STATE OF NEW HAMPSHIRE
BEFORE THE
PUBLIC UTILITIES COMMISSION

Re: Pennichuck Water Works, Inc.

2010 SRF Financing of Drew Woods Interconnection

to the Town of Derry Water System

DW 10-_____

DIRECT PRE-FILED TESTIMONY OF DONALD L. WARE

April 13, 2010

Q. What is your name and what is your position with Pennichuck Water Works, Inc.?

A. My name is Donald L. Ware. I am the President of Pennichuck Water Works, Inc. ("PWW" or the "Company"). I have worked for the Company since 1995. I am a licensed professional engineer in New Hampshire, Massachusetts and Maine.

Q. Please describe your educational background.

A. I have a Bachelor in Science degree in Civil Engineering from Bucknell University in Lewisburg, Pennsylvania and I completed all the required courses, with the exception of my thesis, for a Masters degree in Civil Engineering from the same institution. I have a Masters in Business Administration from the Whittemore Business School at the University of New Hampshire.

Q. Please describe your professional background.

A. Prior to joining PWW, I served as the General Manager of the Augusta Water District in Augusta, Maine from 1986 to 1995. I served as the District's engineer between 1982 and 1986. Prior to my engagement with the District, I served as a design engineer for the State of Maine Department of Transportation for six months and before that as a design engineer for Buchart-Horn Consulting Engineers from 1979 to 1982.

Q. What are your responsibilities as President of the Company?

A. As President, I am responsible for the overall operations of the Company, including water quality and supply, distribution, engineering and water system capital improvements. With regard to capital improvements overseen by the Company's Engineering Department, I work closely with the Department and the Company's Chief Engineer regarding project selection, project design, project management and construction management.

Q. What is the purpose of your testimony?

A. I will be describing the Company's project to interconnect the Drew Woods Water System located in Derry, New Hampshire with the Town of Derry water system for which the Company seeks approval to finance with loan funds issued by the New Hampshire Department of Environmental Services (NHDES) through the State Revolving Loan Fund (SRF).

Q. Could you please describe what has led the Company to decide that interconnecting the Drew Woods community water system with the Town of Derry Water System is a prudent decision?

A. By way of background, in the late 1990's, the Drew Woods water system had three active wells that provided water supply to the Drew Woods water system. The yield of those three wells was approximately 114 gallons per minute (gpm). While this water supply was capable of meeting winter time demands, it fell short of providing an adequate supply of water during the summer months, even with the use of odd/even watering restrictions. In response to this water supply shortage, the Company hired Hydrosource, Inc. (a professional hydro geological services company) to evaluate the potential of developing additional wells on the Drew Woods property. Hydrosource completed an analysis of the Drew Woods well field in 1998 and identified three potential well sites on the Drew Woods property. The Company drilled and permitted 3 additional wells on the Drew Woods property with an approved additional capacity of 162 gallons per minute (gpm). With all six wells running the Drew Woods wells were producing 246 gpm after the 3 new wells were put on line in late 1999.

Q. Have those wells been sufficient to meet the demands of the system?

A. The capacity of the Drew Woods wells was first challenged in 2002 when daily demand in the Drew Woods system exceeded 310,000 gallons (single day event) resulting in extended run times for the wells and a reduction in well capacity. The Company instituted a ban on outside usage during July 2002 to allow for the wells to rest and one of the wells to be redeveloped by drilling it deeper. In 2003, the Company had to place the Drew Woods system on every fourth day pumpage when the average pumpage per day approached 279,000 gallons per day (gpd) during the first week of July and the peak day that week exceeded 369,000 gallons. It was at this point in time that the Company began to investigate the concept of connecting the Drew Woods system to the Town of Derry in order to provide summer water supply.

Q. What efforts did the Company under take to address this potential shortage?

A. As part of the investigation of alternatives, the Company hired Hydrosource to evaluate if there was additional well capacity in the vicinity of Drew Woods. The Hydrosource evaluation indicated, based on USGS data and the surrounding

4

surface drainage, that the Drew Woods well field should be able to sustain approximately 250,000 gallons per day of flow, which was just below the existing well capacity. The study did not recommend the addition of a seventh well as there was no more groundwater to withdraw from the area. At the time this study was completed, the Company projected that it would cost approximately $550,000 to connect to the Town of Derry's water supply. The Company determined that as long as the 250,000 gpd was available from the Drew Woods wells that conservation in conjunction with reasonable restrictions would result in a sufficient supply of water being available from the existing wells to meet the needs of the Company's Drew Woods customers. During the winter of 2003, the Company worked with its Drew Woods customers to educate them regarding the supply limitations of the existing well field and during the summers of 2004, 2005 and 2006 the capacity of the existing wells was not exceeded. During this time period (2004-2006), the Company noted that the pumpage from the Drew Woods wells dropped steadily from the original installed capacity of 246 gpm to approximately 200 gpm. The well pumps were evaluated and it was determined that they were pumping efficiently and that the reduction in pumpage was a result of low ground water elevations.

Q. At what point in time did the availability of water from the Drew Woods wells diminish?

A. During the summer of 2007, it again became necessary for the Company to institute every 4th day irrigation restrictions on its Drew Woods customers. This ban also was in effect for the summer of 2008 and 2009. At the end of the summer of 2009, one of six Drew Woods wells was "dry" and the remaining 5 wells were only producing approximately 143 gpm. The Company again checked the efficiency of the well pumps and they were performing properly with the reduced pumping levels resulting from a continued lowering of the area ground water elevations. During the time frame between the beginning of 2006 and the end of 2009, the average withdrawal from the Drew Woods well field was approximately 114,000 gpd. The drop in ground water elevations were unusual given the wet summers of 2008 and 2009 in conjunction with the fact that the well field demand was well below the estimated capacity of 250,000 gpd.

Q. Did the Company conduct any investigation of this?

A. Yes. In response to the reduced pumping rates and low ground water levels, the Company hired AECOM to evaluate the existing well field as well as to complete extensive testing of the well field during winter of 2009. A copy of the AECOM analysis is attached as Exhibit DW-01 to this testimony. The report indicates that local static (non pumping condition) ground water elevations at the Drew Woods well field have dropped from about 10' below the ground surface elevation in 1986 (when the first three wells were developed) to 60' below the ground surface elevation in 1999 (when the three new wells were develop) to 240' below the ground surface elevation in January of 2010. This data immediately lead AECOM to the conclusion that average daily withdrawals of 114,000 gpd from the Drew Woods well field (average withdrawal per day over the past 4 years) exceeds the local ground water recharge and that continued pumping at that rate is not sustainable. AECOM recommended decreasing the overall well field withdrawal to about 80,000 gpd which is below the base demands of the existing 524 customers.

Q. Based on the history and data presented above it would appear that ground water mining has been occurring. What options is the Company considering to stop the mining of ground water?

A. There is only one way to stop the ground water mining and that is to reduce the demand on the Drew Woods well field to a level that can be sustained. While AECOM recommended a maximum well field withdrawal of 80,000 gpd, it also indicated that it is unclear whether sustained withdrawals at that rate are possible or not. Whereas average annual demands, and even winter time demands of the customers in this system exceed 80,000 gpd, it is clear an additional source of supply is needed for this water system.

Q. What are the potential sources of supply for Drew Woods?

A. There are two potential sources of supply for this area: locate additional groundwater or interconnect with the Town of Derry for a supply to supplement the existing wells. In 2003, the Company completed an extensive evaluation of the potential for additional ground water within reasonable distance of the existing system and with adequate, undeveloped land to provide adequate sanitary radii for potential new wells. At that time, there were no additional sites for groundwater in the East Derry area that were close enough to the existing Drew Woods water system to merit investigation. As a result, the only long term, legitimate new source of supply for the Drew Woods system is an interconnection with the Town of Derry Water System.

Q. Please describe the proposed Drew Woods interconnection with the Town of Derry water system.

A. The interconnection is a joint project of the Company and the Town of Derry. The project will require that the Company upgrade the pumps at the Town of Derry's Pond Road Booster Station in addition to the construction of an 8,775 lineal feet (LF) water main to interconnect the Town of Derry water system with the Drew Woods water system. This approach (e.g. the use of public funds by the Company to make improvements to municipal water systems for the purpose of interconnecting the Company's system to the municipal water system) has been approved by the Commission previously in Order No. 24,957 (DW 09-063) in which the Company was permitted to expend ARRA funds to construct an interconnection between its Ashley Commons system and the Town of Milford's municipal water system.

The 8,775 LF of water main will consist of 6,575 LF of 12" water main down Hampstead Road from the terminus of the existing Derry water main located at the East Derry Library to the intersection of Adams Pond Road and Hampstead Road plus 2,200 LF of 8" water main down Adams Pond Road to a point of connection with the Company's existing water main located at the intersection of Adams Pond Road and Wright Road. A meter pit will be installed at the interconnection of Adams Pond Road and Wright Road with a check valve that will prevent water from Drew Woods flowing back into the Derry water system. Additional valves and piping will be installed in the Drew Woods Pumping Station to allow for the controlled filling of the Drew Woods Tank. The flow through the meter pit will be about 250 gpm when the Drew Woods Tank is being filled. The disinfection process for the Drew Woods wells will be changed from chlorine to chloramines to match the disinfection used by the Town of Derry.

Q. How often does the Company anticipate using the interconnection?

A. On a typical day both the wells and the Town of Derry water will be used to supply water to Drew Woods. A maximum of 80,000 gpd will be taken from the wells (subject to further evaluation over time) and a minimum of 35,000 gpd of water will be purchased from the Derry Water Department (guaranteed minimum purchase from the Town). The Interconnection Agreement between the Company and the Town is described in more detail below. The Town of Derry will own, operate and maintain the water main up to the meter pit located at Adams Pond and Wright Road.

Q. What is the estimated cost of the interconnection?

A. The estimated cost of the project as described above, including engineering and a 15% construction contingency is $1,435,842. The Town of Derry will be paying for upsizing the water main from the 8" diameter required by the Company to the 12" diameter desired by the Town of Derry. Additionally, the Town of Derry will be paying for any hydrants and services installed along the water main interconnection. Additionally, the Town of Derry will be paying for 10% of the cost of the water main installation since it will be hooking up its Meadowbrook community water system to the interconnection. The 10% is the Town's prorated share of the interconnection cost based on its 59 customers and the Company's 524 customers. The Company's estimated cost to complete the interconnection, after the Town of Derry contributions, is approximately $1,218,000. However, it is possible that the cost of the project will exceed this amount, and thus the Company is seeking authority to borrow up to $1,600,000 to cover this contingency.

Of the $1,218,000 invested in the project, the Company will retain ownership and control over the meter pit, the upgrades to the Drew Woods Booster Station and a small amount of interconnecting piping. The majority of the water main will be owned, operated and maintained by the Town of Derry. The Company, based on the interconnection estimate, anticipates booking approximately $82,000 to Account 331.4 and $64,000 to Account 311.2 with the Company proposing to book the residual project costs of approximately $1,072,000, subject to Commission approval, to Account 303.20, as a cost to obtain water rights.

Q. Does Derry have sufficient supply to sell water to the Company's Drew Woods customers?

A. Yes, the Town of Derry gets its water supply from Manchester Water Works. The Town of Derry currently has purchased "rights" to 2.79 million gallons per day (mgd) and is currently only using about 1.6 mgd.

Q. What is the nature of the purchased water contract with the Town of Derry?

A. The Company will be treated as a retail, multifamily customer by the Derry Water Department. The Company will pay the retail rate in effect in Derry (currently $2.47 per CCF) in addition to a base quarterly rate of $22.88 per connected customer to the Company's Drew Woods water system. The $22.88 per quarter per customer includes an allowance of 5 CCF per customer. This is the same rate

10

structure as the Town charges to its multifamily residential units. Finally, the Town is requiring the Company to purchase a minimum of 12.78 million gallons per year of water or 35,000 gallons per day. In exchange for purchasing this minimum amount of water per year, the Town of Derry will sell the Company up to maximum average daily flow of 200,000 gallons per day (based on the total maximum metered flow over 60 days divided by 60 days during the highest use period in any year) without charging the Company any Merrimack Source Development Charge. A copy of the interconnection agreement between Pennichuck and the Town of Derry is attached as Exhibit DW-02.

Q. What is the timeline for this project?

A. The list below provides an estimated timeline for the proposed Drew Woods Interconnection Project:

1. File financing petition with Commission– April 13, 2010
2. Sign Interconnection agreement with the Town of Derry – April 16, 2010.
3. Company Board Resolution approving SRF loan – April 30, 2010
4. Complete Engineering Design of Interconnection – May 7, 2010.
5. NHDES approval of proposed design – May 21, 2010
6. Bid Interconnection project – May 24, 2010
7. NHPUC approval of Financing – June 10, 2010
8. Sign SRF Loan Documents – June 21, 2010
9. Open Bid for interconnection project – June 24, 2010
10. Complete Company, NHDES bid review and award contract –

July 5, 2010.

11. Contractor begin construction – July 26, 2010

12. Project substantial completion – October 22, 2010.

Q. Since the interconnection will not be complete until after the summer is over does the Company plan to implement outside water usage restrictions this summer?

A. Yes. The Company will start the Drew Woods water system on every fourth day lawn irrigation restrictions. If the wells are unable to meet the demands required by this level of usage the Company will need to result to a total ban on lawn irrigation in order to insure adequate water is available for domestic water use.

Q. Does this complete your testimony?

A. Yes.

AECOM Environment
171 Daniel Webster Highway, Suite 11
Belmont, NH 03220
T 603.524.8866 F 603.524.9777 www.aecom.com

March 15, 2010

John J. Boisvert, P.E.
Pennichuck Water Works
25 Manchester Street
Merrimack, NH 03054-1947

Subject: AECOM report on wellfield assessment, Drew Woods Community Water System, Derry, NH; AECOM project # 60137500

Dear John,

AECOM Environment (AECOM) is pleased to present this report to Pennichuck Water Works (Pennichuck) summarizing recently-conducted work to assess the water supply wells that currently serve the Drew Woods Community Water System (EPA ID# 0612150) in Derry, New Hampshire. The work was conducted under a September 2009 contract between AECOM and Pennichuck and based on AECOM's revised proposal dated September 14, 2009. The contract was subsequently modified by Work Orders dated November 2009 and February 2010. The results of other work performed under this contract have been communicated to Pennichuck via meetings, discussions, or electronic mail.

BACKGROUND AND OBJECTIVES

The Drew Woods wellfield consists of seven bedrock wells, six of which are currently or recently have been in service. (Well #2 has been out of service since the early 1990s due to high levels of iron.) Wells 5, 6, and 7 were installed in the late 1990s, augmenting the yield available from pre-existing Wells 1, 3, and 4. A pumping test on Wells 5, 6, and 7 was conducted as part of the new well permitting process in the late 1990s. Well 1 was taken out of service late in 2008 due to declining yield. Even though higher than average precipitation has occurred in 2009, some of the wells have experienced significant declines in yield within the past several months. See the Drew Woods wellfield map provided by Pennichuck and reproduced in Attachment 1.

Water from the wells is treated for radon in the control building. A 225,000-gallon storage tank is also present at the wellfield, providing more than 1.5 days worth of storage, based on recent average daily water usage of 110,000 – 130,000 gallons. Under present operating conditions, Wells 3, 4, 5, 6, and 7 are either all pumped at the same time or none of them are pumping. The cycles tend to be of fairly short duration, with levels in the storage tank dictating when the pumps shut off or turn on. Pennichuck estimates that in order to meet peak demand, the wellfield should be capable of sustaining a combined pumping rate of about 205 gallons per minute (gpm). The Drew Woods wellfield serves the Redfield and Hubbard Hill developments as well as Drew Woods.

Daily water usage, averaged on a monthly and a yearly basis for the past 5 years, has been provided by Pennichuck and is found in Attachment 2. Over the 5 years, the average daily usage is about 114,000 gallons per day (gpd). On a yearly basis, the average daily usage ranges from about 102,000 to 125,000 gpd and has been declining over the past five years. The highest monthly daily water use averages occur in June, July, or August and have been as high as 192,000 gpd. Peak daily usage for a single day can be expected to be higher than the monthly average. Although peak single day data are not available, Pennichuck estimates this value at 205 gpm (295,200 gpd).

