# Module 8: Hydrology
# [§§77.405-407, 77.457, 77.521]

**8.1 Chemical Analysis.**

Provide the following data, in accordance with 8.2 for each point in the background sampling and monitoring program and report on Module 8.1(A) (separate form).

a) pH (field & laboratory)

b) Total Suspended Solids (mg/l)

c) Total Dissolved Solids (mg/l) or Specific Conductance ($\mu S/_{cm}$ at 25°C)

d) Field temperature at sample source (°C).

e) Provide the following in addition to a) through d) above, if requested by the Department. *

Total Alkalinity (mg/l)
Total Acidity (mg/l)
Total Iron (Fe) (mg/l)
Total Manganese (Mn) (mg/l)
Sulfates ($S0_4$) (mg/l)

*If the proposed noncoal minerals to be mined are located within the coal fields or other known acid producing areas or a watershed sensitive to mining impacts, additional parameters may be required by the Department. Contact the appropriate District Mining Office prior to beginning sampling to determine if these parameters are needed.

f) Flows of perennial streams above and below the operation and surface and underground mine discharges must be measured by approved methods. In addition, other flows from springs, streams, seeps or other discharge points in the representative monitoring program should be measured to reflect seasonal variations. (The Department may waive sampling points if there is a representative sampling of the requested points.) The elevations and flows of springs, seeps, and mine discharges are required.

**The existing discharge is to an unnamed tributary to the Donegal Creek which is classified as a (TSF) Trout Stocked Fishery. The proposed 30-acre expansion has surface flows to a separate mapped stream located to the west which is also an unnamed tributary to the Donegal Creek, which is classified as a (CWF) Cold Water Fishery. The mapped stream located to the west of the 30-acre expansion area (BM-3 Upstream & BM-7 Downstream) has been modified and has been completely enclosed in 10" PVC pipe along its course between Heisey Quarry Road and Bossler Road. The NPDES Discharge was measured partially using an hour meter and calculating flow based on pump curves. We have installed a Seametrics EX253B-127 MAG Meter with a data logger on the 16-inch steel discharge line. Elevations of the impoundments were controlled using a Topcon RTK GPS to adjust aerial photography. Upstream (BM-5) and Downstream (BM-4) flow in the unnamed tributary to the Donegal Creek is measured using a float method or by manually gauging using a Global Water FP-111 flow meter.**

g) Provide a description of the type of sample point (e.g. well, spring, etc.) and its relationship to the mine site (e.g. up-gradient, perched aquifer, down-gradient).

**NPDES 001 is the active discharge located immediately east of the Scalehouse. This is the pumped discharge for the entire quarry operation. The proposed expansion will also discharge to this point when it is developed.**

**NPDES 002 did not flow during any of the background sampling. The pond that would discharge to this point is a retention pond and has no outlet structure.**

**BM-3 (this nomenclature matches previous applications) is an upstream point on the tributary located to the west of the expansion which is now completely piped. No measurement could be obtained because of the enclosed pipe. No discharge is proposed to this stream.**

**BM-4 (this nomenclature matches previous applications) is a downstream point on the east tributary which the quarry discharges. It is located just north of a culvert under Bossler Road east of the Swiegart Farm.**

**BM-5 (this nomenclature matches previous applications) is an upstream point on the tributary located to the east. It is located at a culvert under the south side of Market Street near a car dealer.**

**BM-7 is a downstream point on the tributary located to the west and could not be sampled since there is no flow due to the pipe enclosure. It is located near a culvert under Bossler Road under a power line. No discharge is proposed to this tributary.**

**MW-A (this nomenclature matches previous applications) monitoring well was drilled in 1994 and is located across Heisey Quarry Road. This well is multi-level with three discrete zones. A Solinst pressure transducer has been installed to provide continuous water level readings in the middle zone.**

**MW-B (this nomenclature matched previous applications) monitoring well was drilled in 1994 and is located just east of the scalehouse. A Solinst pressure transducer has been installed to provide continuous water level readings.**

**MW-C (this nomenclature matches previous applications) this well was drilled in 1994 and was mined through and destroyed. This well had two discrete zones.**

**MW-D (this nomenclature matches previous applications) monitoring well was drilled in 1994 and is located along western property line and is accessed through Wengers Feed Mill parking lot. This well is a multi-level well with three discrete zones, however the shallow zone is dry. A Solinst pressure transducer has been installed in the middle zone to provide continuous water level data.**

**MW-22-1 is a monitoring well drilled in 2022 near the pond at the asphalt plant. This well has a Solinst pressure transducer installed to provide continuous water level readings.**

**MW-22-2 is a monitoring well drilled in 2022 and is located at the southwest corner of the active pit. This well has a Solinst pressure transducer installed to measure continuous water level readings.**

**MW-22-3 is a monitoring well drilled in 2022 and is located at the southeast end of the overburden pile. This well has a Solinst pressure transducer installed to provide continuous water level readings.**

**MW-22-4 is a monitoring well drilled in 2022 and is located in the front yard of the Wogelmouth Farmhouse along Landis Road. A Solinst pressure transducer is installed to provided continuous water level data.**

**All drilling logs for each well have been attached.**

h) Provide the name(s), address(es) and telephone number(s) of the individual(s) responsible for the collection and analysis of this data.

**Chuck Brown and Rick Caranfa, Akens Engineering Associates, Inc., 219 East Main Street, Shiremanstown, PA 17011 717-975-9933 data collection, field analysis, and static water levels. ALS - Middletown conducted all Laboratory Analysis, 301 Fulling Mill Road, Middletown PA 17057-3500, 717-944-5541**

i) Provide a description of the methodology used to collect and analyze this data.

**The NPDES Discharge was measured partially using an hour meter and calculating flow based on pump curves. We have installed a Seametrics EX253B-127 MAG Meter with a data logger on the 16" steel discharge line. Elevations of the impoundments were controlled using a Topcon RTK GPS to adjust aerial photography. Upstream (BM-5) and Downstream (BM-4) flow in the unnamed tributary to the Donegal Creek were measured using a float method or by manually gauging using a Global Water FP-111 flow meter. For the monthly analysis Field pH, Conductivity, Total Dissolved Solids, and Temperature were analyzed using EX-Tech model EC500 ExStik II or Hanna Instruments HI9813-6 pH/EC/TDS/Temperature meter with CAL Check™, Range: pH 0.0 to 14.0 pH EC 0.00 to 4.00 mS/cm TDS 0 to 1999 ppm (mg/L). Both were calibrated for pH on regular basis with the calibration log maintained. The pH was calibrated with a Carolina Solutions or Apera Instruments one or three-point calibration using NIST Traceable solutions. The conductivity was also calibrated using Hanna Instruments three-point solution set. Manual static water level data was obtained using a Global Instruments WL650 Sonic Water Level Meter and a Solinst Model 101 P7 Water Level Meter with Laser Marked Tape, 200'. Continuous water level data was logged with Solinst Leveloggers Model 3001. Top of casings for the monitoring wells were surveyed using a Topcon RTK GPS system. Points were adjusted horizontally to NAD 83 South and Vertically to NAVD 88 using the OPUS - Online Positioning User Service. ALS - Middletown conducted all Laboratory Analysis, 301 Fulling Mill Road, Middletown PA 17057-3500, 717-944-5541**

### *8.2 Background Sampling and Monitoring.*

a) Background Sampling

Provide the results of the chemical analyses, as required by the Department, that characterize the water quality of sample points listed in 1) through 8). Background sampling points must have at least two (2) complete chemical analyses, at monthly intervals. All sampling points must be keyed to Exhibit 6.2 and identified in Module 8.1(A).

**Note**: *Include sample(s) from a low flow period.*

1) each stream that receives discharge, runoff or drainage from the operation.

**BM-3, BM-4, BM-5, BM-7**

2) streams, springs or wetlands that are representative of the surface and groundwater system of the general area.

**BM-3, BM-4, BM-5, BM-7, NPDES 001**

3) springs, seeps and wetlands within the permit area and springs, seeps and wetlands within 1000 feet of the permit area.

**N/A**

4) impoundments within the permit area and impoundments within 1000 feet of the permit area.

**NPDES 001 & NPDES 002 (no discharge)**

5) impoundments, impoundment discharges, and discharges from backfilled areas associated with previous or current underground or surface coal mines within the permit area and within 1000 feet of the permit area.

**N/A**

6) discharges within the permit area resulting from underground mines and discharges resulting from underground mines that are within the permit area but discharge outside the permit area.

**None**

7) any monitoring wells developed to determine the characteristics of the groundwater. (The Department may require additional monitoring wells.)

**Static Water Level only - MW-A, MW-B, MW-D, MW 22-1, MW 22-2, MW 22-3, and MW 22-4**

8) private water supplies and water supplies abandoned because of degradation or pollution from mining, within the permit area and within 1000 feet of the permit area. For each water supply sampled, provide the data required on the Private Water Supply Information Exhibit 8.2(A)(8) and indicate the source of the information (e.g. owner interview, survey by operator, P.E. etc.). (Provide driller logs if available.) (The Department may require additional water supply information on a case-by-case basis.)

