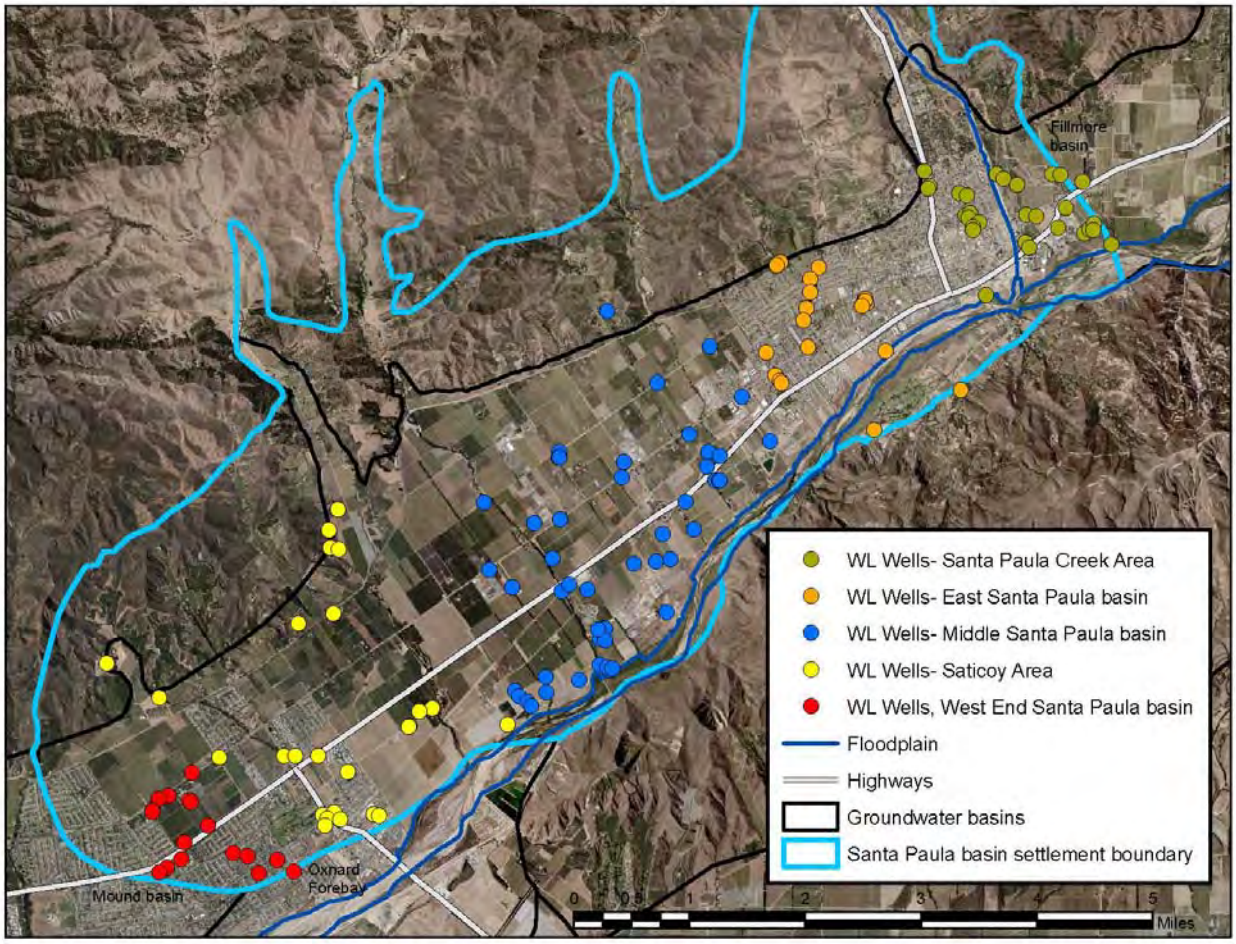
SANTA PAULA BASIN GROUNDWATER ELEVATION TREND ASSESSMENT

United Water Conservation District
Open-File Report 2013-03



PREPARED BY

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

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ABSTRACT

An extensive data set of groundwater elevation records exist for the Santa Paula basin, a highly-developed groundwater sub-basin of the Ventura basin in southern Ventura County, California. This report presents hydrographs for 90 wells with extensive record sets. The hydrographs are presented in groups according to the screened interval and geographic location of the wells, allowing comparison of hydrographs across the basin. Trends in the water level records among various groups of wells are described, including well responses to the drought of the late 1980s. A quantitative approach is also utilized to identify long-term trends in the water level records in individual wells, with wells grouped by depth and location within the basin. Ten evaluation periods of various duration are assessed, periods which generally begin and end in wet years. The average change for each evaluation period shows declining water levels within the basin, but the magnitude of the decline is modest. Most evaluation periods have some wells that show increasing water levels, but increases in levels among these wells are never consistent across all evaluation periods. A number of wells show water level declines for all the evaluation periods. The modest average declines in all of the more-recent evaluation periods indicate that long-term gradual declines in groundwater elevations continue to the present time in the Santa Paula basin.

1 INTRODUCTION

In an effort to better assess long-term water level trends in wells throughout the Santa Paula basin, groundwater elevation hydrographs from individual wells were grouped by the depth of the screened interval of the well and by geographic area down the axis of the basin. The screened intervals generally correspond with the stratigraphic classifications of recent alluvium, older alluvium and the San Pedro Formation as defined by Mann (1959). The grouping of wells by area and depth was performed to determine if trends in groundwater elevations differ with depth or area within the Santa Paula basin.

Groundwater elevation hydrographs were produced for all Santa Paula basin wells with a decent to extensive set of water level records. The records for these wells are plotted by depth classification, allowing a comparison of water level records for wells with similar construction. If trends or similar responses among the wells are recognized, they are discussed. The hydrographs of a number of individual wells with notable or anomalous records are also discussed.

Available records show that there are 151 wells in the basin with a least one groundwater elevation measurement, dating from 1922 to present. The data sets for a number of wells are limited, and hydrographs were not generated for these wells. The greatest number of measurements for a single well is 906 for well 03N21W16K02S which has water level records from 1923 to present. Records maintained by United Water Conservation District (United) indicate that 62 wells in the Santa Paula basin were actively monitored as of 2011. Hydrographs for approximately 90 wells are displayed on the maps in this Open File Report. The principal agencies measuring water levels in the basin include United, Farmers Irrigation Company, the Water Resources Division of the Ventura County Watershed Protection District, the City of Santa Paula, the City of Ventura, and Alta Mutual Water Company.

United's database of water level records for wells in the Santa Paula basin was queried to determine the maximum-recorded groundwater elevation for wells over a number of individual years. Historic changes in groundwater elevations were determined for individual wells, generally corresponding to past "wet-to-wet" cycles within the basin, as determined by cumulative departure analysis of existing precipitation data. Results for individual wells were grouped by location and screened interval as described above, allowing a more quantitative comparison of long-term water level changes among the various groupings of wells.

Groundwater flow is generally east-to-west down the axis of the basin, parallel to the channel of the Santa Clara River (UWCD, 2012). The basin receives recharge from the Fillmore basin to the east, the Santa Clara River, Santa Paula Creek, lesser tributaries to the Santa Clara River, agricultural return flow, and rainfall infiltration, although the relative importance of these various recharge mechanisms remains poorly defined. Depths to groundwater are generally greater in the northern portions of the basin where land surface elevations are higher, as compared to the southern portions near the Santa Clara River.

The basin has historically been thought of as an unconfined basin (Mann, 1959), but notable clays in many of the drillers' logs in wells throughout the basin suggest that broad areas of the basin is confined to some degree. A study regarding the unconfined/confined nature of the basin is currently under way as a specialty study by consultants to the Santa Paula Basin Pumpers Association (SPBPA).

2 GEOGRAPHIC DIVISIONS

The Santa Paula basin was divided into five geographic divisions, aligned down the axis of the basin, with each division spanning the width of the basin. The zones are identified in Figure 1, and all wells with water levels records are labeled in this figure. Hydrographs were not generated for about 60 of these wells, as the number of water level records available for these wells is limited.

The geographic divisions shown in Figure 1 are described below:

Santa Paula Creek Area- This group of wells includes all wells near Santa Paula Creek and the area adjacent the Fillmore groundwater basin to the east. This area is considered to be a major recharge area for the Santa Paula basin, as groundwater underflow from the Fillmore basin is significant (UWCD, 2012). This division includes all wells located east of 10th Street/Highway 150, and an additional three wells (03N21W10A01S, 03N21W10A02S and 03N21W03R02S) which are located just west of the Highway 150 in the northern portion of this division.

Eastern Santa Paula basin - This geographic division is bounded by Highway150 on the east and Peck Road on the west. This area underlies the City of Santa Paula. Most of the wells in this area are municipal wells operated by the City of Santa Paula or irrigation wells operated by Farmers Irrigation Company (FICO). The FICO wells distribute water by pipeline to agricultural areas in the central and western portions of the Santa Paula basin.

Middle Santa Paula basin - This geographic division extends from Peck Road in the east to Olive Road/Edwards Ranch Road in the west. Agriculture is the predominant land use in this central portion of the basin.

Saticoy Area - This geographic division extends from Olive Road on the east to Saticoy Avenue on the west, and is bordered the Oxnard Forebay basin to the south. The western portion of this zone includes the community of Saticoy, where wells operated by the City of Ventura and Alta Mutual Water Company pump groundwater for distribution to surrounding areas to the north and west.

West End of Santa Paula basin - This geographic division includes the area of Santa Paula basin located west of Saticoy Avenue. There is relatively little recent pumping in this western-most portion of the basin, although historically this was an agricultural area. This is an area of geologic complexity that includes the Country Club fault and other faulting.

3 DEPTH ZONE CLASSIFICATIONS

Depth zone classifications were generalized from Mann's (1959) work in the Santa Paula basin, most notably geologic cross-section C-C', drawn north-to-south through the center of the Santa Paula basin (Figure 2 and Figure 3). From this cross-section depth zone intervals roughly corresponding to the recent alluvium, older alluvium and San Pedro Formation were approximated. The depths are generalized and do not take into account variations in depth due to geologic structure such as the Ventura syncline, the Oakridge fault and the numerous faults at the west end of the basin. While the assignment of these depth intervals to specific aquifers is imprecise, the depth zones do allow evaluation of water levels from the groups of shallower and deeper wells within the basin. Additional work regarding the assignment of wells to specific hydrostratigraphic units within the Santa Paula basin is planned by members of the Santa Paula basin Technical Working Group (SPBTWG), as is identification of the degree of confinement associated with individual wells. In the meantime a more general classification scheme is employed for the purposes of this report. The depth zone classifications used in this Open-File Report are discussed briefly below.

Recent Alluvium - The bottom of the well screen is less than 110 feet below ground surface (bgs). These shallow alluvial wells generally exist in the southern portions of the basin near the Santa Clara River. Most of these wells are dedicated monitoring wells as this unit is not known to support groundwater production from the basin. The Recent Alluvium was deposited by the Santa Clara River and overlies Older Alluvium. There are a total of 14 hydrographs observed in this depth zone, shown in Figure 4.

Older Alluvium – This group of wells is screened between approximately 110 feet to 300 feet bgs. The Older Alluvium was primarily deposited by flows of the ancestral Santa Clara River, and by tributaries to the north as alluvial fan material (Mann, 1959). A total of 23 hydrographs are displayed for this depth zone (Figure 5). These deposits support significant groundwater production within the basin (UWCD, 2011), and many older wells were screened in the older alluvial deposits.

San Pedro Formation - The San Pedro Formation underlies the Older Alluvium in the Santa Paula basin. The San Pedro wells presented here have an upper screened interval starting at greater than 300 feet bgs. San Pedro Formation deposits within the Santa Paula basin are of both marine and continental origin and have been subject to both faulting and erosion (Hanson et al, 2003). A total of 19 hydrographs are plotted for this depth zone (Figure 6).

Older Alluvium and San Pedro Formation – This grouping of wells are screened across deposits of both Older Alluvium and the San Pedro Formation, with screened intervals starting at less than 300 feet bgs and extending to depths greater than 300 feet bgs. A total of 23 hydrographs are plotted for wells with good historic water level records that fall within this depth classification. Hydrographs for these wells are shown in Figure 7.

Wells with Unknown Construction - Several lengthy water level records exist for wells for which construction information is unknown. There are a total of 12 hydrographs in this category, displayed in Figure 8.

4 FORMATTING OF WELL HYDROGRAPHS

Prior to the mapping of hydrographs of wells within the various depth classifications, an attempt was made to standardize the scales of the plots. A vertical axis of 80 feet was selected, which captures the (static or non-pumping) water level variability of all individual wells within the Santa Paula basin (although the absolute range of all recorded groundwater elevations across the basin is on the order of 250 feet).

The various time scales for well records within the basin are much more varied. A 10-year period is used as the major division for all hydrographs, and all wells with only recent records are plotted with a time scale ranging from 1975 to 2015. The x-axis of the hydrographs are expanded in decadal increments as necessary to encompass all available records, and the longer records are easily recognized by the closer spacing of individual years and the increased number of labeled major divisions. The x-axis of all hydrographs extend to year 2015, so that discontinued early records from older wells are easily identified.

5 HYDROGRAPH DISCUSSION AND OBSERVATIONS

The following sections provide discussion on water level records within the various grouping of wells by location and depth.

5.1 SHALLOW RECENT ALLUVIUM

The majority of the shallow alluvial wells in the Santa Paula basin are located south of Highway 126 and on either side of Todd Barranca in the area of the middle Santa Paula basin. There are two shallow alluvial well located in the eastern basin area and one shallow alluvial well located in the Saticoy area of the basin. Most of these wells were drilled as dedicated monitor wells. Many of these dedicated monitor wells were installed as part of the geotechnical investigations that preceded the construction of the Freeman Diversion. The shallow alluvial wells located closest to the Santa Clara River record an annual groundwater level variability in the basin at approximately 5 feet. These shallow alluvial wells, and wells screened in the San Pedro Formation in the western area of the basin record the least annual variability in the basin. Most of the shallow alluvial wells have relatively flat hydrographs over the period of record and have relatively minor responses to dry years such as 1990-1991 and 2004. These wells are most likely are in connection with the saturated recent alluvium of the Santa Clara River.

Some of the deeper shallow alluvial wells or those shallow alluvial wells located farther north from the Santa Clara River display annual groundwater level variability of approximately 10 to 12 feet.

These wells record more pronounced water level decline in dry years such as 1990-1991 and 2004. Well 03N21W16H08S (SP2-70, east of Peck Road) shows a 5-foot decline in wet season high groundwater levels between 1995 and 2011. In the Edwards Ranch area, well 03N21W31F05S records a decline of approximately 15 feet in seasonal highs between 1983 and 2011. These wells, even though placed in this grouping, may not be well connected with the saturated recent alluvium that underlies the channel of the Santa Clara River.

5.2 OLDER ALLUVIUM

5.2.1 SANTA PAULA CREEK AREA (OLDER ALLUVIUM)

The annual groundwater level highs in the FICO wells located in 3N/21W Section 12 have remained fairly stable since records begin in the 1970s. Recent highs are about 5 feet below those recorded in 2005. Since approximately 2002 the recorded annual variability has diminished. It is unclear if this is related to a change in discharge from the Fillmore basin or a change in groundwater level monitoring protocols, so that measurements that reflect drawdown from nearby pumping wells are now avoided (annual variability recorded in other FICO wells located elsewhere in the basin has also diminished in recent years). The drought response in these Section 12 wells, as illustrated by the records from well 03N21W12F03S, is relatively muted at approximately 8-10 feet.

Well 03N21W01N01S, located north of Highway 126 at the basin boundary, with records from 1961 to 2003, had a contrasting annual variability commonly 25 to 30 feet. The seasonal high groundwater levels were fairly stable over the period of record. This well had a drought response of approximately 10 feet.

Well 03N21W11J01S, located near the intersection of Highway 126 and Santa Paula Creek, with records primarily from 1971 to present, has an annual variability commonly from 10 to 15 feet. It has groundwater level peaks of approximately 10 feet from wet winters and a groundwater level drought response of approximately 10 feet.

5.2.2 EASTERN BASIN (OLDER ALLUVIUM)

The annual groundwater level variability for wells in this group is commonly 15 feet to 20 feet. Wells 03N21W16K02S and 03N21W16K01S show an increase in annual groundwater level variability after approximately 1945. Wells 03N21W16K01S and 03N21W16K02S show a long-term decline of approximately 20 feet from 1945 to present. The drought response for most wells in this group ranges from 10 feet to 15 feet.

5.2.3 MIDDLE BASIN (OLDER ALLUVIUM)

The annual groundwater level variability for this group is commonly 15 feet to 20 feet with a long-term groundwater level decline from 1945 to present of approximately 20 feet.

Groundwater levels in well 03N21W21E01S declined 10 feet from 1945 to 1975. Groundwater levels in well 03N21W19R01S declined 10 feet from 1975 to present. The two wells combined show a groundwater level decline of 20 feet since 1945. Well 03N21W19R01S has a drought response of approximately 20 feet.

Well 03N21W17Q01S shows a groundwater level decline of 20 feet from 1945 to present. It shows increased annual groundwater level variability after about 1945. The annual variability has been as much as 25 feet in recent years. This well records a drought response of approximately 25 feet.

Well 03N21W31F03S, located on Edwards Ranch, has historically exhibited artesian flow in wetter periods. Artesian flow is noted in water level records but was never measured, so artesian heads are plotted at the elevation of the well head.

5.2.4 Saticoy Area (older alluvium)

This group shows an annual groundwater level variability of approximately 10 to 15 feet and an overall groundwater level decline of approximately 5 feet from the 1970s to 2011. These can be seen in well 02N22W02C01S. This group shows less annual variability and long-term decline than for groupings in the middle basin area.

Well 03N22W36K05S shows a decline of approximately 7 feet from 1998 to 2011.

Well 03N21W31L01S has an annual groundwater level variability of approximately 10 feet and has exhibited artesian conditions in wetter periods. Pre-drought groundwater level measurements, however, do not account for this artesian flow.

5.2.5 West End (older alluvium)

Only one long-term groundwater level record exists in this group which is for well 02N22W03K02S. This well shows a groundwater level decline of approximately 17 feet from 1944 to present. A drought response decline of approximately 20 feet was recorded in the late 1980s through the early 1990s. The annual groundwater level variability began to increase in approximately the mid 1950s. The current annual variability in this well is approximately 10 to 15 feet. The annual groundwater variability in this well is more pronounced than other wells in this area that have deeper perforations.

5.3 SAN PEDRO FORMATION

5.3.1 Santa Paula Creek Area (san pedro formation)

There is only one well in the Santa Paula Creek Area - San Pedro Formation group with a hydrograph (Figure 6)." This is San Pedro well 03N21W11F04S which is located west of Santa

Paula Creek and north of Highway 126. Groundwater level records for this well exist from 2005 to present and display an annual variability of about 15 to 20 feet.

Groundwater elevations in San Pedro well 03N21W11F04S, screened from 570 feet bgs to 850 feet bgs, are lower than in nearby Older Alluvium/San Pedro wells, 03N21W11F03S, screened from 153 feet bgs to 518 feet bgs and 03N21W11E03S, screened from 100 feet bgs to 453 feet bgs. Well 03N21W11F04S has recent 2011 groundwater elevations approximately 20 feet lower than well 03N21W11F03S and well 03N21W11E03S.

5.3.2 Eastern Basin (San Pedro Formation)

Most wells in this grouping show annual groundwater level variability of approximately 15 feet to 20 feet, and groundwater level declines of approximately 5 feet to 10 feet since 1995. Well 03N21W16K03S shows a drought response of about 10 feet to 15 feet.

Groundwater levels are similar for the three deep monitoring wells of the SP1 cluster, located near the Santa Clara River, that have screened intervals at 370-390 feet bgs , 520-540 feet bgs and 660-680 feet bgs.

The groundwater level highs in well 03N21W09R04s have come up since 2005. This is in contrast to other wells in this grouping in which annual groundwater level highs have declined since 2005. As in other FICO monitored wells the annual variability in this well has decreased since 2002. The decrease in annual variability since 2002 can also be seen in FICO monitored San Pedro well 03N21W16K03S.

5.3.3 Middle Basin (San Pedro Formation)

There are four wells with hydrographs in this grouping, three of which are FICO wells. Two of the three FICO wells have been destroyed.

FICO well 03N21W19G01S with a groundwater level record from 1932 to 2005, and FICO well 03N21W19H06S with a groundwater level record from 1952 to 1999, are located near the intersection of Cummings Road and Santa Paula Street. The annual groundwater level variability seen in well 03N21W19G01S before 1945 was approximately 5 feet. The annual groundwater level variability, at approximately 20 feet to 30 feet, seen in both wells since about 1979 to when records cease was a significant increase from years prior. These wells record a groundwater level decline of about 20 feet in the drought years of the late 1980s and early 1990s. They show wet-years highs to be similar throughout the periods of record but show a considerable decline in groundwater level lows over the periods of record.

Nearby FICO well 03N21W19G04S has a record from 1982 to present. Historic groundwater level lows in this well were recorded in 2009, after the seasonal lows remained fairly stable over the prior two decades. The 2009 low groundwater levels, however, may have been the result of a

transducer recording error. Well 03N21W19G04S shows flat stable low groundwater levels with variable high groundwater levels, unlike nearby wells 03N21W19G01S and 03N21W19H06S.

Well 03N21W20J03S, located near Briggs Road and Highway 126, has a recorded annual variability of approximately 10 feet and a decline of less than 5 feet among wet-season groundwater level highs from 1998 to present.

