SANTA PAULA BASIN PUMPING TREND EFFECTS AND ASSESSMENT

United Water Conservation District
Open-File Report 2010-003
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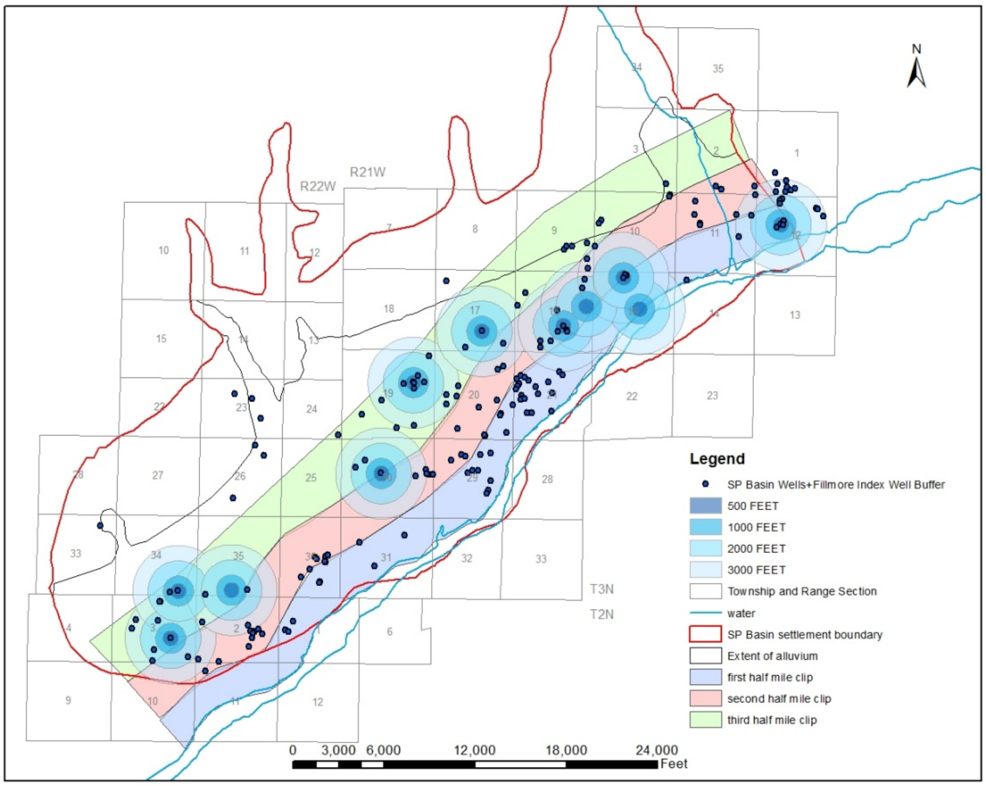

THIS REPORT IS PRELIMINARY AND IS SUBJECT TO MODIFICATION BASED UPON FUTURE ANALYSIS AND EVALUATION

PREPARED BY

GROUNDWATER DEPARTMENT

UNITED WATER CONSERVATION DISTRICT

UWCD OFR 2010-003

SANTA PAULA BASIN PUMPING TREND EFFECTS AND ASSESSMENT

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UWCD OPEN-FILE REPORT 2010-003

EXECUTIVE SUMMARY / ABSTRACT

United Water Conservation District performed an evaluation of the pumping trends in the Santa Paula Basin. It was recognized in a report for the City of San Buenaventura (Hopkins, 2010) that water level declines may have occurred in index wells within the Santa Paula Basin as a result of shifted pumping activities. The Hopkins report questioned if pumping activities have migrated away from the Santa Clara River; and, if increased pumping has occurred in index wells and other proximate wells.

This investigation was conducted by using pumpage data from all of the wells within the Santa Paula Basin from 1980 to 2009. The evaluation included six different approaches to assess the data regarding any possible shift in pumping or increase in pumping related to location or depth within the basin. This investigation included an analysis of total pumpage by location within the entire basin, a basin wide analysis of pumping from several different perforated intervals at various depths, an analysis of pumpage within segregated polygon strips dividing the basin into sections, an analysis of pumping by perforation depth within each polygon strip, an analysis of pumpage within four different radii surrounding eleven index wells within the basin (including the index wells), and an analysis of the highest pumping magnitude location(s) over time. The data indicates that no increased pumping or significant shift in pumping has occurred within the Santa Paula Basin. Although total pumpage within the basin differs from year to year, with a few exceptions the relative pumping from well to well has remained very similar.

1 INTRODUCTION

United Water Conservation District (United Water) is a public agency within Ventura County, California that is charged with conserving the water of the Santa Clara Rivers and tributaries. United Water works to manage the surface water and groundwater resources within seven groundwater basins including the Santa Paula Basin. Figure 1-1 is a location map showing all of the basins including the Santa Paula Basin. Recent interpretation (United Water Conservation District, 2009) has indicated that there is a long term gradual decline in groundwater levels in the Santa Paula Basin, and that the current pumping patterns may be greater than the sustainable yield of the basin. These conclusions have caused a review of available pumping and other data which are related to the basin conditions. Data from 1980 to 2009 were reviewed.

A recent study identified (Hopkins, 2010) that water level declines in several index wells (and other wells) within the Santa Paula Basin could be effected by a shift in pumping activities over time. The potential effect could occur if pumping activities migrated away from the shallow alluvium along the Santa Clara River, and were transferred to deeper more confined aquifer zones, or if pumping had increased in the index wells or other wells in the vicinity of the index wells. The index wells are used to calculate annual changes in groundwater storage. They were chosen due to their length of record and location within the basin. In addition, Hopkins (2010) suggests that the trend in the basin was that new wells were perforated at greater depths.

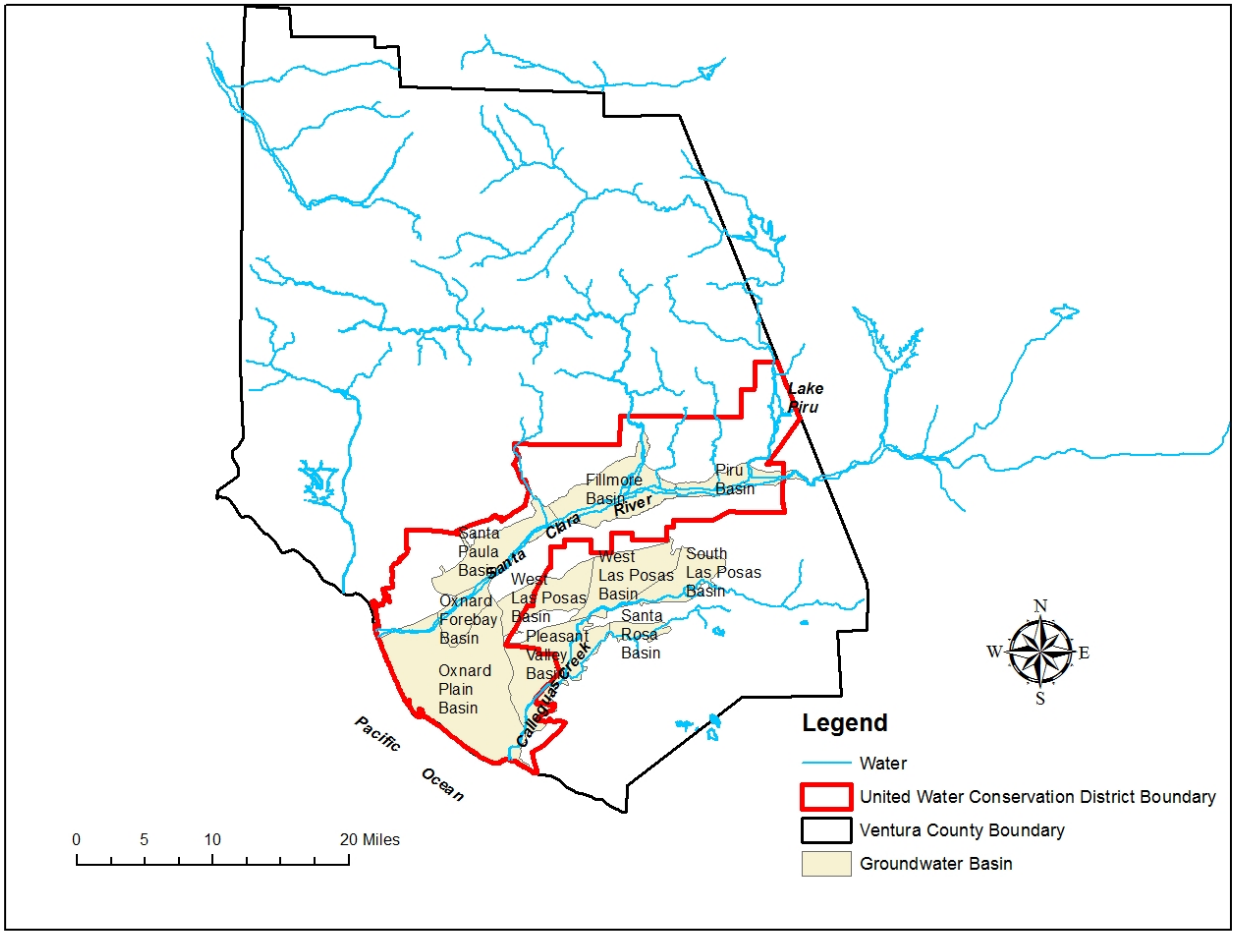

Figure 1-1: Location Map of the Santa Paula Basin with respect to the other six basins and United Water Conservation District.

The objective of this study is to look at basin pumping trends from 1980 through 2009 to see if increased pumping activity has occurred in the vicinity of the index wells in the basin. This was achieved, first of all, by assessing the magnitude and depth of reported pumping across the entire basin over time. The location of the actual pumping over time for all wells in the basin was assessed. This was achieved by six different methods described later in this report. In addition, pumpage in the vicinity of each index well was assessed at four different radii (500 feet, 1000 feet, 2000 feet, and 3000 feet). The data analysis was conducted utilizing the United Water Geographical Information System (GIS) database.

1.1 GEOLOGY/HYDROGEOLOGY OF SANTA PAULA BASIN

The Santa Paula Basin is located within the valley of the Santa Clara River. Figure 1-2 is a geology map of the Santa Paula Basin. The basin is bounded by the Sulphur Mountain foothills on the northwest and South Mountain on the southeast. The basin is elongated in a northeast-southwest orientation. It is approximately 10 miles long and 3.5 miles wide. The surface area of 13,000 acres ranges in elevation from 130 above sea level (near Saticoy) to 270 feet above sea level near the City of Santa Paula. Plio-Pleistocene sediments are approximately 10,000 feet thick in the basin. The fresh water-bearing strata are: the Pleistocene Santa Barbara, Saugus, and San Pedro Formations; overlying river deposits of the Santa Clara River; alluvial fan deposits; and recent river and stream deposits.

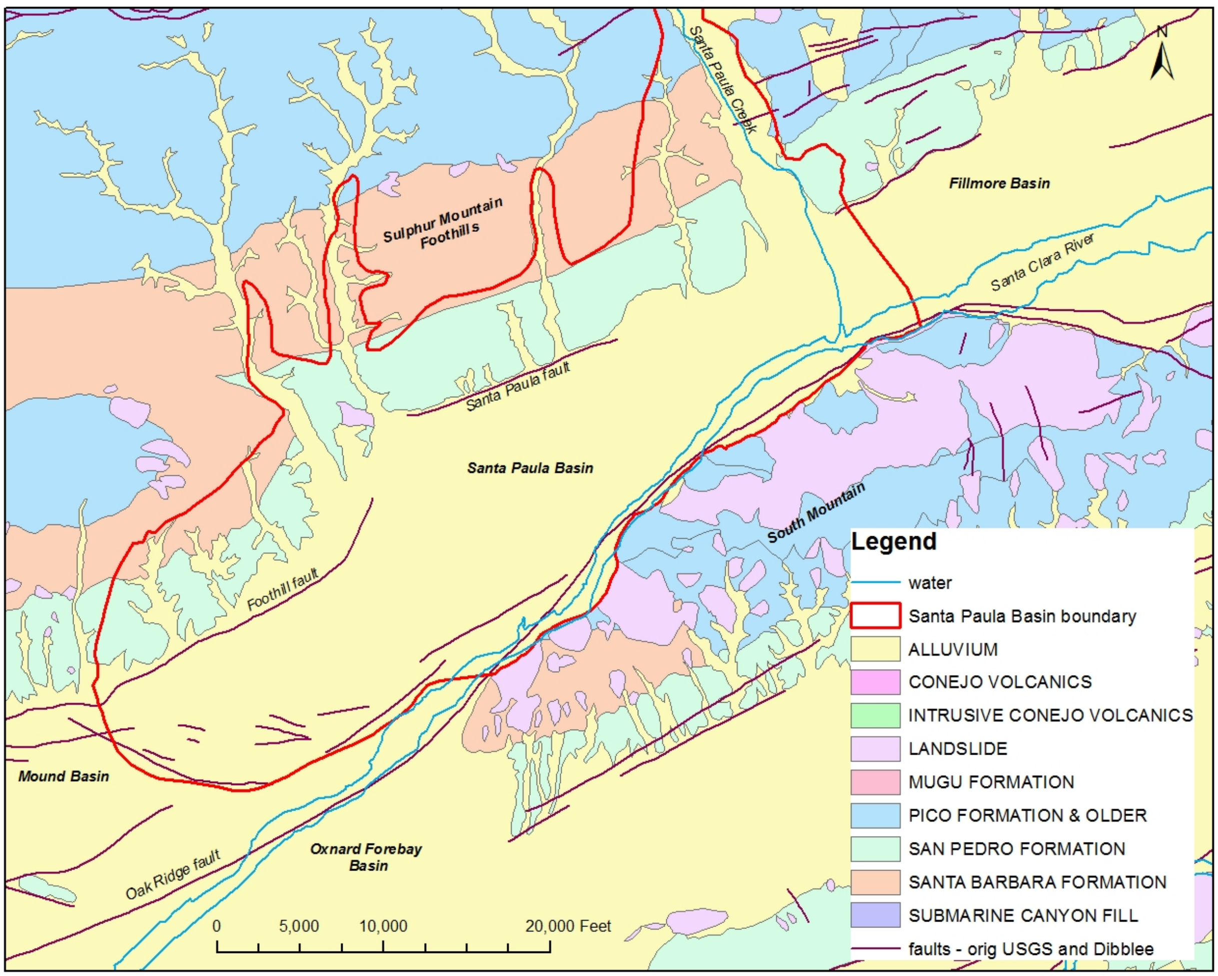

Figure 1-2: Geology Map of Santa Paula Basin.

The basin sediments have been warped into a syncline that is oriented in a northeast-southwest direction. To the east, the Santa Paula Basin is considered to be in hydraulic connection with the Fillmore Basin. To the south, the Oak Ridge fault forms a partial barrier to groundwater movement. On the north, a portion of the aquifer represented by the San Pedro Formation is exposed in an outcrop along the Sulphur Mountain foothills. The Santa Paula basin borders the Oxnard Forebay and Mound basins on the west. The western boundary of the Santa Paula basin is more complex, with local uplift, artesian conditions, and faults mapped by some investigators. Although there is general agreement that there is some hydraulic connection between Santa Paula basin and the Mound Basin, the degree of connection is uncertain. Additional aquifer testing, geophysical, water chemistry, and groundwater level data may be necessary to adequately define the subsurface flow between Santa Paula Basin and the adjacent Mound and Oxnard Forebay basins.

Hydrogen and oxygen isotope data, and other recorded data, indicate that the Santa Paula Basin receives recharge from the Santa Clara River, by rainfall percolation through the San Pedro Formation outcrops that are exposed along the foothills to the north, and by percolation of streams crossing these sediments. Other sources of recharge are by percolation into the recent alluvium of Santa Paula Creek and other tributaries, and underflow from the Fillmore Basin. Recharge from the Santa Clara River is primarily limited to reaches north of the Oak Ridge fault. The Santa Clara River flows north of the fault in an approximately two-mile stretch just south of the City of Santa Paula. Recharge is especially evidenced in hydrographs for wells in the eastern half of the basin which show full recovery from the record low groundwater levels recorded during the 1984 to 1991 drought. Where the river flows south of the Oakridge fault, it overlies a relatively lower permeability Santa Barbara Formation, resulting in less recharge in the central and western portion of the basin. In the western portion of the basin the groundwater gradient indicates groundwater is flowing out of the basin back into the river alluvium and the Oxnard Forebay and the Mound Basin. In general, inflow from the Fillmore Basin (United Water, 2011), along with streambed recharge from the Santa Clara River and Santa Paula Creek appear to be the dominant recharge mechanisms for the basin.

Groundwater levels in the majority of wells throughout the basin show significant seasonal variability. During high rainfall years, monitoring wells in the western portion of the basin just northwest of the Freeman Diversion have shown artesian flow. Groundwater flow is generally east to west.

2 OBJECTIVE AND TECHNICAL APPROACH

The objective of this study is to assess the spatial and temporal pumping trends within the Santa Paula Basin. The technical approach for this study was designed to assess localized increases in pumping over the time of the study period 1980 to 2009 or the shifting of pumping (laterally and vertically) within specific areas of the basin, especially for areas surrounding the index wells. The objectives were achieved in the following ways:

- Maps were made for the Santa Paula Basin showing pumping magnitude and the location of each pumping well for each year from 1980 through 2009. The maps were then inspected and compared for any observable changes in the pumping magnitude and location. Maps were also prepared to show when the wells were drilled within the basin (and their bottom perforation depth) from 1903 to 2010. These were used to augment the pumpage maps.

- An analysis of pumping by perforation depth was also performed for the Santa Paula Basin wells. This was first performed for the entire basin.

- Pumping quantities were tabulated for a series of three zones oriented parallel to the Santa Clara River. Each strip was 0.5 miles wide and extended the length of the basin. The first strip was positioned directly adjacent to the north bank of the river. The subsequent strips were positioned adjacent to each other in a consecutive northwest direction away from the river. The total pumpage from all the wells within each strip was calculated in the GIS. Graphs of total pumpage over time were constructed for each strip (from 1980 to 2009) and compared to identify shifts, if any, in pumping moving away from the Santa Clara River with time.

- An analysis of pumping by perforation depth for Santa Paula Basin wells was also performed within each of the three strips described in the previous bullet.

- The amount of pumpage over time was tallied for all wells within a 500 foot, 1,000 foot, 2,000 foot, and 3,000 foot radius around each of the eleven index wells. This was done for all of the radii for all index wells for each year from 1980 through 2009. These graphs were then used for interpreting pumpage increases or decreases around and including each index well over time. The pumping of the index well itself was also considered.

- Pumping "centroid buffer" maps were also prepared for Santa Paula Basin wells. This indicates the location(s) where the highest magnitude of pumping occurred within the basin for the given map year.

3 STUDY RESULTS

All of the maps and graphs described above are included in the Appendix A through Appendix G of this report or are included as figures within the report. A discussion regarding the characteristics of the maps and data are included in this section. References will be made to the various appendices and specific maps or graphs. Prior to discussing the graphs, background information on rainfall from 1980 to 2009 is included in Figure 3-1. Although rainfall data for the Santa Paula Basin is included on the graphs in Section 3.2, the following graph can be used as reference for the other sections, which have water level information included on the graphs instead.

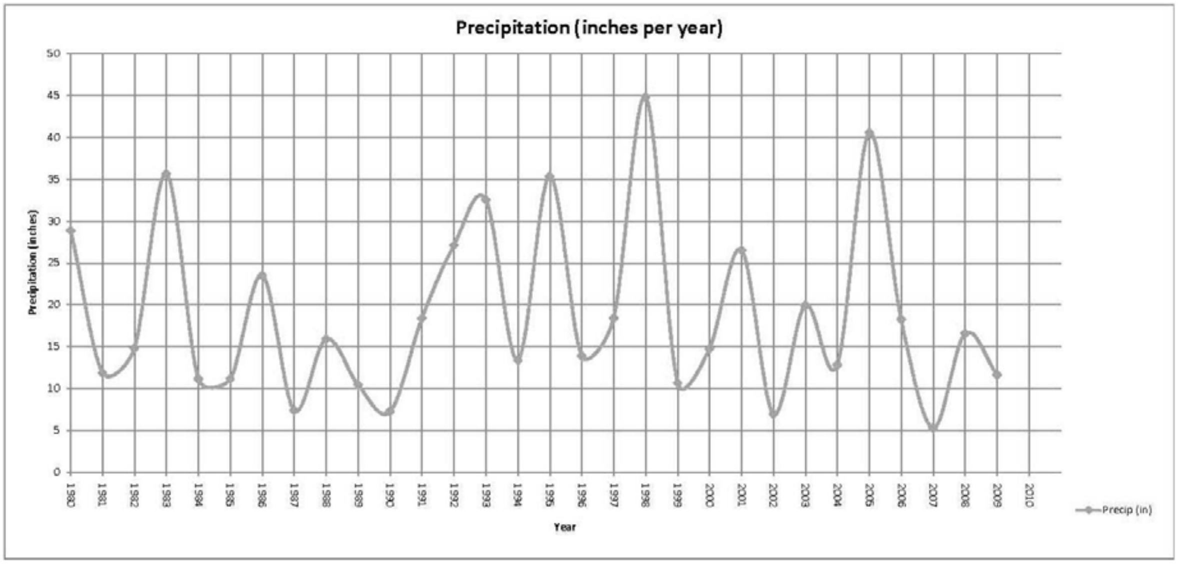

Figure 3-1: Precipitation in the Santa Paula Basin (inches per year) from 1980 through 2009.

3.1 SANTA PAULA BASIN OVERALL PUMPAGE AND BASIN WIDE PUMPAGE BY PERFORATION DEPTH

Appendix A includes Pumpage Maps of the Santa Paula Basin showing the location of all active wells and their associated magnitude of pumping on a year-to-year basis. The pertinent rainfall for a given map and the total pumpage for the entire Santa Paula Basin are also indicated for each year.

Visual inspection of the pumpage maps from 1980 through 2009 indicates that there is insignificant change in the pumping pattern throughout the Santa Paula Basin. The maps are very much alike from year to year. There are slight variations in the pumping patterns; however, for the most part all of the maps are very similar. The maps show when wells were added at various locations. Although the total pumpage varied from year to year within the basin, the locations and magnitude of pumping for the majority of the wells are similar relative to each other.

One factor that could affect pumping location is the agricultural distribution systems within the basin. However, pumpage across the basin is generally consistent. Through the years no obvious concentrated pumping area has emerged from the data. However, there have been discussions of pumping from the eastern portion of the basin, which is a recharge area, and using the distribution systems to move the water. This has not happened and presently there is no plan to do this.

Appendix B contains maps depicting the locations of wells that were drilled since 1903 and their depth to the lowest perforation interval. The maps are in ten-year increments. These data were included to add perspective to the development of the well fields in the Santa Paula basin. Table 3-1 displays a frequency histogram of well depth since 1903. In general from 1903 until 1945 twentyeight (28) wells were drilled (0.7 per year). Of the 28 wells that were drilled only 1 (3.5 percent) was perforated at a depth greater than 400 feet. The remaining 27 wells were perforated at depths less than 400 feet. From 1946 to present 142 wells were drilled (2.2 wells per year). This is not surprising due to the cessation of World War II. It was a time of economic and developmental growth. It was also a period of drought in the valley basins. Of the 142 wells that were drilled after 1946, 51 (35.9 percent) were drilled and perforated below 400 feet. Therefore, from 1903 to present a total of 52 wells were perforated below 400 feet out of a total 170 wells (30.5 percent).

Perforation depths were tabulated for wells drilled since 1903 (Table 3-1). This table shows the frequency of the complete depths over time.

Table 3-1: Frequency of Well Depth since 1903

Depth of Deepest Perforation	1903-1915	1916-1925	1926-1935	1936-1945	1946-1955	1956-1965	1966-1975	1976-1985	1986-1995	1996-2005	2006-2010
1 - 150		1	1	3		6	10	10	2		
151 - 400	3	9	6	4	14	6	10	12	11	5	5
401 - 600	1				4	5	5	4	5	3	
601 - 800					2	3	4	4	3	1	1
801 - 1600						1	1		2	3	
Total # of Wells	4	10	7	7	20	21	30	30	23	12	6

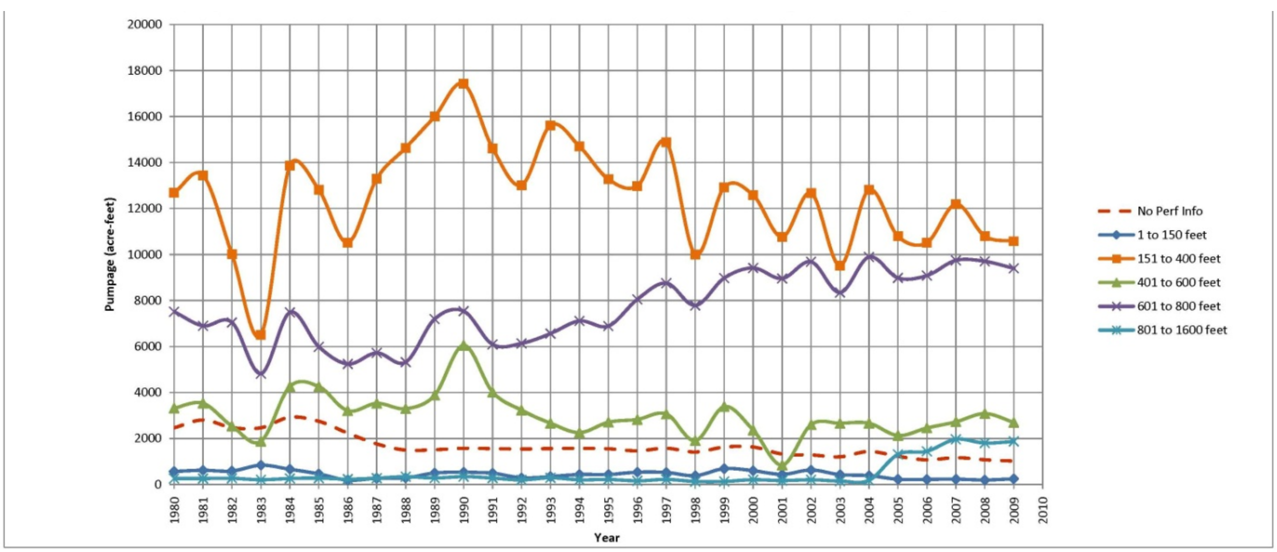

Figure 3-2: Graph of Pumpage versus Time (year) for Five Perforated Intervals in all Santa Paula Basin Reported Pumping Wells.

Figure 3-2 shows that pumpage from the 151 to 400 feet perforated interval has decreased significantly from 1990 to 2009. Pumpage decreased approximately 6,500 acre-feet during that period (approximately 224 acre-feet/year). During the same period pumpage from the 601 to 800 feet perforated interval has increased by approximately 4,000 acre-feet (129 acre-feet/year). The only other increase in pumping is exhibited for the 801 to 1600 feet perforated interval. It has increased approximately 1,500 acre-feet from 2004 to 2009. The 0 to 150 feet perforated interval, and the 401 to 600 feet perforated interval, generally show a “flat” graph with no sustained increase or decrease in pumping from 1979 through 2009 (other than yearly changes due to rainfall). The data from Figure 3-2 suggest a shift towards pumping at deeper perforation depths in some wells within the Santa Paula Basin from the 1990’s to the present. However, the decrease in pumping the from the 151 to 400 perforation interval is slightly greater than the increase in pumping from the 601 to 800 feet and 801 to 1600 feet perforation intervals. While, the net overall actual pumping amount (acre-feet) does not significantly increase from 1990 to 2009 there has been a shift of some pumping from shallower to deeper zones. The locations of the wells that are characterized by increased pumping at a deeper level will be discussed later in this report.

All but one well out of the eleven index wells used for further analysis in this study are perforated in the two shallowest zones (0 to 150 feet and 151 to 400 feet). The other well is perforated between the 401 to 600 feet and 601 to 800 feet depth (Section 3.3). It is completed between two intervals. The downward trend in pumping from the 151 to 400 feet perforation interval is coupled by a long term gradual decline in groundwater levels in the Santa Paula Basin (including the index wells). Therefore, the current pumping patterns may be greater than the sustainable yield of the basin.

Figure 3-3 is a location map of the Santa Paula Basin wells and their bottom perforation. Wells with the shallowest perforation interval (0 – 150 ft) are mostly clustered and adjacent to the Santa Clara River. Wells that have the remaining perforation depth intervals are widely distributed throughout the basin (no significant zones of concentration). Wells in the 601 to 800 ft perforation interval (18 wells) are spread out within the basin and show no preferred concentration. Nine of the wells are on the southeast half of the basin and nine are located in the northwest half of the basin.

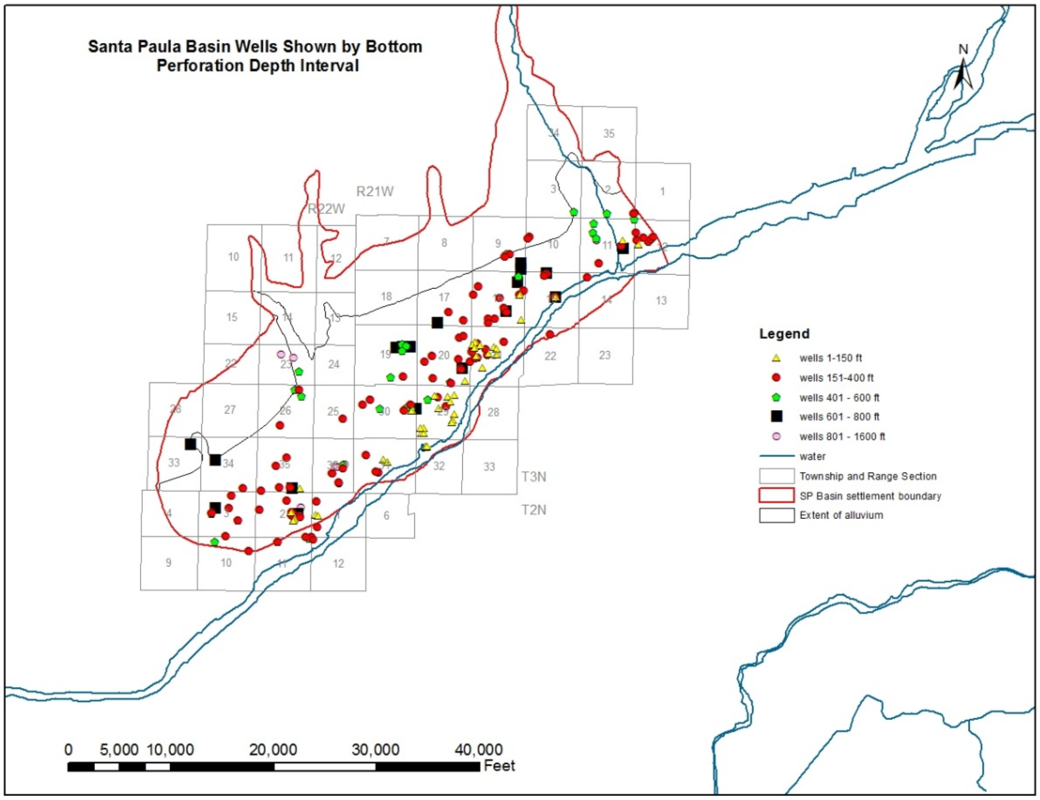

Figure 3-3: Map of Bottom Perforation Depths for Wells in the Santa Paula Basin.

3.2 PUMPAGE LOCATION ASSESSMENT USING POLYGON STRIPS

Appendix C contains graphs of pumpage over time for each of the three zones constructed parallel to the river. Figure 3-4 is a map of Santa Paula Basin showing the three strips used for analysis of pumping within the basin. The "active" wells within the basin are superimposed on the three strips. Strip 1 is 0.5 miles wide and located directly adjacent to the north bank of the river (blue). Strip 2 is directly adjacent to Strip 1 on the northwest side (red) 0.5 to 1.0 miles from the Santa Clara River. Strip 3 (1.0 to 1.5 miles from the Santa Clara River) is adjacent to Strip 2 on the northwest side and occupies the northwest side of the basin/well field (green). United's GIS was used to construct the strips and tally the total pumpage for all wells within each strip over time.

Eight wells are shown to be outside of the strips on the northwest side of the valley outside or near the alluvium boundary. Pumpage from these wells account for 0.7 percent to 3.3 percent of the yearly pumpage for the Santa Paula Basin. Because these wells are significantly separated from the main part of the alluvial basin, and their pumping percent is insignificant compared to the total pumping of the basin, they were not used in the following analysis.

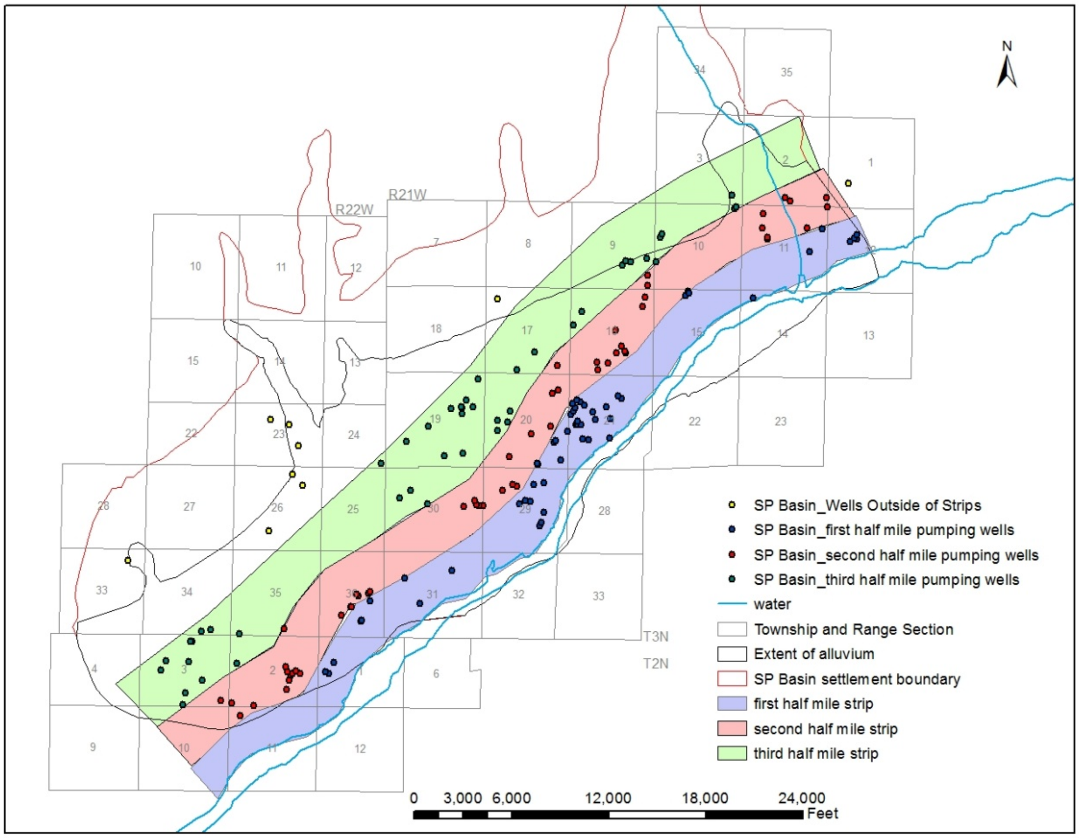

Figure 3-4: Strips used for pumpage analysis in Santa Paula basin. 2009 active basin wells are also shown.

Appendix C contains the results of these analyses. Graphs of total pumpage within each strip versus time were constructed. Total pumpage from all wells within each strip versus time, as well as rainfall (1980 through 2009), are shown. On each graph, pumpage has a strong opposite correlation with precipitation. Years with lower rainfall were characterized by increased pumping and years with higher rainfall typically show decreased pumping.

Strip 1 pumpage ranges from approximately 4,000 acre-feet to approximately 10,200 acre-feet (drought year) per year. However most values are clustered around 8,000 acre-feet. The overall trend of the pumpage data over time, especially after 1991, is generally flat or only slightly decreasing. There is no marked cumulative increase or decrease in pumping over periods of time, except for year-to-year variations which correlate with rainfall. There appears to have been no significant increase or decrease in pumping within Strip 1 from 1980 to 2009. In fact, in 1980 approximately 8,000 acre-feet were pumped and in 2009 approximately 8,300 acre-feet were pumped within one-half mile of the Santa Clara River. 1980 was a significantly wetter year for precipitation.

Strip 2 pumpage ranges from approximately 8,000 acre-feet to approximately 14,800 acre-feet per year. However most values are clustered around 11,000 acre-feet. Like Strip 1, the overall trend of the pumpage data over time is flat. There appears to be no marked cumulative increase or decrease in pumping over periods of time except for year to year variations which correlate with rainfall. There appears to have been no significant increase or decrease in pumping within Strip 2 from 1980 to 2009. In 1980, approximately 13,000 acre-feet were pumped and in 2009 approximately 11,000 acre-feet were pumped.

Strip 3 pumpage ranges from approximately 4,500 acre-feet to approximately 7,500 acre-feet per year. However most values are clustered around 6,000 acre-feet. Like Strip 1 and Strip 2, the overall trend of the pumpage data over time is flat. There appears to be no marked cumulative increase or decrease in pumping over periods of time except for year-to-year variations which correlate with rainfall. Again, on this northwest side of the basin/well field (where most index wells are located), there appears to have been no significant increase or decrease in pumping from 1980 to 2009. In 1980 approximately 5,600 acre-feet were pumped from Strip 3, and in 2009 approximately 5,800 acre-feet were pumped.

The data would suggest that there is essentially no increase in pumping from wells, within any of the three strips, going from near the river to the northwest boundary of the basin from 1980 to 2009. Pumpage data for each of the three strips used to analyze pumping location over time are generally flat, showing no significant increase within all 3 strips. Appendix C also contains a pumpage trend graph for all three strips added together (all Santa Paula Basin). The trend for that graph is also very flat and shows no increasing or decreasing trend in pumping over time.

Figure 3-5 summarizes the pumpage for all three strips. In addition, calculated trend lines are superimposed on each graph for Strips 1 through 3. The trend lines do not show a significant increase in pumping for each curve from 1980 through 2009. The trend line pumpage for Strip 3 is flat. The trend line pumpage for Strip 2 shows a slight decrease in pumping. The trend line pumpage for Strip 1 shows a slight increase in pumping. Note that the year to year variations (increases and decreases) correlate between the curves for all strips. This is due to year to year precipitation changes. Strip 1 (adjacent to the river) shows the only (yet insignificant) increase in pumping. Strip 2 and 3 show a decrease and no change in pumping, respectively. Therefore, there is no evidence that pumping has increased in a direction away from the river.

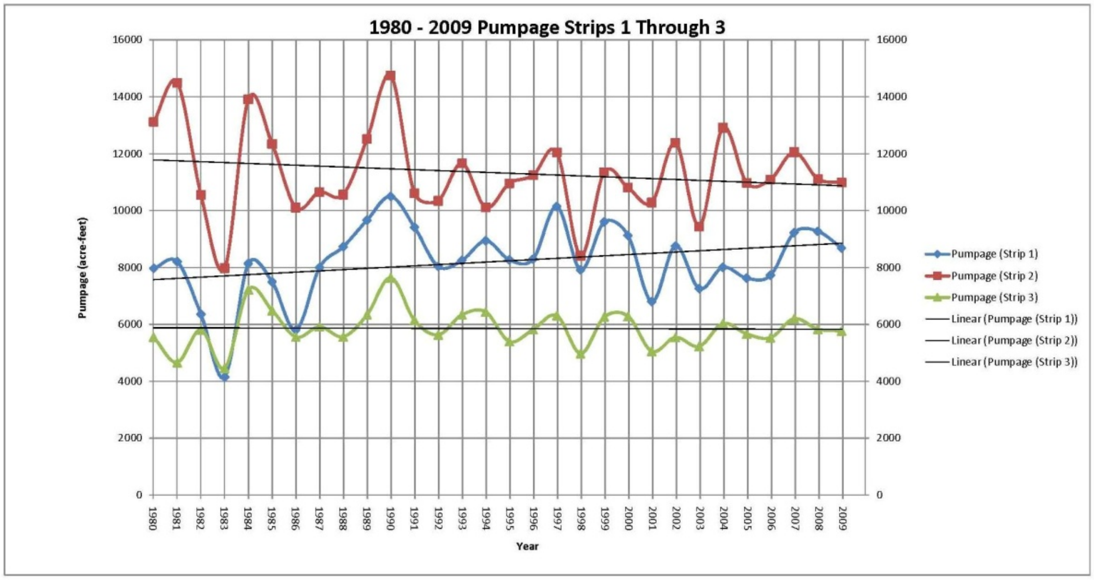

Figure 3-5: Pumpage for Strip1, Strip 2, and Strip 3 1980 through 2009.

3.2.1 VERTICAL DISTRIBUTION OF PUMPING BY PERFORATION DEPTH WITHIN EACH POLYGON STRIP

Figure 3-2 shows the yearly pumpage of wells grouped into five different perforation depths in the Santa Paula Basin. This section presents the same analysis conducted within each of the three polygon strips (Strip1, 2, and 3). Pumpage data per year is presented for each of the five perforation depth intervals for each polygon strip. The results are shown in Figures 3-6, 3-7, and 3-8.

Figure 3-6 shows the results for Strip 1, which is located adjacent to the Santa Clara River. Figure 3-6 indicates that most of the pumpage is from the 151 to 400 foot interval. Yearly pumpage ranges between 3,500 acre-feet to 10,000 acre-feet per year for this interval. There is a definite trend in the data. For the 151 to 400 foot interval pumpage shows a general increasing trend from 1980 to 1990 where it reaches a maximum. From 1990 to 2009 the same perforation interval shows a decreasing trend in pumpage. It decreases from 10,000 acre-feet in 1990 to approximately 5,150 acre-feet in 2009. During that same time period (1990 to 2009) pumpage shows an increase for the perforation interval from 601 to 800 feet. Pumpage for that interval ranges from close to zero in 1990 to 2,000 acre-feet in 1995. From 1995 to 2009 pumpage for the 601 to 800 feet interval maintains pumpage between 2,000 and 2,500 acre-feet per year. This decrease in pumpage from the 151 to 400 feet perforation interval and increase in pumpage from the 601 to 800 feet perforation interval is also reflected in Figure 3-2 (same graph but for the entire Santa Paula Basin). The described pumping patterns on Figure 3-6 from the two perforation intervals discussed are likely the cause for the same or similar pattern shown on Figure 3-2. The other three perforation intervals indicate much lower pumpage on Figure 3-6 (mostly well less than 500 acre-feet). However, there is an increase in pumping from close to zero (2004) to approximately 800 acre-feet

(2009) for the perforation interval between 801 to 1600 feet bgs. There is also an increase from close to zero (2007) to approximately 700 acre-feet (2009) for the 401 to 600 feet depth interval.

In short, for Strip 1 pumping decreased approximately 5,000 acre-feet in the 151 to 400 feet depth interval from 1990 to 2009 and during that same time period pumping increased approximately 2,200 acre feet from the 601 to 800 feet bgs perforation interval.

In addition to the known perforation intervals, wells with no perforation information (17 percent of all Santa Paula Basin wells) also show a flat trend for pumpage from 1980 to 2009. During that period pumpage for wells with no perforation information is very low (approximately 100 acre-feet per year).

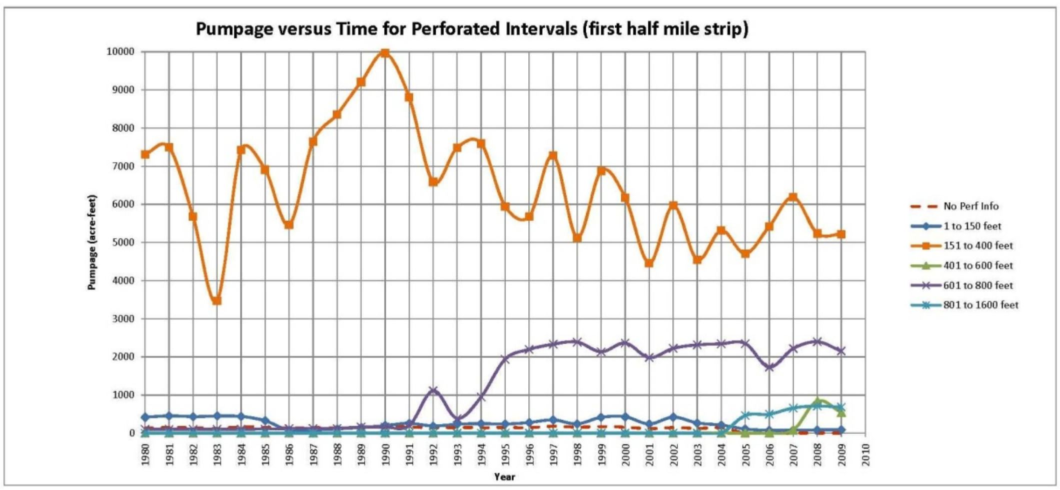

Figure 3-6: Pumpage versus Time (year) for Five Perforated Intervals in Strip 1 Santa Paula Basin Wells.

Figure 3-7 shows the pumpage results over time for Strip 2, which is located within the second half mile from the Santa Clara River. Figure 3-7 indicates that most of the pumpage is from the 151 to 400 foot interval and from the 601 to 800 foot perforation interval. Yearly pumpage ranges mostly between 3,000 acre-feet and 6,000 acre-feet per year for both of those perforation intervals. However, except for year to year variations in pumpage as expected, the graphs for these two intervals generally show a flat trend from 1980 to 2009. There appears to be no increasing trend in pumping for these two perforation intervals within Strip 2. The next highest pumpage is from the perforation interval from 401 to 600 feet bgs. For that interval pumpage ranges between approximately 500 acre-feet to 4,200 acre-feet per year showing high variability. However, there is a trend in the data. Pumpage from the 401 to 600 foot interval shows a decreasing trend from 1990 (4,200 acre-feet) to 2009 (1,300 acre-feet).

Another trend is shown or the 801 to 1600 feet perforation interval. This perforation interval shows pumpage very close to zero from 1980 to 2004. From 2004 to 2009 it shows an increase to 1,000 acre-feet. The perforation interval from 1 to 150 feet bgs shows very little pumping from 1980 to 2009. Pumpage in that perforation interval is less than 500 acre-feet per year.

In general, pumpage over time for the 151 to 400 feet and 601 to 800 feet intervals is flat for Strip 2 and shows no increase from 1980 to 2009. Pumpage from the 401 to 600 feet interval or Strip 2 shows a definite decrease in pumping from 1990 to 2009. Pumpage from the 1 to 150 feet perforation interval is flat and low magnitude from 1980 to 2009. The only increase is a slight increase in pumping from the 801 to 1600 feet perforation interval from 2004 to 2009. However, even at its maximum the magnitude of pumping from the 801 to 1600 feet perforation interval is much less than pumpage from the three main intervals (151 to 400 feet bgs, 401 to 600 feet bgs, and 601 to 800 feet bgs). There appears to be no major increase (shift) in pumping overall for Strip 2. There is an increase in pumping from the 801 to 1600 feet interval from 2004 to 2009 but the increase is about 1,000 acre-feet out of 13,100 acre-feet overall (~7.5% increase). Pumping from the 401 to 600 feet interval decreased to about 1,200 acre-feet per year (2009) from a high of about 4,200 acre-feet per year in 1990 (~22.9% decrease).

In addition to the know perforation intervals, wells with no perforation information (17 percent of all Santa Paula Basin wells) show pumpage values at approximately 1,000 acre-feet per year from 1980 to 1984. They show a decrease in pumpage from 1,000 acre-feet to essentially zero from 1984 to 1988. From 1988 through 2009 wells without perforation information are flat and show essentially zero pumping.

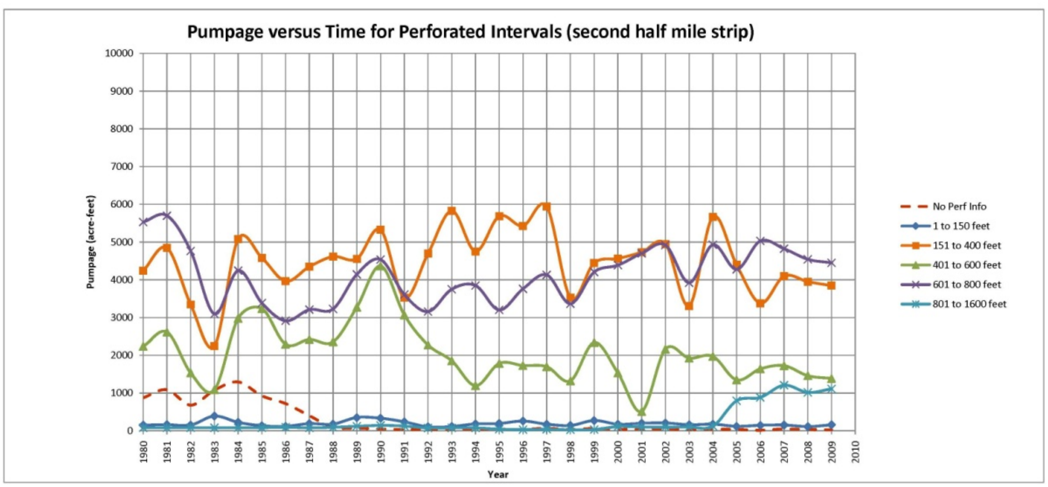

Figure 3-7: Pumpage versus Time (year) for Five Perforated Intervals in Strip 2 Santa Paula Basin Wells.

Figure 3-8 shows the pumpage results over time for Strip 3, which is located within the third half mile from the Santa Clara River. Figure 3-8 indicates that pumping magnitudes are much lower than within Strip 2. The highest pumpage is from the 601 to 800 foot perforation interval for Strip 3. Yearly pumpage ranges mostly between 1,000 acre-feet and 3,000 acre-feet per year for that perforation interval. Except for year to year variations in pumpage as expected, the graph for that interval is generally flat from 1980 to 2009. There appears to be no increasing trend in pumping for the 601 to 800 feet perforation interval within Strip 3. The next highest pumpage is from the perforation intervals from 151 to 400 feet and from 401 to 600 feet bgs. For those intervals pumpage ranges between approximately 200 acre-feet to 1,700 acre-feet per year for both intervals. There is no significant trend in the data. The data are generally flat for those two perforation intervals from 1980 to 2009. The perforation intervals from 1 to 150 feet and from 801 to 1600 feet show zero or close to zero pumpage for both intervals from 2004 to 2009. In addition to the known perforation intervals, wells with no perforation information also show a flat trend for pumpage from 1980 to 2009. These wells have pumped between 1,000 and 1,500 acre-feet per year. There appears to be no major increase (shift) in pumping overall for Strip 3.

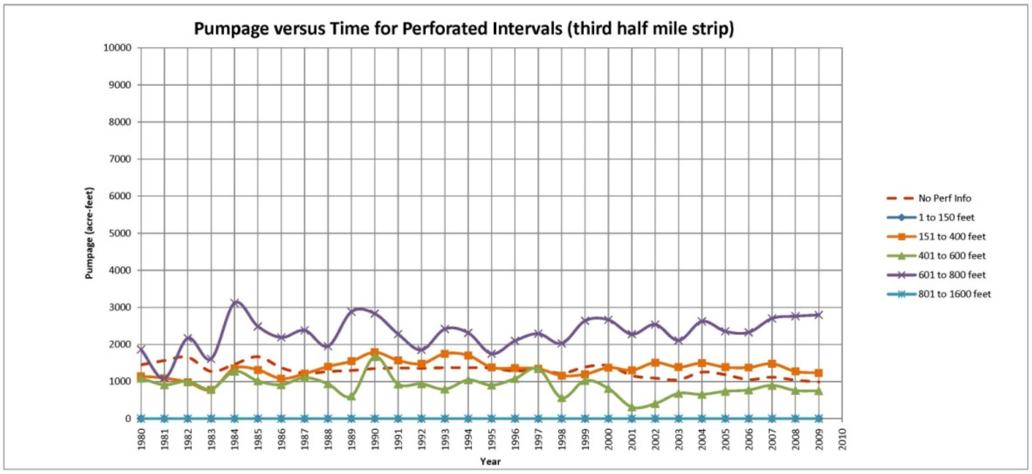

Figure 3-8: Pumpage versus Time (year) for Five Perforated Intervals in Strip 3 Santa Paula Basin Wells.

In general, Strip 1 does show a decrease in pumping from the 151 to 400 feet perforation interval from 1990 to 2009. During the same time period in Strip 1 the perforation interval from 601 to 800 feet bgs shows an increase in pumping. These trends offset each other and do not change the total pumpage for Strip 1 over time. Figure 3-5 shows an overall increase in pumpage of approximately 1,000 acre-feet per year from 1980 to 2009 in Strip 1 (+34 acre-feet per year).

Strip 2 does show a decrease in pumping from the 401 to 600 feet perforation interval from 1990 to 2009. During the same time period in Strip 2 the perforation interval from 801 to 1600 feet bgs shows a very slight increase in pumping. These trends do not significantly affect the overall total pumpage for Strip 2 over time. Figure 3-5 shows an overall decrease in pumpage of approximately 1,000 acre-feet from 1980 to 2009 in Strip 2 (-34 acre-feet per year).

Strip 3 shows no increase or decrease in pumping from any of the perforation intervals from 1990 to 2009. Figure 3-5 shows a perfectly flat trend in pumpage from 1980 to 2009 in Strip 3.

The data indicate that there has been no significant increase or shift in pumping from Strip 1 to Strip 2 and Strip 3 from 1980 through 2009. There have been decreases in pumping in the shallower zones and an increase in pumping in the deeper zones within Strip 1 and Strip 2. However, these have been slight or insignificant changes which have offset each other and did not affect the overall pumpage of the basin. The most significant shift in pumping vertically occurs within Strip 1. Strip 1 indicates a decrease in pumping over time for the 151 to 400 feet bgs perforation interval and an increase in pumping over time for the 601 to 800 feet bgs perforation interval. Strip 2 and Strip 3 do not indicate that trend or effect. There has been no increase in pumping away from the river to the northwest and there has been no increasing trend in pumping from deeper levels away from the river to the northwest. Deeper pumping has increased moderately near the river within Strip 1.

