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SUPERIOR COURT
COUNTY OF SAN BERNARDINO
RANCHO CUCAMONGA DISTRICT
FEE EXEMPT
SEP 25 2007
BY [signature] DEPUTY

Attorneys For
CHINO BASIN WATERMASTER

SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF SAN BERNARDINO

CHINO BASIN MUNICIPAL WATER DISTRICT

Plaintiff,

vs.

CITY OF CHINO, ET AL.

Defendant.

Case No. RCV 51010

[Assigned for All Purposes to the Honorable MICHAEL GUNN]

TRANSMITTAL OF DENNIS WILLIAMS' COMMENTS ON WATERMASTER'S LONG TERM PLAN

Hearing Date: **None**

Department: **R-8**

Attached to this pleading as Exhibit "A" is the expert report of Dennis E. Williams, *Comments on Chino Basin Watermaster's Proposed Long Term Plan for the Management of Subsidence in MZ-1.*

According to correspondence from attorneys for Chino Hills, attached here as Exhibit "B," copies of the report have already been served on the Special Referee and her technical assistant Joe Scalmanini.

On Friday, September 21, 2007, Watermaster posted a copy of the report to its website and served notice on the parties of the availability of the report in accordance with normal Watermaster notice procedures.

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Because of the size of the report and because it has already been served on the parties, additional copies will not be served pursuant to this transmittal pleading.

Dated: September 25, 2007

By: ______________________
HATCH & PARENT
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Michael T. Fife
Attorneys for Chino Basin Watermaster

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EXHIBIT A

Expert Report of
Dennis E. Williams Ph.D.

SUPERIOR COURT OF THE STATE OF CALIFORNIA
COUNTY OF SAN BERNARDINO

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

September 21, 2007

Prepared for:

Jenkins & Hogin, LLP

EXPERT REPORT OF DENNIS E. WILLIAMS Ph.D.

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

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EXPERT REPORT OF DENNIS E. WILLIAMS Ph.D.

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

I. BACKGROUND AND QUALIFICATIONS

1. My name is Dennis E. Williams. I have over 35 years of experience in ground water hydrology and water resources management. I have directed geohydrologic investigations domestically and worldwide which include the design and supervision of construction of over 700 deep large-scale municipal and irrigation water supply wells. I have been a consultant to the United Nations and several foreign governments and am also a part-time research professor in the University of Southern California's (USC) Civil and Environmental Engineering Department where since 1980 I have taught graduate level courses in geohydrology and ground water modeling. I am currently directing ground water research at USC's geohydrologic laboratory which houses the largest sand-tank model in the world. I am the author of over 30 publications on ground water and wells and was the principal author of the *Handbook of Ground water Development* (John Wiley & Sons, 1990). I was also Chief Reviewer and contributing Author of *ASCE's International Manual on Well Hydraulics* (in Press). I have provided expert witness testimony for numerous legal cases including testifying over six times in State or Federal Court on ground water and/or modeling issues.

2. I am the founder and president of GEOSCIENCE Support Services, Inc. which was established in 1978. GEOSCIENCE is a ground water consulting company specializing in ground water supply, development, management and protection. GEOSCIENCE's clients include most of the major water districts and agencies in Southern California, as well as clients in South America, Europe, and the Middle and Far East.

3. I have directed ground water related projects in the Chino Basin since the 1980's and for the City of Chino Hills since 1996. Projects include water quality investigations, artificial recharge, well site investigations, construction of water supply and monitoring wells, drinking water source assessments, well rehabilitation, and development of ground water flow and solute transport models

4. My resume is included in Appendix A.

II. SUMMARY OF COMMENTS

5. The Guidance Level of 245 ft is not supported by long-term data, and is based on only one pumping test (Fall 2004) in only one location (Ayala Park Deep Extensometer), as such the LTP should not be applied to the entire southern MZ-1 area. Repeated observations in wells and extensometers in a number of areas are needed over time to establish a conclusive relationship between depth to ground water levels and land deformation. A time-history of preconsolidated levels needs to be developed based on seasonal variations in ground water levels and aquifer/aquitard compaction.

6. Watermaster has stated in numerous reports and presentations that ground water modeling will be used to support the development of the LTP (WE, 2006; Schneider, 2005; Chino Basin Watermaster, 2004). To date, no modeling results have been shared with MZ-1 producers. Its seems that the interim Guidance Level was simply adopted as the Guidance Level being applied in the LTP without the benefit of additional data or modeling results. This fact together with the Guidance Level being based on only one pumping test reduces confidence in the proposed 245 ft Guidance Level.

7. It is recommended that the Guidance Level of 245 ft remain an interim level until quantitative relationships between ground water level changes and aquifer/aquitard compaction are known either through more controlled pumping tests or seasonal pumping by producers. As such, the 245 ft level should not be included in the LTP, but rather the Interim Plan should remain in effect until the Guidance Level has been determined with more certainty.

8. Only if based on reproducible and defendable preconsolidation depths to ground water can the subsidence threshold (i.e., Guidance Level) be established for a specific region. Additional extensometers should be constructed in areas of suspected subsidence such as the central area of MZ-1. The same procedure should be used to establish the preconsolidation level in this region based on a time history of pumping and changes in aquifer compaction (i.e., stress-strain analysis). In time, and as a result of establishing preconsolidation levels at a number of different locations in the central and southern areas of MZ-1, a regional subsidence threshold surface can be established. This regional

subsidence threshold or Regional Guidance Level (RGL) can be displayed as contours by which management of MZ-1 subsidence can take place.

9. The LTP recommends that the Parties manage their own production to allow water levels to remain above the Guidance Level (pg 2-1; WE, 2007a). However, the LTP also states that annual recovery periods of between 2 to 6 months are recommended (pg 3-1; WE, 2007a) without providing any basis for the annual recovery periods. These statements appear contradictory.

10. The pumping restrictions stated in the LTP do not appear to be based on sufficient scientific work thus far or are structured to meet a minimum acceptable level of subsidence. In other words, it is not clear whether the guidance criteria in the LTP intend to stop all subsidence or if there is a certain minimum amount which will be allowed.

11. Because there has been measured subsidence in the central portion of MZ-1, without significant pumping stress in the immediate subsidence area (Schneider, 2005), additional monitoring and data collection needs to be conducted in the central MZ-1 to establish the causes of increasing subsidence in the area. This is important as, if the cause of subsidence is found not to be from water withdrawal from the deep aquifer, the same mechanism may also be responsible or be contributing to subsidence in the southern portion of MZ-1.

12. The Watermaster's "Managed Area" should be expanded to the central and north MZ-1 area to include the apparent subsidence that is depicted on recent InSAR analysis (1996-2000). This area may be experiencing a delayed response to the long-term lowering of ground water levels in the MZ-1 area. This delayed response hypothesis should be verified through continued monitoring of surface and subsurface deformation (e.g., land surface surveys, extensometers and InSAR analyses).

13. Watermaster has started with collecting important measurements on land deformation and ground water levels, however, it is felt that these data are presently not extensive enough in terms of defining both temporal and spatial variations to draw conclusions that will be implemented in a LTP that has far reaching consequences for local purveyors.

14. Section VII of this report presents a proposed production scenario for operation of City of Chino Hills' deep wells. This scenario was simulated using ground water modeling and ensures that the Watermaster's proposed Guidance Level of 245 ft is met at PA-7.

15. The LTP recommends that the Parties manage their own production to allow water levels to remain above the Guidance Level (pg 2-1; WE, 2007a). With this in mind, ground water model simulations for the City of Chino Hills' wells have shown that Scenario 3 (approximate maximum historical pumping from the City of Chino Hills' wells plus pumping from two new shallow wells west of the barrier and Well 18A east of the barrier, i.e., 7,400 acre-ft/yr), would not allow water level declines more than the Guidance Level of 245 ft as measured in Ayala Park PA-7. As such, this production scenario should be used to test (and/or refine) the Guidance Level for the Ayala Park area by providing seasonal variations in stress-strain relationships of the aquifer/aquitard system.

16. Pumping of City of Chino Hills' wells under Scenario 3 would allow variations in pumping and recovery from which stress-strain relationships could be analyzed and a long-term preconsolidation level determined.

17. Watermaster has not addressed in the Summary Report the Special Referee's question as to whether there was any pre-1990's subsidence that may have occurred that correlates with, or can be attributed to, the large historical changes in ground water levels that predated the Judgment. Knowledge of historical subsidence is important when developing methods of managing future potential subsidence.

18. No ground water or subsidence modeling has been conducted by Watermaster to support the effectiveness of the annual recovery periods.

19. In light of the above comments, the LTP does not meet its specified goals of developing an acceptable pumping plan. Furthermore, no mention of alternative sources of water available to the City of Chino Hills or other purveyors is provided for those periods when deep well pumping is not allowed. Additionally, artificial recharge aspects stated in the goals of the LTP are not included as part of the plan.

20. The ground water level responses in wells during the Fall 2004 pumping test (see Figure 11), indicate that the shallow aquifer (ground water levels in PA-10), has responded to pumping from the deep aquifer system. This may reflect hydraulic connection between the deep and shallow aquifers. Documents leading up to the proposed LTP and the LTP itself do not address any management of shallow well pumping.

III. INTRODUCTION

21. The Chino Basin Optimum Basin Management Program (OBMP) published by the Chino Basin Watermaster (Watermaster) in 1999 identified pumping-induced and subsequent aquifer-system compaction as the likely cause of subsidence (WE, 1999) in Chino Basin's Management Zone 1 (MZ-1, see Figure 1). In order to address this issue and others, the OBMP recommended to "*Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1*".

22. With regard to subsidence in MZ-1, the Superior Court of the State of California issued a Court Order in October 2002 directing Watermaster to implement an Interim Plan Monitoring Program, and to develop a long-term plan (LTP) by fiscal year 2004/05.

23. In January 2003, the Technical Committee (TC) approved the scope and schedule of the Interim Monitoring Program (IMP).

24. As part of the IMP, hydraulic and mechanical changes within the aquifer system have been monitored by measurement of ground water levels and through the use of shallow and deep extensometers at Ayala Park. Monitoring of deformation of land surface through the use of benchmark land surveying and InSAR has also taken place.

25. After a workshop in May 2005, a Special Referee's Report on progress made on implementation of the Watermaster Interim Plan for management of subsidence was issued. The Special Referee's report noted that several more years of studies, model development and analysis would be required, followed by 12 months to reach an agreement on the LTP between Parties. Recommendations were also made that Watermaster prepare a Summary Report and issue guidance criteria for ground water levels that would prevent inelastic compaction.

26. The Management Zone 1 Interim Monitoring Program - MZ-1 Summary Report was finalized in February 2006.

27. On August 1, 2007, the attorneys for Watermaster issued a Motion for Approval of Watermaster's Long Term Plan for the Management of Subsidence.

28. This expert report is in response to the abovementioned Motion.

IV. LAND SUBSIDENCE DUE TO GROUND WATER WITHDRAWAL

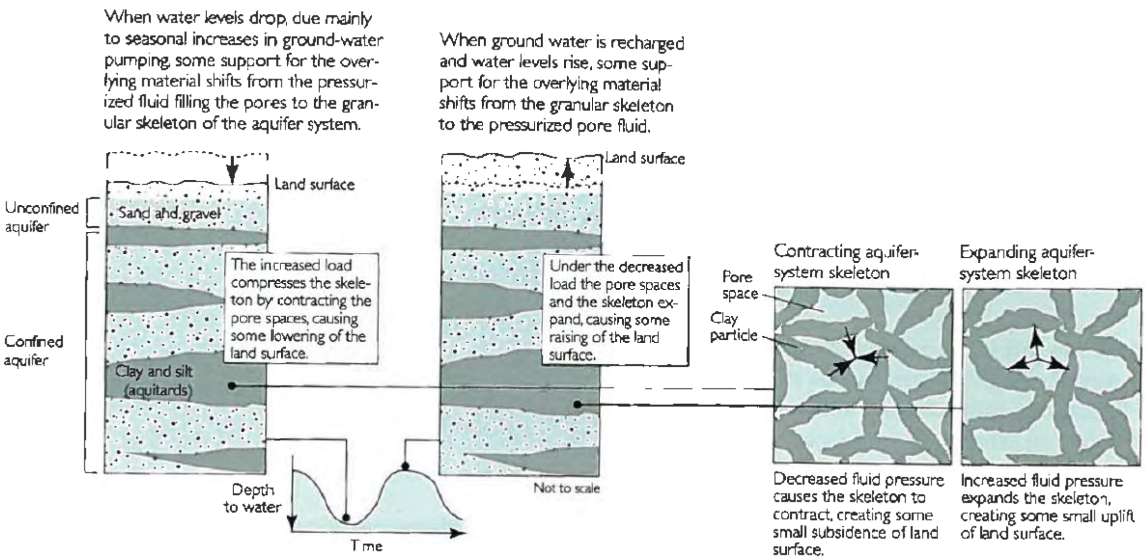
29. The theory pertaining to land subsidence by ground water withdrawal is well documented in the literature and the relationships between changes in ground water levels and corresponding changes in effective stress leading to subsidence of the aquifer system is well understood as a result of important work by Johnson, et al. (1968), Meade (1968), Poland and Ireland (1988), Ireland, et al. (1984); Helm (1984), Helm (1975), and Riley (1969). For purposes of this report it is important to highlight some important principles pertaining to subsidence due to ground water withdrawal, and more specifically how these principles relate to Watermaster's proposed Long Term Plan (LTP) (see Section VI).

30. Appendix B which contains GEOSCIENCE's 2002 preliminary geohydrologic analysis of subsidence in the western portion of the Chino Basin includes a more detailed explanation of the theoretical aspects of subsidence (Section 4).

IV.1 Elasticity of Aquifers

31. Withdrawal of ground water (i.e., by pumping) lowers ground water levels and reduces fluid pressure in the pore spaces (fluid pore pressure) of the aquifer/aquitard system. The fluid pore pressure in part supports the weight of the overlying material (overburden). As such, when the fluid pressure is reduced (due to pumping), more of the overburden weight is transferred to the aquifer/aquitard skeleton which compresses to some degree. This compression (i.e., compaction) of the aquifer system is concentrated in the finer-grained aquitards interbedded within the aquifer system. Conversely, when water levels increase (i.e., recover), fluid pore pressure is increased and support previously provided by the aquifer/aquitard skeleton is transferred back to the fluid and the aquifer/aquitard skeleton expands. In other words, the aquifer skeleton alternately compresses and expands in response to changes in ground water levels (i.e., in response to pumping and recharge) and thus behaves as an elastic system. Figure 2 (below) illustrates aquifer system elasticity.

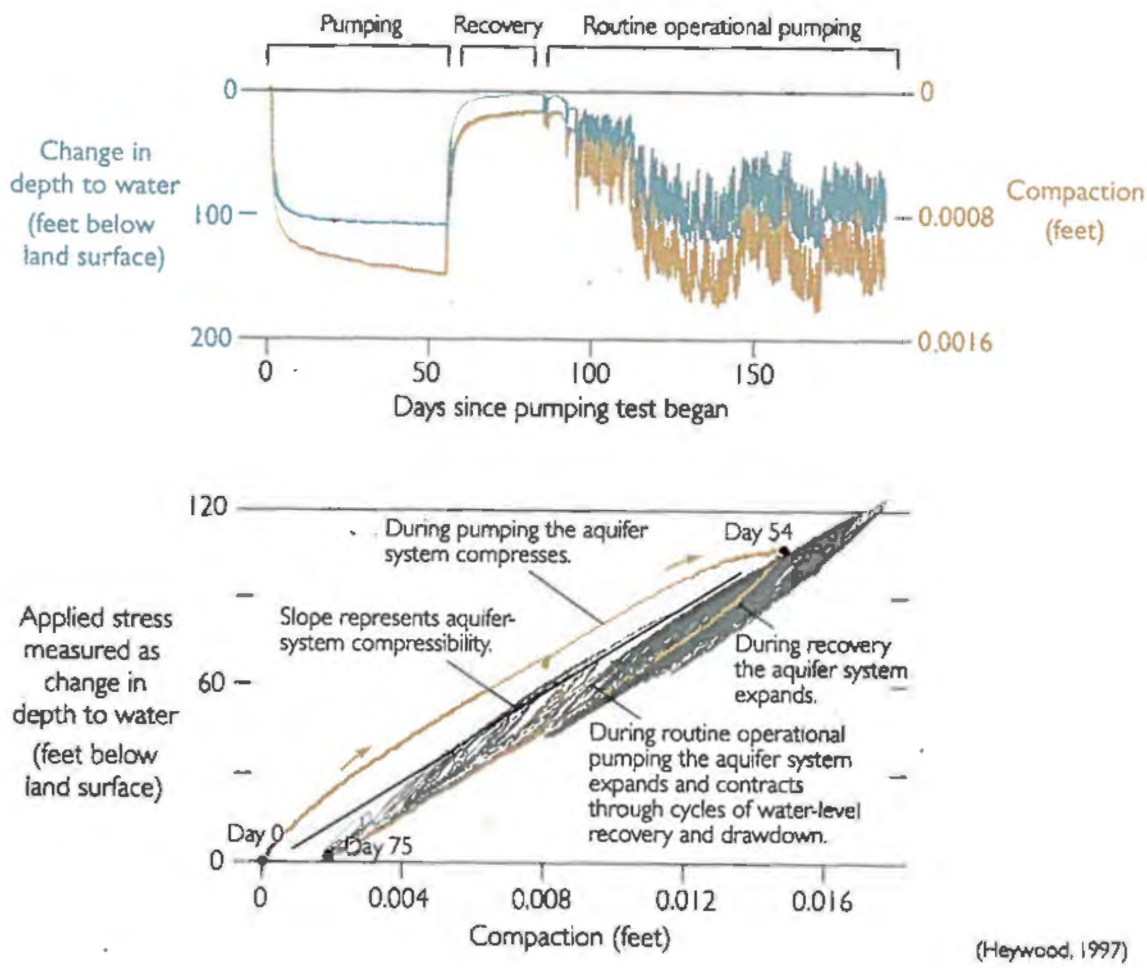
Figure 2: Graphical Representation of the Elasticity of Aquifers



Source: USGS, 1999.

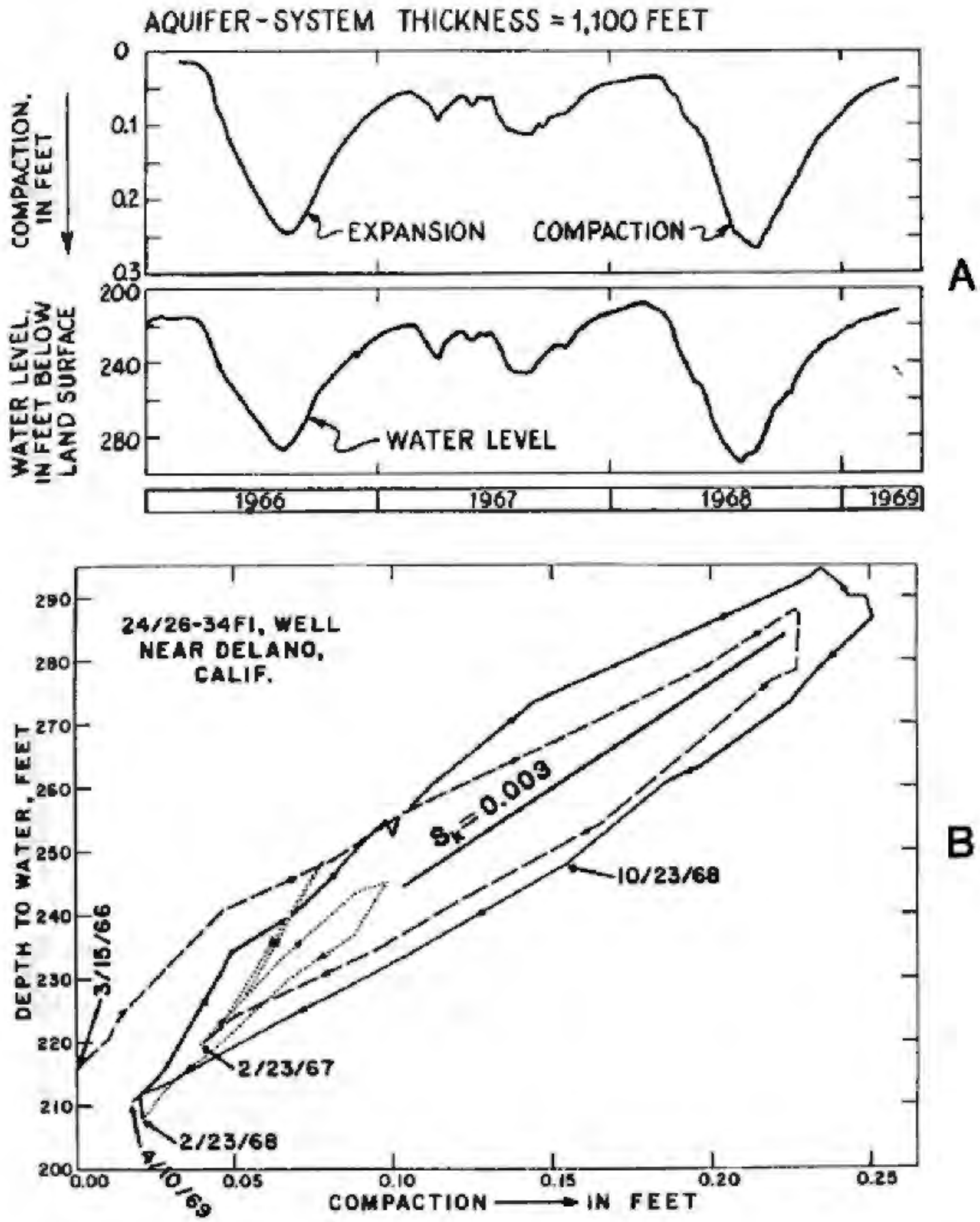
32. When the load on the aquifer skeleton is less than any previous maximum load, the fluctuations in ground water levels create only small elastic deformation of the aquifer system and corresponding small displacements of the land surface. All aquifer systems behave elastically to some degree and exhibit seasonal reversible displacements (compression and expansion) in the land surface in response to changes in ground water withdrawal (see Figures 3 and 4).

Figure 3: Recoverable (Elastic) Deformation Observed During and Following a Pumping Test in Albuquerque, New Mexico



Source: USGS, 1999.

Figure 4: Head Change and Recorded Aquifer-System Deformation
A. Fluctuations in Head (Stress) and Thickness of the Confined Aquifer System
B. Drawdown-Compaction (Stress-Strain) Relationship
A.

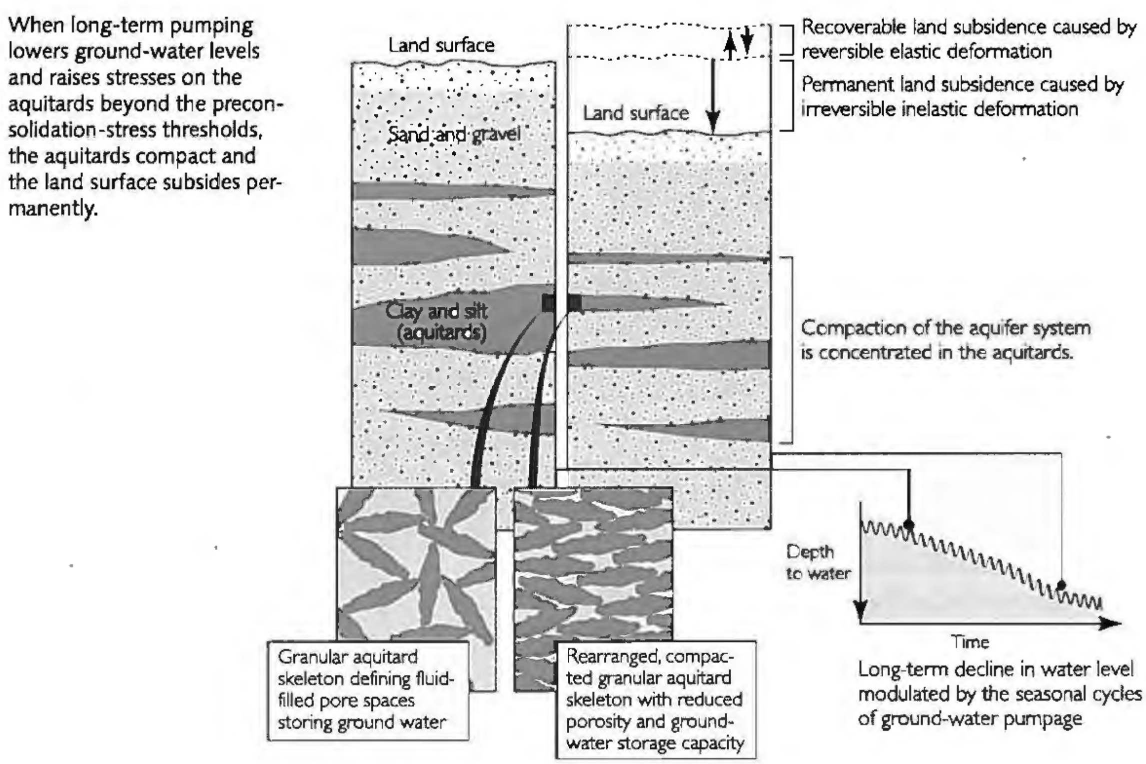


Source: Riley, 1984.

IV.2 Non-Recoverable Compaction

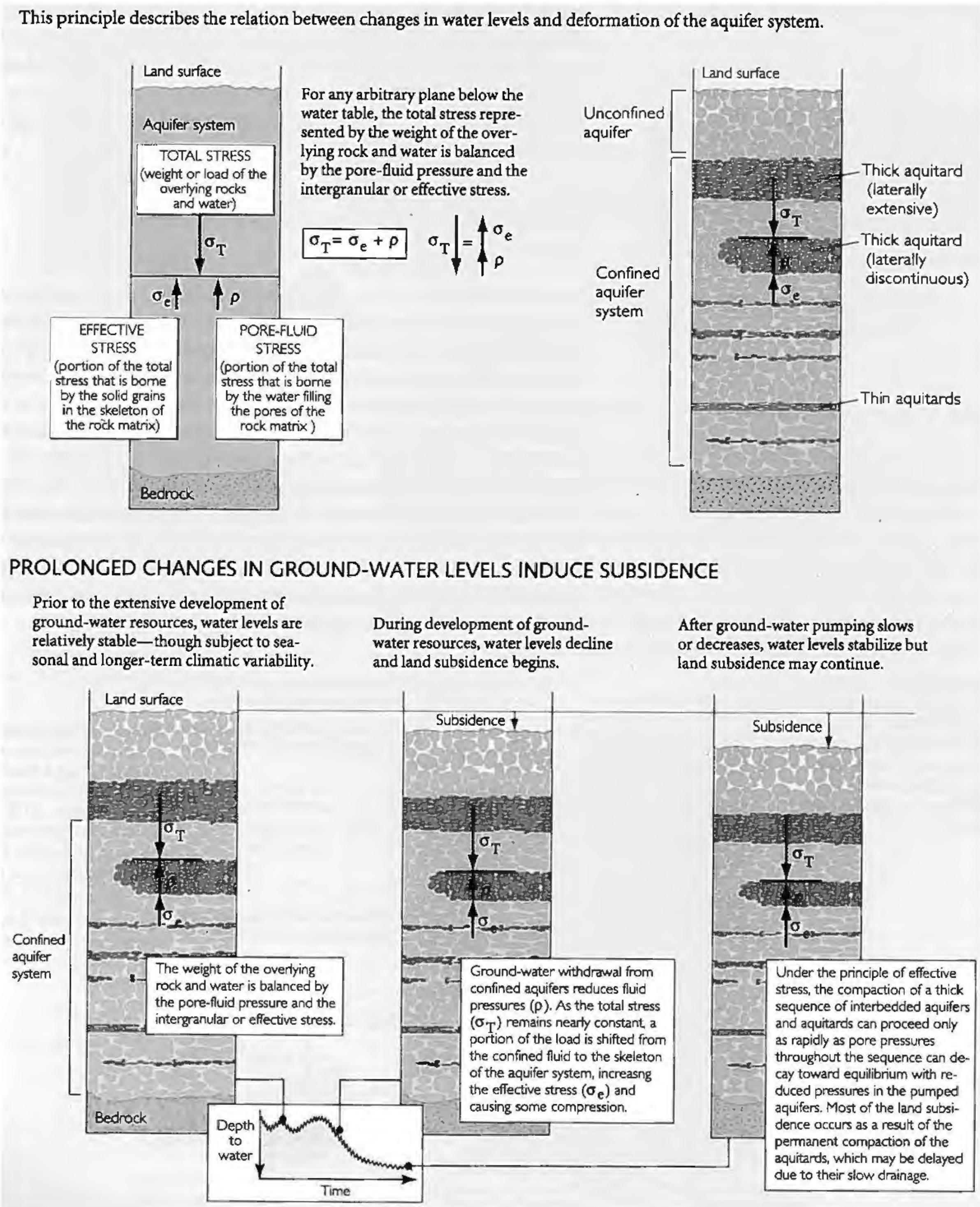
33. The maximum historical level of stress (i.e., ground water level change) which the aquifer skeleton has undergone in the past is known as the preconsolidation stress. When the load on the aquifer skeleton exceeds the preconsolidation stress, the aquitard skeleton may undergo a permanent rearrangement of the granular material. When this happens a permanent reduction in the pore volume results and water is forcibly "drained" out of the aquitards into the adjacent aquifers, the rate of which depends on both permeability and aquitard thickness. This process results in a permanent reduction in aquitard pore volume and is referred to as non-recoverable compaction (see Figures 5 and 6).

Figure 5: Non-Recoverable or Inelastic Compaction



Source: USGS, 1999.

Figure 6: Aquitard Drainage and Aquifer-System Compaction
The Principle of Effective Stress

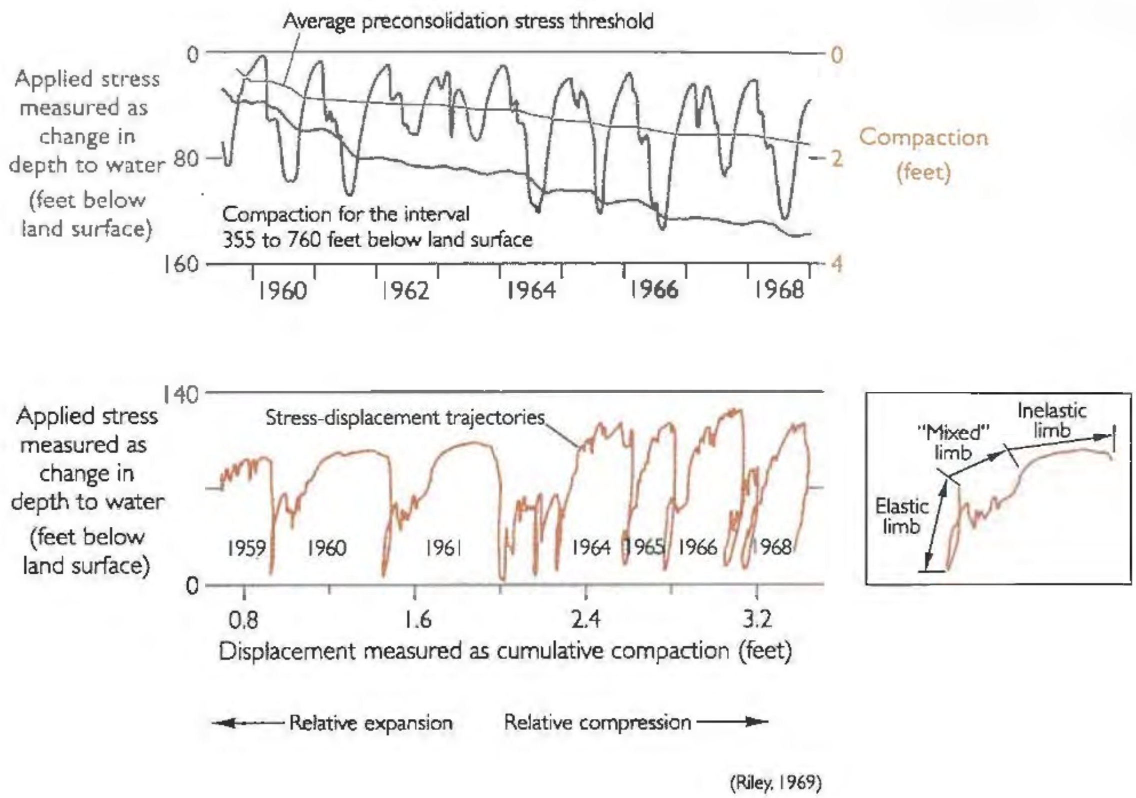


Source: USGS, 1999.

IV.3 Determination of Preconsolidation Levels

34. The preconsolidation ground water level is that ground water level at which non-recoverable compaction will occur. Specifically, if ground water levels are higher than the preconsolidation level, only elastic (i.e., recoverable) compaction will occur. However, if ground water levels fall below preconsolidation levels, inelastic (i.e., plastic) deformation will occur as fine-grained aquitard pore volumes are permanently reduced. Typically, compression occurs most rapidly when the stress (ground water level change) is larger than the preconsolidation stress threshold. When the preconsolidation threshold is exceeded, almost all of the compression is permanent (inelastic) as the fine-grained aquitards compact (see Figure 7 below).

Figure 7: Permanent (Inelastic) Compaction Observed Near Pixley, San Joaquin Valley, California During a 10-Year Period

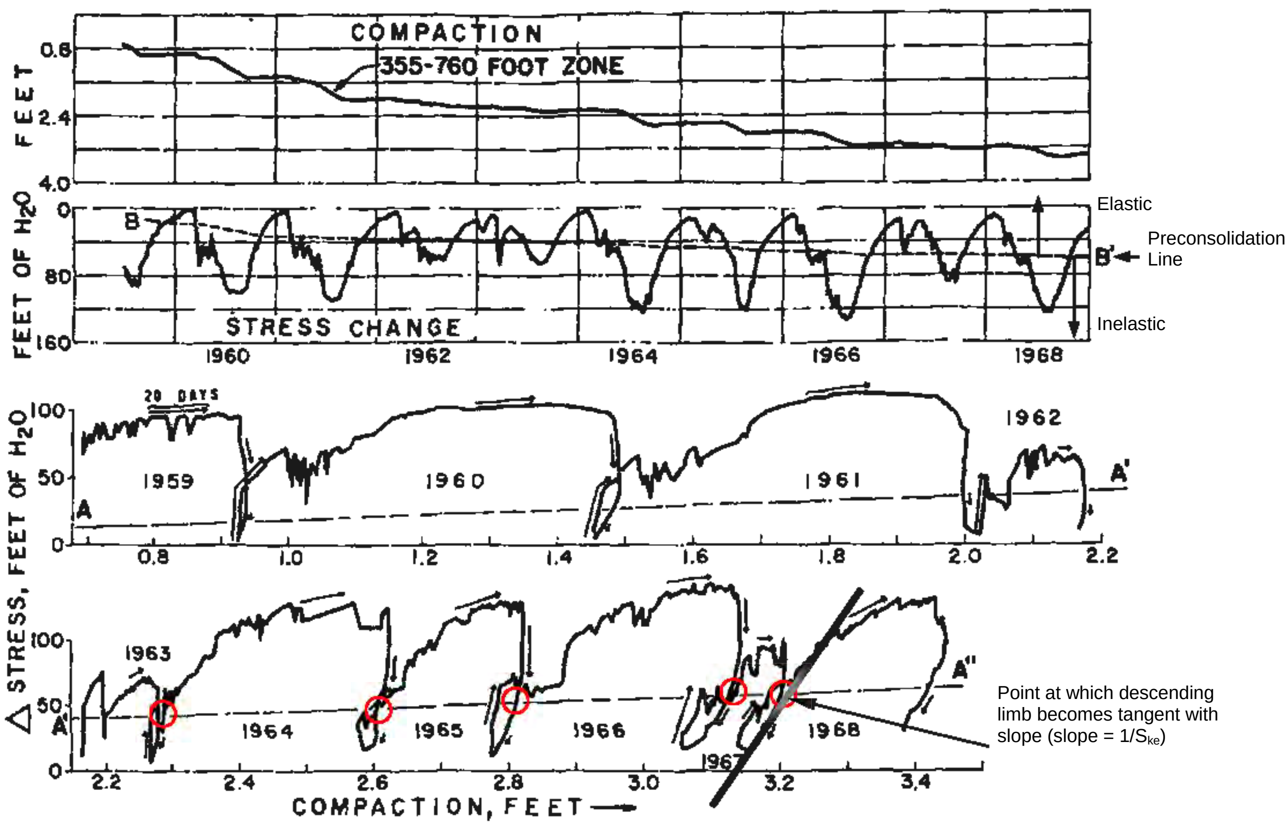


Source: USGS, 1999

35. Determination of preconsolidation levels, based on historical ground water levels and aquitard compaction changes, is outlined by Riley (1969). In this procedure, a time history of ground water level changes and aquifer compaction are obtained for a specific area of interest. When long-term plots of depth to water vs. cumulative compaction are plotted, a time history of stress-strain relationships is developed (i.e., stress-displacement trajectories) (see Figure 8 below). The method proposed by Riley consists of determining the stress level at which the descending expansion curve becomes tangent to the elastic storativity line (S_{ke}) (see points on A' A" of Figure 8).

36. After construction of the preconsolidation line from the stress-strain diagrams (see line A'-A''-A''' on Figure 8), the preconsolidation line can be plotted on the water level graph (see line B-B' on Figure 8) to determine the elastic/inelastic ground water level threshold. In this manner, any water level depths less than the preconsolidation depth will result in elastic or recoverable compaction and water level depths greater than the preconsolidation depth will result in inelastic or non-recoverable compaction.

Figure 8: History of Compaction and Stress Change, and the Relationship between Stress Change and Compaction near Pixley, Tulare County, California



After Riley (1969).

V. HISTORICAL SUBSIDENCE IN CHINO BASIN'S MANAGEMENT ZONE 1

V.1 Summary of Subsidence from 1900's to 2002

37. It has been demonstrated by Poland and Ireland (1988) and Ireland et al. (1984) that land subsidence due to ground water withdrawal is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of a high percentage of fine-grained sediments (silt and clay). Land surface subsidence has been recognized in portions of southwest Chino Basin since the 1930's. Although the phenomenon was a concern in the 1970s and 1980s, increased subsidence observed between 1993 and 1995 coupled with rapid urbanization of the area has resulted in the need to understand all potential causes of subsidence in the Chino area and develop a strategy to mitigate it to the extent necessary and possible. Land subsidence in MZ-1 has been minimal between 1995 and the present, based on both benchmark surveys and InSAR data. This correlates with relatively stable ground water levels over the same time period.

38. A preliminary geohydrological evaluation was carried out in 2002 by GEOSCIENCE to assess the cause(s) of subsidence, based on existing data, in the western portion of the Chino Basin and to provide a technical basis for the development of a sound interim subsidence management plan for the area (see Appendix B for full report). The principal findings of this evaluation were as follows:

    - Land subsidence due to ground water withdrawal is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of a high percentage of fine-grained sediments (silt and clay).

    - The aquifer system in the western portion of the Chino Basin can generally be divided into shallow and deep aquifer zones separated by fine-grained clay layers. However, the boundary between the shallow and deep aquifers is not well defined because the clay layers are heterogeneous, do not occur at the same depth throughout the area, and are laterally discontinuous.

- The highest percentage of clay, relative to total alluvial thickness, occurs in the western portion of MZ-1.

- Due to the heterogeneous and laterally discontinuous nature of the clay layers separating the shallow and deep aquifer systems, it is likely that hydraulic communication occurs between the two systems.

- The shallow and deep aquifers in the Study Area are naturally recharged primarily from deep percolation of precipitation falling on the alluvial slope at the base of the San Gabriel Mountains. Deep percolation of precipitation recharges both the shallow and deep aquifer systems before migrating downgradient in a southerly direction.

- Prior to approximately 1904, the aquifers beneath a large portion of the Study Area were under flowing artesian conditions (i.e., ground water levels were at or above the land surface; Mendenhall, 1905).

- Ground water pumping since 1904 has lowered ground water levels substantially throughout MZ-1. Ground water levels declined steadily from the 1930s through the 1970s. Ground water levels recovered throughout the 1980s and have remained relatively stable since the late 1980s.

- The greatest historical ground water level declines have been observed in the northwestern portion of MZ-1 (Pomona area), which is upgradient of Watermaster's area of greatest subsidence concern. Changes in ground water levels of greater than 200 ft from 1904 to 1973 were observed in some wells in this area. Ground water level decline in Watermaster's area of greatest subsidence concern ranged from approximately 70 to 130 ft between 1904 and 1989.

- Production wells screened in both shallow and deep aquifers upgradient of Watermaster's area of greatest subsidence concern have contributed to the historical ground water level declines in the area of greatest concern by intercepting ground water underflow (recharge) to the area.

- Cumulative deep well pumping by the City of Chino Hills was approximately 22,000 acre-ft during the period 1978-2001. Cumulative deep well pumping by the City of Chino was 85,000 acre-ft during this time period.

- Ground fissures attributed to land subsidence have been observed in Watermaster's area of greatest subsidence concern since the early 1970s.

- Comparison of land surface elevations by the USGS in the early 1930s with benchmark surveys from 1987 indicate that as much as 3.7 ft of subsidence occurred at the corner of Riverside Drive and Pipeline Avenue (2,600 ft northwest of the area mapped by Kleinfelder as being the area of greatest subsidence) during this time period. Furthermore, comparison of a 1963 USGS survey of a benchmark at the corner of Chino Avenue and Ramona with a benchmark survey from 1987 at the same location indicates 3.4 ft of subsidence occurred at that location during that time period. This benchmark is west-northwest of the area previously identified as the area of greatest subsidence.

- The area of greatest subsidence, based on comparison of benchmark surveys between 1933 and 1987, correlates with that portion of MZ-1 where the highest ground water level declines occurred and the highest percentage of clay occurs in the subsurface.

- Review of benchmark surveys and InSAR data from 1993 to 1995 indicate an increased rate of subsidence during this time period for a relatively narrow area immediately west of Central Avenue. The rate and relatively limited extent of subsidence measured during this time period suggests that a secondary causal factor (such as an earthquake) may have contributed to the subsidence and requires further analysis.

- Preliminary subsidence modeling suggests that if ground water levels are maintained in the area of historical subsidence (irrespective of shallow or deep aquifers), subsidence will be maintained at present rates.

- A revised area of greatest subsidence concern (AGSC) was defined based on a combination of historical ground water level changes, historical ground surface elevation changes and lithology (i.e., percentages of fine-grained materials). The revised AGSC encompasses most of the Watermaster AGSC but extends farther to the north and west covering an area of approximately 11 square miles.

39. Subsidence in the western portion of the Chino Basin is a result of widespread ground water level declines due to ground water pumping as early as 1900. In keeping with this conclusion and the results of the analysis, a revision to the area of greatest subsidence concern was recommended. The revised area should be expanded to include areas with the greatest ground water level declines, highest percent clay relative to total alluvial thickness, and measured subsidence from either InSAR or benchmark surveys. In addition, maintenance of subsidence in the area of greatest concern was recommended through control of ground water levels.

V.2 InSAR Analysis

40. Land surface changes using interferograms from Interferometric Synthetic Aperture Radar (InSAR) has been used to remotely analyze land surface displacement in MZ-1.

41. InSAR data from January 1996 to April 2000 shows negative land surface displacement (i.e., subsidence) north of the ground fissures in south MZ-1 (see Figure 9 below). This trend has continued as shown by June 2005 to April 2006 InSAR analysis (WE, 2007b).

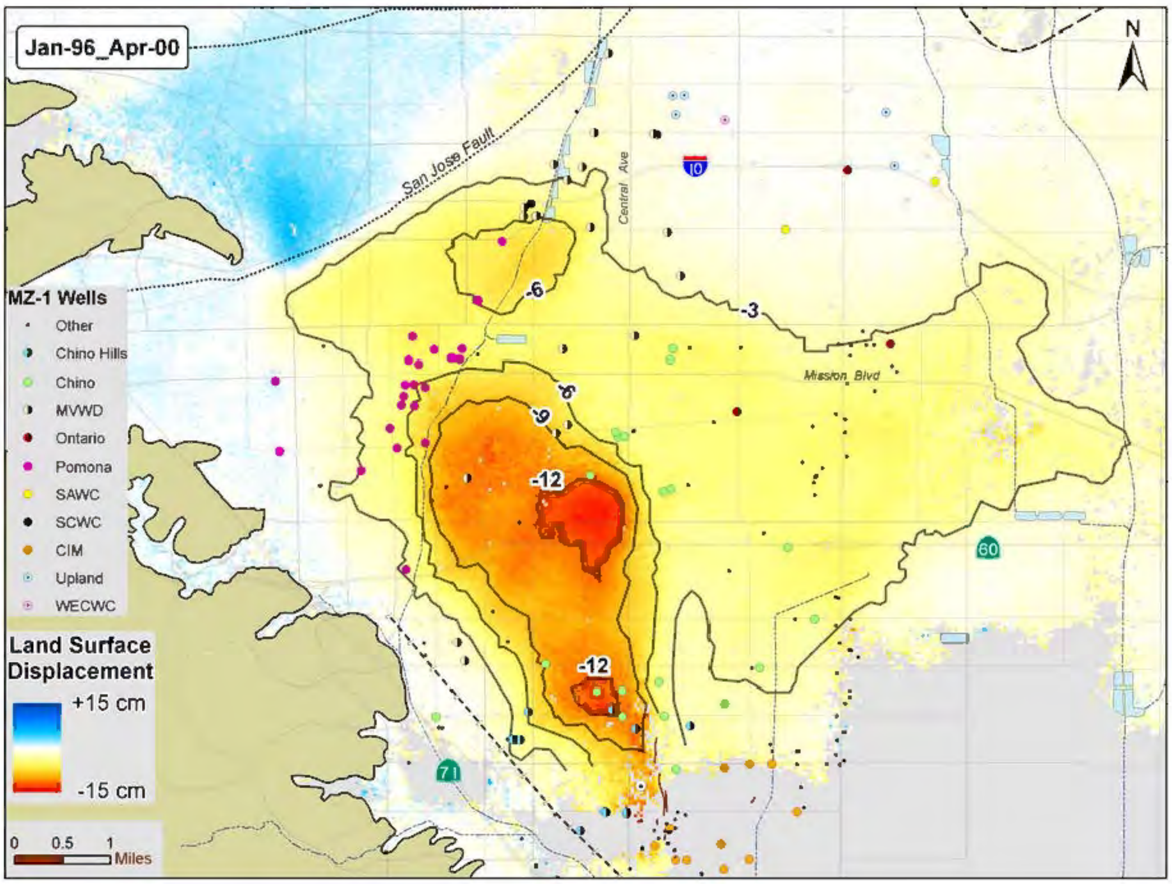
42. For the central portion of MZ-1, just north of the 60 freeway, with more than 12 cm of negative displacement (compaction) between 1996 and 2000 (see Figure 9 below), Watermaster (WE, 2006) has made the following comments:

> *"The central area of MZ-1 is displaying greater rates of subsidence than the south area (near Ayala Park). This subsidence is probably due to aquifer system compaction, but pumping and water level data that would define this relationship have not yet been collected and analyzed in the central area of MZ-1."*

43. Regarding the central MZ-1 area, the Special Referee (Schneider, 2005) has made the following comments:

> *"…the central MZ1 area appears to warrant additional investigation in light of detectable subsidence in spite of no significant pumping stress in the immediate subsidence area."*

Figure 9: InSAR Analysis of Subsidence 1996 to 2000



After Presentation by Wildermuth Environmental (Unknown Date)

44. ***Williams Comment:***

45. ***If the long-term changes in ground water levels (1933-2000) are overlain on the InSAR 1996-2000 map it is apparent that long term ground water level changes throughout MZ-1, and especially in the central portion where up to 120 ft of water level changes have occurred, coincide with the areas of greatest negative land displacement from the***

InSAR analysis (see Figure 10). This area may be experiencing a delayed response to the long-term lowering of ground water levels in the MZ-1 area. This delayed response hypothesis should be verified through continued monitoring of surface and subsurface deformation (e.g., land surface surveys, extensometers and InSAR analyses).

46. ***Thus, it is apparent that additional monitoring and data collection needs to be conducted for the central MZ-1 to establish the causes of increasing subsidence in the area. It is important to verify that the cause of subsidence may not just be from deep aquifer pumping.***

47. ***There is still uncertainty as to the role of regional tectonics in changes to the land surface. This needs to be annually evaluated along with subsurface measurements of aquifer compaction throughout MZ-1 and not just at one location (i.e., Ayala Park).***

48. ***The Watermaster's Summary Report (WE, 2006) does not adequately address the effects of tectonics (i.e., earthquakes) on subsidence in the Chino Basin. The cursory statement made in the report is not based on any observed data such as seismic records compared to subsidence and its rate over time.***

V.3 Findings of State of the Basin Reports

49. Watermaster has prepared three State of the Basin reports since the 1999 Chino Basin Optimum Basin Management Program (OBMP). The first report was the Initial State of the Basin Report in October 2002 (WE, 2002), which included ground water level, ground water quality and ground surface elevation data to July 2000. The second report contained data through fiscal year 2003/2004 (WE, 2005), and the third contains data through fiscal year 2005/2006 (WE, 2007b).

50. Sections V.3.1and V.3.2 included below were extracted directly from the conclusions of the 2004 and 2006 State of the Basin Reports, respectively, and are not a reflection of my personal opinions.

V.3.1 Conclusions from the State of the Basin Report – 2004 (WE, 2005)

51. *There appears to be two distinct aquifer systems in this area – a shallow, un-confined to semi-confined system from about 100-300 ft-bgs and a deep, confined system from about 400-1,200 ft-bgs.*

52. *Under current conditions of aquifer utilization in MZ-1, the aquifer-system deformation appears to be mainly elastic. At the Ayala Park Extensometer, 0.13 feet of elastic land subsidence and rebound were observed during the pumping and recovery seasons of 2003-04. Minor amounts (~0.02 feet) of permanent compaction and associated land subsidence apparently occurred over this same period (confirmation pending).*

53. *The relationships between aquifer-system stress (water level changes) and aquifer-system strain (vertical deformation of the sediment matrix) have been established by comparing piezometer data versus extensometer data. These relationships indicate the nature of the aquifer-system deformation (i.e., elastic vs. inelastic) and provide estimates of aquifer-system parameters for later use in aquifer-system models.*

54. *A deep aquifer-system pumping test in September 2004 appears to have transitioned the system from elastic to inelastic deformation (confirmation pending). From the stress-strain diagram, the slope of the drawdown curve in 2004 begins to deviate from its elastic trend when the seasonal drawdown exceeds 250 ft-bgs indicating a transition to inelastic compaction within draining aquitard interbeds. This provides a "threshold" water level that when exceeded will result in inelastic compaction, but only under the same conditions imposed by the pumping test (i.e., same pumping wells, rates, and durations). The data derived from this test will assist in the creation of management tools for MZ-1 (e.g. ground water flow and subsidence models).*

55. *Multiple lines of evidence suggest that a previously unknown groundwater barrier exists within the deep aquifer-system in the same location as the historic fissure zone.*

V.3.2 Conclusions from the State of the Basin Report – 2006 (WE, 2007b)

56. *Subsidence in the southern portion of MZ-1 (MZ-1 Managed Area) appears to have been eliminated, and it is likely that subsidence will not significantly occur in the future if the Watermaster-proposed management plan is implemented.*

57. *Subsidence in the central portion of MZ-1 appears to have occurred in the recent past and, as described above, may have temporarily abated.*

58. *It appears that the abatement of land subsidence in MZ-1 is related to the recovery of piezometric levels that has resulted from decreased pumping and increased wet-water and in-lieu recharge.*

VI. SUMMARY OF WATERMASTER'S PROPOSED LONG TERM MANAGEMENT PLAN

59. According to the Special Referee (Schneider, 2005), work outlined in the Summary Report (WE, 2006) was enough to develop the Guidance Criteria for the MZ-1 producers. The Guidance Criteria form the basis for the Long Term Plan (also known as the MZ-1 Subsidence Management Plan or the MZ-1 Plan by Wildermuth Environmental, 2007a).

60. Sections VI.1 through VI.3 summarize various aspects of the proposed LTP, with Section VII.1 providing my comments on limitations of the LTP. Note that direct quotations are in italics.

VI.1 Purpose of the MZ-1 LTP

61. The Watermaster states in the June 2007 MZ-1 Subsidence Management Plan (WE, 2007a) that the goal of the MZ-1 Plan is:

    "To develop a pumping and recharge plan to reduce to tolerable levels or abate future land subsidence and ground fissuring."

62. The initial version of the LTP is specific to the southwestern MZ-1, but recognizing that land subsidence has taken place elsewhere in MZ-1, Watermaster continues to monitor the aquifer-system and subsidence in other regions of the Chino Basin (WE, 2007a).

63. The LTP also states that a key element of the plan is its adaptive nature, whereby it will be revised as new data are collected and analyzed to evaluate its on-going effectiveness (WE, 2007a).

VI.2 Work Performed by Watermaster Leading up to the Proposed LTP

64. A timeline of work carried out by Watermaster and reports issued as part of the development of the LTP are shown in Table 1.

65. In summary:

- The Interim Management Plan has been in effect since 2002/2003, during which time the IMP has been developed, coordinated and continues to be conducted.
- In October 2002, the court ordered that the long-term plan (LTP) be developed by fiscal year 2004/05.
- At the end of the fiscal year 2004/05, Watermaster held a workshop to present the results of technical data and analysis completed related to the IMP. During this workshop, Watermaster requested for more time to monitor water levels and land surface deformation before the LTP was prepared.
- The Special Referee reported that no discussion was entertained on a due date, but left it up to the Watermaster to request that the court extend the period for completion of the LTP (Schneider, 2005).
- The Special Referee requested Watermaster to prepare a Summary Report and issue guidance criteria for ground water levels that would prevent inelastic compaction prior to finalizing the LTP.
- The following are items that Watermaster stated at the workshop were to be completed before the LTP was developed:
  - InSAR and ground surveys to be conducted in Fall 2005 and Spring 2006; and
  - Modeling (one-dimensional compaction model, and a three-dimensional ground water flow and subsidence model) to be completed in Spring 2006, with a modeling report in Summer 2006.

VI.2.1 Aquifer Pumping Tests

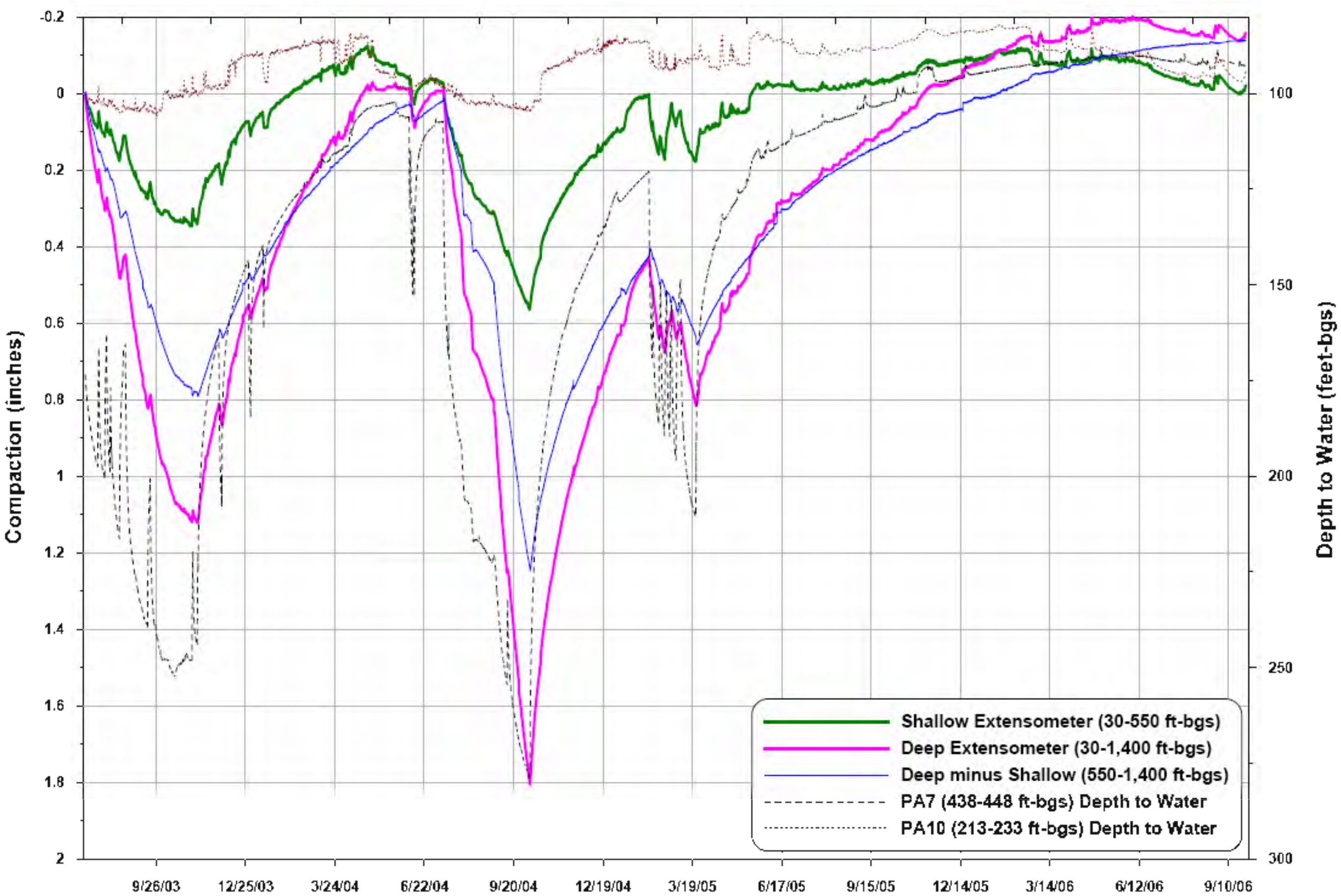
66. A deep aquifer pumping test took place in Fall 2004. The objectives of the test, according to Watermaster (2004) was to:

- Determine the hydraulic and mechanical parameters of the deep aquifer system in the area south of Ayala Park,
- Transition the aquifer-system deformation from elastic compression to inelastic compaction,
- Assist in defining the usable volume of the storage reservoir,
- Provide support for the possible ASR project at CH-1B, and
- Characterize the ground water barrier.

67. The Fall 2004 pumping test (and subsequent recovery in 2005) is the test that Watermaster used to determine the guidance threshold that represents the transition from elastic to inelastic compaction. This test involved pumping of a number of deep aquifer wells (i.e., screened portion below 400 ft bgs) in the southern portion of MZ-1:
    - CH-19 (deep) pumped through the summer
    - CH-15B (deep) turned on September 1, 2004 (1,300 – 1,400 gpm)
    - CH-1B (deep) and CH-17 (deep) never turned on
    - CH-19 (deep) and CH-15B (deep) turned off on October 6, 2004

68. The water levels and compaction measured in the Ayala Park piezometers and extensometers are shown in Figure 11. PA-7 represents the deep aquifer and PA-10 represents the shallow aquifer.

Figure 11: Piezometric and Extensometer Data – Ayala Park Extensometer Facility



Source: WE, 2007b

VI.2.2 Watermaster's Determination of the Guidance Level

69. *"The Guidance Level is a specified depth to water measured in Watermaster's PA-7 piezometer at Ayala Park. It is defined as the threshold water level at the onset of inelastic compaction of the aquifer system as recorded by the extensometer, minus 5 feet. The 5-foot reduction is meant to be a safety factor to ensure that inelastic compaction does not occur. The Guidance Level is established by Watermaster based on the periodic review of monitoring data collected by Watermaster. The initial Guidance Level is 245 feet below the top of the PA-7 well casing."* (WE, 2006).

70. *"If the water level in PA-7 falls below the Guidance Level, Watermaster recommends that the Parties curtail their production from designated Managed Wells as required to maintain the water level in PA-7 above the Guidance Level."* (WE, 2006).

71. The Guidance Level included in the LTP was determined from Watermaster's Fall 2004 pumping test and the subsequent 2005 recovery period as described in Section VI.2.1.

72. The stress (water level changes) vs. strain (aquifer compaction) diagram produced during the pumping test shows parallel trends during seasonal drawdown and recovery (see Figure 12 below). WE (2005) stated that this indicates:

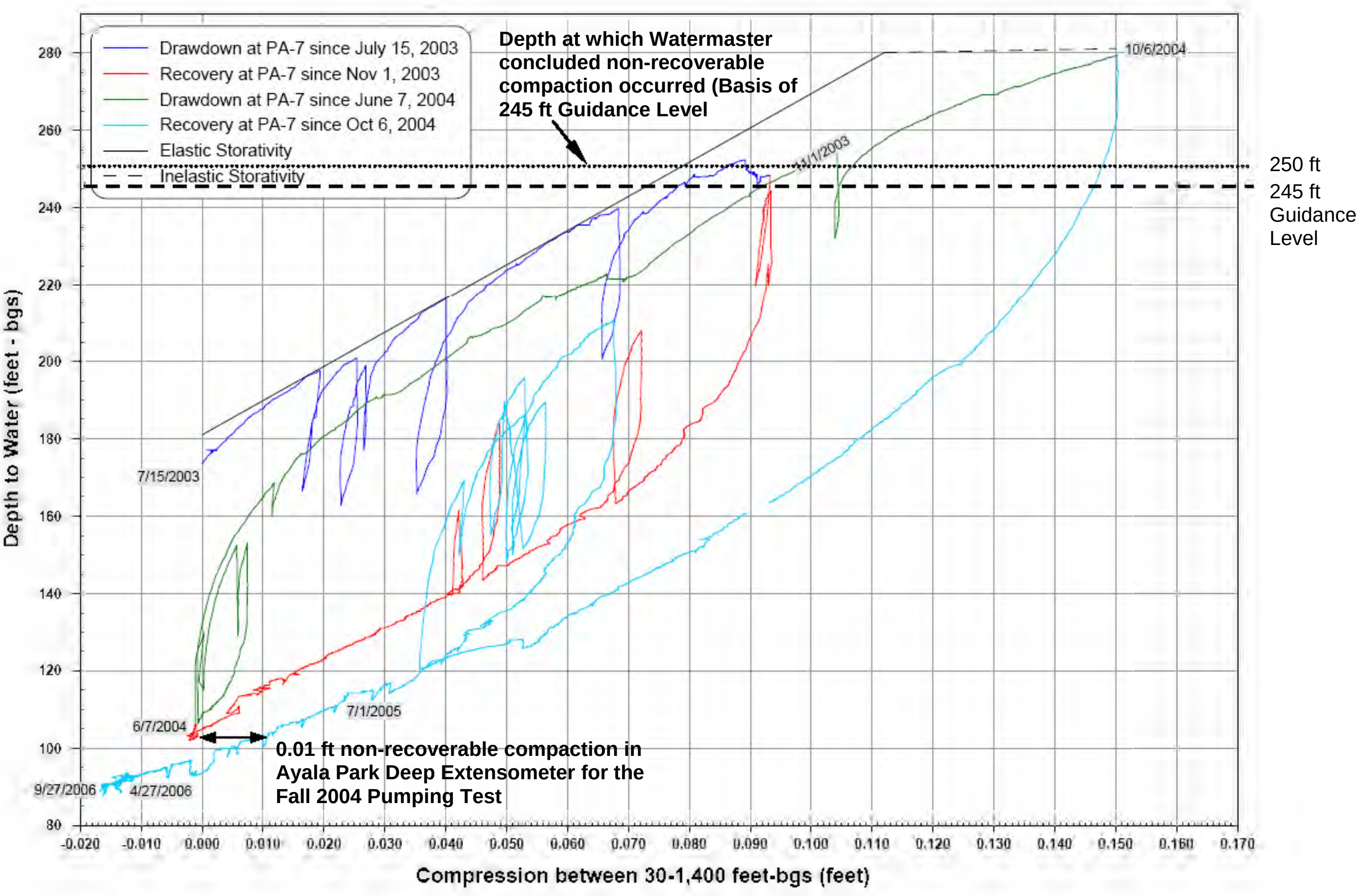
> *"…seasonal drawdown to 250 ft bgs at this site is essentially elastic, recoverable deformation. However, the slope of the drawdown curve in 2004 begins to deviate from its elastic trend when the seasonal drawdown exceeds 250 ft bgs indicating a transition to inelastic compaction within draining aquitard interbeds."*

73. Furthermore, the MZ-1 Summary Report (WE, 2006) states that different pumping conditions may result in a different subsidence threshold. Namely on pages 2-2 and 2-3 of that report:

> *"The applicability of this limit to increasing distances from the piezometer/extensometer facility is dependent on an approximate replication of*

the tested pumping conditions (i.e., specific wells pumped, pumping rates, and pumping durations). A different areal distribution of pumping might cause localized inelastic compaction away from Ayala Park without drawing PA-7 below 250 ft or recording inelastic effects at the extensometer. A different vertical distribution of extraction will stress the aquifer system in a different manner, and may result in a different threshold water level in PA-7."

Figure 12: Stress-Strain Diagram of PA-7 vs. Deep Extensometer



After WE (2007b).

74. The MZ-1 Summary Report (WE, 2006) states that:

> *"…the guidance criteria listed above are a first draft of the long-term plan. Over the next nine months (October 2005 to June 2006), Watermaster will conduct its modeling exercises and coordinate a series of meetings with MZ-1 producers that will likely lead to revisions of the guidance criteria."*

VI.3 Monitoring and Management Aspects of the LTP

VI.3.1 Proposed Monitoring Activities

75. In the Watermaster's MZ-1 LTP, the following monitoring activities are recommend:

Monitoring Activity	Central MZ-1	Southeast MZ-1	Northeast MZ-1
Historical Subsidence	***Permanent Subsidence***	***Very Little Permanent Subsidence***	***Minor but Persistent Subsidence***
Pressure Transducers for Water Levels	In FY 2005/2006 10 pressure transducers were installed in existing production wells (recording data at 15 min intervals)	16 pressure transducers have been installed in existing production wells (recording data at 15 min intervals)	—
InSAR	Semi-annual (until end of Fall 2007, then frequency will be reviewed)	Semi-annual (until end of Fall 2007, then frequency will be reviewed)	Semi-annual (until end of Fall 2007, then frequency will be reviewed)
Vertical Ground Surface Deformation	• Spring and Fall Semi-Annual Surveying • Monitoring of Horizontal Displacement across Zone of Potential Future Ground Fissuring	• Spring and Fall Semi-Annual Surveying	• Spring and Fall Semi-Annual Surveying
Horizontal Ground Surface Deformation	Electronic distance measurement (EDMs) collected semi-annually	—	—

VI.3.2 Management of Ground Water Levels

76. Watermaster's LTP has the following main elements that impact operations of local water purveyors:

77. Watermaster recommends that the Parties manage their ground water production so that the water level in PA-7 remains above the Guidance Level. If the water level falls below the Guidance Level, Watermaster recommends that the Parties curtail their production from the Managed Wells as required to allow for water level recovery and maintain the water level in PA-7 above the Guidance Level.

78. Watermaster recommends that all deep aquifer wells (with the exception of the CIM well) stop pumping for a 2 to 6 month period, from October 1 to March 31 of each year to allow for a recovery period that is long enough to recognize inelastic compaction, if any, at the Ayala Park Extensometer. The recovery period for the next five years will be as follows:

- Year 1 for 6 months
- Year 2 for 4 months
- Year 3 for 3 months
- Year 4 for 2 months
- Year 5 for 6 months

79. After 5 years, the effectiveness of the recovery period will be assessed, and an appropriate annual recovery period recommended for the MZ-1 Plan.

VII. COMMENTS ON WATERMASTER'S PROPOSED LONG TERM MANAGEMENT PLAN

VII.1 Limitations of the Watermaster's Proposed LTP

80. Watermaster has stated in numerous reports that ground water modeling will be used to support the development of the LTP (WE, 2006; Schneider, 2005; Chino Basin Watermaster, 2004). To date, no modeling results have been shared with MZ-1 producers. Its seems that the interim Guidance Level was simply adopted as the Guidance Level being applied in the LTP without the benefit of additional data or modeling results. This fact together with the Guidance Level being based on only one pumping test reduces confidence in the proposed 245 ft Guidance Level.

81. Watermaster has not addressed in the Summary Report the Special Referee's question as to whether there was any pre-1990's subsidence that may have occurred that correlates with, or can be attributed to, the large historical changes in ground water levels that predated the Judgment. Knowledge of historical subsidence is important when developing methods of managing future potential subsidence.

82. The ground water level responses in wells during the Fall 2004 pumping test (see Figure 11), indicate that the shallow aquifer (ground water levels in PA-10), has responded to pumping from the deep aquifer system. This may reflect hydraulic continuity between the deep and shallow aquifers. Documents leading up to the proposed LTP and the LTP itself do not address any management of shallow well pumping.

83. Regarding development of the Guidance Level, there is subjectiveness in interpretation of only one stress-strain cycle (as compared to interpreting multiple stress-strain cycles) in drawing the conclusion of permanent (non-recoverable) compaction which was the basis for the 245 ft Guidance Level. As such, establishment of the Watermaster's Guidance Level did not complete all the steps necessary in the Scientific Method (see below).

84. The scientific method is that process whereby scientists, collectively and over time, endeavor to construct an accurate (i.e., reliable, consistent and non-arbitrary) representation of the world (Villee, 1958). In summary, the scientific method attempts to minimize the influence of bias or prejudice in the experimenter when testing a hypothesis or theory.

85. The scientific method has four main steps:

1. Observation and description of a phenomenon or group of phenomena.
2. Formulation of a hypothesis to explain the phenomena. In physics, the hypothesis often takes the form of a causal mechanism or a mathematical relation.
3. Use of the hypothesis to predict the existence of other phenomena, or to predict quantitatively the results of new observations.
4. Performance of experimental tests of the predictions by several independent experimenters and properly performed experiments.

86. "The single feature that is most characteristic of science is its reproducibility. If scientists cannot duplicate their first results, they are forced to conclude that these were invalid. This problem occurs often. Its cause is usually some unrecognized, and hence uncontrolled, factor in the experiment (e.g., unrecognized variation in the properties of different batches of the materials used in the experiment)". [1]

87. The Guidance Level of 245 ft is not supported by long-term data, and is based on only one pumping test (Fall 2004) in only one location (Ayala Park Deep Extensometer), as such the LTP should not be applied to the entire southern MZ-1 area. Repeated observations in wells and extensometers in a number of areas are needed over time to establish a conclusive relationship between depth to ground water levels and land deformation. A time-history of preconsolidated levels needs to be developed based on seasonal variations in ground water levels and aquifer/aquitard compaction.

[1] http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/S/ScientificMethods.html

88. It is recommended that the Guidance Level of 245 ft remain an interim level until quantitative relationships between ground water level changes and aquifer/aquitard compaction are known either through more controlled pumping tests or seasonal pumping by producers. As such, the 245 ft level should not be included in the LTP, but rather the Interim Plan should remain in effect until the Guidance Level has been determined with more certainty.

89. The LTP recommends that the Parties manage their own production to allow water levels to remain above the Guidance Level (pg 2-1; WE, 2007a). However, the LTP also states that annual recovery periods of between 2 to 6 months are recommended (pg 3-1; WE, 2007a) without providing any basis for the annual recovery periods. These statements appear contradictory.

90. No ground water or subsidence modeling has been conducted by Watermaster to support the effectiveness of the annual recovery periods.

91. In light of the above comments, the LTP does not meet its specified goals of developing an acceptable pumping plan. Furthermore, no mention of alternative sources of water available to the City of Chino Hills or other purveyors is provided for those periods when deep well pumping is not allowed. Additionally, artificial recharge aspects stated in the goals of the LTP are not included as part of the plan.

92. The pumping restrictions stated in the LTP do not appear to be based on sufficient scientific work thus far or are structured to meet a minimum acceptable level of subsidence. In other words, it is not clear whether the guidance criteria in the LTP intend to stop all subsidence or if there is a certain minimum amount which will be allowed.

93. Because there has been measured subsidence in the central portion of MZ-1, without significant pumping stress in the immediate subsidence area (Schneider, 2005), additional monitoring and data collection needs to be conducted in the central MZ-1 to establish the causes of increasing subsidence in the area. This is important as, if the cause of subsidence is found not to be from water withdrawal from the deep aquifer, the same

mechanism may also be responsible or be contributing to subsidence in the southern portion of MZ-1.

94. The Watermaster's "Managed Area" should be expanded to the central and north MZ-1 area to include the apparent subsidence that is depicted on recent InSAR analysis (1996-2000). This area may be experiencing a delayed response to the long-term lowering of ground water levels in the MZ-1 area. This delayed response hypothesis should be verified through continued monitoring of surface and subsurface deformation (e.g., land surface surveys, extensometers and InSAR analyses).

95. Watermaster has started with collecting important measurements on land deformation and ground water levels, however, it is felt that these data are presently not enough to draw conclusions that will be implemented in a LTP that has far reaching consequences for local purveyors. Longer term data with more spatial locations need to be collected before the LTP can be finalized.

96. Section VII of this report presents a proposed production scenario for operation of City of Chino Hills' deep wells. This scenario was simulated using ground water modeling and ensures that the Watermaster's proposed Guidance Level of 245 ft is met at PA-7.

VII.2 Alternative Approach to Establishing a LTP

97. Only if based on reproducible and defendable preconsolidation depths to ground water can the subsidence threshold (i.e., Guidance Level) be established for a specific region. Additional extensometers should be constructed in areas of suspected subsidence such as the central area of MZ-1. The same procedure should be used to establish the preconsolidation level in this region based on a time history of pumping and changes in aquifer compaction (i.e., stress-strain analysis). In time, and as a result of establishing preconsolidation levels at a number of different locations in the central and southern areas of MZ-1, a regional subsidence threshold surface can be established. This regional subsidence threshold or Regional Guidance Level (RGL) can be displayed as contours by which management of MZ-1 subsidence can take place.

VIII. GROUND WATER PUMPING PROPOSED BY THE CITY OF CHINO HILLS

VIII.1 Purpose of the Ground Water Model

98. In order to determine the impacts from pumping by City of Chino Hills, a ground water flow model was developed for a portion of MZ-1 covering the area of the City of Chino Hills wells and vicinity. After construction and calibration, several operational scenarios were run and ground water levels compared with Watermaster's Guidance Level of 245 ft (subsidence threshold).

99. The following sections discuss basic details of model development, calibration, operational scenarios developed for the City of Chino Hills wells and model results.

100. For a full description of the model code and other technical details see Appendix C.

VIII.2 Development of Ground Water Flow Model for a Portion of MZ-1 Containing City of Chino Hills Wells

VIII.2.1 Conceptual Model

101. The City of Chino Hills ground water model was developed for the unconsolidated sediments in the vicinity of City of Chino Hills' wells and surrounding area in the southwestern portion of the Chino Basin (see Figure 13). Consolidated sedimentary and crystalline basement rocks underlying and surrounding the basin fill are considered impermeable and are not part of the alluvial ground water flow system. The conceptual ground water model (see Figure 14) consists of two distinct model layers based on the aquifer systems discussed by GEOSCIENCE (2001):

- Layer 1 – Upper alluvial aquifer system

- Layer 2 – Lower alluvial aquifer system

102. Flow is assumed to occur horizontally within the each of the model layers while the layers maintain hydraulic connection to each other through vertical leakance. The Central Avenue Fault and the Riley Barrier (WE, 2005 and 2007b) were modeled as a lower permeability feature using the MODFLOW Horizontal-Flow-Barrier package (HFB).

103. The sources of recharge to the aquifers in the model area included subsurface inflow from adjoining portions of Chino Basin and Temescal Basin, deep percolation of precipitation falling directly on the land surface (areal recharge), artificial recharge at spreading basins, mountain front runoff, surface water percolation along the unlined river and stream channels and return flow from applied agricultural water. The Santa Ana River was modeled using the MODFLOW Streamflow-Routing package.

104. The discharge terms in the model area included ground water pumping, evapotranspiration along the Santa Ana River, subsurface outflow into the Santa Ana River canyon below Prado Dam and subsurface outflow to the adjoining portions of Chino Basin.

VIII.2.2 Model Size and Grid Geometry

105. The ground water flow model grid covers approximately 154 square miles (98,700 acres) with a finite-difference grid consisting of 270 cells in the I-direction (northeast to southwest along rows), 398 cells in the J-direction (northwest to southeast along columns) and 2 cells in the K-direction (layers) for a total of 214,920 cells (149,613 active cells). All model cells are squares 200 feet by 200 feet (see Figure 13).

106. The origin of the relative model cell coordinate system is in the upper left corner of the top layer (I=1, J=1, K=1), while the origin of the site coordinate system is the lower left corner of the bottom layer (X=0, Y=0, Z=0). The "site" coordinate system origin is located at the Zone 10 UTM coordinate (X = 428,667.1 m, Y = 3,763,263.0 m) and the model grid is rotated 51.4 degrees clockwise from horizontal.

VIII.2.3 Boundary Conditions

107. A boundary condition is any external influence or effect that either acts as a source or sink adding or removing water from the ground water flow system. The City of Chino Hills ground water model includes no-flow cells (inactive), wells, drains, general head boundaries (GHB), streams, recharge and evapotranspiration (see Figure 15). In general, ground water flow model boundary conditions can be grouped into three main types: 1) constant head (this type was not used in the City of Chino Hills ground water model), 2) specified flux (i.e., wells, recharge and no-flow), and 3) head-dependant with a limiting conductance or rate term (i.e., GHB, drains, streams and evapotranspiration).

108. The edge of the active model area immediately surrounding the area of interest is bounded by natural boundaries (contact between basin fill alluvium and bedrock) and open boundaries (where the aquifers extend beyond the bounds of the model area). A GHB is used to simulate the underflow inflow and outflow across the open boundaries based on observed water levels near the open boundaries. The recharge package was used to simulate the contribution of flow from the bedrock outcrops along natural model boundaries into the upper model layer.

VIII.3 Model Calibration

109. The City of Chino Hills ground water model was calibrated for transient conditions. The transient calibration covered the period from January 1982 through September 2005 using quarterly stress periods. This time period includes both wet and dry climatic cycles. Fall 1981 water levels were used as the initial water levels for the model transient calibration (see Figure 16).

110. Figure 17 is an "x-y" plot showing a comparison of measured and model-generated ground water levels. The graphical comparison between measured and model-predicted heads (from 62 target wells) for the transient calibration shows the 5,229 ground water level measurements mainly clustered around the straight line. Some

outliers are scattered further away from the straight line and may have resulted from comparisons of a relative smaller time discretization of water level measurements (e.g. monthly) to a relative larger time discretization of the model-generated water levels (i.e., quarterly stress period). In general, the measured and model-predicted heads compared favorably, and the calibration is further supported by a relative error below 10%. The relative error (the standard deviation of the ground water level residuals[2] divided by the observed head range; Zheng and Bennett, 2002) of the model-generated groundwater levels between January 1982 and September 2005 is approximately 9.2%. Common modeling practice is to consider a good fit between historical and model-predicted data if the relative error is below 10% (Spitz and Moreno, 1996; and Environmental Simulations, Inc., 1999).

111. Residual water levels for the 5,229 measurements from the 62 target wells during the period from January 1982 through September 2005 were plotted as histograms (see Figure 18). The histograms show a bell shape with most of the water level residuals in the range of +/- 25 ft (70% of the measurements), indicating an acceptable model calibration.

112. A comparison of model-generated quarterly streamflow at Prado Dam with gaged outflow at the USGS gage just downstream of the Prado Dam is shown on Figure 19. This comparison shows a good match of model-generated versus gaged streamflow with the model slightly underestimating streamflow in very wet quarters.

113. The quarterly ground water budget for the transient calibration is shown in Table 2.

[2] "Residual" = measured – modeled

VIII.4 Model Operational Scenarios

VIII.4.1 Description of Model Operational Scenarios

114. Predictive scenarios for the City of Chino Hills ground water flow model were developed in the context of various ground water pumping schedules for the City of Chino Hills' wells. All scenarios developed for analysis using the ground water model included the following general assumptions:

- The model-generated water levels at the end model calibration (September 2005, see Figure 20) were used as the initial water levels of model operational scenarios;
- The length of the predictive simulation was 20 years with a quarterly stress period;
- The recorded hydrology (i.e., areal recharge, recharge from mountain front runoff and, streamflow) for the latest 20 years transient calibration period (i.e., October 1985 through September 2005) was repeated for the predictive period;
- Ground water pumping for all the wells other than the City of Chino Hills' wells and heads in GHB cells for the water year 2005 (i.e., October 2004 – September 2005) were repeated for the predictive period.

115. Three model scenarios were developed to assess potential future ground water conditions in the vicinity of City of Chino Hills' wells area, particularly the depth to water in PA-7.

Scenario 1: Simulates the maximum pumping of the City of Chino Hills' wells (as provided by City of Chino Hills). Maximum use of wells would include the use of all wells to 90% capacity. The remaining 10% would account for down time for maintenance. Total ground water production would be approximately 14,800 acre-ft/yr.

Scenario 2: Simulates the approximate historical pumping from City of Chino Hills' wells (see Figure 21 for historical pumping). Total ground water pumping would be approximately 4,400 acre-ft/yr.

Scenario 3: Simulates the pumping used in Scenario 2 plus pumping from shallow aquifer of two new wells located west of the Riley Barrier (see Figure 22) and pumping from City of Chino Hills Well 18A (located east of the Riley Barrier). Total ground water pumping would be approximately 7,400 acre-ft/yr.

116. The following table summarizes the pumping from the City of Chino Hills' wells for each of the model scenarios. For purpose of this study, the annual pumping was evenly distributed to each quarter.

Ground Water Pumping of City of Chino Hills' Wells – Model Operation Runs

Well No.	Aquifer	Annual Ground Water Pumping [acre-ft]		
		Scenario 1	**Scenario 2**	**Scenario 3**
1A	Shallow	1,411	1,000	1,000
1B	Deep	1,717	0	0
7A	Deep	1,010	400	400
7B	Shallow	908	800	800
15	Deep	2,625	600	600
17	Deep	3,533	800	800
19	Deep	3,632	800	800
18A	Deep	0	0	1,000
New 1	Shallow	0	0	1,000
New 2	Shallow	0	0	1,000
Subtotal	**Shallow**	**2,319**	**1,800**	**3,800**
Subtotal	**Deep**	**12,517**	**2,600**	**3,600**
Total		**14,836**	**4,400**	**7,400**

VIII.4.2 Ground Water Flow Model Results

117. Ground water level differences between the current level and the end of model simulation of each the model scenarios were plotted to show the potential impacts from the various pumping schedules for the City of Chino Hills' wells (see Figures 23 through 25). Selected hydrographs for these model operational runs are shown on

Figure 26. Depth to water in PA-7 was plotted to compare the model-predicted level to the proposed Guidance Level (see Figure 27).

118. For Scenario 1 (maximum use of City of Chino Hills' wells, i.e., 14,800 acre-ft/yr), the ground water level in model Layer 1 would decline approximately 10 ft to 30 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 100 ft to 700 ft in the same area. This could deplete almost all the ground water storage of the deep aquifer in the City of Chino Hills' wells area. The depth to water in PA-7 would be 647 ft to 667 ft bgs (see Figure 27), which is approximately 402 ft to 422 ft below the Watermaster's proposed Guidance Level of 245 ft in PA-7. Using Scenario 1, it appears that there could be a significant adverse impact on the ground water level under the City of Chino Hills maximum pumping schedule.

119. For Scenario 2 (approximate maximum historical pumping from the City of Chino Hills' wells, i.e., 4,400 acre-ft/yr), the ground water level in model Layer 1 would decline approximately a few feet to 10 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 20 ft to 140 ft in the same area. The depth to water in PA-7 would be 206 ft to 226 ft bgs (see Figure 27), which is approximately 19 ft to 39 ft above the Watermaster's proposed Guidance Level of 245 ft in PA-7. This suggests that using Scenario 2, additional ground water pumping in the City of Chino Hills' wells area could be available if the proposed initial Guidance Level in PA-7 was implemented.

120. For Scenario 3 (approximate maximum historical pumping from the City of Chino Hills' wells plus two new shallow wells west of the barrier, and Well 18A east of the barrier, i.e., 7,400 acre-ft/yr), the ground water level in model Layer 1 would decline approximately 10 ft to 40 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 30 ft to 160 ft in the same area. The depth to water in PA-7 would be 227 ft to 247 ft bgs (see Figure 27), which is approximately at the Watermaster's proposed Guidance Level of 245 ft in PA-7. This suggests that in order to comply with the initial Guidance Level in PA-7, the maximum ground water pumping that might be produced from the City of Chino Hills' wells is approximately 7,400 acre-ft/yr.

IX. FINDINGS

121. Watermaster has stated in numerous reports and presentations that ground water modeling will be used to support the development of the LTP (WE, 2006; Schneider, 2005; Chino Basin Watermaster, 2004). To date, no modeling results have been shared with MZ-1 producers. Its seems that the interim Guidance Level was simply adopted as the Guidance Level being applied in the LTP without the benefit of additional data or modeling results. This fact together with the Guidance Level being based on only one pumping test reduces confidence in the proposed 245 ft Guidance Level.

122. Watermaster has not addressed in the Summary Report the Special Referee's question as to whether there was any pre-1990's subsidence that may have occurred that correlates with, or can be attributed to, the large historical changes in ground water levels that predated the Judgment. Knowledge of historical subsidence is important when developing methods of managing future potential subsidence.

123. The ground water level responses in wells during the Fall 2004 pumping test (see Figure 11), indicate that the shallow aquifer (ground water levels in PA-10), has responded to pumping from the deep aquifer system. This may reflect hydraulic continuity between the deep and shallow aquifers. Documents leading up to the proposed LTP and the LTP itself do not address any management of shallow well pumping.

124. Regarding development of the Guidance Level, there is subjectiveness in interpretation of only one stress-strain cycle (as compared to interpreting multiple stress-strain cycles) in drawing the conclusion of permanent (non-recoverable) compaction which was the basis for the 245 ft Guidance Level. As such, establishment of the Watermaster's Guidance Level did not complete all the steps necessary in the Scientific Method.

125. The scientific method is that process whereby scientists, collectively and over time, endeavor to construct an accurate (i.e., reliable, consistent and non-arbitrary)

representation of the world (Villee, 1958). In summary, the scientific method attempts to minimize the influence of bias or prejudice in the experimenter when testing a hypothesis or theory.

126. The Guidance Level of 245 ft is not supported by long-term data, and is based on only one pumping test (Fall 2004) in only one location (Ayala Park Deep Extensometer), as such the LTP should not be applied to the entire southern MZ-1 area. Repeated observations in wells and extensometers in a number of areas are needed over time to establish a conclusive relationship between depth to ground water levels and land deformation. A time-history of preconsolidated levels needs to be developed based on seasonal variations in ground water levels and aquifer/aquitard compaction.

127. It is recommended that the Guidance Level of 245 ft remain an interim level until quantitative relationships between ground water level changes and aquifer/aquitard compaction are known either through more controlled pumping tests or seasonal pumping by producers. As such, the 245 ft level should not be included in the LTP, but rather the Interim Plan should remain in effect until the Guidance Level has been determined with more certainty.

128. The LTP recommends that the Parties manage their own production to allow water levels to remain above the Guidance Level (pg 2-1; WE, 2007a). However, the LTP also states that annual recovery periods of between 2 to 6 months are recommended (pg 3-1; WE, 2007a) without providing any basis for the annual recovery periods. These statements appear contradictory.

129. No ground water or subsidence modeling has been conducted by Watermaster to support the effectiveness of the annual recovery periods.

130. In light of the above comments, the LTP does not meet its specified goals of developing an acceptable pumping plan. Furthermore, no mention of alternative sources of water available to the City of Chino Hills or other purveyors is provided for those periods when deep well pumping is not allowed. Additionally, artificial recharge aspects stated in the goals of the LTP are not included as part of the plan.

131. The pumping restrictions stated in the LTP do not appear to be based on sufficient scientific work thus far or are structured to meet a minimum acceptable level of subsidence. In other words, it is not clear whether the guidance criteria in the LTP intend to stop all subsidence or if there is a certain minimum amount which will be allowed.

132. Because there has been measured subsidence in the central portion of MZ-1, without significant pumping stress in the immediate subsidence area (Schneider, 2005), additional monitoring and data collection needs to be conducted in the central MZ-1 to establish the causes of increasing subsidence in the area. This is important as, if the cause of subsidence is found not to be from water withdrawal from the deep aquifer, the same mechanism may also be responsible or be contributing to subsidence in the southern portion of MZ-1.

133. The Watermaster's "Managed Area" should be expanded to the central and north MZ-1 area to include the apparent subsidence that is depicted on recent InSAR analysis (1996-2000). This area may be experiencing a delayed response to the long-term lowering of ground water levels in the MZ-1 area. This delayed response hypothesis should be verified through continued monitoring of surface and subsurface deformation (e.g., land surface surveys, extensometers and InSAR analyses).

134. Watermaster has started with collecting important measurements on land deformation and ground water levels, however, it is felt that these data are presently not enough to draw conclusions that will be implemented in a LTP that has far reaching consequences for local purveyors. Longer term data with more spatial locations need to be collected before the LTP can be finalized.

135. Section VII of this report presents a proposed production scenario for operation of City of Chino Hills' deep wells. This scenario was simulated using ground water modeling and ensures that the Watermaster's proposed Guidance Level of 245 ft is met at PA-7.

136. The LTP recommends that the Parties manage their own production to allow water levels to remain above the Guidance Level (pg 2-1; WE, 2007a). With this in mind,

ground water model simulations for the City of Chino Hills' wells have shown that Scenario 3 (approximate maximum historical pumping from the City of Chino Hills' wells plus pumping from two new shallow wells west of the barrier and Well 18A east of the barrier, i.e., 7,400 acre-ft/yr), would not allow water level declines more than the Guidance Level of 245 ft as measured in Ayala Park PA-7. As such, this production scenario should be used to test (and/or refine) the Guidance Level for the Ayala Park area by providing seasonal variations in stress-strain relationships of the aquifer/aquitard system.

137. Pumping of City of Chino Hills' wells under Scenario 3 would allow variations in pumping and recovery from which stress-strain relationships could be analyzed and a long-term preconsolidation level determined.

X. RECOMMENDATIONS

138. Continue to verify the preliminary elastic/inelastic transition depth to ground water of 250 ft observed during the Fall 2004 pumping test in the vicinity of the Ayala Park Extensometer.

139. Establish a reproducible preconsolidation depth to ground water level for the Ayala Park Extensometer area based on a time history of change in ground water levels vs. change in aquifer/aquitard compaction. Follow the method outlined in Riley (1969) to determine a "preconsolidation line".

140. Based on a reproducible and defendable preconsolidation depth to ground water, the subsidence threshold (i.e., Guidance Level) can be established in that specific region.

141. Additional extensometers should be constructed in areas of suspected subsidence such as the central area of MZ-1. The same procedure should be used to establish the preconsolidation level in this region based on a time history of pumping and changes in aquifer compaction (i.e., stress-strain analysis).

142. In time, and as a result of establishing preconsolidation levels at a number of different locations in the central and southern areas of MZ-1, a regional subsidence threshold surface can be established. This regional subsidence threshold or Regional Guidance Level (RGL) can be displayed as contours by which management of MZ-1 subsidence can take place.

143. The Watermaster's "Managed Area" should be expanded to the north to include the apparent subsidence that is depicted on recent InSAR analysis (1996-2000). This area may be experiencing a delayed response to the long-term lowering of ground water levels in the MZ-1 area. This delayed response hypothesis should be verified through continued monitoring of surface and subsurface deformation (e.g., land surface surveys, extensometers and InSAR analyses).

144. If continued reliance on InSAR as a measure of subsidence (or rebound) of the land surface and one of the monitoring tools used to manage the basin, continuing evaluation of accuracy of this method should be performed. Specifically, those factors such as changes in land use between InSAR images, time intervals between images and the size of area interpreted should be analyzed to rule out factors that could impact the final interpretation of land surface deformation.

145. If the subsidence in MZ-1 due to ground water withdrawal is to be managed based on ground water levels, then operation of wellfield pumping should be allowed if ground water levels are less than the Guidance Levels for specific wellfield areas.

146. A ground water model simulation of an operational scenario by the City of Chino Hill (Scenario 3 – 7,400 acre-ft/yr), would not lower ground water levels below the Guidance Level (245 ft depth). As such, this production scenario should be used to test (and/or refine) the Guidance Level for the Ayala Park area by providing seasonal variations in stress-strain relationships of the aquifer/aquitard system. The seasonal cycles of stress increase (lowering of water levels) and decrease (recovery) will produce a series of stress-strain loops which can be used to establish the preconsolidation level in this area.

147. Only if based on reproducible and defendable preconsolidation depths to ground water can the subsidence threshold (i.e., Guidance Level) be established for a specific region. Additional extensometers should be constructed in areas of suspected subsidence such as the central area of MZ-1. The same procedure should be used to establish the preconsolidation level in this region based on a time history of pumping and changes in aquifer compaction (i.e., stress-strain analysis). In time, and as a result of establishing preconsolidation levels at a number of different locations in the central and southern areas of MZ-1, a regional subsidence threshold surface can be established. This regional subsidence threshold or Regional Guidance Level (RGL) can be displayed as contours by which management of MZ-1 subsidence can take place.

XI. REFERENCES

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FIGURES

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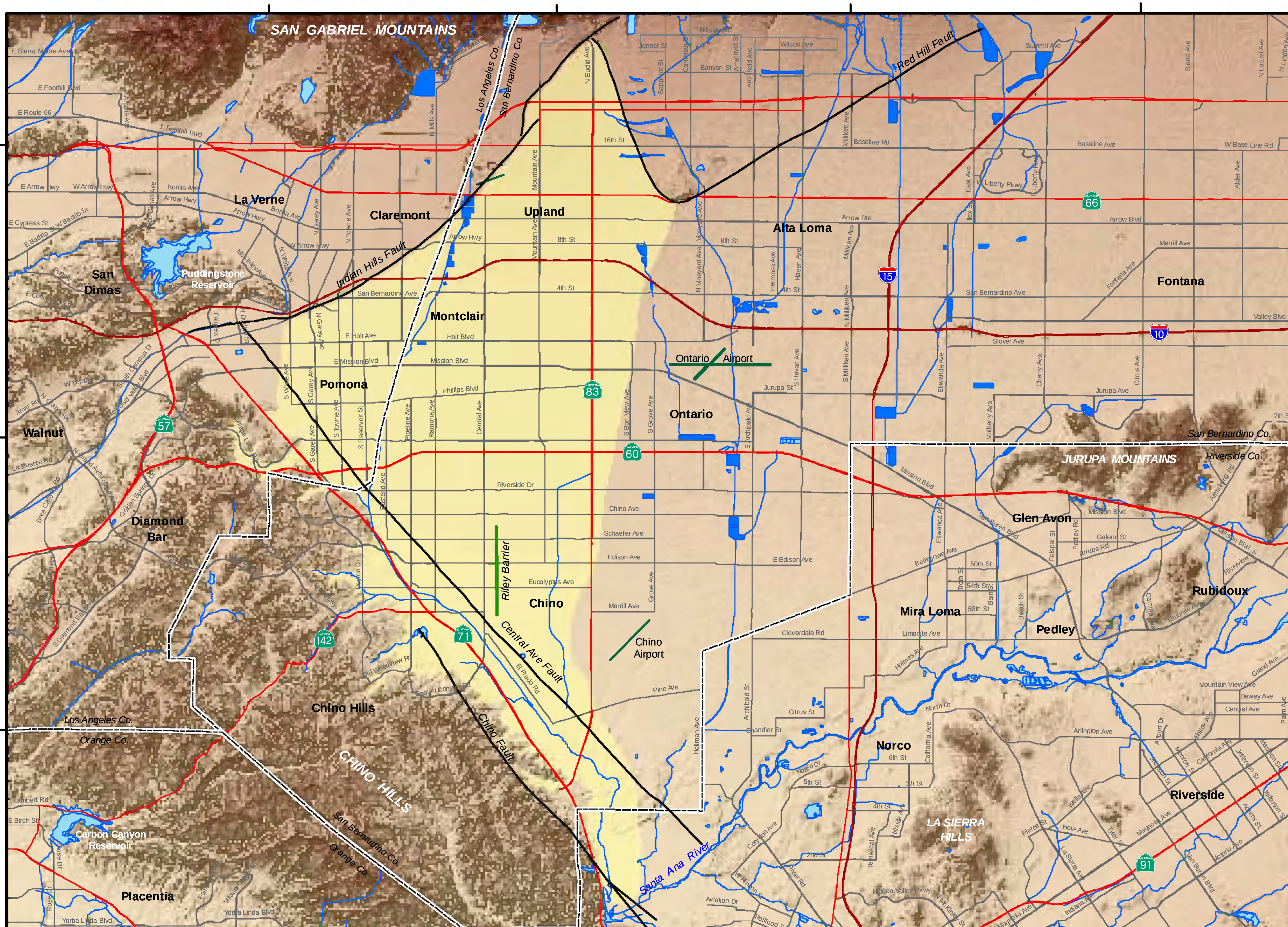
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

CHINO BASIN MANAGEMENT ZONE 1 (MZ-1)

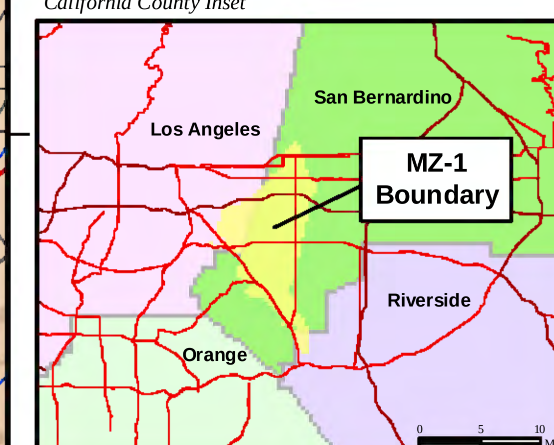


21-Sep-07

EXPLANATION

- Management Zone 1 (MZ-1)
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007b)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

California County Inset



Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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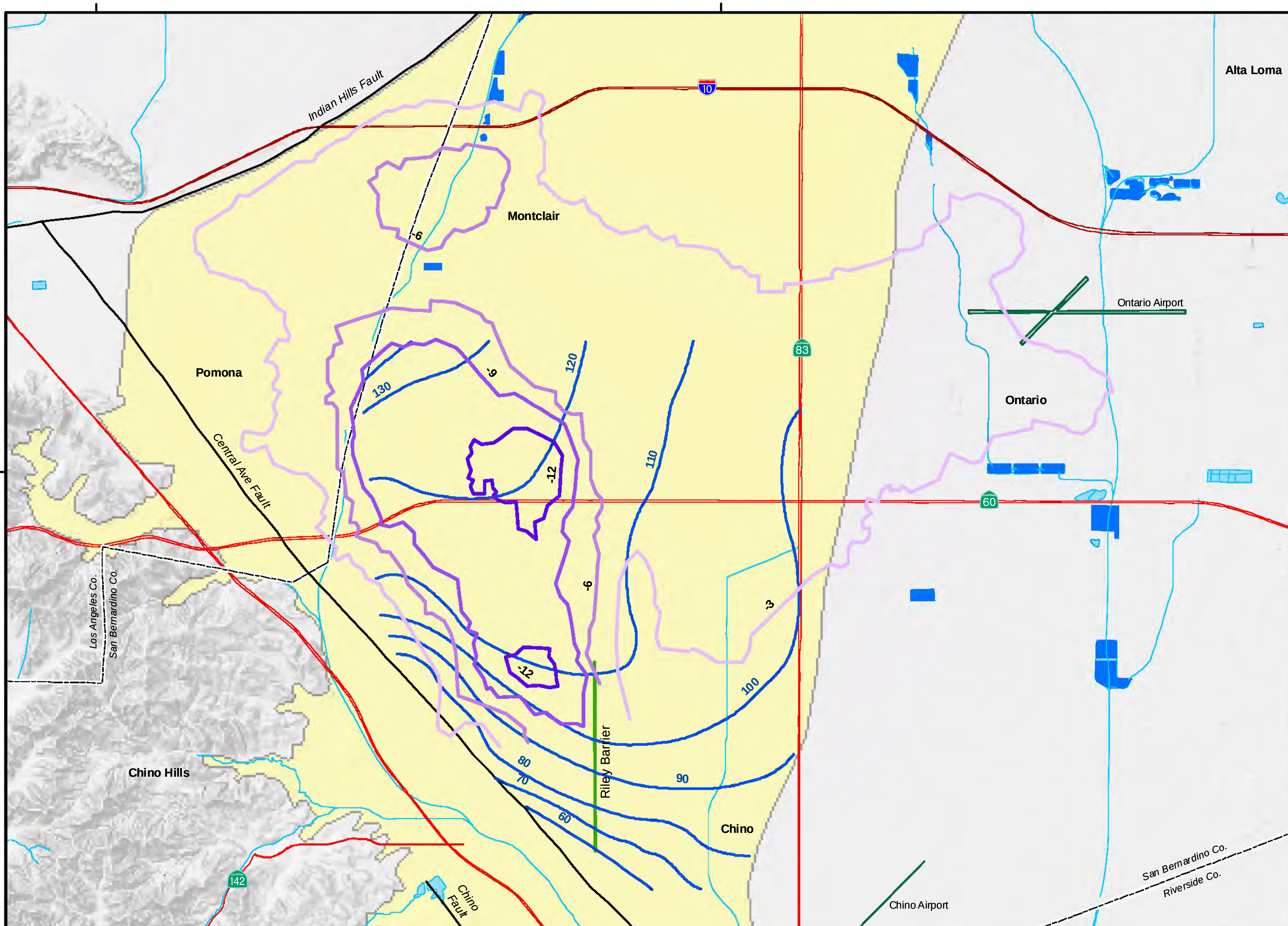
Figure 1

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_1_regional loc_9-07.mxd

COMPARISON OF LONG TERM CHANGES IN GROUND WATER LEVELS (1933 - 2000) WITH INSAR DATA (1996 - 2000)



EXPLANATION

- 80 — Ground Water Elevation Change 1933 - 2000 (feet) Source: GEOSCIENCE, (2002)

Relative Change in Land Surface Elevation from January 1996 to April 2000, Synthetic Aperture Radar Interferometry (InSAR) Source: WE (2005)

- -3 centimeters
- -6 centimeters
- -9 centimeters
- -12 centimeters
- Management Zone 1 (MZ-1)
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007B)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

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Central Meridian: -117 degrees

NORTH

0 1 2 Miles

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Figure 10

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_10_insar_9-07.mxd

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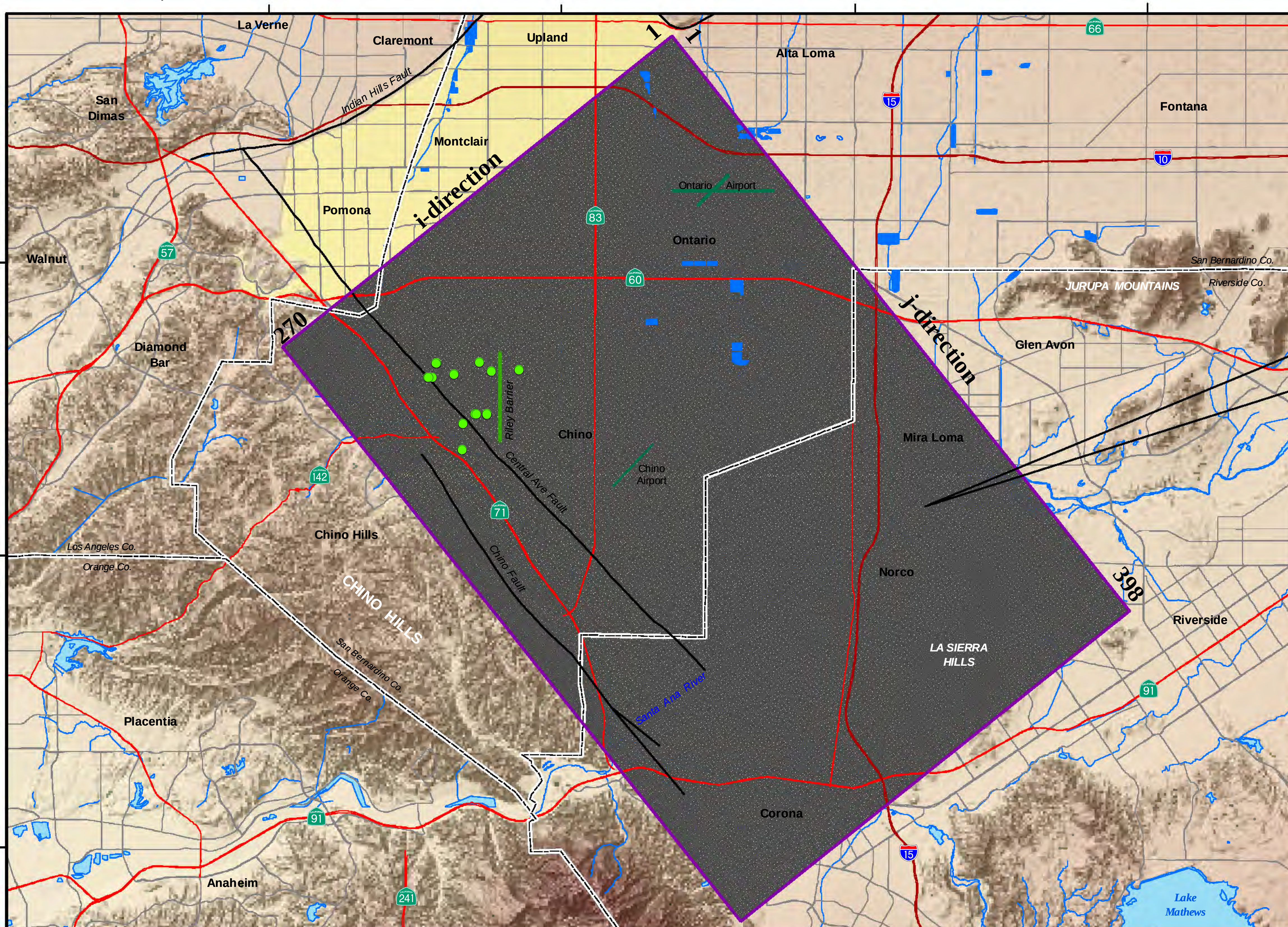
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

CITY OF CHINO HILLS GROUND WATER MODEL

T.1 S.
T.2 S.