5.3.4 Saticoy Area (San Pedro Formation)

Well 02N22W02K09S, screened 300-400 feet bgs, is the only well with a good record in this group of wells. Annual groundwater level highs have remained fairly stable since 1995 when records started. The annual variability in this well is as much as 25 feet. Wet year groundwater level highs are commonly within 10 feet of the land surface elevation. This is an area of historically flowing wells (Freeman, 1968)

5.3.5 West End (San Pedro Formation)

Groundwater level records for well 02N22W10C01S show a steady decline in water levels from the 1920s to the 1960s when records cease with a decline of approximately 25 feet from 1927 to 1965. This well has limited groundwater level variability, commonly less than 5 feet from 1920s to 1960s and has recorded groundwater elevations as low as 40 feet amsl which are some of the lowest in the basin.

Records from well 02N22W03M02S show groundwater levels falling from near 120 feet amsl in the early 1980s to about 80 feet amsl in 1991 for a decline of 40 feet. In recent years groundwater levels have ranged from 90 to 105 feet amsl with an annual variability commonly less than 5 feet. Since 1985 there has been a groundwater level decline of approximately 16 feet. Well 02N22W03M03S, which has groundwater level records from 1994 to 2006, also shows limited annual variability.

These west end area - San Pedro Formation wells and the shallow alluvium wells discussed earlier show some of the smallest annual water level variability among wells in the basin.

5.4 OLDER ALLUVIUM AND SAN PEDRO FORMATION

5.4.1 Santa Paula Creek (Older Alluvium and San Pedro Formation)

This group of wells has a number of different groundwater level responses. Most wells record long-term declines of at least 10 feet.

FICO well 03N21W12F06S is located south of Highway 126 at the basin boundary. Annual groundwater level variability in this well is commonly less than 10 feet. Wet-year highs for the

period of record for this well, from 2005 to 2011, are relatively flat with only a slight decline of 1 to 2 feet.

FICO monitored wells 03N21W01N02S and 03N21W02R02S, located north of highway 126, show the greatest annual groundwater variability in the years prior to 2002 and much less overall annual variability in the years 2002 to present. Well 03N21W02R02S shows a 25 to 30 foot decline from the annual groundwater level highs recorded in 1998 and 2005 to those groundwater level highs recorded in 2011.

Well 03N21W11J02S, located near Santa Paula Creek and Highway 126, shows an annual variability of approximately 15 feet to 20 feet, and declines in annual groundwater level highs of at least 15 feet since 1998.

Wells 03N21W11F03S and 03N21W11E03S, are located west of Santa Paula Creek near the intersection of 12th Street and Santa Paula Street. Well 03N21W11F03S shows an annual groundwater level variability of about 15 to 20 feet and a long-term decline in annual groundwater highs from 1979 to present of about 10 feet. Well 03N21W11E03S has similar long-term declines from 1979 to present but shows reduced annual groundwater level variability beginning in 2002. This decrease in annual groundwater level variability is not seen in well 03N21W11F03S.

Well 03N21W11D02S, located north of highway 126, east of Highway 150 and west of Santa Paula Creek, has water level records dating from 1976 to 1994. The records show an approximate 20-foot decline over the period of record, and a drought response of at least 20 feet.

5.4.2 Eastern Basin (Older Alluvium and San Pedro Formation)

Along the northern margin of the basin well 03N21W09K02S has a groundwater level record dating from 1936. Long-term declines among annual high groundwater levels are approximately 25 feet since 1941.

Wells 03N21W15C02S and 03N21W16H06S, located north of highway 126, show groundwater level declines of 15 feet and 7 feet, from 1995 to present. The annual variability ranges from about 15 feet to 20 feet. The earlier records for well 03N21W15C02S from 1978 to 1995 do not show groundwater level decline among wet-year highs. The annual variability of well 03N21W15C02S diminishes beginning in 2002.

5.4.3 Middle Basin (Older Alluvium and San Pedro Formation)

The annual groundwater level variability among this group of wells is commonly 15 feet to 20 feet as seen in well 03N21W30F01S. Long term declines of wet-season groundwater level highs are 12 feet from 1979 to 2011. Well 03N21W30F01S had drought response of about 30 feet or more. Well 03N21W30H04S had a drought response of 15 feet.

5.4.4 Saticoy Area (older alluvium and san pedro formation)

There are no decent records in this group except for well 02N22W02K07S, located south of Highway 126, with records from 1964 to 2011, and well 03N22W34R01S located north of 126, with records from 1973 to 2011. The wells show an approximately 5 to 10 feet decline in groundwater highs over the period of record.

The annual groundwater level variability of wells in this group is approximately 15 feet to 20 feet. Well 02N22W02K07S recorded a drought response of about 25 feet. Well 03N22W34R01S recorded a drought response of approximately 11 feet. The records show that the groundwater level wet year highs for well 02N22W02K07S were similar up to 1998 with post 1998 wet year highs being lower. Well 02N22W02K07S may have had artesian flow in 1995 and 1998 but the head above ground surface was not recorded.

Well 03N22W36H01S shows a groundwater level decline in annual groundwater level highs since 1998 but is currently monitored only two times per year.

5.4.5 West End (older alluvium and san pedro formation)

Well 02N22W10C02S, located near the basin boundary, was monitored from 1956 to 1997 and over this time wet-year groundwater level highs were fairly stable and annual variability was commonly less than 5 feet. The muted groundwater level variability is similar to other west end wells that are screened exclusively in the San Pedro Formation. This well shows a drought response of about 25 feet.

Well 02N22W03K03S shows a drought recovery of 25 feet but the period of record is limited to 1992 -1999.

5.5 WELLS WITH UNKNOWN CONSTRUCTION

5.5.1 Santa Paula Creek (unknown construction)

Well 03N21W11B01S is located north of Highway 126 near the east bank of Santa Paula Creek and has records from 1980 to present. From 1995 to present seasonal lows and highs remain fairly stable except for the 1997 recorded high and the 2005 recorded high. The annual groundwater level variability is approximately 15 to 20 feet. Post-drought groundwater level lows are higher than pre-drought groundwater level lows. The drought response for this well is approximately 10 to 15 feet.

Well 03N21W02Q01S north of highway 126 and east of Santa Paul Creek shows an approximate 15 to 20 foot annual groundwater level variability from 1969 to 1980 where the record ceases.

5.5.2 Eastern Basin (unknown construction)

There are no wells with hydrographs in this group.

5.5.3 Middle Basin (unknown construction)

Groundwater level records for well 03N2121B01S exist for the period from 1929 to 2005. The annual groundwater level variability for this well increased after 1950. A drought response of about 15 feet was recorded in 1991 and 2005 high groundwater levels are approximately 12 feet lower than historical high groundwater levels recorded in 1941

The groundwater level records for well 03N21W21B01S appear similar to the records from the Reese tract wells 03N21W16K01S and 03N21W16K02S which are both screened in the older alluvium.

Well 03N21W31B01S, located on Edwards Ranch, has a similar hydrograph signature to well 03N21W31F05S which is perforated 92 feet to 102 feet bgs in the recent alluvium.

5.5.4 Saticoy Area (unknown construction)

There are no wells with hydrographs in this group.

5.5.5 West end (unknown construction)

Well 02N22W03F02S, located just south of Telegraph Road, has infrequent groundwater level measurements in recent years. Annual variability in this well, however, appears to be greater than San Pedro Formation wells in the west end area located farther south of Telegraph Road towards the basin boundary

Well 02N22W03Q01S, located just south of Highway 126 shows 30 feet of groundwater level recovery from 1992 to 1998 and little annual variability since the drought. Groundwater elevations range from 70 feet to 80 feet amsl since 1994. Groundwater elevations in this well are lower than those in other nearby west end wells.

Well 02N22W02N04S shows muted and stable groundwater level records since 1992, with groundwater elevations ranging from about 117 feet to 130 feet amsl. This well shows 2 to 3 feet annual groundwater level variability. This muted variability is similar to San Pedro Formation wells in the west end area.

6 ANNUAL HIGH WATER LEVELS AND EVALUATION PERIODS

An evaluation of historic water level records from individual wells was performed in an effort to quantify long-term changes in water levels among the various location/depth groups defined earlier in this report. The process consisted of determining the highest-recorded groundwater elevations for individual wells in single years, and evaluating changes over time. Specific time periods ranging from 11 to 62 years were selected for analysis using cumulative departure methods applied to historic precipitation records from the Santa Paula basin.

6.1 DETERMINATION OF ANNUAL HIGH WATER LEVELS

The highest-recorded groundwater elevation for all Santa Paula basin wells was determined for 13 individual years (see following section). Annual high water levels were queried from United's database of groundwater elevations. An automated approach such as this is useful when dealing with a list of 151 wells with water level records, however, it is recognized that some wells may not have a measurement during the spring of the year when water levels tend to be highest. However, many of the Santa Paula basin wells with good data sets do have a spring measurement for each year within their period of record.

Many of the water level records were collected by United staff, who are competent and experienced water resource technicians. Other records were collected by staff from Ventura County, who also maintain a long-term groundwater elevation monitoring program. The monitoring programs for both these agencies take care to document questionable measurements, should there be some doubt about the quality of a recorded measurement (for example; recent pumping, wells pumping nearby, or oil on the water column within the well.) While some water level measurements may be unwittingly collected when a well is not fully recovered or is influenced by a pumping well out of sight and earshot, this is the nature of most data sets relied upon by groundwater practitioners. The frequent monitoring (monthly) of numerous wells in the Santa Paula basin also provides a measure of quality control, as anomalous records are more easily identified.

Records in the database were compared to records from pressure transducers in basin wells, many of which were deployed in April 2011. Spring highs were generally hand-measured and recorded in March or April of 2011. The inclusion of the transducer recordings of highest groundwater elevations did not significantly influence the annual high values used to assess changes in high water levels over the periods selected for cumulative departure evaluations. Transducer plots are included in the Appendix, and include the manual measurements used to anchor the transducer readings and confirm the proper functioning of the instruments.

Annual high groundwater elevations for selected years are shown for all Santa Paula basin wells in Table 1. Some wells do not have records for any of the years queried. The criteria used for selecting individual years for the comparison of records are detailed in the following section.

6.2 CUMULATIVE DEPARTURE PERIODS

One technique commonly used to assess long-term changes in basin conditions are cumulative departure periods. The basic approach relies on long-term rainfall records to identify periods bracketed by years of abundant precipitation. The wet years are presumed to be years of above-average recharge and below-average groundwater extraction; periods when water levels in the basin can be expected to recover to the degree possible under the current level of development and groundwater pumping. The comparison of water level records from historic wet years to recent wet years provides an indication of long-term trending within a basin. Basins subject to long-term overdraft generally show water level declines over successive wet periods. In basins being pumped near their operational yield, wet-year water levels should remain similar over long periods such as a decade or several decades.

The cumulative departure method entails selecting a period for evaluation, and comparing each year's rainfall to the average annual rainfall for the selected period. The cumulative departure from average is calculated and plotted, such that drier-than-average years result in a downward deflection of the cumulative departure curve and wet years or periods result in an upwards deflection. The trend line always ends at zero cumulative departure for the entire period. If the period starts on a wet year, the line starts above zero, plotting at the difference in rainfall between the starting year and the average rainfall for the period under consideration. The rainfall cumulative departure curve for the period 1944-2011 is displayed in Figure 9.

Ten periods were selected for evaluation in this Open File Report, including the two base periods considered in the 2003 *Investigation of Santa Paula Basin Yield* (1944-1998 and 1983-1995). The periods 1944-2005 and 1983-2005 are also considered, extending the prior periods to a more-recent year of near-record rainfall. The period 1999-2009 is considered, as recommended in a recent memo detailing a frequency analysis study of daily precipitation in the Santa Paula basin (Eid, 2012). Five periods ending in 2011 were also considered in order to evaluate changes in the basin up to a recent year. Precipitation in 2011 was above-average but not exceptionally wet, but the occurrence of large storms in December 2010 and March 2011 resulted in extended periods of considerable base flow in both Santa Paula Creek and the Santa Clara River. Periods beginning in 1980, 1986 and 1997 are included, as rainfall conditions leading to these years are reasonably comparable to the years 2009 and 2010. A period starting in 1993 was not evaluated as water levels in some Santa Paula basin wells had not entirely recovered from the drought ending in winter 1991 (see well hydrographs). The year 1997 was selected instead, representing a precipitation year comparable to 2011 and a time proximate to the year the Stipulated Judgment for the Santa Paula basin went into effect. The period 1999-2011 was evaluated based on a streamflow frequency analysis that compares favorably to long-term records for the basin (Eid, 2012), and the evaluation period of 1983-2011 was recommended by a consultant to the SPBPA.

The cumulative departure methods presented here have some inherent limitations. The use of total annual precipitation, as opposed to some estimate of effective precipitation, is one such shortcoming (Weber and Stewart, 2004). In a basin such as Santa Paula where the degree of

confinement and the prevalence of recharge from stream channels has not been defined in great detail, informed estimates of effective precipitation have not been determined. Numerous water levels records from wells in the Santa Paula basin do indicate that high water levels are commonly recorded in the spring of years of above-average precipitation and abundant stream flow (this report), and this relationship is discussed in some detail in the 2003 *Investigation of Santa Paula Basin Yield*. Accordingly, cumulative departure methods are an appropriate tool for the determination of water level trends in the Santa Paula basin.

6.3 WATER LEVEL CHANGES OVER EVALUATION PERIODS

Changes in groundwater elevations recorded in individual wells in the Santa Paula basin are displayed in Table 2, categorized by the evaluation periods detailed in the previous section. Wells with water level records within the various evaluation periods are grouped by the geographic areas and depth zones detailed earlier in this report. This table serves as a useful accompaniment to the maps displaying hydrographs for Santa Paula basin wells, and serves to quantify changes in water level records that are described in the previous section. The reader may wish to devote some time for comparison of the maps and the table showing changes in groundwater elevations over the various evaluation periods put forth in this report. A total of 68 wells are represented in Table 2: other wells within the basin did have "paired" measurements for the years selected as the beginning and end of the various evaluation periods.

The base-periods 1944-1998 and 1983-1995 were previously evaluated and discussed in the report *Investigation of Santa Paula Basin Yield* (Santa Paula Basin Experts Group, 2003). The period 1999-2009 was evaluated and discussed in a draft technical memorandum from the Santa Paula Basin Pumpers Association, which examines Santa Paula basin rainfall frequencies (Eid, 2012). The period 1999-2011 was evaluated based on streamflow frequency analysis, and consideration of the period 1983-2011 was advocated by a consultant to the SPBPA. The periods 1944-2005, 1983-2005, 1980-2011, 1986-2011 and 1997-2011 are periods selected for evaluation by United.

All of these periods show groundwater levels declining in a majority of the wells with records for the evaluation periods, but some groupings of wells show increasing water levels over specific evaluation periods. Some wells shown decline over every evaluation period, but no well shows recovery over every evaluation period. This is consistent with previous observations of a gradual long-term decline in groundwater levels within the Santa Paula basin (Santa Paula Basin TAC, 2011). This decline might be better described as a long-term decline among periodic wet-year highs in basin wells, as considerable annual variability is recorded in many wells within the Santa Paula basin.

Some discussion of changes in groundwater levels over each evaluation period within the various area/depth groups is presented below. Average values for area/depth groups of wells are discussed, although average values for water levels changes by well group are not presented in tabular form. A limited number of records exist for many of the area/depth groups, especially among the older periods being evaluated, with some groups having only one well with records.

Figure 10 is a graphical representation of the average water level change among wells between the beginning and end of the various evaluation periods. Years are represented on the x-axis, and the length of the colored bars correspond to the evaluation period. The bars are positioned vertically based on the average water level change for the evaluation period. The figure shows that greater decline is generally associated with the longer evaluation periods.

1944-1998: There are only seven wells with records over this evaluation period, and all trend downward. The average change in groundwater level of the seven wells over the evaluation period is -10.0 feet.

The East-Older Alluvium/San Pedro group and East-Older Alluvium group show the greatest decline at 12.3 feet (one well) and 11.4 feet (average of two wells). The West end-Older Alluvium group shows a decline of 10.7 feet (one well). The Middle basin-Older Alluvium group and Middle basin-San Pedro group show lesser declines. The Santa Paula Creek area and the Saticoy area are not represented. There are no wells screened in the recent alluvium.

1944-2005: There are seven wells with records over this evaluation period, and all trend downward except for one Middle basin–San Pedro well which shows a slight increase. The overall decline for this period is greater than the 1944-1998 period. The average change in groundwater level of the seven wells over this evaluation period is -13.3 feet.

The greatest decline is seen in the West end-Older Alluvium group at 21.9 feet (one well). The East-Older Alluvium/San Pedro group and East-Older Alluvium group show the next greatest decline at 14.8 feet (one well) and 16.4 feet (average of two wells) . The Santa Paula Creek area and the Saticoy area are not represented. There are no wells screened in the recent alluvium.

1983-1995: There are thirty wells with records over this evaluation period. This evaluation period shows less overall groundwater level decline than the previously-discussed (longer) evaluation periods. There are some wells that record higher elevations at the end of the period. The majority of wells, however, show a decline. The Recent Alluvium and all geographic areas are represented in this period. The average change in groundwater elevation of the 30 wells over the evaluation period is -1.6 feet.

The greatest decline is seen in the East-Older Alluvium group at 6.4 feet (average of three wells). The greatest increase is seen in the Santa Paula Creek-Older Alluvium group at 0.63 feet (average of three wells) and the Santa Paula Creek-Unknown group at 2.5 feet(average of three wells). The Saticoy area-Older Alluvium group shows an increase of 6.3 feet (average of two wells), which is due to the inclusion of well 03N21W31L01S (pre-drought artesian heads were not recorded, so increases in this well are exaggerated). If this well is excluded then this area shows an Older Alluvium decline of 3.5 feet (one well). The Santa Paula Creek area, the Middle area and the East area had the most individual wells showing groundwater increases during this period.

The East-Older alluvium group, East-Older Alluvium/San Pedro group and the East-San Pedro Groups show declines of 6.4 (average of three wells), 3.4 (one well) and 1.3 feet (average of two

wells). This diminishing decline with depth is in contrast to other geographic areas which record generally increasing decline with depth during this period.

1983-2005: There are 29 wells with records over this evaluation period. This evaluation period shows somewhat more overall groundwater level decline than the 1983-1995 base period. The recent alluvium and all geographic areas are represented in this base period. Some wells show an increase over the period. The majority of wells, however, show a decline over the period. The average change in groundwater level of the 29 wells over the evaluation period is -6.7 feet.

The greatest decline is seen in the West-San Pedro group with a decline of 29.9 feet (one well), followed by a decline of 16.9 feet (one well) in the West-Older Alluvium group.

The greatest increase during this period is seen in the Middle basin-San Pedro group which shows an increase of 5.4 feet (average of two wells). The remaining Middle basin groups of Older Alluvium/San Pedro, Older Alluvium, and Recent Alluvium show declines in groundwater levels. The Santa Paula Creek area and the Middle area had the most individual wells showing groundwater level increases during this period.

The East basin-Older Alluvium group, East-Older Alluvium/San Pedro group and the East-San Pedro group show declines of 11.2 feet (average of three wells), 9.6 feet (average of two wells) and 8.3 feet (average of two wells), respectively. As is the case with the 1983 -1995 base period the decreasing declines with depth contrast with other geographic areas during this period that show generally greater declines in the deeper zones.

1999-2009: This evaluation period includes nine Recent Alluvium wells, and has a total of 54 wells evaluated. The average change in groundwater level of the 54 wells over this evaluation period is -5.5 feet. The greatest decline during this period is in the West end-San Pedro group at 14 feet (one well). This is followed by the Saticoy Area-Older/San Pedro group with a decline of 11.9 feet (average three wells). The Santa Paula Creek-Older Alluvium/San Pedro group had an increase of 0.3 feet (average of four wells). The Santa Paula Creek area had the most individual wells with groundwater level increases over this period.

In addition, the Santa Paula Creek area had some of the lowest average declines of any geographic area. The Santa Paula Creek-Older Alluvium group and Santa Paula Creek-Unknown group had declines of 2.6 feet (average of four wells) and 1.7 feet (average of three wells).

The Middle basin-Recent Alluvium group shows a decline of 2.8 feet (average of seven wells), which is small compared to the declines in the deeper zones. The Middle basin-Older Alluvium, Middle-Older Alluvium/San Pedro and the Middle-San Pedro have declines of 9.5 feet (average of three wells), 10.3 feet (one well) and 10.2 feet (average of two wells).

As with other evaluation periods, the East basin area shows less groundwater level decline with increasing depth. The exception is in the Recent Alluvium which shows the least amount of decline.

The Recent Alluvium in the East basin is represented by the shallow SP1-80 and SP2-70 monitor wells that were drilled in 1994.

1980-2011: As with the previous evaluation periods discussed, most of the groups evaluated in the 1980-2011 base period show groundwater level declines. There are however some wells that record increases in groundwater elevations. The average change in groundwater elevation of the 23 wells with records over this evaluation period is -4.7 feet.

The greatest declines in groundwater levels over this evaluation period are seen in the West-San Pedro group at 12.8 feet (one well), the Santa Paula Creek-Older Alluvium/San Pedro group at 12.4 feet (one well), and in the East basin-Older Alluvium group at 13 feet (average of three wells).

Groundwater level increases are seen in the Santa Paula Creek-Unknown group at 4.6 feet (average of three wells), the Saticoy Area-Older Alluvium group at 2.9 feet (average of two wells) and the Saticoy Area-Older Alluvium/San Pedro group at 3.9 feet (one well). The Saticoy area and Santa Paula Creek area had the most individual wells which groundwater level increases during this period.