3.3 PUMPAGE NEAR INDEX WELLS

Appendix D through Appendix G contain graphs of pumpage over time (1980 through 2009) for a 3,000 foot, 2,000 foot, 1,000 foot, and 500 foot radius area, respectively, around each key index well and selected monitoring wells within the Santa Paula Basin. Pumpage from all wells within the radius (including the index/monitoring well) is included in the analysis. Nine index wells and two monitoring wells were used for this analysis. These wells include:

Well ID	Top of Perforations (depth in feet)	Bottom of Perforations
• 02N22W02C01S	190	225
• 02N22W03K02S	115	164
• 03N21W12E04S	120	204
• 03N21W15C04S	112	253
• 03N21W16K01S	119	214
• 03N21W17Q01S	183	243
• 03N21W19G04S	450	720
• 03N21W30F01S	260	424
• 03N22W34R01S	300	343
• 03N21W15G03S (monitoring well)	370	390
• 03N21W16H06S (monitoring well)	290	310

Figure 3-9 is a map of the Santa Paula Basin showing the eleven index and monitoring wells with the four radii circles around the location of the wells. The other active wells within the basin are also shown.

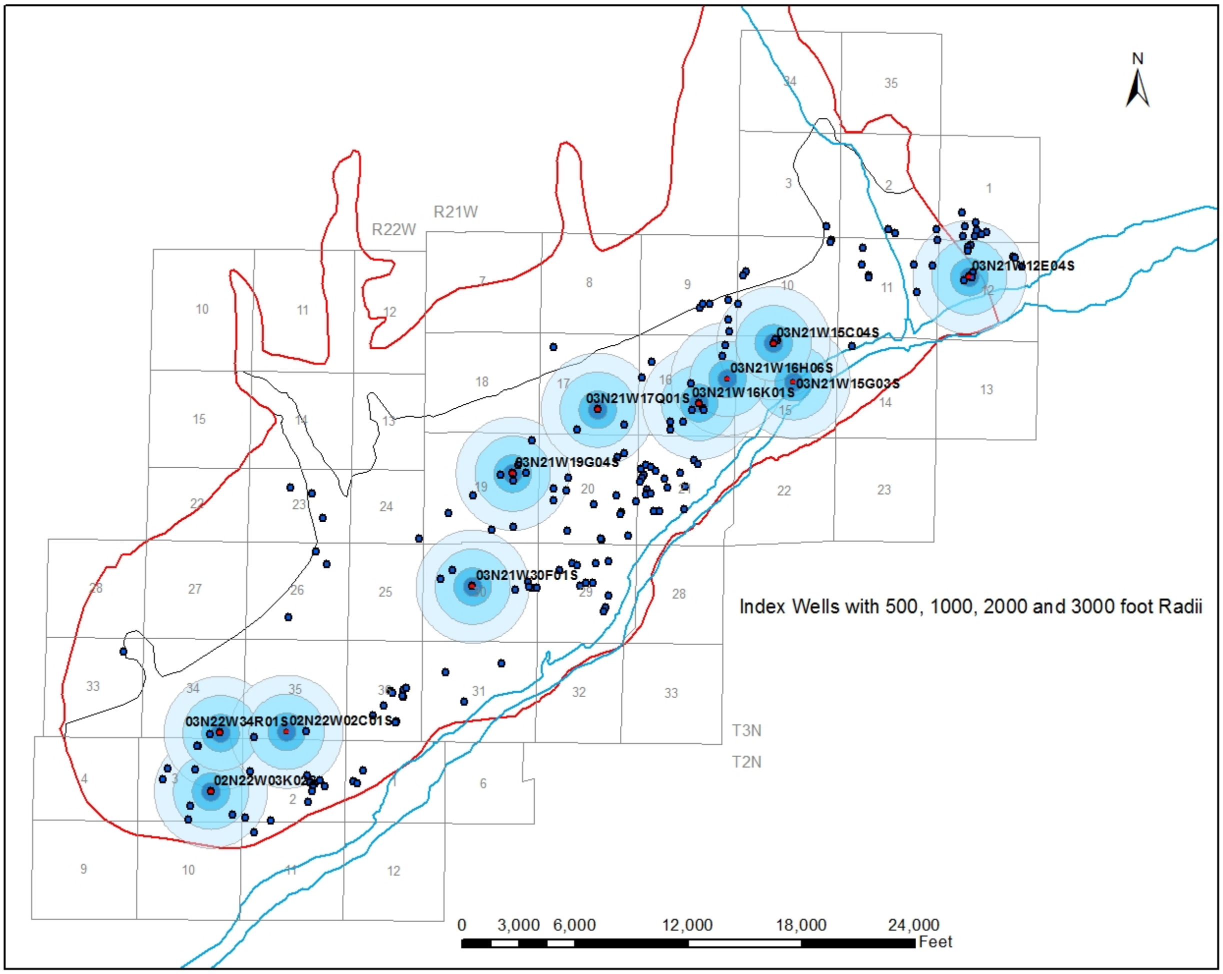

Figure 3-9: Index Wells in the Santa Paula Basin

As shown in Figure 3-9, each key index well is located in the center of a 500 foot, 1,000 foot, 2,000 foot, and 3,000 foot radius circle surrounding the well. The yearly pumpage values were calculated for the wells within the area covered by each circle. This was done for all four radii surrounding each well. United's GIS was used to construct the circles and do the calculations that were necessary for each graph of pumpage over time.

Water level data are also shown on the graphs in Appendix D through Appendix G for each well. This was included for a better understanding of the relationship between pumping of the wells within each radius and the resulting water levels that occur in the index wells. It should be noted that some of the graphs indicate a decline in water level from approximately 1984 through 1991. These data are representative of drought years and are expressed on many graphs. Recovery is from approximately 1991 to 1994.

Appendix D through Appendix G contain forty-four graphs collectively (11 for each appendix). One graph was prepared for each radius (4 radii per index well). Total pumpage from all wells within each radius from 1980 through 2009 are shown.

3.3.1 3000 FOOT RADIUS ANALYSIS

Pumping graphs for the 3,000 foot radius (Appendix D) around each index/monitoring well show some variation. The majority of the graphs are similar in that they indicate generally "flat" or decreasing trends, however, there are some notable differences. There are also some notable relationships with the water levels in the wells. Year to year fluctuations occur which correlate to rainfall for a given year.

The graphs for Wells 03N21W30F01S and 03N21W15G03S indicate a slight upward pumping trend from 1980 to 1990. From 1990 to 2009 the graphs for these wells show a marked decrease in pumping. Well 03N21W15G03S indicates a decreasing trend of approximately 105 acre-feet per year during this time period. Well 03N21W30F01S also shows a significant decreasing trend. The water level data in both wells show a decrease in water level during the same period that pumping shows a decreasing trend. This relationship over time suggests that the water levels are controlled by more than just pumping within the 3,000 foot radius. They are likely affected by the overall basin hydrology.

The graph for Well 03N21W19G04S indicates higher levels of pumping from 1984 to 1991. Water levels show a slight downward trend during that period. From 1991 to 2009 pumping was decreased significantly and the pumping trend is flat during that period. Water levels generally have essentially a flat trend from 1991 to 2009. Since the pumping trend was flat during that period the flat trend of water levels are expected.

The pumping trend for Wells 03N21W17Q01S, 03N21W15C04S, 03N21W12E04S, and 02N22W03K02S is mainly flat or show a slight decrease from 1980 to 2009. Water levels in Well 03N21W12E04S generally have a flat trend for the same time period. Water levels in Wells 03N21W17Q01S, 03N21W15C04S and 02N22W03K02S indicate declining water levels from 1998 to 2009. If pumping has not increased as evidenced by the pumping trends the water levels are expected to remain somewhat constant and not show a decline. This suggests that the water levels are controlled by the overall hydrology of the basin and not solely the pumping of the wells within the 3,000 foot radius.

The graph for Well 02N22W02C01S shows that there was very little pumping from 1980 to 1991. During that period an average of approximately 250 acre-feet were pumped per year. From 1991 to 2009 the graph shows greater pumping and more variability in pumping from year to year. However, the overall trend during that period is generally flat. Even though the pumping shows large variations (600 to 2,750 acre-feet per year) the trend is flat. Water level data from 1998 through 2009 show a gradual decrease. This is likely due to the basin hydrology.

The graph for Well 03N22W34R01S shows a very slight upward trend in pumping from 1980 to 2009. Pumping increased from approximately 300 acre-feet in 1980 to 450 acre-feet in 2009. This generates an average increase of 5 acre-feet per year which is insignificant when considering the basin as a whole. Water level data indicate a downward trend from 1998 to 2009.

The graphs for Wells 03N21W16H06S and 03N21W16K01S indicate a flat pumping trend from 1980 to 1994. From 1994 to 2009 the graphs show an increase in pumping. These are the only graphs for the 3,000 foot radius that show an increase in pumping. Annual pumping has increased by approximately 3,000 acre-feet around 03N21W16K01S and 2,000 acre-feet around 03N21W16H06S from 1994 to 2009 which is an approximate average 175 acre-feet per year increase (0.7 percent of the average yearly basin wide pumpage). Water level data show a decrease from 1995 to 2009 in Well 03N21W16H06S and a decrease from 2004 to 2009 in Well 03N21W16K01S.

Therefore, five wells indicate a flat or slightly decreasing trend in pumping between 1980 and 2009. Three wells indicate a decrease in pumping over the same time. One well shows increased pumping but at an insignificant amount (5 acre-feet per year). Two wells show an increase in pumping since 1995 (03N21W16H06S and 03N21W16K01S). The increase is on the order of 175 acre-feet per year (approximately 0.7 percent of the average yearly pumpage for Santa Paula Basin) which resulted in a total annual increase of about 2,000 acre-feet. In general, when considering the data from all of the wells (and the 3,000 foot radius) the dataset indicates that there was no significant sustained pumping increase from 1980 to 2009 in 9 of the wells. In fact most of these 9 wells show a decrease in pumping. The pumping data and water level data for the wells indicates some minor correlation and considerable non-correlation which suggests that the water levels are more affected by overall basin hydrology.

3.3.2 2000 FOOT RADIUS ANALYSIS

Pumping graphs for the 2,000 foot radius (Appendix E) around each index/monitoring well show some variation. The majority of the graphs are similar in that they indicate generally “flat” or decreasing trends, however, there are some notable differences. There are also some notable relationships with the water levels in the wells. Year to year fluctuations occur which correlate to rainfall for a given year.

The graph for Well 02N22W03K02S indicates a downward pumping trend from 1980 to 2009 (approximately a 75% decrease over time). The water level data in the same well shows a decrease in water level from 1984 to 1992 (drought). It then shows and increase in water levels to 1999 while pumping continued to decrease (drought recovery). The water levels then begin to decrease in approximately 1999 and the overall trend is a shallow decrease to 2009. The lack of correlation between pumping and water levels over time suggests that the water levels are controlled by more than just pumping within the 2000 foot radius. They are likely affected by the overall basin hydrology.

Well 03N21W12E04S also indicates a downward trend in pumping from 1980 to 2009. The well was pumped at higher levels between 1980 and 1992. The average pumpage per year during that period was 5,400 acre-feet. From 1992 to 2009 the average pumpage per year was 3,950 acre-feet. The water levels have essentially maintained a flat trend from 1980 through 2009. This also suggests a lack of strong correlation between pumping within the 2000 foot radius and water levels. It suggests that the water levels are mainly affected by overall basin hydrology.

Well 03N21W15C04S also indicates a downward trend in pumping from 1989 to 2009 (increase in pumping from 1980 to 1989). From 1989 through 2009 pumpage decreased from approximately 3,250 acre-feet per year to 1,250 acre-feet per year (decrease of approximately 95 acre-feet per year). Water levels from 1992 to 2010 indicate a significant decrease over time. If pumping has decreased, water levels should increase or remain constant during non-drought conditions. This suggests that the water levels are controlled by the overall hydrology of the basin and not solely the pumping of the wells within the 2000 foot radius.

Well 03N22W34R01S can be interpreted to have a flat or level pumping trend from 1980 to 1996. From 1996 through 2009 the graph exhibits a slight increase in pumping over time. During that period the trend line for that graph would show an increase of 150 acre-feet over 14 years (increase of 11 acre-feet per year). After the drought and recovery years, water levels fluctuate significantly and show little correlation with pumping. Water levels increase from 1994 to 1999, they then decline and level out in approximately 2002 and the trend remains level until 2009.

The graph for Well 02N22W02C01S indicates a general flat trend in pumping from 1980 to 2009. The water level data in the same well shows a decrease in water levels from 1984 through 1991 (drought). It then shows an increase in water levels until approximately 1998. Following that trend water levels decrease significantly from 1999 to 2009 when pumping is generally flat and consistent. This suggests that the water levels are controlled by more than just pumping within the 2000 foot radius. They are likely affected by the overall basin hydrology.

Well 03N21W15G03S indicates no pumping at all over time within its 2000 foot radius. It is a monitoring well and no production wells exist within the 2,000 foot radius of the well. However, water levels indicate a decrease from 1994 to 2009. This suggests a basin hydrology affect on the water levels.

The graph for Well 03N21W19G04S indicates a general flat trend in pumping from 1991 to 2009 (approximately 2,000 acre-feet per year). From 1984 to 1991 the well was pumped at higher levels (approximately 4,000 acre-feet per year) likely due to the drought. The water level data after the drought and recovery vary significantly (short duration increases and decreases). The pumping data during that period is relatively constant. This lack of correlation suggests that the water levels are controlled by more than just pumping within the 2,000 foot radius.

The remaining four graphs (03N21W16K01S, 03N21W17Q01S, 03N21W30F01S, and 03N21W16H06S) contain pumping data that are interpreted to be generally flat from 1980 through 2009 with some temporary increases during drought years. This implies that pumping has not increased over time within the 2,000 foot radius for the wells. With the exception of lows observed during drought years, the water levels for these five wells show varying increases and decreases.

Some of these changes correlate with temporal changes in pumping data, but some of the subtle changes do not correlate with pumping data, and are likely affected by basin conditions.

Therefore, seven wells indicate a flat trend or no increased pumping between 1980 and 2009. Three graphs indicate a decrease in pumping over time. One graph (03N22W34R01S) shows increased pumping but at an insignificant amount (0.04 percent of the yearly average basin wide pumpage). In general, the dataset indicates that there was no significant sustained pumping increase from 1980 to 2009 in the index wells within a 2,000 foot radius of influence. Correlation with water level data for the wells indicates some minor correlation and considerable non-correlation which suggests that the water levels are more affected by overall basin hydrology.

3.3.3 1000 FOOT RADIUS ANALYSIS

Pumping graphs for the 1,000 foot radius (Appendix E) around each index/monitoring well show some variation. The majority of the graphs are similar in that they indicate generally "flat" or decreasing trends, however, there are some notable differences. There are also some notable relationships with the water levels in the wells. Year to year fluctuations occur which correlate to rainfall for a given year.

The graphs for Wells 03N21W15C04S and 02N22W03K02S indicate an upward trend in pumping from 1980 to approximately 1991 (drought). From that point both of the graphs indicate a significant downward trend in pumping through 2009. Water levels in these wells are also decreasing during that same period through 2009. Since pumping has decreased and the water levels are also decreasing it suggests that the water levels are likely controlled by the basin hydrology. Well 03N21W30F01S also indicates a decrease in pumping from 1990 through 2009. The water levels in that well also show a slight decrease during the same period.

The pumping trend for Wells 03N21W12E04S, 03N21W19G04S, and 03N21W17Q01S do not show a significant increasing or decreasing trend in pumping from 1980 through 2009. During that period the overall pumping trends are interpreted to be generally level (with yearly variations related to rainfall). There is also no significant decreasing or increasing trend in the water levels measured in Wells 03N21W12E04S and 03N21W19G04S from 1980 through 2009. The trend is generally level or flat. The water levels in Well 03N21W17Q01S indicate a slight decline from 1997 through 2009. This suggests that basin hydrology plays a role in the determination of water levels.

For Well 03N21W16K01S the pumping trend varies significantly from 1980 to 1993. After 1993 an increasing trend in pumping occurs through 2009. Pumping increases approximately 1,250 acre-feet (83 acre-feet per year) during that period (0.3 percent of the average yearly basin wide pumpage). This is an insignificant amount when compared to the entire basin pumpage. With the exception of the drought years water levels are consistent until 2005 (even though pumping has increased during that period). From 2005 through 2008 water levels drop and remain at that level through 2010.

For Well 03N22W34R01S the pumping trend decreases approximately 200 acre-feet from 1980 to 1992. After 1992 an increasing trend in pumping occurs through 2009. Pumping increased by 200 acre-feet (11 acre-feet per year) during that period (0.04 percent of the average yearly basin wide pumpage). This is also an insignificant amount when compared to the whole basin. Water levels are affected by drought conditions until approximately 1994. After that they indicate a slight decline from 1998 through 2010.

The graphs for Wells 03N21W16H06S, 03N21W15G03S, and 02N22W02C01S indicate that there was no pumpage within the 1,000 foot radius from 1980 to 2009. Water levels have declined from 1994 to 2009 in Wells 03N21W16H06S and 03N21W15G03S which are the two monitoring wells (wells constructed in 1994). After the drought and recovery water levels have declined from 1994 through 2009 in Well 02N22W02C01S also. Declining water levels with no pumping suggests that the water levels are controlled by the overall basin hydrology.

Therefore, three wells indicate a flat trend or no increased pumping between 1980 and 2009. Three graphs indicate a decrease in pumping over time. Two graphs (03N22W34R01S and 03N21W16K01S) show increased pumping but at an insignificant amount (0.04 percent and 0.3 percent of the yearly average basin wide pumpage, respectively). Three graphs are characterized by no pumping at all. In general, the dataset indicates that there was no significant sustained pumping increase from 1980 to 2009 in the index wells within a 1,000 foot radius of influence. Correlation between pumping and water level data for the wells does not exist which suggests that the water levels are more affected by overall basin hydrology.

3.3.4 500 FOOT RADIUS ANALYSIS

Appendix G contains the data for pumping within the 500 foot radius around each index well. Most of the graphs, for the 500 foot radius around each index well, indicate a flat trend or downward trend in pumping over time. Year-to-year fluctuations occur, which are likely related to rainfall for a given year.

The graph for Well 02N22W03K02S and Well 0321W15C04S indicate a downward trend in pumping from the drought years through 2009. During that period, the water level data decrease and show a downward trend. Therefore there is little correlation between pumping and water level. If correlation were strong a decrease in pumping would result in an increase in water level.

The graph for Well 03N21W12E04S indicates a very slight downward trend in pumping data from 1980 through 2009. However the water level data is generally flat from 1980 to 2009. The slight decrease in pumping may not be enough to affect the water levels.

Well 03N22W34R01S indicates an increase in pumping over time (1980 to 2009). The trend line for that graph would show an increase of only 110 acre-feet over 30 years (4 acre-feet per year), which is an insignificant amount when compared to the entire basin (0.02 percent of the average yearly basin wide pumpage). The water levels show a downturn and recovery during the drought years and after the drought years water levels are characterized by a very slight decline. Therefore, there is a little correlation between pumping and water levels.

Well 03N21W16K01S is flat until 1995 then an increase in pumping occurs to 2009. The trend line for that graph would show an increase of 1,350 acre-feet over 14 years (96 acre-feet per year). This is an insignificant amount (0.4 percent of average yearly basin wide pumpage) when compared to the yearly basin pumpage. Water levels decrease from 1980 to 1992 (drought). They then increase and remain generally flat until 2005. After 2005 water levels decline. The lack of strong correlation suggests conditions controlled by basin hydrology.

Well 03N21W15G03S, Well 03N21W16H06S and Well 02N22W02C01S indicate no pumping at all over time. These three wells are the only wells within the 500 foot radius for each of their sites. The water levels for these wells show a decline from 1995 to 2009. This suggests that they are controlled by the overall hydrology of the basin.

The remaining three graphs (03N21W17Q01S, 03N21W19G04S, and 03N21W30F01S) contain pumping data that are generally flat (except for the drought years), which implies that pumping has not increased over time within the 500 foot radius for the wells. The water levels are generally consistent (with the exception of the drought years).

Therefore, three wells indicate a flat trend or no increased pumping between 1980 and 2009. Three graphs indicate a decrease in pumping over time. Two graphs (03N22W34R01S and 03N21W16K01S) show increased pumping but at an insignificant amount (0.4 percent and 0.02 percent of the average yearly basin wide pumpage). Three graphs show no pumping has occurred. In general, the dataset indicate that there was no significant pumping increase from 1980 to 2009 in the index wells within a 500 foot radius of influence. The correlation between pumping and water levels is not consistent, and suggests that the water levels are affected by the overall basin hydrology.

3.4 MAGNITUDE AND LOCATION OF PUMPING WITHIN THE SANTA PAULA BASIN

Pumpage data from all of the wells within the Santa Paula basin were used to assess the location(s) where the highest magnitude of pumping occurs. This analysis was done for years 1980, 1990, 2000, and 2009. The objective was to assess if the area or areas exhibiting the highest magnitude(s) of pumping (“center of pumping”) has shifted in any direction within the Santa Paula Basin.

The method that we employed involves using the GIS to construct maps of pumpage magnitude. A 2,000 foot radius buffer was constructed around each well within the basin. Total pumpage data for a given year was calculated by adding the pumpage from all wells within the 2,000 foot radius surrounding a given well. This was done for all of the wells in the basin that pumped more than 10 acre-feet per year. The pumpage magnitudes are represented by various shades of gray shown on the maps for each 2,000 foot buffer (buffer for every well). The locations of darker gray areas on the map represent the higher pumping magnitudes (or highest pumping magnitude). In several cases the 2,000 foot buffers may overlap for wells that are relatively close to each other making the localized overlapping area a shade darker. Maps for 1980, 1990, 2,000, and 2009 are shown on Figures 3-10 through 3-13 respectively.

The maps for 1980 and 1990 (Figures 3-10 and 3-11) are very similar. In general, the highest pumpage magnitudes occur in approximately the same locations within the basin for both maps. Total basin pumpage for 1990 (33, 283 acre-ft) was 24 percent greater than total basin pumpage for 1980 (26,820 acre-ft). However, the relative distribution and location of higher pumping magnitudes are very similar for both maps. For Township and Range T2NR22W the highest pumpage occurs in Sections 2 and 3 on both maps. In 1990, for Township and Range T3NR22W the highest pumpage occurs in Section 36 which is slightly greater than the pumping magnitude in Section 36 for 1980. For Township and Range T3NR21W the highest pumpage occurs in Sections 11, 12, 15, 16, 19, 20, 29, and 30 on both maps. For this Township and Range Section 20/21 also shows a slight increase in pumpage from 1980 to 1990.

There also appears to be no significant shift in pumping magnitude location from 1980 to 1990 for wells in the Santa Paula Basin. There is a slight increase in pumping in Section 36 (T3NR22W) and Section 21 (T3NR21W) from 1980 to 1990.

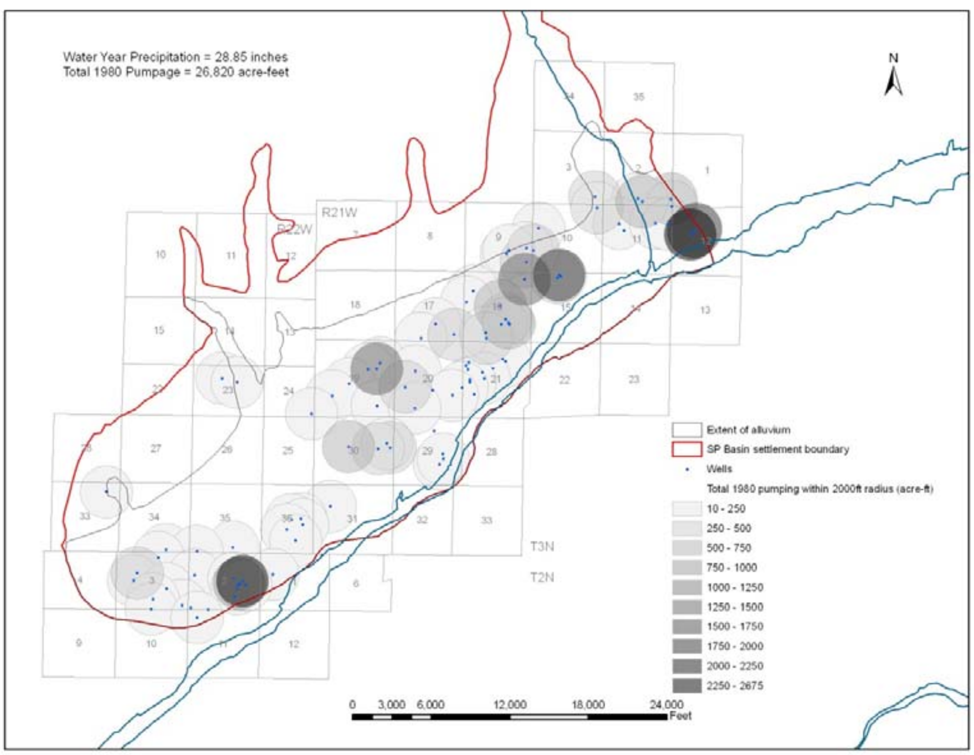

Figure 3-10: Map of 1980 pumping magnitude for Santa Paula Basin wells using 2,000 foot buffer radius.

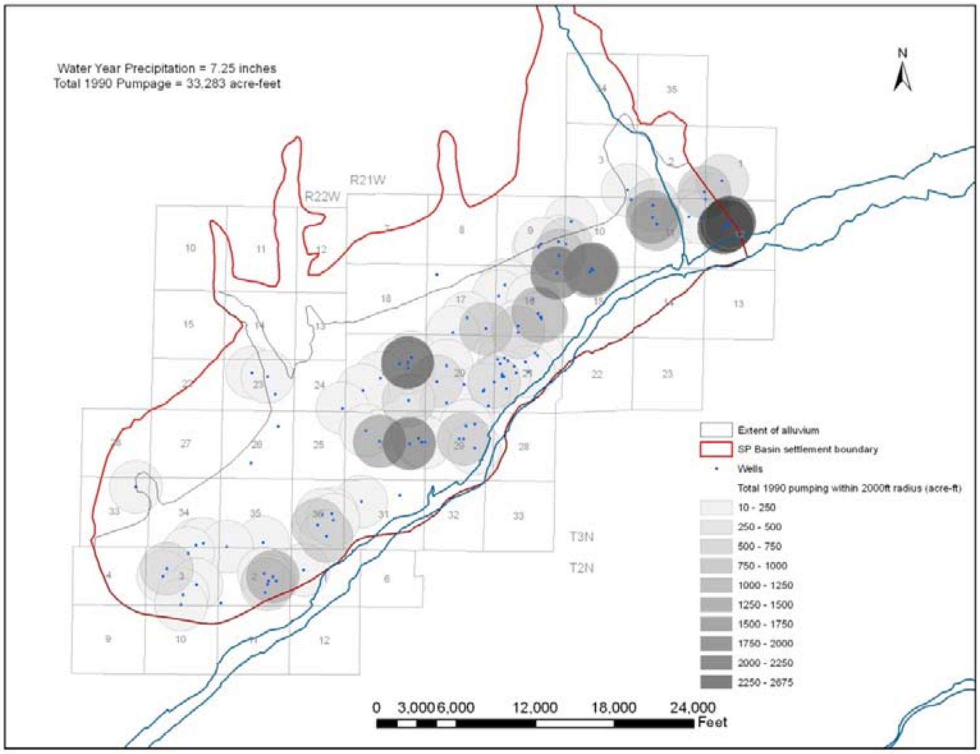

Figure 3-11: Map of 1990 pumping magnitude for Santa Paula Basin wells using 2,000 foot buffer radius.

The maps for 1990 and 2000 (Figures 3-11 and 3-12) are also very similar. The highest pumpage magnitudes also occur in approximately the same locations within the basin for both maps. Total basin pumpage for 1990 (33, 283 acre-ft) was 25 percent greater than total basin pumpage for 2000 (26,499 acre-ft). However, the distribution of the higher pumping magnitudes is very similar for both maps. For Township and Range T2NR22W the highest pumping occurs in Sections 2 and 3 on both maps. For Township and Range T3NR22W the highest pumping occurs in Section 36 on both maps. For Township and Range T3NR21W the highest pumping occurs in Sections 11, 12, 15, 16, 19, 20, 29, and 30 on both maps. Therefore, there appears to be no significant shift in pumping magnitude location from 1990 to 2000. The most significant difference is a slight decrease in pumping in Section 21 on the map for 2000 when compared to the map for 1990.

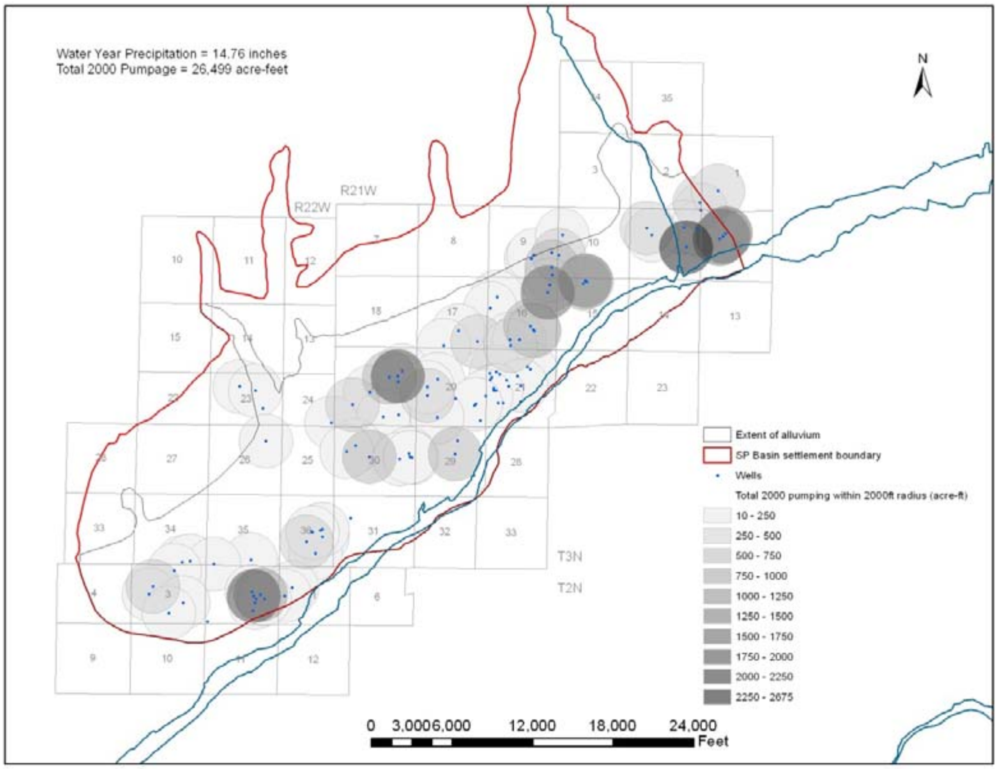

Figure 3-12: Map of 2000 pumping magnitude for Santa Paula Basin wells using 2,000 foot buffer radius.

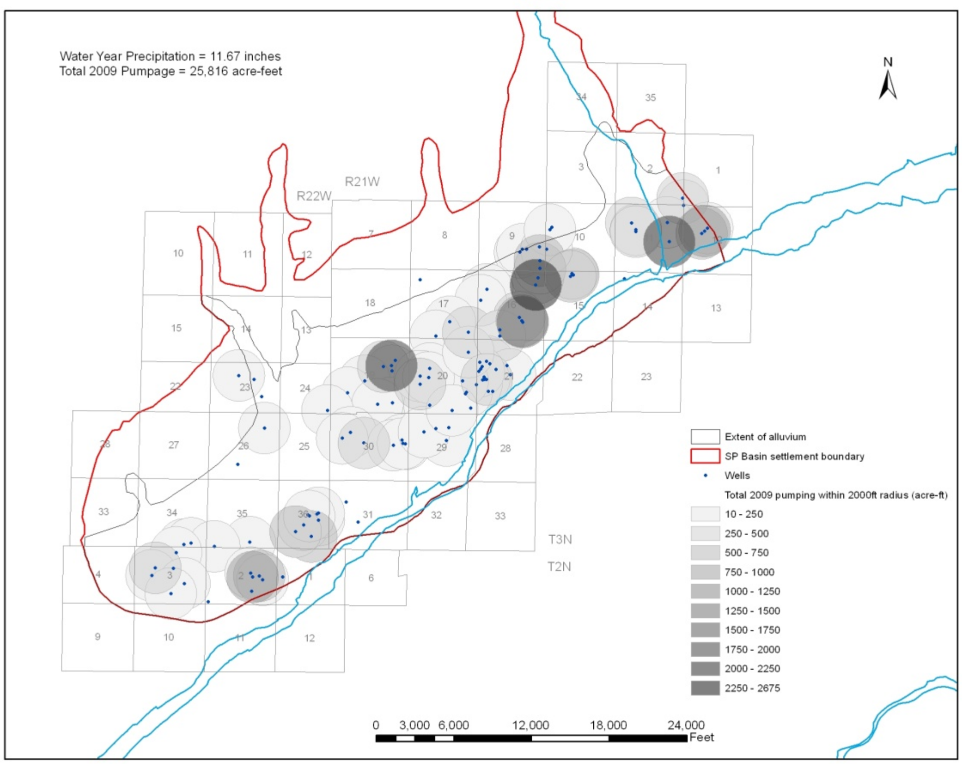

Figure 3-13: Map of 2009 pumping magnitude for Santa Paula Basin wells using 2,000 foot buffer radius.

The maps for 2000 and 2009 (Figures 3-12 and 3-13) are very similar. Again, the highest pumpage magnitudes occur in approximately the same locations within the basin on both maps. Total basin pumpage for 2000 (26,499 acre-ft) was 3 percent greater than total basin pumpage for 2009 (25,816 acre-ft). The distribution and location of the higher pumping magnitudes are very similar for both maps. For Township and Range T2NR22W the highest pumping occurs in Sections 2 and 3 on both maps. For Township and Range T3NR22W the highest pumping occurs in Section 36 on both maps. For Township and Range T3NR21W the highest pumping occurs in Sections 11, 12, 15, 16, 19, 20, and 30 on both maps. In 2009 there is a slight decrease in pumpage within Section 29 compared to the map for 2000. However, there appears to be no significant shift in pumping magnitude location from 2000 to 2009. The most significant difference is a slight decrease in pumping in Section 29 for 2009.

In general, the maps for Figures 3-10 through 3-13 showing pumping magnitude and location within the Santa Paula Basin are all very similar. The higher magnitude pumpage locations occur at the same general locations for the 1980, 1990, 2000, and 2009 maps. Only minor variations from year to year can be observed on the maps.

4 OBSERVATIONS & FINDINGS

Based on the results of this study, United Water offers the following observations and findings:

- Comparison of maps of total pumpage (Appendix A) for all of the wells within Santa Paula Basin indicates that the maps are similar from year to year (1980 through 2009. However, the relative pumping between wells is very similar. No significant shifting of pumping or increase in pumping at any location (location change) within the basin can be observed by inspection of the maps. Increased pumpage farther from the river is not observed over time.

- Analysis of the graphs generated by the pumping “strips” indicates that there is no significant increased pumping over time within any of the strips (1980 through 2009). The pumping trend from 1980 through 2009 from each polygon strip is generally flat or very near to flat. This suggests no systematic shifting of pumping or increase in pumping at varying locations away from the river can be observed within the basin. There appears to be no significant increase in pumping from wells that are located away from the river, near the index wells, on the northwest side of the basin.

- Analysis of perforated intervals for the entire Santa Paula Basin indicates that some newer wells have been constructed to pump from deeper intervals since 1990. Well completion reports indicate that about 18 wells have been drilled to depths exceeding 600 feet since 1946. A significant decrease in pumpage in the shallow zone (151 to 400 feet bgs) is matched by an increase in pumpage in a deeper zone (600 to 800 feet bgs). Although, this counterbalance is approximately equal and does not change or affect the total pumpage for the basin. Further analysis of pumpage and perforated intervals within each of the polygon strips indicates that the shift in pumping from the shallow zone (151 to 400 feet bgs) to the deeper zone (601 to 800 feet bgs) has occurred within Strip 1 which is directly adjacent to the Santa Clara River. There has been no shift in pumping depth over time in Strip 2 or Strip 3.

- Analysis of the graphs generated by the 500 foot, 1,000 foot, 2,000 foot, and 3,000 foot radius around each index well indicates that there is no significant increased pumping over time (1980 through 2009). Approximately 80% of the index well graphs during this period indicate a “flat” trend or a decreasing trend in pumpage. There has been an increase in pumping within 3,000 feet of the two index wells (03N21W16H06S and 03N21W16K01S). However, the increase (2,000 to 3,000 acre-feet out of approximately 26,000 acre-feet of average yearly basin wide pumpage) is minimal. This suggests no major shifting of pumping or increase in pumping can be observed at locations within the basin near the index wells.

- In general, the maps showing the location(s) and pumping magnitude are all very similar for the years displayed. The higher magnitude pumpage locations occur at the same general locations for the 1980, 1990, 2000, and 2009 maps. Only minor variations from year to year can be observed on the maps. There has been no shift away from the Santa Clara River towards the central or northwest part of the basin or from the east toward the central portion of the basin.

5 CONCLUSIONS

The pumping trend data as analyzed for this report do not indicate significant changes in pumping locations over the 30-year study period (1980 to 2009). The following are the conclusions of this study:

1. There were no significant changes in the overall basin pumpage;

2. Pumping has not shifted away from the Santa Clara River with time;

3. The geographic distribution of pumpage does not change significantly over the study period near 9 of the 11 index wells;

4. Pumping in deeper aquifer zones has increased along the river; and

5. The water level fluctuations observed from 1980 to 2009 in the Santa Paula Basin cannot be attributed solely to spatial or temporal variations in pumping.

6 REFERENCES

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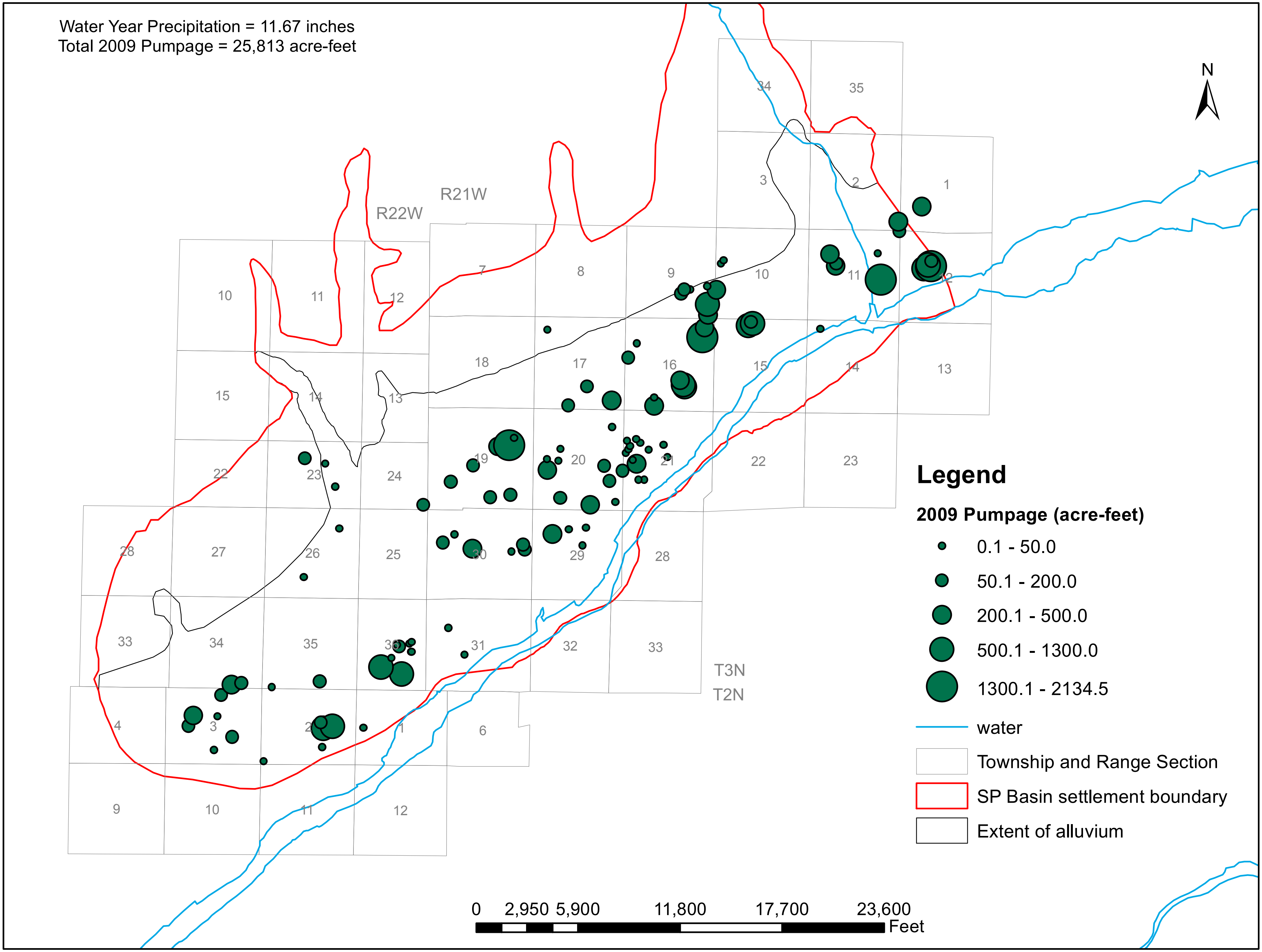
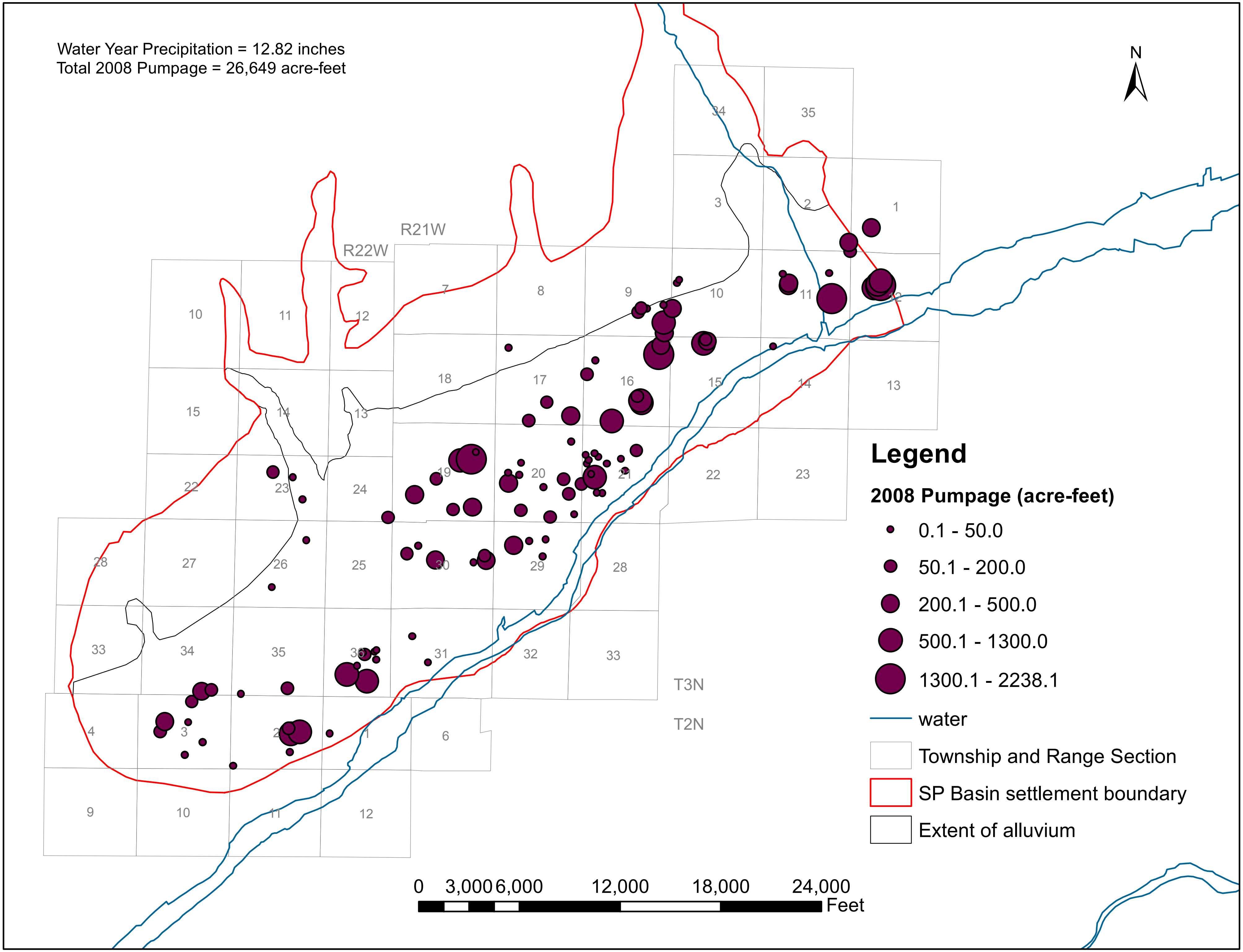
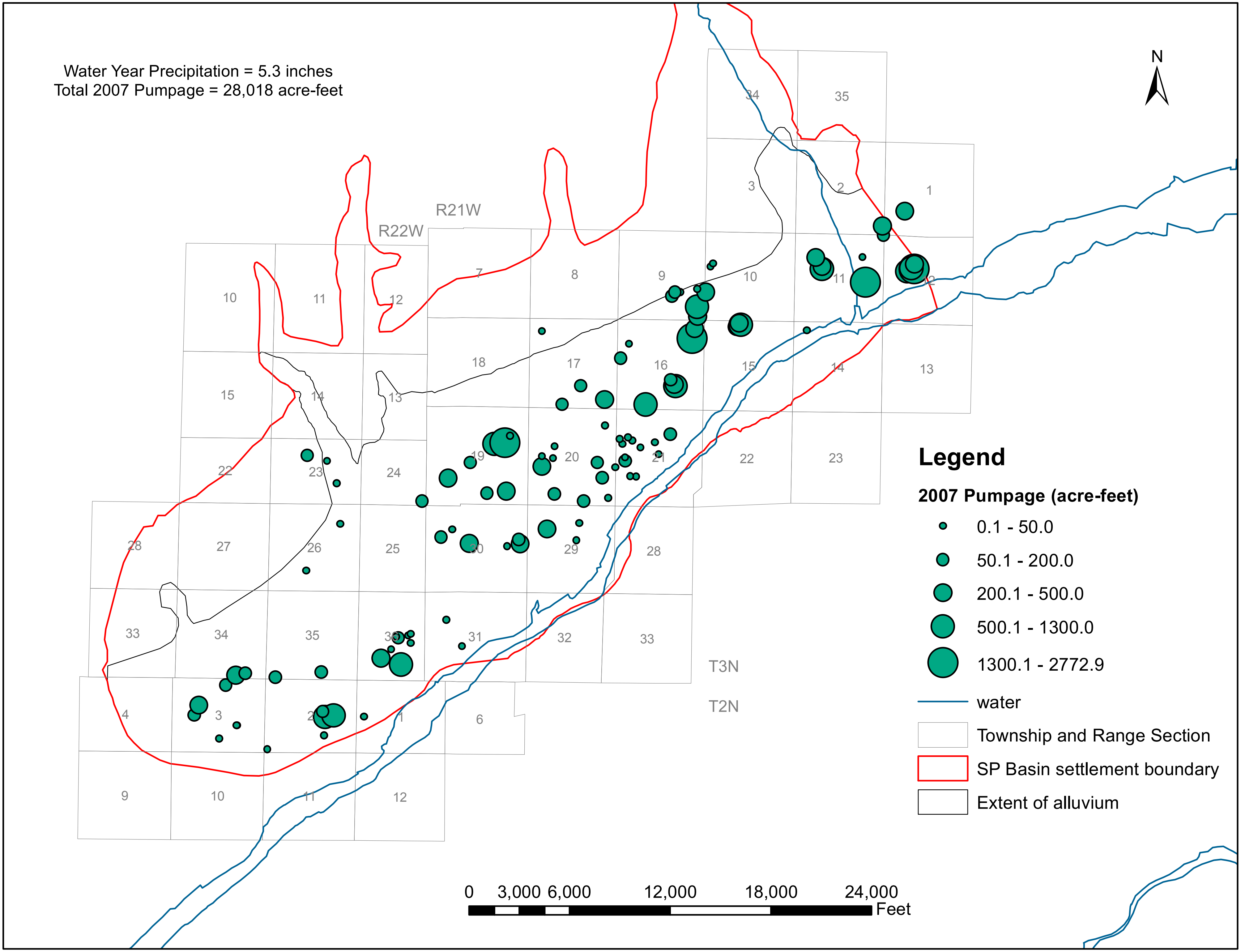
United Water Conservation District, 2011, Combined 2009-2010 Santa Paula Basin Annual Report, prepared by Santa Paula Basin Technical Advisory Committee, United Water Conservation District Professional Paper 2011-001 dated October 2011.

