3. GROUNDWATER QUALITY

3.1 Background

Chino Basin groundwater is not only a critical resource to overlying producers of water; it is a critical resource to the entire Santa Ana Watershed. From a regulatory perspective, the use of Chino Basin groundwater to serve potable demands will be limited by drinking water standards, groundwater basin water quality objectives, and Santa Ana River water quality objectives. In August 1999, Phase 1 of the OBMP established a necessity for conducting groundwater quality and water level monitoring in order to obtain current water quality and water level data in Chino Basin (WEI, 1999). These data are necessary to define and evaluate specific strategies and locations for the mitigation of nitrate, total dissolved solids (TDS), and other constituents of concern (COCs), new recharge sites, and pumping patterns resulting from the implementation of the OBMP.

3.2 Water Quality Monitoring Programs

In the past, various entities have collected groundwater quality data. Municipal and agricultural water supply entities have collected groundwater quality data to comply with the Department of Health Services' requirements under Title 22 or for programs that range from irregular study-oriented measurements to long-term periodic measurements. Groundwater quality observations have been made by the California Department of Water Resources (DWR), by participants in the 1969 Judgment on the Santa Ana River (Orange County Water District *vs.* City of Chino *et al.*), by dischargers under orders from the RWQCB, and by the County of San Bernardino. The DWR and the San Bernardino County Flood Control District (SBCFCD) were very active in collecting groundwater quality data in the Chino Basin prior to the settlement of the Chino Basin adjudication. After the Judgment was entered in 1978, monitoring south of State Route 60 stopped almost completely, except for monitoring conducted by the cities of Chino, Chino Hills, and Norco, the Jurupa Community Services District (JCSD), and the Santa Ana River Water Company (SARWC). Most of the pre-1978 measurements were digitized by the DWR. In 1986, Metropolitan Water District of Southern California (MWDSC) conducted the first comprehensive survey of groundwater quality covering all constituents regulated in California Code of Regulations Title 22.

In 1989, Watermaster initiated a regular monitoring program for Chino Basin. Groundwater quality data were obtained in 1990 and periodically from then on until 1998. Thereafter, Watermaster implemented an aggressive monitoring program as part of the OBMP implementation. Watermaster's program relies on municipal producers and other government agencies supplying their groundwater quality data on a cooperative basis. Watermaster supplements this data with data obtained through its sampling and analysis program in the area generally south of State Route 60. Water quality data are also obtained from special studies and monitoring that takes place under the orders of the Regional Water Quality Control Board (RWQCB), the California Department of Toxic Substances Control (DTSC), and others. Watermaster has combined previously digitized groundwater quality data from all known sources into a comprehensive database.

3.2.1 Title 22 Compliance Monitoring

Water quality samples from wells operated by members of the Appropriative Pool and some members of the overlying Non-agricultural Pool are typically collected as part of the formalized monitoring programs. Constituents include those: (i) regulated for drinking water purposes in the *California Code of Regulations, Title 22;* (ii) regulated in the *1995 Water Quality Control Plan for the Santa Ana River Basin* (Basin Plan); or (iii) that are of special interest to the pumper.

3.2.2 Historical Water Quality Monitoring Programs for Private Wells

Historically, private wells were sampled less methodically and less frequently than wells owned by members of the Appropriative Pool. In addition, Watermaster had a limited groundwater quality monitoring program in the southern part of Chino Basin, wherein general minerals and physical properties were measured at about 60 wells. There is little historical groundwater quality information for most of the 600 private wells in the southern part of Chino Basin; thus, the historic water quality of groundwater being produced at a majority of the wells in Chino Basin is unknown. Prior to the recently completed *Comprehensive Water Quality Monitoring Program* discussed in Section 3.2.3, there was only one other monitoring program to date that included a systematic water quality sampling program of the private wells in the southern portion of the Chino Basin:

- In 1986, the MWDSC (1988) sampled 149 wells in Chino Basin, including 45 privately-owned wells in the southern portion of the Chino Basin. These wells were analyzed for major cations and anions, general physical parameters, volatile organic chemicals (VOCs), base/neutral/acid-extractable organic chemicals (BNAs), organochlorine pesticides and polychlorinated biphenyls (PCBs), organophosphorous pesticides, carbamate pesticides, and triazine herbicides and soil fumigants.

3.2.3 Comprehensive Water Quality Monitoring Program (1999 – 2001)

Watermaster developed the OBMP in 1999 (WEI, 1999), and the Peace Agreement that implemented the OBMP in 2000. The OBMP established management goals for Watermaster. The management plan in the OBMP describes actions that, when implemented, will achieve the goals of the OBMP. These actions are referred to as Program Elements. A groundwater quality monitoring program is a key part of the OBMP; hence, *Program Element 1 – Develop and Implement a Comprehensive Monitoring Program*. Watermaster developed and conducted the Comprehensive Water Quality Monitoring Program to provide comprehensive long-term information on groundwater quality for use in managing the groundwater basin.

The Comprehensive Water Quality Monitoring Program (CMP) consisted of a water quality sampling and analysis from all known active production and monitoring wells in the Chino Basin. Watermaster staff obtained and analyzed samples from all known and active private wells, and obtained water quality for all other known and active wells from cooperating well owners. From October 1999 to March 2001, Watermaster sampled 602 private wells for the private well monitoring program (PWMP) portion of the CMP (The PWMP is a subset of the CMP). These wells were analyzed for:

- general mineral analyses (including cation and anion balances);
- general physical analyses;
- dissolved inorganic chemical analyses;
- perchlorate (US Environmental Protection Agency [US EPA] 300.0-IC);
- VOCs, including MTBE (US EPA 524.2);
- semivolatile organic compounds (US EPA 525.2);
- cyanide (SM 4500 CN-F);
- 1,2-dibromo-3-chloropropane (DBCP)/1,2-dibromoethane (EDB)/1,2,3-trichloropropane (US EPA 504.1); and
- gross alpha and beta (US EPA 900.0).