The Middle basin-Recent Alluvium wells, as with other evaluation periods, shows less average decline than the deeper zones. The Santa Paula Creek area is consistent with other evaluation periods which show deeper wells having greater average declines.

The East basin area remains consistent with other evaluation periods showing less average water level decline in the deeper-screened wells.

1983-2011: Rainfall totals from the 1983 water year were approximately twice the annual average, and measured at 35.63 inches in Santa Paula. Rainfall totals in the two prior years, however, were below average. One well recorded increasing water levels over the period 1983-2011, while all other wells show decline. The average change in groundwater level among the 26 wells with records over this evaluation period is -9.2 feet).

1986-2011: This evaluation period is consistent with other periods in that the majority of groups show declines, with a few wells showing increases in recorded water levels. The average change in groundwater levels of 28 wells with records over the evaluation period is -4.1 feet.

The greatest decline in this evaluation period is in the East Area-San Pedro group at 8.5 feet (average three wells). The greatest increase is in the Santa Paula Creek-Older Alluvium/San Pedro group at 5.2 feet (average of two wells). The Santa Paula Creek area had the most individual wells showing groundwater level increases during this period.

1997-2011: The groundwater level declines over this evaluation period are some of the least of all the evaluation periods. There were four well groups with slight average increases (of less than 1 foot). The average change in groundwater elevation for the 56 wells with records over this evaluation period is -2.4 feet.

The greatest decline was in the Santa Paula Creek- Older Alluvium/San Pedro group at 6.2 feet (average of four wells). The greatest increase was seen in the West end- San Pedro group and the Middle- Recent Alluvium group at 0.7 feet (one well) and 0.5 feet (average of seven wells). The Middle basin area had the most individual wells, seven in total, showing groundwater level increases over this period, but many of these upward-trending wells are shallow wells screened in the Recent Alluvium.

The Middle basin-Recent Alluvium group and Middle basin-Older Alluvium group show an increase of 0.5 feet (average of seven wells) and 0.2 feet (average of four wells). The Middle-Older Alluvium/San Pedro group and Middle-San Pedro group show decreases of 1.3 feet (one well) and 2.9 feet (average of two wells). This shows increasing groundwater level decline with depth.

The East basin area shows a trend of less average decline in the deeper zones (with the exception of the Recent Alluvium). For the 1997-2011 base period the Recent Alluvium, Older alluvium, Older Alluvium/San Pedro and San Pedro zones within this area show declines of 0.8 feet (average of two wells), 4.5 feet (average of five wells), 3.6 feet (average of three wells) and 3.2 feet (average of nine wells).

1999-2011: Rainfall in 1999 was less than that in 2011, but this period was evaluated because streamflow during this period was similar to long-term averages within the basin (based on frequency-analysis methods). Water levels were relatively high in 1999, following the record-high rainfall recorded in 1998.

This evaluation period shows a greater percentage of wells showing water level increases than the other evaluation periods. Unlike most other evaluation periods, no wells in the Saticoy area or west end of the basin show increasing water levels. While the average change recorded in the 1997-2011 and 1999-2011 evaluation periods are similar, recorded changes among a number of individual wells are quite different.

The average change in groundwater elevation of the 57 wells with records over this evaluation period is -2.2 feet.

7 SUMMARY

The qualitative and quantitative evaluations of groundwater elevation records for Santa Paula basin wells detailed in this Open-File Report allow the following summary statements:

- Shallow alluvial wells located near the Santa Clara River display some of the least annual groundwater level variability and the most stable annual high groundwater levels among wells within the Santa Paula basin. Slightly deeper alluvial wells and those alluvial wells located farther from the river record more annual variability and a greater dry-year response.

- Deeper wells located in the west end of the basin also tend to show limited annual groundwater level variability. The greatest groundwater level variability in general is seen in the East basin area and the Middle basin area among wells screened in the San Pedro Formation and Older Alluvium.

- Older Alluvium wells in the Santa Paula Creek area (03N21W Section 12) have relatively flat annual highs and record decreased variability since approximately 2002. Wells north of Highway 126 show considerably more variability, but also record consistent annual highs.

- Wells with long-term records show increased annual variability after approximately 1945.

- Wells with records from about 1945 to present show long-term declines of approximately 20 feet. This decline is recorded in Older Alluvium and San Pedro wells located in the East, Middle and West basin areas.

- In the Santa Paula Creek area of the basin, Canyon Irrigation Company's well screened exclusively in the San Pedro Formation records lower groundwater elevations than the two Canyon Irrigation Company wells with shallower upper screens (in the Older Alluvium).

- Wells located in the West basin area and the Middle basin area, which are screened in the San Pedro Formation, Older Alluvium or across both the San Pedro Formation and Older Alluvium have the some of the greatest groundwater level declines during the 1984-1991 drought. Well 02N22W02K07S (Alta #9), located in the Saticoy area and screened across the San Pedro Formation and Older Alluvium also shows significant drought response.

- Eight of the ten evaluation periods presented in this report begin with a wet year and end with a wet year. Most of the wells show groundwater level declines over these evaluation periods. The declines, although persistent among the evaluation periods, are relatively modest. Each evaluation period, except for 1944-1998 and 1944-2005, have some wells that show an increase in groundwater levels.

- The greatest average groundwater level declines were seen over the 1944-2005 evaluation period, followed by the 1944-1998 and 1983-2011 evaluation periods. The smallest declines are recorded in the 1983-1995 and 1999-2011 evaluation periods.

- The Santa Paula Creek and Middle basin areas have the most individual wells showing groundwater level increases in the various evaluation periods.

- Wells in the East basin area, for the majority of evaluation periods (with the exception of shallow wells in the Recent Alluvium), record less average groundwater level decline with increasing depth. This is contrary to what is observed in other areas of the basin, such as the Santa Paula Creek area and Middle basin area, where there is generally more average groundwater level decline among the deeper wells.

8 CONCLUSIONS

While there are some differences in groundwater level trends among wells located in the various depth zone/geographic groups detailed in this report, differing trends were generally not pronounced between the groups of wells. The most distinct trends are seen among the Recent

Alluvium wells located near the Santa Clara River, in some of the some of the deeper-screened West end wells, and among the Farmers Irrigation wells located in Section 03N21W Section 12.

Every evaluation period showed a modest decline in groundwater levels for the majority of wells represented, and water level decline in the average value of water level changes among the wells represented in each period. Every evaluation period, except for the period 1944-1998, has at least one well that records higher groundwater elevations over the evaluation period. Some wells recorded decline in every evaluation period, but no well recorded an increase in every period.

The groundwater level declines seen over the various evaluation periods, although modest, are persistent among both the older and more-recent evaluation periods. The above-average rainfall and streamflow in year 2011 allows for a reasonable assessment of current basin conditions compared to past years.

The work presented here could be improved by more detailed assignments of wells to specific aquifers. It is recognized that data gaps and the less-frequent monitoring of some basin wells serves to limit the accuracy of the quantitative methods used to assess water level changes over the various evaluation periods. However, the accuracy of this study is sufficient to characterize long-term trending of water levels in the Santa Paula basin.

9 REFERENCES

Eid, Ronald J., 2012, Santa Paula Basin: Rainfall, GEI Memorandum, January 18, 2012

Freeman, Vernon M., 1968, People-Land-Water: Santa Clara Valley and Oxnard Plain, Ventura County, California.

Hanson, R.T., Martin, P. and Koczot, K.M., 2003, Simulation of Ground-Water/Surface-Water Flow in the Santa Clara –Calleguas Ground-Water Basin, Ventura County, California, U.S. Geological Survey, Water-Resources Investigations Report 02-4136, 157p.

Mann, J.F., Jr., 1959, A plan for ground water management, United Water Conservation District: Technical Consultant's Report to United Water Conservation District, 120p.

Santa Paula Basin Experts Group, 2003, Investigation of Santa Paula Basin Yield, prepared for Santa Paula Basin Technical Advisory Committee, 54 p., 4 appendices.

Santa Paula Basin TAC, 2012, 2011 Annual Report of Hydrologic Conditions, Santa Paula basin.

UWCD, 2011, Santa Paula Basin Pumping Trend Effects and Assessment, United Water Conservation District Open-File Report 2010-003.

UWCD, 2012, Groundwater and Surface Water Conditions Report - 2011, United Water Conservation District Open-File Report 2012-02

Weber, Kenneth and Stewart Mark, 2004, A critical analysis of the cumulative rainfall departure concept, GROUNDWATER, Vol. 42, No. 6, November-December 2004, pp 935-938.

10 FIGURES

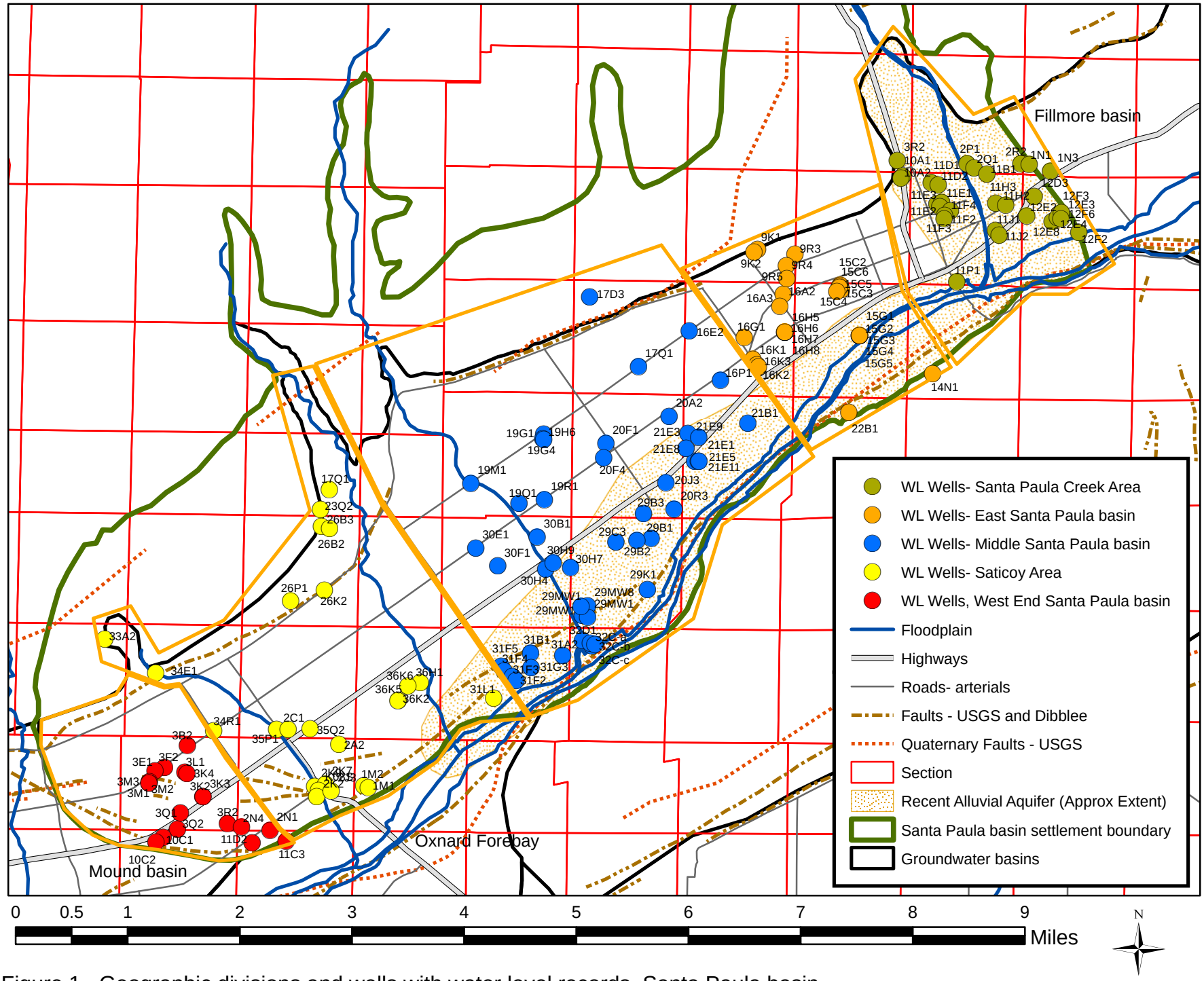


Figure 1. Geographic divisions and wells with water level records, Santa Paula basin

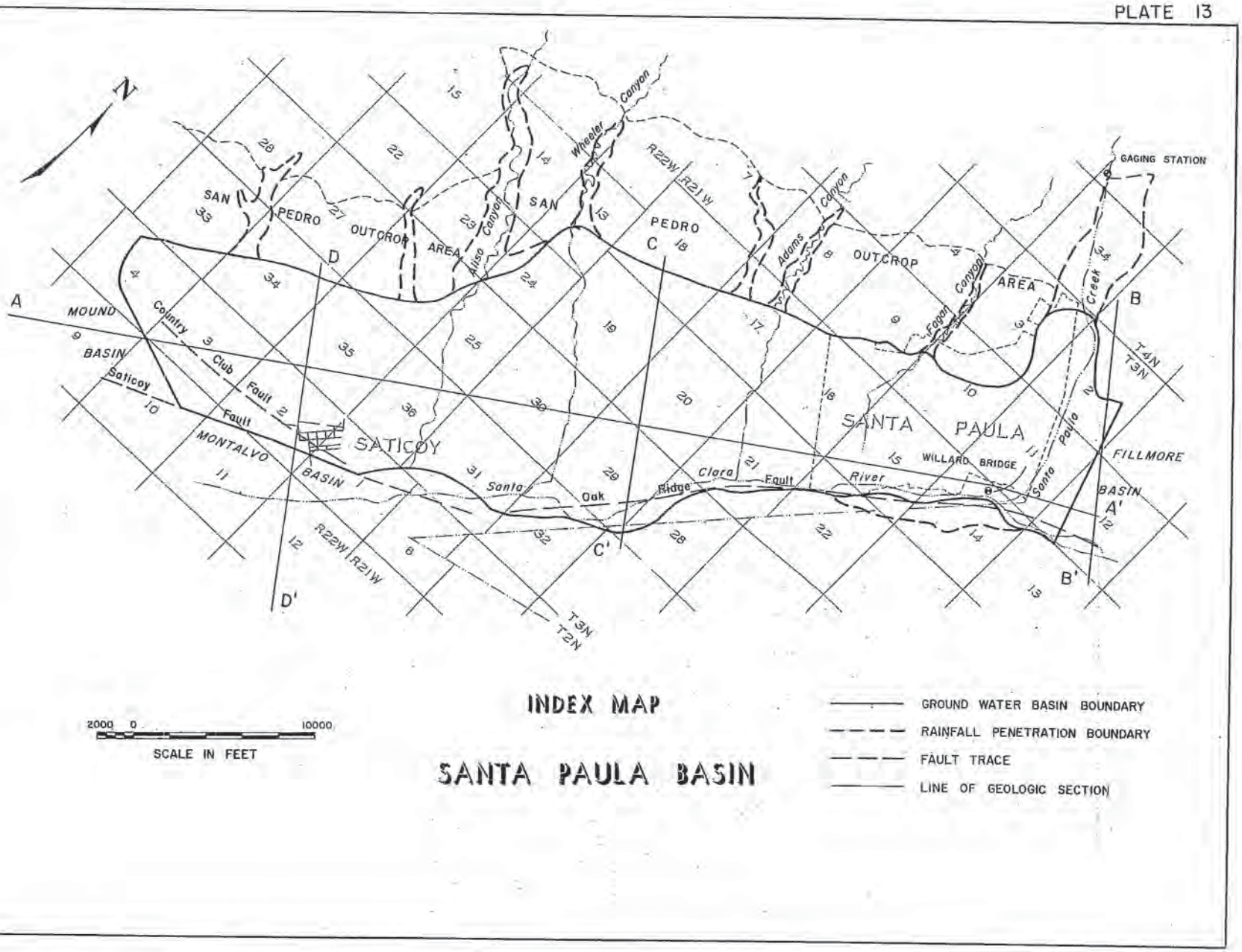


Figure 2. Santa Paula Basin base map for geologic cross-sections (Mann, 1959)

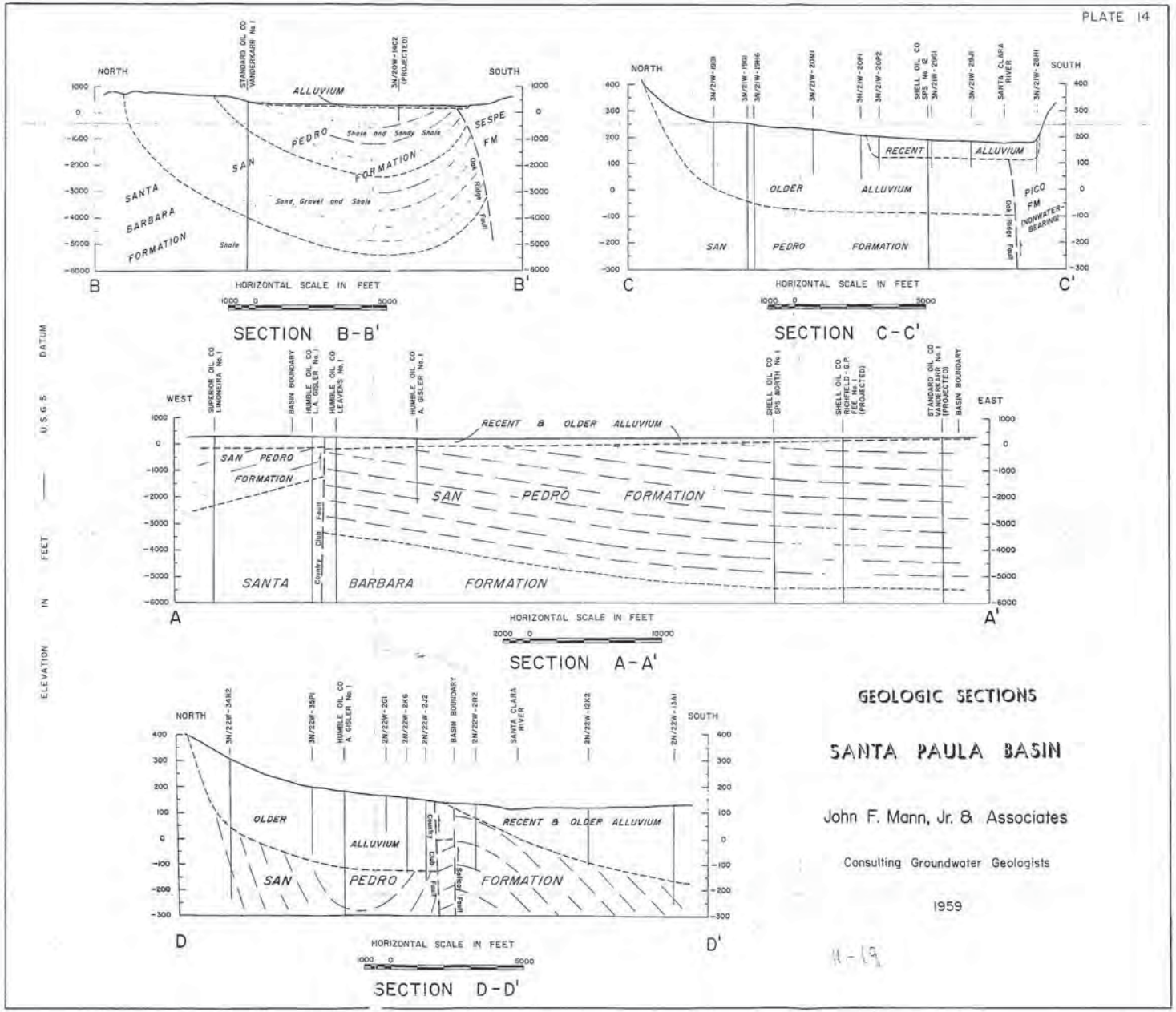


Figure 3. Santa Paula Basin geologic cross-sections (Mann, 1959)