T.2 S.
T.3 S.
T.3 S.
T.4 S.

R.9 W. | R.8 W.   R.8 W. | R.7 W.   R.7 W. | R.6 W.   R.6 W. | R.5 W.

21-Sep-07

EXPLANATION

- Ground Water Model Boundary
- Ground Water Model Cell 200 ft by 200 ft
- Management Zone MZ-1
- City of Chino Hills Well
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007b)
- County Boundary
- Freeway
- State Highway
- Street
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

Prepared by: DWB

Map Projection:
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Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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Figure 13

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_13_model_area_9-07.mxd

Conceptual Model of the City of Chino Hills Ground Water Model

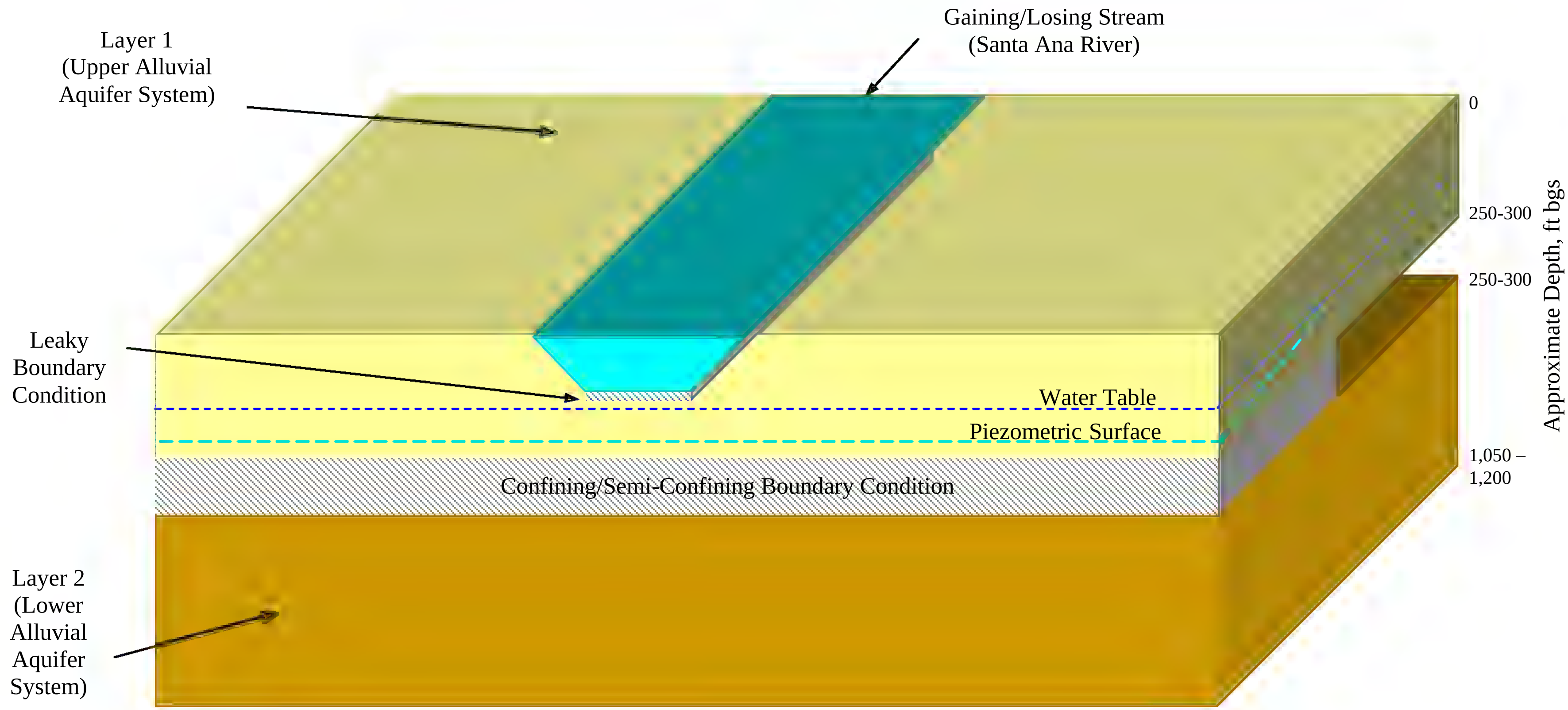

Figure 14

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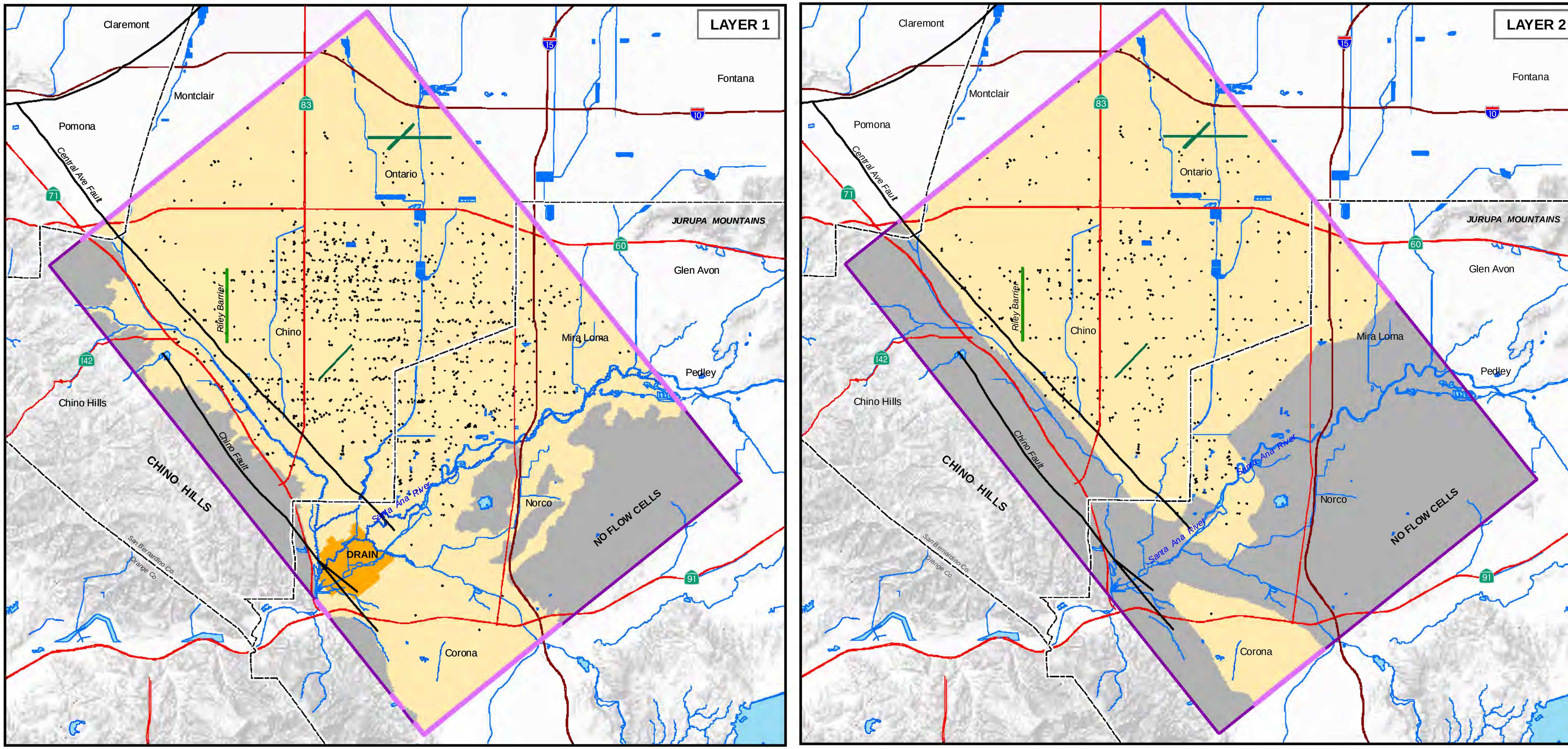
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



NORTH

0 2 4 Miles

EXPLANATION

- Active Model Cell
- Drain
- General Head Boundary
- No Flow Cell
- Stream
- Well
- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007b)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

MODEL BOUNDARY CONDITIONS MODEL LAYERS 1 AND 2

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

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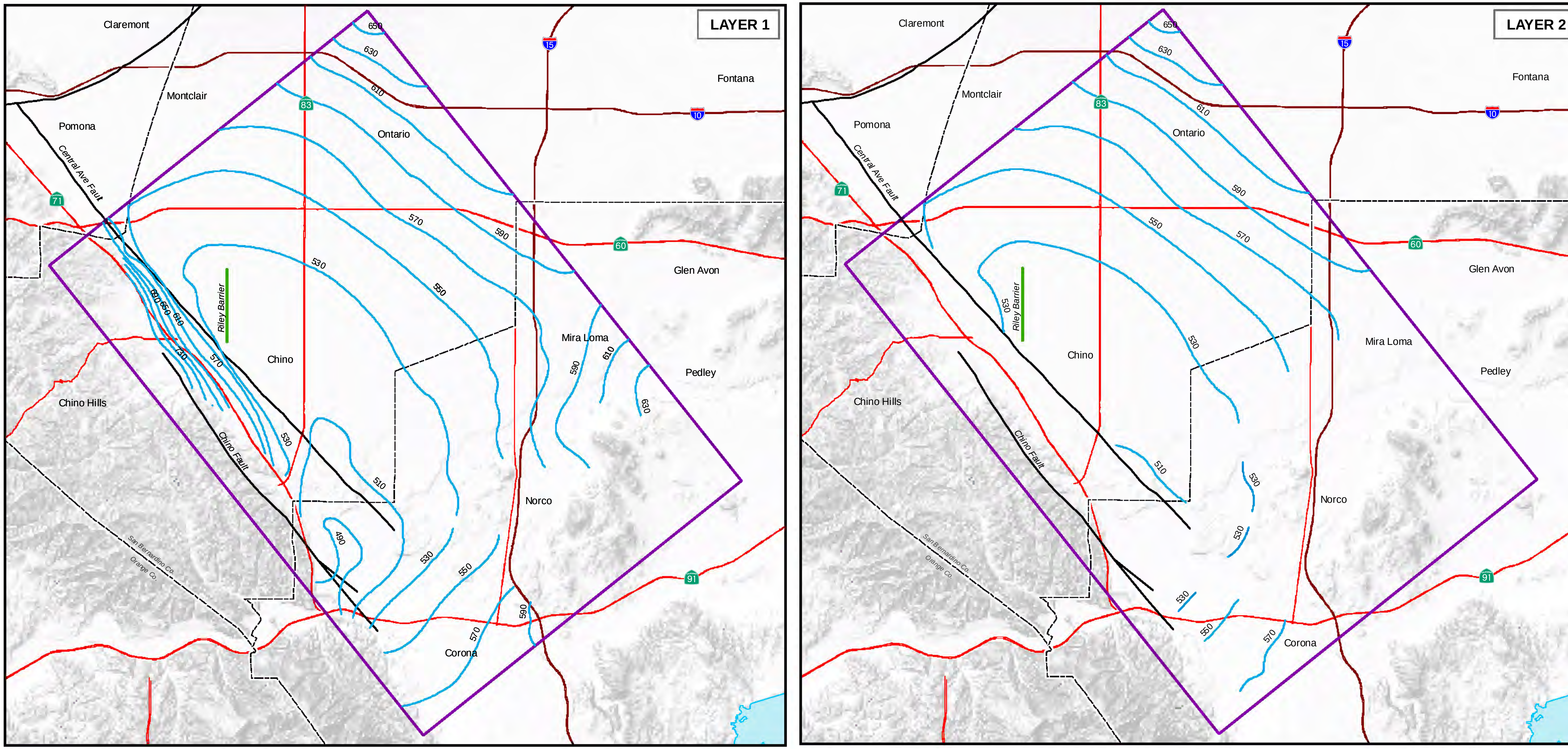
Figure 15

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_15_bndy_cond_L1_L2_9-07.mxd



EXPLANATION

500 — Ground Water Elevations Fall 1981 (ft above msl)

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007b)

County Boundary

Freeway

State Highway

NORTH

0 2 4 Miles

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Map Projection:
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GROUND WATER ELEVATIONS FALL 1981

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Figure 16

Measured vs. Model-Generated Ground Water Elevations - Transient Model Calibration
January 1982 Through September 2005

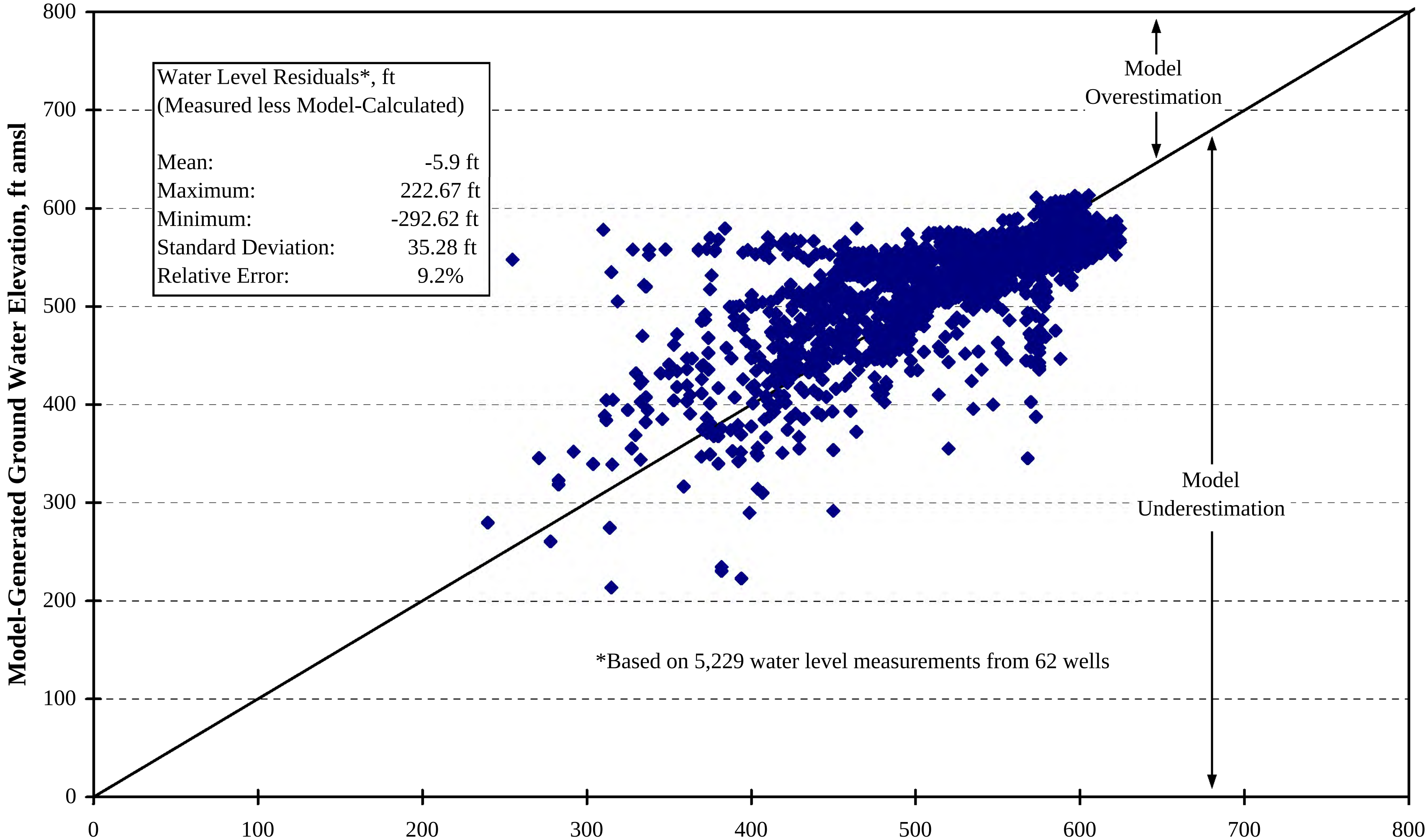

Figure 17

Histogram of Water Level Residuals - Transient Model Calibration
January 1982 Through September 2005

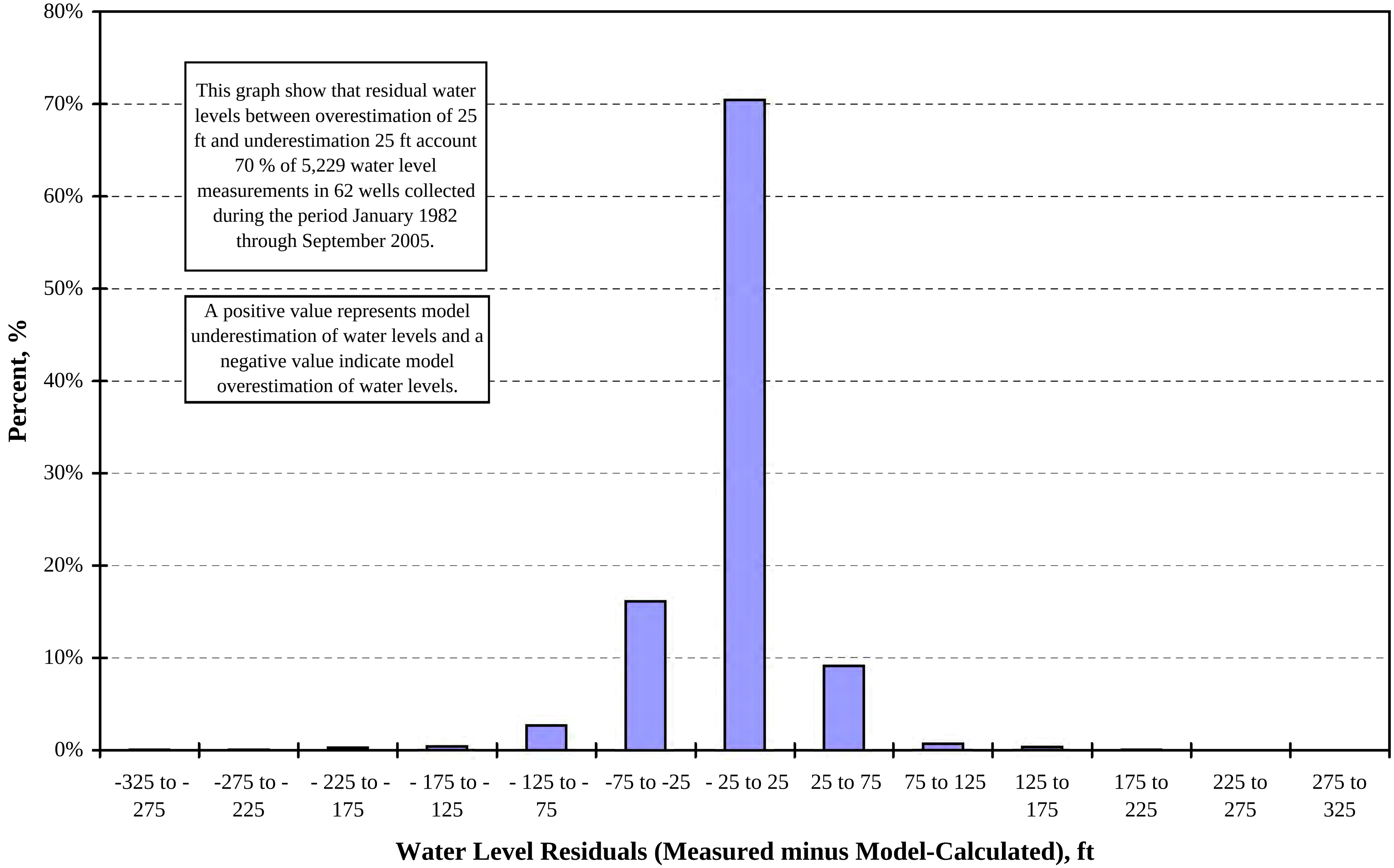

Figure 18

Measured versus Model-Calculated Streamflow at Santa Ana River Below Prado Dam
First Quarter 1982 - Third Quarter 2005

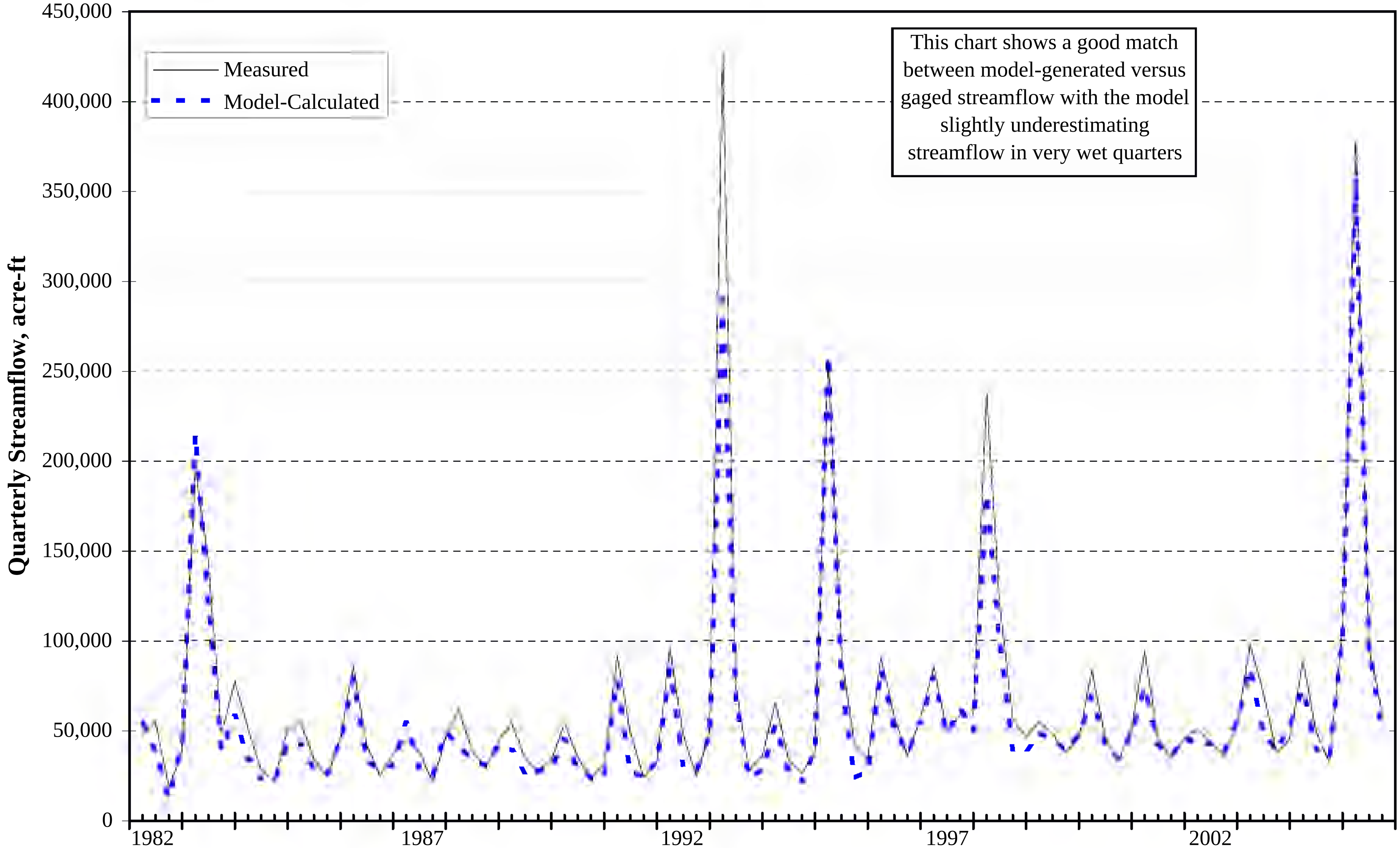

Figure 19

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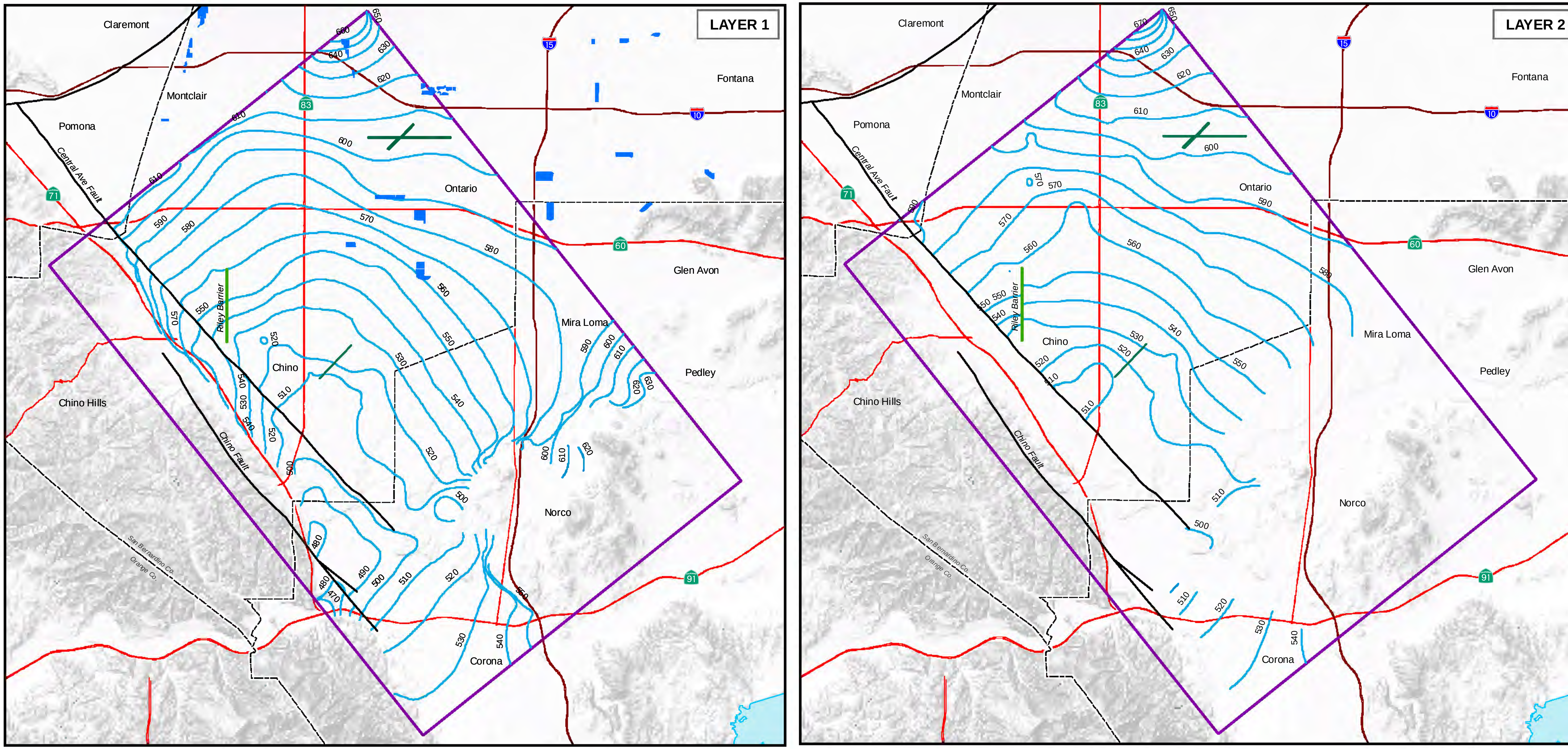
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



EXPLANATION

500	Model-generated ground water elevation contours - end of transient calibration (September 2005), ft amsl
	Ground Water Model Boundary
	Faults Near MZ-1
	Riley Groundwater Barrier (WE, 2005 & 2007b)
	County Boundary
	Freeway
	State Highway
	Airport

NORTH

0 2 4 Miles

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

MODEL-GENERATED GROUND WATER ELEVATION CONTOURS END OF TRANSIENT CALIBRATION (SEPTEMBER 2005)

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Figure 20

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_20_model_gw_contours_L1_L2_9-07.mxd

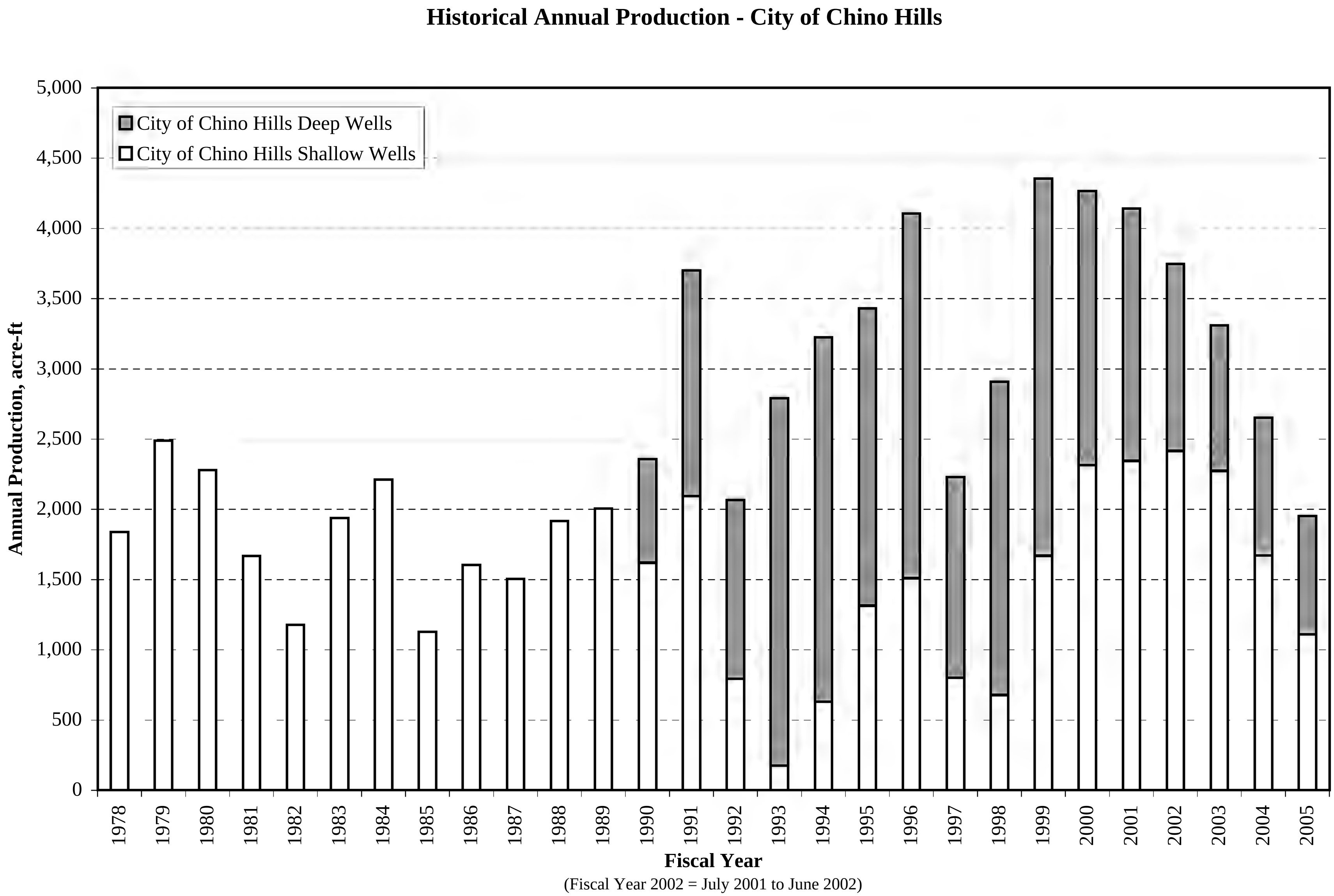
Historical Annual Production - City of Chino Hills
City of Chino Hills Deep Wells
City of Chino Hills Shallow Wells
Annual Production, acre-ft
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Fiscal Year
(Fiscal Year 2002 = July 2001 to June 2002)

Figure 21

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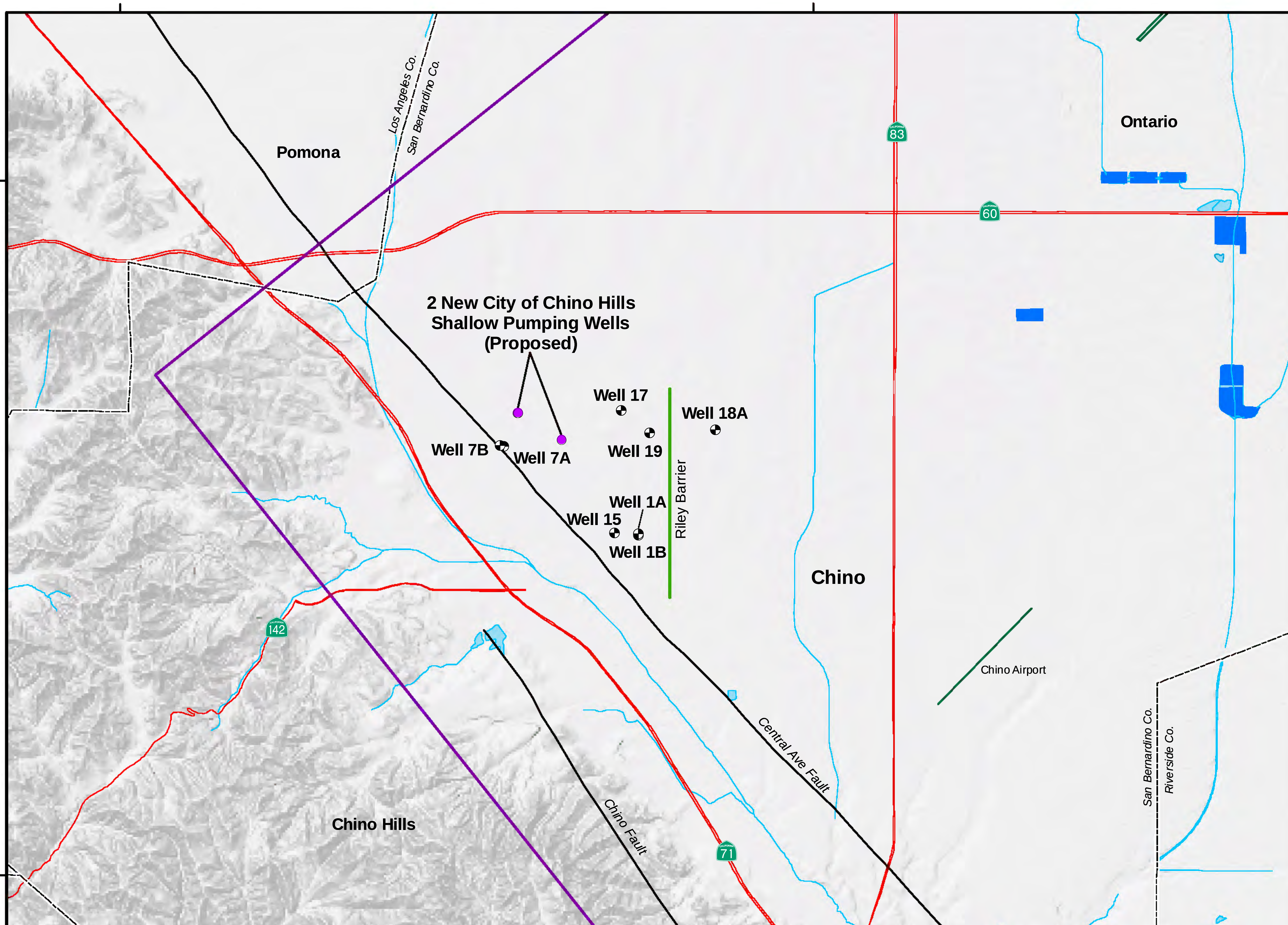
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

PROPOSED PUMPING WELLS CITY OF CHINO HILLS MODEL SCENARIO 3 (7,400 AFY)



21-Sep-07

EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- 2 New City of Chino Hills Wells Shallow Pumping Wells (Proposed for Purposes of Scenario 3)
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007b)
- County Boundary
- Freeway
- State Highway
- Street
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 1 2 Miles

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Figure 22

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_22_Proposed_pumping_wells_9-07.mxd

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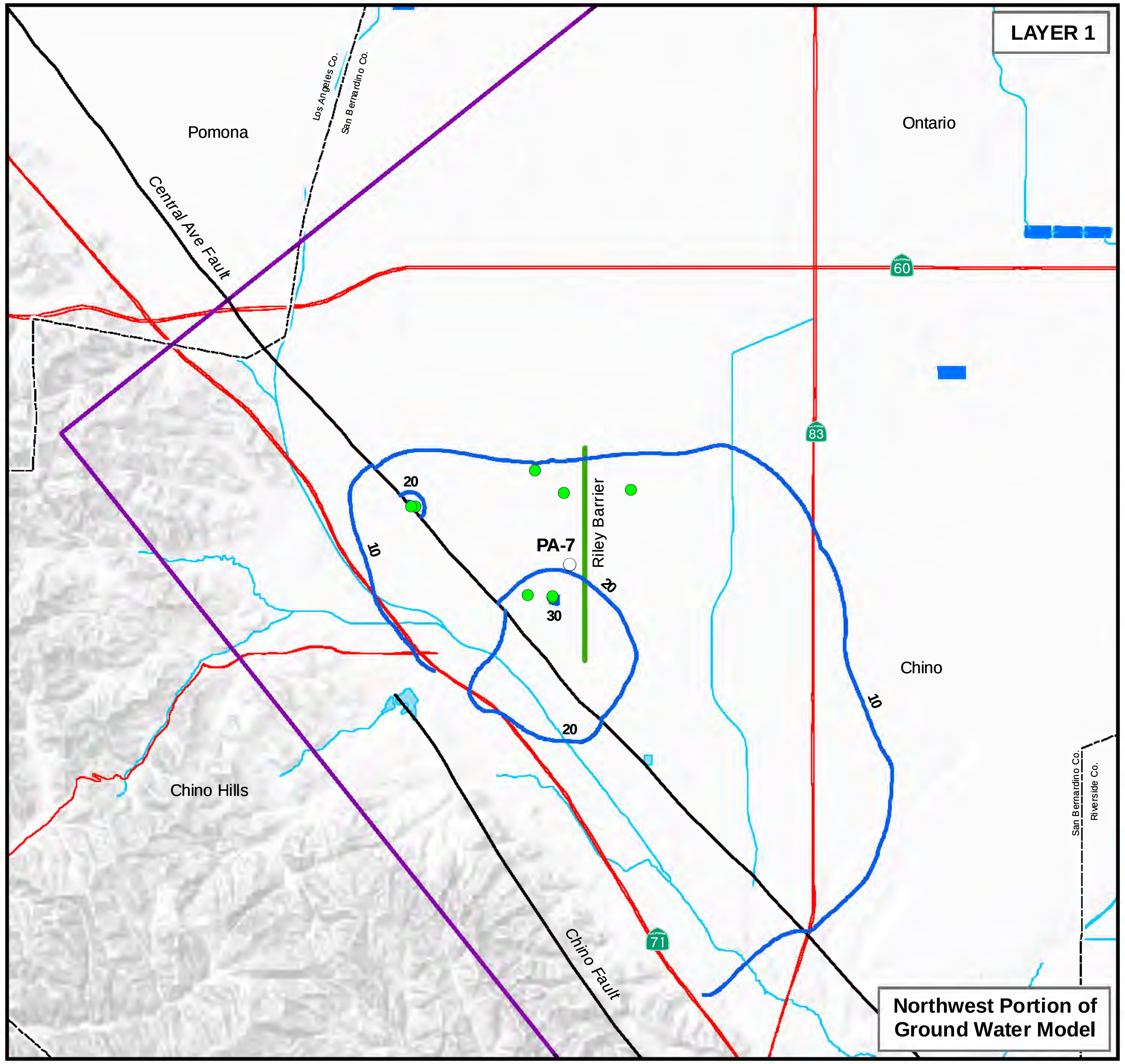
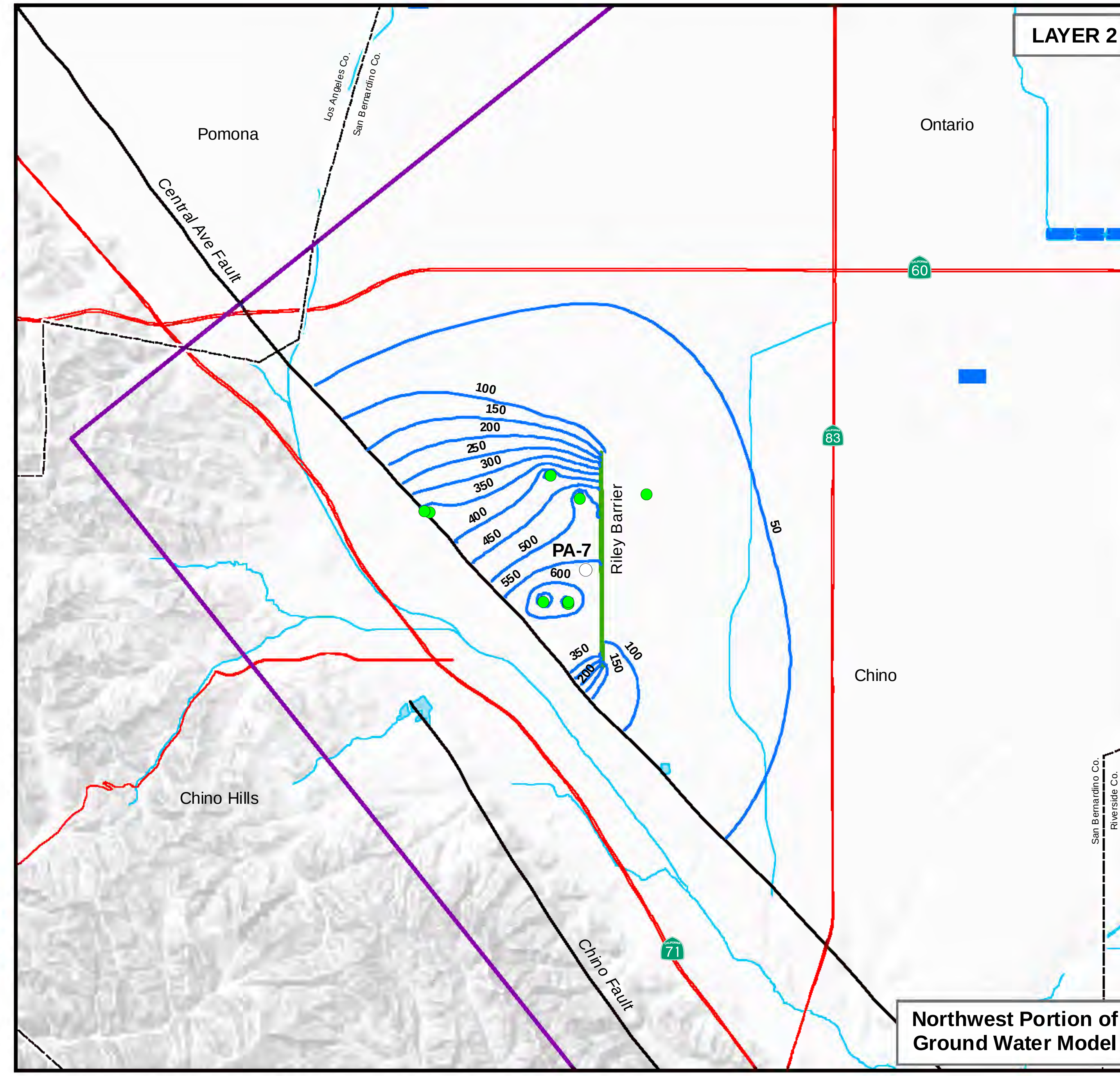
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1





EXPLANATION

NORTH

0 1 2 Miles

10 — Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)

City of Chino Hills Wells Used in Scenario 1 (See Figure C-14 for Well Names)

PA-7 (Deep Ayala Park Piezometer)

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007b)

County Boundary

Freeway

State Highway

Recharge Basin

Surface Water or River Channel

Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

CHANGE IN GROUND WATER LEVELS AFTER 20 YEARS (2005-2025) OF PUMPING BY THE CITY OF CHINO HILLS SCENARIO 1 (14,800 AFY)

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Tel: (909) 920-0707 Fax: (909) 920-0403
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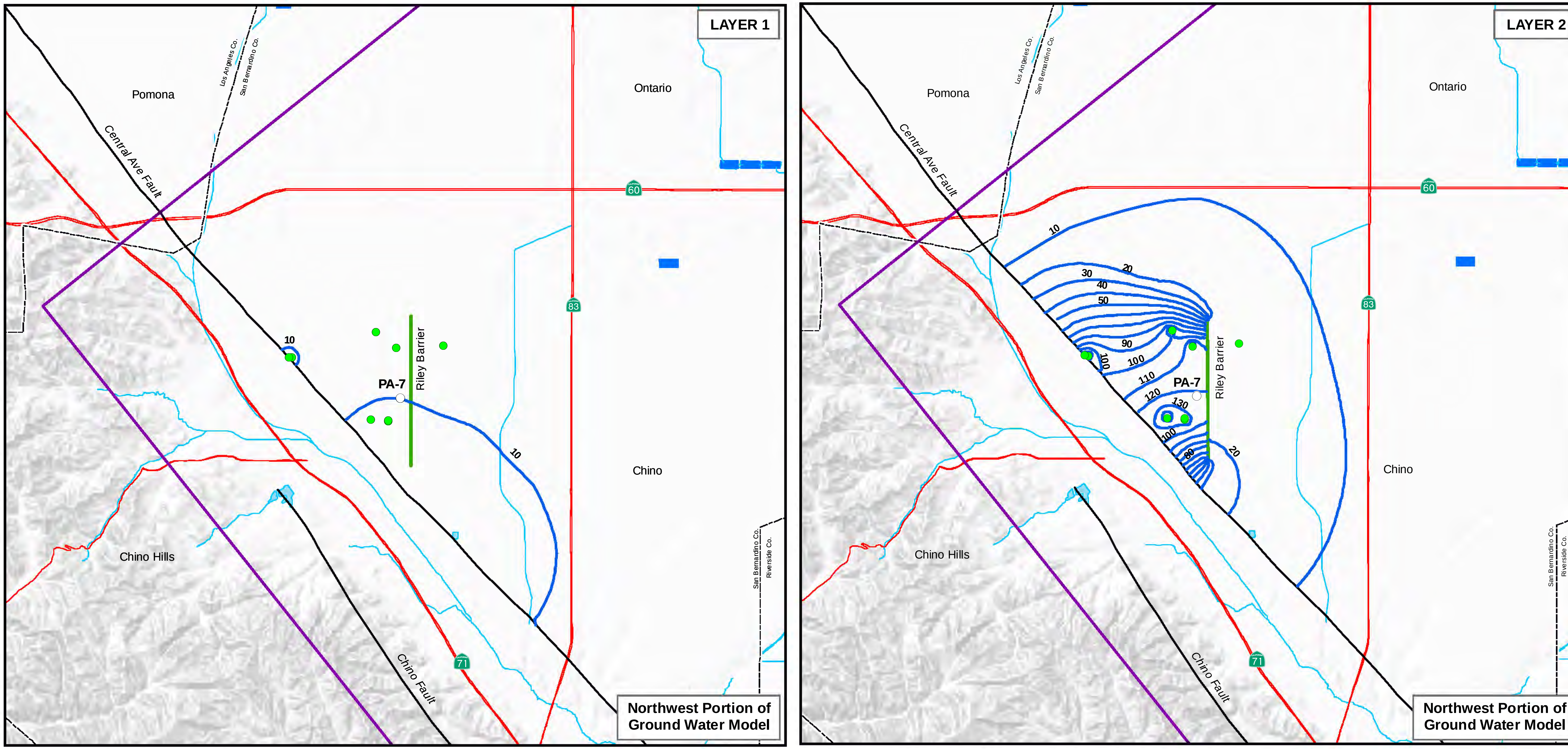
Figure 23

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



NORTH

0 1 2 Miles

EXPLANATION

10 — Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)

City of Chino Hills Wells Used in Scenario 2 (See Figure C-14 for Well Names)

PA-7 (Deep Ayala Park Piezometer)

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007b)

County Boundary

Freeway

State Highway

Recharge Basin

Surface Water or River Channel

Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

CHANGE IN
GROUND WATER LEVELS
AFTER 20 YEARS (2005-2025)
OF PUMPING BY THE
CITY OF CHINO HILLS
SCENARIO 2 (4,400 AFY)

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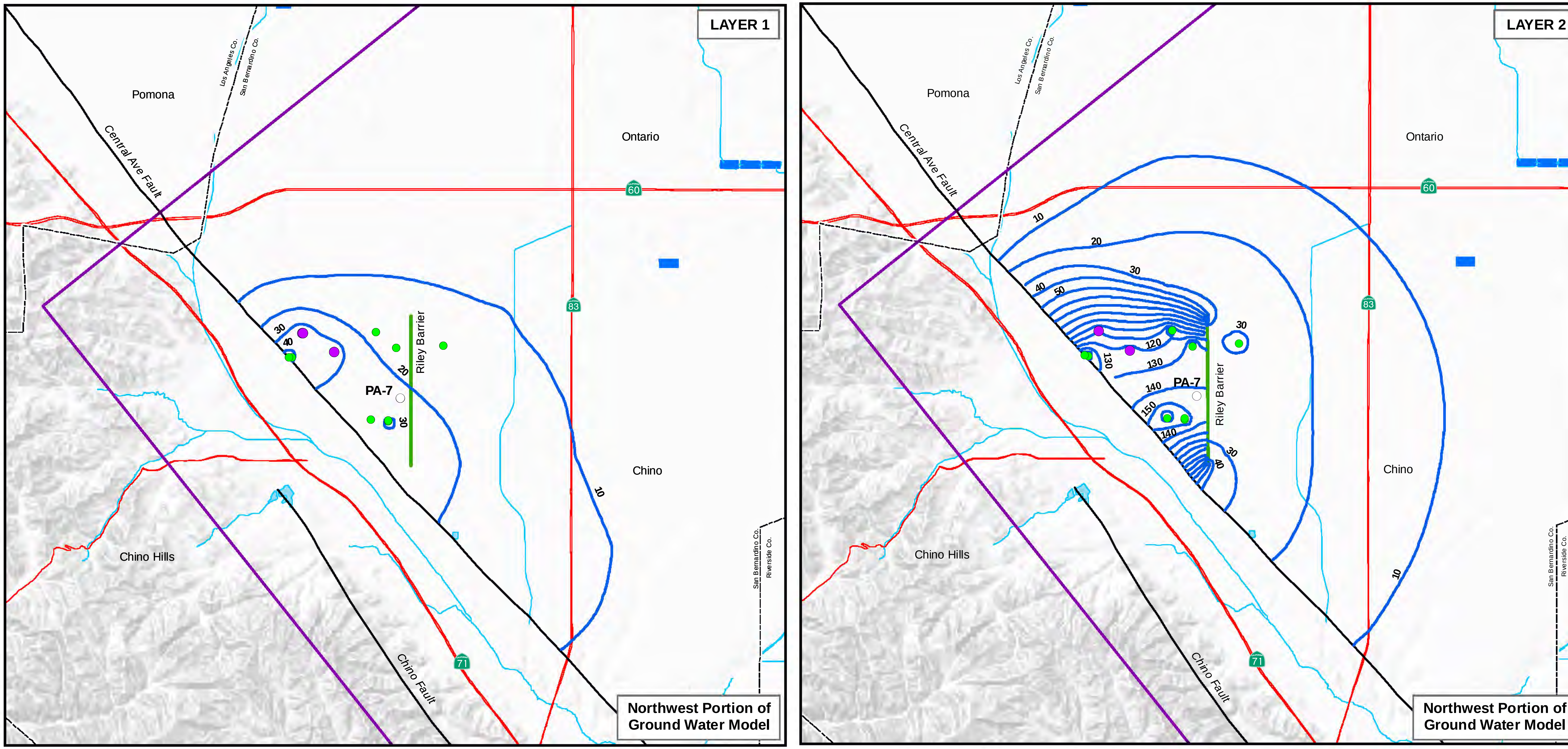
Figure 24

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_24_scen_2_wl_L1_L2_9-07.mxd



NORTH

0 1 2 Miles

EXPLANATION

10 — Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)

City of Chino Hills Wells Used in Scenario 3 (See Figure C-14 for Well Names)

PA-7 (Deep Ayala Park Piezometer)

2 New City of Chino Wells Proposed Shallow Pumping Wells

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007b)

County Boundary

Freeway

State Highway

Recharge Basin

Surface Water or River Channel

Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

CHANGE IN GROUND WATER LEVELS AFTER 20 YEARS (2005-2025) OF PUMPING BY THE CITY OF CHINO HILLS SCENARIO 3 (7,400 AFY)

GEOSCIENCE

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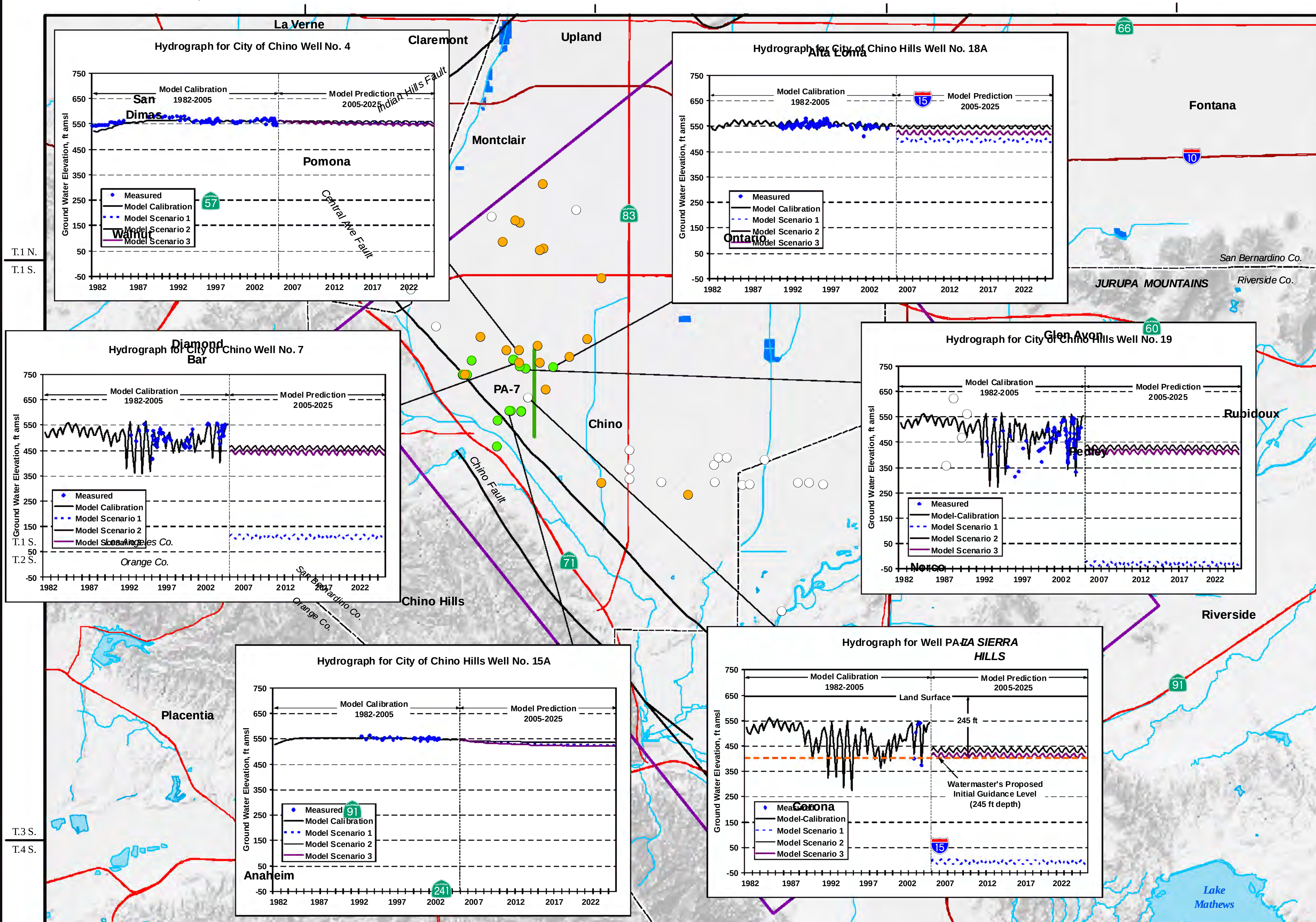
Figure 25

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

SELECTED HYDROGRAPHS FOR MODEL SCENARIOS 1, 2 AND 3



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007b)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

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Figure 26

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_25_selected_hydrographs_9-07.mxd

Depth to Water in Well PA-7 - Scenarios 1, 2 and 3

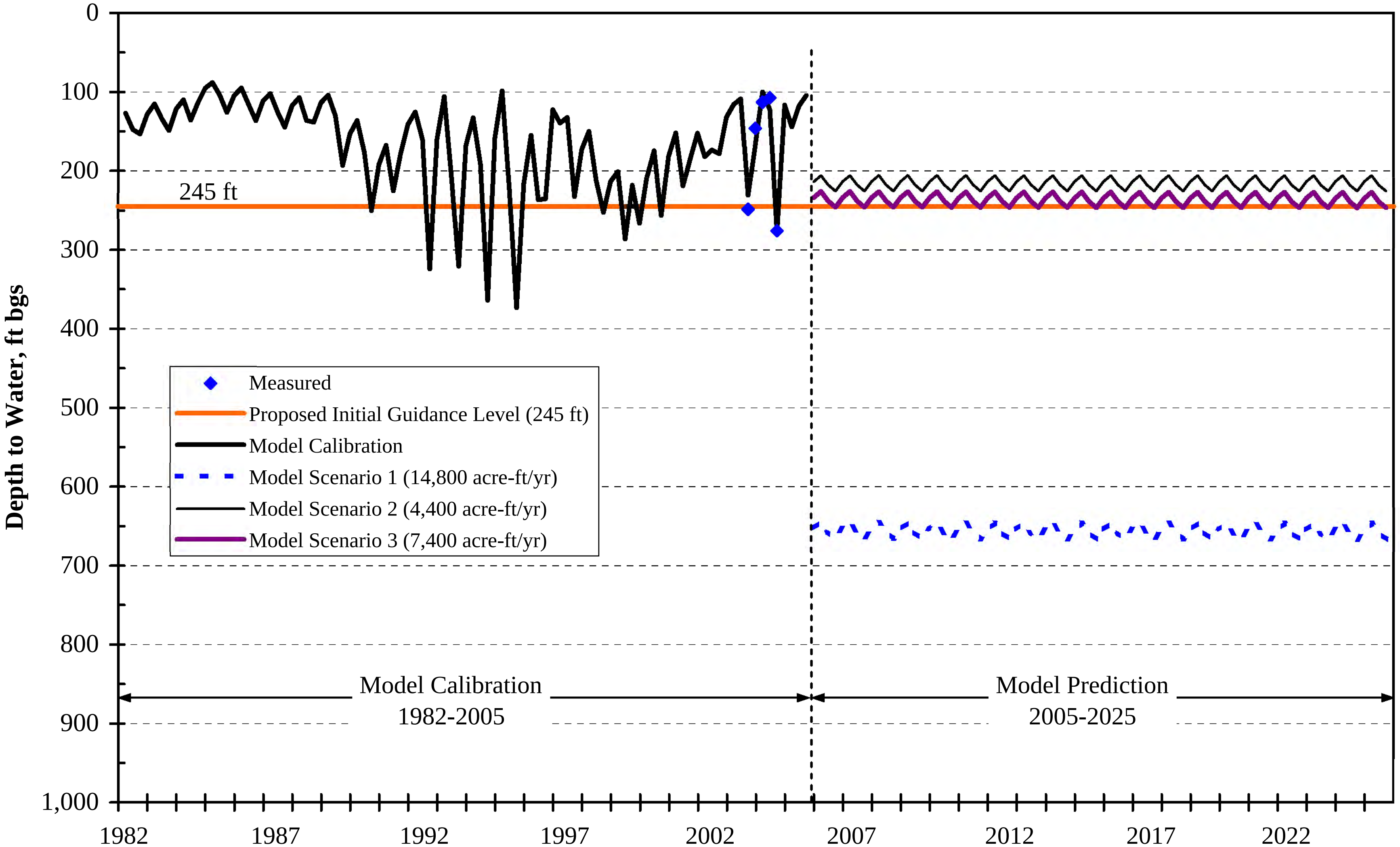


Figure 27

TABLES

GEOSCIENCE Support Services, Inc.

Timeline of Events Leading up to Watermaster's Proposed Long Term Plan

Year	Interim Management Plan	Forbearance Agreement	Pumping Tests	
1973				fissuring first appeared
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				
1983				
1984				
1985				
1986				
1987				
1988				
1989				
1990				
1991				fissuring accelerated
1992				
1993				
1994				
1995				
1996				
1997				
1998				
1999				Phase I report Optimum Basin Management Program (OBMP) - identified pumping-induced and subsequent aquifer-system compaction as likely cause of subsidence. Program Element 4 of OBMP recommended to Develop and Implement a Comprehensive Groundwater Management Plan for Management Zone 1
2000				Implementation Plan in Peace Agreement called for an aquifer-system and land subsidence investigation in SW MZ-1 to support development of a management plan for MZ-1 (MZ-1 Interim Monitoring Program)
2001				December 2001 City of Chino Hills files Petition for Writ of Mandate against City of Chino, split into two matters - a mandamus proceeding under Public Utility Code, and a motion encompassing all claims pertaining to the rights and obligations of the parties. Judge orders all parties to report on the status of technical work performed by Watermaster and others concerning subsidence.
2002	Watermaster developed, coordinated and conducted IMP	x		January 2002 City of Chino filed motion requesting the Court to assume jurisdiction over dispute with Chino Hills regarding water production and subsidence. Watermaster files its *Report of Watermaster Activities Regarding Subsidence and Request for Finding and Further Order* . February 2002 Special Referee files a *Report and Recommendation Concerning Motions Filed Related to Subsidence.* May 2002 Watermaster files a *Report on Progress of the Interim Plan Stakeholder Process* . June 2002 Watermaster transmits the Interim Plan to the Court and requests a workshop on the Plan. August 2002 1st workshop September 2002 *Special Referee's Report on Interim Plan Workshop and Recommendation Concerning Subsidence Issues* . Subsequently the Watermaster files comments to the Referee's Report and a revised Interim Plan and requests a court order to proceed in accordance with the Interim Plan. October 2002 Initial State of the Basin Report - 2000 October 2002 Court Order Concerning Watermaster's Interim Plan for Management of Subsidence November 2002 Ayala Park Piezometer completed
2003		x	x	January 2003 TC approved scope and schedule of IMP July 2003 Ayala Park Extensometer completed
2004		x	x	
2005		x	x	May 2005 2nd Workshop June 2005 Special Referee's Report on Progress Made on Implementation of the Watermaster Interim Plan for Management of Subsidence July 2005 2nd State of the Basin Report - 2004 October 2005 MZ-1 Summary Report
2006		x		February 2006 MZ-1 IMP Summary Report March 2006 Reservations on Summary Report voiced at Appropriative Pool Meeting by City of Chino Hills, with action on the plan delayed until an alternative proposal is submitted. April 2006 With no proposed alternative submitted, the Appropriative Pool approves the Summary Report and Guidance Criteria (with one dissenting vote from Chino Hills). The Summary Report is unanimously approved by the Non-Agricultural Pool and the Agricultural Pool. The Advisory Committee unanimously approves the Summary Report and Guidance Criteria (Chino Hills absent), but allows a delay to accommodate dialogue with Chino Hills. May 2006 Watermaster Board Chair meets with Chino Hills' representatives July 2006 Special Referee workshop held to present the Non-Binding Term Sheet October 2006 Watermaster reconvenes the Technical Committee to resume work on Long Term Plan
2007		x		June 2007 MZ-1 Subsidence Management Plan July 2007 3rd State of the Basin Report - 2006 August 2007 Motion for Approval of Watermaster's Long Term Plan for the Management of Subsidence (prepared by Chino Basin Watermaster attorneys)
2008				April 2008 - MZ-1 Technical Committee will have discussed and evaluated the above activities and developed scopes of work for those that are to be implemented

Sources of Data: WE (1999), We (2002), WE (2005), WE (2006), WE (2007a), WE (2007b), Hatch & Parent (2007)

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow Recharge from Streamflow [acre-ft]	Inflow Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge [acre-ft]	Inflow Underflow Inflow [acre-ft]	Total Inflow [acre-ft]	Outflow Evapotranspiration [acre-ft]	Outflow Net Ground Water Pumping [acre-ft]	Outflow Rising Ground Water [acre-ft]	Total Outflow [acre-ft]	Change in Ground Water Storage [acre-ft]
1982	1st	7,363	1,927	25,533	34,823	0	13,663	5,825	19,488	15,335
1982	2nd	6,920	1,926	24,320	33,167	5,186	21,253	2,711	29,149	4,017
1982	3rd	7,033	1,926	26,692	35,651	6,124	23,150	1,996	31,269	4,382
1982	4th	5,388	1,926	33,852	41,167	1,950	15,914	3,256	21,119	20,048
1983	1st	7,033	3,057	29,513	39,604	0	13,019	5,158	18,177	21,427
1983	2nd	3,966	1,926	26,292	32,185	5,479	20,255	2,779	28,512	3,673
1983	3rd	4,456	1,926	30,500	36,883	6,530	25,399	2,090	34,019	2,864
1983	4th	3,765	1,926	28,719	34,410	2,089	17,461	3,379	22,929	11,481
1984	1st	3,031	1,926	25,129	30,085	0	14,286	4,580	18,866	11,219
1984	2nd	3,351	1,926	24,839	30,116	5,657	22,225	2,792	30,673	-556
1984	3rd	3,961	1,926	26,309	32,196	6,761	23,007	2,094	31,862	334
1984	4th	3,293	1,925	25,643	30,861	2,158	15,817	3,294	21,270	9,591
1985	1st	2,336	1,926	21,901	26,163	0	12,936	4,360	17,296	8,867
1985	2nd	2,866	1,926	23,370	28,162	5,746	20,133	2,548	28,427	-265
1985	3rd	3,501	1,926	27,043	32,470	6,830	22,842	1,882	31,554	916
1985	4th	2,541	1,926	24,862	29,329	2,192	15,680	3,099	20,971	8,358
1986	1st	1,699	2,493	24,013	28,205	0	12,833	4,254	17,087	11,118
1986	2nd	4,447	1,926	9,871	16,244	5,838	19,972	2,505	28,315	-12,070
1986	3rd	5,059	1,926	19,077	26,062	6,887	24,518	1,841	33,246	-7,184
1986	4th	4,459	1,926	17,424	23,809	2,176	16,873	2,950	22,000	1,810
1987	1st	3,944	1,926	15,702	21,572	0	13,774	3,969	17,743	3,829
1987	2nd	4,873	1,926	16,460	23,259	5,666	21,465	2,280	29,410	-6,151
1987	3rd	5,636	1,926	19,399	26,961	6,639	23,393	1,662	31,694	-4,733
1987	4th	5,061	1,926	17,837	24,825	2,105	16,093	2,780	20,978	3,847

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow	Total Inflow	Outflow	Outflow	Outflow	Total Outflow	Change in Ground Water Storage
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow		Evapotranspiration	Net Ground Water Pumping	Rising Ground Water		
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1988	1st	4,596	1,926	15,473	21,995	0	13,154	3,838	16,993	5,003
1988	2nd	5,503	1,926	12,948	20,376	5,523	20,478	2,202	28,202	-7,826
1988	3rd	6,202	1,926	16,758	24,887	6,439	21,924	1,598	29,961	-5,074
1988	4th	5,602	1,926	15,519	23,047	2,043	15,060	2,647	19,750	3,297
1989	1st	5,010	1,926	9,642	16,578	0	12,351	3,662	16,012	566
1989	2nd	5,673	1,926	12,810	20,409	5,358	19,169	2,073	26,600	-6,191
1989	3rd	6,365	1,926	14,899	23,190	6,212	23,163	1,458	30,833	-7,643
1989	4th	5,753	1,926	15,725	23,405	1,970	15,932	2,440	20,342	3,063
1990	1st	5,101	1,926	13,774	20,801	0	13,039	3,411	16,451	4,350
1990	2nd	5,758	1,926	13,361	21,045	5,223	20,271	1,935	27,429	-6,384
1990	3rd	6,628	1,926	14,991	23,545	6,084	22,452	1,382	29,917	-6,373
1990	4th	6,061	1,926	15,657	23,643	1,933	15,427	2,376	19,736	3,907
1991	1st	5,386	2,491	17,218	25,094	0	12,626	3,382	16,008	9,086
1991	2nd	6,006	1,926	15,312	23,244	5,174	19,651	1,940	26,765	-3,522
1991	3rd	6,286	1,926	16,690	24,901	6,123	23,232	1,433	30,787	-5,886
1991	4th	5,179	1,926	22,544	29,649	1,977	15,955	2,495	20,427	9,222
1992	1st	3,976	2,493	20,960	27,429	0	13,085	3,563	16,648	10,781
1992	2nd	4,325	1,926	20,523	26,775	5,406	20,317	2,064	27,787	-1,012
1992	3rd	5,696	1,926	16,368	23,990	6,380	22,452	1,517	30,349	-6,359
1992	4th	5,893	1,926	13,567	21,387	2,032	13,154	2,583	17,769	3,618
1993	1st	8,604	3,056	3,903	15,562	0	10,170	4,291	14,461	1,102
1993	2nd	7,573	1,926	3,903	13,402	5,347	21,901	2,126	29,373	-15,971
1993	3rd	7,950	1,926	12,695	22,571	6,141	18,618	1,534	26,292	-3,721
1993	4th	8,386	1,926	2,870	13,182	1,908	13,613	2,580	18,101	-4,920
1994	1st	7,750	1,926	14,738	24,415	0	11,203	3,602	14,805	9,610

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow	Total Inflow	Outflow	Outflow	Outflow	Total Outflow	Change in Ground Water Storage
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow		Evapotranspiration	Net Ground Water Pumping	Rising Ground Water		
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1994	2nd	8,349	1,926	16,276	26,552	4,901	20,156	2,048	27,105	-553
1994	3rd	8,946	1,926	14,463	25,335	5,673	24,633	1,481	31,786	-6,451
1994	4th	8,480	1,926	10,514	20,921	1,798	16,781	2,505	21,084	-163
1995	1st	12,169	3,058	11,433	26,660	0	12,971	4,160	17,130	9,529
1995	2nd	8,237	1,926	15,702	25,865	4,892	22,337	2,043	29,272	-3,407
1995	3rd	8,933	1,926	17,241	28,099	5,634	25,872	1,467	32,973	-4,874
1995	4th	8,466	1,926	11,111	21,504	1,786	16,529	2,489	20,803	700
1996	1st	7,938	2,491	12,534	22,964	0	14,141	3,508	17,649	5,315
1996	2nd	8,216	1,926	14,624	24,766	4,789	19,261	1,995	26,045	-1,279
1996	3rd	8,871	1,926	15,106	25,902	5,634	21,993	1,437	29,063	-3,161
1996	4th	8,418	1,926	11,272	21,616	1,802	16,919	2,440	21,162	455
1997	1st	7,837	2,493	12,328	22,658	0	15,542	3,425	18,967	3,691
1997	2nd	8,085	1,926	13,131	23,143	4,807	19,444	1,928	26,180	-3,037
1997	3rd	8,446	1,926	15,152	25,523	5,677	20,271	1,380	27,328	-1,804
1997	4th	7,718	1,926	12,420	22,064	1,837	16,368	2,369	20,574	1,490
1998	1st	9,897	3,056	13,499	26,451	0	14,118	4,004	18,122	8,329
1998	2nd	7,146	1,926	10,996	20,069	5,076	18,916	1,935	25,927	-5,859
1998	3rd	7,727	1,926	14,440	24,093	5,895	20,845	1,357	28,097	-4,004
1998	4th	7,195	1,926	13,728	22,849	1,876	18,044	2,323	22,243	606
1999	1st	6,637	1,926	13,499	22,062	0	16,896	3,267	20,163	1,899
1999	2nd	7,257	1,926	13,522	22,704	4,915	18,825	1,798	25,537	-2,833
1999	3rd	7,798	1,926	14,027	23,751	5,762	20,133	1,260	27,156	-3,404
1999	4th	7,241	1,926	11,731	20,898	1,860	17,424	2,227	21,511	-613
2000	1st	6,543	2,493	13,407	22,443	0	16,070	3,182	19,252	3,191
2000	2nd	7,300	1,926	13,039	22,266	4,844	19,605	1,740	26,189	-3,923

Table 2

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow		Outflow	Outflow	Outflow		
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow	Total Inflow	Evapotranspiration	Net Ground Water Pumping	Rising Ground Water	Total Outflow	Change in Ground Water Storage
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
2000	3rd	7,916	1,926	13,522	23,363	5,624	23,600	1,214	30,438	-7,075
2000	4th	7,477	1,926	12,810	22,213	1,791	19,628	2,156	23,574	-1,361
2001	1st	6,837	2,491	12,603	21,931	0	16,185	3,104	19,288	2,642
2001	2nd	7,585	1,926	14,669	24,180	4,637	24,449	1,676	30,762	-6,582
2001	3rd	8,526	1,926	9,711	20,163	5,280	25,230	1,159	31,669	-11,506
2001	4th	8,349	1,926	10,560	20,836	1,676	19,238	2,087	23,000	-2,165
2002	1st	7,870	1,926	10,331	20,126	0	18,549	3,017	21,566	-1,439
2002	2nd	8,299	1,926	12,856	23,081	4,293	23,301	1,605	29,199	-6,118
2002	3rd	9,233	1,926	8,724	19,883	4,890	26,905	1,107	32,902	-13,019
2002	4th	8,921	1,926	12,167	23,014	1,538	20,684	2,002	24,224	-1,210
2003	1st	8,542	2,491	8,264	19,298	0	17,769	2,932	20,700	-1,403
2003	2nd	8,848	1,926	13,085	23,859	4,063	21,166	1,556	26,786	-2,927
2003	3rd	9,447	1,926	13,545	24,917	4,614	29,385	1,067	35,067	-10,149
2003	4th	9,236	1,926	8,953	20,115	1,469	21,212	1,935	24,617	-4,502
2004	1st	8,882	1,926	13,085	23,893	0	17,906	2,849	20,755	3,138
2004	2nd	9,279	1,926	12,626	23,831	3,811	23,691	1,497	28,999	-5,168
2004	3rd	9,759	1,926	11,938	23,623	4,316	29,155	1,024	34,495	-10,872
2004	4th	9,454	1,926	11,019	22,399	1,377	17,034	1,889	20,301	2,098
2005	1st	14,582	3,058	9,412	27,052	0	13,567	3,506	17,073	9,979
2005	2nd	9,180	1,926	9,871	20,978	3,949	20,615	1,561	26,125	-5,147
2005	3rd	9,685	1,490	14,692	25,868	4,385	23,026	1,033	28,444	-2,576

Quarterly Average	**6,832**	**2,029**	**15,756**	**24,616**	**3,205**	**18,850**	**2,463**	**24,517**	**98**
Annual Average	**27,326**	**8,115**	**63,023**	**98,464**	**12,819**	**75,400**	**9,851**	**98,070**	**394**

APPENDIX A

Resume of Dennis E. Williams, Ph.D.

DENNIS E. WILLIAMS, Ph.D., PG, CHG

President / Principal Geohydrologist

Dr. Dennis E. Williams, founder and president of the Southern California based firm GEOSCIENCE Support Services, Inc. has over 35 years of experience in ground water hydrology. During that time he has directed geohydrologic investigations domestically and worldwide which includes the design and supervision of construction of over 700 deep large-scale municipal and irrigation water supply wells. He has been a consultant to the United Nations and several foreign governments and is currently a part-time research professor at the University of Southern California's Civil and Environmental Engineering Department where he has taught graduate level courses in geohydrology and ground water modeling since 1980. Dr. Williams is currently directing research on ground water and wells at USC's geohydrologic laboratory which houses the largest sand-tank model in the world. Dr. Williams is author of over 30 publications on ground water and wells and was the principal author of the *Handbook of Ground Water Development* (John Wiley & Sons, 1990). Dr. Williams was also chief reviewer for the American Society of Civil Engineers (ASCE) *Manual of Water Well Design, Construction, Testing and Maintenance* and primary author for two chapters, *Water Well Construction, and Developing and Testing*, and of Appendix *Example of Water Well System Design* (to be published in 2007). Dr. Williams is a contributor for three entries in the Encyclopedia of Water: "Radial Wells", "Well Tests", and "Well Screens" published by John Wiley and Sons in 2005. Dr. Williams is a technical consultant to the American Water Works Association (AWWA) Standards Committee for Wells (*ANSI/AWWA A100-04*).

EDUCATION

- B.S., Geology. University of Redlands
- M.S., Ground Water Hydrology. New Mexico Institute of Mining and Technology
- Ph. D., Hydrology. New Mexico Institute of Mining and Technology

PROFESSIONAL REGISTRATIONS

- California Professional Geologist (No. 461)
- Certified California Hydrogeologist (No. 139)
- Certified Ground Water Hydrologist (American Institute of Hydrology) (No. 355)

PROFESSIONAL AFFILIATIONS

- American Water Works Association (active member)
    - Member of Water Well Technical Committee.
    - Technical Consultant to AWWA Standards Committee for Wells (*ANSI/AWWA A100-04*).
- American Society of Civil Engineers (affiliate member)

PROFESSIONAL AFFILIATIONS (Cont.)

- National Water Well Association (technical member)
- Orange County Water Association
- Association of Special Districts – San Bernardino County
- American Institute of Hydrology
- Member Industry Advisory Committee – USC Department of Civil and Environmental Engineering

PROFESSIONAL RECOGNITION

- Mathematics (Pi Mu Epsilon)
- Earth Sciences (Sigma Gamma Epsilon)

TRAINING SEMINARS

- *Well Design*, California Water Service Company Employees, San Jose, California. April 18-19, 2002 and June 8-9 2005.
- *Basic Geohydrology*, Los Angeles Regional Water Quality Control Board. July 30, 1997.
- *Ground Water Development*, Government of Vietnam, Hanoi. March 14-16, 1996.

EXPERT / BLUE RIBBON PANELS / PEER REVIEW

- Member of the Upper Santa Clara River Chloride TMDL Technical Advisory Panel
- Peer Review Orange County Water District Ground Water Model – Irvine Ranch Water District
- Ground Water Replenishment System Expert Panel – Orange County Water District
- West Basin Expert Panel – Injection of 100% Recycled Water into the West Coast Basin Barrier
- Peer Review USGS Bunker Hill Basin Ground Water Model - USGS
- Salinas Valley -- White Paper Expert Panel - Monterey County Water Resources Agency
- Peer Review of Tetra Tech/Coachella Valley Water District and the Imperial Valley Irrigation District Salton Sea Ground Water Model
- Head of Taskforce for a Ground Water Model which included input from the USGS, Stetson Engineers, Rancho California Water District, the United States Marines at Camp Pendleton, and the Riverside County Watermaster.
- Peer Review of a Ground Water Surface Model for the Monterey County Water Resources Agency.
- Peer Review of flow model developed for the Santa Clara Valley Water District.
- Azusa Landfill Taskforce – Head of MWD’s Technical Team

DENNIS E. WILLIAMS, Ph.D., PG, CHG

President / Principal Geohydrologist

PROFESSIONAL EXPERIENCE

- 1978 to Present: *Founder and President,* Geoscience Support Services, Inc.

- 2001 to Present: *Part-time Research Professor* in Civil and Environmental Engineering Department, University of Southern California

- 1980 to 2001: *Part-time Instructor* in Civil and Environmental Engineering and Earth Sciences Departments, University of Southern California, Los Angeles, California

- 1977 to 1980 *Consultant to the United Nations UNDP*, United Nations Development Programme, India
- 1976 to 1978 *Special Advisor to the Ministry of Energy, Government of Iran*, Iran
- 1973 to 1978 *Chief Hydrologist / General Manager,* Agro-Water Consulting Engineers, Iran
- 1971 to 1973 *Project Manager,* Louis Berger International Inc., Iran
- 1972 to 1974 *Special Consultant to the United Nations UNDP,* United Nations Development Programme, India
- 1968 to 1971 *Engineering Geologist / Hydrologist*, Los Angeles Department of Water and Power, Los Angeles, California
- 1970 *Instructor* in Civil Engineering Department.
  Part-time Instructor in Hydraulic Engineering, Water Supply Engineering, Engineering Hydrology and Water Quality, California State Polytechnic University, Pomona, California
- 1966 to 1968 *Graduate Research Assistant,* New Mexico Institute of Mining and Technology,
  Socorro, New Mexico
- 1965 to 1966 *Civil Engineering Assistant,* Los Angeles Department of Water and Power, Los Angeles, California
- 1962 to 1965 *Graduate Research Assistant*, New Mexico Institute of Mining and Technology, Socorro, New Mexico

DETAILED EXPERIENCE

GEOSCIENCE Support Services, Inc. Claremont, California

January 1978 to Present

Founder and President of GEOSCIENCE Support Services Inc., a California Corporation specializing in geohydrologic studies leading to development and management of ground water resources. GEOSCIENCE's client list includes most of the major Water Districts and agencies in the Southern California area, as well as clients in South America, Europe, and the Middle and Far East). Dr. Williams has also served as an expert witness on numerous legal issues (including arbitration, mediation, and court trials) for both domestic and international clients.

August 2001 to Present — **UNIVERSITY OF SOUTHERN CALIFORNIA, Civil and Environmental Engineering Department** Los Angeles, California

Part-Time Research Professor. Currently teaching graduate-level class in geohydrology and directing research at USC's geohydrology laboratory related to well design and rehabilitation.

1980 to August 2001 — **UNIVERSITY OF SOUTHERN CALIFORNIA, Civil and Environmental Engineering and Earth Sciences Departments** Los Angeles, California

Part-time Instructor. Taught graduate-level classes in geohydrology and ground water modeling.

November 1979 to November 1980 — **UNITED NATIONS DEVELOPMENT PROGRAMME** India

Consultant to the United Nations (UNDP). Expert member of a UNDP team sent to Madras, India to develop a conjunctive use water supply plan designed to meet the needs of the City of Madras until the year 1990 (population: 8 million).

September 1977 to October 1978 — **UNITED NATIONS DEVELOPMENT PROGRAMME** India

Consultant to the United Nations Development Programme (UNDP). Retained as a ground water modeling expert on a team of UNDP experts conducting a feasibility study on the Ghaggar River Basin (Northwest India). Project responsibilities included evaluation of raw data and direction of local Indian Government personnel in the gathering, reduction and organization of data necessary to construct a digital computer ground water model of the Ghaggar River Basin.

March 1976 to March 1978 — **CONSULTANT TO THE GOVERNMENT OF IRAN** Iran

Special advisor to the Ministry of Energy, Government of Iran on hydrological problems involving water resources evaluation and development. Directed teams of Iranian government personnel in the conduct of feasibility investigations of various basins for purposes of total water resources development. Also provided guidance in development of a computer database for the collection, organization, storage and retrieval of hydrologic data.

DETAILED EXPERIENCE (Cont.)

July 1973 to November 1978 **AGRO-WATER CONSULTING ENGINEERS** Tehran, Iran

Chief Hydrologist/General Manager. In charge of managing the activities of a consulting engineering firm specializing in planning, design and supervision of construction of large-scale irrigation project development. Specific duties included technical and administrative duties for feasibility, final design and supervision of construction and management for irrigation development projects in Iran. Set up a complete mini-computer center for engineering and management computer programs. Directly supervised 30 civil engineers and various other technical personnel as required on various irrigation projects (geologists, hydrologists, soil mechanics experts, surveyors, agronomists and planners).

Designed an advanced supervisory control system for the Dashte-Naz Project incorporating modern telemetering/telecontrol equipment to monitor and control surface and ground water resources of a 6,000-acre irrigation project in Northern Iran.

Incorporated into this project was the first ground water barrier project in Iran, a pilot project that prevented salt-water encroachment by means of a ground water pressure ridge.

Planned and supervised ground water development projects in Karstic limestone areas of Northern and Western Iran. Planned and supervised teams involved in the ground water exploration and development of the limestone formations for municipal and agricultural supplies in Southwest Iran.

July 1971 to July 1973 **LOUIS BERGER INTERNATIONAL INC.** Tehran, Iran

Project Manager in charge of project management and supervision for the Gorgan area project, a one million acre irrigation project in Northeast Iran. Work involved coordinating and supervising the efforts of geologists, civil engineers, hydro-agronomists, economists, and various other scientific and technical personnel. Specifically, the project was oriented toward producing feasibility designs upon which the government could economically justify funds for large-scale agriculture and animal husbandry development (surface and ground water), optimized using modern computer techniques for maximum development of irrigated agriculture, animal husbandry and agro-business.

October 1972 to September 1974 **UNITED NATIONS DEVELOPMENT PROGRAMME** India

Special consultant to the United Nations Development Programme (UNDP). UNDP Expert responsible for direction and coordination of work by United Nations and local personnel in India in connection with development and testing of a digital computer model of the Gujarat ground water reservoir.

DETAILED EXPERIENCE (Cont.)

July 1968 to July 1971 **LOS ANGELES DEPARTMENT OF WATER AND POWER** Los Angeles, California

Engineering Geologist/Hydrologist. Planned and directed geologic and hydrologic studies in the Los Angeles and Owens Valley areas with regard to the amount and disposition of surface and ground water resources available for supply to the City of Los Angeles. Supervised engineering personnel and various construction and technical personnel in geologic and hydrologic investigations. Initiated and coordinated programs involving well drilling, aquifer testing and analysis, and ground water quality monitoring and cleanup.

Developed master plan for optimum basin development and management in the Owens Valley area involving digital computer model simulation. Applied analytical methods to evaluate ground water quantity and quality problems in the Los Angeles area.

Conducted various engineering geology studies including slope stability analyses, foundation and site studies and various tunnel investigations.

Designed injection well barrier for control of a gasoline contaminated ground water reservoir near Los Angeles. Built a model of the system to test analytical and field results of the two-fluid flow regime (gasoline and water).

January 1970 to June, 1970 **CALIFORNIA STATE POLYTECHNIC UNIVERSITY** Pomona, California

Instructor in Civil Engineering Department. Part-time instructor in Hydraulic Engineering, Water Supply Engineering, Engineering Hydrology and Water Quality.

September 1966 to July, 1968 **NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY (NMIMT)** Socorro, New Mexico

Graduate Research Assistant. Worked for the Research and Development Division of NMIMT while attending graduate school. Involved on both model and field-testing of using air injection into ground water reservoirs as an effective means of combating salt-water encroachment. Built viscous-flow model of the system. Field-tested theory using a compressor-tank system into wells drilled by students with school rotary drilling rigs.

Involved in complete water resources study of the Pecos Basin of Southwest New Mexico.

Developed and tested an automatic water-level recording device based on a strain gage transducer coupled to a simple bridge circuit and displayed on a strip chart recorder. Also participated in the design of an experimental borehole-sampling gun powered by an explosive charge designed to take fast, undisturbed samples in the bottom of a well.

DETAILED EXPERIENCE (Cont.)

June 1965 **LOS ANGELES DEPARTMENT OF WATER AND POWER**
to September 1966 Los Angeles, California

Civil Engineering Assistant. Initiated and planned exploration program for water resources development in the Owens Valley area. Supervised drilling and testing operations of exploratory wells in conjunction with development of a supplemental ground water supply to the Los Angeles Aqueduct System. Worked on ground water management models in the Los Angeles area involving well drilling, aquifer testing and data analysis. Assisted in water quality investigations in the Los Angeles area. Worked on bank storage problems in many of the city reservoirs. Helped formulate operational regimens incorporating flood routing.

June 1962 **NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY**
to June 1965 Socorro, New Mexico

Graduate Research Assistant. Half-time work for Research and Development Division. Involved in thermal water studies of New Mexico. Constructed various models (sand, viscous flow), of complex hydrologic systems. Conducted aquifer tests and geologic field mapping in Central New Mexico.

PROFESSIONAL PUBLICATIONS

- Results of Drilling, Construction, Development and Testing of Dana Point Ocean Desalination Project Test Slant Well. Article, NGWA Horizontal Wells Newsletter, Jan 2007.
- Use of Wells to Provide Water for Seawater Desalination Systems. Paper presented at 15th annual GRA meeting San Diego, CA, 22-Sep-06.
- Well Rehabilitation: Is It Time? Is It Worth It? Paper presented at AWWA CA-NV, May 17, 2005 in Lakewood, California. Presentation on why and when well rehabilitation should be considered.
- The Encyclopedia of Water. Contributor for three entries in the Encyclopedia, Radial Wells, Well Tests, and Well Screens. To be published by John Wiley and Sons in 2005.
- Dealing with Emerging Ground Water Contaminants: An Engineer's Perspective. Presented at Confirming Legal Education for Water Law Professionals, sponsored by the Association of California Water Agencies, September 22-23, 2004.
- Chief Reviewer and author for the American Society of Civil Engineers International Manual on Well Hydraulics. Primary author for two chapters, Water Well Construction, and Developing and Testing, and of Appendix in Example of Water Well System Design. To be published in 2005.
- Pilot Study to Determine the Feasibility of Artificial Recharge of Recycled Water in Surface Spreading Basins. Paper presented at the 11th Biennial Symposium on Ground Water Recharge, Arizona Hydrological Society, Salt River Project, U.S. Water Conservation Laboratory and Arizona Department of Water Resources, June 5-7, 2003, Tempe, Arizona
- Author Groundwater Pumping Methods in the *Encyclopedia of Water Science*. July 2003.
- Natural Recharge in the Cadiz Area, San Bernardino County, California. Paper presented at and published in the Symposium Proceedings of the Natural Recharge of Groundwater Symposium, sponsored by the Arizona Hydrological Society, Arizona Department of Water Resources, Salt River Project, U.S. Water Conservation Laboratory of USDA-ARS, and U.S. Geological Survey. June 2000, Tempe, Arizona. Presentation on the methods used to determine a range of recharge estimates for the Fenner Basin.
- The Cadiz Ground Water Storage and Dry-Year Supply Program.
  - Paper presented at the Annual Fall Conference California-Nevada Section of the AWWA. October 1999, San Diego, California.
  - Paper presented at the Innovations in Artificial Recharge Conference, Association of Ground Water Agencies, American Ground Water Trust. May 2000, Ontario, California.

  Presentation of Pilot Recharge test results of the Cadiz project, a Metropolitan Water District Recharge and Recovery Program involving storage and retrieval of up to 150,000 acre-ft/yr via a 30-mile pipeline from the Colorado River Aqueduct.
- Field and Laboratory Research on Well Rehabilitation. Paper presented at the Water Well Maintenance and Rehabilitation Seminar, California-Nevada Section of the AWWA. May 1999.

PROFESSIONAL PUBLICATIONS (Cont.)

- Well Rehabilitation: Is It Time? Is It Worth It? Paper presented at AWWA CA-NV, May 26, 1999 in Lakewood, California (also at AWWA Stockton May 1998). Presentation on the many facets of water well rehabilitation and an overview of why rehabilitation should be considered, what types of rehabilitation methods are available, and how to decide if rehabilitation is an appropriate step in any given situation.
- Corrosion Field Test of Steels Commonly Used in Well Casing and Screen. Paper presented at AWWA CA-NV. May 27, 1999. Lakewood, California.
- Training Seminar on Basic Geohydrology. Presented to the Los Angeles Regional Water Quality Control Board. July 1997.
- Modern Techniques in Ground Water Management. Paper presented at the AWWA Annual Conference. 1997. Atlanta, Georgia.
- International Study On Relining. 84 Case Studies. 1997. Paper prepared for court testimony in international arbitration. Unpublished until case is resolved.
- Seminar on Ground Water Development. Presented to the Government of Vietnam. Hanoi, Vietnam. March 1996.
- Pilot-Scale Field Test to Determine Pathogen Removal Beneath an Artificial Recharge Basin. Paper ASCE International Symposium on Artificial Recharge of Ground Water. July 17-22, 1994.
- Sea-Water Intrusion into Pleistocene Aquifers in the Dominguez Gap Area of Southern California. South Coast Geological Society. Fall 1992.
- Author of five chapters Handbook of Ground Water Development. Published by John Wiley and Sons, New York. January 1990. (Author of Chapters: Ground Water Movement, Hydraulics of Wells, Well and Aquifer Evaluation from Pumping Tests, Ground Water Management, and Artificial Recharge).
- Ground Water Modeling in the Orange County Area. Geological Society of America Guidebook. Hydrogeology of Southern California, Cordilleran Section, 82nd Annual Meeting. March 25-28, 1986.
- Modern Techniques in Water Well Design. Journal of the AWWA. September 1985.
- Computer Assisted Ground Water Management in Orange County, California. Presented at the American Society of Civil Engineers National Conference on Environmental Engineering. June 25-27, 1984. Los Angeles, California.
- Conjunctive Use and Ground Water Management in Orange County California. Paper presented at the NWWA Western Regional Ground Water Management Conference. October 24, 1983.
- The Well/Aquifer Model-Initial Test Results. Published by the Roscoe Moss Company. 1981. Los Angeles, California.
- The Dashte-Naz Ground Water Barrier and Recharge Project. Presented at the Third National Ground Water Quality Symposium. Las Vegas, Nevada. September 1976. Also published in Ground Water. January-February 1977.

PROFESSIONAL PUBLICATIONS (Cont.)

- Digital Computer Models and Ground Water Basin Management. Presented at the International Symposium on Development of Ground Water Resources, sponsored by I.H.D. November 1973. Madras, India.
- Gasoline Pollution of a Ground Water Reservoir. A paper presented at the First National Ground Water Quality Symposium. August 1971. Also published in *Ground Water*. Nov-Dec 1971.
- Modern Techniques in Ground Water Studies. A paper presented at the 91st Annual Conference of the AWWA. June 1971. Also published in the *Journal of the AWWA*. July 1971.
- Ground Water Development and Management in the Owens Valley. Presented at the 90th Annual Conference of the AWWA. October 1970.
- Ground Water Basin Management. A paper presented at the California Section Meeting AWWA. September 1970. (Consulting Engineers Panel).
- Use of Alluvial Faults in the Storage and Retention of Ground Water. A paper presented at the Annual Fall Meeting of the AGU. December 1969. Also published in Ground Water. September-October 1970.
- Management of Gasoline Leaks - A Positive Outlook. A paper presented at the NWWA Seventh National Ground Water Quality Symposium. Sep 27, 1984. Las Vegas, Nevada.
- Geohydrologic Investigation of the Owens Valley Ground Water Reservoir. Ph.D. Dissertation. New Mexico Institute of Mining and Technology. June 1969.
- Viscous-Model Study of Ground Water Flow in a Wedge-Shaped Aquifer. Water Resources Research, Volume 2, Third Quarter 1966.
- Cenozoic Rocks of Socorro Valley and Vicinity. New Mexico Geologic Society Guidebook. 1963.

