Arizona Department of Water Resources

Final
Buckeye Waterlogged Area Analysis
Procedures and Recommendation

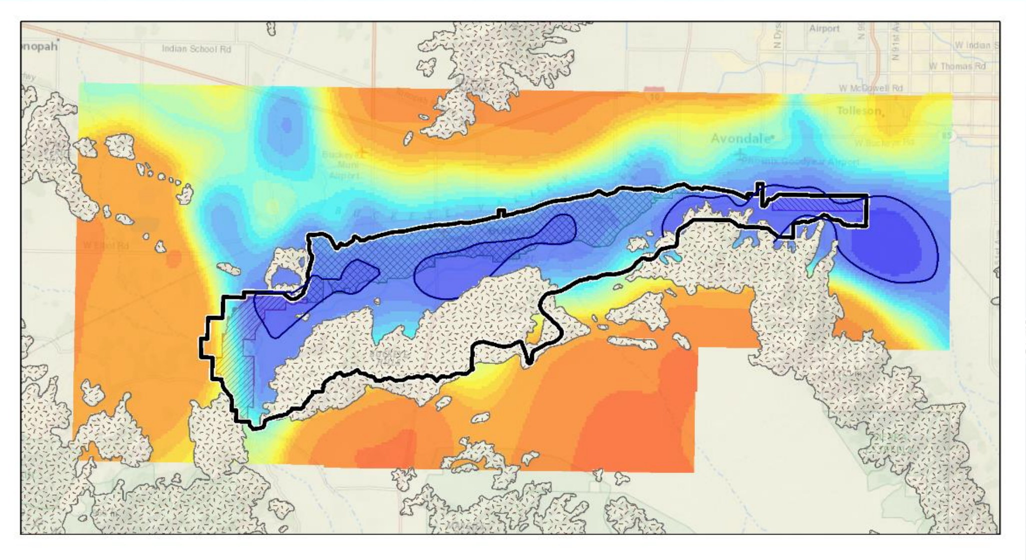

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Table of Contents

List of Tables

List of Figures

List of Appendices

1.0 Objective and Scope

This report documents the Arizona Department of Water Resources' (ADWR) current review of hydrologic conditions in the area commonly known as the Buckeye Water Logged Area (BWLA) pursuant to the statutory requirement in Arizona Revised Statutes (A.R.S.) § 45-411.01(F).

The ADWR Groundwater Modeling Section has conducted an assessment of groundwater conditions in the BWLA from 1986 through 2013. This assessment updates a previous unpublished internal review of the BWLA hydrologic data that was documented in March 2012 (ADWR, 2012). The main objective of this study was to determine whether the shallow groundwater conditions that adversely impacted agricultural practices and other groundwater uses in the area in 1988, when A.R.S. § 45-411.01 was enacted, still exist today.

Figure 1 shows the location of the BWLA within the southwest portion of the Phoenix Active Management Area (AMA), in the vicinity of the City of Buckeye, south of the White Tank Mountains and bounded by the Buckeye Hills to the south. The BWLA covers lands on both sides of the Gila River from near the confluence with the Salt River to Gillespie Dam. The area includes the Buckeye Water Conservation and Drainage District (BWCDD), the Arlington Canal Company (ACC) and the St. John's Irrigation District (SJID) and lands adjacent to those irrigation districts.

The BWLA was established in 1988 by A.R.S. § 45-411.01 **(Appendix A)**. That statute currently provides that until January 1, 2020: (1) lands within the BWLA are exempt from irrigation water duties; (2) BWCDD, SJID and BWCDD are exempt from conservation requirements for the distribution of groundwater; and (3) persons withdrawing groundwater from within the BWLA for an irrigation use within the BWLA are exempt from groundwater withdrawal fees for those withdrawals. The BWLA was created in recognition of unique hydrologic conditions that existed in the area that made the application of normal agricultural conservation goals and methods impractical or inappropriate. This analysis provides a baseline and assesses the changes to the shallow groundwater levels in the area and various stresses that could affect these water levels.

This analysis includes:

- Water Level Elevations and Flow Directions
- Hydrologic Profiles/Hydraulic Gradients
- Depth To Water Maps
- Hydrographs & Transducer Data
- Water Level Change Maps
- Wastewater Treatment Plant Release Information
- Streamgage Data
- Pumping and Drainage Well Activity
- Water Use and Storage Estimates
- Changes in Water Quality Over Time
- Consultations with Irrigation Districts and Field Investigations

1.1 Acknowledgements

The BWLA analysis and report are the result of the assistance and contributions of many individuals and organizations. Special thanks and appreciation goes out to all the well owners in the BWLA who have allowed their wells to be measured over the years. This study would not have been possible without the hard work and dedication of past and present members of the ADWR Field Services Section for collection of water level data, surveying of land surface and installation of automated transducer sites. Special thanks also to Lisa Williams of the ADWR Data Management Section who provided water use information.

The report was compiled by ADWR Hydrology staff Dianne Yunker, Frank Corkhill and Keith Nelson. Reviewers of the report include ADWR staff Jeff Trembly, Jeff Tannler, Andrew Craddock, Doug Dunham, Ken Slowinski and ADWR's director Thomas Buschatzke.

We would also like to thank representatives of each irrigation district and the City of Buckeye who provided consultations and accompanied ADWR staff during field investigations including Ed Gerak of the BWCDD, Gary Gable from the ACC, Robin Maddux and Linda Reitz of SJID and Ron Whitler from the City of Buckeye. Additionally, we wish to extend our thanks to all others who met with us or provided information to ADWR in order to complete this analysis and for the efforts of all those involved in previous investigations mentioned in this report.

2.0 Background

2.1 Summary of Groundwater Conditions

Prior to development, surface water and groundwater flows in the West Salt River Valley (WSRV) groundwater sub-basin were generally directed toward the south, west and southwest, following the general slope of the land surface. West of the confluence of the Salt and Gila Rivers the regional aquifer narrows in width between the White Tank Mountains and the Buckeye Hills. The regional aquifer also generally begins to thin to the west and the Estrella Mountains and Buckeye Hills form a barrier to southerly groundwater flow. Regional groundwater model studies of the Salt River Valley (SRV) by ADWR (Freihoefer and others, 2009) and the Hassayampa sub-basin (Brown and Caldwell, 2006) describe three hydrostratigraphic units underlying the area comprised of an upper alluvial unit (UAU), a middle alluvial unit (MAU) and a lower alluvial unit (LAU), surrounded by mostly impermeable hard rock mountain ranges, assumed to have low transmissivity. Total sediment thickness within the BWLA is estimated to average between 550-580 feet, with greater thicknesses along the northern boundary, and lesser thicknesses south of the Gila River **(Figure 2)**.

This combination of geologic conditions combined with significant converging groundwater flow from the WSRV regional aquifer created shallow groundwater conditions along and near the channel of the Gila River. The naturally occurring shallow groundwater conditions in that area resulted in groundwater discharge along much of the reach of the Gila River from above its confluence with the Salt River to the narrow bedrock constriction at the western end of the Buckeye Hills where the Gila River flows into the Gila Bend groundwater basin. Shallow groundwater conditions also resulted in significant evapotranspiration from riparian vegetation leading to increased salinity in groundwater.

2.2 Previous Investigations

The waterlogged condition and associated high salinity was noted in the Water Development Corporation's March 1983 report *Evaluation of Adequacy and Quality of the Water for the Town of Buckeye, Arizona* (Halpenny, 1983) which states:

> Buckeye is situated close to the "cork in the bottle" at the downstream end of the Salt River Valley. There is a narrows on the Gila River at the site of Gillespie Dam, about 18 miles downstream from Buckeye. The natural gradient of groundwater in the Salt River Valley is toward this narrows. The narrows constricts the natural down gradient movement of groundwater, and this results in shallow water table in the vicinity of Buckeye and Arlington (near Gillespie Dam), further aggravated by construction of Gillespie Dam in the early 1920s. The groundwater in the vicinity of the Buckeye and Arlington is more highly mineralized than in most of the Salt River.

A comprehensive report was prepared for ADWR in 1988 entitled *Study of Waterlogging Problems in the West Salt River and Hassayampa Sub-Basins of the Phoenix Active Management Area (*Errol L. Montgomery and Associates, 1988). The study evaluated hydrologic conditions and the effects on crop production and the causes of drainage and salinity problems, which led to the enactment of A.R.S. § 45-411.01 in 1988 and the establishment of the BWLA and associated exemptions. As originally enacted, A.R.S. § 45-411.01 provided that the exemptions applied through 2009 and required the director of ADWR to review the hydrologic conditions within the BWLA and submit a recommendation to the governor, the president of the senate and the speaker of the house of representatives no later than December 15, 2005 regarding extending the exemptions. In 2000, Montgomery and Associates prepared a follow up report for the BWCDD to document the continued existence of the waterlogged condition (Errol L. Montgomery and Associates, 2000). Following that report, the legislature amended A.R.S. § 45-411.01 in 2001 to extend the exemptions until the end of 2019 and require the director to review the hydrologic conditions within the BWLA and submit a recommendation to the governor, the president of the senate and the speaker of the house of representatives no later than December 15, 2015 regarding extending the exemptions. The current analysis is intended to help determine if the area is still in a waterlogged state and make a recommendation on whether the current exemptions should be extended beyond 2019.

3.0 Groundwater Levels

3.1 Elevations & Flow Directions

Groundwater levels measured in wells were a major source of data used to assess hydrologic conditions in the BWLA. Water level elevations in the general vicinity were evaluated and contours were drawn to assess how groundwater conditions have changed with time. During most years, ADWR measures groundwater levels in several strategically located "index" wells that generally have long histories of water level measurement. However, water level elevation data were also obtained from ADWR's groundwater site inventory (GWSI) database for years when "basin sweeps" was conducted. During basin sweeps, ADWR's Field Services Unit measures as many wells as possible in a single basin during the winter months (November – March) when pumping rates are lowest. From 1986 to 2013 basin sweeps occurred approximately every five years in the Phoenix AMA (1986, 1991, 1997, 2002 2008 and 2013). The additional data obtained during basin sweeps provide for a more detailed water level map. **Figures 3 and**

4 show water level elevation contours and flow direction in 1986 and 2013, respectively, in the vicinity of the BWLA. Computer generated contour lines were used as a guide in the drawing of final contour lines. The general pattern of groundwater flow is very similar in both years with groundwater flowing into the BWLA from the east along the Salt/Gila River corridor and from the north along the Hassayampa River corridor.

3.2 Hydrologic Profiles

Hydrologic profiles along several cross sections were created using digital elevation model (DEM) based land surface elevation data and the underlying groundwater elevations for sweep years to obtain hydraulic gradients and visualize time-varying shallow groundwater conditions underlying the BWLA. The groundwater elevation surfaces are based on both point measurements and interpolated contour lines. The locations of the cross sections are shown on **Figure 5** with 2013 aerial imagery from the National Agriculture Imagery Program (NAIP). Eight cross sections extend from the north bank to the south bank of the Gila River and pass through portions of the waterlogged area. Each cross section begins at an upgradient well location and passes through one or more additional well locations in order to better observe gradients over time. Locations were also selected using automated water level sites at one or both ends, where available.

Two additional longitudinal cross sections extend through the entire length of the BWLA. N-N' is on the north side of the Gila River and passes through the BWCDD and the north side of the ACC and S-S' is located south of the Gila and crosses through the SJID and the southern part of the ACC. The cross sections are provided as **Figures 6 through 15.**

The cross sections indicate shallow water conditions underlying the delineated waterlogged area in most years between 1986 and 2013, with water level elevations fluctuating within a 20 to 40 foot range in that period. Along most cross sections, the depth to water has increased slightly (gotten deeper) whereas the water level declines in the areas north of the BWLA boundary are far more pronounced. For example, along the A-A' and B-B' cross sections, water levels dropped 20 to 30 feet north of the BWLA but decreased only slightly inside the BWLA. Along C-C' and D-D' water levels declined about 15 to 20 feet outside the BWLA but the changes in water levels between years becomes smaller closer to the Gila River. Water levels were stable along the E-E' cross section line most years. Interpolated water level contours indicate increases in the water table and gaining stream conditions along the F-F' cross section line. The G-G' cross section line indicates relatively stable conditions. Cross Section H-H' which extends through the Gillespie Dam southeast into the Gila River valley shows that south of the BWLA, water levels have dropped 100 to 150 feet between 1986 and 2013 while levels inside the BWLA have dropped 20 to 30 feet along that same line. Groundwater level declines in the general area of the ACC may be due to regional and local groundwater withdrawals and also due to the breaching of Gillespie Dam in 1993 that served as a significant barrier to groundwater flow. The longitudinal cross sections N-N' and S-S' confirm the ongoing shallow water conditions within the BWLA.

3.3 Depths to Water

Because the issue of waterlogging is a question of depth to water from the ground surface, that data was analyzed in greater detail, again using the information from the sweep years. Water levels collected in sweep years occur during the winter months when pumping rates are at their lowest, typically November – March.

Utilizing depth to water data from the GWSI database, and filtering for data collected in the winter season when groundwater pumping is reduced, an interpolated depth to water surface was created for each sweep year and 20 foot contours were computer generated. Those contours were used as a guide in the preparation of the final depth to water maps that are shown in **Figures 16 through 21**. The amount of data available varied greatly from one time period to the next.

Using only contour maps it can be difficult to discern the difference from one year to the next. Therefore, the contours were converted into a color surface for easier analysis. The final depth to water contours and depth to water data points were converted back into contiguous raster surfaces and clipped to those townships containing or directly adjacent to the BWLA, excluding areas of hard rock outcrops (Townships 2 South to 1 North, Ranges 6 West to 1 East) which are shown in **Figure 22.**

The results of this analysis show an area of shallow groundwater, less than 20 feet below land surface (BLS), within the BWLA in all sweep years, varying in spatial extent. The size and shape of the shallow zone varies but it has typically gotten smaller and mean depth to water has increased slightly.

3.4 Hydrographs

A total of 27 hydrographs from wells within the BWLA were produced using water level information from the Groundwater Site Inventory (GWSI) database. Locations were selected based on having the most useable (non-remarked) water level data, or for having been measured within the last two years. Several locations are included because they are located along the hydrologic-cross sections and others were included to assure a good spatial distribution within the BWLA **(Figure 23).**

Hydrographs are provided as **Figures 24 through 50** for the selected wells. Periods of record for these wells and changes in water levels since 1986 are summarized in **Table 1**.

Water level elevations in these 27 wells fall between just under 700 feet to nearly 900 feet above mean sea level with historic depths to water ranging from 3.8 feet BLS at C-01-03 08CBD in 1982 to over 200 feet BLS at B-01-02 16BBB in 1971. Most wells that have been measured since the 1940s and 1950s have their maximum depth to water occurring in the mid-1960s to 1970. The minimum depth to water observed occurred in the 1980s and 90s in most of these wells, however there are three wells for which the minimum water depth occurred much earlier and two where it occurred in 2010.

Figures 51 and 52 show water level elevations and depths to water from 1986 to present in 16 hydrograph locations that are inside the BWLA. The trend shows a very slight decrease in water level elevations (Figure 51) or increased depth to water (Figure 52) over the time period averaging -0.52 feet per year. The water table became deeper in 13 of the 16 wells and shallower in the other three. The maximum drop of 66.50 feet over 28 years occurred at C-01-05 28AAB (Figure 42) located in the northernmost part of the ACC area. Water levels in C-01-03 08CBD, located in the center of the BWLA, rose but only by 0.10 foot in 27 years (Figure 36). Water levels observed in C-01-04 07BDD (Figure 39) rose only three feet in 27 years. The only location showing a significant rise in water level since the establishment of the BWLA was well C-02-05 08BCA (Figure 47) where the water table became 7.31 feet shallower between 1986 and 1997 (11 years). There have been no measurements in that well since 1997 so it is not known if the upward trend continued.

3.4.1 Automated Groundwater Monitoring Sites

In addition to conventional techniques for groundwater level collection, ADWR now employs the use of automated groundwater level measuring sites using pressure transducers and shaft encoders that measure water levels 4 times daily and store the data electronically. More frequent water level measurements can better track changes to the aquifer including seasonal variations, and the effects of evapotranspiration and flood recharge pulses as well as relations to other hydrologic monitoring information such as precipitation, stream flow and water use.

Stored water levels data are retrieved quarterly at all sites and in some cases data are available in near real-time via satellite telemetry. At this time there are about 126 sites statewide with more planned as funding and resources are available. About 80 of those sites are equipped with radios that transmit data daily.

Three wells within the BWLA were equipped with automated groundwater monitoring devices in the fall of 2013. BWLA Cotton Lane is located in Section 35 of Township 1 North, Range 2 East at the eastern end of the BWCDD. BWLA Jackrabbit is located in Section 8 of Township 1 South, Range 2 West just south of the Gila River, and Robbins Butte is located in Section 27 of Township 1 South, Range 4 East, also south of the Gila. Each of these sites is located along one of the topographic cross-sections described in Section 2.2 of this report. A-A’ passed through the Cotton Lane site, B-B’ passed through the Jackrabbit site and D-D’ terminates at the Robbins Butte site.

Automated water level monitoring wells are selected based on well and screen depth, location and well use. Unused, non-equipped, un-pumped, and easily accessible wells that are likely to remain inactive over the long term are preferred. In addition to the three automated sites currently in the BWLA, ADWR recently installed a fourth transducer in a monitor well south of the City of Buckeye Waste Water Treatment Facility in Section 8 of Township 1 South, Range 3 East (Registry number 55-578927). **Figure 53** shows the location of the existing and newly installed automated groundwater monitoring sites in and around the BWLA. **Figures 54, 55 and 56** are photographs of the Cotton Lane, Jackrabbit and Robins Butte sites and **Figure 57** is a photograph of the equipment at one of the sites.

Figures 58, 59 and 60 are automated water level hydrographs from the locations as presented on the ADWR GWSI Website. Automated water level data at the Cotton Lane and Jackrabbit sites begin on 10/9/13 and the Robbins Butte location begins on 11/26/13. The Cotton Lane site and the new site (Buckeye WWTP) are not on telemetry but the others are. The data from the telemetry sites are marked “unverified” until the site is physically visited and the data are downloaded. The water level is checked manually at that point to make sure the transducer is reading the correct water level. Downloaded data are then considered verified. Verified data are colored blue and unverified data area colored red. Manual water levels used to check the accuracy of the automated measurements are shown as green circles in Figure 58, 59, and 60.

3.5 Water level Change 1986-2013

Sixty-eight wells in the vicinity of the BWLA were measured in both the 1986 and 2013 sweeps and provide a comparative analysis of water level trends in that time period. **Figure 61** shows both positive (blue = shallower) and negative (red = deeper) water level changes observed at specific well sites. Water level change data are also provided in **Table 2**. There are only four wells that were measured during both sweeps inside the BWLA, and the depth to water increased at all four locations, ranging from 1 to 39.3 feet deeper.

4.0 Surface Water and Effluent

The BWLA is located along the Gila River in the southwest portion of the Phoenix AMA, with the confluence of the Salt and Gila Rivers near its east end. The Agua Fria River, the Hassayampa River and Centennial Wash all drain into the Gila River within the BWLA. The Santa Cruz River drains into the Gila River in Pinal County before the Gila continues into the Phoenix AMA and flows westward.

Surface water inflow into the BWLA comes from storm runoff along major and minor drainages plus occasional large releases of water stored in reservoirs along the Salt, Verde, and Gila and Agua Fria Rivers. Additionally, large volumes of treated effluent from wastewater treatment plants located upgradient and within the BWLA also contribute to surface flow in the area. Some tail water from irrigation upstream of the BWLA also contributes to surface water inflow into the area. These surface water inflows are significant contributors to waterlogged and shallow groundwater conditions in the BWLA.

Surface water and effluent provide an additional supply to users within the BWLA. There are numerous surface water filings (rights and claims) with points of diversion and places of use located within the BWLA boundary. The BWCDD indicated that it holds surface water rights under the 1917 Benson-Allison Decree (Superior Court of Maricopa County, State of Arizona, 1917).

4.1 Wastewater Treatment Plant Releases

There are several wastewater treatment plants (WWTPs) in and around the waterlogged area. The City of Phoenix 91st Avenue WWTP is located just over a mile east of the BWLA and is the largest in Maricopa County. The City of Phoenix 23rd Ave WWTP is also located along the Salt River approximately nine miles east of the BWLA. Both of the City of Phoenix plants process waste water as part of a multi-city partnership known as the Sub-regional Operating Group (SROG) consisting of Phoenix, Glendale, Tempe, Mesa, Scottsdale and Youngtown. There are two small plants within the BWLA including the City of Buckeye's Central WWTP and the City of Goodyear's Corgett Wash WRF. Four others located immediately north of the BWLA are the City of Buckeye's Sundance Water Reclamation Facility (WRF), Tolleson WWTP, the Avondale WWTP and Goodyear's main 157th Ave WWTP **(Figure 62).** Some of the effluent generated is discharged into stream channels or canals within the BWLA, and some of the effluent is discharged into stream channels or canals outside of the BWLA that flow into the BWLA. Much of the effluent is diverted for irrigation of crop lands and to help leach salt from the root zones. The remainder is delivered or exchanged for reuse or recharge outside of the BWLA.

Table 3 provides summary information on these eight plants including ADWR service area numbers, plant names and addresses, years of operation, current capacities and average treatment volumes plus 2013 reported or estimated volumes generated with destinations of the treated wastewater by volumes and percentages. Those percentages are also reflected on the pie charts shown in **Figure 62**. The vast majority (>85%) of effluent generated near the Buckeye Waterlogged Area comes from the City of Phoenix plants, as illustrated in **Figure 63,** which provides the 2013 effluent destinations for the plants from each city. **Table 4** Provides annual volumes generated, delivered or exchanged and discharged for these plants as reported to ADWR on their annual reports. The information from City of Phoenix extends back to 1996 but for most of the other plants, the information only goes back as far as it was available in the Registry of Grandfathered Rights (RoGR) database or provided by plant contact. Several of the plants have been expanded to increase capacity over the years.

In 2010, the City of Phoenix completed construction of the Tres Rios Wetlands Project, a 7-mile long, 1,500 acre area located along the Salt and Gila Rivers which begins just west of the 91st Ave WWTP and extends into the BWLA. ADWR does not have estimates of the water demand of the Tres Rios wetlands, but the maximum allowable consumptive use was listed as 28,000 AFA (25 MGD) in a workshop report published early in the construction phase (WASS Gerke and Associates, Inc., 2003). In 2013 the two City of Phoenix plants generated a combined total of 187,025 AF of effluent with 35% going to Palo Verde, and 16% going to RID. The rest is discharged into the Salt River where some is consumptively used by Tres Rios and a minimum 20,000 AF (11% of the total) is diverted into the BWCDD through the Buckeye Canal. In most years, BWCDD diverts more than the minimum 20,000 AF listed in the 2010 agreement with the SROG cities (BWCDD, 2010) which began in 2011 and will continue through 2015. According to the BWCDD, a total of 71,832 acre-feet of water was diverted from the river in 2013.

4.2 Streamgage Data

Because the Gila River traverses the length of the BWLA, the duration and volumes of surface water flow were also analyzed to gain insight into the hydraulic connection between the groundwater and surface water systems. These data were used to discern possible correlations / relationships between the surface water flows and the water table. **Figure 64** shows the location of 10 USGS Stream gages in the vicinity of the BWLA. Three of the 10 are no longer actively measured, but still offer many years of useful data during the study period. **Figures 65 through 74** show USGS website generated graphs of the daily mean discharge in cubic feet per second (CFS) recorded at each gage from 1986 to present, or the last date recorded.

Figure 75 shows data for gages on the Gila River at Estrella Parkway near Goodyear (09514100) within the narrow eastern portion of the BWLA, on the Gila River leaving the BWLA below Gillespie Dam (09519500) and on the Hassayampa River near Arlington just on the northern BWLA boundary (09517000). Since the designation of the BWLA in 1988, significant flood events occurred in 1993, 1995, 2005 and 2010. **Table 5** provides the peak daily mean stream flow at all 10 gages in those flood years with the dates within each flood year and location where the flow reached that level.

A comparison of flood events with the depth to water maps and well hydrographs indicates that in some locations, groundwater levels increase following major flood events. This is especially true in locations downstream from the BWLA (see hydrograph Figures 49 and 50) where increases were observed in the early 1990s and shortly after the 2005 and 2010 floods. Within the BWLA occasional flood recharge likely occurs, but long-term effects on water levels are less clear. The water table continued to decline between 1991 and 1997 despite the occurrence of a major flood in 1993. However, the flood of 1993 caused the breach of the Gillespie Dam, which has since altered the hydrology of the entire area. Prior to the breach, the dam contributed to shallow groundwater conditions by constricting both the surface water and groundwater outlets of the Hassayampa sub-basin. During the period from 2002 to 2013, the area where groundwater was less than 20 feet BLS decreased and depth to water increased within the BWLA despite the probable addition of significant flood recharge in 2005 and 2010. Since the creation of the BWLA, pumping has increased significantly and losses due to evapotranspiration of riparian vegetation may be offsetting the potential impact of those flood events. It should be noted that although the available annual index well measurements showed little or no effect from flood events it is likely that some recharge occurred. ADWR believes that the new automated sites will provide improved information concerning flood recharge during future events.

5.0 Pumping and Drainage Data

5.1 BWLA and Surrounding Area Pumping

The volume and distribution of groundwater pumping in the area reported for 1986-2013 was analyzed to evaluate the effects on groundwater levels within the BWLA. ADWR's Registry of Grandfathered Rights (RoGR) database was queried for 19 townships that cover or are immediately adjacent to the BWLA (1 North to 2 South, Ranges 6 West to 1 East, excluding Township 2 South, Ranges 1 East and 1 West). Pumping volumes are reported to ADWR and usually estimated based on the power consumed by the pumps, instead of totalizer meters, which may be more accurate but are less common. **Figure 76** shows the spatial distribution, quantities and types of pumping. The RoGR database classifies pumping by numerous "Right Types." These Right Types were placed into five categories: dewatering, drainage, municipal, industrial (dairies, flood control, mineral extraction, hydrologic testing, etc.) and irrigation pumping. Drainage refers to water pumping for the drainage of irrigated lands under the authority of a drainage water withdrawal permit; the volume of water pumped to dewater the BWLA is included in this category. The dewatering category covers water pumped to dewater for mining or temporary construction; much of this pumping occurred in the vicinity of the City of Phoenix 91st Avenue Waste Water Treatment Plant

A breakdown of the type of pumping for each category per year within the entire search area is shown in **Figure 77.** Volumes and percentages of those data are provided in **Table 6.** Within the entire area over the past 28 years, the vast majority of the pumping activity (>60%) has been for irrigation, averaging 154,560 acre feet per year. Drainage pumping occurs only within the BWCDD portion inside the BWLA and averages 24,184 acre feet per year. It represents over 11% of the pumping in the search area and over 28% within the waterlogged area. In recent years the volumes and proportions of the pumping for municipal and industrial uses have both increased. For example, in 1986 only 6,000 acre-feet (2.63%) of the groundwater pumped was for municipal purposes and only 7,803 acre feet (4.02%) was used for industrial purposes. In 2013, the municipal portion had increased to 20,460 acre feet (8.33%) and the industrial portion to 23,029 (9.38%).

5.2 BWLA and Surrounding Area Pumping

Figure 78 and **Table 7** provide a breakdown by pumping category per year inside the BWLA area only. Pumping inside the BWLA has more than doubled in 28 years. Irrigation pumping increased from about 30,000 acre-feet per year to 100,000 acre feet per year in recent years. BWCDD is pumping more groundwater since the construction of the Palo Verde Nuclear Generating Station, which has gradually increased effluent use and currently diverts about 70,000 AFA of effluent that had previously been used by the irrigation districts. The total acreage cropped has remained about the same in the range of 17,000-18,500 acres but there has been an increase in the practice of multi-cropping in recent years, demanding more water. Also, in recent years the ACC has relied more on groundwater. Drainage activity has continued at a relatively steady rate and there has only been minimal pumping inside the waterlogged area for municipal, industrial or dewatering purposes. Most of the BWLA is covered by the BWCDD where almost 80% of the pumping occurs. Only about 5% and 1% of the pumping in the waterlogged area occurs in the ACC and the SJID, respectively, while the remaining 14.7% occurs on non-irrigation district lands within the waterlogged area.

5.3 Arlington Canal Company Pumping

Figures 79 and 80 provide annual pumping volumes and map locations of wells that have reported pumping within the ACC, in addition to one ACC well that is located in the BWCDD boundary. **Table 8** lists pumping within the ACC boundary, including pumping by others, and the total ACC pumping, including pumping from the ACC off-site well, from 1986-2013 by pumping category. Note that pumping by the ACC inside district boundaries is listed under both headings. In the early years of the waterlogged designation, the ACC used very little groundwater, but in the past 4-6 years, groundwater pumping has quadrupled from less than 5,000 AFA to over 20,000 AFA. Nearly all pumping reported within the ACC has been for agriculture.

5.4 Buckeye Water Conservation and Drainage District Pumping

Figures 81 and **82** provide annual pumping volumes and map locations of wells that have reported pumping within the BWCDD boundary in addition to several BWCDD wells that are located east of the irrigation district. **Table 9** lists the pumping within the BWCDD, both by the District and others, and the total BWCDD pumping, including pumping from the BWCDD off-site wells, from 1986-2013 by pumping category. Note that pumping by the district within the district boundaries is listed under both headings. Slightly over 6% of the pumping inside the BWCDD is for various non-irrigation district uses. The remainder is pumped by the BWCDD for irrigation (37%) or drainage (33%). Looking only at BWCDD wells, both on-site and offsite, 30.68% (662,135 AF) of their total reported pumping of 2,158,131 AF over the study period has been for drainage, 56.19% (1,212,682 AF) for irrigation with on-site wells and 13.13 % (283,313 AF) for irrigation from off-site wells. Pumping peaked in 2008 at 118,722 AF and was at its lowest in 1989 at 44,324 AF. On average, the BWCDD pumps 77,076 AFA.

5.5 St. John's Irrigation District Pumping

Figures 83 and 84 provide annual pumping volumes and map locations of wells that have reported pumping within the SJID boundary in addition to the two SRP wells located off-site and to the east of the irrigation district that supply the SJID. The only wells that report pumping within the district boundary are the SJID's own well 55-623410 and two City of Avondale wells that have only been reporting municipal pumping since 2011. Municipal pumping accounts for less than 1% of pumping inside the SJID with irrigation comprising the remainder. SRP well location 2.3E-1.3N was previously registered as 55-607695 and was replaced by 55-523773. SRP well location 3E-1N was originally registered as 55-607694 and was replaced by 55-586184. **Table 10** lists total reported pumping within the SJID and total reported pumping for use within the SJID, by both on-site and off-site wells. Note that irrigation pumping by SJID's own well is listed under both headings. From 1986-2013, The SJID irrigation well has pumped an average of 865 AFA and the SRP wells have supplied an additional 5,752 AFA. Since 1986, pumping for the SJID peaked in 1997 at 9,057 AF and was at its lowest in 1992 at only 3,202 AF. The last few years have been near the average use.

5.6 Roosevelt Irrigation District

The Roosevelt Irrigation District (RID) is located immediately north of the BWLA. The district was founded in 1927 and is comprised of approximately 38,000 acres. The RID has reported irrigation water use and deliveries of about 134,700 AFA from 1984 through 2013. Although the RID is not included in the BWLA it does influence groundwater conditions within the BWLA. Historically and today most agricultural water used in the District comes from dewatering wells located east of the Agua Fria River in the Salt River Valley Water Users' Association (SRVWUA) district in West Phoenix. **Figures 85 and 86** provide annual pumping volumes and map locations of wells that have reported pumping within the RID boundary, in addition to RID wells located within the SRVWUA district in West Phoenix and several more off-site RID wells. **Table 11** lists total reported pumping within the RID and total reported pumping pumped under the RID right number 57-002517.0000.

6.0 Historic Water Budget, Groundwater Storage Estimates & Water Use 1986-2013

Due to data limitations and the annual variability of some groundwater and surface water components, ADWR has not developed historic and contemporary water budgets for the BWLA at this time. However, the ADWR Modeling Section is currently developing a groundwater flow model for the SRV that will include the entire BWLA and will be very useful in simulating underflow, water levels and water in storage. The previous investigation (Errol L. Montgomery and Associates, 1988) based on 1985 or approximate data, included a spreadsheet inflow-outflow model with estimates for both surface water and groundwater in four different reaches of the BWLA.

In 2011, the ADWR Modeling Section calculated the volume of groundwater in storage in the waterlogged area (**Appendix B**) based on 2006 groundwater levels and currently available groundwater modeling data (ADWR, 2011) down to 1,000 feet BLS or bedrock. The results of that calculation were:

Based on available modeling data:	2,813,955 acre-feet in storage
Based on data from ADWR's ongoing SRV Model update:	3,327,337 acre-feet in storage

As stated in the memo, the recoverable amount of water would be limited by changing hydrologic conditions and technical considerations.

ADWR's Data Management Section provided annual water use information for the three irrigation districts in the BWLA from 1986-2013. The information includes total annual water use by type including groundwater, surface water, reclaimed (effluent), and spill water. In most years the amount of groundwater pumped and the amount of groundwater delivered to individual right holders within each district are different, so both values are provided. The information was derived from annual water withdrawal and use reports. Note that spill water is excess surface water that is released when SRP reservoirs (usually Roosevelt Dam) upstream are too full or when SRP has excess water in the canals beneath the dam, often after a localized storm that may cause the canals to overflow. In these cases, water is available on short notice and farmers and irrigation districts are usually the best suited to use the excess water. Spill water is tracked by Data Management separately because it cannot be counted in determining compliance with right holders' maximum annual groundwater allotments and because it is not a reliable resource for future planning. As mentioned in Section 4.1, the City of Phoenix's 20,000 AFA of effluent contracted to the BWCDD is listed separately but is actually discharged to the Salt River where it is comingled with existing surface water in the Salt and Gila Rivers, and is therefore listed in Data Management tables as surface water.

Table 12 includes Water Management's record of annual water use 1986-2013 for BWCDD, ACC and SJID. **Figures 87, 88 and 89** show the volumes by type for each irrigation district and **Figure 90** shows totals for each irrigation district alongside totals by water type category. Total water use for all three districts has increased since 1986 from less than 125,000 AF to over 225,000 AF.

7.0 Water Quality

The Arizona Department of Environmental Quality (ADEQ) recently provided ADWR with groundwater quality data in the vicinity of the BWLA. The data consisted of 8,470 records at 70 locations and included 105 different inorganic chemical parameters spanning sample dates from 1927 to 2013. More than 2,000 records were duplicates with the same location, parameter, date and result associated with multiple ADEQ programs. ADWR's groundwater site inventory (GWSI) data base also contains historic water quality information. A search in GWSI of the 45 townships in and around the BWLA area obtained 2,565 records collected at 1,015 locations between 1945 and 2008.

Within the two datasets, there are numerous chemical constituents of potential interest for the BWLA, including boron, nitrate, selenium, alkalinity, and other individual anions and cations. This analysis focused on salinity, a significant concern for irrigated agricultural land, especially land that is also waterlogged. Shallow groundwater in waterlogged lands can bring higher saline waters directly into contact with the root zone. The situation is further compounded when high evapotranspiration leaves behind even more concentrated salts.

Higher salinity, quantified in this analysis as Total Dissolved Solids (TDS), can make water unsuitable for drinking, or in the case of the BWLA irrigation districts, less usable for irrigation. The Environmental Protection Agency secondary Safe Drinking Water standard for TDS is 500 milligrams per liter (mg/L). For some industrial uses, water with an even lower TDS content is needed. Suitability of high TDS waters for crop irrigation depends on the types of crops planted, drainage and sodium content. Some crops are more salt tolerant and are able to use high TDS waters for plant growth, while others have a very low tolerance. Crops which can tolerate higher salinity may have decreased yields. The irrigation districts in the BWLA pump shallow groundwater to increase drainage in the root zone. The districts also use lower-TDS treated wastewater where possible for irrigating crops.

TDS is a measure of the total concentration of dissolved minerals in water and is used to categorize the salinity of water. Water is classified as slightly saline, moderately saline, very saline, or briny if the TDS concentration is between 1,000 and 3,000 mg/l, 3,000 and 10,000 mg/l, 10,000 and 35,000 mg/l, or greater than 35,000 mg/l, respectively (USGS Water Supply Paper 2254).

There are different methods of measuring, calculating or estimating TDS. It can be measured by evaporating a known quantity of filtered water and weighing the residue (listed in the ADEQ dataset as the parameter "Total Filtratable Residue"). It can also be calculated by summing the concentrations of the principle cations and anions (Na, K, Ca. Mg, SO4, Cl, etc.). In the ADEQ dataset, the parameter representing this summation is listed as "TDS-Calculated".

TDS can also be estimated from specific conductance/conductivity (SC) which is an inherent capacity of water to pass electrical current by the migration of dissolved ions under an applied voltage typically given in micromhos per centimeter (μmhos/cm). SC can be measured easily with a probe either in the field or in a laboratory. In the laboratory, an electric conductivity measurement is taken with the water temperature at 25°C. Within the last few decades, most field instruments measure temperature and conductivity at the same time and adjust the conductance value to 25°C. In the ADEQ dataset, "specific conductivity" was used to denote a laboratory measurement while "specific conductance" was used to denote a field measurement.

Conductivity/conductance values in micromhos per centimeter can be converted to an estimated TDS concentration in mg/L using a coefficient typically between 0.55 and 0.75 (USGS Water Supply Paper 2254). To better estimate TDS in the vicinity of the BWLA, an average ratio between TDS and SC where both were measured was calculated. Comparing the 98 samples with both measured TDS and SC values, an average of 0.628 was obtained with values ranging as low as 0.476 and as high as 0.819. Therefore, for samples with no measured or calculated TDS, the specific conductance or conductivity was multiplied by 0.628 to obtain an estimated TDS concentration.

For samples that include more than one measure of TDS and/or conductivity/conductance a hierarchy was applied so as to use the corresponding value from the most accurate method first. TDS measured from the Total Filtratable Residue was selected as the most accurate, followed by TDS calculated based on the sum of cations and anions. Finally, samples with only specific conductance/conductivity values were multiplied by 0.628 to estimate TDS concentrations.

Table 13 includes the frequency and selected TDS determination methods for the 2,927 samples used for this analysis. The vast majority (94.74%) were estimated from specific conductance/conductivity, therefore it is important to remember that the true value is somewhere within a larger potential range.

Of the 2,927 samples, 657 were from the ADEQ dataset and 2,270 were from the GWSI dataset. 361 were located within the BWLA boundary and the remaining 2,566 were outside. Samples located many miles outside the boundary may provide a good "background" value of the groundwater in the area. **Figure 91** provides the sample locations from each dataset with graduated symbol sizes to represent the number of measurements available, based on any combination of the above methods**.** Please note that the search rectangle provided to ADEQ was smaller than that used to extract data from GWSI.

The combined TDS dataset was then broken into time periods for mapping. If groundwater from a well location was measured multiple times within that time bracket, the *average* was used to map and create an interpolated surface with a technique called "kriging" in ArcMap. **Figure 92** shows average TDS values per location for the following time periods: pre-1960, 1960s, 1970s, early 1980s, late 1980s, early 1990s, late 1990s, 2000-2006 and post 2006. **Table 14** provides minimum, maximum and average total dissolved solids values for each of the date ranges for all the samples and for the average TDS concentration per location values used in the mapping. Values are similar, but not identical, because a single well location may have been measured multiple times within each date range.

Thirty-one well locations were selected for plots of TDS concentration over time. **Table 15** lists the selected well locations and the minimum, maximum and average TDS per location and also provides the date range and a count of TDS measurements. **Figure 93** is a map with the corresponding well locations. The average TDS concentration per location for all years and all 1,009 locations with data was used to derive the interpolated, kriged surface shown on this map. Wells were selected based on having the most available data and/or the longest periods of records. Some wells were added to provide a better geographic distribution. The TDS results for the selected wells are displayed on 11 plots grouped by location to provide a picture of salinity over time in different regions of the BWLA and surrounding area. Plots over time at these locations are provided as **Figures 94 through 104**. The dates of major flood events were added to the plots so the potential diluting effects of such events on the groundwater's salinity could be assessed. Note that the TDS data plotted over time also indicate some possible inaccuracies in the measurement and/or reporting of conductance or TDS because very high and very low values were sometimes observed in the same location over a short period of time.

This analysis indicates that the area delineated by the BWLA boundary has had a greater TDS content in the underlying groundwater than the surrounding area for the span of years for which water quality data are available (1927-2013). Shallow groundwater experiencing continuous evapotranspiration has likely contributed to this situation. Major flood events and the use of treated wastewater having much lower TDS content may have helped decrease salinity in recent decades. On average, the TDS concentration of groundwater within the BWLA is approximately 3,000 to 5,000 mg/L (classified as moderately saline), while groundwater TDS concentrations in the surrounding areas are about 500 to 1,500 mg/L.

8.0 Consultations with Irrigation Districts and the City of Buckeye and Field Investigations

A.R.S. § 45-411.01(F) states: "The director shall consult with representatives of the Arlington canal company, the Buckeye water conservation and drainage district and the St. John's irrigation district, or their successors, on the scope of the review before beginning the review and on the status of the review periodically during the course of the review." ADWR staff involved in this investigation met with the BWCDD twice and with ACC and SJID once each. The City of Buckeye also provided comments. The feedback received and their perspectives are provided in Appendix C.

9.0 Conclusions

Based on the overlay of estimated depth to water maps for sweep years, the average depth to water over the entire BWLA has increased by about 7.5 feet since 1986. The areal extent of the shallowest groundwater, within 20 feet of land surface, has decreased from about 50 square miles in 1986 to 27 square miles in 2013 (53% decrease).

The data analyzed does not show a discernable correlation between Gila River flood events and the depth to water in the shallow groundwater areas. However, the limited frequency of historic groundwater level measurements at index wells may have been insufficient to reveal whether any short term correlation between flood events and groundwater level rises actually occurred. Pumping activity has fluctuated greatly in the vicinity over the past 27 years but the trend has been a gradual increase in total pumping. Pumping for irrigation is by far the largest volume and showed the greatest variability. Municipal and industrial uses have steadily grown in the vicinity around the BWLA but have remained very small percentages within the BWLA. Drainage and dewatering pumping has remained fairly steady, occurring mostly within the BWCDD. Since 2009, the ACC has relied much more heavily on groundwater supplies. The SJID is a relatively small water user within the BWLA and pumping activity for wells that supply that district have averaged only about 6,000 AFA.

Natural hydrologic conditions contribute to a relatively shallow groundwater area where the BWLA is delineated. This is due in part to the natural flow path of groundwater in the WSRV Sub-basin, which is generally toward the west/southwest, toward the gap between the White Tank Mountains and the Buckeye

Hills. In that area, water flows from the WSRV into the Hassayampa Sub-basin either as groundwater underflow or as groundwater discharge to the channel of the Gila River. A timeline comparing the area of shallow groundwater, the mean depth to water in the BWLA, annual pumping information and maximum stream flows is provided in **Table 16.** From this compilation of information, it appears that increased overall pumping in the area is a major factor causing changes to the water table. Overall, the changes are not significant.

This analysis has confirmed the fact that shallow groundwater conditions continue to exist in many parts of the BWLA. The depth to water is still relatively shallow, and the BWCDD must still practice drainage pumping to keep groundwater below the root zones of their crops. The high evapotranspiration rates have continued to cause high salinity of the groundwater and there is evidence of salt damage within all three irrigation districts. The BWCDD lowers average salt content by applying additional, lower TDS water to fields and the ACC treats their highly alkaline groundwater with sulfuric acid. Periodic flood events may alleviate water quality issues but they can also lead to temporary or permanent loss of irrigable acres.

The exemptions from irrigation water duties, conservation requirements and groundwater withdrawal fees established for the BWLA in A.R.S. § 45.411.01 will expire on December 31, 2019 unless extended by the legislature. At this time, all irrigation districts in the area want the exemptions extended and would like the periodic reviews to be less frequent. The City of Buckeye also would like the exemptions extended. However, there is no consensus among the districts and the City as to how many years the exemptions should be extended.

ADWR's review of the hydrologic conditions in the BWLA shows that there have not been significant changes in the hydrologic conditions that led to the establishment of the exemptions. For that reason, ADWR agrees that the exemptions should be extended. However, ADWR is concerned that ongoing drought conditions and possible future changes in pumping patterns or aquifer conditions within or near the BWLA could result in changes in the hydrologic conditions within the next 10-20 years. Potential changes to aquifer conditions and pumping patterns include, but are not limited to, the following:

1. Effluent from the City of Phoenix, which currently provides most of the normal flows of the Gila River into the BWLA, could be used to meet water future demands elsewhere within the AMA. This would potentially reduce available surface water supplies for use within the BWLA, thereby causing a greater reliance on groundwater.
2. Effluent production could continue to increase, creating more supplies and greater stream flows as the population of the Phoenix metropolitan area increases. If Palo Verde Nuclear Generating Station were to adopt a new, less water-intensive type of cooling, some of the effluent currently sent past the BWLA via pipeline could be discharged into the Gila River.
3. The drainage water currently pumped by the BWCDD could be converted to irrigation water or designated as a water supply elsewhere to help establish an assured water supply for new developments.
4. Nearby entities outside the BWLA but hydrologically connected, including the Roosevelt Irrigation District just north of the area, could increase pumping to irrigate higher water demand crops, to support multi-cropping, or to replace currently utilized water supplies such as the City of Phoenix effluent..

5. Advancements in irrigation technology may result in more efficient use of water applied to fields, reducing demand but also reducing agricultural recharge.
6. The dense, invasive riparian vegetation may be cleared, resulting in less evapotranspiration which would increase groundwater in storage and could possibly increase stream flows.
7. Occasional flood events on the Salt, Verde and Hassayampa Rivers may increase flows on the Gila within the BWLA and provide recharge to the aquifer.

Because of the possibility of changes to the hydrologic conditions in the BWLA within the next 10-20 years, ADWR believes that the exemptions should be extended only until the end of the fifth management period, or December 31, 2024. ADWR further believes that any decision on whether to extend the exemptions beyond that date should wait until ADWR completes the development of a groundwater model that fully covers the BWLA. A groundwater model of the BWLA would provide predictions of future groundwater conditions in the area based on the current data and projected changes in pumping patterns and aquifer conditions. Such a model would be a useful tool for evaluating potential future hydrologic conditions in the BWLA, and, when used in conjunction with groundwater monitoring and water use data, would serve as the basis for future recommendations on whether to extend the exemptions past 2024.

ADWR is developing a groundwater model of the Phoenix AMA that includes the entire BWLA. ADWR believes that the model will be completed by the middle of 2019. Therefore, it would be appropriate for the legislation extending the current exemptions to include a requirement that ADWR review the hydrologic conditions within the BWLA and make a recommendation regarding extending the exemptions past 2024 no later than December 15, 2019. Additionally, because the decision on whether to extend the exemptions past 2024 could impact cities and towns within the BWLA, ADWR believes it would be appropriate for the legislation to require ADWR to consult with all cities and towns within the BWLA, in addition to the three irrigation districts in the area, on the scope of the director's review of the hydrologic conditions before beginning the review and on the status of the review during the course of the review.

10.0 Recommendation

Based on available data ADWR recommends that the current exemptions from irrigation water duties, conservation requirements and groundwater withdrawal fees for the Buckeye Waterlogged Area be extended until the end of the fifth management period, which is December 31, 2024. ADWR further recommends that the legislation extending the exemptions include a provision requiring ADWR to review the hydrologic conditions within the BWLA and submit a recommendation to the governor, the president of the senate and the speaker of the house no later than December 15, 2019 regarding extending the exemptions past 2024. ADWR also recommends that the legislation extending the exemptions include a requirement that ADWR consult with the three irrigation districts in the BWLA and all cities and towns in the BWLA on the scope of the hydrologic review before beginning the review and on the status of the review periodically during the course of the review.

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TABLES

Table 1. Summary of Water Level Data for Wells Used in Hydrographs

Hydrograph Figure Number	Local ID	Site ID	Registry ID	Well Type	Water Use	In/Out BWLA	Along Cross Section	Surface Elevation (ft amsl)	Measurement Date Range (Years)	Count	Shallowest DTW (Elevation)	Date of Shallowest DTW	Deepest DTW (Elevation)	Date of Deepest DTW	1986 DTW (Elevation)	Most Recent DTW (Elevation)	Change in Depth to Water (1986 - Last Measurement)	Average Annual Water Level Change Positive (Rising GW)/ Negative (Falling GW)
25	**A-02-01 31DAA**	332816112172301	619314	INDEX	IRRIGATION	OUT	A-A'	1018	1962 - 2014	37	81.3 (936.24)	11/24/1993	167.63 (849.91)	2/13/1962	88 (929.54)	125.5 (892.04)	-37.50	-1.34
26	**B-01-01 10AAA2**	332658112202701	607158	INDEX	IRRIGATION	OUT	B-B'	983	1956 - 2014	40	59.2 (923.02)	11/18/1993	117.2 (865.02)	1/21/1964	61.2 (921.02)	92.8 (889.42)	-31.60	-1.10
27	**B-01-01 25BAA**	332422112185101	606288	INDEX	UNUSED	OUT	A-A'	942	1962 - 2014	14	17.5 (923.38)	11/26/1991	43.14 (897.74)	12/19/1962	NA	25.4 (915.48)	NA	NA
28	**B-01-01 29DDA2**	332342112223201	619782	INDEX	IRRIGATION	IN	B-B'	915	1961 - 2014	16	18.1 (898.14)	1/9/1986	41 (875.24)	1/1/1961	18.1 (898.14)	31 (885.24)	-12.90	-0.46
29	**B-01-02 16BBB**	332607112284001	625579	INDEX	IRRIGATION	OUT	D-D'	987	1962 - 2014	59	124.9 (863.47)	12/4/1998	230.2 (758.17)	2/8/1971	148.8 (839.57)	132 (856.37)	16.80	0.58
30	**B-01-02 23AAB1**	332515112254401	605111	INDEX	UNUSED	OUT	C-C'	943	1962 - 2014	32	56.9 (886.61)	12/4/1998	108.1 (835.41)	12/28/1962	59.3 (884.21)	75.9 (867.61)	-16.60	-0.58
31	**B-01-02 28CBD**	332348112283201	619794	INDEX	IRRIGATION	IN	--	890	1956 - 2014	59	19.7 (870.3)	6/1/1987	64.38 (825.62)	1/21/1966	20.4 (869.6)	40.3 (849.7)	-19.90	-0.74
32	**B-01-02 35AAA (Cotton Lane)**	332328112253601	614377	AUTOMATED	UNUSED	IN	C-C'	892	2007 - 2014	7	26.8 (865.88)	12/13/2007	42.57 (850.11)	10/9/2013	NA	31.71 (860.97)	NA	NA
33	**B-01-02 36BBC**	332320112253201	610939	INDEX	UNUSED	IN	--	891	1951 - 2006	99	7.65 (883.35)	5/16/1973	70.53 (820.47)	2/3/1965	11.4 (879.6)	21.1 (869.9)	-9.70	-0.46
34	**B-01-03 21DBB**	332452112335001	605474	AUTOMATED	IRRIGATION	OUT	E-E'	993	1956 - 2014	80	133.8 (859.88)	12/4/1998	167 (826.68)	5/10/1978	148.8 (844.88)	158.76 (834.92)	-9.96	-0.36
35	**C-01-02 08CDA (Jackrabbit)**	332102112291201	614938	AUTOMATED	UNUSED	IN	D-D'	898	1956 - 2014	49	39.8 (858.77)	11/19/1992	67.65 (830.92)	2/8/1965	43.6 (854.97)	49.61 (848.96)	-6.01	-0.22
36	**C-01-03 06BCB**	332223112362201	619815	INDEX	IRRIGATION	IN	--	878	1982 - 2014	28	36.5 (841.5)	12/9/2010	43.6 (834.4)	12/17/1984	38.3 (839.7)	40.2 (837.8)	-1.90	-0.07
37	**C-01-03 08CBD**	332113112351301		INDEX	UNUSED	IN	E-E'	839	1982 - 2013	36	3.8 (835.86)	12/6/1982	18.2 (821.46)	11/4/1997	16.9 (822.76)	16.8 (822.86)	0.10	0.00
38	**C-01-03 14DAD**	332016112311601	618942	INDEX	IRRIGATION	IN	--	888	1982 - 2013	25	42.1 (845.9)	1/8/1986	50.4 (837.6)	12/27/2006	42.1 (845.9)	47.9 (840.1)	-5.80	-0.21
39	**C-01-04 06BBA**	332236112422901	607189	AUTOMATED	UNUSED	OUT	F-F'	919	1974 - 2014	47	63.49 (855.68)	3/17/2011	97.2 (821.97)	2/20/1978	71.92 (847.25)	68.94 (850.23)	2.98	0.10
40	**C-01-04 07BDD**	332125112420301	619803	INDEX	IRRIGATION	IN	--	867	1981 - 2013	36	34 (833)	12/9/2010	44.2 (822.8)	11/19/1992	40.1 (826.9)	37.1 (829.9)	3.00	0.11
41	**C-01-04 26ABB**	331906112380001	628186	INDEX	IRRIGATION	IN	--	823	1982 - 2014	36	21.5 (801.5)	6/26/1985	33.7 (789.3)	12/21/2011	22.6 (800.4)	24.9 (798.1)	-2.30	-0.08
42	**C-01-04 27BDC (Robbins Butte)**	331846112391501	628188	AUTOMATED	UNUSED	IN	F-F'	836	1954 - 2014	14	23.06 (813.24)	2/1/1954	46.7 (789.6)	1/22/1963	37.2 (799.1)	40.34 (795.96)	-3.14	-0.11
43	**C-01-05 28AAB**	331907112455901	605129	INDEX	IRRIGATION	IN	--	787	1963 - 2014	17	29.8 (757.2)	10/22/1997	102.2 (684.8)	11/26/2014	35.7 (751.3)	102.2 (684.8)	-66.50	-2.38
44	**C-01-05 29ADC**	331844112470201		GWSI	IRRIGATION	IN	--	788	1956 - 2001	52	38.42 (749.58)	4/6/1979	79.94 (708.06)	2/5/1963	42 (746)	48.5 (739.5)	-6.50	-0.44
45	**C-01-05 34ADC1**	331751112445701	628196	INDEX	UNUSED	IN	G-G'	778	1956 - 2010	55	16.6 (761.26)	1/17/1991	49.53 (728.33)	1/29/1969	17.03 (760.83)	40.2 (737.66)	-23.17	-0.96
46	**C-01-06 12AAD**	332137112490001	598717	AUTOMATED	UNUSED	OUT	G-G'	904	2004 - 2014	35	86.52 (818.42)	5/2/2007	89.17 (815.77)	7/27/2010	NA	88.55 (816.39)	NA	NA
47	**C-01-06 14AAA**	332054112494901	608004	INDEX	UNUSED	OUT	H-H'	904	1969 - 2014	12	192.3 (711.7)	3/8/2004	241.4 (662.6)	10/10/1984	222.7 (681.3)	224.4 (679.6)	-1.70	-0.06
48	**C-02-05 08ABA**	331637112470901	604278	INDEX	DOMESTIC	IN	I-I'	775	2004 - 2014	13	36.5 (738.48)	3/16/2004	79.6 (695.38)	11/21/2014	NA	79.6 (695.38)	NA	NA
49	**C-02-05 08BCA**	331622112473501		GWSI	DOMESTIC	IN	--	782	1946 - 1997	33	17.8 (764.9)	2/7/1952	54.01 (728.69)	12/1/1986	54.01 (728.69)	46.4 (736)	7.31	0.66
50	**C-02-05 16DAA**	331518112454801	805914	INDEX	UNUSED	IN	--	762	1956 - 2014	41	12.5 (749.5)	1/9/1986	32.5 (729.5)	1/13/1970	12.5 (749.5)	32.1 (729.9)	-19.60	-0.68
51	**C-03-04 19CCD**	330847112425501	612571	INDEX	IRRIGATION	OUT	H-H'	710	1965 - 2014	52	38.8 (671.2)	2/11/1986	219.7 (490.3)	11/17/2014	38.8 (671.2)	219.7 (490.3)	-180.90	-6.29
52	**C-03-05 02CBB**	331143112450801		INDEX	IRRIGATION	OUT	--	730	1953 - 2014	75	7.4 (722.6)	3/13/1995	137.6 (592.4)	11/17/2014	31.4 (698.6)	137.6 (592.4)	-106.20	-3.80

Note: Map View of Hydrograph Well Locations Shown on Figure 23

Positive (Rising GW)
Negative (Falling GW)

Table 2. Water Level Change Map Data

Local ID	Site ID	Registry ID	Well Altitude (ft amsl)	1986 Depth to Water	1986 Water Level Elevation	2013 Depth to Water	2013 Water Level Elevation	Water Level Change	Positive (Rising GW)/ Negative (Falling GW)
A-01-01 19DCD1	332424112173501		965	26.5	938.5	40.9	924.1	-14.4	NEG
A-01-02 09AAB2	332702112091601	607201	1060	86.7	973.6	137.6	922.7	-50.9	NEG
A-02-01 14BBA	333122112140901	617098	1085	128.4	956.6	165	920	-36.6	NEG
A-02-01 31DAA	332816112172301	619314	1018	89.6	928.4	124	894	-34.4	NEG
A-02-02 02ABC	333259112072901	626556	1197	264.6	932.75	193.7	1003.65	70.9	POS
A-02-02 14CBC2	333048112075901	608376	1142	173.9	968.42	149.1	993.22	24.8	POS
A-02-02 15DCA	333051112082001	626554	1145	174.4	970.6	160.6	984.4	13.8	POS
A-02-02 18DDD	333036112111001	607674	1120	171.9	948.65	183.1	937.45	-11.2	NEG
B-01-01 12BAA2	332656112184501	607580	980	52.3	927.7	77.5	902.5	-25.2	NEG
B-01-02 05CBB	332725112294301	804205	1063	234.3	828.7	213.1	849.9	21.2	POS
B-01-02 16BBB	332607112284001	625579	987	145.6	841.4	134.3	852.7	11.3	POS
B-01-02 28CBD	332348112283201	619794	890	20.4	869.6	40.3	849.7	-19.9	NEG
B-01-03 21DBB	332452112335001	605474	995	148.8	846.98	155.75	837.93	-6.95	NEG
B-01-03 34BBB1	332330112331901	607172	917	63.4	853.6	69.2	847.8	-5.8	NEG
B-01-04 05AAA	332745112404501	802329	1140	220.7	920.04	227.81	910.82	-7.11	NEG
B-01-04 08AAA	332654112403801	802331	1093	211.2	881.8	216.6	876.4	-5.4	NEG
B-01-04 27ABB	332416112390101	604631	988	127.8	860.2	120.5	867.5	7.3	POS
B-01-05 08DAB	332634112470001	800303	1056	95.4	961.4	96.4	960.4	-1	NEG
B-01-05 15CBB1	332541112454501	636568	980	33.6	946.4	45.2	934.8	-11.6	NEG
B-01-05 27BBC	332416112454301	639586	977	71.4	905.89	73.1	904.19	-1.7	NEG
B-01-06 01ABB	332752112492301	803547	1082	112.6	969.4	117.1	964.9	-4.5	NEG
B-01-06 03BBC	332740112515801	800798	1069	101	968	99.9	969.1	1.1	POS
B-01-06 11BCA	332648112504401	629598	1040	84.4	956.29	91.4	949.29	-7	NEG
B-01-06 23DCD	332427112501301	808647	987	143	844	151.4	835.6	-8.4	NEG
B-02-01 14CBB	333052112202401		1057	202.1	854.9	202.8	854.2	-0.7	NEG
B-02-01 18CBB2	333055112243101	620817	1078	381.3	696.7	235.5	842.5	145.8	POS
B-02-01 20BCC	333006112232601	611717	1042	305.4	736.6	208	834	97.4	POS
B-02-02 04DCB	333223112280901	612958	1204	357.8	846.2	345.2	858.8	12.6	POS
B-02-02 22ABB	333028112270701	612055	1119	381.9	737.1	288.4	830.6	93.5	POS
B-02-05 25BAB	332924112433301		1149	148.3	1000.7	153	996	-4.7	NEG
B-02-05 29DAC	332858112470701	804481	1127	140.6	986.4	145.8	981.2	-5.2	NEG
B-02-06 09CBB	333147112530001	617571	1175	310.8	864.2	246.4	928.6	64.4	POS
B-02-06 21BBA	333028112525101	804552	1136	254.6	881.4	172.6	963.4	82	POS
B-02-07 12CBB	333146112560801	802455	1194	326	868	152.4	1041.6	173.6	POS
B-02-07 27AAB	332934112572801	600199	1146	290.6	855.59	153	993.19	137.6	POS
C-01-02 08CDA	332102112291201	614938	885	43.6	841.4	50.03	848.54	-6.43	NEG
C-01-03 08CBD	332113112351301		838	15.8	822.2	16.8	822.86	-1	NEG
C-01-04 03ABB	332238112385901		900	56	844	54	846	2	POS
C-01-04 07BDD	332125112420301	619803	867	40	827	37.1	829.9	2.9	POS
C-01-05 03BAA1	332236112452001		931	91.5	839.5	92.4	838.6	-0.9	NEG
C-01-05 07ACB	332132112482001		876	62.6	813.4	66.3	809.7	-3.7	NEG
C-01-05 17DDA	332015112465001	802217	838	44.13	793.87	44.5	793.5	-0.37	NEG
C-01-05 28AAB	331907112455901	605129	787	35.7	751.3	75	712	-39.3	NEG
C-01-06 14AAA	332054112494901	608004	904	222.7	681.3	222.6	681.4	0.1	POS
C-01-06 19ABB	332000112543801	629644	890	222.1	667.9	207.9	682.1	14.2	POS
C-01-07 14BBB	332053112570801	604464	939	268.4	670.6	253.5	685.5	14.9	POS
C-01-07 24AAB	331955112553301	628648	897	234.8	662.2	226.8	670.2	8	POS
C-02-01 20BAD	331435112230201		1130	351.3	778.7	341.6	788.4	9.7	POS
C-02-01 24ACB	331432112184601	620455	1350	474.4	875.6	492.1	857.9	-17.7	NEG
C-02-01 30AAA	331354112233301	610920	1103	328	775	316.6	786.4	11.4	POS
C-02-01 33AAA	331300112213201	605576	1169	363.9	805.1	361.5	807.5	2.4	POS
C-02-01 33CDD	331214112215501	625645	1142	334.8	807.2	246.4	895.6	88.4	POS
C-02-02 05CDC	331637112291301	800972	990	211	779	267.5	722.5	-56.5	NEG
C-02-02 10DDA	331548112263701	601927	1017	273.5	743.5	277.9	739.1	-4.4	NEG
C-02-02 12ACC	331610112250201	626153	1070	320	750	330.8	739.2	-10.8	NEG
C-02-02 25CCC	331311112252901	607451	1078	341.3	736.7	318.7	759.3	22.6	POS
C-02-04 26BDA	331337112383401		900	277.4	622.6	341.9	558.1	-64.5	NEG
C-02-04 32ADA	331246112410801		822	206.7	615.3	328.7	493.3	-122	NEG
C-02-05 16DAA	331518112454801	614959	762	16	746	31	731	-15	NEG
C-02-05 26CBA	331333112443001		766	80.6	685.4	151.1	614.9	-70.5	NEG
C-03-01 07ACC	331057112235801		1153	339.7	813.3	332.7	820.3	7	POS
C-03-01 19DCC	330846112235501	629000	1225	398	827	398.5	826.5	-0.5	NEG
C-03-01 21DCC	330846112215101	629411	1182	349	833	349.9	832.1	-0.9	NEG
C-03-01 28DDD	330751112213401	614966	1208	361.9	846.1	374.5	833.5	-12.6	NEG
C-03-04 17ADD	331008112410801	622291	749	124.4	624.71	269.21	477.8	-144.81	NEG
D-03-01 07BBB2	331114112181701	615271	1272	419.7	852.6	434	838.3	-14.3	NEG
D-03-01 19AAA	330934112171801	611915	1293	430.1	862.9	448.3	844.7	-18.2	NEG
D-03-01 31CCC	330700112181801		1214	347.8	866.6	368.2	846.2	-20.4	NEG

Table 3. Wastewater Treatment Plants Near the Buckeye Waterlogged Area and 1985/1986 and 2013 Effluent

Water Provider and ADWR Program Number	Wastewater Treatment Plant	Year Built	Address	Capacity (MGPD)	Daily Average Treatment (MGPD)	1985/1986 Generated (Acre-Feet) [3]	2013 Reported Values or Estimates From Daily Average Treatment Volumes: Generated (Acre-Feet)	Deliveries/Exchanges/Discharges/Losses: Destination	Acre-Feet	Percent	Comments
City of Phoenix 56-002030.0000	**Phoenix 91st Ave WWTP**	1958	5615 S 91st Ave Phoenix, AZ 85037	230	137	148,600	153,546	Palo Verde Nuclear Generating Station	66,206	35%	Water From both plants can be comingled at the 91st Ave Location. Totaled 187,025 Acre-Feet in 2013 and output percents are applied to both plants. Delivered to Palo Verde, RIDD, BWCDD, Tres Rios or the Salt River.
								Buckeye WCDD	20,000	11%	
	Phoenix 23rd Ave WWTP	1932	2470 S 22nd Ave Phoenix, AZ 85009	63	30	30,800	33,480	Roosevelt IDD	29,885	16%	
								Salt River & Tres Rios Wetlands	70,934	38%	
City of Tolleson 56-002044.0000	**Tolleson WWTP**	1968	9501 W Pima St Tolleson, AZ 85353	17.9	17.5	8,200	19,602 [1]	Palo Verde Nuclear Generating Station	19,602 [2]	100%	Effluent information not provided on annual reports. Totals based on average rate reported on city website.
City of Avondale 56-002003.0000	**Avondale WWTP**	1992	4800 S Dysart Rd Avondale, AZ 85323	9	6.2	NA	6,131	Avondale Wetlands	4,308	70%	Since 2009, most of their effluent has been piped north to the Avondale Wetlands recharge facility.
								Lost	332	5%	
								Agua Fria River	1,491	24%	
City of Buckeye 56-002006.0000	**Sundance WRF**	2003	21760 W Watkins St Buckeye, AZ 85326	3.5	0.922	NA	1,033	Sundance Golf Course	487	47%	According to emails from Ron Whitler, Buckeye Hydrologist.
								Buckeye Canal	547	53%	
	Buckeye Central WWTP	circa 1949 [4]	915 S 7th St Buckeye, AZ 85326	4.5	1.2	not listed	1,225	Earl Edgar Park	69	6%	According to information gathered during the tour of the WWTP, the effluent is currently discharged into the Gila River. Subsequent emails from Ron Whitler indicate that since 2009 up to 83 AFA are delivered to Earl Edgar Park, located 1/2-mile west and 1/4 mile north of the Central Buckeye WWTP. There are some other small re-uses including fire department training or occasional filling of water trucks. Current off-site effluent reuse is approx. 100 AFA.
								Gila River	1,157	94%	
City of Goodyear 56-002019.0000	**Goodyear 157th Ave WWTP**	1982	5424 S 157th Ave Goodyear, AZ 85338	4	3.2	315	3,771	Soil Aquifer Treatment (SAT) site	3,582 [2]	95%	According to an email from Goodyear, 95% of the effluent produced at the 157th Ave plant is sent to a nearby Soil Aquifer Treatment (SAT) site. All of the effluent processed at the Corgett Wash WRF is discharged into Corgett Wash.
								Process Water	188 [2]	5%	
	Goodyear Corgett Wash WRF	1988	9000 S Santa Barbara Dr Goodyear, AZ 85338	0.8	0.354	NA	469	Corgett Wash	469	100%	

Notes:

1. Acre-Foot Volumes generated are estimated based on daily average volumes treated in million gallons per day.
2. Acre-Feet Delivered or Discharged based on percentage of total generated
3. From Errol L. Montgomery & Associates, Inc., 1988
4. Based on email correspondence with Ron Whitler, City of Buckeye Hydrologist, based on 1949 aerial photo and his conversation with former manager.