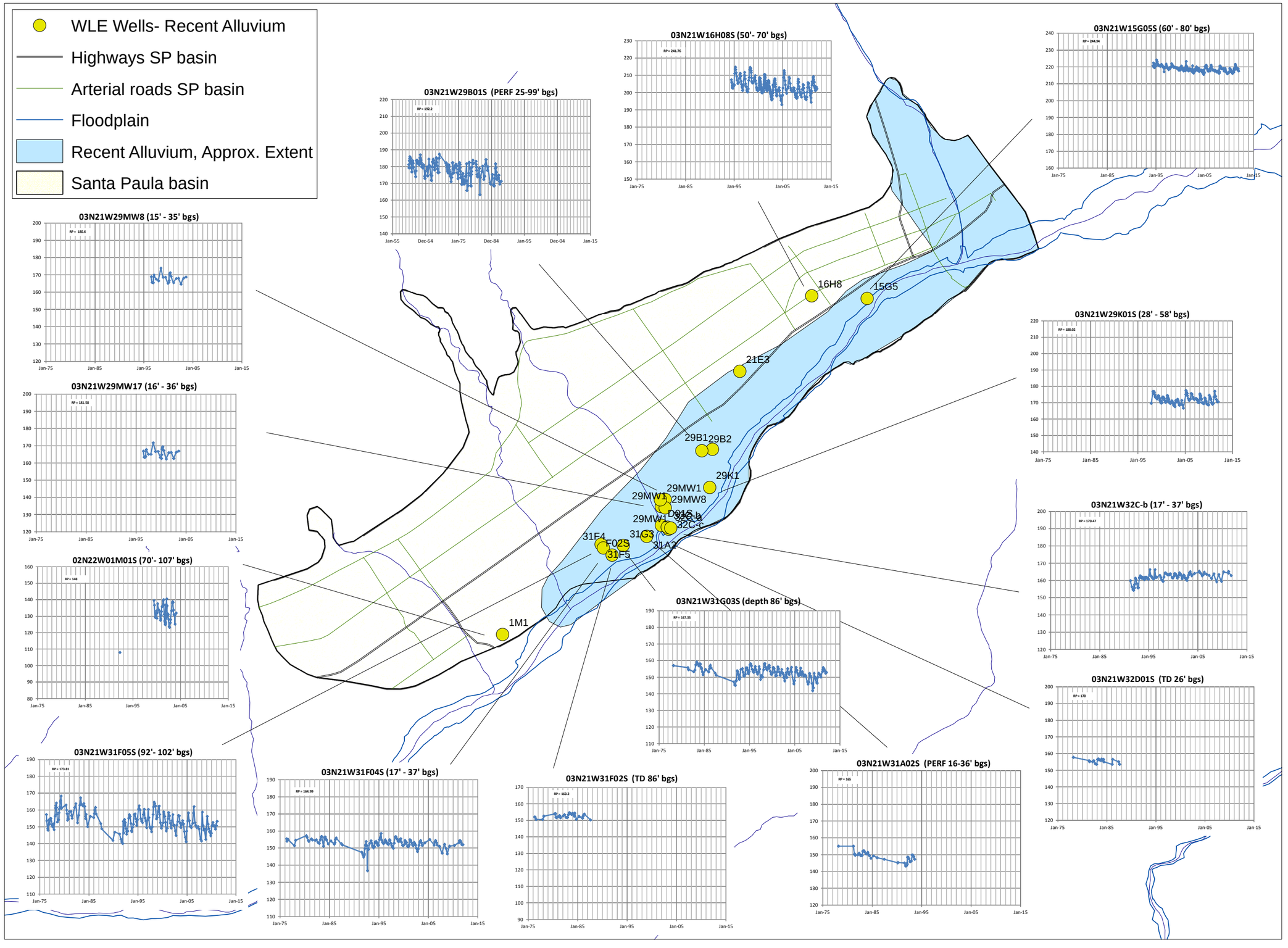


Figure 4. Map with hydrographs for wells screened in Recent Alluvium (<110' bgs)

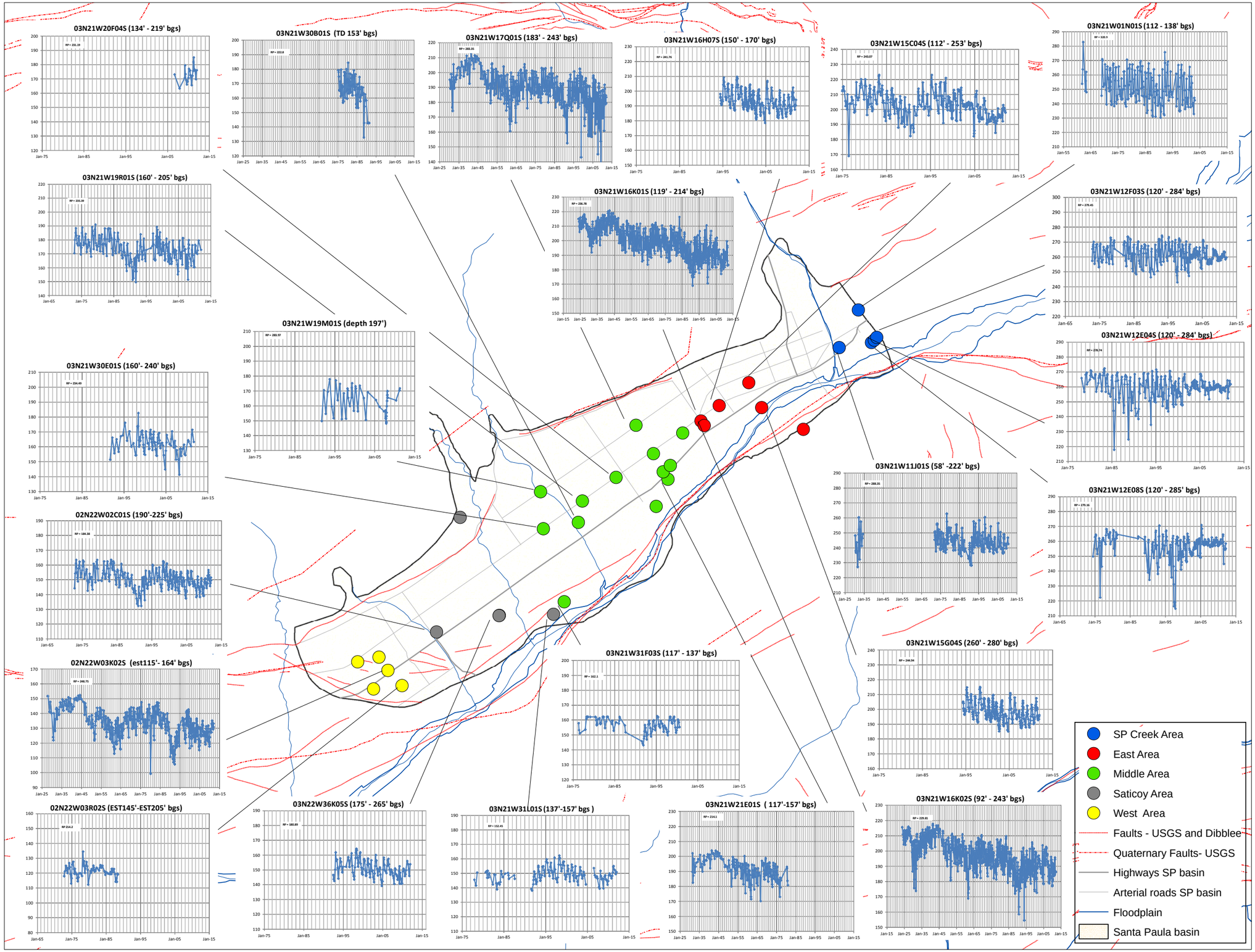


Figure 5. Map with hydrographs for wells screened in Older Alluvium (110' - 300' bgs)

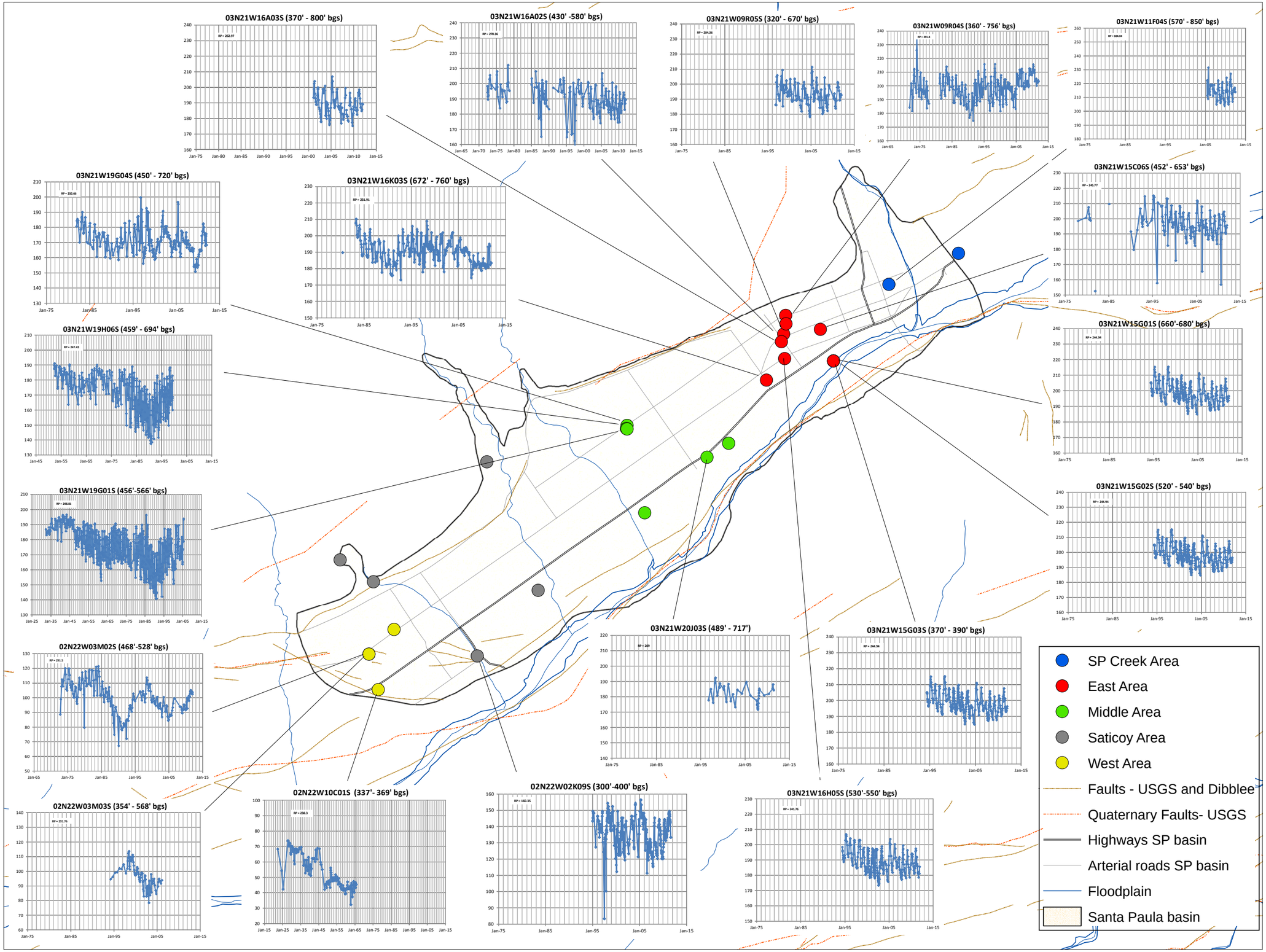


Figure 6. Map with hydrographs for wells screened in the San Pedro Formation (>300' bgs)

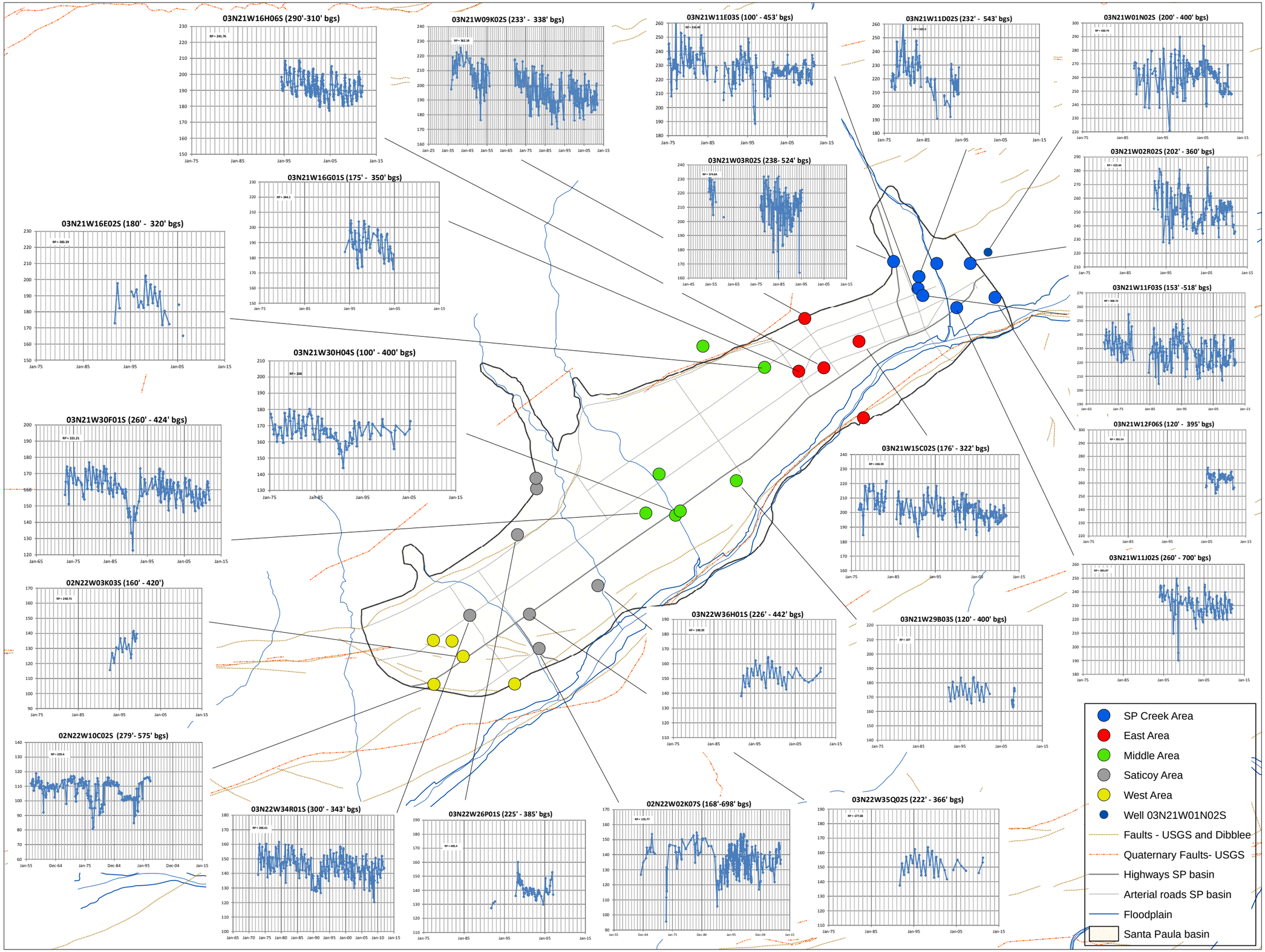


Figure 7. Map with hydrographs for wells screened in Older Alluvium and San Pedro Formation (screened above and below 300' bgs)

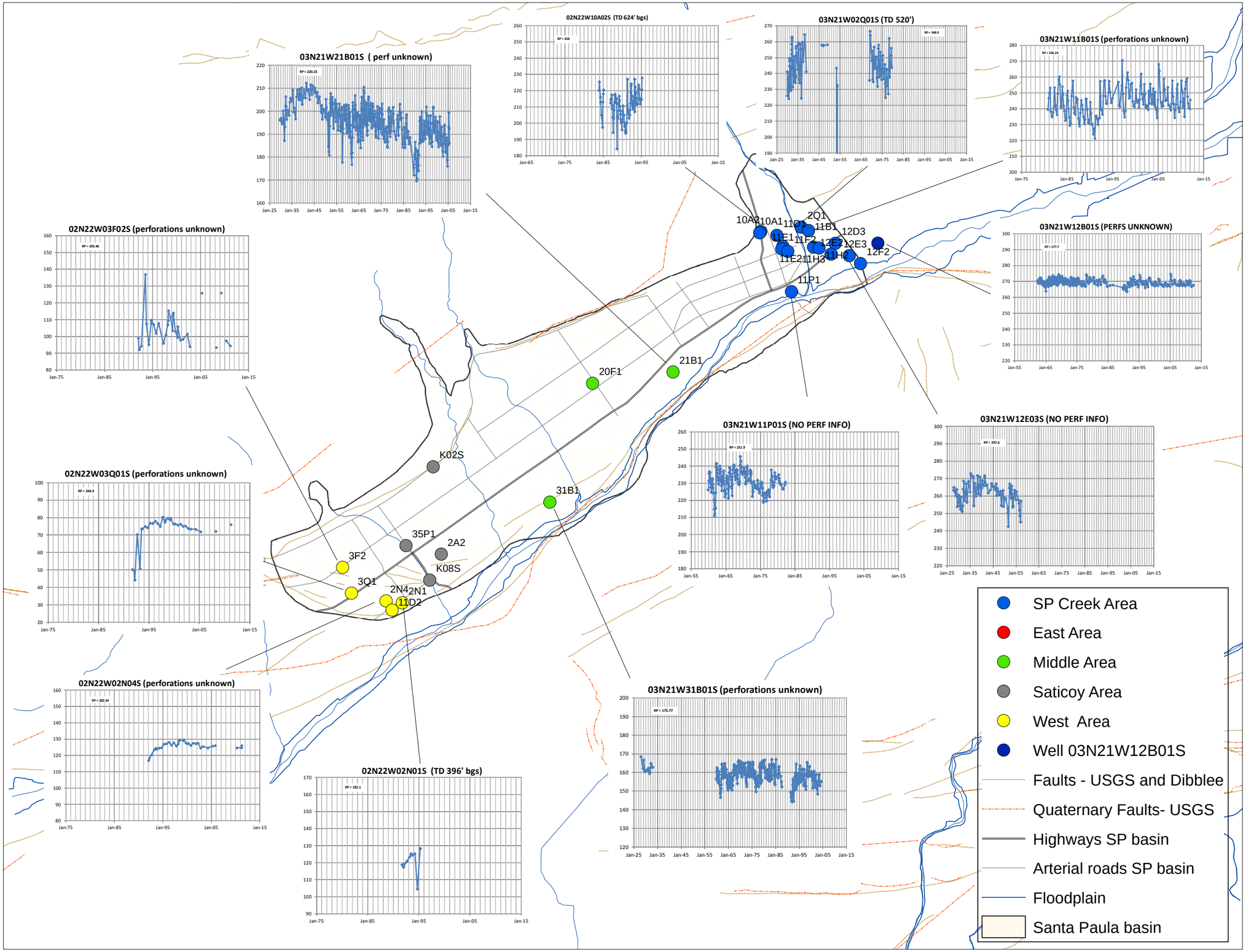


Figure 8. Map with hydrographs for wells with unknown construction

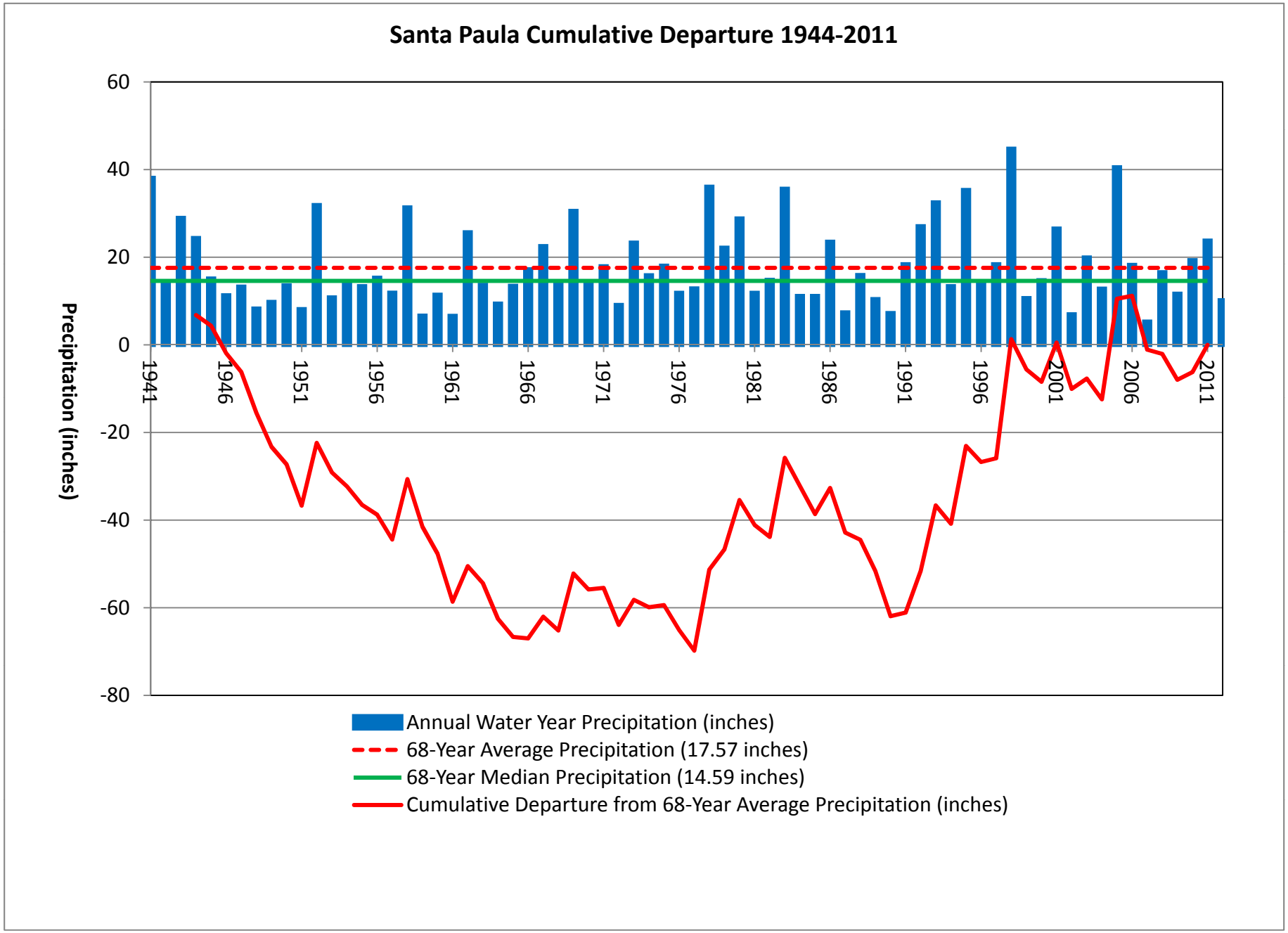


Figure 9. Santa Paula basin precipitation plot 1944-2011, with cumulative departure from average