All known active private wells within the Agricultural Pool of the Chino Basin were selected for sampling; active, as defined by DWR, is "an operating water well." For each of the two years in the monitoring program, wells were selected to provide sufficient areal coverage of the entire southern portion of the Chino Basin. Wells that are clustered together were sampled during the same period, as often as possible, in order to avoid return trips to the same site. In addition, wells along the same street were grouped together, when possible, in order to increase the speed and efficiency of the sample collection.

The selected wells for Year 1 of the PWMP were located approximately within the capture zones of existing and proposed well fields for desalter facilities. Wells known to be within another entity's regular monitoring program were excluded from the PWMP, but the data collected by the other entities were added to the program data set, if available (*e.g.*, California Institution for Men [CIM] wells).

3.2.4 205(j) Groundwater Monitoring Program

The Chino Basin 205(j) Groundwater Monitoring Program (CB205JMP) provided an evaluation of water levels and water quality in the groundwater of Chino Basin. Approximately 200 wells located in the southern portion of the Chino Basin were sampled. The water quality data included general minerals with a focus on TDS and nitrogen species. The collected water quality and water level data were used to develop detailed water quality and water level contour maps.

Partial funding for the CB205JMP was provided through the California State Water Resources Control Board (SWRCB) under Section 205(j) of the Federal Clean Water Act, Agreement Number 00-199-250-0. Funding from the 205(j) grant program was used to partially offset the cost for the necessary water quality and water level monitoring at 200 wells located in the southern portion of Chino Basin in the capture zone of Chino-1 and Chino-2 Desalters. The sampling program took place from February 2002 to June 2002.

3.2.5 Chino Basin Groundwater Quality Monitoring Program (2002/2003)

Continued monitoring of water levels and water quality influent to the desalter well fields is critical to optimizing the performance of these treatment facilities. Water levels will be measured at least once annually. All private wells are proposed to be sampled for general mineral and general physical parameters at least once every three years. In addition to these parameters, the following constituents are included in the on-going groundwater quality monitoring program:

- Perchlorate (all wells). Perchlorate is a contaminant of state and national prominence and importance. Perchlorate was detected in several private wells in the PWMP and, therefore, all private wells will be re-tested for perchlorate so that an accurate distribution of the contaminant can be made.
- 1,2,3-Trichloropropane (all wells). 1,2,3-TCP has a new California Action Level (AL) of 0.005 µg/L. The detection limit for 1,2,3-TCP in the previous monitoring program was 50 µg/L and there was 1,2,3-TCP detected at greater than that detection limits. Because 1,2,3-TCP may be a basin-wide water quality issue, all wells are being re-tested at a lower detection limit – 0.005 µg/L.
- VOCs (wells within or near VOC plumes). Those wells that were within VOC plumes or were within 1000 feet of the suspected edge of a plume will be re-tested for VOCs.
- Hexavalent chromium, silica, strontium, barium, total and fecal coliforms (selected wells). These constituents were added during the PWMP, and hence, not all wells were tested for these constituents

during that monitoring program. Those wells that were not tested for these constituents will be tested during this three year monitoring program.

To date, Watermaster staff have sampled 100 out of 200 private wells that will be monitored in 2002/2003. After the approximately 600 private wells are sampled over the next three years, Watermaster will have two recent, comprehensive groundwater quality sampling rounds in Chino Basin. The second comprehensive round will be used to corroborate tentative conclusions drawn from analyses of the first round of the CMP. At that time, a determination as to the nature of a long-term groundwater quality monitoring program will be made.

3.3 Information Management

As with groundwater level and groundwater production data, groundwater quality data are being managed by Watermaster in order to perform the requisite scientific and engineering analyses to ensure that the goals of the OBMP are being met. Watermaster has a relational database that contains information on well location, construction, lithology, specific capacity, groundwater level, and water quality. Historical water quality data for the period prior to the mid 1980s were obtained from the DWR and were supplemented with data from producers in the Appropriative and Overlying Non-Agricultural Pools and others. For the period from the mid 1980s forward, Watermaster loaded the database with water quality data from its own sampling programs, the State of California database – State Water Quality Information System (SWQIS), and from other cooperators.

3.4 Groundwater Quality in Chino Basin

Figure 3-1 shows all wells in that have groundwater quality monitoring results for the period ranging from 1997 to 2002. The locations of existing and proposed desalter supply wells are shown in Figure 3-1 for areal reference.

Inorganic and organic constituents that were detected in groundwater samples from wells in the Chino Basin through 2002 were analyzed synoptically; the analysis contained all available data, including data from several monitoring programs and studies. The water quality data reviewed in this synoptic analysis are derived from production wells and monitoring wells. Hence, the data do not represent a programmatic investigation of potential sources nor do they represent a randomized study designed to ascertain the water quality status of the Chino Basin. However, the data do represent the most comprehensive information available to date. Monitoring wells targeted at a potential source will likely have a greater concentration than a municipal or agricultural production well. Wells with constituent concentrations greater than one-half the MCL represent areas that warrant concern and inclusion in a long-term monitoring program. Additionally, groundwater in the vicinity of wells with samples greater than the MCL may be impaired from a beneficial use standpoint.

As discussed previously, the database includes both production wells and monitoring wells, including many monitoring wells associated with the Stringfellow NPL Site. However, much of the monitoring well data from the Mid-Valley Landfill have been removed from Watermaster's database, pending resolution of quality control issues for electronic data transmitted from the County of San Bernardino.

