Steel)
650 – 670	28	18 5/8 OD (18 ID)	5/16	-	Blank Casing w/End Plate (304L Stainless Steel)
670 – 690	28	-	-	-	Filter Pack Below Casing

5.3.3 Filter Pack Gradation

Mechanical grading analysis (i.e. sieve analysis) will be performed on formation samples from a minimum of eight different intervals. Based on the results of these sieve analyses, the recommended filter pack gradations will be determined. The filter pack design for the well shall have a Uniformity Coefficient (defined as the ratio of the 60% passing size to the 10% passing size) of approximately 2 to control sand production, and will meet Terzaghi's permeability and migration criteria. Although the final filter pack design may vary between wells, the following anticipated filter pack design summarized in the table below is expected to be applicable:

Anticipated Filter Pack Design – ¼ in. x 16 Custom Blend

U.S. Standard Sieve No.	Sieve Opening [in.]	Sieve Opening [mm]	Cumulative Percent Passing
3/8"	0.375	9.53	100
1/4"	0.250	6.35	90
4	0.187	4.75	70
8	0.094	2.38	17
10	0.079	2.00	10
12	0.066	1.68	7
16	0.047	1.19	2
20	0.033	0.84	0.1

5.4 Sequence of Drilling Operations

Operations at each of the proposed Chino II expansion well sites will involve the following:

1- Mobilizing a fluid reverse circulation rotary drilling rig and its associated equipment to the well site including sound barriers for noise control, reservoirs for fluid containment, solids control equipment, and a working geolograph.

2- Drilling, installing and cementing a 36-inch OD conductor casing to a depth of 50 ft within a 48-inch diameter borehole.

3- Drilling and sampling the 17 ½ -inch diameter pilot borehole to total depth with deviation surveys being performed every 100 ft.

4- Conditioning and cleaning the borehole, if necessary, prior to running the specified geophysical borehole logs.

5- Performing isolated aquifer zone testing within the pilot borehole.

6- Destroying the borehole in accordance with County of San Bernardino requirements if unsuitable as a production well. If suitable, the following steps will be completed:

7- Enlarging the pilot borehole from 17 ½ inches to 28 inches in diameter to total depth.

8- Performing a caliper survey on the enlarged borehole less than six hours prior to the installation of the casing and screen.

9- Installing 18-inch ID casing and louvered well screen within the reamed borehole, with centralizers and sounding tube.

10- Installing an artificial filter pack in the annular space between the casing and/or screen and the borehole wall.

11- Performing initial development by airlifting and swabbing from between packers.

12- Cleaning out the blank casing below the screened interval.

13- Demobilizing the drilling rig and associated drilling equipment.

14- Mobilizing the test pump and support equipment.

15- Installing a deep well turbine test pump with a variable speed engine.

16- Performing final development using a deep well turbine test pump.

17- Performing well and aquifer tests (including step drawdown, constant rate and recovery tests).

18- Collecting water quality samples for Title 22 (California Code of Regulations) and other selected analyses.

19- Performing a spinner (flowmeter) survey prior to the end of the constant rate pumping test.

20- Removing the test pump from the well.

21- Performing a gyroscopic alignment survey of the well.

22- Bailing the well to remove sediments, which have accumulated during test pumping.

23- Performing a dual-cam video survey of the well.

24- Disinfecting the well using a sodium hypochlorite solution and securing the well against entry.

25- Demobilizing all equipment, including site clean up, restoration and wellhead completion.

6.0 ADDITIONAL CONSTRUCTION CONSIDERATIONS

6.1 Separation Distances

CDPH and the County of San Bernardino Department of Public Health, Division of Environmental Health Services (DEHS) has specific requirements regarding minimum separation distances that must be complied with when permitting a public water supply well. These include, but are not limited to the following:

- 100 ft from a sewer manhole, and
- 50 ft from sewer lines and laterals.

Additional requirements may be stipulated based on the location of above and below ground facilities at the Chino I Desalter and RP-5 solids handling facilities (i.e. the locations of proposed Chino Creek Wells A-4 and A-6). As such, a detailed drawing showing the well locations and surrounding facilities should be submitted to CDPH and DEHS for review and approval prior to proceeding with the bidding process for the drilling contract. This will allow these public agencies to provide valuable input and/or modifications to the proposed well siting and/or well design.

6.2 Well Site Areas and Access Considerations

Optimum well locations will include easy site access for heavy machinery and enough available area for the well drilling contractor to place the drilling rig and associated equipment, and enough space to allow the work to proceed. At minimum, a 10,000 ft^2 area is required for well drilling operations. Additionally, consideration should be given to overhead obstructions such as power lines, and below ground utilities and infrastructure.

Proposed Chino Creek Well A-4 is to be located at the Chino I Desalter facility at 6905 Kimball Avenue in the City of Chino. As shown on Figure 4, there are currently two proposed extraction

well sites for Well A-4, designated A-4a and A-4b. Additionally, there are two proposed sites for each monitoring well. The first of these proposed sites (A-4a) is on the north side of the facility on a landscaped area immediately west of a row of parking stalls. This site has no overhead obstructions and a hydrant immediately adjacent to the site. There are two sewer manholes, connected by a sewer line, located on the access road to the south. Each of these manholes is less than 100 ft from site A-4a. At its closest point the sewer line is approximately 35 ft from the proposed well. A block wall runs east-west to the north of the site.

The second proposed site (Well A-4b) is located on the south side of the Desalter facility. There are no overhead obstructions present; however, the site is enclosed on three sides by a wall to the north, large storage tanks to the west, and a fence to the south. The access on the east side is 39 feet across and extends 48 ft west. To the north there is an east-west access road with a parallel sewer line that is approximately 54 ft from the site. There is also a sewer manhole approximately 95 ft to the northeast of the site.

Clearance should be obtained from CDPH and DEHS to allow installation of Well A-4 within stipulated minimum separation distances of sewer lines and manholes.

Proposed Chino Creek Well A-6 will be located within the property boundary of the RP-5 Solids Handling Facility at the intersection of Mountain Avenue and Flowers Street in the City of Chino. The well is to be located in the northeast corner of the facility approximately 175 feet north of the entrance to the facility, in a large open area that is enclosed by a chain link fence. There were no overhead obstructions, and no observable sewer lines or sewer manholes.

The sites for proposed wells A-4a and A-6 have adequate open area to facilitate well construction activities. The alternate site A-4b does not have adequate space for well construction activities due to the close proximity of existing facilities. However, a well could be constructed at site A-4b if the location were moved into the open area to the east.

6.3 Discharge Considerations and Removal of Drill Cutting and Fluids

The drilling contractor would be responsible for containing and removing all drill cuttings, fluid, and waste water associated with well construction. Waste water may be discharged to nearby storm-drains providing that National Pollutant Discharge Elimination System (NPDES) requirements are met. It may be necessary for the contractor to supply multiple large storage containers (i.e. Baker tanks) for temporary holding of wastewater to allow settling of suspended solids prior to discharge.

6.4 Noise Abatement Measures to be Taken During Drilling:

Drilling and testing operations shall be performed in a manner to minimize unnecessary noise generation and minimize disturbance to persons living or working nearby, and to the general public, while meeting local noise abatement ordinances (but no more than 65 decibels at the property boundary). The measures to be used in noise suppression shall include (but are not limited to):

- Equipping all internal combustion engines with critical residential silencers (mufflers);
- Shielding noise-producing equipment from nearby areas of human occupancy by erecting sound barriers of at least 24-ft height which completely surround each work site, and by locating equipment in positions which will direct the greatest noise emissions away from these areas;
- Wrapping the mast with insulated sound blankets (which will additionally shield nearby residences from nighttime lighting); and
- Conducting operations in the most effective manner that will minimize noise generation, while being consistent with the prosecution of the Contract in a timely and economic manner.

It is noted that some of the proposed well sites may not require noise abatement measures. As such, the applicable noise abatement measures for each well site will be evaluated on a case by case basis during preparation of the technical specifications.

7.0 ENGINEER'S ESTIMATES

Tables 2 through 10 include engineer's estimates for drilling, construction, development and testing of six Chino Creek production wells and two companion monitoring wells, and three Chino II expansion wells. These estimated costs are based on recent winning bids for similar construction projects in the southern California area. It should be noted that these engineer's estimates may require revision should too much time pass between the date of this report and the initiation of the bidding process.

The following table summarizes the total bid price for each of the engineer's estimates:

Summary of Engineer's Estimates

Well	Total Bid Price
Chino Creek Well A-4 and A-6	$1,362,574
Chino Creek Monitoring Wells MW A-4 and MW A-6	$271,230
Chino Creek Well A-1	$747,127
Chino Creek Well A-2	$747,127
Chino Creek Well A-3	$747,127
Chino Creek Well A-5	$678,827
Chino II Expansion Well II-10	$631,017
Chino II Expansion Well II-11	$658,337
Chino II Expansion Well II-12	$740,297

8.0 REFERENCES

Carollo Engineers, 2007. Chino Desalter Phase 3 Alternatives Evaluation. Prepared for the City of Ontario and Western Municipal Water District. May 2007.

Carollo Engineers, 2008. Draft Chino II Desalter Expansion Preliminary Engineering Report. Prepared for Western Municipal Water District, City of Ontario, and Jurupa Community Services District. January, 2008

Chino Basin Watermaster, 2009. Ground Water Level Data, Water Quality Data, Well Locations, Extraction Data, and Well Construction Details.

Department of Water Resources, 1970. Meeting Water Demands in the Chino-Riverside Area, Bulletin No. 104-3. September 1970.

Durham, D.L., and Yerkes, R.F., 1964. Geology and Oil Resources of the Eastern Puente Hills Area, Southern California. U.S. Geological Survey Professional Paper 420-B.

Fox, R., 1994. Chino Basin Desalination Project – Summary of Well Construction and Testing. Prepared for the Santa Ana Watershed Project Authority. September 1994.

GEOSCIENCE, 2001. Draft Geohydrologic Analysis and Ground Water Flow Model of the Proposed Chino Desalter System Projects Area. Prepared for the Santa Ana Watershed Project Authority and RBF Consulting. August, 31, 2001.

GEOSCIENCE, 2005. Results of Drilling, Construction, Development and Testing of Well No. 20. Prepared for the City of Chino Hills. December 21, 2005.

GEOSCIENCE, 2008. Chino Desalter Ground Water Flow Model Update. Prepared for Chino Basin Desalter Authority. September 15, 2008.

Montgomery Watson, 1999. Summary of Groundwater Production Well Drilling, Construction, Development and Testing – Phases I and II – Chino Basin Desalter Project Program Project – FINAL. Prepared for: Santa Ana Watershed Project Authority. April 1999.

Wildermuth Environmental, Inc., 2007. Chino Basin Optimum Basin Management Program: State of the Basin Report – 2006. Prepared for: Chino Basin Watermaster. July 24, 2007.

FIGURES

WESTERN MUNICIPAL WATER DISTRICT

PRELIMINARY DESIGN REPORT FOR THE CHINO CREEK WELLFIELD AND CHINO II EXPANSION WELLFIELD - CHINO DESALTER PHASE 3 PROJECT

T.1 S.
T.2 S.
T.2 S.
T.3 S.

R.8 W. | R.7 W.

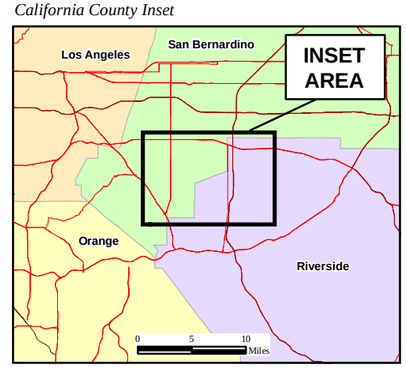
R.7 W. | R.6 W.

PROJECT LOCATION

EXPLANATION

- Existing Chino Desalter Well Location
- Proposed Chino II Expansion Well Location
- Proposed Chino Creek Well Location
- County Boundary
- Fault
- Recharge Basin

California County Inset



1-Sep-09

Prepared by: DWB

Map Projection: UTM (1927), Zone 11

NORTH

0 1 2 Miles

DRAFT

GEOSCIENCE

GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 1

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_1_project_loc_9-09.mxd

WESTERN MUNICIPAL WATER DISTRICT

PRELIMINARY DESIGN REPORT FOR THE CHINO CREEK WELLFIELD
AND CHINO II EXPANSION WELLFIELD - CHINO DESALTER PHASE 3 PROJECT

T.2 S.

R.8 W. | R.7 W.

PROPOSED WELL SITES CHINO CREEK WELLFIELD

EXPLANATION

- Existing Chino Desalter Well Location
- Proposed Chino Creek Well Location
- Other Selected Wells

1-Sep-09

Prepared by: DWB

Map Projection: UTM (1983), Zone 11

Airphoto from Terraserver (dated June, 2002)

NORTH

0 1,000 2,000 Feet

DRAFT

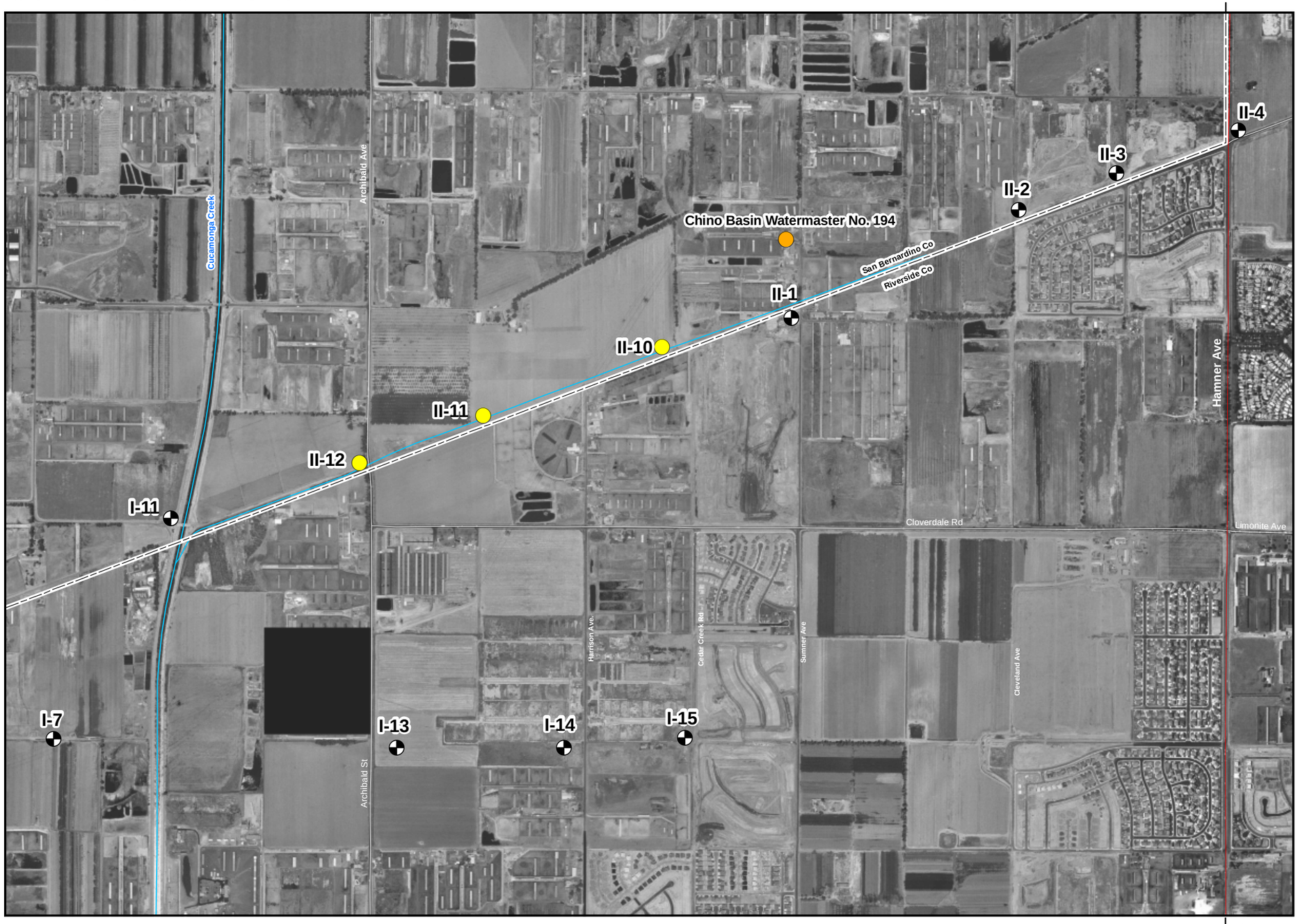
GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 451-6650 Fax: (909) 451-6638
www.gssiwater.com

Figure 2

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_2_chino_creek_wellfield_9-09.mxd

WESTERN MUNICIPAL WATER DISTRICT

PRELIMINARY DESIGN REPORT FOR THE CHINO CREEK WELLFIELD
AND CHINO II EXPANSION WELLFIELD - CHINO DESALTER PHASE 3 PROJECT



T.2 S.

R.7 W. | R.6 W.

PROPOSED WELL SITES CHINO II EXPANSION WELLFIELD

EXPLANATION

- Existing Chino Desalter Well Location
- Proposed Chino II Expansion Well Location
- Other Selected Wells

1-Sep-09

Prepared by: DWB

Map Projection: UTM (1983), Zone 11

Airphoto from Terraserver (dated June, 2002)

NORTH

0 1,000 2,000 Feet

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Figure 3

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_3_chino3_expansion_wellfield_9-09.mxd

DETAILED LOCATION OF CHINO CREEK WELL A-4

EXPLANATION

- Proposed Chino Creek Well Location
- Proposed Monitoring Well Location

T.2 S.
R.7 W.

1-Sep-09

Prepared by: DWB

Map Projection: State Plane 1983, Zone V

Airphoto from Eagle Aerial, 2008.

NORTH

0 40 80 Feet

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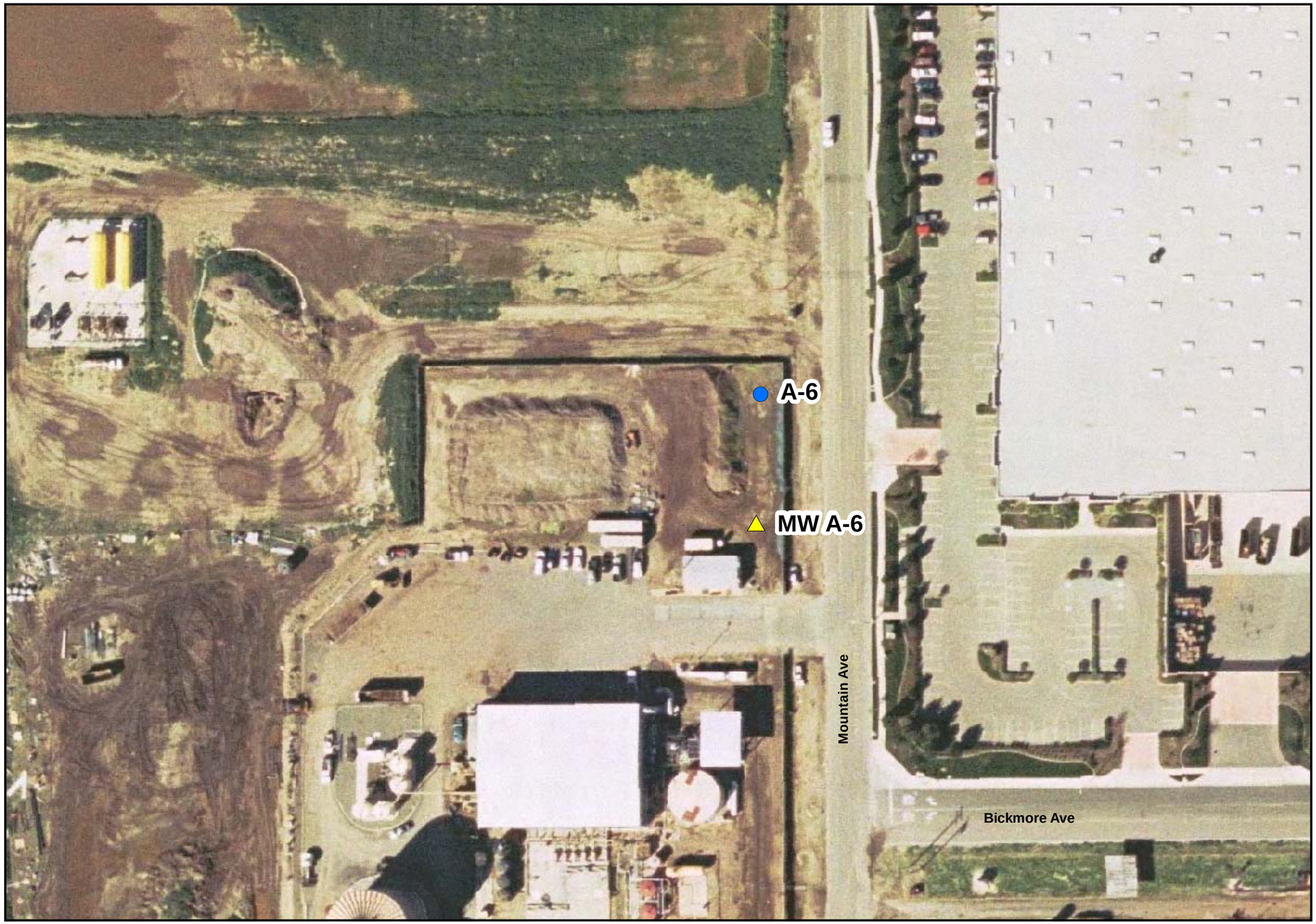
Figure 4

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_4_well_A-4_closeup_9-09.mxd

DETAILED LOCATION OF CHINO CREEK WELL A-6



EXPLANATION

- Proposed Chino Creek Well Location
- Proposed Monitoring Well Location

T.2 S.
R.8 W.

