REPORT

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Prepared for:

RESOLUTION COPPER

Analysis of Groundwater Level Trends Upper Queen Creek/Devils Canyon Study Area

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ANALYSIS OF GROUNDWATER LEVEL TRENDS UPPER QUEEN CREEK/DEVILS CANYON STUDY AREA

RESOLUTION COPPER, PINAL COUNTY, ARIZONA

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1 EXECUTIVE SUMMARY

1.1 Introduction

At the request of Resolution Copper (RC), Montgomery & Associates (M&A) has prepared this report summarizing review and analysis of long-term hydrographs to support ongoing National Environmental Policy Act (NEPA) review process for the Resolution Project near Superior, Arizona. The principal objective of this report is to present and review groundwater level and hydraulic head data for the RC hydrologic monitoring network. Limited interpretation is provided to help describe notable hydraulic changes.

This addendum is intended to augment the body of work previously reported by M&A (2010).

1.2 Results

Data collected since 2010 provide new insight into the hydrologic system. For this addendum, M&A has updated figures and tables with total head and water level data through the end of 2016.

Water levels and total heads presented in this report are affected by a variety of natural and anthropogenic factors. Observations of these factors in the head and water level measurements are useful for developing the hydrogeologic conceptual model. Natural factors effecting head and water level observations include:

- Precipitation and streamflow related recharge events
- Drought
- Long-term fluxes of water from areas of high hydraulic head to areas of low hydraulic head

Anthropogenic factors affecting head and water level observations include:

- Historic large scale dewatering of the Magma Mine and current dewatering of the planned Resolution Copper Mine
- Groundwater pumping of other mines and quarries
    - Past groundwater pumping associated with the historic Silver King Mine, Lake Superior and Arizona Mine, and Belmont Mine.

  - Ongoing groundwater pumping associated with the OMYA quarry.
- Mineral exploration drilling activities
- Hydrogeologic testing and groundwater sampling activities
- Closure and reclamation of the Magma Mine and Belmont Mine
- Other groundwater uses
  - Irrigation and stock wells
  - Domestic wells

Water levels and total heads are reported for wells in four separate groundwater domains:

- *Shallow alluvial aquifers*, hosted in alluvial veneers that are limited areal extent

- The *Apache Leap Tuff aquifer* (ALT) which is a fractured-rock aquifer hosted in the Tertiary Apache Leap Tuff (Tal) outcrop belt that extends throughout much of the Upper Queen Creek and Devils Canyon drainages, and a portion of the Mineral Creek drainage

- A *deep groundwater system east of the Concentrator Fault* that is hosted in several volcanic and sedimentary rock units and is considered in two separate domains

  - *Inside the Resolution graben*

  - *Outside the Resolution graben and east of the Concentrator Fault*

- A *groundwater system outside the Resolution graben and west of the Concentrator Fault* that is hosted in volcanic and sedimentary rock units.

1.2.1 Shallow Alluvial Aquifers

Three wells currently monitor shallow alluvial aquifers; however, these wells are also likely to be open to the uppermost part of the Tal. The Corral Well and Middle Well are installed near Top of the World and show clear seasonal responses to spring snowmelt and summer precipitation events. The Corral Well is documented to have gone dry in both 2014 and 2015. The Hackberry Windmill well is in Hackberry Canyon in the Devils Canyon watershed and also shows a seasonal response to snowmelt and precipitation. Hackberry Windmill well has gone dry at multiple points in the past. None of the wells monitored in the shallow groundwater system are documented to have been impacted by RC dewatering activities.

1.2.2 Apache Leap Tuff Aquifer

The ALT aquifer is monitored in 24 dedicated monitoring wells (HRES-01 through HRES-24, Oak Flat Well, A-06, and MJ-11) and using grouted piezometers installed in seven deep groundwater system monitoring wells (DHRES-01, DHRES-02, DHRES-06, DHRES-07, DHRES-08, DHRES-11, and DHRES-14). For the majority of its central and southern extent the Tal is underlain by the low-permeability Whitetail Conglomerate (Tw), although there are local areas along the western margin of the Tal outcrop belt where Tal directly overlies Paleozoic carbonates. Groundwater recharge to the ALT aquifer naturally occurs through infiltration of precipitation along the principal drainage ways within the Tal outcrop belt and to a lesser extent over the entire outcrop belt as areal recharge. Groundwater discharge from the ALT aquifer occurs in perennial reaches of Devils Canyon and Mineral Creek. Hydraulic gradients are downward from the ALT aquifer to the deep groundwater system in nearly all nested piezometers (except at DHRES-07 where heads have risen in the Tw) indicating that water from the deep system does not recharge the ALT aquifer. The only ALT aquifer well that shows impacts from shaft dewatering is well HRES-01, which is within 300 feet of Shaft 10.

Hydrograph responses in the ALT aquifer are reviewed in five sectors that are grouped primarily based on their location:

North Sector (HRES-06, HRES-12, Middle Well): These wells all show stable long term trends, but are subject to snowmelt and precipitation-related seasonal variability.

East Sector (HRES-14, HRES-15, HRES-16, HRES-17, HRES-18, HRES-20, DHRES-14, A-06, and MJ-11): The hydrographs for most of these wells have had some variability introduced by drilling and testing activities and instrument error. None of these wells show a strong response to surface water events. Small, but steady declines have occurred in all of these wells with most wells showing 2 to 4 feet of water level decline over the period 2011-2014. These declines in water level are considered to be responses to the long-term and ongoing drought conditions that are pervasive across the southwestern United States. These declines generally correspond well with declines observed in Arizona Department of Water Resources (ADWR) index wells in the Dripping Springs Valley, AZ and the Klondyke, AZ area.

Oak Flat Sector (HRES-03S, HRES-03D, and Oak Flat Well): The hydrographs for these wells are the longest continuously monitored water levels available in the ALT aquifer with the record for Oak Flat Well extending back 13 years to 2004. All three wells show a relatively steady long-term decline in water level of approximately 4 feet during the period from 2006-2015. The record for the Oak Flat Well, which extends back three years earlier, verifies that this trend was present at least as far back in time as 2003. These data are important for confirming that the declines in ALT aquifer water levels are not a response to RC shaft dewatering activities which began in 2009. HRES-03S and the Oak Flat well, which are nearly co-located and show almost identical trends, show a seasonal response to precipitation and snowmelt.

Southwest Sector (HRES-01, HRES-02, HRES-04, HRES-05, HRES-07, HRES-08, HRES-09, HRES-13, HRES-19, and HRES-21): Wells in this sector are most closely located to shaft dewatering activities and also show more varied responses than the other sectors. Well HRES-01, which is adjacent to Shafts 9 and 10 has shown some head declines likely because of its close proximity to the shaft and shaft related activities. Wells HRES-13 and HRES-07, which are the most distant from Shafts 9 and 10 within the sector, both show steady declines of 1-2 feet during the period from 2011-2014 in response to the long term drought. Water levels in wells HRES-02, HRES-04, HRES-05, and HRES-09 are all stable over the period of record, but show some variability as well. In well HRES-02, the variability appears to be primarily in response to surface hydrologic conditions, while variability in HRES-04, HRES-05, and HRES-09 appears to be primarily a response to drilling and testing activities.

Southeast Sector (Wells HRES-10 and HRES-11): Well HRES-10 is near Lyons Fork, a tributary to Mineral Creek. Water levels within well HRES-10 fluctuate by as much as 50 feet in response to streamflow events, with water levels typically rising rapidly in response to winter runoff, and receding throughout the rest of the year. In contrast, well HRES-11 has shown a relatively steady decline in water level since 2010, with a slight rise in water level occurring in 2013. The timing of this rise in water level corresponds to the largest rise in water level in HRES-10 in response to winter runoff, indicating that recharge at HRES-11 is also supplied by surface water. The longer term decline in HRES-11 water level is understood to be a response to the drought.

1.2.3 Deep Groundwater System East of the Concentrator Fault

The Deep Groundwater System is monitored in eleven monitor wells, most of which have several grouted piezometers. The DHRES series wells monitor depths of up to 6,700 feet beneath land surface and encounter significant geologic complexity. To simplify this complexity, the Deep Groundwater System east of the Concentrator Fault is described in two sectors.

Inside the Resolution graben (Wells DHRES-01, DHRES-02, and DHRES-08): Rock units within the graben include the Tal, the Whitetail Conglomerate (Tw), Cretaceous volcaniclastic rocks (Kvs), Paleozoic limestones and shales (Pz), and younger Precambrian diabase (pCdiab), quartzites (pCds), limestones (pCmls) and shales (pCp), and Precambrian Pinal Schist (pCpi). The deep groundwater system inside the Resolution graben is in clear hydraulic communication with Shafts 9 and 10. Wells DHRES-01, DHRES-02, and DHRES-08 have all seen head/water level declines of over 1,000 feet since 2010. However, these large head declines have only been documented in the Tw3, the Kvs, Pz, and pCdiab. Lesser head declines of nearly 200-500 feet have been observed in the Tw3 in DHRES-02 and DHRES-08 and the lower portion of the Tw2 in DHRES-01. However, piezometers in the upper portion of the Tw2 and the Tal have not shown meaningful head declines, supporting the conceptualization that the Tw2 is an effective aquitard and acts as a barrier to upward propagation of head declines. Small head declines have been documented in the ALT within the graben, but are consistent with declines seen prior to the onset of Shafts 9 and 10 dewatering and regional declines due to drought.

Outside the Resolution graben (DHRES-06, DHRES-07, DHRES-09, DHRES-10, DHRES-11, DHRES-13, DHRES-14, and DHRES-15): Head measurements outside of the Resolution graben are of particular interest because they provide indications of the extent to which hydraulic impacts from mining operations could be expected to propagate outside of the graben. In general, head declines outside of the graben are much smaller than those inside of the graben. The water level in well DHRES-11, north of the graben, showed the largest head decline outside of the graben with heads dropping approximately 400 feet since 2011. This may be an indication of a connected flow path from the graben to DHRES-11, or may indicate that the northern boundary of the graben is not a significant impediment to flow. By comparison, the next largest head declines observed over the same time period were in wells DHRES-07 and DHRES-13, which were less than 100 feet, and DHRES-09, which was less than 50 feet. Well DHRES-06 has shown a maximum of about 10 feet of head decline during the same period. Overall, this data supports the conceptual model that the boundaries of the graben act as an impediment to lateral flow.

1.2.4 Deep Groundwater System West of the Concentrator Fault

West of the Concentrator Fault (DHRES-03, DHRES-04, DHRES-05B, and DHRES-16): Several thousand feet of vertical displacement is evident across the Concentrator Fault. Wells west of the Concentrator Fault are both laterally more distant from shaft dewatering in the graben and are separated by the physical barrier of the fault. However, the Magma Mine workings do extend west of the fault, providing the potential for hydraulic impacts to extend beyond the fault. Wells DHRES-03, DHRES-04, and DHRES-16 have all shown head rises and subsequent declines of nearly 50 feet. In contrast, DHRES-05B has undergone a nearly linear head decline of about 50 feet since late 2010. Several MCC wells monitor the Gila Conglomerate (Qtg) near the West Plant Site. All of these wells, except MCC-3C and MCC-5, have shown steady long term declines in water level since 1996. These declines are consistent with water level declines occurring regionally in response to drought conditions.

2 INTRODUCTION

At the request of Resolution Copper (RC), Montgomery & Associates (M&A) has completed review and analysis of long-term hydrographs for the RC groundwater monitoring system in the Upper Queen Creek/Devils Canyon (QCDC) study area, Pinal and Gila Counties, Arizona. This report summarizes results of this data review and analysis, and was prepared to support the ongoing National Environmental Policy Act (NEPA) review process for the Resolution Project near Superior, Arizona.

RC initiated hydrogeologic investigations of the QCDC study area beginning in 2001 in conjunction with preliminary studies related to development of a large-scale copper mine east of Superior, Arizona. RC has proposed to develop a new mine that targets the Resolution orebody using the block-cave mining method. The Resolution orebody is located southeast of the existing Magma Mine at depths ranging from 6,000 to 7,000 feet below land surface (bls); elevation of the ore body ranges from 2,000 to 3,000 feet below mean sea level (bmsl).

RC has been monitoring groundwater levels/total hydraulic head across a broad range of hydrogeologic units as part of both the hydrogeologic characterization investigations for the proposed block-cave mine and near former mineral processing facilities on the West Plant Site (WPS)near Superior.

The study area covered by this addendum encompasses:

- The upper Queen Creek watershed from the Town of Superior upstream to the headwaters
- The Devils Canyon watershed
- The western part of the upper Mineral Creek watershed
- The RC WPS near Superior

The QCDC study area is a subset of the overall Resolution Project study area; location for the study area is shown on **Figure 1**. Early hydrogeologic investigations focused on evaluating potential impacts from proposed block-cave mining operations on groundwater and surface water in the QCDC study area. Because the proposed block-cave mining operations are deep and subsidence impacts from the block-cave are assumed to propagate to land surface, these studies have focused on the hydrogeologic system adjacent to and overlying the proposed mine. Hydrogeologic characterization has since expanded to include other areas where proposed mineral processing, tailing storage, and transportation corridors are planned by RC. This addendum is limited to water level and hydraulic head data collected in the QCDC study area and select wells at the WPS.

This report was prepared, in part, as an addendum to an earlier report published by M&A that included data and discussion of water level hydrographs for groundwater in the QCDC study area:

- *Interim Results of Groundwater Monitoring, Upper Queen Creek and Devils Canyon Watersheds*, published February 17, 2010 (M&A, 2010)

A substantial number of new hydrogeologic characterization wells have been installed since 2010, and many new water level/total head hydrographs are provided in this report. The scope of this review is mainly confined to the period from 1995 through present. This period represents the timeframe for which routine water level data collection began for the Superior area.

2.1 Background

Starting in 1995, monitoring of groundwater levels was initiated on the RC West Plant Site with the construction of several monitoring wells adjacent to existing and former mineral processing facilities. Following shut-down of mine dewatering operations at the Magma Mine by BHP in May 1998, water level monitoring was initiated for the East Plant Site (EPS) at Shaft 9 starting in mid-1999. Groundwater level monitoring on the WPS and EPS were related to permitting activities for the Arizona Department of Environmental Quality (ADEQ) Aquifer Protection Permit (APP) process for the WPS and EPS.

In 2001, RC initiated preliminary hydrogeologic investigations, in conjunction with studies to evaluate the potential for development of a block-cave mine of the RC ore body in the EPS area. The studies were initiated in order to refine the conceptual hydrogeologic model for the Apache Leap Tuff (ALT) aquifer and the adjacent groundwater system.

A geologic map of the study area and locations of monitoring wells are shown on **Figure 2.** Monitoring well construction is summarized in **Table 1**.

2.2 Climate

Climate of the project area is generally arid to semi-arid. Precipitation typically occurs as high-intensity, short-duration storms during the months of July through September, and longer-term storms of more moderate intensity that occur during the months of November through March. Although several meteorological stations have been, and are currently, maintained in the study area there is no one data set that is complete for the period covered in this report (2002 through 2016). Precipitation data from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) data set for the Superior location (Oregon State University, 2016) was evaluated. PRISM data are interpolated from gage data for the entire USA using the Parameter-elevation Regressions on Independent Slopes Model.

Average annual precipitation report in PRISM over the period 1920 to 2015 in the Superior area is 20.5 inches (in) (**Figure 3**). Precipitation varies considerably over the project area as the area incorporates elevations ranging from 5,500 feet above mean sea level (amsl) at Kings Crown in the Queen Creek headwaters to 2,400 feet amsl near the confluence of Devils Canyon and Mineral Creek and is therefore subject to substantial orographic variability.

An extended period of below average precipitation has occurred in the Superior area starting in 1995 and continuing to present (M&A, 2013). This drought period follows a period of anomalously high precipitation that occurred from 1978 through 1994. This same pattern of drought following an anomalously wet period has been observed in other parts of Arizona (Blasch and others, 2005).

2.3 Hydrogeologic Context

Four principal groundwater domains have been identified in the study area including: (1) perched shallow aquifers hosted in sparsely distributed, discontinuous, unconsolidated alluvial sediments, (2) the ALT aquifer hosted in fractured dacite tuff that extends across much of the study area, (3) a deep groundwater system hosted in a variety of older rock units, and (4) a groundwater system west of the Concentrator Fault in the Superior area that includes basin-fill sedimentary rocks and volcanic rocks, and a deeper system hosted in older fractured-rock units. **Table 2** summarizes the geologic units and subunits within each of these groundwater systems. Salient observations regarding each groundwater system are summarized below.

Table 2. Summary of Aquifer Hydrostratigraphic Units

Aquifer	HGU	Subunit
Shallow Groundwater System	Quaternary Alluvium (Qal)	---
Apache Leap Tuff Aquifer	Apache Leap Tuff (Tal)	White Unit (Talw) Gray Unit (Talg) Brown Unit (Talb) Vitrophyre (Talv) Basal Tuff (Talbt)
	Tertiary Early Sediments and Volcanics (Tes/Tev)	Sediments (Tes) Basalt (Tev)
Deep Groundwater System	***Inside the Resolution graben***	
	Whitetail Conglomerate (Tw)	Channel-fill (Tw1) Lacustrine (Tw2) Conglomerate (Tw3) Ferricrete (Tw4)
	Volcaniclastics (Kvs)	Leached Cap Diatreme Facies (Kvs1)
	Younger Precambrian (pCy)	Diabase (pCdiab) Mescal Limestone (pCmls) Dripping Spring Quartzite (pCds)
	Outside the Resolution graben	
	Whitetail Conglomerate (Tw)	Channel-fill (Tw1) Lacustrine (Tw2) Conglomerate (Tw3) Ferricrete (Tw4)
	Paleozoic Sedimentary Units (Pz)	Naco Formation (Pnaco) Escabrosa Limestone (Me) Martin Formation (Dm) Bolsa Quartzite (Cb)
	Younger Precambrian (pCy)	Diabase (pCdiab) Troy Quartzite (pCt) Basalt (pCb) Mescal Limestone (pCmls) Dripping Spring Quartzite (pCds) Pioneer Shale (pCp)
	Older Precambrian (pC)	Pinal Schist (pCpi)
	West of the Concentrator Fault	
	Gila Conglomerate (QTg)	---
	Tertiary Volcanics (Tvs)	---
	Apache Leap Tuff (Tal)	White Unit (Talw) Gray Unit (Talg) Brown Unit (Talb) Vitrophyre (Talv) Basal Tuff (Talbt)
	Tertiary Cretaceous Intrusives (TKg)	---
	Paleozoic Sedimentary Units (Pz)	Martin Formation (Dm)

2.3.1 Shallow Alluvial Aquifers

In the QCDC study area, there are numerous shallow perched, largely seasonal aquifers of limited areal extent hosted in unconsolidated alluvial deposits and veneers. The areal extent of these alluvial deposits ranges from several hundred square feet to more than 300 acres. The largest of these deposits are found above Pump Station Spring in upper Queen Creek, and at Top of the World, Hackberry Canyon, and Rancho Rio Canyon in the Devils Canyon watershed **(Figure 2)**. Thickness of these deposits ranges from less than 10 feet to several tens of feet. Groundwater occurs in these deposits and in the underlying weathered bedrock units, and is recharged by direct infiltration of precipitation and runoff. Groundwater discharge from these units is typically seasonal, with sustained discharge extending up to several months after the winter rains/snows and subsequent snowmelt period.

There are also numerous accumulations of alluvium resulting from construction of many check dams and several stock tanks in the Oak Flat area. Thickness of the alluvial deposits captured by these check dams and stock tanks is generally less than 10 feet. As with the larger deposits of alluvium, groundwater that accumulates in these alluvial deposits may support sustained discharge to surface water drainages for several weeks or months following the winter snowmelt.

2.3.2 Apache Leap Tuff Aquifer

The ALT aquifer is a fractured-rock aquifer hosted in the Tal outcrop belt that extends throughout much of the Upper Queen Creek and Devils Canyon drainages, and a portion of the Mineral Creek drainage (**Figure 2**). The ALT aquifer is separated from the deep groundwater system by a thick sequence of Tertiary basin fill sediments – the Tw. For the majority of its central and southern extent the Tal is underlain by the low-permeability Tw, although there are local areas along the western margin of the Tal outcrop belt where Tal directly overlies Paleozoic carbonates. In the northern area of the Tal outcrop belt, early Tertiary volcanics and sediments (Tev and Tes) lie between the Tw and the Tal; however, the Tw still separates the ALT aquifer from the deep groundwater system.

Groundwater recharge to the ALT aquifer naturally occurs through infiltration of precipitation along the principal drainages within the Tal outcrop belt and as areal recharge across the outcrop. Groundwater discharge from the ALT aquifer occurs in Devils Canyon and Mineral Creek. Currently, groundwater discharge does not occur from the ALT aquifer to Queen Creek, although anecdotal reports indicate that some groundwater discharge may have occurred via several springs in upper Queen Creek canyon prior to sinking of Shaft 9 by Magma Copper in the early 1970s (Bassett and others, 1994). ALT aquifer groundwater continues to discharge to the shaft and tunnel, where it is collected and put to beneficial use. Shaft 10 was shotcrete lined and completed through the Tal with little change to groundwater discharge occurring. Deep Groundwater System East of the Concentrator Fault

The deep groundwater system, as defined for the QCDC study area, includes three principal groundwater domains that encompass a variety of geologic units including the Tw and underlying units. These groundwater domains are currently defined as follows:

- *Deep groundwater system within the Resolution graben:* The Resolution graben hosts the Resolution ore body; a series of regional faults offsets the rocks within the graben from those units that are located outside the graben. Rock units within the graben include Tw, Kvs, Pz, and pCdiab, pCds, pCmls, and pCpi. Within the Resolution graben, the deep groundwater system is hydraulically connected to existing mine workings and a clear hydraulic response to ongoing dewatering of the mine workings is observed.

- *Deep groundwater system outside Resolution graben:* Outside the graben, rock units include Tw, Pz, and pCy units, but the Kvs units are absent. Graben-bounding faults appear to impede hydraulic communication between the deep groundwater system outside the graben and the deep groundwater system within the graben. Water levels are substantially higher outside the graben and limited response to dewatering of the existing mine workings has been observed to date.

2.3.3 Groundwater System West of Concentrator Fault

The groundwater system west of the Concentrator Fault is hosted in low-permeability Tertiary Gila Conglomerate (QTg) and fractured Tertiary volcanic rocks (Tvs) **(Figure 4)**. At greater depths, many of the same rock units that crop out east of the Concentrator Fault (Tal, Tw, Pz, pCy, and pCpi rocks) are encountered. Groundwater levels within the basin-fill deposits at selected wells in the WPS, and for several deep groundwater system wells completed on the WPS and in the Town of Superior are discussed in this report.

3 GROUNDWATER LEVEL MONITORING

A robust groundwater monitoring network has been developed and refined as the understanding of the systems has improved with data. This data is important for establishing baseline conditions, predicting potential impacts from mining operations, and establishing a comprehensive groundwater protection plan to be implemented once construction of the mine begins. Observations of short-term changes and long-term trends in groundwater level within the systems provide important guidance on groundwater circulation.

Groundwater Level/Pore Pressure Monitoring Network

RC monitors groundwater level/pore pressure from a network of 42 wells in the QCDC study area. At some of these wells, monitoring of water levels/pore pressures occurs at multiple levels in the subsurface using annular standpipe piezometers or grouted vibrating-wire piezometers (VWPs). Locations for these wells are shown on **Figure 2**. In addition, water levels are measured routinely at monitoring wells in the WPS. A subset of 11 of these WPS monitoring wells with the longest periods of record are discussed in this report. Location and construction information for wells in the QCDC study area, and for the subset of WPS monitoring wells that are discussed in this report are given in **Table 1**. The total number of wells completed in each part of the groundwater system and included for discussion in this report is summarized below:

- 3 wells completed in the shallow groundwater system
- 25 wells/piezometers and 11 VWPs completed in the ALT aquifer
- 21 VWPs completed in the Tw
- 10 wells, one mineral exploration hole, and 15 VWPs completed in the deep groundwater system east of the Concentrator Fault
- 2 wells and 10 VWPs completed in basin-fill deposits (QTg), volcanics (Tvs), and deeper geologic units west of the Concentrator Fault
- 11 WPS monitoring wells completed in the QTg

3.1 Anthropogenic Impacts on Groundwater Levels

Anthropogenic activities can impact water levels across a variety of time scales from hours to decades and include:

- Dewatering of underground mine workings
- Dewatering of open-pit mines and quarries
- Mineral exploration drilling
- Hydrogeologic and monitoring well drilling and testing
- Groundwater purging and sampling
- Mine and mineral processing facility reclamation activities
- Irrigation and stock water pumping
- Domestic water supply pumping

More detailed descriptions of each of these potential anthropogenic impacts are described in the following sections.

3.1.1 Mine/Quarry Dewatering

Dewatering of underground mines in the Superior area began in 1875 at the Silver King mine. In more recent years, several open-pit quarries have been developed in the Superior area for mining of marble, perlite, and decorative stone. These open-pit quarries can impact water levels via pit dewatering and also by the discharge of the dewatered water to surface water.

Magma/Resolution Copper Mine

Dewatering of the Magma Mine was initiated in 1910, when groundwater was encountered at an elevation of about 3,150 feet amsl at Shaft 1 (Short and others, 1943).

The historical workings are distributed in two sectors (**Figure 2**):

> West sector: By 1939, Shafts 1 through 8 had been sunk. Current maximum depth of mine workings in the west sector is more than 1,315 feet bmsl.
>
> East sector: Development of the east sector workings (East Development Area) began in earnest in 1970 with the sinking of Shaft 9 to a depth of about 615 feet bmsl. RC began sinking Shaft 10 in 2009, and as of 2016, Shaft 10 had reached a total depth of 2,780 feet bmsl

Figure 4 is an oblique view from the southeast of the distribution of mine workings in the subsurface beneath the WPS and EPS. The two sectors are connected by several tunnels with the lowest connecting tunnel (3600 Level) located approximately at sea level. This is important when considering water levels during mine dewatering operations, as water level in the west can be maintained at or slightly below sea level even when water levels in the east sector drop well below sea level.

The first reliable records of water level in the Magma Mine commenced in mid-1999 after shutdown of the mine dewatering pumps in 1998. Nearly continuous measurements of water levels in Shafts 9 and 3 were obtained from pressure transducers/dataloggers installed at both shafts to document water level recovery. These data are shown on **Figure 5**. Groundwater level was also tracked in the deep groundwater system adjacent to the mine workings at RC exploration borehole RES-03 **(Figure 2)** starting in late 2007; a water level hydrograph for RES-03 is shown on **Figure 5**.

In preparation for commencement of shaft sinking operations for Shaft 10 by RC, dewatering operations were reinitiated at Shaft 9 on March 17, 2009. Water levels in the mine workings and the adjacent groundwater system had recovered to about 2,138 feet amsl when dewatering was reinitiated **(Figure 5)**. Initial pumping rates ranged from about 1,250 to 2,500 gallons per minute (gpm) as stored water was removed from mine workings. By late 2011, water in storage was largely removed from Shaft 9 and existing mine workings, and the source of water to the dewatering system was dominantly groundwater inflow.

RC began sinking Shaft 10 in 2009, and as of 2016, Shaft 10 had reached a total depth of 2,780 feet bmsl **(Figure 5)**. Shaft 10 is located 274 feet south of Shaft 9, and as such is completed within the east sector mine workings. Groundwater inflows continue to occur in the Magma Mine workings at both Shafts 9 and 10, indicating that groundwater levels in the adjacent hydrogeologic units are higher than the bottoms of these shafts and workings. Currently, RC maintains water levels in the west sector mine workings at 300 feet bmsl while water levels in the mine workings in the east sector are maintained below 2,700 feet bmsl (Shaft 10). Dewatering rates for the period from 2013 through mid-2016 have averaged 640 gpm from Shafts 9 and 10 and 330 gpm from Shaft 8 and have decreased over time.

Silver King Mine, LS&A Mine, and Belmont Mine

A number of other smaller mines and mine adits occur in the QCDC study area. The largest of these mines include the Silver King, the Lake Superior and Arizona (LS&A) and the Belmont Mine **(Figure 2)**. Most activity at these three mines ceased in the early 20th century, although more recent efforts to reopen the Silver King mine may have resulted in some limited dewatering pumping on occasion, but records are not available. Reports on historical dewatering requirements reported for Silver King mine indicate that water production from mine workings was very limited (San Felice, 2006).

OMYA Quarry

The OMYA marble quarry is located at the head of Queen Creek Canyon above Pump Station Spring **(Figure 2)**. This quarry is situated above the water table, and water that accumulates in the quarry is derived solely from runoff (Brown and Caldwell, 2008). When the quarry is operating, periodic dewatering is required during rainy periods, and this water is discharged to Queen Creek above Pump Station Spring where it may augment water levels in the perched alluvial aquifer above the spring. These activities may result in changes in discharge from the alluvial deposits and Pump Station Spring, and therefore seasonal flow in Queen Creek below the spring.

3.1.2 Mineral Exploration and Hydrogeologic Test Drilling Activities

Impacts on groundwater levels can also occur from active exploration drilling when fluids in the borehole create head conditions that can result in fluid loss into the formation. Such fluid losses can occur rapidly as a “lost-circulation event”. In the RC hydrograph set, such events are relatively common where drilling is actively occurring, and can have small to large short-term impact on water levels or hydraulic head at nearby wells and grouted piezometers. As expected, the extent of impact from exploration drilling activities is confined to the area of active exploration by RC near Oak Flat. Locations for mineral exploration holes and hydrogeologic test wells in the EPS area are shown on **Figure 2**. A timeline for RC exploration drilling activities for the period 2001 through mid-2015 is shown on **Figure 6**.

Pumping Tests. Starting in 2004, numerous short-term pumping tests were conducted for hydrogeologic characterization wells, often immediately following construction. Test duration is typically 12-24 hours, and impacts from these tests are generally confined to the tested well only. Several long-term aquifer tests were conducted for periods of up to 90 days, and groundwater level impacts from these long-term pumping tests are often observed at multiple wells, sometimes at a substantial distance from the pumped well. A timeline for RC hydrogeologic characterization drilling and testing activities for the period 2004 through 2015 is shown on **Figure 7**.

Well Purging and Sampling. Following construction and initial testing of hydrogeologic characterization wells, additional hydrochemical sampling was conducted to establish baseline water quality and hydrochemistry. Each well is purged prior to sampling to ensure that a representative sample is obtained. In some cases, water level recovery is very slow and is evident in long-term hydrographs.

3.1.3 Mine Closure and Reclamation

Closure and reclamation of mining and mineral processing facilities may result in local changes in recharge to the groundwater system. Shut-down of mining and mineral processing activities by BHP in 1998, and subsequent closure of ponds and reclamation of facilities by RC on the WPS may have resulted in local changes to seepage/recharge to the groundwater system, and may partly explain long-term trends observed in WPS monitor wells. Extensive reclamation of former tailings impoundments and realignment and lining of drainage channels throughout the WPS has likely resulted in reduction in infiltration and local recharge to the groundwater system in this area.

3.1.4 Other Water Users

Irrigation/Stock Water Pumping. Small amounts of irrigation pumping in the study area can have local impacts on groundwater levels. Several private wells in the Town of Superior have been used for irrigation in the past, although use of these wells is now reported to be negligible. Impacts from pumping of these wells may be observed locally at private wells in the area. West of the study area, the Boyce-Thompson Southwestern Arboretum (BTSWA) uses a more substantial amount of groundwater for irrigation of plants and trees, and impacts from this pumping may have an impact on groundwater levels locally and downstream along Queen Creek.

Domestic Groundwater Pumping. The two principal areas of domestic water use from private wells are the Town of Superior and the community of Top of the

World **(Figure 2)**. Municipal water supply is provided to the Town of Superior by Arizona Water Company (AWC) who operates production wells in the Desert Wellfield located about 10 miles west from Superior. Numerous private wells are located in the Town of Superior. Although most residences in Superior are currently connected to the AWC water distribution system, some limited domestic/potable water use still occurs in Superior. In interviews with local residents, many wells are apparently used to augment the metered supply from AWC and are used for potable use, gardens and other uses.

Numerous private wells are located in the Top of the World area, and some small distribution systems are connected to wells in the area. Little information on water use from these wells is currently available.

3.2 Hydrograph Review and Analysis

Hydrographs for the various hydrogeologic units (HGUs) are included in **Appendices A and B** and are described below. **Table 3** provides a summary of well drilling and testing-related events for 2004-2015. **Table 4** provides a summary of the observed change in water levels and hydraulic heads at each groundwater monitoring location.

Figure 8 is a composite hydrograph showing water levels for all open-standpipe wells (no grouted VWPs) and shafts monitored by RC in the QCDC study area. The figure shows the Shaft 9 water level and Shaft 10 bench level declining over 4,000 feet during the period from 2009-2014. Water levels in the deep groundwater system within the Resolution graben (DHRES-01 and DHRES-02) declined over 2,000 feet in response to shaft dewatering. Water levels in the deep system outside the graben, in the overlying ALT and shallow alluvial aquifers, and at wells located west of the Concentrator Fault, are generally much more stable during the period of record. The most notable exception is well DHRES-11, where water levels have declined by nearly 400 feet since 2011.

4 SHALLOW ALLUVIAL AQUIFERS

The shallow groundwater system in the study area consists of numerous shallow aquifers and alluvial veneers of limited areal extent. RC currently monitors three wells completed in alluvium and the underlying ALT in the QCDC study area **(Table 1)**. Two of these wells (Corral and Middle wells) are located at JI Ranch near the west edge of the alluvial deposits outcrop belt at Top of the World **(Figure 2)**. The third well, Hackberry windmill, is located near the downstream outlet of the alluvial deposits outcrop belt in Hackberry Canyon. A summary of observed changes in water level elevations and causes of water level changes is provided in **Table 4**.

4.1 Water Level Monitoring Results

4.1.1 JI Ranch/Top of the World

RC currently monitors two wells completed in the Qal and the uppermost Tal at JI Ranch near Top of the World. The Corral well and Middle well have been monitored starting in 2007. A combined hydrograph for these wells is shown in **Appendix A (Figure A-2a)**. Water levels at both wells are very shallow, generally less than 20 feet bls. Inspection of the hydrographs shows clear response to winter precipitation/snowmelt periods, with occasional response from summer rains. The alluvium at Corral Well went dry in late 2014 and in 2015, coinciding with water levels at Middle Well reaching their lowest levels as well.

4.1.2 Hackberry Canyon

Hackberry Windmill well is in a relatively remote location, with limited stock use of an earthen stock tank adjacent to the well. The Hackberry Windmill well hydrograph **(Appendix A; Figure A-3a)** shows a repetitive drying sequence in late summer/early fall for years 2009 through 2011. The sharp drop in water level is attributed to drying of the thin veneer of alluvial deposits in this area. Water level is less than 10 feet bls for most of the year, except when the alluvium goes dry.

5 APACHE LEAP TUFF AQUIFER

The ALT aquifer is a fractured-rock aquifer hosted in dacite tuff (Tal) that extends throughout much of the upper Queen Creek and Devils Canyon drainages, and the western portion of the upper Mineral Creek drainage. Continuous monitoring of groundwater levels began in late 2003 at an existing well, Oak Flat well, located near the campground at Oak Flat. As additional wells and grouted piezometer arrays were installed in the ALT aquifer, automated water level monitoring was initiated.

Schematic diagrams of construction for wells completed in the ALT aquifer are given in **Appendix A; Figures A-4 through A-27**. Annular grouted piezometers have been installed within the ALT aquifer at 7 deep well locations, including DHRES-01, DHRES_02, DHRES-06, DHRES-07, DHRES-08, DHRES-11, and DHRES-14. Schematic diagrams of construction for these wells are given in **Appendix B; Figures B-1, B-2, B-6, B-7, B-8, B-11 and B-14**. Well construction details are summarized in **Table 1**. A summary of observed changes in water levels/hydraulic heads and causes of these changes is provided in **Table 4**. Hydrographs of the ALT aquifer are described below and are grouped according to geographic location.

5.1 North Sector – Upper Queen Creek and Top of the World

Wells included in the north sector of the Apache Leap outcrop belt include wells HRES-06 and HRES-12, and grouted piezometers DHRES-11_967 and DHRES-11_705 **(Figure 9; Appendices A and B; Figures A-9, A-15 and B-11)**. In July 2015, water level/total head elevations at these sites ranged from 4,030 to 4,100 feet amsl (**Figure 9**). These wells/piezometers are placed in the same sector due to the unusually high water level elevation as compared to the rest of the ALT wells in the study area. They are also located adjacent to major streams in the watershed, with HRES-12 and DHRES-11 located adjacent to Queen Creek and HRES-06 located adjacent to Iron Canyon near the outlet of the Top of the World alluvial basin.

A summary hydrograph for these wells is shown on **Figure 9** along with a hydrograph for the JI Ranch Middle Well, which is located near well HRES-06 and along Iron Canyon wash. Inspection of **Figure 9** shows that water levels fluctuate seasonally up to 5 feet at all of the ALT wells in this sector. High seasonal water levels correspond with runoff of snowmelt/spring rains in the drainages adjacent to these wells. Dampened and delayed seasonal effects are seen at wells that are deeper and further away from drainages (i.e., HRES-06).

Long-term water levels at the ALT aquifer wells in the north sector are generally stable or slowly rising. Water levels in the shallow alluvium appear to be declining from a high in 2010.

5.2 East Sector

Wells east of Devils Canyon are included in the east sector of the Apache Leap outcrop belt and include hydrologic test wells HRES-14 through HRES-18, HRES-20, A-06, and MJ-11 **(Figure 10)**. Well HRES-15, which is completed in the Tes and Tev in addition to the Tal is the only well in this group that is screened in a formation other than the Tal. Water level hydrographs for individual wells are provided in **Appendix A** (**Figures A-17a through A-21a, A-23a, and A-25a-A-26a**). In addition, there are two grouted piezometers completed in the ALT aquifer in this area at deep hydrologic test well DHRES-14. Hydrographs of total head at DHRES-14_1214 and DHRES-14_1071 are provided in **Appendix B** (**Figures B-13a through B-13d**). Wells HRES-14 through HRES-18 and HRES 20 all exhibited head declines of 2-10 feet over the period from late 2011 (2012 for HRES-20) through 2016 likely as a result of drought conditions (**Figure 10**). A pumping test was conducted at HRES-20 in spring of 2013. Response to this pumping test was observed in wells HRES-14, HRES-15, and A-06 (**Appendix A;Figures A-17a, A-18a, and A-23b**) and to a lesser extent at HRES-16, HRES-17, and MJ-11 (**Appendix A; Figures A-19a and A-20a**). Water levels at both HRES-14 and HRES-15 were declining prior to the HRES-20 pumping test.

5.3 Oak Flat

RC monitors two wells completed in the ALT aquifer immediately east of the Oak Flat Campground, including well HRES-03 and Oak Flat well **(Table 1; Figure 11)**. Well HRES-3 is completed in two zones within the ALT **(Appendix A; Figure A-6)**. The main part of the well (HRES-03D) is completed in the lowermost part of the ALT from 1,456 to 1,500 feet bls. In addition, well HRES-03 is equipped with a 1-inch annular standpipe piezometer (HRES-03S), which is perforated from 338 to 398 feet bls. This piezometer was installed to monitor a water-bearing fracture zone that was observed during drilling operations. The Oak Flat well was completed in 1990 (Borehole USW UZP-4, USDOE, 1990). This well is completed in the upper part of the ALT, with a perforated zone between 401 and 432 feet bls, in the same general depth within the ALT aquifer as well HRES-03S **(Appendix A; Figure A-27)**.

Individual water level hydrographs for these two wells are shown in **Appendix A** (**Figures A-6A and A-27A)**. A summary hydrograph for these wells is shown on **Figure 11**. Water levels at Oak Flat well and piezometer HRES-03S follow nearly identical trends, and are at essentially the same elevation. Annual rise of water levels often occurs in the first half of the year at these wells, with notable rises in water level noted during particularly rainy winter season years such as those that occurred in 2004-2005 and 2009-2010. Magnitude of water level rise is small, generally less the 2-3 feet.

Groundwater level elevation at well HRES-03D is several feet higher than HRES-03S indicating an upward hydraulic gradient. The 18-foot drop in water level at HRES-03D in 2013 was the result of a probe malfunction during the long term pumping test at HRES-20.

5.4 Southwest Sector

Wells included in the southwest sector of the Apache Leap outcrop belt include wells HRES-01, HRES-02, HRES-04, HRES-05, HRES-07, HRES-08, HRES-09, HRES-13, HRES-19, and HRES-21 **(Figure 12)**. Water level hydrographs for individual wells are provided in **Appendix A**. Note that, while other HRES wells are only completed in Tal, HRES-08 is completed in both Tal and Tw3. In addition, there are six grouted piezometers completed in the ALT aquifer in this area, including wells DHRES-01, DHRES-02, DHRES-06, DHRES-07, and DHRES-08. Hydrographs for water level/total head for these wells are provided in **Appendix B.**

A summary hydrograph for these wells is shown on **Figure 12**. Groundwater levels in the southwest sector of the ALT aquifer have been substantially influenced by numerous events related to mineral exploration drilling and hydrologic drilling and testing activities. Individual water level spikes exceeding 10 feet in water level rise or decline are observed at some sites, particularly for wells HRES-02, HRES-04, HRES-05, and HRES-09. In some cases, these events have resulted in a shift of the hydrograph upward or downward by several feet. For example, a 23-day pumping test at well HRES-09 in mid-2011 resulted in more than 10 feet of drawdown at wells HRES-05 and nearly 3 feet of drawdown at well HRES-04 **(Figure 12, and Appendix A; Figures A-7a, A-8a, and A-12a)**. Water level recovery at these wells was to varying degrees incomplete, resulting in a shift of the hydrographs downward. General water level and head trends within this sector have varied substantially between wells with some wells showing long-term declines (e.g. DHRES-07_3018), while other wells show long-term rises (e.g. HRES-02). When taken as a whole, there is not a consistent increasing or decreasing trend in heads within the southwest sector of the ALT.

5.5 Southeast Sector

Two RC monitor wells, HRES-10 and HRES-11, are located in the southeast sector of the ALT outcrop belt **(Table 1; Figure 13)**. Water level hydrographs for HRES-10 and 11 are shown in **Appendix A; Figures A-13a and A-14a**. In July 2015, water level elevations ranged from about 2,860 feet amsl at HRES-10 to 2,826 feet amsl at well HRES-11.

A combined hydrograph for both wells is shown on **Figure 13**. Hydrographs for these wells are strikingly different. Well HRES-10 shows repeated cycles of rapid water level rise followed by slow water level decline. Well HRES-10 is currently equipped with a rubber packer plug separating the upper and lower perforated zone (**Appendix A; Figure A-14**), therefore water level measurement reflects the upper zone only. The large fluctuations coincide with large precipitation events which presumably resulted in surface water runoff in the adjacent Lyons Fork creek, which is ephemeral at this location. There appears to be a significant hydraulic connection between the bed of Lyons Fork and the upper part of the ALT aquifer at HRES-10, possibly near the contact between the Tal and a wedge of overlying QTg. Rapid local recharge to the ALT aquifer from runoff events is then followed by rapid dissipation likely due to release of groundwater from the ALT aquifer to the adjacent Lyons Fork of Mineral Creek. In contrast, the water-level trend at HRES-11 is characterized by a long-term decline of about 5 feet between late 2010 and late 2015. This trend was briefly interrupted by a rise in head during early 2013. The long-term decrease in head is likely due to the ongoing drought conditions. The lack of response to surface water events observed in HRES-10 is expected because of the larger depth to water and greater distance from surface water drainage.

5.6 Discussion

Results of long-term water level monitoring for wells and grouted piezometers completed in the ALT aquifer support the following conclusions:

- *Long-term Water Level Trends:* Long-term water level trends for the period of record generally show overall decline of groundwater level within the ALT aquifer. Exceptions include well HRES-02 in the southwest sector, where water level steadily rose from 2006 through 2011, declined from 2011 to 2014, and is now rising once again. The cause of these periods of water level rise are not known, but may be due to enhanced recharge from a nearby stock pond, or from ongoing exploration drilling in the area with some drill fluid losses to the ALT aquifer during pre-collar drilling operations.

  The cause of long-term water level declines in the ALT aquifer is likely due to the ongoing regional drought, which began around 1995. Observations at wells in other parts of Arizona where little groundwater development exists show a similar magnitude of decline over the period of record. **Figure 14** shows the locations of two wells in Dripping Spring Valley and the Klondyke area that display these responses. The water level hydrograph for the Dripping Springs well (**Figure 15**) shows water levels rising in response to higher than usual precipitation during the period from 1952 through 1993. The years 1992 and 1993 were particularly wet years that resulted in an abrupt rise in water levels. Water level declined over 80 feet from 1993 through 2015 in response to a period of lower than average precipitation. Similar trends are present in the hydrograph of the Klondyke area well (**Figure 16**), which shows water levels rising from 1952 through 1993 and then declining from 1993 through 2015 at an average rate of about 1.4 feet per year (ft/yr). Both **Figure 15 and Figure 16** show a hydrograph of the Oak Flat well for comparison, which exhibits about 8 feet of water level decline from 2004 through 2015 or about 0.7 ft/yr.

- *Seasonal Water Level Change:* Water levels in some parts of the ALT aquifer system show seasonal or occasional pulses of water level rise which are likely the result of aquifer recharge from infiltration of surface water along upper Queen Creek, Devils Canyon, Mineral Creek, and their tributaries Most of these recharge pulses are less than 1 foot to more than

5 feet in magnitude. Substantial water level fluctuations related to recharge from surface water runoff occurs at well HRES-10, where more than 50 feet of water level rise is observed over very short time periods. These fluctuations appear to be related to rapid recharge from runoff events followed by rapid dissipation and release of groundwater to Lyons Fork of Mineral Creek.

- *Vertical Hydraulic Gradient:* Where measurements are available (e.g. HRES-01, Oak Flat/HRES-03, HRES-12/DHRES-11, DHRES-01/HRES-04, DHRES-14, DHRES-07/HRES-09, DHRES-06/HRES-08), vertical hydraulic gradients in the ALT aquifer are generally downward (**Appendices A and B**). In the case of HRES-01, for the period of record this is likely due to ongoing drainage of groundwater from the ALT into Shaft 9/Shaft 10 and the Never Sweat Tunnel from higher conductivity fracture zones within the lower part of the ALT at this location. In the case of the other sites where vertical gradient can be observed, the observed downward vertical hydraulic gradient is likely due to recharge to the ALT aquifer focused along principal drainage ways or fracture zones. An upward vertical gradient is observed at HRES-3, where water levels in the deepest part of the ALT aquifer (HRES-03D) are nearly 5 feet higher than water levels in the shallow part of the saturated zone (HRES-3S). This is likely due to somewhat lower hydraulic conductivity of the upper part of the ALT aquifer, and higher hydraulic conductivity in the deep part of the ALT at this location.

  Response to Lost Circulation/Hydraulic Testing Activities: Aquifer response to pulses of water level rise due to lost circulation events at adjacent core holes, or drawdown resulting from long-term aquifer tests, can result in a shift of the hydrograph upwards or downwards by several feet in some locations within the southwest sector of the ALT aquifer (e.g. HRES-04, HRES-05, and HRES-09). This observation suggests that fracture connectivity within the ALT aquifer is limited in these areas.

6 DEEP GROUNDWATER SYSTEM EAST OF CONCENTRATOR FAULT

The deep groundwater system, as defined for the Resolution Project area, includes two groundwater domains east of the Concentrator Fault that encompass the Tw and lower geologic units. These groundwater domains are currently defined as follows: (1) deep groundwater within the Resolution graben, and (2) deep groundwater outside the Resolution graben and east of the Concentrator Fault. Hydraulic data has been collected in a set of eleven DHRES series wells. Hydraulic head is monitored in these wells both as water levels in open screened intervals and at individual points using grouted piezometers.

Deep groundwater levels and pore pressures are monitored in deep hydrogeologic characterization wells at eleven locations in the Resolution Project area (**Table 1; Figure 2**):

- DHRES-01: Completed within the Resolution graben in Kvs and pCy, with grouted VWPs in Tal and Tw
- DHRES-02: Completed within the Resolution graben in Kvs and pCy, with grouted VWPs in Tal and Tw
- DHRES-06: Completed in Pz carbonate rocks and pCy south of the Resolution graben with grouted VWPs in Tal and Tw rocks
- DHRES-07: Completed in pCy rocks south of the Resolution graben with grouted VWPs in Tal, Tw, and Pz rocks
- DHRES-08: Completed as grouted VWP array only; units include Tal, Tw, Kvs, and pCy rocks
- DHRES-09: Completed in the pCds and pCdiab to the west of the Resolution graben and between the Main and Concentrator Faults
- DHRES-10: Completed with a single screen interval in the pCy rocks to the west of the Resolution graben and between the Main and Concentrator Faults and adjacent to Shaft 8
- DHRES-11: Completed in Pz and pCy rocks northeast of the Resolution graben with grouted VWPs in Tal, Tev, Tw, and Pz

- DHRES-13: Completed in the pCy and pCpi to the southwest of the Resolution graben with grouted VWPs in pCy

- DHRES-14: Completed in Tw and pCpi northeast of the Resolution graben with grouted VWPs in Tal and Tw

- DHRES-15: Completed in Pz rocks south of the Resolution graben with grouted VWPs in Tw and Pz

Hydraulic heads are measured in the deep groundwater system at 41 grouted piezometers in numerous geologic units (**Table 1; Figure 2**). Well DHRES-10 was drilled and completed in old mine workings adjacent to Shaft 8 on the WPS. Well DHRES-12 was drilled and abandoned near the DHRES-13 well site. A summary of observed changes in water level elevations/hydraulic heads and causes of these changes is provided in **Table 4**.

6.1 Inside Resolution Graben

Three deep wells, DHRES-01, DHRES-02, and DHRES-08, monitor the groundwater inside the Resolution graben (**Figure 17**). Well schematics and hydrographs of DHRES-01, DHRES-02, and DHRES-08 are presented in **Appendix B (Figures B-1 through B-2d and B-8 through B-8d)**. All of these wells were completed with arrays of grouted piezometers that continuously monitor the pressure at multiple depths within the well column. DHRES-01 and DHRES-02 also have screened zones that monitor the water level in these locations.

Water level hydrographs for the DHRES series wells inside the graben all exhibit a similar inflection in hydrograph slope (**Figure 17**). The hydrograph slope prior to 2013 is declining at a rate of approximately 250 ft/yr, whereas the hydrograph slope during late 2013 and 2014 was approximately 300-400 ft/yr. This change is most pronounced in the groundwater level hydrograph from DHRES-02. The timing of these changes coincides approximately with the advancement of the Shaft 10 bench level beneath -2,250 feet amsl, and an increase in the combined dewatering rate of Shafts 9 and 10 from less than 500 gpm at the beginning of 2013 to 750 gpm by the end of the 2013. The timing of these changes suggests a strong hydraulic connection within the Kvs represented by the screened portions of DHRES-01 and DHRES-02, and piezometer DHRES-08-231, and strata penetrated by Shaft 10 during 2013.

6.1.1 DHRES-01

At well DHRES-01, groundwater is monitored in three screened intervals in the Kvs spanning the depths from 4,793-5,938 feet bls (**Appendix B; Figure B-1**). During the period from early 2009 to early 2016 water level dropped nearly 2,200 feet (**Appendix B; Figures B-1a and B-1b**) in response to dewatering operations in Shafts 9 and 10. Observations of head in the DHRES-01 piezometer stack show a progressive dampening of this response moving up the well column. Data from DHRES-01_66, in the Tw3 subunit, show a decline in hydraulic head of nearly 2,000 feet from 2008-2016, closely matching the declines in groundwater level observed in the screened interval of DHRES-01. Higher in the well column, data from DHRES-01_374 in the Tw2 subunit, exhibit a less-pronounced decline in hydraulic head of approximately 300 feet from 2008-2016. Hydraulic heads observed near the top of the Tw2 from DHRES-01_683 and in the ALT above from DHRES-01_772 and DHRES-01_973 have been stable over the period of record. The observed dampening of head declines moving from lower elevations to higher elevations in DHRES-01 indicates that the effects of dewatering of Shafts 9 and 10 have not impacted the ALT aquifer in this location. The dampening is likely to be the result of a combination of low hydraulic conductivities in the Tw2 subunit and the large vertical distance between observed declines in the Kvs and stable conditions in the Tal above. Vertical gradients at DHRES-01 are downward between all piezometer pairs in the well stack. The downward vertical gradient has increased through time between DHRES-01_683 and DHRES-01_374 and between DHRES-0_374 and DHRES-01_66 as the heads in the lower units have decreased in response to dewatering.

6.1.2 DHRES-02

A composite water level is monitored in three screened intervals in well DHRES-02 spanning the depths from 3,506-6,555 feet bls (**Appendix B; Figure B-2**). The upper two screened intervals are in the Kvs and the lower screened interval is in the pCy. Water level declines of nearly 2,500 feet during the period from late 2008 through early 2016 have resulted in desaturation of the uppermost screened interval in the well (**Appendix B; Figures B-2, B-2a and B-2b**). The declines in water level in the Kvs and Pcy indicate that these units have been impacted by dewatering of Shafts 9 and 10. Five grouted piezometers are installed in DHRES-02; two are installed in the Tw3 subunit (DHRES-02_319 and DHRES-02_458), two are installed in the Tw2 subunit (DHRES-02_608 and

DHRES-02_666), and one is installed in the ALT. Data from DHRES-02_319 indicate a decline in hydraulic head of nearly 200 feet from mid-2009 through mid-2013, followed by a brief rise and then approximately stable conditions to date. Hydraulic heads at DHRES-02_458 and DHRES-02_608 exhibit a gradual rise over the entire period of record, whereas hydraulic head at DHRES-02_666 is generally stable over the period of record. The observed rises in hydraulic head at DHRES-02_319, DHRES-02_458 and DHRES-02_608 are interpreted as resulting from a combination of poroelastic aquitard deformation and hydraulic diffusion within the aquitard.

6.1.3 DHRES-08

Eight grouted piezometers were installed in well DHRES-08. Water level is not monitored in DHRES-08. Two grouted piezometers – DHRES-08_-580 and DHRES-08_-657 – were installed in pCds and pCdiab strata of the pCy. These sensors became unresponsive during the second half of 2012 and are no longer transmitting data. However, prior to sensor failure, the trend in total hydraulic head recorded at both sensors was similar in slope to the trend from DHRES-08_ -231, installed in the Kvs (**Appendix B; Figures B-8a and B-8b**). In addition, the earliest head measurements at these two wells showed an upward gradient from the two probes in the pCy to the lowermost piezometer in the Kvs (DHRES-08_-231). These upward gradients are likely reflecting differences in horizontal hydraulic conductivity in the deep groundwater system where some elevation zones, in this case the lower Kvs, are more connected to the system that is experiencing active hydraulic stress from dewatering.

Grouted piezometers DHRES-08_-231, DHRES-08_196 and DHRES-08_406 are all installed in the Kvs. Head declines of nearly 1,600 feet were observed in DHRES-08_-231 during the period from 2011-2015. However, hydrographs DHRES-08_196 and DHRES-08_406, near the top of the Kvs, declined by only approximately 500 feet during the same period (**Appendix B; Figure B-8b**). The rate of decline observed in these hydrographs is similar to the rate of decline at DHRES-08_512, installed in the Tw3 unit indicating that the Tw3 subunit in this location is in good hydraulic communication with the Kvs below.

At well DHRES-08, two grouted piezometers are installed in the Tw (**Appendix B; Figure B-8**), with one installed in the Tw3 subunit (DHRES-08_512) and one installed in the Tw2 subunit (DHRES-08_792). Hydraulic head as measured at DHRES-08_512 declined by over 400 feet from 2010-2016, with a rate of decline similar to the rate observed at piezometers from DHRES-08 installed in the Kvs unit. On the other hand, hydraulic head as measured at DHRES-08_792 exhibits a gentle rise of approximately 50 feet from 2010-2016. This rise in hydraulic head is likely to be a response to poroelastic deformation.

6.2 Outside Resolution Graben

Wells in this domain include DHRES-06, DHRES-07, DHRES-09, DHRES-10, DHRES-11, DHRES-13, DHRES-14, and DHRES-15 (**Figures 18 and 19**). Trends in groundwater levels and hydraulic heads in this domain are of particular interest as they are broadly indicative of the extent to which depressurization and dewatering stresses associated with shaft sinking and dewatering activities at Shafts 9 and 10 may propagate outside the graben. Long-term trends in groundwater levels and hydraulic heads outside the Resolution graben vary both with distance from the graben and by geologic unit. In general, the deepest head measurements from wells outside the graben exhibit dampened responses to shaft dewatering compared to those inside the graben (**Figure 18**). Some hydraulic head declines outside the graben are evident in the wells closest to the graben in the Tw and Pz, including DHRES-07 and DHRES-15 (**Figures 18 and 19**). However, several monitoring locations distant from the graben also indicate long-term groundwater level declines such as DHRES-11, DHRES-9, and DHRES-13 (**Figure 19**). The most pronounced head decline is actually observed in DHRES-11 north of the graben, which has shown nearly 400 feet of decline since 2011. These observations suggest that there may be better connectivity between the graben and the area to the north than the area to the south.

6.2.1 DHRES-06

DHRES-06 is located just over a mile south of the Resolution graben. Water level at DHRES-06 is monitored in the Pz and the pCdiab in a screened interval spanning the distance from 1,636-2,649 feet bls (**Appendix B; Figure B-6**). The groundwater level in DHRES-06 is consequently judged to be representative broadly of groundwater conditions in the Pz Units, including the Escabrosa Limestone (Me), Devonian Martin Limestone (Dm), and Bolsa quartzite (Cb) and the underlying pCdiab. Water level declines of approximately 12 feet were observed during the period from early 2010 through early 2016 (**Appendix B; Figure B-6f**). The hydrograph at DHRES-06 shows a pronounced response to the long-term aquifer test at DHRES-15 beginning in late 2014. With the exception of this response, the slope of the hydrograph is relatively steady and nearly linear.

Three of the grouted piezometers, DHRES-06_1022, DHRES-06_994, and DHRES-06_928, at well DHRES-06 are installed in the Tw3 subunit. Observations of head in DHRES-06_928 indicate over 20 feet of head rise occurred during the period from 2010-2012 followed by relatively stable conditions since that period. The head rise observed during this period may also be indicative of geomechanical deformation. DHRES-06_994 and DHRES-06_1022 show approximately 10 feet decline in hydraulic head from 2010-2012, followed by stable conditions from 2013-2014, and then rising hydraulic head from 2015 to date (**Appendix B; Figure B-6d**). The first change in slope, during early 2013, coincides approximately with a reduction in the rate of advancement in the Shaft 10 bench level. The rise in hydraulic head during 2015-2016 runs contrary to the declining trends in groundwater level at the DHRES-06 screen. However, it should be noted that a reverse water level fluctuation (RWF) was observed at both DHRES-06_1022 and DHRES-06_994 during the long-term pumping test at DHRES-15 (M&A, 2016). This suggests that changing pore pressures as measured at these piezometers were effected by short-term geomechanical deformation known as the Noordbergum effect (M&A, 2016) resulting from groundwater pumping in the underlying limestone unit.

6.2.2 DHRES-07

DHRES-07 is located south of the Resolution graben **(Figure 18)**. The well screen at DHRES-07 is completed across a suite of pCy rocks, including pCmls and pCdiab (**Appendix B; Figure B-7**). The hydrograph at the DHRES-07 well screen indicates a water level rise of over 100 feet from 2011-2015. The long-term trend at the DHRES-07 screened interval contrasts with the long-term trends in hydraulic head observed at the DHRES-07 grouted piezometers and is opposite of the decreasing head trend that would be expected in response to shaft dewatering. The cause of this long term rising head trend is not known.

Two of the grouted piezometers at DHRES-07 are installed in the Pz Units. DHRES-07_-108 is installed in the Cb, and DHRES-07_95 is installed in the Me. Hydraulic head at both piezometers has decreased since 2010, and both piezometers exhibited a response to the long-term DHRES-15 aquifer test beginning in late 2014 (**Appendix B; Figure B-7b**). Hydraulic head at DHRES-07_-108 declined at a rate of approximately 25 to 50 ft/yr from 2011-2013, but has declined at a far more gradual rate from 2014-2016. It should be noted the advancement of Shaft 10 occurred most rapidly, and over the greatest depth (nearly 1,500 feet) from 2011-2012, then subsequently advanced at a slower rate. Furthermore, the bench level of Shaft 10 crossed the elevation of DHRES-07_-108 during mid-2011. Data currently available do not conclusively link the more significant (during 2011-2013) declines observed at DHRES-07_-108 to the rate of advancement in Shaft 10, although this is certainly one possible explanation. Finally, the hydrograph from DHRES-07_-108 exhibits irregular rapid spikes in hydraulic head followed by gradual recessions over the entire period of record. The specific causes of some of the individual responses are correlated with adjacent mineral exploration drilling activities within the graben. The general behavior suggests connection to a fracture system or systems within the graben. Since late 2014 the water level measured in DHRES-07 and the head in DHRES-07_95 have both been above the head measured in DHRES-07_-108 indicating that there is a gradient towards piezometer DHRES-07_-108 from both above and below. This and the presence of fault breccia in this location noted during drilling (**Appendix B; Figure B-7**) support the notion that a fracture may be a conduit for water in this area.

Three of the grouted piezometers, DHRES-07_800, DHRES-07_374, and DHRES-07_169, are installed in the Tw. The hydraulic head at DHRES-07_169 (Tw4 subunit) exhibited a nearly linear decline of approximately 10 feet/year from mid-2012 to present (**Appendix B; Figure B-7b**). In contrast, the hydraulic heads at DHRES-07_374 (Tw3 subunit) and DHRES-07_800 (Tw2 subunit) both show trends of increasing hydraulic head similarly to those observed in DHRES-02 inside the graben and are likely responses to geomechanical deformation.

Hydrographs of DHRES-07_374, DHRES-07_169, DHRES-07_95, and DHRES-07_-108 exhibit a response to the long-term pumping test at DHRES-15 during late 2014 through early 2015, whereas the hydrographs of DHRES-07_800 and DHRES-07_920 show no response to this event, indicating that connectivity between the Tw2 and the lower Tw units is minimal. The hydrograph of water level in DHRES-07 shows a small decline and subsequent recovery in response to the pumping test at DHRES-15.

The cause of the sudden head declines observed in DHRES-07_95 in 2011, and in DHRES-07_169 and DHRES-07_374 in 2012 is not well understood and probably is not aquifer conditions. It is possible that these responses are associated with delayed upward propagation of a disturbance through the grout column or in the rock units adjacent to the well.

6.2.3 DHRES-09

DHRES-09 is located northwest of the graben between the Main fault and the Concentrator Fault (**Figure 18**). DHRES-09 has three screened intervals in the pCy units spanning the depths 431-2071 feet bls (**Appendix B; Figure B-9**). Water levels in this well are judged to be broadly representative of groundwater conditions in the pCy. Between early 2011 and early 2016, water levels in DHRES-09 declined approximately 46 feet (**Appendix B; Figure B-9a)**. During the period from 2011 through mid-2013 head declined nearly linearly at a rate of approximately 11 ft/yr. From mid-2013 through early 2016, the rate of head decline slowed to approximately 7 ft/yr. The decline in head is likely a response to dewatering of Shafts 9 and 10. While DHRES-09 is about 2 miles from Shafts 9 and 10, it is only about 3000 feet from the East-West working divide. The slower rate of head decline that began in mid-2013 may be a lagged response to the reduced shaft dewatering rate that began in 2012. Another possible explanation for the decline in the drawdown rate in DHRES-09 is that it is a long-term equilibration as water moves between the screened zones in the well, which span nearly 1,600 feet of aquifer. No grouted piezometers were installed in DHRES-09.

6.2.4 DHRES-10

Well DHRES-10 was installed between the Main Fault and the Concentrator Fault in 2010 to characterize hydrogeologic conditions in the vicinity of Shaft 8. Later, in 2012, a production well (RESPW-01) also known as Shaft 8 was installed 58 feet from DHRES-10 in order to maintain the water level in the west sector mine workings below the 3600-foot mining level (i.e., approximately sea level). Pumping at Shaft 8 began in June, 2012 and continues to date at an approximate rate of 330 gpm. Well DHRES-10 has a single screened interval that spans 1,033feet of pCy units from 3,147 feet bls to 4,180 feet bls. In May, 2011, water levels at DHRES-10 were approximately 140 feet amsl (**Appendix B; Figure B-10**). Currently, water levels at DHRES-10 fluctuate between -230 feet and -360 feet amsl in response to the pumping at Shaft 8. Water level in DHRES-10 is reflective of managed Shaft 8 water levels, not regional trends.

6.2.5 DHRES-11

Well DHRES-11 was installed northeast of Shafts 9 and 10 and due north of the graben (**Figure 18**). It has a single screened interval that spans the depth from

4,910 feet bls to 6,679 feet bls (**Appendix B; Figure B-11**). The upper 210 feet of the well screen at DHRES-11 is installed in the Dm and Cb. The remaining 1,660 feet of screen penetrates pCy units. However, the annulus adjacent to and above the perforations is open up to 3,703 feet bls across a thick sequence of Pz rocks including the Dm, Me, and Paleozoic Naco Formation (Pnaco). For the purposes of hydrograph analysis in this report, the groundwater level hydrograph from DHRES-11 is considered to be representative of composite Pz and pCy hydrologic conditions.

Manual measurements show that water levels rose over 150 feet in early 2011. The cause of this rise is not known, but may be attributable to water level recovery from well drilling. The groundwater level at well DHRES-11 has declined almost linearly by approximately 370 feet from 2011-2016 (**Appendix B; Figure B-11b**). However, the onset of water level decline coincides very closely with the sinking of Shaft 10 below the bottom of Shaft 9 beginning in late 2011. Furthermore, the screened interval at DHRES-11 extends downward to nearly the same elevation as the bottom of Shaft 10. A likely explanation for the pronounced water level declines at DHRES-11 is dewatering at Shafts 9 and 10. Significant variability in the measured head is apparent in the hydrograph during the last half of 2016. This signal is likely an indication that the water level has dropped beneath the transducer depth.

Grouted piezometer DHRES-11_214 is installed in the upper portion of the Pnaco. Hydraulic head has declined by approximately 80 feet from 2011-2016; however, the hydrograph is characterized by two distinct phases (**Appendix B; Figure B-11b**). The initial, rapid decline in hydraulic head as recorded at DHRES-11_214 may be associated with grout setting and equilibration with the surrounding rock mass. The second phase of the hydrograph, from 2012 to 2014, is judged to be more representative of longer-term Pnaco conditions. Data collected during mid 2015 exhibit significant scatter which is interpreted as electrical noise from malfunction and eventual failure of the sensor.

Two of the grouted piezometers, DHRES-11_320 and DHRES-11_457, are installed in the Tw. Water levels recorded at both piezometers are somewhat erratic, but do show general downward trends. (**Appendix B; Figure B-11d**). Hydraulic head monitored in piezometer DHRES-11_565 in the Tev has been stable throughout the period from 2011-2016 (**Appendix B; Figure B-11d**).

6.2.6 DHRES-13

Well DHRES-13 is located between the West Boundary Fault and the Concentrator Fault (**Figure 18**). The screen at well DHRES-13 extends across a sequence of pCy rocks, including pCds and the Pioneer shale (pCp) which overlie a 300-foot thick interval of older pCpi . Both the pCy rocks and the pCpi rocks have been intruded by the pCdiab (**Appendix B; Figure B-12**). Because there are no annular materials outside the casing and screened interval, the water level response at the DHRES-13 screen is judged to represent composite head conditions in pCy and pCpi rock units. **Figure B-12b (Appendix B)** shows that the groundwater level in the DHRES-13 screen declined by nearly 65 feet from 2012 to 2015. The slope of the hydrograph is slightly steeper than the slopes of the hydrographs in the DHRES-13 grouted piezometers. It should be noted that the elevation of the screened interval of DHRES-13 is approximately coincident with the elevation of the vertical center of the Kvs due to the considerable vertical displacement of the pCy rocks across the West Boundary Fault.

Four of the grouted piezometers, DHRES-13_649, DHRES-13_730, DHRES-13_788, and DHRES-13_846, are completed in different strata (pCmls, pCt, and pCdiab) of the pCy rocks (**Appendix B; Figure B-12**). The long-term trend in hydraulic head at all four piezometers is similar (**Appendix B; Figure B-12b**), with each exhibiting a decline of approximately 25 feet from the beginning of 2012 through the end of 2015. The vertical gradient is consistently downward between all of the DHRES- 13 piezometers. The uppermost piezometer, DHRES-13_846, is installed in pCdiab, and coincides laterally with the uppermost portion of the Kvs. Differences in slope between the hydrograph trends at the DHRES-13 grouted piezometers and the DHRES-13 screen may be attributed to differences in elevation, hydraulic properties of pCy subunits, or some combination of the two. In general, however, the declining trends in both pore pressures at the grouted piezometers and groundwater level at the DHRES-13 screen likely indicate a response to depressurization and dewatering of the Kvs, and therefore, the existence of groundwater flow across the West Boundary Fault.

6.2.7 DHRES-14

Well DHRES-14 is located about 3 miles east of Shafts 9 and 10 (**Figure 18**). The Pz and pCy rocks were not encountered during drilling of DHRES-14, indicating that the Tw rocks lie directly over the pCpi. The well screen at

DHRES-14 extends from 3,117 to 3,249 feet bmsl and intersects the lower 26 feet of the Tw, and the upper 106 feet of the pCpi (**Appendix B; Figure B-13**). However, the annular space is open up to 2,141 feet bmsl, intersecting an even larger section of the Tw. The hole at DHRES-14 was deepened approximately 2,500 feet (total depth of ~5,789 feet bmsl) into the pCpi following well construction for mineral exploration purposes. During exploration drilling, rods became stuck and left in the hole, thereby leaving drilling mud in the lower portion of the hole. Consequently, the water level at DHRES-14 is judged in a general sense to represent a composite water level of Tw and pCpi. After declining approximately 25 feet through 2012 and early 2013 the water level in DHRES-14 has shown small fluctuations of less than 4 feet from late 2013 to 2016 (**Appendix B; Figure B-13b**).

Two of the grouted piezometers, DHRES-14_822 and DHRES-14_888, at well DHRES-14 are installed in the Tw. Both hydrographs exhibit a period of oscillation from March through June 2012 associated with coring activities at DHRES-14. The hydrograph from DHRES-14_888 exhibits about 20 feet of decline from 2012 through 2015 (**Appendix B; Figure B-13b**). Hydrographs of DHRES-14_888 and DHRES-14_1071 both show a step change in hydraulic head on July 15, 2014. This step change is attributed as a sensor error. Due to the presence of this feature in the DHRES-14_888 hydrograph, the general trend can be interpreted qualitatively, but the calculated hydraulic head may be inaccurate. DHRES-14_822 shows a gentle rise from 2014 through 2016. The cause of this rise is not known.

6.2.8 DHRES-15

Well DHRES-15 is located south of the Resolution graben and was installed in July, 2014 **(Figure 18)**. The screen at well DHRES-15 is completed primarily across Pz formations, including Pnaco, Me, and Dm, and also is screened through 30 feet of Cb. Open borehole extends through 287 feet of pCdiab below the well screen. (**Appendix B; Figure B-14**). The groundwater level hydrograph at well DHRES-15 shows a period of recovery from the DHRES-15 long-term pumping test that occurred from December 10, 2014 to February 18, 2015 (M&A, 2016). Following the recovery period, the groundwater level appears to have stabilized.

Piezometers DHRES-15_355 and DHRES-15 398 are installed at different elevations in the Pnaco. Hydraulic heads at DHRES-15_355 and DHRES-15_398 have declined by over 60 feet from 2014 to 2016, with most of the decline beginning in 2015. The cause of these declines is unknown, but may indicate a connection between the Pnaco south of the graben and hydrogeologic units within the graben. Both sensors show several high magnitude spikes in hydraulic head associated with the DHRES-15 long-term pumping test that occurred in late 2014 and early 2015.

One of the grouted piezometers, DHRES-15_710, is installed in the Tw. The DHRES-15 monitoring suite was installed in mid-2014, and consequently the period of record is shorter at this well than at other DHRES-series wells and indicates a slight rising trend in hydraulic head.

6.3 Discussion

Results of long-term water level monitoring for wells and grouted piezometers completed in the deep groundwater system east of the Concentrator Fault support the following observations:

Deep water levels within the graben have been impacted by Shafts 9 and 10 dewatering: The DHRES wells inside of the graben have shown significant declines in head.

The Whitetail Conglomerate acts as a barrier to upward propagation of dewatering impacts: Whereas water levels in the Deep Groundwater System inside the graben have declined over 1,000 feet, water levels within the overlying Tal have not shown a discernable impact from dewatering with the exception of HRES-01which is within 300 feet of Shaft 10. The Tw2 lakebeds subunit of the Tw appears to be particularly effective at reducing impacts from shaft dewatering. The apparent dewatering of the Tw3 at DHRES-01 may not be real and may be due to well construction characteristics.

Hydraulic impacts in the deep groundwater system east of the ConcentratorFault and outside of the graben are much less than inside of the graben: Boundaries of the graben act as an impediment to groundwater flow in the deep system. The largest head decline outside of the graben was observed at DHRES-11 suggesting that there may be better connectivity between the graben and the area to the north than the area to the south. Lesser drawdown is observed in the Pnaco south of the graben at DHRES-15.

Poroelastic deformation may be occurring: Rising heads observed in some piezometers and open standpipes may suggest poroelastic deformation of some geologic units.

7 GROUNDWATER SYSTEM WEST OF CONCENTRATOR FAULT

Several thousand feet of vertical displacement of geologic units and hydraulic head is evident across the Concentrator Fault. The down-dropped geologic units to the west of the fault, the pCy, Pz, and Tal, are overlain by a thick wedge of Quaternary-Tertiary basin fill (QTg) and Tertiary volcanic (Tvs) rocks that are up to 3,150 feet thick, as encountered at DHRES-16. DHRES-series monitor wells constructed from 2009 to 2014 west of the Concentrator Fault include DHRES-03, DHRES-04, DHRES-05, and DHRES-16 (**Figures 20 and 21**). These DHRES wells monitor water level at depths from 198 to 4002 feet below land surface. Hydrographs of the strata below the QTg encountered at the DHRES wells indicate stable to declining groundwater levels and pore pressures, whereas hydrographs of the more shallow strata encountered at the MCC wells generally indicate stable water levels (**Figures 20 and 21).**

7.1.1 DHRES-03

Well DHRES-03 is 1,962 feet deep and does not have a well screen. It was installed with four grouted piezometers. Grouted piezometer DHRES-03_335 is installed in the Tvs. Three of the grouted piezometers, DHRES-03_539, DHRES-03_729, and DHRES-03_782, are installed in the QTg. Hydrographs from all four piezometers (**Appendix B; Figure B-3a**) exhibit a rise in hydraulic head of approximately 10 feet during 2010, followed by a gradual decline that falls below the initial (2009) hydraulic head. Declines since 2011 range from approximately 10 to 30 feet and are greatest in the deeper piezometers. The similarity of the trends suggests that all four hydrographs are likely in response to similar hydraulic stresses.

7.1.2 DHRES-04

The screen at DHRES-04 extends from 1,770 feet bls to 2,318 feet bls and is constructed across a sequence of volcanic rocks (Tvs) including tuff, scoria, and basalt (**Appendix B; Figure B-4**). An open annulus extends 252 feet above the screen to 1,518 feet bls, into the QTg. Both the elevation of the water level and the long-term trend in water level at DHRES-04 is very similar to those observed at DHRES-03 (**Figure 19**). The decline in water level at DHRES-04 since 2011 is approximately 30 feet. The trends observed in DHRES-04 are likely a result of the same hydraulic stresses observed in DHRES-3.

7.1.3 DHRES-05B

Well DHRES-05B was constructed with a single screened interval in the Tal ranging from 3,135 to 4,002 feet bls (**Appendix B; Figure B-5**). An open annulus extends from 1,142 to 3,021 feet bls. Annulus packers and cement baskets were installed above the perforated zone to isolate the Tal from the overlying annulus that is open to the QTg and Tvs. Since initial recovery from drilling near the start of 2011, the water level in DHRES-05B has declined 50 feet (approximately 9 ft/yr; **Figure 21**).

7.1.4 DHRES-16

Well DHRES-16 extends to 4,085 feet bls and was constructed as a fully grouted VWP array with six grouted piezometers: one installed in the Dm, one in the upper Tal, two in the Tvs, and two in the overlying QTg (**Appendix B; Figure B-15**). The lowest piezometer, DHRES-16_-387, is installed in the Dm. The hydrograph from this piezometer shows a rapid increase in hydraulic head during late 2014 and early 2015 and is likely associated with recovery of hydraulic head from drilling activities, and equilibration of the formation with the grouted borehole (**Figure 22**; **Appendix B; Figure B-15d**). The later portion of the hydrograph beginning in mid-2015 exhibits a steep decline in hydraulic head of approximately 70 feet in one year. The hydrograph from DHRES-16_-157, installed in the Tal, shows a rapid increase in hydraulic head during late 2014 through early 2015, followed by a step-like decline and subsequent gentle rise followed by a decline of about 5 feet in late 2016 (**Appendix B; Figure B-15c**). The initial rise may be associated with setting of the pressure grout and equilibration of the grout with the adjacent rock mass.

DHRES-16_287 and DHRES-16_535 are completed in the Tvs. Data from these piezometers indicate declines in hydraulic head of approximately 20 feet and 10 feet, respectively (**Appendix B; Figure B-15b**). DHRES-16_577 and DHRES-16_743 are installed in the QTg at shallower depths. The shallower of the two, DHRES-16_743, is installed approximately 200 feet bls and may be influenced by surficial recharge based on relatively frequent rises and falls of water levels. The hydrograph at DHRES-16_577 is flat indicating stable conditions to date in this area of the QTg.

In general, there is a significant downward gradient from the shallower QTg and Tvs to the deeper Dm. However, there is an upward vertical gradient extending from the top of the Tvs upward through the QTg.

7.2 Discussion

Results of long-term water level monitoring for wells and grouted piezometers completed in the groundwater system west of the Concentrator Fault support the following observations:

Water level declines have been occurring in some areas of the deep system west of the Concentrator Fault. Water level declines of as much as 70 feet (DHRES-16_ -387) have been observed in the deep system in 2016. Long term declines of approximately 60 feet have been observed in DHRES-05B during the period 2011-2016.

Water level trends have varied near the West Plant Site. Hydraulic heads in wells DHRES-03 and DHRES-04 rose and subsequently fell during the period 2011-2016. Further monitoring is needed to better understand the meaning of these trends.

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9 ACRONYMS & ABBREVIATIONS

ADEQ ....Arizona Department of Environmental Quality
ADWR ....Arizona Department of Water Resource
ALT ....Apache Leap Tuff
APP ....Aquifer Protection Permit
AWC ....Arizona Water Company
amsl ....above mean sea level
BTSWA ....Boyce-Thompson Southwestern Arboretum
bls ....below land surface
bmsl ....below mean sea level
EPS................East Plant Site
ft/yr ....feet per year
gpm................gallons per minute
HGUs.............hydrogeologic units
in ....inches
LS&A ....Lake Superior and Arizona
M&A ....Montgomery & Associates
NEPA ....National Environmental Policy Act
PRISM...........Parameter-elevation Regressions on Independent Slopes Model
QCDC............Upper Queen Creek/Devils Canyon
RC ....Resolution Copper
RWF ....reverse water level fluctuation
VWPs ....vibrating-wire piezometers
WPS...............West Plant Site

TABLE 1. SUMMARY OF CONSTRUCTION DETAILS FOR SELECTED WELLS AND BOREHOLES
GROUNDWATER LEVEL MONITORING PROGRAM, RESOLUTION COPPER, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	……CASING…… DIAMETER (inches)	……CASING…… DEPTH (feet, bls)[a]	PERFORATED INTERVAL (feet, bls)	……SURVEY COORDINATES[b]…… (AZSPC, feet) NORTHING (feet)	……SURVEY COORDINATES[b]…… (AZSPC, feet) EASTING (feet)	SURVEYED ELEVATION (feet, amsl)[c]	LAND SURFACE ELEVATION (feet, amsl)[c]	MEASURE POINT ELEVATION (feet, amsl)[c]	GROUTED VIBRATING-WIRE PIEZOMETER IDENTIFIER	OPEN INTERVAL OF WELL or DEPTH OF GROUTED PIEZOMETER[f] (feet, bls)	OPEN INTERVAL OF WELL or ELEVATION OF GROUTED PIEZOMETER[f] (feet, amsl)	HYDROGEOLOGIC UNIT(S) ADJACENT TO OPEN INTERVAL OF WELL or GROUTED PIEZOMETER LOCATION	PERIOD OF RECORD
SHALLOW GROUNDWATER SYSTEM													
Corral Well	8 open	0 - 10 10 - 83	--- 10 - 83[d]	852639.9	977697.2	4438.99	4435.4	4436.89	NA	--- 10 - 83[d]	--- 4425 - 4352[d]	Qal - Shallow Alluvium Tal - Upper Apache Leap Tuff	Jun 2004 - present
Middle Well	8 4	NA 0 - 53	--- 1 - 53	852431.0	977608.9	4444.97	4441.7	4442.39	NA	--- 1 - 53	--- 4441 - 4389	Qal - Shallow Alluvium Tal - Upper Apache Leap Tuff	Jun 2004 - present
Hackberry Windmill	5-1/2	NA	NA	828601.6	967894.1	3899.76	3898.6	3899.98	NA	NA	NA	Qal - Shallow Alluvium Tal - Upper Apache Leap Tuff	Jan 2003 - present
APACHE LEAP TUFF AQUIFER													
HRES-01	12 4	0 - 19 0 - 1597.5	--- 1055 - 1077 1360 - 1403 1577.5 - 1597.5	839000.3	959223.4	4172.38	4168.9	4172.03	NA	--- 1055 - 1077 1360 - 1403 1577.5 - 1597.5	--- 3114 - 3092 2809 - 2760 2591 - 2571	--- Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Lithic) Tal - Apache Leap Tuff (Lithic)	Feb 2004 - Mar 2010
HRES-02	12 4	0 - 19 0 - 1310	--- 655.9 - 677.7 1026.1 - 1047.9 1265.7 - 1310	836245.4	961757.2	3981.72	3979.1	3980.71	NA	--- 655.9 - 677.7 1026.1 - 1047.9 1265.7 - 1310	--- 3323 - 3301 2953 - 2931 2713 - 2669	--- Tal - Apache Leap Tuff (Gray) Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Lithic)	Feb 2004 - present
HRES-03	12 4	0 - 19 0 - 1500	--- 338.5 - 398[e] 1456.5 - 1500	841033.2	967959.7	4078.16	4075.6	4078.16	NA	--- 338.5 - 398[e] 1456.5 - 1500	--- 3737 - 3678 2619 - 2576	--- Tal - Apache Leap Tuff (Lower White) Tal - Apache Leap Tuff (Brown)	Feb 2004 - present
HRES-04	12 4	0 - 19 0 - 1440	--- 584.4 - 624.4 724.4 - 764.4 1284.3 - 1304.3 1419.3 - 1440	835383.3	964531.6	4076.80	4074.7	4075.80	NA	--- 584.4 - 624.4 724.4 - 764.4 1284.3 - 1304.3 1419.3 - 1440	--- 3490 - 3450 3350 - 3310 2790 - 2770 2655 - 2635	--- Tal - Apache Leap Tuff (Gray) Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Brown)	Mar 2004 - present
HRES-05	12 4	0 - 19 0 - 1055	--- 385 - 425 585 - 605[g] 1015 - 1035	830986.2	965229.7	3995.08	3992.1	3994.27	NA	--- 385 - 425 585 - 605[g] 1015 - 1035	--- 3607 - 3567 3407 - 3387[g] 2977 - 2957	--- Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Lithic)	Mar 2004 - present
HRES-06	12 4	0 - 18 0 - 800	--- 340 - 800	852681.7	977111.8	4434.85	4431.9	4434.16	NA	--- 340 - 800	--- 4092 - 3632	--- Tal - Apache Leap Tuff (Gray - Brown)	Apr 2007 - present
HRES-07	10 4	0 - 19 0 - 1041	--- 335 - 749 812 - 1019	829960.1	969606.5	4018.97	4016.5	4018.53	NA	--- 335 - 749 812 - 1019	--- 3681 - 3267 3204 - 2997	--- Tal - Apache Leap Tuff (Brown) Tal - Apache Leap Tuff (Brown - Vitro.)	Nov 2007 - present
HRES-08	10 4	0 - 20 0 - 1022	--- 194 - 297 793 - 1000[h]	825985.6	965599.8	4049.59	4046.8	4048.78	NA	--- 194 - 297 793 - 1000[h]	--- 3853 - 3750 3254 - 3047[h]	--- Tal - Apache Leap Tuff (Brown- Basal) Tw3 - WhiteTail Conglomerate	Nov 2007 - present
HRES-09	16 8-5/8	0 - 23 0 - 1122	--- 271 - 1078	831903.0	965770.2	3925.58	3923.3	3925.23	NA	--- 271 - 1078	--- 3652 - 2845	--- Tal - Apache Leap Tuff (Gray - Brown)	Apr 2010 - present
HRES-10	12 4-1/2	0 - 94 0 - 1119	--- 158 - 398 698 - 1099[i]	829224.9	990434.2	2938.04	2935.1	2937.32	NA	--- 158 - 398 698 - 1099[i]	--- 2777 - 2537 2237 - 1836[i]	--- Tal - Apache Leap Tuff (White - Gray) Tal - Apache Leap Tuff (Brown)	May 2010 - present
HRES-11	12 4-1/2	0 - 20 0 - 1078	--- 598 - 1078	821967.1	980584.3	3468.69	3466.1	3468.50	NA	--- 598 - 1078	--- 2868 - 2388	--- Tal - Apache Leap Tuff (Brown - Basal)	May 2010 - present
HRES-12	12-1/4 4-1/2	0 - 80 0 - 1988	--- 1767 - 1967	847210.3	963794.1	4172.05	4168.6	4170.95	NA	--- 1767 - 1967	--- 2402 - 2202	--- Tal - Apache Leap Tuff (Brown)	Feb 2011 - present
HRES-13	12 4-1/2	0 - 30 0 - 900	--- 423 - 860	829165.0	962267.7	4201.81	4199.1	4201.10	NA	--- 423 - 860	--- 3737 - 3339	--- Tal - Apache Leap Tuff (Brown - Basal)	Mar 2011 - present
HRES-14	12-1/4 4-1/2	0 - 40 0 - 1460	--- 962 - 1440	848272.5	972011.0	4218.38	4214.7	4217.28	NA	--- 962 - 1440	--- 3253 - 2775	--- Tal - Apache Leap Tuff (Brown - Basal)	Apr 2011 - present
HRES-15	12-1/4 4-1/2	0 - 60 0 - 1977	--- 679 - 1530 1750 - 1958	842357.3	971983.4	4318.29	4315.4	4317.15	NA	--- 679 - 1530 1750 - 1958	--- 3636 - 2785 2565 - 2357	--- Tal - Apache Leap Tuff (Gray - Brown) Tev - Tertiary Basalt	Jun 2011 - present
HRES-16	16 8-5/8	0 - 64 0 - 1160	--- 361 - 886 949 - 1139	832538.4	973982.8	3992.65	3989.6	3992.27	NA	--- 361 - 886 949 - 1139	--- 2629 - 3104 3041 - 2851	--- Tal - Apache Leap Tuff (Gray - Brown) Tal - Apache Leap Tuff (Brown - Basal)	Jul 2011 - present
HRES-17	12-1/4 4-1/2	0 - 40 0 - 1345	--- 726 - 1330	840709.6	976950.8	4395.32	4392.3	4394.68	NA	--- 726 - 1330	--- 3666 - 3062	--- Tal - Apache Leap Tuff (Gray - Brown)	Jul 2011 - present
HRES-18	12-1/4 4-1/2	0 - 40 0 - 960	--- 462 - 940	834909.7	976321.5	4093.18	4090.4	4093.18	NA	--- 462 - 940	--- 3628 - 3150	--- Tal - Apache Leap Tuff (Gray - Brown)	Jul 2011 - present
HRES-19	16 8-5/8	0 - 39 0 - 908	--- 340 - 718 760 - 880	829579.8	969195.7	4027.15	4024.3	4027.12	NA	--- 340 - 718 760 - 880	--- 3684 - 3306 3264 - 3144	--- Tal - Apache Leap Tuff Tal - Apache Leap Tuff	Nov 2012 - present

TABLE 1. SUMMARY OF CONSTRUCTION DETAILS FOR SELECTED WELLS AND BOREHOLES
GROUNDWATER LEVEL MONITORING PROGRAM, RESOLUTION COPPER, PINAL COUNTY, ARIZONA

	……………………CASING…………………			…………SURVEY COORDINATES[b]……….. (AZSPC, feet)									
WELL IDENTIFIER	DIAMETER (inches)	DEPTH (feet, bls)[a]	PERFORATED INTERVAL (feet, bls)	NORTHING (feet)	EASTING (feet)	SURVEYED ELEVATION (feet, amsl)[c]	LAND SURFACE ELEVATION (feet, amsl)[c]	MEASURE POINT ELEVATION (feet, amsl)[c]	GROUTED VIBRATING-WIRE PIEZOMETER IDENTIFIER	OPEN INTERVAL OF WELL or DEPTH OF GROUTED PIEZOMETER[f] (feet, bls)	OPEN INTERVAL OF WELL or ELEVATION OF GROUTED PIEZOMETER[f] (feet, amsl)	HYDROGEOLOGIC UNIT(S) ADJACENT TO OPEN INTERVAL OF WELL or GROUTED PIEZOMETER LOCATION	PERIOD OF RECORD
APACHE LEAP TUFF AQUIFER (continued)													
HRES-20	16 8-5/8	0 - 39 0 - 1057	--- 597 - 1035	842286.0	971988.0	4318.14	4314.8	4318.06	NA	--- 597 - 1035	--- 3718 - 3280	--- Tal - Apache Leap Tuff (Gray - Brown)	Dec 2012 - present
HRES-21	16 4	0 - 41 0 - 1360	--- 709 - 1360	832967.8	967381.4	4109.68	4107.4	4109.68	NA	--- 709 - 1360	--- 3398 - 2747	--- Tal - Apache Leap Tuff (Brown) Tw - WhiteTail Conglomerate	May 2014 - present
Oak Flat Well	14 10-3/4 9-1/2	0 - 20 0 - 450 450 - 1108	--- 401 - 432 ---	841129.2	967933.9	4079.28	4076.9	4079.28	NA	--- 401 - 432 ---	--- 3676 - 3645 ---	--- Tal - Apache Leap Tuff ---	Jan 2003 - present
A-06	8 open	0 - 10.2 10.2 - 1665	--- 10.2 - 1665[d]	834171.5	971258.0	4170.23	4167.8	4169.39	NA	--- 10.2 - 1665[d]	--- 4158 - 2503[d]	Tal - Apache Leap Tuff Tw - Whitetail Conglomerate	Jun 2004 - present
MJ-11	6 open	0 - 10.2 10.2 - 786	--- 10.2 - 786[d]	829455.9	973629.3	3920.45	3918.3	3920.13	NA	--- 10.2 - 786[d]	--- 3908 - 3132[d]	--- Tal - Apache Leap Tuff	Jun 2004 - present
DEEP GROUNDWATER SYSTEM - EAST OF CONCENTRATOR FAULT													
RES-03	NA	NA	3635 - 3704[d]	835647.3	961818.7	3989.47	3987.7	3989.15	NA	3635 - 3704	352.7 - 283.7	QEP - Quartz Eye Prophyry	Dec 2007 - Apr 2012
DHRES-01	14 7-5/8 4-1/2	0 - 25 0 - 4538 4423 - 6002	--- ---[f] 4793 - 4978 5304 - 5489 5594 - 5618 5814 - 5938	835362.8	964528.3	4076.66	4076.3	4077.16		4791 to 5936	-715 to -1860	Kvs - Volcaniclastics - Leached Cap Kvs - Volcaniclastics	Jun 2008 - present
									DHRES-01_973	883	3193	Talb - Apache Leap Tuff - Brown Unit	Jun 2008 - present
									DHRES-01_772	1543	2533	Talb - Apache Leap Tuff - Brown Unit	Jun 2008 - present
									DHRES-01_683	1833	2243	Tw2 - Whitetail Conglomerate - Lacustrine Unit	Jun 2008 - present
									DHRES-01_375	2846	1230	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jun 2008 - present
									DHRES-01_66	3858	218	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jun 2008 - present
DHRES-02	14 7-5/8 4-1/2	0 - 40 0 - 3325 3117 - 6555	--- ---[f] 3506 - 3732 5904 - 6007 6430 - 6533	836733.3	961873.6	3977.13	3976.7	3978.80		3506 to 6533	471 to -2556	Kvs - Volcaniclastics - Leached Cap Kvs - Volcaniclastics p€bdiab - Younger Precambrian - Diabase	Sep 2008 - present
									DHRES-02_915	973	3004	Talb - Apache Leap Tuff - Brown Unit	Jul 2008 - present
									DHRES-02_666	1790	2187	Tw2 - Whitetail Conglomerate - Lacustrine Unit	Jul 2008 - present
									DHRES-02_608	1979	1998	Tw2 - Whitetail Conglomerate - Lacustrine Unit	Jul 2008 - present
									DHRES-02_458	2470	1507	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jul 2008 - present
									DHRES-02_319	2927	1050	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jul 2008 - present
DHRES-06	14 7-5/8 4-1/2	0 - 40 0 - 1254 1225 - 2690	--- ---[f] 1636 - 2649	826028.6	965587.8	4047.95	4045.6	4047.44		1636 to 2649	2410 to 1397	Paleozic Sedimentary - Bolsa, Martin, Escabrosa, Naco p€bdiab - Younger Precambrian - Diabase	Mar 2010 - present
									DHRES-06_1152	262	3783	Talv - Apache Leap Tuff - Vitrophyre	Mar 2010 - present
									DHRES-06_1022	689	3357	Tw 3 - Conglomerate Unit	Mar 2010 - present
									DHRES-06_994	781	3265	Tw 3 - Conglomerate Unit	Mar 2010 - present
									DHRES-06_928	1000	3045	Tw 3 - Conglomerate Unit	Mar 2010 - present
DHRES-07	14 7-5/8 4-1/2	0 - 38 0 - 4396 4252 - 5207	--- ---[f] 4363 - 5165	831891.0	965873.4	3924.69	3922.8	3924.69		4363 to 5165	-440 to -1242	p€bdiab - Younger Precambrian - Diabase	Oct 2010 - present
									DHRES-07_920	902	3021	Talb - Apache Leap Tuff - Brown Unit	Jun 2010 - present
									DHRES-07_800	1296	2627	Tw 2 - Whitetail Conglomerate - Lacustrine Unit	Jun 2010 - present
									DHRES-07_374	2694	1229	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jun 2010 - present
									DHRES-07_169	3366	557	Tw 4 - Whitetail Conglomerate - Ferricrete Unit	Jun 2010 - present
									DHRES-07_95	3609	314	Me - Escabrosa Limestone	Jun 2010 - present
									DHRES-07_-108	4275	-352	Cb - Bolsa Quartzite	Jun 2010 - present
DHRES-08	14 7-5/8 2-3/8	0 - 30 0 - 3040 0 - 6308	--- --- ---[f]	833211.5	962041.4	4122.39	4120.6	NA		NA	NA	NA	NA
									DHRES-08_980	902	3219	Talb - Apache Leap Tuff - Brown Unit	Jul 2010 - present
									DHRES-08_792	1519	2602	Tw 2 - Whitetail Conglomerate - Lacustrine Unit	Jul 2010 - present
									DHRES-08_512	2438	1683	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jul 2010 - present
									DHRES-08_406	2788	1333	Kvs1 - Cretaceous Volcaniclastics	Jul 2010 - present
									DHRES-08_196	3475	646	Kvs1 - Cretaceous Volcaniclastics	Sep 2010 - present
									DHRES-08_-231	4876	-755	Kvs1 - Cretaceous Volcaniclastics	Sep 2010 - present
									DHRES-08_-581	6023	-1902	pCdsql - Lower Dripping Spring Quartzite	Sep 2010 - Sep 2012
									DHRES-08_-657	6273	-2152	pCd - Precambrian Diabase	Sep 2010 - Sep 2012