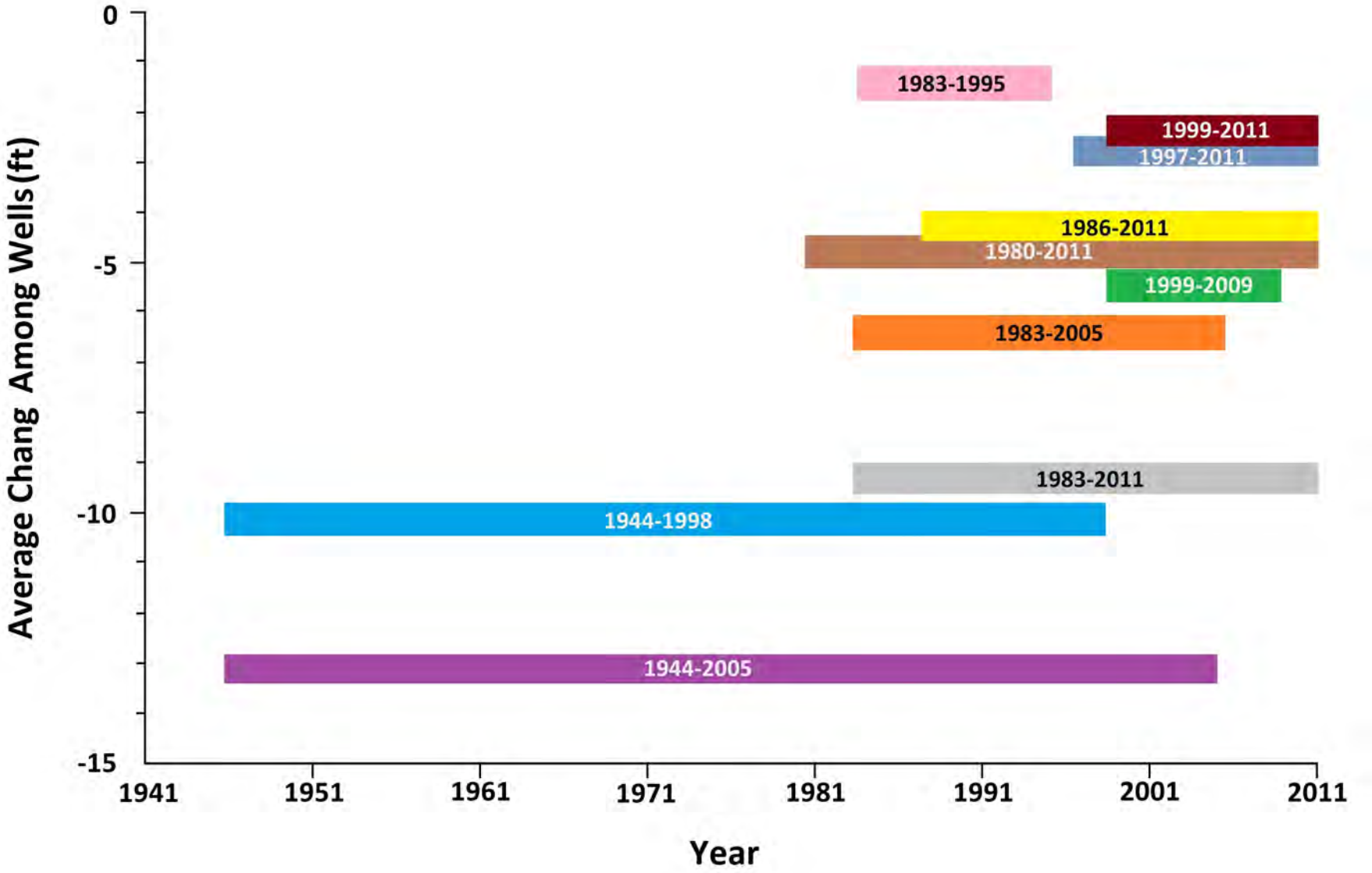


Figure 10. Average change in Santa Paula basin water levels for various evaluation periods

11 TABLES

Table 1. Annual maximum-recorded groundwater elevations for wells in Santa Paula basin

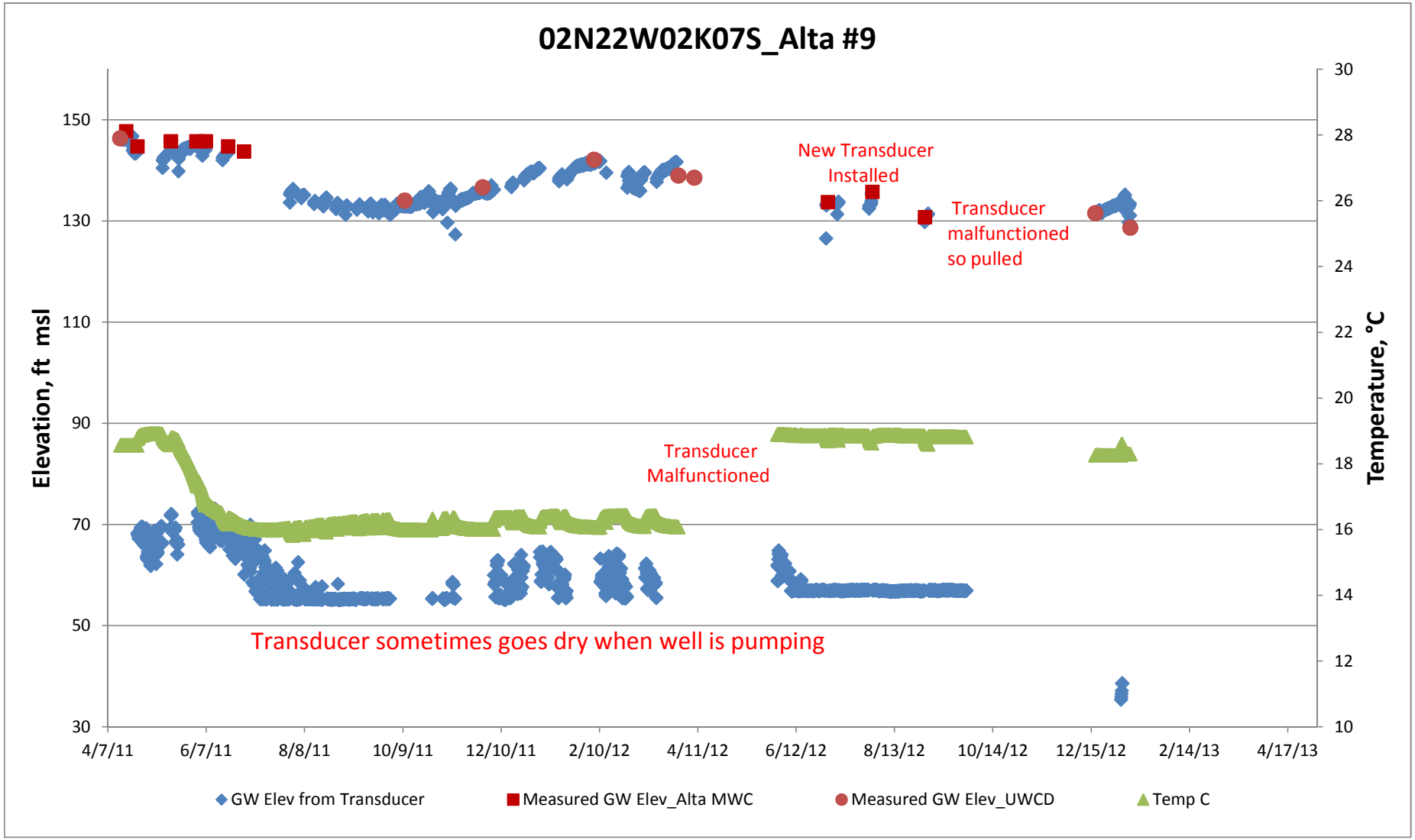
WELLID	Geographic Area	Depth Zone	Hydrograph	1944 Max WLE	1978 Max WLE	1980 Max WLE	1983 Max WLE	1986 Max WLE	1993 Max WLE	1995 Max WLE	1997 Max WLE	1998 Max WLE	1999 Max WLE	2005 Max WLE	2009 Max WLE	2011 Max WLE
03N21W01N01S	Santa Paula Creek	Older Alluvium				270.7	267.3	269.7	268.0	269.3		267.0	267.1	261.5		
03N21W11J01S	Santa Paula Creek	Older Alluvium	yes			262.9	253.4	255.4	253.4	256.3	258.5	250.4	260.5	246.6	256.5	242.6
03N21W12E04S	Santa Paula Creek	Older Alluvium	yes			266.0	271.1	272.5	269.7	268.9	271.7	267.3	270.7	263.7	268.7	261.8
03N21W12E08S	Santa Paula Creek	Older Alluvium	yes			268.3	267.7			270.7	267.3	263.7	263.2	261.0	271.0	262.6
03N21W12F03S	Santa Paula Creek	Older Alluvium	yes			273.0		273.6	270.5	274.4	273.4	271.5	272.5	268.5	271.4	262.5
03N21W02P01S	Santa Paula Creek	Older/San Pedro	yes			279.1										
03N21W02P01S	Santa Paula Creek	Older/San Pedro				279.1										
03N21W02R02S	Santa Paula Creek	Older/San Pedro	yes							281.4	271.5	267.3	280.8	262.4	282.4	256.9
03N21W03R02S	Santa Paula Creek	Older/San Pedro				231.6	231.8	227.8	217.8	216.0	222.4					
03N21W11D02S	Santa Paula Creek	Older/San Pedro				247.2	248.1	248.0	220.9	222.7						
03N21W11E03S	Santa Paula Creek	Older/San Pedro	yes			253.2	249.7	251.5	218.5	243.5	248.9	237.3		225.5	237.5	234.0
03N21W11F03S	Santa Paula Creek	Older/San Pedro	yes			254.7			244.8	247.7	250.7	241.0		229.3	239.7	228.9
03N21W11J02S	Santa Paula Creek	Older/San Pedro	yes							236.3	244.5	241.5	249.7	236.5	245.1	235.1
03N21W12F06S	Santa Paula Creek	Older/San Pedro	yes												271.5	266.7
03N21W01N03S	Santa Paula Creek	San Pedro														
03N21W11F04S	Santa Paula Creek	San Pedro	yes												231.4	221.0
03N21W02Q01S	Santa Paula Creek	Unknown				262.0										
03N21W10A01S	Santa Paula Creek	Unknown						137.0								
03N21W10A02S	Santa Paula Creek	Unknown						220.2	286.0	227.0	227.8					
03N21W11B01S	Santa Paula Creek	Unknown	yes				246.8	260.3	257.6	257.9		270.5	262.9	256.3	268.1	255.5
03N21W11D01S	Santa Paula Creek	Unknown														
03N21W11E01S	Santa Paula Creek	Unknown														
03N21W11E02S	Santa Paula Creek	Unknown														
03N21W11F02S	Santa Paula Creek	Unknown														
03N21W11H02S	Santa Paula Creek	Unknown														
03N21W11H03S	Santa Paula Creek	Unknown	yes			266.0	253.4	262.8	272.7	260.7	262.1	256.2	261.7	253.3	260.2	248.9
03N21W11P01S	Santa Paula Creek	Unknown				237.7	234.9									
03N21W12B01S	Santa Paula Creek	Unknown	yes			274.3	272.6	273.5	267.7	273.1	274.0	270.4	272.2	268.6	274.5	268.7
03N21W12D03S	Santa Paula Creek	Unknown														
03N21W12E02S	Santa Paula Creek	Unknown														
03N21W12E03S	Santa Paula Creek	Unknown			267.1											
03N21W12F02S	Santa Paula Creek	Unknown														
03N21W14N01S	East	Older Alluvium														
03N21W15C04S	East	Older Alluvium	yes			218.3	220.2	223.1	214.3	218.1	223.1	218.4	221.1	208.2	212.5	196.5
03N21W15G04S	East	Older Alluvium	yes								214.9	208.9	215.2	207.6	211.0	202.5
03N21W16H07S	East	Older Alluvium	yes								209.2	204.3	209.8	203.2	206.9	197.6
03N21W16K01S	East	Older Alluvium	yes		219.0	210.4	209.7	216.4	205.7	202.5	206.7	197.8	207.3	210.7	202.1	193.8
03N21W16K02S	East	Older Alluvium	yes		216.9	207.8	207.6	209.8	202.0	202.3	200.3	201.6	205.8	201.8	201.1	196.3
03N21W09K02S	East	Older/San Pedro	yes		222.5	213.0	208.7	213.3	207.0	208.6		206.6	210.2	203.8	207.7	192.6
03N21W15C02S	East	Older/San Pedro	yes			218.6	219.8	221.9	214.8	217.6	218.5	210.0		210.6	208.2	204.4
03N21W16G01S	East	Older/San Pedro	yes			204.0				183.9	204.7	203.9	204.3	200.7		
03N21W16H06S	East	Older/San Pedro	yes								208.5	203.5	208.8	202.4	207.2	196.8
03N21W22B01S	East	Older/San Pedro														
03N21W15G05S	East	Recent Alluvium	yes								224.2	221.8	222.0	219.7	225.1	219.2
03N21W16H08S	East	Recent Alluvium	yes								214.8	211.8	214.7	209.9	212.8	204.8
03N21W09R04S	East	San Pedro	yes					214.1	207.8	210.8	215.8	206.8	215.9	204.7	208.9	212.8
03N21W09R05S	East	San Pedro	yes									205.9	209.4	202.4	211.4	199.4
03N21W15C06S	East	San Pedro	yes				207.7			214.8	215.3	208.7	213.4	208.8	212.0	202.2
03N21W15G01S	East	San Pedro	yes								215.3	209.1	215.5	207.8	211.3	202.6
03N21W15G02S	East	San Pedro	yes								215.1	209.2	215.3	207.7	211.1	202.5
03N21W15G03S	East	San Pedro	yes								215.1	209.1	215.3	207.7	211.1	202.5
03N21W16A02S	East	San Pedro	yes			212.3			208.2	202.9	197.4	197.0	202.7	200.4	207.0	198.3
03N21W16A03S	East	San Pedro													207.0	196.5
03N21W16H05S	East	San Pedro	yes								206.8	203.0	203.1	198.1	203.7	196.4
03N21W16K03S	East	San Pedro	yes				189.7	210.1	204.0	203.9	205.8	201.7	208.9	201.9	198.7	189.2
03N21W09K01S	East	unknown			222.9											
03N21W09R03S	East	unknown			223.8	202.8	213.6	213.7								
03N21W15C03S	East	unknown	yes					212.9	216.2	208.8	213.9	209.0	213.4	202.3		
03N21W15C05S	East	unknown														
03N21W16P01S	Middle	Older Alluvium								199.1						
03N21W17Q01S	Middle	Older Alluvium	yes		210.8	202.9	202.9	203.2	197.4	198.6	200.8	197.9	202.6	197.4	197.9	187.4
03N21W19M01S	Middle	Older Alluvium	yes							178.0	177.2	168.6	171.7	175.3	164.0	
03N21W19R01S	Middle	Older Alluvium	yes			189.4	183.6	188.5	185.2	184.1		184.7	189.4	185.5	179.5	176.3
03N21W20A02S	Middle	Older Alluvium														
03N21W20F04S	Middle	Older Alluvium	yes													179.5
03N21W20R03S	Middle	Older Alluvium														
03N21W21E01S	Middle	Older Alluvium			203.1		193.1									
03N21W21E08S	Middle	Older Alluvium														
03N21W21E09S	Middle	Older Alluvium														
03N21W30B01S	Middle	Older Alluvium				178.0	184.4	179.1	174.5							
03N21W30E01S	Middle	Older Alluvium	yes							165.2	176.2	162.6	182.7	170.9	168.0	161.5
03N21W31F03S	Middle	Older Alluvium				10161.1	10161.1	162.2	162.0	159.5	162.6	154.9	10161.1	10161.1		
03N21W16E02S	Middle	Older/San Pedro	yes								192.6	186.5	202.4	197.0	184.5	
03N21W17D03S	Middle	Older/San Pedro												296.0		
03N21W19Q01S	Middle	Older/San Pedro														
03N21W29B03S	Middle	Older/San Pedro	yes							180.8	183.6	175.9	183.9	180.2		
03N21W30F01S	Middle	Older/San Pedro	yes			172.8	173.9	174.5	169.9	173.1		168.0	172.8	171.0	167.2	160.7
03N21W30H04S	Middle	Older/San Pedro	yes			177.8	178.9	180.3	174.3	172.8		171.0	164.0	174.0	172.8	
03N21W30H09S	Middle	Older/San Pedro														
03N21W21E03S	Middle	Recent Alluvium														
03N21W29B01S	Middle	Recent Alluvium				182.5	183.1	184.2	181.6							
03N21W29B02S	Middle	Recent Alluvium														
03N21W29K01S	Middle	Recent Alluvium	yes									169.8	176.8	174.2	177.4	172.9
03N21W29MW1	Middle	Recent Alluvium										165.2	170.4	165.7		
03N21W29MW11	Middle	Recent Alluvium	yes									166.6	169.9	165.6		
03N21W29MW17	Middle	Recent Alluvium	yes									167.8	171.7	166.8		
03N21W29MW8	Middle	Recent Alluvium	yes									170.0	174.0	168.7		
03N21W31A02S	Middle	Recent Alluvium				155.0		152.4		149.8						
03N21W31F02S	Middle	Recent Alluvium				152.5	154.0	154.6	153.7							
03N21W31F04S	Middle	Recent Alluvium	yes			154.6	157.2	156.7	155.9	154.3	158.6	154.7	156.6	155.5	155.0	151.1
03N21W31F05S	Middle	Recent Alluvium	yes			164.2	163.0	167.3	161.6	157.3	162.6	160.4	164.8	162.4	158.3	156.3
03N21W31G03S	Middle	Recent Alluvium	yes			157.1		159.1	157.3	155.1	158.0	156.3	158.1	157.2	156.0	152.4
03N21W32C-a	Middle	Recent Alluvium	yes							162.8	163.1	163.4	164.3	163.6	164.4	162.6
03N21W32C-b	Middle	Recent Alluvium	yes							162.6	166.3	163.0	164.4	163.8	164.9	163.4
03N21W32C-c	Middle	Recent Alluvium	yes							162.8	164.0	164.3	164.9	164.5	165.3	162.7
03N21W32D01S	Middle	Recent Alluvium				157.8		156.8	156.5							
03N21W21E05S	Middle	Recent/Older														
03N21W29C03S	Middle	Recent/Older														
03N21W19G01S	Middle	San Pedro	yes		193.4	178.8	188.8	189.9	189.9	180.8	187.3	186.8	186.8	180.8	193.9	
03N21W19G04S	Middle	San Pedro	yes					190.0	182.0	182.7	182.0	191.7	192.7	171.8	196.7	159.1
03N21W19H06S	Middle	San Pedro	yes			186.7	187.2	188.9	179.1	182.9	184.2	200.7	188.2	239.2		
03N21W20J03S	Middle	San Pedro	yes									185.1	192.5	188.8	189.6	181.0
03N21W21E11S	Middle	San Pedro														
03N21W30H07S	Middle	San Pedro														
03N21W20F01S	Middle	Unknown														
03N21W21B01S	Middle	Unknown	yes		211.1	201.5	201.7	203.1	198.6	199.8	201.9	198.1	201.9	197.5	199.4	
03N21W31B01S	Middle	Unknown	yes			164.8	166.7	166.9	163.1	164.5	163.5	161.5	165.3	163.3		
02N22W02C01S	Saticoy Area	Older Alluvium	yes			161.0	154.6	163.7	160.9	156.3	160.2	158.6	162.7	161.1	156.2	151.2
03N21W31L01S	Saticoy Area	Older Alluvium	yes			150.6	151.4	143.6	148.6	155.1	159.6	160.8	162.3	158.1		148.6
03N22W26B03S	Saticoy Area	Older Alluvium														
03N22W36K02S	Saticoy Area	Older Alluvium			172.2	164.1	165.7	166.6	160.5							
03N22W36K05S	Saticoy Area	Older Alluvium	yes							161.9	152.2	161.3	164.4	161.9	158.4	152.6
02N22W02K07S	Saticoy Area	Older/San Pedro	yes			150.3		154.8	150.8	139.4	147.4	149.1	153.8	153.8	140.6	137.6
03N22W23Q02S	Saticoy Area	Older/San Pedro														
03N22W26B02S	Saticoy Area	Older/San Pedro														
03N22W26P01S	Saticoy Area	Older/San Pedro	yes									136.1	160.2	146.8	148.6	
03N22W34R01S	Saticoy Area	Older/San Pedro	yes			158.2	148.0	159.0	156.8	152.5	156.2	154.4	158.4	157.3	151.9	150.7
03N22W35Q02S	Saticoy Area	Older/San Pedro	yes							157.2	162.4	154.4	163.7	161.3	155.1	
03N22W36H01S	Saticoy Area	Older/San Pedro	yes							157.0	162.3	154.1	164.6	161.8	157.1	149.0
02N22W01M01S	Saticoy Area	Recent Alluvium	yes											139.5		
02N22W01M02S	Saticoy Area	Recent/Older														
02N22W02J03S	Saticoy Area	Recent/Older								140.9						
02N22W02K02S	Saticoy Area	Recent/Older								148.4						
02N22W02K09S	Saticoy Area	San Pedro	yes								149.4	149.4	154.4	152.4	156.4	144.4
03N22W23Q01S	Saticoy Area	San Pedro												257.4	238.7	247.0
03N22W33A02S	Saticoy Area	San Pedro											159.5			
03N22W34E01S	Saticoy Area	San Pedro														
03N22W36K06S	Saticoy Area	San Pedro														
02N22W02A02S	Saticoy Area	Unknown								28.0						
02N22W02K08S	Saticoy Area	Unknown								138.2						
03N22W26K02S	Saticoy Area	Unknown														
03N22W35P01S	Saticoy Area	Unknown														
02N22W03K02S	West	Older Alluvium	yes		152.4	142.9	138.4	147.4	140.1	127.8		136.1	141.6	141.4	130.5	131.7
02N22W03K04S	West	Older Alluvium														
02N22W03M01S	West	Older Alluvium														95.7
02N22W03Q02S	West	Older Alluvium								46.4						
02N22W03R02S	West	Older Alluvium				134.6	122.9	125.5	123.0							
02N22W03E01S	West	Older/San Pedro								134.5	110.3					
02N22W03K03S	West	Older/San Pedro	yes							127.1	136.8	132.8	141.8	139.8		
02N22W03L01S	West	Older/San Pedro								145.9	150.7					
02N22W10C02S	West	Older/San Pedro				111.4	97.4	115.7	110.9	111.8	115.4	114.5				
02N22W11C03S	West	Older/San Pedro								131.0						
02N22W03B02S	West	San Pedro														
02N22W03M02S	West	San Pedro	yes			113.6	118.0	121.2	106.5	95.0		104.5	113.8	109.5	91.3	95.5
02N22W03M03S	West	San Pedro	yes								99.4	104.8	113.8	111.3	95.0	
02N22W10C01S	West	San Pedro			68.9											
02N22W02N01S	West	Unknown								125.2	128.2					
02N22W02N04S	West	Unknown	yes							124.6	127.2	127.8	129.5	129.7	126.1	
02N22W03F02S	West	Unknown	yes							136.9	107.2	100.9	115.4	114.1	125.8	125.9
02N22W03Q01S	West	Unknown	yes							73.6	76.8	80.4	79.7	79.6	71.9	
02N22W11D02S	West	Unknown								108.1						