PROFESSIONAL PRESENTATIONS AND TRAINING SEMINARS

- *Impacts of Implementing the Proposed SARWQCB Resolution on Conjunctive Use in the San Bernardino Basin Area*, 2006 Water Policy & Law Briefing, July 20, 2006

- *Well Design Training Seminar*. Conducted a 1½ day Well Design Seminar for California Water Service Company employees that operate wells throughout the State of California. June 8-9 2005. San Jose, California.

- *Pumping Tests and Data Analysis*. Paper presented at the America Water Works Association California – Nevada Section Well Design & Construction Seminar. May 1, 2002. Lakewood, California.

- *Well Design Training Seminar*. Conducted a two-day Well Design Seminar for California Water Service Company employees that operate wells throughout the State of California. April 18-19, 2002. San Jose, California.

- *Natural Recharge in the Cadiz Area, San Bernardino County, California*. Paper presented at and published in the Symposium Proceedings of the Natural Recharge of Ground Water Symposium, sponsored by the Arizona Hydrological Society, Arizona Department of Water Resources, Salt River Project, U.S. Water Conservation Laboratory of USDA-ARS, and U.S. Geological Survey. June 2, 2000. Tempe, Arizona. Presentation on the methods used to determine a range of recharge estimates for the Fenner Basin.

- *The Cadiz Ground Water Storage and Dry-Year Supply Program.*
  - Paper presented at the Innovations in Artificial Recharge Conference, Association of Ground Water Agencies and the American Ground Water Trust. May 4-5, 2000. Ontario, California.
  - Paper presented at the Annual Fall Conference California-Nevada Section of the AWWA. October 27, 1999. San Diego, California.

  Presentation of Pilot Recharge test results of the Cadiz Project, a Metropolitan Water District Recharge and Recovery Program involving storage and retrieval of up to 150,000 acre-ft/yr via a 30-mile pipeline from the Colorado River Aqueduct.

- Paper presented at the Innovations in Artificial Recharge Conference, Association of Ground Water Agencies and the American Ground Water Trust. May 4-5, 2000. Ontario, California.

- Paper presented at the Annual Fall Conference California-Nevada Section of the AWWA. October 27, 1999. San Diego, California.

- *Field and Laboratory Research on Well Rehabilitation.* Paper presented at the Water Well Maintenance and Rehabilitation Seminar, California-Nevada Section of the AWWA. May 27, 1999.

- *Corrosion Field Test of Steels Commonly Used in Well Casing and Screen.* Paper presented at the Water Well Maintenance and Rehabilitation Seminar, California-Nevada Section, American Water Works Association. May 27, 1999. Lakewood, California.

PROFESSIONAL PRESENTATIONS AND TRAINING SEMINARS (Cont.)

- Dr. Williams was the keynote speaker at the Water Well Maintenance and Rehabilitation Seminar, California-Nevada Section, American Water Works Association in May 1998 (AWWA in Stockton) and May 1999 Workshop (AWWA in Lakewood), and presented the paper entitled *"Well Rehabilitation: Is It Time? Is It Worth It?"* The presentation discussed the many facets of water well rehabilitation including an overview of why rehabilitation should be considered, what types of rehabilitation methods are available, and how to decide if rehabilitation is an appropriate step in a given situation.
- In 1997, GEOSCIENCE conducted an International Study on Relining. Eighty-four case studies were gathered and analyzed. A paper was prepared for court testimony in international arbitration, aimed at educating the Tribunal in methods of rehabilitation for large-capacity water wells. The paper remains unpublished until the case is resolved. The case involved 126 wells in northern Africa, 60 of which have failed due to corrosion. GEOSCIENCE also prepared a rehabilitation plan for the entire well field.
- *Training Seminar on Basic Geohydrology*. Presented to the Los Angeles Regional Water Quality Control Board. July 30, 1997.
- *Modern Techniques in Ground Water Management.* Paper presented at the Annual Conference, American Water Works Association. June 19, 1997. Atlanta, Georgia.
- *A Case Study of Unprecedented Well Failures and Rehabilitation Efforts.* Paper presented at the Well Construction, Operation, and Rehabilitation Seminar, American Water Works Association. September 20, 1996.
- *Seminar on Ground Water Development*. Presented to the Government of Vietnam. March 14-16, 1996. Hanoi, Vietnam.
- *Aquifer Pump Tests and Data Analysis.* Presented at the California-Nevada Section Water Well Construction Workshop, American Water Works Association. March 22, 1995.
- *Pilot-Scale Field Test to Determine Pathogen Removal Beneath an Artificial Recharge Basin*. Presented at the Second International Symposium on Artificial Recharge of Ground Water, American Society of Civil Engineers. July 17-22, 1994.
- *Seawater Intrusion into Pleistocene Aquifers in the Dominguez Gap Area of Southern California.* Paper presented to the South Coast Geological Society. August 1992.
- *Ground Water Modeling in the Orange County Area.* Paper presented at the Cordilleran Section, 82nd Annual Meeting, Geological Society of America Guidebook. Hydrogeology of Southern California. March 25-28, 1986.
- *Management of Gasoline Leaks - A Positive Outlook*. A paper presented at the NWWA Seventh National Ground Water Quality Symposium. September 27, 1984. Las Vegas, Nevada.
- *Computer Assisted Ground Water Management in Orange County, California.* Presented at the National Conference on Environmental Engineering, American Society of Civil Engineers. June 25-27, 1984. Los Angeles, California.

PROFESSIONAL PRESENTATIONS AND TRAINING SEMINARS (Cont.)

- *Conjunctive Use and Ground Water Management in Orange County, California.* Paper presented at the Western Regional Ground Water Management Conference, National Water Works Association. October 24, 1983.
- *Seminar on Ground Water Development.* Presented to the Asian Institute of Technology. Bangkok, Thailand. 1980.
- *The Dashte-Naz Ground Water Barrier and Recharge Project.* Presented at the Third National Ground Water Quality Symposium. September, 1976. Las Vegas, Nevada. Also published in *Ground Water*. January-February 1977.
- *Digital Computer Models and Ground Water Basin Management.* Presented at the International Symposium on Development of Ground Water Resources, sponsored by I.H.D. November 1973. Madras, India.
- *Gasoline Pollution of a Ground Water Reservoir.* A paper presented at the First National Ground Water Quality Symposium. August 1971. Also published in *Ground Water*. November-December 1971.
- *Modern Techniques in Ground Water Studies*. A paper presented at the 91st Annual Conference, American Water Works Association. June 15, 1971. Also published in *Journal of the American Water Works Association*. July 1971.
- *Ground Water Development and Management in the Owens Valley.* Presented at the 90th Annual Conference, American Water Works Association. October 1, 1970.
- *Use of Alluvial Faults in the Storage and Retention of Ground Water*. A paper presented at American Geophysical Union National Fall Meeting. December 15-18, 1969. Also published in *Ground Water*, Vol. 8, No. 5. September-October 1970.
- *Ground Water Basin Management.* A paper presented at the California Section Meeting AWWA. September 1970. (Consulting Engineers Panel).

DENNIS E. WILLIAMS, Ph.D., PG, CHG

President / Principal Geohydrologist

REFERENCES

Mr. Craig Elitharp **(Director of Systems Operations)**
Rancho California Water District
42135 Winchester Road, P.O. Box 9017
Temecula, California 92590 (909) 676-4101

Mr. Bob Reiter **(Former General Manager and Chief Engineer)**
San Bernardino Valley Municipal Water District
1350 So. E Street
San Bernardino, California 92408 (909) 387-9222

Mr. Anthony Araiza **(General Manager)**
West Valley Water District
P.O. Box 188
Rialto, California 92376 (909) 875-2007

Mr. George Moss
Roscoe Moss Company
P.O. Box 31064
Lincoln Heights Station
Los Angeles, California 90031 (323) 261-4185

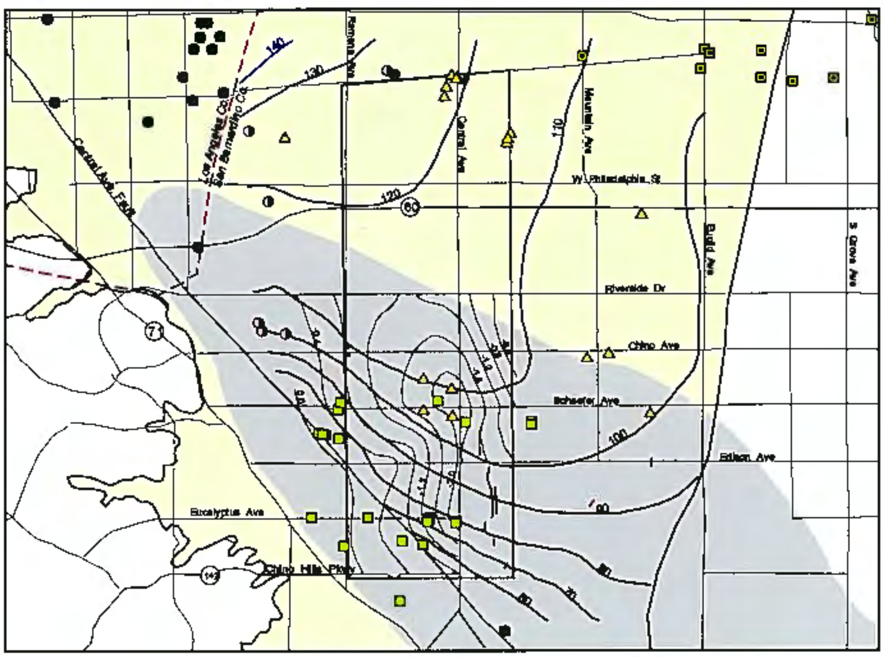
Mr. Richard B. Bell **(Principal Engineer)**
Municipal Water District of Orange County
10500 Ellis Avenue
Fountain Valley, California 92728 (714) 271-6641

APPENDIX B

Ground Water Flow Model of a Portion of MZ-1
Containing City of Chino Hills Wells

GEOSCIENCE Support Services, Inc.

Preliminary Geohydrologic Analysis of Subsidence in the Western Portion of the Chino Basin



Change in Ground Water Levels 1933 – 2000, ft

Prepared for:

Chino Hills

City of Chino Hills

August 29, 2002

Prepared by:

DRAFT

GEOSCIENCE Support Services, Inc.
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1326 Monte Vista Ave., Suite 3, Upland, CA 91786
email: email@geoscience-water.com

CONTENTS

FIGURES

FIGURES
(Continued)

FIGURES
(Continued)

FIGURES

(Continued)

APPENDICES

Ltr.	Description
A	Well Logs
B	Well Completion Summary Table for Municipal Wells in MZ-1
C	Annual Production Data for MZ-1

PRELIMININARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

1.0 EXECUTIVE SUMMARY

Land subsidence due to ground water withdrawal is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of a high percentage of fine-grained sediments (silt and clay). Land surface subsidence has been recognized in portions of southwest Chino Basin since the 1930's. Although the phenomenon was a concern in the 1970s and 1980s, increased subsidence observed between 1993 and 1995 coupled with rapid urbanization of the area has resulted in the need to understand all potential causes of subsidence in the Chino area[1] and develop a strategy to mitigate it to the extent necessary and possible. Land subsidence in MZ-1 has been minimal between 1995 and the present, based on both benchmark surveys and InSAR data. This correlates with relatively stable ground water levels over the same time period.

The Chino Basin Watermaster (Watermaster) is in the process of developing a long-term plan for managing subsidence in Management Zone 1 (MZ-1) of the Chino Basin. However, collection and interpretation of the data necessary to develop the long-term plan will require time. Until these data are collected, an interim plan is being developed to ensure that ground water levels in the Chino area are properly managed to minimize any further land surface elevation decline.

The purpose of this geohydrological evaluation is to assess the cause(s) of subsidence, based on existing data, in the western portion of Chino Basin and provide a technical basis for the development of a sound interim subsidence management plan for the area. The principal findings of this evaluation are as follows:

[1] These potential causes include ground water withdrawal and tectonic factors.

- Land subsidence due to ground water withdrawal is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of a high percentage of fine-grained sediments (silt and clay).

- The aquifer system in the western portion of the Chino Basin can generally be divided into shallow and deep aquifer zones separated by fine-grained clay layers. However, the boundary between the shallow and deep aquifers is not well defined because the clay layers are heterogeneous, do not occur at the same depth throughout the area, and are laterally discontinuous.

- The highest percentage of clay, relative to total alluvial thickness, occurs in the western portion of MZ-1.

- Due to the heterogeneous and laterally discontinuous nature of the clay layers separating the shallow and deep aquifer systems, it is likely that hydraulic communication occurs between the two systems.

- The shallow and deep aquifers in the Study Area are naturally recharged primarily from deep percolation of precipitation falling on the alluvial slope at the base of the San Gabriel Mountains. Deep percolation of precipitation recharges both the shallow and deep aquifer systems before migrating downgradient in a southerly direction.

- Prior to approximately 1904, the aquifers beneath a large portion of the Study Area were under flowing artesian conditions (ground water levels were at or above the land surface).

- Ground water pumping since 1904 has lowered ground water levels substantially throughout MZ-1. Ground water levels declined steadily from the 1930s through the 1970s. Ground water levels recovered throughout the 1980s and have remained relatively stable since the late 1980s.

- The greatest historical ground water level declines have been observed in the northwestern portion of MZ-1 (Pomona area), which is upgradient of Watermaster's area of greatest subsidence concern. Changes in ground water levels of greater than 200 ft from 1904 to 1973 were observed in some wells in this area. Ground water level decline in Watermaster's area of greatest subsidence concern ranged from approximately 70 to 130 ft between 1904 and 1989.

- Production wells screened in both shallow and deep aquifers upgradient of Watermaster's area of greatest subsidence concern have contributed to the historical ground water level declines in the area of greatest concern by intercepting ground water underflow (recharge) to the area.

- Cumulative deep well pumping by the City of Chino Hills was approximately 22,000 acre-ft during the period 1978-2001. Cumulative deep well pumping by the City of Chino was 85,000 acre-ft during this time period.

- Ground fissures attributed to land subsidence have been observed in Watermaster's area of greatest subsidence concern since the early 1970s.

- Comparison of land surface elevations by the USGS in the early 1930s with bench mark surveys from 1987 indicate that as much as 3.7 ft of subsidence occurred at the corner of Riverside Drive and Pipeline Avenue (2,600 ft northwest of the area mapped by Kleinfelder as being the area of greatest subsidence) during this time period. Furthermore, comparison of a 1963 USGS survey of a benchmark at the corner of Chino Avenue and Ramona with a bench mark survey from 1987 at the same location indicates 3.4 ft of subsidence occurred at that location during that time period. This benchmark is west-northwest of the area previously identified as the area of greatest subsidence.

- The area of greatest subsidence, based on comparison of benchmark surveys between 1933 and 1987, correlates with that portion of MZ-1 where the highest ground water level declines occurred and the highest percentage of clay occurs in the subsurface.

- Review of benchmark surveys and InSAR data from 1993 to 1995 indicate an increased rate of subsidence during this time period for a relatively narrow area immediately west of Central Avenue. The rate and relatively limited extent of subsidence measured during this time period suggests that a secondary causal factor (such as an earthquake) may have contributed to the subsidence and requires further analysis.

- Land subsidence in MZ-1 has been minimal between 1995 and the present, based on both benchmark surveys and InSAR data. This correlates with relatively stable ground water levels over the same time period.

- Preliminary subsidence modeling suggests that if ground water levels are maintained in the area of historical subsidence (irrespective of shallow or deep aquifers), subsidence will be maintained at present rates.

- A revised area of greatest subsidence concern (AGSC) is defined in this report based on a combination of historical ground water level changes, historical ground surface elevation changes and lithology (i.e. percentages of fine-grained materials). The revised AGSC encompasses most of the Watermaster AGSC but extends farther to the north and west covering an area of approximately 11 square miles.

In summary, subsidence in the western portion of the Chino Basin may be the result of widespread ground water level declines as a result of ground water pumping as early as 1900. However, this needs to be verified with further studies. Until those studies are completed, a revision to the area of greatest subsidence concern is recommended. The revised area would be expanded to include areas with the greatest ground water level declines, highest percent clay relative to total alluvial thickness, and measured subsidence from either InSAR or benchmark surveys (see Figure 36). In addition, maintenance of subsidence in the area of greatest concern is best conducted through maintenance of ground water levels using a comprehensive ground water management program. This program should include monitoring of ground water levels, extensometer data, and ground water pumping. If it has been determined, in the future, that subsidence due to ground water withdrawal is an issue, ground water levels would be adjusted as required. Until those studies are completed, a more evenly distributed reduction in pumping across the area of greatest subsidence concern is recommended rather than a drastic reduction from a small area.

2.0 INTRODUCTION

2.1 Background

Land subsidence as a result of ground water, or other subsurface fluid, withdrawal has been recognized in many parts of California (Meade, 1968, Helm, 1975, Ireland et al., 1984, Poland and Ireland, 1988, Sneed and Galloway, 2000). In all cases, the measured subsidence is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of very fine-grained sediments (clay). In many cases, subsidence can be correlated with areas that historically were flowing artesian (the ground water level was at or above the land surface).

Land surface subsidence has been recognized in portions of western Chino Basin since the late 1960s (Lofgren, 1971). Although the phenomenon was a concern in the 1970s and 1980s (Fife, et al., 1976), increased subsidence observed between 1993 and 1995 coupled with rapid urbanization of the area has resulted in the need to understand the causes of subsidence in the Chino area and develop a strategy to mitigate it to the extent possible.

The Chino Basin Watermaster (Watermaster) is in the process of developing a long-term plan for managing subsidence in Management Zone 1 (MZ-1) of the Chino Basin. The plan includes the installation of extensometer instrumentation in the area of measured land surface elevation changes and observed ground fissures that have been attributed to subsidence. However, collection of the data necessary to assess the causes of subsidence will require at least three years and most probably longer after the extensometers have been installed. Until these data are collected, properly analyzed, correlated with both land surface elevations and ground water levels, and incorporated into a long-term management plan, an interim plan is being developed to ensure that ground water levels in the Chino area are properly managed to minimize any further land surface elevation decline.

2.2 Purpose and Scope

The purpose of this geohydrological evaluation is to assess the cause(s) of subsidence, based on existing data, in the western portion of the Chino Basin and provide a technical basis for the development of a sound interim subsidence management plan for the area. The scope of work to assess subsidence in this area included:

1. Compilation of data from multiple sources and incorporation into a relational database for analysis. The types of data included:

    - Ground Water Levels – Monthly (both static and pumping)
    - Locations of Wells (UTM coordinates and/or state well number)
    - Well Use (domestic, irrigation, dairy, municipal)
    - Well Construction Details

        - Reference Point Elevation
        - Year Drilled
        - Total Depth
        - Diameter(s)
        - Construction Type (gravel envelope, cable tool)
        - Casing Type (stove pipe, mild steel, copper-bearing steel)
        - Screen Intervals
        - Screen Type (mill's knife, louvered, wire-wrap, mill-slot)
        - Modifications (liners, rehabilitation, structural problems requiring maintenance, etc.)

    - Well Production History
    - Lithologic and/or Geophysical Logs
    - Specific Capacity (i.e. Edison) Pumping Tests and/or other Pumping Tests
    - Ground Surface Elevation History
    - Historical Land Use

2. A detailed analysis of the land use and ground water development history of the western portion of the Chino Basin.

3. A detailed geohydrologic analysis of the relationships between historical ground water levels, ground water pumping, subsurface stratigraphy and potential for land surface elevation change.

4. Development of a subsidence model to assess historical nonrecoverable compaction and potential for future subsidence.

2.3 Sources of Data

Data used in the subsidence analysis was obtained from multiple sources. The primary sources and the types of data provided by them are summarized as follows:

- Wildermuth, 2000 (TIN/TDS Database); well locations, well completion data, ground water level data, and information on geology including basin boundaries and locations of alluvial faults (ground water barriers).
- CBWM, 2002a,b; well status, ground water levels, specific capacity data, InSAR data and ground water production data.
- California Department of Water Resources (DWR); driller's logs.
- United States Geological Survey (USGS); aerial photographs, land surface survey data and detailed surface geology.
- Selected cities within the Chino Basin provided refined well locations, ground water levels, specific capacity data, driller's logs, geophysical logs, well completion data, and production data for their respective wells.

In addition to these sources, numerous published reports, consultant reports, and maps were consulted in the analysis and findings, as summarized in the references at the end of the report.

2.4 Location of Subsidence Study Area

The focus of this evaluation (hereafter referred to as the study area) is that portion of the Chino Basin where land surface subsidence has been observed through ground fissures or measured using benchmark surveys or satellite data (see Figure 1). This area encompasses most of watermaster's MZ-1, which defines the westernmost portion of chino basin. The area also encompasses all of watermaster's area of greatest subsidence concern (see Figure 1).

3.0 GEOHYDROLOGY

3.1 Topography

The Study Area is located on the relatively level valley floor of the Chino Basin (referred to as the Chino Plain in DWR, 1970). The ground surface slopes gently from an elevation of approximately 1,000 feet above mean sea level (ft amsl) in the north to approximately 600 ft amsl in the southern portion of the Study Area. Prominent physiographic features in the immediate vicinity of the Project Area include the Chino Hills to the southwest, the Prado Flood Control Basin to the south, the Santa Ana River to the southeast, the Chino Plain to the east, and the San Gabriel Mountains to the north (see Figure 1).

3.2 Geologic Setting

The Chino Basin is a structural depression located between the San Gabriel Mountains to the north and the Chino and La Sierra Hills to the south (see Figure 1). The San Gabriel Mountains are part of the Transverse Ranges geomorphic province and are composed primarily of granitic and metamorphic rocks. The Chino and La Sierra Hills are part of the Peninsular Ranges geomorphic province and are composed of granitic rocks to the southeast (La Sierra Hills) and sedimentary rocks to the south and southwest (Chino Hills). The Chino Hills are located adjacent to the Study Area to the southwest (see Figure 1).

The Chino Basin was formed as a result of tectonic activity along major faults that are generally located at the base of the mountain ranges surrounding the basin (see Figure 1). These include the Chino Fault at the base of the Chino Hills, adjacent to the Study Area. The Chino Fault has not likely been active since Late Quaternary time (last 700,000 years; Jennings, 1994). However, the Chino Fault is a northerly extension of the Elsinore Fault Zone, which shows evidence of movement within the last 10,000 years.

A more ambiguous fault, known as the Central Avenue Fault, has been postulated along the southwest margin of the Study Area based on water level and lithologic differences on either side of the inferred fault trace. Although this fault may act as a ground water flow barrier, its effect on ground water flow is currently unknown.

3.3 Stratigraphic Units

Weathering of the mountains surrounding the Chino Basin has resulted in the deposition of alluvial sediments that have filled the basin. Where these sediments are saturated in the subsurface, they form the basin's aquifers. The deepest portion of the Chino Basin occurs in the Study Area south of State Highway 60 where the thickness of alluvial sediments is greater than 1,000 feet (GEOSCIENCE, 2001). This area also corresponds to the area of historically measured subsidence.

Alluvial sediments in the vicinity of the Study Area are generally divided into two units: a recent alluvial unit and an older alluvial unit (DWR, 1970). Recent (Holocene) alluvium is found primarily in the drainage channel of the Santa Ana River and other drainages in the Puente (Chino) Hills and as wind-blown sand and fan deposits on the Chino Plain (see Figure 2). Because these sediments are typically comprised of more coarse-grained materials, they are not likely subject to compaction from ground water withdrawal. The channel sediments were deposited during periods of heavy runoff and are characterized by sand, gravel and silt that extend from the ground surface to as deep as 150 feet below ground surface (bgs) (DWR, 1970). Recent alluvial channel deposits, as defined by coarse-grained sediments in the upper 100 to 150 feet bgs, occur along the western margin of the Study Area as a result of recent deposition in the San Antonio Creek and Chino Creek drainages (see Figure 2). These deposits are generally absent in the vicinity of the areas of mapped subsidence.

The older alluvial unit in the Study Area consists of Pleistocene fan and terrace deposits resulting from weathering of bedrock in the Chino Hills (Durham and Yerkes, 1964). These sediments consist of varying percentages of interbedded sand, gravel, silt and clay. The older alluvium in the Study Area typically consists of a higher percentage of silt and clay than in other parts of the Chino Basin, which may be explained through the two potential sources of the sediment:

1. The Study Area (southern portion of MZ-1) is located at the furthest downstream portion of Chino Basin where the finest sediments weathering off of the San Gabriel Mountains would be deposited, and

2. Weathering of sedimentary bedrock in the Chino Hills, which contains beds of siltstone (Durham and Yerkes, 1964; USGS, 1999), could be a source of clay and silt in the older alluvium.

The bedrock underlying the alluvial sediments in the Study Area is composed of rocks similar to those that outcrop in the Chino Hills (Tertiary sedimentary rocks of the Puente Formation). The bedrock encountered in boreholes drilled in the southern portion of MZ-1 consists of gray to black shale/siltstone that has been correlated by Fox (1994) with the Upper Miocene Puente formation (see Figure 2). To the north, the bedrock is composed of granitic and metamorphic rocks similar to those of the San Gabriel Mountains.

3.4 Ground Water

3.4.1 Aquifer Systems

As with any alluvial basin, many different interconnected water-bearing zones make up the aquifer system of the Chino Basin. In the Study Area, the water-bearing zones have been grouped into two general aquifer systems: a shallow system that is generally unconfined to semi-confined and a deep aquifer system that is generally semi-confined to confined. Additional information used to delineate the aquifer systems includes general lithologic differences and ground water level fluctuation patterns. The differences are most pronounced in the southern portion of the Study Area and least pronounced in the northern portion of the Study Area.

The primary criteria for delineation of the two aquifer systems is as follows:

Shallow Aquifer System	Deep Aquifer System
Unconfined to semi-confined	Generally semi-confined to confined
Higher percentage of sand and gravel relative to silt and clay sediments	Higher percentage of silt and clay relative to sand and gravel sediments
Less pronounced ground water level fluctuations in pumping wells (generally less than 50 feet in high capacity municipal supply wells)	Greater ground water level fluctuations in pumping wells (generally greater than 50 feet in high capacity municipal supply wells)

The boundary between the shallow and deep aquifers in the Study Area is not well defined. The clay layers that confine the deeper aquifers are heterogeneous, do not occur at the same depth throughout the Study Area, and are laterally discontinuous. Furthermore, the depth at which confined conditions have occurred has changed over time as ground water levels have been lowered due to pumping. Figure 3 shows the portion of the Study Area characterized by flowing artesian (confined at the ground surface) conditions in approximately 1900. This area of flowing artesian condition has consistently shrunk over time as ground water levels have been lowered such that no flowing artesian conditions exist today. Accordingly, the definition of a shallow aquifer has changed over time as ground water levels have changed.

The relative percentage of silt/clay in the alluvial section of the Study Area is shown on Figure 4. Wells used for control in generation of Figure 4 are summarized in Table 1 (following page). Selected drillers logs used in the analysis are presented in Appendix A. Wells selected for the clay percentage map were typically greater than 500 ft deep and, where possible, greater than 1,000 ft deep to provide as complete a representation of the alluvial section as possible. The percentages are based on evaluation of geophysical logs (when available) and lithologic descriptions in driller's logs from wells drilled in the area. Although driller's logs are not generally relied on for precise lithologic descriptions, they provide a general indication of aquifer conditions. Evaluation of percent clay suggests that the highest percentage of clay, relative to the entire alluvial section, occurs in the northwestern portion of the Study Area with lower relative percentages toward the southeast.

Table 1

Relative Percent Sand and Clay for Selected Wells in the Study Area

Well Name	Well Owner	Total Depth (ft)	Sand Thickness (ft)	Clay Thickness (ft)	Percent Sand*	Percent Clay*
15	Ontario	1000	431	569	43%	57%
25	Pomona	808	202	606	25%	75%
29	Pomona	539	77	462	14%	86%
33	Ontario	1200	535	665	45%	55%
35	Ontario	1320	700	620	53%	47%
02S/08W-02B04	Private	728	330	398	45%	55%
02S/08W-02K01	Chino	986	335	651	34%	66%
02S/07W-18C04	Private	600	350	250	58%	42%
02S/07W-19B02	CIM	520	195	325	38%	63%
C-2	Chino	453	154	299	34%	66%
C-5	Chino	1100	398	702	36%	64%
C-6	Chino	1157	498	659	43%	57%
C-7	Chino	806	401	405	49%	51%
C-9	Chino	1200	610	590	51%	49%
C-10	Chino	1150	679	471	59%	41%
C-11	Chino	1155	365	790	32%	68%
C-12	Chino	1180	943	237	80%	20%
C-13	Chino	999	527	472	53%	47%
C-14	Chino	1264	674	590	53%	47%
CH-1A	Chino Hills	1230	665	565	54%	46%
CH-7C	Chino Hills	969	460	509	47%	53%
CH-14	Chino Hills	886	491	395	55%	45%
CH-15A	Chino Hills	1003	518	485	52%	48%
CH-16A	Chino Hills	980	400	580	41%	59%
CH-17	Chino Hills	1000	660	340	66%	34%
CH-18A	Chino Hills	1080	780	300	72%	28%
CH-19	Chino Hills	1010	610	400	60%	40%
MVWD-21	Monte Vista	1165	464	701	40%	60%

* Percentages are applied to entire well depth.

Another indicator of shallow and deep aquifer systems is the signature and magnitude of ground water level changes observed during pumping. Ground water level fluctuations due to pumping in the shallow aquifer system are not as pronounced (i.e. "damped out") as ground water level fluctuations in wells pumping from the deeper aquifer system. The different water level signatures between the deep and shallow wells reflect the difference in aquifer parameters (e.g. hydraulic conductivity and Storativity). This is most evident in wells of the City of Chino Hills where fluctuations in upper aquifer ground water levels (e.g. Well 1A; screened from 166 to 317 ft bgs) are generally less than 50 ft whereas fluctuations in lower aquifer ground water levels (e.g. Well 1B; screened from 440 to 1,180 ft bgs) are commonly greater than 100 ft (see Figure 5). The wide fluctuation in pumping vs. static ground water levels in the wells with deep screen intervals is a function of the confined nature and low transmissivity and storativity of the deeper aquifers.

In summary, the distinction between the shallow and deep aquifers depends upon both the areal and vertical extent of confining and semi-confining (i.e. leaky) layers, which vary considerably over the study area.

3.4.2 Ground Water Flow

A ground water contour map generated from ground water levels measured in Fall (September to December) 2000 indicates that ground water flows in a southerly direction across the Study Area (see Figure 6). The ground water gradient ranges from 0.0021 ft/ft (11 ft/mile) to 0.0026 ft/ft (14 ft/mile).

3.4.3 Ground Water Recharge

The primary source of recharge to the Chino Basin is deep percolation of precipitation falling on the alluvial slope at the base of the San Gabriel Mountains (see Figure 7). The amount of precipitation that falls on the Chino Basin, on an average annual basis, is greatest at the north end of the basin and decreases toward the south. Average annual precipitation at the Chino Fire Station Weather Station (see Figure 1 for location), was 14.7 inches between 1928 and 2001 (San Bernardino County Flood Control District, 2002; see Figure 8).

Cumulative departure from mean precipitation for the Chino Fire Station Weather Station is also shown on Figure 8. The periods from approximately 1945 to 1978, and 1984 to 1991 were relatively dry. The periods of 1928 to 1945, 1978 to 1984 and 1992 to 1998 have been relatively wet periods.

As ground water migrates down-gradient from the alluvial fan at the base of the San Gabriel Mountains, it becomes confined under multiple silt and clay layers at depth (see Figure 7). Due to the heterogeneous and laterally discontinuous nature of the clay layers separating the shallow and deep aquifer systems, it is likely that hydraulic communication occurs between the two systems, particularly upgradient of Watermaster's area of greatest subsidence concern. Thus, production wells that are screened in both the deep and shallow aquifers hydraulically upgradient of the area of subsidence have, over time, intercepted recharge to this area and contributed to historical ground water level declines. Section 3.2.5 discusses the historical ground water level changes in detail.

3.4.4 Ground Water Discharge

3.4.4.1 Natural Ground Water Discharge

Ground water in the western portion of the Chino Basin flows in a southerly direction from the base of the San Gabriel Mountains towards the Santa Ana River and Prado Dam (see Figure 6). Natural ground water discharge from the basin occurs as subsurface underflow to the Santa Ana River, evapotranspiration of surface water in the Prado Flood Control Basin and Santa Ana River, and rising ground water at Prado Dam that is discharged as streamflow.

3.4.4.2 Ground Water Pumping

Ground water pumping accounts for the majority of the ground water discharge in the Chino Basin. The locations of current and historical production wells in the Chino Basin are shown on Figure 9. Historically, the majority of ground water pumping in the Chino Basin was from relatively shallow wells used for agricultural purposes. Most of the wells shown on Figure 9 are agricultural wells (dairy and/or irrigation farming). As agricultural land use has given way to urbanization, regional ground water pumping patterns in the basin have shifted from lower volume (per well) pumping in numerous wells spread across a wide area of the basin to higher volume (per well) pumping in a smaller number of municipal wells located primarily along the margins of the basin. In addition, exploitation of deeper aquifers has also increased with the increase in deeper municipal wells.

Current production wells (including agricultural wells) in MZ-1 are shown on Figure 10. Summaries of municipal well completion data are provided in Appendix B. Most of the municipal wells are entirely or partially screened across both the shallow and deep aquifer zones. These wells are described as multi-aquifer wells (Papadopulos, 1966) and pumping from these wells will tap ground water from both of the aquifer zones. The relative contribution from each zone depends on the geohydrologic properties of the aquifer zones (transmissivity and storativity) and the relative hydraulic head differences between the zones. In general, however, the static ground water level in the wells will stabilize nearest the head in the zone with the highest transmissivity (typically the shallow aquifer). Figure 11 illustrates a multi-aquifer well showing drawdown and flow rates in both aquifers before pumping (i.e. static conditions) and after pumping.

3.4.4.3 Ground Water Production in MZ-1 – 1978-1989

Cumulative ground water production from wells in MZ-1 from 1978 through 1989 is shown on Figure 12. Production data for MZ-1 wells are summarized in Appendix C. Production from deep and shallow wells (as defined by Watermaster) that were operated by the City of Chino is shown in Box A. As shown, deep aquifer production upgradient of the area of measured subsidence occurred from three City of Chino Wells. During this time period, total ground water production by the City of Chino from deep aquifers was approximately 44,000 acre-ft with approximately 6,800 acre-ft of ground water produced from deep well No. 7, located in Watermaster's area of greatest subsidence concern. Approximately 16,800 acre-ft of ground water was produced from shallow wells (primarily Well No. 6) from Watermaster's area of greatest subsidence concern between 1978 and 1989 (see Figure 12, Box A). No production from City of Chino Hills deep wells occurred prior to 1989 (see Figure 12, Box B) although some shallow ground water production occurred, including approximately 1,700 acre-ft of ground water that was produced from Well 1A, located in Watermaster's area of greatest concern.

Production from other municipal wells in MZ-1 is shown on Figure 12, Box C. As shown, most of the ground water production in MZ-1 between 1978 and 1989 occurred upgradient of the area of measured subsidence.

3.4.4.4 Ground Water Production in MZ-1 – 1978-2001

Cumulative ground water production from 1978 through 2001 is shown on Figure 13. As shown, the primary change to the pumping distribution, as compared to the time period 1978 through 1989, is the addition of the deep wells operated by the City of Chino Hills in the area of measured subsidence. Cumulative deep well pumping by the City of Chino Hills was approximately 22,000 acre-ft during this time period. Cumulative deep well pumping by the City of Chino was 85,000 acre-ft during this time period. Production from City of Chino deep well No. 7 was discontinued after 1992.

3.4.5 Historical Changes in Ground Water Elevation

Historical ground water pumping in MZ-1 has resulted in substantial changes in ground water levels in MZ-1 over time. As mentioned previously, aquifers in the southern portion of MZ-1 were flowing artesian in 1904 (i.e. ground water levels were at or above the land surface; see Figure 3). Ground water pumping has resulted in both lowering of the ground water levels and changes to the direction of ground water flow (see Figure 14).

Changes in ground water levels over time are shown on Figures 15 through 17. Figure 15 shows ground water level changes between 1933 and 1989, prior to the time that the City of Chino Hills began pumping from their deep aquifer wells. As shown, the greatest change in ground water levels occurred to the northwest of Watermaster's area of greatest subsidence concern, where the ground water level dropped by as much as 150 feet (more than 200 feet between 1933 and 1977). Ground water levels in the area of greatest subsidence concern dropped by 70 to 130 feet during this time period. Ground water level hydrographs from selected wells in the area indicate that ground water levels were even lower in the 1970s (see Figure 15).

Changes in ground water levels between 1933 and 2000 are shown on Figure 16. This figure shows that ground water levels have not changed substantially from 1989 to 2000 with the exception of a slight lowering of ground water levels in the south central portion of Watermaster's area of greatest concern (in the vicinity of Wells C-4, C-7, CH-17 and CH-19). The ground water level data shown on the hydrographs on Figures 5 and 15 support this conclusion.

4.0 LAND SUBSIDENCE DUE TO GROUND WATER WITHDRAWAL

Land subsidence due to ground water withdrawal is a long-term gradual phenomenon. It is well established (Johnson, et al., 1968; Meade, 1968; Poland and Ireland, 1988; Ireland, et al., 1984; Helm, 1984; and Helm, 1975) that land subsidence due to ground water withdrawal is commonly associated with:

- Aquifers having a high percentage of fine-grained interbedded materials, which are normally consolidated.
- High rates of sustained pumping which cause long-term (i.e. decades) declines on ground water levels ranging from 100-200 ft.

The following Section 4.1 describes the theoretical aspects of subsidence. Section 4.2 presents the background and explanation of the currently accepted mechanism for determining land subsidence due to ground water withdrawal. Section 4.3 shows some classic examples of land subsidence due to long-term ground water withdrawal.

4.1 Theoretical Aspects of Subsidence

4.1.1 Terzaghi's Rate-of-Consolidation Theory

Terzaghi in 1923 published a rigorous solution of a theory concerned with the rate of consolidation of clay layers. Terzaghi's work laid the foundation for the modern science of soil mechanics. Because of the importance of his work to the mechanism of subsidence, the general outline of this theory is presented below.

4.1.2 Applied, Effective and Pore Water Stress

Consider a clay layer of thickness 2H (see Figure 18), which is interbedded between two pervious sand layers and stressed at the surface by a unit load σ. Under the influence of the load, the clay layer will begin to compress as the excess water within the pores is squeezed out toward the two impervious boundaries. If the clay is homogeneous, the excess pore water in the upper half will flow toward the upper boundary and the excess water in the lower half flow toward the lower boundary.

The relation between stresses in the clay is shown as:

$$\sigma = p + \sigma_e \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where:

σ = Compressive stress (applied stress) created by the load, [F/L^2]

p = Neutral stress (hydrostatic excess pressure or excess pore pressure), [F/L^2]

σ_e = Effective stress (grain-to-grain load borne by the soil skeleton), [F/L^2]

Equation (1) must remain valid for all times and at all points in the clay layer.

Referring to Figure 18, at the moment the load (applied stress) is applied (*t0*), all of the pressure σ is carried by the pore water so that $\sigma = p$. This is represented by the straight line on the right side of the figure. After a few moments, water begins escaping into the sand so that the pore pressure p at both pervious boundaries equal zero at all times. With increasing time, the shape of the curve relating pore pressure p and the effective stress σ_e throughout the depth of the clay layer is indicated by the curves *t1*, *t2* and *t3*. The slope of these curves at any point gives the rate of change of p with depth at a given time.

The change of p along the depth of the layer represents the hydraulic gradient $-\partial h / \partial z$ upon which the velocity ν depends for eliminating express pore water from the voids. After a certain period of time (t), consolidation is complete as all excess pore pressure is expelled and $p = 0$ with $\sigma = \sigma_e$.

Consider now a small prism of clay from the upper half of the layer (see Figure 19). The prism has a horizontal cross section equal to one and a height ∂z. Since water is flowing in the upward direction, there must be a drop in head in the direction of flow. The drop in head ∂h over the height of the prism is related to the decrease in pore-water pressure ∂p over the same distance:

$$\partial h = \partial p / \gamma \quad \text{...(2)}$$

where:

γ = Specific weight of water [62.4 lbs/ft^3]

The hydraulic gradient may be expressed as:

$$-\partial h / \partial z \quad \text{...(3)}$$

Substituting equation (2) into (3) results in:

$$-\partial h / \partial z = -(1/\gamma)\partial p / \partial z \quad \text{.................................(4)}$$

Darcian velocity is expressed as:

$$\nu = -K \partial p / \partial z \quad \text{..(5)}$$

where:

ν = Darcian (bulk) velocity, [L/T]

K = Hydraulic Conductivity, [L/T]

The rate of change of velocity ν over the distance ∂z for a time interval ∂t is obtained by differentiating equation (5):

$$-\partial v / \partial z = -K \partial^2 p / \partial z^2 \quad (6)$$

The discharge Q during time t through a cross sectional area A may be expressed in terms of velocity ν as:

$$\nu = Q/At \quad (7)$$

Since the horizontal cross sectional area A of the elemental prism is equal to one, the velocity ν represents the amount of water flowing in the lower face of the prism during the time interval ∂t after having been squeezed out from the underlying clay layers above the center-plane elevation. It also follows that the increment of velocity gained ∂v over the distance ∂z during the time interval ∂t will equal the amount of water ∂Q by which the discharge at the upper face of the prism has been increased compared to the inflow Q into the lower face. That is, ∂v and ∂Q represent the amount of water squeezed out of the prism during the time interval ∂t.

Since any expulsion of water from the voids must be accompanied by a corresponding decrease Δn of its pore space, during the time interval ∂t:

$$-\partial n' / \partial t = \partial v / \partial z \quad (8)$$

where:

n' = porosity $n/100$

We can now relate $\Delta n'$ to the compressibility coefficient a_v and the modulus of volume change m_v by:

$$\Delta n' = \Delta e/(1+e) = a_v \Delta\sigma/(1+e) = m_v \Delta\sigma \quad \text{.................(9)}$$

(Also see Figures 20 and 21).

Since the decrease $\Delta n'$ of the pore space is completed when the pressure σ is fully carried by the grains of the soil skeleton $(\sigma = \sigma_e)$, equation (9) can be modified to:

$$\partial n'/\partial t = -m_v \partial\sigma_e/\partial t \quad \text{.....................................(10)}$$

During consolidation, any increase in effective stress σ_e due to a unit load σ during the time interval ∂t must equal the decrease in neutral stress p:

$$\partial p/\partial t = -\partial\sigma_e/\partial t \quad \text{..(11)}$$

Combining equations (10) and (11) we obtain:

$$\partial n'/\partial t = m_v \partial p/\partial t \quad \text{...(12)}$$

Also, combining equations (12), (8) and (6) results in:

$$\partial p / \partial t = K m_v \partial^2 p / \partial z^2 \quad \text{.................................(13)}$$

or

$$\partial p / \partial t = c_v \partial^2 p / \partial z^2 \quad \text{.....................................(14)}$$

where:

$c_v = K / m_v$ = Coefficient of Consolidation, $[L^2/T]$

Equation (14) relates the change of excess pore pressure p with respect to time to the amount of water squeezed out of the voids of a clay prism during the same time period.

4.1.3 Relationship Between Effective Stress and Compaction

The amount of compaction that an aquifer will experience is a function of the compressibility of the sediments within the range of change in applied stress (change in water level) as well as the magnitude of the change. Compressibility decreases with reduction in porosity (or void ratio), which typically accompanies an increasing depth of burial. The amount of compaction is also dependant on the thickness and vertical permeability of the clay beds and also the length of time that the decline in head has existed in the permeable layers.

Other factors influencing compactions are: particle size, which is inversely related to pore volume; clay mineralogy (montmorillonite clays are the most compressible due to their small colloidal size resulting in the large surface areas as compared to illite or kaolinite); and geochemistry of the pore water in the clay beds (which affects clay structure) (Poland and Davis, 1969).

4.1.4 Recoverable and Nonrecoverable Aquitard Storage

Consolidation tests in the laboratory show that nonrecoverable consolidation occurs when a clay sample is subjected to an applied stress greater than any experienced in the past. Nonrecoverable consolidation is the difference between the increase in void ratio upon unloading (see B to C on Figure 22) and the larger decrease from A to B.

The assumption of using a constant specific storativity is justified due to the relatively small changes in effective stress (less than 200 ft). The actual non-linear loading curve (solid line on Figure 22) can be approximated by a straight line (dashed line on Figure 22).

The response of a clay layer to stresses less than its previous maximum (preconsolidation) stress is recoverable. The swelling and recompression typically shows hysteresis in laboratory examples.

Riley (1969) and Helm (1975) have shown that elastic compaction or expansion of sediments is proportional to the change in effective stress:

$$\Delta b = (\Delta\sigma / \gamma) S_{ske} b_o \quad \text{.....................................(15)}$$

where:

Δb = Change in thickness of clay layer (positive for compaction), [L]

S_{ske} = Skeletal component of elastic storativity, [1/L]

b_o = Thickness of clay layer, [L]

The relation between the change in heads and the change in thickness is expressed by Leake and Prudic (1988):

$$\Delta b = -\Delta h S_{ske} b_o \quad (16)$$

Equations (15) and (16) are applicable to both fine and coarse-grained sediments. Laboratory consolidation tests show that when fine-grained sediments are stressed beyond a previous maximum stress, compaction is permanent (non recoverable or inelastic). Compaction per unit of increase in effective stress in the inelastic range is greater than in the elastic range. When effective stress of clays compacting in the inelastic range is reduced, sediments again expand and compact with elastic characteristics until effective stress exceeds the new maximum.

Inelastic compaction as related to increase in effective stress is expressed as:

$$\Delta b^* = (\Delta \sigma / \gamma) S_{skv} b_o \quad (17)$$

where:

Δb^* = Inelastic compaction, [L]

S_{skv} = Skeletal component of inelastic (virgin) storativity, [1/L]

b_o = Thickness of clay layer, [L]

For a confined aquifer, the expression for inelastic compaction as a function of change in head is:

$$\Delta b^* = -\Delta h S_{skv} b_o \quad (18)$$

4.1.5 Preconsolidation Stress

Preconsolidation stress is the maximum stress to which a deposit has been subjected, and which it can withstand without undergoing additional permanent deformation. In terms of changes in ground water levels, the preconsolidation stress may be stated as the critical depth to water at which nonrecoverable compaction is stopped during the unloading phase of a pumping/recharge cycle and reinitiated during the reloading phase.

Normally consolidated materials have been only subjected to the cumulative weight of the overburden. Over-consolidated sediments have been either subjected to additional overburden weights (which may have been eroded away), subsequent wetting and drying (i.e. desiccation) of clayey materials or subjected to extreme drawdowns in the past (increasing effective stresses and resulting compaction).

4.1.6 Hydraulic Diffusivity

Hydraulic diffusivity ν is the ratio of the hydraulic conductivity K to the specific storativity S_s or the ratio of transmissivity T to storativity S. With regard to compaction, the hydraulic diffusivity and the coefficient of consolidation c_v are identical.

$$\nu = K/S_s = c_v = K/m_v \quad (19)$$

where:

m_v = modulus of volume change = S_s [1/L]

4.2 Land Subsidence Mechanism - Doubly Draining Aquitard Theory

The concept of subsidence resulting from drainages of aquitards was originally proposed by Tolman and Poland (1940) to explain the mechanism of subsidence in the Santa Clara Valley. Later, Poland founded the USGS research center in Sacramento exclusively to study subsidence. Subsequent publications arising from his work (and the work of others) have greatly aided in understanding subsidence in general, as well as subsidence in the Santa Clara Valley.

The total applied stress on interbedded aquitards includes the weight of the overburden (dry plus saturated material) and is balanced by a combination of "effective stress" (i.e. grain-to-grain contact) and "neutral stress" (hydrostatic or pore water pressure). When ground water levels are significantly lowered, the pore water pressure is reduced causing a corresponding increase in effective stress (grain-to-grain stress) within the aquitards. The result is a gradual compression of the aquitards wherein excess pore water is squeezed outward towards the permeable strata (see Figure 23). The compression of aquitards and corresponding nonrecoverable compaction results in a large-scale subsidence of the land as the overburden moves downward replacing volume lost from the compressed aquitards.

4.3 Examples of Long-Term Ground Water Withdrawal

Land subsidence has occurred in the San Jose area of the Santa Clara Valley, California since the early 1900's when significant amounts of ground water were removed from the basin's aquifer to provide water for large-scale irrigation. Later, after World War II, rapid urbanization took place and pumping centers shifted from the farms to the cities to meet increasing urban demands. Between 1916 and the mid 1960's, the total pumping for irrigation, domestic, and industrial use caused ground water levels to decline 180 to 220 ft (see Figure 24). The lowered ground water levels increased the effective stress on numerous clay layers found interbedded with permeable materials in the central portion of the Valley. As a result, the land surface subsided as much as 12.7 ft in San Jose (Poland and Ireland, 1988). The water level recovery since 1967 has been substantial. In downtown San Jose, the water level recovered 70 to 100 ft in the eight years to 1975. A marked decrease in annual compaction in response to the water level recovery since 1967 has been measured in the extensometers installed by the USGS in 1960. The annual compaction decreased from approximately 1 ft in 1961 to 0.24 ft in 1967 and to 0.01 ft in 1973 (Poland and Ireland, 1988).

Land subsidence due to ground water withdrawal in the San Joaquin Valley, central California began in the mid-1920's. During the period between 1925 and 1977, ground water levels declined 150 ft to 200 ft. As a result, subsidence reached a maximum of 29.6 ft in western Fresno County in 1977 (see Figure 25).

5.0 HISTORICAL LAND SUBSIDENCE

5.1 Ground Fissuring

5.1.1 Ground Fissuring near Edison and San Antonio Avenues

Fife, et al. (1976) report a communication with Dr. Douglas M. Morton of the U.S. Geological Survey (USGS) who observed "A north-south trending fissure immediately north of the California Institution for Men at Chino lies within the Chino-Prado artesian belt and probably represents an active subsidence feature." The ground fissuring was observed in 1973 (Harding Lawson Associates, 1991) near the dairy facility along Edison Avenue just west of San Antonio Avenue (Kleinfelder, 1993) (see Figure 26). It extended both north and south of Edison Avenue for an unknown distance (Harding Lawson Associates, 1991).

Dr. Morton suggests that the ground fissure probably represents an active subsidence feature (Fife, et al., 1976). No leveling data is available to quantify the subsidence of the location. However, water levels declined more than 100 ft in this area during the period between 1930 and 1970 (see Figure 15).

5.1.2 Ground Fissuring in the CIM Area in 1991-1995

In February 1991, ground fissuring was also observed by California Institution for Men (CIM) personnel during field plowing in preparation for planting. In May 1991, Harding Lawson Associates (1991) measured fissures at the CIM to be approximately 900 ft long. By December 1992, the CIM fissure had expanded northward and southward to a length of approximately 2,200 ft (Geomatrix, 1994). This ground fissuring is located east of Central Avenue between Edison and Eucalyptus Avenues (see Figure 26).

In January 1995 following heavy rainfall, fissuring was observed, extending approximately 1,800 ft north from the pavement edge of Edison Avenue, and approximately 145 ft east of 12th St. (Kleinfelder, 1996a) (see Figure 26). As part of Kleinfelder's general review of field conditions, they performed a site reconnaissance of the areas immediately south of Edison Avenue (where fissuring was observed in 1993 along a similar trend but slightly east of the most recent fissure). They observed no conditions that would indicate that the 1995 fissure extended south of Edison Avenue (Kleinfelder, 1996a).

In addition, Geomatrix (1994) reports that casing failure of the CIM Well No. 8 occurred in approximately 1989. In July 1993, casing failure also occurred at the CIM Well No. 6 at a depth of approximately 250 ft (Geomatrix, 1994). Figure 26 shows the locations of these wells.

Geomatrix (1994) suggests that land subsidence and hydraulic seepage stresses as ground water migrates toward extraction wells are the primary causal mechanisms of the ground fissures observed at the CIM area.

5.2 Land Subsidence

5.2.1 Subsidence Between 1933 and 1987

Land subsidence prior to 1987 within the artesian area of MZ-1 was assessed through an evaluation of USGS bench mark and land surface control data and bench mark survey data collected by the City of Chino in 1987[2]. The following table summarizes the changes in land elevations between the USGS control and bench marks surveyed in 1933 (and, in one case, 1963) and the City of Chino bench marks surveyed in 1987.

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2 1933 elevations are based on the bench mark elevations of the USGS 7 1/2 minute topographic quadrangles map (personal communication with Dan Daniels of USGS, 2002) and the 1987 elevations are based on the bench mark elevations surveyed by the City of Chino (Kleinfelder, 1999).

Land Subsidence 1933 - 1987

Bench Mark or Land Surface Elevation Control Location	1933 Elevation [ft amsl]	1987 Elevation [ft amsl]	Land Subsidence [ft]
Intersection of Chino Hills Pkwy. and Central Avenue	609	607.46	1.5
Intersection of Edison Avenue and Central Avenue	661	659.20	1.8
Intersection of Schaefer Avenue and Central Avenue	695	692.88	2.1
Intersection of Chino Avenue and Ramona Avenue	706*	702.63	3.4
Intersection of Chino Avenue and Benson Avenue	730	728.12	1.9
Intersection of Riverside Drive and Pipeline Avenue	734	730.33	3.7

* surveyed in 1963

Based on a comparison of the survey data, the maximum subsidence during this time period (3.7 ft) occurred at the intersection of Riverside Drive and Pipeline Avenue, which is approximately 2,600 ft west of Watermaster's Area of Greatest Subsidence Concern. A significant amount of subsidence also occurred at the corner of Chino Avenue and Ramona Avenue (3.4 feet). The magnitude of subsidence at these locations is consistent with the historical decline in ground water levels and the higher percentage of clay in the vicinity of the bench marks (see Figure 27).

It should be noted that, in the case of the Riverside Drive and Pipeline Avenue location, the 1933 USGS control elevation is based on photogrametry and not the survey of a bench mark on the ground. As such, the difference in elevation between the USGS land surface elevation control at this location with the City of Chino bench mark survey is approximate. Nevertheless, the data suggests a land surface elevation decline at this intersection and is corroborated by comparison of actual bench mark data at the corner of Chino and Ramona Avenues, located nearby.

According to Watermaster (2002), the City of Chino operated five deep wells in the area of greatest subsidence concern: Well Nos. C-5, C-7, C-9, C-10 and C-12. The cumulative total pumping from City of Chino deep wells was approximately 45,000 acre-ft during the period from 1978 to 1987 (see Figure 28). Pumping data from these wells prior to 1978 were not available. However, four of these five wells were drilled before 1978: Well C-5 was drilled in 1958, Well C-7 in 1962, Well C-9 in 1974 and Well C-10 in 1975. Compared to the total deep well pumping of 45,000 acre-ft from the City of Chino, pumping from the deep wells of City of Chino Hills in Watermaster's area of greatest subsidence concern was zero.

5.2.2 Subsidence Between 1987 and 2001

Leveling data on bench marks in the ground fissuring area of MZ-1 are available for 1987, June 1993, November 1995, February 1999, April 2000, June 2000, and October 2001 (Kleinfelder, 1993, 1996a and 1999; Associated Engineers, Inc. 2001). These bench marks are bounded by Riverside Drive on the north, Chino Hills Pkwy. on the south, Benson Avenue on the east and Pipeline Avenue on the west. Land surface changes using interferograms from Peltzer's (1999) Interferometric Synthetic Aperture Radar (InSAR) study were also available over the periods from October 1993 to December 1995, January 1996 to October 1997, and September 1996 to January 1999. The InSAR study includes most of the MZ-1.

Figure 29 shows a land subsidence contour map of the period from 1987 to 1999 constructed by Kleinfelder (1999). Land subsidence from 1987 to 2001 at selected locations is also shown in the figure. Land subsidence during the period from 1987 to 1999 is aligned north-south with the axis of maximum subsidence (2.2 ft) along Central Avenue. GeoPentech (2002) pointed out that the following has been observed (see Figure 29):

- Significant to moderate land subsidence and subsidence rates during the time period from 1987 to 1993;
- Significant subsidence and significant increases in the subsidence rate for the time period from 1993 to 1995;

- Relatively small land subsidence and significant decreases in the subsidence rate for the time period from 1995 to 1999; and

- No significant land subsidence during the period from 2000 to 2001.

GeoPentech (2002) concluded that pumping from deep wells including the City of Chino Well C-7 and the City of Chino Hills Wells CH-1B, CH-15B and CH-17 could have contributed in a significant way to the land subsidence observed during the period from 1987 to 1993. They also claimed that the City of Chino Hills deep Wells CH-1B, CH-15B, CH-17 and CH-19 likely caused the land subsidence for the period from 1993 to 1995. However, GeoPentech's conclusions are unsupportable for the following reasons:

- Review of InSAR data indicates that the area of rapid subsidence that occurred between 1993 and 1995 not only includes the area of subsidence measured from surveyed bench marks but extends to the north, north of State Highway 60, where no bench mark data are available (see Wildermuth Environmental, 2002; Figure 5-1). This area is referred to as the "red zone" and no ground water production wells (including Chino Hills "deep" wells) are located in this zone north of approximately Chino Avenue (see Figure 10).
- Although deep well hydrographs show large changes in ground water levels, the changes do not last for any significant period of time (such as would be typically necessary for subsidence to occur). In addition, the "static" ground water levels were typically measured within a few hours after each well was shut down (City of Chino Hills, personal communication, 2002). Given the slow recovering nature of the ground water levels in the wells, this is not enough time to allow the ground water levels to fully recover to static conditions. Accordingly, the ground water levels measured at these wells may not be representative of true static ground water conditions and, thus, may exaggerate the level of drawdown in the aquifer.
- There is a discrepancy between the leveling data and the InSAR data for the period from 1993 to 1995. The maximum land subsidence as measured from survey data was approximately 1.12 ft (Kleinfelder, 1999). The maximum land subsidence based on InSAR data was 0.66 ft (Wildermuth Environmental, 2002).

- Until the shallow and deep extensometers are installed and correlations are made between shallow and deep water levels and land surface changes, land subsidence as the result of changes in deep or shallow ground water levels cannot be quantified in the area.
- Residual subsidence due to long-term lowering of ground water levels since early 1900's has not been quantified.
- According to the ground motion attenuation model developed by Geomatrix (1994), six of the seven greatest peak ground accelerations experienced by this area due to earthquakes occurred between 1987 and 1994. These earthquakes include Whitter Narrows in 1987 (M6.0), Upland in 1990 (M5.6), Sierra Madre in 1991 (M5.6), Landers in 1992 (M7.3), Big Bear in 1992 (M6.5), and Northridge in 1994 (M6.7). The impact of earthquakes on land subsidence during this same period of time is not clear.
- Based on the precipitation data measured at Chino Substation - Edison and Chino Fire Station No. 2, during the period from 1928 to 2001, the greatest monthly precipitation (17.79 in.) occurred in January 1993 and the third greatest (14.72 in.) occurred in January 1995 (San Bernardino County Flood Control District, 2002). Land subsidence caused by the additional stress of these significant events has not been quantified. In fact, in February 1993, Geomatrix team members observed subsurface erosion occurring during a heavy rainstorm in the CIM area (Geomatrix, 1994).

6.0 PRELIMINARY PREDICTION OF SUBSIDENCE

The purpose of the subsidence prediction was to evaluate potential future subsidence in the Study Area given a hypothetical range of future ground water level conditions. The prediction was carried out using the PRESS model (**P**redictions **R**elating **E**ffective **S**tress and **S**ubsidence). Since model calibration was only conducted at one location, the results from the subsidence model are considered preliminary. Section 6.1 discusses the selection of the subsidence prediction model. Section 6.2 describes the PRESS model code. Section 6.3 presents the preliminary model calibration and Section 6.4 summarizes the preliminary results of the subsidence prediction.

6.1 Selection of a Subsidence Prediction Model

Based on an historical review of methods used to predict subsidence, the PRESS model was selected to predict subsidence in the western portion of the Chino Basin. Criteria for selection included:

- Demonstrated success in predicting subsidence (Helm, 1975; Helm, 1977 and Leake and Prudic, 1988);
- Accepted model for use in the subsidence industry (e.g. used by Harris-Galveston Coastal Subsidence District); and
- Readily available program with source code.

6.2 The PRESS Model

6.2.1 General Description

The PRESS model is a modified version of a program initially developed by Helm for one-dimensional simulation of aquifer system compaction in Pixley, California (Helm, 1975). Revisions were made in 1979-1980 by the Harris-Galveston Coastal Subsidence District, which included changes in format, plotting and input/output routines. Specifically, the modifications allow for multiple aquifers and simplification of input preparation.

The PRESS model computes ground surface subsidence resulting from a given change in potentiometric head within a system of aquifers. Both the virgin (non-elastic) and rebound (elastic) compressibilities of the clay layers (aquitards) are taken into account when estimating total subsidence.

The program uses the one-dimensional Terzaghi consolidation theory with some simplification of parameters to relate a time history of potentiometric head changes to a time history of subsidence. The total ground surface subsidence, as a function of time, is computed by summing up the individual subsidence occurring in each clay layer. Calibration of the model to historically measured subsidence using observed changes in potentiometric head for a given lithology allows prediction of future subsidence.

The following differential equation (also known as the diffusion equation) is the governing equation used in the PRESS model to evaluate aquifer system compaction. Note that the only difference between Terzaghi's equation (equation 14) and the PRESS model equation is the addition of a rate of applied stress term:

$$\frac{\partial p}{\partial t} - \frac{\partial \sigma}{\partial t} = \frac{\upsilon \partial^2 p}{\partial z^2} \quad \text{...(20)}$$

where:

$$\frac{\partial \sigma}{\partial t} = \text{Rate of Applied Stress.}$$

If applied stress is constant then equation (20) reduces to equation (14)(see Pg. 23).

6.2.2 Equivalent Layer Concept

Subsurface conditions are rarely known with a high degree of confidence and even a single layer may vary in both thickness and consolidation characteristics over a small horizontal distance. For these reasons, as well as to decrease the computational time required for the PRESS model, the equivalent layer concept was used.

Multiple clay layers within an aquifer can be assumed to have similar boundary loading conditions as a result of the potentiometric surface drawdown within the aquifer. The net contribution of the set of actual aquitards to the subsidence at the site may be approximated by analyzing an idealized set of equivalent layers, each having the same thickness and change in boundary stresses. Thus, only one calculation is needed for the multiple layer set of aquitards, and the resulting subsidence contribution of the set may be obtained by multiplying the consolidation of one of the equivalent layers by the number of equivalent layers in the set.

Figure 31 illustrates the equivalent layer concept used in the PRESS model.

6.2.3 Compacting Interval

A set of aquitards that is idealized as a set of equivalent layers is termed a compacting interval. The entire alluvial thickness can then be idealized as several compacting intervals. Each compacting interval contains one or more idealized clay layers.

6.2.4 Single and Dual Controlling Aquifers

The PRESS model is able to simulate one or two controlling aquifers by specifying potentiometric head at three places in the total alluvial thickness. The change in potentiometric surface over time (drawdown) is specified for the upper and lower aquifers and for the bottom of the alluvial thickness. When only one aquifer is used, the drawdown is only specified at two locations over time. This drawdown over time is the PRESS loading function.

6.3 Preliminary PRESS Model Calibration

6.3.1 Model Input Parameters

The model was calibrated to the USGS benchmark surveys at the intersection of Riverside Drive and Pipeline Avenue (the area of highest historically measured subsidence as determined from USGS benchmark surveys). An idealized lithologic log was constructed from the geophysical borehole log of a deep well located near this benchmark (CH-16, a.k.a. Test Hole #5). The idealized log was constructed by identifying permeable and compressible (i.e. clay) layers from the geophysical log of Well CH-16. Five compacting intervals were selected based on the number and thickness of observed clay layers, and the number of multiple clay layers contained between thick permeable zones (see Figure 32). Within each compacting interval, the total clay thickness and equivalent thickness was estimated from the short guard resistivity log.

The PRESS model simulates a transient loading condition (i.e. changes in applied stress) as the potentiometric surface changes in response to pumping and recharge. The three necessary loading functions were derived from water levels measured in several nearby wells over time. The historical loading function (see Figure 33) for the deep aquifer was estimated by averaging water levels measured in C-7, CH-17A and CH-19 (See Appendix B for municipal well construction data). The shallow aquifer loading function was estimated by averaging ground water levels measured in CIM-12, C-4 and two additional unnamed shallow wells (O-2 and O-5 from Geomatrix, 1994).

Zero drawdown was assumed at the beginning of the loading record (1904) when all three water levels (shallow, deep and bottom of the alluvial thickness) were assumed to be equal to the land surface elevation (see Figure 3 for historical artesian area). Previous to the early 1990s, limited deep aquifer water level data were available, so the deep loading function was assumed to be lower than the shallow loading function by a factor which grew linearly from 1930 (both loading functions were assumed to be equal) to 1991 when consistent deep water level data were available (deep water levels were observed approximately 100 feet below those in nearby shallow wells). The third loading function (drawdown at the bottom of the modeled interval) was assumed to equal 90% of the drawdown loading function for the shallow zone aquifer. This assumption is based on examples from the PRESS manual (Espey, Huston & Associates, 1979).

The PRESS model calculates changes in effective stress for each compacting interval based on changes in applied stress (i.e. the loading function), depths to the midplanes of the compacting intervals, and depths to the top and bottom of the aquifer zones. Across each compaction interval, the potentiometric head is assumed to be constant. The depths to the top and bottom of aquifers were estimated from the geophysical borehole log for Well CH-16 (see Figure 32 for geophysical log and aquifer designations).

Preconsolidation stress is the state of the clay layers before the model simulation. A preconsolidation stress of zero (normally consolidated) assumes the aquifer has never been stressed beyond its present state. Pre-model stresses could include an historical or pre-historical decline in ground water levels, loading by pre-existing sediments (overburden) that have been removed due to erosion and/or sudden changes in stress due to seismic activity.

The hydraulic diffusivity is the ratio of hydraulic conductivity to specific storativity or the ratio of hydraulic conductivity to elastic or virgin compressibility. Elastic compressibility indicates the rebound ability of the clay layer while inelastic or virgin compressibility represents non-recoverable compaction.

It was assumed that since the change in effective stress was relatively small (less than several hundred ft), a straight line approximation could be made of the loading-unloading curves (see dashed lines on loading curve Figure 33). Also by assuming a linear relationship between stress and strain, constant compressibilities could be used as they are related to the slope of the line.

The input loading function to the PRESS model is designed to make maximum use of measured water level data. This is accomplished by designation of a reference stress in each compaction interval. The reference stress is typically equated to the effective vertical stress existing prior to any significant potentiometric surface drawdown (equal to elevation head in the center of the compaction interval). The change in vertical effective stress at any time after drawdown occurs is simply the amount of pressure change associated with the change in potentiometric surface.

6.3.2 Calibration Process

The PRESS model was calibrated to measured historical changes in land surface elevation given the ground water level record for the period 1904 – 2001. The model input parameters were adjusted until the simulated land subsidence reasonably matched the measured benchmark survey data. To enhance the calibration process, PEST (Model-Independent **P**arameter **EST**imation, developed by John Doherty of Watermark Numerical Computing, 2001), an inverse modeling technique, was used for parameter estimation and predictive analysis.

The inverse modeling process involves estimating different distributions of parameters with the goal of producing less residual error than produced by the previous parameter set. This process is repeated until the sum-of-squared-residual error (residual is the difference between the measured and model-calculated subsidence) is at a minimum. PEST uses a nonlinear estimation technique known as the Gauss-Marquardt-Levenberg method to estimate the parameter upgrades from the Jacobian matrix of parameter sensitivity to each observation. The inverse calibration method enables a closer match between measured and model-generated results with fewer model runs than trial and error calibration. The adjustable parameters, which PEST changed to reduce the residual error, included vertical hydraulic conductivity, virgin compressibility, elastic compressibility and the preconsolidation stress. The other parameters, which were not changed, included the number and depth of compacting intervals, the number and thickness of equivalent clay layers within the compacting intervals, the top and bottom of controlling aquifers, and the model-loading function (ground water level drawdown). These other parameters were estimated from the geophysical log and observed ground water level measurements.

The preconsolidation stress was one of the four parameters estimated using PEST. Each of the compaction intervals was assumed to have the same preconsolidation stress and PEST changed the value for all five compaction intervals together, simultaneously.

Vertical hydraulic conductivity and the virgin and elastic compressibilities were estimated for each of the five compaction intervals using PEST (see Figure 32 for resulting parameter distributions). These values were fixed for individual layers but varied slightly from layer to layer, based on reductions in the overall residual error. Prior information equations were added to the PEST control file for the two compressibilities and vertical hydraulic conductivity, which state that the difference between the parameters assigned to any two layers should be zero. This is the regularization assumption (see Doherty, 2001), which helps to constrain the parameterization of the model while allowing PEST to make small parameter changes between the layers, if necessary. These "observations" were assigned weights, which kept their contributions to the objective function about 10 percent of the total objective function.

The results of the calibration show an adequate fit to the observed land surface subsidence (see Figure 34). The average residual (model-generated subsidence minus measured subsidence) was 0.0468 ft. The maximum residual was 0.18 ft and the minimum was -0.0463 ft. Given the range of observed subsidence (4.07 ft) and the standard deviation of the residuals (0.085 ft), the standard error is approximately 2.1%. Good model fit is generally considered to be a calibration with standard error less than 10%.

6.4 Subsidence Predictions

Using the calibrated PRESS model as described in the previous section, two predictions were run ten years into the future. The variable that was changed between the two scenarios was the loading function (drawdown). The first scenario assumed that drawdown does not increase for the next ten years and the second scenario assumes a drop to the greatest recorded historical drawdown (350 feet total drawdown in the deep zone and 150 feet drawdown in the shallow zone), which is held constant for ten years. PEST was used to analyze the predicitive capability of the model using predictive analysis mode (Doherty, 2001). This technique estimates a minimum and maximum prediction based on analyzing the uncertainty inherent in the model.

The results of running the first scenario (maintaining current ground water levels for 10 years into the future) show that approximately 0.165 (ranging from 0.1 to 0.2) feet of additional land subsidence is predicted to occur (see Figure 35). The results of the second scenario (lowering of current ground water levels to the historical low for 10 years into the future) show that approximately 2.0 (ranging from 1.1 to 3.3) feet of additional land subsidence are predicted to occur.

7.0 FINDINGS

The primary findings resulting from the geohydrologic analysis of subsidence in MZ-1 presented in this report are summarized as follows:

- Land subsidence due to ground water withdrawal is a function of excessive lowering of ground water levels in areas where a significant portion of the subsurface consists of a high percentage of fine-grained sediments (silt and clay).

- The aquifer system in the western portion of the Chino Basin can generally be divided into shallow and deep aquifer zones separated by fine-grained clay layers. However, the boundary between the shallow and deep aquifers is not well defined because the clay layers are heterogeneous, do not occur at the same depth throughout the area, and are laterally discontinuous.

- The highest percentage of clay, relative to total alluvial thickness, occurs in the western portion of MZ-1.

- Due to the heterogeneous and laterally discontinuous nature of the clay layers separating the shallow and deep aquifer systems, it is likely that hydraulic communication occurs between the two systems.

- The shallow and deep aquifers in the Study Area are naturally recharged primarily from deep percolation of precipitation falling on the alluvial slope at the base of the San Gabriel Mountains. Deep percolation of precipitation recharges both the shallow and deep aquifer systems before migrating downgradient in a southerly direction.

- Prior to approximately 1904, the aquifers beneath a large portion of the Study Area were under flowing artesian conditions (ground water levels were at or above the land surface).

- Ground water pumping since 1904 has lowered ground water levels substantially throughout MZ-1. Ground water levels declined steadily from the 1930s through the 1970s. Ground water levels recovered throughout the 1980s and have remained relatively stable since the late 1980s.

- The greatest historical ground water level declines have been observed in the northwestern portion of MZ-1 (Pomona area), which is upgradient of Watermaster's area of greatest subsidence concern. Changes in ground water levels of greater than 200 ft from 1904 to 1973 were observed in some wells in this area. Ground water level decline in Watermaster's area of greatest subsidence concern ranged from approximately 70 to 130 ft between 1904 and 1989.

- Production wells screened in both shallow and deep aquifers upgradient of Watermaster's area of greatest subsidence concern have contributed to the historical ground water level declines in the area of greatest concern by intercepting ground water underflow (recharge) to the area.

- Cumulative deep well pumping by the City of Chino Hills was approximately 22,000 acre-ft during the period 1978-2001. Cumulative deep well pumping by the City of Chino was 85,000 acre-ft during this time period.

- Ground fissures attributed to land subsidence have been observed in Watermaster's area of greatest subsidence concern since the early 1970s.

- Comparison of land surface elevations by the USGS in the early 1930s with bench mark surveys from 1987 indicate that as much as 3.7 ft of subsidence occurred at the corner of Riverside Drive and Pipeline Avenue (2,600 ft northwest of the area mapped by Kleinfelder as being the area of greatest subsidence) during this time period. Furthermore, comparison of a 1963 USGS survey of a benchmark at the corner of Chino Avenue and Ramona with a bench mark survey from 1987 at the same location indicates 3.4 ft of subsidence occurred at that location during that time period. This benchmark is west-northwest of the area previously identified as the area of greatest subsidence.

- The area of greatest subsidence, based on comparison of benchmark surveys between 1933 and 1987, correlates with that portion of MZ-1 where the highest ground water level declines occurred and the highest percentage of clay occurs in the subsurface.

- Review of benchmark surveys and InSAR data from 1993 to 1995 indicate an increased rate of subsidence during this time period for a relatively narrow area immediately west of Central Avenue. The rate and relatively limited extent of subsidence measured during this time period suggests that a secondary causal factor (such as an earthquake) may have contributed to the subsidence and requires further analysis.

- Land subsidence in MZ-1 has been minimal between 1995 and the present, based on both benchmark surveys and InSAR data. This correlates with relatively stable ground water levels over the same time period.

- Preliminary subsidence modeling suggests that if ground water levels are maintained in the area of historical subsidence (irrespective of shallow or deep aquifers), subsidence will be maintained at present rates.

- A revised area of greatest subsidence concern (AGSC) is defined in this report based on a combination of historical ground water level changes, historical ground surface elevation changes and lithology (i.e. percentages of fine-grained materials). The revised AGSC encompasses most of the Watermaster AGSC but extends farther to the north and west covering an area of approximately 11 square miles.

In summary, subsidence in the western portion of the Chino Basin may be the result of widespread ground water level declines as a result of ground water pumping as early as 1900. However, this needs to be verified with further studies. Until those studies are completed, a revision to the area of greatest subsidence concern is recommended. The revised area would be expanded to include areas with the greatest ground water level declines, highest percent clay relative to total alluvial thickness, and measured subsidence from either InSAR or benchmark surveys (see Figure 36). In addition, maintenance of subsidence in the area of greatest concern is best conducted through maintenance of ground water levels using a comprehensive ground water management program. This program should include monitoring of ground water levels, extensometer data, and ground water pumping. If it has been determined, in the future, that subsidence due to ground water withdrawal is an issue, ground water levels would be adjusted as required. Until those studies are completed, a more evenly distributed reduction in pumping across the area of greatest subsidence concern is recommended rather than a drastic reduction from a small area.

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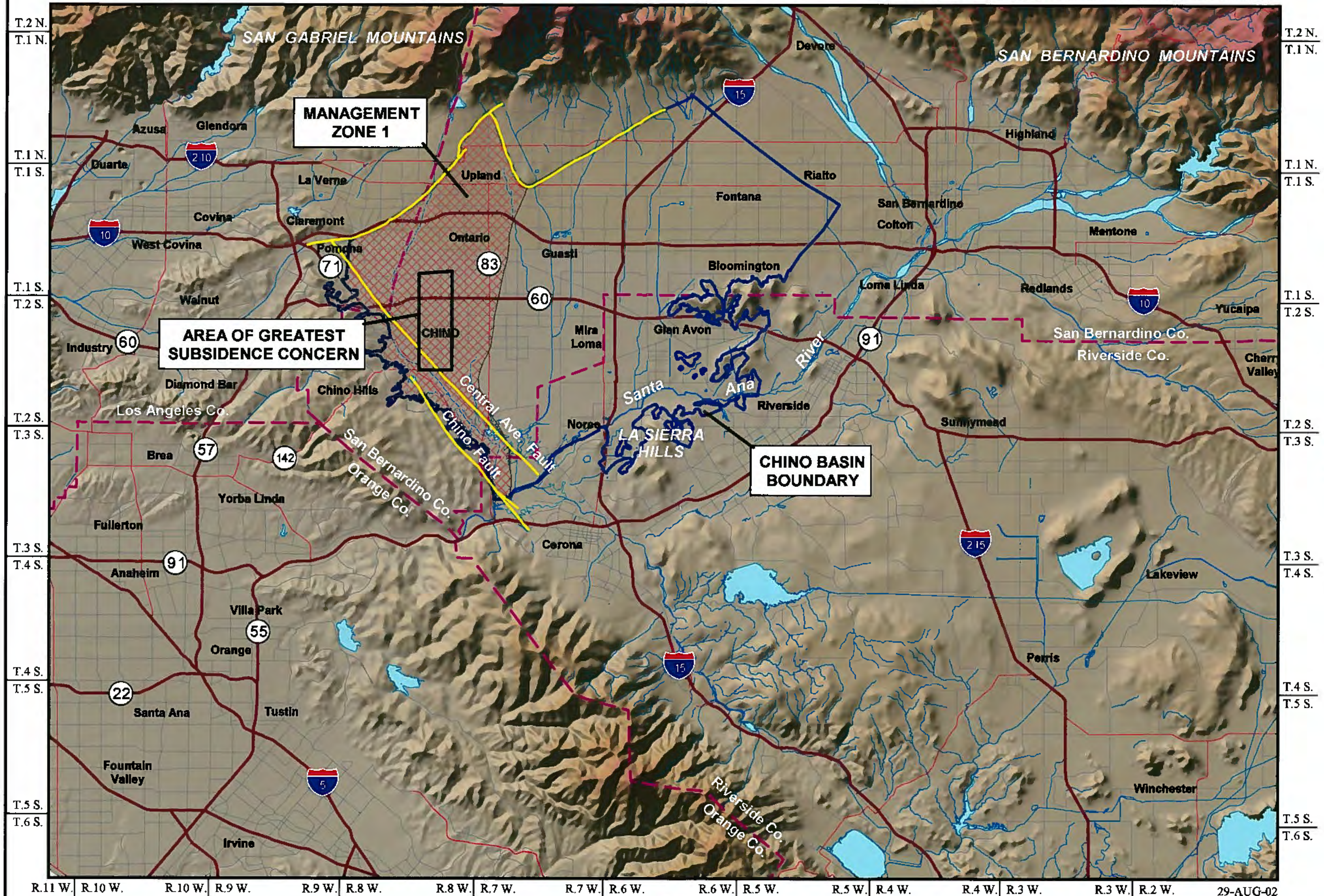
FIGURES

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE
IN THE WESTERN PORTION OF THE CHINO BASIN

GENERAL PROJECT LOCATION



EXPLANATION

- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Chino Basin Boundary
- Faults Within the Chino Basin (Chino Basin Watermaster, 1999)
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: DWB

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

DRAFT

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Figure 1

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

SURFACE GEOLOGY

EXPLANATION

- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Area of Historical Artesian Condition Early 1900's
- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary
- Precipitation Station

San Bernardino Sheet Geology

- Qw — Wash deposits
- Qs — Wind-blown sand
- Qyf — Younger fan deposits
- Qf — Fan deposits
- Qod — Well-dissected alluvial fans
- Mpe — Puente Formation (Marine siltstone, sandstone and shale)

Santa Ana Sheet Geology

- Qls — Landslide deposits
- Qyfa — Young deposits of alluvial fans, Unit 1
- Qyaa — Young axial channel deposits
- Qyls — Young landslide deposits
- Qyls? — Young landslide deposits?
- Qvofa — Very old alluvial fan deposits, Unit 2
- Puente Formation:
  - Tpsc — Sycamore Canyon Member
  - Tpy — Yorba Member
  - Tps — Soquel Member

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: DWB

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Geology Source:
NORTHERN PORTION: Division of Mines and Geology - "Geologic Map of the San Bernardino Quadrangle, California:, 1:250,000 (1986)
SOUTHERN PORTION: USGS - "Preliminary Digital Geologic Map of the Santa Ana 30' X 60' Quadrangle, Southern California", Version 1.0 (2001)

NORTH

0 2000 4000 Feet

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Figure 2

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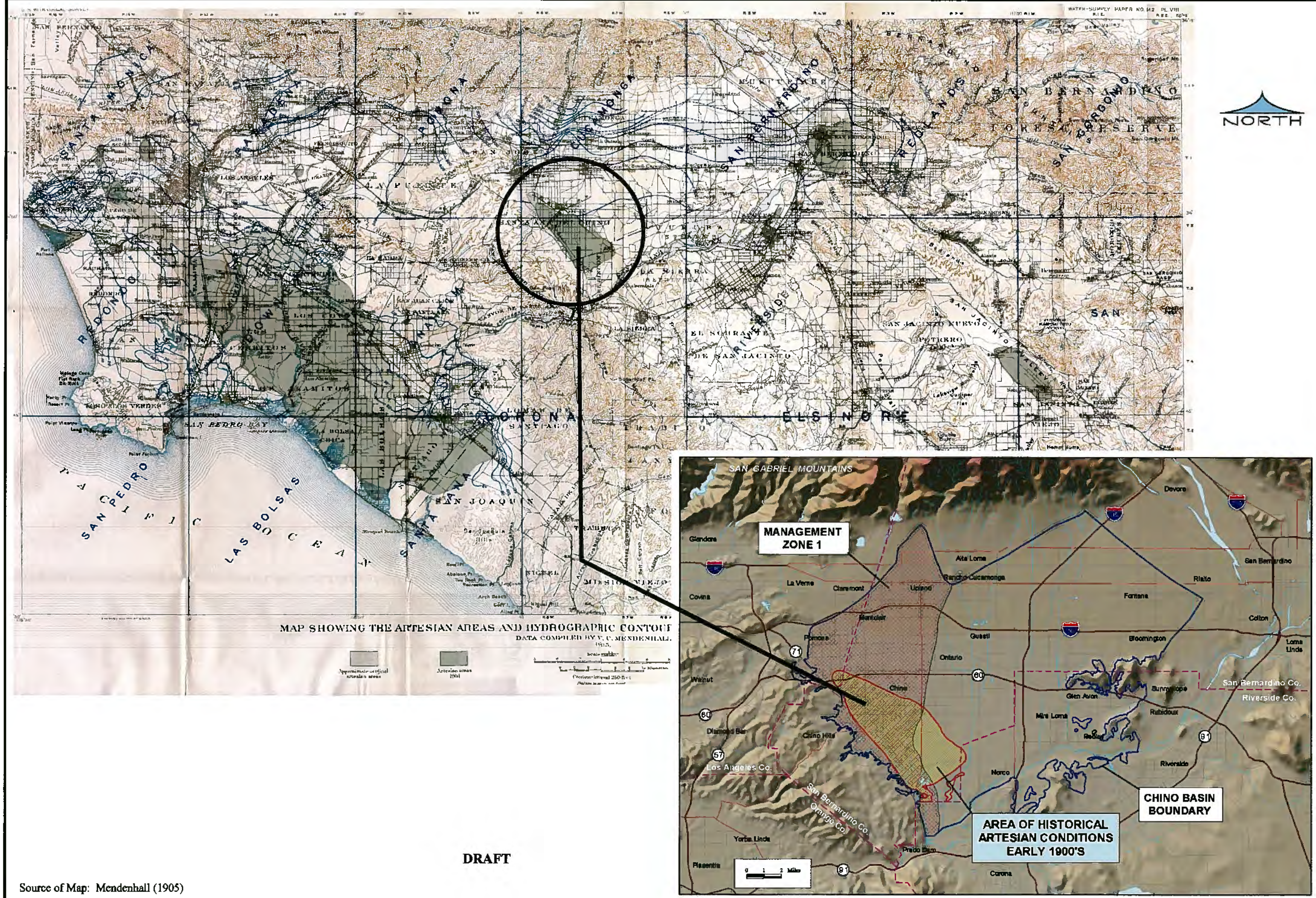

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Source of Map: Mendenhall (1905)

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CITY OF CHINO HILLS

ARTESIAN AREA - 1904

Figure 3

Drawn: DWB
Checked:
Approved:
Date: 29-AUG-02

JN 12959-02

Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 3 - artesian area 1904.ai

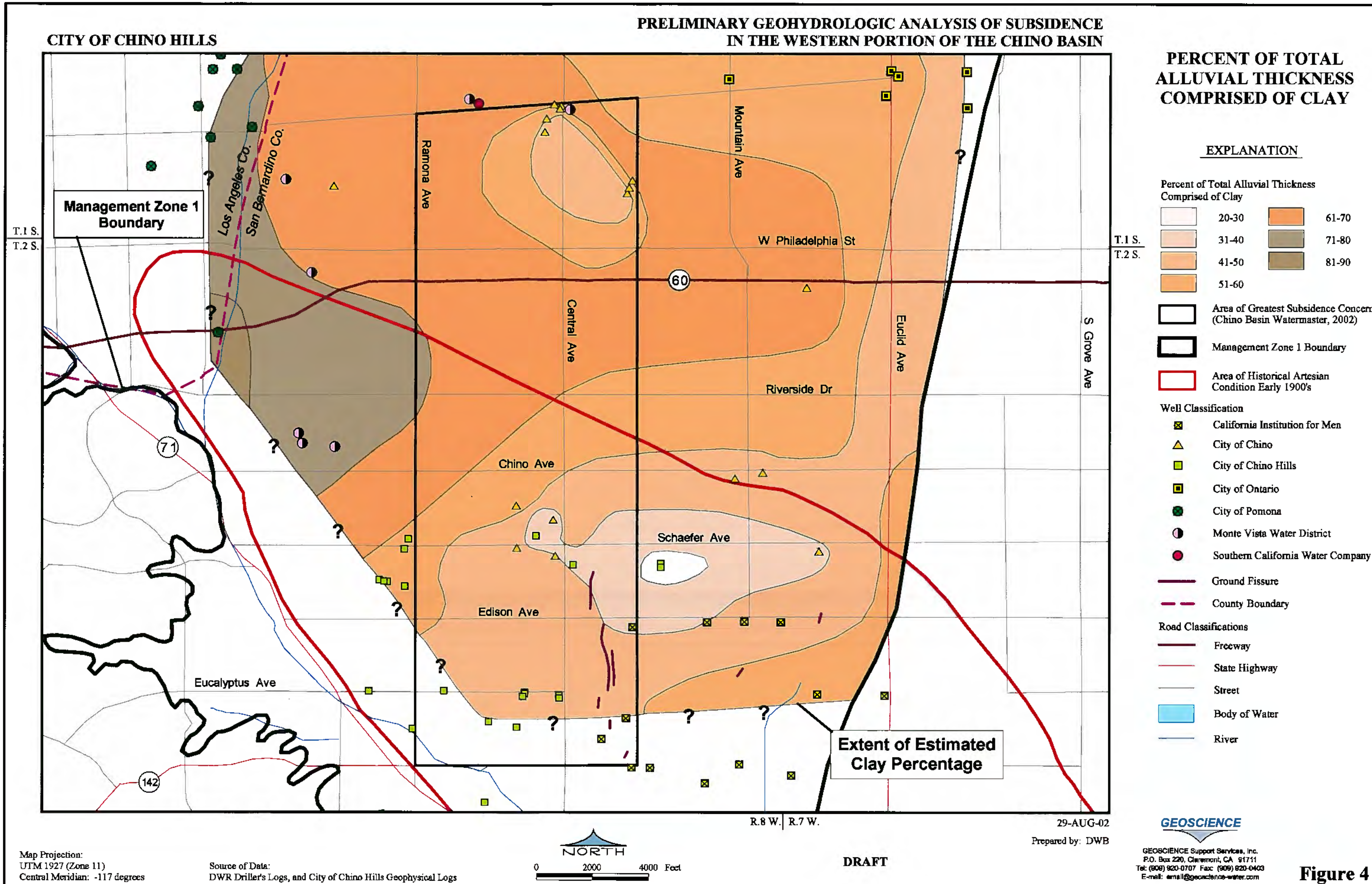

Figure 4

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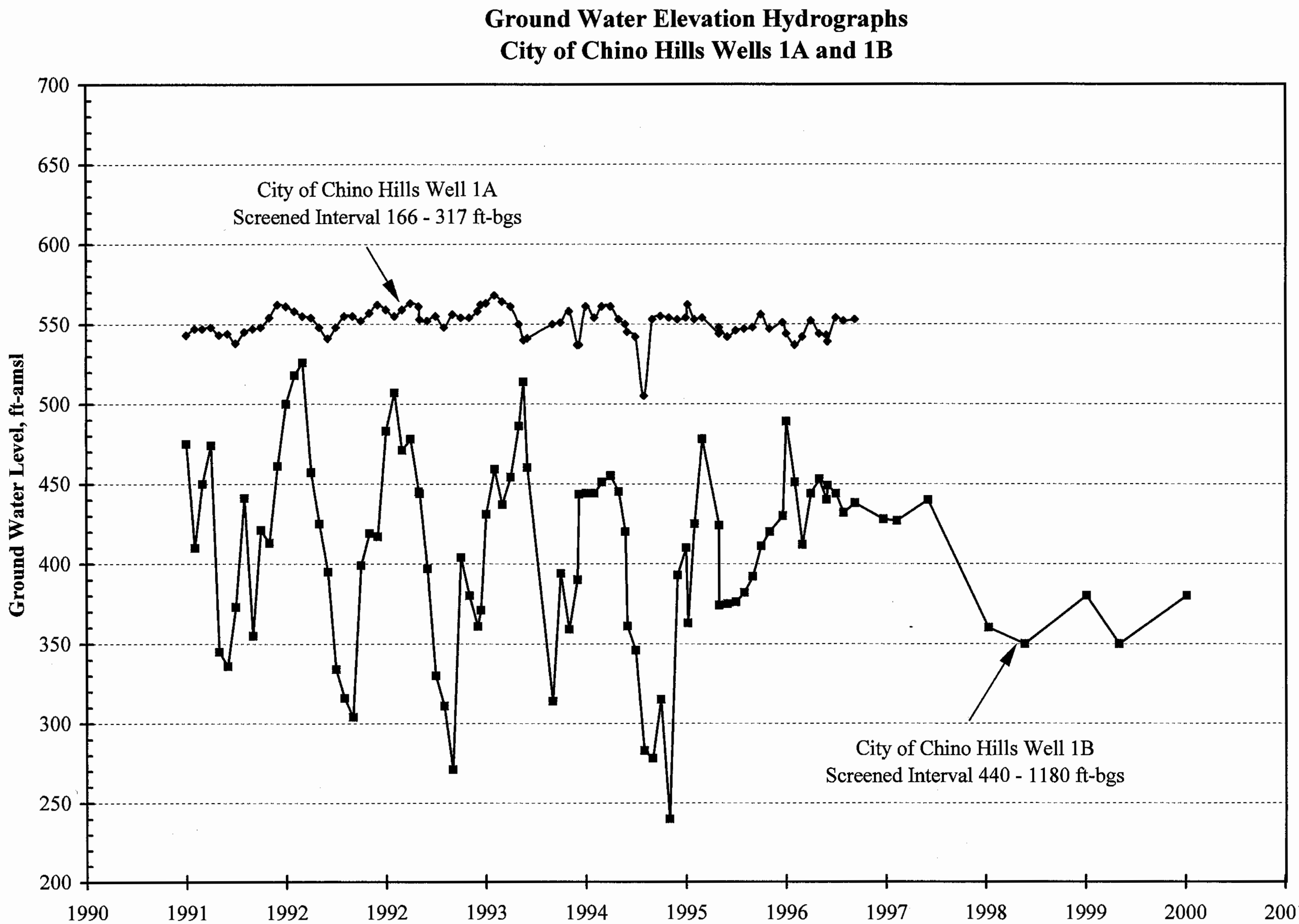
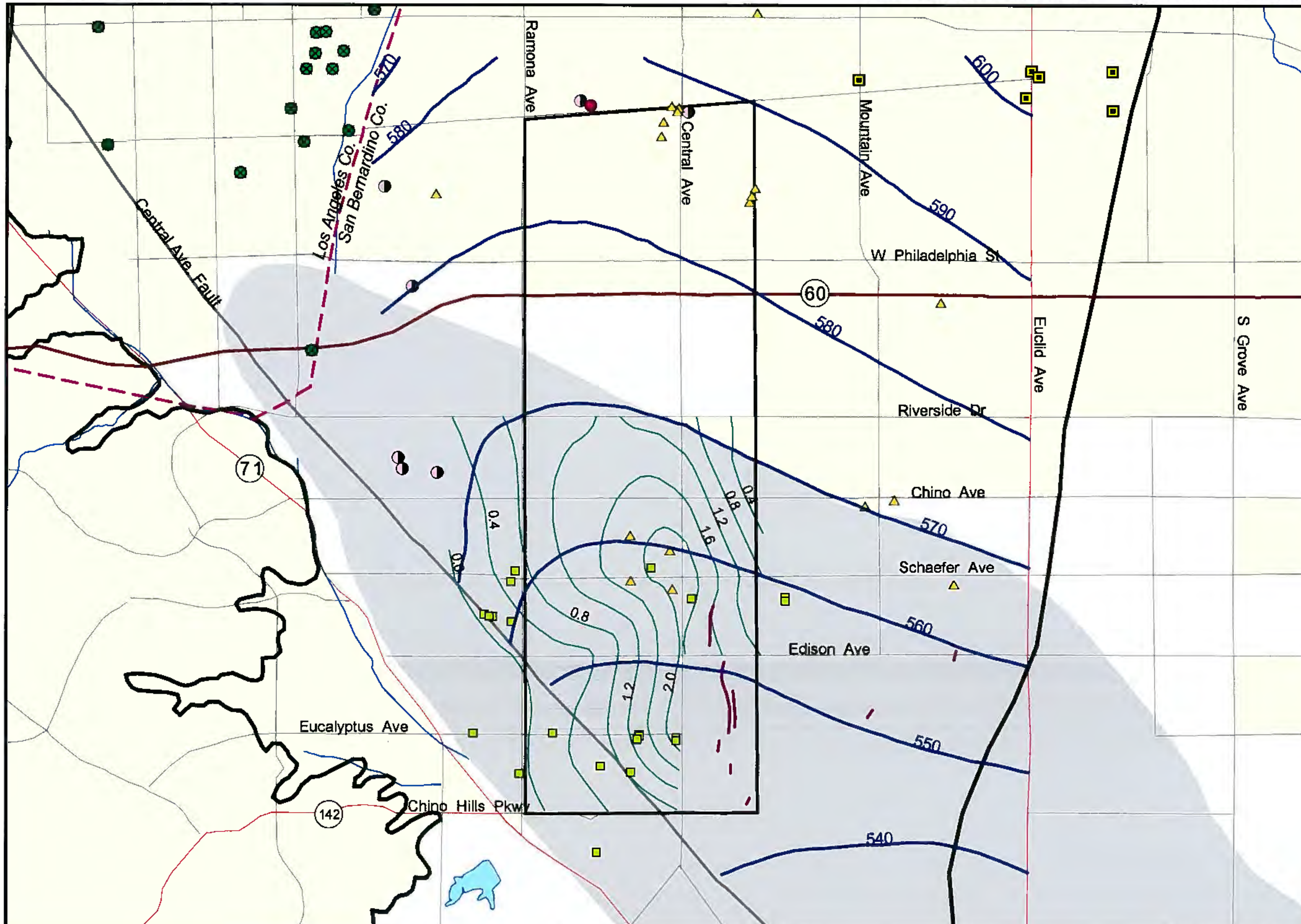


Figure 5

Source of Data: Wildermuth Environmental (2000) and WMWD (2001)

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN



GROUND WATER ELEVATION IN FALL 2000

EXPLANATION

- 580 Ground Water Elevation (ft amsl)
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

- 0.4 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

T.1 S.
T.2 S.

R.8 W. | R.7 W.