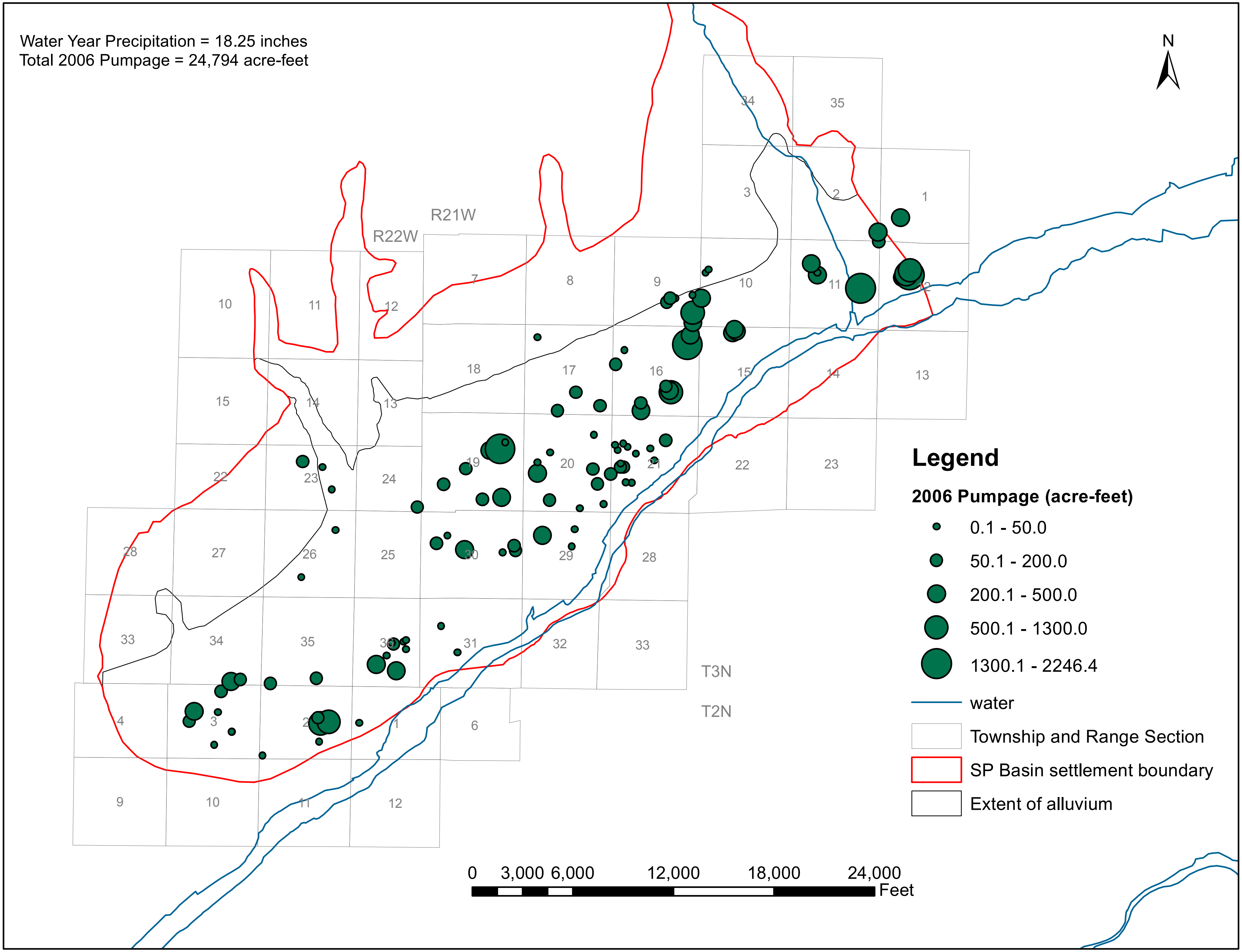
APPENDIX A – PUMPAGE MAPS OF SANTA PAULA BASIN (1980 THROUGH 2009)

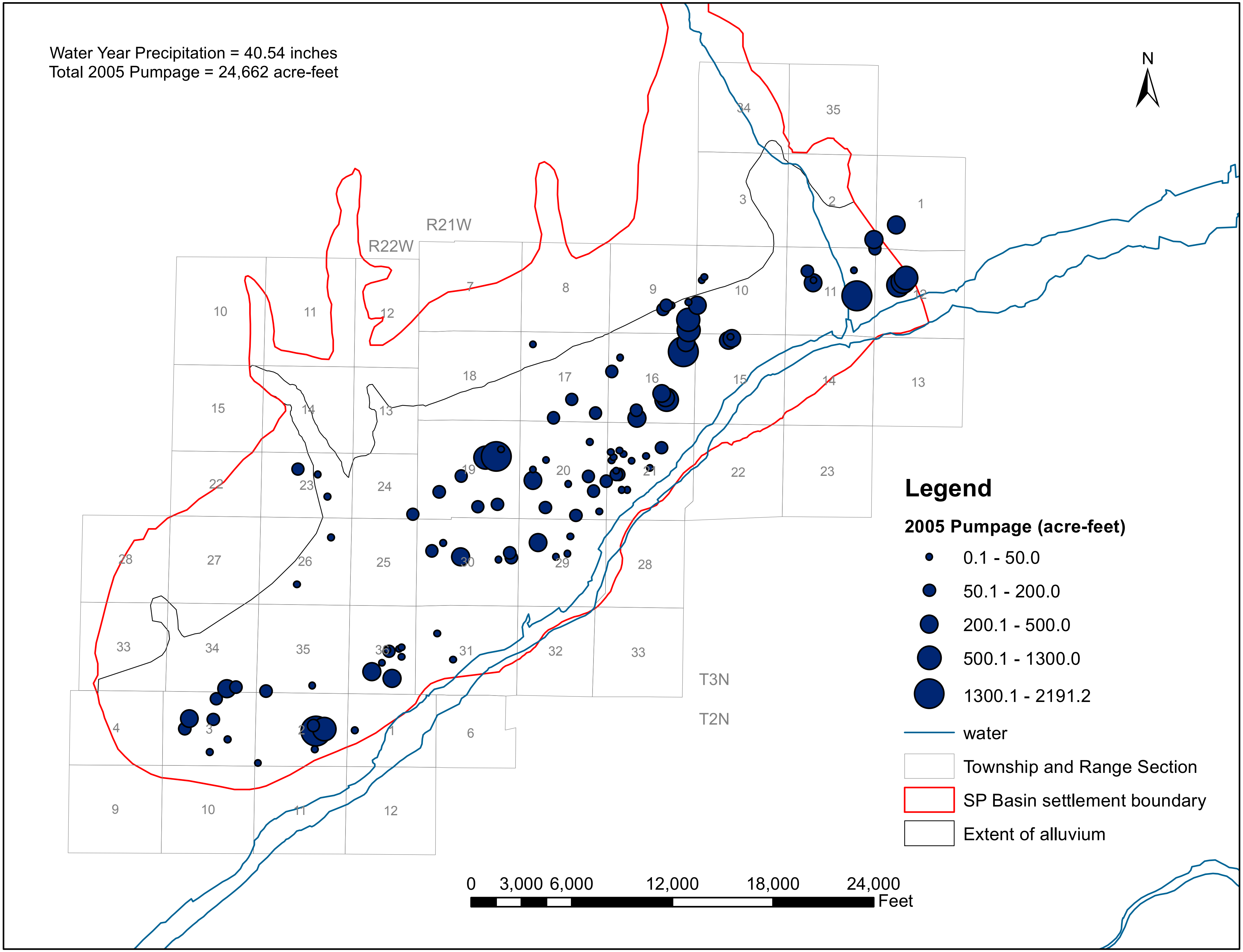


Water Year Precipitation = 11.67 inches
Total 2009 Pumpage = 25,813 acre-feet
R22W
R21W
T3N
T2N
N
Legend
2009 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2134.5
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
2,950
5,900
11,800
17,700
23,600
Feet

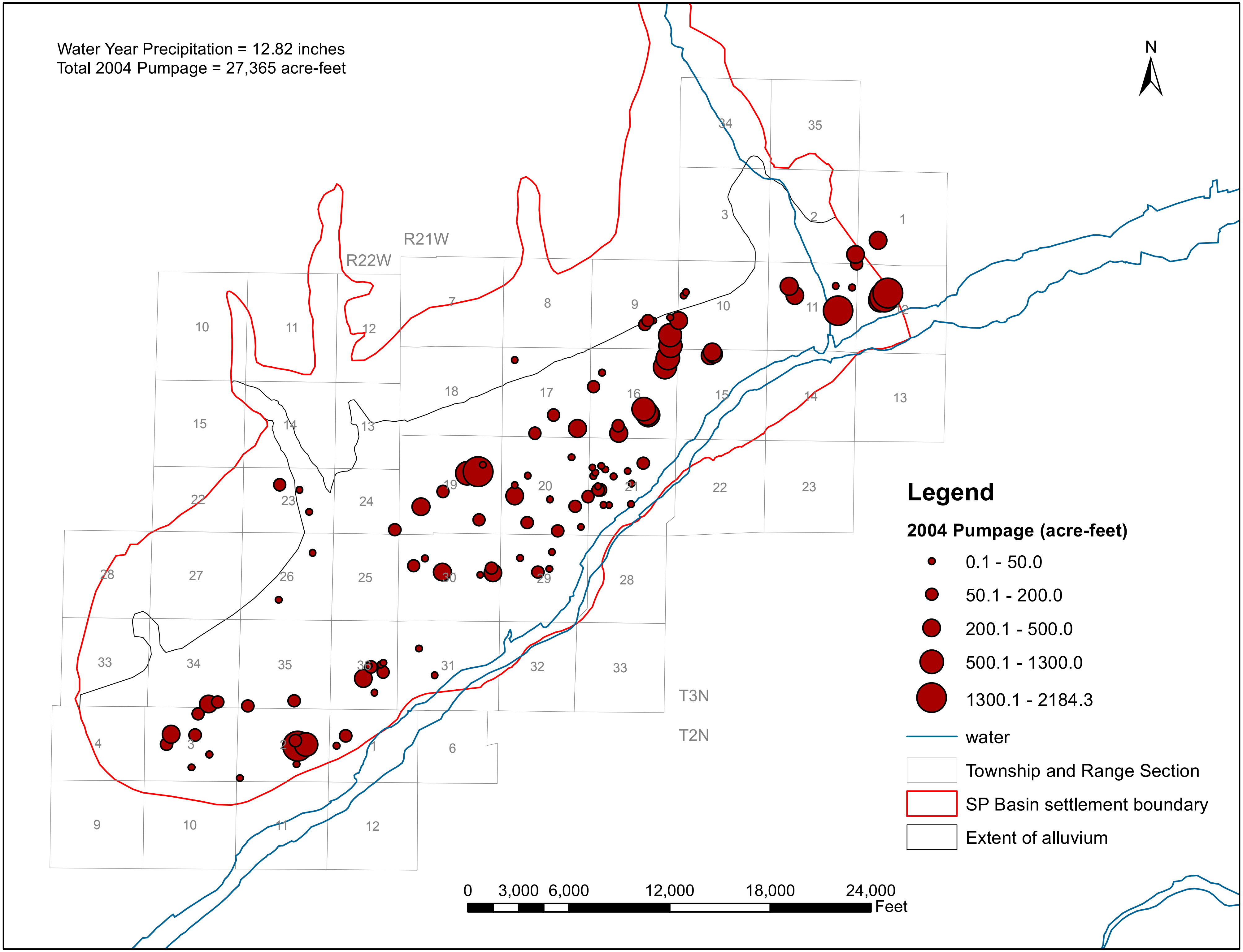

Water Year Precipitation = 12.82 inches
Total 2008 Pumpage = 26,649 acre-feet
N
R22W
R21W
T3N
T2N
Legend
2008 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2238.1
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

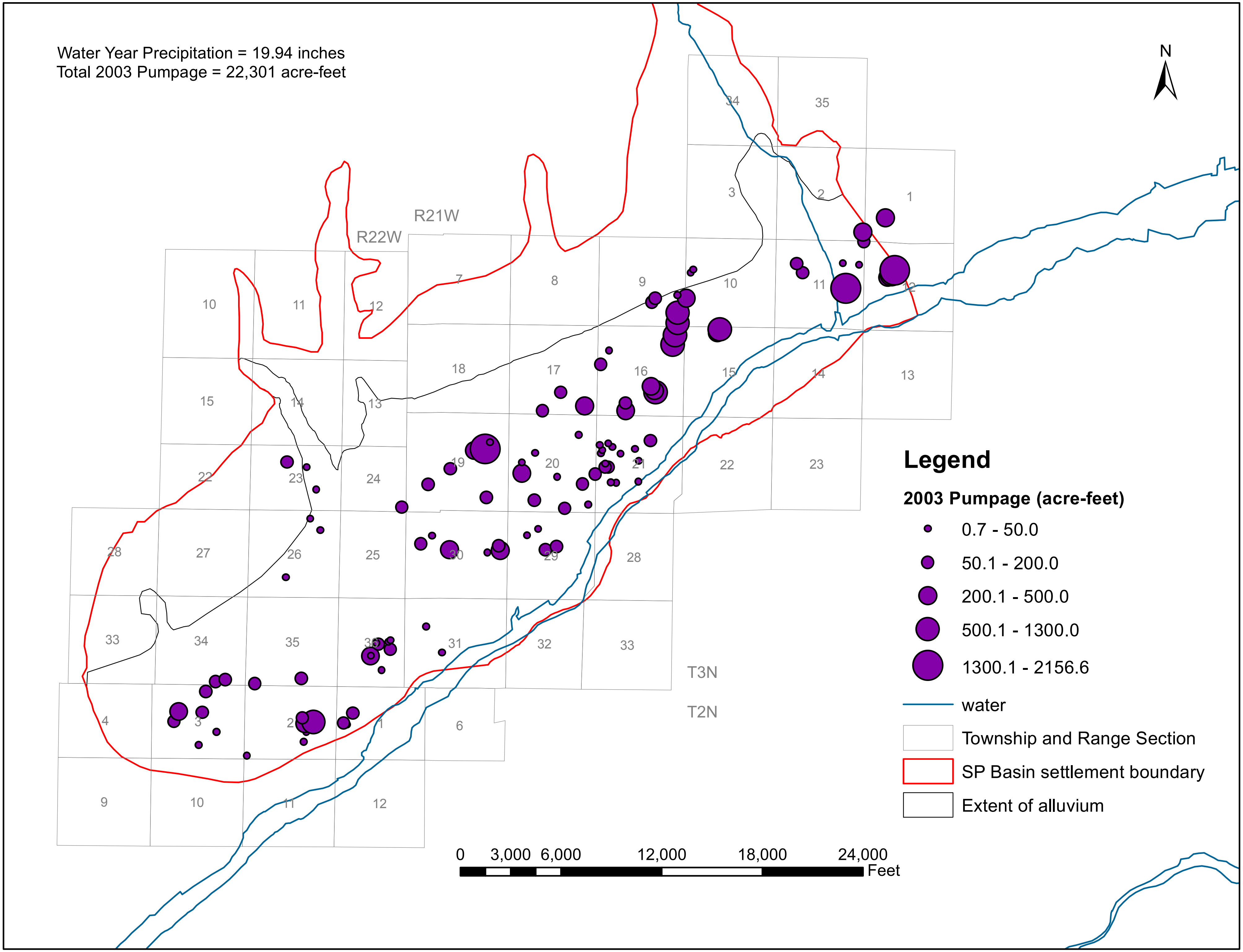

Water Year Precipitation = 5.3 inches
Total 2007 Pumpage = 28,018 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2007 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2772.9
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet


Water Year Precipitation = 18.25 inches
Total 2006 Pumpage = 24,794 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2006 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2246.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

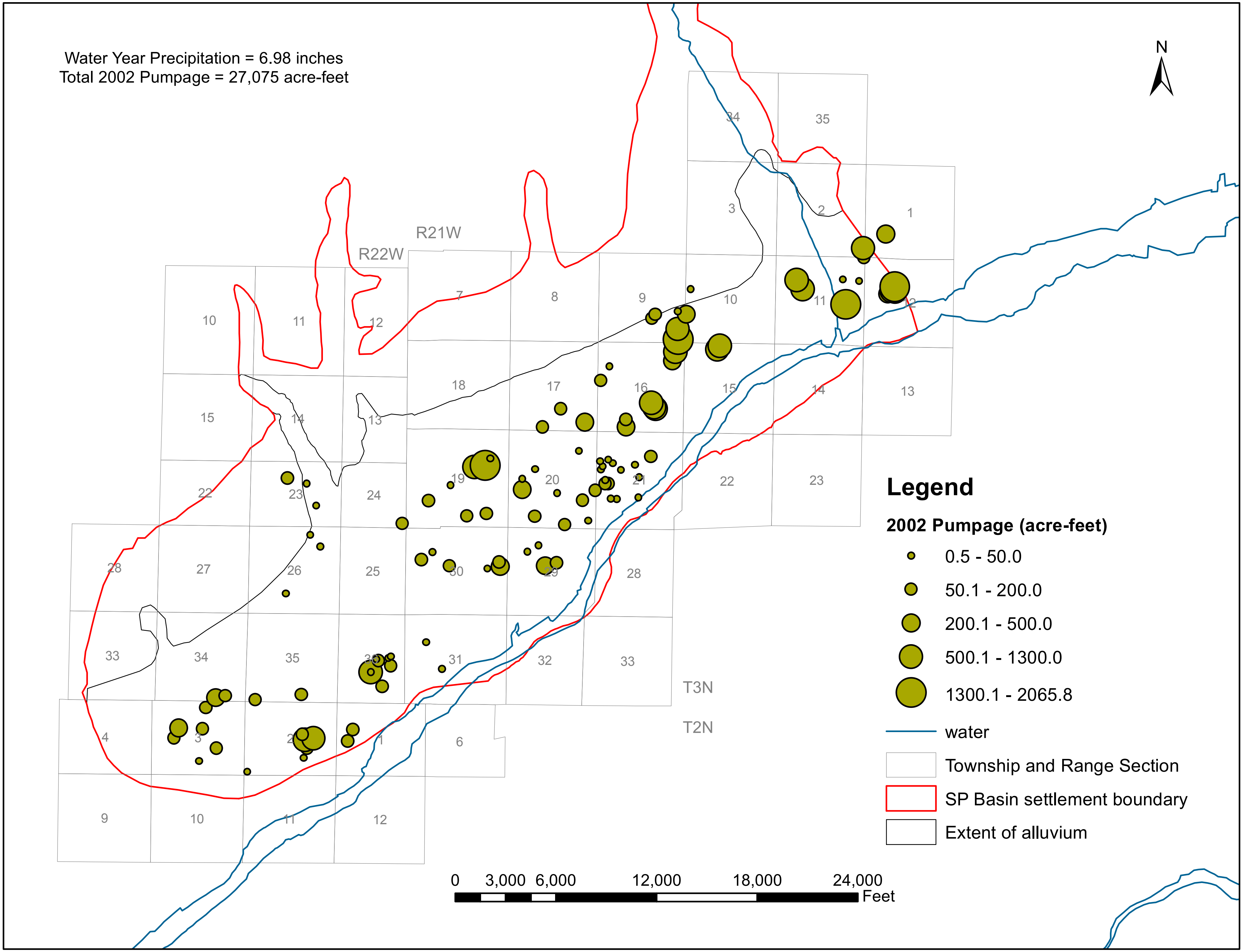


Water Year Precipitation = 40.54 inches
Total 2005 Pumpage = 24,662 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2005 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2191.2
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

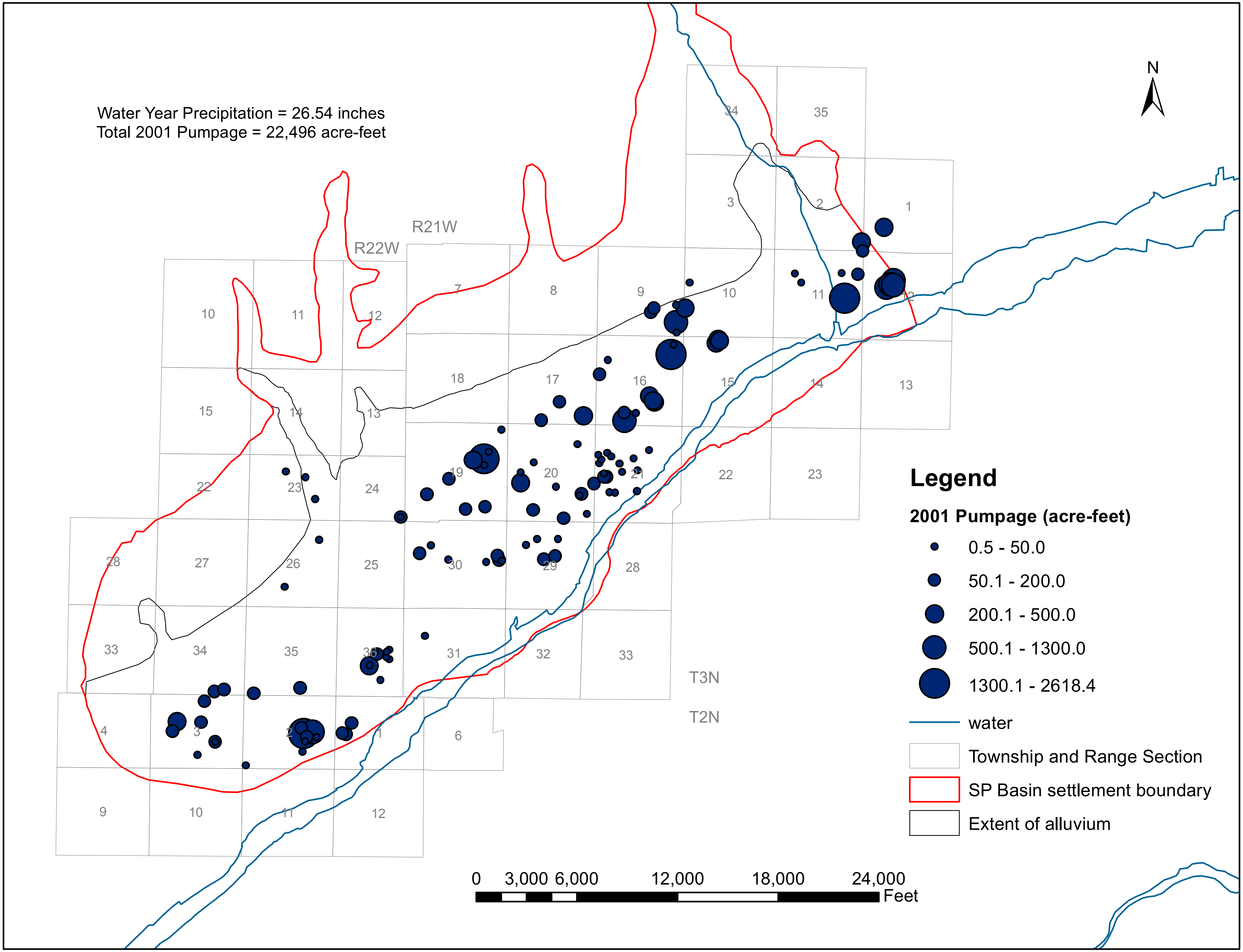

Water Year Precipitation = 12.82 inches
Total 2004 Pumpage = 27,365 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2004 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2184.3
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet



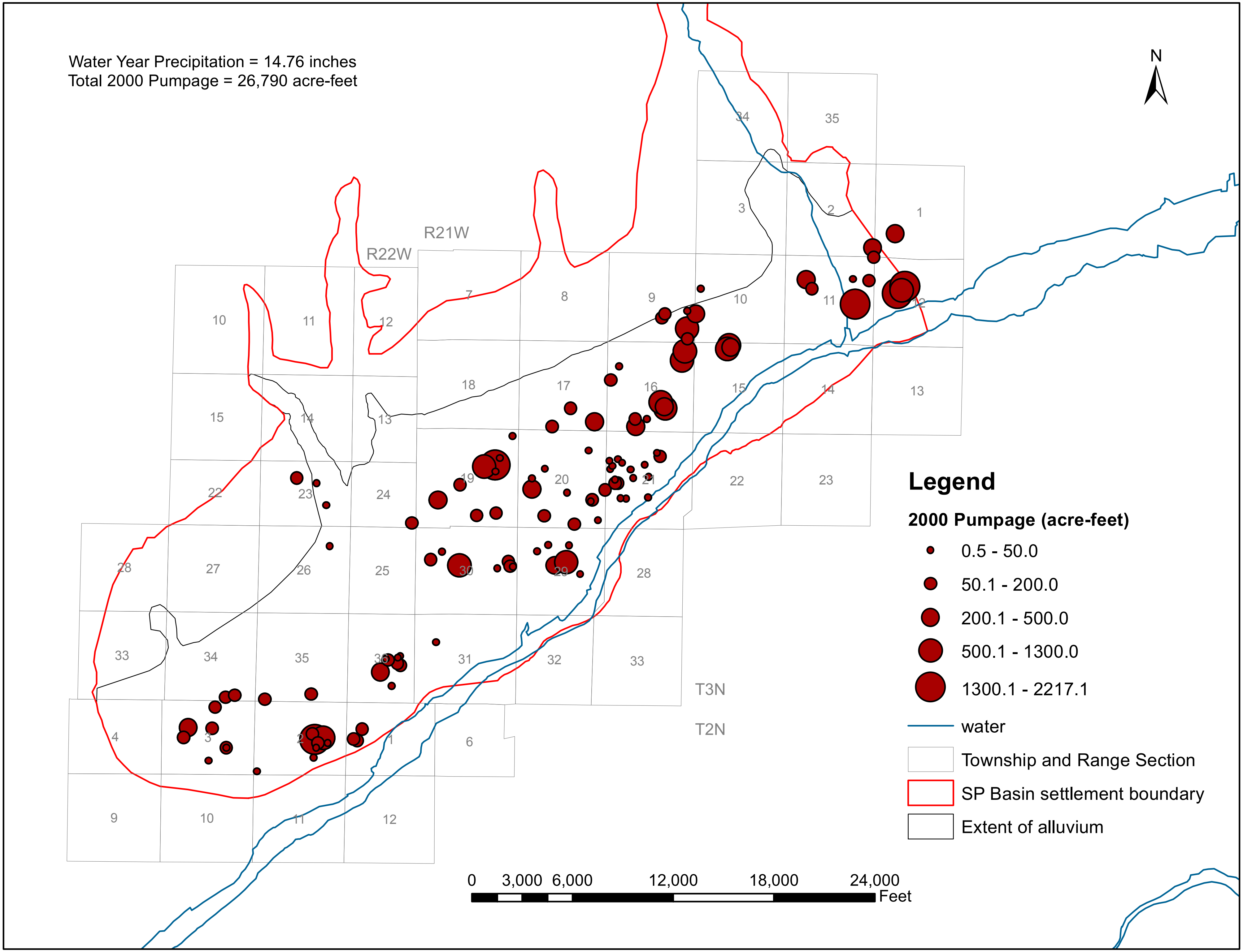
Water Year Precipitation = 19.94 inches
Total 2003 Pumpage = 22,301 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2003 Pumpage (acre-feet)
0.7 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2156.6
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



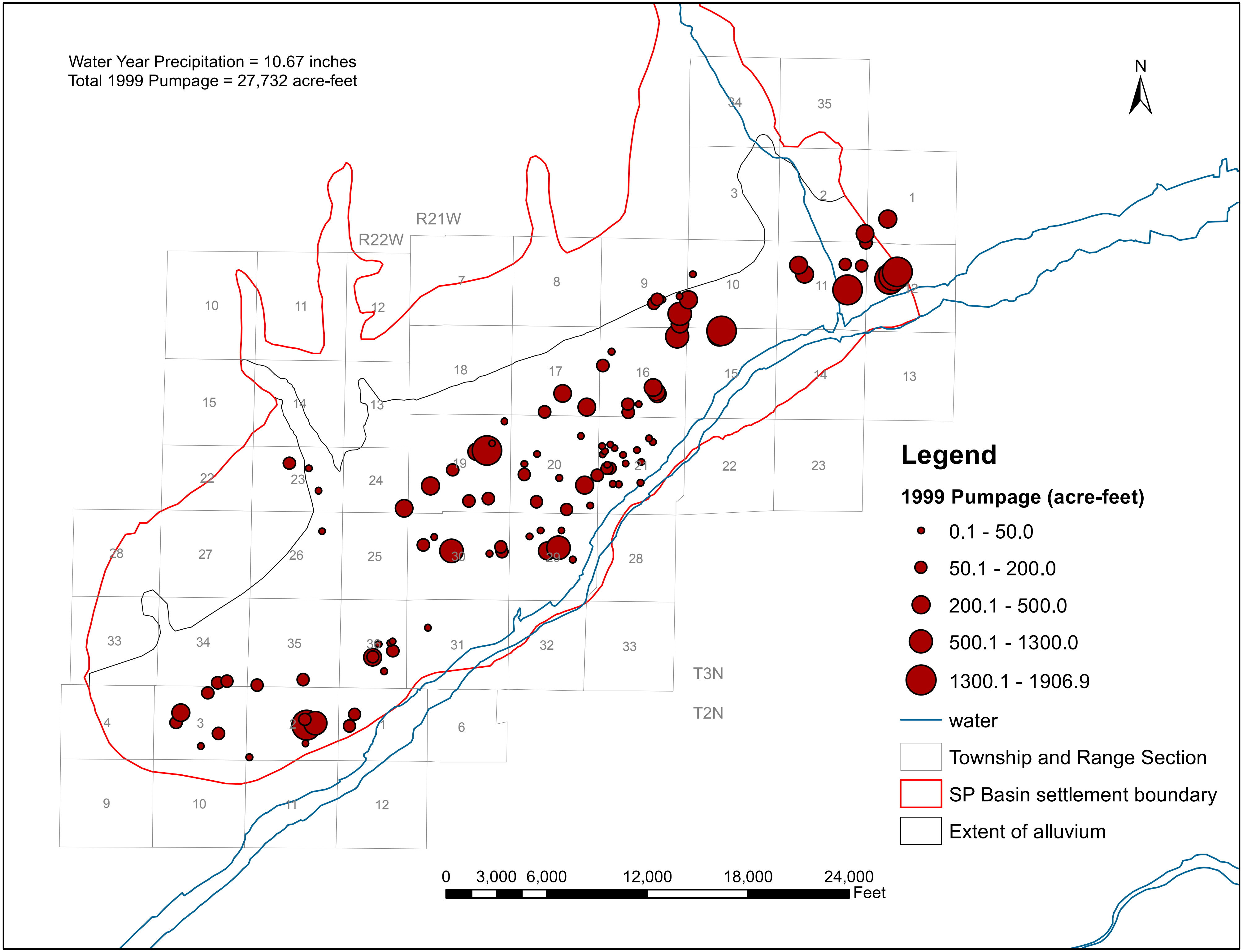
Water Year Precipitation = 6.98 inches
Total 2002 Pumpage = 27,075 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2002 Pumpage (acre-feet)
0.5 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2065.8
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



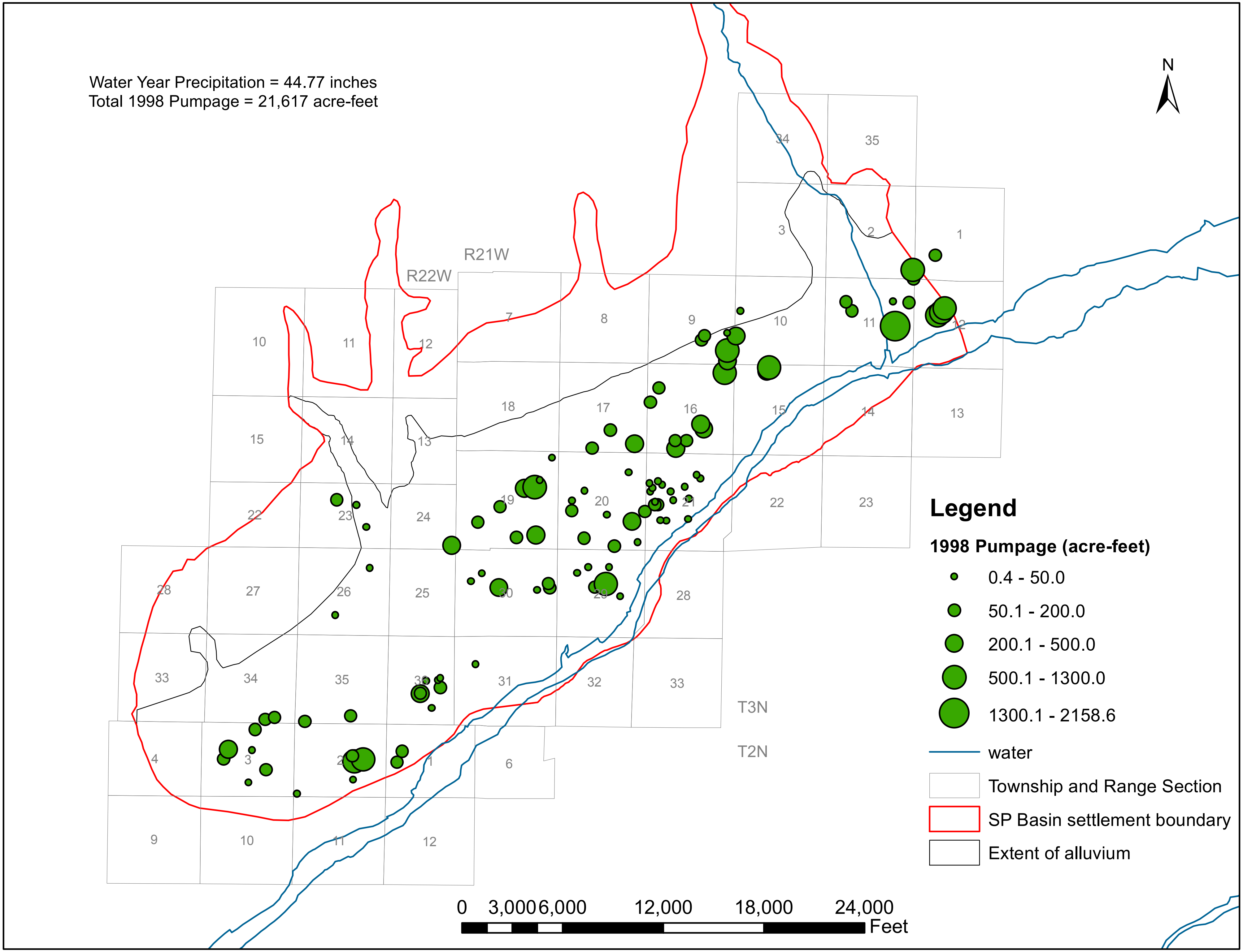
Water Year Precipitation = 26.54 inches
Total 2001 Pumpage = 22,496 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2001 Pumpage (acre-feet)
0.5 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2618.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



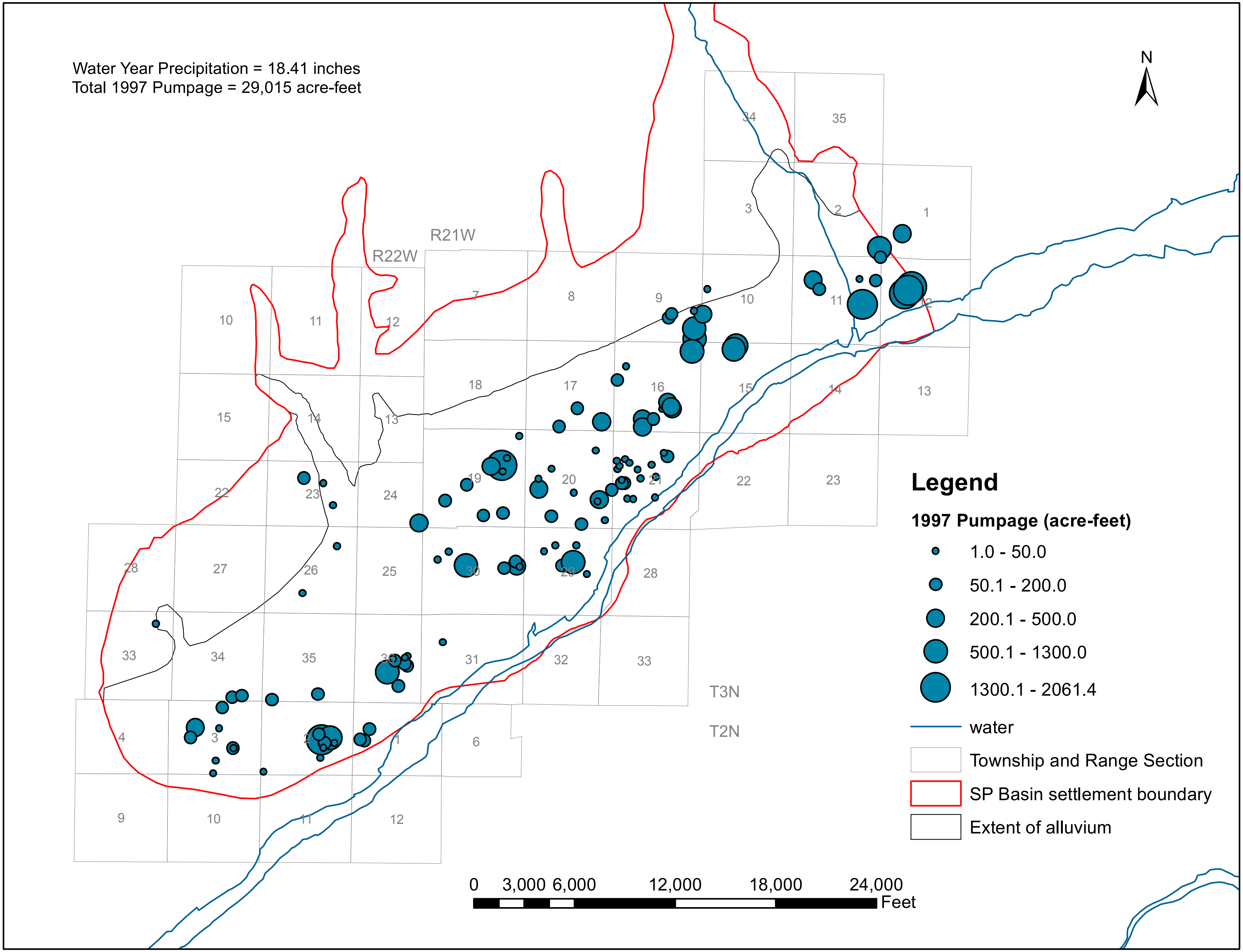
Water Year Precipitation = 14.76 inches
Total 2000 Pumpage = 26,790 acre-feet
N
R21W
R22W
T3N
T2N
Legend
2000 Pumpage (acre-feet)
0.5 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2217.1
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

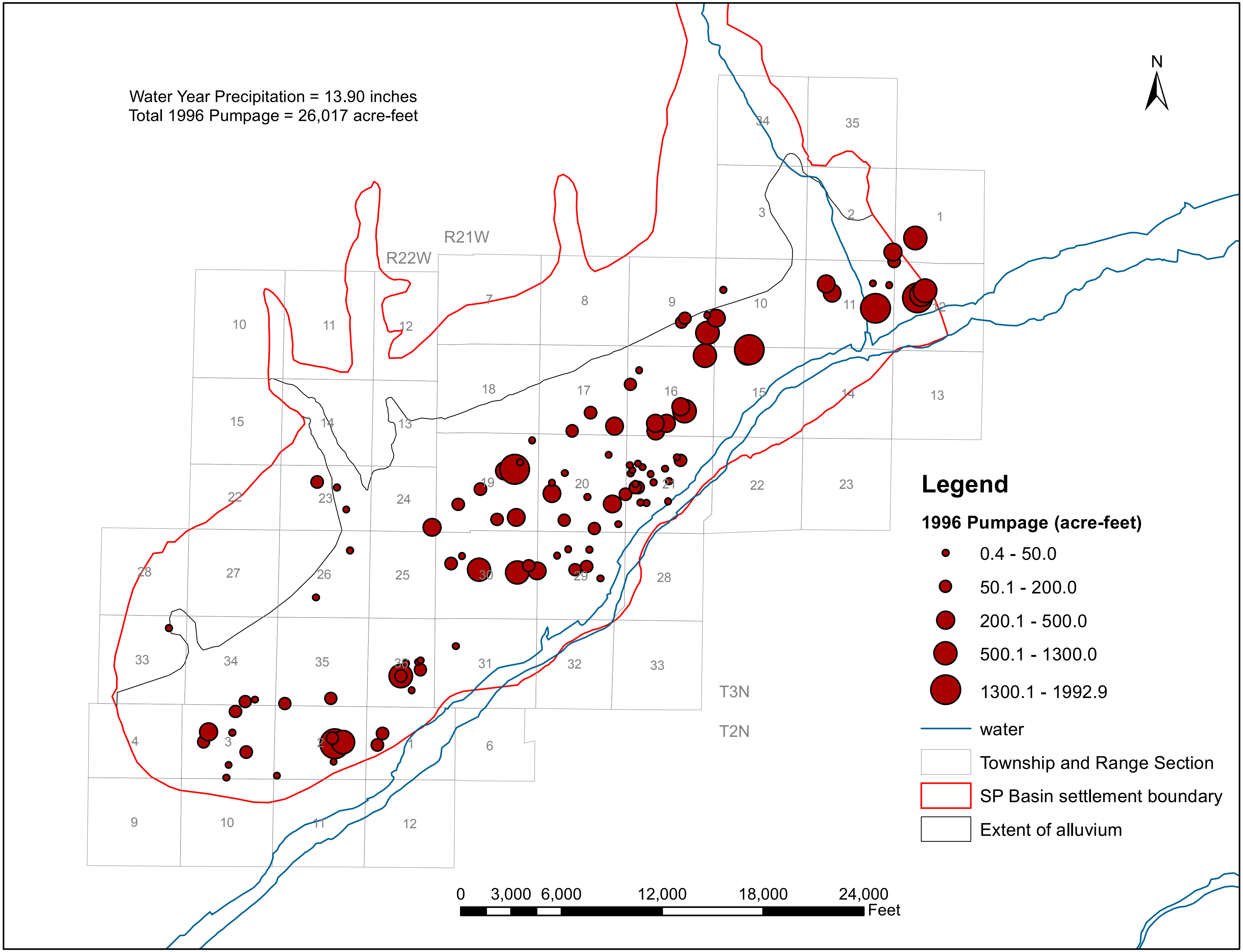


Water Year Precipitation = 10.67 inches
Total 1999 Pumpage = 27,732 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1999 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1906.9
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet

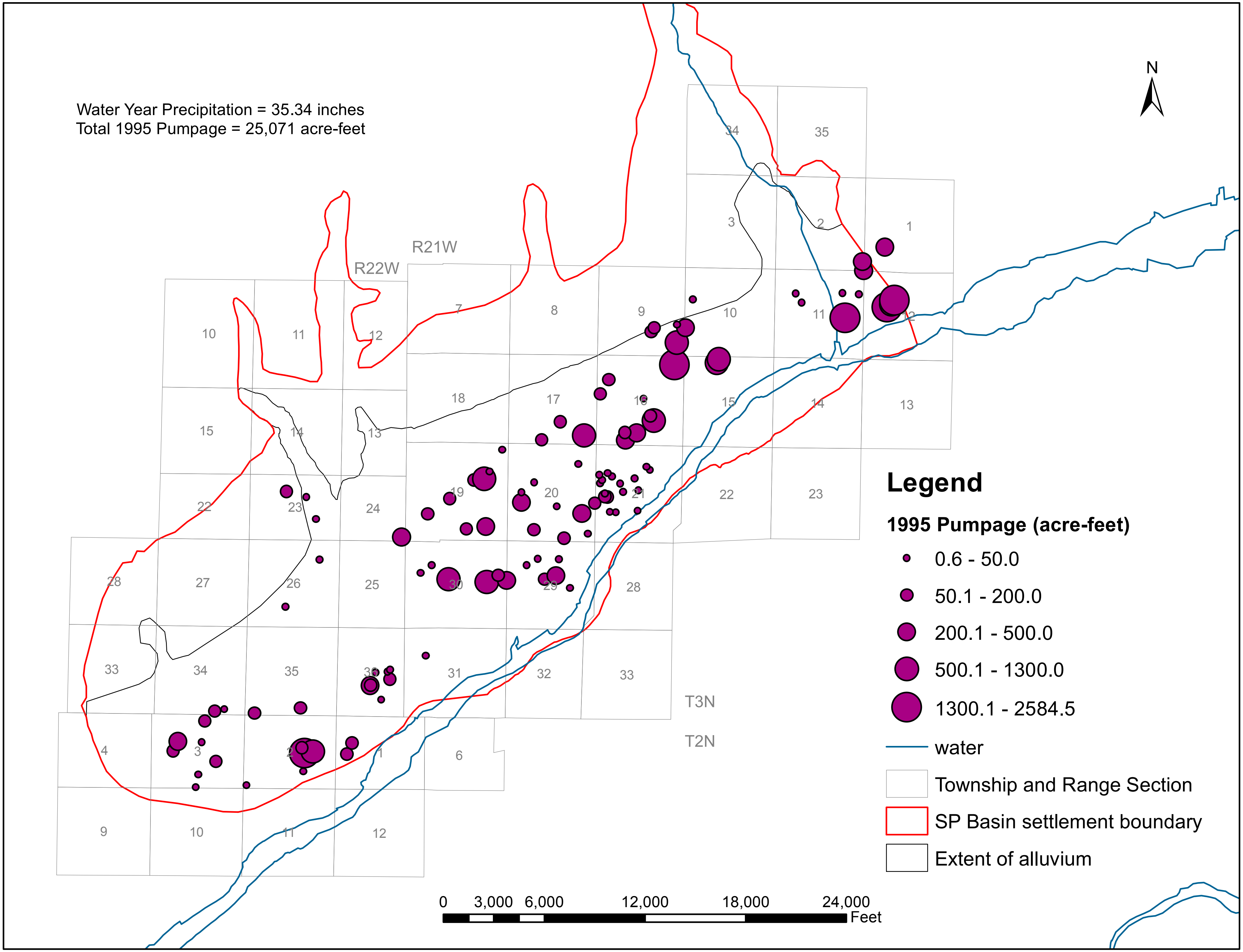


Water Year Precipitation = 44.77 inches
Total 1998 Pumpage = 21,617 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1998 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2158.6
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

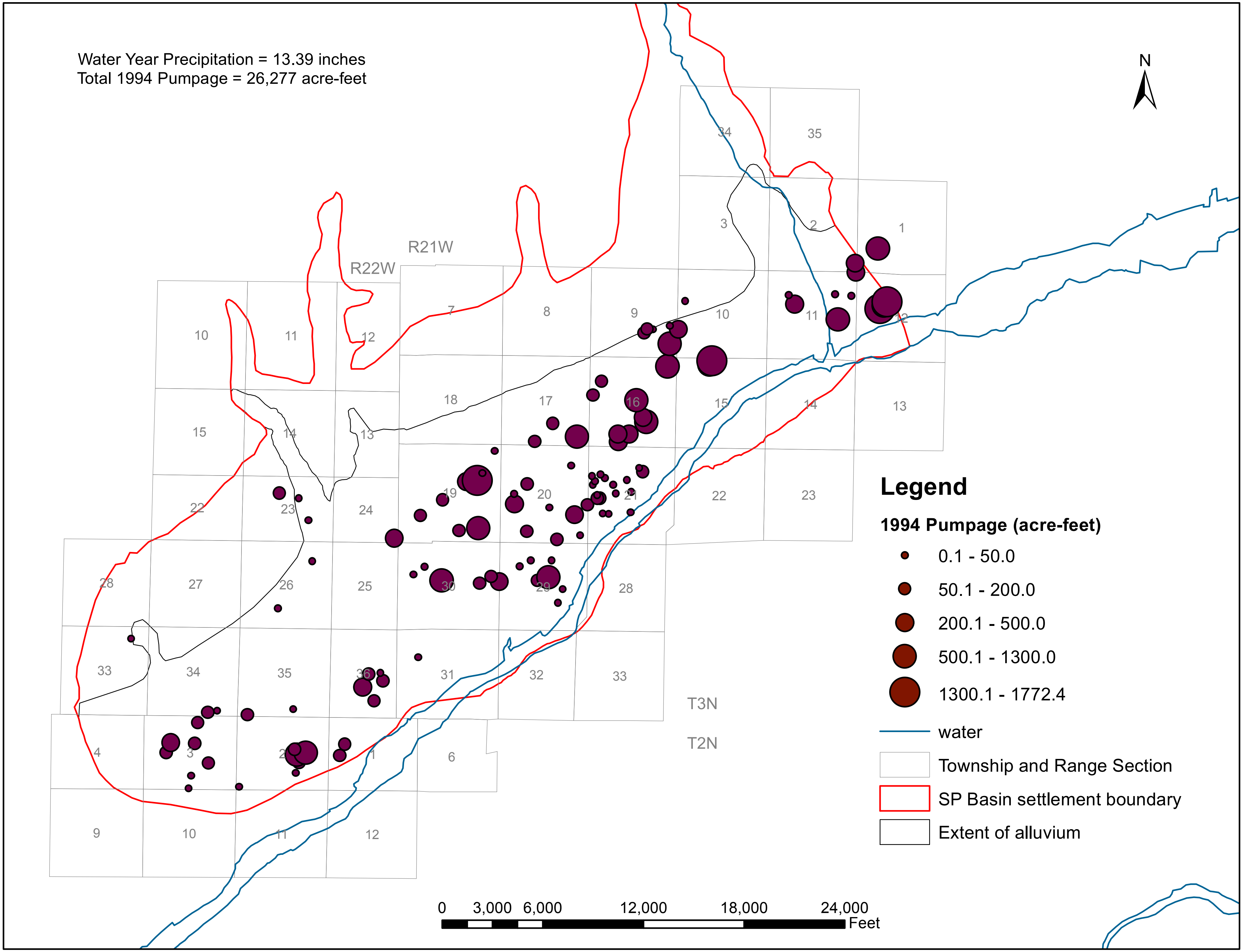

Water Year Precipitation = 18.41 inches
Total 1997 Pumpage = 29,015 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1997 Pumpage (acre-feet)
1.0 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2061.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



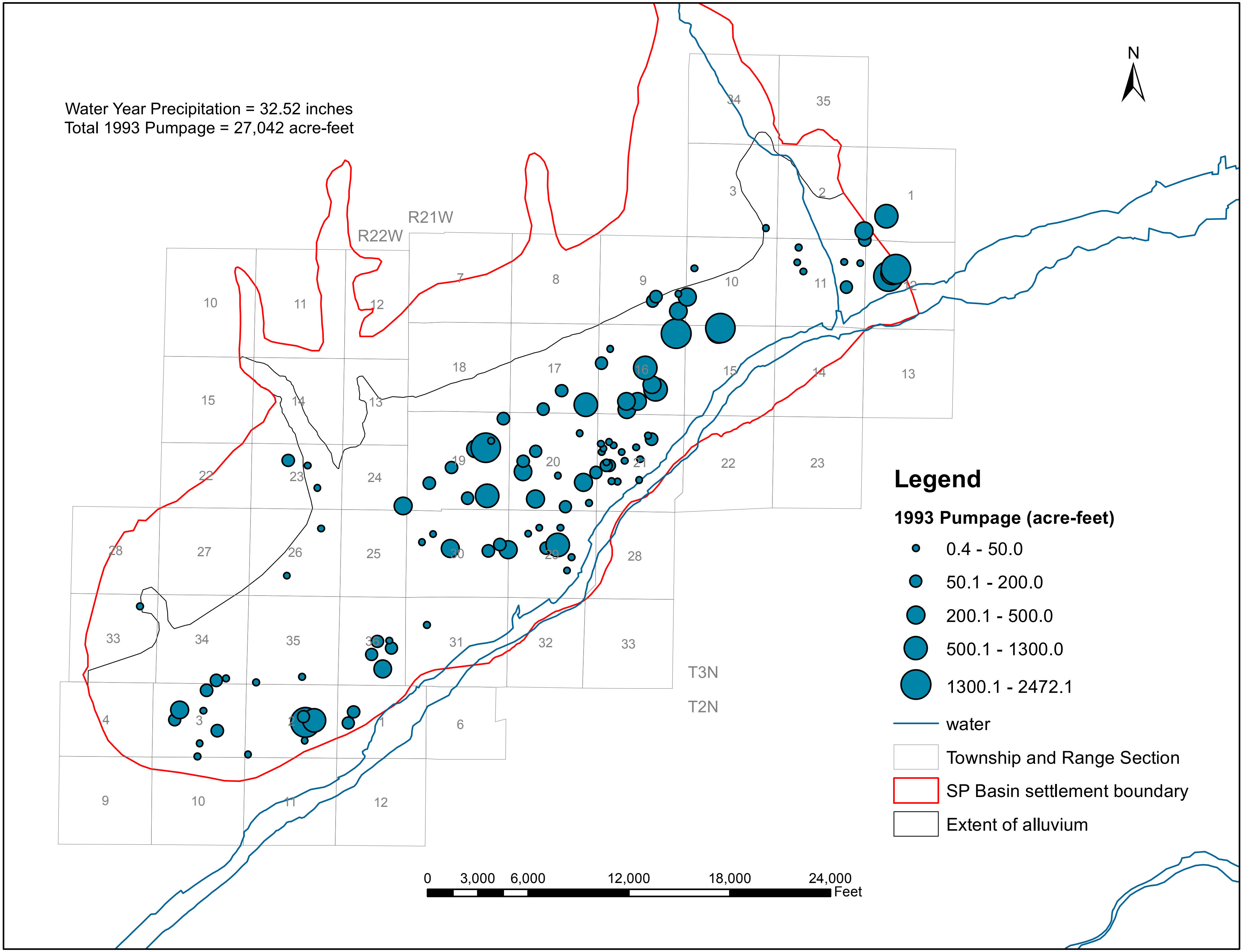
Water Year Precipitation = 13.90 inches
Total 1996 Pumpage = 26,017 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1996 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1992.9
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



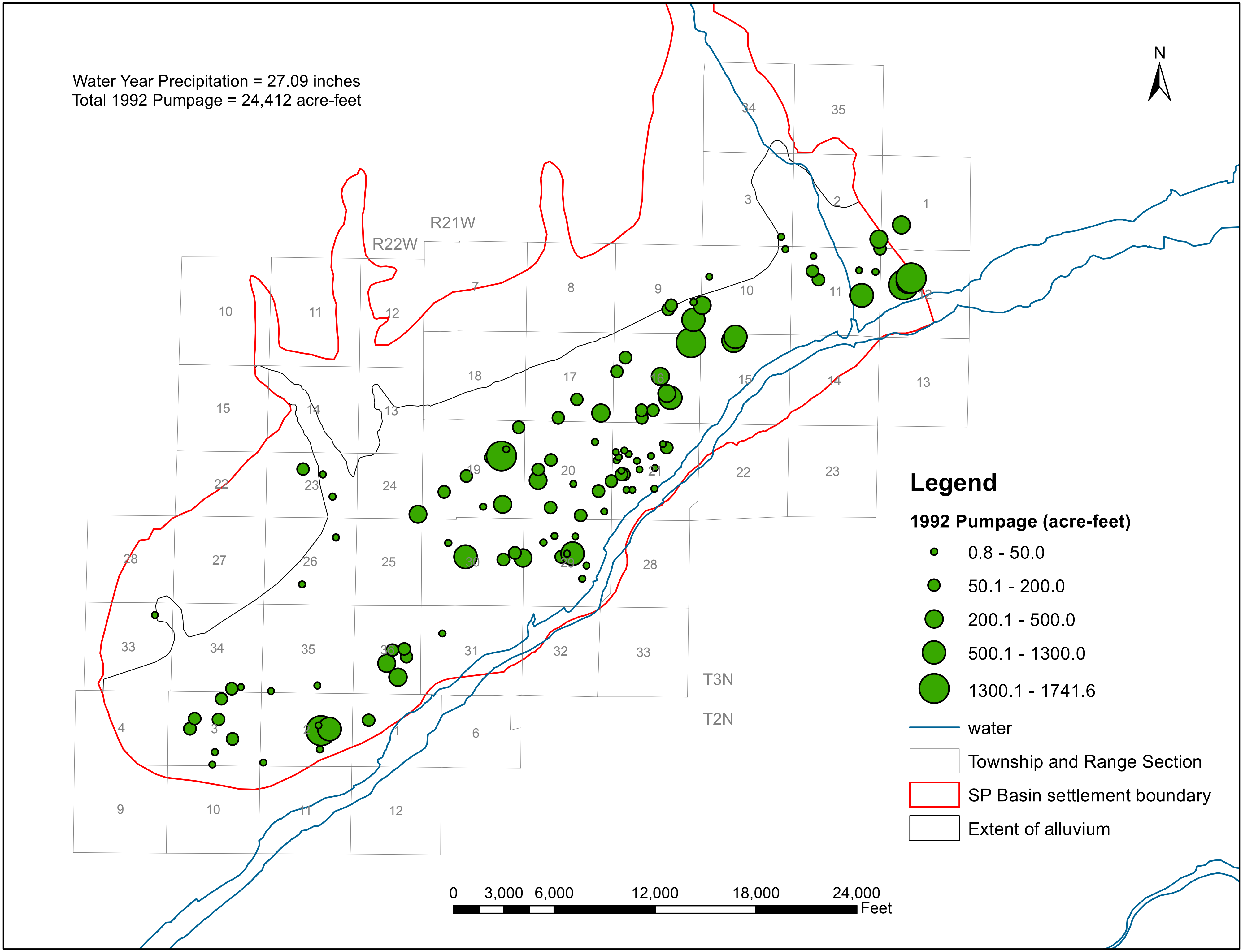
Water Year Precipitation = 35.34 inches
Total 1995 Pumpage = 25,071 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1995 Pumpage (acre-feet)
0.6 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2584.5
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

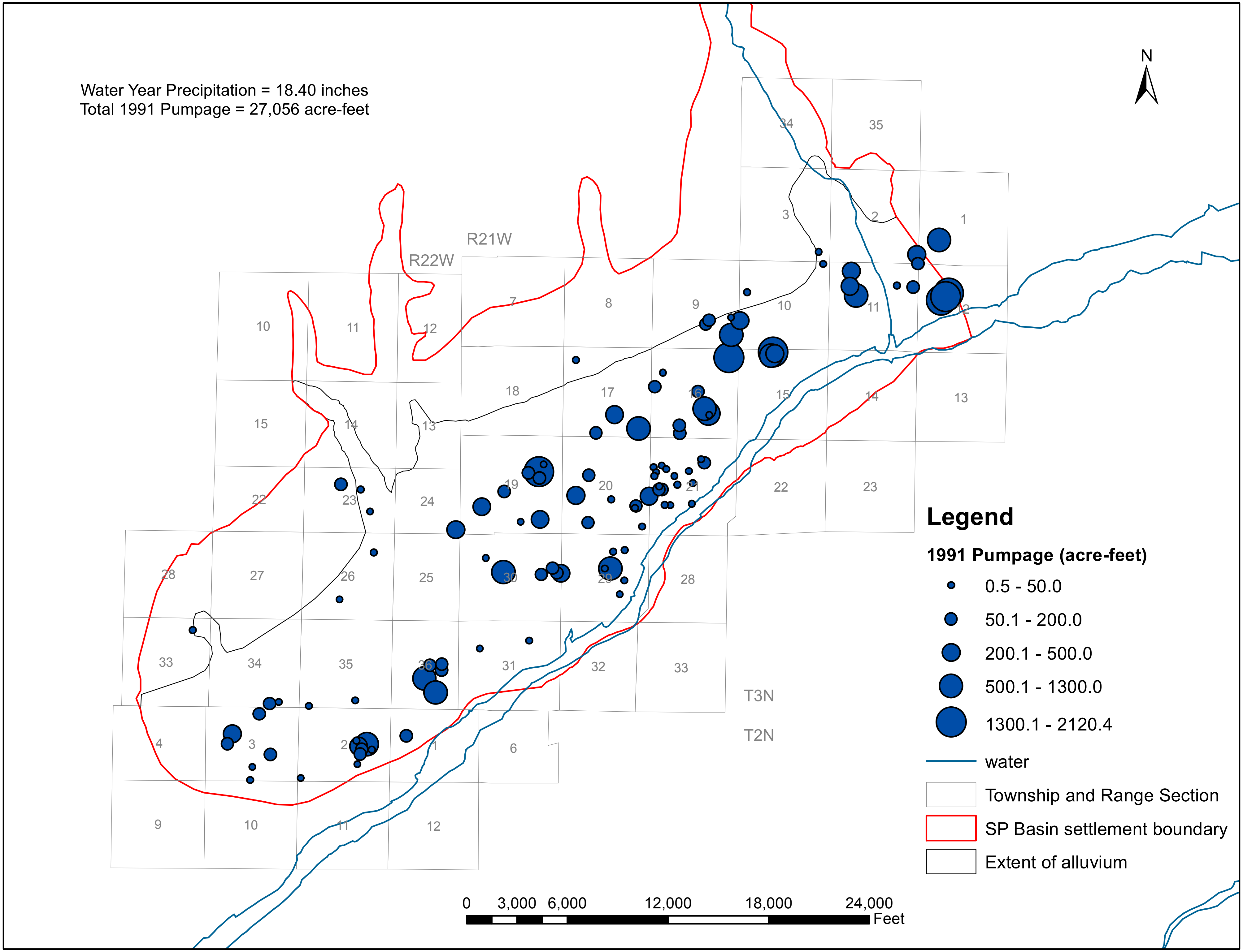


Water Year Precipitation = 13.39 inches
Total 1994 Pumpage = 26,277 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1994 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1772.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