**The only private wells located within 1,000 feet of the expansion area are the (PW-2) Sweigart farm and the (PW-1) Wolgemuth Farm, (PW-3) Agri-Source, and (PW-4 Wenger Group). Water supplies within the 1,000-foot permit setback line located to the north and northwest are within the public water supply service area of the Elizabethtown Water Authority as shown on the attached public water service area map downloaded from the eMapPA. We have included previously submitted Private Water Supply form for reference. We have completed an updated Exhibit 8.2(A)(8). We have attached a spreadsheet for tracking the private well owners. We have contacted all owners listed via USPS Certified Letters. Copies of those documents have been attached. We have also identified additional owners based on comments received at the zoning hearings for this project. We have sent USPS Certified letters to those owners as well. We sampled seven private well owners that responded to the correspondence. We also attempted contact with key private well owners via telephone and direct home visits. We tracked all of this data via the attached spreadsheet.**

b) Monitoring Program

Describe the proposed surface and groundwater monitoring plan that will be conducted. The monitoring plan shall include quantity and quality measurements of discharges from the operation; points that will show any effect of the discharge on the receiving stream; and points that will show any effect on the groundwater system. Unless otherwise approved by the District Mining Office prior to permit application submittal, monitoring points must have a minimum series of six (6) complete chemical analyses collected at monthly intervals and should include the month of August, September or October to reflect low flow conditions. A minimum of six (6) monthly samples should be submitted with the application and any additional samples while the application is in process.

**Monthly sampling of NPDES permit for the NPDES 001 discharge point was sampled for the following: pH, Total Suspended Solids, Specific Conductance, Total Dissolved Solids, Acidity, Alkalinity. Static Water Levels were monitored in MW-A, MW-B, MW-D, MW 22-1, MW 22-2, MW 22-3, and MW 22-4.**

**The proposed Monitoring Plan for this operation is as follows: No changes to the NPDES monitoring.**

**Static Water Levels once per month on MW-A, MW-B, MW-D MW 22-1, MW 22-2, MW 22-3, and MW 22-4. Once per quarter, sampling of the Upstream (BM-5) and Downstream (BM-4) on the unnamed tributary (UNT) to the Donegal Creek located to the east of the operation is conducted for flow, pH, Total Suspended Solids, Specific Conductance, Total Dissolved Solids, Acidity, and Total Alkalinity.**

All monitoring points must be keyed to Exhibit 6.2. Monitoring plans must provide for collection and monitoring on a quarterly basis unless otherwise specified by the Department. All monitoring data must be compiled on Module 8.1(A) or equivalent facsimile. All monitoring points should be identified in the field with durable markers that can be maintained (wooden stakes, metal or plastic tags, etc.; not just plastic flagging).The following monitoring locations should be included in the monitoring program:

| | | Monitoring Points (Key to Exhibit 6.2) |
|---|---|---|
| 1) | receiving streams above proposed discharge points | **BM-3, BM-5** |
| 2) | receiving streams below proposed discharge points | **BM-7, BM-4** |
| 3) | abandoned underground or surface mine discharges that are hydrologically connected and may be impacted by the proposed mining | **None** |
| 4) | representative springs and seeps within the permit area and within 1000 feet of the permit area | **None** |
| 5) | representative wetlands with **defined discharge points** within the permit area and wetlands within 1000 feet of the permit area that may be impacted by the proposed mining, | **None** |
| 6) | water supplies | **None** |
| 7) | cased boreholes/piezometers | **MW-A, MW-B, MW-D, MW 22-1, MW 22-2, MW 22-3, MW 22-4** |
| 8) | point source discharges | **NPDES 001 NPDES 002** |
| 9) | treatment pond discharges | **None** |
| 10) | sedimentation pond discharges | **None** |
| 11) | pit water during active mining (identify by mineral being mined) | **Same as NPDES 001** |

12) each monitoring well developed to determine the characteristics of the groundwater **Wells were monitored for Static Water Level only since we have an active mine with Pit Sump MW-A, MW-B, and MW-D existed since 1994. MW 22-1, MW 22-2 MW 22-3 MW 22-4 were all drilled in 2022 for this permit modification.**

Note: In cases where cased boreholes/piezometers or monitoring wells are not necessary, insert NA above and provide an explanation.

## 8.2(A)(8) PRIVATE WATER SUPPLY INFORMATION (key to Module 6.2)

| Sample Point No | Owner | Type of Supply (Dug or Drilled Well, Spring) | Use | Surface Elevation (AMSL) | Depth of Casing | Diameter of Well | Static Water Elevation (AMSL) or Flow, Date of Measurement | Depth of Well | Type of Treatement If Any (iron filter, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| PW-1 | Wolgemuth | Drilled | Residential | | | 6" | | | |
| PW-2 | Sweigart | | | | | | | | |
| PW-3 | Graybill | | | | | | | | |
| PW-4 | Wengers Feed Mill Inc. | | | | | | | | |
| PW-5 | Ream | | | | | | | | |
| PW-6 | Ruhl | | | | | | | | |
| PW-7 | Kreider | Drilled | | | | | | | |
| PW-8 | Foreman | | | | | | | | |
| PW-9 | Rheems Fire Co. #1 | Drilled | | | | | | | |
| PW-10 | Smith | | | | | | | | |

## 8.2(A)(8) PRIVATE WATER SUPPLY INFORMATION (key to Module 6.2)

| Sample Point No | Owner | Type of Supply (Dug or Drilled Well, Spring) | Use | Surface Elevation (AMSL) | Depth of Casing | Diameter of Well | Static Water Elevation (AMSL) or Flow, Date of Measurement | Depth of Well | Type of Treatement If Any (iron filter, etc.) |
|---|---|---|---|---|---|---|---|---|---|
| PW-11 | American Assn. Meat Processors | | | | | | | | |
| PW-12 | Kramer | | | | | | | | |
| PW-13 | Price | Drilled | | | | | | | |
| PW-14 | Dohner | | | | | | | | |
| PW-15 | Spayd Properties | | | | | | | | |
| PW-16 | Daniel M Heisey Jr., Revocable Trust | | | | | | | | |
| PW-17 | Charles | | | | | | | | |
| PW-18 | Burke | | | | | | | | |
| PW-19 | Hernley | | | | | | | | |

### *8.3 Characterization of Groundwater* [§§ 77.405, 77.457 and 77.521]

Characterize the existing hydrologic balance of the permit and general areas. Cite all references and sources of information.

a) Identify all aquifers above the lowest mineral to be mined and the first aquifer below the lowest mineral to be mined. Include stratigraphic units, depths, and current use. Discuss the general uses of these aquifers in the area and known quality or quantity issues with these aquifers in relation to their uses.

**The hydrologic setting of this quarry is predominantly in the Oe-Epler Formation. The surface mine permit area is bordered on the north by the New Oxford Conglomerate, then the New Oxford Sandstone.**

**The setting at the Rheems Quarry is defined by an unnamed tributary to the Donegal Creek to the West which is a cold-water fishery (CWF) which has been altered by a pipe enclosure. There is an unnamed tributary to the Donegal Creek on the east which is a trout stocked fishery. The unnamed tributaries confluence together approximately 1.5 miles to south of the surface mine permit. The surface waters flow from north to south by the permit area. Groundwater is generally following topography and flows in and north to south direction towards the Donegal Creek. The current site has been operated previously as a surface mine for many years.**

**The Village of Rheems lies in a carbonate valley in northern Lancaster County, southeastern Pennsylvania, within the Lowland Section of the Piedmont Physiographic Province. Rheems is 2 miles east of Elizabethtown, shown on the 7 ½-minute quadrangle bearing that town's name. The quarry is a short distance west of the village, adjacent to Harrisburg Avenue in West Donegal Township.**

**The quarry exposes only the Lower Ordovician Epler Formation, an approximately 2,500-foot thick carbonate unit within the Beekmantown Group (Meisler and Becher, 1971) present throughout the entire Lebanon Valley nappe from Reading to Harrisburg.**

**The Epler is interbedded with limestone and dolomite. The limestone is mostly medium to medium-light gray (locally light pinkish gray) and weather to a light olive- gray or light gray. The finely crystalline beds contain very fine dark gray laminations.**

**The medium crystalline dolomite beds are medium gray in color, and weather to a yellowish gray. The dolomite is also laminated, and both lithologies tend to be medium to thick bedded. Chert, occurring as dark gray to black nodules, lenses, and stringers, is scattered throughout the Epler Formation.**

**The quarry highwalls provide excellent exposures of the mesoscale structures that comprise the local tectonic grain. The north and south highwalls approximately parallel the 0.75-azimuth trend of the folds and display the change along the grain; the east and west walls exhibit good cross sections of the structures.**

**The important faults present in this quarry occur in two orientations – parallel and transverse to the fold trends (Faill, 1983). Both types of faults, a steeply north-dipping parallel fault, and a steeply west-dipping transverse fault, are present at the south wall. They are both post folding because they offset parts of a fold. Another steeply west-dipping transverse fault along the southeast wall has an apparent offset of 6 feet down on the west, but its gently south-plunging slickenlines indicate strike-slip movement. This fault extends northward across the quarry to the northeast wall where the slickenlines plunge steeply (obliquely) to the northwest.**

**The Epler Formation is considered an excellent source of water. It is capable of producing an adequate water supply for industrial and municipal needs. Reported yields from the Epler Formation range from 3 to 1,800 gallons per minute (GPM) with a non-domestic median yield of 265 GPM. Specific Capacity values also vary greatly, but the median is around 9 GPM. As the case with the other carbonate rocks, the water is very hard with a median hardness of 291 mg/L. In addition, the unit has a high median specific conductance, which means that there is an abundance of dissolved solids.**

**The general uses of the aquifer in the area are domestic located to the north northeast and south of the quarry. There are agricultural uses located west and south of the quarry. The town of Rheems is located northeast which is served by public water supplies. There are two industrial users (Agrisource and Wengers Feed) of water located west of the existing quarry and will be just north and northwest of the proposed expansion.**

**We have contacted both users to obtain additional use information and details on the users wells. We received no response.**

**The quarry has operated at this site for many years with no water quality violations.**

b) Describe the groundwater movement and the conditions that control and influence the groundwater system. Include the influence on quantity and quality from underground mines, industrial or municipal effects, fracture zones, faults, karst features and cave systems. Provide a groundwater contour map, if suitable.