1-Sep-09

Prepared by: DWB

Map Projection: UTM (1927), Zone 11

Airphoto from Eagle Aerial, 2008.

NORTH

0 40 80 Feet

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Figure 5

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_11_well_A-6_closeup_9-09.mxd

Hydrographs for Wells in the Vicinity of the Chino Creek Wellfield

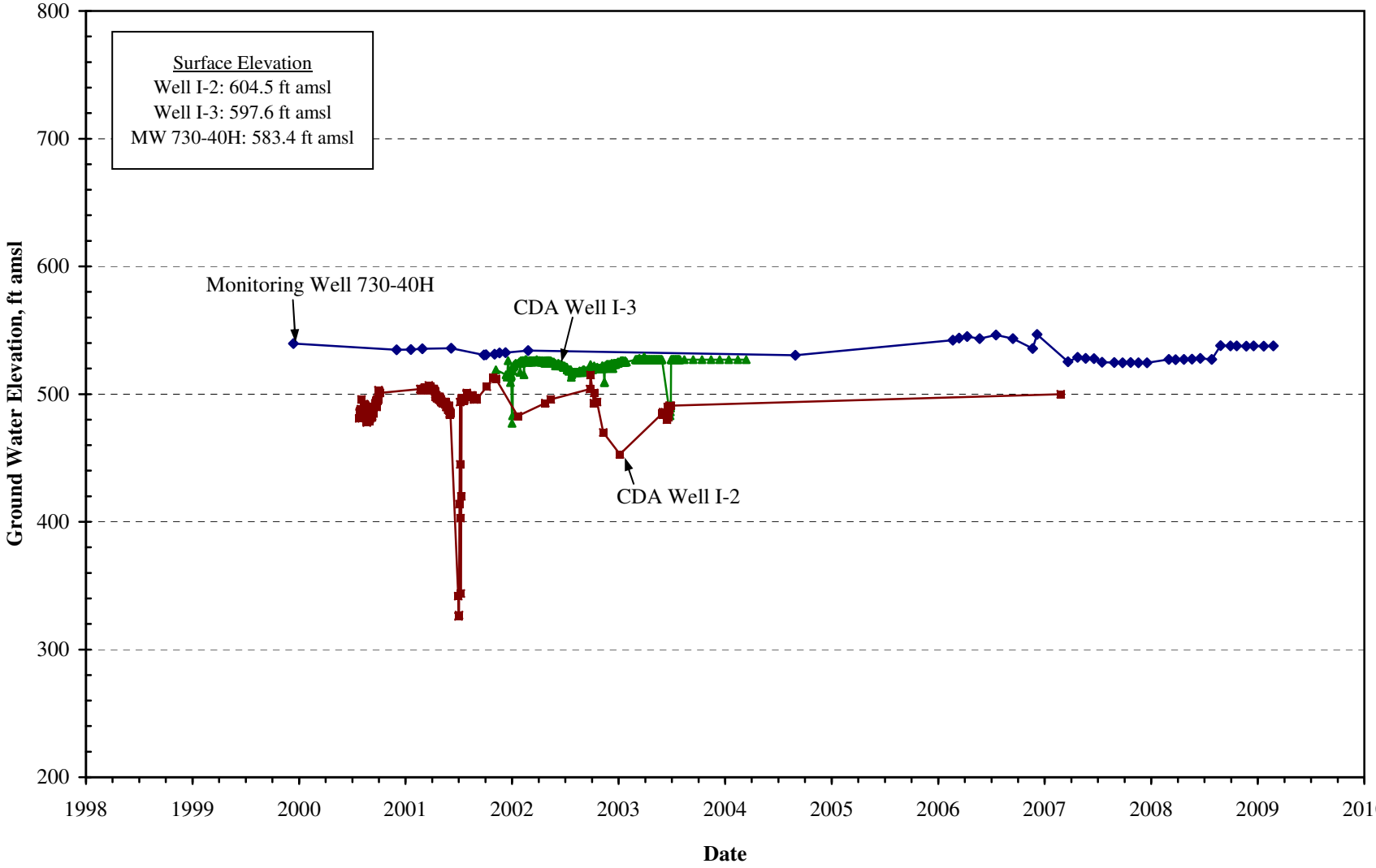


Figure 6

Hydrographs for Wells in the Vicinity of the Chino II Expansion Wellfield

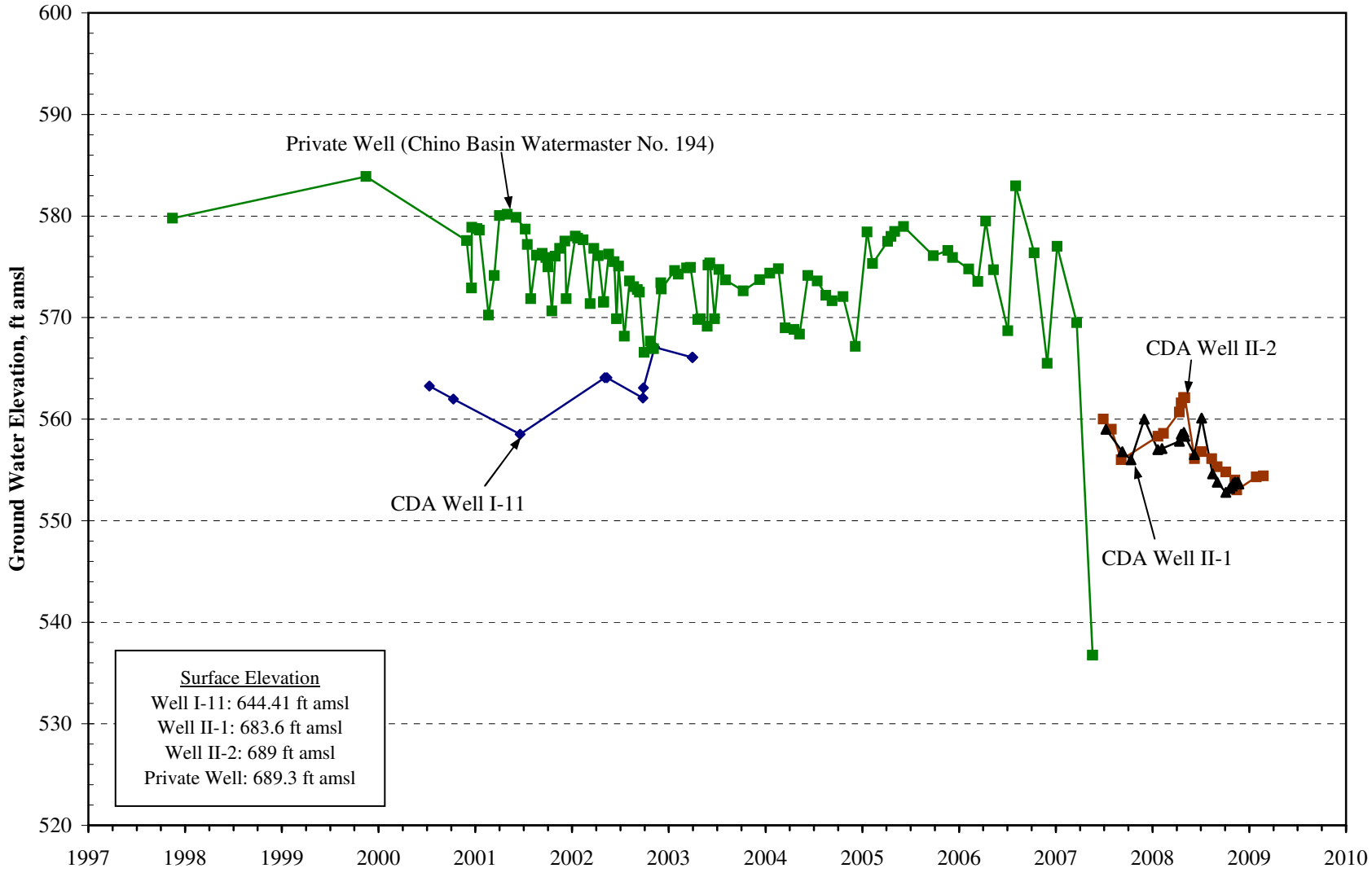


Figure 7

Recent TDS Concentrations in the Vicinity of Chino Creek Wellfield

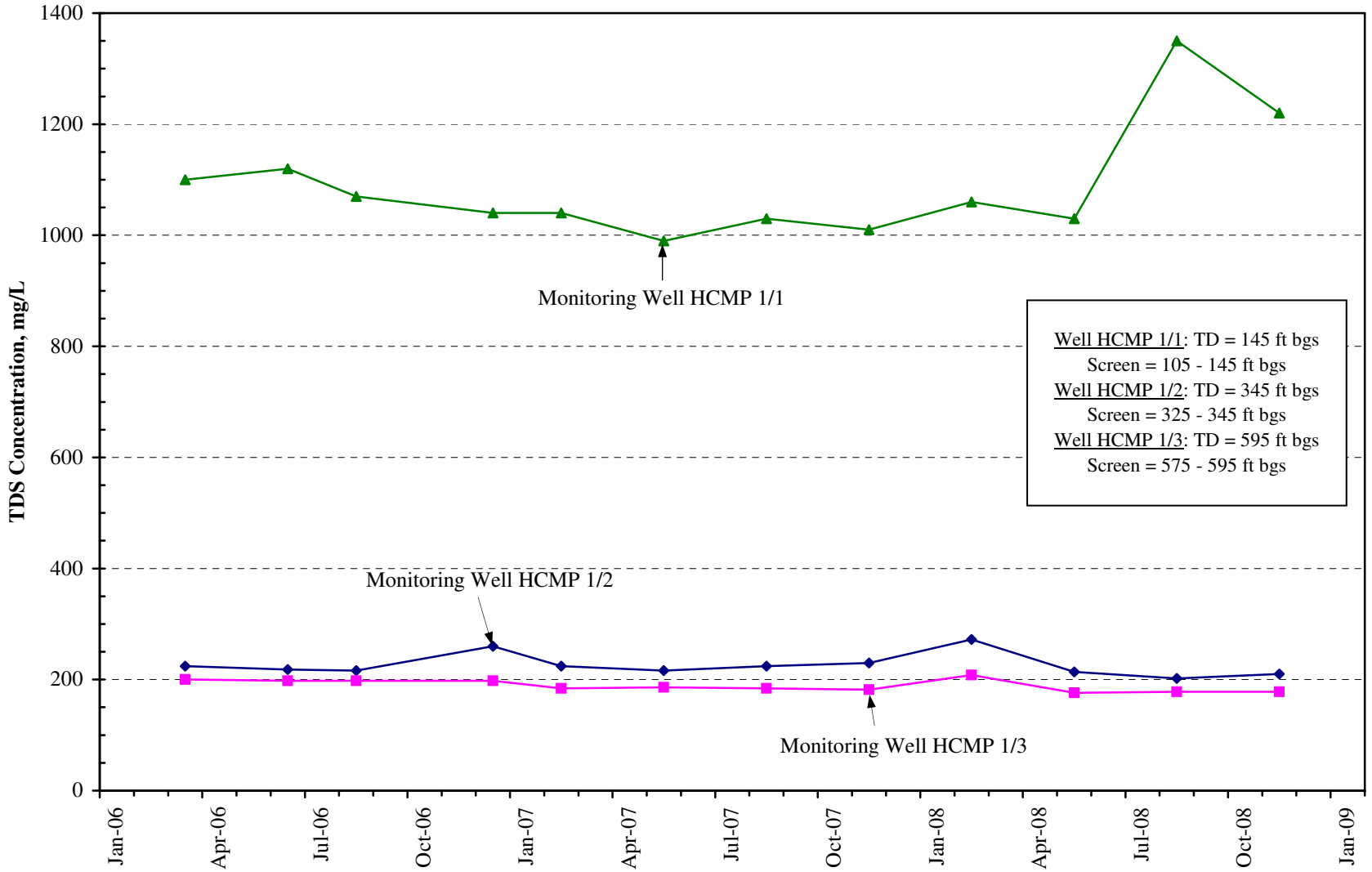


Figure 8

Recent Nitrate as Nitrogen Concentrations in the Vicinity of Chino Creek Wellfield