The objective of the project was to assess the cause(s) for the recent decline in well yields and to work with Pennichuck to select and carry out a solution. Pennichuck also needed to assess whether production from the Drew Woods wellfield can be increased to about 205 gpm in order to meet peak demand.

INVESTIGATIONS CONDUCTED

Investigations conducted by AECOM included:

- Review of historical well records provided by Pennichuck
- File review at NHDES
- Research and recommend pressure transducer and related equipment options
- Collection of water level data with pressure transducers in selected Drew Woods and off-site wells during part or all of the period from December 18, 2009 – February 4, 2010
- Conduct of an approximately 24-hour pumping test by AECOM and Pennichuck on Drew Woods wells on February 3 – 4, 2010
- Analysis of water level and well yield data from the pumping test
- Wellfield survey by Meridian Land Services for Pennichuck, with well elevations provided to AECOM

RESULTS

Historical Water Levels

Figure 1 shows a schematic cross-section of the Drew Woods wellfield. The diagram has a vertical scale, but no horizontal scale and shows the seven Drew Woods wells. Pump depths, and depths of key water-bearing fractures are shown where these are known. Historical water levels are shown where these are known. Starting water levels and water levels at maximum drawdown are shown for the February 2010 pumping test, discussed below.

According to NHDES files, static (non-pumping) water levels in Wells 1 and 2 in 1986 were about 10 feet below ground surface (ft bgs). In 1999, just before the start of the pumping test for (then new) wells 5, 6, and 7, water levels were 50 – 70 ft bgs. These were probably not true static water levels, as nearby existing Wells 1, 3, and 4 may have been pumping or had been recently pumped at the time of measurement.

During downloads of pressure transducers and hand measurements in Drew Woods wells during resting cycles in December 2009 and January 2010, typical water levels were on the order of 240 ft bgs. These cannot be considered static water levels because rest periods in between pumping cycles tended to be too short for full recovery.

After a longer rest period (but still not long enough for full recovery) and before the start of the pumping test on February 3, 2010, water levels in the Drew Woods wells were approximately 200 - 215 ft bgs. Although Well 1 has been out of service since late in 2008, its water levels were also at about 200 - 215 ft bgs. An exception is Well 2, which has not been used since the early 1990s. When observed by AECOM during non-pumping periods for the other wells, water levels in Well 2 were typically 60 – 100 feet shallower than in the other wells.

Water levels have not been observed after sufficient recovery time to allow measurement of true present-day static water levels. However, it is clear that historical water level declines have occurred in the past two decades. Observations at Well 2 indicate that this decline is not uniform over the Drew Woods site, and it is unknown whether the decline may be related to the pumping of off-site wells in East Derry. (Information obtained from Pennichuck and NHDES indicates that a number of domestic wells and other community wells are present in the Drew Woods vicinity and in throughout much of the East Derry area.)

AECOM's measurements at off-site wells are not conclusive in this regard. Well #1 at the Glen Ridge water system, approximately two miles from the Drew Woods site, showed deep water levels similar to those at Drew Woods, but this may be due to that well's hillside location. Water levels at the Farmstead water system Well #1, approximately one mile from the Drew Woods site, were very shallow, but this may be due to the topographic setting and nearby source of potential recharge. Two wells at the Hi & Lo water system proved not to be accessible to pressure transducers, but showed deep water levels when measured by hand.

Available Recharge

On August 10, 2001 (Attachment 2), Atlantic Geoscience Corporation (AGC; now AECOM) submitted a letter report to Pennichuck entitled "Feasibility Investigation Results for New Water Supply at Drew Woods Site…". This report concluded that pumping (up to 300,000 gallons per day at that time) may have been exceeding the theoretically estimated recharge for the topographically upgradient drainage basin for the wellfield. The report also indicated that due to generally subdued topography in the area, the wells may receive recharge from bedrock fractures that extend beyond topographic drainage divides.

Assuming that the topographically upgradient drainage basin for the wellfield is characterized by thin, sandy glacial till, the 2001 letter report estimated that the theoretically available recharge was about 250,000 gallons per day (gpd) or about 177 gpm. If the thick glacial till present at the wellfield persists over much of the recharge area, the estimate could be lower. Further, such estimates are considered upper bounds for the amount of water that can be pumped, because no well or wellfield can capture all the water that is theoretically available (unless the wells obtain some water from outside the surficial drainage basin). Thus, the recharge calculation suggests that the 300,000 gpd of estimated usage at that time (2001) exceeds the estimated available recharge. The 205 gpm (295,200 gpd) peak demand that Pennichuck now seeks to meet also exceeds the estimated recharge.

Extensive wetlands are present near the Drew Woods wells. Anecdotal and qualitative observations indicate that these wetlands have not diminished over time, with pumping. AECOM's project manager for the present project sited and tested Wells 5, 6, and 7 and recalls similar wetland conditions at that time (late 1990s) to those at present. This suggests that the wells receive recharge from elsewhere. Low-permeability glacial till at the site may provide partial hydraulic isolation between the wetlands and the bedrock fractures at the Drew Woods site.

Pumping Test and Well Interference

On February 2, 2010, Pennichuck shut off the well pumps at Drew Woods to allow water levels in the wells to recover prior to the pumping test. (However, three short pumping cycles were required in the hours prior to the pumping test in order to maintain minimum water levels in the storage tank, required for fire protection.) On February 3, the pumping test began with a staggered start-up phase. Once all the wells (3, 4, 5, 6, and 7) were started, they all pumped together for 22 hours, 55 minutes. Then a staggered shut-down phase began, with the well pumps turned off at 15-minute increments until all were shut down. Water levels were then monitored for about the first hour of recovery.

The staggered start-up and shut-down allowed an assessment of well interference and pumping efficiency for selected well combinations. When all the wells had been pumping for several hours, the storage tank overflowed. Water level data shows no evidence that the overflow water infiltrated directly into any of the wells. When the wells were pumping, the valves were fully opened, and water was pumped directly into the system, including the atmospheric storage tank. No attempt was made to keep pumping rates constant. With all wells pumping together, the combined pumping rate was about 189 gallons per minute (gpm) during the first 310 minutes of the pumping test (Attachment 3). The combined pumping rate was about 160 gpm for the remaining time during which all the wells were pumping (about 18 hours). Pump meter readings and flow rate data and summaries are presented in Attachment 3. Water level data and graphs are presented in Attachment 4.

These results indicate the following qualitative well interference effects:

- Non-pumping Well 1 is hydraulically connected to Wells 3, 4, and 5 (Well 1 water levels draw down when these wells pump);
- Well 1 has no noticeable connection with Well 7;
- Non-pumping Well 2 has no direct, immediate hydraulic connection to any of the other wells;
- Non-pumping Well 2 may have a delayed, subdued, and generalized hydraulic connection to the other wells;
- Well 3 interferes with Wells 4 and 5 (and vice versa);
- Well 3 has a slight hydraulic connection with Well 6;
- Well 3 does not have a noticeable hydraulic connection to Well 7;
- Wells 4 and 6 perform better (less drawdown) when Well 5 is not pumping;
- Well 5 has hydraulic connections (interferes with and is interfered with) to Wells 6, 4, and 3;
- Well 6 has a hydraulic connection with Well 5 and a slight connection with Well 4;
- Well 7 has a slight hydraulic connection to Well 6;
- Well 7 has a slight or no connection to Well 5.

Observations and notes concerning specific wells follow:

Well 1: This well is not currently in use and was not pumped during the test. When Well 3 is pumping and Well 1 is not, Well 1 water levels are nearly identical to those in Well 3. When other wells are pumping, Well 1 water levels are even lower than those in Well 3. Well 1 is probably only useful as a monitoring well or as an inefficient backup for Well 3 or Well 5 (and only if most of the other wells are not pumping).

Well 2: This well has not been used since the early 1990s (due to high levels of iron) and was not pumped during the test. Well 2's pre-test water level was 60 – 80 feet higher than the other wells' pre-test levels. Well 2 shows a delayed response to the other wells; Well 2 water levels did not start declining until about 6 hours after the start of the pumping test, and water levels were still declining one hour into the recovery period. These observations, combined with high iron levels in the water, suggest that Well 2 is at least partially hydraulically isolated from the other wells. It might be possible to pump Well 2 with little effect on the other wells (but this is not done because of elevated iron in the water).

Well 3: This well is the highest yielding and most efficient well (highest yield per foot of drawdown), as it pumped at 50 gpm throughout the test (no matter which other wells were pumping) and experienced less than 50 feet of drawdown. This is a greater specific capacity than was measured for the well in its original test in 1999, probably because the well was deepened in 2003. Significant additional drawdown is available in this well before the primary water-bearing fractures are reached at a depth of about 470 feet. Probably, a higher yield could be obtained from this well with a larger pump, but this could create greater interference with other wells at the site. Well 3 is the only well with a fully accessible monitoring tube.

Well 4: This well has no monitoring tube, so no water level data were obtained during this study. This well is the second or third highest-yielding well in the wellfield, and produced about 38 gpm during the test. Well 4 has a significantly higher yield (Attachment 3) when Well 5 is not pumping.

Well 5: This well is one of the three highest-yielding wells at the site, but Wells 4 and 6 perform better when Well 5 is not pumping. Well 5 produced about 40 gpm during the test. Well 5's monitoring tube was too small diameter to allow installation of a pressure transducer to sufficient depth, and it only accommodated electronic water level probes with thin round cables (as opposed to the type with flat tape-type cables).

Well 6: This well produced about 23 gpm during the test. Well 6 performs more efficiently (higher yield; less drawdown) when Well 5 is not pumping. The monitoring tube accommodated electronic water level probes but not a pressure transducer (to sufficient depth).

Well 7: This is the lowest-yielding well (not counting Well 1), and it produced about 12 gpm during the test. However, it does not significantly interfere with the other wells, nor is it significantly impaired by the other wells. The monitoring tube accommodated electronic water level probes but not a pressure transducer (to sufficient depth).

Figure 1 shows that non-pumping Well 2 showed the least drawdown during the February test, and it shows that of the pumping wells, Well 3 showed the least drawdown. Even though it was not pumped, Well 1 showed greater drawdown than Well 3 and similar drawdown to Well 5. Figure 1 also shows that Well 7 experienced the greatest drawdown; this well also had the lowest yield. Well 3 had the least drawdown and highest yield, and Well 6 had intermediate yield and drawdown; both have more than 100 feet of drawdown available before the primary water-bearing fractures or pumps are reached. This suggests that larger pumps could produce higher yields for these two wells, at least in the short term. However, this would likely produce greater interference effects on the other wells, and pumping more water in the short term would not resolve recharge or long-term water level concerns.

Semi-log plots of pumping and recovery water levels are found in Attachment 5 and extend pumping and recovery water level plots to one month and three months by extrapolating late-time data. This extrapolation assumes that drawdown (or recovery) continues at the same rate relative to the log of time. However, this may not prove to be the case. For the pumping plot, as drawdown continues, the pump may limit the yield that can be maintained, thereby causing the rate of water level decline to change. On the other hand, if drawdown causes a water-bearing fracture to become de-watered, this may cause the rate of drawdown to increase.

With these cautions in mind, the semi-log pumping plots (Attachment 5) suggest the following extrapolations to three months of pumping:

- water level in Well 3 would remain above an elevation of 100 feet above mean sea level (ft amsl) (equivalent to depth of about 300 feet);
- water level in Well 5 would remain above sea level (depth of about 400 feet); and
- water levels in Wells 6 and 7 would remain above an elevation of -50 ft amsl (depth of about 450 feet). However, for Well 6, extrapolation of the last several data points suggests a much steeper rate of decline for this well.

The semi-log recovery plots (Attachment 5) suggest that after roughly 24 hours of pumping, one month of recovery would produce water elevations of approximately 200 ft amsl (depth of about 200 ft). Recovery to static conditions such as those observed in the 1980s (or even those observed at the start of the 1999 pumping test) would appear to require far longer than three months.

DISCUSSION

Consideration of water usage information, historical water level declines, and recharge estimates, in combination, indicate that neither the estimated peak water usage of 295,200 gpd, nor historic water usage, nor recent average water usage are sustainable over the long term and would probably result in continued water level decline. Well interference observations (described above) and associated recommendations (below) may result in improved efficiency and even increased yield for limited periods of time. However, increased well interference and drawdown would be expected.

The estimated theoretically available recharge of about 250,000 gpd is an upper bound for actual well production unless the wells obtain water from outside the topographic drainage basin. Significant historic water level declines indicate that pumping has exceeded recharge over time. Pennichuck's experience of declining yield and well performance even during 2009, which was a wet year, indicates that current water usage is not sustainable on either an average or a peak demand basis.

In other words, the estimated available recharge is clearly not sufficient to meet Pennichuck's peak demands. Further, combined lines of evidence indicate that available recharge is not sufficient to meet current average demands, especially during the summer. Improved efficiency can be achieved, and increased yield can probably be obtained for limited periods of time. However, neither present nor increased yields appear sustainable for long periods of time without increased water level declines and well interference.

With presently available data, it is difficult to estimate a combined wellfield yield that would be sustainable in the long term and that would stop or reverse long-term water level declines. Factors such as precipitation, off-site water usage from other wells, increasing the duration of Drew Woods resting cycles, and using well combinations to address interference effects can be expected to impact the amount of water that can be withdrawn from the wellfield on a sustainable basis. Pennichuck's experience suggests that this amount is something less than the present average withdrawal of about 114,000 gpd (for the last 5 years). The best way to determine a sustainable yield is to select a reduced, combined pumping rate (once an alternative source of water is available), and to pump this amount while monitoring the amount of pumping and water levels in the wells over several seasons and a variety of weather conditions. See recommendations below.

CONCLUSIONS

1. There has been a water level decline in the Drew Woods wells since the mid-1980s and late 1990s. The amount of this decline cannot be quantified since recent non-pumping water levels have not been measured after full recovery. It is clear, however, that water levels in non-pumping Well 2 have declined less than in the pumping wells or in non-pumping Well 1.

2. It is unknown if the historical water level decline is regional throughout much of East Derry. A number of domestic wells are located near Drew Woods, and numerous community water supply wells are located in East Derry. Most, if not all of these are completed in fractured bedrock.

3. The combined withdrawal rate for the Drew Woods wells has likely exceeded the average recharge rate for at least some of the time since Wells 5, 6, and 7 began operating.

4. The Drew Woods wells probably obtain their recharge from off-site, as wetlands on the site appear (qualitatively) unaffected by pumping. The approximately 15 feet of glacial till overburden at the site may act as an aquitard.

5. All of the Drew Woods wells except Well 2 (and possibly Well 7) are directly hydraulically interconnected with each other.

6. Well 3 is the highest-yielding well, and its yield may be pump-limited. More water may be obtained from this well with a larger pump, but this will likely affect other wells. Other notes and conclusions regarding specific Drew Woods wells are listed above.

7. During the February 2010 test, Wells 3, 4, 5, 6, and 7 produced a combined yield of nearly 190 gpm for 5 hours and a combined yield of about 160 gpm for the remaining 18 hours of the test.

8. The shallower the water level when pumping begins, the higher the yield of the wells (because the well pumps do not have to lift the water so far). With longer recovery periods before pumping, shallower starting water levels and higher pumping rates can be expected, at least for a few hours.

9. Continuous pumping for 24 hours a day for a day or more may result in larger drawdowns than observed in the February pumping test, but these drawdowns may be pump limited. While most of the wells have additional drawdown that is theoretically available before the pump or main water-bearing fracture is reached, additional drawdowns would exacerbate interference effects and would require longer recovery times before the next pumping cycle. It is unlikely that longer recoveries would lead to a return to 1986 static water levels, unless more than 3 months without pumping occurred. Neither the current short on/off cycles nor 24/7 pumping appears to be optimal.

10. Grouping the Drew Woods wells (see below) may provide more efficient pumping scenarios than the present practice of pumping all the wells together and resting them all together.

11. While improvements can be made and efficiencies gained (see recommendations below), a combined yield of 205 gallons per minute in order to meet peak demand will exceed the available recharge and cannot be expected to be sustainable in the long term.