The following constituents exceeded water quality criteria for more than 10 wells in Chino Basin for the approximate 5-year period January 1997 through June 2002:

Analyte Group/Constituent	Wells with Exceedances
Inorganic Constituents	
total dissolved solids	467
nitrate	617
aluminum	91
arsenic	12
chloride	45
fluoride	12
iron	83
manganese	41
perchlorate	140
sulfate	72
General Physical	
color	13
pH	24
odor	17
Chlorinated VOCs	
1,1-dichloroethene	12
1,2,3-trichloropropane	40
1,2-dichloroethane	16
cis-1,2-dichloroethene	15
tetrachloroethene (PCE)	37
trichloroethene (TCE)	119
Radiological	
gross alpha	156
total radon 222	23

The following inorganic constituents were detected at or above their MCL in more than 10 wells:

- total dissolved solids
- nitrate
- aluminum
- arsenic
- chloride
- fluoride
- iron
- manganese
- perchlorate
- sulfate

TDS, nitrate, arsenic, and perchlorate are discussed below in some detail. With the exception of perchlorate, all of the other inorganic constituents occur naturally in groundwater.

Chloride, sulfate, iron, and manganese all exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS.

The concentrations of aluminum, arsenic, fluoride, iron, and manganese depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature. Based on the available data, none of these constituents except aluminum and iron showed a spatial pattern throughout Chino Basin. Aluminum and iron were both high in the Stringfellow plume. This may be an artifact of the sampling methodology – relatively high concentrations of aluminum, iron, and trace metals are often the result of dissolution of aluminosilicate particulate matter and colloids caused by the acid preservative in unfiltered samples.

Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). However, site-specific monitoring wells may reveal point sources (*e.g.*, wells near landfills have shown relatively high concentrations of manganese).

Color, odor, and pH were detected at greater than their secondary MCLs (or outside the range in the case of pH) in more than 10 wells in the last 5 years. These parameters should not limit water quality in Chino Basin.

3.4.1 Total Dissolved Solids

In Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water maximum contaminant level (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L. For irrigation uses, TDS should generally be less than 700 mg/L. The RWQCB has established TDS limitations for all municipal wastewater plants that discharge recycled water to the Santa Ana River. However, a problem arises in that TDS concentrations increase through municipal use, typically by about 150 to 250 mg/L. The TDS limitations for water recycling plants that discharge to the Santa Ana River in the Chino Basin are listed below:

Plant	TDS Limit (mg/L)
IEUA RP1	540
IEUA RP2	610
IEUA Carbon Canyon	555
IEUA RP4	505
Western Riverside Regional	625
City of Riverside	650
Jurupa Indian Hills	650

Generally, the TDS concentration in source (drinking) water must be kept well below 500 mg/L (preferably less than 300 mg/L) to ensure that recycled water discharged to the Santa Ana River and its tributaries meets RWQCB limitations.

TDS concentrations in the northeast part of Chino Basin range from about 170 to about 300 mg/L for the pre-1980 period ranging, with typical concentrations in the mid to low 200s. TDS concentrations in excess of 200 mg/L would indicate degradation from overlying land use. With a few exceptions, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation; for instance, the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near the IEUA Regional Plant No. 1 (RP1) in South Ontario.

The impacts of agriculture on TDS in groundwater are primarily caused by fertilizer use on crops, consumptive use, and dairy waste disposal. As irrigation efficiency increases, the impact of consumptive use on TDS in groundwater also increases. For example, if source water has a TDS concentration of 250 mg/L and the irrigation efficiency is about 50 percent (flood irrigation), the resulting TDS concentration in the returns to groundwater will be 500 mg/L, exclusive of the mineral increments from fertilizer. If the irrigation efficiency were increased to 75 percent, the resulting TDS concentration in the returns to groundwater will be 1,000 mg/L, exclusive of the mineral increments from fertilizer. For modern irrigated agriculture, the TDS impacts of consumptive use are more significant than mineral increments from fertilizers.

TDS concentrations in groundwater have either increased slightly or remained relatively constant in the northern part of the Chino-North Management Zone (MZ). TDS concentrations are significantly higher in the southern part of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin Management Zone (PBMZ). In these areas, TDS concentrations typically exceed the 500 mg/L recommended MCL and frequently exceed the upper limit of 1,000 mg/L.

In the figures that depict distributions of water quality in Chino Basin, the following convention is typically followed in setting the class intervals in the legend (where WQS is the applicable water quality standard. Variations from this convention may be employed to highlight certain aspects of the data.

Symbol	Class Interval
○ (small open circle)	Not Detected
● (small blue circle)	<0.5•WQS, but detected
● (green circle)	0.5•WQS to WQS
● (yellow circle)	WQS to 2•WQS
● (orange circle)	2•WQS to 4•WQS
● (large red circle)	> 4•WQS

Figures 3-2 through 3-4 show the distribution of TDS concentrations in Chino Basin for three periods:

- pre-1980;

- 1981 through 1997; and
- 1998 through 2002.

In Figure 3-2 (pre-1980), the TDS concentrations in the northern portion (north of the 60 Freeway) of the Chino-North MZ are generally less than 250 mg/L. TDS concentrations south of the 60 Freeway were typically in the range of 250 to 500 mg/L with the exception of the following areas, which have higher TDS concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP1 discharge point. This pattern is replicated in the period ranging from 1981 to 1997 (Figure 3-3), with the following change:

- More wells in the southern Chino Basin area have TDS concentrations in the 500 to 1000 and 1000 to 2000 mg/L class intervals.

Figure 3-4 shows the distribution of TDS concentrations in Chino Basin for the 1998-2002 period. This sampling period reflects the addition of PWMP data in the southern part of Chino Basin. As shown on the map, the distribution of private wells in the PWMP by class intervals is:

Class Interval	Number of Wells
< 125 mg/L	0
125 – 250 mg/L	35
250 –500 mg/L	134
500 – 1000 mg/L	222
1000 – 2000 mg/L	208
> 2000 mg/L	13

Seventy-two percent of the private wells in the PWMP (443 wells) had TDS concentrations greater than the secondary MCL. In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality. However, there is a paucity of information concerning well construction/perforation intervals; therefore, the vertical differences in water quality are currently unverifiable.