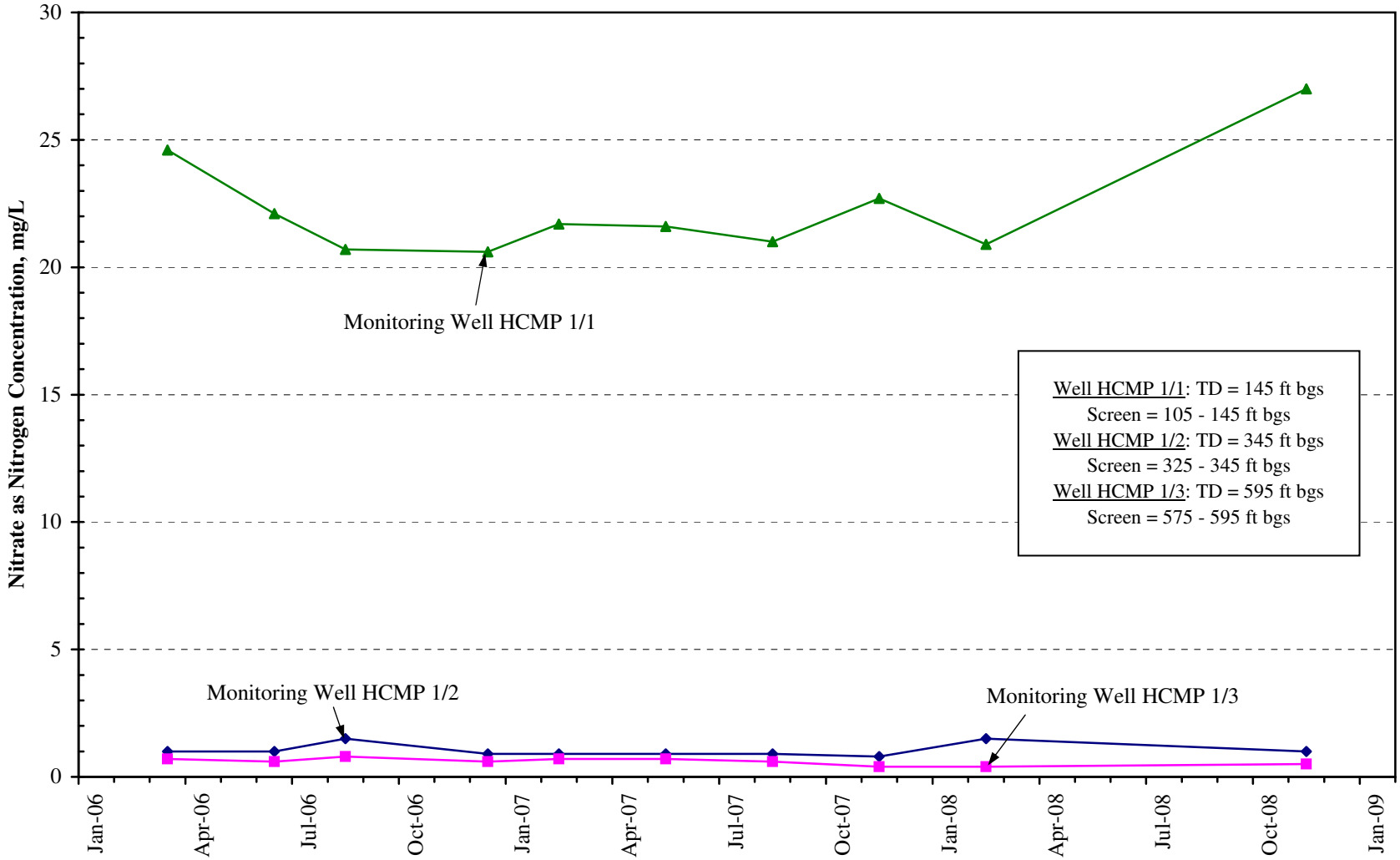


Figure 9

Recent Silica Concentrations in the Vicinity of Chino Creek Wellfield

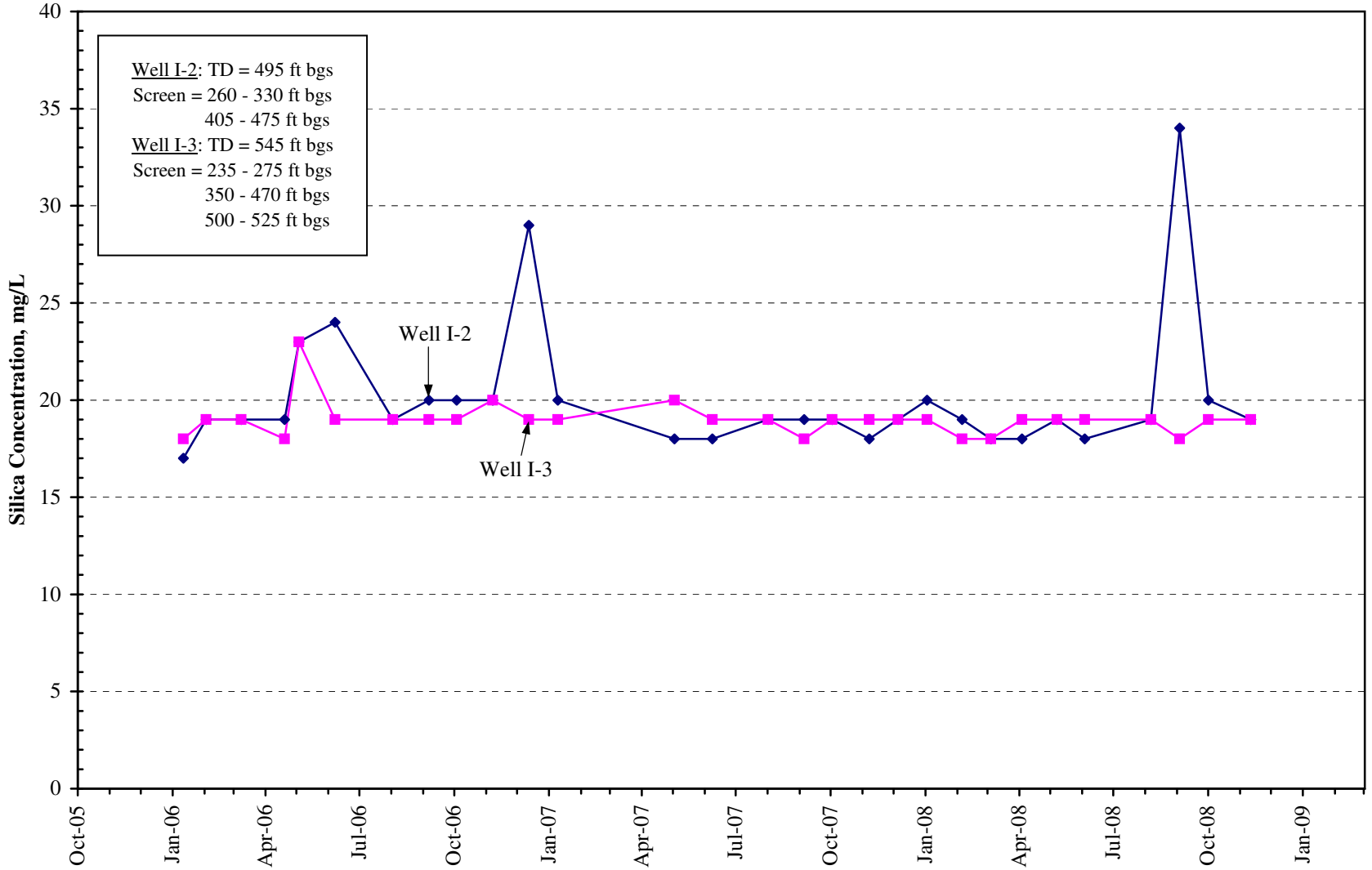


Figure 10

Recent Chloride Concentrations in the Vicinity of Chino Creek Wellfield

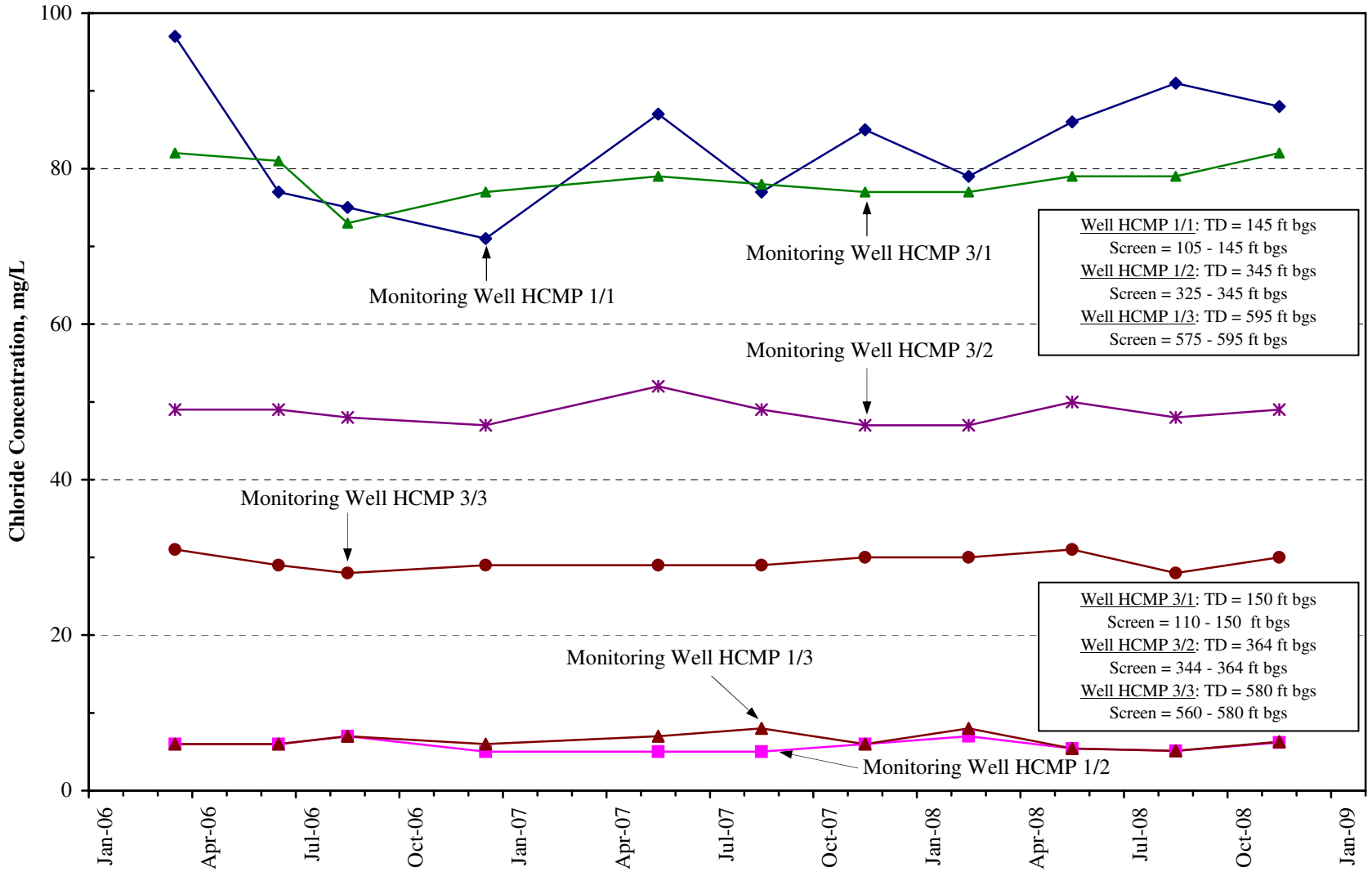


Figure 11

Recent TDS Concentrations in the Vicinity of the Chino II Expansion Wellfield

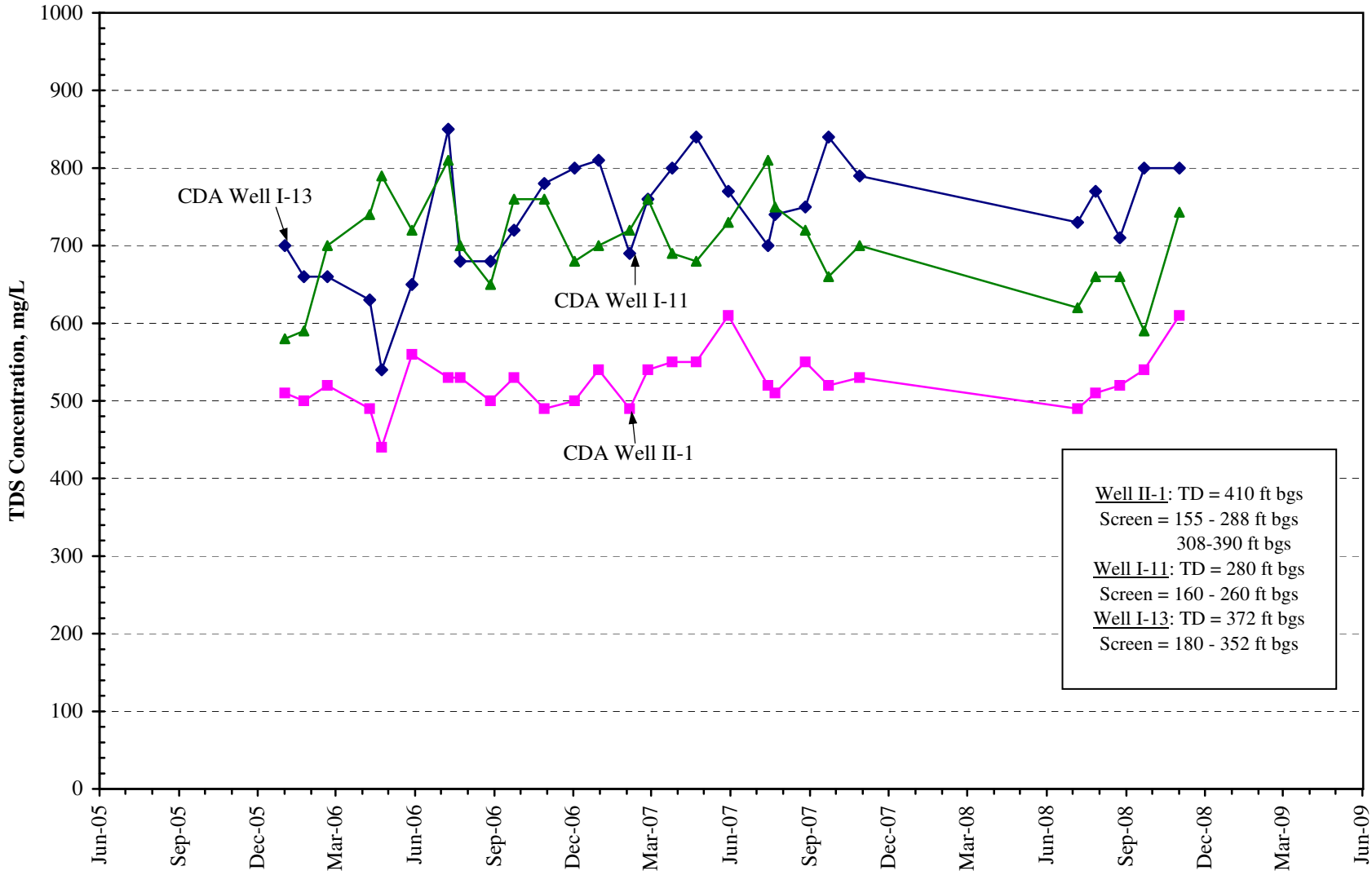


Figure 12

DRAFT

Recent Nitrate as Nitrogen Concentrations in the Vicinity of the Chino II Expansion Wellfield

