ADDENDUM TO:

HYDROGEOLOGIC ANALYSIS OF THE PROPOSED EXPANSION OF THE HANSON AGGREGATES NEW YORK LLC HONEOYE FALLS QUARRY

Prepared for:

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Jamesville, New York 13078

Original Report: April 1, 2013
~~Addendum: October 9, 2015~~
Revised Addendum: February 6, 2016

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Prepared for:

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Original Report: April 1, 2013
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1.0 INTRODUCTION

This report presents additional hydrogeologic analysis for the proposed expansion of the Honeoye Falls Quarry of Hanson Aggregates New York LLC (Hanson) and is an Addendum to the report by Alpha Geoscience (Alpha) entitled “Hydrogeologic Analysis of the Proposed Expansion of the Hanson Aggregates New York LLC Honeoye Falls Quarry.” The additional evaluation was requested by the NYSDEC in the document entitled “Additional NYSDEC Technical Comments Related to the Hydrogeologic Analysis and the Sound Level and Attenuation Analysis” that was attached to an April 2, 2014 letter from Thomas P. Haley, New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Permits, to Mr. Michael Lewis (Hanson). The additional analyses and information requested by the NYSDEC were discussed and clarified in a May 13, 2014 meeting at the NYSDEC Avon, NY office with representatives from the NYSDEC, Hanson and Alpha. The outcome of the meeting resulted in the following list of items that the NYSDEC felt needed further attention:

1. Evaluate the available historical water level data (since 1999) that exists for the sump, quarry wells, and residential wells in the vicinity of the proposed expansion area and analyze water level trends and fluctuations;
2. Provide a ground water contour map of the seasonal high water table at full build out of the quarry, add the seasonal high water table to the cross sections, and discuss the impacts of quarry drawdown during the seasonal high water table;
3. Provide a ground water contour map of the seasonal low water table at full build out of the quarry;
4. Further evaluate confined/unconfined aquifer conditions within the Onondaga, Akron and Bertie Formations;
5. Further evaluate the similarity in water level trends between certain residential wells near the proposed expansion and the sump, and assess the connection/impact on those wells by the sump;
6. Further evaluate the relationship between the wetland south of the expansion area and the bedrock aquifer in that area;

7. Provide the methodology and documentation necessary to support the interpretation of where seepage faces are likely to occur; and
8. Modify cross-sections A-A’ and C-C’ to reflect the expansion area limits.

Each of these items is addressed in the subsequent sections.

2.0 Historical Water Level data

The NYSDEC requested that historical water level data from the site and surrounding area adjacent to the expansion area from 1999 to the present be incorporated into the hydrogeologic evaluation.

2.1 Sources of Water Level Data

The data include historical water level measurements from the mine sump, on site monitoring wells, onsite water supply wells, and residential water supply wells local to the expansion area. Figure 1 shows the locations of all the wells at the site and the residential wells adjacent to the proposed expansion for which water level data were available from Hanson or from the health departments of Livingston and Monroe counties. Tables 1 and 2 list the residential wells and quarry wells, respectively, that are shown on Figure 1. The tables provide information about surface elevation, well depth, deepest geologic unit tapped, and other pertinent information.

The period of time that the water level data covers is from August 1999 to January 2015. Most of the data from the residential wells are from 1999-2005, when the health departments of Monroe and Livingston Counties were monitoring water levels in the area surrounding the quarry in response to the deepening of the sump in 1999 and a significant drought in the region. Additional water level data from some of the quarry wells and residential wells were obtained from Hanson and from a report on a sump pumping test that was conducted in March of 2000 by Spectra Environmental Group, Inc. (Spectra, 2000). The Spectra data provide an increased frequency of monitoring during the spring of 2000 for selected wells, especially during March. Hanson has been measuring water levels at quarry wells and certain residential water supply wells on a regular basis since 2009.

The county health departments and Hanson did not measure all wells for the same length of time, nor on the same days from 1999-2005. Water level data for most wells were sporadic from 2005 until 2009, at which time Hanson resumed routine water level monitoring of site wells. The sump and most of the quarry wells have been measured on a fairly consistent basis, generally bi-weekly or monthly, since 2009. Hanson was given permission to monitor the off-site water levels at 1110 Dalton Rd (Well 36) and the “Silo Well” (Well 35), which are east of the quarry, and at 916 Works Rd (Well 9), which is west of the quarry (Figure 1). The Silo Well is not in use. The other two are active residential wells. Water levels have been measured in those three residential wells on a routine basis along with the quarry wells since 2009; intermittent water level data for these wells were collected by Hanson back to 2005. All of the water level data back to 1999 are presented on a compact disc in Appendix A, including Hanson data, Spectra data, and data from the county health departments.

2.2 Analysis

An assessment of water level fluctuations and long term trends was conducted by plotting hydrographs (Appendix B) of the sump, the quarry wells, the two residential wells on Dalton Rd east of the quarry, and the residential wells adjacent to the expansion area. Monthly actual and normal (30-yr average) precipitation data were plotted along with the hydrographs so that the relationship between precipitation and water table fluctuations could be evaluated.

The hydrographs in Appendix B indicate that, historically, the water levels in the vast majority of the wells were responding to the same hydraulic factors. All the wells show a cyclical rising and falling pattern that is directly related to the seasons, regardless of geologic unit screened. The data indicate that the water table typically reaches a seasonal low in the fall (September through December), begins to rise in the winter (January), rises steeply during the spring thaw (February through early to mid-April) and then falls sharply throughout the summer (Appendix B Hydrographs). The hydrograph of Well 16 in Figure 2 typifies this pattern of seasonal water level changes.

The amplitude of these seasonal cycles is variable and ranges from over 30 feet at some residential wells along HF No. 6 Rd (west of the mine entrance) to less than seven feet at Well 7 on Oak Openings Rd. The factors that cause these seasonal ranges include bedrock type, bedrock permeability, bedrock storage and the local aquifer connection to recharge and discharge. For example, the residential well with the smallest amplitude of seasonal fluctuation is residential Well 7 (Figure 2), which is located southwest of the proposed expansion area. Well 7 extends through most of the Onondaga Fm (Table 1) at a location where the Onondaga is likely covered by shale of the Marcellus Fm (Fisher, D.W. et al, 1970). The presence of the shale above the Onondaga Fm at that location may limit the rapid recharge that causes water level spikes that are common in the Onondaga/Akron wells at places where the Onondaga is not covered by shale, such as at Well 16 (Figure 2).

The sump is pumped year-round and has a tempering effect on the water level fluctuations in wells nearby the sump. Wells that are closer to the sump, such as Hanson wells 25, 28 and 29, do not display seasonal water level fluctuations of as high an amplitude as wells further away from the sump, such as residential wells 9 through 16 (Appendix B).

Water level data for most of the nearby resdidential wells was only available for late 1999-2004; consequently, the evaluation of water level trends for these wells is limited to that time period. The hydrographs for the residential wells are very similar with respect to the fact that the low levels that appear during late fall and early winter show successively lower levels from 2000 through 2002; however, several wells have data going back to late 1999 and in some cases such as wells 15 and 35, the water levels were even lower. The low water levels in1999 occurred during, and following, an eight month period (April-November) when precipitation was below normal in all but one of the eight months (Figure 3). The amount of precipitation for the year 2000 was greater than average for the first three quarters of the year, with several months well above normal; consequently, the low water table in 2000 was not quite as low as in 1999. The years 2001 and 2002 experienced very little precipitation in the late summer and early fall, and followed the last quarter of a very dry 2000. These late season dry periods appear to have caused the levels to drop consecutively further than in 2000 in some wells. The hydrographs in

Appendix B generally show higher water levels from 2003-2005 as a result of normal to above-normal precipitation during those years.

The sensitivity of the on-site and residential wells to short term dry periods is consistent with the high sensitivity to short term recharge events observable in the hydrographs. All but one of the wells, regardless of the geologic unit screened, show a dramatic water level increase during the first quarter of 2011, with a sharp decline beginning around April 1, 2011. The only well in which this water level spike was not distinctly noted was the Garage Well (18). In fact, the water level in Well 18 displayed a slightly downward trend during the first quarter of 2011. From 2000-2009, wells 17 and 18 displayed nearly identical water level elevations and hydrographs, despite their being open to different depths into the Bertie Group. These two wells, however, display distinctly different hydrographs during certain periods from 2009-2015. Table 2 notes that these two wells are rarely used. It is likely that the differences in the hydrographs of these two wells from 2009-2015 reflect some occasional, or rare, usage of one or both of these wells at different times.

Many of the wells have lower water levels during 2009-2015 than they exhibited during 1999-2005; however, the water level trend during 2009-2015 has been stable, or slightly upward overall. The average elevation of the water level in the sump was higher in 2009-2015 than it was from 1999-2005.

The deepening of some wells (Alpha 2013 report, Table 1) resulted in deeper water levels in those wells, with some reports of cascading water occasionally heard while measuring a water level. Care was taken to gather true water levels measurements in these instances, when possible, by using a plastic shroud to protect the water level probe from cascading water in the well. Cascading water indicates the presence of shallow, transmissive fractures that are not well connected to deeper, transmissive fractures in the vicinity of the well. The water supply wells that penetrate deep into the Onondaga, or below, serve as short circuits that were previously not present, and transmit water from shallow fractures more quickly to deeper fractures than the natural fracture system. Several wells that were deepened were formerly quite shallow (70 ft or less) and tapped only the shallow fracture system (Alpha 2013 report, Table 1). The shallow fracture system recharges quickly, but also drains fairly quickly. Not all residential or quarry wells encountered transmissive fractures in the upper 70 ft and most do not exhibit cascading.

3.0 Ground Water Elevation Contour Maps, Existing Conditions

3.1 Seasonal Low Water Table

A seasonal low ground water elevation contour map was provided in Alpha's 2013 report and has been updated herein as Figure 4. Figure 4 was updated since the 2013 report to reflect the numbering system in Tables 1 and 2. The map shows the elevation of the water table surface as measured in the wells on August 23, 2010. An estimate for the water level at Well 22 is provided because water levels were not measured at that well from August 2009-August 2014. The estimate at Well 22 was based on the water level at Well 23. The average difference in water levels measured at wells 22 and 23 from 2005-2008 was approximately 12 feet, with the Well 22 water level being higher than at Well 23 (Figure 5). An estimate for Well 16 was also used as described in Section 3.2.2.2 of the Alpha 2013 report.

Ground water flows from the areas of high water elevations toward low elevations and perpendicular to the ground water elevation contours. The regional flow is to the north. The local flow pattern is radially outward from recharge areas and inward toward discharge areas such as the quarry sump, which is where the water entering the quarry is pumped out on a year-round basis.

3.2 Seasonal High Water Table

A seasonal high ground water elevation contour map is provided as Figure 6. The map shows the elevation of the water table surface as measured in the wells on February 25, 2011. The regional flow pattern is similar to the seasonal low and exhibits a regional flow to the north with local flow radially outward from recharge areas and inward toward discharge areas such as the quarry sump. An estimate for the water level at Well 22 is provided using the same approach explained for the seasonal low value for that well. Water level measurements were also not available for residential wells 11 through 16 along Honeoye Falls Rd No. 6; consequently, the pattern of ground water elevation contours for the seasonal low (Figure 4) were used as the analogue for the seasonal high water table conditions in that area.

4.0 Ground Water Elevation Contour Maps, Future Conditions

The maximum drawdown of the water table is predicated on the interpretation that the base of the water table aquifer is defined by the deepest fractures associated with the water table aquifer and that ground water cannot be drawn lower than the base of the aquifer. The vast majority of water-bearing fractures encountered during the drilling of deep drill holes, monitoring wells, and residential water supply wells in the immediate vicinity of the mine were encountered within the Onondaga Fm and/or at the contact between the Onondaga and the underlying Akron Fm (upper Bertie Group). Natural fractures below the Onondaga Fm in the rock cores that were examined were scarce and none showed evidence of being water-bearing fractures. The base of the water table aquifer is interpreted to be at the contact between the Onondaga Fm and the Bertie Group (top of Bertie Group = top of Akron Fm).

The maximum drawdown is also based on the premise that ground water will enter the mine through a seepage face on the quarry wall that extends upward from the aquifer base. The predicted seepage face on the quarry walls is anticipated to be approximately one third the vertical distance between the base of the aquifer and the elevation of the existing seasonal high water table. This is a conservative estimate because seepage in some areas of the existing mine has been seen coming from quarry faces at elevations higher than one third the way up the high wall. The effect of this is that the maximum drawdown, and the extent of drawdown away from the mine, likely would be less than predicted herein. The structural contours for the top of the Bertie Group (top of Akron Fm) are presented in Figure 7. The proposed mine floor is relatively coincident with the top of the Bertie Group in some areas around the mine perimeter; in other areas, there will be some Onondaga Fm remaining in order to maintain the desired quarry floor slopes at end of mining.

The elevation of the aquifer base and the existing water table vary around the perimeter of the mine; consequently, the water table and the associated drawdown are expected to vary around the perimeter of the mine. The maximum water table gradients, sustained under existing conditions, were used as a guide to predict the drawdown gradients and extent of water table drawdown impacts outward from the quarry face. The gradient was assumed to be steeper closer to the quarry walls.

Seepage will occur on the southern high wall where the ground water contours intersect the benches; on the sloping floor of the mine where the existing water table intersects the proposed mine floor; and along the northwestern quarry wall, just above the mine floor. Some areas of the existing seasonal high and low water tables are already below a portion of the proposed final quarry floor elevation; consequently, it will not be drawn down any further where that is the case.

The NYSDEC requested (see previous Section 1.0, item 7) that the methodology and documentation, which supports the interpretation of where seepage faces are likely to occur, be provided. A further description of the methods used in calculating the seepage faces and drawdown impacts is included in Appendix C. Appendix C also includes the calculations of the seepage faces for the seasonal low and high water tables.

4.1 Seasonal Low Water Table at Full Mine Buildout

The seasonal low water table contour map at full mine expansion (Figure 8) was constructed by adding the mine dimensions at full build out to Figure 4 and using the criteria described in Section 4.0. The future seasonal low water table is also illustrated in the cross sections on Figures 9, 10 and 11. The existing seasonal low water table is currently below the proposed quarry floor across much of the mine expansion area. The only drawdown will be in the southern portion of the mine expansion, south of where seepage faces are anticipated. There are no nearby residential wells south of the expansion, so no wells will be impacted by the drawdown in that area. The only residential wells near the proposed expansion are to the north and west of the expansion, where there are no seepage faces and the seasonal low water table is already below the quarry floor. No drawdown impacts are anticipated at any of the residential wells around the mine expansion during seasonal low water table at full mine build out.

4.2 Seasonal High Water Table at Full Mine Buildout

Figure 6 was used as a starting point to construct the predicted seasonal high water table contours at full mine build out (Figure 12). Figure 12 was constructed as described in Section 4.0. The future seasonal high water table is also illustrated in the cross sections on Figures 7, 8 and 9.

The closest wells to the mine expansion are Well 9,which is west of the expansion, and Well 10, which is near the northwest corner of the expansion. The anticipated drawdown at those locations is neglible at the time of the seasonal high water table. These two wells will not experience a loss of access to water during future high water table conditions as the result of the anticipated drawdowns because there will still be drawdown available in those wells. There also is no reason to expect any changes in water quality in any of the wells since ground water flow from all directions is toward the mine.

5.0 Unconfined/Confined Conditions in the Onondaga, Akron, and Bertie

Ground water within the bedrock of the region surrounding the quarry is contained within, and flows along, fractures, bedding plane partings, fault zones and dissolution-widened openings in the rock. The ground water intersected by the quarry occurs primarily in the top 150 feet of the rock and is unconfined. At the quarry and in the immediate vicinity, the water table generally occurs within the Onondaga Formation (Fm). Unconfined conditions exist in the Onondaga Fm and the upper Bertie Group (Akron Fm). The 2013 Alpha report described how the vast majority of fractures that were indicative of water movement, and potential water movement, were found in the Onondaga Fm, with little to none encountered in the underlying Akron Fm. Additionally, the depths of lost circulation zones encountered in the deep holes drilled in 1998 were all within the Onondaga Fm, despite four of the drill holes penetrating from 13 ft to 45 ft into the Bertie Group. Several drillers' logs of residential wells indicated that additional water was encountered at, or near, the contact between the Onondaga and underlying Bertie (Akron). Some residential wells were drilled deeper (below the contact) for storage but no indication of any further yield was noted, at least not within the Akron Fm.

The Spectra report from 2000 detailed the installations of seven monitoring wells in the quarry. Four of these wells (22, 23, 25, 29), were screened wholly within the Onondaga Fm (Table 2). One Well (24) was screened only at the Onondaga/Akron contact. The hydrographs of wells 1-99 (23) and 1A-99 (24) are very similar, despite the fact that Well 23 is an Onondaga well and Well 24 is an Onondaga/Akron well (Figure 13). The water levels in the two wells are typically within 2 ft of each other, and often less than 0.5 ft apart. This supports the use of Onondaga and Akron wells together in creating ground water level elevation contour maps for the area, especially when contouring at 10 ft intervals.

One of the Spectra wells (28) is screened only within the Akron Fm. Well 28 has a 10 ft screened interval that was approximately 20-30 feet below the 2000 mine floor and 5-15 ft below the Onondaga/Akron contact (Table 2). Well 27 was installed as a deep well pair to Well 28. Water was encountered during the drilling of Well 27 at approximately 45 ft below the mine floor, or equivalent to approximately 30 ft below the Onondaga/Akron contact. The water at that depth was under confined, or semi-confined, conditions and rose to approximately 25 ft above the quarry floor. Well 27, which was installed as a vibrating wire piezometer and is no longer accessible, was the only well in the vicinity of the mine that is known to have encountered confined conditions within the Bertie Group.

Figure 14 shows the hydrographs of the data collected by the Monroe Co. Health Dept. in the early 2000s from the existing well and the old well at 1919 Honeoye Falls No. 6 Rd. Well #16 (“new” well) was drilled circa 1997 to approximately 150 ft to replace an approximately 86 ft deep well, which was open in the Onondaga Fm. The “new” well is open in the Onondaga Fm and the Bertie Group (Akron and below) and likely is deep enough to have encountered the confined aquifer in the Bertie Group (if it is present at that location). The hydrographs in Figure 14 indicate that the water levels at the two wells were remarkably similar, despite the fact that one of the wells is much deeper (Bertie Group) than the other (Onondaga Fm only). The only difference between the two well hydrographs occurs when the water level reaches the bottom of the old well. The hydrographs in Figure 14 indicate that it is reasonable to use Onondaga wells and Onondaga/Bertie wells to construct water ground water contour maps in the area.

No wells known to penetrate the confined aquifer within the Bertie Group were used in the construction of the ground water contour maps in Figures 4 and 6. The only well known to have penetrated confined conditions in the vicinity of the mine was Well 27.

6.0 Similarities in Water Level Trends Between Certain Residential Wells and the Sump

The NYSDECs April 2, 2014 letter to Mr. Lewis (Hanson) pointed out apparent similarities among the hydrographs for wells 20, 9 and 09-002. In particular, the NYSDEC noted that these three wells show a rise in water elevations from December 2010 through April 1, 2011, then an abrupt drop on April 8, 2011 (Figure 15). The ground water contour maps of the seasonal low and high water table indicate that a northeast trending local ground water divide exists in the area between these wells (Figures 4 and 6), with Well 20 being southeast of the divide, Well 9 on the west side of the divide, and 09-002 being nearly on the divide. The similar trend in water levels among these three wells led the NYSDEC to question the presence of a ground water divide in that area. The NYSDEC's opinion is predicated on the assumption that water levels in wells on opposite sides of a ground water divide would normally behave differently unless acted upon by some other mechanism. In this case, the NYSDEC suggested that the wells in question were all affected by the sump because it exhibits a similar trend.

The data contained Appendix A and the Spectra 2000 Report indicate that the abrupt drop in water levels at wells 9, 20, and 09-002 in April 2011 was not caused by a lowering of the water level in the sump. The hydrographs in Appendix B indicate that the majority of wells in the vicinity of the mine historically respond to the same weather-related conditions and seasonal patterns. The water level in the sump also responds to weather conditions, seasonal patterns, as well as increased or decreased pumping rates.

The presence of the divide (Figures 4 and 6) is indicated by the relationship of the water levels at wells 9, 18, 20, 21, and wells 09-001, 09-002 and 09-003. Figure 15 shows the hydrographs of these wells and the sump for the time period in question (December 2010 through early April 2011). Well 9 (west of the divide) typically has a lower water level than wells 09-001 and 09-003 (west of the divide) and well 09-002 (on the divide; Figure 15). Wells 18, 20 and 21, which are east of the divide, typically have lower water levels than wells 09-001, 09-002, and 09-003. The fact that wells on either side of the divide may show similar hydrographs is not surprising since the wells are all reacting to the same natural hydraulic factors. Some wells have a more direct connection to transmissive, low storage, fractures and other wells may be connected to fractures that are less transmissive, provide higher fluid storage or are connected to a more circuitous path to discharge. These characteristics are typical in fractured limestone associated with the karst hydrology that exists in the vicinity of the site. This karst related variability causes some wells to react more quickly and show a wider range of fluctuation than others when responding to the same precipitation events and dry periods, regardless of the geologic unit screened. It is apparent that Well 20 and Well 9 are connected to fractures that have similar hydraulic characteristics, despite being completed to different depths and at locations on opposite sides of the divide (Tables 1 and 2). The ground water contour maps show that the fractures in the vicinity of Well 20 are connected to the discharge at the sump and the fractures at Well 9 are draining to the west into an area where the ground water likely enters a network of northward draining fractures and dissolution conduits (karst features) that ultimately discharge into the Honeoye Creek drainage network. The karst hydrology is evidenced as enclosed surface depressions and springs along the limestone outcrop north of the Honeoye Falls 6 Rd.

Additional evidence showing the lack of a relationship between Well 9 and the sump can be gleaned from the sump pumping test conducted in 2000 by Spectra (Spectra, 2000). Spectra drew the water down 16 ft on March 9th and held the drawdown at 16 ft for 72 hours starting late in the day on March 10th. Spectra prepared a graph of long-term water level monitoring results for Well 9 and the sump level, and Spectra also plotted the short-term Well 9 results with precipitation prior to, during and after the sump level drawdown test (Appendix D). Figure 16 is a similar figure to the long term plot by Spectra, although the precipitation bars are more legible. The long-term results show that the most dramatic response in the Well 9 water level occurred February 22-26 and was related to major precipitation events with snow melt that occurred on February 15th and 19th (Figure 16). A sudden rise also occurred after the sump level was allowed to return to its original level, but the increase is more likely the result of two precipitation events during the test. A notable observation is that the water level rebound at Well 9 was observed to occur several days after the February recharge events and the recharge events during the test.

These results appear to support that the recharge events caused the water level changes rather than the changing water level in the sump.

This is further supported by looking at the short-term results in Appendix D. These results reveal that the Well 9 level had dropped approximately 0.84 ft during the period from March 1st through March 3rd. The level rebounded from the 0.84 ft drop after less than 0.2 inches of precipitation. The water level in Well 9 had begun to drop after the sump drawdown started, but the maximum drop only reached 0.92 ft, which is nearly the same magnitude of drop that occurred without lowering the sump level at all. The Well 9 water level rose approximately 3 ft after the sump was allowed to return to its original level. This amount of rise was approximately 2.5 ft above the water level in the well at the start of the sump drawdown. The additional rise after the sump had returned to its original level is likely due to the 0.75 inches of precipitation that occurred several days before (during the test).

Figure 15 shows further evidence that the similarity between the patterns of the hydrographs for well 20, 9 and 09-002 is not the direct result of water level changes in the sump. The sump level declined 2.84 ft from April 1, 2011 to April 8 2011(Figure 15 and Appendix A). This is in sharp contrast to the water level drops shown during that time at wells 9, 20 and 09-002, which were 26.24 ft, 26.28 ft, and greater than 48 ft, respectively. By comparison, the sump water level was lowered 16 ft in March of 2000 and held there for three days, yet the water levels in Well 9, over a mile to the west, only went down by less than a foot (and likely not because of the sump, as explained above). Given the results of the Spectra pumping test, it is not reasonable to attribute a greater than 26 ft drop in water level at wells 9 and 20 to a mere 2.84 ft lowering of the sump, when the 16 ft lowering of the sump had little or no effect on Well 9 over the course of nearly 4 days in March 2000.

The response of Well 9 to precipitation is a much more plausible explanation for the Well 9 response than changes in the sump level, not to mention the temperature, snowmelt, viscosity and storage issues that factor into the water level response to precipitation events during the period in question. It is apparent to Alpha that the ground water divide exists between Well 9 and the sump (Figures 4 and 6) as interpreted from the water level data.

7.0 Evaluation of Bedrock Aquifer and the Wetland

The NYSDEC requested additional data to support Alpha's conclusion that the shallow ground water in the wetland area, which is located southwest of the proposed expansion, is perched and that the bedrock aquifer in the expansion area does not discharge to the wetland. The NYSDEC noted that the water level in 10-002 was higher than in the wetland piezometer P1. The NYSDEC suggested that this could indicate an upward vertical gradient from the bedrock to the wetland; consequently, the wetland could be recharged by the bedrock aquifer. Data collected since the Alpha report in 2013 indicate that the wetland rests on clay and/or bedrock that has little fracture connection to the water table; that the water table elevation, represented by the bedrock aquifer, is routinely beneath the elevation of the wetland; and that the wetland is primarily supported by shallow, perched ground water flow from locations further upgradient and from ditches that drain offsite areas located south and southeast of the wetland.

Additional piezometers and staff gauges were installed in the wetland area so that additional data could be obtained to address the NYSDEC's concerns regarding the bedrock/wetland relationship. The data that support Alpha's conclusion regarding the perched nature of the ground water at the wetland comes from water levels measured at the shallow piezometers P1, P2 and P3; the soils encountered at the shallow piezometers; water levels at staff gauges SG-1 and SG-2; observations of flow at SG-3 and at a drain tile pipe at the edge of a cornfield southwest of the wetland; and water levels measured at bedrock wells 09-003, 10-001 and 10-002. Figure 17 shows the locations of the monitoring points in the wetland area. Well construction logs and boring logs for P1, P2 and P3 are contained in Appendix E.

The boring logs for P1 and P2 indicate that silty clay underlies the wetland area. As discussed in Alpha's 2011 report, clay and silt of medium plasticity were the primary constituents (other than cobbles) of P1 cuttings to approximately 2.7 ft below grade, which is the depth where bedrock was encountered. Significant water flow was encountered just above bedrock. This is an indication that the bedrock surface in the immediate area is not readily draining the soils. This could be due to a lack of fractures or because the presence of clay on top of bedrock is inhibiting infiltration.

Piezometer P2 was installed adjacent to the wetland stream and near staff gauge SG-1. A sample of medium plasticity grey clay was collected at P2 from a depth of approximately 4 ft and submitted to Atlantic Testing Laboratories (ATL) for grain size analysis. The results of the analysis indicate the primary constituents of the sample were silt and clay (Appendix F). The subsurface at P1 and P2 is consistent with the published soil surveys that indicate the wetland area is underlain by soils derived from glaciolacustrine deposits that can be clayey, or have clayey horizons (see discussion in Alpha 2013 report, page 6).

Water level data from the wetland area monitoring points and flow observations are also contained in Appendix A. Figure 18 shows hydrographs of P1, P2, SG-1, the culvert at Oak Openings Rd, and 10-002. The hydrographs indicate that the water level in the water table (represented by 10-002) is routinely below the perched water of the wetland area (represented by P-1 and P2) by more than nine ft. The period from March 11, 2011 to April 15, 2011 was the only time in the last five years that measurements indicated the water level at 10-002 rose above that at P1.

Piezometers P2 and P3 were installed in July of 2014 to address the issue of vertical hydraulic gradients. P3 was installed to a depth of 4.5 ft at a location approximately 7 ft north of bedrock Well 10-002. P3 has been dry every time it was measured, except for May 13, 2015, after significant rainfall occurred in the area. Figure 19 shows hydrographs for selected wetland area monitoring points at a scale so that the water level elevations can be seen for P3 in relation to the others. The water level at P3, 705.88 ft, is 6.39 ft above the water level at 10-002, which was 699.49 ft on May 13, 2015. This water level difference indicates that a downward vertical gradient exists in the area of the wetland.

It is worth noting that the water level in P2, which is adjacent to the wetland stream, occasionally rises above the level of the stream (Figures 18 and 19). The water level in bedrock Well 10-002 during these times is considerably lower than the stream or P2 (Figure 18). This indicates that P2 is receiving flow from a source that is further upgradient within the unconsolidated deposits and not from bedrock in the vicinity of the wetland. The only time that P2 has been dry was on

10/16/2014 and the adjacent wetland stream was still flowing on that date (Appendix A). The upgradient sources likely are represented by the flow in the stream at SG-3 and the flow from the drain pipe at the edge of an agricultural field. Water has been observed continually upstream from the wetland at SG-3, which is the same stream that flows through the wetland. The water flowing from the nearby drain tile pipe flows into the stream, however, a portion of the flow may be seeping back into the ground. Similarly, water has been seen flowing in the ditch upstream from SG-2; yet, at the same time, the ditch at SG-2 is dry.

The loss of water contribution to the wetland from the bedrock aquifer will be negligible since the wetland rarely, if ever, receives recharge from the bedrock aquifer. The wetland receives recharge from direct precipitation; influx from the ditches and stream located to the south and southwest; runoff from the north, south and east; and from the perched ground water flow within the unconsolidated deposits. As described in Section 3.4 of the Alpha 2013 report, the removal of overburden in the expansion area will remove a relatively small portion of the recharge area for the wetland (equivalent to approximately 31 acres out of approximately 1,820-acre drainage basin for the stream).

8.0 Conclusions

Historical water level data going back to 1999 for the site and residential wells in the vicinity of the expansion area were evaluated for trends and fluctuations. Confined/unconfined conditions within the Onondaga, Akron and Bertie formations were evaluated. Similarities in water level trends on opposite sides of a ground water divide were examined. Piezometers and staff gauges were installed and monitored to assess the relationship between the wetland south of the expansion area and the bedrock aquifer in that area. The additional analysis and evaluation provided in this Addendum supports the conclusions that were presented in the 2011 report. The mine expansion will have little or no impact on the expansion area residential wells and their ability to provide water as they do currently. The following bullets summarize the key findings of this additional evaluation.

- The water table reaches a seasonal low in the fall, begins to rise in the winter, steeply rises during the spring thaw, and falls sharply throughout the summer. The magnitude of the seasonal water level change is quite variable, with over 30 ft of change in some wells.
- The seasonal low water table is already below the proposed quarry floor elevation across much of the expansion area and the rest of the mine; consequently, the water table will not be drawn down any further in those areas at full build out of the expansion area. The only water table drawdown during the seasonal low conditions will be in the area south of the southern portion of the mine expansion, south of where seepage faces are predicted along the highwall. There are no residential wells in this area south of the mine expansion.
- The seasonal high water table, as with the low water table, is already below a portion of the proposed quarry floor. As with the seasonal low water table, seepage faces are predicted for the southern highwall of the mine expansion. Seepage faces are also predicted to occur along the northwestern quarry wall of the mine expansion during the seasonal high water table. Water table drawdown is anticipated to be negligible at wells 9 and 10, which are the closest wells to the northwest corner of the expansion area. Plenty of available drawdown will still exist in these wells during seasonal high water table conditions.
- The only well known to have encountered confined conditions within the Bertie Group in the vicinity of the mine is former monitoring well 27. Confined conditions within the Bertie Group are of limited areal extent in the vicinity of the mine. Onondaga wells, Onondaga/Akron and Onondaga/Akron/Bertie wells were shown to have remarkably similar hydrographs; consequently, it is reasonable to use any of the wells for constructing water table contours.
- The majority of wells on both sides of the divide were shown to be responding to the same weather-related conditions and seasonal patterns. The sump water level responds to these same conditions, as well as increased or decreased pumping rates. Some wells are better connected to transmissive fractures than other wells. The karst related variability causes some wells to react more quickly to precipitation events or dry periods, regardless of geologic unit screened. Data from the Spectra 2000 report, and further analysis of water level data from the spring of 2011, indicate that it is not reasonable to attribute

large water level declines in residential wells over a mile from the sump to small water level declines in the sump.