12. Further, the five-year daily average withdrawal of about 114,000 gpd appears to exceed the available recharge, based on evidence of declining water levels and well yield. The practical sustainable yield depends on many factors, but is clearly less than the current average withdrawal as presently configured. Quantification of sustainable yield could be attempted and

assessed with water withdrawal and water level monitoring, once an alternative source is available. However, with short-term testing of different well combinations and withdrawal rates, it may be possible to project water level recovery rates and estimate a sustainable yield on a preliminary basis.

RECOMMENDATIONS

- A monitoring tube should be installed in Well 4, and this tube should be able to accommodate either an electronic water level probe for hand measurements or a pressure transducer for automatic measurements. A tube of the same or greater diameter than the black polyethylene tube in Well 3 is recommended.

- A black polyethylene tube of equal or greater diameter than the one in Well 3 should be installed in Well 5. This is also recommended (but a lower priority) for Wells 6 and 7.

- Pressure transducers should be installed in the 3 highest-yielding wells (3, 4, and 5) and set to collect water level data as long as the wellfield is operational. The frequency of data reading can be selected based on transducer storage capacity, battery life, and how often Pennichuck intends to download the data. AECOM recommends taking a measurement from one to four times per hour. As a lower priority, Pennichuck should consider monitoring Wells 6 and 7 with transducers also. With the drawdowns expected, barometric measurements and corrections are probably not necessary.

- Use longer resting periods to allow starting water levels to be shallower, thus allowing higher pumping rates and/or longer pumping cycles when the wells are pumping. In order to accomplish this, a change in the level of the "pump-on" and/or "pump-off" switches in the storage tank will be necessary.

- Do tests of different well groupings, as the current practice of pumping all the wells together and resting them all together is probably not optimal. With present pumps, Wells 3 and 7 produce the same yield whether other wells are pumping or not, so these two wells could be pumped whenever pumping is occurring. However, Wells 4 and 6 perform better when Well 5 is not pumping. Therefore AECOM recommends trying two groups of wells:
    a. Group A: Wells 3, 5, and 7
    b. Group B: Wells 3, 4, 6, and 7

  AECOM recommends that each grouping be tested for several hours, with pump meter readings recorded during the test, and water levels for the pumping and non-pumping wells obtained using transducers or hand measurements. AECOM would be pleased to assist with either measurement, data analysis, or both for such a test.

- To estimate a yield (lower than the current average daily water usage of about 114,000 gpd, AECOM recommends reducing the overall withdrawal to 80,000 gpd, although this selection is somewhat arbitrary. This could be done after an alternate source of water is available, during a low-demand time of year, and/or for a short period of time. The amount of water withdrawn from each well should be monitored, as should be water levels in each well. The results should be interpreted by a hydrogeologist. Such tests could be combined with the testing recommended in item 5, above, at least for short periods of time.

Thank you for this opportunity to work with Pennichuck. Thanks also to you, Chris Countie, and the Pennichuck staff who assisted with the test. Please contact me with any questions regarding the results, conclusions, or recommendations of this study.

Yours sincerely,

James H. Vernon

James H. Vernon, Ph.D.
Senior Hydrogeologist/Project Manager

jim.vernon@aecom.com

Figure 1. Schematic Cross Section

List of Attachments

1. Drew Woods Wellfield Map
2. Water Use Information and Recharge Estimate
3. Pumping Data from February 2010 Pumping Test
4. Water Level Data from February 2010 Pumping Test
    a. Pre-test Water Level Plot
    b. Pumping Period Plots
    c. Start-up Zoom-in Plots
    d. Shut-down Zoom-in Plots
5. Semilog Projections

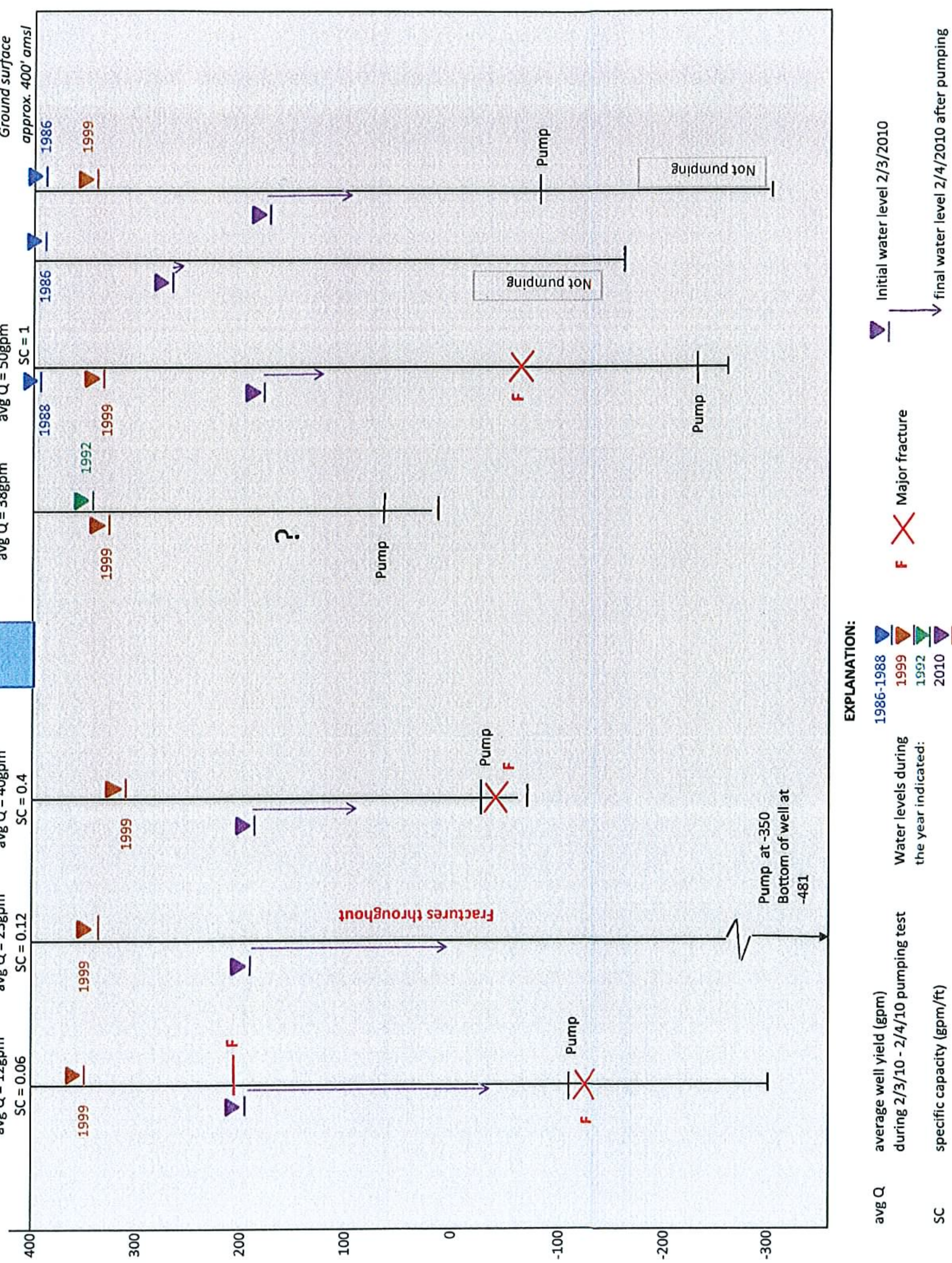


Figure 1. Schematic Cross Section
Drew Woods Water System, Pennichuck Water Works

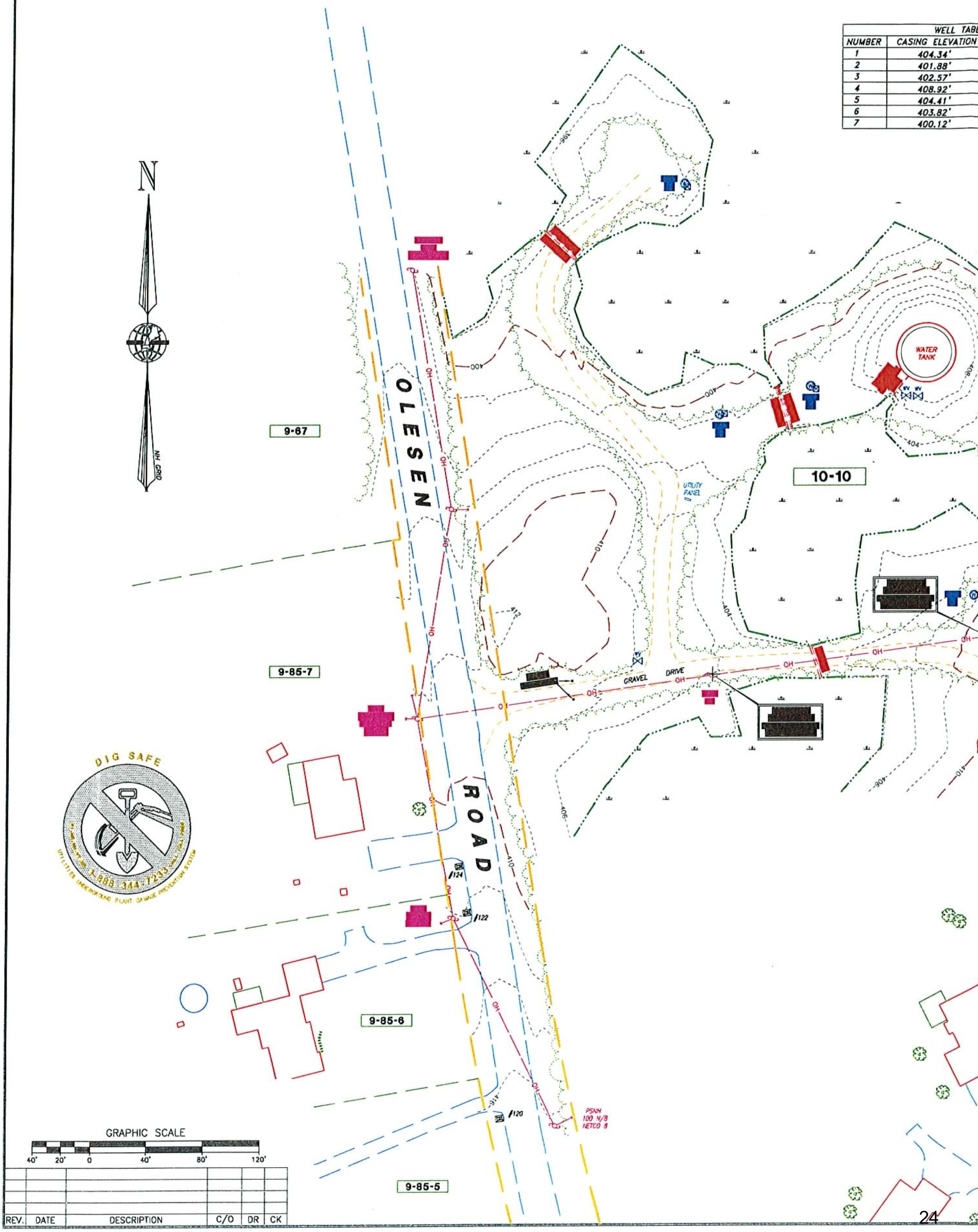
Attachment 1

Drew Woods Wellfield Map

(Provided by Pennichuck)

WELL TABL

NUMBER	CASING ELEVATION
1	404.34'
2	401.88'
3	402.57'
4	408.92'
5	404.41'
6	403.82'
7	400.12'



Attachment 2

Water Use Information and Recharge Estimate

Water Usage (in ccf) for Drew Woods, Redfield and Hubbard Hill

	2005		2006		2007		2008		2009	
	Usage (CCF)	Ave. Monthly GPD*	Usage	Ave. Monthly GPD*	Usage	Ave. Monthly GPD*	Usage	Ave. Monthly GPD*	Usage	Ave. Monthly GPD*
January	4,406	116,944	4,275	113,467	3,310	87,854	3,390	89,977	3,040	80,687
February	3,358	98,677	3,092	90,861	3,199	94,005	3,933	115,574	3,886	114,193
March	3,445	91,437	3,210	85,200	3,193	84,748	2,795	74,185	2,893	76,786
April	4,124	113,108	3,959	108,582	3,879	106,388	3,291	90,261	2,941	80,662
May	3,699	98,179	4,106	108,981	3,404	90,349	3,750	99,532	4,409	117,023
June	4,604	126,272	4,462	122,378	6,162	169,003	6,470	177,451	4,841	132,772
July	7,238	192,111	6,517	172,974	5,683	150,838	4,780	126,870	3,750	99,532
August	6,457	171,381	5,720	151,820	4,535	120,368	5,793	153,757	5,376	142,689
September	5,734	157,265	5,984	164,121	6,406	175,695	4,562	125,120	4,355	119,443
October	5,525	146,644	3,845	102,054	3,535	93,826	3,519	93,401	3,141	83,368
November	3,651	100,135	3,288	90,179	3,205	87,902	3,915	107,375	3,676	100,820
December	3,007	79,812	3,935	104,443	3,897	103,434	3,199	84,908	3,051	80,979
Annual Totals -	55,248	124,543	52,393	118,107	50,408	113,632	49,397	111,353	45,359	102,250

*Average monthly flow includes the average system unaccounted for water of **10%**

Average Daily Usage for the past Five Years - **113,977 gallons per day**

August 10, 2001

Mr. Donald Ware
Pennichuck Water Works Inc.
P. O. Box 448
Nashua, NH 03061-0448

SUBJECT: Feasibility Investigation Results for New Water Supply at Drew Woods Site, East Derry, New Hampshire, AGC Project No. NH-0228b

Dear Don:

This letter constitutes Atlantic Geoscience Corporation's (AGC's) report, including results and recommendations based on our feasibility study for developing new water supply wells at the Drew Woods site in East Derry, New Hampshire.

INTRODUCTION

This report is the finished product for AGC's contract with Pennichuck Water Works, dated July 9, 2001. The goal of this phase of work is to assess the feasibility of installing additional water supply wells on a 40-acre parcel, located directly east of the current Drew Woods wellfield, east of Olesen Road. This letter also proposes new, Phase II work.

Concerns identified by Pennichuck include whether there is sufficient recharge to allow additional groundwater withdrawal in the vicinity. A second concern is whether new wells, when pumped, would draw significant quantities of water away from the existing wells.

At the existing wellfield site, six of seven existing bedrock wells are pumped. (One of the wells is not in service because of high levels of iron in the water). The site supplies water for Drew Woods and other nearby developments. Average withdrawals of 215,000 gallons per day (gpd) occur in summer, with 60,000 gpd in winter, and with maximum daily withdrawals of approximately 300,000 gpd. Wells 5, 6, and 7 were installed in the late 1990's and augment the yield of previous wells 1 through 4. Wells 5, 6, and 7 are highly productive, but are known to interfere with each other and with wells 1 through 4.

The new site under consideration for additional wells consists of approximately 40 acres. It is roughly rectangular with dimensions of about 1500 feet east-west and about 500 feet north-south. The site lies immediately east of the existing wellfield and north of the Drew Woods homes. The site is wooded and is bounded by woodlands to the north and east.

The feasibility study included three types of investigation. First, AGC assessed existing information, including published maps and in-house fracture data. Second, AGC conducted reconnaissance geologic field mapping in and around the parcel. Third, AGC calculated and assessed potential recharge for the site.

GEOLOGIC SETTING

Based on published mapping and on AGC's field reconnaissance, the bedrock formations that underlie the study area are primarily meta-sedimentary rock. Intrusions of granitic rock and quartz veins are also present in the general area and could be encountered during well drilling. The meta-sedimentary rocks consist of layers of schist; sometimes weathered rusty, due to the presence of iron oxide. Quartz veins, either concordant with the layering or filling cross-cutting fractures in the bedrock, are also common. In some outcrops, the rock has a granitic appearance, with some alignment of biotite (black mica) imparting a weak foliation to the rock.