TABLE 1. SUMMARY OF CONSTRUCTION DETAILS FOR SELECTED WELLS AND BOREHOLES
GROUNDWATER LEVEL MONITORING PROGRAM, RESOLUTION COPPER, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	……………….CASING………………. DIAMETER (inches)	DEPTH (feet, bls)[a]	PERFORATED INTERVAL (feet, bls)	………..SURVEY COORDINATES[b]………. (AZSPC, feet) NORTHING (feet)	EASTING (feet)	SURVEYED ELEVATION (feet, amsl)[c]	LAND SURFACE ELEVATION (feet, amsl)[c]	MEASURE POINT ELEVATION (feet, amsl)[c]	GROUTED VIBRATING-WIRE PIEZOMETER IDENTIFIER	OPEN INTERVAL OF WELL or DEPTH OF GROUTED PIEZOMETER[f] (feet, bls)	OPEN INTERVAL OF WELL or ELEVATION OF GROUTED PIEZOMETER[f] (feet, amsl)	HYDROGEOLOGIC UNIT(S) ADJACENT TO OPEN INTERVAL OF WELL or GROUTED PIEZOMETER LOCATION	PERIOD OF RECORD
DEEP GROUNDWATER SYSTEM - EAST OF CONCENTRATOR FAULT (continued)													
DHRES-10	20 7-5/8 4-1/2	0 - 84 0 - 2500 2377 - 4233	--- --- 3147 - 4202	839250.4	950598.9	3161.95	3159.3		NA	3147 to 4201	12 to -1042	p€bdiab - Younger Precambrian - Diabase p€mls - Younger Precambrian - Mescal Limestone p€bdsq Younder Precambrian Dripping Spring Quartzite	Nov 2010 - present
DHRES-11	14 7-5/8 4-1/2	0 - 38 0 - 3691 3631 - 6700	--- ---[f] 4910 - 6679	847171.3	963819.9	4168.98	4168.3	4169.31		4910 to 6679	-742 to -2511	p€bdiab - Younger Precambrian - Diabase	Jan 2011 - present
									DHRES-11_967	993	3175	Talb - Apache Leap Tuff - Brown Unit	Feb 2011 - present
									DHRES-11_705	1854	2314	Talb - Apache Leap Tuff - Brown Unit	Feb 2011 - Sep 2014
									DHRES-11_565	2312	1857	Tvo - Andesitic Basalt	Feb 2011 - present
									DHRES-11_457	2668	1501	Tw 2 - Whitetail Conglomerate - Lacustrine Unit	Feb 2011 - present
									DHRES-11_320	3117	1051	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Feb 2011 - present
									DHRES-11_213	3466	703	Pnaco - Pennsylvanian Naco Formation	Feb 2011 - Apr 2014
DHRES-13	14 7-5/8 4-1/2	0 - 40 0 - 1499 1385 - 3550	--- ---[f] 1768 - 2296 2457 - 3530	832219.3	954075.4	3444.78	3443.3	3444.96		1768 to 3530	1675 to -87	p€bdiab - Younger Precambrian Xpl - Older Precambrian - Pinal Schist	Feb 2011 - present
									DHRES-13_846	666	2778	pCd - Precambrian Diabase	Jan 2011 - present
									DHRES-13_788	886	2558	pCdsql - Lower Dripping Spring Quartzite	Jan 2011 - present
									DHRES-13_730	1048	2396	pCdsql - Barnes Conglomerate	Jan 2011 - present
									DHRES-13_648	1314	2130	pCm - Precambrian Mescal	Jan 2011 - present
DHRES-14	14 7-5/8 4-1/2	0 - 30 0 - 2136 2074 - 3270	--- ---[f] 2617 - 3249	840819.3	974467.0	4684.71	4683.0	4684.71		2618 to 3249	2065 to 1434	Tw3 - Whitetail Conglomerate - Conglomerate Unit Xpl - Older Precambrian - Pinal Schist	May 2011 - present
									DHRES-14_1214	699	3984	Talg - Apache Leap Tuff - Gray Unit	Apr 2011 - present
									DHRES-14_1071	1168	3515	Talb - Apache Leap Tuff - Brown Unit	Apr 2011 - present
									DHRES-14_888	1768	2915	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Apr 2011 - present
									DHRES-14_822	1985	2698	Tw 3 - Whitetail Conlomerate - Schist Conglomerate	Apr 2011 - present
DHRES-15	14 7-5/8 4-1/2	0 - 37 37 - 2872 2872 - 3633	--- ---[f] 2875 - 3633	831076.1	964977.7	3993.52	3990.8	3991.78		2875 to 3633	1116 to 358	Paleozic Sedimentary - Bolsa, Martin, Escabrosa, Naco p€bdiab - Younger Precambrian - Diabase	Jul 2014 - present
									DHRES-15_710	1662	2329	Tw3 - Whitetail Conglomerate - Conglomerate Unit	Jun 2014 - present
									DHRES-15_921	2355	1636	Pnaco - Paleozic Sedimentary - Naco (Dead Sensor)	Never Functional
									DHRES-15_398	2685	1306	Pnaco - Paleozic Sedimentary - Naco	Jun 2014 - present
									DHRES-15_355	2826	1165	Pnaco - Paleozic Sedimentary - Naco below Maroon Shale	Jun 2014 - present
GROUNDWATER SYSTEM WEST OF CONCENTRATOR FAULT													
DHRES-03	7-5/8 3	0 - 39 0 - 1939	--- ---[f]	837612.4	947362.8	3024.37	3020.6	NA		NA	NA	NA	NA
									DHRES-03_782	454	2567	QTg - Gila Conglomerate	Feb 2009 - present
									DHRES-03_729	628	2392	QTg - Gila Conglomerate	Feb 2009 - present
									DHRES-03_539	1249	1771	QTg - Gila Conglomerate	Feb 2009 - present
									DHRES-03_335	1920	1101	Tvs - Tertiary Volcanics	Feb 2009 - present
DHRES-04	14 7-5/8 4-1/2	0 - 40 0 - 1504 1432 - 2340	--- --- 1770 - 2318	837627.4	947291.0	3024.37	3021.6	3024.37	NA	1770 to 2319	1252 to 703	Tvs - Tertiary Volcanics	Feb 2009 - present
DHRES-05B	14 7-5/8 4-1/2	0 - 20 0 - 1142 1108 - 4002	--- --- 3135 - 4002	836291.4	943640.1	2781.32	2778.4	2781.32	NA	3135 to 4002	-357 to -1224	Talb - Apache Leap Tuff - Brown, Gray, White Units	Aug 2010 - present
DHRES-16	14 7-5/8 2-3/8	0 - 56 0 - 1800 0 - 4075	--- --- ---[f]	830712.8	944004.4	2635.92	2634.3	4684.71		NA	NA	NA	NA
									DHRES-16_743	198	2436	QTg - Gila Conglomerate	Sep 2014 - present
									DHRES-16_577	743	1891	QTg - Gila Conglomerate	Sep 2014 - present
									DHRES-16_535	880	1754	Tss - Sandstone	Sep 2014 - present
									DHRES-16_287	1695	939	Tb - Basalt	Sep 2014 - present
									DHRES-16_-157	3151	-517	Talw - Apache Leap Tuff - White Unit	Sep 2014 - present
									DHRES-16_-387	3904	-1270	Dm - Martin Formation	Sep 2014 - present

NA = Not Applicable
[a] bls = below land surface
[b] Datum NAD83 (Epoch NA2011), Arizona State Plane Coordinates, Zone 0202 - NAVD88 (Geoid12A), in feet. Data from Geodetic Analysis, LLC (August 2013)
[c] amsl = above mean sea level
[d] open borehole, no casing
[e] 1-inch standpipe peizometer installed in annulus (HRES-03S)
[f] grouted vibrating-wire piezometers attached to outside of conductor casing
[g] plastic-core rubber plug installed at 440 feet below land surface on May 25, 2011
[h] plastic-core rubber plug installed at 320 feet below land surface on May 24, 2011
[i] plastic-core rubber plug installed at 460 feet below land surface on December 6, 2011
--- = Not available

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
A-06	Equipment Installation/removal	Not Discernible	9/1/07 17:00		A-06; Pump installed; well completion modified; new MP = 1.56' als
A-06	Pumping Test	Rapid Decrease	9/24/07 8:00	9/24/07 16:21	Pumping at A-06
A-06	Equipment Installation/removal	Correction Shift	2/20/08 15:03		Remove PT and LC-1; Install LevelTroll; Probe shift correction
A-06	Purge and collect water sample	Rapid Decrease	6/3/08 13:50	6/3/08 15:45	Purge well and collect water sample
A-06	Purge and collect water sample	Rapid Decrease	8/26/08 16:55		Purge well and collect water sample
A-06	Purge and collect water sample; Probe shift correction	Rapid Decrease / Correction Shift	12/4/08 12:45	12/4/08 14:15	Purge well and collect water sample; Probe shift correction
A-06	Purge and collect water sample	Rapid Decrease	3/5/09 10:25	3/5/09 12:00	Purge well and collect water sample
A-06	Purge and collect water sample	Rapid Decrease	7/4/09 10:55	7/4/09 13:00	Purge well and collect water sample
A-06	Probe shift correction	Correction Shift	3/4/10 14:25		Probe shift correction
A-06	Probe shift correction	Correction Shift	9/3/12 20:00		Probe shift correction
A-06	Probe shift correction	Correction Shift	11/6/12 20:00		Probe shift correction
A-06	Pumping Test	Rapid Decrease and Increase	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
A-06	Pumping Test	Rapid Increase	7/1/13 12:00	10/16/13 11:00	Shut-down of HRES-20 pumping test; begin recovery period
A-06	Probe shift correction	Correction Shift	5/15/15 20:00		Probe shift correction
A-06	Probe shift correction	Correction Shift	7/9/15 14:09		Probe shift correction
Corral Well	Purge and collect water sample; Equipment Installation/removal	Rapid Decrease	5/23/12 14:00	5/23/12 20:00	Remove transducer; Purge well and collect water sample
DHRES-01 All Piezos	Drilling Activity	Rapid Increase and Decrease	6/1/08 6:00	6/28/08 0:00	Continued drilling activity at DHRES-01, air-lift test 6/24/08; Adjacent HRES-04 began being used for water supply well for DHRES-01 on 6/14/08
DHRES-01 All Piezos	Adjacent Drilling Activity	Rapid Increase and Decrease	11/24/08 0:00	12/1/08 0:00	Multiple lost circulation events at RES-017 at depths of 1687 m and 1744 m
DHRES-01_683	Adjacent Drilling Activity	Rapid Increase and Decrease	5/23/10 0:00	6/1/10 0:00	Response to drilling activity at RES-021, multiple lost circulation events from 5/23/10 to 5/29/10
DHRES-01_683	Adjacent Drilling Activity	Rapid Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
DHRES-01_772	Adjacent Drilling Activity	Rapid Increase and Decrease	5/23/10 0:00	6/1/10 0:00	Response to drilling activity at RES-021, multiple lost circulation events from 5/23/10 to 5/29/10

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GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
DHRES-01_772	Adjacent Drilling Activity	Rapid Decrease and Increase	4/2/11 0:00	4/3/11 9:00	Drilling activity at RES-028, cement job to seal 1207 m back to 1080 m to re-drill towards target that was strayed from. May also be responding to drilling activity at PHRES-03 and PHRES-04 from 4/3/11 to 4/22/11.
DHRES-01_772	Adjacent Pump Activity	Slow Decrease	6/11/11 13:00	7/4/11 13:00	23-day constant rate pumping test conducted at HRES-09
DHRES-01_772	Adjacent Drilling Activity	Rapid Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
DHRES-01_772	Adjacent Drilling Activity	Rapid Increase and Decrease	7/3/15 0:00		Lost circulation event at RES-034C. Cemented hole with 150 gallons of cement and noted zero cement in the hole after waiting 24 hrs. Loss zone then sealed off with bentonite and cement.
DHRES-01_973	Adjacent Drilling Activity	Rapid Increase and Decrease	5/23/10 0:00	6/1/10 0:00	Response to drilling activity at RES-021, multiple lost circulation events from 5/23/10 to 5/29/10
DHRES-01_973	Drilling Activity	Rapid Increase and Decrease	6/1/08 6:00	6/28/08 12:00	Continued drilling activity at DHRES-01, air-lift test 6/24/08; Adjacent HRES-04 began being used for water supply well for DHRES-01 on 6/14/08
DHRES-01_973	Adjacent Drilling Activity	Rapid Increase and Decrease	11/24/08 0:00	12/1/08 0:00	Multiple lost circulation events at RES-017 at depths of 1687 m and 1744 m; however no apparent response at HRES-04
DHRES-01_973	Adjacent Drilling Activity	Rapid Increase and Decrease	5/23/10 0:00		Response to drilling activity at RES-021, multiple lost circulation events from 5/23/10 to 5/29/10
DHRES-01_973	Adjacent Drilling Activity	Rapid Decrease and Increase	4/2/11 0:00	4/3/11 9:00	Drilling activity at RES-028, cement job to seal 1207 m back to 1080 m to re-drill towards target that was strayed from. May also be responding to drilling activity at PHRES-03 and PHRES-04 from 4/3/11 to 4/22/11.
DHRES-01_973	Adjacent Pump Activity	Slow Decrease	6/11/11 13:00	7/4/11 13:00	23-day constant rate pumping test conducted at HRES-09
DHRES-01_973	Adjacent Drilling Activity	Rapid Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012; DHRES-01_772 significantly greater response than DHRES-01_973 and HRES-04

WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
DHRES-01_973	Adjacent Drilling Activity	Rapid Increase and Decrease	7/3/15 0:00	12/1/15 0:00	Lost circulation event at RES-034C. Cemented hole with 150 gallons of cement and noted zero cement in the hole after waiting 24 hrs. Loss zone then sealed off with bentonite and cement. Various evvents at RES-037 and RES-38
DHRES-02 All Piezos	Drilling Activity	Rapid Increase and Decrease	7/20/08 12:00	9/11/08 0:00	Grouted piezos installed in upper zone 7/19/08; continued/ongoing drilling and testing activity at DHRES-02 through 9/11/08
DHRES-02 All Piezos	Adjacent Drilling Activity	Rapid Increase and Decrease / Variable	5/3/11 0:00	5/11/11 0:00	Drilling Precollar at RES-029, response also seen at HRES-02
DHRES-02 All Piezos	Adjacent Drilling Activity	Rapid Increase and Decrease / Variable	7/14/11 0:00	7/20/11 0:00	Multiple core drilling at surrounding adjacent sites with potential lost circulation events
DHRES-02 WL	Sensor Error	No Data	12/23/12 0:00	6/3/13 0:00	Water Level fell below sensor level, new deeper sensor installed 6/03/13
DHRES-02 All Piezos	Adjacent Drilling Activity	Rapid Increase and Decrease / Variable	10/13/11 0:00	10/28/11 0:00	Multiple core drilling at surrounding adjacent sites with potential lost circulation events; Multiple lost circulation and partial return events during drilling of RES-027 and RES-028 through 10/26/11. Lost all returns twice at RES-027A at depth of 1754 m on 10/11/11. RES-028 saw little returns at depth of 1825 m on same day. Lost returns again at RES-027 on 10/13/11 at 1056 m and 10/14 at 1783 m but began regaining returns same day. Bridging encountered in RES-028 at 1861 m on 10/15/11. Minimal returns at RES-028 through 10/27.
DHRES-02_608	Adjacent Drilling Activity	Rapid Increase and Decrease	8/29/14 0:00		Cement job for abandonment of daughter corehole RES-028F at depths 6596 ft to 6355 ft. Also lost half of returns at RES-029F on 8/29.
DHRES-02_666	Adjacent Drilling Activity	Rapid Increase and Decrease	8/29/14 0:00		Cement job for abandonment of daughter corehole RES-028F at depths 6596 ft to 6355 ft. Also lost half of returns at RES-029F on 8/29.
DHRES-02_915	Adjacent Drilling Activity	Rapid Decrease and Increase	7/24/13 0:00	7/31/13 0:00	Drilling resumed at RES-003 going deeper with a reduced hole. Drilled through obstruction at 2565 ft on 7/24 on way down to bottom of hole; Wood plug and wedge installed followed by cement job 7/25 through 7/26; Drilling and cementing issues through 7/31.

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DHRES-02_915	Adjacent Drilling Activity	Rapid Increase and Decrease	8/29/14 0:00		Cement job for abandonment of daughter corehole RES-028F at depths 6596 ft to 6355 ft. Also lost half of returns at RES-029F on 8/29.
DHRES-03_335	Adjacent Pump Activity	Rapid Decrease and Increase	12/21/09 0:00	12/21/09 0:00	DHRES-04 12hr constant rate test
DHRES-03_539	Adjacent Pump Activity	Rapid Decrease and Increase	12/21/09 0:00	12/21/09 0:00	DHRES-04 12hr constant rate test
DHRES-04 WL	Pumping Test	Rapid Decrease and Increase	12/21/09 0:00	12/21/09 0:00	DHRES-04 12hr constant rate test
DHRES-05 WL	Sensor Error	No Data	9/9/15 18:00	12/18/15 12:00	Water Level fell below sensor level, new deeper sensor installed 12/18/15
DHRES-06 WL	Pumping Test	Rapid Increase and Decrease	1/7/11 18:28	1/9/11 12:30	Pretest and 24-hour constant rate test at DHRES-06, collect water samples RESE-1003186 and RESE-1003184
DHRES-06 WL	Adjacent Pump Activity	Rapid Decrease and Increase	12/10/14 0:00	2/18/15 0:00	DHRES-15 70 day 130 gpm constant rate test
DHRES-06 All Piezos	Pumping Test	Rapid Increase and Decrease	1/7/11 18:28	1/9/11 12:30	Pretest and 24-hour constant rate test at DHRES-06, collect water samples RESE-1003186 and RESE-1003184
DHRES-06 All Piezos	Adjacent Pump Activity	Rapid Decrease and Increase	7/19/11 15:31	7/21/11 12:10	Unsustainable pumping test activity at HRES-08
DHRES-06_1152	Adjacent Pump Activity	Rapid Decrease and Increase	5/10/12 16:00		HRES-08 well purged and collected water sample
DHRES-07 All Piezos	Drilling Lower completion DHRES-07 and DHRES-07A	Rapid Increase and Decrease / Variable	6/10/10 12:26	7/4/10 0:00	Drilling lower completion of DHRES-07 5229.6 ft bls. Borehole was cemented and a deviated borehole (DHRES-07A) was attempted without success. Borehole was cemented up to 4396.5 ft bls
DHRES-07 All Piezos	Drilling Lower completion DHRES-07B	Rapid Increase and Decrease / Variable	9/14/10 0:00	9/24/10 0:00	Drilled to depth of 5090 ft bls
DHRES-07 All Piezos	Airlift Purging/Testing	Rapid Increase and Decrease / Variable	10/6/10 9:30	10/7/10 18:00	Airlift surging was conducted to develop the well but discharge was not sustainable for testing
DHRES-07_95	Unexplained Response / Adjacent Pump Activity	Rapid Decrease	6/16/11 0:00		50 ft H_2O decrease in head over 1 month may be related to test at HRES-09 6/2011 or connecting of DHRES-07_169 and DHRES-07_95 zones through grout
DHRES-07_95	Adjacent Drilling Activity	Rapid Decrease and Increase	5/27/14 0:00	7/15/14 0:00	Drilling DHRES-15, Drilled lower well completion to 3920 ft bls.
DHRES-07_95	Adjacent Pump Activity	Rapid Decrease and Increase	10/28/14 0:00	12/10/14 0:00	Install and test pump at DHRES-15
DHRES-07_95	Adjacent Pump Activity	Rapid Decrease and Increase	12/10/14 0:00	2/18/15 0:00	DHRES-15 70 day 130 gpm constant rate test

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DHRES-07_169	Unexplained Response / Adjacent Pump Activity	Rapid Decrease	3/23/12 0:00		25ft H2O decrease in head over 1 month may be related to test at HRES-09 6/2011 or connecting of DHRES-07_169 and DHRES-07_95 zones through grout
DHRES-07_169	Adjacent Drilling Activity	Rapid Decrease and Increase	5/27/14 0:00	7/15/14 0:00	Drilling DHRES-15, Drilled lower well completion to 3920 ft bls
DHRES-07_169	Adjacent Pump Activity	Rapid Decrease and Increase	10/28/14 0:00	12/10/14 0:00	Install and test pump at DHRES-15
DHRES-07_169	Adjacent Pump Activity	Rapid Decrease and Increase	12/10/14 0:00	2/18/15 0:00	DHRES-15 70 day 130 gpm constant rate test
DHRES-07_374	Adjacent Drilling Activity	Rapid Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
DHRES-07_374	Adjacent Pump Activity	Rapid Decrease and Increase	10/28/14 0:00	12/10/14 0:00	Install and test pump at DHRES-15
DHRES-07_374	Adjacent Pump Activity	Rapid Decrease and Increase	12/10/14 0:00	2/18/15 0:00	DHRES-15 70 day 130 gpm constant rate test
DHRES-07_920	Pump installation, Test pump and step test	Rapid Decrease and Increase	12/20/10 13:30	12/21/10 18:50	Install and test pump at HRES-09; 10-hour Step Test on 12/21/10
DHRES-07_920	Adjacent Pump Activity	Rapid Decrease and Increase	12/28/10 13:30	12/29/10 13:30	24-hour constant rate test at HRES-09; approx. 80 gpm
DHRES-07_920	Pumping and collect water sample	Rapid Decrease and Increase	1/10/11 11:50		Pump HRES-09 to collect water sample RESE-1003109
DHRES-07_920	Pumping and collect water sample	Rapid Decrease and Increase	2/8/11 11:15	2/8/11 17:50	Time series sampling at HRES-09
DHRES-07_920	Adjacent Drilling Activity	Rapid Decrease and Increase	3/23/11 22:34	5/8/11 18:53	Drilling of PHRES-01 to 04; Colog hydrophysical tests PHRES-01 to 04
DHRES-07_920	Adjacent Pump Activity	Rapid Decrease and Increase	6/11/11 10:33	7/4/11 13:00	23 day Constant Rate test at HRES-09; approx. 76 gpm
DHRES-07_920	Adjacent Drilling Activity	Rapid Increase	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
DHRES-07_-108	Adjacent Pump Activity	Rapid Decrease and Increase	12/10/14 0:00	2/18/15 0:00	DHRES-15 70 day 130 gpm constant rate test
DHRES-08_980, 792, 512,406	Drilling Activity - Lower completion	Rapid Increase and Decrease / Variable	7/12/10 0:00	9/5/10 0:00	Drilling lower zone of DHRES-08
DHRES-08_980, 792, 512,406	Halliburton Grouting - Lower completion	Rapid Increase and Decrease / Variable	9/8/10 23:50	9/9/10 2:07	Grouting Piezometers in lower completion DHRES-08
DHRES-08_980	Adjacent Well Pumping Test	Slow Decrease	6/11/11 10:33	7/4/11 13:00	23 day Constant Rate test at HRES-09; approx. 76 gpm
DHRES-08_980	Adjacent Drilling Activity	Slow Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012

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DHRES-08_980	Adjacent drilling activity	Slow Increase and Decrease	11/16/14 0:00	11/17/14 0:00	Stuck tooling at RES-037; circulating fluids to free stuck tooling
DHRES-08_-580	Sensor Error	No Data	9/26/12 18:00		Sensor malfunction, not repairable
DHRES-08_-657	Sensor Error	No Data	9/26/12 18:00		Sensor malfunction, not repairable
DHRES-11	Pumping Test	Rapid Decrease and Increase	1/27/11 20:30	1/28/11 5:04	8.5 hour airlift test at DHRES-11; pumping rate ~16 gpm
DHRES-11	Pumping Test	Rapid Decrease and Increase	6/27/11 9:45	6/27/11 18:37	9-hour variable rate test at DHRES-11
DHRES-11	Pumping Test	Rapid Decrease and Increase	6/28/11 6:31	6/28/11 13:31	31-hour variable rate test at DHRES-11
DHRES-11	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_214	Pumping Test	Rapid Decrease and Increase	6/27/11 9:45	6/28/11 13:31	9-hour variable rate test followed by 31-hour variable rate test at DHRES-11
DHRES-11_214	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_214	Sensor Error	Variable Bad Readings	5/11/15 13:00		Bad Readings from sensor, occasional on trend values
DHRES-11_320	Pumping Test	Rapid Decrease and Increase	6/27/11 9:45	6/28/11 13:31	9-hour variable rate test followed by 31-hour variable rate test at DHRES-11
DHRES-11_320	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_457	Pumping Test	Rapid Decrease and Increase	6/27/11 9:45	6/28/11 13:31	9-hour variable rate test followed by 31-hour variable rate test at DHRES-11
DHRES-11_457	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_565	Pumping Test	Rapid Decrease and Increase	6/27/11 9:45	6/28/11 13:31	9-hour variable rate test followed by 31-hour variable rate test at DHRES-11
DHRES-11_565	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_705	Hydrochem Sampling	Rapid Decrease and Increase	5/15/12 12:00		Purge adjacent well HRES-12 for hydrochem sampling; RCM personnel
DHRES-11_705	Hydrochem Sampling	Rapid Decrease and Increase	8/14/12 12:00		Purge adjacent well HRES-12 for hydrochem sampling; RCM personnel
DHRES-11_705	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-11_705	Hydrochem Sampling	Rapid Decrease and Increase	11/7/12 12:00		Purge adjacent well HRES-12 for hydrochem sampling; RCM personnel
DHRES-11_967	Hydrochem Sampling	Rapid Decrease and Increase	8/15/12 10:00	8/15/12 17:00	Purge DHRES-11 for hydrochem sampling
DHRES-14_1071	Drilling Activity in lower completion	Variable Increase and Decrease	3/16/12 0:00	6/6/12 0:00	4.5" casing was removed. Coring drilling occurred to a depth of approximately 6,078' bls. Crew demobilized from site on 6/6/12

WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
DHRES-14_1071	Unexplained Response	Shift Decrease	7/15/14 13:00		Instantaneous 5.94-foot drop in head between 13:00 and 14:00 hours; rain gage at this location saw more than 1.5 inches of rain during that same period, which was verified at other gages in the area; electronics check out; piezos good, logger good; could verify with water level measurement but currently not feasible to pull manual water level due to mud on casing walls
DHRES-14_1214	Unexplained Response	Shift Decrease	7/15/14 13:00		Instantaneous 1.68-foot drop in head between 13:00 and 14:00 hours; rain gage at this location saw more than 1.5 inches of rain during that same period, which was verified at other gages in the area; electronics check out; piezos good, logger good; could verify with water level measurement but currently not feasible to pull manual water level due to mud on casing walls
DHRES-14_888	Unexplained Response	Shift Decrease	7/15/14 13:00		Instantaneous 12.31-foot drop in head between 13:00 and 14:00 hours; rain gage at this location saw more than 1.5 inches of rain during that same period, which was verified at other gages in the area; electronics check out; piezos good, logger good; could verify with water level measurement but currently not feasible to pull manual water level due to mud on casing walls
DHRES-14_WL	Unexplained Response	Shift Decrease	7/15/14 13:00		Instantaneous 0.79-foot drop in head between 13:00 and 14:00 hours; rain gage at this location saw more than 1.5 inches of rain during that same period, which was verified at other gages in the area; electronics check out; piezos good, logger good; could verify with water level measurement but currently not feasible to pull manual water level due to mud on casing walls
DHRES-15 All Piezos	Drilling Lower completion DHRES-15	Variable Increase and Decrease	5/27/14 0:00	7/15/14 0:00	Drilled lower well completion to 3920 ft bls.
DHRES-15 All Piezos	Pump installation, Test pump and step test	Variable Increase and Decrease	10/28/14 0:00	12/10/14 0:00	Install and test pump at DHRES-15
DHRES-15 All Piezos	Pumping Test	Variable Increase and Decrease	12/10/14 0:00	2/18/15 0:00	70 day 130 gpm constant rate test
Hackberry Windmill Well	Purge and collect water sample	Rapid Decrease	6/3/08 13:55	6/3/08 14:56	Purge well and collect water sample

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HRES-02	Equipment Installation/removal	Shift	9/28/06 12:00		Installed packer at 700 ft bls and inflated; commence monitoring of HRES-02S and HRES-02D
HRES-02	Adjacent Drilling Activity	Rapid Increase and Decrease	6/30/08 12:00		Drilling commences at well DHRES-02; air rotary to 485 feet - can see some drawdown impact at HRES-02; lost circulation immediately after switching to flooded reverse at 485 feet on July 1st
HRES-02	Equipment Installation/removal	Rapid Increase and Decrease	3/2/10 12:00		Packer deflated; continue monitoring HRES-02 with one logger
HRES-02	Adjacent Drilling Activity	Rapid Increase and Decrease	5/3/11 0:00		Drilling Precollar at RES-029, response seen at HRES-02 from 5/12/2011 - 5/16/2011
HRES-02	Equipment Installation	Rapid Increase and Decrease	5/20/11 0:00		Pump installation at HRES-02; new measuring point
HRES-02	Adjacent Drilling Activity	Rapid Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
HRES-02	Probe shift/Correction	Correction Shift	3/1/13 8:00	3/1/13 14:00	Correction to water level deviation
HRES-02	Probe shift/Correction	Correction Shift	7/10/13 8:00	7/10/13 14:00	Correction to water level deviation
HRES-02	Probe shift/Correction	Correction Shift	7/24/13 10:00		Correction to water level deviation; pre-pumping test
HRES-02	Constant Rate Pumping Test	Rapid Decrease and Increase	7/24/13 10:10	7/30/13 10:10	Approx. 13 gpm
HRES-02	Probe shift/Correction	Correction Shift	5/21/14 8:00	5/21/14 14:00	Correction to water level deviation
HRES-03D	Adjacent Well Pumping Test	Rapid Decrease and Increase	10/9/06 13:00	11/3/06 13:00	25-day constant rate pumping test at HRES-04. Monitor wells were HRES-02, Oak Flat Well
HRES-03D	Falling Head Test - Slug Test	Rapid Increase	4/16/09 17:40		Slug (3,744 cm^3) installed; 5.7 days
HRES-03D	Rising Head Test - Slug Test	Rapid Decrease	5/6/09 19:20	5/19/09 13:25	Slug (3,744 cm^3) removed; 12.75 days
HRES-03D	Sensor Error / Monitor Well for adjacent pumping test	Anomalous drift	4/2/13 12:00	9/29/13 12:00	90-day pumping test conducted at HRES-20; HRES-03D was used as a monitor well; probe readings initially drifted higher and then showed steep decline - manual measurements showed no discernible response
HRES-03S	Equipment Installation/removal; Probe shift/Correction	Correction Shift	8/14/06 6:00	8/15/06 13:00	Minitroll test ended 8/14/06 at 06:00, WL 292.109 ft bls. New Minitroll test started 8/15/06 with WL 288.793 ft bls
HRES-03S	Adjacent Well Pumping Test	Rapid Decrease and Increase	10/9/06 13:00	11/3/06 13:00	25-day constant rate pumping test at HRES-04. Monitor wells were HRES-02, Oak Flat Well
HRES-03S	Probe shift/Correction	Correction Shift	7/25/07 13:00	7/25/07 18:00	Correction to water level deviation

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HRES-03S	Equipment Installation/removal	Rapid Increase and Decrease	3/3/10 10:30		Remove minitroll and install LevelTroll; water level effected by removal and install
HRES-03S	Probe shift/Correction	Correction Shift	11/17/10 13:30		Correction to water level deviation; Probe shift correction
HRES-04	Equipment Installation	Rapid Increase	9/14/06 15:22		Pump Installation
HRES-04	Test Pump	Rapid Decrease	9/15/06 12:38		Test Pump; loggers set to 1 minute intervals
HRES-04	Pumping Test	Rapid Decrease and Increase	10/9/06 13:00	11/3/06 13:00	25-day constant rate pumping test at HRES-04. Monitor wells were HRES-02, Oak Flat Well
HRES-04	Probe Shift (Data Gap)	Correction Shift	1/4/08 16:00	2/18/08 10:00	New transducer installed with new reference. Not sure why replacement was needed.
HRES-04	Adjacent Drilling Activity	Rapid Decrease and Increase	5/4/08 5:25		HRES-04 responded to drilling of DHRES-01 (on same pad); can see drawdown impact at a penetration depth of approx. 565 ft bls
HRES-04	Pumping for Water Supply	Rapid Decrease and Increase	6/14/08 10:51	6/17/08 10:33	HRES-04 began being used for water supply well during the drilling of DHRES-01; pumping rates are unknown; followed by 4 month data gap
HRES-04	Packer Test at Adjacent Well	Rapid Increase and Decrease	5/25/10 0:00		Packer installation and testing at DHRES-07; May also be responding to drilling activity at RES-021, lost circulation event on 5/29/10
HRES-04	Adjacent Drilling Activity	Rapid Increase and Decrease	4/2/11 0:00	4/3/11 9:00	Drilling activity at RES-028, cement job to seal 1207m back to 1080m to re-drill towards target that was strayed from. May also be responding to drilling activity at PHRES-03 and PHRES-04 from 4/3/11 to 4/22/11.
HRES-04	Adjacent Pump Activity	Rapid Decrease and Increase	6/11/11 13:00	7/4/11 13:00	23-day constant rate pumping test conducted at HRES-09
HRES-04	Adjacent Drilling Activity	Rapid Increase and Decrease	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
HRES-05	Equipment Installation/removal	Shift Decrease	9/28/06 12:00		Installed packer at 450 feet below land surface and inflated; commence monitoring of HRES-05S and HRES-05D; HRES-05S decreased WL with packer initally but return to matched levels
HRES-05	Adjacent Drilling Activity	Rapid Increase and Decrease	4/1/10 0:00		Drilling at HRES-09; hole taking fluid morning of 4/1/10
HRES-05	Adjacent Pump Activity	Rapid Increase and Decrease	12/20/10 13:30	12/21/10 18:50	Install and test pump at HRES-09; 10-hour Step Test on 12/21/10
HRES-05	Adjacent Pump Activity	Rapid Increase and Decrease	12/28/10 13:30	12/29/10 13:30	24-hour constant rate test at HRES-09; approx. 80 gpm

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HRES-05	Adjacent Pump Activity	Rapid Increase and Decrease	1/10/11 11:50		Pump HRES-09 to collect water samples
HRES-05	Adjacent Pump Activity	Rapid Increase and Decrease	2/8/11 11:15	2/8/11 17:50	Time series sampling at HRES-09
HRES-05	Adjacent Drilling Activity	Rapid Increase and Decrease	3/22/11 0:00	4/22/11 0:00	Drilling of PHRES-01, PHRES-02, PHRES-03, and PHRES-04
HRES-05	Adjacent Pump Activity	Rapid Increase and Decrease	6/11/11 10:33	7/4/11 13:00	23 day Constant Rate test at HRES-09; approx. 76 gpm
HRES-05	Adjacent Drilling Activity	Rapid Increase	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
HRES-06	Pumping Test	Rapid Decrease and Increase	7/12/07 10:00	7/12/07 22:00	12 hour constant rate test; approx. 15 gpm
HRES-06	Probe shift/Correction	Correction Shift	1/4/08 14:25		Correction to water level deviation
HRES-06	Purge and collect water sample	Rapid Decrease and Increase	2/27/08 17:20		Purge well and collect water sample
HRES-06	Purge and collect water sample	Rapid Decrease and Increase	5/28/08 14:55	5/28/08 17:40	Purge well and collect water sample
HRES-06	Purge and collect water sample; Probe shift/Correction	Rapid Decrease and Increase	8/25/08 14:28		Purge well and collect water sample; correction to water level deviation
HRES-06	Purge and collect water sample	Rapid Decrease and Increase	12/3/08 9:15	12/3/08 12:30	Purge well and collect water sample; approximately 3 gpm
HRES-06	Purge and collect water sample	Rapid Decrease and Increase	3/4/09 10:15	3/4/09 12:00	Purge well and collect water sample; approximately 17 gpm
HRES-06	Purge and collect water sample	Rapid Decrease and Increase	6/3/09 13:20	6/3/09 15:00	Purge well and collect water sample; approximately 15.7 gpm
HRES-07	Falling-Head Slug Test	Rapid Increase and Decrease	7/28/09 11:00	7/28/09 15:20	Prior to removing the packer that separated the shallow and deep zones of the ALT aquifer at well HRES-07, a falling-head slug test was conducted in July 2009
HRES-07	Pumping Test	Rapid Decrease and Increase	10/7/09 18:30	12/6/09 18:30	60 day constant rate pumping test; approximately 35 gpm
HRES-07	Pumping Test	Rapid Decrease and Increase	10/30/12 14:00	11/6/12 14:00	Pretest Pumping
HRES-07	Pumping Test	Rapid Decrease and Increase	1/21/13 15:00	1/23/13 15:00	48-hour constant rate pumping test
HRES-08	Adjacent Drilling Activity	Rapid Increase and Decrease	2/23/10 17:40	2/28/10 8:00	Drilling commences at DHRES-06; drilled through Tal and Tw
HRES-08	Adjacent Pump Activity	Rapid Decrease and Increase	1/7/11 18:28	1/9/11 12:30	Pretest and 24-hour constant rate test at DHRES-06
HRES-08	Probe shift/Correction	Correction Shift	3/1/11 12:00		Set new reference WL at Q1 download
HRES-08	Pumping Test	Rapid Decrease and Increase	7/19/11 15:31	7/21/11 12:10	Unsustainable pumping test activity; water sample collected at 12:05, 7/21/2011
HRES-08	Purge and collect water sample	Rapid Decrease and Increase	5/10/12 16:00		Collected Sample RESE-1003246
HRES-09	Pump installation, Test pump and step test	Rapid Decrease and Increase	12/20/10 13:30	12/21/10 18:50	Install and test pump at HRES-09; 10-hour Step Test on 12/21/10
HRES-09	Pumping Test	Rapid Decrease and Increase	12/28/10 13:30	12/29/10 13:30	24-hour constant rate test at HRES-09; approx. 80 gpm

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
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WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
HRES-09	Pumping and collect water sample	Rapid Decrease and Increase	1/10/11 11:50		Pump HRES-09 to collect water sample RESE-1003109
HRES-09	Pumping and collect water sample	Rapid Decrease and Increase	2/8/11 11:15	2/8/11 17:50	Time series sampling at HRES-09
HRES-09	Adjacent Drilling Activity	Rapid Decrease and Increase	3/23/11 22:34	3/31/11 10:40	Drilling of PHRES-01
HRES-09	Adjacent Drilling Activity	Rapid Decrease and Increase	4/2/11 11:30	4/5/11 4:39	Drilling of PHRES-02
HRES-09	Adjacent Drilling Activity	Rapid Decrease and Increase	4/12/11 11:49	4/16/11 15:21	Drilling of PHRES-03
HRES-09	Adjacent Drilling Activity	Rapid Decrease and Increase	4/18/11 8:21	4/22/11 2:19	Drilling of PHRES-04
HRES-09	Adjacent Pump Activity	Rapid Decrease and Increase	5/4/11 10:57	5/4/11 17:16	Colog hydrophysical test at PHRES-02
HRES-09	Adjacent Pump Activity	Rapid Decrease and Increase	5/6/11 9:18	5/6/11 18:30	Colog hydrophysical testing at PHRES-03
HRES-09	Adjacent Pump Activity	Rapid Decrease and Increase	5/8/11 8:00	5/8/11 18:53	Colog hydrophysical test of PHRES-04
HRES-09	Pumping Test	Rapid Decrease and Increase	6/11/11 10:33	7/4/11 13:00	23 day Constant Rate test at HRES-09; approximately 76 gpm
HRES-09	Adjacent Drilling Activity	Rapid Increase	6/23/12 0:00	8/7/12 0:00	Drilling at RES-032; multiple lost circulation events beginning 6/23/2012; hole drilled to depth of 1379.36 m bls and cemented in casing on 8/11/2012
HRES-10	Equipment Installation/removal; test pump	Rapid Increase	7/28/10 11:57		Install 4 prong well plug at HRES-10; test pump; data record starts after pumping
HRES-10	Probe shift correction and scan interval	Rapid Decrease and Increase	9/21/10 8:20	9/25/10 8:14	Start of Monitoring for HRES-11 Pumping Test
HRES-10	Pumping Test	Rapid Decrease and Increase	9/24/10 9:45	9/24/10 19:45	Constant rate pumping test at HRES-10
HRES-10	Probe shift correction	Bad data / Correction Shift	4/16/11 2:00	5/31/11 14:00	Water Level below probe; lower to 95' bmp; flat line data during dry period
HRES-11	Equipment Installation/removal; test pump	Rapid Decrease and Increase	6/28/10 11:57	6/28/10 12:32	Install test pump at HRES-11; test pump
HRES-11	Pumping Test	Rapid Decrease and Increase	9/20/10 14:04	9/20/10 15:28	Pre test at HRES-11
HRES-11	Pumping Test	Rapid Decrease and Increase	9/21/10 10:05	9/23/10 10:05	Constant Rate test HRES-11; approximately 9 gpm
HRES-11	Purge and collect water sample	Rapid Decrease and Increase	11/14/12 14:50		Purge well and collect water sample
HRES-11	???	Rapid Decrease and Increase	12/3/12 14:00	12/12/12 14:00	Multiple pumping events
HRES-11	Probe shift correction	Correction Shift	8/26/13 14:00		Probe shift correction
HRES-12	Pumping Test	Rapid Decrease and Increase	5/17/11 10:30	5/19/11 12:00	Pull logger at 10:30; install permanent pump; function test on May 19, 2011
HRES-12	Pumping Test	Rapid Decrease and Increase	7/9/11 19:01	7/10/11 2:31	7.5-hour constant-rate test at HRES-12; pumping rate ~8 gpm
HRES-12	Hydrochem Sampling	Rapid Decrease and Increase	5/15/12 12:00		Purge HRES-12 for hydrochem sampling; RCM personnel
HRES-12	Hydrochem Sampling	Rapid Decrease and Increase	8/14/12 12:00		Purge HRES-12 for hydrochem sampling; RCM personnel
HRES-12	Hydrochem Sampling	Rapid Decrease and Increase	11/7/12 12:00		Purge HRES-12 for hydrochem sampling; RCM personnel

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
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WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
HRES-13	Pump Install and Testing	Rapid Decrease and Increase	6/1/11 12:22	6/3/11 21:30	Conduct Pretest, step test and constant rate test at HRES-13
HRES-13	Purge and collect water sample	Rapid Decrease and Increase	5/17/12 13:00		Collect samples RESE-1000456 and RESE-1000457
HRES-13	Probe shift/Correction	Correction Shift	6/24/13 20:00		Probe shift correction
HRES-13	Probe shift/Correction	Correction Shift	8/20/13 14:00		Probe shift correction
HRES-14	Pump installation, Test pump	Rapid Decrease and Increase	7/8/11 11:30	7/8/11 12:13	Install pump and test pump
HRES-14	Pumping Test	Rapid Decrease and Increase	7/13/11 13:15	7/15/11 13:15	48-hour constant rate test; approx. 12 gpm
HRES-14	Unknown	Anomalous drift / Bad Data	8/26/12 14:00	2/22/13 8:00	Anomalous drift, unknown; Drilling activity at HRES-20 11/21/12 to 12/2/12; Airlift development at HRES-20 12/7/12 to 12/8/12
HRES-14	Pumping Test	Rapid Decrease	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
HRES-14	Pumping Test	Rapid Increase	7/1/13 12:00	10/1/13 12:00	Shut-down of HRES-20 pumping test; begin recovery period
HRES-15	Install equipment	Rapid Increase and Decrease	9/29/11 14:00		pull LC-1 and PT; install LevelTroll
HRES-15	Pump installation, Test pump	Shift	12/8/11 0:00		Install pump at HRES-15
HRES-15	Pumping test	Rapid Increase and Decrease	4/2/12 14:00	4/4/12 14:00	48-hour pumping test at HRES-15
HRES-15	Adjacent Pumping Test	Rapid Decrease	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
HRES-15	Adjacent Pumping Test	Rapid Increase	7/1/13 12:00	10/1/13 12:00	Shut-down of HRES-20 pumping test; begin recovery period
HRES-16	Pump installation, Test pump	Shift	12/10/11 0:00		Install pump at HRES-16
HRES-16	Probe shift/Correction	Correction Shift	2/27/13 14:00		Probe shift correction
HRES-16	Probe shift/Correction	Correction Shift	3/28/13 12:00		Probe shift correction; set to 1-hr readings for HRES-20 aquifer test
HRES-16	Adjacent Pumping Test	Slow Decrease	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
HRES-16	Adjacent Pumping Test	Slow Increase	7/1/13 12:00	10/1/13 12:00	Shut-down of HRES-20 pumping test; begin recovery period

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
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WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
HRES-16	Probe shift/Correction	Correction Shift	5/28/14 14:00		Probe shift correction
HRES-17	Pump installation, Test pump	Shift / Rapid Decrease and Increa	12/9/11 15:00		Install and test pump at HRES-17
HRES-17	Pumping Test	Rapid Decrease and Increase	4/9/12 11:15	4/12/12 8:47	24-hour pumping test at HRES-17
HRES-17	Probe shift/Correction	Mismatch with Sounder / Bad data	3/28/13 14:00		Probe shift correction; set to 1 hr readings for HRES-20 aquifer test; LevelTroll water levels begin to deviate from manual measurements; probe possibly dry or set to Level rather than Depth to Water
HRES-17	Adjacent Pumping Test	Mismatch with Sounder / Bad data	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
HRES-17	Adjacent Pumping Test	Mismatch with Sounder / Bad data	7/1/13 12:00	10/1/13 12:00	Shut-down of HRES-20 pumping test; begin recovery period
HRES-17	Probe shift/Correction	Correction Shift	12/4/13 14:00		Probe shift correction
HRES-17	Pumping test	Mismatch with Sounder	4/9/15 11:15	4/10/15 11:15	24-hour pumping test at HRES-17
HRES-18	Probe shift/Correction	Correction Shift	8/17/11 13:00		set new reference point to top of vault
HRES-18	Install equipment	Correction Shift	9/29/11 14:00		pull LC-1 and PT; install LevelTroll
HRES-18	Probe shift/Correction	Correction Shift	2/21/12 14:00		Probe shift correction
HRES-18	Probe shift/Correction	Correction Shift	3/28/13 13:00		Probe shift correction; set to 1 hr readings for HRES-20 aquifer test; LevelTroll water levels begin to deviate from manual measurements; probe possibly dry
HRES-19	Adjacent Pumping Test	Rapid Decrease	1/21/13 15:00	1/23/13 15:00	48-hour constant rate pumping test at HRES-07

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
GROUNDWATER LEVEL MONITORING PROGRAM
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WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
HRES-20	Probe shift/Correction	Correction Shift	4/1/13 14:45		Probe shift correction; set to 1-hr readings for HRES-20 aquifer test
HRES-20	Pumping Test	Rapid Decrease	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073
HRES-20	Pumping Test	Rapid Increase	7/1/13 12:00	10/16/13 11:00	Shut-down of HRES-20 pumping test; begin recovery period
Middle Well	Purge and collect water sample; remove equipment	Rapid Decrease	5/28/08 15:30	5/28/08 18:10	Remove LevelTroll; purge well to collect water sample
Middle Well	Purge and collect water sample; remove equipment	Rapid Decrease	5/30/08 9:30		Remove LevelTroll; purge well to collect water sample
Middle Well	Purge and collect water sample; remove equipment	Rapid Decrease	12/3/08 10:15	12/3/08 13:00	Remove LevelTroll; purge well to collect water sample
Middle Well	Purge and collect water sample; remove equipment	Rapid Decrease	6/5/09 11:15	6/5/09 13:30	Remove LevelTroll; purge well to collect water sample
MJ-11	Equipment Installation/removal	Rapid Increase Post Sample	2/21/08 0:00		Remove PT and LC-1; Install LevelTroll; Probe shift correction
MJ-11	Purge and collect water sample	Rapid Decrease and Increase	6/2/08 10:30	6/2/08 11:50	Purge well and collect water sample
MJ-11	Purge and collect water sample	Rapid Decrease	8/26/08 12:00	8/27/08 2:00	Purge well and collect water sample
MJ-11	Unknown WL shift	Rapid Increase	3/27/12 14:00		Unknown WL shift
MJ-11	Unknown WL shift	Rapid Increase	5/16/12 14:00		Unknown WL shift
MJ-11	Unknown WL shift	Rapid Increase	5/27/12 14:00		Unknown WL shift
MJ-11	Pumping Test	Slow Decrease	4/2/13 12:00	7/1/13 12:00	90-day constant-rate pumping test conducted at HRES-20; average pumping rate 77 gpm; the following wells were observation wells for this test: A-06, Oak Flat, HRES-03D/S, 04, 06, 12, 14, 15, 16, 17, 18, and DHRES-14_1216 and _1073

TABLE 3. SUMMARY OF EVENTS RESULTING IN WATER LEVEL/TOTAL HEAD CHANGE
GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	EVENT TYPE	MAJOR EVENT EFFECT	START DATE/TIME	STOP DATE/TIME	DESCRIPTION
Oak Flat Well	Adjacent Drilling Activity	Disturbed / Variable	2/14/04 3:30	2/22/04 19:30	Drilling activity at HRES-03
Oak Flat Well	Probe shift correction and scan interval	Correction Shift	8/22/06 14:00		Probe shift correction and change scan interval
Oak Flat Well	Probe shift correction and scan interval	Correction Shift	9/24/09 17:00		miniTROLL reset to 1-hr readings for HRES-7 test
Oak Flat Well	Equipment Installation/removal	Correction Shift	3/2/10 11:00		Remove minitroll and install LevelTroll

als = above land surface
m = meters
m bls= meters below land surface
ft = feet
gpm = gallons per minute
cm^3 = cubic centimeters
bmp = below measuring point

TABLE 4. SUMMARY OF WATER LEVEL/TOTAL HEAD CHANGE, GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	Geologic Unit	Water Level or Head Elevation in Q3/Q4 2011 (ft, amsl)	Water Level or Head Elevation in Q3/Q4 2014 (ft, amsl)	Water Level or Head Elevation in Q4 2015 (ft, amsl)	4-Year Change in Water Level (2011 - 2015) (feet)	1-Year Change in Water Level (2014 - 2015) (feet)	Overall Trend in Head	Cause of Overall Trend	Short-Term Natural Variability Influences	Cause of Short-Term Natural Variability Influences to Head	Comments	Anthropogenic Variability Influences
SHALLOW ALLUVIAL AQUIFER												
Corral Well	Qal	4426.5	4420.1	DRY	---	---	---	Drought	Seasonal recharge mainly in winter	Infiltration of surface water	Has gone dry seasonally on occasion	
Middle Well	Qal	4423.9	4420.8	4420.6	-3.3	-0.2	Declining	Drought	Seasonal recharge mainly in winter	Infiltration of surface water	Rapid seasonal recharge followed by a slow decline	
Hackberry Windmill	Qal	DRY	3894.4	3890.5	---	-4.0	---	---	Seasonal recharge mainly in winter	Infiltration of surface water	Has gone dry seasonally on occasion	
APACHE LEAP TUFF AQUIFER - NORTH SECTOR												
HRES-06	Tal	4041.2	4040.3	4041.0	-0.2	0.6	Stable	Reflects trend in precipitation	Seasonal recharge mainly in spring	Infiltration of surface water	Dampened and lagged seasonal recharge response in regional ALT	
HRES-12	Tal	4091.6	4091.5	4092.3	0.7	0.8	Rising	Unknown	Seasonal recharge in spring	Infiltration of surface water	Seasonal high and lows show increase over time	Pumping test; hydrochemical sampling
DHRES-11_967	Tal	Probe equilibrating	4017.0	4018.6	---	1.6	---	Unknown	Not discernable	---	---	
DHRES-11_705	Tal	4006.8	4016.4	---	---	---	---	---	---	---	Geokon malfunctioned late 2014	Pumping test; hydrochemical sampling
APACHE LEAP TUFF AQUIFER - EAST SECTOR												
HRES-14	Tal	3684.4	3680.6	3680.1	-4.3	-0.5	Declining	Drought	Not discernable	---	Water levels starting to stabilize in 2015	Strong influence from HRES-20 pumping test in 2013; data gap due to probe issue
HRES-15	Tal and Tev	3671.3	3669.0	3668.8	-2.5	-0.2	Declining	Drought	Not discernable			Strong influence from HRES-20 pumping test in 2013
HRES-16	Tal	3618.8	3616.4	3616.3	-2.5	-0.1	Declining	Drought	Winter recharge	Infiltration of surface water	Water levels starting to stabilize in 2015	Probe shift in 2014
HRES-17	Tal	3651.2	3649.0	3648.6	-2.5	-0.3	Declining	Drought	Recharge variability	Infiltration of surface water	Water levels gradually declining	Pumping test; probe shift in 2013
HRES-18	Tal	3402.6	3396.0	3394.9	-7.6	-1.1	Declining	Drought	Not discernable	---	Unexplained changes in water level in 2011	Probe shift in 2011/2012
HRES-20	Tal	---	3669.6	3669.0	---	-0.6	Stable	---	Not discernable		Long recovery from pumping test	Pumping test; probe drift in 2014 and 2015
A-06	Tal	3646.4	3644.0	3643.7	-2.7	-0.3	Declining	Drought	Recharge pulses	Recharge pulses from adjacent drainages	Water levels starting to stabilize in 2015	Moderate influence from HRES-20 pumping test in 2013
MJ-11	Tal	3615.7	3615.4	3615.1	-0.6	-0.4	Declining	Drought	Possible seasonal winter recharge	Influenced by recharge pulses from adjacent drainages	Unexplained drop in water level in 2008; water levels starting to stabilize in 2015	
DHRES-14_1214	Tal	3982.6	3978.9	3978.7	-3.9	-0.2	Declining	---	Not discernable	---	Unexplained instantaneous water level drop of 1.68 feet in 2014	Coring at DHRES-14
DHRES-14_1071	Tal	3655.8	3642.0	3641.2	-14.6	-0.9	Declining	---	Not discernable	---	Shift occurred in 2013 possibly due to HRES-20 long-term pumping test; unexplained instantaneous water level drop of 5.94 feet in 2014	Coring at DHRES-14
APACHE LEAP TUFF AQUIFER - OAK FLAT SECTOR												
HRES-03S	Tal	3783.8	3782.2	3781.2	-2.6	-1.0	Declining	Drought	Recharge variability	Infiltration of surface water in Devils Canyon		
HRES-03D	Tal	3790.5	3789.6	3789.2	-1.3	-0.4	Declining	Drought	Seasonal recharge in winter	Infiltration of surface water in Devils Canyon	More subdued response to recharge; upward vertical hydraulic gradient evident at HRES-03 site	
Oak Flat Well	Tal	3783.9	3782.3	3781.1	-2.8	-1.2	Declining	Drought	Seasonal recharge mainly in spring	Infiltration of surface water		

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WELL IDENTIFIER	Geologic Unit	Water Level or Head Elevation in Q3/Q4 2011 (ft, amsl)	Water Level or Head Elevation in Q3/Q4 2014 (ft, amsl)	Water Level or Head Elevation in Q4 2015 (ft, amsl)	4-Year Change in Water Level (2011 - 2015) (feet)	1-Year Change in Water Level (2014 - 2015) (feet)	Overall Trend in Head	Cause of Overall Trend	Short-Term Natural Variability Influences	Cause of Short-Term Natural Variability Influences to Head	Comments	Anthropogenic Variability Influences
APACHE LEAP TUFF AQUIFER - SOUTHWEST SECTOR												
HRES-01	Tal	---	---	---	---	---	---	---	Unknown	---	Presence of natural variability unknown due to large-scale anthropogenic influence; water level data not collected after May 2010	Installation and removal of packer; lost circulation events; sinking Shaft No. 10
HRES-02	Tal	3685.7	3683.4	3686.7	1.0	3.2	Stable	Trend in precipitation	Recharge variability	Potentially enhanced local recharge due to adjacent stock pond	Natural influences partially obscured by anthropogenic influences; general trend also observed in piezometer DHRES-02_915; water levels starting to stabilize in 2015	Lost circulation events; pumping tests
HRES-04	Tal	3673.3	3673.9	3673.7	0.4	-0.2	Declining	Drought	Recharge variability	Infiltration of surface water	Natural influences partially obscured by anthropogenic influences; anthropogenic influences result in base level shift of hydrograph both upward and downward; lost access to well in 2015;	Lost circulation events; pumping tests
HRES-05	Tal	3671.5	3672.2	3672.1	0.6	-0.1	Declining	Drought	Recharge variability	Infiltration of surface water	Anthropogenic influences result in base level shift of hydrograph both upward and downward; water levels starting to stabilize in 2015	Lost circulation events; pumping tests
HRES-07	Tal	3634.4	3633.5	---	---	---	Declining	Drought	Possible seasonal recharge in winter	Infiltration of surface water	Natural influences partially obscured by anthropogenic influences	Pumping tests
HRES-08	Tal	3859.0	3859.1	3858.3	-0.7	-0.8	Declining	Drought	Recharge variability	---	Rate of decline increases in 2015	Adjacent drilling; pumping test
HRES-09	Tal	3671.4	3672.1	3671.9	0.6	-0.2	Declining	Drought	Seasonal recharge in winter	Infiltration of surface water	Anthropogenic influences result in base level shift of hydrograph both upward and downward	Adjacent drilling; hydrophysical testing; pumping tests; lost circulation events
HRES-13	Tal	3728.5	3726.1	3724.8	-3.7	-1.3	Declining	Drought	Minor seasonal recharge in winter	Infiltration of surface water		Pumping test
HRES-19	Tal	3634.0	3633.5	3633.6	-0.4	0.1	Stable	---	---	---	Sparse water level data from quarterly manual measurements	
HRES-21	Tal	---	3668.6	3673.0	---	4.4	Stable	---	Possible minor seasonal recharge in winter; observed winter	---	Sparse water level data from quarterly manual measurements	
DHRES-01_973	Tal	3659.0	3662.1	3677.8	18.9	15.8	Stable	Trend in precipitation	Recharge variability	Surface water interaction	Tracks well with HRES-04	Lost circulation; nearby drilling; pumping tests
DHRES-01_772	Tal	3643.0	3643.4	3646.7	3.7	3.3	Stable	---	Not discernable	---	Anthropogenic influences result in base level shift of hydrograph both upward and downward	Lost circulation; nearby drilling; pumping tests
DHRES-02_915	Tal	3685.7	3683.4	3683.8	-2.0	0.3	Stable	Trend in precipitation	Recharge variability	Surface water interaction	---	
DHRES-06_1152	Tal	3853.4	3853.9	3853.1	-0.2	-0.7	Stable	Drought	Not discernable	---	Head decline is gradual through 2014 and increases starting in 2015	Deepening DHRES-06; pumping tests
DHRES-07_920	Tal	3653.4	3651.1	3650.4	-3.0	-0.8	Declining	Drought	Seasonal recharge in winter	Infiltration of surface water	Anthropogenic influences result in base level shift of hydrograph both upward and downward	Nearby drilling; pumping tests; hydrophysical testing
DHRES-08_980	Tal	3655.7	3652.1	3651.5	-4.1	-0.6	Declining	Drought	Unknown	---	---	Pumping tests; lost circulation
APACHE LEAP TUFF AQUIFER - SOUTHEAST SECTOR												
HRES-10	Tal	2866.2	2876.1	2858.1	-8.2	-18.1	Declining	Drought	Fluxuations of up to 50 feet in response to winter recharge	Precipitation-driven runoff events resulting in rapid recharge followed by rapid dissipation	Seasonal high and low water levels show general decline over time	
HRES-11	Tal	2827.2	2825.9	2824.7	-2.5	-1.2	Declining	Drought	Not discernable	---	Early 2013 rise in water level due to local recharge from stock pond, likely anthropogenic	Pumping test

TABLE 4. SUMMARY OF WATER LEVEL/TOTAL HEAD CHANGE, GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	Geologic Unit	Water Level or Head Elevation in Q3/Q4 2011 (ft, amsl)	Water Level or Head Elevation in Q3/Q4 2014 (ft, amsl)	Water Level or Head Elevation in Q4 2015 (ft, amsl)	4-Year Change in Water Level (2011 - 2015) (feet)	1-Year Change in Water Level (2014 - 2015) (feet)	Overall Trend in Head	Cause of Overall Trend	Short-Term Natural Variability Influences	Cause of Short-Term Natural Variability Influences to Head	Comments	Anthropogenic Variability Influences
DEEP GROUNDWATER SYSTEM - EAST OF CONCENTRATOR FAULT - INSIDE GRABEN												
DHRES-01_683	Tw2	3632.0	3627.4	3629.5	-2.5	2.1	Declining	---	Not discernable	---	Presence of natural variability unknown due to anthropogenic influence	Lost circulation; nearby drilling; pumping tests
DHRES-01_374	Tw3	3437.4	3267.3	3234.1	-203.4	-33.2	Declining	Shaft dewatering	Not discernable	---	Presence of natural variability unknown due to large-scale anthropogenic influence	Shaft No. 10 dewatering
DHRES-01_66	Tw3	2488.2	1607.9	1433.4	-1054.8	-174.5	Declining	Shaft dewatering	Not discernable	---	Presence of natural variability unknown due to large-scale anthropogenic influence	Shaft No. 10 dewatering
DHRES-01 WL	Kvs	1631.5	272.6	11.0	-1620.4	-261.5	Declining	Shaft dewatering	Not discernable	---	Presence of natural variability unknown due to large-scale anthropogenic influence	Shaft No. 10 dewatering
DHRES-02_666	Tw2	3646.6	3632.6	3641.5	-5.1	8.9	Declining	Poroelastic deformation	Not discernable	---	Head increase is likely a result of poroelastic deformation related to shaft dewatering	Nearby drilling; pumping test
DHRES-02_608	Tw2	3673.9	3680.2	3684.9	10.9	4.7	Increasing	Poroelastic deformation	Not discernable	---	Head increase is likely a result of poroelastic deformation related to shaft dewatering	Nearby drilling; pumping test
DHRES-02_458	Tw3	3617.7	3626.4	3628.3	10.6	1.9	Increasing	Poroelastic deformation	Not discernable	---	Head increase is likely a result of poroelastic deformation related to shaft dewatering	Nearby drilling; pumping test
DHRES-02_319	Tw3	3470.1	3360.4	3345.6	-124.6	-14.9	Declining	Shaft dewatering, poroelastic deformation	Not discernable	---	Head increase is likely a result of poroelastic deformation related to shaft dewatering	Nearby drilling; pumping test
DHRES-02 WL	Kvs and pCy	1266.7	-47.1	-293.6	-1560.3	-246.4	Declining	Shaft dewatering	Not discernable	---	Presence of natural variability unknown due to large-scale anthropogenic influence	
DHRES-08_792	Tw2	3522.3	3549.6	3554.5	32.3	4.9	Increasing	Poroelastic deformation	Not discernable	---	---	Pumping tests; lost circulation
DHRES-08_512	Tw3	3234.6	2974.6	2901.0	-333.6	-73.6	Declining	Shaft dewatering	Not discernable	---	Rate of decline in head is decreasing	Shaft No. 10 dewatering
DHRES-08_406	Kvs	2412.0	2188.3	2074.3	-337.6	-114.0	Declining	Shaft dewatering	Not discernable	---	Head decline rate increasing	Shaft No. 10 dewatering
DHRES-08_196	Kvs	2447.9	2175.3	2061.0	-386.9	-114.3	Declining	Shaft dewatering	Not discernable	---	Head decline rate increasing	Shaft No. 10 dewatering
DHRES-08_-231	Kvs	1600.9	555.7	336.4	-1264.5	-219.3	Declining	Shaft dewatering	Not discernable	---	Rapid decline rate until mid 2013 and then decline rate decreases	Shaft No. 10 dewatering
DHRES-08_-580	pCy	1673.3	---	---	---	---	---	---	---	---	Geokon failure; general trend before probe failure due to shaft dewatering, upward gradient	
DHRES-08_-657	pCy	1695.6	---	---	---	---	---	---	---	---	Geokon failure; general trend before probe failure due to shaft dewatering, upward gradient	
DEEP GROUNDWATER SYSTEM - EAST OF CONCENTRATOR FAULT - OUTSIDE GRABEN												
RES-03		1561.6	---	---	---	---	---	---	---	---	Tracks well with water level decline in Resolution Graben	
DHRES-06_1022	Tw3	3812.4	3805.2	3808.5	-4.0	3.3	Declining	Unknown	Not discernable	---	Upward vertical gradient evident between DHRES-06_994 and DHRES-06_1022	Pumping tests; equipment installation/removal at HRES-08
DHRES-06_994	Tw3	3823.1	3817.1	3819.3	-3.8	2.2	Declining	Unknown	Not discernable	---	Upward vertical gradient evident between DHRES-06_994 and DHRES-06_1022	Pumping tests; equipment installation/removal at HRES-08
DHRES-06_928	Tw3	3694.0	3702.9	3701.3	7.3	-1.6	Increasing	Poroelastic deformation	Not discernable	---	---	Pumping tests
DHRES-06 WL	Pz and pCy	3246.8	3251.9	3241.4	-5.4	-10.5	Declining	Unknown	Not discernable	---	Anthropogenic influences result in base level shift of hydrograph downward	Pumping tests
DHRES-07_800	Tw	3661.1	3675.6	3677.7	16.6	2.1	Increasing	Poroelastic deformation	Not discernable	---	---	Drilling lower completion from Shaft 10 dewatering
DHRES-07_374	Tw	3401.2	3391.3	3387.3	-13.9	-4.0	Declining	Poroelastic deformation, possible grout column failure	Not discernable	---	Anthropogenic influences result in base level shift of hydrograph both upward and downward; piezo still possibly recovering from long-term pumping test at DHRES-15	Drilling lower completion; pumping tests

TABLE 4. SUMMARY OF WATER LEVEL/TOTAL HEAD CHANGE, GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	Geologic Unit	Water Level or Head Elevation in Q3/Q4 2011 (ft, amsl)	Water Level or Head Elevation in Q3/Q4 2014 (ft, amsl)	Water Level or Head Elevation in Q4 2015 (ft, amsl)	4-Year Change in Water Level (2011 - 2015) (feet)	1-Year Change in Water Level (2014 - 2015) (feet)	Overall Trend in Head	Cause of Overall Trend	Short-Term Natural Variability Influences	Cause of Short-Term Natural Variability Influences to Head	Comments	Anthropogenic Variability Influences
DHRES-07_169	Tw	3097.7	3032.5	3018.4	-79.4	-14.2	Declining	Shaft dewatering, possible grout column failure	Not discernable	---	Piezometer recovered from long-term pumping test at DHRES-15 and declining again	Drilling lower completion; pumping tests; Shaft No. 10 dewatering
DHRES-07_95	Pz	3035.5	3018.0	3014.9	-20.6	-3.1	Declining	Shaft dewatering, possible grout column failure	Not discernable	---	---	Drilling lower completion; pumping tests; Shaft No. 10 dewatering
DHRES-07_-108	Pz	2963.9	2897.1	2889.7	-74.2	-7.4	Declining	Shaft dewatering	Rapid head rises followed by slower recession	Fracture flow	---	Shaft No. 10 dewatering; pumping test; lost circulation
DHRES-07 WL	pCy	2846.2	2897.7	2906.5	60.3	8.7	Increasing	Unknown	Not discernable	---	Poroelastic deformation, delayed recovery from cessation of shaft dewatering in 1998, equilibration across well screen, or bad data	Unknown
DHRES-09 WL	pCy	2981.5	2953.8	2947.4	-34.1	-6.5	Declining	Unknown	Not discernable	---	Decline rate possibly due to Shaft No. 10 dewatering	
DHRES-11_565	Tev	3842.6	3845.2	3843.6	1.0	-1.6	Stable	Unknown	Not discernable	---	---	Pumping test; hydrochemical sampling
DHRES-11_457	Tw2	3783.7	3769.6	3768.5	-15.3	-1.1	Declining	Possible poroelastic deformation and shaft dewatering	Unknown	---	---	Shaft No. 10 dewatering; pumping test; hydrochemical sampling
DHRES-11_320	Tw3	3744.8	3732.4	3715.6	-29.2	-16.8	Declining	Shaft dewatering	Unknown	---	---	Shaft No. 10 dewatering; pumping test
DHRES-11_214	Pz	3713.3	3677.7	---	---	---	---	Shaft dewatering	Unknown	---	Sensor malfunctioning in 2015	Shaft No. 10 dewatering; pumping test
DHRES-11 WL	Pz and pCy	3301.1	3024.4	2954.8	-346.3	-69.6	Declining	Shaft dewatering	Unknown	---	Declining trend is linear, cause of variability is unknown	Shaft No. 10 dewatering; pumping test
DHRES-13_846	pCy	2960.5	2931.4	2928.3	-32.2	-3.1	Declining	Shaft dewatering	Not discernable	---	---	Shaft No. 10 dewatering; pumping test
DHRES-13_788	pCy	2878.6	2854.8	2848.9	-29.7	-5.9	Declining	Shaft dewatering	Not discernable	---	---	Shaft No. 10 dewatering
DHRES-13_730	pCy	2876.8	2853.6	2847.8	-29.1	-5.8	Declining	Shaft dewatering	Not discernable	---	---	Shaft No. 10 dewatering
DHRES-13_649	pCy	2854.3	2833.3	2825.3	-29.1	-8.1	Declining	Shaft dewatering	Not discernable	---	---	Shaft No. 10 dewatering; pumping tests
DHRES-13 WL	pCy and pCpi	2777.4	2723.1	2709.2	-68.2	-13.9	Declining	Shaft dewatering	Not discernable	---	---	Shaft No. 10 dewatering; pumping tests
DHRES-14_888	Tw3	3645.8	3615.8	3613.0	-32.9	-2.9	Declining	---	Not discernable	---	Minor shift in 2013 associated with HRES-20 long-term pumping test; unexplained instantaneous water level drop of 12.31 feet in 2014	Coring at DHRES-14
DHRES-14_822	Tw3	3629.8	3619.7	3621.4	-8.4	1.7	Declining	Possible poroelastic deformation	Not discernable	---	Head increasing since early 2014	Coring at DHRES-14
DHRES-14 WL	Tw3 and pCpi	---	3483.1	3484.7	---	1.7	Stable since 2014	---	Not discernable	---	Unexplained instantaneous water level drop of 0.79 feet in 2014	
DHRES-15_710	Tw3	---	3547.5	3539.3	---	-8.2	---	---	Unknown	---	Head increasing since recovery of DHRES-15 long-term pumping test	
DHRES-15_398	Pz	---	3418.1	3376.2	---	-41.9	---	---	Unknown	---	Head declining since recovery of DHRES-15 long-term pumping test	Shaft No. 10 dewatering; pumping tests
DHRES-15_355	Pz	---	3301.4	3261.8	---	-39.5	---	---	Unknown	---	Head declining since recovery of DHRES-15 long-term pumping test	Shaft No. 10 dewatering; pumping tests
DHRES-15 WL	Pz and pCy	---	---	3238.2	---	---	---	---	Unknown	---	Water level recovered through 2015 and has been stable since	
SHAFT No. 9[a]	---	-211.0	-510.0	-510.0	-299.0	0.0	Declining	Shaft dewatering	---	---	---	
SHAFT No. 10[b]	---	-675	-2774.0	-2774.0	-2099.0	0.0	Declining	Shaft dewatering	---	---	---	

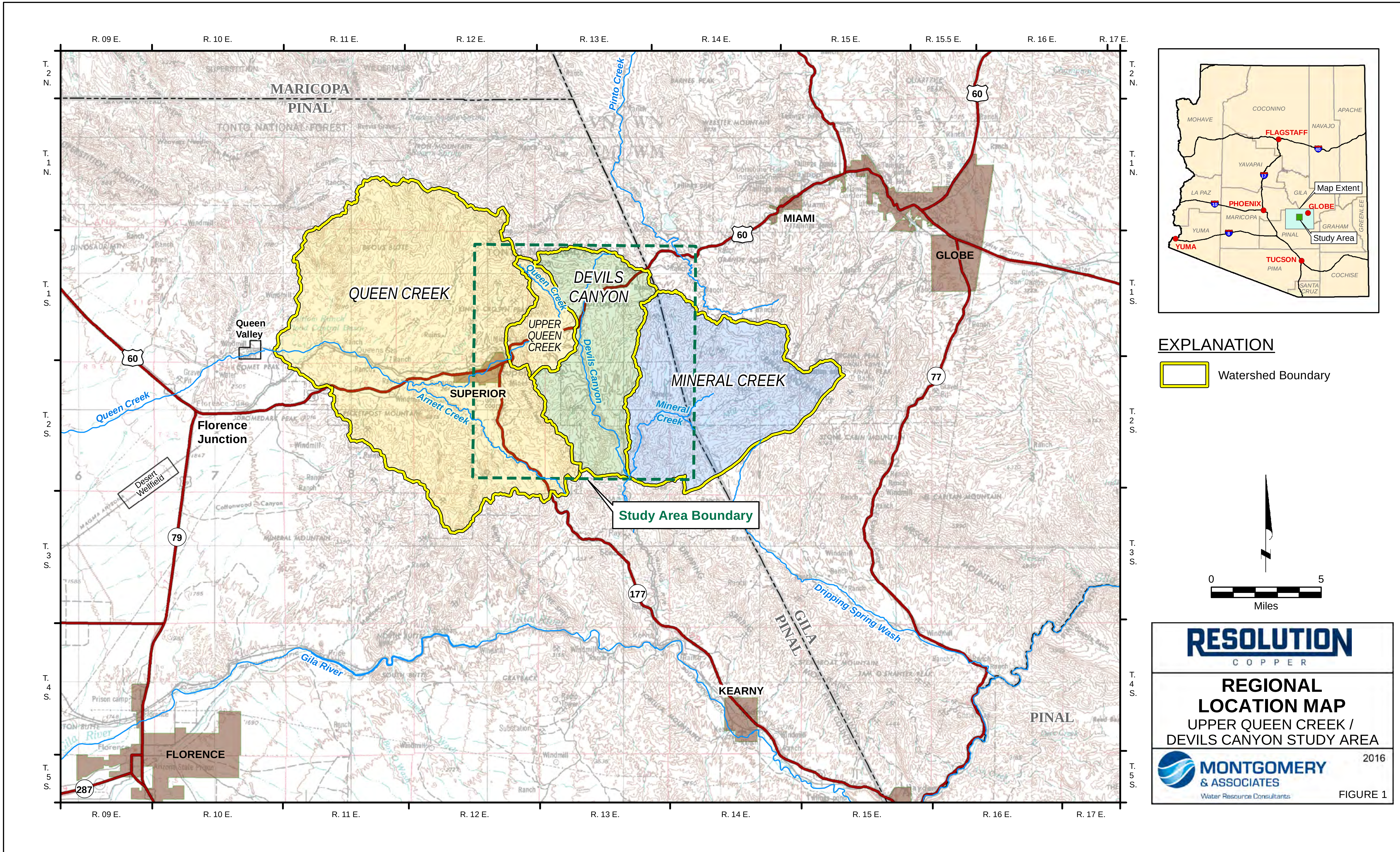
TABLE 4. SUMMARY OF WATER LEVEL/TOTAL HEAD CHANGE, GROUNDWATER LEVEL MONITORING PROGRAM
RESOLUTION COPPER MINING LLC, PINAL COUNTY, ARIZONA

WELL IDENTIFIER	Geologic Unit	Water Level or Head Elevation in Q3/Q4 2011 (ft, amsl)	Water Level or Head Elevation in Q3/Q4 2014 (ft, amsl)	Water Level or Head Elevation in Q4 2015 (ft, amsl)	4-Year Change in Water Level (2011 - 2015) (feet)	1-Year Change in Water Level (2014 - 2015) (feet)	Overall Trend in Head	Cause of Overall Trend	Short-Term Natural Variability Influences	Cause of Short-Term Natural Variability Influences to Head	Comments	Anthropogenic Variability Influences
GROUNDWATER SYSTEM - WEST OF CONCENTRATOR FAULT												
DHRES-03_782	QTg	2737.0	2724.7	2723.15	-13.9	-1.6	Declining	Unknown	Not discernable	---	Head begins to increase in early 2010; peaks in early 2011 and begins to decline	
DHRES-03_729	QTg	2669.6	2658.6	2657.2	-12.4	-1.4	Declining	Unknown	Not discernable	---	Head begins to increase in early 2010; peaks in mid 2011 and begins to decline	
DHRES-03_539	QTg	2590.9	2578.1	2573.58	-17.3	-4.5	Declining	Unknown	Not discernable	---	Head begins to increase in early 2010; peaks in mid to late 2011 and begins to decline	
DHRES-03_335	Tvs	2528.6	2505.4	2497.2	-31.4	-8.2	Declining	Unknown	Not discernable	---	Head begins to increase in early 2010; peaks in late 2011 and begins to decline	
DHRES-04 WL	QTg	2627.5	2607.6	2602.0	-25.5	-5.6	Declining	Unknown	Not discernable	---	Increase in water level in early 2010; peaks in late 2011/early 2012; water level declining	
DHRES-05B	Tal	2621.6	2594.5	2581.1	-40.5	-13.4	Declining	Unknown	Not discernable	---	---	Possible influence from Shaft No. 10 dewatering
DHRES-16_743	QTg	---	2599.0	2485.9	---	-113.2	---	---	Possible seasonal recharge in spring; observed 2015/2016	Infiltration of surface water	---	Resident local pumping
DHRES-16_577	QTg	---	2618.9	2114.2	---	-504.7	---	---	Unknown	---	Gradually declining since early 2015	
DHRES-16_535	Tvs	---	2626.7	2019.5	---	-607.2	---	---	Unknown	---	Water level declining	
DHRES-16_287	Tvs	---	2620.7	1448.8	---	-1171.9	---	---	Unknown	---	Water level declining	
DHRES-16_-157	QTg and Tal	---	2484.2	408.1	---	-2076.1	---	---	Unknown	---	Change in head in early 2015 likely associated with grout equilibration; head rising since mid 2015	
DHRES-16_-387	Tal	---	2238.6	-186.3	---	-2424.9	---	---	Unknown	---	Head declining since mid 2015	

ft, amsl = ft above mean sea level

[a] Water level based on LevelTROLL in 2011 and bottom of Shaft No. 9 in 2014 and 2015

[b] Water level based on bottom of Shaft No. 10 in Q4



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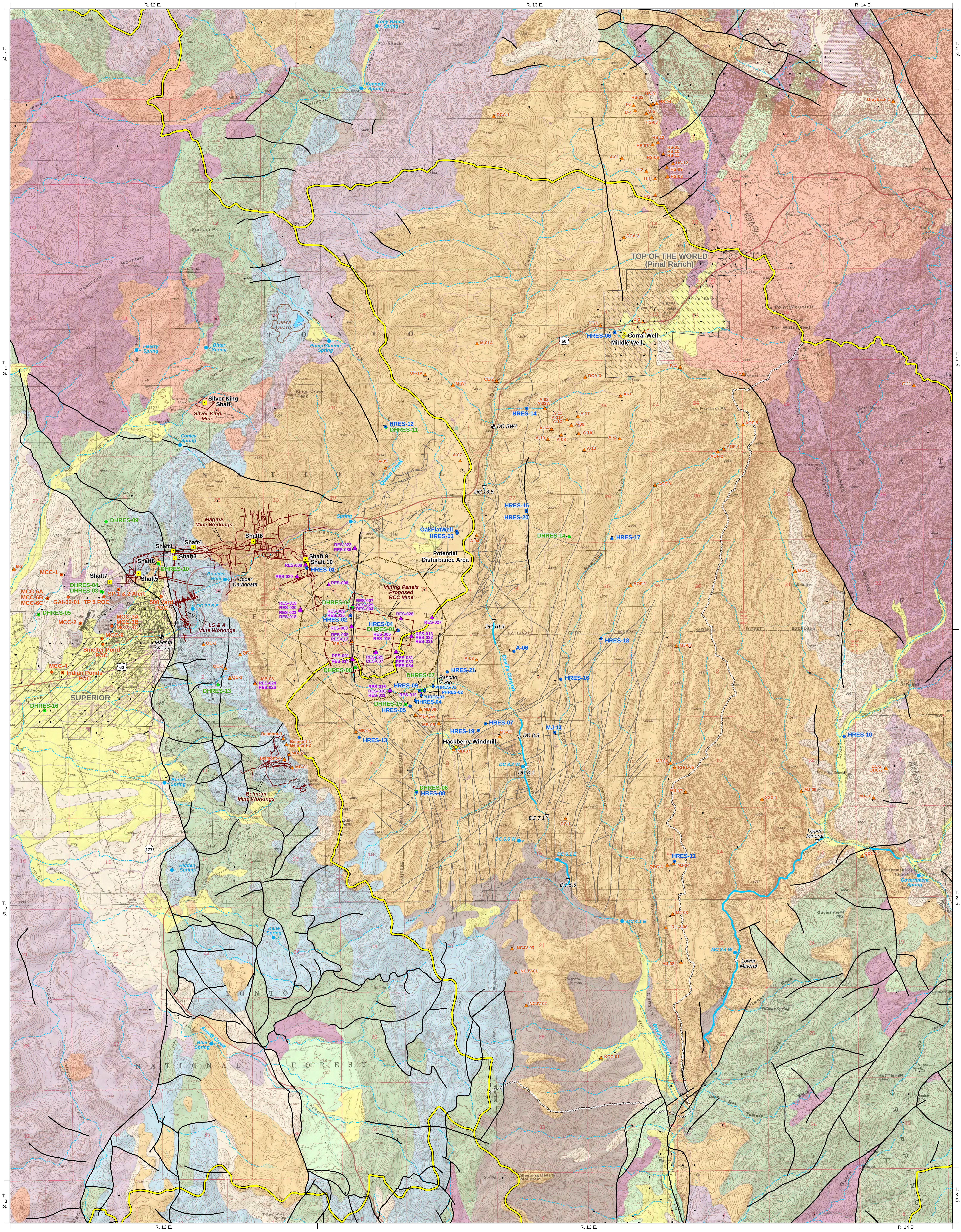

EXPLANATION

Middle Well	Shallow Alluvium Monitor Well and Identiifier
DHRES-11	Deep Groundwater System Monitor Well and Identifier
HRES-1,2	Apache Leap Tuff Monitor Well and Identifier
PHRES-04	Apache Leap Tuff Aquifer Piezometer and Identifier
MCC-1	West Plant Site Monitor Well and Identifier
Shaft 3	Shaft and Identifier
A-08	Superior District Exploration Borehole and Identifier
RES-30	Resolution Copper Exploration Borehole and Identifier
•	ADWR 55-Well Registry
DC SW1	Stream Gage - Permanent Installation
DC 5.5	Stream Gage - Data Sonde
	Perennial Stream
	Ephemeral Intermittent Stream
	Fault
	Watershed Boundary
	OMYA Standing Water

GEOLOGIC UNITS

d	Disturbed Surficial Deposits
Qal	Quaternary Alluvial Deposits
QTg	Quaternary-Tertiary Basin-Fill Deposits
Tal	Tertiary Apache Leap Tuff
Tvu	Tertiary Volcanic Rocks, undifferentiated
Tw	Tertiary Whitetail Conglomerate
TKg	Cretaceous and Tertiary Intrusive Rocks
Pz	Paleozoic Sedimentary Rocks
p€y	Younger Precambrian Sedimentary Rocks, Basalt, and Diabase
p€gu	Undifferentiated Precambrian Intrusive Rocks
p€pi	Older Precambrian Pinal Schist

0 1,000 2,000 3,000 4,000
Feet

RESOLUTION
COPPER

WELL LOCATION MAP

MONTGOMERY & ASSOCIATES
Water Resource Consultants

2015

FIGURE 2

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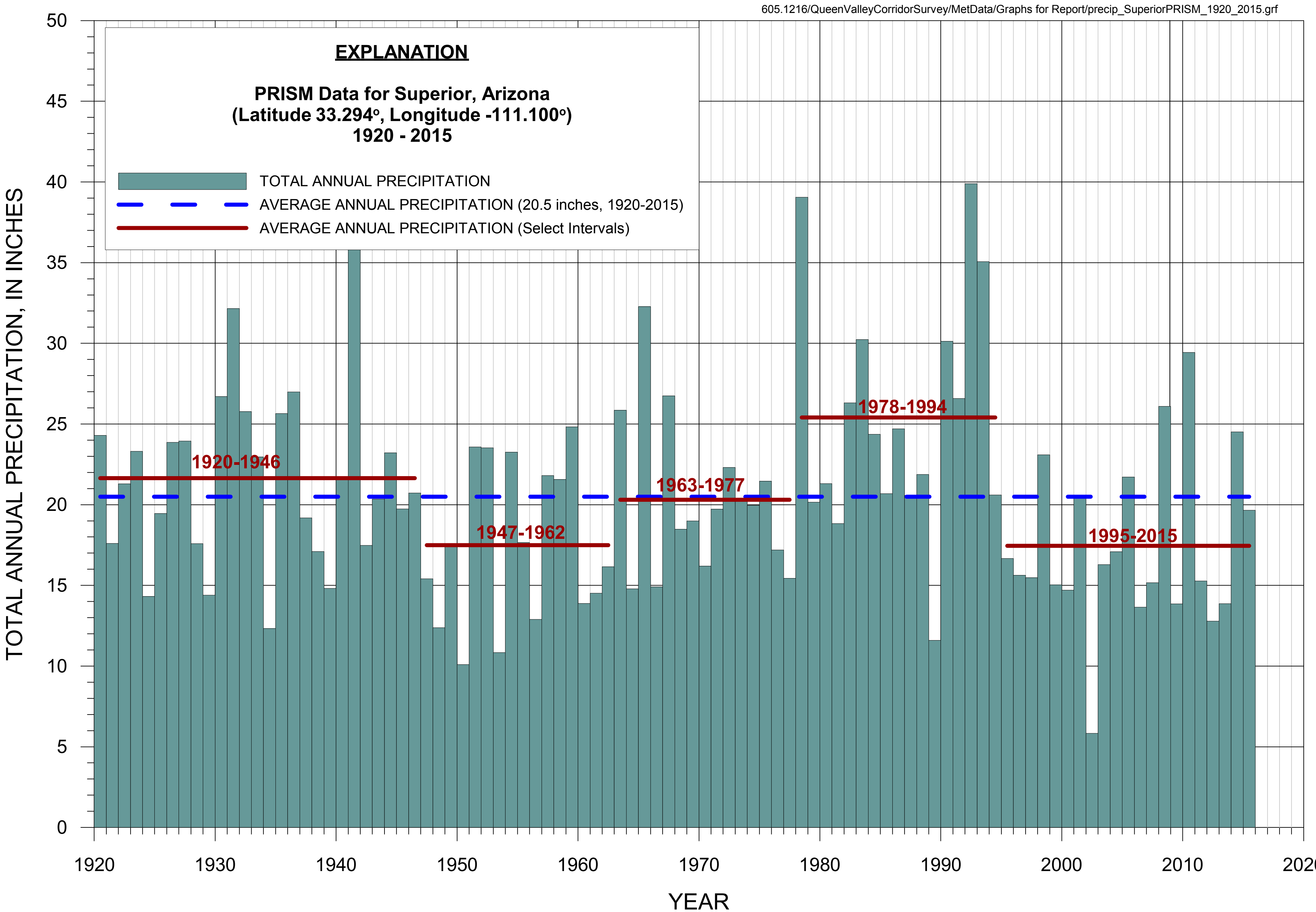

FIGURE 3. TOTAL ANNUAL PRECIPITATION, SUPERIOR, ARIZONA

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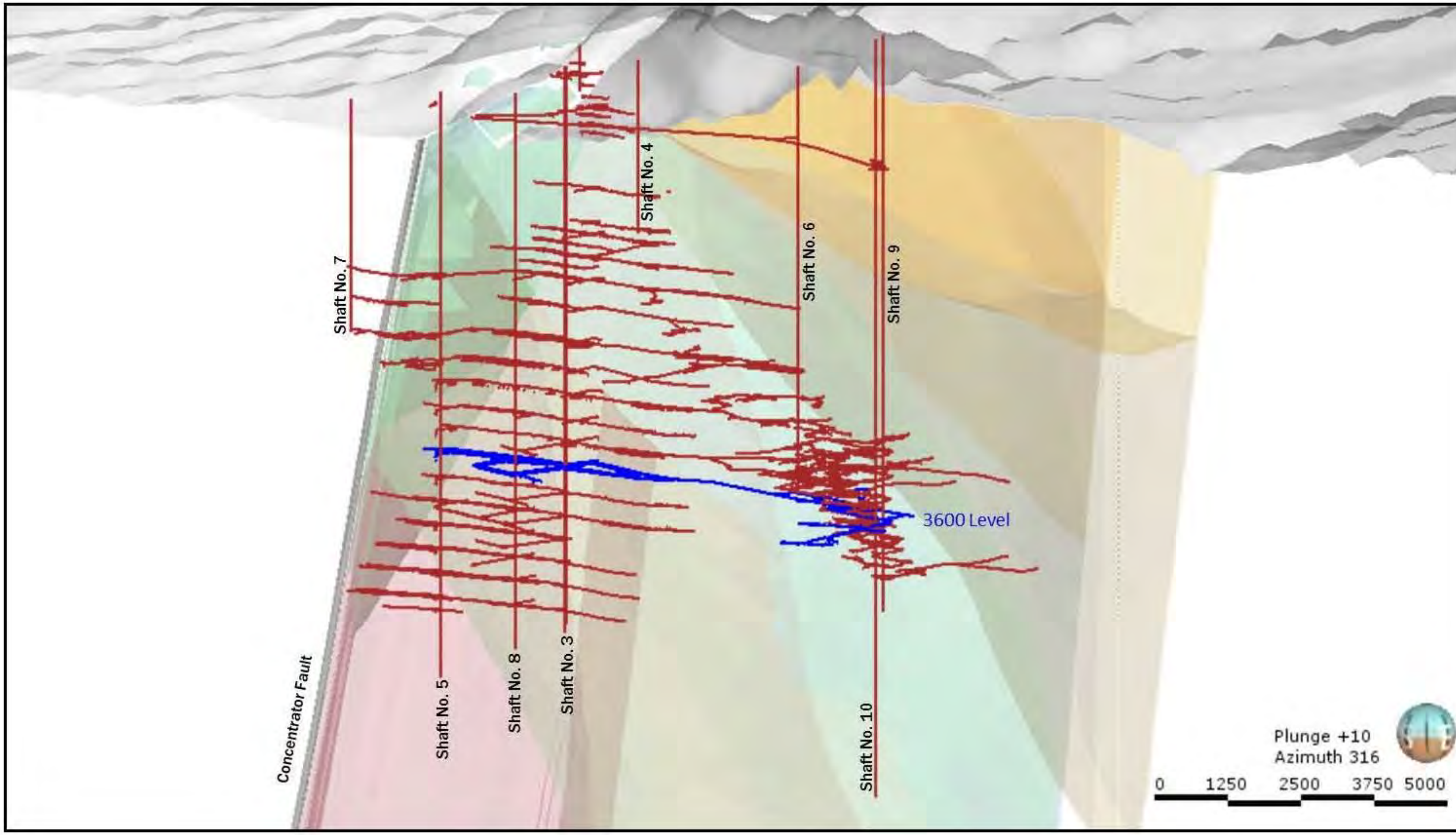

FIGURE 4. CUTAWAY DIAGRAM WITH OBLIQUE VIEW FROM SOUTHEAST OF MAGMA MINE WORKINGS AND SHAFTS

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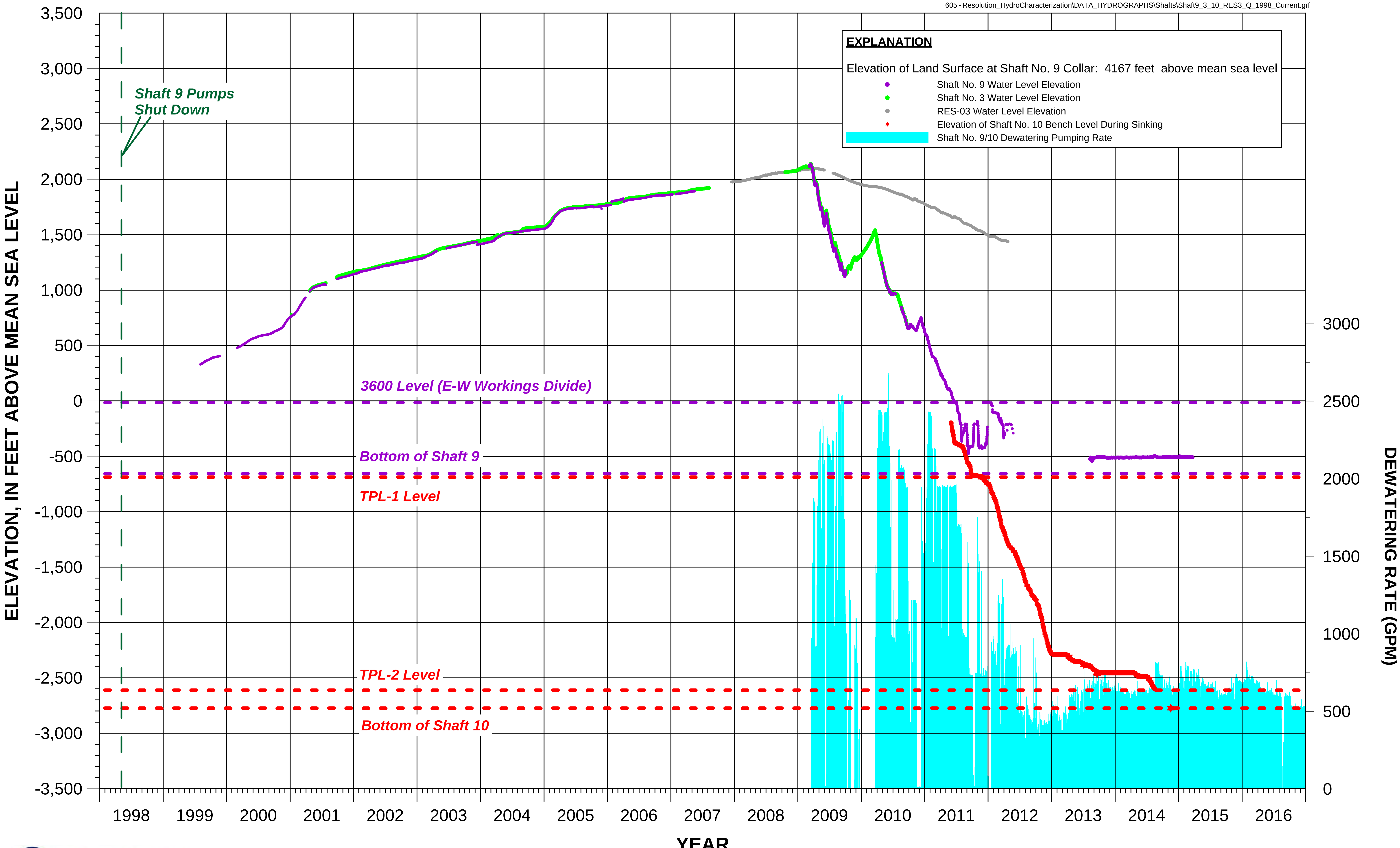