(yellow)	= Portion of effluent sent to Palo Verde Nuclear Generating Station
(orange)	= Portion of effluent delivered or exchanged for recharge or reuse outside the BWLA
(green)	= Portion of effluent going to the Buckeye Water Conservation and Drainage District or Turf Irrigation Inside the BWLA
(gray)	= Portion of effluent lost or used in the processing
(light blue)	= Portion of effluent discharged into surface streams within or flowing into the BWLA

Table 4. Annual Effluent Generated, Delivered and Discharged (AF) Reported in ADWR Annual Reports

Year	City of Phoenix (56-002030.0000)						City of Avondale (56-002003.0000)				City of Buckeye (56-002006.0000)						City of Goodyear (56-002019.0000)			
	Generated		Deliveries/Exchanges Outside BWLA		Delivered to BWCDD	Balance Discharged to river (includes CU to Tres Rios)[1]	Generated Avondale WWTP	Deliveries to Avondale Wetland	Discharged into Agua Fria River	Lost	Generated at the Central WWTP	Deliveries to Turf Irrigation/Other Uses	Discharged into the Gila River	Generated at the Sundance WRF	Golf Course Reuse	Discharged into the Buckeye Canal	Generated		Deliveries to SAT (157th Ave)	Discharged (Both)
	91st Ave WWTP	23rd Ave WWTP	Palo Verde Nuclear Plant	Roosevelt Irrigation District													157th Ave	Corgett Wash		
1996	111,208	63,421	48,452	30,505	**28,200**	**67,472**														
1997	72,911	64,909	53,998	30,000	**28,200**	**25,622**														
1998	Missing																			
1999	82,000	57,662	57,037	30,110	**28,200**	**24,315**														
2000	77,675	61,186	56,831	30,000	**28,200**	**23,830**														
2001	170,573	54,557	52,594	35,265	**28,200**	**109,071**														
2002	158,929	54,928	58,916	32,547	**28,200**	**94,193**					621	0	621							
2003	147,150	53,093	54,300	30,953	**28,200**	**86,789**					497	0	497							
2004	158,469	47,504	52,513	31,344	**28,200**	**93,916**					494	0	494							
2005	160,710	56,031	49,100	33,788	**28,200**	**105,653**					621	0	621							
2006	160,311	53,409	47,935	35,226	**28,200**	**102,359**	4,993	0	4,993	0	823	0	823							
2007	151,645	51,448	53,696	38,618	**28,200**	**82,578**	5,472	0	5,472	0	1,157	0	1,157	845.85	386	390	2,838	599	2,838	599
2008	151,664	45,831	59,249	31,796	**28,200**	**78,250**	5,559	0	5,559	0	1,299	0	1,299	953.92	650	304	2,961	678	1,515	678
2009	160,072	33,961	63,015	28,481	**28,200**	**74,337**	5,812	326	5,486	0	1,237	100	1,137	977.16	668	310	3,160	571	3,161	571
2010	154,838	33,346	67,692	27,336	**28,200**	**64,956**	5,594	3,071	2,351	172	1,107	100	1,007	1016.95	622	395	3,452	545	3,452	544
2011	157,983	34,001	66,281	22,691	**20,000**	**83,011**	5,857	5,169	688	0	1,160	100	1,060	994.31	531	543	3,468	493	3,030	931
2012	156,517	32,960	67,060	27,533	**20,000**	**74,884**	6,087	5,666	420	0	1,127	119	1,009	1,082	530	552	3,239	519	2,818	939
2013	153,546	33,480	66,206	29,885	**20,000**	**70,934**	6,131	4,308	1,491	332	1,225	69	1,157	1,033	487	547	3,771	469	3,060	758

1. This does not include the effluent acre-feet delivered to BWCDD under a separate agreement but both volumes are co-mingled and discharged into the Salt

Table 5. Maximum of Daily Mean Flow (CFS) Per Gage In the Vicinity of the BWLA for Flood Years1993, 1995, 2005 and 2010

Hydrograph Figure Number	Streamgage Number	Name	1993		1995		2005		2010	
			Flow (CFS)	Date	Flow (CFS)	Date	Flow (CFS)	Date	Flow (CFS)	Date
65	**09479500**	Gila River Near Laveen, Ariz.	36,500	1/22/1993	4,460	1/7/1995				
66	**09489000**	Santa Cruz River Near Laveen, Az.	9,460	1/21/1993	530	2/19/1995	461	2/19/2005	787	1/23/2010
67	**09512406**	Salt River At 51St Avenue, Phoenix, AZ					29,610	2/13/2005		
68	**09514100**	Gila River At Estrella Parkway, Near Goodyear, Az.	132,000	1/9/1993	51,400	2/16/1995	29,900	2/13/2005	11,700	1/23/2010
69	**09517000**	Hassayampa River Near Arlington, Az.	2,040	2/9/1993	1,400	2/15/1995	5,400	2/12/2005	2,580	1/22/2010
70	**09517490**	Centennial Wash At Southern Pacific Railroad Brdg	2,540	1/11/1993	11	7/16/1995	2	10/18/2005	1,970	1/22/2010
71	**09518500**	Gila Bend Canal At Gillespie Dam, AZ	189	6/20/1993	198	4/19/1995	126	12/18/2005	194	5/9/2010
72	**09519000**	Enterprise Canal At Gillespie Dam, AZ	75	1/9/1993	122	2/16/1995	15	10/5/2005	35	11/21/2010
73	**09519500**	Gila River Below Gillespie Dam, Arizona-River Flow Below Dam	130,000	1/9/1993	50,000	2/16/1995	16,600	2/14/2005	9,120	3/15/2010
74	**09519501**	Gila R Blw Gillespie Dam, AZ (Low-Water-Gage)	130,000	1/9/1993	50,000	2/16/1995	349	12/11/2005	9,120	3/15/2010

Table 6. Annual Pumping Volumes and Percentage by Category, Wells In and Near the BWLA

Year	Volumes (Acre-Feet)						Percentage				
	Dewatering	Drainage	Municipal	Industrial	Irrigation	TOTAL	Dewatering	Drainage	Municipal	Industrial	Irrigation
1986	750	25,711	5,100	7,803	154,702	194,066	0.39%	13.25%	2.63%	4.02%	79.72%
1987	15,496	23,425	5,127	9,938	144,198	198,184	7.82%	11.82%	2.59%	5.01%	72.76%
1988	5,503	25,356	5,482	8,521	172,831	217,693	2.53%	11.65%	2.52%	3.91%	79.39%
1989	3,827	21,577	6,226	5,647	163,600	200,876	1.91%	10.74%	3.10%	2.81%	81.44%
1990	3,153	24,767	4,741	6,796	167,889	207,346	1.52%	11.94%	2.29%	3.28%	80.97%
1991	2,024	31,324	4,885	7,001	139,921	185,155	1.09%	16.92%	2.64%	3.78%	75.57%
1992	8,533	31,619	4,820	6,237	94,398	145,608	5.86%	21.72%	3.31%	4.28%	64.83%
1993	13,786	24,563	5,208	6,642	115,461	165,659	8.32%	14.83%	3.14%	4.01%	69.70%
1994	10,771	30,325	5,635	7,962	169,699	224,391	4.80%	13.51%	2.51%	3.55%	75.63%
1995	12,281	20,707	6,189	9,000	157,261	205,438	5.98%	10.08%	3.01%	4.38%	76.55%
1996	5,261	23,789	6,416	10,006	163,350	208,822	2.52%	11.39%	3.07%	4.79%	78.22%
1997	1,911	20,396	6,659	10,138	163,175	202,278	0.94%	10.08%	3.29%	5.01%	80.67%
1998	0	15,746	6,112	10,885	120,872	153,615	0.00%	10.25%	3.98%	7.09%	78.69%
1999	0	25,358	5,257	12,460	146,892	189,966	0.00%	13.35%	2.77%	6.56%	77.33%
2000	15,378	24,401	5,077	11,232	166,936	223,024	6.90%	10.94%	2.28%	5.04%	74.85%
2001	6	24,229	4,878	13,231	161,512	203,855	0.00%	11.89%	2.39%	6.49%	79.23%
2002	2,088	23,692	8,320	16,823	183,178	234,101	0.89%	10.12%	3.55%	7.19%	78.25%
2003	4,383	27,218	8,659	18,321	171,963	230,544	1.90%	11.81%	3.76%	7.95%	74.59%
2004	14,291	22,968	9,156	23,221	162,292	231,927	6.16%	9.90%	3.95%	10.01%	69.98%
2005	10,308	21,099	11,447	20,870	125,792	189,515	5.44%	11.13%	6.04%	11.01%	66.38%
2006	9,515	22,670	15,227	24,289	127,753	199,454	4.77%	11.37%	7.63%	12.18%	64.05%
2007	7,349	31,120	18,365	24,589	151,655	233,077	3.15%	13.35%	7.88%	10.55%	65.07%
2008	12,754	26,946	17,791	23,072	166,406	246,969	5.16%	10.91%	7.20%	9.34%	67.38%
2009	13,607	21,998	18,014	23,836	163,958	241,412	5.64%	9.11%	7.46%	9.87%	67.92%
2010	7,763	17,368	18,630	23,651	137,703	205,115	3.78%	8.47%	9.08%	11.53%	67.13%
2011	2,392	18,314	18,551	26,436	179,818	245,510	0.97%	7.46%	7.56%	10.77%	73.24%
2012	4,091	27,256	18,884	28,417	176,448	255,096	1.60%	10.68%	7.40%	11.14%	69.17%
2013	925	23,202	20,460	23,029	178,027	245,643	0.38%	9.45%	8.33%	9.38%	72.47%
TOTAL	**188,144**	**677,144**	**271,312**	**420,051**	**4,327,687**	**5,884,337**					
Percent	**3.20%**	**11.51%**	**4.61%**	**7.14%**	**73.55%**	**100.00%**					
min	**0**	**15,746**	**4,741**	**5,647**	**94,398**	**145,608**	**0.00%**	**7.46%**	**2.28%**	**2.81%**	**64.05%**
max	**15,496**	**31,619**	**20,460**	**28,417**	**183,178**	**255,096**	**8.32%**	**21.72%**	**9.08%**	**12.18%**	**81.44%**
average	**6,719**	**24,184**	**9,690**	**15,002**	**154,560**	**210,155**	**3.23%**	**11.72%**	**4.48%**	**6.96%**	**73.61%**

Table 7. Annual Pumping Volumes and Percentages by Category inside the BWLA Only 1986-2013

Year	Volumes (Acre-Feet)						Volumes By Area[1]				Percentage				
	Dewatering	Drainage	Municipal	Industrial	Irrigation	TOTAL	ACC	BWCDD	SJIDD	Non-ID	Dewatering	Drainage	Municipal	Industrial	Irrigation
1986	0	25,711	117	761	31,141	57,730	1,485	47,629	492	8,124	0.00%	44.54%	0.20%	1.32%	53.94%
1987	0	23,425	97	1,237	33,837	58,596	1,197	48,698	376	8,324	0.00%	39.98%	0.17%	2.11%	57.75%
1988	463	25,356	117	1,272	41,820	69,028	874	57,954	1,133	9,067	0.67%	36.73%	0.17%	1.84%	60.58%
1989	2,027	21,577	88	1,075	30,432	55,198	598	46,881	1,242	6,477	3.67%	39.09%	0.16%	1.95%	55.13%
1990	0	24,767	81	1,233	46,012	72,093	1,535	61,659	866	8,032	0.00%	34.35%	0.11%	1.71%	63.82%
1991	0	31,324	131	1,451	45,436	78,342	1,055	66,034	354	10,899	0.00%	39.98%	0.17%	1.85%	58.00%
1992	0	31,619	19	1,379	30,188	63,206	1,186	53,968	492	7,560	0.00%	50.03%	0.03%	2.18%	47.76%
1993	0	24,563	0	1,279	39,362	65,205	904	54,235	809	9,256	0.00%	37.67%	0.00%	1.96%	60.37%
1994	0	30,325	28	1,524	44,744	76,621	985	62,003	1,643	11,990	0.00%	39.58%	0.04%	1.99%	58.40%
1995	0	20,707	23	2,167	48,249	71,146	1,035	58,316	1,291	10,504	0.00%	29.11%	0.03%	3.05%	67.82%
1996	0	23,789	15	2,476	53,545	79,825	897	68,735	196	9,998	0.00%	29.80%	0.02%	3.10%	67.08%
1997	0	20,396	25	2,139	56,709	79,269	1,442	62,324	2,355	13,148	0.00%	25.73%	0.03%	2.70%	71.54%
1998	0	15,746	140	1,853	43,670	61,408	1,525	52,340	1,204	6,339	0.00%	25.64%	0.23%	3.02%	71.11%
1999	0	25,358	28	2,256	55,080	82,722	1,657	67,401	1,111	12,553	0.00%	30.65%	0.03%	2.73%	66.58%
2000	0	24,401	77	1,831	66,776	93,085	3,020	76,073	995	12,998	0.00%	26.21%	0.08%	1.97%	71.74%
2001	0	24,229	172	1,617	71,071	97,089	1,976	79,305	1,004	14,803	0.00%	24.96%	0.18%	1.67%	73.20%
2002	0	23,692	322	1,363	85,316	110,693	4,172	91,002	784	14,736	0.00%	21.40%	0.29%	1.23%	77.07%
2003	0	27,218	318	1,311	78,802	107,649	4,760	86,826	846	15,217	0.00%	25.28%	0.30%	1.22%	73.20%
2004	2,567	22,968	398	1,943	73,143	101,020	4,047	86,813	187	9,973	2.54%	22.74%	0.39%	1.92%	72.41%
2005	869	21,099	566	2,331	63,192	88,057	2,867	71,189	734	13,267	0.99%	23.96%	0.64%	2.65%	71.76%
2006	9,110	22,670	688	1,564	68,258	102,290	1,537	85,294	1,241	14,218	8.91%	22.16%	0.67%	1.53%	66.73%
2007	525	31,120	671	890	90,367	123,574	3,372	101,359	1,201	17,642	0.42%	25.18%	0.54%	0.72%	73.13%
2008	0	26,946	530	1,737	105,649	134,862	5,173	102,948	1,057	25,685	0.00%	19.98%	0.39%	1.29%	78.34%
2009	0	21,998	444	2,245	109,448	134,135	14,092	94,601	1,176	24,267	0.00%	16.40%	0.33%	1.67%	81.60%
2010	2,290	17,368	308	2,339	89,165	111,469	22,374	66,511	587	21,998	2.05%	15.58%	0.28%	2.10%	79.99%
2011	36	18,314	341	5,559	102,865	127,115	20,102	86,743	4	20,267	0.03%	14.41%	0.27%	4.37%	80.92%
2012	300	27,256	360	2,597	95,565	126,077	19,670	87,362	526	18,518	0.24%	21.62%	0.29%	2.06%	75.80%
2013	309	23,202	338	2,182	101,276	127,307	21,759	85,378	379	19,790	0.24%	18.23%	0.27%	1.71%	79.55%
TOTAL	**18,495**	**677,144**	**6,441**	**51,611**	**1,801,116**	**2,554,807**	**145,295**	**2,009,579**	**24,286**	**375,647**					
Percent	**0.72%**	**26.50%**	**0.25%**	**2.02%**	**70.50%**	**100.00%**	**5.69%**	**78.66%**	**0.95%**	**14.70%**					
min	**0**	**15,746**	**0**	**761**	**30,188**	**145,608**	**598**	**46,881**	**4**	**6,339**	**0.00%**	**14.41%**	**0.00%**	**0.72%**	**47.76%**
max	**9,110**	**31,619**	**688**	**5,559**	**109,448**	**255,096**	**22,374**	**102,948**	**2,355**	**25,685**	**8.91%**	**50.03%**	**0.67%**	**4.37%**	**81.60%**
average	**661**	**24,184**	**230**	**1,843**	**64,326**	**210,155**	**5,189**	**71,771**	**867**	**13,416**	**0.71%**	**28.61%**	**0.23%**	**2.06%**	**68.40%**

Note:

1. These volumes are based on geographic location within the Buckeye Waterlogged Area. Some pumping for each district comes from wells located offsite and some pumping inside each district is not associated with the district itself. See tables 8, 9 and 10 for details on pumping inside and for each irrigation district.

Table 8. Pumping Within the Arlington Canal Company Boundary and Arlington Canal Company Pumping On-Site and Off-Site 1986-2013

Year	Inside ACC Boundary				ACC Pumping (57-002502.0000)		
	Industrial (non ID)	Irrigation (non ID)	Irrigation (ACC On-Site Wells)	Total Inside ACC Boundary[1]	Irrigation (ACC On-Site Wells)	Irrigation (ACC Offsite Wells)	Total ACC Pumping[2]
1986	8	995	482	**1,485**	482	0	**482**
1987	108	684	406	**1,197**	406	4	**409**
1988	16	517	342	**874**	342	0	**342**
1989	16	454	128	**598**	128	0	**128**
1990	20	458	1,058	**1,535**	1,058	28	**1,086**
1991	10	450	595	**1,055**	595	2	**597**
1992	19	436	732	**1,186**	732	16	**748**
1993	21	408	475	**904**	475	57	**532**
1994	10	426	548	**985**	548	0	**548**
1995	128	219	688	**1,035**	688	60	**748**
1996	126	586	185	**897**	185	4	**188**
1997	121	460	862	**1,442**	862	32	**894**
1998	119	96	1,310	**1,525**	1,310	80	**1,390**
1999	269	636	753	**1,657**	753	29	**782**
2000	154	541	2,325	**3,020**	2,325	63	**2,388**
2001	177	543	1,256	**1,976**	1,256	44	**1,300**
2002	12	1,048	3,112	**4,172**	3,112	109	**3,221**
2003	4	1,084	3,672	**4,760**	3,672	175	**3,847**
2004	0	1,509	2,538	**4,047**	2,538	170	**2,708**
2005	0	1,061	1,806	**2,867**	1,806	0	**1,806**
2006	54	529	954	**1,537**	954	62	**1,016**
2007	29	1,415	1,928	**3,372**	1,928	117	**2,046**
2008	27	1,634	3,513	**5,173**	3,513	228	**3,740**
2009	22	1,485	12,584	**14,092**	12,584	846	**13,430**
2010	22	1,496	20,857	**22,374**	20,857	626	**21,483**
2011	41	539	19,523	**20,102**	19,523	1,130	**20,652**
2012	136	222	19,313	**19,670**	19,313	1,000	**20,313**
2013	0	911	20,848	**21,759**	20,848	1,011	**21,859**
TOTAL	**1,666**	**20,837**	**122,792**	**145,295**	**122,792**	**5,892**	**128,684**
Percent	**1.15%**	**14.34%**	**84.51%**	**100.00%**	**95.42%**	**4.58%**	**100.00%**
min	**0**	**96**	**128**	**598**	**128**	**0**	**128**
max	**269**	**1,634**	**20,857**	**22,374**	**20,857**	**1,130**	**21,859**
average	**60**	**744**	**4,385**	**5,189**	**4,385**	**210**	**4,596**

Notes:

1. Pumping within the ACC boundary, both non-irrigation district wells and ACC wells
2. ACC wells pumped under right number 57-002502.0000 for the irrigation district, both on-site and off-site wells

Table 9. Pumping Within the Buckeye Water Conservation and Drainage District Boundary and Pumping for the BWCDD

Year	Inside BWCDD Boundary								BWCDD Pumping			
	Dewatering (non ID)	Drainage (non ID)	Municipal (non ID)	Industrial (non ID)	Irrigation (non ID)	Drainage (BWCDD Rights)	Irrigation (BWCDD Rights)	Total Inside BWCDD Boundary[1]	Drainage (BWCDD Rights)	Irrigation (BWCDD Rights)	Irrigation (BWCDD Offsite Wells)	Total BWCDD Pumping[2]
1986	0	0	15	235	2,589	25,711	19,080	**47,629**	25,711	19,080	5,827	50,618
1987	0	0	18	358	2,564	23,425	22,329	**48,694**	23,425	22,329	5,650	51,404
1988	463	1,629	19	517	4,734	23,727	26,866	**57,954**	23,727	26,866	6,382	56,975
1989	2,027	0	24	286	3,826	21,577	19,142	**46,881**	21,577	19,142	3,605	44,324
1990	0	2,579	18	402	4,634	22,188	31,810	**61,631**	22,188	31,810	4,996	58,994
1991	0	1,756	103	465	3,551	29,568	30,590	**66,033**	29,568	30,590	7,695	67,853
1992	0	4,617	19	354	1,966	27,002	19,993	**53,951**	27,002	19,993	5,402	52,397
1993	0	4,204	0	243	472	20,359	28,900	**54,178**	20,359	28,900	7,178	56,437
1994	0	0	25	388	1,005	30,325	30,260	**62,003**	30,325	30,260	8,854	69,439
1995	0	0	20	333	549	20,707	36,647	**58,257**	20,707	36,647	8,718	66,072
1996	0	0	15	406	2,029	23,789	42,493	**68,732**	23,789	42,493	7,869	74,151
1997	0	0	25	378	2,303	20,396	39,189	**62,291**	20,396	39,189	10,663	70,248
1998	0	223	48	346	2,983	15,523	33,137	**52,260**	15,523	33,137	3,742	52,402
1999	0	0	28	231	6,099	25,358	35,656	**67,372**	25,358	35,656	8,831	69,845
2000	0	0	64	155	4,107	24,401	47,282	**76,010**	24,401	47,282	10,608	82,291
2001	0	0	76	229	1,972	24,229	52,756	**79,261**	24,229	52,756	11,289	88,274
2002	0	0	110	273	3,807	23,692	63,011	**90,892**	23,692	63,011	12,690	99,393
2003	0	0	70	502	4,405	27,218	54,457	**86,652**	27,218	54,457	11,636	93,311
2004	2,567	0	101	1,098	3,037	22,968	56,872	**86,643**	22,968	56,872	8,129	87,969
2005	869	0	221	1,449	0	21,099	47,552	**71,189**	21,099	47,552	10,688	79,339
2006	9,110	0	270	654	3,732	22,670	48,797	**85,232**	22,670	48,797	10,800	82,267
2007	525	0	223	611	3,953	31,120	64,809	**101,241**	31,120	64,809	15,228	111,157
2008	0	0	151	550	4,363	26,946	70,711	**102,720**	26,946	70,711	21,065	118,722
2009	0	0	87	454	3,739	21,998	67,478	**93,756**	21,998	67,478	18,699	108,175
2010	2,287	0	46	192	3,082	17,368	42,910	**65,885**	17,368	42,910	16,895	77,173
2011	36	0	23	472	3,103	18,314	63,665	**85,613**	18,314	63,665	11,692	93,671
2012	300	0	13	490	1,266	27,256	57,038	**86,362**	27,256	57,038	13,679	97,973
2013	309	0	27	494	1,083	23,202	59,252	**84,367**	23,202	59,252	14,803	97,257
TOTAL	**18,492**	**15,009**	**1,855**	**12,563**	**80,951**	**662,135**	**743,086**	**2,003,687**	**662,135**	**1,212,682**	**283,313**	**2,158,131**
Percent	**0.92%**	**0.75%**	**0.09%**	**0.63%**	**4.04%**	**33.05%**	**37.09%**	**100.00%**	**30.68%**	**56.19%**	**13.13%**	**100.00%**
min	**0**	**0**	**0**	**155**	**0**	**15,523**	**19,080**	**46,881**	**15,523**	**19,080**	**3,605**	**44,324**
max	**9,110**	**4,617**	**270**	**1,449**	**6,099**	**31,120**	**70,711**	**102,720**	**31,120**	**70,711**	**21,065**	**118,722**
average	**660**	**536**	**66**	**449**	**2,891**	**23,648**	**43,310**	**71,560**	**23,648**	**43,310**	**10,118**	**77,076**

Notes:

1. Pumping within the BWCDD boundary, both non-irrigation district wells and BWCDD wells
2. BWCDD wells pumped under right numbers 57-002503.0000, 58-105010.0000, 58-105011.0000, 59-504164.0000, 59-508298.0000, 59-527176.0000 & 59-527176.0001 for the irrigation district, both on-site and off-site wells

Table 10. Pumping within the St. John's Irrigation District Boundary and Pumping for SJID

Year	Inside SJID Boundary			SJID Pumping		
	Municipal (non ID)	Irrigation (SJID Right)	Total Inside SJID Boundary1	Irrigation (SJID On-Site Well Right 57-002519.0000)	Irrigation (SRP Wells Offsite Supplied to SJID Right 57-002520.0000)	Total SJID Pumping2
1986	--	492	**492**	492	5,382	**5,875**
1987	--	376	**376**	376	4,276	**4,652**
1988	--	1,133	**1,133**	1,133	7,179	**8,311**
1989	--	1,242	**1,242**	1,242	7,171	**8,413**
1990	--	866	**866**	866	6,686	**7,553**
1991	--	354	**354**	354	6,093	**6,447**
1992	--	492	**492**	492	2,709	**3,202**
1993	--	809	**809**	809	3,759	**4,568**
1994	--	1,643	**1,643**	1,643	7,154	**8,797**
1995	--	1,291	**1,291**	1,291	6,556	**7,847**
1996	--	196	**196**	196	6,517	**6,713**
1997	--	2,355	**2,355**	2,355	6,702	**9,057**
1998	--	1,204	**1,204**	1,204	5,491	**6,694**
1999	--	1,111	**1,111**	1,111	5,627	**6,738**
2000	--	995	**995**	995	4,861	**5,856**
2001	--	1,004	**1,004**	1,004	4,635	**5,639**
2002	--	784	**784**	784	6,158	**6,942**
2003	--	846	**846**	846	5,775	**6,621**
2004	--	187	**187**	187	6,290	**6,477**
2005	--	734	**734**	734	4,231	**4,964**
2006	--	1,241	**1,241**	1,241	6,358	**7,599**
2007	--	1,201	**1,201**	1,201	6,461	**7,662**
2008	--	1,057	**1,057**	1,057	4,326	**5,382**
2009	--	1,176	**1,176**	1,176	7,329	**8,504**
2010	--	587	**587**	587	5,447	**6,033**
2011	4	0	**4**	0	6,301	**6,301**
2012	41	485	**526**	485	5,795	**6,280**
2013	14	365	**379**	365	5,781	**6,146**
TOTAL	**60**	**24,225**	**24,286**	**24,225**	**161,048**	**185,273**
Percent	**0.25%**	**99.75%**	**100.00%**	**13.08%**	**86.92%**	**100.00%**
min	**4**	**0**	**4**	**0**	**2,709**	**3,202**
max	**41**	**2,355**	**2,355**	**2,355**	**7,329**	**9,057**
average	**20**	**865**	**867**	**865**	**5,752**	**6,617**

1. Pumping within the SJID boundary, both non-irrigation district wells and SJID's Well.
2. SJID's well pumped under right 57-002519.0000 and off-site SRP wells that supply water to SJID under right 57-002520.0000

Table 11. Pumping within the Roosevelt Irrigation District Boundary and Pumping for RID

Year	Inside RID Boundary					RID Pumping (57-002517.0000)			
	Municipal (non ID)	Industrial (non ID)	Irrigation (non RID)	Irrigation (RID On-Site Wells)	Total Inside RID Boundary[1]	Irrigation (RID On-Site Wells)	Irrigation (RID Wells Inside the SRVWUA District)	Irrigation (Other RID Offsite Wells)	Total RID Pumping[2]
1986	821	93	25,774	17,579	**44,267**	17,579	102,429	13,848	**133,856**
1987	861	80	22,101	18,527	**41,569**	18,527	96,006	12,407	**126,939**
1988	1,102	83	25,980	18,536	**45,702**	18,536	105,167	15,238	**138,941**
1989	1,067	108	22,022	16,465	**39,662**	16,465	124,446	14,936	**155,847**
1990	1,359	88	25,157	12,566	**39,169**	12,566	99,312	14,961	**126,839**
1991	1,144	42	20,376	11,886	**33,448**	11,886	91,833	15,169	**118,888**
1992	1,219	71	13,148	7,487	**21,924**	7,487	72,236	10,695	**90,417**
1993	1,143	35	19,550	9,172	**29,900**	9,172	95,742	13,774	**118,688**
1994	1,186	119	24,215	19,414	**44,934**	19,414	117,013	18,886	**155,314**
1995	1,247	50	24,186	15,140	**40,623**	15,140	111,976	17,309	**144,425**
1996	1,401	273	24,805	14,688	**41,167**	14,688	110,376	12,174	**137,238**
1997	1,940	93	22,981	12,565	**37,579**	12,565	95,661	13,289	**121,515**
1998	2,062	99	13,864	9,215	**25,240**	9,215	88,292	13,092	**110,598**
1999	2,424	114	16,492	13,397	**32,427**	13,397	109,073	13,407	**135,877**
2000	2,073	0	22,404	15,930	**40,407**	15,930	107,552	15,236	**138,718**
2001	1,192	56	22,295	15,133	**38,675**	15,133	102,439	13,894	**131,466**
2002	1,604	186	26,621	16,156	**44,568**	16,156	114,098	15,476	**145,730**
2003	1,670	0	24,396	16,738	**42,803**	16,738	103,726	14,348	**134,811**
2004	2,219	10	20,471	16,726	**39,426**	16,726	101,123	12,785	**130,634**
2005	3,301	271	17,446	11,567	**32,584**	11,567	88,350	12,698	**112,614**
2006	4,412	466	12,920	6,226	**24,023**	6,226	97,998	10,954	**115,178**
2007	6,496	451	19,053	8,565	**34,564**	8,565	95,477	11,120	**115,162**
2008	6,631	123	27,413	9,162	**43,330**	9,162	97,574	12,550	**119,286**
2009	7,693	263	15,913	5,843	**29,712**	5,843	94,772	10,368	**110,983**
2010	6,606	210	12,141	5,409	**24,366**	5,409	99,513	12,327	**117,249**
2011	6,623	205	18,024	16,160	**41,012**	16,160	120,188	14,994	**151,341**
2012	6,773	369	16,215	10,217	**33,573**	10,217	116,420	14,203	**140,839**
2013	6,766	321	16,871	9,429	**33,386**	9,429	106,438	11,459	**127,326**
TOTAL	**83,033**	**4,278**	**572,834**	**359,897**	**1,020,041**	**359,897**	**2,865,230**	**381,592**	**3,606,718**
Percent	**8.14%**	**0.42%**	**56.16%**	**35.28%**	**100.00%**	**9.98%**	**79.44%**	**10.58%**	**100.00%**
min	**821**	**0**	**12,141**	**5,409**	**21,924**	**5,409**	**72,236**	**10,368**	**90,417**
max	**7,693**	**466**	**27,413**	**19,414**	**45,702**	**19,414**	**124,446**	**18,886**	**155,847**
average	**2,965**	**153**	**20,458**	**12,853**	**36,430**	**12,853**	**102,330**	**13,628**	**128,811**

1. Pumping within the RID boundary, both non-irrigation district wells and RID's Well.
2. RID's well pumped under right 57-002517.0000 for the irrigation district, including on-site, within the SRVWUA district boundary and off-site wells

Table 12. ADWR AMA Planning and Data Management Report of Annual Water Use 1986-2013 for BWCDD, ACC and SJID

Year	BWCDD Water use					ACC Water Use					St. John's Irrigation District Water use						Total BWCDD, ACC and SJIDD					
	Groundwater					Groundwater					Groundwater						Total Groundwater[1]					
	Supply (Pumped)[1]	Delivered to Rights[2]	Surface Water[3]	Reclaimed[4]	Total BWCDD	Supply (Pumped)	Delivered to Rights[2]	Surface Water[3]	Spill[5]	Total ACC	Supply (Pumped)[6]	Received (Pumped SRP Wells)[7]	Delivered to Rights[2]	Surface Water (Tail Water)[8]	Spill[5]	Total SJIDD	Supply (Pumped)[9]	Delivered to Rights[10]	Surface Water[3]	Total Reclaimed[4] (Effluent)	Total Spill[5]	Grand Totals BWCDD, ACC and SJIDD[11]
1986	24,907	20,377	31,866	30,000	86,773	482	482	25,392	0	25,874	492	5,382	6,029	0	0	5,875	31,263	26,887	57,258	30,000	0	145,409
1987	27,980	10,664	49,399	30,000	107,379	410	410	21,862	0	22,272	376	4,165	5,166	3,043	0	7,584	32,931	16,240	74,304	30,000	0	153,475
1988	33,248	9,239	58,863	30,000	122,111	342	342	19,919	1,755	22,016	1,133	7,233	8,394	5,295	0	13,661	41,955	17,975	84,077	30,000	1,755	175,762
1989	22,747	8,818	61,600	30,000	114,347	128	128	19,631	0	19,759	1,242	7,208	9,990	1,369	0	9,819	31,325	18,936	82,600	30,000	0	162,861
1990	36,806	11,651	42,264	30,000	109,070	1,086	1,085	18,647	0	19,733	866	6,544	6,544	1,610	172	9,192	45,302	19,280	62,521	30,000	172	157,275
1991	38,285	17,036	37,717	30,000	106,002	597	597	16,393	0	16,990	354	5,205	5,205	3,185	264	9,008	44,441	22,838	57,295	30,000	264	154,838
1992	25,395	6,346	37,000	30,000	92,395	748	749	14,593	0	15,341	492	3,210	3,209	2,124	2,494	8,320	29,845	10,304	53,717	30,000	2,494	126,360
1993	36,078	18,183	34,856	30,000	100,934	532	532	13,098	0	13,629	809	3,777	4,377	2,166	1,822	8,574	41,196	23,092	50,119	30,000	1,822	146,229
1994	39,114	13,256	58,324	30,000	127,438	548	548	17,480	0	18,028	1,643	5,321	7,322	4,583	0	11,547	46,626	21,126	80,387	30,000	0	178,139
1995	45,365	15,322	53,720	30,000	129,085	748	748	17,143	0	17,891	1,291	6,093	10,468	1,088	1,505	9,978	53,497	26,538	71,951	30,000	1,505	183,491
1996	50,362	19,453	66,778	28,200	145,340	188	188	16,498	0	16,687	196	6,538	8,139	1,678	0	8,413	57,285	27,779	84,955	28,200	0	198,219
1997	49,852	16,017	67,244	28,200	145,296	894	892	18,791	0	19,685	2,355	6,283	8,589	2,015	30	10,683	59,384	25,498	88,050	28,200	30	201,162
1998	36,879	12,201	64,596	28,200	129,675	1,390	1,390	19,434	0	20,824	1,204	5,096	6,308	2,116	299	8,715	44,569	19,899	86,146	28,200	299	179,113
1999	44,487	12,028	66,214	28,200	138,901	782	782	21,725	0	22,507	1,111	5,238	6,349	2,844	39	9,232	51,618	19,159	90,783	28,200	39	189,799
2000	57,890	23,282	69,777	28,200	155,867	2,388	2,388	22,418	0	24,806	995	4,439	5,435	3,744	11	9,189	65,712	31,104	95,939	28,200	11	220,967
2001	64,045	22,910	76,310	28,200	168,555	1,300	1,300	20,019	0	21,320	1,004	3,740	4,744	4,322	36	9,102	70,089	28,954	100,651	28,200	36	227,931
2002	75,701	27,852	72,182	28,200	176,083	3,221	3,220	20,431	0	23,653	784	6,598	6,598	3,170	35	10,586	86,304	37,670	95,783	28,200	35	247,992
2003	66,093	24,947	60,552	28,200	154,845	3,847	3,817	20,364	0	24,211	846	5,530	6,376	2,473	44	8,893	76,316	35,140	83,389	28,200	44	223,089
2004	65,001	25,780	67,909	28,200	161,110	2,708	2,708	20,587	0	23,295	187	6,203	6,203	2,053	21	8,464	74,099	34,692	90,549	28,200	21	227,561
2005	55,760	23,399	73,226	28,200	157,186	1,806	1,806	21,447	0	23,252	734	3,663	4,397	2,553	1,015	7,965	61,963	29,602	97,226	28,200	1,015	218,005
2006	55,944	20,797	83,499	28,200	167,643	1,016	1,016	24,267	0	25,283	1,241	6,973	6,973	1,703	57	9,974	65,174	28,786	109,468	28,200	57	231,686
2007	75,092	28,127	70,802	28,200	174,094	2,046	2,046	21,280	0	23,325	1,201	7,220	7,220	1,773	178	10,372	85,559	37,393	93,855	28,200	178	245,184
2008	87,658	27,093	73,067	28,200	188,925	3,740	3,770	24,464	0	28,204	1,057	3,694	4,750	2,717	903	8,370	96,149	35,613	100,247	28,200	903	261,113
2009	80,948	23,681	77,852	28,200	187,000	13,430	NR	28,409	0	41,839	1,175	6,726	7,901	1,559	1,065	10,525	102,279	31,582	107,820	28,200	1,065	270,946
2010	54,944	16,511	73,330	28,200	156,474	21,483	25,387	0	0	21,483	587	5,252	5,839	2,432	2,046	10,317	82,266	47,737	75,762	28,200	2,046	236,010
2011	78,681	31,280	85,035	20,000	183,716	20,652	31,511	0	0	20,652	717	8,899	9,616	2,797	20	12,433	108,949	72,407	87,832	20,000	20	289,208
2012	70,717	26,516	86,668	20,000	177,385	20,313	NR	0	0	20,313	485	5,236	5,721	2,153	1,788	9,662	96,751	32,237	88,822	20,000	1,788	239,597
2013	74,055	31,497	103,365	20,000	197,420	21,859	18,600	0	0	21,859	365	4,934	5,299	4,295	11	9,605	101,213	5,397	107,660	20,000	11	284,281

Notes:

1. Prior to 2005 the BWCDD reported drainage pumping under Right Number 57-002503.0000 (irrigation type). That volume of water has been subtracted from the total reported pumping for 1986-2004.
2. Volume of groundwater supply delivered to other right holders within the irrigation districts. Usually less than total supply to account for losses.
3. Surface Water includes decreed/appropriative and other sources and represents a combination of natural and effluent-dominated stream sources.
4. The reclaimed (treated effluent) water listed here is the minimum volume the City of Phoenix is obligated to provide the BWCDD. This water source is actually comingled with the remaining effluent dominated surface water discharged into the Salt River.
5. Spill water is excess surface water available on short notice either due to too full reservoirs or excess water in canals below the dams after storm events. It's tracked separately because it is not counted against allotments nor is it a reliable resource for future planning.
6. Pumped from St. John's own on-site well.
7. Groundwater supplied by offsite SRP wells to SJID.
8. SJID reports their surface water as 'tail water'.
9. Total Pumped from all irrigation wells for BWCDD, ACC and SJID combined, both onsite or offsite.
10. Total groundwater reported as having been delivered by BWCDD, ACC and SJID to other rights. Note that in some years for some districts, this volume was not reported so the total may not be accurate.
11. This total reflects the volume of groundwater pumped, not just delivered, plus surface water, reclaimed and spill supplies.

Table 13. Total Dissolved Solids (TDS) Estimates, Methods and Hierarchy

Hierarchy	TDS Estimate Methodology Selected For Sample	TDS Measured	TDS Calculated	Specific Conductance	Specific Conductivity	Total	Percent
1st	**TDS Measured (From total filtratable residue measurement - weighing dried residue filtered from sample)**	102	11	1	98	**102**	3.48%
2nd	**TDS Calculated (Based on the sum of anions and cations in solution)**	0	52	0	50	**52**	1.78%
3rd	**Estimated from Specific Conductance/Conductivity (measured with a probe)**	0	0	2733	42	**2773**	94.74%
	Totals	**102**	**63**	**2,734**	**190**	**2,927**	**100.00%**

Table 14. Summary of TDS Data by Date Ranges

Date Range	All Total Dissolved Solids (TDS) Data								Average Total Dissolved Solids (TDS) Per Location Used for Mapping							
	Inside BWLA				Outside BWLA				Inside BWLA				Outside BWLA			
	Count Samples	Min	Max	Ave	Count Samples	Min	Max	Ave	Count Locations	Min	Max	Ave	Count Locations	Min	Max	Ave
Before 1960	1	1,871	1,871	1,871	82	328	4,040	2,271	1	1,871	1,871	1,871	32	328	3,251	1,417
1960s	12	389	3,454	1,611	117	182	4,396	1,280	12	389	3,454	1,611	113	182	4,396	1,243
1970s	29	747	4,836	3,226	228	176	5,087	1,259	20	845	4,726	3,142	179	176	5,087	1,358
Early 1980s	38	430	5,150	2,849	387	207	5,966	1,445	32	430	5,150	2,772	348	207	5,966	1,487
Late 1980s	26	804	4,333	2,870	680	176	6,092	1,405	26	804	4,333	2,870	467	176	6,029	1,473
Early 1990s	17	747	5,765	2,916	246	208	5,495	1,333	17	747	5,765	2,916	220	208	5,495	1,357
Late 1990s	139	286	6,000	3,188	310	201	5,840	1,563	65	317	5,495	3,116	242	201	5,840	1,453
2000-2006	50	941	5,966	3,415	137	251	4,270	1,744	34	941	5,535	3,257	105	251	4,270	1,760
Post 2006	49	502	6,946	3,164	379	344	5,457	919	20	2,098	3,737	3,045	69	417	3,335	1,147
TOTALS/ OVERALL	**361**	**286**	**6,946**	**3,092**	**2,566**	**176**	**6,092**	**1,378**	**227**	**317**	**5,765**	**2,957**	**1,775**	**176**	**6,029**	**1,436**

Note: Apparent trends in averages may be strongly influenced by the amount of data available, rather than actual increases in TDS

Table 15. TDS Plot Locations

Plot Number	Plot Map Number	Dataset	Well ID	Local ID/ Cadastral Location	Nad 83 UTM X	Nad 83 UTM Y	Well Registry ID	Well Depth (feet)	Water Use(s)	Inside Our Outside BWLA	First Sample Date	Last Sample Date	Count of Samples	Min TDS	Max TDS	Average TDS
1	**1-1**	GWSI	333053112571001	B-02-07 14CBB	318,526	3,710,117	610549	685	Irrigation, Domestic, Municipal	OUT	7/29/1953	6/11/1997	8	405	716	607
	1-2	GWSI	332936112535001	B-02-06 29BAB	323,713	3,707,598	617317	1,000	Irrigation	OUT	8/6/1984	5/16/2007	15	678	816	733
2	**2-1**	GWSI	331932112525801	C-01-06 21CBB2	324,753	3,689,055	602602	1,012	Irrigation, Commercial	OUT	8/6/1968	8/22/1996	5	1,036	1,771	1,582
	2-2	GWSI	331858112515601	C-01-06 27BBC	326,240	3,687,879	611935	1,090	Irrigation, Stock	OUT	7/18/1974	6/11/1997	9	785	1,702	1,420
3	**3-1**	ADEQ	45607	C-01-05 03DAC	337,224	3,693,324	Unknown[1]	--	--	OUT	4/10/1992	10/12/2011	24	440	1,316	869
	3-2	ADEQ	46611	C-01-05 03DAB	337,237	3,693,511	Unknown[1]	--	--	OUT	6/1/1999	10/11/2011	18	509	5,457	842
	3-3	ADEQ	006244	C-01-05 03DAA	337,362	3,693,658	Unknown[1]	--	--	OUT	8/24/1989	10/13/2011	23	408	590	460
4	**4-1**	ADEQ	56875	C-02-05 08AAA	334,129	3,683,613	565361	532	Monitoring	IN	2/19/1998	4/16/2012	17	641	6,946	4,902
	4-2	ADEQ	56876	C-01-05 29DDD	334,183	3,686,515	565363	997	Monitoring	IN	2/19/1998	4/16/2012	17	1,608	4,528	3,667
	4-3	GWSI	331738112450101	C-01-05 34DBD	336,963	3,685,241	Unknown[2]	532	Irrigation	IN	7/18/1974	6/24/1981	3	3,140	4,836	3,894
5	**5-1**	ADEQ	56872	C-01-05 13CCC	339,289	3,689,654	565362	unk	Monitoring	IN	2/19/1998	4/16/2012	17	0	3,919	2,861
	5-2	GWSI	332053112425401	C-01-05 13AAB	340,254	3,691,216	612448	unk	Irrigation	IN	6/10/1970	8/9/2007	10	1,319	3,831	3,113
	5-3	ADEQ	56870	C-01-04 19BBB	340,793	3,689,628	516809	unk	Test	IN	2/19/1998	4/16/2012	18	546	4,735	3,019
6	**6-1**	ADEQ	23353	C-02-05 26CDD	337,920	3,676,940	622283	1,040	Irrigation	OUT	4/19/1946	4/2/2013	5	1,790	2,400	2,127
	6-2	GWSI	331210112425701	C-03-04 06BBA	340,010	3,675,103	622286	unk	Irrigation	OUT	4/9/1946	5/9/2000	6	2,129	2,622	2,425
	6-3	GWSI	331247112404901	C-02-04 33BCA	343,365	3,676,263	Unknown[2]	997	Irrigation	OUT	9/30/1965	5/13/1998	4	1,382	5,840	4,498
	6-4	GWSI	330750112401501	C-03-04 33ABA	344,077	3,666,987	622298	802	Irrigation	OUT	5/27/1946	6/22/2000	5	1,394	2,575	2,148
7	**7-1**	ADEQ	56873	C-01-04 17ADD	343,945	3,690,470	Unknown[2]	--	--	IN	2/19/1998	7/18/2002	11	3	4,226	3,154
	7-2	ADEQ	22894	C-01-04 09DDD	345,558	3,691,156	Unknown[2]	--	--	IN	8/1/1965	7/29/2002	3	1,225	3,094	2,315
	7-3	ADEQ	56869	C-01-04 10ADD	347,176	3,692,084	Unknown[2]	--	--	IN	2/19/1998	4/16/2012	18	286	4,000	2,880
	7-4	ADEQ	22895	C-01-04 10DAD	347,176	3,691,541	Unknown[2]	--	--	IN	5/3/1979	7/29/2002	3	3,522	5,765	4,459
	7-5	ADEQ	56871	C-01-03 06CCC	350,555	3,692,706	565365	40	Monitoring	IN	2/19/1998	7/18/2002	11	2	4,270	2,976
8	**8-1**	ADEQ	56874	C-01-03 01CDC	359,007	3,692,568	565367	30	Monitoring	IN	2/19/1998	4/16/2012	18	345	3,781	2,852
	8-2	GWSI	332353112235601	B-01-01 30DBB	369,898	3,696,385	619786	425	Irrigation	IN	5/29/1987	5/31/2006	6	2,707	4,076	3,290
9	**9-1**	GWSI	331437112294401	C-02-02 19AAD	360,604	3,679,297	636073	434	Stock, Irrigation, Domestic	OUT	8/5/1981	5/3/2001	18	741	835	786
	9-2	GWSI	330914112065801	D-03-02 23ADD	395,851	3,668,908	Unknown[2]	1,040	Unused	OUT	4/15/1975	5/7/1997	11	414	1,570	571
10	**10-1**	GWSI	332905112181701	A-02-01 30CBB	378,612	3,705,889	607239	680	Irrigation	OUT	7/16/1965	7/31/2007	6	484	942	768
	10-2	GWSI	333028112172002	A-02-01 20BBB	380,199	3,708,343	607243	800	Irrigation	OUT	5/1/1979	6/3/2008	10	537	885	736
11	**11-1**	ADEQ	8783	A-01-01 28CAC	382,115	3,695,904	607695	152	Irrigation Utility (Water Co)	OUT	12/15/1933	1/27/2009	43	1,200	4,040	2,491
	11-2	ADEQ	8777	A-01-01 27CBB	383,421	3,696,150	Unknown[3]	--	--	OUT	7/20/1927	3/22/1960	28	1,850	3,390	2,574
	11-3	GWSI	332520112063801	A-01-02 13CDD2	396,944	3,698,712	607209	400	Irrigation	OUT	9/13/1982	9/12/2008	6	948	1,287	1,052

1. Unknown registry ID. There are several potential matches in this location.
2. Unknown registry ID. There are no wells registered in this location.
3. Unknown registry ID. There are wells in this location but they don't appear to be a match.

Table 16. Timeline
Shallow Water Conditions Vs. Pumping
Drainage and Dewatering and Stream Flow 1986-2014

Year	Area Within the BWLA With Shallow (≤ 20 ft bgs) Groundwater (Sq Mi)					Mean Depth To Water (Feet bgs)					Pumping Volumes Inside the BWLA (Acre-Feet)					Pumping Volumes In the Vicinity of BWLA (Acre-Feet)		Max of Mean Daily Stream Flow (CFS)
	BWCDD	ACC	SJID	Non-ID	Total	BWCDD	ACC	SJID	Non-ID	Inside BWLA	BWCDD	ACC	SJIDD	Non-ID	Total Inside BWLA	Total	Drainage & Dewatering	
1986	19.61	0.67	3.20	26.70	**50.18**	22.37	38.43	16.61	28.12	**26.59**	47,629	1,485	492	8,124	**57,730**	194,066	26,461	600
1987											48,698	1,197	376	8,324	**58,543**	198,184	38,921	1,380
1988											57,954	874	1,133	9,067	**69,028**	217,693	30,858	915
1989											46,881	598	1,242	6,477	**55,198**	200,876	25,404	319
1990											61,659	1,535	866	8,032	**71,923**	207,346	27,920	1,430
1991	21.66	0.89	3.25	31.08	**56.88**	19.35	36.29	13.57	24.86	**23.54**	66,034	1,055	354	10,899	**78,260**	185,155	33,348	1,800
1992											53,968	1,186	492	7,560	**63,136**	145,608	40,153	13,000
1993											54,235	904	809	9,256	**65,128**	165,659	38,349	132,000
1994											62,003	985	1,643	11,990	**76,552**	224,391	41,096	500
1995											58,316	1,035	1,291	10,504	**71,038**	205,438	32,988	51,400
1996											68,735	897	196	9,998	**79,803**	208,822	29,050	555
1997	19.14	0.23	1.26	24.30	**44.92**	19.96	36.85	29.49	29.73	**26.88**	62,324	1,442	2,355	13,148	**79,186**	202,278	22,307	1,880
1998											52,340	1,525	1,204	6,339	**61,311**	153,615	15,746	5,350
1999											67,401	1,657	1,111	12,553	**82,662**	189,966	25,358	630
2000											76,073	3,020	995	12,998	**92,907**	223,024	39,779	6,100
2001											79,305	1,976	1,004	14,803	**97,066**	203,855	24,235	445
2002	13.65	0.74	0.00	19.70	**34.09**	22.84	41.13	32.63	32.36	**29.75**	91,002	4,172	784	14,736	**110,562**	234,101	25,780	980
2003											86,826	4,760	846	15,217	**107,292**	230,544	31,601	1,330
2004											86,813	4,047	187	9,973	**100,883**	231,927	37,259	2,205
2005											71,189	2,867	734	13,267	**87,909**	189,515	31,407	29,900
2006											85,294	1,537	1,241	14,218	**102,209**	199,454	32,185	424
2007											101,359	3,372	1,201	17,642	**123,444**	233,077	38,469	619
2008	13.68	0.00	3.01	15.91	**32.61**	21.65	46.97	19.56	30.21	**28.27**	102,948	5,173	1,057	25,685	**134,538**	246,969	39,700	2,800
2009											94,601	14,092	1,176	24,267	**132,553**	241,412	35,605	1,476
2010											66,511	22,374	587	21,998	**109,244**	205,115	25,131	11,700
2011	10.03	0.00	0.00	5.79	**15.82**	24.99	58.78	23.27	37.26	**34.30**	86,743	20,102	4	20,267	**124,397**	245,510	20,706	1,040
2012											87,362	19,670	526	18,518	**123,826**	255,096	31,347	2,050
2013	7.61	1.49	2.76	15.05	**26.92**	25.48	62.58	17.73	36.32	**34.13**	85,378	21,759	379	19,790	**124,000**	245,643	24,127	1,120
2014																		286

FIGURES

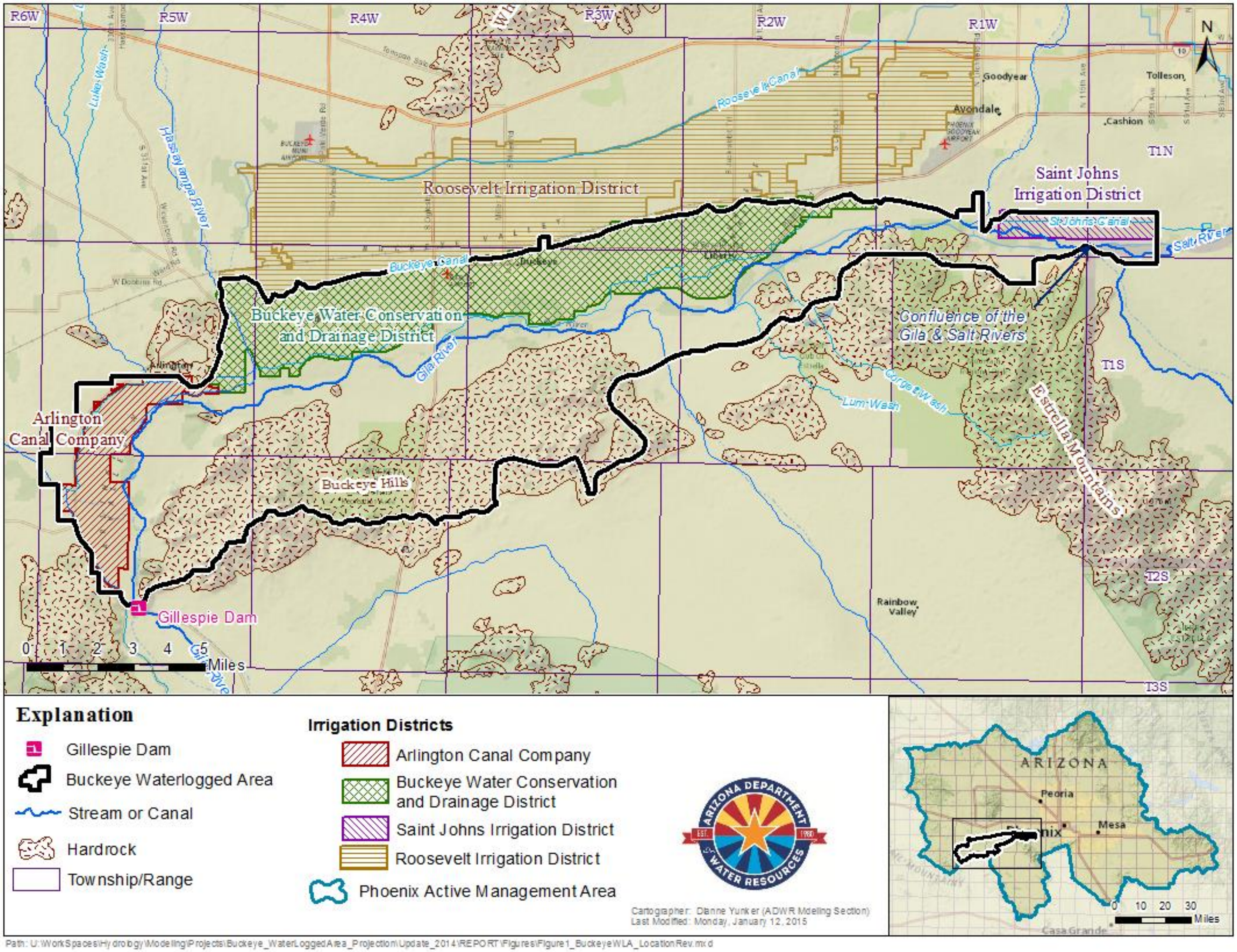

Figure 1. Location of the Buckeye Waterlogged Area

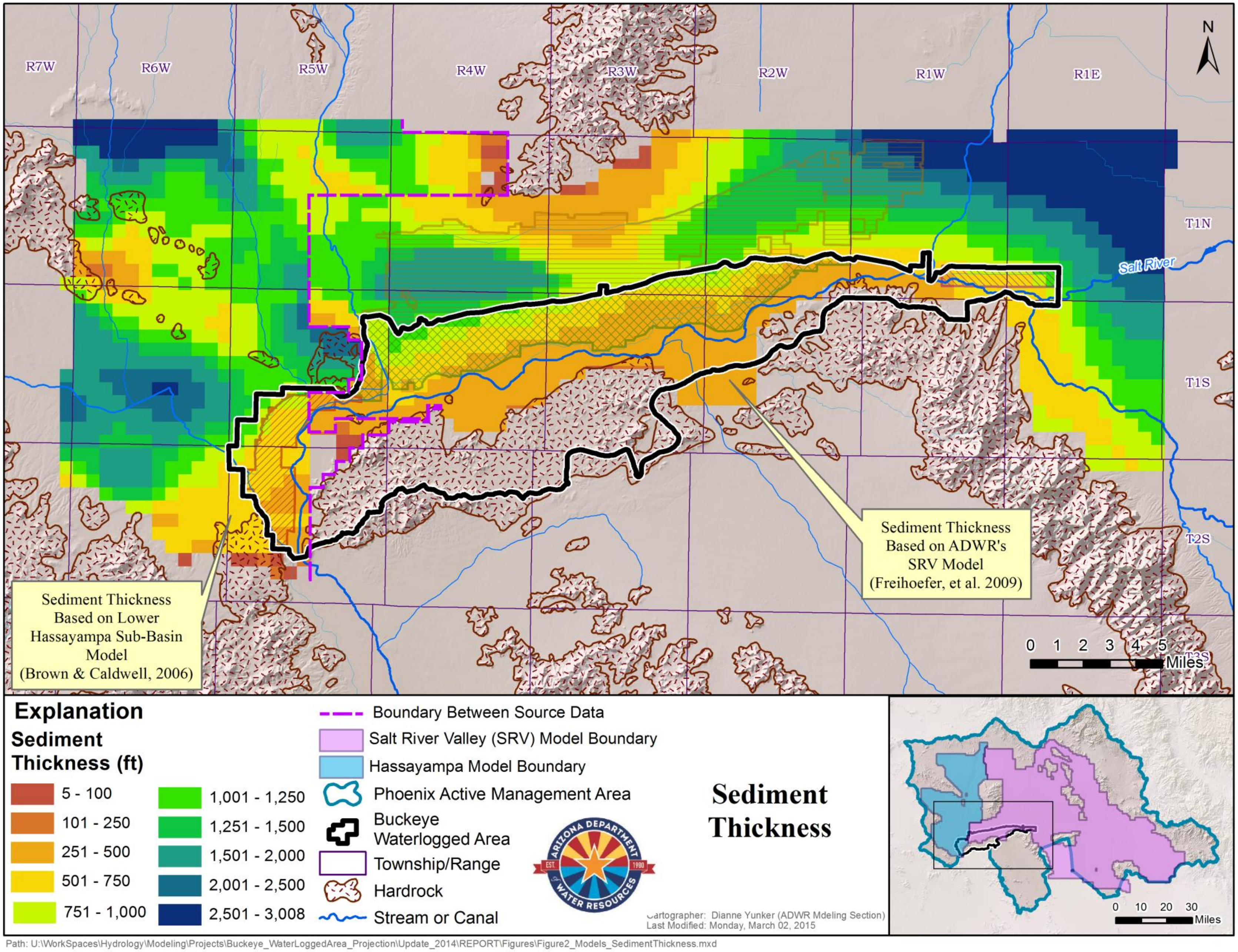

Figure 2. Sediment Thickness Based on Geology and Well Data Compiled in Groundwater Models