Potential water-bearing structures include northeasterly-trending metamorphic foliation and cross-cutting fracture zones. Some of these fracture zones may be open and water-bearing; others may be filled with quartz or weathered material. The published USGS Bedrock Aquifer Map for the area shows lineaments in or near the site that trend 10, 80, 95, 145, and 155 degrees.

Based on published mapping and field reconnaissance, overburden in much of the area consists of relatively thin, bouldery glacial till, with bedrock present at the surface in some areas. The surficial geologic map of New Hampshire indicates a small area of sand and gravel to the north of the site. Extensive sand and gravel aquifers are probably not present in the area; therefore, new wells would almost certainly be drilled into bedrock.

Existing fracture data in AGC's files includes data from five outcrops within one mile of the site, for a total of 156 fracture measurements. These fracture measurements show statistical peaks trending 42 degrees, 116 degrees, and 145 – 146 degrees. New measurements as part of the current study show foliation striking 40 – 50 degrees, with statistical fracture peaks at 110 degrees and 140 degrees. These data are internally consistent, and the 140 (145 – 146) degree fracture set corresponds to the most prominent of the USGS lineaments. At outcrops in the pond near the east end of Drew Woods Drive (immediately south of 40-acre parcel), foliation dips from 67 to 79 degrees southeast; at outcrops on the parcel, foliation dips from 77 degrees northwest to vertical. Fracture dips range from 37 degrees northeast through vertical.

In summary, the rocks are strongly foliated in the northeast direction, with steep dips in either the northwest or southeast directions. Experience indicates that fractures or intrusions along these structures may be water-bearing and should produce geophysical anomalies. However, whether to offset drilling targets to the northwest or southeast may be ambiguous. Two sets of northwest-trending fractures are present, with dips ranging from shallow to the northeast, to vertical.

RECHARGE ANALYSIS

Recharge analysis can provide an order-of-magnitude estimate of the amount of water that may be theoretically available to a well drilled in a certain area. Recharge analysis assumes that in a year with average precipitation, a certain portion of the precipitation that falls will be recharged to groundwater. This portion depends upon a number of factors including the permeability characteristics of the soils and surficial geologic deposits in the area. Precipitation that is not recharged to groundwater flows as surface runoff, evaporates, or is transpired into the air by plants.

Studies by the USGS in Connecticut have provided ranges of recharge rates that apply to different types of surficial deposits. For example, for a sand and gravel deposit, up to 50% of the precipitation that falls can be recharged to groundwater, whereas less than 20% may be recharged when the surficial deposit is compact glacial till or clay. It must also be remembered that no well can capture all of the recharge that is theoretically available in a given area. On the other hand, the method assumes that a well can only capture recharge that occurs within the surface drainage basin upgradient of the well. This assumption may be significantly violated for deep bedrock wells and in areas of subdued topography where drainage basin divides are subtle. In such situations, through-going fractures can draw water from across drainage basin divides.

The area that is topographically upgradient of the combined existing Drew Woods water supply site and the 40-acre parcel under consideration for the present study is 12,436,812 square feet. Topographic relief in the area is very low in all directions except the east and northeast, and even in these directions the hills are less than 100 feet above the surroundings. With northeast-southwest trending foliations and northwest trending fractures, it is likely that a deep bedrock well could draw water from beyond the surficial drainage divides.

With the above considerations in mind, we have performed a recharge estimate. Based on published mapping and AGC's reconnaissance, surficial deposits in the drainage basin area for existing and proposed Drew Woods wellfield sites can best be characterized as thin, sandy glacial till, with bedrock exposed at the surface in some areas. Based on USGS work in Connecticut and using a cautious approach, an average recharge rate of 12 inches (one foot) per year was assigned (annual precipitation in New Hampshire is generally between 40 and 45 inches per year). Therefore, on average, greater than 12 million gallons per year (area multiplied by recharge rate of one foot) should recharge the drainage basin area above the sites. This translates to more than more than 250,000 gpd, or about 177 gallons per minute (gpm).

Since the recharge calculation indicated that 177 gpm are available, and since up to 208 gpm (300,000 gpd) are already taken from the existing 6 wells, it might appear that no additional water could be taken from the site. However, the existing wells occupy only a small portion of the total area considered, and the upgradient drainage area for the existing wellfield is considerably less than half of the overall area on which the recharge calculation was based. This demonstrates already that either recharge occurs at a greater rate than 12 inches per year, or that recharge occurs from beyond the surficial drainage basin boundary. The wells are high-yielding wells, and the fracture zones that deliver water to these wells likely extend for some distance. Also, since the fractures dip, they may reach the top of the bedrock surface outside of the surficial drainage basin, thereby capturing water from a larger area.

SITE RECONNAISSANCE

Although property boundaries were not observed, AGC believes that fair coverage was obtained on an initial reconnaissance basis during AGC's July 17, 2001 visit. The western end of the property, abutting the existing Drew Woods wellfield, consists largely of swampy, wooded wetlands. Proceeding east, the land rises a bit, but is thickly overgrown. While this type of terrain is similar to areas where successful wells were found in the existing wellfield, the wetlands will limit access and permitting, and the thick overgrowth will make the cutting of geophysical survey lines more time consuming than would otherwise be the case. In the center of the property, the loop road that was originally installed to access house lots is still present, but is surrounded by thick brush.

Bedrock outcrops occur to the east of this loop road, and a potentially promising area is a topographic saddle that may represent a bedrock fracture zone. The woods in this area and in the eastern end of the parcel are more open, and geophysical lines will be easier to install. Also, the greater distance from the existing wells will decrease the risk of pumping interference. One potential drawback to this area is the presence of the community leachfield near the south edge of the property. *AGC requests a site map showing the location of the leachfield relative to property lines.*

CONCLUSIONS AND RECOMMENDATIONS

1. AGC believes that the apparent limit to recharge based on the recharge calculation is not necessarily a real limit and should not be a reason for dismissing the 40-acre parcel in question as a site for additional water supply.
2. A bigger concern is that new wells located on the parcel to the east of the present wellfield may interfere with one or more of the existing wells due to particular fracture connection at the site. This likelihood will decrease as one moves eastward in the new 40-acre parcel. If there is hydraulic connection between new wells and existing wells, it will likely be by a bedrock fracture and not by overburden, as overburden is generally thin in the area. Furthermore, since foliations trend northeastward and fractures trend northwestward, direct connection due east of the parcel is less likely than if the new parcel lay to the northeast or southwest, along strike of foliation.
3. AGC recommends that detailed geophysical surveys to site test wells should be conducted on the new parcel with the following cautions.
   - The Sanitary Protective Area (200 feet or more) may be difficult to obtain because of the narrow dimensions of the parcel in the north-south direction.

- While the land to the north of the site is currently undeveloped, AGC has not investigated the ownership or future development likelihood of this area. It may be advisable for Pennichuck to obtain an easement here.
- Also, the presence of the community leachfield near the south edge of the property may further limit the potential well location.

4. AGC recommends that one set of aerial photographs be purchased and examined for presence of fracture traces, as well as terrain considerations for laying out geophysical survey lines.
5. AGC recommends that magnetic and electromagnetic geophysical surveys be carried out in the central and eastern portions of the property. Lines will be designed to cross both the northeast trending metamorphic foliations and the northwest trending fracture zones. Line locations will take into consideration terrain, property boundary setbacks, and the location of the community leachfield as well as wetlands.
6. Assuming that suitable drilling targets are found, drilling rig access will have to be considered. The loop road in the central part of the property is still accessible from the main Drew Woods road. However, the area connecting between the main Drew Woods road and the access to the property is now landscaped. Two homeowner driveways can provide access if the homeowners will grant permission.

Thank you for the opportunity to be of service. Please contact me if there are any questions regarding the study to date.

Sincerely,

ATLANTIC GEOSCIENCE CORPORATION

JAMES H. VERNON, Ph.D.
Sr. Hydrogeologist/Project Manager

Attachment 3

Pumping Data from February 2010 Pumping Test

Penichuck Drew Woods Pumping Test Phases

February 3-4, 2010

Phased Start-up

Well	Wells 3, 6, 7 Pumping: Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)	Wells 3, 6, 7, and 4 Pumping: Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A	Not Pumping						N/A
2	Not Pumping						N/A	Not Pumping						N/A
3	11:20	12:20	60	4424560	4425000	3291.2	54.9	12:20	12:50	30	4425000	4425200	1496	49.9
4							0	12:20	12:50	30	1226470	1226660	1421.2	47.4
5							0							0
6	11:20	12:20	60	1374340	1374570	1720.4	28.7	12:20	12:50	30	1374570	1374680	822.8	27.4
7	11:20	12:20	60	101520	101650	972.4	16.2	12:20	12:50	30	101650	101710	448.8	15.0
						Total =	99.7						Total =	139.6

Pumping Phase
Wells 3, 4, 5, 6, 7 Pumping

Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:50	11:45	1375	4425200	4434400	68816	50.0
4	12:50	11:45	1375	1226660	1233880	54005.6	39.3
5	12:50	11:45	1375	8402680	8410380	57596	41.9
6	12:50	11:45	1375	1374680	1379070	32837.2	23.9
7	12:50	11:45	1375	101710	103980	16979.6	12.3
						Total =	167.4

Phased Shut-down
Wells 7,6,5,4,3 Shut down in 15 min increments

Well	Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)	Gallons
1	Not Pumping						N/A	0
2	Not Pumping						N/A	0
3	11:45	12:45	60	4434400	4434800	2992	49.9	76595
4	11:45	12:30	45	1233880	1234100	1645.6	36.6	57072
5	11:45	12:15	30	8410380	8410530	1122	37.4	58718
6	11:45	12:00	15	1379070	1379110	299.2	19.9	35680
7	11:45	11:45	0	103980	103980	0	0.0	18401
						Total =	143.8	246466.0

Phased Pumping

Wells 3, 4, 5, 6, 7 Pumping - Entire Phase

Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:50	11:45	1375	4425200	4434400	68816	50.0
4	12:50	11:45	1375	1226660	1233880	54005.6	39.3
5	12:50	11:45	1375	8402680	8410380	57596	41.9
6	12:50	11:45	1375	1374680	1379070	32837.2	23.9
7	12:50	11:45	1375	101710	103980	16979.6	12.3
						Total =	167.4

Wells 3, 4, 5, 6, 7 Pumping - First Quarter

Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:50	18:00	310	4425200	4427460	16904.8	54.5
4	12:50	18:00	310	1226660	1228510	13838	44.6
5	12:50	18:00	310	8402680	8404700	15109.6	48.7
6	12:50	18:00	310	1374680	1375800	8377.6	27.0
7	12:50	18:00	310	101710	102300	4413.2	14.2
						Total =	189.2

Wells 3, 4, 5, 6, 7 Pumping - Second Quarter

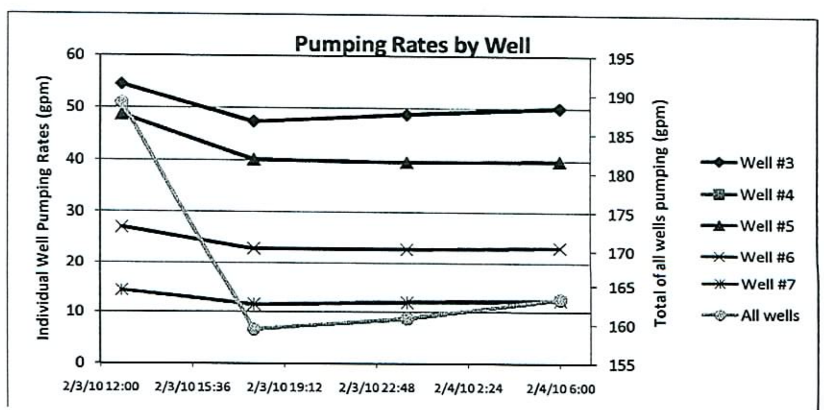
Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	18:00	0:00	360	4427460	4429740	17054.4	47.4
4	18:00	0:00	360	1228510	1230320	13538.8	37.6
5	18:00	0:00	360	8404700	8406630	14436.4	40.1
6	18:00	0:00	360	1375800	1376900	8228	22.9
7	18:00	0:00	360	102300	102850	4114	11.4
						Total =	159.4

Wells 3, 4, 5, 6, 7 Pumping - Third Quarter

Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	0:00	6:00	360	4429740	4432090	17578	48.8
4	0:00	6:00	360	1230320	1232130	13538.8	37.6
5	0:00	6:00	360	8406630	8408540	14286.8	39.7
6	0:00	6:00	360	1376900	1378000	8228	22.9
7	0:00	6:00	360	102850	103420	4263.6	11.8
						Total =	160.8

Wells 3, 4, 5, 6, 7 Pumping - Fourth Quarter

Well	Start Time (2/3)	End Time (2/4)	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
1	Not Pumping						N/A
2	Not Pumping						N/A
3	6:00	11:45	345	4432090	4434400	17278.8	50.1
4	6:00	11:45	345	1232130	1233880	13090	37.9
5	6:00	11:45	345	8408540	8410380	13763.2	39.9
6	6:00	11:45	345	1378000	1379070	8003.6	23.2
7	6:00	11:45	345	103420	103980	4188.8	12.1
						Total =	163.3



Phased Shut-down

Well	Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
	Well 7 shut down; Wells 6, 5, 4, 3 Pumping						
1	Not Pumping						N/A
2	Not Pumping						N/A
3	11:45	12:00	15	4434400	4434500	748	49.9
4	11:45	12:00	15	1233880	1233950	523.6	34.9
5	11:45	12:00	15	8410380	8410450	523.6	34.9
6	11:45	12:00	15	1379070	1379110	299.2	19.9
7	11:45	12:00	15	103980	103980	0	0.0
						Total =	**139.6**

Well	Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
	Wells 7 &6 shut down; Wells 5, 4, 3 Pumping						
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:00	12:15	15	4434500	4434600	748	49.9
4	12:00	12:15	15	1233950	1234030	598.4	39.9
5	12:00	12:15	15	8410450	8410530	598.4	39.9
6	12:00	12:15	15	1379110	1379110	0	0.0
7	12:00	12:15	15	103980	103980	0	0.0
						Total =	**129.7**

Well	Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
	Wells 7, 6, 5 shut down; Wells 4, 3 Pumping						
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:15	12:30	15	4434600	4434700	748	49.9
4	12:15	12:30	15	1234030	1234100	523.6	34.9
5	12:15	12:30	15	8410530	8410530	0	0.0
6	12:15	12:30	15	1379110	1379110	0	0.0
7	12:15	12:30	15	103980	103980	0	0.0
						Total =	**84.8**

Well	Start Time	End Time	Duration (min)	Start Meter (cu ft)	End Meter (cu ft)	Total gal pumped	Average Flow (gpm)
	Wells 7, 6, 5, 4 shut down; Well 3 Pumping						
1	Not Pumping						N/A
2	Not Pumping						N/A
3	12:30	12:45	15	4434700	4434800	748	49.9
4	12:30	12:45	15	1234100	1234100	0	0.0
5	12:30	12:45	15	8410530	8410530	0	0.0
6	12:30	12:45	15	1379110	1379110	0	0.0
7	12:30	12:45	15	103980	103980	0	0.0
						Total =	**49.9**

Attachment 4

Water Level Data from February 2010 Pumping Test

Pennichuck Drew Woods Water System, East Derry, NH
Well Information

Well	Date Drilled	Depth	Yield (gpm)											Pump Information			Wa				
			Airlift	Orig Ptest	1993 Var Rate Ptests	Lewis 6/99	6/99 Ptest	NHDES PPV (or WHPA) 2000 (gpd)	1/2/2001	5/11/2005	8/01 AGC	8/09 Penn verbal	2/10 ptest	1st pump	2nd pump	Pump Depth (ft)	Static (1986) (ft)	End of 1986 Test (ft)	Static (Lewis, 1999) (ft)	End of 1999 ptest (after 4320 min)	12_18_09
1	Oct-86	700		30	38	22	20	33000	22	17		Near zero	not pumped	20 gpm; 3 hp		483	8	440	65	275	266.3 @9:05
2	1986	550		60		0	0						not pumped				10	166		some interference	139.4 @ 9:55
3	1988; deepened 7/15/03	formerly 320; now 660	after deepen: 60		21	25	30	33000	67	49		27.7	50	40 gpm; 7.5 hp		630	5		63	253	264.5@ 9:25
4	Nov-92	390	100+		75	63	50	34000	25	48		24.6	38	7.5 hp		338	60		71	251	
1,3,4 total				110																	
5	3/22-24/99	472	160				60	79200	90	82		46.6	40	90 gpm; 10 hp	smaller 2009	430			88.5*	183	
6	3/29-30/99	881	71				35	36000	44	41		22.3	23	50 gpm; 7.5 hp	25 gpm; 7.5 hp	750			63	272	249.94 @ 10:19
7	3/25-26/99	700	43				20	25920	28	19		5	12	25 gpm; 3 hp		510			53	195	245.85 @ 10:30
Avg Daily											42 winter; 149 summer		90								
Pk Daily											208										