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FIGURE 5. HYDROGRAPH OF WATER LEVEL FOR SHAFTS No. 3 AND No. 9, AND SHAFT No. 10 BENCH LEVEL DURING SINKING

RESOLUTION COPPER

605/DATA/RES Series Boreholes/Timeline_All RES Holes Thru 2016.grf

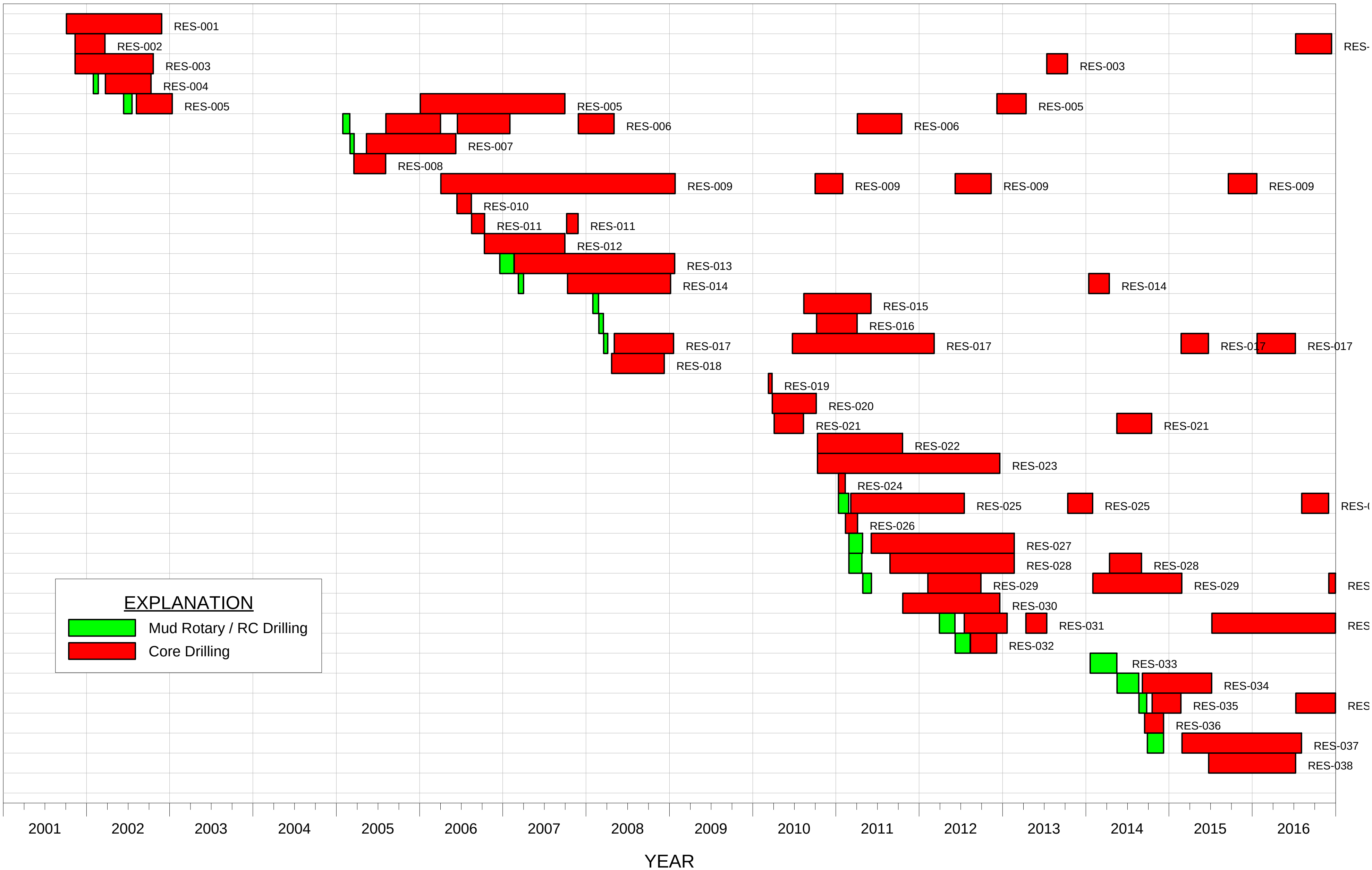

FIGURE 6. TIMELINE FOR DRILLING ACTIVITIES RELATED TO RESOLUTION COPPER MINERAL EXPLORATION

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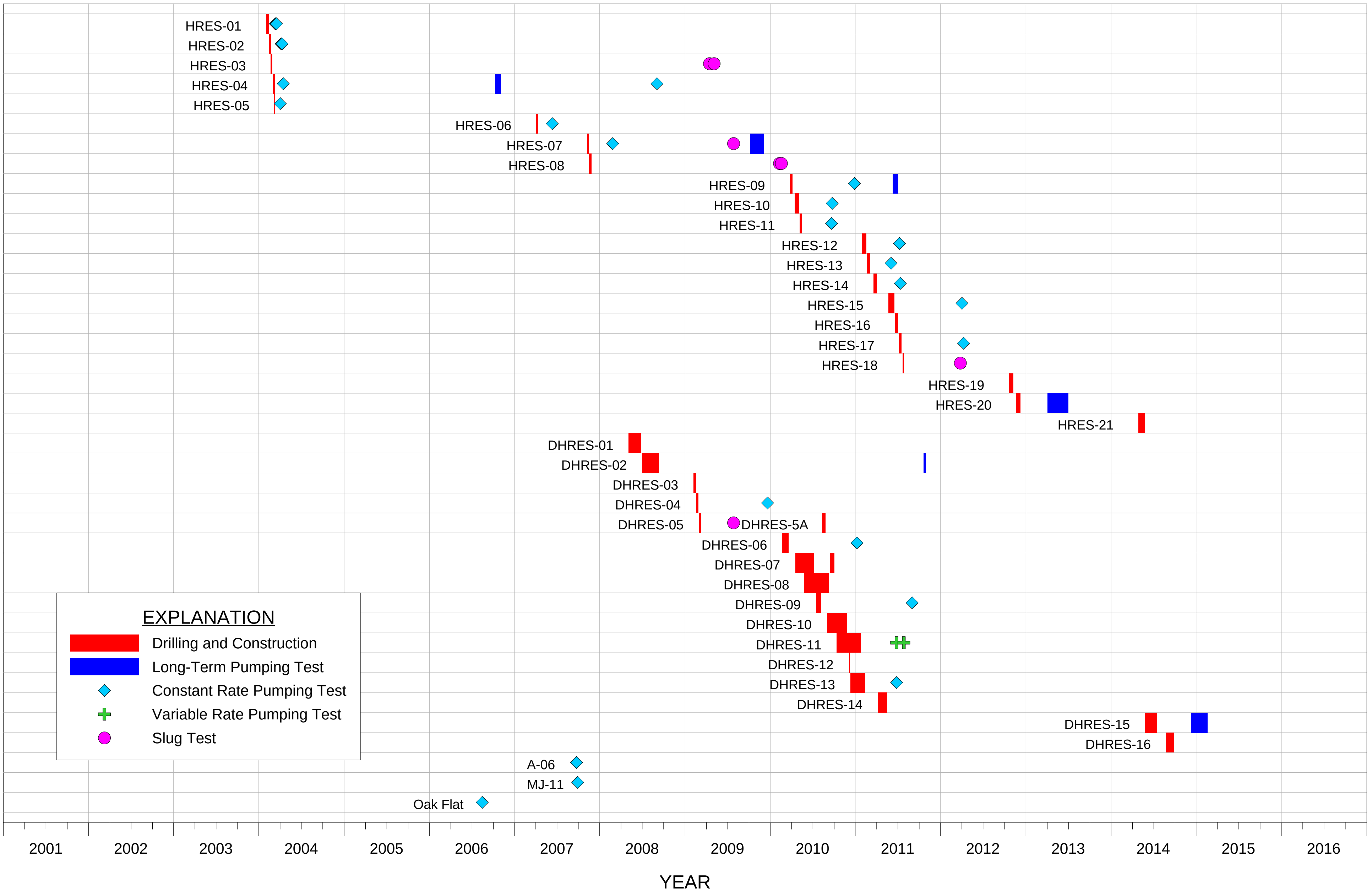

FIGURE 7. TIMELINE FOR DRILLING ACTIVITIES RELATED TO RESOLUTION COPPER HYDROGEOLOGIC CHARACTERIZATION STUDIES

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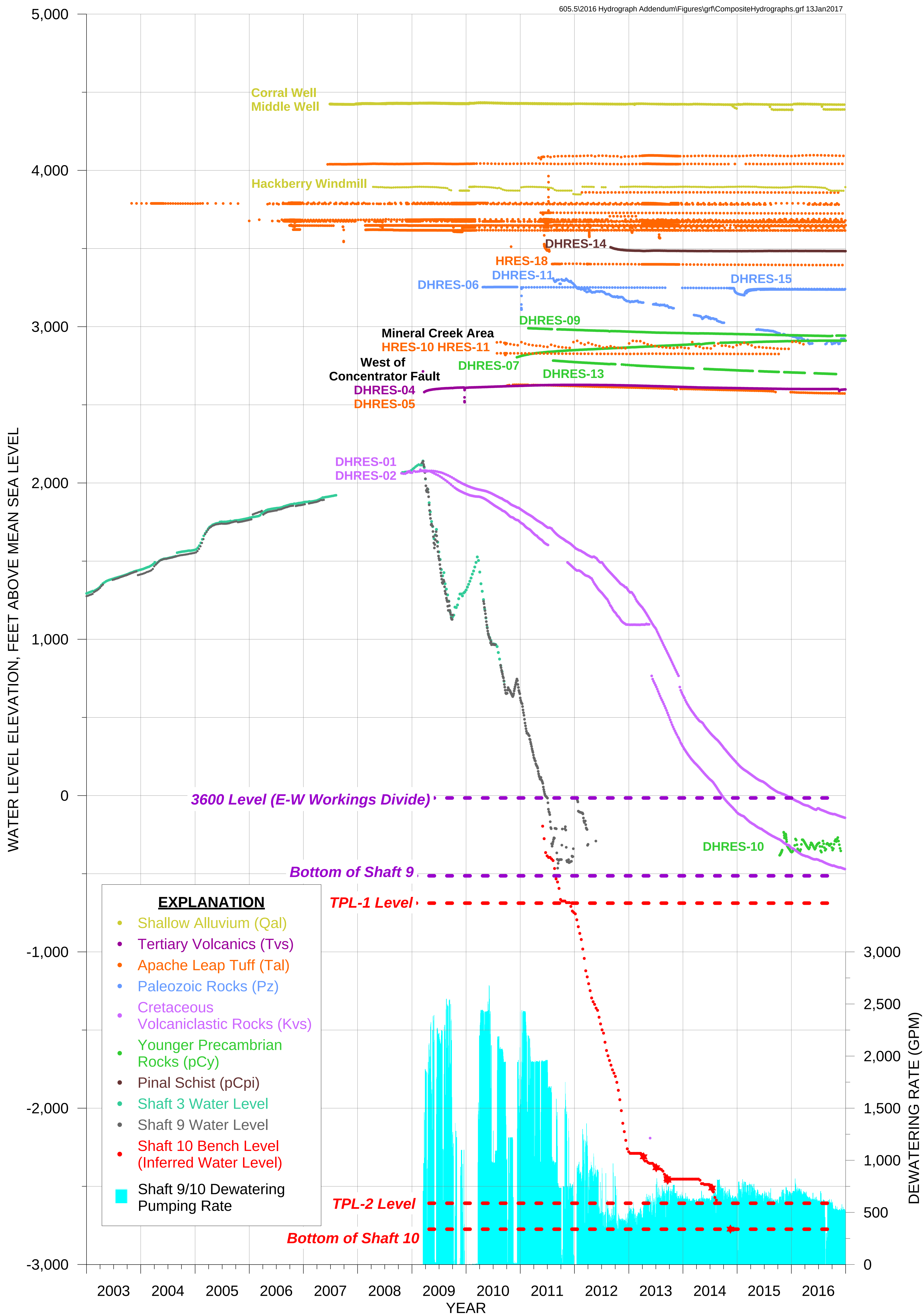

FIGURE 8. COMPOSITE WATER LEVEL HYDROGRAPHS FOR WELLS AND SHAFTS AND SHAFT DEWATERING RATE

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

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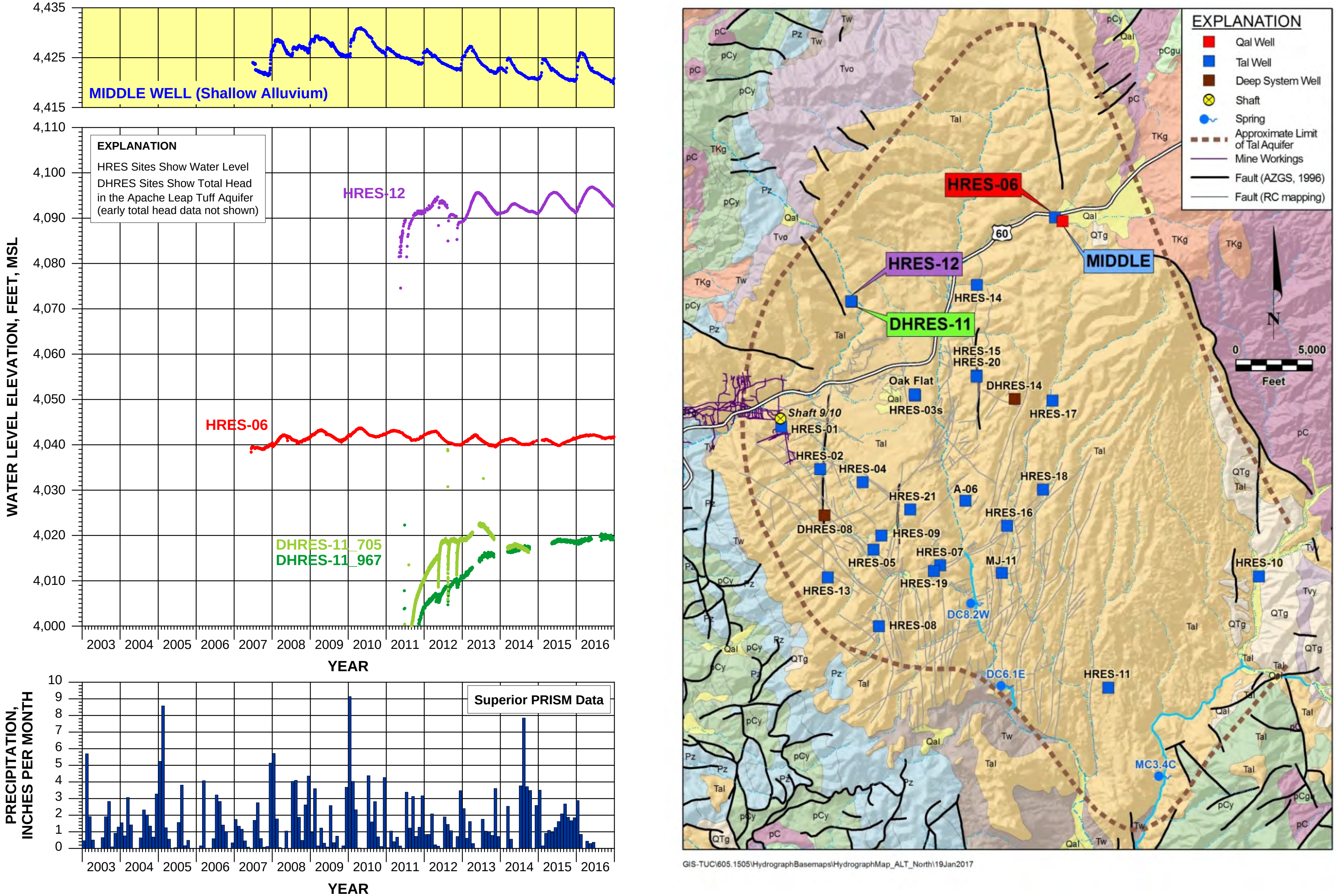

FIGURE 9. WATER LEVEL AND TOTAL HEAD HYDROGRAPHS FOR APACHE LEAP TUFF AQUIFER WELLS – NORTH SECTOR

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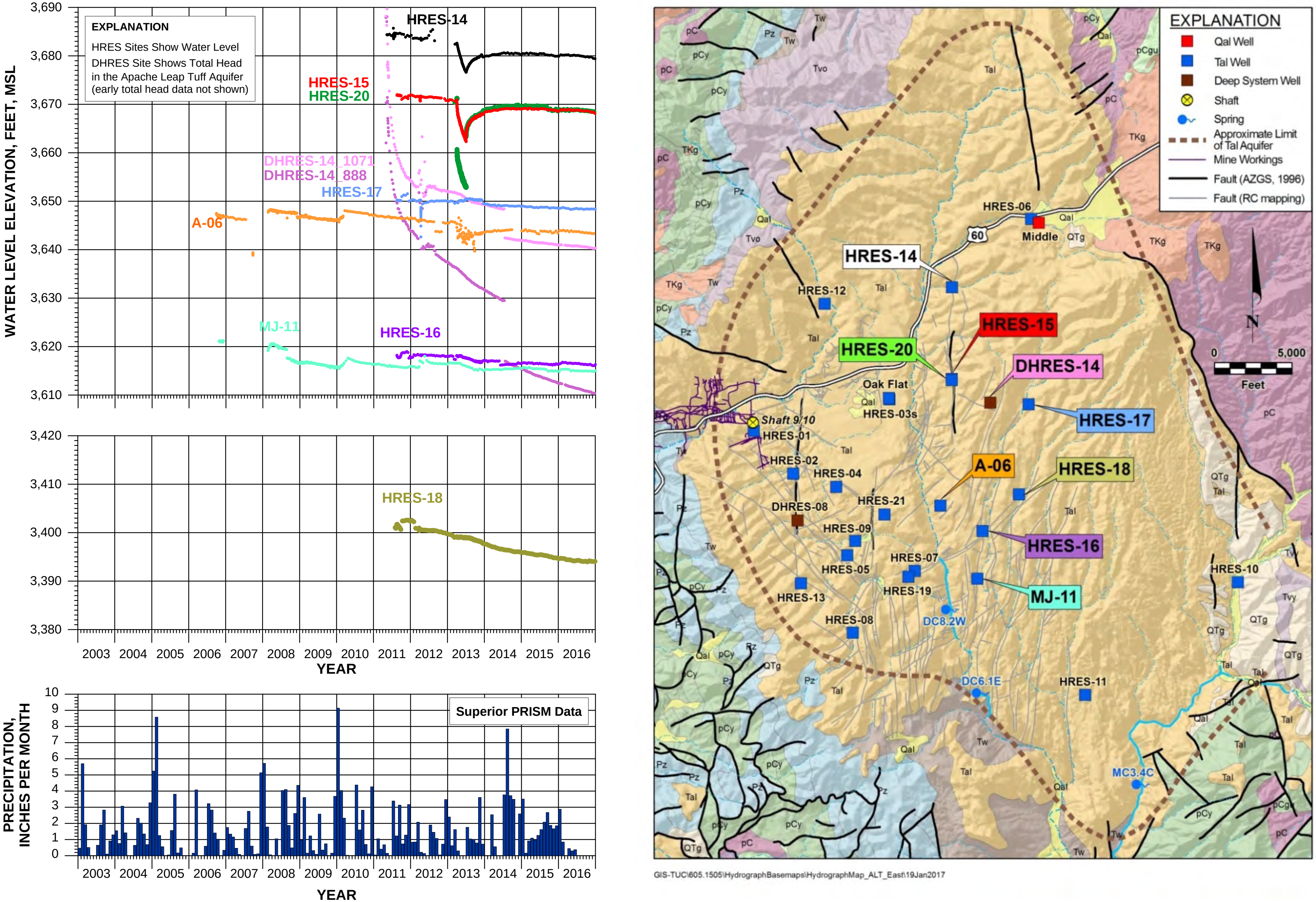
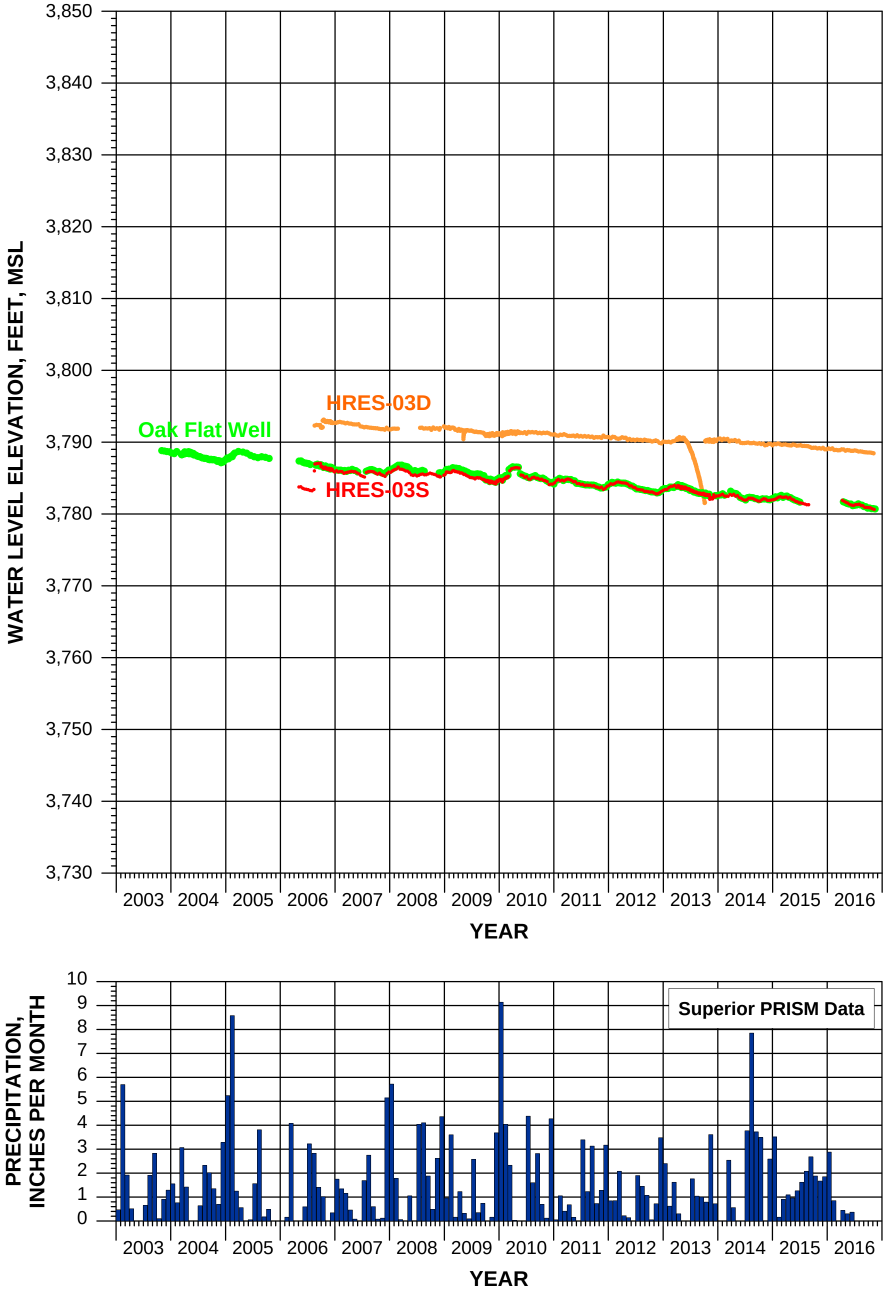


FIGURE 10. WATER LEVEL AND TOTAL HEAD HYDROGRAPHS FOR APACHE LEAP TUFF AQUIFER WELLS – EAST SECTOR



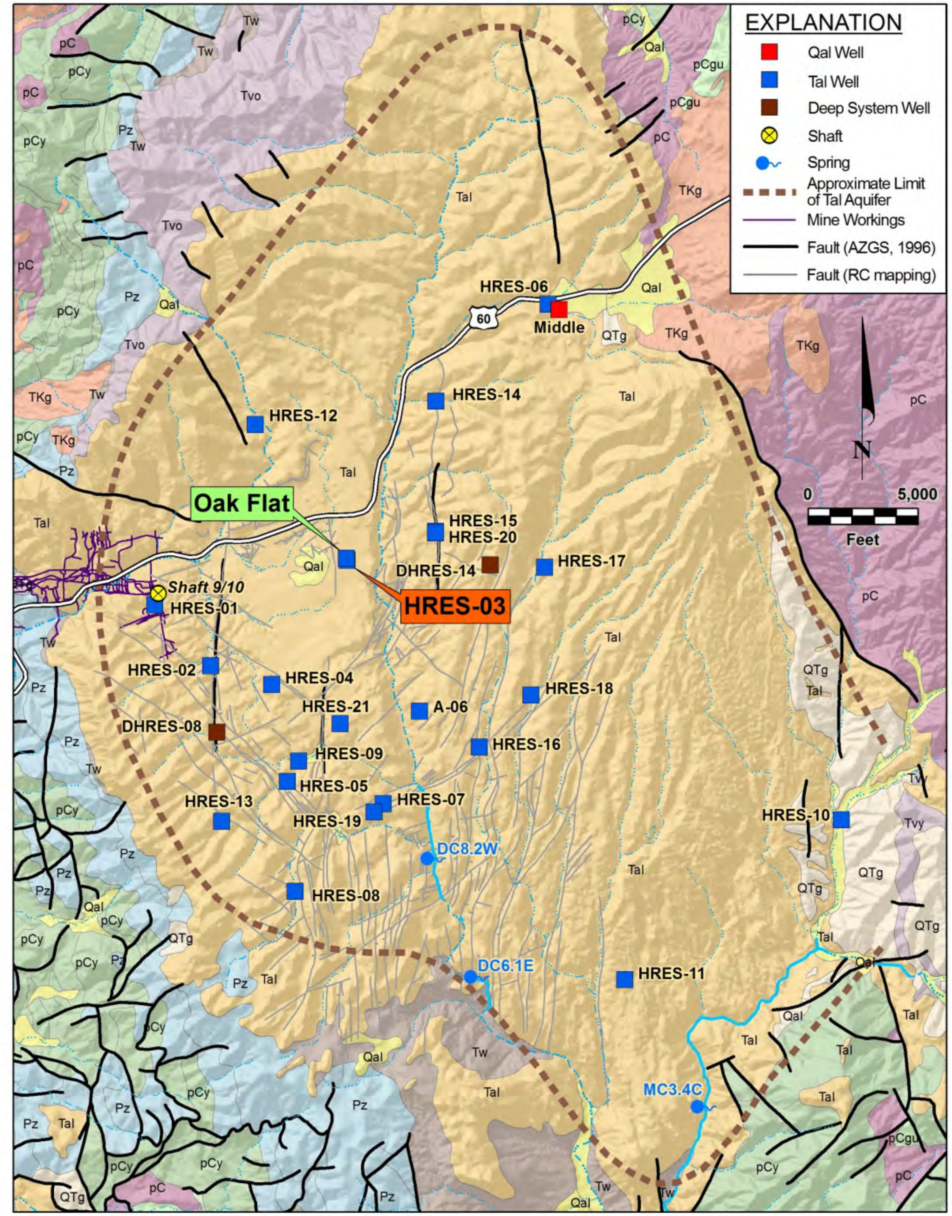


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FIGURE 11. WATER LEVEL HYDROGRAPHS FOR APACHE LEAP TUFF AQUIFER WELLS – OAK FLAT SECTOR

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RESOLUTION COPPER

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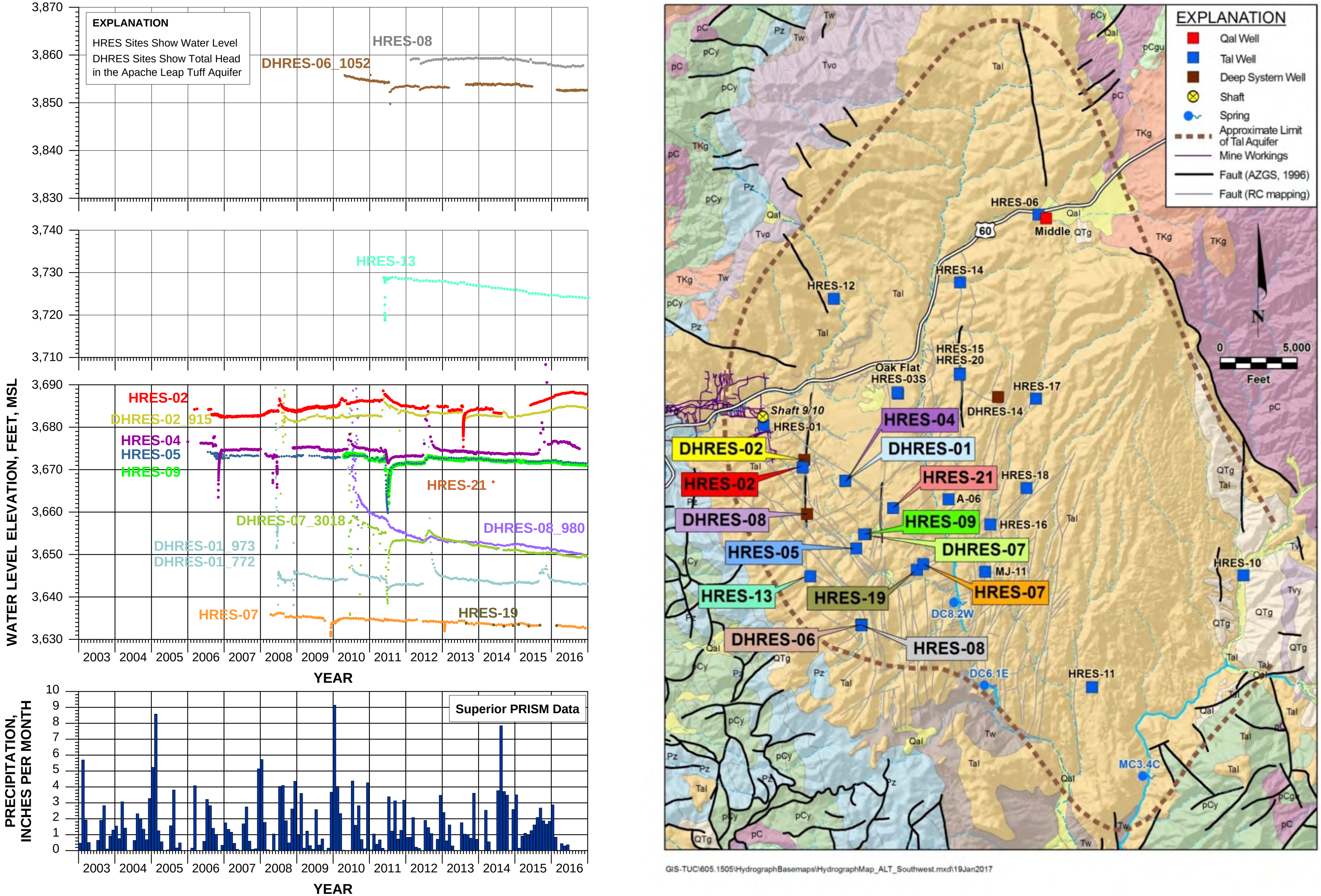

FIGURE 12. WATER LEVEL AND TOTAL HEAD HYDROGRAPHS FOR APACHE LEAP TUFF AQUIFER WELLS – SOUTHWEST SECTOR

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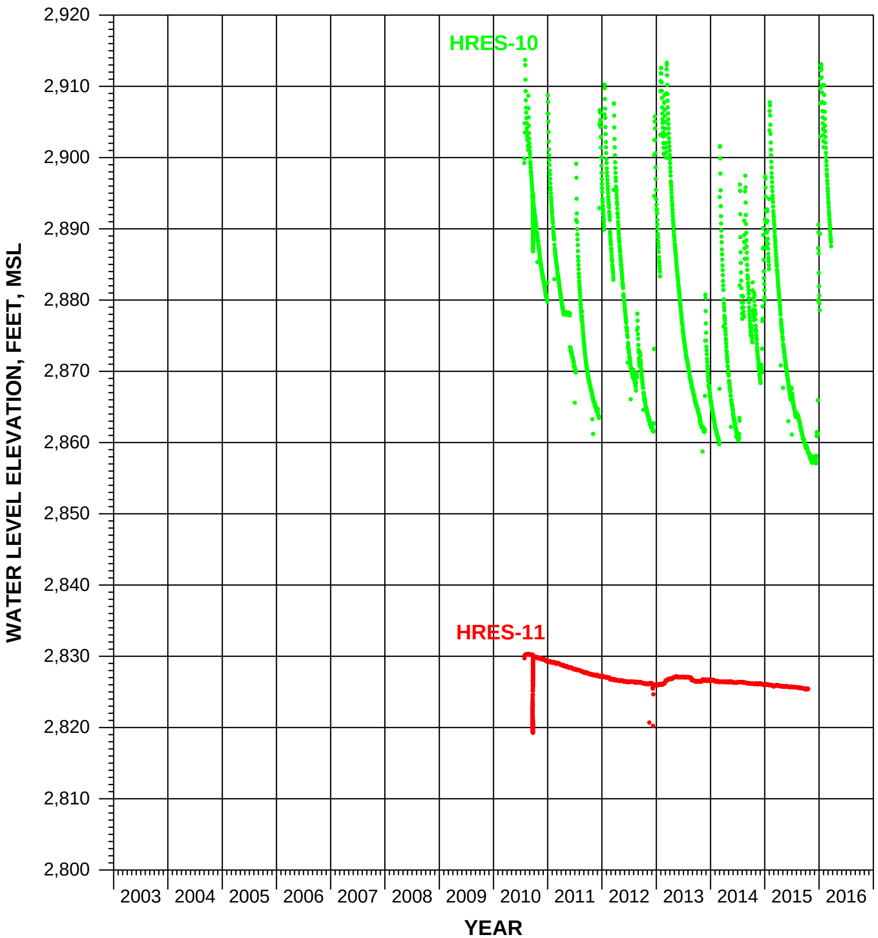
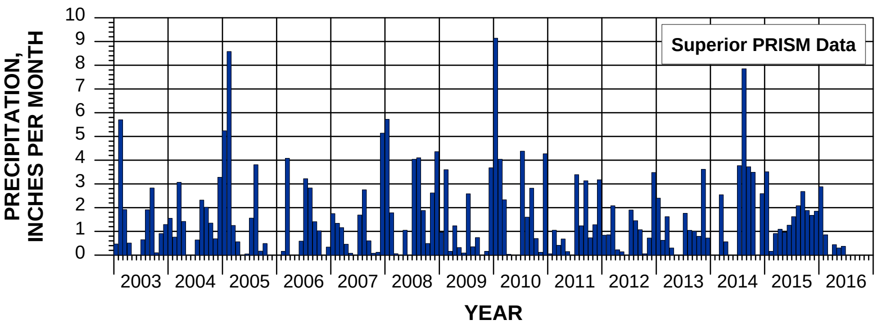
RESOLUTION COPPER





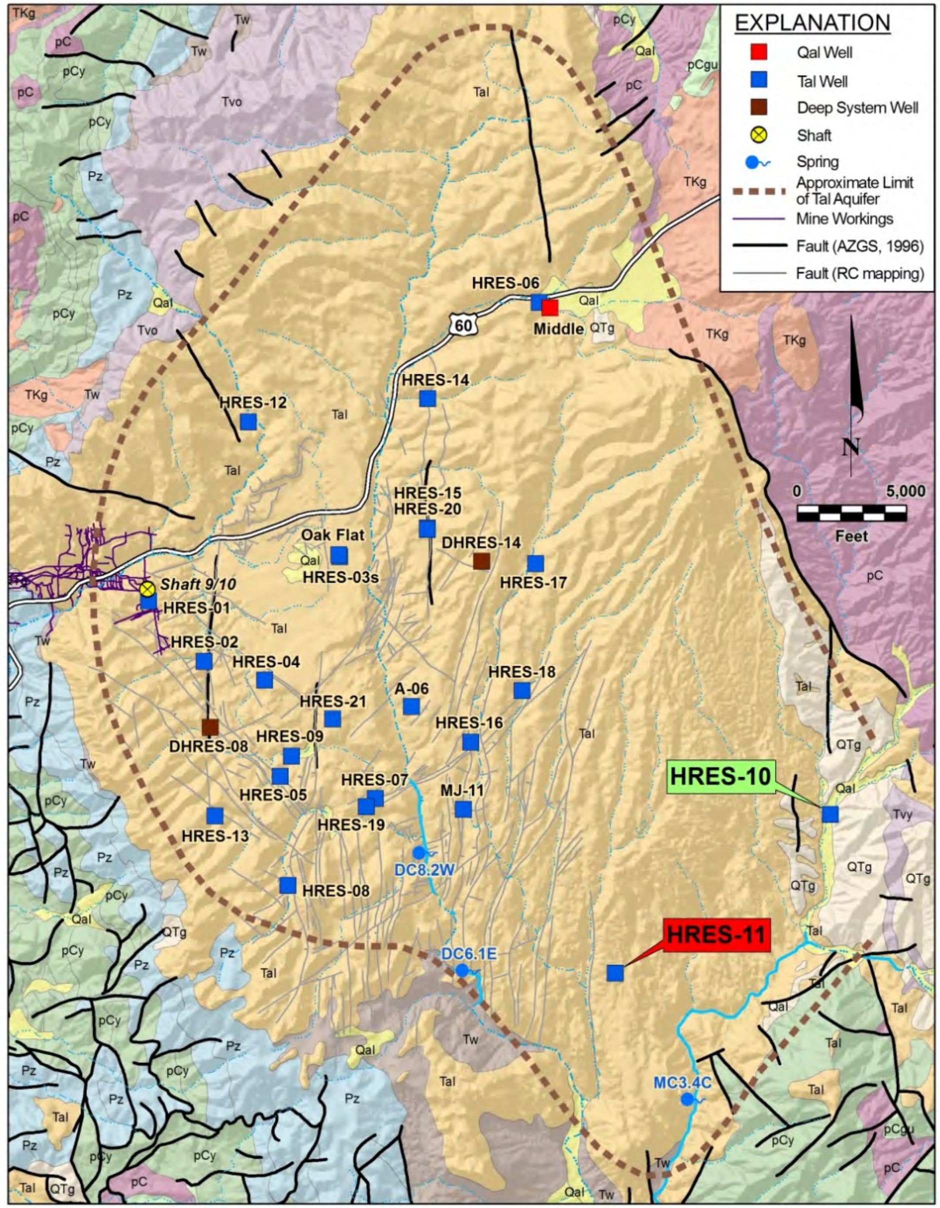


FIGURE 13. WATER LEVEL HYDROGRAPHS FOR APACHE LEAP TUFF AQUIFER WELLS – SOUTHEAST SECTOR

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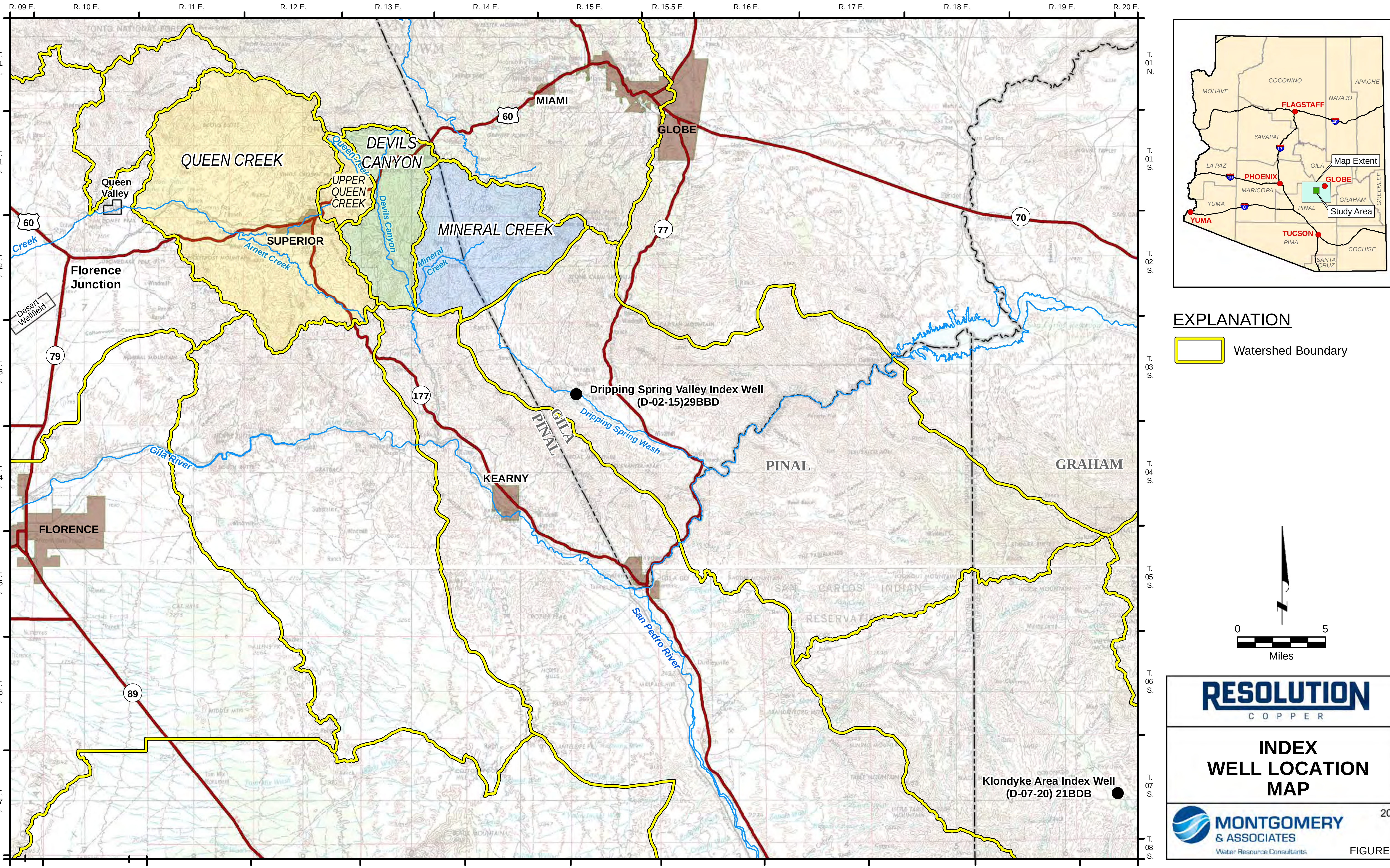
RESOLUTION COPPER



RESOLUTION COPPER

INDEX WELL LOCATION MAP

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2016

FIGURE 14

GIS-Tuc\605.1505\GWSI_IndexWell_Locmap.mxd\20Jan2017

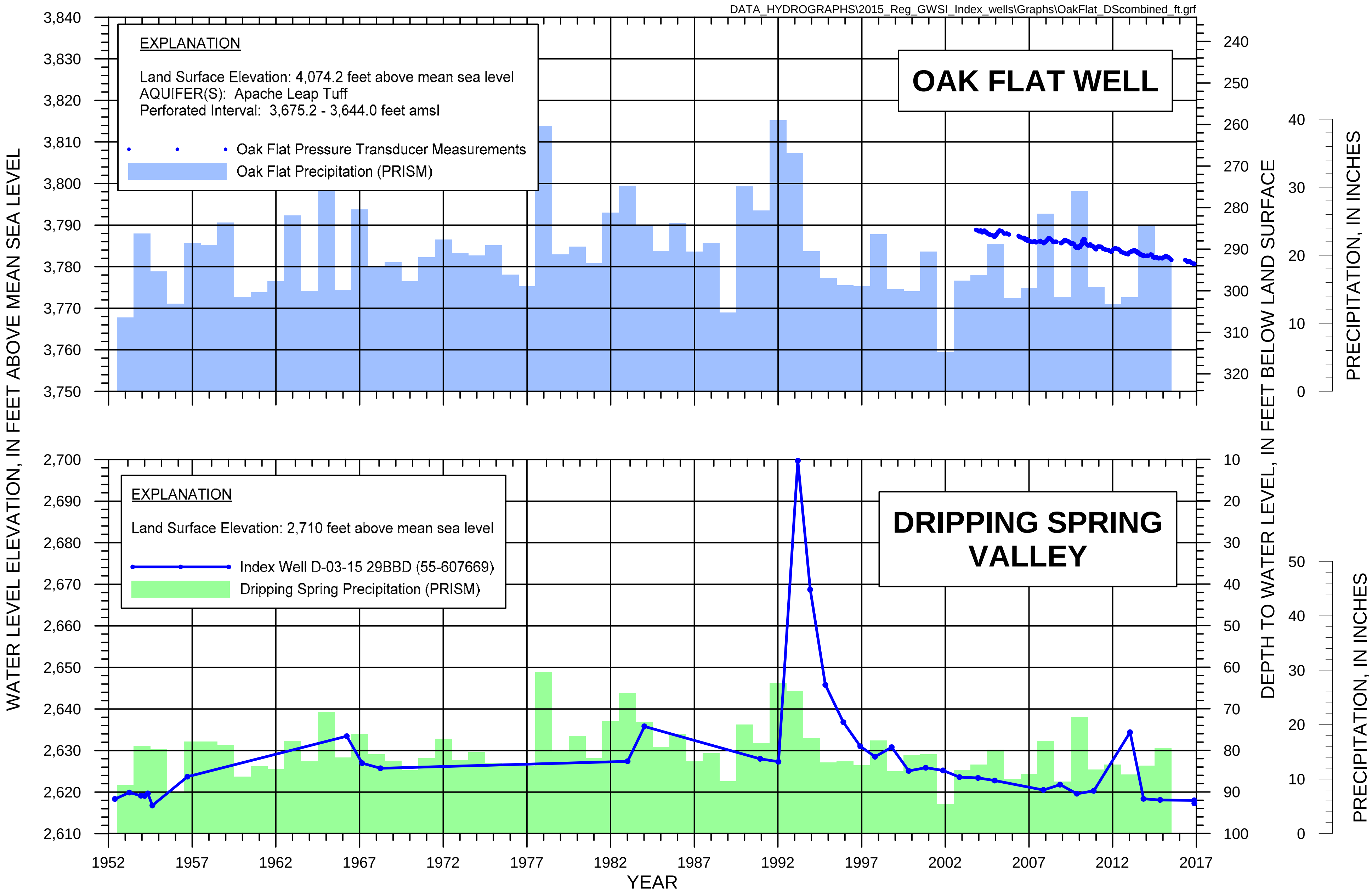

FIGURE 15. COMPARISON OF WATER LEVEL ELEVATION AND PRECIPITATION BETWEEN OAK FLAT WELL AND DRIPPING SPRING VALLEY INDEX WELL D-03-15 29BBD

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RESOLUTION COPPER

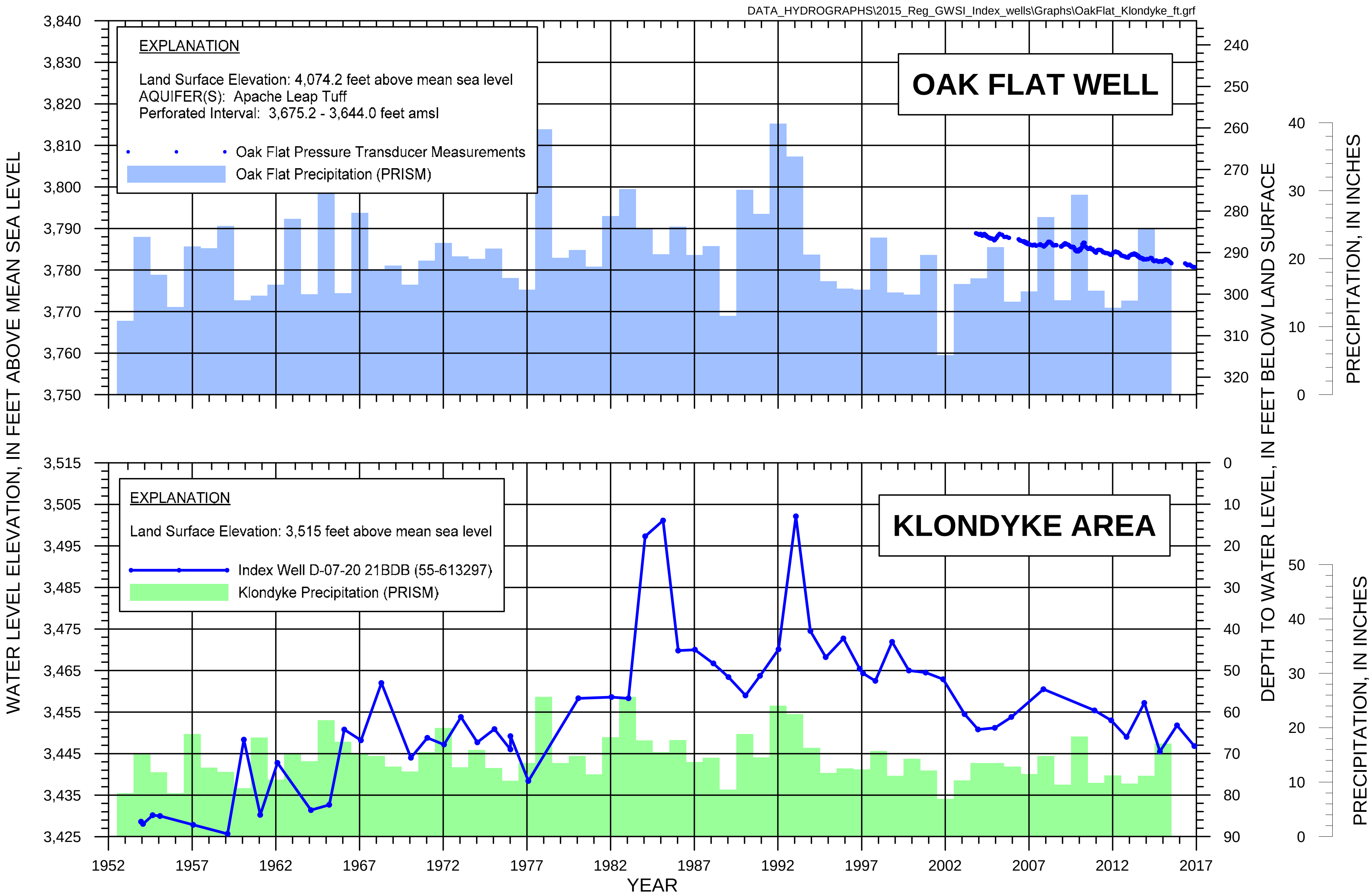

FIGURE 16. COMPARISON OF WATER LEVEL ELEVATION AND PRECIPITATION BETWEEN OAK FLAT WELL AND KLONDYKE AREA INDEX WELL D-07-20 21BDB

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RESOLUTION COPPER

PPT: 605\DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\MultiWell_DeepSstem_PrecipHydrographs.pptx
Grapher: DATA_HYDROGRAPHS\Shafts\Shaft9_3_10_DHRES1_2_8_11_13_9_7_6_15_plus Q_2008_Current.grf

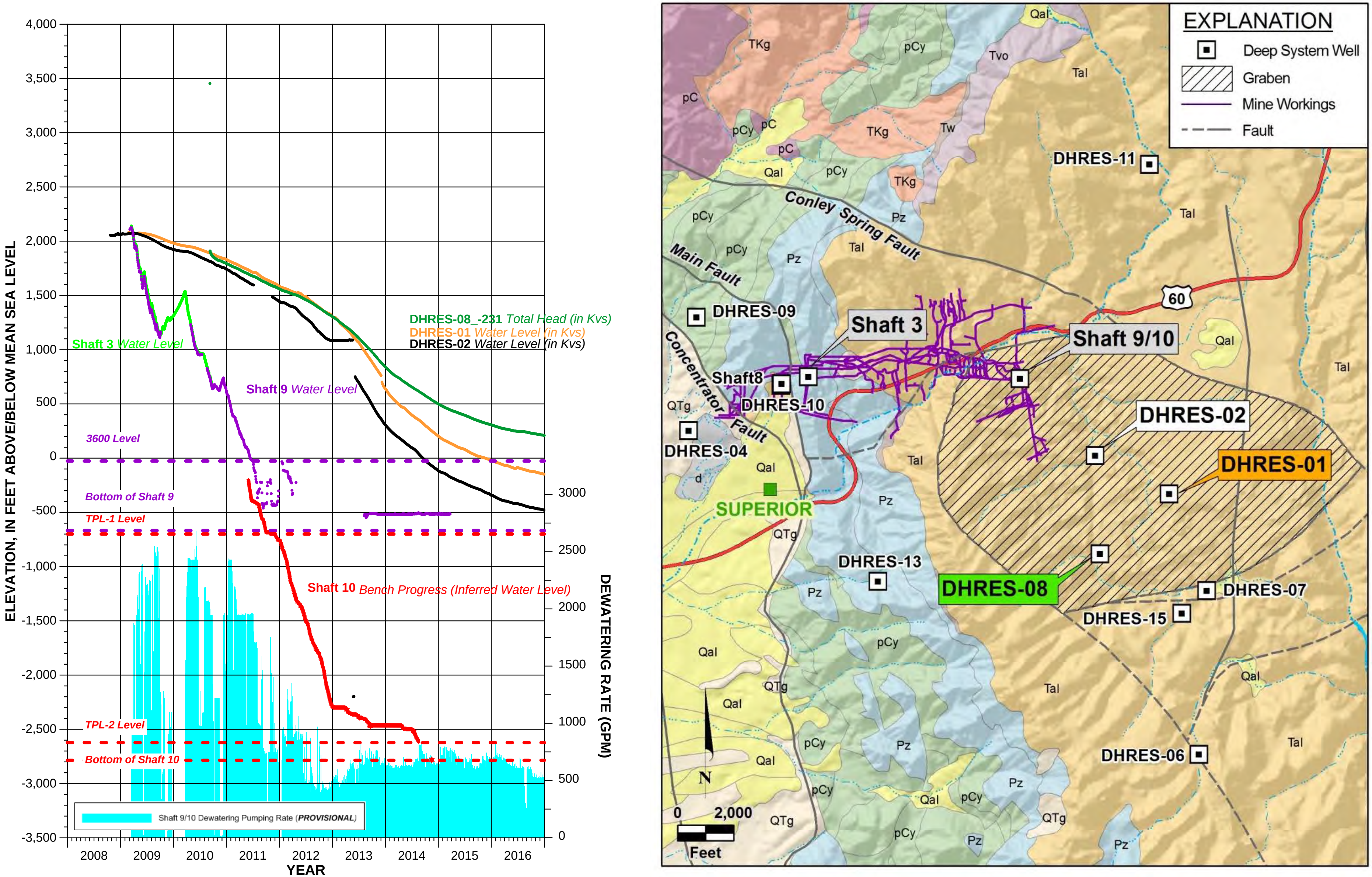

FIGURE 17. HYDROGRAPHS OF WATER LEVEL/TOTAL HEAD FOR WELLS AND SHAFTS AND SHAFT DEWATERING RATES, DEEP GROUNDWATER SYSTEM, INSIDE RESOLUTION GRABEN

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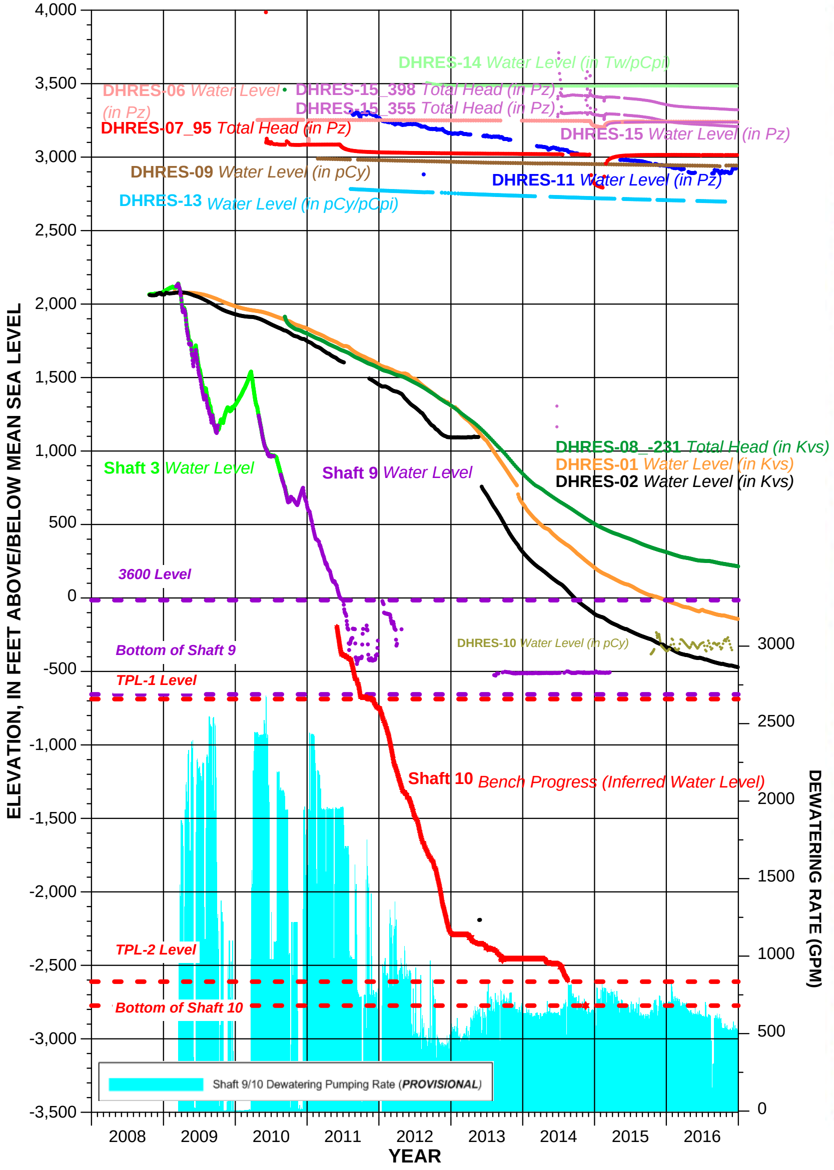
RESOLUTION COPPER



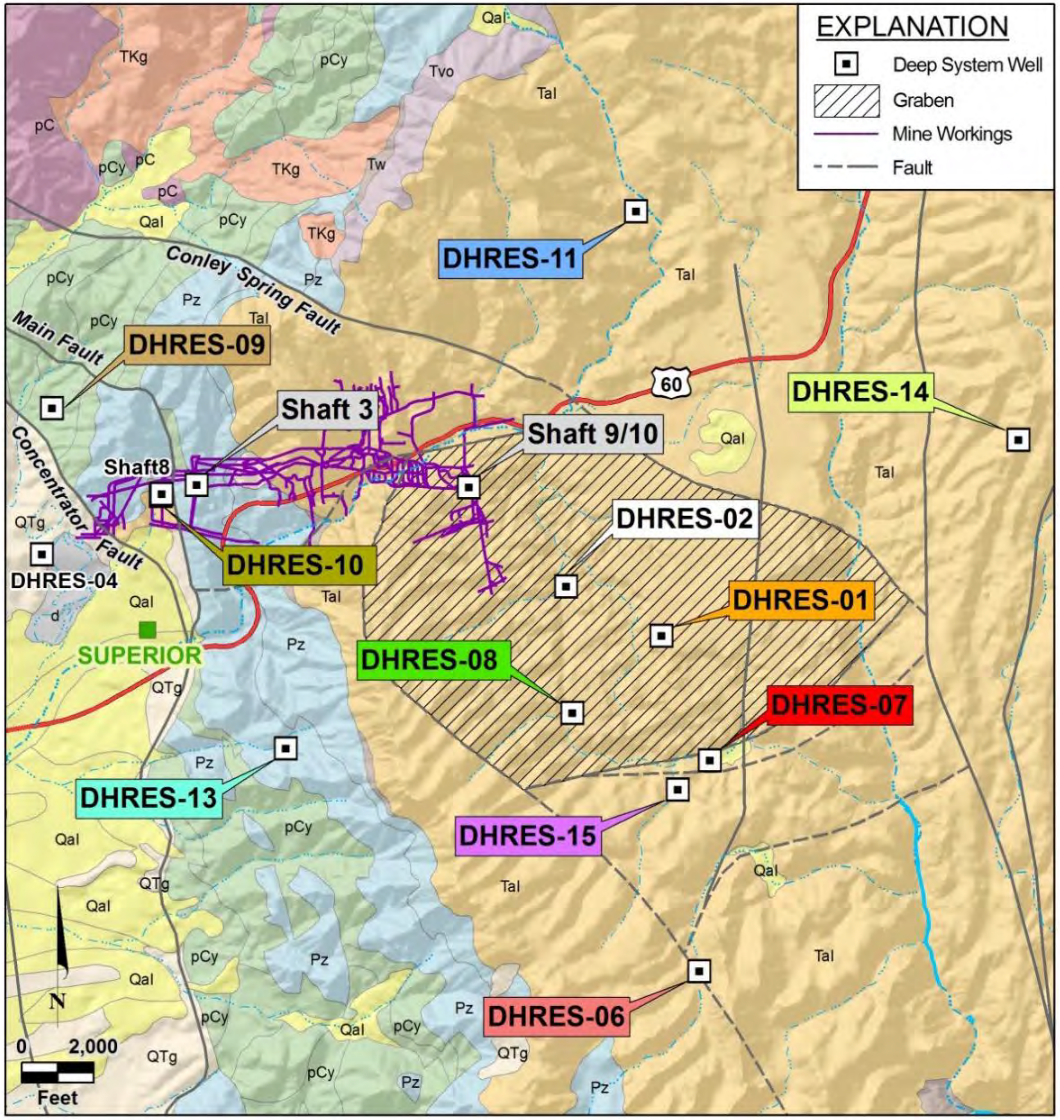


FIGURE 18. HYDROGRAPHS OF WATER LEVEL/TOTAL HEAD FOR WELLS AND SHAFTS AND SHAFT DEWATERING RATES, DEEP GROUNDWATER SYSTEM, INSIDE AND OUTSIDE RESOLUTION GRABEN

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RESOLUTION COPPER

PPT: 605\DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\MultiWell_DeepSstem_PrecipHydrographs.pptx
Grapher: DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\DeepGS_OutsideGraben_2009_Current.grf

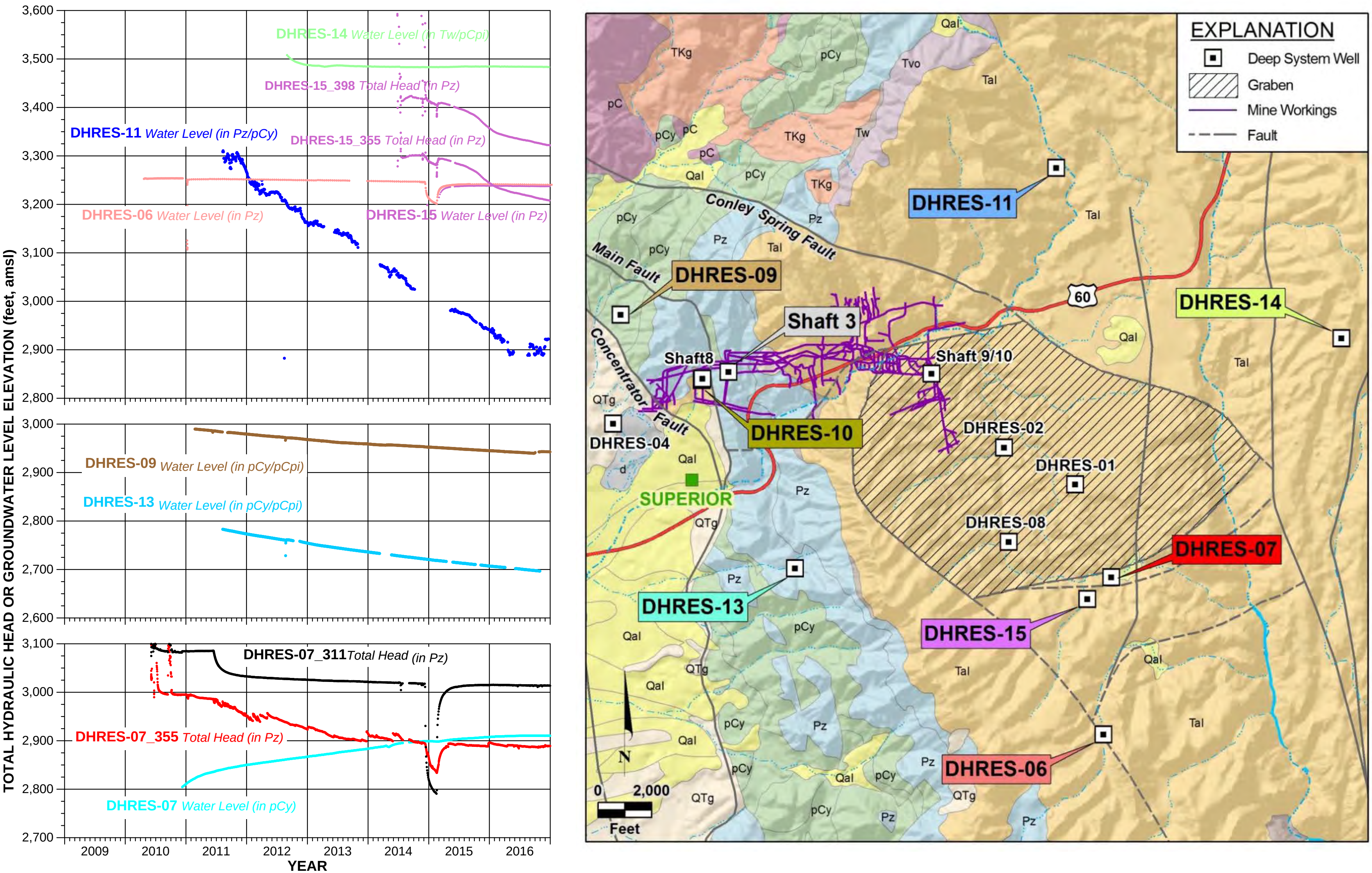

FIGURE 19. HYDROGRAPHS OF WATER LEVEL/TOTAL HEAD, DEEP GROUNDWATER SYSTEM OUTSIDE RESOLUTION GRABEN

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

PPT: 605\DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\MultiWell_DeepSstem_PrecipHydrographs.pptx
Grapher: DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\DeepGS_WestConc_2009_Current.grf

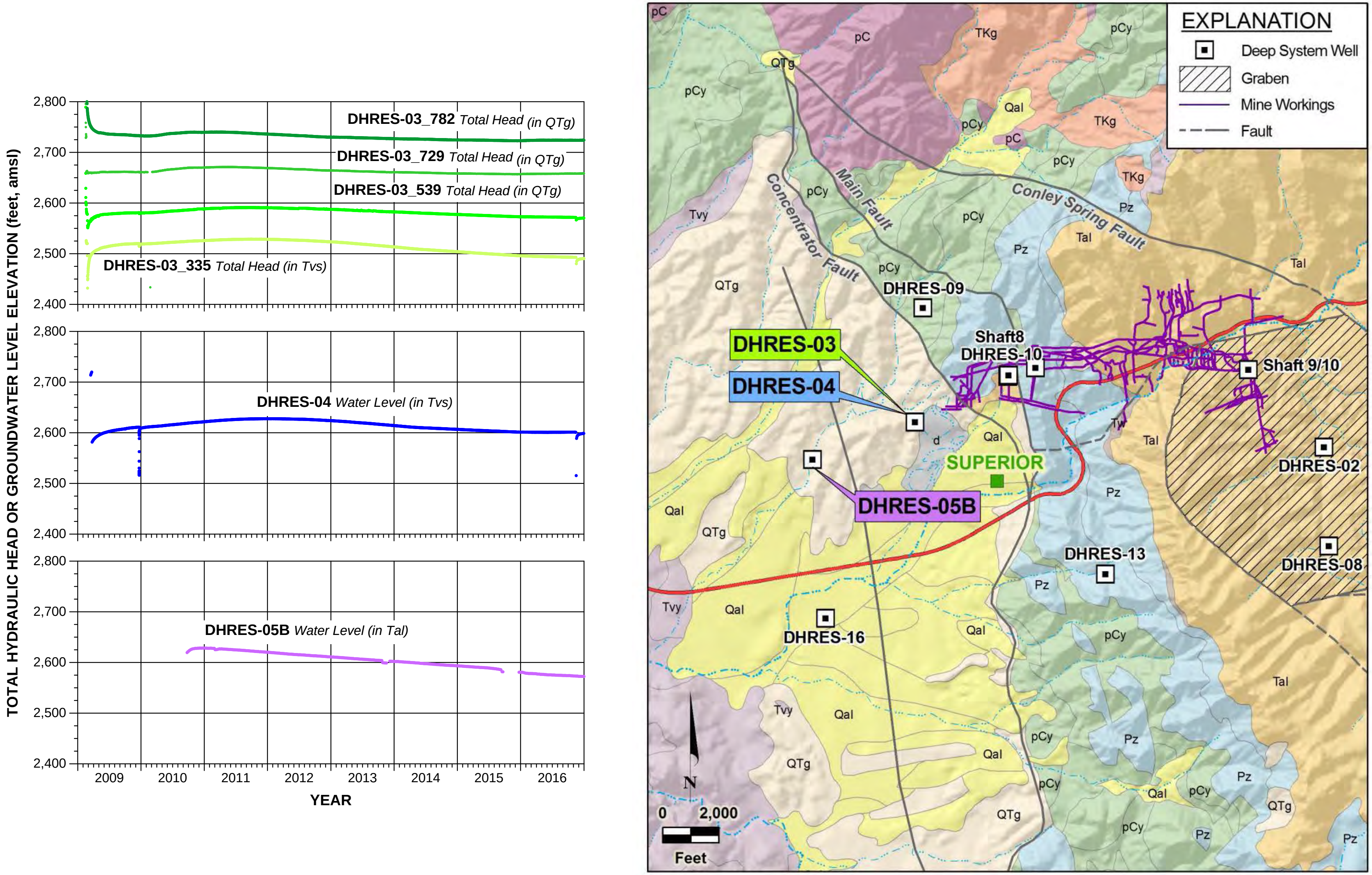

FIGURE 20. HYDROGRAPHS OF WATER LEVEL/TOTAL HEAD, DEEP GROUNDWATER SYSTEM WEST OF CONCENTRATOR FAULT

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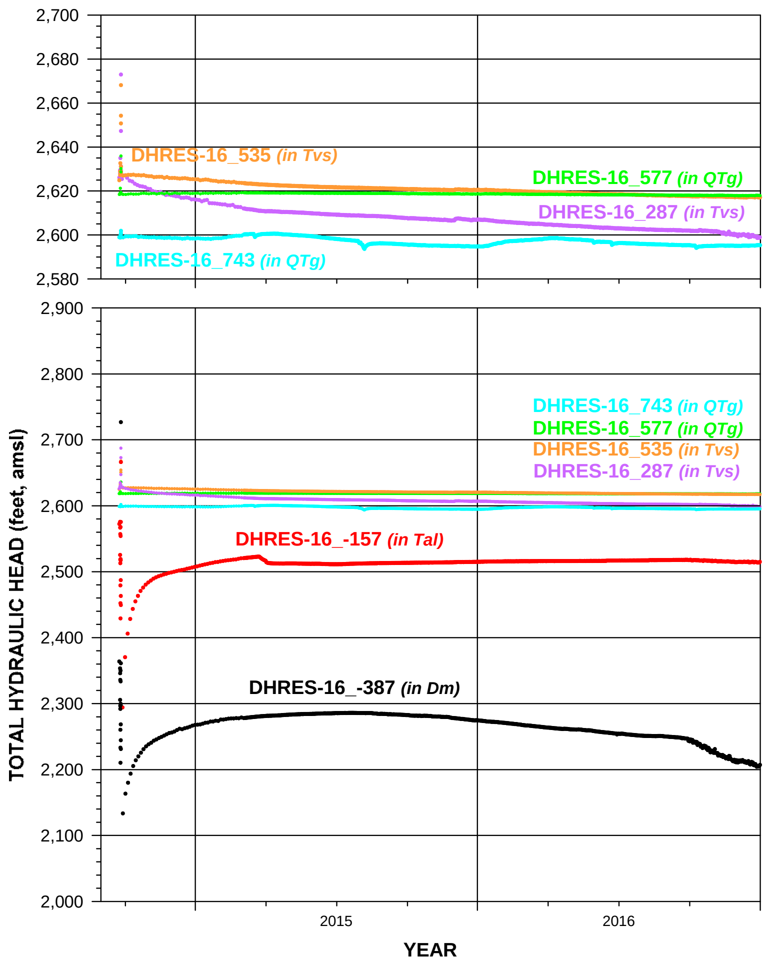
RESOLUTION COPPER

PPT: 605\DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\MultiWell_DeepSstem_PrecipHydrographs.pptx
Grapher: DATA_HYDROGRAPHS\Multi-well_Precip_Hydrographs\DeepGS_DHRES-16_2014_Current.grf



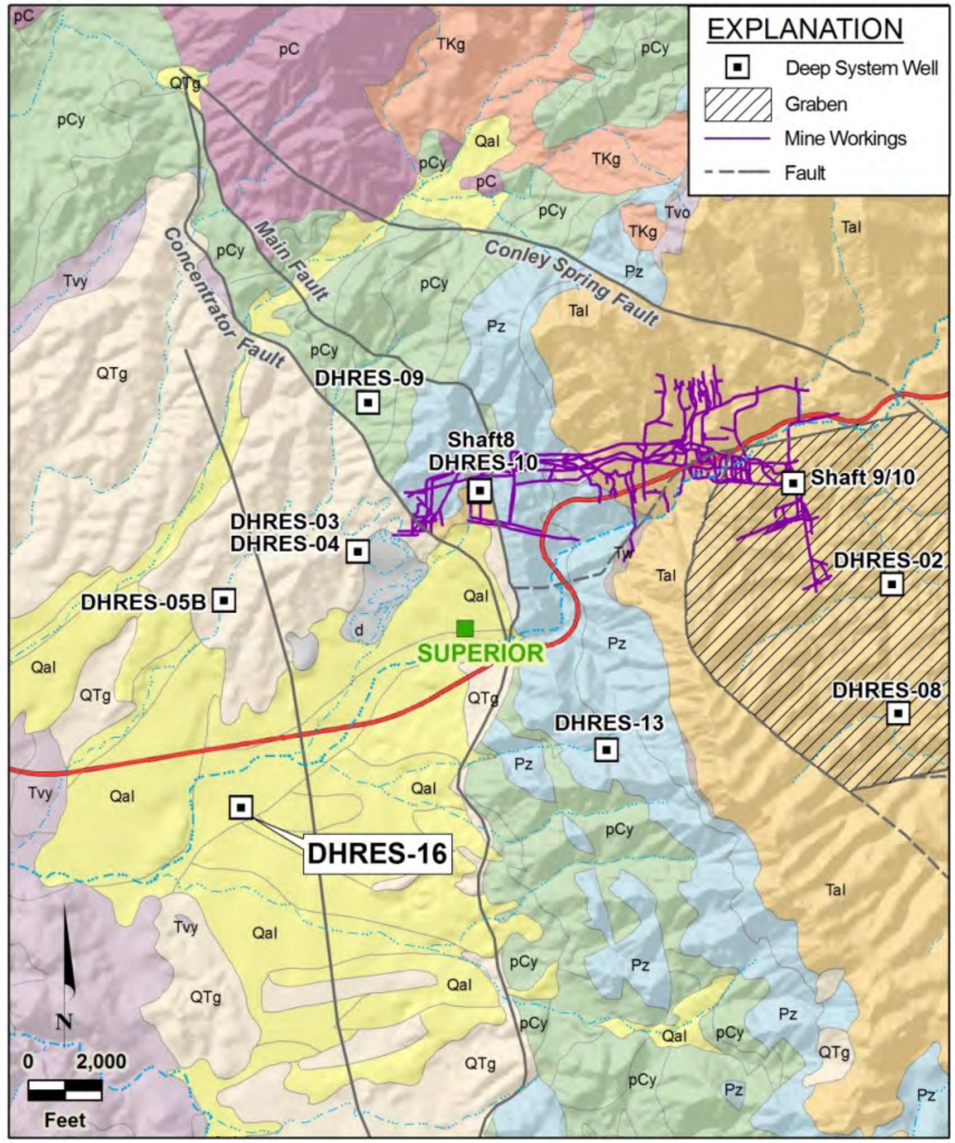


FIGURE 21. HYDROGRAPHS OF WATER LEVEL/TOTAL HEAD, HYDROLOGIC TEST WELL DHRES-16

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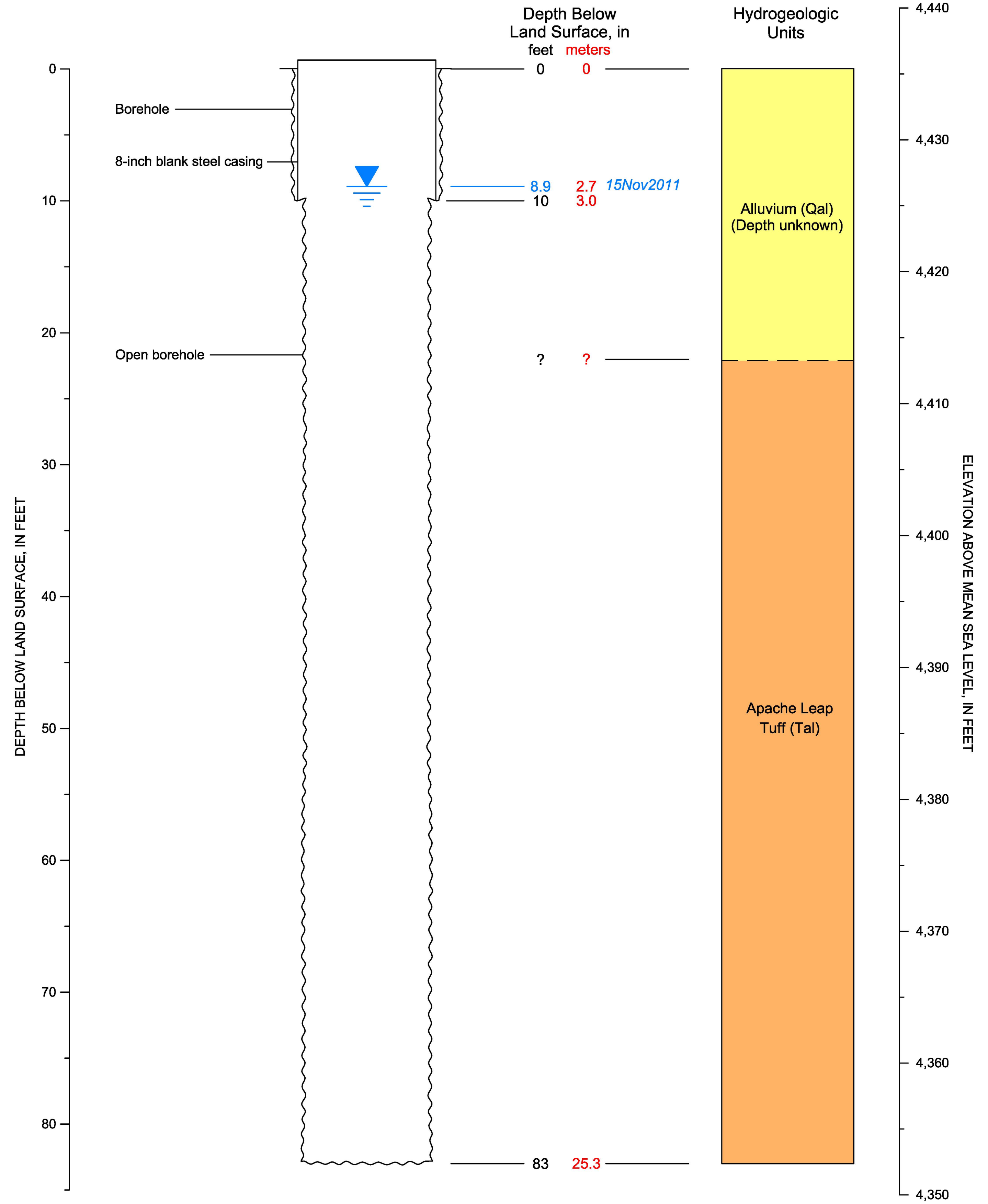
RESOLUTION COPPER

Appendix A

Schematic Diagrams of Well Construction and Water Level Hydrographs for Wells Completed in Shallow Groundwater System and Apache Leap Tuff



CADASTRAL: (D-1-13) 14dbd	ADWR NO: 55-609685
NORTHING: 852639.865	EASTING: 977697.153
LAND SURFACE ELEVATION: 4435.39 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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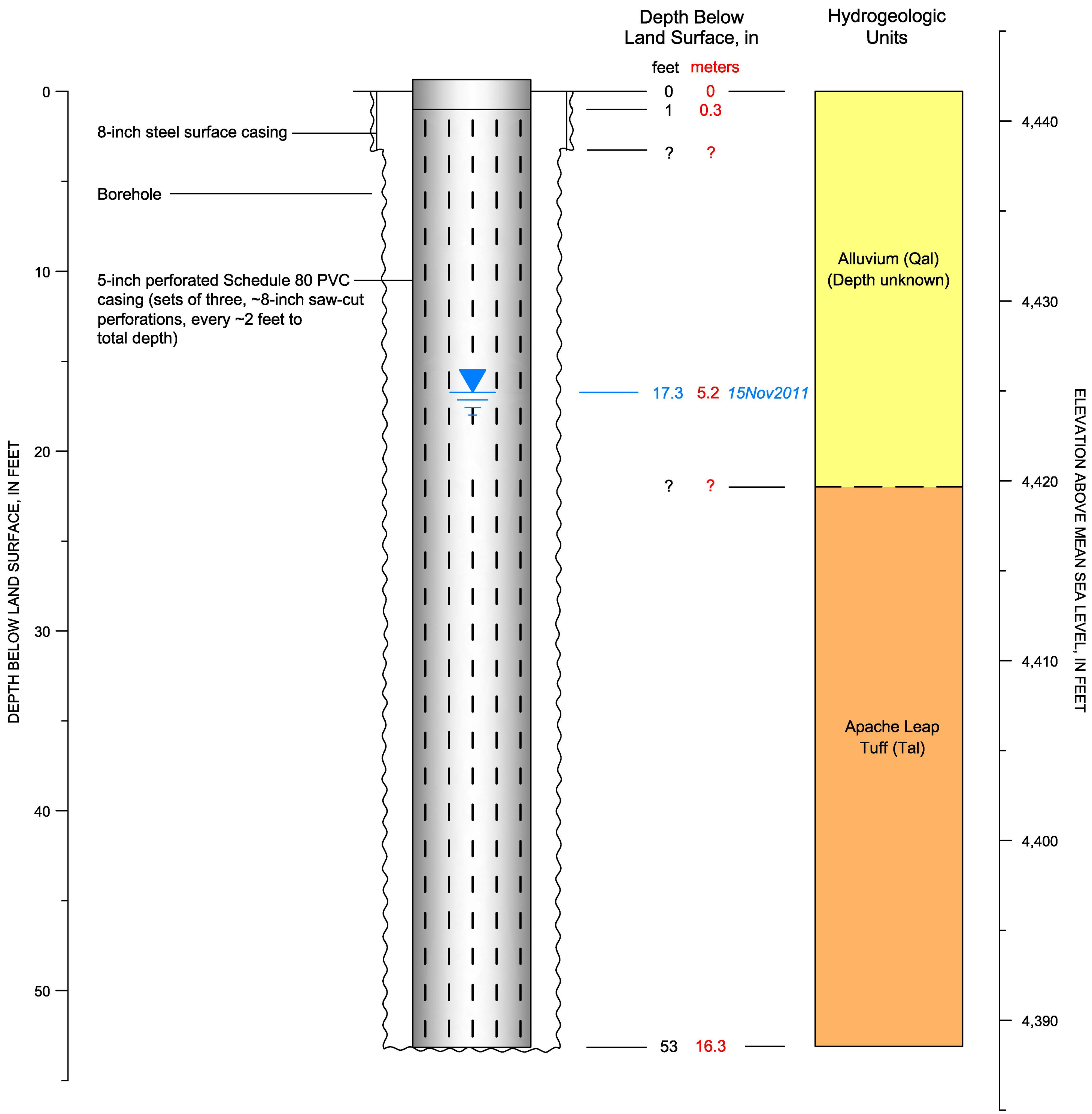
CORRAL WELL
DIAGRAM OF WELL CONSTRUCTION

Version: November 2016

FIGURE A-1

Drafting\605\WellSchematics_2016\HRESwells_SP83\CORRAL-WS_Letter_SP83r2\08Nov2016



CADASTRAL: (D-1-13) 14dbd	ADWR NO: Not registered
NORTHING: 852431.030	EASTING: 977608.906
LAND SURFACE ELEVATION: 4441.65 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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MIDDLE WELL
DIAGRAM OF WELL CONSTRUCTION

Version: November 2016

FIGURE A-2

Drafting\605\WellSchematics_2016\HRESwells_SP83\Middle_WS_SP83r2\08Nov2016

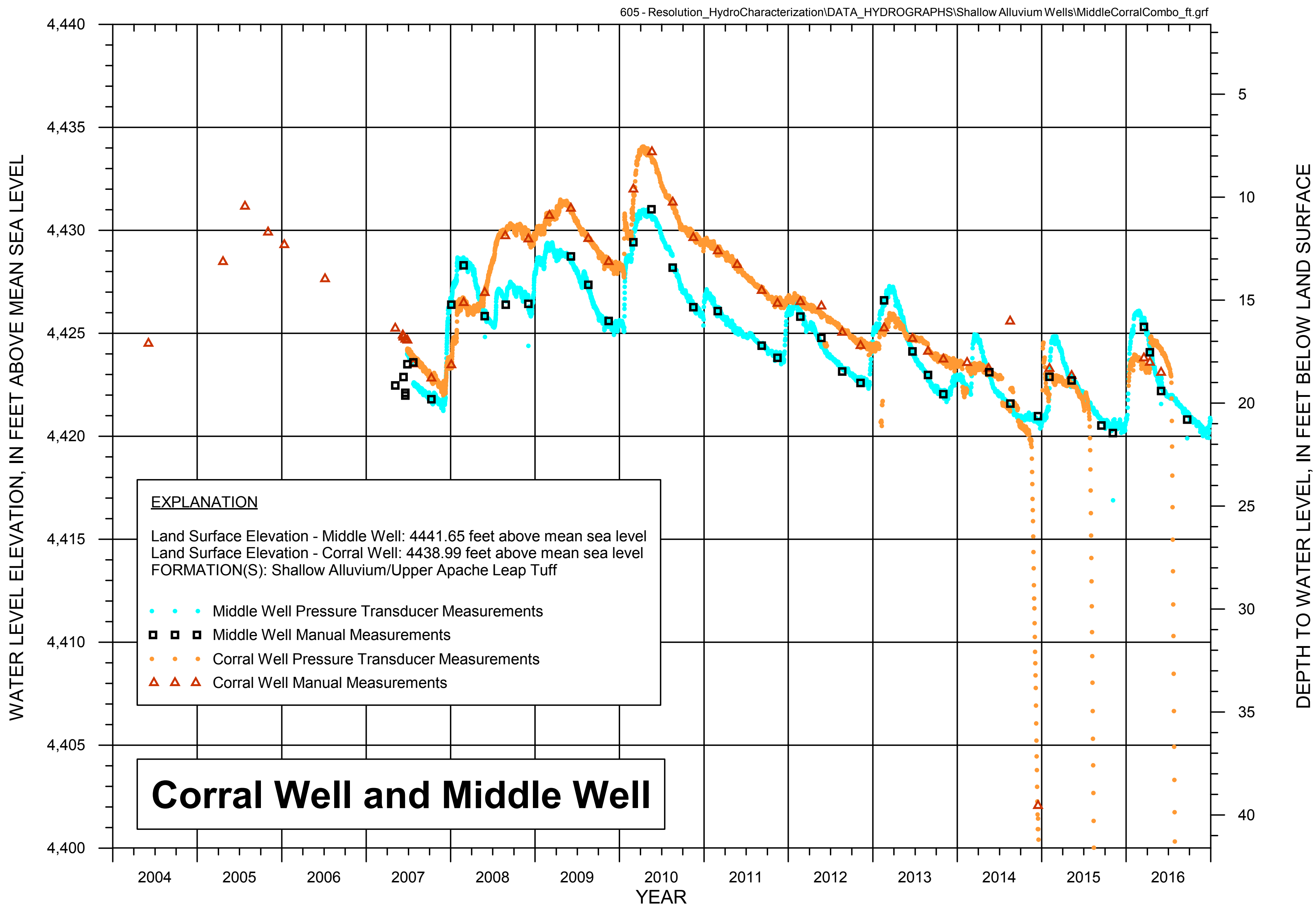

FIGURE A-2a. WATER LEVEL HYDROGRAPH FOR CORRAL WELL AND MIDDLE WELL

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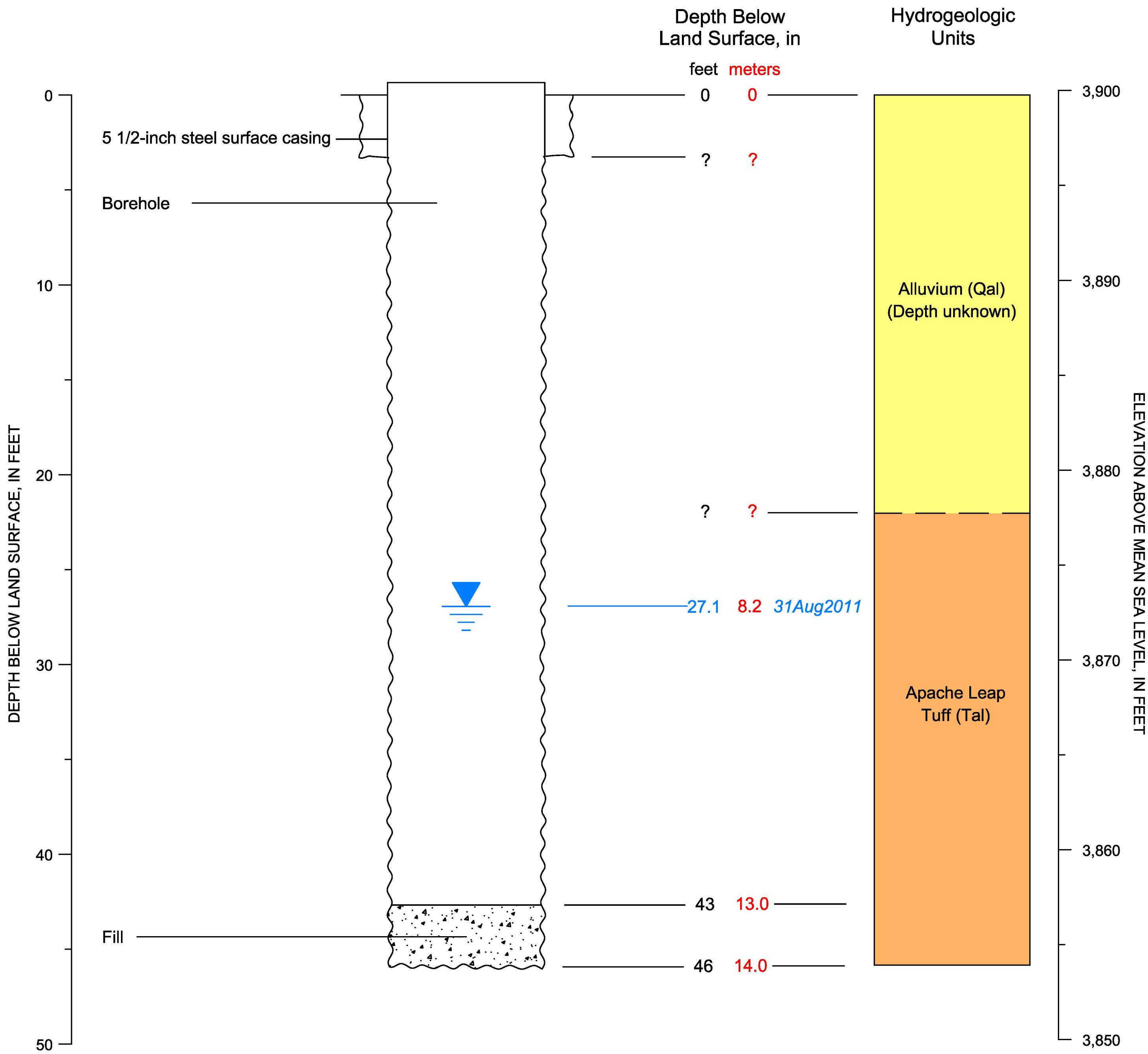

CADASTRAL: (D-2-13) 8acb	ADWR NO: 55-615244
NORTHING: 828601.598	EASTING: 967894.073
LAND SURFACE ELEVATION: 3899.76 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HACKBERRY WINDMILL
DIAGRAM OF WELL CONSTRUCTION

Version: November 2016

FIGURE A-3

Drafting\605\WellSchematics_2016\HRESwells_SP83\HackberryWindmill_WS_SP83r2\08Nov2016