Table 2. Change in maximum-recorded groundwater elevations over various time periods

WELLID	Geographic Area	Depth Zone	Hydrograph	Change 1944-1998	Change 1944-2005	Change 1983-1995	Change 1983-2005	Change 1999-2009	Change 1980-2011	Change 1983-2011	Change 1986-2011	Change 1997-2011	Change 1999-2011
03N21W11J01S	Santa Paula Creek	Older Alluvium	yes			**3.0**	**1.0**	-3.9					
03N21W12E04S	Santa Paula Creek	Older Alluvium	yes			-0.8	-3.8	-1.9	-6.7	-8.1	-5.3	-2.9	**0.7**
03N21W12E08S	Santa Paula Creek	Older Alluvium	yes					**1.6**	-3.0			**1.0**	**3.7**
03N21W12F03S	Santa Paula Creek	Older Alluvium	yes			-0.3	-2.3	-6.1		-10.0	-6.8	-7.8	-4.9
03N21W02R02S	Santa Paula Creek	Older/San Pedro	yes					-5.5				-12.9	-8.0
03N21W03R02S	Santa Paula Creek	Older/San Pedro				-5.4							
03N21W11E03S	Santa Paula Creek	Older/San Pedro	yes			-2.6	-14.0	**8.5**	-12.4	-14.2	**18.8**	**0.0**	**11.8**
03N21W11F03S	Santa Paula Creek	Older/San Pedro	yes					-0.4			-8.4	-4.6	**7.1**
03N21W11J02S	Santa Paula Creek	Older/San Pedro	yes					-1.4				-7.4	-2.4
03N21W10A02S	Santa Paula Creek	Unknown				**7.6**							
03N21W11B01S	Santa Paula Creek	Unknown	yes				**7.8**	-0.8	**13.2**	-0.3	**2.4**	-10.5	**3.7**
03N21W11H03S	Santa Paula Creek	Unknown	yes			-0.7	-2.6	-4.4	**2.4**	-7.0	-16.9	-0.4	**2.5**
03N21W12B01S	Santa Paula Creek	Unknown	yes			**0.5**	**1.0**	**0.1**	-1.9	-2.8	**3.0**	**0.3**	**2.1**
03N21W15C04S	East basin	Older Alluvium	yes			**0.0**	-10.6	-11.7	-17.1	-20.0	-11.2	-15.3	-5.1
03N21W15G04S	East basin	Older Alluvium	yes					-5.1				-1.3	**0.0**
03N21W16H07S	East basin	Older Alluvium	yes					-5.6				-1.8	-0.8
03N21W16K01S	East basin	Older Alluvium	yes	-11.7	-16.9	-9.7	-14.3	-16.9	-10.1	-16.8	-6.1	**1.8**	-11.1
03N21W16K02S	East basin	Older Alluvium	yes	-11.1	-15.8	-9.5	-8.7	-5.5	-11.7	-13.9	-6.1	-5.7	-5.9
03N21W09K02S	East basin	Older/San Pedro	yes	-12.3	-14.8		-5.6	-11.2	-7.5	-12.1	-5.8	-5.4	-2.6
03N21W15C02S	East basin	Older/San Pedro	yes			-3.4	-13.7	-6.2	-14.6	-16.7	-9.6	-4.8	-5.4
03N21W16H06S	East basin	Older/San Pedro	yes					-5.7				-0.6	**0.5**
03N21W15G05S	East basin	Recent Alluvium	yes					-0.5				**0.2**	**2.3**
03N21W16H08S	East basin	Recent Alluvium	yes					-5.1				-1.9	**0.0**
03N21W09R04S	East basin	San Pedro	yes			**1.7**	-5.2	**8.1**		-8.8	-2.5	-1.5	**0.6**
03N21W09R05S	East basin	San Pedro	yes					-3.0				-4.6	-1.1
03N21W15C06S	East basin	San Pedro	yes					-6.6	-2.9			-3.9	-4.0
03N21W15G01S	East basin	San Pedro	yes					-5.2				-1.3	**0.0**
03N21W15G02S	East basin	San Pedro	yes					-5.2				-1.6	-0.1
03N21W15G03S	East basin	San Pedro	yes					-5.2				-0.8	**0.6**
03N21W16A02S	East basin	San Pedro	yes					-2.1			-13.9	-2.7	-6.1
03N21W16H05S	East basin	San Pedro	yes					-1.7				-5.6	-0.6
03N21W16K03S	East basin	San Pedro	yes			-4.3	-11.4	-12.7	**5.2**	-15.2	-9.1	-6.8	-7.0
03N21W15C03S	East basin	unknown	yes			**1.0**							
03N21W17Q01S	Middle basin	Older Alluvium	yes	-8.2	-12.8	-2.4	-5.2	-10.0	-11.1	-11.4	-5.6	-6.1	-5.6
03N21W19M01S	Middle basin	Older Alluvium	yes									**3.2**	-3.5
03N21W19R01S	Middle basin	Older Alluvium	yes				-9.0	-9.2	-4.0	-8.9	-5.6	-5.1	-5.9
03N21W30E01S	Middle basin	Older Alluvium	yes					-9.4				**8.9**	**0.6**
03N21W31F03S	Middle basin	Older Alluvium				**0.4**							
03N21W30F01S	Middle basin	Older/San Pedro	yes				-7.3	-10.3	-7.2	-7.8	-3.2	-1.3	-4.3
03N21W30H04S	Middle basin	Older/San Pedro	yes				-7.5						
03N21W29K01S	Middle basin	Recent Alluvium	yes					-1.4				**7.2**	**2.8**
03N21W31F04S	Middle basin	Recent Alluvium	yes			**1.9**	-1.7	-4.3	-2.9	-2.4	-1.6	-0.4	-1.1
03N21W31F05S	Middle basin	Recent Alluvium	yes			-4.8	-9.0	-6.1	-9.7	-14.0	-8.3	-7.1	-9.1
03N21W31G03S	Middle basin	Recent Alluvium	yes			-1.1	-3.2	-4.8		-3.4	-1.5	-0.5	-1.4
03N21W32C-a	Middle basin	Recent Alluvium	yes					-1.0				**1.2**	**1.1**
03N21W32C-b	Middle basin	Recent Alluvium	yes					-0.4				**2.1**	**1.3**
03N21W32C-c	Middle basin	Recent Alluvium	yes					-1.8				**1.3**	**1.1**
03N21W19G01S	Middle basin	San Pedro	yes	-6.6	**0.5**	-2.6	**4.0**						
03N21W19G04S	Middle basin	San Pedro	yes			-8.0	**6.7**	-12.7		-7.6	**0.4**	-9.3	**10.6**
03N21W19H06S	Middle basin	San Pedro	yes			-4.7							
03N21W20J03S	Middle basin	San Pedro	yes					-7.8				**3.5**	-0.2
03N21W21B01S	Middle basin	Unknown	yes	-9.3	-11.7	-1.2	-3.7						
03N21W31B01S	Middle basin	Unknown	yes			-3.4							
02N22W02C01S	Saticoy Area	Older Alluvium	yes			-3.5	-7.5	-9.9	**2.1**	-7.0	-4.2	-1.9	-4.4
03N21W31L01S	Saticoy Area	Older Alluvium	yes			**16.1**		-9.6	**3.7**	**11.5**	**6.4**	-5.7	-3.1
03N22W36K05S	Saticoy Area	Older Alluvium	yes					-9.3				-5.2	-5.8
02N22W02K07S	Saticoy Area	Older/San Pedro	yes			-7.4	-14.2	-16.2		-7.0	-3.0	-1.3	-6.0
03N22W34R01S	Saticoy Area	Older/San Pedro	yes			-2.8	-7.1	-6.6	**3.9**	-7.1	-4.9	-2.5	-5.4
03N22W35Q02S	Saticoy Area	Older/San Pedro	yes									**2.2**	-4.7
03N22W36H01S	Saticoy Area	Older/San Pedro	yes					-12.8				**3.1**	-4.6
02N22W02K09S	Saticoy Area	San Pedro	yes					-8.0				**0.0**	-3.0
03N22W23Q01S	Saticoy Area	San Pedro						-10.4					-7.1
02N22W03K02S	West end	Older Alluvium	yes	-10.7	-21.9		-16.9	-9.6	-3.3	-12.3	-5.0	-1.0	-6.3
02N22W10C02S	West end	Older/San Pedro				-0.3							
02N22W03M02S	West end	San Pedro	yes				-29.9	-14.0	-12.8	-16.0	-1.3	**0.7**	-4.3
02N22W02N04S	West end	Unknown	yes									-1.7	-3.6
02N22W03F02S	West end	Unknown	yes					**11.8**				-6.4	-19.6
02N22W03Q01S	West end	Unknown	yes									-4.4	-3.6
Average change, all wells with records within time period				-10.0	-13.3	-1.6	-6.7	-5.5	-4.7	-9.2	-4.1	-2.4	-2.2

Note: positive values noted in bold

12 APPENDIX


02N22W02K07S_Alta #9
Elevation, ft msl
Temperature, °C
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130
110
90
70
50
30
30
28
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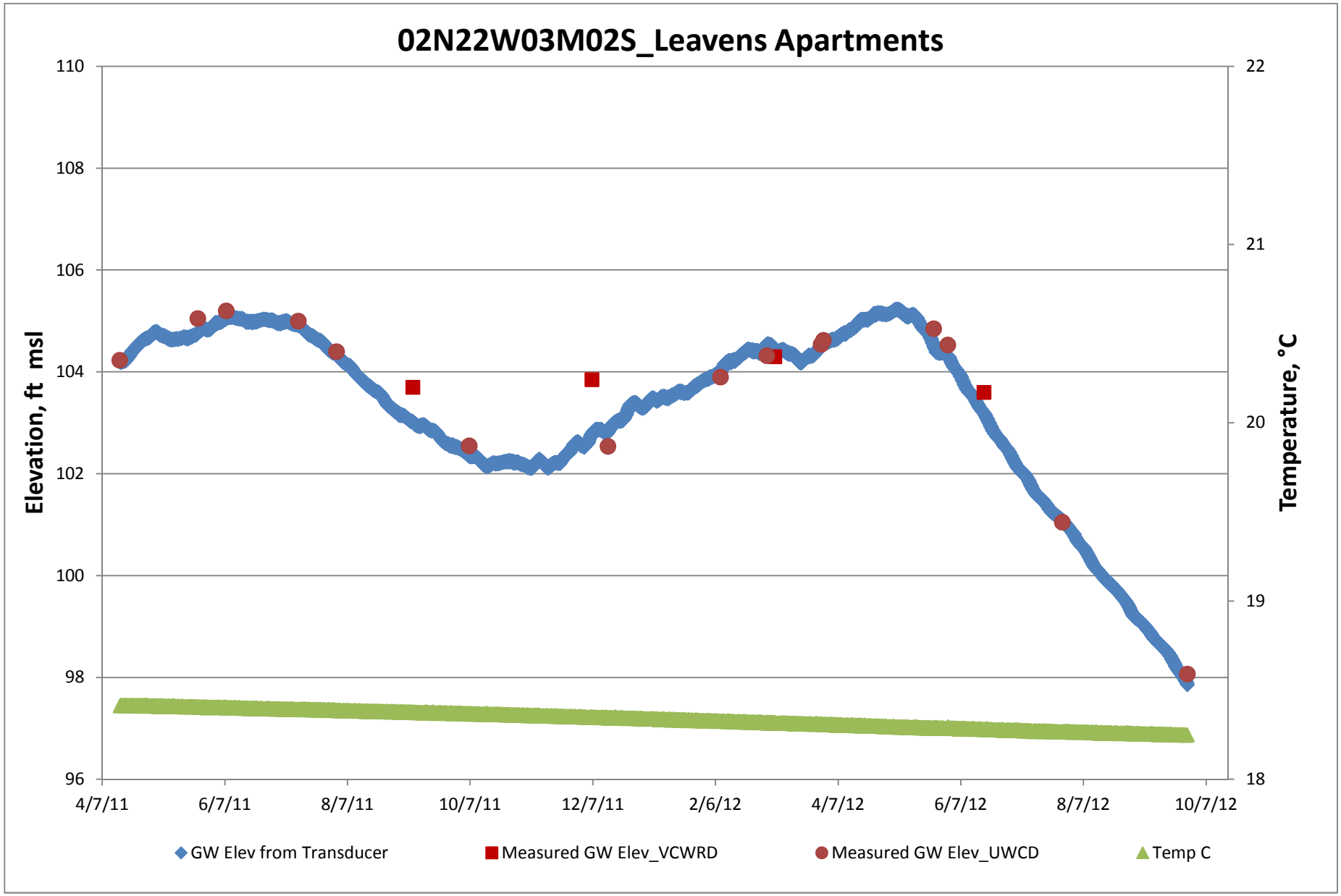
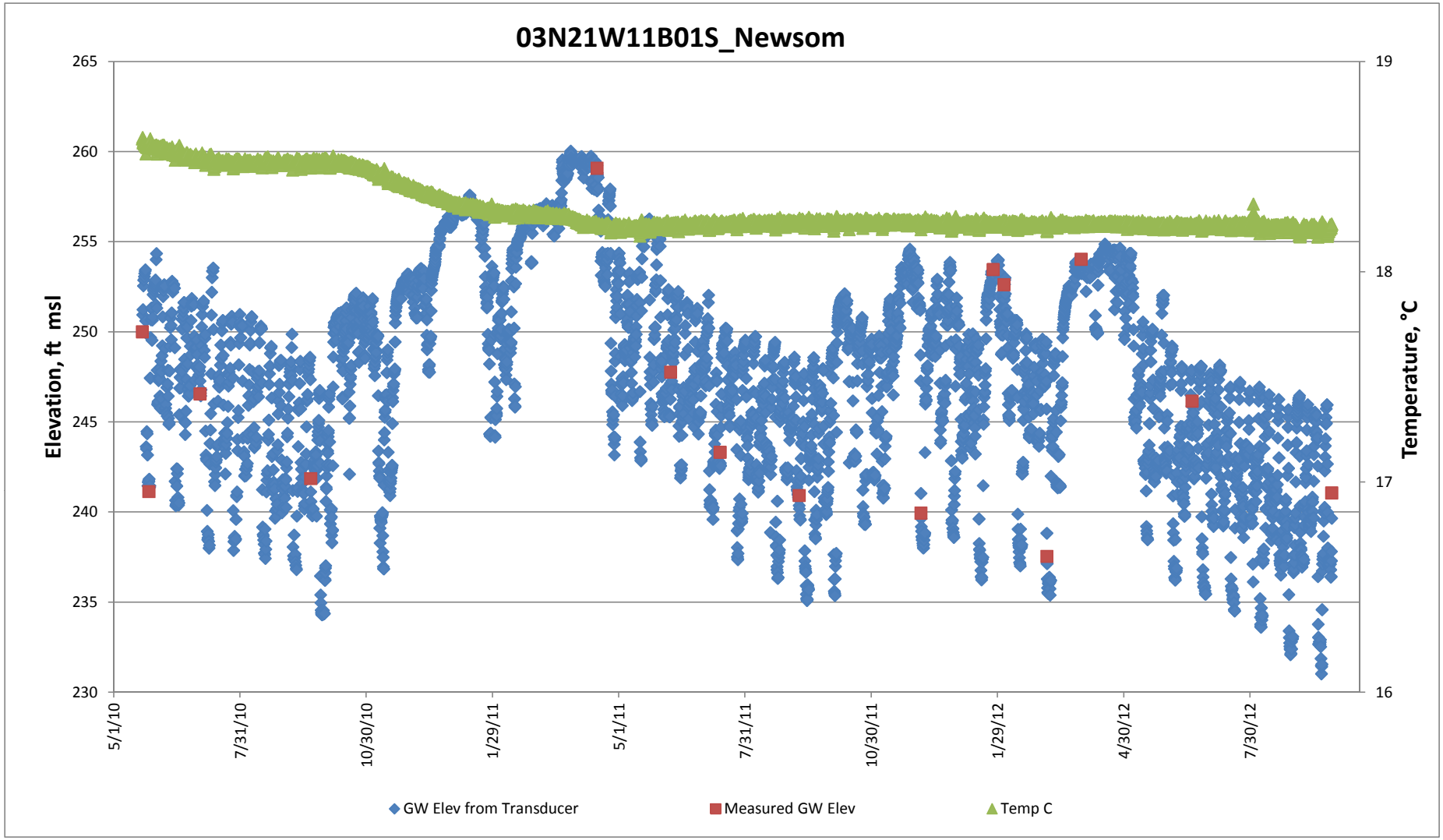
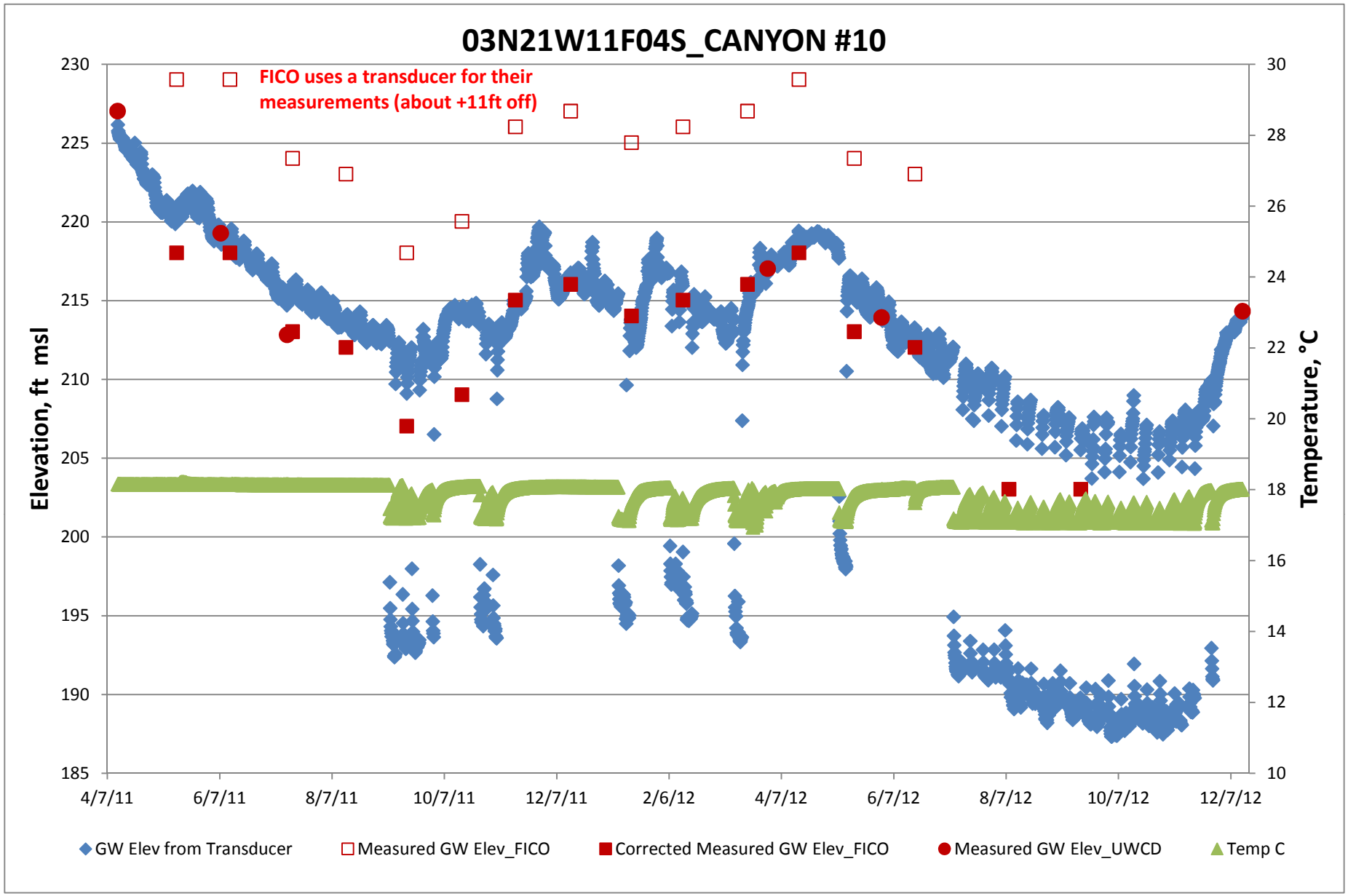
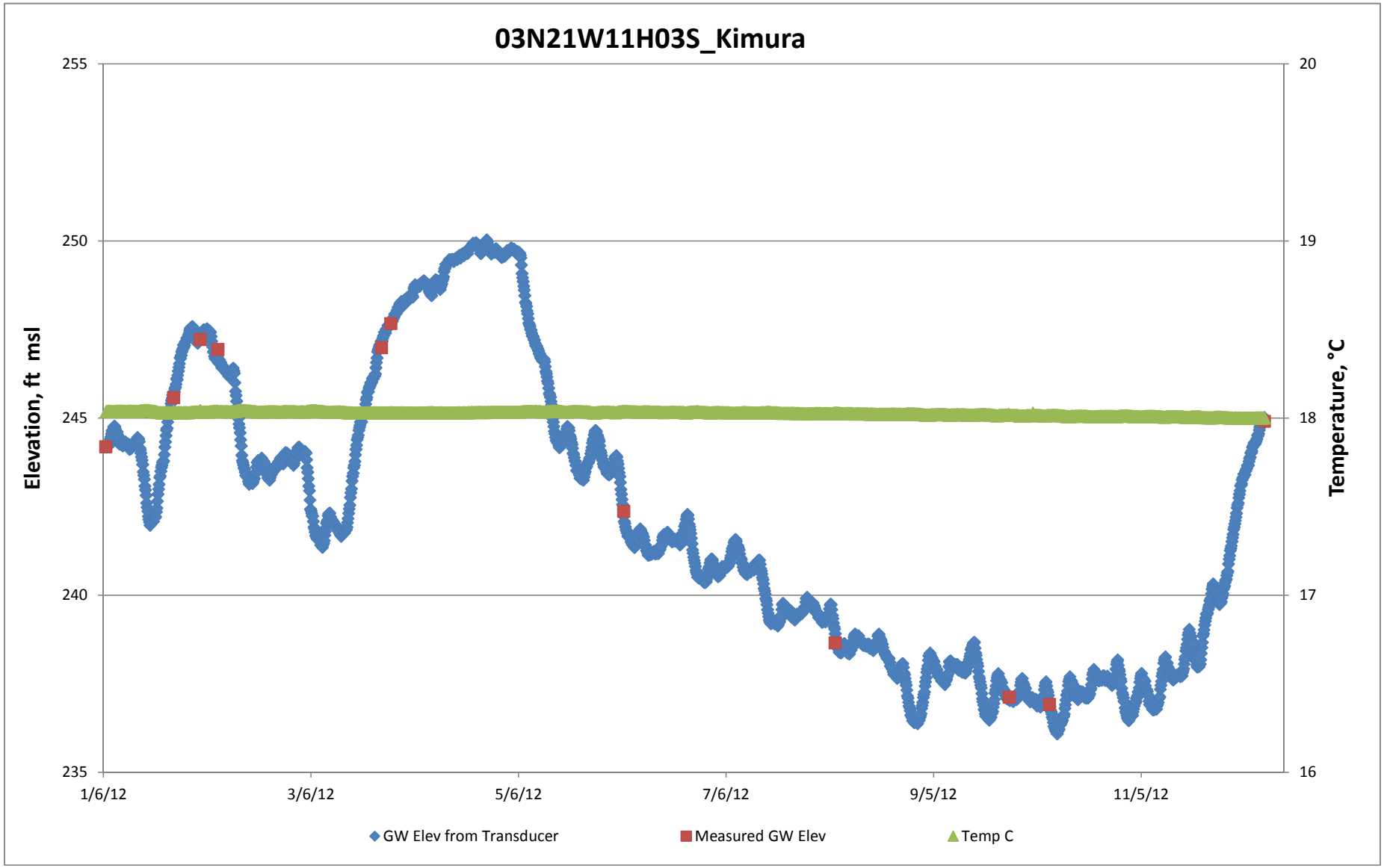
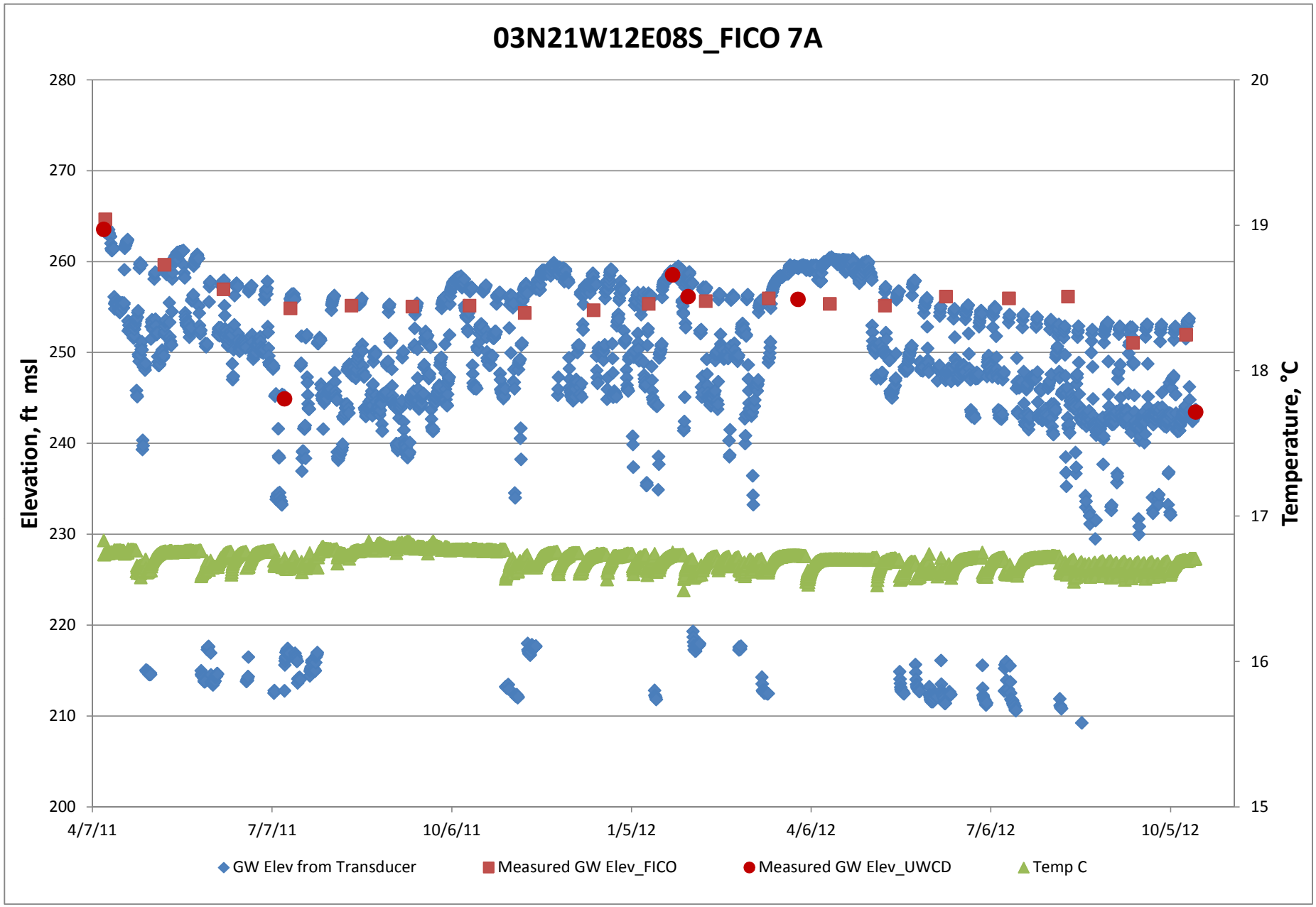
22
20
18
16
14
12
10
4/7/11
6/7/11
8/8/11
10/9/11
12/10/11
2/10/12
4/11/12
6/12/12
8/13/12
10/14/12
12/15/12
2/14/13
4/17/13
New Transducer Installed
Transducer malfunctioned so pulled
Transducer Malfunctioned
Transducer sometimes goes dry when well is pumping
GW Elev from Transducer
Measured GW Elev_Alta MWC
Measured GW Elev_UWCD
Temp C