Pennichuck 8/24/09: non-summertime demand 99,000 gpd
Peak summer day of record: 369,680 gpd
Peak summer month of record: 195,801 gpd
Peak summer week of record: 279,001 gpd

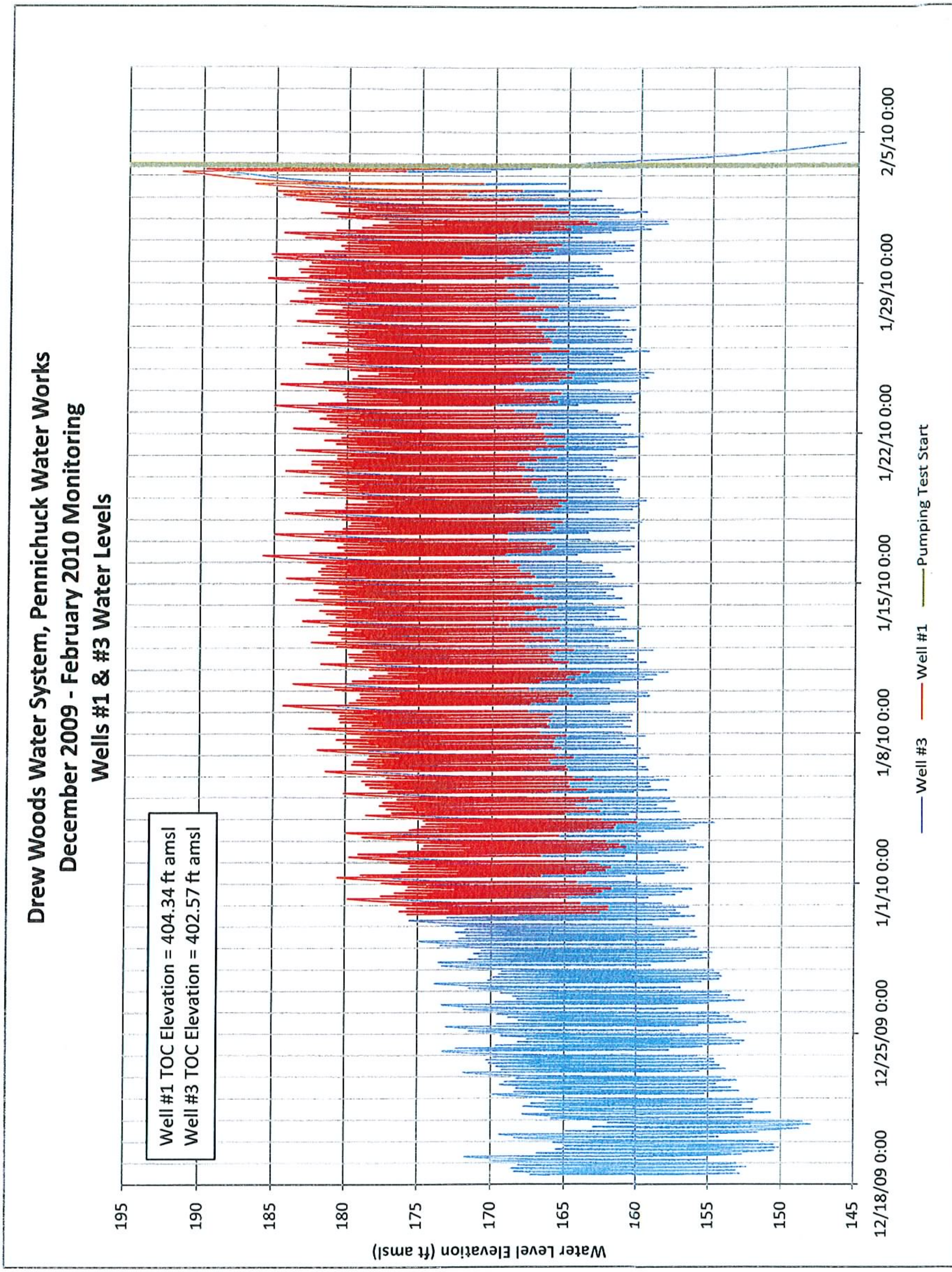
* In 1999 ptest, Well 5 started 15 min after Wells 6 and 7. Well 5 @ 90 gpm; turned back to 60 gpmat 3825 min; Well 6@ 35 gpm; Well 7 @ 20 gpm; Well 1 @ 20 gpm; Well 3 @ 30 gpm; Well 4 @ 50 gpm

Attachment 4

Water Level Data from February 2010 Pumping Test

a. Pre-test Water Level Plot

AECOM

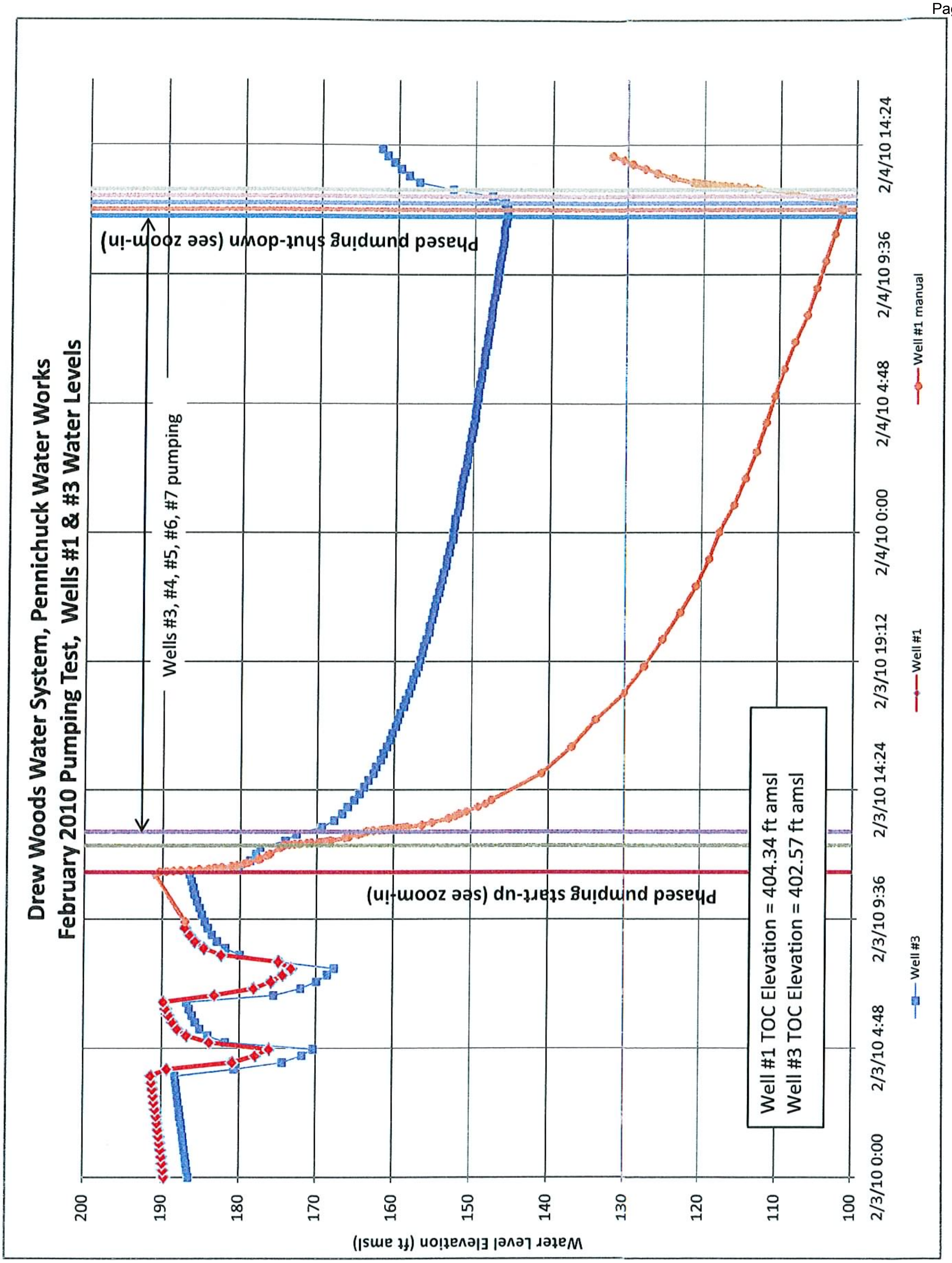


All compiled transducers.xlsx

Attachment 4

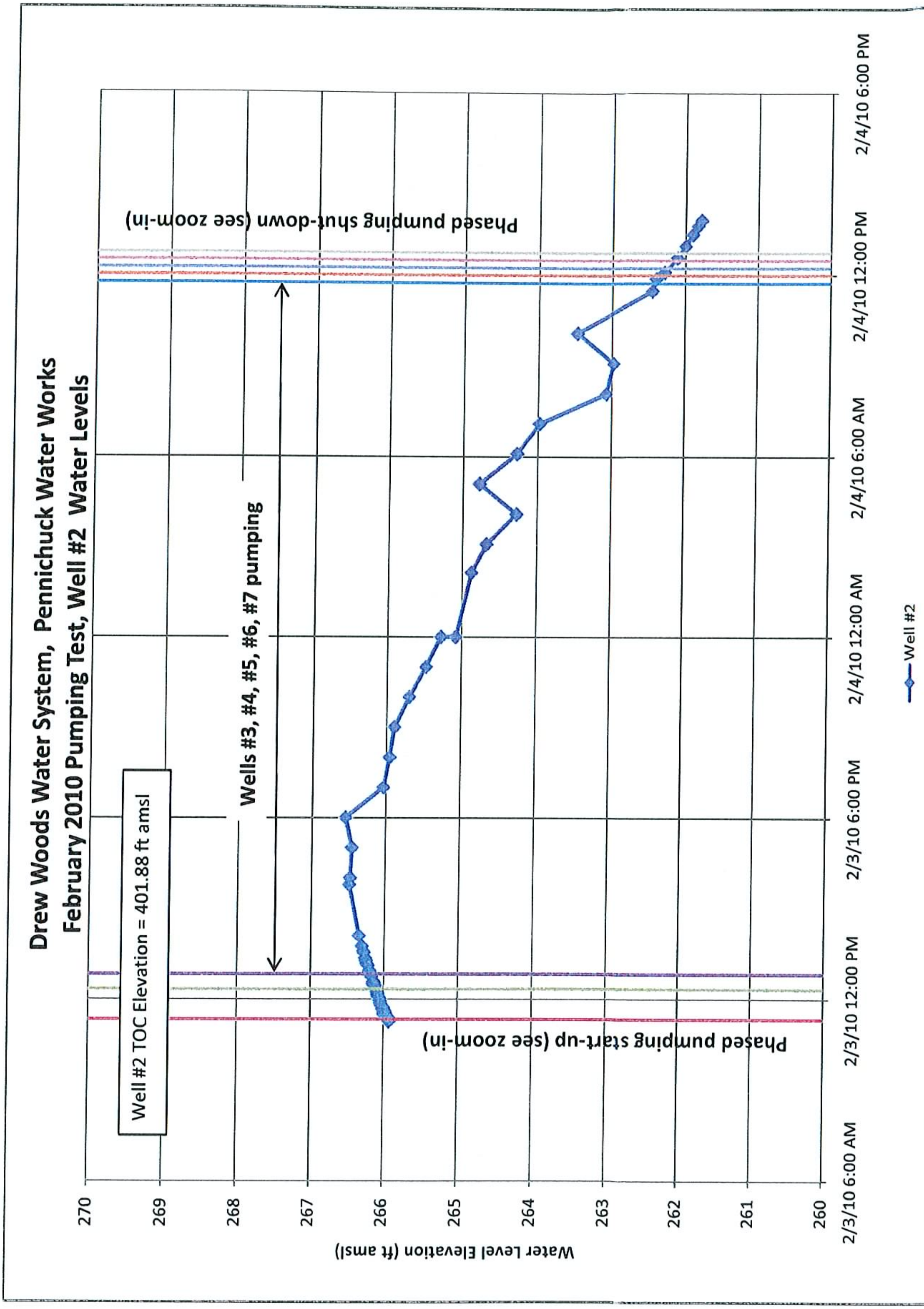
Water Level Data from February 2010 Pumping Test