29-AUG-02

Prepared by: GK

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Ground Water Elevation Data:
Wildermuth Environmental, Inc. (2002)

NORTH

0 2000 4000 Feet

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Figure 6

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

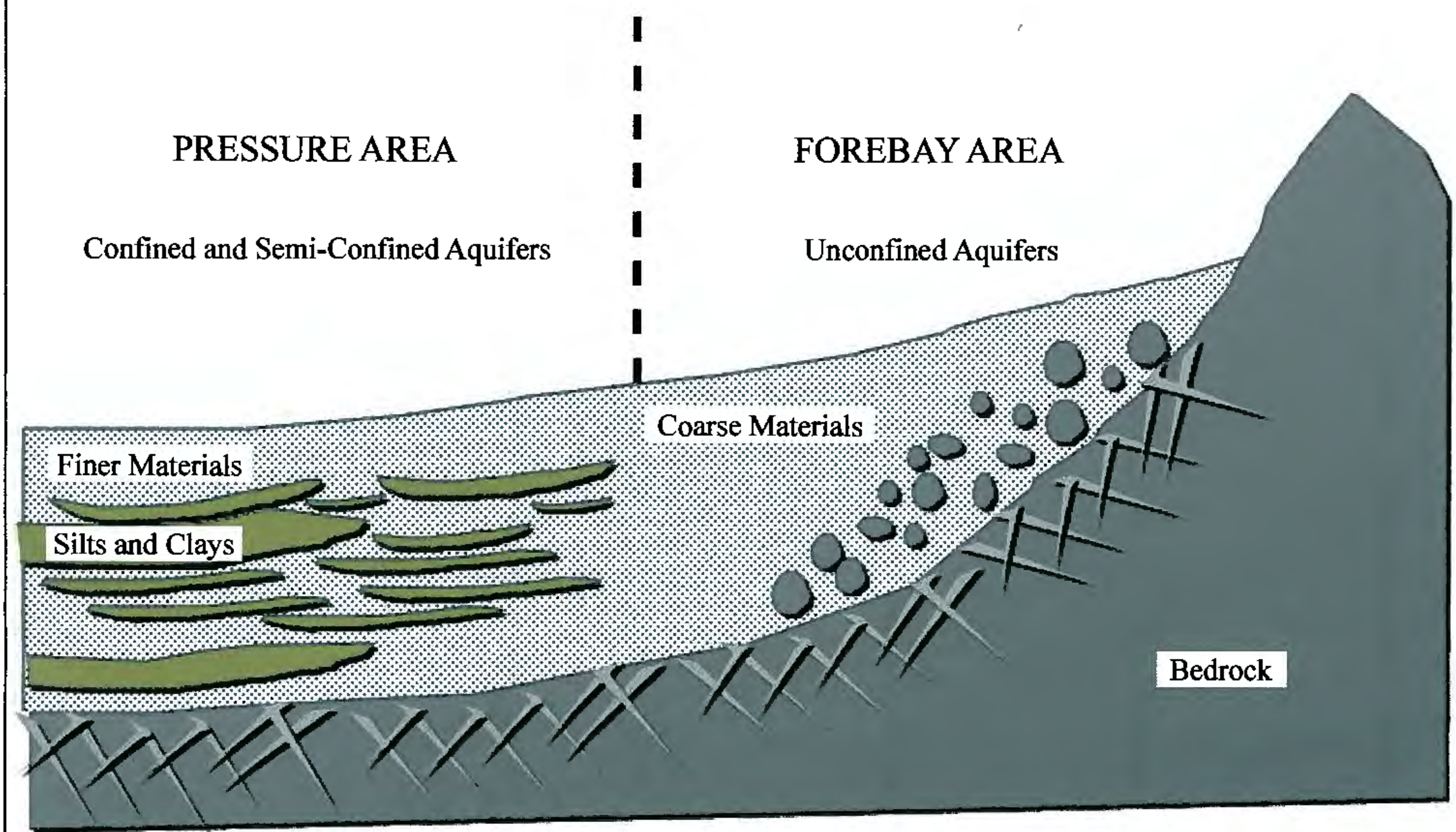

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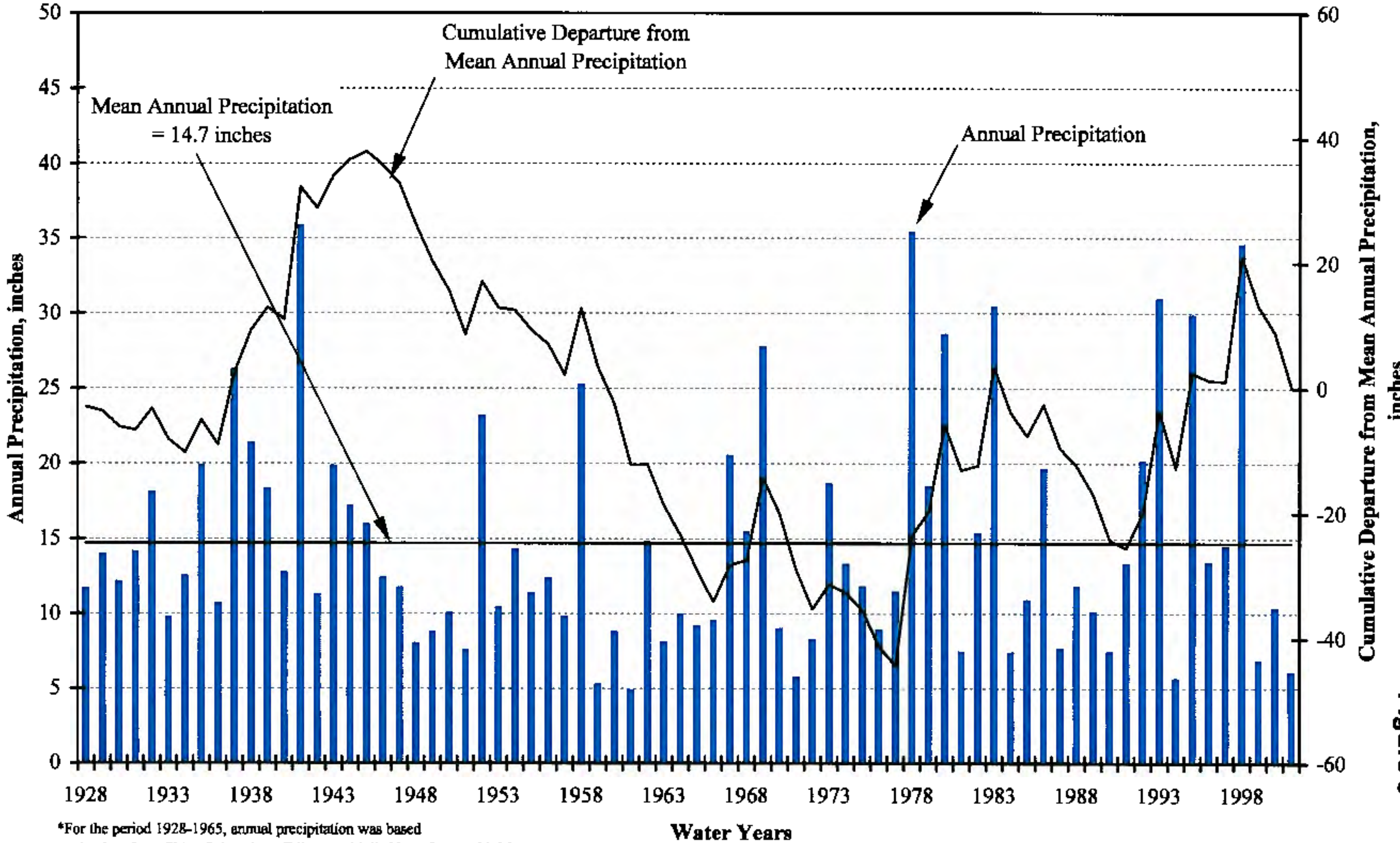
Figure 7	Drawn: DWB	CITY OF CHINO HILLS	GEOSCIENCE Support Services, Inc.
	Checked:	CONCEPTUAL AQUIFER SYSTEMS IN MZ-1 OF CHINO BASIN	Mailing Address: P.O. Box 220, Claremont, CA 91711 Physical Address: 1326 N. Monte Vista, Ste 3, Upland CA. 91786 Tel: (909) 920-0707 Fax: (909) 920-0403 E-mail: email@geoscience-water.com
	Approved:		
JN 12959-02	Date: 29-AUG-02		

Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 7 - conceptual aquifer system.ai

Cumulative Departure from Mean Annual Precipitation
Chino Fire Station No. 2*, 1928-2001



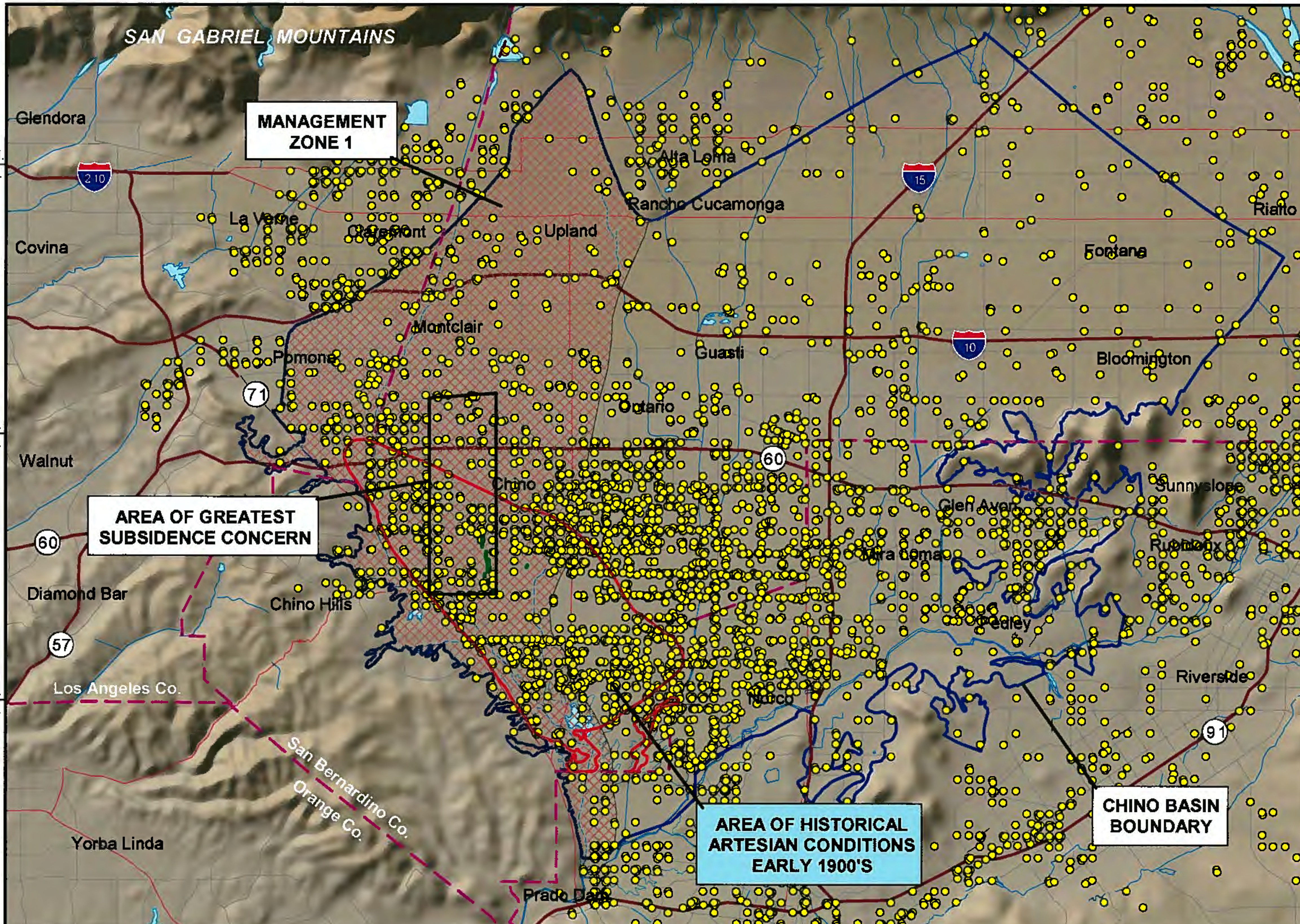
*For the period 1928-1965, annual precipitation was based on the data from Chino Substation - Edison multiplied by a factor of 0.96

Figure 8

Source: San Bernardino County Flood Control District

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE
IN THE WESTERN PORTION OF THE CHINO BASIN



T.1 N. | T.1 S. | T.2 S. | T.3 S.

R.9 W. | R.8 W. | R.7 W. | R.6 W. | R.5 W.

PRODUCTION WELLS IN THE CHINO BASIN AND VICINITY

EXPLANATION

- Production Well
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Conditions Early 1900's
- Chino Basin Boundary
- Ground Fissure
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: DWB

NORTH

0 2 4 Miles

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Well Data: Wildermuth Environmental, Inc. (2000).

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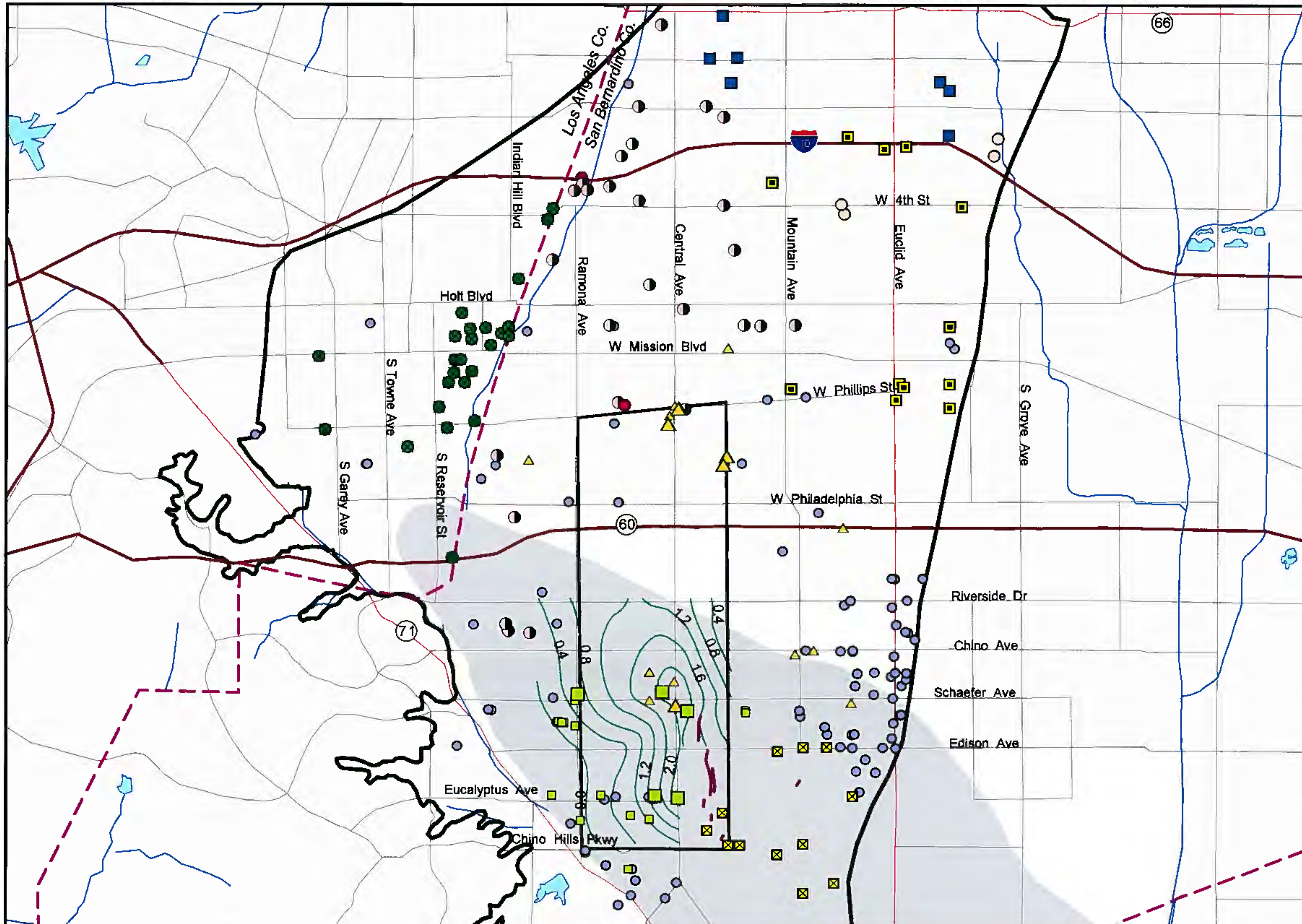
Figure 9

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

PRODUCTION WELLS IN MZ-1 OF CHINO BASIN



EXPLANATION

Well Classification

- Agricultural Wells
- California Institution for Men
- Deep / Shallow: City of Chino Hills
- Deep / Shallow: City of Chino
- City of Ontario
- City of Upland
- City of Pomona
- Monte Vista Water District
- San Antonio Water Company
- Southern California Water Company
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's
- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: GK

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Well Data:
Wildermuth Environmental, Inc. (2000)
and Chino Basin Watermaster (2002)

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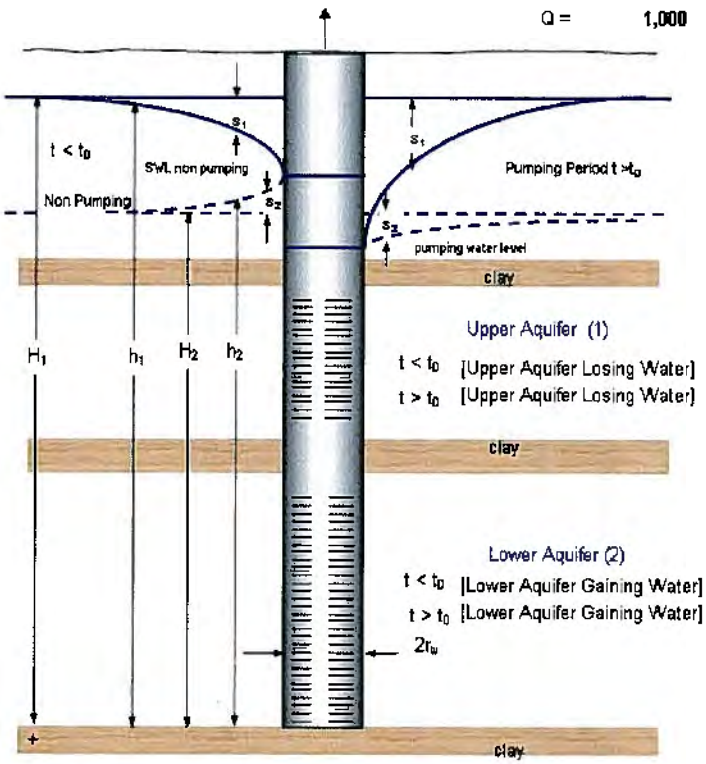
Figure 10

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr



Drawdown (s) = H - h

T_1 = 20000 gpd/ft

S_1 = 0.15

T_2 = 7000 gpd/ft

S_2 = 6.00E-06

Well Radius (r_w) = 0.5 ft

Time since well was completed (t) = 365.0 days

Time at which pumping started (t_0) = 300.0 days

Initial Head in Upper Aquifer (H_1) = 550 ft

Initial Head in Lower Aquifer (H_2) = 500 ft

Radial Distance r = 0.001 ft

For Time <=	300	days	
s_1 =	13	ft	[Upper Aquifer Losing Water]
Q_1 =	79	gpm	
s_2 =	-37	ft	[Lower Aquifer Gaining Water]
Q_2 =	-79	gpm	

For Time =	365	days	
s_1 =	79	ft	[Upper Aquifer Losing Water]
Q_1 =	889	gpm	
s_2 =	-9	ft	[Lower Aquifer Gaining Water]
Q_2 =	111	gpm	

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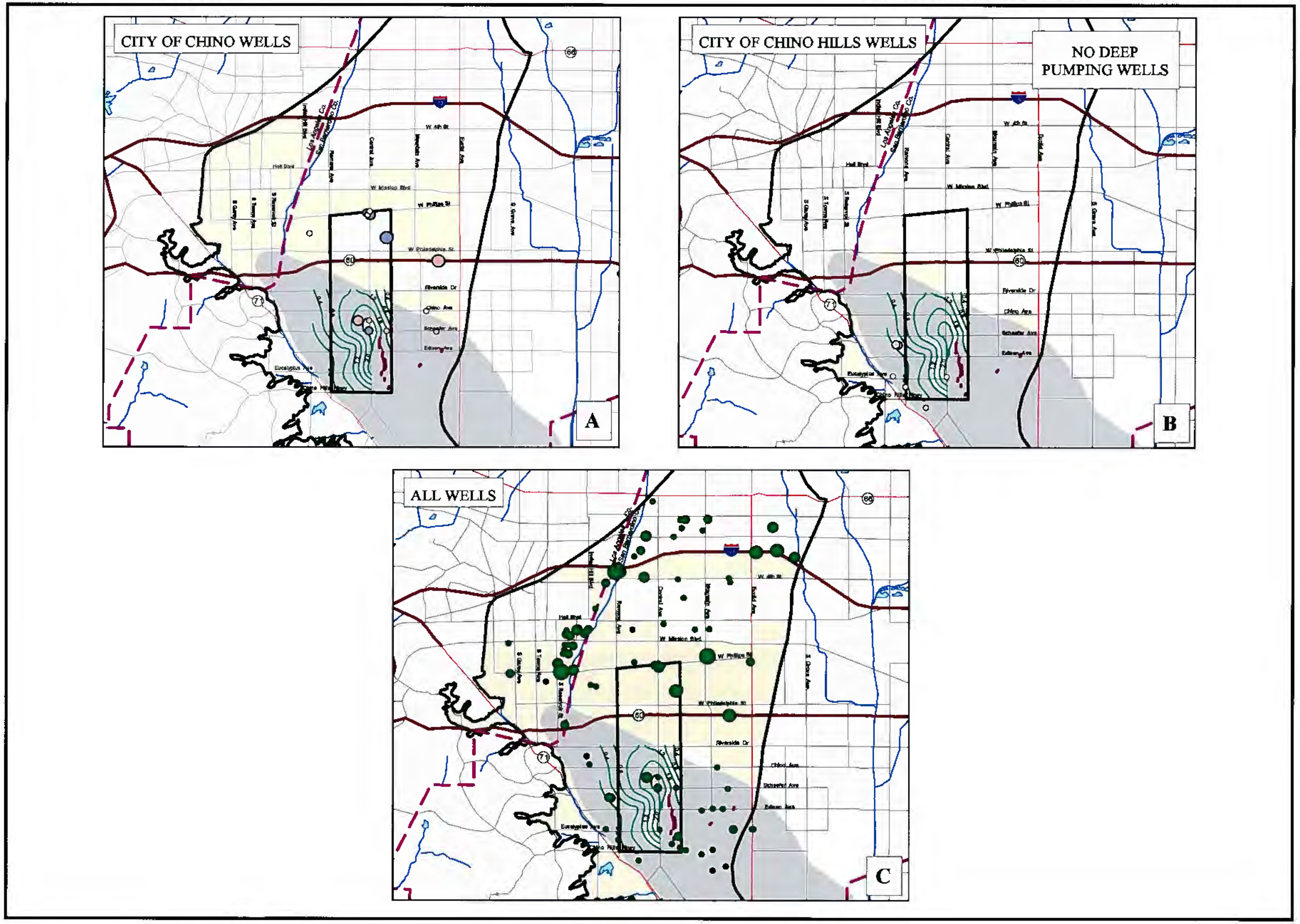
Figure 11	Drawn: DWB	CITY OF CHINO HILLS	GEOSCIENCE Support Services, Inc.
	Checked:	NON-STEADY FLOW TO MULTI-AQUIFER WELLS	Mailing Address: P.O. Box 220, Claremont, CA 91711
	Approved:		Physical Address: 1326 N. Monte Vista, Ste 3, Upland CA. 91786
JN 12959-02	Date: 29-AUG-02		Tel: (909) 920-0707 Fax: (909) 920-0403 E-mail: email@geoscience-water.com

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN



CUMULATIVE PRODUCTION FROM 1978 - 1989

EXPLANATION

Cumulative Well Production (acre-ft)

Deep	Shallow	Deep & Shallow	
o	o	•	< 5,000
o	o	•	5,000 - 10,000
o	o	•	10,000 - 15,000
o	o	•	15,000 - 20,000
		•	20,000 - 40,000

Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)

Management Zone 1

Area of Historical Artesian Condition Early 1900's

0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)

Ground Fissure

County Boundary

Road Classifications

Freeway

State Highway

Street

Body of Water

River

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Data:
Production Data from Chino Basin Watermaster (2002)

NORTH
0 1 2 Miles

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29-AUG-02
Prepared by: GK

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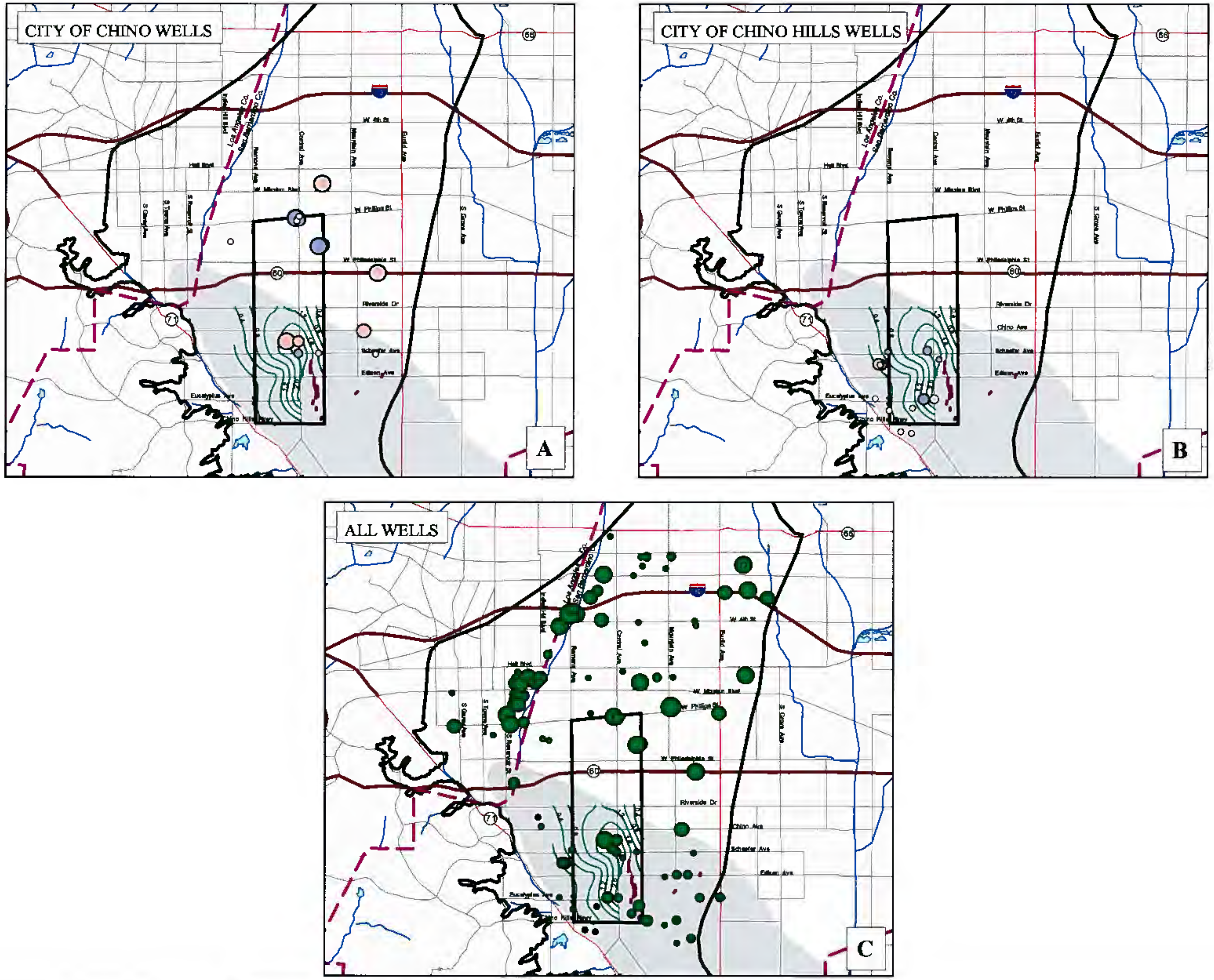
Figure 12

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

CUMULATIVE PRODUCTION FROM 1978 - 2001



EXPLANATION

Cumulative Well Production (acre-ft)

Deep	Shallow	Deep & Shallow	
○	○	●	< 5,000
○	○	●	5,000 - 10,000
○	○	●	10,000 - 15,000
○	○	●	15,000 - 20,000
○	○	●	20,000 - 40,000
○	○	●	> 40,000

Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)

Management Zone 1

Area of Historical Artesian Condition Early 1900's

0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)

Ground Fissure

County Boundary

Road Classifications

Freeway

State Highway

Street

Body of Water

River

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Data:
Production Data from Chino Basin Watermaster (2002)

NORTH
0 1 2 Miles

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29-AUG-02
Prepared by: GK

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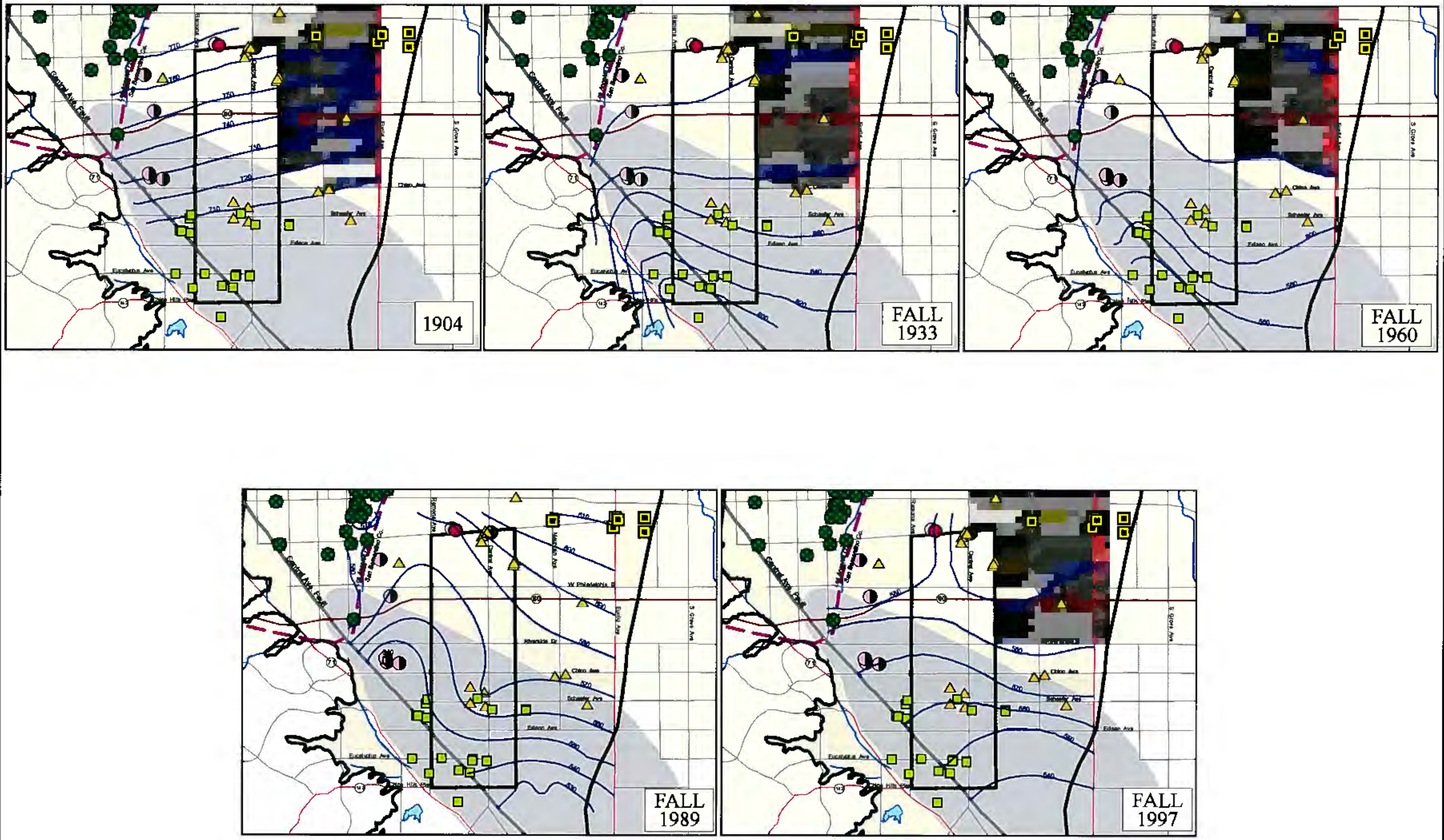
Figure 13

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

HISTORICAL GROUND WATER ELEVATIONS



EXPLANATION

- 580 Ground Water Elevation (ft amsl)
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Ground Water Elevation Data:
1904 - Mendenhall (1905)
1933 - Department of Water Resources (1970)
1960 - Department of Water Resources (1970)
1989 - Contoured using water level data from Wildermuth Environmental, Inc. (2000)
1997 - Wildermuth Environmental, Inc. (2000)

NORTH

0 1 2 Miles

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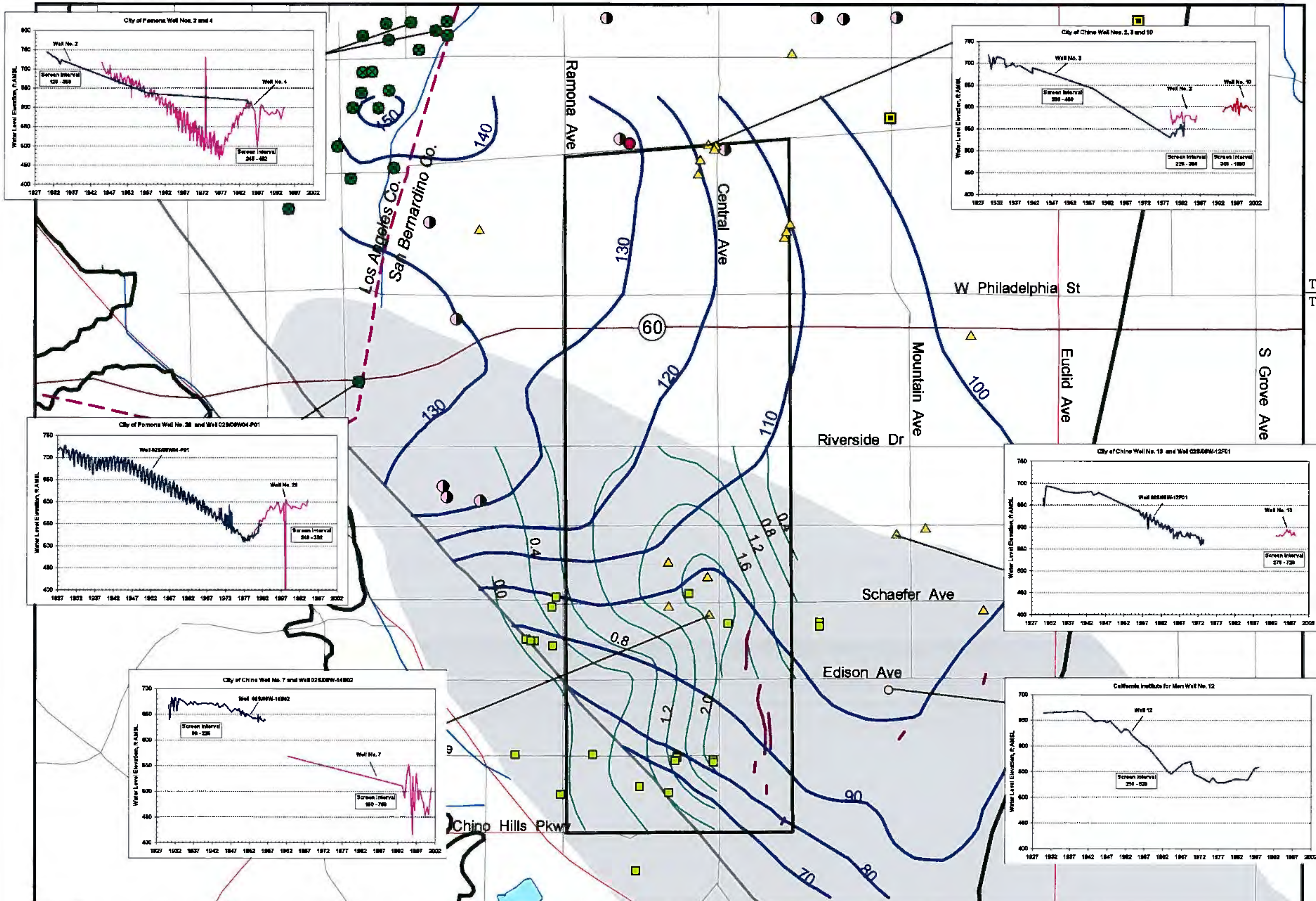
Figure 14

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE
IN THE WESTERN PORTION OF THE CHINO BASIN



DECLINE IN GROUND WATER ELEVATION 1933 - 1989

EXPLANATION

- 120 — Decline in Ground Water Elevation (ft)
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

Other Wells

- California Institute for Men

- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

T.1 S.
T.2 S.

R.8 W. R.7 W.

29-AUG-02

Prepared by: GK

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Hydrograph Data:
Wildermuth Environmental, Inc. (2000)

NORTH

0 2000 4000 Feet

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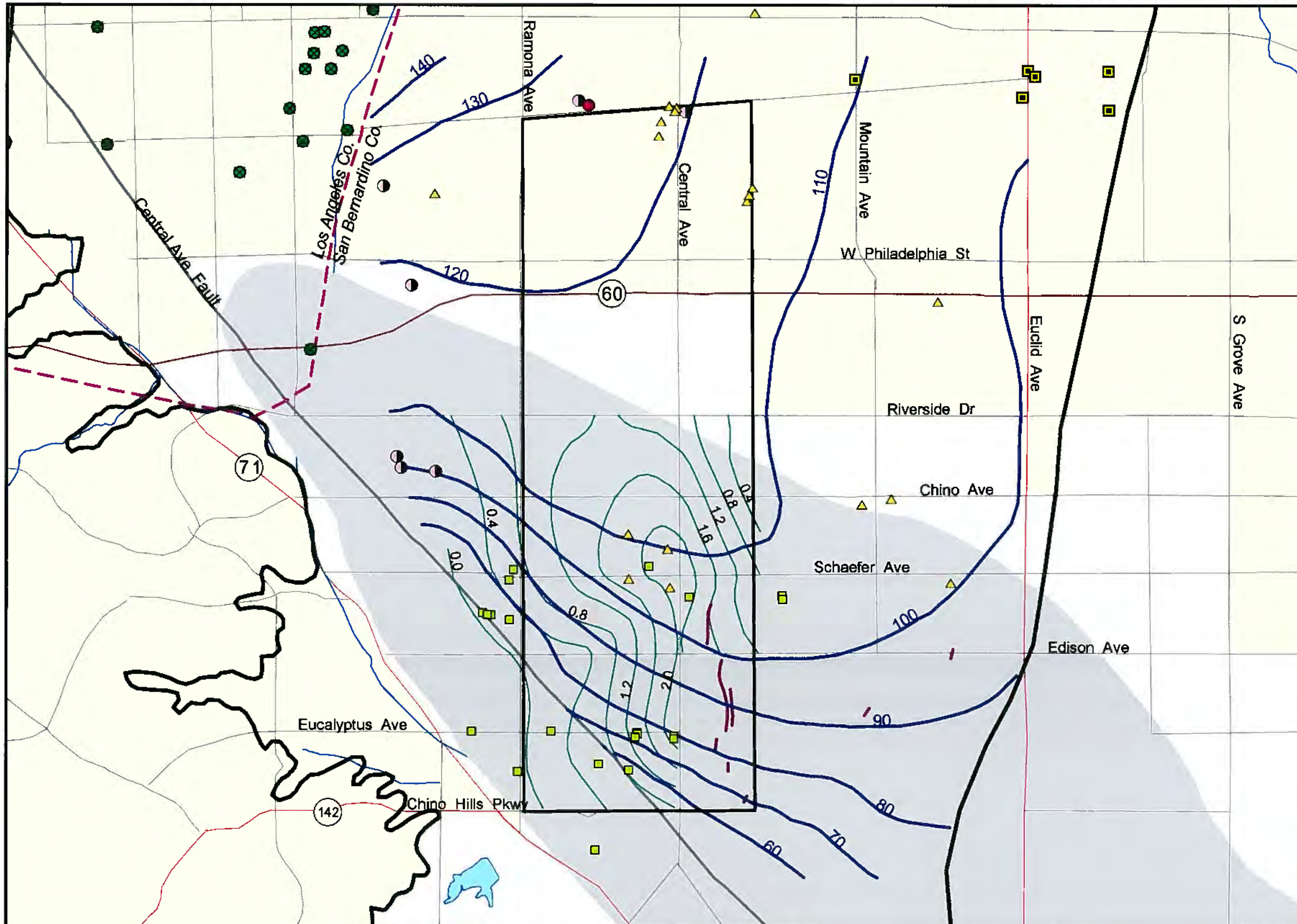
Figure 15

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE
IN THE WESTERN PORTION OF THE CHINO BASIN



DECLINE IN GROUND WATER ELEVATION 1933 - 2000

EXPLANATION

- 120 Decline in Ground Water Elevation (ft)
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

- 0.4 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: GK

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

NORTH

0 2000 4000 Feet

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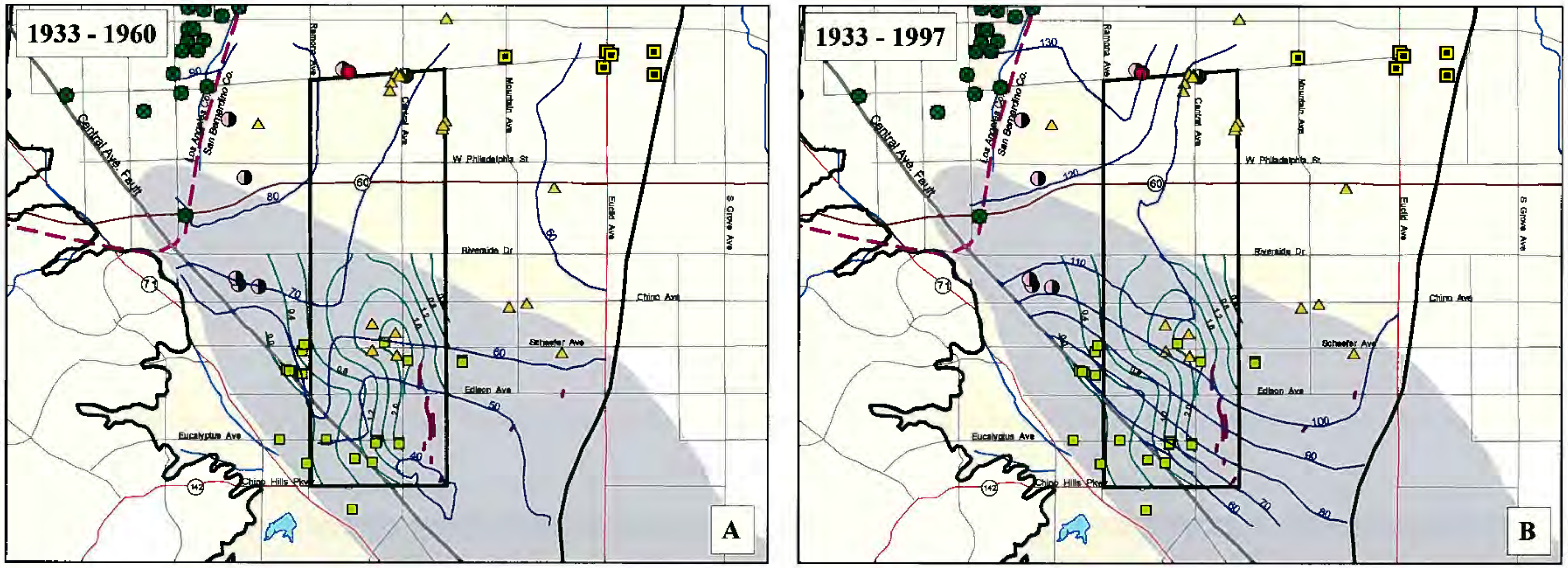
Figure 16

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

DECLINE IN GROUND WATER ELEVATIONS



EXPLANATION

- 120 — Decline in Ground Water Elevation (ft)
- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1
- Area of Historical Artesian Condition Early 1900's

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

NORTH

0 4000 8000 Feet

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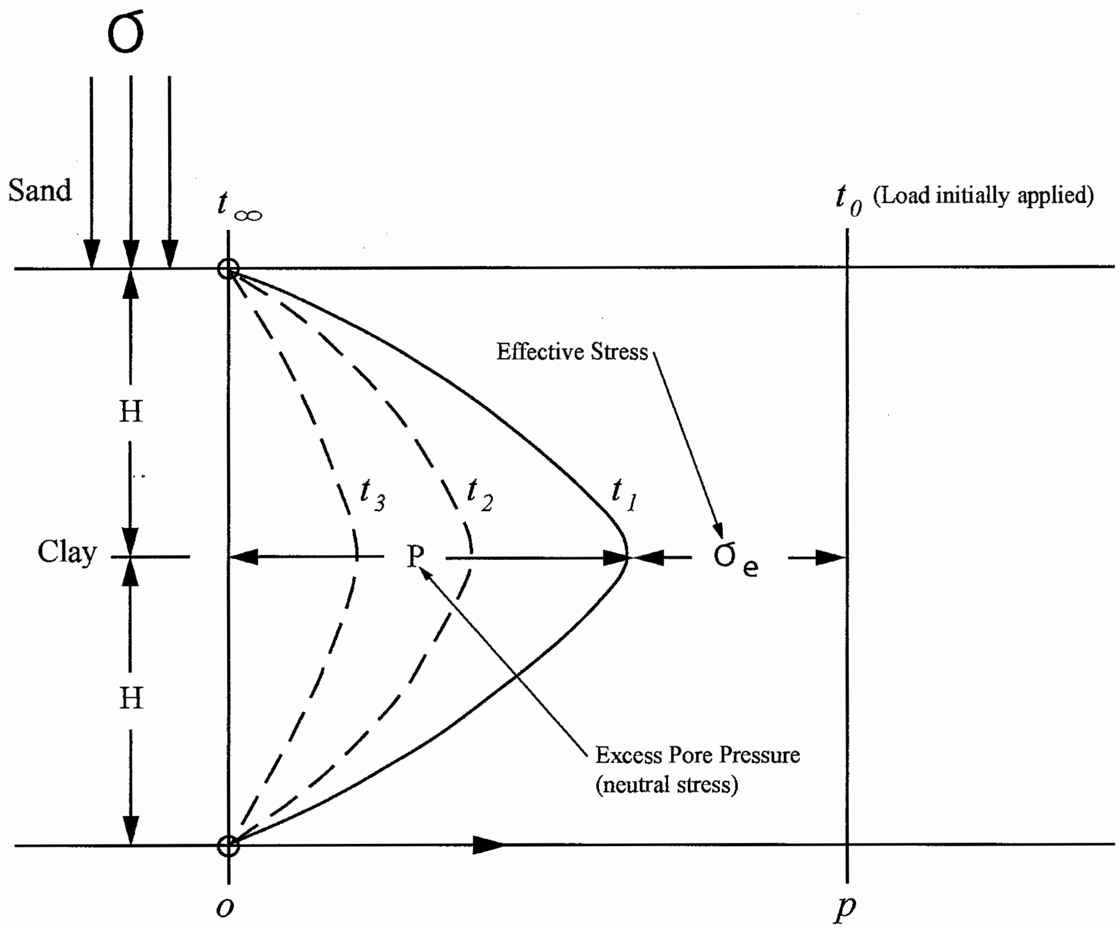
Figure 17



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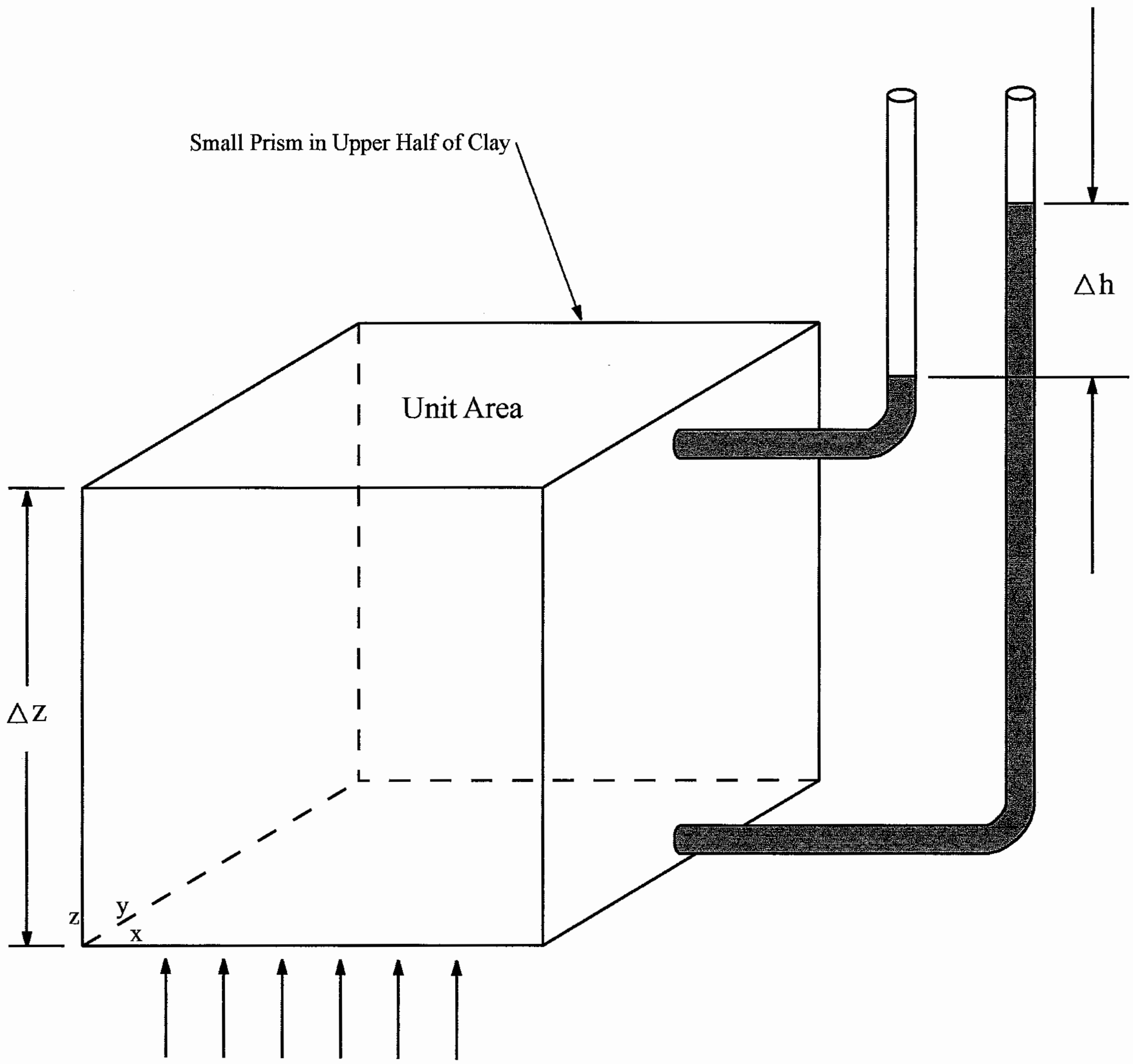
Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 18 - double draining.ai



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GEOSCIENCE	Drawn: PLP	CITY OF CHINO HILLS	Figure
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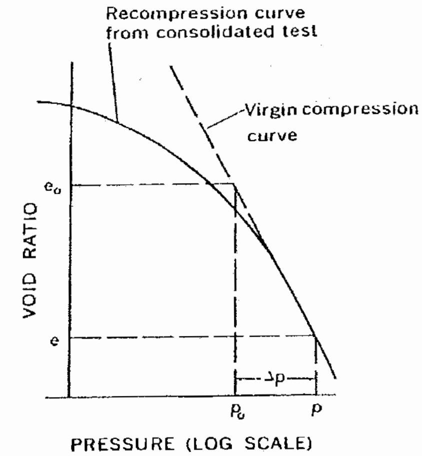
Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 19 - clay prism.ai



The virgin compression curve or the field consolidation curve, for clayey soils, appears on a semilogarithmic diagram as a straight line as shown at left. This line can be represented by the equation

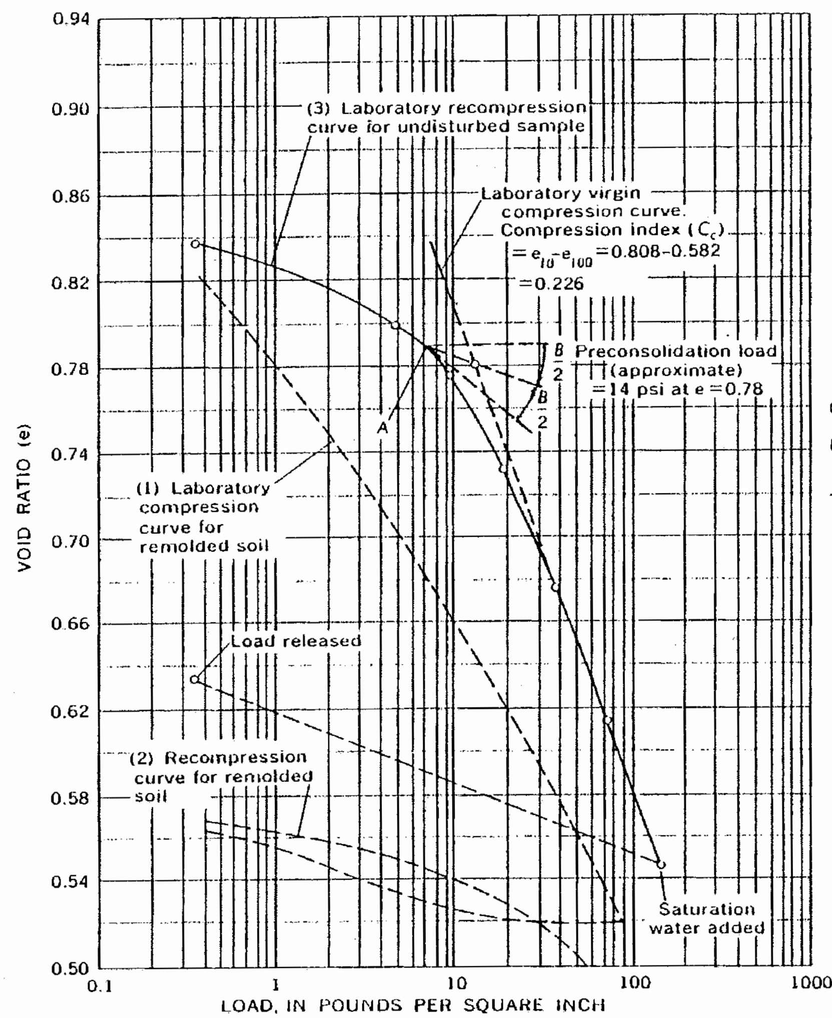
$$e = e_o - C_c \log_{10} \frac{P_o + \Delta P}{P_o}$$

in which C_c (dimensionless) is the compression index

The virgin compression curve is established by extending the straight-line part of the recompression curve. By selecting two points (e_o, p_o) and (e, p) and substituting in the above equation, C_c can be determined

$$C_c = \frac{e_o - e}{\log_{10} \frac{P_o + \Delta P}{P_o}}$$

A. METHOD OF DETERMINING THE COMPRESSION INDEX (C_c)



Graphical determination of preconsolidation load:
Draw tangent and horizontal line to point of maximum curvature (A)
The point of intersection between virgin compression curve and line bisecting angle B, is preconsolidation load and void ratio

B. VOID RATIO-LOAD CURVES AND PRECONSOLIDATION LOAD

Void Ratio - Load Curve

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Source: Johnson, Moston, and Morris, 1975

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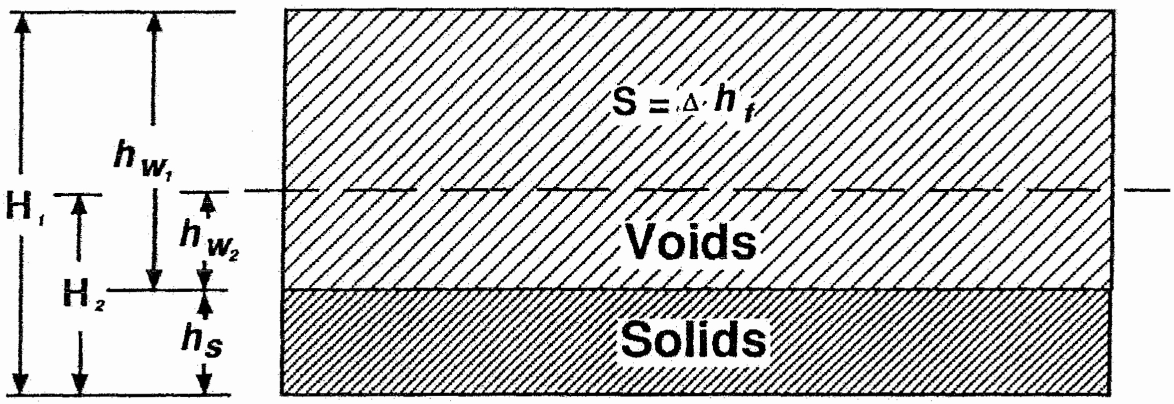
	Checked:	VOID RATIO - LOAD CURVE	
	Approved:		
	Date: 29-AUG-02		JN 12959-02

Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 20 - void ratio.ai



$$S = \frac{h_{w_1} - h_{w_2}}{h_{w_1} + h_s} = \frac{(h_{w_1} / h_s) - (h_{w_2} / h_s)}{(h_{w_1} / h_s) + 1}$$

$$\text{Void Ratio} \quad e = \frac{\text{Vol. Voids}}{\text{Vol. Solids}} = \frac{h_{w_1}}{h_s}$$

$$S = \frac{e_1 - e_2}{1 + e_1} H_1 \quad ; \quad \text{Since } -\Delta e = a_v \Delta p \times 10^{-3}$$

$$S = \frac{-\Delta e}{1 + e_1} H_1 = \frac{a_v \Delta p \times 10^{-3}}{1 + e_1} H_1$$

"Modulus of Volume Change"

$$m = \frac{a_v}{1 + e_1} \quad [cm^2/g]$$

a_v = Compressibility Coefficient (slope of e vs. p curve)

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GEOSCIENCE	Drawn: PLP	CITY OF CHINO HILLS	Figure 21
	Checked:	TOTAL COMPRESSION	
	Approved:		
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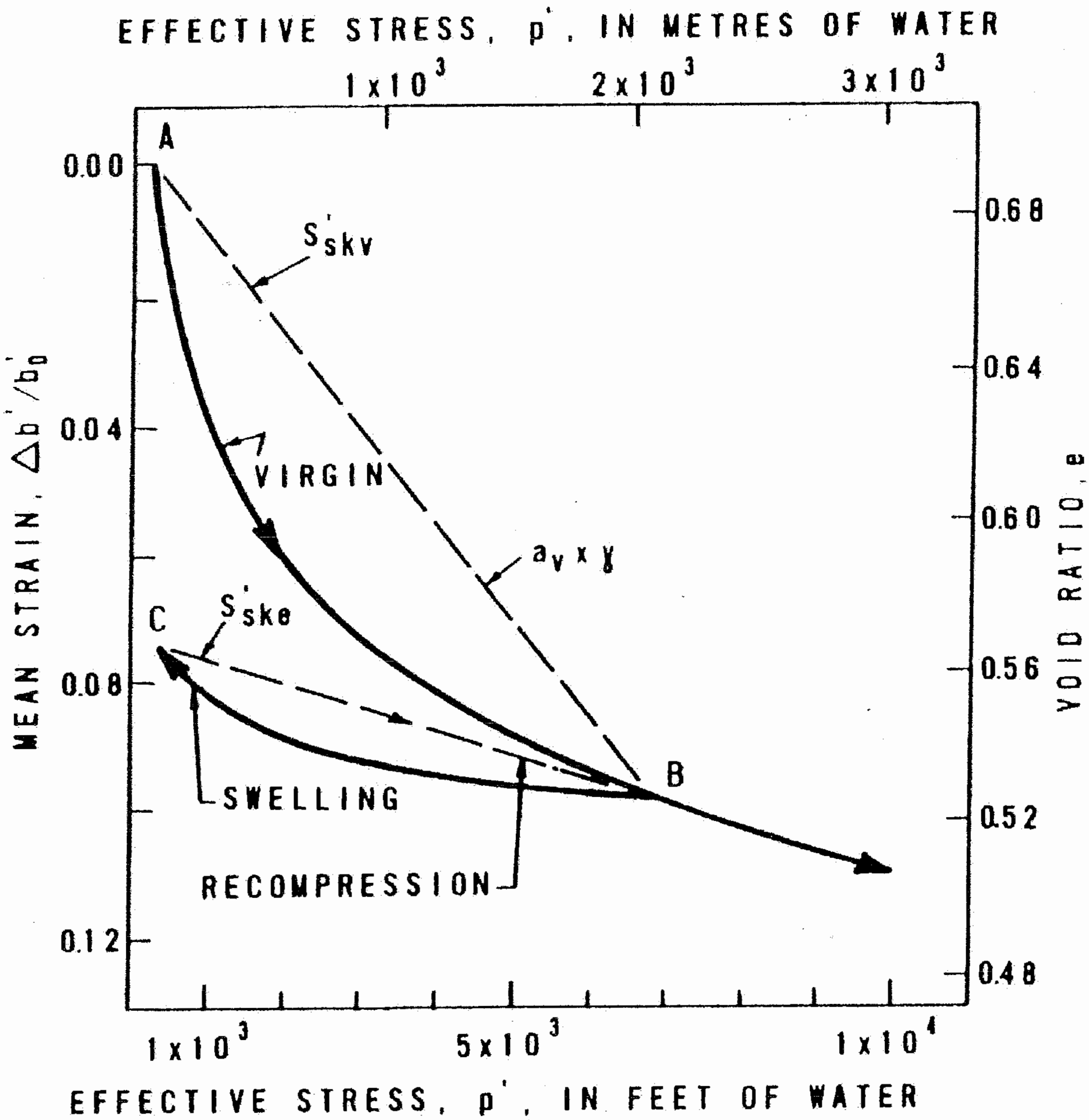
Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 21 - total compression.ai



Stress - Strain Relations

Source: Helm, 1975.

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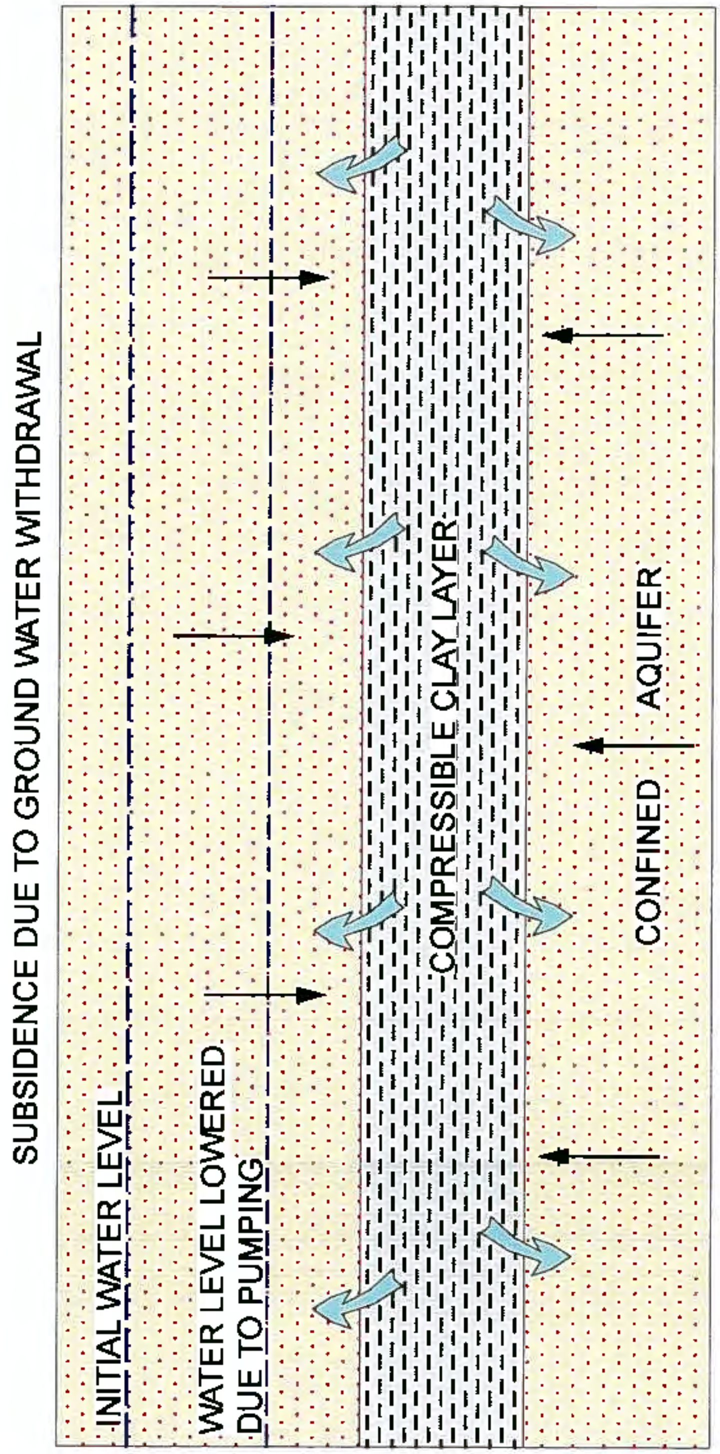
Drawn: PLP	CITY OF CHINO HILLS	Figure 22
Checked:	STRESS - STRAIN RELATIONS	
Approved:		
Date: 29-AUG-02		JN 12959-02



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Checked:
Approved:
Date: 29-AUG-02

CITY OF CHINO HILLS

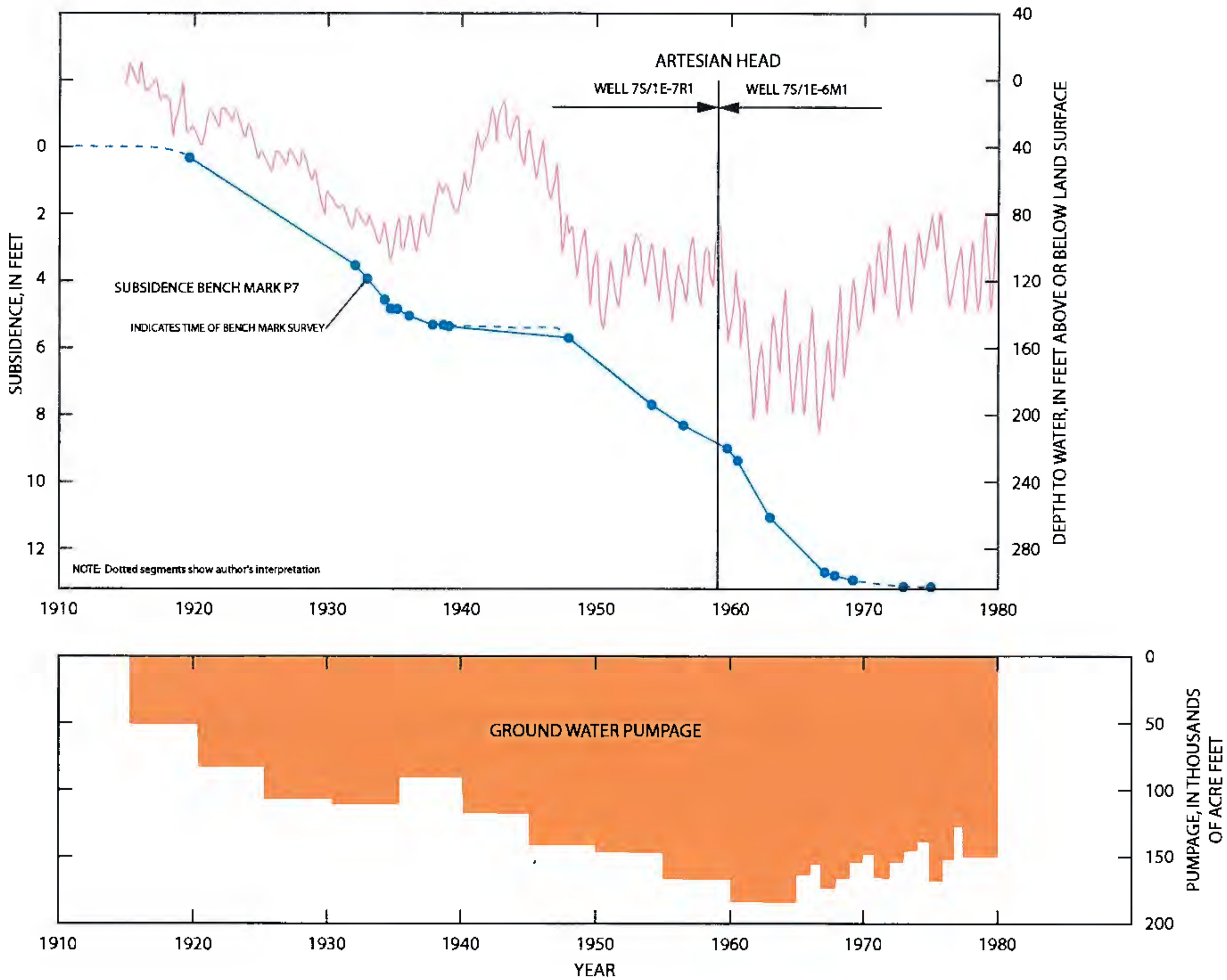
SUBSIDENCE DUE TO
GROUND WATER WITHDRAWAL
DOUBLY DRAINING AQUITARDS THEORY

Figure
23

JN 12959-02

Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 23 - aquitard.ai

ARTESIAN-HEAD CHANGE, PUMPAGE AND LAND SUBSIDENCE, SAN JOSE



SOURCE: Poland and Ireland, 1988

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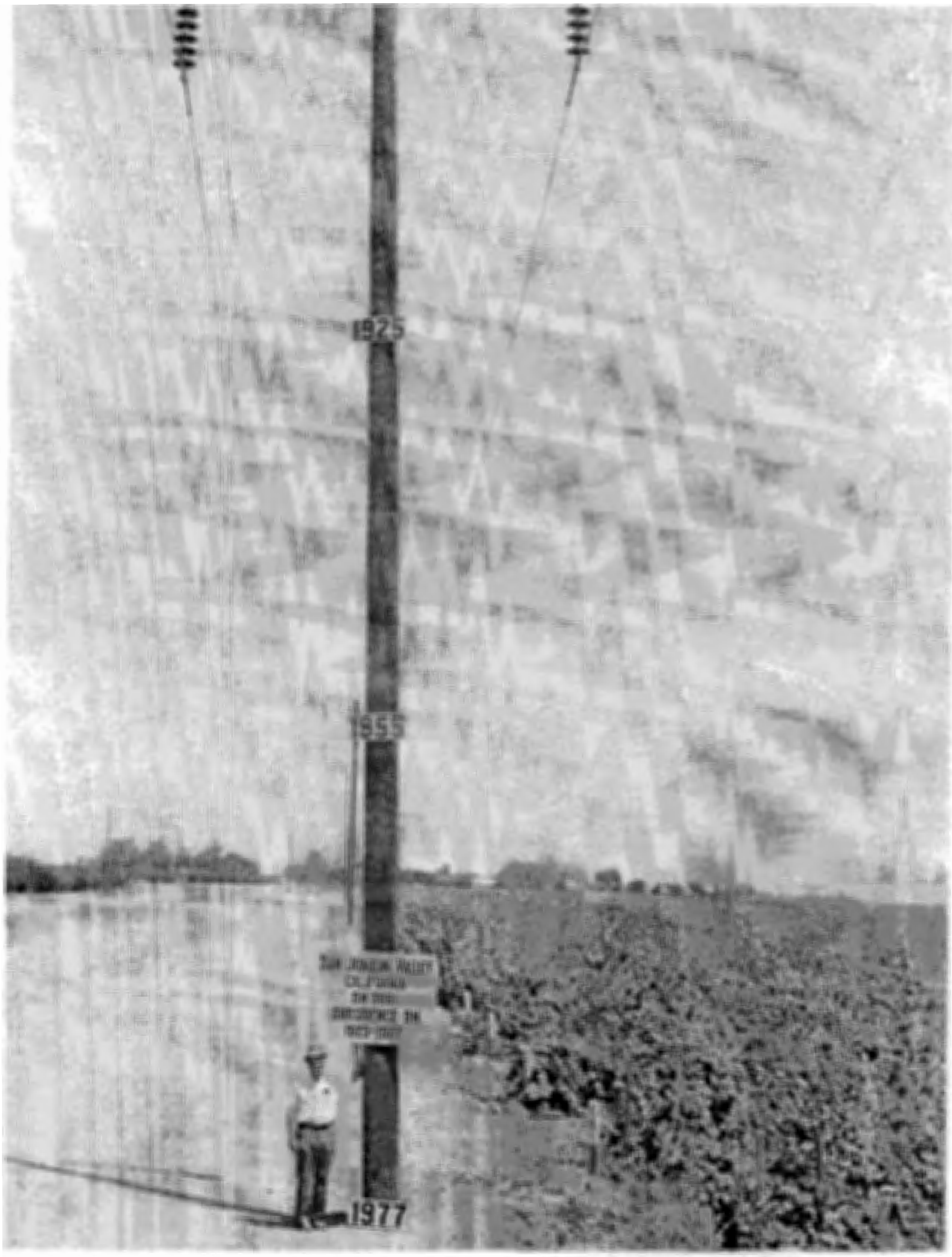
CITY OF CHINO HILLS

ARTESIAN-HEAD CHANGE, PUMPAGE AND LAND SUBSIDENCE SAN JOSE, CALIFORNIA

Figure 24

Drawn: PLP
Checked:
Approved:
Date: 29-AUG-02
JN 12959-02



Magnitude of subsidence at a site 10 mi southwest of Mendota in the San Joaquin Valley, Calif. Joseph F. Poland, principal subsidence researcher and coauthor of report, stands alongside a power pole which shows the approximate position of land surface in 1925, 1955, and 1977. Land surface was lowered about 9 m during that period.

Source: Ireland, et.al., 1984

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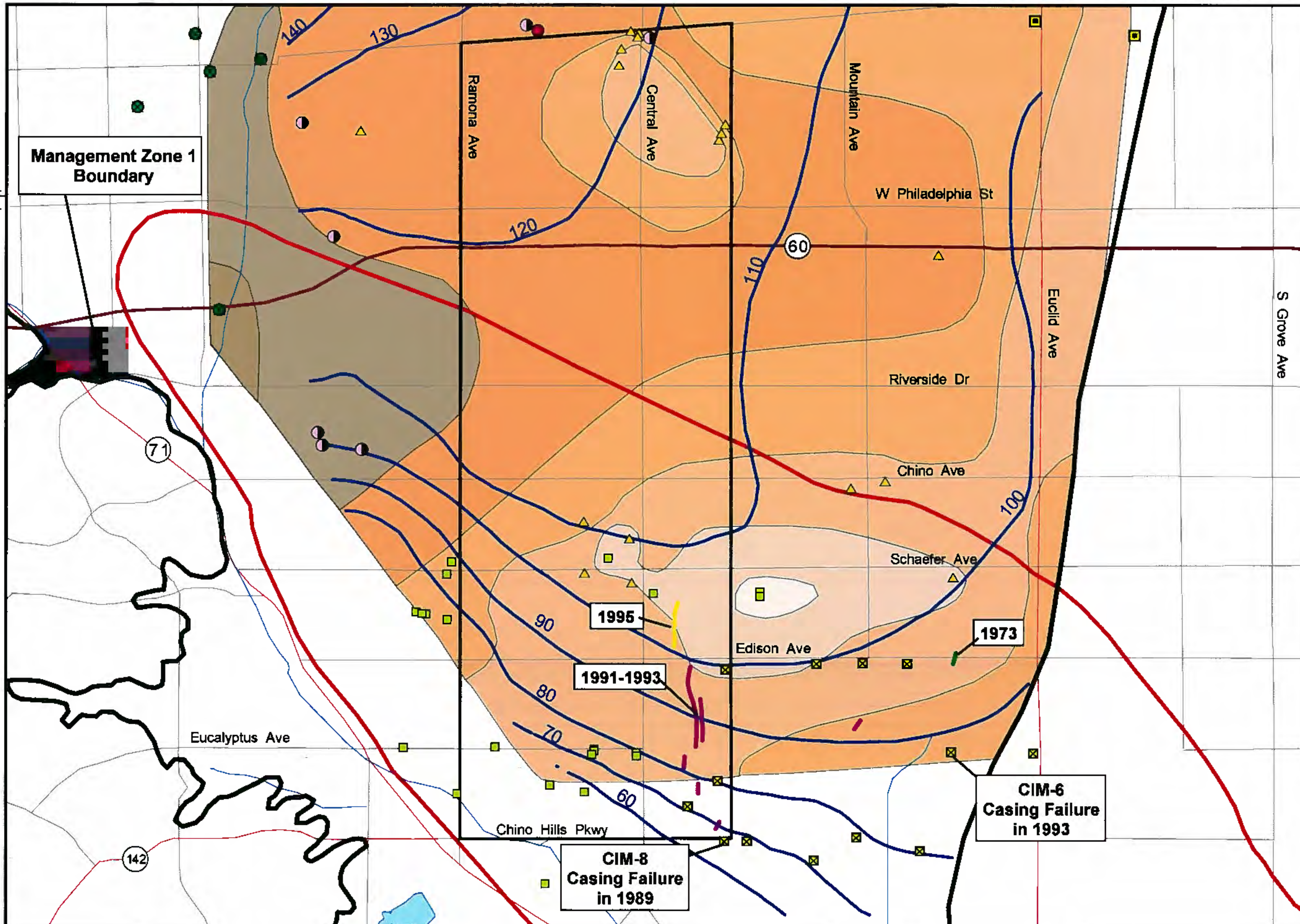
Projects\City_of_Chino_Hills\Subsidence\03) Geohydrologic Report\29-Aug-02 DRAFT\Figures\Final_Figures\fig 25 - subsidence photograph.ai

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE
IN THE WESTERN PORTION OF THE CHINO BASIN



LOCATION OF GROUND FISSURES AND CASING FAILURE WELLS

EXPLANATION

Ground Fissure
- 1973
- 1991-1993
- 1995

100 Decline in Ground Water Elevation (ft) 1933 to Fall 2000

Percent of Total Alluvial Thickness Comprised of Clay
- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90

Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)

Management Zone 1 Boundary

Area of Historical Artesian Condition Early 1900's

Ground Fissure

County Boundary

Well Classification
- California Institution for Men
- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

Road Classifications
- Freeway
- State Highway
- Street
- Body of Water
- River

R.8 W. | R.7 W.

29-AUG-02

Prepared by: DWB

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Source of Ground Fissures and Casing Failure Wells:
Geomatrix (1994) and Kleinfelder (1996).

NORTH

0 2000 4000 Feet

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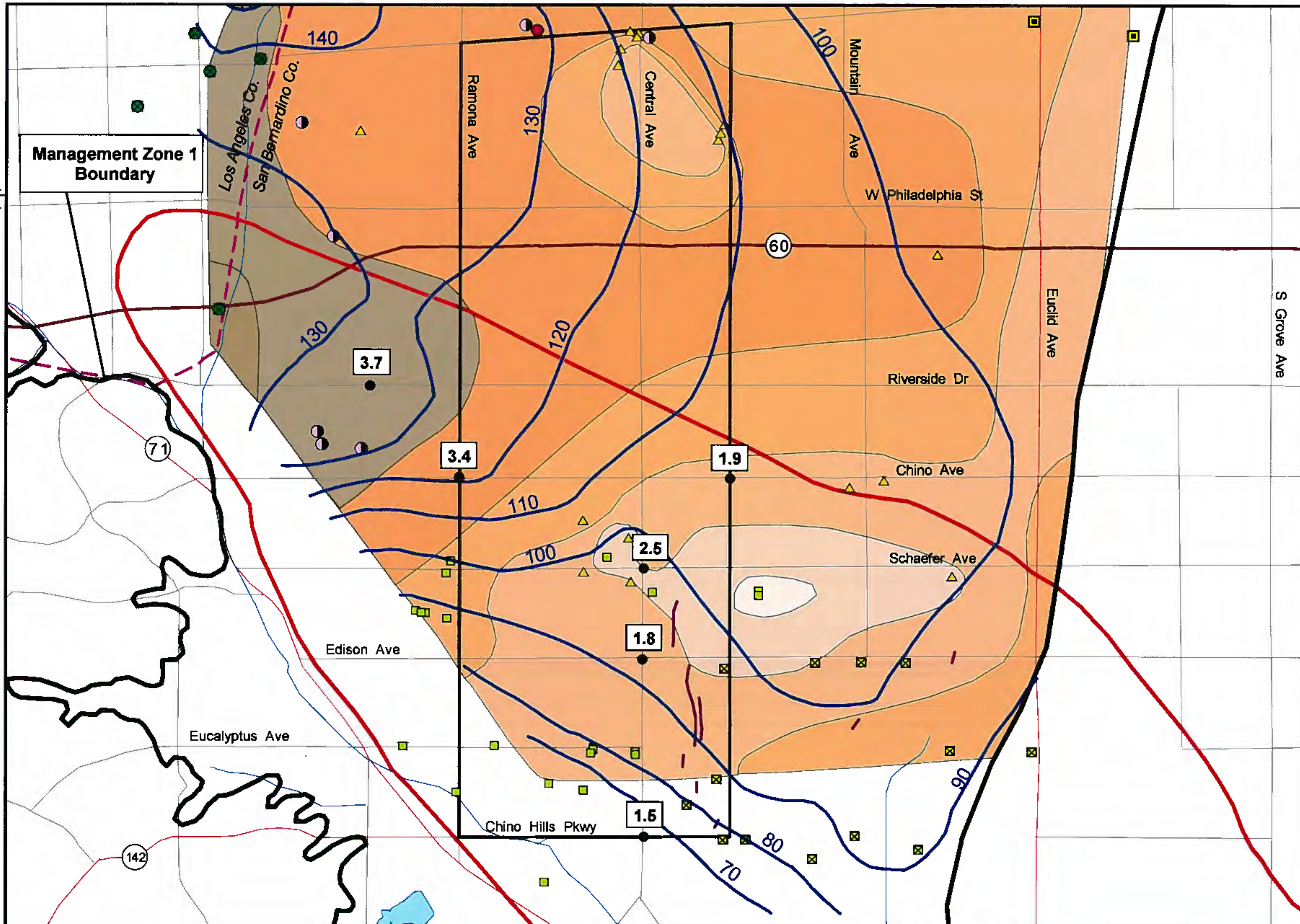
Figure 26

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN



LAND SUBSIDENCE 1933 TO 1987

EXPLANATION

- 120 — Decline in Ground Water Elevation (ft) 1933 to Fall 1989
- 1.9 — Measured Land Subsidence (ft) between 1933 to 1987
- Surveyed Benchmark Location

Percent of Total Alluvial Thickness Comprised of Clay

- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90

- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1 Boundary
- Area of Historical Artesian Condition Early 1900's

Well Classification

- California Institution for Men
- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company
- Ground Fissure
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: DWB

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Benchmark Elevations from: USGS 7 1/2 Minute Ontario (1981) and Prado Dam (1981) Quadrangles; USGS, Personal Communication (2002); and Kleinfelder (1999).

NORTH

0 2000 4000 Feet

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Figure 27

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

Deep Well Pumping vs. Subsidence - Cities of Chino and Chino Hills

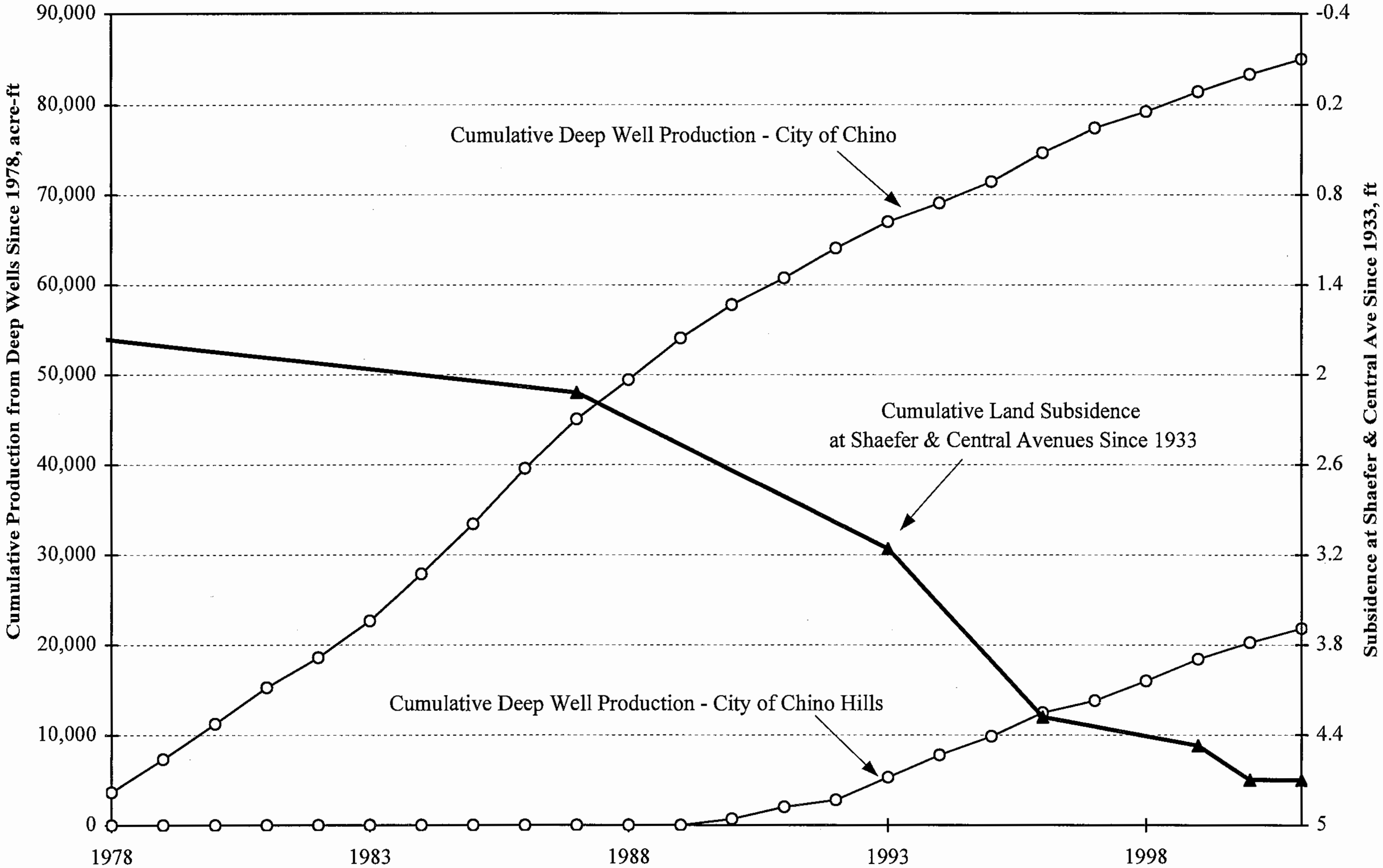


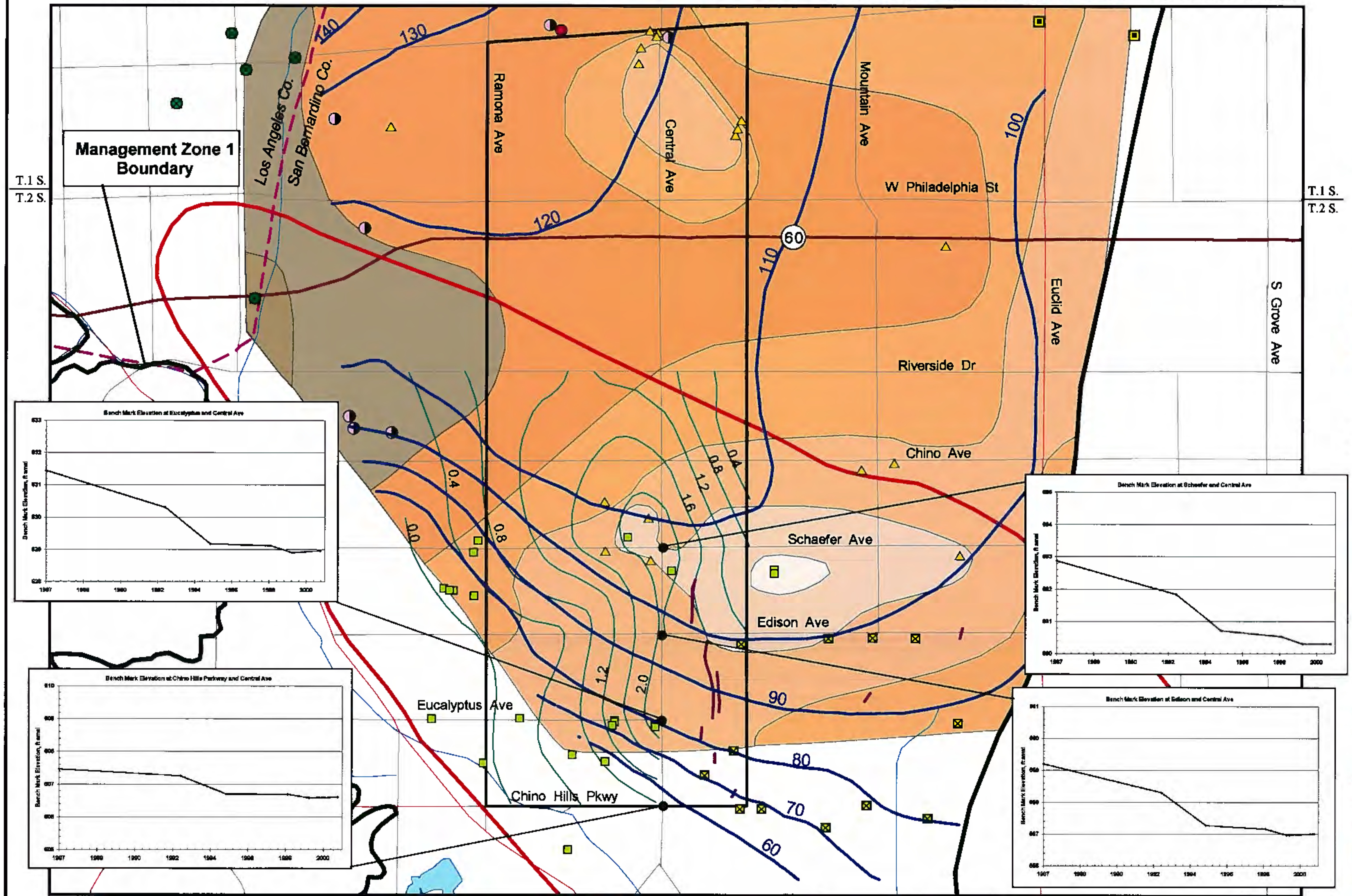
Figure 28

Sources: Kleinfelder, 1999; GeoPentech, 2002; CBWM, 2002; and USGS topographic map (USGS, personal communication, 2002)

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN

LAND SUBSIDENCE 1987 TO 2001



EXPLANATION

- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- 120 — Decline in Ground Water Elevation (ft) 1933 to Fall 2000
- Surveyed Benchmark Location

Percent of Total Alluvial Thickness Comprised of Clay

- 20-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90

- Area of Greatest Subsidence Concern (Chino Basin Watermaster, 2002)
- Management Zone 1 Boundary
- Area of Historical Artesian Condition Early 1900's

Well Classification

- California Institution for Men
- City of Chino
- City of Chino Hills
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company
- Ground Fissure
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

29-AUG-02

Prepared by: DWB

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

Subsidence Data from: Kleinfelder (1999) and GeoPentech (2002).

NORTH

0 2000 4000 Feet

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Figure 29

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

Subsidence vs. Deep Well Pumping - Wells CH-1B, CH-15B, CH-17, CH-19 and C-7

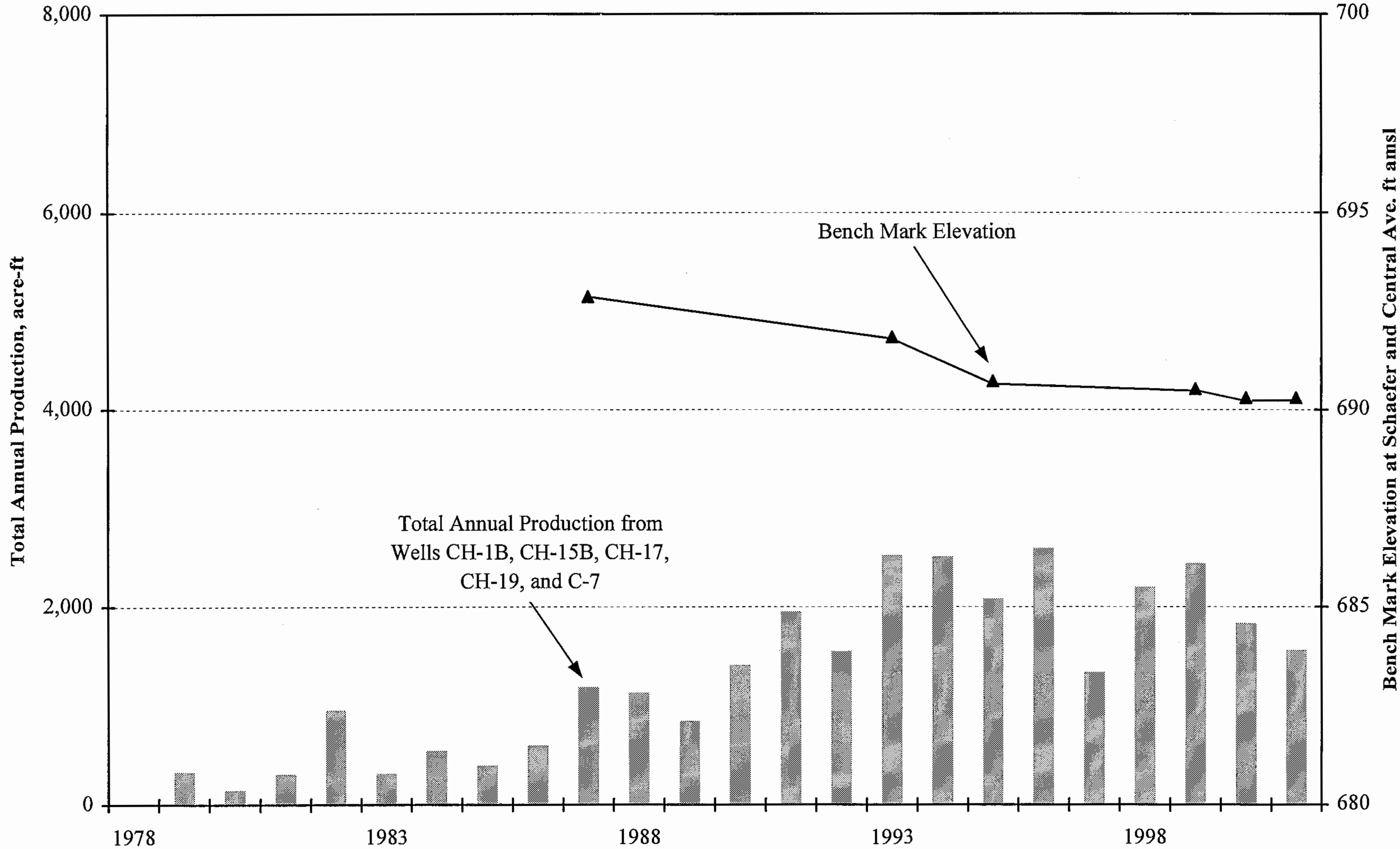
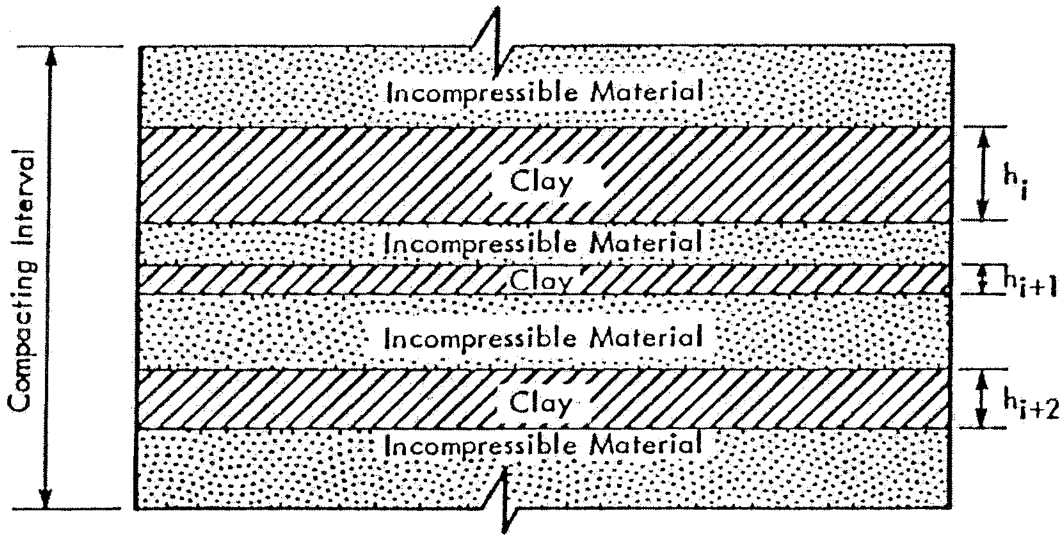


Figure 30

Sources - Kleinfelder, 1999; GeoPentech, 2002 and, CBWM, 2002

SOIL STRATIGRAPHY



Where:

h_i = Individual clay layer thickness

N = Number of clay layers in a compacting interval

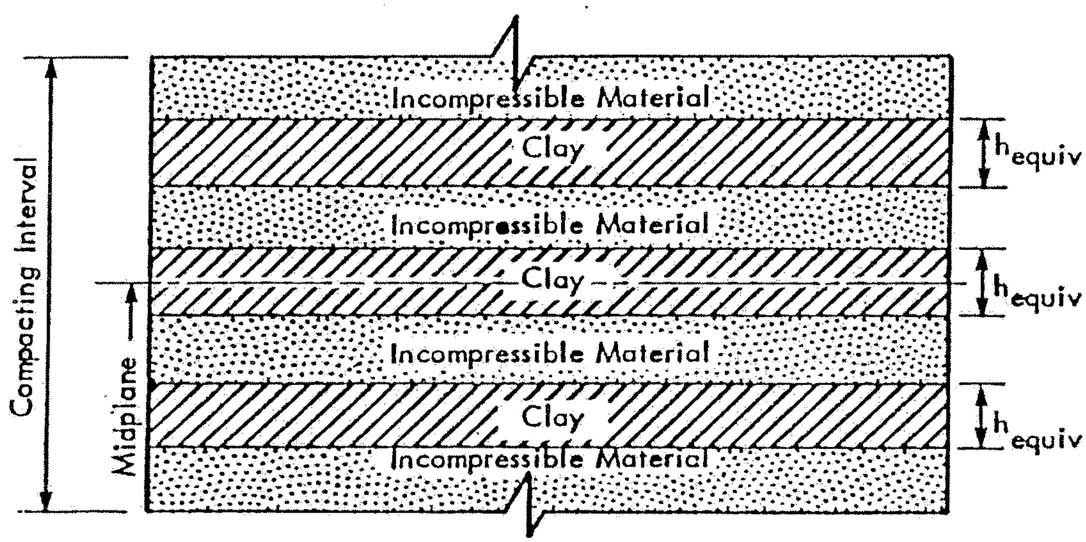
ho_{sum} = Sum of the individual clay layer thicknesses

h_{equiv} = Equivalent clay layer thickness

N_{equiv} = Equivalent number of clay layers in a compacting interval

$$h_{equiv} = 2 \left[\sum_{i=1}^{N} (h_i/2)^2 / N \right]^{1/2} \quad \text{and} \quad N_{equiv} = ho_{sum} / h_{equiv}$$

EQUIVALENT SOIL STRATIGRAPHY

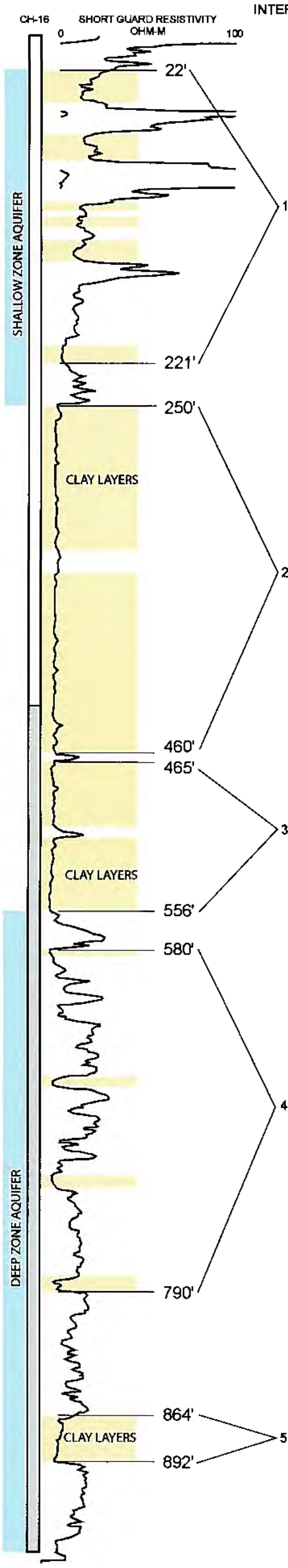


Equivalent Layer Concept Used in the PRESS Model

Source: Espey, Huston and Assos. Inc., 1979

DRAFT

GEOSCIENCE	Drawn: PLP	CITY OF CHINO HILLS	Figure 31
GEOSCIENCE Support Services, Incorporated P.O. Box 220, Claremont, CA 91711 Tel: (909)920-0707 Fax: (909)920-0403 E-mail: email@geoscience-water.com	Checked: Approved: Date: 29-AUG-02	EQUIVALENT LAYER CONCEPT USED IN THE PRESS MODEL	JN 12959-02



COMPACTION INTERVAL	TOTAL THICKNESS OF CLAY LAYERS, ft	THICKNESS OF EQUIVALENT CLAY LAYER, ft	VERTICAL HYDRAULIC CONDUCTIVITY ft/yr	VIRGIN COMPRESSIBILITY 1/ft	ELASTIC COMPRESSIBILITY 1/ft
1	72.0	12.0	1.39×10^{-3}	1.25×10^{-4}	1.31×10^{-5}
2	197.8	98.9	1.07×10^{-3}	3.55×10^{-4}	1.58×10^{-5}
3	85.2	42.6	6.81×10^{-4}	2.96×10^{-4}	1.51×10^{-5}
4	32.8	8.2	1.22×10^{-3}	1.16×10^{-4}	1.43×10^{-5}
5	28.0	28.0	1.45×10^{-3}	1.16×10^{-4}	1.37×10^{-5}

DRAFT

Figure 32	Drawn: PLP	CITY OF CHINO HILLS	GEOSCIENCE
	Checked:	IDEALIZED LITHOLOGIC LOG AT THE INTERSECTION OF RIVERSIDE DR. AND PIPELINE AVE.	
	Approved:		
JN 12959-02	Date: 29-AUG-02		

GEOSCIENCE Support Services, Incorporated
P.O. Box 220, Claremont, CA 91711
Tel: (909)920-0707 Fax: (909)920-0403
E-mail: email@geoscience-water.com

Drawdown Loading Function at Intersection of Riverside Dr. and Pipeline Ave.