3.4.2 Nitrate-Nitrogen

In Title 22, nitrate is regulated in drinking water with an MCL of 10 mg/L (as nitrogen). [As discussed previously, the data queried from the database are a combination of data from the Watermaster database and the State of California database (SWQIS). By convention, all nitrate values are reported in this document as nitrate-nitrogen (NO_3-N). Hence, the values of nitrate-nitrogen reported in this document should be compared with an MCL of 10 mg/L.] Nitrate measurements in the surface water flows of the San Gabriel Mountains and in the groundwater near the foot of these mountains are generally less than 0.5 mg/L (Montgomery Watson, 1993). Nitrate concentrations in excess of 0.5 mg/L may indicate degradation from overlying land use. Similar to TDS, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by:

- Citrus in the northern parts of the Chino-North MZ; and

- Dairy areas in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ (PBMZ).

Nitrate concentrations in groundwater have increased slightly or remained relatively constant in the northern parts of the Chino-North MZ over the period ranging from 1960 to the present. These are areas formerly occupied by citrus groves and vineyards. Nitrate concentrations underlying these areas rarely exceed 20 mg/L (as nitrogen). Over the same period, nitrate concentrations have increased significantly in the southern parts of southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the PBMZ. These are areas where land use was progressively converted from irrigated/non-irrigated agricultural land to dairies, and nitrate concentrations typically exceed the 10 mg/L MCL and frequently exceed 20 mg/L.

Figures 3-5 through 3-7 show the distribution of nitrate-nitrogen concentrations in Chino Basin for three periods:

- pre-1980;
- 1981 through 1997; and
- 1998 through 2002.

In Figure 3-5 (pre-1980), most of the nitrate concentrations in the northern portions (north of the 60 Freeway) of Chino-North MZ are generally less than 5 mg/L. However, the Pomona-Claremont area (up to 25 mg/L), the eastern Fontana area (up to 10 mg/L), and the Cucamonga Basin (up to 25 mg/L), all have elevated nitrate concentrations. The following areas, south of the 60 Freeway, have somewhat elevated nitrate concentrations: east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP1 discharge point (Figure 3-5).

This pattern is generally replicated in the period ranging from 1981 to 1997 (Figure 3-6); however, several wells in the southern portion of Chino Basin have nitrate concentrations greater than the MCL and 21 wells exceed 50 mg/L (5 times the MCL).

Figure 3-7 shows the distribution of nitrate concentrations in Chino Basin for the post-1997 period. This sampling period primarily reflects the PWMP data in the southern portion of Chino Basin. As shown on the map, the distribution of wells in the southern Chino Basin area by class intervals is:

Class Interval	Number of Wells
< 2.5 mg/L	14
2.5 – 5 mg/L	35
5 –10 mg/L	52
10 – 25 mg/L	141
25 – 50 mg/L	171
> 50 mg/L	197

About eighty-three percent of the private wells in the PWMP (101 wells) had nitrate concentrations greater than the MCL and 60 percent are more than 2.5 times greater than the MCL.

3.4.3 Water Character Index

Water character index (WCI) is a parameter that can be used to generally characterize groundwater. WCI is a unitless parameter that provides a numerical estimation of water character. WCI is used to assess the ionic distribution of constituents in a water sample. This is analogous to a trilinear or Piper diagram, which is a graphical means of displaying the ratios of the principal ionic constituents in water (Piper, 1944; Watson and Burnett, 1995). Water character is defined by the following equation:

$$WCI = 100 \cdot \left(\left\{ \frac{Ca + Mg}{Na + K} \right\} + \left\{ \frac{CO_3 + HCO_3}{Cl + SO_4} \right\} \right)$$

Where Ca, Mg, *et cetera*, are expressed in terms of milliequivalents per liter (meq/L) rather than milligrams per liter (mg/L). The first term on the right hand side of the equation is the ratio of divalent to monovalent cations and the second term on the right hand side of the equation is a ratio of carbonate character to chloride/sulfate character. The utility of the WCI method, compared with a Stiff or Piper/trilinear diagram, is that many data points can be plotted as time histories for a given well or surface water station. The points can also be plotted to show areal and spatial distributions of water character.

Figure 3-8 is a representation of the distribution of WCI using average data for the period 1997 through 2002. Wells in the Fontana area of Chino Basin typically have a WCI greater than 600, which is representative of native groundwater (calcium-bicarbonate water character). The wells along the Santa Ana River have WCI values less than 400, which reflects the influence of wastewater in the Santa Ana River (more sodium-chloride-sulfate character). In the reach of the Santa Ana River northwest of La Sierra Hills, the river recharges the groundwater basin, with the recharged water flowing westward and along the river. This is shown by the lower WCI values (less than 400) in wells immediately northwest of the river in this reach. Wells with WCI values from 200 to 600 further to the northwest probably reflects mingling of groundwater and water recharged from river.

3.4.4 Other Constituents of Concern

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, manganese, and perchlorate. In addition, radon and gross alpha, while naturally-occurring, are found above their MCLs in Chino Basin. Chromium and hexavalent chromium may be problematic, depending on the promulgation of future standards.

3.4.4.1 VOCs

Volatile Organic Chemicals. The following six volatile organic chemicals (VOCs) were detected at or above their MCL in more than 10 wells:

- 1,1-dichloroethene;
- 1,2-dichloroethane;
- 1,2,3-trichloropropane;
- cis-1,2-dichloroethene;

- tetrachloroethene (PCE); and
- trichloroethene (TCE).

TCE and PCE were/are widely used industrial solvents. TCE was commonly used for metal degreasing and as a food extractant. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners use PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). The areal distributions of PCE and TCE are shown in Figures 3-9 and 3-10. 1,1-Dichloroethene (1,1-DCE), 1,2-dichloroethane (1,2-DCA), and *cis*-1,2-dichloroethene (*cis*-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988), and their areal distributions are shown in Figures 3-11 though 3-13. 1,1-DCE and *cis*-1,2-DCE are formed by the reductive dehalogenation of TCE. 1,2-DCA is the by-product of the transformation of the carbon-carbon double bond in a *cis*-1,2-DCE or *trans*-1,2-DCE molecule to a carbon-carbon single bond. The spatial distributions of TCE and PCE and their by-products appear to be associated with identified point sources in the Chino Basin (see Section 3.5).