b. Pumping Period Plots



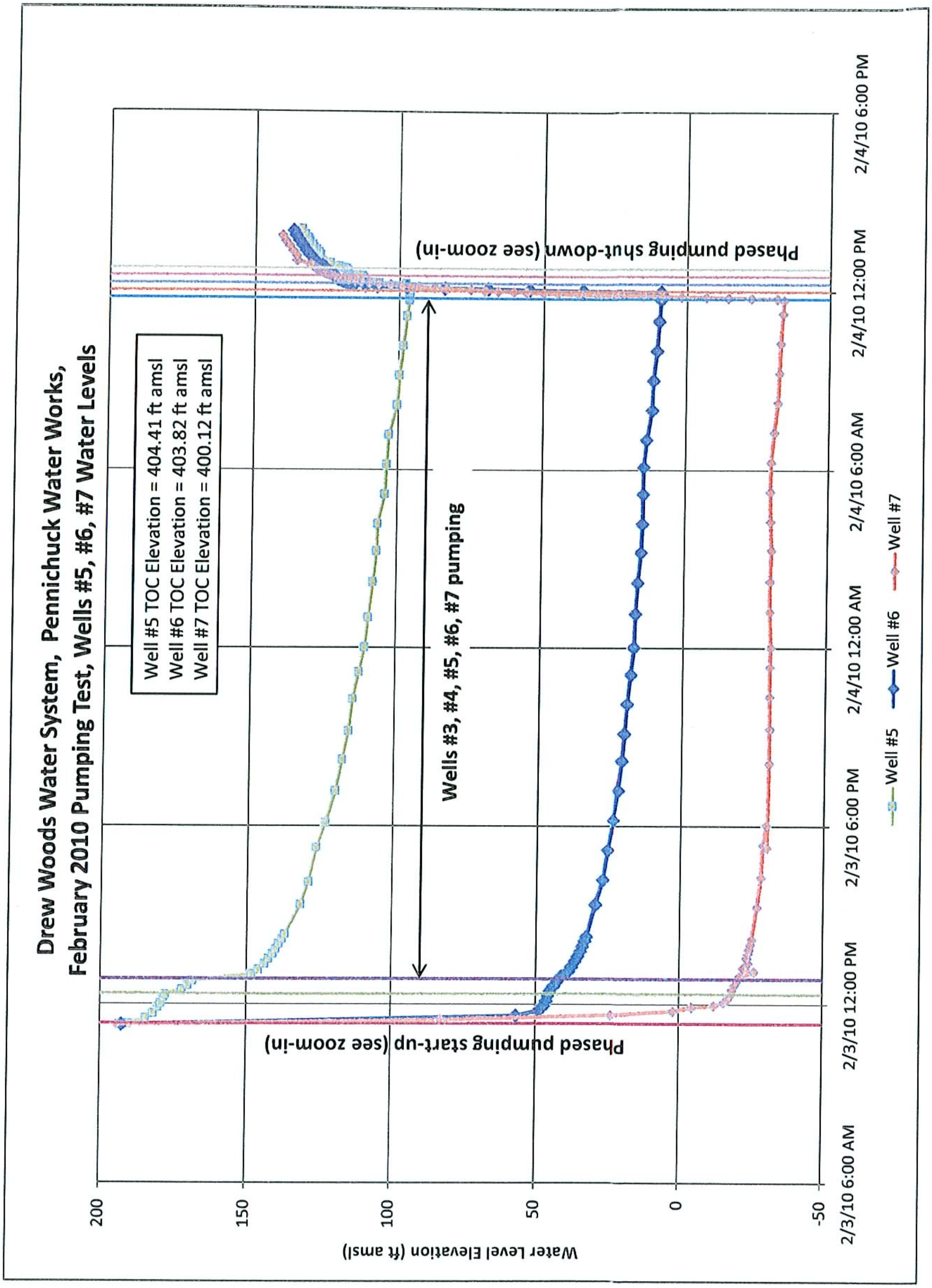
AECOM

All compiled transducers.xlsx



AECOM

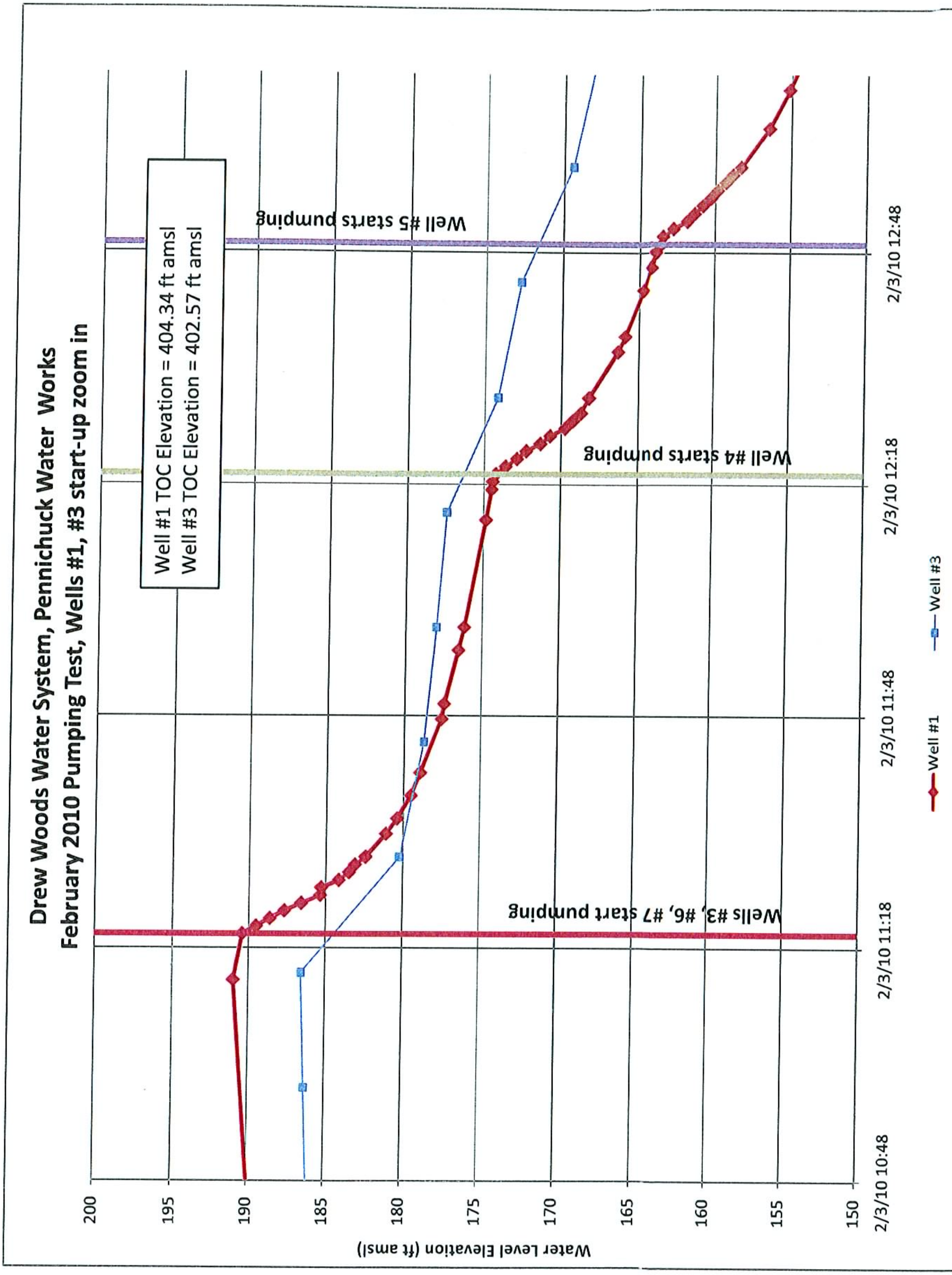
Manual well data.xlsx


Drew Woods Water System, Pennichuck Water Works,
February 2010 Pumping Test, Wells #5, #6, #7 Water Levels
Well #5 TOC Elevation = 404.41 ft amsl
Well #6 TOC Elevation = 403.82 ft amsl
Well #7 TOC Elevation = 400.12 ft amsl
Phased pumping start-up (see zoom-in)
Wells #3, #4, #5, #6, #7 pumping
Phased pumping shut-down (see zoom-in)
Water Level Elevation (ft amsl)
200
150
100
50
0
-50
2/3/10 6:00 AM
2/3/10 12:00 PM
2/3/10 6:00 PM
2/4/10 12:00 AM
2/4/10 6:00 AM
2/4/10 12:00 PM
2/4/10 6:00 PM
Well #5
Well #6
Well #7

Attachment 4

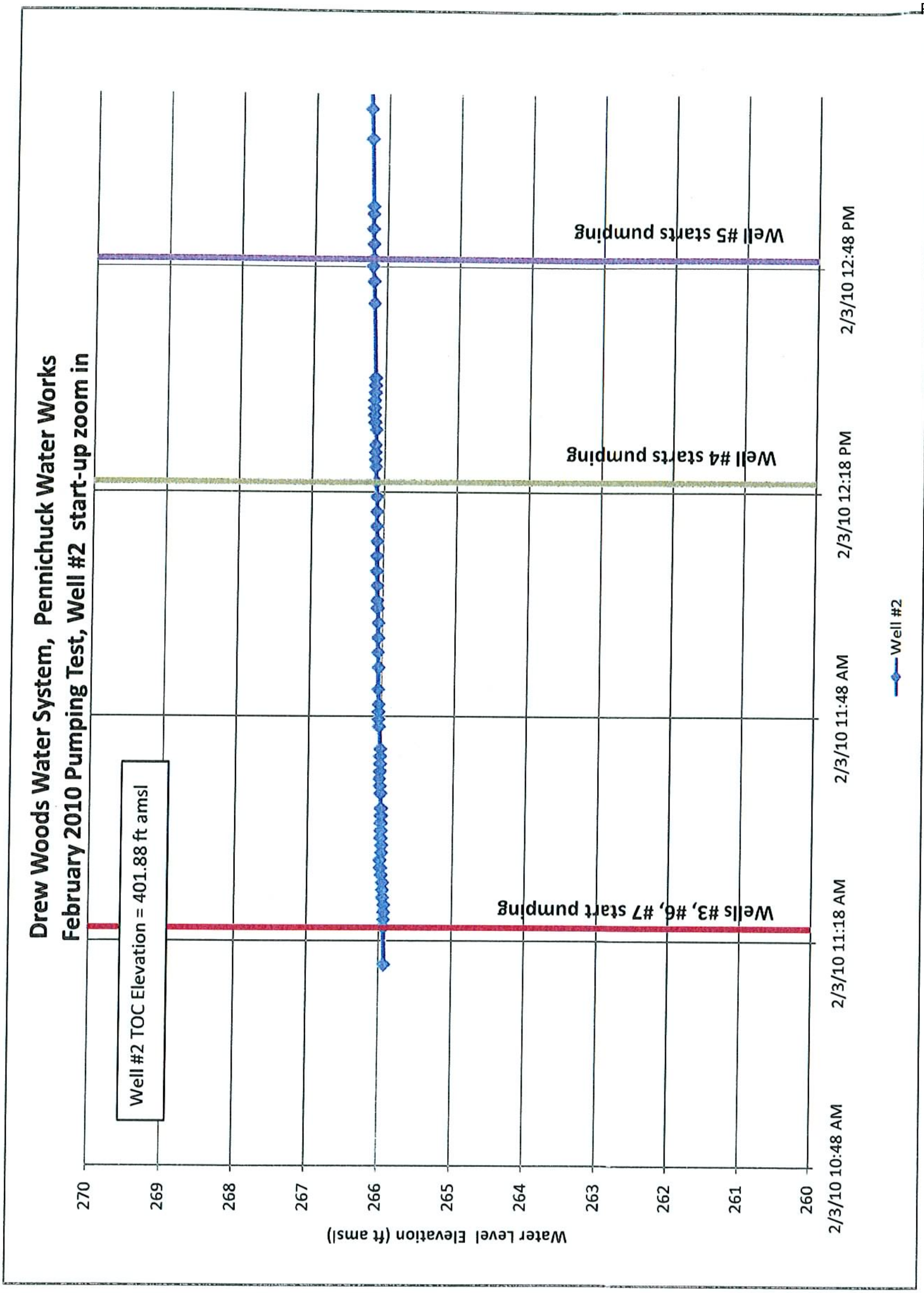
Water Level Data from February 2010 Pumping Test