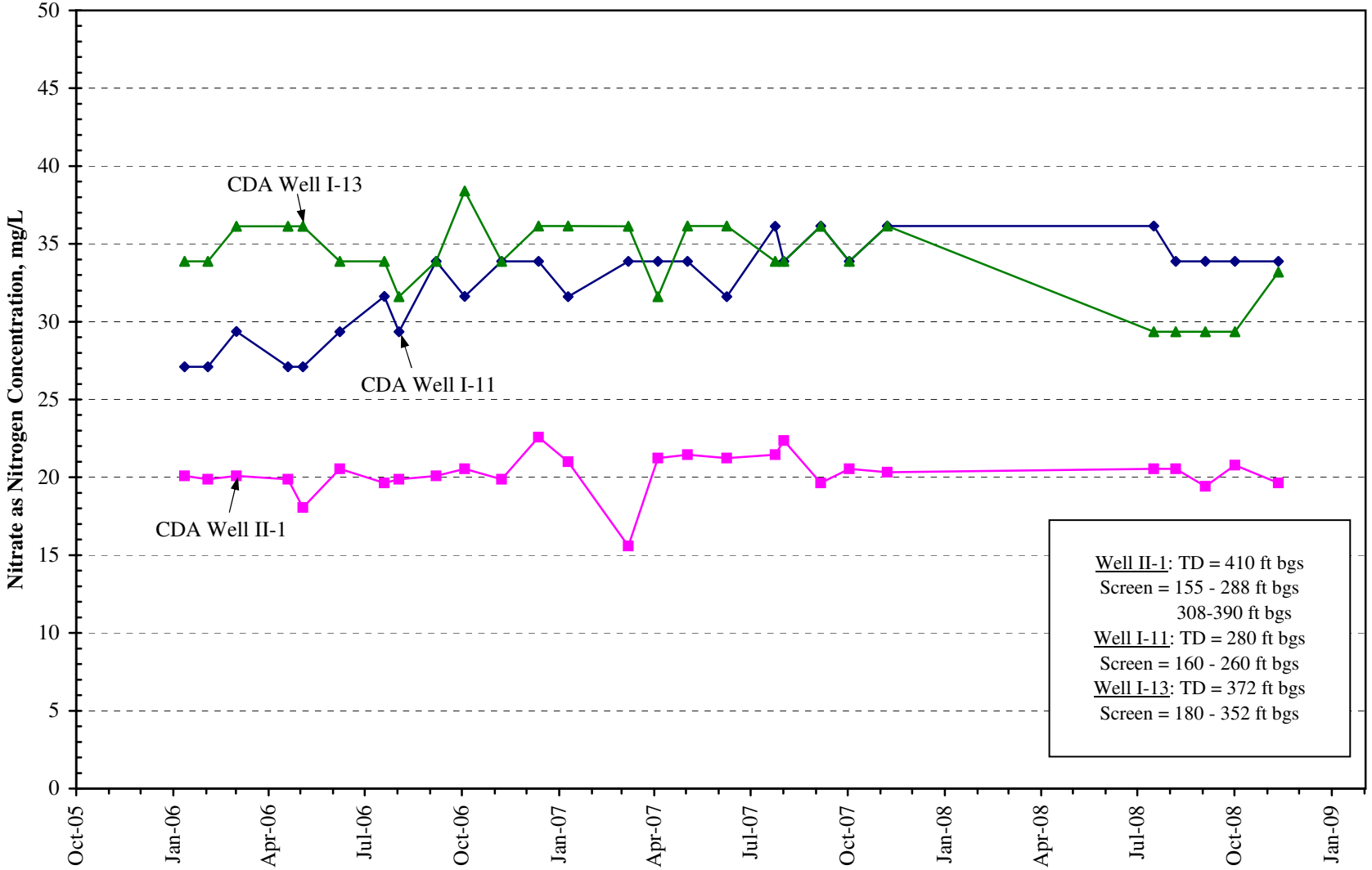


Figure 13

Recent Silica Concentrations in the Vicinity of the Chino II Expansion Wellfield

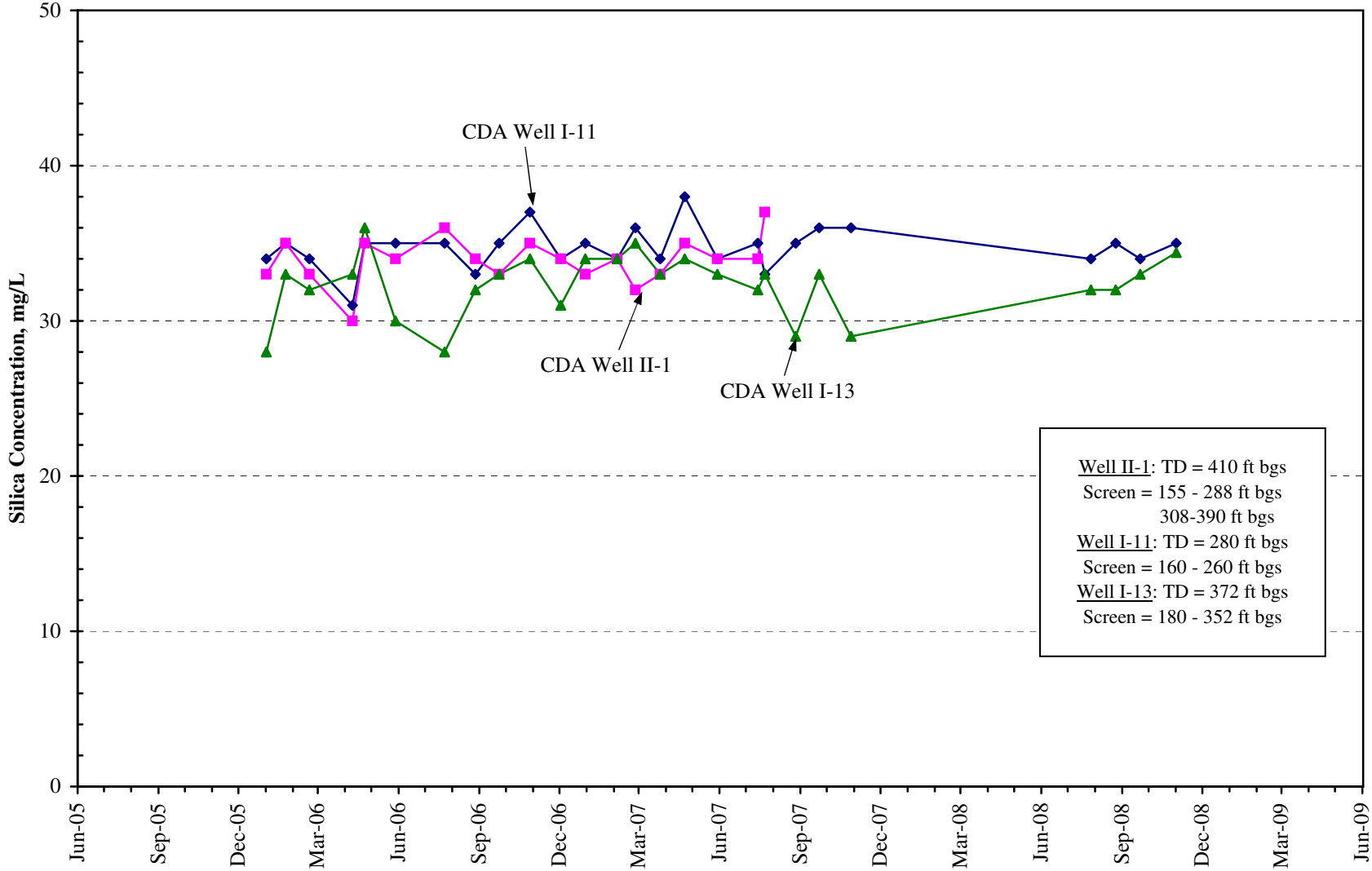


Figure 14

Recent Chloride Concentrations in the Vicinity of Chino II Expansion Wellfield

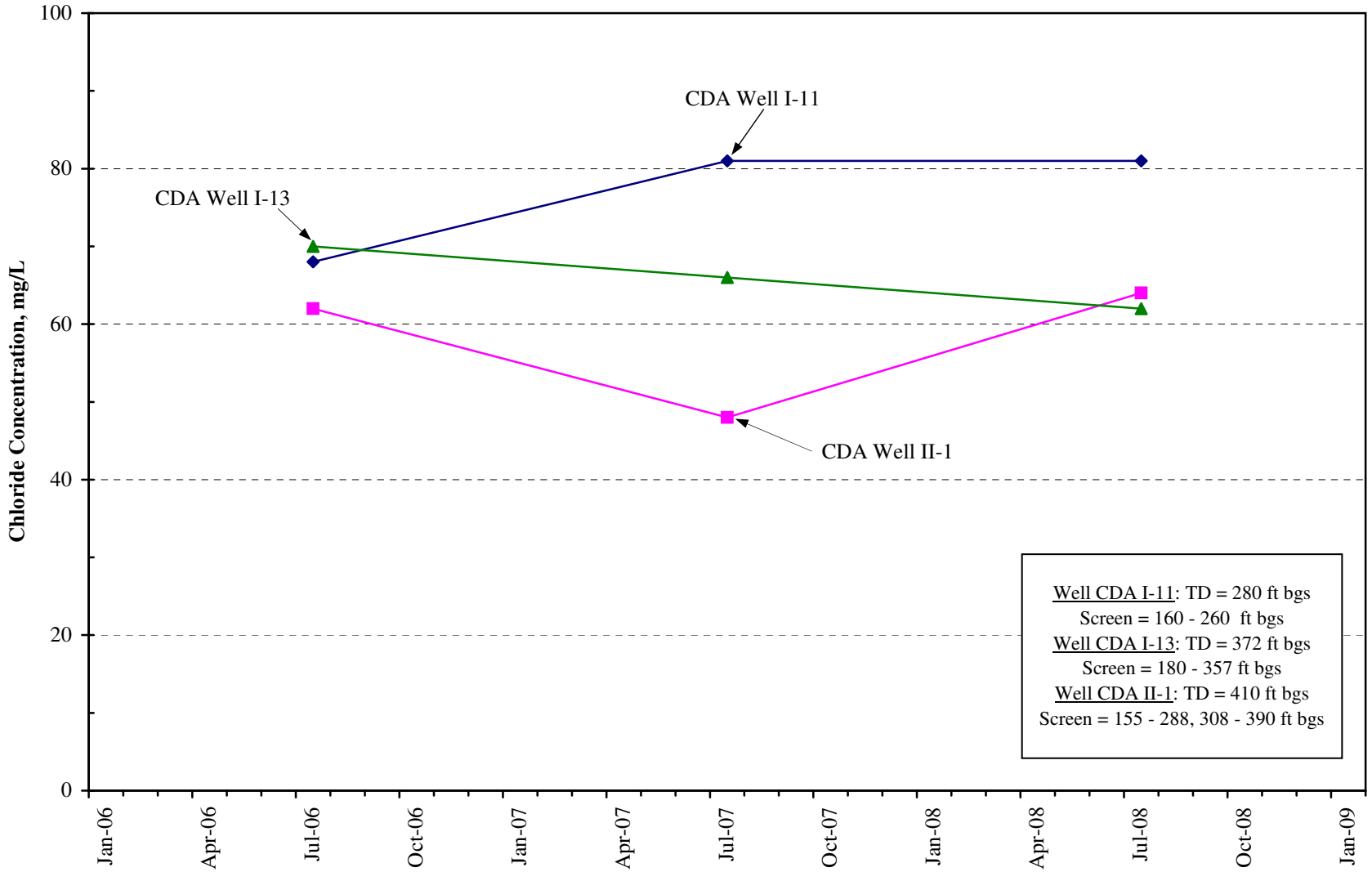
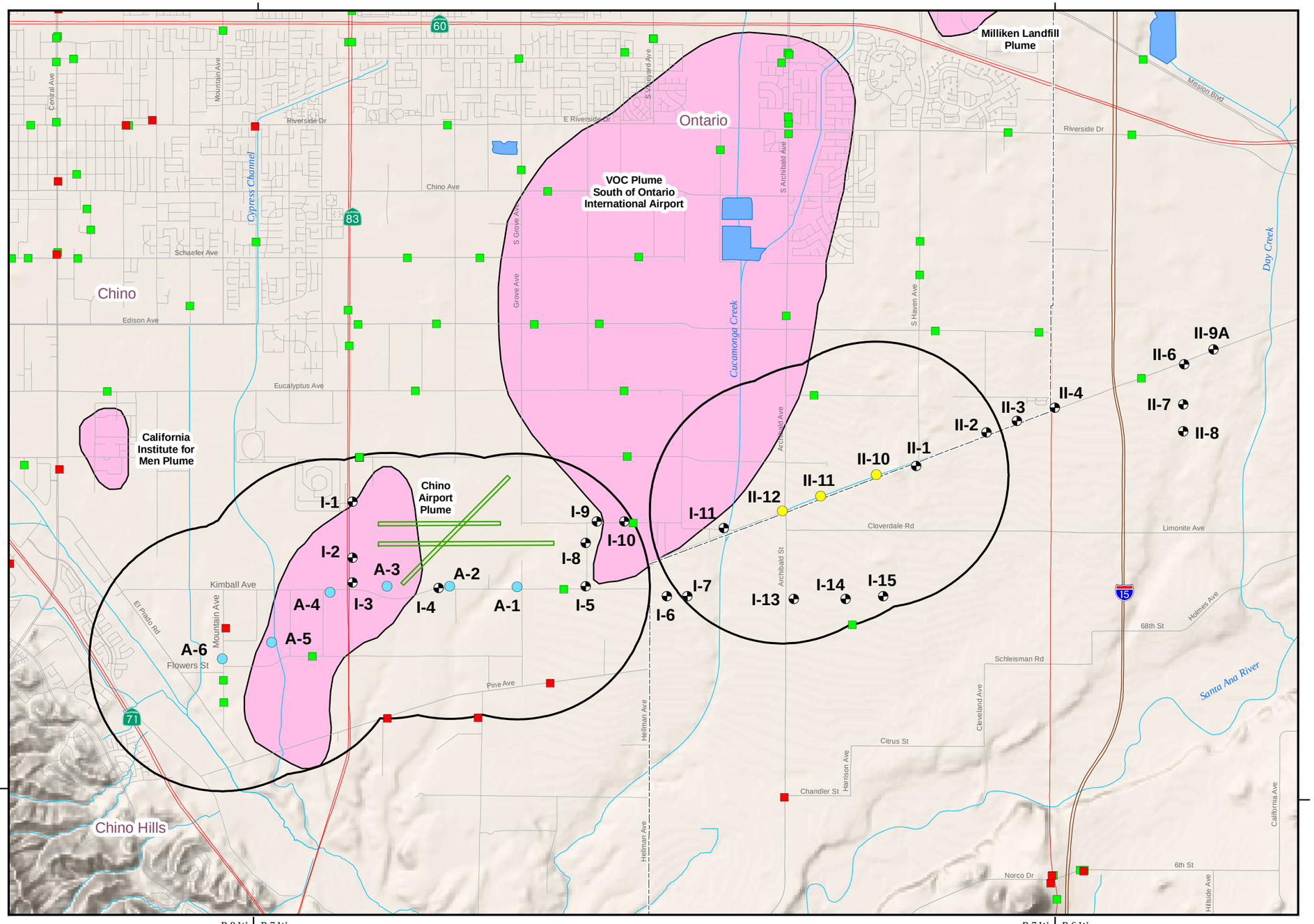


Figure 15

WESTERN MUNICIPAL WATER DISTRICT

PRELIMINARY DESIGN REPORT FOR THE CHINO CREEK WELLFIELD
AND CHINO II EXPANSION WELLFIELD - CHINO DESALTER PHASE 3 PROJECT



T.2 S.
T.3 S.

R.8 W. | R.7 W.

R.7 W. | R.6 W.

POINT SOURCES OF CONTAMINANTS AND APPROXIMATE EXTENTS OF KNOWN PLUME BOUNDARIES

EXPLANATION

- Existing Chino Desalter Well Location
- Proposed Chino II Expansion Well Location
- Proposed Chino Creek Well Location
- Extent of Known Plume Boundaries (Source: Wildermuth "State of the Basin Report - 2006)

LUST and UST Site Locations (Source: Geotracker, 2009)

- Leaking Underground Storage Tank
- Underground Storage Tank
- 1 Mile Buffer Around Proposed Wells
- County Boundary
- Recharge Basin

1-Sep-09

Prepared by: DWB

Map Projection: UTM (1927), Zone 11

NORTH

0 1 2 Miles

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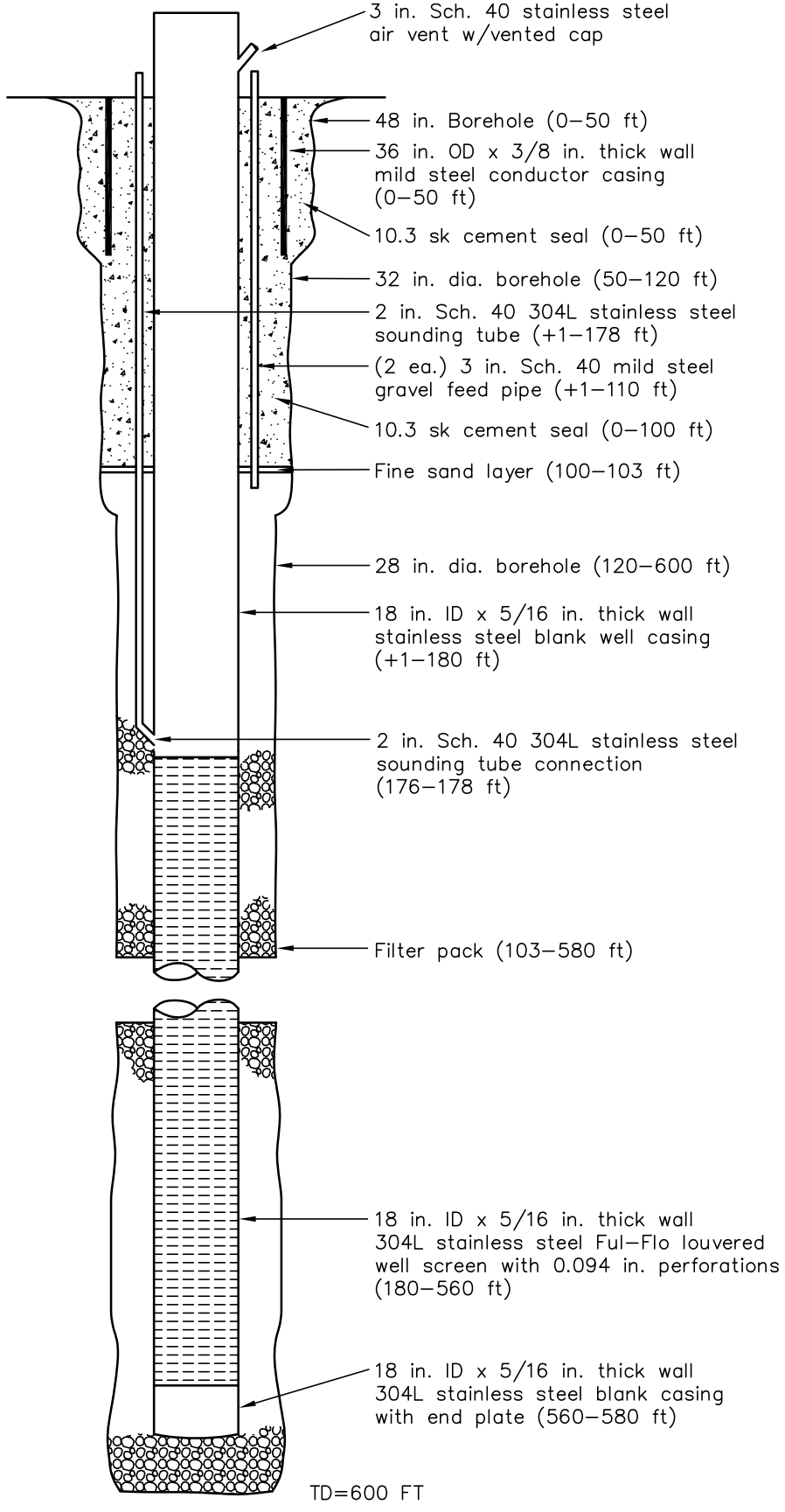
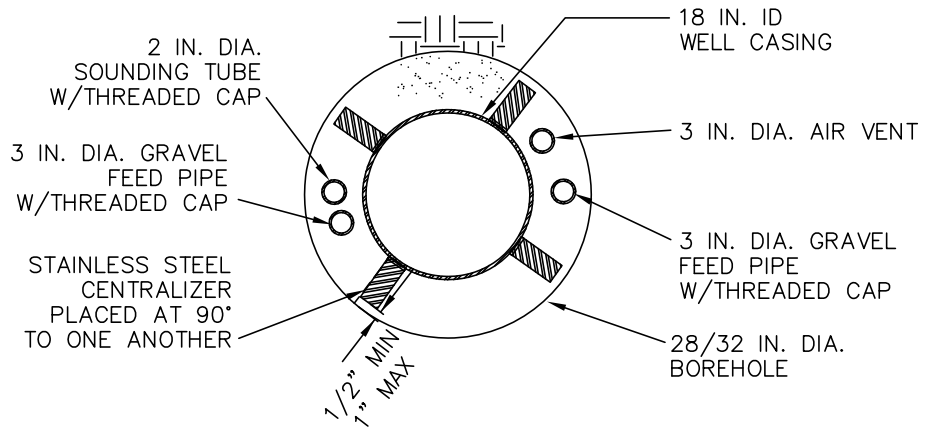
Figure 16

GIS_proj/wmwd_chino_phase3_PDR_9-09/0_Fig_16_plumes_9-09.mxd



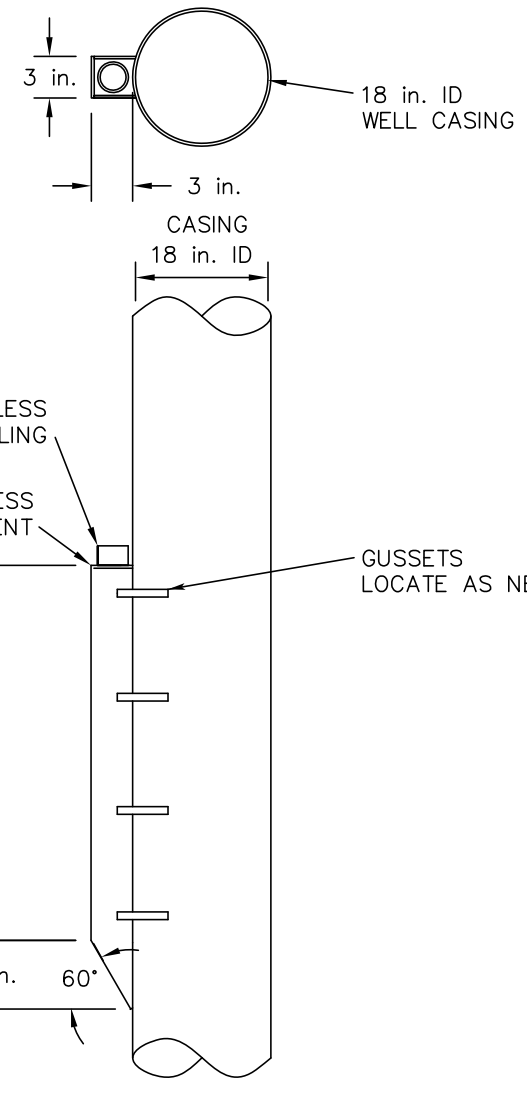
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



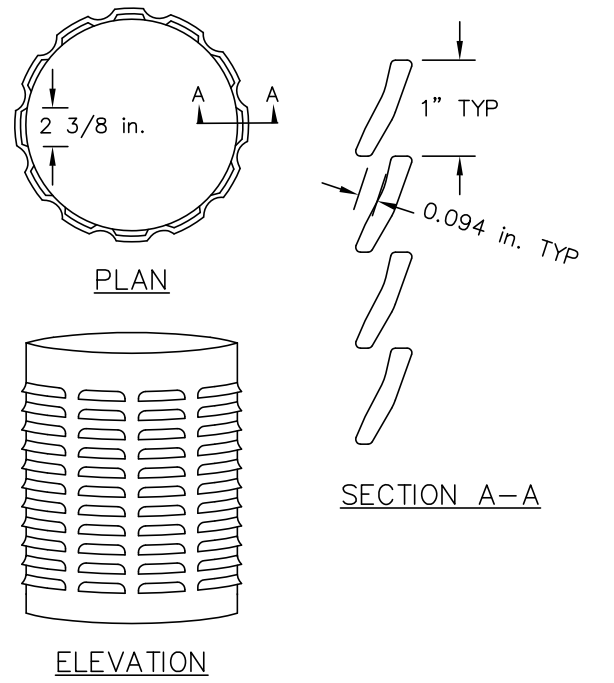
WELL CASING AND TUBE PLAN

NOT TO SCALE



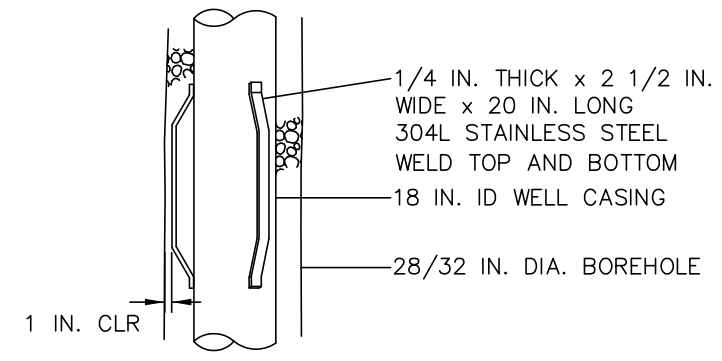
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

NOTE: Casing centralizers to straddle casing collars at 120 ft intervals beginning immediately below the screened interval as the casing is installed. Centralizers are to be welded at the top and bottom and shall be of similar material to casing at point of attachment. Centralizers shall not be welded onto louvers.

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WESTERN MUNICIPAL WATER DISTRICT