- Data collected since the Alpha report in 2013 indicate that the wetland rests on clay and/or bedrock that has little fracture connection to the water table; that the water table elevation, represented by the bedrock aquifer, is routinely beneath the elevation of the wetland; and that the wetland is primarily supported by shallow, perched ground water flow from locations further upgradient and from ditches that drain offsite areas located south and southeast of the wetland.

References

Fisher, D.W., Y.W. Isachsen, and L.V. Rickard, 1970, Geologic Map of New York – Finger Lakes Sheet, New York State Museum And Science Service, Map and Chart Series No. 15.

Spectra Environmental Group, Inc, 2000, Sump Deepening Impact Assessment March 9-17, 2000, Pump Test & Long Term Monitoring Report, Unpublished Consulting report for Hanson Aggregates East, 162 p., plus Appendices.

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TABLES

TABLE 1
Residential Well Construction Data
Hanson Aggregates New York, LLC
Alpha Project No. 11110

Well ID	Address	Add'l Well ID	Elevation at Grade (approx)	Total Depth	Elevation at Well Base	Top of Bertie Grp (Akron Fm)	Difference in Elev. of Well Base & Top of Bertie Grp.	Bedrock at Well Base	Notes
7	1068 Oak Openings Rd		722	163	559	545	14	Onondaga Fm	
8	919 Works Rd	alt	708.5	123	585.5	544	41.5	Onondaga Fm	
55		old	706.5	86	620.5	546	74.5	Onondaga Fm	
9	916 Works Rd		705	147	558	568	-10	Bertie Grp (Akron)	deepened well from 119' to 147' some time after 10/19/09
10	1815 Honeoye Falls No. 6 Rd		720	126.7	593.3	588	5.3	Onondaga Fm	
11	1819 Honeoye Falls No. 6 Rd		713	152	561	589	-28	Bertie Grp (Akron)	cascading water reported in 2000
12	1820 Honeoye Falls No. 6 Rd		707	140	567	587	-20	Bertie Grp (Akron)	"Broke up limestone" at 120 ft (Driller's Log); drilled in 2009
13	1855 Honeoye Falls No. 6 Rd		721.5	180	541.5	599	-57.5	Bertie Group	Bedrock should be Bertie Fm - personal communication from R. Moravec (driller) to S. Trader (Alpha); deepened from 140 ft in 2009
14	1895 Honeoye Falls No. 6 Rd		702.2	147	555.2	600	-44.8	Bertie Group	
15	1901 Honeoye Falls No. 6 Rd		699.6	140	559.6	606	-46.4	Bertie Group	cascading water reported in 2000
16	1919 Honeoye Falls No. 6 Rd	new	697	150	547	609	-62	Bertie Group	Drilled circa 1997; DOH records indicate 150 ft TD; former resident indicated in phone call with M. Lewis (Hanson) that well TD was 120 ft; cascading H2O in 2009
16		old	697	86	611	609	2	Onondaga Fm	
35	Silo Well		665	94	571	<557	>0	Onondaga Fm	well not in use
36	1110 Dalton Rd		678	113	565	<557	>0	Onondaga Fm	Replacement well drilled circa 2004; former well was 54 ft deep (Onondaga)

Intrpretation of bedrock at base of well based on top of Akron elevation contours on Figure 7, with additional information in Notes column

Grade elevations are from driller's log or estimates from topo map, except for residential wells 9, 35 and 36, which were surveyed by Hanson.

Sources of information include Monroe County Department of Health, Livingston County Department of Health, NYSDEC Well completion Reports, personel communication with residents and drillers, and Spectra 2000 report

TABLE 2
Quarry Well Construction Data
Hanson Aggregates New York, LLC
Alpha Project No. 11110

Well ID	Additional Well ID	Elevation at Grade (TOC - stickup, if known)	Total Depth	Elevation at Well Base	Top of Bertie Grp (Akron Fm)	Difference in Elev. of Well Base & Top of Bertie Grp.	Bedrock at Well Base	Notes
17	Wash Plant No. 2	688	125	563	606	-43	Bertie Group	rarely used; see note 1
18	Garage	712	120	592	610	-18	Bertie Grp (Akron)	rarely used; see note 1
---	Office Well	700	111	589	609.5	-20.5	Bertie Grp (Akron)	used for bathrooms and non-potable; see note 1
20	Crusher Run Plant	656.5	110	546.5	578	-31.5	Bertie Group	dust supression; see note 1
21	Primary Crusher Plant	660	110	550	582	-32	Bertie Group	dust supression; see note 1
22	3-99	690.2	120	570.2	<570.2	>0	Onondaga Fm	see note 2
23	1-99	547.4	131	416.4	<547.4	>0	Onondaga Fm	see note 2
24	1A-99	677.9	145	532.9	537.9	-5	Onondaga / Akron	10-ft screen is 135-145 ft below grade and screened across Onon/Akron contact; contact assumed at middle of screened interval; see note 2
25	2-99	662.7	105	557.7	<557.7	>0	Onondaga Fm	see note 2
28	5-99	578.4	30	548.4	568.4	-20	Bertie Grp (Akron)	10-ft screen interval is 20-30 ft below quarry floor and entirely within Akron; top of Akron assumed to be 10 ft above well screen; see note 2
29	4-99	670	100	570	<570	>0	Onondaga Fm	see note 2
---	09-001	700.2	90	610.2	615.2	-5	Bertie Grp (Akron)	see note 3
---	09-002	708.4	102	606.4	618.7	-12.3	Bertie Grp (Akron)	see note 3
---	09-003	705.4	120	585.4	580	5.4	Onondaga Fm	see notes 1 &3
---	10-001	705.7	125	580.7	557	23.7	Onondaga Fm	see note 1
---	10-002	708.2	120	588.2	564	24.2	Onondaga Fm	see note 1

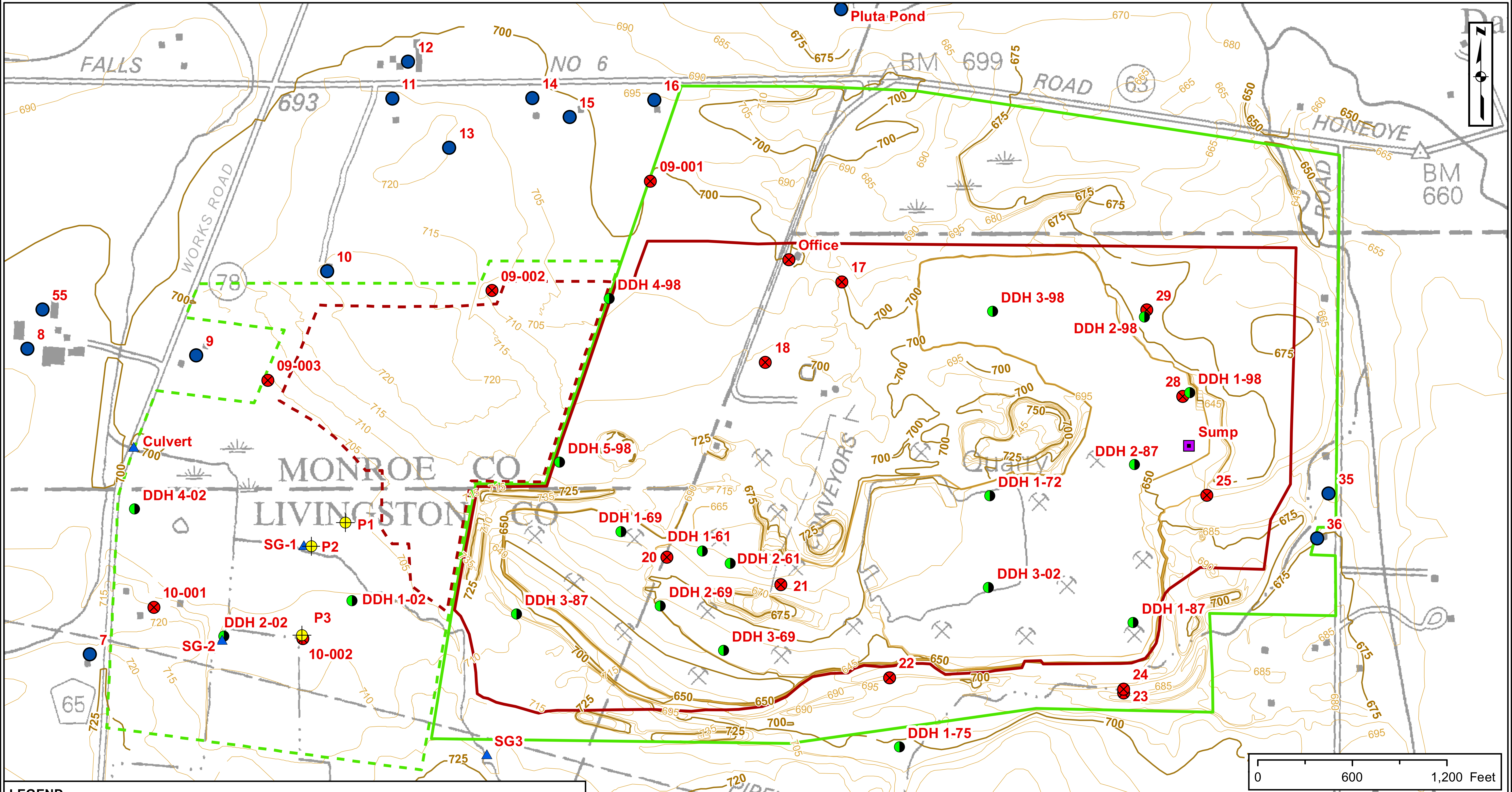
Notes:

[1] Interpretation of bedrock at base of well based on top of Akron elevation contours on Figure 7

[2] Interpretation of bedrock at base of well based well construction data in Spectra (2000)

[3] Interpretation of bedrock at base of well based on drill cuttings

FIGURES



LEGEND

- Monitoring Well
- Residential Well
- Piezometer
- Deep Drill Hole
- Surface Water Monitoring Location
- Sump
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approx. excavation limit at end of mining (future)

Notes:
-Basemap: NYSDOT 7.5-minute topographic map (Honeoye Falls and Rush Quadrangles).
-Elevations are shown in feet above mean sea level.
-Contour interval is 5 feet.

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Proj. No. 11110

FIGURE 1
Water Level Monitoring Locations and Deep Drillhole Locations

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

Path: Z:\projects\2011\11100-11120\11110 - Hanson Honeoye Expansion\GIS\Well Locations with DDH.mxd
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FIGURE 2
Hydrographs
Wells 7 and 16

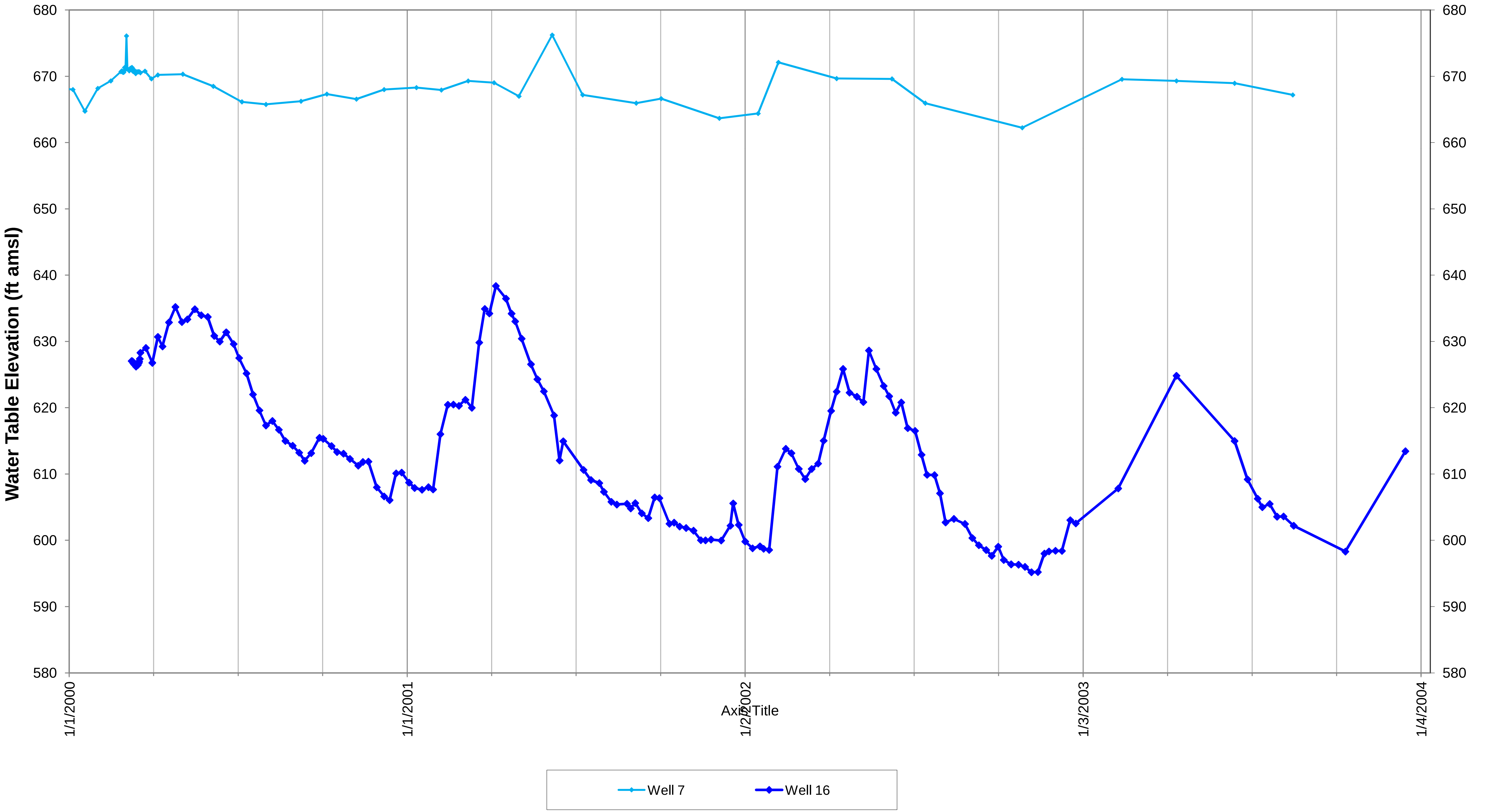

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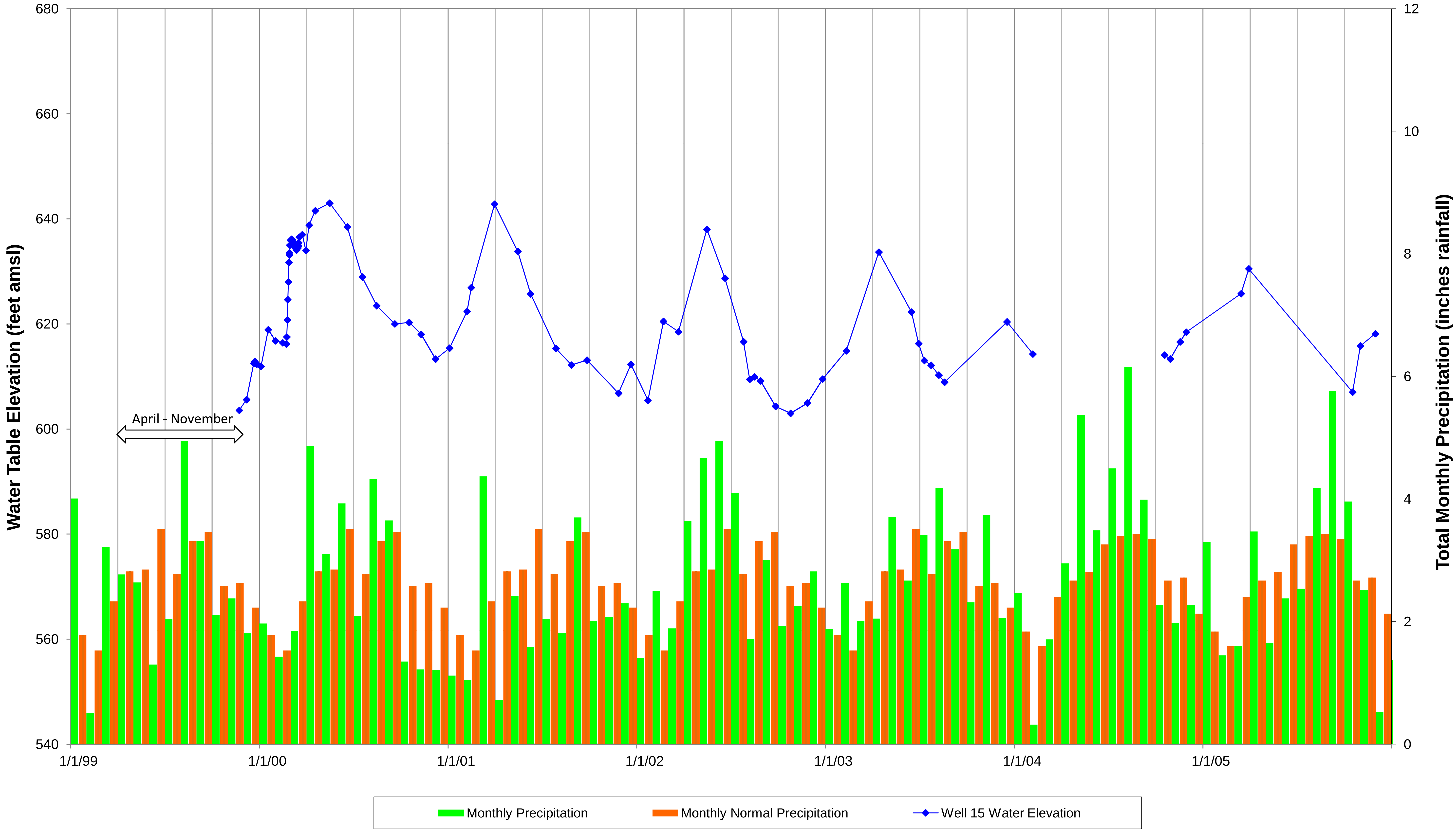
FIGURE 3
Hydrograph
1901 Honeoye Falls #6 (Well 15)



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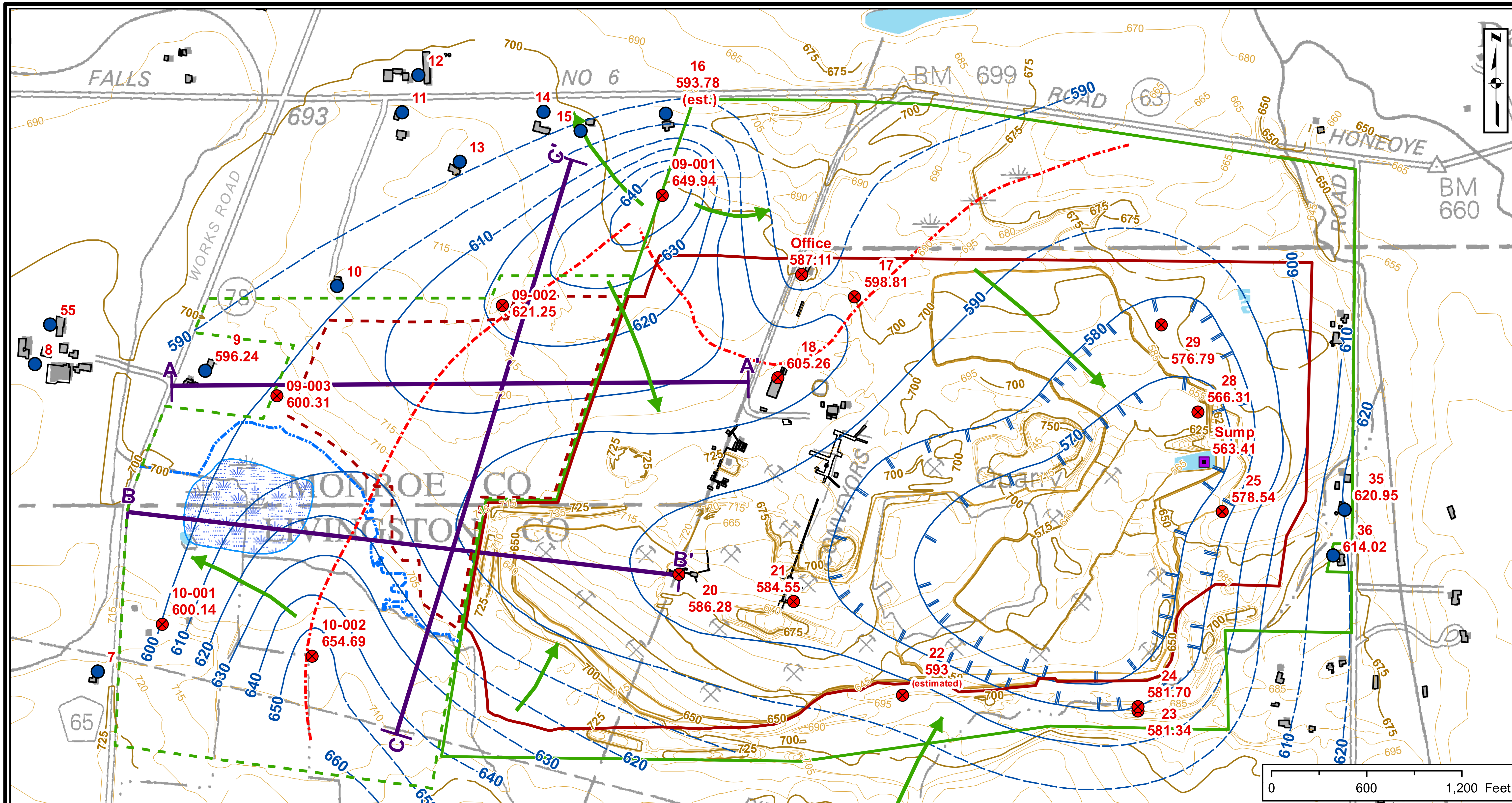

LEGEND

- Monitoring Well
- Residential Well
- Sump
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approx. excavation limit at end of mining (future)
- Wetland Delineation
- Water Table Contour (feet msl) [Dashed where inferred]
- Ground Water Divide
- Ground Water Flow Direction
- Building
- Water
- Wet Area

Source: NYSDOT 7.5-minute topographic map (Honeoye Falls and Rush Quadrangles)

Note: -Elevations are shown in feet above mean sea level.
-Contour interval is 5 feet.

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FIGURE 4
Seasonal Low
Ground Water Elevation Contours
August 23, 2010
Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

Path: Z:\projects\2011\11100-11120\11110 - Hanson Honeoye Expansion\GIS\Fig 4 - 2010-08-23_GW_Contours_11X17.mxd
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FIGURE 5
Hydrographs for Wells 22 & 23
2005-2008

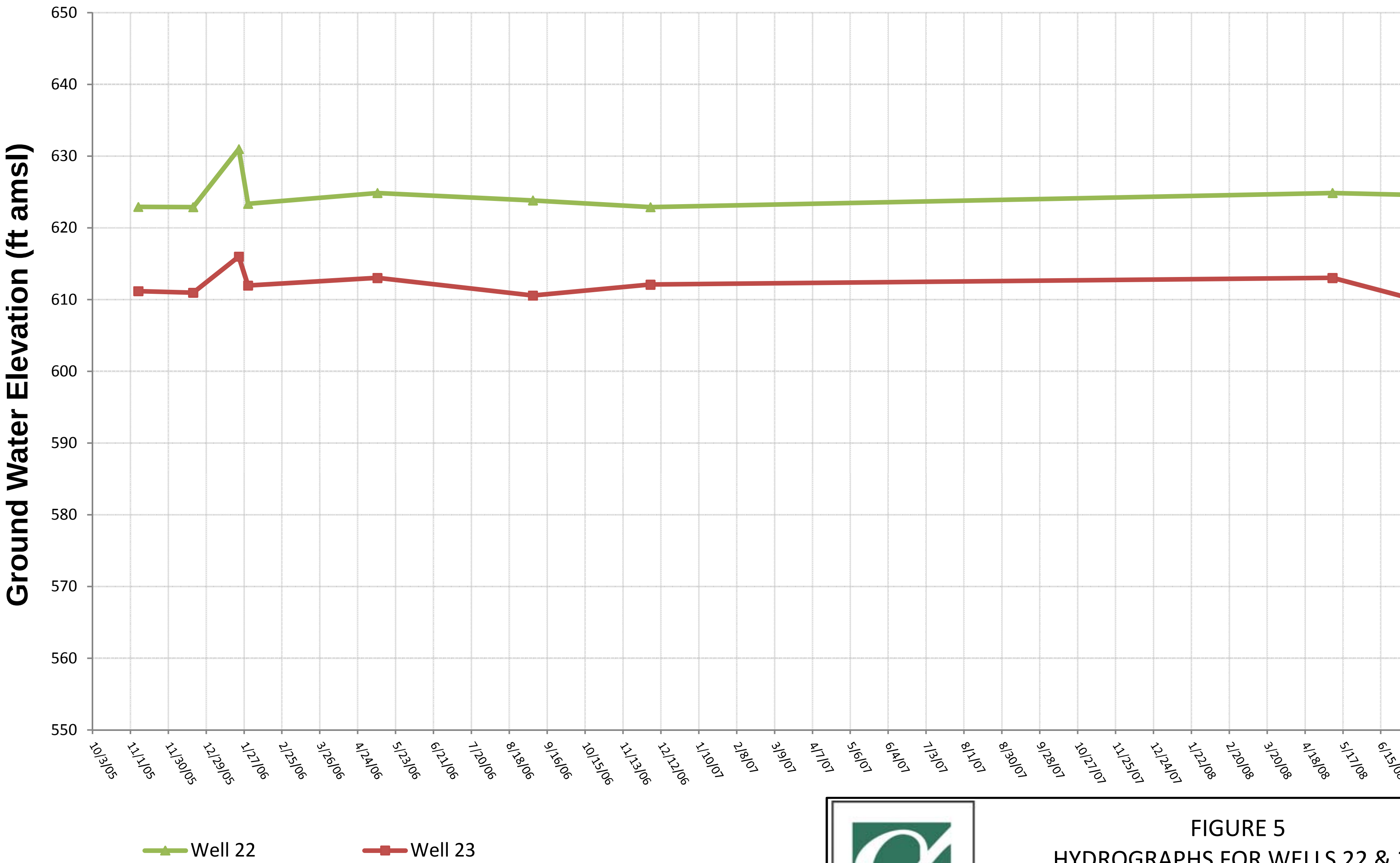

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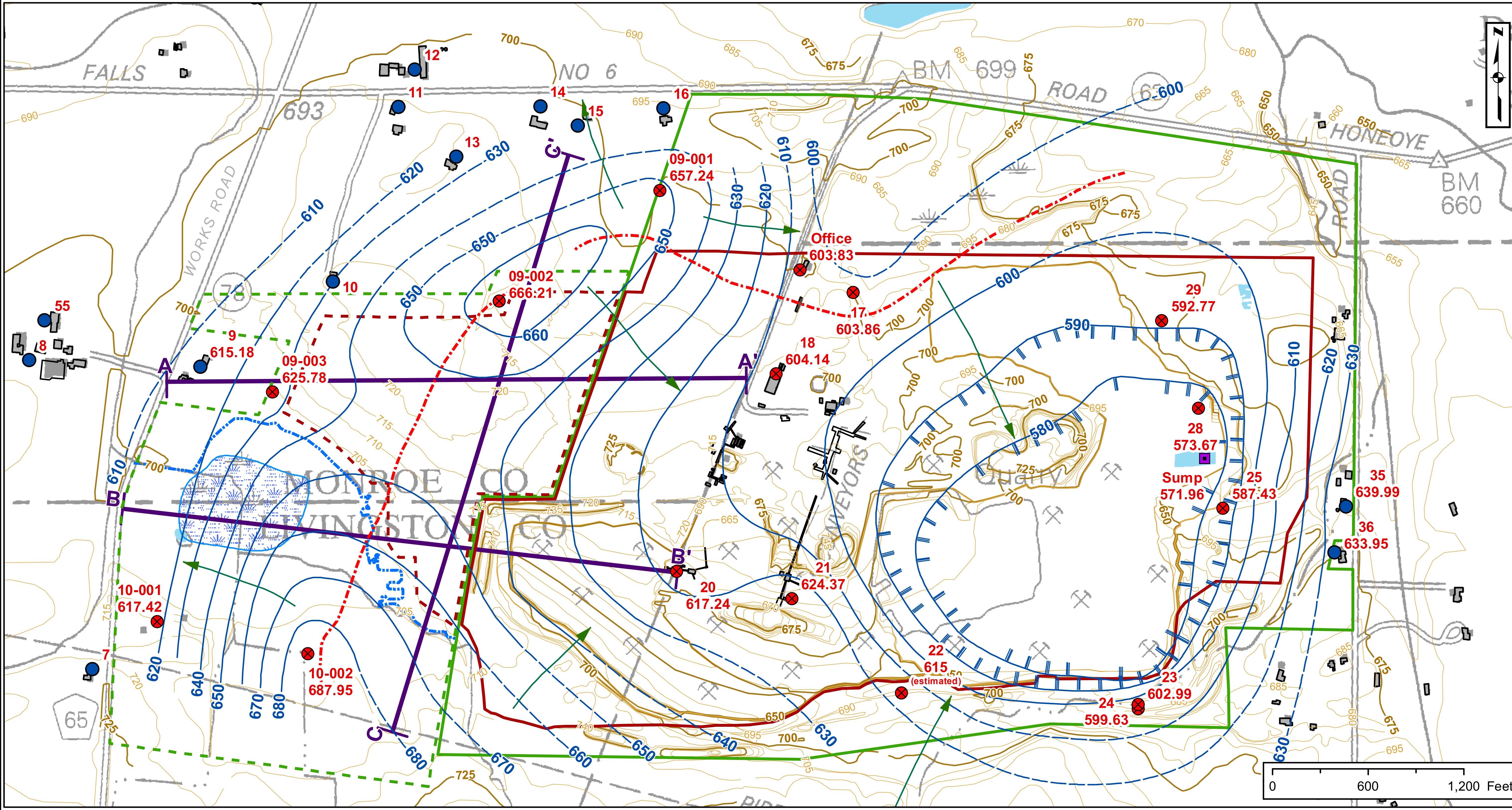
FIGURE 5
HYDROGRAPHS FOR WELLS 22 & 23

Hanson Aggregates NY, LLC
Livingston and Monroe Counties, New York



LEGEND

- Monitoring Well
- Residential Well
- Sump
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approx. excavation limit at end of mining (future)
- Wetland Delineation
- Water Table Contour (feet msl) [Dashed where inferred]
- Ground Water Flow Direction
- Ground Water Divide
- Building
- Water
- Wet Area

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Proj. No. 11110

FIGURE 6
Seasonal High Ground Water Elevation Contours
February 25, 2011

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC

Livingston and Monroe Counties, NY

Source: NYSDOT 7.5-minute topographic map (Honeoye Falls and Rush Quadrangles)

Note: -Elevations are shown in feet above mean sea level.
-Contour interval is 5 feet.