c. Start-up Zoom-in Plots



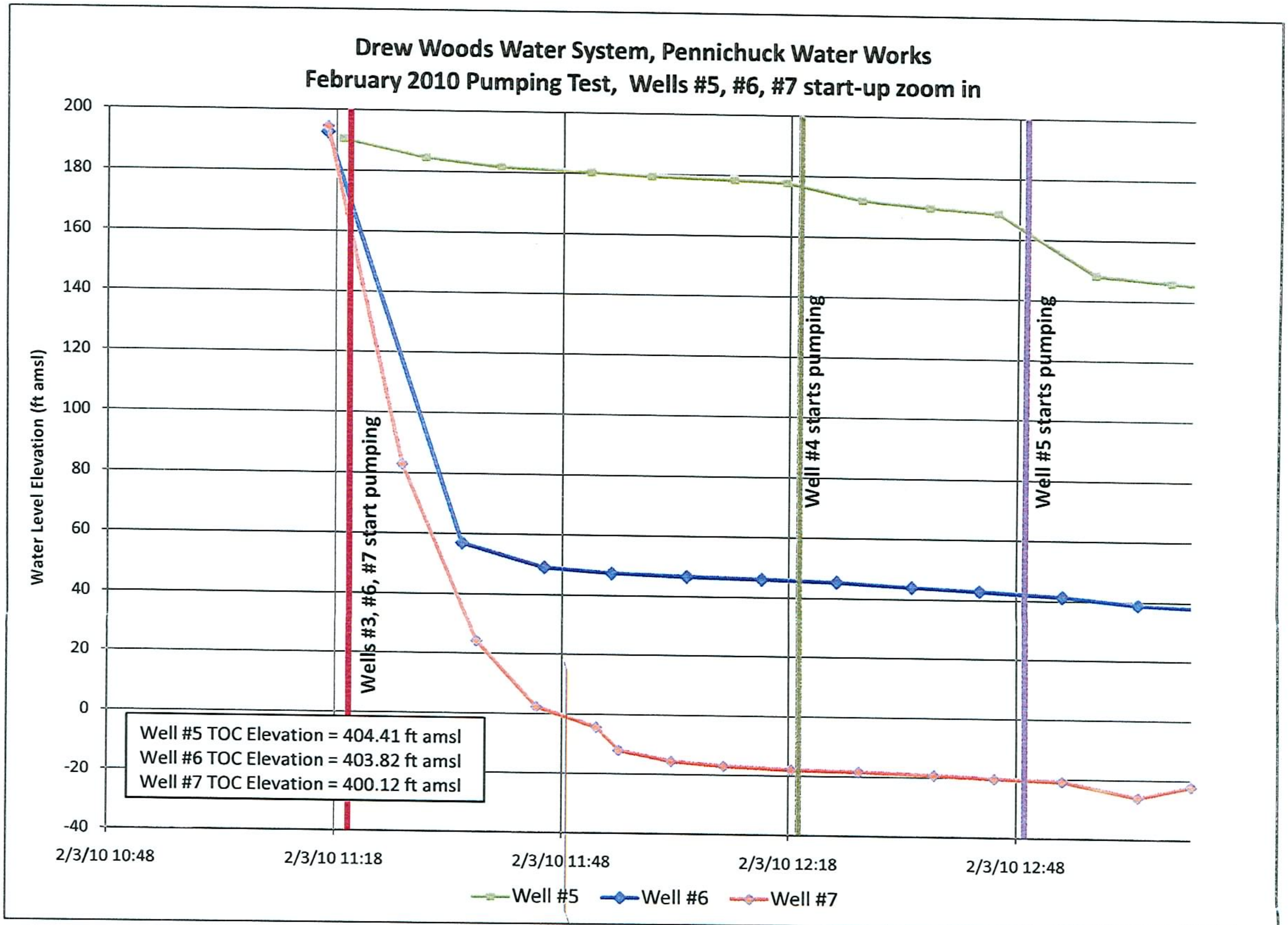
AECOM

All compiled transducers.xlsx



AECOM

Manual well data.xlsx



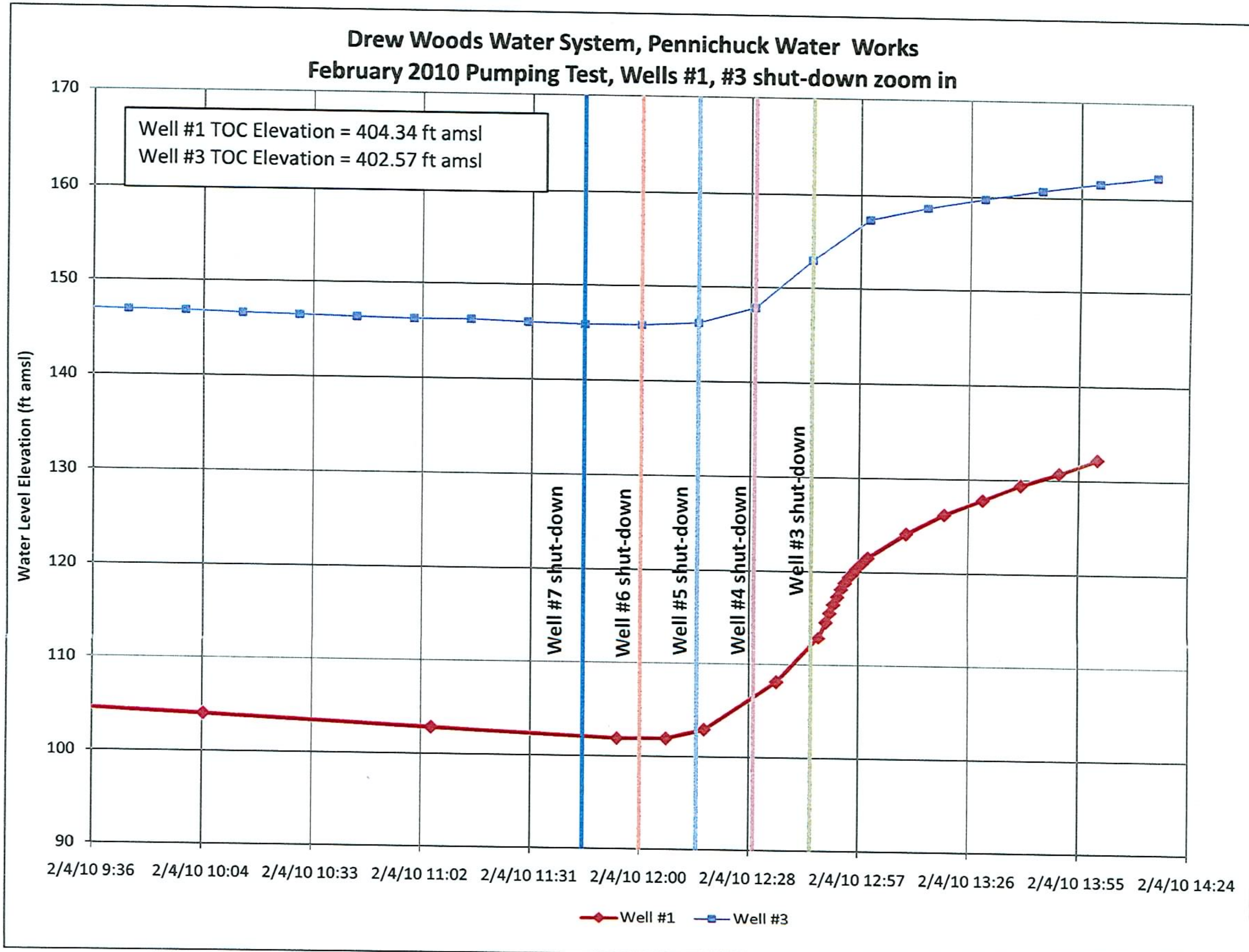
Manual well data.xlsx

AECOM

Attachment 4

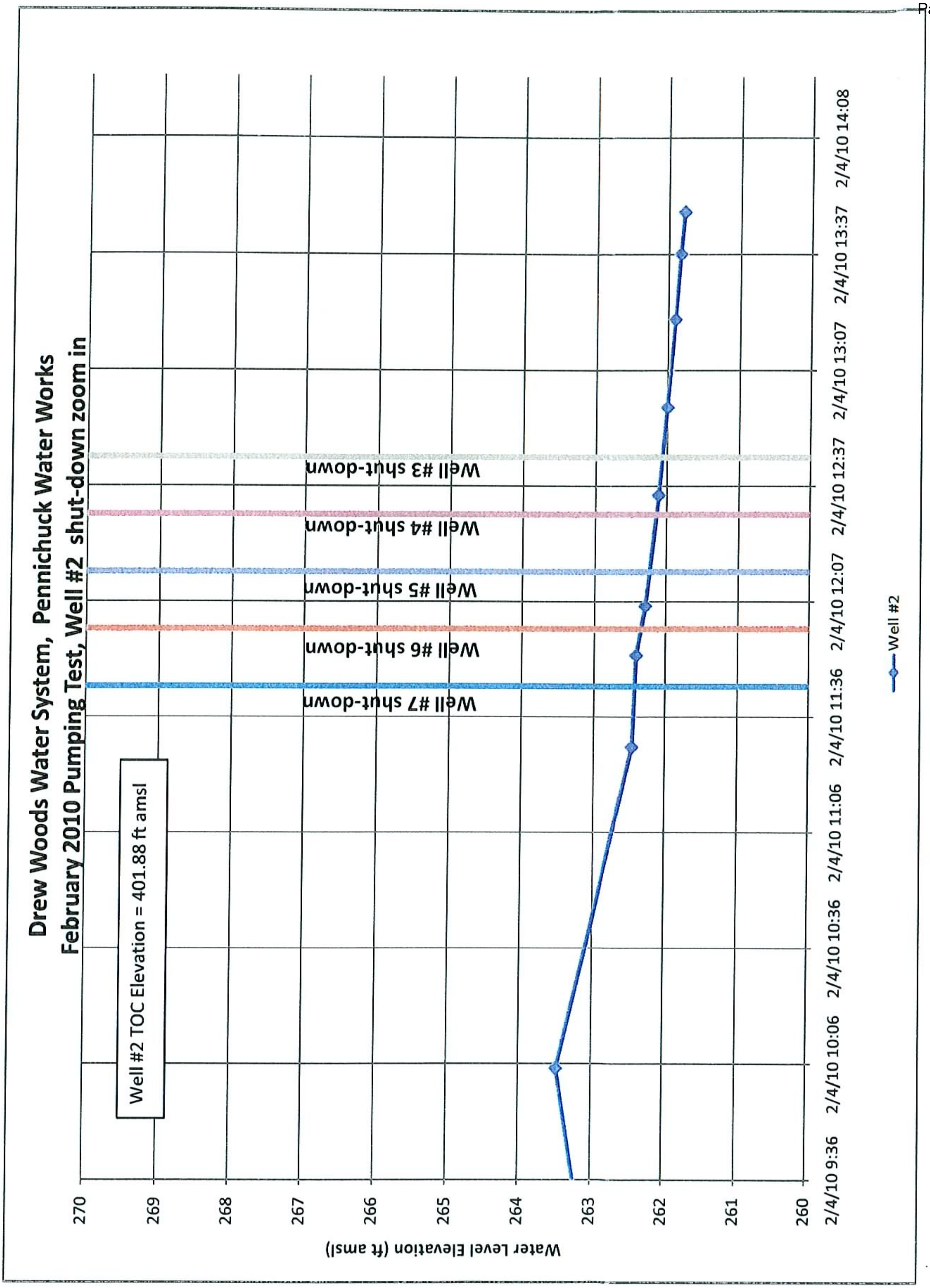
Water Level Data from February 2010 Pumping Test

d. Shut-down Zoom-in Plots

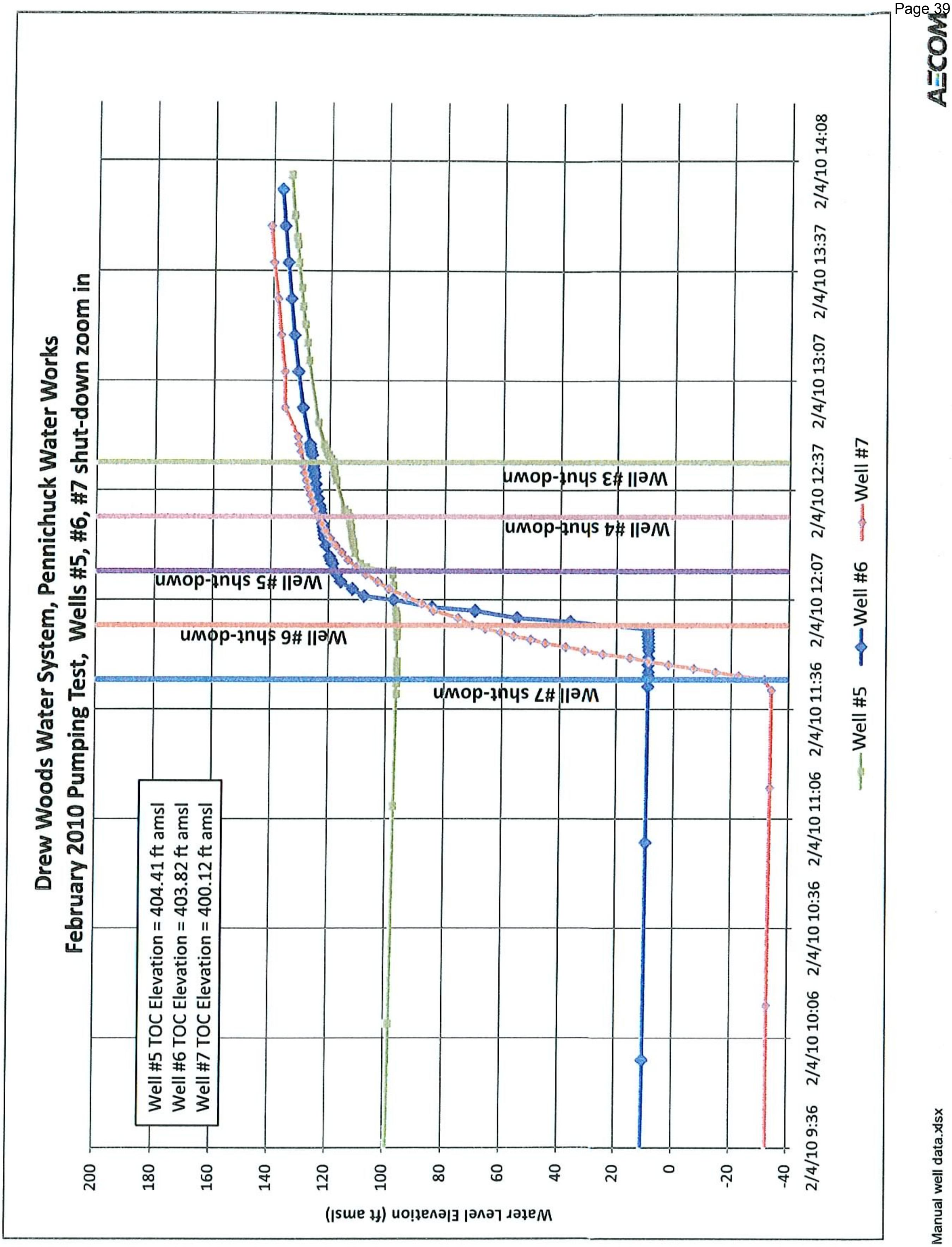


All compiled transducers.xlsx

AECOM

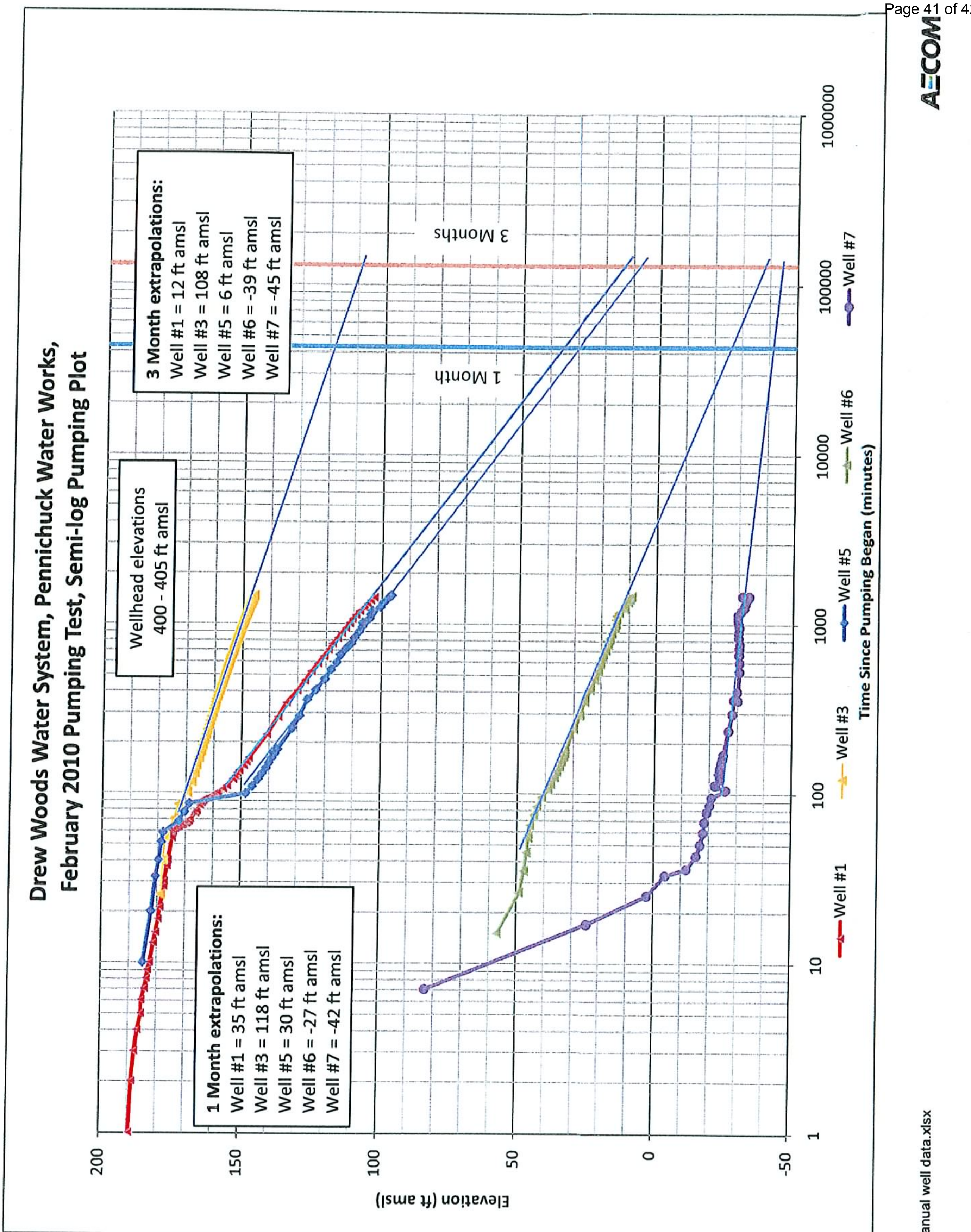


Manual well data.xlsx

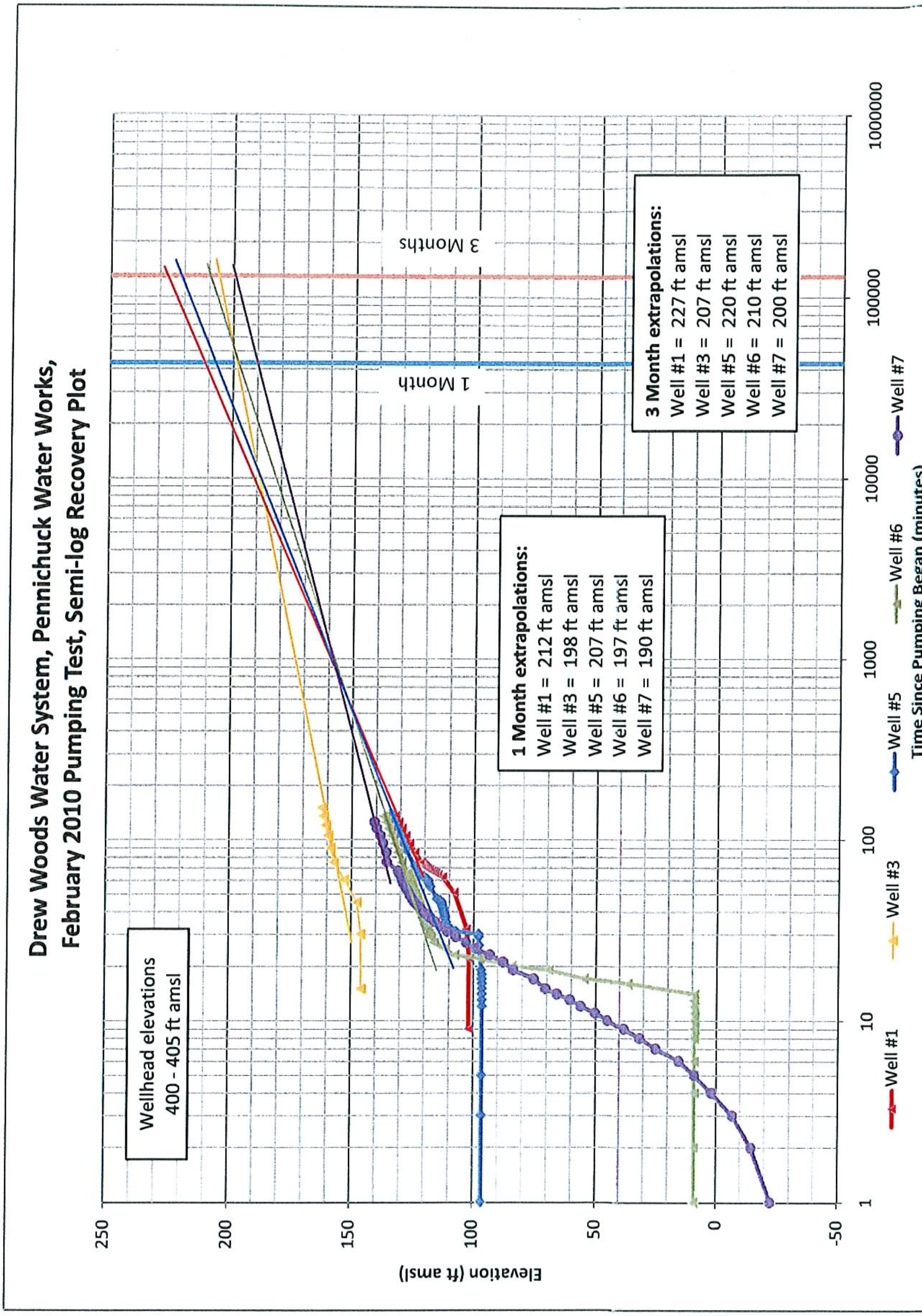

Drew Woods Water System, Pennichuck Water Works
February 2010 Pumping Test, Wells #5, #6, #7 shut-down zoom in
Well #5 TOC Elevation = 404.41 ft amsl
Well #6 TOC Elevation = 403.82 ft amsl
Well #7 TOC Elevation = 400.12 ft amsl
Well #7 shut-down
Well #6 shut-down
Well #5 shut-down
Well #4 shut-down
Well #3 shut-down
Water Level Elevation (ft amsl)
200
180
160
140
120
100
80
60
40
20
0
-20
-40
2/4/10 9:36
2/4/10 10:06
2/4/10 10:36
2/4/10 11:06
2/4/10 11:36
2/4/10 12:07
2/4/10 12:37
2/4/10 13:07
2/4/10 13:37
2/4/10 14:08
Well #5
Well #6
Well #7
AECOM
Manual well data.xlsx

Attachment 5

Semilog Projections



Manual well data.xlsx



Manual well data.xlsx

AECOM

East Derry Municipal Water Extension Community Water System Interconnection Agreement

April _____ 2010

AGREEMENT made and entered into this ___________ day of ___________________ 2010 ("Agreement"), by and between Pennichuck Water Works (PWW), and the Town of Derry, New Hampshire, a municipal association duly established and existing under New Hampshire Revised Statutes Annotated ("RSA") Chapter 31 (Derry).