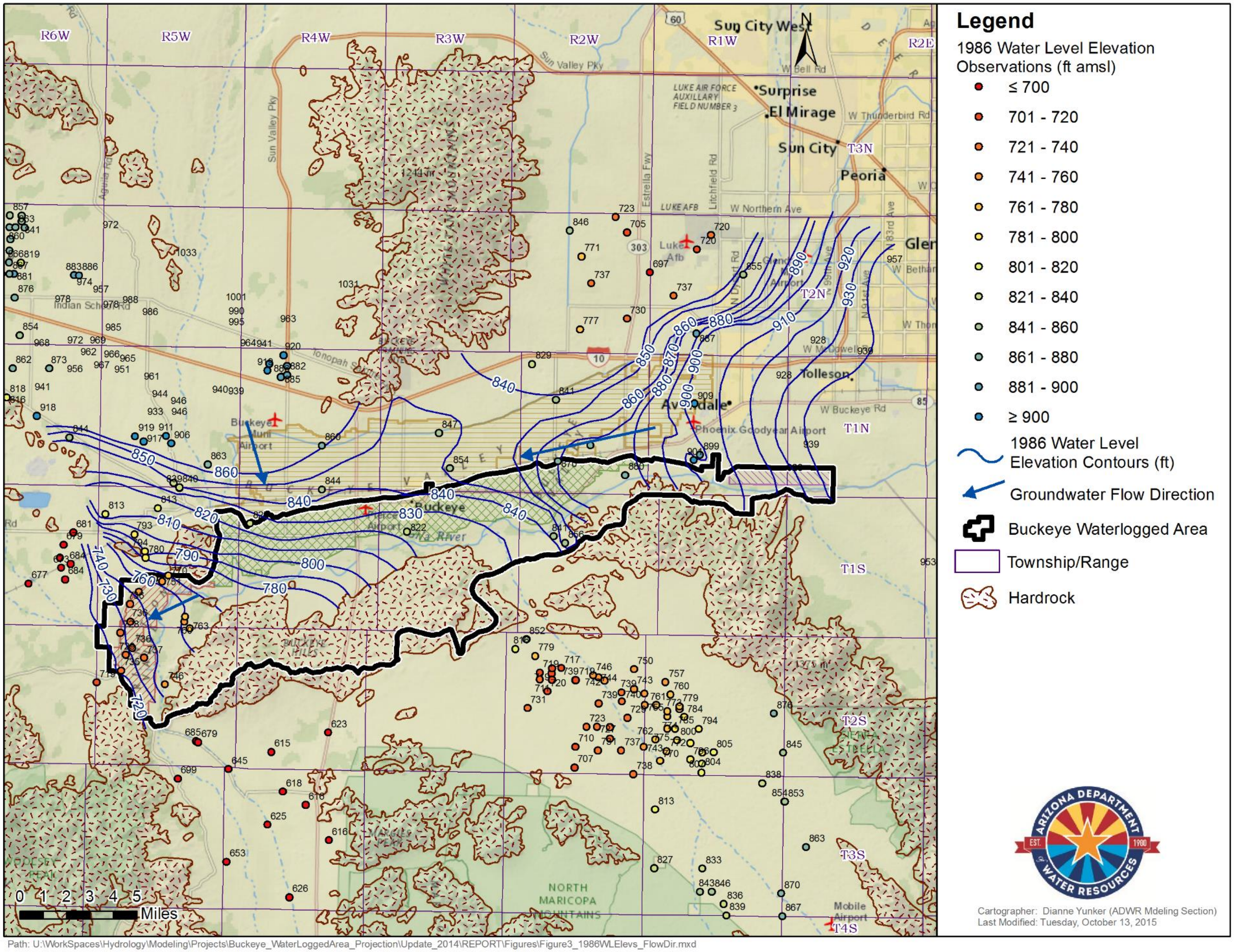

Figure 3. 1986 Water Level Elevations and Flow Direction

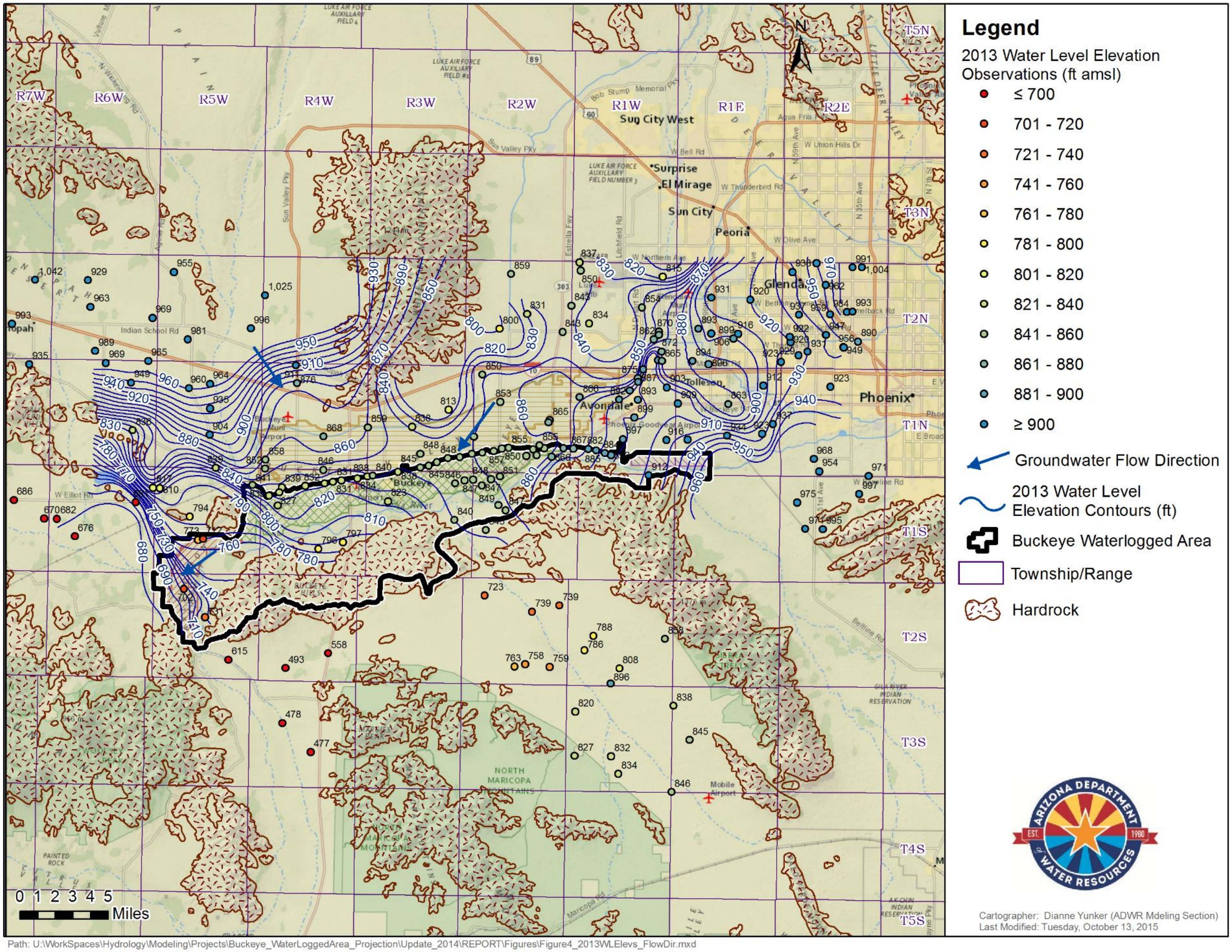

Figure 4. 2013 Water Level Elevations and Flow Direction

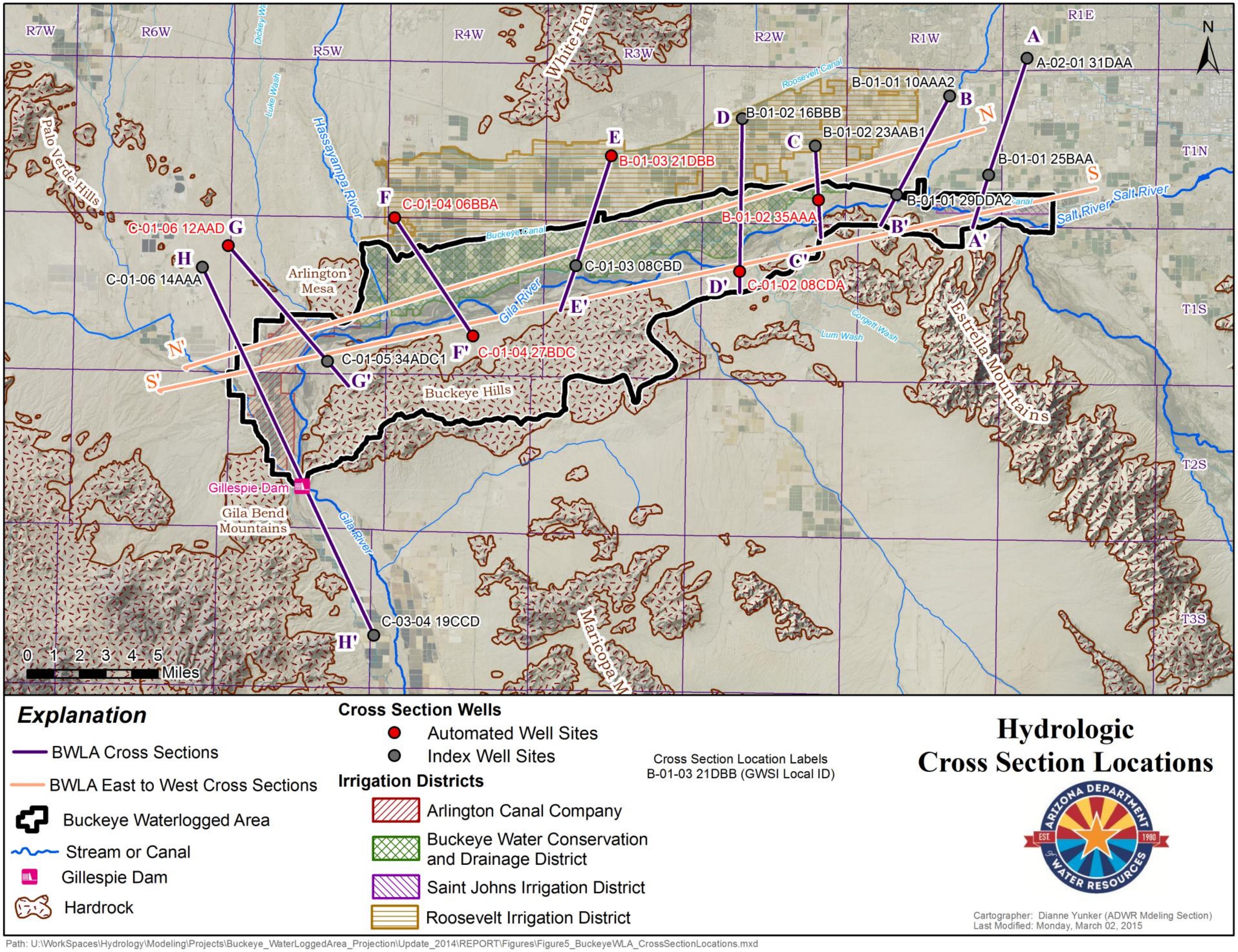

Figure 5. Hydrologic Cross Section Locations

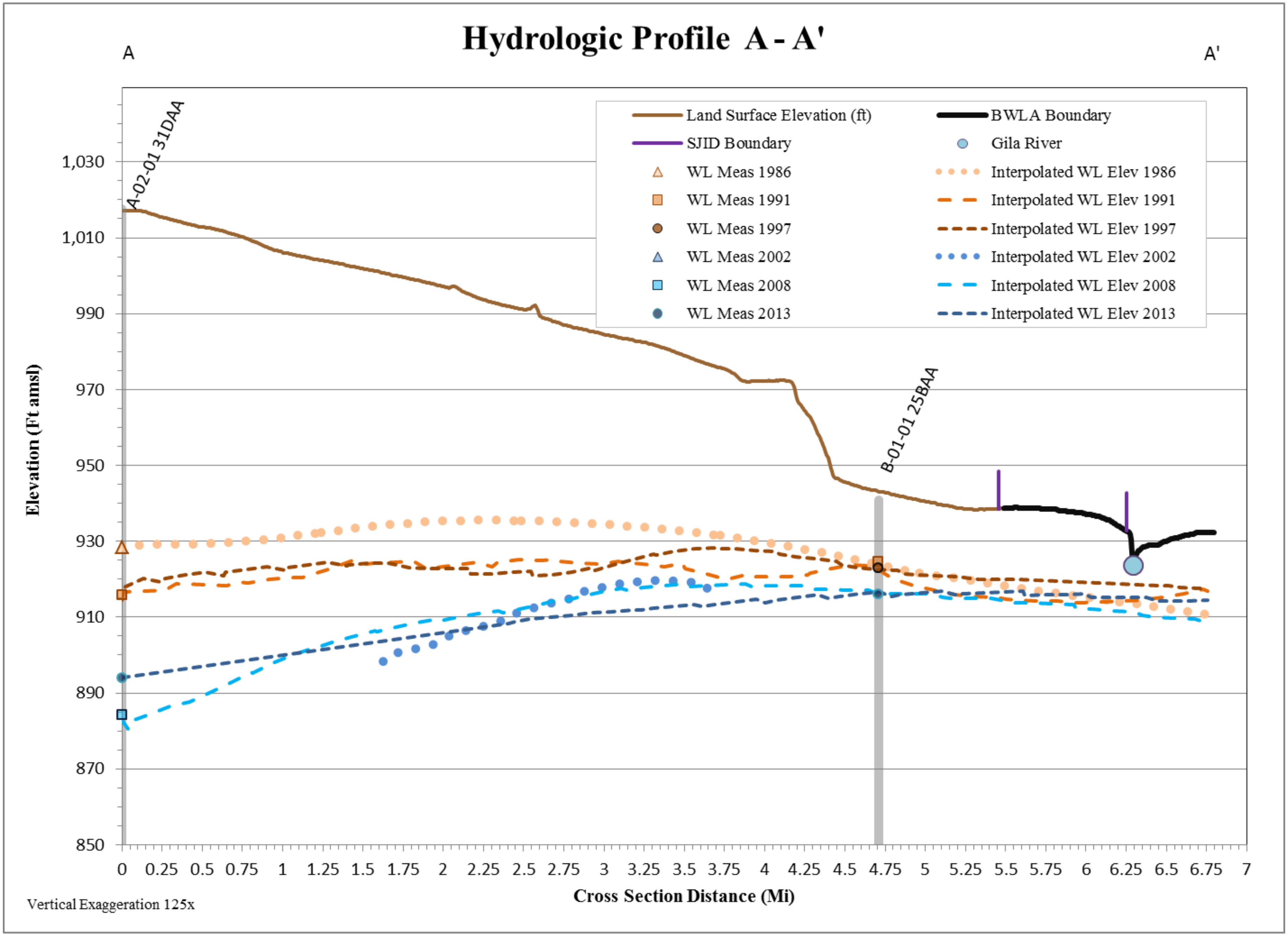

Figure 6. Hydrologic Profile A – A’

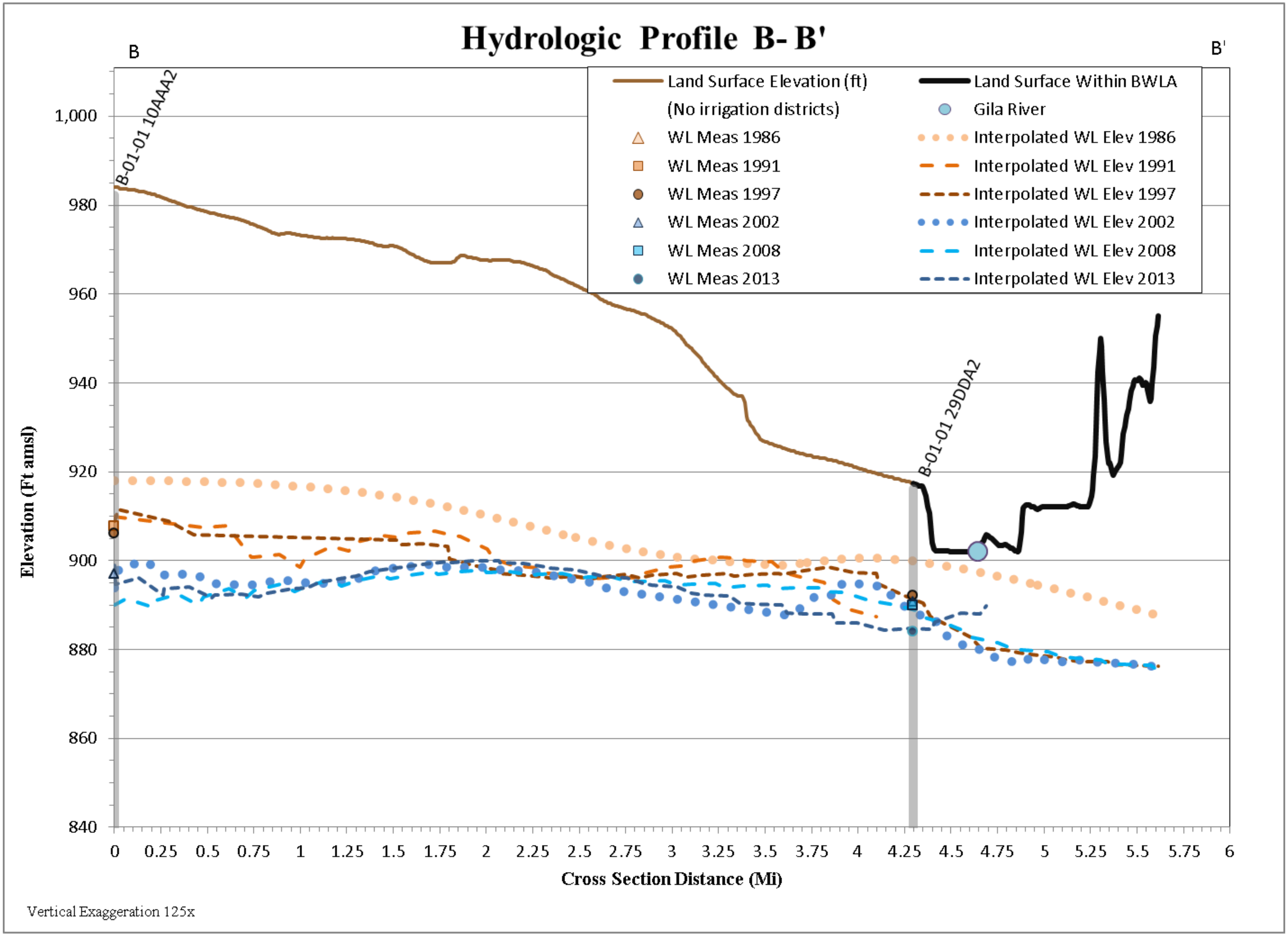

Figure 7. Hydrologic Profile B - B'

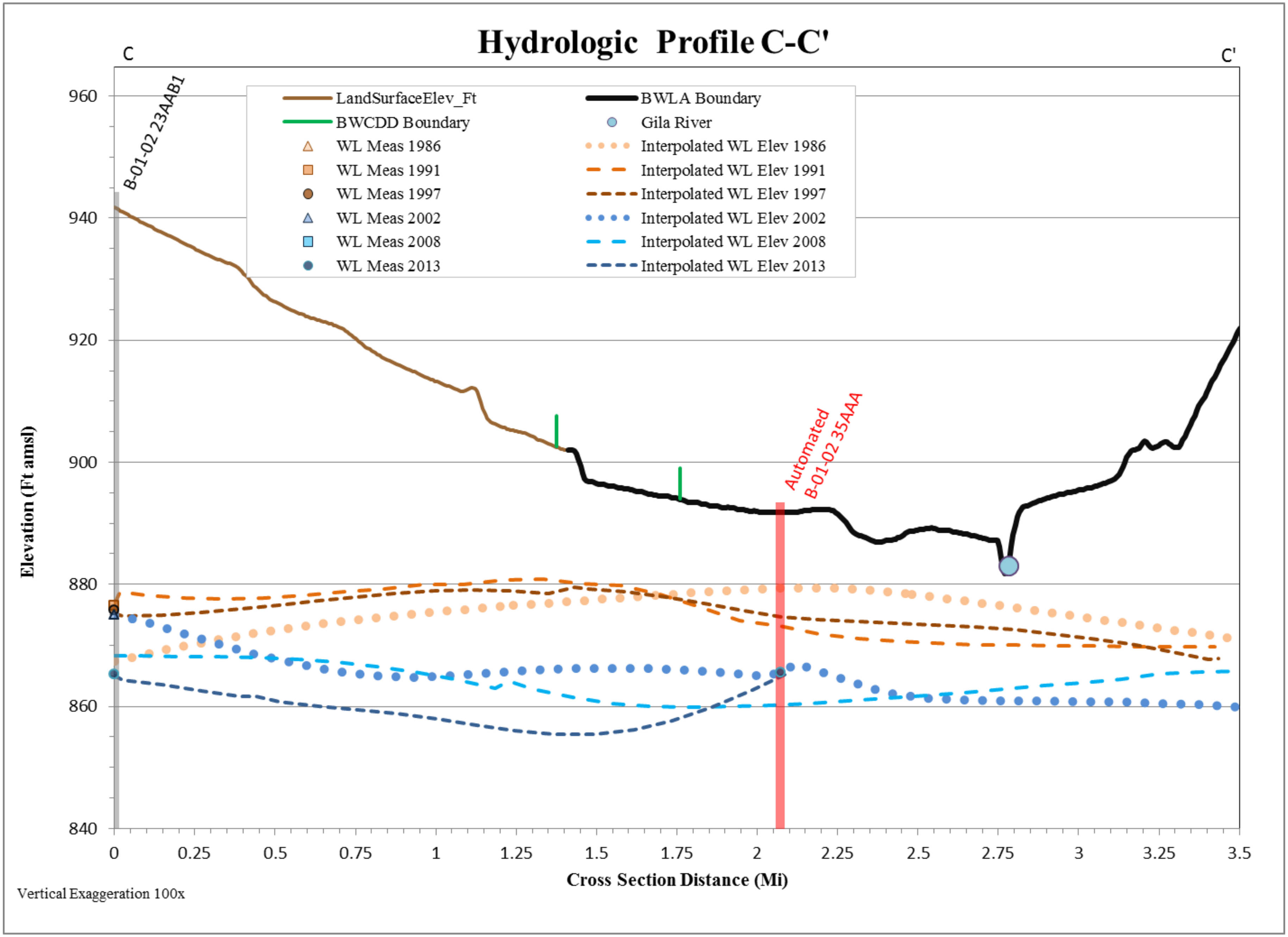

Figure 8. Hydrologic Profile C - C'

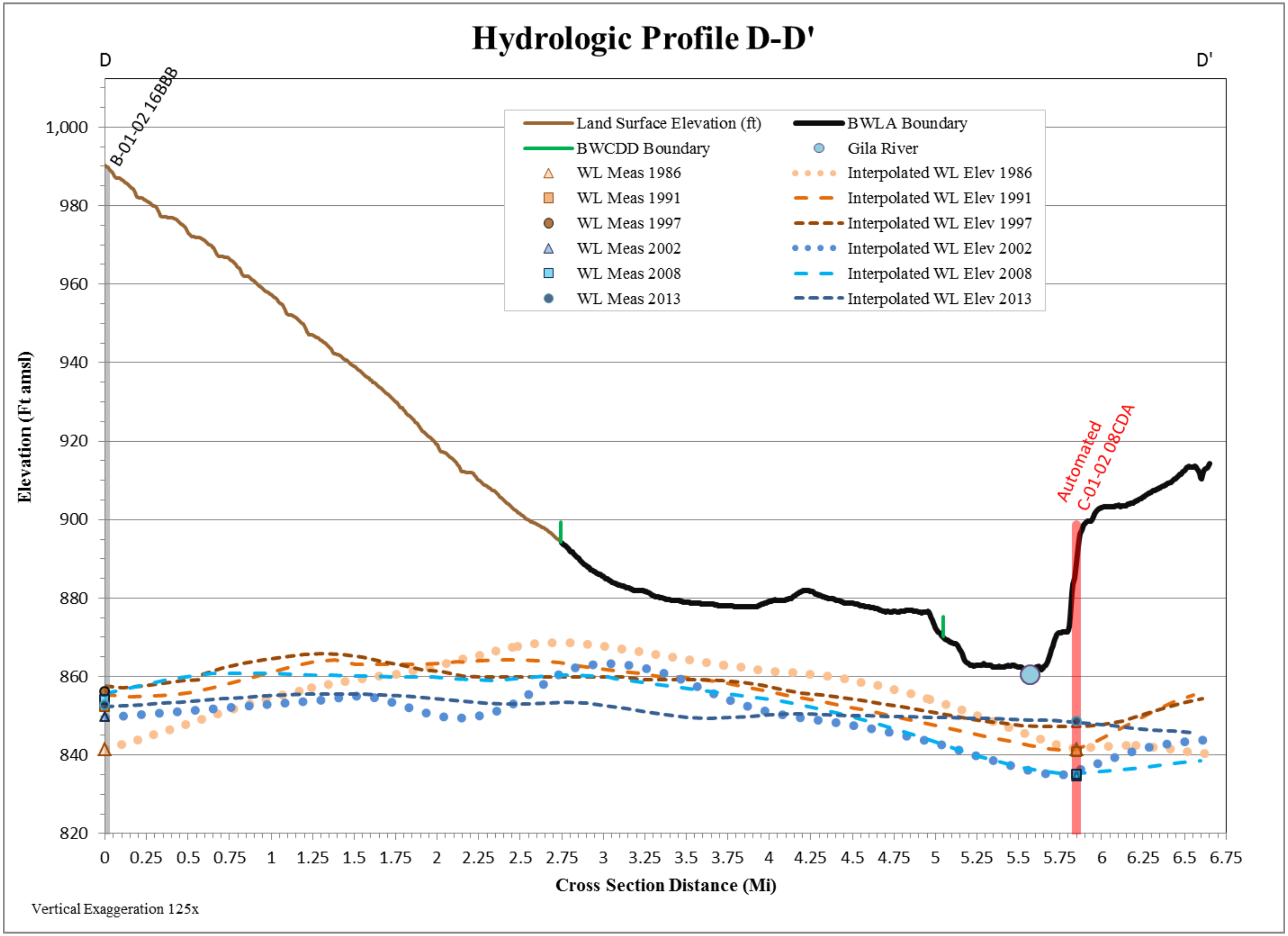

Figure 9. Hydrologic Profile D - D'

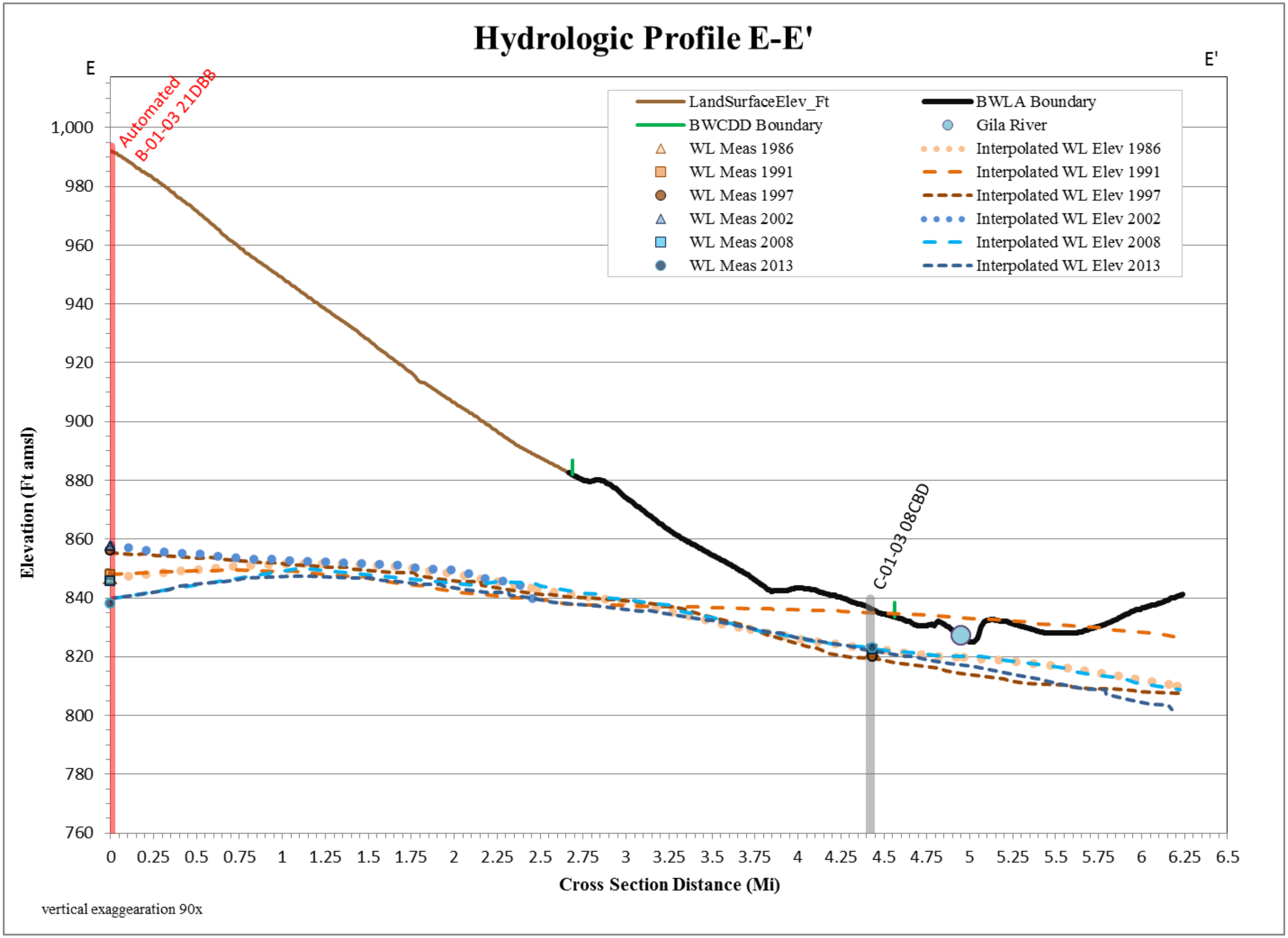

Figure 10. Hydrologic Profile E - E'

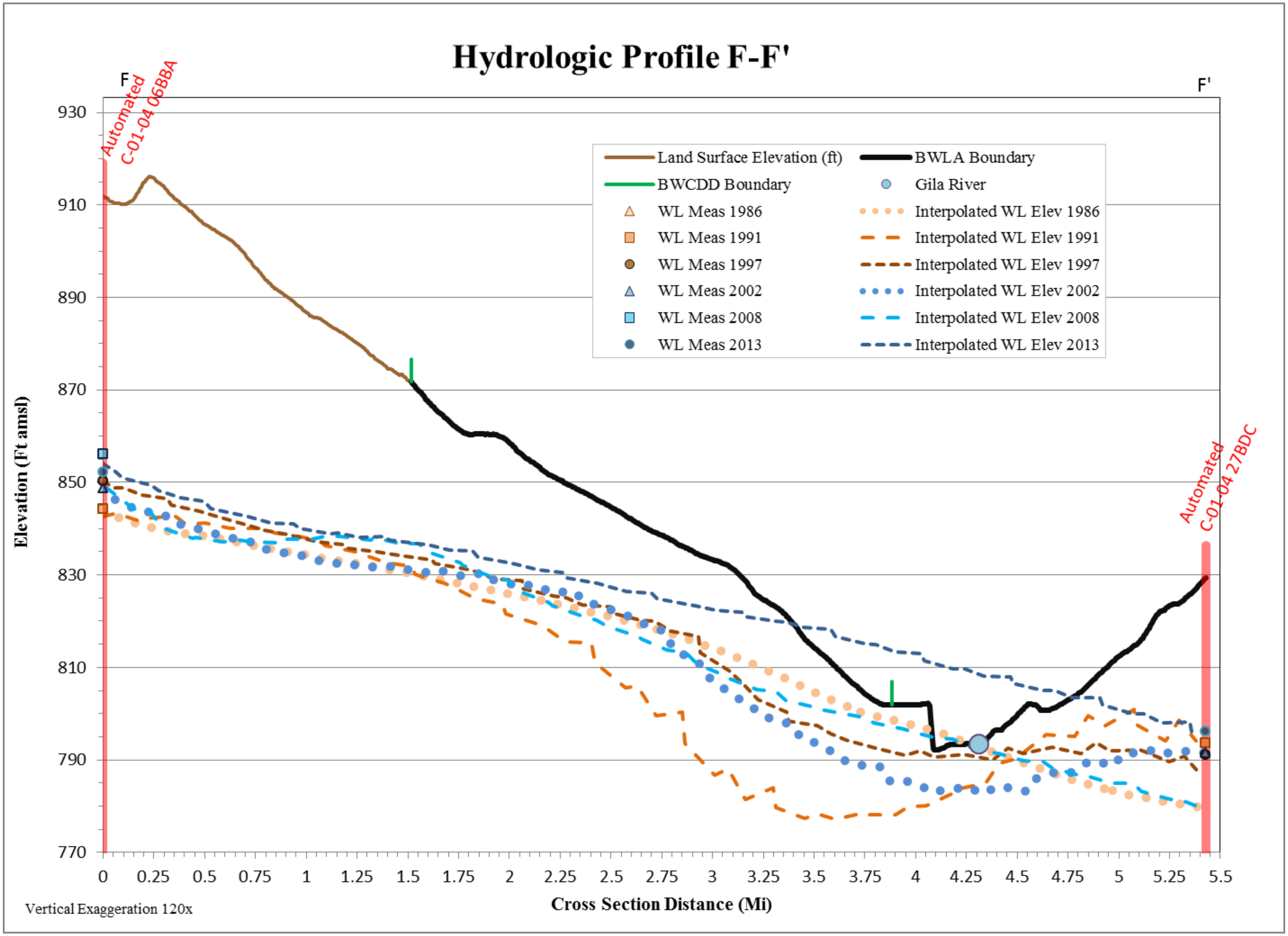

Figure 11. Hydrologic Profile F - F'

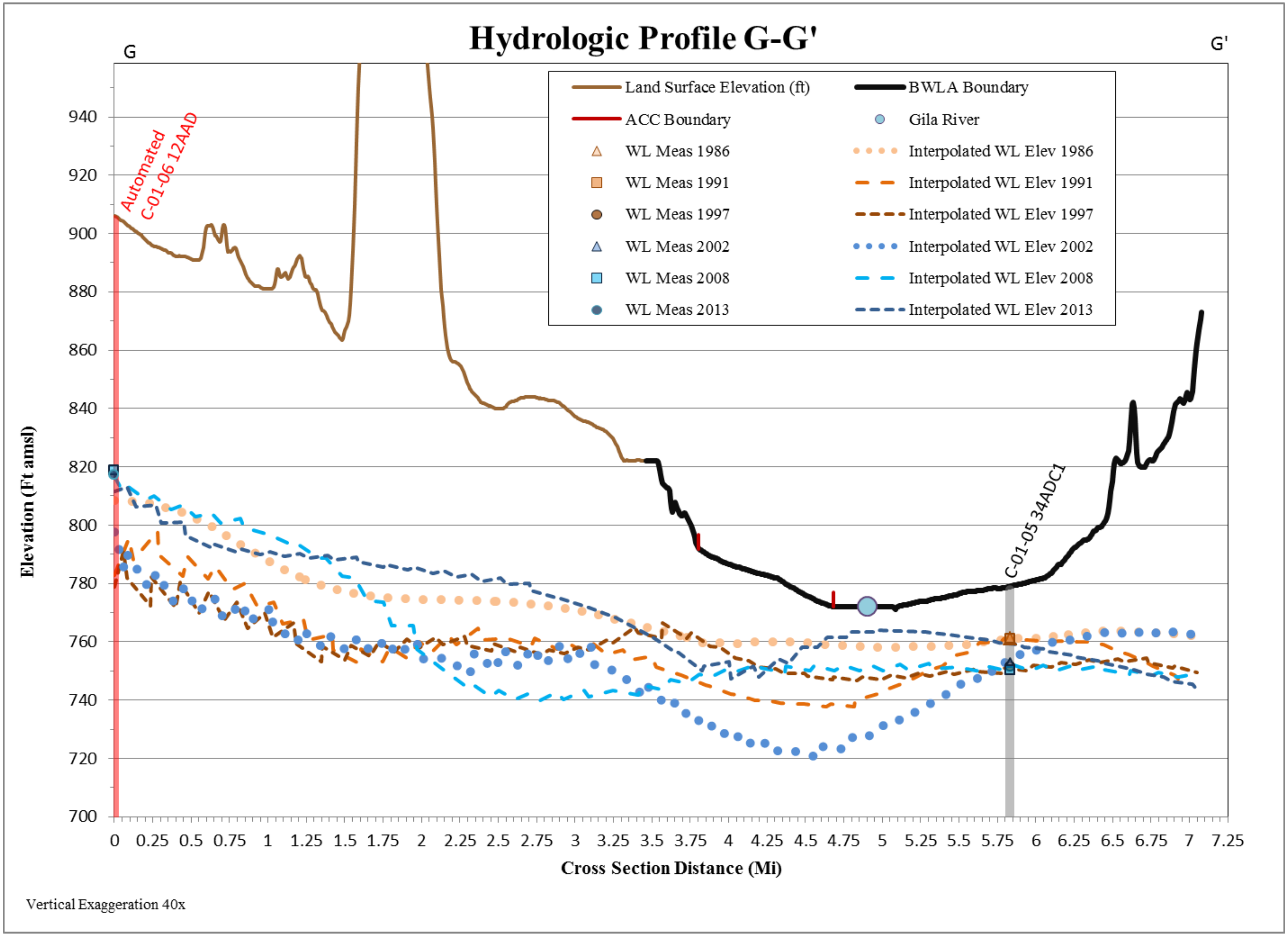

Figure 12. Hydrologic Profile G - G'

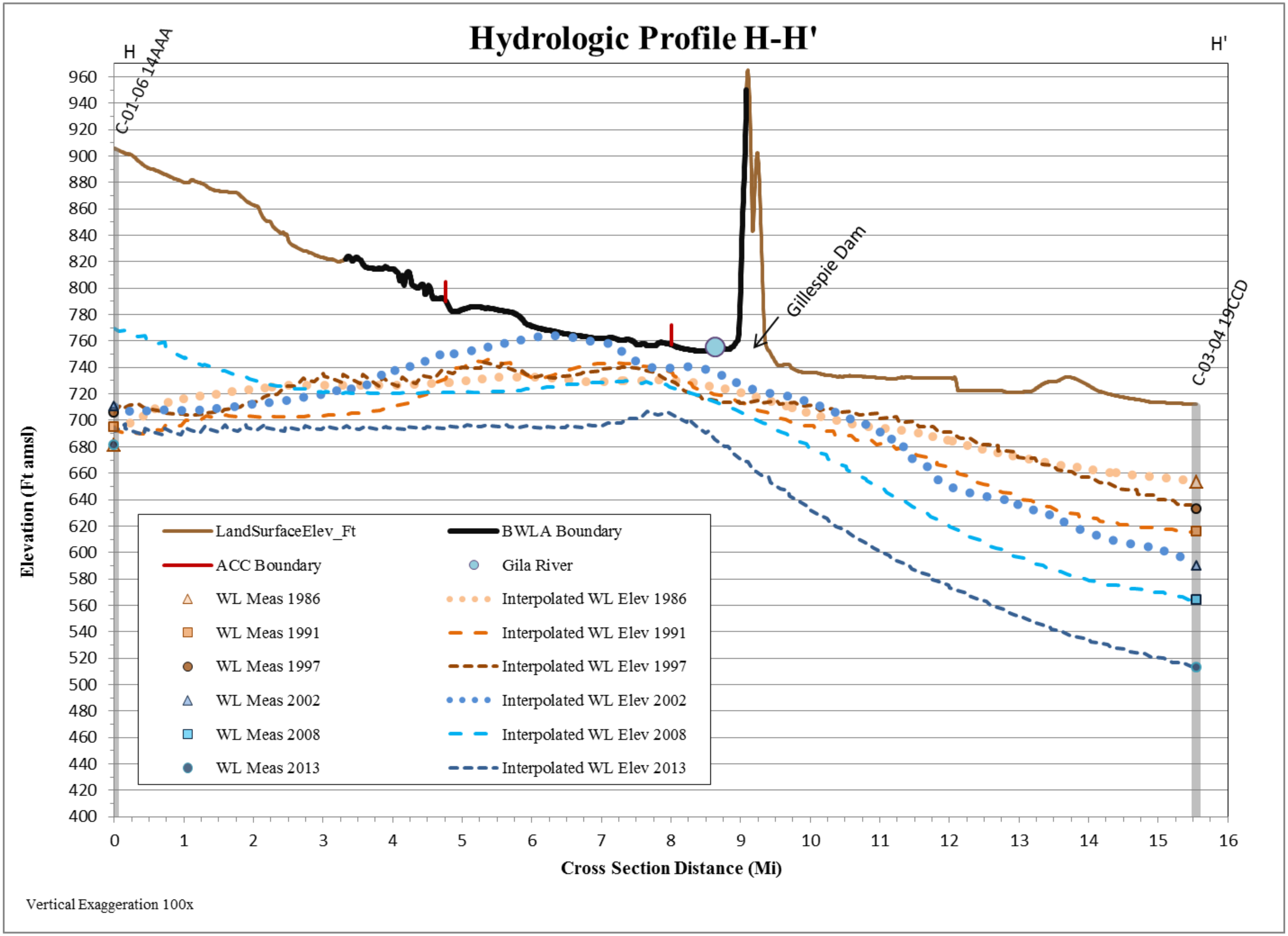

Figure 13. Hydrologic Profile H - H'

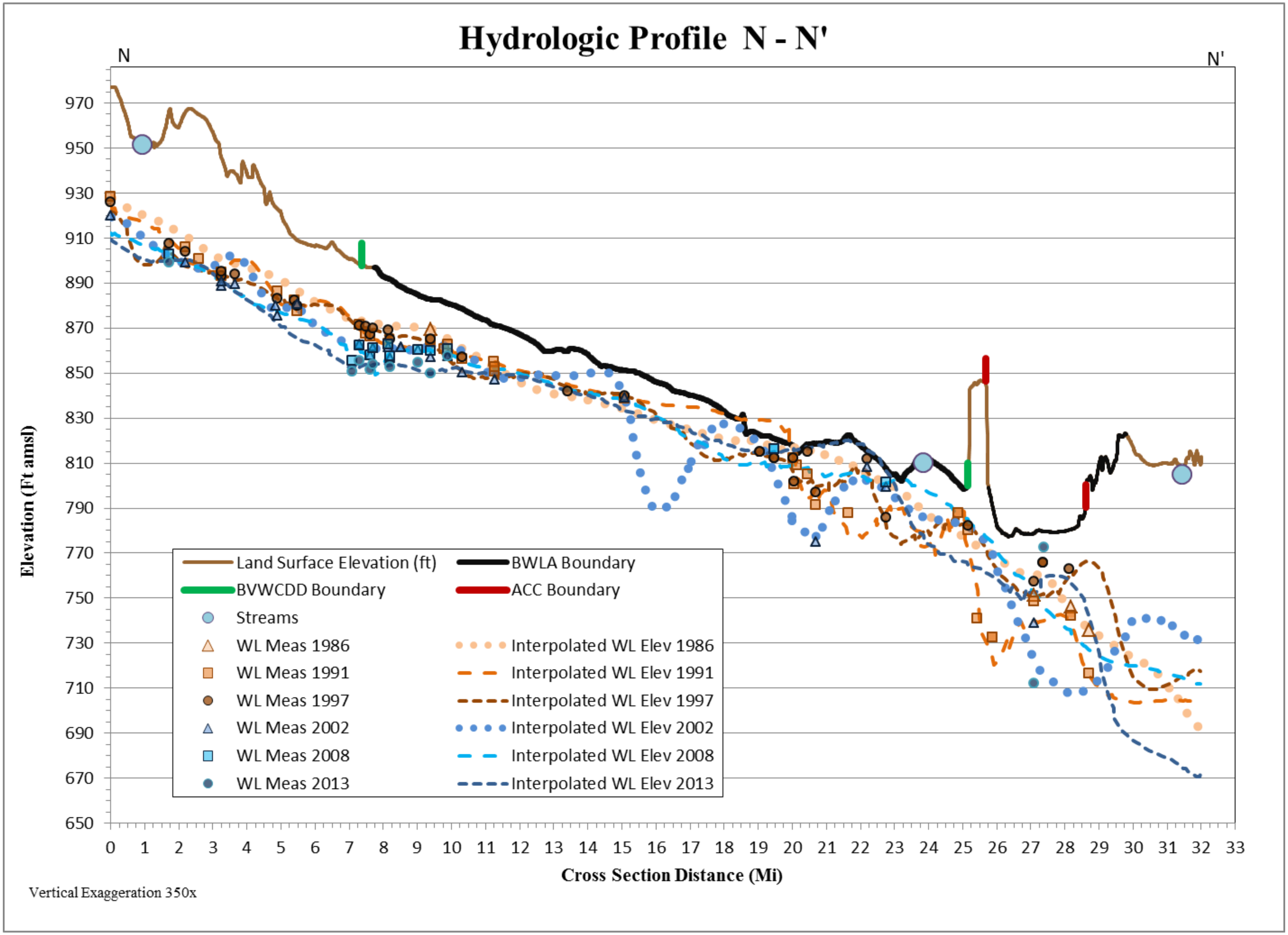

Figure 14. Hydrologic Profile N-N'

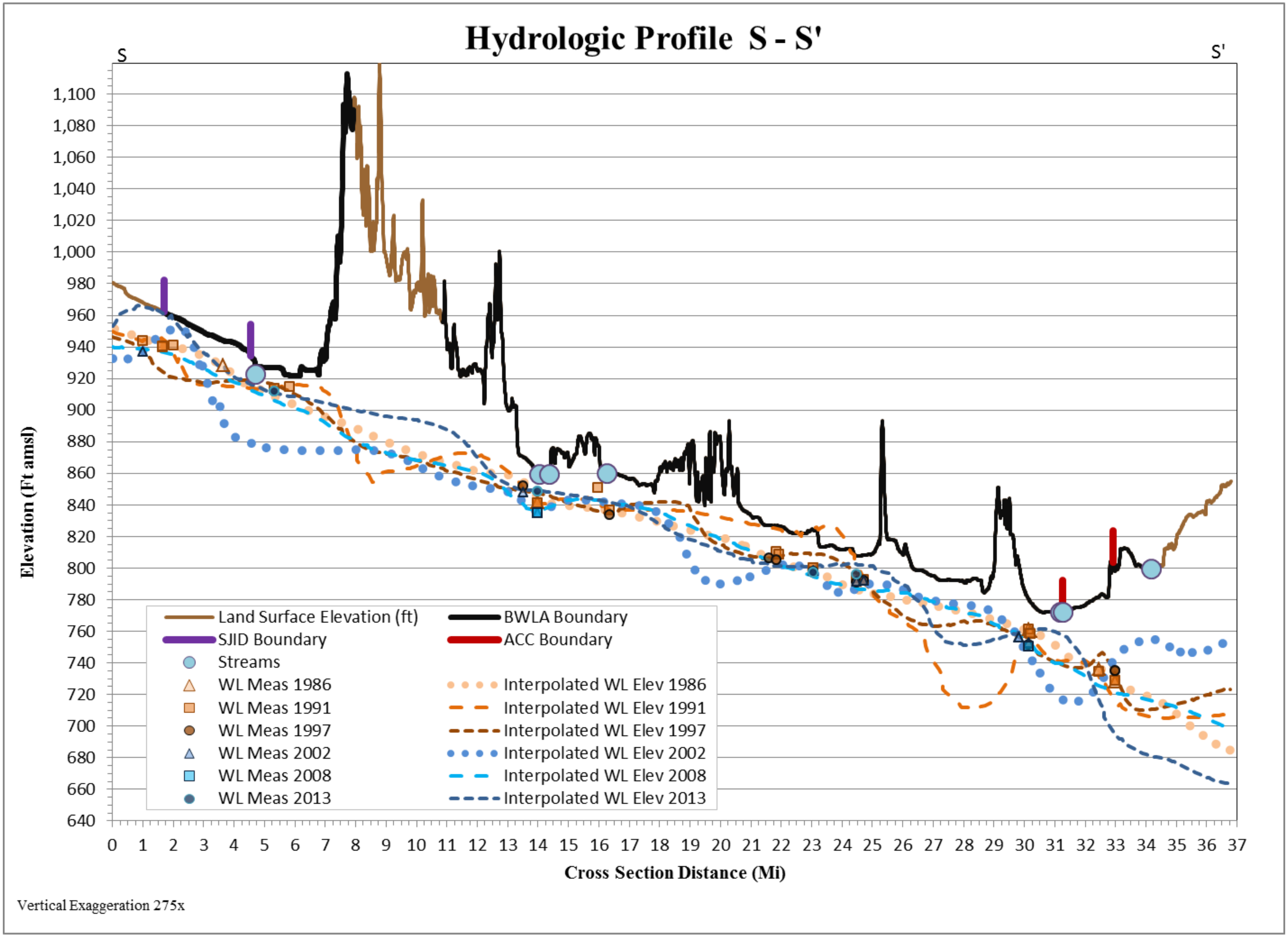

Figure 15. Hydrologic Profile S - S'

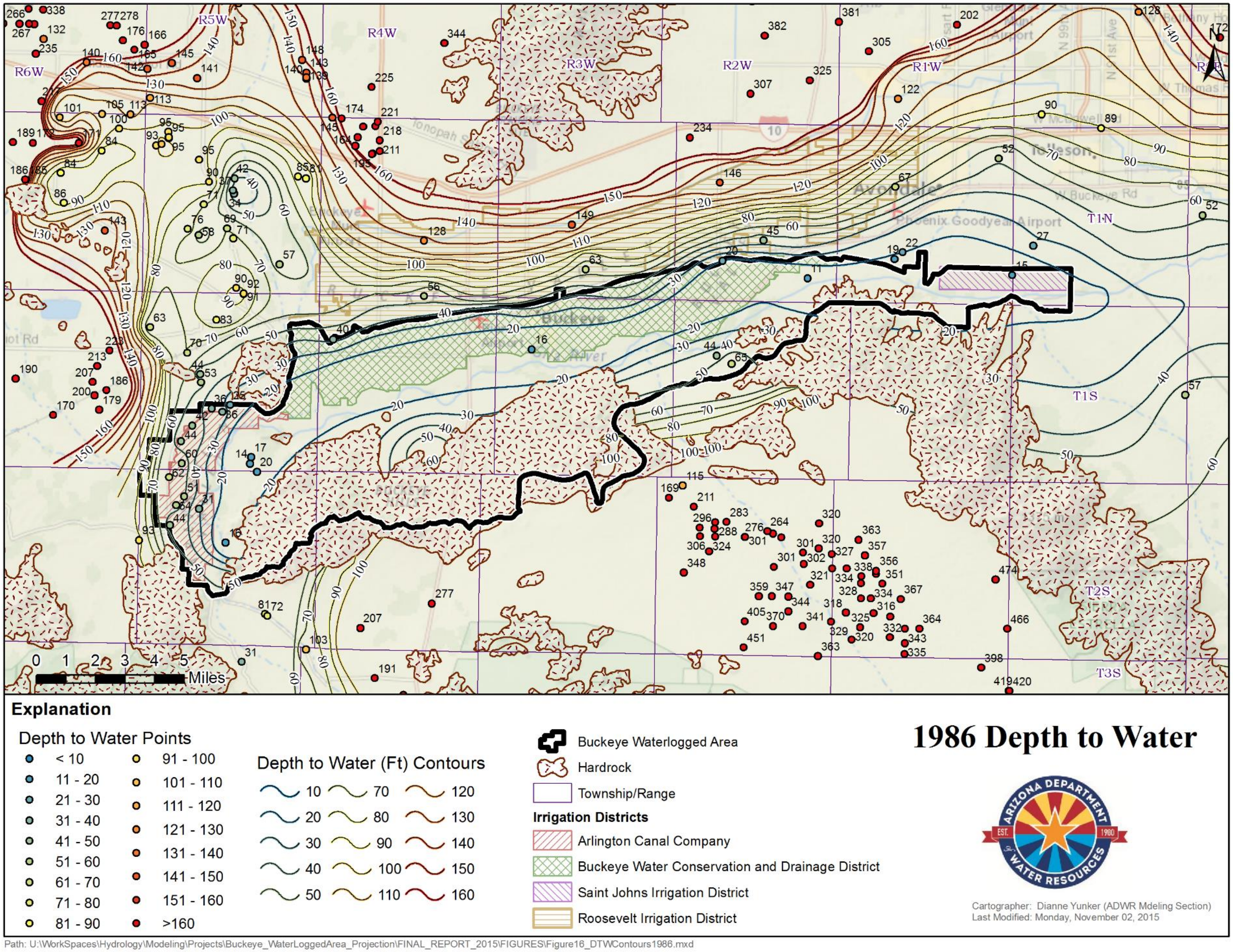

Figure 16. 1986 Depth to Water

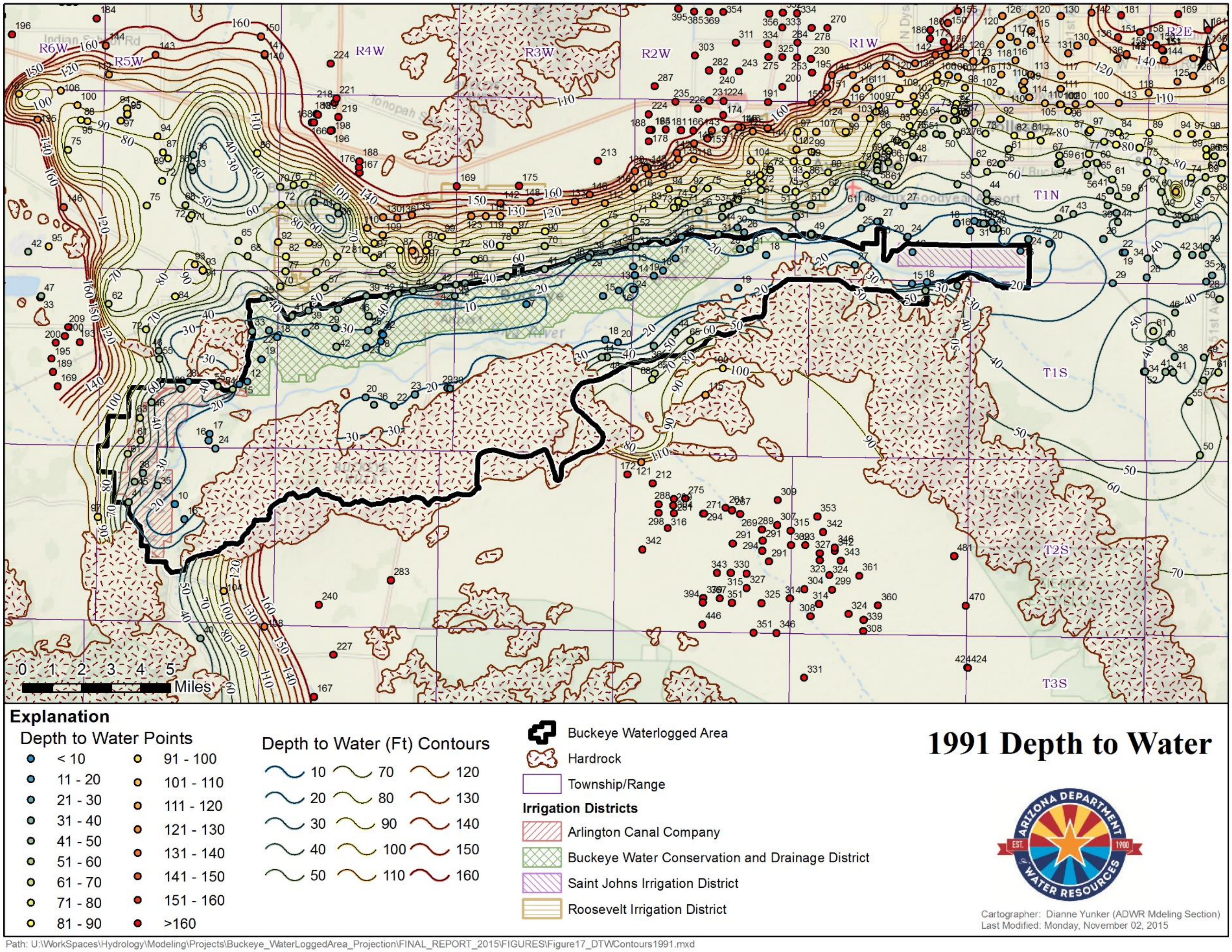

Figure 17. 1991 Depth to Water

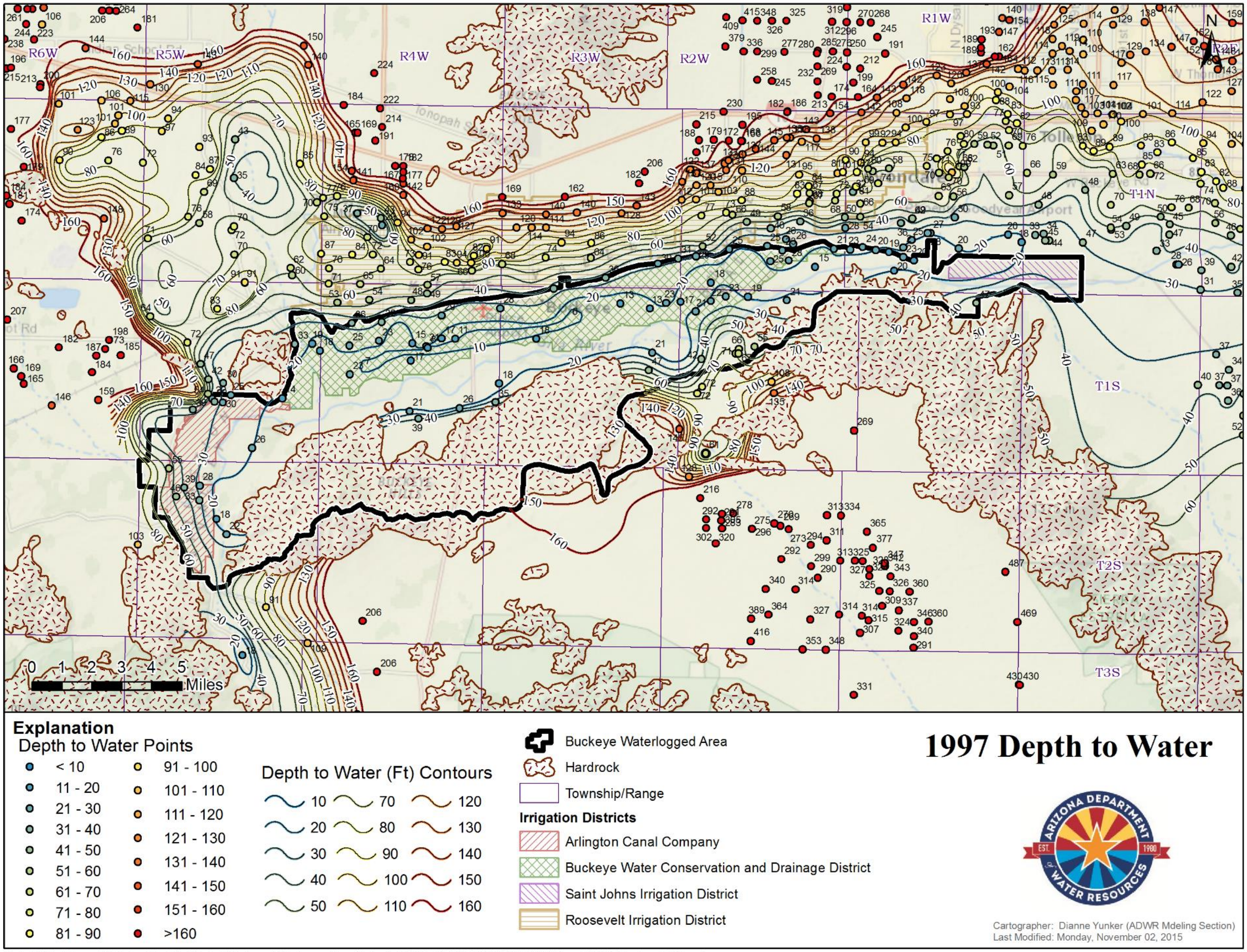

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Figure 18. 1997 Depth to Water

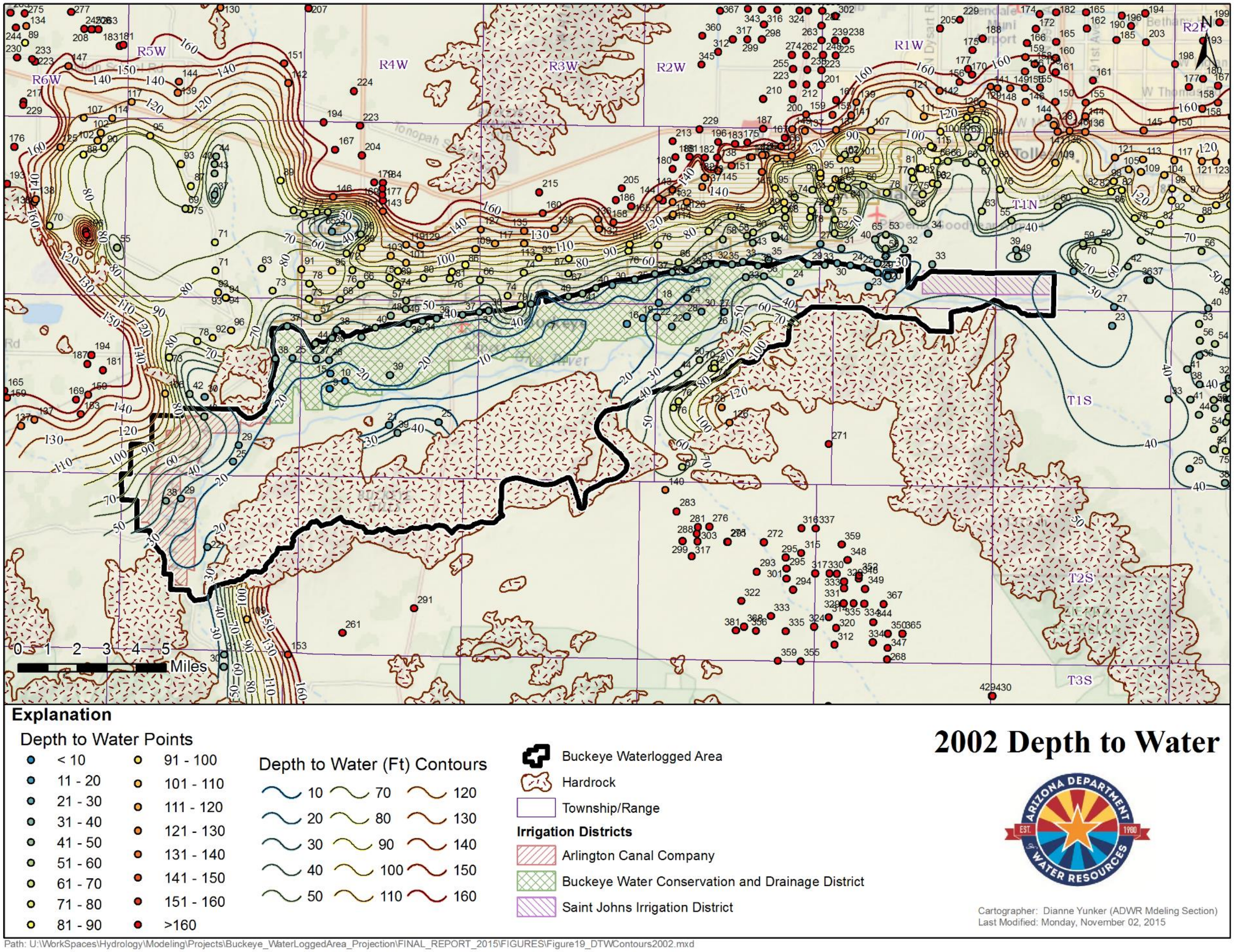

Figure 19. 2002 Depth to Water

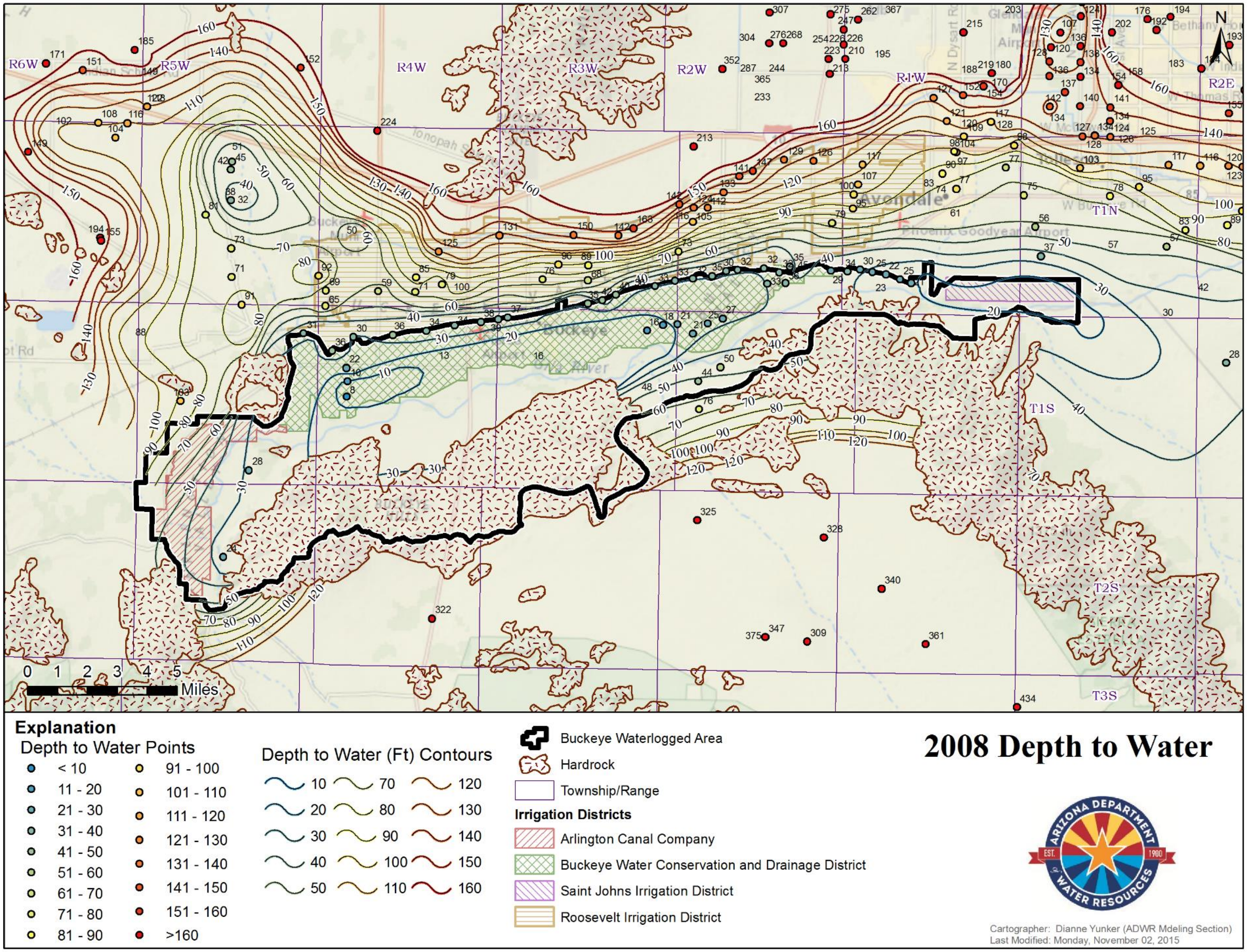

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Figure 20. 2008 Depth to Water

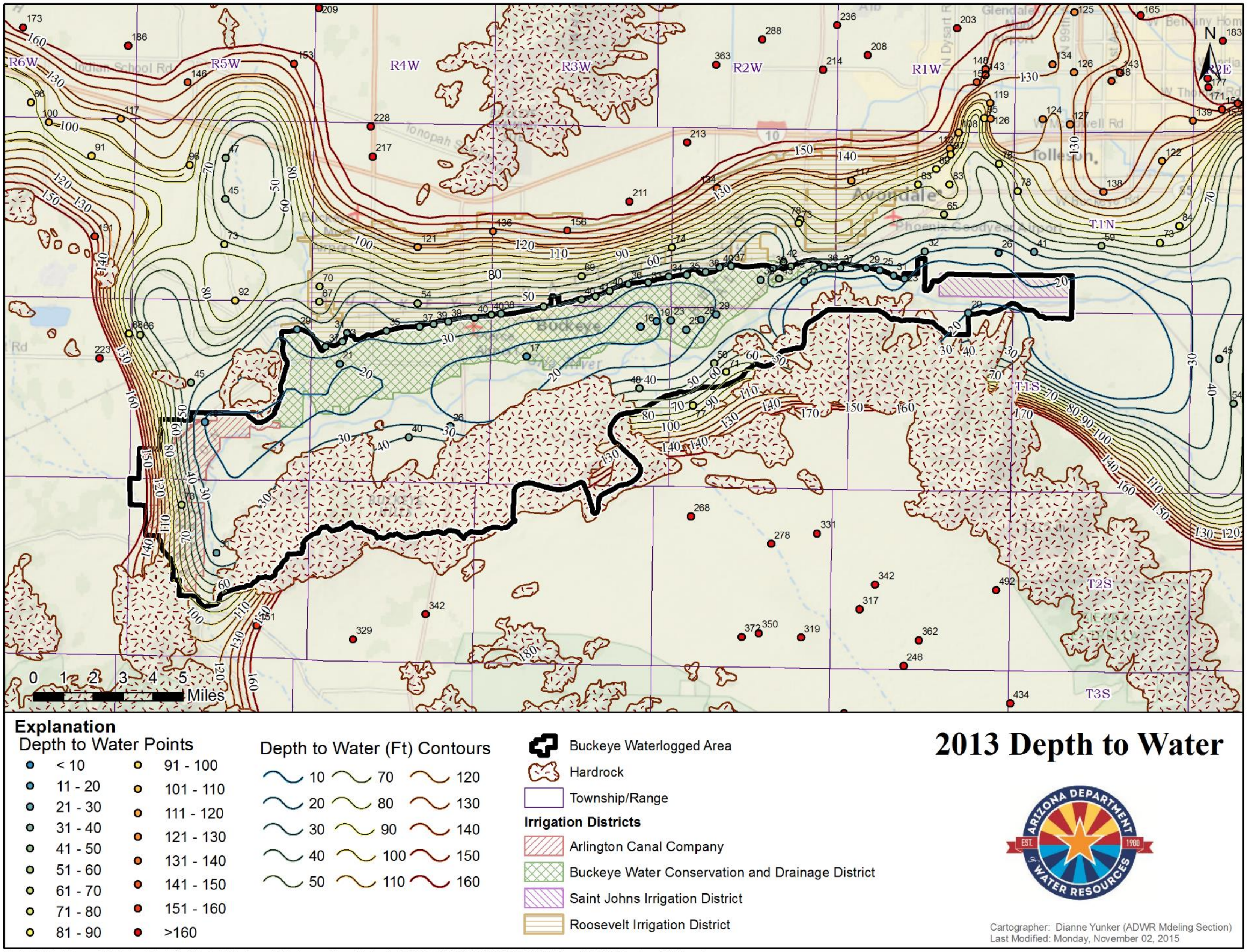

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Figure 21. 2013 Depth to Water