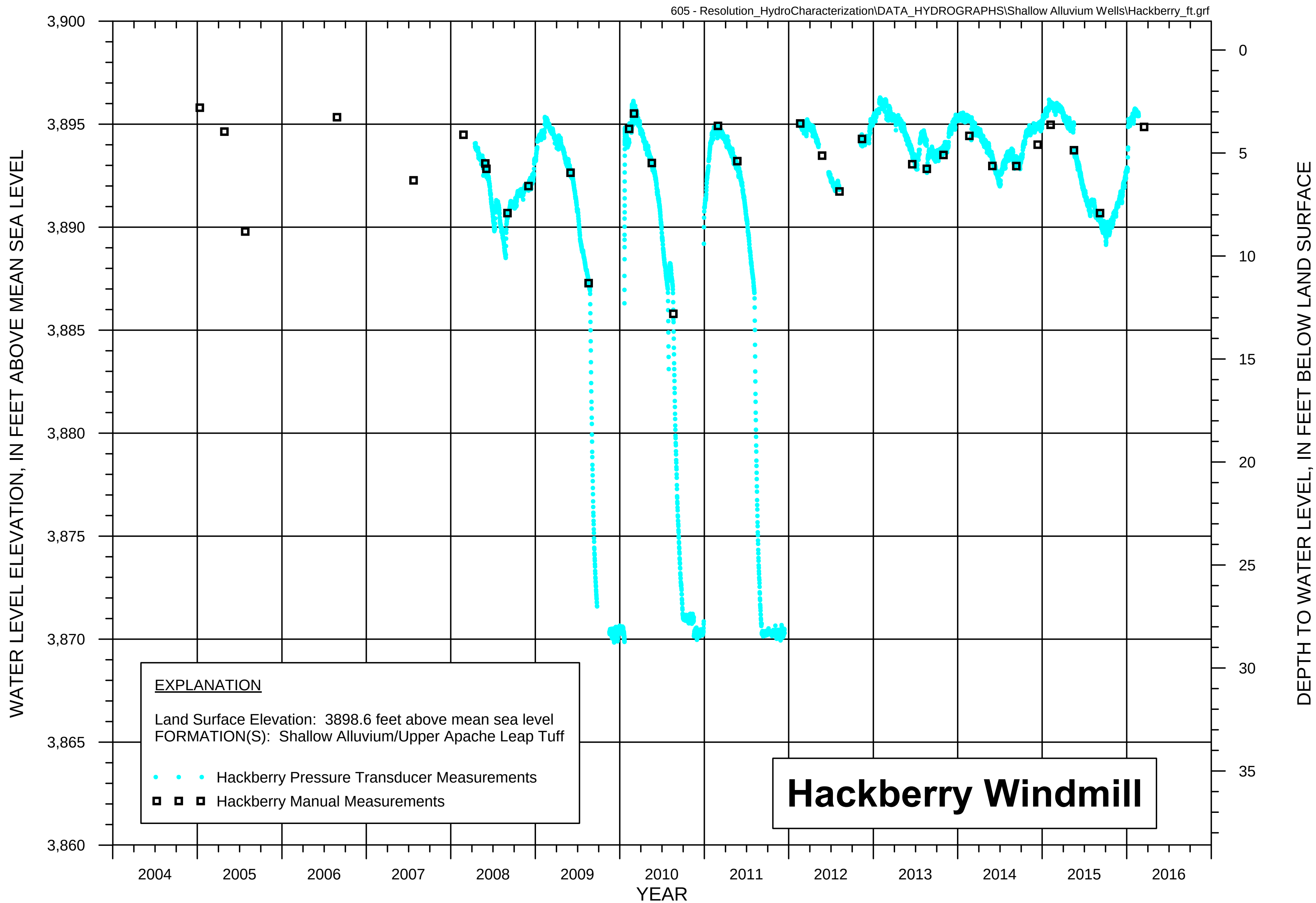

FIGURE A-3a. WATER LEVEL HYDROGRAPH FOR HACKBERRY WINDMILL WELL

RESOLUTION COPPER

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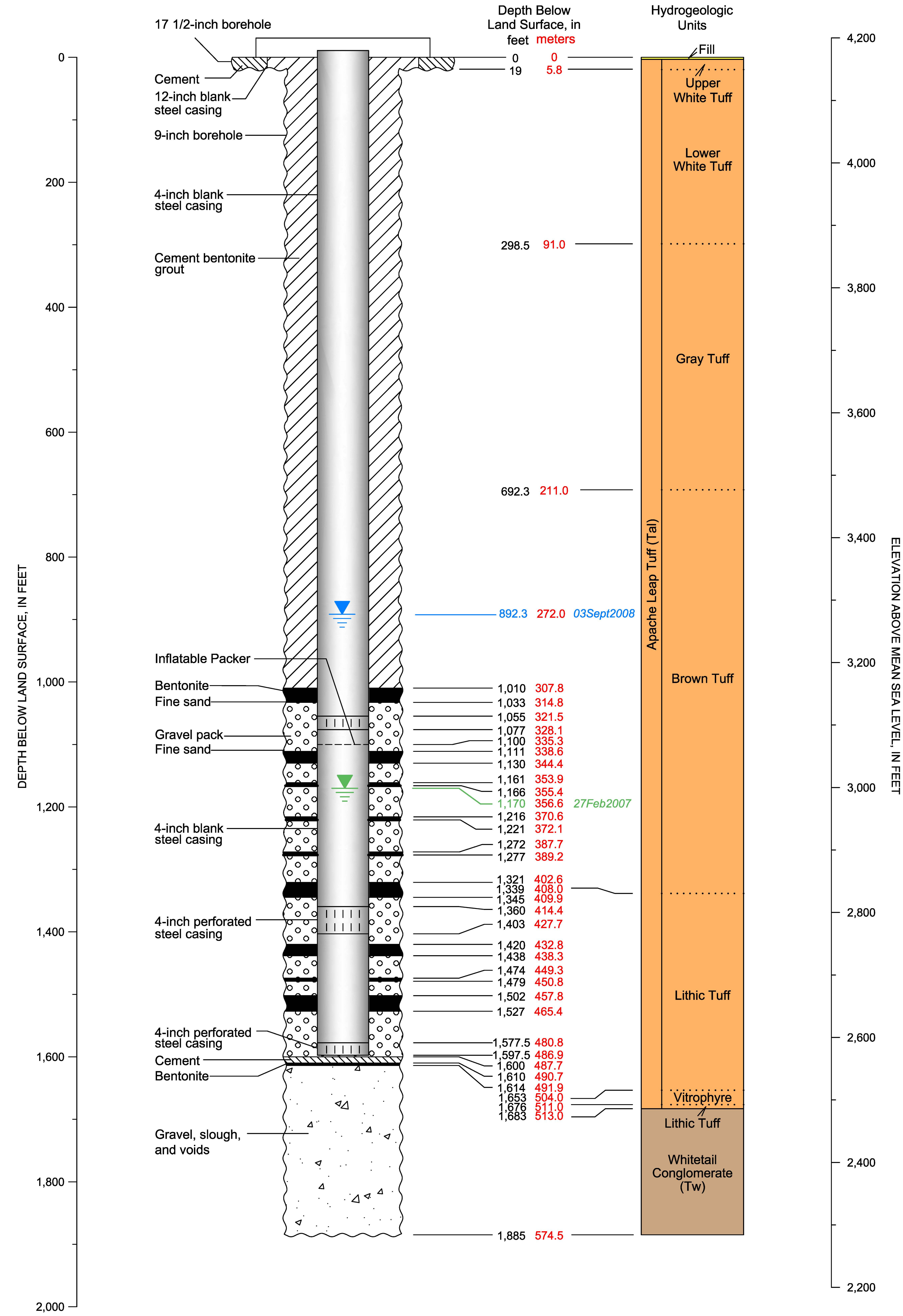

CADASTRAL: (D-1-13) 32bca | ADWR NO: 55-201852

NORTHING: 839000.266 | EASTING: 959223.381

LAND SURFACE ELEVATION: 4168.92 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-01
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-4

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-1-WS_SP83\26Sept2016

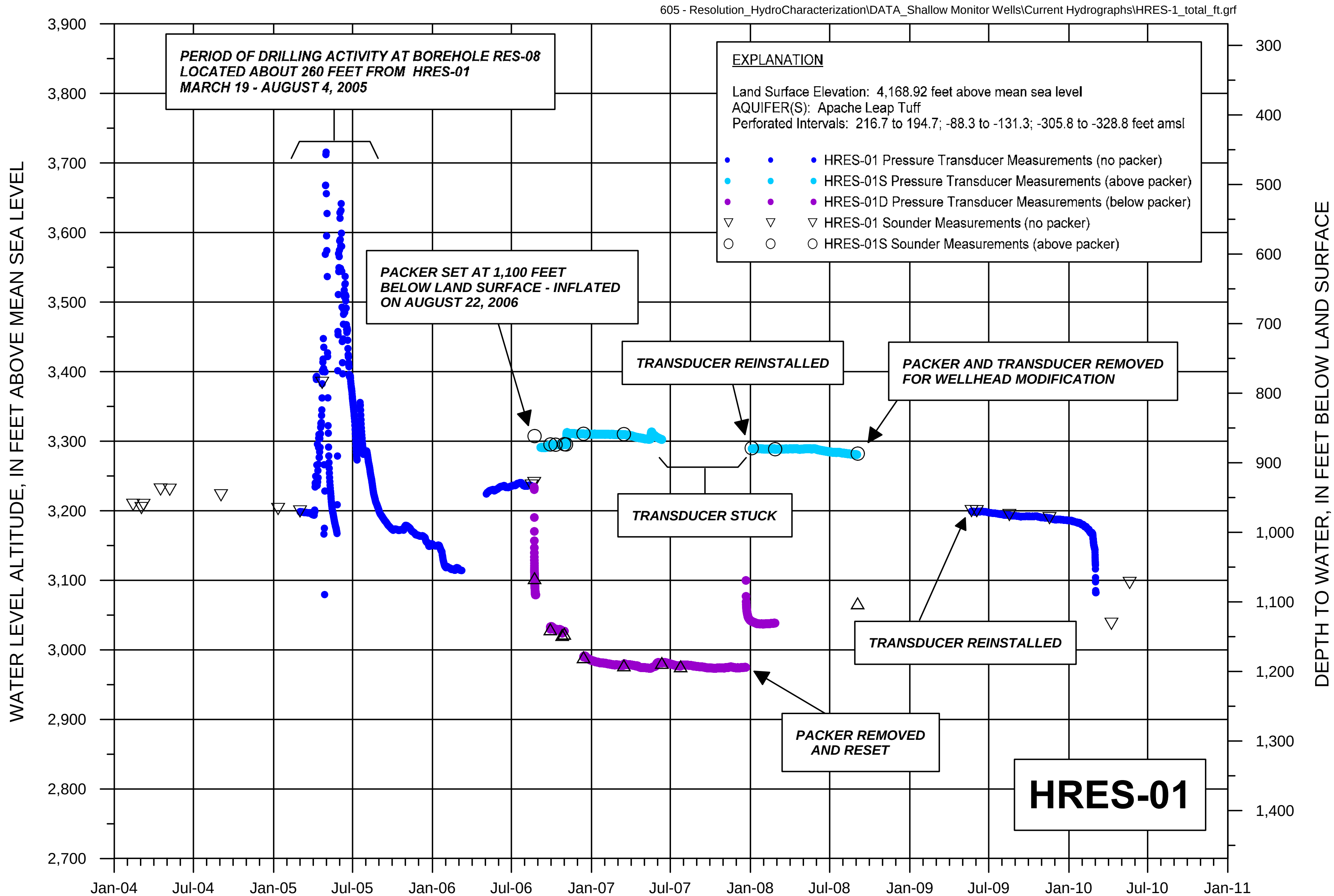
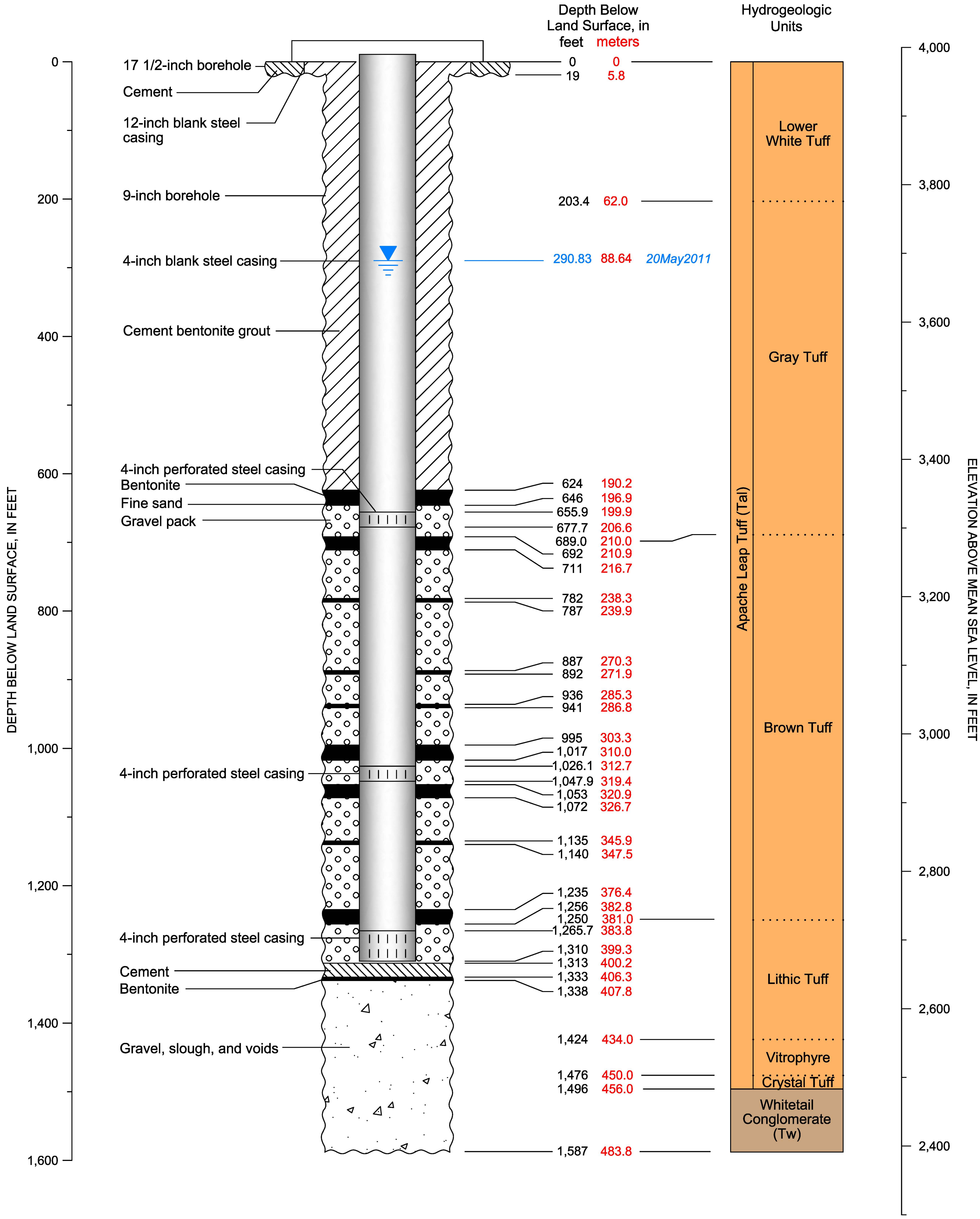


FIGURE A-4a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-01



CADASTRAL: (D-1-13) 32dca	ADWR NO: 55-201850
NORTHING: 836245.400	EASTING: 961757.156

LAND SURFACE ELEVATION: 3979.08 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-02
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-5

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-2-WS_SP83\26Sept2016

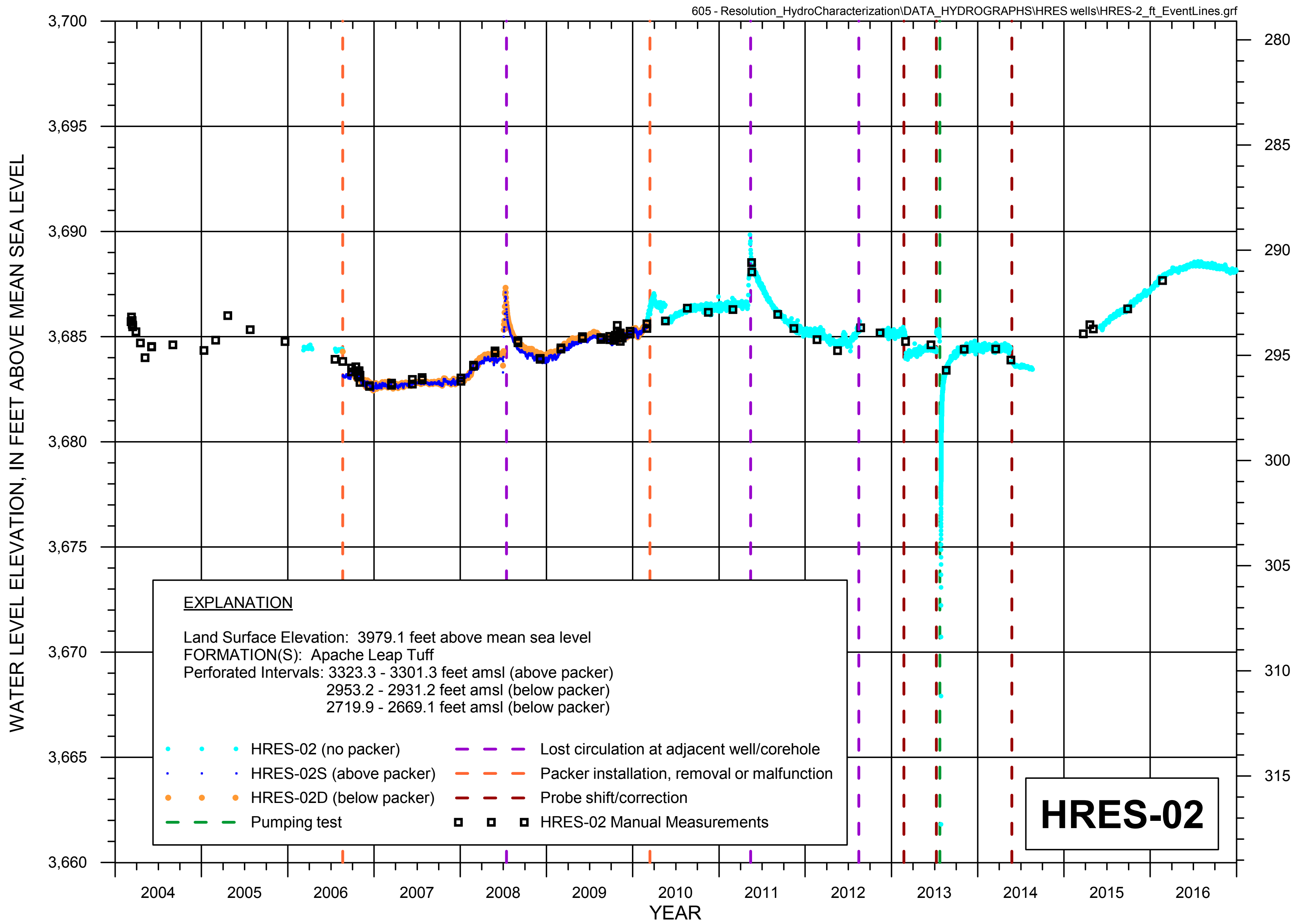

FIGURE A-5a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-02

RESOLUTION COPPER

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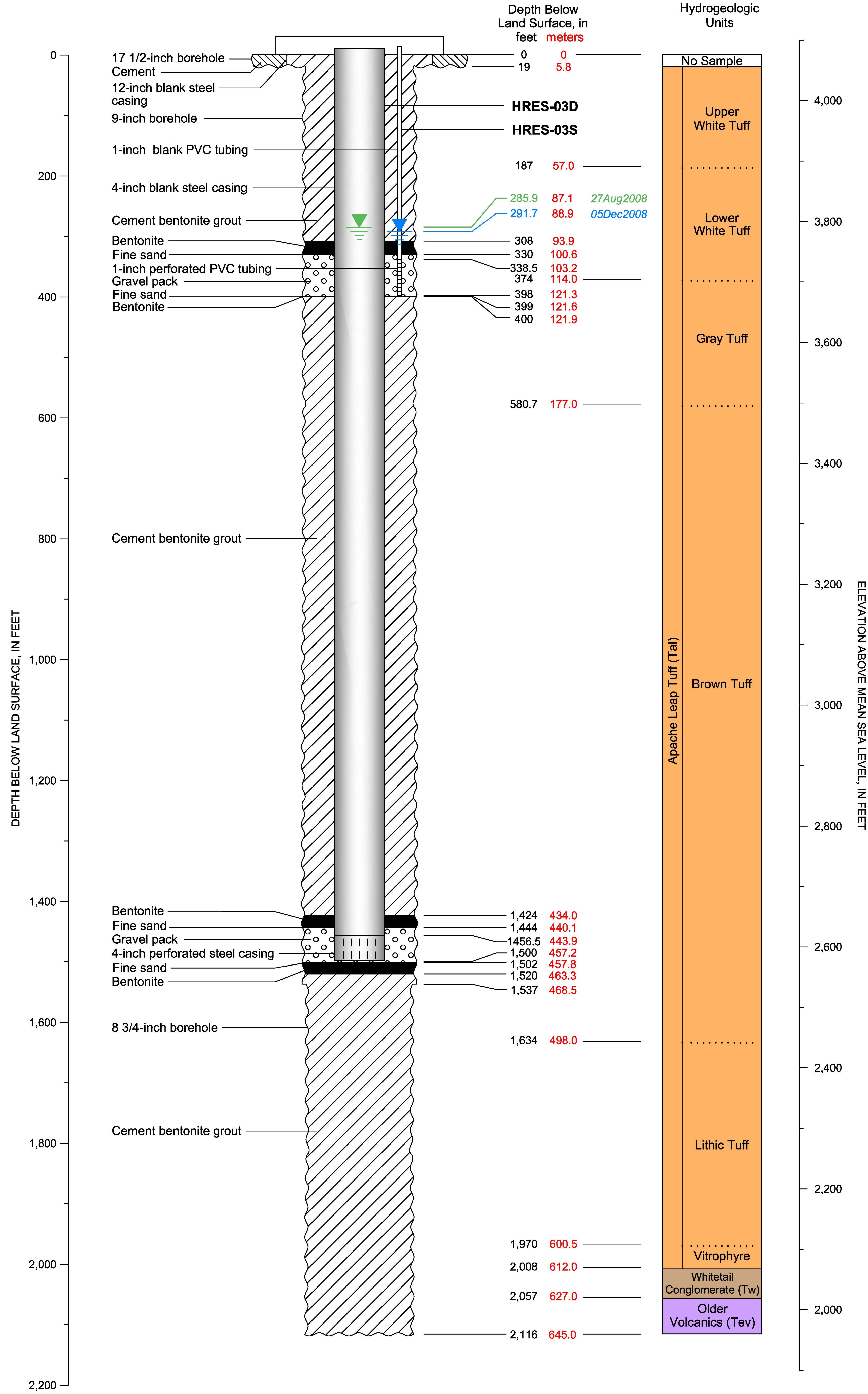

CADASTRAL: (D-1-13) 28ddb	ADWR NO: 55-201851
NORTHING: 841033.155	EASTING: 967959.749
LAND SURFACE ELEVATION: 4075.56 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-03
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-6

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-3-WS_SP83\26Oct2016

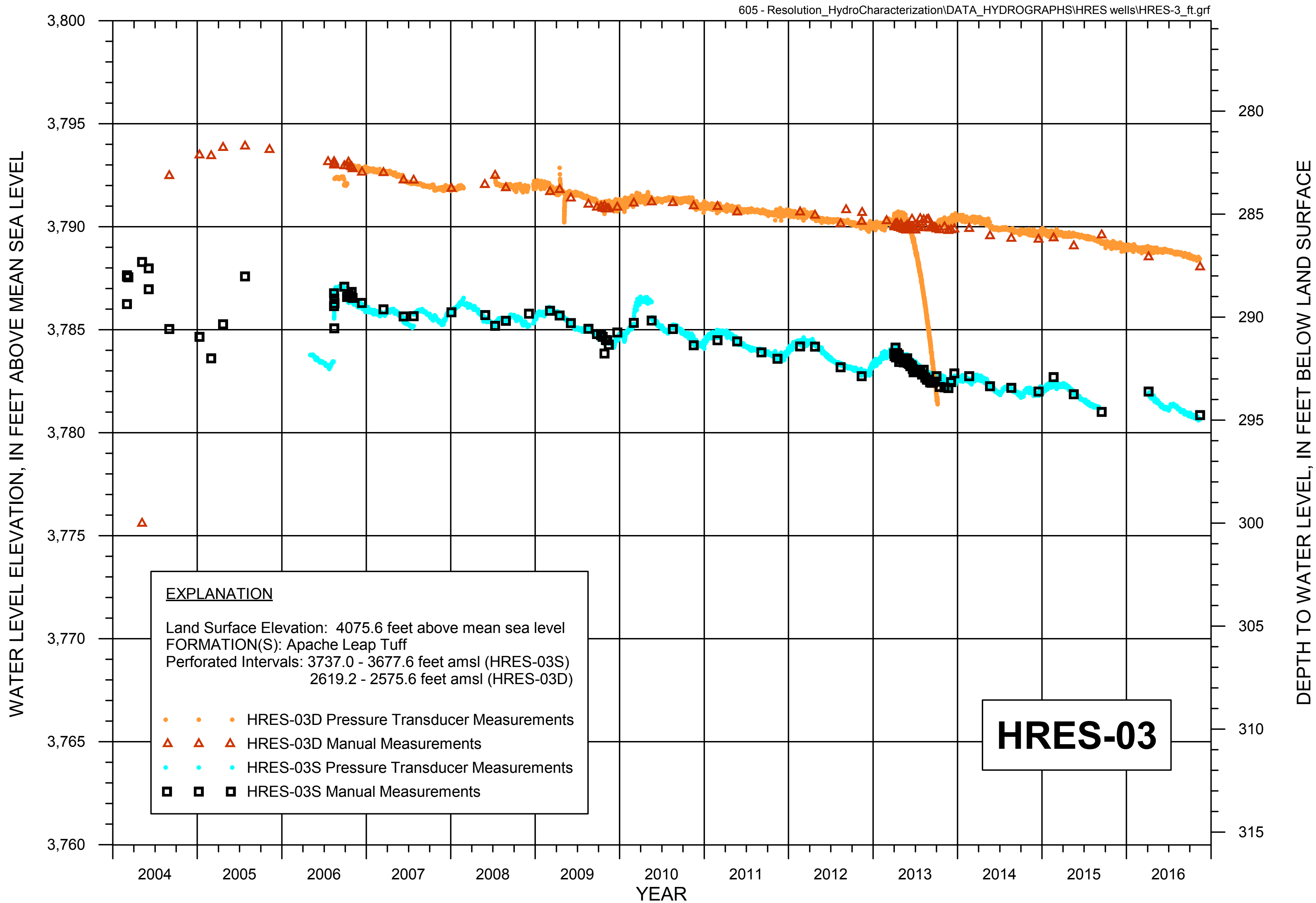
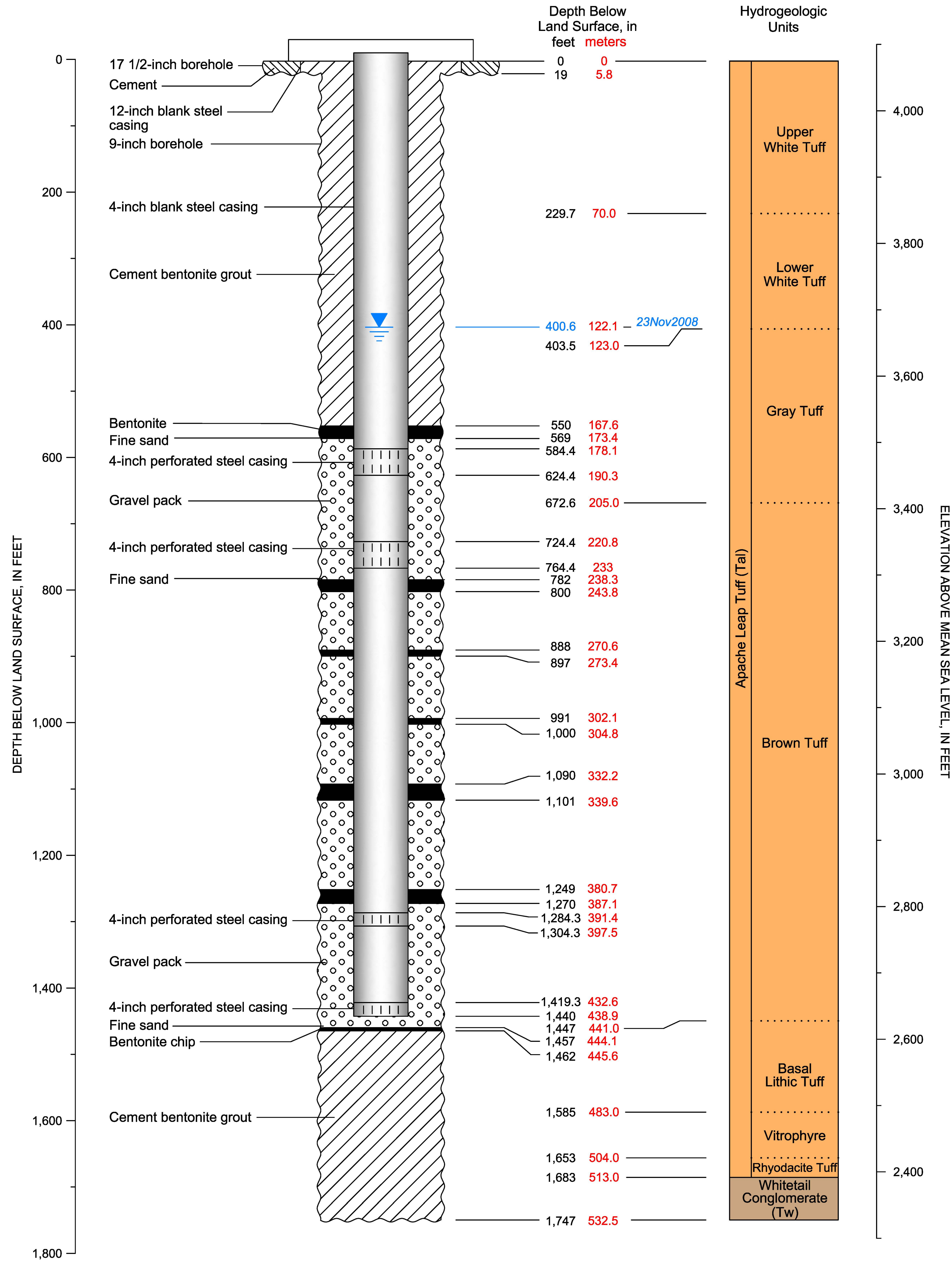


FIGURE A-6a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-03



CADASTRAL: (D-1-13) 33ccd	ADWR NO: 55-201849
NORTHING: 835383.253	EASTING: 964531.555
LAND SURFACE ELEVATION: 4074.71 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

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HRES-04
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-7

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-4-WS_SP83\26Sept2016

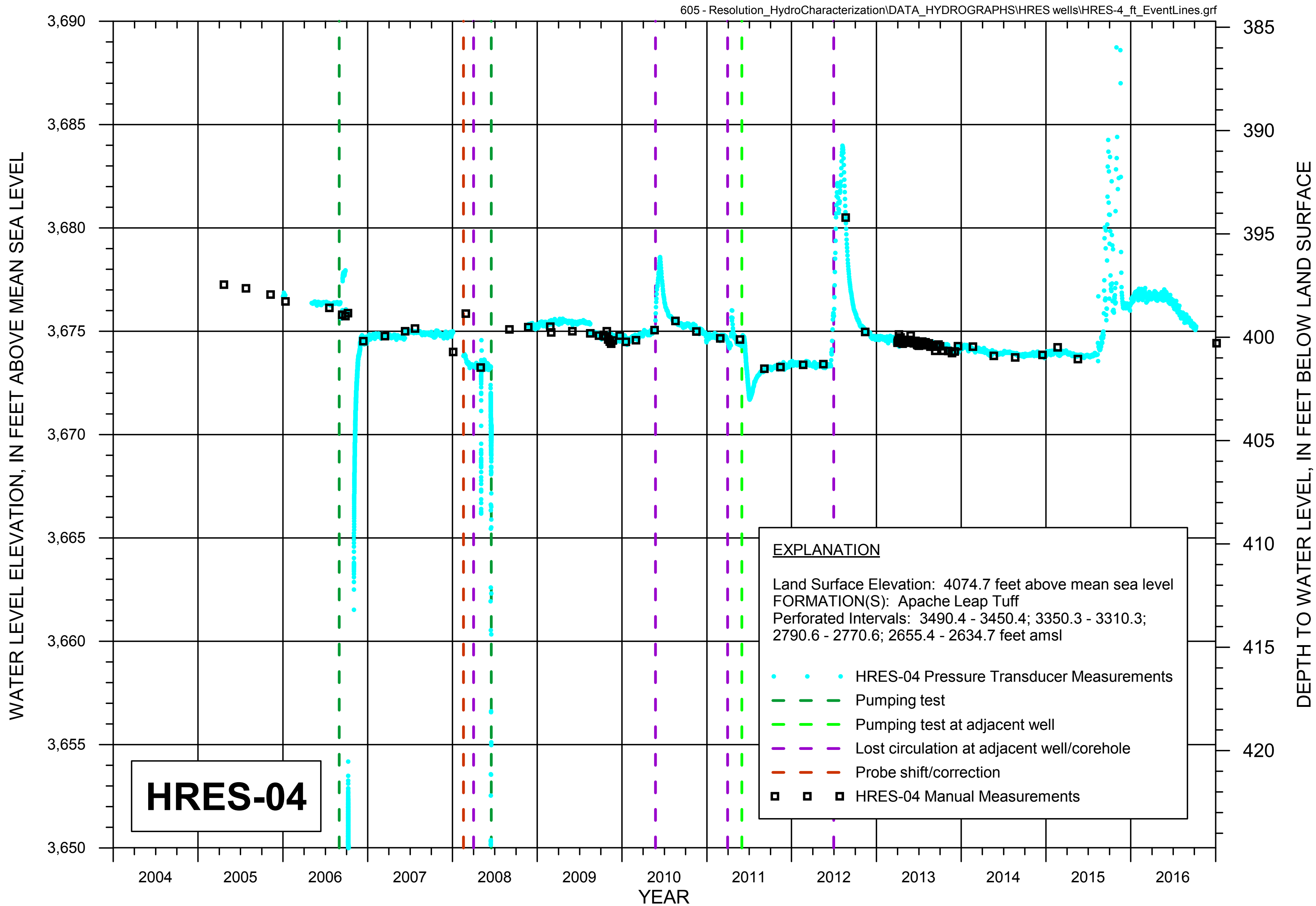

FIGURE A-7a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-04

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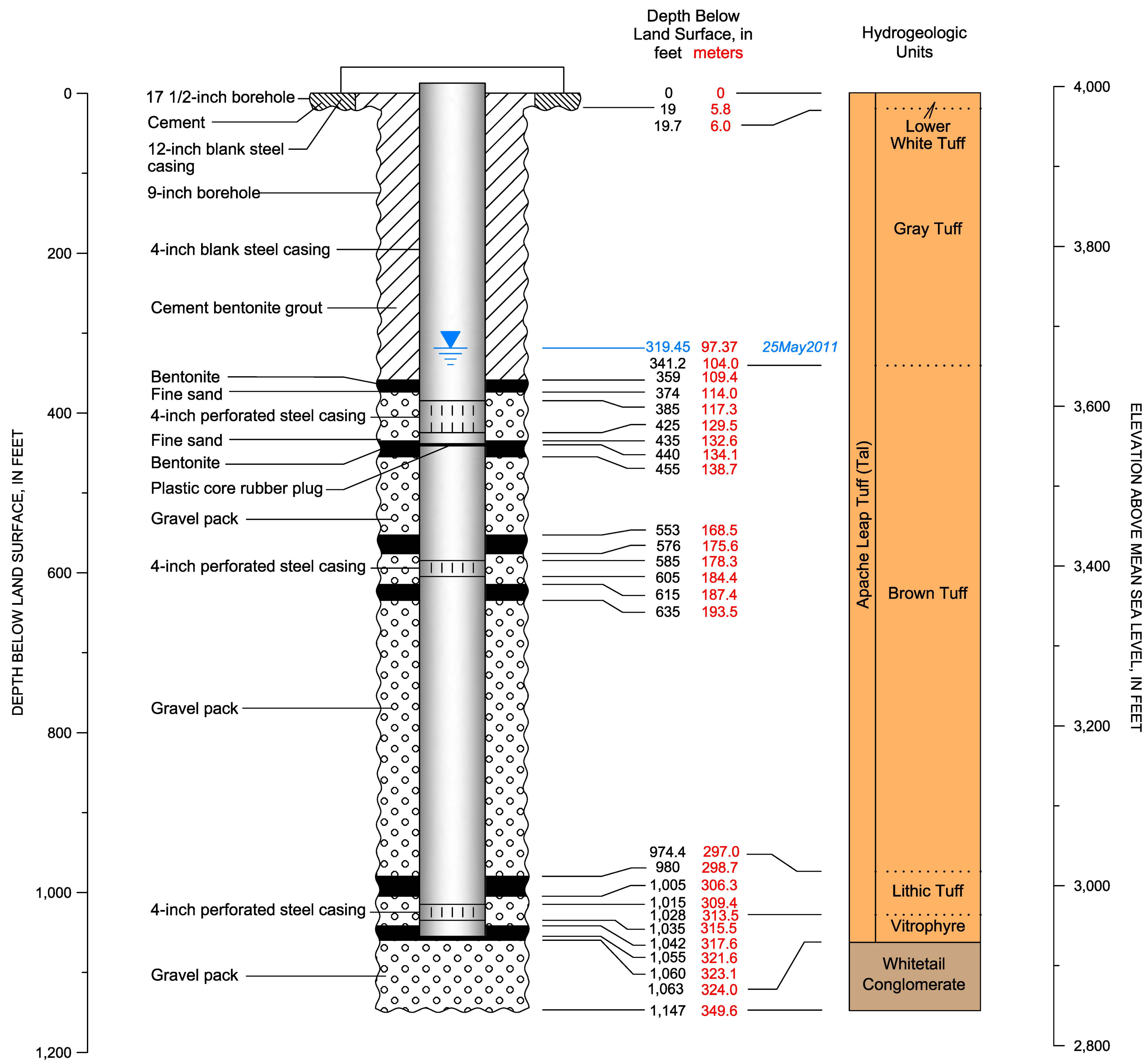

CADASTRAL: (D-2-13) 05ccb	ADWR NO: 55-201848
NORTHING: 830986.161	EASTING: 965229.746
LAND SURFACE ELEVATION: 3992.14 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

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HRES-05
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-8

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-5-WS_SP83\26Sept2016

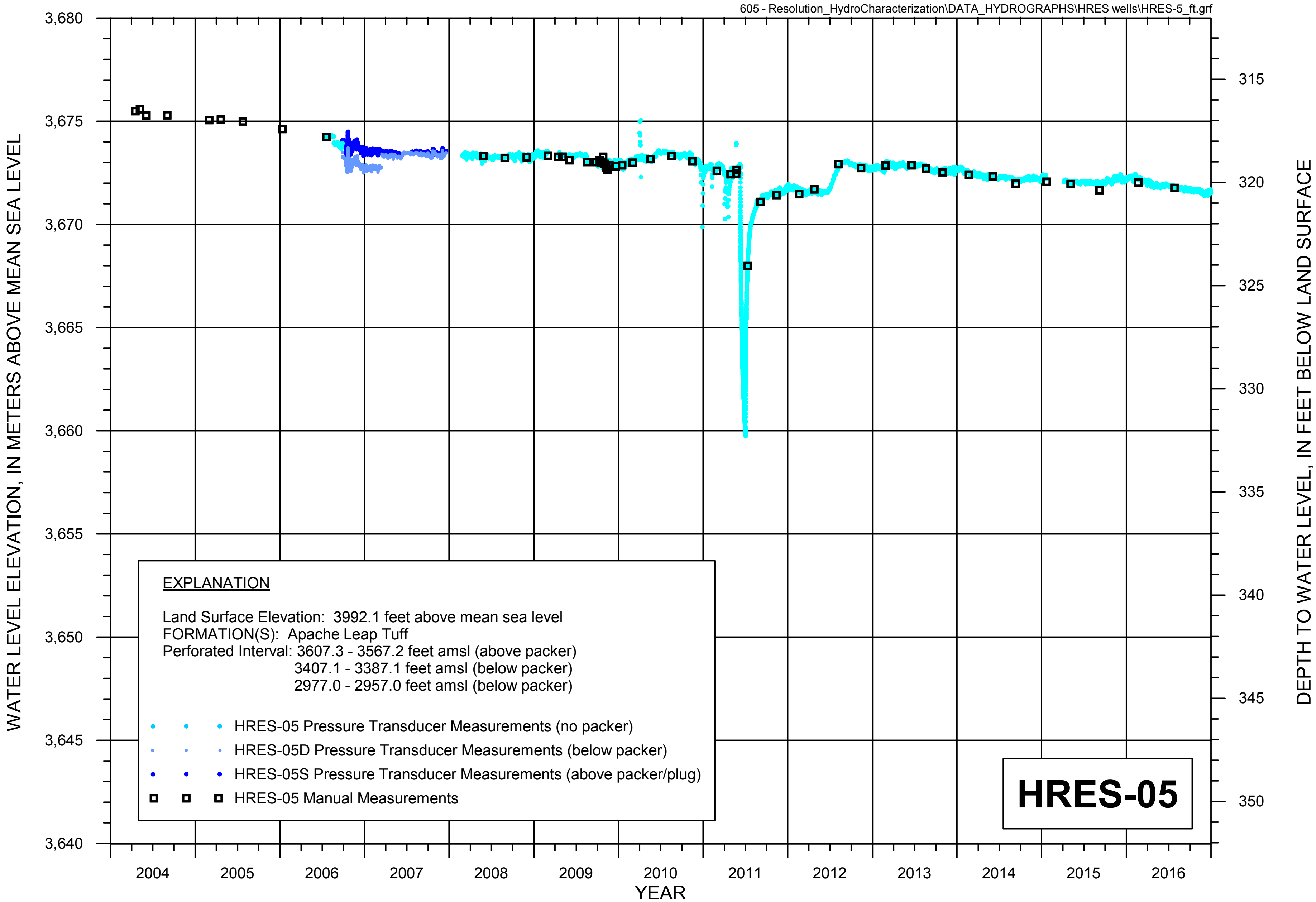
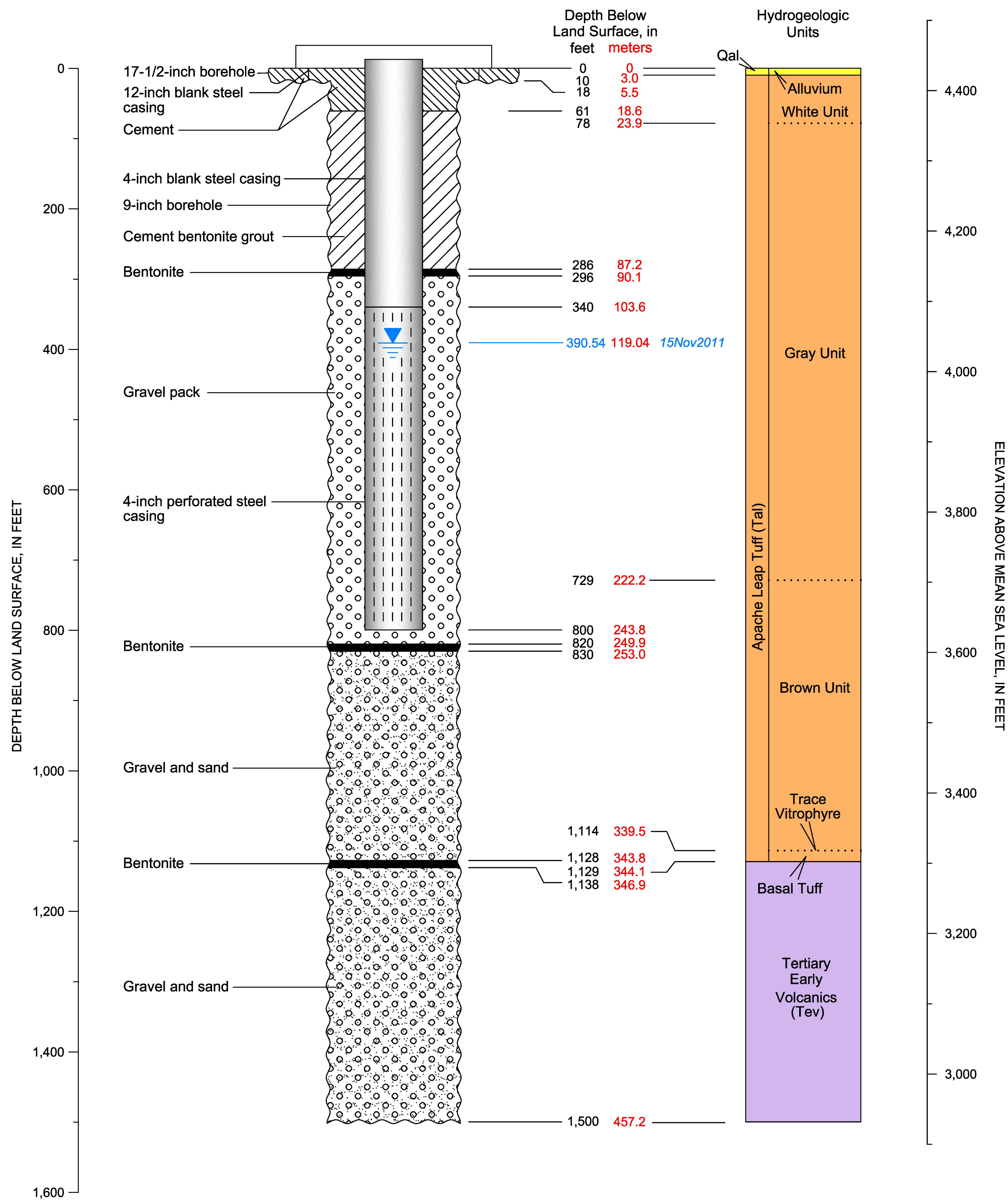


FIGURE A-8a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-05



CADASTRAL: (D-1-13) 14dbc	ADWR NO: 55-214967
NORTHING: 852681.669	EASTING: 977111.797
LAND SURFACE ELEVATION: 4431.86 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

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HRES-06
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-9

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-6-WS_SP83\26Sept2016

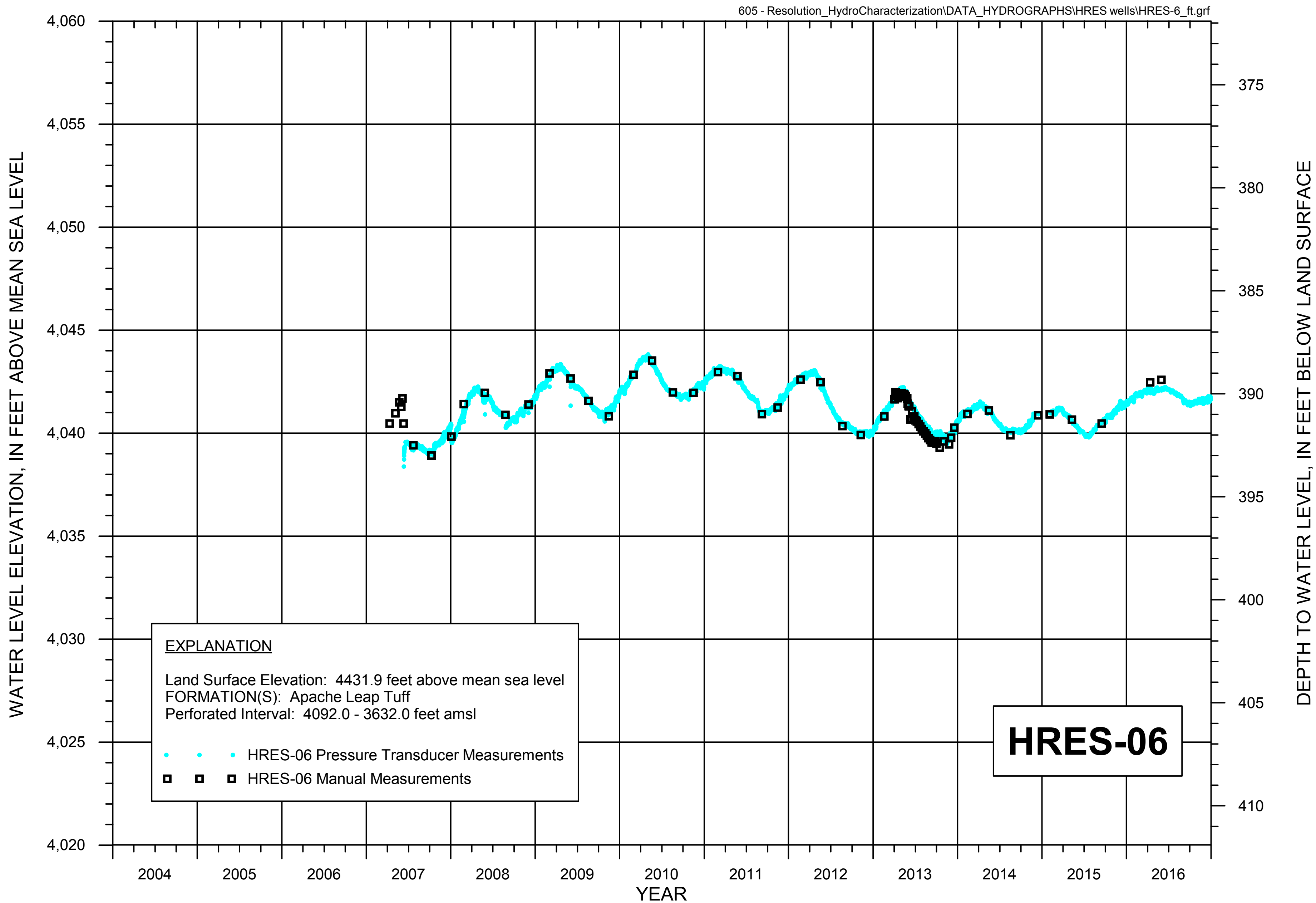

FIGURE A-9a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-06

RESOLUTION COPPER

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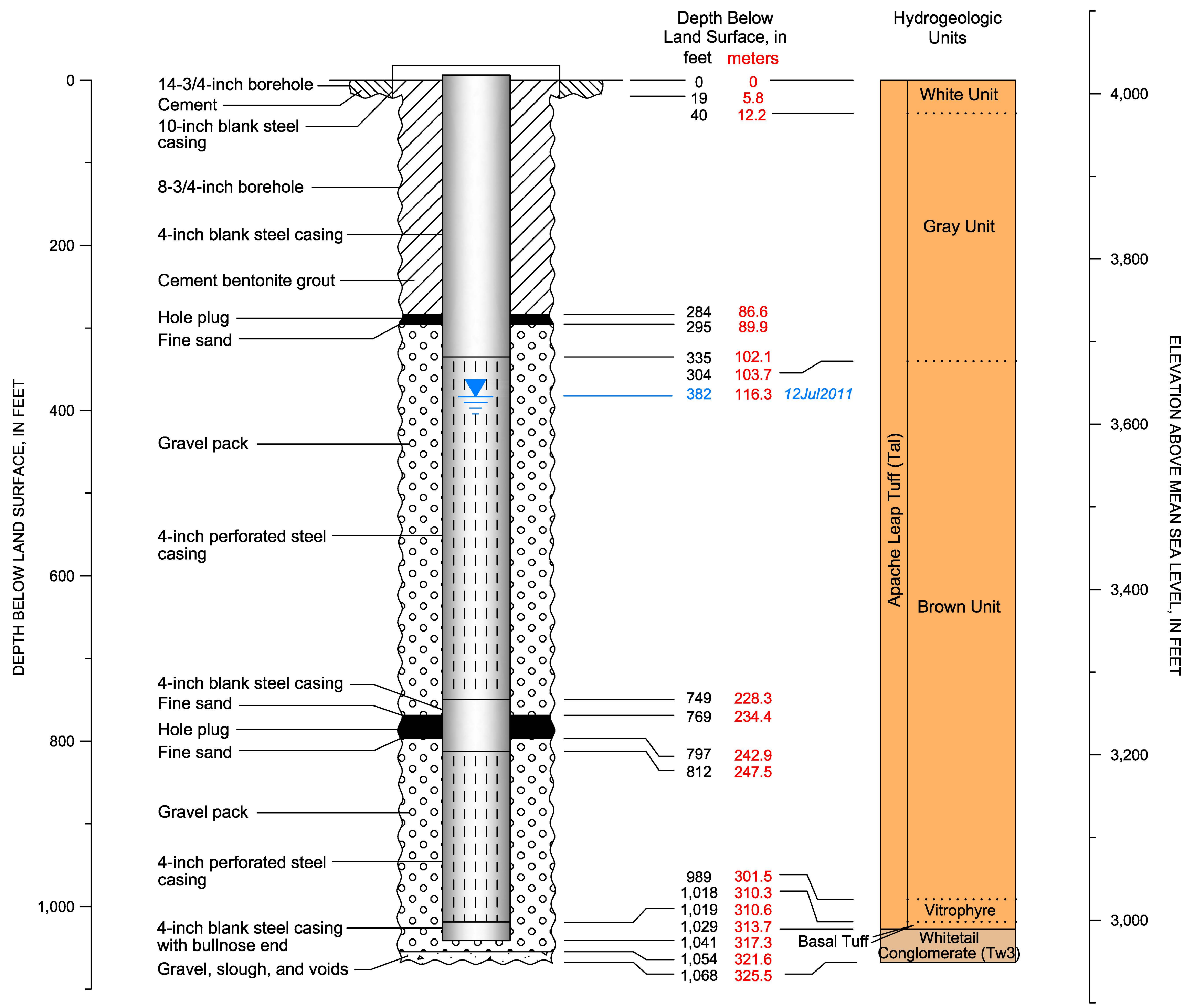

CADASTRAL: (D-2-13) 08aaa	ADWR NO: 55-907947
NORTHING: 829960.075	EASTING: 969606.450
LAND SURFACE ELEVATION: 4016.46 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

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HRES-07
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-10

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-7-WS_SP83\26Sept2016

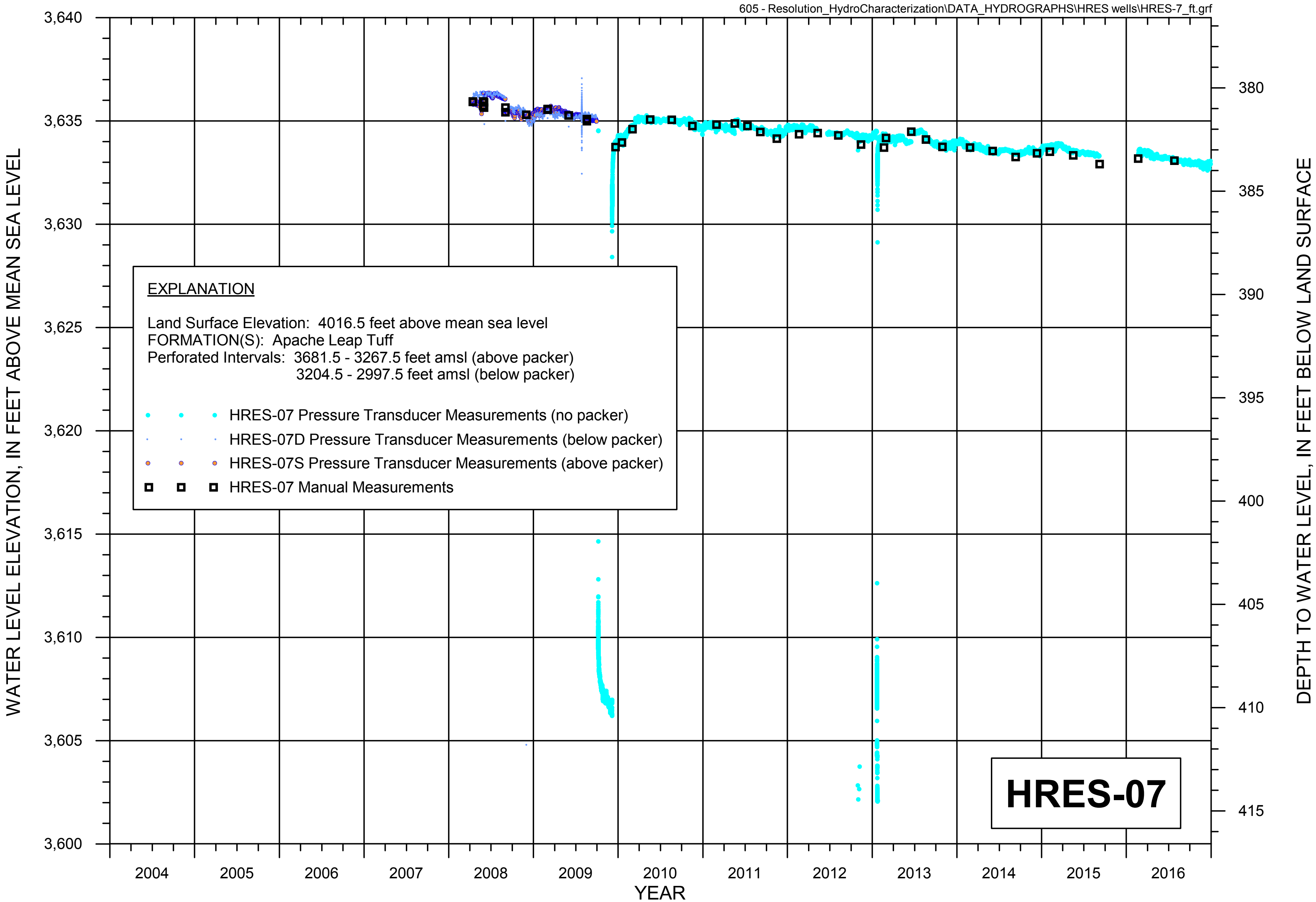

FIGURE A-10a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-07

RESOLUTION COPPER

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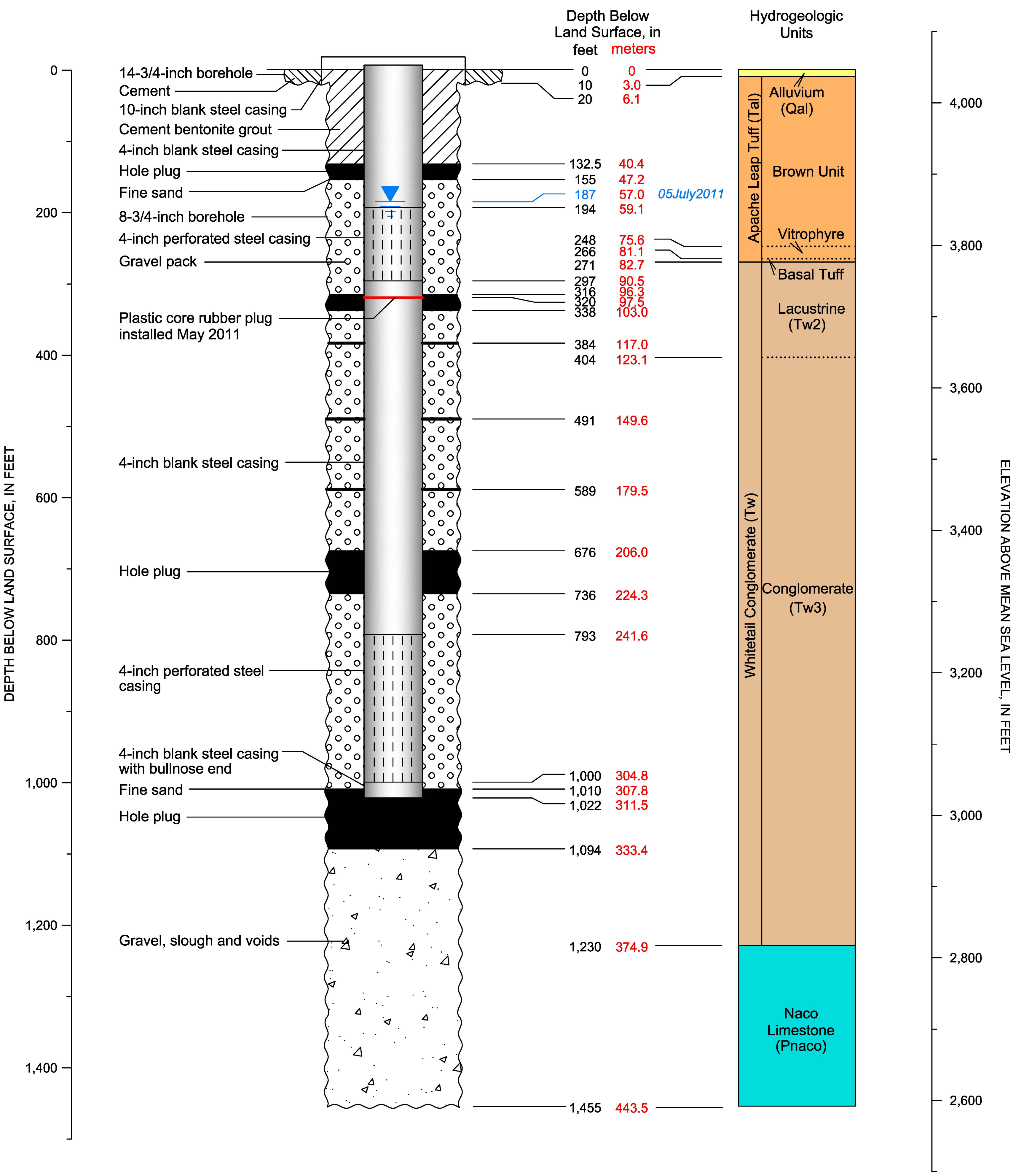

CADASTRAL: (D-2-13) 08cca	ADWR NO: 55-907946
NORTHING: 825985.648	EASTING: 965599.776
LAND SURFACE ELEVATION: 4046.77 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-08
DIAGRAM OF WELL CONSTRUCTION

Version: November 2016

FIGURE A-11

Drafting\605\WellSchematics_2016\HRESwells_SP83\HRES-8_WS_SP83r2\08November 2016

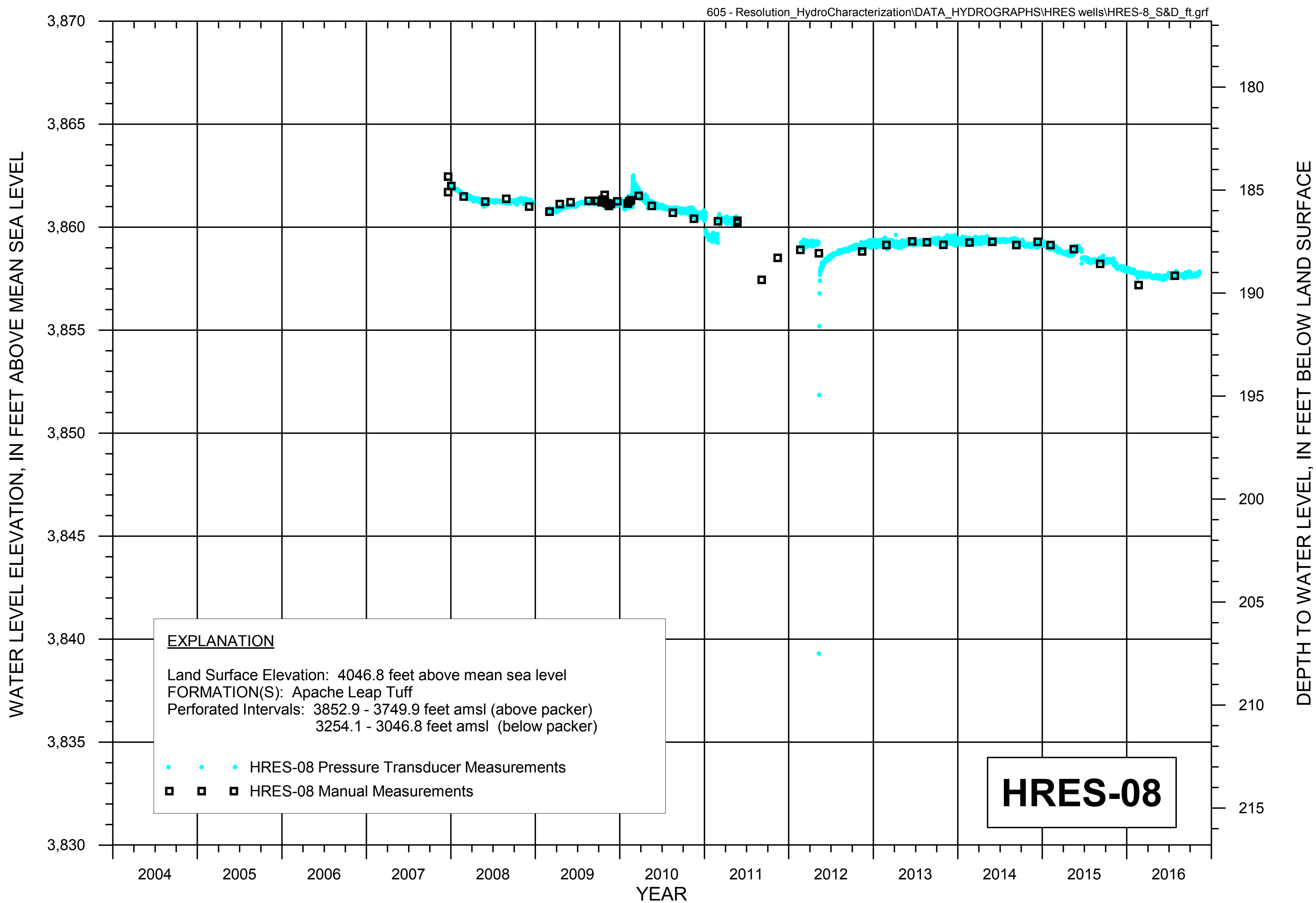

FIGURE A-11a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-08

RESOLUTION COPPER

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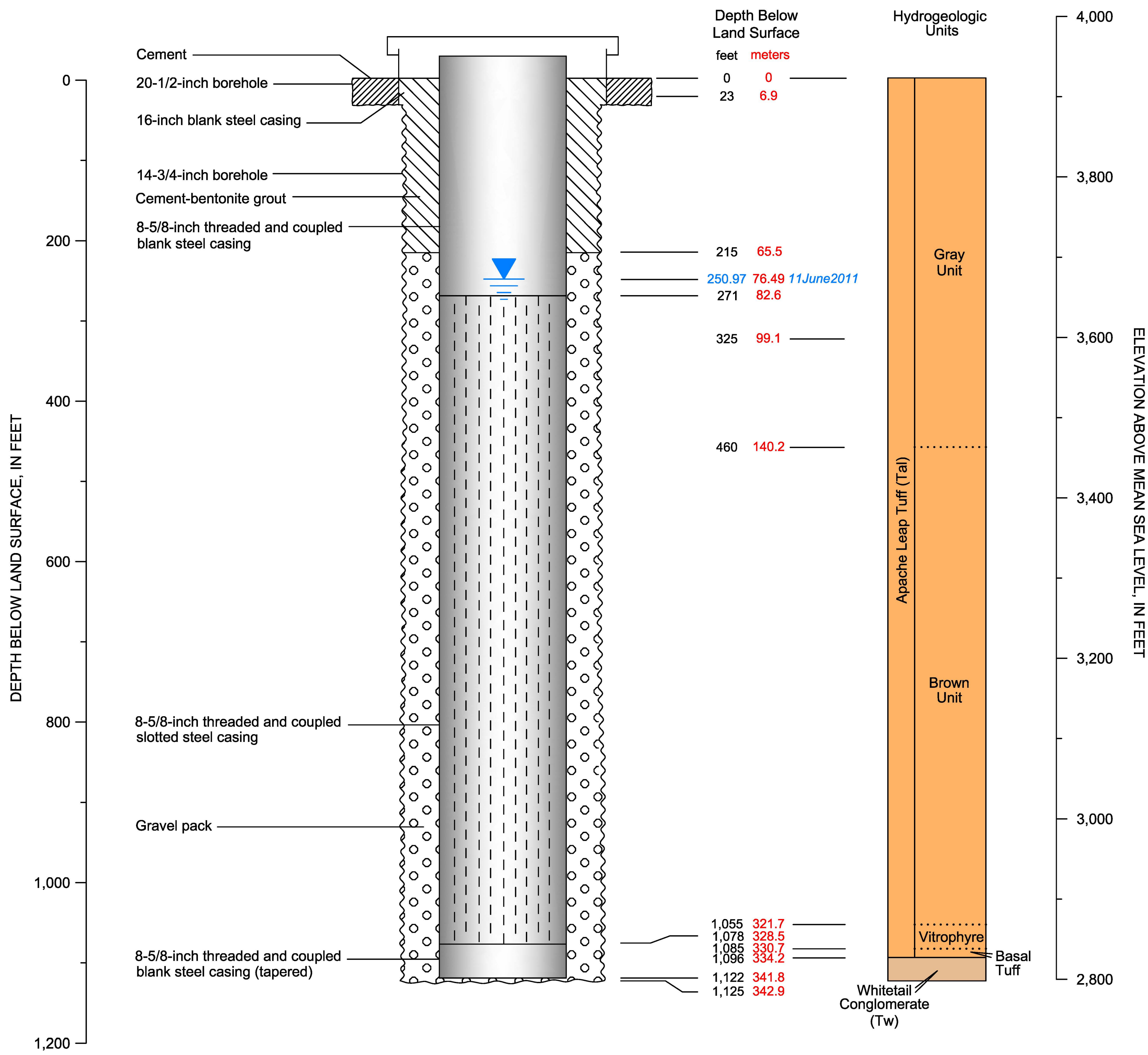

CADASTRAL: (D-2-12) 05cbd	ADWR NO: 55-911875
NORTHING: 831902.978	EASTING: 965770.234
LAND SURFACE ELEVATION: 3923.32 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-09
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-12

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-9-WS_SP83\26Sept2016

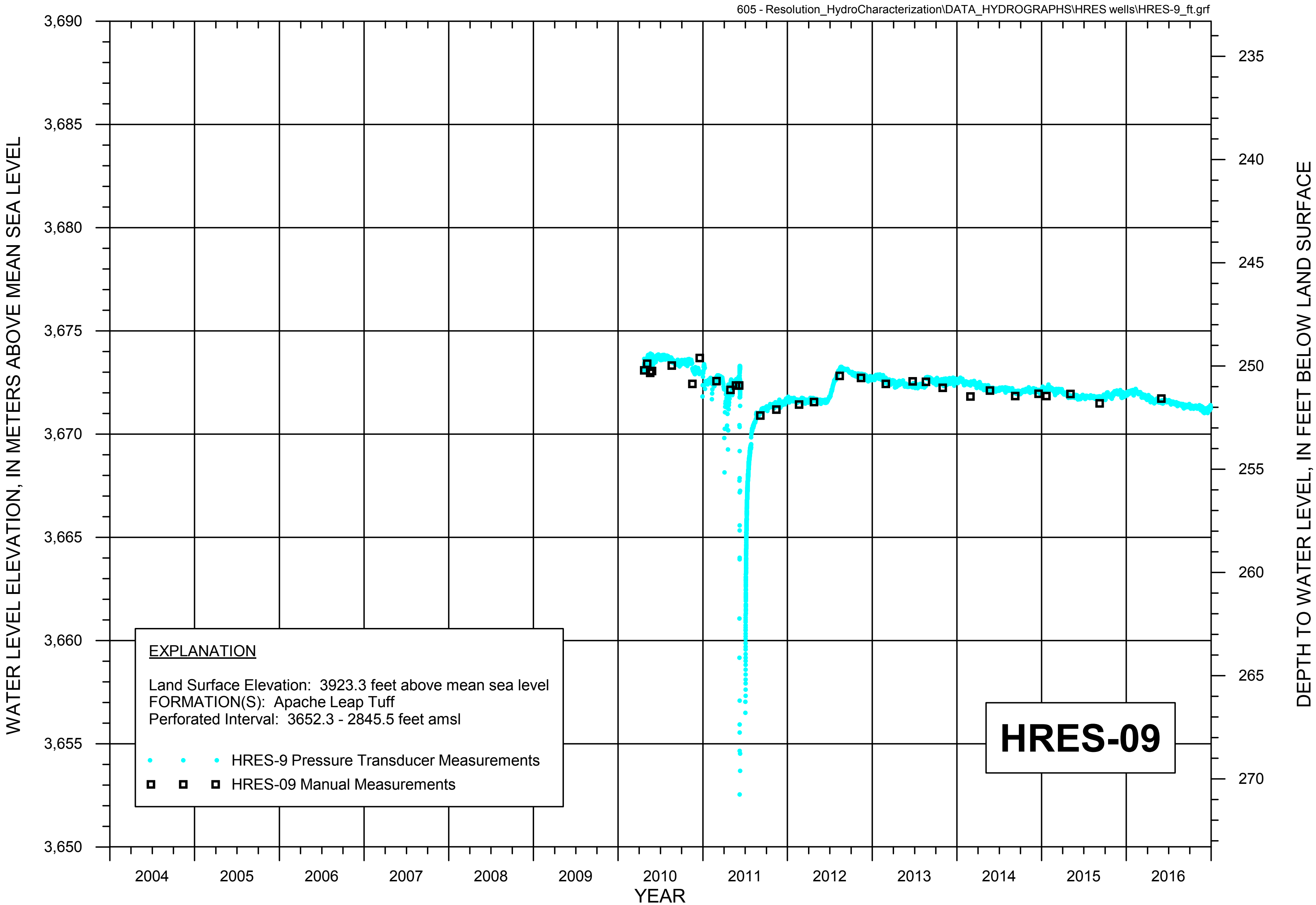
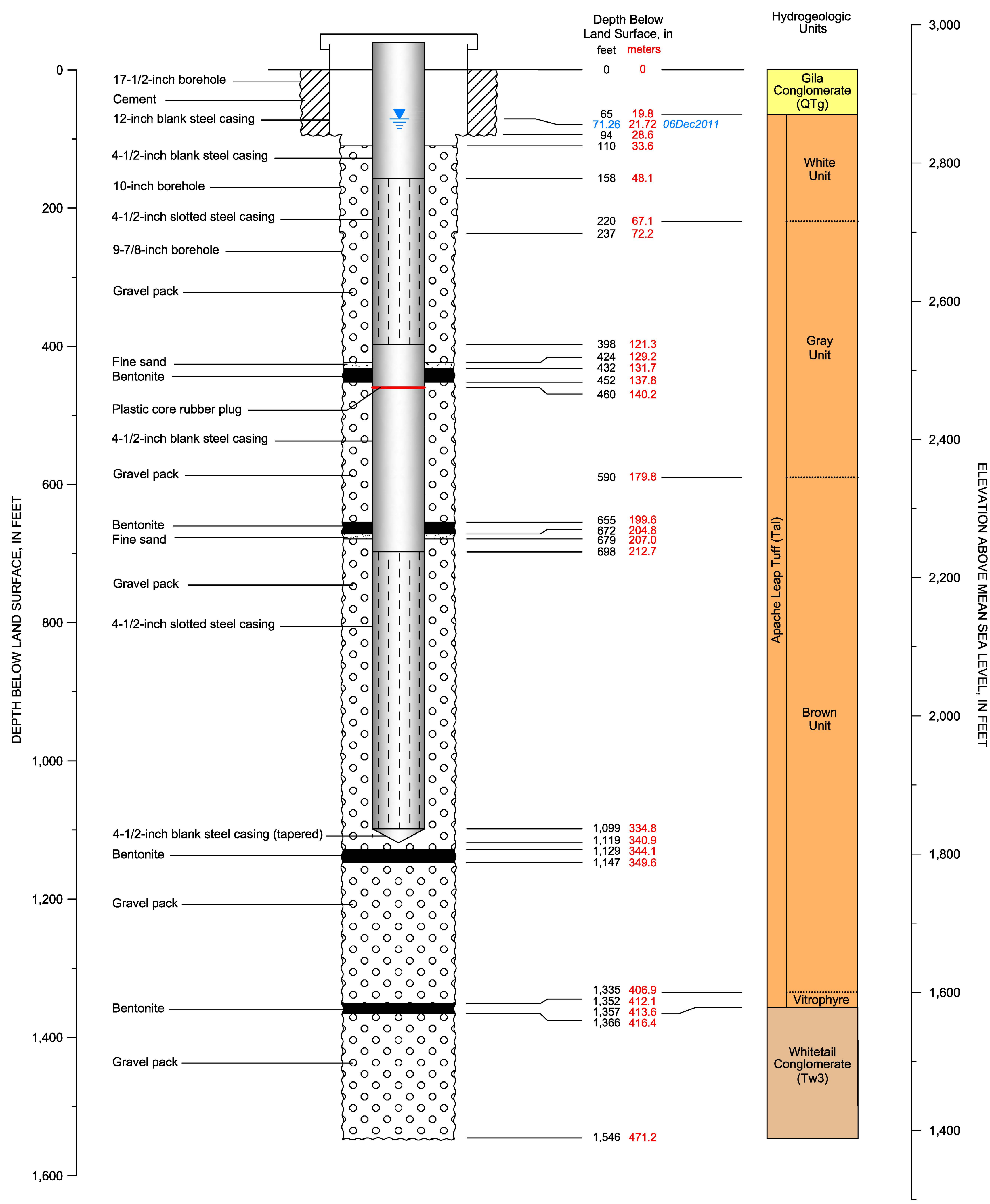


FIGURE A-12a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-09

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-13) 12aac	ADWR NO: 55-911941
NORTHING: 829224.879	EASTING: 990434.231
LAND SURFACE ELEVATION: 2935.14 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-10
DIAGRAM OF WELL CONSTRUCTION

Version: November 2016

FIGURE A-13

Drafting\605\WellSchematics_2016\HRESwells_SP83\HRES-10-WS_SP83r2\08Nov2016

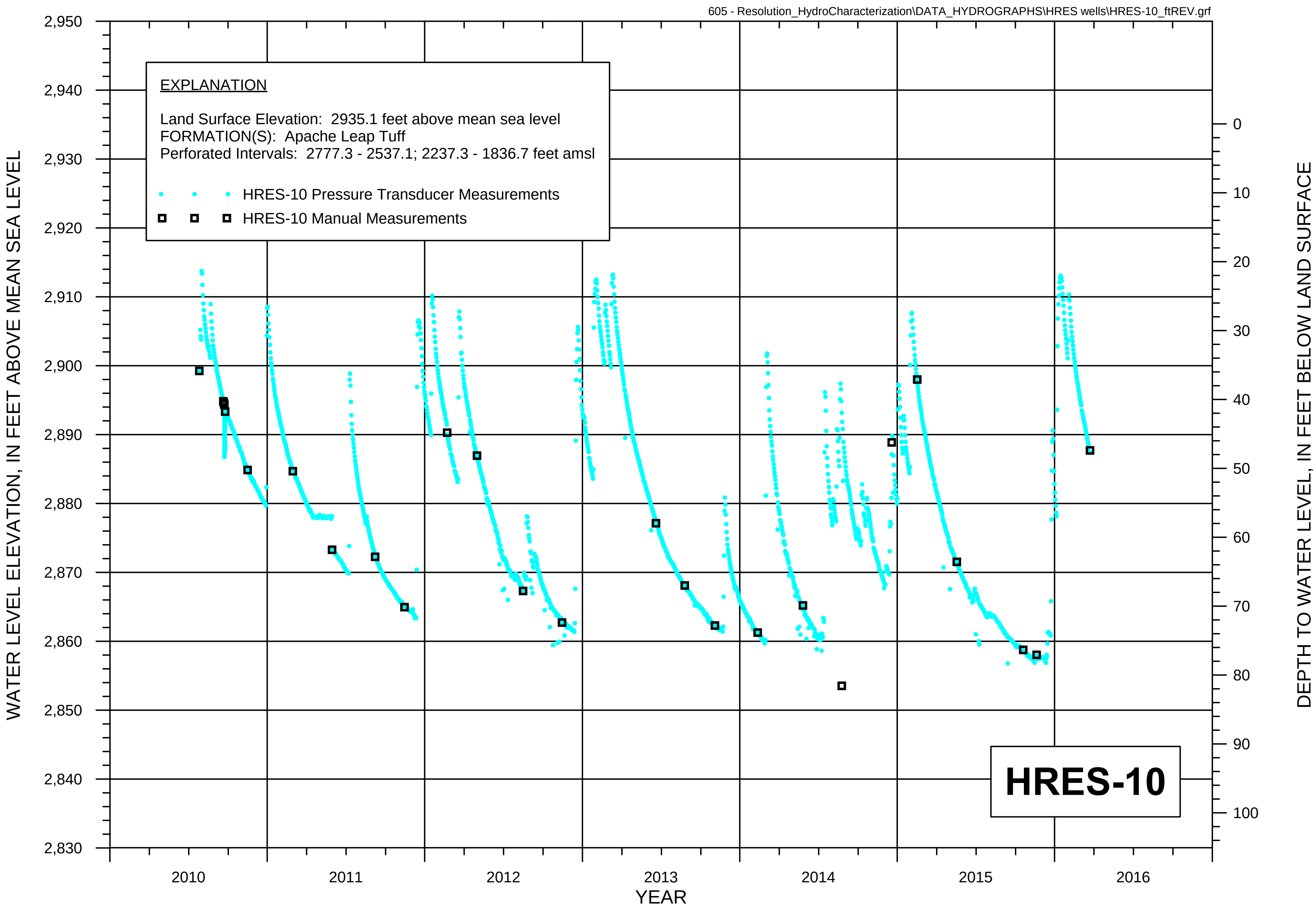
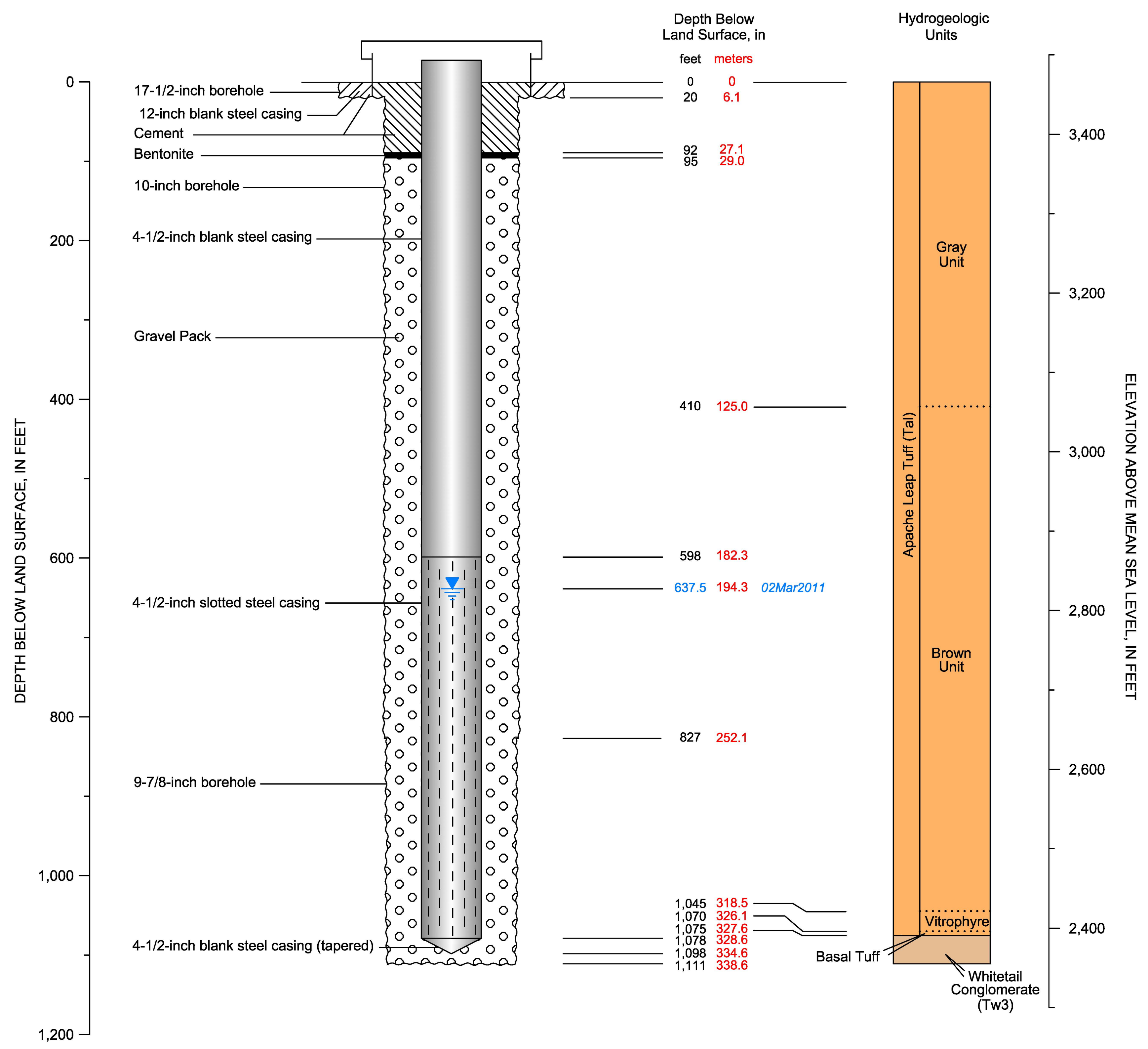


FIGURE A-13a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-10

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-13) 15daa	ADWR NO: 55-912021
NORTHING: 821967.096	EASTING: 980584.270
LAND SURFACE ELEVATION: 3466.09 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-11
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-14

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-11-WS_SP83\26Sept2016

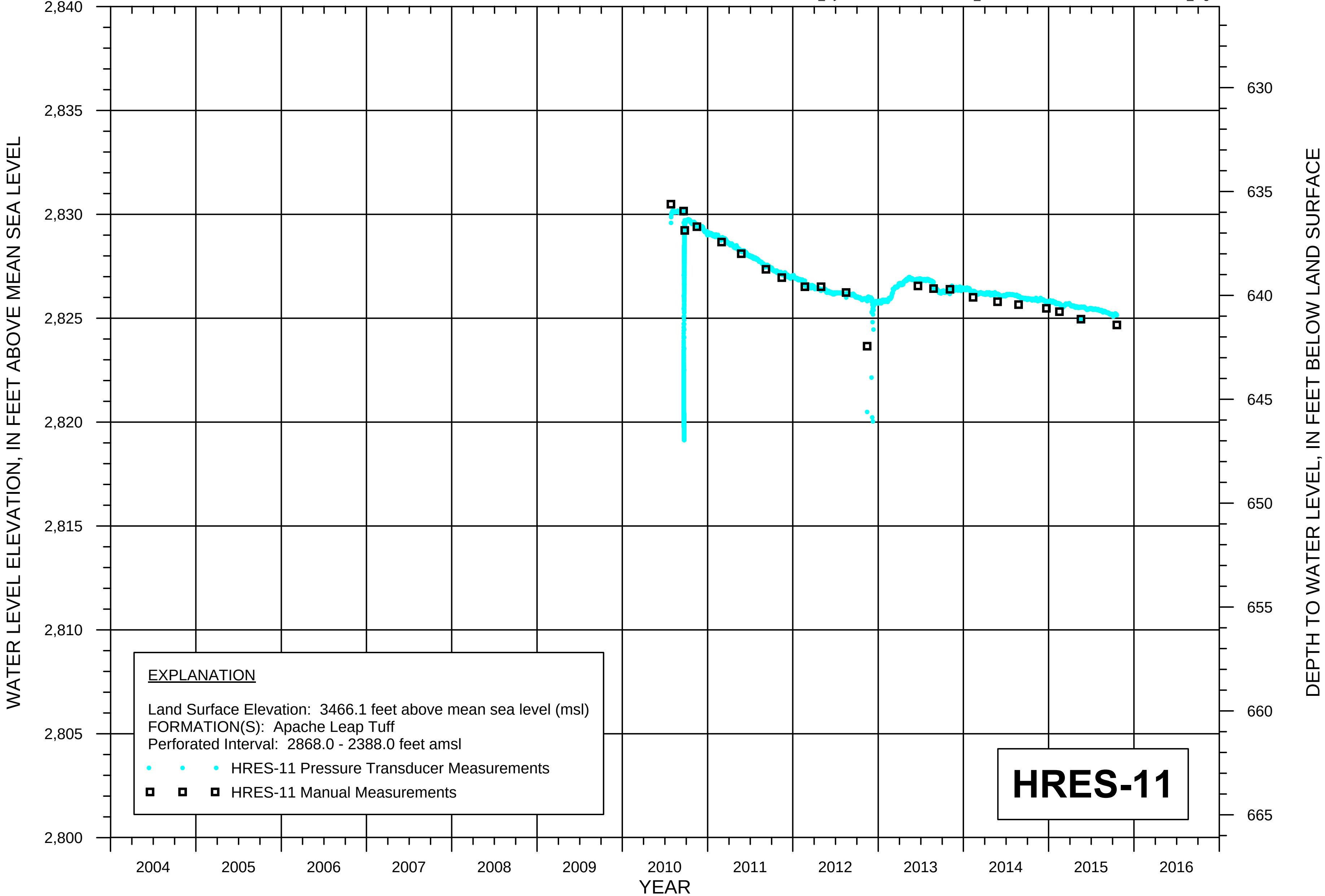

FIGURE A-14a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-11

RESOLUTION COPPER

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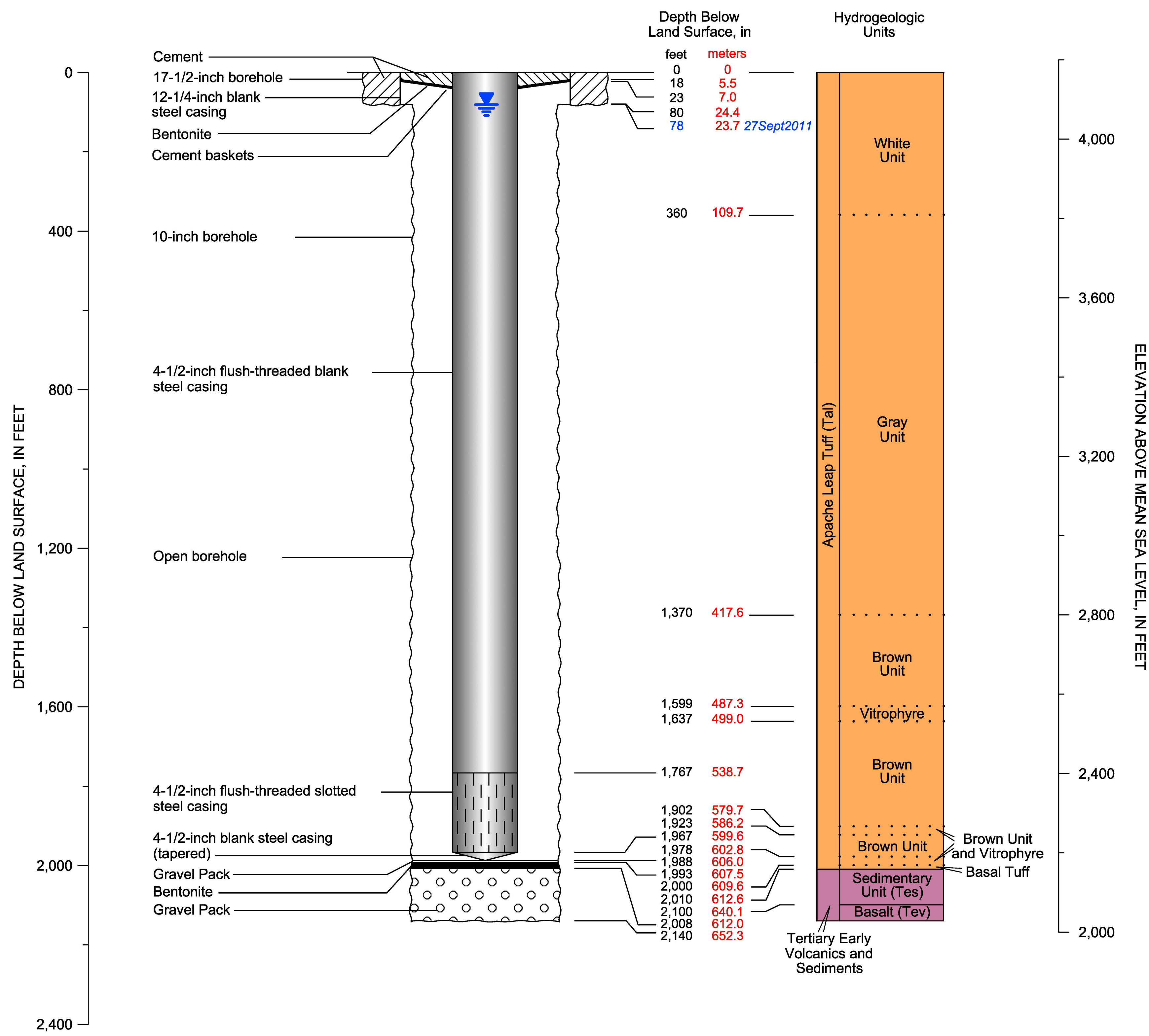

CADASTRAL: (D-1-13) 21cbc	ADWR NO: 55-912917
NORTHING: 847210.324	EASTING: 963794.061
LAND SURFACE ELEVATION: 4168.58 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

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HRES-12
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-15