**Groundwater at this site is influenced by the following: the unnamed tributary to the Donegal Creek, pumping from the active sump, pumping from PW-1 and PW-2 which are agricultural uses, and PW-3 and PW-4 which are manufacturing processes. Public water supplies everything to the northeast and east. There are mapped faults and contact lines to the north and northeast. The 6.2 Environmental Resources Map illustrates the locations of these features. Empirical data was obtained while observing sump drawdown tests for the active pit sump the sump was allowed to fill approximately 10 feet, which took four weeks of pumping only the diesel pump at approximately 650 GPM. The pit sump was allowed to fill to the bottom of diesel pumps which is approximately 210 Above Mean Seal Level (AMSL). The current quarry floor elevation is 200 AMSL. The electric pumps were then engaged increasing the pumping rate to a peak rate of 2,500 GPM, dewatering the 10 feet in 10 days. Pumping has been occurring at this site since approximately the late 1980's. Monitoring of the wells and pumping have been reported since the 1990's. A groundwater contour map has been included in the application. The mapped faults and contacts have been shown on the Environmental Resources Map. See the attached Karst Supplement for the discussion on karst in the area.**

c) Identify the effects any current or previous mining (including previous mining at this site) has had on the quantity and quality of the groundwater in the area, including impacts from diminution, increased turbidity, suspended solids or settleable solids. Include description of the source, rock unit involved and the reasons for the effect.

**The current pit is approximately 32 acres. The active pit is excavated to a depth of approximately 210 AMSL. The existing maximum permitted depth is 126 AMSL. The proposed expansion is requesting the same ultimate permitted depth of 126 AMSL. We have many years of sampling data indicating compliance with the NPDES permit. The source rock is limestone/dolomite and generally does not have water quality issues for a noncoal quarry use.**

### *8.4 Characterization of Surface Water* [§§ 77.406 77.457 and 77.521]

a) Identify each stream receiving drainage from the proposed operation and the 25 Pa Code Chapter 93 projected water use classification.

| ***Stream*** | ***Classification*** |
|---|---|
| ***UNT to Denegal Creek (West)*** | ***Cold Water Fishery (CWF)*** |
| ***UNT to Dongeal Creek (East) recieves NPDES*** | ***Trout Stocked Fishery (TSF)*** |

b) Identify the effects which current or previous mining (including previous mining at this site) has had on the quantity and quality of the surface waters in this area, including impacts from increased turbidity, suspended solids or settleable solids. Include the source, rock unit involved, and reasons for the effect.

**The aquifer is primarily located in the Ordovician - Epler Formation. This formation generally consists of Limestone, Dolomite, Shale, and Siltstone. The type of mineral mined, and the typical surface mine operation located at this site generally can affect the following water quality parameters: pH and Total Suspended Solids. The proposed expansion is located within an unnamed tributary to the Donegal Creek. This tributary is listed as impaired for aquatic life with siltation by agriculture and recreation with pathogens from an unknown source. There is a Total Maximum Daily Load (TMDL) study for this tributary which is the "Chiques Creek Alternative Restoration Plan" approved in 2019 (the plan referenced is listed as draft). The existing quarry and the proposed expansion are located in the Donegal Creek Watershed. The discharge from the proposed expansion will be to an unnamed tributary to the Donegal Creek where the existing NPDES discharge point is located. This tributary is impaired for aquatic life by AGRICULTURE - TOTAL SUSPENDED SOLIDS (TSS); AGRICULTURE - EUTROPHICATION and recreation with pathogens by and unknown source and is also part of the Chiques Creek Alternative Restoration Plan. The tributaries confluence approximately 1.5 miles south of the quarry operation near Donegal Springs. The existing quarry operation has not had a water quality violation as per a review of EFACTS dating back to 2008.**

**The Pierson Rheems Quarry has an existing NPDES permit to discharge an average monthly rate of 2.88 million gallons per day (MGD) to the UNT to the Donegal Creek.**

**We have attached the Streamstats for each tributary. The West UNT which is where the expansion is occurring lists a total contributing drainage area of 0.29 square miles, a mean annual flow of 0.266 cubic feet per second (CFS) or 119 GPM or 0.17 MGD. It lists the Q7-10 as 0.012 CFS or 5 GPM or 0.0072 MGD. The UNT to east where the NPDES discharge is located lists the contributing drainage area as 0.73 square miles, a mean annual flow of 0.78 CFS or 350 GPM or 0.504 MGD. It lists the Q7-10 as 0.0828 CFS or 37 GPM or 0.05328 MGD.**

**The proposed expansion is not expected to have any adverse effects on the streams. The current operation has been operating for decades with no impact. No changes to the NPDES permit are required at this time to add the 30-acre expansion.**

c) Identify any current or previous land uses that may have significant impacts on surface water quantity and quality.

**The current land use is surface mining and the expansion area is agricultural. The previous land use was mining for decades and agriculture in the expansion area. Located to the north of the operation is a mix of residential and light industrial uses and the Amtrak Railroad. Located directly east is Copes/Sudanos food processing facility. A warehouse is currently in the design stage to the east/southeast. Located to the West is Wenger Feed Mill. South and southwest is agricultural activities. A more detailed discussion of adjacent land use effects is located in the attached Karst Supplement.**

### *8.5 Public Water Supply Information.*

Provide the name, type, and location of all current public (community and non-community) surface water supplies that have intakes on the receiving stream within 10 miles downstream of the proposed permit area; public (community and non-community) water supplies (wells or springs) in or within one half mile of the proposed permit area; and public water supply wells for which any part of the permit area is within the Wellhead Protection Zone. Show the location of these supplies on Exhibit 6.1 or 6.2.

**The Elizabethtown Water Authority has two wells located 1.7 miles away. Water supplies within the 1,000-foot permit setback line are within or will be within the Public Water Service area of the Elizabethtown Water Company.**

***8.6 Hydrologic Impact Assessment*** [§ 77.457 and 77.521]

a) Describe the groundwater hydrology in relation to the proposed mining operation (at maximum depth and lateral development) - i.e., - intercept regional water table, above regional water table, intercept perched water table, etc. State if and when groundwater will be intercepted (e.g., mining below the water table, installation of a production well for support or processing facilities). Include the depth to groundwater and the water table conditions present (artesian, regional, perched, etc.), the relationship to the mineral to be mined.

**The existing operation already impacted the surrounding aquifer when the operation was pumping groundwater from 1980's through today. The proposed 30-acre expansion will have the same ultimate quarry depth as existing operation of 126 AMSL. We have included a groundwater contour map and graphs of continuous measurements of the monitoring wells plotted against rainfall. All these items provide a detail of the groundwater elevations. Visual observations of the existing active pit indicate no perched water tables and is confirmed in well drilling logs. We included in this application the well logs for reference. There is a formation contact between a sandstone conglomerate and the limestone (mined formation). The north face of the quarry is located very near the mapped contact line. This contact will limit impacts in the northerly direction.**

b) Describe the probable hydrologic consequences of the proposed mining activities on the hydrologic system of the permit area and adjacent area both during the stages of and after the conclusion of operations. Describe the impact, during and after mining, on existing quantity and quality of the surface and groundwater as described in Sections 8.3 and 8.4.

**A model is attached which predicts the hydrologic consequences of expansion which includes the impacts of the current mining activities. Empirical data was obtained while observing sump drawdown tests for the current operation and existing pit sump. Adding 18 acres of expanded pit is expected to have no additional consequences to northeast and east due to the existing pit sump at the proposed depth of the expansion area. Impacts to the north is limited by the formational contact line.**

**Empirical data is listed in 8.3b which shows the exact impacts on the surrounding aquifer from the existing operation.**

**In addition the area located to north and east is served by public water.**

**Historical water quality records indicate no impacts during or after mining is complete on water quality.**

c) Is pumping of groundwater planned within the life of the operation. ☒ Yes ☐ No.

If yes, indicate the estimated gallons/day to be pumped for each stage of mining. Submit a science-based estimate of the zone of influence for each proposed stage of the operation. This may require a groundwater model to be developed using existing aquifer data as well as collecting new data, tracer tests or fracture trace analysis. Provide all documentation for the modeling. Use of groundwater modeling may be required to support the discussion of potential effects of groundwater withdrawal if the withdrawal has the potential to adversely impact water supplies, wetlands and other water resources and their affiliated uses, or if the withdrawal has the potential to cause or exacerbate sinkhole formation (See section 8.7). (Key groundwater elevations to cross-sections in 7.1 (c).)