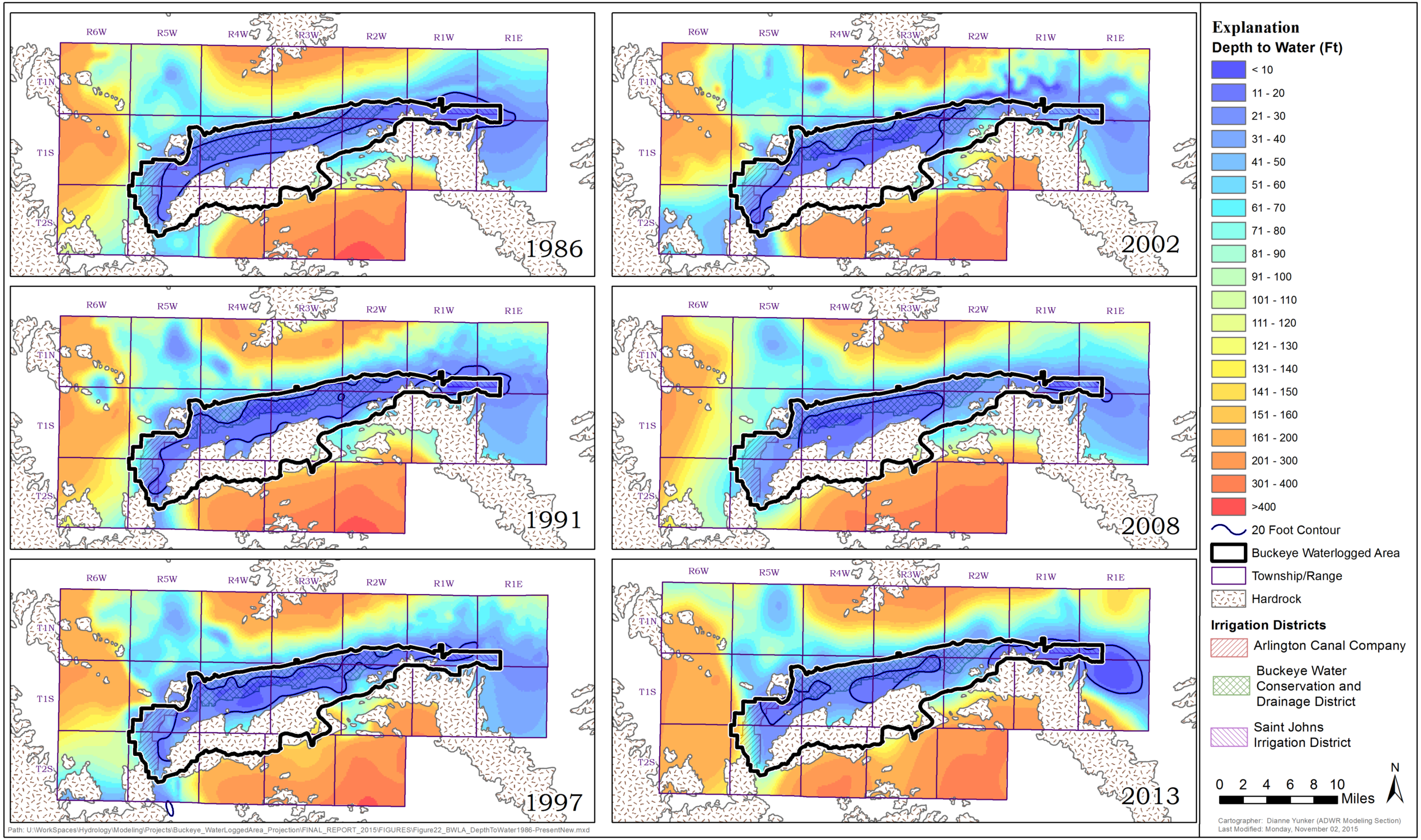

Figure 22. Depth to Water Estimates 1986 - 2013

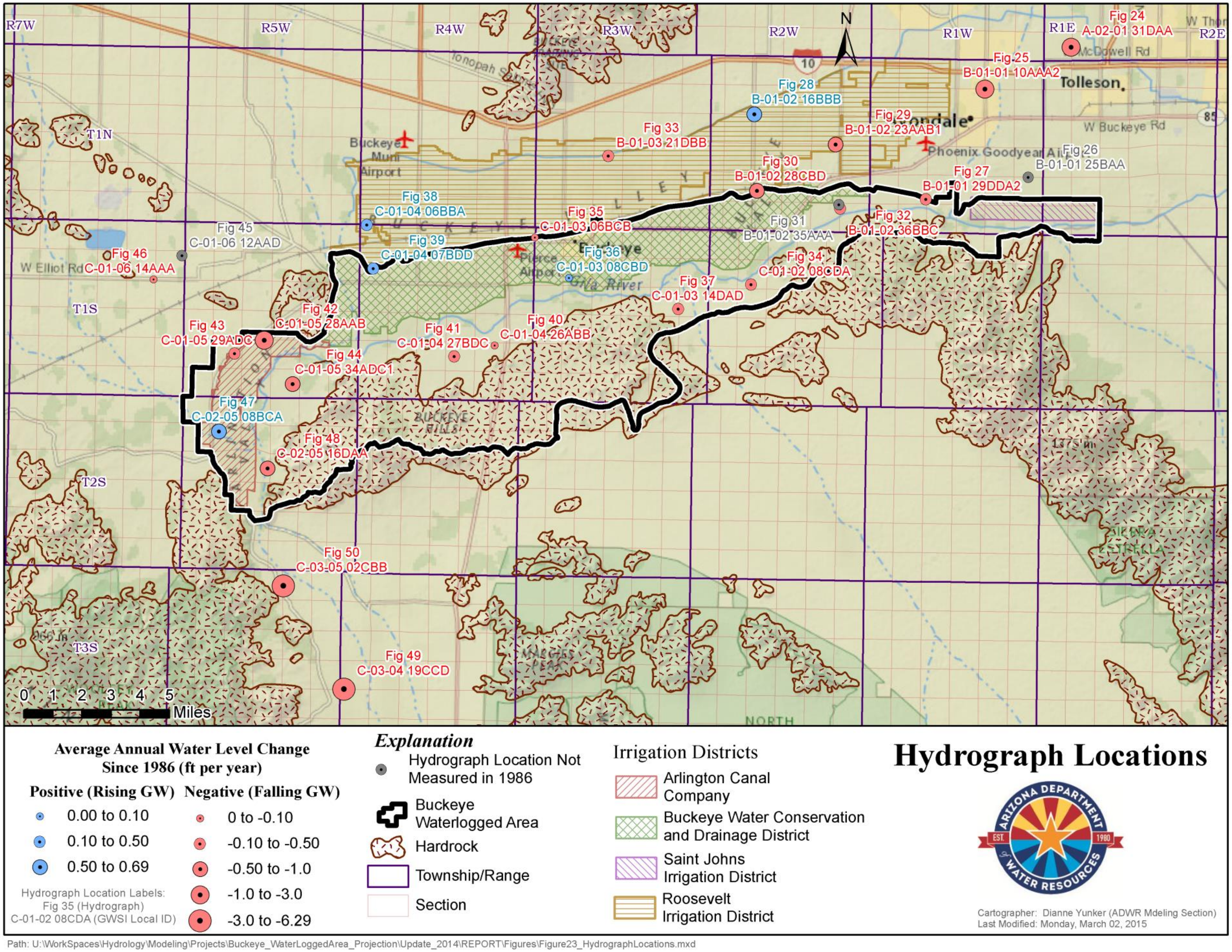

Figure 23. Hydrograph Locations

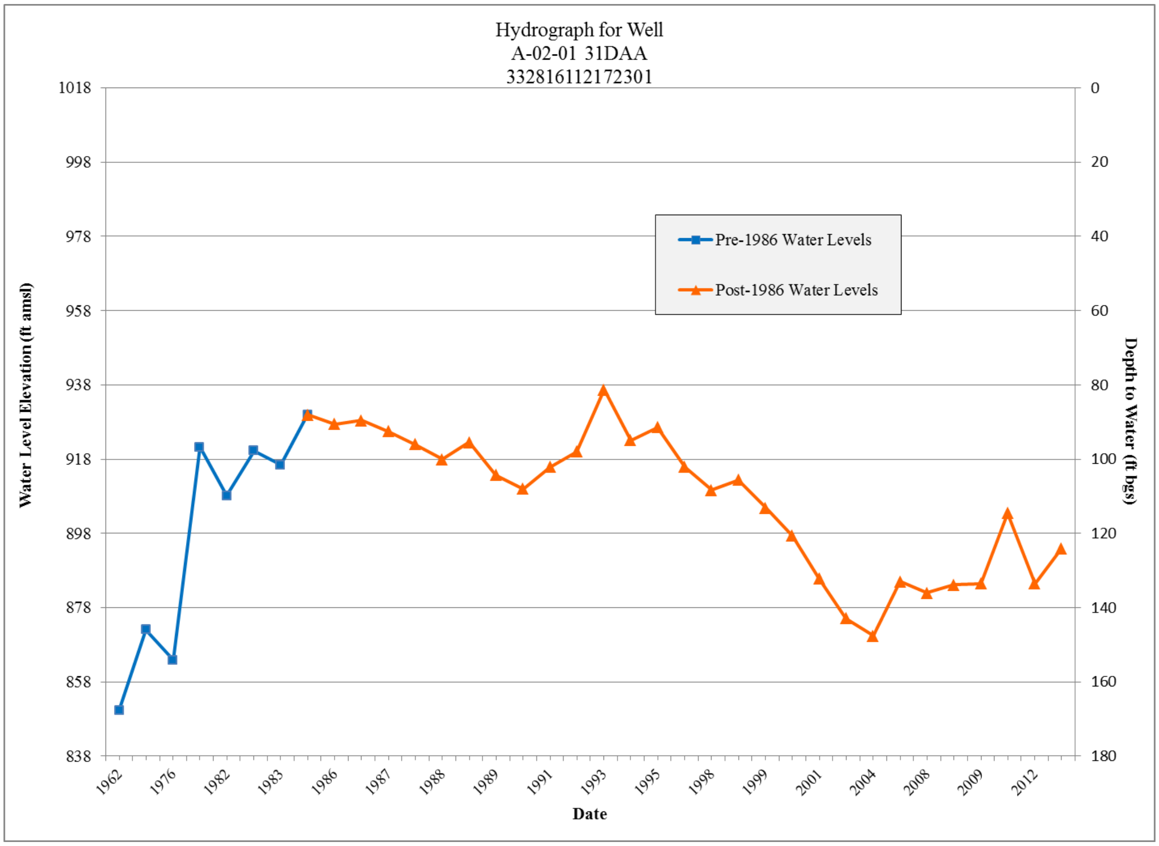

Figure 24. Hydrograph for Well A-02-01 31DAA

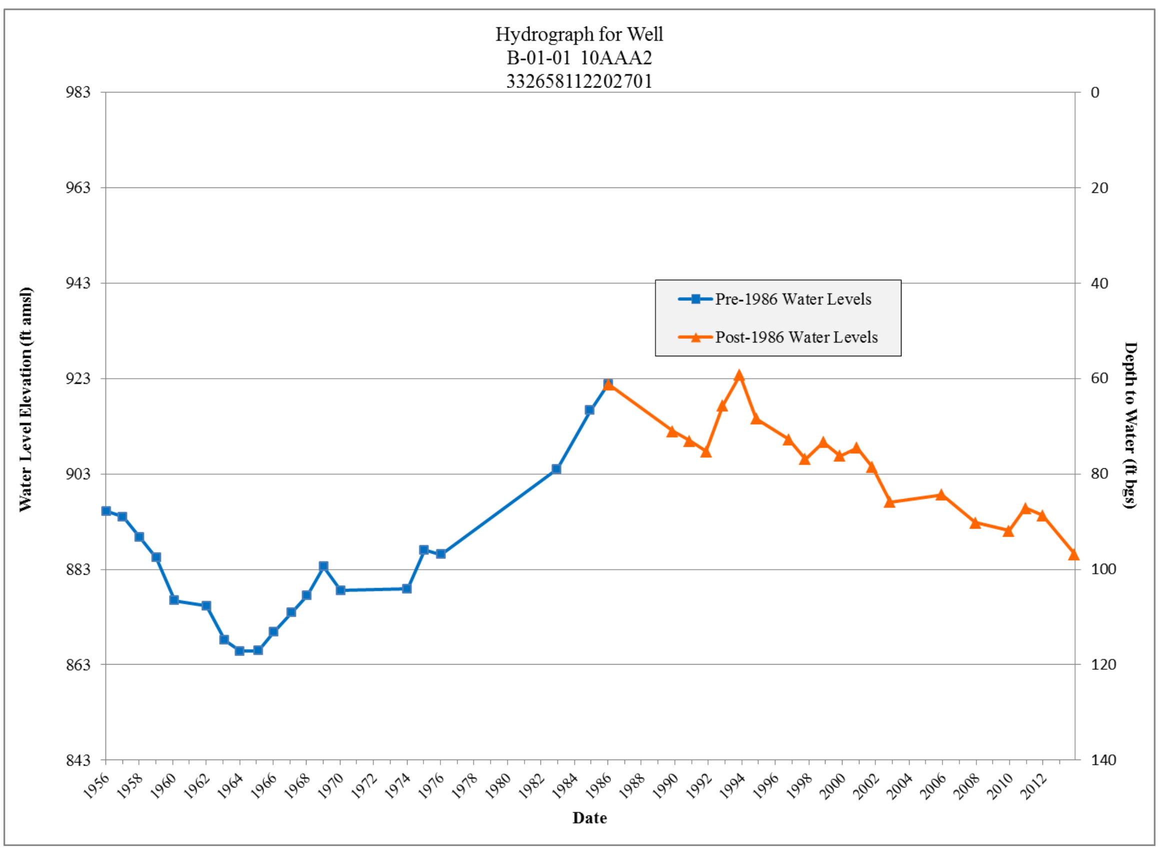

Figure 25. Hydrograph for Well B-01-01 10AAA2

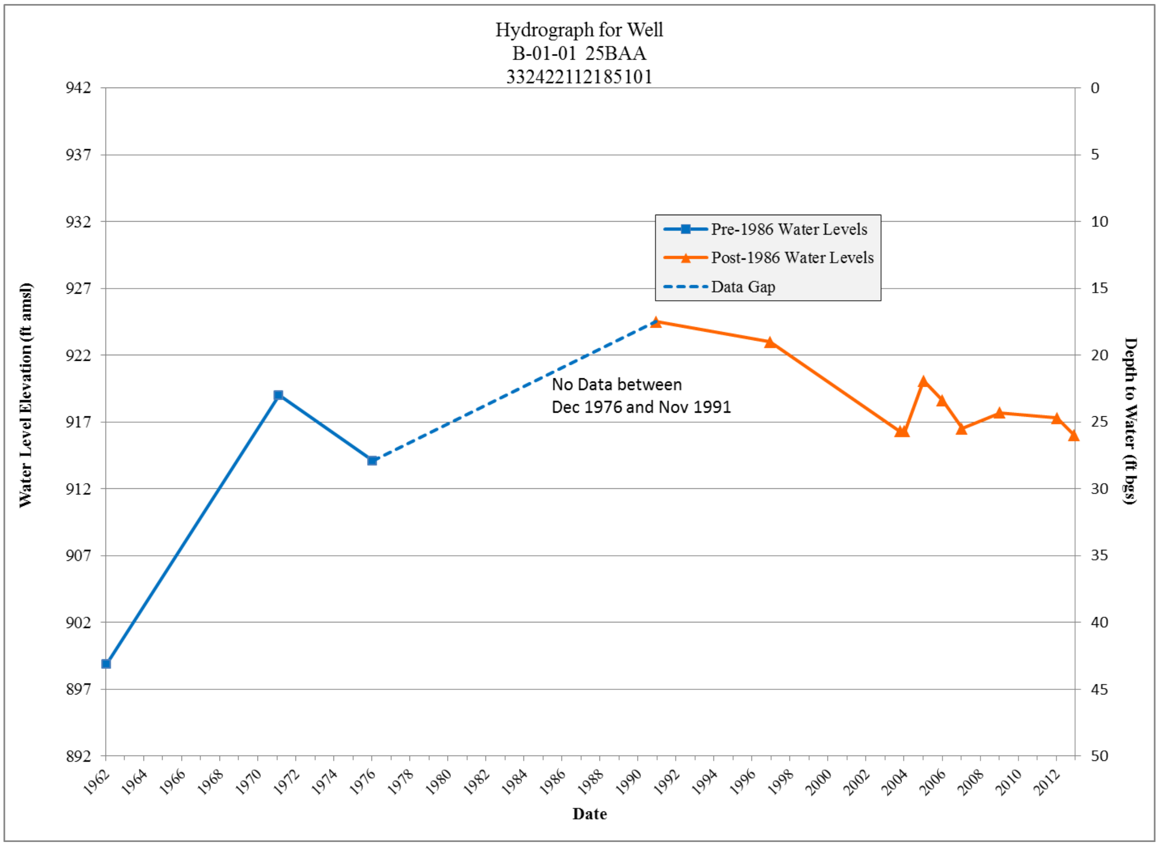

Figure 26. Hydrograph for Well B-01-01 25BAA

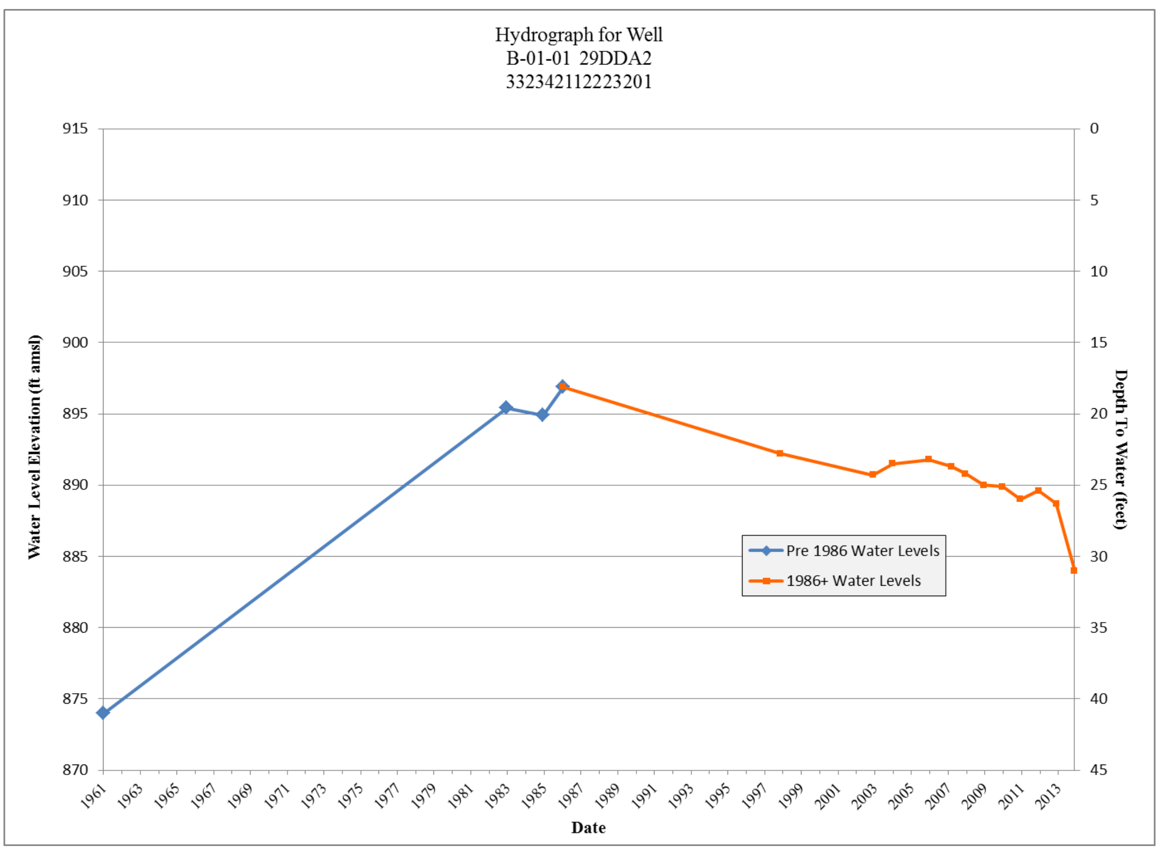

Figure 27. Hydrograph for Well B-01-01 29DDA2

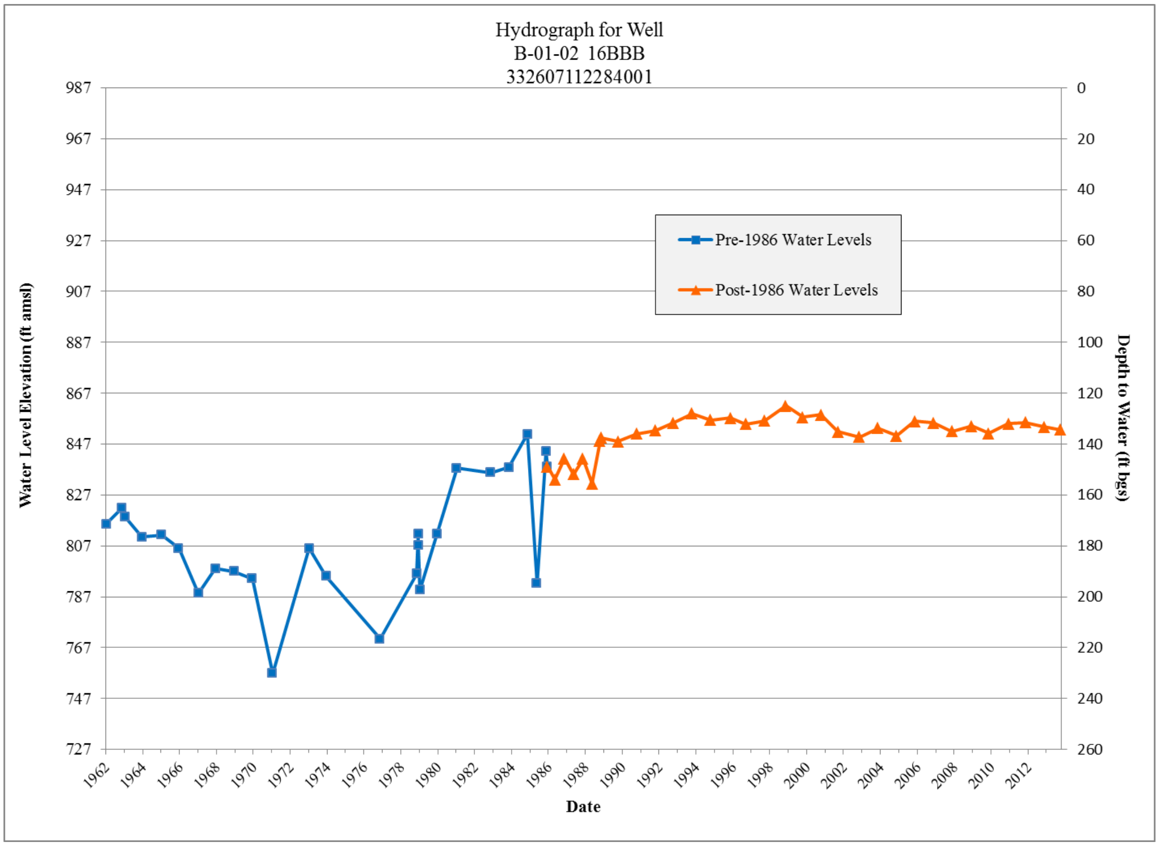

Figure 28. Hydrograph for Well B-01-02 16BBB

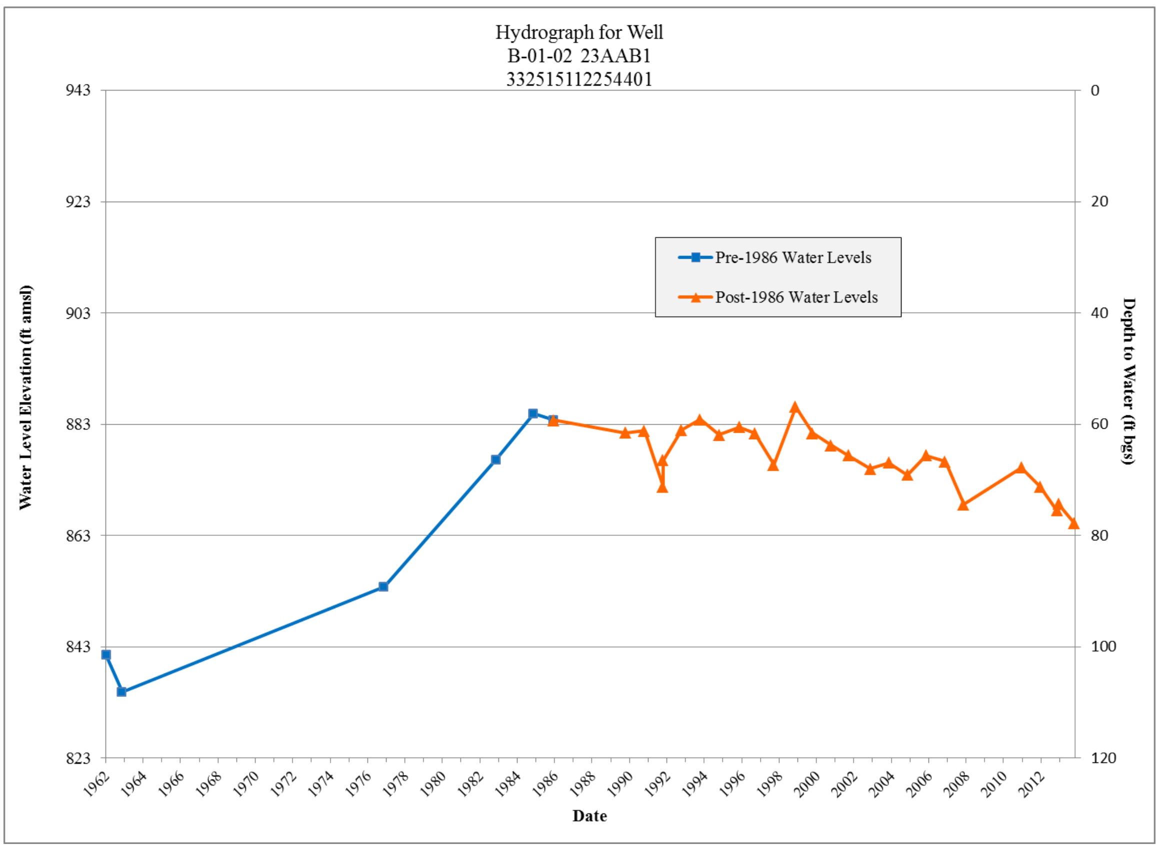

Figure 29. Hydrograph for Well B-01-02 23AAB1

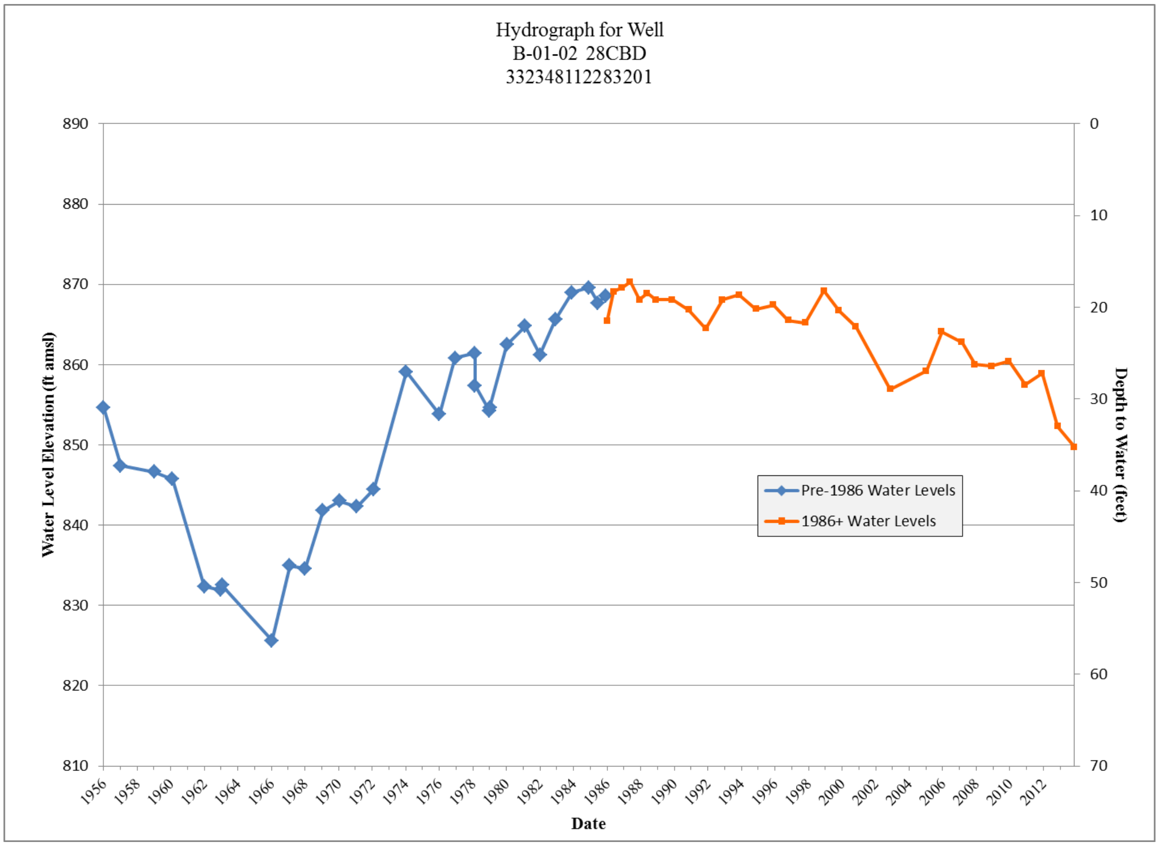

Figure 30. Hydrograph for Well B-01-02 28CBD

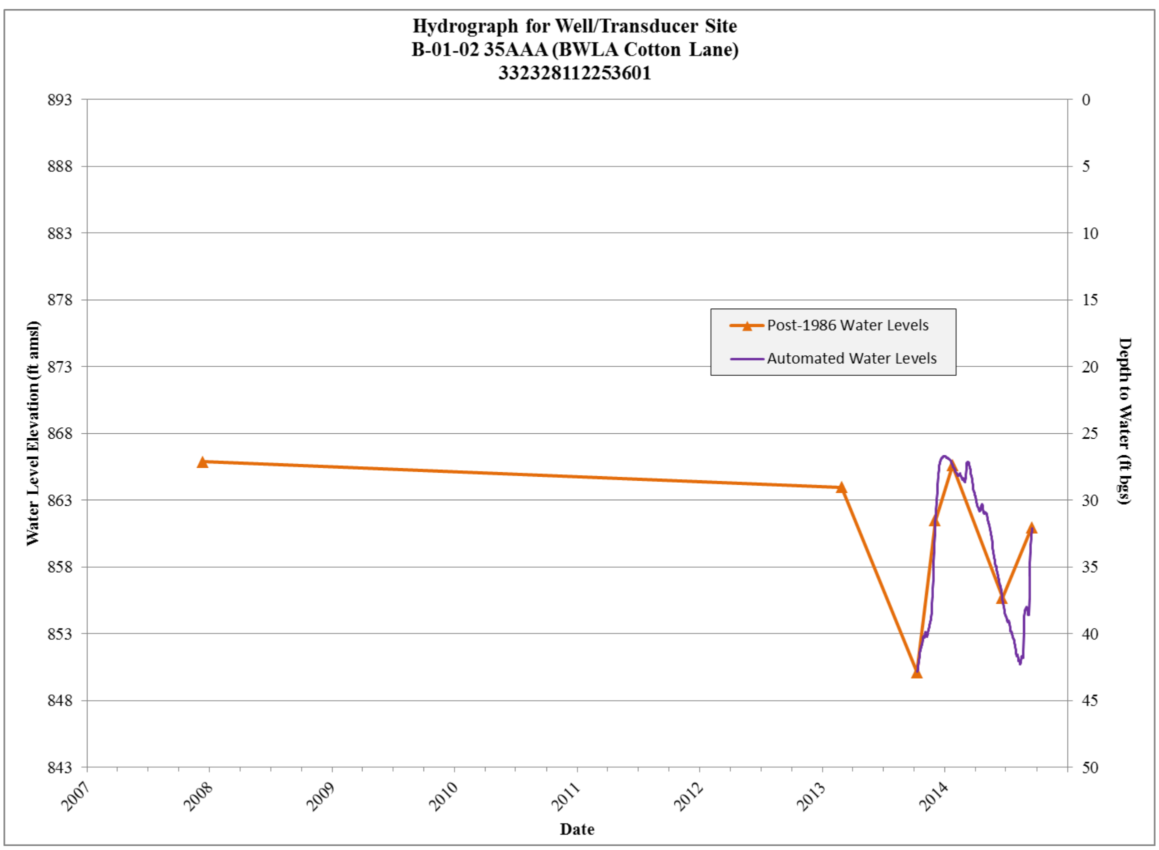

Figure 31. Hydrograph for Well/Transducer Site B-01-02 35AAA (BWLA Cotton Lane)

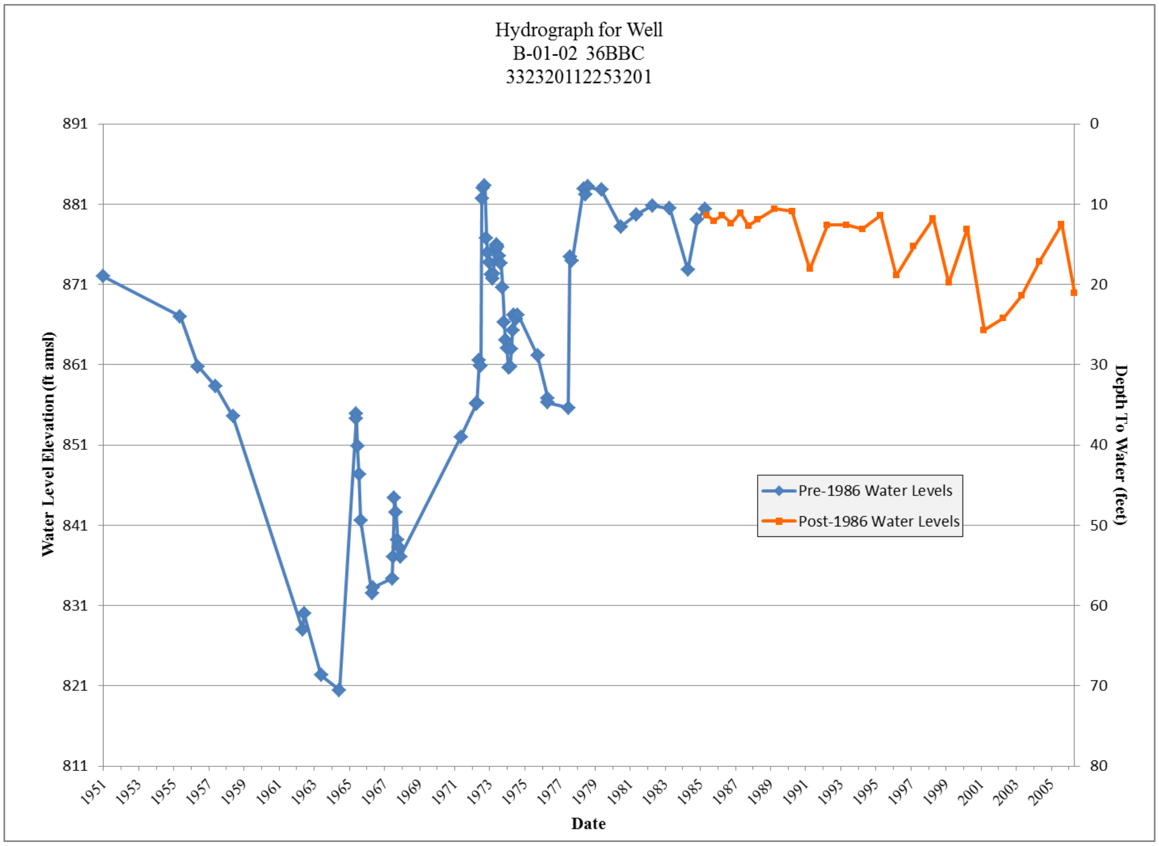

Figure 32. Hydrograph for Well B-01-02 36BBC

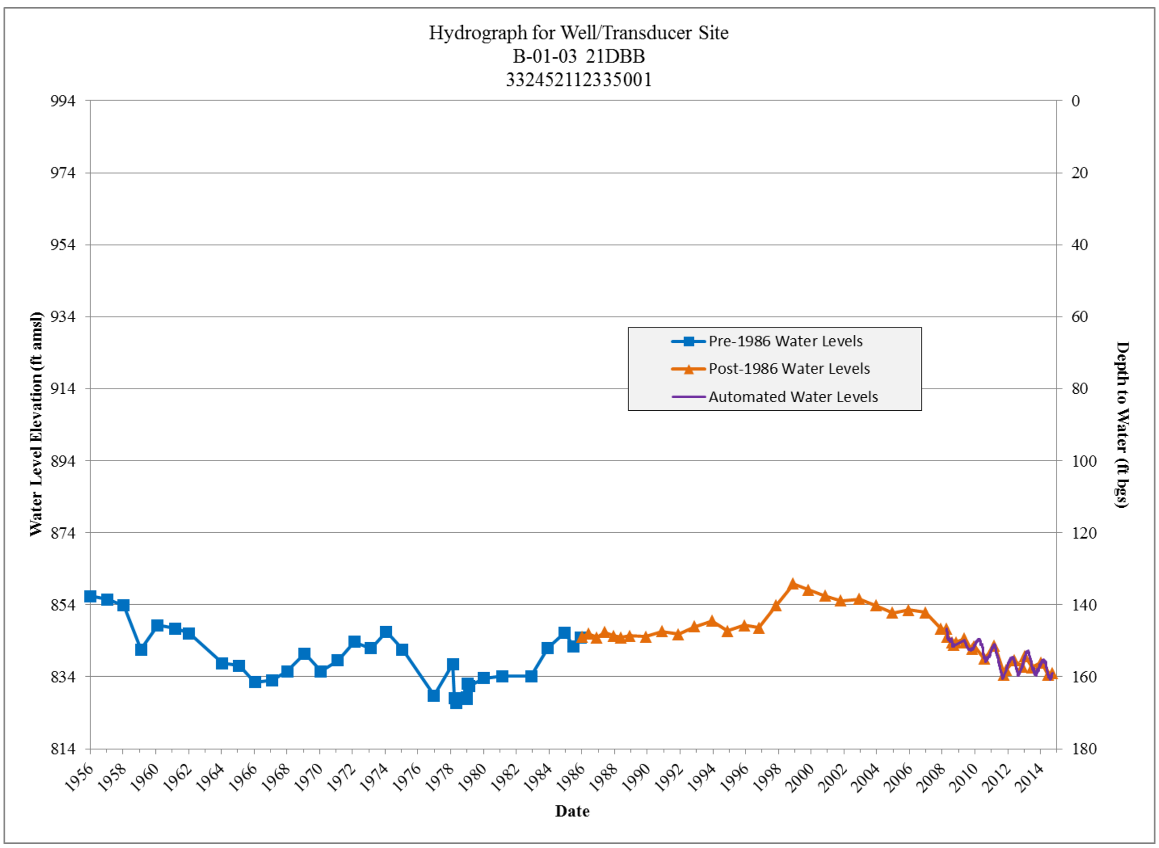

Figure 33. Hydrograph for Well/Transducer Site B-01-03 21DBB

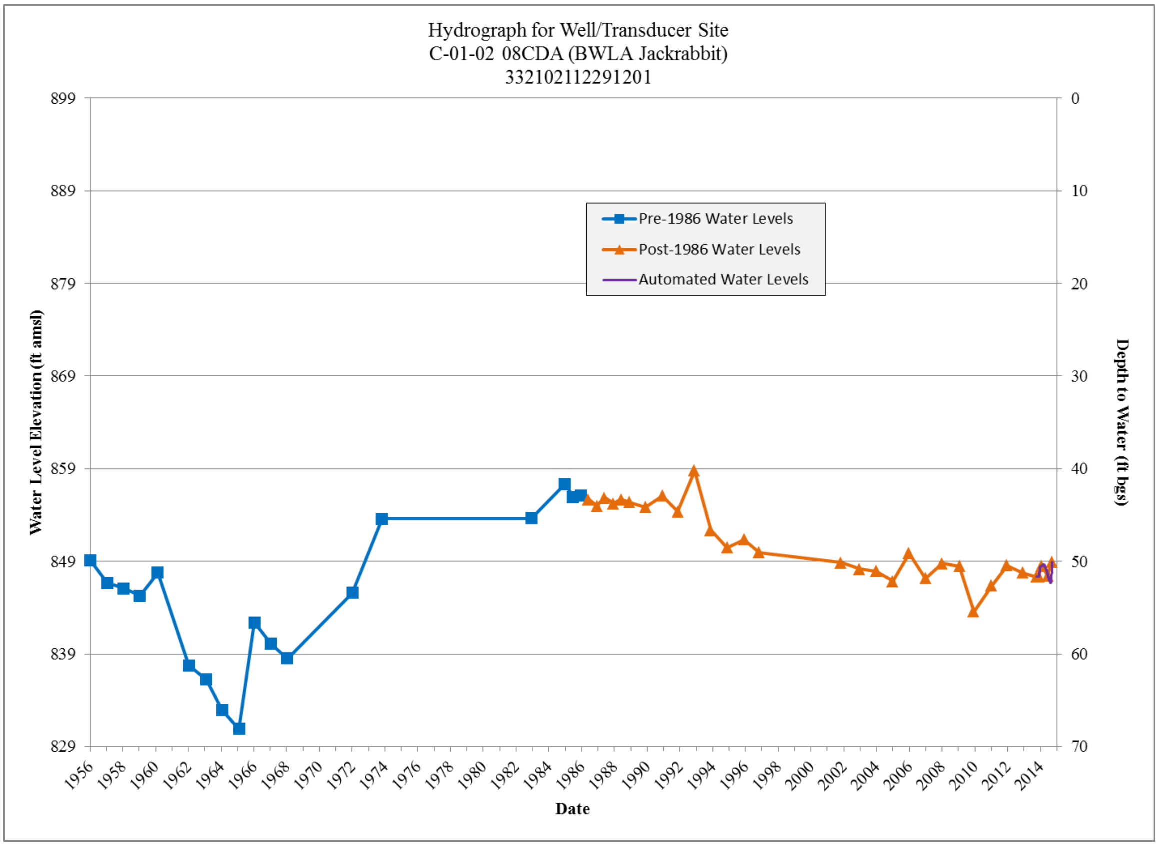

Figure 34. Hydrograph for Well/Transducer Site C-01-02 08CDA (BWLA Jackrabbit)

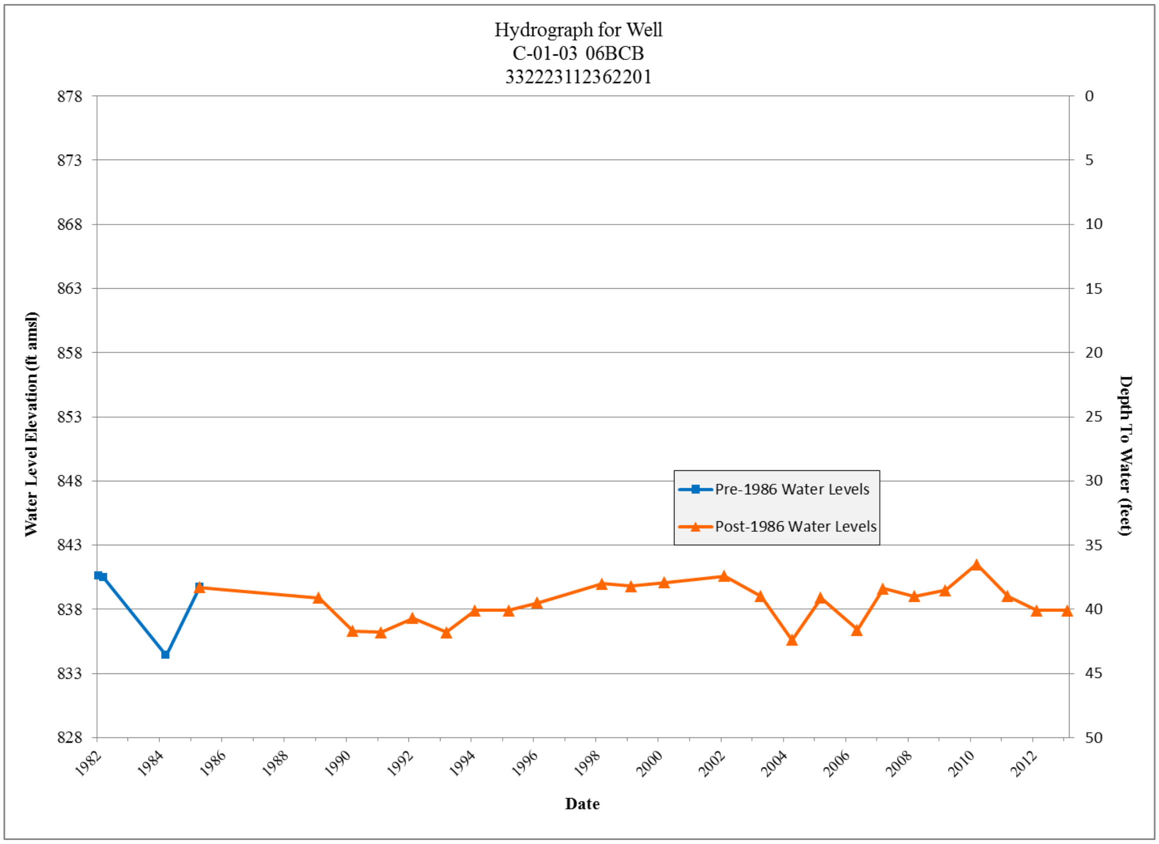

Figure 35. Hydrograph for Well C-01-03 06BCB

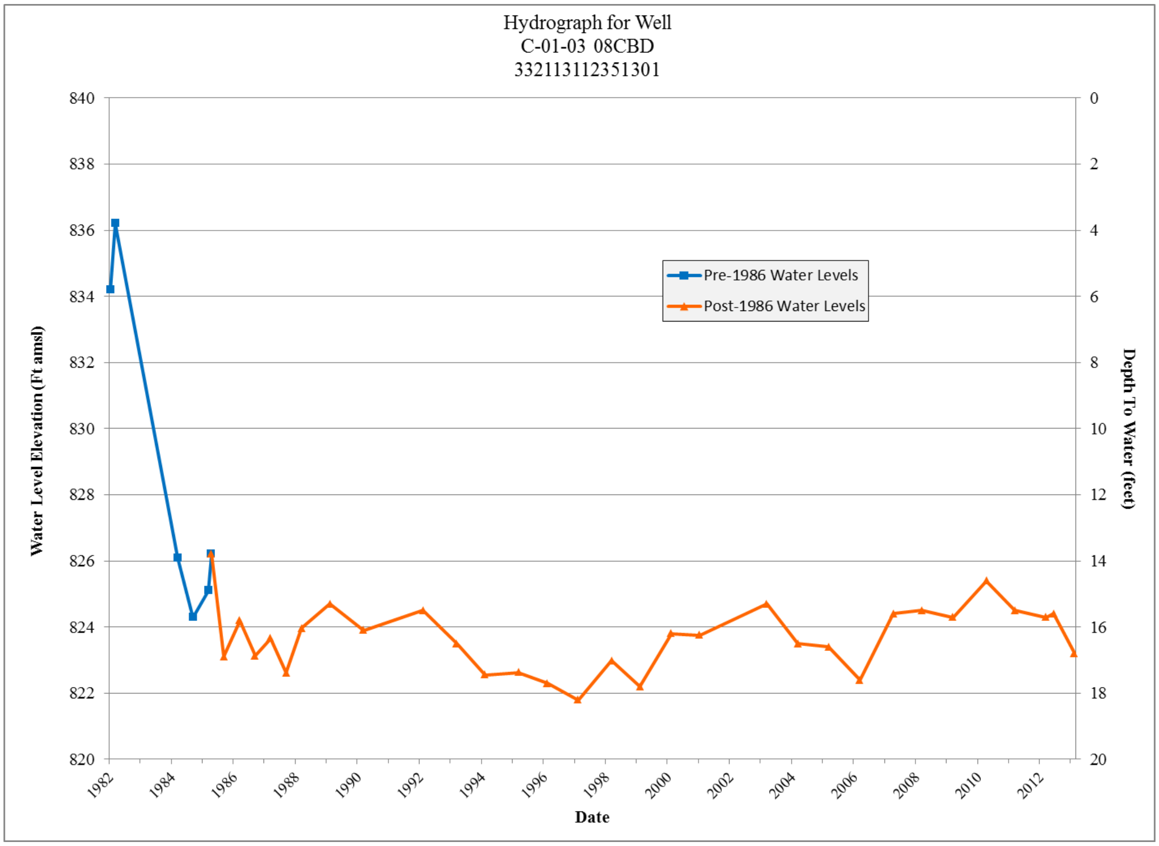

Figure 36. Hydrograph for Well C-01-03 08CBD

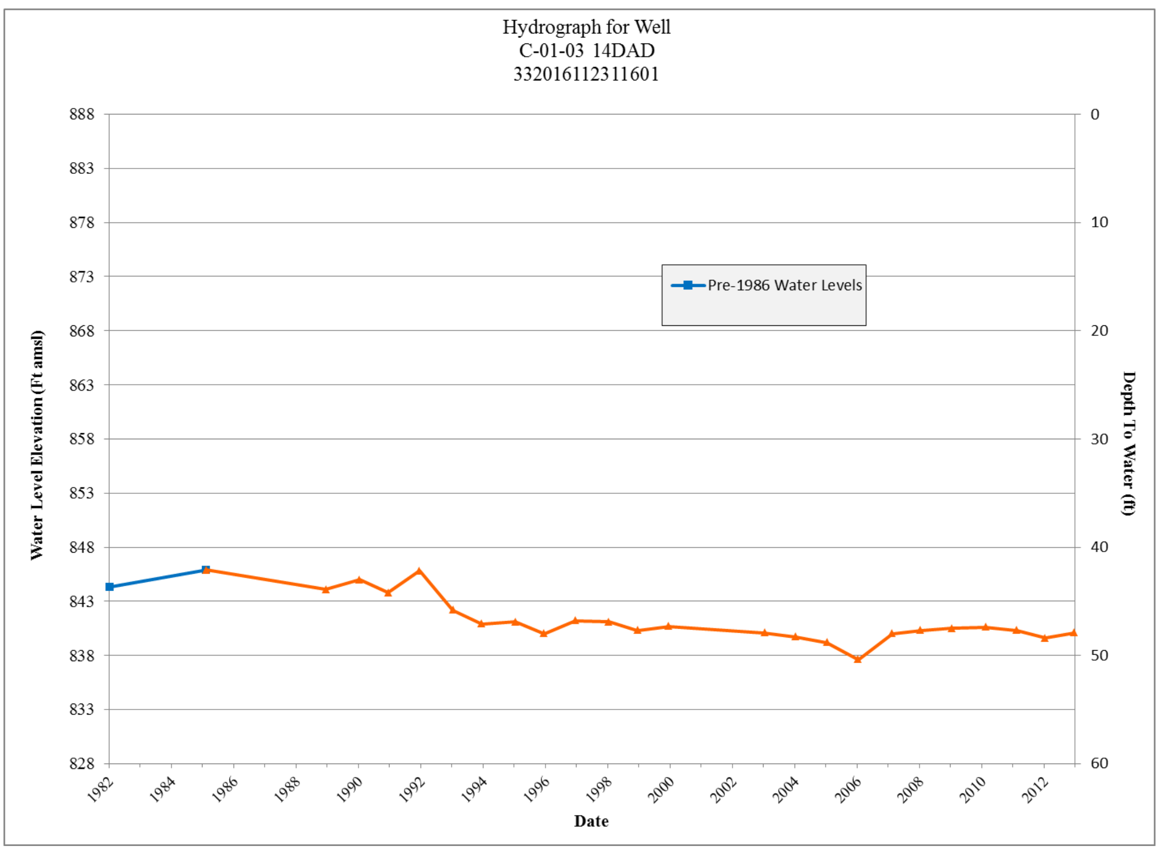

Figure 37. Hydrograph for Well C-01-03 14DAD

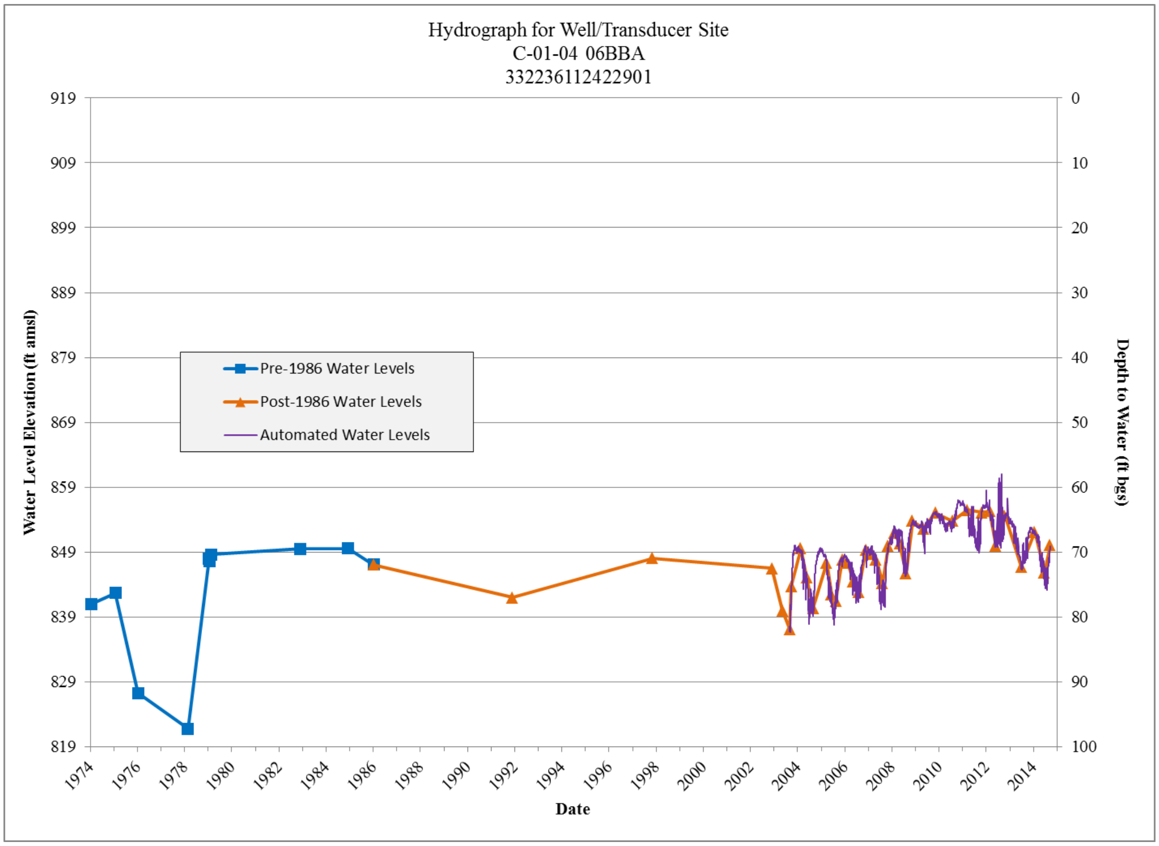

Figure 38. Hydrograph for Well/Transducer Site C-01-04 06BBA

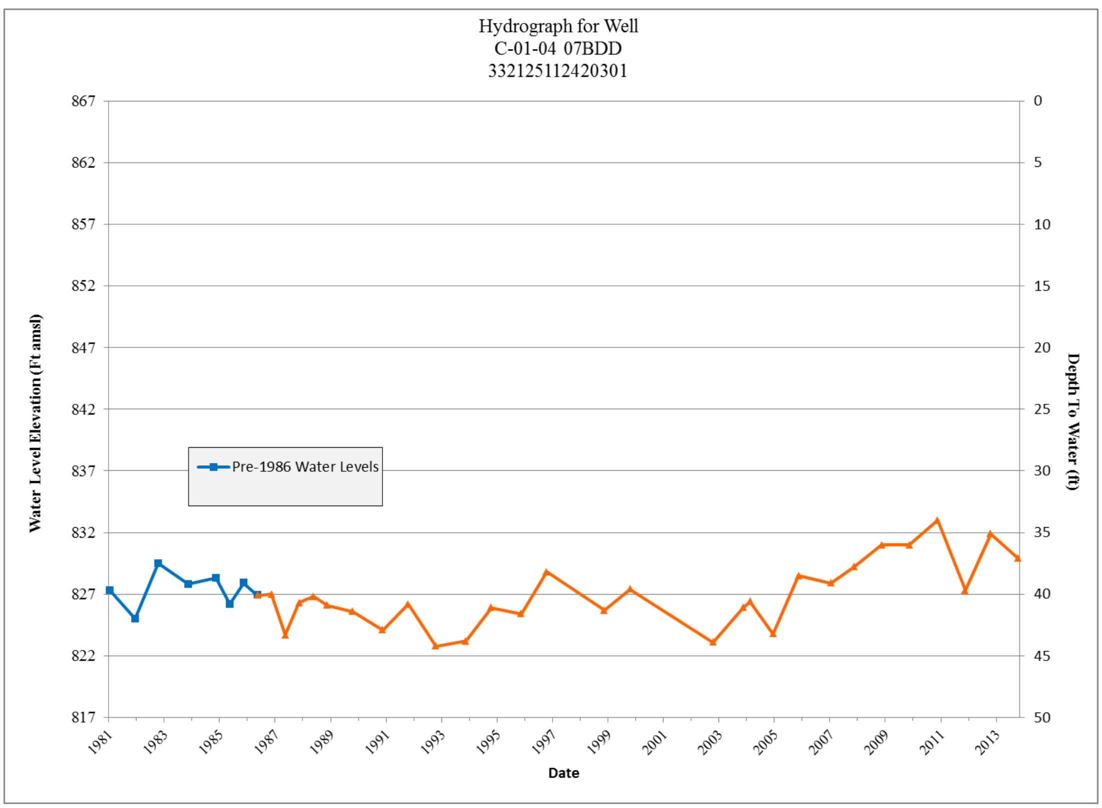

Figure 39. Hydrograph Well for C-01-04 07BDD

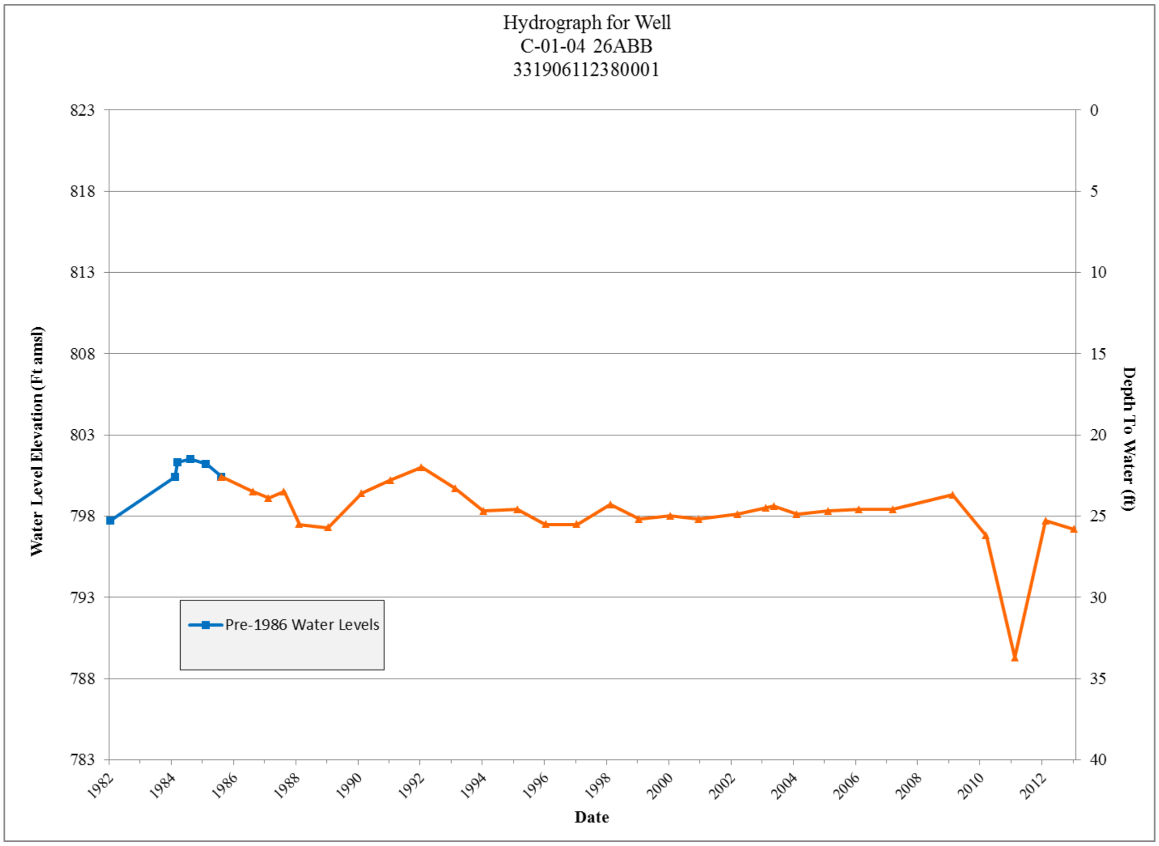

Figure 40. Hydrograph for Well C-01-04 26ABB

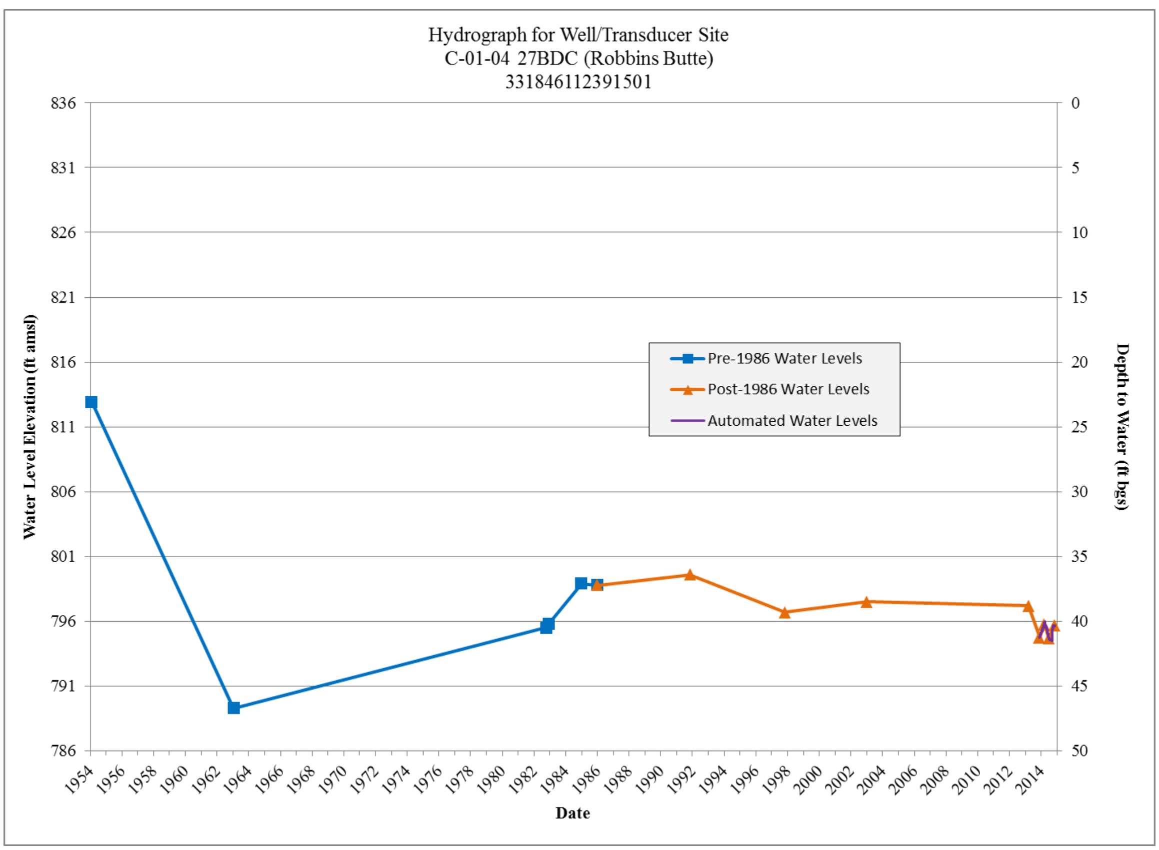

Figure 41. Hydrograph for Well/Transducer Site C-01-04 27BDC (Robbins Butte)