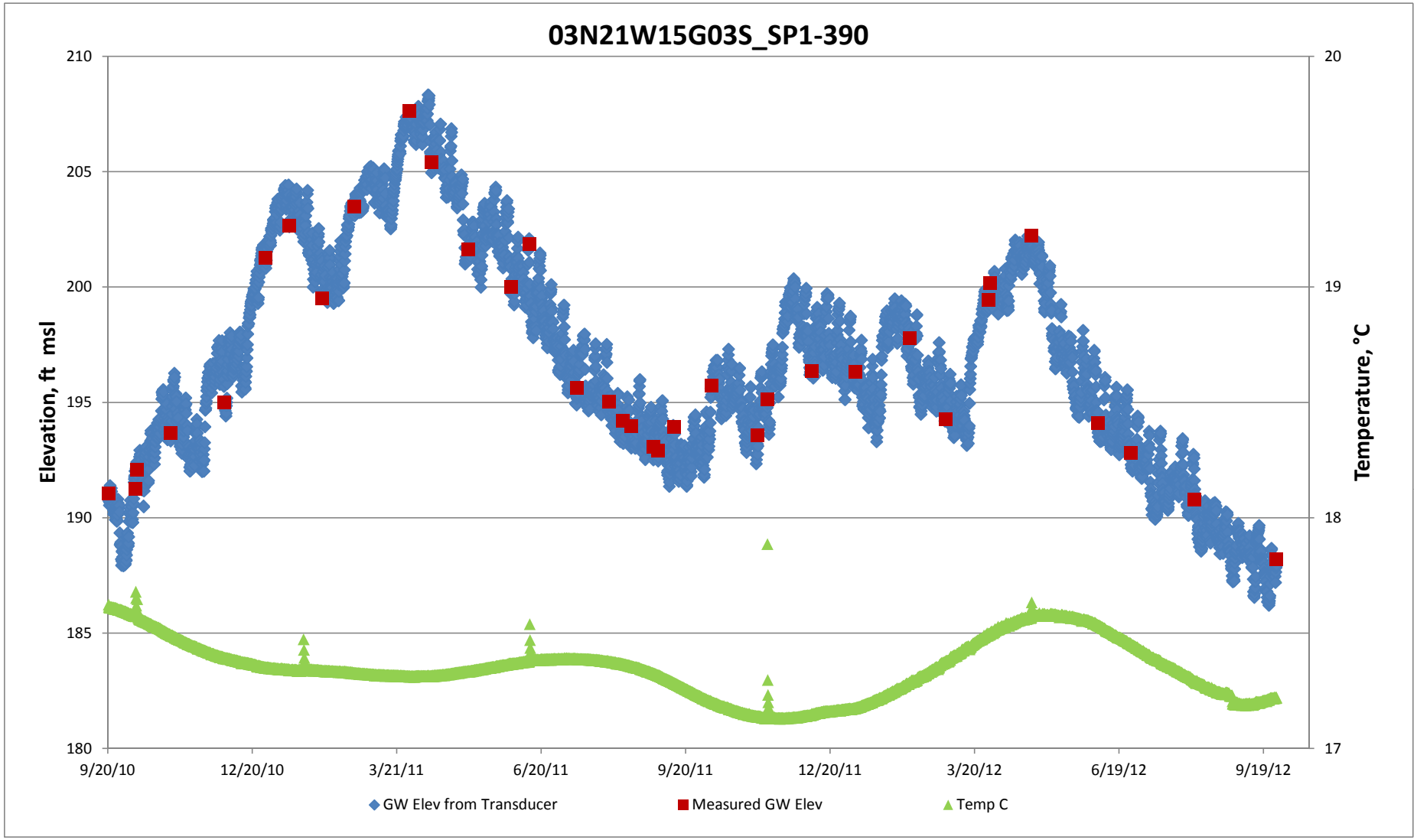

02N22W03M02S_Leavens Apartments
Elevation, ft msl
Temperature, °C
110
108
106
104
102
100
98
96
22
21
20
19
18
4/7/11
6/7/11
8/7/11
10/7/11
12/7/11
2/6/12
4/7/12
6/7/12
8/7/12
10/7/12
GW Elev from Transducer
Measured GW Elev_VCWRD
Measured GW Elev_UWCD
Temp C


03N21W11B01S_Newsom
Elevation, ft msl
Temperature, °C
265
260
255
250
245
240
235
230
19
18
17
16
5/1/10
7/31/10
10/30/10
1/29/11
5/1/11
7/31/11
10/30/11
1/29/12
4/30/12
7/30/12
GW Elev from Transducer
Measured GW Elev
Temp C

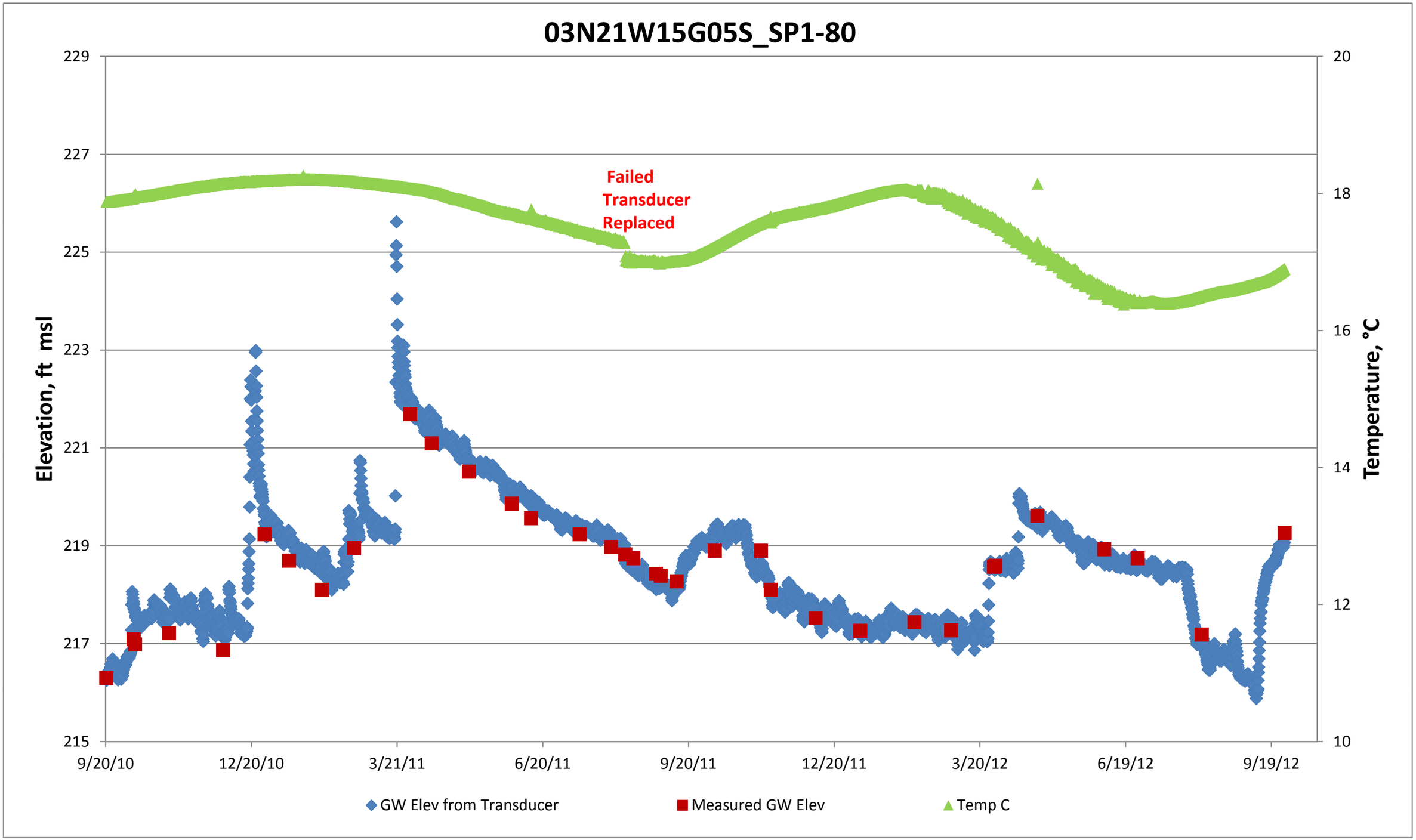

03N21W11F04S_CANYON #10
FICO uses a transducer for their measurements (about +11ft off)
Elevation, ft msl
Temperature, °C
230
225
220
215
210
205
200
195
190
185
30
28
26
24
22
20
18
16
14
12
10
4/7/11
6/7/11
8/7/11
10/7/11
12/7/11
2/6/12
4/7/12
6/7/12
8/7/12
10/7/12
12/7/12
GW Elev from Transducer
Measured GW Elev_FICO
Corrected Measured GW Elev_FICO
Measured GW Elev_UWCD
Temp C

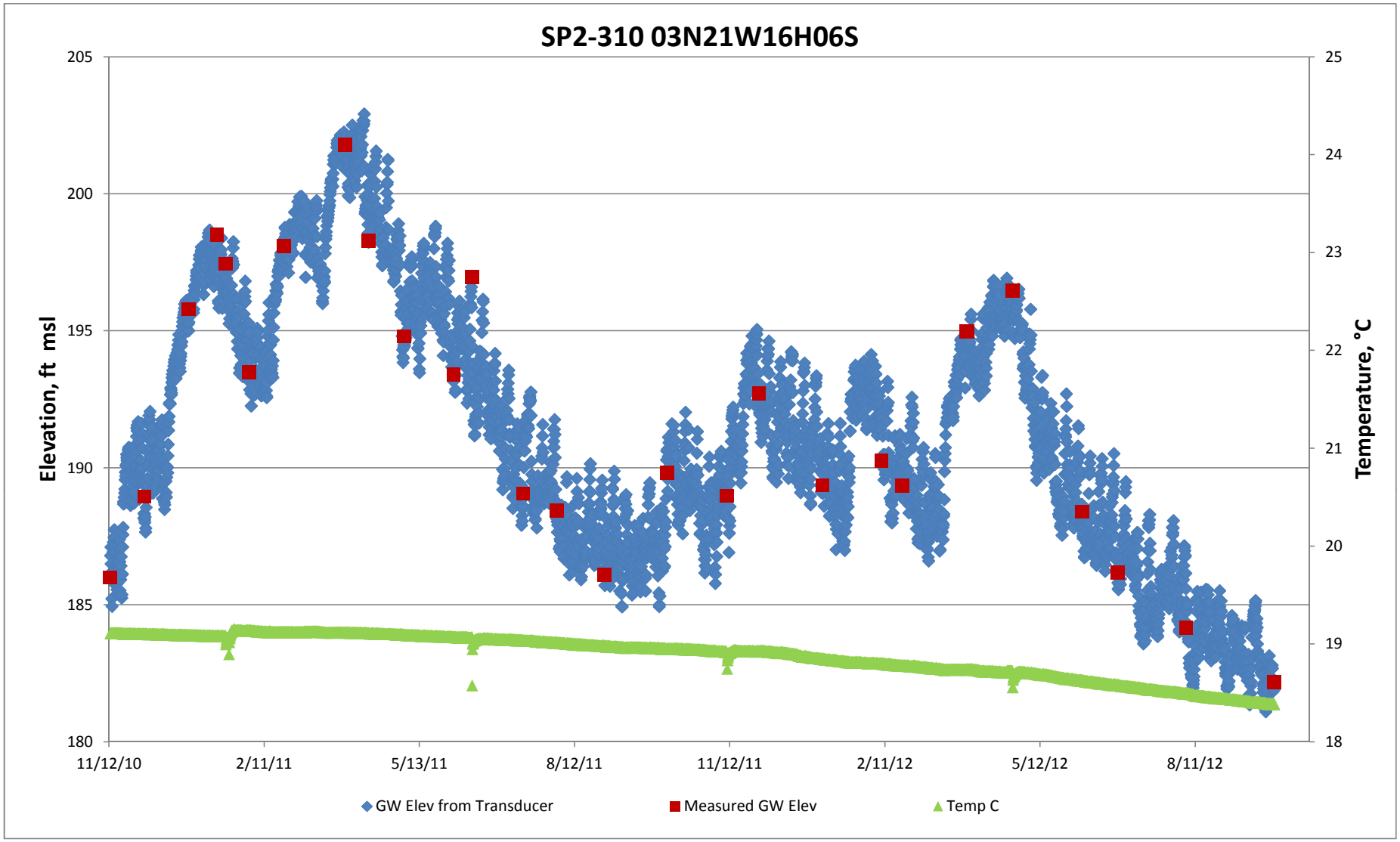

03N21W11H03S_Kimura
Elevation, ft msl
Temperature, °C
255
250
245
240
235
20
19
18
17
16
1/6/12
3/6/12
5/6/12
7/6/12
9/5/12
11/5/12
GW Elev from Transducer
Measured GW Elev
Temp C