**We have prepared a groundwater model which is attached as a separate report. The empirical effects on the water table are listed in 8.3b which was obtained by monitoring the surrounding wells while the pit sump was dewatered.**

NOTE: Operations in karst geology areas may be required to complete the *Karst Permitting Supplement* **(**5600-PM-BMP0456**)** in addition to supplying this information.

**8.7. Water Supply Replacement** [§§ 77.407 and 77.533]

a) Identify water supply sources that may be contaminated, diminished or interrupted by the mining operation and the means to restore or replace the affected supply. Include a demonstration that the quantity of the water supply will be sufficient to meet the needs of the water supply use. Note why other water supplies will not be affected.

**PW-1, PW-2, PW-3, and PW-4 along with three residences on Bossler Road (PW-20, PW-21, and PW-22) directly south of the quarry which are within the zone of influence have the potential to have water supply affected by the proposed operation. There are no predicted issues with contamination of surrounding wells based on decades of monitoring from the current operation.**

b) Provide a specific capacity, step-drawdown, or other approved yield test for all water supplies that may be impacted by mining and for each proposed replacement supply source. Yield tests on other wells are at the discretion of the applicant or as requested by the Department. Provide specific capacity data on Module 8.6(A). Please refer to the guidance document, "Procedures for Establishing the Quantity of Water in Low-Yield Wells" (TGD # 563-2112-606) for methods.

**Public Water serves the town of Rheems to the east. Replacement supplies for parcels located to the north shall be through public water supply extensions. Maximum predicted impacts are as follows:**

**PW-1 approx 25 feet**
**PW-2 approx 100 feet**
**PW-3 approx 50 feet**
**PW-4 approx 70 feet**
**PW-18 approx 25 feet**
**PW-20 approx 50 feet**
**PW-21 approx 50 feet**
**PW-22 approx 50 feet**

**The proposed replacement cost per well is approximately $11,000 per well. Based on actual repalcement costs submitted for a 300 foot deep well. We have attached the an invoice from a local well driller. We are proposing a water replacement bond for 5 wells for an estimated water repalcement bond of $55,000.**

c) Provide the existing operation and maintenance costs for each water supply that may be contaminated, diminished or interrupted by the mining operation and the projected operation and maintenance costs for the proposed replacement supply.

**Operation and maintnenance costs are not expected to be significantly different based on well replacement.**

d) If the operation and maintenance costs for the proposed replacement water supply will be more than for the existing water supply, identify the provisions for compensating the water supply owner for the increased costs or provide the consent to Lesser Water Supply Agreement Form 5600-FM-BMP0110 for the increased operation/maintenance costs.

# Module 8.1(A)
## ☒ BACKGROUND or ☐ MONITORING REPORT*
## (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW-A
Latitude: 40° 07' 51.6" N and
Longitude: 76° 34' 52.1" W
Surface Elevation (MSL): 452.09

Description of Sample Point**: Across Heisey Quarry Road near old gate

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| | | Deep | Medium/ probe | Shallow | | | | | | | | | | | |
| 1/27/2022 | Meter | 336.19 | 387.49 | 406.79 | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 336.19 | 387.39 | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 335.49 | 388.29 | 406.89 | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 348.09 | 390.09 | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | | 391.15 | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | | 383.02 | | | | | | | | | | | | |
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I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW-B
Latitude: 40° 07' 48.3" N and
Longitude: 76° 34' 33.6" W
Surface Elevation (MSL): 411.20

Description of Sample Point**: Adjacent to scalehouse

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Meter | 356.70 | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 357.90 | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 357.80 | | | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 365.20 | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | 369.20 | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 343.73 | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW-D
Latitude: 40° 07' 41.9" N and
Longitude: 76° 34' 53.4" W
Surface Elevation (MSL): 425.97

Description of Sample Point**: West property line near Wengers Feed parking lot

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| | | Shallow | Medium/ probe | Deep | | | | | | | | | | | |
| 1/27/2022 | Meter | 366.77 | 370.77 | 396.87 | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | | 366.97 | 370.47 | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 370.47 | 365.37 | 397.17 | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | | 377.47 | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | | 377.10 | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | | 366.19 | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW 22-1
Latitude: 40° 07' 39.3" N and
Longitude: 76° 34' 31.9" W
Surface Elevation (MSL): 406.32

Description of Sample Point**: Near pond at asphalt plant

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Meter | 297.82 | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 299.82 | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 300.02 | | | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 306.60 | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | 309.62 | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 290.43 | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW 22-2
Latitude: 40° 07' 33.6" N and
Longitude: 76° 34' 43.9" W
Surface Elevation (MSL): 413.42

Description of Sample Point**: SW corner of active pit

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Meter | 313.22 | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 314.52 | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 315.22 | | | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 315.67 | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | 316.02 | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 311.74 | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
## ☒ BACKGROUND or ☐ MONITORING REPORT*
## (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW 22-3
Latitude: 40° 07' 24.8" N and
Longitude: 76° 34' 39.6" W
Surface Elevation (MSL): 408.55

Description of Sample Point**: SE end of overburden pile

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Meter | 302.75 | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 305.15 | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 305.15 | | | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 309.19 | | | | | | | | | | | | | Chuck Brown |
| 5/18/2022 | Meter | 315.75 | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 306.85 | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: MW 22-4
Latitude: 40° 07' 14.6" N and
Longitude: 76° 35' 05.9" W
Surface Elevation (MSL): 407.31

Description of Sample Point**: front yard of Wolgelmuth farmhouse along Landis Road

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Meter | 385.71 | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | Meter | 386.01 | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | Meter | 384.91 | | | | | | | | | | | | | Chuck Brown |
| 4/18/2022 | Meter | 390.49 | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | 392.21 | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 387.58 | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: BM-3
Latitude: 40° 07' 43.0" N and
Longitude: 76° 35' 14.3" W
Surface Elevation (MSL): 432

Description of Sample Point**: South of culvert under Heisey Quarry Road west of Wenger Feed south of pond

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 3/16/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 4/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: BM-4
Latitude: 40° 07' 16.6" N and
Longitude: 76° 34' 15.9" W
Surface Elevation (MSL): 380

Description of Sample Point**: north of culvert under Bossler Road East of Sweigart

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Visual | 3500 GPM | 7.62 | | 17 | 338 | 5.06 | 161 | 7 | | | | | | Chuck Brown |
| 2/23/2022 | Visual | 3400 | 7.62 | | 13 | 406 | 16.78 | 198 | <5 | | | | | | Chuck Brown |
| 3/27/2022 | Visual | 5000 | 7.81 | | 8 | 204 | 10.11 | 55 | <5 | | | | | | Chuck Brown |
| 4/27/2022 | Visual | 3100 | 7.71 | | 18 | 342 | 9.28 | 205 | 8 | | | | | | Chuck Brown |
| 5/16/2022 | Measured | 1221 | 7.9 | | 8 | 440 | 19.1 | 238 | 8 | | | | | | Chuck Brown |
| 6/30/2022 | Measured | 808 | 7.48 | | <5 | 244 | 15.11 | 111 | <5 | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: BM-5
Latitude: 40° 08' 6.1" N and
Longitude: 76° 34' 33.7" W
Surface Elevation (MSL): 440

Description of Sample Point**: Culvert under South side of S. Market Street near car dealer

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Visual | 25 GPM | 7.31 | | 6 | 182 | 6.0 | 62 | 5 | | | | | | Chuck Brown |
| 2/23/2022 | Visual | 30 | 7.38 | | 28 | 310 | 17.28 | 60 | <5 | | | | | | Chuck Brown |
| 3/27/2022 | Visual | 50 | 7.33 | | 20 | 412 | 8.78 | 198 | 9 | | | | | | Chuck Brown |
| 4/27/2022 | Visual | 35 | 7.42 | | 7 | 183 | 9.56 | 70 | 6 | | | | | | Chuck Brown |
| 5/16/2022 | Visual | 50 | 7.2 | | 7 | 197 | 19.7 | 69 | 9 | | | | | | Chuck Brown |
| 6/30/2022 | Visual | 10 | 7.57 | | 6 | 412 | 15.39 | 233 | <5 | | | | | | Chuck Brown |
| | | | | | | | | | | | | | | | |
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I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
## ☒ BACKGROUND or ☐ MONITORING REPORT*
## (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: BM-7
Latitude: 40° 07' 11.7" N and
Longitude: 76° 34' 48.6" W
Surface Elevation (MSL): 388

Description of Sample Point**: a culvert under Bossler Road under Power Line

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 3/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 4/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
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Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
# ☒ BACKGROUND or ☐ MONITORING REPORT*
# (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: NPDES 001
Latitude: 40° 07' 48.0" N and
Longitude: 76° 34' 32.9" W
Surface Elevation (MSL): 404.05