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-3-WS_SP83\26Sept2016

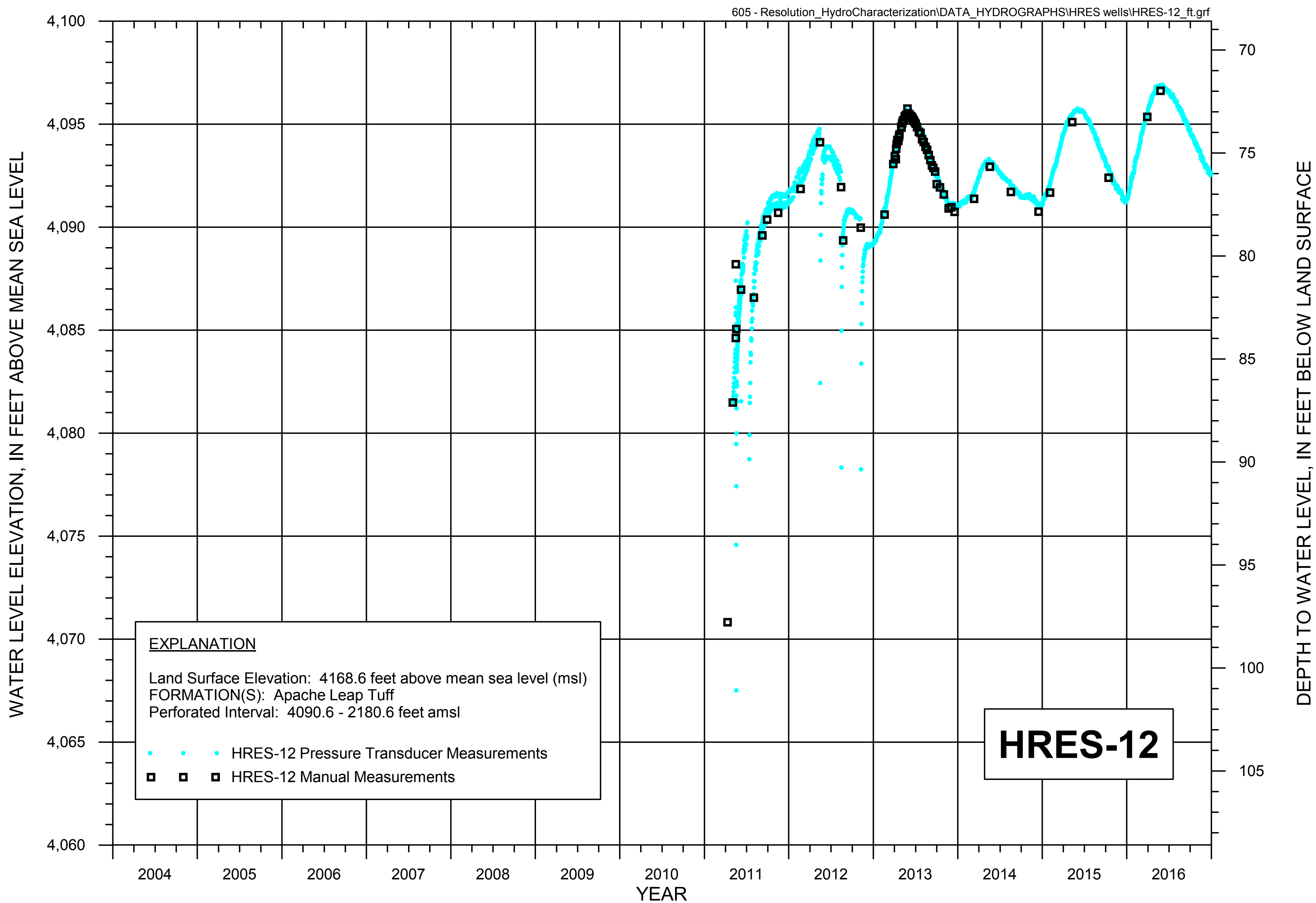
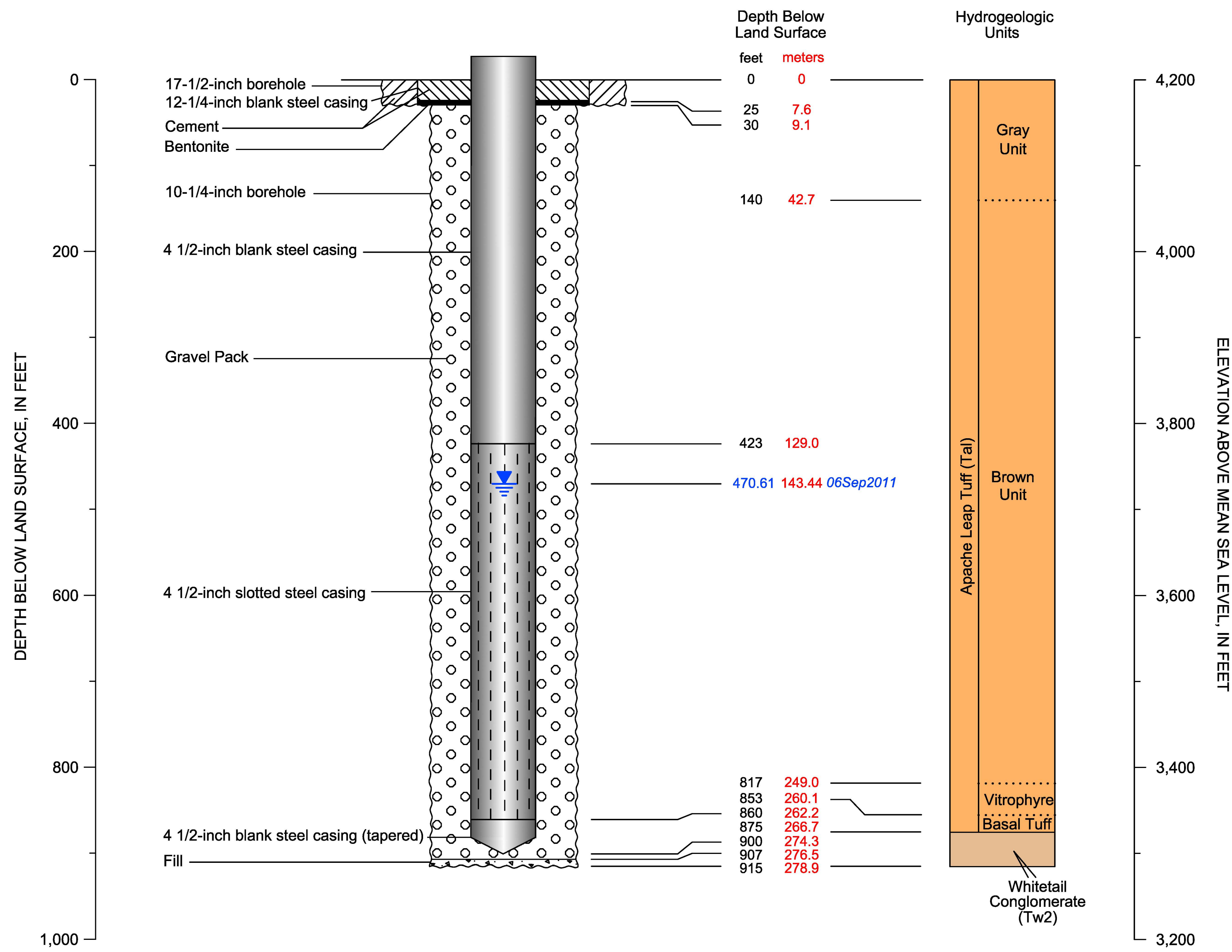


FIGURE A-15a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-12

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-13) 07abc	ADWR NO: 55-912967
NORTHING: 829164.988	EASTING: 962267.671
LAND SURFACE ELEVATION: 4199.09 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-13
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-16

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-13-WS_SP83\26Sept2016

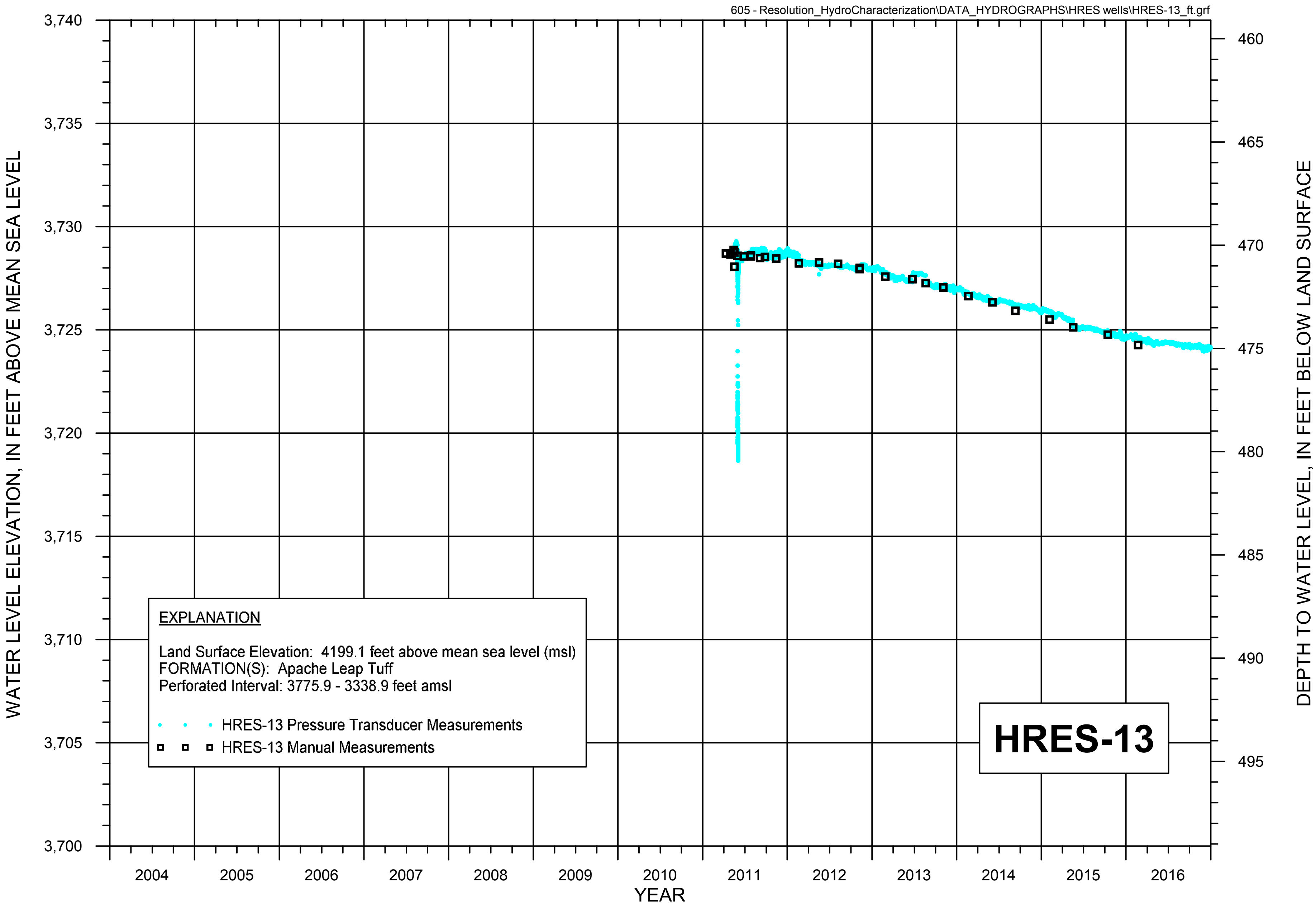
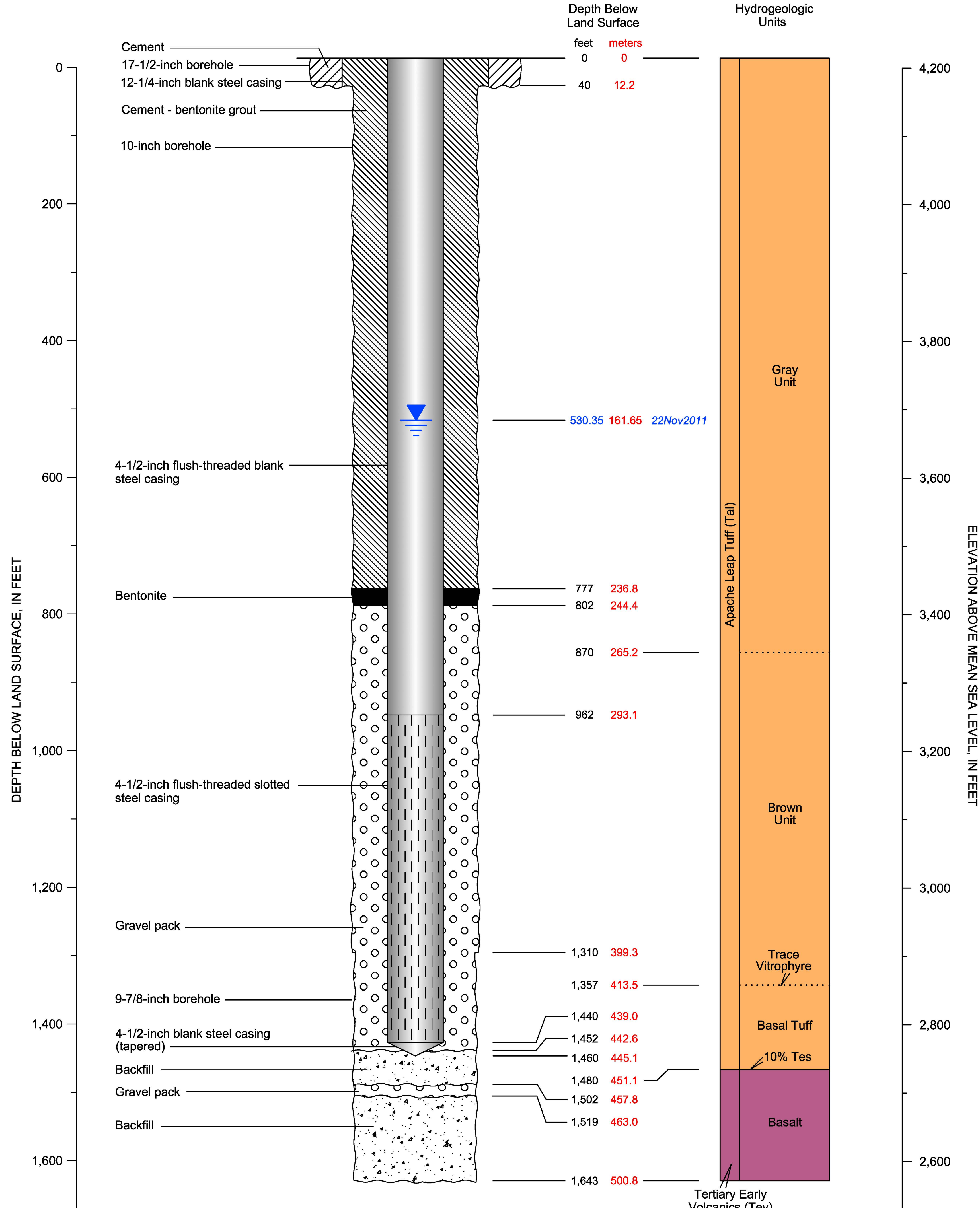


FIGURE A-16a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-13

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-13) 22dba	ADWR NO: 55-912993
NORTHING: 848272.497	EASTING: 972011.005
LAND SURFACE ELEVATION: 4214.69 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-14
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-17

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-14-WS_SP83\26Sept2016

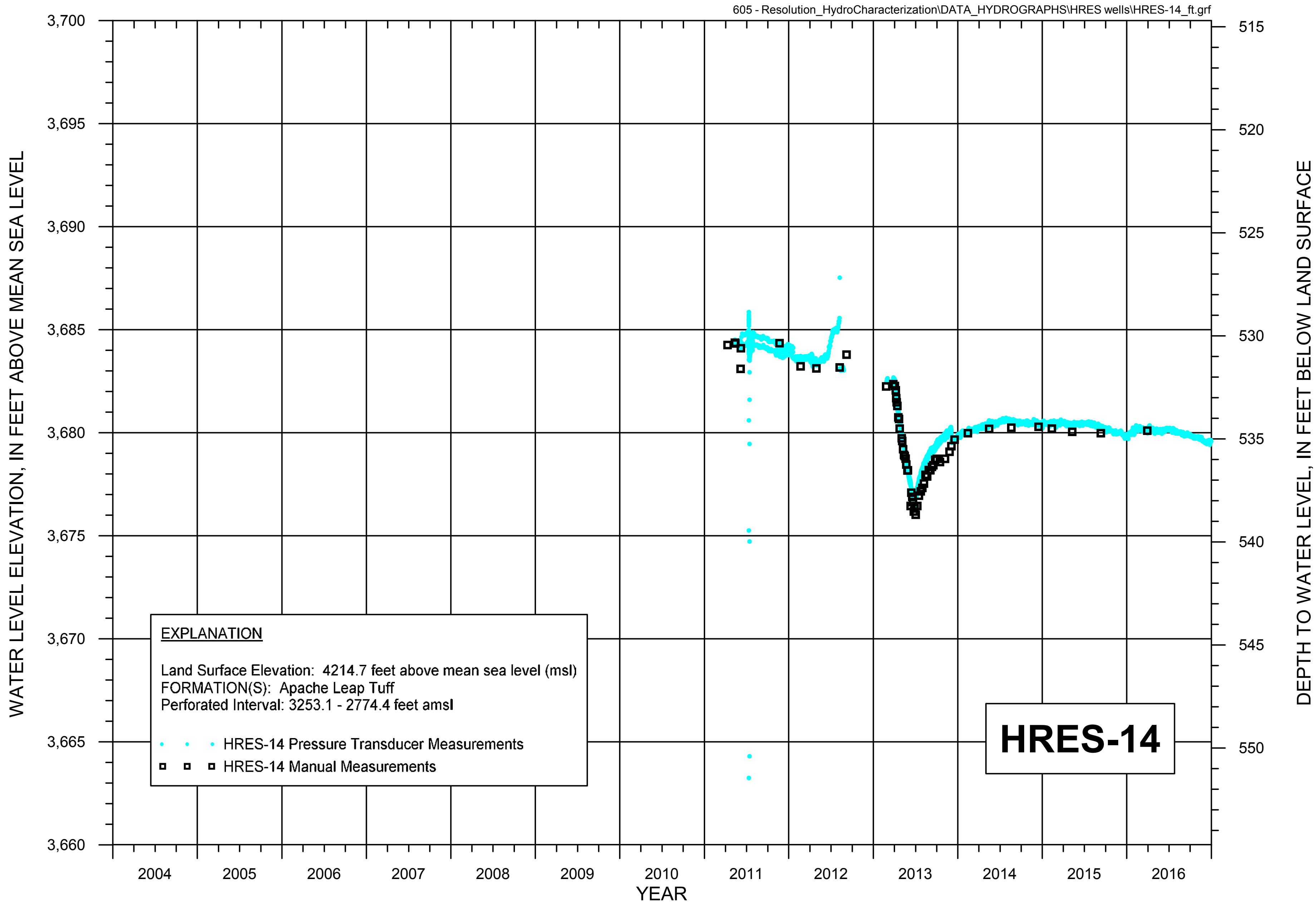
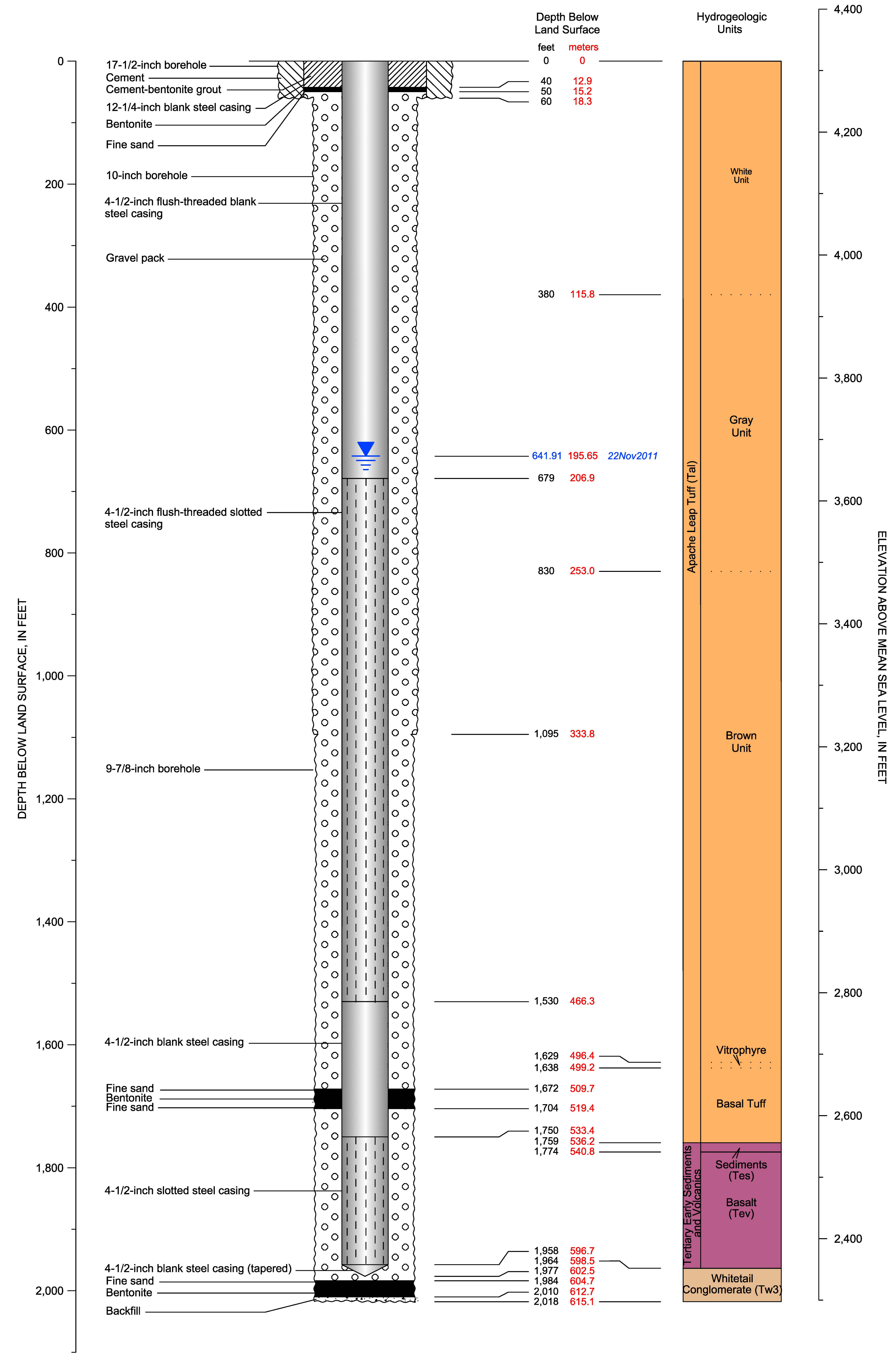


FIGURE A-17a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-14

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-13) 27dbc	ADWR NO: 55-913292
NORTHING: 842357.318	EASTING: 971983.412
LAND SURFACE ELEVATION: 4315.37 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-15
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-18

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-15-WS_SP83\26Sept2016

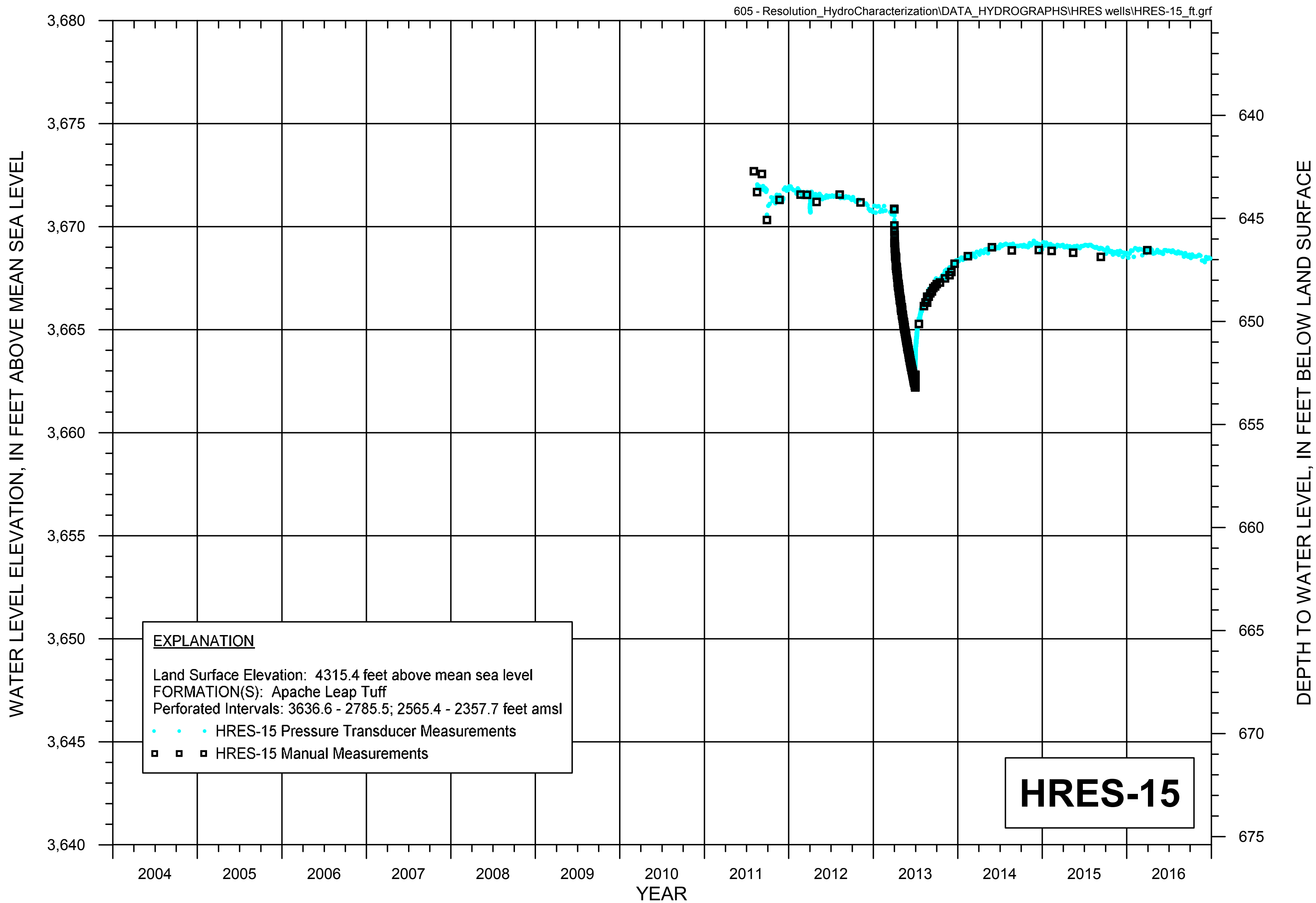
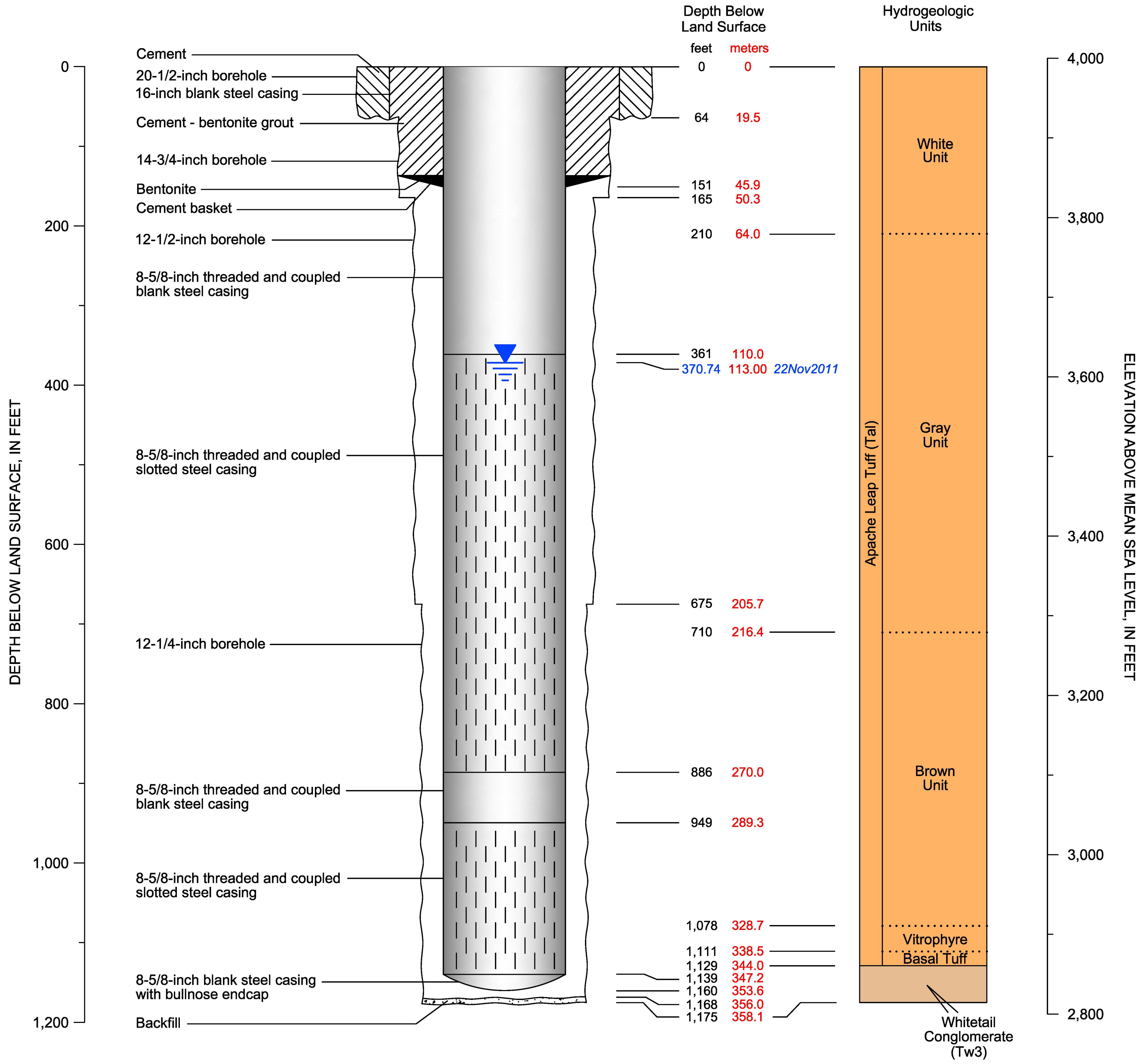


FIGURE A-18a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-15



CADASTRAL: (D-2-13) 04dba	ADWR NO: 55-913342
NORTHING: 832538.408	EASTING: 973982.778
LAND SURFACE ELEVATION: 3989.59 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-16
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-19

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-16-WS_SP83\26Sept2016

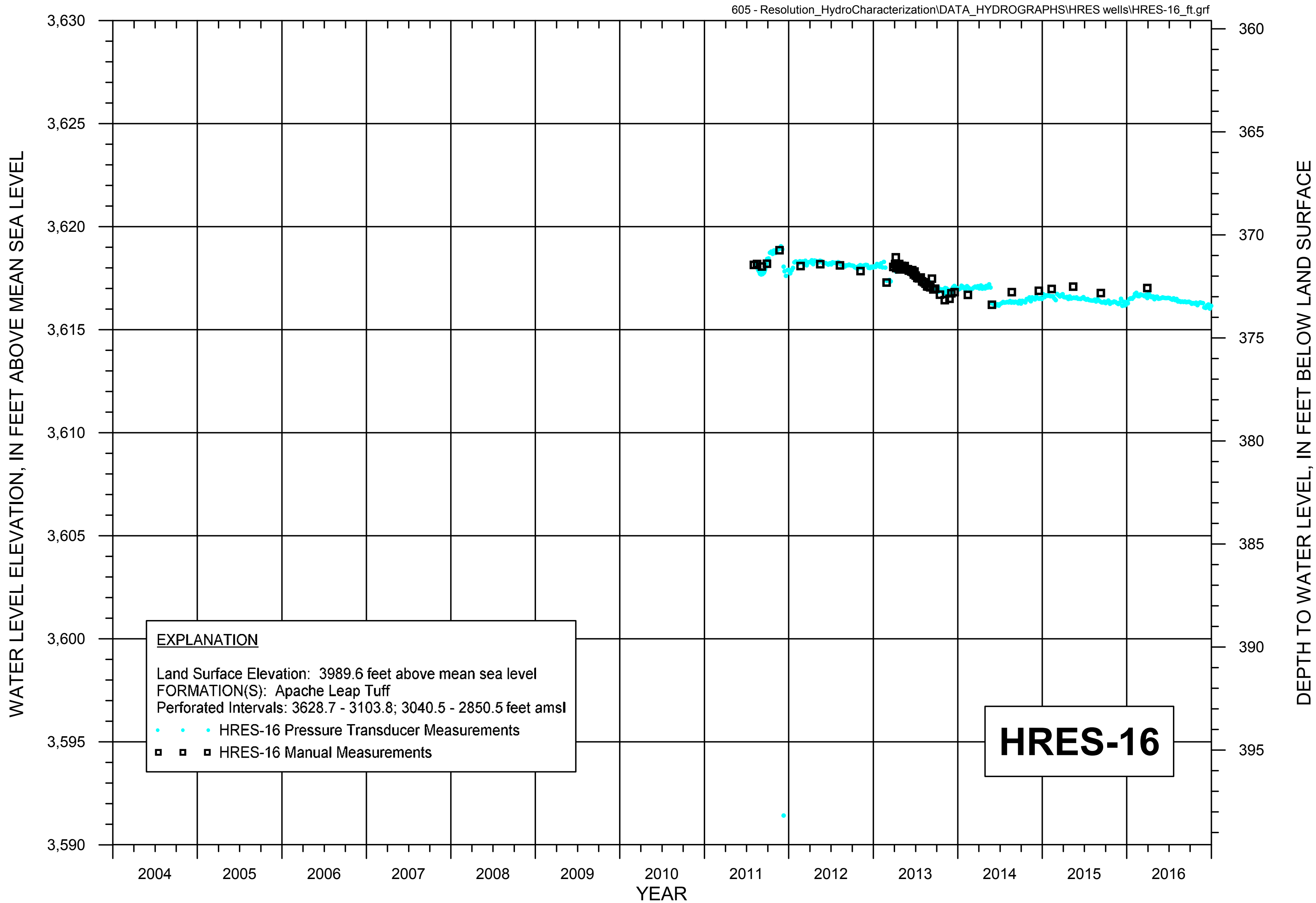
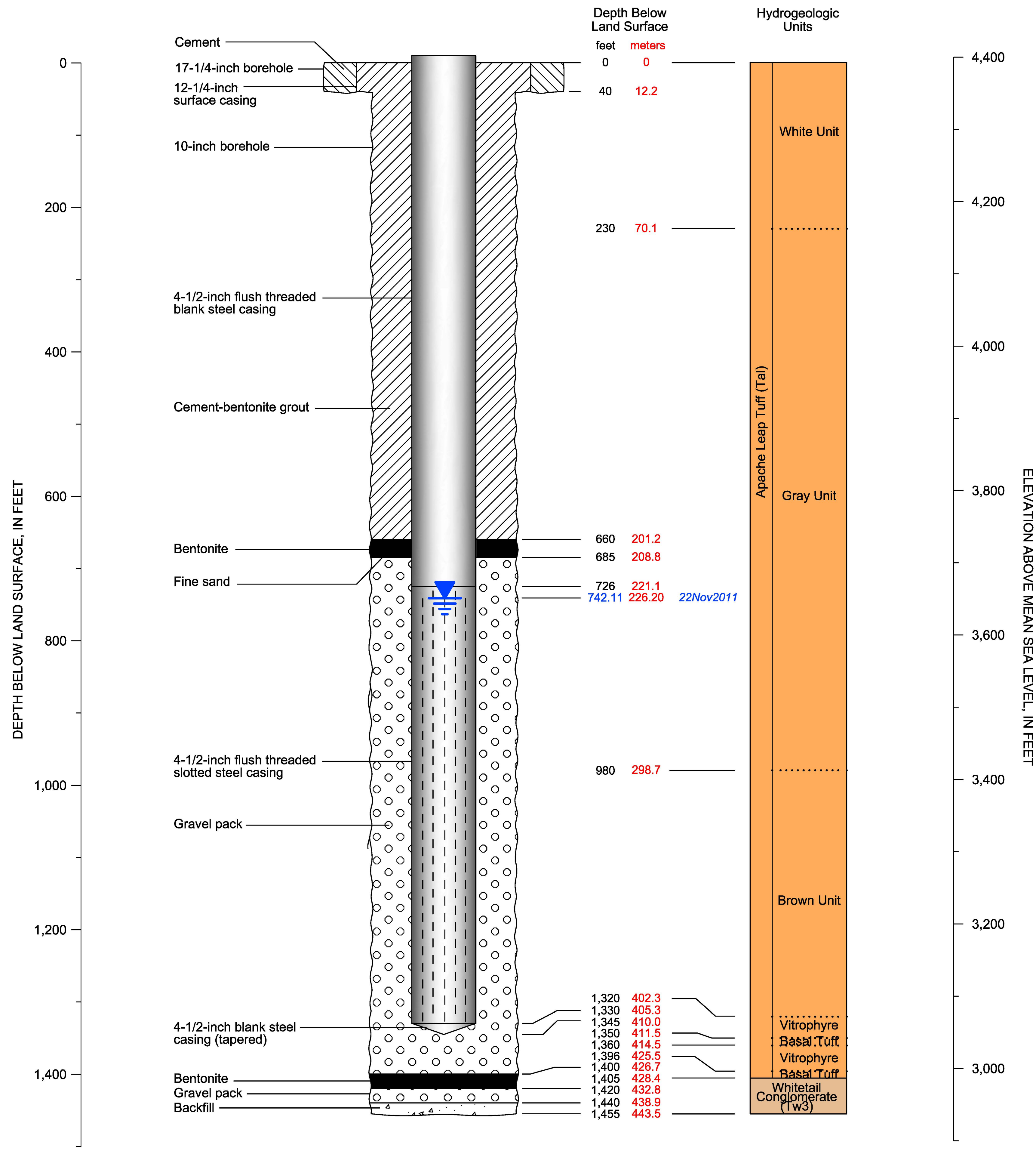


FIGURE A-19a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-16

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-13) 26dcc	ADWR NO: 55-913427
NORTHING: 840709.579	EASTING: 976950.799
LAND SURFACE ELEVATION: 4392.33 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-17
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-20

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-17-WS_SP83\26Sept2016

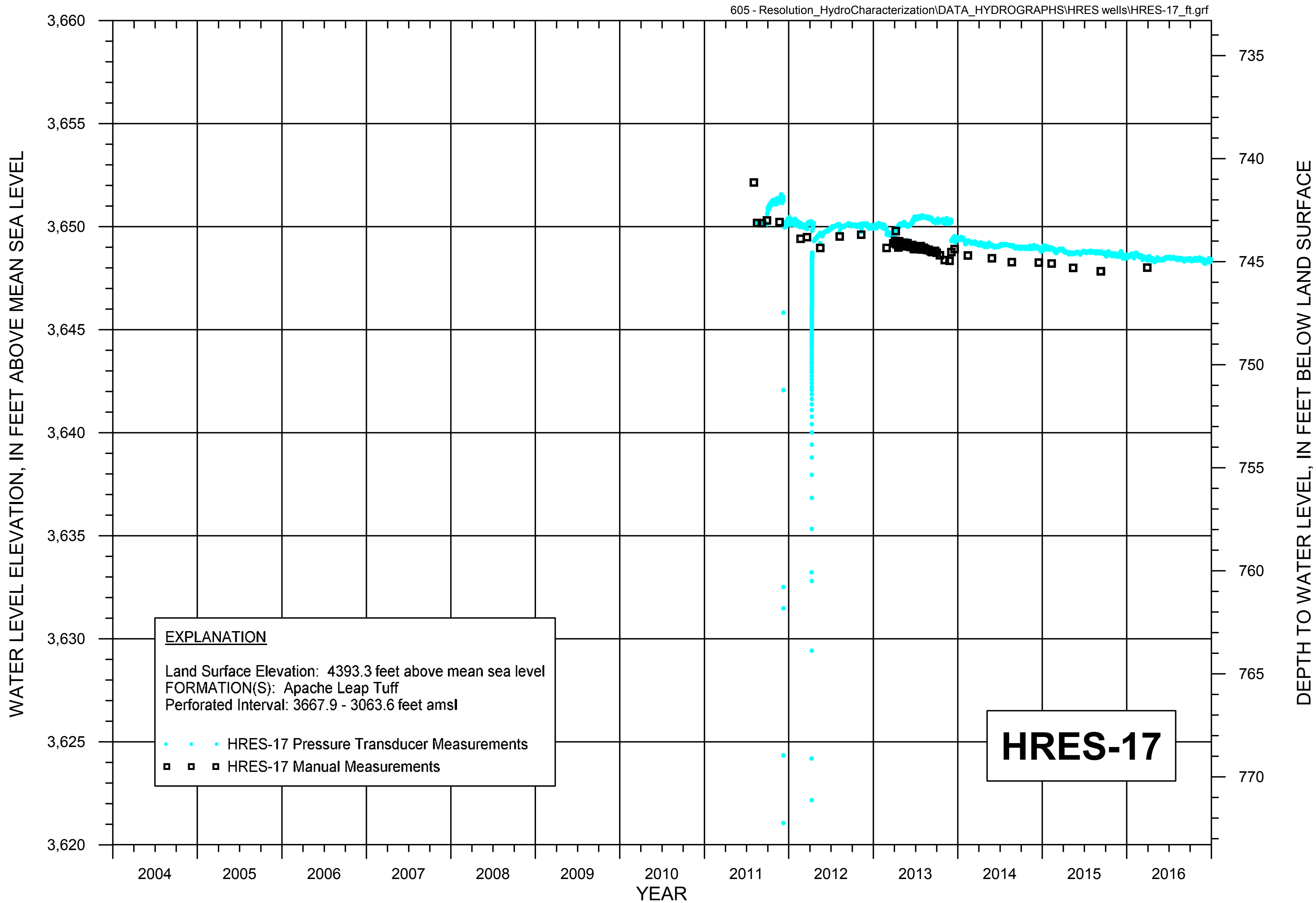
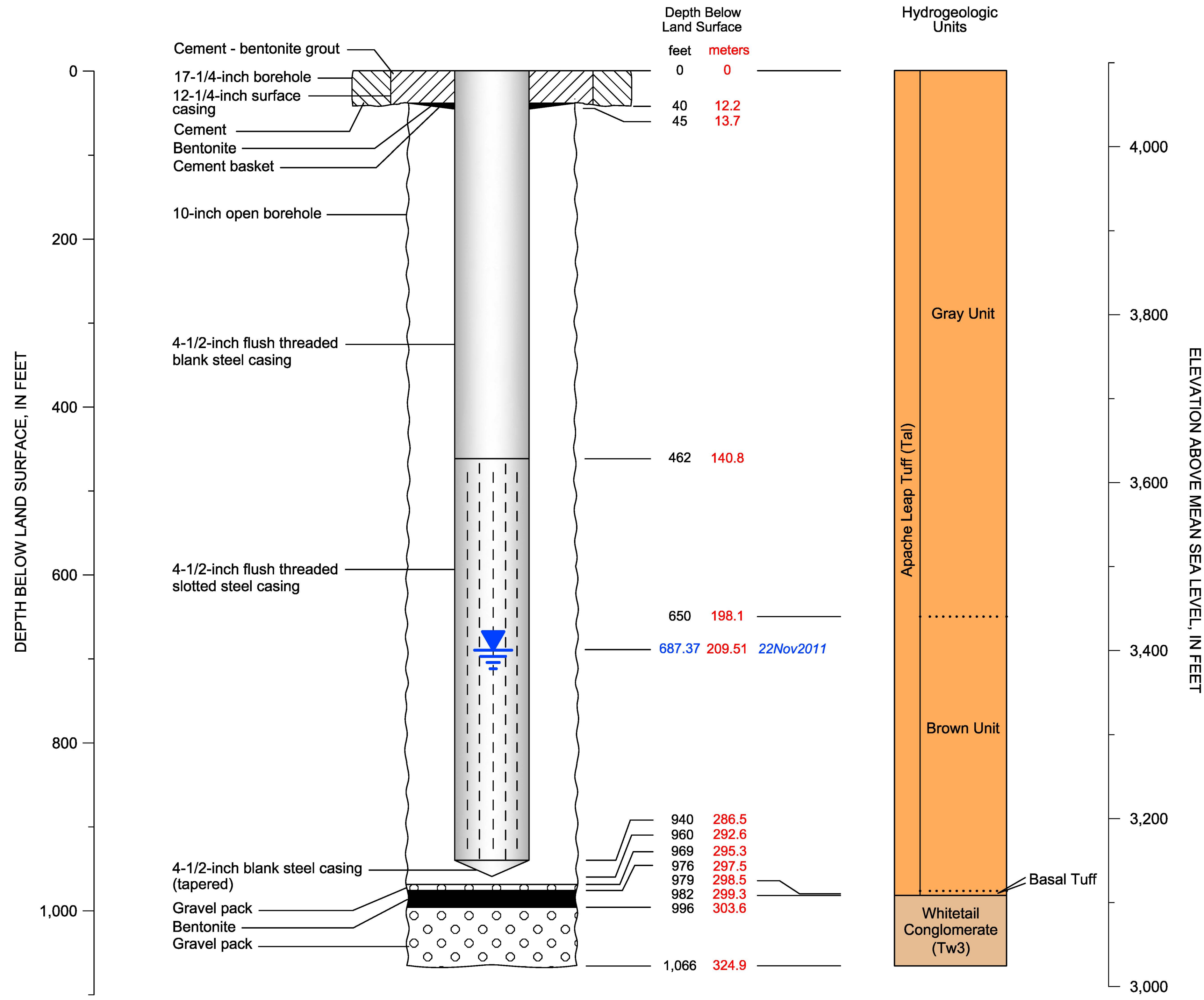


FIGURE A-20a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-17

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-13) 03bba	ADWR NO: 55-913308
NORTHING: 834909.703	EASTING: 976321.471
LAND SURFACE ELEVATION: 4090.44 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Shallow non-pumping Water Level

Deep non-pumping Water Level

RESOLUTION COPPER

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HRES-18
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-21

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-18-WS_SP83\26Sept2016

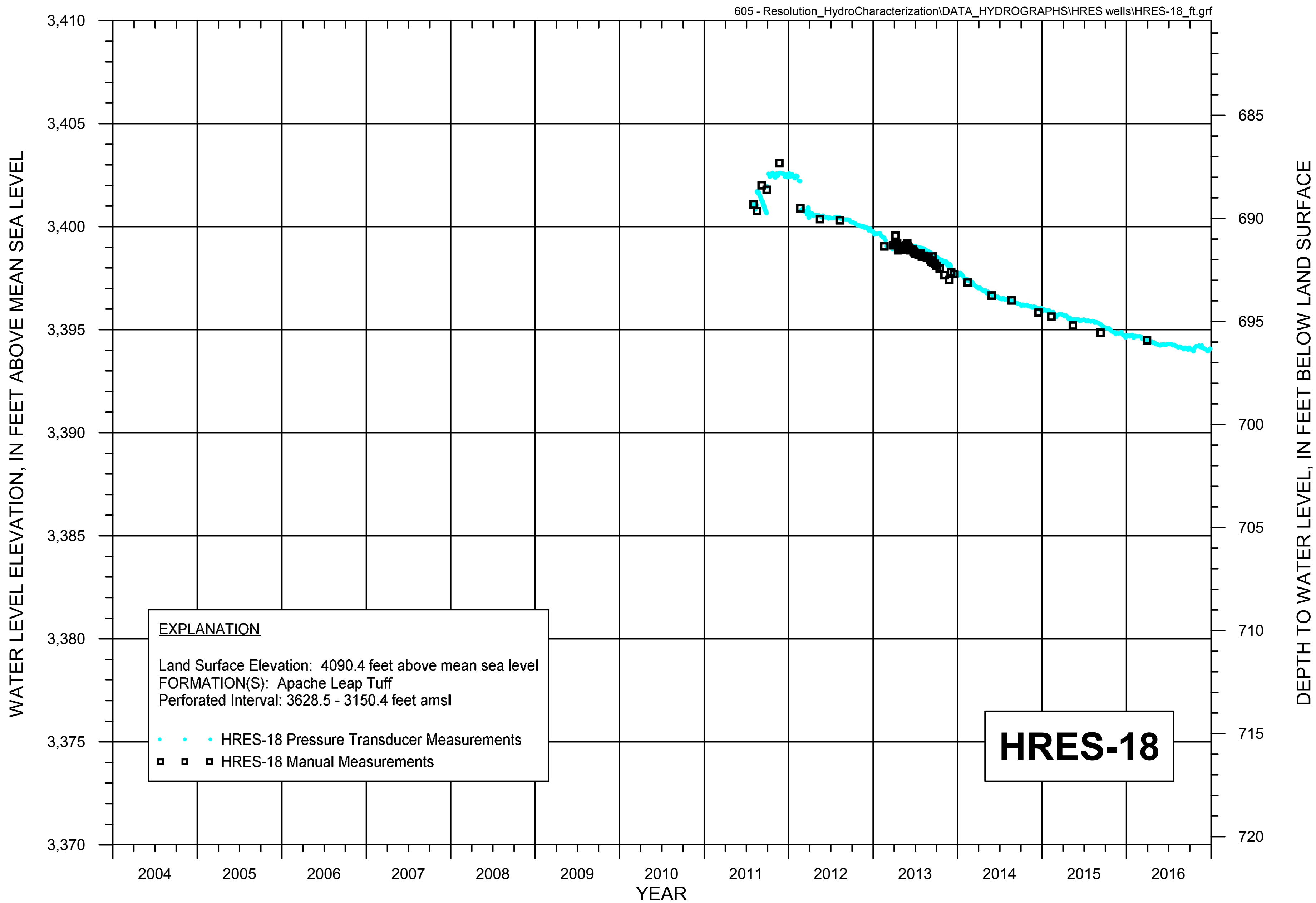
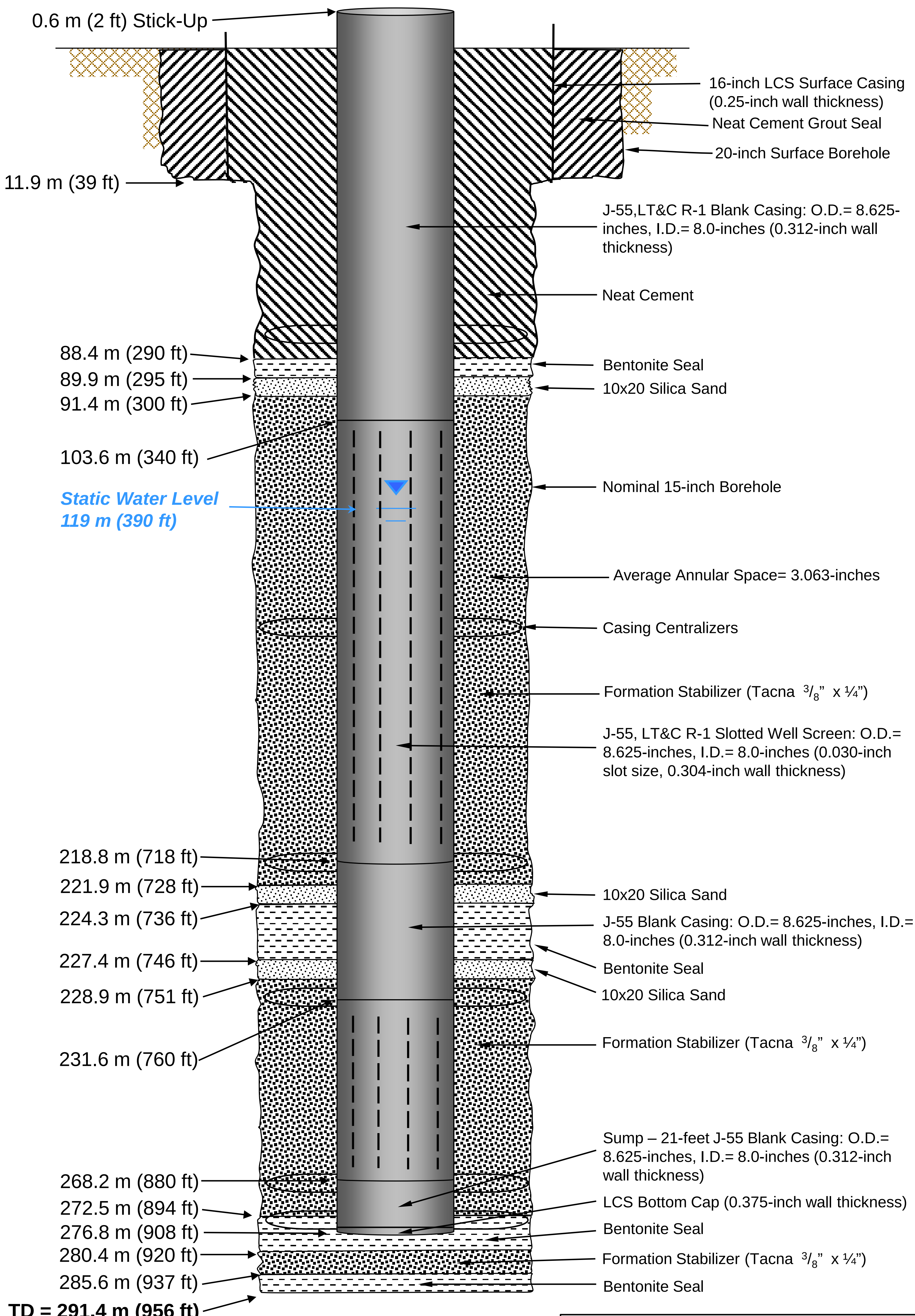


FIGURE A-21a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-18

HRES-19

ADWR No. 55-914789



Not To Scale

Notes: LCS = Low Carbon Steel
O.D.= Outside Diameter
I.D. = Inside Diameter

CLEAR CREEK ASSOCIATES

HRES-19 Well
As-Built Diagram
ADWR No. 55-914789
Completion Date
11/8/2012
Job No. 313001

FIGURE A-22. HRES-19 - SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-19-WS\27Sept2016

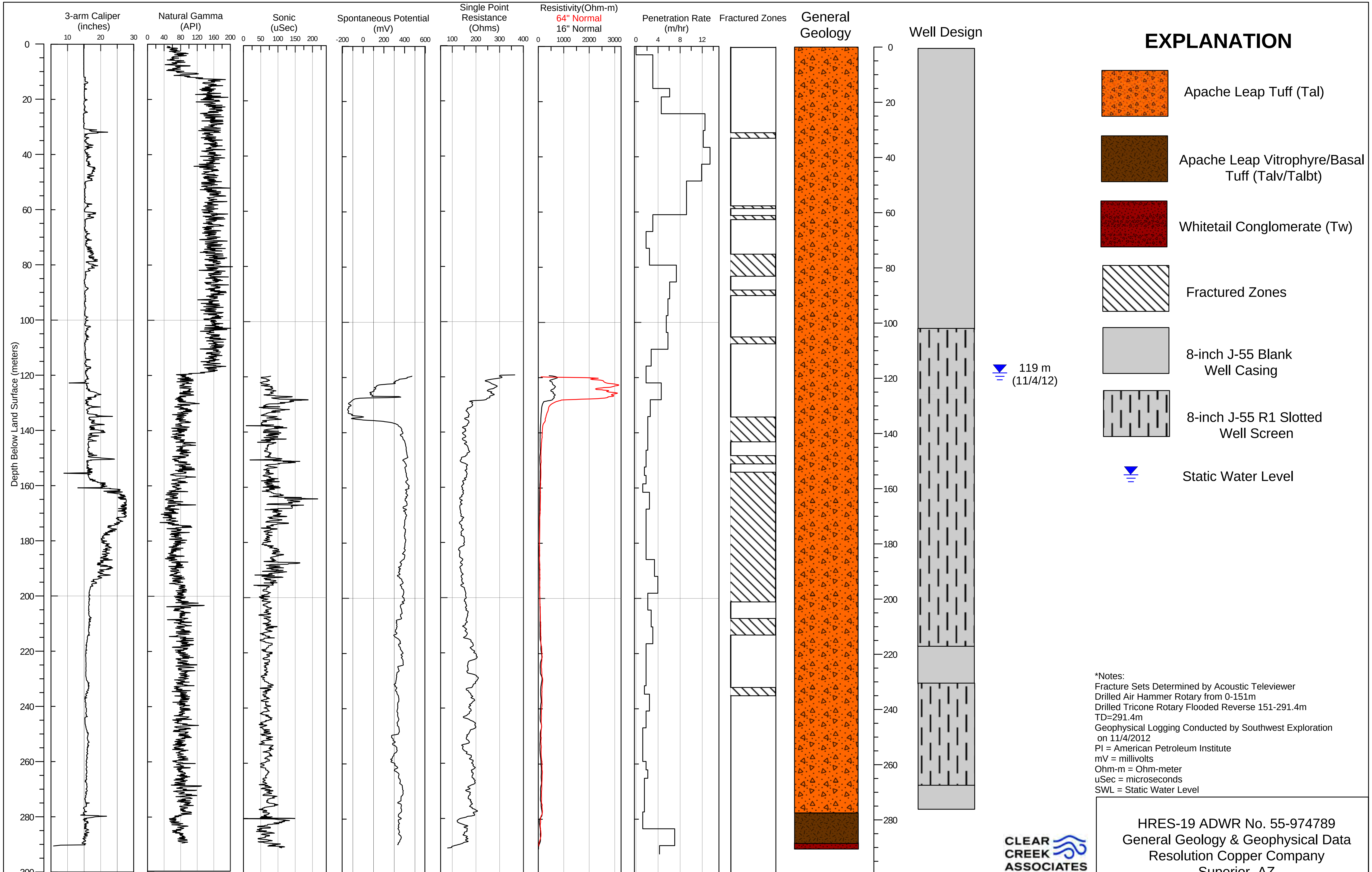


FIGURE A-22a. HRES-19 - GEOLOGY AND GEOPHYSICAL LOGS

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-19-WS_GPlogs\27Sept2016

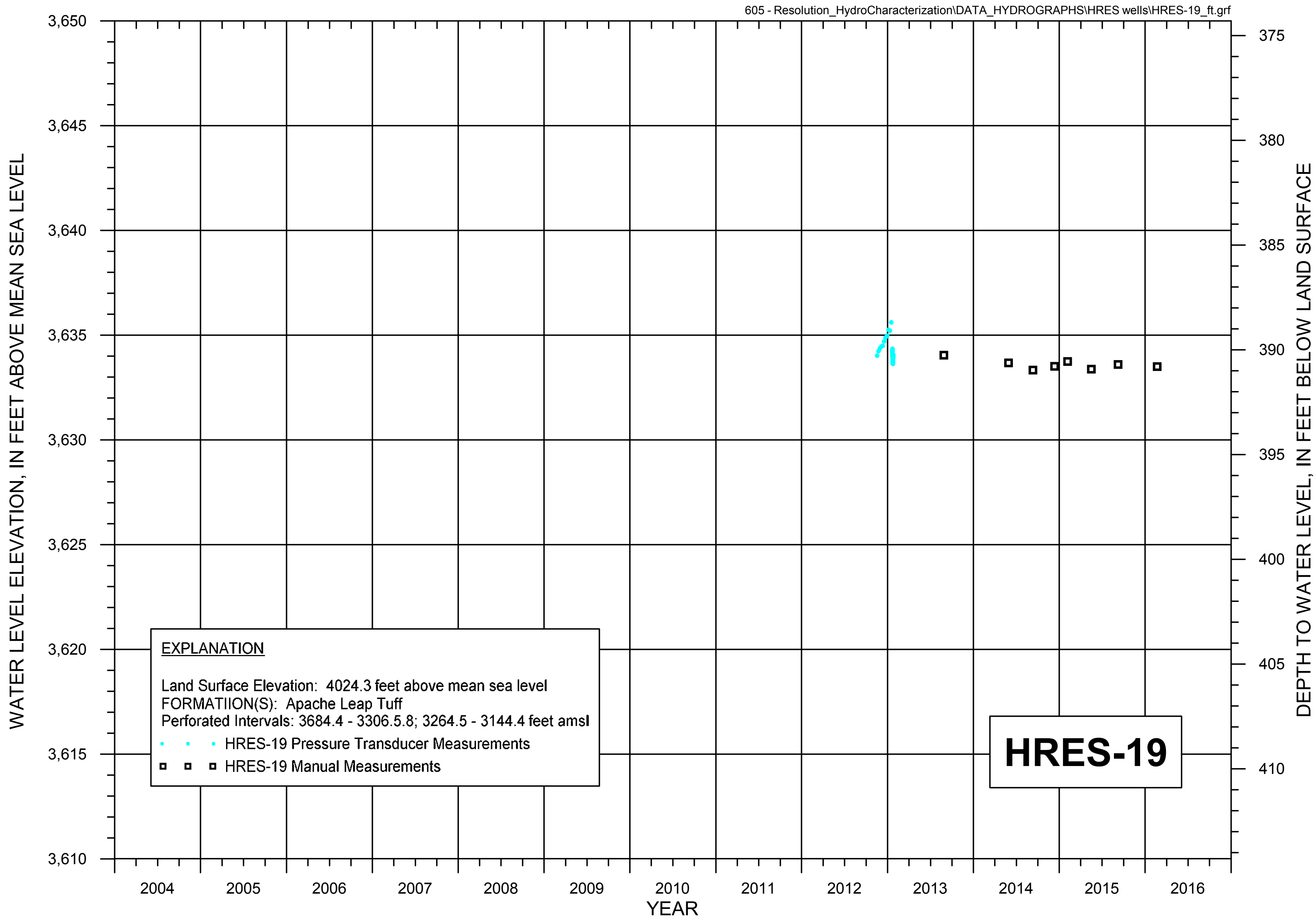


FIGURE A-22b. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-19

RESOLUTION COPPER

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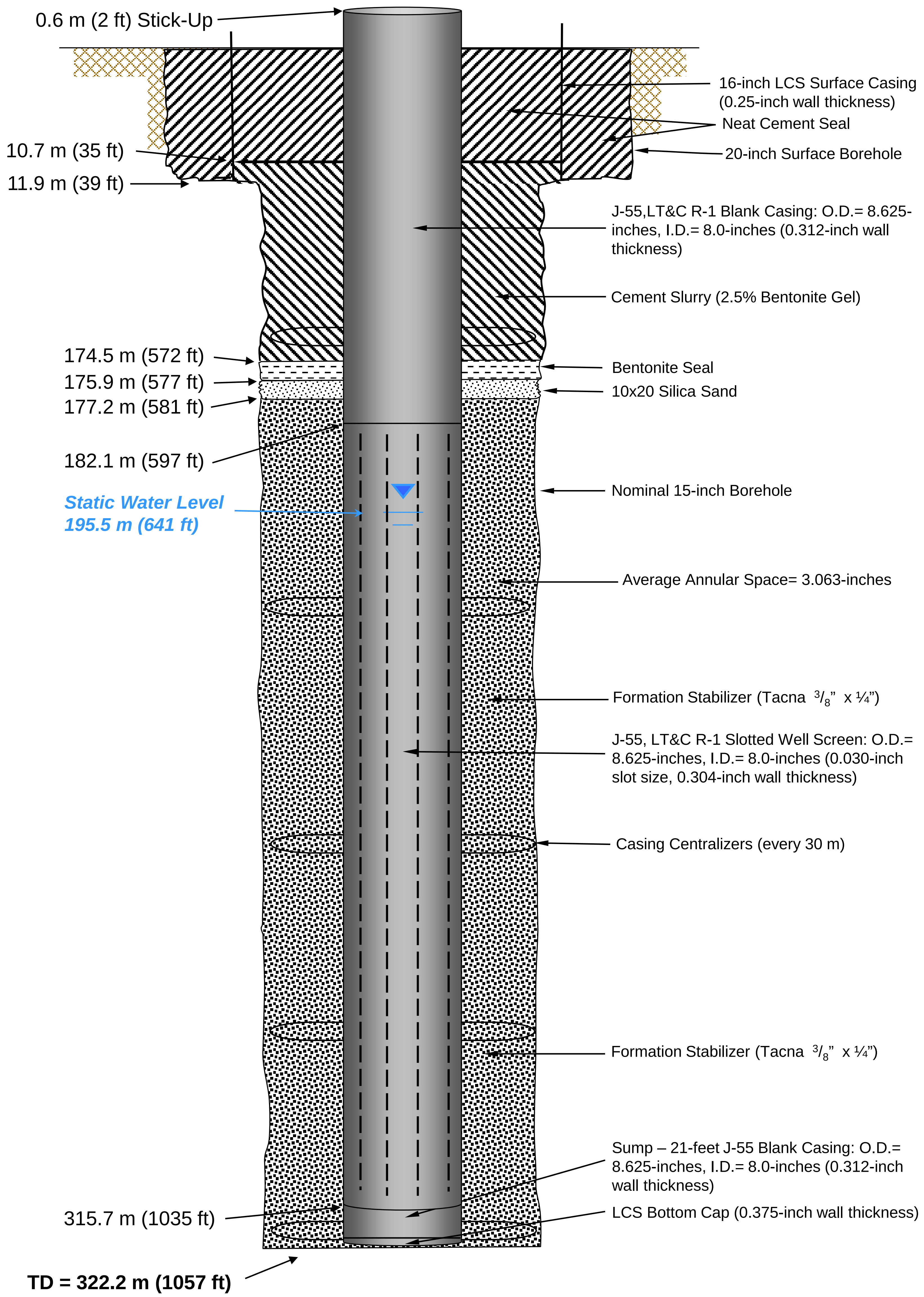
HRES-20

ADWR No. 55-914790



Not To Scale

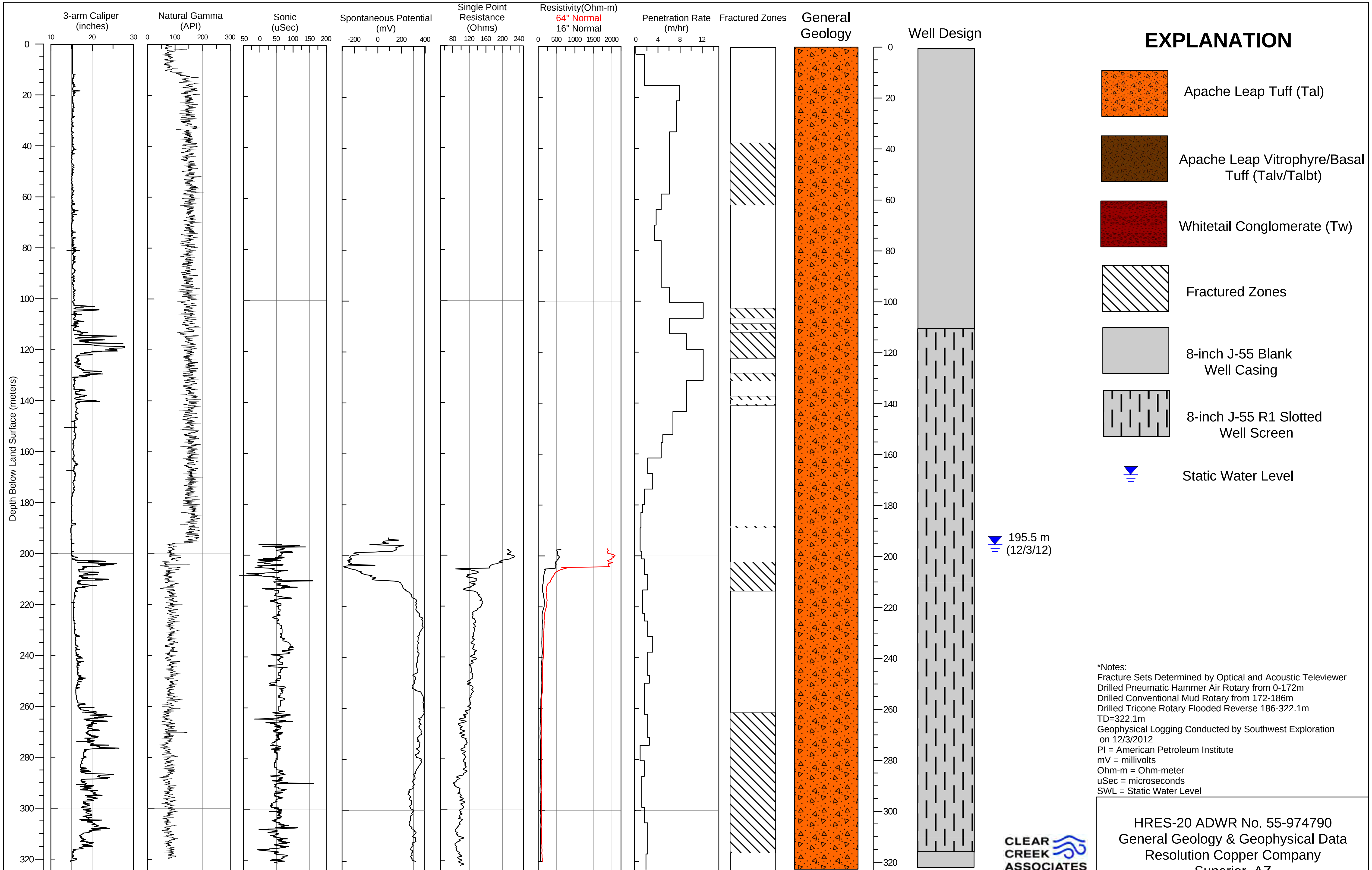
Notes: LCS = Low Carbon Steel
O.D.= Outside Diameter
I.D. = Inside Diameter

CLEAR CREEK ASSOCIATES

HRES-20 Well
As-Built Diagram
ADWR No. 55-914789
Completion Date
12/7/2012
Job No. 313001

FIGURE A-23. HRES-20- SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-20-WS\27Sept2016



*Notes:
Fracture Sets Determined by Optical and Acoustic Televiewer
Drilled Pneumatic Hammer Air Rotary from 0-172m
Drilled Conventional Mud Rotary from 172-186m
Drilled Tricone Rotary Flooded Reverse 186-322.1m
TD=322.1m
Geophysical Logging Conducted by Southwest Exploration on 12/3/2012
PI = American Petroleum Institute
mV = millivolts
Ohm-m = Ohm-meter
uSec = microseconds
SWL = Static Water Level

CLEAR CREEK ASSOCIATES

HRES-20 ADWR No. 55-974790
General Geology & Geophysical Data
Resolution Copper Company
Superior, AZ

FIGURE A-23a. HRES-20 - GEOLOGY AND GEOPHYSICAL LOGS

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-20-WS_GPlogs\27Sept2016

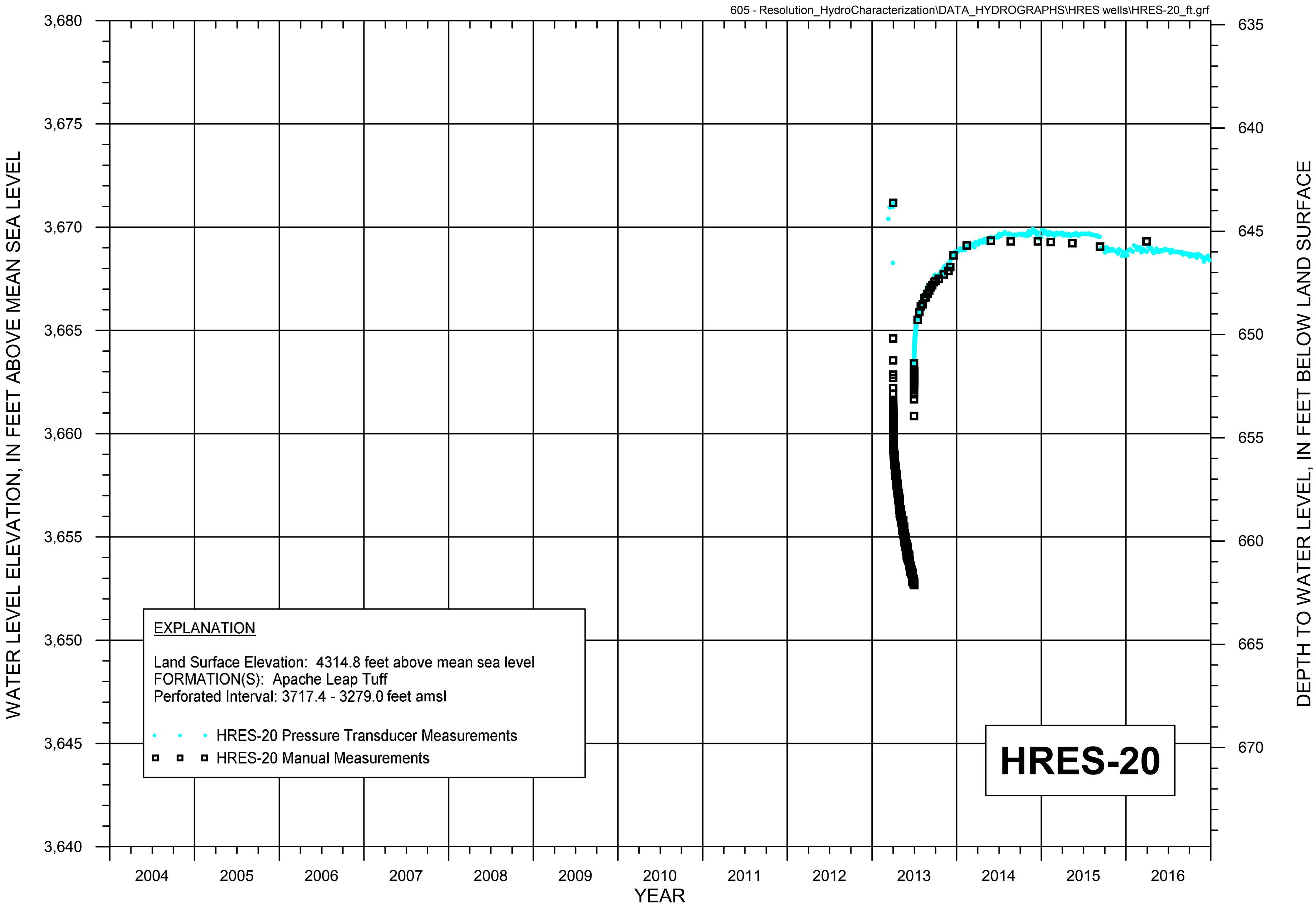


FIGURE A-23b. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-20

RESOLUTION COPPER

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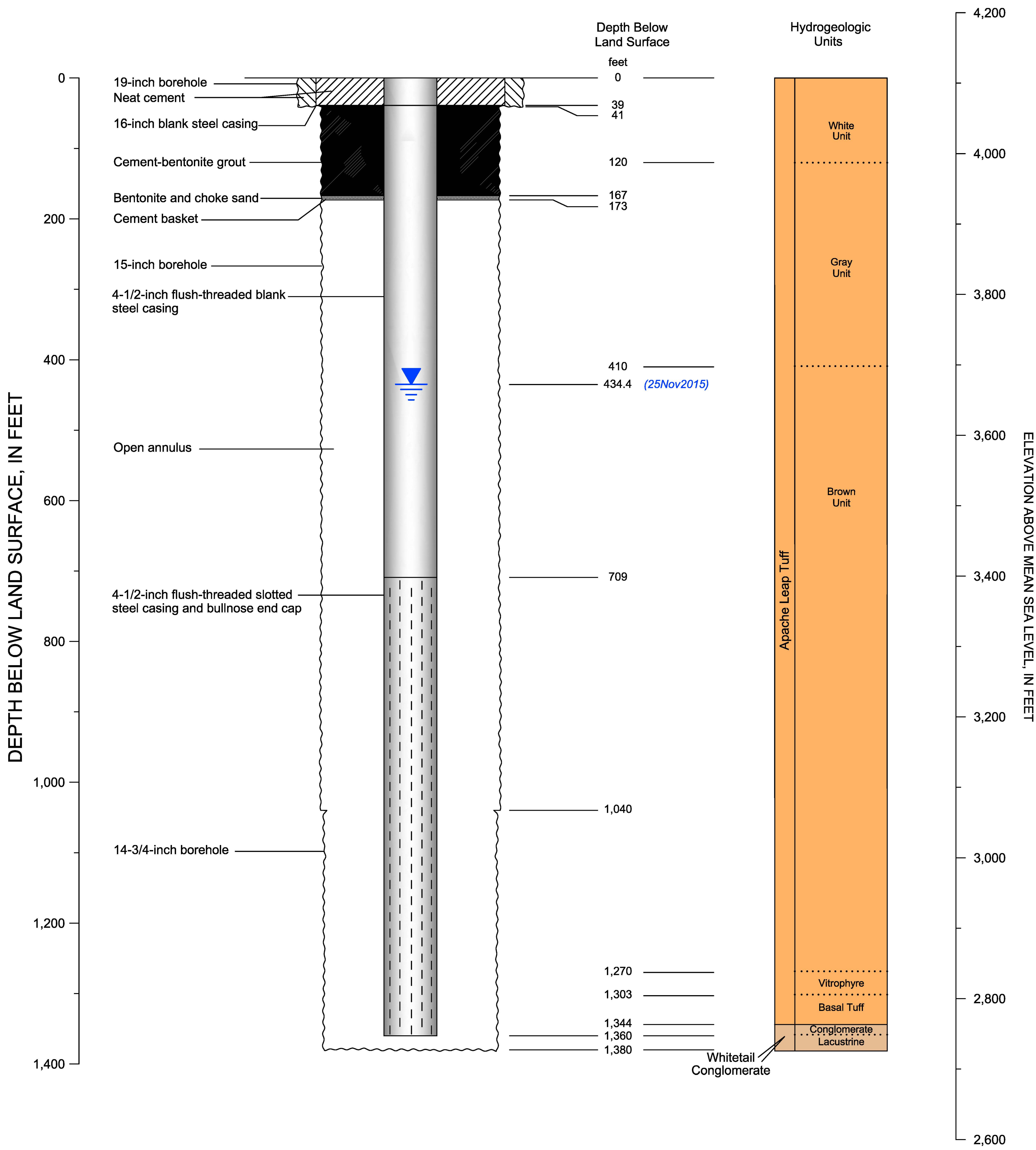

CADASTRAL: (D-02-13) 05acc | ADWR NO: 55-916689

NORTHING: 832967.78 | EASTING: 967381.39

LAND SURFACE ELEVATION: 4107.38 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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HRES-21
DIAGRAM OF WELL CONSTRUCTION

Version: February 2016

FIGURE A-24

Drafting\605\WellSchematics_2015\HRESwells_SP83\HRES-21-WS_SP83\26Sept2016

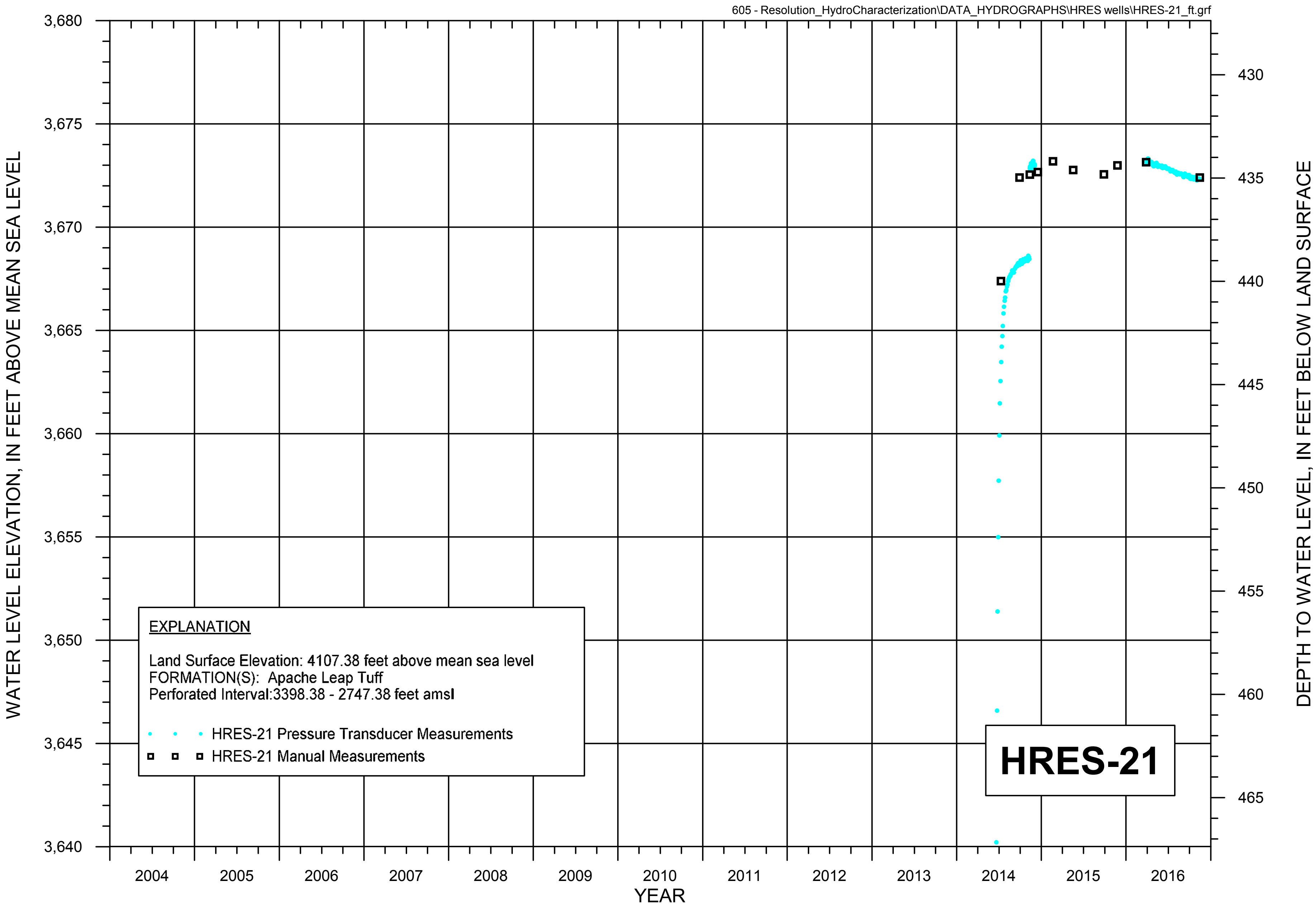

FIGURE A-24a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-21

RESOLUTION COPPER

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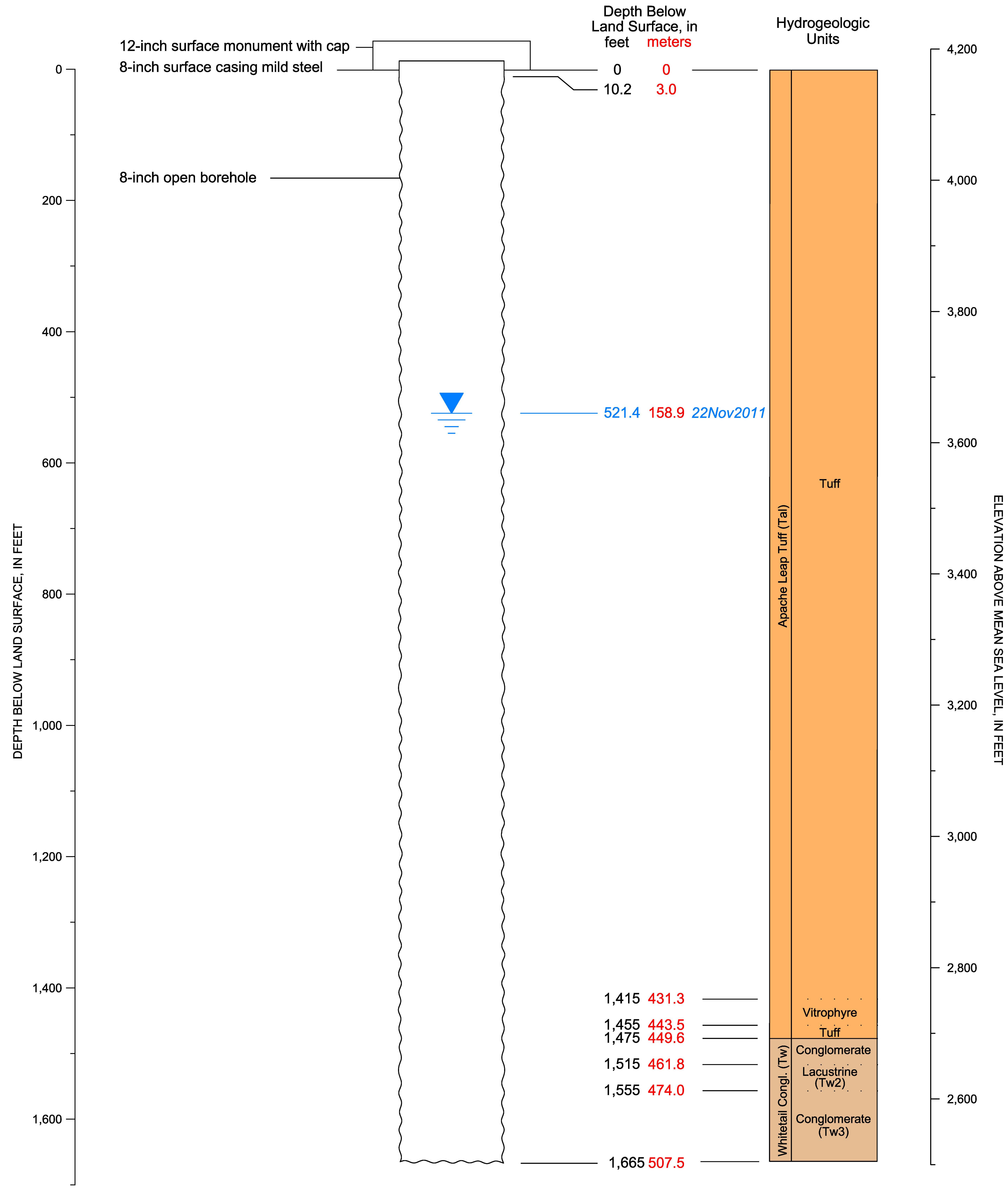

CADASTRAL: (D-2-13) 04bbd | ADWR NO: 55-615241
NORTHING: 834171.542 | EASTING: 971257.978
LAND SURFACE ELEVATION: 4167.82 FEET AMSL
DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983
North American Vertical Datum of 1983

EXPLANATION
Shallow non-pumping Water Level
Deep non-pumping Water Level

RESOLUTION COPPER
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Water Resource Consultants

A-06
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-25

Drafting\605\WellSchematics_2015\HRESwells_SP83\A-06_WS_SP83\26Sept2016

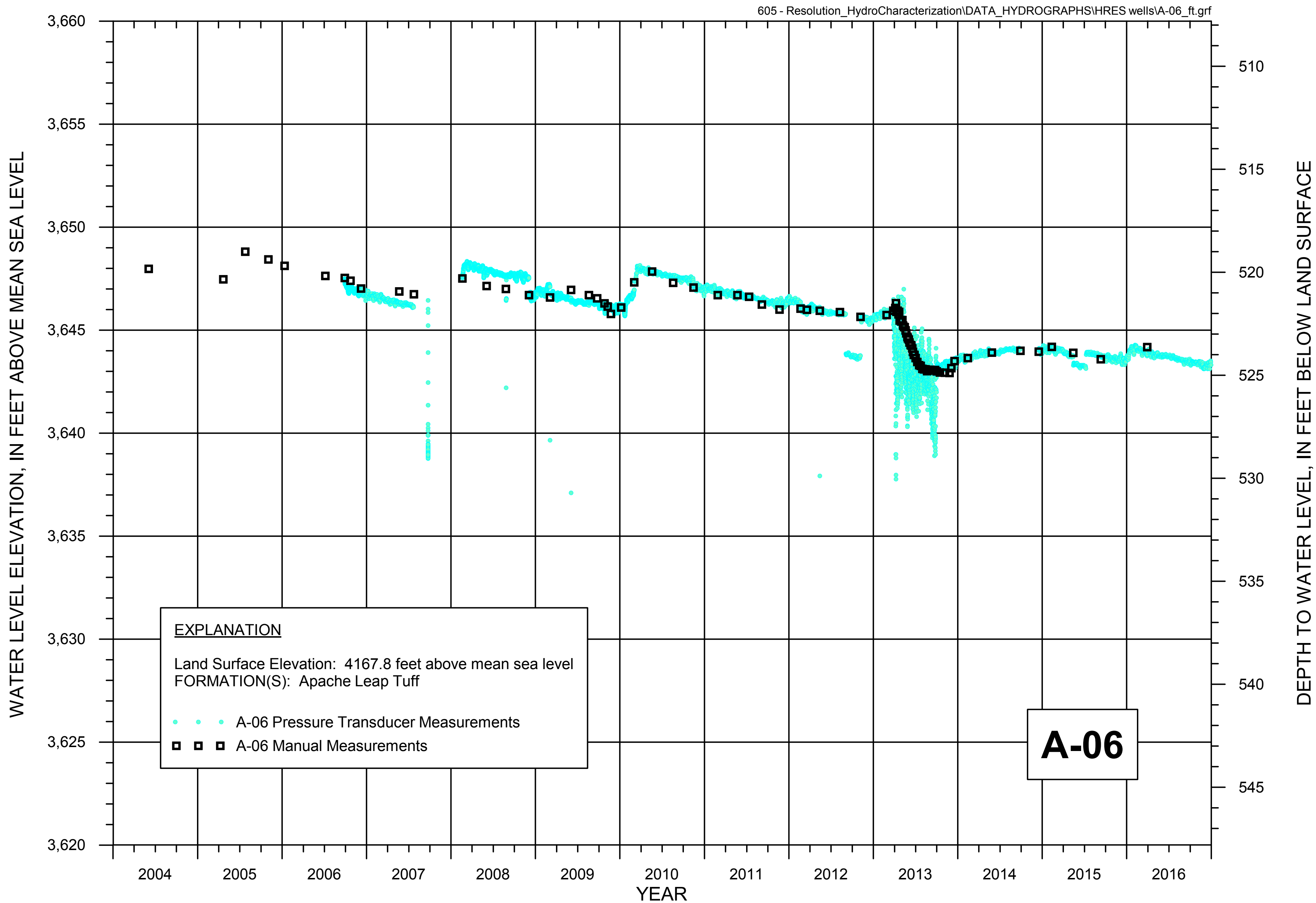
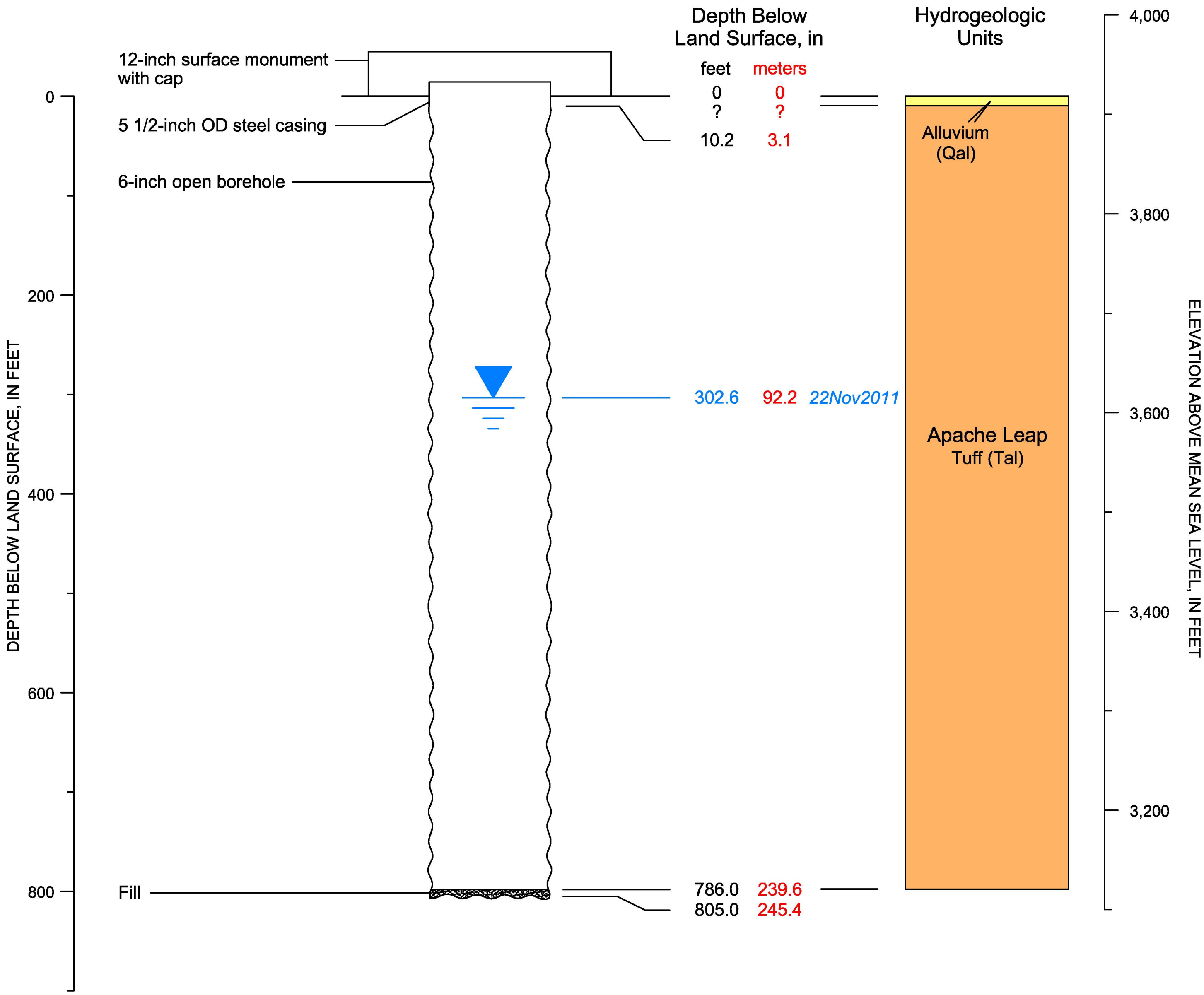


FIGURE A-25a. WATER LEVEL HYDROGRAPH FOR MONITORING WELL A-06



CADASTRAL: (D-2-13) 09abd	ADWR NO: 55-615246
NORTHING: 829455.906	EASTING: 973629.342
LAND SURFACE ELEVATION: 3918.33 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

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MJ-11
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-26