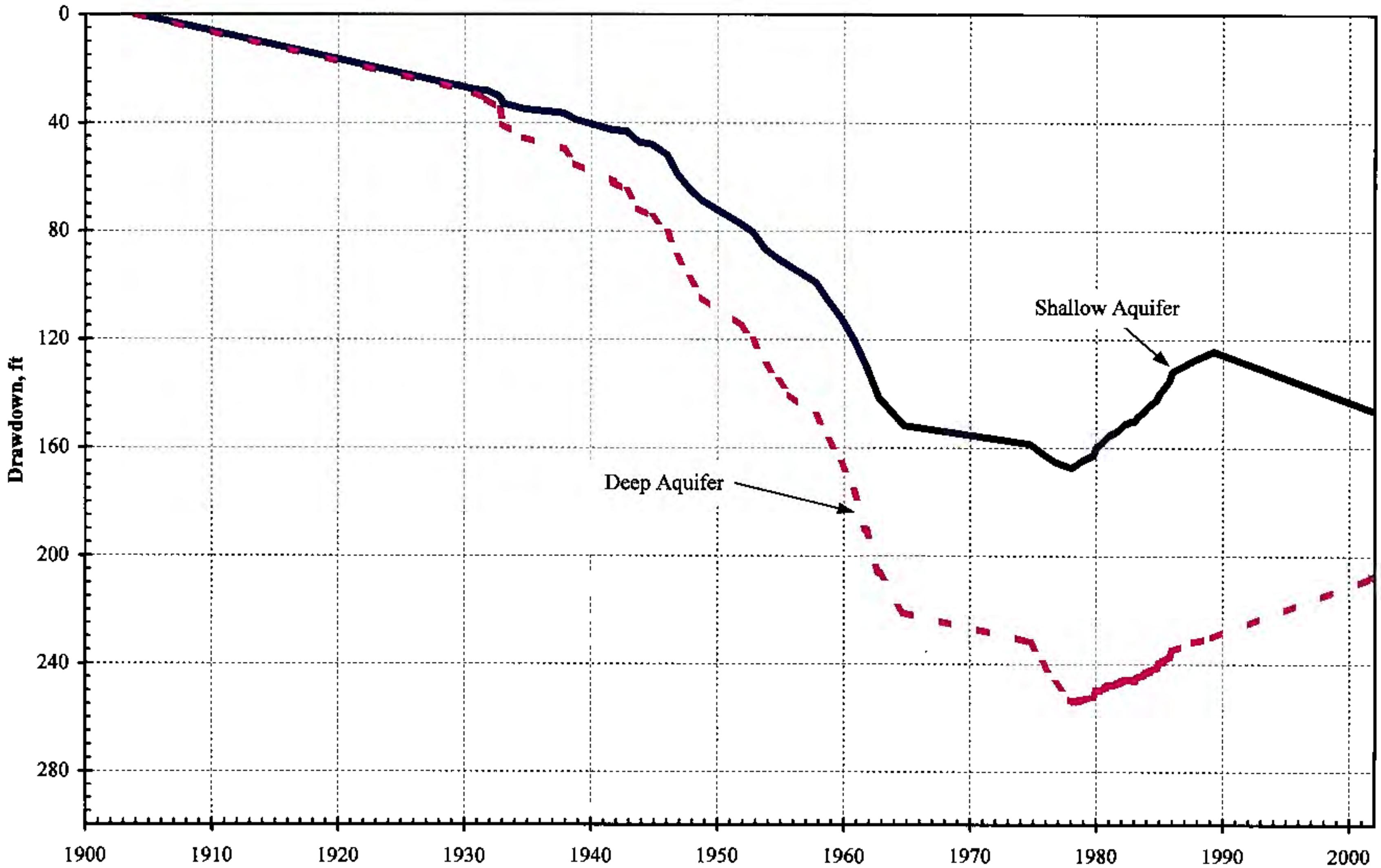


Figure 33

Sources of Data: Geomatrix, 1994; TIN/TDS; WMWD

Subsidence Calibration - Intersection of Riverside Dr. and Pipeline Ave.

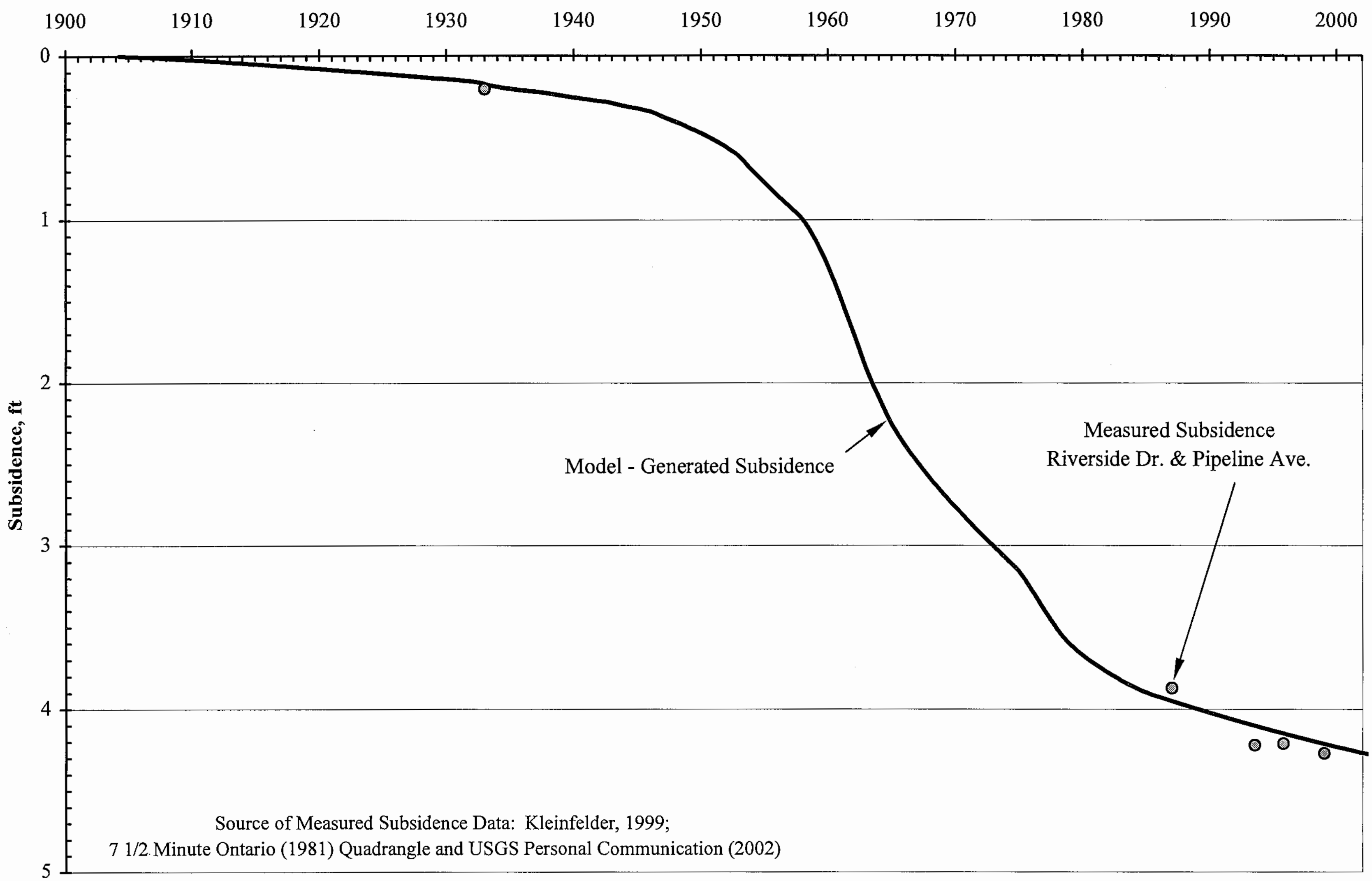


Figure 34

Subsidence Prediction - Intersection of Riverside Dr. and Pipeline Ave.

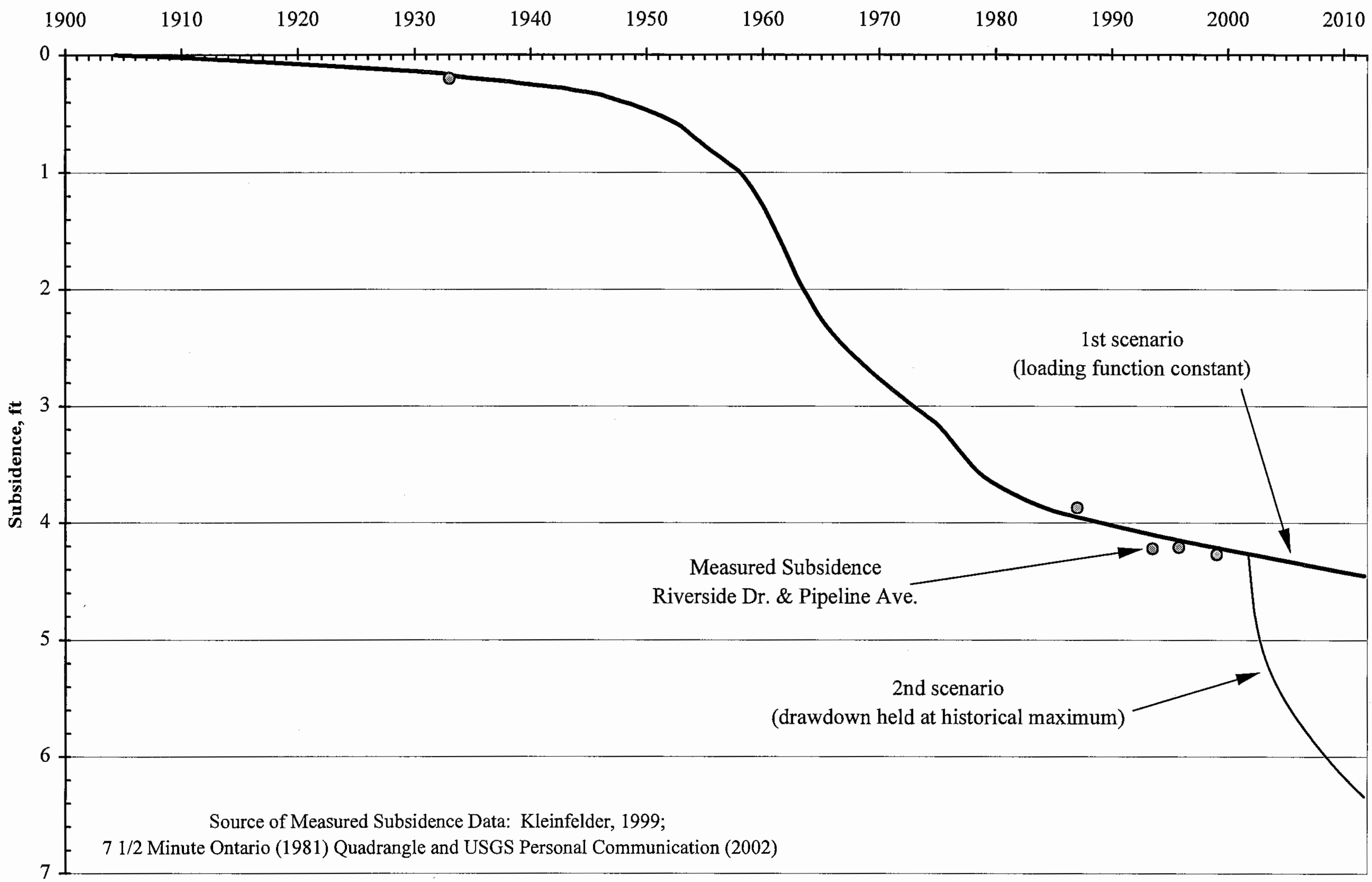
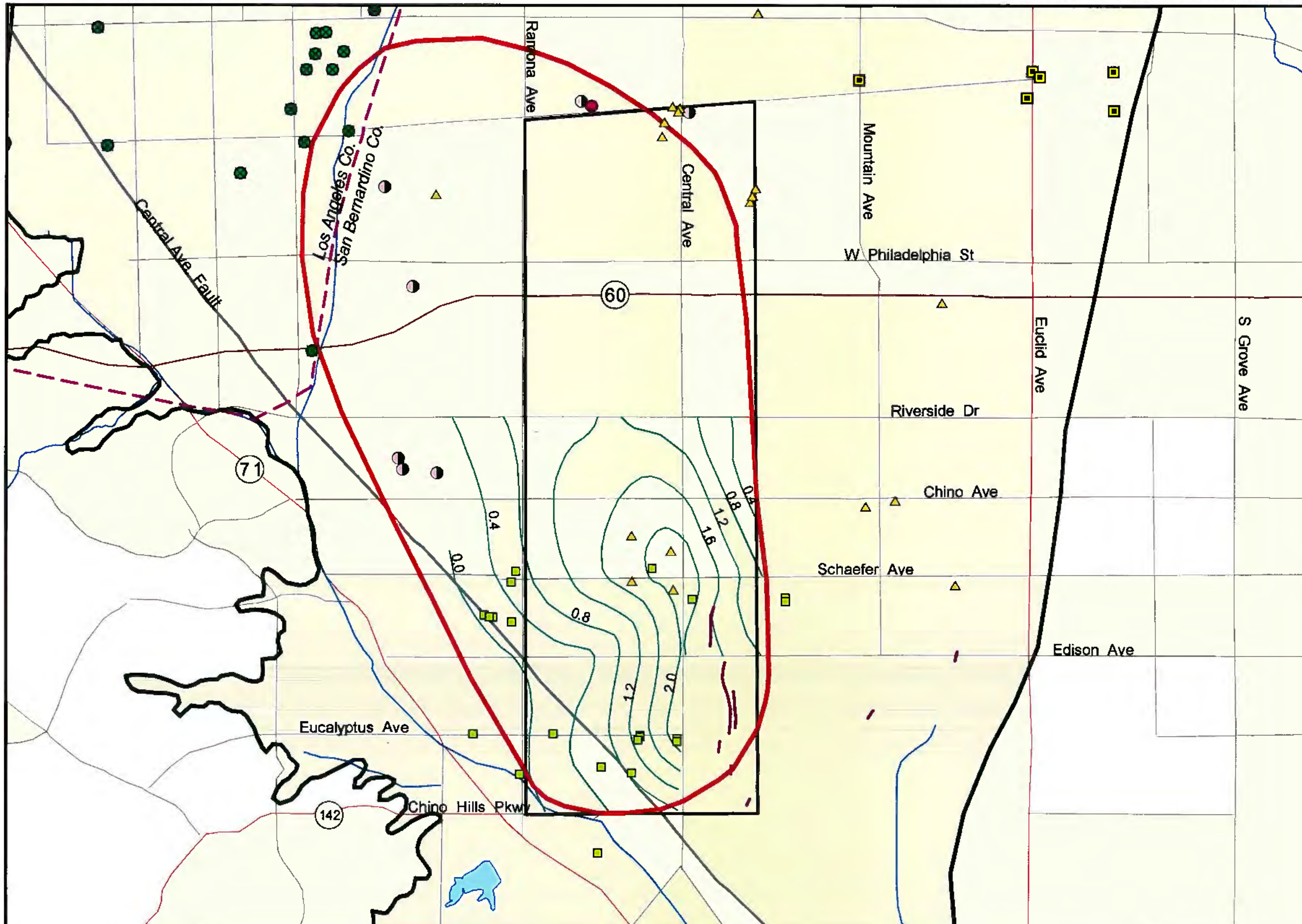


Figure 35

CITY OF CHINO HILLS

PRELIMINARY GEOHYDROLOGIC ANALYSIS OF SUBSIDENCE IN THE WESTERN PORTION OF THE CHINO BASIN



T.1 S.
T.2 S.

R.8 W. | R.7 W.

AREA OF GREATEST SUBSIDENCE CONCERN GEOSCIENCE 2002

EXPLANATION

- Area of Greatest Subsidence Concern (GEOSCIENCE, 2002)
- Area of Greatest Subsidence Concern (Chino Basin Water Master, 2002)
- Management Zone 1

Municipal Wells

- City of Chino Hills
- City of Chino
- City of Ontario
- City of Pomona
- Monte Vista Water District
- Southern California Water Company

- 0.4 — 1987-1999 Land Subsidence Contours (ft) (Kleinfelder, 1999)
- Ground Fissure
- Central Ave. Fault
- County Boundary

Road Classifications

- Freeway
- State Highway
- Street
- Body of Water
- River

Map Projection:
UTM 1927 (Zone 11)
Central Meridian: -117 degrees

NORTH

0 2000 4000 Feet

DRAFT

29-AUG-02

Prepared by: GK

GEOSCIENCE

GEOSCIENCE Support Services, Inc.
P.O. Box 220, Claremont, CA 91711
Tel: (909) 920-0707 Fax: (909) 920-0403
E-mail: email@geoscience-water.com

Figure 36

Projects\City_of_Chino_Hills\Subsidence\GK_GIS\rpt_figs_gk.apr

APPENDIX A

Well Logs

DRAFT

GEOSCIENCE Support Services, Inc.

015/08W-35C01S

~~D740~~ **Appendix A**

FORM 115 INVESTIGATION South Coastal Basin

DIVISION OF WATER RESOURCES

DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

SHEET 1

NUMBER D740a

WELL LOG

LOCAL DESIGNATION

17605
Loc. ~~#176050~~

LOCATION 600' south and 500' west from intersection of Franklin and Central Aves., north of Chino.

OWNER City of Chino

DATE COMPLETED 10-22-29

DIAMETER OF CASING 16"

DRILLED BY Chas. York

SOURCE OF INFORMATION "

INSPECTED WHILE DRILLING No SEE FILE NO.

SURFACE ELEVATION 885 or 881 ?

SKETCH

Water Analysis
17605

DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL		THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
1-6		Dry gravel	g	6			
6-11		Clay	c	5			
11-70		Dry gravel	g	39+20			
70-146		Clay	c	30+46			
146-159		Dry gravel	g	4+9			
159-230		Clay	c	41+30			
230-245		Good water gravel	g PERF	15			
245-278		Clay	c	5+28			
278-300		Fine water gravel	g "	22			
300-330		Hard clay	c	30			
330-344		Fine gravel and clay	gc	14			
344-379		Clay	c	6+29			
379-383		Coarse gravel	g	4			
383-393		Hard clay	c	10			
393-396		Good gravel	g "	3			
396-414		Clay	c	4+14			
414-418		Good gravel	g "	4			
418-428		Clay	c	10			
428-435		Good coarse gravel	g "	7			
435-443		Clay	c	8			
443-450		Good coarse gravel	g "	7			
450-453	432	Clay	c	3			

Water level 160'
Pumps 125"

MICROFILMED

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE

Appendix A

Do not fil

ORIGINAL
with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

No. 269796

Intent No. ______
Permit No. or Date 5-16-88

State Well No. ______
Other Well No. ______

(1) OWNER: Name San Bernardino County
Address Waterworks Dist. No. 8
City 14575 Pipeline Ave., Chino, Calif. ZIP 91709

(2) LOCATION OF WELL (See instructions) Broadfoot #8
County San Bernardino Owner's Well Number #8
Well address if different from above ______
Township 2S Range 8W Section 23
Distance from cities, roads, railroads, fences, etc. apprx. N.W. corner of Central and Eucalyptus in Chino

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 8 x 16
Diameter of bore 30
Packed from 380 to 1230 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	100	34	.375	440	470	.040
0	1200	18"	3/8	490	610	
				720	900 and	
				940 to 1180 ft.		

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 380 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 380 ft.
Method of sealing 6 sack grout

(10) WATER LEVELS:
Depth of first water, if known 181 ft.
Standing level after well completion 181 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 181 ft. At end of test 181 ft.
Discharge 1200 gal/min after 36 hours Water temperature ______
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? ______
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1230 ft. Completed depth 1200

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	110 ft.	clay
110	140 ft.	gravel and clay
140	150 ft.	clay
150	200 ft.	rocks and gravel
200	210 ft.	clay and gravel
210	250 ft.	gravel & small rock
250	380 ft.	clay
380	410 ft.	clay and gravel
410	430 ft.	clay
430	470 ft.	gravel and clay
470	490 ft.	hard clay
490	530 ft.	clay, gravel
530	550 ft.	clay
550	600 ft.	clay, some gravel
600	620 ft.	clay, fine gravel
620	640 ft.	firm clay
640	660 ft.	clay, fine gravel
660	690 ft.	clay
690	700 ft.	clay, sandy gravel
700	710 ft.	rocky clay
710	730 ft.	clay/gravel
730	760 ft.	gravel
760	770 ft.	gravel, hard clay
770	790 ft.	gravel and clay
790	820 ft.	clay, gravel and rock
820	840 ft.	gravel
840	860 ft.	clay
860	888 ft.	rock and gravel
888	900 ft.	rock and gravel
900	920 ft.	clay, med rock
920	930 ft.	clay
930	950 ft.	gravel with some clay
950	990 ft.	gravel, clay and rock
990	1000 ft.	clay/gravel
1000	1030 ft.	clay very little rock
1030	1040 ft.	clay
1040	1070 ft.	gravel with little clay

continued on next page #296797

Work started June 1, 1988 Completed July 8,

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed [signature] (Well Driller)
NAME BEYLIK DRILLING, INC. (Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, Calif ZIP 90631
License No. 306291C57 & -C61 Date of this report Jly 21

COMPANY ID NOT FOR PUBLIC ... WATER

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DWR 188 (REV. 12-86)

This is page 1 of two pages -see also #2

ORIGINAL
F[illegible] with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

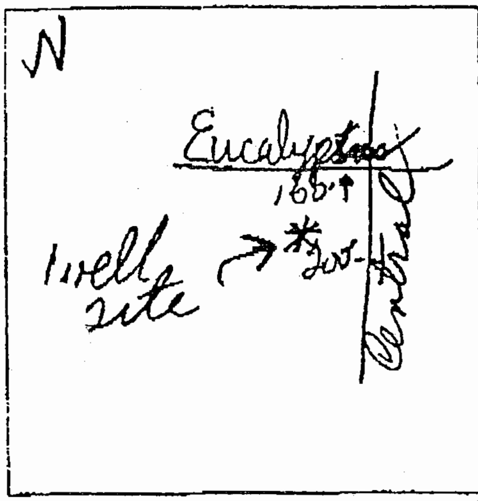
No. 269797

Notice of Intent No. ____
Local Permit No. or Date 5/16/88

State Well No. ____
Other Well No. ____

(1) OWNER: Name San Bernardino County
Address Waterworks Dist. No. 8
City 14575 Pipeline Ave., Chino, Calif ZIP 91709

(2) LOCATION OF WELL (See instructions): Broadfoot
County San Bernardino Owner's Well Number #8
Well address if different from above ____
Township 2S Range 8W Section 23
Distance from cities, roads, railroads, fences, etc. apprx.
N.W. corner of Central and Eucalyptus
in Chino



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☒
Industrial ☐
Test Well ☐
Municipal ☒
Other ☒
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 8 x 16
Diameter of bore 30
Packed from 380 to 1230 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	100	34	.375	440	470	.040
0	1200	18"	3/8	490	610	
				720	900 and	

940 to 1180 ft.

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 380 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 380 ft.
Method of sealing 6 sack grout

(10) WATER LEVELS:
Depth of first water, if known 181 ft.
Standing level after well completion 181 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 181 ft. At end of test 181 ft.
Discharge 1200 gal/min after 36 hours Water temperature ____
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? ____
Was electric log made Yes ☒ No ☐ If yes attach copy to this report

(12) WELL LOG: Total depth 1230 ft. Completed depth 1200 ft.

from ft. to ft. Formation (Describe by color, character, size or material)

from ft.		to ft.	Formation
1070	-	1090	ft. clay, gravel and rock
1090	-	1100	ft. gravel, clay
1100	-	1110	ft. gravel and rock
1110	-	1140	ft. gravel, rock with clay
1140	-	1150	ft. gravel, small amt. and
clay	-		
1150	-	1170	ft. clay with rock and gravel
1170	-	1180	ft. gravel and clay
1180	-	1190	ft. clay
1190	-	1200	ft. clay, rock
1200	-	1230	ft. clay, gravel
end	-		

Work started June 1 19 1988 Completed July 8 1988

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed John R. Beylik
(Well Driller)

NAME BEYLIK DRILLING, INC
(Person, firm, or corporation) (Typed or printed)

Address 591 S. Walnut STreet
City La Habra, Calif. ZIP 90631
License No. 306291 C57&C-61 Date of this report July 21, 1988

ORIGINAL
File with DWR

OCT 22 1968

(Index Card On File)

Appendix A

N.I. [illegible]

WATER WELL DRILLERS REPORT

(Sections 7079, 7080, 7081, 7082, Water Code)

THE RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

Do Not Fill In

No 35142

State Well No. 01S/08W-33E1

Other Well No.

(1) OWNER:

Name City of Pomona

Address City Hall, Pomona, Calif

(2) LOCATION OF WELL:

County Los Angeles   Owner's number, if any Well 25

Township, Range, and Section 100' S of Phillips and

Distance from cities, roads, railroads, etc. 244' E of Reservoir st

(3) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]

If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic [ ] Industrial [ ] Municipal [X]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [X]
Other [ ]

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE [ ] DOUBLE [X]

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
50' - 26" x 1/4" conductor casing						
808' - 20" No. 8 gauge double well casing						

Size of shoe or well ring: Size of gravel:

Describe joint

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
245	780	9 holes per 5 inches		

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes [X] No [ ]   To what depth 50 ft.

Were any strata sealed against pollution? Yes [ ] No [ ]   If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known ft. 270

Standing level before perforating, if known ft. 270

Standing level after perforating and developing ft. 270

(10) WELL TESTS:

Pump test made? Yes [X] No [ ]   If yes, by whom? Roscoe Moss

Yield: 2740 gal./min. with ft. drawdown after 76-3/4 hrs.

Temperature of water   Was a chemical analysis made? Yes [ ] No [ ]

Was electric log made of well? Yes [ ] No [ ]   If yes, attach copy

(11) WELL LOG:

Total depth 808 ft.   Depth of completed well ft.

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

ft. to ft.

0 to 18 Sandy clay
18 to 37 Sand and rock
37 to 41 Sandy clay
41 to 47 Clay
47 to 64 Sand and rock
64 to 150 Brown clay and gravel
150 to 172 Brown silty clay
172 to 195 Gravel and brown clay
195 to 294 Brown clay and gravel
294 to 350 Gravel and brown sandy clay
350 to 390 Brown sticky clay
390 to 425 Brown clay and stks of cemented gravel
425 to 452 Gravel to 2"
452 to 464 Tight gravel to 1" brown clay
464 to 494 Hard brown clay, some gravel
494 to 524 Tight gravel to 6"
524 to 730 Hard brown clay, some gravel
730 to 780 Brown clay, stks of sand and gravel to 1/4"
780 go 798 Hard brown clay, gravel embedded
798 to 800 Sand and gravel to 1/4
800 to 808 Brown sandy clay

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

Work started 7-31-68, Completed 9-25-68

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 Roscoe Moss Company
(Person, firm, or corporation) (Typed or printed)

Address 4360 Worth Street
Los Angeles, California.

[SIGNED] [signature] (Well Driller) Secretary

License No. 624 C-57   Dated 10-16-68, 19

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-65)

Appendix A

2S/8W-4M06,S

MAY 31 1975

ORIGINAL with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In

Nº 80028

State Well No. [redacted]

Other Well No.

(1) OWNER:

Name: City of Pomona
Address: P. O. Box 660
Pomona, CA 91769

(2) LOCATION OF WELL:

County: Los Angeles — Owner's number, if any: No. 29
Township, Range, and Section: City of Pomona
Distance from cities, roads, railroads, etc.: 50' South of County ~~Line~~ Rd and 50' West of Mills Avenue

(3) TYPE OF WORK (*check*):

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (*check*):

Domestic [ ] Industrial [ ] Municipal [X]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [X]
Other [ ]

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE [ ] DOUBLE [X]

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	539	20"	8 Gauge			

Size of shoe or well ring: 20 X 16 X 1 — Size of gravel:
Describe joint: Butt Weld

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen: Hydraulic Louvre

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
248	254	8	5"Center	1/4" X 2½"
254	267	8	5" Center	1/4" X 2½"
314	324	8	5" Center	1/4" X 2½"
327	352	8	5" Center	1/4" X 2½"

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes [X] No [ ] To what depth 53½' ft.
Were any strata sealed against pollution? Yes [ ] No [ ] If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing: Conductor cemented in place

(9) WATER LEVELS:

Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing 225 ft.

(10) WELL TESTS:

Pump test made? Yes [X] No [ ] If yes, by whom? McCalla Bros.
Yield: 865 gal./min. with 101 ft. drawdown after 114 hrs.
Temperature of water - Was a chemical analysis made? Yes [ ] No [X]
Was electric log made of well? Yes [ ] No [X] If yes, attach copy

(11) WELL LOG:

Total depth 539 ft. Depth of completed well 539 ft.

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

From ft.	To ft.	Formation
0	5	Top Soil
5	45	Clay
45	55	Dirty Sand and Small Gravel
55	155	Clay
155	163	Sand and Gravel
163	178	Sandy Clay-Streaks of Gravel
178	210	Clay
210	235	Sandy Clay-Streaks of Gravel
235	248	Clay
248	254	Gravel and Glay
254	267	Gravel - up to 2"
267	275	Clay and Gravel
275	314	Hard Clay
314	324	Sand Gravel - loose up to 2"
324	327	Clay
327	352	Sand and Gravel - up to 3"
352	539	Clay

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

TEST PUMP DATA

GPM	Pumping Water Level	Drawdown
865	320'	101'
630	272'	53'
512	266'	43'
424	252'	33'
290	246'	27'

Work started 11-18-74, Completed 4-28-75

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 McCalla Bros., Inc.
(Person, firm, or corporation) (*Typed or printed*)

Address 3819 W. First Street
Santa Ana, CA 92703

[SIGNED] [signature]
(*Well Driller*)

License No. 196824 Dated April 29, 1975

SKETCH LOCATION OF WELL ON REVERSE SIDE

DUPLICATE Owner's Copy

NOTE: THIS IS PAGE One of 2 pages.

Appendix A

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 00015

Notice of Intent No. 199063
Local Permit No. or Date 3/9/83 (by City Ontario)

State Well No.
Other Well No.

(1) OWNER: Name CITY OF ONTARIO
Address 303 East "B" Street
City Ontario, Calif. Zip 91764

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 33
Well address if different from above
Township 1S Range 7W Section 30, SBBM
Distance from cities, roads, railroads, fences, etc.
in DeAnza Park at Euclid & Phillips Sts. Ontario

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [X]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [X]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size #5
Diameter of bore 30
Packed from 0 to 1112 ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

(8) PERFORATIONS:
Type of perforation or size of screen Johnson Screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	60	36"	5/16"	520	1090	.80 slots
2	498	24	3/8"			
498	1110	18"	5/16"			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 60 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval 0 - 60 ft.
Method of sealing 9 sack grout mix

(10) WATER LEVELS:
Depth of first water, if known 311 ft.
Standing level after well completion 313 ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? Beylik Drilling
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test 211 ft. At end of test 313 ft
Discharge 3500 gal/min after 37 hours Water temperature 75°
Chemical analysis made? Yes [ ] No [ ] If yes, by whom?
Was electric log made? Yes [X] No [ ] If yes, attach copy to this report

(12) WELL LOG: Total depth 1200 ft. Depth of completed well 1112 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	- 50 ft.	sand
50	- 95 ft.	gravel, small rock, sand
95	100 ft.	clay, small rock silt
100	105 ft.	sand, gravel and silt
105-	115 ft.	sand and gravel
115	135 ft.	gravel
135-	140 ft.	gravel, fine sand
140	155 ft.	gravel andsand
155	160 ft.	fine sand and some gravel
160	175 ft.	sandy clay
175	180 ft.	sand
180	185 ft	sand and gravel
185	195 ft.	sand and clay, some gravel
195	200 ft.	rock and gravel
200	220 ft.	hard rock, some gravel
220	240 ft.	small rock, gravel
240	250 ft.	small rock and gravel,sandy clay
250	260 ft.	rock, small amt. gravel
260	265 ft.	clay
265	275 ft.	gravel, small rock, some sand
275	290 ft.	sand, small rock and gravel
290	310 ft.	gravel, sand fine silty clay
310	320 ft.	silty soft clay with sand
320	335 ft.	silty clay,sand and gravel
335	380 ft.	med.fine gravel w/small rocks/cla
380	400 ft.	sand, gravel, rock and clay
400	425 ft.	brown sandy clay,gravel, rocks
425	440 ft.	clay, gravel, sand
440	445 ft.	silty sandy clay,gravel
445	465ft.	sandy clay, gravel
465	500 ft.	clay, gravel
500	520 ft.	clay, small rocks, sand
520	540 ft.	clay, gravel
540	560 ft.	clay, sandy clay,fine gravel
560	575 ft.	soft silty clay,fine gravel
575	650 ft.	sandy clay, brown/. small rocks
650	660 ft.	sand,gravel small rocks
660	690 ft.	clay vcontinued over

Work started March 29 1983 Completed May 10 1983

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED John R. Beylik (Well Driller)
NAME BEYLIK DRILLING, INC. (Person, firm, or corporation) (Typed or printed)
Address 591 S.Walnut Street
City La Habra, Calif Zip 90631
License No. 306291-C57&SC-61 Date of this report June 3, 1983

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 43816-950 7-76 50M QUAD OSP

NOTE: WELL Pumped 4000 GPM after 37 hours. with a drawdown of 63 ft. and a specific yield of: 55.5

NOTE: THIS IS PAGE ONE OF 2 pages.....

Appendix A

TRIPLICATE
Owner's Copy

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. [redacted]
No. 00015

Notice of Intent No. 199063
Local Permit No. or Date 3/9/83 (By City Ontario)

State Well No.
Other Well No.

(1) OWNER: Name CITY OF ONTARIO
Address 303 East "B" Street
City Ontario, Calif. Zip 91764

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number #33
Well address if different from above
Township 1S Range 7W Section 30 SBBM
Distance from cities, roads, railroads, fences, etc.
in DeAnza Park at Euclid & Phillips Sts.
Ontario, Calif.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☒
Other ☐

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size #8
Diameter of bore 30"
Packed from 0 to 1112 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	60	36"	5/16"
2	498	24"	3/8"
498	1110	18"	5/16"

(8) PERFORATIONS:
Type of perforation or size of screen Johnson Screens

From ft.	To ft.	Slot size
520	1190	80 slot

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 60 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 60 ft.
Method of sealing 9 sack grout mix

(10) WATER LEVELS:
Depth of first water, if known 311 ft.
Standing level after well completion 313 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 311 ft At end of test 313 ft
Discharge 3500 gal/min after 37 hours Water temperature 87.5°
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1200 ft. Depth of completed well 1112 ft

from ft.	to ft.	Formation (Describe by color, character, size or material)
690	710 ft.	sandy clay, small rocks, gravel
710	725 ft.	clay, silty soft clay, gravel
725	735 ft.	sandy clay, sand, rock
735	755 ft.	gravel, rock, sand, clay
755	770 ft.	clay, sandy clay
770	775 ft.	gravel, rock and clay
775	785 ft.	gravel, sand, small rocks/clay
785	795 ft.	clay, sand small rocks
795	810 ft.	clay, sand small rocks
810	840 ft.	gravel, sandy clay and rocks
840	855 ft.	sandy clay, small gravel, rock
855	865 ft.	sandy clay, gravel, rock
865	895 ft.	sandy clay, sm. rock, some gravel
895	920 ft.	sand, small roks, sandy clay
920	945 ft.	sandy clay, med. fine gravel
945	955 ft.	sandy clay and gravel
955	985 ft.	brown sandy clay,
985	1020 ft.	sandy clay, small amt. gravel
1020	1045 ft.	sandy clay, gravel
1045	1060 ft.	sandy clay, med. fine gravel
1050	1070 ft.	med. fine gravel, sandy clay
1070	1155 ft.	brown sandy clay, small rock
1155	1165 ft.	sandy clay, some gravel, rocks
1165	1170 f.t	sand stone clay, small rocks
1170	1190 ft.	med. fine gravel, some clay
1190	1195 ft.	med. fine gravel, sandy clay
1195	1200 ft.	med. fine gravel with small rocks and sandy clay

end end

Work started March 29 19 83 Completed May 10 19 83

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED John R. Beylik (Well Driller)

NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut St.
City La Habra, California Zip 90631
License No. 306291-C-57&SC-61 Date of this report June 3, 1983

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

NOTE: THIS IS PAGE 2 OF TWO PAGES.......

NOTE: Well Pumped 3500 GPM after 37 hrs. with drawdown of 63 ft. & a specific Yield: 55.5

TRIPLICATE
Owner's Copy

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 172735

State Well No. ____
Other Well No. ____

Notice of Intent No. 232805
Local Permit No. or Date 10/29/85

(1) OWNER: Name CITY OF ONTARIO
Address 303 East "B" Street
City Ontario, Calif. Zip 91764

(2) LOCATION OF WELL (See instructions):
County SAN BERNARDINO Owner's Well Number #35
Well address if different from above ____
Township 1S Range 7W Section 34
Distance from cities, roads, railroads, fences, etc. S.W. Corner of
in Street and Campus Street - Ontario, Calif.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal XX
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse XX
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size #5
Diameter of bore 34
Packed from 0 to 1190 ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

(8) PERFORATIONS: JOHNSON SCREENS
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	60	36"	5/16"	580	1020	18" OD
0	560	24"	3/8"			
0	1190	18"				

(9) WELL SEAL:
Was surface sanitary seal provided? Yes XX No [ ] If yes, to depth 60 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval 0 - 60 ft.
Method of sealing 9 sack grout

(10) WATER LEVELS:
Depth of first water, if known 348 ft.
Standing level after well completion 354 ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? Beylik Drilling
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test 348 ft. At end of test 354 ft.
Discharge 3950 gal/min after 41 hours Water temperature ____
Chemical analysis made? Yes [ ] No [X] If yes, by whom? ____
Was electric log made? Yes [X] No [ ] If yes, attach copy to this report

(12) WELL LOG: Total depth 1320 ft. Depth of completed well 1190 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	70	pft. gravel
70	100	ft. gravel and rock
100	110	ft. gravel
110	120	ft. gravel/rock
120	130	ft. gravel
130	140	ft. rock
140	150	ft. clay, small rock
150	160	ft. small rock, gravel and sand
160	200	ft. sand, rock and gravel
200	210	ft. clay
210	220	ft. gravel and rocks
220	230	ft. gravel and mushy clay
230	240	ft. rock, gravel, sandy clay
240	260	ft. rock , gravel sand and some cl
260	270	ft. sandy clay
270	300	ft. sandy clay and gravel
300	310	ft. sand and gravel
310	320	ft gravel and small rocks
320	400	ft.gravel, some clay
400	430	ft. sandy brown clay, some gravel
430	440	ft. rock and gravel
440	460	ft. small rock,gravel, sandy bwn.c
460	480	ft. sandy brown clay
480	500	ft. sandy clay, gravel
500	510	ft. brown sticky clay ,some gravel
510	540	ft. brown sandy clay
540	550	ft. brown clay
550	560	ft brown sandy soft clay
560	580	ft gravel, sandy brown clay
580	600	ft. brown sandy clay,gravel
600	620	ft. gravel, brown sandy clay
620	680	ft. brown sandy clay
680	710	ft. brown sandy clay, some gravel
710	730	ft. brown sandy clay
730	740	ft. brown sandy clay, sticky
740	760	ft. brown sandy clay little gravel
760	790	ft. sticky bwn.clay,rock and grave

continued on Page 2........172736

Work started Feb. 5, 1986 Completed March 25, 1986

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED John R. Beylik (Well Driller)
NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut St
City La Habra, California Zip 90631
License No. 306291C57 &SC-61 Date of this report April 29,1986

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

NOTE: THIS IS PAGE 1 of 2 Pages.

Well produced 3950 gpm after 41 hours with drawdown of 105 ft. and specific yield: 37.61

TRIPLICATE
Owner's Copy

STATE OF CALIFORNIA ALSO SEE No. 172735
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 172736

State Well No.
Other Well No.

Notice of Intent No. 232505
Local Permit No. or Date 10/29/85

(1) OWNER: Name CITY OF ONTARIO
Address 303 East "B" Street
City Ontario, Calif. Zip 91764

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number #35
Well address if different from above
Township 1S Range 7W Section 34
Distance from cities, roads, railroads, fences, etc. S.W.Corner of Main St.& Campus Street, Ontario, Calif.

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal [X]
Other ☐

(5) EQUIPMENT:
Rotary ☐ Reverse [XX]
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes [XX] No ☐ Size #5
Diameter of bore 34"
Packed from 0 - to 1190 ft.

(7) CASING INSTALLED:
Steel [X] Plastic ☐ Concrete ☐

(8) PERFORATIONS: Johson Scrns
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	60	36"	5/16"	580	1020	18" OD
0	560	24"	3/8"			
0	1190	18"				

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No ☐ If yes, to depth 60 ft.
Were strata sealed against pollution? Yes [X] No ☐ Interval 0 - 60 ft.
Method of sealing 9 sack grout

(10) WATER LEVELS:
Depth of first water, if known 348 ft.
Standing level after well completion 354 ft.

(11) WELL TESTS:
Was well test made? Yes [X] No ☐ If yes, by whom? Beylik Drilling
Type of test Pump [X] Bailer ☐ Air lift ☐
Depth to water at start of test 348 ft. At end of test 354 ft
Discharge 3950 gal/min after 41 hours Water temperature
Chemical analysis made? Yes [X] No ☐ If yes, by whom?
Was electric log made? Yes [X] No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1320 ft. Depth of completed well 1190 ft.
from ft. to ft. Formation (Describe by color, character, size or material)

continued from No. 172735

790 - 800 ft. sandy clay, some gravel
800 - 830 ft. rock, gravel
830 - 850 ft. sandy brown clay
850 - 860 ft. rock, gravel, clay
860 - 870 ft. some gravel, clay
870 - 880 ft/ small rock,gravel, some clay
880 - 890 ft. small rock,gravel,brown sandy c
890 - 900 ft. gravel,sand, some brown clay
900 - 910 ft. sand and sandstone
910 - 940 ft. sand and gravel
940 - 970 ft. clay, gravel, some sand
970 - 990 ft. clay, gravel, small rock, sand
990 - 1010 ft. gravel, small rock, sand/clay
1010 - 1040 ft. gravel, brown soft clay
1040 - 1070 ft. gravel, some soft brwn sandy cl
1070 - 1080 ft. gravel, hard bwn clay, some sa
1080 - 1090 ft. sand, brwn clay
1090 - 1110 ft. stick brown clay, sand and grav
1100 - 1120 ft. sticky brown clay, some gravel
1120 - 1130 ft. gravel, little sandy clay
1130 - 1140 ft. dry sandy clay, little gravel
1140 - 1160 ft. clay, gravel small rocks
1160 - 1170 ft. brown sticky clay, little grave
1170 - 1180 ft. brown clay, rock chips, sticky
1180 - 1200 ft. brown sandy clay,some rock/grav
1200 - 1210 ft. brown sandy clay
1210 - 1230 ft. brown clay, gravel,small rocks
1230 - 1250 ft. clay, gravel, small rocks
1250 - 1280 ft. hard/soft brwn sandy clay/grave
1280 - 1290 ft. sandy brown clay,sand,rock,grav
1290 - 1300 ft. sandy sticky brown clay with g
1300 - 1310 ft. med. gravel,little rock,sandy c
1310 - 1320 ft. gravel, rock chips,sand and little brown clay
end - end end end

Page 2 of 2 pages...

Work started Feb. 5 1986 Completed March 25 1986

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED John R Beylik (Well Driller)
NAME BEYLIK DRILLING INC
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, Calif. Zip 90631
License No. 306291 C57&C-61 Date of this report April 29,1986

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WELL PRODUCED 3950 GPM after 41 hours with a drawdown of 105 ft. and specific yield: 37.61....

NOTE: THIS IS PAGE 2 of 2 Page

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

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

CONFIDENTIAL
STATE OF CALIFORNIA
Sec. 7076.1, State Water Code

Do Not Fill In
№ 99142 Bol (Fintds)
State Well No. 2S/8W-2B04
Other Well No.

(1) OWNER:

Name Pete Borba and Sons
Address Rt.2, Box 30, Ontario, California

(2) LOCATION OF WELL:

County San Bernardino Owner's number, if any—
R. F. D. or Street No. 5433 Philadelphia, Chino, Calif.

75' south of Philadelphia and approximately 600' east of Central Avenue, Chino.

(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 ☐ 16"OD Diam. .250 Gage or Wall

From ft.	to ft.
1	743

30' of 24" conductor pipe

If gravel packed: Diameter of Bore 24" from 1 ft. to 743 ft.

Type and size of shoe or well ring
Size of gravel: 3/4"
Describe joint Welded

(7) PERFORATIONS:

Type of perforator used Machine
Size of perforations 2½" in., length, by 3/16" in.

From 1 ft. to 240 ft. blank
240 to 743 every other 20' section perforated with 14 rows of 188 mesh ending with perforated.

(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 220' ft.
Standing level before perforating 220' ft.
Standing level after perforating 220' ft.

(10) WELL TESTS:

Was a pump test made? ☒ Yes ☐ No If yes, by whom? F. LaHorgue
Yield: 2000 GPM gal./min. with 50' 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 743 ft. Depth of completed well 756 ft.

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

	From ft.	to ft.	Formation
4	0	12	top soil
2	12	18	soarse sand and gravel
1	18	22	light blue and brown caly
1	22	28	" " " " " some rocl
2	28	106	coarse sand, gravel, rock, bld
5	106	168	br own clay and rock
4	168	196	coarse sand, gravel, rock with brwn clay
2	196	208	gravel, rock, coarse sand
5	208	220	brown clay, gravel and rock
2	220	238	gravel and rock
5	238	268	brown caly, coarse sand & rock
2	268	283	coarse sand, gravel and rock
5	283	294	brown clay, gravel and rock
2	294	311	gravel, coarse sand, rock with streaks of claay
5	311	324	brown and red clay, and rock
2	324	338	gravel, rock, few boulders with streaks of clay
5	338	366	brown and red clay with rock
2	366	380	fine and coarse sand with rock
4	380	402	coarse sand, rock some brown c
2	402	420	coarse sand, gravel and rock
4	420	446	gravel, rock with brwn clay
1	446	530	soft brown clay
5	530	542	red and white clay with gravel and rock.
2	542	551	gravel, sand and some rock
5	551	574	brown and red clay with gravel and rock
1	574	588	brown clay
2	588	604	coarse, gravel and some rock
1	604	624	mix clay
5	624	648	mixed clay, sand, some gravel and rock
2	648	664	gravel, sand and rock
5	664	686	hard red sandy clay, rock, blc
1	686	708	red clay
2	708	716	course sand, gravel and rock
1	716	728	red and brown clay
4	728	756	rock, coarse sand and gravel to clay

Work started 5/9/64 19 . Completed 6/23/64 19

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, P.O. Box 605
Chino, California

[SIGNED] F. LaHorgue
Well Driller
License No. 18159 3 Dated 7/21/64, 19

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

CONFIDENTIAL
Sec. 7076.1, State Water Code

WATER WELL DRILLERS REPORT
(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

Appendix A

Do Not Fill In

No 99142

State Well No. 2S/8W-2B04

Other Well No.

(1) OWNER:
Name Pete Borba and Sons

Address Rt.2, Box 30, Ontario, California

(2) LOCATION OF WELL:
County San Bernardino Owner's number, if any—

R. F. D. or Street No. 5433 Philadelphia, Chino, Calif.

75' south of Philadelphia and approximately 600' east of Central Avenue, Chino.

(3) TYPE OF WORK (check):
New well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]

If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:
Rotary [X]
Cable [ ]
Dug Well [ ]

(6) CASING INSTALLED:
SINGLE [X] DOUBLE [ ]

From ft.	to ft.	Diam.	Gage or Wall
1	743	16"OD	.250
30' of 24" conductor pipe			

If gravel packed

Diameter of Bore	From ft.	to ft.
24"	1	743

Type and size of shoe or well ring

Size of gravel: 3/4"

Describe joint Welded

(7) PERFORATIONS:
Type of perforator used Machine

Size of perforations 2½" in., length, by 3/16" in.

From ft.	to ft.	Perf. per row	Rows per ft.
1	240	blank	
240	743	every other 20' section perforated with 14 rows of 188 mesh ending with perforated.	

(8) CONSTRUCTION:
Was a surface sanitary seal provided? [ ] Yes [X] No To what depth ft.

Were any strata sealed against pollution? [ ] Yes [X] No If yes, note depth of strata

From ft. to ft.

Method of Sealing

(9) WATER LEVELS:
Depth at which water was first found 220' ft.

Standing level before perforating 220' ft.

Standing level after perforating 220' ft.

(10) WELL TESTS:
Was a pump test made? [X] Yes [ ] No If yes, by whom? F. LaHorgue

Yield: 2000 GPM gal./min. with 50' ft. draw down after 48 hrs.

Temperature of water Was a chemical analysis made? [ ] Yes [X] No

Was electric log made of well? [ ] Yes [ ] No

(11) WELL LOG:
Total depth 743 ft. Depth of completed well 756 ft.

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

From ft.	to ft.	Formation
0	12	top soil
12	18	soarse sand and gravel
18	22	light blue and brown caly
22	28	" " " " " some rocl
28	106	coarse sand, gravel, rock, bld
106	168	br own clay and rock
168	196	coarse sand, gravel, rock with brwn clay
196	208	gravel, rock, coarse sand
208	220	brown clay, gravel and rock
220	238	gravel and r ock
238	268	brown caly, coarse sand & rock
268	283	coarse sand, gravel and rock
283	294	brown clay, gravel and rock
294	311	gravel, coarse sand, rock with streaks of clay
311	324	brown and red clay, and rock
324	338	gravel, rock, few boulders with streaks of clay
338	366	brown and red clay with rock
366	380	fine and coarse sand with rock
380	402	coarse sand, rock some brown c
402	420	coarse sand, gravel and rock
420	446	gravel, rock with brwn clay
446	530	soft brown clay
530	542	red and white clay with gravel and rock.
542	551	gravel, sand and some rock
551	574	brown and red clay with gravel and rock
574	588	brown clay
588	604	coarse, gravel and some rock
604	624	mix clay
624	648	mixed clay, sand, some gravel and rock
648	664	gravel, sand and rock
664	686	hard red sandy clay, rock, blc
686	708	red clay
708	716	course sand, gravel and rock
716	728	red and brown clay
728	756	rock, coarse sand and gravel to clay

Work started 5/9/64 19 , Completed 6/23/64 19

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, P.O. Box 605
Chino, California

[SIGNED] F. LaHorgue
Well Driller

License No. 18159 3 Dated 7/21/64, 19

Form 115

INVESTIGATION South Coastal Basin

DIVISION OF WATER RESOURCES
DEPARTMENT OF PUBLIC WORKS
STATE OF CALIFORNIA

WELL LOG

SHEET 1

NUMBER D-745 h

LOCAL DESIGNATION 2S/8W-2K1

Loc.#17617B

LOCATION 50' S. of Walnut Ave., 50' E. of Central Ave., N. of Chino.

OWNER W. B. Thompson

DATE COMPLETED

DIAMETER OF CASING

DRILLED BY Hallstrom Well Drilling Co.

SOURCE OF INFORMATION City of Chino

INSPECTED WHILE DRILLING SEE FILE NO.

SURFACE ELEVATION 785 DWR Map

SKETCH

DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL		THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
0-7	2	Sandy soil	sc	7			
24	2	Loose sand	s	17			
40	1	Soft clay	c	16			
60	5	Sandy clay and surface water	sc	20			
68	1	Yellow clay	c	8			
70	2	Water gravel 0 loose CUT	g	2			
111	1	Yellow clay	c	30+11			
122	2	Water gravel CUT	g	11			
126	1	Yellow clay	gc	4			
132	2	Water gravel CUT	g	6			
210	5	Clay and boulders	gc	68+10			
220	2	Coarse water gravel CUT	g	10			
310	1	Clay	c	80+10			
317	2	Water gravel CUT	g	7			
354	5	Red clay and gravel	gc	37			
359	2	Water gravel CUT	g	5			
410	5	Red clay with gravel	gc	41+10			
440	5	Clay and sandstone or (cemented clay and sand)	sc	30			
462	2	Dead sand	ts	22			
466	5	Clay and boulders	gc	4			
502	1	Chalk rock and clay	gc	34+2			
560	5	White clay and cemented sandstone		58			
572	2	Sediment and packed sand	sc	12	MED		
584	2	Sand rock	sc	FILL			
590	1	Clay	c ERO	6			
596	2	Cemented sandstone	MISC	6			
634	1	Yellow clay	c	4+34			
684	5	Clay and sandstone	sc	50			
686	2	Packed gravel	tg	2			
691	5	Hard clay and sandstone	sc	5			
704	1	Hard red clay	c	9+4			
706	2	Cemented gravel	tg	2			

FOR FIELD COPIES USE ALTERNATE LINES

LOG OBTAINED BY DATE

02S/08W-02K01 SHEET 2

DIVISION OF WATER RESOURCES

DEPARTMENT OF PUBLIC WORKS

STATE OF CALIFORNIA

Coastal

Basin x785

02S/08W-02K1 NUMBER D-745h-

Loc. #17671B

WELL LOG

LOCAL DESIGNATION 17

DEPTH	ELEVATION OF BOTTOM OF STRATUM	MATERIAL	THICKNESS FEET	% VOIDS	ABSOLUTE VOIDS FEET	TOTAL VOIDS FEET
710	2	Packed gravel				
725	1	Red clay	15			
762	5	Hard clay, with gravel	37			
774	2	Cemented gravel				
780	1	Red clay	6			
788	5	Clay and cemented gravel	8			
986	2	Coarse gravel and boulders CUT				

FOR FIELD COPIES USE ALTERNATE LINES

MICROFILMED

RIGINAL
le Original, Duplicate and Triplicate with the
EGIONAL WATER POLLUTION
ONTROL BOARD No. 8
(Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

Do Not Fill In
No 88531
State Well No. 2S/7W-18C04S
Other Well No.

(1) OWNER:

Name MR. L.O. BADDERS
Address 3800 GRAND AVE.
POMONA, CALIFORNIA

(2) LOCATION OF WELL:

County SAN BERNARDINO Owner's number, if any—
R. F. D. or Street No.
100' S. OF SHAFFER
400' E. OF SAN ANTONIO

(3) TYPE OF WORK (check):

New well [X] Deepening [ ] Reconditioning [ ] Abandon [ ]
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):

Domestic [ ] Industrial [ ] Municipal [ ]
Irrigation [X] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [X]
Cable [ ]
Dug Well [ ]

(6) CASING INSTALLED:

SINGLE [X] DOUBLE [ ]

From ft.	to ft.	Diam.	Gage or Wall	If gravel packed: Diameter of Bore	from ft.	to ft.
0	590	16	5/16	26	0	590

Type and size of shoe or well ring BULL NOSE
Size of gravel: 3/8 pea
Describe joint WELDED

(7) PERFORATIONS:

Type of perforator used MILLS KNIFE
Size of perforations $2\frac{1}{2}$ in., length, by $\frac{1}{4}$ in.

From ft.	to ft.	Perf. per row	Rows per ft.
360	393	8	2
438	560	8	2
560	590 PRECUT		

(8) CONSTRUCTION:

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

(9) WATER LEVELS:

Depth at which water was first found 129 ft.
Standing level before perforating 129 ft.
Standing level after perforating 129 ft.

(10) WELL TESTS:

Was a pump test made? [ ] Yes [ ] No If yes, by whom?
Yield: 1900 gal./min. with 183 ft. draw down after 45 hrs.
Temperature of water Was a chemical analysis made? [ ] Yes [ ] No

(11) WELL LOG:

Total depth 600 ft. Depth of completed well 590 ft.
Formation: Describe by color, character, size of material, and structure.

ft. to	ft.	Formation
0	18	TOPSOIL
18	29	SAND & GRAVEL
29	57	BROWN CLAY
57	65	SAND & GRAVEL
65	110	SANDY CLAY
110	161	CORSE SAND & GRAVEL
161	172	BROWN SANDY CLAY
172	202	SAND & GRAVEL
202	253	BROWN CLAY
253	282	HARD ROCK
282	283	CLAY
283	347	HARD ROCK
347	362	BROWN CLAY
362	393	SAND & GRAVEL
393	438	SANDY CLAY
438	492	SAND & GRAVEL
492	495	CLAY
495	522	SAND & GRAVEL
522	537	BROWN CLAY
537	582	SAND & GRAVEL
582	600	BROWN CLAY

"WELL TEST DATA

950	6 PM @	248' PL
1200	" "	272 "
1450	" "	292 "
1900	" "	312 "

Work started 3-30-65 19 . Completed 5/11/65 19

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 McCalla Bros
(Person, firm, or corporation) (Typed or printed)
Address 3819 W. Bolsa
Santa Ana, Calif
[SIGNED] [signature] McCalla
Well Driller
License No. 196824 Dated 6/15, 1965

SEP 30 1979

ORIGINAL
File with DWR

Note: Originally sent Notice of Intent No. 98010 which is void

Intent No. 154465

Permit No. or Date

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

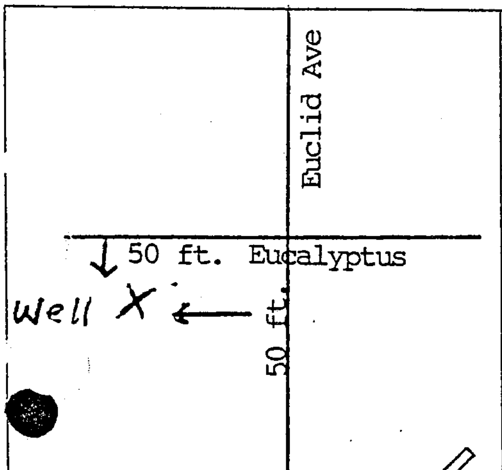
No. 126772

State Well No. 02S/07W-19B02 S

Other Well No.

(1) OWNER: Name STATE OF CALIF.-Dept. of Corrections
Address Calif. Youth Authority - P. O. Box 800
City Ontario, Calif. Zip 91764

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number
Well address if different from above
Township Range Section
Distance from cities, roads, railroads, fences, etc. 50 ft. West of Euclid and 50 ft. south of Eucalyptus-Chino



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [ ]
Irrigation [X]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [ ] Reverse [X]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size 3/8" minus
Diameter of bore 26"
Packed from 0 to 520 ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	50	30"	.281	240	500	1/8"
0	520	14"	1/4"			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 50 ft.
Were strata sealed against pollution? Yes [ ] No [X] Interval ft.
Method of sealing 9 sack grout

(10) WATER LEVELS:
Depth of first water, if known 126 ft.
Standing level after well completion 126 ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? BEYLIK DRILLING, INC
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test 126 ft. At end of test ft
Discharge 450 gal/min after 65 hours Water temperature
Chemical analysis made? Yes [ ] No [X] If yes, by whom?
Was electric log made? Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 520 ft. Depth of completed well 520 ft.

from ft. to ft.	Formation (Describe by color, character, size or material)
0-60 ft.	clay
60-80 ft.	rock
80-100 ft.	clay and rock
100-160 ft.	clay
160-180 ft.	gravel
180-200 ft.	clay
200-205 ft.	gravel
205-220 ft.	gravel & clay
220-260 ft.	clay
260-280 ft.	hard clay
280-320 ft.	clay and gravel
320-340 ft.	gravel
340-360 ft.	clay,
360-375 ft.	sand, gravel and clay
375-380 ft.	hard conglomerate
380-400 ft.	clay and gravel
400-420 ft.	gravel, clay
420-430 ft.	sand, gravel and clay
430-440 ft.	gravel
440-450 ft.	clay and gravel
450-520 ft.	gravel and sandy clay

Work started 4/1/79 19 Completed 5/5/ 197

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED John R Beylik (Well Driller)

NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut St
City La Habra, Calif. Zip 90631
License No. 306291-C-57 &SC61 Date of this report July 24, 1979

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Appendix A

DUPLICATE
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No. 8
(Insert appropriate number)

WATER WELL REPORT
(Sections ...)

STATE OF CALIFORNIA

Do Not Fill In
No 40127
State Well No. 1S/8W-35 J01S
Other Well No. Ontario

CONFIDENTIAL Electric log available
Sec. 7076.1, State Water Code

(1) OWNER:
Name City of Chino
Address 13219 Central Ave.
Chino Calif.

(2) LOCATION OF WELL: #5
County San Bernardino Owner's number, if any—
R. F. D. or Street No. 11830 So. Bensen Ave.
800 ft. South Francis St. and
195 ft. West of Bensen Ave.

(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	1100	20	8

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring 20x18x1¼ Size of gravel:
Describe joint Round seam welded

(7) PERFORATIONS:
Type of perforator used Mills
Size of perforations 5/16 in., length, by 2½ in.

From ft.	to ft.	Perf. per row	Rows per ft.
430	1078	11	11

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 12 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 208 ft.
Standing level before perforating 212 ft.
Standing level after perforating 208 ft.

(10) WELL TESTS:
Was a pump test made? ☒ Yes ☐ No If yes, by whom? Ray Roberts
Yield: 2800 gal./min. with 56 ft. draw down after 1 hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No
Was electric log made of well? ☐ Yes ☐ No

(11) WELL LOG:
prev. located - no variances made

Total depth 1100 ft. Depth of completed well 1100 ft.
Formation: *Describe by color, character, size of material, and structure.*

From ft.	to ft.	Formation
0	4	Top Soil
4	18	Gravel 1" some Clay
18	24	Brown & Grey sandy Clay
24	47	Red Clay sandy
47	58	Gravel 1"
58	97	Red & Brown sandy Clay
97	106	Gravel 1" some Clay
106	122	Red Clay sandy
122	132	Brown Clay sandy
132	156	Gravel 2"
156	171	Brown Clay some Gravel
171	196	Brown Clay sandy
196	212	Gravel 1" lots of Sand
212	230	Sand & Clay (don't cut)
230	243	Brown Clay sandy
243	253	Gravel 3"
253	285	Brown Clay sandy
285	289	Gravel 2" lots of sand
289	299	Red Clay sandy
299	320	Gravel 1" lots of sand
320	344	Gravel 1" sand & Clay
344	402	Red Sandy Clay (don't cut
402	407	Gravel & Clay
407	431	Red Clay sandy
431	448	Gravel & Clay
448	468	Red Clay sandy
468	477	Yellow Clay, some Gravel
477	510	Red Clay sticky
510	515	Clay Gravel ½"
515	517	Red sticky Clay
517	527	Gravel 1" loose
527	558	Yellow Clay sandy
558	570	Gravel 1" loose
570	634	Yellow sticky Clay
634	640	Sand & Yellow Clay
640	735	Yellow sticky Clay
735	762	White sticky Clay
762	764	Decomposed Gravel hard
764	770	Red Clay
770	782	Ledge Rock hard
782	799	Decomposed Gravel & Clay
799	801	Ledge Rock

Cont on 2nd page

Work started July 7 1958 Completed Dec. 1 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 R. H. Forney
(Person, firm, or corporation) (Typed or printed)
Address 10224 Hillside Rd.
P.O. Box 233 Alta Loma Calif.

[Signed] RH Forney
Well Driller

License No. 114736 C57 Dated Dec. 5, 1958

Appendix A

DUPLICATE
File Original, Duplicate and Triplicate with the
REGIONAL WATER POLLUTION
CONTROL BOARD No.
(Insert appropriate number)

WATER WELL DR

(Sections 7076, 7077,

STATE OF CALIFORNIA

CONFIDENTIAL

Do Not Fill In
No 40128

State Well No. D1S/08W-35J01 S
Other Well No.

(1) OWNER:

Name Cityo of Chino
Address 13219 Central Ave.
Chino Calif.

(2) LOCATION OF WELL:

County
Owner's number, if any— #5
R. F. D. or Street No.

(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

If gravel packed

Diameter of Bore	from ft.	to ft.

Type and size of shoe or well ring
Size of gravel:
Describe joint

(7) PERFORATIONS:

Type of perforator used
Size of perforations in., length, by in.

From ft.	to ft.	Perf. per row	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 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☐ No If yes, by whom?
Yield: gal./min. with ft. draw down after hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

(11) WELL LOG:

Total depth ft. Depth of completed well ft.

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

ft.	to ft.	Formation
801	806	Red sticky Clay
806	810	Ledge Rock
810	814	Red Clay
814	815	Ledge Rock
815	823	Yellow Clay
823	825	Ledge Rock
825	827	Red Clay
827	830	Ledge Rock
830	859	Yellow sandy Clay
859	862	Alluvain fill Decomposed
862	901	Yellow Clay & Decomposed Gravel hard
901	909	Yellow Clay sandy
909	930	Decomposed Gravel & Clay
930	933	Rock & Decomposed Gravel
933	964	Brown Clay sticky
964	968	Red Clay & Decomposed Gravel
968	1033	Decomposed Gravel & Yellow Clay
1033	1095	Red Clay & Decomposed Gravel
1095	1100	Yellow Clay & Decomposed Gravel

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

555
255
570

MICROFILMED

Work started 19 , Completed 19

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 R.H. Forney
(Person, firm, or corporation) (Typed or printed)

Address

[SIGNED] R H Forney
Well Driller

License No.
Dated , 19

A-17

THERE ARE OTHERS IN SEC BUT NOT AS DEEP AS THIS

CITY HALL CENTRAL & D ST.

Appendix A

DUPLICATE

File Original, Duplicate and Triplicate with the REGIONAL WATER POLLUTION CONTROL BOARD No. 8 (Insert appropriate number)

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

Do Not Fill In

№ 53911

State Well No. 02S/08W-11M1

Other Well No.

CONFIDENTIAL Sec. 7076.1, State Water Code

(1) OWNER:

Name City of Chino

Address 13219 Central Avenue, Chino, California

(2) LOCATION OF WELL:

County San Berarndino Owner's number, if any ~~None~~ #6

R. F. D. or Street No. 120' south of East "H" Street and 120' ~~130'~~ ~~East~~ WEST of ~~Third~~ FOURTH Street, Chino, Calif.

(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 0 ft. to 375 ft. 16" Diam. 5/16" Gage or Wall

If gravel packed: Diameter of Bore 28" from 0-375' ft.

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

Type and size of shoe or well ring

Size of gravel: 3/8"

Describe joint Welded

(7) PERFORATIONS:

Type of perforator used Mills Knife and precut (machine)

Size of perforations 160 mesh x 30 rows, length, by 3/8" Mills in.

From 200 ft. to ~~375~~ 220 ft. 160 mesh Perf. per row 30 Rows per ft.

" 220 " 375 " 3/8" 8 cuts per round, 2 rounds per foot

(8) CONSTRUCTION:

Was a surface sanitary seal provided? ☒ Yes ☐ No To what depth 70 ft.

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

From ft. to ft.

Method of Sealing 30" conductor cemented in place

(9) WATER LEVELS:

Depth at which water was first found 130' ft.

Standing level before perforating ft.

Standing level after perforating 131' ft.

(10) WELL TESTS: See Additional report

Was a pump test made? ☒ Yes ☐ No If yes, by whom?

Yield: 2170 gal./min. with ~~[illegible]~~ 69 ft. draw down after 45 hrs.

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

Was electric log made of well? ☒ Yes ☐ No

(11) WELL LOG:

Total depth 1157' ft. Depth of completed well 375 ft.

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

From (ft.)	To (ft.)	Formation
0	18	Top Soil
18	34	Clay
34	43	Gravel
43	47	Clay
47	60	Gravel
60	95	Clay
95	148	Gravel
148	202	Clay
202	218	Gravel
218	241	Clay
241	249	Gravel
249	251	Clay
251	260	Gravel
260	267	Clay
267	280	Hard Rock
280	289	Clay
289	293	Gravel
293	309	Clay
309	375	Gravel
375	453	Sandy Clay
453	662	Clay
662	680	Hard Gravel
680	686	Sandy Clay
686	698	Sand and Gravel
698	719	Clay
719	773	Gravel in clay
773	777	Clay
777	833	Hard Gravel
833	839	Clay
839	863	Hard Gravel
863	899	Gravel in Clay - Hard
899	909	Clay
909	956	Hard Rock
956	961	Clay
961	1042	Hard Rock
1042	1049	Clay
1049	1076	Hard Rock
1076	1100	Blue Clay
1100	1105	Hard Rock
1105	1120	Blue Clay
1120	1123	Hard Rock
1123	1130	Brown Clay
1130	1141	Blue Clay 1141-1157 Hard Ro

DEPTH TO WATER 114.6 7 JAN 64

THIS HOLE "E" LOGGED

MICROFILMED

Work started 19 , Completed 19

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 McCalla Brothers, Inc. (Person, firm, or corporation) (Typed or printed)

Address 3819 W. Bolsa Avenue

Santa Ana, Calif.

[SIGNED] Robert J. McCalla (Well Driller)

License No. 196824 C-57 Dated August 20, 1963

A-18

DWR 188 (REV. 3-54)

025108W - 14C015

QUINTUPLICATE
RETAIN THIS COPY

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

STATE OF CALIFORNIA

8 NOTE: THIS LOG [illegible] 53729 (corrected)

Appendix A

Do Not Fill In

№ 53730

State Well No.

Other Well No.

(1) OWNER:

Name George Newport - c/o D. B. Company

Address 7833 Sierra Vista

Cucamonga, California

(2) LOCATION OF WELL:

County San Bernardino Owner's number, if any— none ?

R. F. D. or Street No.

250 ft. West of Central - 50 ft. North of Schaefer St., Chino, California

(SOUTH OF SCHAEFER) CHINO #7

(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	406	14"	1/4"
406	806	10"	1/4"

If gravel packed

Diameter of Bore 22" from 0 ft. to 806 ft.

Type and size of shoe or well ring

Size of gravel: Pea

Describe joint: Welded

(7) PERFORATIONS:

Type of perforator used: Pro-cut and Mills Knife

Size of perforations: 150 mesh 22 row on machine cut; 12 cuts per ft. on Mills Knife

From ft. to ft.

730' to 800' Machine Cut Perforations

400' to 730' Mills Knife Perforations

250 - 400 MILLS KNIFE

(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 120'

Standing level before perforating

Standing level after perforating 120'

(10) WELL TESTS:

Was a pump test made? ☐ Yes ☐ No If yes, by whom?

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

Temperature of water Was a chemical analysis made?

(11) WELL LOG:

Total depth 806 ft. Depth of completed well 806

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

From ft.	to ft.	Formation
0	30	Top Soil
30	40	Sand and gravel
40	75	Sandy Clay
75	102	Boulders
102	106	Coarse Sand
106	116	Clay
116	121	Sand
121	134	Sandy Clay
134	150	Boulders
150	224	Brown Clay
224	272	Coarse Sand
272	284	Brown Clay
284	302	Coarse Sand
302	337	Boulders
337	346	Coarse Sand
346	382	Sandy Clay
382	407	Gravel
407	422	Sandy Clay
422	438	Sand and gravel
438	455	Hard Rock
455	485	Blue Clay
485	500	Brown Clay
500	510	Hard Rock
510	590	Sand and gravel
590	632	Sandy Clay
632	650	Tight packed sand
650	655	Red Clay
655	673	Sand and gravel
673	689	Boulders
689	700	Sand and gravel
700	806	Red clay

PUMPING LEVELS

GPM	FT.	Static Level
717	135'	130 Ft.
[illegible]	150'	
1200	155'	
[illegible]	165'	
1401	167'	
[illegible]	172'	
[illegible]	150'	
1727	175'	

Work started 5/8/57 Completed 6/21/57

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 McCalla Brothers, Inc.

Address 9210 West Colon Avenue

Santa Fe, Calif.

[Signed] Robert J. McCalla

License No. C 57 196806 Dated 9 August

LOCATION OF WELL ON

Appendix A

ORIGINAL APR 30 1974
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do Not Fill In
Nº 83641
State Well No. 1S/8W-35
Other Well No.

(1) OWNER:
Name City of Chino
Address P. O. Box 67
Chino, CA 91710

(2) LOCATION OF WELL:
County San Bernardino Owner's number, if any No. 9
Township, Range, and Section
Distance from cities, roads, railroads, etc. 1320' South of Francis and 660' West of Benson

(3) TYPE OF WORK (check):
New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic [ ] Industrial [ ] Municipal [X]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:
Rotary [X]
Cable [ ]
Other [ ]

(6) CASING INSTALLED:
STEEL: OTHER:
SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	If gravel packed From ft.	To ft.
0	100'	30"	5/16	36	1	100
1	1050	16"	5/16	27	100	1050

Size of shoe or well ring: SE Head Size of gravel: 5/32-Special
Describe joint Welded Collars

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen Roscoe Moss Full Flow

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
310	1030	12	12	3/32 X 2 1/2

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes [X] No [ ] To what depth 100 ft.
Were any strata sealed against pollution? Yes [ ] No [ ] If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing Cement in Place

(9) WATER LEVELS:
Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing 270 ft.

(10) WELL TESTS:
Was pump test made? Yes [X] No [ ] If yes, by whom? McCalla Bros.
Yield: 2960 gal./min. with 53 ft. drawdown after 100 hrs.
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]
Was electric log made of well? Yes [X] No [ ] If yes, attach copy

(11) WELL LOG:
Total depth 1200 ft. Depth of completed well 1050 ft.
Formation: *Describe by color, character, size of material, and structure*

From	To	Formation
0	4	Top Soil
4	30	Sand
30	35	Sandy Clay
35	145	Gravel
145	150	Gravel-Rocks
150	180	Sand - Gravel
180	187	Sandy Brown Clay
187	217	Sand - Gravel
217	258	Sand
258	262	Sandy Clay
262	267	Sandy & Clay
267	290	Sand and Gravel
290	304	Clay-Streaks of Rocks
304	306	Gravel
306	310	Sandy Clay
310	334	Sand - Clay
334	344	Clay
344	354	Clay
354	373	Sand - Gravel
373	388	Sandy Clay
388	429	Gravel
429	439	Clay
439	459	Sandy Clay
459	479	Gravel
479	517	Brown Clay
517	525	Sand and Gravel
525	565	Clay
565	575	Sandy Clay
575	665	Clay
665	675	Gravel
675	740	Sandy Clay
740	741	Rocks
741	760	Sandy Clay
760	775	Sand and Gravel
775	785	Clay
785	795	Sandy Clay
795	855	Sandy Clay

Continued on back page.

Work started 12-17-73, Completed 2-25-74

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 McCalla Bros., Inc.
(Person, firm, or corporation) (*Typed or printed*)
Address 3819 W. First Street
Santa Ana, CA 92703
[SIGNED] [signature]
(*Well Driller*)
License No. 196824 Dated April 8, 1974

SKETCH LOCATION OF WELL ON REVERSE SIDE

OVER

DWR 188 (REV. 9-68)
25179-950 9-68 50M TRIP ΔDC

JUN 30 1975

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do Not Fill In
№ 80033
State Well No. 1S/8W-35C5
Other Well No.

(1) OWNER:
Name City of Chino
Address P. O. Box 667
Chino, CA 91710

(2) LOCATION OF WELL:
County San Bernardino Owner's number, if any Wll No. 10
Township, Range, and Section City of Chino
Distance from cities, roads, railroads, etc. 100' West of Central Ave. and 500' South of Phillips

(3) TYPE OF WORK (check):
New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]
If destruction, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic [ ] Industrial [ ] Municipal [X]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:
Rotary [X]
Cable [ ]
Other [ ]

(6) CASING INSTALLED:
STEEL: OTHER:
SINGLE [X] DOUBLE [ ]

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft. (if gravel packed)	To ft. (if gravel packed)
0	1090	16"	5/16"	28"	0	1090

Size of shoe or well ring: SE Head Size of gravel: Special 3/8"
Describe joint Lap Weld with Collars

(7) PERFORATIONS OR SCREEN:
Type of perforation or name of screen Roscoe Moss Full Flow

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
355	380	10	4.5	3/32 X 2 1/2
420	440	"	"	"
460	485	"	"	"
502	525	"	"	"
750	770	"	"	"
790	800	"	"	"
890	1090	"	"	"

(8) CONSTRUCTION:
Was a surface sanitary seal provided? Yes [X] No [ ] To what depth 100 ft.
Were any strata sealed against pollution? Yes [ ] No [X] If yes, note depth of strata
From ft. to ft.
From ft. to ft.
Method of sealing 30" Conductor Cemented in Place

(9) WATER LEVELS:
Depth at which water was first found, if known ft.
Standing level before perforating, if known ft.
Standing level after perforating and developing 321 ft.

(10) WELL TESTS:
Was pump test made? Yes [X] No [ ] If yes, by whom? McCallaBros.
Yield: 2750 gal./min. with 110 ft. drawdown after 76 hrs.
Temperature of water Was a chemical analysis made? Yes [ ] No [X]
Was electric log made of well? Yes [X] No [ ] If yes, attach copy N/A

(11) WELL LOG:
Total depth 1150 ft. Depth of completed well 1090 ft.
Formation: Describe by color, character, size of material, and structure

From ft.	To ft.	Formation	
0	6	Top Soil	
6	15	Sand	
15	88	Sand - Gravel	
88	100	Gravel - Clay Streak	
100	245	Gravel and Brown Rock	
245	260	Gravel with Clay	
260	270	Sand and Gravel	
270	275	Sandy Clay- Brown	5
275	286	Sand-Gravel	
286	310	Sandy Clay-Brown	24
310	330	Gravel - Coarse	
330	346	Gravel - Rocks	
346	352	Sandy Clay - Brown	6
352	372	Gravel - Coarse and Brown Rock	
372	410	Sandy Clay	38
410	415	Gravel	
415	420	Clay - Brown	5
420	441	Gravel - Rocks	
441	447	Clay	6
447	485	Gravel - Brown Rock	
485	502	Clay	17
502	510	Gravel	
510	517	Clay	7
517	526	Gravel	
526	560	Clay	34
560	566	Gravel	
566	705	Sandy Clay - Brown	139

Continued on reverse side

TEST PUMP DATA

GPM	Pumping Level
2760	429'
2420	416
2100	404
1620	390
1350	380

CONFIDENTIAL - NOT FOR PUBLIC RELEASE

Work started 3-11-75 19 , Completed 4-15-75

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 McCalla Bros., Inc.
(Person, firm, or corporation) (Typed or printed)
Address 3819 W. First Street
Santa Ana, CA 92703
[SIGNED] (signature)
(Well Driller)
License No. 196824 Dated June 30, 1975, 19

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

OVER

25179-950 9-68 50M TRIP ΔD OSP

Log has been #Appendix A
35C06 and 35C07

Do not fill in

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

No. 074360

Notice of Intent No. ________
Local Permit No. or Date ________

State Well No. 01S/08W-35C
Other Well No. ________

(1) OWNER: Name City of Chino
Address P. O. Box 667
City Chino, CA Zip 91710

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 12
Well address if different from above ________
Township ________ Range ________ Section ________
Distance from cities, roads, railroads, fences, etc.
400' West of Central
200' South of Phillips

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☒
Other ☐

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 3/8" Spec.
Diameter of bore 30"
Packed from 0 to 1170 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
R/M Horizontal Louvre
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	100	32	1/4	420	1150	3/32
0	1170	18	5/16			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ________ ft.
Method of sealing 32" Steel Cond. Cemented in Place

(10) WATER LEVELS:
Depth of first water, if known ________ ft.
Standing level after well completion 305 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? McCalla Bros.
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test ____ ft. At end of test ____ ft
Discharge 4000 gal/min after 92 hours Water temperature ________
Chemical analysis made? Yes ☐ No ☐ If yes, by whom? ________
Was electric log made? Yes ☒ No ☐ If yes, attach copy to this report N/A

(12) WELL LOG: Total depth 1200 ft. Depth of completed well 1170 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	100	Sand, gravel, boulders @ 35'
100	115	Sand and small gravel
115	120	Coarse gravel and sand
120	140	Red clay and gravel streaks
140	150	Sand and gravel, coarse
150	240	Sandy clay and gravel (tight)
240	255	Boulders, snad and gravel
255	265	Coarse sand and gravel
265	315	Streaks of clay and sand
315	420	Sand and coarse gravel
420	430	Sandy clay
430	450	Sandy and gravel clay streaks
450	500	Sand and gravel, fine and coarse
500	535	Sand and gravel, fine and coarse-
535	550	Clay with clay streak
550	560	Sand and gravel, fine and coarse-
560	630	Sandy clay (tigh)and clay
630	635	Sand and gravel, coasre
635	810	Sand, clay and gravel streaks
810	820	Sand and coarse gravel
820	850	Sand coarse and clay (tight)
850	915	Sand, gravel and clay streaks
915	988	Sand, gravel and boulders, clay s
988	990	Clay
990	1150	Sand, clay and gravel streaks
1150	1170	Sandy clay
1170	1180	Sandy clay, gravel streaks, coar

Work started Dec. 6 1982 Completed Jan. 7 198

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED [signature] (Well Driller)

NAME McCalla Bros.
(Person, firm, or corporation) (Typed or printed)
Address 3819 W. First St.
City Santa Ana, CA Zip 92703
License No. 196824 Date of this report 1/14/83

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

IGINAL
with DWR
ntent No.
it No. or Date

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill
No. 158764
State Well No. 02S/08W12
Other Well No. 12K

OWNER: Name City of Chino
ress P.O. Box 667
Chino, CA Zip 91710

LOCATION OF WELL (See instructions):
nty San Bernardino Owner's Well Number 13
address if different from above
nship 2S Range 8W Section 12
ance from cities, roads, railroads, fences, etc.
500' W. Mountain
100' S. Chino

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☒
Other ☐

EQUIPMENT:
ary ☒ Reverse ☐
le ☐ Air ☐
er ☐ Bucket ☐

(6) GRAVEL PACK: Monterey
Yes ☒ No ☐ Size 6 x 12
Diameter of bore 28"
Packed from 270 to 740 ft.

CASING INSTALLED:
l ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen: Wire wrap screen.

rom ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	740	18	5/16	290	360	.060
				410	430	
				460	560	
				600	720	

WELL SEAL:
s surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 60 ft.
re strata sealed against pollution? Yes ☒ No ☐ Interval 0 to 270'
hod of sealing 34" Conductor cemented in place

WATER LEVELS:
th of first water, if known ft.
nding level after well completion 160' ft.

WELL TESTS:
s well test made? Yes ☒ No ☐ If yes, by whom? McCalla Bros.
e of test Pump ☐ Bailer ☐ Air lift ☐
th to water at start of test ft. At end of test ft
3000 gal/min after 32 hours Water temperature
alysis made? Yes ☒ No ☐ If yes, by whom?
s electric log made? Yes ☒ No ☐ If yes, attach copy to this report N.A.

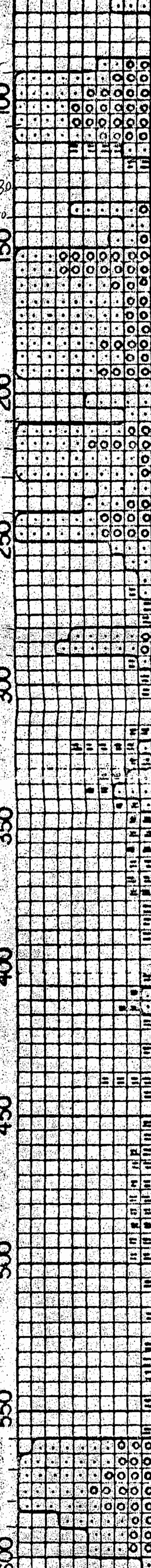
(12) WELL LOG: Total depth 1185 ft. Depth of completed well 740

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	20	Sandy Clay
20	112	Sandy Clay & Small Gravel
112	147	Sand, Gravel to 1" & Clay
147	162	Sand & Gravel
162	174	Sand, Gravel & Clay
174	182	Sand & Gravel to 3"
182	198	Sand, Gravel & Clay
198	205	Sand & Gravel to 4"
205	272	Clay & Sand
272	312	Sand & Gravel to 2" & Some Clay
312	325	Sand, Gravel & Clay
325	358	Sand, Gravel to 2" & Some Clay
358	400	Sand, Gravel & Clay
400	425	Sand, Gravel to 3" x Less Clay
425	447	Sand, Gravel & Clay
447	466	Sand, Gravel to 2", Less Clay
466	492	Sand, Gravel & Clay
492	558	Clay, Gravel & Little Sand
558	589	Very Dense Rock Pan & Clay Strip
589	621	Clay & Sand Stripe & ¼" Gravel
621	652	Clay & Sand
652	710	Sandy Clay
710	742	Gravely Clay
742	777	Clay
777	790	Sandy Clay
790	820	Sandy Clay, Stripe of Rock
820	850	Gravel & Clay
850	873	Sand, Clay & Gravel, ½"
873	968	Gravel Pan & Clay
968	999	Lrg. Rock Strips, Sand & Gravel,

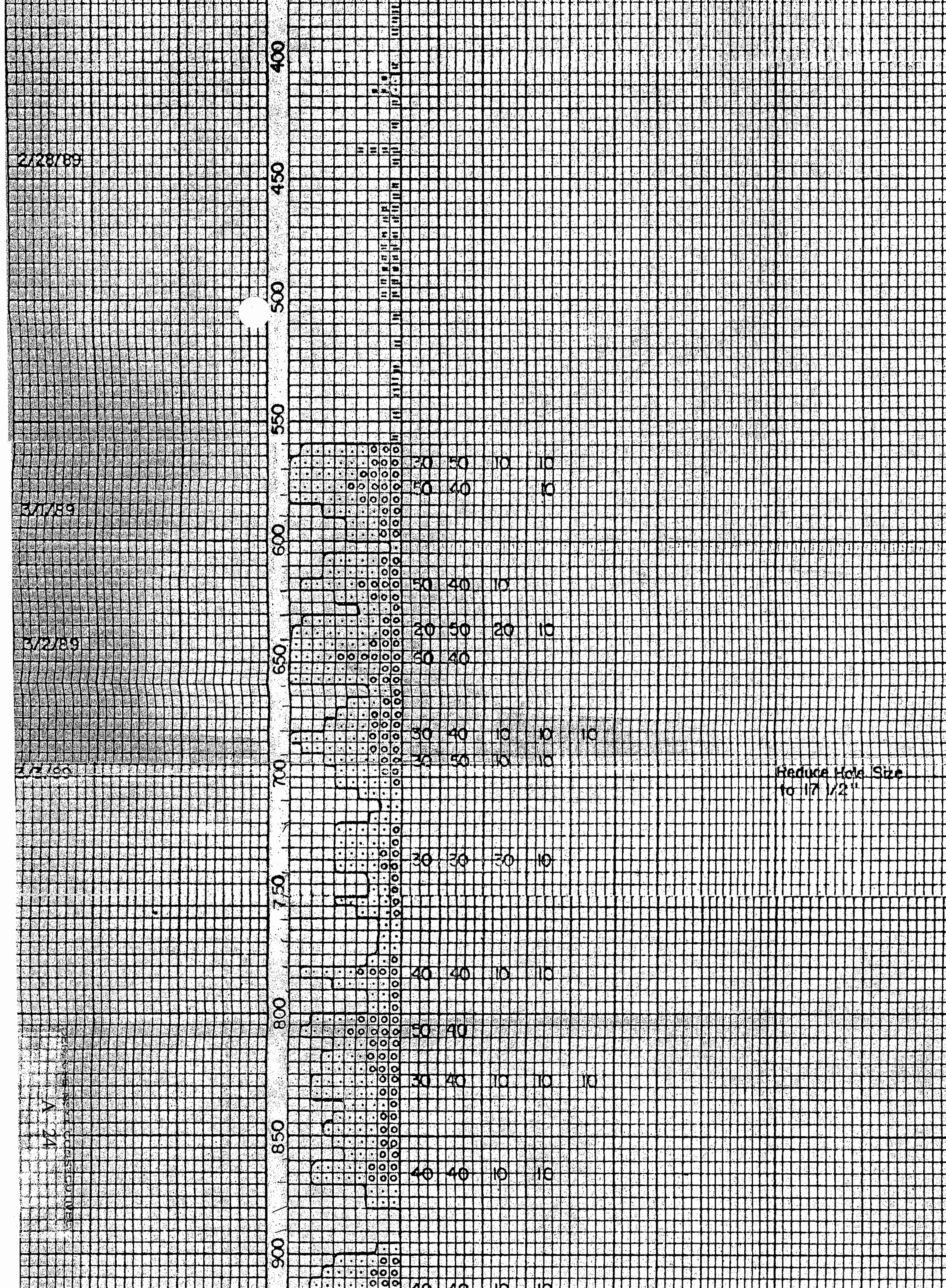
Work started 7-28 1987 Completed 8-24 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
SIGNED [signature] (Well Driller)
NAME McCalla Bros.
(Person, firm, or corporation) (Typed or printed)
Address 3132 W. 17th St.
City Santa Ana, CA Zip 92703
License No. 196824 Date of this report 9-30-87

R 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM



Date	Depth (ft)	Percentages	Remarks	Description
				Clay: yellow grey, soft solubl
2/25/89	100	60 40	Set 30" Conductor at 100'. Drilling 23" Hole	Coarse gravels and cobbles up to 4", unconsolidated.
	130, 140			Clay: yellowish grey brown.
2/26/89	150	70 30	Use bentonite based mud to stop gravels from caving	Cobbles and boulders at 160'.
		20 60 10 10; 40 50 10		Gravel: multicolored, unconsolidated, granitics and lithics, coarse sand matrix.
2/27/89	200	50 50; 10 70 10 10; 40 40 10 10		Gravel: multicolored, as above, predominately coarse quartz sand at 230', some thin brown clay interbeds.
	250			Clay: brown, soft, silty.
		20 40 10 20 10		Sand: coarse quartz lense in brown clay matrix.
	300			Clay: brown clay with streaks of dark brown sandy silt at 325' and 340'.
	350			Clay: brown, soft-firm, slightly silty in part, soluble-insoluble, massive.
	400			Clay: brown, firm, increase in brown silt at 440'.
2/28/89	450			Clay: brown, silty, firm.
	500			Clay: brown, with occasional dark brown silty lenses.
3/1/89	550, 600	30 50 10 10; 50 40 10		Sand and Gravel: clean and unconsolidated coarse sands and gravels, granitics and quartzites, subangular-rounded, occasional cobbles,



tly silty in part, soluble-insoluble, massive.

Clay: brown, firm, increase in brown silt at 440'.

Clay: brown, silty, firm.

Clay: brown, with occasional dark brown silty lenses.

Sand and Gravel: clean and unconsolidated coarse sands and gravels, granitics and quartzites, subangular-rounded, occasional cobbles, with thin brown clay lenses and streaks, becoming more massive and coarse at 650'.

Clay: brown, very sandy.

Gravel and Sand: multicolored granitics/quartz/and lithic fragments, poorly sorted-well graded, brown clay matrix, with clay interbeds.

Clay: brown, soluble, silty and sandy.

Coarse gravel streak at 810'.

Gravel and Sand: fine-coarse grained granitics-quartz-and lithic fragments, angular-rounded, brown clay matrix.

Clay: color change in clay to grey green at 870'.

Gravel: multicolored gravels

025/08W ~~23M04S~~ changed to 23D **Appendix A**

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

ORIGINAL
File with DWR

Do not fill in

No. 294142

Notice of Intent No. ____
Local Permit No. or Date ____

State Well No. 025/08W-23 ~~M04~~ D02
Other Well No. ____

(1) OWNER: Name San Bernardino County Water Dist. #8
Address 14575 Pipeline
City Chino, CA ZIP 91710

(2) LOCATION OF WELL (See instructions):
County ~~Riverside~~ 36 (SB.) Owner's Well Number 14
Well address if different from above ____
Township ____ Range ____ Section ____
Distance from cities, roads, railroads, fences, etc.
1320' S. Eucalyptus
100' E. Monte Vista

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [X]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Municipal [X]
Other [ ]
(Describe)

(5) EQUIPMENT:
Rotary [ ] Reverse [X]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK: 5/8 Special
Yes [X] No [ ] Size
Diameter of bore 28"
Packed from 320 to 880 ft.

(7) CASING INSTALLED:
Steel [X] Plastic [ ] Concrete [ ]

(8) PERFORATIONS: Roscoe Moss Horiz. Louver Full Flow
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	880	16	5/16	350	860	3/32
0	340	4	Std.			
0	340	2	Std.			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 100 ft.
Were strata sealed against pollution? Yes [X] No [ ] Interval 0 - 320 ft.
Method of sealing ____

(10) WATER LEVELS:
Depth of first water, if known ____ ft.
Standing level after well completion 158 ft.

(11) WELL TESTS:
Was well test made? Yes [X] No [ ] If yes, by whom? McCalla Bros. ~~100~~
Type of test Pump [X] Bailer [ ] Air lift [ ]
Depth to water at start of test ____ ft. At end of test ____ ft.
Discharge 600 gal/min after 51 hours Water temperature ____
Chemical analysis made? Yes [ ] No [X] If yes, by whom? ____
Was electric log made Yes [X] No [ ] If yes, attach copy to this report N/A

(12) WELL LOG: Total depth 880 ft. Completed depth 880 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	10	Sand
10	50	Sand w/Sm. Gravel & Clay
50	60	Sandy Clay
60	70	Sand, Clay & Gravel
70	120	Sand & Clay
120	130	Sand, Clay & Rock
130	150	Clay
150	160	Sandy Clay
160	170	Sand, Clay & Gravel Rock
170	180	Sandy Clay
180	200	Clay
200	210	Sandy Clay & Gravel
210	300	Clay
300	320	Sand, Gravel & Rock
320	340	Clay
340	350	Sand & Clay
350	360	Clay
360	370	Some Sand & Clay
370	410	Clay
410	440	Gravel & Clay
440	450	Clay
450	490	Gravel & Clay
490	500	Large Gravel & Clay
500	510	Sand & Gravel
510	540	Sand, Clay & Gravel
540	550	Gravel & Some Clay
550	620	Sand & Clay
620	640	Grey Clay
640	660	Clay
660	690	Grey Clay
690	700	Grey Clay & Grey Rock
700	710	Grey Clay
710	780	Sandy Clay & Gravel
780	810	Sand & Clay
810	880	Sandy Clay & Gravel

Work started 2-17 1989 Completed 3-21 1989

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed [signature] (Well Driller)
NAME McCalla Bros., Div. of Layne-Western Co. (Person, firm, or corporation) (Typed or printed)
Address 3132 W. 17th St.
City Santa Ana, CA ZIP 92703
License No. 510011 Date of this report 7-13-89

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

No. 344026

State Well No. 02S/08W 23 C06
Other Well No.

Notice of Intent No.
Local Permit No. or Date 07078905

(1) OWNER: Name San Bernardino Co. Dist. #8
Address 14575 Pipeline
City Chino, CA ZIP 91710

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 15A
Well address if different from above Eucalyptus & Telephone
Township 2S Range 8W Section 23
Distance from cities, roads, railroads, fences, etc.
50' S. of Eucalyptus
50' E of Telephone

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 5/16x4
Diameter of bore 28"
Packed from 330 to 900 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	900	16		360	440	3/32
				480	900	3/32

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 330 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.
Method of sealing Cement

(10) WATER LEVELS:
Depth of first water, if known 123 ft.
Standing level after well completion 123 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? McCalla
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 123 ft. At end of test 180 ft.
Discharge 2000 gal/min after 55 hours Water temperature
Chemical analysis made? Yes ☐ No ☐ If yes, by whom?
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1000 ft. Completed depth 900 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	55	Top Soil & Sand
55	100	Sand & Clay
100	110	Clay
110	170	Fine Sand
170	180	Fine Sand & Clay
180	220	Clay, Gravel
220	280	Sand & Clay
280	310	Sand, Clay & Gravel
310	340	Sand & Clay
340	360	Sand, Clay & Gravel
360	400	Sand & Gravel
400	490	Sand & Clay
490	500	Sand, Clay & Gravel
500	520	Sand & Gravel
520	600	Sand, Clay & Gravel
600	620	Clay
620	640	Clay & Sand
640	680	Sand, Gravel & Clay
680	700	Sand & Clay
700	720	Sand & Gravel
720	850	Sand, Gravel & Clay
850	880	Clay
880	940	Clay & Some Gravel
940	980	Sand, Gravel & Clay
980	1000	Clay & Sand

Work started 7-12 19 89 Completed 9-21 198

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed [signature] (Well Driller)
NAME McCalla Div. of Layne-Western
(Person, firm, or corporation) (Typed or printed)
Address P.O. Box 13990
City Palm Desert, CA ZIP 92255-39
License No. 510011 Date of this report 10-02-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

DWR 188 (REV. 12-86)

Appendix A

QUADRUPLICATE
Use to comply with local requirements

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

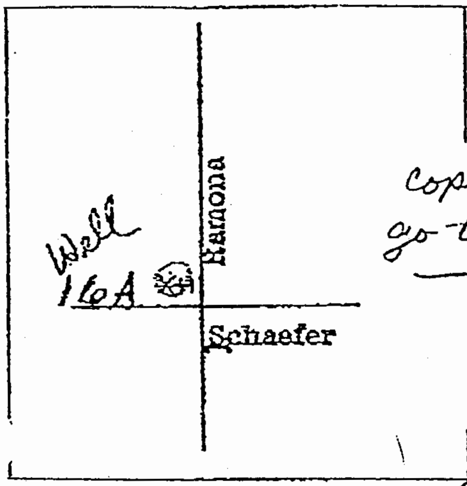
Do not fill in
No. 289291

Notice of Intent No. ______
Local Permit No. or Date 03288908

State Well No. ______
Other Well No. ______

(1) OWNER: Name San Bernardino County Dist.8
Address 14575 Pipeline Avenue
City Chino, California ZIP 91709

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 16A
Well address if different from above
Township 2N Range 8W Section 10
Distance from cities, roads, railroads, fences, etc.
100 ft. N. of Schaefer St.
and 100 ft. West of Ramona



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Other (Describe)

copy needs to go to DWR.

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK: All American Aggregates
Yes ☒ No ☐ Size 5/16 x 4
Diameter of bore 36"
Packed from 300 to 960 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	430	16"	.312	430	940	.080
940	960	16"	.312			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 300 ft.
Method of sealing cement grout seal

(10) WATER LEVELS:
Depth of first water, if known 210 ft.
Standing level after well completion 196 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 198 ft. At end of test 196 ft.
Discharge 1750 gal/min after 24 hours Water temperature
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Babcock Labs
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 980 ft. Completed depth 960 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	100 ft.	big rock and med. gravel
100	120 ft.	med. gravel
120	130 ft.	small and med. gravel
130	150 ft.	clay
150	160 ft.	gravel
160	170 ft.	clay
170	190 ft.	sandy clay, small gravel
190	220 ft.	soft clay
220	230 ft.	gravel and clay
230	240 ft.	clay
240	250 ft.	firm clay
250	280 ft.	soft clay
280	290 ft.	firm clay
290	300 ft.	firm clay with large rocks
300	330 ft.	sticky clay
330	350 ft.	hard brown clay
350	370 ft.	brown clay
370	380 ft.	med. clay
380	420 ft.	clay
420	440 ft.	firm clay
440	450 ft.	firm clay, small rocks
450	560 ft.	clay
560	570 ft.	pea gravel, small rocks
570	590 ft.	hard clay, some fine gravel
590	600 ft.	soft clay, gravel, small rocks
600	610 ft.	gravel
610	620 ft.	clay, sandy
620	640 ft.	fine gravel, some clay
640	650 ft.	small gravel, some clay
650	660 ft.	small gravel, some clay
660	690 ft.	gravel and small rock
690	710 ft.	soft clay
710	720 ft.	hard brown clay
720	730 ft.	gravel and rock
730	740 ft.	sand and gravel
740	750 ft.	sand, gravel and rock
750	760 ft.	sand and gravel
760	770 ft.	small bits clay, gravel/small ro

continued on No. 289292 Page 2..............