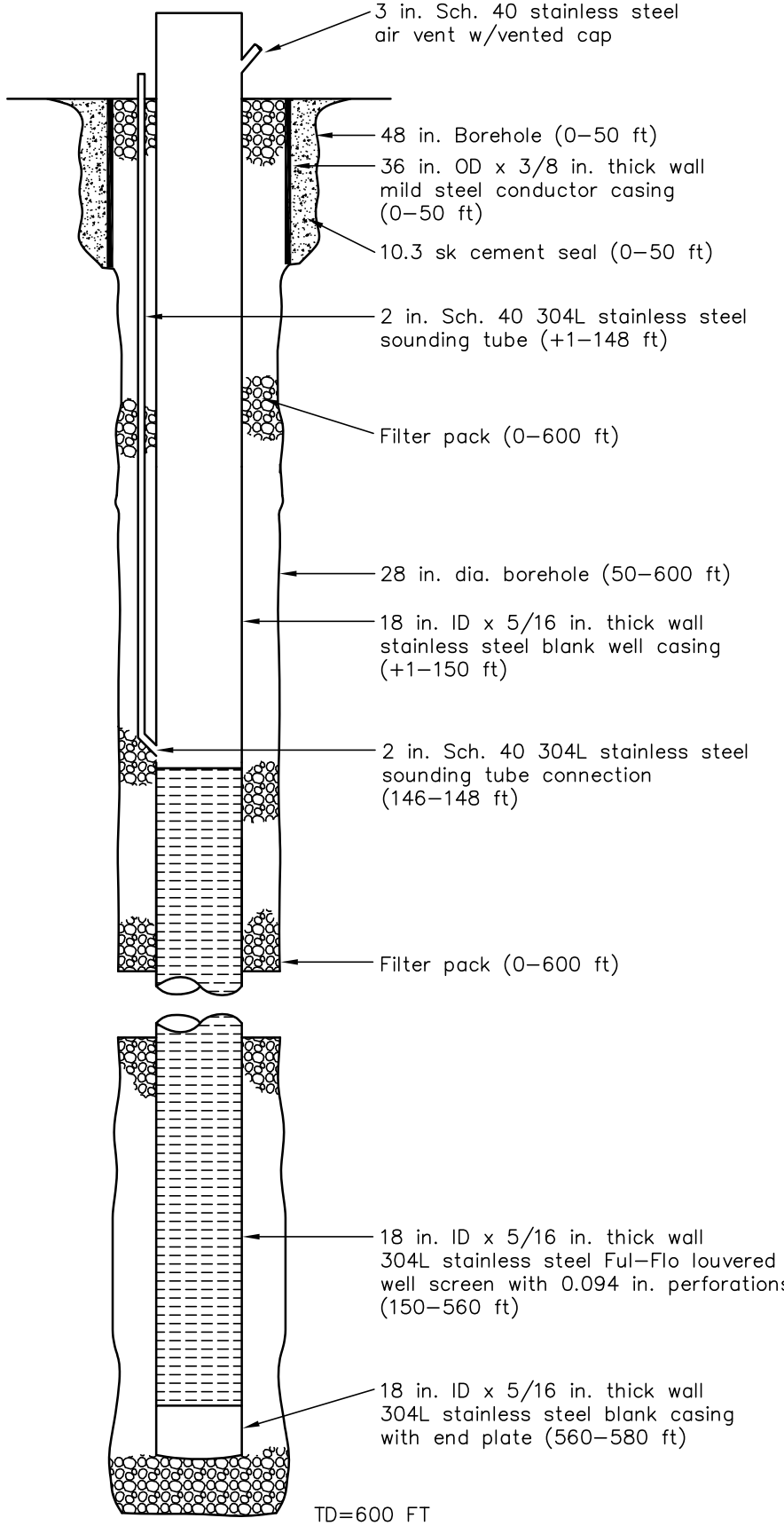
CONCEPTUAL WELL COMPLETION DIAGRAM
CHINO CREEK WELL Nos A–4 & A–6

Drawn: PLP	Checked:	Approved:	Date: 1–SEP–09

Figure 17

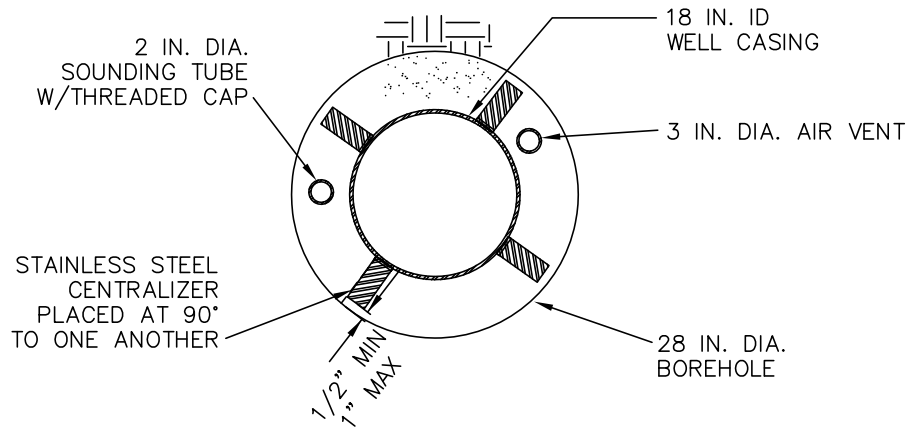
JN 657–09

chino basin desalter\phase 3 pdr\090515\figures\wella4 and a6 design.dwg



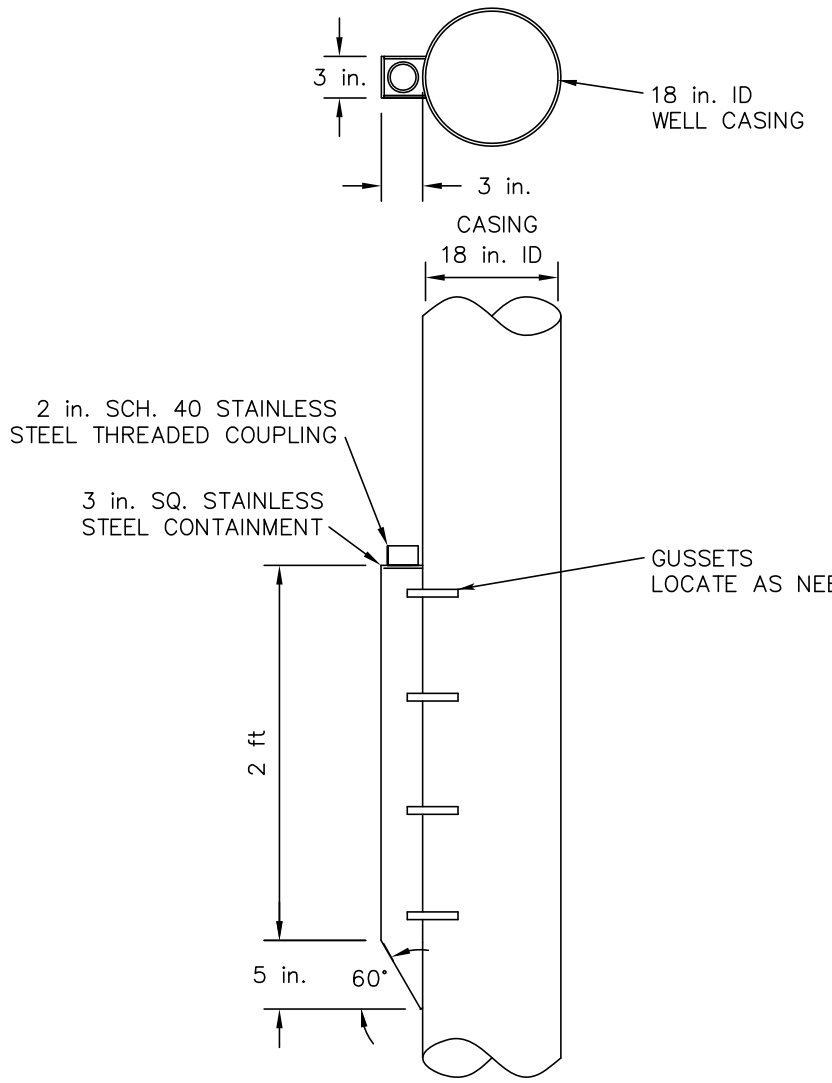
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



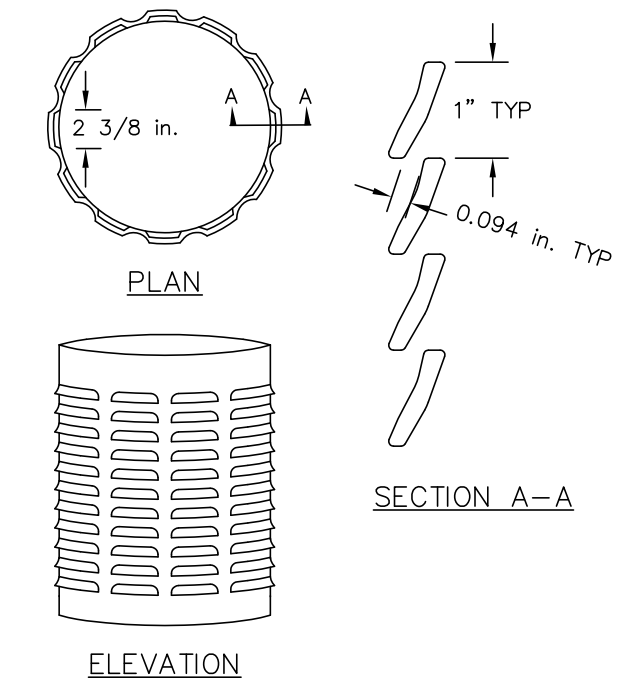
WELL CASING AND TUBE PLAN

NOT TO SCALE



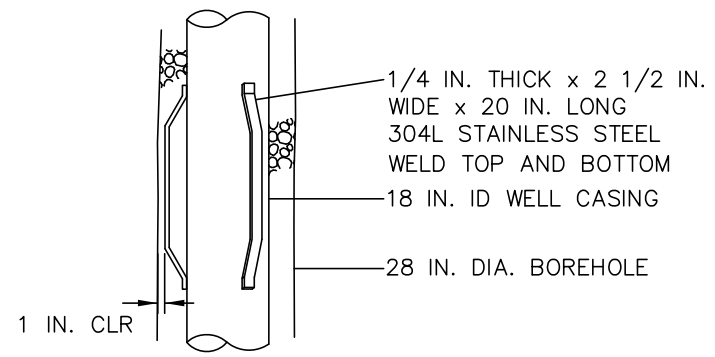
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

NOTE: Casing centralizers to straddle casing collars at 120 ft intervals beginning immediately below the screened interval as the casing is installed. Centralizers are to be welded at the top and bottom and shall be of similar material to casing at point of attachment. Centralizers shall not be welded onto louvers.

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WESTERN MUNICIPAL WATER DISTRICT

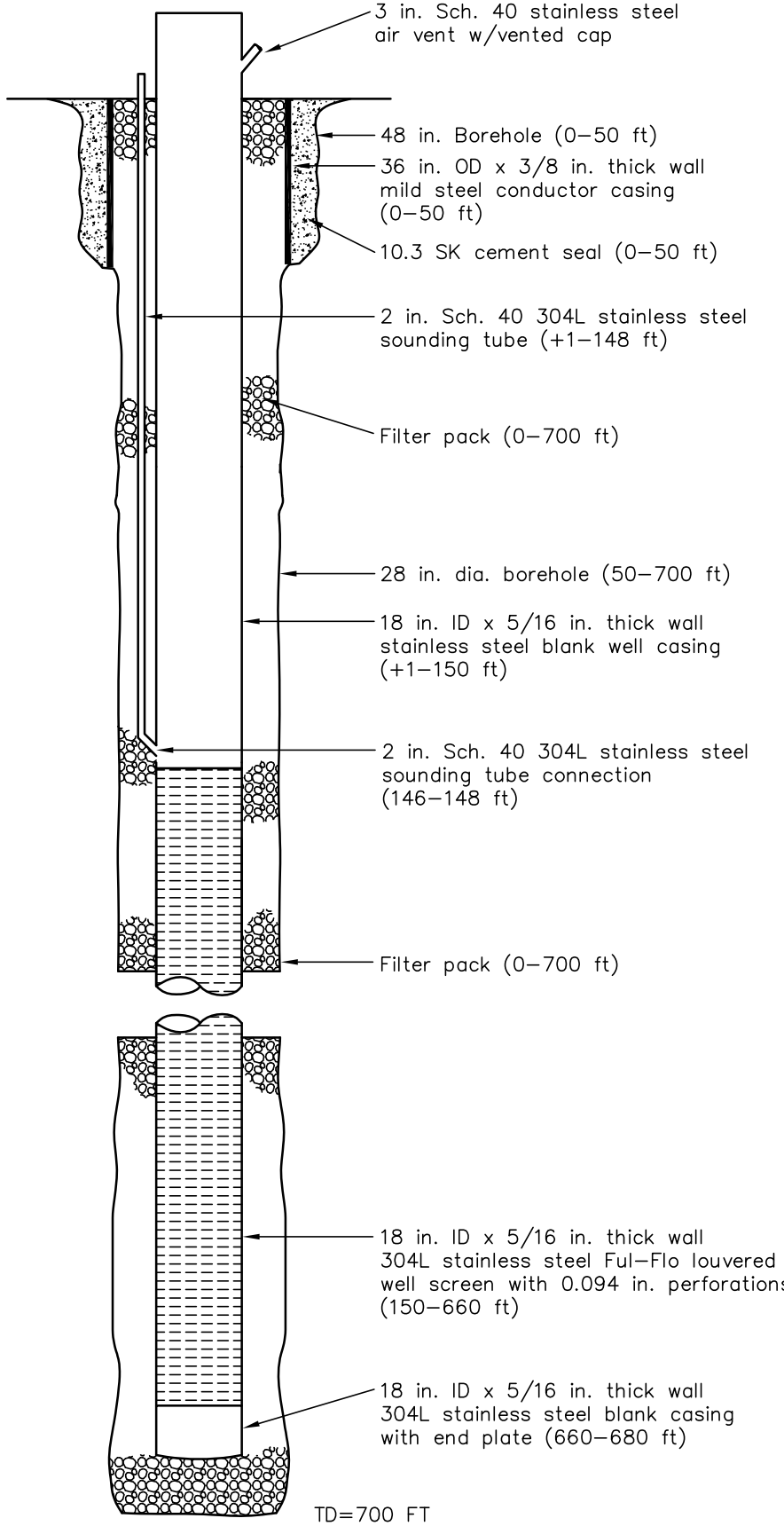
CONCEPTUAL WELL COMPLETION DIAGRAM
CHINO CREEK WELL No A–5

Drawn:	Checked:	Approved:	Date:
PLP			1–SEP–09

Figure 18

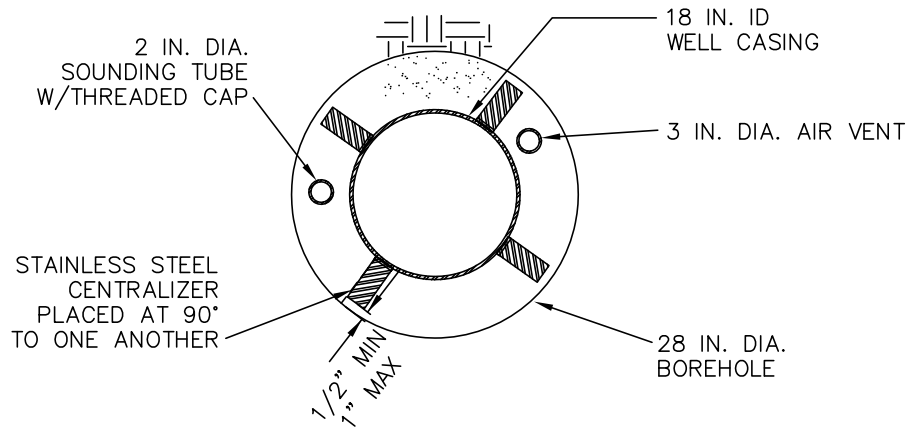
JN 657–09

chino basin desalter\phase 3 pdr\090515 final\figures\wella5 design.dwg



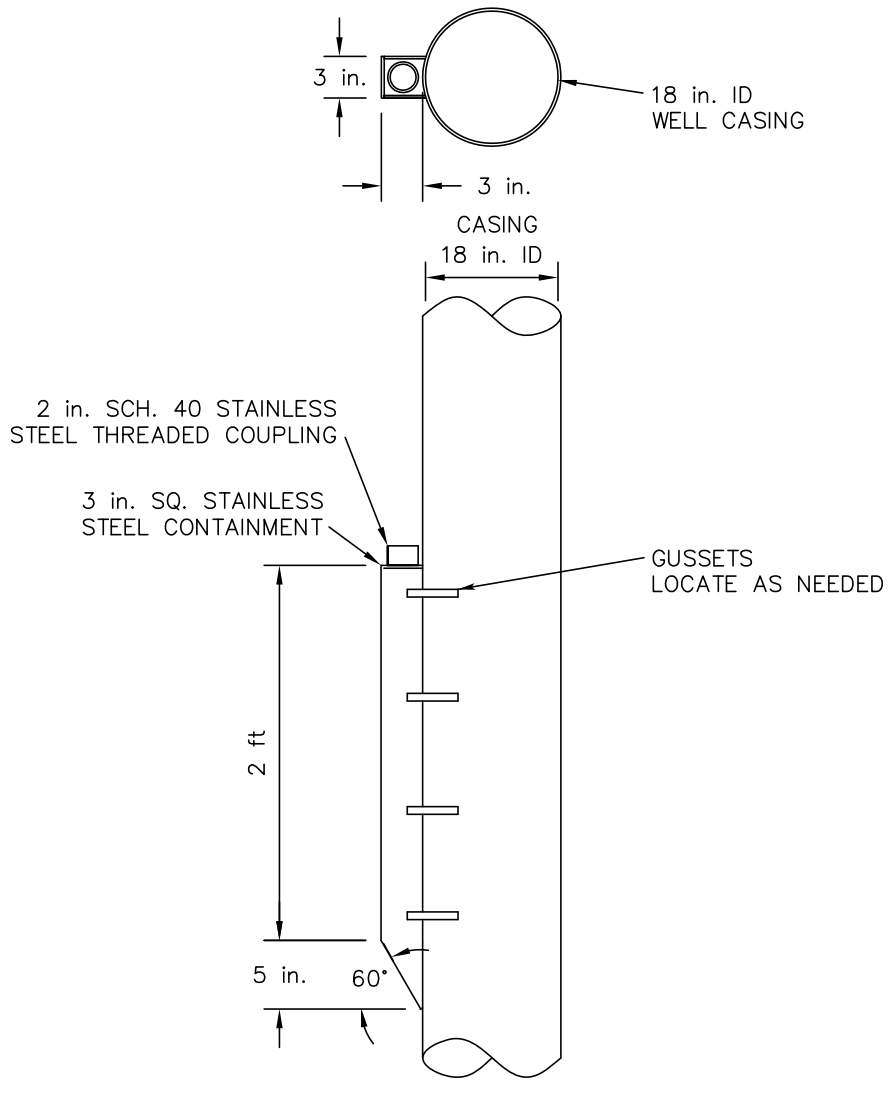
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



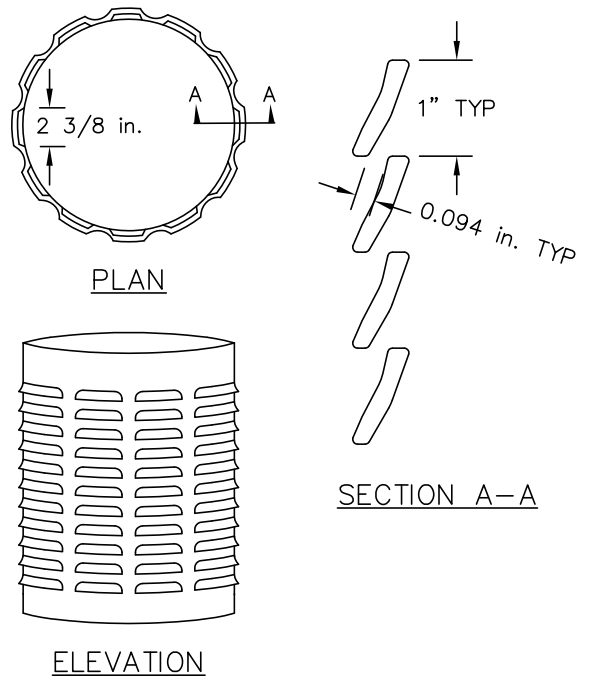
WELL CASING AND TUBE PLAN

NOT TO SCALE



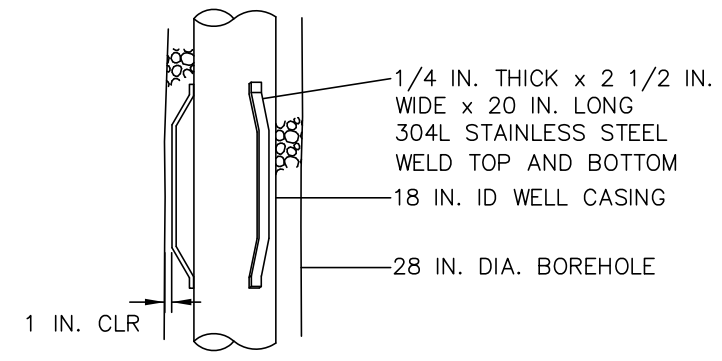
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

NOTE: Casing centralizers to straddle casing collars at 120 ft intervals beginning immediately below the screened interval as the casing is installed. Centralizers are to be welded at the top and bottom and shall be of similar material to casing at point of attachment. Centralizers shall not be welded onto louvers.

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WESTERN MUNICIPAL WATER DISTRICT