Drafting\605\WellSchematics_2015\HRESwells_SP83\MJ-11_WS_SP83\26Sept2016

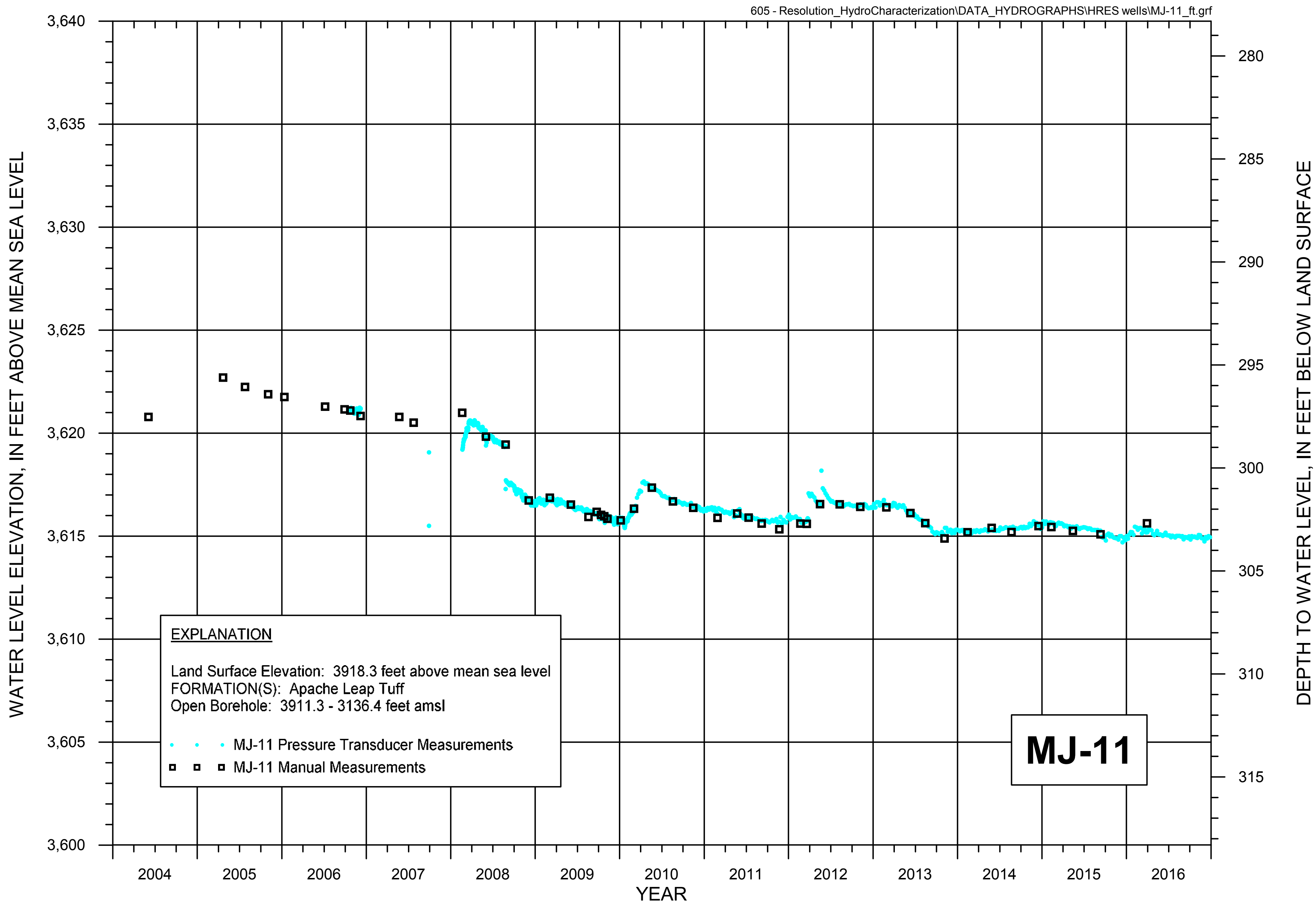

FIGURE A-26a. WATER LEVEL HYDROGRAPH FOR WELL MJ-11

RESOLUTION COPPER

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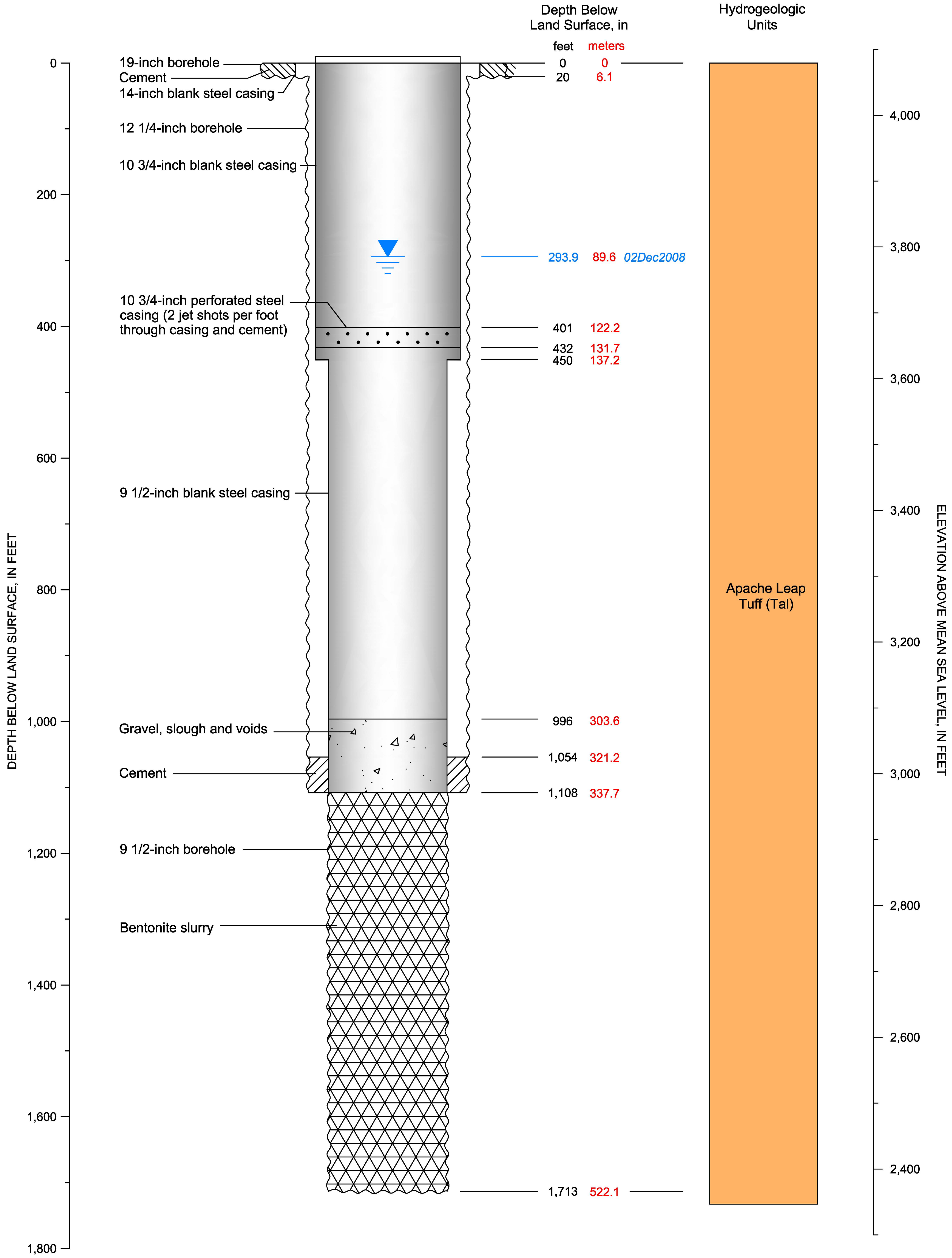

CADASTRAL: (D-1-13) 29dcc	ADWR NO: 55-526592
NORTHING: 841129.208	EASTING: 967933.915
LAND SURFACE ELEVATION: 4076.88 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

RESOLUTION
COPPER

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& ASSOCIATES
Water Resource Consultants

OAK FLAT WELL
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE A-27

Drafting\605\WellSchematics_2015\HRESwells_SP83\OakFlat_WS_SP83\26Sept2016

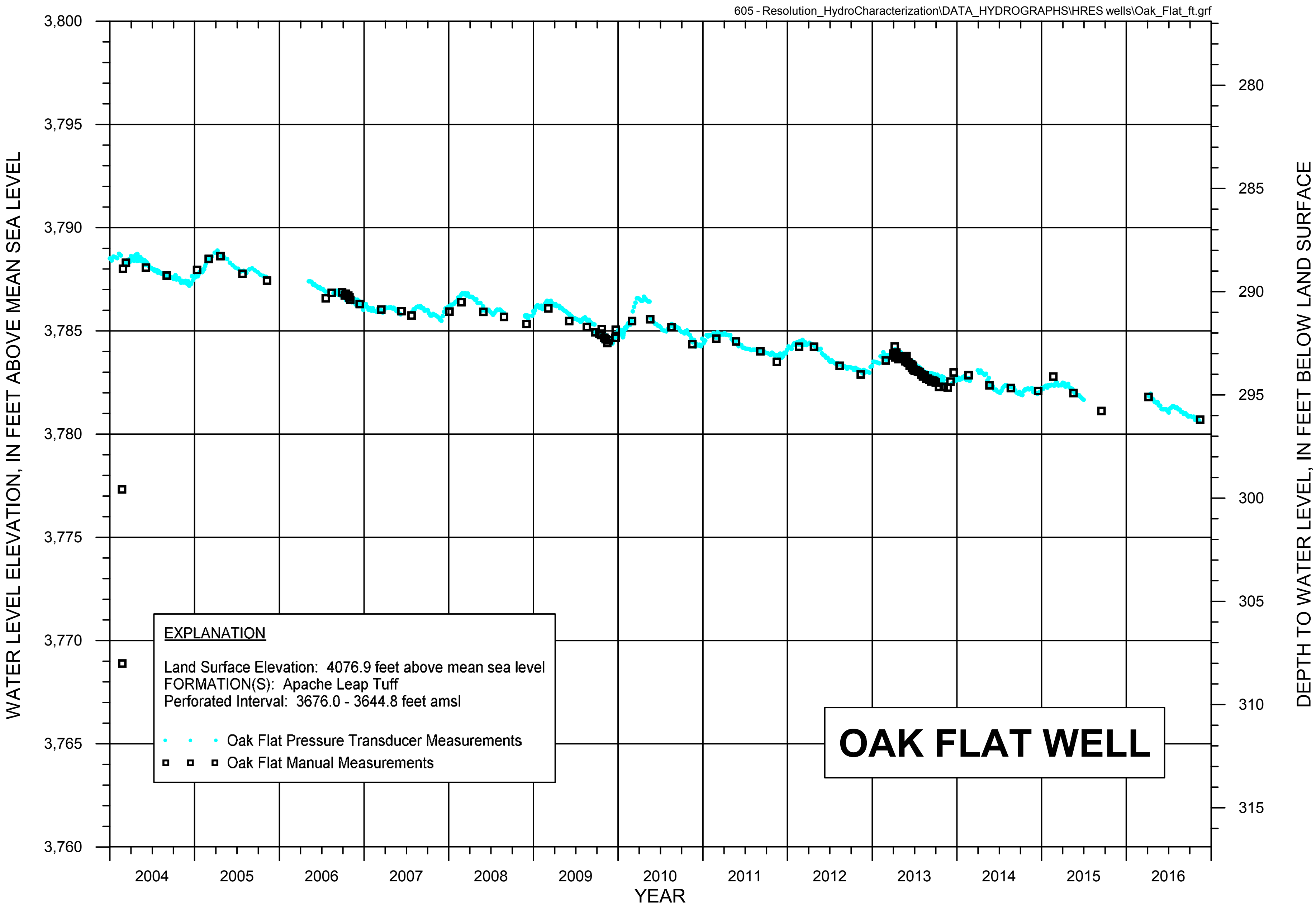


FIGURE A-27a. WATER LEVEL HYDROGRAPH FOR OAK FLAT WELL

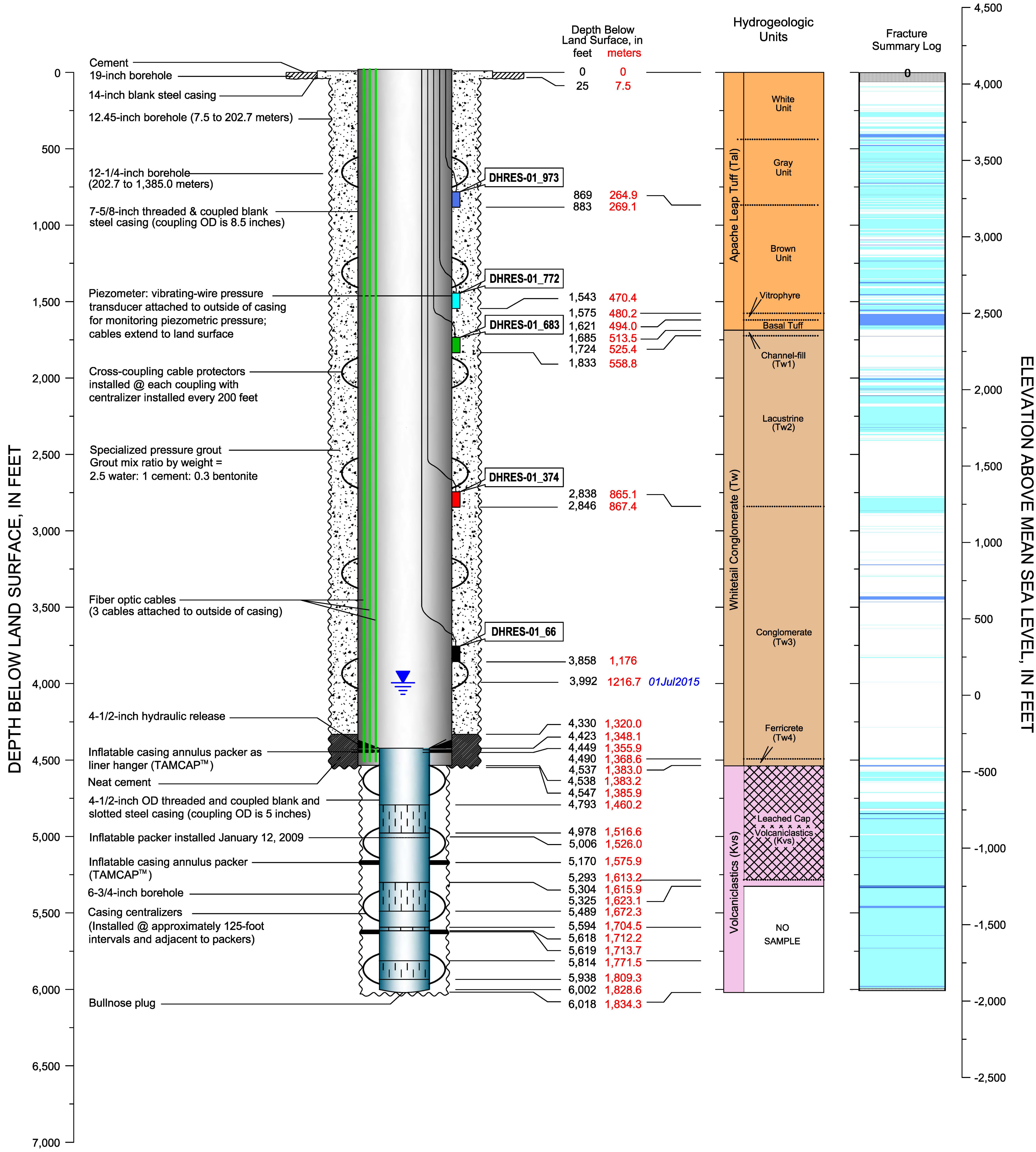
RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

MONTGOMERY & ASSOCIATES

Appendix B

Schematic Diagrams of Well Construction and Water Level/Total Head Hydrographs for Wells and Piezometers Completed in Deep Groundwater System



CADASTRAL: (D-1-13) 33ccd	ADWR NO: 55-217406
NORTHING: 835362.846	EASTING: 964528.342
LAND SURFACE ELEVATION: 4076.27 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level
- DHRES-01_973 — Well Identifier, Piezometer Elevation, in meters amsl

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Water Resource Consultants

DHRES-01
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-1

Drafting\605\WellSchematics_2015\DHRESwells\DHRES1_Feet\26Sept2016

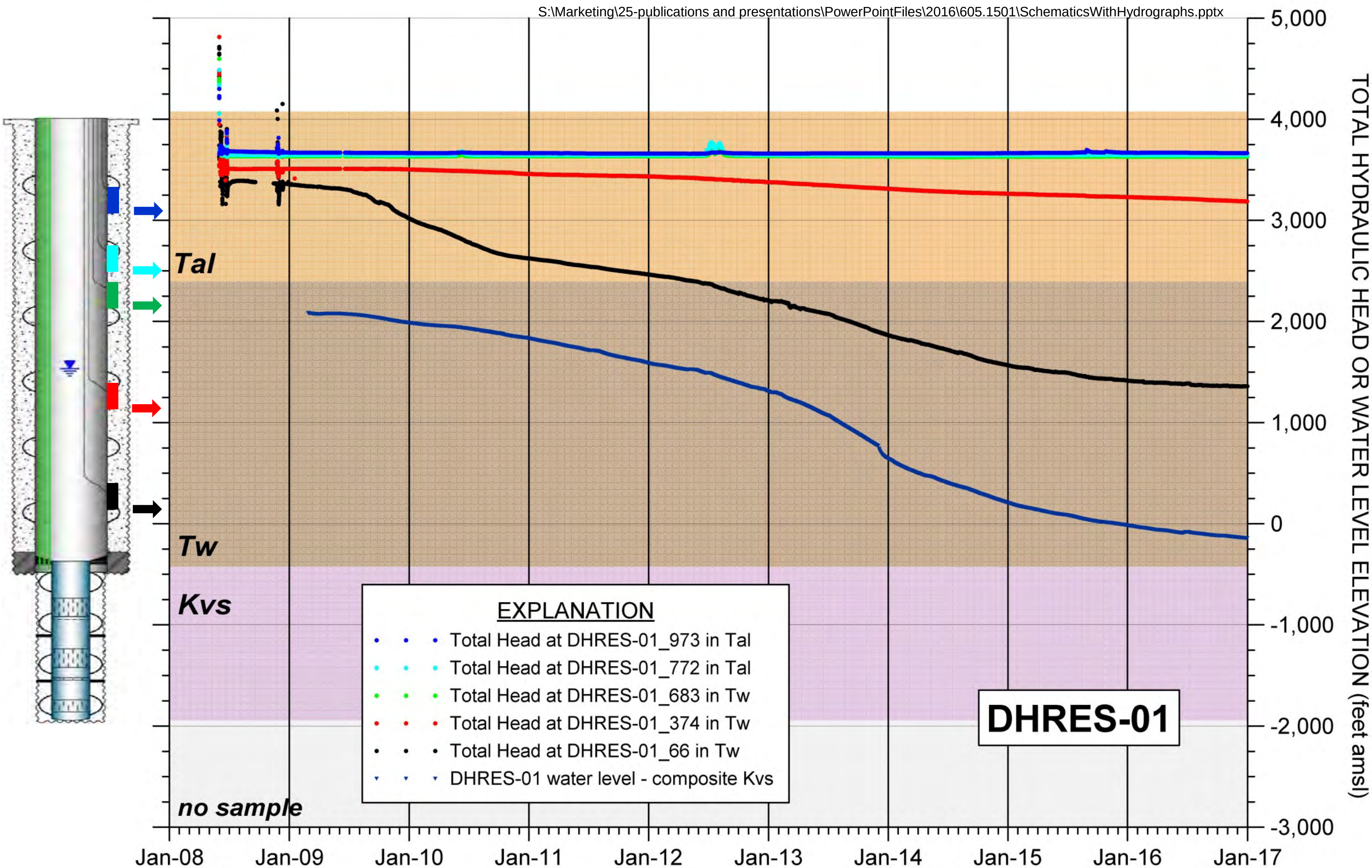


FIGURE B-1a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-01

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

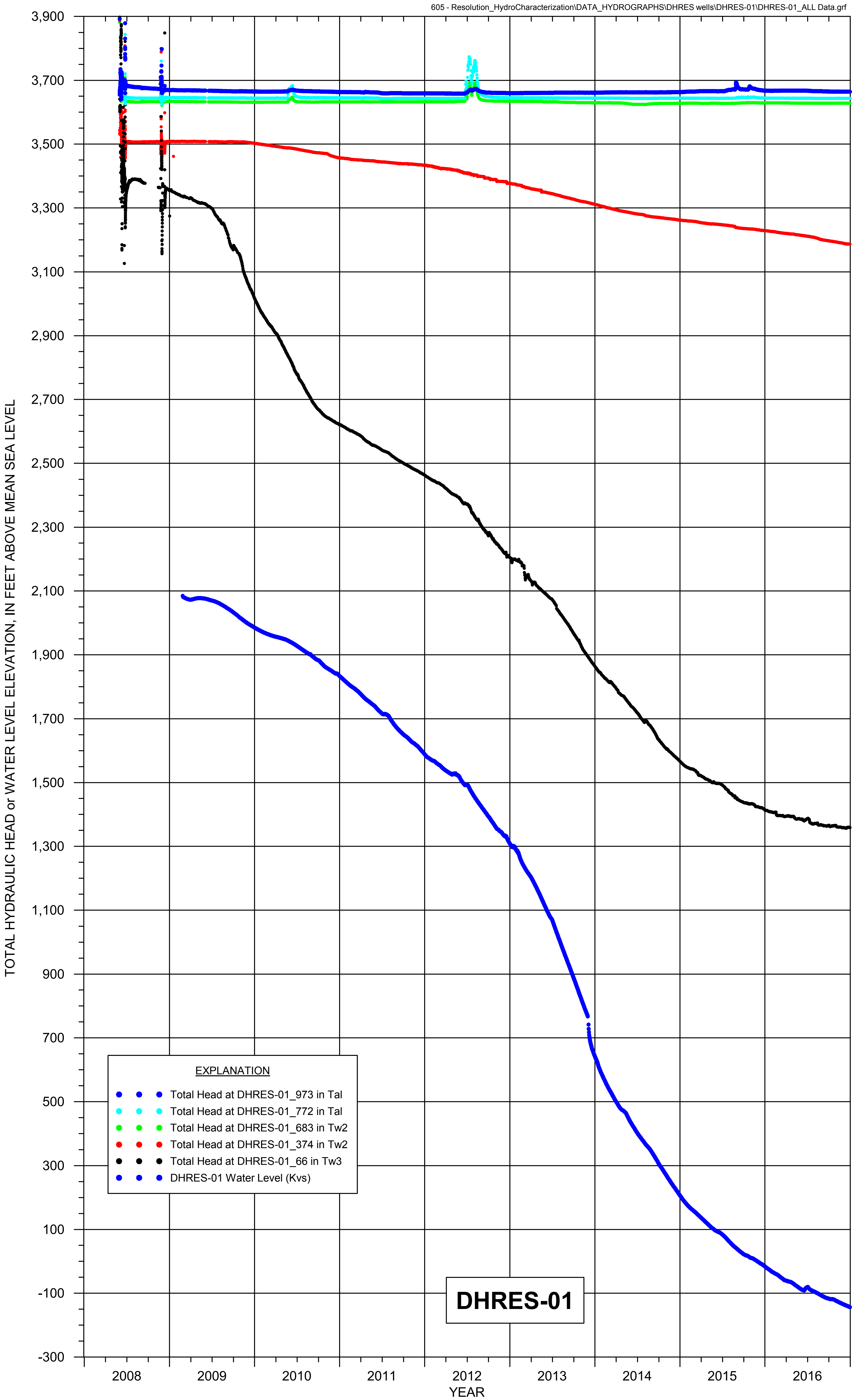


FIGURE B-1b. HYDROGRAPH OF WATER LEVEL, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-01

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

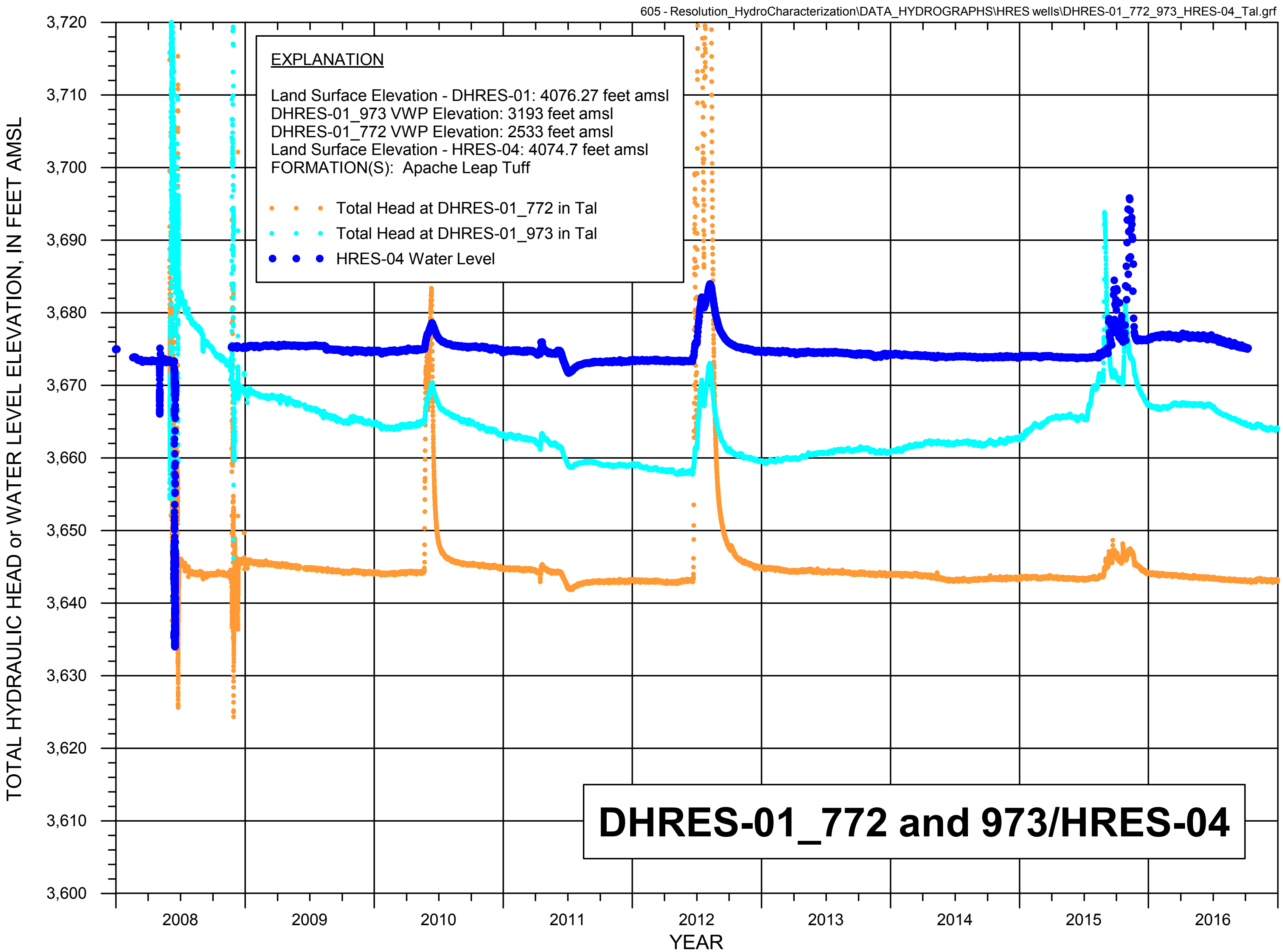


FIGURE B-1c. TOTAL HYDRAULIC HEAD HYDROGRAPH FOR GROUTED PIEZOMETERS DHRES-01_772 AND DHRES-01_973, AND WATER LEVEL FOR WELL HRES-04

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

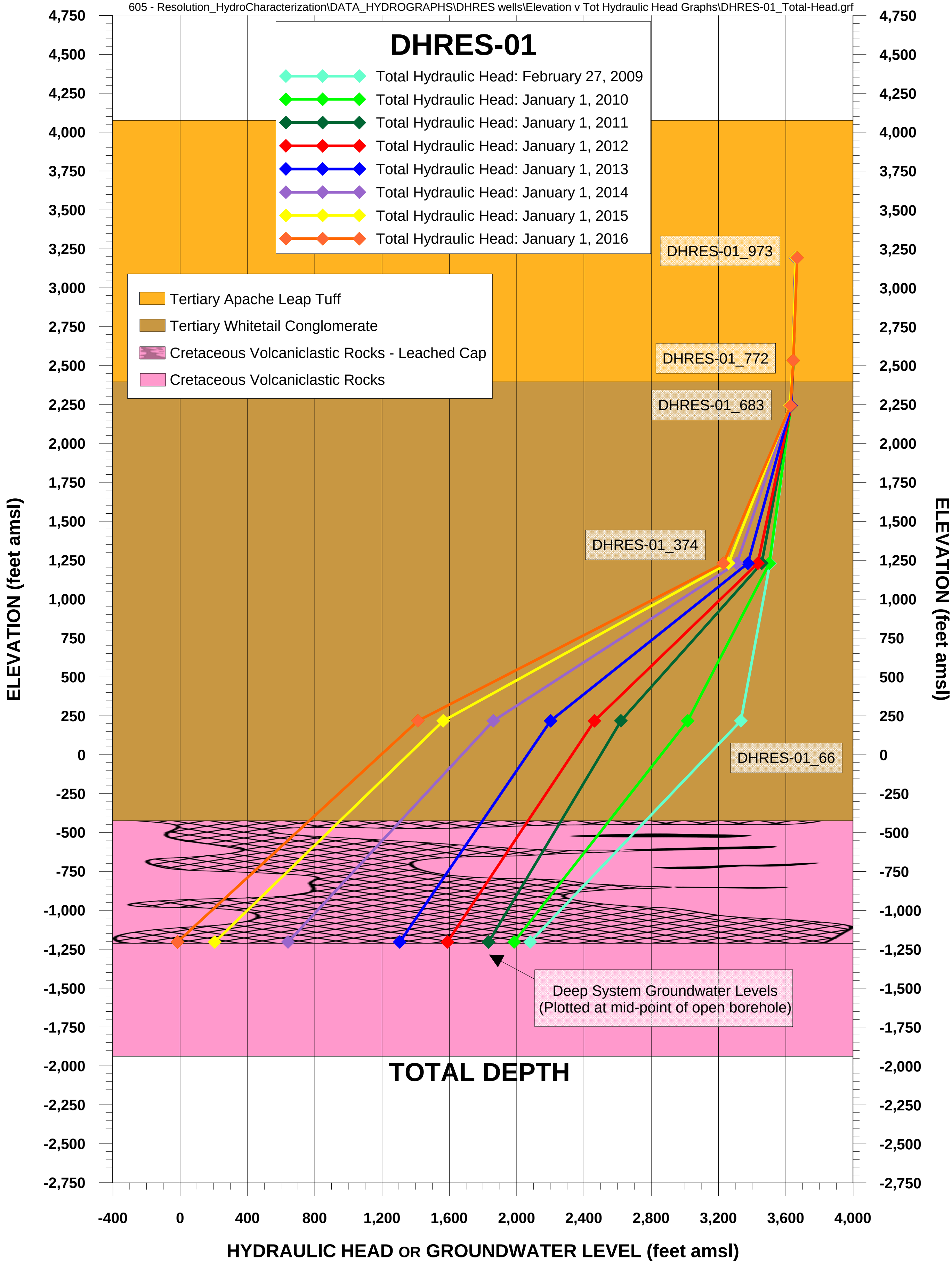
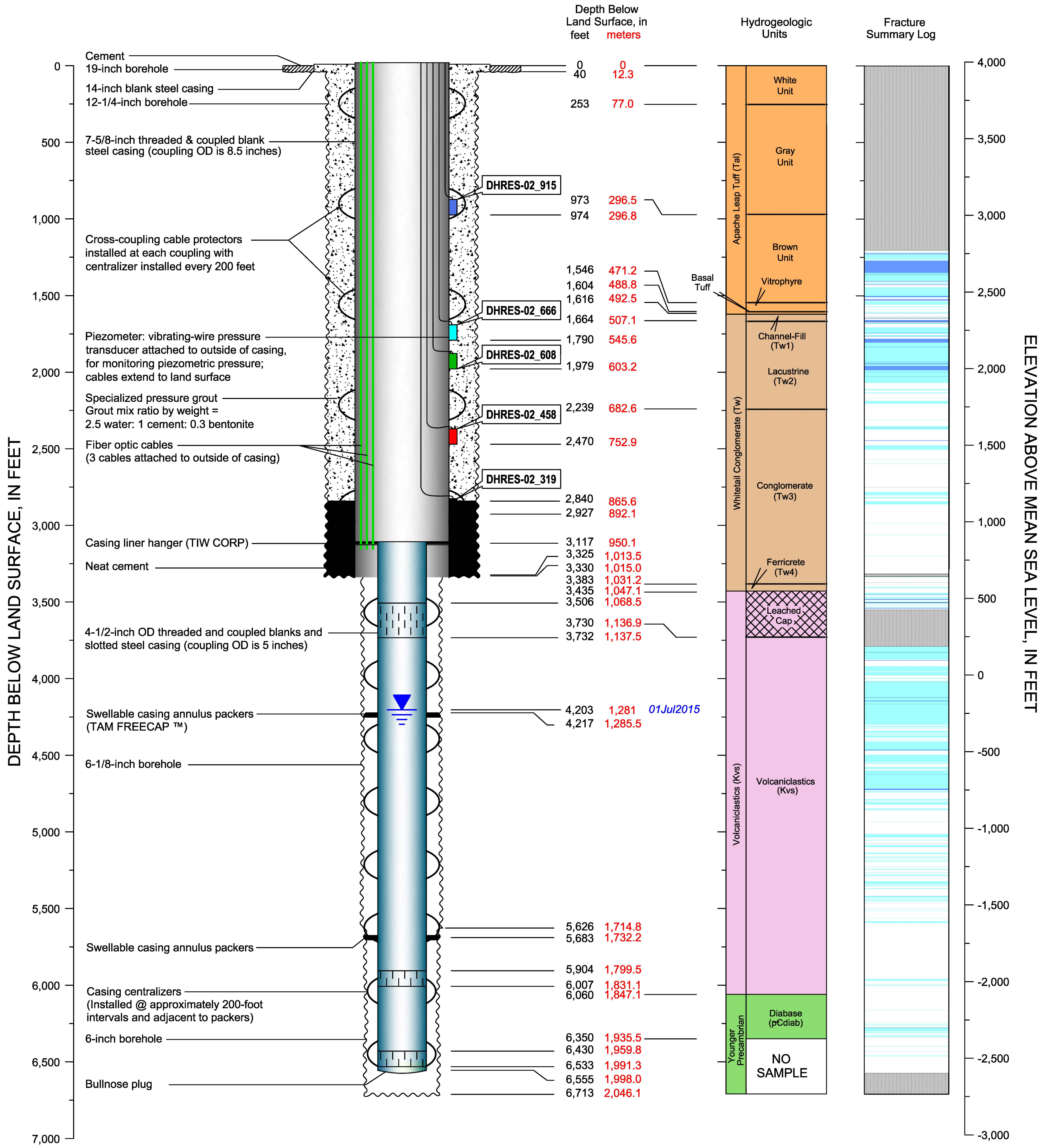


FIGURE B-1d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-01, RESOLUTION PROJECT



CADASTRAL: (D-1-13) 32dbd	ADWR NO: 55-217467
NORTHING: 836733.333	EASTING: 961873.632
LAND SURFACE ELEVATION: 3976.67 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level
- DHRES-02_915 — Well Identifier — Piezometer Elevation, in meters amsl

RESOLUTION COPPER

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Water Resource Consultants

DHRES-02
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-2

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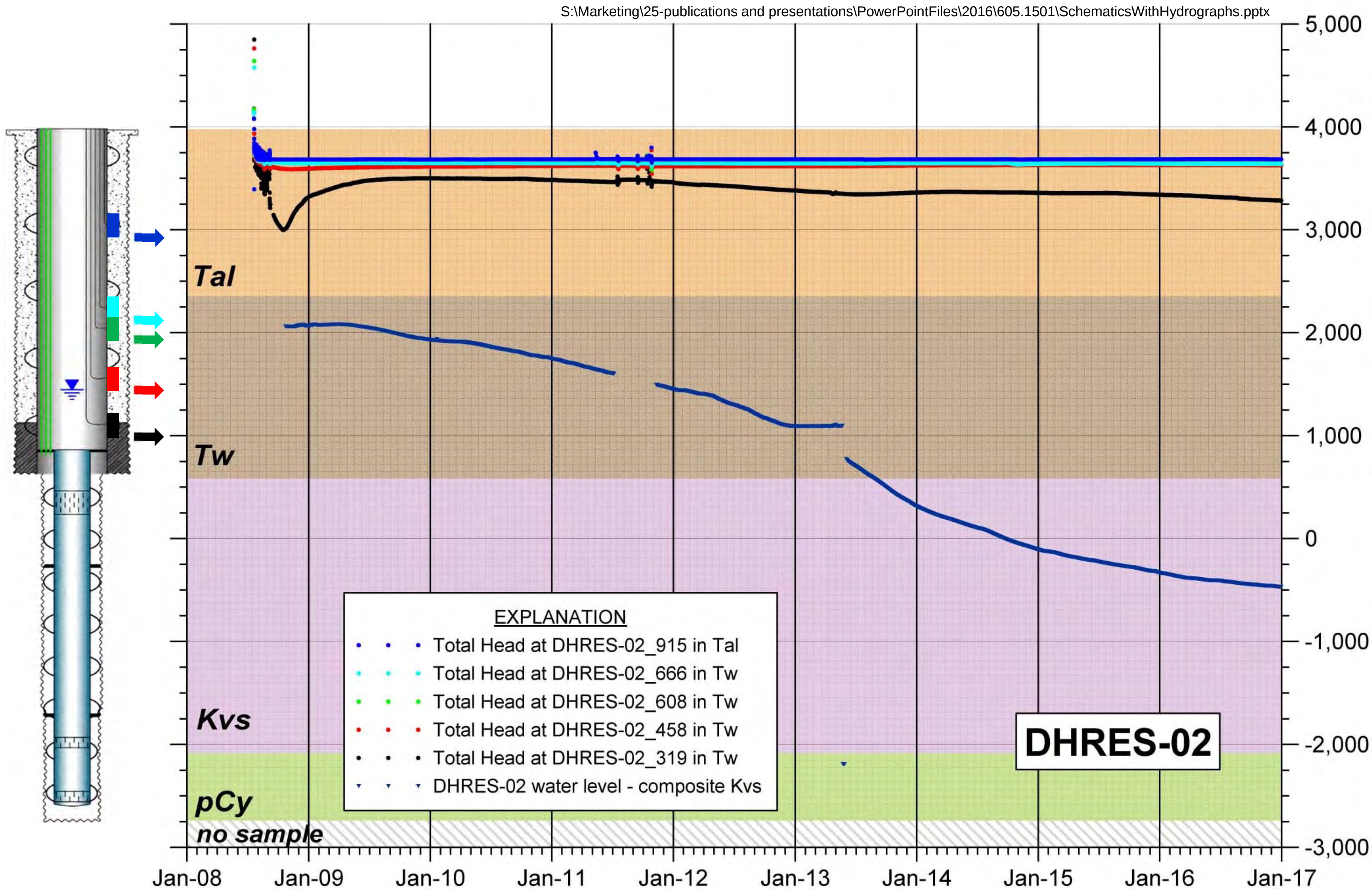


FIGURE B-2a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-02

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

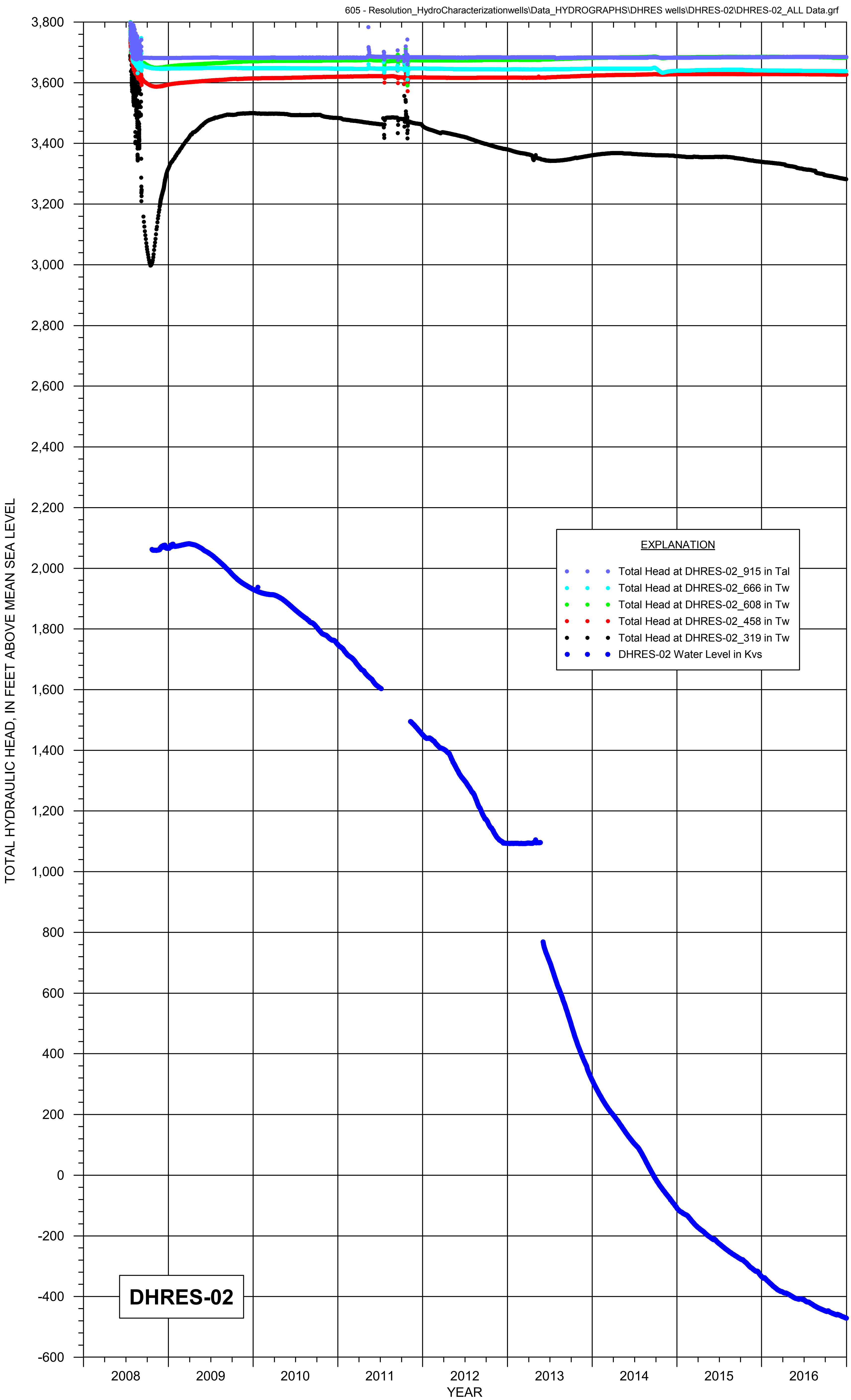


FIGURE B-2b. HYDROGRAPH OF WATER LEVEL, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-02

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

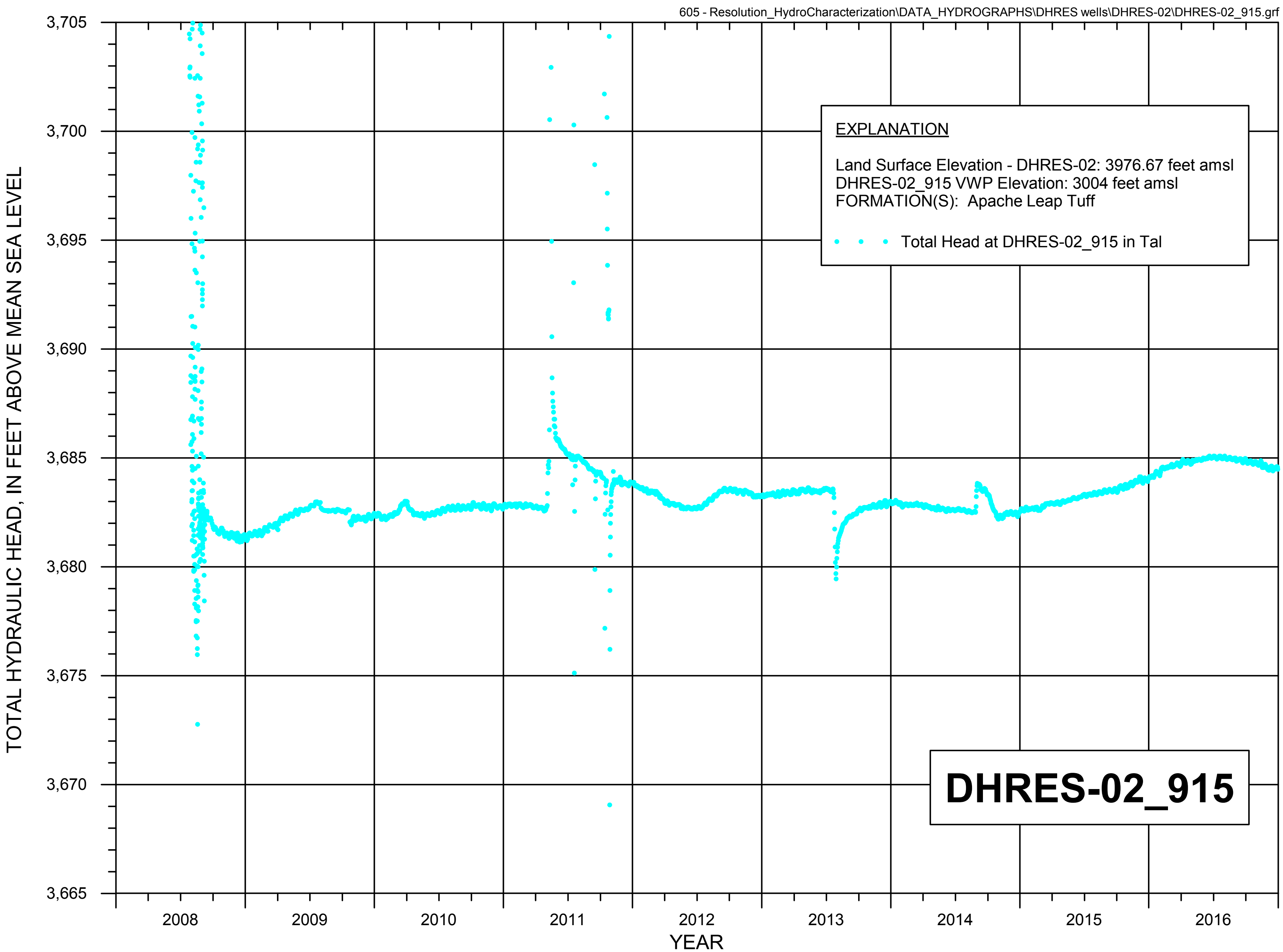


FIGURE B-2c. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETER DHRES-02_915, APACHE LEAP TUFF

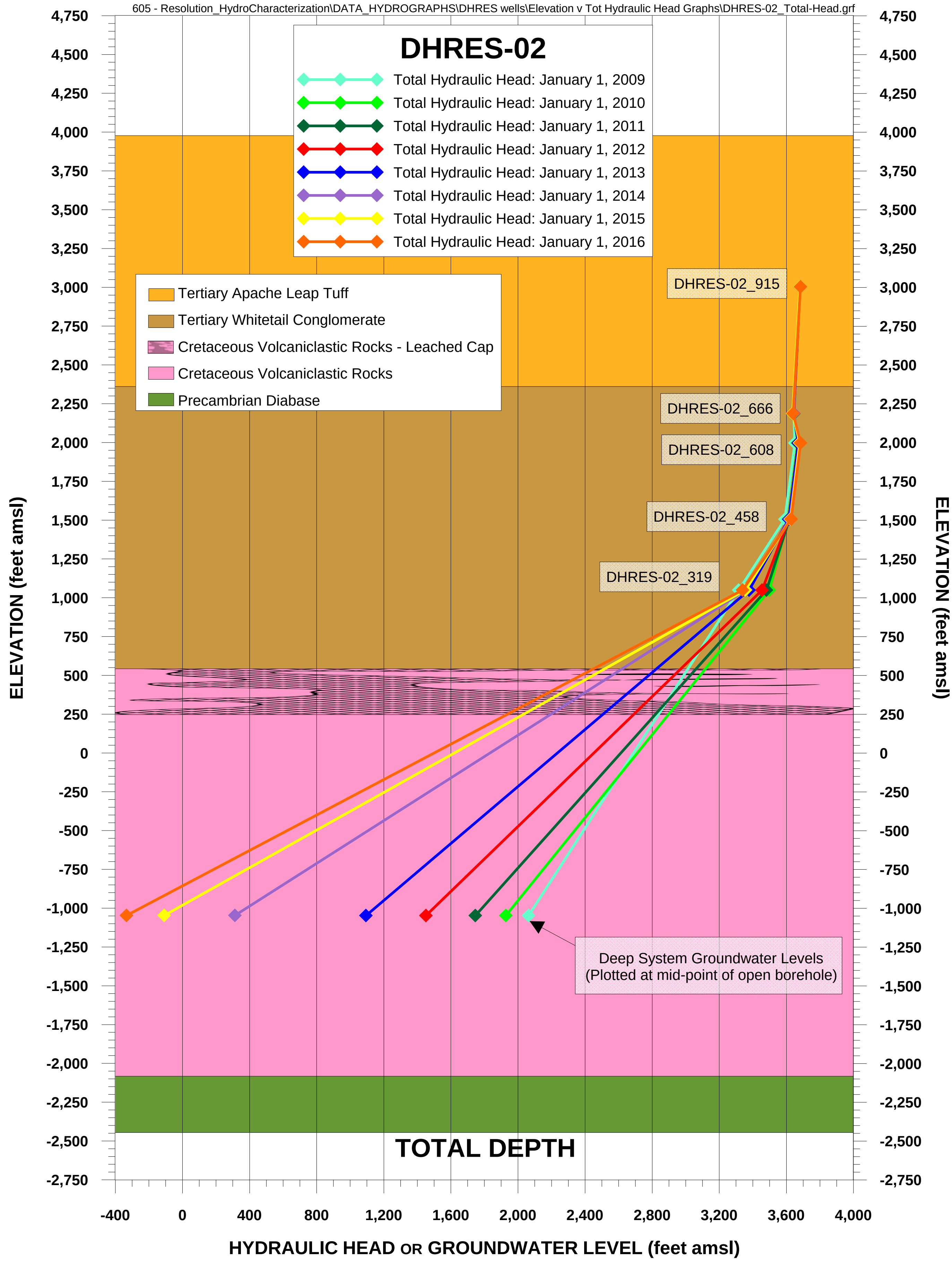
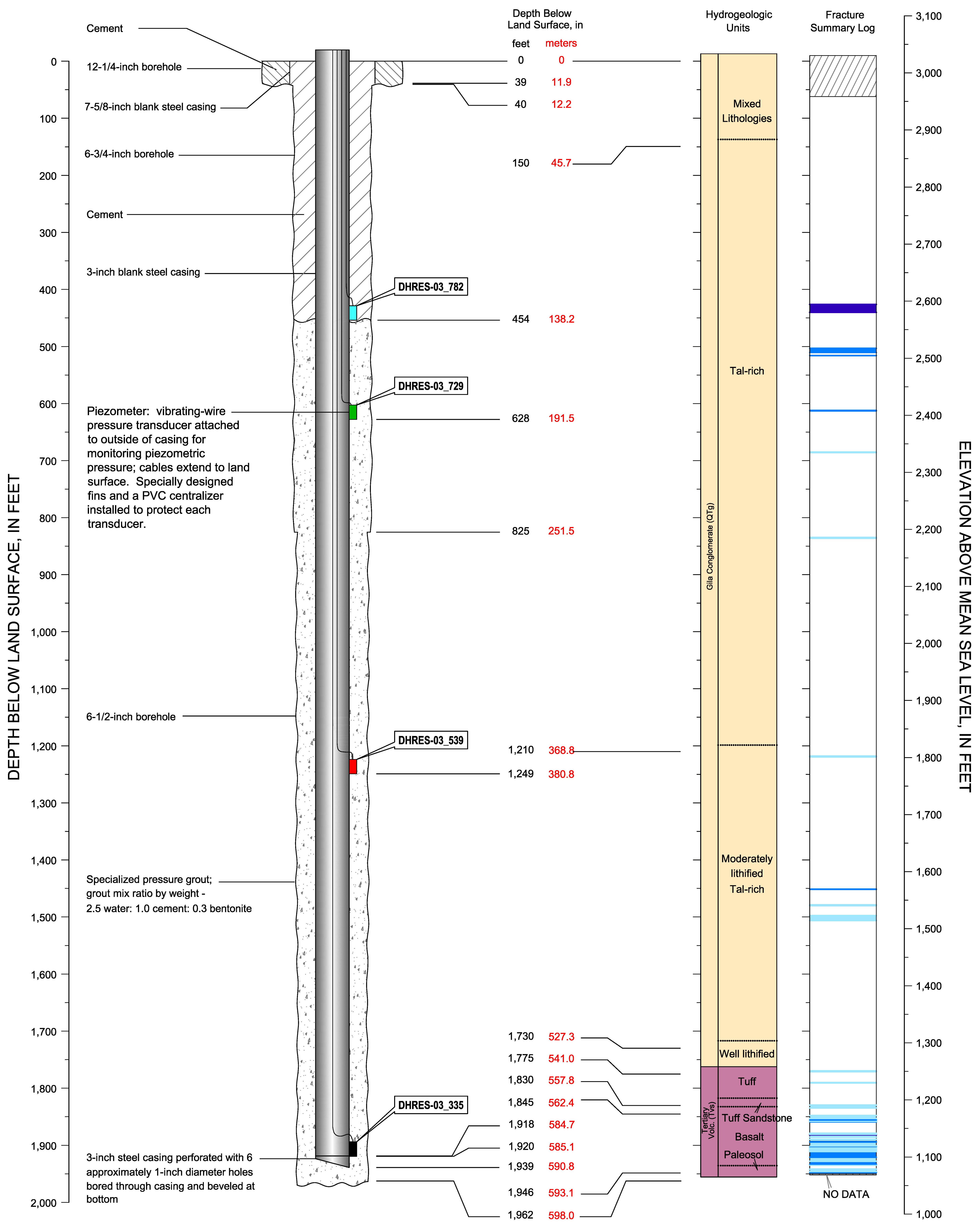


FIGURE B-2d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-02, RESOLUTION PROJECT

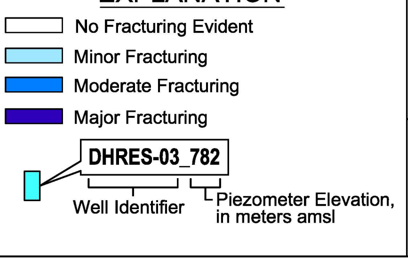
RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-12) 35bcd	ADWR NO: 55-218637
NORTHING: 837612.381	EASTING: 947362.791
LAND SURFACE ELEVATION: 3020.58 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION



RESOLUTION COPPER

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DHRES-03
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-3

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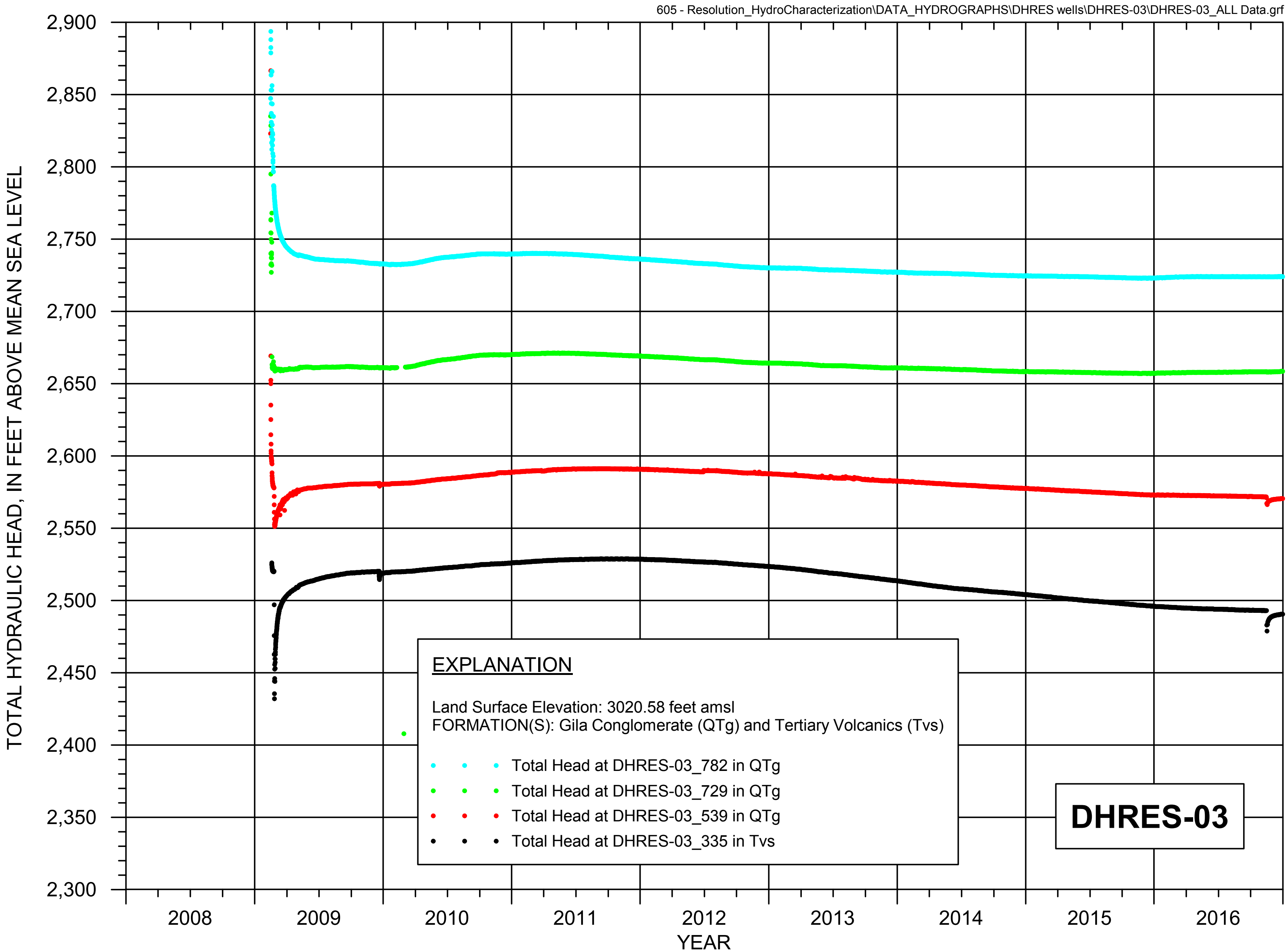

FIGURE B-3a. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-03

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

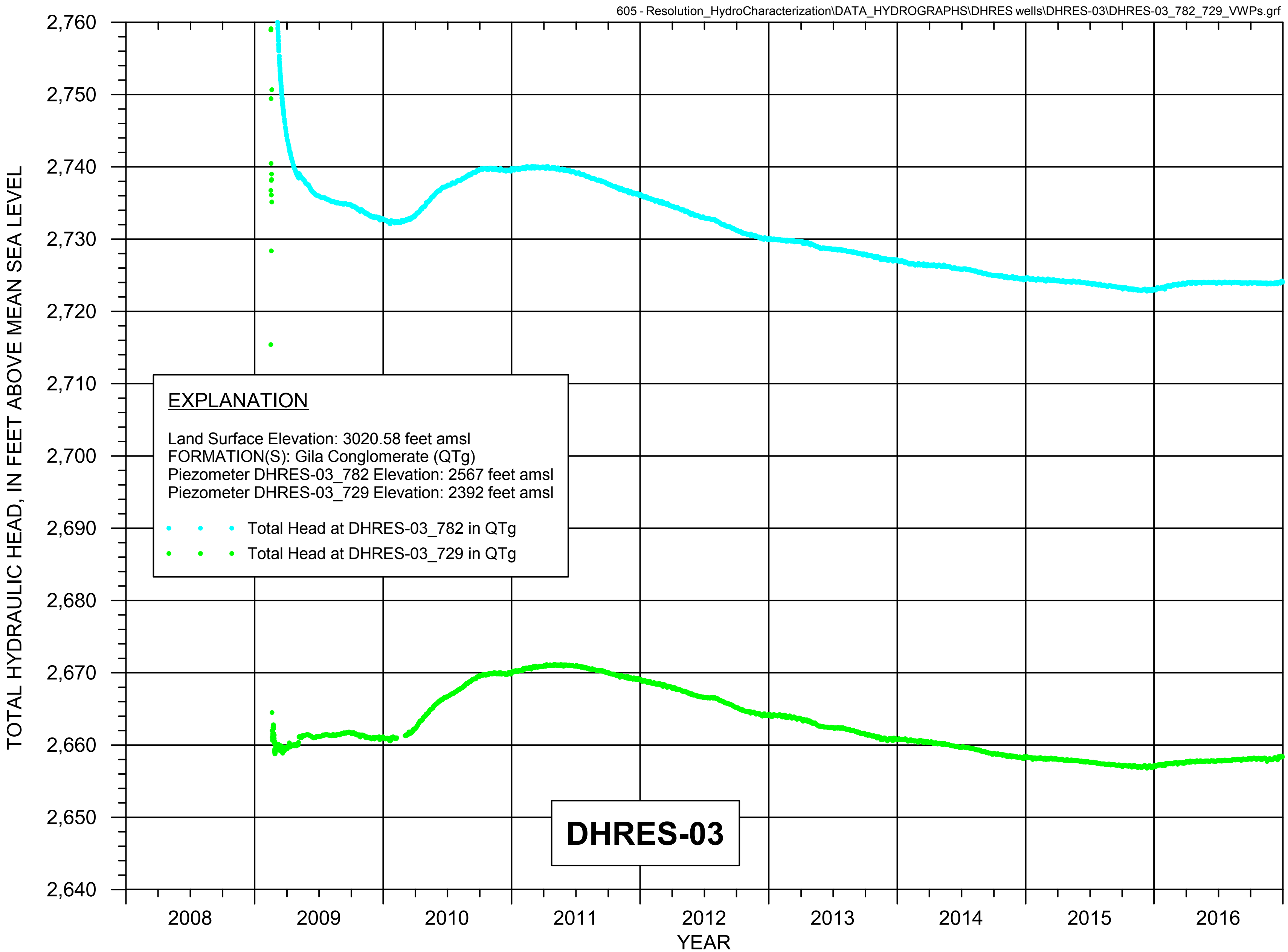

FIGURE B-3b. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS DHRES-03_782 AND 729 AT HYDROLOGIC TEST WELL DHRES-03

RESOLUTION COPPER

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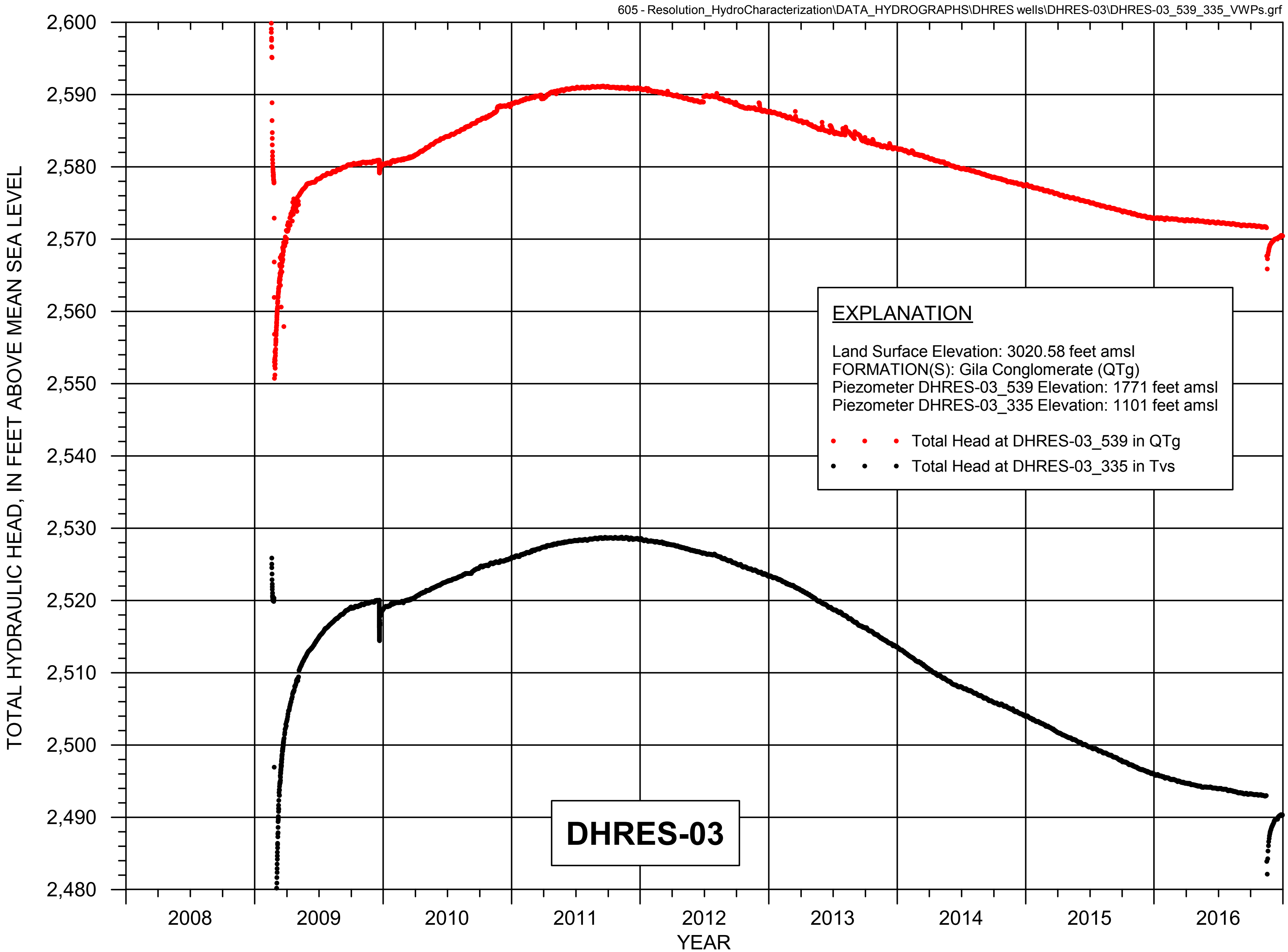

FIGURE B-3c. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS DHRES-03_539 AND 335 AT HYDROLOGIC TEST WELL DHRES-03

RESOLUTION COPPER

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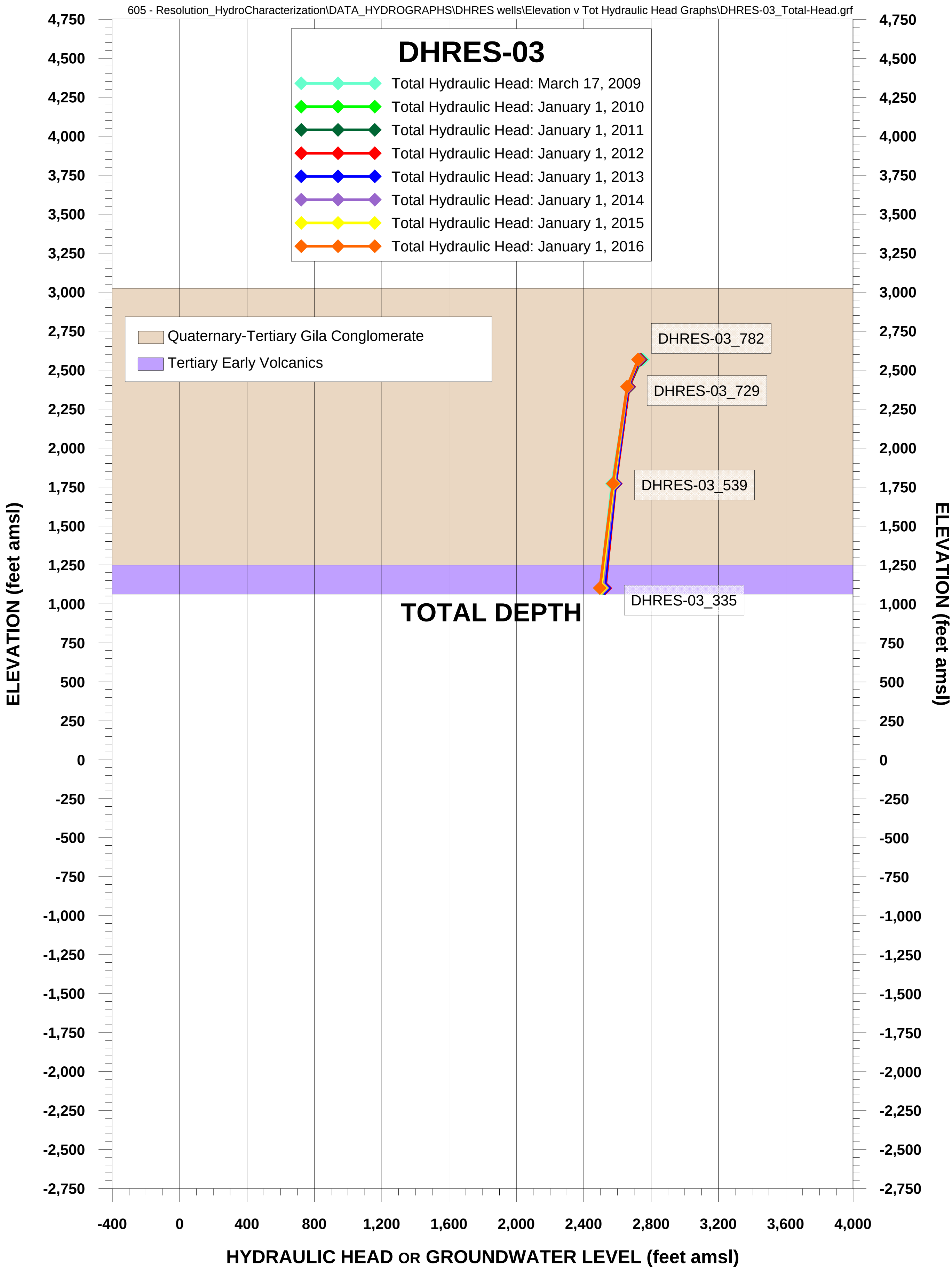
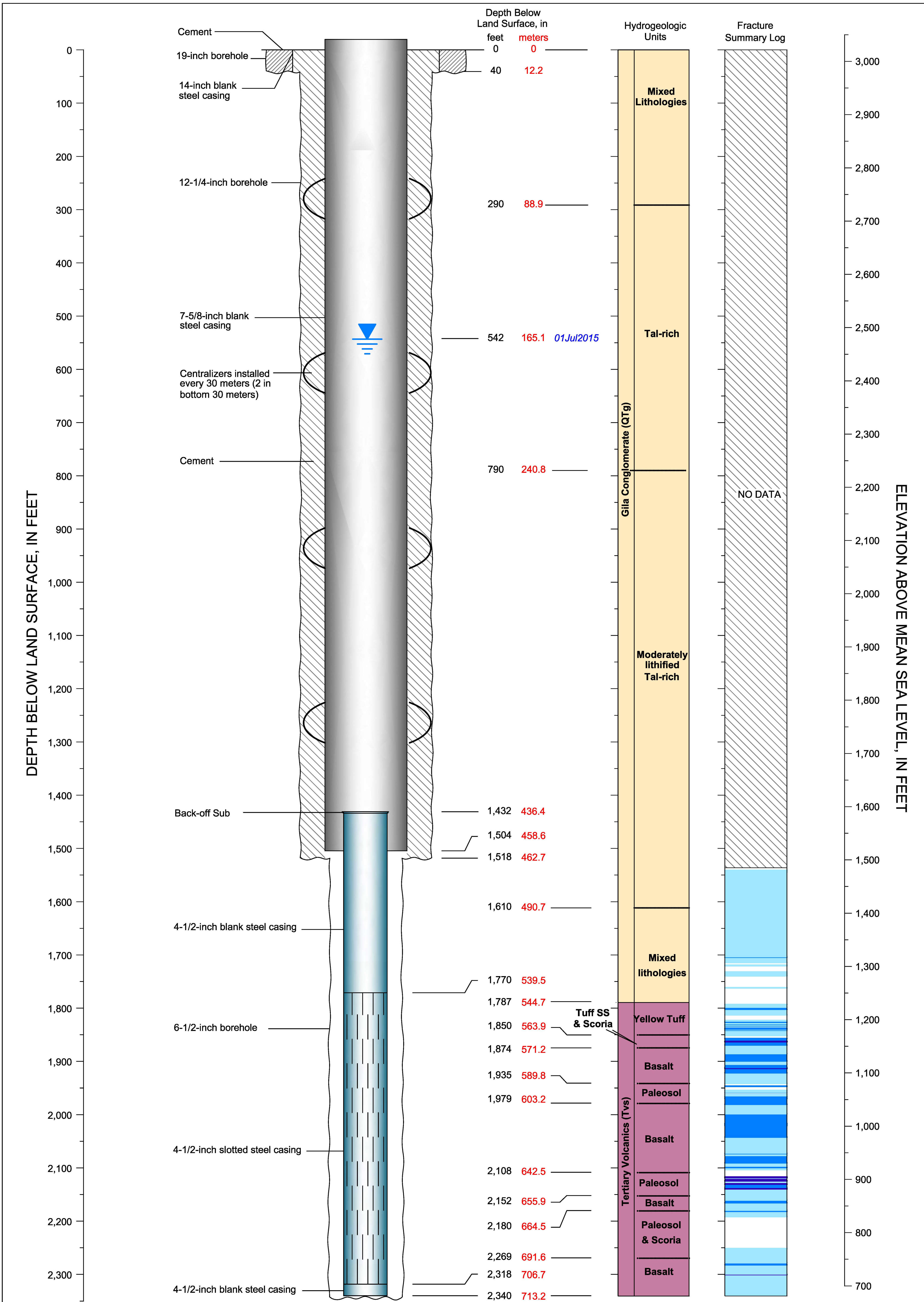


FIGURE B-3d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-03, RESOLUTION PROJECT

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-12) 35bcd	ADWR NO: 55-218676
NORTHING: 837627.381	EASTING: 947290.983

LAND SURFACE ELEVATION: 3021.63 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level

RESOLUTION COPPER

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DHRES-04
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-4

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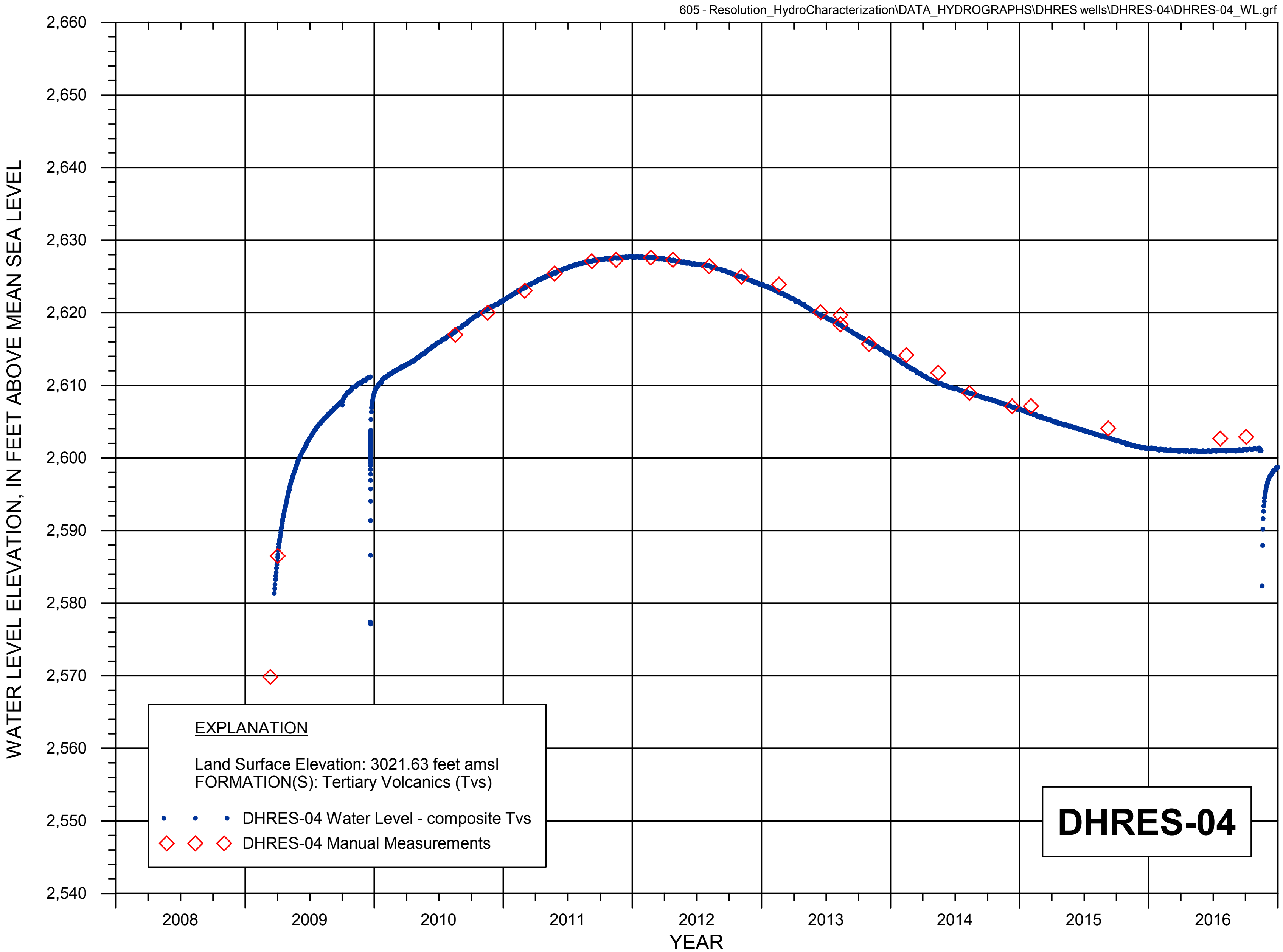
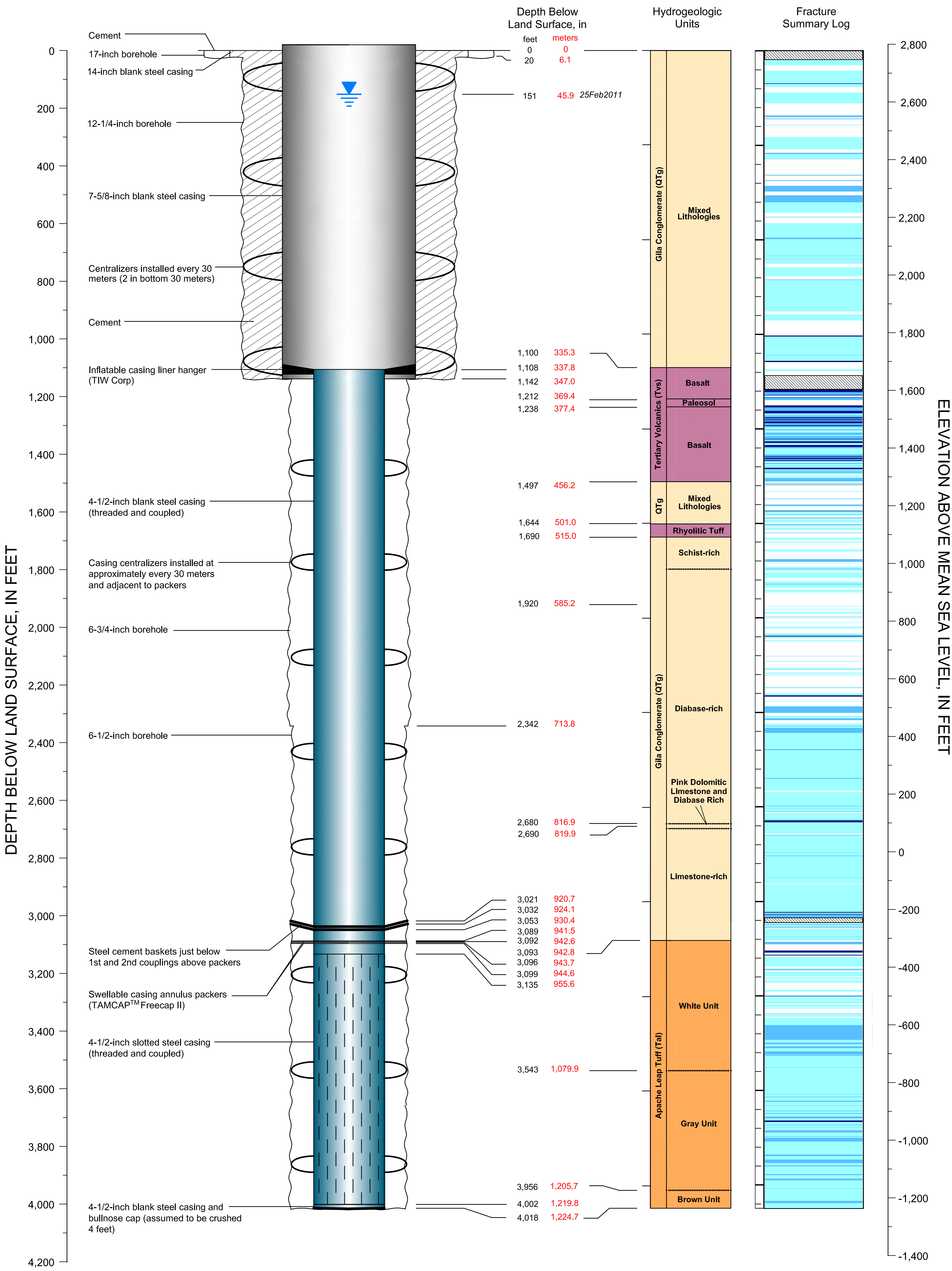


FIGURE B-4a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-04



CADASTRAL: (D-1-12)34dbc	ADWR NO: 55-219677
NORTHING: 836291.433	EASTING: 943640.130
LAND SURFACE ELEVATION: 2778.37 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level

RESOLUTION COPPER

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DHRES-05B
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-5

Drafting\605\WellSchematics_2015\DHRESwells\DHRES05B_Feet\26Sept2016

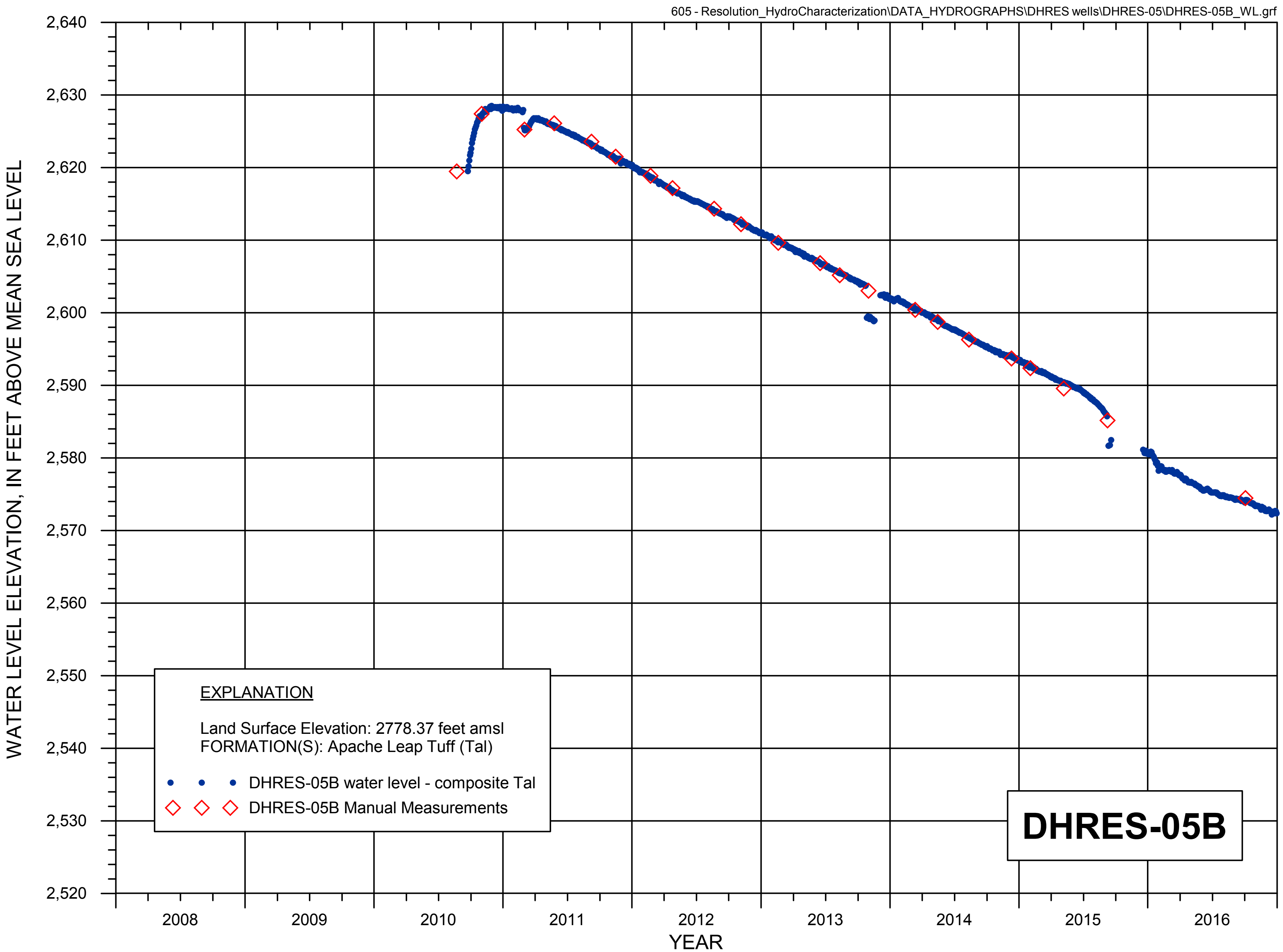
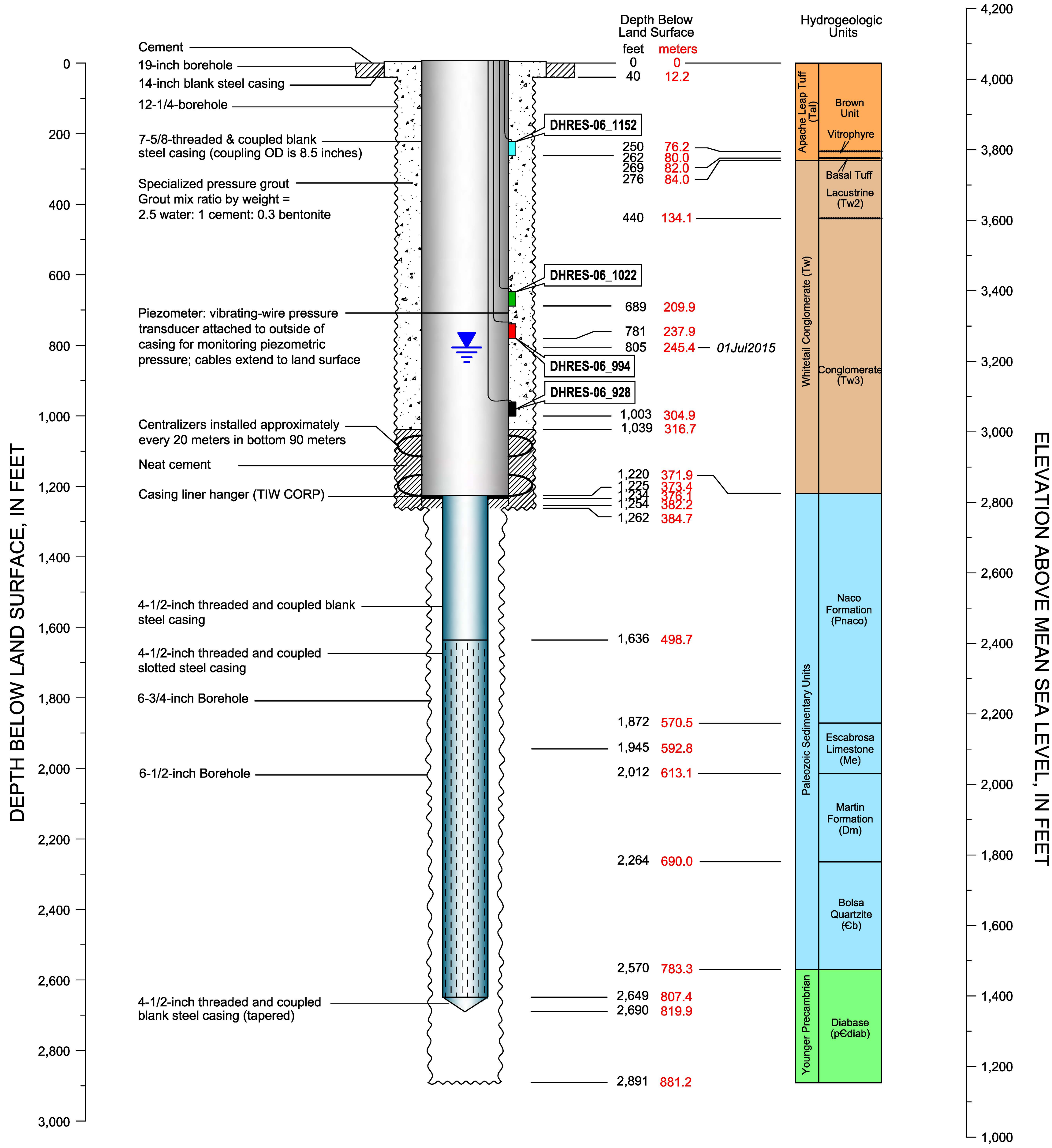


FIGURE B-5a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-05B

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-13) 8cca | ADWR NO: 55-911688

NORTHING: 826028.632 | EASTING: 965587.788

LAND SURFACE ELEVATION: 4045.57 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

Non-pumping Water Level

DHRES-06_1152

Well Identifier

Piezometer Elevation, in meters amsl

RESOLUTION COPPER

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Water Resource Consultants

DHRES-06
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-6

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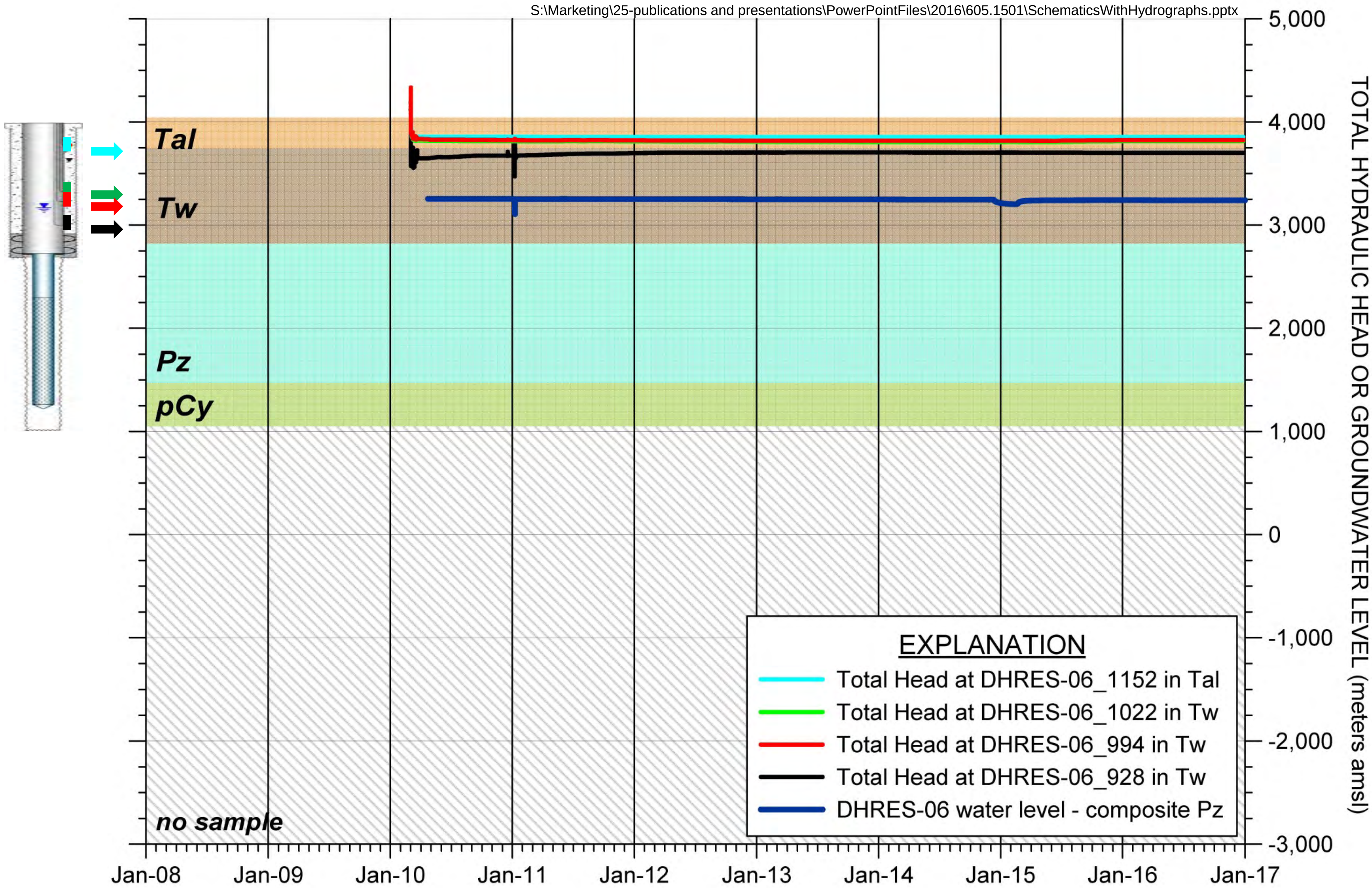


FIGURE B-6a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-06

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

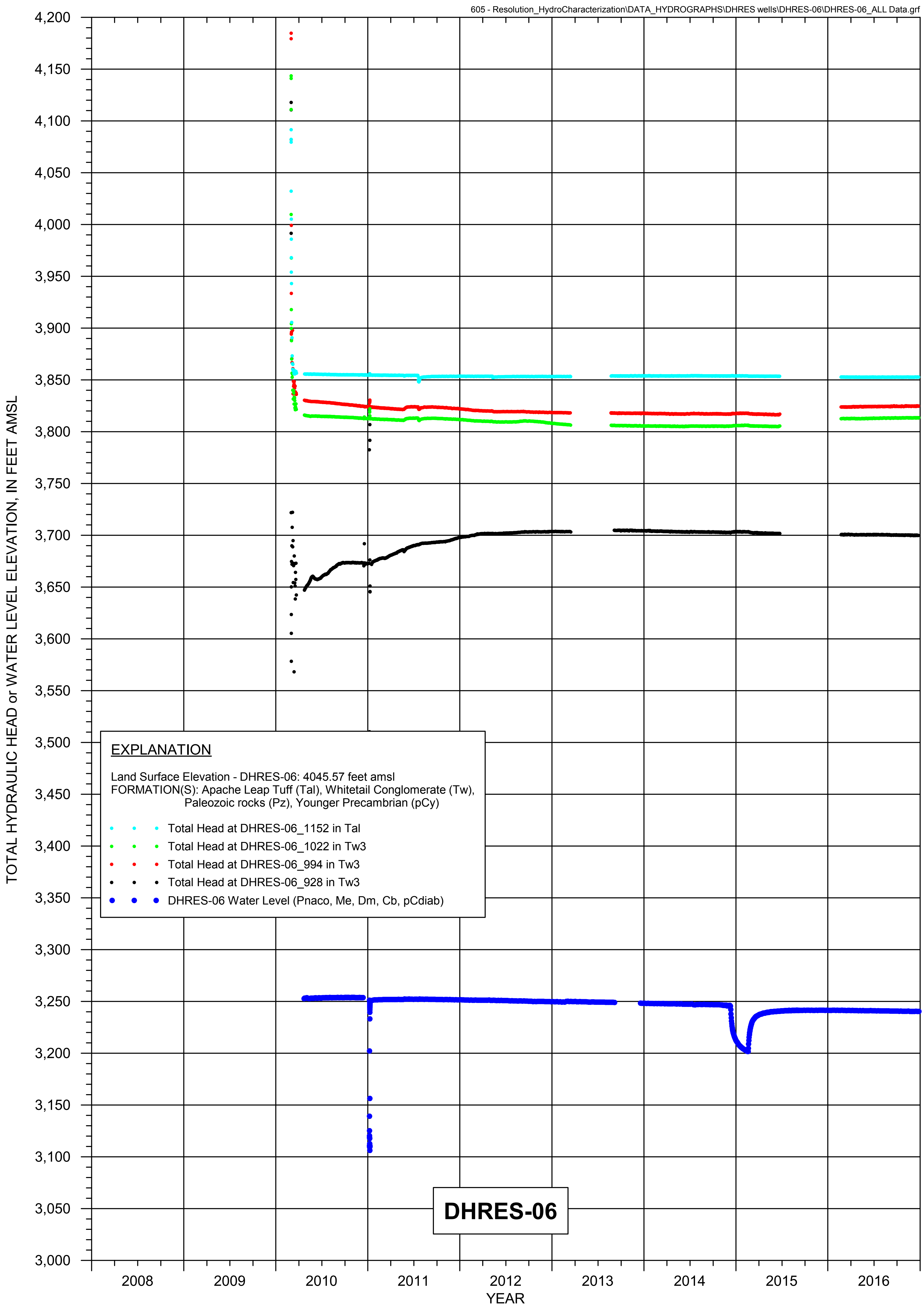


FIGURE B-6b. HYDROGRAPH OF WATER LEVEL, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-06