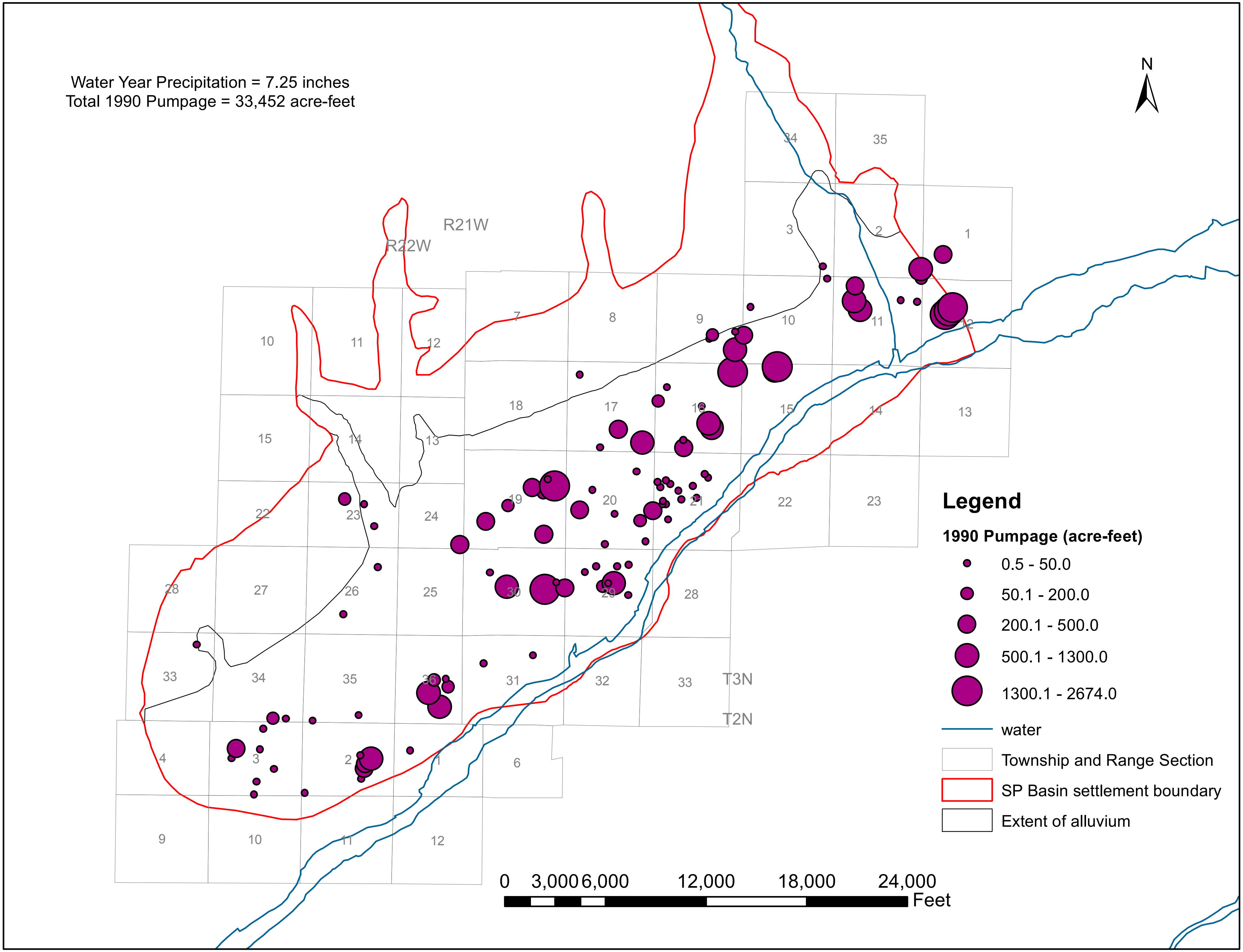


Water Year Precipitation = 32.52 inches
Total 1993 Pumpage = 27,042 acre-feet
R21W
R22W
T3N
T2N
N
Legend
1993 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2472.1
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

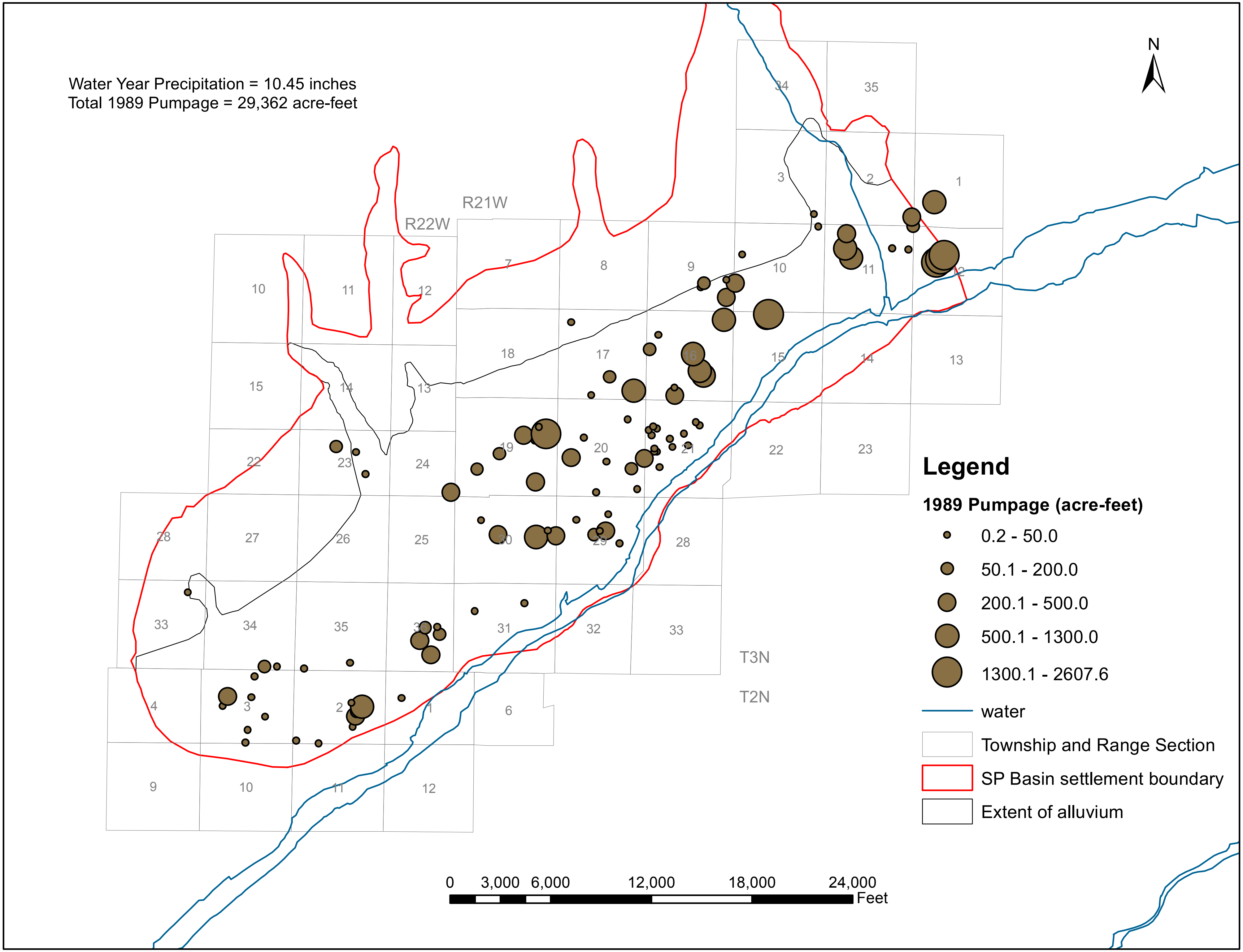

Water Year Precipitation = 27.09 inches
Total 1992 Pumpage = 24,412 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1992 Pumpage (acre-feet)
0.8 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1741.6
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



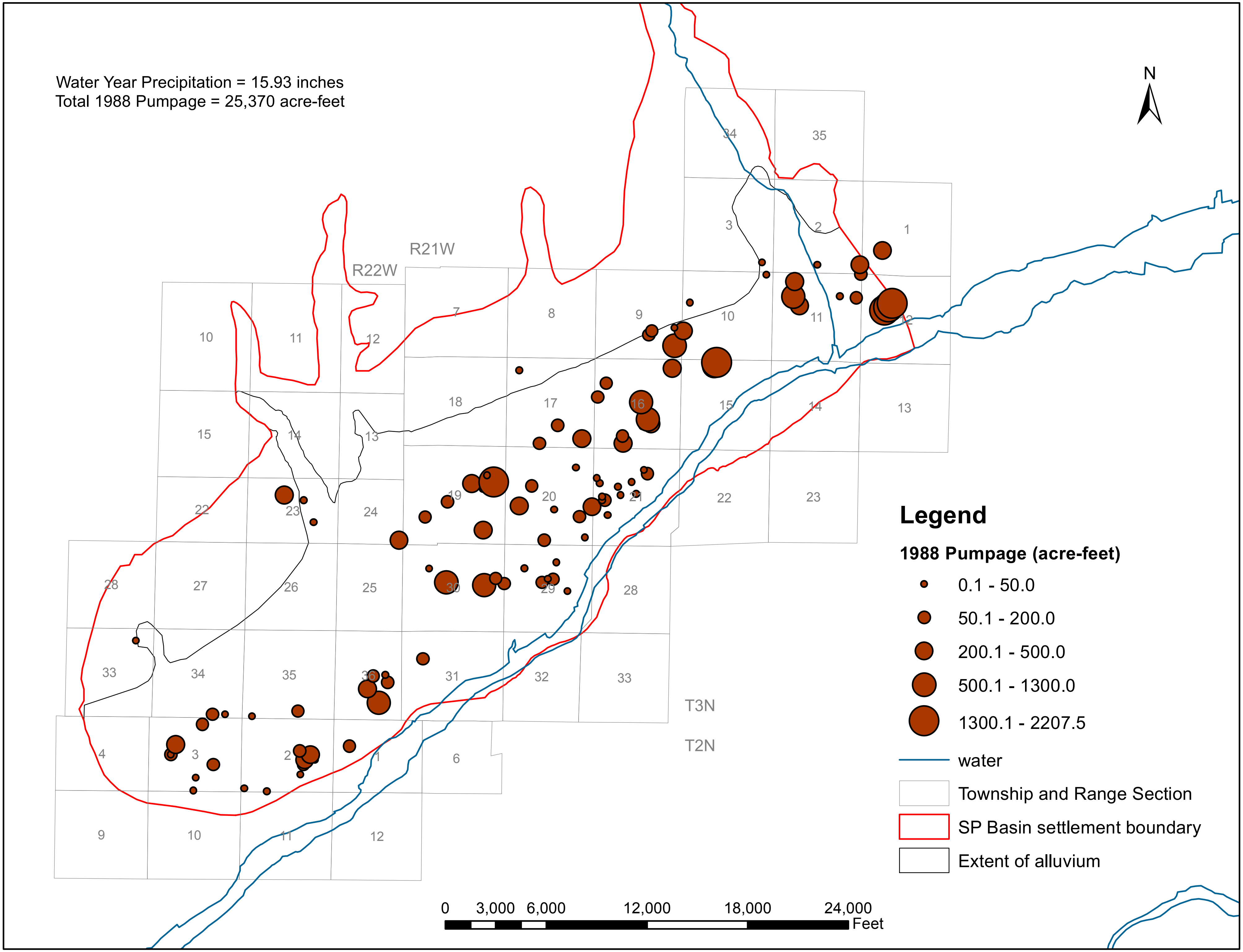
Water Year Precipitation = 18.40 inches
Total 1991 Pumpage = 27,056 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1991 Pumpage (acre-feet)
0.5 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2120.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



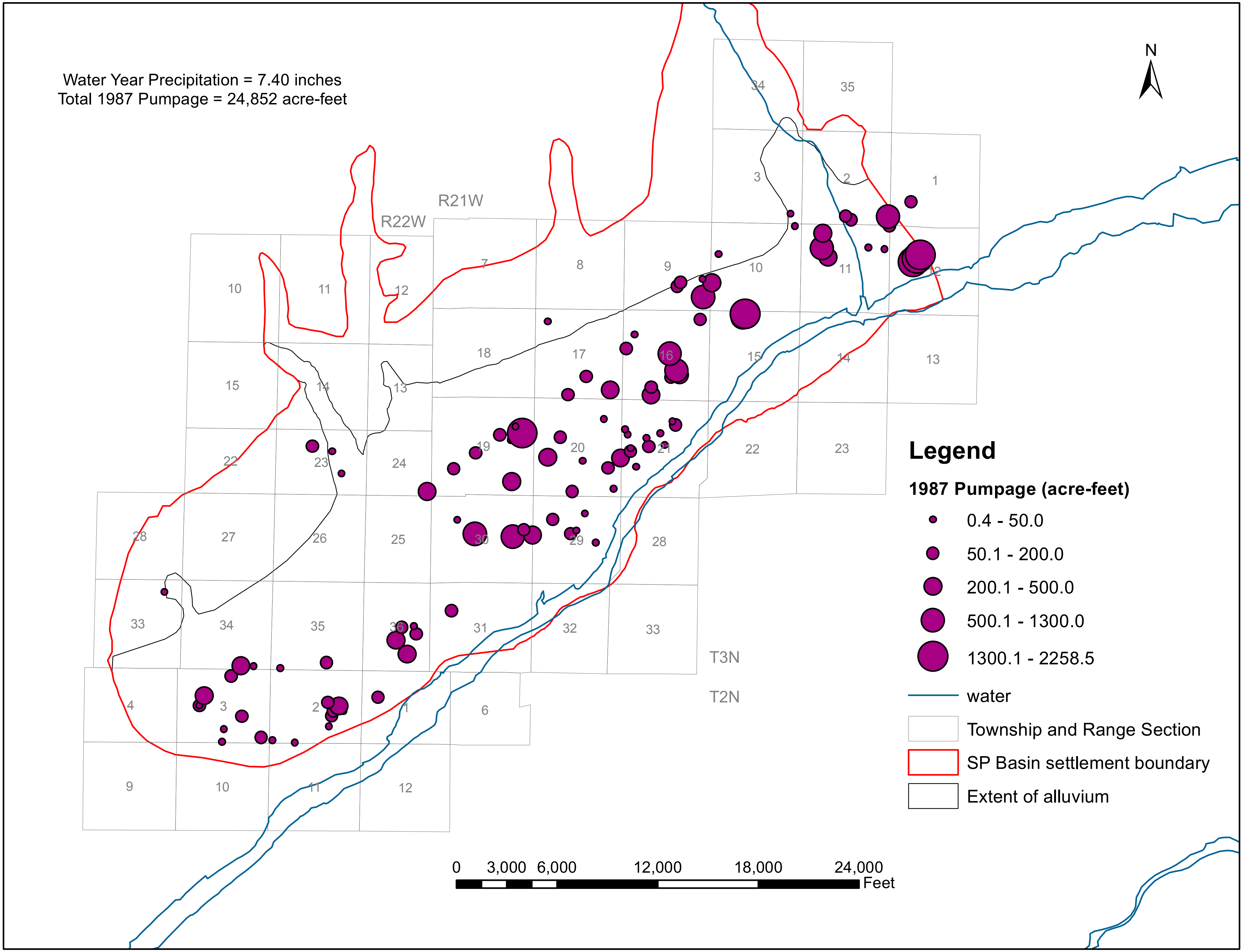
Water Year Precipitation = 7.25 inches
Total 1990 Pumpage = 33,452 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1990 Pumpage (acre-feet)
0.5 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2674.0
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



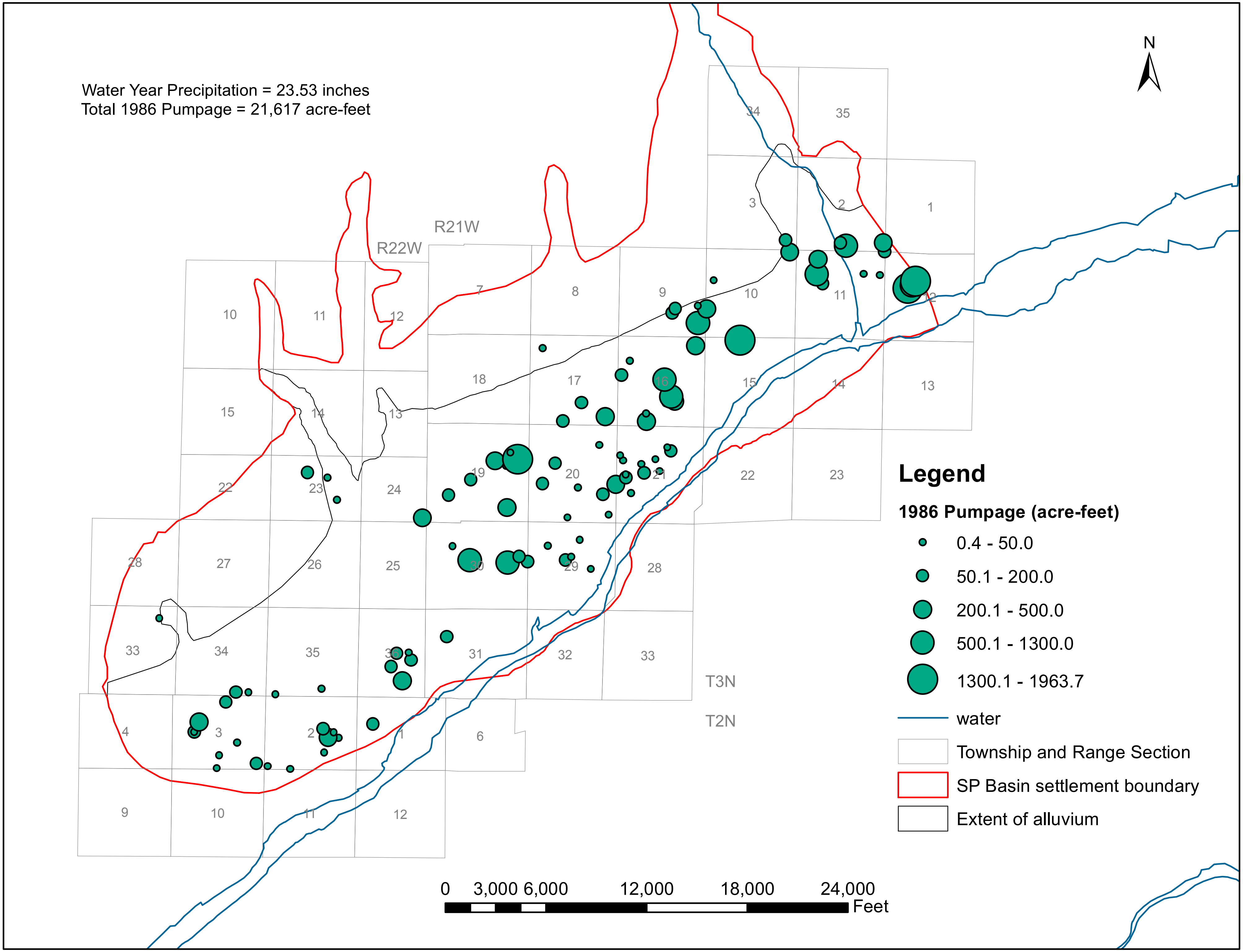
Water Year Precipitation = 10.45 inches
Total 1989 Pumpage = 29,362 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1989 Pumpage (acre-feet)
0.2 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2607.6
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

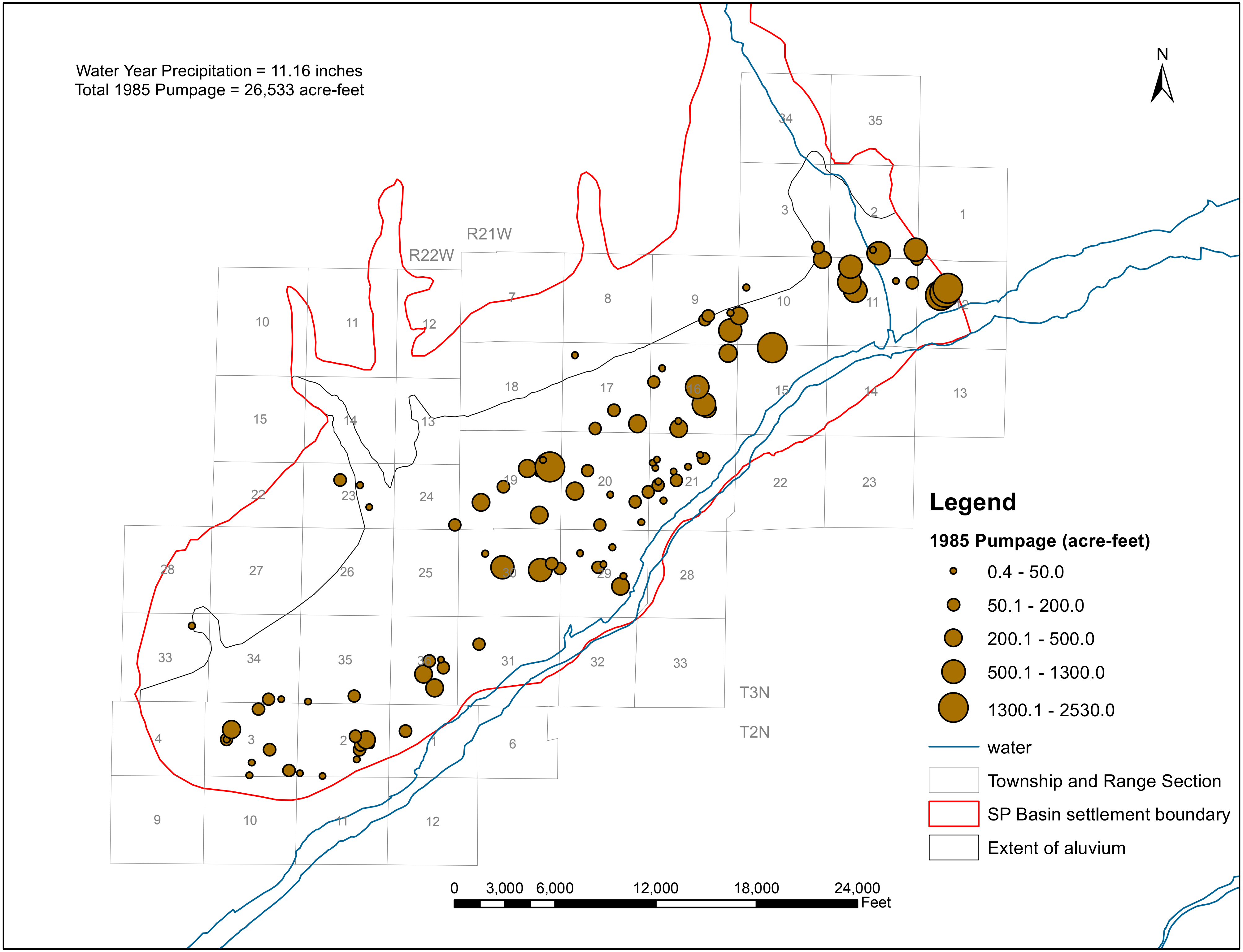


Water Year Precipitation = 15.93 inches
Total 1988 Pumpage = 25,370 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1988 Pumpage (acre-feet)
0.1 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2207.5
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

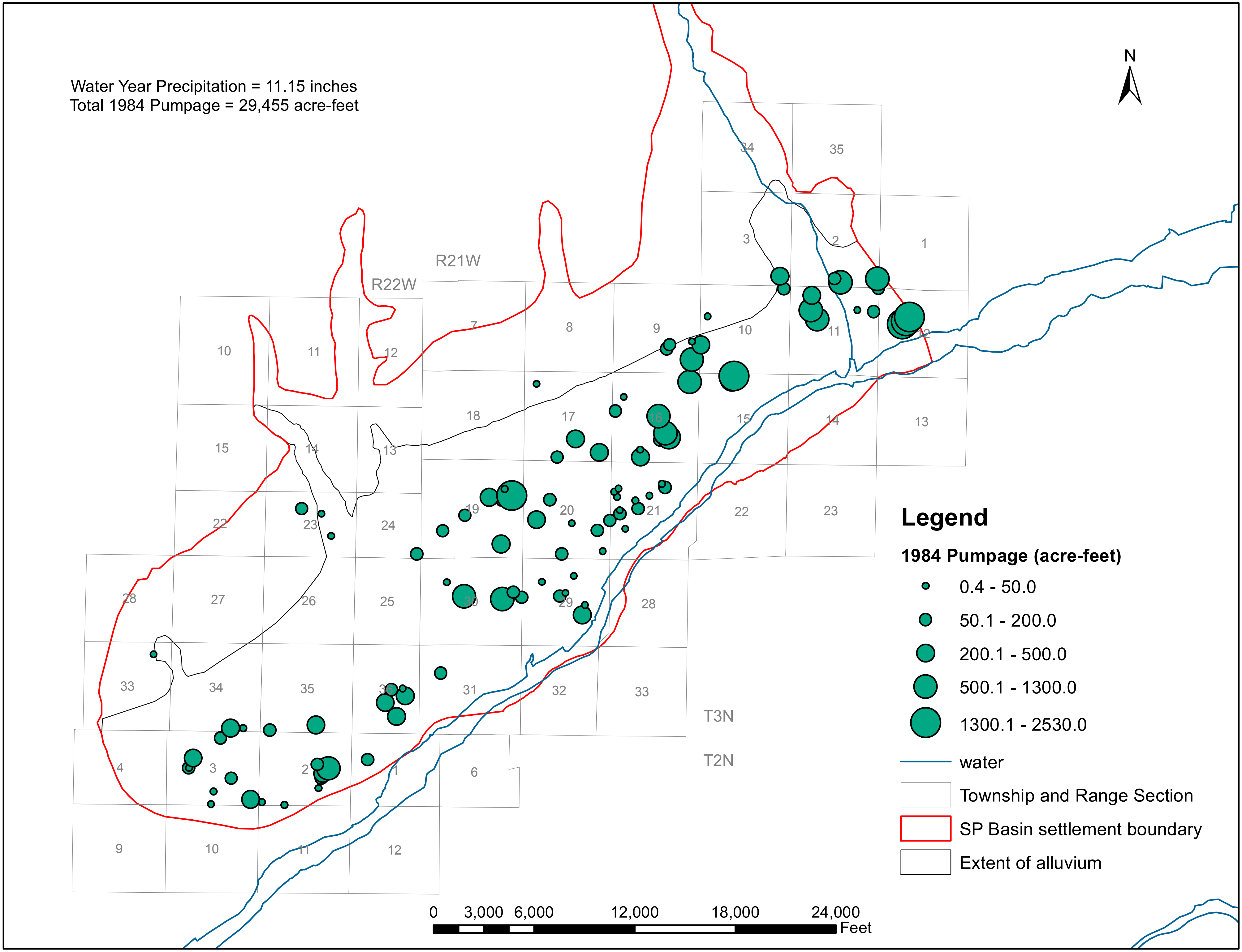


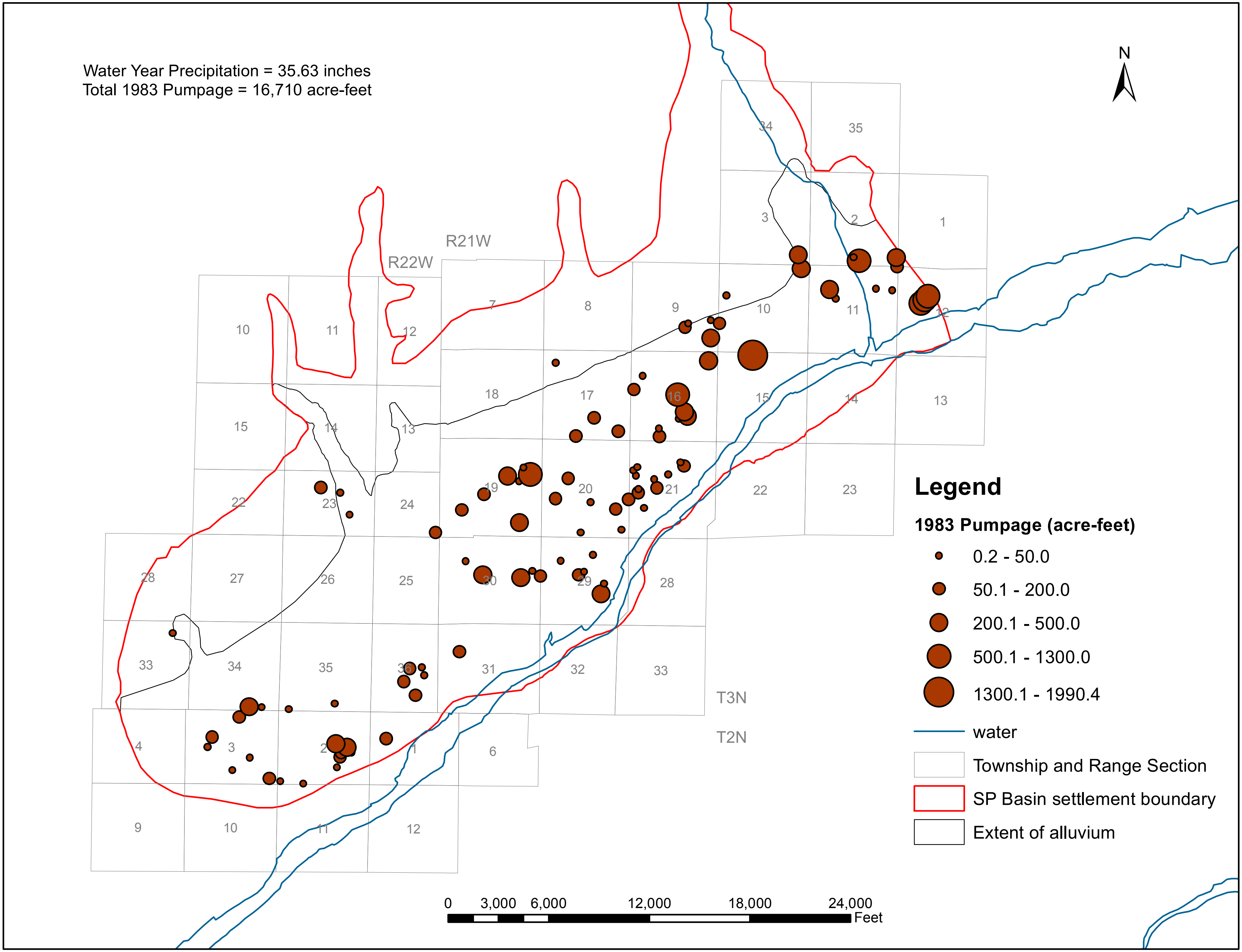
Water Year Precipitation = 7.40 inches
Total 1987 Pumpage = 24,852 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1987 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2258.5
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet


Water Year Precipitation = 23.53 inches
Total 1986 Pumpage = 21,617 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1986 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1963.7
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

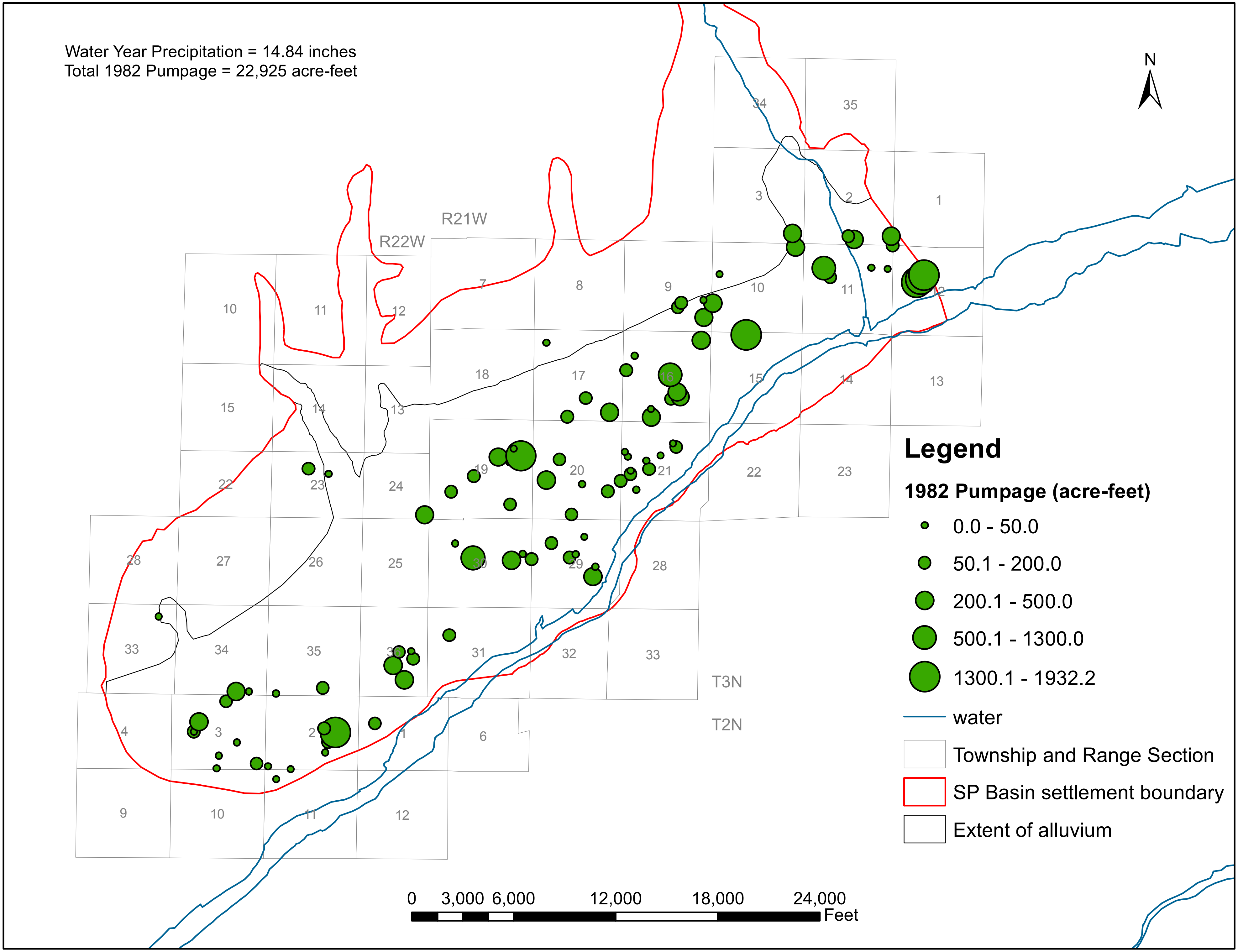


Water Year Precipitation = 11.16 inches
Total 1985 Pumpage = 26,533 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1985 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2530.0
water
Township and Range Section
SP Basin settlement boundary
Extent of aluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

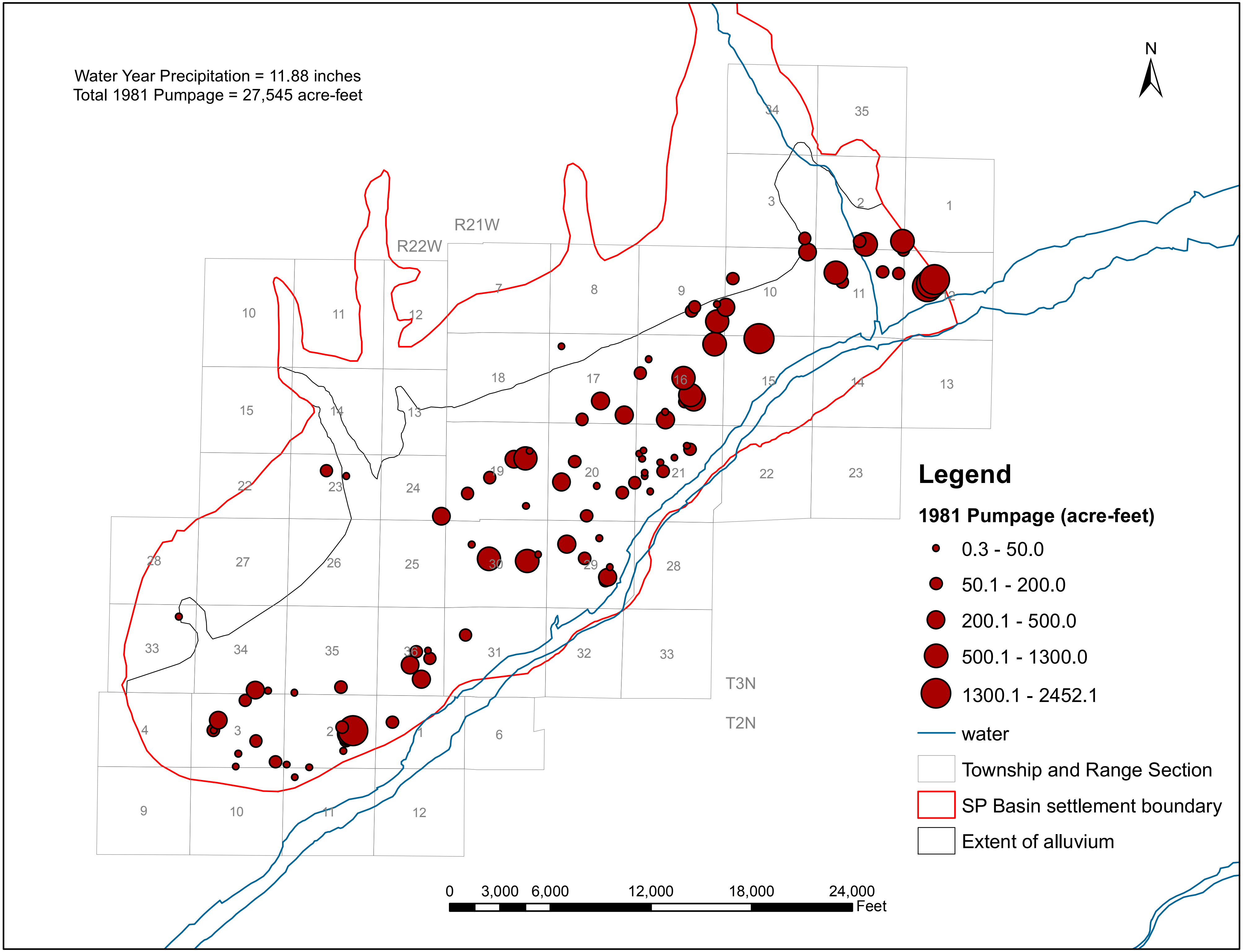

Water Year Precipitation = 11.15 inches
Total 1984 Pumpage = 29,455 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1984 Pumpage (acre-feet)
0.4 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2530.0
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

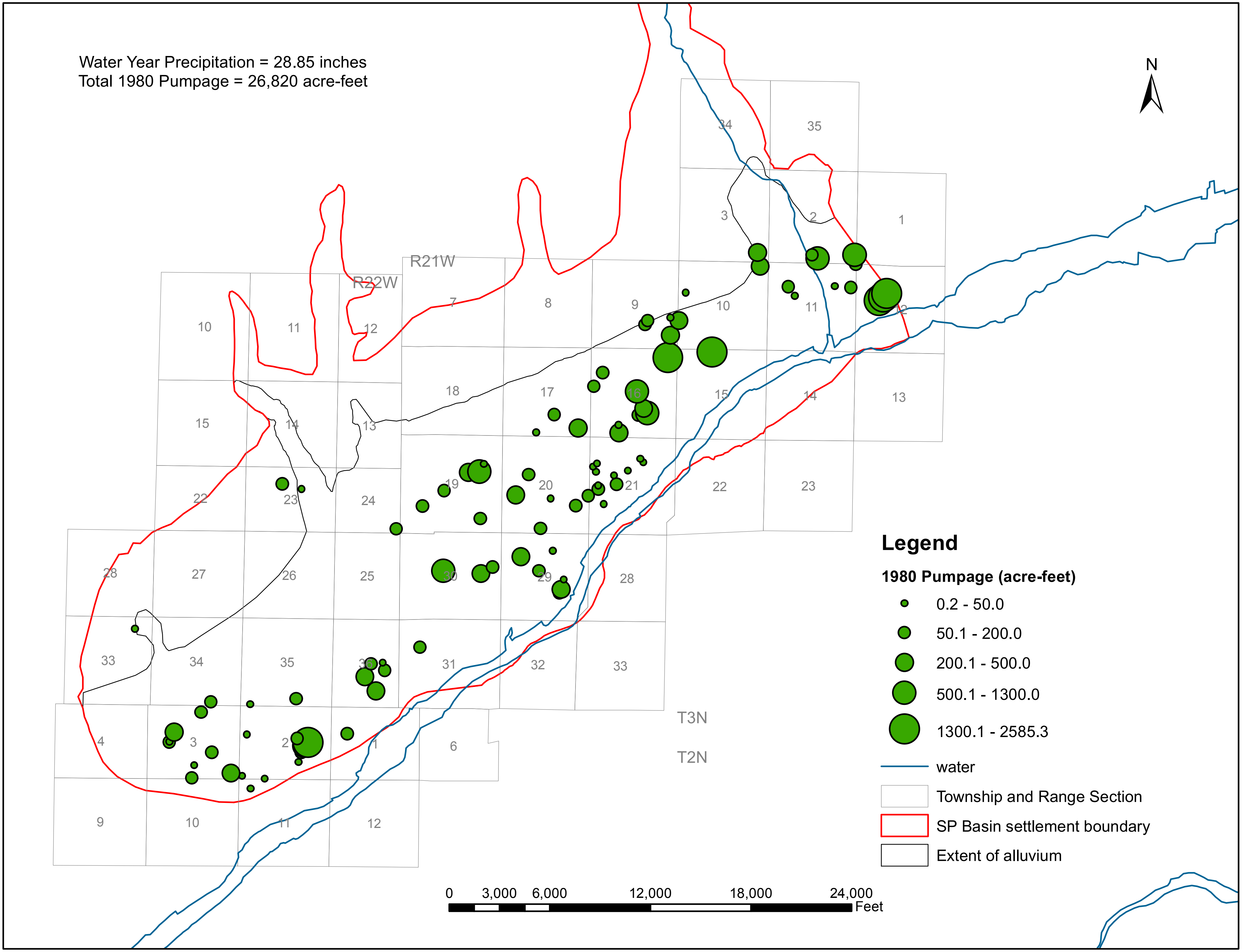


Water Year Precipitation = 35.63 inches
Total 1983 Pumpage = 16,710 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1983 Pumpage (acre-feet)
0.2 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1990.4
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



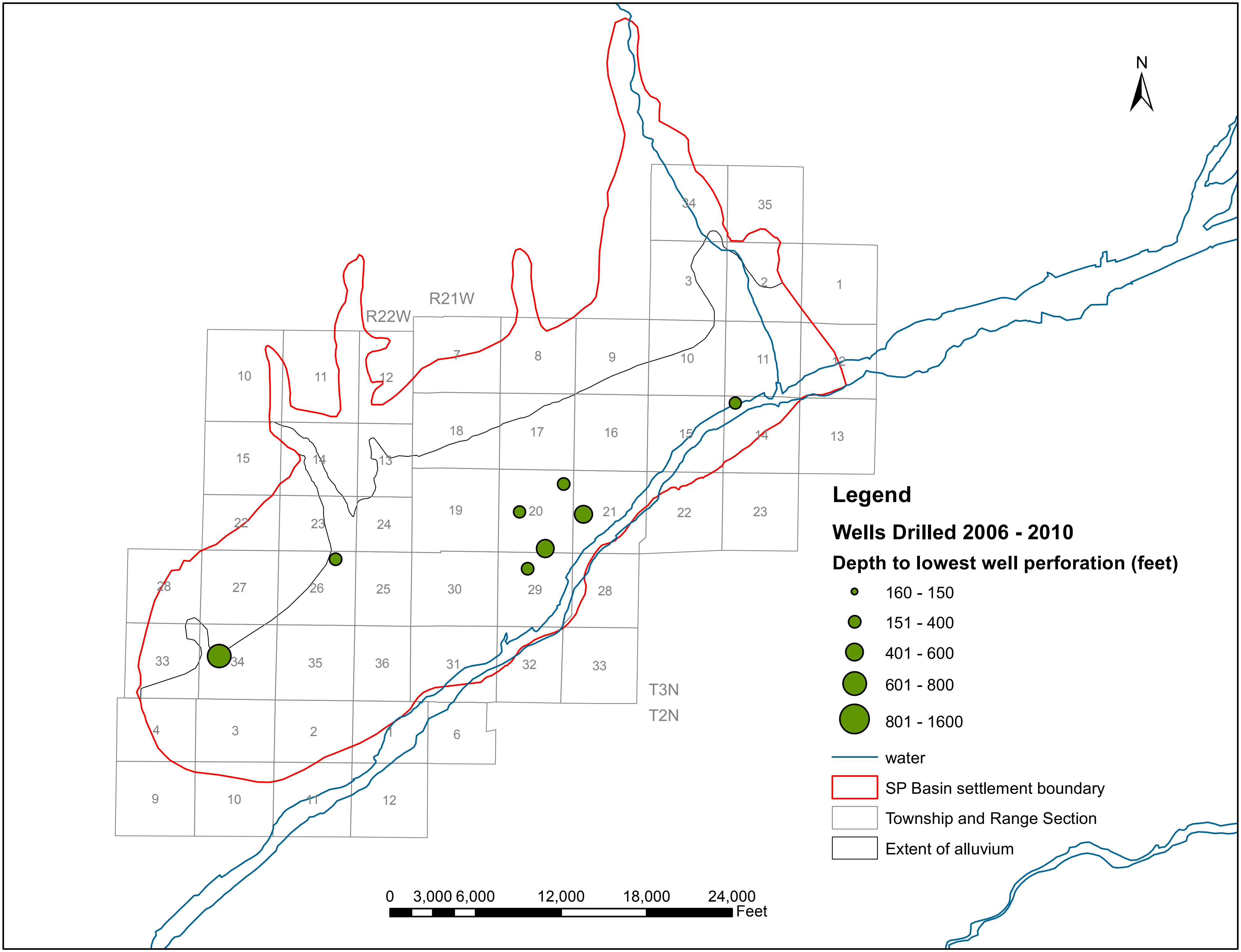
Water Year Precipitation = 14.84 inches
Total 1982 Pumpage = 22,925 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1982 Pumpage (acre-feet)
0.0 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 1932.2
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

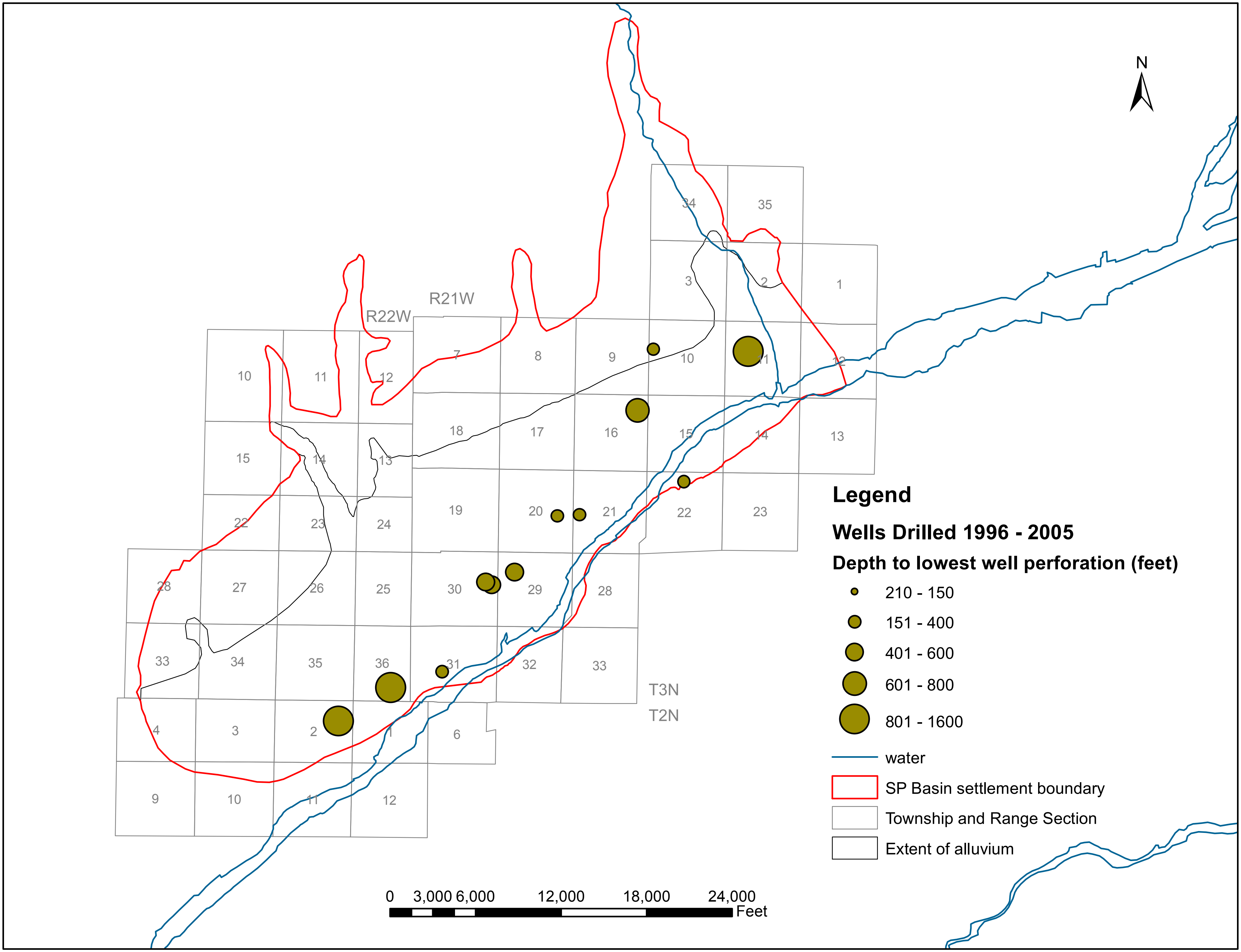

Water Year Precipitation = 11.88 inches
Total 1981 Pumpage = 27,545 acre-feet
N
R21W
R22W
T3N
T2N
0
3,000
6,000
12,000
18,000
24,000
Feet
Legend
1981 Pumpage (acre-feet)
0.3 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2452.1
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium

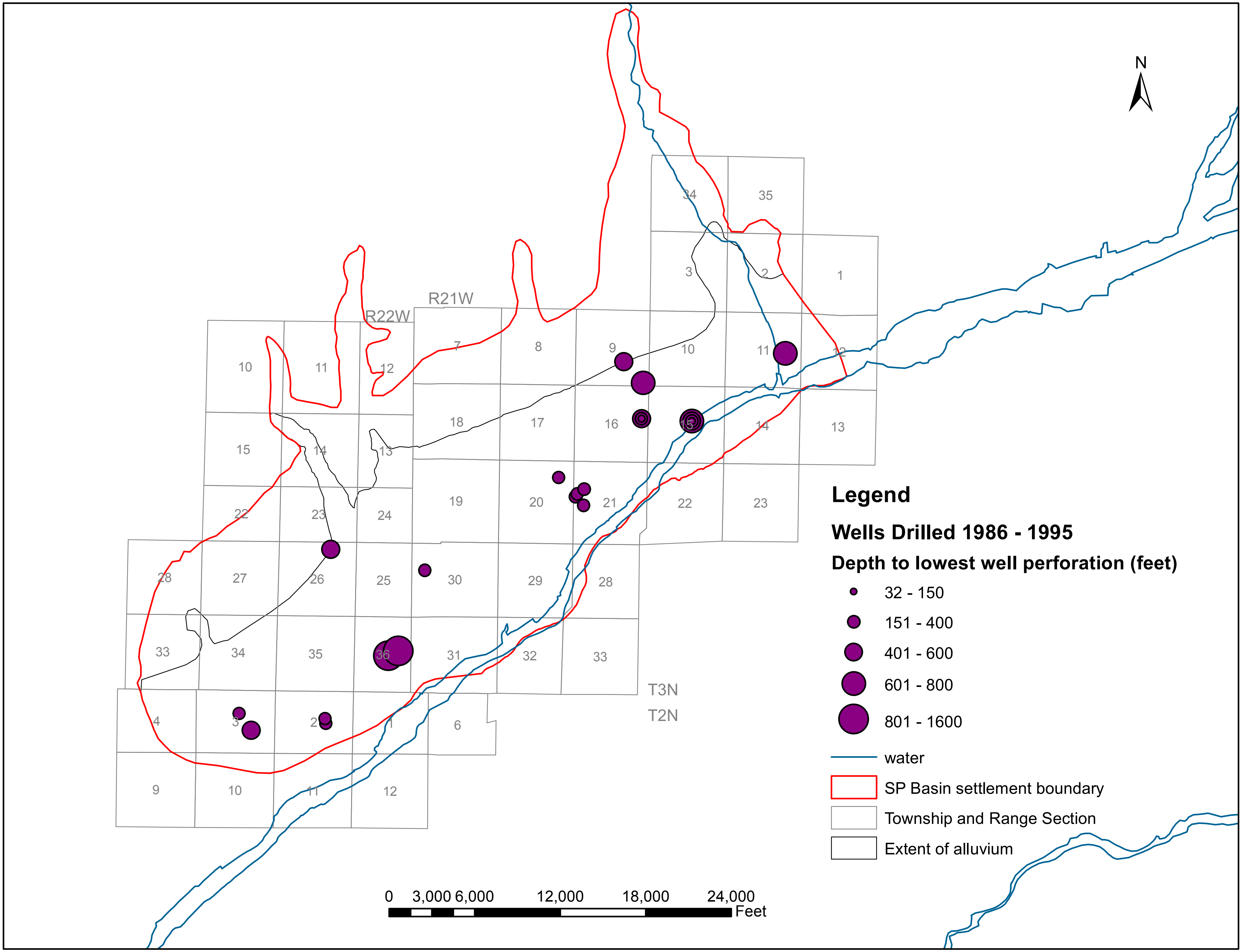


Water Year Precipitation = 28.85 inches
Total 1980 Pumpage = 26,820 acre-feet
N
R21W
R22W
T3N
T2N
Legend
1980 Pumpage (acre-feet)
0.2 - 50.0
50.1 - 200.0
200.1 - 500.0
500.1 - 1300.0
1300.1 - 2585.3
water
Township and Range Section
SP Basin settlement boundary
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