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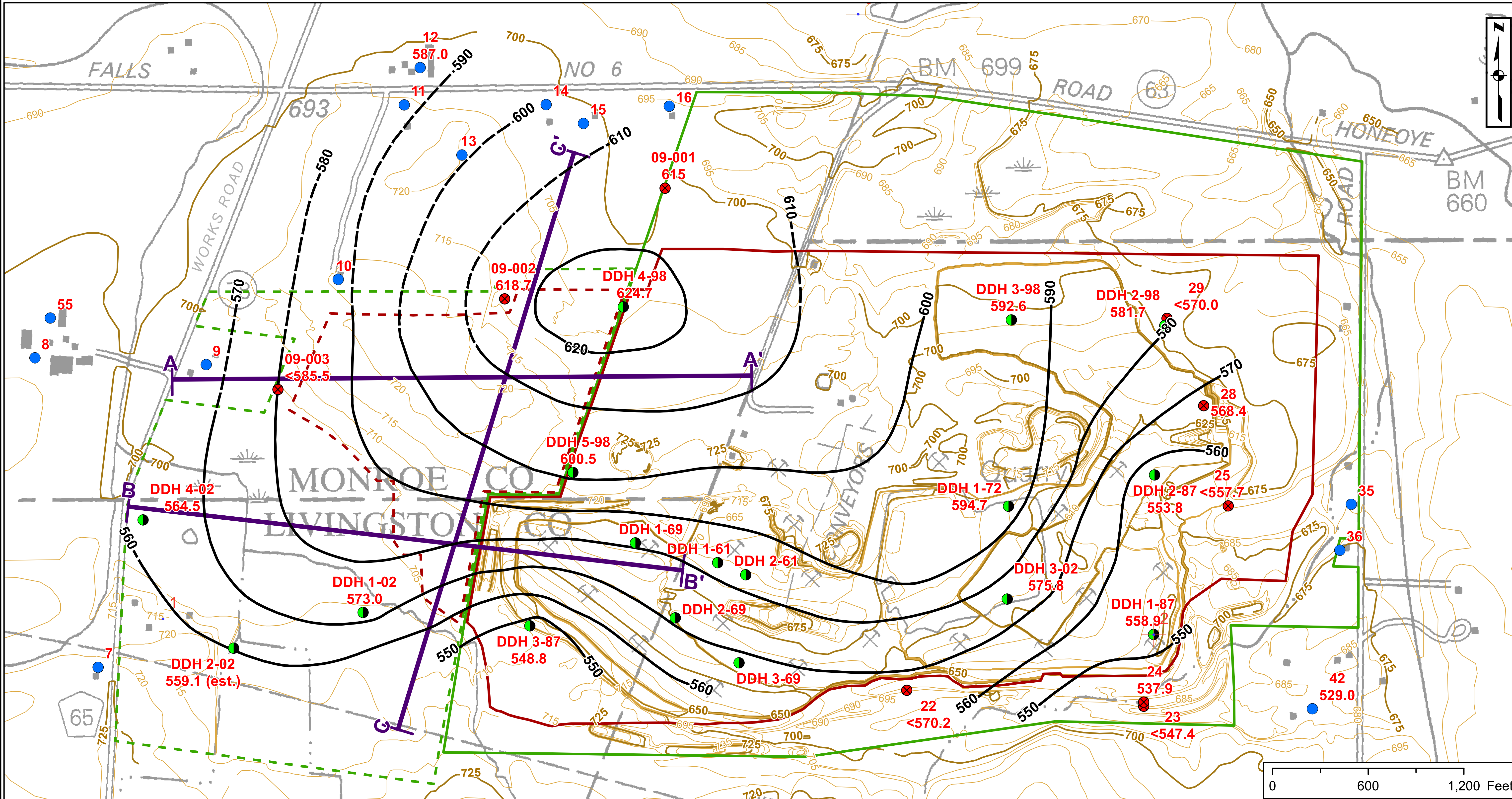

Notes: estimated (est.) elevations interpolated using data from surrounding core holes.

LEGEND

- Monitoring Well
- Residential Well
- Deep Drill Hole
- Top of Bertie Contour (feet msl)

Topographic Contours (feet amsl)

- 25 feet interval
- 5 feet interval

- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approximate excavation limit at end of mining (future)

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FIGURE 7

Top of Bertie Group (Top of Akron Formation) Structural Contours

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

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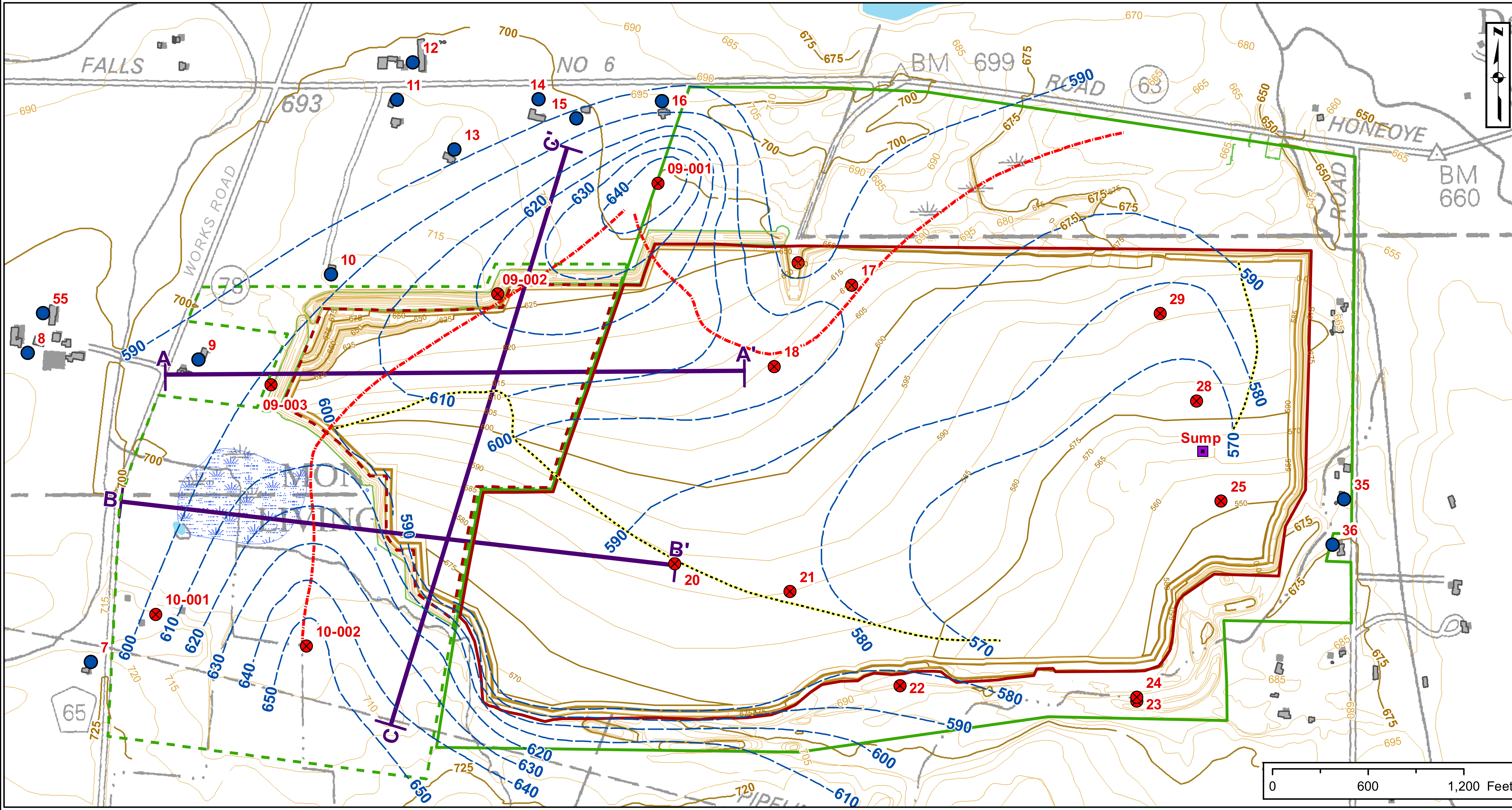

LEGEND

- Monitoring Well
- Residential Well
- Sump
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approx. excavation limit at end of mining (future)
- Predicted Future Water Table Contour (feet msl)
- Water Table Divide
- Seepage
- Building
- Water
- Wet Area

Source: NYSDOT 7.5-minute topographic map (Honeoye Falls and Rush Quadrangles)

Note: -Elevations are shown in feet above mean sea level.
-Contour interval is 5 feet.

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Proj. No. 11110

FIGURE 8

Seasonal Low Ground Water Elevation Contours at Full Mine Build Out

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

Path: Z:\projects\2011\11100-11120\11110 - Hanson Honeoye Expansion\GIS\Fig XX - Reclaimed Seasonal Low_11X17.mxd
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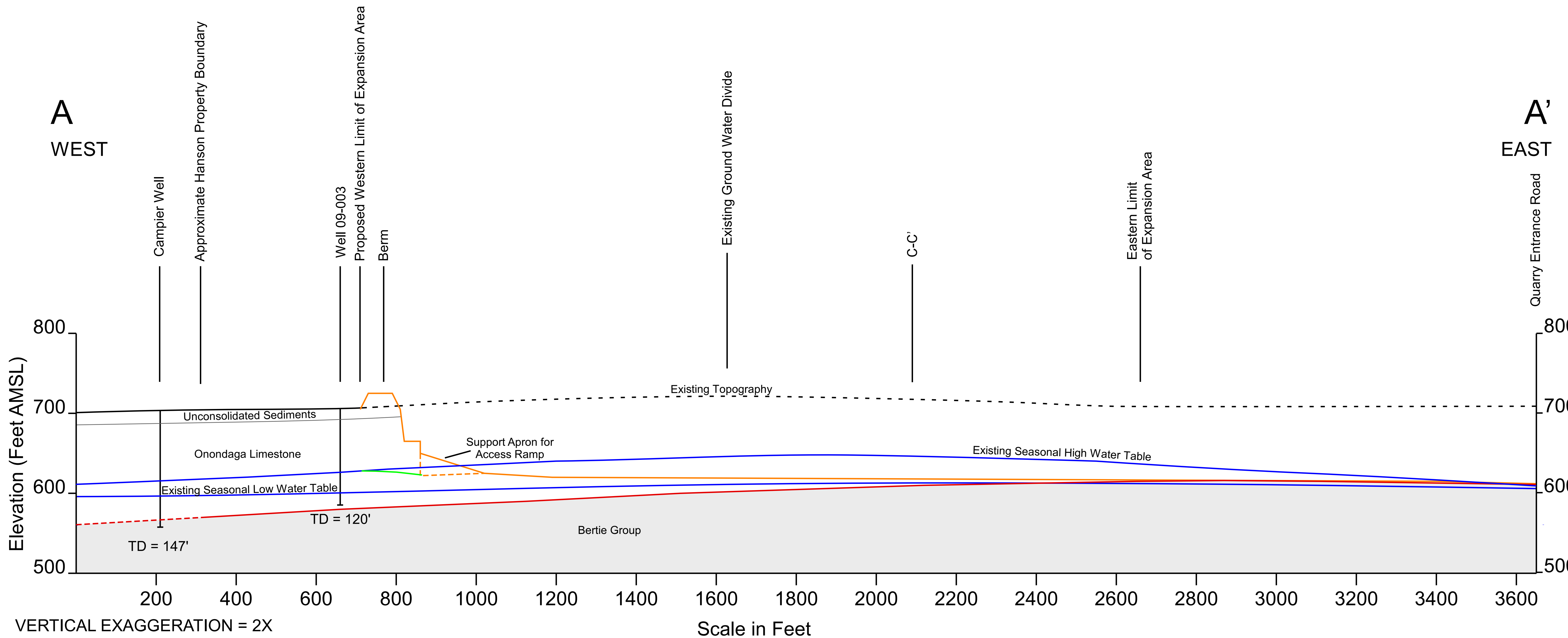

VERTICAL EXAGGERATION = 2X

LEGEND

- Proposed Quarry Expansion
- Top of Bedrock Surface
- Top of Bertie Group (Akron Fm)
- Water Table
- Future Water Table at End of Mining

NOTES:

Well locations shown are extrapolated to the cross-section line from Figure 4.
Seasonal Low Water Table, Seasonal High Water Table and Top of Akron surfaces shown are based on the contours in Figures 4, 6 and 7, respectively.
Quarry profile based on contours in Figures 8 and 12.

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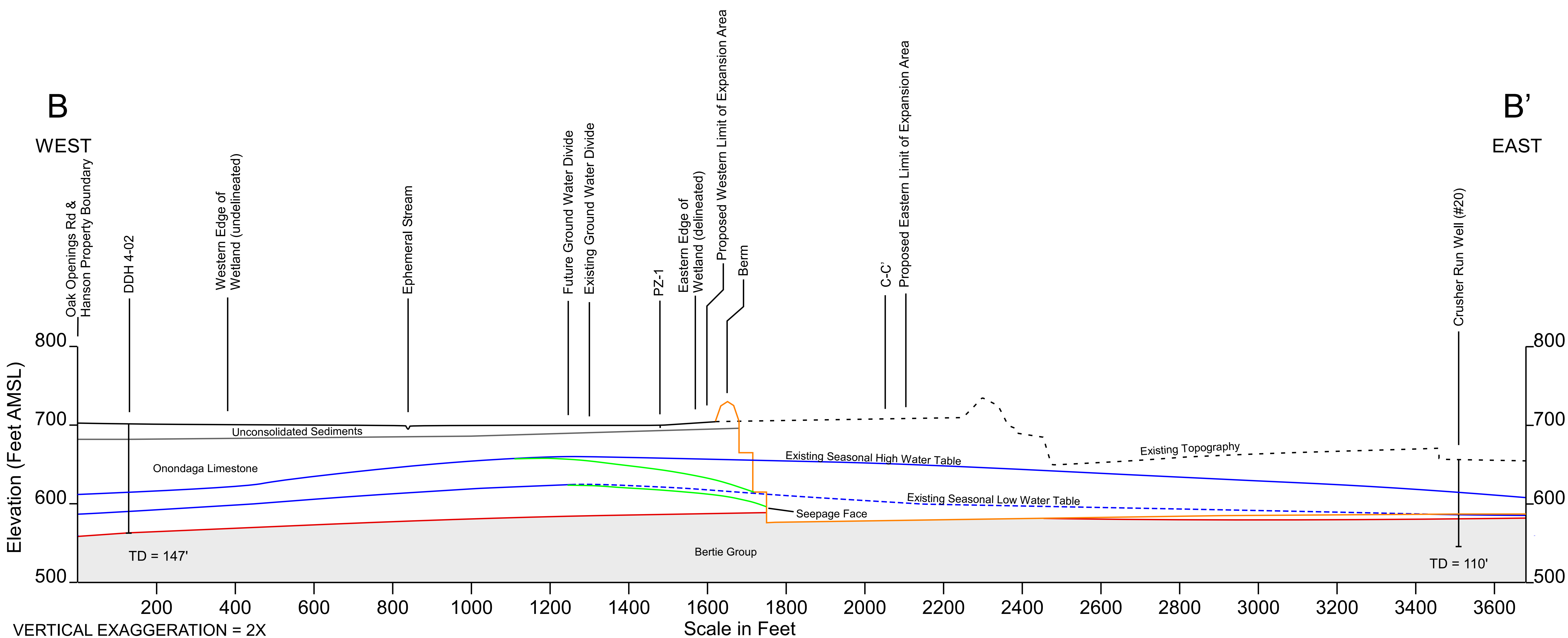
Project #11110

Figure 9
Hydrogeologic Cross-Section A-A'
Full Mine Expansion

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

11110\Cross Sections\A-A' E-W Cross-Section 2014.cvx



LEGEND

- Proposed Quarry Expansion
- Top of Bedrock Surface
- Top of Bertie Group (Akron Fm)
- Water Table
- Future Water Table at End of Mining

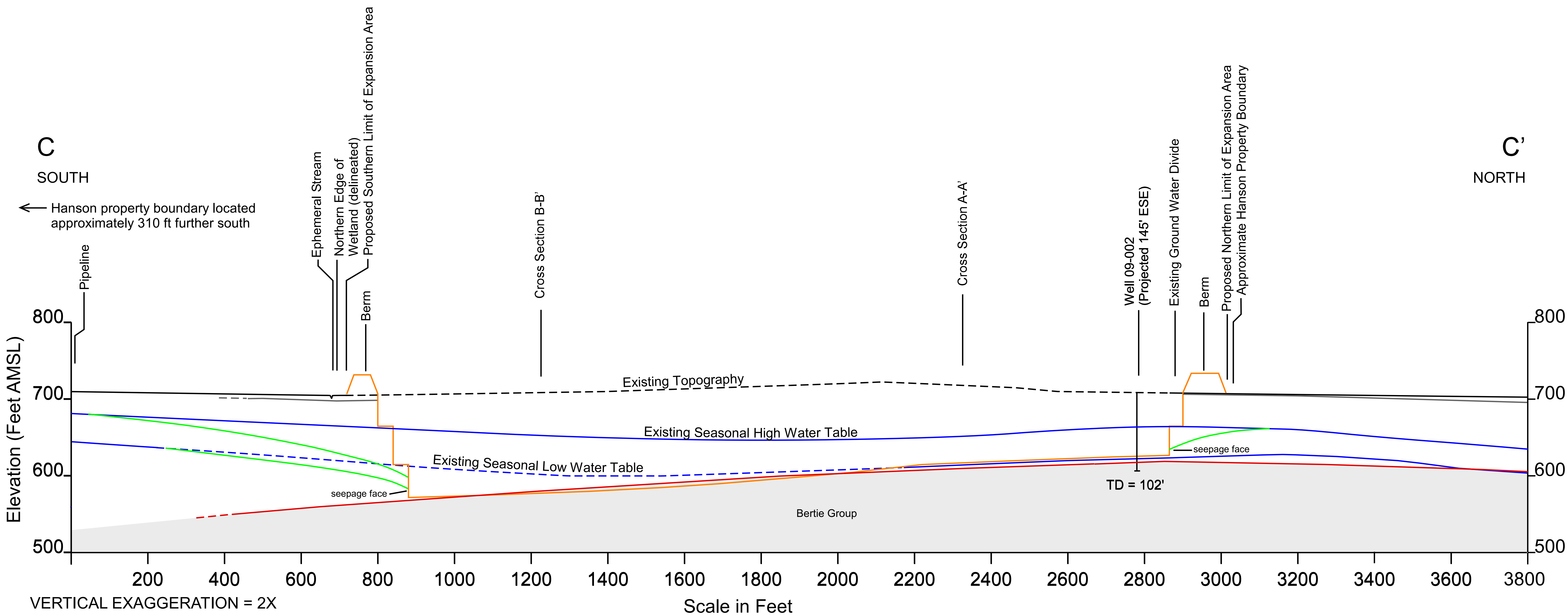
NOTES:

Well and deep drill hole locations shown are extrapolated to the cross-section line from Figures 4 & 7, respectively.
Seasonal Low Water Table, Seasonal High Water Table and Top of Akron surfaces shown are based on the contours in Figures 4, 6 and 7, respectively.
Quarry profile based on contours in Figures 8 and 12.

11110\Cross Sections\B-B' E-W Cross-Section 2014.cvx

ALPHA GEOSCIENCE
Project #11110

Figure 10
Hydrogeologic Cross-Section B-B'
Full Mine Expansion
Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY



LEGEND

- Proposed Quarry Expansion
- Top of Bedrock Surface
- Top of Bertie Group (Akron Fm)
- Water Table
- Future Water Table at End of Mining

NOTES:

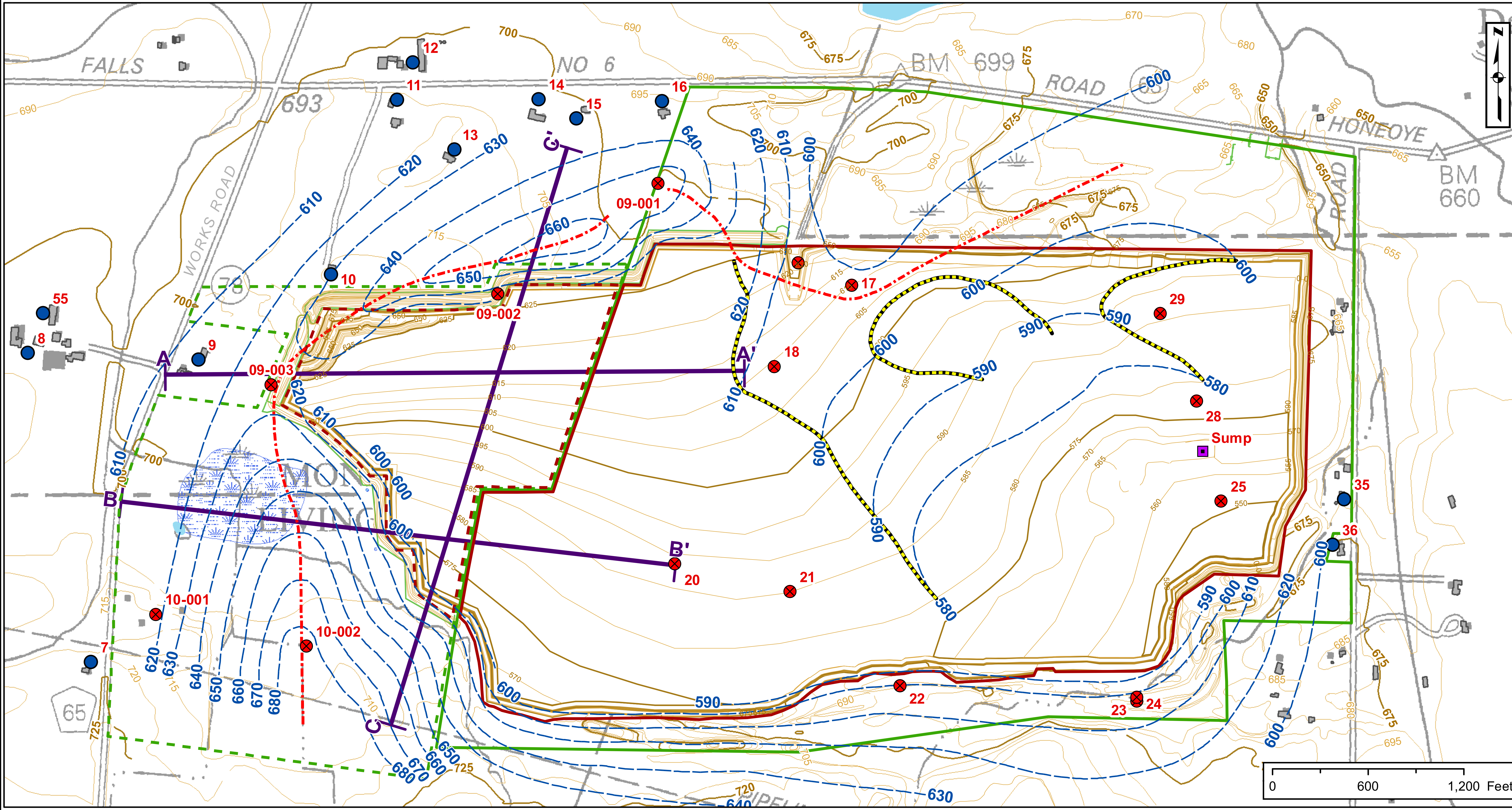
Well location shown is extrapolated to the cross-section line (refer to Figure 4)
Seasonal Low Water Table, Seasonal High Water Table and Top of Akron surfaces shown are based on the contours in Figures 4, 6 and 7, respectively.
Quarry profile based on contours shown in Figures 8 and 12.

11110\Cross Sections\C-C' E-W Cross-Section 2014.cvx

ALPHA GEOSCIENCE
Project #11110

Figure 11
Hydrogeologic Cross-Section C-C'
Full Mine Expansion

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY



LEGEND

- Monitoring Well
- Residential Well
- Sump
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approx. excavation limit at end of mining (future)
- Predicted Future Water Table Contour (feet msl)
- Ground Water Divide
- Ground Water Seepage
- Building
- Water
- Wet Area

Source: NYSDOT 7.5-minute topographic map (Honeoye Falls and Rush Quadrangles)

Note: -Elevations are shown in feet above mean sea level.
-Contour interval is 5 feet.

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Proj. No. 11110

FIGURE 12
Seasonal High Ground Water Elevation Contours at Full Mine Build Out

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, NY

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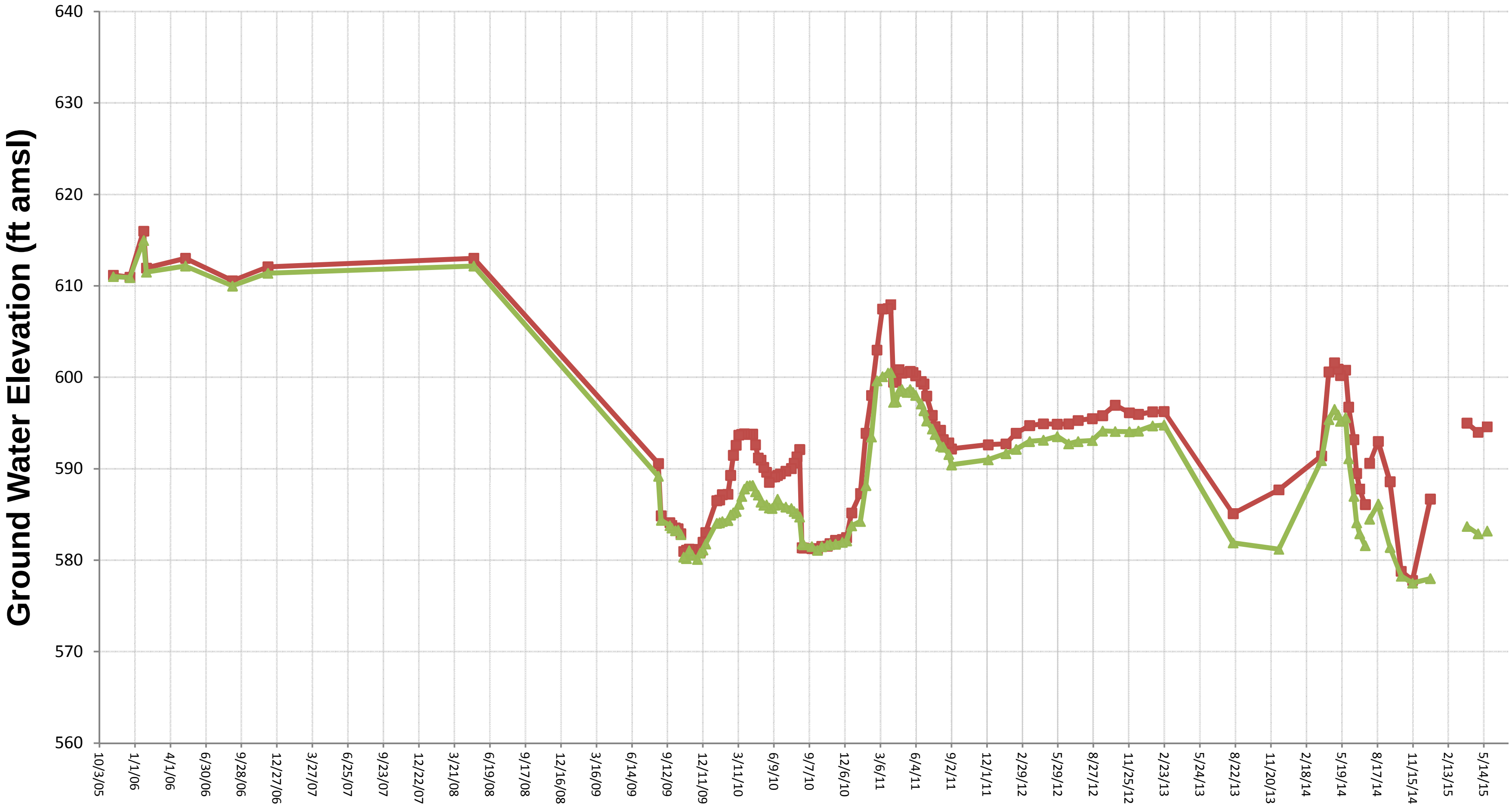
FIGURE 13
Hydrographs for Wells 23 & 24



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Proj. No. 11110

FIGURE 13
HYDROGRAPHS FOR WELLS 23 & 24

Hanson Aggregates NY, LLC
Livingston and Monroe Counties, New York

FIGURE 14
Hydrographs
Old and New Wells at 1919 Honeoye Falls #6 Rd (Well 16)

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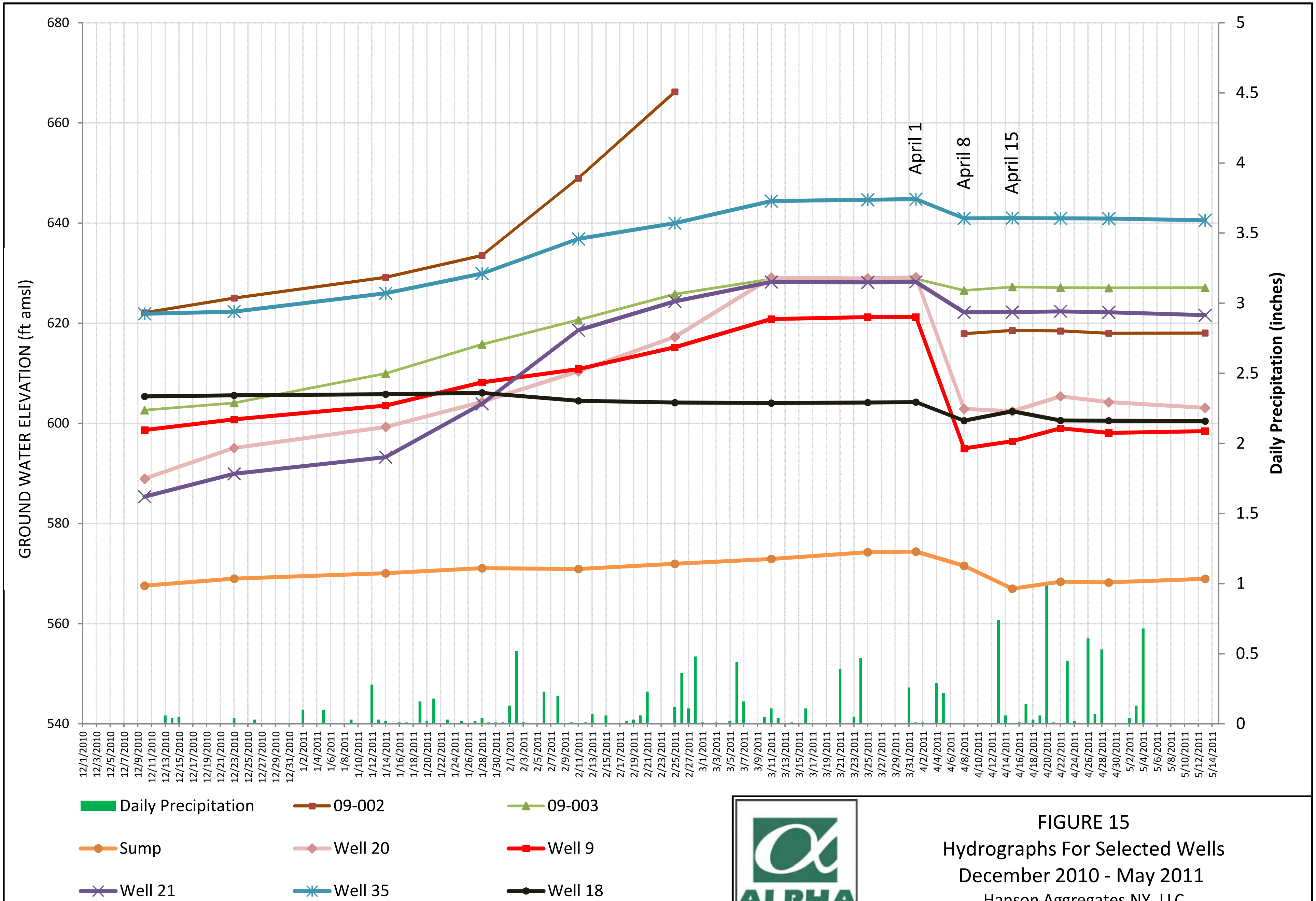