Description of Sample Point**: east of scalehouse

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | Visual | 700 GPM | 7.84 | | 5 | 374 | 8.67 | 201 | 9 | | | | | | Chuck Brown |
| 2/23/2022 | Visual | 800 | 7.76 | | 16 | 518 | 14.94 | 221 | 10 | | | | | | Chuck Brown |
| 3/27/2022 | Visual | 1000 | 7.82 | | 5 | 446 | 9.5 | 220 | 12 | | | | | | Chuck Brown |
| 4/27/2022 | Meter | 800 | 7.81 | | | | 11.17 | | | | | | | | Chuck Brown |
| 5/16/2022 | Meter | 3500 | 7.4 | | 7 | 478 | 16.9 | 237 | 22 | | | | | | Chuck Brown |
| 6/30/2022 | Meter | 1088 | 7.31 | | 9 | 416 | 14.55 | 237 | 6 | | | | | | Chuck Brown |
| | | | | | | | | | | | | | | | |
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I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

# Module 8.1(A)
## ☒ BACKGROUND or ☐ MONITORING REPORT*
## (check appropriate block)

Operator: Pierson Rheems, LLC
Operation Name: Rheems Quarry
Permit No.: 36080301
Township: West Donegal Township
County: Lancaster

Monitoring Point I.D.: NPDES 002
Latitude: 40° 07' 38.6" N and
Longitude: 76° 34' 30.9" W
Surface Elevation (MSL): 428

Description of Sample Point**: SE of MW 22-1 east of pond near asphalt plant

**Instructions: Use a separate sheet for each sample point and list results consecutively by date.**

| Date Sampled | Method of Flow Measurement | Flow (GPM) or Static Water Elevation | Field pH | Laboratory pH | Suspended Solids mg/l | Total Dissolved Solids mg/l or Specific Conductance µS/cm @25°C | Field Temp. °C | Alkalinity mg/l | Acidity mg/l | Iron Mg/l | Manganese mg/l | Aluminum mg/l | Sulfate mg/l | | Laboratory and Name of Sampler |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Submit above as requested by the Department | | | | | | | |
| 1/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 2/23/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 3/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 4/27/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 5/16/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
| 6/30/2022 | | No Discharge | | | | | | | | | | | | | Chuck Brown |
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I certify under penalty of law that I have personally examined and am familiar with the information submitted herein, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Signature of Permittee or Responsible Official or Authorized Representative ***

Date

* Water Monitoring Report Cover Sheet Form 5600-FM-MR0113 may be used for mutliple monitoring point sample submittals.

** Description should include type of sample point, relation to mine site, treatment and other comments (such as odor, color, etc.)

*** Written notification of delegation of signatory authority must be submitted to the Department if signature is other than company official. Signature not necessary if this report is submitted as part of the permit application.

Pierson Rheems LLC
Quarry Operation
SMP #36080301

Background Water Quality Data

NPDES 001
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPDES 001 | Grab | 25-Apr-07 | | | | 7.91 | | ND | | | | | |
| NPDES 001 | Grab | 27-May-08 | | | 69.1 | 7.71 | | 9 | | | | | |
| NPDES 001 | Grab | 27-Apr-11 | | | 57.4 | 7.51 | | 7 | | | | | |
| NPDES 001 | Grab | 25-Mar-10 | | | 57.7 | 7.3 | | 14 | | | | | |
| NPDES 001 | Grab | 27-Jan-22 | 11:00 | CB | 47.6 | 7.84 | 2-Feb-22 | 5 | 374 | 201 | 9 | 700 | estimated |
| NPDES 001 | Grab | 23-Feb-22 | 13:30 | CB | 58.9 | 7.76 | 28-Feb-22 | 16 | 518 | 221 | 10 | 800 | estimated |
| NPDES 001 | Grab | 16-Mar-22 | 10:45 | CB | 49.1 | 7.82 | 17-Mar-22 | 5 | 446 | 220 | 12 | 1,000 | estimated |
| NPDES 001 | Grab | 27-Apr-22 | 10:40 | CB | 52.1 | 7.81 | 28-Apr-22 | 13 | 434 | 237 | 18 | 800 | estimated |
| NPDES 001 | Grab | 16-May-22 | 9:10 | RC | 62.4 | 7.30 | 18-May-22 | 7 | 478 | 237 | 22 | 4,206 | |
| NPDES 001 | Grab | 30-Jun-22 | 9:35 | CB | 58.2 | 7.31 | 1-Jul-22 | 9 | 416 | 237 | 6 | 1,088 | |

Green Fill indicates part of background sampling program

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NPDES 002 | | NO DISCHARGE | | January-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | February-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | March-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | April-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | May-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | June-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | July-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | August-22 | | | | | | | | |
| NPDES 002 | | NO DISCHARGE | | September-22 | | | | | | | | |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP #36080301

Background Water Quality Data

BM-5 Upstream Tributary
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BM-5 | Grab | 25-Apr-07 | | | | 8.30 | | ND | | | | | |
| BM-5 | Grab | 27-May-08 | | | 56.8 | 7.04 | | ND | | | | | |
| BM-5 | Grab | 25-Mar-10 | | | 51.1 | 7.52 | | ND | | | | | |
| BM-5 | Grab | 27-Apr-11 | | | 51.1 | 7.52 | | ND | | | | | |
| BM-5 | Grab | 27-Jan-22 | 11:20 | CB | 42.8 | 7.31 | 2-Feb-22 | 6 | 182 | 62 | 5 | 25 | estimated |
| BM-5 | Grab | 23-Feb-22 | 12:45 | CB | 63.1 | 7.38 | 28-Feb-22 | 28 | 310 | 60 | 2.5 | 30 | estimated |
| BM-5 | Grab | 16-Mar-22 | 9:45 | CB | 47.8 | 7.33 | 17-Mar-22 | 20 | 412 | 198 | 9 | 50 | estimated |
| BM-5 | Grab | 27-Apr-22 | 10:50 | CB | 49.2 | 7.42 | 28-Apr-22 | 7 | 183 | 70 | 6 | 35 | estimated |
| BM-5 | Grab | 16-May-22 | 11:30 | RC | 67.5 | 7.20 | 18-May-22 | 7 | 197 | 69 | 9 | 50 | estimated |
| BM-5 | Grab | 30-Jun-22 | 9:25 | CB | 59.7 | 7.57 | 1-Jul-22 | 6 | 412 | 233 | 2.5 | 10 | estimated |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP #36080301

Background Water Quality Data

BM-4 Downstream Tributary
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BM-4 | Grab | 1-Oct-03 | | | | 8.00 | | ND | | | | | |
| BM-4 | Grab | 25-Apr-07 | | | | 8.26 | | 6 | | | | | |
| BM-4 | Grab | 27-May-08 | | | 69.8 | 7.89 | | ND | | | | | |
| BM-4 | Grab | 25-Mar-10 | | | 57.2 | 7.79 | | 12 | | | | | |
| BM-4 | Grab | 27-Apr-11 | | | 55.4 | 7.95 | | 18 | | | | | |
| BM-4 | Grab | 27-Jan-22 | 10:35 | CB | 41.1 | 7.62 | 2-Feb-22 | 17 | 338 | 161 | 7 | 800 | estimated |
| BM-4 | Grab | 23-Feb-22 | 10:15 | CB | 62.2 | 7.62 | 28-Feb-22 | 13 | 406 | 198 | 2.5 | 3,400 | estimated |
| BM-4 | Grab | 16-Mar-22 | 11:20 | CB | 50.2 | 7.81 | 17-Mar-22 | 8 | 204 | 55 | 2.5 | 5,000 | estimated |
| BM-4 | Grab | 27-Apr-22 | 10:20 | CB | 48.7 | 7.71 | 28-Apr-22 | 18 | 342 | 205 | 8 | 3,100 | estimated |
| BM-4 | Grab | 16-May-22 | 11:00 | RC | 66.4 | 7.90 | 18-May-22 | 8 | 440 | 238 | 8 | 1,221 | |
| BM-4 | Grab | 30-Jun-22 | 9:50 | CB | 59.2 | 7.48 | 1-Jul-22 | 5 | 244 | 111 | 2.5 | 808 | |

Green Fill indicates part of background sampling program

| Width (ft) | Depth (ft) | Velocity (ft/s) | Flow (ft3/sec) |
|---|---|---|---|
| 1 | 0.50 | 0.40 | 0.20 |
| 1 | 0.50 | 0.40 | 0.20 |
| 1 | 0.80 | 0.60 | 0.48 |
| 1 | 1.00 | 0.40 | 0.40 |
| 1 | 0.90 | 0.60 | 0.54 |
| 1 | 1.00 | 0.90 | 0.90 |

5/16/2022 **Discharge** **2.72**

| | Total Discharge (cu.ft./sec) | GPM | MGD |
|---|---|---|---|
| 5/16/2022 | 2.72 | 1,221 | 1.757982 |

| Width (ft) | Depth (ft) | Velocity (ft/s) | Flow (ft3/sec) |
|---|---|---|---|
| 1 | 0.30 | 0.30 | 0.09 |
| 1 | 0.40 | 0.40 | 0.16 |
| 1 | 0.76 | 0.50 | 0.38 |
| 1 | 0.90 | 0.50 | 0.45 |
| 1 | 0.90 | 0.40 | 0.36 |
| 1 | 0.90 | 0.40 | 0.36 |