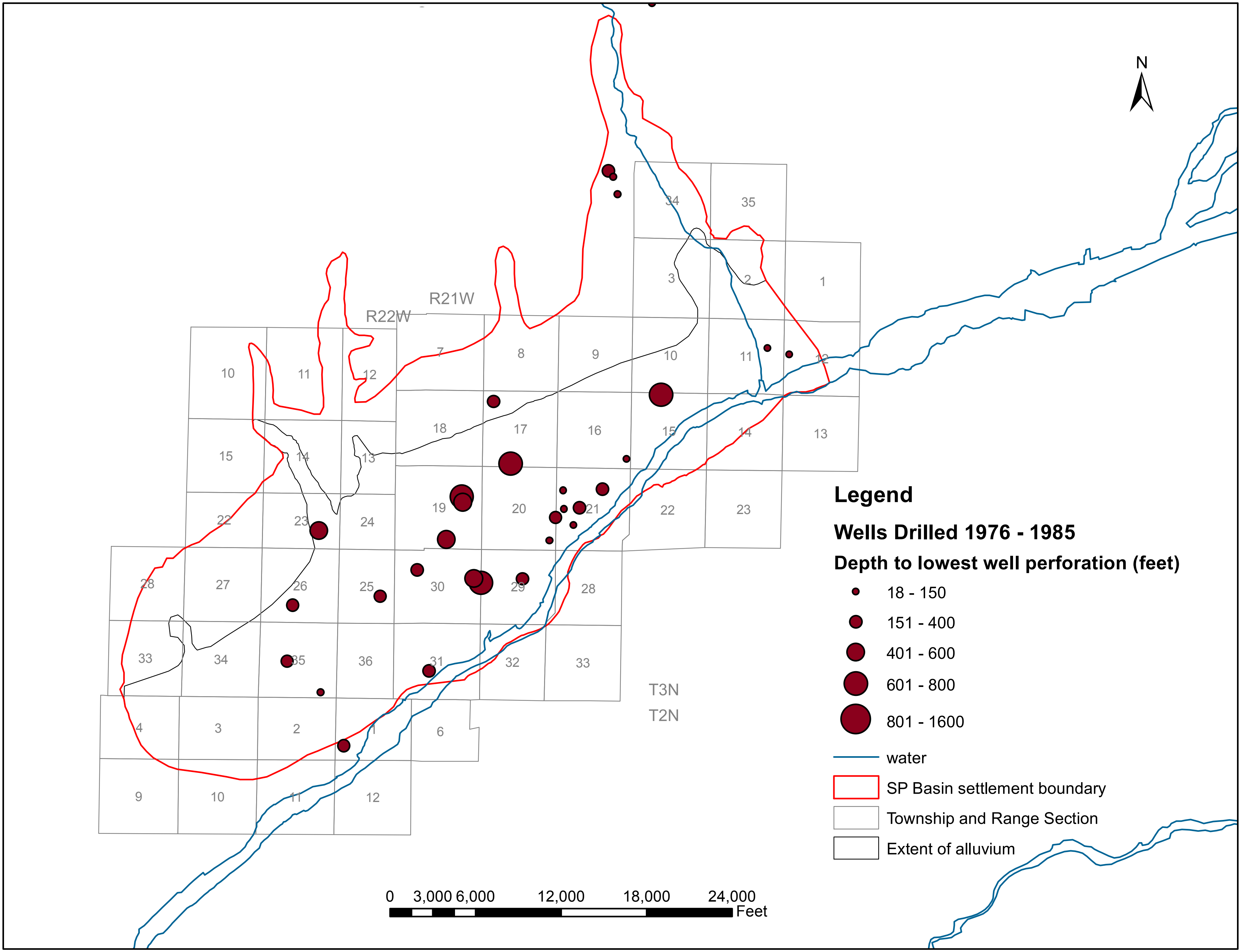
APPENDIX B – PERFORATION AND DRILLING LOCATION MAPS (1913 THROUGH 2010)


N
R22W
R21W
T3N
T2N
Legend
Wells Drilled 2006 - 2010
Depth to lowest well perforation (feet)
160 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

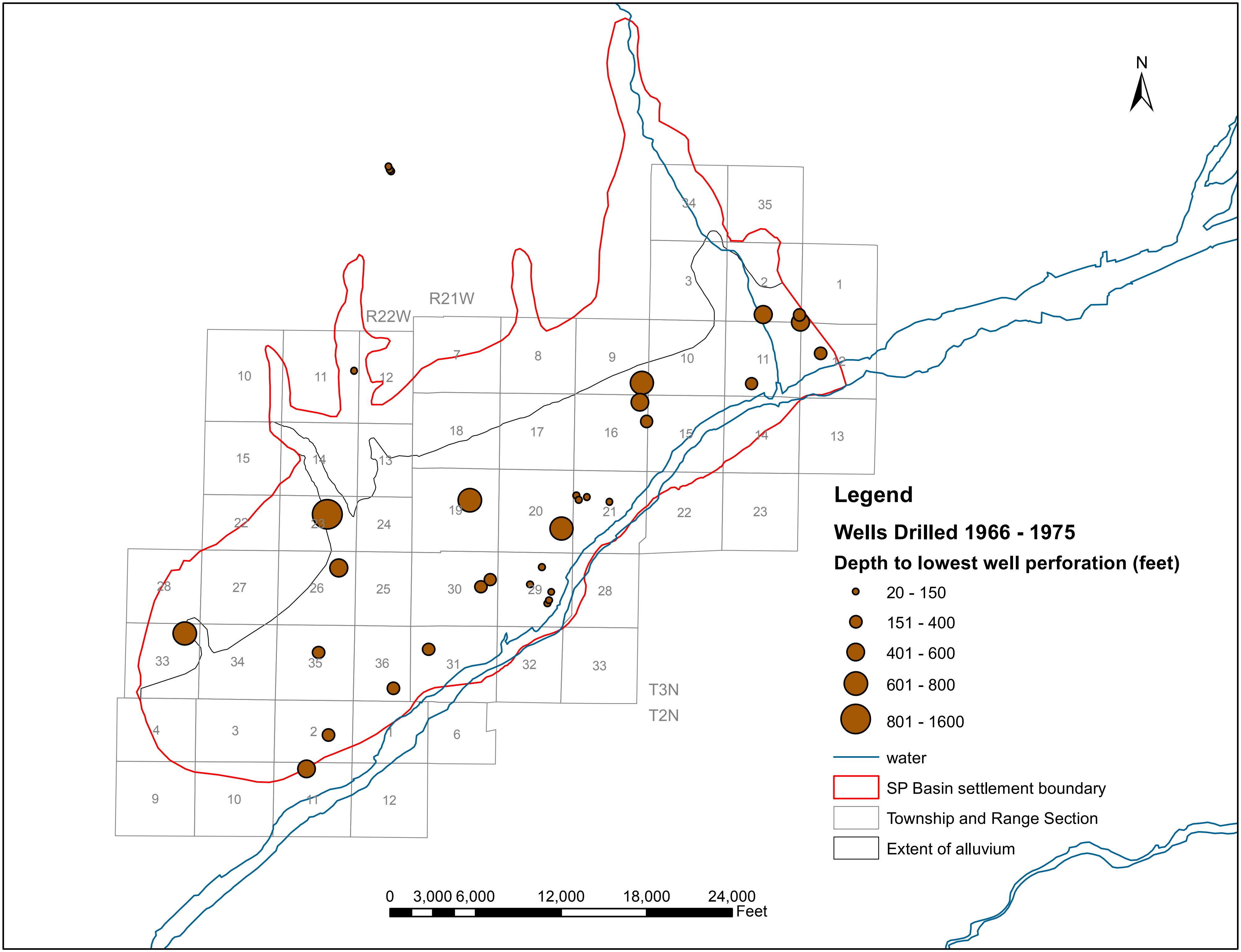

N
R22W
R21W
T3N
T2N
Legend
Wells Drilled 1996 - 2005
Depth to lowest well perforation (feet)
210 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



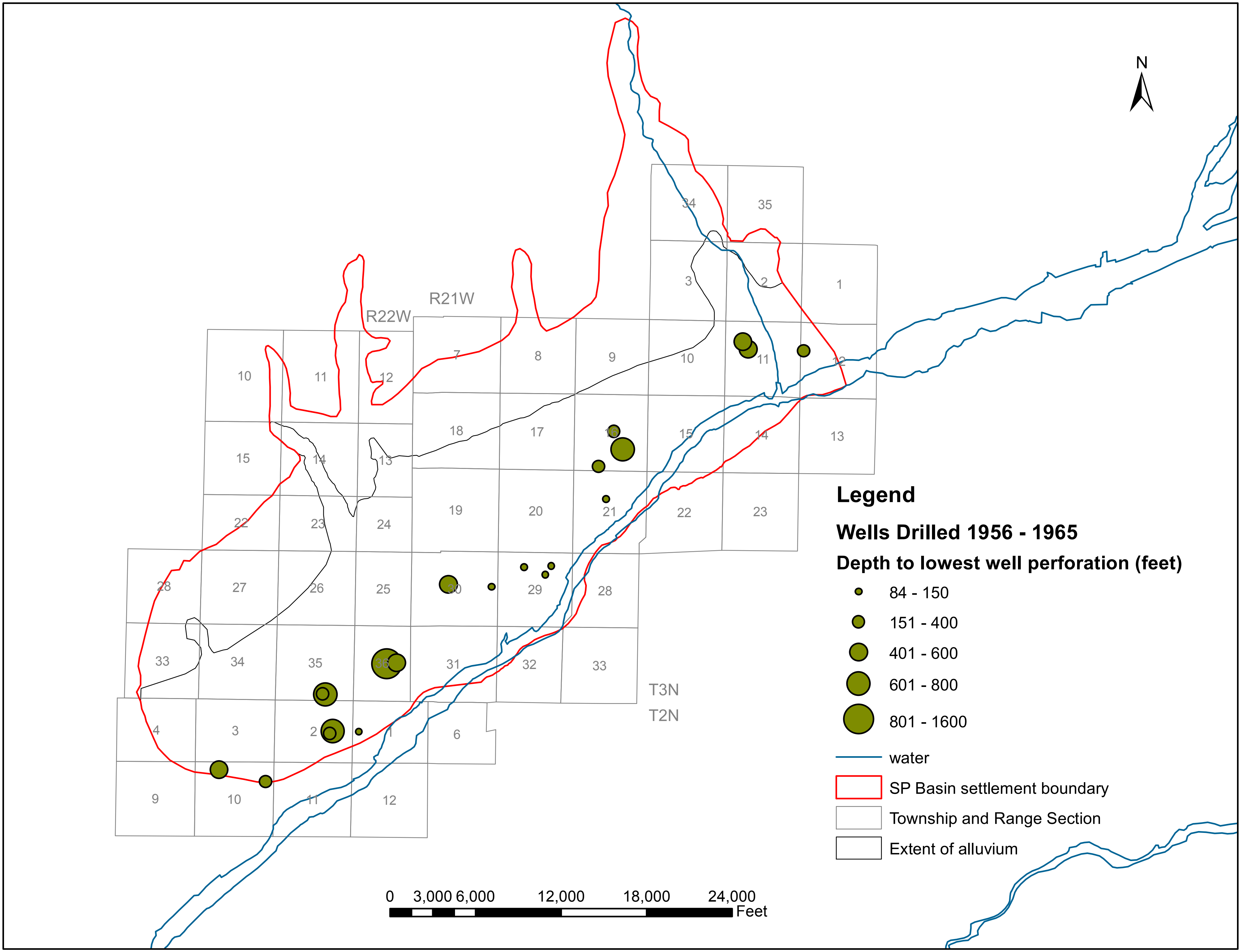
N
R21W
R22W
T3N
T2N
Legend
Wells Drilled 1986 - 1995
Depth to lowest well perforation (feet)
32 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet

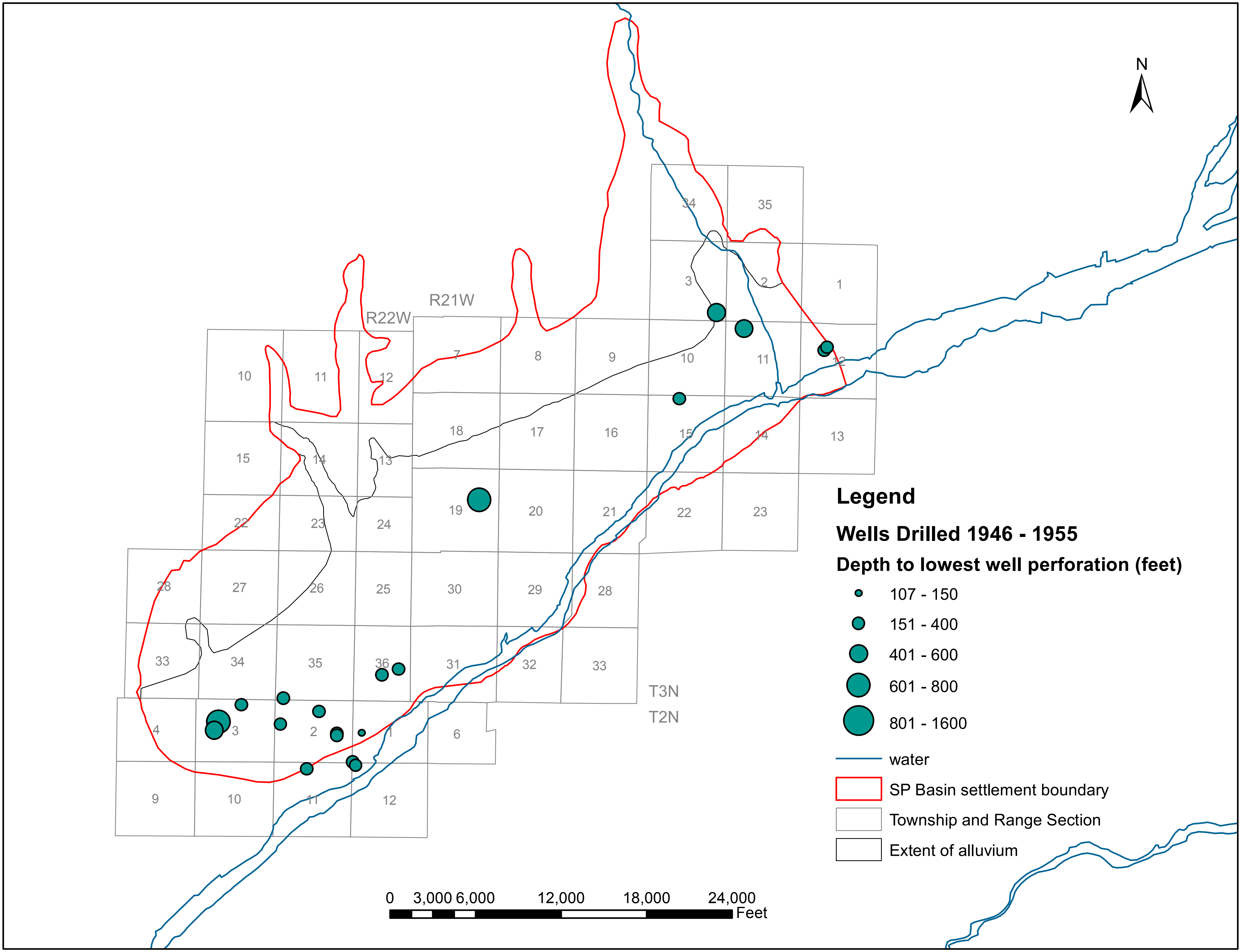


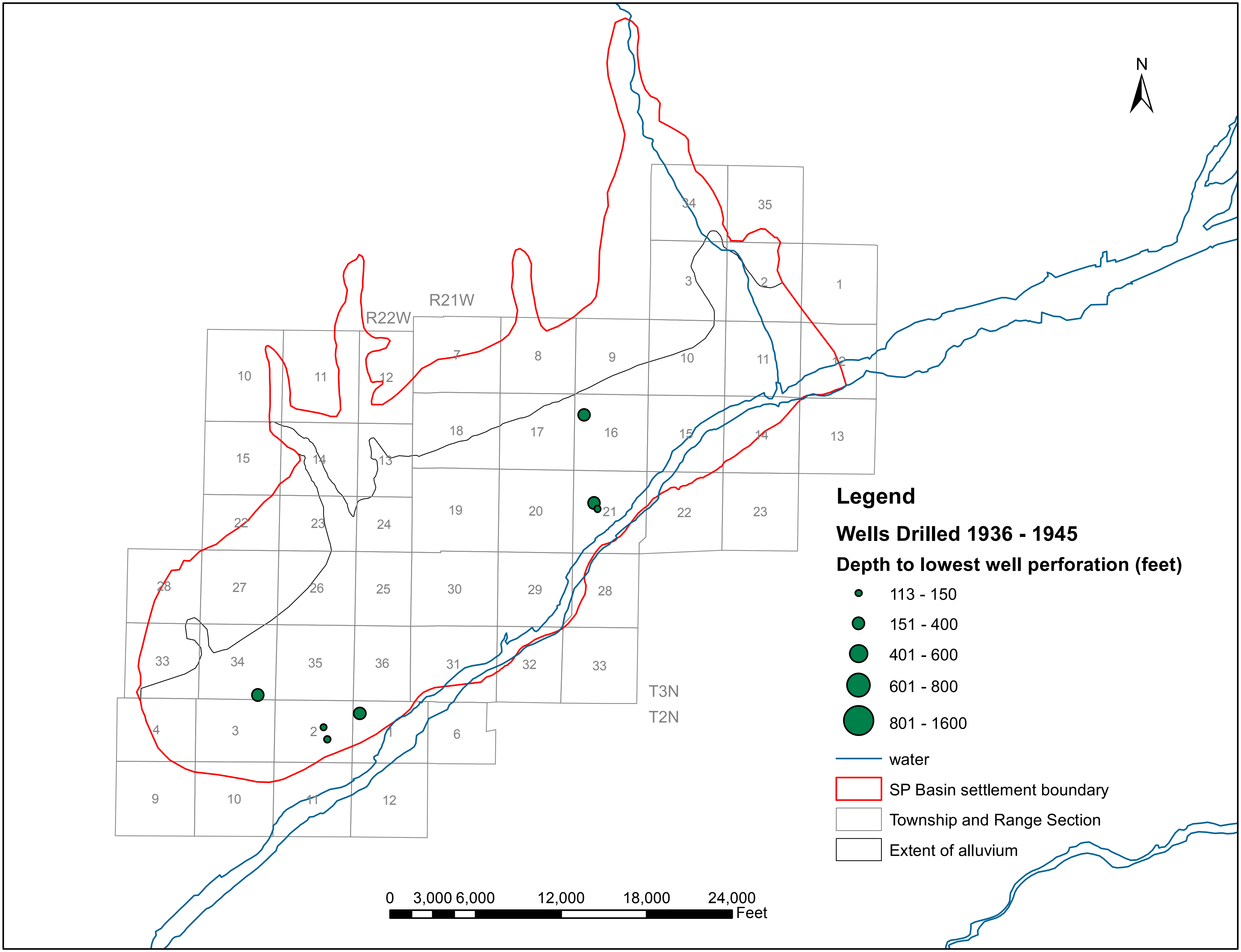
N
R21W
R22W
T3N
T2N
Legend
Wells Drilled 1976 - 1985
Depth to lowest well perforation (feet)
18 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet



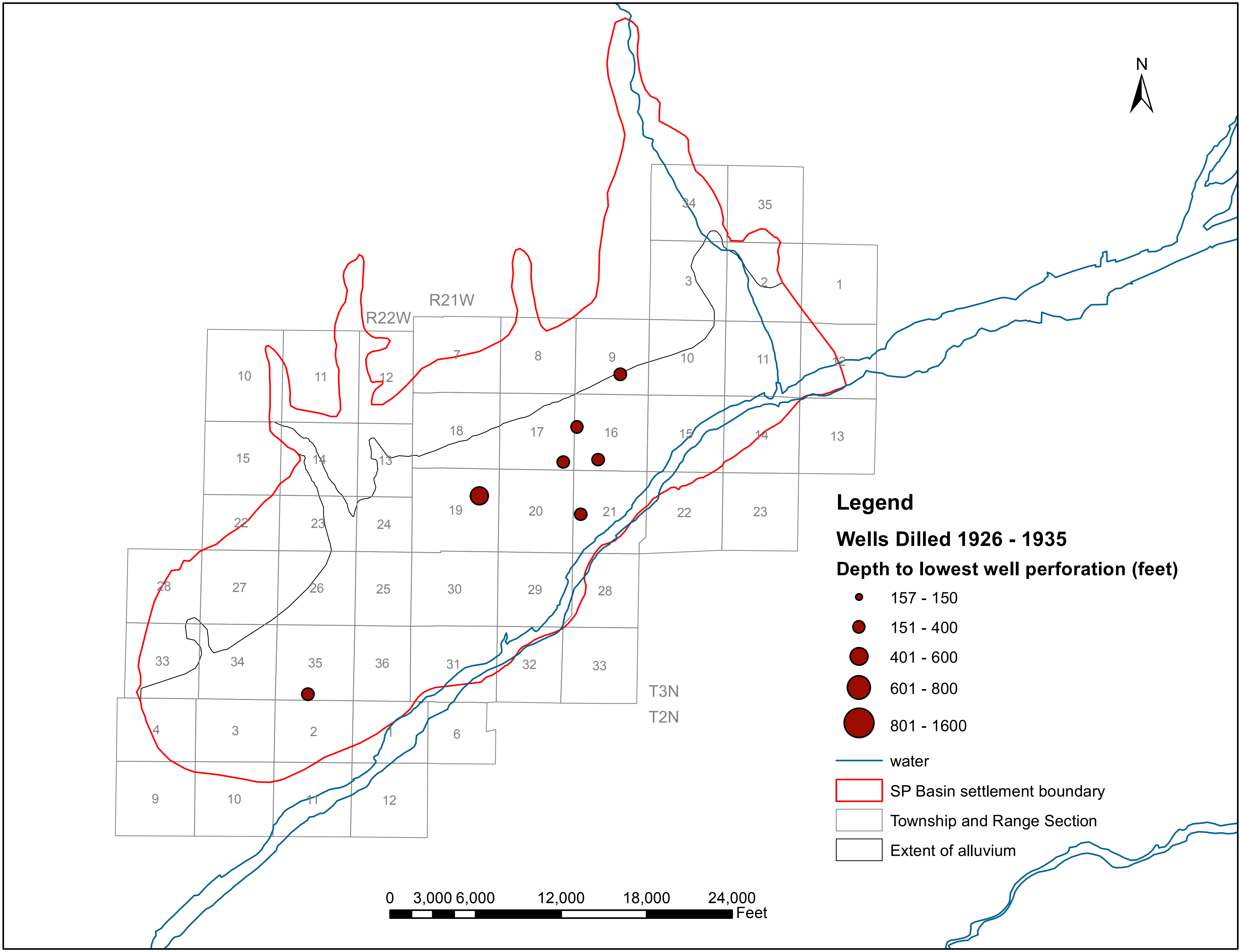
N
R22W
R21W
T3N
T2N
Legend
Wells Drilled 1966 - 1975
Depth to lowest well perforation (feet)
20 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet

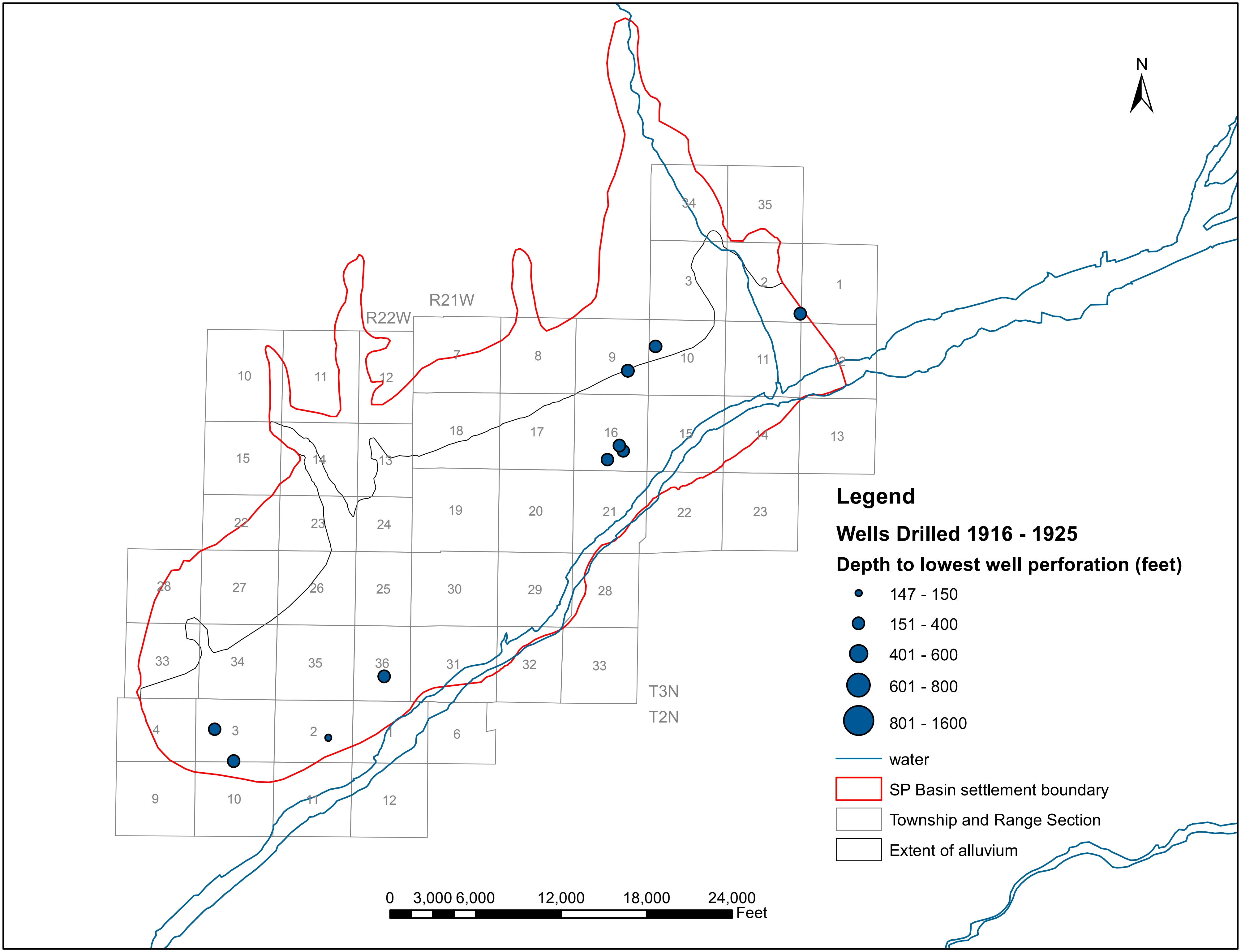

N
R22W
R21W
T3N
T2N
Legend
Wells Drilled 1956 - 1965
Depth to lowest well perforation (feet)
84 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

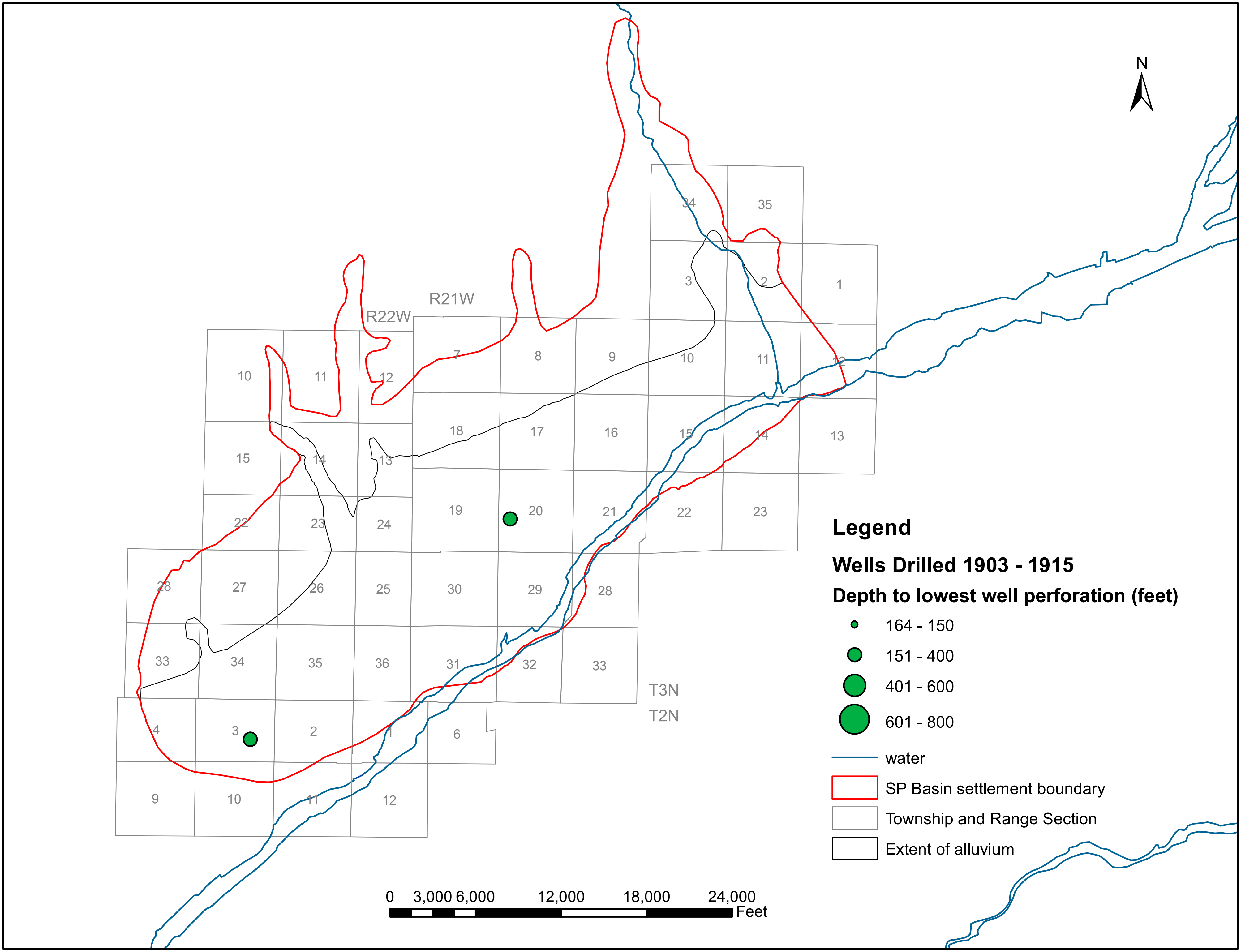

N
R22W
R21W
T3N
T2N
Legend
Wells Drilled 1946 - 1955
Depth to lowest well perforation (feet)
107 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet



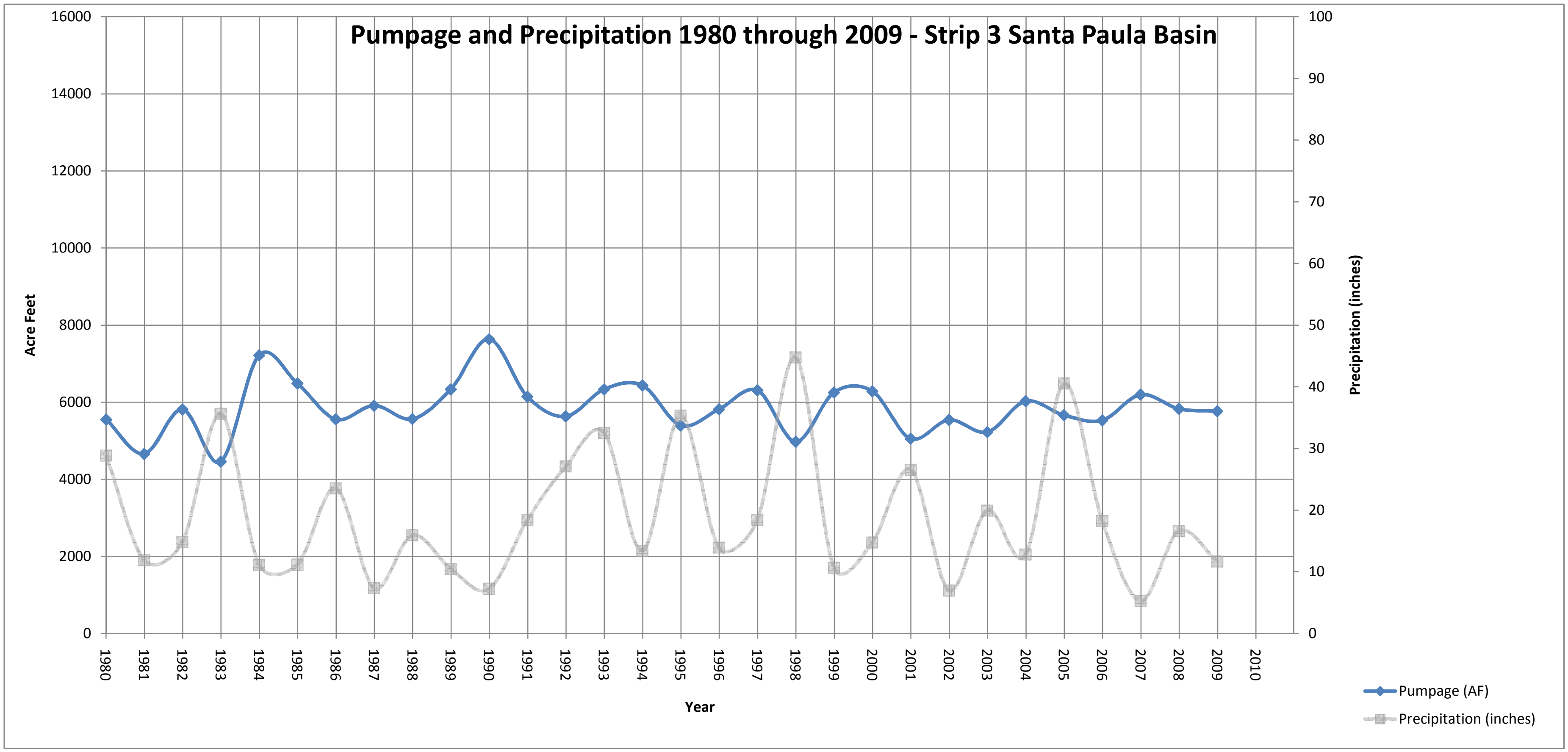
N
R22W
R21W
T3N
T2N
10
11
12
7
8
9
10
11
12
34
35
3
2
1
15
14
13
18
17
16
15
14
13
22
23
24
19
20
21
22
23
28
27
26
25
30
29
28
33
34
35
36
31
32
33
4
3
2
1
6
9
10
11
12
Legend
Wells Drilled 1936 - 1945
Depth to lowest well perforation (feet)
113 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

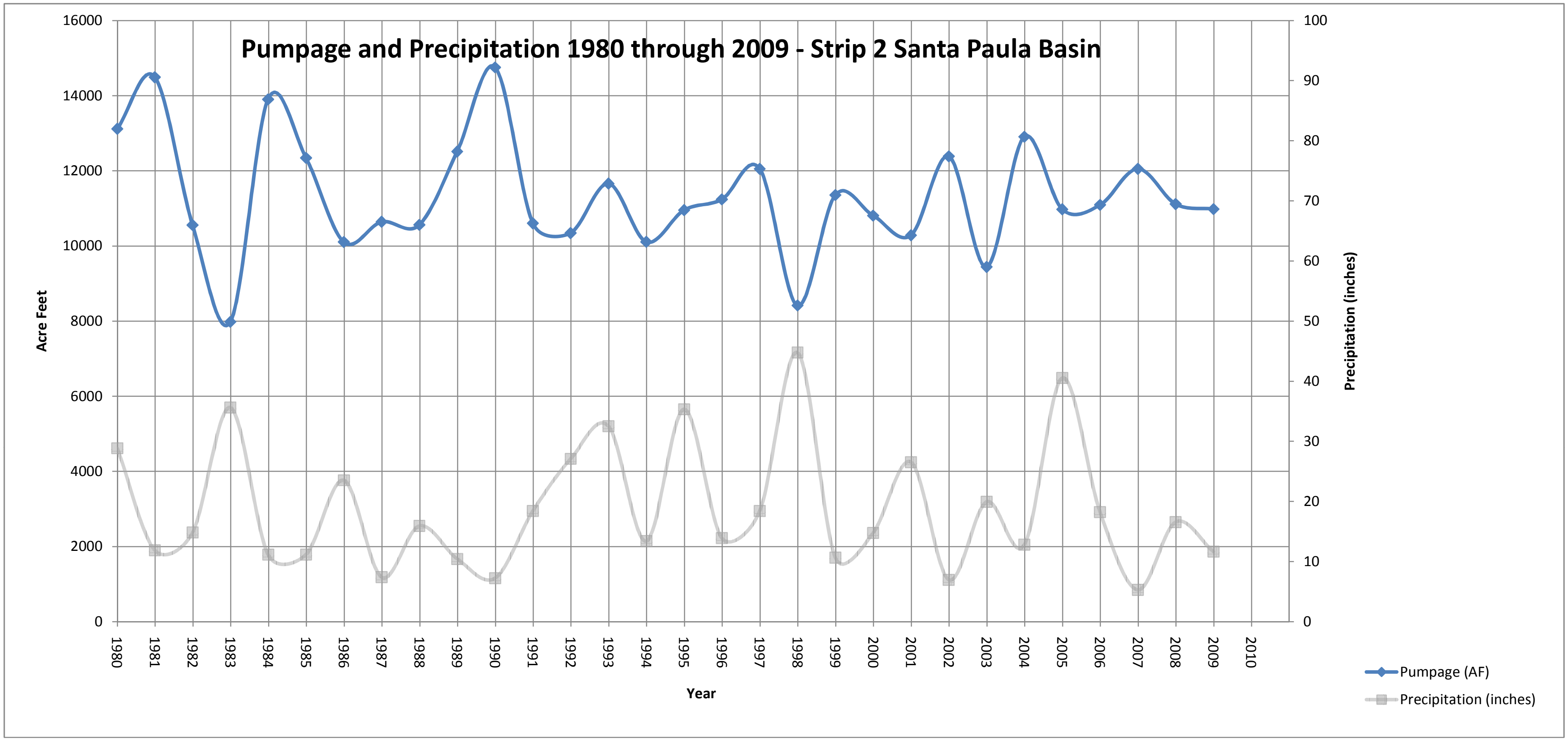

N
R22W
R21W
T3N
T2N
Legend
Wells Dilled 1926 - 1935
Depth to lowest well perforation (feet)
157 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0 3,000 6,000 12,000 18,000 24,000
Feet


N
R21W
R22W
T3N
T2N
Legend
Wells Drilled 1916 - 1925
Depth to lowest well perforation (feet)
147 - 150
151 - 400
401 - 600
601 - 800
801 - 1600
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

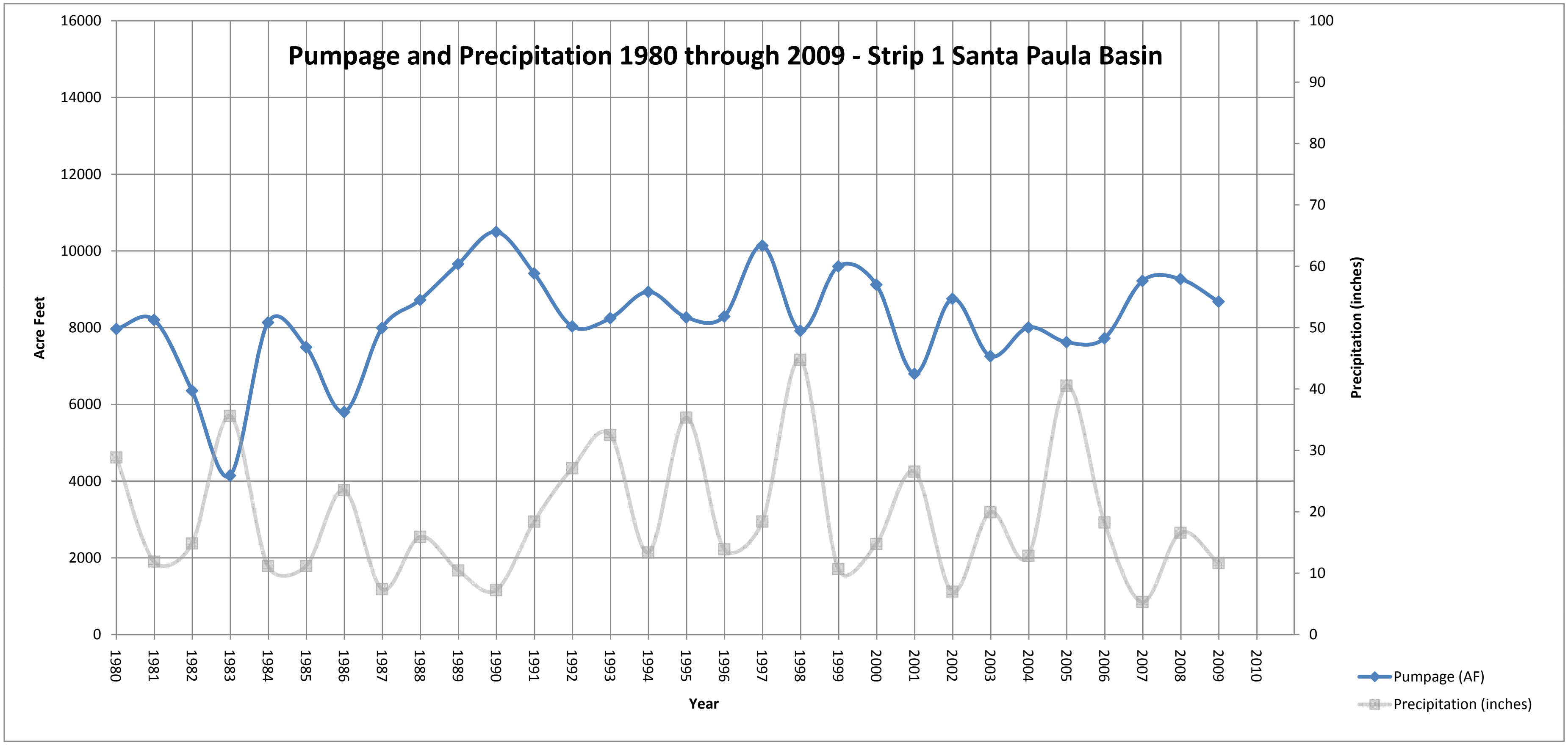

N
R22W
R21W
T3N
T2N
10
11
12
7
8
9
10
11
12
34
35
3
2
1
15
14
13
18
17
16
15
14
13
22
23
24
19
20
21
22
23
28
27
26
25
30
29
28
33
34
35
36
31
32
33
4
3
2
1
6
9
10
11
12
Legend
Wells Drilled 1903 - 1915
Depth to lowest well perforation (feet)
164 - 150
151 - 400
401 - 600
601 - 800
water
SP Basin settlement boundary
Township and Range Section
Extent of alluvium
0
3,000
6,000
12,000
18,000
24,000
Feet

APPENDIX C – GRAPHS OF PUMPAGE PER YEAR FROM DIVISIONS WITHIN SANTA PAULA BASIN (1980 THROUGH 2009)

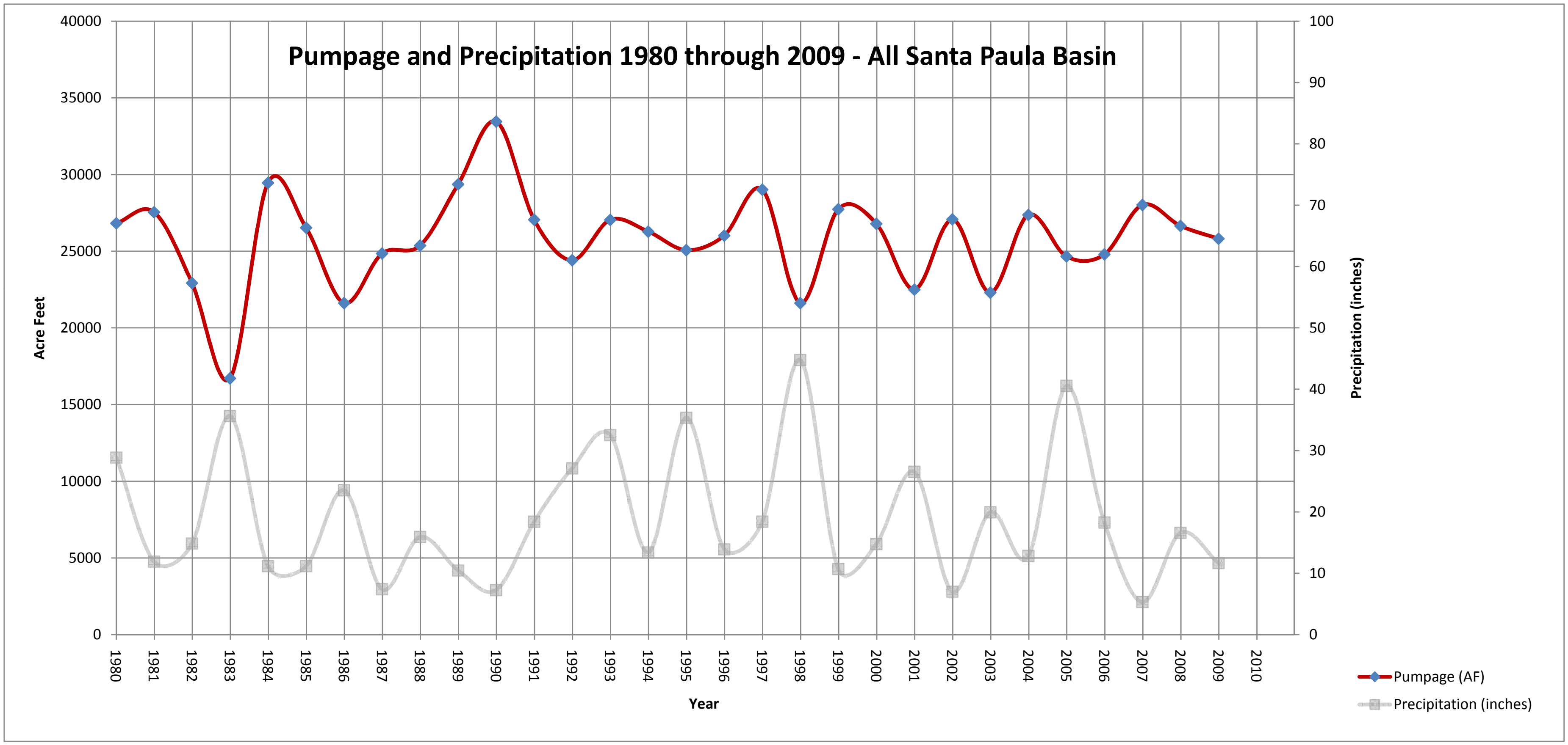

Pumpage and Precipitation 1980 through 2009 - Strip 3 Santa Paula Basin
Acre Feet
16000
14000
12000
10000
8000
6000
4000
2000
0
Precipitation (inches)
100
90
80
70
60
50
40
30
20
10
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Pumpage (AF)
Precipitation (inches)



Pumpage and Precipitation 1980 through 2009 - Strip 2 Santa Paula Basin
Acre Feet
Precipitation (inches)
Year
Pumpage (AF)
Precipitation (inches)

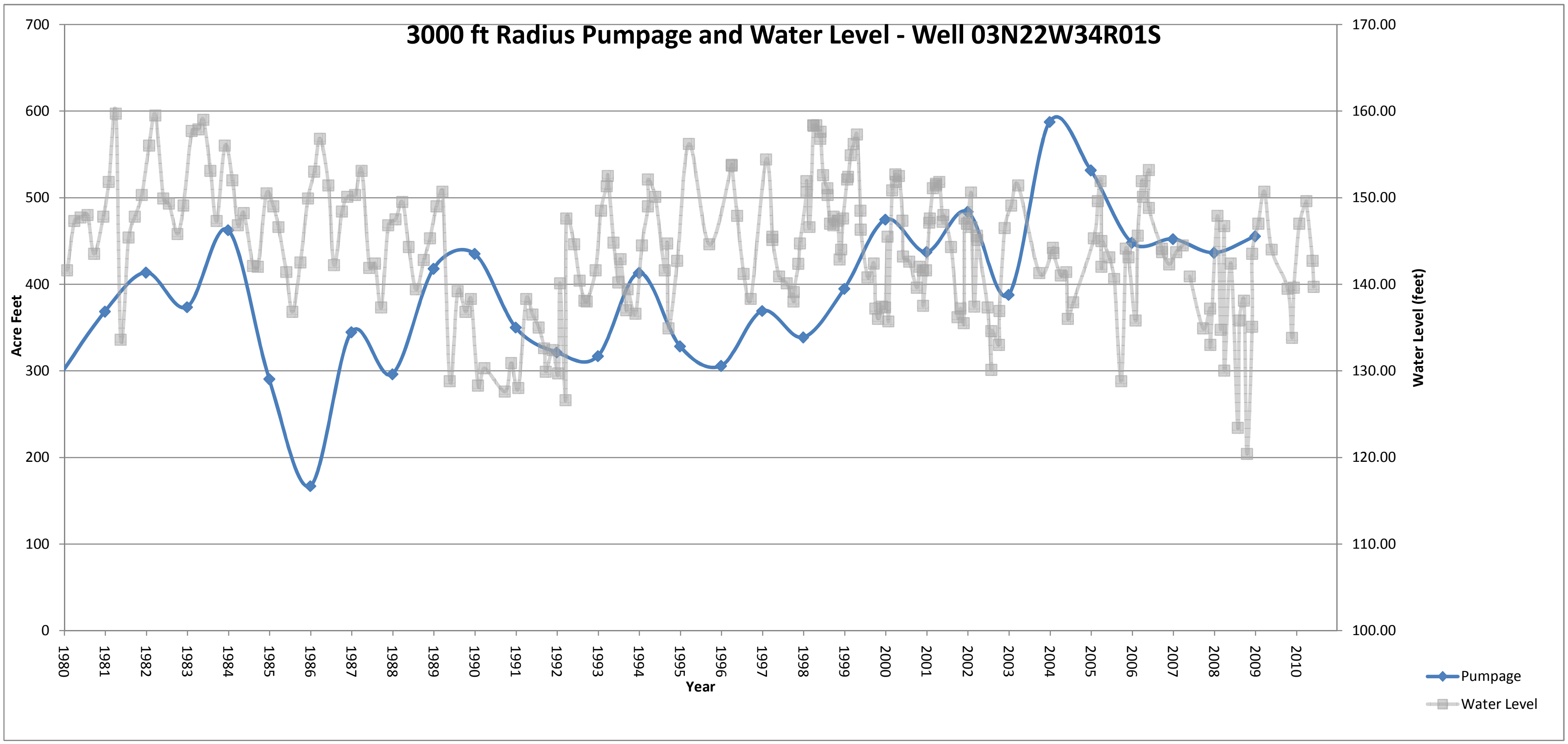


Pumpage and Precipitation 1980 through 2009 - Strip 1 Santa Paula Basin
Acre Feet
Precipitation (inches)
Year
0
2000
4000
6000
8000
10000
12000
14000
16000
0
10
20
30
40
50
60
70
80
90
100
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage (AF)
Precipitation (inches)

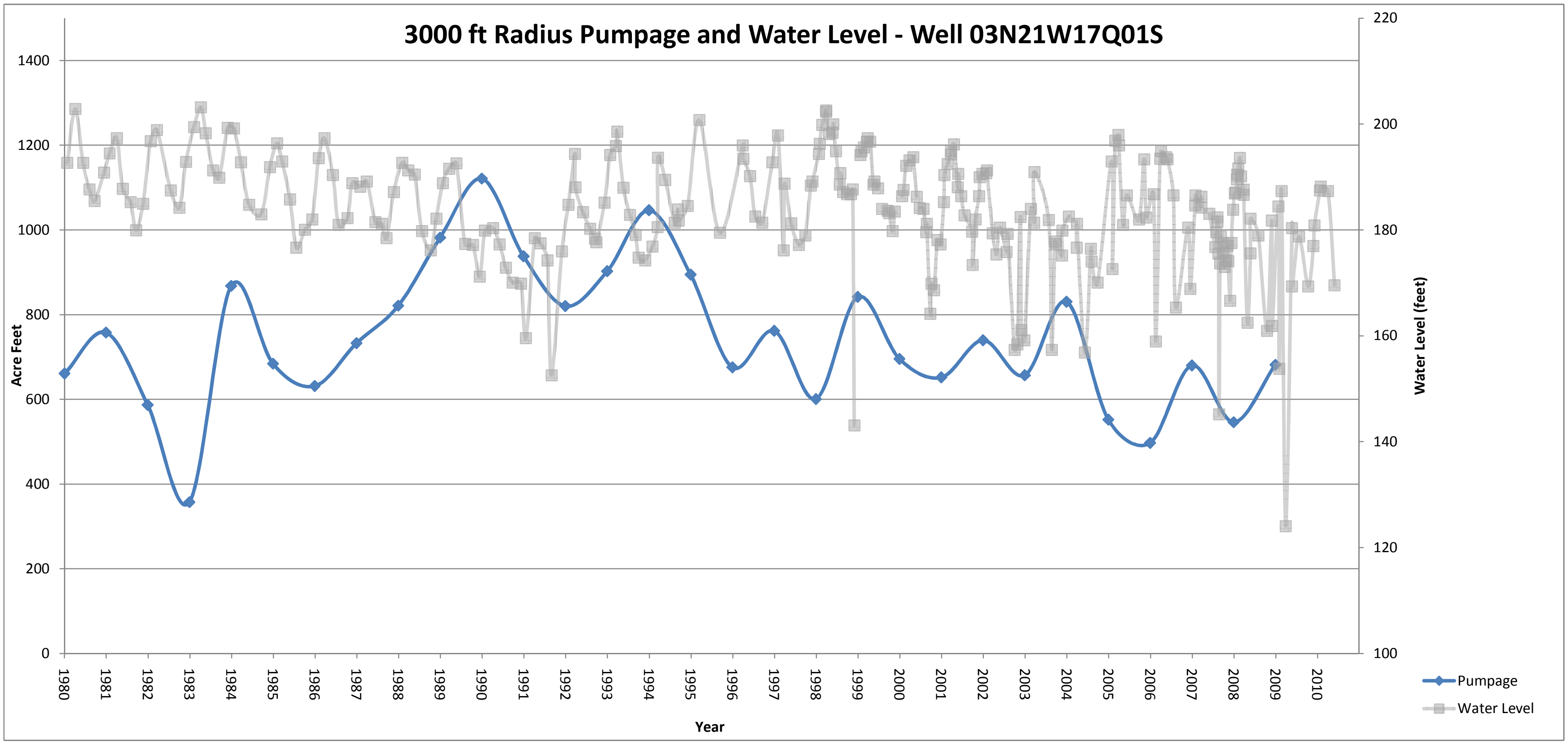


Pumpage and Precipitation 1980 through 2009 - All Santa Paula Basin
Acre Feet
Precipitation (inches)
Year
40000
35000
30000
25000
20000
15000
10000
5000
0
100
90
80
70
60
50
40
30
20
10
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage (AF)
Precipitation (inches)