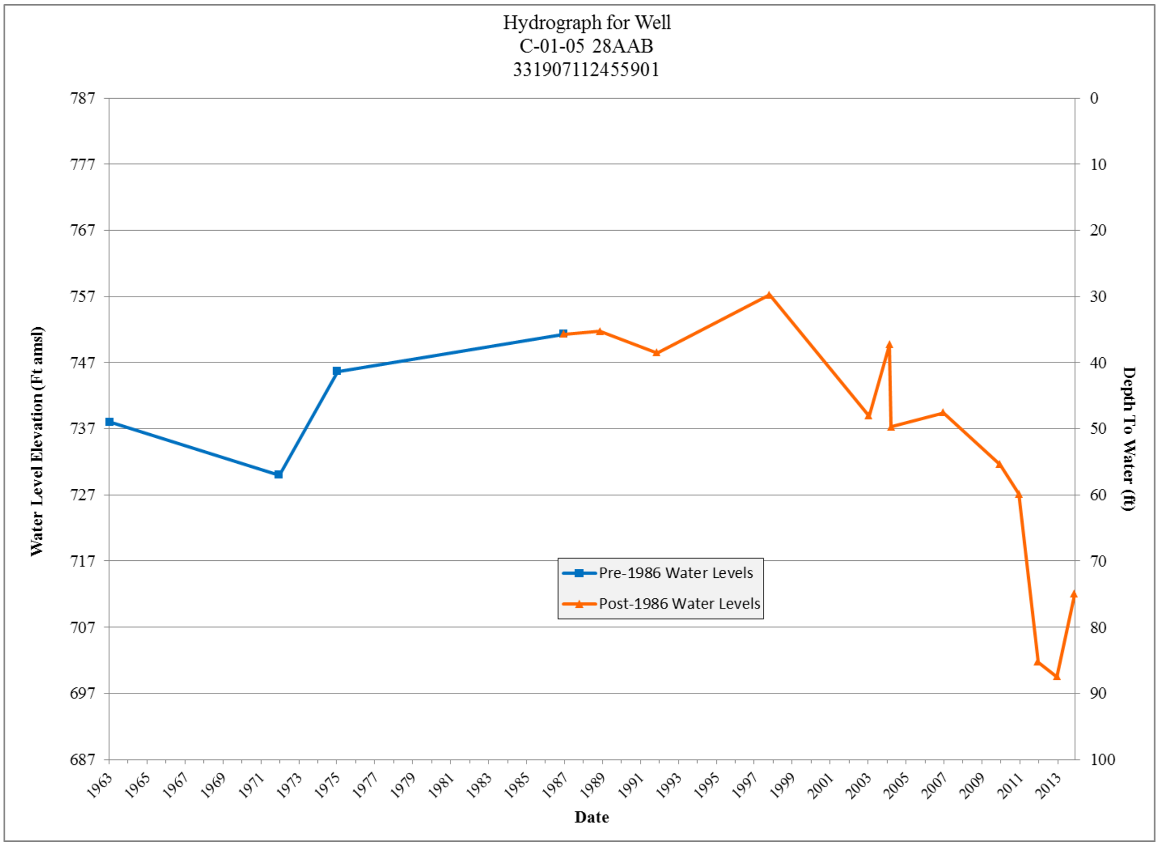

Figure 42. Hydrograph for Well C-01-05 28AAB

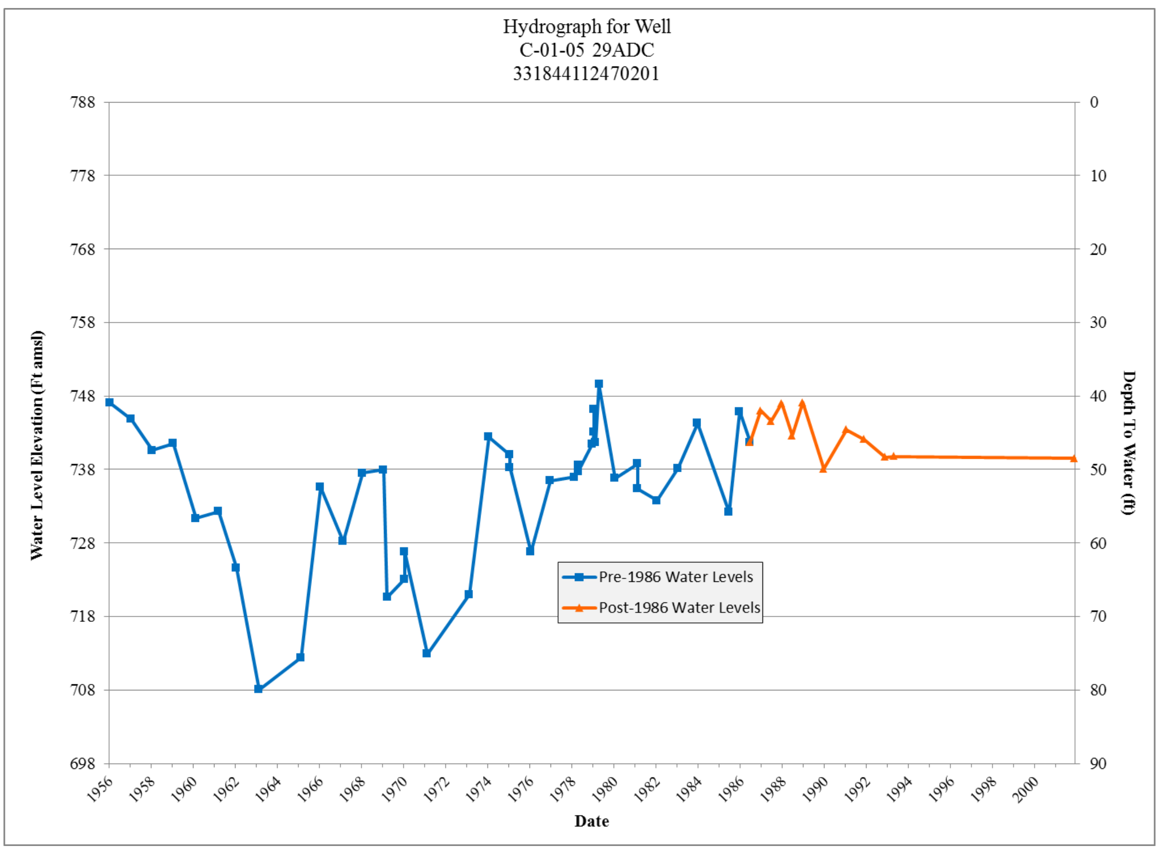

Figure 43. Hydrograph for Well C-01-05 29ADC

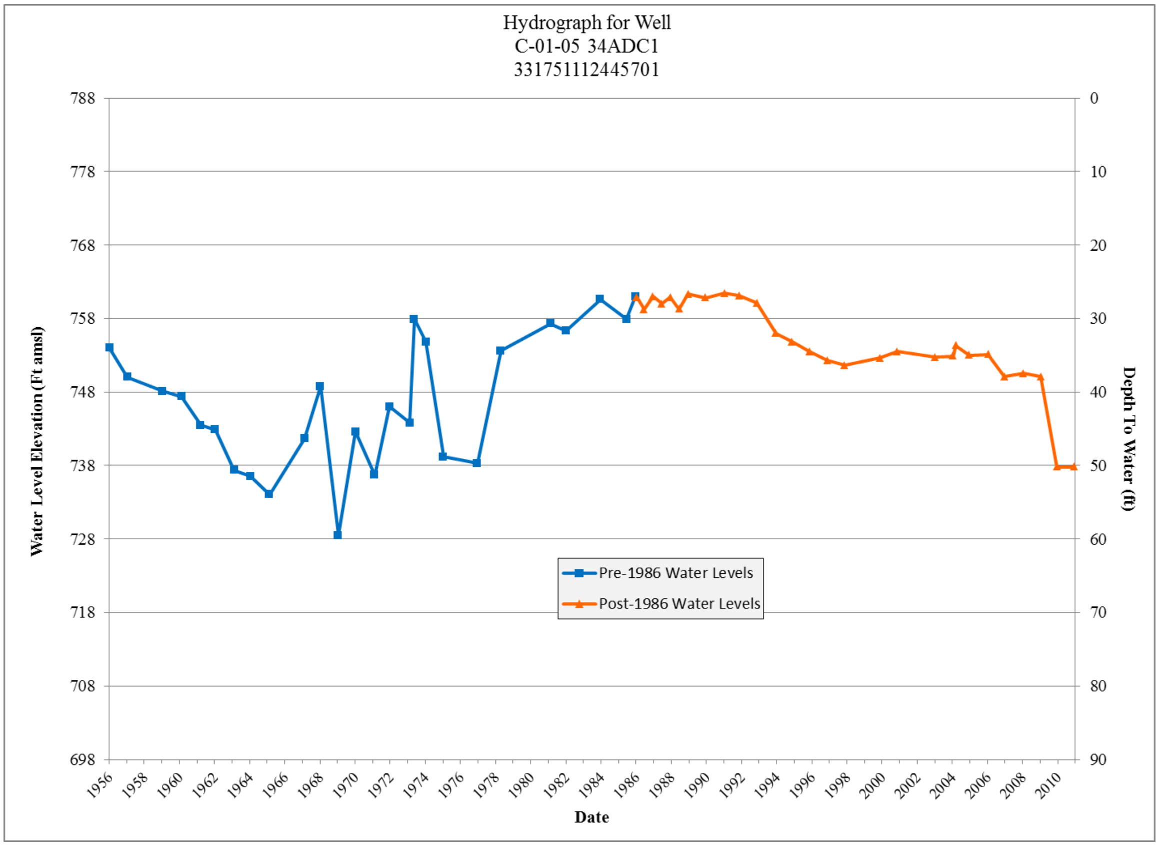

Figure 44. Hydrograph for Well C-01-05 34ADC1

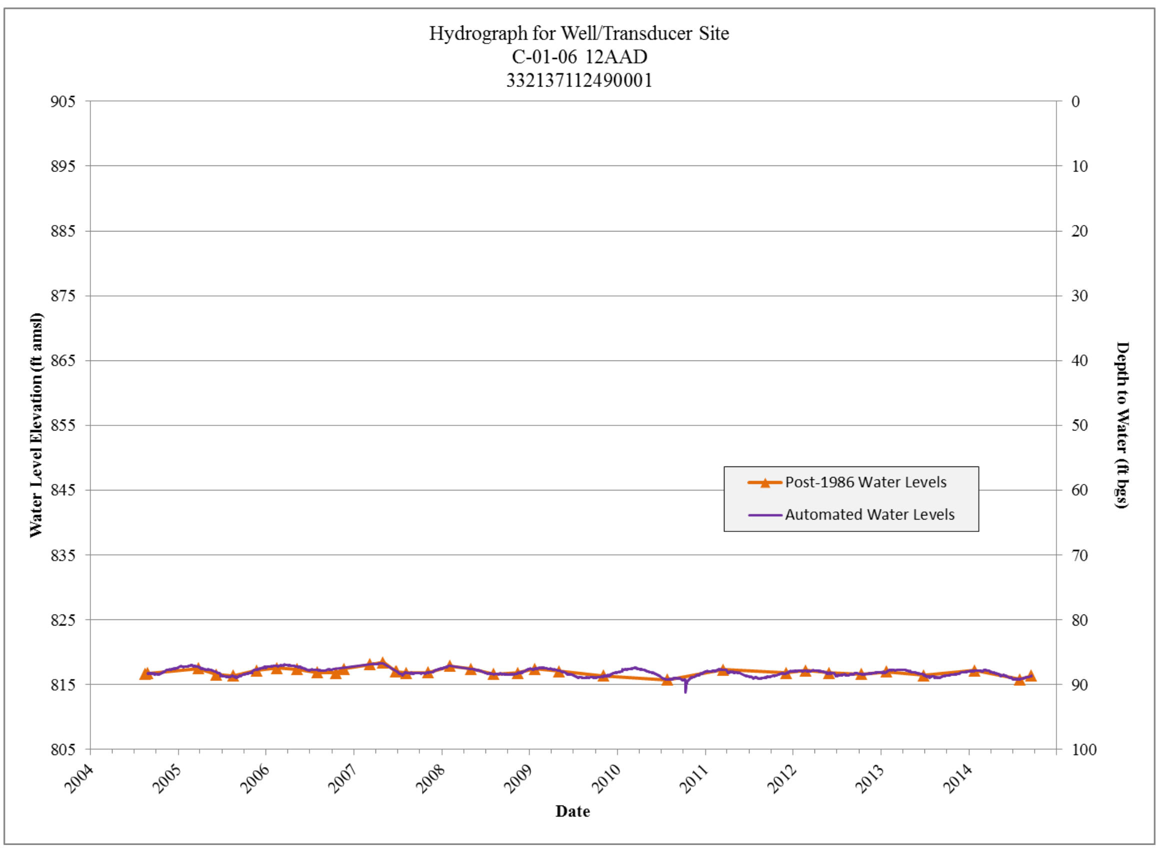

Figure 45. Hydrograph for Well/Transducer Site C-01-06 12AAD

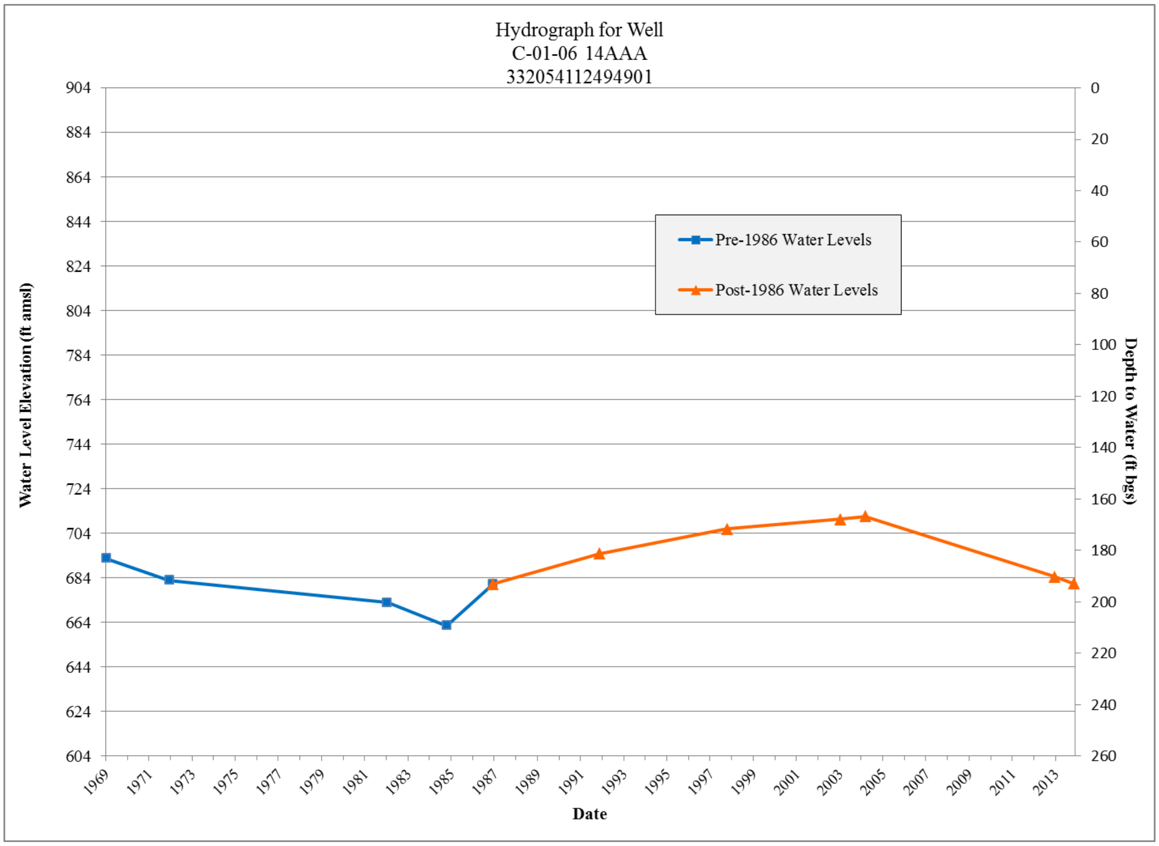

Figure 46. Hydrograph for Well C-01-06 14AAA

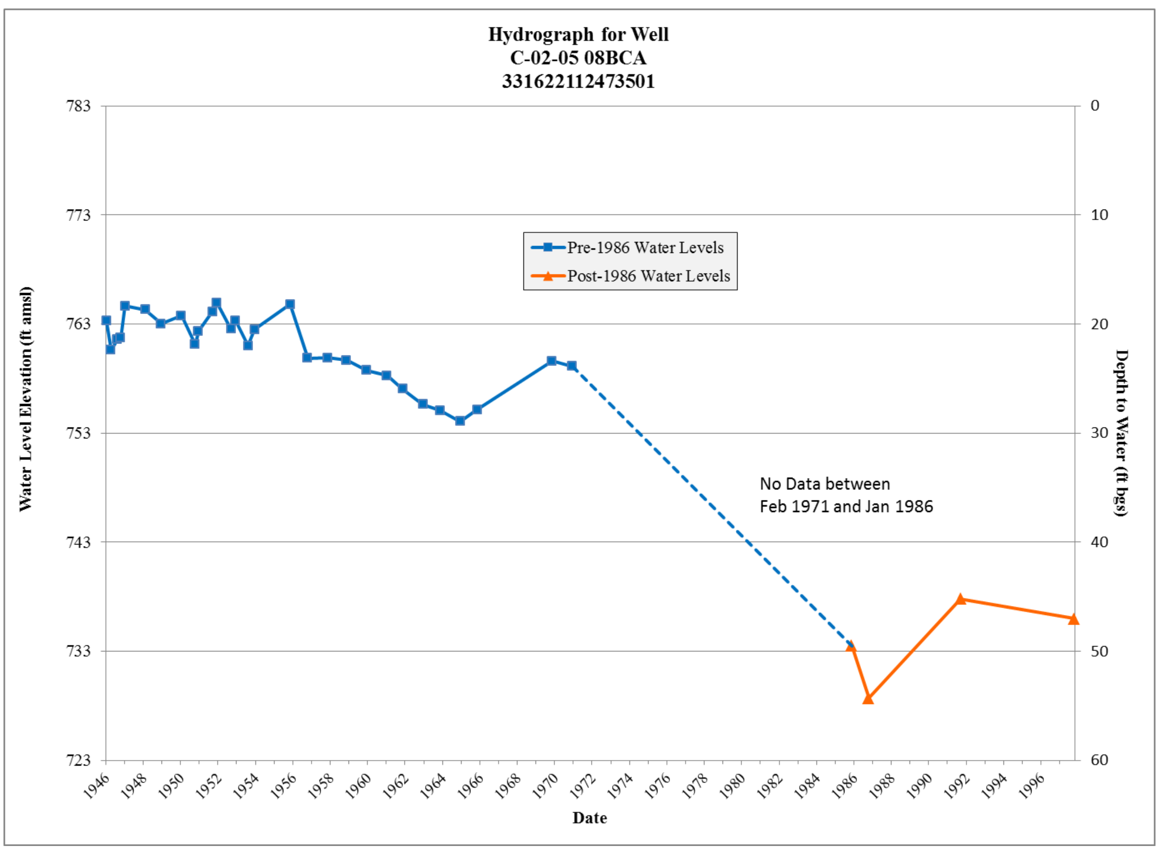

Figure 47. Hydrograph for Well C-02-05 08BCA

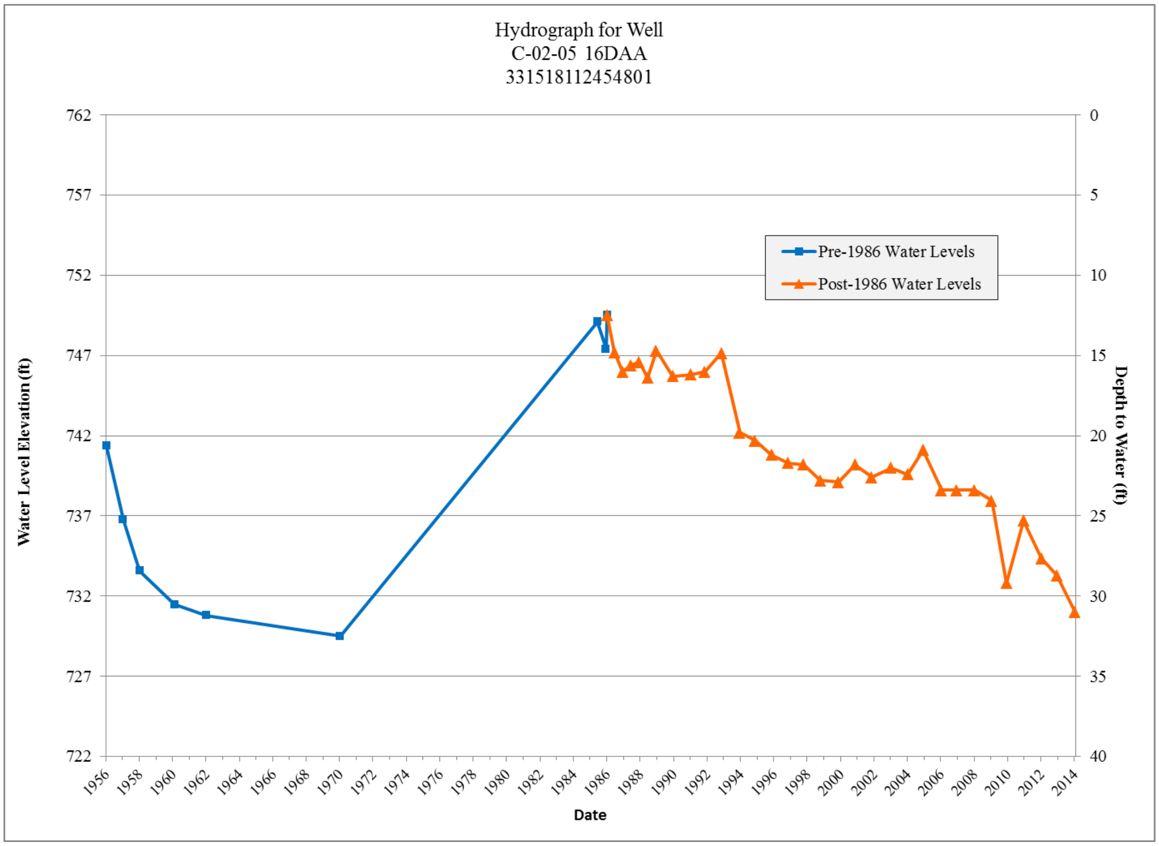

Figure 48. Hydrograph for Well C-02-05 16DAA

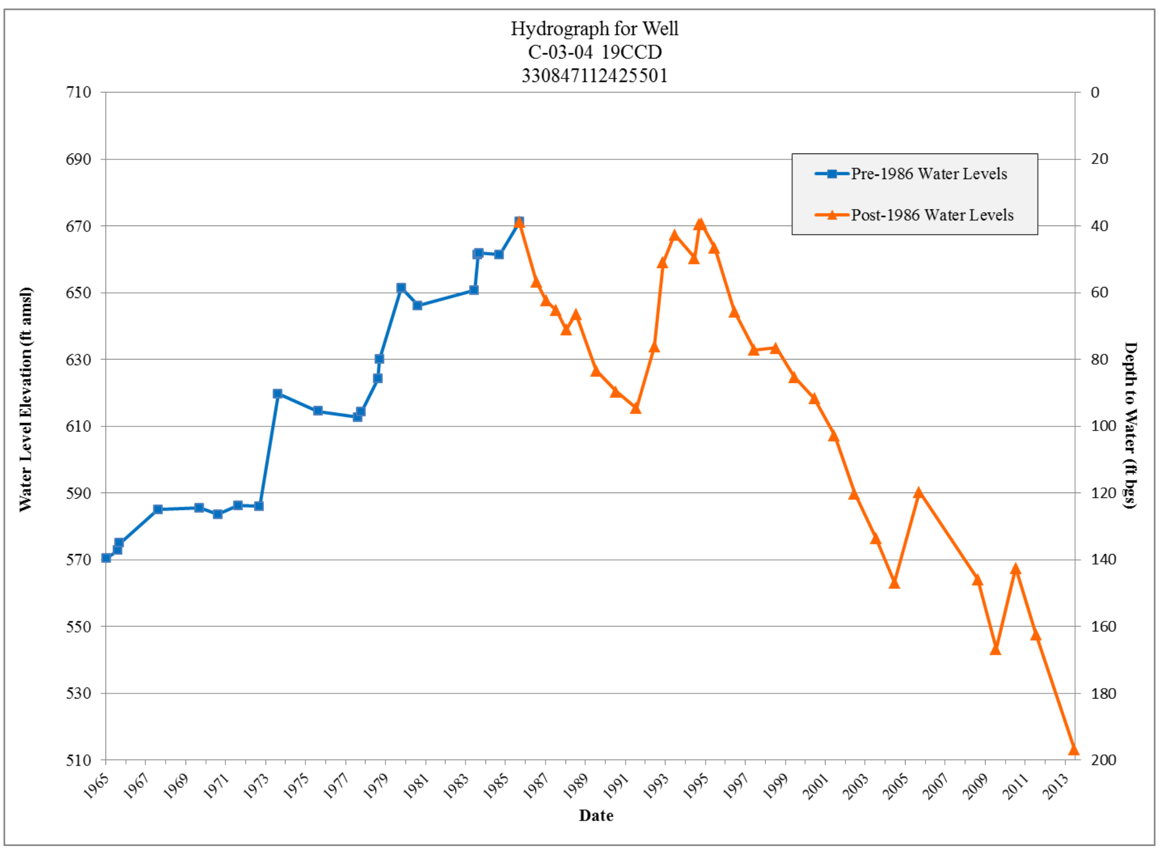

Figure 49. Hydrograph for Well C-03-04 19CCD

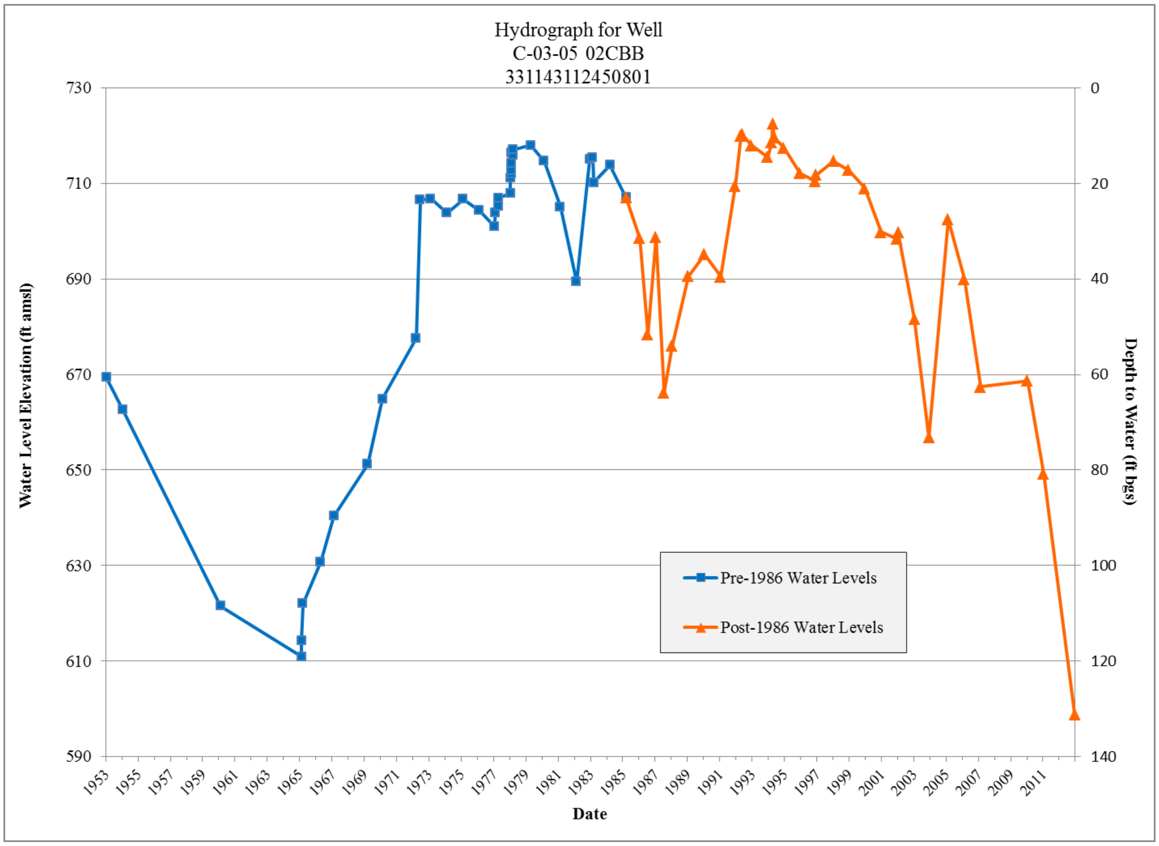

Figure 50. Hydrograph for Well C-03-05 02CBB

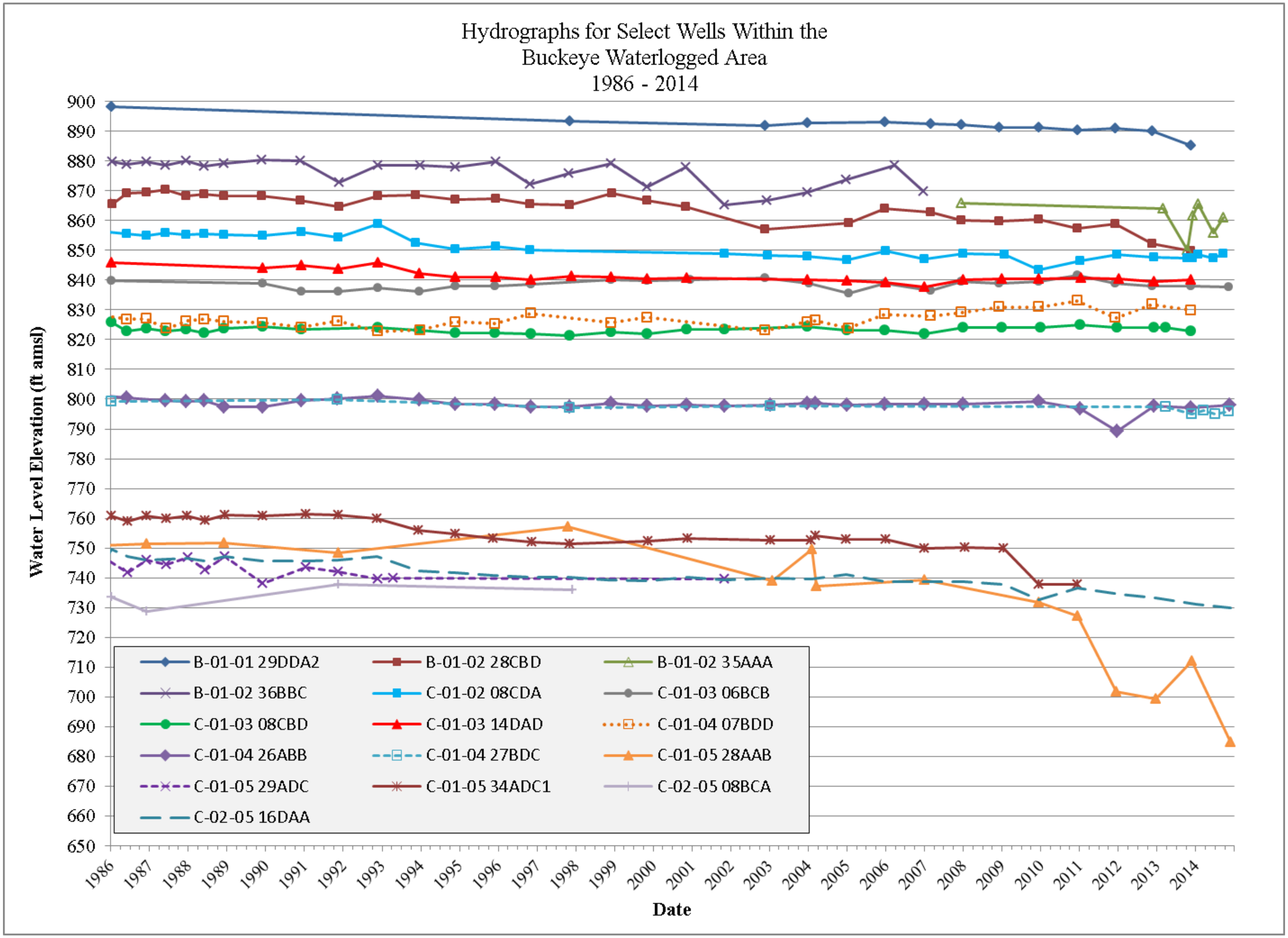

Figure 51. Hydrographs for Select Wells Within the Buckeye Waterlogged Area 1986-2014

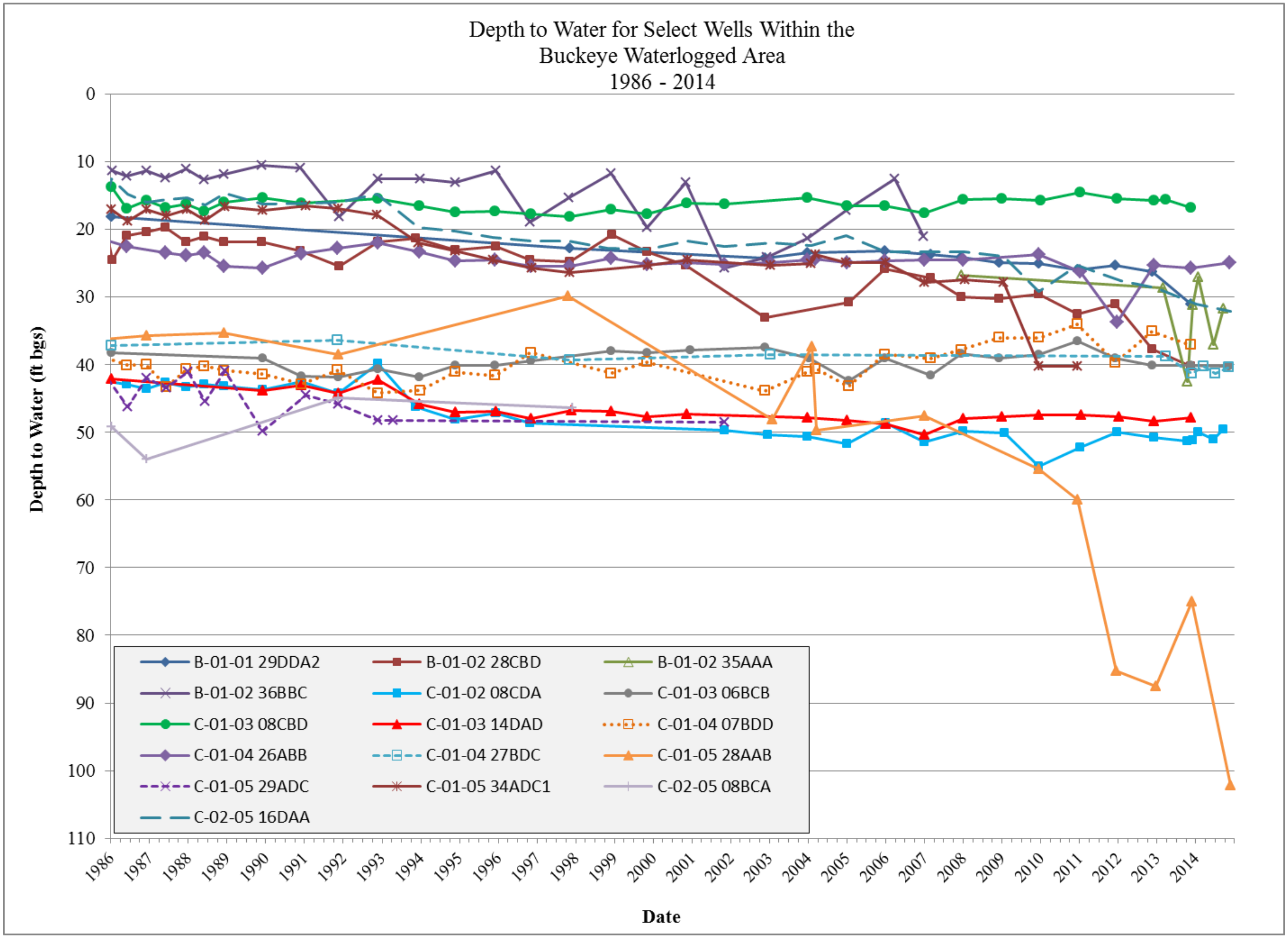

Figure 52. Depth to Water for Select Wells Within the Buckeye Waterlogged Area 1986-2014

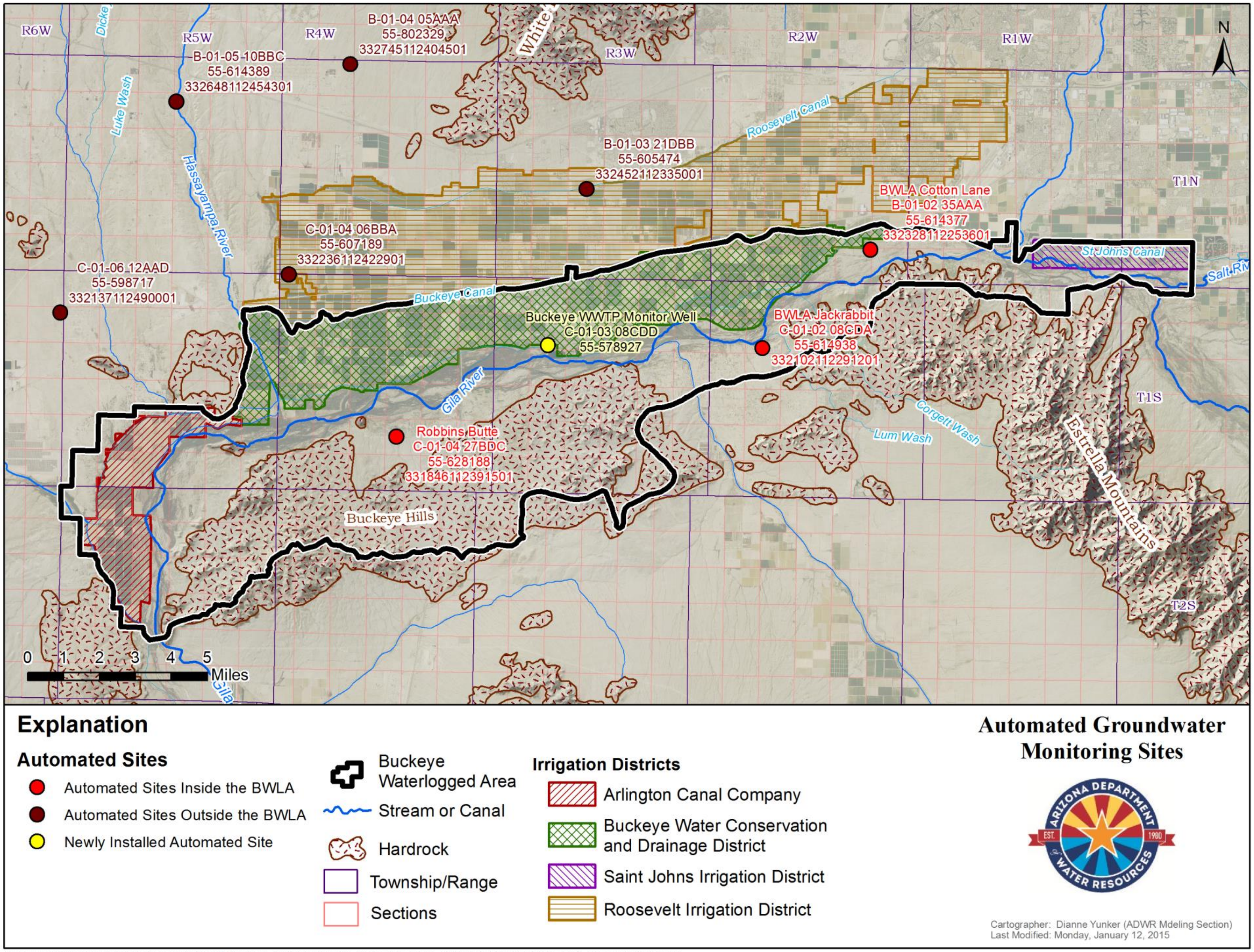

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Figure 53. Automated Groundwater Monitoring Sites

Figure 54. BWLA Cotton Lane Transducer Site

Figure 55. BWLA Jackrabbit Transducer Site

Figure 56. Robbins Butte Transducer Site

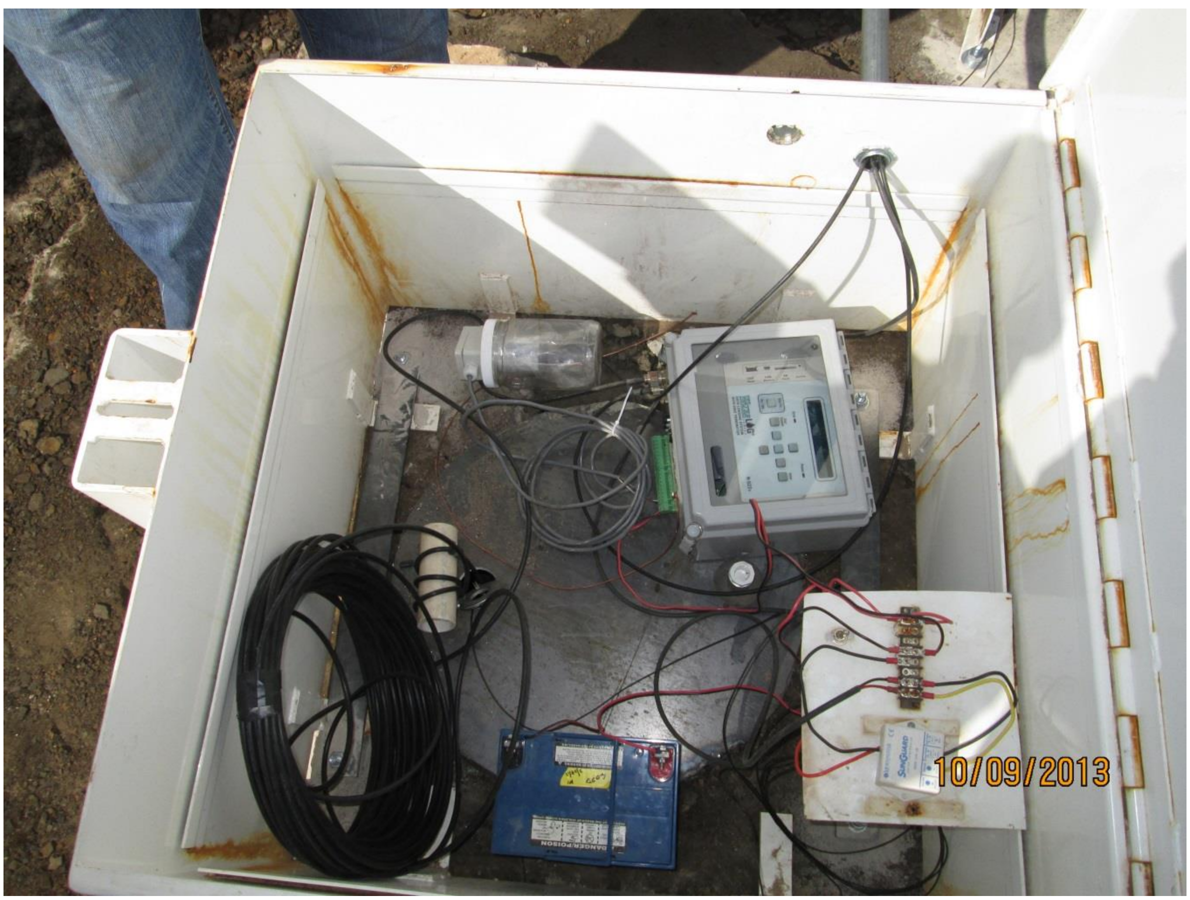


Figure 57. Automated Equipment (Jackrabbit Transducer Site)

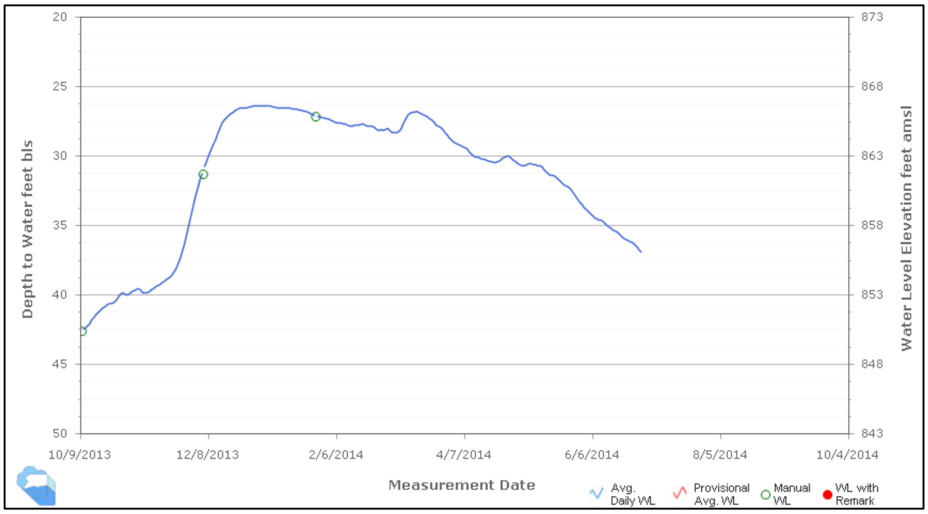


Figure 58. Automated Water Level Hydrograph for well B-01-02 35AAA (BWLA Cotton Lane)

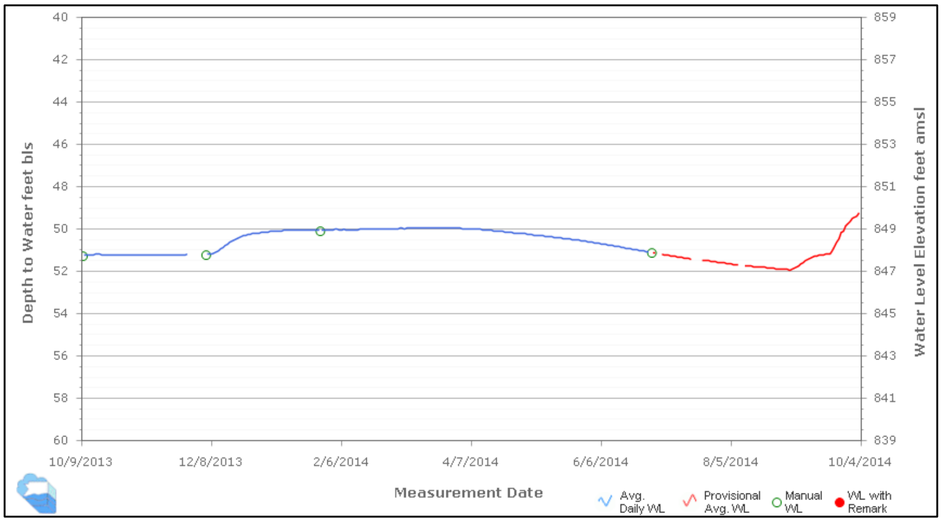


Figure 59. Automated Water Level Hydrograph for well C-01-02 08CDA (BWLA Jackrabbit)

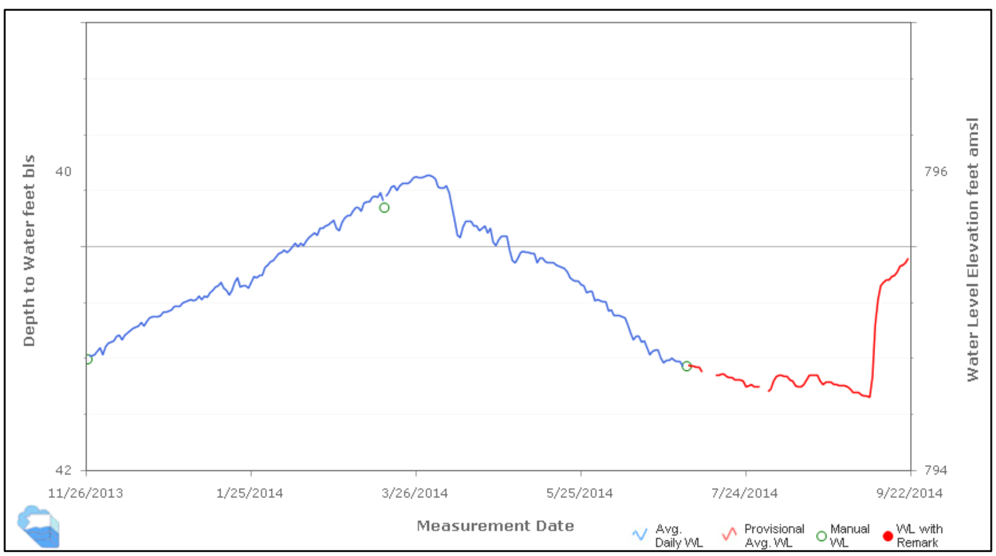


Figure 60. Automated Water Level Hydrograph for well C-01-04 27BDC (Robbins Butte)

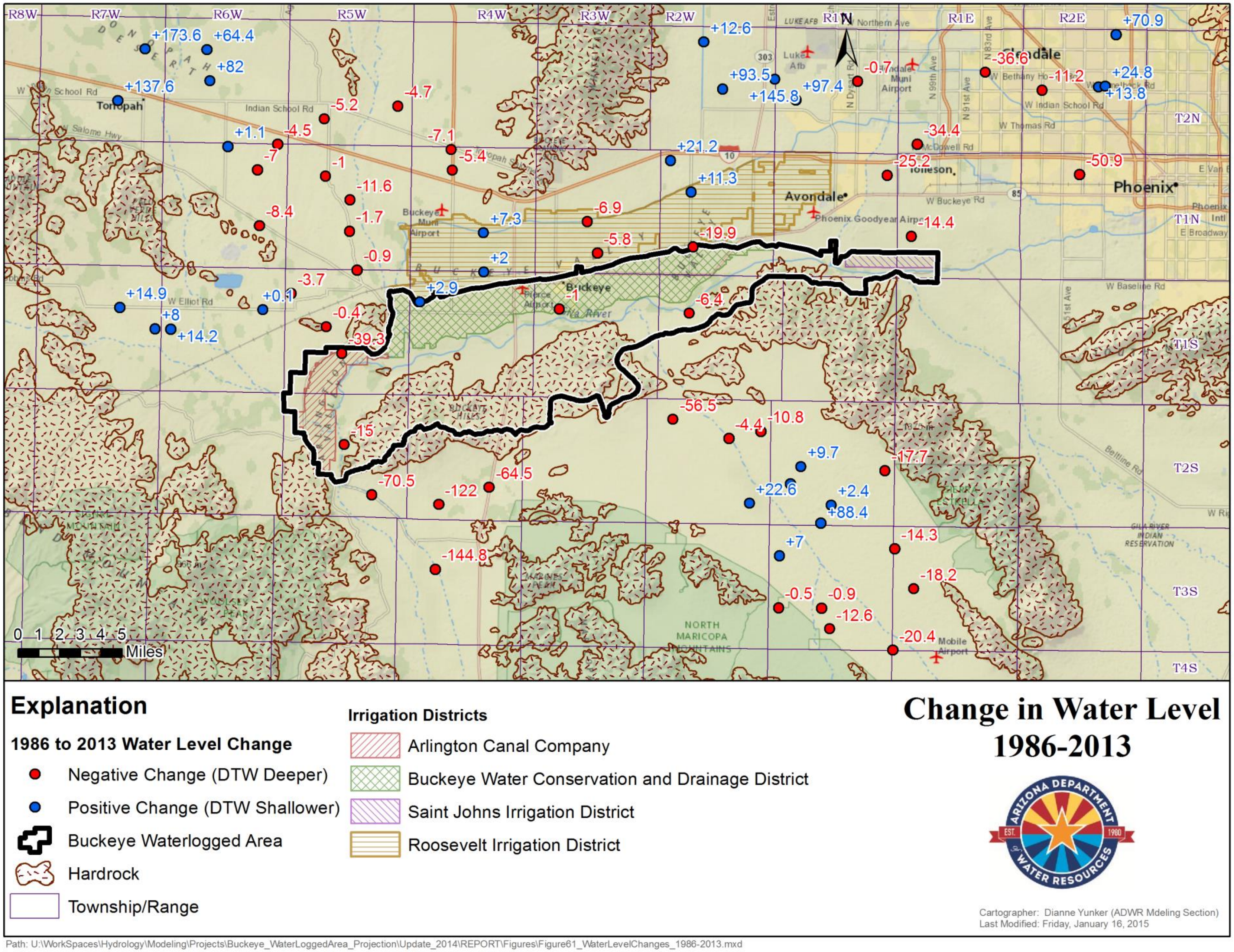


Figure 61. Water Level Change Map 1986 – 2013

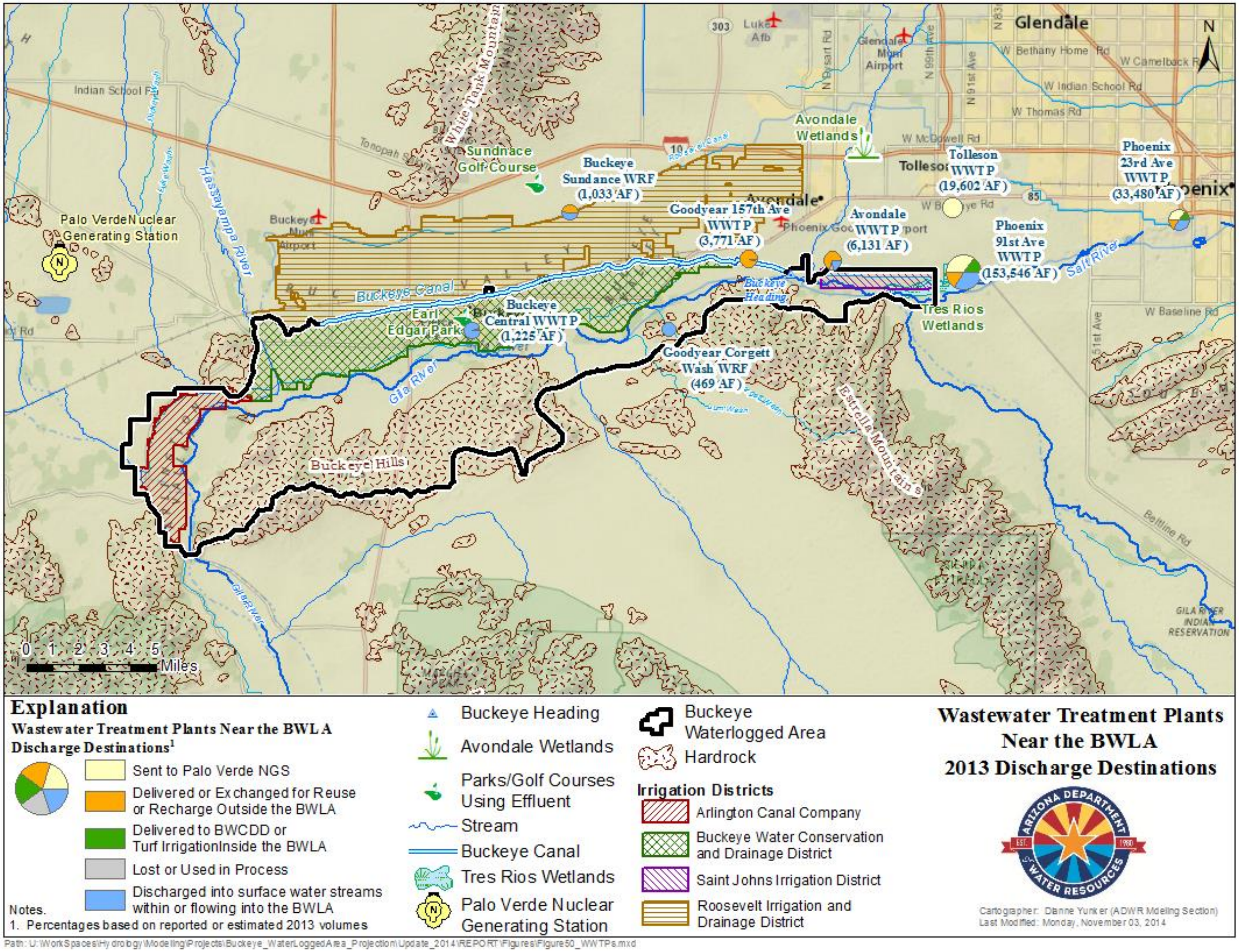


Figure 62. Wastewater Treatment Plants Near the BWLA

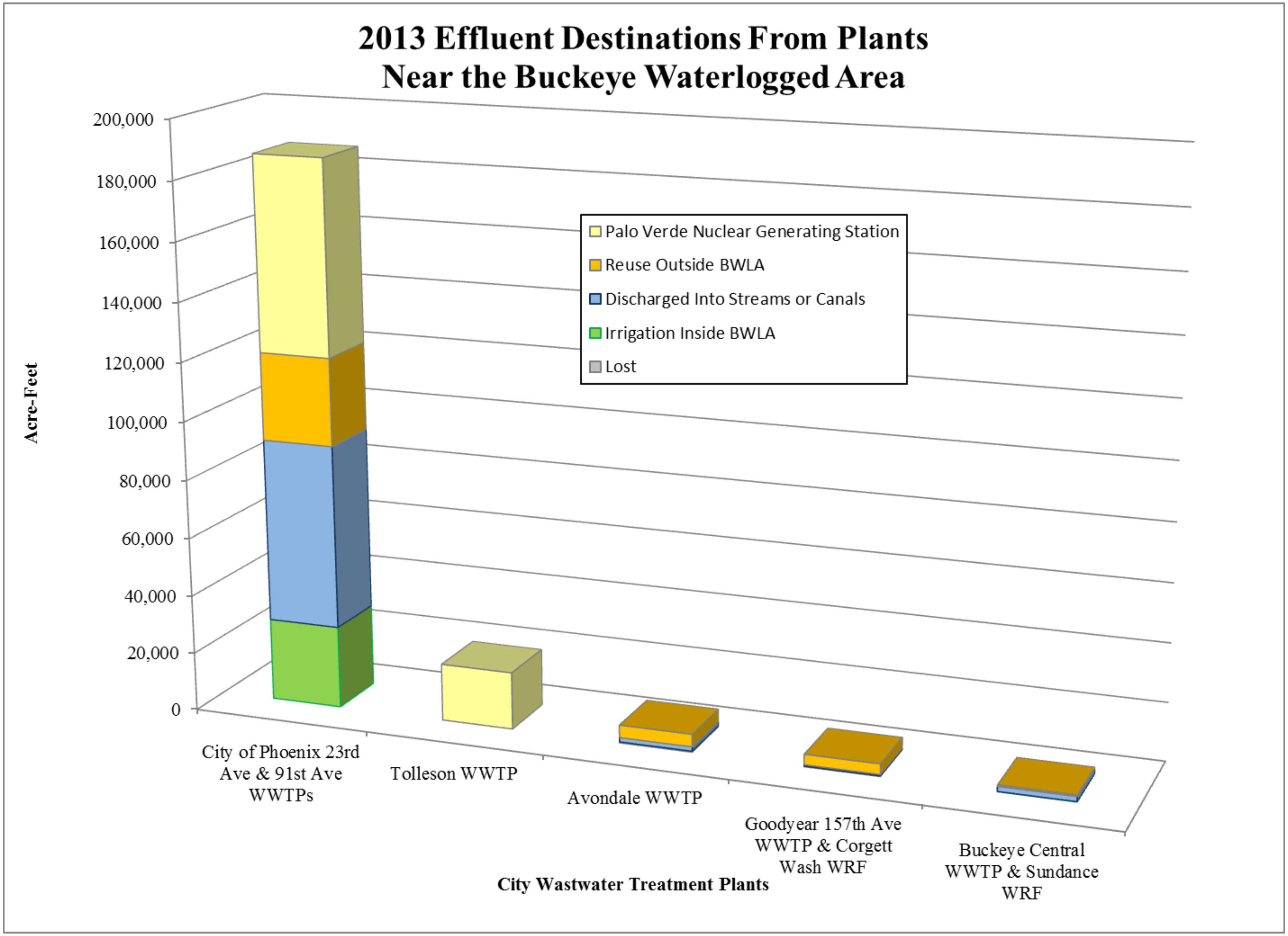


Figure 63. 2013 Effluent Destinations From Plants Near the Buckeye Waterlogged Area