ALPHA GEOSCIENCE
Proj. No. 11110

FIGURE 15
Hydrographs For Selected Wells
December 2010 - May 2011
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, New York

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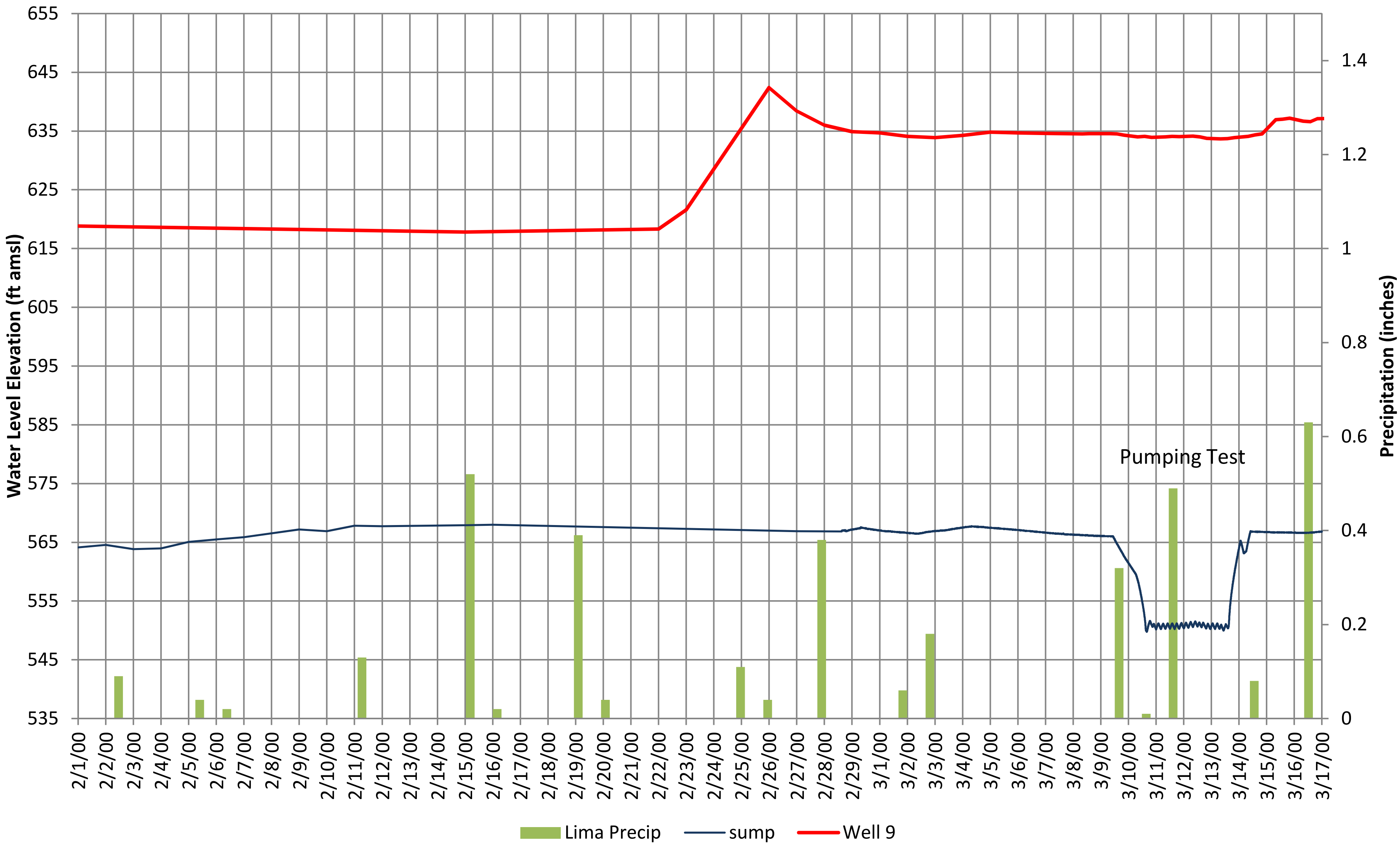
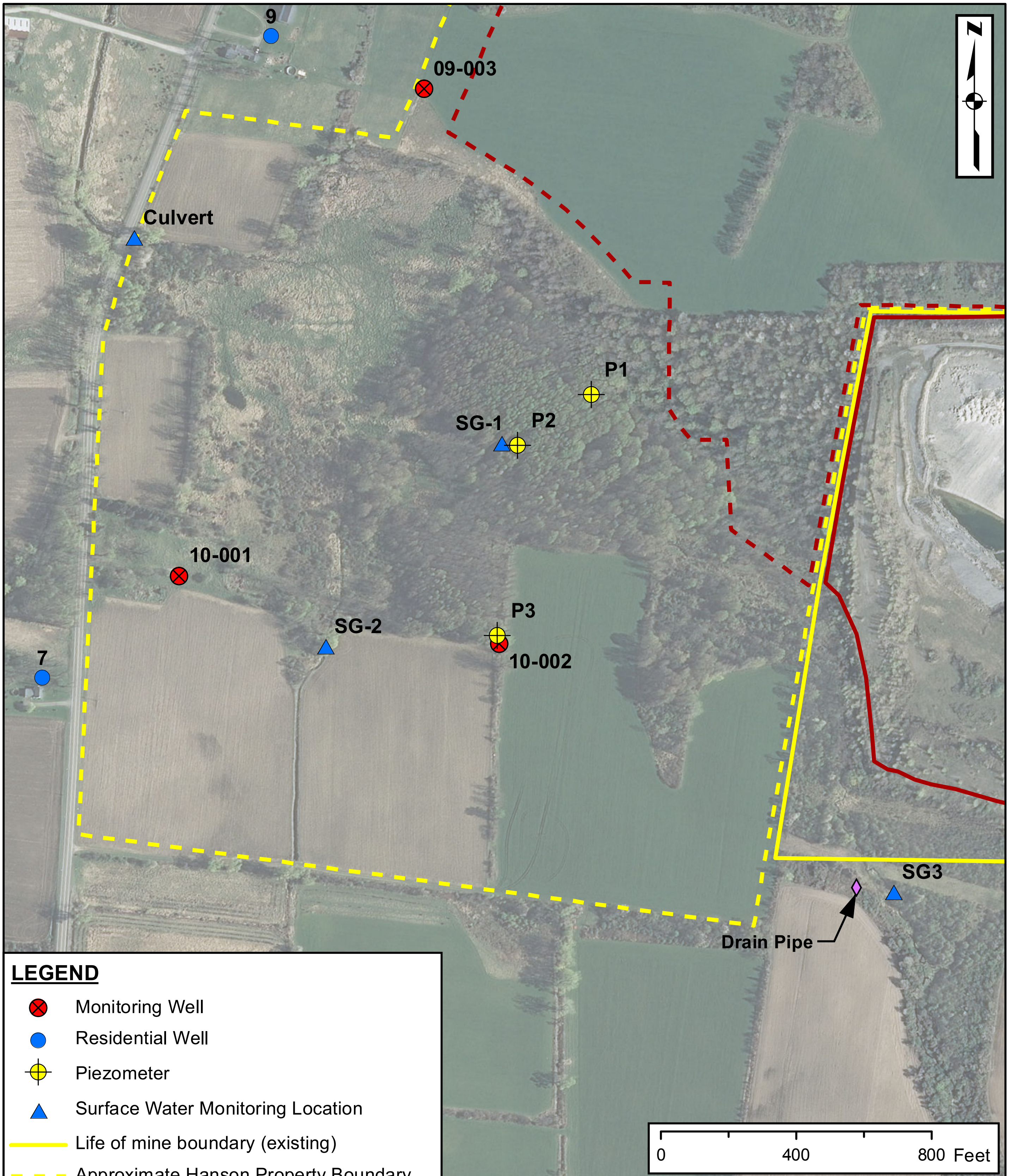
FIGURE 16
Spectra 2000 Sump Drawdown Test
Hydrographs of Sump and Well 9





LEGEND

- Monitoring Well
- Residential Well
- Piezometer
- Surface Water Monitoring Location
- Life of mine boundary (existing)
- Approximate Hanson Property Boundary
- Current excavation limit (existing)
- Approximate excavation limit at end of mining (future)

Source:
- Livingston County 24-inch resolution natural color orthoimagery (2010), NYS Office of Information Technology Services (ITS).

ALPHA GEOSCIENCE
Proj. No. 11110

FIGURE 17
Wetland Area Monitoring Locations

Honeoye Falls Quarry Expansion
Hanson Aggregates NY, LLC
Livingston and Monroe Counties, New York

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FIGURE 18
Wetland Area Hydrographs
Hanson - Honeoye Falls

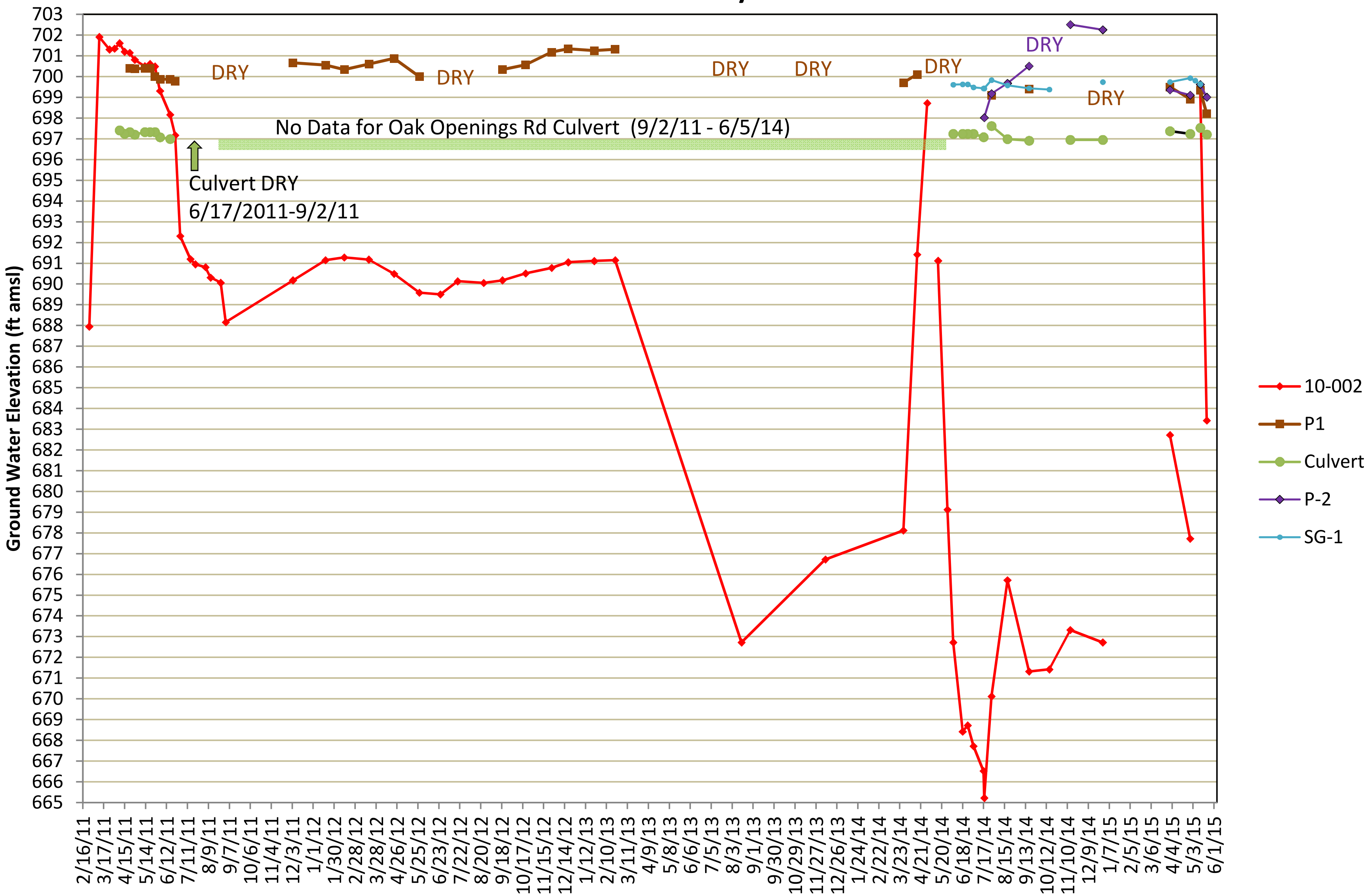

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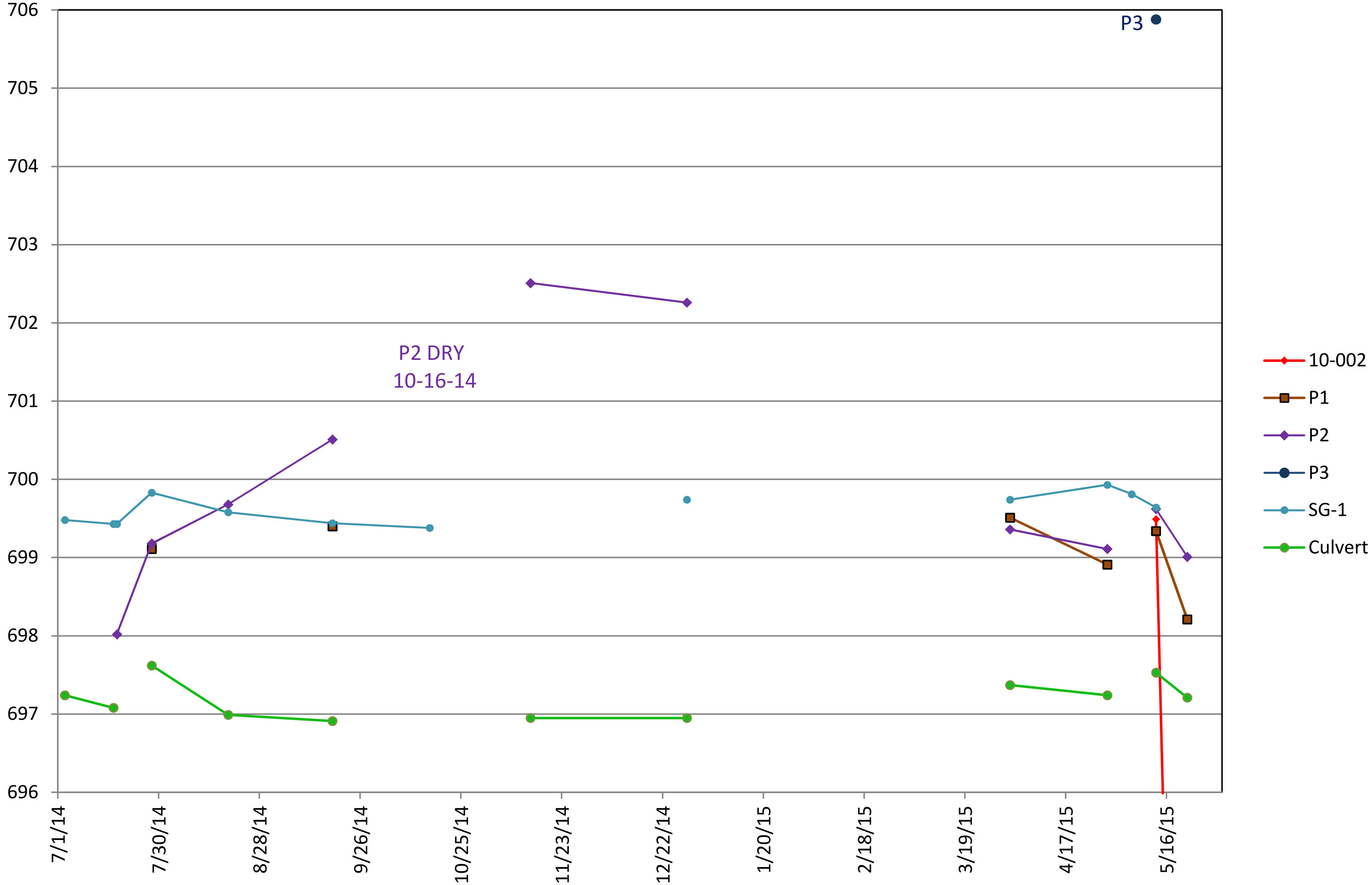
FIGURE 19
Wetland Area Hydrographs With P3
Hanson - Honeoye Falls



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APPENDIX A

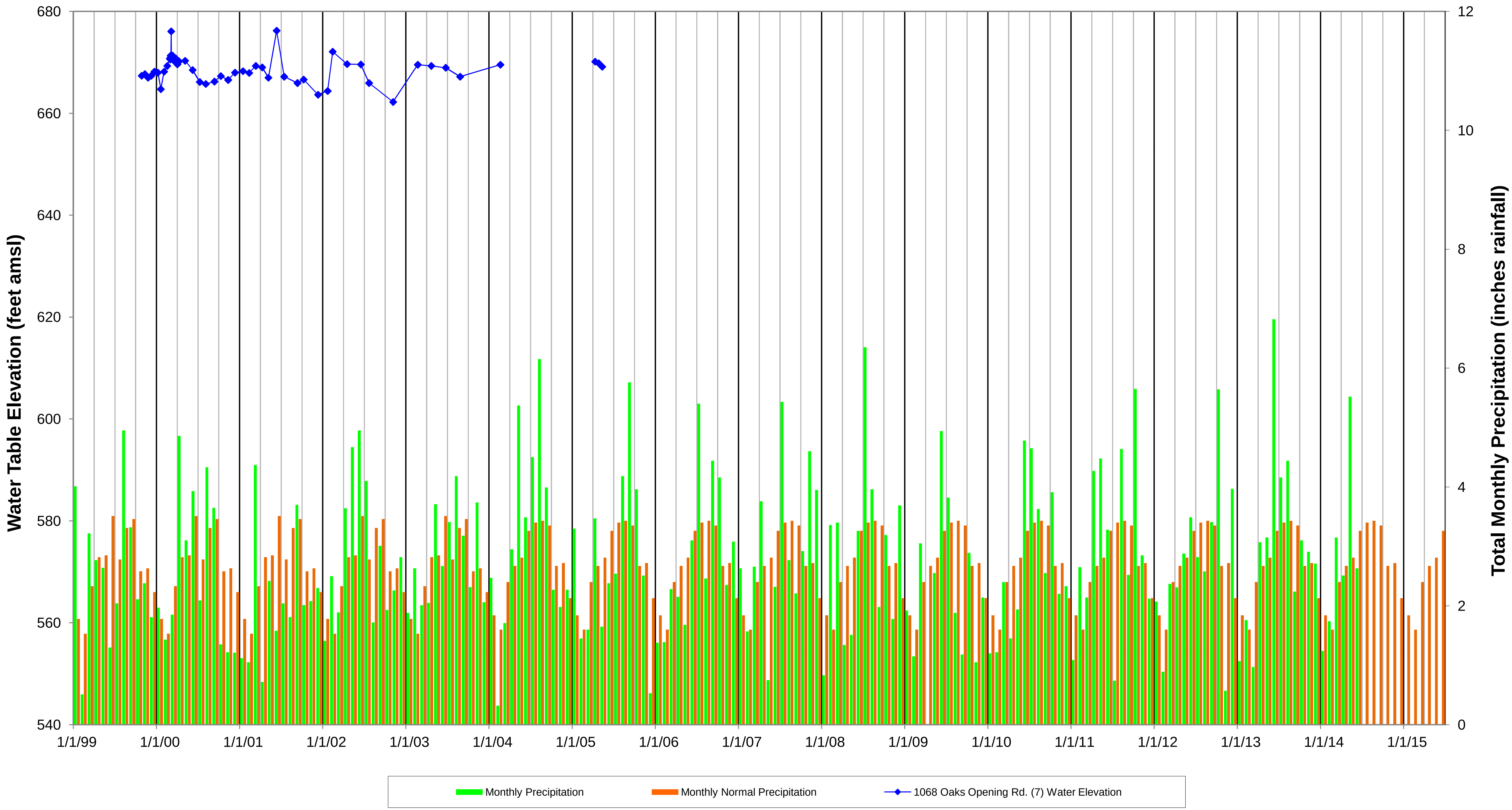
Water Level Data

(file on compact disc)

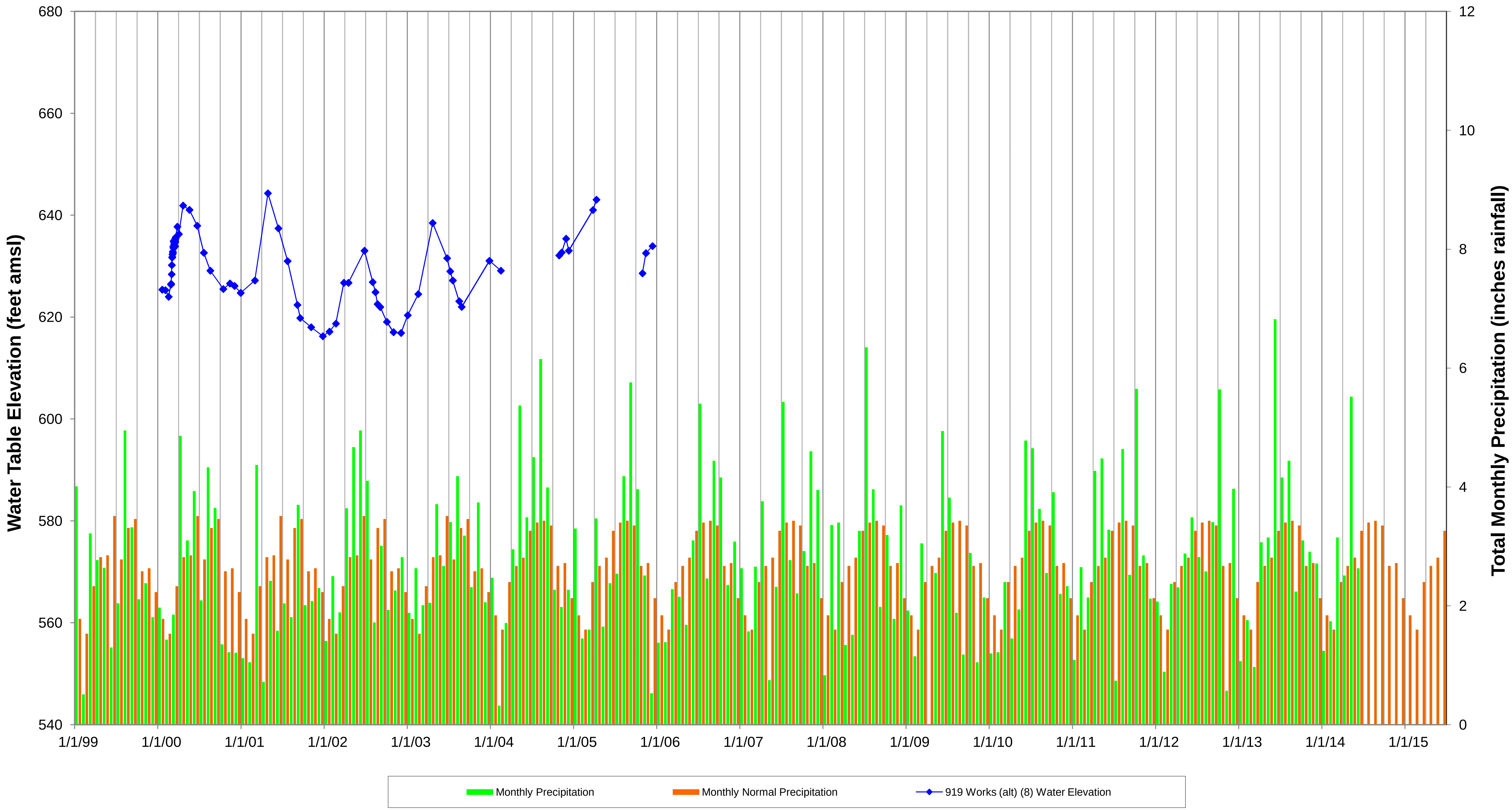
APPENDIX B

Well Hydrographs

Well Hydrograph
1068 Oak Openings Road (7)



Well Hydrograph
919 Works Road (alt) (8)



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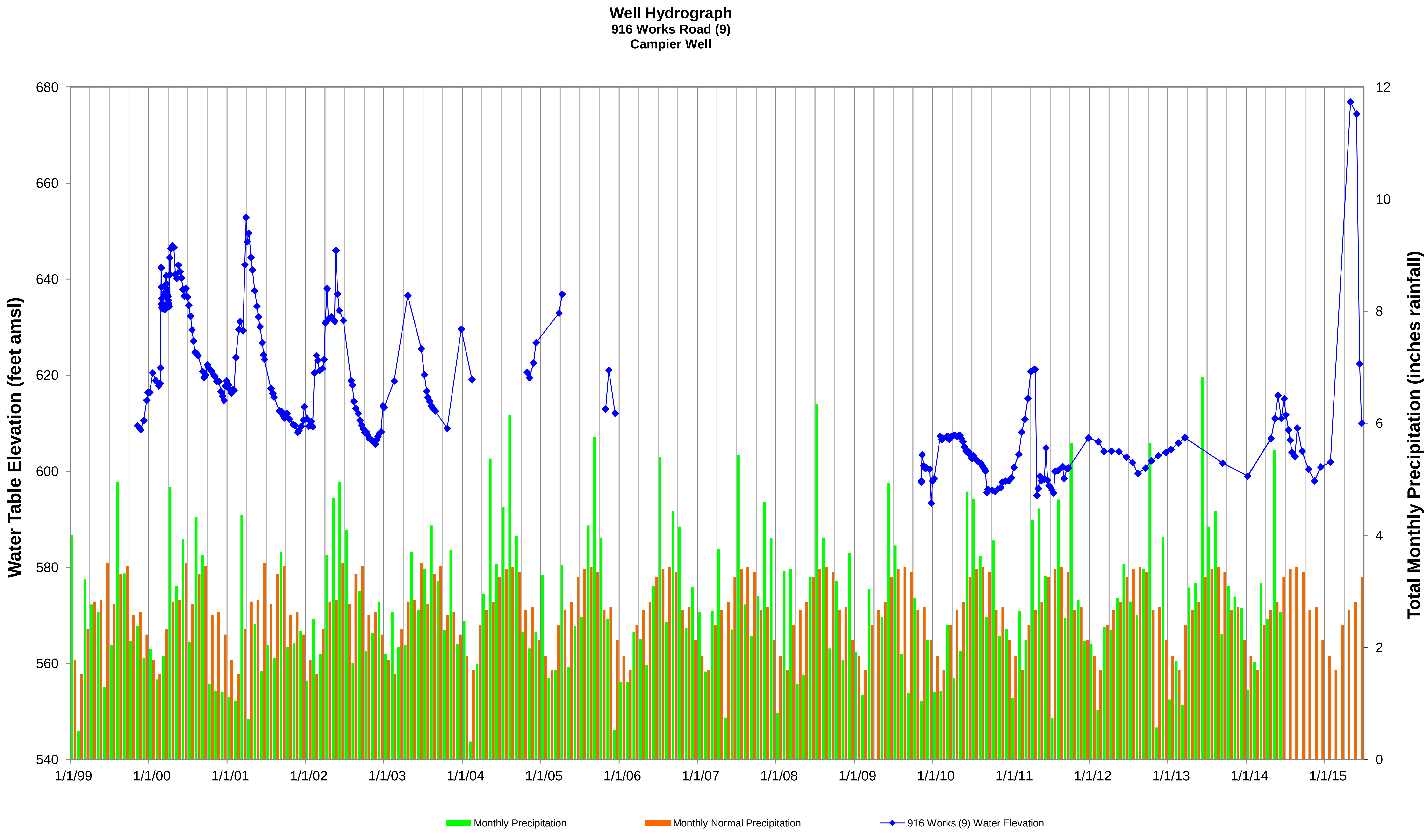

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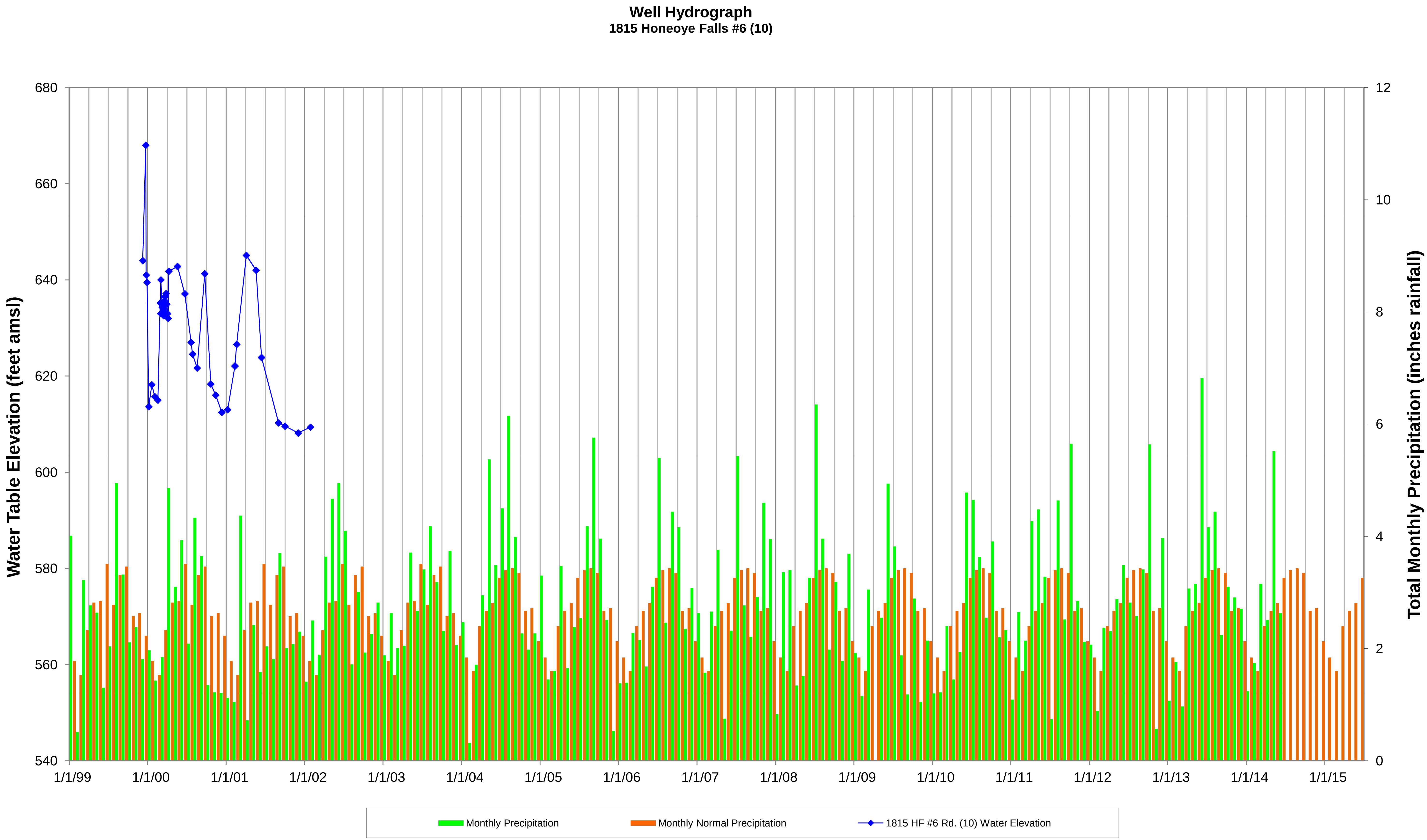