6/16/2022 **Discharge** **1.80**

| | Total Discharge (cu.ft./sec) | GPM | MGD |
|---|---|---|---|
| 6/16/2022 | 1.80 | 808 | 1.16337 |

| Width (ft) | Depth (ft) | Velocity (ft/s) | Flow (ft3/sec) |
|---|---|---|---|
| 1 | 0.90 | 0.30 | 0.27 |
| 1 | 0.90 | 0.40 | 0.36 |
| 1 | 1.00 | 0.40 | 0.40 |
| 1 | 0.76 | 0.40 | 0.30 |
| 1 | 0.65 | 0.30 | 0.20 |
| 1 | 0.58 | 0.05 | 0.03 |
| 1 | 0.54 | 0.00 | 0.00 |

8/1/2022 **Discharge** **1.56**

| | Total Discharge (cu.ft./sec) | GPM | MGD |
|---|---|---|---|
| 8/1/2022 | 1.56 | 699 | 1.006962 |

| Width (ft) | Depth (ft) | Velocity (ft/s) | Flow (ft3/sec) |
|---|---|---|---|
| 1 | 0.84 | 0.30 | 0.25 |
| 1 | 0.84 | 0.20 | 0.17 |
| 1 | 0.70 | 0.10 | 0.07 |
| 1 | 0.60 | 0.05 | 0.03 |
| 1 | 0.52 | 0.05 | 0.03 |

8/25/2022 **Discharge** **0.55**

| | Total Discharge (cu.ft./sec) | GPM | MGD |
|---|---|---|---|
| 8/25/2022 | 0.55 | 245 | 0.352889 |

Lots grass in channel affecting measurement

| Width (ft) | Depth (ft) | Velocity (ft/s) | Flow (ft3/sec) |
|---|---|---|---|
| 1 | 1.36 | 0.10 | 0.14 |
| 1 | 1.26 | 0.20 | 0.25 |
| 1 | 1.06 | 0.20 | 0.21 |
| 1 | 1.00 | 0.10 | 0.10 |
| 1 | 0.96 | 0.05 | 0.05 |

9/29/2022 **Discharge** **0.75**

| | Total Discharge (cu.ft./sec) | GPM | MGD |
|---|---|---|---|
| 9/29/2022 | 0.75 | 336 | 0.483445 |

Lots grass in channel affecting measurement

Pierson Rheems LLC
Quarry Operation
SMP #36080301

Background Water Quality Data

BM-3 Upstream Tributary
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BM-3 | Grab | 1-Oct-03 | | | | 7.5 | | 26 | | | | |
| BM-3 | Grab | 25-Apr-07 | | | | 7.92 | | 16 | | | | |
| BM-3 | Grab | 27-May-08 | | | 73.6 | 8.76 | | ND | | | | |
| BM-3 | Grab | 25-Mar-10 | | | 58.3 | 7.78 | | ND | | | | |
| BM-3 | Grab | 27-Apr-11 | | | 54.1 | 7.76 | | ND | | | | |
| BM-3 | | 27-Jan-22 | No Sample | | | | | | | | | Dry |
| BM-3 | | 23-Feb-22 | No Sample | | | | | | | | | Dry |
| BM-3 | | 16-Mar-22 | No Sample | | | | | | | | | Dry |
| BM-3 | | 27-Apr-22 | No Sample | | | | | | | | | Dry |
| BM-3 | | 16-May-22 | No Sample | | | | | | | | | Dry |
| BM-3 | | 30-Jun-22 | No Sample | | | | | | | | | Dry |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP #36080301

Background Water Quality Data

BM-7 Downstream Tributary
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Alkalinity (mg/L) | Acidity (mg/L) | Flow (GPM) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BM-7 | | 27-Jan-22 | No Sample | | | | | | | | | Dry |
| BM-7 | | 23-Feb-22 | No Sample | | | | | | | | | Dry |
| BM-7 | | 16-Mar-22 | No Sample | | | | | | | | | Dry |
| BM-7 | | 27-Apr-22 | No Sample | | | | | | | | | Dry |
| BM-7 | | 16-May-22 | No Sample | | | | | | | | | Dry |
| BM-7 | | 30-Jun-22 | No Sample | | | | | | | | | Dry |

Green Fill indicates part of background sampling program

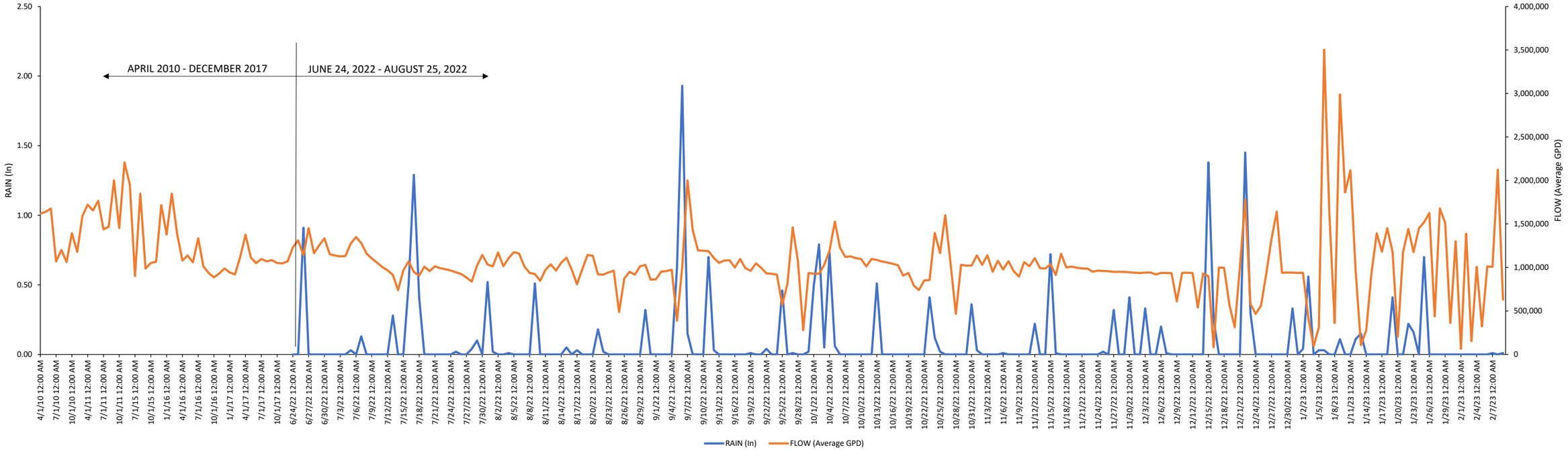
Pierson Rheems LLC
Quarry Operation
SMP #36080301