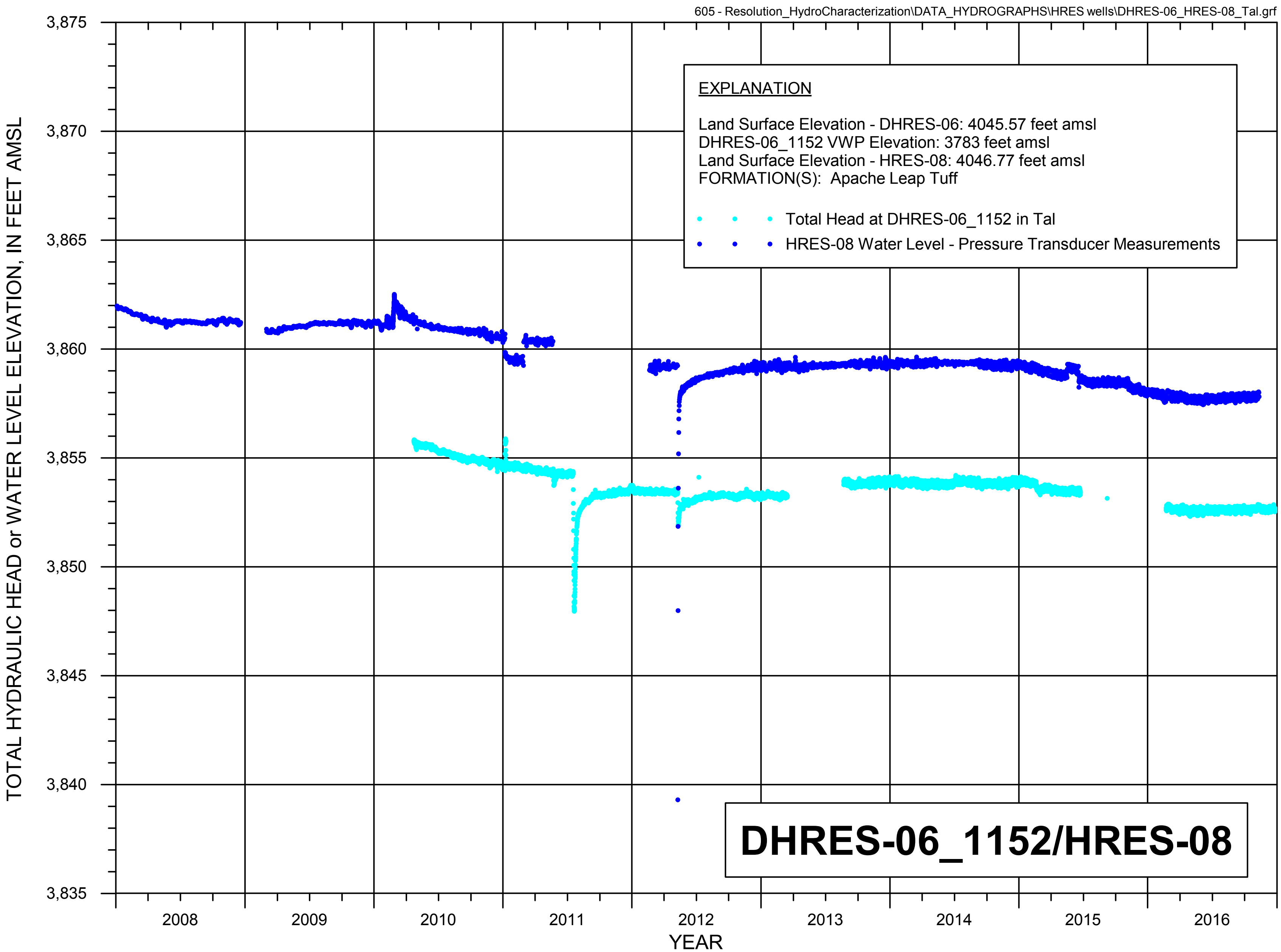


FIGURE B-6c. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-08, AND HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETER DHRES-06_1152

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

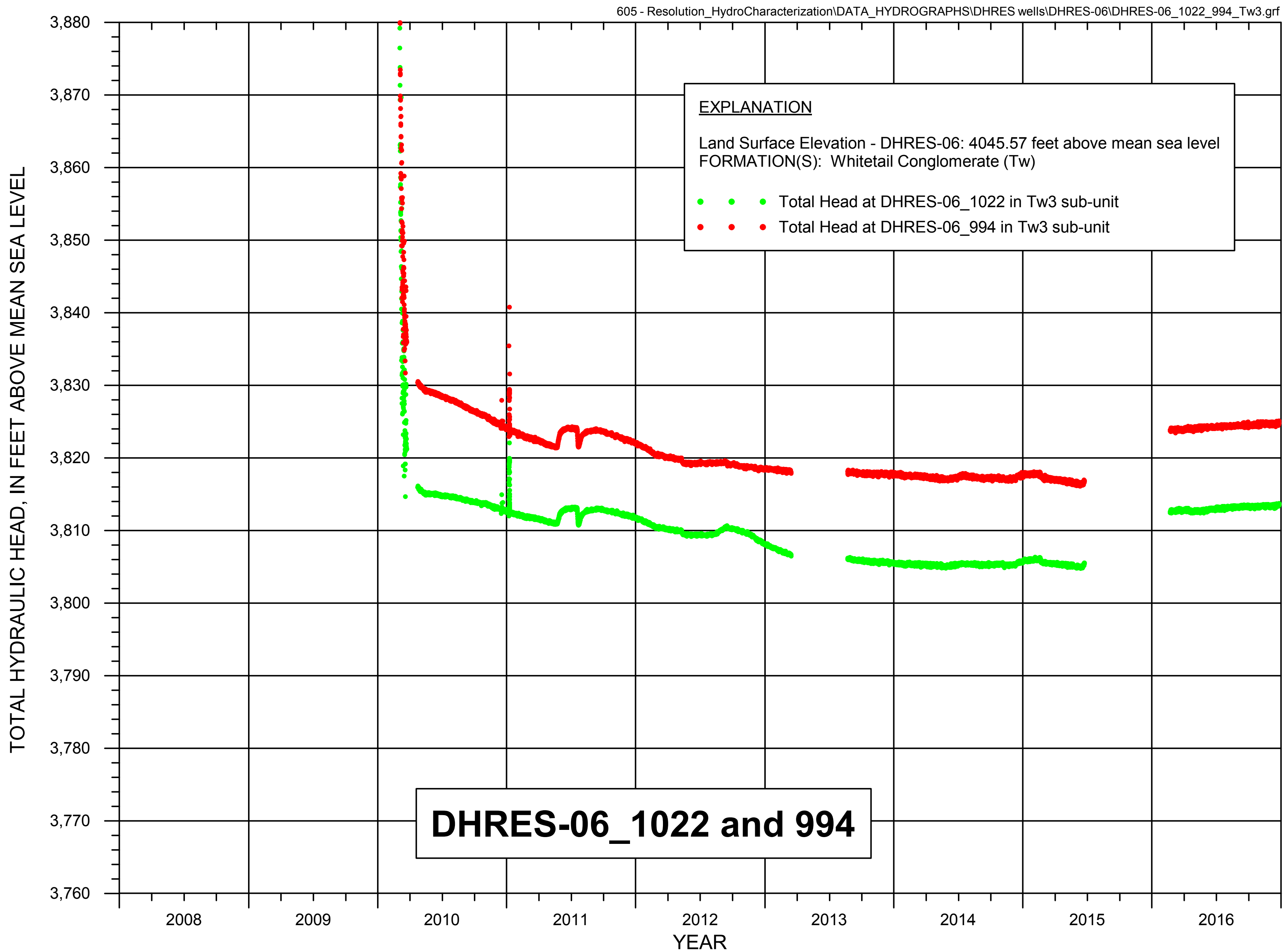


FIGURE B-6d. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS DHRES-06_1022 and DHRES-06_994, WHITETAIL CONGLOMERATE

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

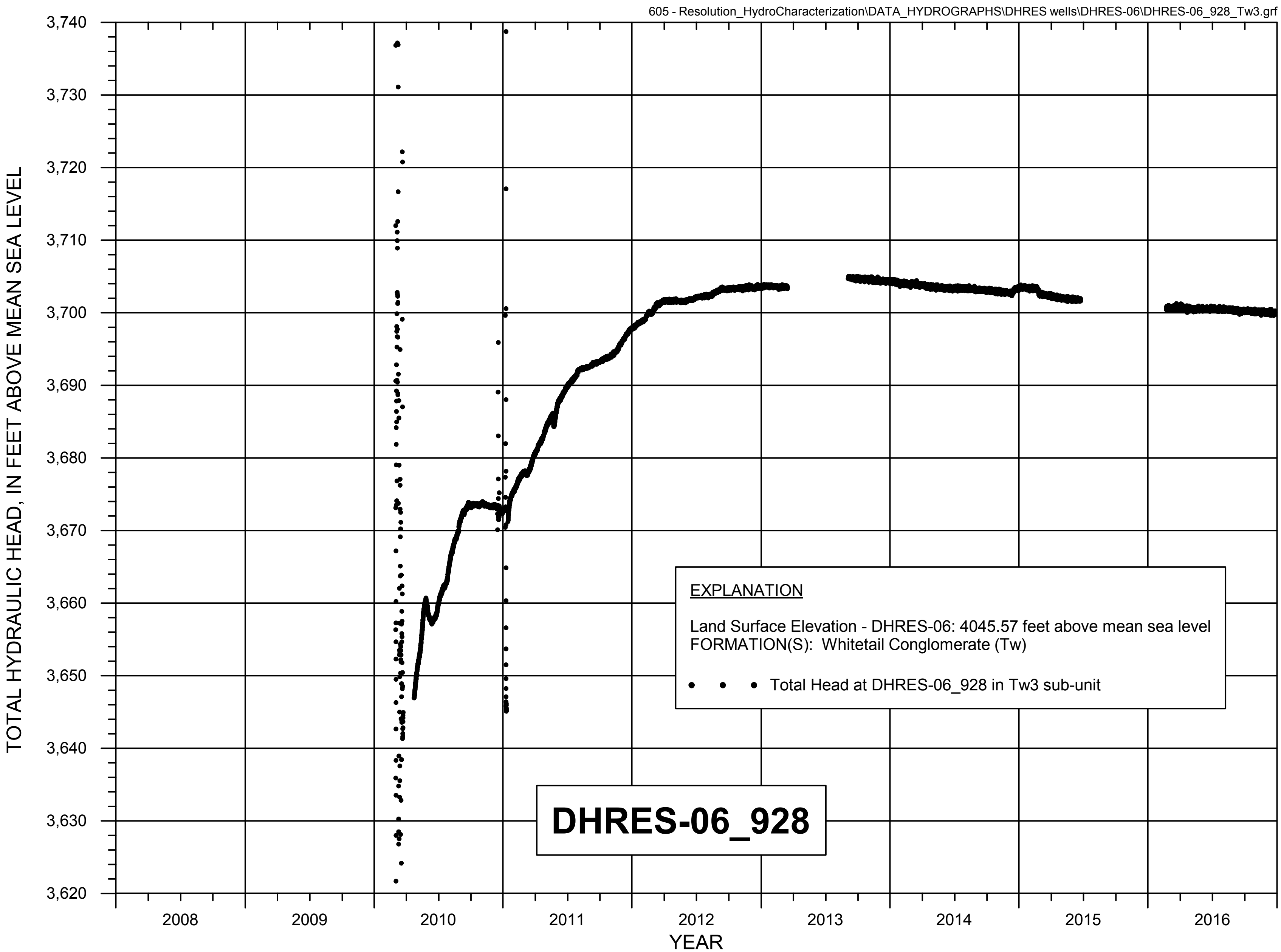


FIGURE B-6e. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETER DHRES-06_928, WHITETAIL CONGLOMERATE

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

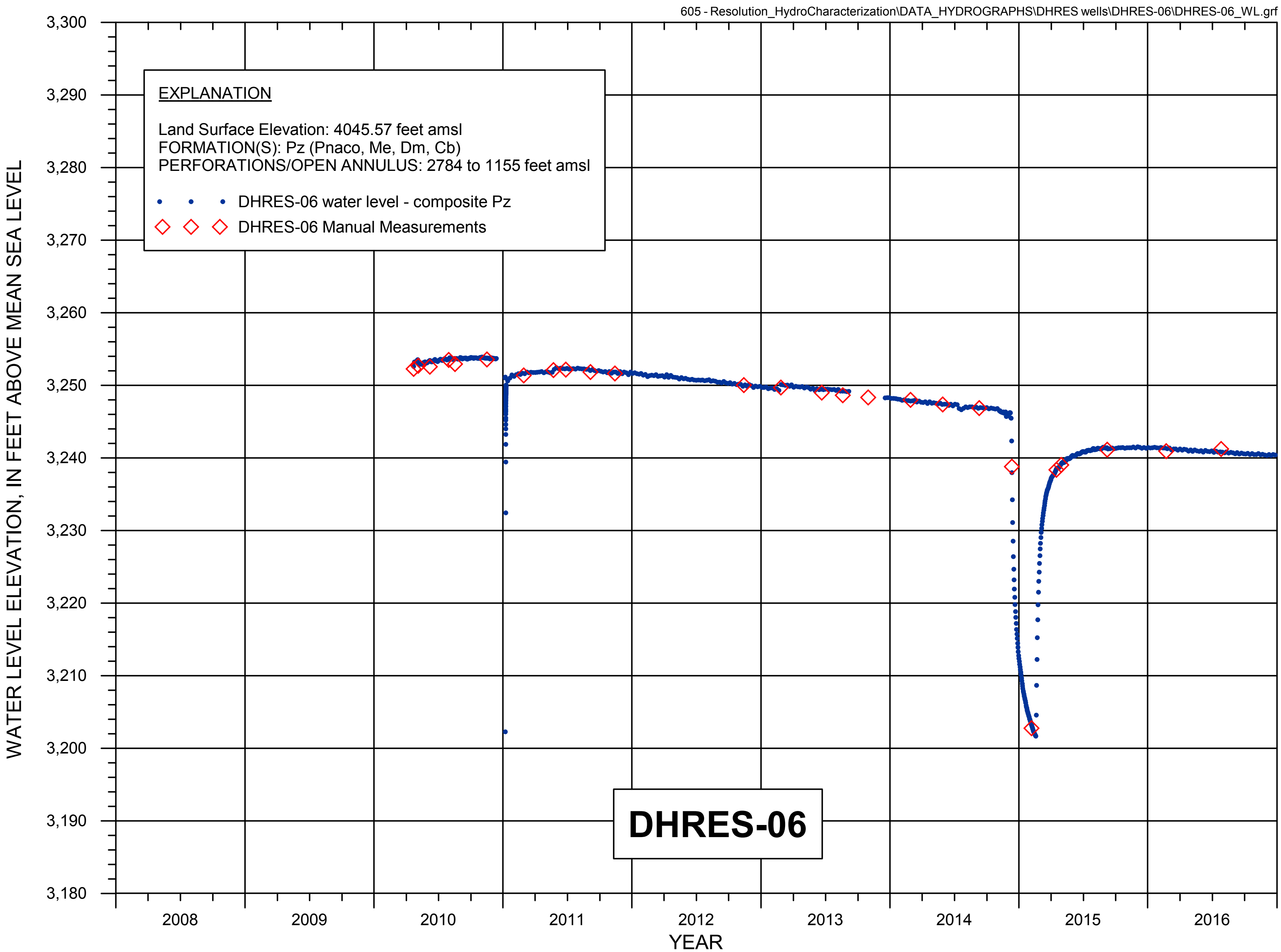


FIGURE B-6f. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-06

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

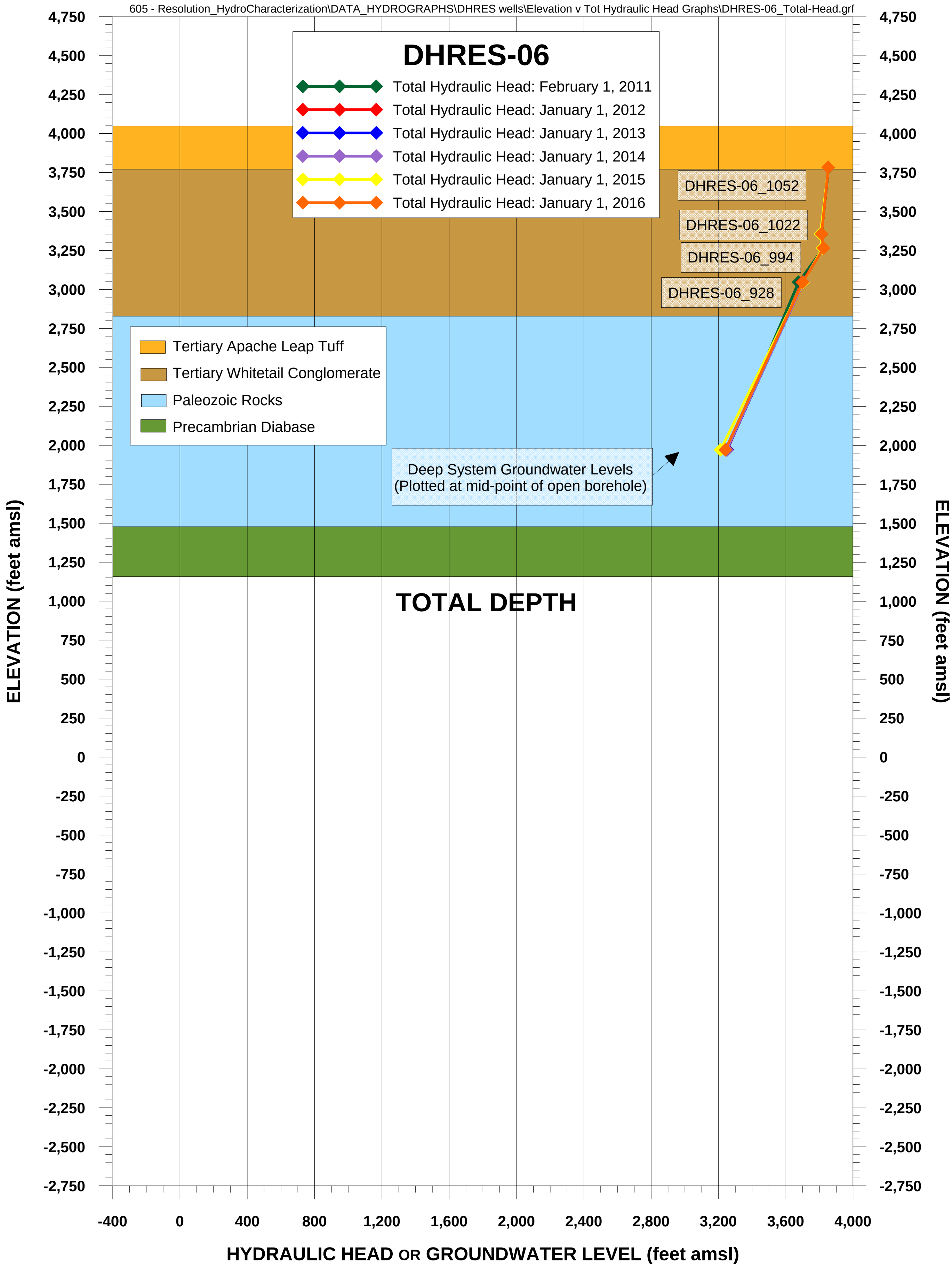
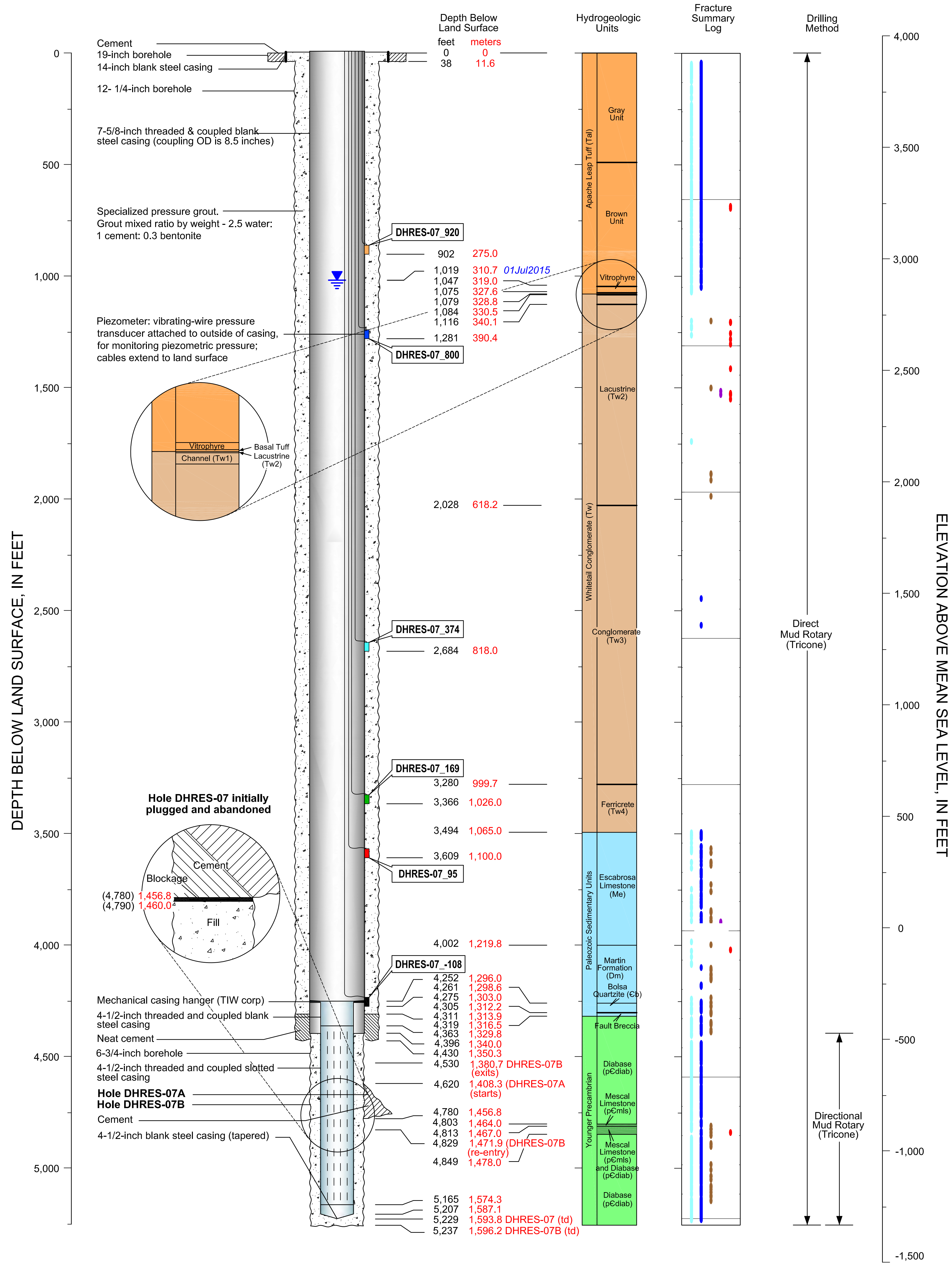


FIGURE B-6g. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-06, RESOLUTION PROJECT



CADASTRAL: (D-2-13)05cbd	ADWR NO: 55-911954
NORTHING: 831890.964	EASTING: 965873.361

LAND SURFACE ELEVATION: 3922.79 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- Partial conductive fractures
- Continuous conductive fractures
- Clay-filled fractures
- Faults
- Resistive mineral-filled fractures
- Non-pumping Water Level

DHRES-07_800
Well Identifier
Piezometer Elevation, in meters amsl

RESOLUTION COPPER

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DHRES-07
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-7

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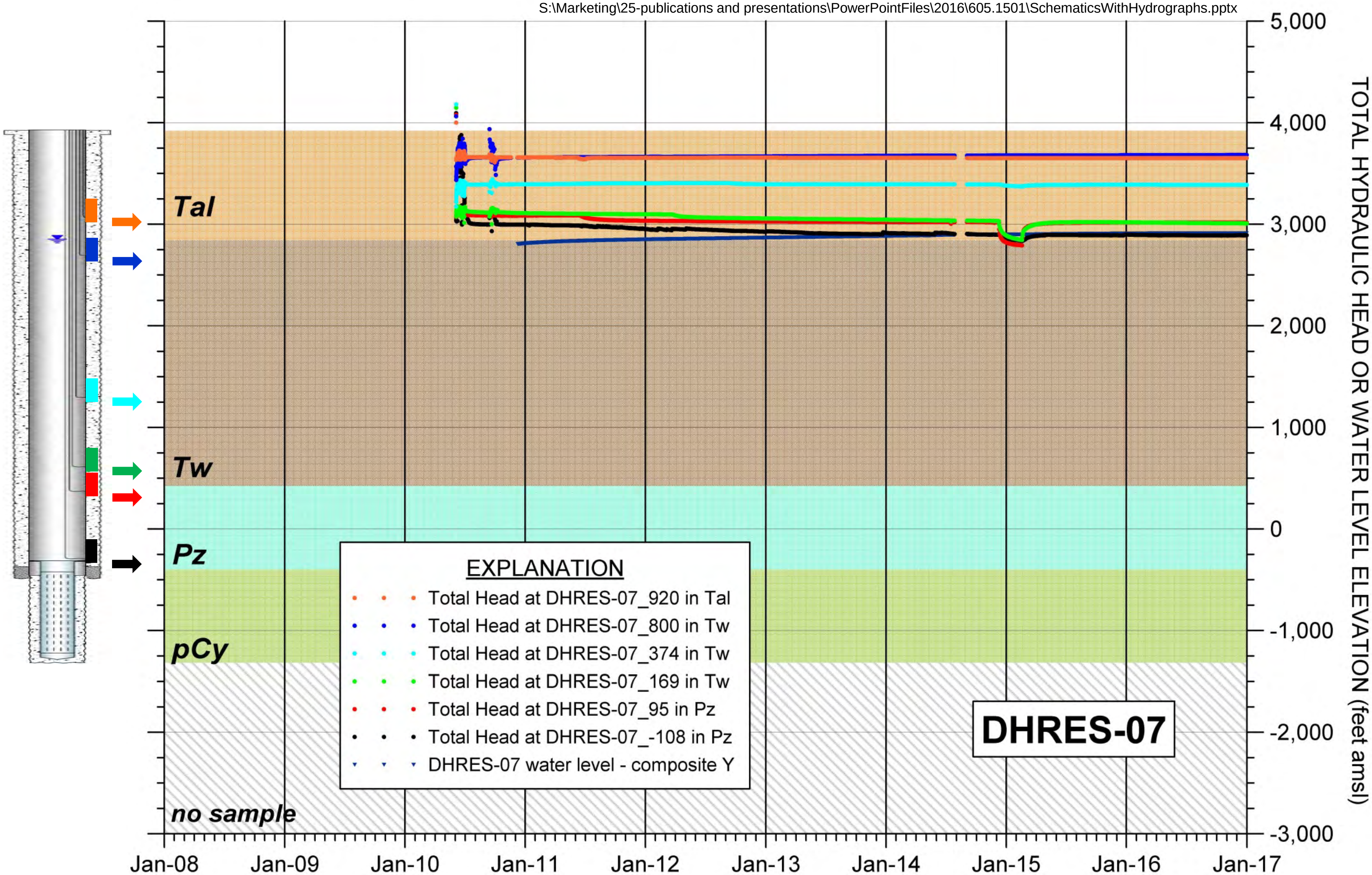

FIGURE B-7a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-07

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

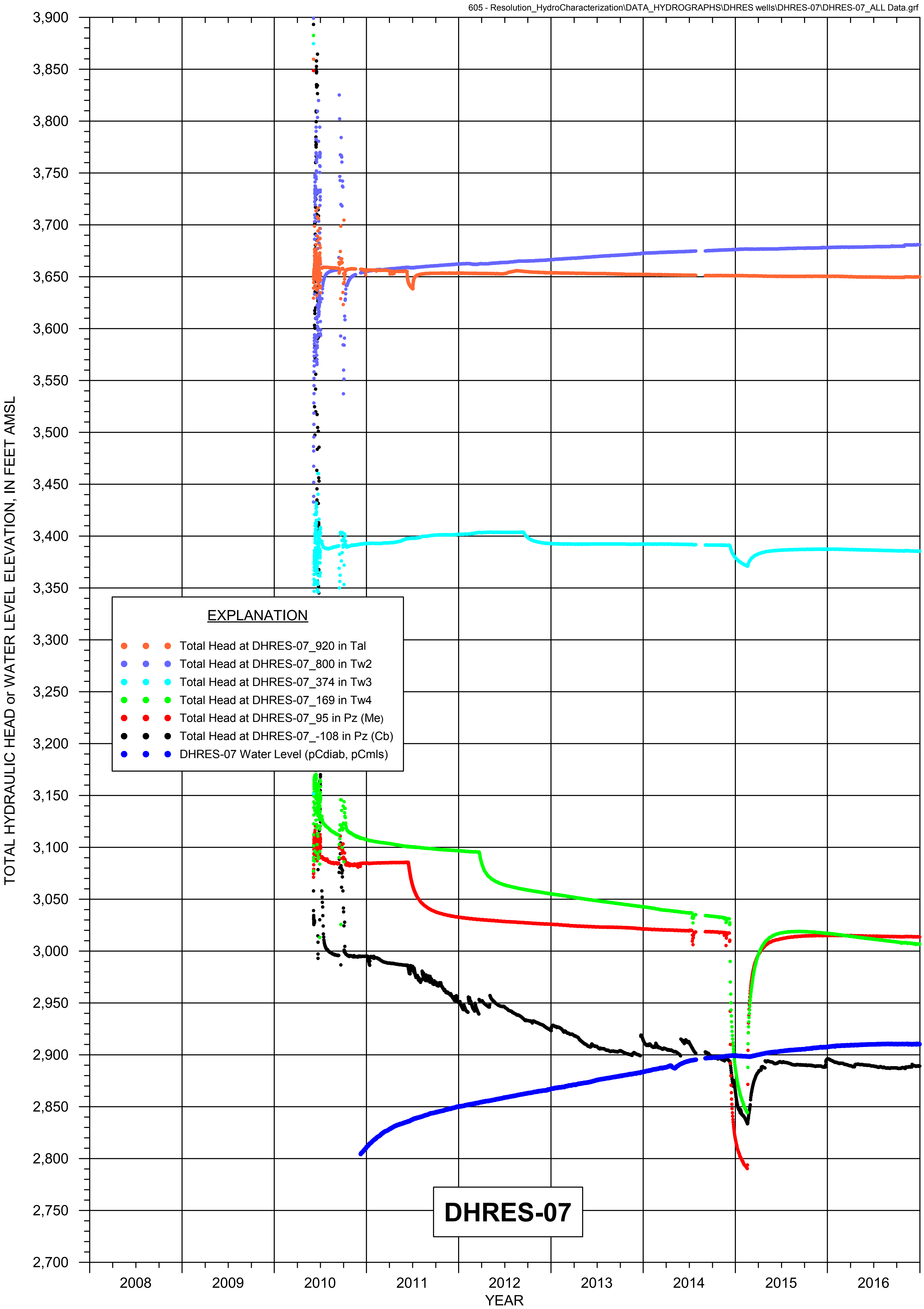

FIGURE B-7b. HYDROGRAPH OF WATER LEVEL, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-07

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

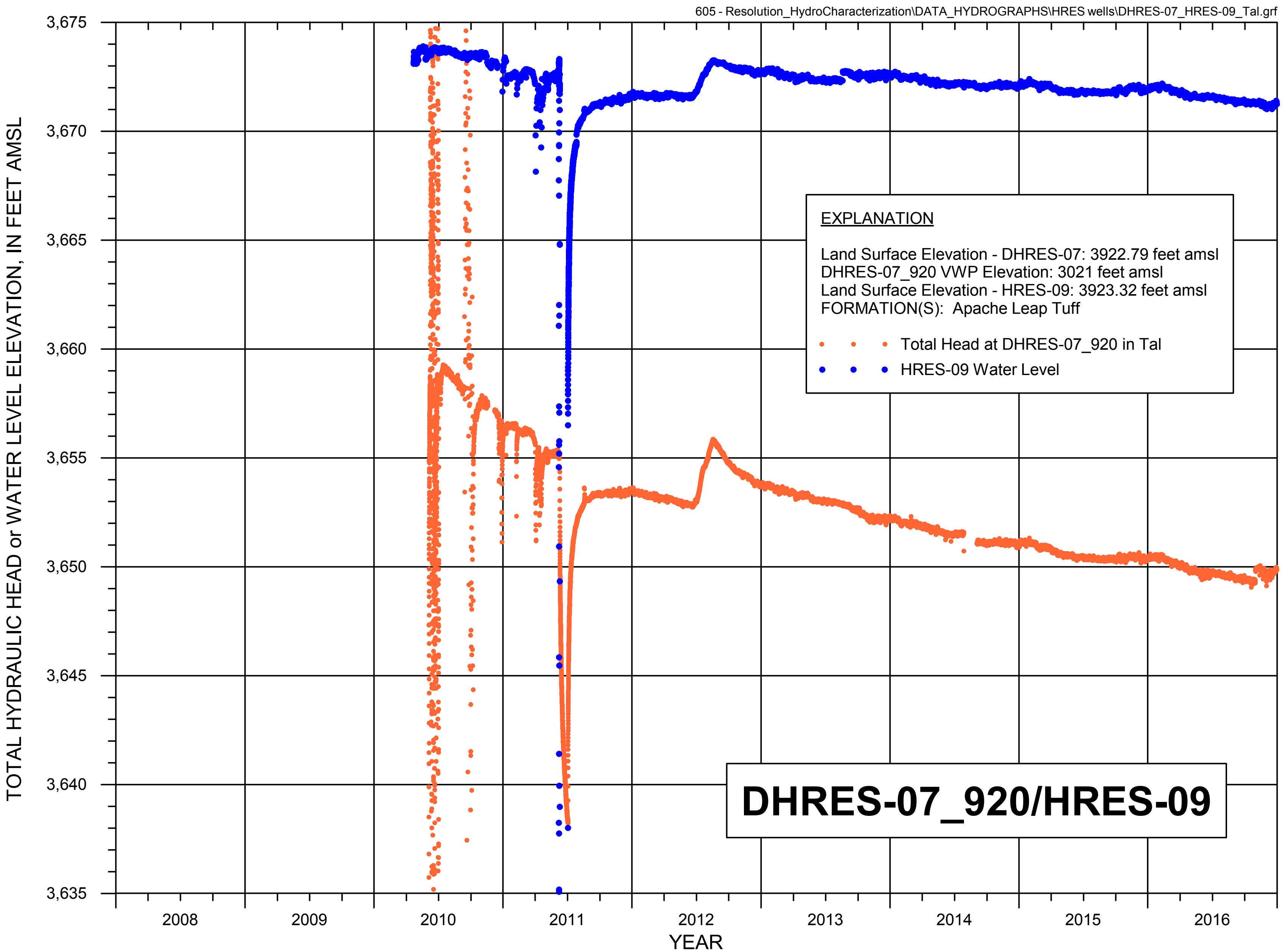

FIGURE B-7c. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-09, AND HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOEMETER DHRESD-07_920

RESOLUTION COPPER

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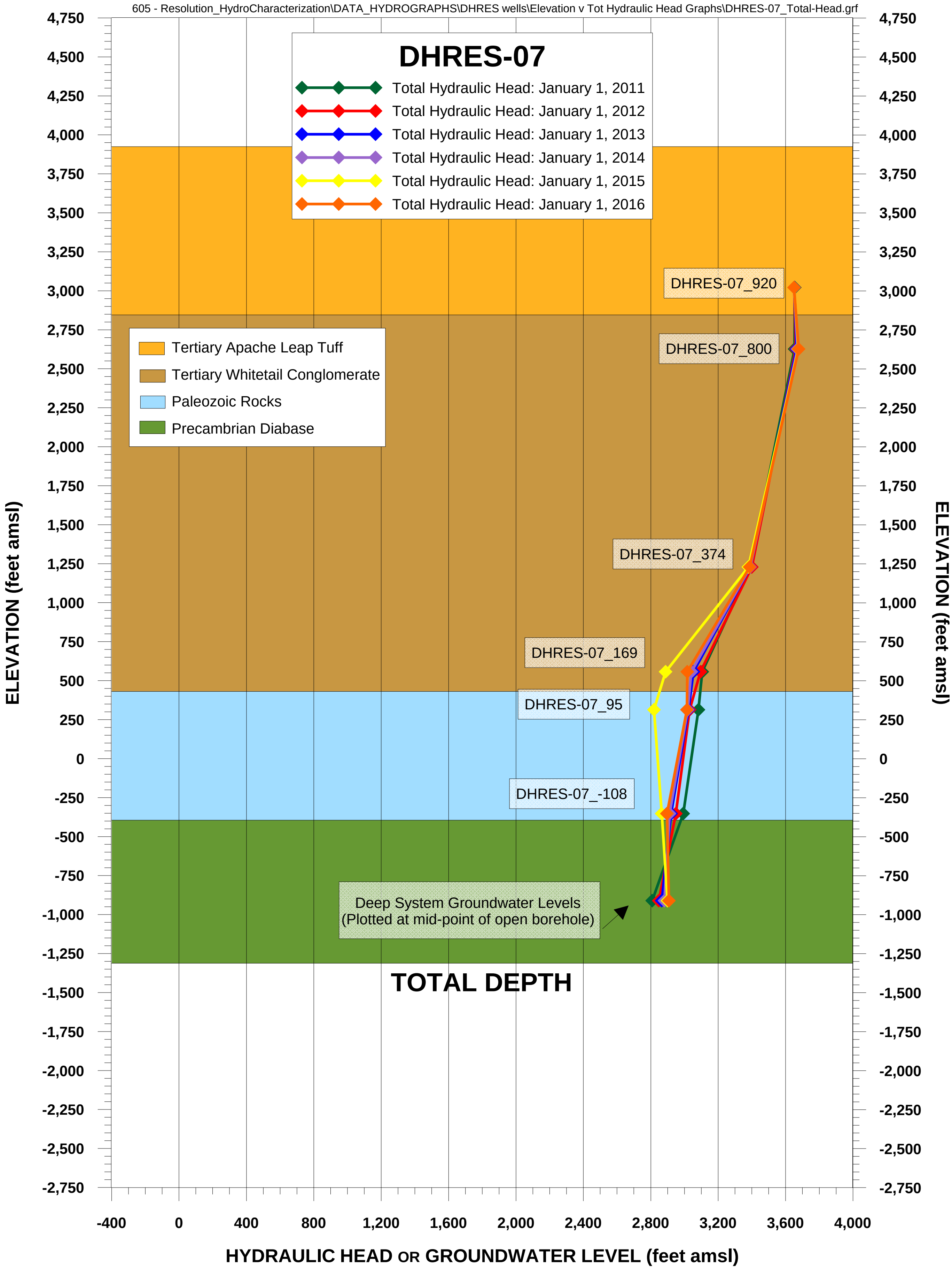
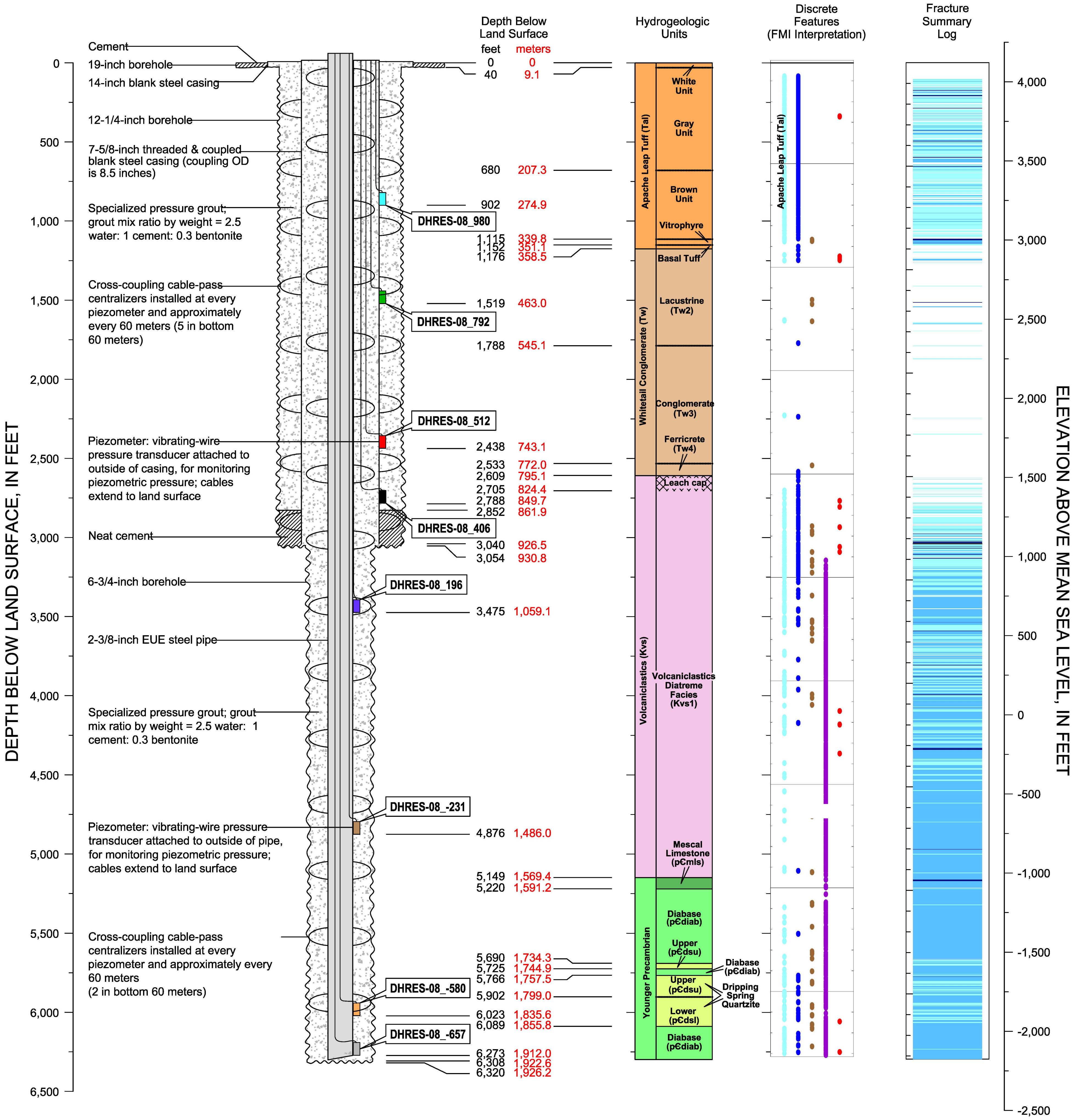
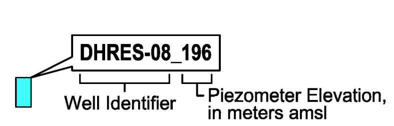


FIGURE B-7d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-07, RESOLUTION PROJECT





CADASTRAL: (D-2-13) 6bdd	ADWR NO: 55-912102
NORTHING: 833211.488	EASTING: 962041.397
LAND SURFACE ELEVATION: 4120.58 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- Partial conductive fractures
- Continuous conductive fractures
- Clay-filled fractures
- Faults
- Resistive mineral-filled fractures
- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing

RESOLUTION COPPER

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DHRES-08
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-8

Drafting\605\WellSchematics_2015\DHRESwells\DHRES8_Feet\26Sept2016

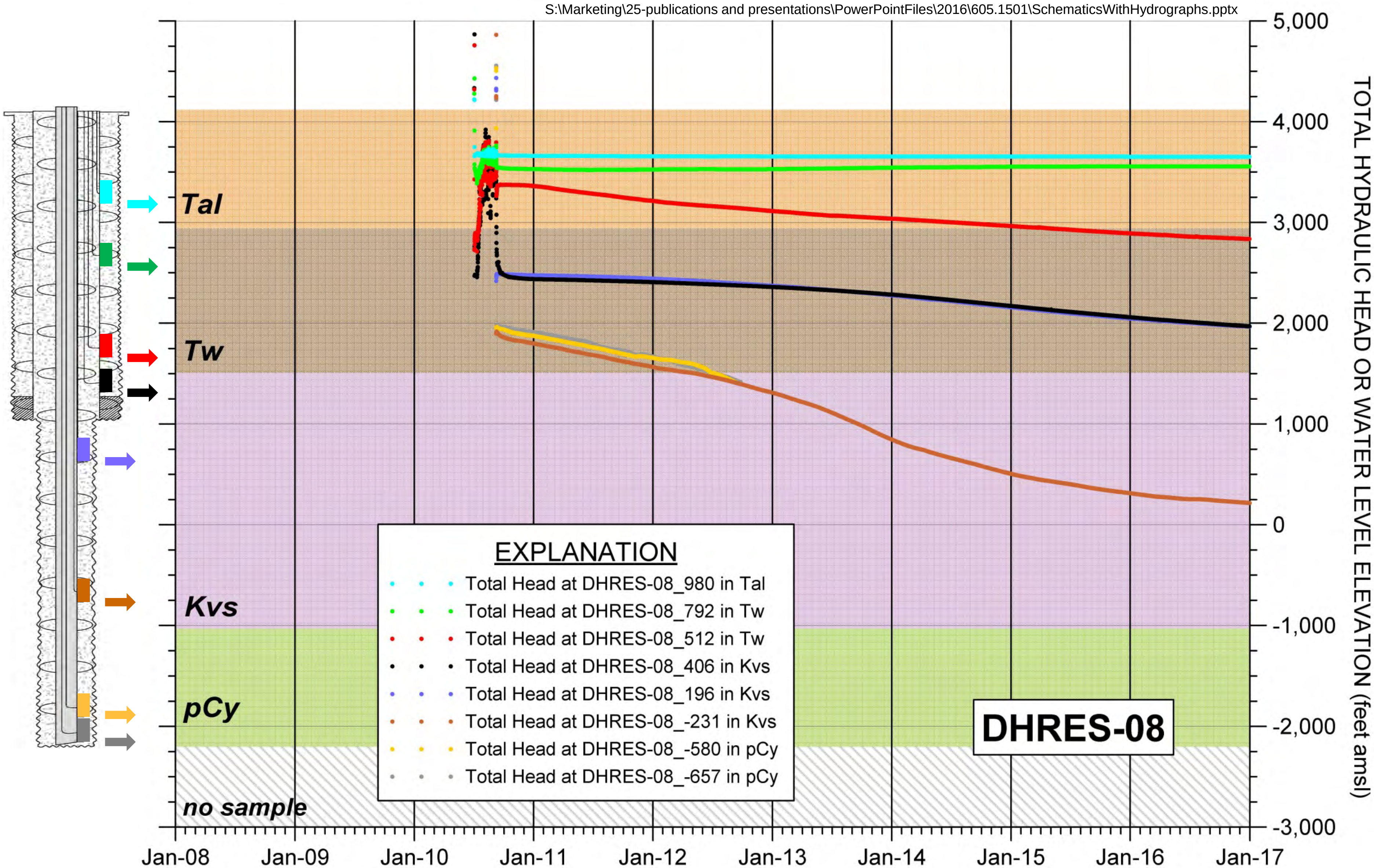

FIGURE B-8a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-08

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RESOLUTION COPPER

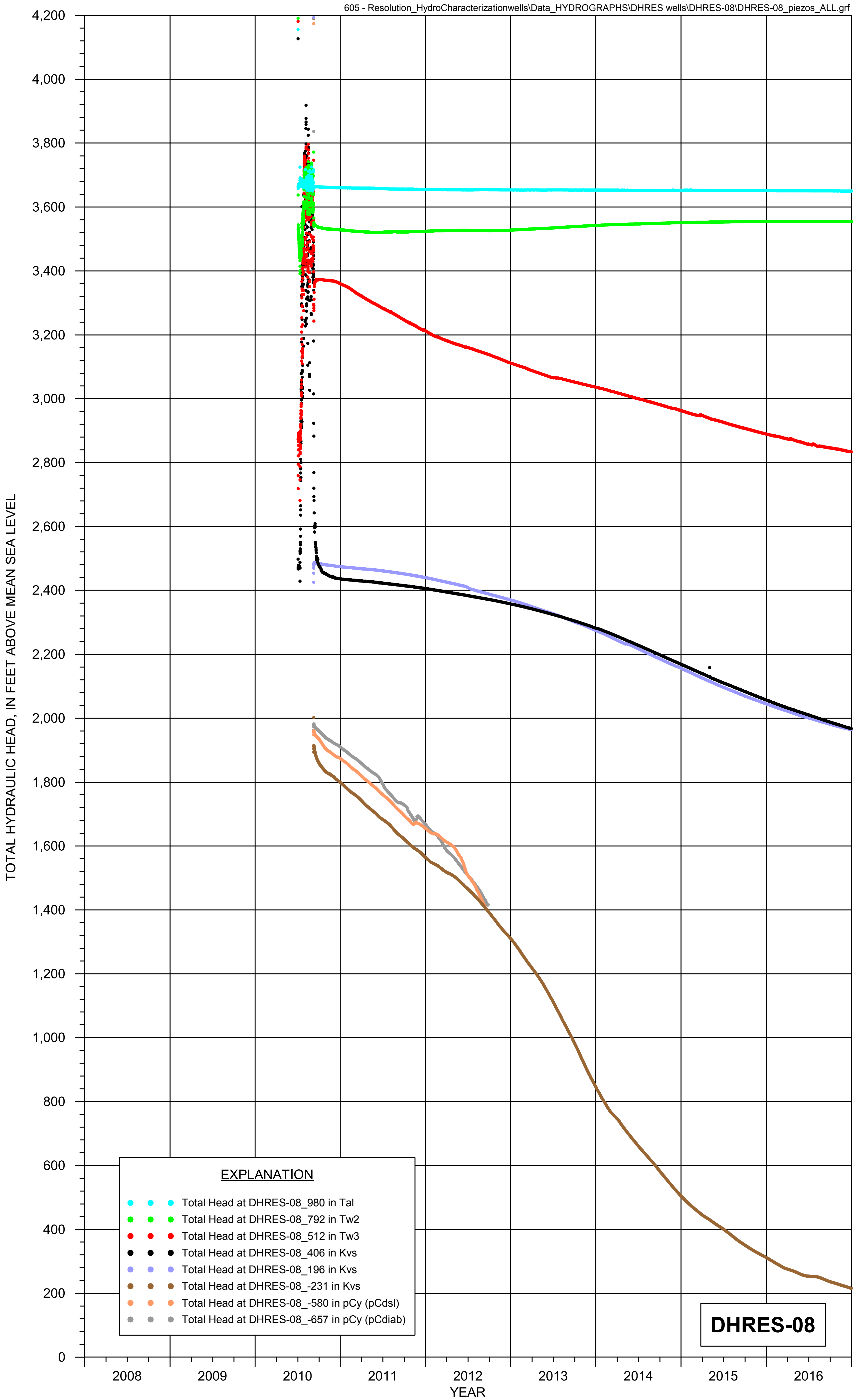


FIGURE B-8b. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-08

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

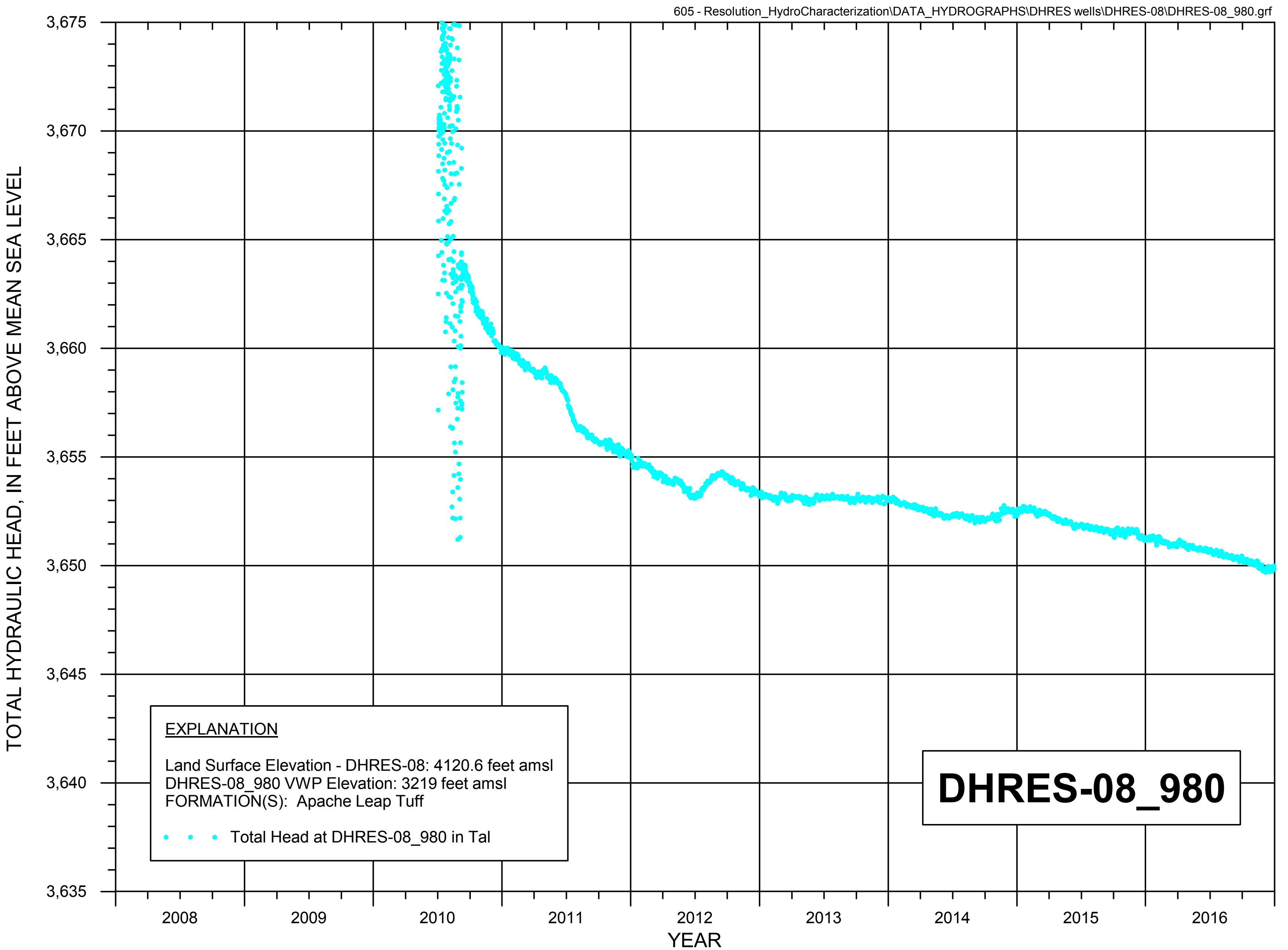


FIGURE B-8c. TOTAL HYDRAULIC HEAD HYDROGRAPH FOR GROUTED PIEZOMETER DHRES-08_980

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

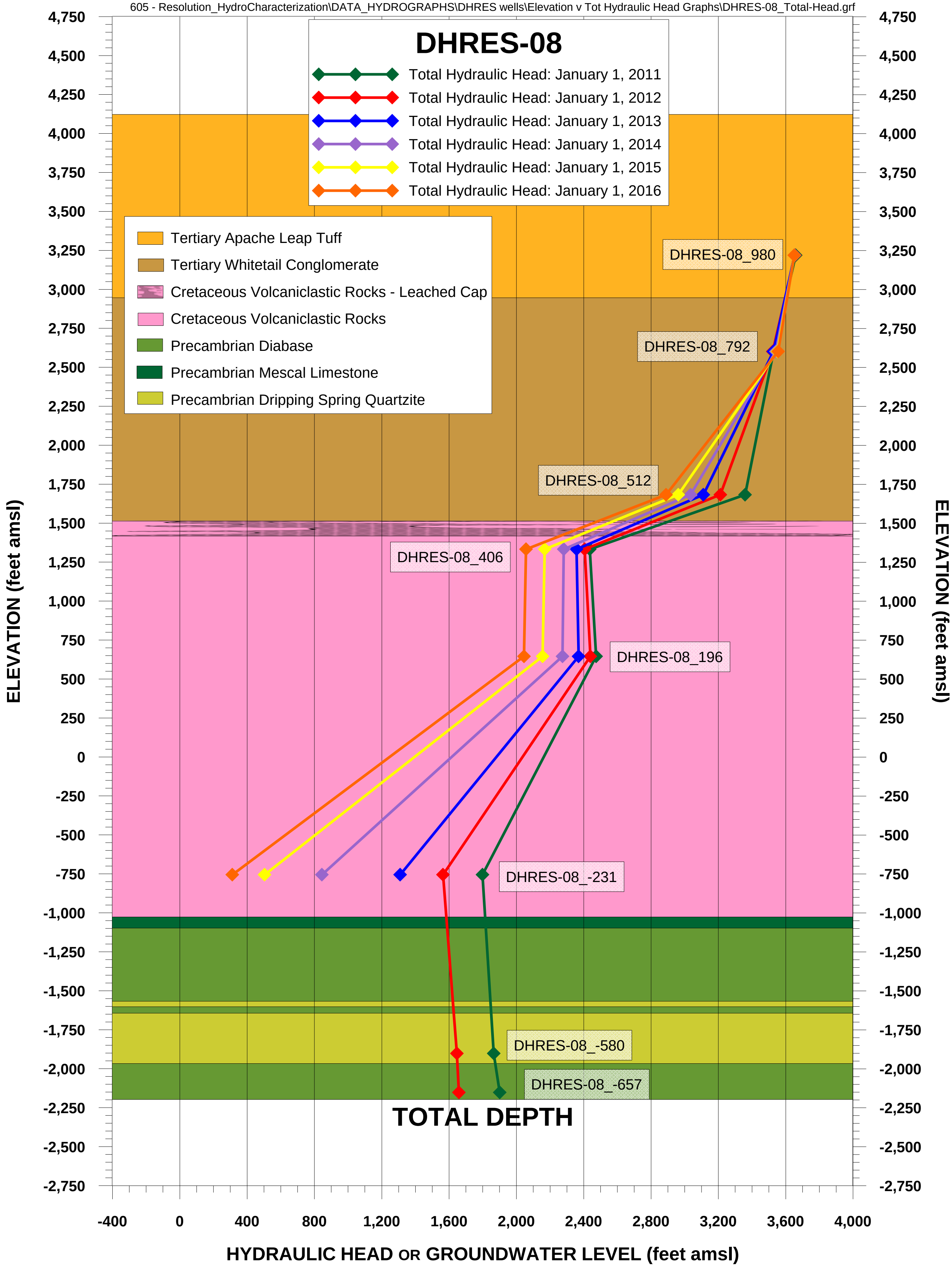
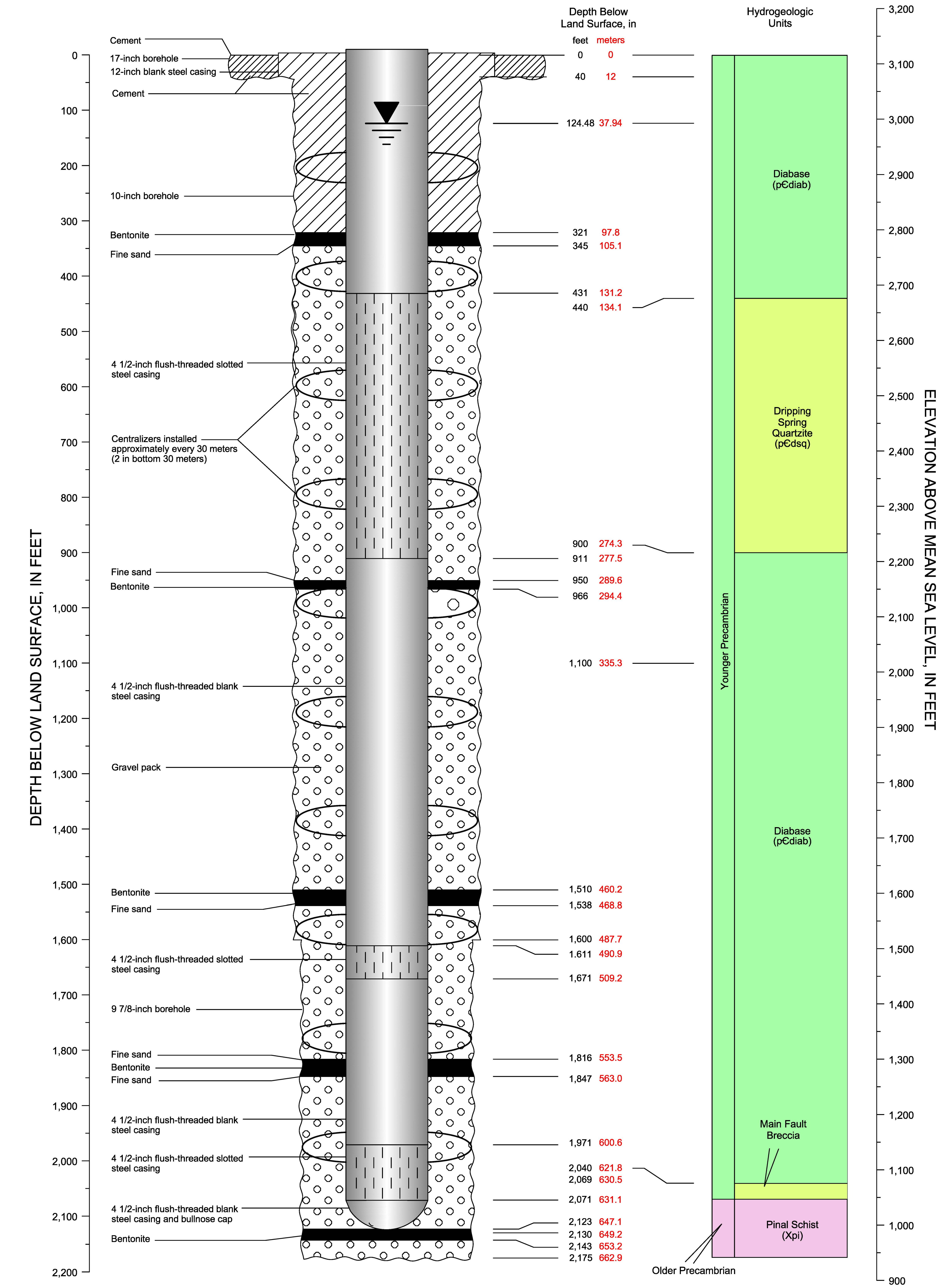


FIGURE B-8d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-08, RESOLUTION PROJECT



CADASTRAL: (D-1-12)26acc	ADWR NO: 55-912289
NORTHING: 841697.19	EASTING: 947570.518
LAND SURFACE ELEVATION: 3115.90 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

Non-pumping Water Level

RESOLUTION COPPER

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DHRES-09
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-9

Drafting\605\WellSchematics_2015\DHRESwells\DHRES09_Feet\26Sept2016

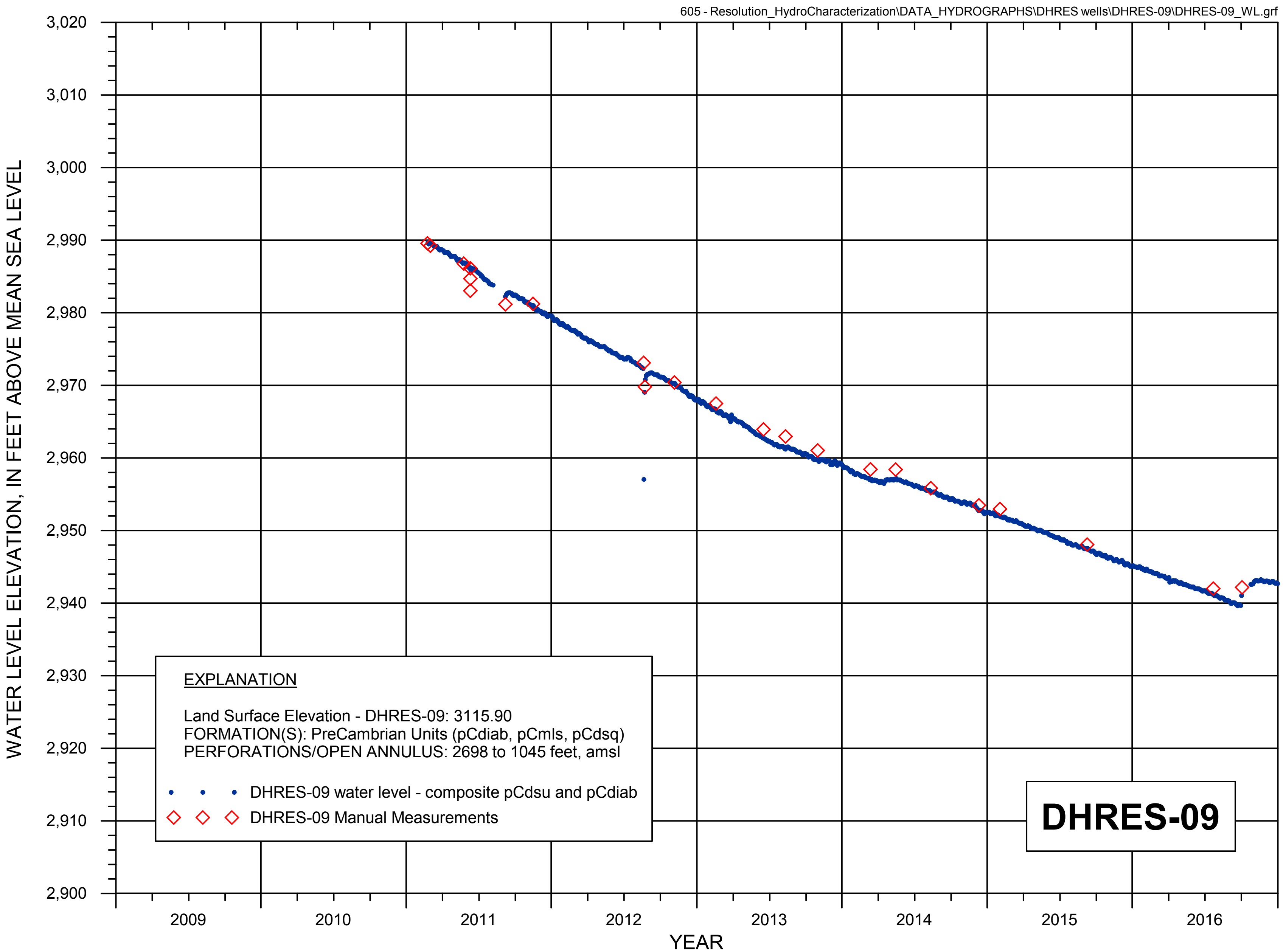

FIGURE B-9a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-09

RESOLUTION COPPER

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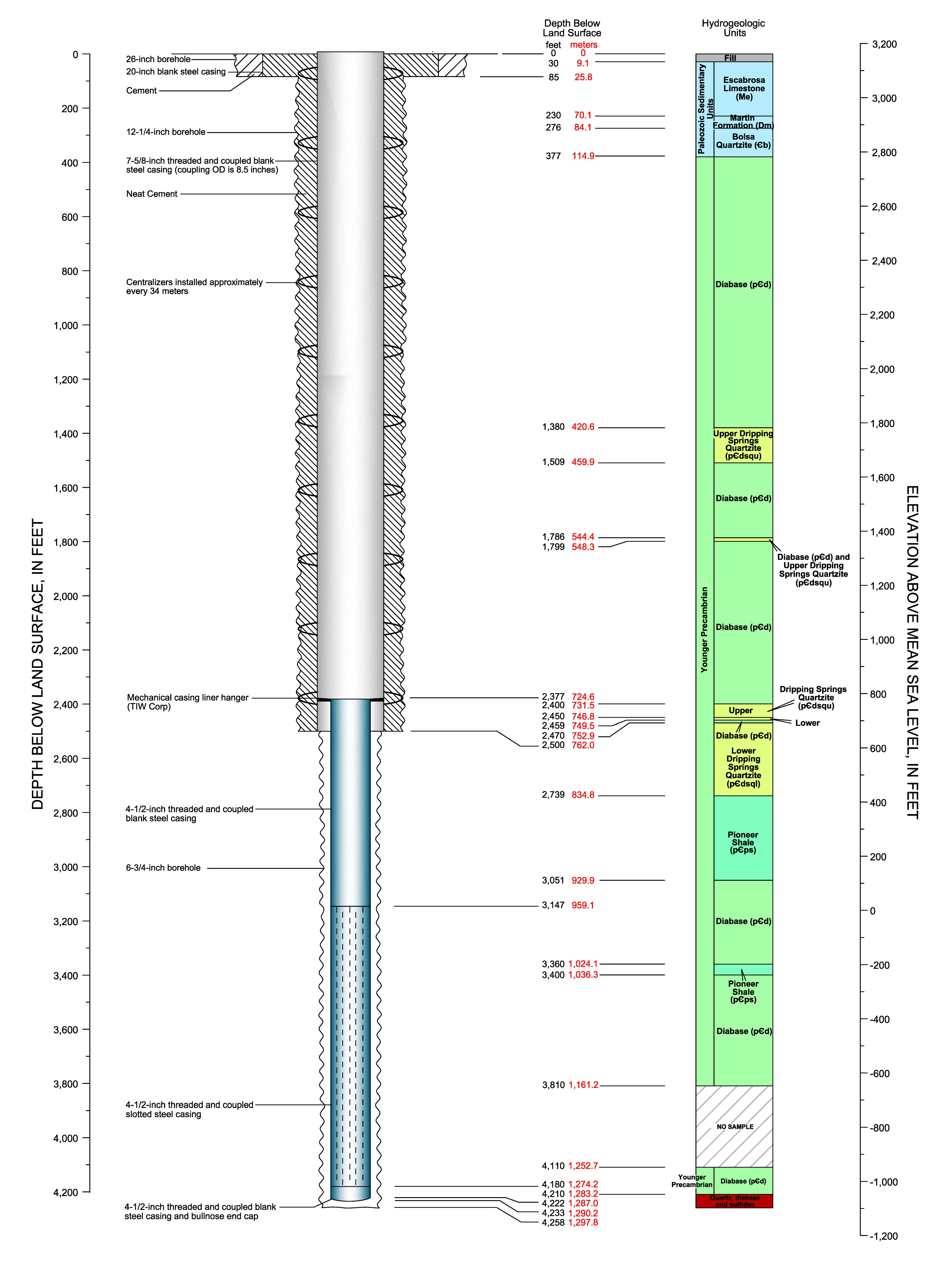

CADASTRAL: (D-1-12)35aac	ADWR NO: 55-912484
NORTHING: 839250.351	EASTING: 950598.911
LAND SURFACE ELEVATION: 3159.25 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

RESOLUTION COPPER

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DHRES-10
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-10

Drafting\605\WellSchematics_2015\DHRESwells\DHRES10_Feet\26Sept2016

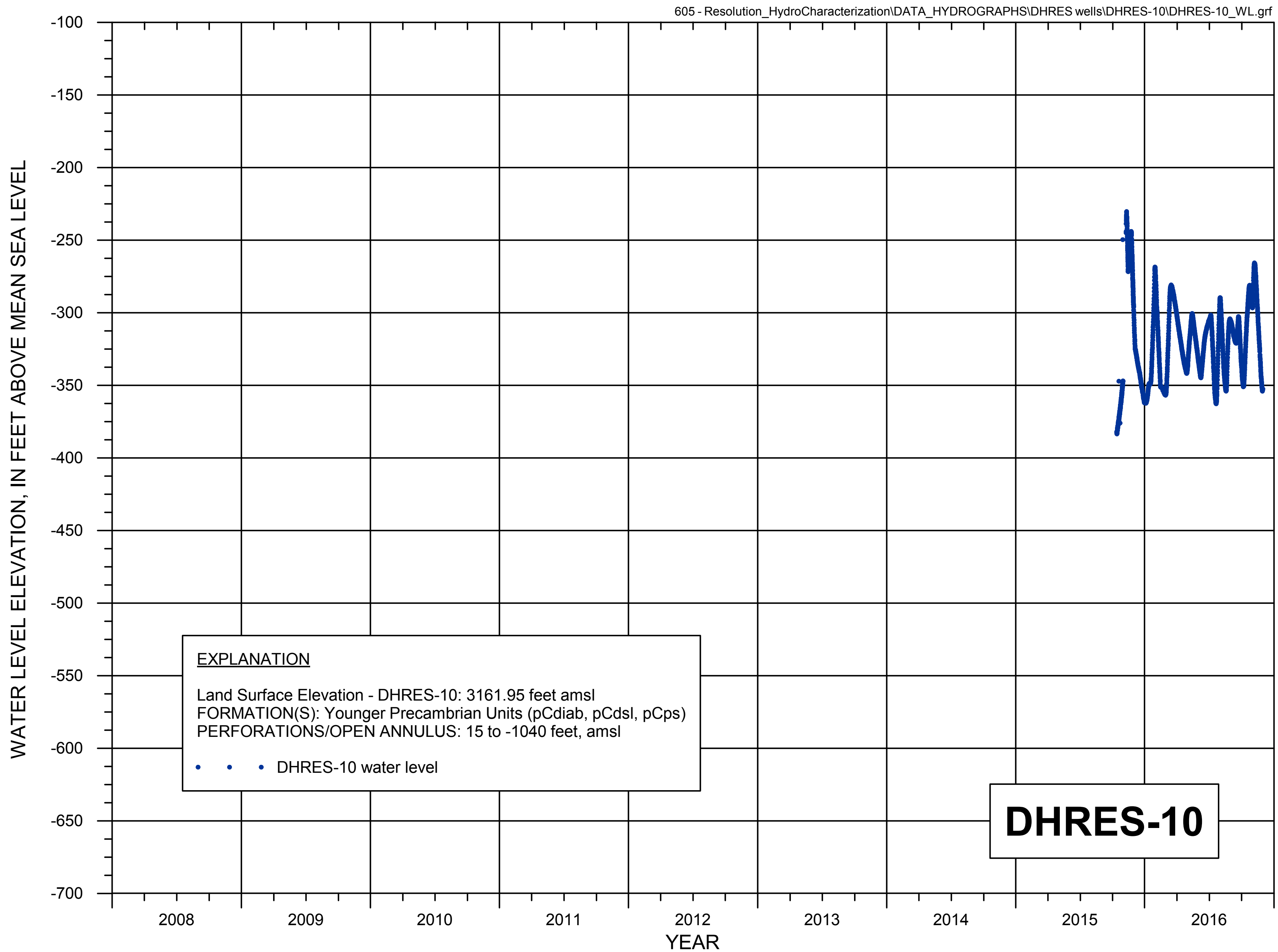
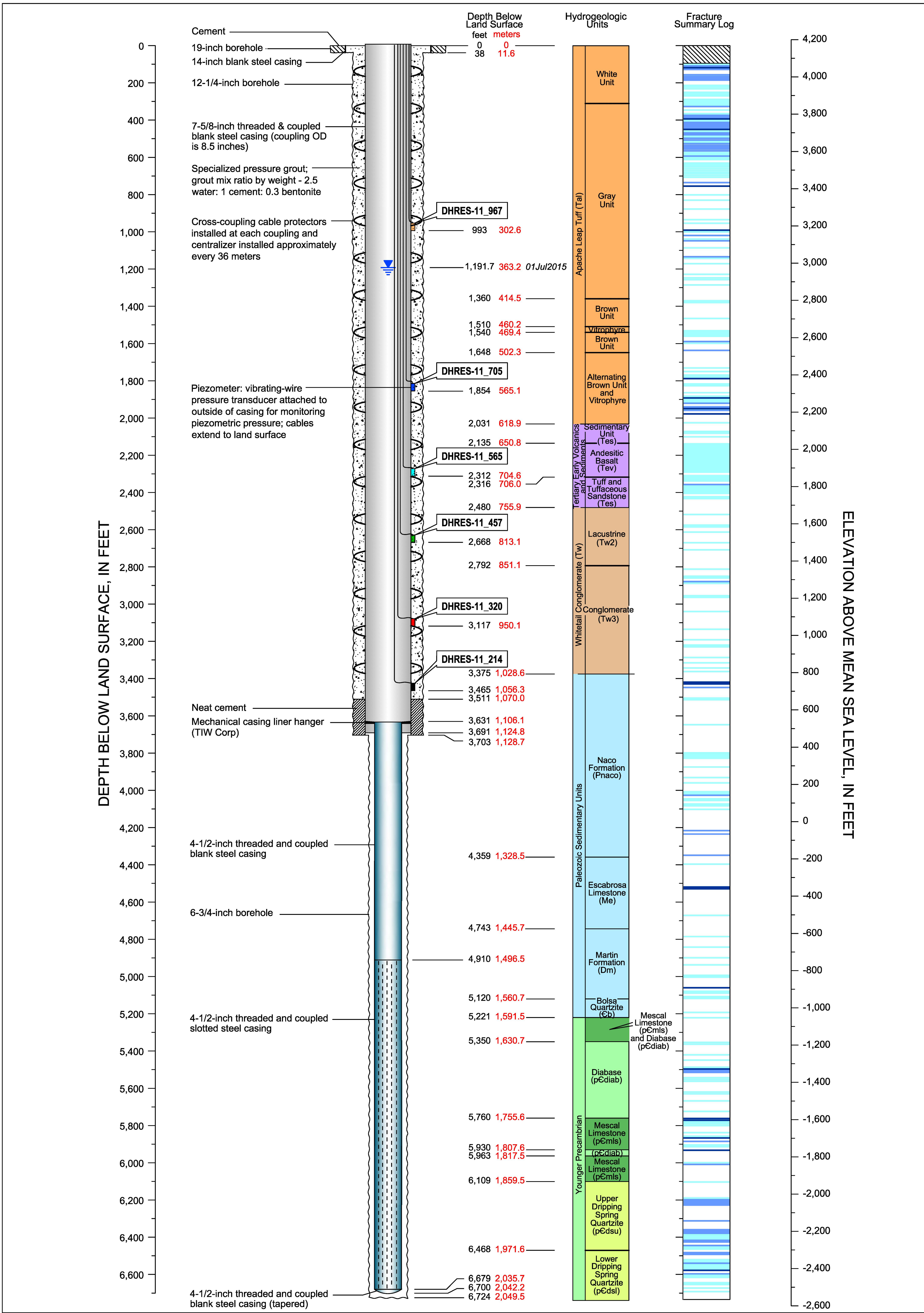


FIGURE B-10a. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-10

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-1-13) 21cbc	ADWR NO: 55-912601
NORTHING: 847171.255	EASTING: 963819.937

LAND SURFACE ELEVATION: 4168.33 FEET AMSL

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level
- DHRES-11_705 — Well Identifier; Piezometer Elevation, in meters amsl

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DHRES-11
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-11

Drafting\605\WellSchematics_2015\DHRESwells\DHRES11_Feet\26Sept2016

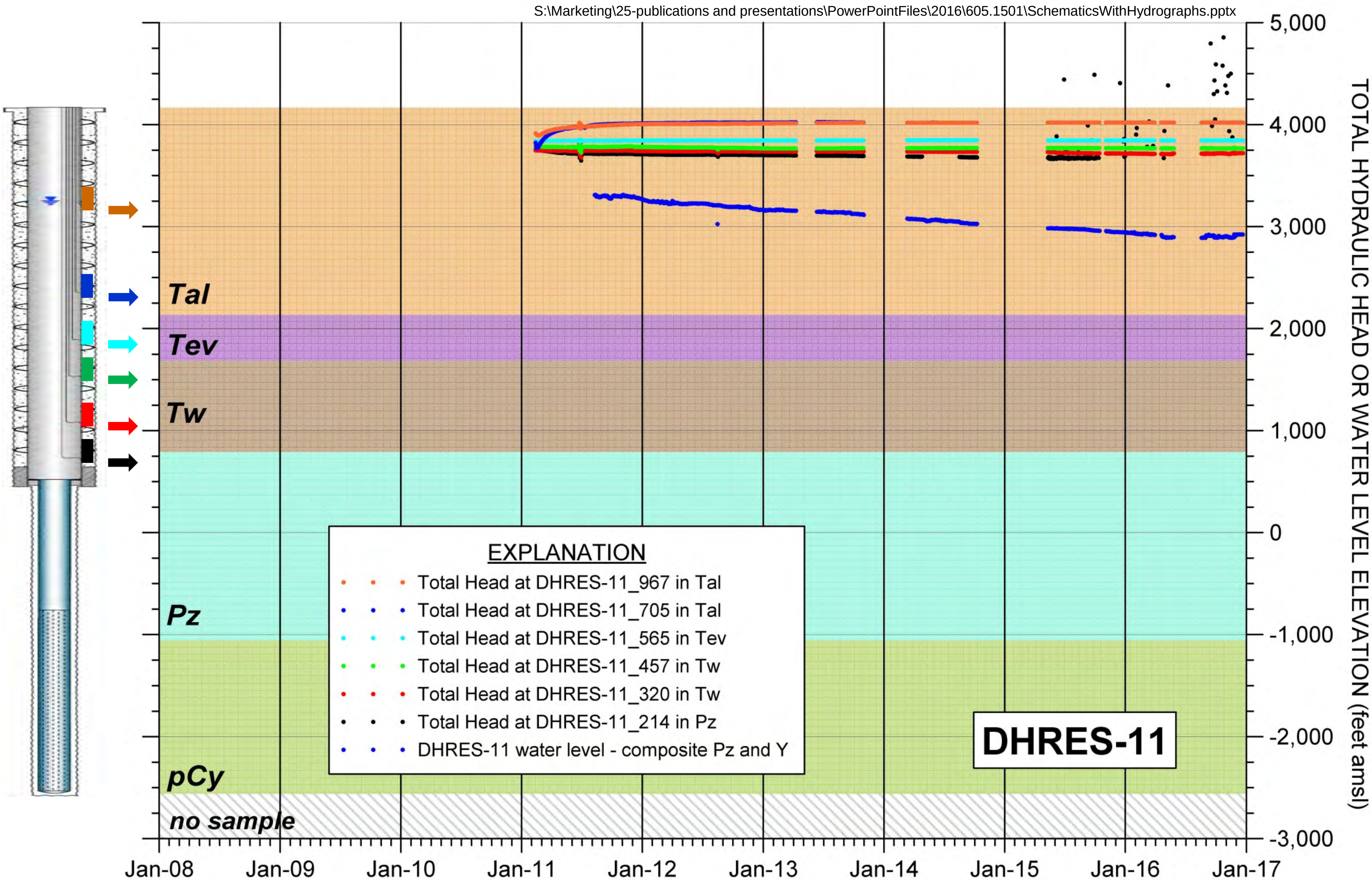

FIGURE B-11a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-11

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

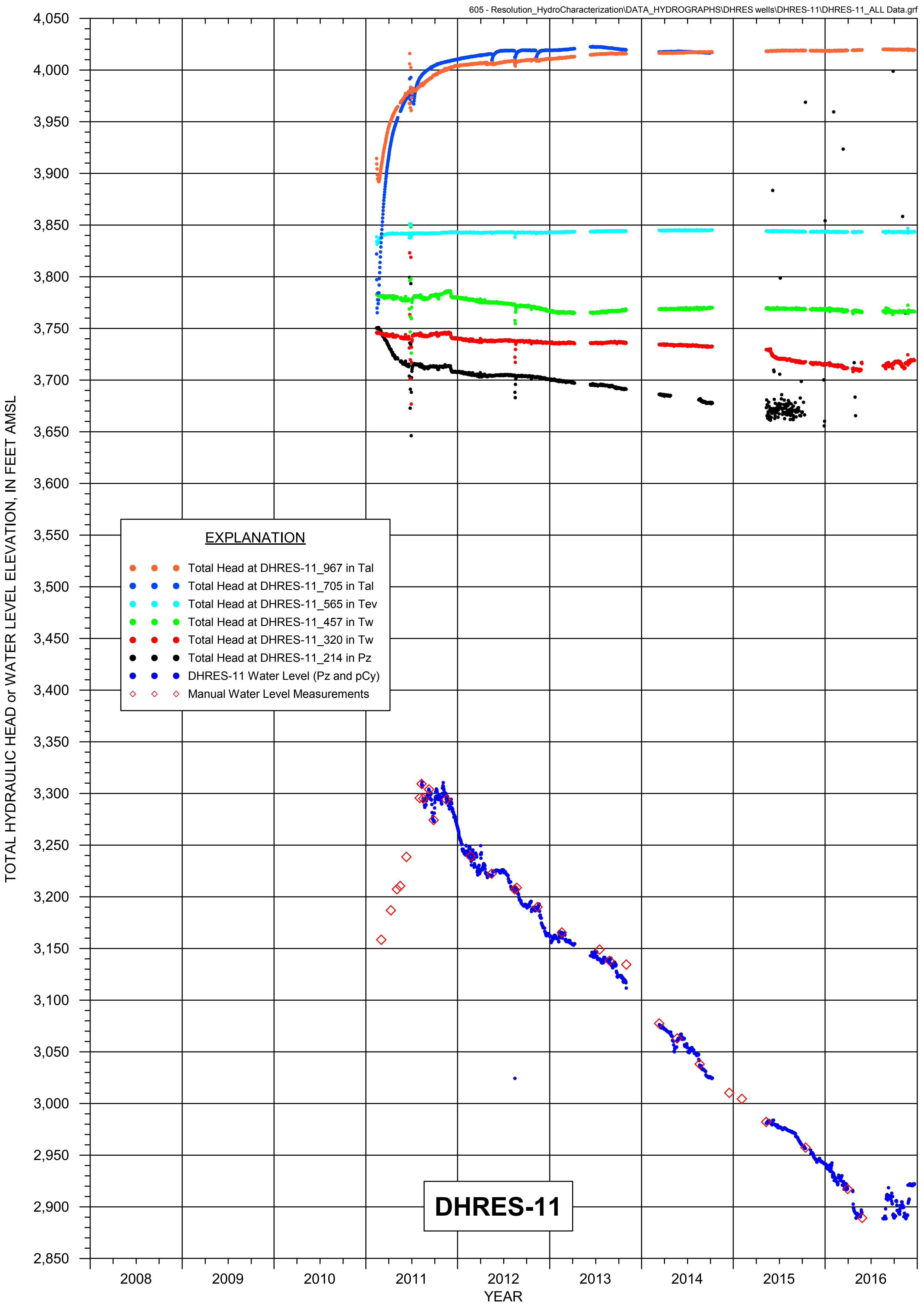

FIGURE B-11b. HYDROGRAPH OF WATER LEVEL, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-11

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

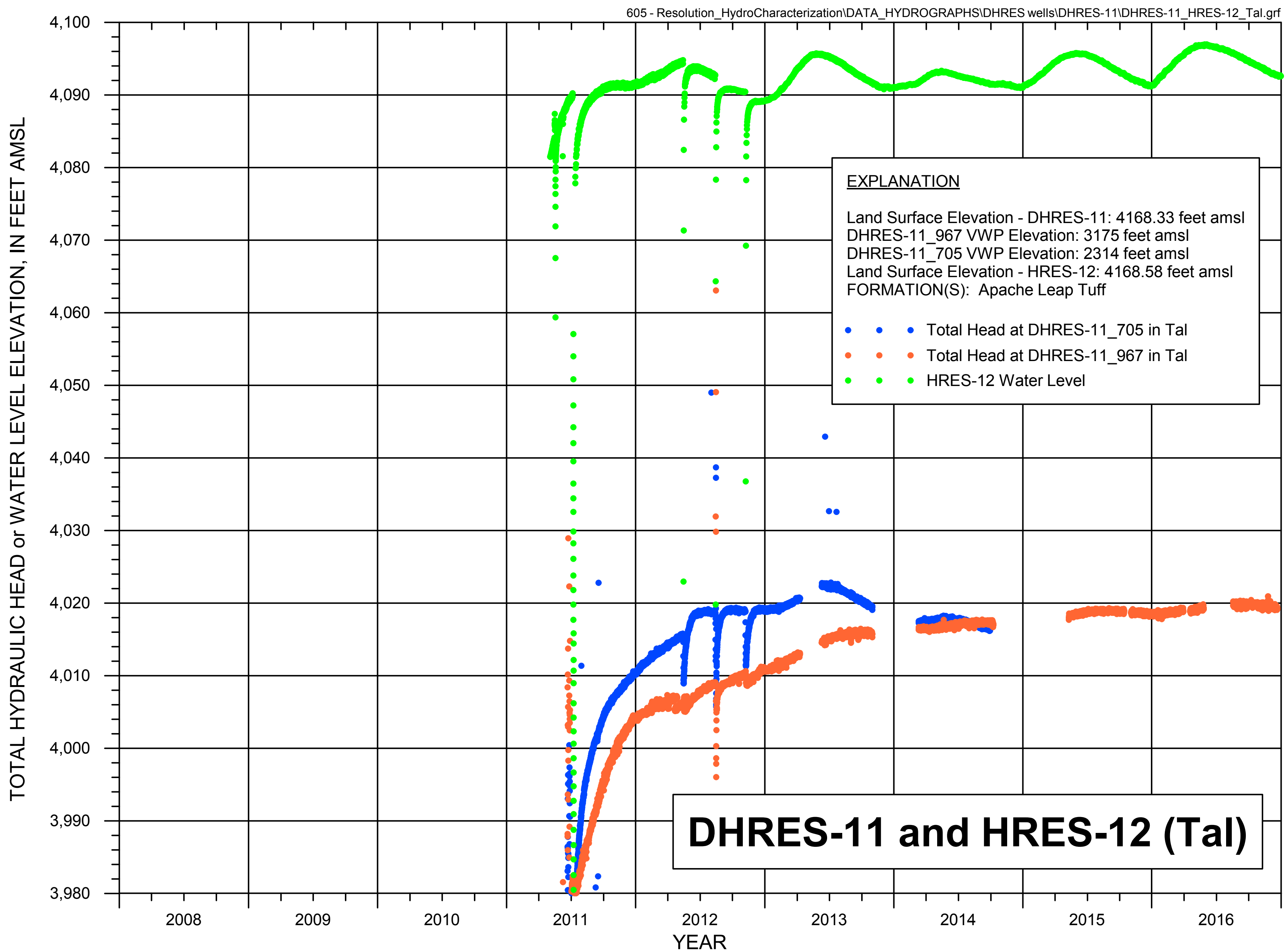

FIGURE B-11c. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL HRES-12, AND HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS DHRES-11_967 AND DHRES-11_705

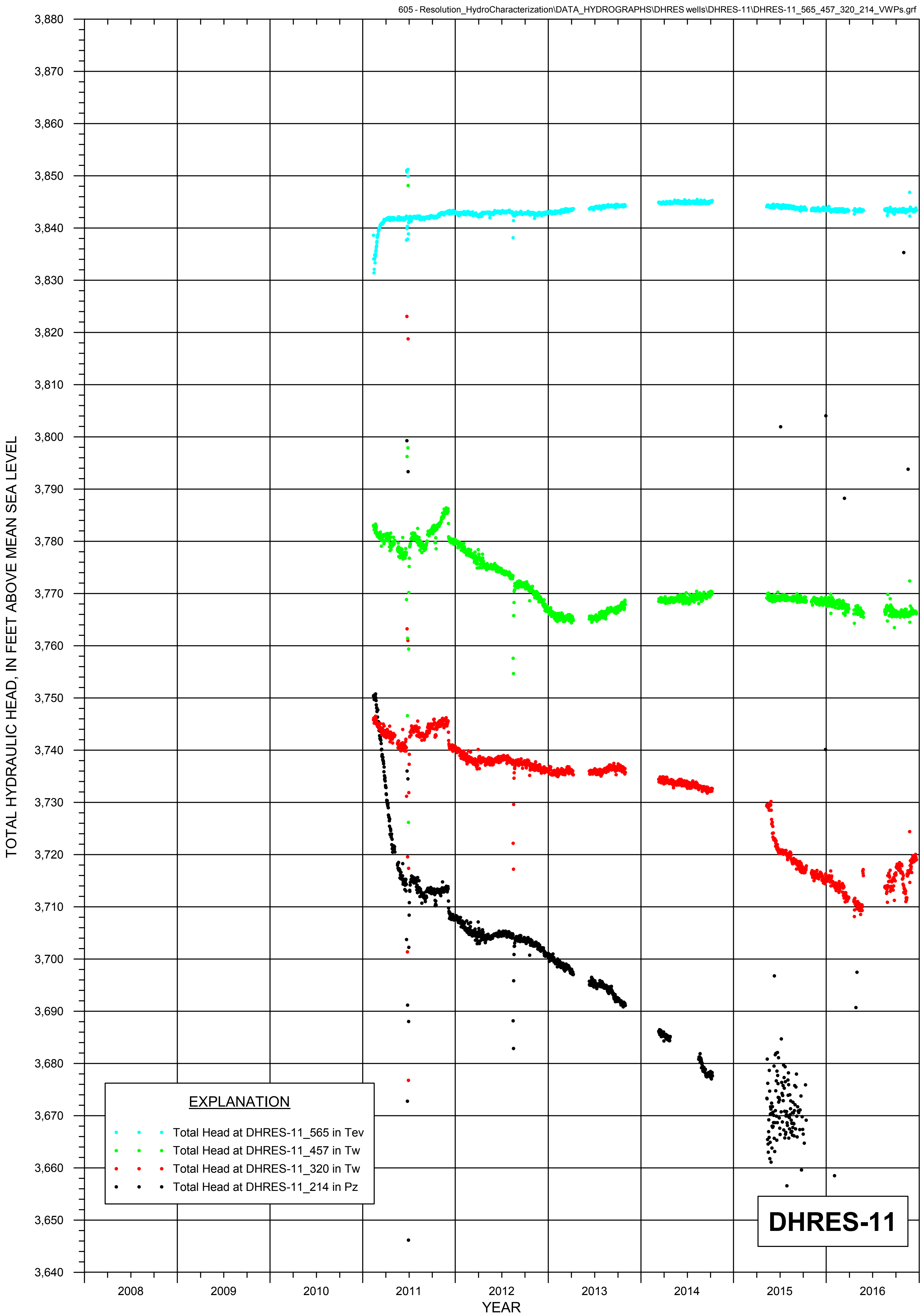

FIGURE B-11d. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS DHRES-11_565, 457, 320, AND 214 AT HYDROLOGIC TEST WELL DHRES-11