Recitals:

1. Pennichuck Water Works (PWW) owns and operates three community water systems within their franchise area of the Town of Derry known as Drew Woods (PWS No. 0612150), Hubbard Hill (PWS No. 0612020), and Redfield Estates (PWS No. 0612080) consisting of 524 existing residential water service connections providing water to an estimated 1310 Derry residents on Hampstead Road, Adams Pond Road, Pond View Dr., Rain Pond Place, Wright Road, Marcell Ct., Judith Ln., Rachel Ct., Donovan Dr., Olsen Rd., Drew Woods Dr., Pine Bluff, Village Brook Ln., Belle Brook Ln., Colony Brook Ln., Dubeau Dr., Hunter Dr., Remington Ct., Gardners Way., Ballard Rd., Brier Ln., Cyril Rd., Warner Hill Road., Floyd Rd., Hubbard Hill Rd. Redfield Circle, Quincy Drive, Jewell Lane, and Hubbard Ct., as shown on the attached Map.

2. The Drew Woods, Hubbard Hill and Redfield Estates water systems are interconnected with a common distribution system and bedrock wells as the source of supply which have experienced seasonal water supply shortages.

3. The Town of Derry owns and operates the Meadowbrook Community Water System (PWS No., 0612120) which abuts the PWW systems and consists of 59 residential water service connections which provides water to an estimated 145 Derry residents on Adams pond Rd., Meadowbrook Rd., Berge Ln., Coventry Ln., Belmont Terrace, and Blake Farm Road as shown on the attached Map.

4. The Meadowbrook System has also experienced seasonal water supply shortages as well as arsenic, iron and manganese issues.

5. The Town of Derry owns and operates a municipal public water system (Public Water System ID No. 0611010) whose source of supply is Manchester Water Works by Wholesale Water Agreement and which is located at East Derry and Pond Roads approximately 6,500 feet west of the Derry and PWW Community water Systems.

6. PWW desires to extend the Derry municipal core water system for the purpose of interconnecting its Drew Woods, Hubbard Hill and Redfield Estates water systems and purchase from Derry certain volumes of water as a single retail customer to supplement their existing bedrock well

supply.

7. Derry also desires to extend its municipal core water system for the purpose of interconnecting its Meadowbrook CWS.

8. PWW and Derry have determined to enter into this Agreement to establish the conditions for the extension of the Derry municipal core water system and the supply of water to PWW.

NOW THEREFORE, the parties hereto, each binding itself, its respective representatives, successors and assigns agree as follows:

This Agreement may be referred to as the East Derry Municipal Water Extension Community Water System Interconnection Agreement.

Terms:

I **<u>Water Main Design and Construction</u>**

1. Any and all connections between the Derry Water System and PWW's Drew Woods, Hubbard Hill and Redfield Estates Water Systems including but not limited to water main extension along East Derry/Hampstead Road and Adams Pond Road, metering vault and metering devices shall be subject to review and approval of the Town of Derry and shall be constructed in accordance with the Town of Derry Water Main Specifications. The Cost of all construction undertaken to construct, modify or upgrade the connection to the Derry Water System including the purchasing of metering devices and appurtenances shall be paid by PWW and Derry as specified herein.

2. PWW will complete the design of all required improvements for the entire project including survey and ledge probes at its expense. PWW will administer the construction including permitting, bid, and inspection. The following project scope is intended to provide a general layout and description of the water main extension and a basis for bid development. Minor field changes in design and construction consistent with the general project scope, including but not limited to service connections, hydrant installations, main laterals may be made upon mutual agreement between the Derry Department of Public Works and PWW staff provided such changes do not exceed 10% of the Project bid or exceed, as to expenditures required of Derry, budgeted funds for the Derry portion of the Project.

    a. The water main will be installed along the northerly side of East Derry Road within the existing sidewalk and along the northerly side of Hampstead Road and shall be 12 inch diameter CL52 ductile iron.

    b. Hydrant assemblies including 12x6 wyes, 6 inch resilient wedge gate valves (open left) and 6 inch CL52 DI lateral to the property lines as designated by the Town and American Darling B-84B hydrant (plugged) will be installed at the intersections of Old Chester Road; Young Road; Hampstead Road (vic. No. 74), Hampstead Road (vic. across from No. 95); Hampstead Road (vic No. 108); Senter Cove Road; and Adams Pond Road;

    c. A 20 foot 12 inch CL52 DI stub shall be left at Adams Pond Road for future extension along Hampstead Road.

d. In-line resilient wedge 12 inch gate valves (open left) will be installed within the intersections of Old Chester Road, Young Road, Senter Cove Road and Adams Pond Road.

e. 18 one inch type K copper services will be installed from the main to the property lines for all existing homes on the north side of East Derry Road/Hampstead Road. (No.'s 64, 66 East Derry Road; 2 Old Chester; No.'s 68,70,76,78, 80, 82, 84, 86, 90, 92, 94, 96, 108, Hampstead Road; No.'s 124, 126 Hampstead Road), and ten (10) one inch type k copper services to the property lines for existing homes at No.'s 2, 4, 6, 8, 10, 12, 14, 16, 18, and 22 Adams Pond Road).

f. Improvements shall be made to the existing Pond Road Booster Station as required to accommodate the main extension contemplated herein.

II <u>Water Purchase Volume:</u> PWW may use its Derry Core system interconnection as a supplemental source to their well supply. PWW will use chlorimination treatment at their source supply wells. The PWW finished well supply source shall at all times comply with NHDES and EPA primary drinking water quality standards. In the event PWW fails to meet primary drinking water quality standards Derry reserves the right to suspend service following reasonable notice to PWW or to require PWW to install approved cross-connection control devices at PWW's interconnection to the Derry system. PWW maximum average daily flow shall not exceed 200,000 gallons per day demand from the Derry system. Maximum average daily flow will be calculated by taking the total monthly metered consumption in any 60 day period and dividing that amount by 60.

PWW agrees to a minimum annual average purchase volume of 12.78 million gallons (35,000 gals/day). This amount is inclusive of the minimum base allocation of 500 cft/living unit/quarter (7.839 million gals/yr) and calculated by adding all purchased water from January 1 to December 31. Should PWW's purchased water volume be less than 12.78 million gals for any calendar year, Derry shall invoice and PWW shall pay the difference.

III <u>Metering:</u> PWW will install a water tight metering vault in the vicinity of the Wright Road and Adams Pond Road intersection. The location shall be approved by the Town. The vault shall have a 3 inch Badger Turbo meter and corresponding Orion pit transponder per Derry specifications. PWW shall provide Derry reasonable access to the meter as necessary for inspection and testing. PWW may retain its storage and booster station facilities.

IV <u>Infrastructure ownership</u>: Upon completion of the water main extension and its acceptance and approval by the Town of Derry's engineers, PWW will convey all new water mains and appurtenances within the public right of way along East Derry Road/Hampstead and Adams Pond Road up to within 10 feet of the proposed metering pit described in Section III. PWW will retain their current franchise areas and service customers. Derry will service any new customers outside PWW's existing franchise along East Derry Road/ Hampstead Road and Adams Pond Road. In accordance with existing PUC order Derry has the first right of refusal to service any new customers outside PWW's existing franchise area.

V Payments by PWW

1. MSDC charges & other Town fees: PWW will use existing Derry MSDC credits. Derry Hook-up fees will be charged based on meter size. (Current cost 3 inch =$10,062.00); Meter purchase will be at Derry's cost plus 5% administrative fee. Derry will assist PWW in inspections at no additional costs.

2. Purchased water: Derry will bill PWW quarterly the same retail rates as Derry's other multifamily retail customers (i.e. as of 3/10/2010 $22.88 per quarter per living unit to include the first 500 cft of usage plus $2.47 per 100 cubic feet of usage over the initial 500 cft). 3. PWW shall pay to Derry 90% of costs required to upgrade the Pond Road Water Booster Station the scope of which is to supply and install a second 40 hp pump large enough to meet the anticipated peak summer demands of the existing East Derry customer base.

4. PWW shall be responsible for an amount equal to 90% of the project costs that would be incidental to an 8" main extension from the Town's existing main at East Derry Road to the proposed metering pit location at Adams Pond Road and Wright Road not to include any service connections, hydrant assemblies, or main laterals specified by Derry.

5. PWW will pay to Derry following completion of the work and within 30 days of invoice costs associated with the Pond Road Booster Station upgrade, such work to be performed by Derry.

VI Payments by Derry

1. Derry will pay to PWW an amount equal to 10% of the project costs that would be incidental to an 8" main extension from the Town's existing main at East Derry Road to the proposed metering pit location at Adams Pond Road and Wright Road not to include any service connections, hydrant assemblies, or main laterals specified by Derry.

2. Derry shall pay to PWW costs associated with upsizing the water main extension from 8 inch to 12 inch based on the following unit pricing:

   a. Supply and install 12 inch DI CL52 Main along East Derry/Hampstead Rd: $11.60/ft

   b. Supply and Install 12 inch Gate Valves: $623/ea

   c. Supply and install 12 inch in lieu of 8 inch DI Bends:

      11° = $315/ea

      22° = $327/ea

      45° = $282/ea

      90° = $296/ea

d. Supply and Install 12 x 12 DI Tee in lieu of 8 x 8: $405/ea

e. Supply and install 12 x 6 DI reducer in lieu of 8 x 6: $ 325.00

The above costs are based on the difference in catalog pricing listed in the EJP reference Manual Seventh Edition.

3. Derry shall pay to PWW 100% of all costs based on unit pricing of the successful bidder and actual quantities measured in the field for supplying and installing hydrant assemblies including tee, gate valve, pipe lateral and hydrant at locations specified by Derry.

4. Derry shall pay to PWW 100% of all costs based on unit pricing of the successful bidder and actual quantities measured in the field for supplying and installing service connections including corporation, service pipe, curb valves, rods and boxes at locations specified by Derry.

5. Derry shall pay to PWW 100% of all costs based on unit pricing of the successful bidder and actual quantities measured in the field for supplying and installing a 12 DI main lateral for future extension along Hampstead Road at Adams Pond Road to include tee and gate valve.

6. Derry shall pay to PWW 100% of all costs based on unit pricing of the successful bidder and actual quantities measured in the field for supplying and installing an interconnection to the Derry Meadowbrook water system along Adams Pond Road including tee, main gate valve, reducer and other fittings as necessary.

VII <u>Pavement and Trench Restoration</u>

1. PWW shall be responsible for performing and completing pavement, trench and sidewalk restoration along East Derry Road per Derry specifications. Sidewalk restoration to include 6 inches of crushed gravel, 2 inches of ¾ inch binder and 1 inch of 3/8 inch top machine paved. Costs for this work shall be apportioned as specified in V.4 and VI.1 above.

2. PWW shall be responsible for performing and completing all pavement, trench, and road restoration along Hampstead Road per NHDOT specifications.

3. Derry shall be responsible for any extra costs associated with pavement, trench and road restoration associated with hydrant and service connection installations including ledge excavation incident thereto and private property repairs. All such cost items to be approved by Derry prior to commencement of work.

4. PWW shall be responsible for execution and payment of the full depth/width reclamation of Adams Pond Road from Hampstead Road to Wright Road. Such work to be performed and completed by PWW. PWW shall be responsible for the maintenance of the water main trench including any settlement or private driveway repairs required because of damage during the water main installation. Derry shall be responsible for the cost of fine grading, compaction, and base/finished pavement of Adams Pond Road.

VIII **General**

1. This Agreement applies to the interconnection of the Drew Woods, Hubbard Hill and Redfield Estates Community Water Systems only. PWW may add additional customers within these existing franchise areas upon notification to the Town. Any additional interconnections proposed by PWW must be approved by Derry.

2. In the event that PWW exceeds its maximum daily demand as defined in para. II above, Derry may assess to PWW additional Merrimack River Source Development charges based on the additional demand in accordance with the Derry Water Use Ordinance.

3. PWW agrees to abide by the Code of the Town of Derry Chapter 156, and any subsequent amendments thereto, as a water customer and to ensure all customers within the Drew Woods, Hubbard Hill and Redfield Estates and other customers as may be added with the approval of the Town abide by the Code of the Town of Derry including the maintenance of an approved cross-connection control program.

4. Upon completion and acceptance of the work, PWW shall provide to Derry one set of record reproducible drawings (mylars) and an electronic copy of the pipeline.

5. During the term of construction, PWW shall procure and maintain such public liability and property damage insurance as shall protect Derry and PWW for claims for damages for personal injury, including accidental death, and for property damage in a form and amount acceptable to the Town. Such insurance shall cover all work and operations performed by PWW, its agents, servants, employees or licensees. Derry shall be named as an additional insured in all such liability and property damage insurance policies and shall be provided a copy of the policy of insurance which policies shall not be cancelled nor terminated without 30 days prior notice to Derry, except that upon completion of the work, PWW may terminate said insurance without permission of Derry.

6. This Agreement is subject to approved funding by the Town of Derry Council.

IX **Terms of Payment:**

1. Derry and PW will jointly review all payment requisitions submitted by the Contractor for this project. Upon mutual acceptance and approval, Derry shall make payment for its share of approved costs payable to PWW under the same terms and conditions of the Bid.

2. PWW shall complete a water service application to the Town of Derry for approval, such application to include payment of the required Hook-up fee and meter purchase cost prior to commencement of any work.

3. PWW will pay to Derry following completion of the work and within 30 days of invoice costs associated with the Pond Road Booster Station upgrade, such work to be performed by Derry.

4. Derry will issue to PWW a quarterly bill for usage for which PW shall make payment in accordance with the Code of the Town of Derry Chapter 156. The bill shall be inclusive of all metering points.

X **Severability:**

If any term or provision of this Agreement or the application thereof to any person or circumstance shall, to any extent, be invalid or unenforceable, then the remainder of this Agreement, or the application of such term or provision to persons or circumstances other than to those to which it is held invalid or unenforceable, shall not be affected thereby, and each term and provision of this Agreement shall be valid and enforced to the fullest extent permitted by law.

Governing Law:

This Agreement shall be governed by and construed in accordance with the laws of the State of New Hampshire. The benefits and burdens of this Agreement shall be inure to and be binding upon the respective legal successors to the parties hereto.

IN WITNESS WHEREOF, the parties have executed this Agreement on the dates set forth below, but effective as of the date written above in multiple counterparts each of which shall be deemed an original this ____ day of ________________2010.

PENNICHUCK WATER WORKS

By:________________________________

TOWN OF DERRY
By its Councilors acting as Water Commissioners:

By: ________________________________
Brad Benson, Council Chairman

By: ________________________________
Kevin Coyle

By: ________________________________
Janet Fairbanks

By: ________________________________
Brian Chirichiello

By: ________________________________
David Milz

By: ________________________________
Neil Wetherbee

By: ________________________________
Joel Olbricht