1,2,3-Trichloropropane (12,3,-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, extractive agent, paint and varnish remover, cleaning and degreasing agent, and as an intermediate in the synthesis of other chemicals (*e.g.*, pesticides).

The current California State Action Level for 1,2,3-TCP is 0.005 μg/L. The adoption of the Unregulated Chemicals Monitoring Requirements (UCMR) regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to the DHS, some utilities moved ahead with monitoring and the samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 μg/L do not provide DHS with adequate information needed for possible standard setting. New methodologies to analyze for 1,2,3-TCP with a DLR of 0.005 μg/L have since been developed and the DHS is requesting that any utility with 1,2,3-TCP findings of nondetect with reporting levels of 0.01 μg/L or higher do follow-up sampling using a DLR of 0.005 ug/L. Private wells in the PWMP in 1999 through 2001 were analyzed for 1,2,3-TCP at a DLR of 50 μg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, all private wells are being re-tested at a lower detection limit – 0.005 μg/L.

Figures 3-14 and 3-15 show the distribution of 1,2,3-trichloropropane in Chino Basin, based on the data limitations discussed previously. Figure 3-14 uses the legend convention typically employed throughout this report. However, all of the previously detected values were using a method with a DLR of 50 μg/L, and, therefore, any detection would be 10,000 times the Action Level. Figure 3-15 uses an expanded legend by defining different class intervals. Figure 3-15 shows that the very high values of 1,2,3-TCP are associated with the Chino Airport VOC plume. In addition, there is a cluster of wells that have 1,2,3-TCP in concentrations greater than the Action Level north of the Chino Airport.

3.4.4.2 Arsenic

The current arsenic MCL is 50 μg/L. In January 2001, EPA mandated that compliance with the new federal arsenic MCL of 10 μg/L would be required by 2006. After adopting 10 μg/L as the new standard for arsenic in drinking water, the US EPA decided to review the decision to ensure that the final standard was based on sound science and accurate estimates of costs and benefits. In October 2001, the US EPA decided to move forward with implementing the 10 μg/L standard for arsenic in drinking water (US EPA, 2001). Figure 3-16 shows the distribution of arsenic in Chino Basin. Three wells in the PWMP had arsenic concentrations that exceed the 2006 MCL. Five wells in the City of Chino Hills area have concentrations of arsenic that exceed the 2006 MCL, with three wells having exceeded the current MCL of 50 µg/L. Higher concentrations of arsenic in this area are found at depths greater than about 350 feet below ground surface:

Well	Arsenic Concentrations 1997 – 2002 (mg/L)			Perforated Intervals (ft bgs)
	Minimum	Maximum	Average	
Chino Hills 16A	ND	67	39	430 – 940
Chino Hills 19	11	25	19	340 – 420 460 – 760 800 – 1000
Chino Hills 14	26	37	31	350 – 860
Chino Hills 15B	15	72	56	360 – 440 480 – 900
Chino Hills 1B	58	80	66	440 – 470 490 – 610 720 – 900 940 – 1180

Chino Hills 1A is a production well that is located about 30 feet from Chino Hills 1B, the well with the highest concentration of arsenic in the period from 1997 to 2002. During this period samples from Chino Hills 1A (perforated interval: 166 – 317 ft bgs) were all non-detect.

3.4.4.4 Manganese

Manganese is a naturally-occurring element that is a component of over 100 minerals. Because of the natural release of manganese into the environment by the weathering of manganese-rich rocks and sediments, manganese occurs ubiquitously at low levels in soil, water, air, and food. Manganese compounds are used in a variety of products and applications including water and wastewater treatment, matches, dry-cell batteries, fireworks, fertilizer, varnish, livestock supplements, and as precursors for other manganese compounds. Manganese is often found near landfills, especially when oxidation-reduction conditions promote its mobility in groundwater. that Neither manganese nor any manganese compounds are regulated in drinking water. However, manganese has a non-enforceable, secondary MCL 0.05 mg/L. High concentrations of manganese in groundwater have been observed along the Santa Ana River in Reach 3, scattered throughout the southern portion of Chino Basin and near the Milliken Landfill (Figure 3-17).

3.4.4.5 Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 3-18), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate (ClO_4^-) originates as a contaminant in the environment from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4^-) is exceedingly mobile in soil and groundwater environments. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions. Perchlorate is a kinetically stable ion, which means that reduction of the chlorine atom from a +7 oxidation state in perchlorate to a -1 oxidation state as a chloride ion requires activation energy or the presence of a catalyst to facilitate the reaction. Since perchlorate is chemically stable in the environment, natural chemical reduction in the environment is not expected to be significant.

Ammonium perchlorate is manufactured for use as an oxygenating component in solid propellant for rockets, missiles, and fireworks. Because of its limited shelf life, inventories of ammonium perchlorate must be periodically replaced with a fresh supply. Thus, large volumes of the compound have been disposed of since the 1950s in Nevada, California, Utah, and possibly in other states. While ammonium perchlorate is also used in certain munitions, fireworks, the manufacture of matches, and in analytical chemistry, perchlorate manufacturers estimate that about 90 percent of the substance is used for solid rocket fuel.

Speculation has arisen that perchlorate in groundwater may be the result of using “Chilean fertilizer” for agricultural purposes. The EPA recently completed a comprehensive survey of fertilizers and other raw materials for perchlorate to determine whether these could be significant contributors to environmental perchlorate contamination (Urbansky *et al.*, 2001). Four laboratories analyzed 48 fertilizer products from manufacturers of major commodity chemicals. Samples were collected from representative sites in the United States during the spring of 2000.