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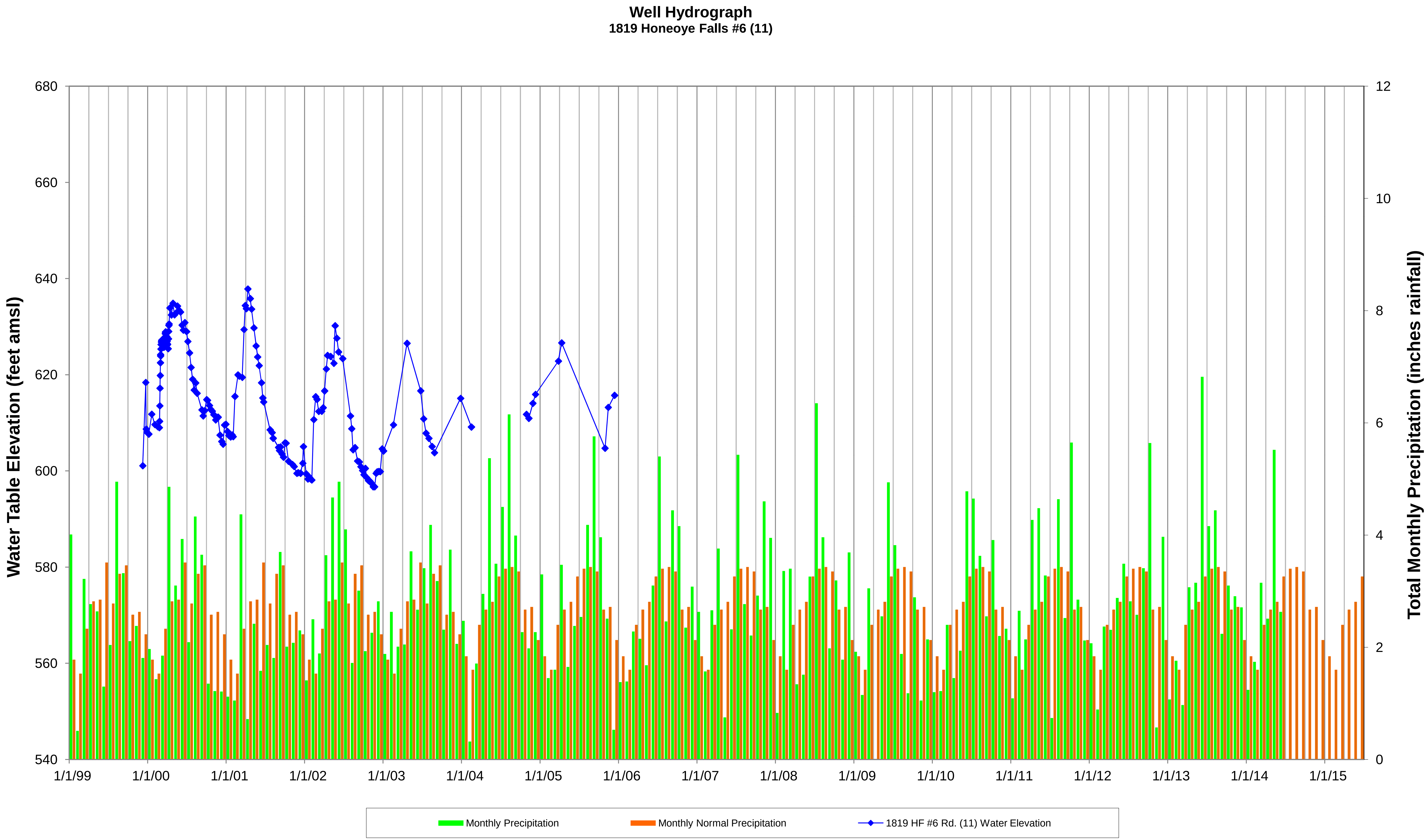

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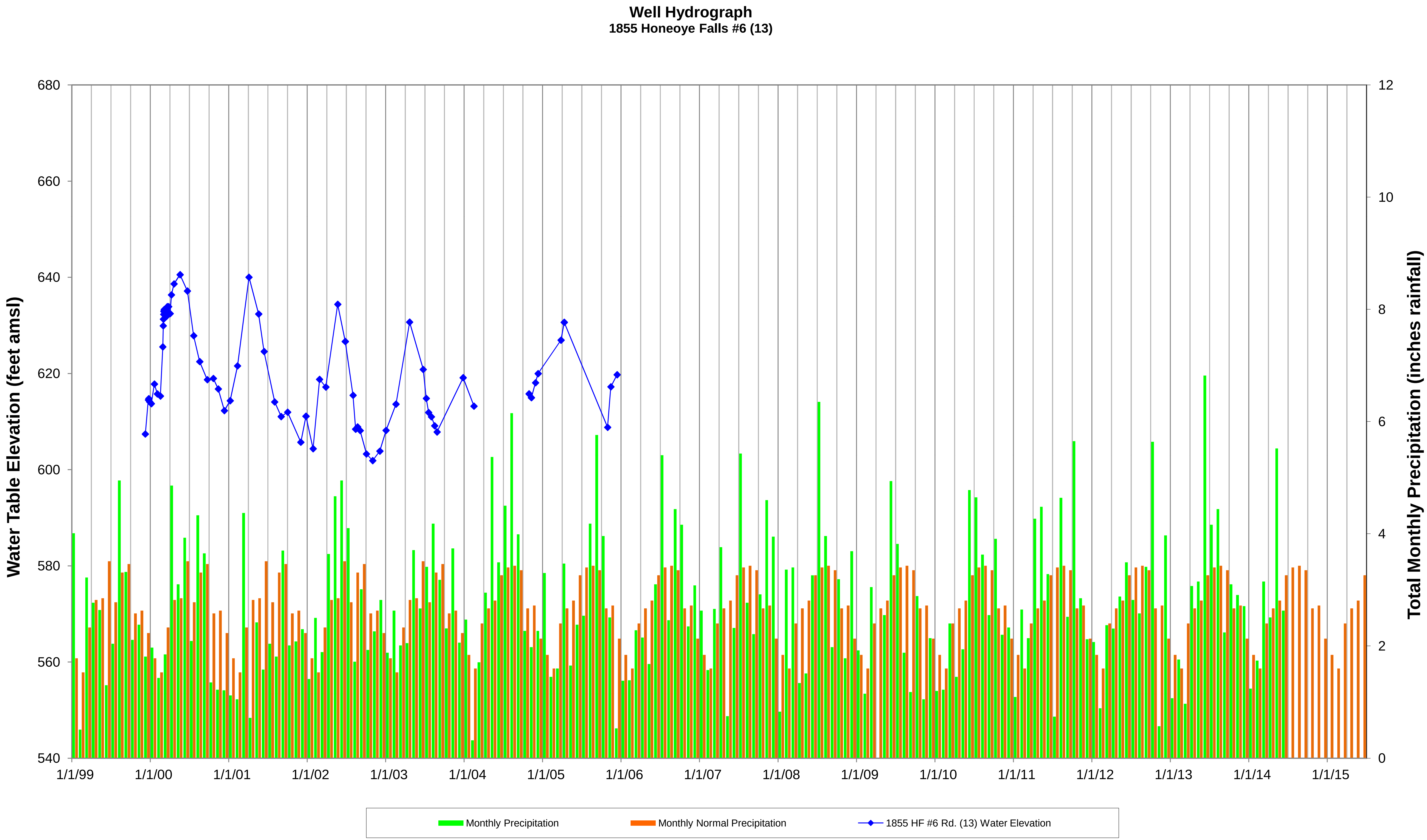

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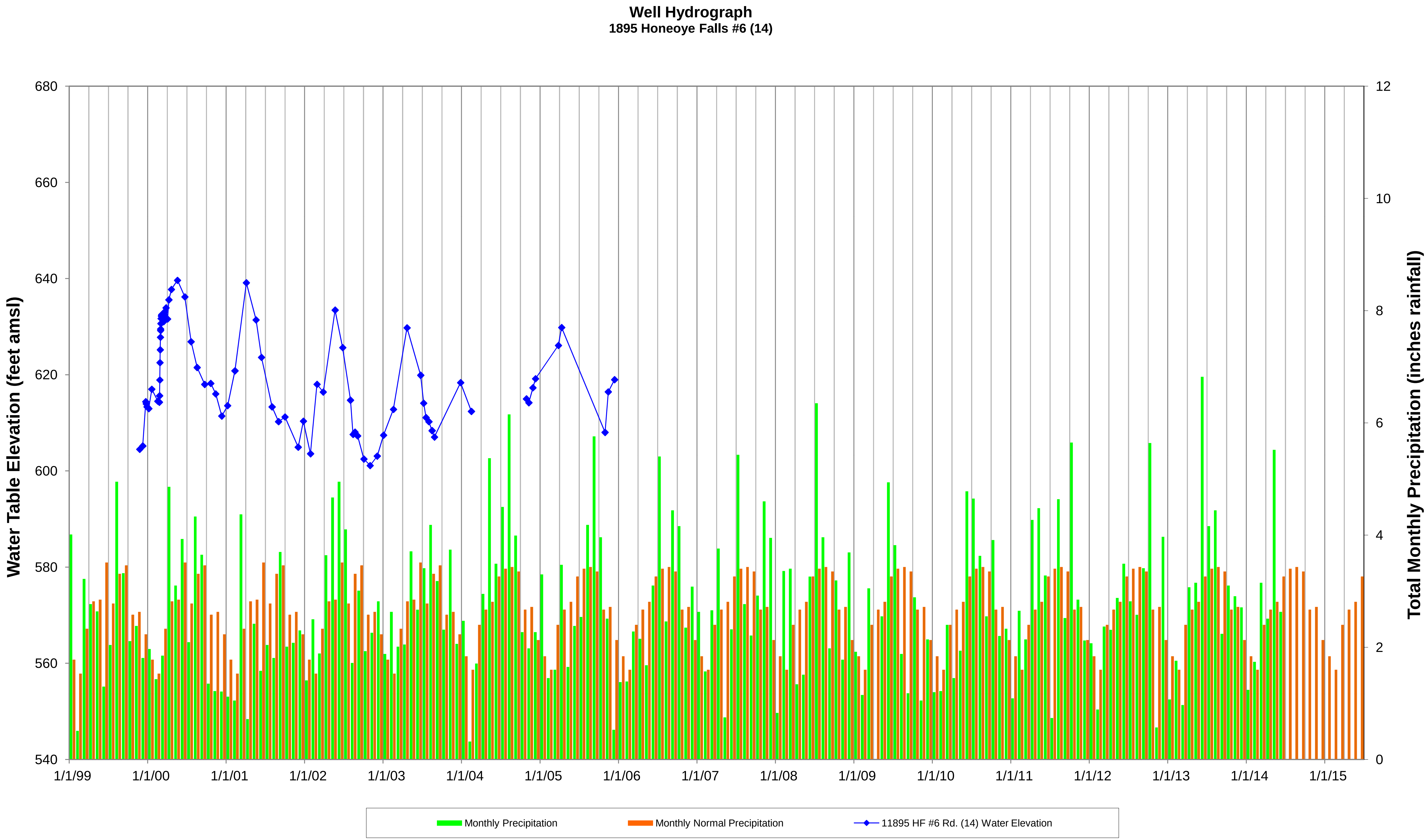

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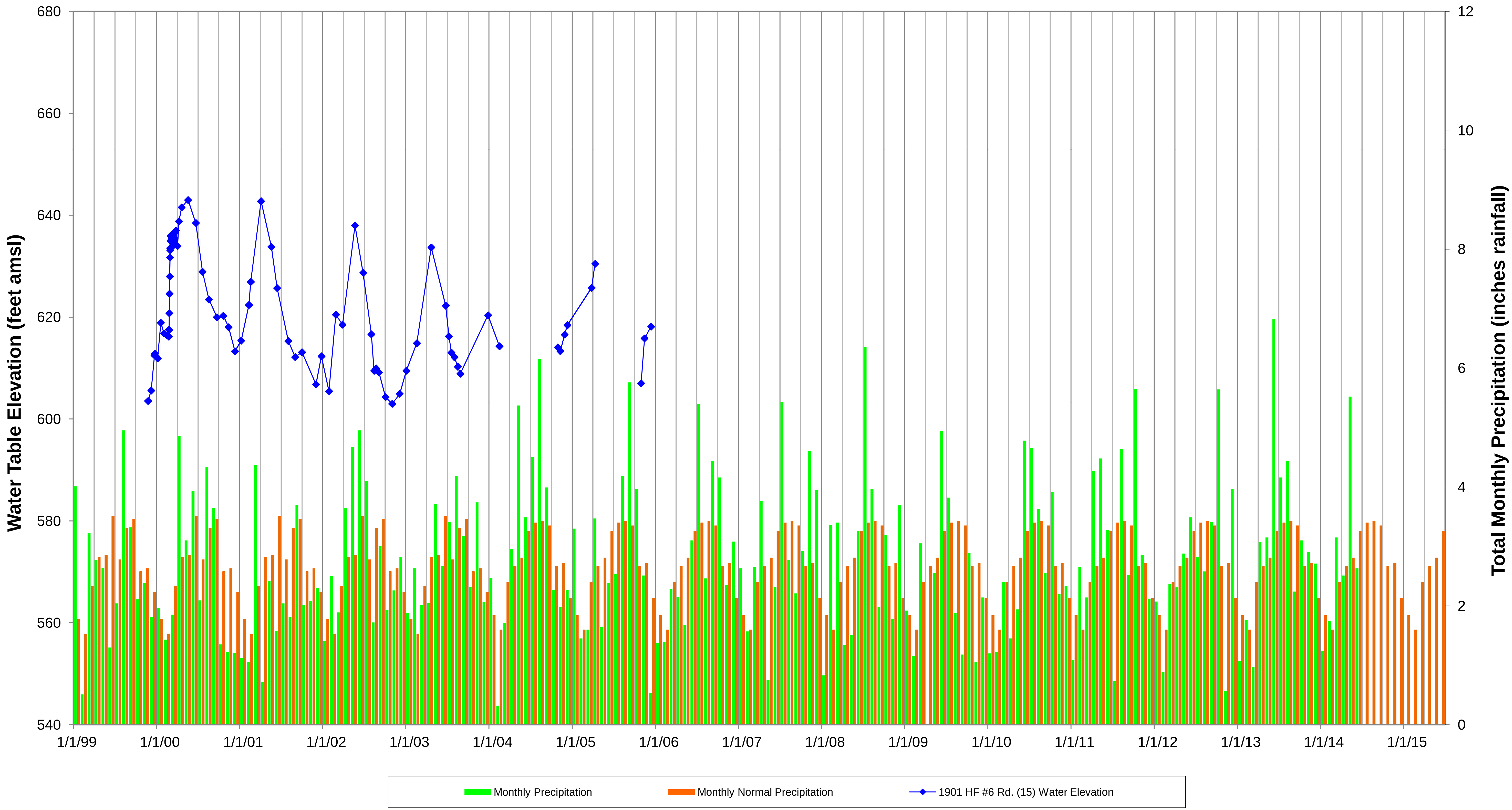
Well Hydrograph

1901 Honeoye Falls #6 (15)



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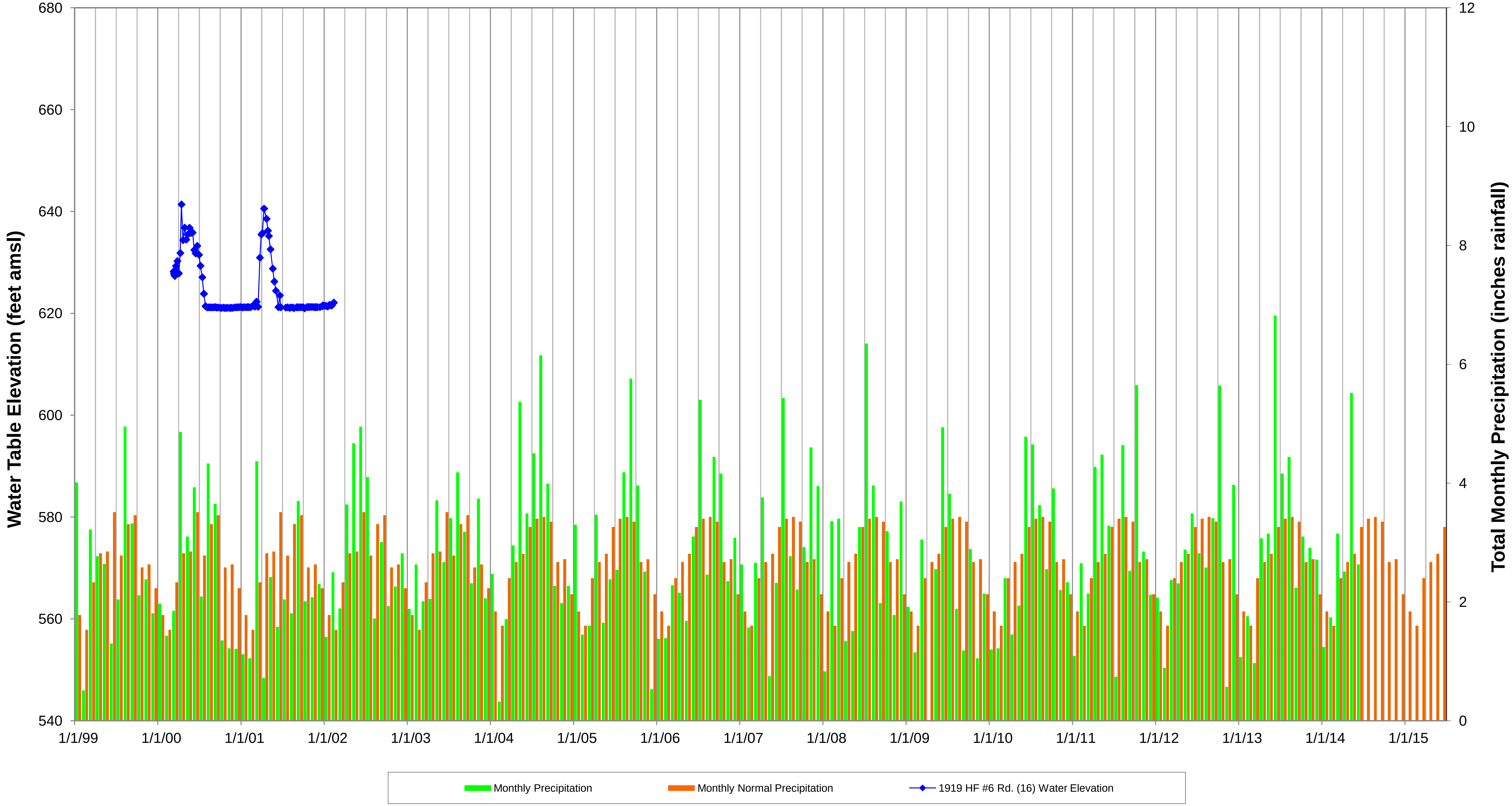
Well Hydrograph

1919 Honeoye Falls #6 Rd - old (16)



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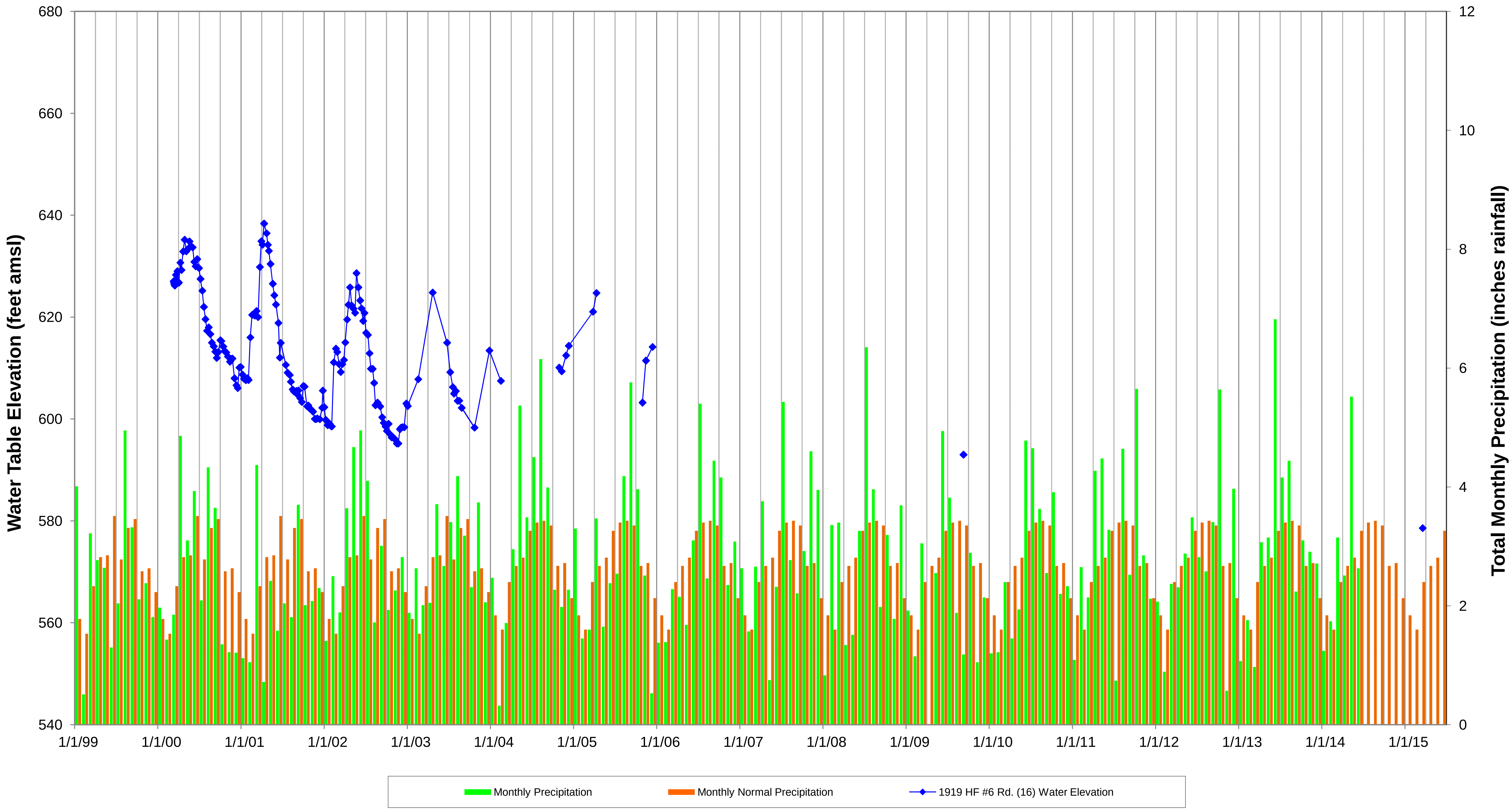
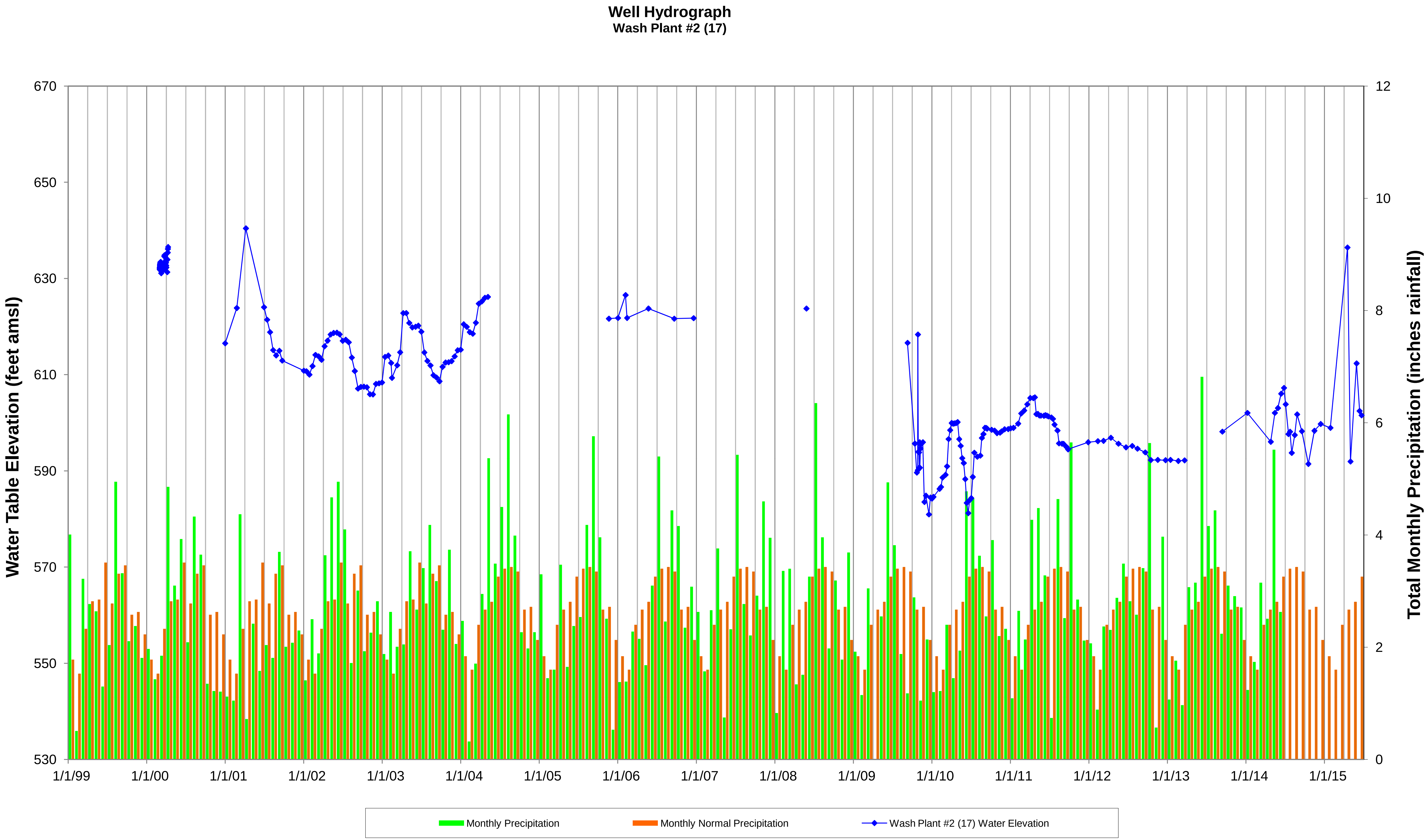
Well Hydrograph
1919 Honeoye Falls #6 Rd - new (16)





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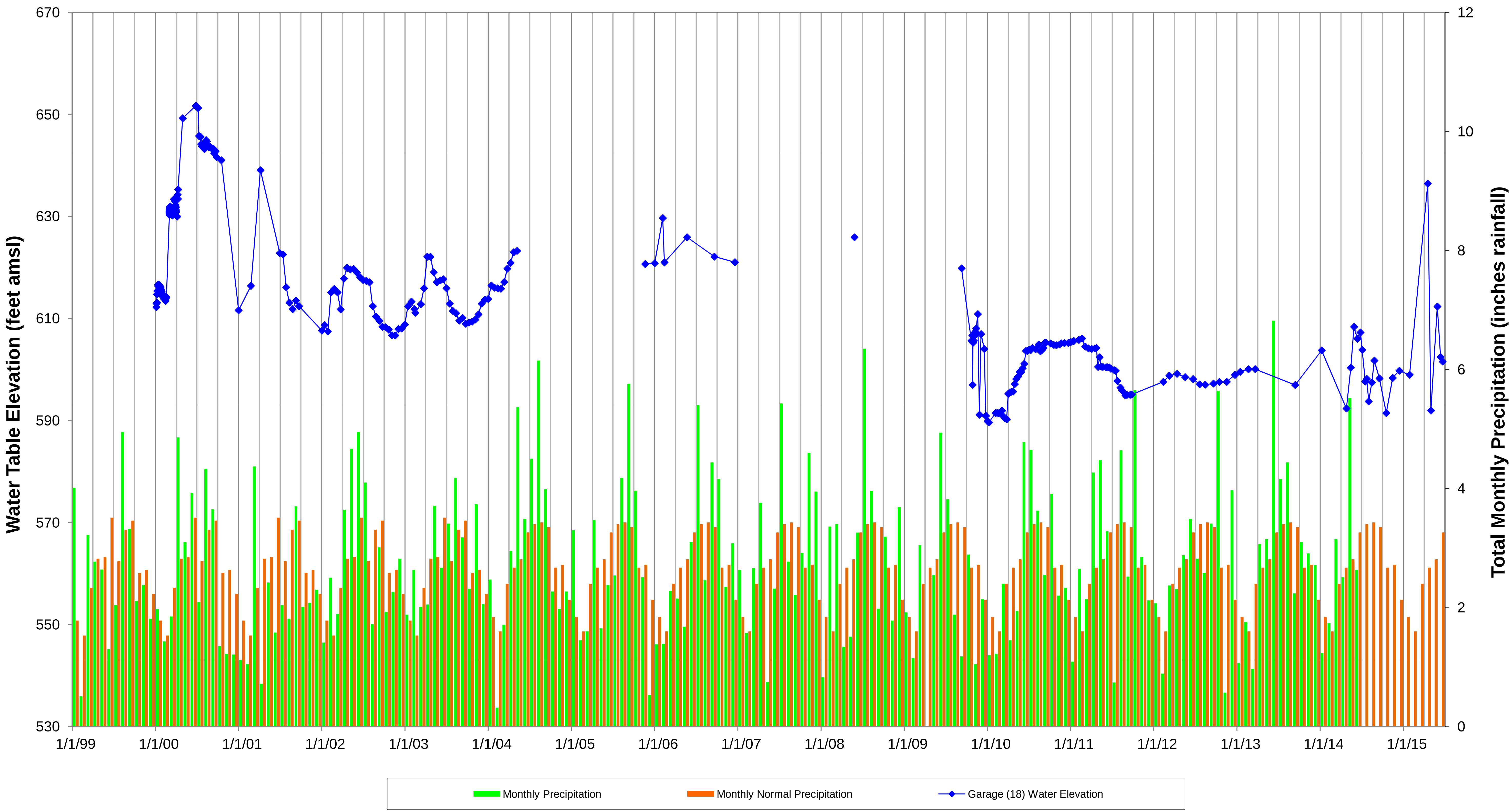
Well Hydrograph
Garage Well (18)