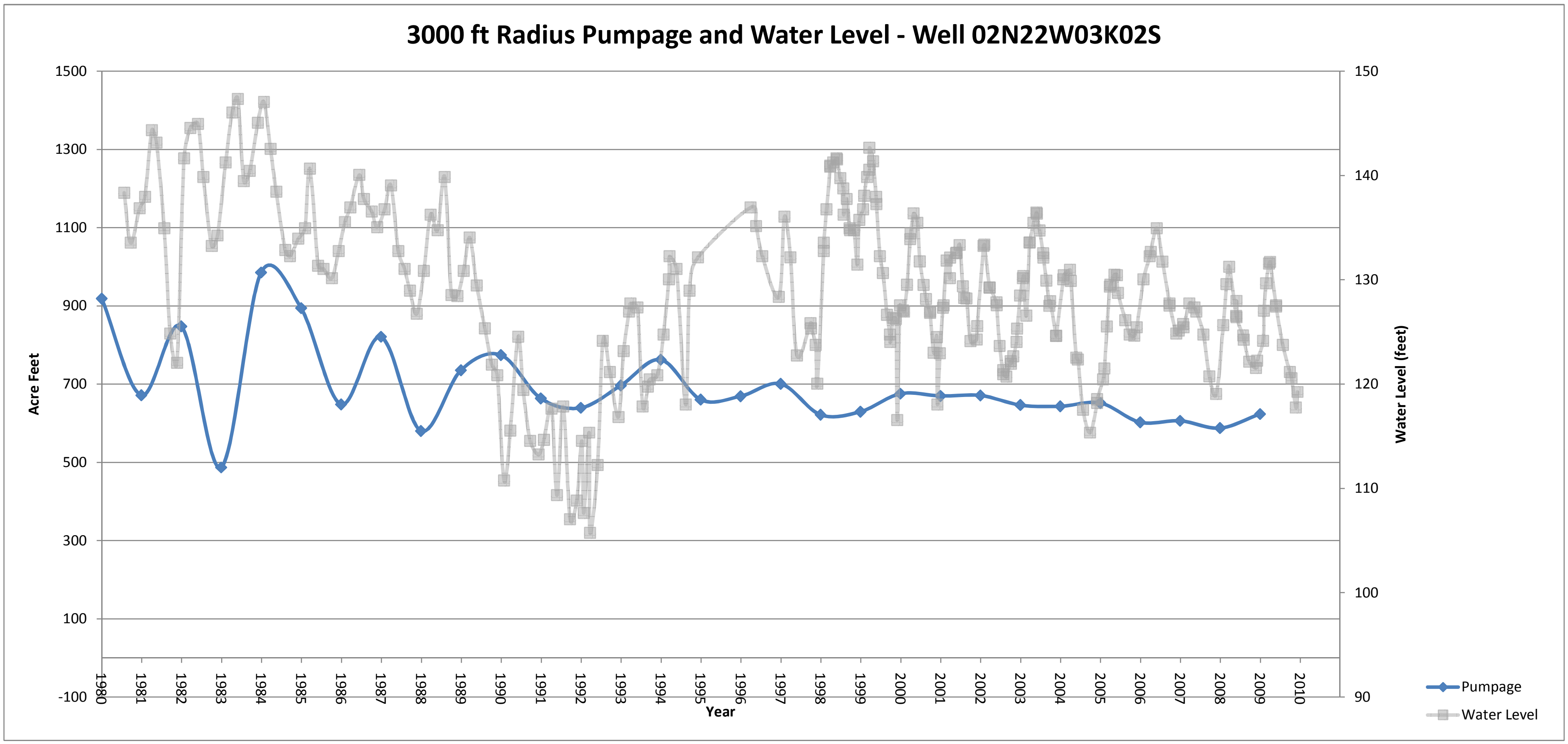
APPENDIX D – GRAPHS OF PUMPAGE PER YEAR IN VICINITY OF INDEX WELLS (1980 THROUGH 2009) – 3,000 FOOT RADIUS



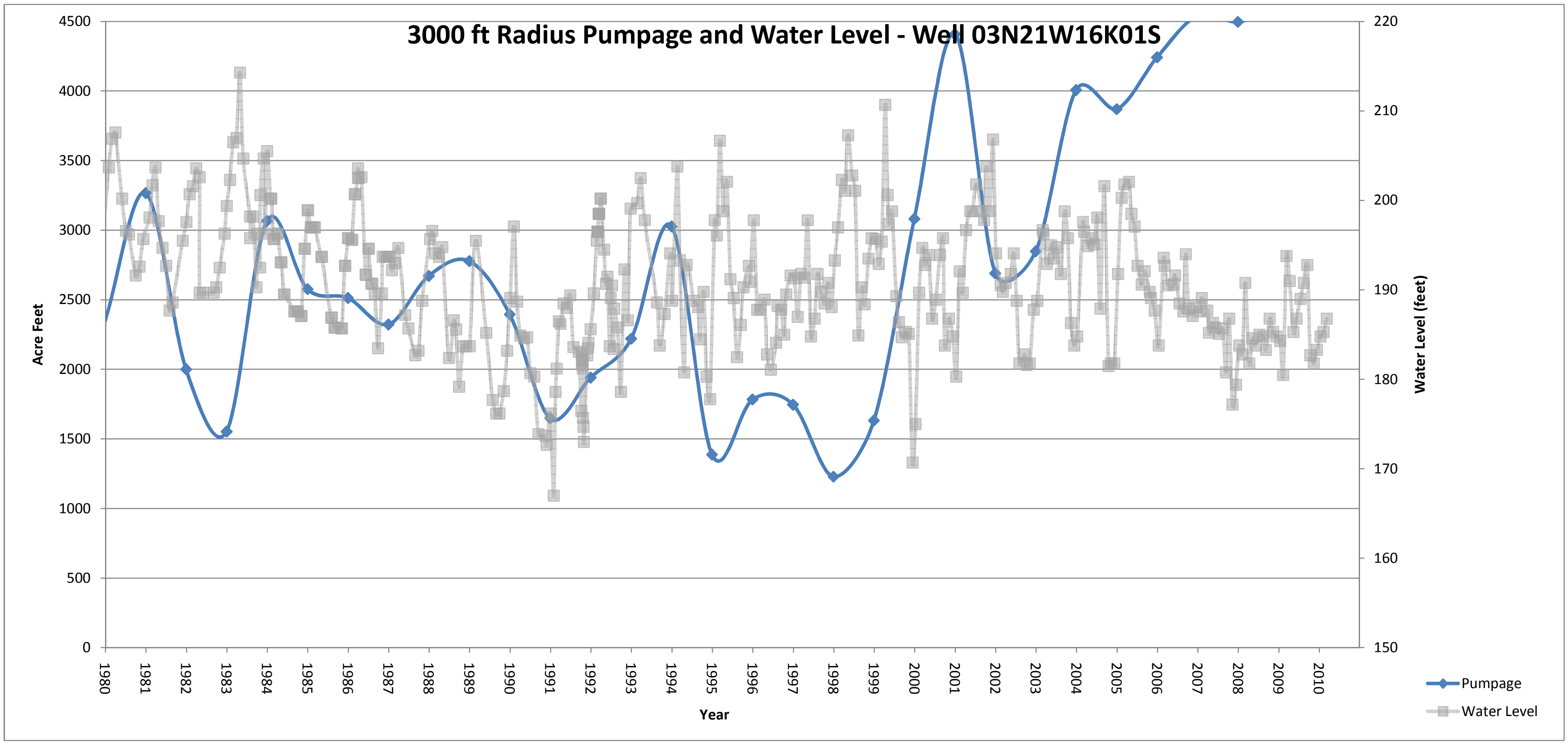
3000 ft Radius Pumpage and Water Level - Well 03N22W34R01S
Acre Feet
Water Level (feet)
Year
0
100
200
300
400
500
600
700
100.00
110.00
120.00
130.00
140.00
150.00
160.00
170.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



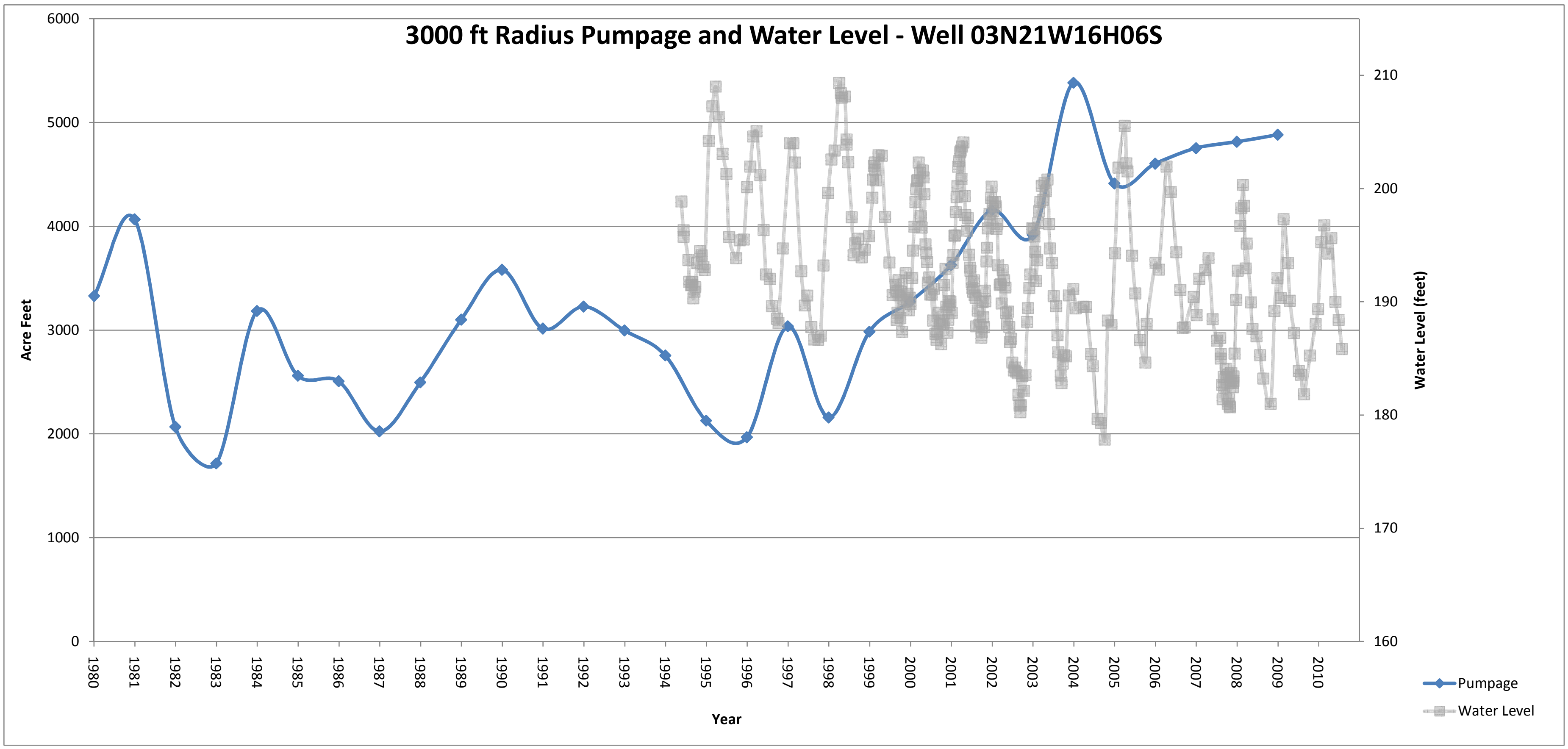
3000 ft Radius Pumpage and Water Level - Well 03N21W17Q01S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
200
400
600
800
1000
1200
1400
100
120
140
160
180
200
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010



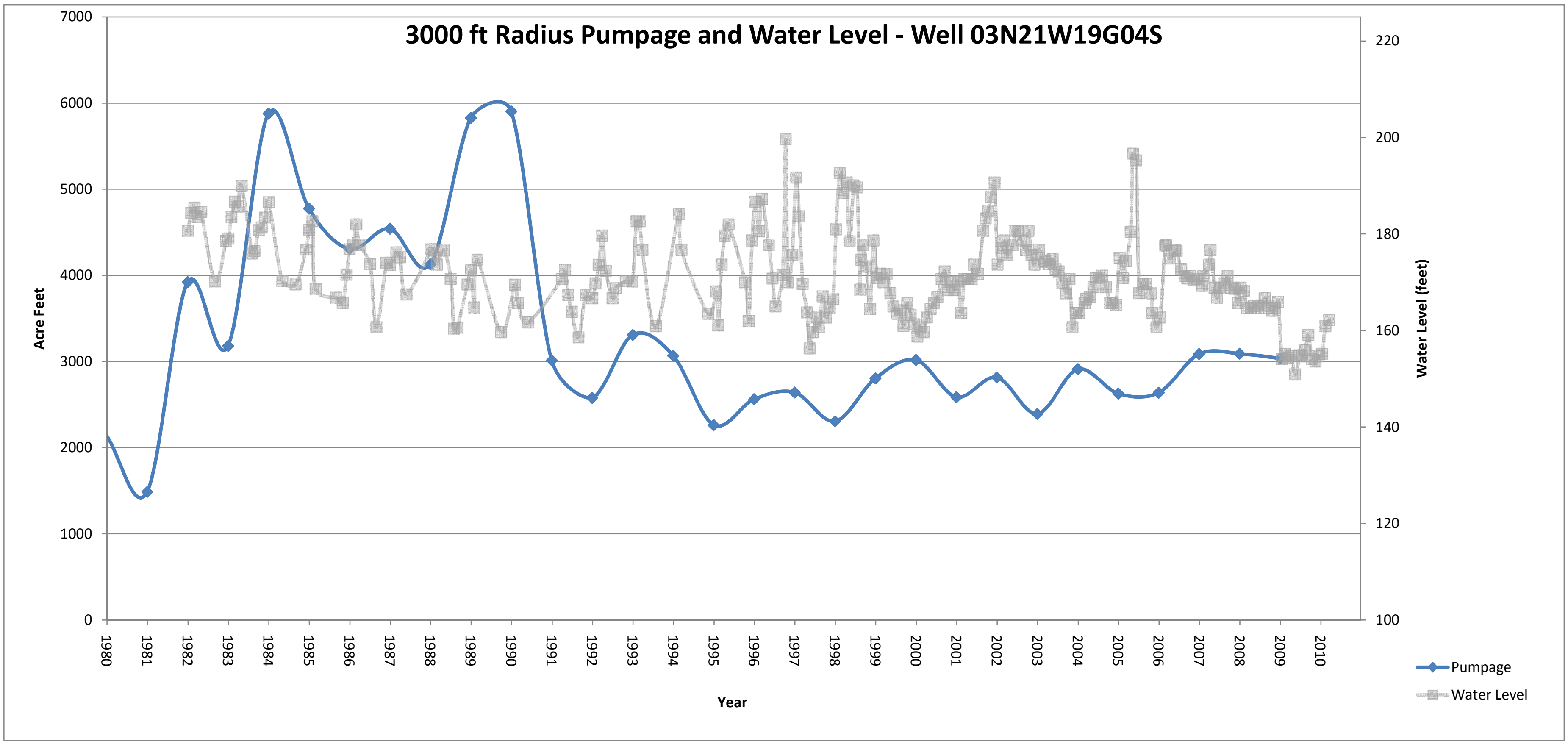
3000 ft Radius Pumpage and Water Level - Well 02N22W03K02S
Acre Feet
Water Level (feet)
Year
1500
1300
1100
900
700
500
300
100
-100
150
140
130
120
110
100
90
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



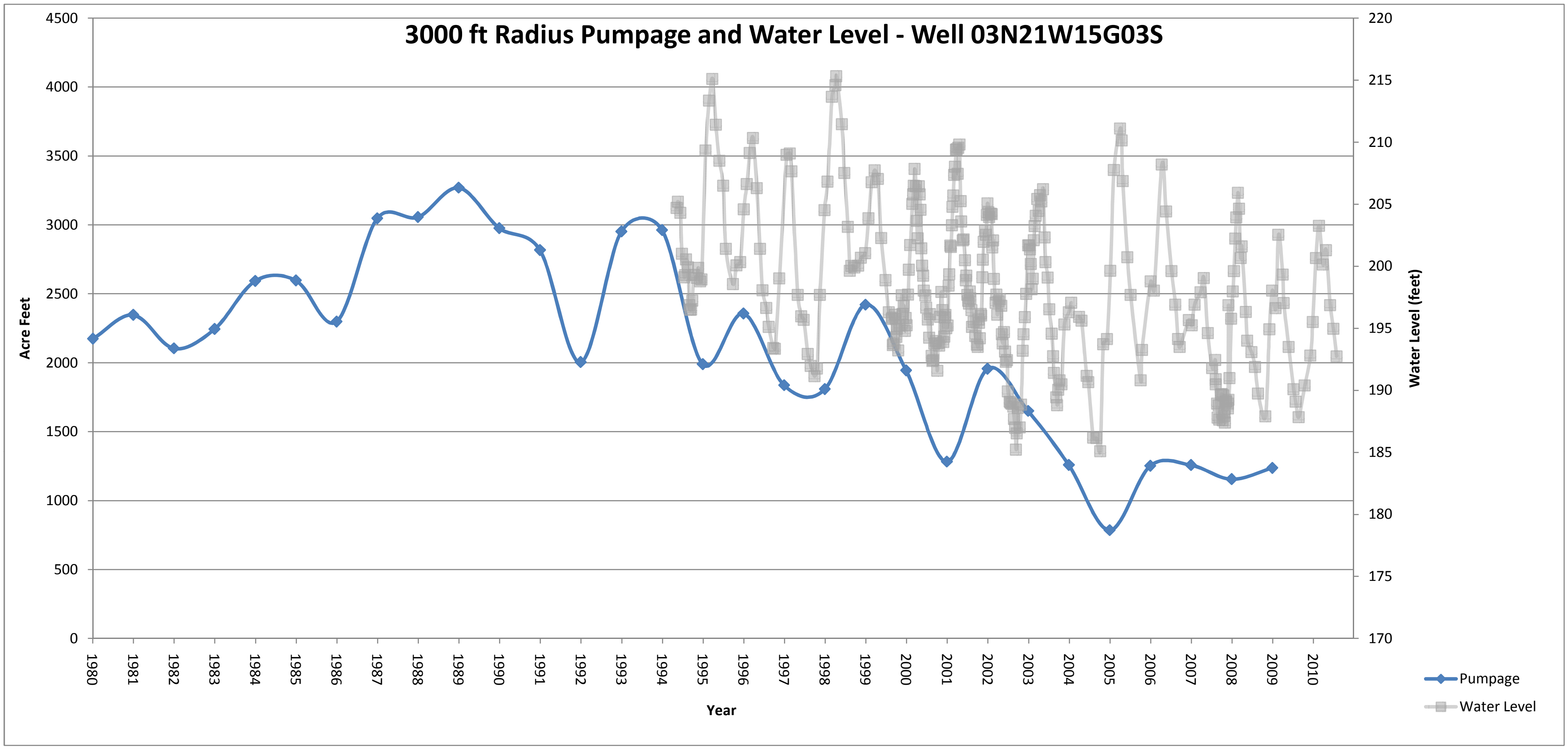
3000 ft Radius Pumpage and Water Level - Well 03N21W16K01S
Acre Feet
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Water Level (feet)
220
210
200
190
180
170
160
150
Year
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



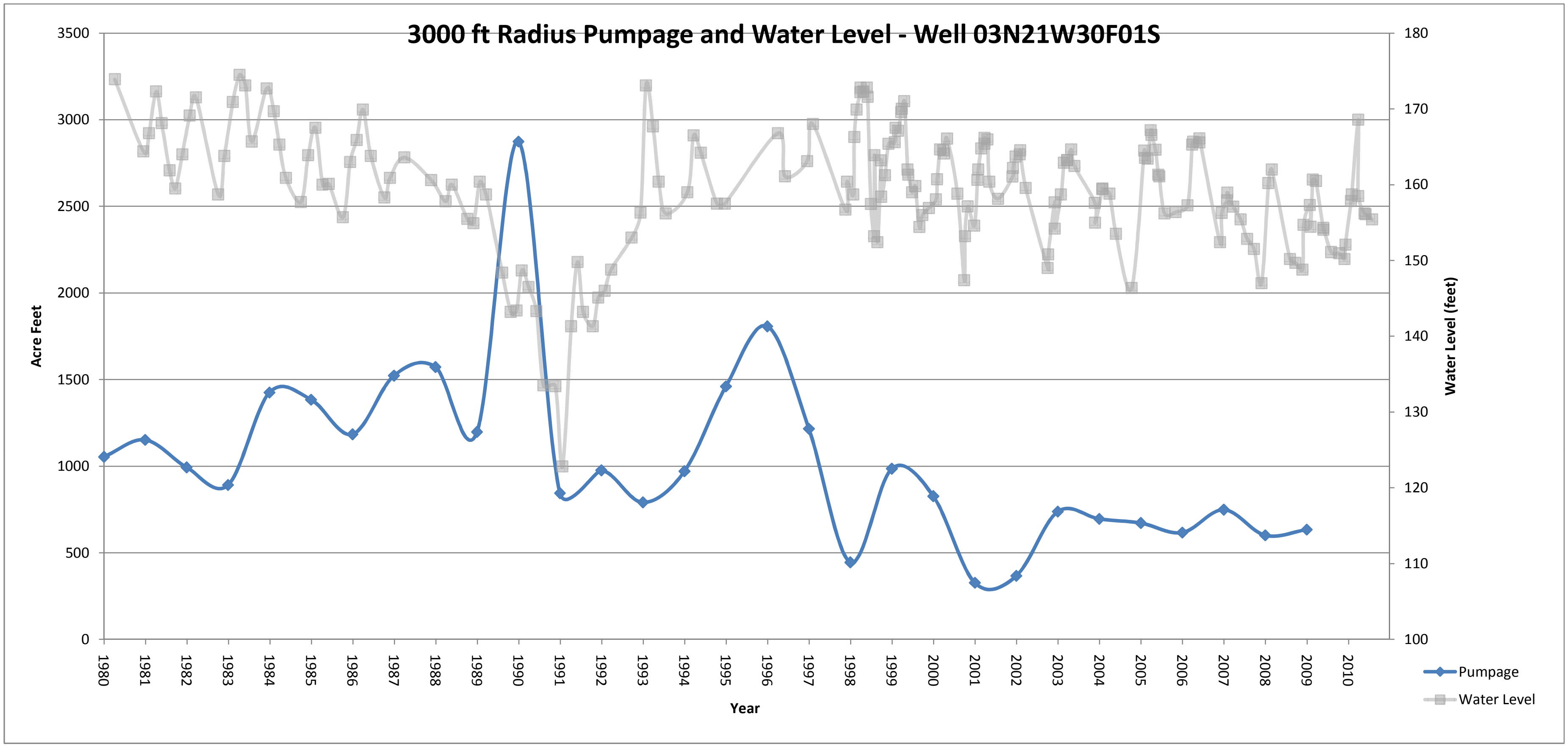
3000 ft Radius Pumpage and Water Level - Well 03N21W16H06S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
160
170
180
190
200
210
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

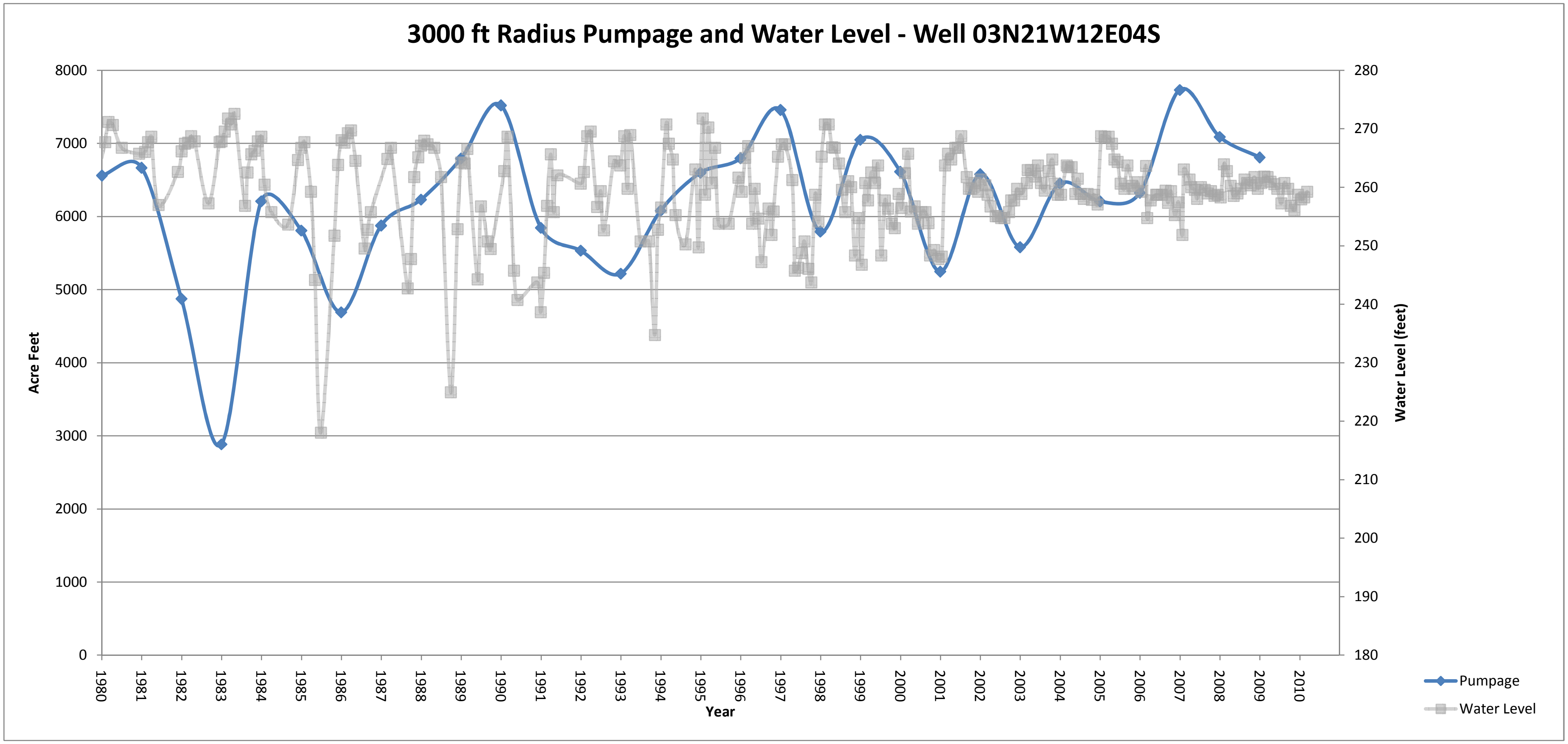


3000 ft Radius Pumpage and Water Level - Well 03N21W19G04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
7000
100
120
140
160
180
200
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

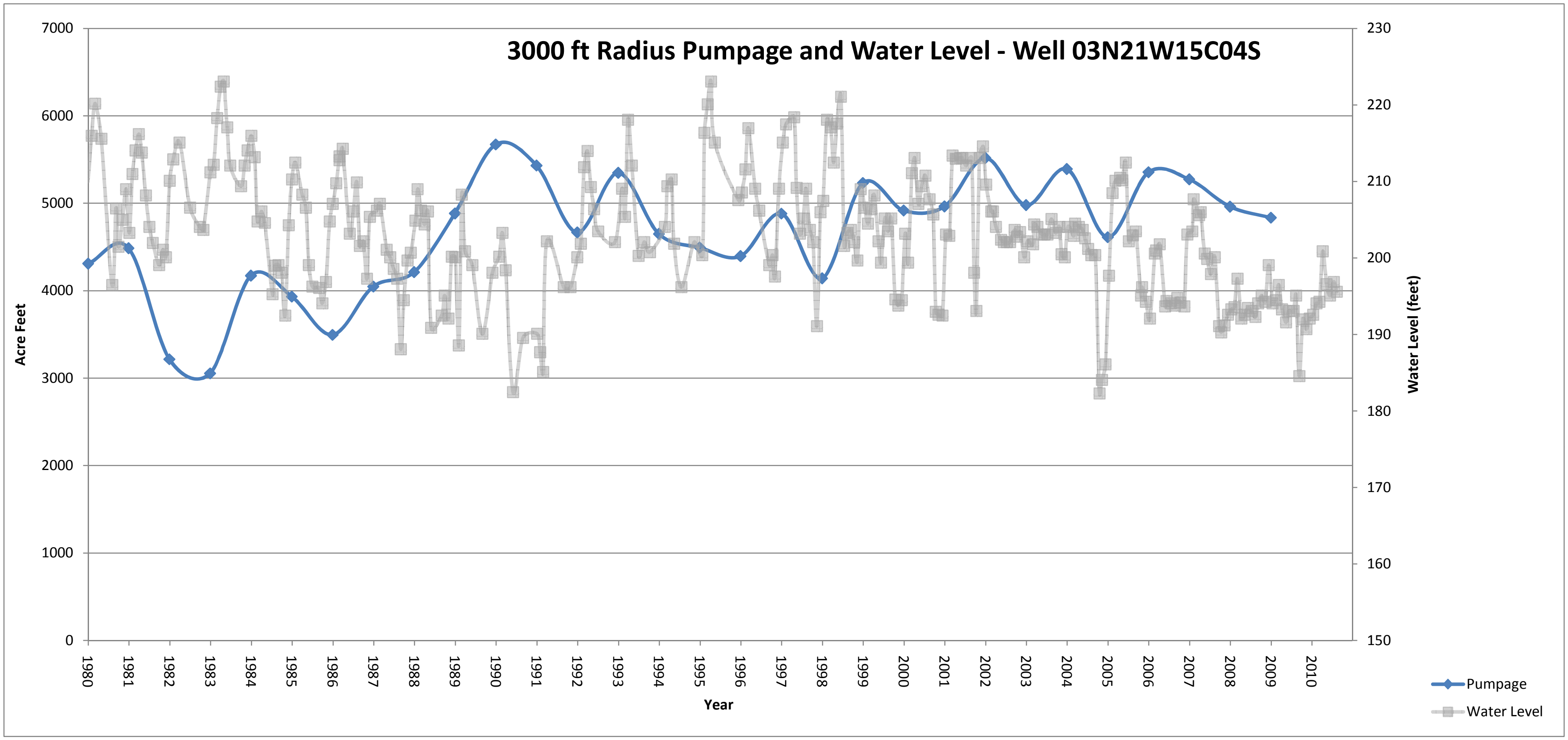


3000 ft Radius Pumpage and Water Level - Well 03N21W15G03S
Acre Feet
Water Level (feet)
Year
4500
4000
3500
3000
2500
2000
1500
1000
500
0
220
215
210
205
200
195
190
185
180
175
170
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

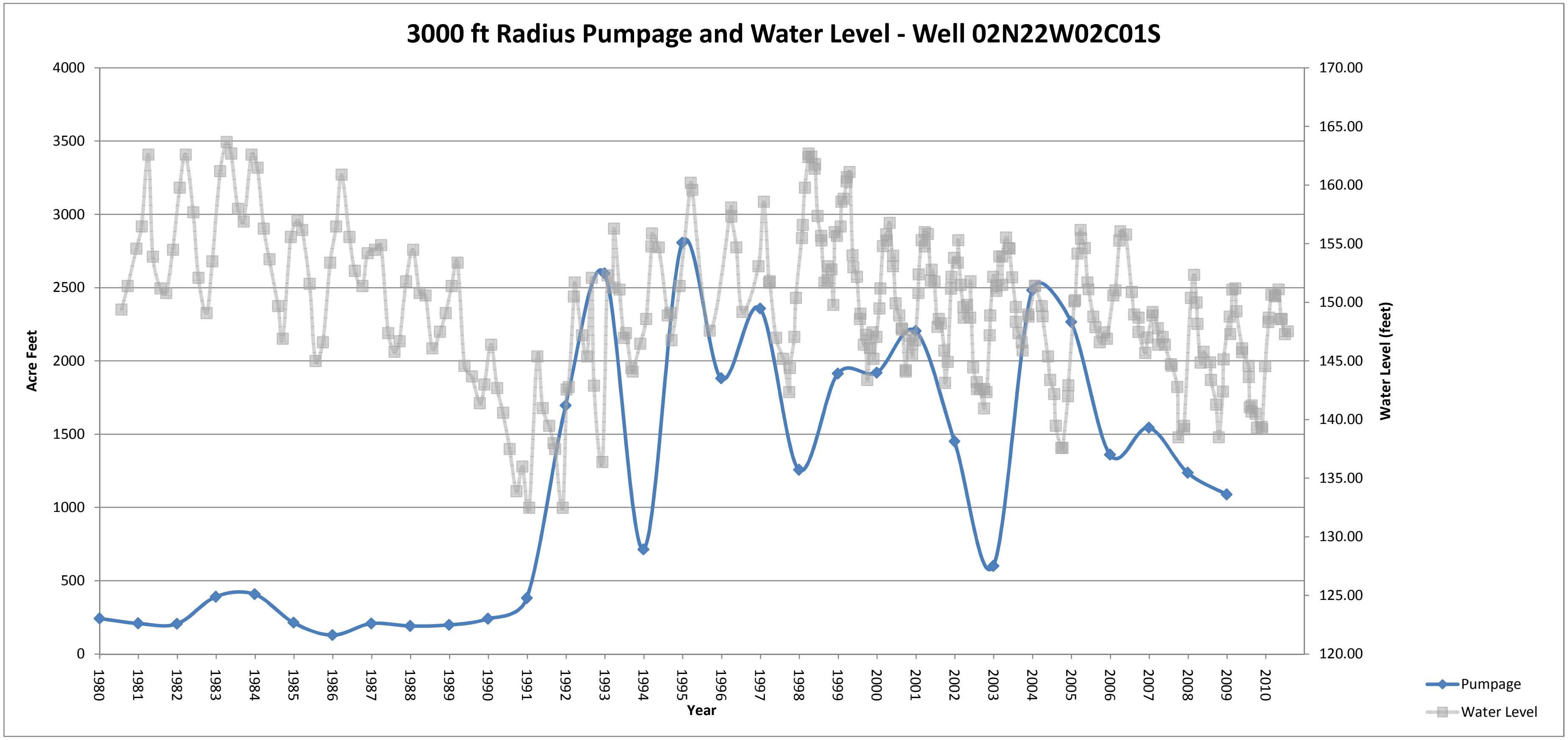

3000 ft Radius Pumpage and Water Level - Well 03N21W30F01S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
500
1000
1500
2000
2500
3000
3500
100
110
120
130
140
150
160
170
180
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010



3000 ft Radius Pumpage and Water Level - Well 03N21W12E04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
180
190
200
210
220
230
240
250
260
270
280
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
2006
2007
2008
2009
2010
Pumpage
Water Level

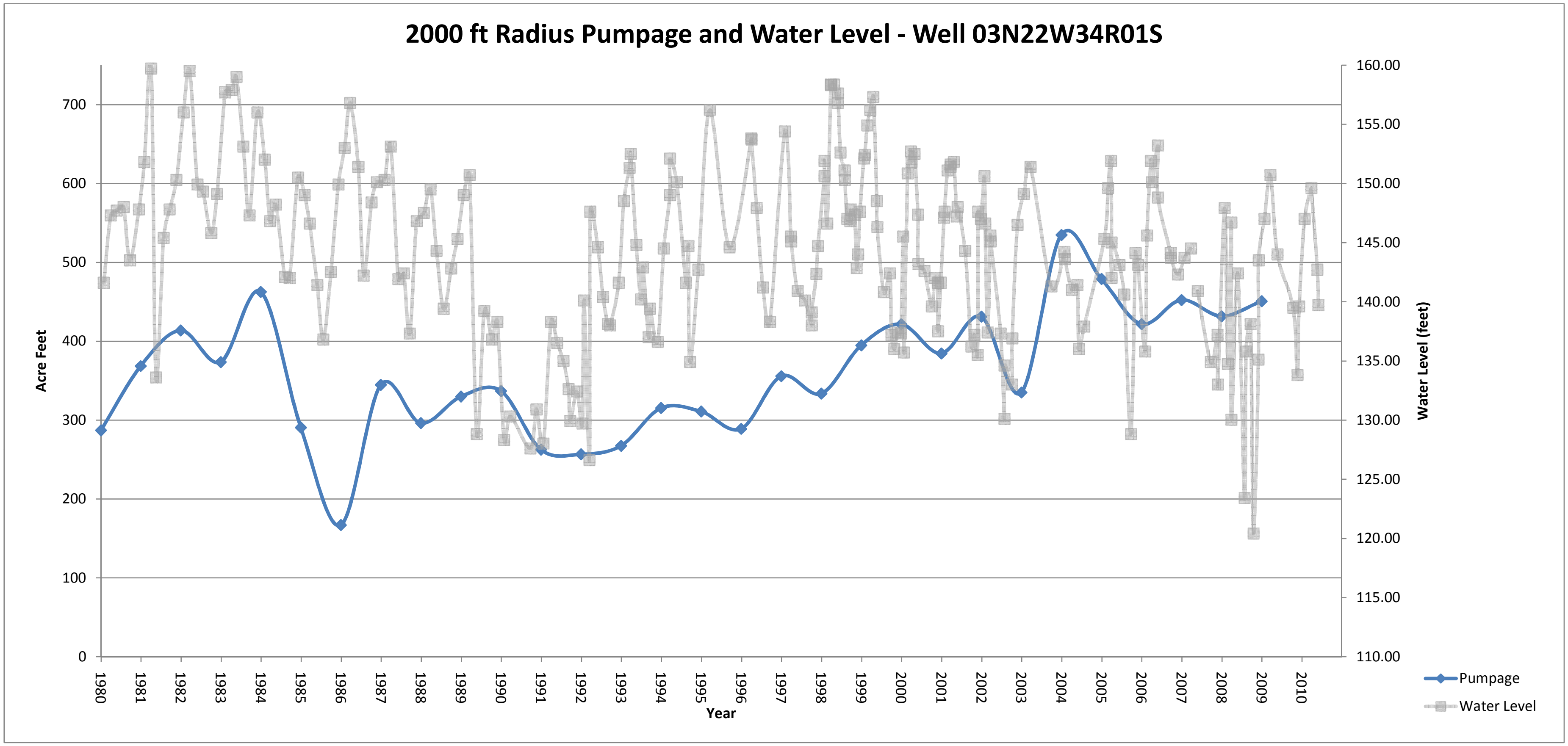


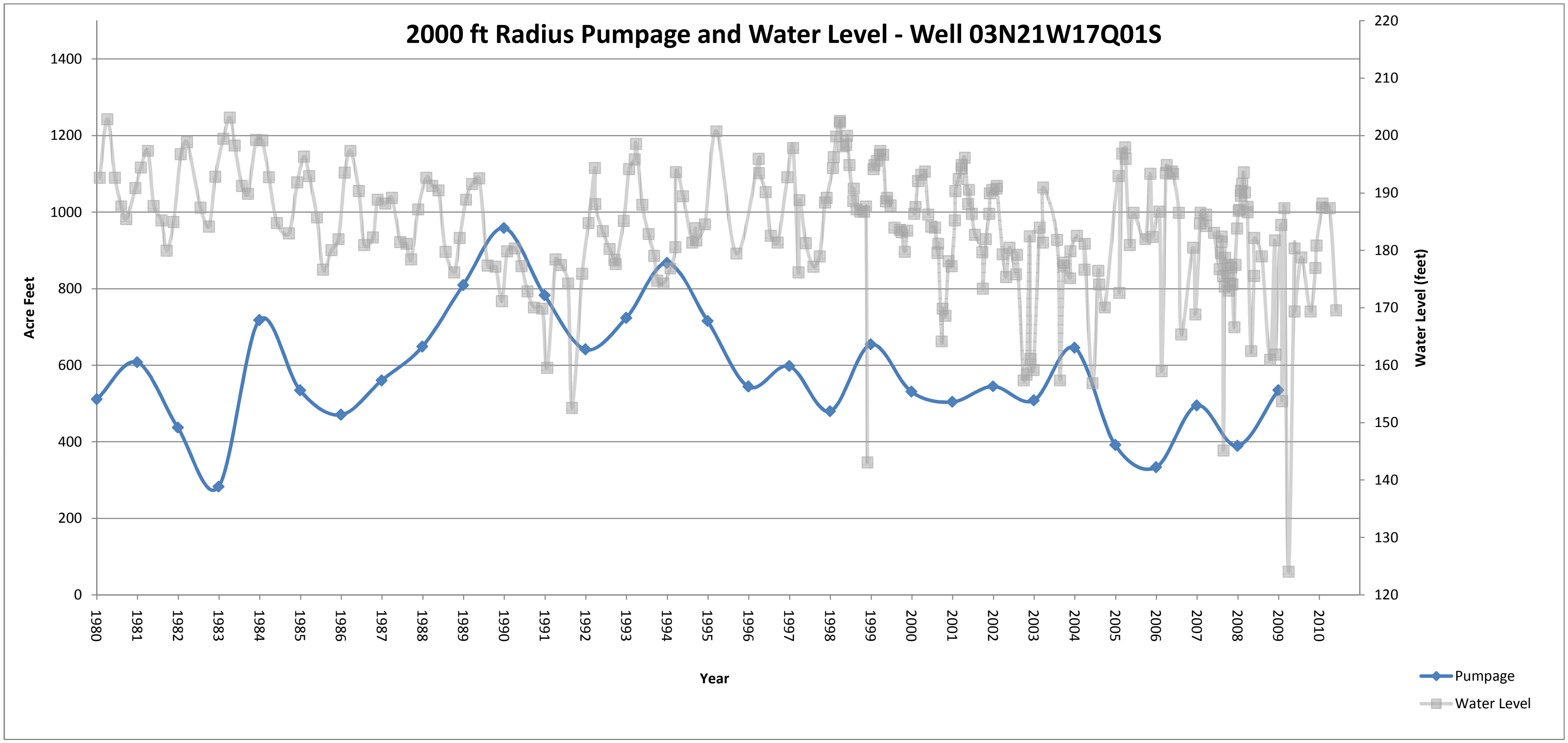
3000 ft Radius Pumpage and Water Level - Well 03N21W15C04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
7000
150
160
170
180
190
200
210
220
230
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



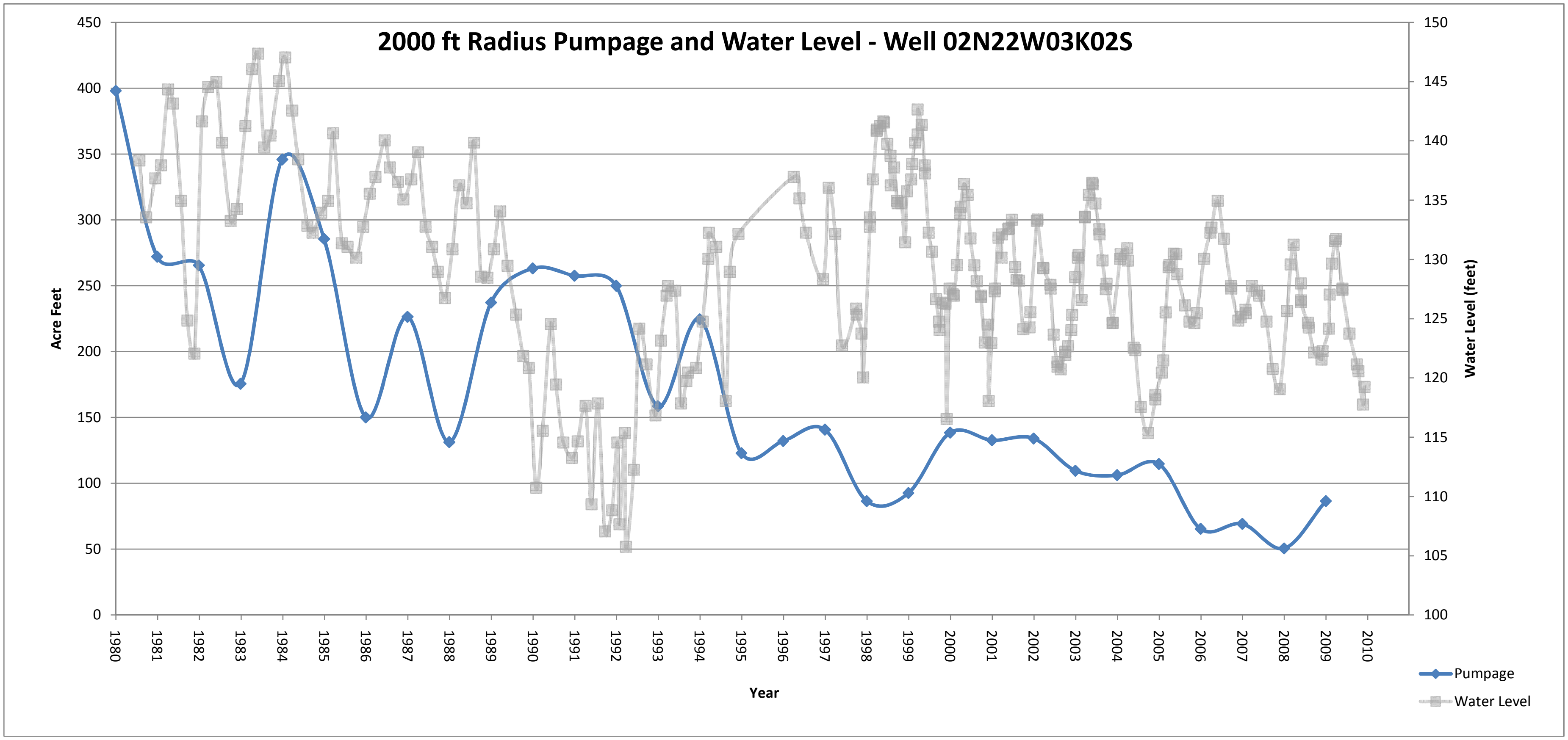
3000 ft Radius Pumpage and Water Level - Well 02N22W02C01S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level

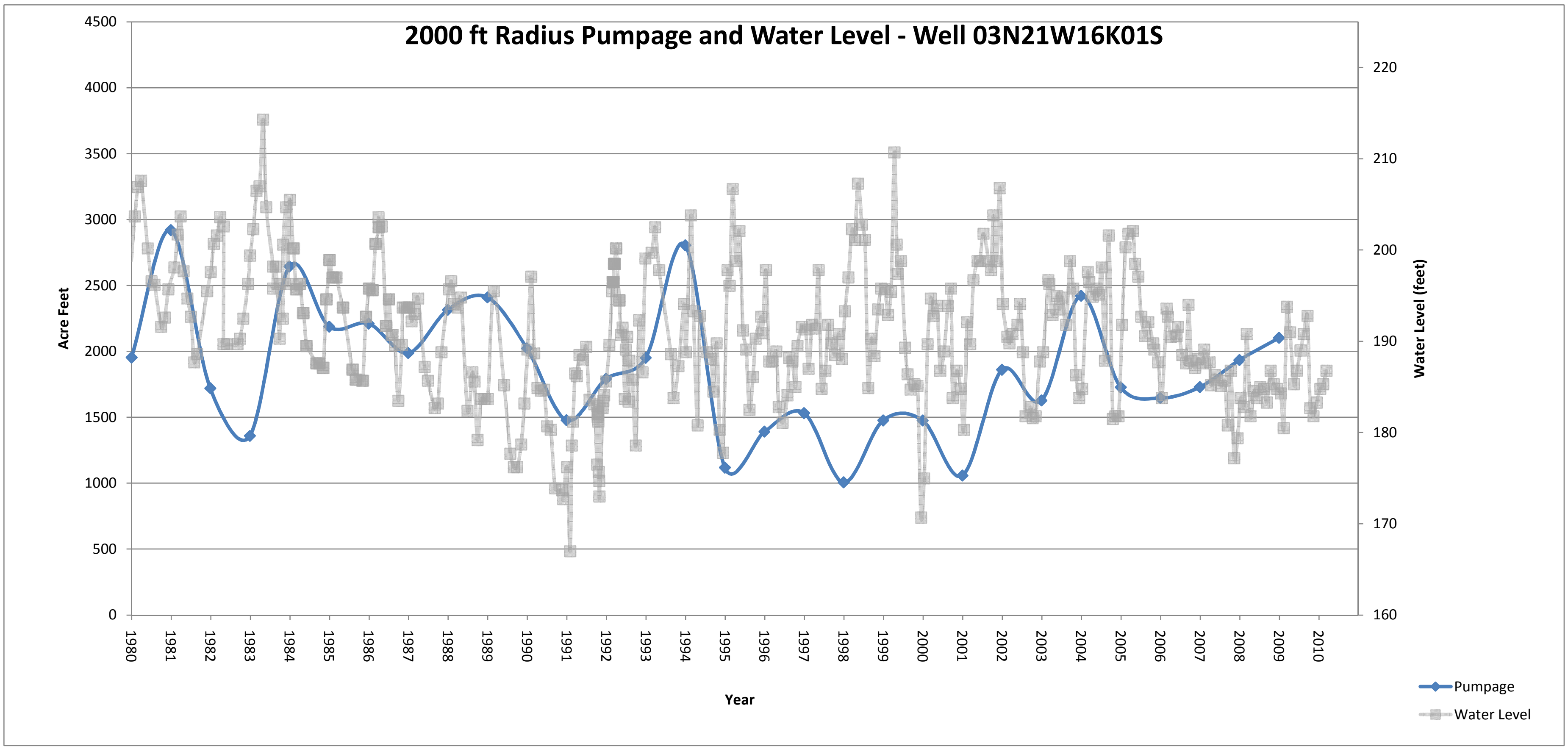
APPENDIX E – GRAPHS OF PUMPAGE PER YEAR IN VICINITY OF INDEX WELLS (1980 THROUGH 2009) – 2,000 FOOT RADIUS


2000 ft Radius Pumpage and Water Level - Well 03N22W34R01S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
100
200
300
400
500
600
700
110.00
115.00
120.00
125.00
130.00
135.00
140.00
145.00
150.00
155.00
160.00
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
2006
2007
2008
2009
2010

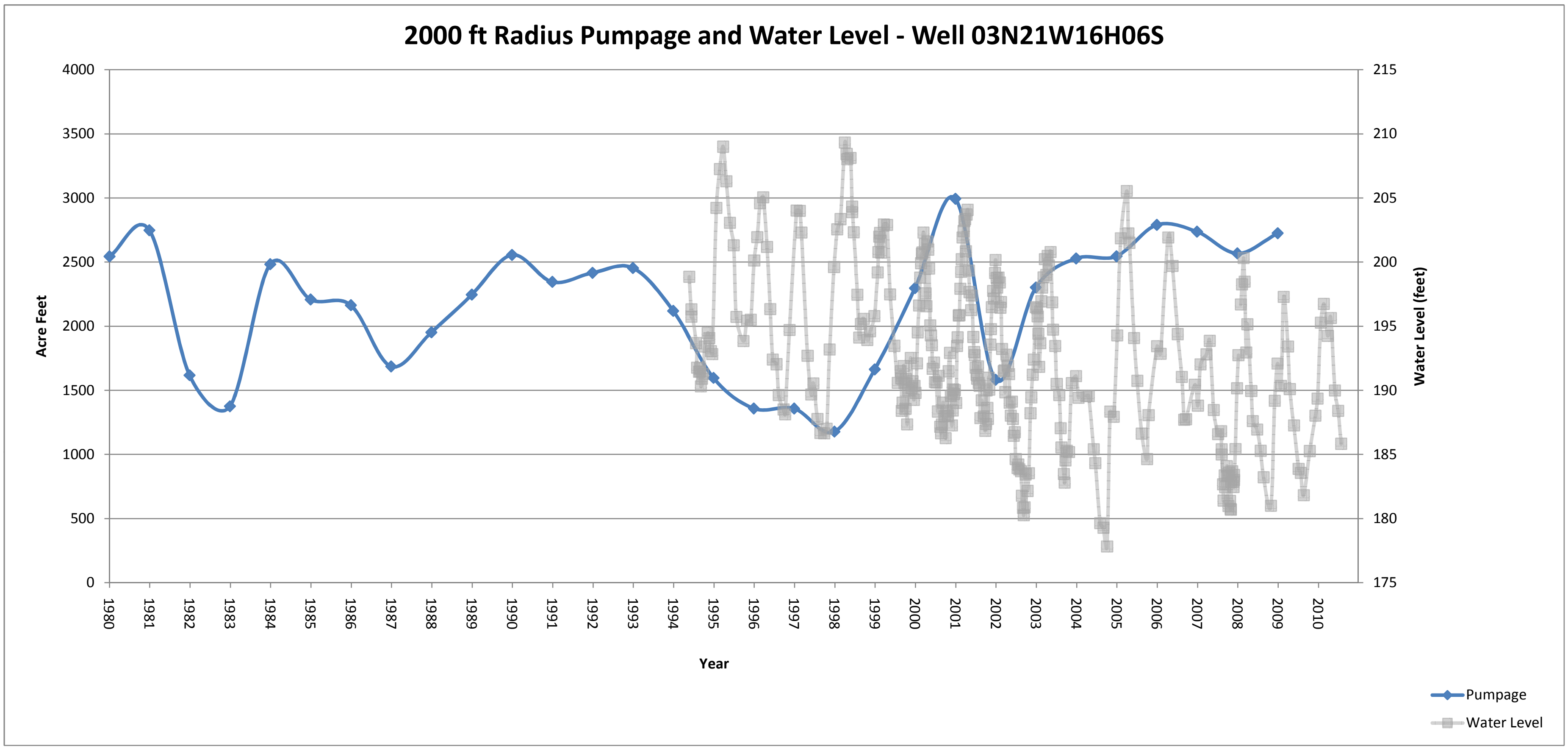


2000 ft Radius Pumpage and Water Level - Well 03N21W17Q01S
Acre Feet
Water Level (feet)
Year
1400
1200
1000
800
600
400
200
0
220
210
200
190
180
170
160
150
140
130
120
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