Work started March 23 19 89 Completed April 9 19 89

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed [signature] (Well Driller)
NAME BEYLIK DRILLING, INC. (Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, California ZIP 90631
License No. 306291 C57&C-61 Date of this report Aug. 9,19

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Appendix A

Page 2 See Also Pg #28 *Do not fill in*

QUADRUPLICATE
Use to comply with local requirements

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

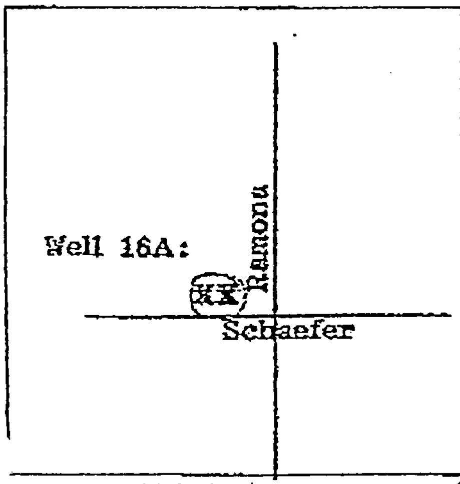
No. 289292

Notice of Intent No. ______
Local Permit No. or Date 03288908

State Well No. ______
Other Well No. ______

(1) OWNER: Name San Bernardino County Dist.8
Address 14575 Pipeline Avenue
City Chino, California ZIP 91709

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 16A
Well address if different from above ______
Township 2N Range 8W Section 10
Distance from cities, roads, railroads, fences, etc. of Schaefer St.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK: All American Aggregates
Yes ☒ No ☐ Size 5/16 x 4
Diameter of bore 26"
Packed from 300 to ______ ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	430	16"	.312	430	940	.080
940	960	16"	.312			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 300 ft.
Method of sealing cement grout seal

(10) WATER LEVELS:
Depth of first water, if known 210 ft.
Standing level after well completion 196 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 196 ft. At end of test 196 ft.
Discharge 1750 gal/min after 24 hours Water temperature ______
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Babcock Labs
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 980 ft. Completed depth 960 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
770	780 ft.	clay, gravel and small rock
780	790 ft.	clay and gravle
790	800 ft.	gravel and small rock
800	830 ft.	dry sandy clay and gravel
830	850 ft.	gravel, small rocks/sand/cla
850	860 ft.	gravel, small rocks
860	870 ft.	gravel and rocks
870	880 ft.	hard clay, sand
880	890 ft.	black clay
890	900 ft.	black clay and gravel
900	910 ft.	clay and gravel
910	920 ft.	gravel, large
920	950 ft.	gravel and small rock
950	960 ft.	gravel and soft gray clay
960	970 ft.	soft clay and gravel
970	980 ft.	soft gray clay

NOT PUBLIC INFORMATION WATER CODE SEC. 13752

Work started March 23 19 89 Completed April 9 19 89

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed ______ (Well Driller)
NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, California ZIP 90631
License No. 306291-C57 &C61 Date of this report Aug. 9,1

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

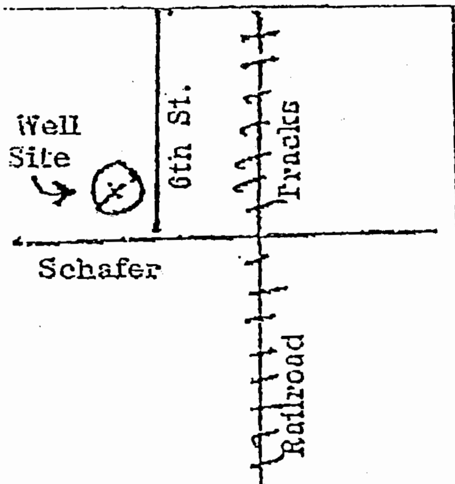
No. 289359

Notice of Intent No. ______
Local Permit No. or Date ______

State Well No. ______
Other Well No. ______

(1) OWNER: Name San Bernardino County Water Dist #8
Address 14575 Pipeline Ave
City Chino, Calif. ZIP 91709

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 17A
Well address if different from above ______
Township 2S Range 8 W Section 11
Distance from cities, roads, railroads, fences, etc. well site approx. 150' west of railroad tracks



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐ (Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 5/16 x4
Diameter of bore 28"
Packed from 200 to 1000 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen Ful Flo

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	300	16	.312	300	460	.080
460	500	16	.312	500	980	.080
980	1000	16	.312			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 - 200 ft.
Method of sealing cement grout seal

(10) WATER LEVELS:
Depth of first water, if known 138 ft.
Standing level after well completion ______ ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 138 ft. At end of test 138 ft.
Discharge 2800 gal/min after 8 hours Water temperature ______
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Babcock Labs
Was electric log made Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth ______ ft. Completed depth ______ ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	100 ft.	sand
100	110 ft.	sand/gravel
110	120 ft.	clay and gravel/sand
120	140 ft.	sand and gravel
140	160 ft.	sand
160	170 ft.	sand and clay
170	200 ft.	clay
200	260 ft.	rock, gravel and some clay
260	270 ft.	clay
270	280 ft.	rock and gravel
280	290 ft.	sand and clay
290	300 ft.	clay, sand and gravel
300	310 ft.	clay and gravel
310	330 ft.	gravel and rock
330	400 ft.	clay
400	410 ft.	gravel
410	430 ft.	clay, rock, some gravel
430	460 ft.	rock, gravel/clay
460	470 ft.	clay and sand
460	500 ft.	clay
500	510 ft.	gravel and rock
510	520 ft.	clay
520	540 ft.	clay and gravel
540	550 ft.	clay
550	590 ft.	gravel and clay
580	600 ft.	clay and sand
600	630 ft.	clay
630	650 ft.	gravel and rock
650	660 ft.	gravel and clay
660	680 ft.	sand, gravel and rock
680	720 ft.	sand, gravel and rock
720	730 ft.	clay
730	740 ft.	clay and gravel
740	800 ft.	gravel and rock
800	810 ft.	clay and gravel
810	830 ft.	gravel, rock and clay
830	850 ft.	gravel and clay
850	860 ft.	gravel, rock and clay
860	870 ft.	clay and gravel

* continued on NO. 289360 - Page 2....

Work started Aug. 11, 1989 Completed Aug. 29, 1989

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Dean Marshall (Well Driller)

NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, Calif. ZIP 90631
License No. 306291 C57&C61 Date of this report Dec. 27, 198

A-29

NOTE: THIS IS PAGE 2 of 2 pages
See No. 289359 , Page #1

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STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

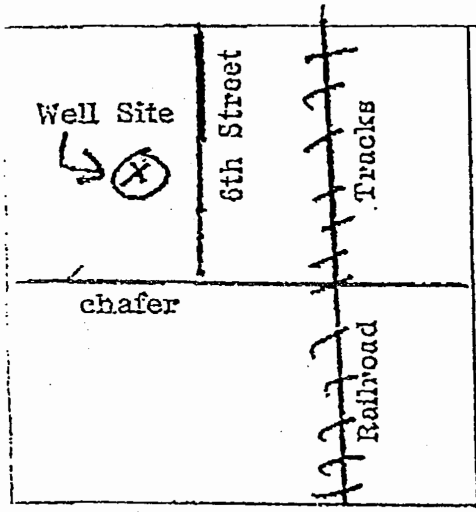
No. 289360

Notice of Intent No. ____
Local Permit No. or Date ____

State Well No. ____
Other Well No. ____

(1) OWNER: Name San Bernardino County Water Dist. #8
Address 14575 Pipeline Ave.
City Chino, California ZIP 91709

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 17A
Well address if different from above ____
Township 2S Range 8W Section 11
Distance from cities, roads, railroads, fences, etc.
well site approx. 150' west of Railroad Tracks



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☒
Irrigation ☒
Industrial ☐
Test Well ☐
Municipal ☒
Other ☒
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 5/16 x 4
Diameter of bore 28"
Packed from 200 to 1000 ft.

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS: ful-flo
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	300	16	.312	300	460	.080
460	500	16	.312	500	980	.080
980	1000	16	.312			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☐ No ☐ Interval 0 - 200 ft.
Method of sealing cement grout seal

(10) WATER LEVELS:
Depth of first water, if known 138 ft.
Standing level after well completion ____ ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 138 At end of test 138 ft.
Discharge 2800 gal/min after 8 hours Water temperature ____
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Babcock Labs
Was electric log made? Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1000 ft. Completed depth 1080 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
870	880 ft.	gravel, clay and rock
880	910 ft.	gravel and clay
910	920 ft.	clay, gravel and rock
920	930 ft.	clay, and gravel
930	940 ft.	clay, gravel and rock
940	990 ft.	gravel and clay
990	1000 ft.	gravel, clay and rock

Work started Aug. 11, 1989 Completed Aug 29, 1989

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Dean Marshall
(Well Driller)

NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, Calif. ZIP 90631
License No. 306291 C57 &C-61 Date of this report Dec. 27,19

GINAL
with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

Do not fill in

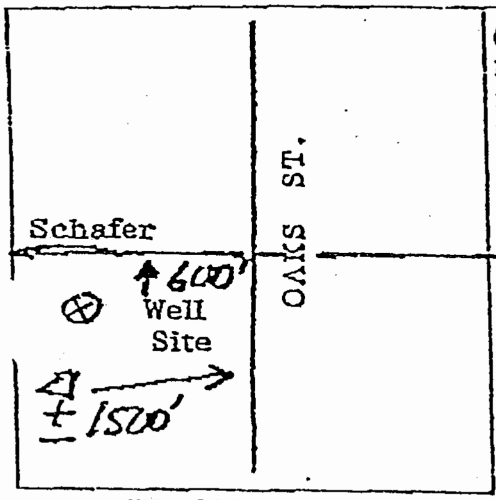
No. 289358

Notice of Intent No. ________
Local Permit No. or Date ________

State Well No. ________
Other Well No. ________

(1) OWNER: Name San Bernardino County Water Dist.
Address 14575 PipelineAve.
City Chino, Calif. ZIP 91709

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 18A
Well address if different from above ________
Township 2S Range 8W Section 10
Distance from cities, roads, railroads, fences, etc. ________



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐
(Describe)

(5) EQUIPMENT:
Rotary ☐ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 5716x4
Diameter of bore 28"
Packed from 300' to 1000

(7) CASING INSTALLED:
Steel ☒ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen Ful-flo

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	420	16	.312	420	460	.080
460	480	16	.312	480	980	.080
980	1000	16	.312			

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 100 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 0 – 300 ft.
Method of sealing cement grout seal

(10) WATER LEVELS:
Depth of first water, if known 169 ft.
Standing level after well completion 169 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Beylik Drilling
Type of test Pump ☒ Bailer ☐ Air lift ☐
Depth to water at start of test 170 ft. At end of test 170 ft.
Discharge 1600 gal/min after 8 hours Water temperature ________
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? Babcock Lab
Was electric log made? Yes ☒ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth 1080 ft. Completed depth 1000 ft.

from ft. to ft.	Formation (Describe by color, character, size or material)
0 – 60 ft.	sand, clay
60 – 100 ft.	clay, sand
100 – 190 ft.	gravel, clay
190 – 200 ft.	clay
200 – 220 ft.	clay, gravel
220 – 250 ft.	gravel
250 – 260 ft.	gravel, clay
260 – 280 ft.	clay
280 – 320 ft.	gravel
320 – 350 ft.	gravel, sand
350 – 390 ft.	sand
390 – 420 ft.	clay
420 – 460 ft.	sand, gravel and clay
460 – 470 ft.	clay
470 – 500 ft.	gravel, sand
500 – 520 ft.	clay, sand
520 – 550 ft.	sand, gravel and rock
550 – 610 ft.	gravel and sand
610 – 640 ft.	clay
640 – 680 ft.	clay, granite, gravel
680 – 720 ft.	gravel, clay
720 – 730 ft.	clay
730 – 850 ft.	gravel, sand and clay
850 – 960 ft.	clay, gravel, granite
960 – 1000 ft.	clay, gravel
1000 – 1080 ft.	gravel, clay, rock

Work started Aug 29, 1989 Completed Sept. 11, 1989

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Dean Marshall
(Well Driller)
NAME BEYLIK DRILLING, INC.
(Person, firm, or corporation) (Typed or printed)
Address 591 S. Walnut Street
City La Habra, Calif. ZIP 90631
License No. 306291 C57 & C61 Date of this report Dec.27,1989

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in

No. 321931

Notice of Intent No. ______
Local Permit No. or Date 10318905

State Well No. ______
Other Well No. ______

(1) OWNER: Name San Bernardino Dist. #8
Address 14575 Pipeline
City Chino, CA ZIP 91710

(2) LOCATION OF WELL (See instructions):
County San Bernardino Owner's Well Number 19
Well address if different from above Central & Anderson
Township 2S Range 8W Section 14
Distance from cities, roads, railroads, fences, etc.
150' E of Central
75' N. of Anderson

WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☒
Other ☐ (Describe)

(5) EQUIPMENT:
Rotary ☒ Reverse ☒
Cable ☐ Air ☐
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size 5/16x8
Diameter of bore 28"
Packed from 290 to 1010

(7) CASING INSTALLED:
Steel ☐ Plastic ☐ Concrete ☐

(8) PERFORATIONS:
Type of perforation or size of screen

From ft	To ft	Dia. in.	Gage or Wall	From ft	To ft	Slot size
0	1010	18	5/16	340	420	3/32
				460	760	3/32
				800	1000	3/32

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 290 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval ______ ft.
Method of sealing Concrete

(10) WATER LEVELS:
Depth of first water, if known 60 ft.
Standing level after well completion 130 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? McCalla
Type of test Pump ☐ Bailer ☐ Air lift ☐
Depth to water at start of test 130 ft. At end of test 155 ft.
Discharge 3600 gal/min after 48 hours Water temperature ______
Chemical analysis made? Yes ☒ No ☐ If yes, by whom? ______
Was electric log made Yes ☒ No ☐ If yes attach copy to this report

(12) WELL LOG: Total depth 1010 ft. Completed depth 1000 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	50	Top Soil & Sand
50	60	Sand Clay
60	70	Clay
70	80	Sand, Gravel & Little bit Clay
80	90	Sand & Gravel
90	104	Gravel & Small Rocks
104	140	Sandy Brown Clay
140	150	Sand, Gravel & Rocks
150	160	Sand, Gravel, Rocks & Some Clay
160	170	Sand
170	200	Sand & Clay
200	210	Brown Clay
210	230	Fine Sand
230	300	Sand, Gravel & Rocks
300	340	Fine to Coarse Sand & Clay
340	350	Brown Clay, Little Sand
350	360	Sand Gravel, Rocks & Clay
360	390	Sandy Clay
390	410	Gravel & Rocks
410	450	Clay
450	500	Sand Gravel & Rocks
500	520	Clay-Brown
520	540	Sand Gravel, Small Rocks & Clay
540	590	Brown Clay & Sand
590	630	Sand & Small Gravel
630	700	Sand, Gravel & Some Clay
700	720	Redish Clay, Sand & Gravel
720	740	Sand & Gravel
740	820	Redish Brown Clay
820	830	Hard Sand Stone
830	930	Sand, Gravel & Little Clay
930	980	Sand & Gravel
980	990	Sandy Clay
990	1010	Sand, Gravel & Little Clay

Work started 11-19 19 89 Completed 1-16 19 90

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed (Well Driller)
NAME McCalla Div. of Layne-Western
(Person, firm, or corporation) (Typed or printed)
Address P.O. Box 13990
City Palm Desert, CA ZIP 92255
License No 510011 Date of this report 9-28-90

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ll No. 21 Job No. A-477

ner Monte Vista County Water District

dress P. O. Box No. 71, Montclair, Ca.

cation T ___ R ___ Sec. ___

¼ ¼ ¼

1/4 Mile west of Central on 11th. Street

North of 11th. Street

rted Work November 24, 1977

mpleted Work August 21, 1978

tal Depth Drilled 1165'

pth Water First Encountered 405'

MATERIALS

Conductor Casing

terial Mild Steel

ameter XXXX(ID) 26" in. Wall Thickness 1/4 in.

stalled From 0 ft. To 100 ft.

Cemented between 20" & 26"

mented From 100 ft. To 0 ft.

Cemented on outside of 26" pipe from 100' up to 12'- used 7 yards of cement slurry

Well Casing

DIAMETER XXX(ID)	WALL OR GAUGE	MATERIAL	FROM	TO
29"	1/4'	mild steel	0'	13'
26"	1/4"	mild steel	0'	100'
20"	8x8	Kai-well	0'	694'
16"	8x8	Kai-well	684'	872'
14"	5/16	High Tensile	865'	1165'

tter Used 23' long ft. of 2 ply 6 wall or gauge

re Shoe 20"x14"x1-1/4 heat treated steel bit shoe

Starter on 16" lile 19' long of 3ply 8 ga.

Shoe size 16"x14"x1-1/4" jeat treated steel bit shoe

PERFORATIONS

pe of Perforator Used Moss Hydraulic

FROM	TO	WIDTH	LENGTH	HOLES PER FOOT	SQ. INCH PER FOOT
450'	674'	3/16"	2-1/4"	21	7.9
698'	860'	3/16"	2-1/4"	21	7.9
saw perforations					
875'	1145'	5/32"	2-1/2"	28	11"?

Development & Test Record

s Well Swabbed? Sand Pumped

thod Line

. of Hours 30 Hours

tal Material Removed 60' course & fine material

ter level when Test first started 377 ft.

aw down from standing level 162 ft.

. of gallons per minute pumped when Test first started 275

. of gallons per minute pumped when Test completed 275

aw down at completion of Test 139 ft.

urs Testing Well 118-1/3

Formation: Mention size of water gravel —

From (ft.)	To (ft.)	Formation
0	35	From beer cans to Model
		frame, junk
35	75	Sand, gravel & boulders
75	100	Sand, gravel, boulders & cla
100	180	Sand, gravel & clay
180	230	Sand, gravel, & clay hardst
230	280	Brown clay & gravel
280	325	Brown clay, gravel & boul
325	345	Brown clay & gravel - har
345	400	Brown sticky clay with gr
400	430	Sand, some gravel, little cl
430	460	Sand, clay, & gravel
460	470	Sticky clay with gravel
470	510	Clay & gravel to 1-1/4"
510	535	Clay & gravel - sticky
535	565	Clay & gravel to 1"
565	570	Clay & gravel - sticky
570	580	Gravel to 1-1/2" some cl.
		hard
580	655	Clay & gravel = hard
655	670	Clay & gravel imbedded h.
670	690	Hard cement, gravel sand
		with clay
690	700	Hard clay gravel imbedde
700	710	Hard clay & gravel
710	715	Hard clay some gravel
715	740	Cemented sand, gravel w/c
740	744	Gravel some clay - hard
744	756	Clay some rocks - hard
756	760	Hard clay
760	764	Clay & gravel - hard !
764	772	Gravel & little clay-hard
772	780	Clay & rocks - hard!
780	788	Hard clay
788	792	Clay & rocks - hard
792	796	Clay ball
796	812	Clay & rocks - hard!
812	816	Hard clay fine gravel, so

turn to back of log for the rest of form.

If Well Is Reduced, Indicate:

Amount of Lap at Reduction 16" in 20"-10' ft.

Amount of Lap at Reduction 14" in 16" - 7' ft.

Amount of lap at Reduction ___ ft.

Method of Sealing at Reduction Reduction Funnel 16" into 20".

Give any additional data which may be of future value Swaged 5' liner on 20" pipe at top 348' 6" to bottom 352' 6". Rounded 20" pipe perforations by swaging with 20" swage. From 450' to 674' rounded 16" pipe perforations by swaging from 698' to 860'.

Driller Joe Garcia

Date of Report Aug. 21, 1978

Type and Rig No. Used Cable Tool Rig No. 44

APPENDIX B

Well Completion Summary Table for Municipal Wells in MZ-1

DRAFT

GEOSCIENCE Support Services, Inc.

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1201273	City of Chino	-	01S08W35J04	2/1/1959	-	1,100	-
1002709	City of Chino	F1	-	-	-	-	-
1002735	City of Chino	1	-	1/1/1912	-	402	-
1203283	City of Chino	10	-	4/15/1975	16	1,090	355-380 420-440 460-485 502-525 750-770 790-800 890-1,090
1003741	City of Chino	11	-	-	16	910	390-910
1002739	City of Chino	12	-	1/7/7983	18	1,170	420-1,150
1004185	City of Chino	13	-	8/24/1978	18	740	290-360 410-430 460-560 600-720
1203125	City of Chino	13	02S08W12J	1/1/1963	-	404	-
1002645	City of Chino	14	-	9/15/1988	18	1,220	480-500 520-600 640-660
1002737	City of Chino	2	-	4/24/1925	16	-	228-256 272-301 322-328 331-394
1002734	City of Chino	3	-	-	16	-	230-245 278-300 330-344 379-383 393-396 414-418 428-435 443-450
1004178	City of Chino	4	-	-	16	375	160-200 220-275
1002741	City of Chino	5	-	1/2/1959	-	1,100	430-1,078
1004176	City of Chino	6	-	-	16	375	200-375
1004204	City of Chino	7	02S08W14C01S	-	-	780	180-780
1004205	City of Chino	8	-	-	10	550	89-203 271-383 473-496
1002743	City of Chino	9	01S08W35J02S	2/25/1974	16	1,050	310-1,030
1202495	City of Chino	TEV	02S07W18D	-	-	-	-
1004219	City of Chino Hills	-	-	-	-	238	-
1004261	City of Chino Hills	9A	-	-	-	-	-
1004268	City of Chino Hills	13	-	-	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1203217	City of Chino Hills	14	-	3/21/1889	2	880	350-860
1203220	City of Chino Hills	14A	02S08W23E01	6/7/1989	-	-	-
1203106	City of Chino Hills	16A	-	4/9/1989	16	960	430-940
1004179	City of Chino Hills	17A	-	8/29/1989	16	1,000	300-460 500-980
1203149	City of Chino Hills	18A	-	9/11/1989	16	1,000	420-460 480-980
1004190	City of Chino Hills	18B	-	-	-	-	-
1203158	City of Chino Hills	19	-	1/16/1990	16	1,000	340-420 460-760 800-1,000
1004280	City of Chino Hills	1A	-	-	16	317	166-317
1004279	City of Chino Hills	1B	-	7/8/1988	18	1,200	440-470 490-610 720-900 940-1,180
1205141	City of Chino Hills	2 (Dairys)	02S08W22B	-	-	-	-
1004215	City of Chino Hills	7A	-	6/14/1989	16	960	550-950
1004216	City of Chino Hills	7B	-	-	14	360	120-192 264-312 326-360
1004217	City of Chino Hills	7C	02S08W15C03S	1989	16	960	540-940
1004218	City of Chino Hills	7D	-	4/24/1989	16	950	320-400 490-810 850-930
1004266	City of Chino Hills	9	-	-	-	-	-
1203218	City of Chino Hills	95045	02S08W23D91W	-	-	-	-
1203215	City of Chino Hills	W15-A	02S08W14N91W	9/21/1989	16	900	360-440 480-900
1203214	City of Chino Hills	W15-B	-	9/9/1989	16	320	190-310
1002329	City of Ontario	-	-	4/30/1958	16	940	600-620 620-690 690-760 760-790 790-820 820-895
1201115	City of Ontario	-	01S07W18	-	-	-	-
1201122	City of Ontario	-	01S07W23M02	-	-	-	-
1201124	City of Ontario	1	01S07W24G01	1/1/1969	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002318	City of Ontario	10	-	8/1/1926	16	744	401-482 493-584 593-606 612-627 632-717 724-735
1002346	City of Ontario	11	-	9/20/1958	20	1,100	464-625 770-1,080
1002538	City of Ontario	13	-	-	-	705	-
1002636	City of Ontario	15	01S08W25Q05	4/19/1960	20	1,000	474-550 570-966
1002348	City of Ontario	16	-	1/1/1960	12	638	366-375 455-460 500-510 535-550 575-630
1002349	City of Ontario	17	-	4/26/1963	20	1,028	415-430 510-695 770-885 925-1,007
1002330	City of Ontario	18	-	8/4/1926	20	1,035	297-315 319-407 783-795 825-859 947-1,017
1002335	City of Ontario	19	-	-	-	507	-
1206120	City of Ontario	2	-	-	-	-	-
1002305	City of Ontario	20	-	-	-	500	-
1002365	City of Ontario	21	-	-	10	440	220-440
1002353	City of Ontario	23	01S07W29N01S	-	-	460	-
1002339	City of Ontario	24	-	1/1/1969	16	1,012	484-850 880-952
1002337	City of Ontario	25	-	1/1/1971	20	903	370-903
1002340	City of Ontario	26	-	1/1/1971	18	522	330-350 370-390 420-440 470-510
1002362	City of Ontario	27	-	3/14/1961	16	702	406-455 468-475 508-520 538-552 619-635

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002323	City of Ontario	28	-	1/1/1974	20	943	611-630 635-646 700-729 796-807 851-884
1002333	City of Ontario	29	-	1/1/1979	18	1,120	400-1,095
1002327	City of Ontario	3	-	3/28/1962	20	1,130	540-570 590-610 634-644 674-682 840-860 924-944 950-1,090
1002253	City of Ontario	30	-	1/1/1978	18	1,100	420-1,040
1002254	City of Ontario	31	-	1/1/1979	18	1,000	400-980
1002360	City of Ontario	33	-	1/1/1983	18	1,110	520-1,090
1002367	City of Ontario	34	01S07W32C01S	1/1/1983	18	1,112	522-1,092
1002350	City of Ontario	35	-	3/25/1986	18	1,190	580-1,020
1002372	City of Ontario	36	-	1/1/1986	18	1,020	530-1,000
1002230	City of Ontario	37	01S06W19N01S	4/15/1994	4	870	400-860
1006998	City of Ontario	38	-	-	-	-	-
1002328	City of Ontario	4	-	1/1/1919	16	920	526-910
1002359	City of Ontario	5	-	1/1/1926	16	507	360-470
1002361	City of Ontario	6	-	7/1/1930	26	551	203-217 224-245 260-264 276-288 296-300 302-310 330-334 340-348
1002343	City of Ontario	7	-	-	-	-	-
1002371	City of Ontario	8	-	9/6/1942	-	536	175-188 260-287 348-360 492-524
1002319	City of Ontario	9	-	-	20	1,204	610-840 850-1,054 1,067-1,125
1202042	City of Ontario	Lift Station	02S07W04A	-	-	-	-
1201123	City of Ontario	Ontario Motor Speedway	01S07W24F01	10/26/1969	-	-	-
1002325	City of Ontario	Owner #3	-	6/13/1919	-	604	-
1201146	City of Ontario	Sewage Plant	01S07W32D01	-	-	-	-
1201236	City of Pomona	-	01S08W22D01	5/23/1973	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1201224	City of Pomona	7	01S08W17Q01	3/14/1957	-	-	-
1002602	City of Pomona	Fairgrounds Well	-	8/22/1922	-	-	-
1201223	City of Pomona	P-01	01S08W17P07	2/21/1990	-	-	-
1002653	City of Pomona	P-02	-	-	-	360	120-360
1002604	City of Pomona	P-03	-	1/20/1955	16	800	405-540 540-580 580-780
1002655	City of Pomona	P-04	-	-	-	-	254-338 403-452
1002651	City of Pomona	P-05 (Old)	-	1/1/1931	20	-	141-220 254-258 284-304 312-316 326-340 470-488
1205314	City of Pomona	P-05B	01S08W28	-	-	-	-
1002650	City of Pomona	P-06	-	-	-	536	185-536
1002584	City of Pomona	P-07	-	-	14	734	223-233 298-300 300-304 304-307 462-466 482-513 564-570 581-624 634-659 670-682 710-714
1002583	City of Pomona	P-08 (Old)	01S08W17K01W	-	-	-	-
1002585	City of Pomona	P-08B	-	-	-	-	-
1002489	City of Pomona	P-09	-	-	16	606	160-565
1002656	City of Pomona	P-10	-	8/21/1965	20	784	295-784
1002660	City of Pomona	P-11	-	-	-	550	168-550
1002661	City of Pomona	P-12	-	-	-	530	240-530
1002494	City of Pomona	P-13	-	1/1/1930	-	-	-
1002663	City of Pomona	P-14	-	-	-	535	317-535
1002664	City of Pomona	P-15	-	-	-	533	210-533
1002654	City of Pomona	P-16	-	5/27/1953	20	560	270-275 288-328
1002659	City of Pomona	P-17	-	-	20	637	454-464 511-536
1002662	City of Pomona	P-18	-	-	-	660	307-660
1002814	City of Pomona	P-19	01S09W26H01S	-	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002432	City of Pomona	P-20	-	-	18	420	90-205 217-223 253-259 271-277 283-333 392-400
1002678	City of Pomona	P-21	-	1/2/1928	16	-	130-255
1002668	City of Pomona	P-22	-	7/25/1962	16	478	216-248 260-268 362-365 384-446
1002704	City of Pomona	P-23	-	-	-	635	235-635
1201255	City of Pomona	P-24	01S08W32G05S	2/1/1991	24	795	-
1002706	City of Pomona	P-25	01S08W33E03S	9/25/1968	20	808	245-780
1002703	City of Pomona	P-26	-	2/3/1971	20	800	300-775
1002549	City of Pomona	P-27	-	-	-	-	472-480 497-530 540-549 611-633 640-681 723-732 740-746 773-789 791-818 835-849
1002815	City of Pomona	P-28	01S09W27H01S	-	-	-	132-245
1203062	City of Pomona	P-29	02S08W04M06S	4/28/1975	20	539	248-267 314-324 327-352
1002623	City of Pomona	P-30	-	4/8/1977	20	875	565-875
1203259	City of Pomona	P-31	01S09W26H02	-	-	-	-
1002619	City of Pomona	P-33	-	-	-	-	-
1201247	City of Pomona	P-34	01S08W28G03	-	-	-	-
1201246	City of Pomona	P-35	01S08W28C01	-	-	-	-
1002605	City of Pomona	Pomona City #1	-	-	-	831	-
1002588	City of Pomona	Pomona City #2	-	4/1/1920	12	-	426-1,088
1002603	City of Pomona	Pomona City #3	-	8/1/1903	14	-	116-142 168-176 312-316 444-450 480-492 506-552 640-662
1002598	City of Pomona	Pomona City #4	-	2/1/1922	-	-	-
1201221	City of Pomona	Pomona City #5	01S08W17L02	6/25/1910	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002402	City of Pomona	T 1	-	-	-	-	-
1002404	City of Pomona	T 2	-	-	-	-	-
1002403	City of Pomona	T 3	-	5/31/1929	-	-	-
1002405	City of Pomona	T 4	01S08W03F05S	-	-	-	-
1206121	City of Upland	1	-	-	-	-	-
1002529	City of Upland	13	-	8/1/1932	20	928	528-600 600-900 900-915
1201205	City of Upland	14	01S08W11A	-	-	-	-
1000554	City of Upland	15	-	4/30/1988	16	1,000	470-990
1000555	City of Upland	16	-	-	16	1,080	450-1,070
1000674	City of Upland	17	-	2/29/1988	16	920	430-910
1201103	City of Upland	18	01S07W05D01	7/21/1988	-	922	-
1200268	City of Upland	19	01N07W31E01	8/17/1988	-	-	-
1200289	City of Upland	1A	-	-	-	192	1-192
1000613	City of Upland	2	-	-	-	-	-
1002535	City of Upland	3	-	7/1/1926	-	904	-
1200293	City of Upland	4	01N08W25K06	4/1/1925	-	252	-
1000618	City of Upland	5	-	-	-	-	-
1002301	City of Upland	7	-	1/1/1929	24	901	443-880
1006997	City of Upland	7A	-	-	-	1,070	640-760 780-1,020
1002531	City of Upland	8	-	2/24/1948	-	-	522-985
1200290	City of Upland	Owner #3	01N08W25F01	9/10/1924	-	475	-
1002313	City of Upland	Repair 9	-	1/9/1952	20	1,003	445-874
1002299	City of Upland (Upland Landfill)	MW-1	-	-	-	-	-
1100000	City of Upland (Upland Landfill)	MW-2	-	-	-	-	-
1100001	City of Upland (Upland Landfill)	MW-3	-	-	-	-	-
1002642	Monte Vista Water District	1	-	4/1/1936	18	472	245-294 300-315 325-344 348-378 440-472
1002546	Monte Vista Water District	10	-	3/2/1981	14	675	-
1002552	Monte Vista Water District	11	-	3/1/1929	18	816	352-362 510-528 575-583 620-628 640-665 682-760

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002630	Monte Vista Water District	12	-	7/1/1920	18	634	259-288 294-367 371-410 438-498 514-588 594-618 628-632
1002628	Monte Vista Water District	13	-	1/1/1919	18	490	203-475
1002625	Monte Vista Water District	15	-	-	18	800	255-270 270-355 355-448 448-644
1002560	Monte Vista Water District	16	-	6/1/1920	20	888	277-865
1002563	Monte Vista Water District	19	01S08W15R01	3/1/1977	20	1,260	620-780 808-908 930-1,008 1,008-1,230
1002722	Monte Vista Water District	2	-	1/1/1951	20	1,000	397-962
1002561	Monte Vista Water District	20	01S08W15Q03S	6/12/1978	16	1,326	665-695 735-776 790-920 955-970 980-992 1,000-1,025 1,030-1,107 1,127-1,145 1,150-1,156 1,165-1,180 1,196-1,206 1,210-1,220 1,225-1,232 1,240-1,265 1,275-1,295
1201206	Monte Vista Water District	21	01S08W11D01S	8/21/1978	14	1,165	450-674 698-860 875-1,145
1002504	Monte Vista Water District	22	-	9/1/1959	16	486	270-300
1004161	Monte Vista Water District	23	-	9/12/1959	16	486	270-300
1002746	Monte Vista Water District	24	-	2/1/1956	14	450	244-420
1201178	Monte Vista Water District	25	01S08W04A02	8/20/1948	-	512	-
1004160	Monte Vista Water District	27B	-	-	-	348	267-271 290-310 318-325
1002540	Monte Vista Water District	3	-	-	-	664	334-664

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1002541	Monte Vista Water District	4	A01 was the pit	10/1/1931	20	920	484-500 508-556 594-608 634-680 702-714 722-750 770-776 796-804 858-864
1002544	Monte Vista Water District	5	-	-	14	1,040	600-990
1002551	Monte Vista Water District	6	-	6/21/1937	-	905	360-410 500-520 620-630 730-754 764-776 839-850
1002556	Monte Vista Water District	7	-	5/23/1929	20	-	312-390 418-428 434-446 469-486 528-536
1002646	Monte Vista Water District	8	-	1/1/1929	14	450	225-249 284-312 354-373 390-396 405-410 423-445? 432-477?
1002627	Monte Vista Water District	9	-	-	-	592	316-592
1002641	Monte Vista Water District	MVIC 2	-	-	-	-	-
1002632	Monte Vista Water District	MVIC 4	-	1/1/1925	16	-	265-278 359-445 445-450 450-477 477-518 518-539 539-580
1002631	Monte Vista Water District	MVIC 5	-	-	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1003875	Owner Unknown	6	-	2/21/1961	16	358	154-170 174-188 258-268 316-320 340-358 392-410 420-422 474-478 508-539
1203213	Owner Unknown	74280-1	-	-	-	-	-
1004293	Owner Unknown	74280-10	-	-	-	288	124-288
1004286	Owner Unknown	74280-11	-	-	-	-	-
1004196	Owner Unknown	74280-12	-	-	-	-	-
1003879	Owner Unknown	74280-13	-	-	-	505	133-505
1004297	Owner Unknown	74280-1A	-	-	-	529	160-529
1004207	Owner Unknown	74280-3	-	-	-	-	-
1004194	Owner Unknown	74280-4	-	-	-	520	240-520
1003873	Owner Unknown	74280-5	-	-	-	-	-
1004295	Owner Unknown	74280-7	-	9/17/1942	16	-	122-125 178-202 206-
1004288	Owner Unknown	74280-8	-	-	-	226	122-226
1004299	Owner Unknown	9	-	1/17/1962	6	212	182-204
1002634	Owner Unknown	MVIC 3	-	-	-	-	-
1000672	San Antonio Water Co.	-	-	-	-	-	-
1200281	San Antonio Water Co.	-	01N07W35	2/14/1958	-	-	-
1002315	San Antonio Water Co.	12	-	2/2/1921	-	-	-
1000549	San Antonio Water Co.	14	-	-	-	-	-
1206569	San Antonio Water Co.	15	-	-	-	-	-
1000624	San Antonio Water Co.	17	-	1/1/1924	12	-	261-585
1002321	San Antonio Water Co.	18	-	-	24	-	342-476 601-649 696-722
1000559	San Antonio Water Co.	19	-	1/1/1926	-	-	-
1000562	San Antonio Water Co.	2	-	1/1/1924	12	-	100-941
1002320	San Antonio Water Co.	21	-	2/1/1931	-	-	-
1002298	San Antonio Water Co.	22	-	2/1/1931	-	851	-
1000576	San Antonio Water Co.	24	01N07W33N03S	-	-	-	-
1000671	San Antonio Water Co.	25	-	-	-	-	-
1000639	San Antonio Water Co.	26	-	-	-	-	-
1000668	San Antonio Water Co.	27	-	-	-	-	-
1000563	San Antonio Water Co.	3	-	-	12	-	100-912

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Completion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1000580	San Antonio Water Co.	31	-	-	18	1,473	200-1,000 1,000-1,300 1,300-1,327 1,327-1,348 1,350-1,367 1,374-1,465 1,465 -
1006968	San Antonio Water Co.	32	01N07W20F01	6/1/1987	-	430	-
1000574	San Antonio Water Co.	4	-	-	-	-	-
1000546	San Antonio Water Co.	Adams Well	-	-	-	-	-
1002314	San Antonio Water Co.	San Antonio 6th St. Well	-	2/1/1921	-	-	-
1000885	Southern California Water Co.	-	-	2/1/1955	18	278	130-256
1000888	Southern California Water Co.	-	-	3/4/1968	16	272	203-257
1002723	Southern California Water Co.	ALA-02	01S08W34A04S	-	-	-	-
1000653	Southern California Water Co.	Alamosa 2	-	-	-	-	-
1000656	Southern California Water Co.	Boulder 1	-	-	-	-	-
1201199	Southern California Water Co.	Del Monte #4	-	5/7/1991	16	775	160-560 580-755
1002517	Southern California Water Co.	Delmonte 1	-	-	-	450	170-435
1002519	Southern California Water Co.	Delmonte 2	-	5/1/1911	-	456	-
1002526	Southern California Water Co.	Delmonte 3	-	-	-	-	-
1002507	Southern California Water Co.	Dreher 1	-	-	-	-	-
1002496	Southern California Water Co.	Ford 1	-	-	-	537	236-304 342-412 418-428 433-487 490-495 502-509
1002510	Southern California Water Co.	Garlock 1	-	-	-	-	-
1002524	Southern California Water Co.	Green St 1	-	-	-	-	-
1002506	Southern California Water Co.	Harr Hom 1	-	-	-	-	-
1000647	Southern California Water Co.	Ind Hill 3	-	4/1/1903	-	-	-
1002554	Southern California Water Co.	Margarite 1	-	9/4/1948	20	500	182-238 266-318 392-448
1000661	Southern California Water Co.	Marlboro 1	-	-	-	-	-
1000662	Southern California Water Co.	Miramar 3	-	-	-	-	-
1000655	Southern California Water Co.	Miramar 5	-	-	16	666	250-580
1000651	Southern California Water Co.	Pomello 1	-	-	-	-	-
1000652	Southern California Water Co.	Pomello 4	-	4/26/1930	20	-	250-315 360-370
1000644	Southern California Water Co.	Pomeroy 1	-	-	-	-	-
1002498	Southern California Water Co.	Richards 1	-	-	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

Well Completion Summary Table for Muncipal Well in MZ-1

WE Id No.	Owner Name	Local Name	State Well No.	Comp-letion Date	Casing Diameter [inches]	Casing Depth [ft]	Screen Intervals [ft]
1004197	State of California, CIM	-	02S08W13L01S	9/17/1942	13	409	70-74 158-161 188-201 210-225 245-248 258-261 309-316 339-351 384-396
1202543	State of California, CIM	-	02S07W19B02	5/5/1979	-	520	-
1202547	State of California, CIM	-	02S07W19M04	8/26/1975	-	505	-
1203231	State of California, CIM	-	02S08W24C01	1/1/1941	-	-	-
1004285	State of California, CIM	11A	-	-	-	540	135-540
1004195	State of California, CIM	12	-	-	-	520	250-520
1203152	State of California, CIM	2	02S08W13F01	1/8/1982	-	-	-
1202542	State of California, CIM	5	-	-	-	-	-

Source of Data: Wildermuth Environmental, Inc. (2000)

APPENDIX C

Annual Production Data for MZ-1

DRAFT

GEOSCIENCE Support Services, Inc.

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1003757	-	Agricultural/Other	Domestic #1-900C	95	95	95	74	74	130	130
1004184	-	Agricultural/Other	-	57	21	1	1	1	1	0
1004188	-	Agricultural/Other	29680-Domestic	39	39	32	47	48	53	27
1201253	-	Agricultural/Other	Domestic	0	0	0	0	0	0	0
1201262	-	Agricultural/Other	Milk Processing	16	16	10	10	10	10	10
1201276	-	Agricultural/Other	72130-Domestic	0	0	0	0	1	5	5
1202101	-	Agricultural/Other	Dairy	30	30	40	34	23	29	24
1202117	-	Agricultural/Other	49360	1	1	10	10	10	10	18
1202136	-	Agricultural/Other	-	60	120	120	0	113	77	115
1202139	-	Agricultural/Other	IRR-#2-12P	20	20	20	69	69	67	75
1202143	-	Agricultural/Other	23680-DI	36	40	40	27	20	10	30
1202145	-	Agricultural/Other	95011-Domestic	105	5	6	11	4	3	5
1202146	-	Agricultural/Other	Domestic-2 Houses	0	0	69	66	15	13	1
1202147	-	Agricultural/Other	76240-Irrigation	240	0	72	119	105	108	143
1202451	-	Agricultural/Other	95032-1	3	3	56	56	11	20	44
1202508	-	Agricultural/Other	95069	1	1	1	0	1	1	1
1202525	-	Agricultural/Other	68760	4	1	4	4	4	4	4
1202531	-	Agricultural/Other	87960	62	59	47	46	45	52	21
1202665	-	Agricultural/Other	83000-Domestic	70	70	16	7	24	99	89
1202675	-	Agricultural/Other	83000-Irrigation	69	69	16	24	15	11	8
1203046	-	Agricultural/Other	90280	16	30	33	33	33	40	54
1203050	-	Agricultural/Other	-	1	1	3	3	3	3	3
1203068	-	Agricultural/Other	-	0	0	0	0	0	0	0
1203141	-	Agricultural/Other	29680-Irrigation	5	60	3	80	46	18	44
1203153	-	Agricultural/Other	760	59	35	35	40	40	40	40
1203169	-	Agricultural/Other	30500-Irrigation	105	198	270	295	198	195	308
1203170	-	Agricultural/Other	-	35	34	64	44	41	18	43
1203186	-	Agricultural/Other	87240	1	1	1	1	1	1	1
1203209	-	Agricultural/Other	21320-1	80	80	80	84	54	24	24
1203210	-	Agricultural/Other	Irrigation	-	-	-	-	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1203260	-	Agricultural/Other	24840-4 (Ted's Ranch)	50	50	50	42	2	27	20
1203774	-	Agricultural/Other	-	5	0	0	0	0	0	0
1203882	-	Agricultural/Other	-	10	0	0	0	0	0	0
1206489	-	Agricultural/Other	-	-	-	-	-	-	-	-
1206496	-	Agricultural/Other	Irrigation	-	-	-	-	-	-	-
1206519	-	Agricultural/Other	-	-	-	-	-	-	-	-
1202485	Abbona Trust	Agricultural/Other	95048-ABO	40	40	40	40	40	40	66
1201267	Ambrosia Farms	Agricultural/Other	Irr	-	-	-	-	-	-	-
1201250	Angelica Textile Service	Agricultural/Other	1	17	9	19	21	21	18	13
1202137	Best Eight Inc.	Agricultural/Other	-	5	5	0	2	2	2	2
1203137	Bohlander & Holmes	Agricultural/Other	-	2	7	2	1	4	1	7
1004229	Boys Republic	Agricultural/Other	11480-2	169	166	136	31	22	19	12
1203182	Boys Republic	Agricultural/Other	3	35	11	1	0	0	0	0
1203278	CA State Dept Of Fish & Game	Agricultural/Other	74240	54	40	50	84	69	106	33
1002639	Chino Water Co.	Agricultural/Other	16520-3	206	79	238	198	48	0	20
1002733	Chino Water Co.	Agricultural/Other	1	0	0	0	0	0	0	0
1004267	City Of Chino Hills	Agricultural/Other	Pelesier	0	0	4	31	243	0	0
1201246	City of Pomona	Agricultural/Other	P-35	0	0	0	0	0	0	0
1201247	City of Pomona	Agricultural/Other	P-34	0	0	0	0	0	0	0
1203776	City of Pomona	Agricultural/Other	-	0	0	318	0	0	0	0
1203262	Dotta Bros	Agricultural/Other	Irrigation - Elena Ranch	-	-	-	-	-	-	-
1203205	Estate of Patterson Ranch	Agricultural/Other	1	32	30	7	0	0	0	0
1202123	Foss Brothers Dairy	Agricultural/Other	29240-Domestic	12	12	36	59	27	18	23
1203219	George Hilarides Testamentary	Agricultural/Other	1	120	120	141	256	238	107	111
1202486	H & Z Trust	Agricultural/Other	Domestic	65	65	65	65	0	0	28
1202489	H & Z Trust	Agricultural/Other	Irrigation	51	51	51	51	28	35	60
1003750	J.G.J. Joint Venture	Agricultural/Other	95075	60	20	4	4	4	4	4

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1003751	J.G.J. Joint Venture	Agricultural/Other	95075-3	92	92	92	92	92	92	63
1202111	J.G.J. Joint Venture	Agricultural/Other	1	140	140	0	0	0	0	0
1202150	Jongsma Dairy	Agricultural/Other	DD	45	45	27	45	41	55	47
1202151	Jongsma Dairy	Agricultural/Other	DI	48	48	22	17	0	0	0
1202492	Land Design Services	Agricultural/Other	95067-3	35	82	82	10	3	7	10
1202503	Land Design Services	Agricultural/Other	95067-2	40	135	119	93	27	0	0
1203749	Louisa Thorsheim	Agricultural/Other	-	-	-	-	-	-	-	-
1203218	Majestic Reality	Agricultural/Other	95045	165	40	28	28	1	0	0
1203203	Mary Brogurere Estate	Agricultural/Other	84490-2	226	282	284	215	48	10	14
1002646	Monte Vista Water District	Agricultural/Other	8	-	-	-	-	-	-	-
1201242	Nor'East Min Roses	Agricultural/Other	1	203	185	194	77	0	0	0
1203033	Ontario Christian School	Agricultural/Other	-	76	76	28	58	56	56	74
1004278	Pierce Family Corp.	Agricultural/Other	-	0	0	0	0	0	0	0
1002691	Pomona Cemetery Assoc.	Agricultural/Other	61760-1	3	1	5	1	0	0	1
1201256	Pomona Cemetery Assoc.	Agricultural/Other	61760-2	63	153	86	75	88	72	62
1202519	Richard Hoeskema	Agricultural/Other	4	10	3	8	6	6	10	5
1202110	SBFCD	Agricultural/Other	11960-BEC	12	12	12	12	12	12	45
1206490	Stanton Nurseries	Agricultural/Other	Nursery	-	-	-	-	-	-	-
1202140	Sterk Family Trust	Agricultural/Other	74680-Domestic	56	62	102	83	97	98	125
1202141	Sterk Family Trust	Agricultural/Other	74680-Irrigation	132	127	127	195	113	34	243
1206497	Sterk Family Trust	Agricultural/Other	Irrigation	-	-	-	-	-	-	-
1202504	Stratham Homes	Agricultural/Other	Irrigation	41	56	157	230	9	52	102
1202523	Stratham Homes	Agricultural/Other	84480-Dry	94	94	52	51	55	69	73
1203228	Sukut Charitable Trust	Agricultural/Other	75770	140	120	120	120	120	1	84
1201127	Sunkist Growers Inc	Agricultural/Other	1	668	629	369	560	448	209	450
1201129	Sunkist Growers Inc	Agricultural/Other	3	0	0	0	0	0	0	0
1201129	Sunkist Growers Inc	Agricultural/Other	3	-	-	-	-	-	-	-
1003756	Sunshine Dairy	Agricultural/Other	5080	65	65	0	0	0	1	1
1202133	Sunshine Dairy	Agricultural/Other	5080-2	0	0	29	48	30	39	52
1201245	U.S. Lubricants	Agricultural/Other	-	0	0	0	0	0	0	0

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1206503	Victory Baptist Church	Agricultural/Other	Domestic	-	-	-	-	-	-	-
1201201	Vulcan Materials Co/ Calmat Div	Agricultural/Other	-	0	0	0	0	0	0	0
1202118	West Euclid Water Group	Agricultural/Other	93760	12	4	4	5	5	5	5
1003873	CIM	CIM	74280-5	0	234	98	202	425	360	331
1003875	CIM	CIM	6	371	387	514	672	592	615	608
1003879	CIM	CIM	74280-13	257	339	213	126	290	248	0
1004194	CIM	CIM	74280-4	322	399	474	458	490	162	466
1004196	CIM	CIM	74280-12	249	297	330	356	274	247	315
1004207	CIM	CIM	74280-3	176	256	248	320	381	0	48
1004286	CIM	CIM	74280-11	581	1,059	353	206	489	0	0
1004288	CIM	CIM	74280-8	171	188	141	336	198	198	241
1004293	CIM	CIM	74280-10	157	252	425	362	400	560	503
1004295	CIM	CIM	74280-7	117	139	181	263	280	255	200
1004297	CIM	CIM	74280-1A	245	417	163	798	476	261	35
1004299	CIM	CIM	9	160	218	82	264	149	1	17
1202542	CIM	CIM	5	445	619	336	0	0	0	0
1203213	CIM	CIM	74280-1	761	622	789	259	223	1,027	369
1002645	City Of Chino	City Of Chino	14	0	0	0	0	0	0	0
1002709	City Of Chino	City Of Chino	F1	458	418	443	542	659	369	594
1002734	City Of Chino	City Of Chino	3	376	69	135	54	0	16	0
1002735	City Of Chino	City Of Chino	1	0	0	77	30	53	11	0
1002739	City Of Chino	City Of Chino -- Deep (in PAS)	12	0	0	0	0	0	0	689
1002741	City Of Chino	City Of Chino -- Deep (in PAS)	5	762	928	624	711	324	952	1,138
1002743	City Of Chino	City Of Chino -- Deep (in PAS)	9	1,804	1,453	2,594	2,278	795	1,588	1,890
1003741	City Of Chino	City Of Chino	11	7	1,995	2,010	2,058	2,110	1,420	1,700
1004176	City Of Chino	City Of Chino	6	1,596	357	520	954	630	833	1,075
1004178	City Of Chino	City Of Chino	4	1,028	1,104	551	771	537	544	398

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1004185	City Of Chino	City Of Chino	13	0	0	0	0	0	0	0
1004204	City Of Chino	City Of Chino -- Deep (in PAS)	7	0	327	149	307	954	313	547
1202495	City Of Chino	City Of Chino	TEV	90	50	182	85	74	0	0
1203157	City Of Chino	City Of Chino	34320	1	1	1	1	1	1	1
1203283	City Of Chino	City Of Chino -- Deep (in PAS)	10	1,074	979	568	733	1,264	1,206	927
1004179	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	17A	0	0	0	0	0	0	0
1004215	City Of Chino Hills	City Of Chino Hills	7A	415	713	578	505	439	788	874
1004216	City Of Chino Hills	City Of Chino Hills	7B	472	652	659	517	442	793	845
1004218	City Of Chino Hills	City Of Chino Hills	7D	0	0	0	0	0	0	0
1004261	City Of Chino Hills	City Of Chino Hills	9A	117	214	126	188	0	0	0
1004266	City Of Chino Hills	City Of Chino Hills	9	127	104	94	110	0	0	0
1004267	City Of Chino Hills	City Of Chino Hills	Pelesier	-	-	-	-	-	-	-
1004268	City Of Chino Hills	City Of Chino Hills	13	251	277	320	282	234	289	443
1004279	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	1B	0	0	0	0	0	0	0
1004280	City Of Chino Hills	City Of Chino Hills	1A	456	529	501	68	62	66	48
1203106	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	16A	0	0	0	0	0	0	0
1203158	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	19	0	0	0	0	0	0	0
1203214	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	W15-B	0	0	0	0	0	0	0
1203217	City Of Chino Hills	City Of Chino Hills	14	0	0	0	0	0	0	0
1002319	City of Ontario	City of Ontario	9	888	2,323	1,550	2,259	720	1,293	960
1002350	City of Ontario	City of Ontario	35	0	0	0	0	0	0	0
1002360	City of Ontario	City of Ontario	33	0	0	0	0	0	0	0
1002636	City of Ontario	City of Ontario	15	1,720	2,311	1,657	2,638	1,629	1,990	1,942
1002623	City of Pomona	City of Pomona	P-30	0	398	617	568	203	274	249

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1002650	City of Pomona	City of Pomona	P-06	1,000	1,168	1,328	517	1,367	517	381
1002651	City of Pomona	City of Pomona	P-05 (Old)	205	162	95	18	13	1	1
1002653	City of Pomona	City of Pomona	P-02	1,157	1,011	495	1,336	469	125	942
1002654	City of Pomona	City of Pomona	P-16	1,293	859	929	273	638	485	0
1002655	City of Pomona	City of Pomona	P-04	912	445	393	259	278	947	334
1002656	City of Pomona	City of Pomona	P-10	370	228	191	764	141	148	0
1002659	City of Pomona	City of Pomona	P-17	295	484	385	325	164	372	475
1002660	City of Pomona	City of Pomona	P-11	390	226	74	48	48	1	6
1002661	City of Pomona	City of Pomona	P-12	739	396	224	74	126	3	109
1002662	City of Pomona	City of Pomona	P-18	801	392	269	81	151	0	90
1002663	City of Pomona	City of Pomona	P-14	401	324	181	206	34	62	1,034
1002664	City of Pomona	City of Pomona	P-15	1,049	1,412	745	693	293	742	417
1002668	City of Pomona	City of Pomona	P-22	0	0	0	0	0	0	100
1002678	City of Pomona	City of Pomona	P-21	163	139	498	720	338	384	583
1002685	City of Pomona	City of Pomona	-	95	24	172	375	263	150	183
1002703	City of Pomona	City of Pomona	P-26	1,212	1,156	966	313	1,067	1,269	908
1002704	City of Pomona	City of Pomona	P-23	1,089	1,025	1,201	1,250	1,325	1,387	1,282
1002706	City of Pomona	City of Pomona	P-25	2,056	957	1,708	2,006	2,041	2,124	785
1201236	City of Pomona	City of Pomona	P-27	570	207	403	393	658	458	335
1201246	City of Pomona	City of Pomona	P-35	-	-	-	-	-	-	-
1201247	City of Pomona	City of Pomona	P-34	-	-	-	-	-	-	-
1203062	City of Pomona	City of Pomona	P-29	661	674	180	338	578	154	640
1002301	City of Upland	City of Upland	7	1,106	937	859	931	1,368	881	916
1002313	City of Upland	City of Upland	Repair 9	263	645	1,282	1,805	1,456	1,522	1,681
1002529	City of Upland	City of Upland	13	219	38	18	35	10	0	0
1002531	City of Upland	City of Upland	8	0	0	171	347	220	16	105
1002535	City of Upland	City of Upland	3	41	237	317	294	690	844	688
1006997	City of Upland	City of Upland	7A	-	-	-	-	-	-	-
1002631	Monte Vista Irrigation Co	City Of Chino	MVIC 5	67	24	0	0	0	0	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1002632	Monte Vista Irrigation Co	City Of Chino	MVIC 4	305	348	381	359	264	230	314
1002634	Monte Vista Irrigation Co	City Of Chino	MVIC 3	135	90	57	14	23	0	0
1002641	Monte Vista Irrigation Co	City Of Chino	MVIC 2	0	0	0	0	0	0	0
1002541	Monte Vista Water District	Monte Vista Water District	4	362	301	172	309	132	139	81
1002544	Monte Vista Water District	Monte Vista Water District	5	879	585	871	893	833	297	478
1002546	Monte Vista Water District	Monte Vista Water District	10	0	0	0	0	1,605	1,933	1,065
1002551	Monte Vista Water District	Monte Vista Water District	6	519	861	353	683	1,086	573	845
1002552	Monte Vista Water District	Monte Vista Water District	11	366	96	30	63	383	382	525
1002560	Monte Vista Water District	Monte Vista Water District	16	346	216	125	0	0	0	0
1002561	Monte Vista Water District	Monte Vista Water District	20	0	0	1,075	1,270	1,219	584	1,290
1002563	Monte Vista Water District	Monte Vista Water District	19	234	923	1,774	1,689	1,158	2,558	3,398
1002627	Monte Vista Water District	Monte Vista Water District	9	120	60	225	96	52	64	64
1002630	Monte Vista Water District	Monte Vista Water District	12	298	177	1	410	3	0	0
1002642	Monte Vista Water District	Monte Vista Water District	1	353	366	320	272	55	34	90
1002646	Monte Vista Water District	Monte Vista Water District	8	16	23	28	29	29	1	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1978 [acre-ft]	1979 [acre-ft]	1980 [acre-ft]	1981 [acre-ft]	1982 [acre-ft]	1983 [acre-ft]	1984 [acre-ft]
1002722	Monte Vista Water District	Monte Vista Water District	2	1,003	624	806	394	254	107	24
1002746	Monte Vista Water District	Monte Vista Water District	24	114	71	32	100	88	134	271
1004160	Monte Vista Water District	Monte Vista Water District	22	8	14	22	95	127	83	262
1004161	Monte Vista Water District	Monte Vista Water District	23	86	78	167	211	244	364	421
1201178	Monte Vista Water District	Monte Vista Water District	25	0	0	0	0	0	0	0
1201206	Monte Vista Water District	Monte Vista Water District	21	0	0	17	6	0	0	0
1002315	San Antonio Water Co.	San Antonio Water Co.	12	418	964	817	1,079	1,230	1,153	1,137
1002320	San Antonio Water Co.	San Antonio Water Co.	21	0	0	0	0	67	0	0
1002321	San Antonio Water Co.	San Antonio Water Co.	18	704	0	0	0	602	0	0
1002534	West End Consolidated Water Co	San Antonio Water Co.	Owner #2	4	898	1,085	1,531	975	1,102	181
1002536	West End Consolidated Water Co	San Antonio Water Co.	WE#1	0	0	6	0	0	0	4
1002554	So Cal Water Co.	So Cal Water Co.	Margarite 1	370	739	469	755	942	627	772

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1003757	-	Agricultural/Other	Domestic #1-900C	126	133	126	125	131	189	162
1004184	-	Agricultural/Other	-	0	0	0	0	0	0	0
1004188	-	Agricultural/Other	29680-Domestic	4	112	55	27	84	61	62
1201253	-	Agricultural/Other	Domestic	0	0	0	1	1	0	1
1201262	-	Agricultural/Other	Milk Processing	10	10	10	10	10	10	10
1201276	-	Agricultural/Other	72130-Domestic	10	10	10	8	13	3	0
1202101	-	Agricultural/Other	Dairy	23	22	22	10	10	9	10
1202117	-	Agricultural/Other	49360	10	10	10	10	5	5	0
1202136	-	Agricultural/Other	-	78	46	124	114	33	0	134
1202139	-	Agricultural/Other	IRR-#2-12P	77	45	114	70	86	9	3
1202143	-	Agricultural/Other	23680-DI	22	15	19	20	6	11	86
1202145	-	Agricultural/Other	95011-Domestic	2	2	1	5	1	2	0
1202146	-	Agricultural/Other	Domestic-2 Houses	14	2	2	10	5	1	0
1202147	-	Agricultural/Other	76240-Irrigation	93	0	45	38	255	181	80
1202451	-	Agricultural/Other	95032-1	45	44	40	42	29	21	35
1202508	-	Agricultural/Other	95069	1	1	1	1	0	1	0
1202525	-	Agricultural/Other	68760	4	4	4	4	4	4	4
1202531	-	Agricultural/Other	87960	30	45	56	57	60	62	61
1202665	-	Agricultural/Other	83000-Domestic	67	70	71	56	56	60	66
1202675	-	Agricultural/Other	83000-Irrigation	110	37	29	14	0	90	84
1203046	-	Agricultural/Other	90280	57	58	51	28	17	8	8
1203050	-	Agricultural/Other	-	1	1	1	1	1	0	0
1203068	-	Agricultural/Other	-	0	0	0	0	0	0	0
1203141	-	Agricultural/Other	29680-Irrigation	27	2	2	291	164	15	18
1203153	-	Agricultural/Other	760	50	41	50	50	50	56	65
1203169	-	Agricultural/Other	30500-Irrigation	8	8	5	5	0	0	18
1203170	-	Agricultural/Other	-	56	67	67	50	10	87	0
1203186	-	Agricultural/Other	87240	1	1	1	1	1	1	1
1203209	-	Agricultural/Other	21320-1	24	16	19	19	16	33	1
1203210	-	Agricultural/Other	Irrigation	-	-	-	-	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1203260	-	Agricultural/Other	24840-4 (Ted's Ranch)	45	60	85	47	55	185	64
1203774	-	Agricultural/Other	-	0	0	0	0	0	0	0
1203882	-	Agricultural/Other	-	0	0	0	0	0	0	0
1206489	-	Agricultural/Other	-	-	-	-	-	-	-	-
1206496	-	Agricultural/Other	Irrigation	-	-	-	-	-	-	-
1206519	-	Agricultural/Other	-	-	-	-	-	-	-	-
1202485	Abbona Trust	Agricultural/Other	95048-ABO	0	66	66	10	10	10	0
1201267	Ambrosia Farms	Agricultural/Other	Irr	-	-	-	-	-	-	-
1201250	Angelica Textile Service	Agricultural/Other	1	21	15	11	12	25	25	22
1202137	Best Eight Inc.	Agricultural/Other	-	2	2	2	2	1	1	0
1203137	Bohlander & Holmes	Agricultural/Other	-	2	2	1	1	0	0	0
1004229	Boys Republic	Agricultural/Other	11480-2	135	133	178	167	294	295	300
1203182	Boys Republic	Agricultural/Other	3	0	0	0	0	0	0	0
1203278	CA State Dept Of Fish & Game	Agricultural/Other	74240	99	102	117	89	35	9	1
1002639	Chino Water Co.	Agricultural/Other	16520-3	0	0	0	0	0	0	4
1002733	Chino Water Co.	Agricultural/Other	1	0	0	0	0	0	0	0
1004267	City Of Chino Hills	Agricultural/Other	Pelesier	0	0	0	0	0	0	78
1201246	City of Pomona	Agricultural/Other	P-35	0	0	0	0	0	0	0
1201247	City of Pomona	Agricultural/Other	P-34	0	0	0	0	0	0	0
1203776	City of Pomona	Agricultural/Other	-	0	0	0	0	0	0	0
1203262	Dotta Bros	Agricultural/Other	Irrigation - Elena Ranch	-	-	-	-	-	-	-
1203205	Estate of Patterson Ranch	Agricultural/Other	1	0	0	0	0	0	0	0
1202123	Foss Brothers Dairy	Agricultural/Other	29240-Domestic	17	17	11	10	10	15	14
1203219	George Hilarides Testamentary	Agricultural/Other	1	36	1	5	5	0	5	0
1202486	H & Z Trust	Agricultural/Other	Domestic	21	28	85	57	47	25	0
1202489	H & Z Trust	Agricultural/Other	Irrigation	35	30	30	94	64	48	30
1003750	J.G.J. Joint Venture	Agricultural/Other	95075	4	0	0	0	0	0	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1003751	J.G.J. Joint Venture	Agricultural/Other	95075-3	71	75	25	25	0	0	0
1202111	J.G.J. Joint Venture	Agricultural/Other	1	0	0	0	0	0	0	0
1202150	Jongsma Dairy	Agricultural/Other	DD	45	58	60	62	51	38	11
1202151	Jongsma Dairy	Agricultural/Other	DI	0	0	0	0	0	0	0
1202492	Land Design Services	Agricultural/Other	95067-3	81	71	58	121	170	110	177
1202503	Land Design Services	Agricultural/Other	95067-2	14	3	1	3	1	0	0
1203749	Louisa Thorsheim	Agricultural/Other	-	-	-	-	-	-	-	-
1203218	Majestic Reality	Agricultural/Other	95045	0	0	0	1	0	0	0
1203203	Mary Brogurere Estate	Agricultural/Other	84490-2	9	0	0	0	0	0	0
1002646	Monte Vista Water District	Agricultural/Other	8	-	-	-	-	-	-	-
1201242	Nor'East Min Roses	Agricultural/Other	1	0	0	0	0	0	0	0
1203033	Ontario Christian School	Agricultural/Other	-	61	57	61	49	66	19	25
1004278	Pierce Family Corp.	Agricultural/Other	-	0	0	0	0	0	0	0
1002691	Pomona Cemetery Assoc.	Agricultural/Other	61760-1	0	0	3	0	0	0	0
1201256	Pomona Cemetery Assoc.	Agricultural/Other	61760-2	92	94	90	103	108	104	127
1202519	Richard Hoeskema	Agricultural/Other	4	13	2	0	0	0	39	0
1202110	SBFCD	Agricultural/Other	11960-BEC	13	15	15	10	10	10	90
1206490	Stanton Nurseries	Agricultural/Other	Nursery	-	-	-	-	-	-	-
1202140	Sterk Family Trust	Agricultural/Other	74680-Domestic	138	75	39	40	111	56	50
1202141	Sterk Family Trust	Agricultural/Other	74680-Irrigation	135	195	173	219	143	125	154
1206497	Sterk Family Trust	Agricultural/Other	Irrigation	-	-	-	-	-	-	-
1202504	Stratham Homes	Agricultural/Other	Irrigation	114	72	52	127	150	100	10
1202523	Stratham Homes	Agricultural/Other	84480-Dry	7	5	5	5	6	2	2
1203228	Sukut Charitable Trust	Agricultural/Other	75770	75	50	50	30	14	0	13
1201127	Sunkist Growers Inc	Agricultural/Other	1	243	324	320	339	485	568	339
1201129	Sunkist Growers Inc	Agricultural/Other	3	0	0	0	0	0	0	0
1201129	Sunkist Growers Inc	Agricultural/Other	3	-	-	-	-	-	-	-
1003756	Sunshine Dairy	Agricultural/Other	5080	1	1	3	4	4	2	2
1202133	Sunshine Dairy	Agricultural/Other	5080-2	47	51	58	62	63	52	54
1201245	U.S. Lubricants	Agricultural/Other	-	1	1	1	0	0	1	1

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1206503	Victory Baptist Church	Agricultural/Other	Domestic	-	-	-	-	-	-	-
1201201	Vulcan Materials Co/ Calmat Div	Agricultural/Other	-	0	0	0	0	0	0	0
1202118	West Euclid Water Group	Agricultural/Other	93760	5	5	5	5	1	1	1
1003873	CIM	CIM	74280-5	5	154	1,717	383	30	31	75
1003875	CIM	CIM	6	201	205	342	401	147	537	379
1003879	CIM	CIM	74280-13	0	34	218	446	238	649	455
1004194	CIM	CIM	74280-4	249	276	992	389	300	482	586
1004196	CIM	CIM	74280-12	107	248	571	416	338	380	368
1004207	CIM	CIM	74280-3	47	0	195	0	43	0	0
1004286	CIM	CIM	74280-11	0	75	3	332	235	327	321
1004288	CIM	CIM	74280-8	50	13	17	105	0	9	0
1004293	CIM	CIM	74280-10	0	376	1,251	384	147	525	345
1004295	CIM	CIM	74280-7	114	170	204	573	116	292	251
1004297	CIM	CIM	74280-1A	0	709	240	404	560	490	522
1004299	CIM	CIM	9	0	132	602	566	211	445	336
1202542	CIM	CIM	5	0	0	0	0	0	0	0
1203213	CIM	CIM	74280-1	208	613	1,385	625	156	552	0
1002645	City Of Chino	City Of Chino	14	0	0	0	0	0	1,185	2,091
1002709	City Of Chino	City Of Chino	F1	135	0	0	0	0	0	0
1002734	City Of Chino	City Of Chino	3	0	0	0	0	0	0	0
1002735	City Of Chino	City Of Chino	1	0	0	0	0	0	0	0
1002739	City Of Chino	City Of Chino -- Deep (in PAS)	12	2,649	1,848	1,842	1,407	1,499	1,098	1,034
1002741	City Of Chino	City Of Chino -- Deep (in PAS)	5	455	895	877	992	1,276	1,073	842
1002743	City Of Chino	City Of Chino -- Deep (in PAS)	9	444	1,324	1,225	844	998	424	455
1003741	City Of Chino	City Of Chino	11	1,214	1,175	1,353	1,885	1,745	980	1,520
1004176	City Of Chino	City Of Chino	6	931	945	1,470	1,682	854	1,349	664
1004178	City Of Chino	City Of Chino	4	0	0	0	0	0	0	0

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1004185	City Of Chino	City Of Chino	13	0	0	0	0	794	1,828	1,670
1004204	City Of Chino	City Of Chino -- Deep (in PAS)	7	395	601	1,193	1,131	846	722	611
1202495	City Of Chino	City Of Chino	TEV	0	0	0	0	0	0	0
1203157	City Of Chino	City Of Chino	34320	1	1	1	1	1	1	2
1203283	City Of Chino	City Of Chino -- Deep (in PAS)	10	1,586	1,498	367	0	21	414	7
1004179	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	17A	0	0	0	0	0	0	0
1004215	City Of Chino Hills	City Of Chino Hills	7A	389	645	604	802	867	740	503
1004216	City Of Chino Hills	City Of Chino Hills	7B	379	646	585	893	956	754	926
1004218	City Of Chino Hills	City Of Chino Hills	7D	0	0	0	0	0	0	0
1004261	City Of Chino Hills	City Of Chino Hills	9A	0	0	0	0	0	0	0
1004266	City Of Chino Hills	City Of Chino Hills	9	0	0	0	0	0	0	0
1004267	City Of Chino Hills	City Of Chino Hills	Pelesier	-	-	-	-	-	-	-
1004268	City Of Chino Hills	City Of Chino Hills	13	351	314	314	221	184	124	26
1004279	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	1B	0	0	0	0	0	152	90
1004280	City Of Chino Hills	City Of Chino Hills	1A	7	0	0	0	0	0	614
1203106	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	16A	0	0	0	0	0	52	269
1203158	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	19	0	0	0	0	0	0	0
1203214	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	W15-B	0	0	0	0	0	537	1,250
1203217	City Of Chino Hills	City Of Chino Hills	14	0	0	0	0	0	0	25
1002319	City of Ontario	City of Ontario	9	1,786	1,641	1,568	1,184	1,069	89	75
1002350	City of Ontario	City of Ontario	35	0	0	0	0	0	0	1,320
1002360	City of Ontario	City of Ontario	33	0	0	857	2,018	2,994	3,015	2,965
1002636	City of Ontario	City of Ontario	15	2,443	2,784	2,885	818	2,622	2,878	2,146
1002623	City of Pomona	City of Pomona	P-30	422	422	291	220	364	315	128

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1002650	City of Pomona	City of Pomona	P-06	629	615	569	491	405	607	201
1002651	City of Pomona	City of Pomona	P-05 (Old)	2	0	208	208	80	137	38
1002653	City of Pomona	City of Pomona	P-02	1,173	1,091	904	1,663	1,300	1,639	899
1002654	City of Pomona	City of Pomona	P-16	1,160	1,304	1,025	564	779	798	318
1002655	City of Pomona	City of Pomona	P-04	183	1,437	1,022	981	1,284	1,254	622
1002656	City of Pomona	City of Pomona	P-10	515	905	573	1,047	883	1,029	454
1002659	City of Pomona	City of Pomona	P-17	410	827	733	700	666	739	363
1002660	City of Pomona	City of Pomona	P-11	11	0	50	117	316	255	126
1002661	City of Pomona	City of Pomona	P-12	64	83	56	252	576	383	231
1002662	City of Pomona	City of Pomona	P-18	357	112	211	64	179	219	113
1002663	City of Pomona	City of Pomona	P-14	100	478	469	163	690	596	276
1002664	City of Pomona	City of Pomona	P-15	599	808	782	733	465	465	336
1002668	City of Pomona	City of Pomona	P-22	227	126	255	3	4	14	0
1002678	City of Pomona	City of Pomona	P-21	722	1,033	941	889	659	861	605
1002685	City of Pomona	City of Pomona	-	190	218	444	201	485	233	149
1002703	City of Pomona	City of Pomona	P-26	805	940	611	515	264	877	404
1002704	City of Pomona	City of Pomona	P-23	992	926	579	681	1,147	1,257	770
1002706	City of Pomona	City of Pomona	P-25	1,726	1,103	1,807	2,039	1,911	722	1,372
1201236	City of Pomona	City of Pomona	P-27	833	930	1,041	1,538	1,295	1,407	1,003
1201246	City of Pomona	City of Pomona	P-35	-	-	-	-	-	-	-
1201247	City of Pomona	City of Pomona	P-34	-	-	-	-	-	-	-
1203062	City of Pomona	City of Pomona	P-29	681	692	655	358	318	501	295
1002301	City of Upland	City of Upland	7	1,639	1,213	952	1,656	192	1,289	1,469
1002313	City of Upland	City of Upland	Repair 9	1,032	1,691	1,959	2,006	1,515	1,073	1,655
1002529	City of Upland	City of Upland	13	0	0	0	351	480	80	1
1002531	City of Upland	City of Upland	8	392	363	416	865	581	1	20
1002535	City of Upland	City of Upland	3	861	139	818	638	20	2	1
1006997	City of Upland	City of Upland	7A	-	-	-	-	-	-	-
1002631	Monte Vista Irrigation Co	City Of Chino	MVIC 5	0	0	0	0	0	0	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1002632	Monte Vista Irrigation Co	City Of Chino	MVIC 4	305	286	258	237	255	262	310
1002634	Monte Vista Irrigation Co	City Of Chino	MVIC 3	0	0	0	0	0	0	0
1002641	Monte Vista Irrigation Co	City Of Chino	MVIC 2	0	0	0	0	0	0	0
1002541	Monte Vista Water District	Monte Vista Water District	4	14	249	148	80	20	0	0
1002544	Monte Vista Water District	Monte Vista Water District	5	1,160	1,772	2,182	2,212	1,608	1,570	697
1002546	Monte Vista Water District	Monte Vista Water District	10	1,495	1,500	1,329	2,313	1,143	487	627
1002551	Monte Vista Water District	Monte Vista Water District	6	774	858	767	615	313	24	164
1002552	Monte Vista Water District	Monte Vista Water District	11	479	125	1,022	498	498	797	489
1002560	Monte Vista Water District	Monte Vista Water District	16	0	0	0	0	0	0	0
1002561	Monte Vista Water District	Monte Vista Water District	20	1,789	1,372	1,172	985	941	1,314	906
1002563	Monte Vista Water District	Monte Vista Water District	19	3,199	2,722	2,345	2,500	2,268	2,895	2,369
1002627	Monte Vista Water District	Monte Vista Water District	9	14	11	0	0	0	0	0
1002630	Monte Vista Water District	Monte Vista Water District	12	0	0	0	0	0	0	0
1002642	Monte Vista Water District	Monte Vista Water District	1	60	92	51	7	1	0	0
1002646	Monte Vista Water District	Monte Vista Water District	8	0	0	0	0	0	0	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1985 [acre-ft]	1986 [acre-ft]	1987 [acre-ft]	1988 [acre-ft]	1989 [acre-ft]	1990 [acre-ft]	1991 [acre-ft]
1002722	Monte Vista Water District	Monte Vista Water District	2	1	0	0	0	0	0	0
1002746	Monte Vista Water District	Monte Vista Water District	24	60	0	0	0	0	0	0
1004160	Monte Vista Water District	Monte Vista Water District	22	141	108	159	252	180	150	0
1004161	Monte Vista Water District	Monte Vista Water District	23	325	410	433	401	342	104	0
1201178	Monte Vista Water District	Monte Vista Water District	25	0	0	0	0	0	0	0
1201206	Monte Vista Water District	Monte Vista Water District	21	0	0	0	0	0	0	0
1002315	San Antonio Water Co.	San Antonio Water Co.	12	1,124	1,183	1,202	1,171	1,092	684	453
1002320	San Antonio Water Co.	San Antonio Water Co.	21	0	0	0	0	0	0	0
1002321	San Antonio Water Co.	San Antonio Water Co.	18	0	0	0	0	0	0	0
1002534	West End Consolidated Water Co	San Antonio Water Co.	Owner #2	0	683	667	0	0	0	0
1002536	West End Consolidated Water Co	San Antonio Water Co.	WE#1	636	0	0	0	0	0	0
1002554	So Cal Water Co.	So Cal Water Co.	Margarite 1	651	485	663	651	627	514	585

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1003757	-	Agricultural/Other	Domestic #1-900C	127	132	121	90	86	32	0
1004184	-	Agricultural/Other	-	0	0	0	0	-	-	-
1004188	-	Agricultural/Other	29680-Domestic	60	42	0	0	0	-	-
1201253	-	Agricultural/Other	Domestic	1	1	1	3	0	1	0
1201262	-	Agricultural/Other	Milk Processing	10	1	2	5	0	5	0
1201276	-	Agricultural/Other	72130-Domestic	1	0	0	0	-	-	-
1202101	-	Agricultural/Other	Dairy	0	9	11	20	0	5	2
1202117	-	Agricultural/Other	49360	5	1	0	3	0	1	0
1202136	-	Agricultural/Other	-	68	65	11	3	2	10	5
1202139	-	Agricultural/Other	IRR-#2-12P	0	9	8	25	36	11	0
1202143	-	Agricultural/Other	23680-DI	22	73	4	16	24	0	0
1202145	-	Agricultural/Other	95011-Domestic	0	1	4	4	1	0	0
1202146	-	Agricultural/Other	Domestic-2 Houses	6	15	37	4	82	33	0
1202147	-	Agricultural/Other	76240-Irrigation	72	117	80	232	98	0	0
1202451	-	Agricultural/Other	95032-1	31	42	72	0	-	-	-
1202508	-	Agricultural/Other	95069	1	1	1	3	2	5	0
1202525	-	Agricultural/Other	68760	4	1	1	3	0	0	0
1202531	-	Agricultural/Other	87960	59	64	71	59	50	49	68
1202665	-	Agricultural/Other	83000-Domestic	29	20	0	0	-	-	-
1202675	-	Agricultural/Other	83000-Irrigation	15	15	18	49	160	130	38
1203046	-	Agricultural/Other	90280	4	9	20	5	0	0	3
1203050	-	Agricultural/Other	-	0	1	0	3	-	-	-
1203068	-	Agricultural/Other	-	0	0	0	0	-	-	-
1203141	-	Agricultural/Other	29680-Irrigation	56	6	0	0	0	0	0
1203153	-	Agricultural/Other	760	27	13	44	93	45	62	30
1203169	-	Agricultural/Other	30500-Irrigation	0	88	4	3	0	350	0
1203170	-	Agricultural/Other	-	40	27	27	0	-	-	-
1203186	-	Agricultural/Other	87240	1	1	1	3	1	5	1
1203209	-	Agricultural/Other	21320-1	16	42	43	132	0	168	-
1203210	-	Agricultural/Other	Irrigation	-	-	-	-	72	175	39

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1203260	-	Agricultural/Other	24840-4 (Ted's Ranch)	65	39	49	71	30	57	73
1203774	-	Agricultural/Other	-	0	0	0	0	-	-	-
1203882	-	Agricultural/Other	-	0	0	0	0	-	-	0
1206489	-	Agricultural/Other	-	-	-	-	-	-	-	-
1206496	-	Agricultural/Other	Irrigation	-	-	-	-	-	-	0
1206519	-	Agricultural/Other	-	-	-	-	-	0	-	-
1202485	Abbona Trust	Agricultural/Other	95048-ABO	0	0	0	2	0	47	0
1201267	Ambrosia Farms	Agricultural/Other	Irr	-	-	-	-	-	3	0
1201250	Angelica Textile Service	Agricultural/Other	1	23	25	25	22	26	19	29
1202137	Best Eight Inc.	Agricultural/Other	-	0	0	0	0	-	-	-
1203137	Bohlander & Holmes	Agricultural/Other	-	0	0	0	0	-	-	-
1004229	Boys Republic	Agricultural/Other	11480-2	136	174	510	627	254	604	334
1203182	Boys Republic	Agricultural/Other	3	0	0	0	0	0	201	-
1203278	CA State Dept Of Fish & Game	Agricultural/Other	74240	119	14	99	2	0	0	0
1002639	Chino Water Co.	Agricultural/Other	16520-3	0	0	0	0	0	0	0
1002733	Chino Water Co.	Agricultural/Other	1	0	0	0	0	-	-	-
1004267	City Of Chino Hills	Agricultural/Other	Pelesier	101	128	170	92	24	15	0
1201246	City of Pomona	Agricultural/Other	P-35	0	0	0	106	-	-	-
1201247	City of Pomona	Agricultural/Other	P-34	0	0	0	1,416	-	-	-
1203776	City of Pomona	Agricultural/Other	-	0	0	0	0	-	-	-
1203262	Dotta Bros	Agricultural/Other	Irrigation - Elena Ranch	-	-	-	-	-	0	29
1203205	Estate of Patterson Ranch	Agricultural/Other	1	0	0	0	0	-	-	-
1202123	Foss Brothers Dairy	Agricultural/Other	29240-Domestic	12	13	14	913	12	11	3
1203219	George Hilarides Testamentary	Agricultural/Other	1	5	0	0	0	-	-	-
1202486	H & Z Trust	Agricultural/Other	Domestic	0	0	0	35	18	0	0
1202489	H & Z Trust	Agricultural/Other	Irrigation	27	20	33	51	53	68	0
1003750	J.G.J. Joint Venture	Agricultural/Other	95075	0	0	0	123	35	0	0

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1003751	J.G.J. Joint Venture	Agricultural/Other	95075-3	25	0	0	0	0	0	0
1202111	J.G.J. Joint Venture	Agricultural/Other	1	0	0	0	0	-	-	-
1202150	Jongsma Dairy	Agricultural/Other	DD	49	61	75	150	130	79	184
1202151	Jongsma Dairy	Agricultural/Other	DI	25	37	0	0	23	-	-
1202492	Land Design Services	Agricultural/Other	95067-3	136	258	0	0	0	0	1
1202503	Land Design Services	Agricultural/Other	95067-2	0	0	78	2	0	0	80
1203749	Louisa Thorsheim	Agricultural/Other	-	-	-	-	-	-	0	0
1203218	Majestic Reality	Agricultural/Other	95045	0	1	1	3	0	0	0
1203203	Mary Brogurere Estate	Agricultural/Other	84490-2	0	69	87	96	90	92	77
1002646	Monte Vista Water District	Agricultural/Other	8	-	-	-	-	39	-	-
1201242	Nor'East Min Roses	Agricultural/Other	1	0	0	0	0	-	0	-
1203033	Ontario Christian School	Agricultural/Other	-	25	44	6	24	291	164	0
1004278	Pierce Family Corp.	Agricultural/Other	-	0	0	0	86	80	80	77
1002691	Pomona Cemetery Assoc.	Agricultural/Other	61760-1	0	0	0	0	0	0	0
1201256	Pomona Cemetery Assoc.	Agricultural/Other	61760-2	113	135	151	112	162	115	122
1202519	Richard Hoeskema	Agricultural/Other	4	0	0	0	0	-	0	1
1202110	SBFCD	Agricultural/Other	11960-BEC	10	7	0	72	44	0	0
1206490	Stanton Nurseries	Agricultural/Other	Nursery	-	-	-	-	-	-	0
1202140	Sterk Family Trust	Agricultural/Other	74680-Domestic	44	89	134	31	156	111	352
1202141	Sterk Family Trust	Agricultural/Other	74680-Irrigation	144	857	354	119	123	52	0
1206497	Sterk Family Trust	Agricultural/Other	Irrigation	-	-	-	-	-	-	0
1202504	Stratham Homes	Agricultural/Other	Irrigation	0	0	0	0	-	-	-
1202523	Stratham Homes	Agricultural/Other	84480-Dry	63	90	1	3	0	23	23
1203228	Sukut Charitable Trust	Agricultural/Other	75770	14	13	2	0	0	0	75
1201127	Sunkist Growers Inc	Agricultural/Other	1	443	483	526	448	475	288	0
1201129	Sunkist Growers Inc	Agricultural/Other	3	0	0	0	5	-	-	-
1201129	Sunkist Growers Inc	Agricultural/Other	3	-	-	-	-	4	79	0
1003756	Sunshine Dairy	Agricultural/Other	5080	7	5	9	2	4	6	1
1202133	Sunshine Dairy	Agricultural/Other	5080-2	45	29	39	23	34	40	59
1201245	U.S. Lubricants	Agricultural/Other	-	1	0	0	0	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1206503	Victory Baptist Church	Agricultural/Other	Domestic	-	-	-	-	-	-	-
1201201	Vulcan Materials Co/ Calmat Div	Agricultural/Other	-	0	0	0	0	0	0	12
1202118	West Euclid Water Group	Agricultural/Other	93760	1	4	5	16	5	0	0
1003873	CIM	CIM	74280-5	224	0	63	113	49	173	53
1003875	CIM	CIM	6	398	414	1,410	382	449	144	0
1003879	CIM	CIM	74280-13	274	328	229	588	165	502	274
1004194	CIM	CIM	74280-4	209	246	283	62	151	224	190
1004196	CIM	CIM	74280-12	268	362	366	102	38	270	95
1004207	CIM	CIM	74280-3	211	134	61	212	136	66	655
1004286	CIM	CIM	74280-11	179	282	21	942	1,504	200	247
1004288	CIM	CIM	74280-8	1	0	0	0	4	0	0
1004293	CIM	CIM	74280-10	311	119	71	129	347	312	23
1004295	CIM	CIM	74280-7	468	205	152	105	200	171	81
1004297	CIM	CIM	74280-1A	617	766	941	262	243	796	659
1004299	CIM	CIM	9	284	257	96	165	37	48	102
1202542	CIM	CIM	5	0	0	0	0	-	-	-
1203213	CIM	CIM	74280-1	0	0	0	0	0	0	334
1002645	City Of Chino	City Of Chino	14	1,638	1,246	705	1,329	1,879	2,055	2,096
1002709	City Of Chino	City Of Chino	F1	0	0	0	0	-	-	-
1002734	City Of Chino	City Of Chino	3	0	0	0	0	-	-	-
1002735	City Of Chino	City Of Chino	1	0	0	0	0	-	-	-
1002739	City Of Chino	City Of Chino -- Deep (in PAS)	12	1,194	1,675	1,244	1,303	1,747	1,629	923
1002741	City Of Chino	City Of Chino -- Deep (in PAS)	5	1,021	861	571	830	971	816	765
1002743	City Of Chino	City Of Chino -- Deep (in PAS)	9	328	332	255	271	410	301	100
1003741	City Of Chino	City Of Chino	11	1,384	1,159	987	1,491	1,748	2,211	2,033
1004176	City Of Chino	City Of Chino	6	973	518	147	582	1,006	1,370	619
1004178	City Of Chino	City Of Chino	4	0	0	148	1,113	1,233	1,102	1,015

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1004185	City Of Chino	City Of Chino	13	1,452	1,456	1,656	1,649	361	925	1,390
1004204	City Of Chino	City Of Chino -- Deep (in PAS)	7	777	38	0	0	-	-	-
1202495	City Of Chino	City Of Chino	TEV	0	0	0	0	-	-	-
1203157	City Of Chino	City Of Chino	34320	2	1	0	3	10	10	0
1203283	City Of Chino	City Of Chino -- Deep (in PAS)	10	0	0	6	-38	98	11	15
1004179	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	17A	228	1,201	450	134	509	447	950
1004215	City Of Chino Hills	City Of Chino Hills	7A	292	35	7	305	294	95	55
1004216	City Of Chino Hills	City Of Chino Hills	7B	262	0	7	343	431	126	185
1004218	City Of Chino Hills	City Of Chino Hills	7D	3	0	0	0	0	0	0
1004261	City Of Chino Hills	City Of Chino Hills	9A	0	0	0	0	-	-	-
1004266	City Of Chino Hills	City Of Chino Hills	9	0	0	0	0	-	-	-
1004267	City Of Chino Hills	City Of Chino Hills	Pelesier	-	-	-	-	45	28	0
1004268	City Of Chino Hills	City Of Chino Hills	13	0	0	0	0	0	267	0
1004279	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	1B	41	40	46	163	188	8	0
1004280	City Of Chino Hills	City Of Chino Hills	1A	182	2	454	511	512	285	435
1203106	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	16A	502	132	89	37	4	92	33
1203158	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	19	0	270	916	902	575	165	162
1203214	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	W15-B	503	973	1,096	881	1,320	717	1,088
1203217	City Of Chino Hills	City Of Chino Hills	14	53	137	160	154	227	0	1
1002319	City of Ontario	City of Ontario	9	64	468	283	206	693	694	19
1002350	City of Ontario	City of Ontario	35	1,990	1,616	2,525	2,273	2,694	2,562	3,154
1002360	City of Ontario	City of Ontario	33	2,100	2,237	0	0	-	-	-
1002636	City of Ontario	City of Ontario	15	2,737	1,797	1,783	1,938	2,412	2,450	2,545
1002623	City of Pomona	City of Pomona	P-30	64	97	53	178	240	196	77

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1002650	City of Pomona	City of Pomona	P-06	40	653	1,080	914	1,395	945	898
1002651	City of Pomona	City of Pomona	P-05 (Old)	1	768	774	686	1,084	891	857
1002653	City of Pomona	City of Pomona	P-02	892	828	1,183	939	858	1,006	1,129
1002654	City of Pomona	City of Pomona	P-16	84	667	881	226	635	795	926
1002655	City of Pomona	City of Pomona	P-04	592	851	777	722	951	720	913
1002656	City of Pomona	City of Pomona	P-10	759	447	511	399	496	871	1,096
1002659	City of Pomona	City of Pomona	P-17	295	586	244	595	745	584	586
1002660	City of Pomona	City of Pomona	P-11	5	7	16	400	707	571	265
1002661	City of Pomona	City of Pomona	P-12	19	15	281	107	843	502	393
1002662	City of Pomona	City of Pomona	P-18	1	7	19	523	566	796	335
1002663	City of Pomona	City of Pomona	P-14	187	410	487	468	728	439	546
1002664	City of Pomona	City of Pomona	P-15	147	582	579	777	825	837	754
1002668	City of Pomona	City of Pomona	P-22	0	0	0	0	0	0	0
1002678	City of Pomona	City of Pomona	P-21	871	605	812	567	785	760	467
1002685	City of Pomona	City of Pomona	-	41	119	125	133	270	144	0
1002703	City of Pomona	City of Pomona	P-26	197	46	1	309	370	870	386
1002704	City of Pomona	City of Pomona	P-23	608	248	147	699	888	929	773
1002706	City of Pomona	City of Pomona	P-25	1,596	820	1,042	1,109	833	1,013	822
1201236	City of Pomona	City of Pomona	P-27	1,198	430	602	975	1,044	1,193	1,117
1201246	City of Pomona	City of Pomona	P-35	-	-	-	-	466	883	368
1201247	City of Pomona	City of Pomona	P-34	-	-	-	-	1,160	1,178	720
1203062	City of Pomona	City of Pomona	P-29	378	553	440	612	626	608	697
1002301	City of Upland	City of Upland	7	992	960	1,271	1,462	992	692	0
1002313	City of Upland	City of Upland	Repair 9	1,526	1,411	1,394	1,547	1,497	1,185	1,476
1002529	City of Upland	City of Upland	13	21	1	0	0	-	6	0
1002531	City of Upland	City of Upland	8	23	0	0	0	-	0	0
1002535	City of Upland	City of Upland	3	23	0	1	0	-	3	0
1006997	City of Upland	City of Upland	7A	-	-	-	-	-	-	448
1002631	Monte Vista Irrigation Co	City Of Chino	MVIC 5	0	0	0	0	-	-	-

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1002632	Monte Vista Irrigation Co	City Of Chino	MVIC 4	288	291	295	223	249	300	181
1002634	Monte Vista Irrigation Co	City Of Chino	MVIC 3	0	0	0	0	-	-	-
1002641	Monte Vista Irrigation Co	City Of Chino	MVIC 2	0	0	0	0	-	-	-
1002541	Monte Vista Water District	Monte Vista Water District	4	0	0	0	0	94	94	0
1002544	Monte Vista Water District	Monte Vista Water District	5	1,699	1,222	1,450	2,212	1,764	2,240	1,202
1002546	Monte Vista Water District	Monte Vista Water District	10	384	277	113	236	529	804	1,035
1002551	Monte Vista Water District	Monte Vista Water District	6	608	134	112	116	331	328	882
1002552	Monte Vista Water District	Monte Vista Water District	11	1,122	962	1,023	976	1,088	996	639
1002560	Monte Vista Water District	Monte Vista Water District	16	0	0	0	0	-	-	-
1002561	Monte Vista Water District	Monte Vista Water District	20	1,403	1,469	703	1,047	325	1,613	732
1002563	Monte Vista Water District	Monte Vista Water District	19	2,418	1,837	2,388	2,546	1,998	3,052	2,339
1002627	Monte Vista Water District	Monte Vista Water District	9	0	0	0	0	0	0	0
1002630	Monte Vista Water District	Monte Vista Water District	12	0	0	0	0	0	0	0
1002642	Monte Vista Water District	Monte Vista Water District	1	0	0	0	1	0	0	0
1002646	Monte Vista Water District	Monte Vista Water District	8	0	0	0	0	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1992 [acre-ft]	1993 [acre-ft]	1994 [acre-ft]	1995 [acre-ft]	1996 [acre-ft]	1997 [acre-ft]	1998 [acre-ft]
1002722	Monte Vista Water District	Monte Vista Water District	2	0	0	0	0	0	0	0
1002746	Monte Vista Water District	Monte Vista Water District	24	0	0	0	0	0	0	0
1004160	Monte Vista Water District	Monte Vista Water District	22	0	0	0	0	0	0	0
1004161	Monte Vista Water District	Monte Vista Water District	23	0	0	0	0	0	0	0
1201178	Monte Vista Water District	Monte Vista Water District	25	0	0	0	0	0	0	0
1201206	Monte Vista Water District	Monte Vista Water District	21	0	0	0	0	0	0	0
1002315	San Antonio Water Co.	San Antonio Water Co.	12	942	1,061	740	0	0	24	0
1002320	San Antonio Water Co.	San Antonio Water Co.	21	0	0	0	0	0	-	-
1002321	San Antonio Water Co.	San Antonio Water Co.	18	0	0	0	0	0	-	-
1002534	West End Consolidated Water Co	San Antonio Water Co.	Owner #2	0	0	0	0	0	0	0
1002536	West End Consolidated Water Co	San Antonio Water Co.	WE#1	0	0	0	0	0	0	0
1002554	So Cal Water Co.	So Cal Water Co.	Margarite 1	441	367	199	251	306	576	380

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1003757	-	Agricultural/Other	Domestic #1-900C	109	72	138
1004184	-	Agricultural/Other	-	-	-	-
1004188	-	Agricultural/Other	29680-Domestic	22	34	57
1201253	-	Agricultural/Other	Domestic	0	-	-
1201262	-	Agricultural/Other	Milk Processing	4	0	0
1201276	-	Agricultural/Other	72130-Domestic	-	-	-
1202101	-	Agricultural/Other	Dairy	27	0	0
1202117	-	Agricultural/Other	49360	0	8	1
1202136	-	Agricultural/Other	-	1	3	0
1202139	-	Agricultural/Other	IRR-#2-12P	34	0	0
1202143	-	Agricultural/Other	23680-DI	0	-	-
1202145	-	Agricultural/Other	95011-Domestic	0	1	1
1202146	-	Agricultural/Other	Domestic-2 Houses	0	-	-
1202147	-	Agricultural/Other	76240-Irrigation	0	-	-
1202451	-	Agricultural/Other	95032-1	-	-	-
1202508	-	Agricultural/Other	95069	0	0	0
1202525	-	Agricultural/Other	68760	4	5	2
1202531	-	Agricultural/Other	87960	67	69	65
1202665	-	Agricultural/Other	83000-Domestic	-	-	0
1202675	-	Agricultural/Other	83000-Irrigation	188	177	177
1203046	-	Agricultural/Other	90280	13	33	11
1203050	-	Agricultural/Other	-	0	0	0
1203068	-	Agricultural/Other	-	-	-	-
1203141	-	Agricultural/Other	29680-Irrigation	0	0	0
1203153	-	Agricultural/Other	760	58	47	57
1203169	-	Agricultural/Other	30500-Irrigation	61	174	15
1203170	-	Agricultural/Other	-	-	-	-
1203186	-	Agricultural/Other	87240	0	1	0
1203209	-	Agricultural/Other	21320-1	-	-	-
1203210	-	Agricultural/Other	Irrigation	186	166	48

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1203260	-	Agricultural/Other	24840-4 (Ted's Ranch)	0	-	-
1203774	-	Agricultural/Other	-	-	-	-
1203882	-	Agricultural/Other	-	-	-	-
1206489	-	Agricultural/Other	-	11	0	0
1206496	-	Agricultural/Other	Irrigation	25	19	0
1206519	-	Agricultural/Other	-	-	-	-
1202485	Abbona Trust	Agricultural/Other	95048-ABO	0	47	65
1201267	Ambrosia Farms	Agricultural/Other	Irr	13	29	18
1201250	Angelica Textile Service	Agricultural/Other	1	28	32	34
1202137	Best Eight Inc.	Agricultural/Other	-	1	0	0
1203137	Bohlander & Holmes	Agricultural/Other	-	0	0	0
1004229	Boys Republic	Agricultural/Other	11480-2	221	318	175
1203182	Boys Republic	Agricultural/Other	3	-	-	-
1203278	CA State Dept Of Fish & Game	Agricultural/Other	74240	0	0	0
1002639	Chino Water Co.	Agricultural/Other	16520-3	0	0	0
1002733	Chino Water Co.	Agricultural/Other	1	-	-	-
1004267	City Of Chino Hills	Agricultural/Other	Pelesier	7	0	0
1201246	City of Pomona	Agricultural/Other	P-35	-	-	-
1201247	City of Pomona	Agricultural/Other	P-34	-	-	-
1203776	City of Pomona	Agricultural/Other	-	-	-	-
1203262	Dotta Bros	Agricultural/Other	Irrigation - Elena Ranch	0	-	-
1203205	Estate of Patterson Ranch	Agricultural/Other	1	-	-	-
1202123	Foss Brothers Dairy	Agricultural/Other	29240-Domestic	13	7	0
1203219	George Hilarides Testamentary	Agricultural/Other	1	-	-	-
1202486	H & Z Trust	Agricultural/Other	Domestic	1	41	0
1202489	H & Z Trust	Agricultural/Other	Irrigation	28	0	13
1003750	J.G.J. Joint Venture	Agricultural/Other	95075	0	0	0

Source of Data: CBWM (2002)

Appendix C

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1003751	J.G.J. Joint Venture	Agricultural/Other	95075-3	0	0	0
1202111	J.G.J. Joint Venture	Agricultural/Other	1	-	-	-
1202150	Jongsma Dairy	Agricultural/Other	DD	96	73	74
1202151	Jongsma Dairy	Agricultural/Other	DI	-	-	-
1202492	Land Design Services	Agricultural/Other	95067-3	63	19	16
1202503	Land Design Services	Agricultural/Other	95067-2	69	63	47
1203749	Louisa Thorsheim	Agricultural/Other	-	0	0	2
1203218	Majestic Reality	Agricultural/Other	95045	0	-	-
1203203	Mary Brogurere Estate	Agricultural/Other	84490-2	74	55	57
1002646	Monte Vista Water District	Agricultural/Other	8	-	-	-
1201242	Nor'East Min Roses	Agricultural/Other	1	-	-	-
1203033	Ontario Christian School	Agricultural/Other	-	25	34	30
1004278	Pierce Family Corp.	Agricultural/Other	-	103	0	-
1002691	Pomona Cemetery Assoc.	Agricultural/Other	61760-1	0	0	0
1201256	Pomona Cemetery Assoc.	Agricultural/Other	61760-2	150	166	142
1202519	Richard Hoeskema	Agricultural/Other	4	1	0	1
1202110	SBFCD	Agricultural/Other	11960-BEC	0	73	29
1206490	Stanton Nurseries	Agricultural/Other	Nursery	0	5	15
1202140	Sterk Family Trust	Agricultural/Other	74680-Domestic	127	169	156
1202141	Sterk Family Trust	Agricultural/Other	74680-Irrigation	-	-	-
1206497	Sterk Family Trust	Agricultural/Other	Irrigation	144	88	121
1202504	Stratham Homes	Agricultural/Other	Irrigation	-	-	-
1202523	Stratham Homes	Agricultural/Other	84480-Dry	23	60	14
1203228	Sukut Charitable Trust	Agricultural/Other	75770	0	-	-
1201127	Sunkist Growers Inc	Agricultural/Other	1	0	0	24
1201129	Sunkist Growers Inc	Agricultural/Other	3	-	-	-
1201129	Sunkist Growers Inc	Agricultural/Other	3	28	2	0
1003756	Sunshine Dairy	Agricultural/Other	5080	13	7	5
1202133	Sunshine Dairy	Agricultural/Other	5080-2	29	46	26
1201245	U.S. Lubricants	Agricultural/Other	-	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1206503	Victory Baptist Church	Agricultural/Other	Domestic	1	0	10
1201201	Vulcan Materials Co/ Calmat Div	Agricultural/Other	-	27	9	7
1202118	West Euclid Water Group	Agricultural/Other	93760	1	5	10
1003873	CIM	CIM	74280-5	325	479	72
1003875	CIM	CIM	6	-	-	-
1003879	CIM	CIM	74280-13	354	85	288
1004194	CIM	CIM	74280-4	301	105	0
1004196	CIM	CIM	74280-12	128	132	52
1004207	CIM	CIM	74280-3	67	576	621
1004286	CIM	CIM	74280-11	502	87	754
1004288	CIM	CIM	74280-8	0	0	-
1004293	CIM	CIM	74280-10	118	158	91
1004295	CIM	CIM	74280-7	93	124	105
1004297	CIM	CIM	74280-1A	39	383	473
1004299	CIM	CIM	9	79	127	179
1202542	CIM	CIM	5	-	-	-
1203213	CIM	CIM	74280-1	617	756	755
1002645	City Of Chino	City Of Chino	14	2,241	2,377	2,004
1002709	City Of Chino	City Of Chino	F1	-	-	-
1002734	City Of Chino	City Of Chino	3	-	-	-
1002735	City Of Chino	City Of Chino	1	-	-	-
1002739	City Of Chino	City Of Chino -- Deep (in PAS)	12	1,337	974	1,179
1002741	City Of Chino	City Of Chino -- Deep (in PAS)	5	846	586	524
1002743	City Of Chino	City Of Chino -- Deep (in PAS)	9	20	6	4
1003741	City Of Chino	City Of Chino	11	2,451	2,010	1,512
1004176	City Of Chino	City Of Chino	6	1,046	1,061	278
1004178	City Of Chino	City Of Chino	4	1,111	1,093	992

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1004185	City Of Chino	City Of Chino	13	1,160	1,903	1,124
1004204	City Of Chino	City Of Chino -- Deep (in PAS)	7	-	-	-
1202495	City Of Chino	City Of Chino	TEV	-	-	-
1203157	City Of Chino	City Of Chino	34320	0	-	-
1203283	City Of Chino	City Of Chino -- Deep (in PAS)	10	3	321	1
1004179	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	17A	524	423	469
1004215	City Of Chino Hills	City Of Chino Hills	7A	224	384	547
1004216	City Of Chino Hills	City Of Chino Hills	7B	410	884	879
1004218	City Of Chino Hills	City Of Chino Hills	7D	0	0	0
1004261	City Of Chino Hills	City Of Chino Hills	9A	-	-	-
1004266	City Of Chino Hills	City Of Chino Hills	9	-	-	-
1004267	City Of Chino Hills	City Of Chino Hills	Pelesier	12	7	0
1004268	City Of Chino Hills	City Of Chino Hills	13	0	0	0
1004279	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	1B	115	0	0
1004280	City Of Chino Hills	City Of Chino Hills	1A	1,021	1,037	1,069
1203106	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	16A	245	113	182
1203158	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	19	514	107	318
1203214	City Of Chino Hills	City Of Chino Hills-- Deep (in PAS)	W15-B	1,289	1,308	776
1203217	City Of Chino Hills	City Of Chino Hills	14	1	1	0
1002319	City of Ontario	City of Ontario	9	0	0	0
1002350	City of Ontario	City of Ontario	35	2,350	2,426	3,128
1002360	City of Ontario	City of Ontario	33	-	-	-
1002636	City of Ontario	City of Ontario	15	2,279	2,162	1,627
1002623	City of Pomona	City of Pomona	P-30	22	54	110

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1002650	City of Pomona	City of Pomona	P-06	1,272	1,458	1,382
1002651	City of Pomona	City of Pomona	P-05 (Old)	1,219	1,008	698
1002653	City of Pomona	City of Pomona	P-02	1,444	910	1,639
1002654	City of Pomona	City of Pomona	P-16	469	415	690
1002655	City of Pomona	City of Pomona	P-04	1,117	1,074	977
1002656	City of Pomona	City of Pomona	P-10	1,107	1,262	1,255
1002659	City of Pomona	City of Pomona	P-17	656	860	848
1002660	City of Pomona	City of Pomona	P-11	78	803	635
1002661	City of Pomona	City of Pomona	P-12	46	778	193
1002662	City of Pomona	City of Pomona	P-18	526	1,016	882
1002663	City of Pomona	City of Pomona	P-14	208	274	803
1002664	City of Pomona	City of Pomona	P-15	932	790	735
1002668	City of Pomona	City of Pomona	P-22	0	0	0
1002678	City of Pomona	City of Pomona	P-21	737	519	639
1002685	City of Pomona	City of Pomona	-	0	0	0
1002703	City of Pomona	City of Pomona	P-26	357	531	0
1002704	City of Pomona	City of Pomona	P-23	990	1,270	568
1002706	City of Pomona	City of Pomona	P-25	1,173	1,196	1,257
1201236	City of Pomona	City of Pomona	P-27	1,176	1,487	1,379
1201246	City of Pomona	City of Pomona	P-35	1,019	965	1,025
1201247	City of Pomona	City of Pomona	P-34	1,320	1,593	1,646
1203062	City of Pomona	City of Pomona	P-29	697	705	91
1002301	City of Upland	City of Upland	7	-	-	-
1002313	City of Upland	City of Upland	Repair 9	1,049	150	1
1002529	City of Upland	City of Upland	13	0	2	0
1002531	City of Upland	City of Upland	8	0	2	4
1002535	City of Upland	City of Upland	3	0	1	3
1006997	City of Upland	City of Upland	7A	1,227	1,570	1,566
1002631	Monte Vista Irrigation Co	City Of Chino	MVIC 5	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1002632	Monte Vista Irrigation Co	City Of Chino	MVIC 4	121	0	-
1002634	Monte Vista Irrigation Co	City Of Chino	MVIC 3	-	-	-
1002641	Monte Vista Irrigation Co	City Of Chino	MVIC 2	-	-	-
1002541	Monte Vista Water District	Monte Vista Water District	4	396	703	928
1002544	Monte Vista Water District	Monte Vista Water District	5	2,126	1,506	2,186
1002546	Monte Vista Water District	Monte Vista Water District	10	263	1,681	939
1002551	Monte Vista Water District	Monte Vista Water District	6	763	328	788
1002552	Monte Vista Water District	Monte Vista Water District	11	523	948	1,003
1002560	Monte Vista Water District	Monte Vista Water District	16	-	-	-
1002561	Monte Vista Water District	Monte Vista Water District	20	1,953	1,700	1,429
1002563	Monte Vista Water District	Monte Vista Water District	19	2,600	2,447	2,648
1002627	Monte Vista Water District	Monte Vista Water District	9	0	0	0
1002630	Monte Vista Water District	Monte Vista Water District	12	0	0	0
1002642	Monte Vista Water District	Monte Vista Water District	1	0	0	0
1002646	Monte Vista Water District	Monte Vista Water District	8	-	-	-

Source of Data: CBWM (2002)

Annual Production Data for MZ-1

WE Id No.	Company Name	Owner	Local Name	1999 [acre-ft]	2000 [acre-ft]	2001 [acre-ft]
1002722	Monte Vista Water District	Monte Vista Water District	2	0	0	0
1002746	Monte Vista Water District	Monte Vista Water District	24	0	0	0
1004160	Monte Vista Water District	Monte Vista Water District	22	0	0	0
1004161	Monte Vista Water District	Monte Vista Water District	23	0	0	0
1201178	Monte Vista Water District	Monte Vista Water District	25	0	-	-
1201206	Monte Vista Water District	Monte Vista Water District	21	0	0	0
1002315	San Antonio Water Co.	San Antonio Water Co.	12	0	10	0
1002320	San Antonio Water Co.	San Antonio Water Co.	21	-	-	-
1002321	San Antonio Water Co.	San Antonio Water Co.	18	-	-	-
1002534	West End Consolidated Water Co	San Antonio Water Co.	Owner #2	0	0	0
1002536	West End Consolidated Water Co	San Antonio Water Co.	WE#1	0	0	0
1002554	So Cal Water Co.	So Cal Water Co.	Margarite 1	243	482	372

Source of Data: CBWM (2002)

APPENDIX C

Ground Water Flow Model of a Portion of MZ-1

Containing the City of Chino Hills Wells

GEOSCIENCE Support Services, Inc.