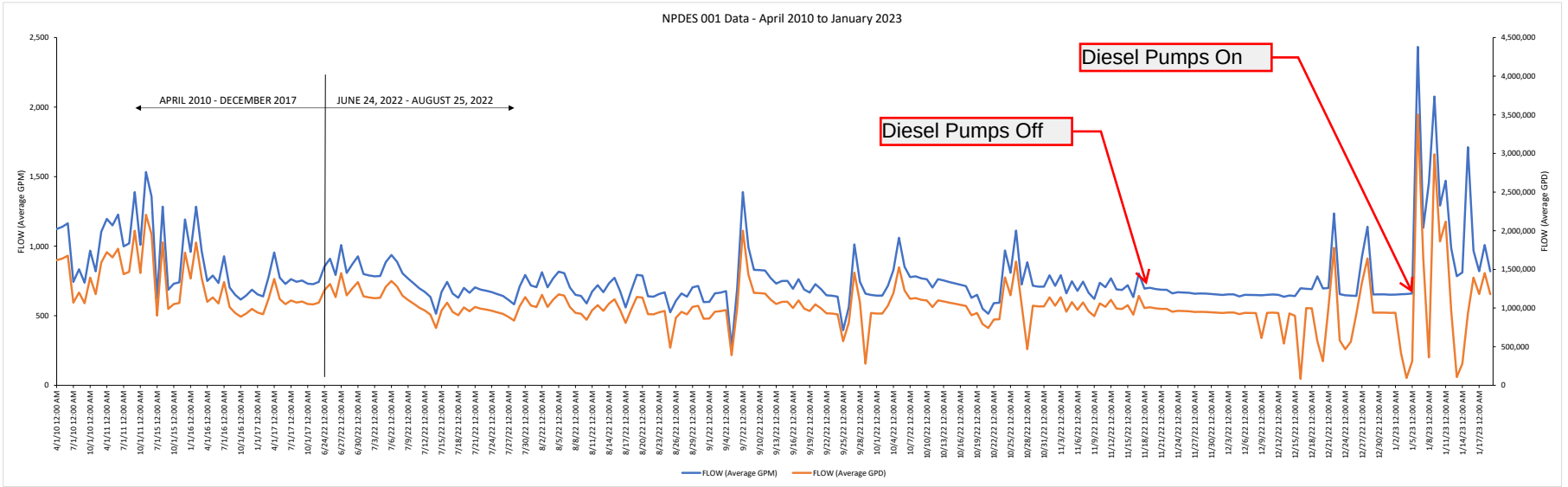
Adjoiner Background Water Quality Data

NPDES 001
West Donegal Mt. Joy Townships
Lancaster County, PA

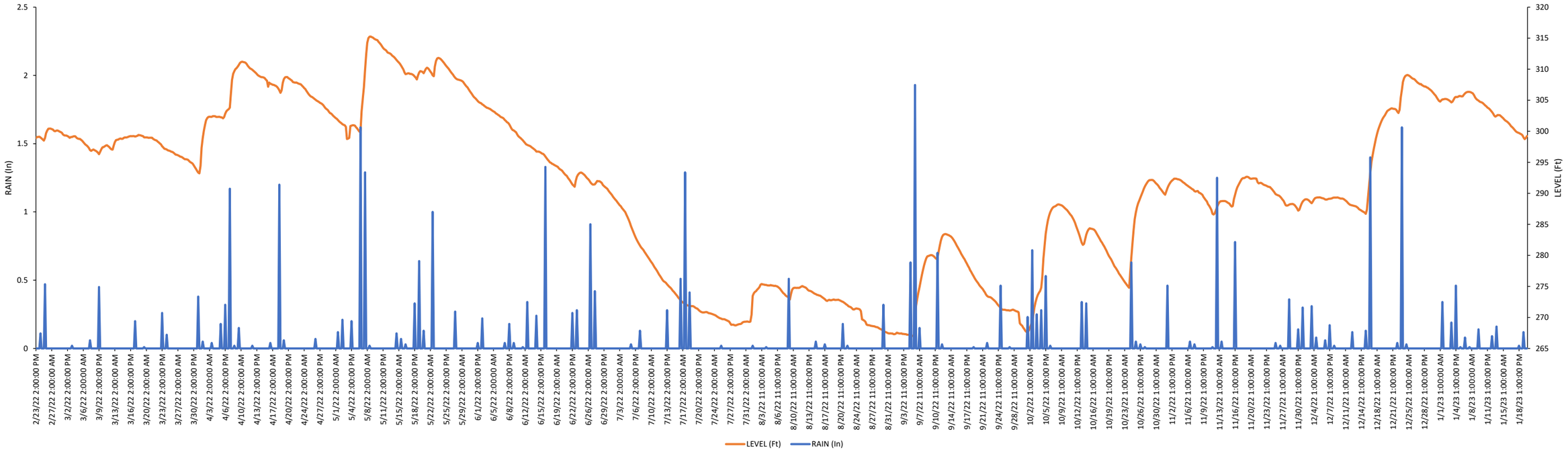
| Monitoring Point # | Type of Sample | Date of Sample | Time of Sample | Collected By | Field Temp. (°F) | Field pH | Analysis Date Sus. Solids | Suspended Solids (mg/l) | Total Dissolved Solids (mg/L) | Static Water Level | Alkalinity (mg/L) | Acidity (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PW-1 | Grab | 19-Jul-22 | 15:05 | CB | 25.3 | 7.40 | 20-Jul-22 | 2.5 | 394 | inaccesible | 210 | 16 |
| PW-7 | Grab | 19-Jul-22 | 14:05 | CB | 22.9 | 7.60 | 20-Jul-22 | 7.0 | 290 | 47.7 | 169 | 10 |
| PW-13 | Grab | 19-Jul-22 | 15:30 | CB | 21.0 | 7.40 | 20-Jul-22 | 2.5 | 426 | 29.6 | 168 | 9 |
| PW-15 | Grab | 19-Jul-22 | 14:50 | CB | 26.1 | 7.20 | 20-Jul-22 | 2.5 | 442 | inaccesible | 265 | 22 |
| PW-19 | Grab | 19-Jul-22 | 14:35 | CB | 24.6 | 7.10 | 20-Jul-22 | 2.5 | 366 | 47.6 | 226 | 18 |
| AO-1 | Grab | 11-Aug-22 | 13:15 | CB | 22.8 | 6.90 | 15-Aug-22 | <5.0 | 298 | 20.8 | 206 | 38 |
| AO-3 | Grab | 11-Aug-22 | 13:40 | CB | 22.9 | 7.20 | 15-Aug-22 | <5.0 | 458 | 50.4 | 205 | 16 |

NPDES 001 Data - April 2010 to February 2023

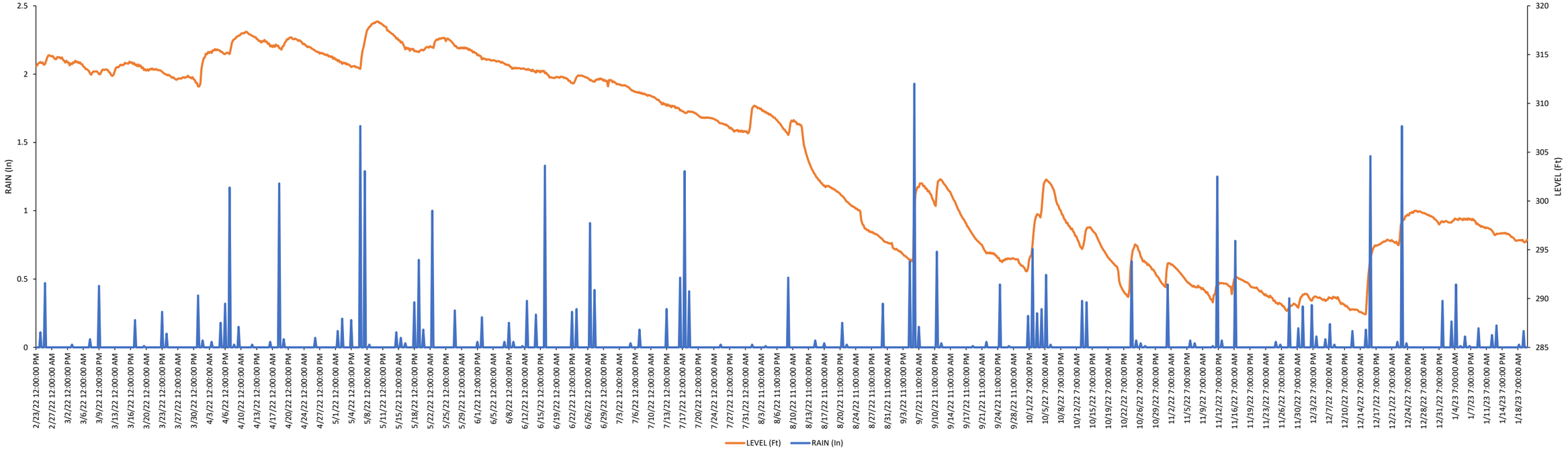



NPDES 001 Data - April 2010 to January 2023
Diesel Pumps On
Diesel Pumps Off
APRIL 2010 - DECEMBER 2017
JUNE 24, 2022 - AUGUST 25, 2022
FLOW (Average GPM)
FLOW (Average GPD)
FLOW (Average GPM)
FLOW (Average GPD)

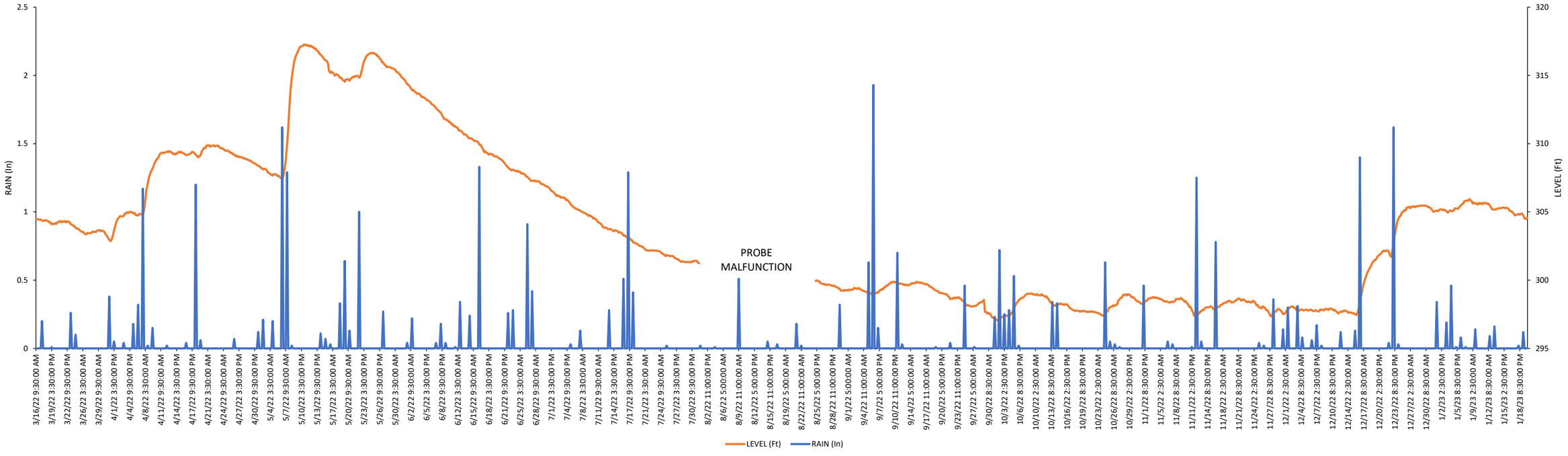
MW 22-1 Data - February 2022 to January 2023