> Except for those products derived from Chilean caliche (a natural perchlorate source), the specific natures of the manufacturing processes suggest that perchlorate should not be present in most fertilizers. Chilean nitrate salts constitute about 0.14% of U.S. fertilizer application. Perchlorate was positively detected only in those materials known to be derived from Chilean caliche. The data obtained here fail to suggest that fertilizers contribute to environmental perchlorate contamination other than in the case of natural saltpeters or their derivatives. (Urbansky *et al.*, 2001)

In addition, fertilizers derived from Chilean caliche are used in small quantities, on specialized crops, including tobacco, cotton, fruits, and vegetables (Renner, 1999).

The requisite toxicology data available to evaluate the potential health effects of perchlorate are extremely limited. The US Environmental Protection Agency (EPA) Superfund Technical Support Center issued a provisional reference dose (RfD) in 1992 and a revised provisional RfD in 1995. Standard assumptions for ingestion rate and body weight were then applied to the RfD to calculate the reported range in the groundwater cleanup guidance levels of 4 to 18 (µg/L). In 1997, the DHS and the California EPA’s Office of Environmental Health Hazard Assessment reviewed the EPA’s risk assessment reports for perchlorate. Consequently, California established its provisional action level of 18 µg/L. On August 1, 1997, DHS informed drinking water utilities of its intention to develop a regulation to require monitoring for perchlorate as an unregulated chemical. Legislative action to establish a state drinking water standard for perchlorate has been introduced, but has not been brought to a vote (CA Senate Bill 1033).

The California DHS (2002a) has stated that perchlorate in groundwater in California likely reflects its use in the aerospace industry as a solid rocket propellant (in the form of ammonium perchlorate). To protect the public from perchlorate's adverse health effects – and in the absence of a drinking water standard for the contaminant – DHS established an action level of 18 µg/L, which was derived from available risk assessments. "Following the release of US EPA's 2002 draft risk evaluation, DHS concluded that its AL needed to be revised downward. Accordingly, on January 18, 2002, DHS reduced the perchlorate AL to 4 µg/L, the lower of the 4- to 18-µg/L range. The 4-µg/L AL also corresponds to the current detection limit for purposes of reporting (DLR)" (DHS, 2002c).

Historical values of perchlorate exceeding the State Action Level have occurred in the following areas of Chino Basin (Figure 3-18):

- There is a significant perchlorate plume in the Rialto-Colton and Chino Basins. The source of the plume is being investigated by the RWQCB and it appears to be located near the Mid-Valley Sanitary Landfill. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29).
- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.
- City of Pomona well field (source unknown).
- Wells in the City of Ontario Water Service Area, south of the Ontario Airport (source(s) unknown).
- Scattered wells in the Monte Vista Water Service Area (source(s) unknown).
- Scattered wells in the City of Chino Water Service Area (source(s) unknown).

3.4.4.6 Radon and Gross Alpha

Radon is a radioactive gas found in nature. It has no color, odor, or taste and is chemically inert. It's source is uranium – as the uranium molecule decays to form stable lead, a process taking many, many years, it changes from one radioactive element to another in a sequence known as the Uranium Decay Cycle. Partway through this cycle, the element radium becomes radon, which, as a gas moves up through the soil to atmosphere. Uranium is found in most soils and in granite. Radon may be found in drinking water and indoor air. Some people who are exposed to radon in drinking water may have an increased risk of getting cancer over the course of their lifetime, especially lung cancer. The US EPA has established a proposed MCL of 300 pCi/L (Macler, 2000).

Similarly, alpha radiation is a type of energy released when certain radioactive elements decay or break down. For example, uranium and thorium are two radioactive elements found naturally in the earth's crust. Over billions of years, these two elements slowly change form and produce "decay products" such as radium and radon. During this change process, energy is released. One form of this energy is alpha radiation.

Higher concentrations of radon and gross alpha in groundwater typically occur near granitic bedrock outcrops; one might expect to see higher occurrences of these constituents near the San Gabriel Mountains, Jurupa Hills, Puente Hills, and Chino Hills and along fault zones – Rialto-Colton Fault, San Jose Fault, and the Red Hill Fault. While the areal distributions of radon and gross alpha do not show the expected pattern, there are no spatial patterns or outside evidence to suggest a source other than naturally-occurring (Figures 3-19 and 3-20).

3.5 Point Sources of Concern

The previous water quality discussion broadly described water quality conditions across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 3-21 shows the location of various point sources and areas of water quality degradation associated with these sources.

3.5.1 Chino Airport

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fire-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells downgradient of Chino Airport. The most common VOC detected above its MCL was TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 μg/L.

Figure 3-21 shows the approximate areal extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 2002. The plume is elongate in shape, up to 3,600 feet wide and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction. During the period from 1997 to 2002, the maximum TCE concentration in groundwater detected at an individual well within the Chino Airport plume was 570 μg/L.

The County of San Bernardino has recently submitted a work plan to the Regional Board for installing up to five monitoring wells at and around Chino Airport in Summer 2003.

3.5.2 California Institute for Men

The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue, and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geomatrix Consultants, 1996). In 1990, PCE was detected at a concentration of 26 μg/L in a sample of water collected from a CIM drinking water supply well. Analytical results from groundwater sampling indicated that the most common VOCs detected in groundwater underlying CIM were PCE and TCE. Other VOCs detected included carbon tetrachloride, chloroform, 1,2-DCE, bromodichloromethane, 1,1,1-trichloroethane (1,1,1-TCA), and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 μg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 μg/L (Geomatrix Consultants, 1996).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 2,900 feet wide and extends about 5,800 feet from north to south. During the period from 1997 to 2002, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 1,990 μg/L and 141 μg/L, respectively.

3.5.3 General Electric Flatiron Facility

The General Electric Flatiron Facility (Flatiron Facility) occupied the site at 234 East Main Street, Ontario, California from the early 1900s to 1982. Its operations primarily consisted of the manufacturing of clothes irons. Currently, the site is occupied by an industrial park. The RWQCB issued an investigative order to General Electric (GE) in 1987 after an inactive well in the City of Ontario was found to contain TCE and chromium above drinking water standards. Analytical results from groundwater sampling indicated that VOCs and total dissolved chromium were the major groundwater contaminants. The most common VOC detected at levels significantly above its MCL is TCE, which reached a measured maximum concentration of 3,700 μg/L. Other VOCs periodically detected, but commonly below MCLs, included PCE, toluene, and total xylenes, (Geomatrix Consultants, 1997).