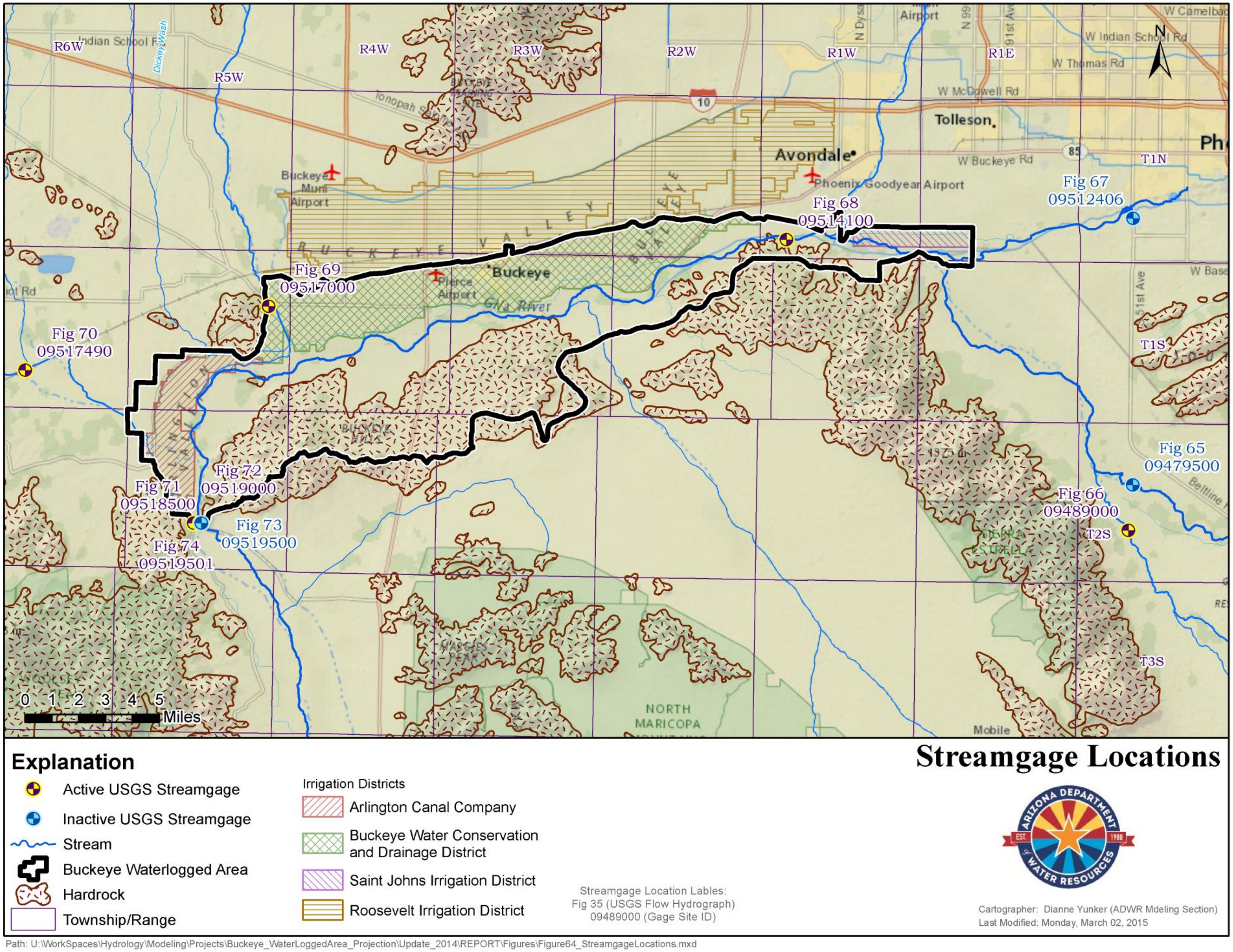


Figure 64. Location of USGS Stream Gages in the Vicinity of the BWLA

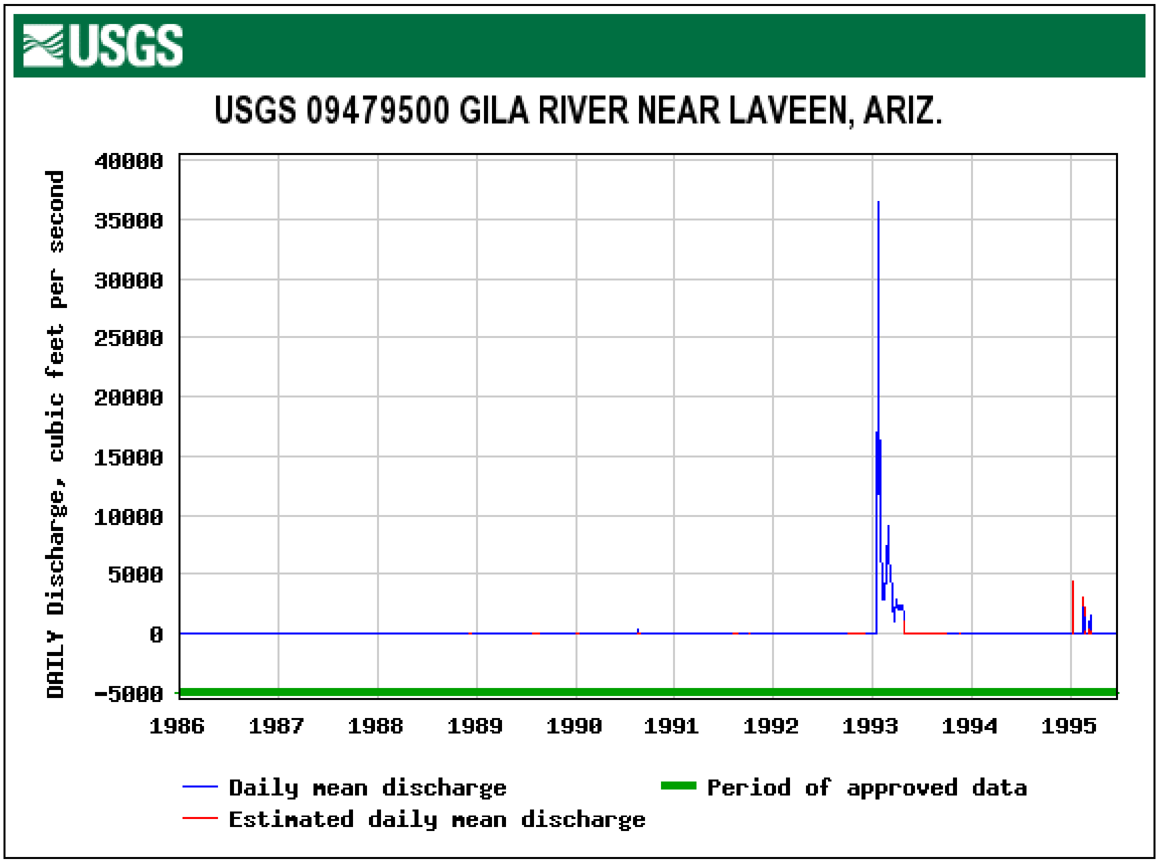


Figure 65. USGS Stream Gage 09479500

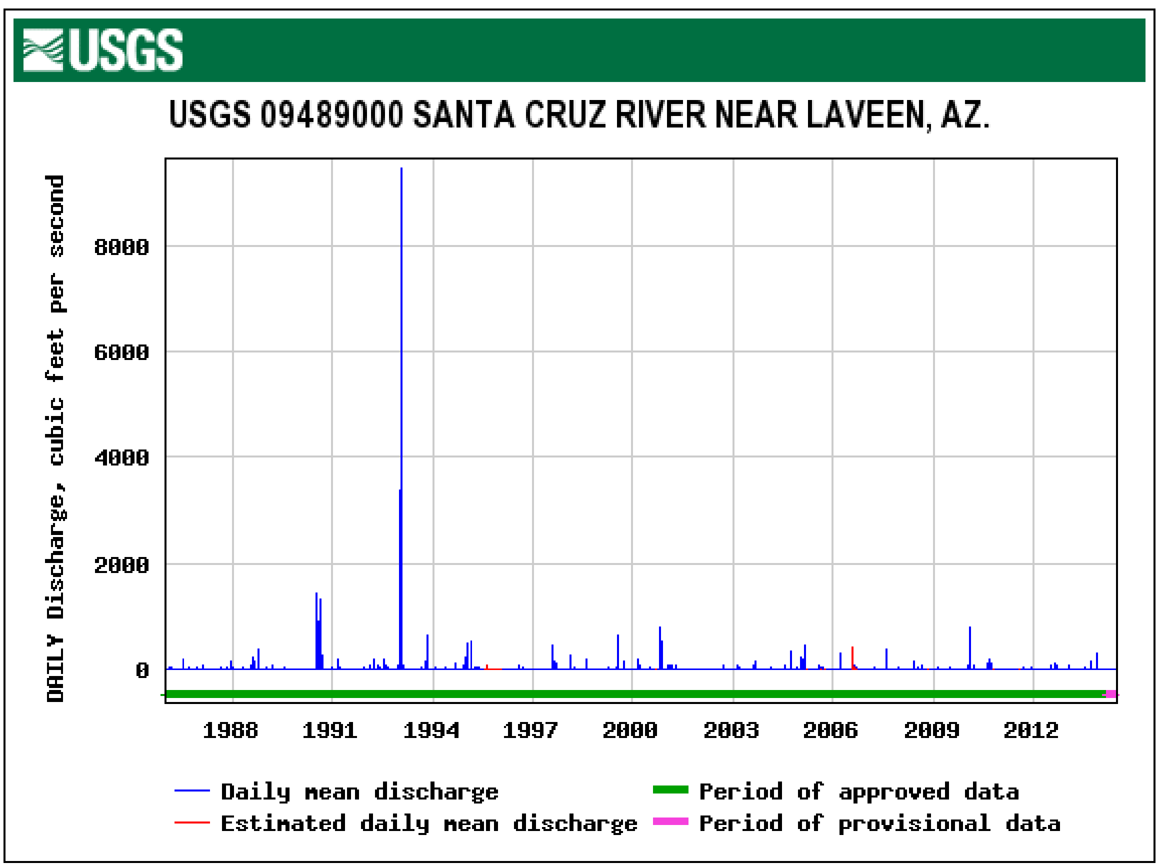


Figure 66. USGS Stream Gage 09489000

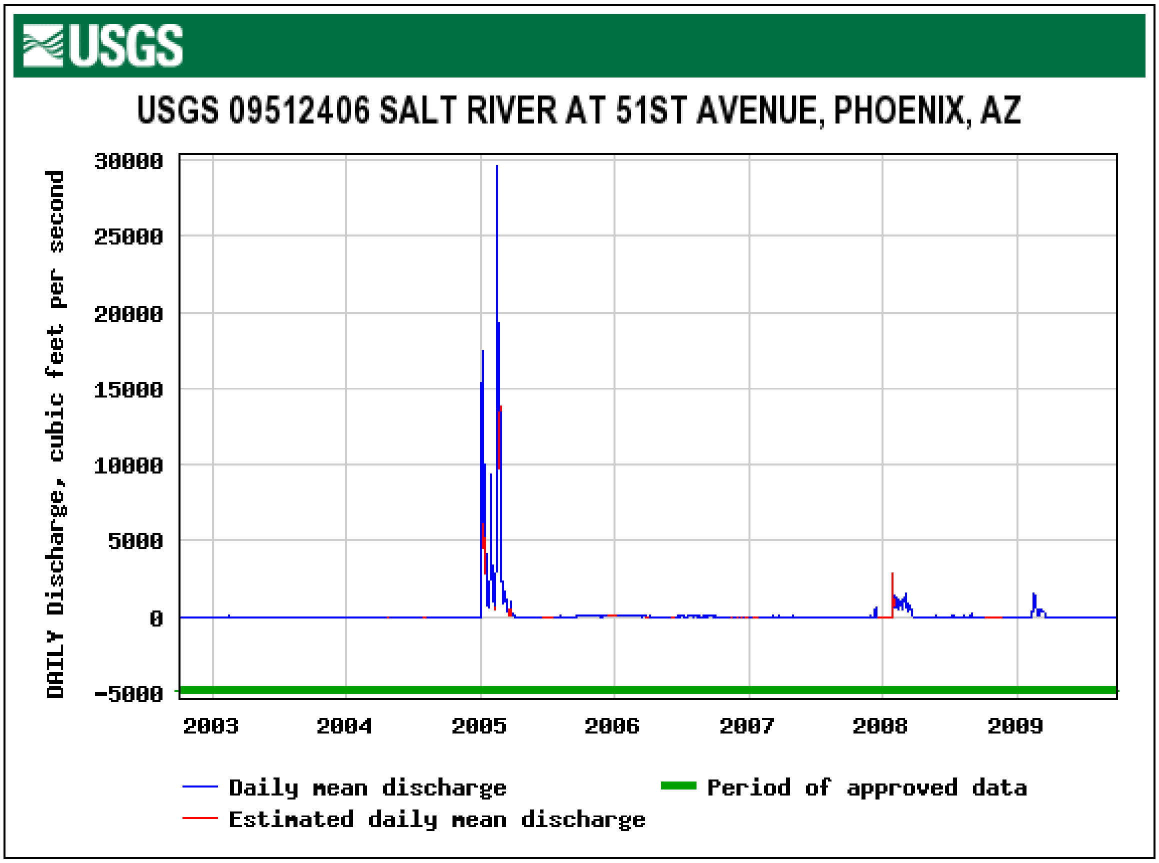


Figure 67. USGS Stream Gage 09512406

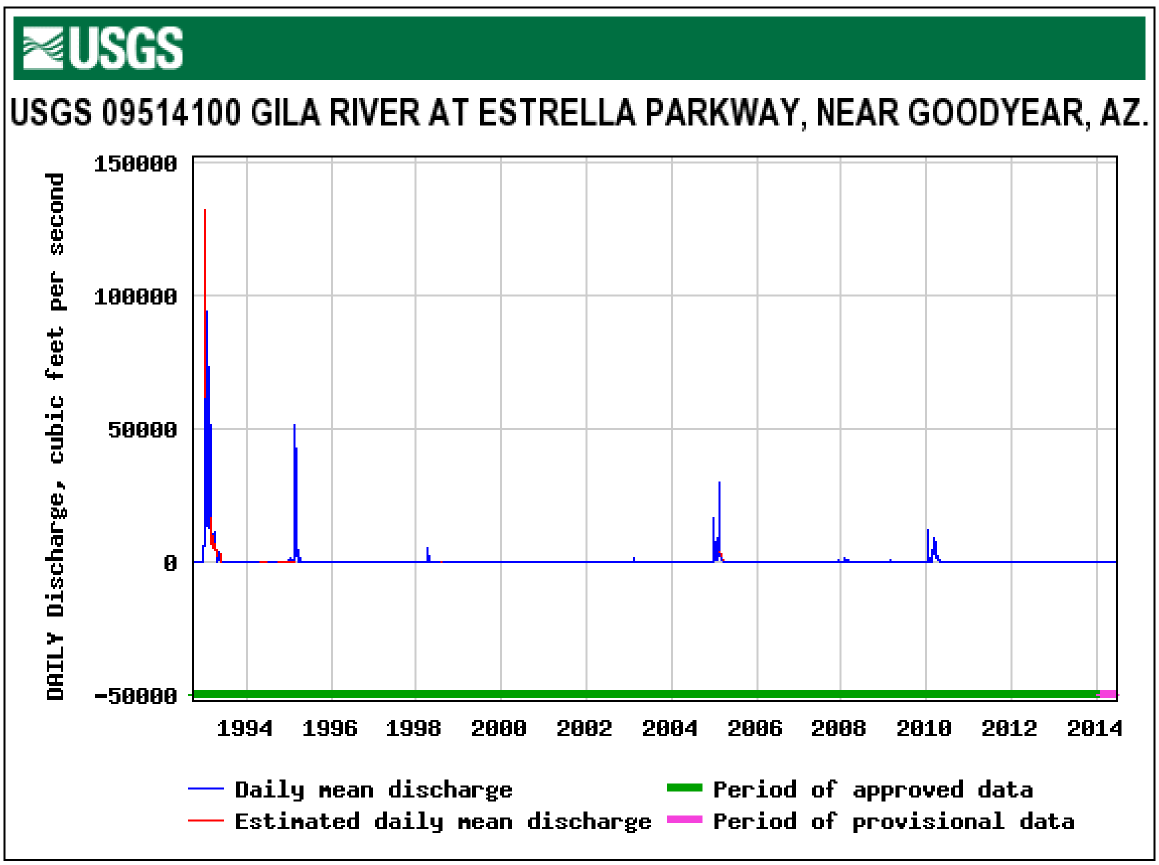


Figure 68. USGS Stream Gage 09514100

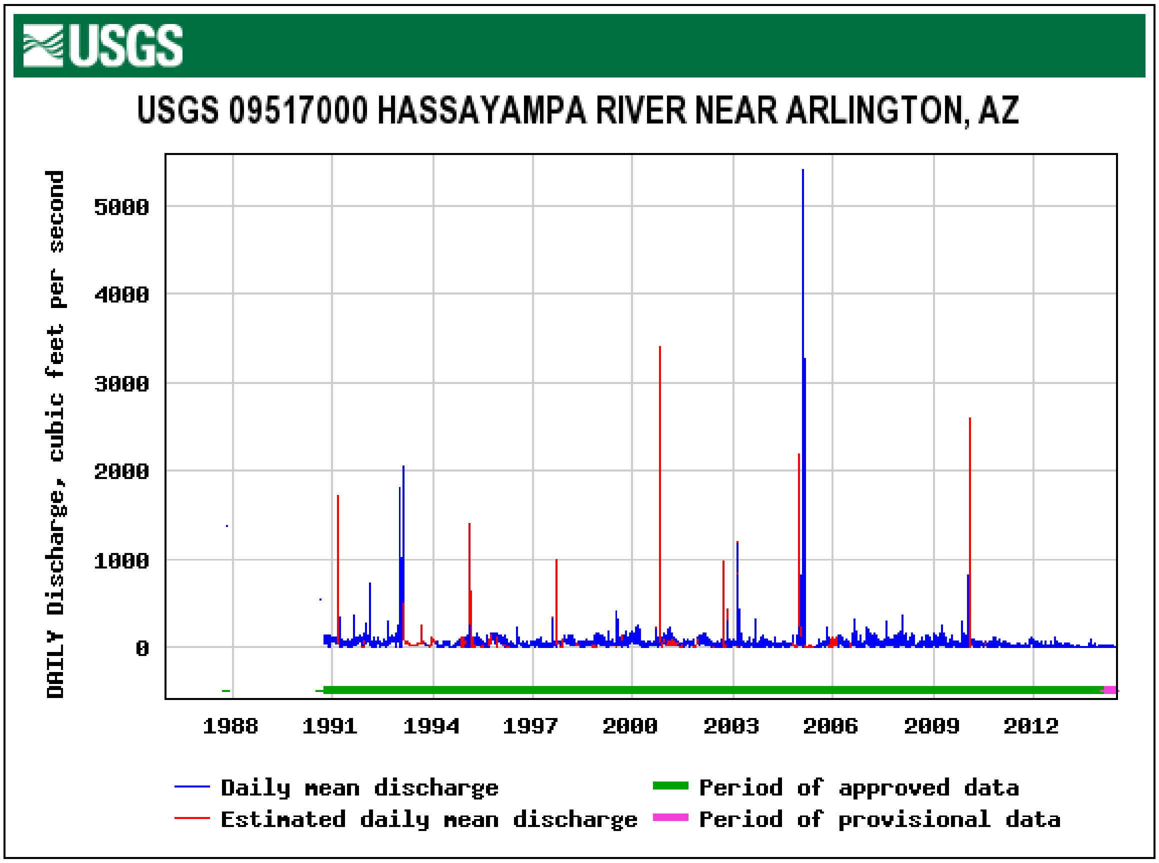


Figure 69. USGS Stream Gage 06517000

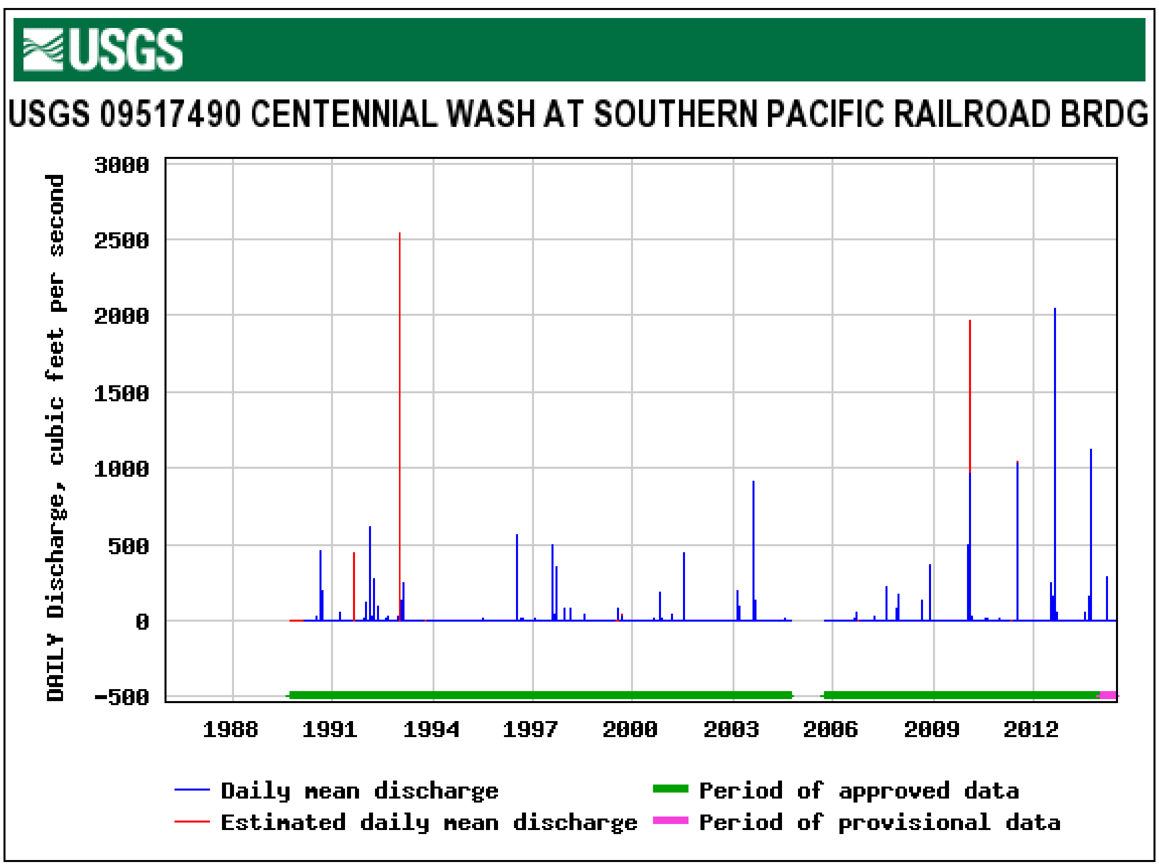


Figure 70. USGS Stream Gage 06517490

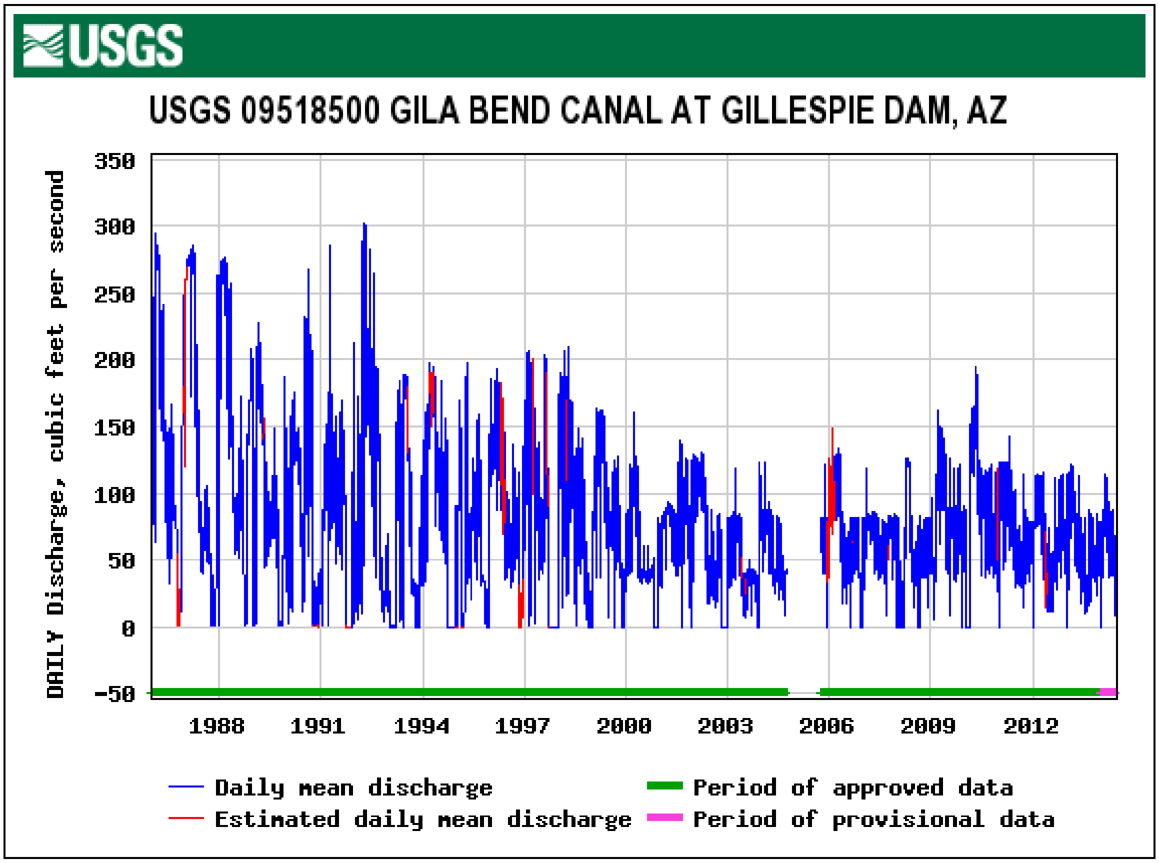


Figure 71. USGS Stream Gage 09518500

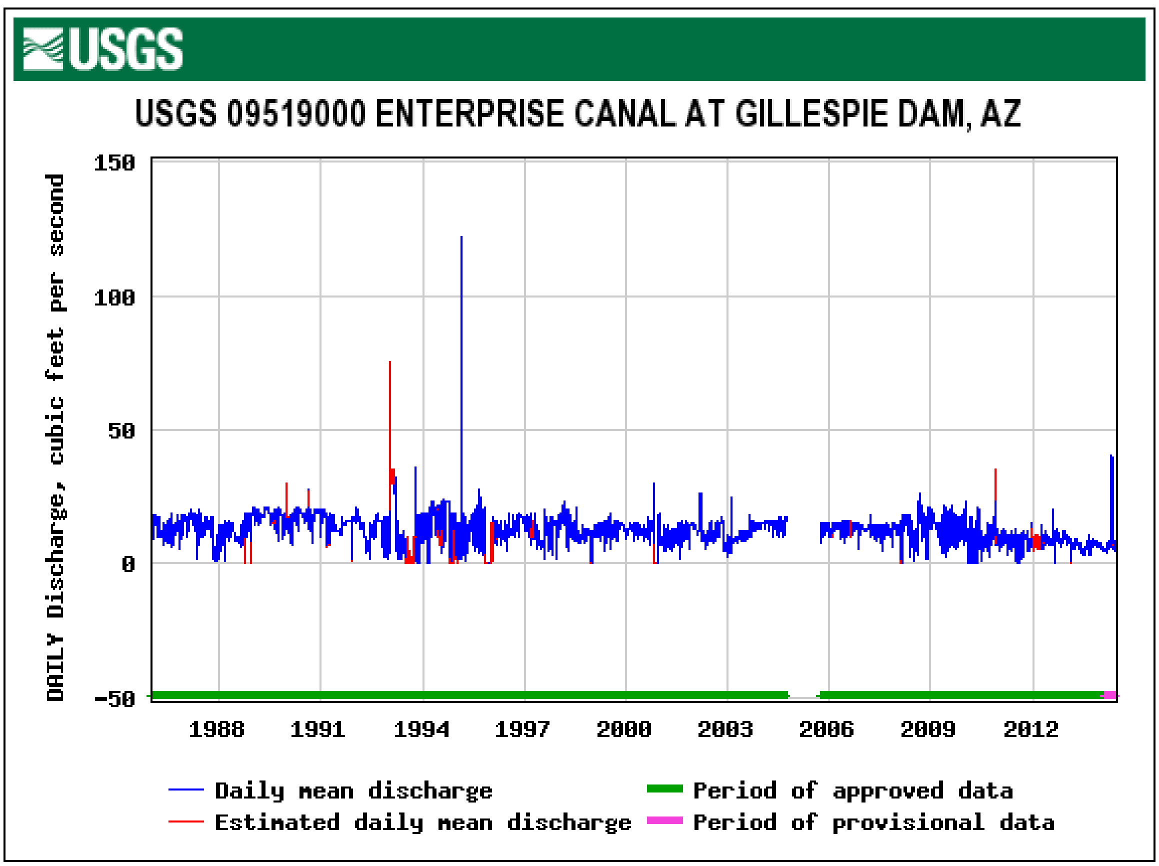


Figure 72. USGS Stream Gage 09519000

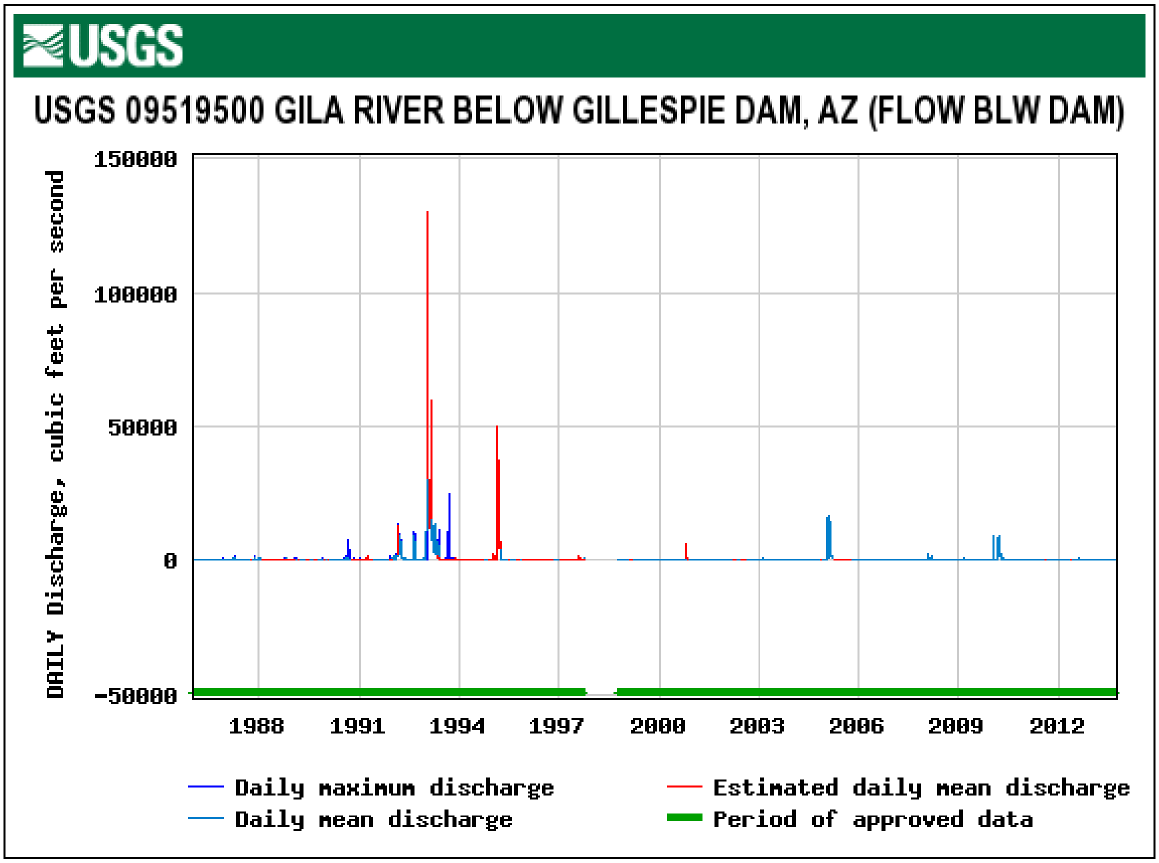


Figure 73. USGS Stream Gage 09519500

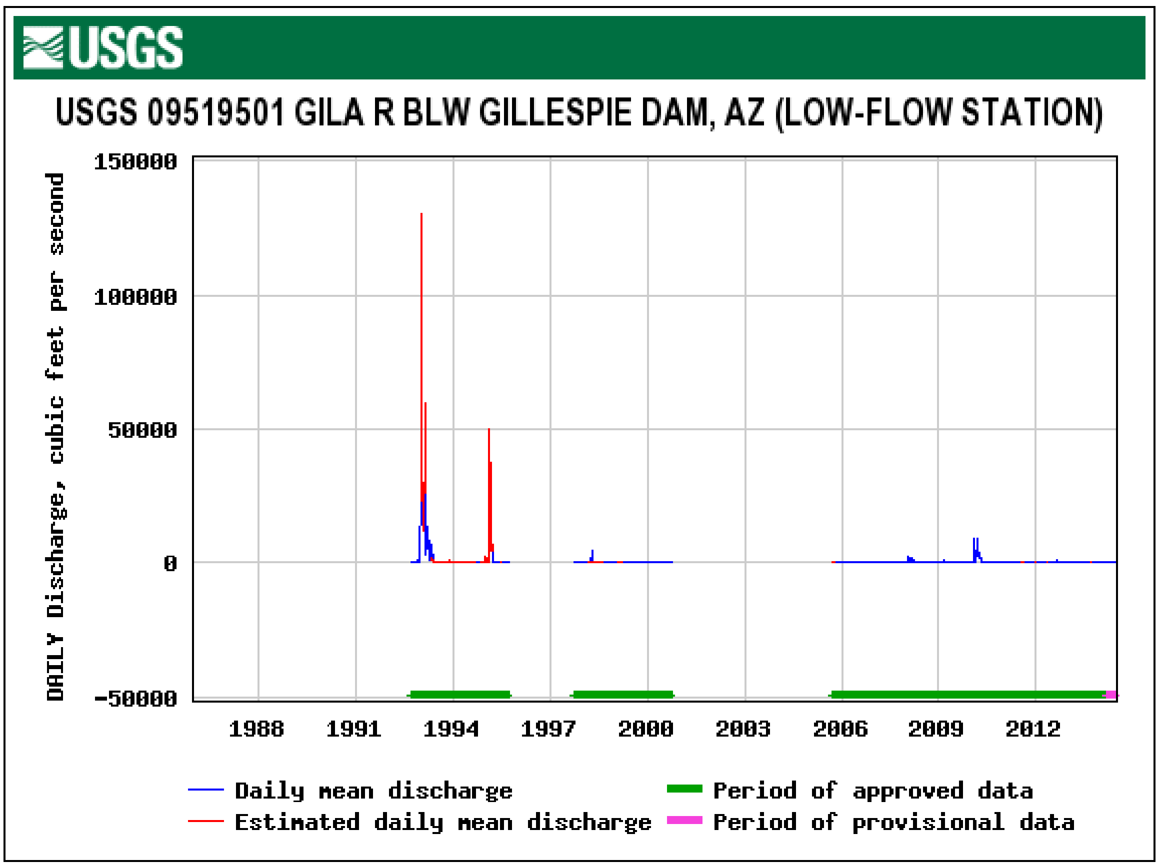


Figure 74. USGS Stream Gage 09519501

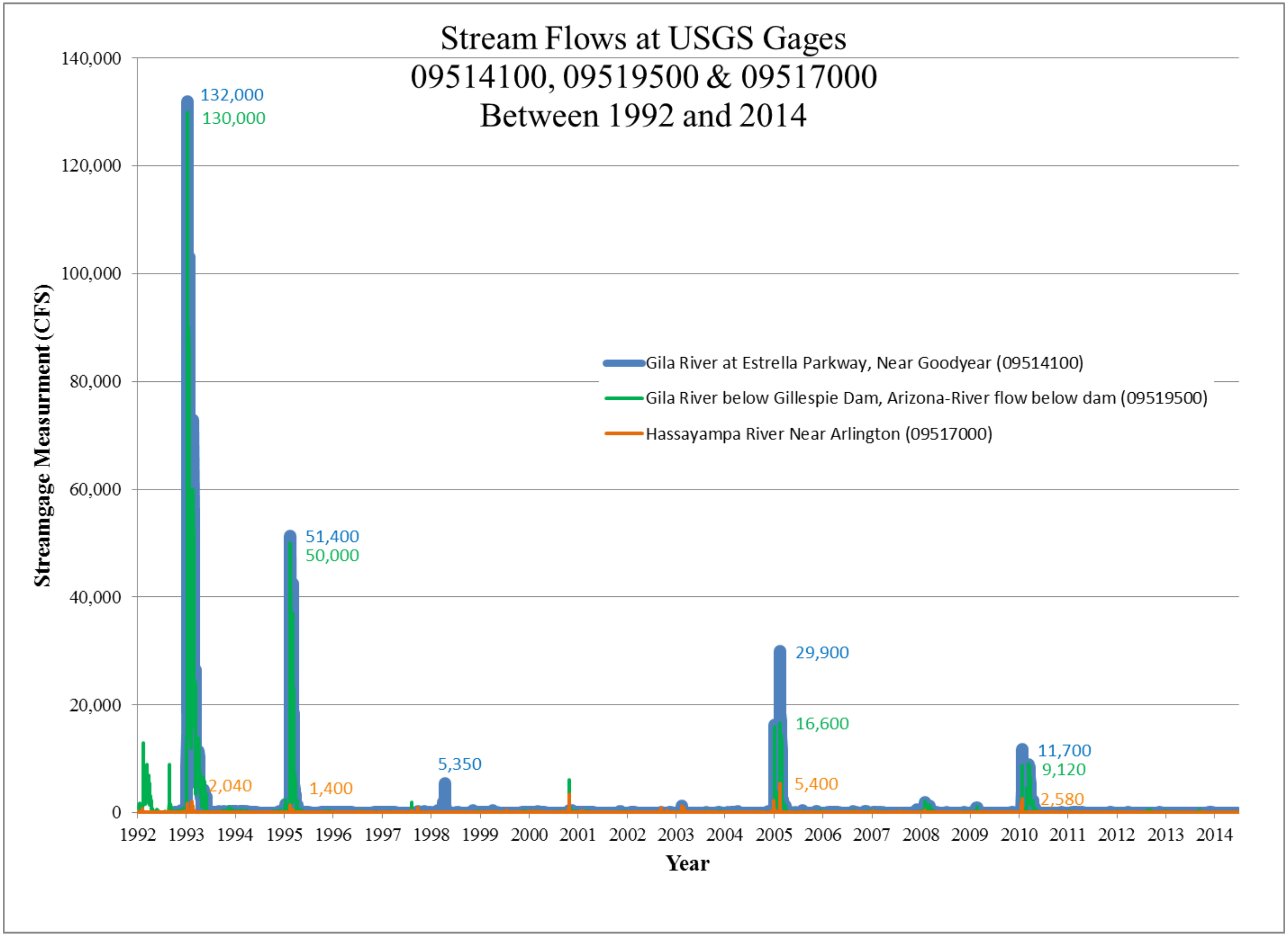


Figure 75. Stream Flows at USGS Gages 09514100, 09519500 and 09517000 Between 1992 and 2014

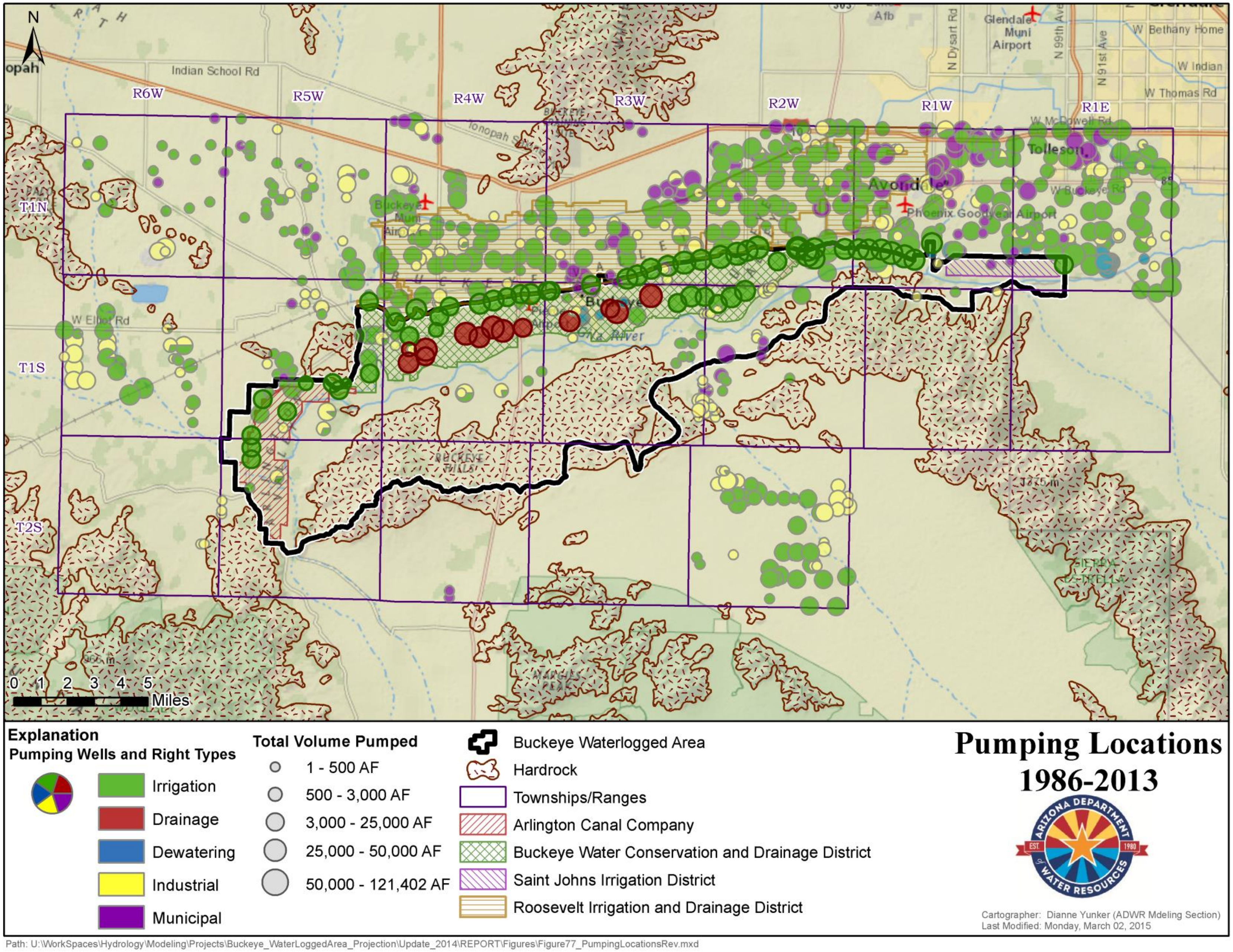


Figure 76. Pumping Locations and Types 1986-2013

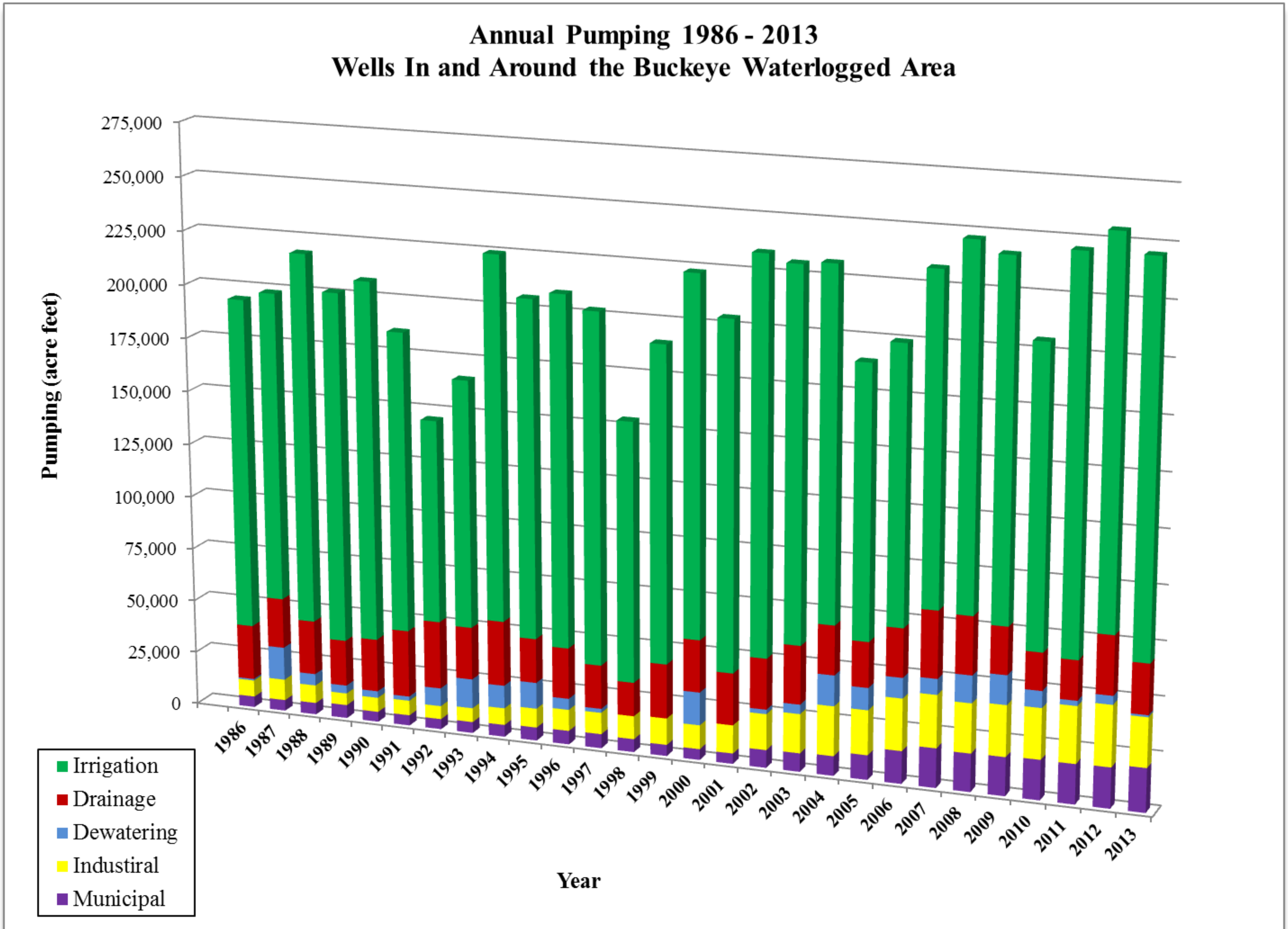


Figure 77. Annual Pumping in and Around the BWLA 1986-2013

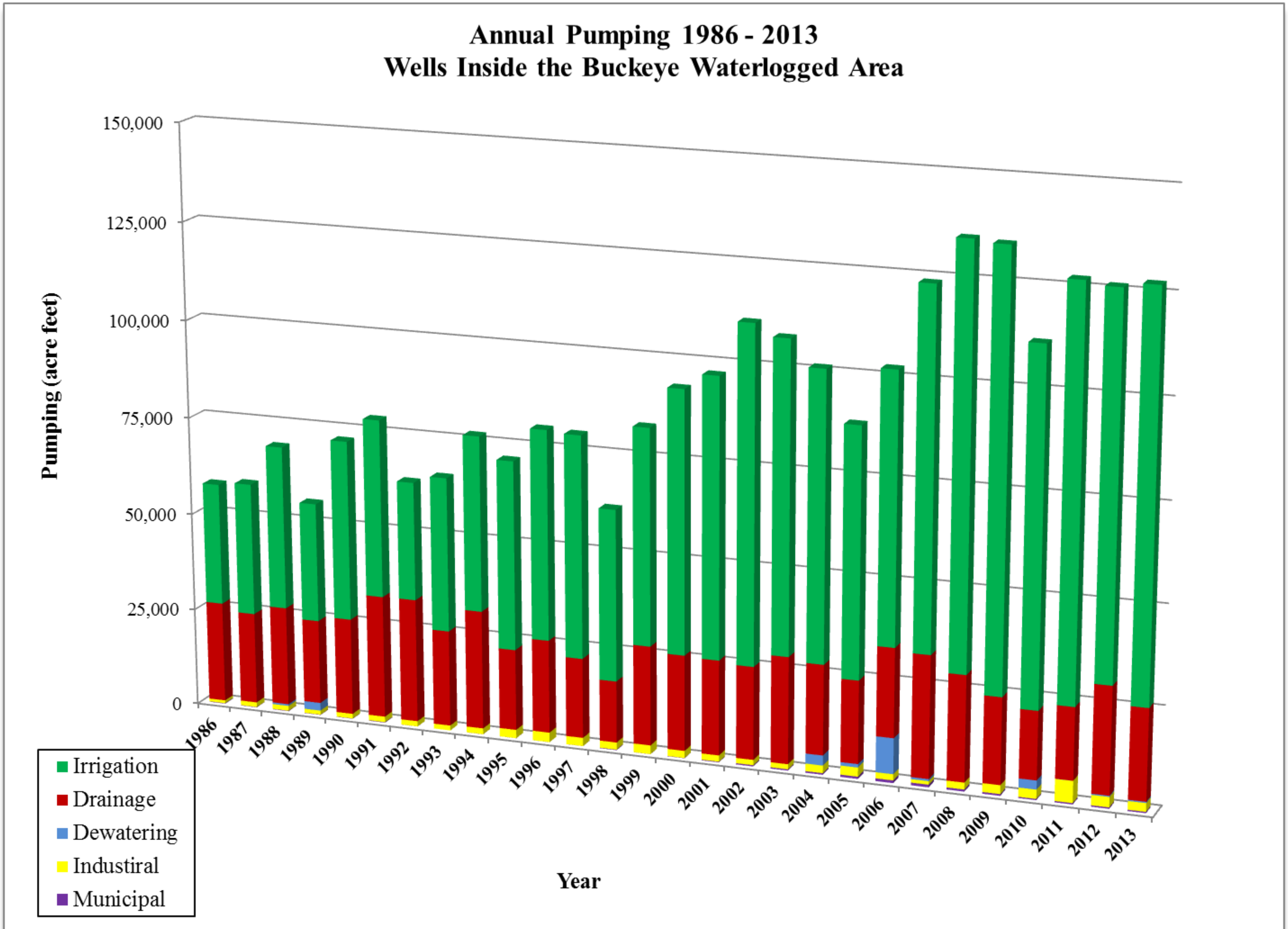


Figure 78. Annual Pumping Inside the BWLA Boundary Only 1986 -2013

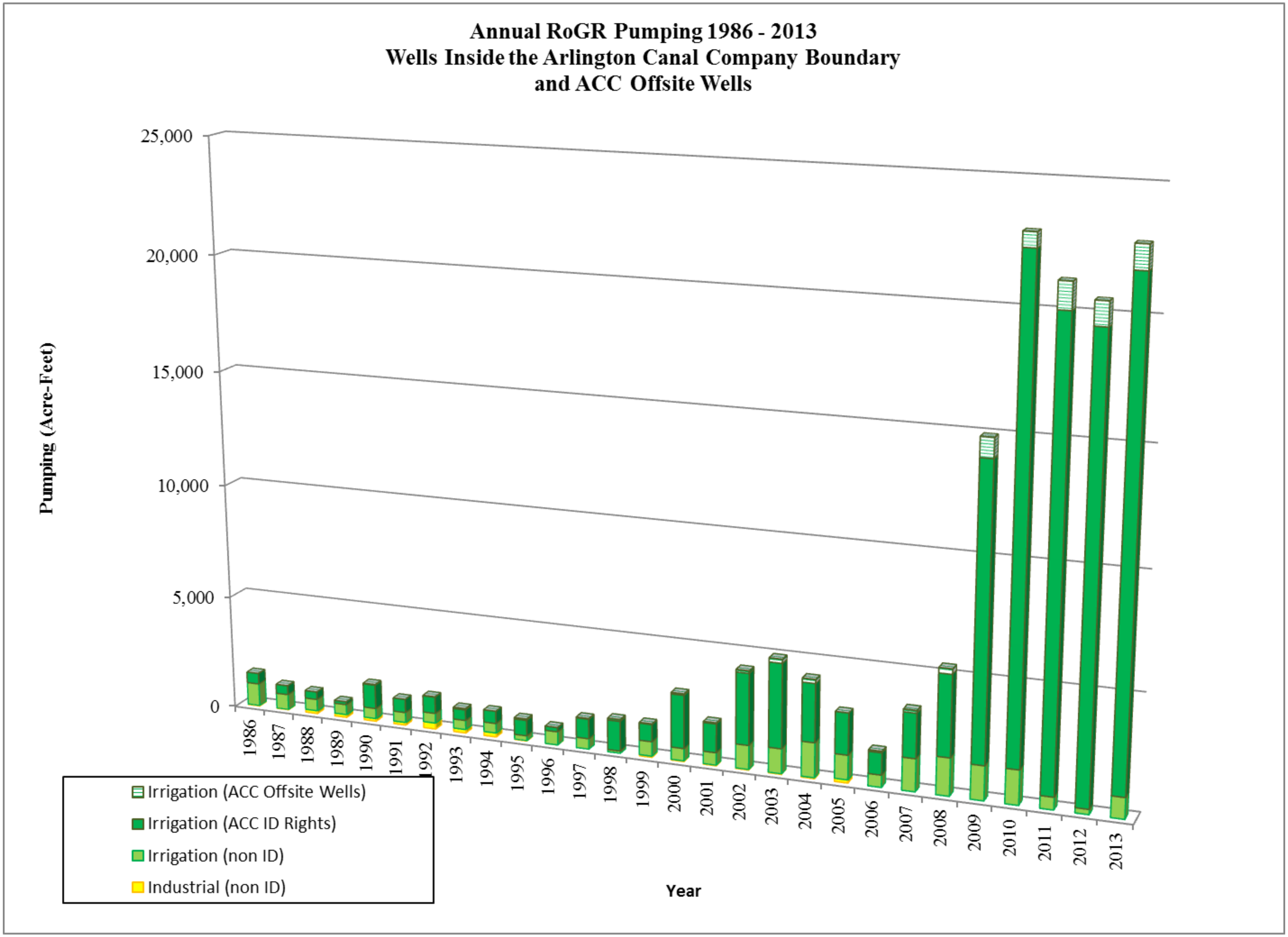


Figure 79. Chart of Annual Pumping 1986-2013 Arlington Canal Company

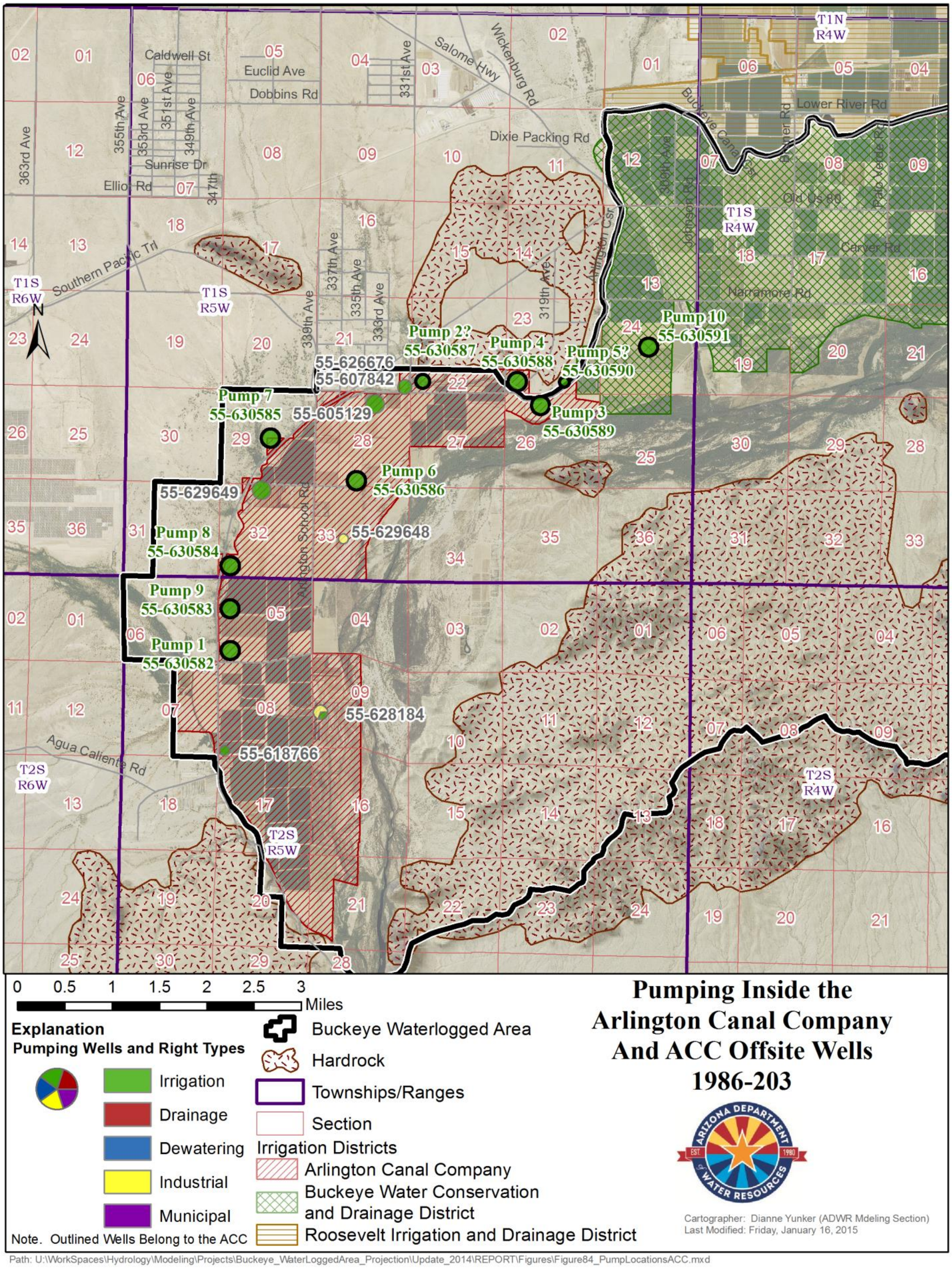


Figure 80. Pumping Inside the ACC 1986-2013

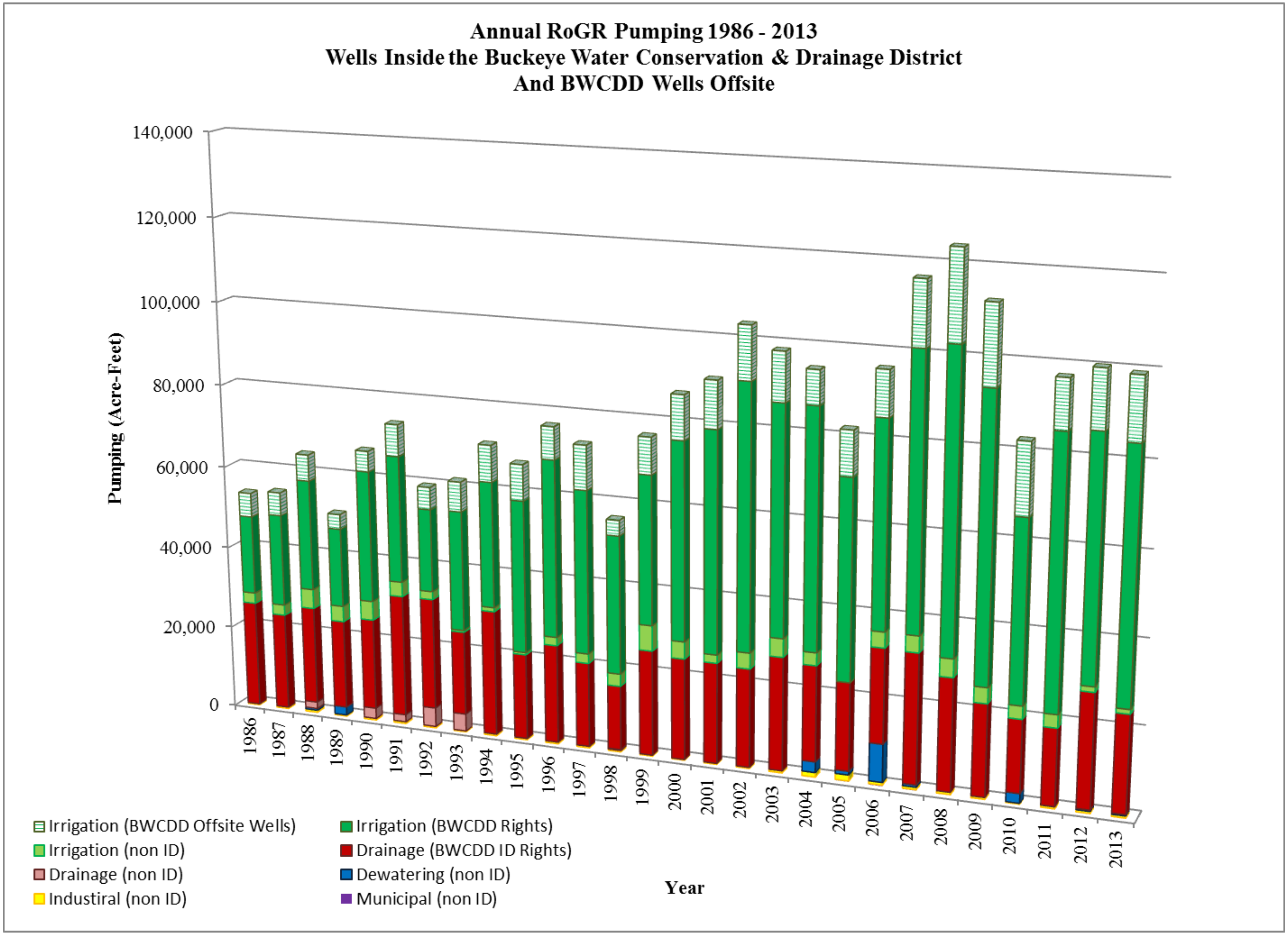


Figure 81. Chart of Annual Pumping 1986-2013 Buckeye Water Conservation and Drainage District

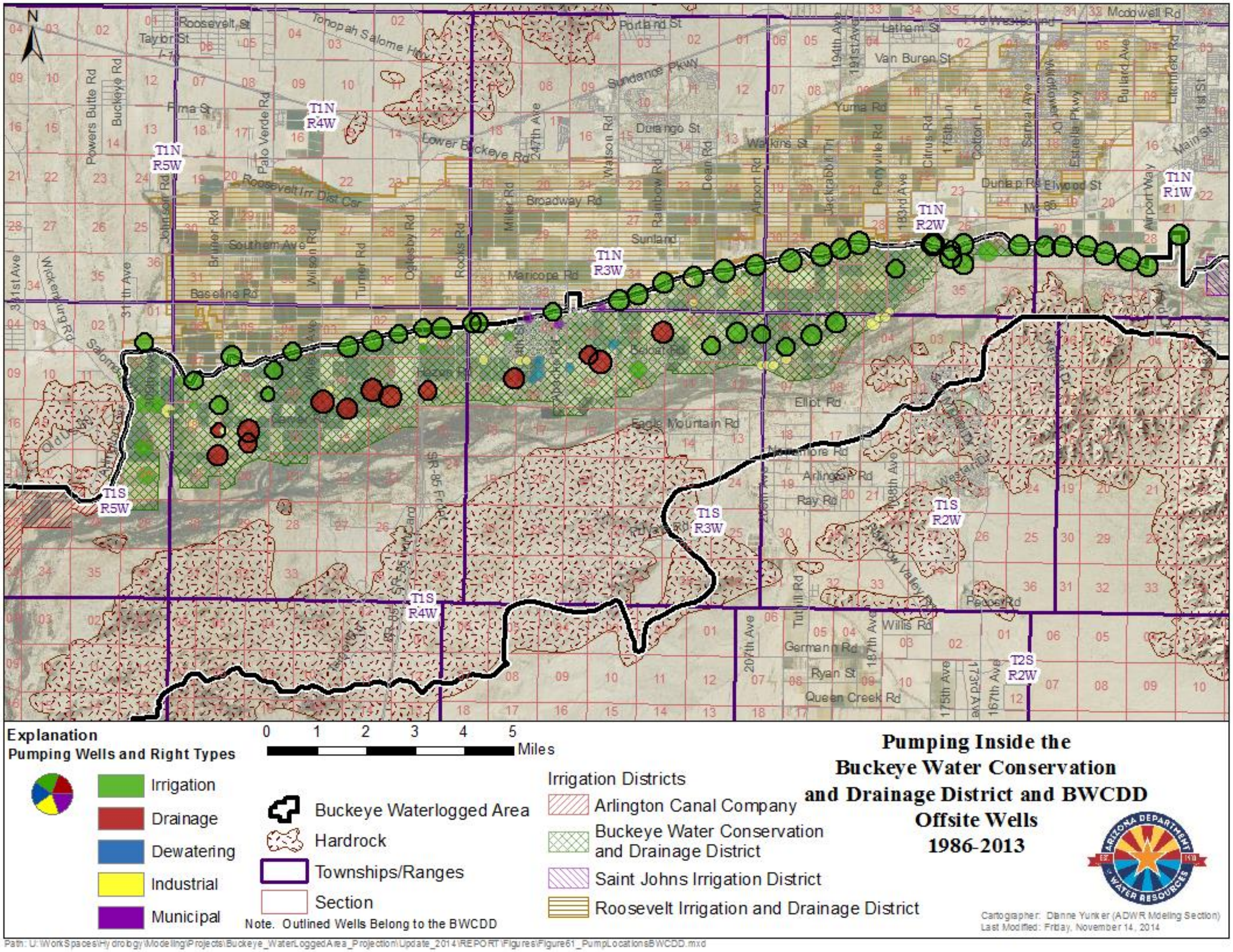


Figure 82. Map of Pumping BWCDD 1986-2013

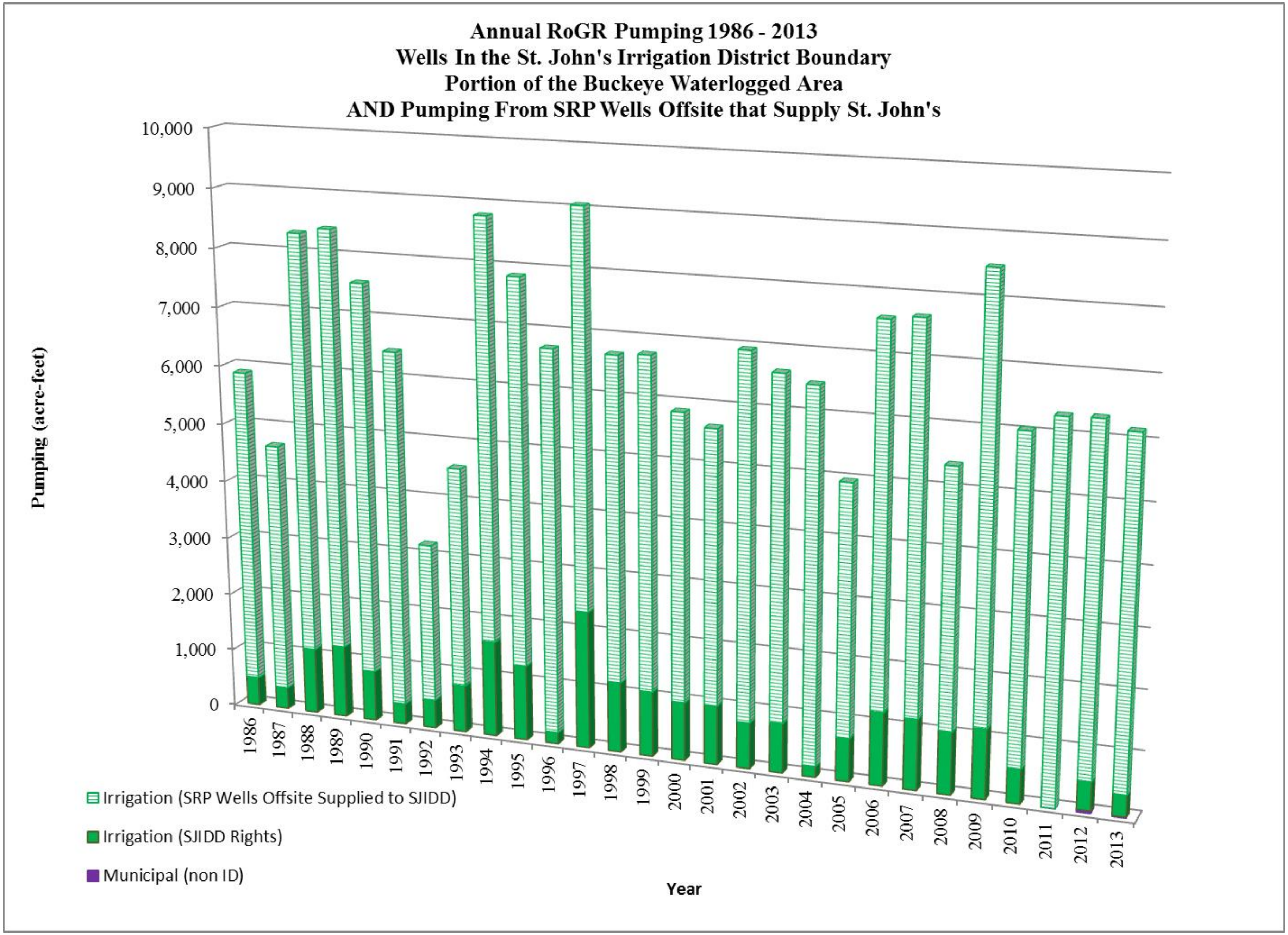


Figure 83. Chart of Annual Pumping 1986-2013 St. John's Irrigation District

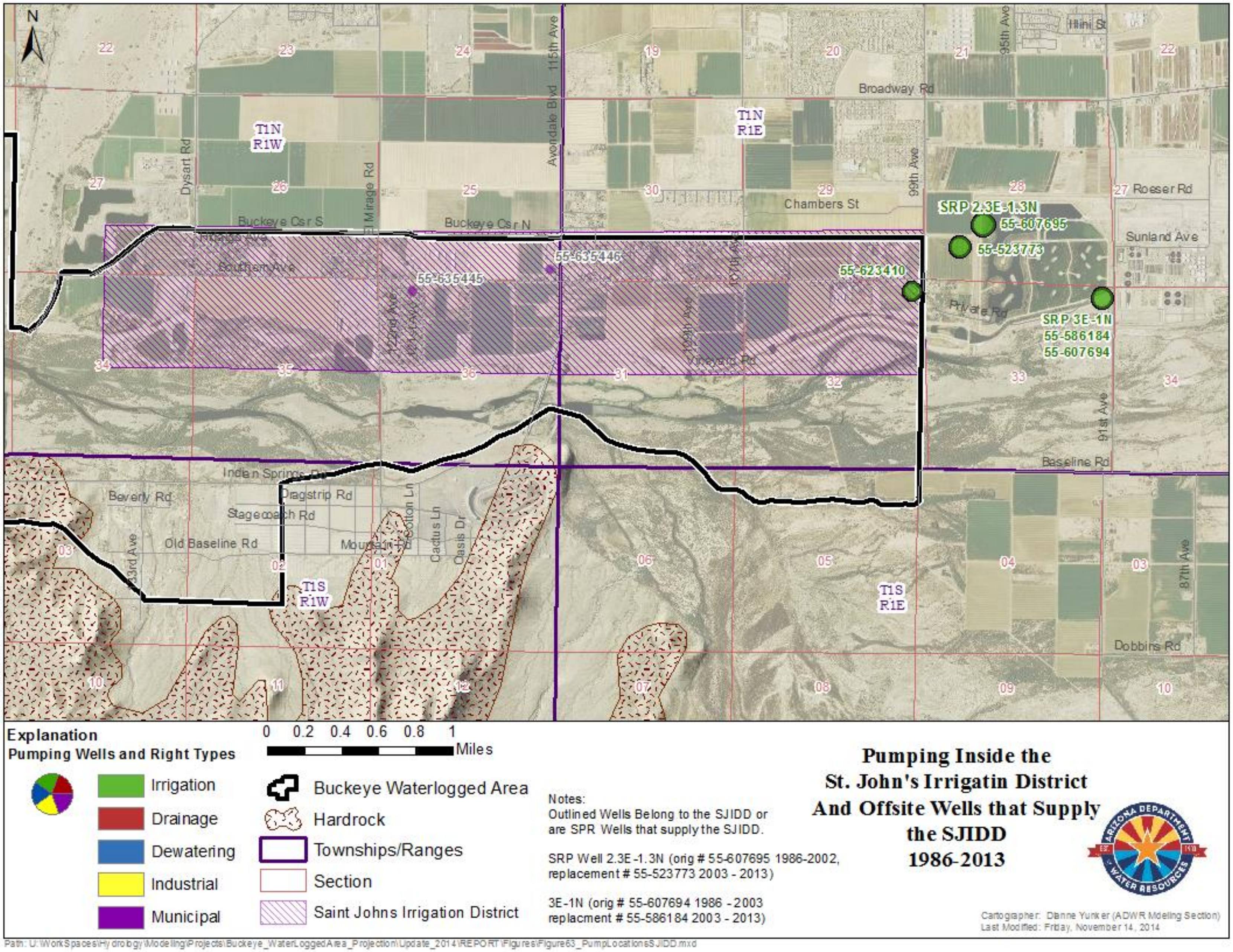


Figure 84. Map of SJIDD Pumping 1986-2013

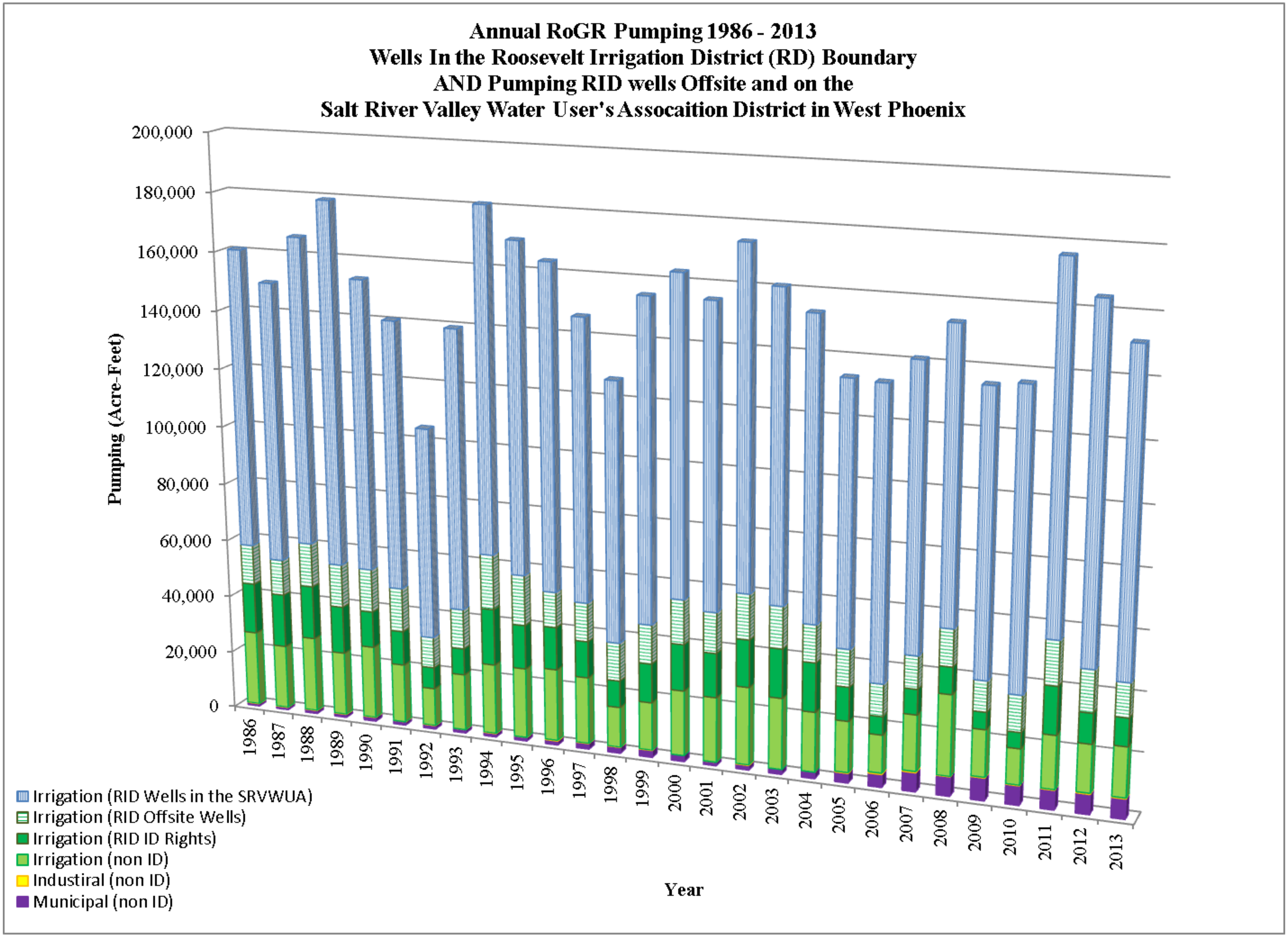
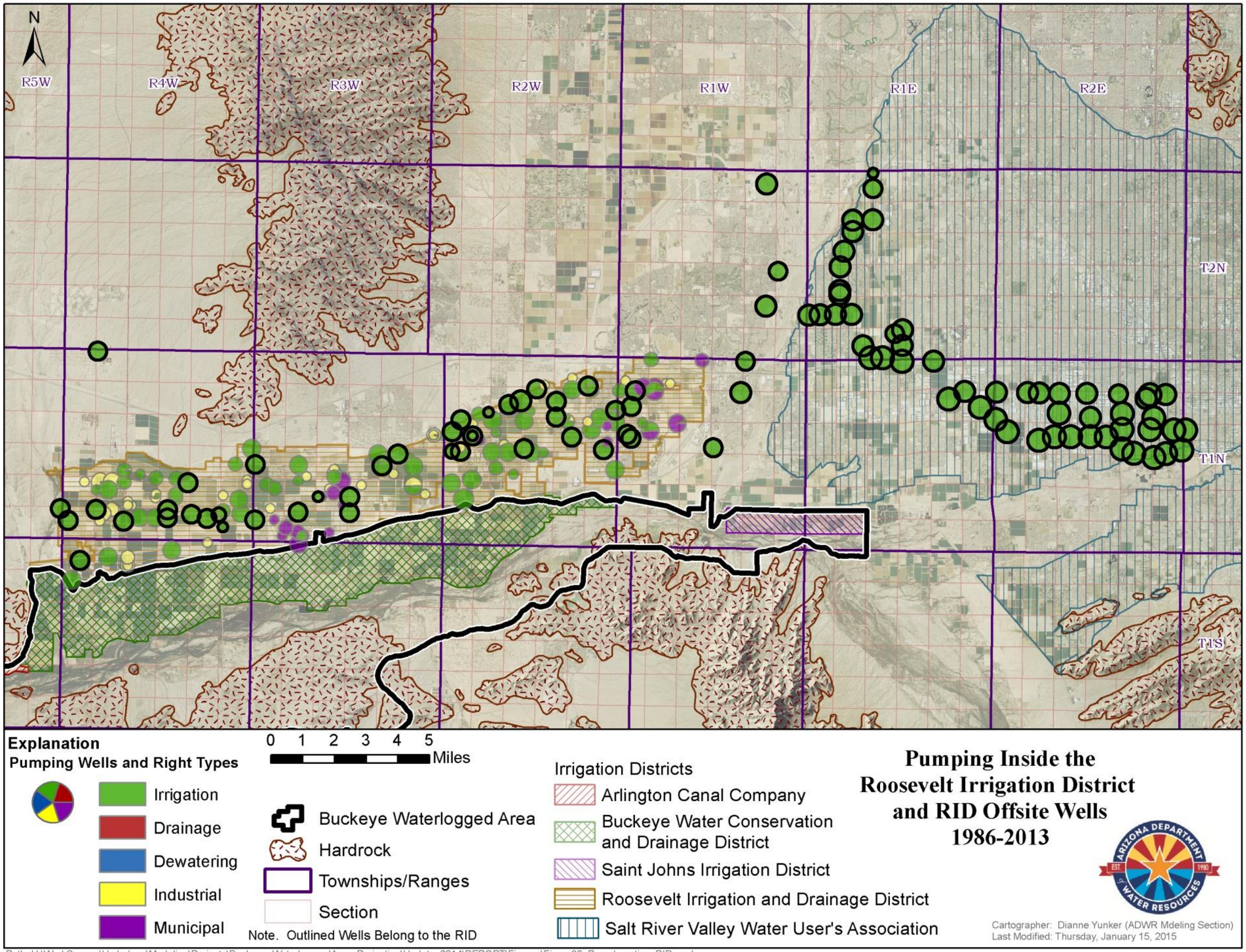