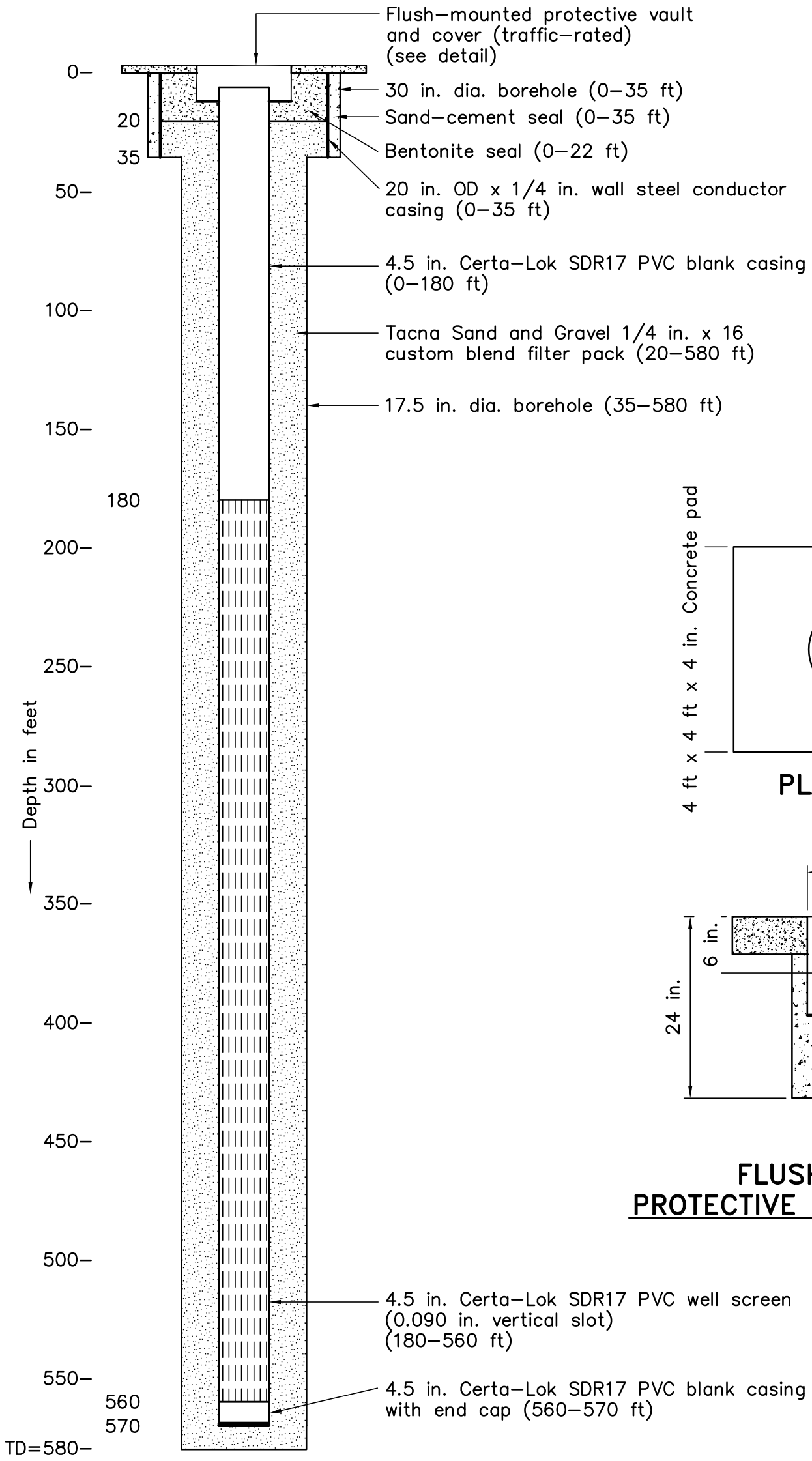
CONCEPTUAL WELL COMPLETION DIAGRAM CHINO CREEK WELL Nos A–1, A–2, & A–3

Drawn:	Checked:	Approved:	Date:
PLP			1–SEP–09

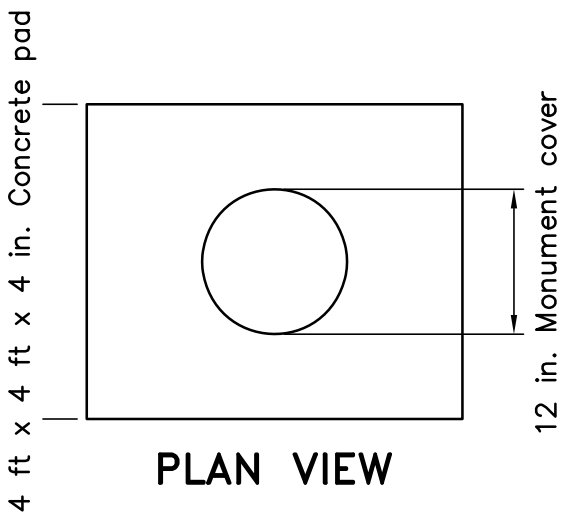
Figure 19

JN 657–09

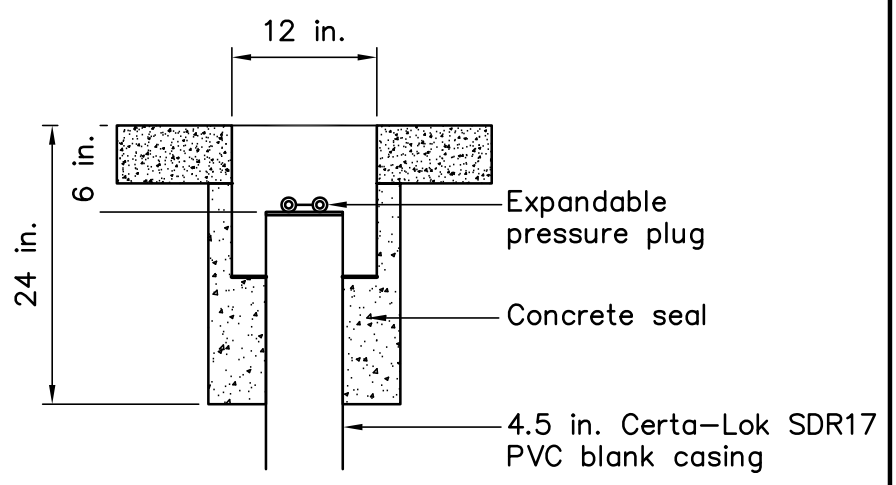
chino basin desalter\phase 3 pdr\090515 final\figures\wella1 a2 and a3 design.dwg



WELL CROSS SECTION



PLAN VIEW



FLUSH MOUNTED PROTECTIVE VAULT AND COVER

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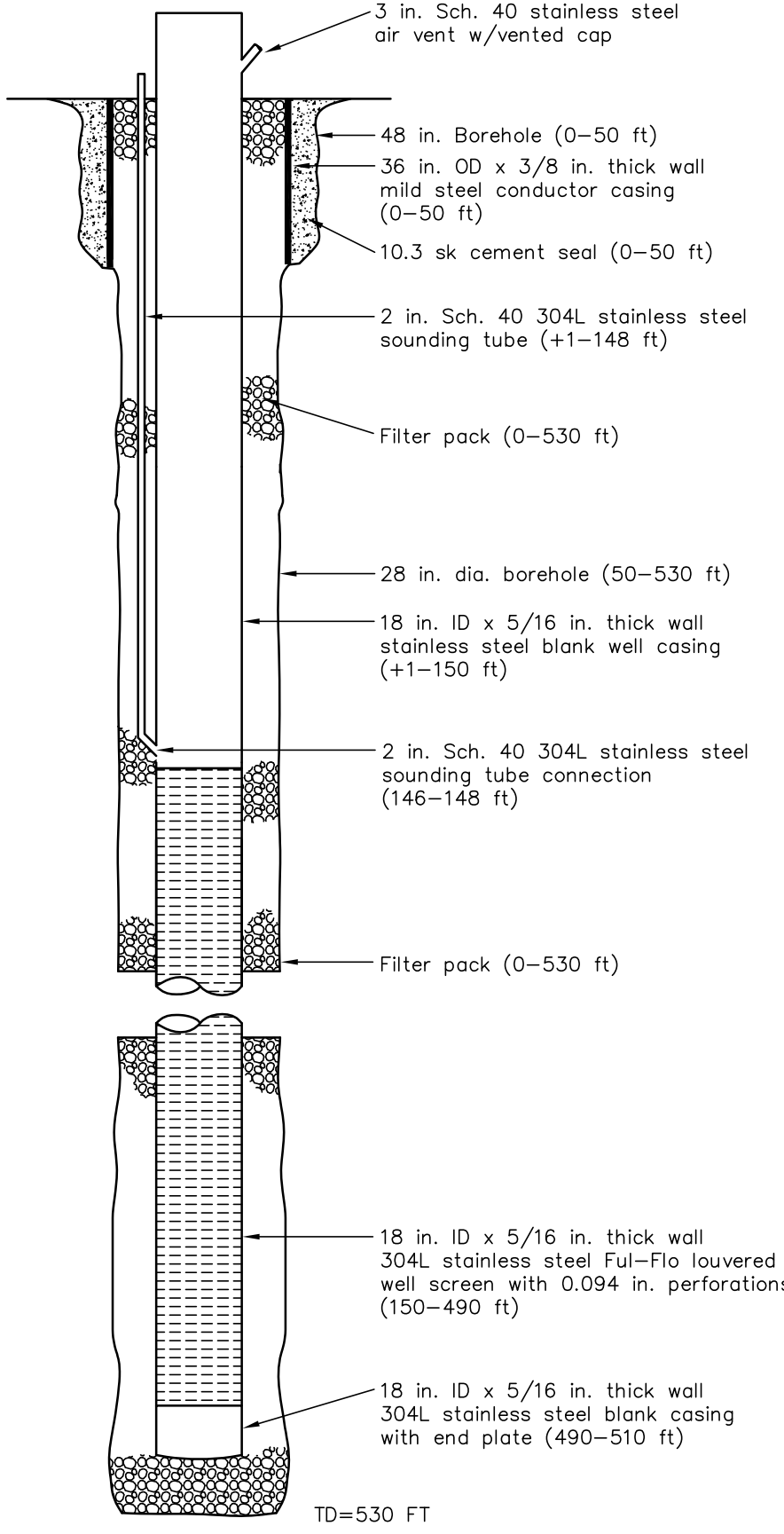
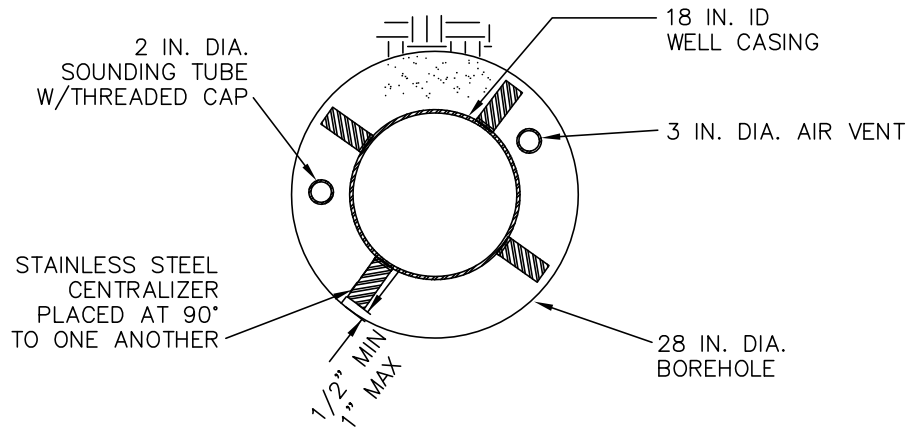
Figure 20	Drawn: PLP	WESTERN MUNICIPAL WATER DISTRICT	GEOSCIENCE Support Services, Incorporated P.O. Box 220, Claremont, CA 91711 Tel: (909)451–6650 Fax: (909)451–6638 www.gssiwater.com
	Checked:	CONCEPTUAL WELL COMPLETION DIAGRAM CHINO CREEK MONITORING WELLS MW A–4 & MW A–6	
	Approved:		
JN 657–09	Date: 1–SEP–09		

chino basin desalter\phase 3 pdr\090515 final\mw4 4 and 6 design.dwg



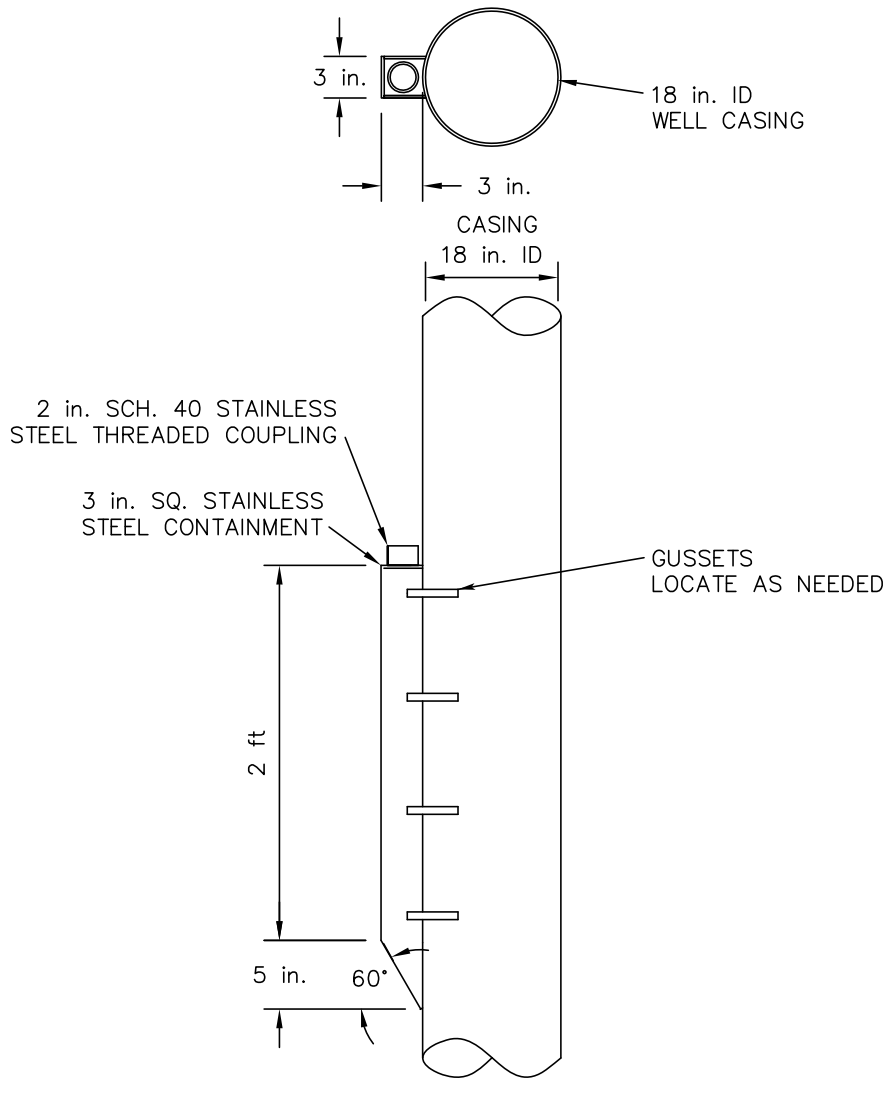
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



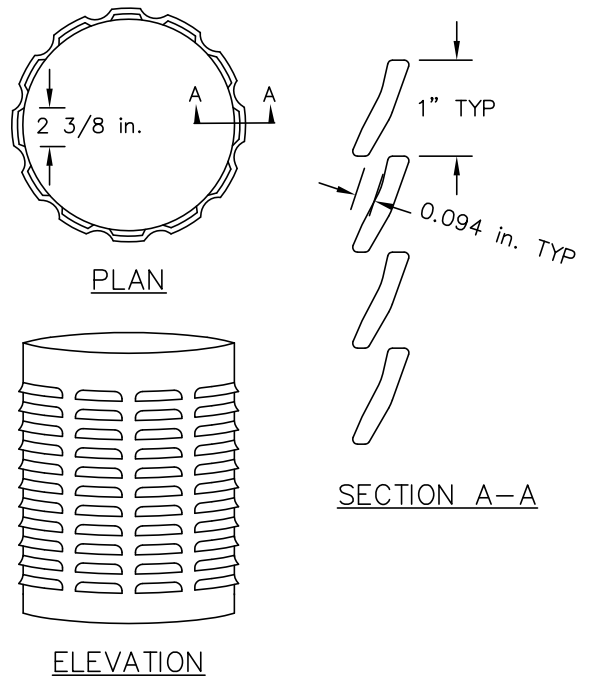
WELL CASING AND TUBE PLAN

NOT TO SCALE



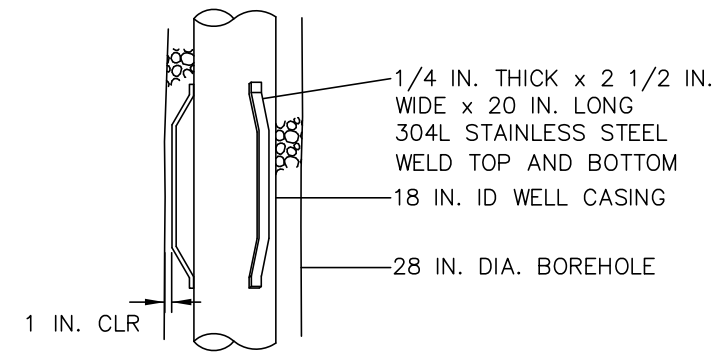
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

NOTE: Casing centralizers to straddle casing collars at 120 ft intervals beginning immediately below the screened interval as the casing is installed. Centralizers are to be welded at the top and bottom and shall be of similar material to casing at point of attachment. Centralizers shall not be welded onto louvers.

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WESTERN MUNICIPAL WATER DISTRICT