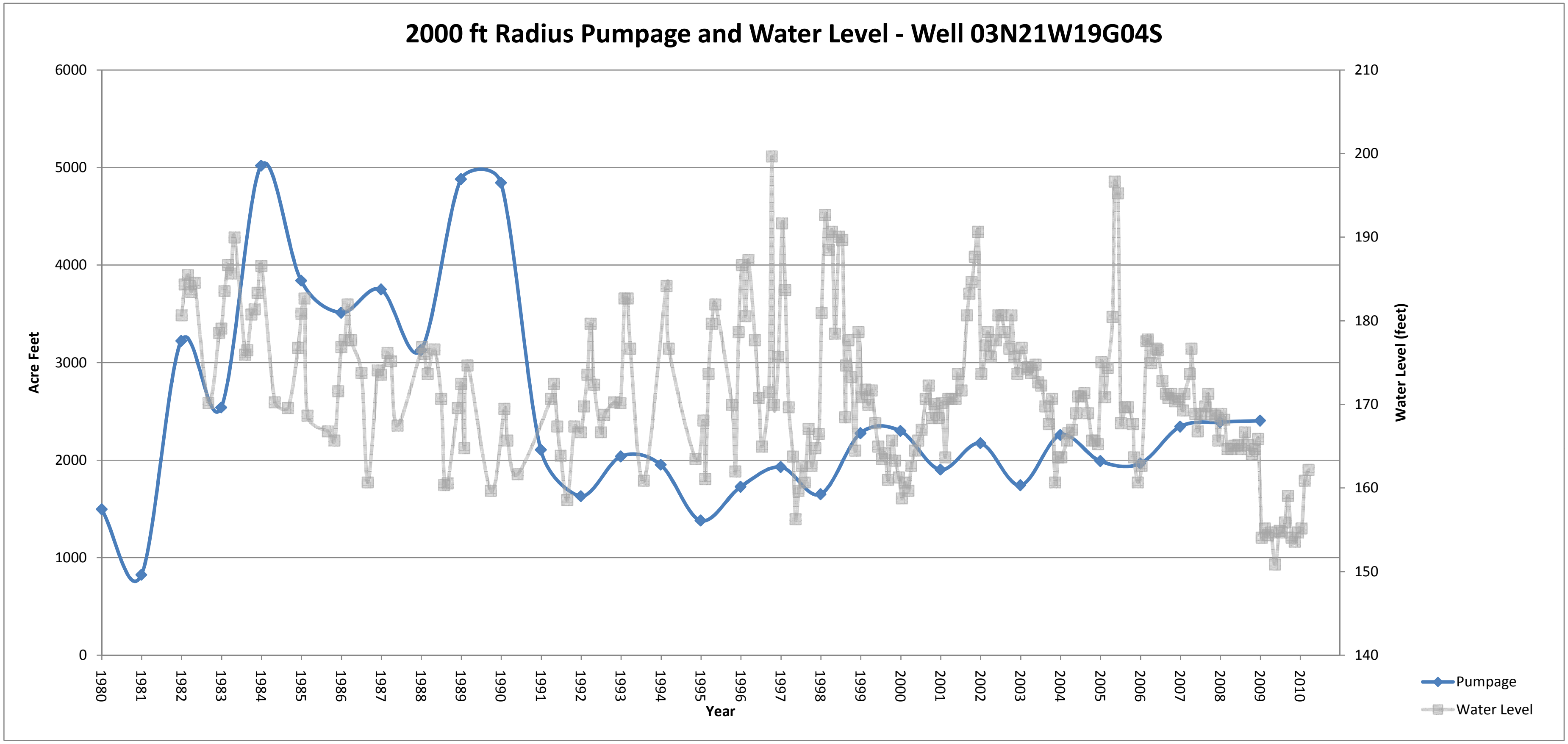

2000 ft Radius Pumpage and Water Level - Well 02N22W03K02S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
50
100
150
200
250
300
350
400
450
100
105
110
115
120
125
130
135
140
145
150
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010



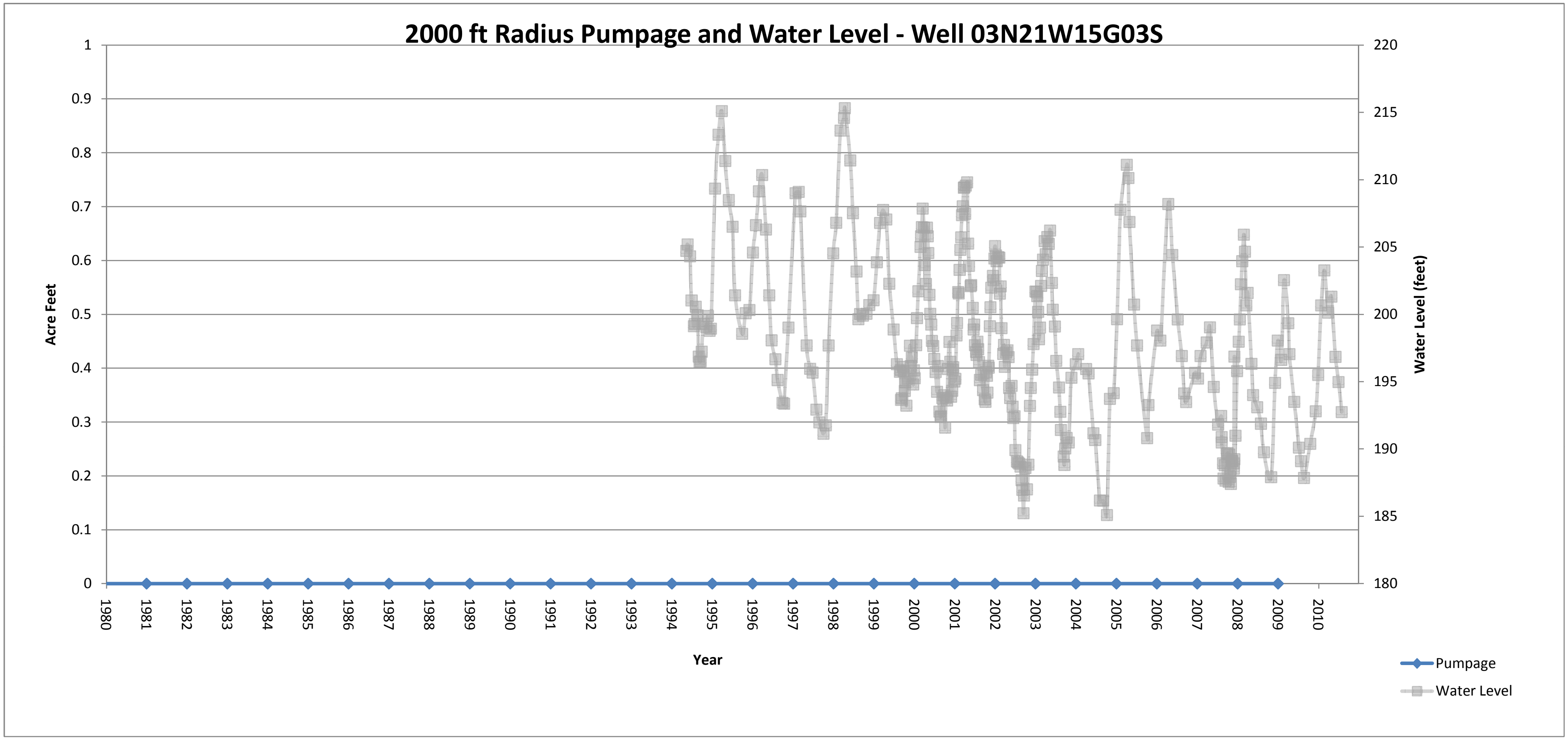
2000 ft Radius Pumpage and Water Level - Well 03N21W16K01S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
4000
4500
160
170
180
190
200
210
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

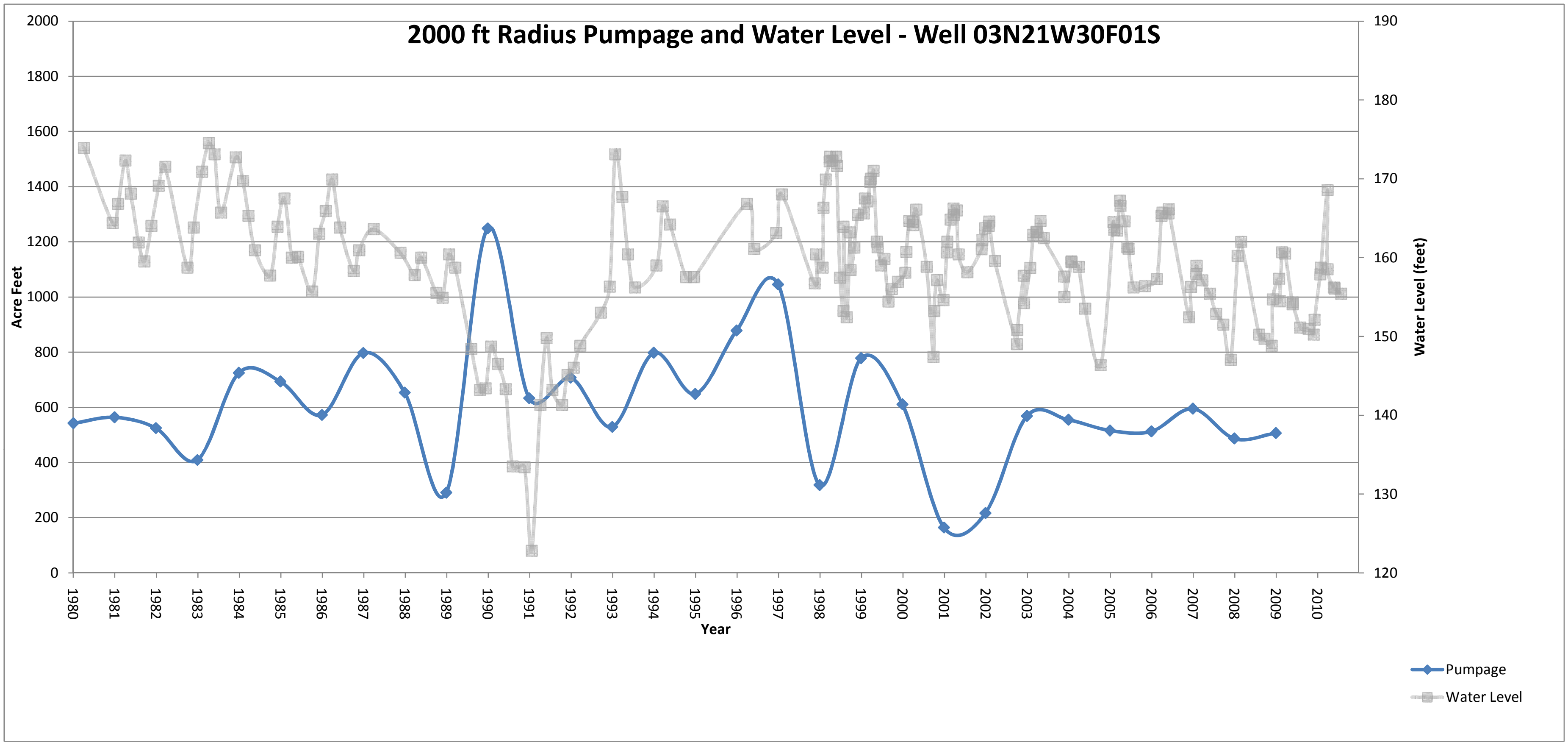


2000 ft Radius Pumpage and Water Level - Well 03N21W16H06S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
4000
175
180
185
190
195
200
205
210
215
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

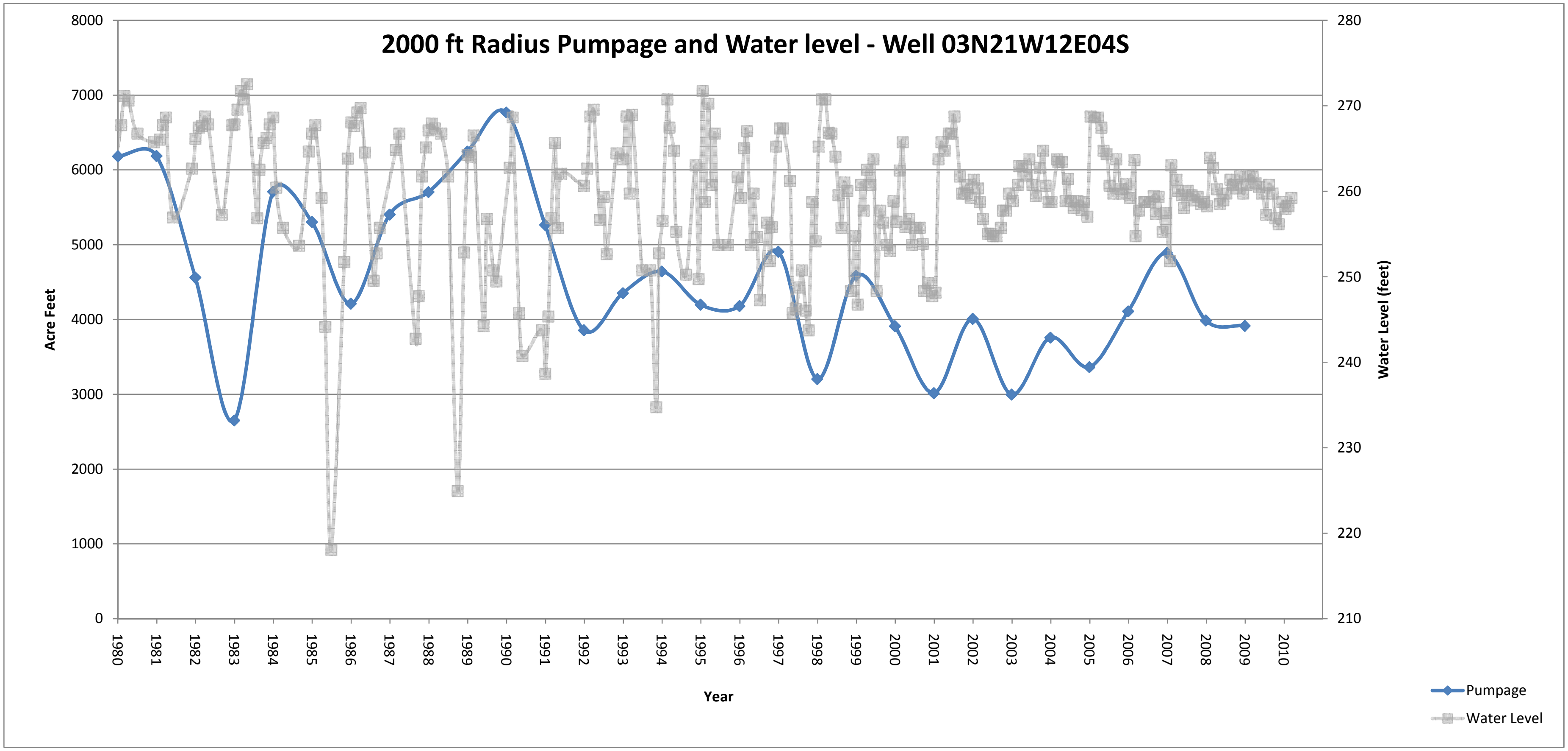


2000 ft Radius Pumpage and Water Level - Well 03N21W19G04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
140
150
160
170
180
190
200
210
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

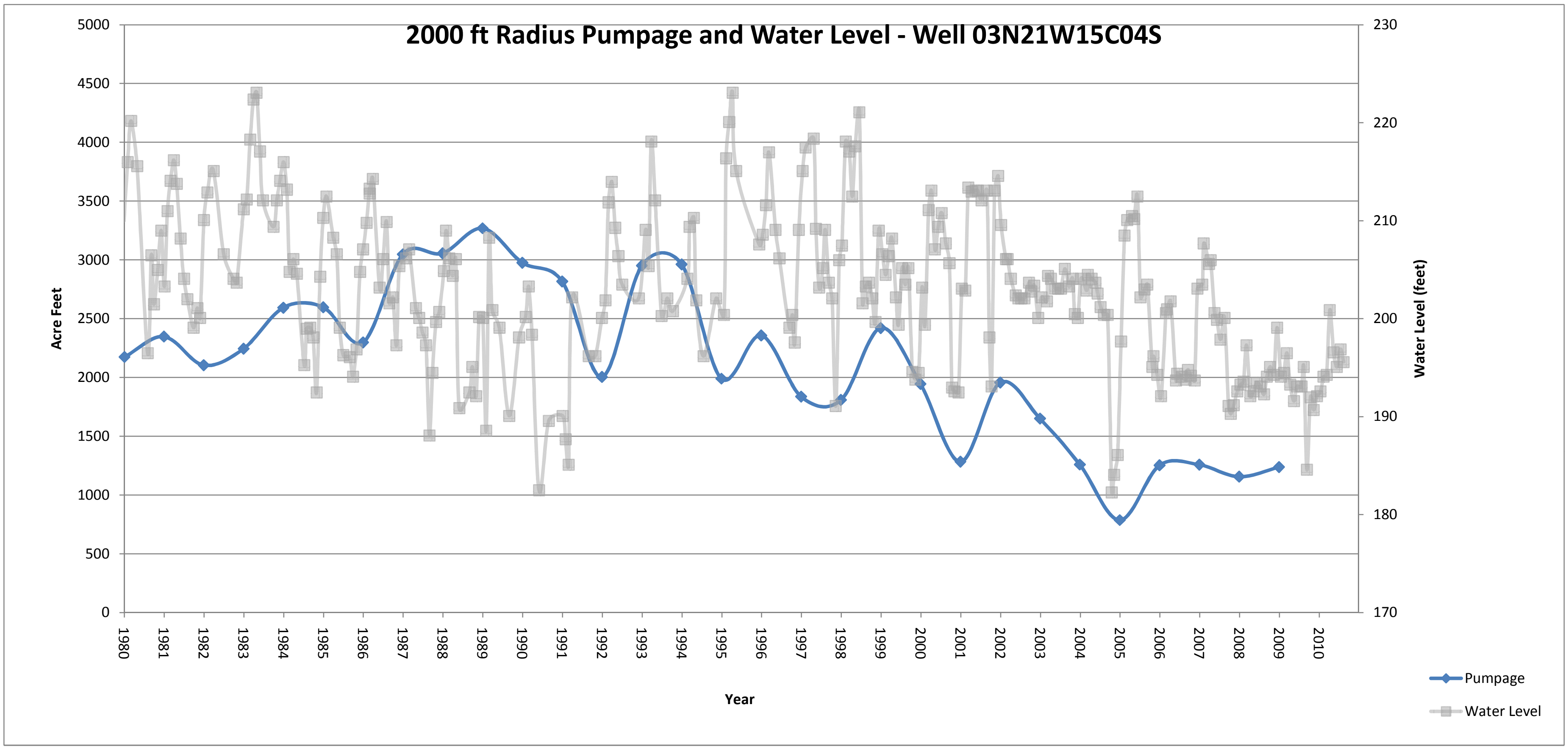

2000 ft Radius Pumpage and Water Level - Well 03N21W15G03S
Acre Feet
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Water Level (feet)
180
185
190
195
200
205
210
215
220
Year
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



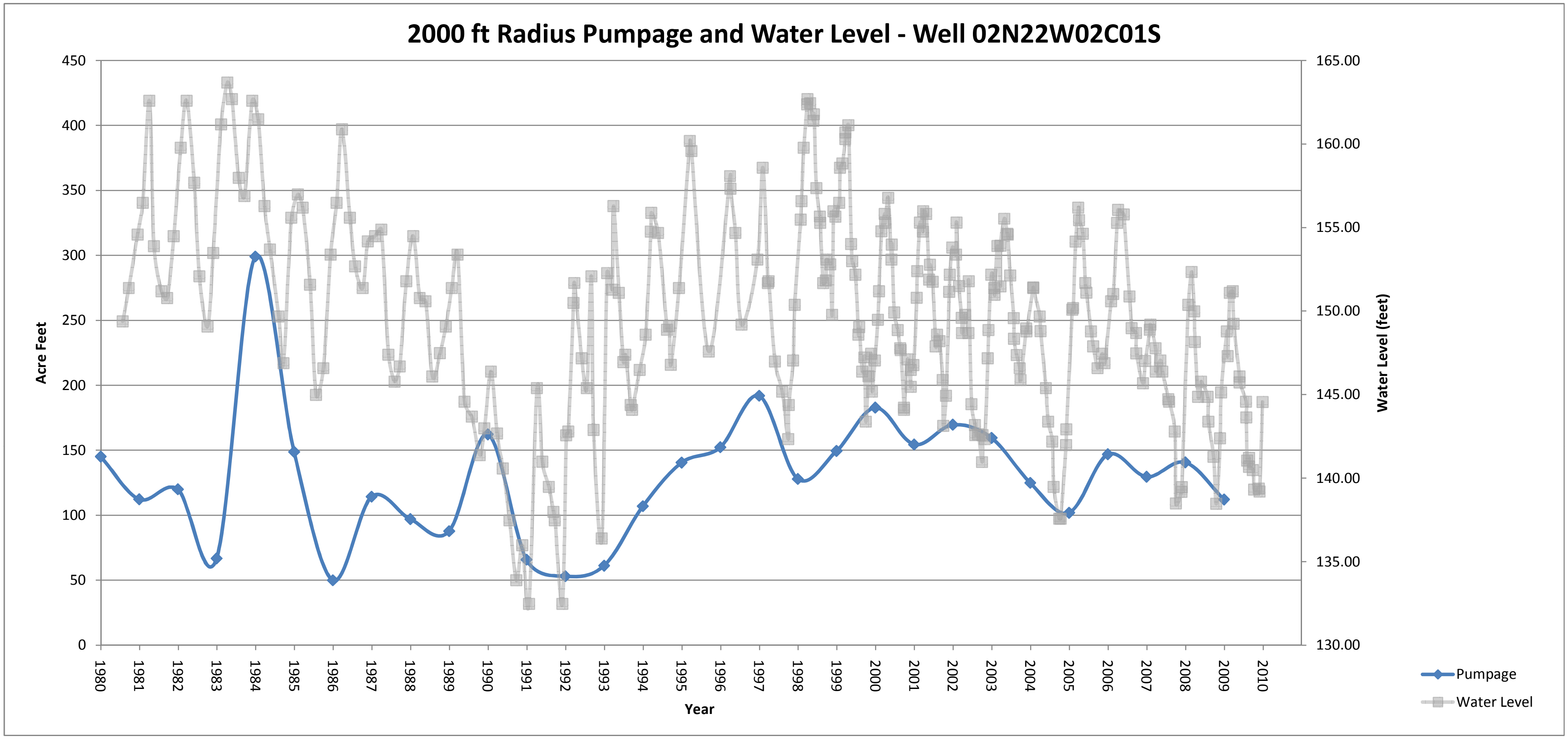
2000 ft Radius Pumpage and Water Level - Well 03N21W30F01S
Acre Feet
Water Level (feet)
Year
0
200
400
600
800
1000
1200
1400
1600
1800
2000
120
130
140
150
160
170
180
190
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



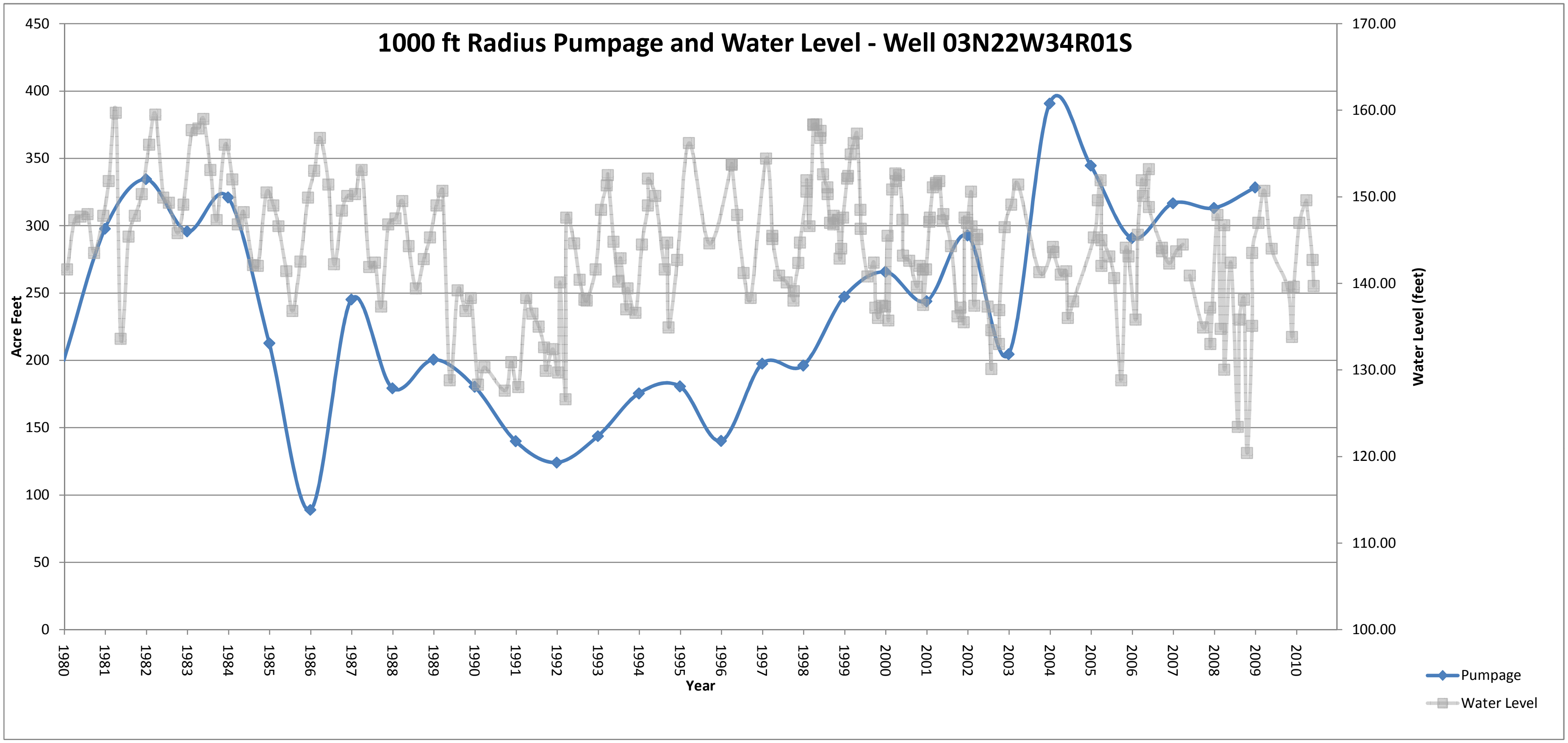
2000 ft Radius Pumpage and Water level - Well 03N21W12E04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
210
220
230
240
250
260
270
280
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level



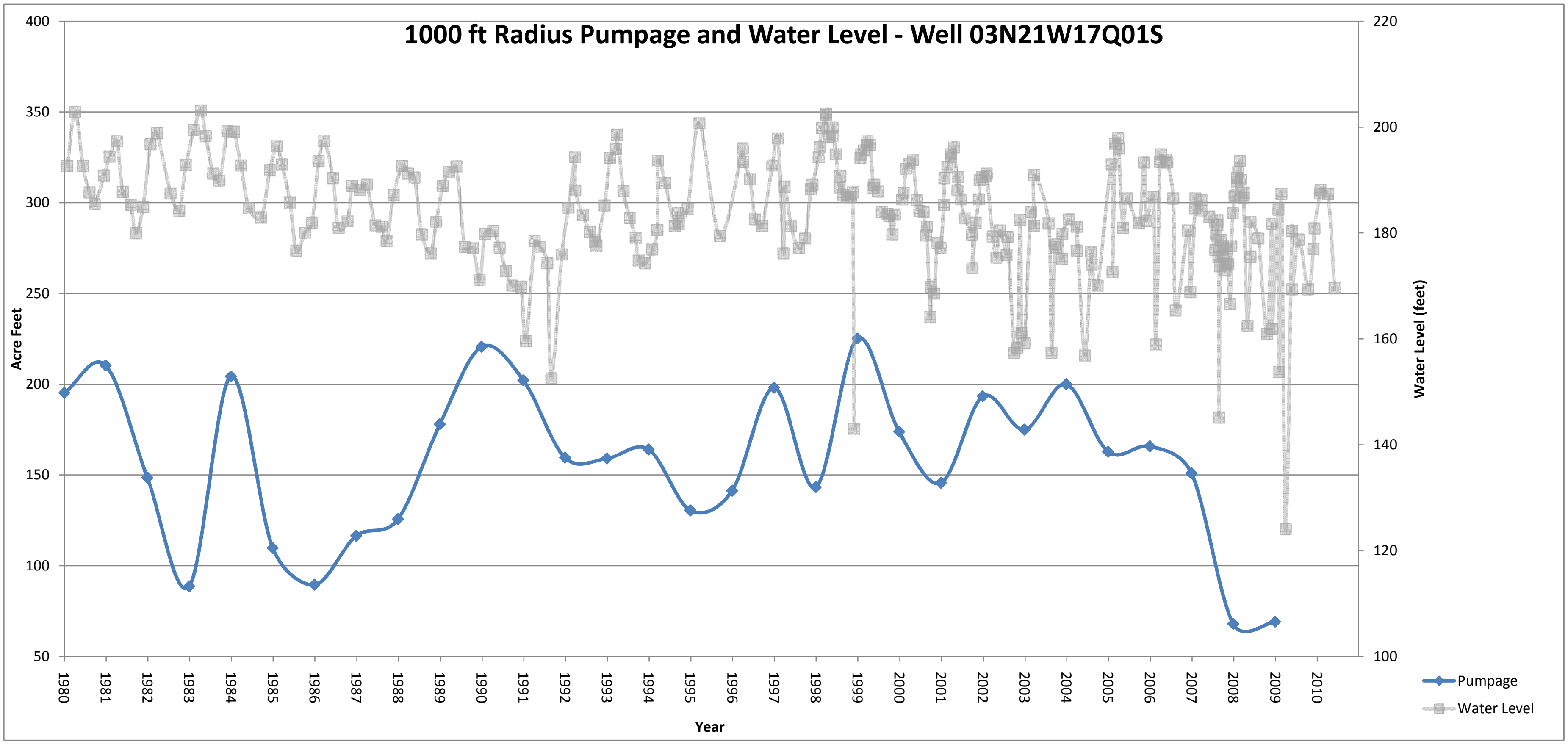
2000 ft Radius Pumpage and Water Level - Well 03N21W15C04S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
170
180
190
200
210
220
230
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

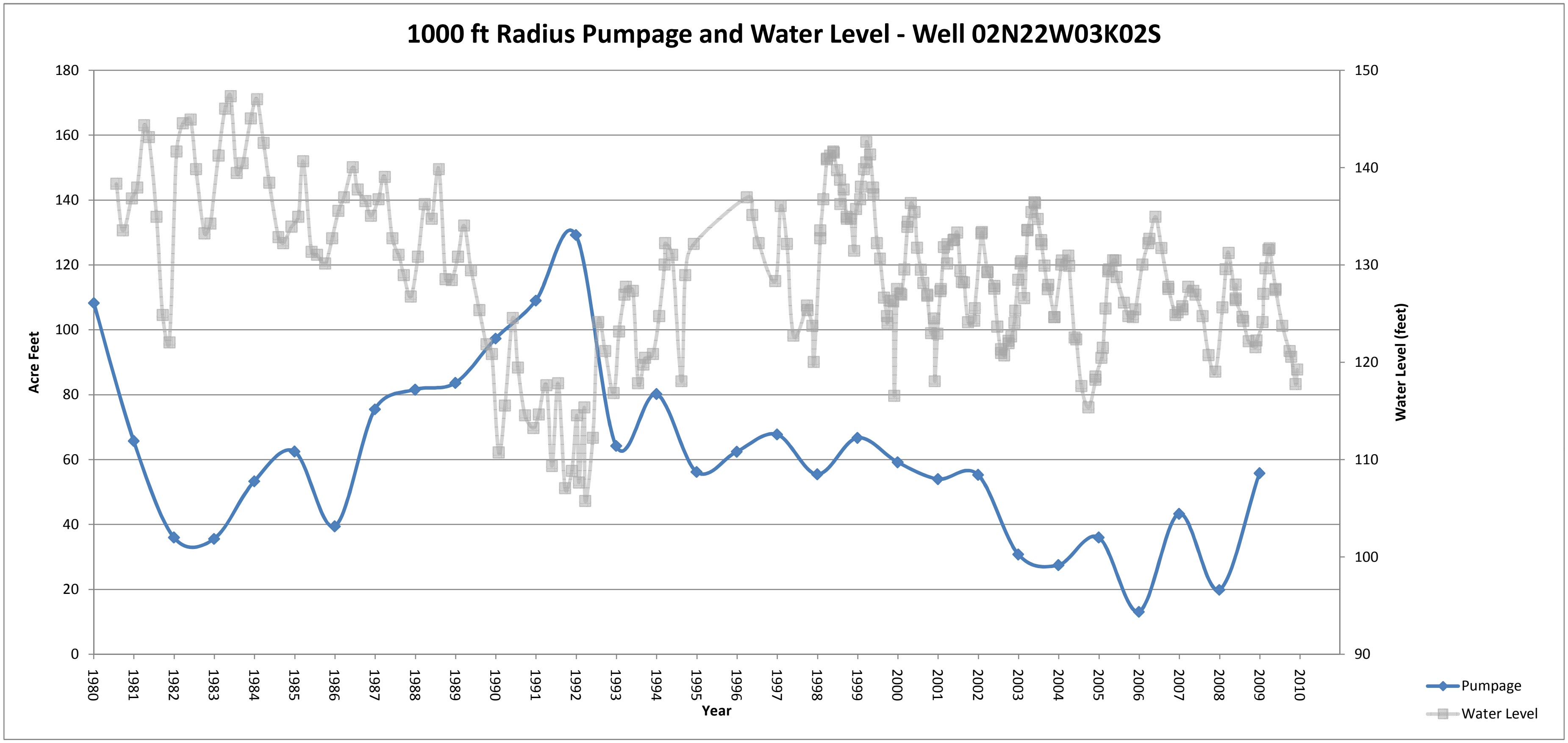

2000 ft Radius Pumpage and Water Level - Well 02N22W02C01S
Acre Feet
Water Level (feet)
Year
450
400
350
300
250
200
150
100
50
0
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

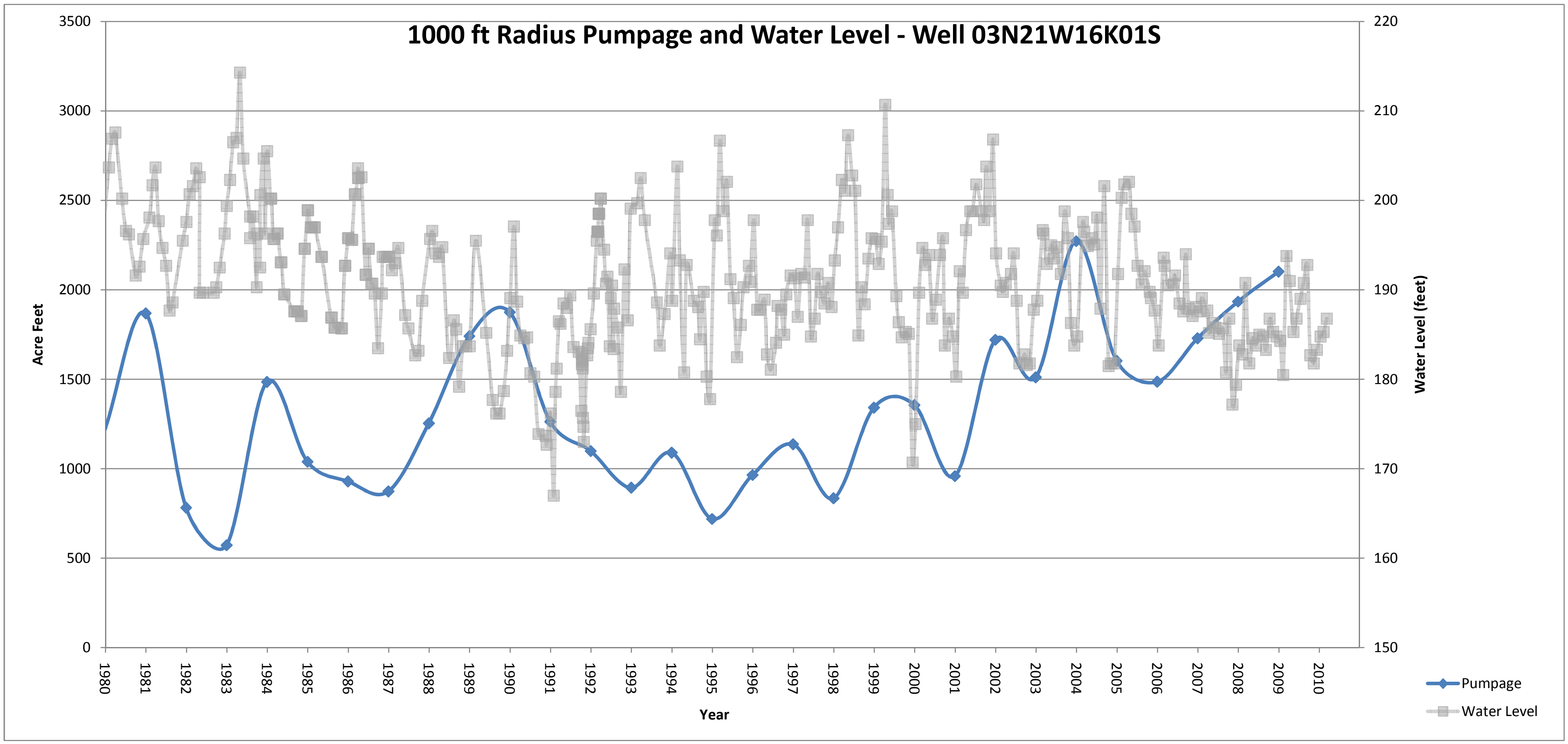
APPENDIX F – GRAPHS OF PUMPAGE PER YEAR IN VICINITY OF INDEX WELLS (1980 THROUGH 2009) – 1,000 FOOT RADIUS



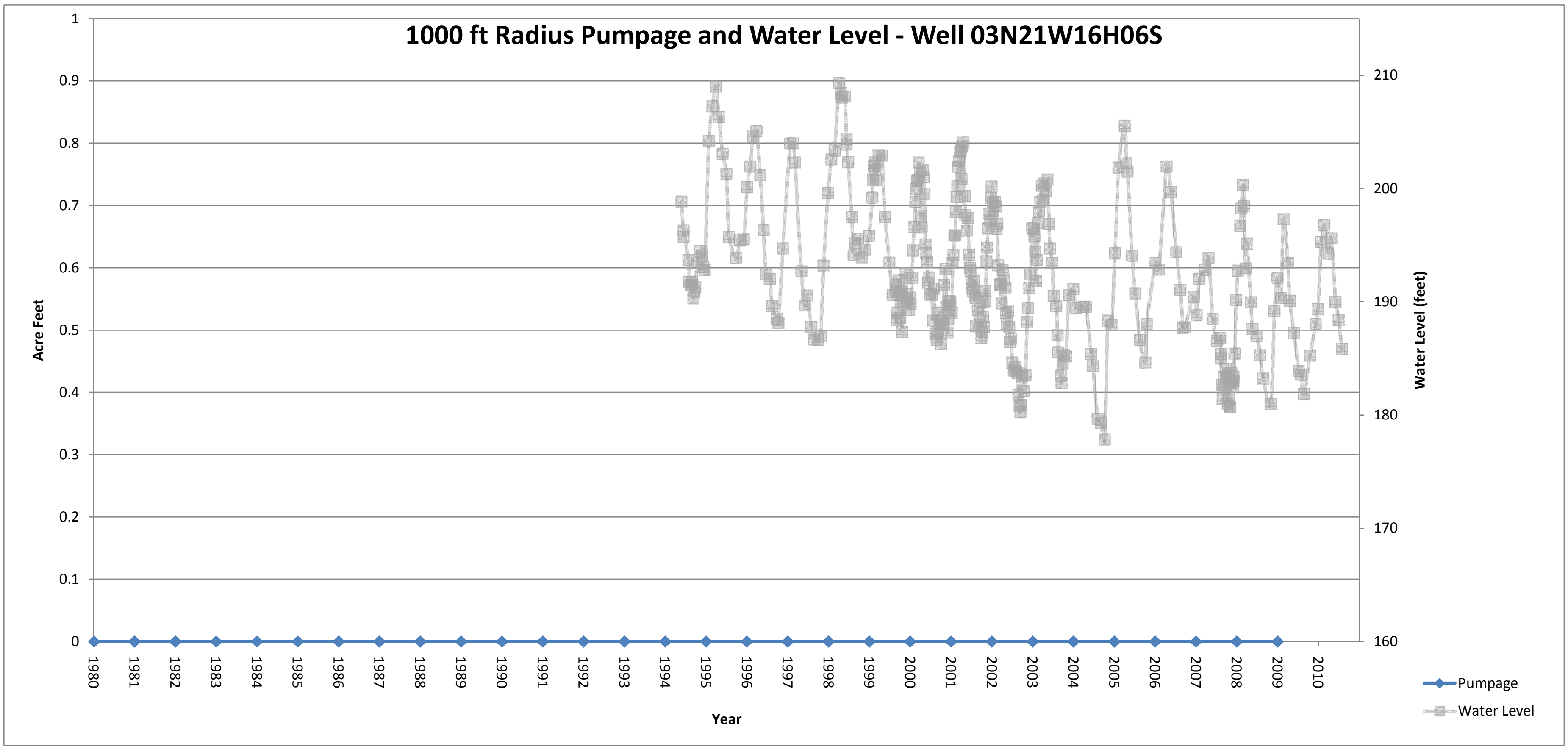
1000 ft Radius Pumpage and Water Level - Well 03N22W34R01S
Acre Feet
Water Level (feet)
Year
0
50
100
150
200
250
300
350
400
450
100.00
110.00
120.00
130.00
140.00
150.00
160.00
170.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level


1000 ft Radius Pumpage and Water Level - Well 03N21W17Q01S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
400
350
300
250
200
150
100
50
220
200
180
160
140
120
100
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
2006
2007
2008
2009
2010

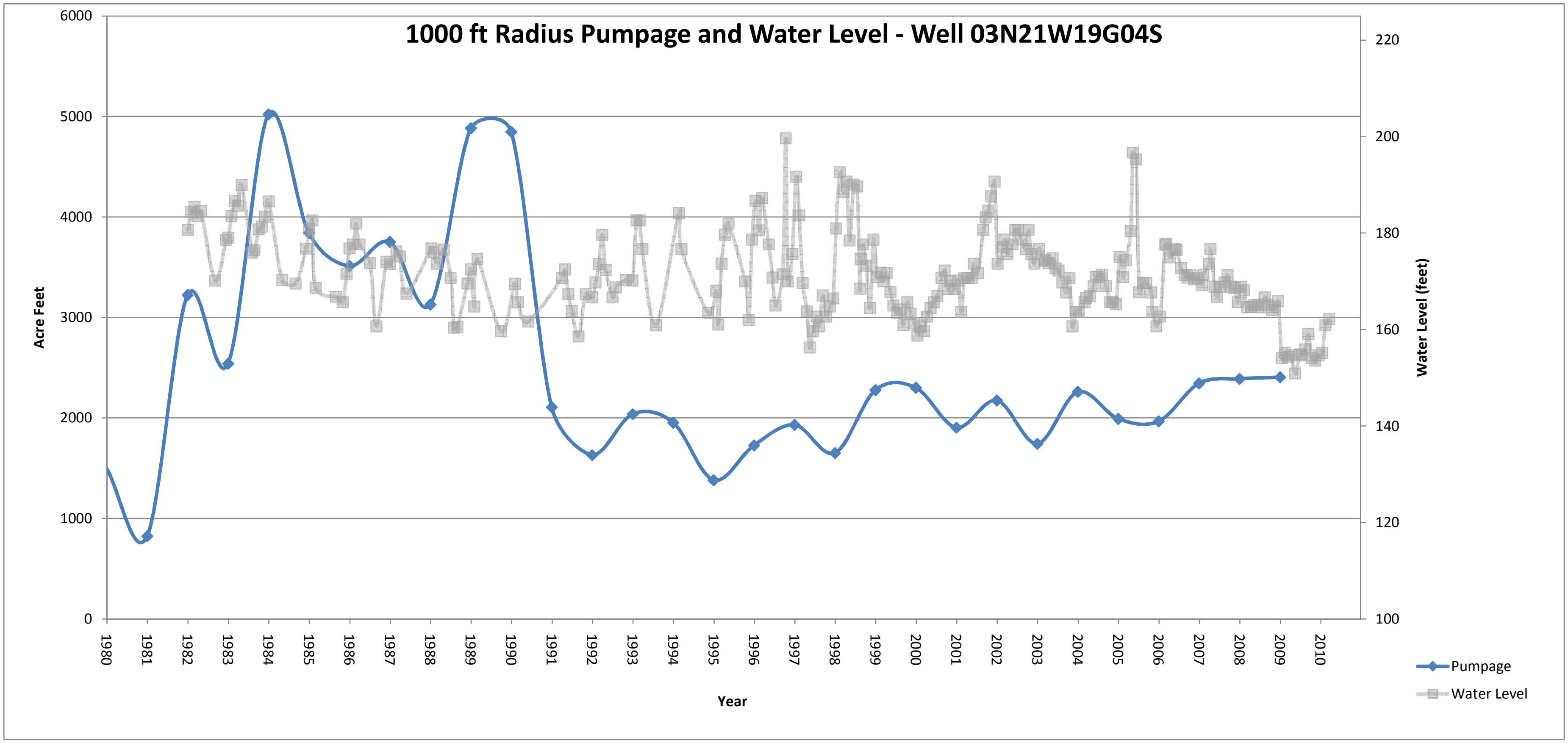

1000 ft Radius Pumpage and Water Level - Well 02N22W03K02S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
20
40
60
80
100
120
140
160
180
90
100
110
120
130
140
150
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

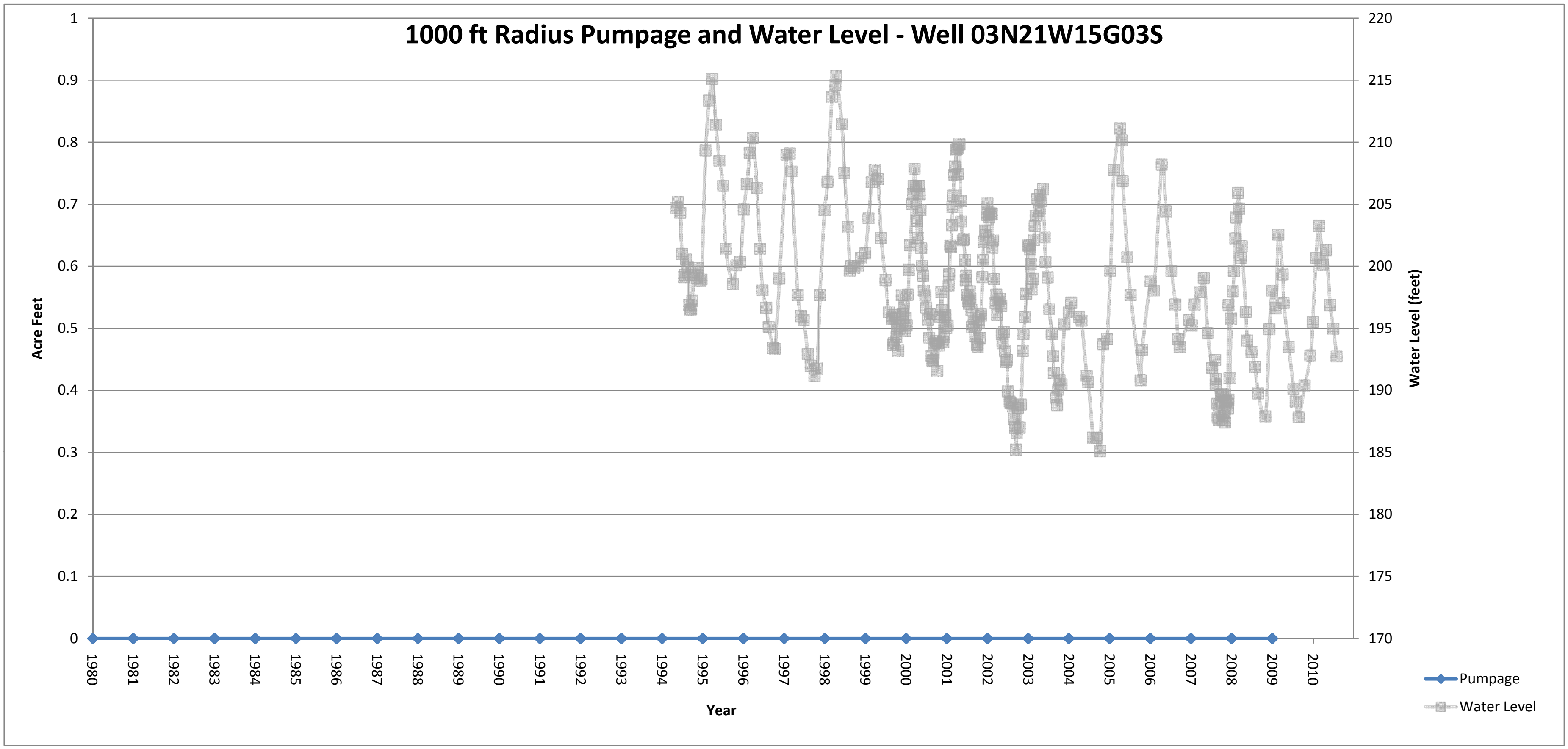


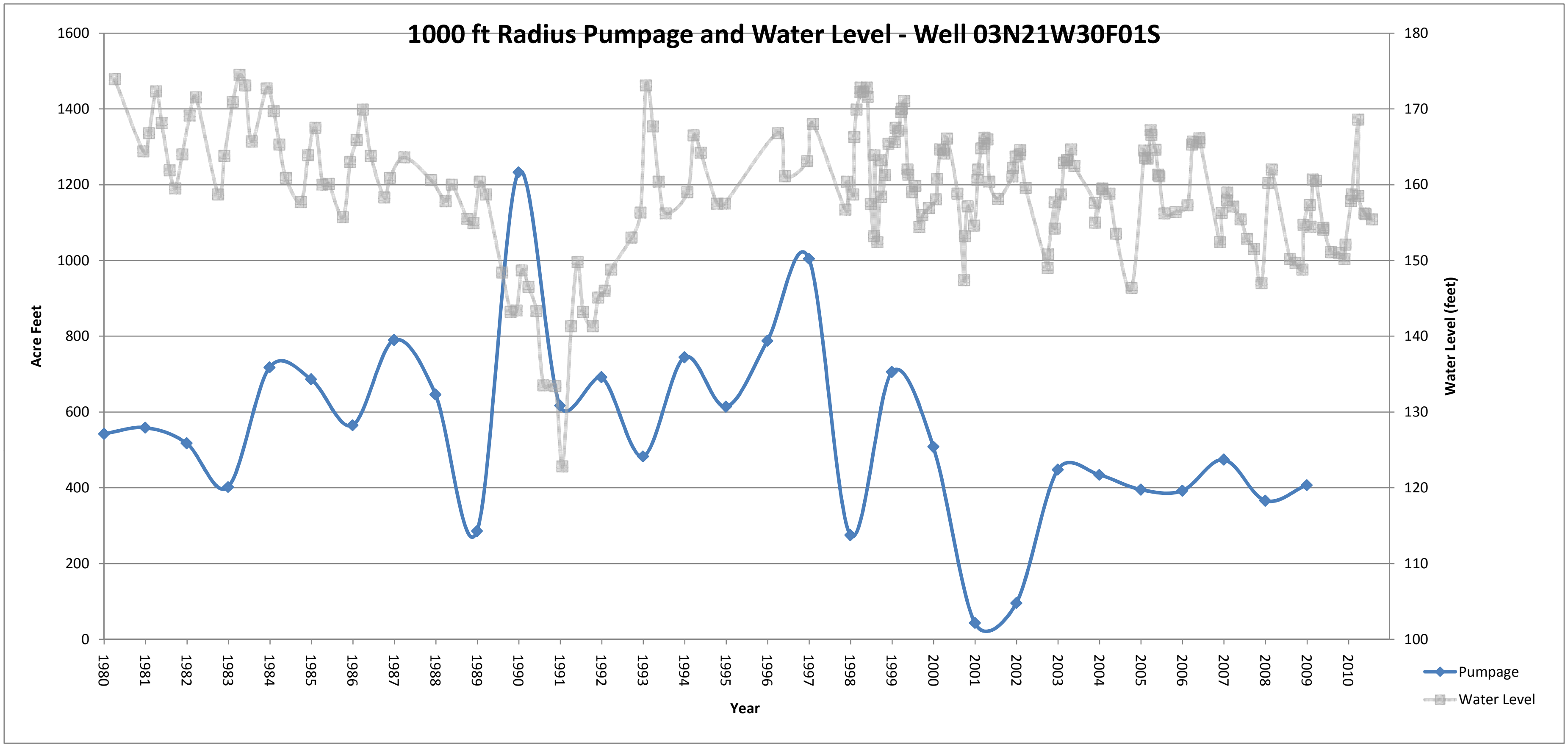
1000 ft Radius Pumpage and Water Level - Well 03N21W16K01S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
150
160
170
180
190
200
210
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