Figure 85. Annual Pumping 1986-2013 Roosevelt Irrigation District



Path: U:\WorkSpaces\Hydrology\Modeling\Projects\Buckeye_WaterLoggedArea_Projection\Update_2014\REPORT\Figures\Figure80_PumpLocationsRID.mxd

Figure 86. Pumping Inside the Roosevelt Irrigation District and RID Offsite Wells 1986-2013

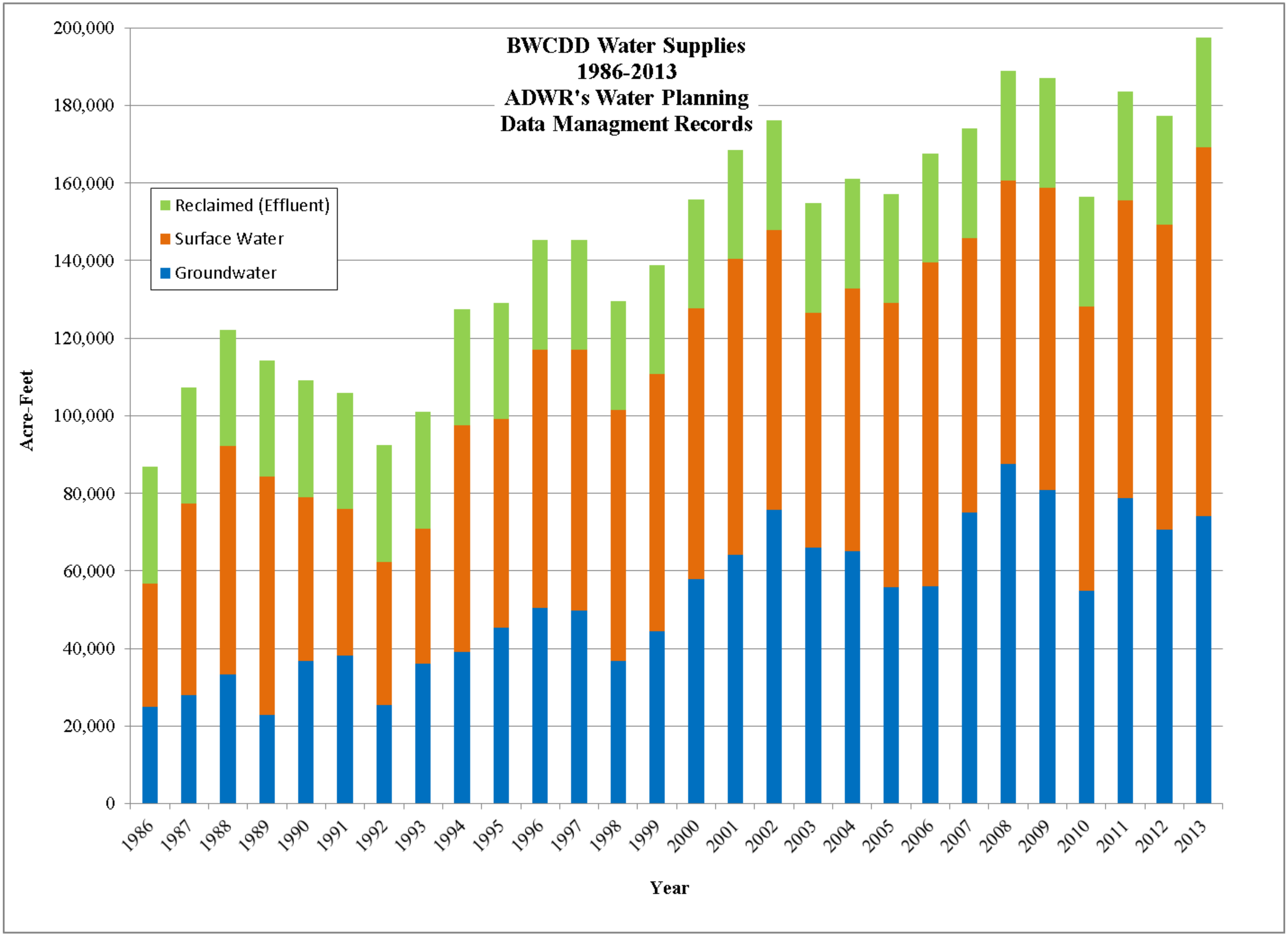


Figure 87. BWCDD Water Supplies 1986-2013 Data Management Records

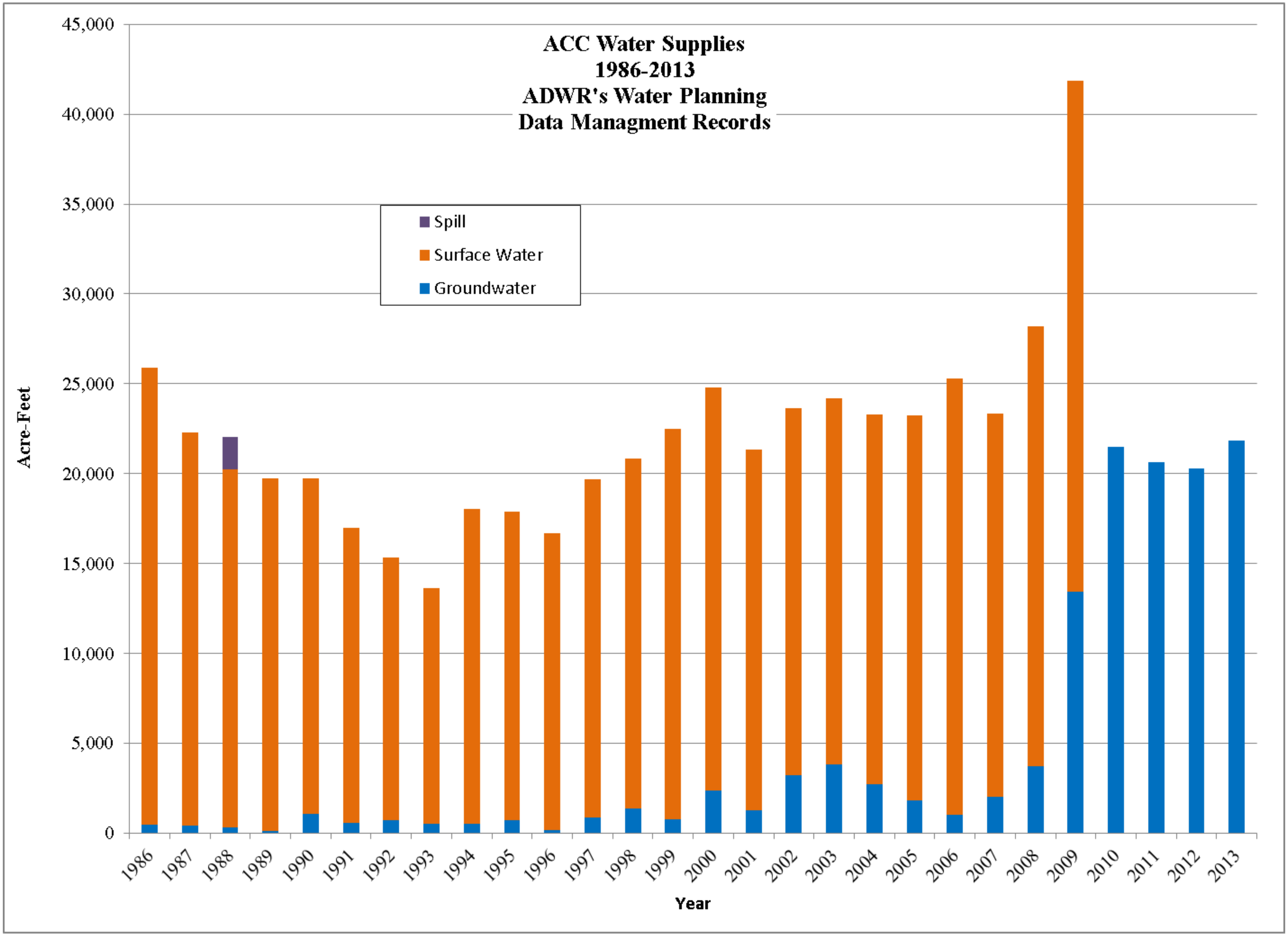


Figure 88. ACC Water Supplies 1986-2013 Data Management Records

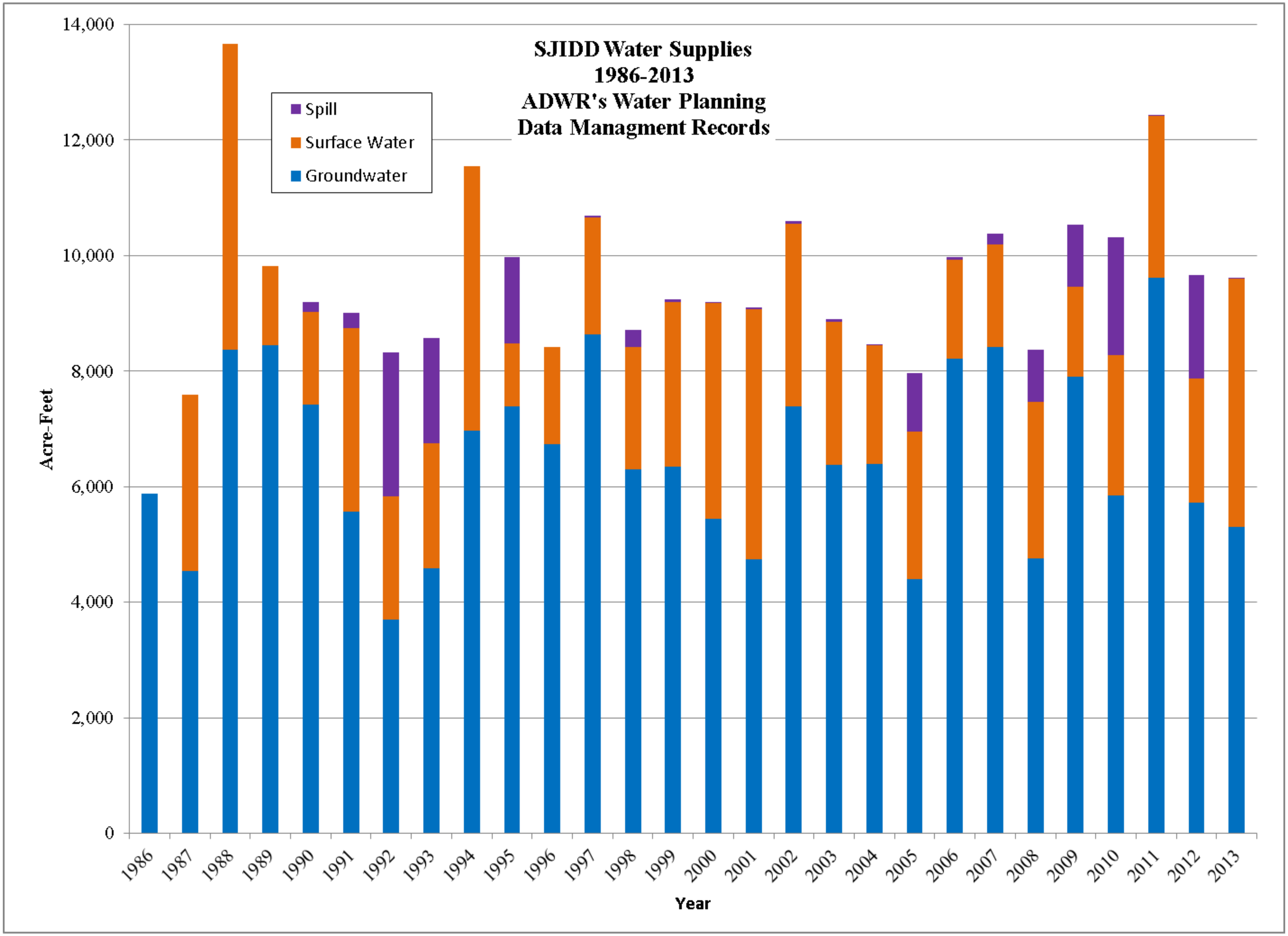


Figure 89. SJIDD Water Supplies 1986-2013 Data Management Records

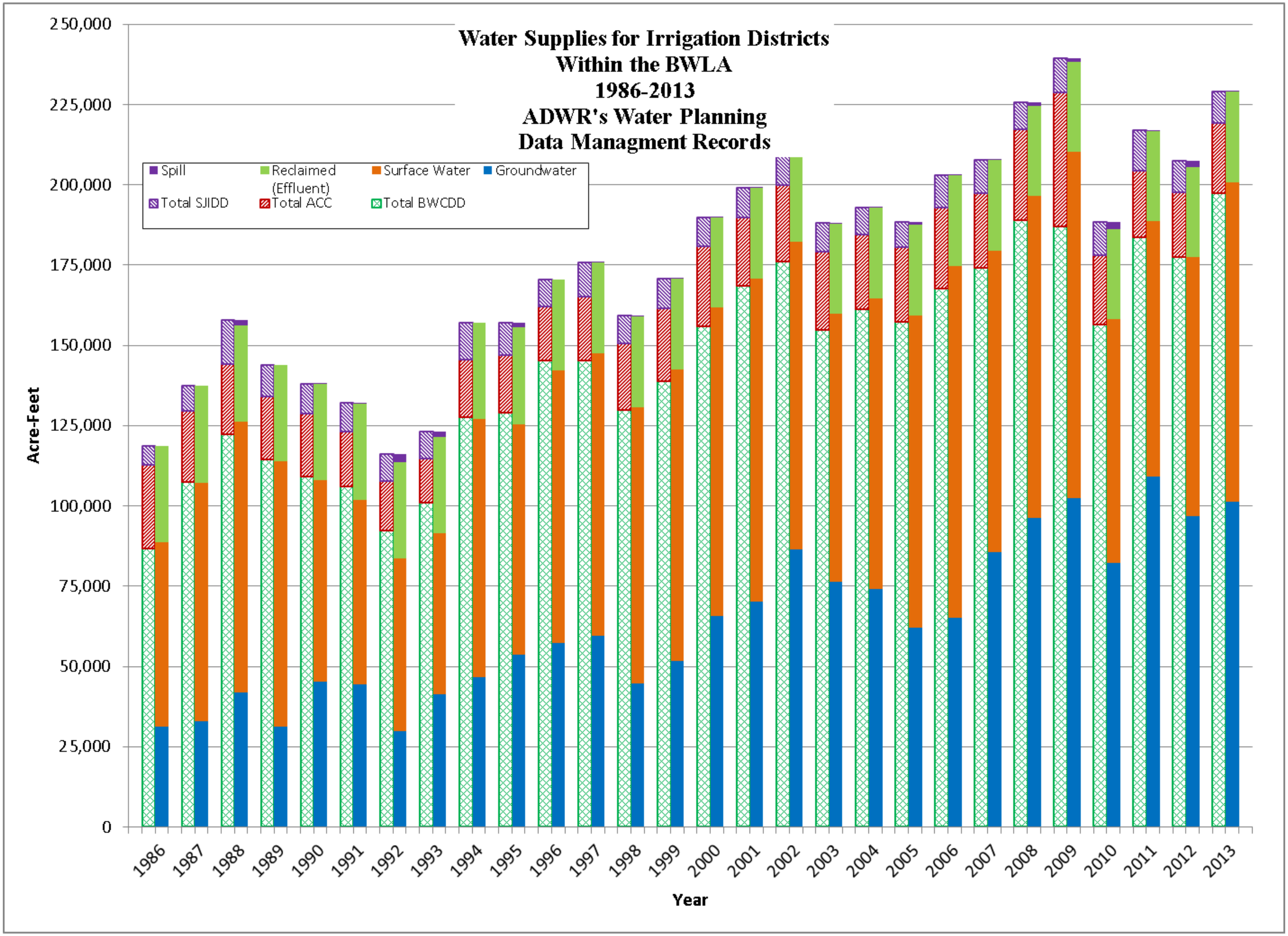


Figure 90. Water Supplies for Irrigation Districts Within the BWLA 1986-2013 Data Management

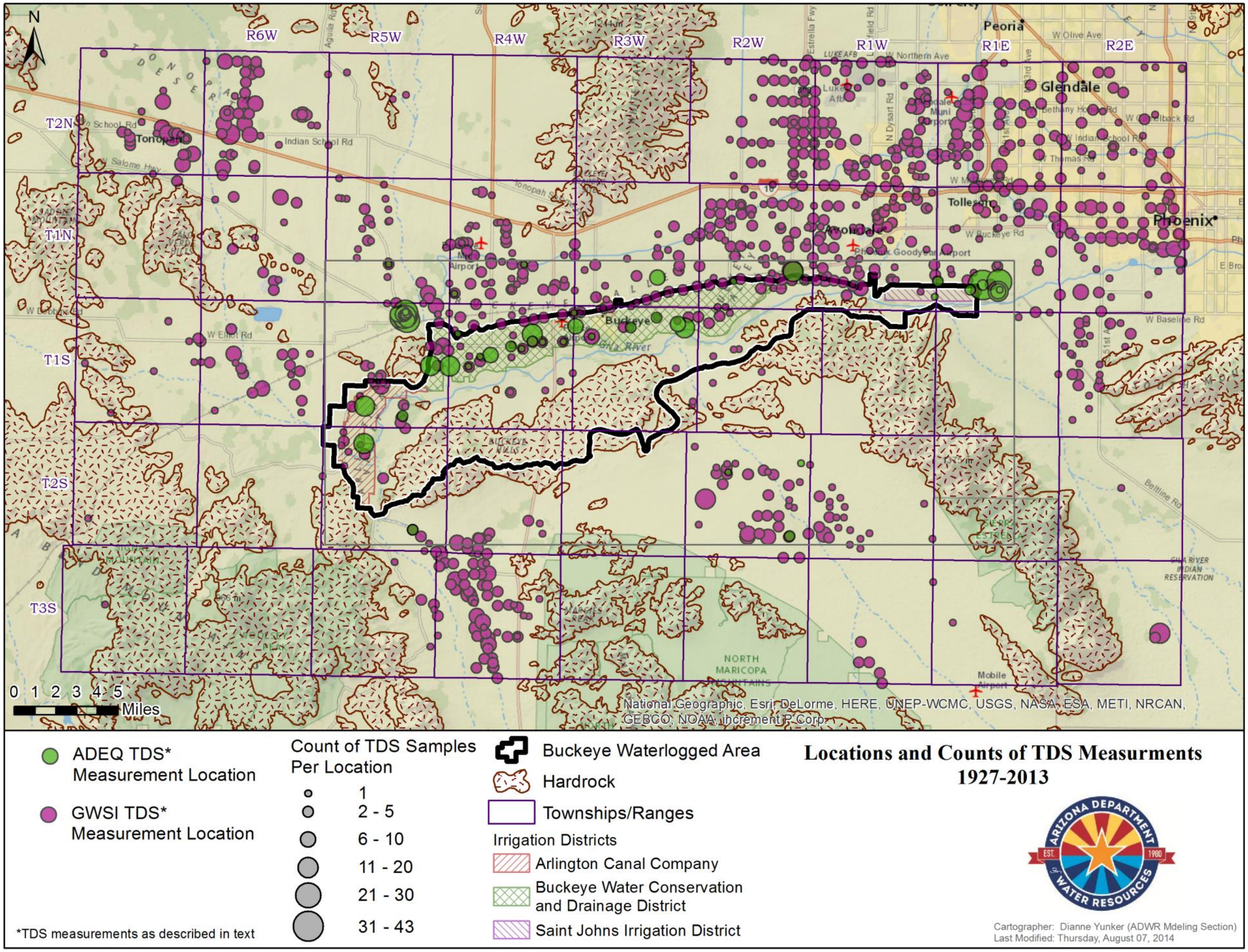


Figure 91. Total Dissolved Solids (TDS) Measurement Locations from the ADEQ and GWSI Datasets 1927-2013

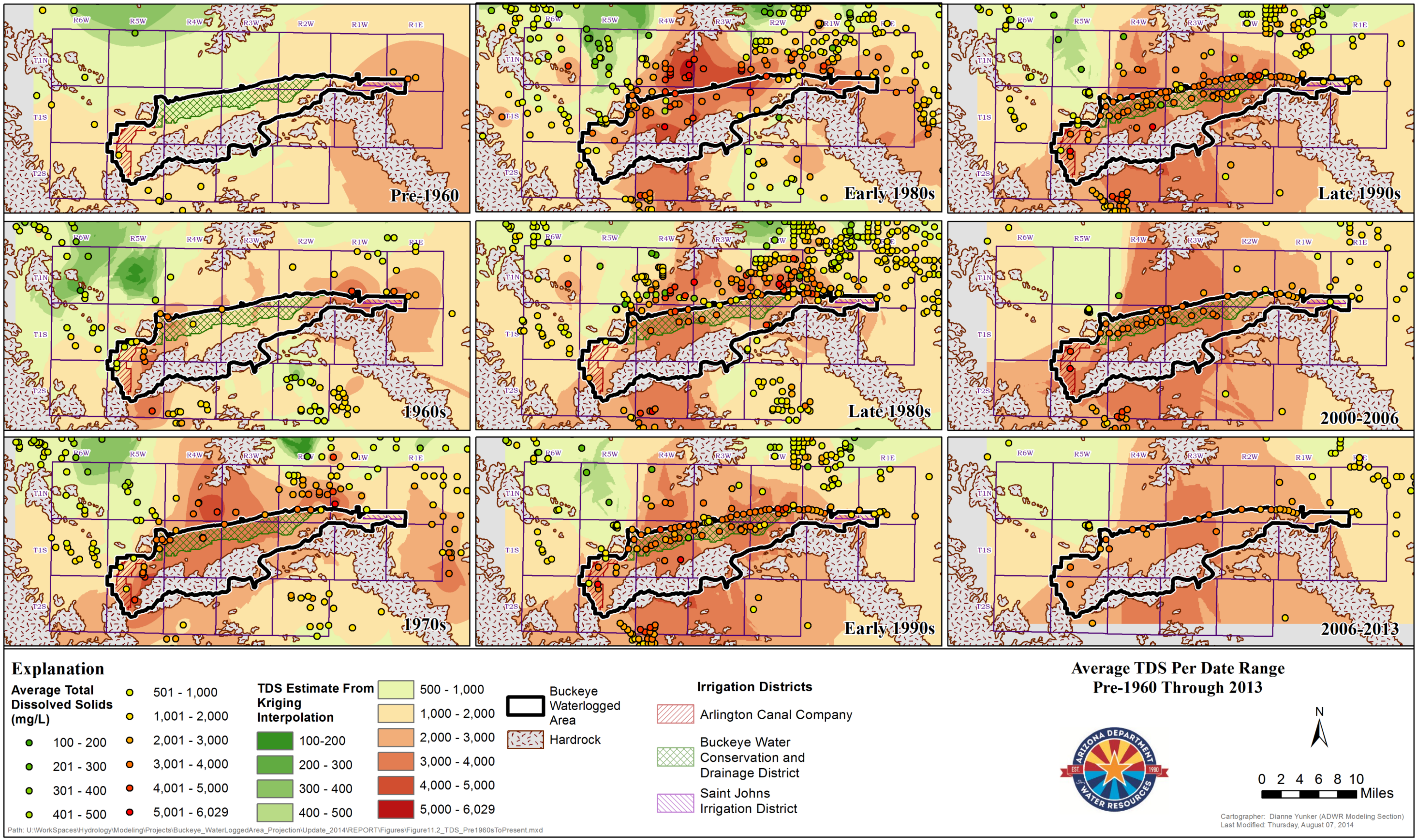


Figure 92. Average TDS Per Date Range Pre 1960s Through Present

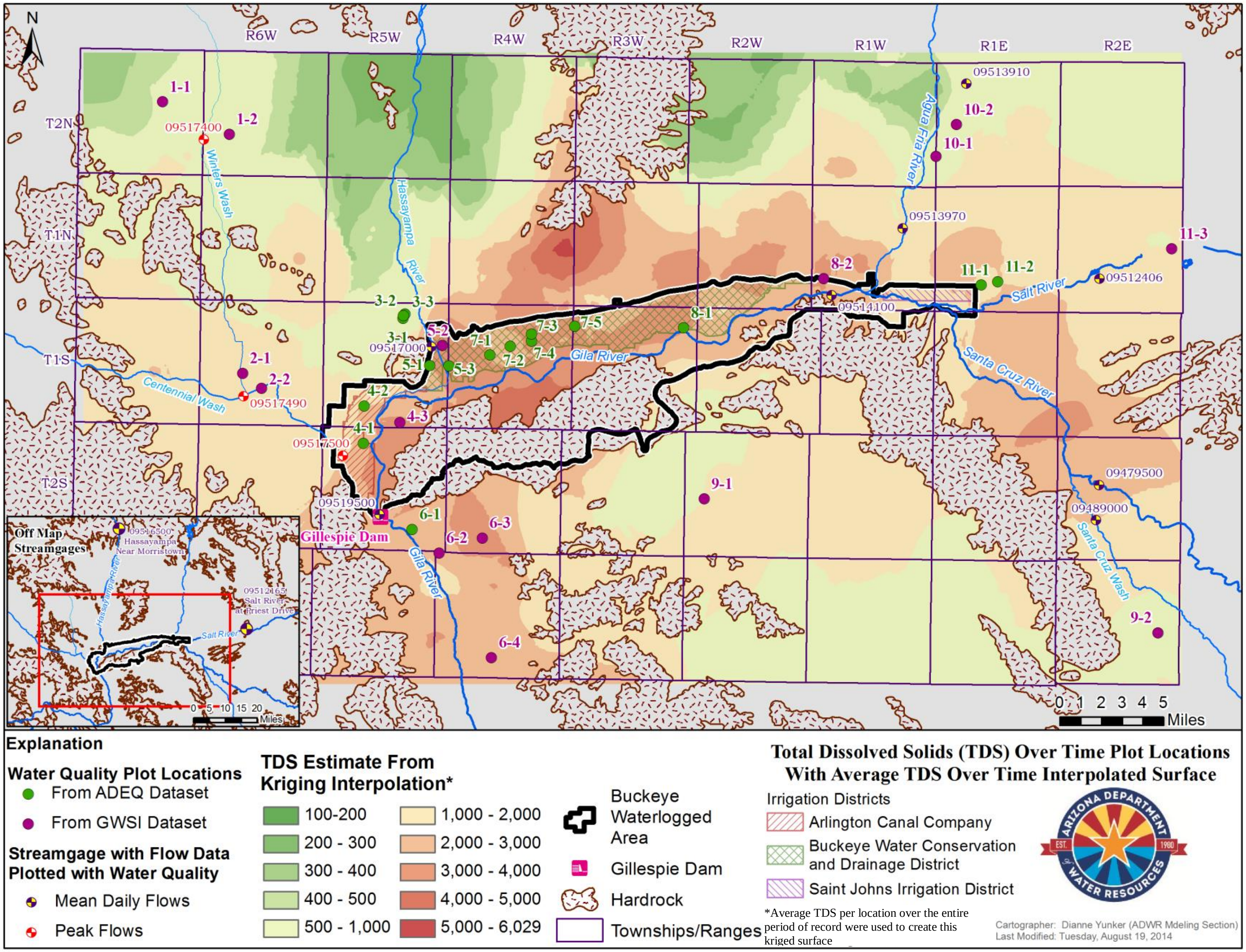


Figure 93. Plot Locations and Average TDS over time

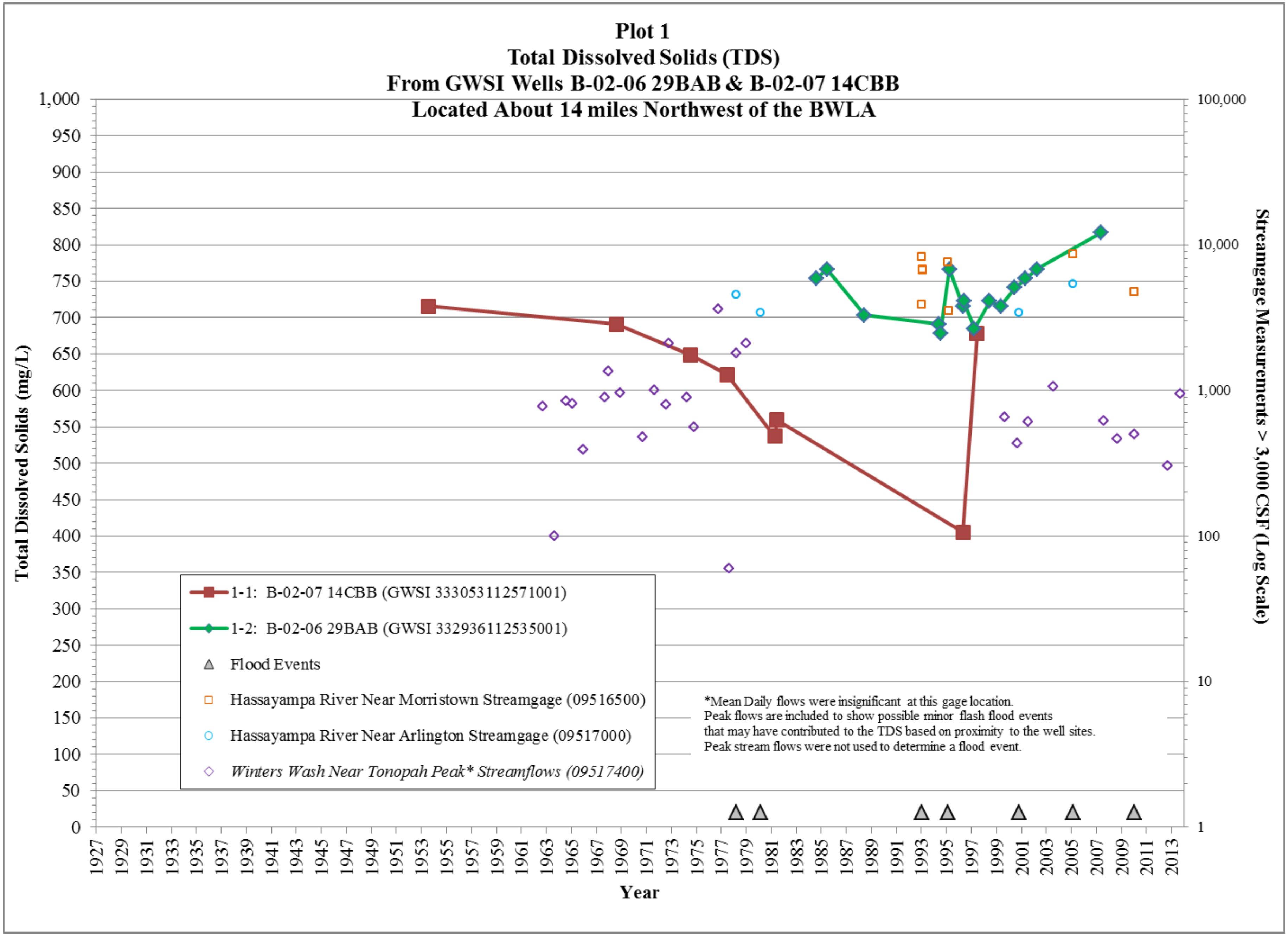


Figure 94. TDS Plot 1

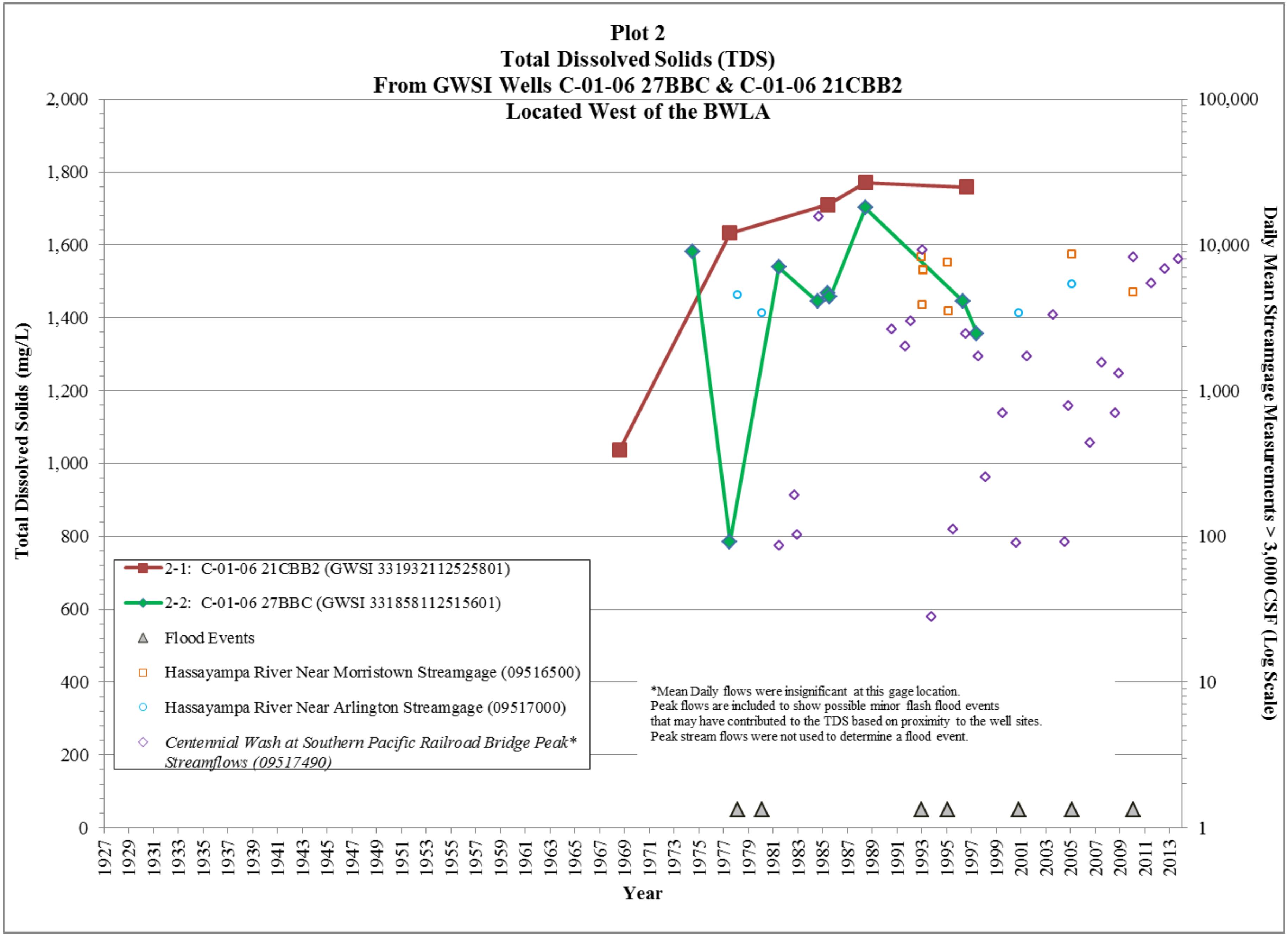


Figure 95. TDS Plot 2

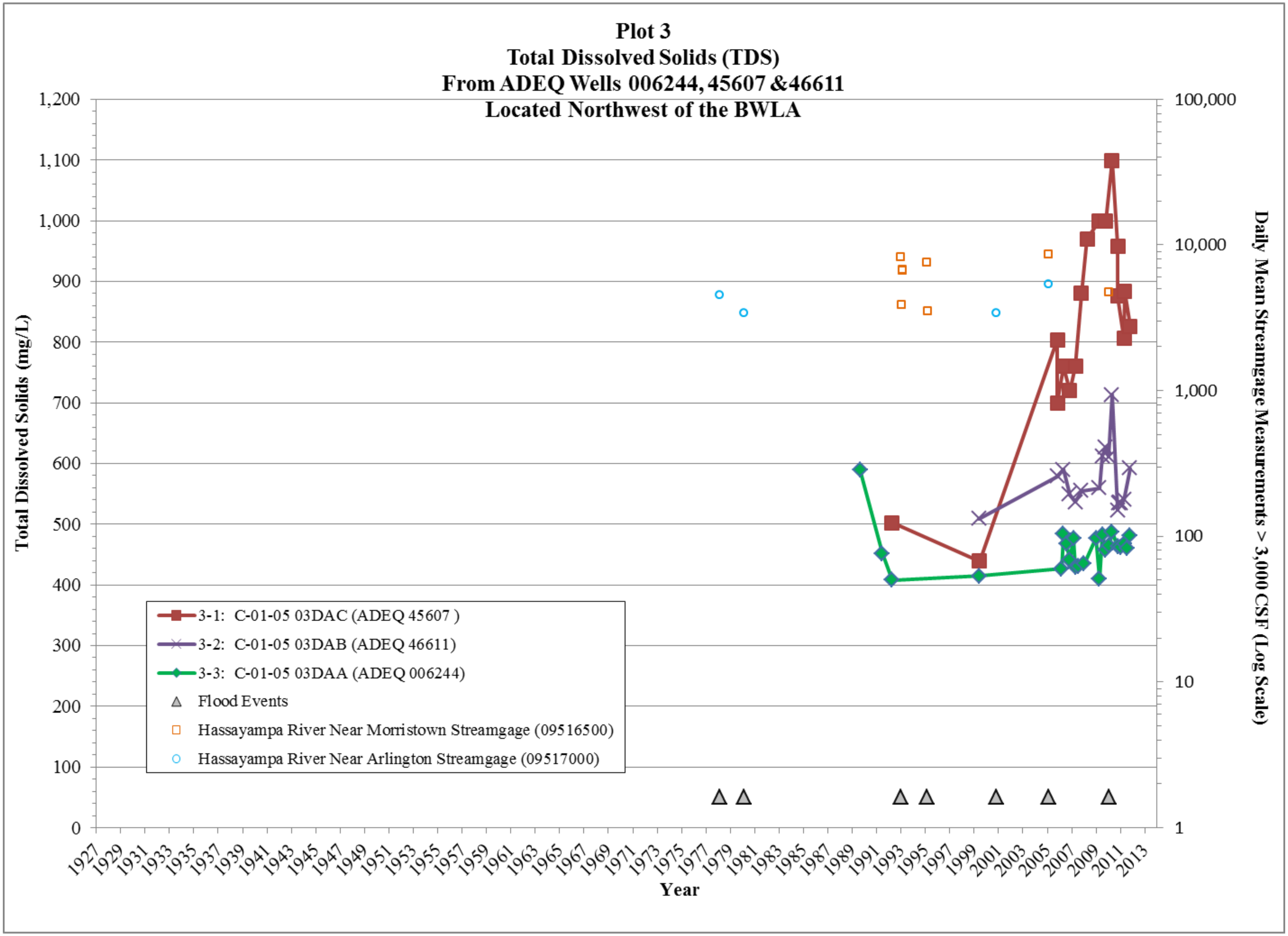


Figure 96. TDS Plot 3

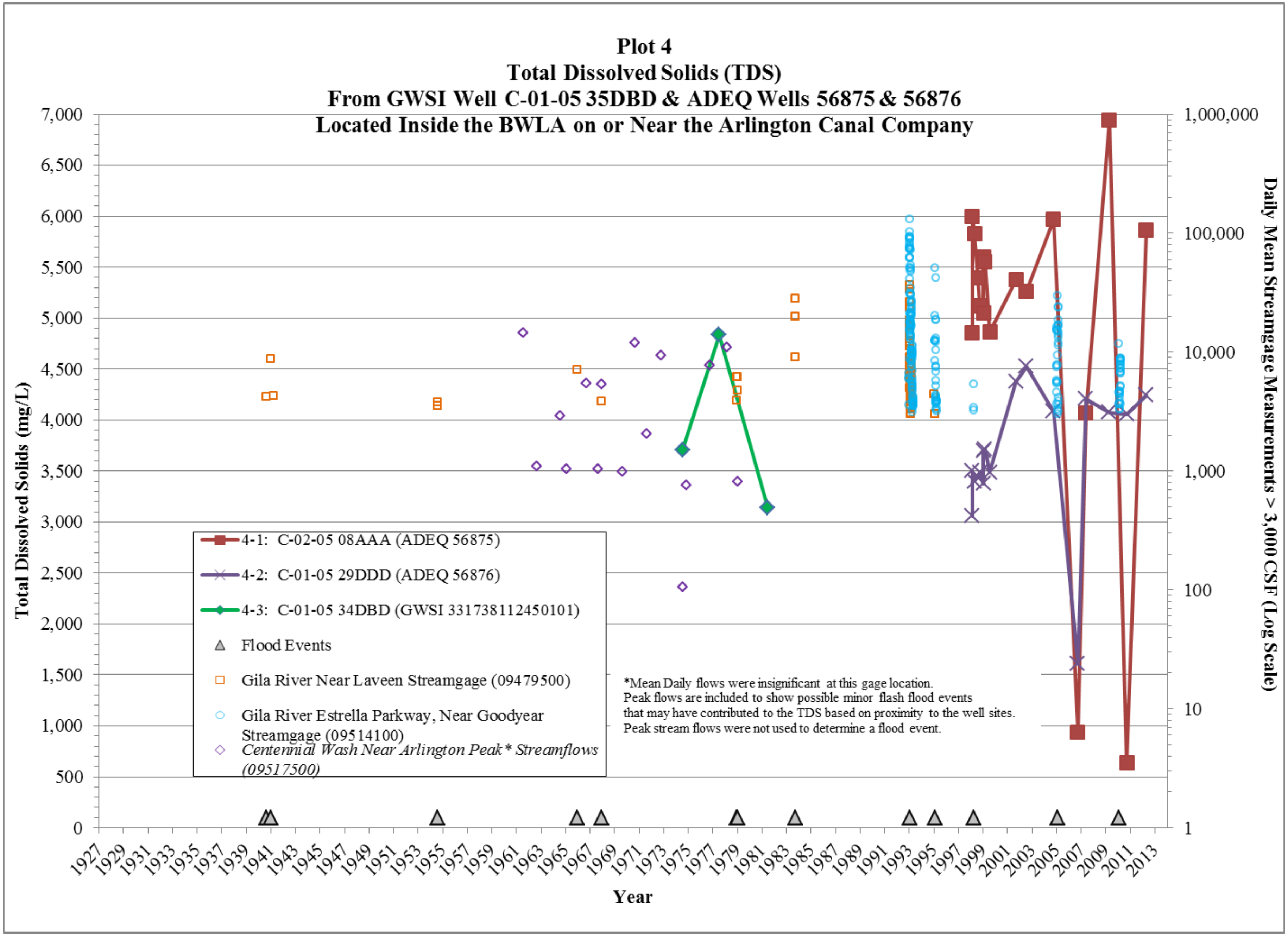


Figure 97. TDS Plot 4

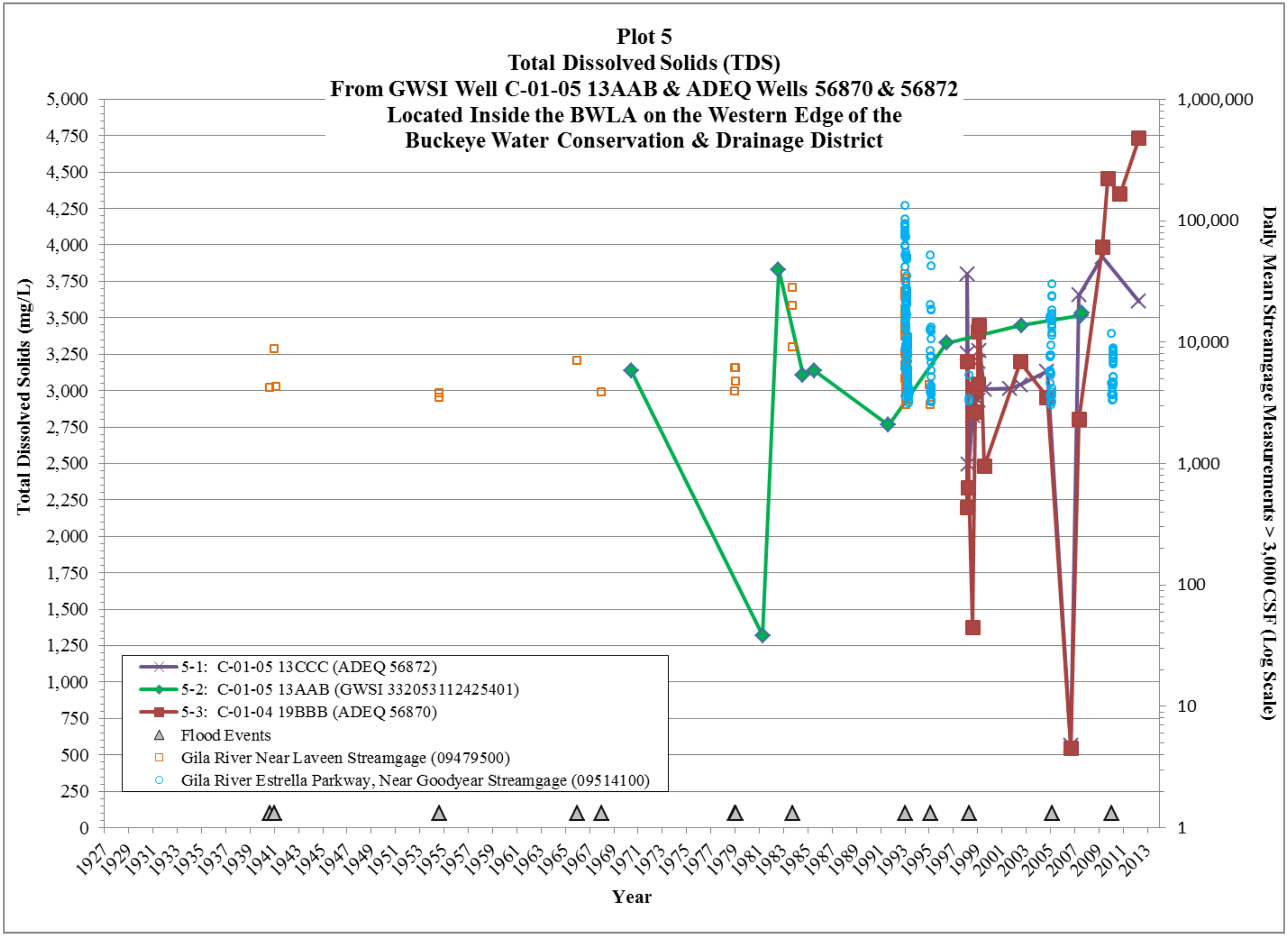


Figure 98. TDS Plot 5

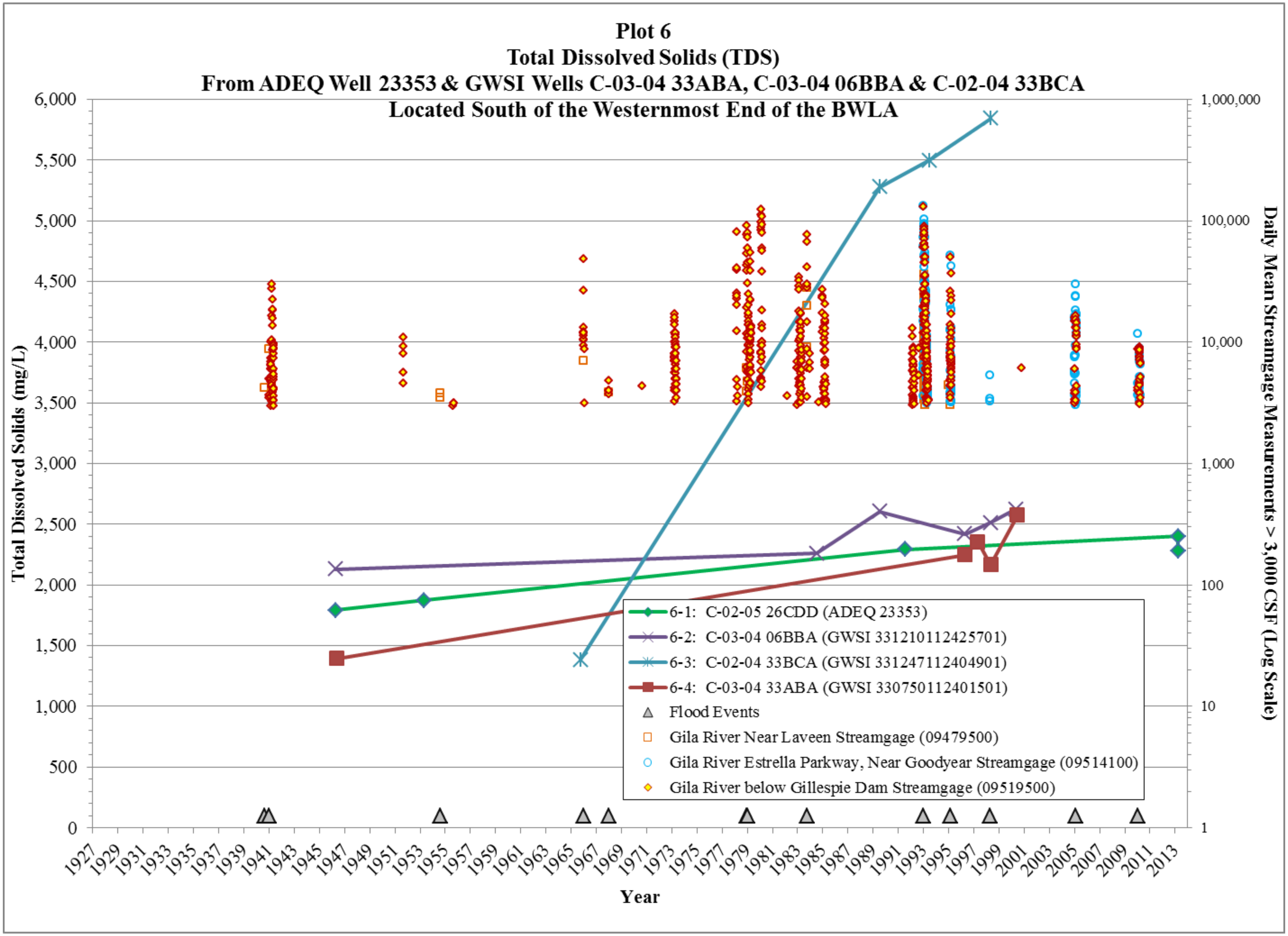


Figure 99. TDS Plot 6

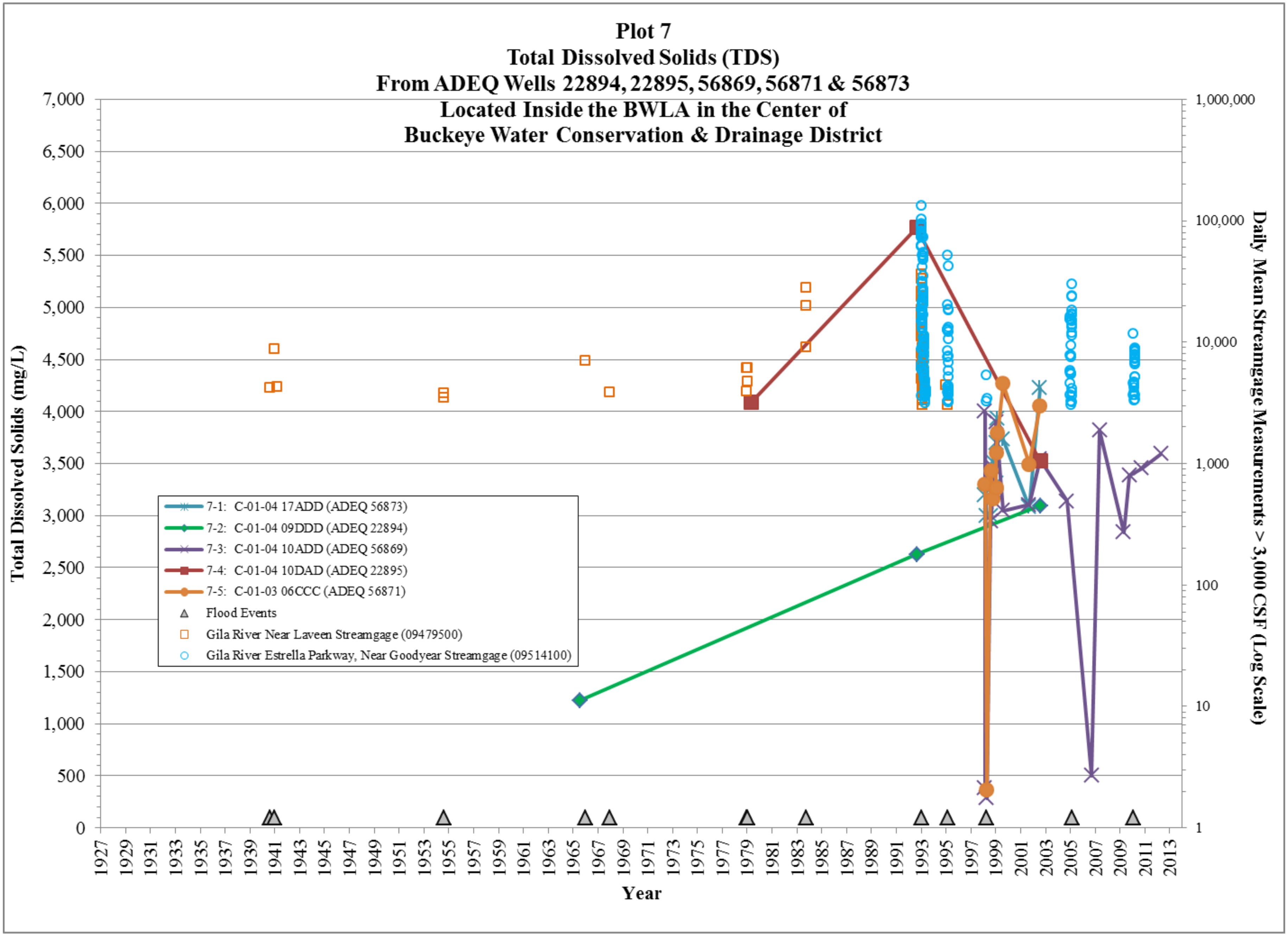


Figure 100. TDS Plot 7

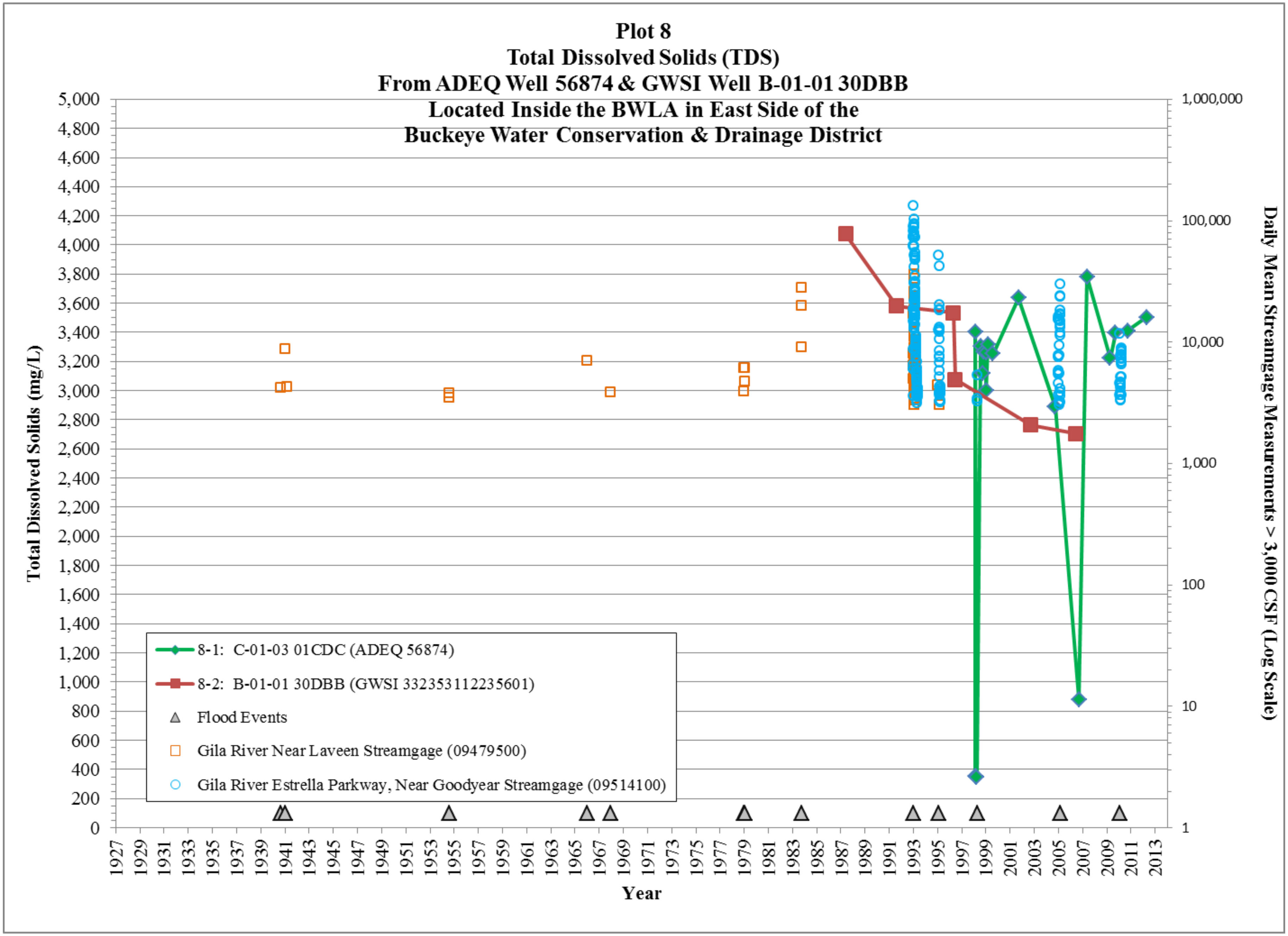


Figure 101. TDS Plot 8

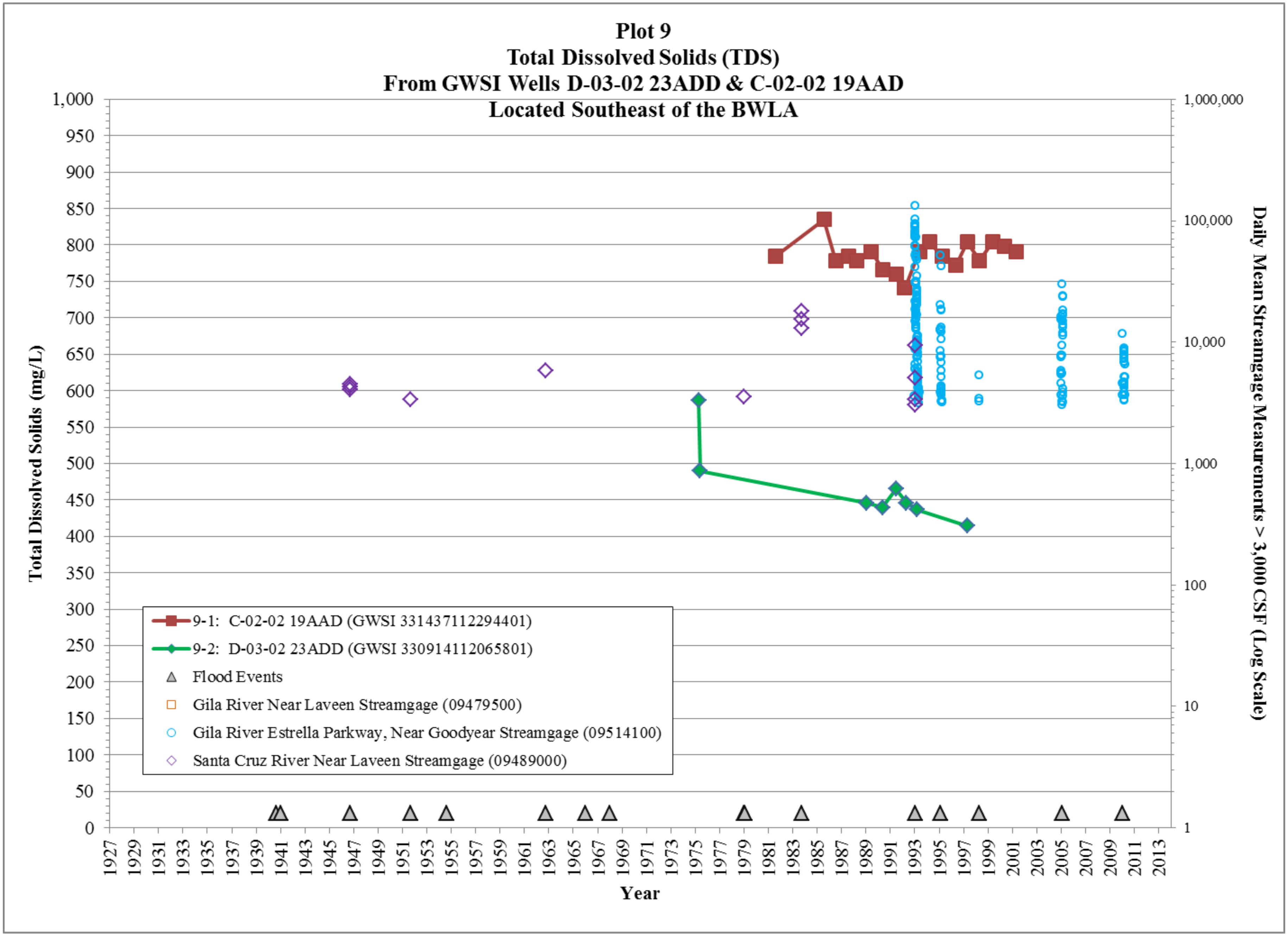


Figure 102. TDS Plot 9

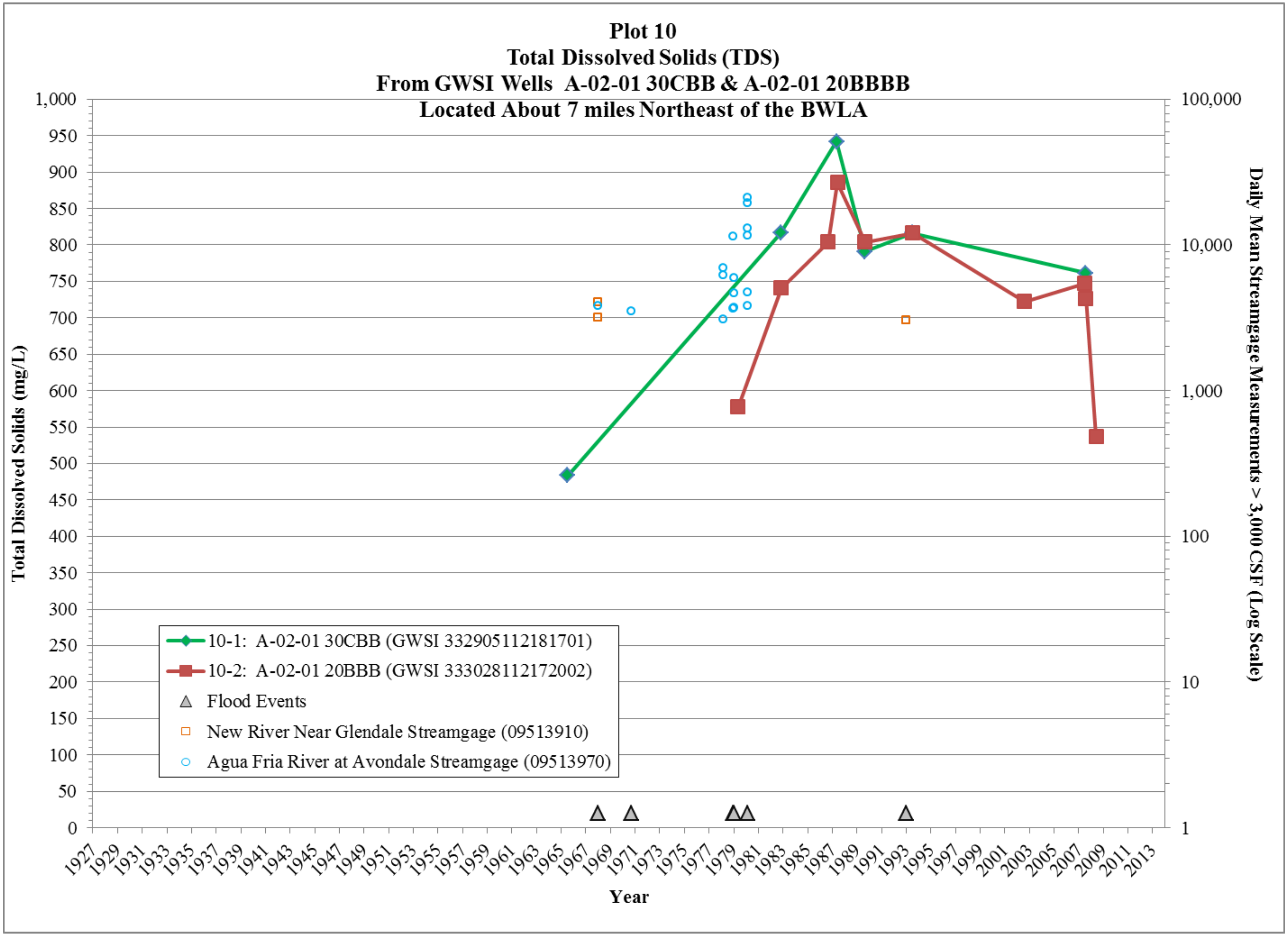


Figure 103. TDS Plot 10

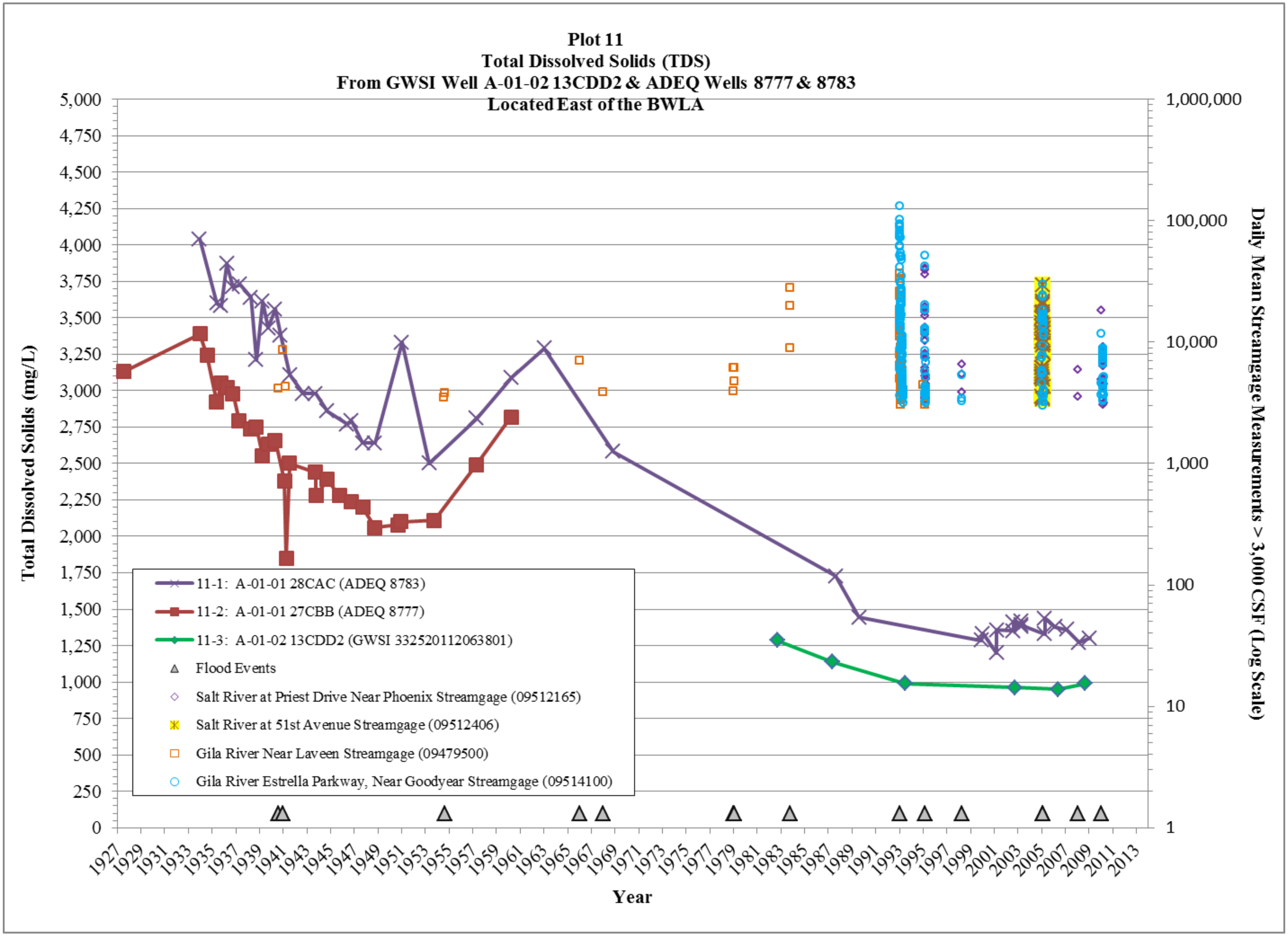


Figure 104. TDS Plot 11

Appendix A

Arizona Revised Statutes § 45-411.01

45-411.01. Exemptions from irrigation water duties, conservation requirements for distribution of groundwater and portions of groundwater withdrawal fee for portions of Phoenix active management area; fee; review

A. Each person who is entitled to use groundwater pursuant to an irrigation grandfathered right under article 5 of this chapter on irrigation acres located within the area delineated for exemption under subsection E of this section is exempt, beginning January 1, 1989, from any irrigation water duties or intermediate water duties established or required to be established for those irrigation acres in the management plans for the first, second, third and fourth management periods for the Phoenix active management area adopted pursuant to article 9 of this chapter.