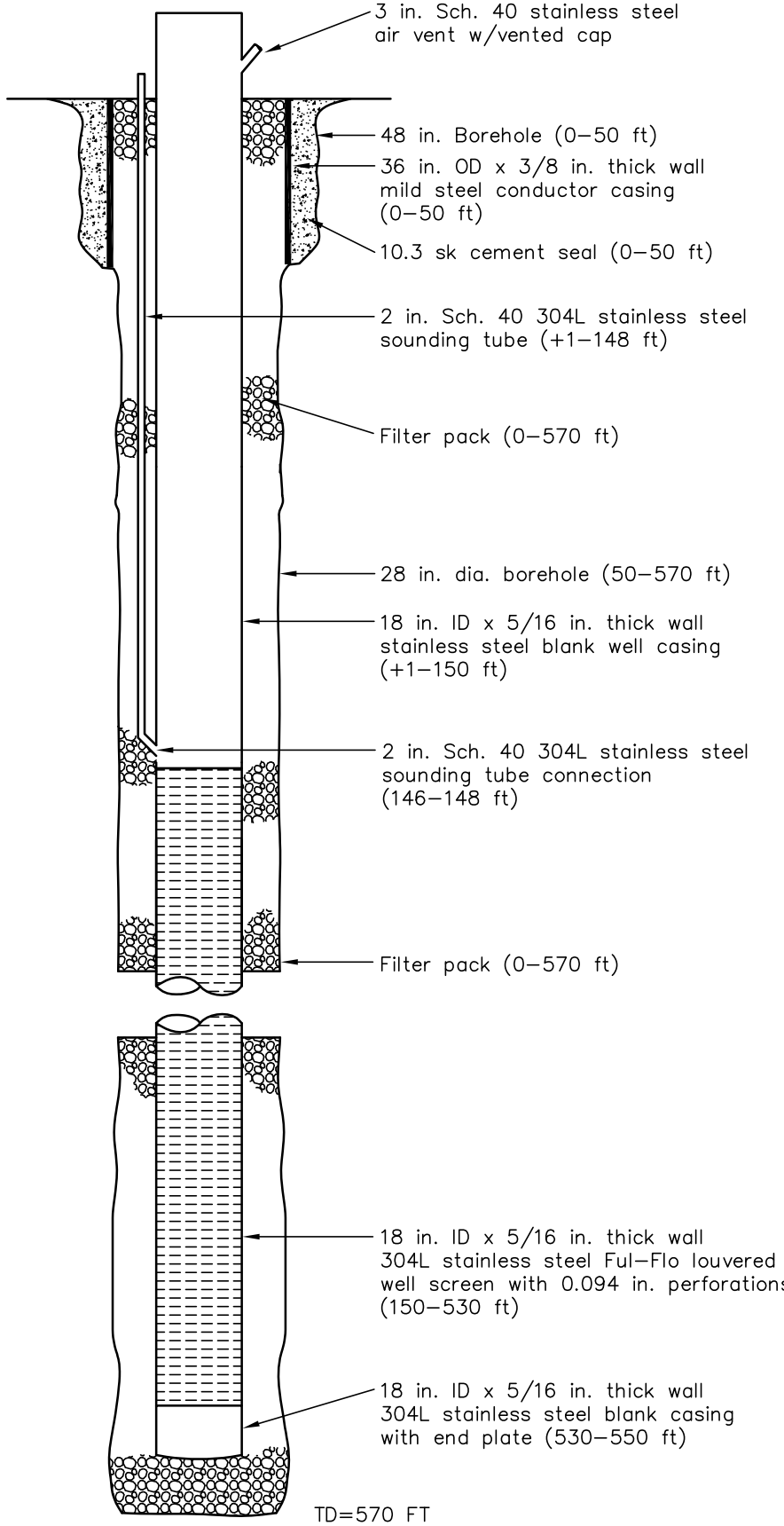
CONCEPTUAL WELL COMPLETION DIAGRAM CHINO II EXPANSION WELL No II–10

Drawn:	Checked:	Approved:	Date:
PLP			1–SEP–09

Figure 21

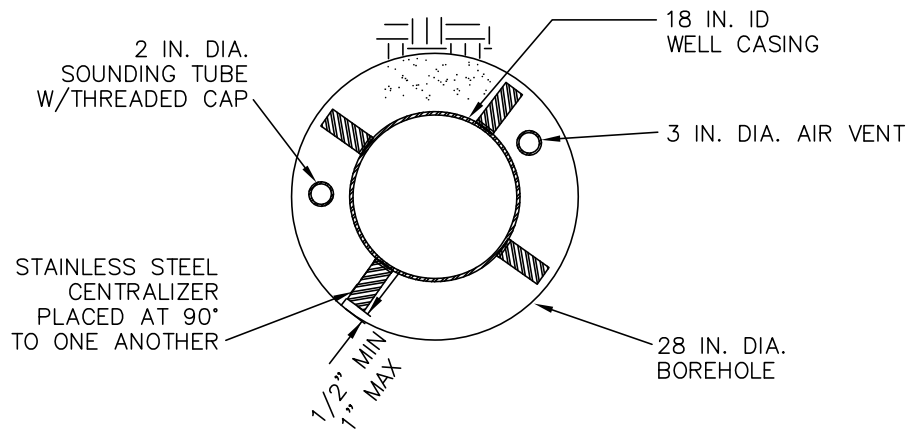
JN 657–09

chino basin desalter\phase 3 pdr\pdr apr 09\figures\II10 design.dwg



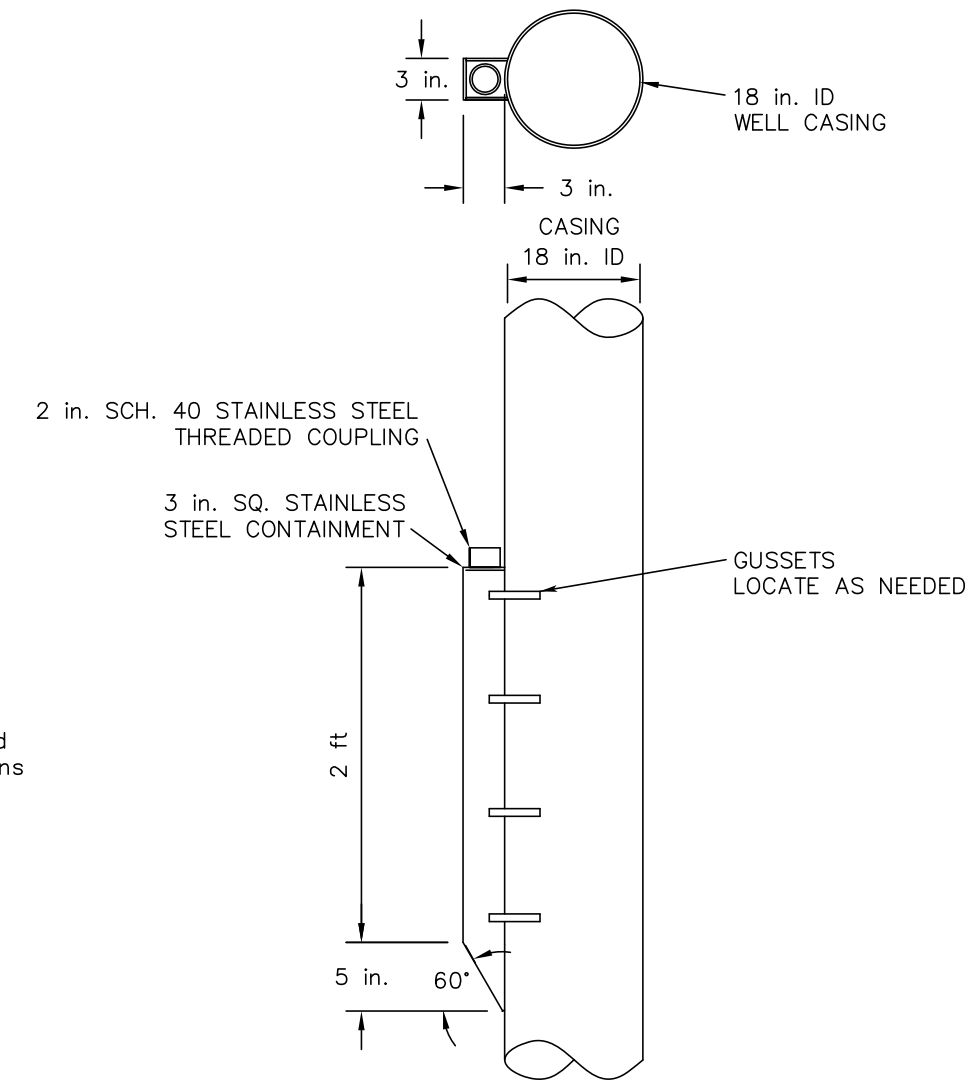
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



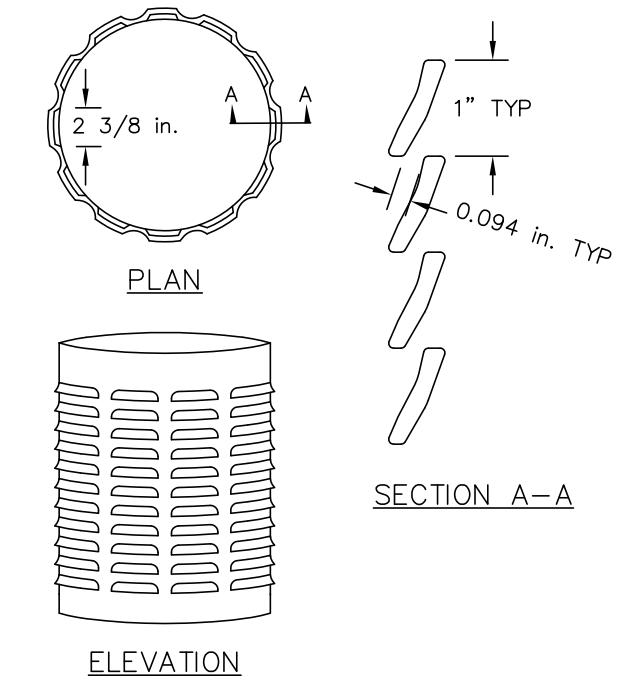
WELL CASING AND TUBE PLAN

NOT TO SCALE



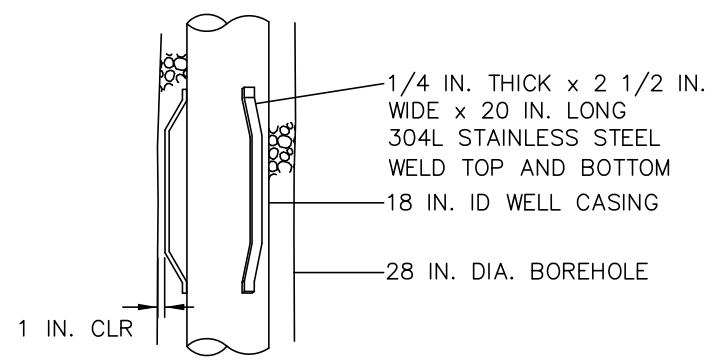
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

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WESTERN MUNICIPAL WATER DISTRICT

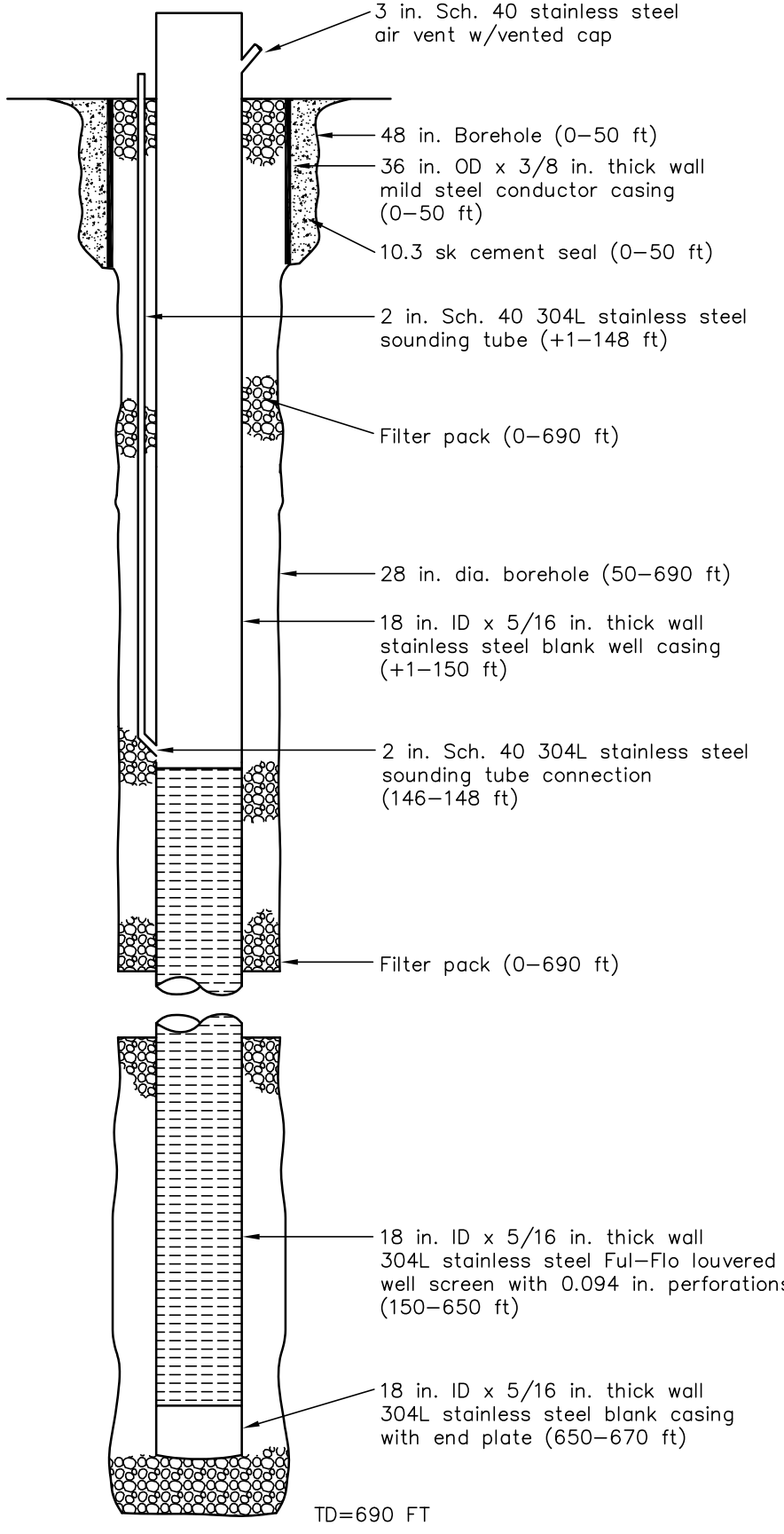
CONCEPTUAL WELL COMPLETION DIAGRAM
CHINO II EXPANSION WELL No II–11

Drawn:	PLP	Date:	1–SEP–09
Checked:			
Approved:			

Figure 22

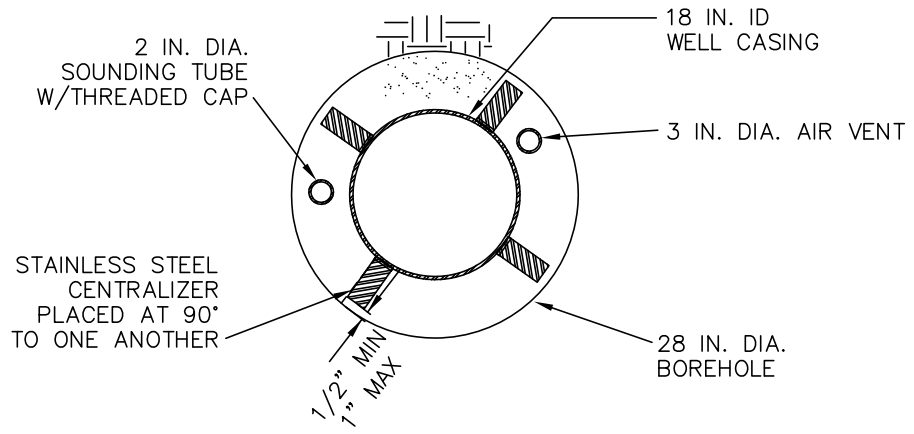
JN 657–09

chino basin desalter\phase 3 pdr\090515 final\figures\II11 design.dwg



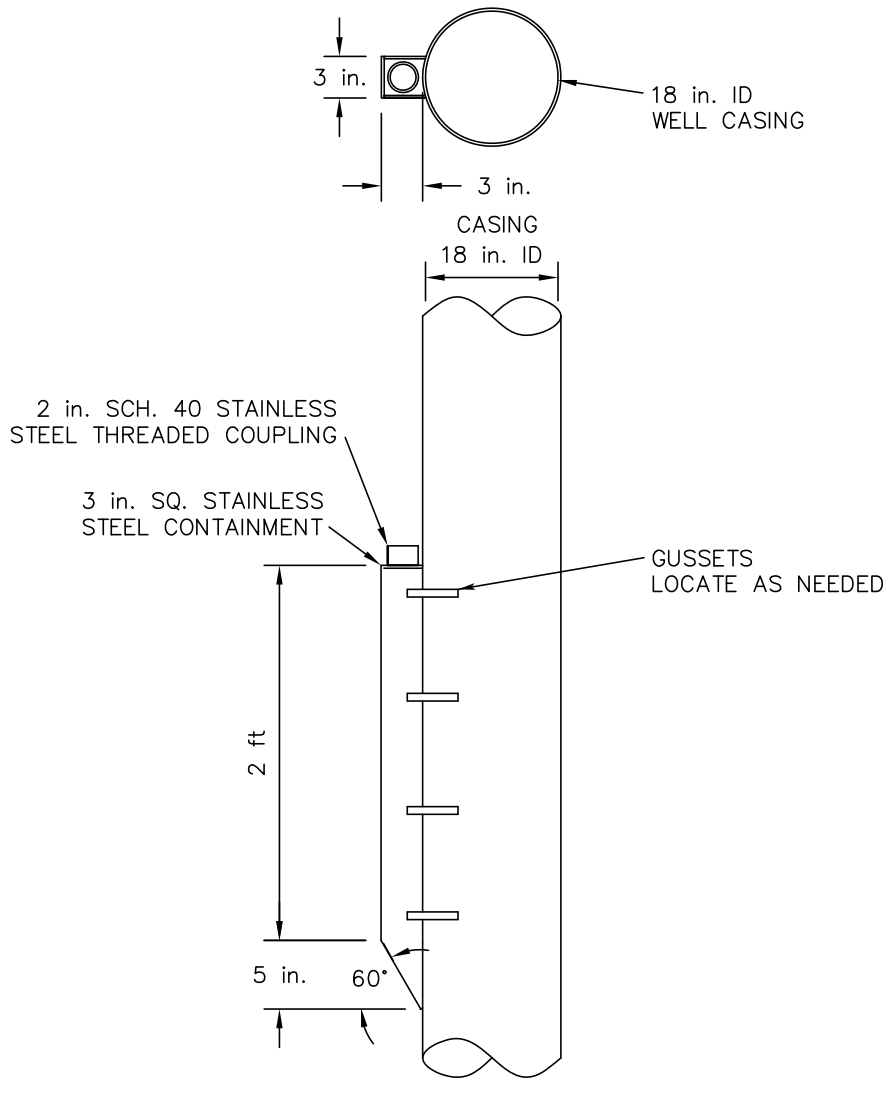
CONCEPTUAL WELL COMPLETION DIAGRAM

NOT TO SCALE



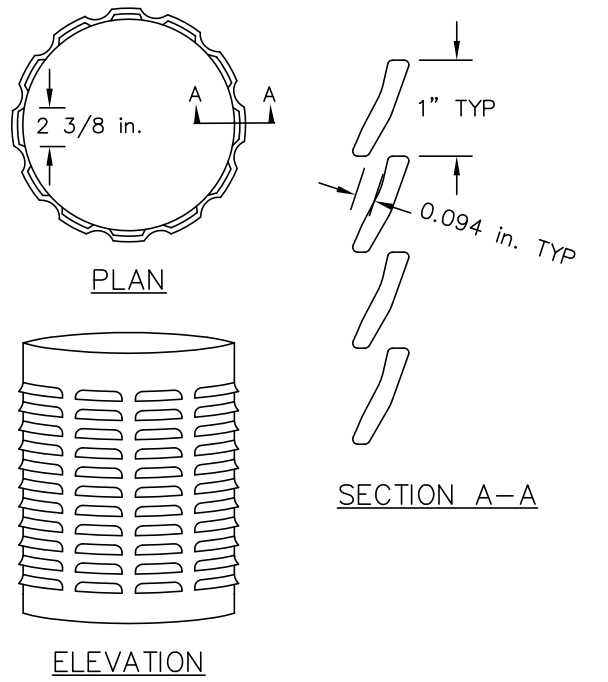
WELL CASING AND TUBE PLAN

NOT TO SCALE



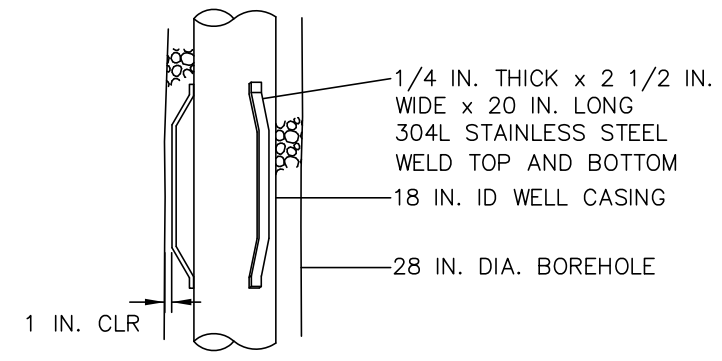
SOUNDING TUBE CONNECTION

NOT TO SCALE



HORIZ. FUL–FLO LOUVER SCREEN

NOT TO SCALE



TYPICAL CASING CENTRALIZER

NOT TO SCALE

NOTE: Casing centralizers to straddle casing collars at 120 ft intervals beginning immediately below the screened interval as the casing is installed. Centralizers are to be welded at the top and bottom and shall be of similar material to casing at point of attachment. Centralizers shall not be welded onto louvers.

DRAFT

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WESTERN MUNICIPAL WATER DISTRICT

CONCEPTUAL WELL COMPLETION DIAGRAM CHINO II EXPANSION WELL No II–12

Drawn:	Checked:	Approved:	Date:
PLP			1–SEP–09

Figure 23

JN 657–09

chino basin desalter\phase 3 pdr\090515final\figures\II12 design.dwg

TABLES

Summary of Well Information for Existing Chino I and II Wells

	Well Number	Year Drilled	Total Well Depth [ft bgs][3]	Perforated Interval(s) [ft bgs]	Instantaneous Discharge Rate[1] [gpm][4]	Specific Capacity[2] [gpm/ft][5]	Land Surface Elevation [ft amsl][6]	Current Pump Setting [ft bgs]
Chino I	CDA I-1	1997	520	290-300, 320-400, 480-500	399	2.8	625	260
	CDA I-2	1997	495	260-330, 405-475	188	1.4	607	340
	CDA I-3	1997	545	235-275, 350-470, 500-525	483	8.3	600	285
	CDA I-4	1997	500	200-280, 390-480	268	1.7	609	290
	CDA I-5	1997	405	160-245, 345-385	1,277	25.6	628	255
	CDA I-6	1997	325	175-305	365	4.6	630	170
	CDA I-7	1997	320	180-300	225	3.5	629	175
	CDA I-8	1998	435	180-275, 340-415	1,051	19.4	639	285
	CDA I-9	1998	450	190-220, 260-340, 390-430	1,081	43.6	648	185
	CDA I-10	1998	360	180-270, 290-340	1,240	54.6	650	175
	CDA I-11	1999	280	160-260	1,062	14.4	648	275
Chino I Expansion	CDA I-13	2002	372	180-352	1,559	16.7	631	190
	CDA I-14	2002	480	100-136, 146-174, 184-460	2,689	93.4	634	140
	CDA I-15	2003	330	100-140, 150-310	2,331	142.1	640	150
Chino II	CDA II-1	2004	410	155-288, 308-390	2,025	99.3	676	298
	CDA II-2	2004	342	156-312	2,001	113.1	689	325
	CDA II-3	2004	355	160-325	1,899	104.3	692	335
	CDA II-4	2004	370	156-340	2,000	123	696	154
	CDA II-6	2004	315	150-295	2,015	111.9	709	305
	CDA II-7	2004	275	140-245	1,511	82.6	692	255
	CDA II-8	2004	260	130-230	1,492	79.4	689	240
	CDA II-9a	2004	315	180-195, 206-295	1,724	82.9	722	200

Notes:

[1] Instantaneous discharge rates were obtained from recent Southern California Edison (SCE) and General Pump Company, Inc. (GPC) pumping test reports, or recent well construction reports.

[2] Specific capacity data were obtained from each well's recent SCE or GPC pumping test report.