Figure 3-21 shows the approximate areal extent of TCE in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 3,400 feet wide and extends about 9,000 feet south-southwest (hydraulically downgradient) from the southern border of the site. During the period from 1997 to 2002, the maximum TCE and total dissolved chromium concentrations in groundwater detected at an individual well within the Flatiron Facility plume were 7,990 μg/L and 1,700 μg/L, respectively.

3.5.4 General Electric Test Cell Facility

The General Electric Company's Engine Maintenance Center Test Cell Facility (Test Cell Facility) is located at 1923 East Avon, Ontario, California. Primary operations at the Test Cell Facility include the testing and maintenance of aircraft engines. A soil and groundwater investigation, followed by a subsequent quarterly groundwater-monitoring program, began in 1991 (Dames & Moore, 1996). The results of these investigations showed that VOCs exist in the soil and groundwater beneath the Test Cell Facility and that the released VOCs have migrated off site. Analytical results from subsequent investigations indicated that the most common and abundant VOC detected in groundwater beneath the Test Cell Facility was TCE. Other VOCs detected included PCE, *cis*-1,2-DCE, 1,2-dicholoropropane, 1,1-DCE, 1,1-DCA, benzene, toluene, and xylenes, among others. The historical maximum TCE concentration measured at an on-site monitoring well (directly beneath the Test Cell Facility) was 1,240 μg/L. The historical maximum TCE concentration measured at an off-site monitoring well (downgradient) was 190 μg/L (BDM International, 1997).

Figure 3-21 shows the areal extent of VOC contamination exceeding federal MCLs as of 2002. The plume is elongate in shape, up to 2,400 feet wide and extends approximately 10,300 feet from the Test Cell Facility in a southwesterly direction. During the period from 1997 to 2002, the maximum TCE and

PCE concentrations in groundwater detected at an individual well within the Test Cell Facility plume were 1,100 µg/L and 29 µg/L, respectively.

3.5.5 Kaiser Steel Fontana Steel Site

Between 1943 and 1983, the Kaiser Steel Corporation (Kaiser) operated an integrated steel manufacturing facility in Fontana. During the first 30 years of the facility's operation (1945-1974), a portion of the Kaiser brine wastewater was discharged to surface impoundments and allowed to percolate into the soil. In the early 1970s, the surface impoundments were lined to eliminate percolation to groundwater (Wildermuth, 1991). In July of 1983, Kaiser initiated a groundwater investigation that revealed the presence of a plume of degraded groundwater under the facility. In August of 1987, the RWQCB issued Cleanup and Abatement Order Number 87-121, which required additional groundwater investigations and remediation activities. The results of these investigations showed that the major constituents of the release to groundwater were inorganic dissolved solids and low molecular weight organic compounds. Wells sampled during the groundwater investigations measured concentrations of total dissolved solids (TDS) ranging from 500-1,200 mg/L and concentrations of total organic carbon (TOC) ranging from 1 to 70 mg/L. As of November 1991, the plume had migrated almost entirely off the Kaiser site.

Figure 3-21 shows the approximate areal extent of the TDS/TOC groundwater plume as of 2002. Based on a limited number of wells, including City of Ontario Well No. 30, the plume is up to 3,400 feet wide and extends about 17,500 feet from northeast to southwest.

3.5.6 Mid-Valley Sanitary Landfill

The Mid-Valley Sanitary Landfill (MVSL) is a Class III Municipal Solid Waste Management Unit located at 2390 North Adler Avenue in the City of Rialto. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. VOCs and perchlorate have been detected in groundwater beneath and downgradient from the MVSL. The most common and abundant VOCs in groundwater are PCE, 1,1-DCA, and 1,1-DCE. TCE, cis-1,2-DCE, 1,2-DCA, vinyl chloride, and benzene also have been detected. The VOC plume from the MVSL does not appear to extend into the Chino Basin as of 2002 (Figure 3-21).

Perchlorate has been detected in the Rialto-Colton and Chino Basins (Figure 3-18). The sources of the perchlorate plume are being investigated by the RWQCB and it appears that one set of sources is located near the MVSL. According to the RWQCB, other companies including B. F. Goodrich, Kwikset Locks, American Promotional Events Inc., and Denova Environmental Inc. operated nearby and used or produced perchlorate. These companies were located on a 160-acre parcel at T1N R5W S21 SW1/4. Denova Environmental also operated on a 10-acre lot at T1N R5W S20 S1/2 (along the boundary between Sections 20 and 29). The perchlorate plume appears to migrate initially to the southeast prior to moving to the southwest in the direction of regional groundwater flow. The local groundwater flow direction at the landfill is to the southeast, potentially influenced by the Alder Avenue Barrier (GeoLogic, 2002). The perchlorate plume in the Rialto Basin appears to extend well into the Chino Basin, crossing the Rialto-Colton Fault. The plume is about seven miles long from the middle of the Mid-Valley Sanitary Landfill.