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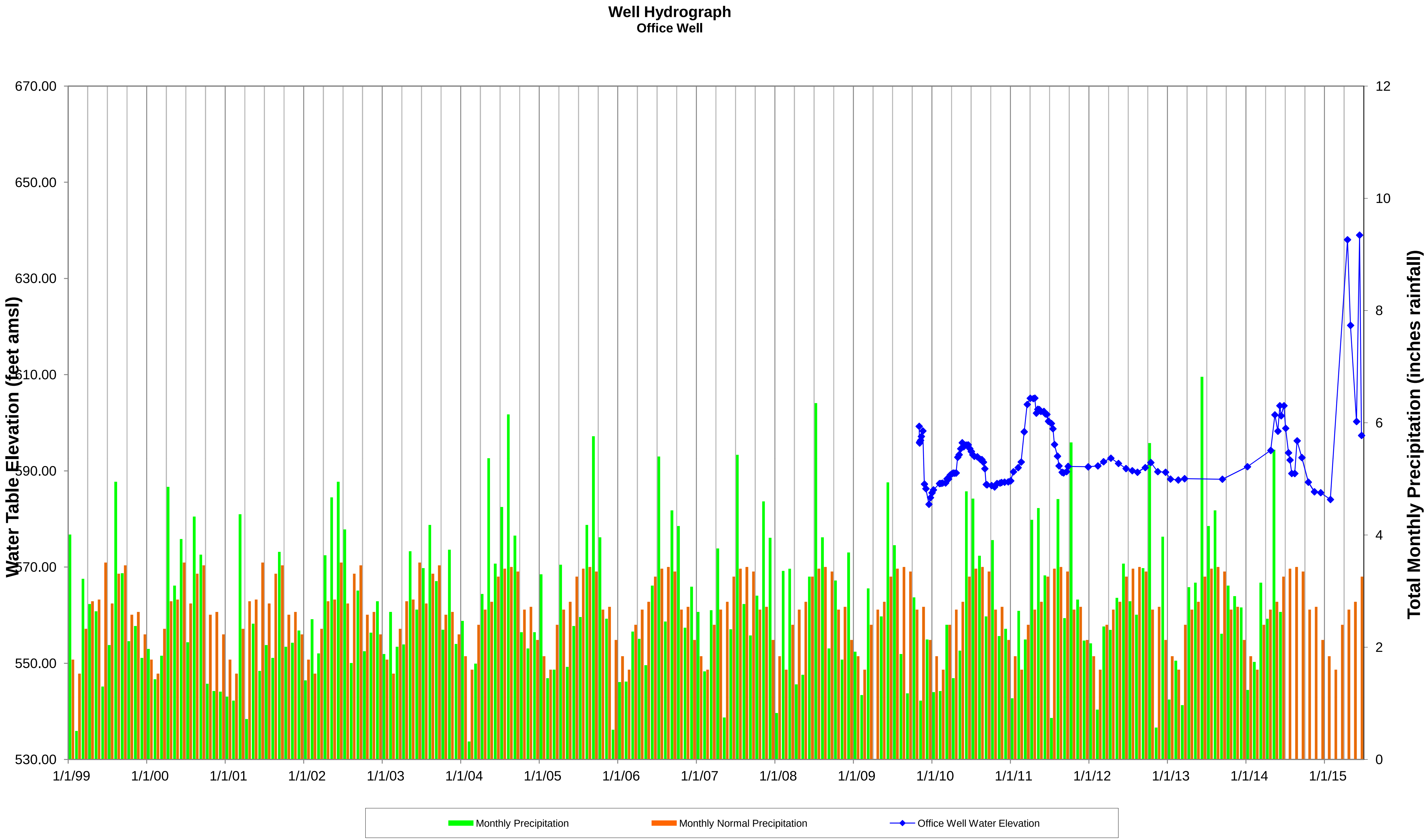

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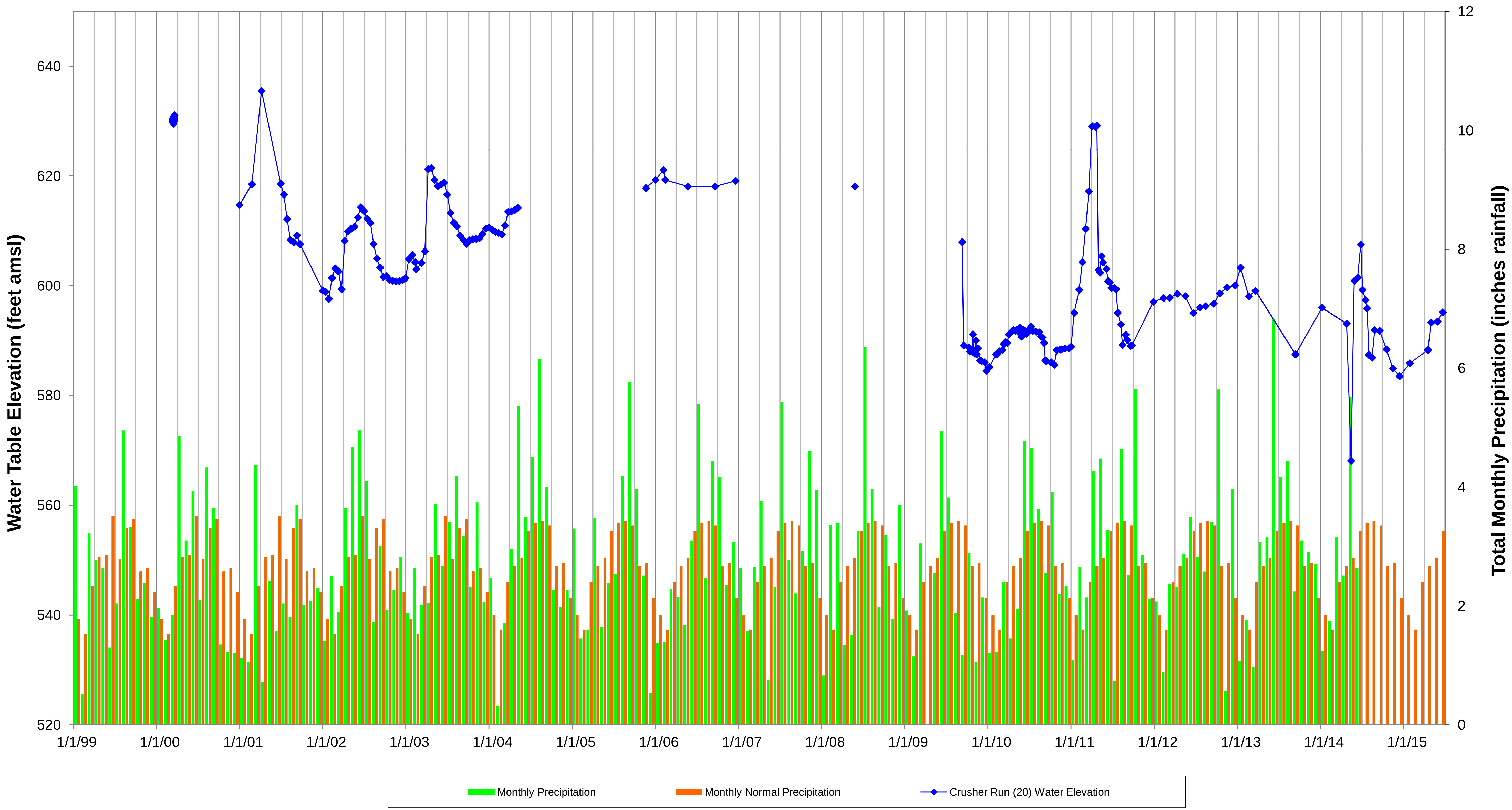
Well Hydrograph
Crusher Run Plant (20)



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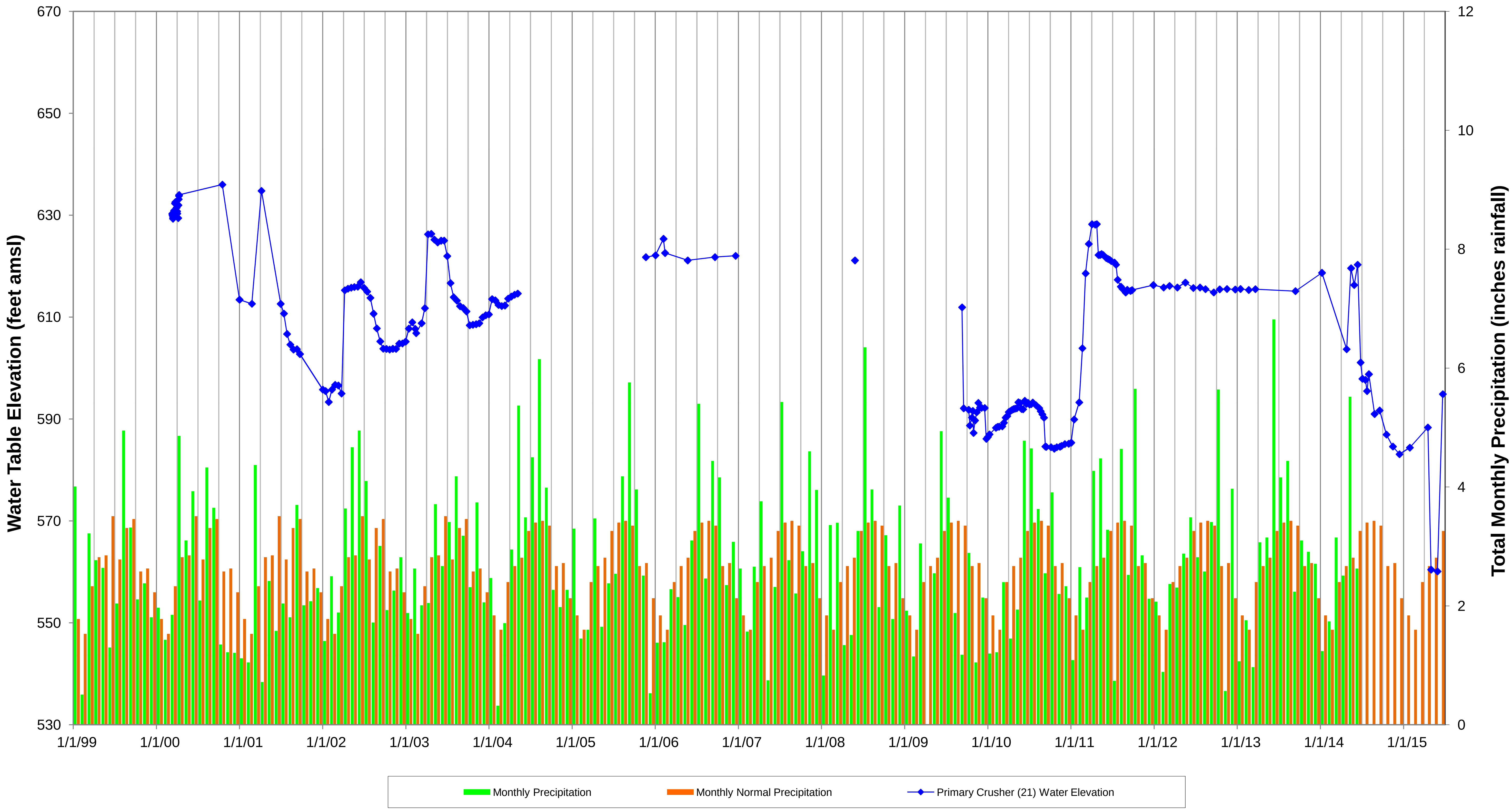
Well Hydrograph
Primary Crusher (21)



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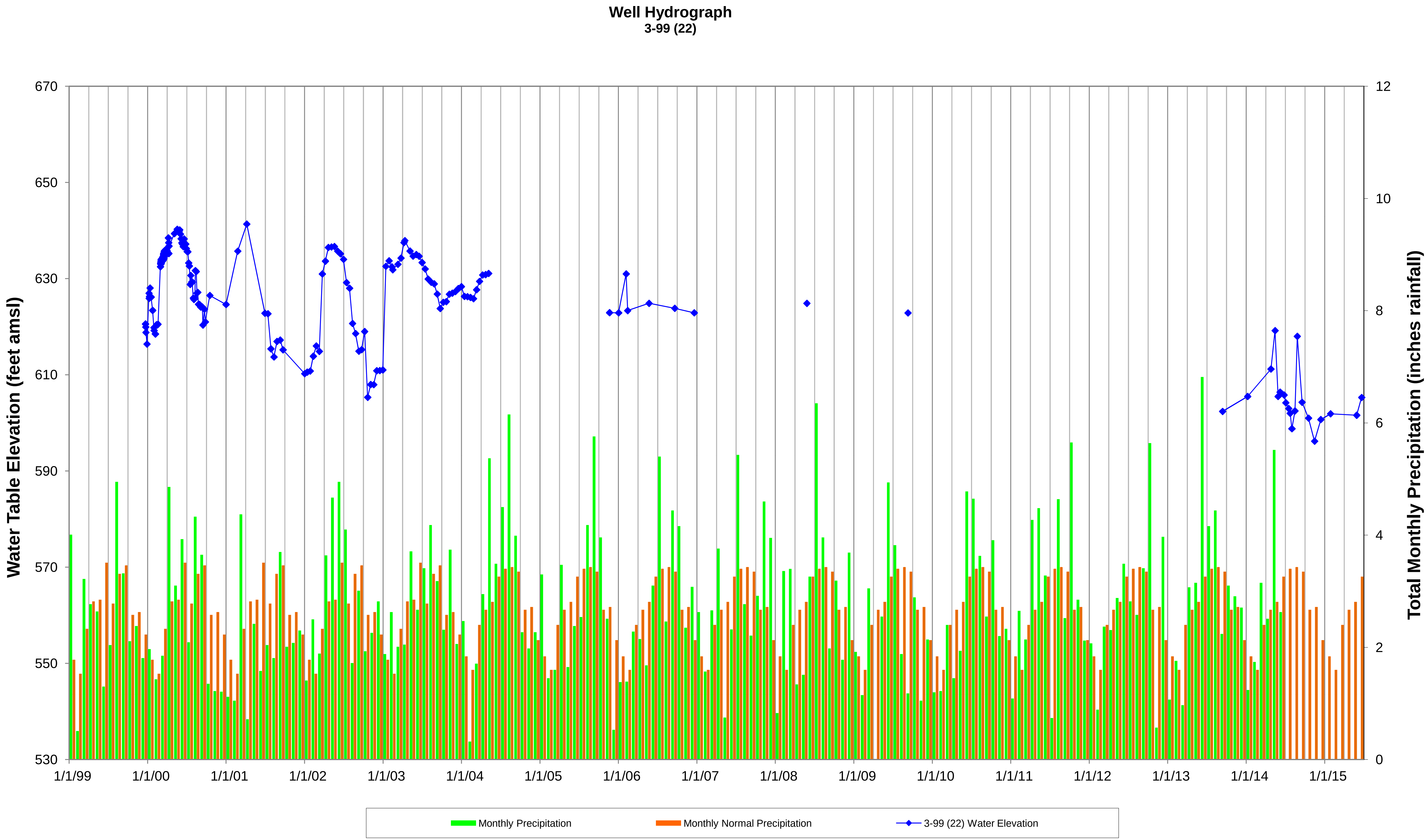

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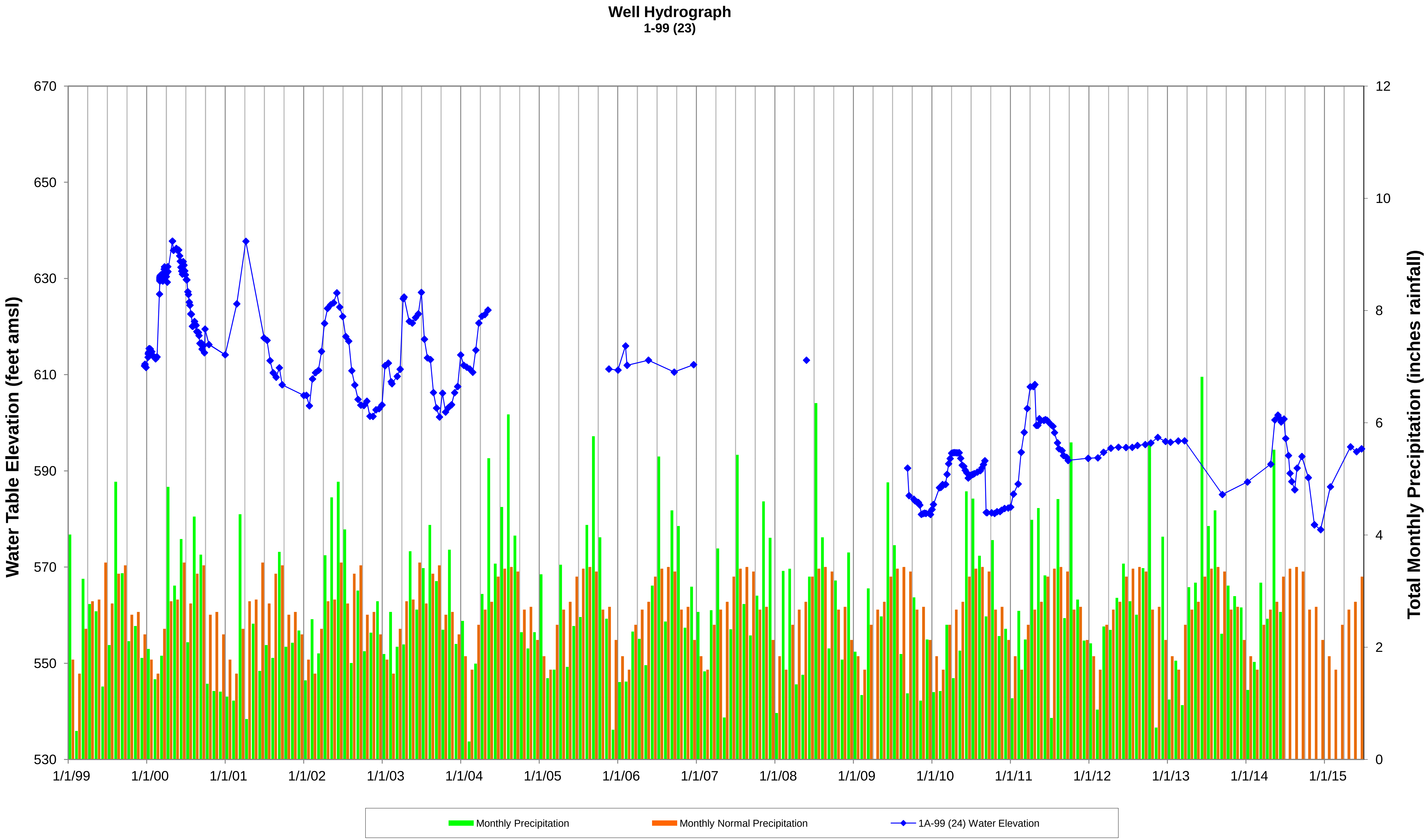

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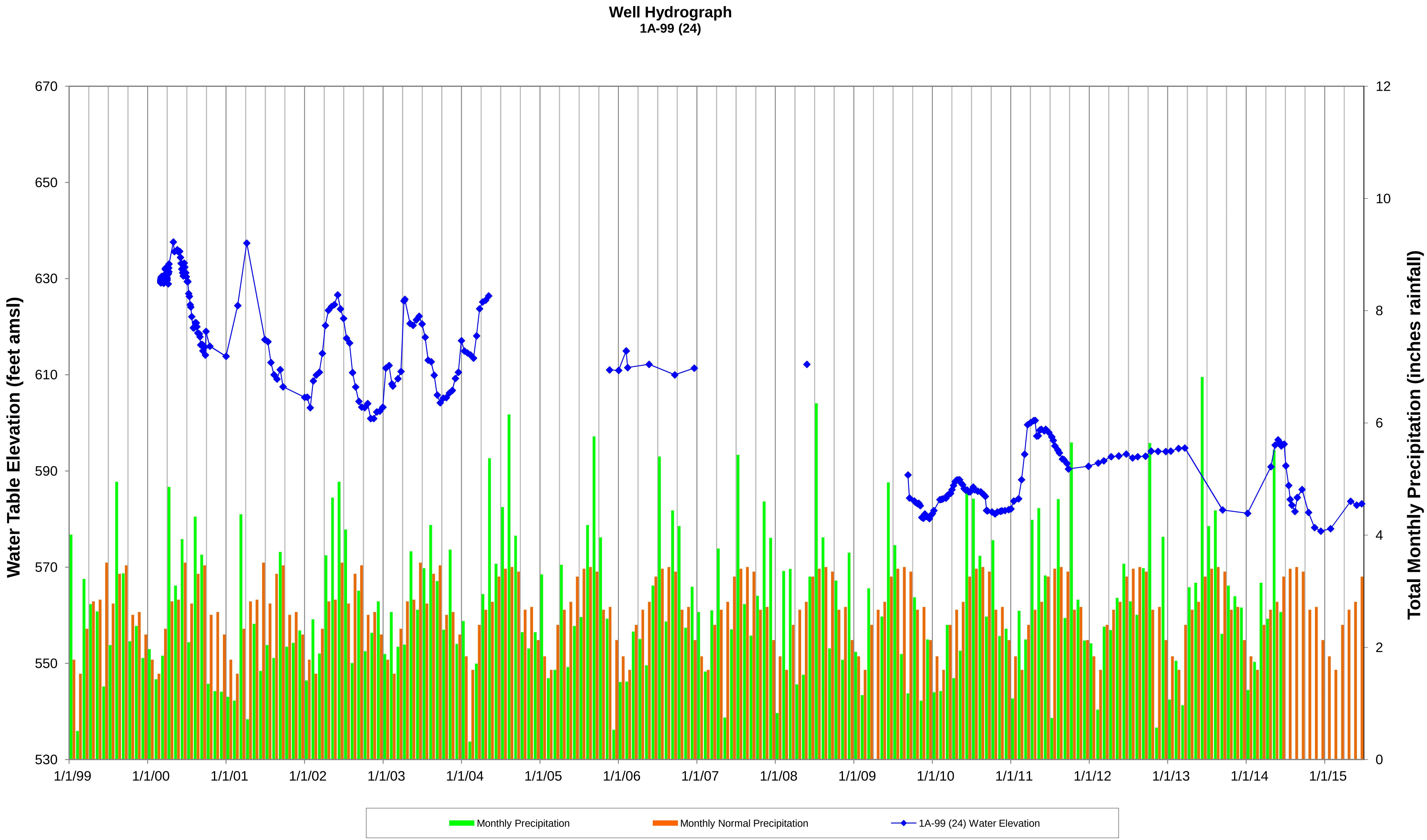

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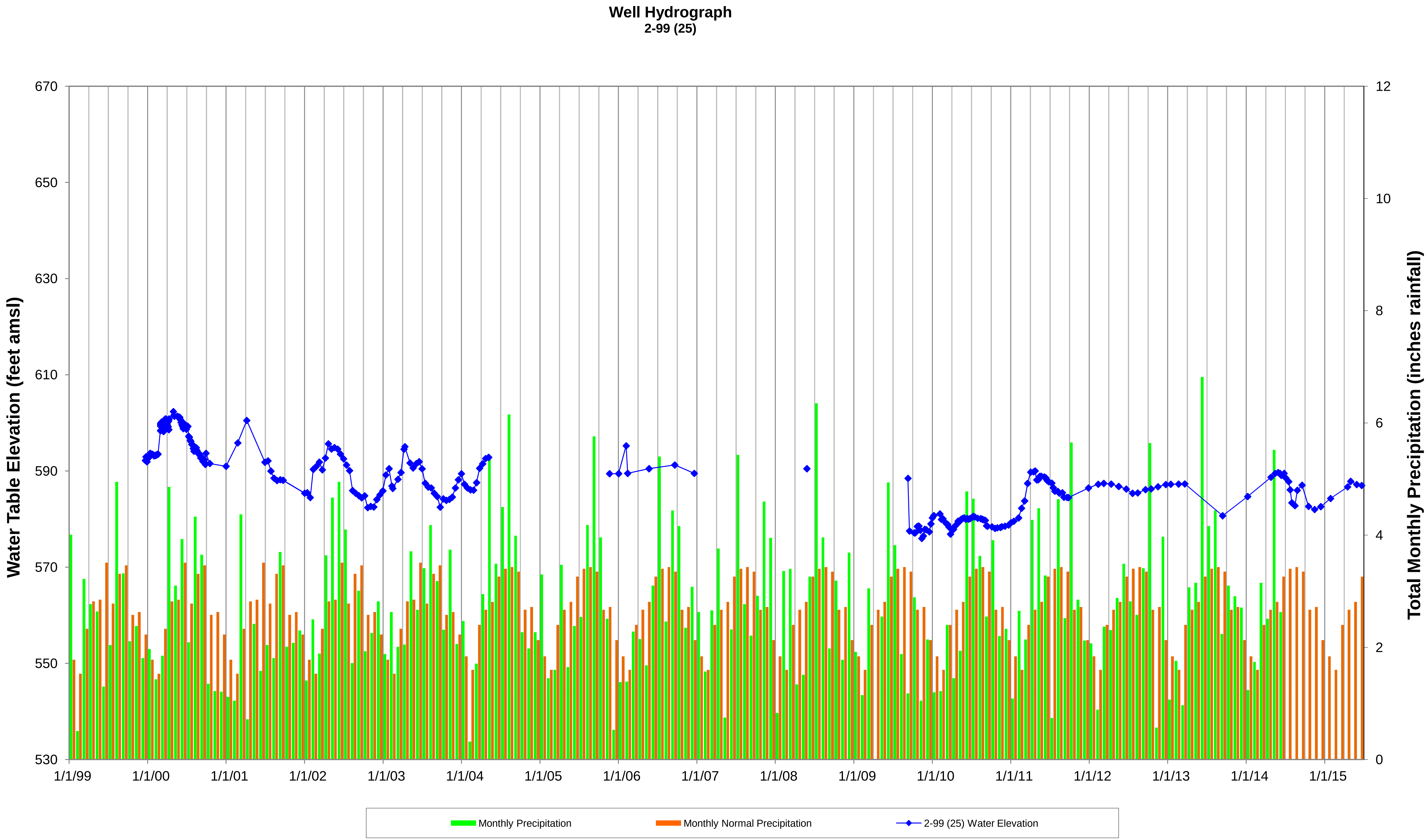

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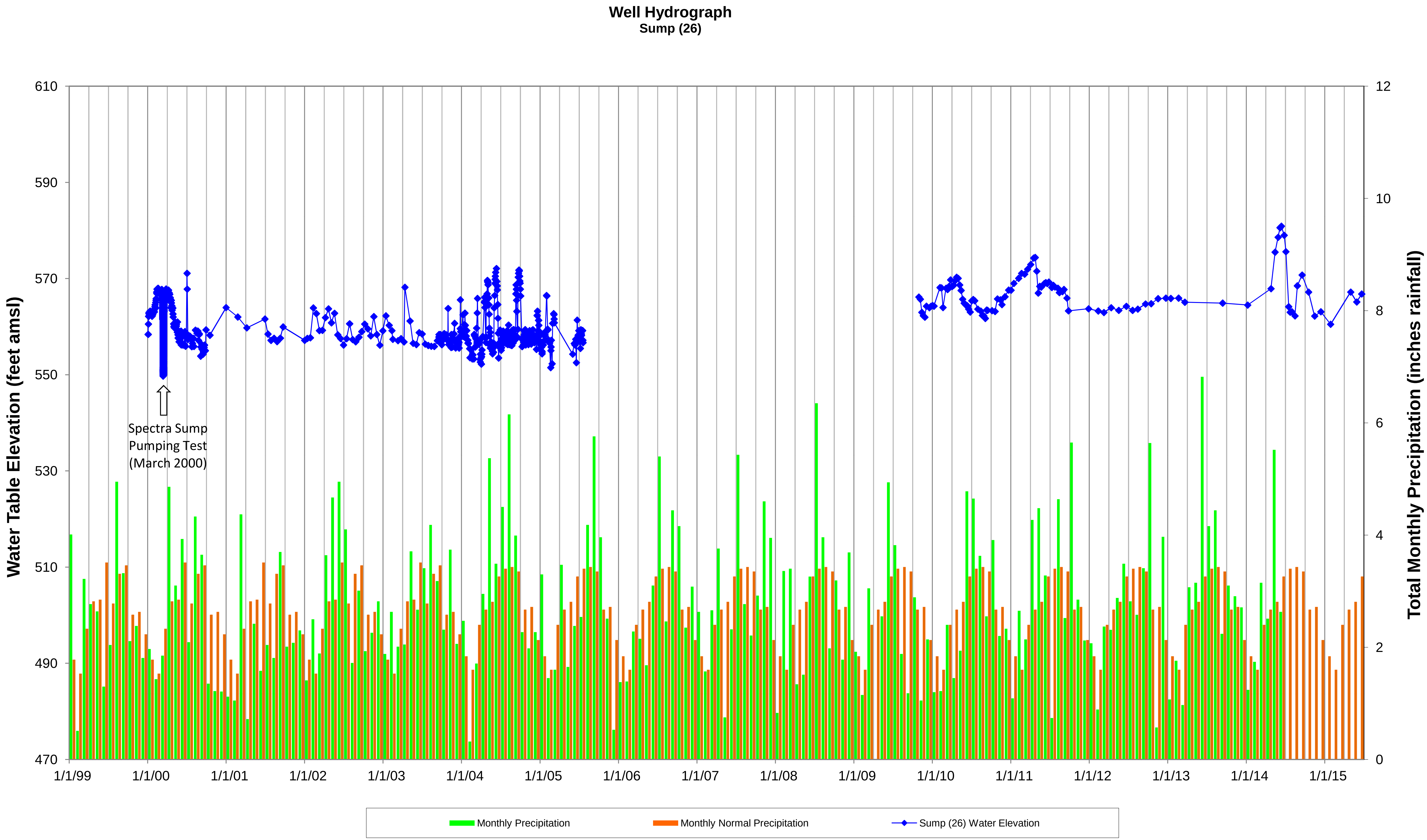