[3] ft bgs = feet below ground surface

[4] gpm = gallons per minute

[5] gpm/ft = gallons per minute per foot of drawdown

[6] ft amsl = feet above mean sea level

Table 1

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL NOS. A-4 AND A-6

Item No.	Description	Qty	Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	2 sites	$60,000 LS	$120,000
2	Provide noise control measures as specified	2 sites	$35,000 LS	$ 70,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	2 sites	$ 5,000 LS	$ 10,000
4	NPDES compliance including waste water treatment and water quality sampling.	2 sites	$15,000 LS	$ 30,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place (50 ft per well, 2 wells)	100 ft	$ 550 /ft	$ 55,000
6	Drill maximum 17-1/2 inch diameter pilot borehole (550 ft per well, 2 wells)	1100 ft	$ 60 /ft	$ 66,000
7	Provide geophysical borehole logs, as specified (2 wells)	2 set	$ 5,500 LS	$ 11,000
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones per well, 2 wells)	6 zones	$ 8,000 /zone	$ 48,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well, 2 wells).	108 hrs	$ 300 /hr	$ 32,400
10	Zone test water quality analyses (1 sample per zone, 3 zones per well, 2 wells).	6 sample	$ 3,000 /sample	$ 18,000
11	Ream 17-1/2 inch pilot bore hole to 32 inches in diameter (50 ft to 120 ft per well, 2 wells)	140 ft	$ 60 /ft	$ 8,400
12	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (120 ft to 600 ft per well, 2 wells)	960 ft	$ 50 /ft	$ 48,000
13	Provide caliper survey of reamed borehole. (2 wells)	2 each	$ 2,250 /ea	$ 4,500
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 180 ft per well, 2 wells)	362 ft	$ 434 /ft	$157,108
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (180 to 560 ft per well,	760 ft	$ 533 /ft	$405,080
16	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft per well)	40 ft	$ 434 /ft	$ 17,360
17	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 178 ft per well, 2 wells).	358 ft	$ 67 /ft	$ 23,986
18	Furnish and install 3-inch sch 40 mild steel gravel feed pipes, as specified (+1 to 110 ft, 2 per well, 2 wells)	444 ft	$ 10 /ft	$ 4,440
19	Furnish and install filter pack material and fine sand layer, as specified (2 wells).	1000 ft	$ 40 /ft	$ 40,000
20	Furnish and install annular cement seal, as specified.	200 ft	$ 45 /ft	$ 9,000
21	Develop and clean well by airlifting and swabbing from between packers (96 hours per well, 2 wells).	192 hrs	$ 325 /hr	$ 62,400
22	Install and remove development/test pump.	2 each	$20,000 LS	$ 40,000

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL NOS. A-4 AND A-6

Item No.	Description	Qty	Unit Price	Total Item Price
23	Provide development by pumping and surging with deep well turbine pump (60 hours per well, 2 wells).	120 hrs	$ 275 /hr	$ 33,000
24	Provide pumping tests for yield and drawdown as specified (38 hours per well, 2 wells).	76 hrs	$ 275 /hr	$ 20,900
25	Provide spinner survey, as specified (2 wells).	2 each	$ 4,500 LS	$ 9,000
26	Title 22 water quality analyses (2 wells).	2 each	$ 5,000 LS	$ 10,000
27	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection (2 wells).	2 each	$ 2,500 LS	$ 5,000
28	Provide Dual-Cam video survey on DVD format (2 wells).	2 each	$ 2,000 LS	$ 4,000
	TOTAL BID PRICE (2 WELLS) ITEMS 1 - 28:		**$**	**1,362,574.00**
29	Abandonment of pilot hole in accordance with county standards, if required (2 wells).	1200 ft	$ 25 /ft	$ 30,000

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, AND DEVELOPMENT OF TWO COMPANION CHINO CREEK MONITORING WELLS

Item No.	Description	Qty	Unit Price		Total Item Price
1	Mobilization, demobilization, site clean-up and restoration. Move between sites.	1 each	$ 45,000	LS	$ 45,000
2	Provide noise control measures as specified.	2 each	$ 20,000	each	$ 40,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	2 each	$ 5,000	each	$ 10,000
4	NPDES compliance including waste water treatment and water quality sampling.	2 each	$ 6,500	each	$ 13,000
5	Drill 30 inch diameter conductor borehole, furnish and install 20 inch diameter by 1/4 inch wall mild steel conductor casing. Cement into place. (35 ft per well, 2 wells)	70 ft	$ 150	/ft	$ 10,500
6	Drill maximum 17-1/2 inch diameter borehole. (est. TD = 580 ft per well, 2 wells)	1,090 ft	$ 40	/ft	$ 43,600
7	Provide geophysical borehole logs, as specified.	2 set	$ 4,200	set	$ 8,400
8	Furnish and install 4.5 inch Certa Lok™ SDR17 PVC blank well casing. (191 ft per well, 2 wells)	382 ft	$ 15	/ft	$ 5,730
9	Furnish and install 4.5 inch Certa Lok™ SDR17 PVC well screen with 0.090-inch vertical mill-slotted openings. (380 ft per well, 2 wells)	760 ft	$ 20	/ft	$ 15,200
10	Furnish and install filter pack material and fine sand layer, as specified. (560 ft per well, 2 wells)	1,120 ft	$ 25	/ft	$ 28,000
11	Furnish and install annular bentonite seal, as specified. (20 ft per well, 2 wells)	40 ft	$ 45	/ft	$ 1,800
12	Develop and clean well by airlifting and swabbing from between packers. (40 hours per well, 2 wells)	80 hrs	$ 300	/hr	$ 24,000
13	Install and remove development pump.	2 each	$ 5,000	each	$ 10,000
14	Provide development by pumping and surging with submersible pump. (20 hours per well, 2 wells)	40 hrs	$ 200	/hr	$ 8,000
15	Complete wellhead as designed and cleanup well site.	2 each	$ 4,000	each	$ 8,000
	TOTAL BID PRICE (2 WELLS) ITEMS 1 - 15:		**$**		**271,230.00**
16	Abandonment of borehole in accordance with county standards, if required.	1,160 ft	$ 25	/ft	$ 29,000

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-1

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 700 ft.	650	ft	$ 60 /ft	$ 39,000
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 700 ft).	650	ft	$ 50 /ft	$ 32,500
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 660 ft).	510	ft	$ 533 /ft	$271,830
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	700	ft	$ 40 /ft	$ 28,000
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-1

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**747,127.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	700 ft	$ 25 /ft	$ 17,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-2

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 700 ft.	650	ft	$ 60 /ft	$ 39,000
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 700 ft).	650	ft	$ 50 /ft	$ 32,500
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 660 ft).	510	ft	$ 533 /ft	$271,830
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	700	ft	$ 40 /ft	$ 28,000
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-2

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**747,127.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	700 ft	$ 25 /ft	$ 17,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-3

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 700 ft.	650	ft	$ 60 /ft	$ 39,000
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 700 ft).	650	ft	$ 50 /ft	$ 32,500
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 660 ft).	510	ft	$ 533 /ft	$271,830
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	700	ft	$ 40 /ft	$ 28,000
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-3

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**747,127.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	700 ft	$ 25 /ft	$ 17,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-5

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 600 ft.	550	ft	$ 60 /ft	$ 33,000
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 600 ft).	550	ft	$ 50 /ft	$ 27,500
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 560 ft).	410	ft	$ 533 /ft	$218,530
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	600	ft	$ 40 /ft	$ 24,000
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO CREEK WELL A-5

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**678,827.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	600 ft	$ 25 /ft	$ 15,000

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-10

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 530 ft.	480	ft	$ 60 /ft	$ 28,800
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 530 ft).	480	ft	$ 50 /ft	$ 24,000
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 490 ft).	340	ft	$ 533 /ft	$181,220
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	530	ft	$ 40 /ft	$ 21,200
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-10

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**631,017.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	530 ft	$ 25 /ft	$ 13,250

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-11

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 570 ft.	520	ft	$ 60 /ft	$ 31,200
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 570 ft).	520	ft	$ 50 /ft	$ 26,000
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 530 ft).	380	ft	$ 533 /ft	$202,540
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 2-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	570	ft	$ 40 /ft	$ 22,800
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-11

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**658,337.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	570 ft	$ 25 /ft	$ 14,250

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-12

Item No.	Description	Qty		Unit Price	Total Item Price
1	Mobilization, demobilization, site clean-up and restoration.	1	site	$60,000 LS	$ 60,000
2	Provide noise control measures as specified.	1	site	$35,000 LS	$ 35,000
3	Testing and disposal of drill cuttings from pilot and conductor boreholes, if required.	1	site	$ 5,000 LS	$ 5,000
4	NPDES compliance including waste water treatment and water quality sampling.	1	site	$15,000 LS	$ 15,000
5	Drill 48 inch diameter conductor borehole, furnish and install 36 inch diameter by 3/8 inch wall mild steel conductor casing. Cement into place.	50	ft	$ 550 /ft	$ 27,500
6	Drill maximum 17-1/2 inch diameter pilot borehole to 690 ft.	640	ft	$ 60 /ft	$ 38,400
7	Provide geophysical borehole logs, as specified.	1	set	$ 5,500 LS	$ 5,500
8	Install isolated aquifer zone test tools, gravel envelope, and seals (3 zones).	3	zones	$ 8,000 /zone	$ 24,000
9	Airlift and pump isolated aquifer zones (est. 18 hours per zone, 3 zones per well).	54	hrs	$ 300 /hr	$ 16,200
10	Zone test water quality analyses (1 sample per zone, 3 zones per well).	3	samples	$ 3,000 /sample	$ 9,000
11	Ream 17-1/2 inch pilot bore hole to 28 inches in diameter (50 ft to 690 ft).	640	ft	$ 50 /ft	$ 32,000
12	Provide caliper survey of reamed borehole.	1	each	$ 2,250 /ea	$ 2,250
13	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing (+1 to 150 ft).	151	ft	$ 434 /ft	$ 65,534
14	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel ful-flo louvered screen (150 to 650 ft).	500	ft	$ 533 /ft	$266,500
15	Furnish and install 18-inch ID x 5/16-inch wall 304L stainless steel blank casing with end plate (20 ft).	20	ft	$ 434 /ft	$ 8,680
16	Furnish and install 4-inch sch 40 304L stainless steel sounding tube, as specified (+1 to 148 ft).	149	ft	$ 67 /ft	$ 9,983
17	Furnish and install filter pack material, as specified.	690	ft	$ 40 /ft	$ 27,600
18	Develop and clean well by airlifting and swabbing from between packers (96 hours).	96	hrs	$ 325 /hr	$ 31,200
19	Install and remove development/test pump.	1	each	$20,000 LS	$ 20,000
20	Provide development by pumping and surging with deep well turbine pump (60 hours).	60	hrs	$ 275 /hr	$ 16,500
21	Provide pumping tests for yield and drawdown as specified (38 hours).	38	hrs	$ 275 /hr	$ 10,450
22	Provide spinner survey, as specified.	1	each	$ 4,500 LS	$ 4,500
23	Title 22 water quality analyses.	1	each	$ 5,000 LS	$ 5,000
24	Complete wellhead as designed and cleanup well site, including plumbness and alignment surveys and disinfection.	1	each	$ 2,500 LS	$ 2,500

ENGINEER'S ESTIMATE FOR DRILLING, CONSTRUCTION, DEVELOPMENT AND TESTING OF CHINO II EXPANSION WELL II-12

Item No.	Description	Qty	Unit Price	Total Item Price
25	Provide Dual-Cam video survey on DVD format.	1 each	$ 2,000 LS	$ 2,000
	TOTAL BID PRICE ITEMS 1 - 25:		**$**	**740,297.00**
26	Abandonment of pilot hole in accordance with county standards, if required.	690 ft	$ 25 /ft	$ 17,250

APPENDIX A

Chino Basin Watermaster Comments to

May 18, 2009 Preliminary Design Report

CHINO BASIN WATERMASTER

9641 San Bernardino Road, Rancho Cucamonga, Ca 91730
Tel: 909.484.3888 Fax: 909.484.3890 www.cbwm.org

KENNETH R. MANNING
Chief Executive Officer

July 8, 2009

Geoscience Support Services
Attention: Mr. Russell Kyle, P.G.
P.O. Box 220
Claremont, CA 91711

Subject: Review of the Preliminary Design Report for the Chino Creek Wellfield and Chino II Expansion Wellfield Chino Desalter Phase 3 Project

Dear Mr. Kyle,

The Chino Basin Watermaster (Watermaster) and our engineering consultant, Wildermuth Environmental, Inc. (WEI), have reviewed the *Preliminary Design Report for the Chino Creek Wellfield And Chino II Expansion Wellfield Chino Desalter Phase 3 Project, May 2009,* prepared by Geoscience Support Services (GSS). After reviewing the technical comments submitted by WEI, Watermaster has the following comments.

Regarding Production Well Design:

Watermaster's main concern is that hydraulic control is achieved in this area via groundwater pumping at the Chino Creek Wellfield (CCWF). Our current understanding based on piezometric monitoring and modeling is that most of the groundwater in this area is discharging south through the shallow aquifer system. Therefore, the wells must be screened to intercept the groundwater discharge in the shallow aquifer system. This is described in the Peace II Agreement Item 5.8a(i), which states specifically "New wells will be constructed in the shallow aquifer system among Desalter I wells No. 1 through 4 and west of Desalter I."

Watermaster is concerned that the screen intervals of the test production wells, as proposed in the Preliminary Design Report (PDR), do not screen across enough of the shallow aquifer system and may not be consistent with the Peace II Agreement. Watermaster urges GSS and the CDA to construct the wells in the CCWF so they will intercept the groundwater discharge in the shallow aquifer system and achieve hydraulic control in this area.

Regarding Monitoring Wells:

The PDR states that the purpose of the monitoring wells are to collect data to estimate aquifer properties and assess groundwater level interference caused by the pumping. To achieve these objectives, the PDR states that the wells will be located in close proximity to the production wells and will be screened across the same depth interval as the production wells. Because of their location and screened interval, the monitoring wells will have limited usefulness to Watermaster for its assessment of hydraulic control through future piezometric monitoring. Watermaster will likely need to construct additional monitoring wells in this area to assess hydraulic control.

Regarding Land Subsidence:

There is no mention of the potential for land subsidence, even though it is stated that (1) the aquifer system in this area consists of a high percentage of fine-grained sediments and (2) that pumping at the CCWF will cause significant drawdown of groundwater levels—the necessary conditions for aquifer-system compaction and land subsidence. Watermaster would have liked to see some mention of the potential for land subsidence in Section 3.0 – *Expected Geohydrologic Conditions.*

Please contact either Andy Malone or me if you have any questions regarding Watermaster comments on the *Preliminary Design Report for the Chino Creek Wellfield and Chino II Expansion Wellfield Chino Desalter Phase 3 Project.*

Sincerely,

Kenneth R. Manning
CEO, Chino Basin Watermaster

cc: Ben Pak, Chino Basin Watermaster
Jack Safely, Western Municipal Water District
Michael Fife, Brownstein Hyatt Farber Schreck
Tom McCarthy, Wildermuth Environmental
Gary Meyerhofer, Carollo Engineers
Andy Malone, Wildermuth Environmental

APPENDIX B

Well Driller's Logs

29501

Duplicate and Triplicate with the
WATER POLLUTION
BOARD No. CONFIDENTIAL
(State number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

Do Not Fill In
No. 13433
State Well No. 2S/7W-29Pd5
Other Well No. Vendor Num

(1) OWNER:

Name W. F. Durrington
Address 8107 Kimball
Chino, California

(2) LOCATION OF WELL:

County San Bernardino Owner's number, if any—
R. F. D. or Street No. 1000 feet South of Kimball Ave.
300 feet West of Grove

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☒ Municipal ☐
Irrigation ☐ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☐
Cable ☒
Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☐ DOUBLE ☒

Depth from	ft. to	ft.	Diam.	Gage or Wall
0	402	14	12	

Type and size of shoe or well ring Mild Steel
Describe joint Prick Punch

If gravel packed

Diameter of Bore	from ft.	to ft.

Size of gravel:

(7) PERFORATIONS:

Type of perforator used Mills Knife
Size of perforations 2½" in., length, by 3/8" in.
From 74 ft. to 390 ft. 10 Perf. per row 1 Rows per ft.

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☐ Yes ☒ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☒ No If yes, note depth of strata
From ft. to ft.
Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found 22 ft.
Standing level before perforating 22 ft.
Standing level after perforating 22 ft.

(10) WELL TESTS:

Was pump test made? ☒ Yes ☐ No If yes, by whom? Mogle Brothers
Yield: 1400 gal./min. with 58 ft. draw down after 48 hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:

Total depth 402 ft. Depth of completed well 402 ft.
Formation: Describe by color, character, size of material, and structure.

ft. to	ft.	
0	9	Top Soil
9	72	Sandy Clay
72	88	Gravel
88	102	Clay
102	113	Clay & Gravel
113	128	Clay
128	143	Sand & Gravel
143	194	Sandy Clay
194	198	Sand Stone
198	254	Hard Sandy Clay
254	272	Clay
272	283	Gravel
283	306	Clay & Gravel
306	312	Gravel
312	334	Sandy Clay
334	392	Gravel
392	398	Clay & Gravel
398	402	Clay

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

MICROFILMED

Work started 2/14 1958 Completed 3/14 1958

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Mogle Brothers
(Person, firm, or corporation) (Typed or printed)
Address 13165 Central Ave.
Chino, California
[SIGNED] Well Driller
License No. 167191 Dated August 22, 1958

ORIGINAL
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
NTROL BOARD No. 8
(If appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

CONFIDENTIAL
Sec. 7078, State Water Code

Do Not Fill In
No. 33832
State Well No. 2S/7W-29M01 S3
Other Well No. e

(1) OWNER:

Name Scott Brothers Dairy

Address 1097 Philadelphia, Pomona, Calif.

(2) LOCATION OF WELL:

County San Bernardino Owner's number, if any—

R. F. D. or Street No. 2, 3

Kimball Avenue ½ mile east of Euclid Avenue, Chino, California 75' S/o Kimball 200' E/o Brother well

(3) TYPE OF WORK (check):

New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic ☐ Industrial ☐ Municipal ☐

Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:

Rotary ☒

Cable ☐

Dug Well ☐

(6) CASING INSTALLED:

SINGLE ☒ DOUBLE ☐

From ft.	to ft.	Diam.	Gage or Wall
0	400	14	5/16

Type and size of shoe or well ring: Pointed

Describe joint: Welded Joints

If gravel packed

Diameter of Bore	from ft.	to ft.
28	0	400

Size of gravel: 3/4"

(7) PERFORATIONS:

Type of perforator used: Machine Perforated

Size of perforations: ~~3/32~~ 1 in., length, by 4 in.

From ft.	to ft.	Perf. per row	Rows per ft.
90	400	16	8

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth: 7 ft.

Were any strata sealed against pollution? ☐ Yes ☒ No If yes, note depth of strata

From ft.	to ft.

Method of Sealing

(9) WATER LEVELS:

Depth at which water was first found	68 ft.
Static level before perforating	49 ft.
Standing level after perforating	49 ft.

(10) WELL TESTS:

Was a pump test made? ☒ Yes ☐ No If yes, by whom? F.L LaHorgue

Yield: 2350 gal./min. with 35 ft. draw down after 12 hrs.

Temperature of water: 60 Was a chemical analysis made? ☐ Yes ☐ No

(11) WELL LOG:

Total depth: 400 ft. Depth of completed well: 400 ft.

Formation: *Describe by color, character, size of material, and structure.*

0 ft. to	10 ft.	sandy soil
10 "	16 "	sand
16 "	48 "	clay
48 "	68 "	clay and gravel
68 "	74 "	gravel
74 "	93 "	clay
93 "	116 "	sand
116 "	141 "	gravel
141 "	155 "	large gravel
155 "	181 "	sand and clay
181 "	234 "	clay and gravel
234 "	245 "	gravel and boulders
245 "	300 "	large gravel
300 "	307 "	sand and gravel
307 "	331 "	sand and gravel
331 "	350 "	sand and clay
350 "	375 "	sandy clay
375 "	395 "	gravel and boulders
395 "	400 "	sandy clay

Work started October 7 19 58 Completed Dec. 7 19 58

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME F.LaHorgue
(Person, firm, or corporation) (Typed or printed)

Address 13654 Central Avenue

Chino, California

[SIGNED] Elsa J. Markley
(Well Driller)

License No. 179502 Dated Dec. 7, 19 58