B. The Arlington canal company, the Buckeye water conservation and drainage district and the St. John's irrigation district, or their successors, are exempt, beginning January 1, 1989, from any applicable conservation requirements for the distribution of groundwater established in the management plans for the first, second, third and fourth management periods for the Phoenix active management area adopted pursuant to article 9 of this chapter.

C. No groundwater withdrawal fee shall be levied or collected pursuant to section 45-611 and no water quality assurance fee shall be levied or collected pursuant to section 45-616 for:

1. Groundwater withdrawn during calendar years 1989 through 2019 for irrigation use on irrigation acres within the area exempted from irrigation water duties and intermediate water duties under subsection A of this section.

2. Groundwater withdrawn and used in the area delineated for exemption under subsection E of this section during calendar years 1999 through 2019 for a non-irrigation use pursuant to section 45-519, subsection B, if the user of the groundwater pays a fee of five hundred dollars to the director by March 31 of each year following a year in which the groundwater was used. The director shall deposit, pursuant to sections 35-146 and 35-147, the monies collected under this paragraph in the water quality assurance revolving fund established by section 49-282.

D. Except as provided in subsection G of this section, a water duty exemption fee of twenty-five cents per irrigation acre per year shall be paid to the department for each irrigation acre in the exempted area. The water duty exemption fee shall be paid to the department no later than March 31 of each year from 1990 through 2020 for the preceding year by each person who owns irrigation acres within the exempted area as of December 31 of the year preceding the date the payment is due except that, if the Arlington canal company, the Buckeye water conservation and drainage district or the St. John's irrigation district, or a successor, delivers water to the irrigation acres during the year preceding the date payment is due, the fee shall be paid by the company or district delivering water to the irrigation acres. If a person who is required to pay a fee pursuant to this subsection fails to pay the fee for the calendar year in question on or before March 31 of the following year, the director may assess and collect a penalty of ten per cent of the unpaid fee, without compounding, for each month or portion of a month that the fee is delinquent. The total penalty assessed under this subsection shall not exceed sixty per cent of the unpaid fee. The director shall deposit, pursuant to sections 35-146 and 35-147, all monies collected by the department under this subsection in the water resources fund established by section 45-117.

E. The boundaries of the exempted area under this section are delineated on a map of the Phoenix active management area filed in the office of the secretary of state on May 12, 1988. A true copy of the map filed in the office of the secretary of state shall be on file in the department and shall be available for examination by the public during regular business hours.

F. The director shall review the hydrologic conditions within the area delineated on the map filed in the office of the secretary of state pursuant to subsection E of this section. The director shall consult with representatives of the Arlington canal company, the Buckeye water conservation and drainage district and the St. John's irrigation district, or their successors, on the scope of the review before beginning the review and on the status of the review periodically during the course of the review. The director shall submit a recommendation to the governor, the president of the senate and the speaker of the house of representatives no later than December 15, 2015 regarding extending the exemptions established in this section.

G. A person who owns an irrigation grandfathered right appurtenant to ten or fewer irrigation acres located in the exempt area is exempt from the payment of a water duty exemption fee for the acres prescribed by subsection D of this section unless the irrigation acres are part of an integrated farming operation. The exemption provided by this subsection does not apply to the Arlington canal company, the Buckeye water conservation and drainage district or the St. John's irrigation district, or any successor, in any year in which the company or district delivers water to the irrigation acres.

Appendix B

ADWR Memorandum: Calculation of the water in storage for the Buckeye water logged area, dated 02/22/2011

ARIZONA DEPARTMENT OF WATER RESOURCES
HYDROLOGY DIVISION

MEMORANDUM

To: Frank Corkhill, Chief Hydrologist
From: John Mawarura, Hydrologist
Wesley Hipke, Modeling Section Supervisor
Date: 02/22/2011

Re: Calculation of the water in storage for the Buckeye water logged area.

Background

Estimating the volume of groundwater in storage within the area encompassed by the boundary of the Buckeye Water Logged Area was accomplished by compiling existing GIS layers and other data types. Most of the data sources were GWSI Database, SRV and Hassayampa Models. All these datasets were brought into ArcGIS software. Volume calculations were carried out using ArcGIS Surface Spot Tool and Field Calculator. A summary of the process is presented below.

Data Used

- Main sources of data;
  - GWSI - 2006_Water Level point data
  - Hassayampa Model Data & SRV Model Data
  - Phoenix Model Data - preliminary
  - GIS – Buckeye Water Logged Area

Methodology

Used ArcGIS to create a 2006 water level surface derived from the GWSI database. ArcGIS Surface Spot Tool was used to determine a water level per model cell (model cells are 2,640 ft. by 2,640 ft.). The CAM model grid was used as a base since it encompasses the Hassayampa Model and the SRV Model. The geological layers used in the models along with their corresponding specific yield values were obtained from the modeling databases.

The water in storage was calculated by first determining the saturated aquifer thickness for each layer using the 2006 water level data. The saturated thickness was then multiplied by the cell area to determine the cell volume by layer. The cell volume was multiplied by the specific yield per layer to determine the water storage in each layer. The layer water in storage volumes where summed to determine the total water in storage for the Buckeye water logged area.

Where the SRV model and the Hassayampa model overlap the values from the SRV model was used.

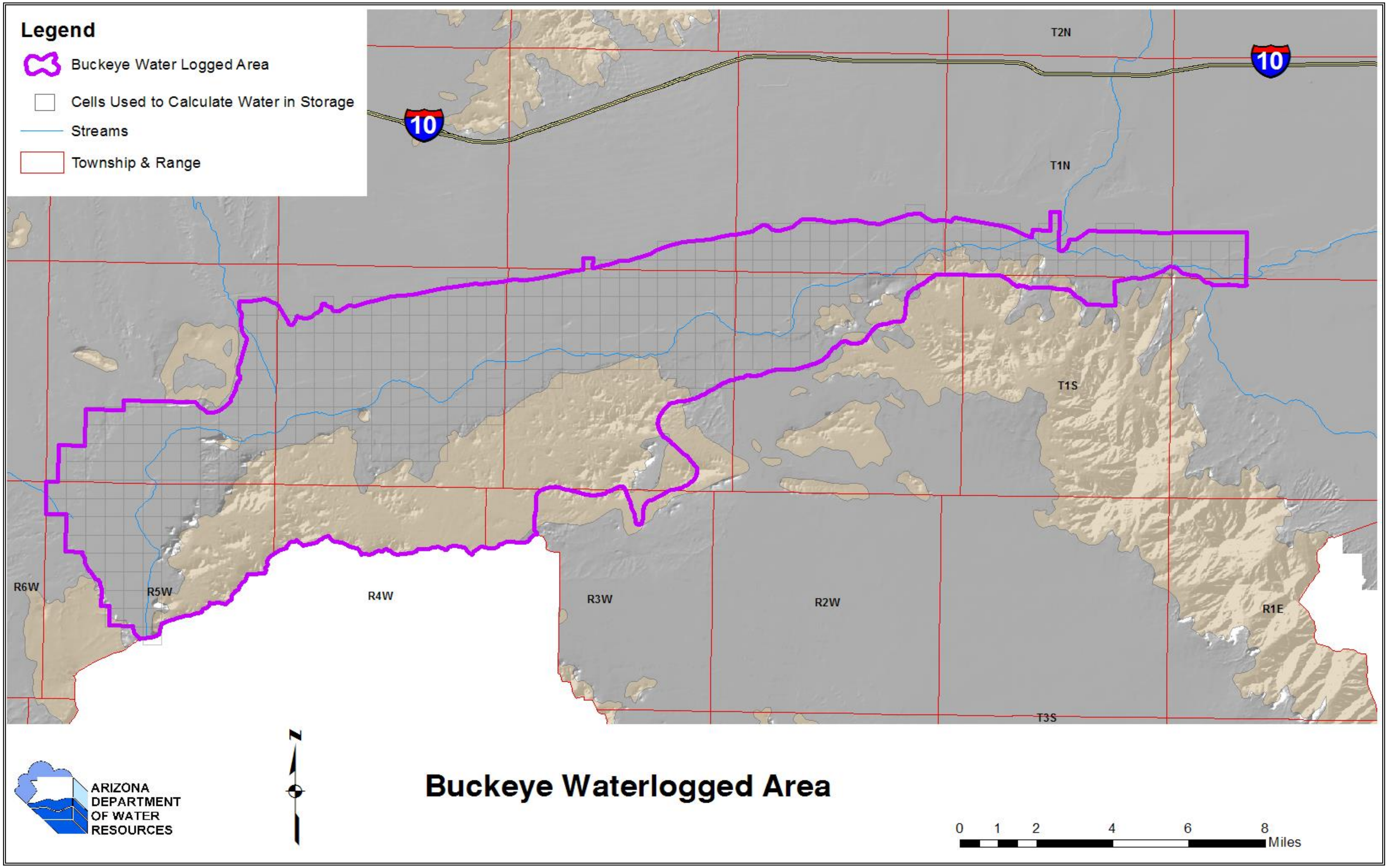
Results

The water in storage was calculated using the geology and specific yield in the most current published versions of the respective models. A second estimate of water in storage was calculated using the values that are being developed for a model that will combine the SRV and Hassayampa sub-basins. The second method uses updated geology and higher specific yield estimates, however, these estimates have not gone through a calibration process.

The calculated water in storage is from the 2006 water level (from GWSI) to bedrock and covers an approximate area of 89 square miles. The Buckeye Waterlogged area covers a larger area, however, water in storage was not calculated for hardrock areas or for the limited areas where data were unavailable.

	Water in Storage
Using current published models:	2,813,955 acre-feet
Using values from the modeling being developed:	3,327,337 acre-feet

Please note that the estimated volume of groundwater in storage is based on currently available hydrogeologic data. However, due to actual hydrologic conditions and technical considerations the volume of recoverable groundwater would be less than the listed estimates.


Legend
Buckeye Water Logged Area
Cells Used to Calculate Water in Storage
Streams
Township & Range
T2N
T1N
T1S
T3S
R6W
R5W
R4W
R3W
R2W
R1E
10
ARIZONA
DEPARTMENT
OF WATER
RESOURCES
Buckeye Waterlogged Area
0 1 2 4 6 8
Miles

Appendix C

Consultations with Irrigation Districts and the City of Buckeye and Field Investigations

Table of Contents

List of Figures

Attachments

Attachment C-1 2013 National Agriculture Imagery Program (NAIP) Aerial Photographs of the BWLA

Attachment C-2 BWCDD System Map

Attachment C-3 ACC Static and Pumping Water Levels

1.0 Introduction

This appendix provides details on ADWR's consultations the Buckeye Water Conservation and Drainage District (BWCDD), the Arlington Canal Company (ACC) and the St. John's Irrigation District (SJID) conducted as part of the statutory requirement under Arizona Revised Statutes § 45-411.01. Also included comments from the City of Buckeye (COB). **Attachment C-1** contains 2013 aerial photographs of many of the areas and features that are discussed in the following sub-sections, is included for geographic reference.

2.0 Buckeye Water Conservation and Drainage District, March 2012 & August 2014

ADWR began the investigation of the waterlogged area in 2012 and at that time there was an initial meeting and field investigation of the conditions in the BWLA in the vicinity of the BWCDD. In 2014, there was a second consultation with the BWCDD. Both times, ADWR staff met with General Manager Ed Gerak at the district office, followed by a field visit to several well sites and associated water conveyance systems, in addition to agricultural fields. Mr. Gerak has worked for the District for over seven years.

Chief Hydrologist Frank Corkhill and Dianne Yunker (Hydrology Division, Modeling Section) attended both meetings. The 2012 meeting also included Wes Hipke, Shuyun Liu and Scott Miller (formerly of ADWR) and the 2014 meeting included Modeling Supervisor Keith Nelson, Field Services Supervisor Teri Davis and Paul Ivanich from the Surveying Unit.

The first meeting took place March 5, 2012. Mr. Gerak explained that much of the irrigation water used on the fields within the BWCDD is surface water diverted from the Gila River, which contains large quantities of treated effluent from the City of Phoenix 91st Avenue Treatment Plant. They also use groundwater from irrigation wells, but he indicated the high salinity of the area's groundwater necessitates the use of supplemental surface water. The District primarily grows crops not for human consumption including cotton and dairy feed products such as alfalfa, barely, sorghum and corn. **Figure C-1** shows an alfalfa field visited during the 2012 field trip.

Figure C-1. Alfalfa Field, BWCDD, March 2012

Mr. Gerak explained how the shallow depths to water cause major problems for efficient farming, and makes it necessary to run 10 drainage wells to lower the water table. The water pumped from the drainage wells is placed in laterals and routed south to the channel of the Gila River or to other drains. In July 2011 the district shut off all drainage pumping to assess the response of the water table. He indicated that within three days one well (5-D) became artesian (began to flow at land surface).

Mr. Gerak escorted ADWR crew to several active drainage well sites where large quantities of water were being pumped **(Figures C-2 and C-3)** and discharged in laterals or drainage ditches (**Figure C-4**). Drainage water is eventually discharged into the Gila River where in most years, it has been comingled with other surface water and used by the Arlington Canal Company downstream. Mr. Gerak showed ADWR staff several fields that had become damaged from the high salt levels (**Figure C-5**) and could no longer be used for growing crops. The tour ended at the BWCDD impoundment about one quarter mile upstream of Buckeye Heading Diversion Canal (**Figure C-6**). Shortly after the first consultation with BWCDD, Mr. Gerak sent ADWR the district system map (**Attachment C-2**) and the information on the drainage wells used to make the adjustments to the pumping volumes. Most (80%) of their canals are not lined but Mr. Garak indicated that they have become hermetically sealed and don't lose a great deal of water to seepage. Water movement in the canal system is fed by gravity with gates. Four of their gates have been automated.

Figure C-2. Drainage Well 2-D, March 2012

Figure C-3. Drainage Well 12-D, March 2012

Figure C-4. Lateral Ditch, BWCDD, March 2012

Figure C-5. Salt Damaged Field, BWCDD, March 2012

Figure C-6. BWCDD Impoundment, March 2012

The second consultation occurred on August 14, 2014. Mr. Gerak indicated that BWCDD cultivates about 16,500 to 17,000 acres per year and that BWCDD has been monitoring for total dissolved solids (TDS) for the past 7 years.

When asked about the status of waterlogging conditions, Mr. Gerak indicated that it is still a problem and has been since 1918. He would like to see a more clear definition of what constitutes waterlogging in the future. From his perspective, the BWCDD needs the special designation to be able to provide the drainage needed for the crops. He does not have a target depth to water or target TDS at this time. When asked how often the state should review the status he said every 25 to 50 years. He said they use about 60,000 AFA of effluent dominated surface water per year. When asked about potential alternative uses of drainage water, Mr. Gerak said that the BWCDD had discussed potential uses with the City of Buckeye (ADWR has since learned from the City of Buckeye that the BWCDD have entered into an agreement concerning the operation of BWCDD drainage wells). ADWR staff informed Mr. Gerak that they were updating the groundwater flow model of the Salt River Valley (SRV) and that it might be helpful in projecting if the waterlogging issue will remain in the future.

Next, Mr. Gerak escorted ADWR staff to several key sites within the BWCDD including a few drainage wells and drain pipes and a look at their canal system. **Figure C-7** shows the Dean Drain. Mr. Gerak indicated that former drainage well 8-D had become inactive and that if ADWR was interested, they might be able to use the well for automated water level measurements **(Figure C-8).**

Figure C-7. BWCDD Dean Drain, August 2014

Figure C-8. Dirt Road leading to inactive Drainage Well 8-D, August 2014

During the second field tour with the BWCDD, Ed Gerak indicated again that well 5-D would exhibit artesian flow within 24 hours if its drainage pump was turned off. He said that much of their drainage water goes to Arlington but that there is no obligation to send them any. He also mentioned that some BWCDD drainage water is now impounded in man-made ponds near the western portion of the district to provide water to the land owner who farms in that general area.

Mr. Gerak estimated that that approximately 27,000 AFA of water is drained from the drainage wells each year. He also estimated approximately 35,000 AFA of water is evapotranspired from the invasive tamarisk trees along the river from Phoenix International Raceway to Gillespie Dam if one assumes a rate of 7Acre-Feet per Acre ET for the riparian areas.

In additional correspondence, Mr. Gerak reiterated that the BWCDD was formed in 1922 with the express purpose of addressing the waterlogging issues that were recorded prior to 1919. He stated that he has advocated for a 25-buckeye year extension of the waterlogged status with longer review periods prior to a possible expiration to adjust for the possibility of a changing dynamic. He feels that the exemptions, including the exemption from groundwater withdrawal fees, help offset the costs of drainage pumping. Mr. Gerak has indicated that the BWCDD has to flush high salt levels to combat negative impacts of already salty irrigation water (1550-2100 ppm).

2.0 Arlington Canal Company, September 2014

On September 26, 2014 ADWR Staff; Frank Corkhill, Teri Davis, Keith Nelson and Dianne Yunker met with ACC representatives Gary Gable and his father Carter Gable, Bill Roussel and their attorney Reed King. The meeting started at Gary Gable's home that also serves as the ACC office. ADWR explained the purpose of the visit and discussed the hydrologic conditions in the area, providing the ACC with several maps and other figures and solicited their feedback on whether the ACC portion of the Buckeye Waterlogged Area (BWLA) is still experiencing negative impacts of waterlogging.

Gary Gable believed the area had always been waterlogged, citing depths to water as shallow as 4.5 to 5 feet. He said groundwater had started to seep into a trench recently dug for a water supply line that would provide water to two center pivot irrigation systems near the Gila River. He has observed increasingly 'boggy' conditions near the river in recent years as well as evidence of salt build-up. Gary Gable and his family have been farming within the area of the Arlington Canal Company for several generations and his family farms about 60% of the approximately 3,600-4,000 acres comprising the district. Overall there are only 6 or 7 farmers involved, some of whom are absentee land owners that have their lands farmed by the Gables and their crews. On average about seven AFA is needed to grow their mix of alfalfa, cotton, sorghum and burmuda grass, but in some cases more is needed. Typical crop rotation occurs every 3 years.

The District operates 8 pumping wells and two lift pumps located at an old gravel pit along the Gila River that has become an impoundment full of water (**Figure C-9**), which pumps at 11,000 GPM to lift water up 5 to 6 feet and discharge into the ACC canal system. The original surface water diversion of the ACC canal along the Gila River was located near this impoundment. However, past flood events eventually destroyed the original diversion point so pumping from the impoundment now serves as the "head" of the ACC canal.

Figure C-9. Arlington Canal Company Impoundment, September 2014

ACC representatives are also concerned about the quality of the groundwater, indicating that the pH is too high (alkaline) due to residual salts, with a salt content of about 900-1,100 PPM. They have had to treat it with sulfuric acid. They mentioned having to take a well out of production due to scaling of Mg/Ca. Their irrigation wells are all about 750-800 feet deep with static depths to water around 90 feet. It was mentioned that sometime in the early history of ADWR (probably the 1980s) ACC applied to ADWR for an additional 2 acre-feet per acre allotment to help leach salts from the soil. ACC said they run their wells continuously despite the financial burden of high electric cost because of the waterlogging that would naturally occur if they did not.

Mr. Gable said that the ACC used to receive large quantities of surface water via canals from the BWCDD but that around 2007 the supply began to decline. ACC thought the reductions might be due to other uses of drainage water by BWCDD, or that fewer drainage wells were in operation due to equipment failure.

The ACC contracts for water level measurement collection with consultant Kris Johnson of Well Test Energy who provided ADWR with pumping and static water levels at several locations within the ACC from 2008- 2014. Those water level measurements are provided as **Attachment C-3**.

ACC was asked if it had noticed any changes to the groundwater levels in the ACC area after Gillespie Dam was breached during the 1993 flood. Mr. Gable indicated that had seen some drop in water level but that it has since come back up. They speculated that sedimentation had occurred at the dam site that may have negated effects of the breach over time. They are very concerned about flooding and have experienced damaging floods in the past, in particular the 1993 flood when agricultural acres were lost, with water saturating fields and backing up into homes. The Gables showed ADWR staff an old photo of some family friends wadding in floodwaters where the Gila River spilled over during such an event **(Figure C-10).**

Figure C-10. ACC field near Gila River, September 2014 Compared to a time it was covered in flood waters

ACC indicated that it is participating with other downstream irrigation districts in a water-balance study being conducted to better quantify their water diversions and use. Mr. Gable stated that ACC has senior surface water rights to SRP dating back to 1889, established under the 1940 Simpson Decree. The ACC measures outflow of the ACC canal with poles at a weir 2 or 3 times a day. They mentioned that the currently don't measure inflow into the ACC canal but think they should. The water-balance study may incorporate those data in addition to a calculation of water pumped from the gravel pits based on electrical power consumption. ADWR indicated interest in the results of that study because the ACC is located at a key boundary of the SRV model area.

The ACC representatives escorted the ADWR staff around the area, stopping at several well sties. The wells are identified by pump number, sequentially in the order in which they were installed. **Figure C-11** shows one of their irrigation wells and **Figure C-12** shows a salt damaged field within the ACC. The tour included a stop at the breached Gillespie Dam **(Figures C-13 and C-14).**

Figure C-11. Arlington Canal Company Irrigation Well, September 2014

Figure C-12. Salt Damaged Field at ACC, September 2014

Figure C-13. View of Breach in the Gillespie Dam, September 2014

Figure C-14. Gillespie Dam, 2014

Similar to the perspective of the BWCDD, the ACC representatives feel that the waterlogging condition should be better defined in state statute. The ACC felt that if well defined, the waterlogged status should be assumed to persist indefinitely into the future unless there is a major hydrologic system change. Mr. Gable said the ACC is essentially in a state of perpetual safe-yield and didn't think they should be subject to rules of the AMA that don't apply to their hydrologic situation. They feel that the area is especially vulnerable to flood events.

3.0 St. John's Irrigation District, October 2014

ADWR visited the St. John's Irrigation District on October 23, 2014. The meeting included Frank Corkhill, Dianne Yunker, Keith Nelson and Paul Ivanich of ADWR and St. John's Irrigation District representatives Robin Maddux, Kevin Farris and Linda Reitz at her home which also serves as the District office. Mr. Farris has been the zanjero since 1988, Mr. Maddux has been the District President 5 or 6 years and Ms. Reitz has served as secretary for the past 3 years. The St. John's representatives stated that they were unaware the special waterlogged area designation or that the SJID was in it. This was perhaps due changes in district management and leadership since the original establishment of the district and also perhaps due to the relatively small groundwater demand of the district itself.

The irrigation district was created in 1921 and about 1,900 acres are farmed applying about 9,750 acre feet of water per year. Previously, the same lands had been farmed with surface water rights that date to 1895. When SRP installed storage dams in 1924, an agreement was made for SRP to deliver 600 miners inches. Later agreements were made to supplement that supply and St. John's drilled their own well in 1949 (55-623410) located in A-01-01 32DDD **(Figure C-15)**. According to Mr. Maddux, the water they use comes from two SRP Wells (2.3E-1.3N) and (3E-1N) (**Figures C-16 and C-17)** and a district well. The SJID also receives some 'tail water' from SRP. They try to avoid running their own well because it costs $6,000/month in electricity. However, they typically run it about 4 months per year in the summertime. They indicated that the water table is shallow 20-30 feet BLS but varies by up to 50 feet seasonally. They indicated that the same consultant used by ACC, Kris Johnson of Well Test Energy, occasionally measures water levels of wells in their District.

Figure C-15. SJID Well 55-623410, October 2014

Figure C-16. SRP Well 2.3E-1.3N that Serves SJID, October 2014

Figure C-17. SRP Well 3E-1N that serves SID, October 2014

The SJID does not monitor for water quality but Mr. Maddux indicated that the water is salty. They have observed visible salt lines on some fields (**Figure C-18**). SJID representatives then escorted ADWR staff to several parts of their irrigation district including the St. John's own irrigation well and the two SRP wells. They explained that much of the water is pumped through buried pipelines instead of open or unlined canals and that SRP had funded some of the infrastructure but St. John's had built several hundred feet themselves at a cost of approximately $35/foot which they anticipate will be recuperated through water savings. During the tour, large effluent dominated river flow was observed in the Salt River below the 91st Ave WWTP near the Tres Rios Wetlands **(Figure C-19)**. Standing water (approximately 20-30 feet below land surface) observed at flooded sand and gravel pit located near the Gila River provided an excellent illustration of the shallow water table conditions typical of the entire area **(Figure C-20)**.

Figure C-18. Salt Damaged Soil within the SJID, October 2014

Figure C-19. Effluent dominated river flow near Tres Rios Wetlands, October 2014

Figure C-20. Gravel Operation Exposing Shallow Water Table in SJID, October 2014

4.0 City of Buckeye

ADWR asked the City of Buckeye for its perspective of the status of the hydrologic conditions in the BWLA during the investigation. The majority of the area is located within the City's municipal boundaries and the waterlogged condition directly impacts the City, its businesses and residents.

Several ADWR staff toured the City of Buckeye's Central Wastewater Treatment Plant (WWTP) in August 2014, located inside the BWLA and spoke to Ron Whitler, City of Buckeye Hydrologist about the process, which has a four day sludge retention time. Shallow groundwater conditions at the plant make it necessary to operate two dewatering wells (**Figure C-21**) at the plant which stay on constantly to prevent flooding of the manholes below the facility.

Figure C-21. One of Two Dewatering Wells located at the City of Buckeye WWTP

City of Buckeye Water Resources Director Dave Nigh provided additional comments to ADWR. He indicated that the shallow groundwater that is pumped and discharged into the Gila River is often lost because it flows downstream and out of the AMA. He stated that after three decades, the waterlogged condition still exists and has continued to impact the City's largest wastewater treatment facility by requiring continuous operation of dewatering wells (**Figure C-21**) to protect underground structures and equipment.

Mr. Nigh indicated that dewatering wells are also required in order for the City to constructs sanitary sewer lines and that the City must construct costly force-main sewer lines instead of gravity sewer lines in many areas due to the waterlogged condition. The City also is limited in where it can recharge effluent because doing so within the BWLA would cause groundwater levels to rise more than current guidelines allow. Mr. Nigh indicated the waterlogged condition is a serious consideration when major building projects are contemplated and that that there are 855 commercially permitted facilities within the boundaries of the BWLA and nearly 2,000 homes.

The City would like the State's policy with regards to the BWLA to take into consideration impacts to industrial and municipal water supplies, and not just impacts on agricultural activities. The exemption from groundwater withdrawal fees currently applies only to groundwater withdrawn for irrigation use and groundwater withdrawn pursuant to a drainage withdrawal permit and used at a turf-related facility or riparian habitat in the BWLA. The City suggested that ADWR consider how this water supply might be used to meet long-term urban water needs. However, due to the low quality of water withdrawn, treatment and brine disposal is necessary and would only be cost-effective if the waterlogged area designation remains in effect and the exemption from groundwater withdrawal fees expanded to include groundwater withdrawn for municipal and industrial uses. The City is concerned that a change in the status that might result in less drainage pumping in the area could damage its own return on investment for infrastructure. The City wants ADWR to consider maximizing the efficient use of this and all water supplies in the area.

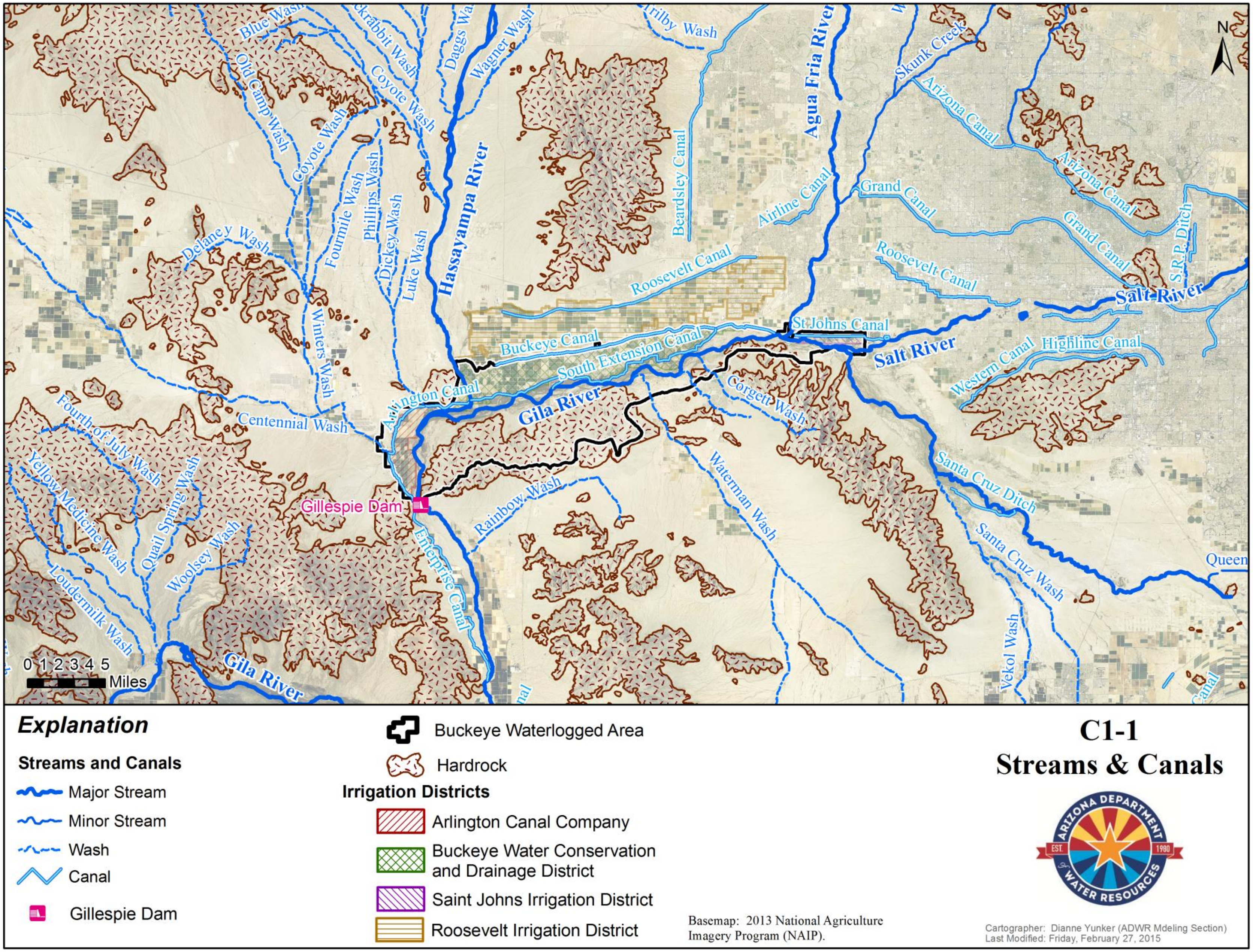
The City of Buckeye has offered to help gather additional data, including the installation of totalizer meters on their wells to fill in data gaps. They also agree with ADWR that the SRV groundwater model will be a valuable tool for future investigations and scenario development.

5.0 Conclusion

A.R.S. § 45-411.01 currently provides exemptions from irrigation water duties, conservation requirements and groundwater withdrawal fees for the BWLA until the end of the fourth management period, or December 31, 2019. At this time, all three irrigation districts and the City of Buckeye wish to extend the water logging exemptions past 2019. However, there is no consensus at this time as to how many years the exemptions should be extended. The BWLA irrigation districts want there to be a clearer definition of what constitutes waterlogging. They would like the periodic reviews to be less frequent and for the exemptions to remain in place as long as possible, while some make the point that the status should remain indefinitely or until major hydrologic conditions change. The City of Buckeye has asked that municipal and industrial water supply be considered when evaluating the waterlogged area.

Attachment C-1

2013 National Agriculture Imagery Program (NAIP)
Aerial Photographs of the BWLA



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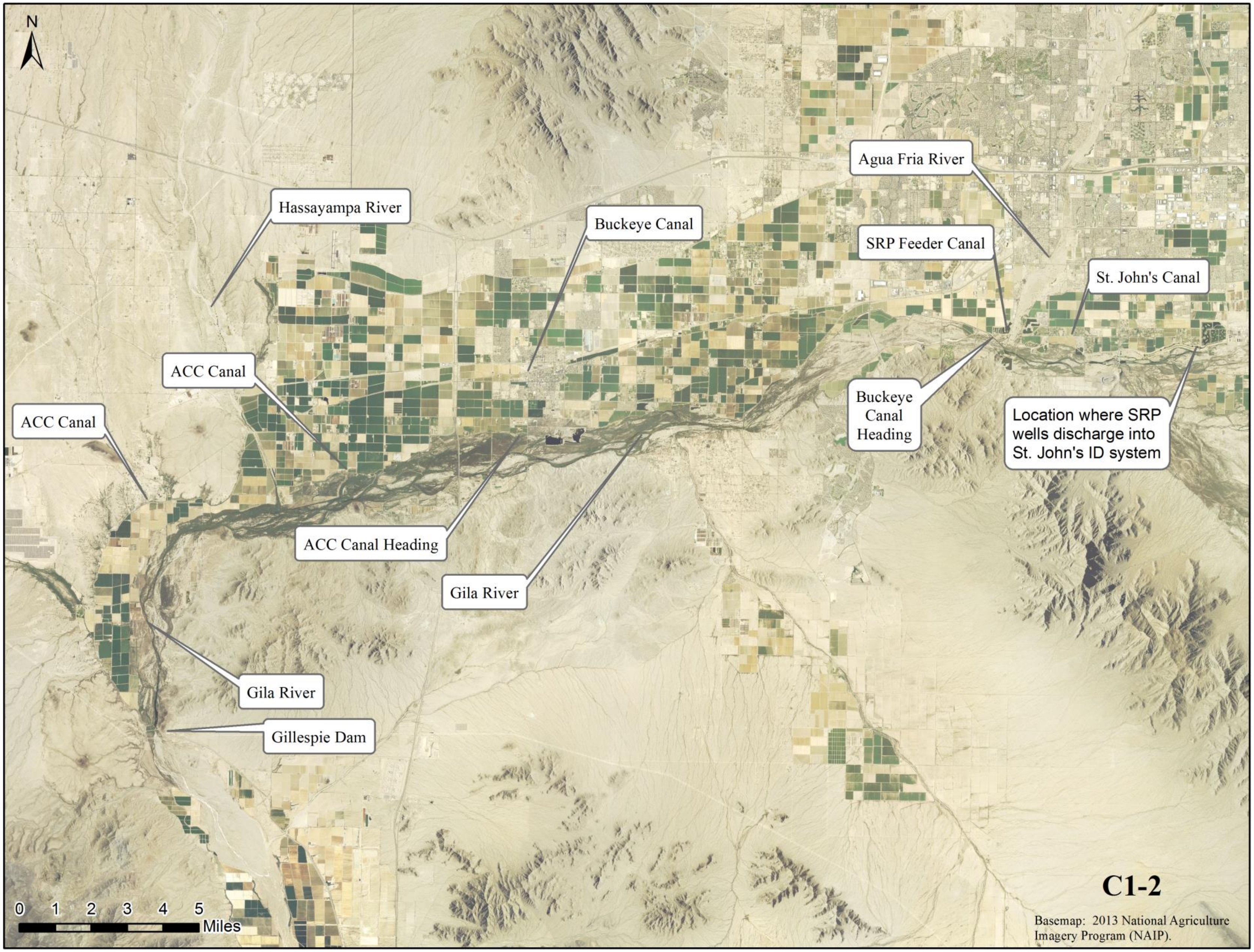

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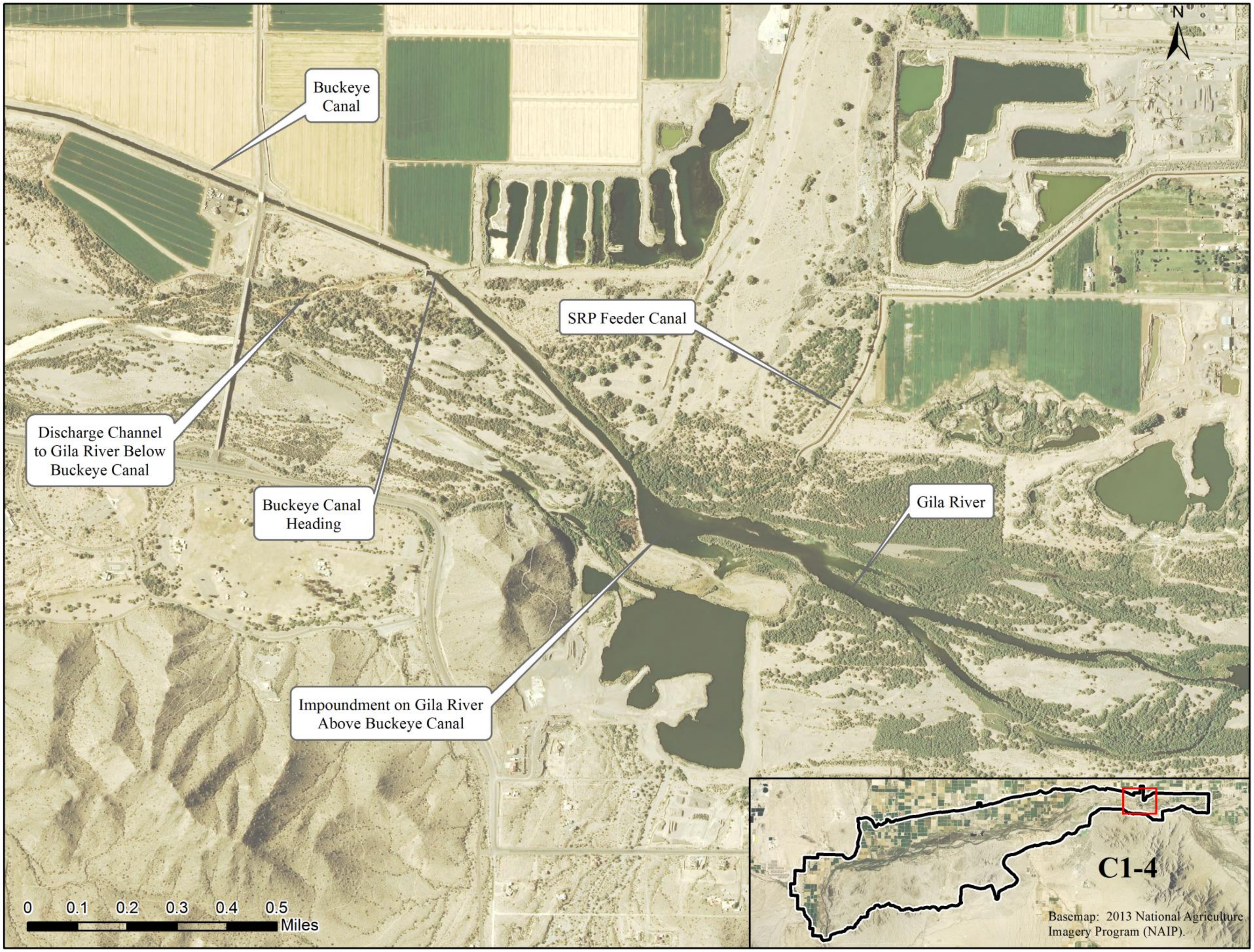

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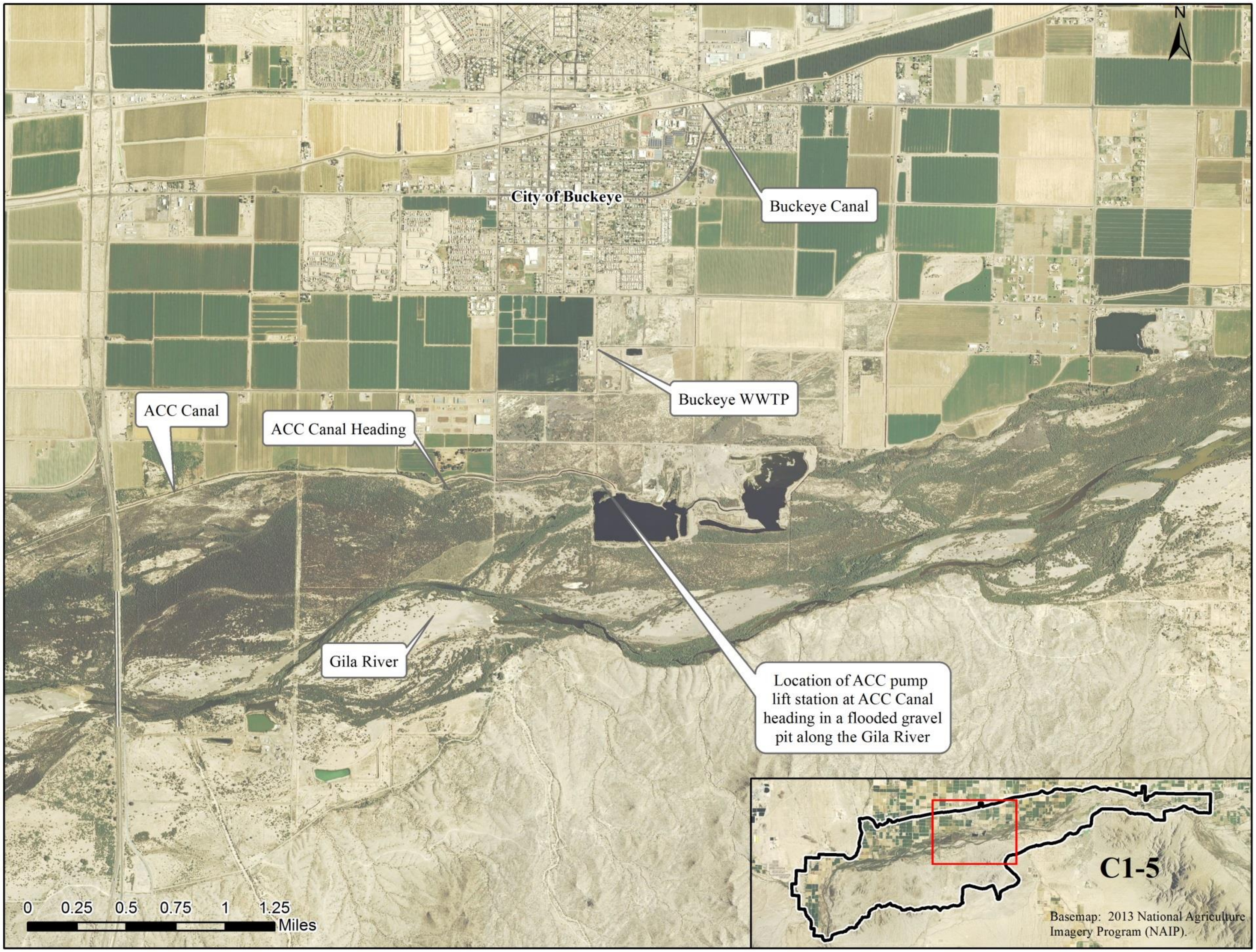

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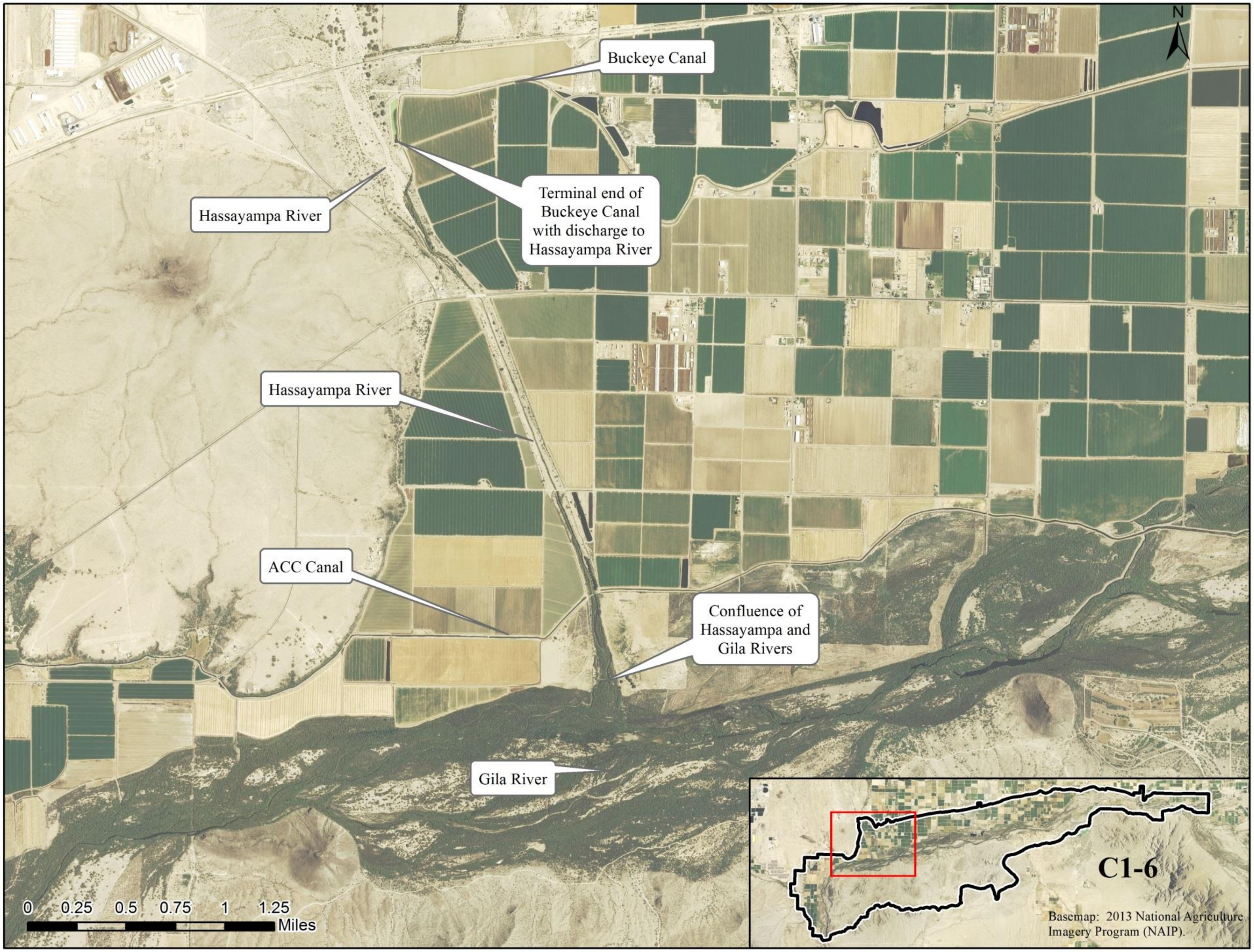

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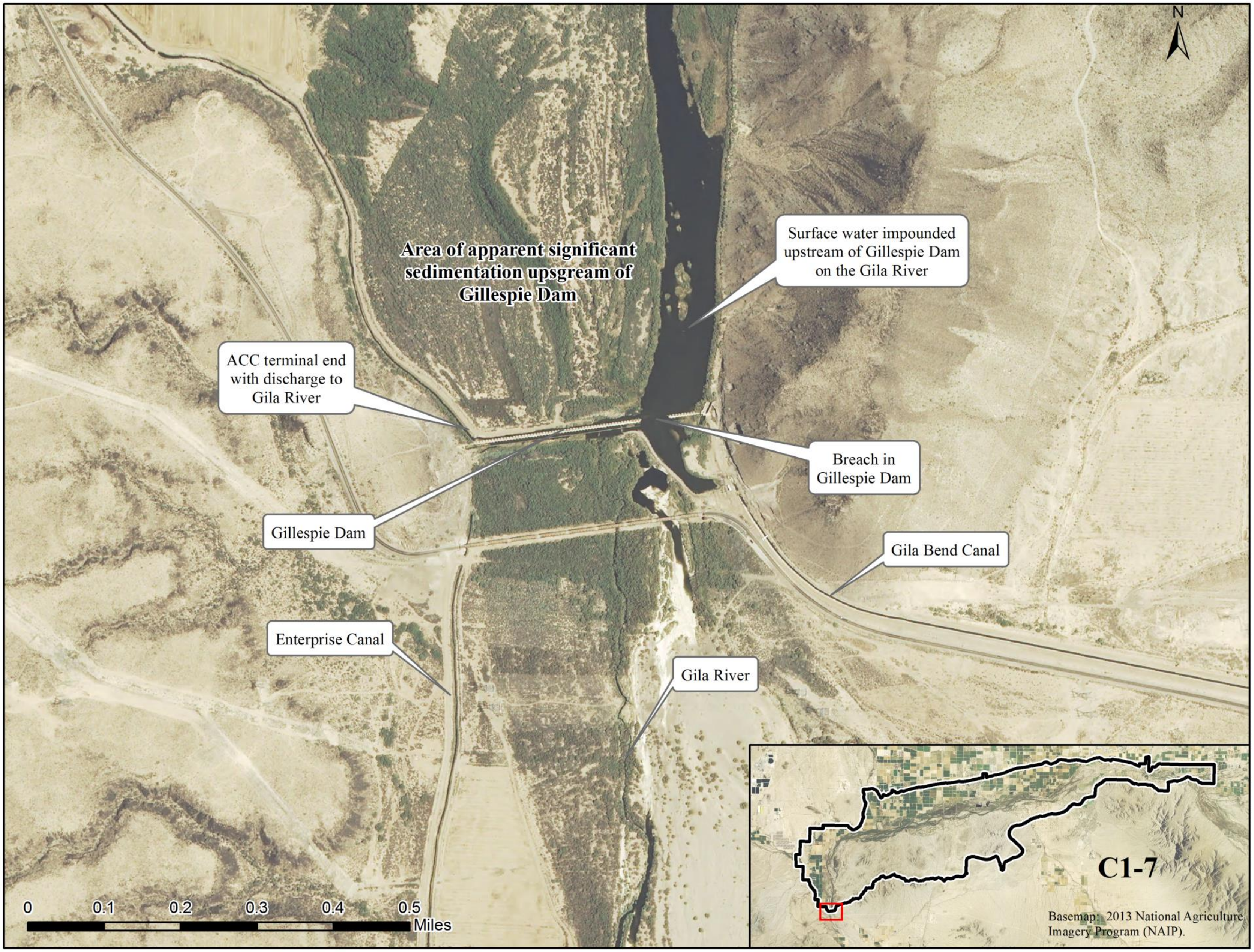

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Attachment C-2

BWCDD System Map

MAP OF

BUCKEYE WATER CONSERVATION & DRAINAGE DISTRICT

MARICOPA COUNTY, ARIZONA

ED GERAK, GENERAL MANAGER
LARRY OWENS, SUPERINTENDENT

JULY 2008

Attachment C-3

ACC Static and Pumping Water Levels

Table C-1. Static Water Levels, Arlington Canal Company Wells

ADWR Well #	55-630582	55-603589	55-630588	55-630586	55-630585	55-630584	55-630583	55-630591	Lueck
Pump #	**1**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	
6/1/2008	11	32	32	38	45	55	55	57	
4/29/2010	13	37	32	39	52	58	62	60	
10/1/2010	n/a	n/a	n/a	n/a	n/a	n/a	n/a	81	
4/5/2011	n/a	n/a	n/a	n/a	n/a	n/a	n/a	72	
6/4/2012	n/a	n/a	n/a	57	70	75	75	n/a	
9/4/2012	n/a	n/a	n/a	60	70	n/a	n/a	n/a	
10/1/2012	8	47	43	50	60	68	68	66	
1/3/2013	11	51	48	55	67	74	73	71	n/a
2/1/2013	n/a	76	n/a	n/a	72	n/a	n/a	n/a	n/a
3/4/2013	n/a	70	n/a	n/a	n/a	n/a	n/a	n/a	n/a
4/4/2013	n/a	n/a	70	n/a	n/a	n/a	n/a	n/a	n/a
5/1/2013	n/a	n/a	70	68	95	94	90	87	n/a
6/3/2013	n/a	n/a	74	n/a	n/a	n/a	n/a	n/a	n/a
9/2/2013	n/a	n/a	n/a	n/a	n/a	92	82	77	n/a
10/2/2013	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	90
11/1/2013	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	90
12/10/2013	locked out	acid	acid	52	65	70	70	68	65
1/6/2014	locked out	acid	acid	59	68	72	71	70	66
3/5/2014	n/a	n/a	68	n/a	n/a	n/a	n/a	n/a	n/a
10/1/2014	n/a	n/a	66	n/a	n/a	n/a	n/a	n/a	n/a
11/3/2014	n/a	n/a	65	n/a	n/a	n/a	n/a	n/a	n/a
2/14/2015	10	67	66	52	70	76	74	70	68
6/1/2015	n/a	n/a	n/a	n/a	n/a	n/a	95	n/a	n/a
8/3/2015	n/a	n/a	86	n/a	n/a	n/a	n/a	n/a	n/a
8/31/2015	n/a	n/a	86	n/a	n/a	n/a	n/a	n/a	n/a
10/1/2015	n/a	n/a	85	n/a	n/a	n/a	n/a	n/a	n/a
11/2/2015	n/a	n/a	80	n/a	n/a	100	98	90	n/a

Data compiled by Well Energy Testing, Inc. For the Arlington Canal Company

Table C-2. Pumping Water Levels, Arlington Canal Company Wells

ADWR Well #	55-630582	55-630589	55-630588	55-630586	55-630585	55-630584	55-630583	55-630591	Lueck
Pump #	**1**	**3**	**4**	**6**	**7**	**8**	**9**	**10**	
2008	42		108	72	96	130	121	162	
5/7/2009	39		104	78	90	156	120	150	
6/5/2009	39		104	68	100	150	120	124	
7/3/2009	39		112	72	100	150	n/a	154	
8/7/2009	44		104	80	100	154	125	157	
9/9/2009	42		114	78	100	152	140	160	
10/1/2009	44		114	78	96	152	140	156	
7/2/2010	39		110	68	100	154	140	154	
8/3/2010	45		100	68	100	152	140	156	
9/1/2010	44		110	68	100	153	136	155	
10/1/2010	39		113	68	100	148	133	n/a	
4/5/2011	41		104	68	100	144	n/a	n/a	
5/9/2011	46		110	69	100	152	n/a	160	
6/1/2011	39		114	69	100	152	n/a	156	
7/1/2011	39		108	71	102	151	n/a	155	
8/3/2011	36		114	76	95	156	n/a	152	
9/5/2011	41		118	69	100	154	n/a	156	
10/1/2011	39		116	72	100	155	n/a	161	
11/9/2011	39		116	80	100	154	n/a	158	
12/27/2011	41		114	69	OFF	152	n/a	156	
2/1/2012	40		114	69	OFF	152	160	156	
3/1/2012	39		115	71	120	154	OFF	156	
4/3/2012	44		112	73	120	154	155	156	
6/4/2012	40		110	OFF	OFF	OFF	OFF	156	
8/2/2012	44		109	72	125	154	142	152	
9/5/2012	38		102	OFF	OFF	147	138	148	
11/5/2012	41		108	72	120	154	141	151	
12/3/2012	42		107	77	120	155	143	151	
2/1/2013	40	-	100	80	off	152	138	139	-
3/4/2013	40	-	94	77	120	153	140	150	-
4/4/2013	41	-	OFF	70	140	153	140	150	-
5/1/2013	42	-	n/a	n/a	n/a	n/a	n/a	n/a	-
5/10/2013	-	198	-	70	120	154	150	150	-
6/3/2013	41	196	-	70	120	156	152	150	-
7/3/2013	locked out	201	110	69	140	160	145	152	125
7/31/2013	43	205	acid	74	140	160	145	152	118
9/2/2013	locked out	acid	acid	68	140	OFF	OFF	OFF	125
10/2/2013	39	acid	acid	70	140	155	142	151	OFF
11/1/2013	locked out	acid	acid	81	140	155	142	151	OFF
1/6/2014	Locked out	acid	acid	OFF	OFF	OFF	OFF	OFF	OFF
2/4/2014	Locked out	acid	acid	66	120	156	139	140	OFF
3/5/2014	39	acid	OFF	72	140	153	137	147	OFF
4/1/2014	Locked out	acid	110	68	120	154	148	150	OFF
4/30/2014	Locked out	acid	123	70	120	154	140	150	OFF
6/3/2014	Locked out	acid	123	68	120	156	145	150	OFF & BEES
7/1/2014	Locked out	acid	125	68	120	160	148	154	140
8/4/2014	Locked out	acid	acid	67	120	160	145	152	140
9/2/2014	Locked out	acid	acid	60	120	160	144	150	140
10/1/2014	39	acid	OFF	65	120	160	142	150	130
11/3/2014	39	136	OFF	56	120	160	145	150	130
12/1/2014	39	130	138	56	120	162	152	152	130
1/2/2015	39	132	130	58	120	162	155	155	200
3/6/2015	39	n/a	n/a	67	120	162	145	154	130
4/1/2015	39	n/a	n/a	60	120	162	145	152	BEES
5/1/2015	40	n/a	n/a	60	120	162	148	154	BEES
6/1/2015	39	n/a	n/a	65	120	159	OFF	151	BEES
7/1/2015	39	being pulled	110	60	120	165	152	155	BEES
8/3/2015	40	225	OFF	60	120	165	153	161	BEES
8/31/2015	40	217	OFF	60	120	167	154	160	BEES
10/1/2015	40	214	OFF	60	120	165	154	157	BEES
11/2/2015	40	212	OFF	59	120	OFF	OFF	OFF	BEES

Data compiled by Well Energy Testing, Inc. For the Arlington Canal Company