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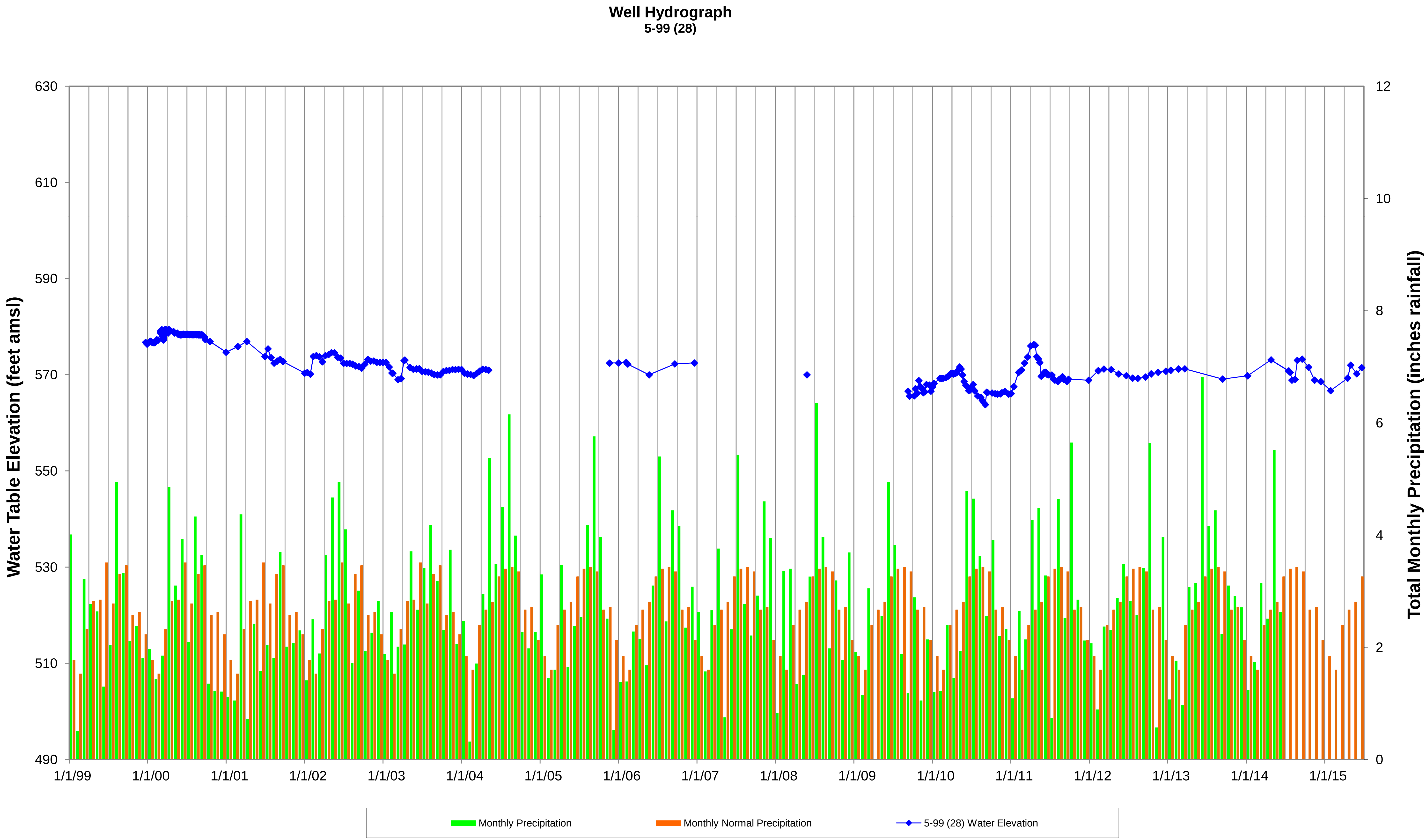
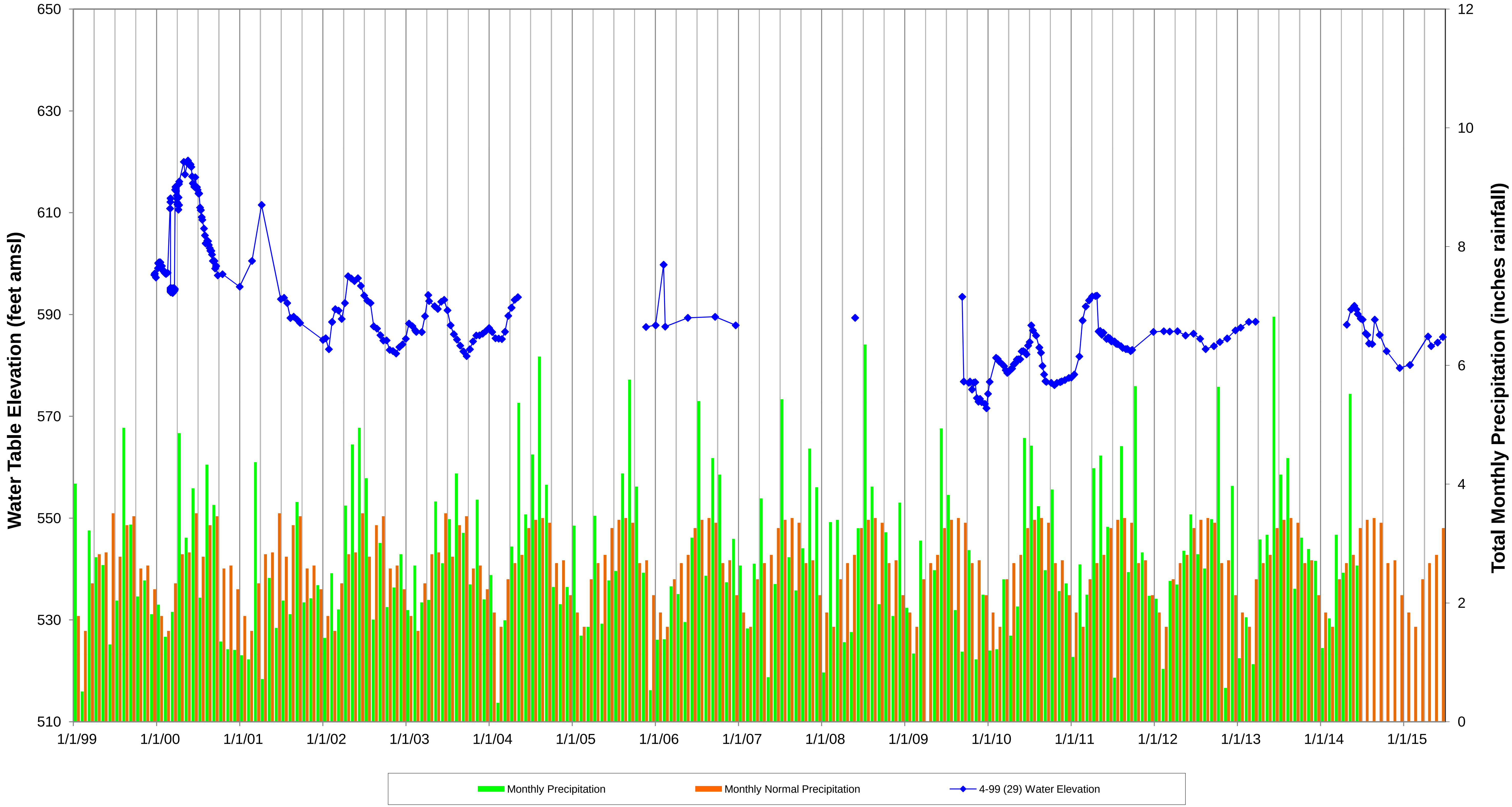

Well Hydrograph
5-99 (28)
Water Table Elevation (feet amsl)
Total Monthly Precipitation (inches rainfall)
630
610
590
570
550
530
510
490
12
10
8
6
4
2
0
1/1/99
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14
1/1/15
Monthly Precipitation
Monthly Normal Precipitation
5-99 (28) Water Elevation

Well Hydrograph
4-99 (29)



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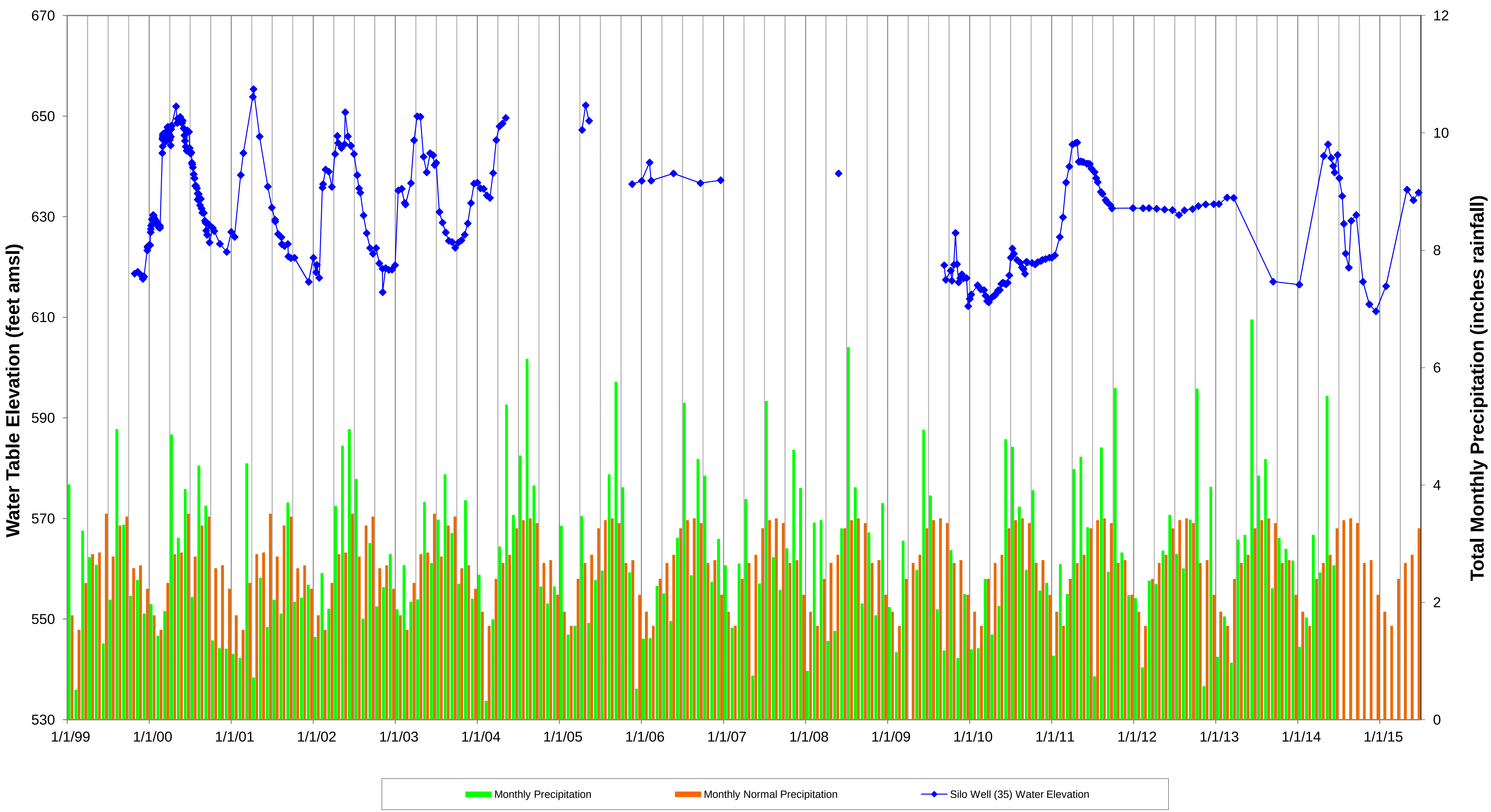
Well Hydrograph
Silo Well (35)



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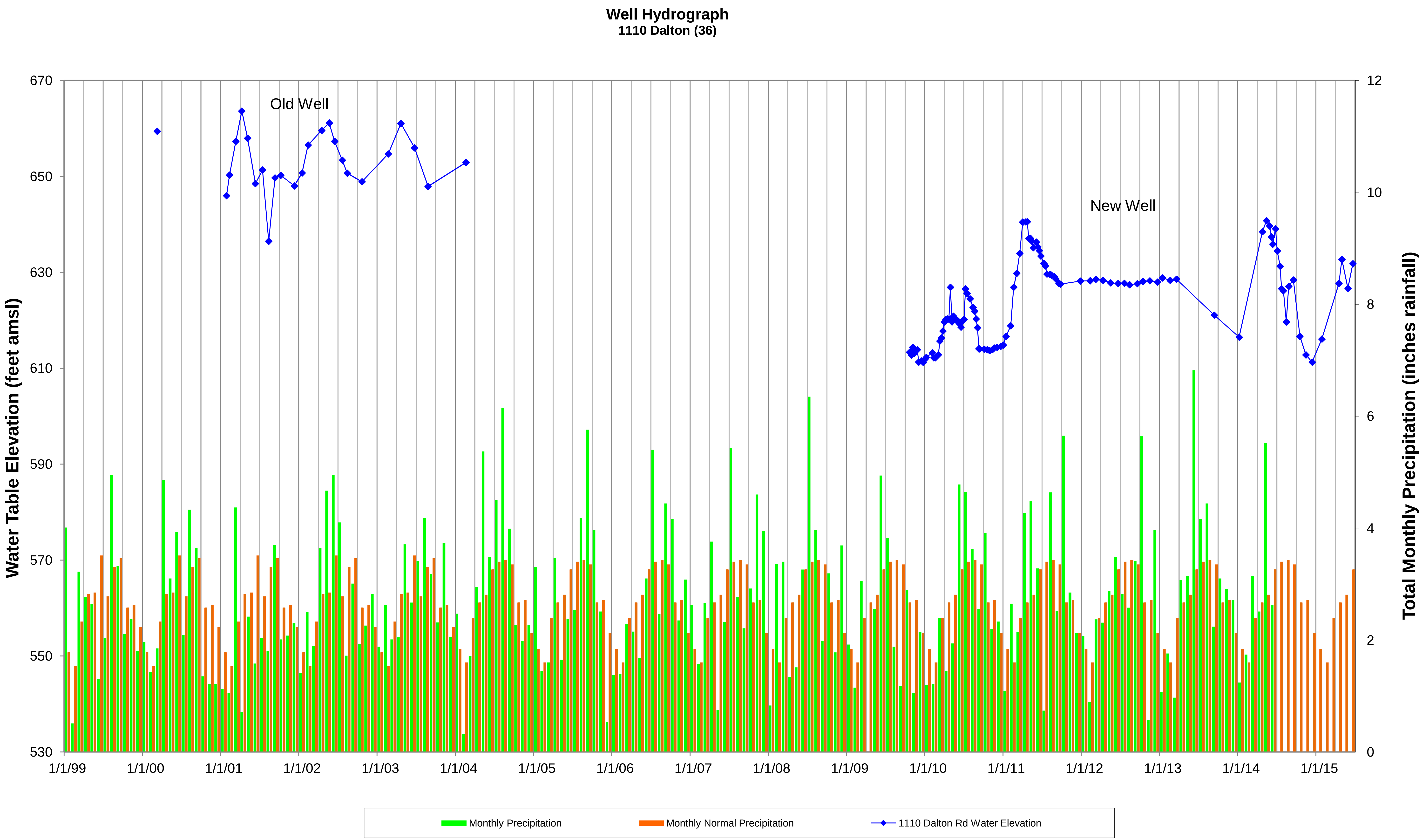

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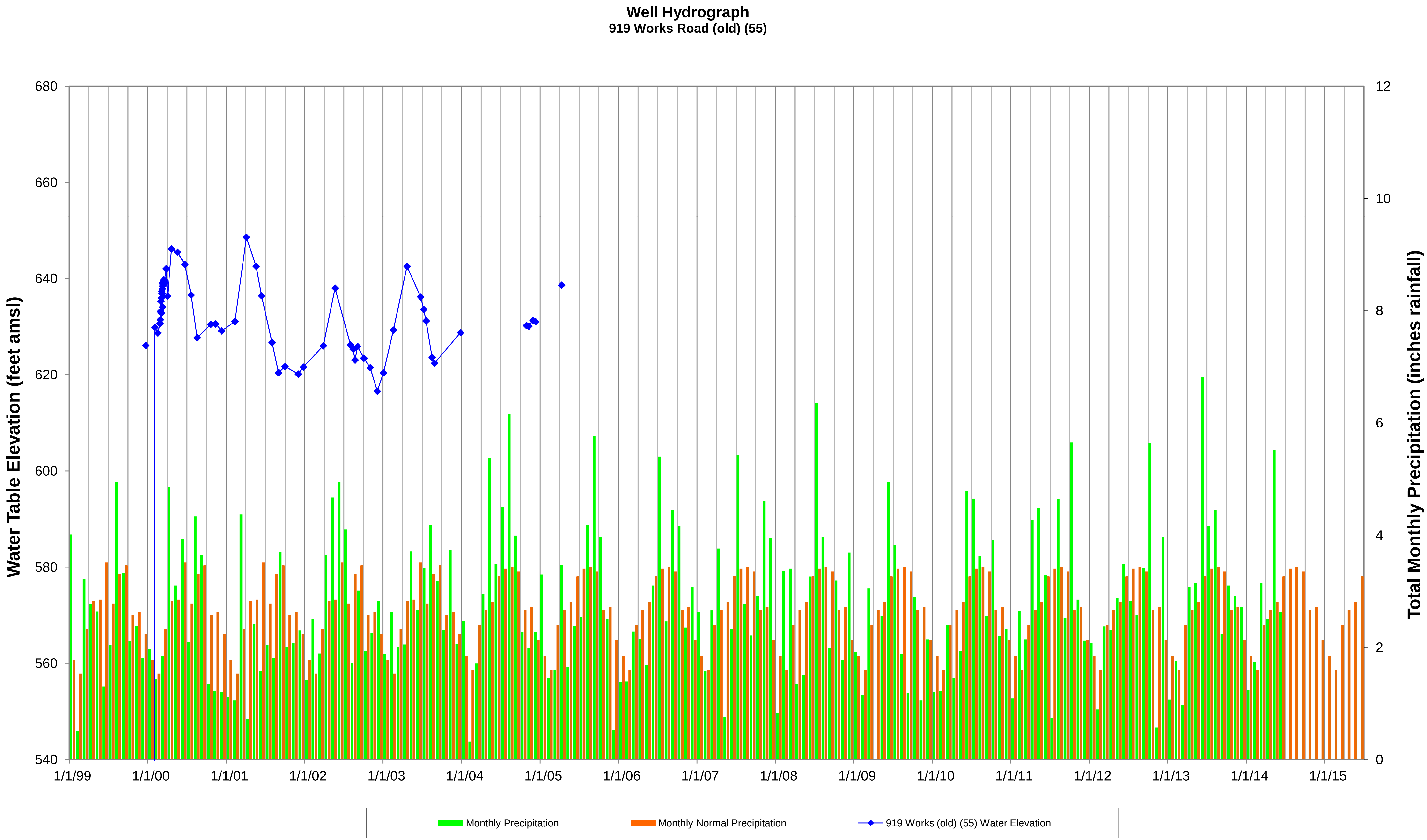

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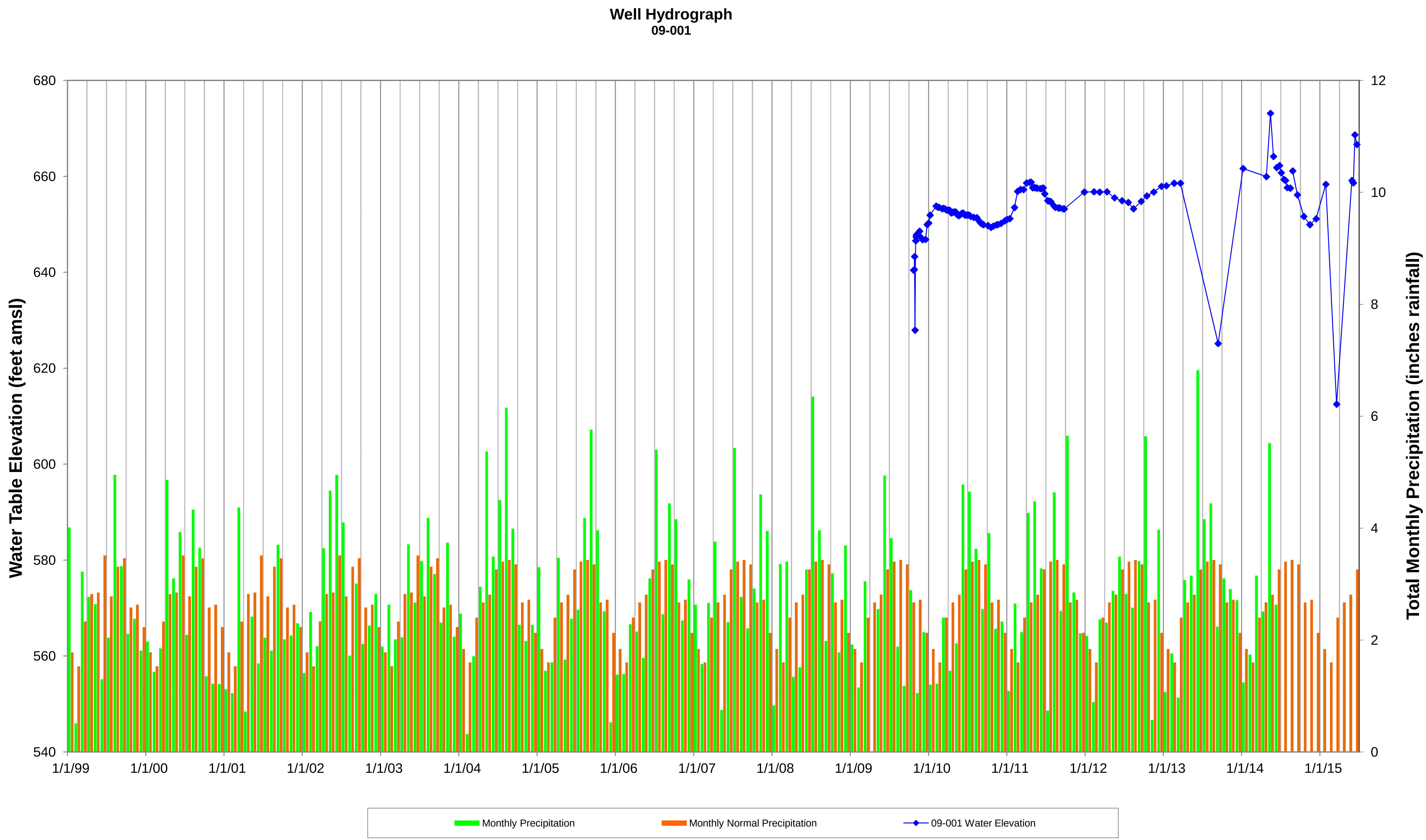

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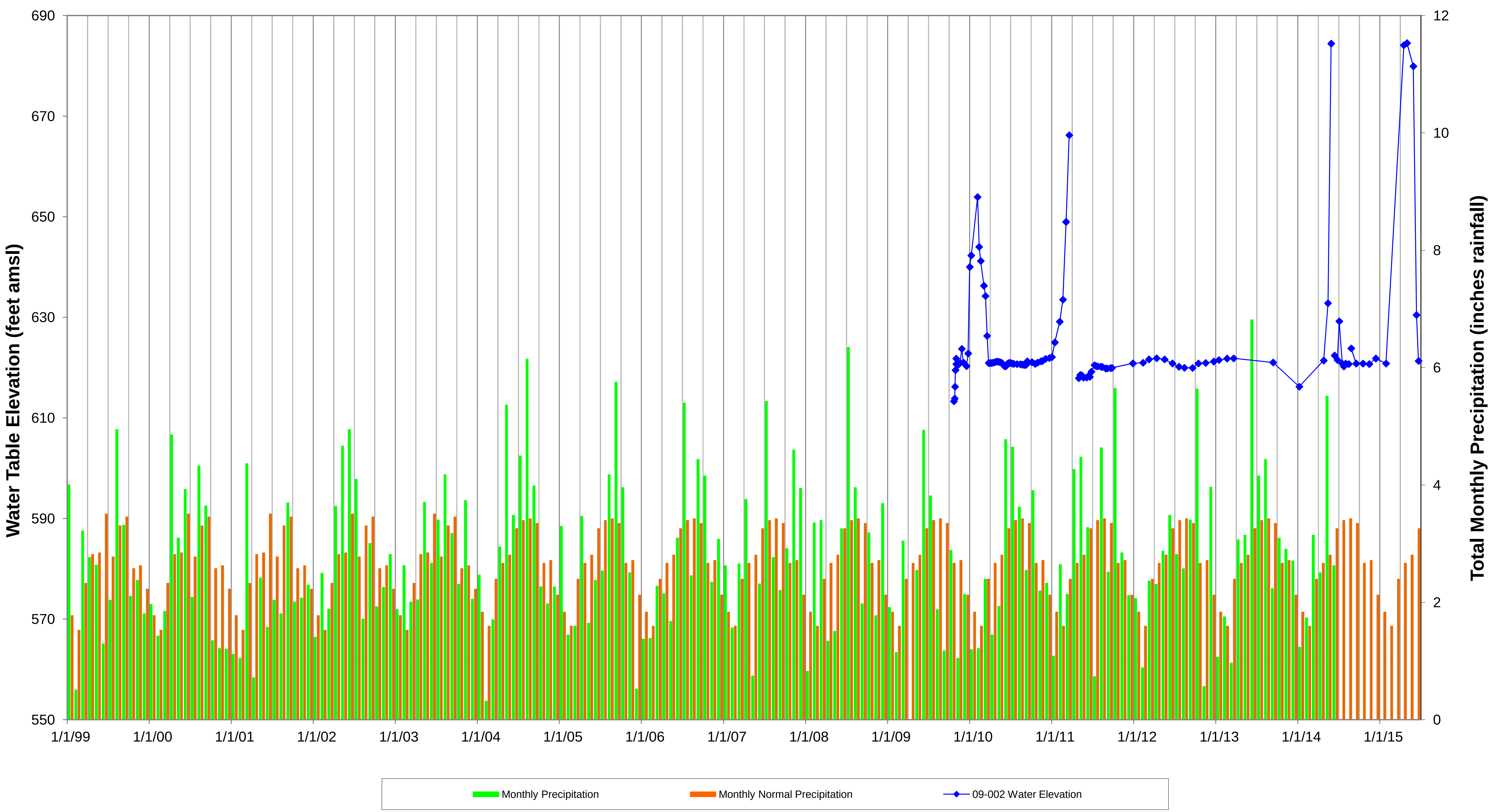
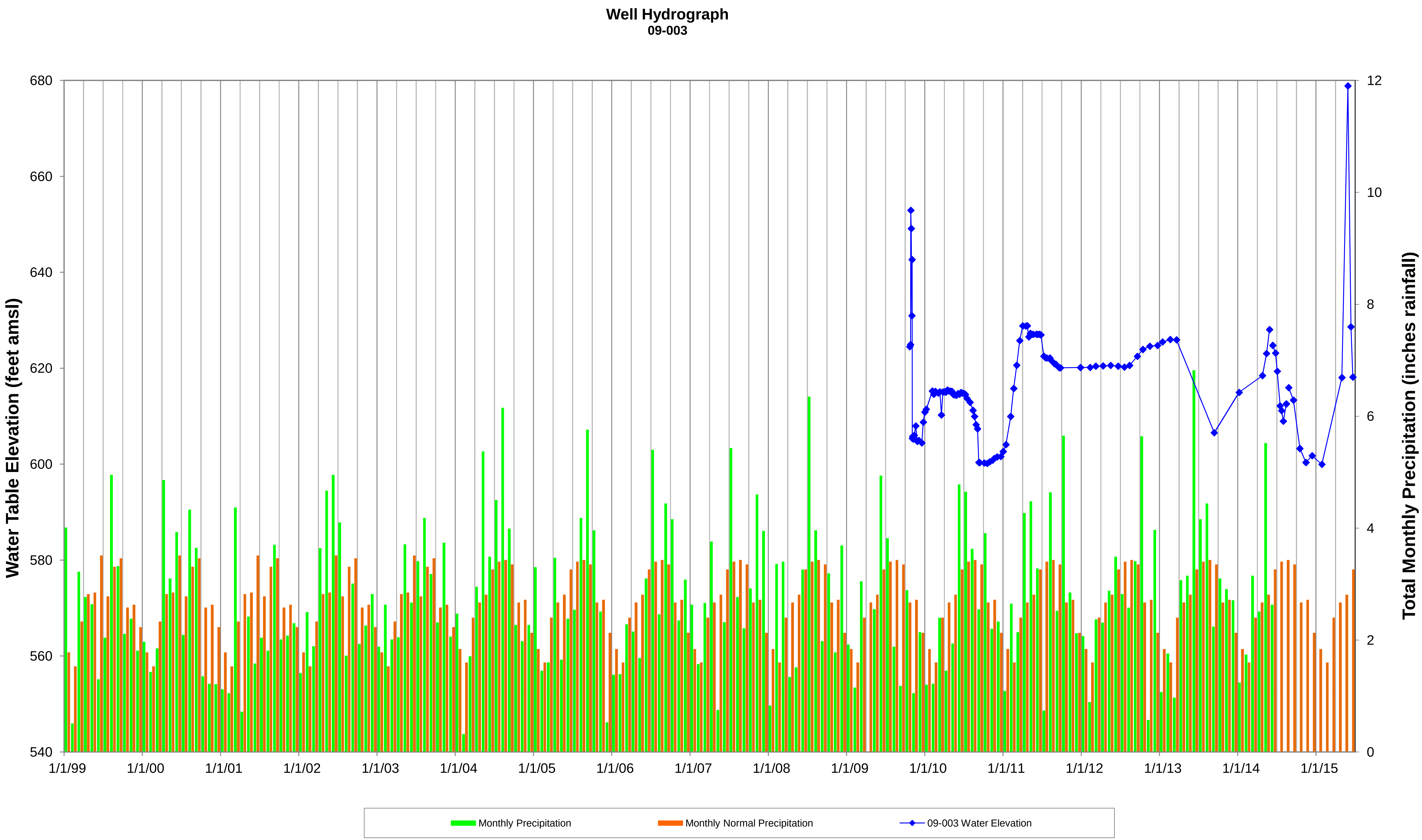
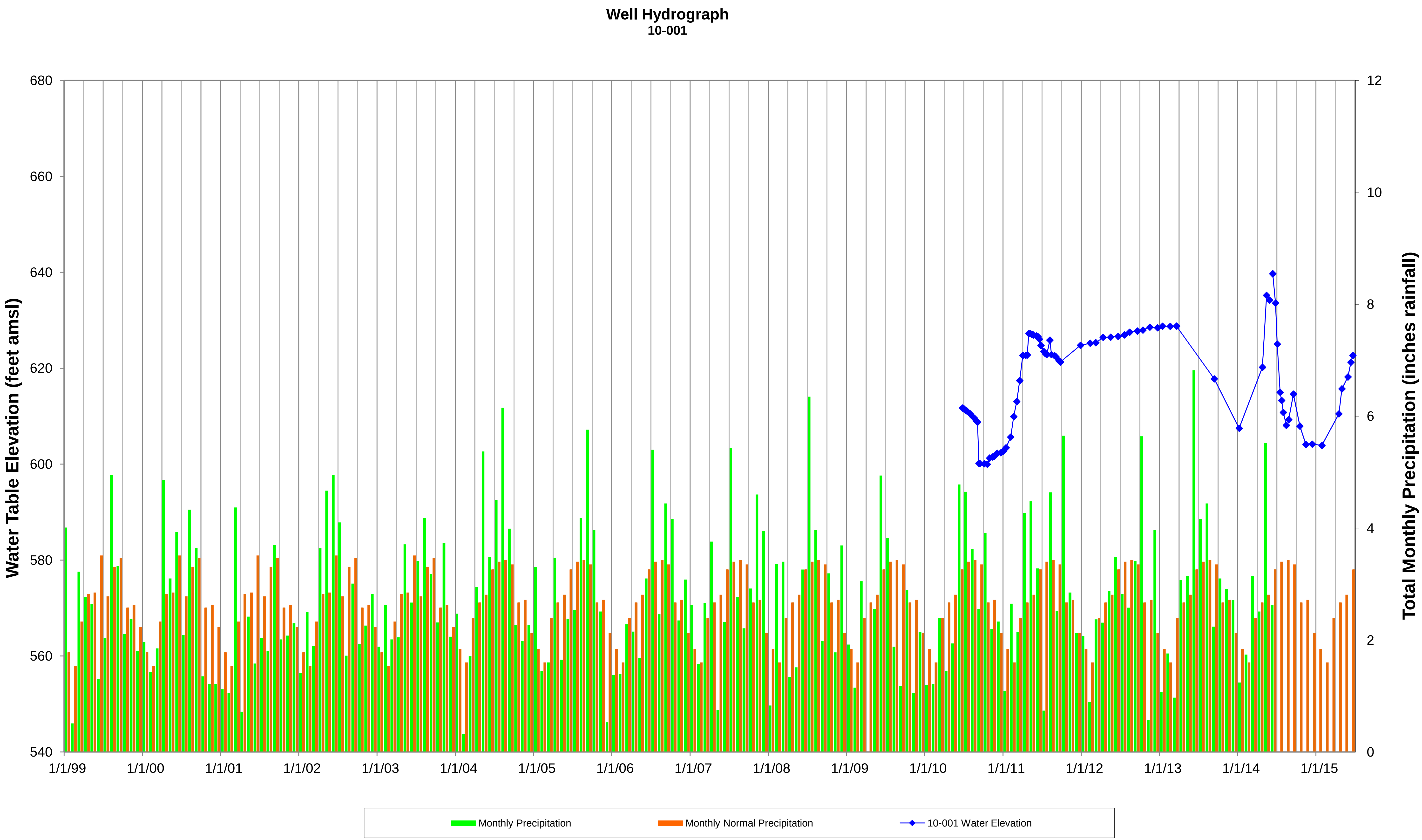
Well Hydrograph
09-002





Well Hydrograph
09-003
Water Table Elevation (feet amsl)
Total Monthly Precipitation (inches rainfall)
680
660
640
620
600
580
560
540
12
10
8
6
4
2
0
1/1/99
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
1/1/10
1/1/11
1/1/12
1/1/13
1/1/14
1/1/15
Monthly Precipitation
Monthly Normal Precipitation
09-003 Water Elevation



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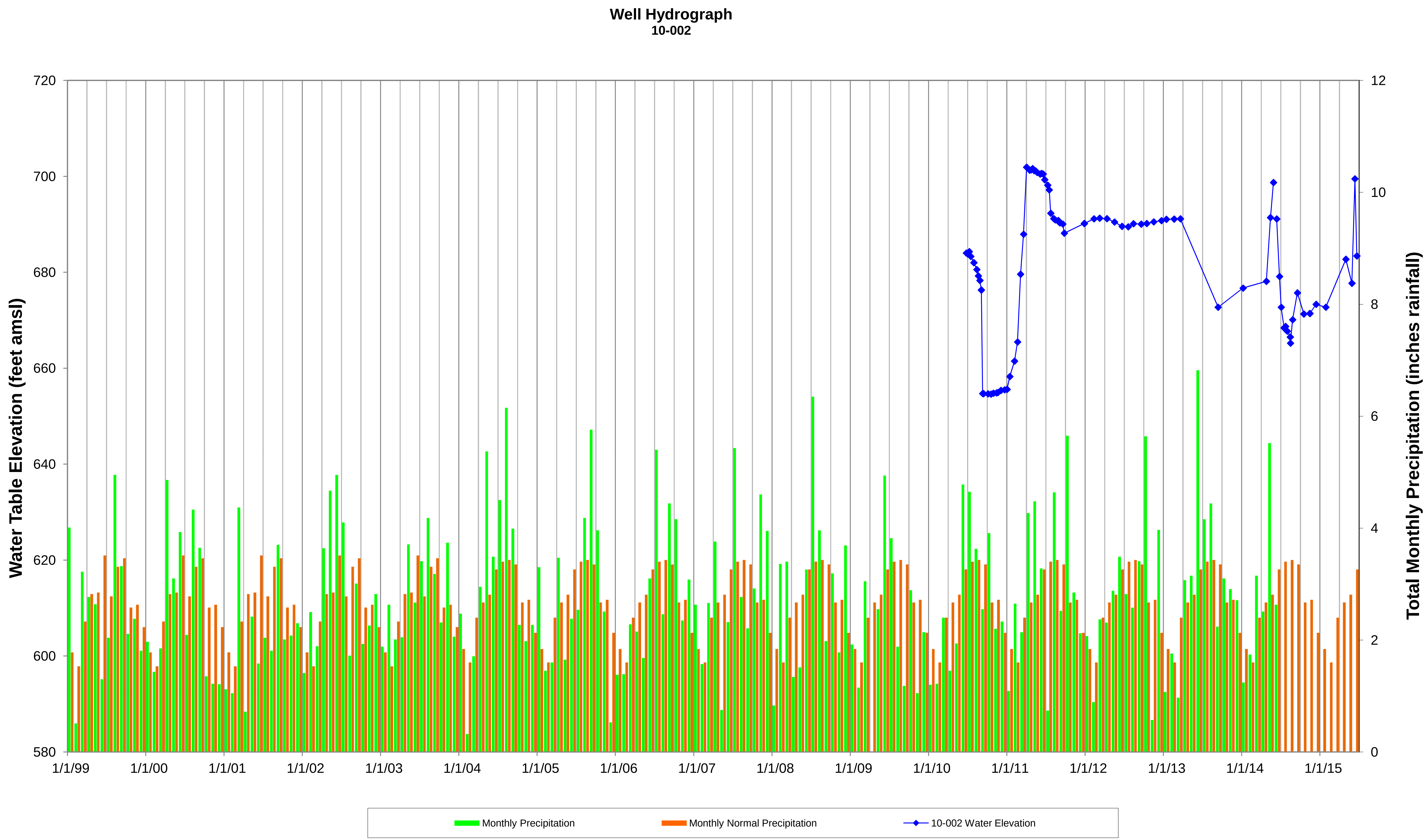

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APPENDIX C

Seepage Face Height Calculations
And Drawdown Impacts

Date: 12/15/15
To: Michael Lewis, Hanson Aggregates New York LLC
From: Steve Trader, Alpha Geoscience

Additional Response to NYSDEC Comment #7

The NYSDEC asked for further calculations, data and documentation to supplement the description of the methodology used in calculating seepage faces and drawdown impacts. The greatest potential drawdown could occur when the quarry is at its maximum vertical and lateral extent. Knowledge of the existing hydrogeologic conditions was used to project the extent of this drawdown.