APPENDIX C

DEVELOPMENT OF GROUND WATER FLOW MODEL FOR A PORTION OF MZ-1 CONTAINING CITY OF CHINO HILLS WELLS

CONTENTS

FIGURES

FIGURES (continued)

TABLES

APPENDIX C

DEVELOPMENT OF GROUND WATER FLOW MODEL FOR A PORTION OF MZ-1 CONTAINING CITY OF CHINO HILLS WELLS

1.0 INTRODUCTION

The proposed ground water production from City of Chino Hills' wells under the 245 ft Guidance Level is based on ground water flow modeling of a portion of the Chino Basin. The following sections describe the development of the model, its calibration, development of model scenarios and model results.

2.0 MODEL DEVELOPMENT

2.1 Conceptual Model

The City of Chino Hills ground water model was developed for the unconsolidated sediments in the vicinity of City of Chino Hills' wells and surrounding area in the southwestern portion of the Chino Basin (see Figure C-1). Consolidated sedimentary and crystalline basement rocks underlying and surrounding the basin fill are considered impermeable and are not part of the alluvial ground water flow system. The conceptual ground water model (see Figure C-2) consists of two distinct model layers based on the aquifer systems discussed by GEOSCIENCE (2001):

- Layer 1 – Upper alluvial aquifer system
- Layer 2 – Lower alluvial aquifer system

Flow is assumed to occur horizontally within the each of the model layers while the layers maintain hydraulic connection to each other through vertical leakance. The Central Avenue Fault and the Riley Barrier (WE, 2005 and 2007) were modeled as a lower permeability feature using the MODFLOW Horizontal-Flow-Barrier package (HFB).

The sources of recharge to the aquifers in the model area included subsurface inflow from adjoining portions of Chino Basin and Temescal Basin, deep percolation of precipitation falling directly on the land surface (areal recharge), artificial recharge at spreading basins, mountain front runoff, surface water percolation along the unlined river and stream channels and return flow from applied agricultural water. The Santa Ana River was modeled using the MODFLOW Streamflow-Routing package.

The discharge terms in the model area included ground water pumping, evapotranspiration along the Santa Ana River, subsurface outflow into the Santa Ana River canyon below Prado Dam and subsurface outflow to the adjoining portions of Chino Basin.

2.2 Description of Model Codes

2.2.1 USGS MODFLOW

MODFLOW, a block-centered, finite-difference ground water flow model, was the computer code used in the City of Chino Hills ground water model. Widely used and highly versatile, it was developed by the United States Geologic Survey (McDonald and Harbaugh, 1988) for the purpose of modeling ground water flow. The Streamflow-Routing package (Prudic, 1989) was incorporated for use in the USGS MODFLOW model to account for the interaction between surface streams and ground water.

MODFLOW is modular in the sense that a standard format has been established for the interface between each module of the program, as well as the common variables that must be accessible to all modules. Consequently, new modules (also called packages) may be added as necessary. Since its initial development, various modifications and additional packages have been added.

The following modules or packages were used in the City of Chino Hills model:

- Basic (BAS1 by McDonald and Harbaugh, 1988);
- Block Centered Flow (BCF3 by McDonald et al., 1991);
- Drain (DRN1 by McDonald and Harbaugh, 1988);
- Evapotranspiration (EVT1 by McDonald and Harbaugh, 1988);
- Horizontal-Flow-Barrier (HFB1 by Hsieh and Freckleton, 1993);
- Preconditioned Conjugate-gradient Method (PCG2 by Hill, 1990);
- Recharge (RCH1 by McDonald and Harbaugh, 1988);
- General Head Boundary (GHB1 by McDonald and Harbaugh, 1988)
- Streamflow-Routing (STRM v2 by Prudic, 1989); and
- Well (WEL1 by McDonald and Harbaugh, 1988).

The Basic package (BAS1) handles most of the administrative tasks for the model. It contains the definition of the finite-difference model grid, the listing of all active and inactive cells (cells make up rows, columns, and layers) and the basic building blocks of time that the model simulation will use (stress periods and time steps). It also contains the initial head for each model cell and the identification of the solver and each of the source and sink packages that will be used in the model.

The Block Centered Flow package (BCF3) includes the definitions of horizontal hydraulic conductivity and vertical leakance that are used to compute the conductance component of the finite-difference equations that determines flow between adjacent cells and layers. This package computes the terms that determine the rate of movement of water to and from storage within each cell, based on the cell-by-cell storativity and effective porosity.

The Drain Package (DRN1) is a head dependant sink boundary condition that removes water from a model cell based on the difference between the model calculated head and the specified stage of the drain. The drain package was used to simulate the discharge of rising ground water in the vicinity of Prado Dam.

The Evapotranspiration package (EVT1) is a head-dependant sink that simulates the effects of plant transpiration and bare-soil evaporation on ground water. Evapotranspiration was included along the Santa Ana River in the areas of riparian vegetation.

The Horizontal-Flow-Barrier package (HFB1) was designed to simulate thin, vertical, low-permeability geologic features that impede the horizontal flow of ground water. This package lowers the conductance term between two adjacent cells without explicitly modeling the fault as a row or column of low permeability model cells. The Central Avenue Fault and the Riley Barrier were modeled in model Layers 1 and 2 as a HFB.

The Preconditioned Conjugate-Gradient method solver package (PCG2) solves the equations produced by the model that determine hydraulic head using iterative methods that are less susceptible to round-off error, are more efficient for large problems, and require less computer storage. Nonlinear flow conditions (unconfined aquifers) may be simulated using this package.

The Recharge package (RCH1) is a specified flux source that is used to simulate areally distributed recharge to the ground water system as a result of precipitation, mountain front runoff or artificial recharge in spreading basins. Direct infiltration of precipitation was included across the entire model area. Mountain front runoff was included along the natural model boundaries in model Layer 1 to simulate the indirect recharge of precipitation that falls on the bedrock outcrops. Artificial recharge was added to the model at the Chino Basin Watermaster (Watermaster) spreading basin facilities, in accordance with Watermaster documentation. Recharge was added to the highest active cell at each location.

The General Head Boundary (GHB1) simulates the flow from an external source provided in proportion to the difference between the head in the cell and the head assigned to the external source. General Head boundary (GHB1) was assigned to borders of the City of Chino Hills ground water model to simulate the underflow inflow and underflow outflow from and to the aquifers extended beyond the bounds of the model area.

The Streamflow-Routing package (STRM) is a variable head source or sink and is used to simulate interaction between surface streams and ground water, and to account for the amount of flow in streams. This package accounts for the flow of surface water available for percolation in the stream and estimates percolation based on the difference between the model calculated head and the stage of the stream. The rate of percolation of groundwater to or from the aquifer is controlled by the conductance term, which represents the material in the streambed. The stream package accounts for surface water using a reach and segment hierarchy, where flow proceeds downstream from one reach to another and flows from one or more tributary segments into another segment. All stream flow is tributary to the Santa Ana River and leaves the model at Prado Dam.

The Well package (WEL1) is a specified flux source or sink. Water is either added to (injection) or taken from (pumping) a cell at a rate that is independent of the calculated head at that cell. Wells occur throughout the model area in both layers, representing all types of municipal, industrial and irrigation wells.

2.2.2 Model Pre- and Post-Processors

The pre- and post-processors that were used to manipulate model input and output arrays include GWV5 (Groundwater Vistas version 5.01 released by Environmental Simulations, Inc., 2007), and ArcGIS 9.2 (Environmental Systems Research Institute, Inc., 2007). GWV5 and ArcGIS 9.2 are available as public domain.

FORTRAN programs were developed by GEOSCIENCE to prepare transient MODFLOW input data for the WEL1, GHB1 and STRM packages.

2.3 Model Size and Grid Geometry

The ground water flow model grid covers approximately 154 square miles (98,700 acres) with a finite-difference grid consisting of 270 cells in the I-direction (northeast to southwest along rows), 398 cells in the J-direction (northwest to southeast along columns) and 2 cells in the K-direction (layers) for a total of 214,920 cells (149,613 active cells). All model cells are squares 200 feet by 200 feet (see Figure C-1).

The origin of the relative model cell coordinate system is in the upper left corner of the top layer (I=1, J=1, K=1), while the origin of the site coordinate system is the lower left corner of the bottom layer (X=0, Y=0, Z=0). The "site" coordinate system origin is located at the Zone 10 UTM coordinate (X = 428,667.1 m, Y = 3,763,263.0 m) and the model grid is rotated 51.4 degrees clockwise from horizontal.

2.4 Boundary Conditions

A boundary condition is any external influence or effect that either acts as a source or sink adding or removing water from the ground water flow system. The City of Chino Hills ground water model includes no-flow cells (inactive), wells, drains, general head boundaries (GHB), streams, recharge and evapotranspiration (see Figure C-3). In general, ground water flow model boundary conditions can be grouped into three main types: 1) constant head (this type was not used in the City of Chino Hills ground water model); 2) specified flux (i.e., wells, recharge and no-flow); and 3) head-dependant with a limiting conductance or rate term (i.e., GHB, drains, streams and evapotranspiration).

The edge of the active model area immediately surrounding the area of interest is bounded by natural boundaries (contact between basin fill alluvium and bedrock) and open boundaries (where the aquifers extend beyond the bounds of the model area). A GHB is used to simulate the underflow inflow and outflow across the open boundaries based on observed water levels near the open boundaries. The recharge package was used to simulate the contribution of flow from the bedrock outcrops along natural model boundaries into the upper model layer.

2.5 Aquifer Characteristics

2.5.1 Layer Elevations

Land surface elevation, as determined from Digital Elevation Models (DEMs) for the 7.5" Topographic Quadrangles which covers the City of Chino Hills ground water model area, was used as the top of Layer 1. The top of model Layer 2 was considered the bottom of model Layer 1. The bottom elevation of Layer 2 was the effective base of the aquifer (see Figure C-4).

Delineation of the boundary between Layer 1 and Layer 2 was based on the geohydrologic criteria discussed by GEOSCIENCE for the construction of the Chino Desalter model (2001). The bottom of Layer 2 was based on published contour maps of the effective base of the aquifer (James M. Montgomery, 1992; DWR, 1970).

2.5.2 Hydraulic Conductivity

Hydraulic conductivity values were initially estimated based on transmissivity values from pumping test data and specific capacity data. Zones of equivalent hydraulic conductivity were created, based on the distribution of hydraulic conductivity data and understanding of the depositional environment (see Figure C-5). For areas of the model where no data were available, hydraulic conductivity in Layer 2 was assigned lower values than in Layer 1 based on depth-specific aquifer test data from wells in other areas of the model and a general conceptual interpretation that overburden and confining pressure results in lower permeability in the lower aquifer zones.

The values for each hydraulic conductivity zone were further modified during model calibration. Figure C-5 shows the zones of hydraulic conductivity for model Layers 1 and 2 and the calibrated hydraulic conductivity values obtained from the transient model calibration. In the immediate vicinity of City of Chino Hills' wells area, the hydraulic conductivity values range from 1.2 ft/day (9 gpd/ft^2) in model Layer 2 to 30.8 ft/day (230 gpd/ft^2) in model Layer 1.

2.5.3 Effective Porosity and Storativity

The initial effective porosity zones for model Layer 1 were developed based on the specific yield map provided in DWR (1934). The values for each zone were further modified during model calibration. The calibrated effective porosity values in the immediate vicinity of City of Chino Hills' wells area range from 10% to 11% (see Figure C-6).

Layer 2 is assigned as a confined aquifer and a storativity value was initially assigned based on published values for similar aquifer types and conditions. The values for each zone were further modified during model calibration. Based on the transient model calibrations results, a storativity value of 6.4 x 10^{-7}) was assigned in the immediate vicinity of City of Chino Hills' wells.

2.5.4 Vertical Leakance Between Aquifers

Vertical leakance between model Layers 1 and 2 was determined based on model calibration results. Because published estimates of vertical conductance between the model layers were not available, these values were initially estimated based on differences in historical water levels between wells screened only in model Layer 2 and wells screened in model Layer 1, and then modified during calibration. The lowest calibrated leakance values (lowest inter-layer conductivity) is in the immediate vicinity of City of Chino Hills wells area (1.9×10^{-8} day^{-1}), while leakance values are as high as 10 day^{-1} in the northern portion of the model where the two model layers are conceptually treated as one aquifer (see Figure C-7).

2.5.5 Conductance of Horizontal-Flow-Barriers

The Central Avenue Fault and the Riley Barrier were modeled with the Horizontal-Flow-Barrier package by assigning a lower hydraulic conductivity value to the conductance term between model cells along the fault trace (see Figure C-8). The values were derived primarily by trial-and-error during model calibration. For model layer 1, the hydraulic characteristic of the barrier is the barrier hydraulic conductivity divided by the width of the horizontal-flow-barrier (units of day^{-1}). For model layer 2, the hydraulic characteristic value is the barrier transmissivity divided by the width of the horizontal-flow-barrier (units of ft/day)[1].

The final calibrated hydraulic characteristic value of horizontal-flow-barrier for model Layer 1 was 1 day^{-1} at the Riley Barrier, and ranged from 0.01 day^{-1} to 1 day^{-1} at the Central Avenue Fault. For model Layer 2, the values ranged from 0.000662 to 0.000922 ft/day at the Riley Barrier, and ranged from 0.00002 to 0.000835 ft/day at the Central Avenue Fault.

[1] As model layer 1 is unconfined, the HFB package requires the hydraulic characteristic to be calculated using hydraulic conductivity. For confined and semi-confined aquifers, transmissivity is used.

2.6 Recharge and Discharge

2.6.1 General

The model packages that representing the boundary conditions that were used to simulate the sources (recharge) and sinks (discharge) of water in the model area include Streamflow-Routing, Recharge, Well, Drain, Evapotranspiration and General Head Boundary packages. These packages are described in the following sections.

2.6.2 Streamflow-Routing Package

The streamflow-routing package was used to simulate the interaction between the surface water and aquifers within the model domain. Major streams with current USGS gage data and wastewater treatment plants that report discharges to the tributaries of the Santa Ana River were included in the Streamflow-Routing package. The streams were divided into segments and reaches. The reaches indicate the order in which a stream flows across the active model cells. A stream segment is defined as the longest portion of a surface watercourse having no tributaries. Segments and reaches for the streamflow-routing package are shown on Figure C-9. Quarterly streamflow inflow and wastewater discharge during the model calibration period from January 1982 through September 2005 are summarized in Table C-1.

A "reach" is defined as that portion of a segment within a single model cell. Model cells containing a portion of a stream across a cell corner or along a cell edge were generally not included as reaches. Reaches were identified by their i, j coordinates and were numbered in each segment upstream to downstream. The streambed's top elevation for each reach was determined based on the average surface elevation along the trace of the stream within the reach. The stream stage and the bottom elevation of the streambed were assumed to be 2 ft above and 5 ft below the top elevation of the streambed, respectively.

The initial streambed conductance was calculated using the following equation:

$$C_{STR} = \frac{KLW}{M}$$

where:

C_{STR} = streambed conductance, [ft^2/day]
K = vertical hydraulic conductivity of streambed, [ft/day]
L = length of reach (distance across cell), [ft]
W = width of stream, [ft]
M = thickness of streambed, [ft]

During the model calibration, streambed conductance values were adjusted, within reasonable limits, to match measured outflow at Prado Dam. Figure C-9 shows the streambed conductance values used for the final model calibration. Streambed conductance values for the Santa Ana River ranged from 1,787 to 15,809 ft^2/day. Streambed conductance values for tributaries ranged from 19 ft^2/day to 226 ft^2/day.

During "wet" years, an increase in the width of the stream usually occurs due to significant amounts of streamflow overflowing the stream channels (i.e., "over bank" flow). In addition, the vertical hydraulic conductivity of the streambed increases due to the removal of fine-grained sediments by the high energy of the streamflow. Both of these result in an increase in streambed conductance. In order to account for variations of streambed conductance in the Santa Ana River over time, conductance values for each reach of the river were doubled when annual streamflow at the gage below Prado Dam was greater than 400,000 acre-ft (for years 1983, 1993, 1995, 1998 and 2005).

2.6.3 Recharge Package

The Recharge package simulates regionally distributed recharge to the ground water system as a result of precipitation, mountain front runoff or artificial recharge. Areal recharge for most of the basin was assigned a constant rate of 1.192×10^{-4} ft/day to simulate the percolation of precipitation in the model area (Woolfenden and Koczot, 1999). This rate was held constant for all stress periods over the entire simulation.

The mountain front runoff (recharge zones along alluvium-bedrock contact in Layer 1) was increased in wet years to simulate the increase in runoff and percolation from the bedrock outcrops. All recharge rates for the mountain front runoff zones were doubled in the first quarter of all lower magnitude wet years (for years 1986, 1991, 1992, 1996, 1997, 2000, 2001 and 2003) and tripled in the first quarter of all exceptional above normal precipitation years (for years 1983, 1993, 1995, 1998 and 2005) to account for additional recharge due to runoff. Artificial recharge was simulated by adding water to the model in the location of artificial recharge basins. Figure C-10 shows the location of mountain front runoff zones and artificial recharge facilities. Table C-2 summarizes the quarterly recharge rates used during the model calibration period from January 1982 through September 2005.

2.6.4 Well Package Data

The well package includes municipal, industrial and agricultural production from wells screened in Layer 1, Layer 2 or both (see Figure C-11). Ground water production data was obtained from Watermaster and included annual summaries from 1982 to 1992 and quarterly summaries from 1993 to September 2005. The annual data (1982 to 1992) was subdivided into quarters based on the average quarterly split for the period when quarterly pumping records were available (see following table for split applied to annual data).

Criteria for Subdividing Annual Production Data into Quarterly Data

Quarter	Average Fraction of Total Annual Ground Water Production (1993-2000)
1st	0.18
2nd	0.28
3rd	0.32
4th	0.22

Four different criteria were used to assign model layers (or ratio of both layers) from which a well would pump. These criteria were established due to the large number of wells with little or no completion information or well screen data. If information was available regarding the top and bottom of the screened interval, this information was used with the following equation, to assign the layer or layer ratio:

$$ratio_1 = \frac{b_1 \times k_1}{(b_1 \times k_1) + (b_2 \times k_2)}, \qquad ratio_2 = \frac{b_2 \times k_2}{(b_1 \times k_1) + (b_2 \times k_2)}$$

where:

$ratio_i$ = ratio or fraction of pumping from model layer i,
b_i = length of production interval in layer i, [ft]
k_i = hydraulic conductivity of layer i at well, [ft/day]

If no screened interval was available, the total depth was used to estimate the production interval and the layer ratio using the above relationship. If no completion information was available but the well's use was listed as "irrigation" it was assumed to be screened entirely in model Layer 1. If no information was available regarding any of the previous criteria, the average ratio for all wells that did have completion or total depth data was assigned to the well (62 percent Layer 1, 38 percent Layer 2).

All pumping from model Layer 1 was reduced 30 percent to account for return flow from irrigation or agricultural use. Wells located within the same model cell were combined into one well in the model.

2.6.5 Drain Package

The drain package was used to simulate the removal of rising ground water from the upper aquifer at Prado Dam (see Figure C-3 for location of drain cells). The drains were assigned a stage elevation equal to the average land surface at the model cell and a conductance term.

2.6.6 Evapotranspiration Package

The Evapotranspiration (ET) package simulates the effects of plant transpiration and direct evaporation on the saturated ground water regime (see Figure C-12 for location of model cells with ET). Evapotranspiration from ground water was applied to the Santa Ana River and Prado Dam area based on potential ET data obtained from the USGS and adjusted to account for precipitation. An extinction depth of 10 ft was used for all stress periods.

Evapotranspiration Estimates Applied to the City of Chino Hills Ground Water Model

Quarter	Average Precipitation [inches] Fontana (Station # 43120)	Potential Evapotranspiration [inches]	Evapotranspiration from Ground Water [inches]
1	10.0	10.0	0.0
2	1.5	19.7	18.2
3	0.5	24.2	23.7
4	3.9	10.9	7.0
Total	**15.9**	**64.8**	**48.9**

2.6.7 General Head Boundary Package

A general head boundary (GHB) was assigned to portions of the ground water model where the aquifers extended beyond the bounds of the model area (see Figure C-3). The heads assigned to the GHB cells in the model were varied over time, based on measured fluctuations in ground water levels at wells located near the model edge during the model calibration period from January 1982 through 2005.

3.0 MODEL CALIBRATION

The City of Chino Hills ground water model was calibrated for transient conditions. The transient calibration covered the period from January 1982 through September 2005 using quarterly stress periods. This time period includes both wet and dry climatic cycles. Fall 1981 water levels were used as the initial water levels for the model transient calibration (see Figure C-13)

3.1 Calibration Process

The method of calibration used by this model was the standard "history matching" technique. In this method, a transient calibration period of January 1982 to September 2005 was chosen to represent a historical time period where water levels, streamflows, pumping, and evapotranspiration are known with a reasonable degree of accuracy. Model-generated ground water levels were compared with measured levels for wells in the model area, particularly for the wells in the immediate vicinity of the City of Chino Hills' wells. Adjustments in hydrogeologic parameters (e.g., hydraulic conductivity, effective porosity, storativity, vertical leakance between layers, and hydraulic characteristic of the horizontal-flow barriers) were made within tolerable limits until a satisfactory match between modeled and measured ground water levels was obtained. Parameter changes during model calibration were assigned to groups of cells. Adjustment of individual parameters for individual model cells was not considered. Model-calculated quarterly streamflow was also compared to the measured streamflow at Prado Dam.

3.2 Transient Model Calibration Results

Measured versus model-generated ground water levels for 62 selected target wells is shown on Figure C-14. The selection of target wells was based on water level data availability, areal distribution of the wells, and the aquifer screened. In general, the pattern of model-generated and measured levels are similar in that the model appears to capture the long- and short-term temporal trends in ground water levels throughout the model area. Hydrographs of 20 selected wells were plotted showing the comparisons between model-generated water levels and historical water levels (see Figures C-15 through C-18). As shown in Figure C-15, the model-generated water levels closely matched the measured water levels in Well 18A (City of Chino of Hills) and PA-7[2] with an average water level residuals of -5.01 ft (overestimation) and 1.44 ft (underestimation), respectively. These two wells are both screened in the deep aquifer and separated by the Riley Barrier.

Figure C-19 is an "x-y" plot showing a comparison of measured and model-generated ground water levels. The graphical comparison between measured and model-predicted heads (from 62 target wells) for the transient calibration shows the 5,229 ground water level measurements mainly clustered around the straight line. Some outliers are scattered further away from the straight line and may have resulted from comparisons of a relative smaller time discretization of water level measurements (e.g., monthly) to a relative larger time discretization of the model-generated water levels (i.e., quarterly stress period). In general, the measured and model-predicted heads compared favorably, and the calibration is further supported by a relative error below 10%. The relative error (the standard deviation of the ground water level residuals[3] divided by the observed head range (Zheng and Bennett, 2002) of the model-generated groundwater levels between January 1982 and September 2005 is approximately 9.2%. Common modeling practice is to consider a good fit between historical and model-predicted data if the relative error is below 10% (Spitz and Moreno, 1996; and Environmental Simulations, Inc., 1999).

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2 The Watermaster's proposed Long Term Plan for the Management of Subsidence in MZ-1 uses a depth to water of 245 ft in PA-7 as the initial Guidance Level for the subsidence threshold.

3 "Residual" = measured – modeled

Residual water levels for the 5,229 measurements from the 62 target wells during the period from January 1982 through September 2005 were plotted as histograms (see Figure C-20). The histograms show a bell shape with most of the water level residuals in the range of +/- 25 ft (70% of the measurements), indicating an acceptable model calibration.

A comparison of model-generated quarterly streamflow at Prado Dam with gaged outflow at the USGS gage just downstream of the Prado Dam is shown on Figure C-21. This comparison shows a good match of model-generated versus gaged streamflow with the model slightly underestimating streamflow in very wet quarters.

The quarterly ground water budget for the transient calibration is shown in Table C-3.

4.0 MODEL OPERATIONAL SCENARIOS

4.1 Description of Model Operational Scenarios

Predictive scenarios for the City of Chino Hills ground water flow model were developed in the context of various ground water pumping schedules for the City of Chino Hills' wells. All scenarios developed for analysis using the ground water model included the following general assumptions:

- The model-generated water levels at the end model calibration (September 2005, see Figure C-22) were used as the initial water levels of model operational scenarios;
- The length of the predictive simulation was 20 years with a quarterly stress period;
- The recorded hydrology (i.e., areal recharge, recharge from mountain front runoff and, streamflow) for the latest 20 years transient calibration period (i.e., October 1985 through September 2005) was repeated for the predictive period;
- Ground water pumping for all the wells other than the City of Chino Hills' wells and heads in GHB cells for the water year 2005 (i.e., October 2004 – September 2005) were repeated for the predictive period.

Three model scenarios were developed to assess potential future ground water conditions in the vicinity of City of Chino Hills' wells area, particularly the depth to water in PA-7.

Scenario 1: Simulates the maximum pumping of the City of Chino Hills' wells (as provided by City of Chino Hills). Maximum use of wells would include the use of all wells to 90% capacity. The remaining 10% would account for down time for maintenance. Total ground water production would be approximately 14,800 acre-ft/yr.

Scenario 2: Simulates the approximate historical pumping from City of Chino Hills' wells (see Figure C-23 for historical pumping). Total ground water pumping would be approximately 4,400 acre-ft/yr.

Scenario 3: Simulates the pumping used in Scenario 2 plus pumping from shallow aquifer of two new wells located west of the Riley Barrier (see Figure C-24) and pumping from City of Chino Hills Well 18A (located east of the Riley Barrier). Total ground water pumping would be approximately 7,400 acre-ft/yr.

The following table summarizes the pumping from the City of Chino Hills' wells for each of the model scenarios. For purpose of this study, the annual pumping was evenly distributed to each quarter.

Ground Water Pumping of City of Chino Hills' Wells – Model Operation Runs

Well No.	Aquifer	Annual Ground Water Pumping [acre-ft]		
		Scenario 1	Scenario 2	Scenario 3
1A	Shallow	1,411	1,000	1,000
1B	Deep	1,717	0	0
7A	Deep	1,010	400	400
7B	Shallow	908	800	800
15	Deep	2,625	600	600
17	Deep	3,533	800	800
19	Deep	3,632	800	800
18A	Deep	0	0	1,000
New 1	Shallow	0	0	1,000
New 2	Shallow	0	0	1,000
Subtotal	**Shallow**	**2,319**	**1,800**	**3,800**
Subtotal	**Deep**	**12,517**	**2,600**	**3,600**
Total		**14,836**	**4,400**	**7,400**

4.2 Ground Water Flow Model Results

Ground water level differences between the current level and the end of model simulation of each the model scenarios were plotted to show the potential impacts from the various pumping schedules for the City of Chino Hills' wells (see Figures C-25 through C-27). Selected hydrographs for these model operational runs are shown on Figure C-28. Depth to water in PA-7 was plotted to compare the model-predicted level to the proposed Guidance Level (see Figure C-29).

For Scenario 1 (maximum use of City of Chino Hills' wells, i.e., 14,800 acre-ft/yr), the ground water level in model Layer 1 would decline approximately 10 ft to 30 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 100 ft to 700 ft in the same area. This could deplete almost all the ground water storage of the deep aquifer in the City of Chino Hills' wells area. The depth to water in PA-7 would be 647 ft to 667 ft bgs (see Figure C-29), which is approximately 402 ft to 422 ft below the Watermaster's proposed Guidance Level of 245 ft in PA-7. Using Scenario 1, it appears that there could be a significant adverse impact on the ground water level under the City of Chino Hills maximum pumping schedule.

For Scenario 2 (approximate maximum historical pumping from the City of Chino Hills' wells, i.e., 4,400 acre-ft/yr), the ground water level in model Layer 1 would decline approximately a few feet to 10 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 20 ft to 140 ft in the same area. The depth to water in PA-7 would be 206 ft to 226 ft bgs (see Figure C-29), which is approximately 19 ft to 39 ft above the Watermaster's proposed Guidance Level of 245 ft in PA-7. This suggests that using Scenario 2, additional ground water pumping in the City of Chino Hills' wells area could be available if the proposed initial Guidance Level in PA-7 was implemented.

For Scenario 3 (approximate maximum historical pumping from the City of Chino Hills' wells plus two new shallow wells west of the barrier, and Well 18A east of the barrier, i.e., 7,400 acre-ft/yr), the ground water level in model Layer 1 would decline approximately 10 ft to 40 ft in the vicinity of the City Chino Hills' wells. The ground water level in model Layer 2 would decline approximately 30 ft to 160 ft in the same area. The depth to water in PA-7 would be 227 ft to 247 ft bgs (see Figure C-29), which is approximately at the Watermaster's proposed Guidance Level of 245 ft in PA-7. This suggests that in order to comply with the initial Guidance Level in PA-7, the maximum ground water pumping that might be produced from the City of Chino Hills' wells is approximately 7,400 acre-ft/yr.

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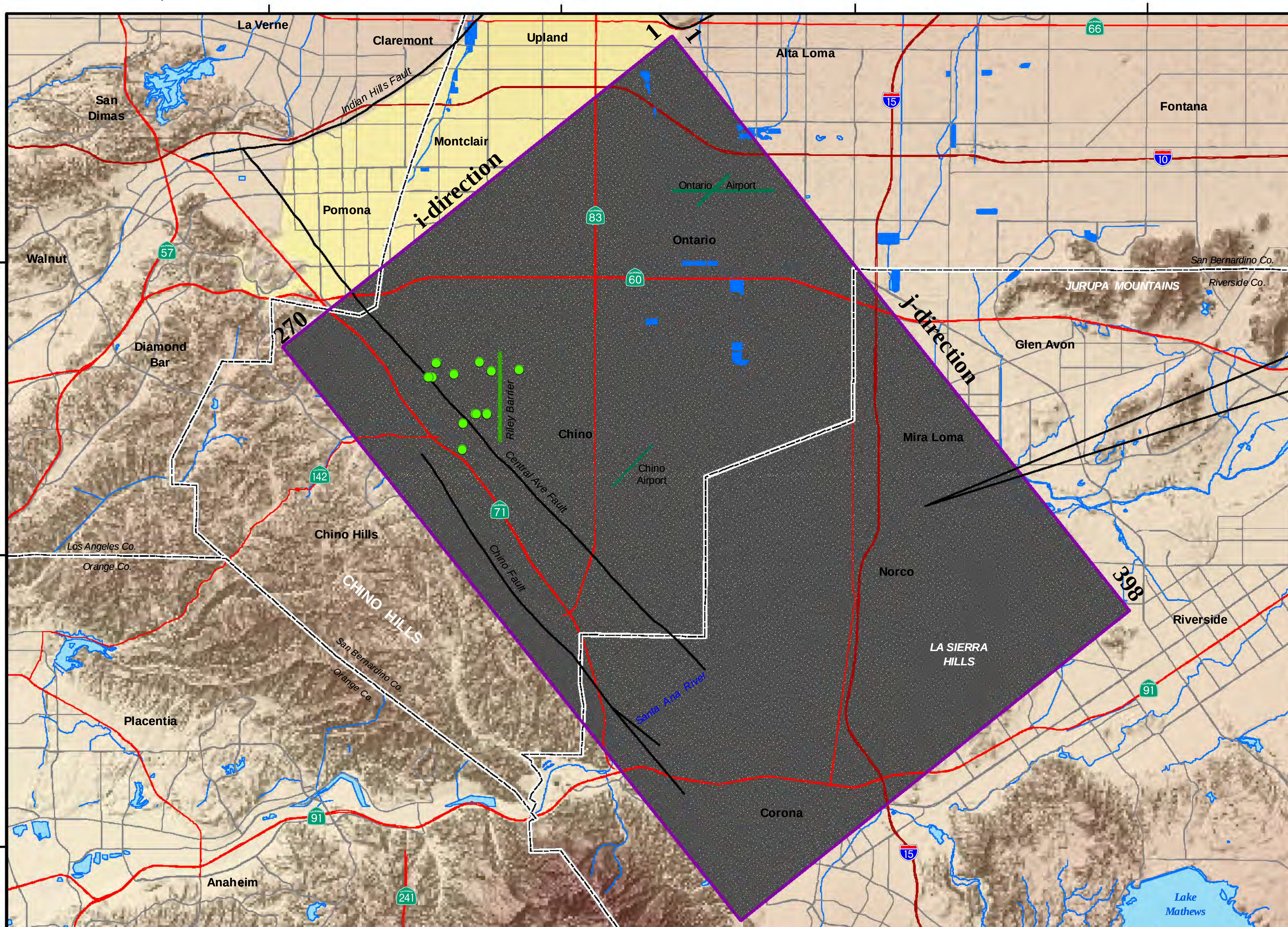
APPENDIX C
FIGURES

GEOSCIENCE Support Services, Inc.

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

CITY OF CHINO HILLS GROUND WATER MODEL



EXPLANATION

- Ground Water Model Boundary
- Ground Water Model Cell 200 ft by 200 ft
- Management Zone MZ-1
- City of Chino Hills Well
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Street
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

GEOSCIENCE

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Figure C-1

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-1_model_area_9-07.mxd

Conceptual Model of the City of Chino Hills Ground Water Model

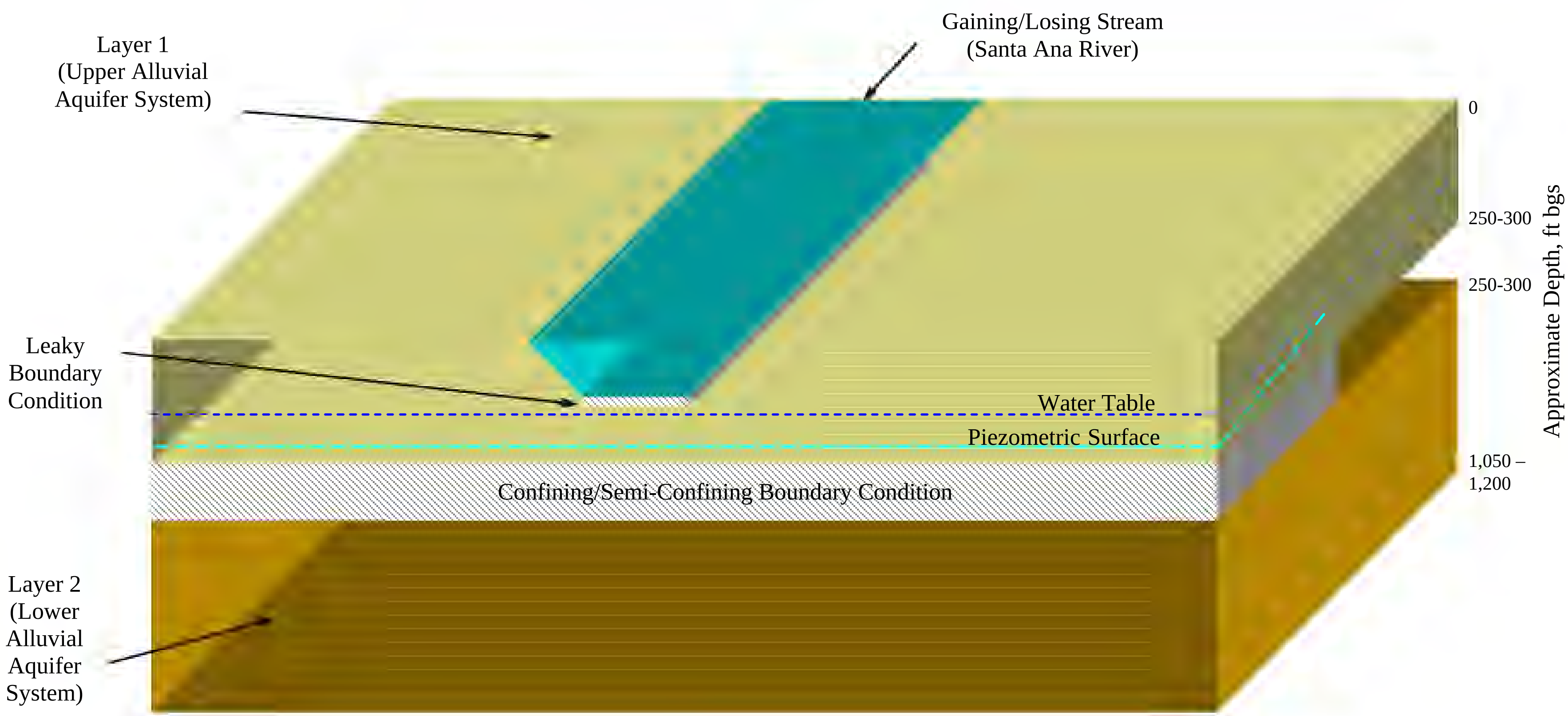

Figure C-2

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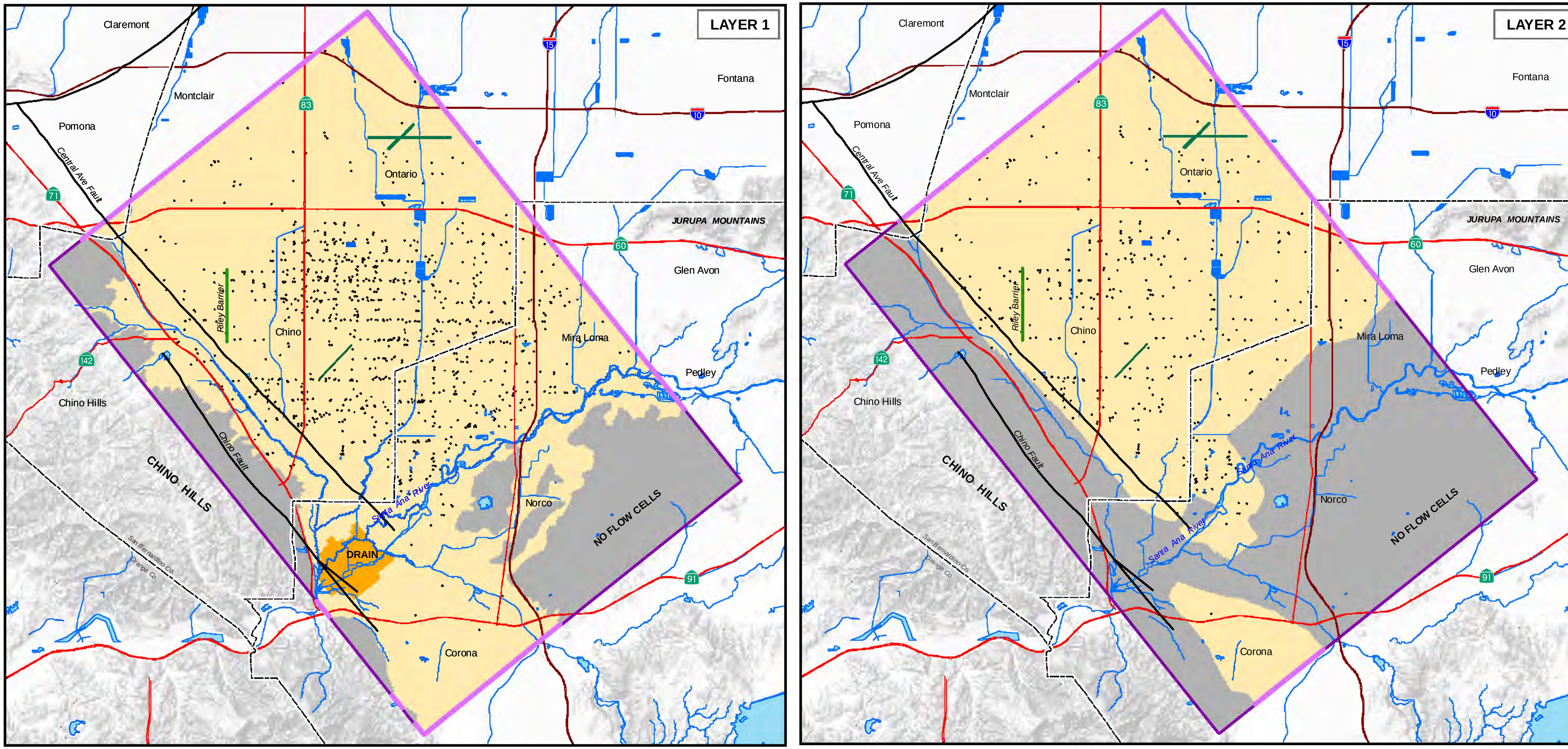
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



NORTH

0 2 4 Miles

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

EXPLANATION

- Active Model Cell
- Drain
- General Head Boundary
- No Flow Cell
- Stream
- Well
- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

MODEL BOUNDARY CONDITIONS MODEL LAYERS 1 AND 2

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Figure C-3

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-3_bndy_cond_L1_L2_9-07.mxd

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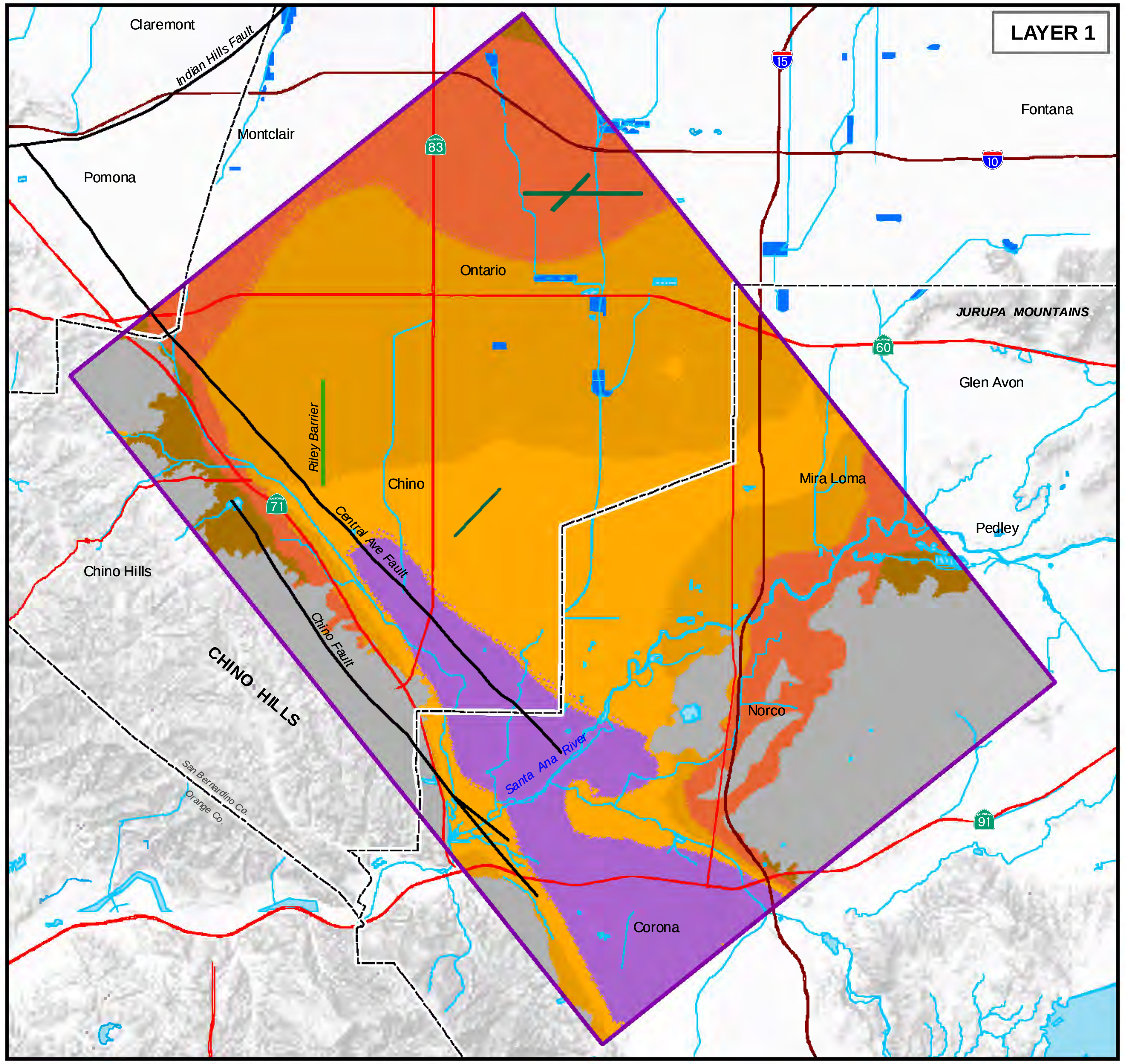
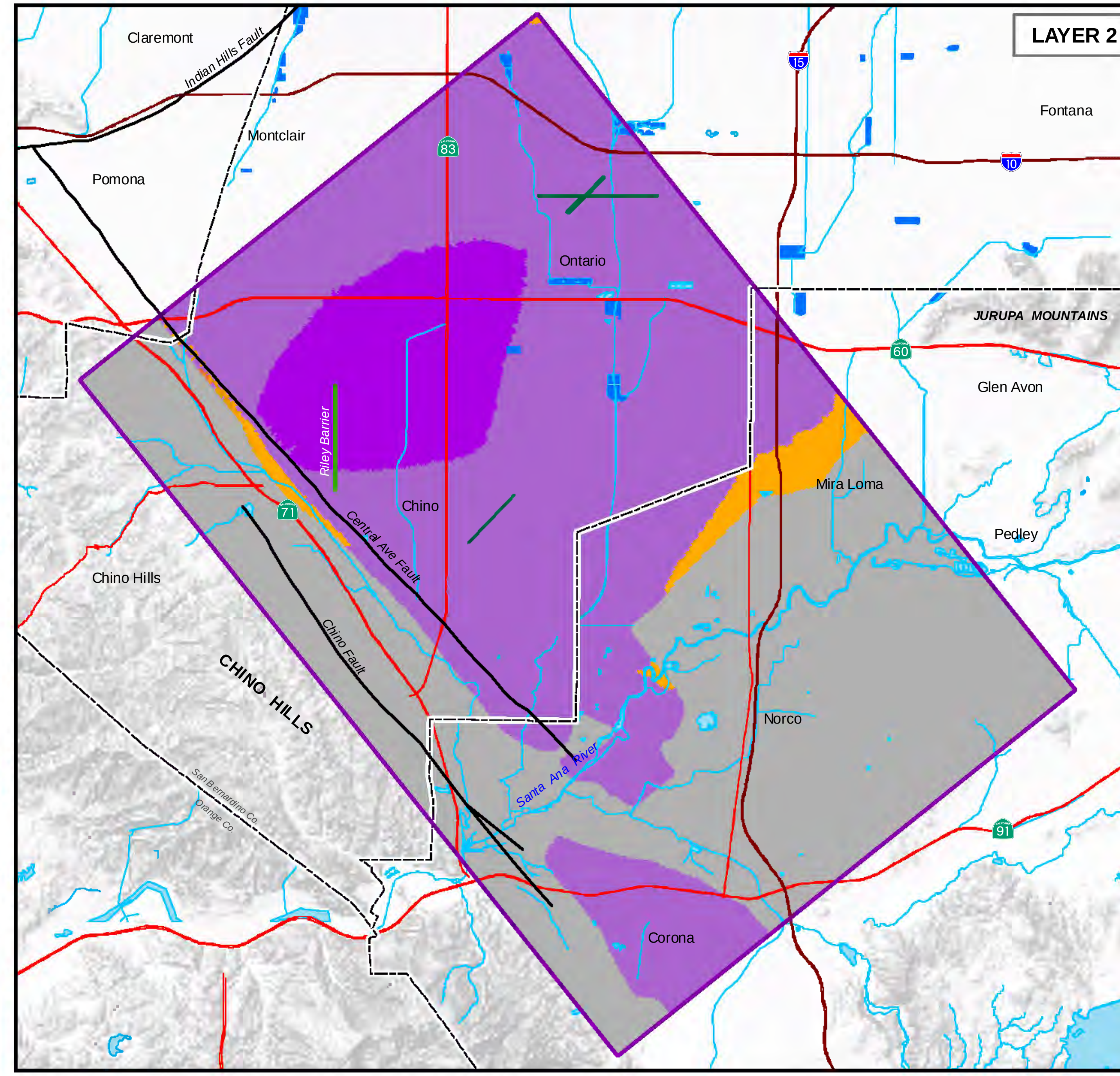
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1





NORTH

0 2 4 Miles

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

EXPLANATION

Elevation (ft above msl)
- -500 - -400
- -400 - -300
- -300 - -200
- -200 - -100
- -100 - 0
- 0 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- >600

- No Flow Cell
- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

BASE ELEVATIONS OF MODEL LAYERS 1 AND 2

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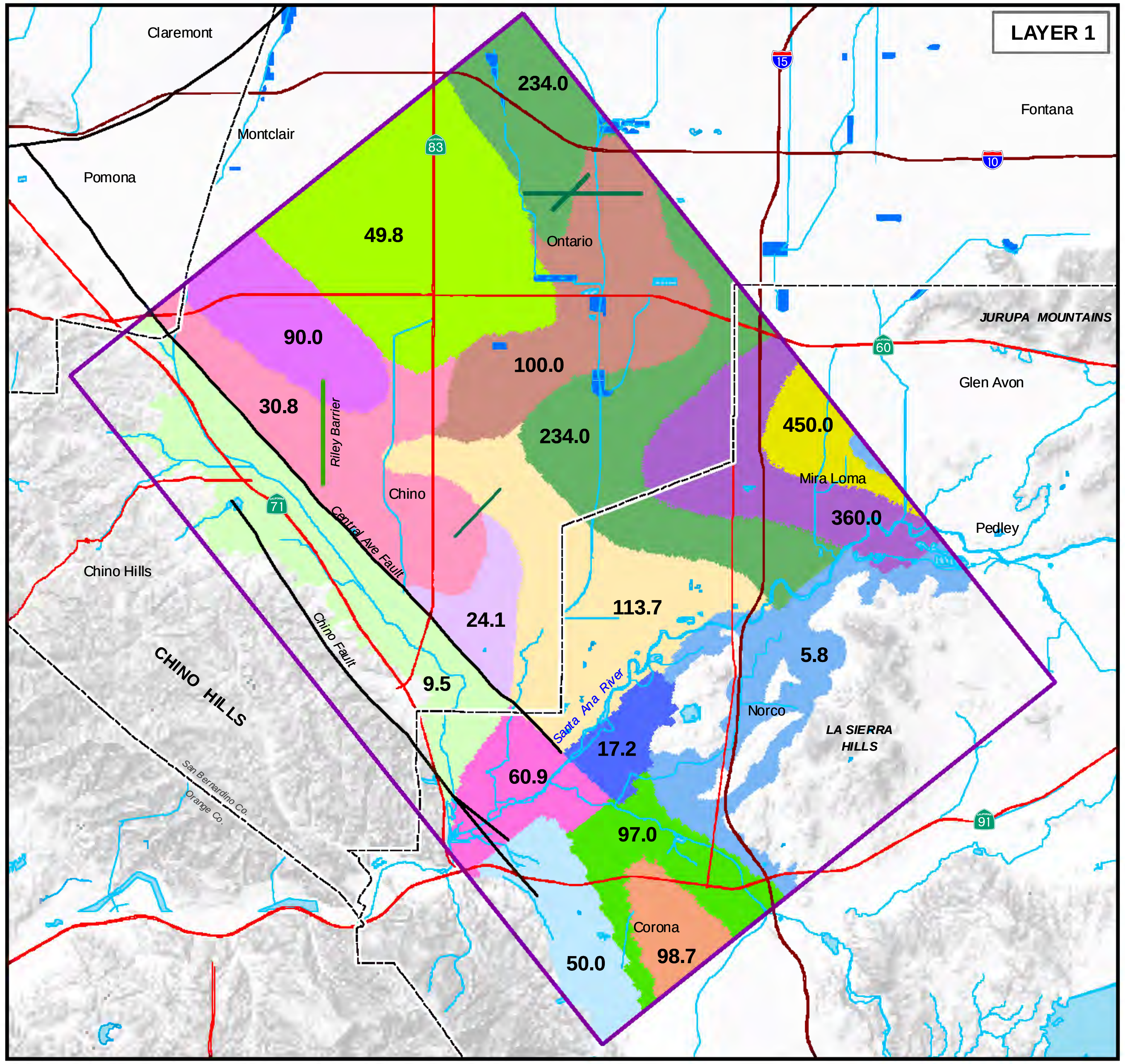
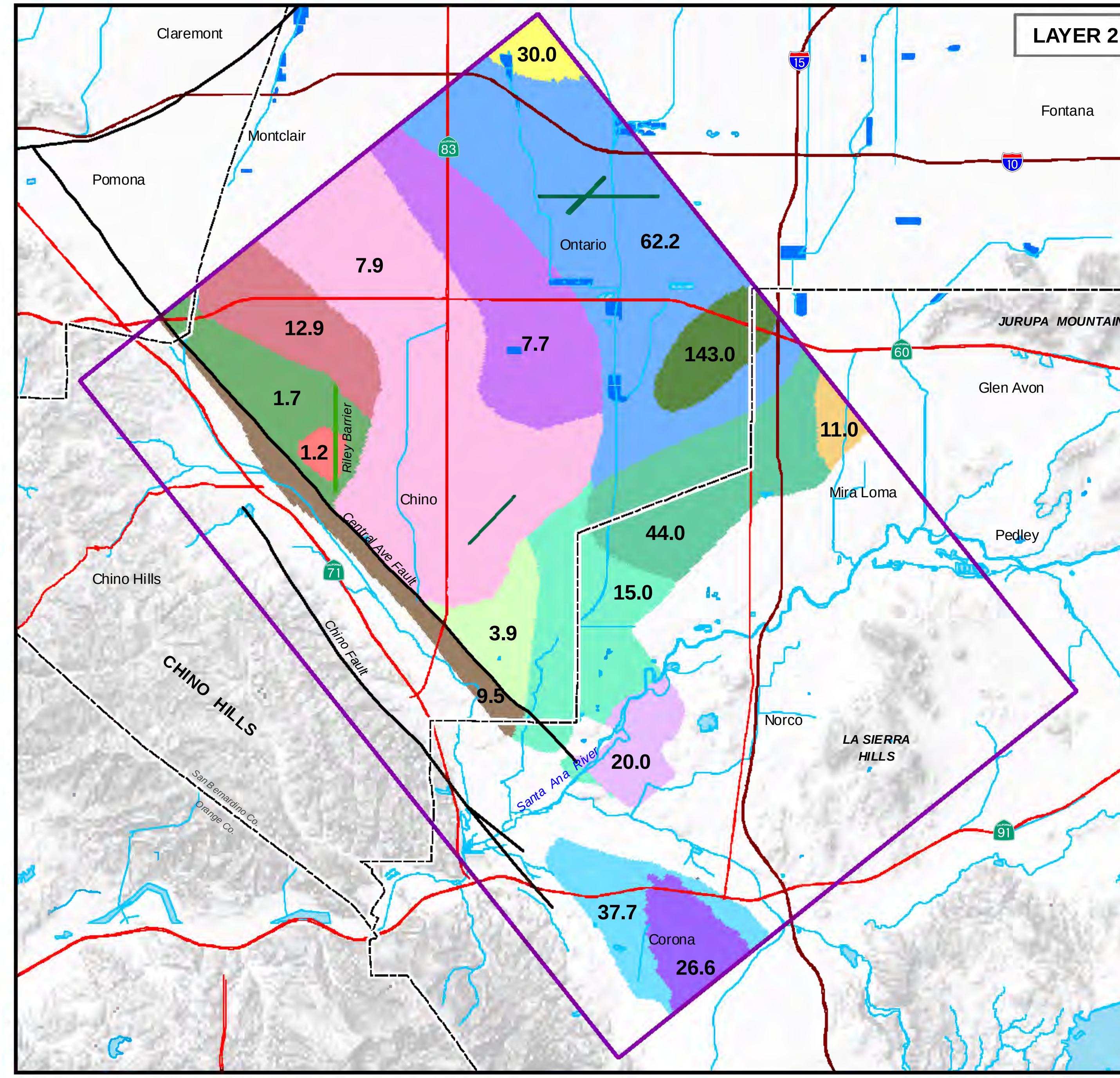
Figure C-4

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-4_base_elev_L1_L2_9-07.mxd





EXPLANATION

NORTH

0 2 4 Miles

Hydraulic Conductivity (ft/day)
Layer 1

5.8	90.0		
9.6	97.0		
17.2	98.6		
24.1	100.0		
30.8	113.7		
49.8	234.0		
50.0	360.0		
60.9	450.0		

- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

Hydraulic Conductivity (ft/day)
Layer 2

1.2	15.0
1.7	20.0
3.9	26.6
7.7	30.0
7.9	37.7
9.5	44.0
11.0	62.2
12.9	143.0

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

HYDRAULIC CONDUCTIVITY ZONES MODEL LAYERS 1 AND 2

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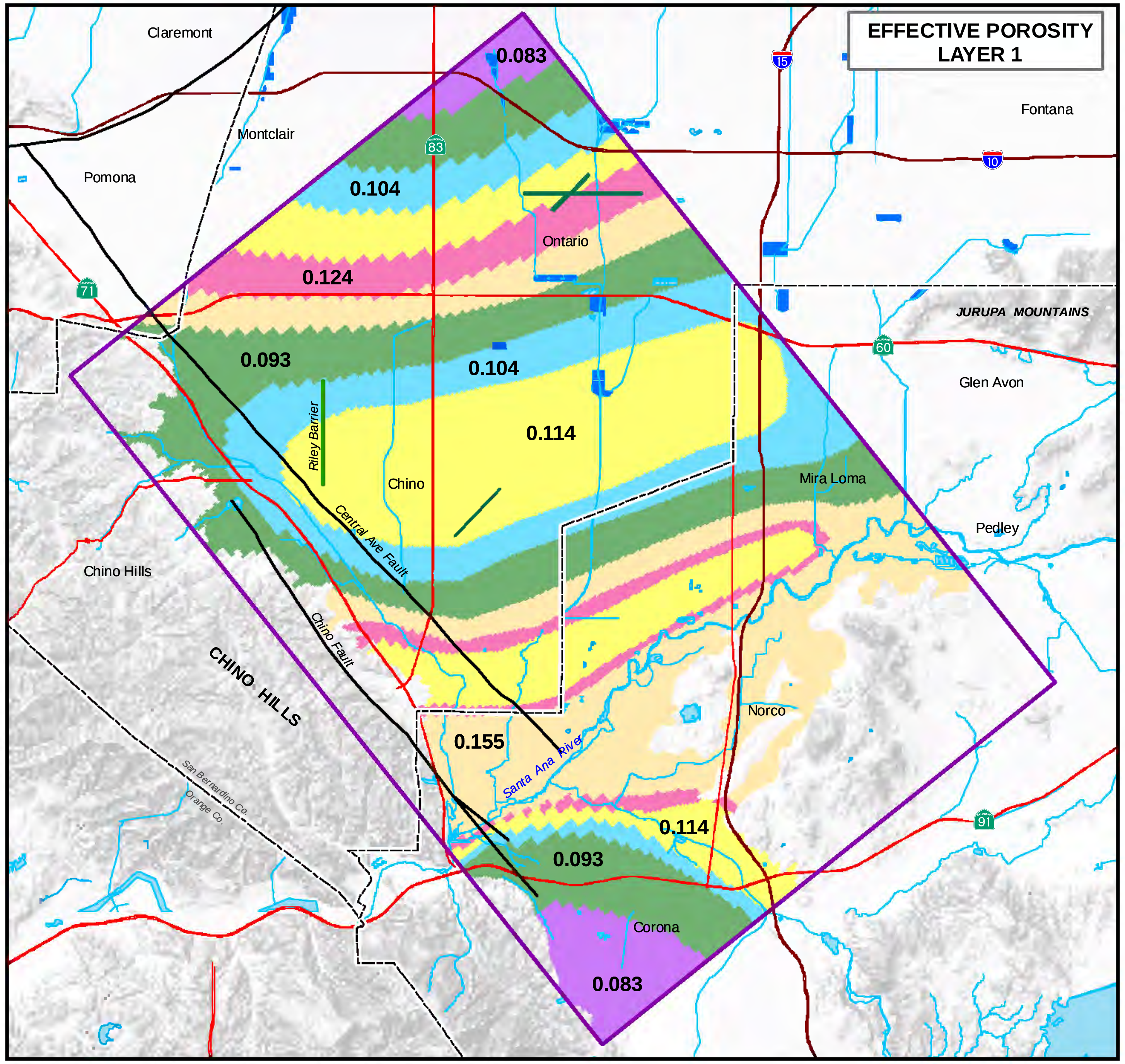
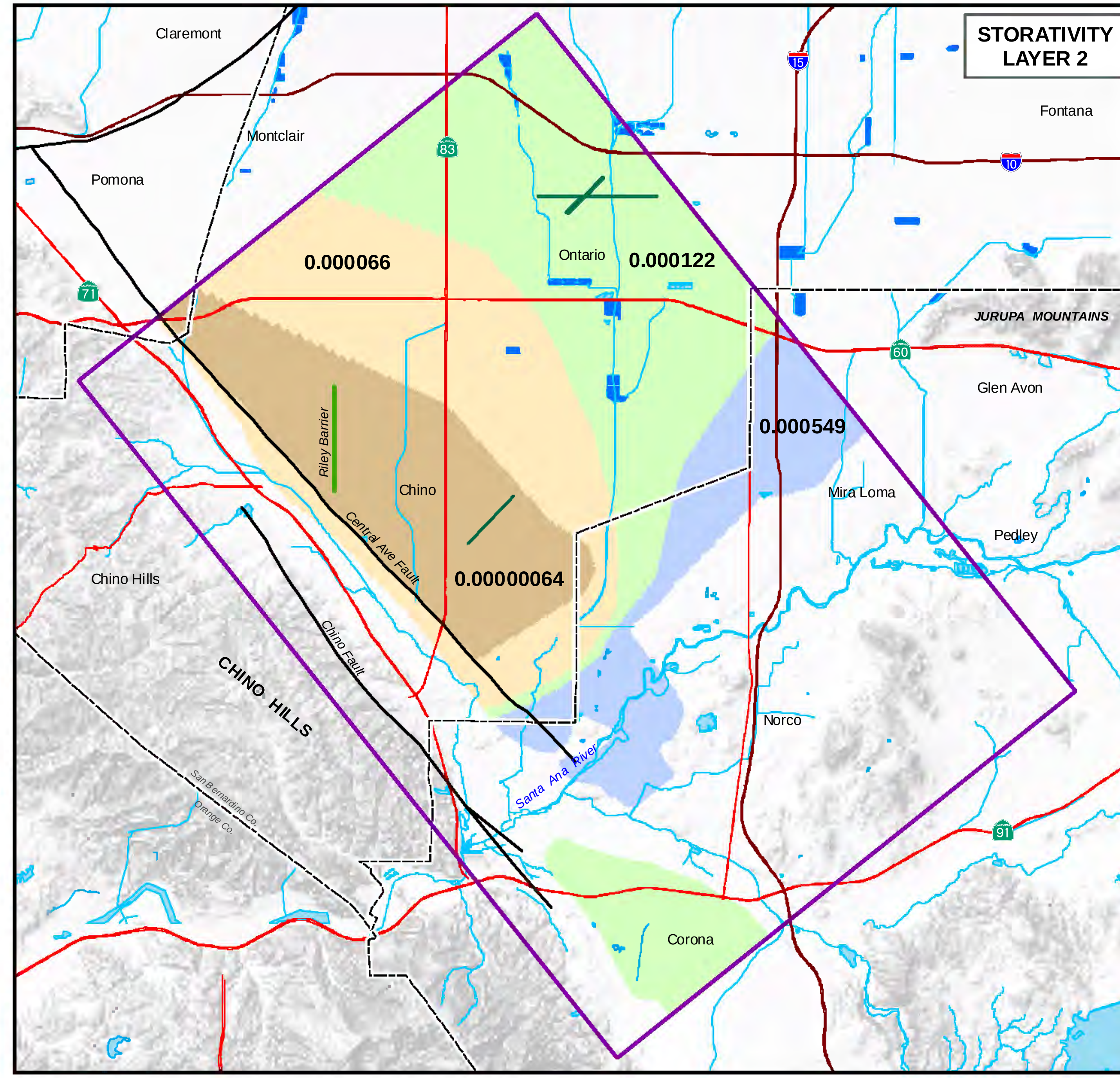
Figure C-5

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1





EXPLANATION

NORTH

0 2 4 Miles

Effective Porosity			
	0.073		0.114
	0.083		0.124
	0.093		0.155
	0.104		

- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

Storativity
0.00000064
0.000066
0.000122
0.000549

EFFECTIVE POROSITY AND STORATIVITY MODEL LAYERS 1 AND 2

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Map Projection:
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Central Meridian: -117 degrees

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Figure C-6

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-6_porosity_stor_L1_L2_9-07.mxd

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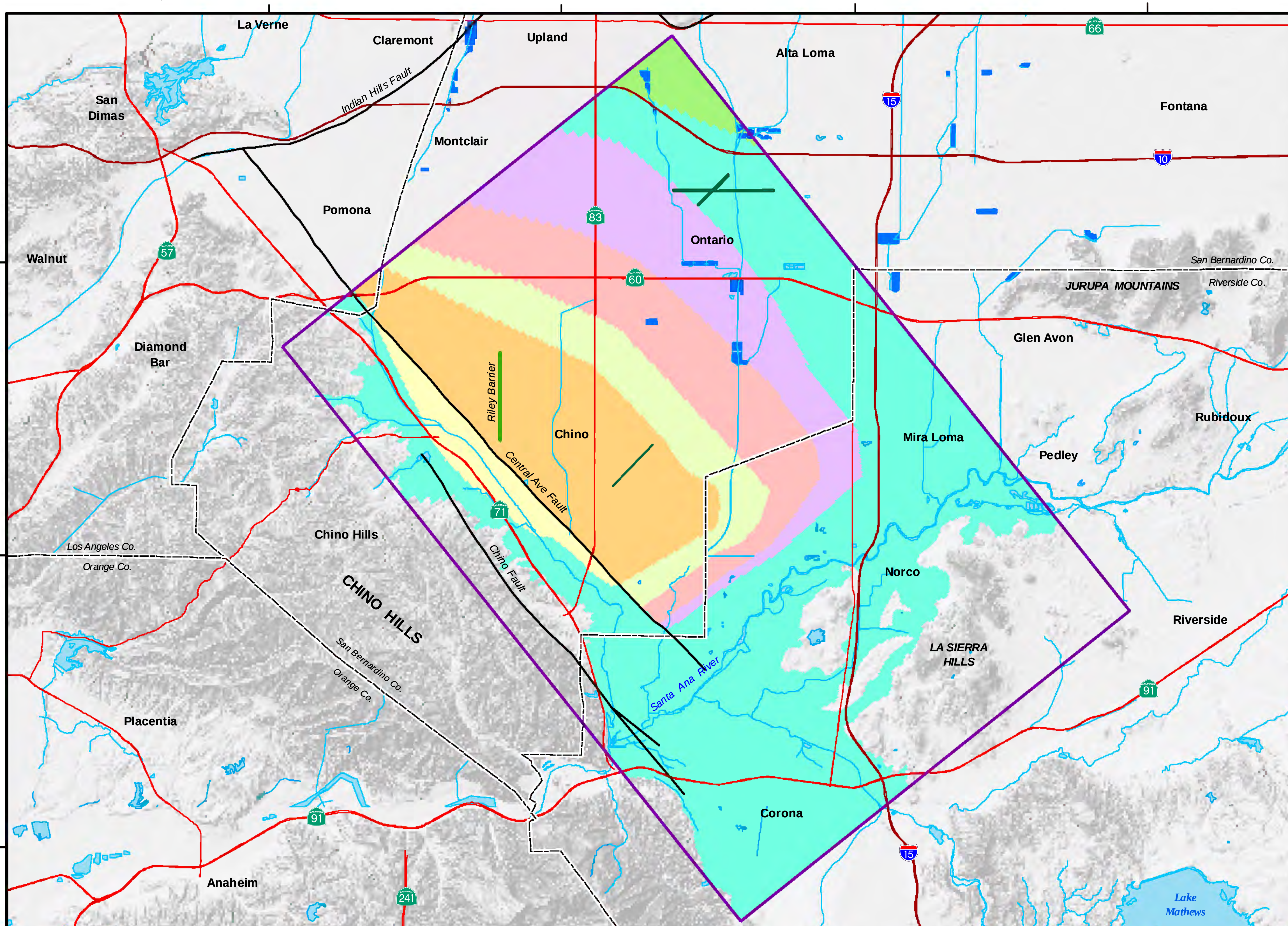
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

LEAKANCE ZONES BETWEEN MODEL LAYERS 1 AND 2



R.9 W. R.8 W. R.8 W. R.7 W. R.7 W. R.6 W. R.6 W. R.5 W.

21-Sep-07

EXPLANATION

Ground Water Model Boundary

Leakance (day $^{-1}$)

- 1.934×10^{-8}
- 0.000002
- 0.000028
- 0.001
- 0.003381
- 5.20319
- 10

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

Airport

Recharge Basin

Surface Water or River Channel

Creek or River

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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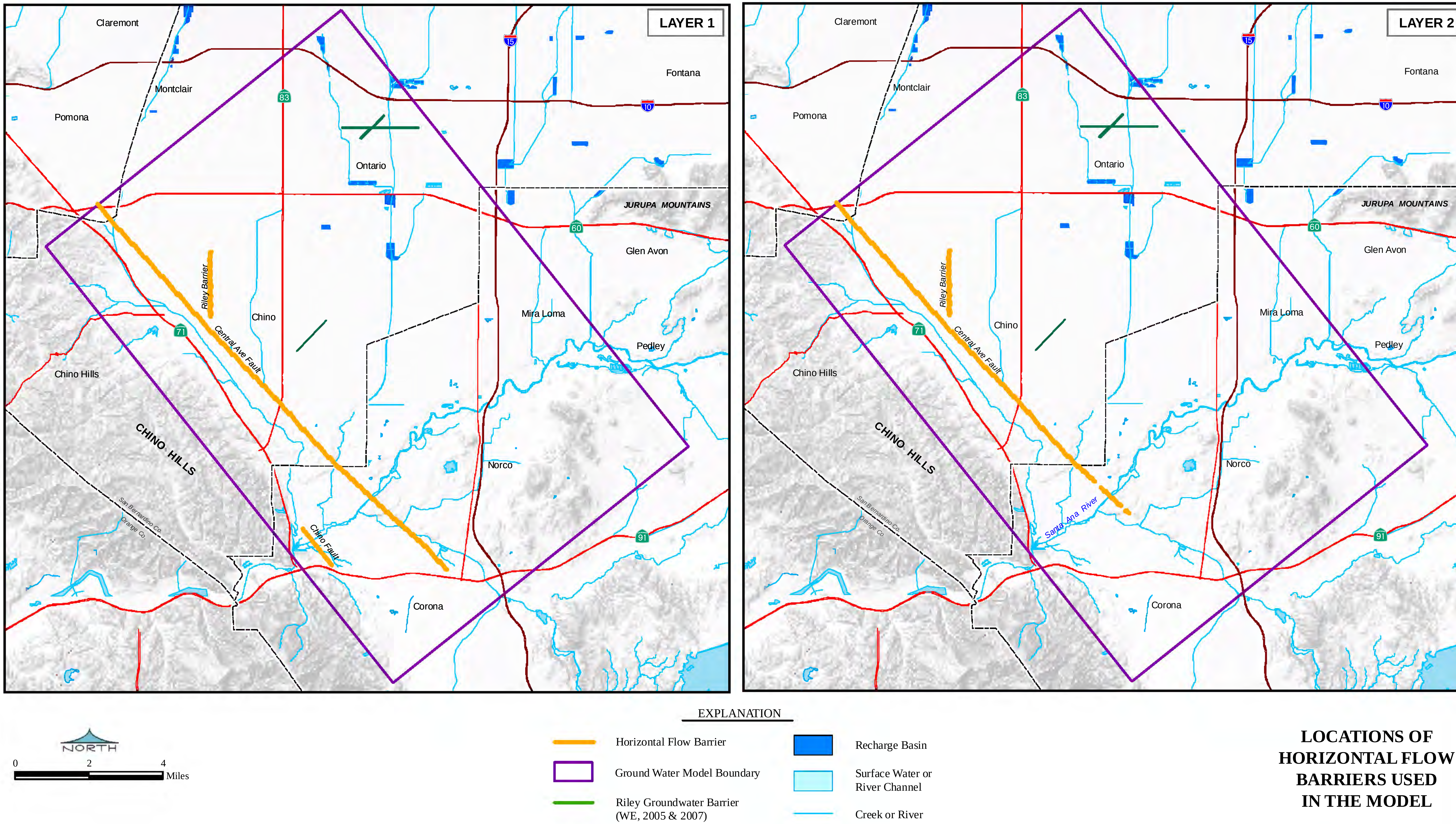
Figure C-7

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



LOCATIONS OF HORIZONTAL FLOW BARRIERS USED IN THE MODEL

21-Sep-07

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

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Figure C-8

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-8_horiz_flow_barriers_L1_L2_9-07.mxd

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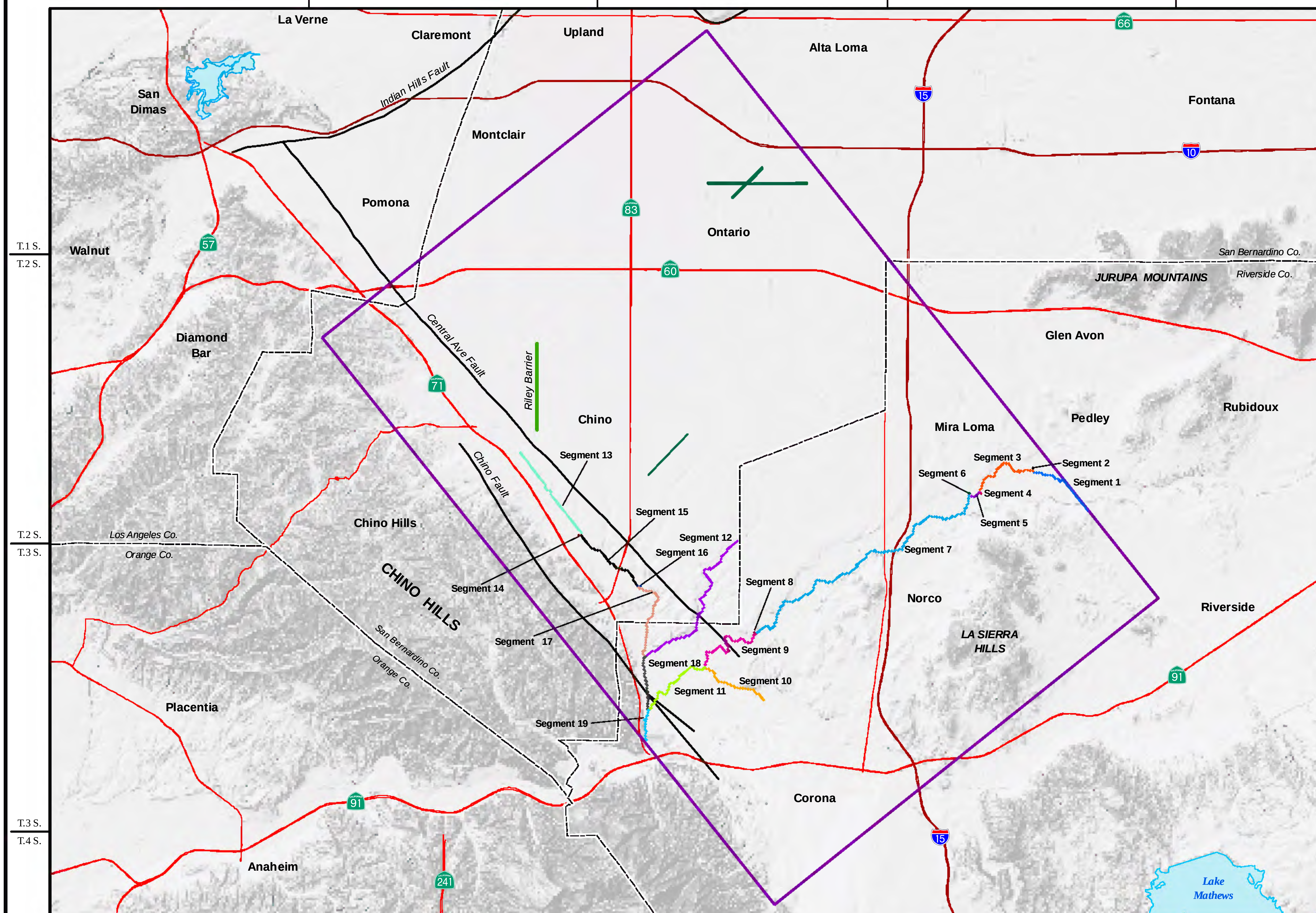
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

STREAMBED CONDUCTANCE



21-Sep-07

EXPLANATION

Ground Water Model Boundary

Streambed Conductance (ft [2]/day)

Segment	Conductance
1	15,809
2	1
3	1,787
4	1
5	2,031
6	1
7	1,452
8	1
9	2,154
10	226
11	3,829
12	19
13	175
14	1
15	63
16	1
17	54
18	94
19	15,064

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

Airport

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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Figure C-9

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-9_streambed_cond_9-07.mxd

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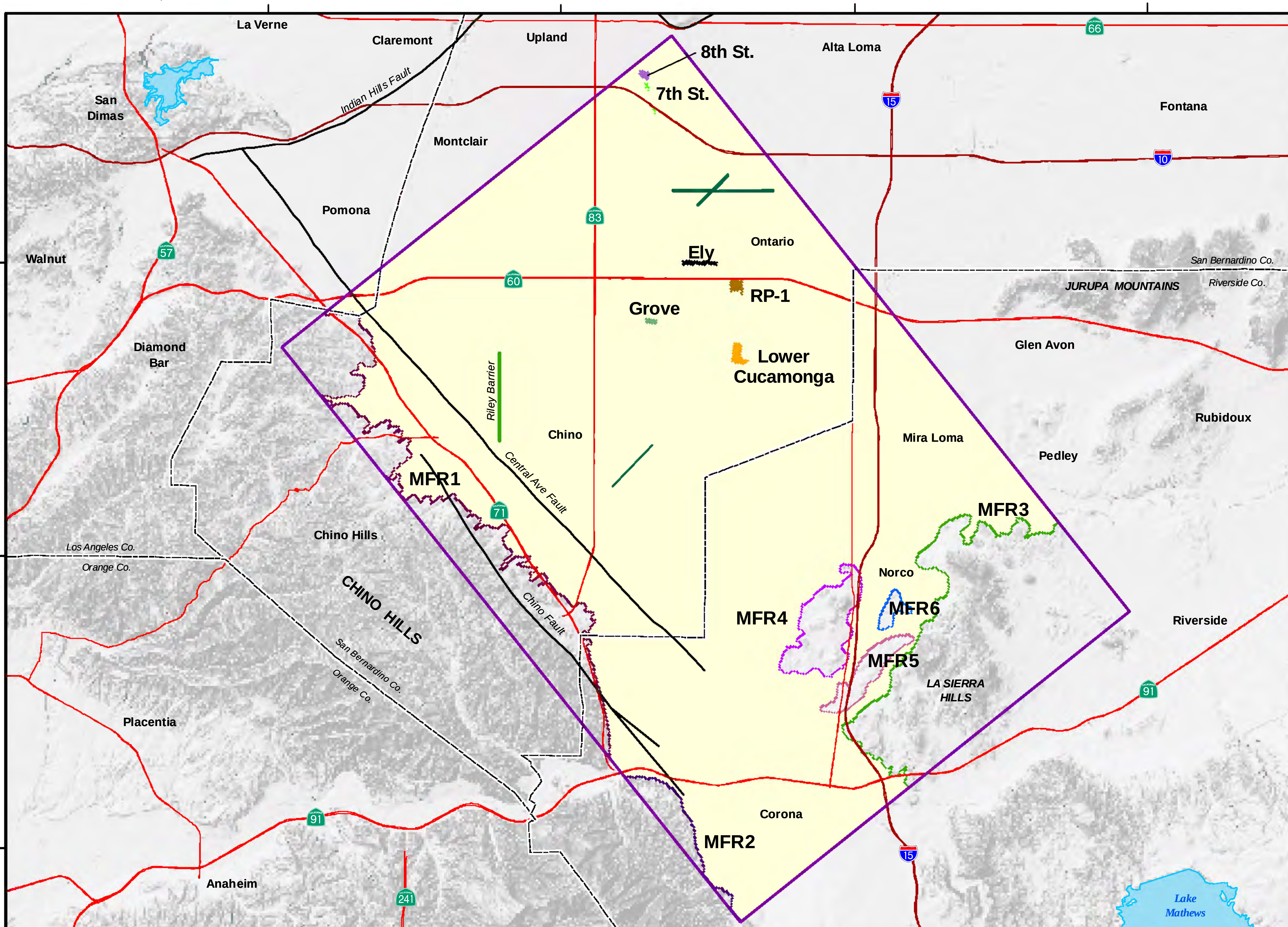
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

RECHARGE FROM MOUNTAIN FRONT RUNOFF, ARTIFICIAL RECHARGE ZONES, AND AREAL RECHARGE



EXPLANATION

Ground Water Model Boundary

Mountain Front Runoff Zones (MFR)
- MFR1
- MFR2
- MFR3
- MFR4
- MFR5
- MFR6

Artificial Recharge
- Ely
- Grove
- Lower Cucamonga
- RP-1
- 7th Street
- 8th Street

Areal Recharge Zone

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

Airport

21-Sep-07

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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Figure C-10

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-10_mtn_front_runoff_9-07.mxd

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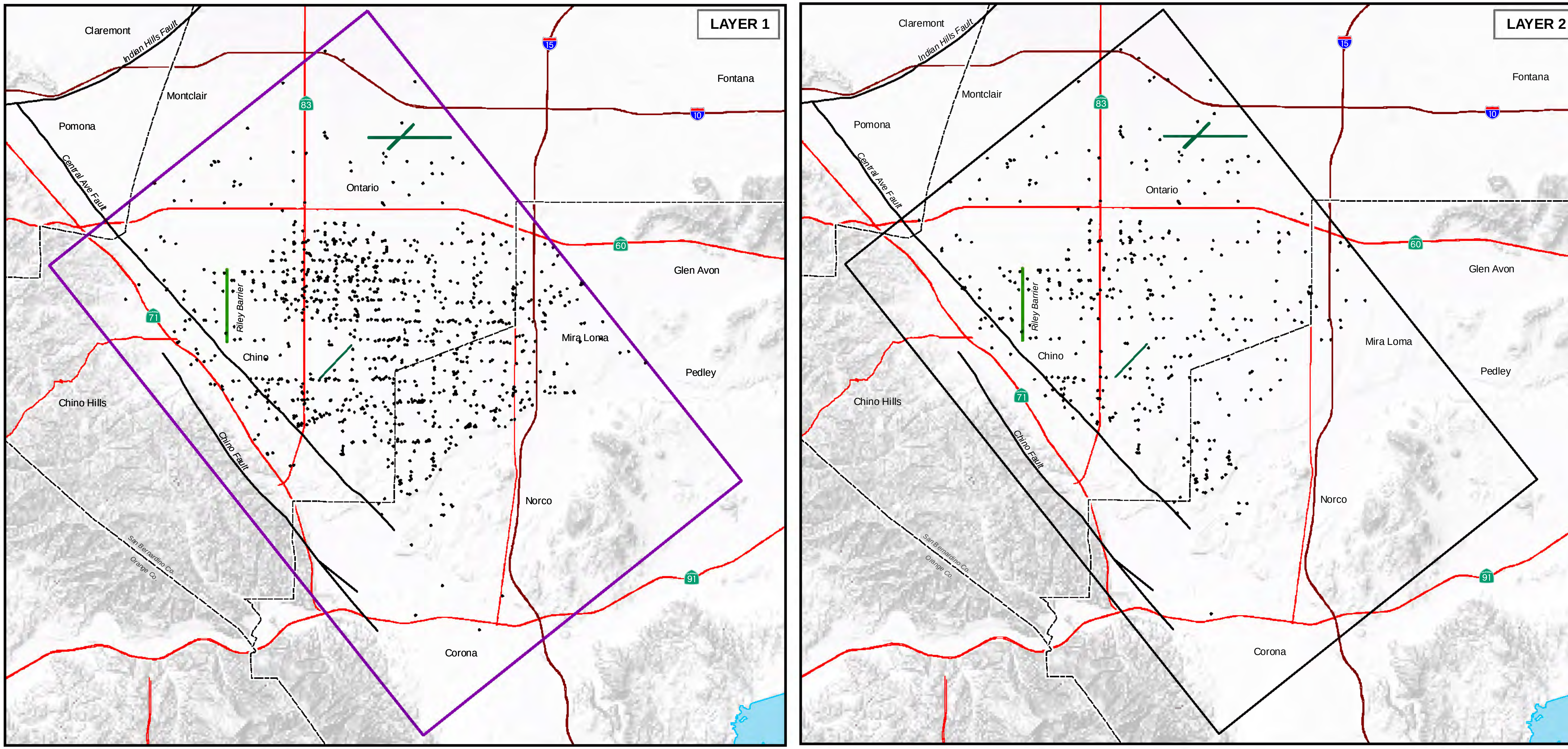
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



NORTH

0 2 4 Miles

EXPLANATION

- Ground Water Pumping Wells
- Ground Water Model Boundary
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport

LOCATION OF GROUND WATER PUMPING WELLS MODEL LAYERS 1 AND 2

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Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

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Figure C-11

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-11_GW_wels_L1_L2_9-07.mxd

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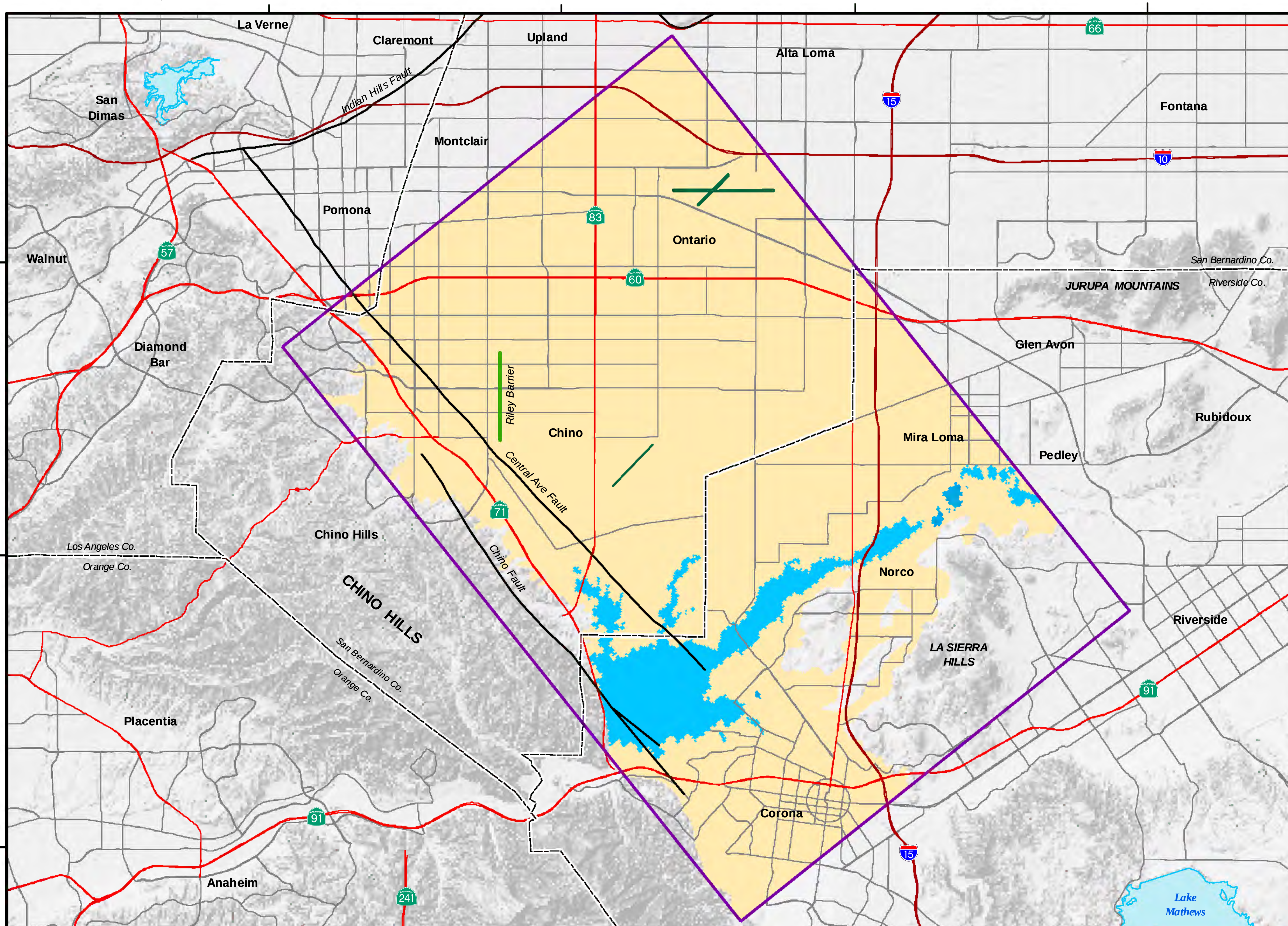
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

EVAPOTRANSPIRATION ZONES



EXPLANATION

- Ground Water Model Boundary

Evapotranspiration Zones

- Inactive
- Active

- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Street
- Airport

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Map Projection:
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Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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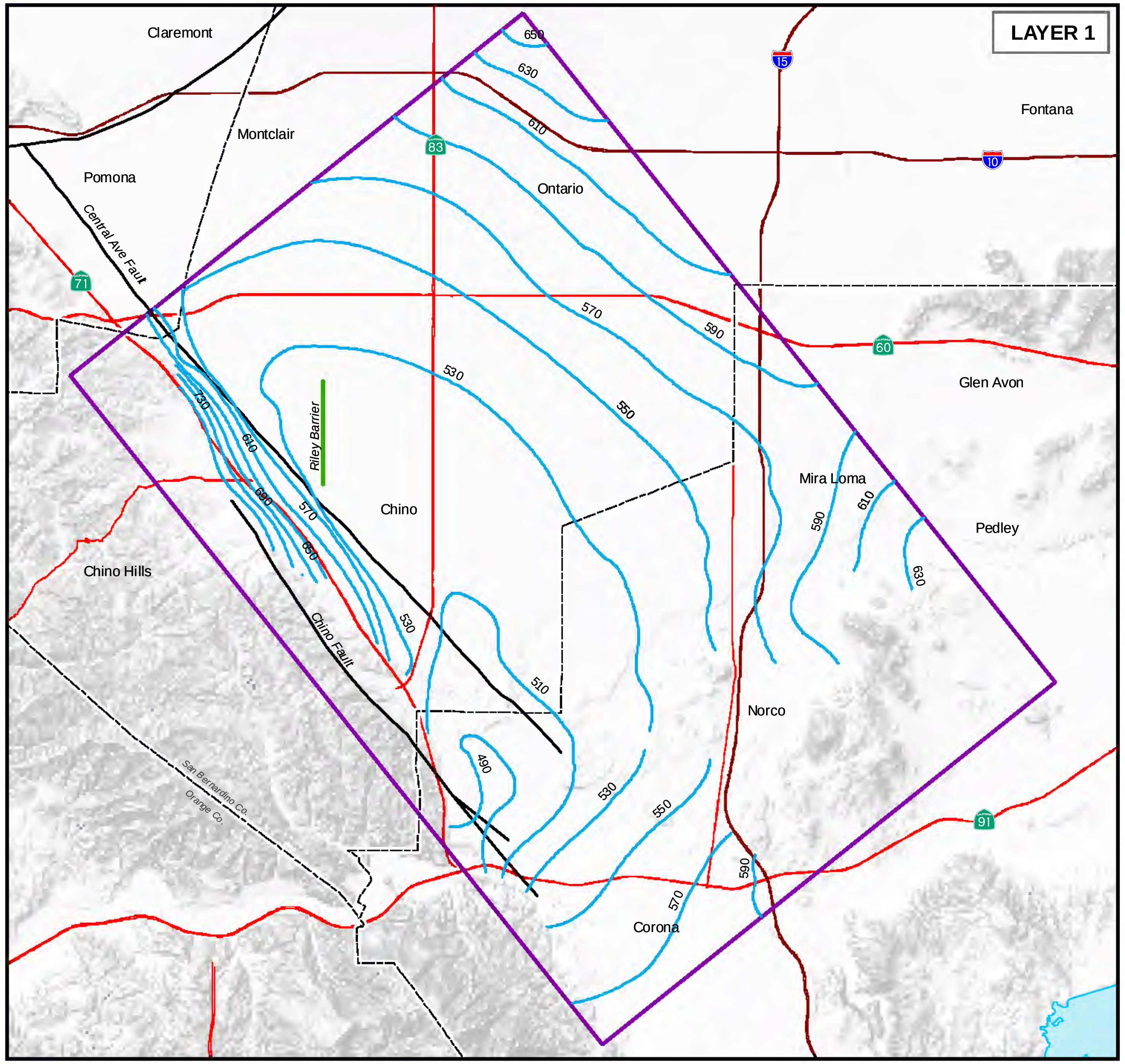
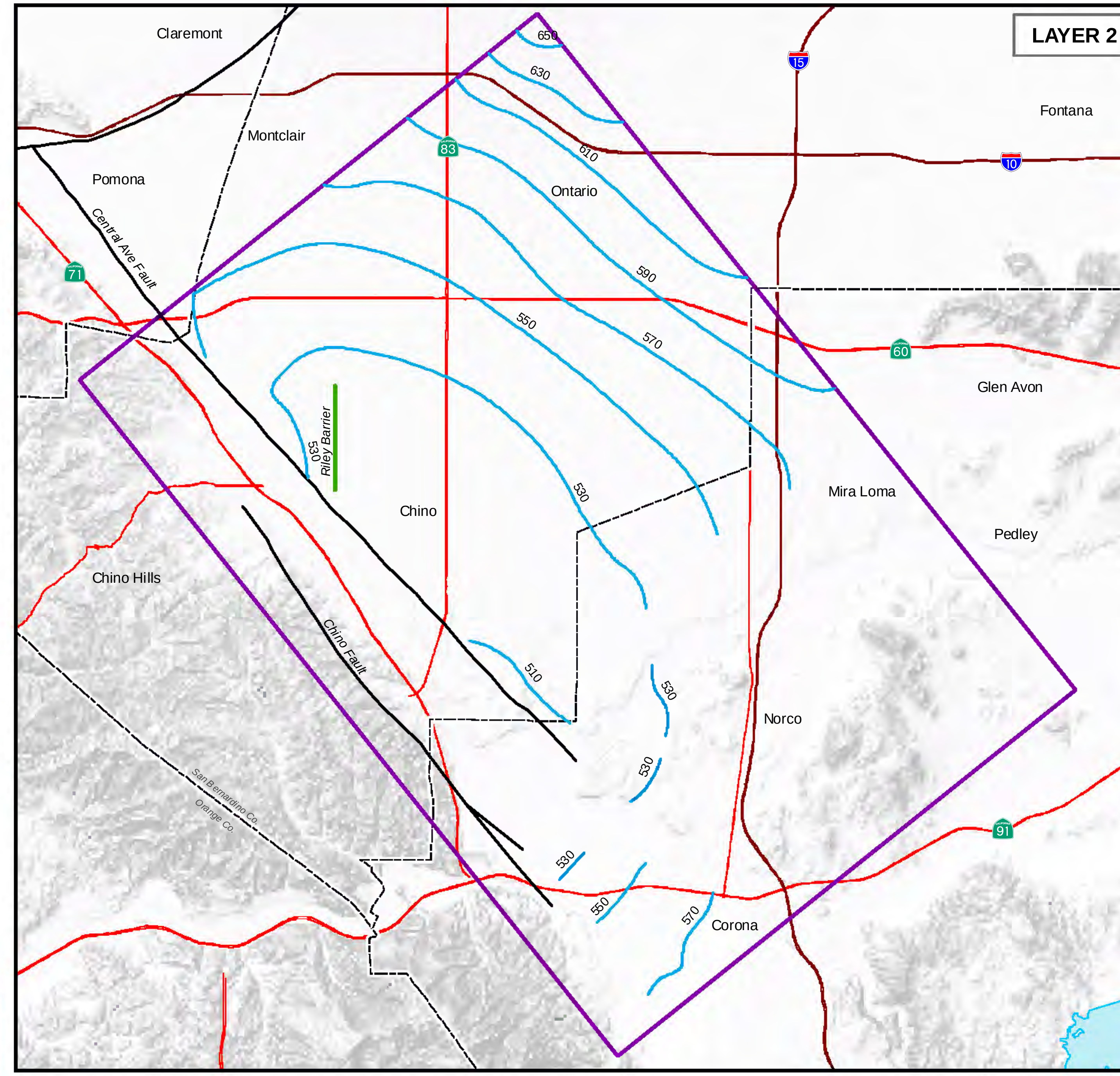
Figure C-12

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-12_ET_zones_9-07.mxd





EXPLANATION

NORTH

0 2 4 Miles

500 Ground Water Elevations Fall 1981 (ft above msl)

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

GROUND WATER ELEVATIONS FALL 1981

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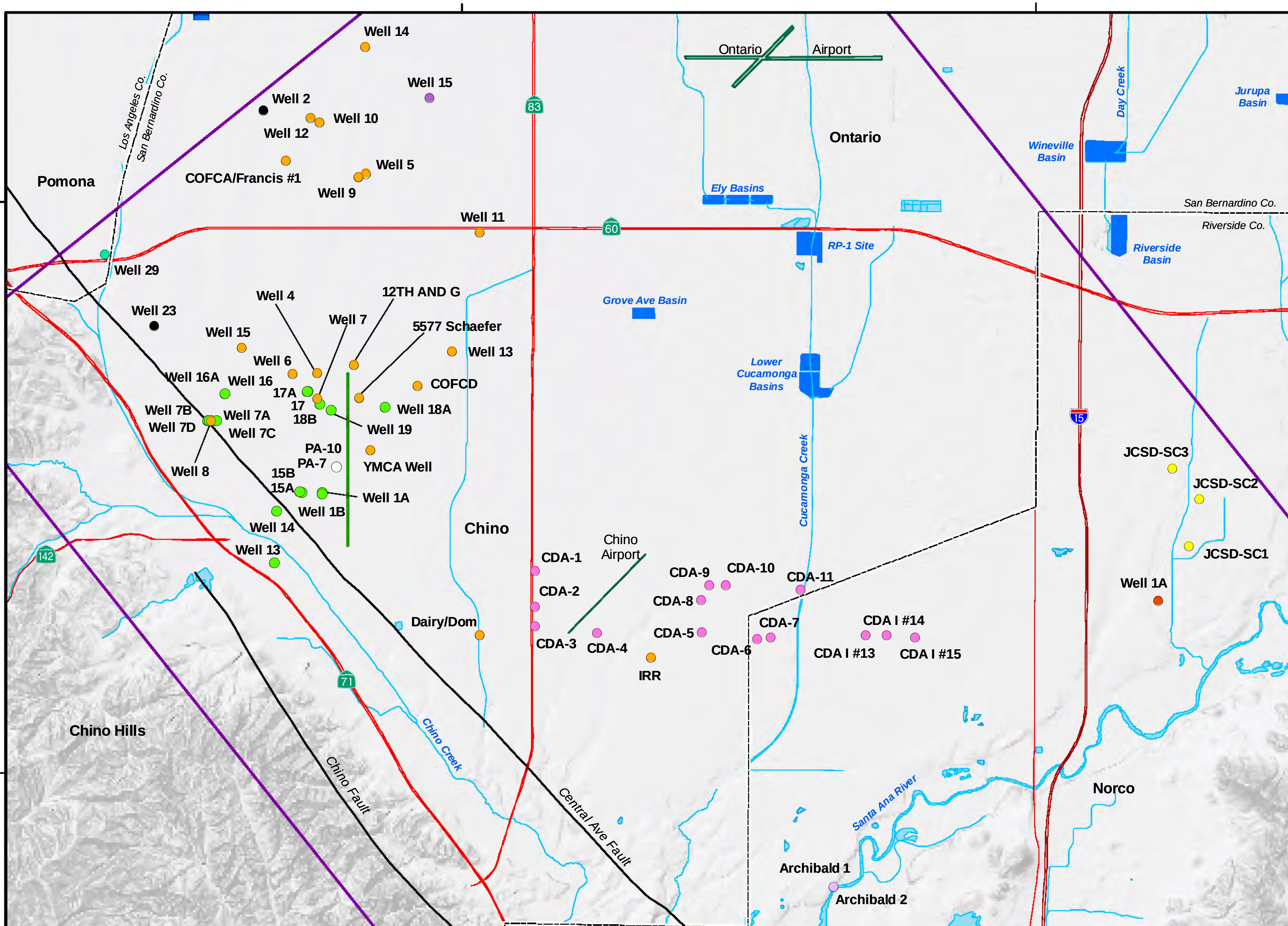
Figure C-13

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-13_gw_contours_L1_L2_9-07.mxd

LOCATION OF TRANSIENT CALIBRATION TARGET WELLS



EXPLANATION

- Ground Water Model Boundary
- Well Classification
  - City of Chino Hills
  - City of Chino Wells
  - City of Ontario
  - City of Pomona
  - Chino Basin Watermaster
  - Chino Desalter Authority
  - Monte Vista Water District
  - Santa Ana River Water Company
  - USGS
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

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Map Projection:
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Figure C-14

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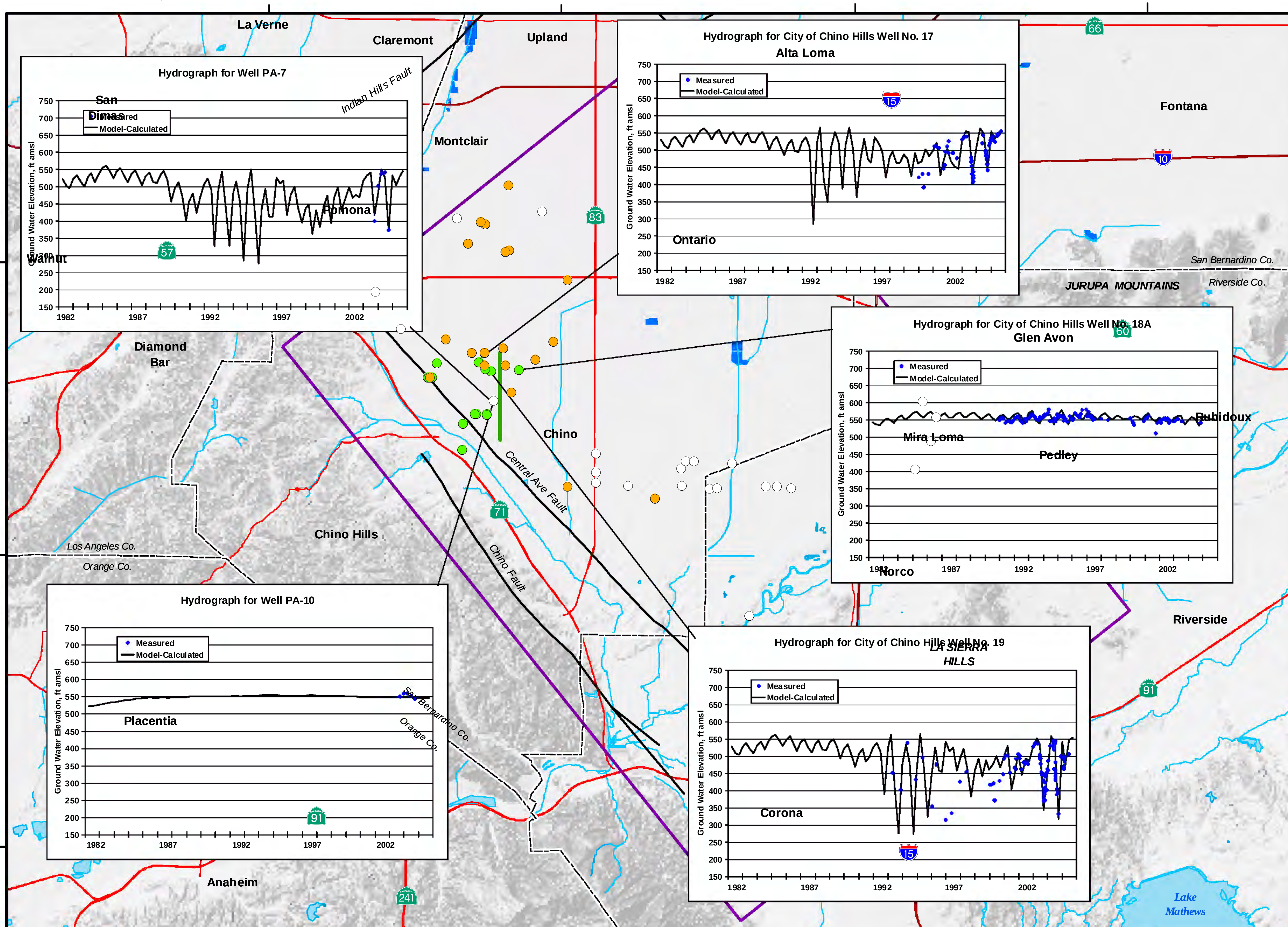
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



T.1 S. T.2 S. T.3 S. T.4 S.