RESOLUTION COPPER

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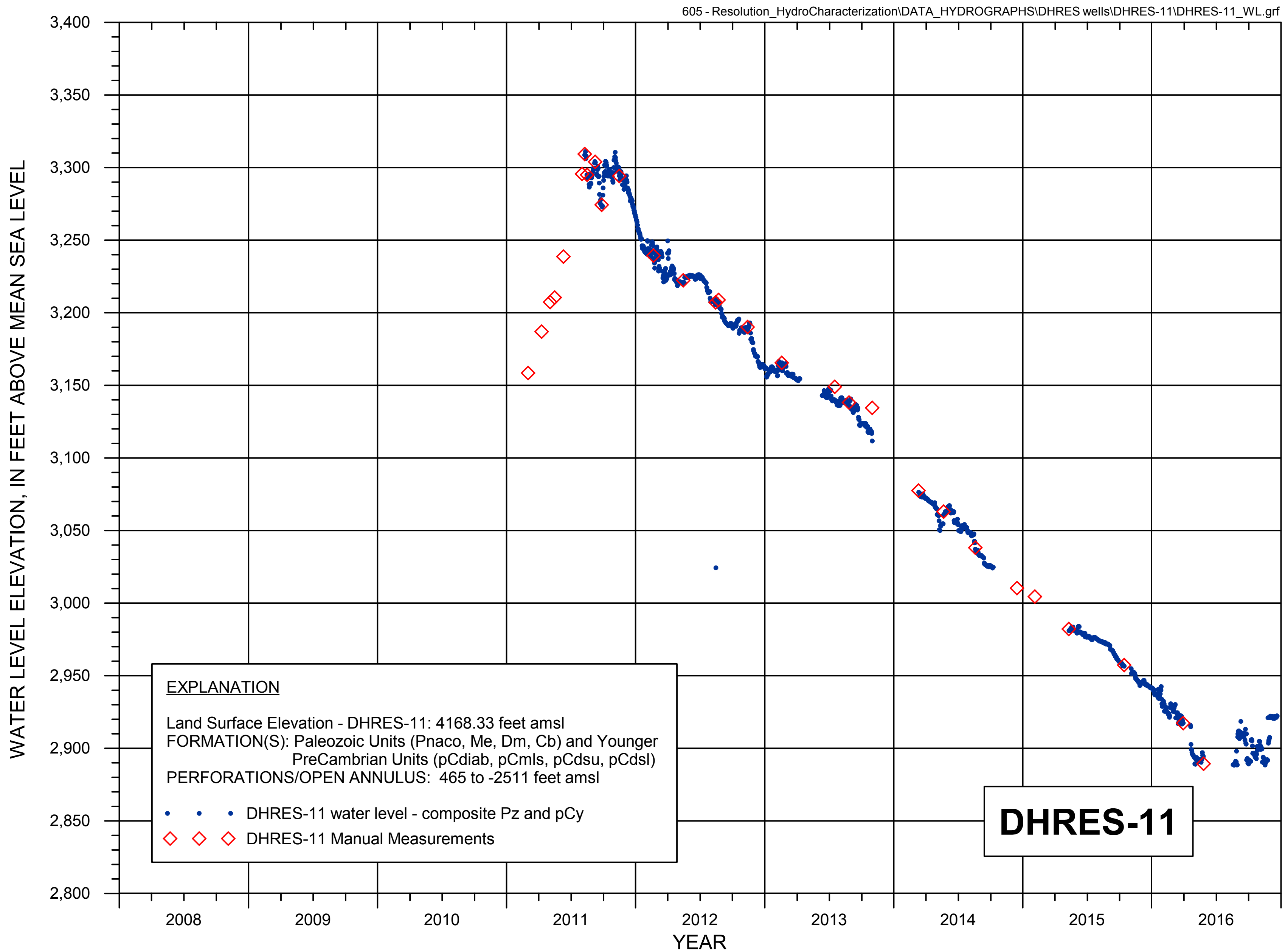

FIGURE B-11e. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-11

RESOLUTION COPPER

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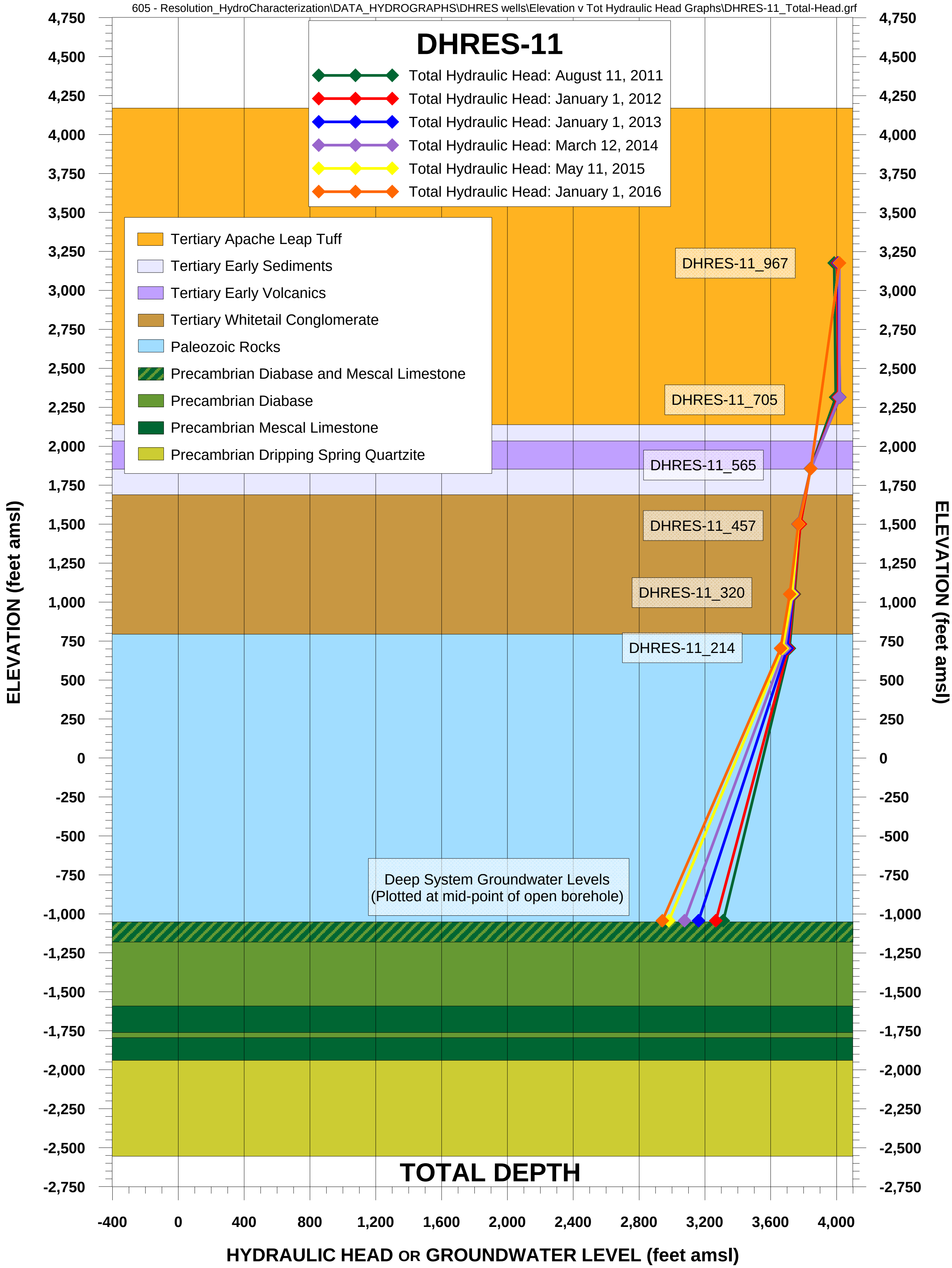
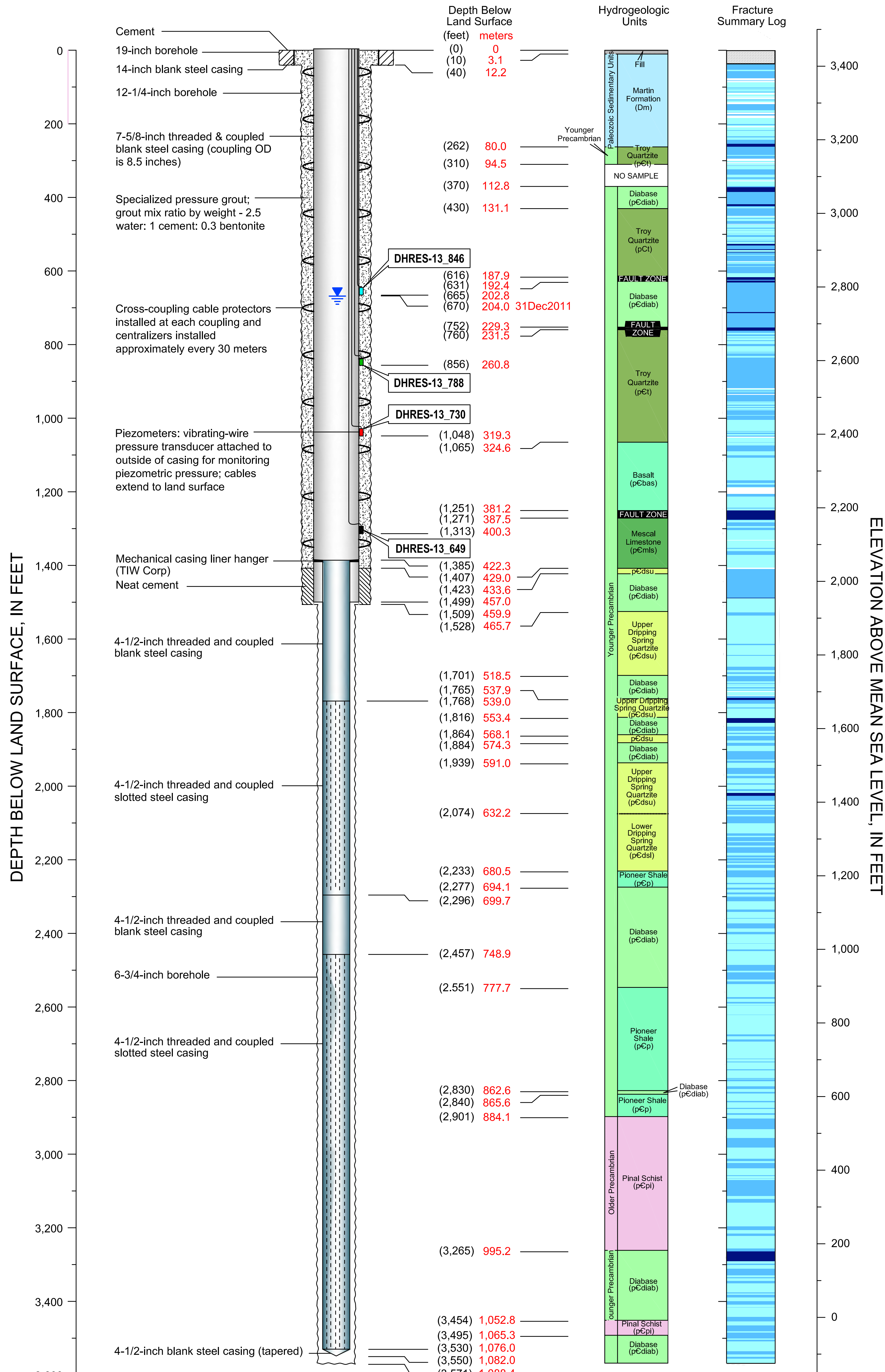


FIGURE B-11f. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-11, RESOLUTION PROJECT

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-2-12) 02dba	ADWR NO: 55-912770
NORTHING: 832219.347	EASTING: 954075.423
LAND SURFACE ELEVATION: 3443.33 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

EXPLANATION
- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level
- DHRES-13_846: Well Identifier, Piezometer Elevation, in meters amsl

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DHRES-13
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-12

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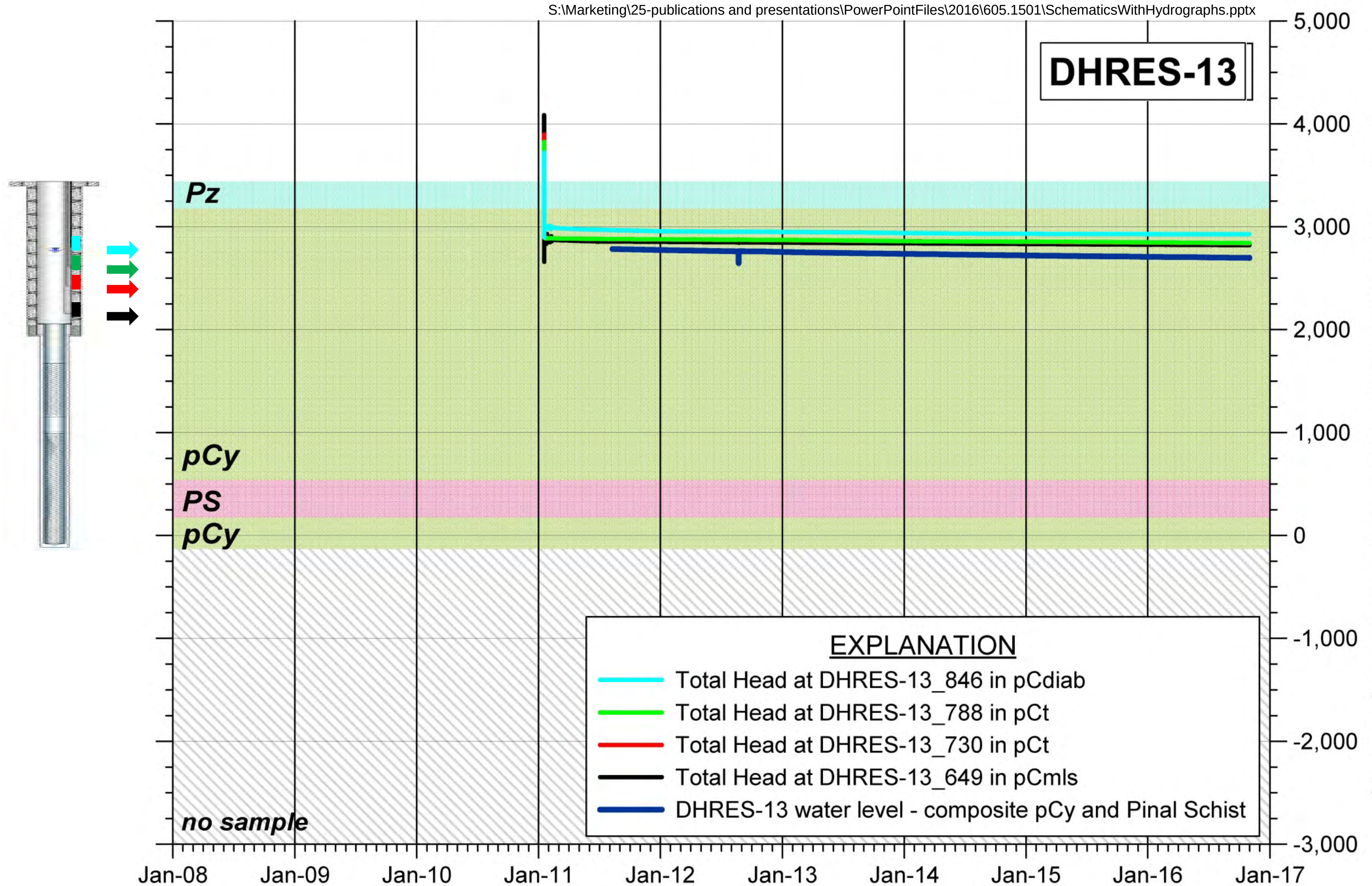

FIGURE B-12a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-13

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

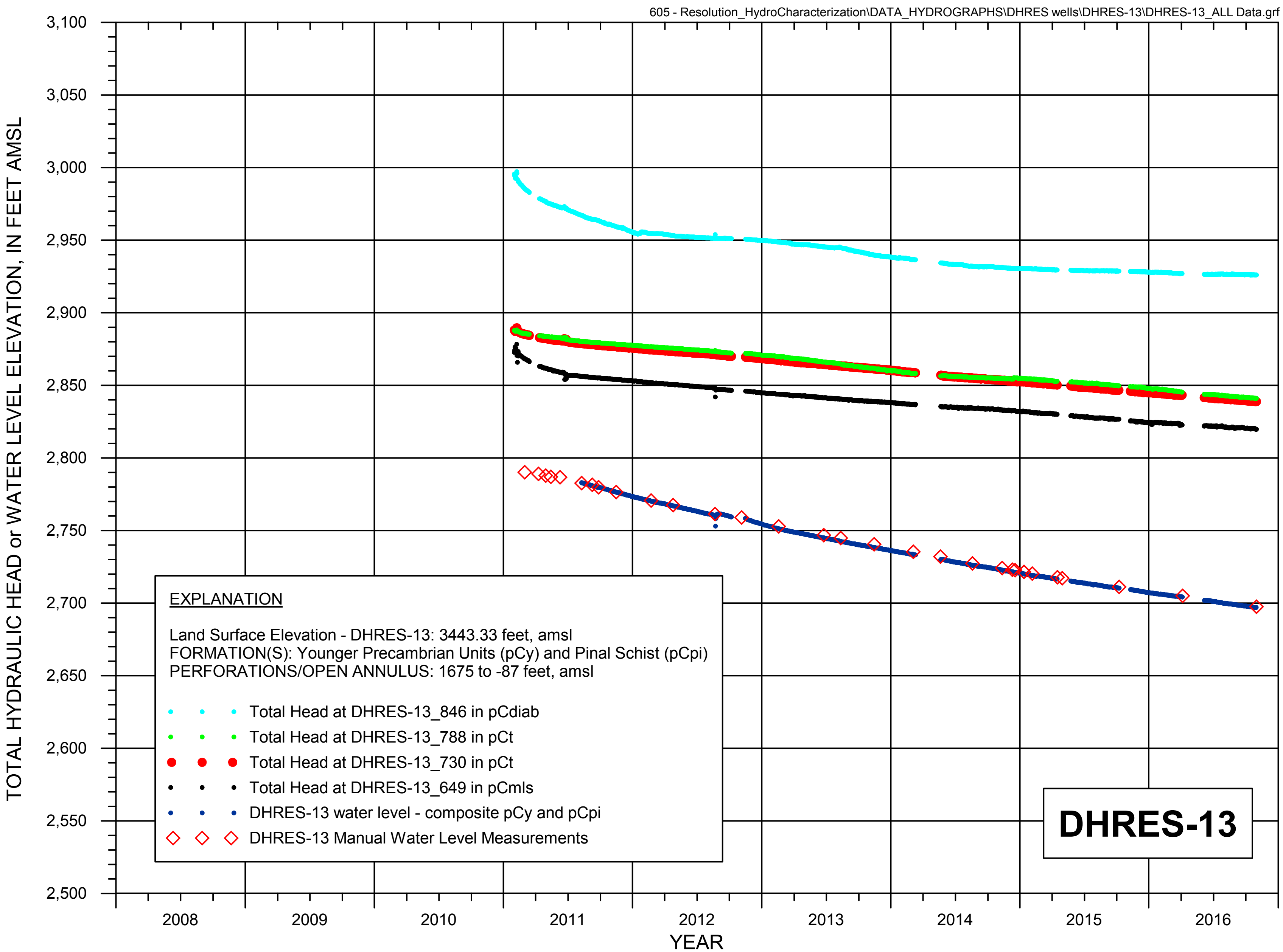

FIGURE B-12b. WATER LEVEL HYDROGRAPH, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-13

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

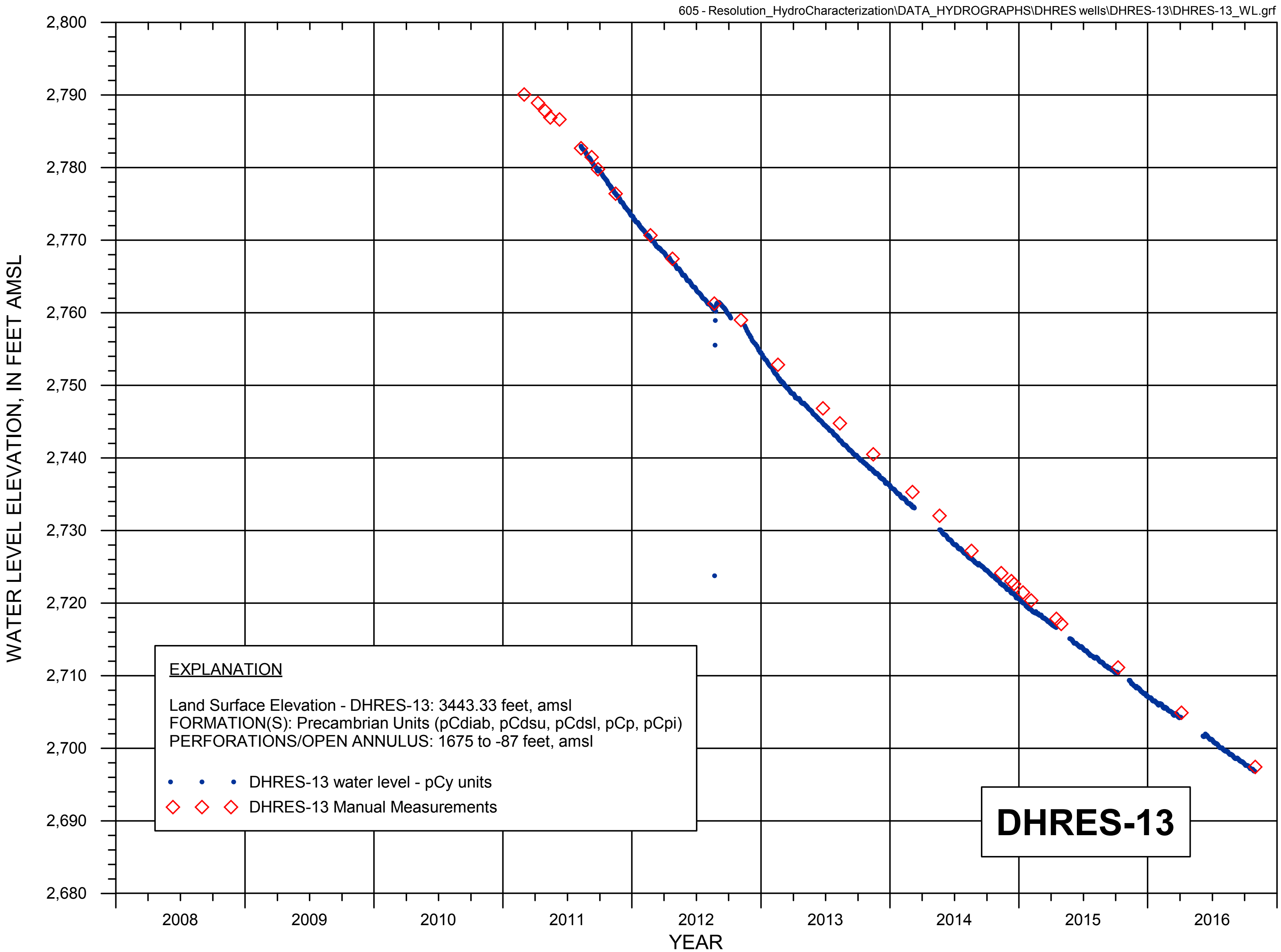

FIGURE B-12c. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-13

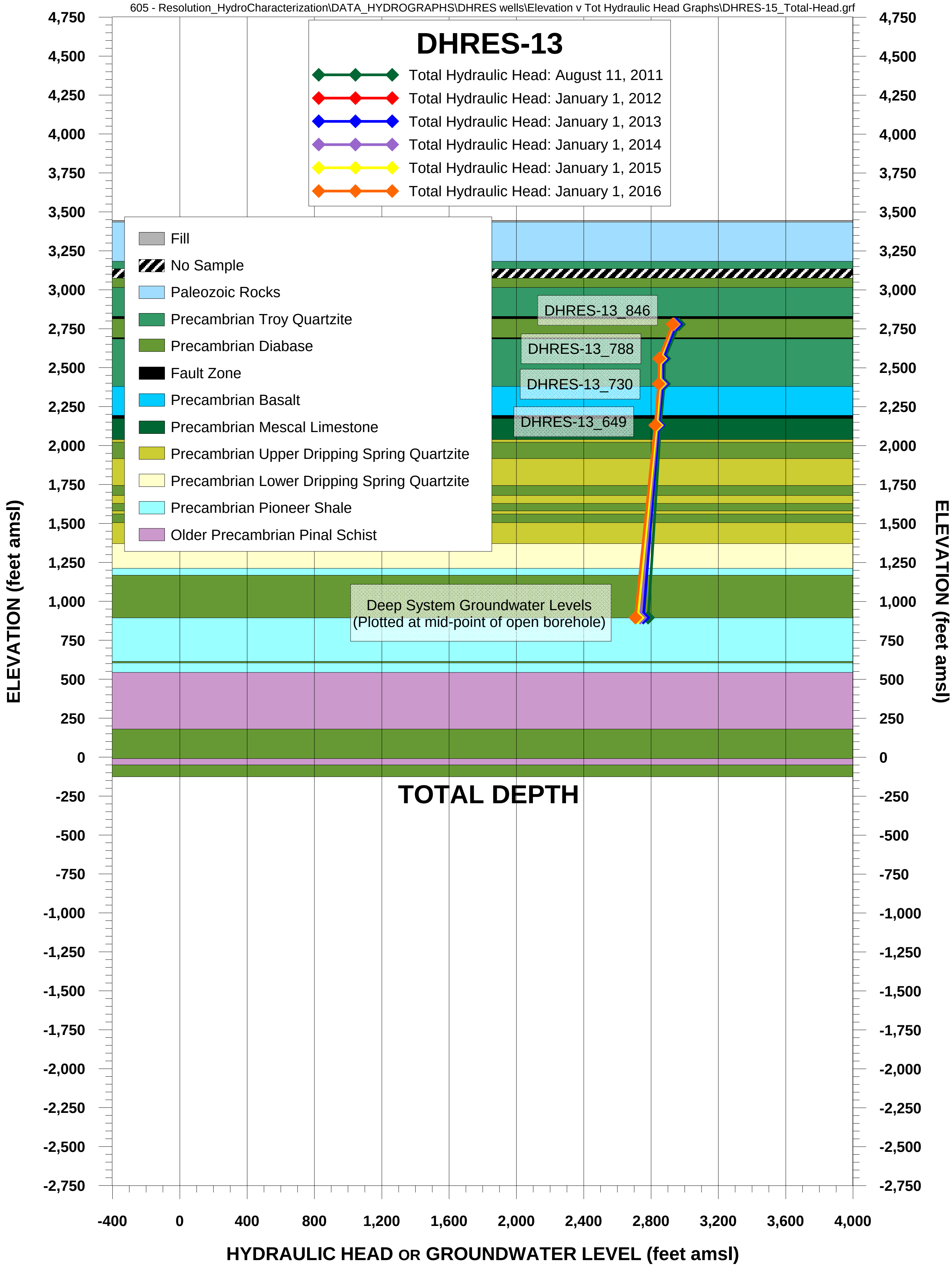

FIGURE B-12d. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-13, RESOLUTION PROJECT

RESOLUTION COPPER

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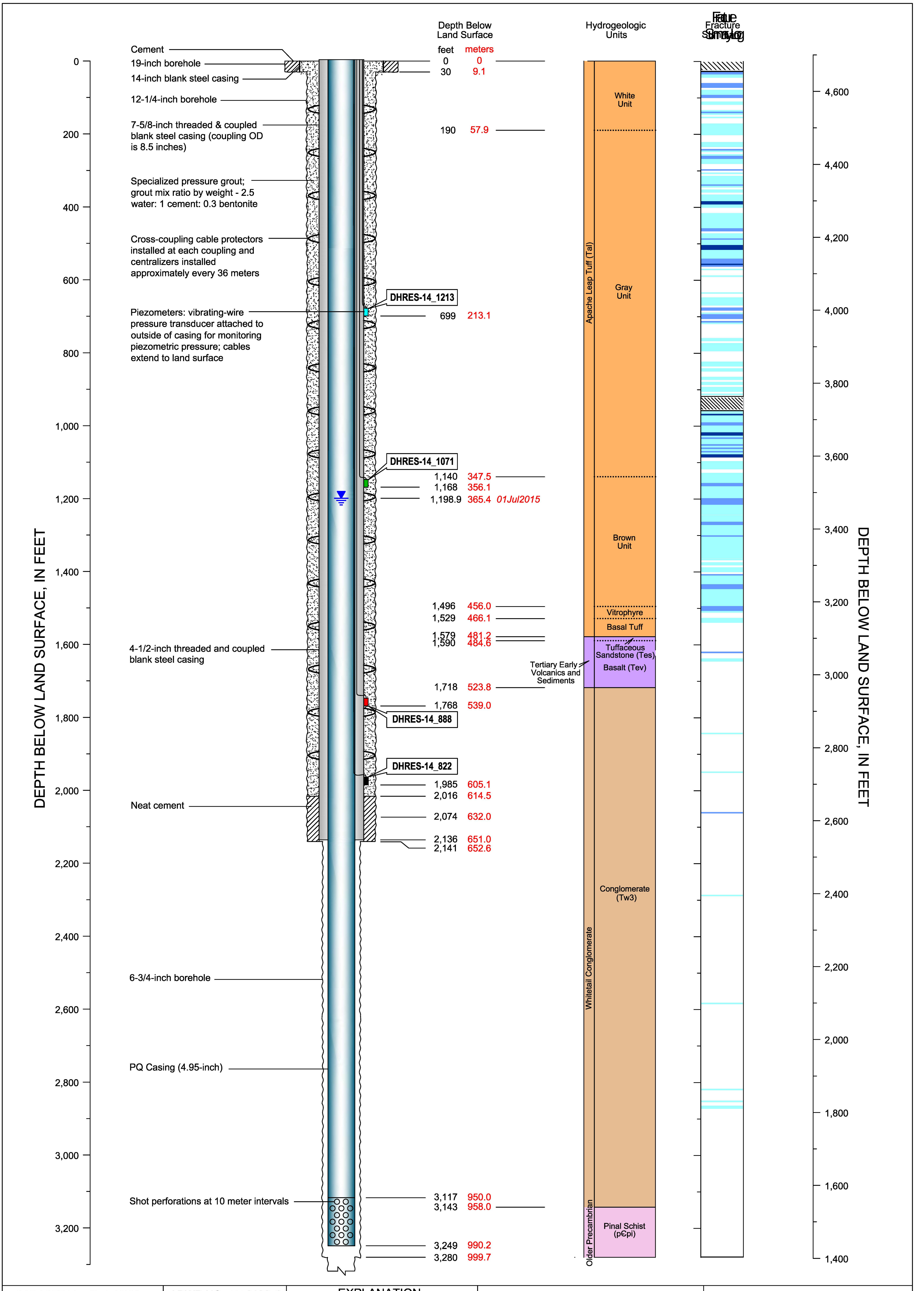

CADASTRAL: (D-1-13)28ccc	ADWR NO: 55-913073
NORTHING: 840819.297	EASTING: 974466.978
LAND SURFACE ELEVATION: 4682.98 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-pumping Water Level
- DHRES-14_1213 — Well Identifier; Piezometer Elevation, in meters amsl

RESOLUTION COPPER

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DHRES-14
DIAGRAM OF WELL CONSTRUCTION

Version: October 2015

FIGURE B-13

Drafting\605\WellSchematics_2015\DHRESwells\DHRES14_Feet\26Sept2016

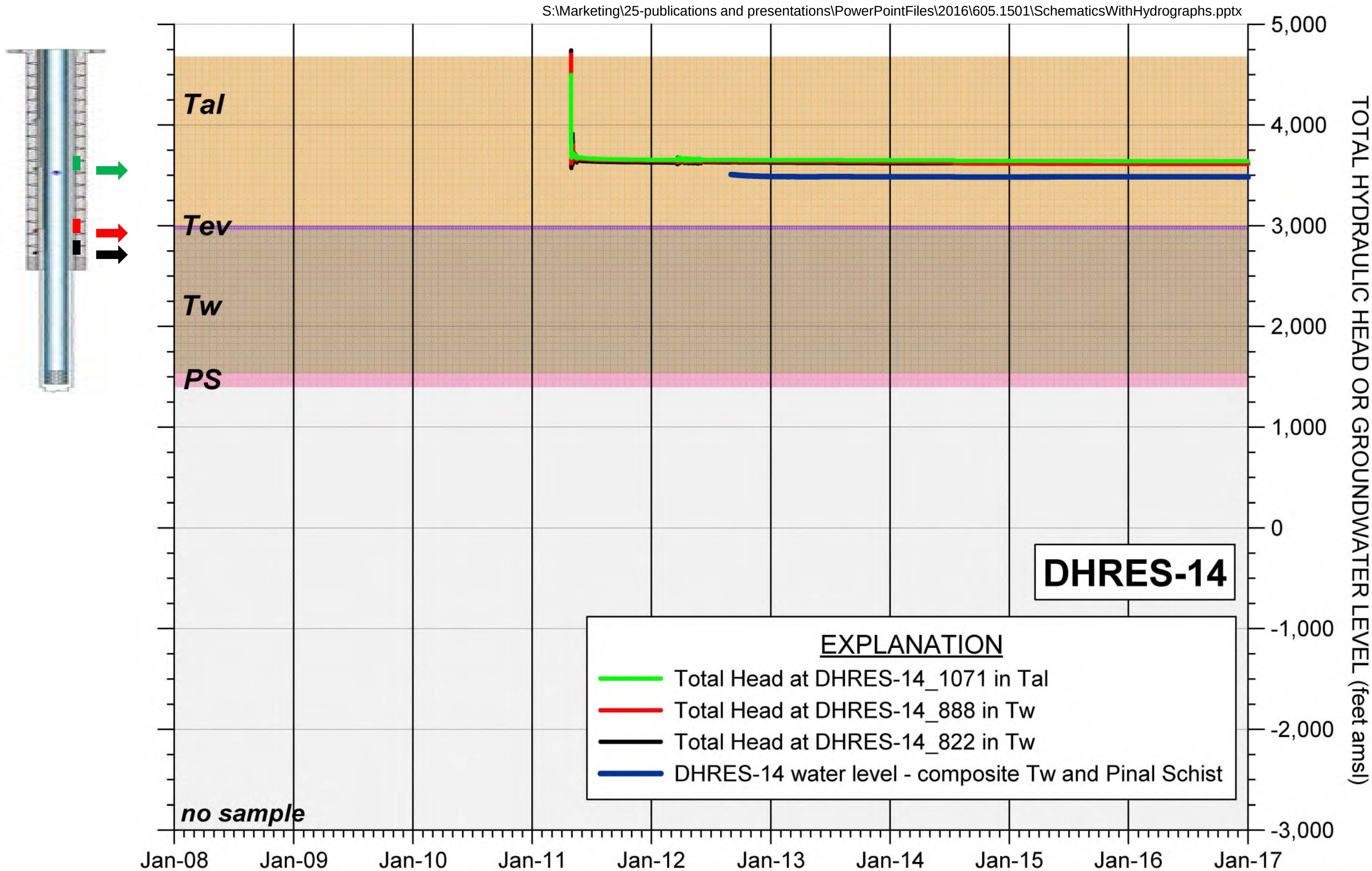

FIGURE B-13a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-14

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

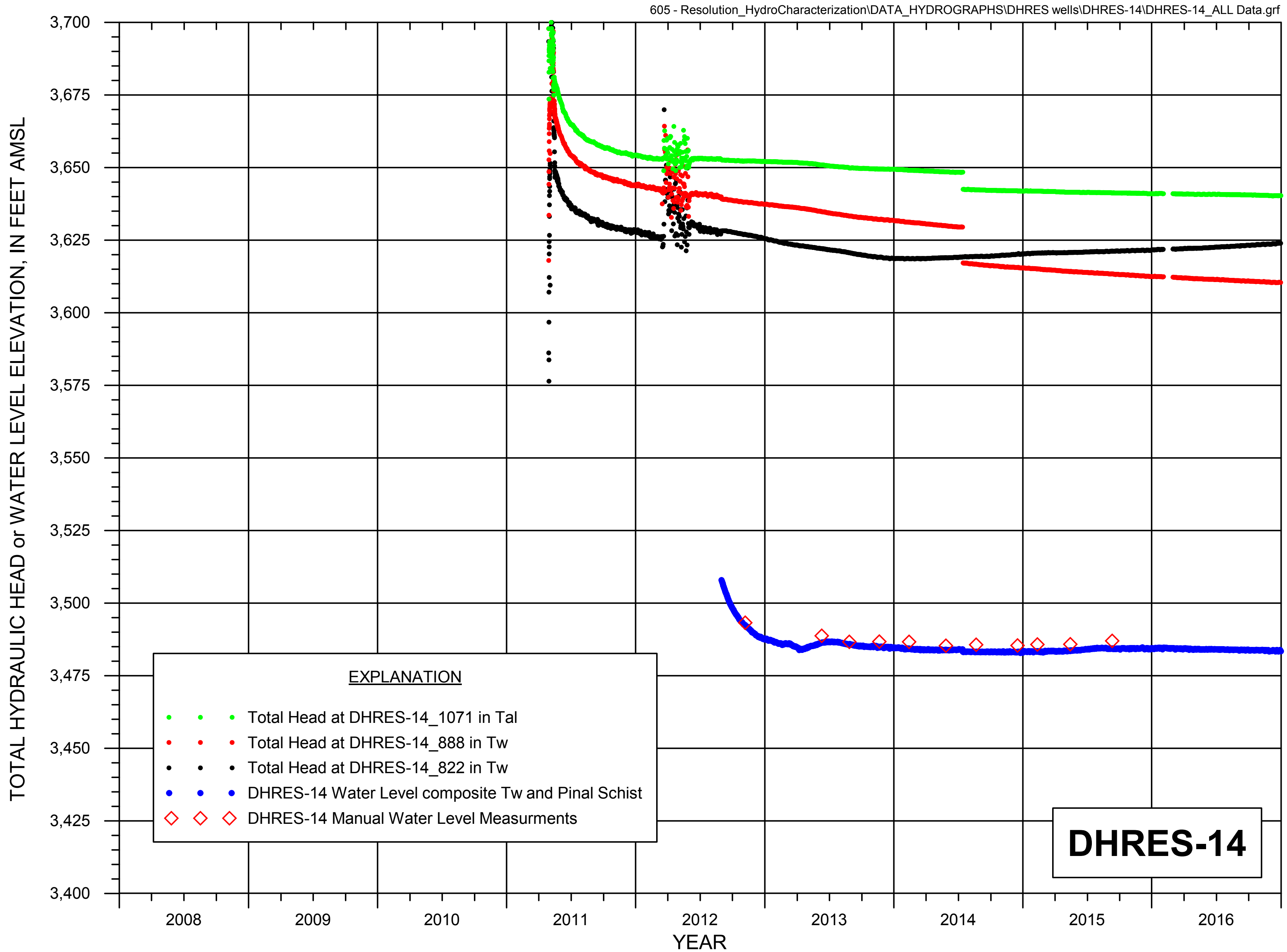

FIGURE B-13b. WATER LEVEL HYDROGRAPH, AND TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-14

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

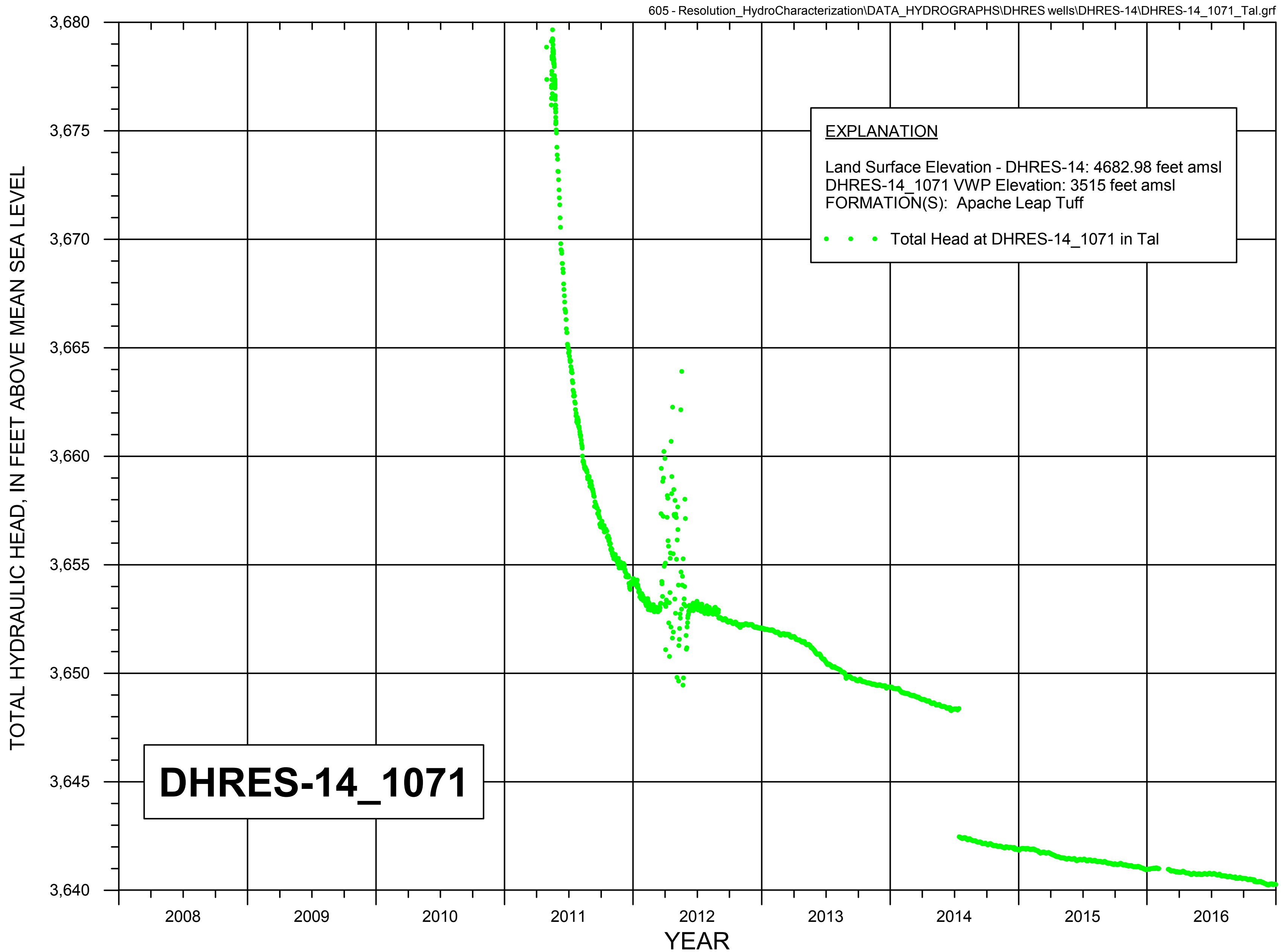

FIGURE B-13c. TOTAL HYDRAULIC HEAD HYDROGRAPH FOR GROUTED PIEZOMETER DHRES-14_1071, APACHE LEAP TUFF

RESOLUTION COPPER

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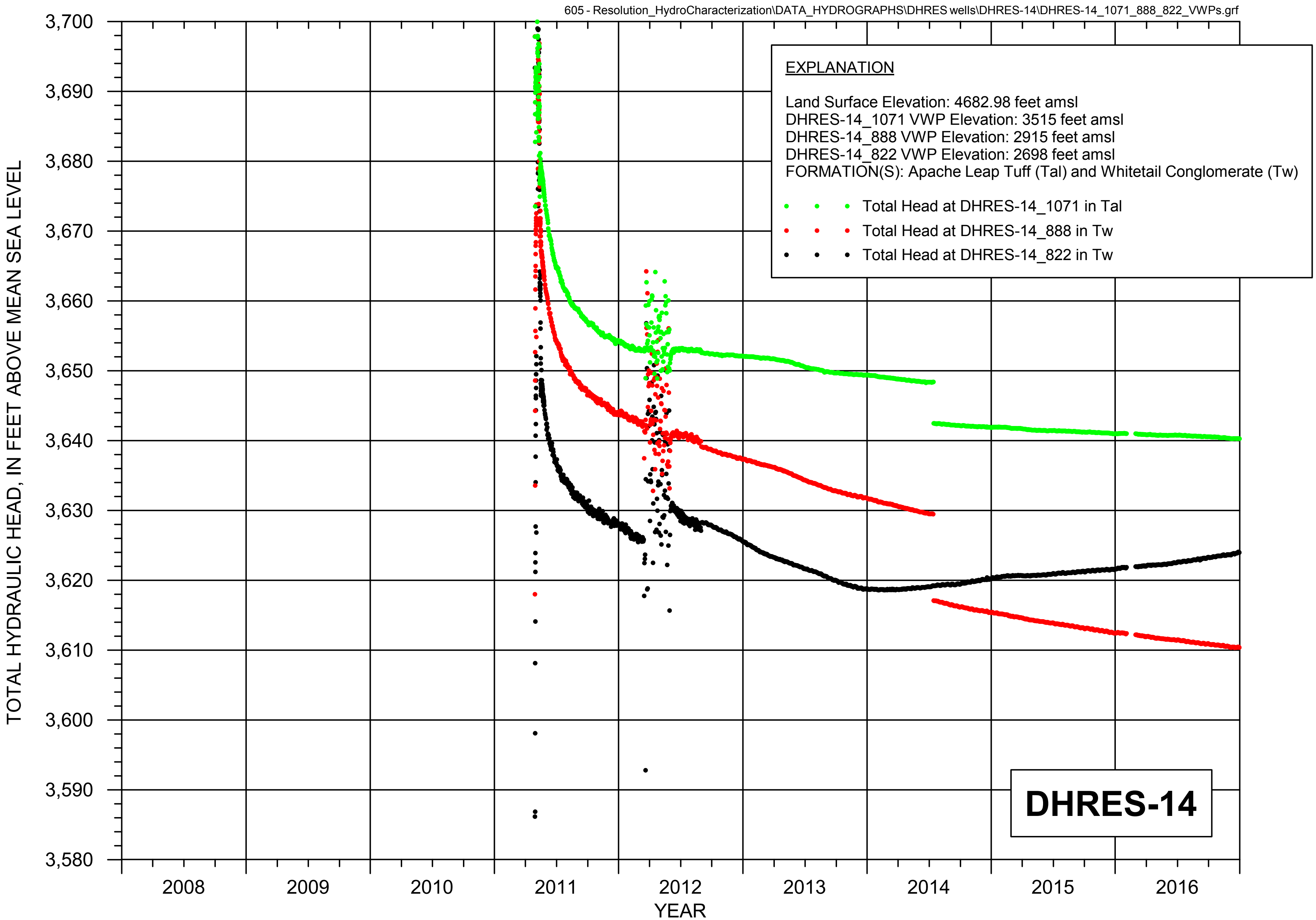


FIGURE B-13d. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-14

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

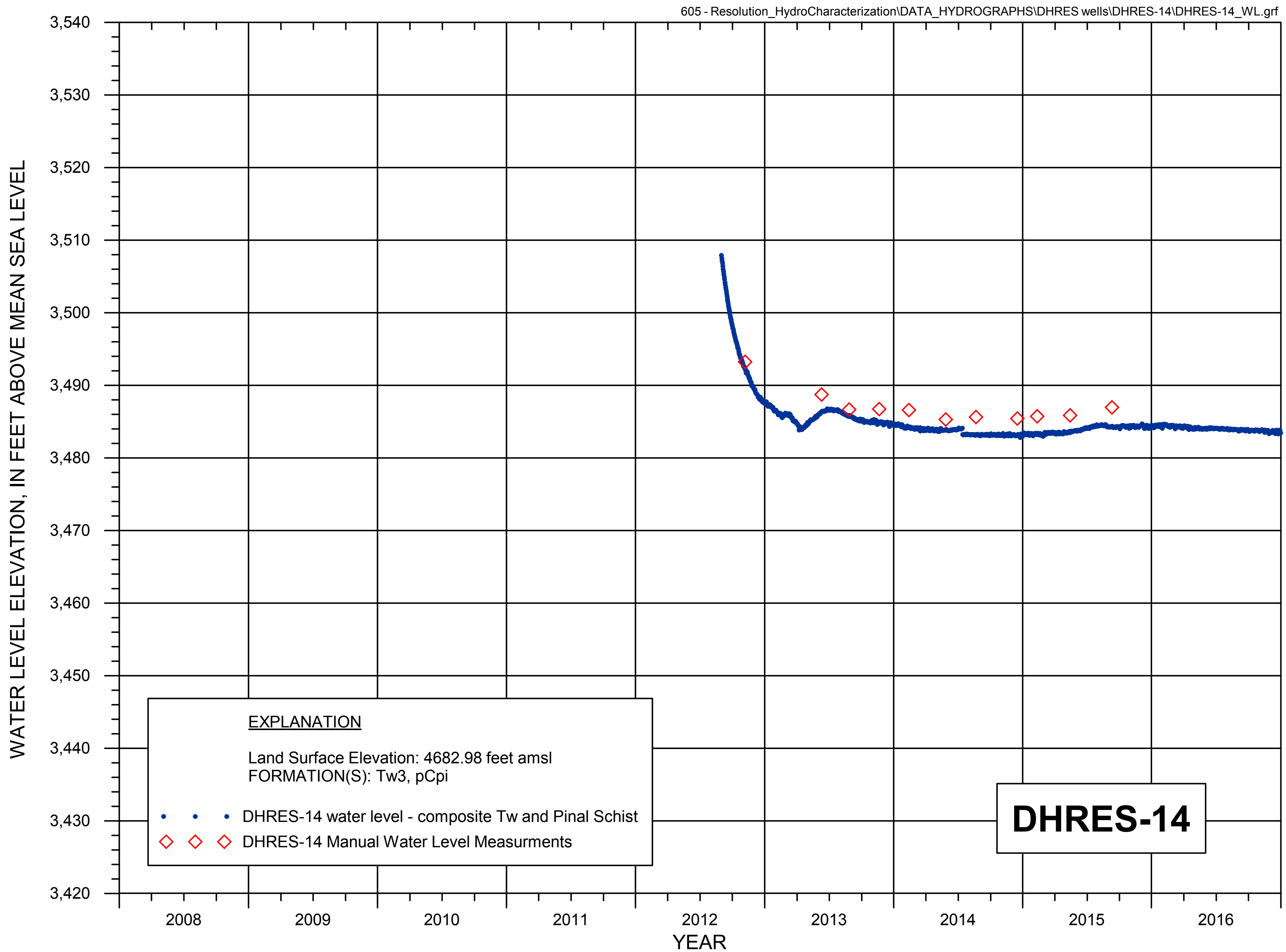


FIGURE B-13e. WATER LEVEL HYDROGRAPH FOR HYDROLOGIC TEST WELL DHRES-14

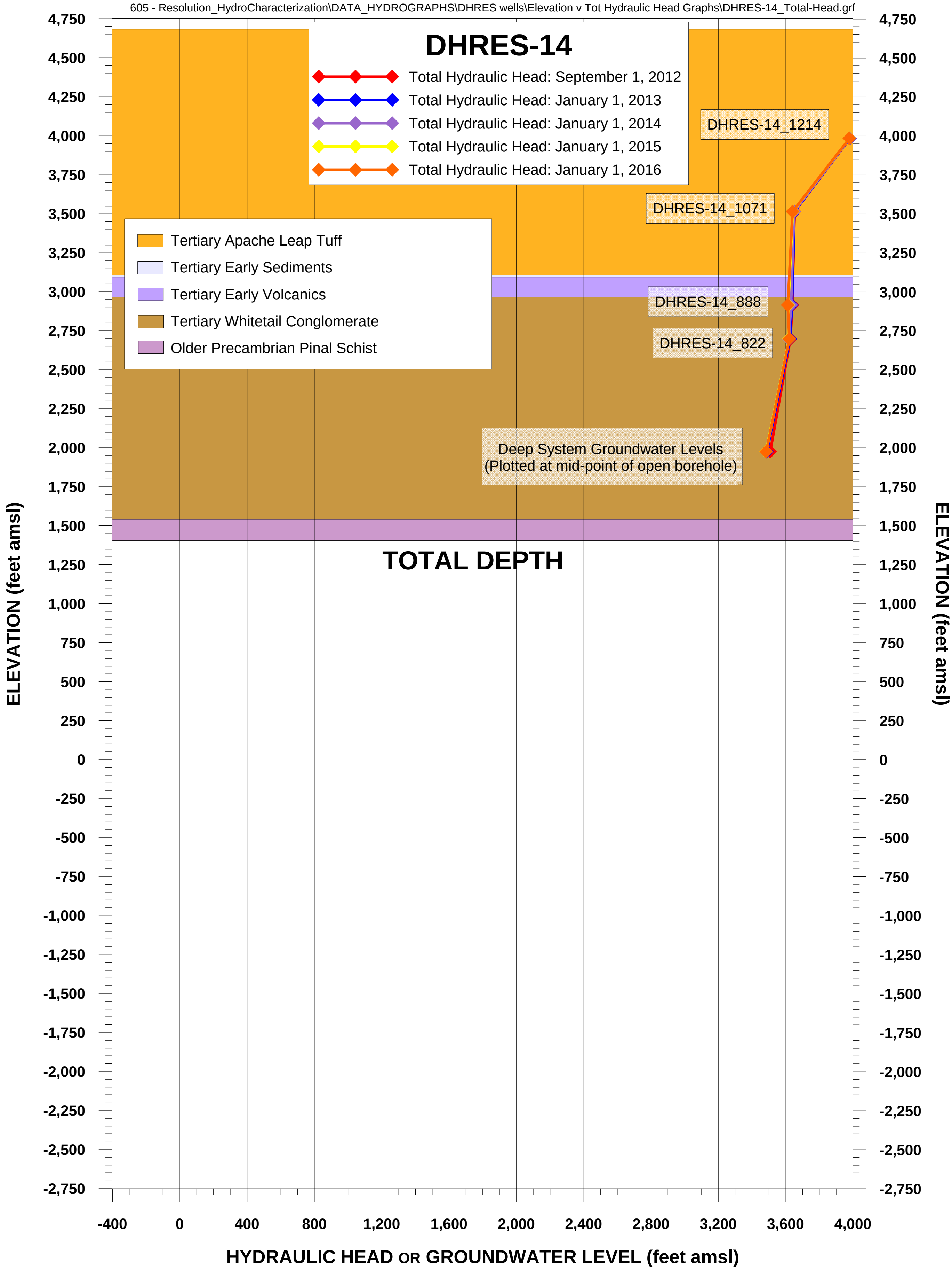
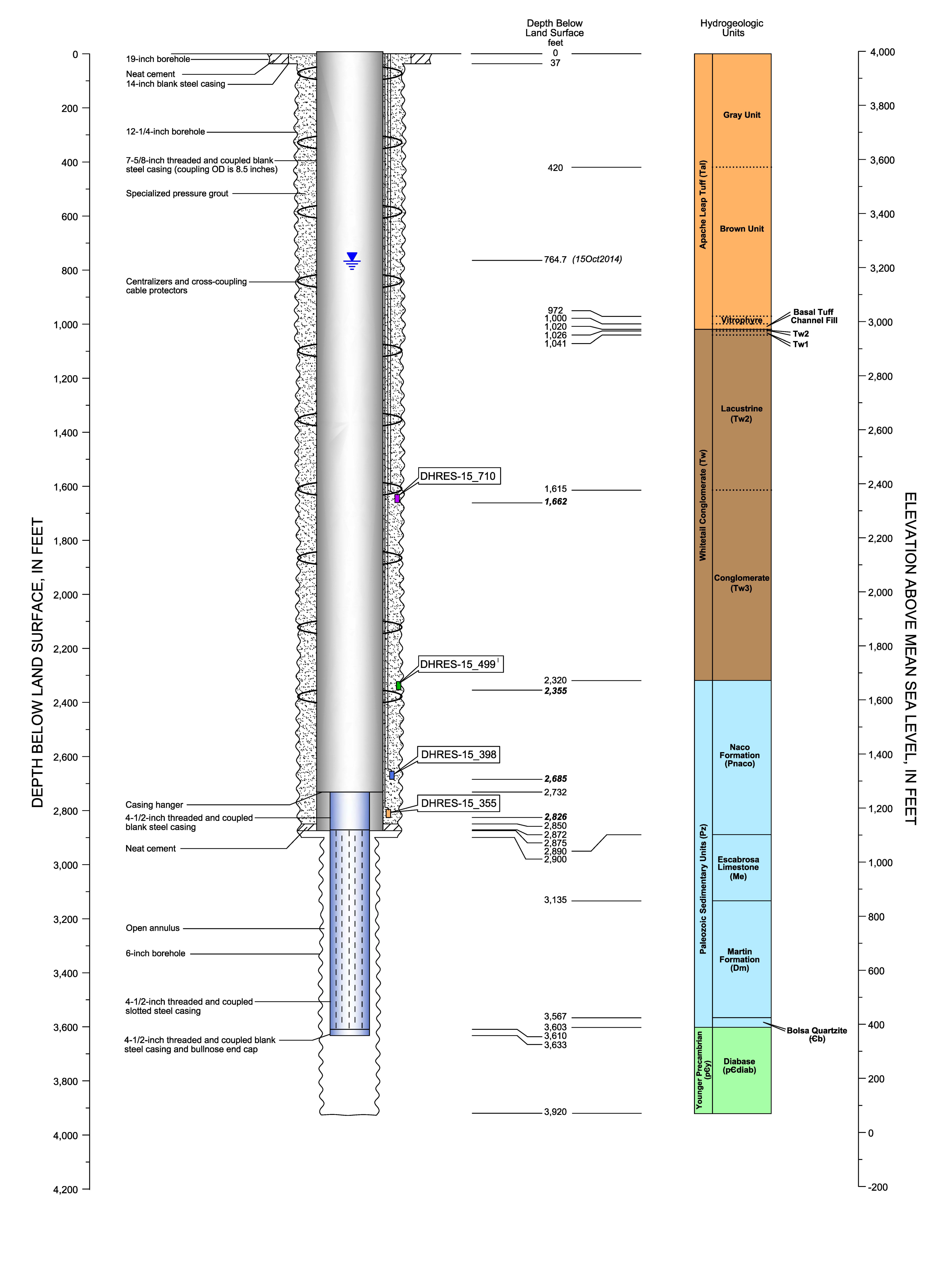


FIGURE B-13f. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-14, RESOLUTION PROJECT

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES



CADASTRAL: (D-02-13)05ccb	ADWR NO: 55-916688
NORTHING: 831075.50	EASTING: 964978.32
LAND SURFACE ELEVATION: 3990.83 FEET AMSL	
DATUM: U.S. State Plane Coordinate System of 1983 Epoch 2011 (NAD83 NA2011) Arizona Central Zone (0202) North American Datum 1983 North American Vertical Datum of 1983	

Non-pumping Water Level

DHRES-15_398

Well Identifier

Piezometer Elevation, in meters amsl

¹ Piezometer was installed and is not longer functioning

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES Water Resource Consultants

DHRES-15
DIAGRAM OF WELL CONSTRUCTION

Version: May 2016

FIGURE B-14

Drafting\605\WellSchematics_2015\DHRESwells\DHRES15_Feet\27Oct2016

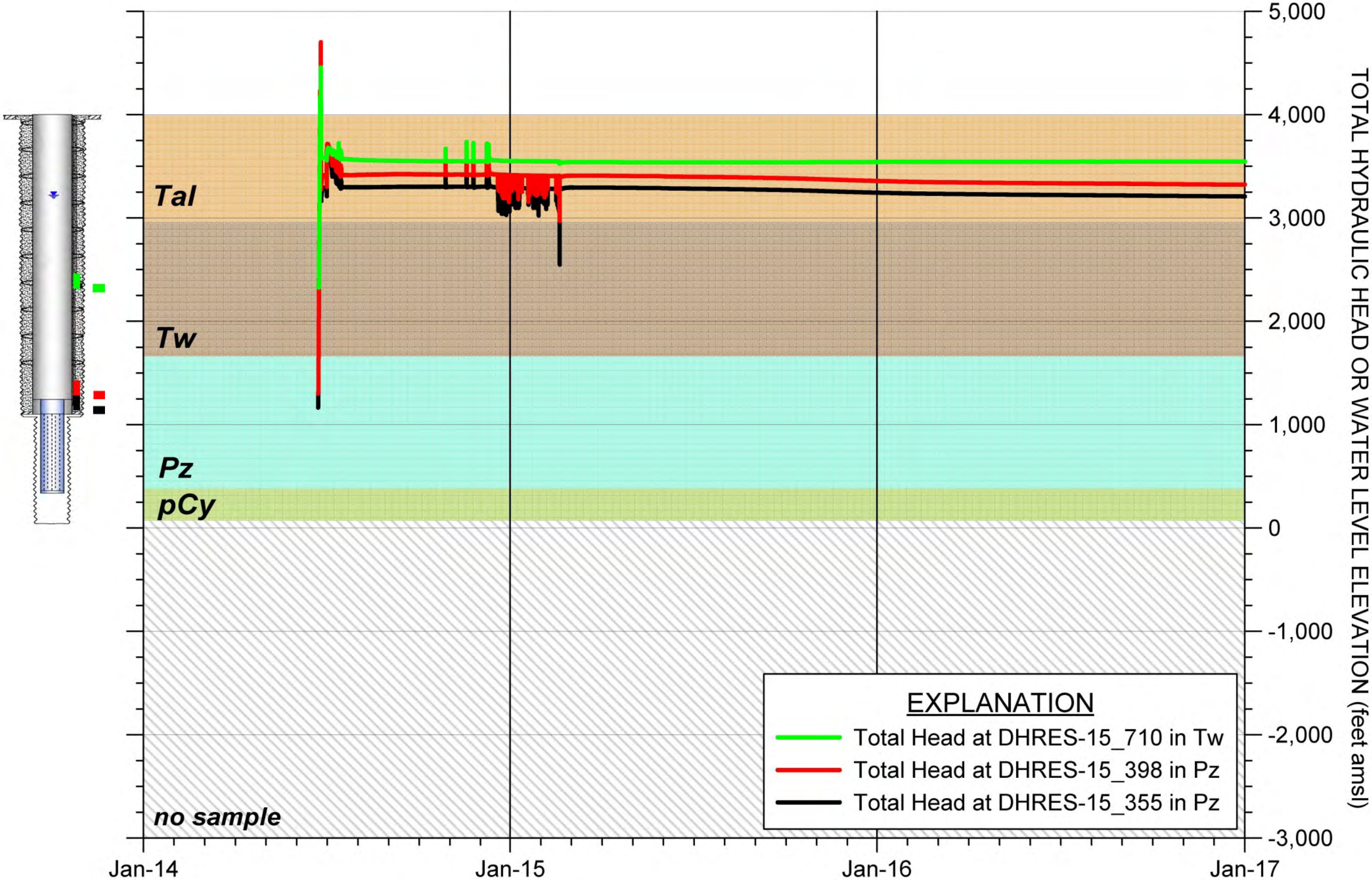


FIGURE B-14a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-15

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

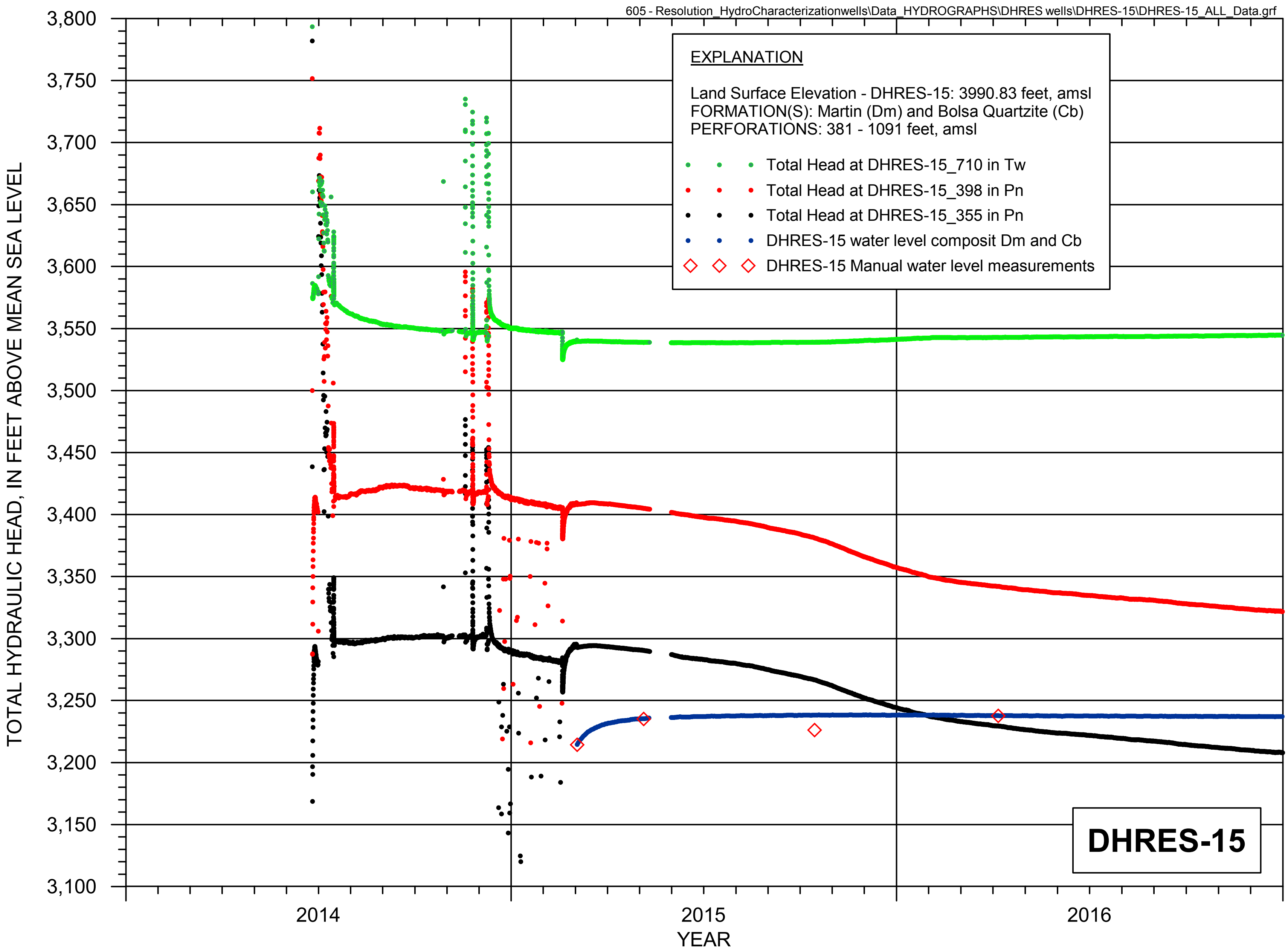


FIGURE B-14b. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS AT HYDROLOGIC TEST WELL DHRES-15

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

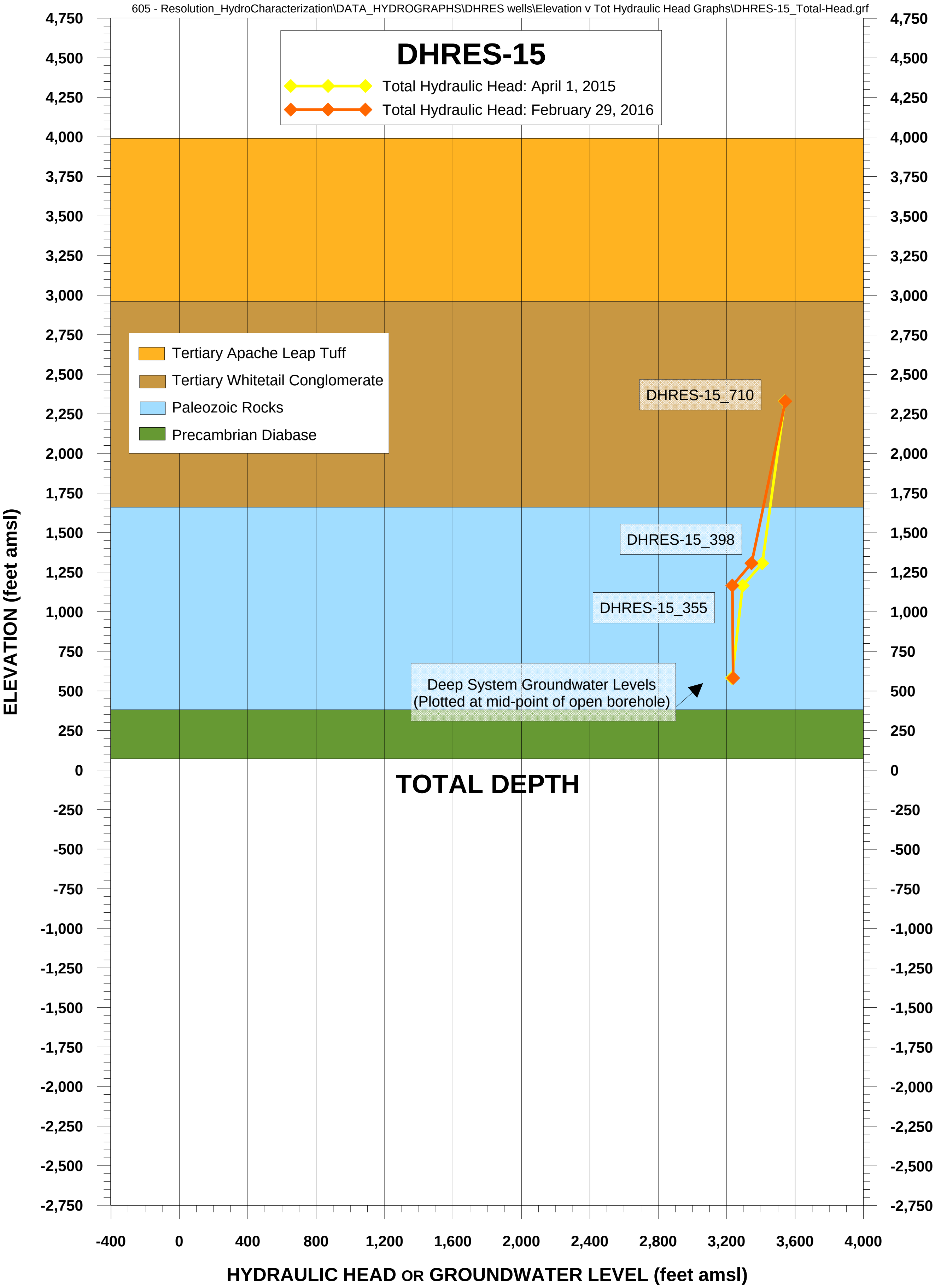
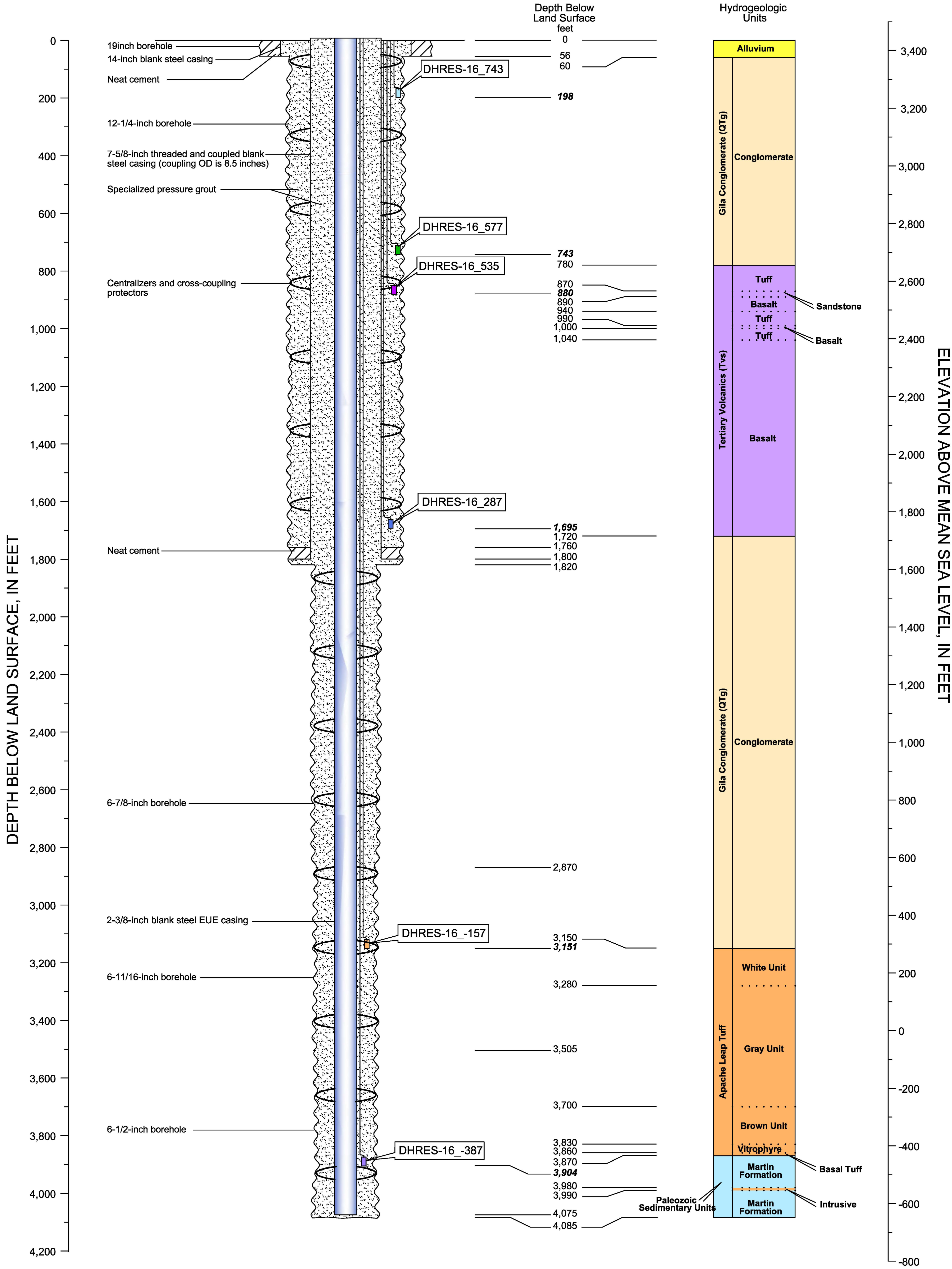


FIGURE B-14c. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-15, RESOLUTION PROJECT



CADASTRAL: (D-02-12)04acd	ADWR NO: 55-917232
NORTHING: 830712.766	EASTING: 944004.384
LAND SURFACE ELEVATION: 2634.254 FEET AMSL	

DATUM: U.S. State Plane Coordinate System of 1983
Epoch 2011 (NAD83 NA2011)
Arizona Central Zone (0202)
North American Datum 1983

North American Vertical Datum of 1983

DHRES-16_535
Well Identifier
Piezometer Elevation, in meters amsl

RESOLUTION COPPER

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Water Resource Consultants

DHRES-16
DIAGRAM OF WELL CONSTRUCTION

Version: January 2016

FIGURE B-15

Drafting\605\WellSchematics_2015DHRESwells\DHRES16_Feet\27Oct2016

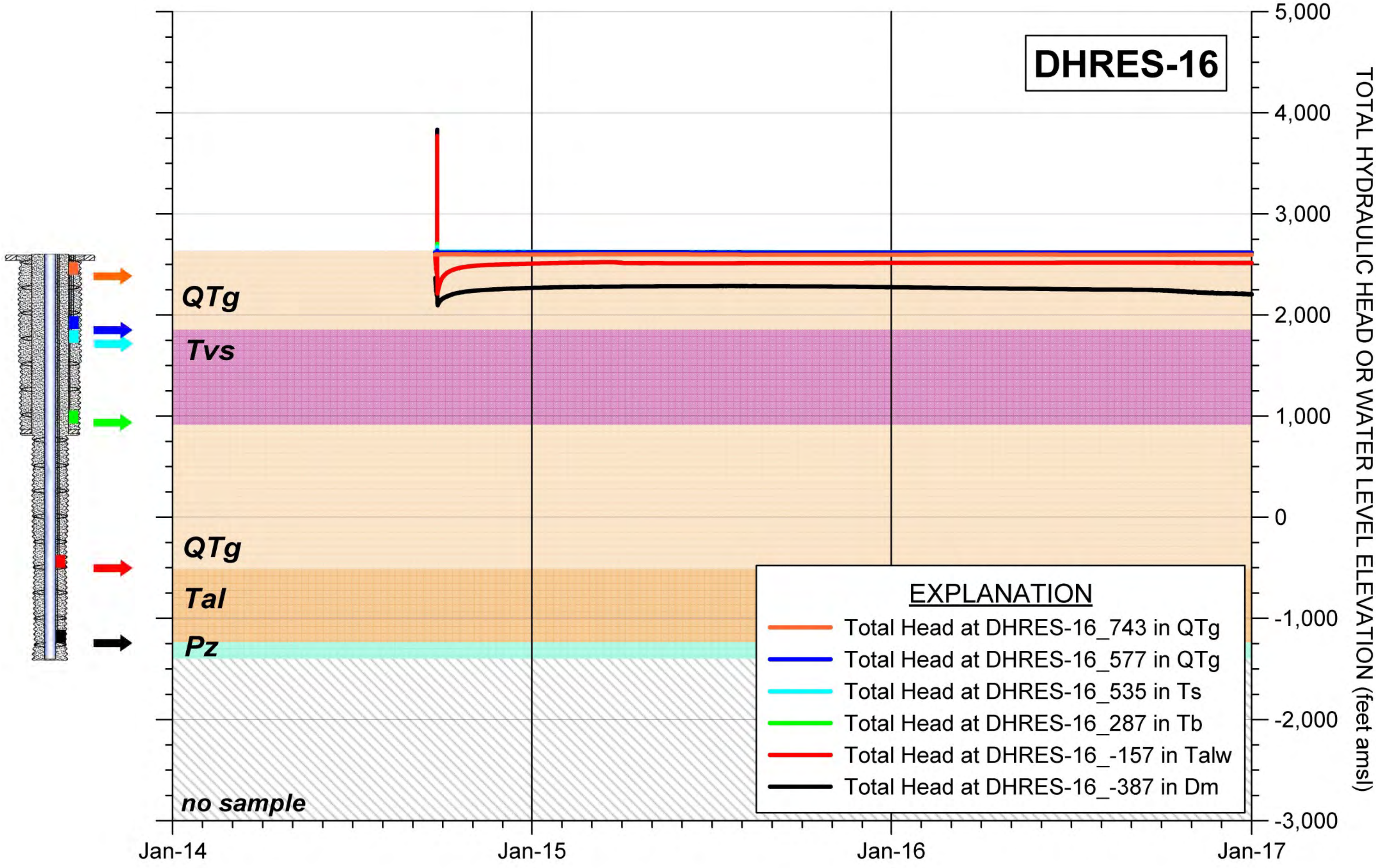

FIGURE B-15a. COMPOSITE HYDROGRAPH OF TOTAL HYDRAULIC HEAD OR WATER LEVEL FOR HYDROLOGIC TEST WELL DHRES-16

MONTGOMERY & ASSOCIATES

RESOLUTION COPPER

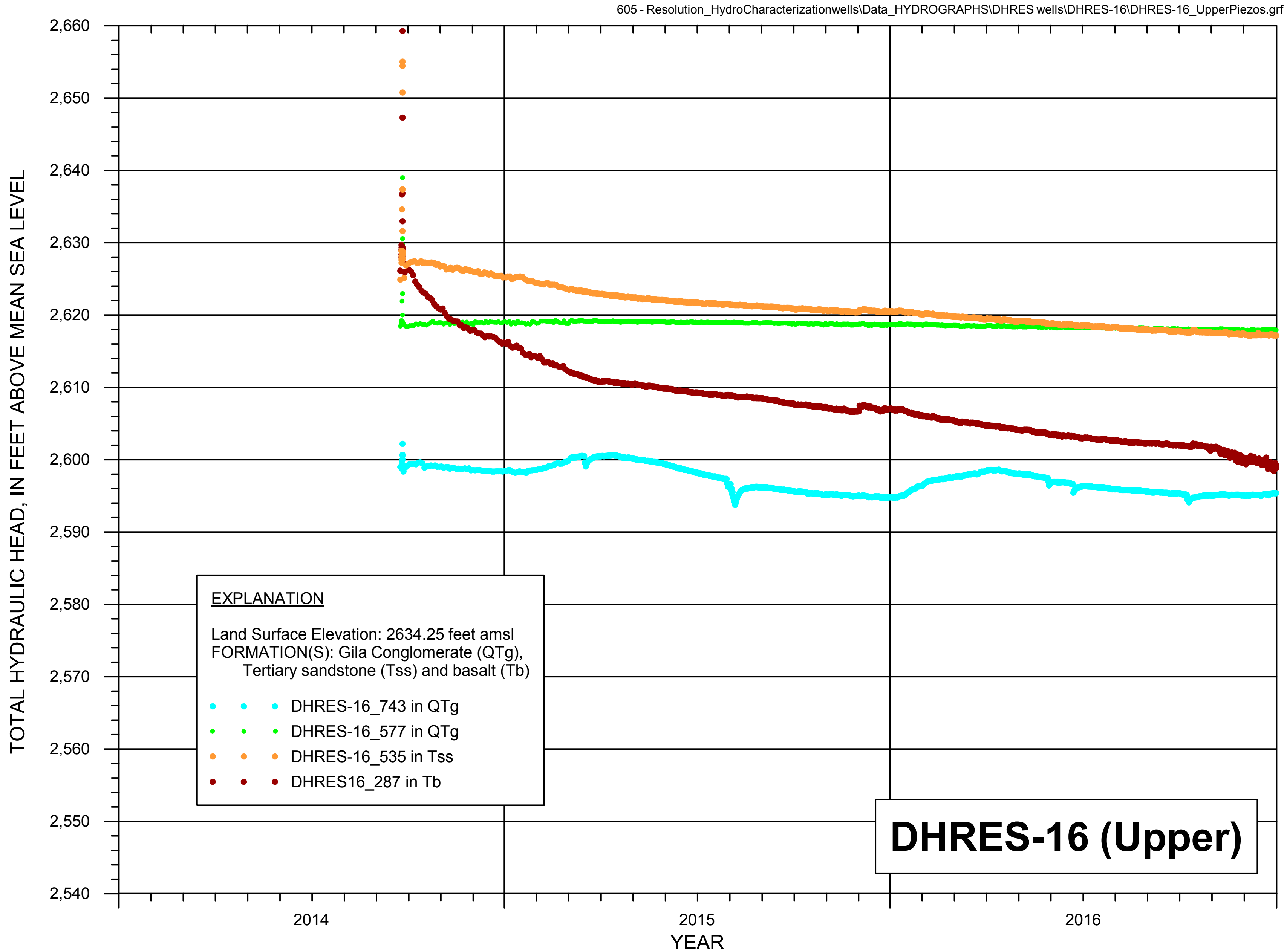

FIGURE B-15b. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETERS, UPPER BOREHOLE, DHRES-16

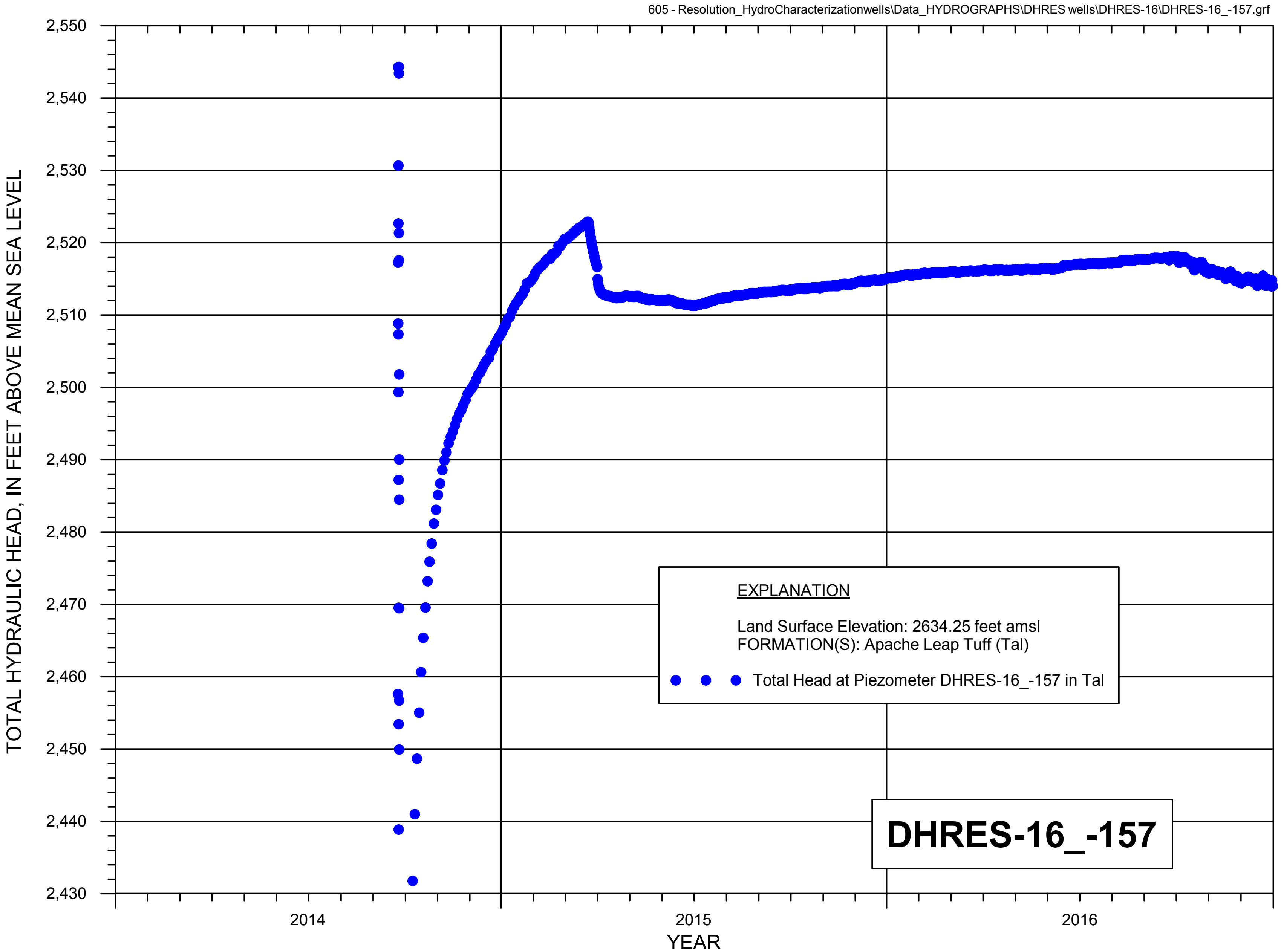

FIGURE B-15c. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETER DHRES-16_-157, LOWER BOREHOLE AT DHRES-16

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

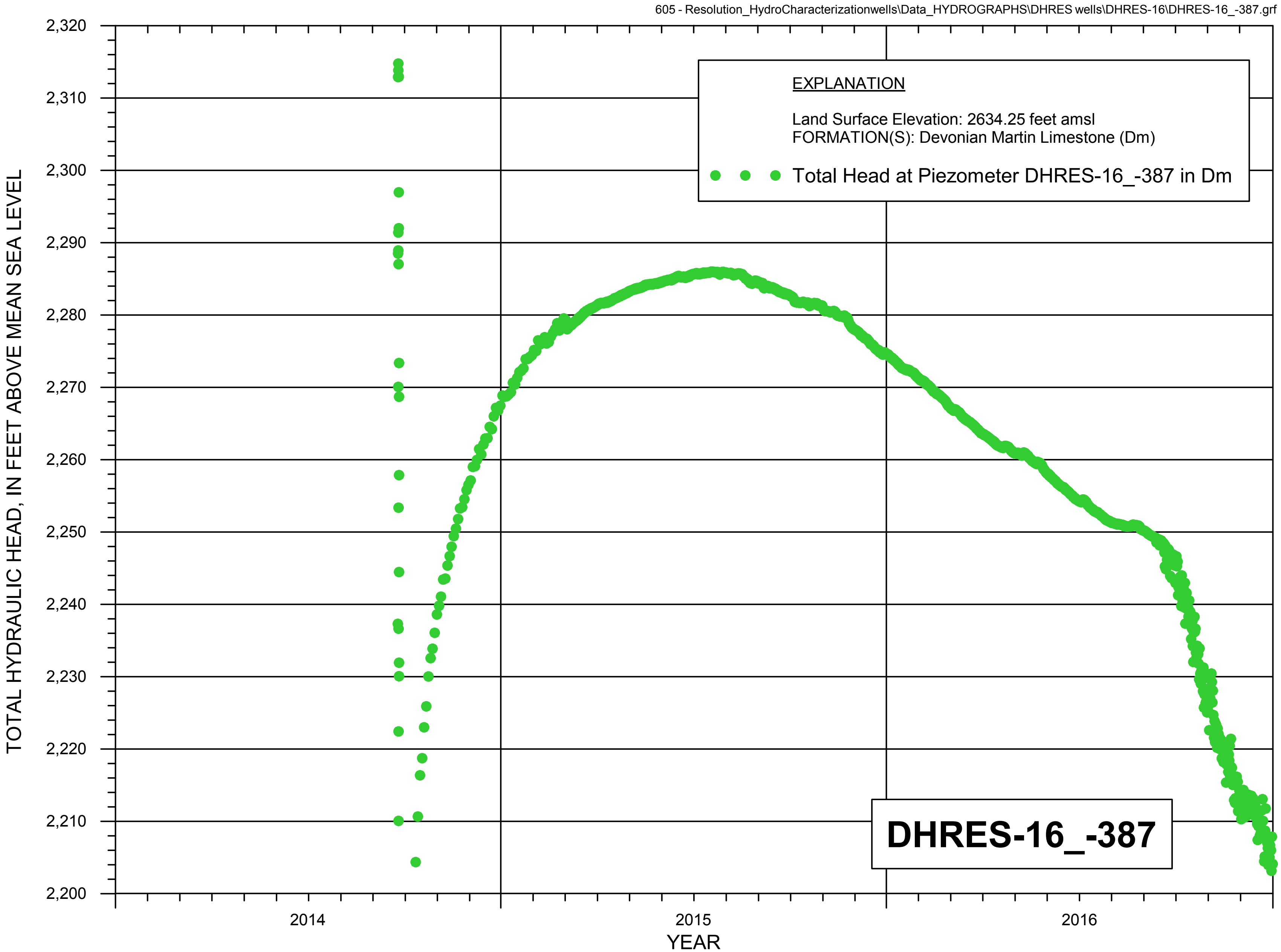

FIGURE B-15d. HYDROGRAPH OF TOTAL HYDRAULIC HEAD FOR GROUTED PIEZOMETER DHRES-16_-387, LOWER BOREHOLE AT DHRES-16

RESOLUTION COPPER

MONTGOMERY & ASSOCIATES

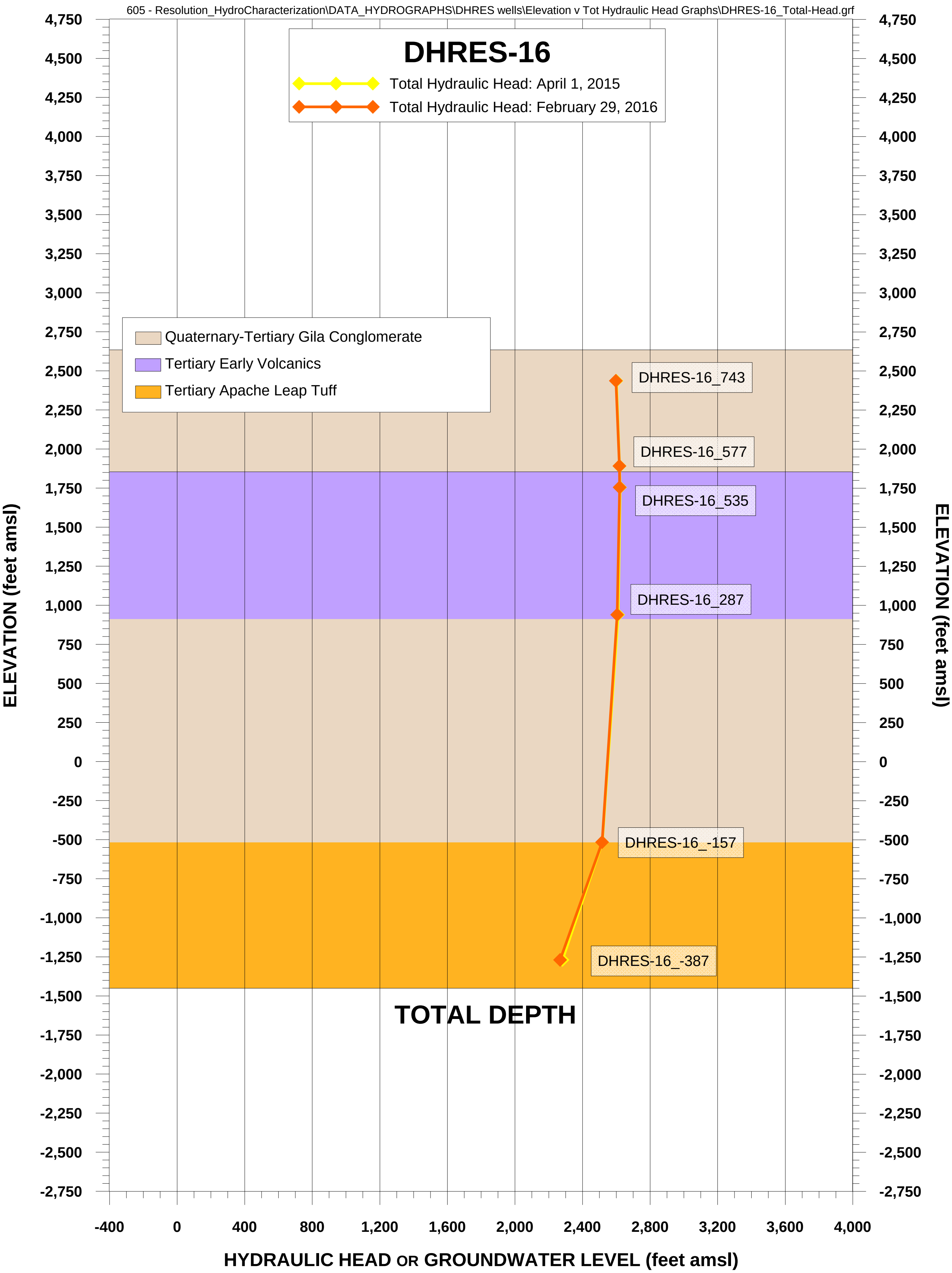

FIGURE B-15e. TOTAL HYDRAULIC HEAD AND GROUNDWATER LEVEL AT WELL DHRES-16, RESOLUTION PROJECT

RESOLUTION COPPER

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