The projected drawdown at the quarry face is shown on the cross sections (Figures 9-11) and is based on the knowledge of the elevation of the base of aquifer around the quarry face and that a seepage face will form on the quarry wall up from the base of the aquifer. The base of the aquifer is defined as the depth of the deepest water bearing openings observed in the cores. The base of the aquifer was established as the top of the Akron Formation (top of Bertie Group). Elevation contours of the top of the Bertie Group were provided in Figure 7. The extent of the seepage face up from the base of the aquifer is assumed to be one-third of the distance from the aquifer base to the existing piezometric surface (ground water elevation contours) shown on Figures 4 and 6 for the seasonal low and high ground water tables, respectively. The calculations to determine the height of the seepage face, at the locations where the cross sections intersect the quarry walls, are attached.

The projection of the ground water elevations outward from the seepage face into the surrounding region relies on the knowledge gained from the existing ground water contour maps (Figures 4 and 6). The existing ground water contours provide empirical data on the ground water pressure gradients that can be sustained around the quarry. The projected piezometric surface around the quarry was drawn under the assumption that the steeper gradients exhibited by the existing ground water contours can be sustained in the first few hundred feet adjacent to the quarry and level out to the flatter gradients at further distances from the quarry. Both the existing and future elevations of the piezometric surface are shown on the cross sections (Figures 9-11). The drawdown impacts around the expansion area during the seasonal high water table are predicted to extend approximately 150 ft to 800 ft from the quarry. The drawdown outward from the quarry during the seasonal low water table is predicted to extend 0 ft to approximately 650 ft from the edge of the quarry. The water table will rebound subsequent to cessation of quarry pumping at the conclusion of mining activities.

Seepage Face Height Calculations For
Seasonal Low and High Water Tables

Honeoye Falls Quarry Expansion

Hanson Aggregates NY, LLC

Cross Section A-A', western edge

Seasonal Low Water Table, lower bench wall

Base of Aquifer =	584	ft amsl
Existing Water Table =	602.5	ft amsl
Proposed Quarry Floor =	622	ft amsl

No Seepage Face; low water table already below quarry floor

Seasonal High Water Table, lower bench wall

Base of Aquifer =	584	ft amsl
Existing Water Table =	632	ft amsl
Proposed Quarry Floor =	622	ft amsl
Top of Seepage Face =	((632-584)/3) + 584 = 600	ft amsl

Proposed Quarry Floor is higher than the calculated top of seepage face; consequently, seepage will occur at the base of the lower bench

Cross Section B-B', western edge

Seasonal Low Water Table, lower bench wall

Base of Aquifer =	588	ft amsl
Existing Water Table =	612	ft amsl
Proposed Quarry Floor =	575.5	ft amsl
Top of Seepage Face =	((612-588)/3) + 588 = 596	ft amsl

Seasonal High Water Table, middle bench wall

Base of Aquifer =	588	ft amsl
Existing Water Table =	655	ft amsl
Proposed Quarry Floor =	575.5	ft amsl
Top of Seepage Face =	((655-588)/3) + 588 = 610	ft amsl
Top of Lower bench = 614.5		ft amsl

Drawdown projected to intersect top of lower bench; consequently, top of seepage face estimated to be at base of middle bench

Cross Section C-C', southern edge

Seasonal Low Water Table, lower bench wall

Base of Aquifer =	568	ft amsl
Existing Water Table =	612	ft amsl
Proposed Quarry Floor =	571.5	ft amsl
Top of Seepage Face =	((612-568)/3) + 568 =582.5	ft amsl

Seasonal High Water Table, lower bench wall

Base of Aquifer =	568	ft amsl
Existing Water Table =	661	ft amsl
Proposed Quarry Floor =	571.5	ft amsl
Top of Seepage Face =	((661-568)/3) + 568 =599	ft amsl

Cross Section C-C', northern edge

Seasonal Low Water Table, lower bench wall

Base of Aquifer =	618.5	ft amsl
Existing Water Table =	623	ft amsl
Proposed Quarry Floor =	626.5	ft amsl

No Seepage Face; low water table already below quarry floor

Seasonal High Water Table, lower bench wall

Base of Aquifer =	618.5	ft amsl
Existing Water Table =	665	ft amsl
Proposed Quarry Floor =	626.5	ft amsl
Top of Seepage Face =	((665-618.5)/3) + 618.5 =634	ft amsl

Notes:

Seepage Faces are Calculated for Full Mine Build Out (Figure 8)

Top of Seepage Face = 1/3 of saturated thickness above aquifer base

Aquifer Base = Top of Bertie Group/Top of Akron Formation (Figure 7)

Existing Seasonal Low and High Ground Water Elevations obtained from Figures 4 and 6, respectively

See Section 4.0 (pages 7-8) for discussion of Methodology to Calculate Seepage Face Heights

APPENDIX D

Spectra Figures

HAN 001562

HANSON ROCHESTER
HONEOYE FALLS QUARRY
Time vs. Elevation of Water
Sump vs. 916 Works Road (Well 9)

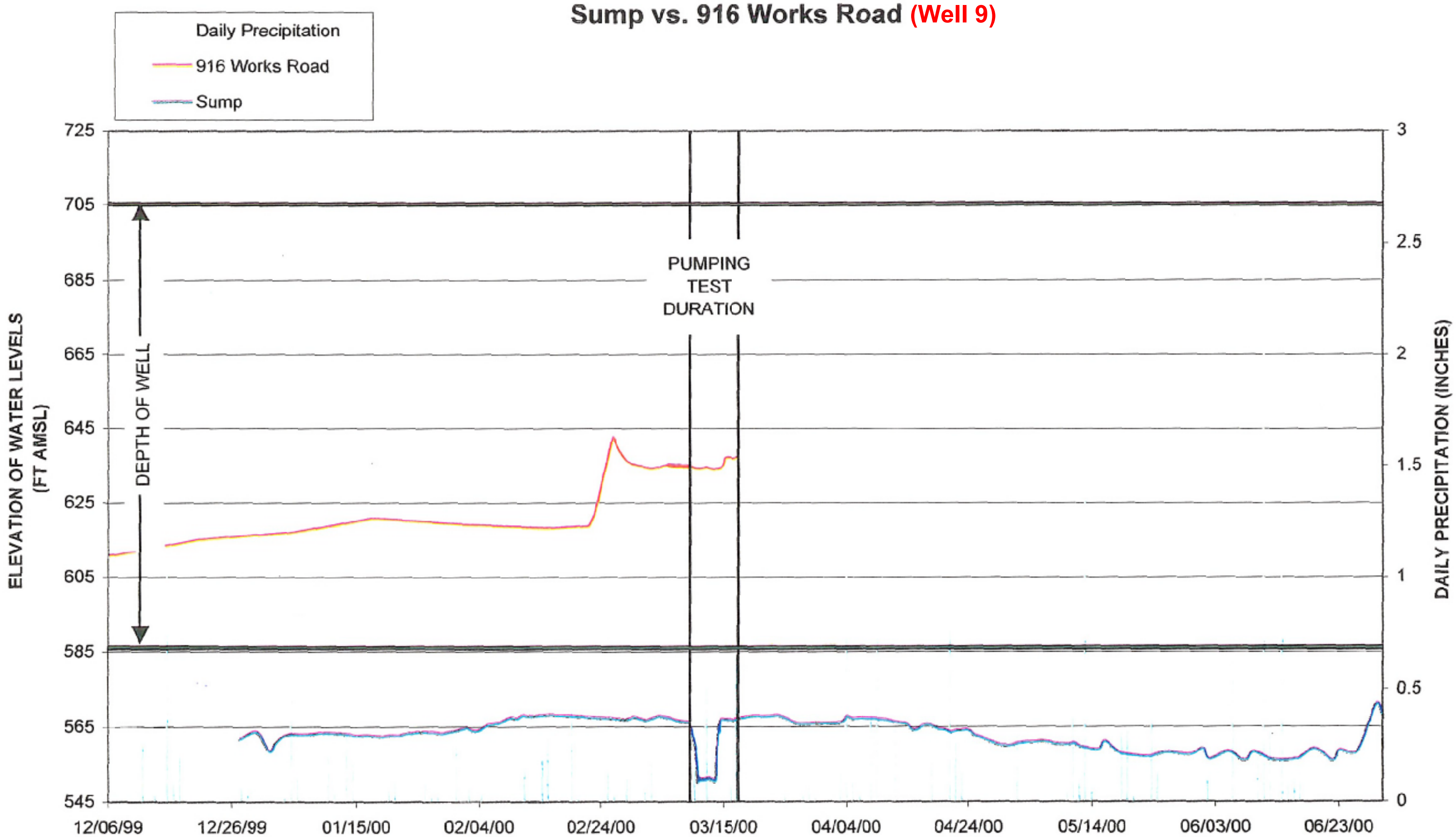

Figure IV.21

Note: Annotations in red added by Alpha Geoscience

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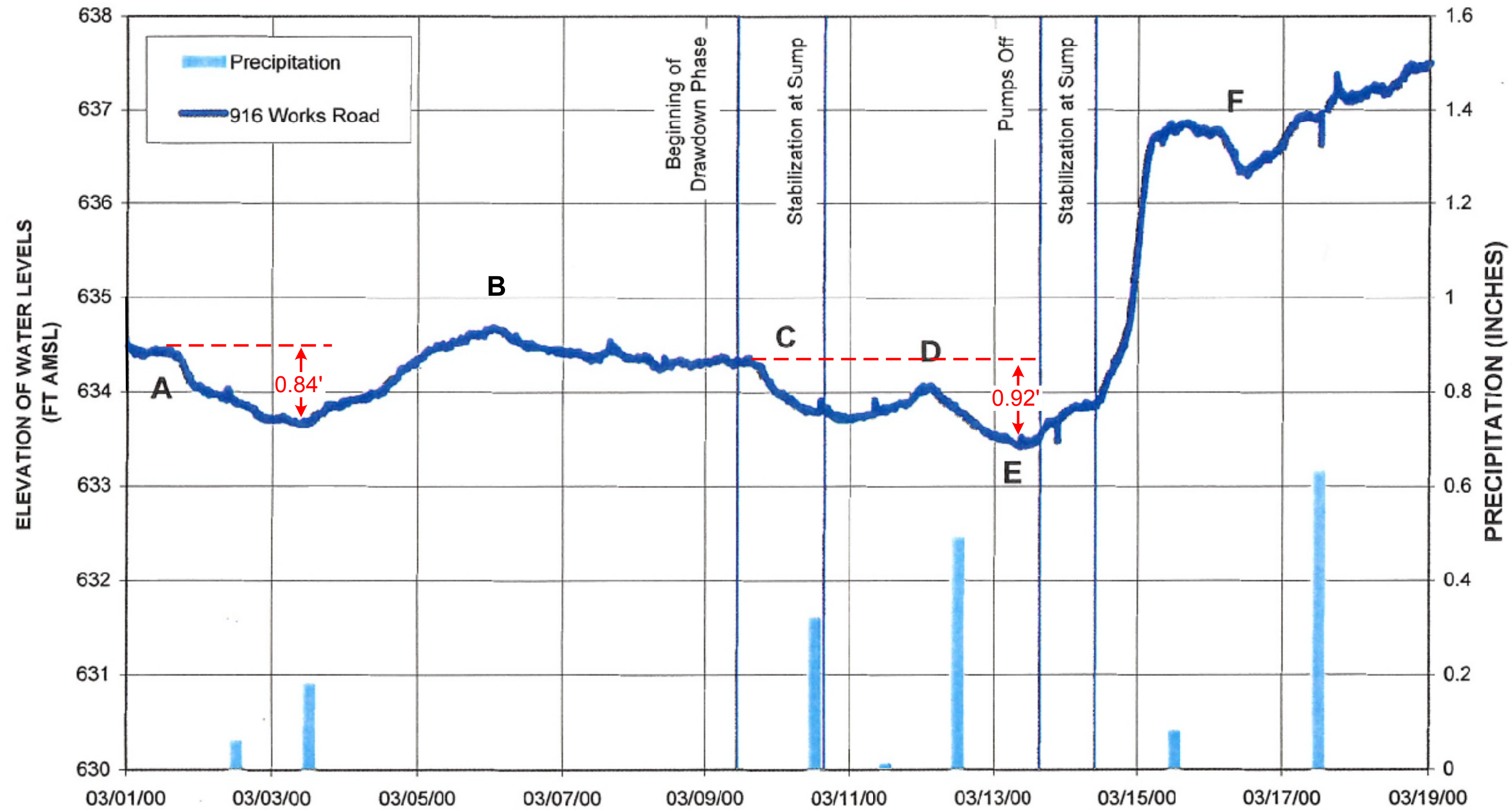
HAN 001446

HANSON ROCHESTER
HONEOYE FALLS QUARRY
Time vs. Elevation of Water
(Well 9) 916 Works Road vs. Precipitation



Note: Annotations in red added by Alpha Geoscience

Figure 6.21

Z:\projects\2011\11100-11120\11110 - Hanson Honeoye Expansion\Spectra Figure 2.cvx

APPENDIX E

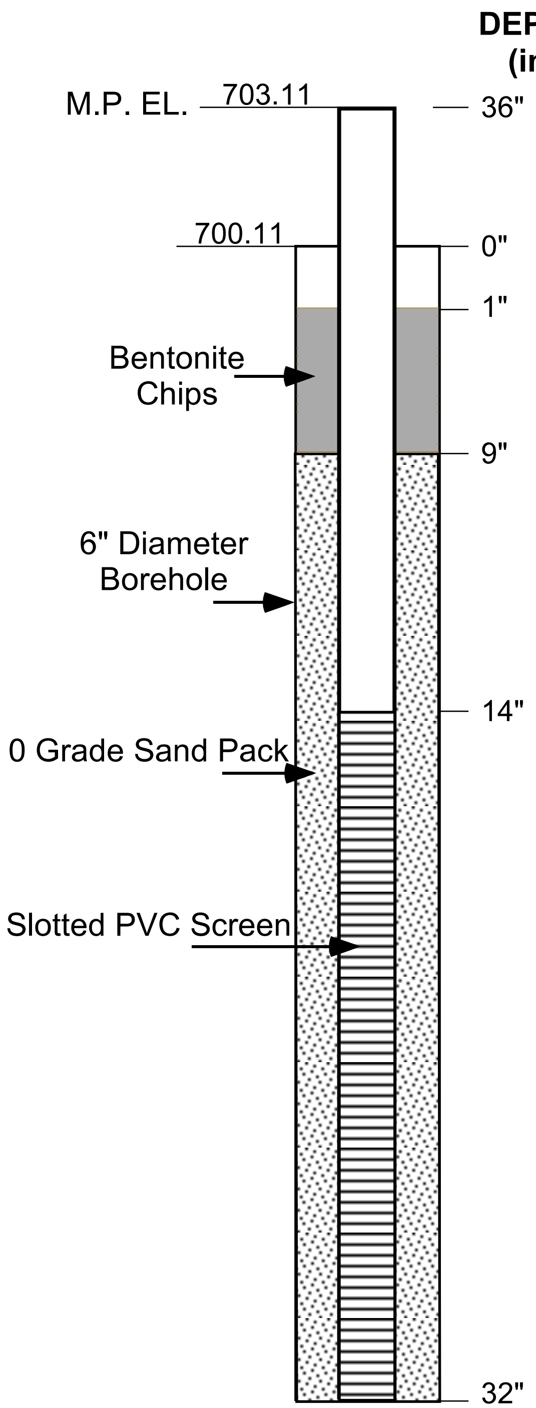
P1, P2, P3 Well Construction & Boring Logs

MONITORING WELL COMPLETION LOG

679 Plank Road
Clifton Park, New York
(518) 348-6995
ALPHA GEOSCIENCE

Well: P1
Project: Hanson-Honeoye Falls
Project No.: 11110
Client: Hanson
Date Drilled: 4/20/11
Date Developed: 4/20/11

WELL CONSTRUCTION DETAILS



NOT TO SCALE

INSPECTION NOTES

Geologist: Matt Dupee
Drilling Contractor:
Type of Well: Piezometer
Static Water Level: ______ Date: ______
Measuring Point: Top PVC
Total Well Depth: 68" (32" below grade)

Riser Pipe
Material: PVC   Diameter: 1"
Length: 50"   Joint Type: Threaded

Screen
Material: PVC   Diameter: 1"
Slot Size: .002 in   Length: 18"
Stratigraphic Unit Screened: Silt & Clay

Packing
Sand: 0   Gravel: ______   Natural: ______
Amount: 0.4 ft^3 Interval: 9"-32"

Seal
Type: Bentonite Chips   Interval: 1"-9"

Locking Case: ______   Yes [ ]   No [X]
Diameter: ______

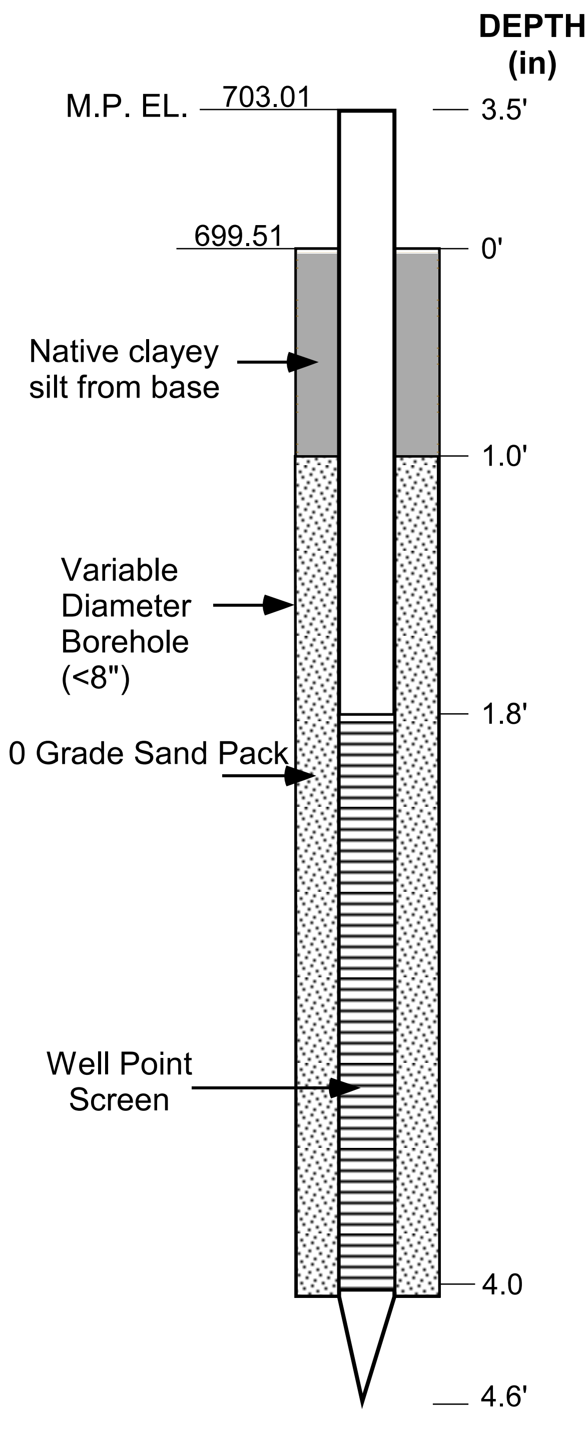
Notes:

MONITORING WELL COMPLETION LOG

679 Plank Road
Clifton Park, New York
(518) 348-6995
ALPHA GEOSCIENCE

Well: P2
Project: Hanson-Honeoye Falls
Project No.: 11110
Client: Hanson
Date Drilled: 7/18/2014
Date Developed: 7/18/2014

WELL CONSTRUCTION DETAILS



NOT TO SCALE

INSPECTION NOTES

Geologist: Steve Trader
Drilling Contractor:
Type of Well: Well Point for Water Level Monitoring
Static Water Level: Date:
Measuring Point: Top of Steel
Total Well Depth: 4.6 ft below grade

Riser Pipe
Material: Steel Diameter: 1.25" (I.D.)
Length: 1.8' + 3.5' Stickup Joint Type: Threaded

Screen
Material: steel mesh Diameter: 1.25"
Slot Size: — Length: 2.2 ft
Stratigraphic Unit Screened: Unconsolidated

Packing
Sand: 0 Gravel: Natural:
Amount: ---- Interval: 1' - 4'

Seal
Type: clayey silt Interval: 0' - 1'

Locking Case: Yes [ ] No [X]
Diameter:

Notes:

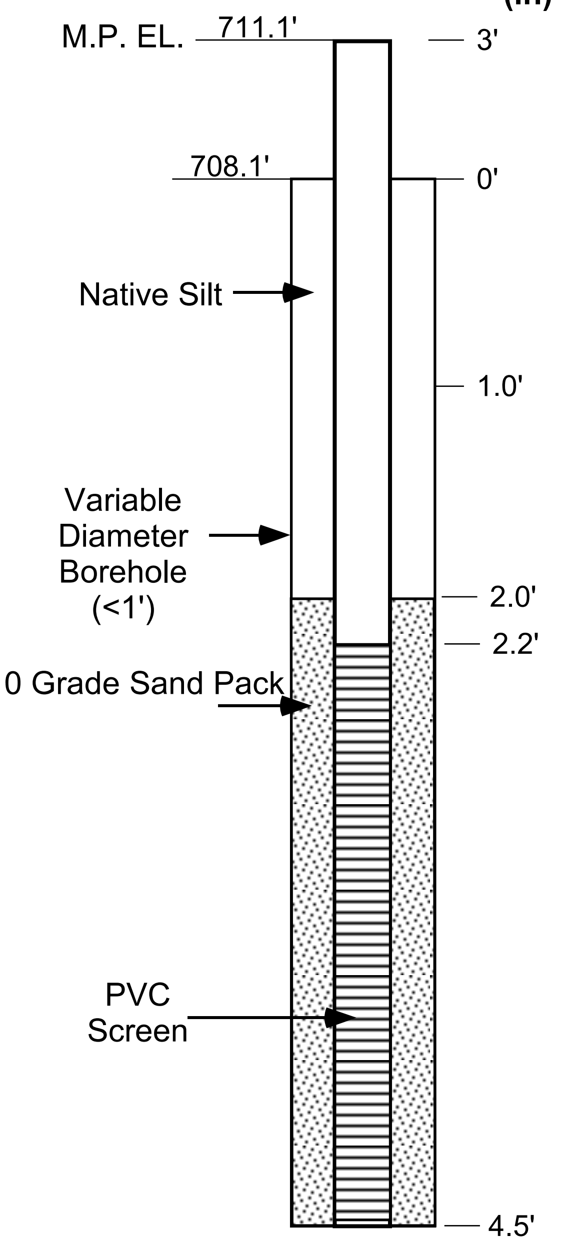
Used hand auger to 4 ft; well point driven to 4.6 ft below grade

MONITORING WELL COMPLETION LOG

679 Plank Road
Clifton Park, New York
(518) 348-6995
ALPHA GEOSCIENCE

Well: P3
Project: Hanson-Honeoye Falls
Project No.: 11110
Client: Hanson
Date Drilled: 7/18/2014
Date Developed: 7/18/2014

WELL CONSTRUCTION DETAILS



NOT TO SCALE

INSPECTION NOTES

Geologist: Steve Trader
Drilling Contractor:
Type of Well: Piezometer for Water Level Monitoring
Static Water Level: Date:
Measuring Point: Top of Steel
Total Well Depth: 4.6 ft below grade

Riser Pipe
Material: PVC Diameter: 1" (I.D.)
Length: 2.2' + 3.0' Stickup Joint Type: Threaded

Screen
Material: PVC Diameter: 1"
Slot Size: .002 Length: 27.5"
Stratigraphic Unit Screened: Unconsolidated

Packing
Sand: 0 Gravel: Natural:
Amount: ---- Interval: 2' - 4'

Seal
Type: none Interval:

Locking Case: Yes ☐ No ☒
Diameter:

Notes:

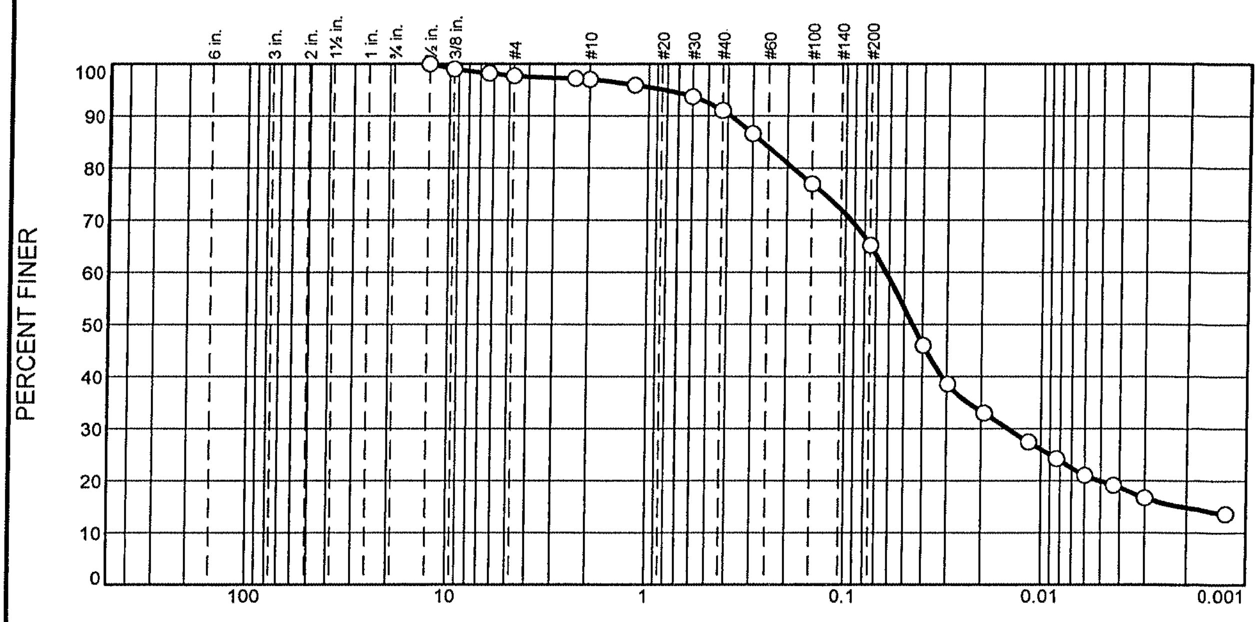
Used hand auger and power auger to refusal at 57 inches; dry at installation

APPENDIX F

Sieve Analysis Results – P2

ATLANTIC TESTING LABORATORIES

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	2	1	6	26	45	20

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	OUT OF SPEC (X)
.5	100		
.375	99		
.25	98		
#4	98		
#8	97		
#10	97		
#16	96		
#30	94		
#40	91		
#50	87		
#100	77		
#200	65		

* (no specification provided)

Soil Description

Grey Clay

Atterberg Limits

PL= --- LL= --- PI= ---

Coefficients

D_{85}= 0.2681 D_{60}= 0.0623 D_{50}= 0.0453
D_{30}= 0.0147 D_{15}= 0.0021 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Sampled and delivered by the client on 7/23/2014.
ASTM D 422 with hydrometer

Location: Clay, P-2
Sample Number: AT1860S55 **Depth:** N/A

ATLANTIC TESTING LABORATORIES, LIMITED
Albany, New York

Client: Alpha Geoscience
Project: Laboratory Service Agreement
Report No: AT1860SL-55-07-14 **Date:** 7/31/2014

Tested by: RL Date: 7/26/14
Reviewed by: RFF Date: 7/31/14