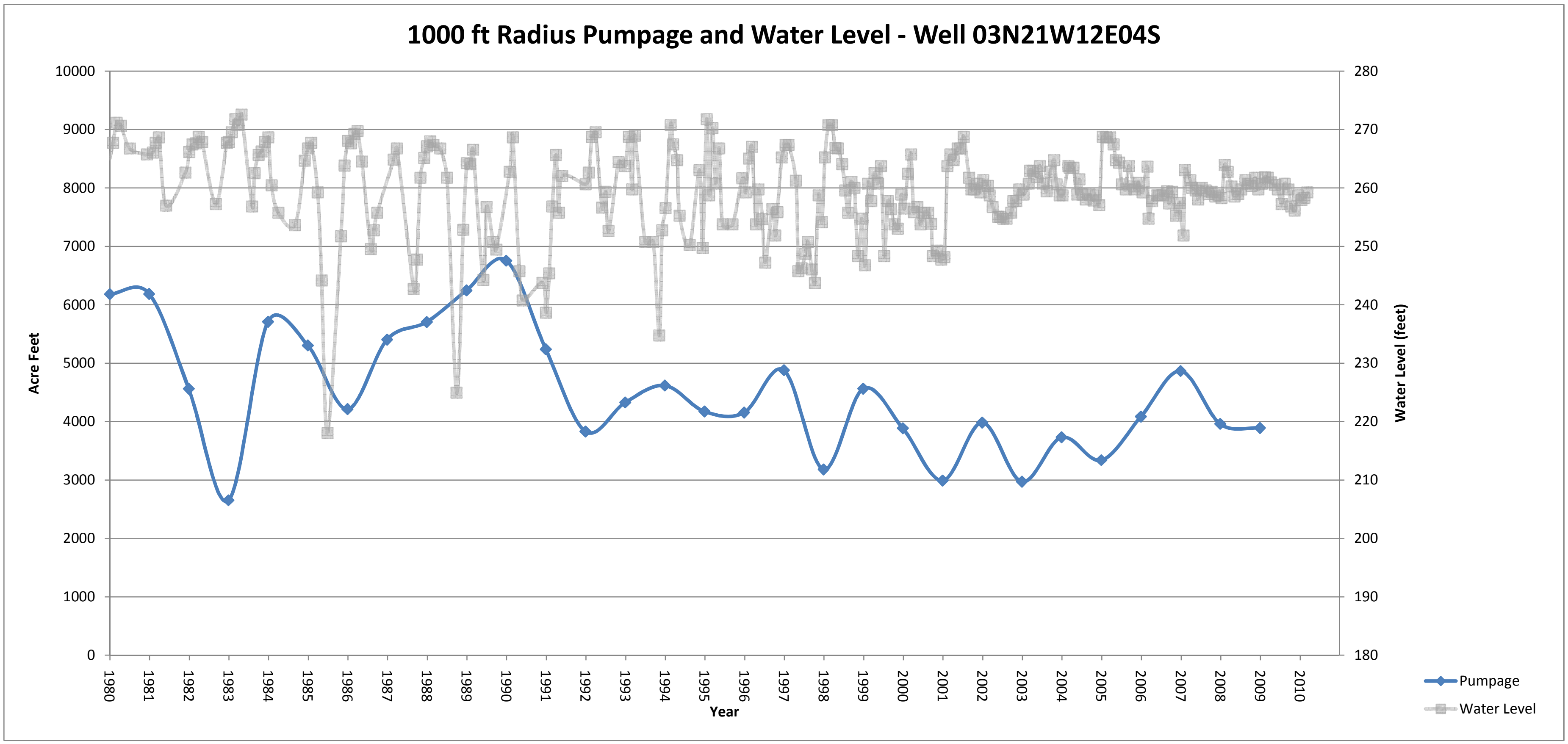


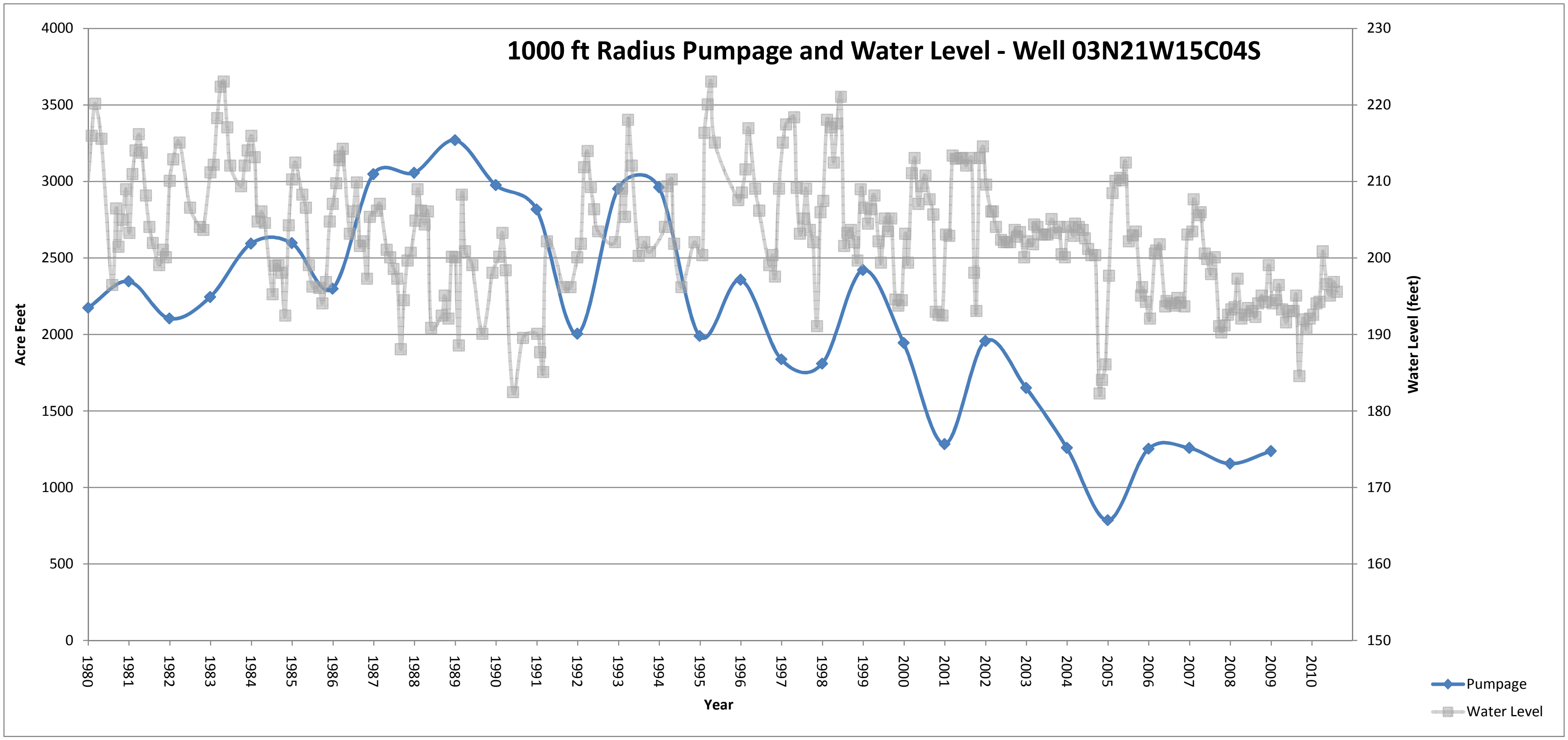
1000 ft Radius Pumpage and Water Level - Well 03N21W16H06S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
210
200
190
180
170
160
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

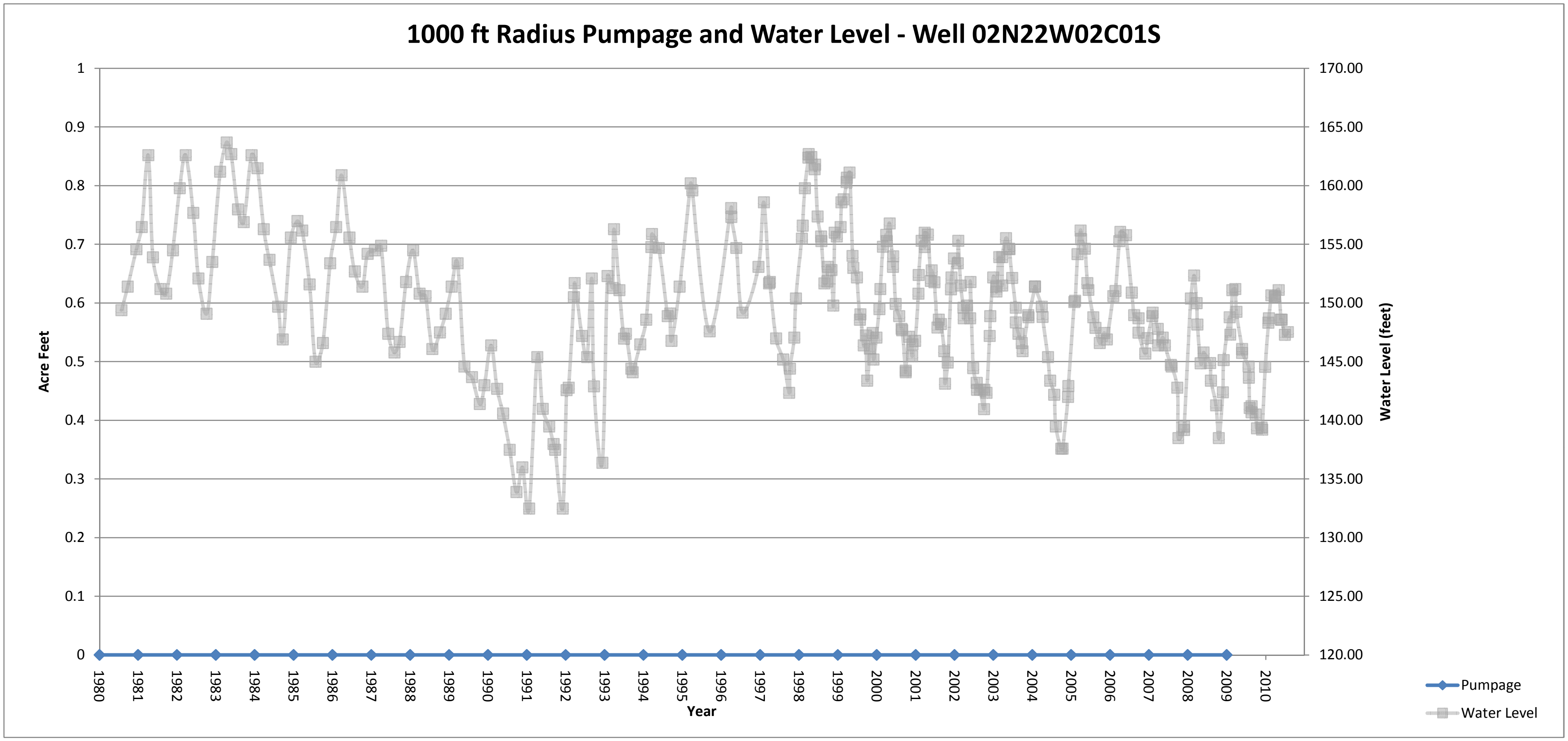

1000 ft Radius Pumpage and Water Level - Well 03N21W19G04S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
1000
2000
3000
4000
5000
6000
100
120
140
160
180
200
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


1000 ft Radius Pumpage and Water Level - Well 03N21W15G03S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
220
215
210
205
200
195
190
185
180
175
170
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
2006
2007
2008
2009
2010
Pumpage
Water Level


1000 ft Radius Pumpage and Water Level - Well 03N21W30F01S
Acre Feet
Water Level (feet)
Year
0
200
400
600
800
1000
1200
1400
1600
100
110
120
130
140
150
160
170
180
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
2006
2007
2008
2009
2010
Pumpage
Water Level

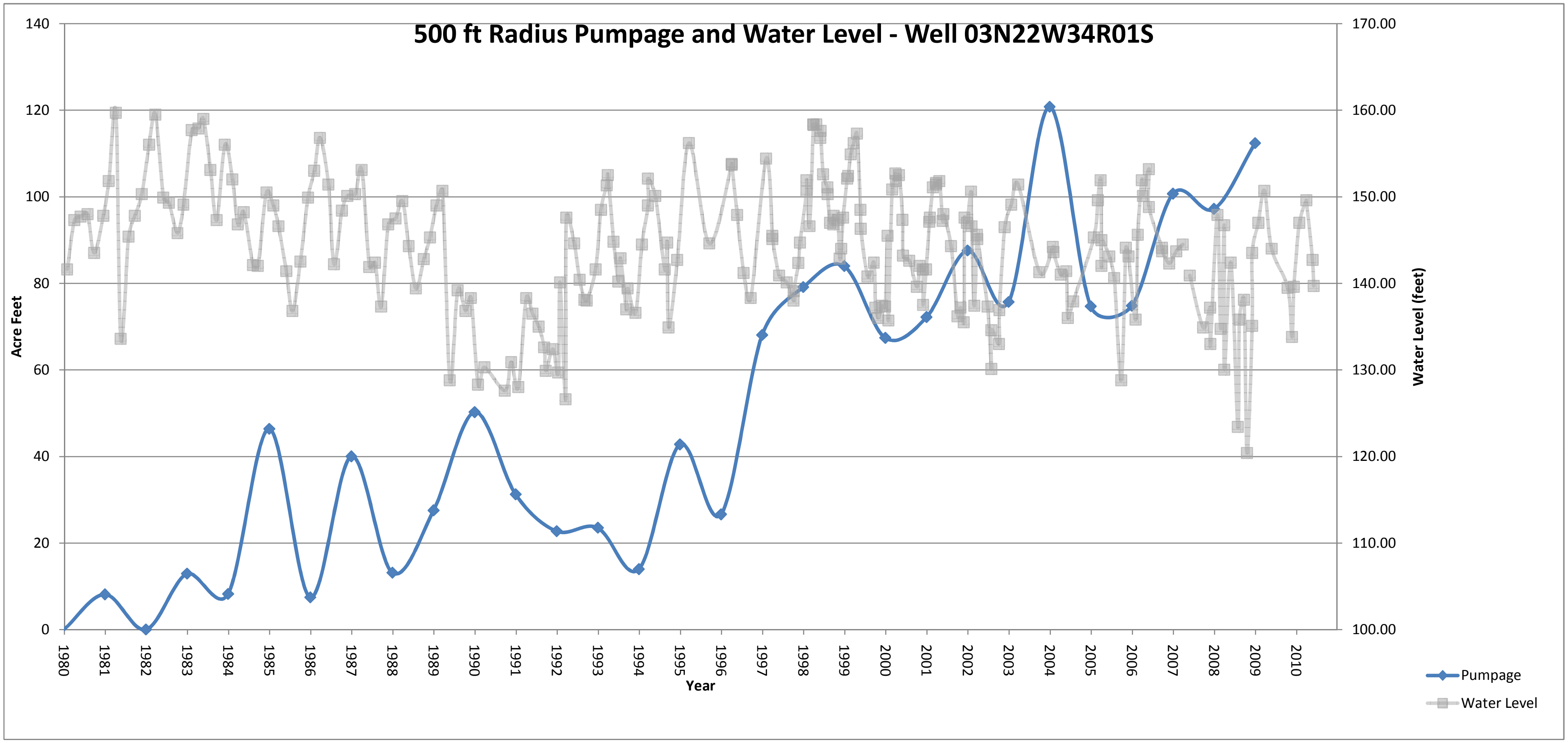

1000 ft Radius Pumpage and Water Level - Well 03N21W12E04S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
180
190
200
210
220
230
240
250
260
270
280
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


1000 ft Radius Pumpage and Water Level - Well 03N21W15C04S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
4000
150
160
170
180
190
200
210
220
230
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
2006
2007
2008
2009
2010
Pumpage
Water Level

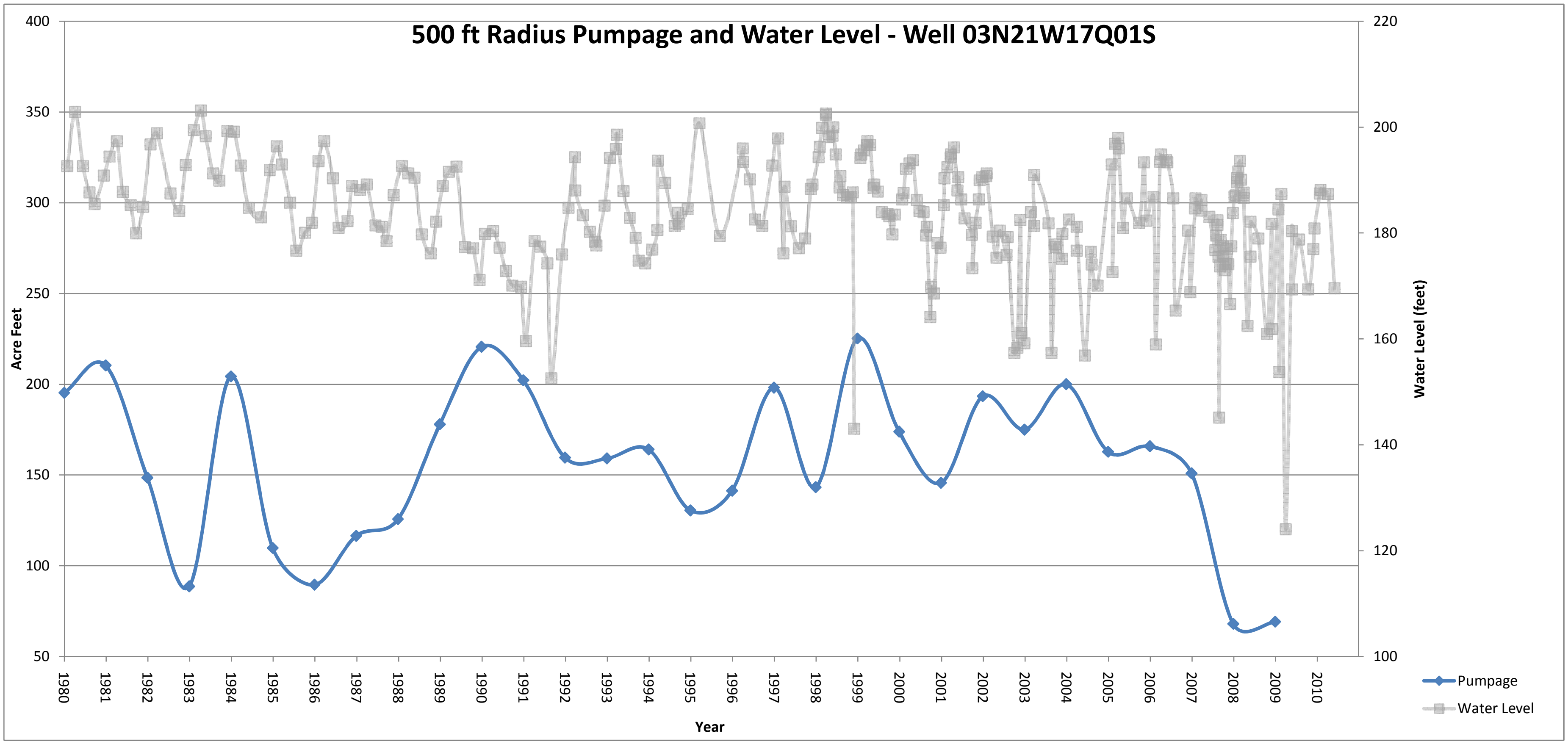


1000 ft Radius Pumpage and Water Level - Well 02N22W02C01S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

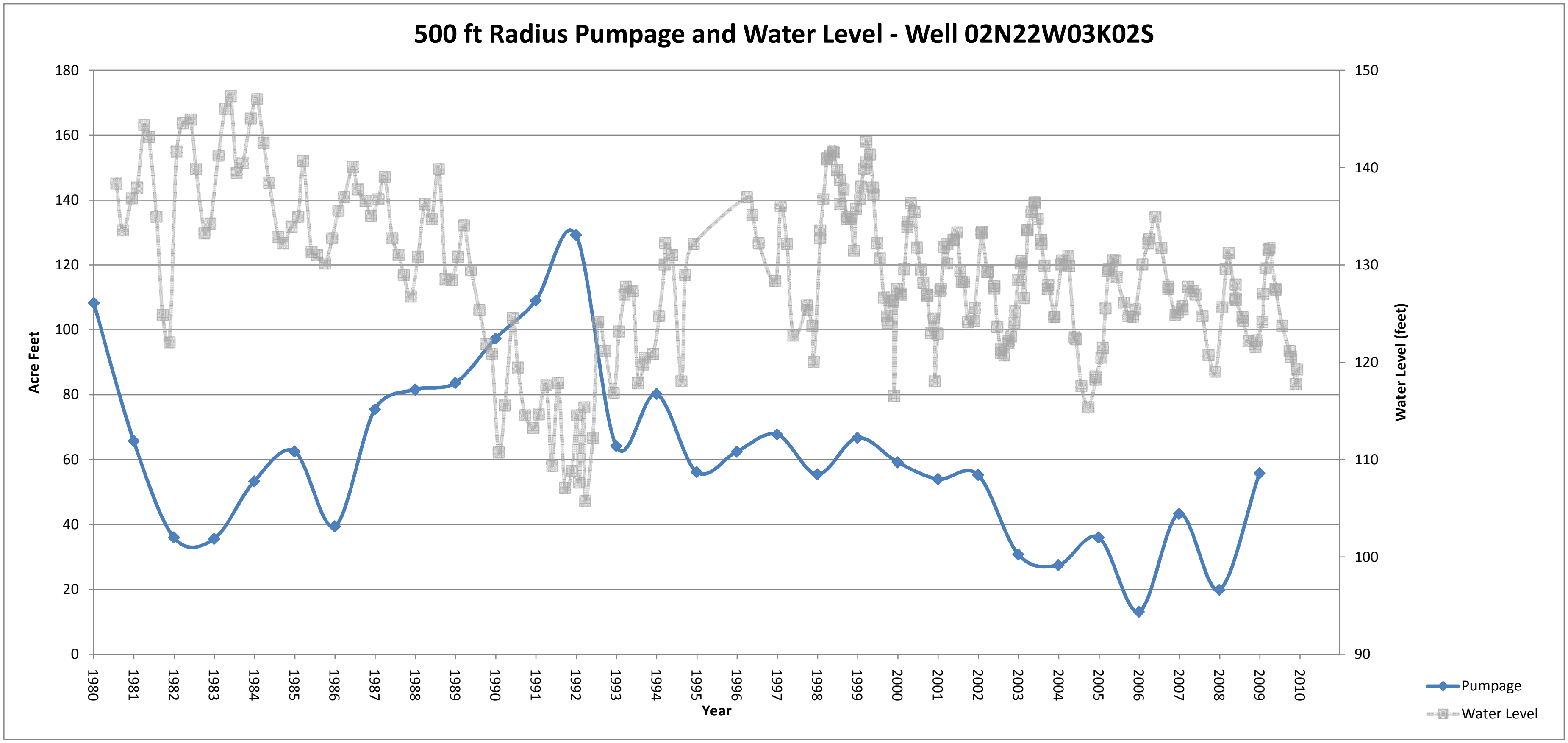
APPENDIX G – GRAPHS OF PUMPAGE PER YEAR IN VICINITY OF INDEX WELLS (1980 THROUGH 2009) – 500 FOOT RADIUS

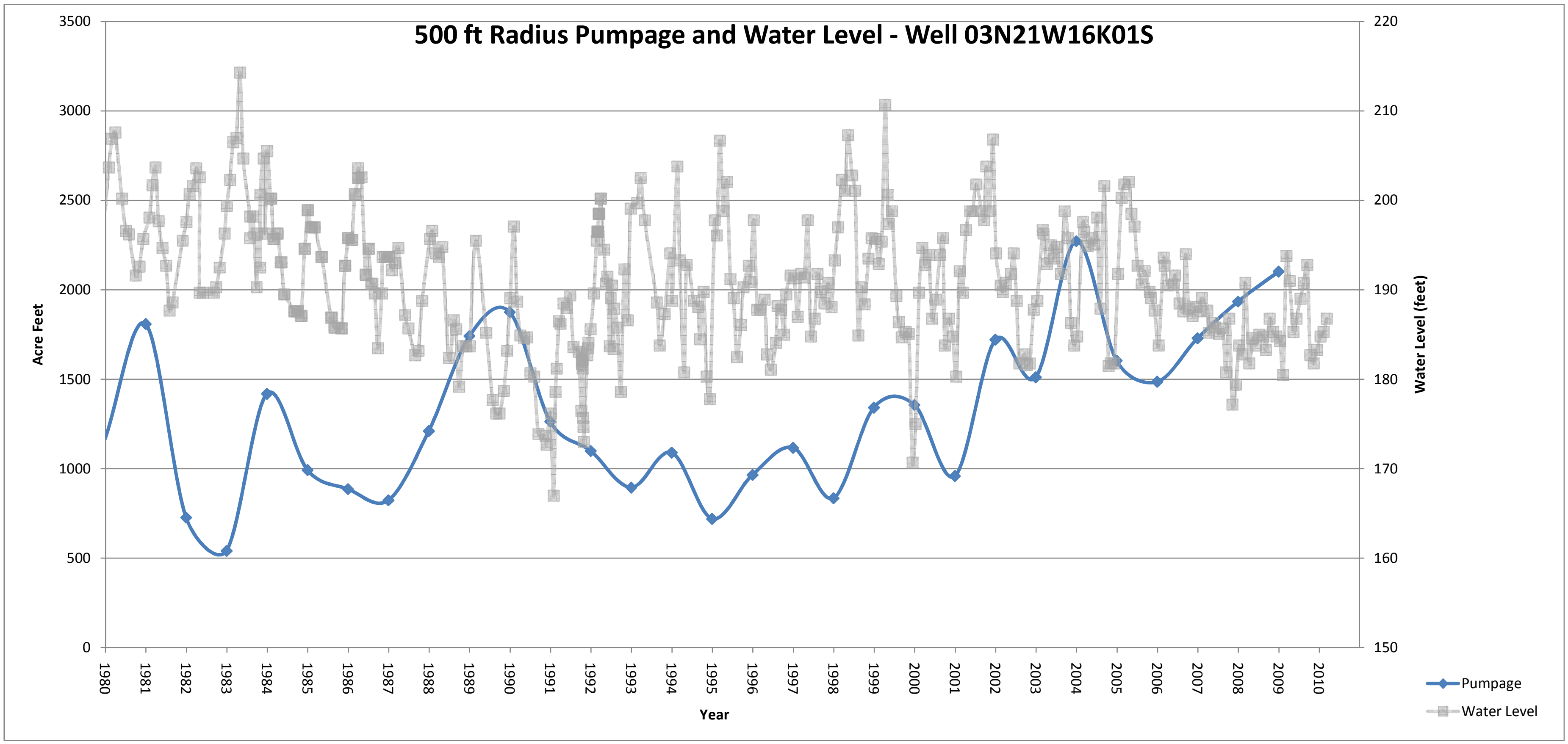


500 ft Radius Pumpage and Water Level - Well 03N22W34R01S
Acre Feet
Water Level (feet)
Year
140
120
100
80
60
40
20
0
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

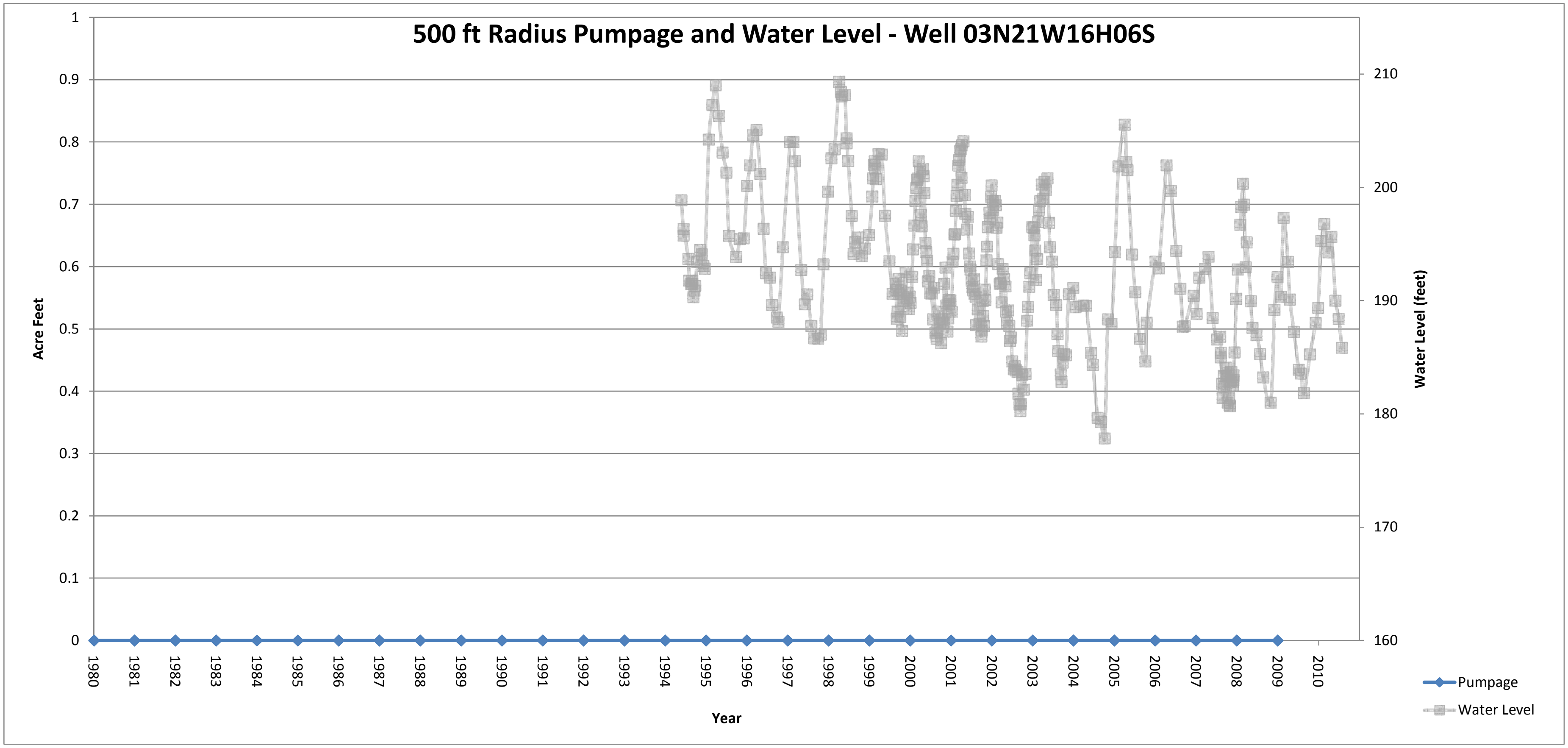


500 ft Radius Pumpage and Water Level - Well 03N21W17Q01S
Acre Feet
Water Level (feet)
Year
400
350
300
250
200
150
100
50
220
200
180
160
140
120
100
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

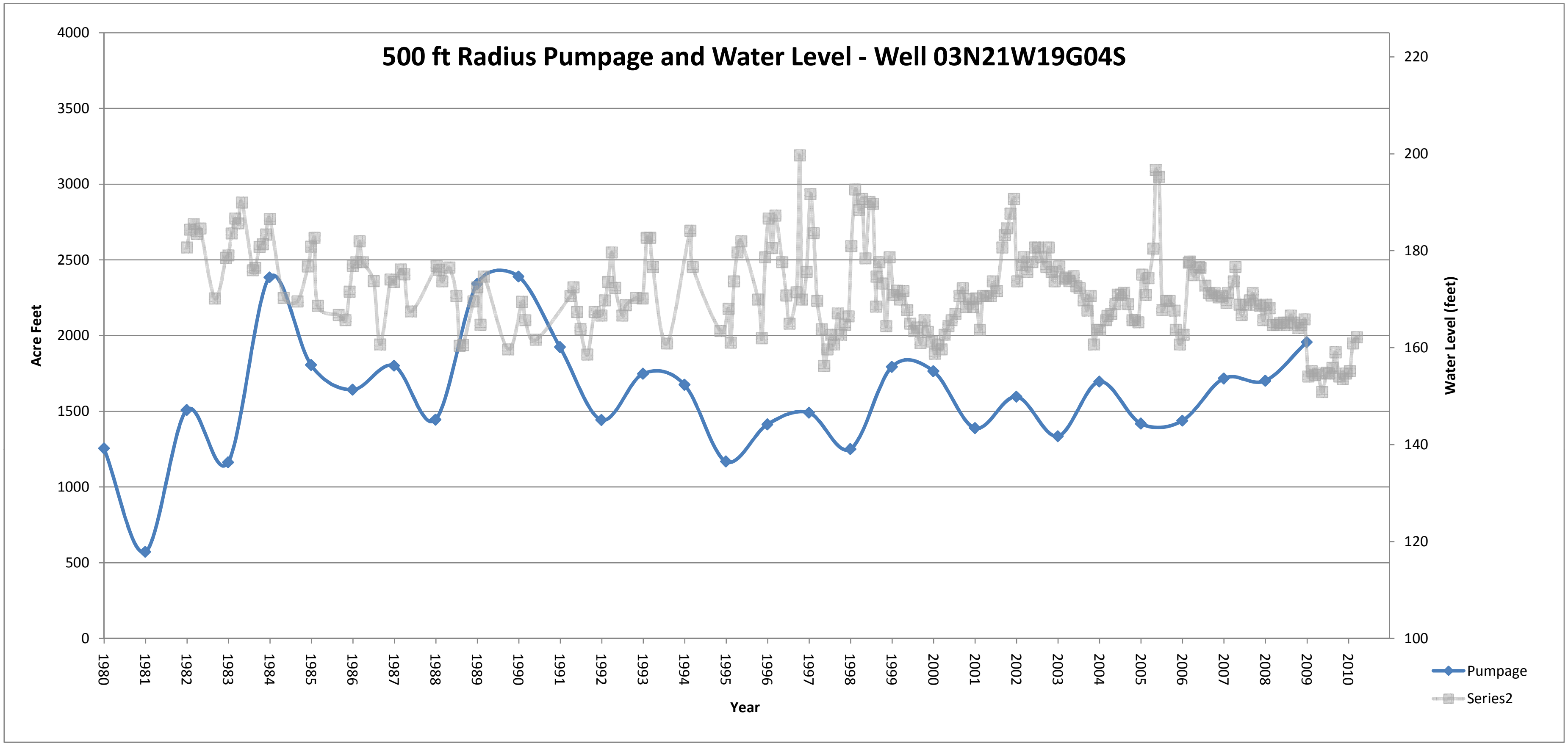

500 ft Radius Pumpage and Water Level - Well 02N22W03K02S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
20
40
60
80
100
120
140
160
180
90
100
110
120
130
140
150
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

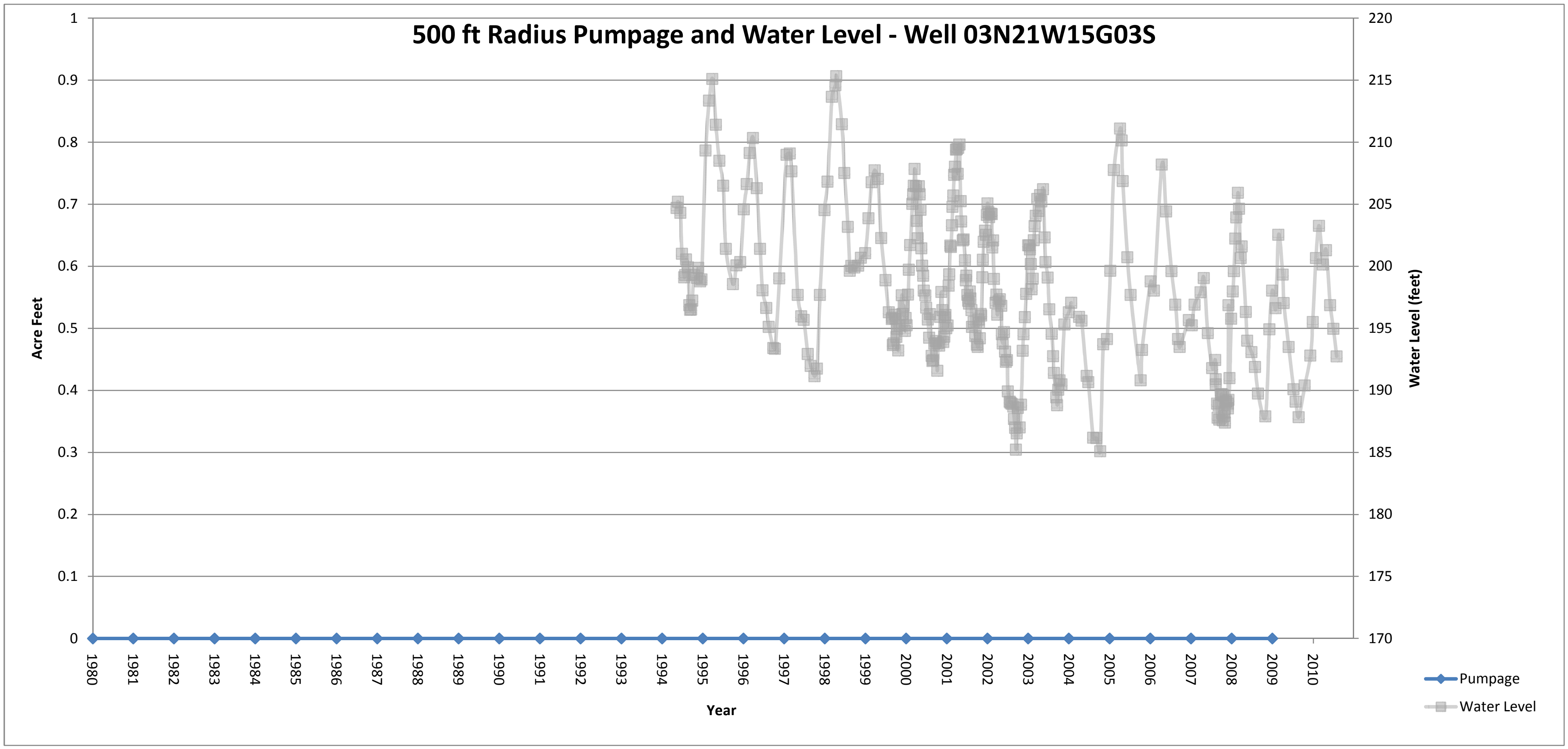


500 ft Radius Pumpage and Water Level - Well 03N21W16K01S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
150
160
170
180
190
200
210
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

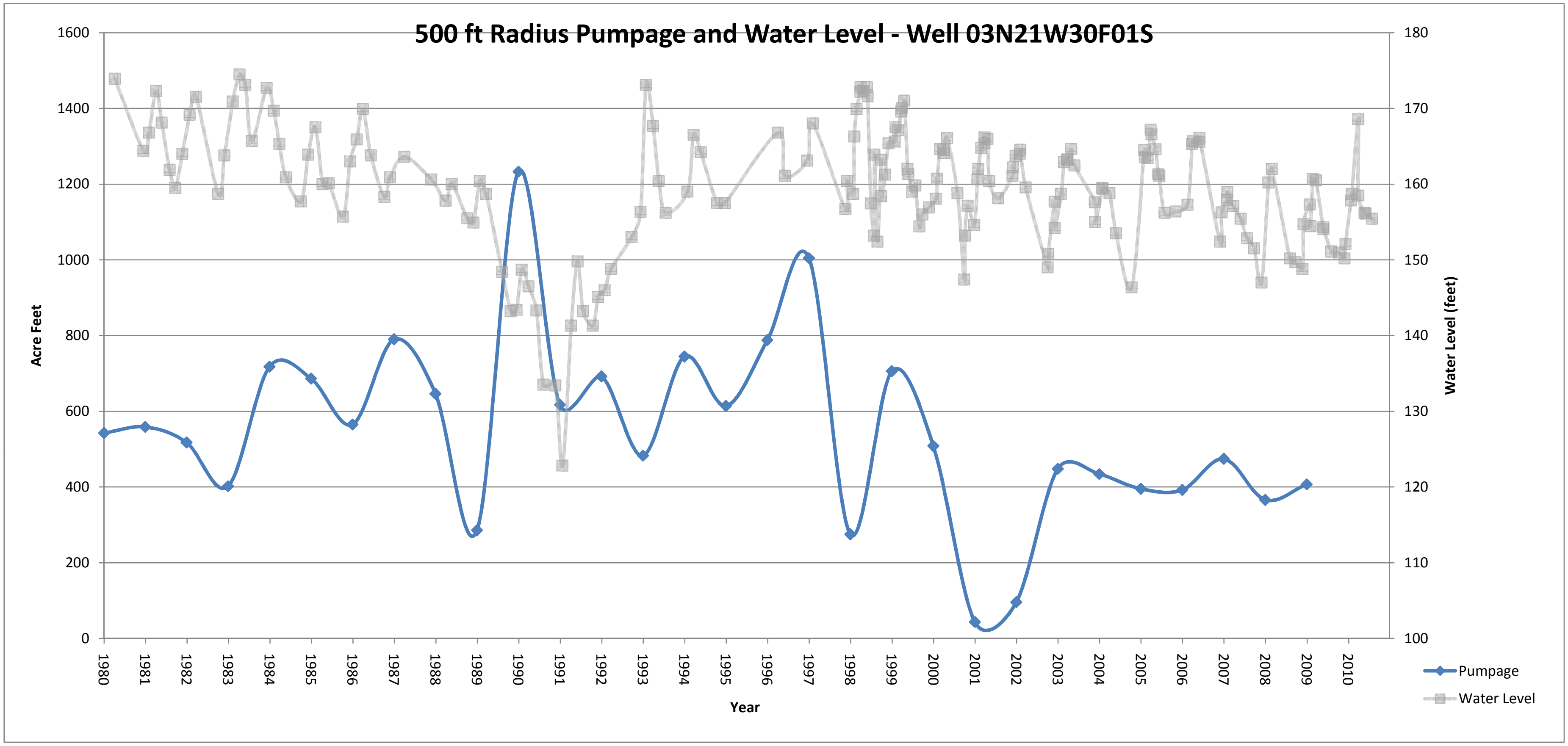


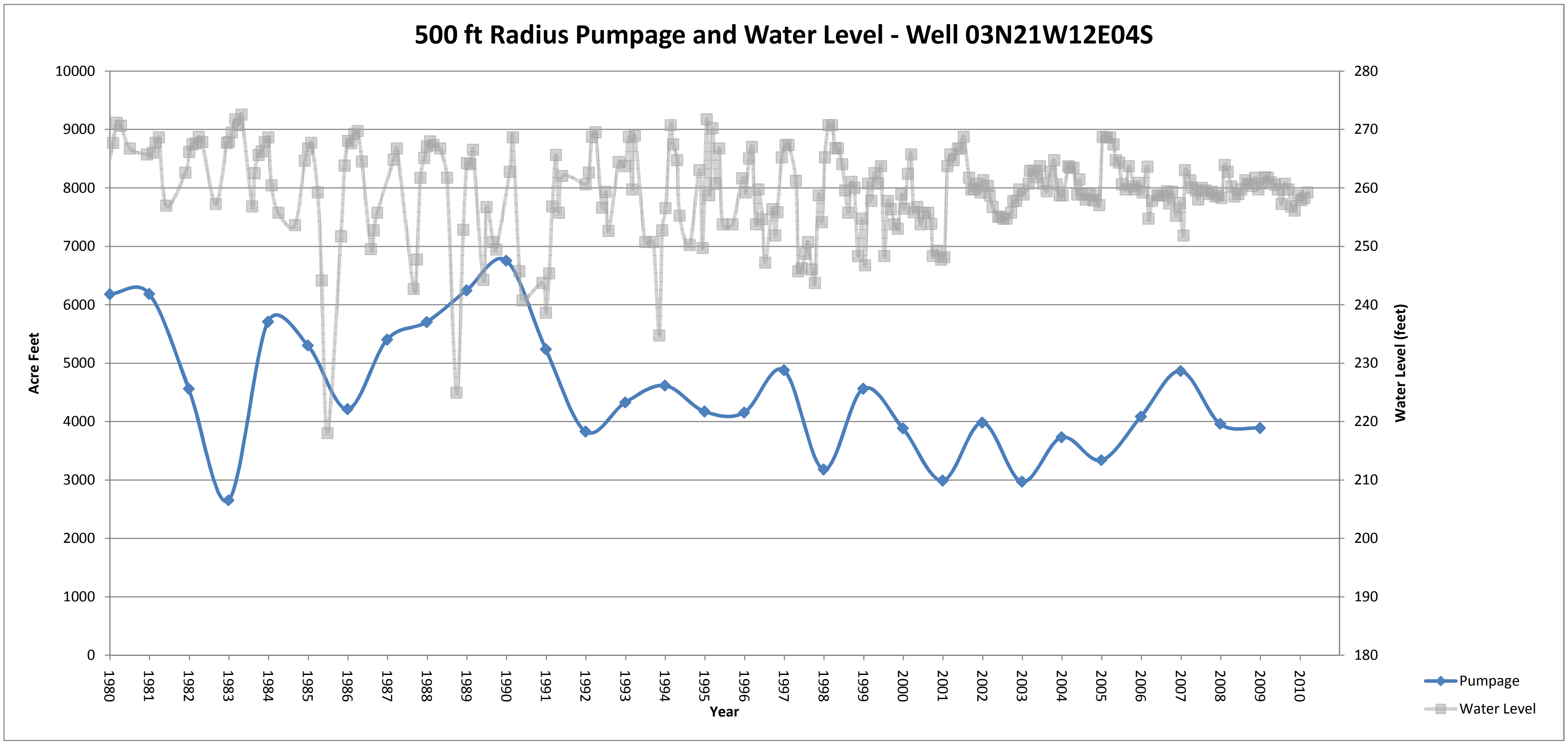
500 ft Radius Pumpage and Water Level - Well 03N21W16H06S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
210
200
190
180
170
160
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Water Level

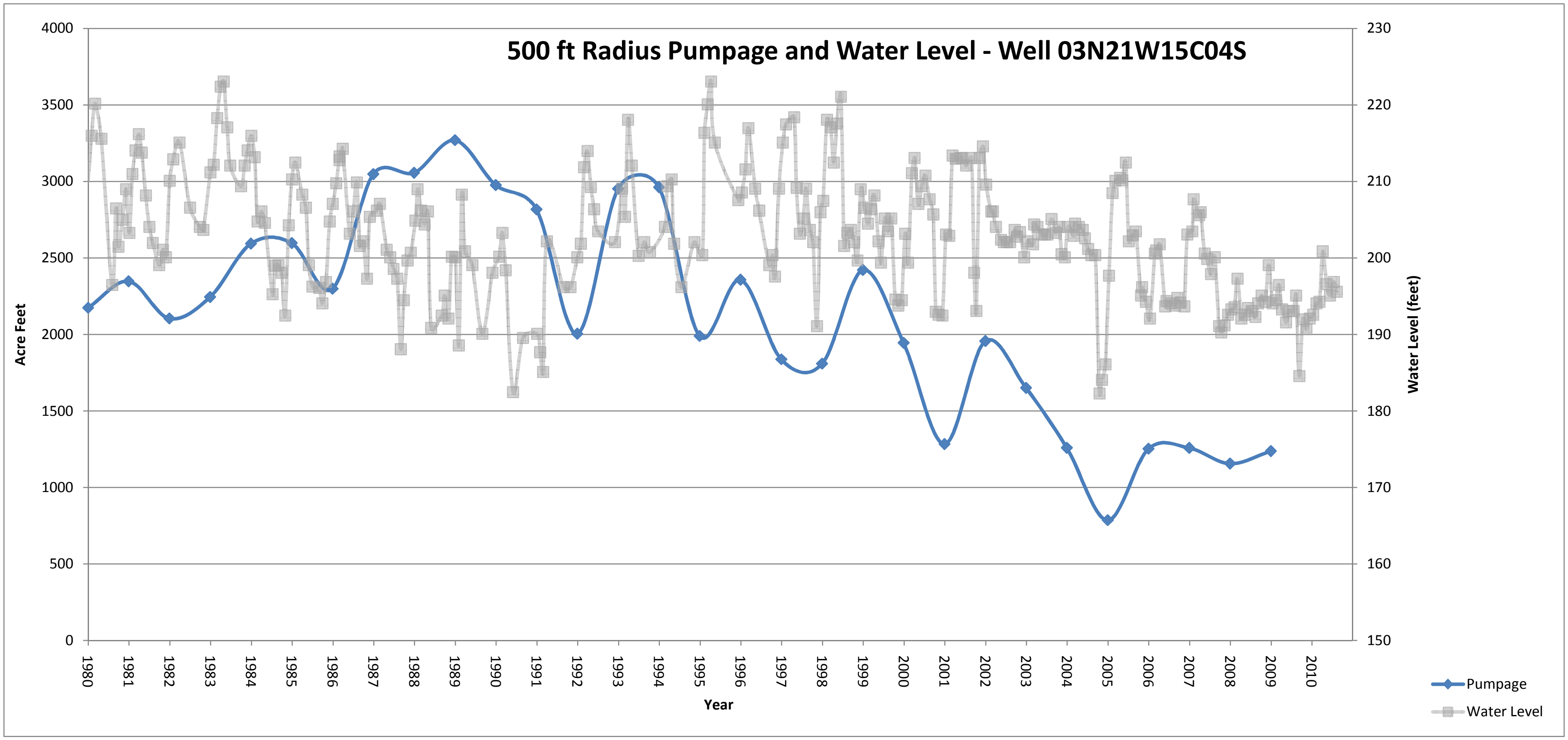

500 ft Radius Pumpage and Water Level - Well 03N21W19G04S
Acre Feet
Water Level (feet)
Year
0
500
1000
1500
2000
2500
3000
3500
4000
100
120
140
160
180
200
220
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Pumpage
Series2



500 ft Radius Pumpage and Water Level - Well 03N21W15G03S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
220
215
210
205
200
195
190
185
180
175
170
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
2006
2007
2008
2009
2010
Pumpage
Water Level


500 ft Radius Pumpage and Water Level - Well 03N21W30F01S
Acre Feet
Water Level (feet)
Year
0
200
400
600
800
1000
1200
1400
1600
100
110
120
130
140
150
160
170
180
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
2006
2007
2008
2009
2010
Pumpage
Water Level


500 ft Radius Pumpage and Water Level - Well 03N21W12E04S
Acre Feet
Water Level (feet)
Year
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
180
190
200
210
220
230
240
250
260
270
280
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
2006
2007
2008
2009
2010
Pumpage
Water Level


500 ft Radius Pumpage and Water Level - Well 03N21W15C04S
Acre Feet
Water Level (feet)
Year
Pumpage
Water Level
0
500
1000
1500
2000
2500
3000
3500
4000
150
160
170
180
190
200
210
220
230
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
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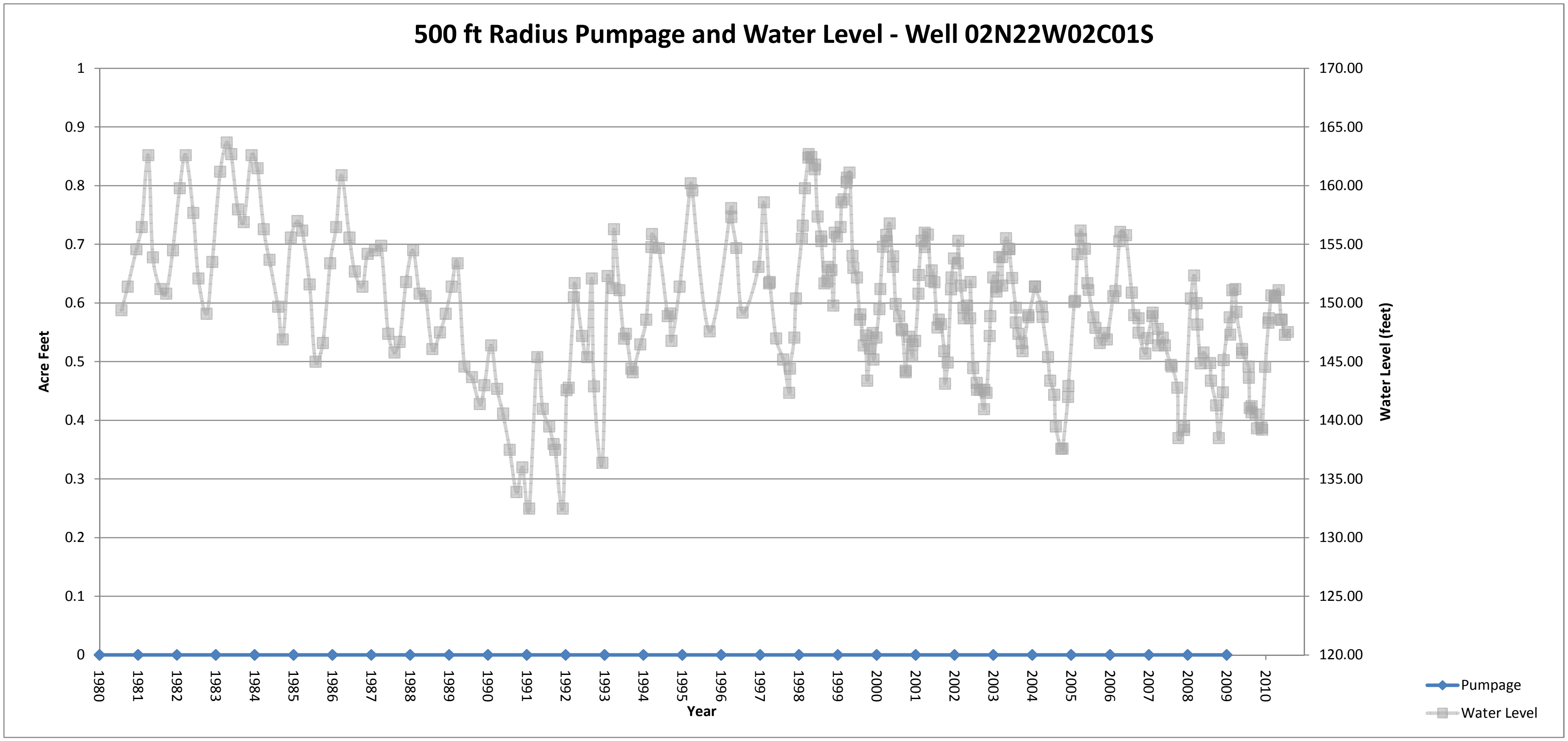
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


500 ft Radius Pumpage and Water Level - Well 02N22W02C01S
Acre Feet
Water Level (feet)
Year
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
170.00
165.00
160.00
155.00
150.00
145.00
140.00
135.00
130.00
125.00
120.00
1980
1981
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2010
Pumpage
Water Level