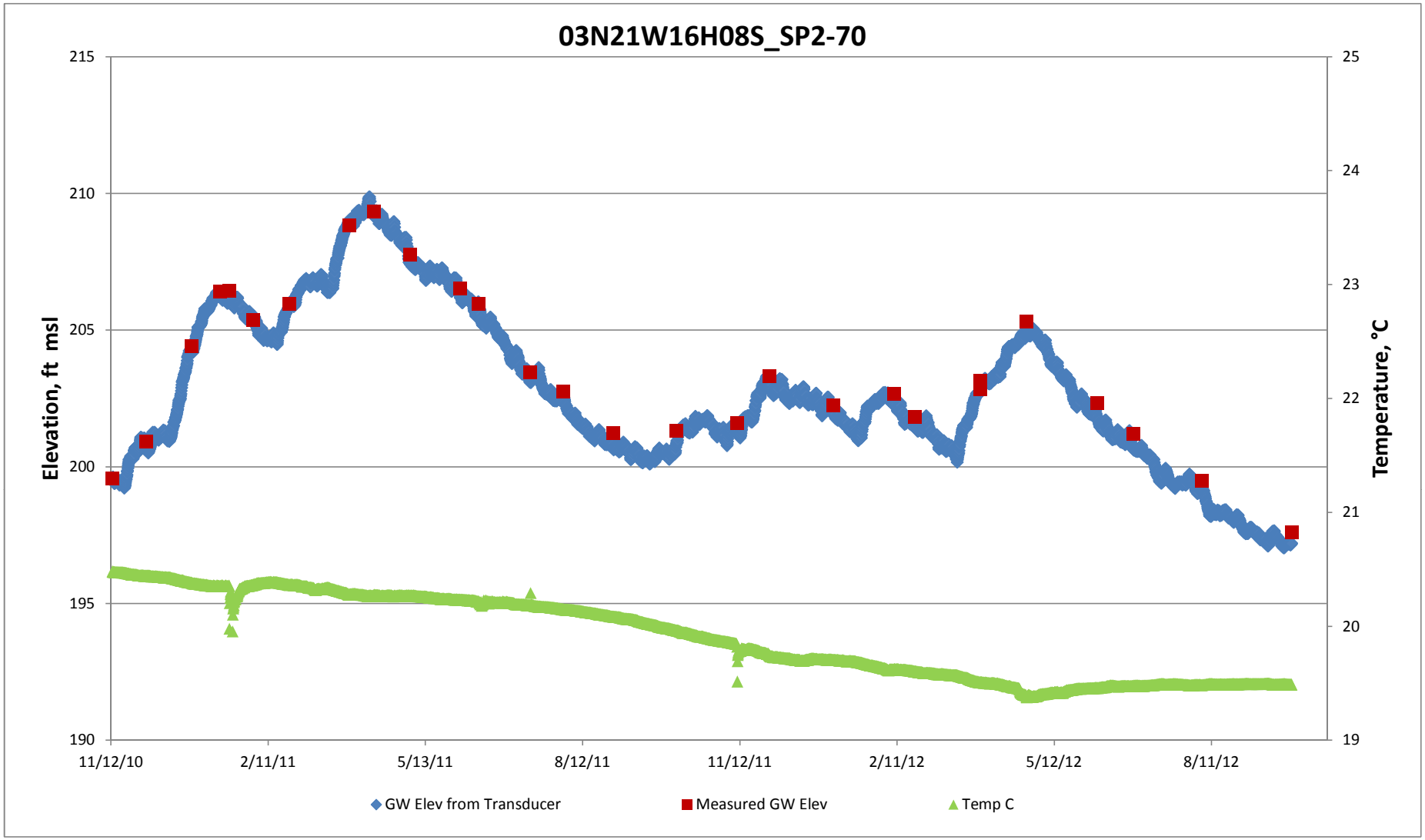

03N21W12E08S_FICO 7A
Elevation, ft msl
Temperature, °C
280
270
260
250
240
230
220
210
200
20
19
18
17
16
15
4/7/11
7/7/11
10/6/11
1/5/12
4/6/12
7/6/12
10/5/12
GW Elev from Transducer
Measured GW Elev_FICO
Measured GW Elev_UWCD
Temp C

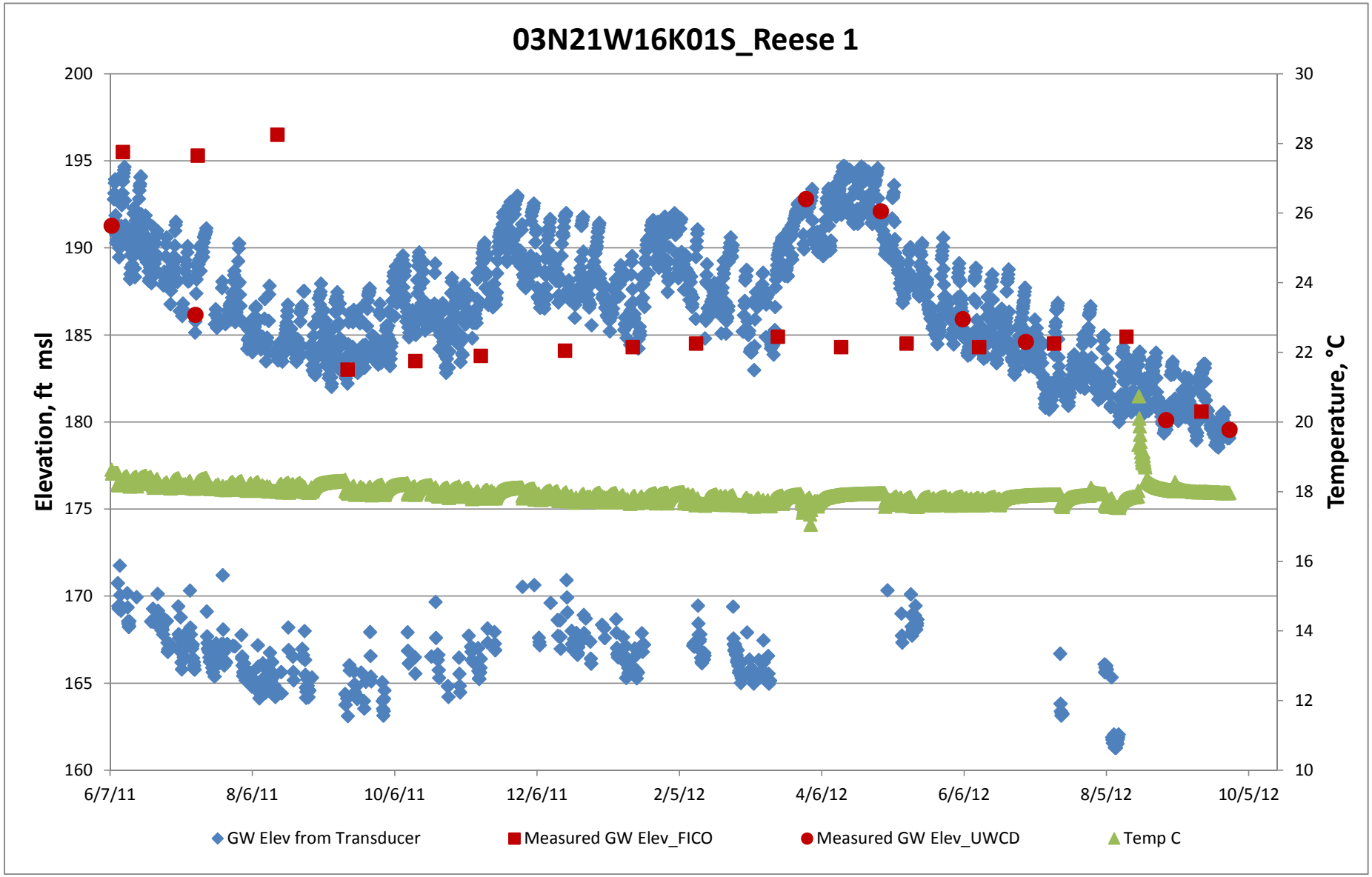

03N21W15G03S_SP1-390
Elevation, ft msl
Temperature, °C
210
205
200
195
190
185
180
20
19
18
17
9/20/10
12/20/10
3/21/11
6/20/11
9/20/11
12/20/11
3/20/12
6/19/12
9/19/12
GW Elev from Transducer
Measured GW Elev
Temp C

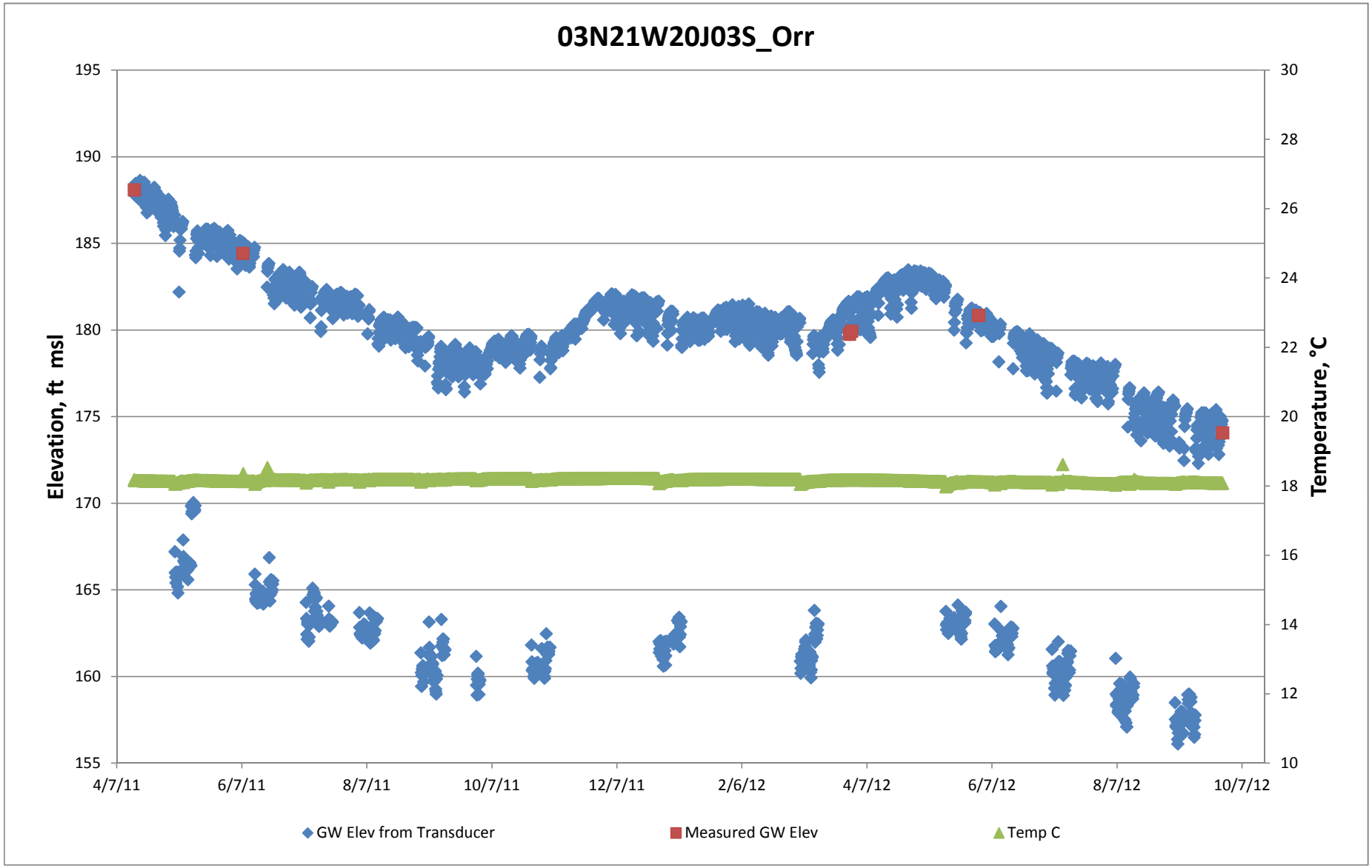
03N21W15G05S_SP1-80

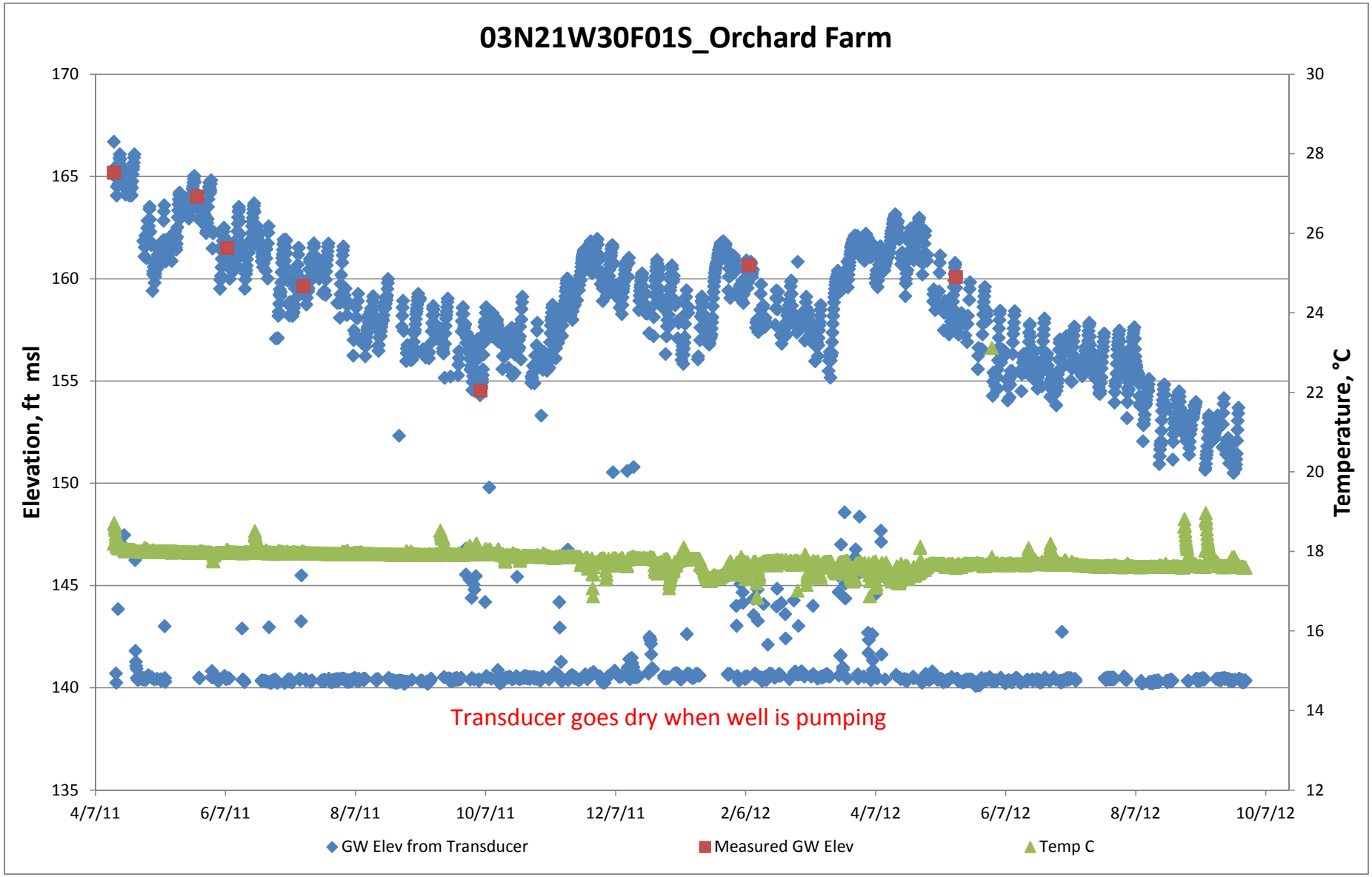


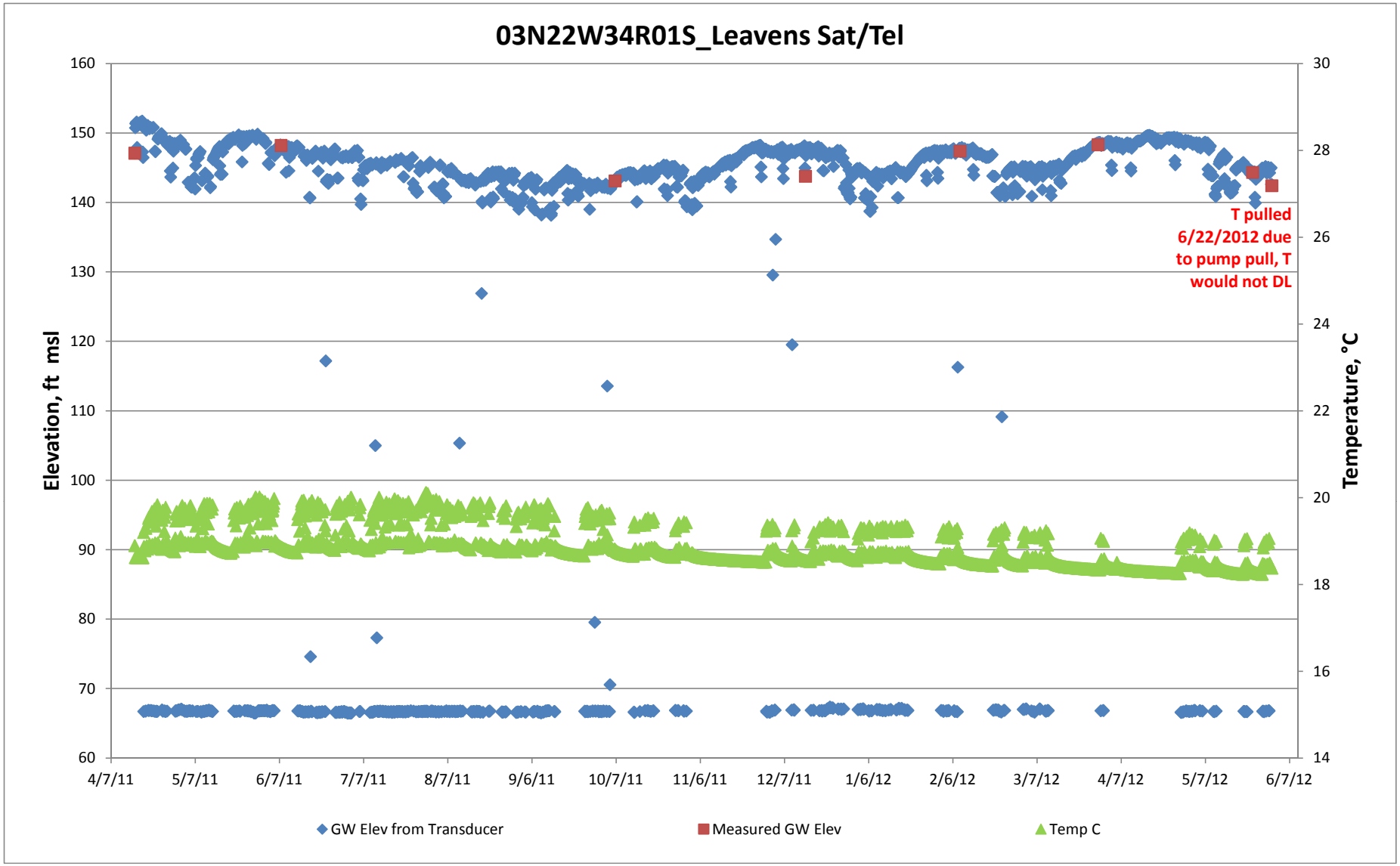

SP2-310 03N21W16H06S
Elevation, ft msl
Temperature, °C
205
200
195
190
185
180
25
24
23
22
21
20
19
18
11/12/10
2/11/11
5/13/11
8/12/11
11/12/11
2/11/12
5/12/12
8/11/12
GW Elev from Transducer
Measured GW Elev
Temp C


03N21W16H08S_SP2-70
Elevation, ft msl
Temperature, °C
215
210
205
200
195
190
25
24
23
22
21
20
19
11/12/10
2/11/11
5/13/11
8/12/11
11/12/11
2/11/12
5/12/12
8/11/12
GW Elev from Transducer
Measured GW Elev
Temp C


03N21W16K01S_Reese 1
Elevation, ft msl
Temperature, °C
200
195
190
185
180
175
170
165
160
30
28
26
24
22
20
18
16
14
12
10
6/7/11
8/6/11
10/6/11
12/6/11
2/5/12
4/6/12
6/6/12
8/5/12
10/5/12
GW Elev from Transducer
Measured GW Elev_FICO
Measured GW Elev_UWCD
Temp C


03N21W20J03S_Orr
Elevation, ft msl
Temperature, °C
195
190
185
180
175
170
165
160
155
30
28
26
24
22
20
18
16
14
12
10
4/7/11
6/7/11
8/7/11
10/7/11
12/7/11
2/6/12
4/7/12
6/7/12
8/7/12
10/7/12
GW Elev from Transducer
Measured GW Elev
Temp C


03N21W30F01S_Orchard Farm
Elevation, ft msl
Temperature, °C
170
165
160
155
150
145
140
135
30
28
26
24
22
20
18
16
14
12
4/7/11
6/7/11
8/7/11
10/7/11
12/7/11
2/6/12
4/7/12
6/7/12
8/7/12
10/7/12
Transducer goes dry when well is pumping
GW Elev from Transducer
Measured GW Elev
Temp C


03N22W34R01S_Leavens Sat/Tel
Elevation, ft msl
Temperature, °C
160
150
140
130
120
110
100
90
80
70
60
30
28
26
24
22
20
18
16
14
4/7/11
5/7/11
6/7/11
7/7/11
8/7/11
9/6/11
10/7/11
11/6/11
12/7/11
1/6/12
2/6/12
3/7/12
4/7/12
5/7/12
6/7/12
T pulled 6/22/2012 due to pump pull, T would not DL
GW Elev from Transducer
Measured GW Elev
Temp C