3.5.7 Milliken Sanitary Landfill

The Milliken Sanitary Landfill (MSL) is a Class III Municipal Solid Waste Management Unit located near the intersections of Milliken Avenue and Mission Boulevard in the City of Ontario. The facility is owned by the County of San Bernardino and managed by the County's Waste System Division. The facility was opened in 1958 and continues to accept waste within an approximate 140-acre portion of the 196-acre permitted area (GeoLogic Associates, 1998). Groundwater monitoring at the MSL began in 1987 with five monitoring wells as part of a Solid Waste Assessment Test investigation (IT, 1989). The results of this investigation indicated that the MSL has released organic and inorganic compounds to the underlying groundwater. At the completion of an Evaluation Monitoring Program (EMP) investigation (GeoLogic Associates, 1998), a total of 29 monitoring wells were drilled to evaluate the nature and extent of groundwater impacts identified in the vicinity of the MSL. Analytical results from groundwater sampling indicated that VOCs are the major constituents of the release. The most common VOCs detected were TCE, PCE, and dichlorodifluoromethane. Other VOCs detected above MCLs included vinyl chloride, benzene, 1,1-dichloroethane, and 1,2-dichloropropane. The historical maximum total VOC concentration in an individual monitoring well was 159.6 μg/L (GeoLogic Associates, 1998).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. The plume is up to 1,800 feet wide and extends about 2,100 feet south of the MSL's southern border. During the period from 1997 to 2002, the maximum TCE and PCE concentrations in groundwater detected at an individual well within the MSL plume were 64 μg/L and 81 μg/L, respectively.

3.5.8 Municipal Wastewater Disposal Ponds

Treated municipal wastewater has been disposed into ponds located near the current IEUA Regional Plant 1 (RP1), located in south Ontario, and the former Regional Plant 3 (RP3), located in south Fontana. The ponds located just east of RP1, commonly called the Cucamonga ponds, were used to dispose of untreated effluent collected by the Cucamonga County Water District (CCWD) and the IEUA. RP3 and its disposal ponds are located on the southwest corner of Beech and Jurupa Avenues in the City of Fontana. Discharge to the Cucamonga ponds and the ponds of RP3 ceased between the early 1970s and the mid-1980s. The areas downgradient of these recharge ponds typically have elevated TDS and nitrate concentrations. Contaminant plumes emanating from these ponds have never been fully characterized.

3.5.9 Upland Sanitary Landfill

The closed and inactive Upland Sanitary Landfill (USL) is located on the site of a former gravel quarry at the southeastern corner of 15th Street and Campus Avenue in the City of Upland. The facility operated from 1950 to 1979 as an unlined Class II and Class III municipal solid waste disposal site. In 1982, USL was covered with a 10-inch thick, low permeability layer of sandy silt over the entire disposal site (GeoLogic Associates, 1997). Groundwater monitoring at the USL began in 1988 and now includes three on-site monitoring wells, an upgradient well, a cross-gradient well, and a downgradient well (City of Upland, 1998). The results of historic groundwater monitoring indicate that USL has released organic and inorganic compounds to underlying groundwater (GeoLogic Associates, 1997). Groundwater samples from the downgradient monitoring well consistently contain higher concentrations of organic and inorganic compounds than samples from the upgradient and cross-gradient monitoring wells. Analytical results from historic groundwater sampling indicate that VOCs are the major constituents of the organic release. All three monitoring wells have shown detectable levels of VOCs. The most common VOCs detected above MCLs are dichlorodifluoromethane, PCE, TCE, and vinyl chloride. Other VOCs that have been periodically detected above MCLs include methylene chloride, *cis*-1,2-DCE, 1,1-DCA, and benzene.

The 1990 to 1995 average total VOC concentration in the downgradient monitoring well is 125 μg/L (GeoLogic Associates, 1997).

Figure 3-21 shows the approximate areal extent of VOCs in groundwater at concentrations exceeding MCLs as of 2002. However, the plume is defined only by the three on-site monitoring wells. The extent of the plume may be greater than currently depicted in Figure 3-21. During the period from 1997 to 2002, the maximum TCE and PCE concentrations detected in the downgradient monitoring well within the USL plume were 4.2 μg/L and 16 μg/L, respectively.

3.5.10 Un-named VOC Plume – South of the Ontario Airport

A VOC plume containing primarily TCE exists south of the Ontario Airport. The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. Figure 3-21 shows the approximate areal extent of the plume as of 2002. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1997 to 2002, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 μg/L.

3.5.11 Stringfellow NPL Site

One facility in the Chino Basin is on the current National Priorities List (NPL) of Superfund sites. The Stringfellow site is located in Pyrite Canyon, north of Highway 60, near the community of Glen Avon, in Riverside County (Figure 3-21). From 1956 until 1972, the 17-acre Stringfellow site was operated as a hazardous waste disposal facility. More than 34 million gallons of industrial waste, primarily from metal finishing, electroplating, and pesticide production were deposited at the site (USEPA, 2001). A groundwater plume of site-related contaminants exists underneath portions of the Glen Avon area. Groundwater at the site contains various VOCs, perchlorate, N-nitrosodimethylamine (NDMA), and heavy metals such as cadmium, nickel, chromium, and manganese. Soil in the original disposal area is contaminated with pesticides, PCBs, sulfates, and heavy metals. The original disposal area is now covered with a barrier and fenced. Contamination at the Stringfellow site has been addressed by cleanup remedies described in four US Environmental Protection Agency (USEPA) Records of Decision. These cleanup actions have focused on control of the source of contamination, installation of an onsite pretreatment plant, cleanup of the lower part of Pyrite Canyon, and cleanup of the community groundwater area.

Figure 3-21 shows the approximate areal extent of the Stringfellow plume as of 2002. The plume is elongate in shape, up to 6,000 feet wide and extends approximately 22,500 feet from the original disposal area in a southwesterly direction. During the period from 1997 to 2002, the maximum total VOC concentration detected in the Stringfellow plume was 1,241 μg/L.

3.6 Current State of Groundwater Quality in Chino Basin

As discussed in Section 1, the baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of OBMP implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP. In terms of TDS and nitrate, the initial state of groundwater quality in Chino Basin is illustrated by Figures 3-4 and 3-7. These figures were developed from data derived from Watermaster's water quality database. This database can be queried in future studies to determine the state of the basin's groundwater quality for any constituent.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Twenty-eight percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations below the secondary MCL. In places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting that there is a vertical stratification of water quality. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL.

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. As discussed in Sections 3.4.4.1 and Section 3.5, there are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate (MVSL area, Stringfellow, *et cetera*) as well as what appears to be non-point source related perchlorate contamination from currently undetermined sources. Arsenic at levels above WQS appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.