R.9 W. R.8 W. R.7 W. R.6 W. R.5 W.

SELECTED HYDROGRAPHS FOR TRANSIENT MODEL CALIBRATION 1 OF 4

EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

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Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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Figure C-15

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-15_hydrographs_1of4_9-07.mxd

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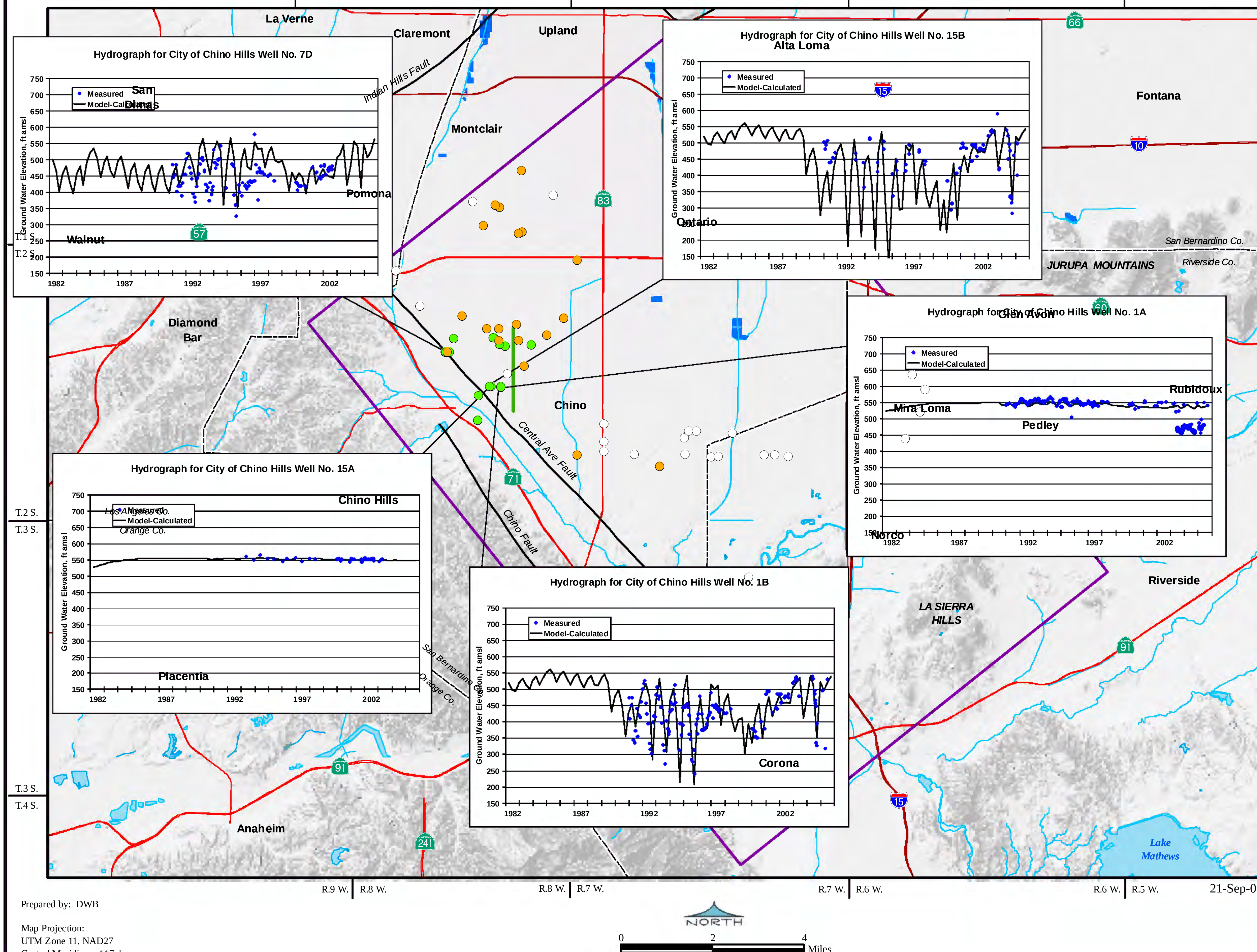
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

SELECTED HYDROGRAPHS FOR TRANSIENT MODEL CALIBRATION 2 OF 4



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
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Central Meridian: -117 degrees

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Figure C-16

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_24_hydrographs_2of4_9-07.mxd

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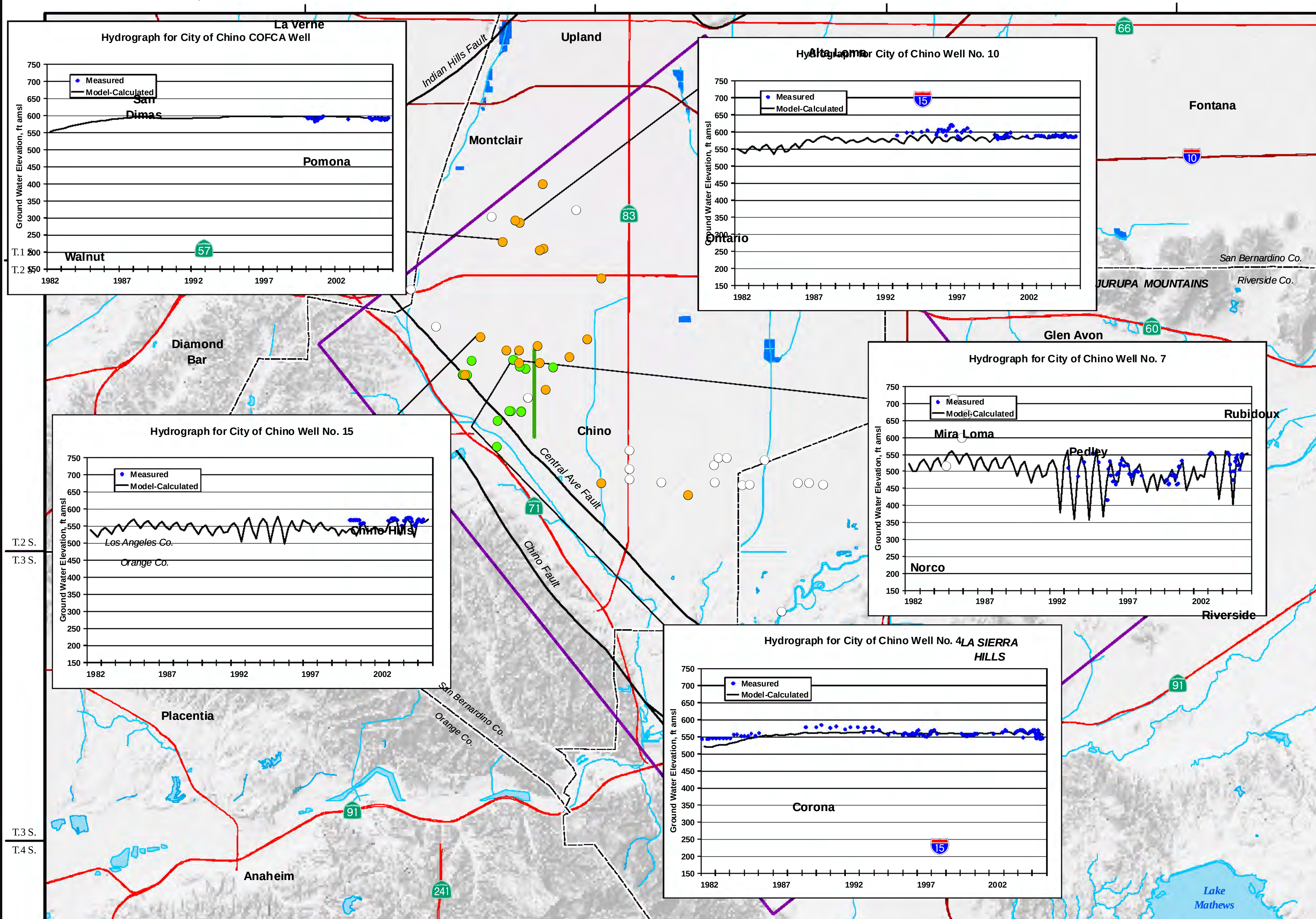
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

SELECTED HYDROGRAPHS FOR TRANSIENT MODEL CALIBRATION 3 OF 4



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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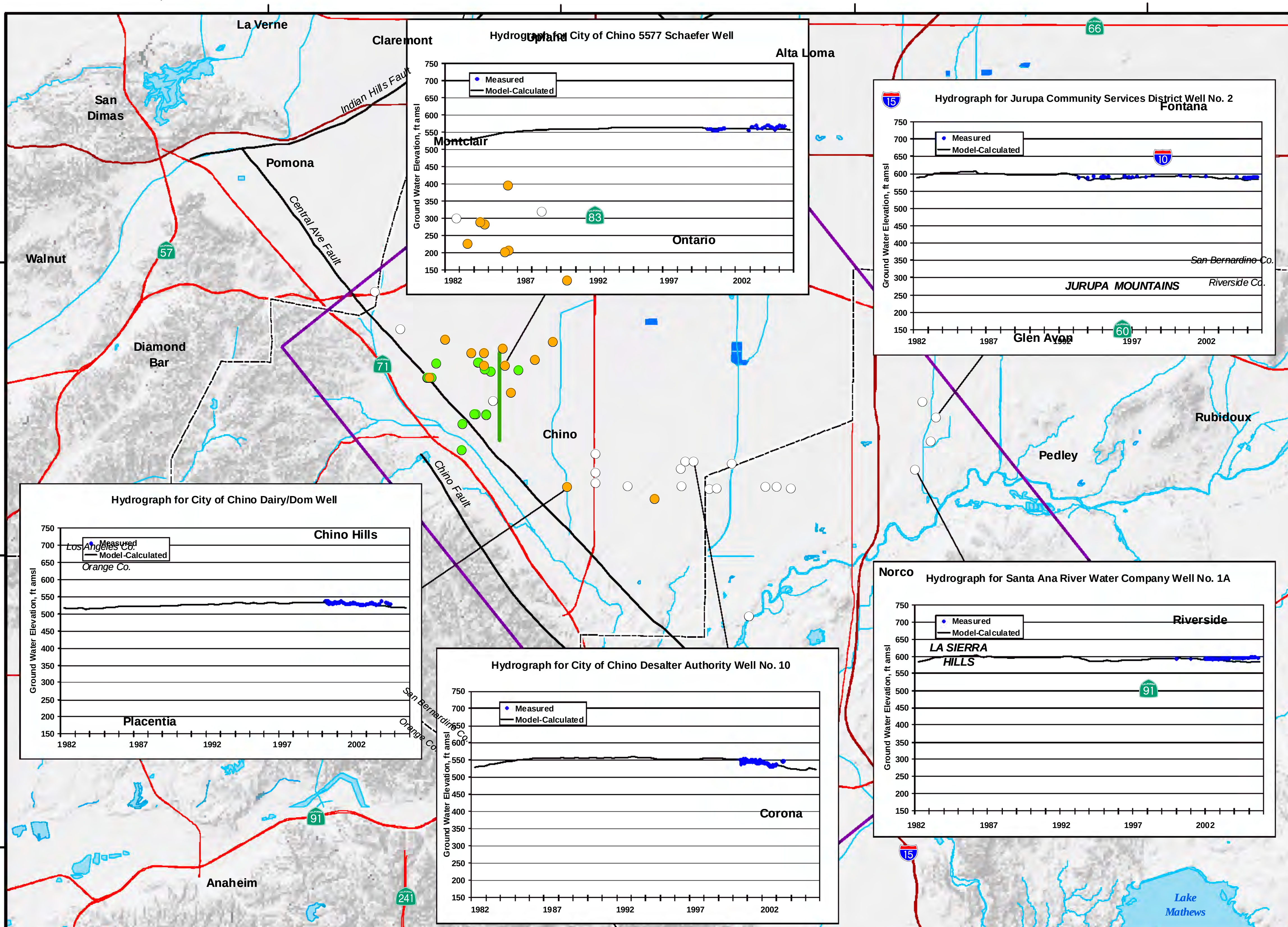
Figure C-17

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_25_hydrographs_3of4_9-07.mxd

SELECTED HYDROGRAPHS FOR TRANSIENT MODEL CALIBRATION 4 OF 4



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 2 4 Miles

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Figure C-18

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_26_hydrographs_4of4_9-07.mxd

Measured vs. Model-Generated Ground Water Elevations - Transient Model Calibration
January 1982 Through September 2005

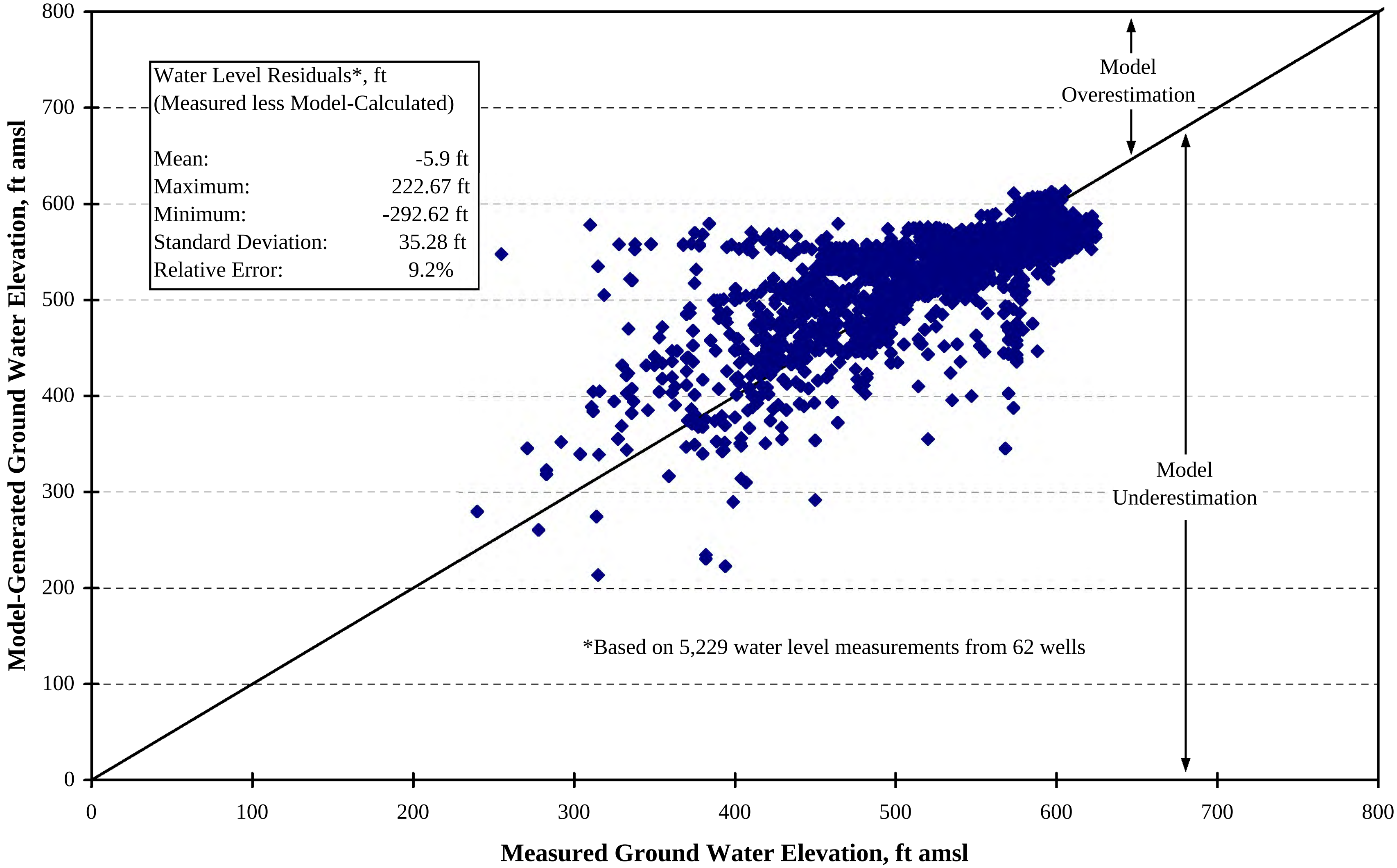


Figure C-19

Histogram of Water Level Residuals - Transient Model Calibration
January 1982 Through September 2005

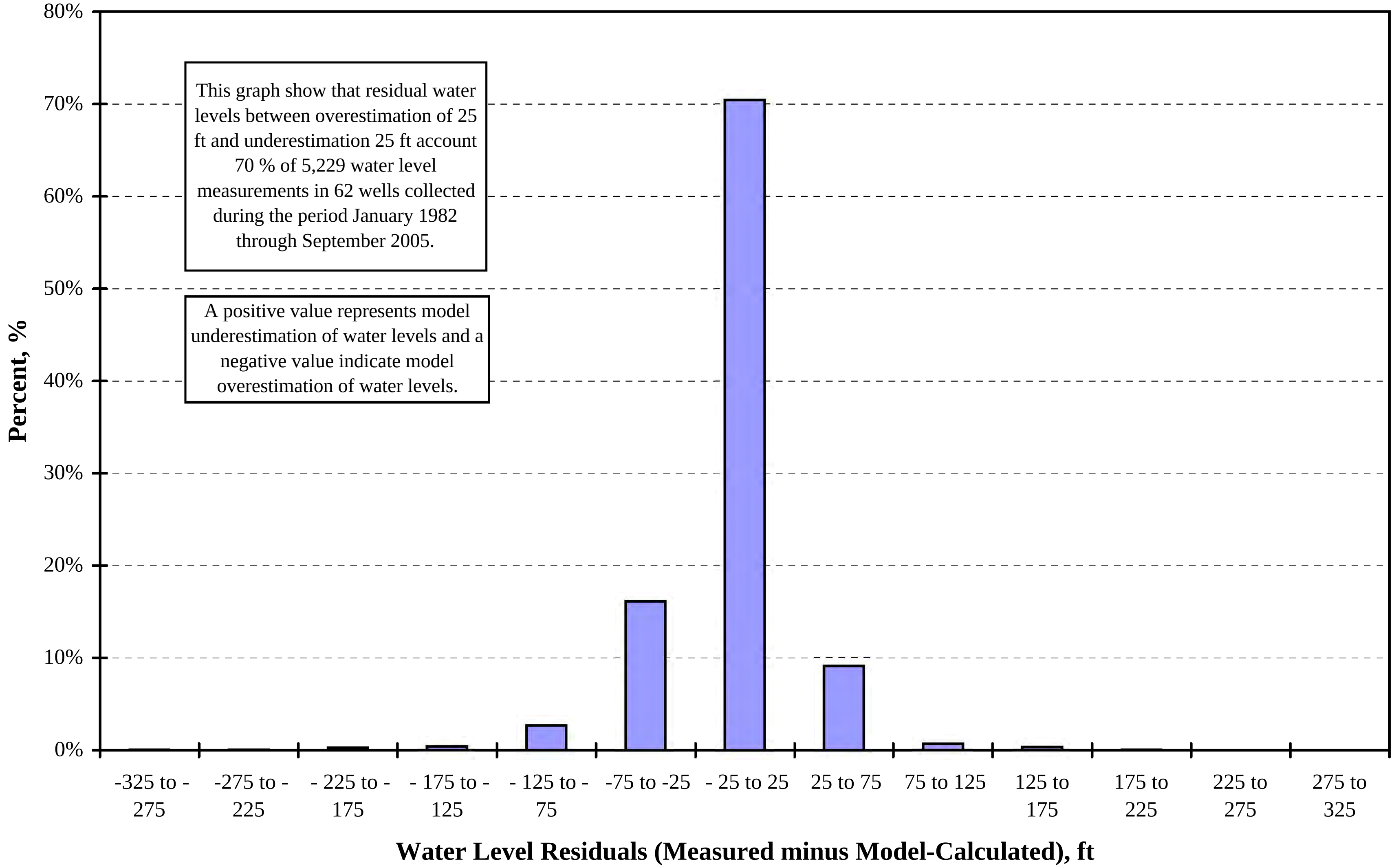


Figure C-20

Measured versus Model-Calculated Streamflow at Santa Ana River Below Prado Dam
First Quarter 1982 - Third Quarter 2005

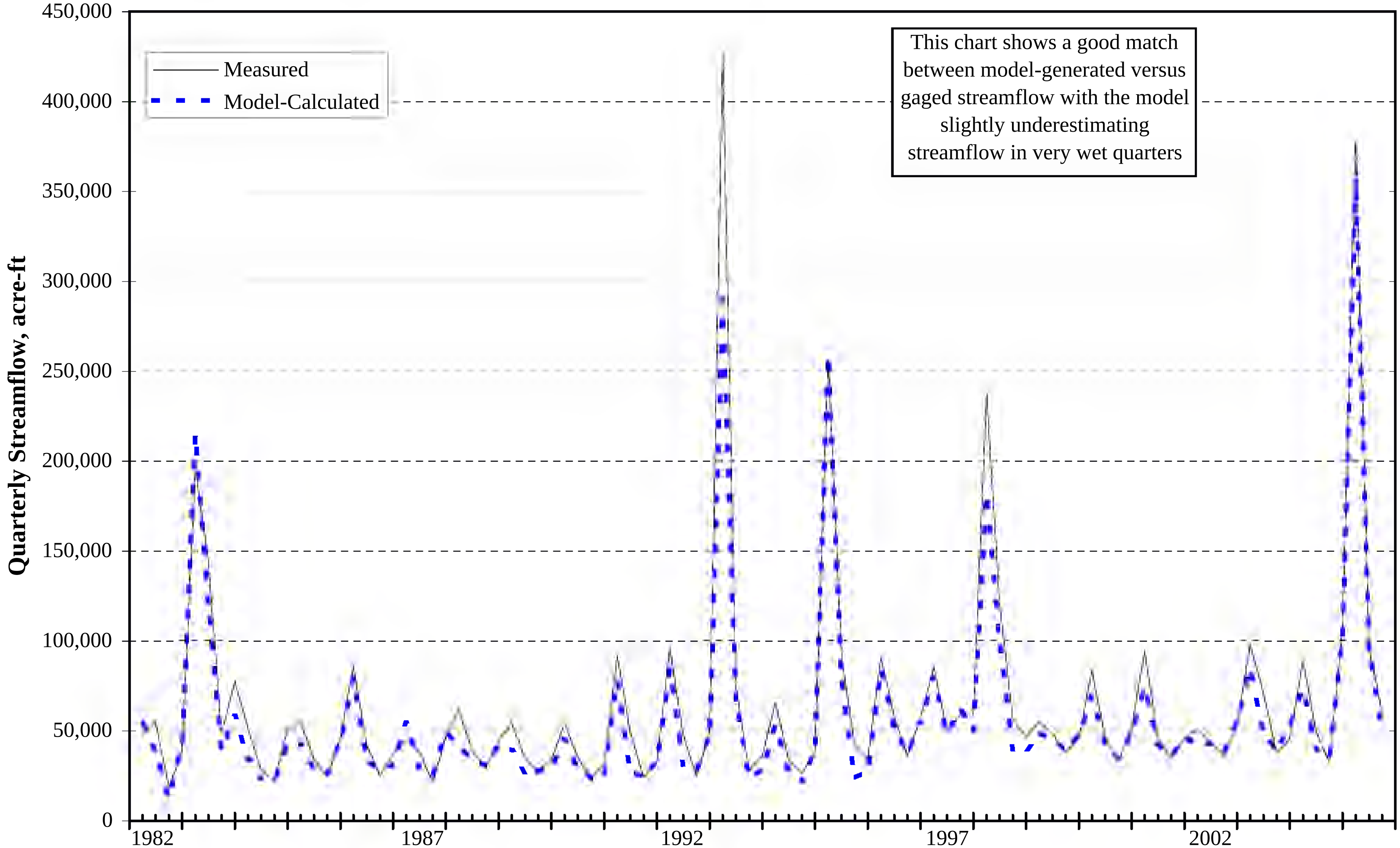
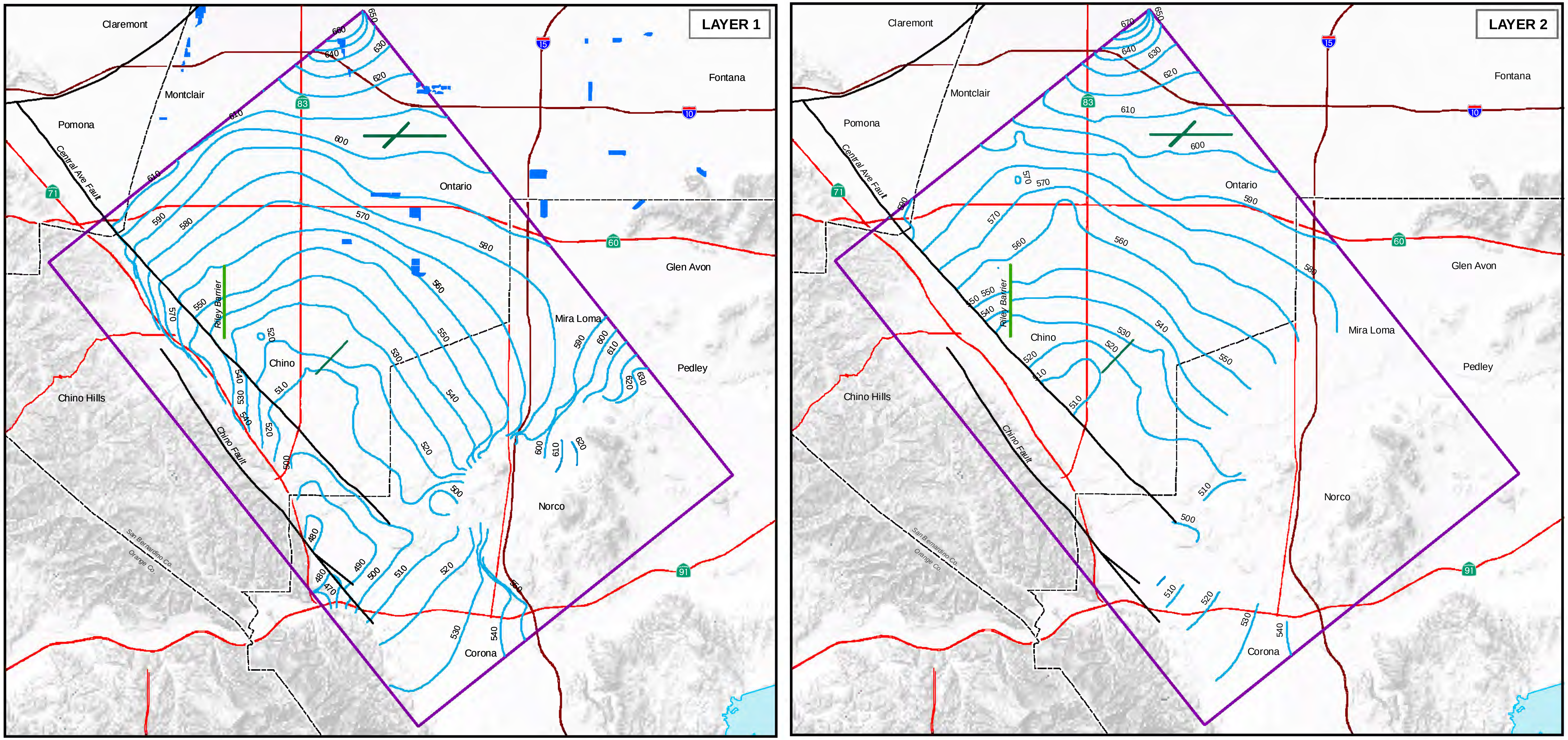


Figure C-21

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1



EXPLANATION

500	Model-generated ground water elevation contours - end of transient calibration (September 2005), ft amsl
	Ground Water Model Boundary
	Faults Near MZ-1
	Riley Groundwater Barrier (WE, 2005 & 2007)
	County Boundary
	Freeway
	State Highway
	Airport

NORTH

0 2 4 Miles

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

MODEL-GENERATED GROUND WATER ELEVATION CONTOURS END OF TRANSIENT CALIBRATION (SEPTEMBER 2005)

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Figure C-22

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-22_model_gw_contours_L1_L2_9-07.mxd

Historical Annual Production - City of Chino Hills

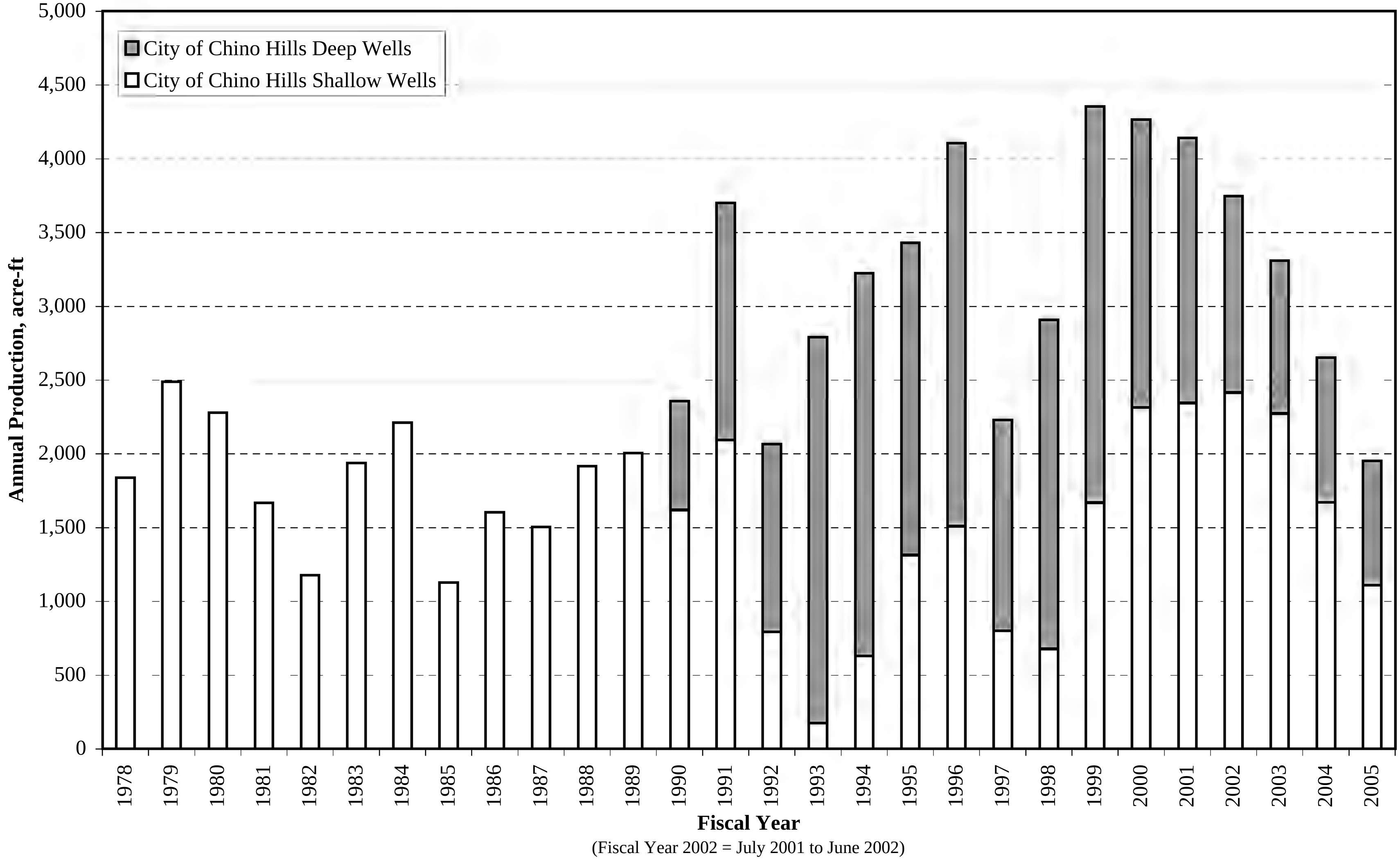
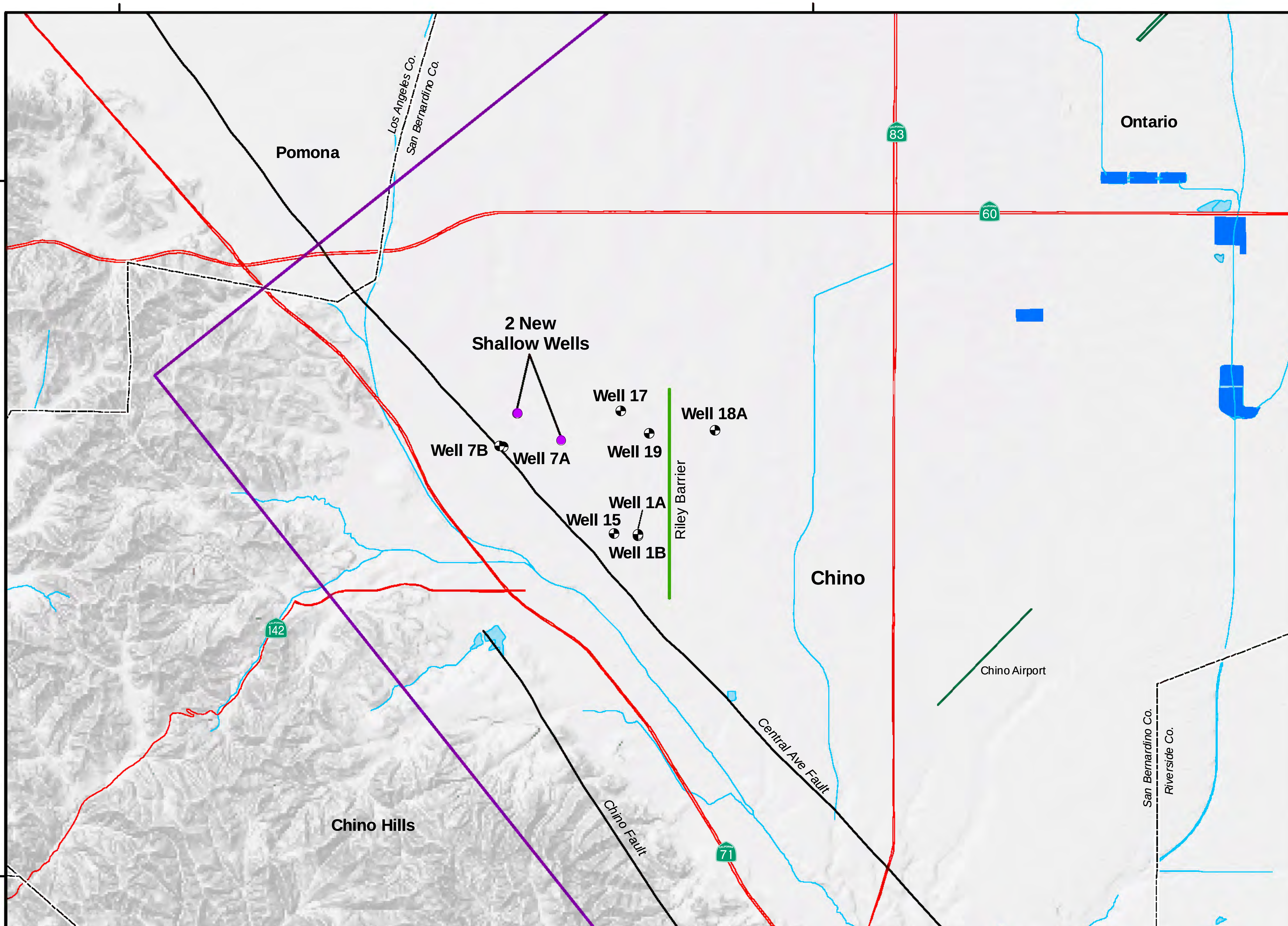


Figure C-23

PROPOSED PUMPING WELLS CITY OF CHINO HILLS MODEL SCENARIO 3 (7,400 AFY)



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- 2 New City of Chino Wells Proposed Shallow Pumping Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Street
- Airport
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

NORTH

0 1 2 Miles

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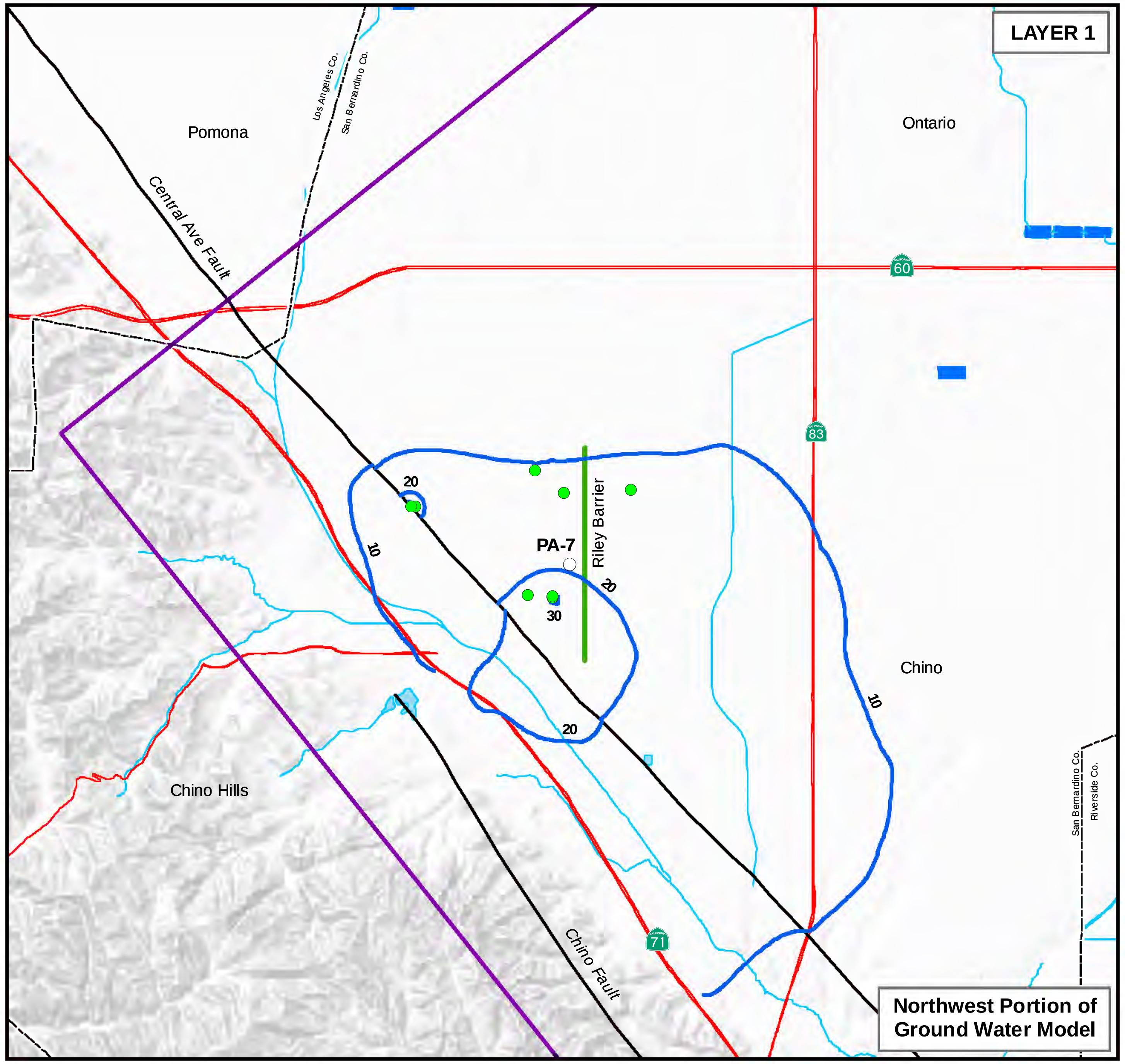
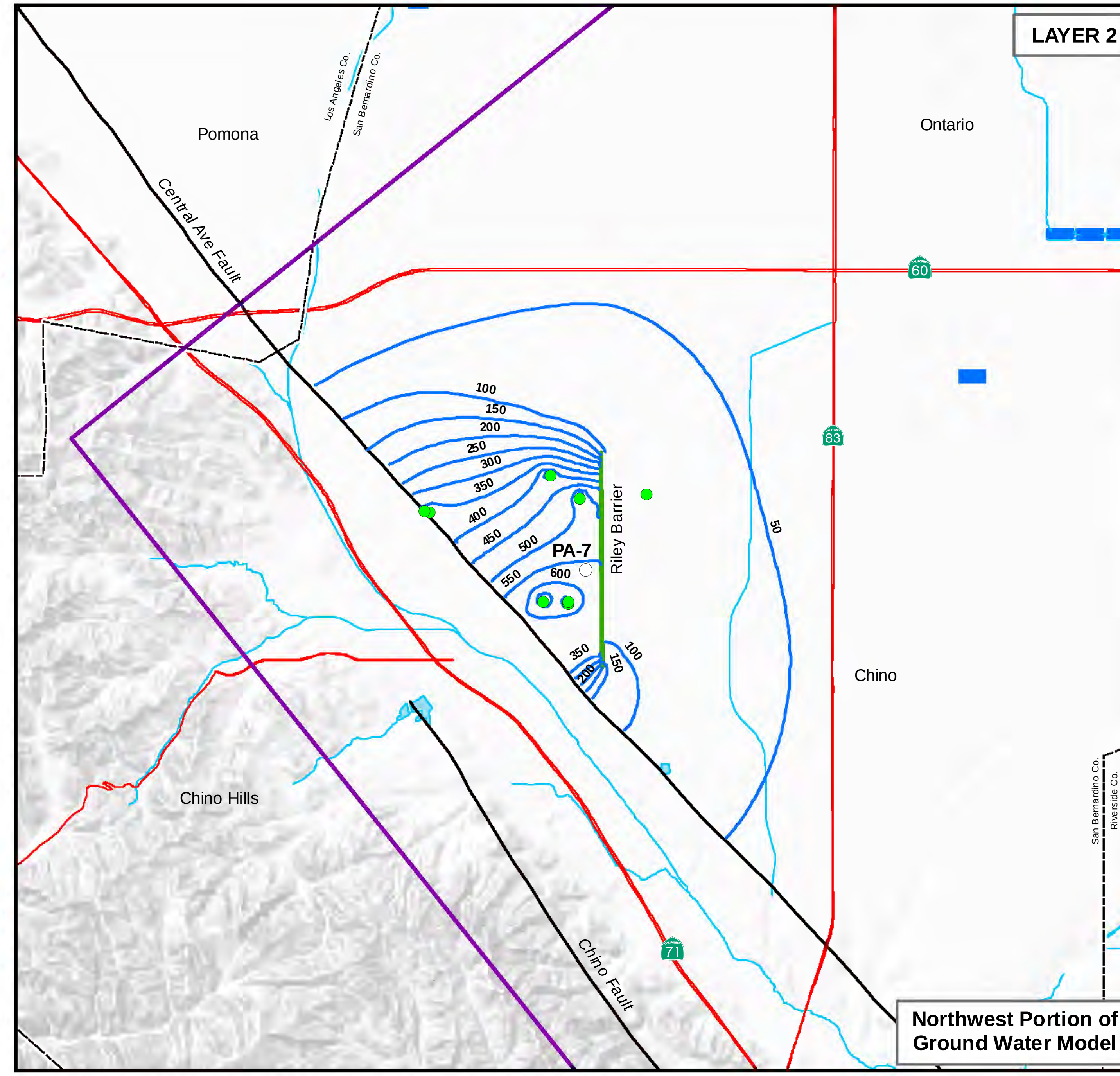
Figure C-24

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-23_Proposed_pumping_wells_9-07.mxd





EXPLANATION

NORTH

0 1 2 Miles

10 — Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)

City of Chino Hills Wells Used in Scenario 1 (See Figure C-14 for Well Names)

PA-7 (Deep Ayala Park Piezometer)

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

Recharge Basin

Surface Water or River Channel

Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

CHANGE IN GROUND WATER LEVELS AFTER 20 YEARS (2005-2025) OF PUMPING BY THE CITY OF CHINO HILLS SCENARIO 1 (14,800 AFY)

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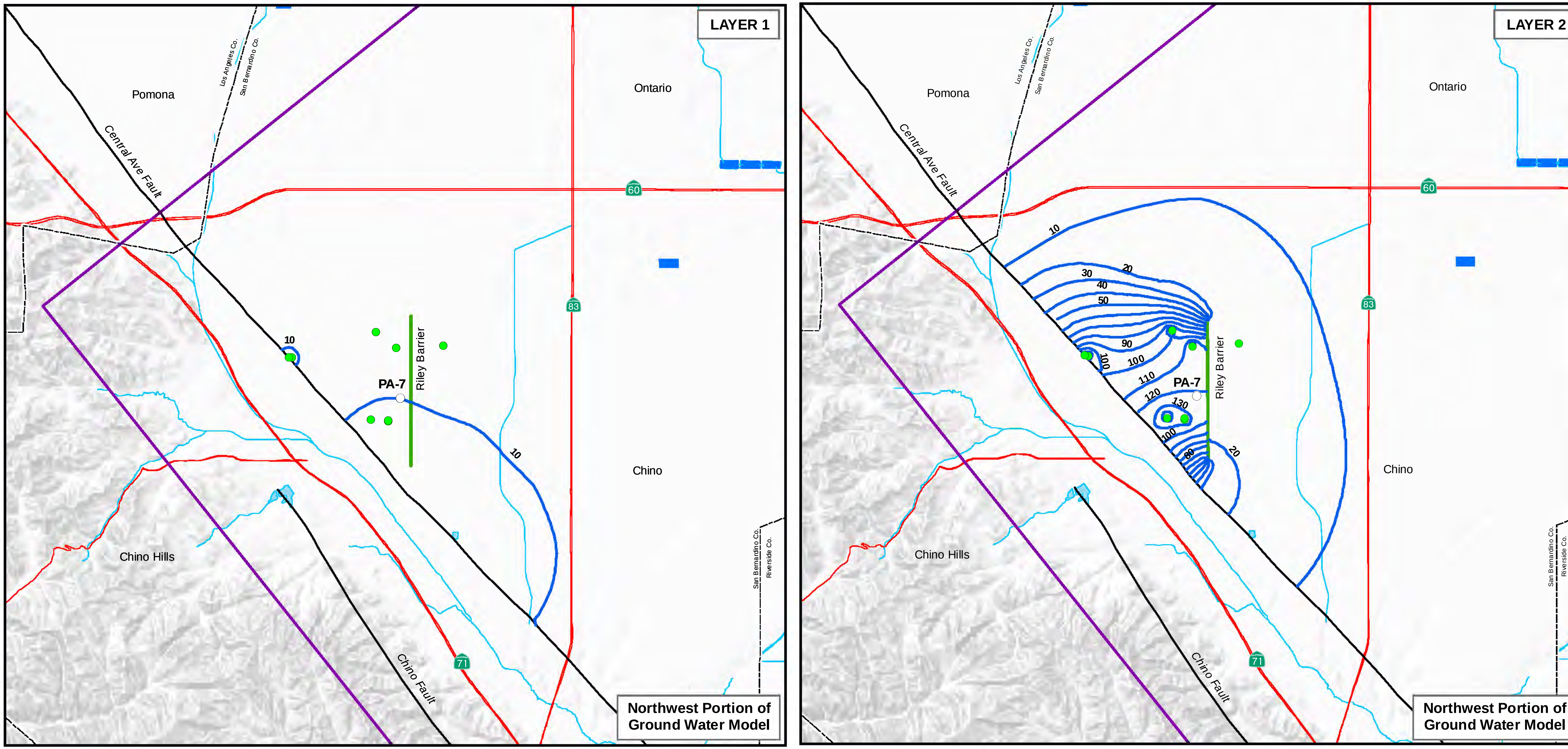
Figure C-25



EXPLANATION

NORTH

0 1 2 Miles

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

10	Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)		Ground Water Model Boundary		Recharge Basin
			Faults Near MZ-1		Surface Water or River Channel
	City of Chino Hills Wells Used in Scenario 2 (See Figure C-14 for Well Names)		Riley Groundwater Barrier (WE, 2005 & 2007)		Creek or River
	PA-7 (Deep Ayala Park Piezometer)		County Boundary		
			Freeway		
			State Highway		

CHANGE IN GROUND WATER LEVELS AFTER 20 YEARS (2005-2025) OF PUMPING BY THE CITY OF CHINO HILLS SCENARIO 2 (4,400 AFY)

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Figure C-26

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_24_scen_2_wl_L1_L2_9-07.mxd

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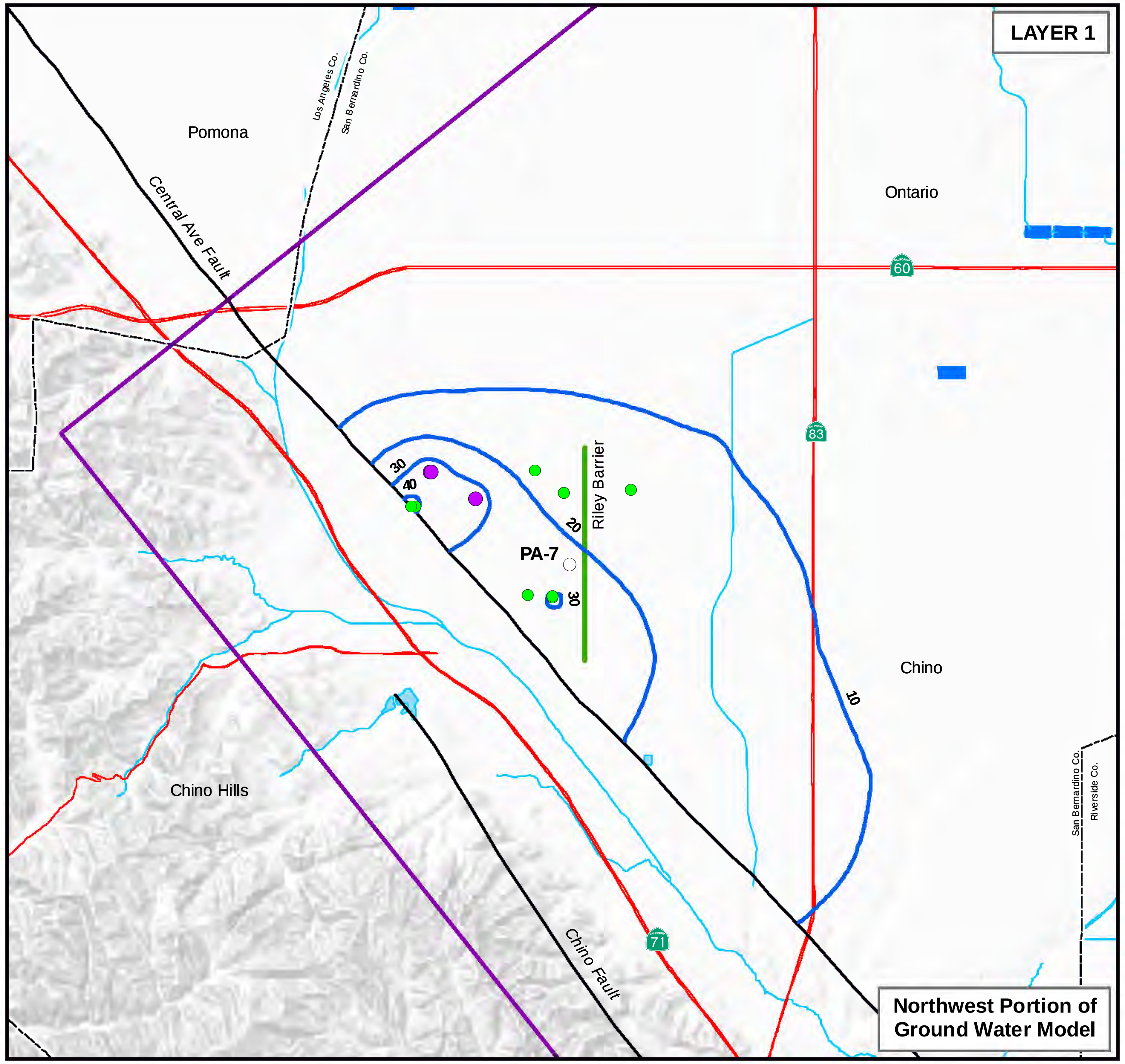
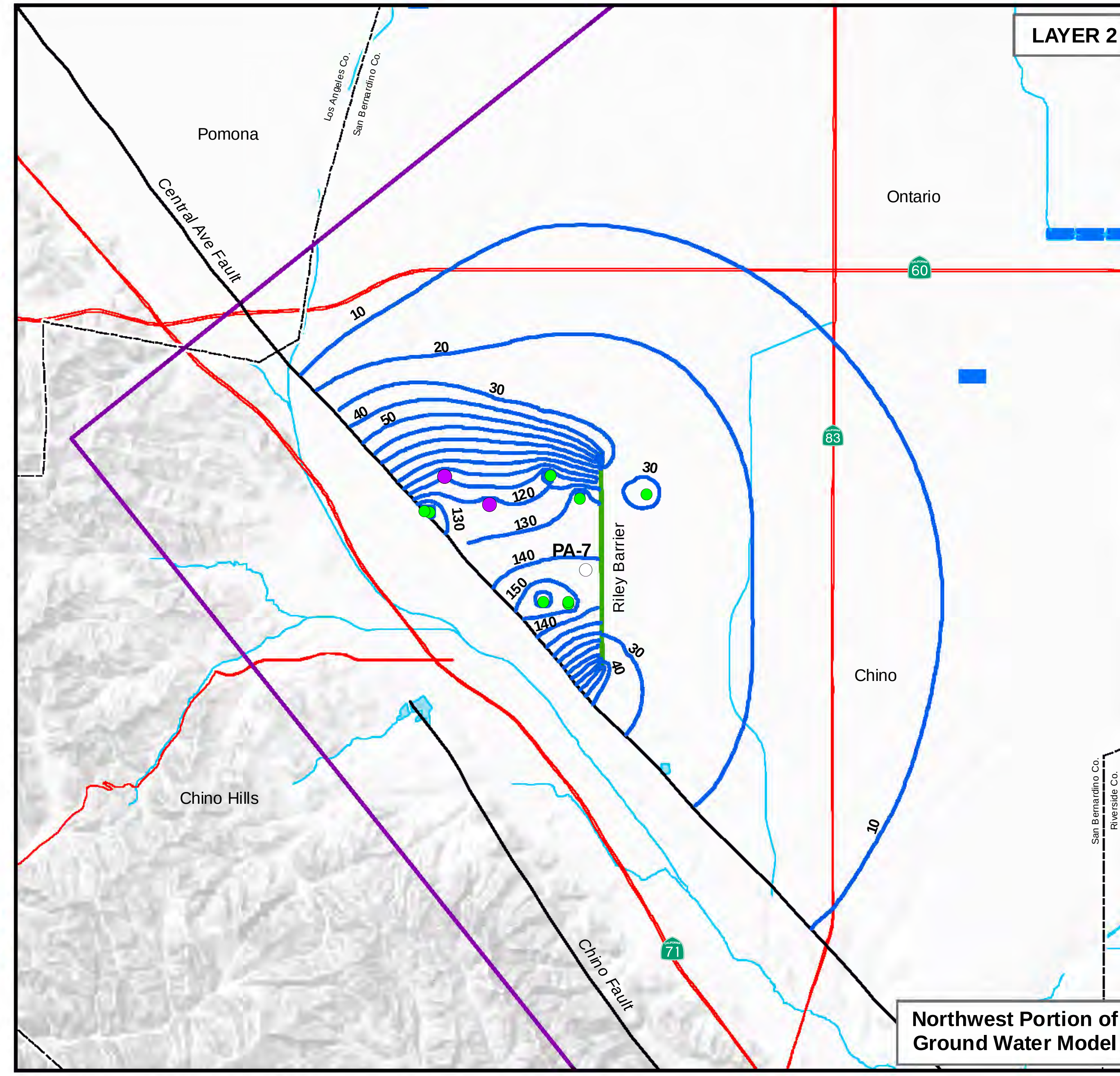
COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1





EXPLANATION

NORTH

0 1 2 Miles

10 — Change in ground water levels (ft) after 20 years of pumping by the City of Chino Hills Scenario 1 (14,800 acre-feet/year) (Sept 2005 minus Sept 2025)

City of Chino Hills Wells Used in Scenario 3 (See Figure C-14 for Well Names)

PA-7 (Deep Ayala Park Piezometer)

2 New City of Chino Wells Proposed Shallow Pumping Wells

Ground Water Model Boundary

Faults Near MZ-1

Riley Groundwater Barrier (WE, 2005 & 2007)

County Boundary

Freeway

State Highway

Recharge Basin

Surface Water or River Channel

Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

CHANGE IN GROUND WATER LEVELS AFTER 20 YEARS (2005-2025) OF PUMPING BY THE CITY OF CHINO HILLS SCENARIO 3 (7,400 AFY)

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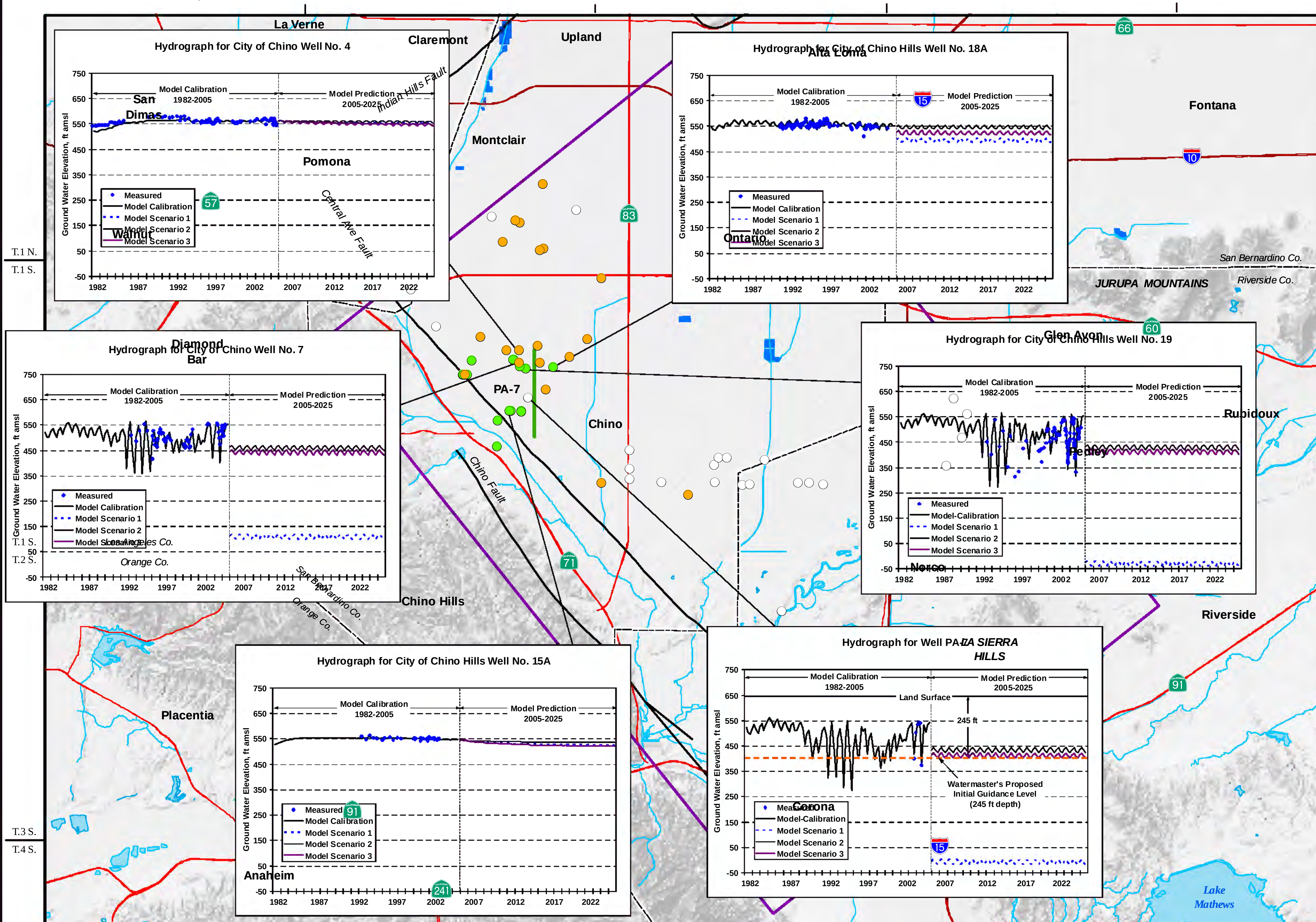
Figure C-27

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_25_scen_3_wl_L1_L2_9-07.mxd

JENKINS & HOGIN, LLP

COMMENTS ON CHINO BASIN WATERMASTER'S PROPOSED
LONG TERM PLAN FOR THE MANAGEMENT OF SUBSIDENCE IN MZ-1

SELECTED HYDROGRAPHS FOR MODEL SCENARIOS 1, 2 AND 3



EXPLANATION

- Ground Water Model Boundary
- City of Chino Hills Wells
- City of Chino Wells
- Other Target Wells
- Faults Near MZ-1
- Riley Groundwater Barrier (WE, 2005 & 2007)
- County Boundary
- Freeway
- State Highway
- Recharge Basin
- Surface Water or River Channel
- Creek or River

21-Sep-07

Prepared by: DWB

Map Projection:
UTM Zone 11, NAD27
Central Meridian: -117 degrees

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Figure C-28

GIS_proj/city_of_chino_hills_model_9-07/0_Fig_C-27_selected_hydrographs_9-07.mxd

Depth to Water in Well PA-7 - Scenarios 1, 2 and 3

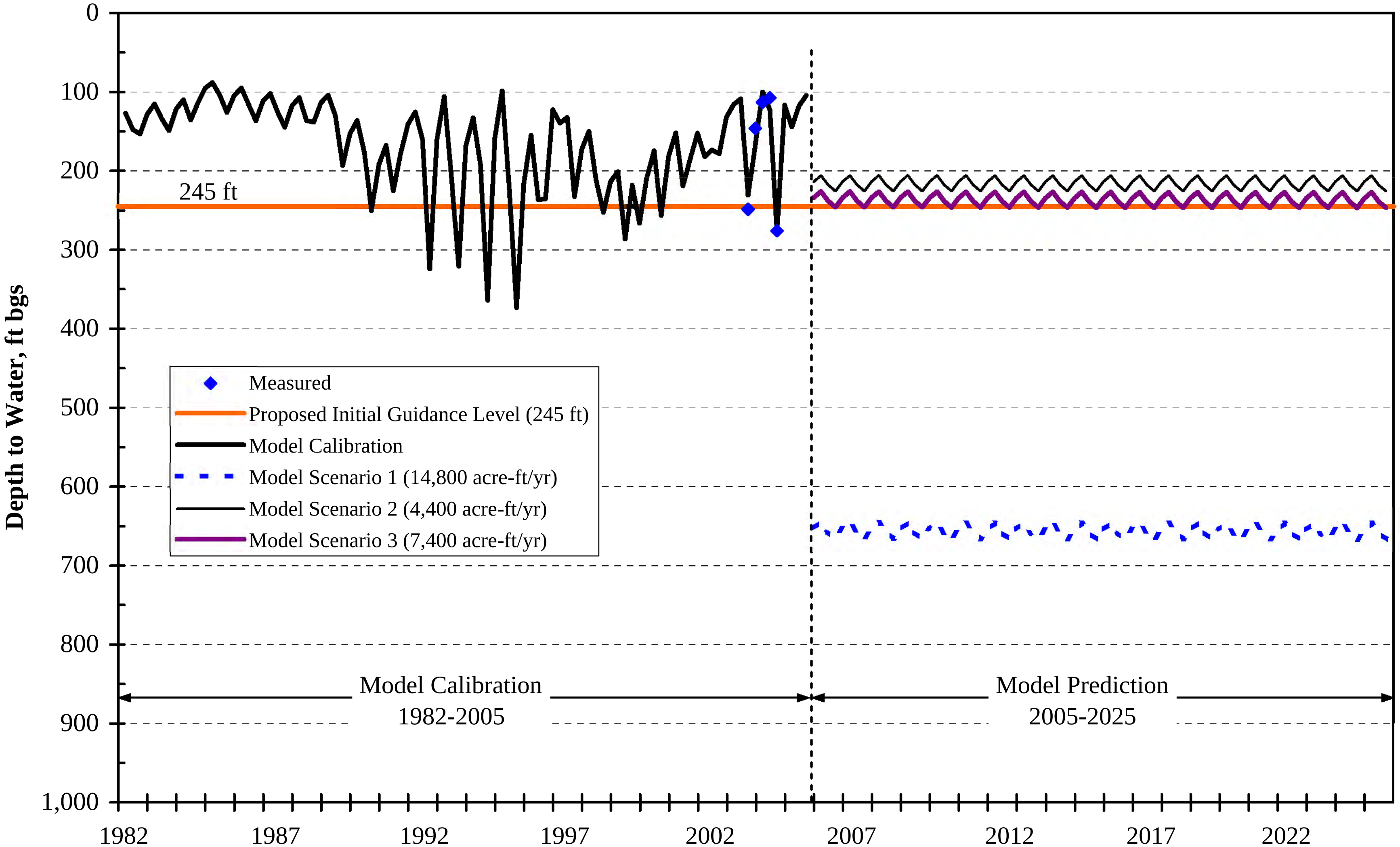

Figure C-29

APPENDIX C
TABLES

GEOSCIENCE Support Services, Inc.

Quarterly Streamflow Inflow for the Streamflow-Routing Package
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Santa Ana River and Riverside Water Quality Control Plant	Western Riverside County Regional Wastewater Treatment Plant	Temescal and Corona Plant No. 1 and No. 2	Cucamonga Creek	Chino Creek and IEUA Carbon Canyon Water Reclamation Facility	IEUA RP#2
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1982	1st	44,444	0	4,026	1,260	4,216	1,340
1982	2nd	38,073	0	2,287	249	791	1,340
1982	3rd	13,639	0	1,744	97	308	1,340
1982	4th	34,104	0	2,540	2,274	3,705	1,340
1983	1st	154,031	0	18,165	30,889	12,036	1,073
1983	2nd	104,318	0	8,282	5,158	1,700	1,073
1983	3rd	34,733	0	3,724	703	1,106	1,073
1983	4th	49,780	0	2,349	3,469	2,166	1,073
1984	1st	26,762	0	4,231	326	270	988
1984	2nd	20,204	0	2,480	208	309	988
1984	3rd	20,880	0	1,942	230	361	988
1984	4th	30,792	0	3,672	3,534	2,551	988
1985	1st	33,388	0	3,309	1,151	1,093	1,070
1985	2nd	23,132	0	3,940	1,069	211	1,070
1985	3rd	20,544	0	3,553	2,848	229	1,070
1985	4th	30,312	0	4,579	6,021	1,432	1,070
1986	1st	52,712	0	5,746	12,139	4,778	665
1986	2nd	25,775	0	2,810	4,784	534	665
1986	3rd	21,769	0	2,959	5,659	844	665
1986	4th	24,538	0	2,422	3,982	649	665
1987	1st	41,425	0	3,096	7,035	1,747	1,250
1987	2nd	24,671	0	2,403	3,541	240	1,250
1987	3rd	21,135	0	2,615	4,760	281	1,250
1987	4th	36,417	0	3,949	6,745	2,392	1,250
1988	1st	29,216	0	3,141	6,136	1,680	1,375
1988	2nd	26,911	0	3,190	3,940	2,212	1,375
1988	3rd	22,435	0	2,722	3,360	4,766	1,375
1988	4th	28,613	0	3,556	6,480	4,000	1,375
1989	1st	28,658	0	3,233	5,695	1,426	1,545
1989	2nd	20,344	0	2,717	4,808	1,314	1,545
1989	3rd	19,204	0	2,824	4,935	3,433	1,545
1989	4th	22,269	0	2,640	5,713	448	1,545
1990	1st	28,648	0	4,442	9,677	2,378	1,433
1990	2nd	22,494	0	3,779	4,790	562	1,433
1990	3rd	17,800	0	4,164	5,050	200	1,433
1990	4th	19,134	0	4,927	4,814	299	1,433
1991	1st	52,122	0	10,151	11,650	4,446	1,525
1991	2nd	20,593	0	4,135	4,808	156	1,525

Quarterly Streamflow Inflow for the Streamflow-Routing Package
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Santa Ana River and Riverside Water Quality Control Plant	Western Riverside County Regional Wastewater Treatment Plant	Temescal and Corona Plant No. 1 and No. 2	Cucamonga Creek	Chino Creek and IEUA Carbon Canyon Water Reclamation Facility	IEUA RP#2
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1991	3rd	15,483	0	4,799	6,449	144	1,525
1991	4th	18,801	0	4,538	8,983	1,017	1,525
1992	1st	51,420	0	7,121	16,971	6,221	1,833
1992	2nd	19,415	0	3,139	8,778	622	1,833
1992	3rd	16,507	0	4,581	8,869	550	1,833
1992	4th	28,977	0	5,890	9,321	3,446	1,833
1993	1st	203,148	0	39,926	31,161	16,474	2,590
1993	2nd	54,313	0	7,775	6,099	1,682	2,590
1993	3rd	14,959	0	5,748	5,502	1,352	2,590
1993	4th	15,967	0	5,488	8,030	1,816	2,590
1994	1st	30,973	0	8,819	9,339	4,024	3,110
1994	2nd	17,790	0	5,236	5,743	2,245	3,110
1994	3rd	14,804	0	3,494	5,737	1,922	3,110
1994	4th	23,775	0	4,095	8,645	4,897	3,110
1995	1st	188,939	0	37,370	26,081	10,566	3,513
1995	2nd	47,765	0	21,400	7,095	3,117	3,513
1995	3rd	17,757	0	3,653	4,036	2,418	3,513
1995	4th	19,223	0	3,366	5,038	2,509	3,513
1996	1st	50,610	0	8,901	17,791	7,013	3,468
1996	2nd	25,802	0	5,269	6,992	16,394	3,468
1996	3rd	22,376	0	4,394	7,185	7,319	3,468
1996	4th	36,010	0	5,365	10,564	5,022	3,468
1997	1st	58,097	0	5,230	11,644	5,096	3,635
1997	2nd	24,577	0	3,287	6,039	16,730	3,635
1997	3rd	22,544	0	3,335	7,029	31,758	3,635
1997	4th	32,330	0	4,596	7,982	6,655	3,635
1998	1st	117,057	365	25,540	27,227	13,598	3,558
1998	2nd	75,610	365	9,009	9,375	6,328	3,558
1998	3rd	29,113	365	4,532	5,213	3,571	3,558
1998	4th	26,851	365	3,720	6,636	3,194	3,558
1999	1st	29,499	1,149	5,785	7,867	3,659	3,720
1999	2nd	28,829	1,149	5,605	8,175	3,326	3,720
1999	3rd	25,987	1,149	5,115	6,305	2,852	3,720
1999	4th	23,731	1,149	5,152	6,250	11,694	3,720
2000	1st	38,014	593	7,203	11,716	11,025	3,583
2000	2nd	27,045	593	6,015	7,644	3,535	3,583
2000	3rd	22,213	593	5,762	6,673	2,797	3,583
2000	4th	26,696	593	5,707	7,330	9,005	3,583

Quarterly Streamflow Inflow for the Streamflow-Routing Package
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Santa Ana River and Riverside Water Quality Control Plant	Western Riverside County Regional Wastewater Treatment Plant	Temescal and Corona Plant No. 1 and No. 2	Cucamonga Creek	Chino Creek and IEUA Carbon Canyon Water Reclamation Facility	IEUA RP#2
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
2001	1st	40,227	553	6,828	17,689	7,836	4,004
2001	2nd	25,072	553	5,797	9,381	3,785	4,004
2001	3rd	22,225	553	5,350	7,855	3,329	4,004
2001	4th	27,648	553	6,237	9,393	4,033	4,004
2002	1st	26,368	595	5,091	8,712	3,409	3,683
2002	2nd	27,798	595	5,598	8,362	3,087	3,683
2002	3rd	22,706	595	5,622	8,253	5,924	3,683
2002	4th	30,670	595	6,262	14,485	5,105	3,683
2003	1st	47,451	602	9,921	20,736	7,096	3,795
2003	2nd	27,131	602	7,245	13,062	3,857	3,795
2003	3rd	23,862	602	5,047	8,663	4,762	3,795
2003	4th	29,140	602	5,758	14,304	7,029	3,795
2004	1st	42,167	705	6,794	18,570	6,231	4,060
2004	2nd	22,535	705	4,526	10,522	5,432	4,060
2004	3rd	20,442	705	3,637	9,249	5,640	4,060
2004	4th	60,350	705	10,673	24,416	9,265	4,060
2005	1st	226,902	880	57,196	54,840	23,288	4,354
2005	2nd	70,223	880	13,824	12,006	1,348	4,354
2005	3rd	35,147	880	7,339	8,911	1,082	4,354

Quarterly Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Areal	Recharge from Mountain Front runoff						Artificial Recharge	
		Recharge	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Ely	8th street
		[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]
1982	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1982	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1982	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1982	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1983	1st	0.000119	0.022826	0.016063	0.016264	0.007308	0.004033	0.002441	0.126737	0.000119
1983	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1983	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1983	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1984	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1984	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1984	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1984	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1985	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1985	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1985	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1985	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1986	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
1986	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1986	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1986	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1987	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1987	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1987	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1987	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1988	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1988	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1988	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1988	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1989	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119

Quarterly Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Areal Recharge	Recharge from Mountain Front runoff						Artificial Recharge	
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Ely	8th street
		[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]
1989	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1989	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1989	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1990	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1990	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1990	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1990	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1991	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
1991	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1991	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1991	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1992	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
1992	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1992	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1992	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1993	1st	0.000119	0.022826	0.016063	0.016264	0.007308	0.004033	0.002441	0.126737	0.000119
1993	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1993	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1993	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1994	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1994	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1994	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1994	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1995	1st	0.000119	0.022826	0.016063	0.016264	0.007308	0.004033	0.002441	0.126737	0.000119
1995	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1995	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1995	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1996	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
1996	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119

Quarterly Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Areal Recharge [ft/day]	Recharge from Mountain Front runoff						Artificial Recharge	
			Zone 1 [ft/day]	Zone 2 [ft/day]	Zone 3 [ft/day]	Zone 4 [ft/day]	Zone 5 [ft/day]	Zone 6 [ft/day]	Ely [ft/day]	8th street [ft/day]
1996	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1996	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1997	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
1997	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1997	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1997	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1998	1st	0.000119	0.022826	0.016063	0.016264	0.007308	0.004033	0.002441	0.126737	0.000119
1998	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1998	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1998	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1999	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1999	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1999	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
1999	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2000	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
2000	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2000	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2000	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2001	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
2001	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2001	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2001	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2002	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2002	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2002	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2002	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2003	1st	0.000119	0.015217	0.010709	0.010843	0.004872	0.002689	0.001627	0.126737	0.000119
2003	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2003	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119

Quarterly Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Areal Recharge	Recharge from Mountain Front runoff						Artificial Recharge	
			Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Ely	8th street
		[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]	[ft/day]
2003	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2004	1st	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2004	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2004	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2004	4th	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2005	1st	0.000119	0.022826	0.016063	0.016264	0.007308	0.004033	0.002441	0.126737	0.000119
2005	2nd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.126737	0.000119
2005	3rd	0.000119	0.007609	0.005354	0.005421	0.002436	0.001344	0.000814	0.000119	0.031232

Table C-3

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow		Outflow	Outflow	Outflow		
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow	Total Inflow	Evapotranspiration	Net Ground Water Pumping	Rising Ground Water	Total Outflow	Change in Ground Water Storage
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1982	1st	7,363	1,927	25,533	34,823	0	13,663	5,825	19,488	15,335
1982	2nd	6,920	1,926	24,320	33,167	5,186	21,253	2,711	29,149	4,017
1982	3rd	7,033	1,926	26,692	35,651	6,124	23,150	1,996	31,269	4,382
1982	4th	5,388	1,926	33,852	41,167	1,950	15,914	3,256	21,119	20,048
1983	1st	7,033	3,057	29,513	39,604	0	13,019	5,158	18,177	21,427
1983	2nd	3,966	1,926	26,292	32,185	5,479	20,255	2,779	28,512	3,673
1983	3rd	4,456	1,926	30,500	36,883	6,530	25,399	2,090	34,019	2,864
1983	4th	3,765	1,926	28,719	34,410	2,089	17,461	3,379	22,929	11,481
1984	1st	3,031	1,926	25,129	30,085	0	14,286	4,580	18,866	11,219
1984	2nd	3,351	1,926	24,839	30,116	5,657	22,225	2,792	30,673	-556
1984	3rd	3,961	1,926	26,309	32,196	6,761	23,007	2,094	31,862	334
1984	4th	3,293	1,925	25,643	30,861	2,158	15,817	3,294	21,270	9,591
1985	1st	2,336	1,926	21,901	26,163	0	12,936	4,360	17,296	8,867
1985	2nd	2,866	1,926	23,370	28,162	5,746	20,133	2,548	28,427	-265
1985	3rd	3,501	1,926	27,043	32,470	6,830	22,842	1,882	31,554	916
1985	4th	2,541	1,926	24,862	29,329	2,192	15,680	3,099	20,971	8,358
1986	1st	1,699	2,493	24,013	28,205	0	12,833	4,254	17,087	11,118
1986	2nd	4,447	1,926	9,871	16,244	5,838	19,972	2,505	28,315	-12,070
1986	3rd	5,059	1,926	19,077	26,062	6,887	24,518	1,841	33,246	-7,184
1986	4th	4,459	1,926	17,424	23,809	2,176	16,873	2,950	22,000	1,810
1987	1st	3,944	1,926	15,702	21,572	0	13,774	3,969	17,743	3,829
1987	2nd	4,873	1,926	16,460	23,259	5,666	21,465	2,280	29,410	-6,151
1987	3rd	5,636	1,926	19,399	26,961	6,639	23,393	1,662	31,694	-4,733
1987	4th	5,061	1,926	17,837	24,825	2,105	16,093	2,780	20,978	3,847

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow		Outflow	Outflow	Outflow		
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow	Total Inflow	Evapotranspiration	Net Ground Water Pumping	Rising Ground Water	Total Outflow	Change in Ground Water Storage
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1988	1st	4,596	1,926	15,473	21,995	0	13,154	3,838	16,993	5,003
1988	2nd	5,503	1,926	12,948	20,376	5,523	20,478	2,202	28,202	-7,826
1988	3rd	6,202	1,926	16,758	24,887	6,439	21,924	1,598	29,961	-5,074
1988	4th	5,602	1,926	15,519	23,047	2,043	15,060	2,647	19,750	3,297
1989	1st	5,010	1,926	9,642	16,578	0	12,351	3,662	16,012	566
1989	2nd	5,673	1,926	12,810	20,409	5,358	19,169	2,073	26,600	-6,191
1989	3rd	6,365	1,926	14,899	23,190	6,212	23,163	1,458	30,833	-7,643
1989	4th	5,753	1,926	15,725	23,405	1,970	15,932	2,440	20,342	3,063
1990	1st	5,101	1,926	13,774	20,801	0	13,039	3,411	16,451	4,350
1990	2nd	5,758	1,926	13,361	21,045	5,223	20,271	1,935	27,429	-6,384
1990	3rd	6,628	1,926	14,991	23,545	6,084	22,452	1,382	29,917	-6,373
1990	4th	6,061	1,926	15,657	23,643	1,933	15,427	2,376	19,736	3,907
1991	1st	5,386	2,491	17,218	25,094	0	12,626	3,382	16,008	9,086
1991	2nd	6,006	1,926	15,312	23,244	5,174	19,651	1,940	26,765	-3,522
1991	3rd	6,286	1,926	16,690	24,901	6,123	23,232	1,433	30,787	-5,886
1991	4th	5,179	1,926	22,544	29,649	1,977	15,955	2,495	20,427	9,222
1992	1st	3,976	2,493	20,960	27,429	0	13,085	3,563	16,648	10,781
1992	2nd	4,325	1,926	20,523	26,775	5,406	20,317	2,064	27,787	-1,012
1992	3rd	5,696	1,926	16,368	23,990	6,380	22,452	1,517	30,349	-6,359
1992	4th	5,893	1,926	13,567	21,387	2,032	13,154	2,583	17,769	3,618
1993	1st	8,604	3,056	3,903	15,562	0	10,170	4,291	14,461	1,102
1993	2nd	7,573	1,926	3,903	13,402	5,347	21,901	2,126	29,373	-15,971
1993	3rd	7,950	1,926	12,695	22,571	6,141	18,618	1,534	26,292	-3,721
1993	4th	8,386	1,926	2,870	13,182	1,908	13,613	2,580	18,101	-4,920
1994	1st	7,750	1,926	14,738	24,415	0	11,203	3,602	14,805	9,610

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow	Total Inflow	Outflow	Outflow	Outflow	Total Outflow	Change in Ground Water Storage
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow		Evapotranspiration	Net Ground Water Pumping	Rising Ground Water		
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
1994	2nd	8,349	1,926	16,276	26,552	4,901	20,156	2,048	27,105	-553
1994	3rd	8,946	1,926	14,463	25,335	5,673	24,633	1,481	31,786	-6,451
1994	4th	8,480	1,926	10,514	20,921	1,798	16,781	2,505	21,084	-163
1995	1st	12,169	3,058	11,433	26,660	0	12,971	4,160	17,130	9,529
1995	2nd	8,237	1,926	15,702	25,865	4,892	22,337	2,043	29,272	-3,407
1995	3rd	8,933	1,926	17,241	28,099	5,634	25,872	1,467	32,973	-4,874
1995	4th	8,466	1,926	11,111	21,504	1,786	16,529	2,489	20,803	700
1996	1st	7,938	2,491	12,534	22,964	0	14,141	3,508	17,649	5,315
1996	2nd	8,216	1,926	14,624	24,766	4,789	19,261	1,995	26,045	-1,279
1996	3rd	8,871	1,926	15,106	25,902	5,634	21,993	1,437	29,063	-3,161
1996	4th	8,418	1,926	11,272	21,616	1,802	16,919	2,440	21,162	455
1997	1st	7,837	2,493	12,328	22,658	0	15,542	3,425	18,967	3,691
1997	2nd	8,085	1,926	13,131	23,143	4,807	19,444	1,928	26,180	-3,037
1997	3rd	8,446	1,926	15,152	25,523	5,677	20,271	1,380	27,328	-1,804
1997	4th	7,718	1,926	12,420	22,064	1,837	16,368	2,369	20,574	1,490
1998	1st	9,897	3,056	13,499	26,451	0	14,118	4,004	18,122	8,329
1998	2nd	7,146	1,926	10,996	20,069	5,076	18,916	1,935	25,927	-5,859
1998	3rd	7,727	1,926	14,440	24,093	5,895	20,845	1,357	28,097	-4,004
1998	4th	7,195	1,926	13,728	22,849	1,876	18,044	2,323	22,243	606
1999	1st	6,637	1,926	13,499	22,062	0	16,896	3,267	20,163	1,899
1999	2nd	7,257	1,926	13,522	22,704	4,915	18,825	1,798	25,537	-2,833
1999	3rd	7,798	1,926	14,027	23,751	5,762	20,133	1,260	27,156	-3,404
1999	4th	7,241	1,926	11,731	20,898	1,860	17,424	2,227	21,511	-613
2000	1st	6,543	2,493	13,407	22,443	0	16,070	3,182	19,252	3,191
2000	2nd	7,300	1,926	13,039	22,266	4,844	19,605	1,740	26,189	-3,923

Quarterly Ground Water Budgets for the City of Chino Hills Model
Transient Model Calibration January 1982 - September 2005

Year	Qtr	Inflow	Inflow	Inflow		Outflow	Outflow	Outflow		
		Recharge from Streamflow	Areal Recharge, Recharge from Mountain Front Runoff and Artificial Recharge	Underflow Inflow	Total Inflow	Evapotranspiration	Net Ground Water Pumping	Rising Ground Water	Total Outflow	Change in Ground Water Storage
		[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]	[acre-ft]
2000	3rd	7,916	1,926	13,522	23,363	5,624	23,600	1,214	30,438	-7,075
2000	4th	7,477	1,926	12,810	22,213	1,791	19,628	2,156	23,574	-1,361
2001	1st	6,837	2,491	12,603	21,931	0	16,185	3,104	19,288	2,642
2001	2nd	7,585	1,926	14,669	24,180	4,637	24,449	1,676	30,762	-6,582
2001	3rd	8,526	1,926	9,711	20,163	5,280	25,230	1,159	31,669	-11,506
2001	4th	8,349	1,926	10,560	20,836	1,676	19,238	2,087	23,000	-2,165
2002	1st	7,870	1,926	10,331	20,126	0	18,549	3,017	21,566	-1,439
2002	2nd	8,299	1,926	12,856	23,081	4,293	23,301	1,605	29,199	-6,118
2002	3rd	9,233	1,926	8,724	19,883	4,890	26,905	1,107	32,902	-13,019
2002	4th	8,921	1,926	12,167	23,014	1,538	20,684	2,002	24,224	-1,210
2003	1st	8,542	2,491	8,264	19,298	0	17,769	2,932	20,700	-1,403
2003	2nd	8,848	1,926	13,085	23,859	4,063	21,166	1,556	26,786	-2,927
2003	3rd	9,447	1,926	13,545	24,917	4,614	29,385	1,067	35,067	-10,149
2003	4th	9,236	1,926	8,953	20,115	1,469	21,212	1,935	24,617	-4,502
2004	1st	8,882	1,926	13,085	23,893	0	17,906	2,849	20,755	3,138
2004	2nd	9,279	1,926	12,626	23,831	3,811	23,691	1,497	28,999	-5,168
2004	3rd	9,759	1,926	11,938	23,623	4,316	29,155	1,024	34,495	-10,872
2004	4th	9,454	1,926	11,019	22,399	1,377	17,034	1,889	20,301	2,098
2005	1st	14,582	3,058	9,412	27,052	0	13,567	3,506	17,073	9,979
2005	2nd	9,180	1,926	9,871	20,978	3,949	20,615	1,561	26,125	-5,147
2005	3rd	9,685	1,490	14,692	25,868	4,385	23,026	1,033	28,444	-2,576
Quarterly Average		**6,832**	**2,029**	**15,756**	**24,616**	**3,205**	**18,850**	**2,463**	**24,517**	**98**
Annual Average		**27,326**	**8,115**	**63,023**	**98,464**	**12,819**	**75,400**	**9,851**	**98,070**	**394**

EXHIBIT B

Janine Wilson

From: Elizabeth M. Calciano [ecalciano@localgovlaw.com]

Sent: Friday, September 21, 2007 1:52 PM

To: Anne Schneider; Joe Scalmanini; sslater@hatchparent.com; mwildermuth@wildermuthenvironmental.com

Cc: dwilliams@geoscience-water.com; Georgina King; Ron Craig; Mark Hensley; John C. Cotti; Janine Wilson

Subject: Dr. Williams/Geoscience Report

Dr. Williams of Geoscience Support Services, Inc. is delivering his report to Watermaster today for filing with the court and serving on all parties through the FTP website. Because it is a large document, for convenience we are also providing a disc that contains the same information via overnight mail to each of you.

Elizabeth M. Calciano
Deputy City Attorney
City of Chino Hills

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<u>CHINO BASIN WATERMASTER</u>
Case No. RCV 51010
Chino Basin Municipal Water District v. The City of Chino

PROOF OF SERVICE

I declare that:

I am employed in the County of San Bernardino, California. I am over the age of 18 years and not a party to the within action. My business address is Chino Basin Watermaster, 9641 San Bernardino Road, Rancho Cucamonga, California 91730; telephone (909) 484-3888.

On September 25, 2007, I served the following:

1) **TRANSMITTAL OF DENNIS WILLIAMS' COMMENTS ON WATERMASTER'S LONG TERM PLAN**

/_x_/ BY MAIL: in said cause, by placing a true copy thereof enclosed with postage thereon fully prepaid, for delivery by United States Postal Service mail at Rancho Cucamonga, California, addresses as follows:
See attached service list: Mailing List 1

/___/ BY PERSONAL SERVICE: I caused such envelope to be delivered by hand to the addressee.

/___/ BY FACSIMILE: I transmitted said document by fax transmission from (909) 484-3890 to the fax number(s) indicated. The transmission was reported as complete on the transmission report, which was properly issued by the transmitting fax machine.

/_x_/ BY ELECTRONIC MAIL: I transmitted notice of availability of electronic documents by electronic transmission to the email address indicated. The transmission was reported as complete on the transmission report, which was properly issued by the transmitting electronic mail device.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on September 25, 2007 in Rancho Cucamonga, California.

Janine Wilson

JANINE WILSON
Chino Basin Watermaster

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