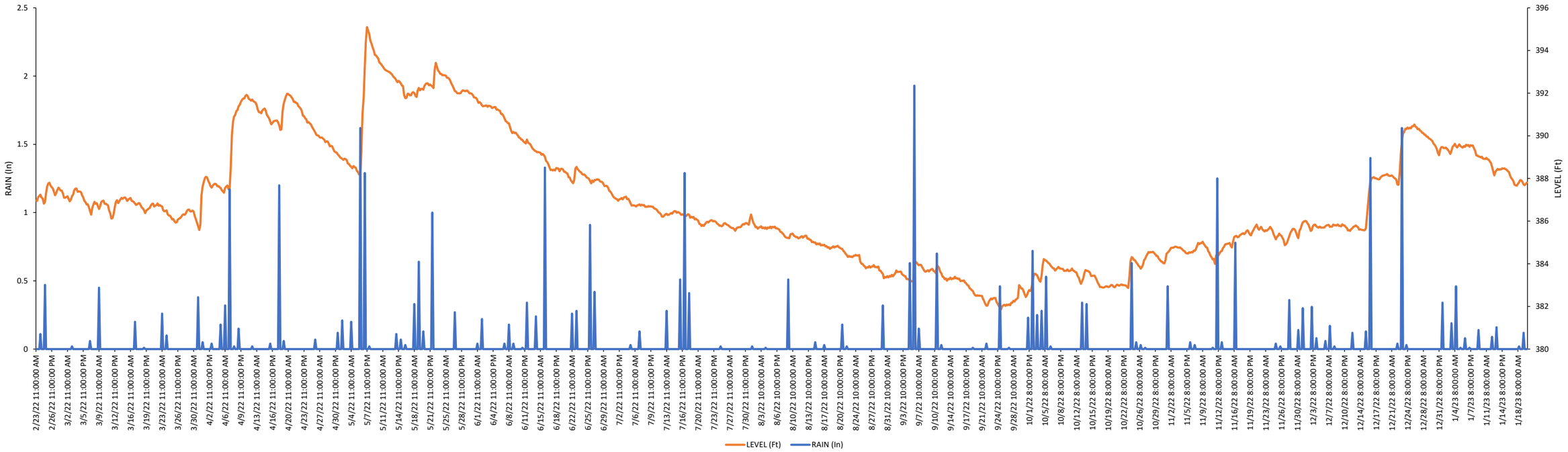
MW 22-2 Data - February 2022 to January 2023



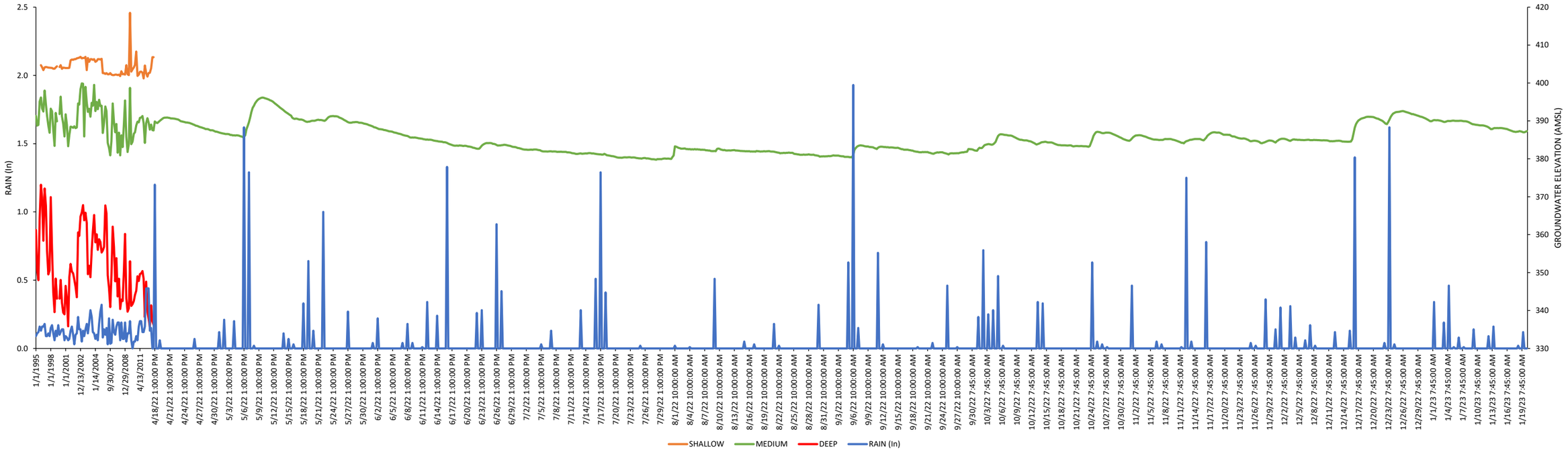
MW 22-3 Data - March 2022 to January 2023



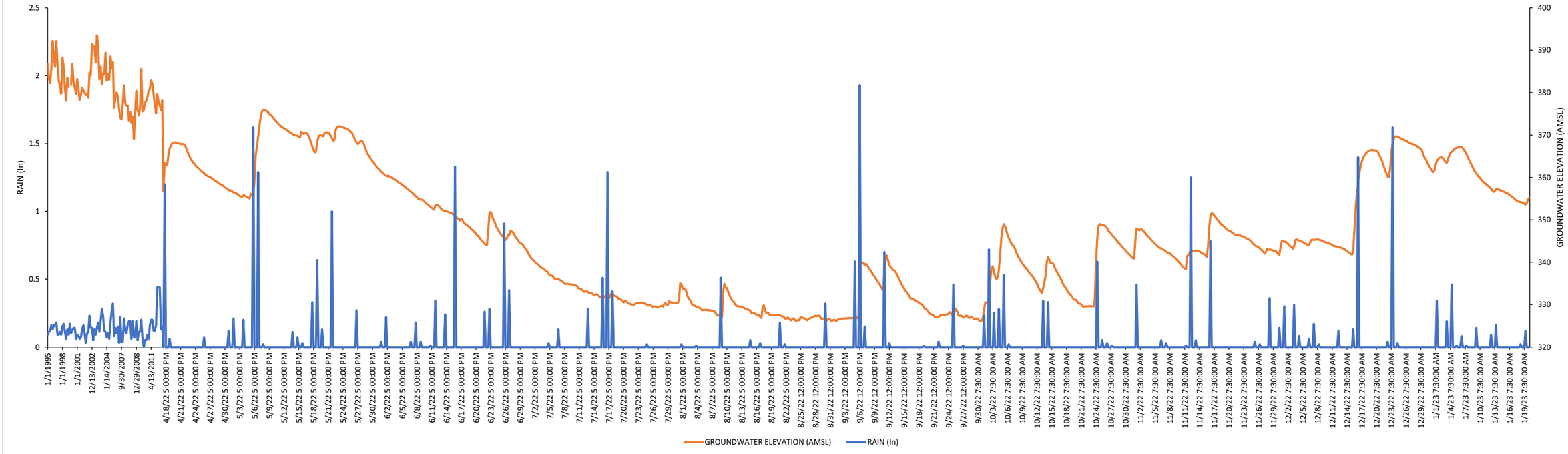
MW 22-4 Data - February 2022 to January 2023



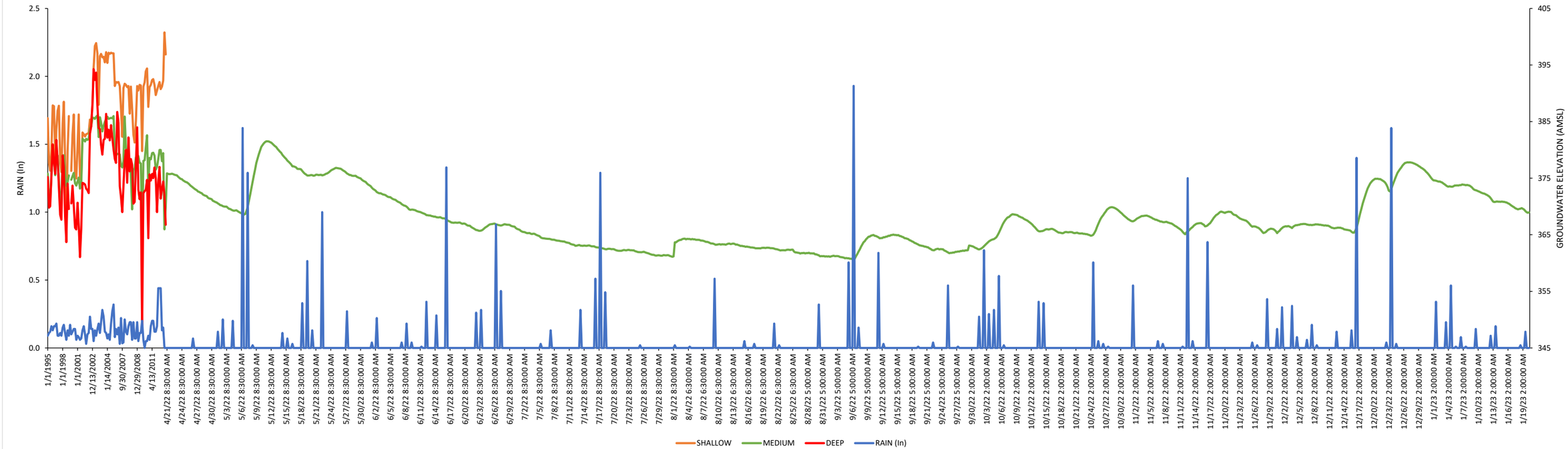
MW-A Data - January 1995 to January 2023



MW-B Data - January 1995 to January 2023



MW-D Data - January 1995 to January 2023



Point | Polyline | Polygon

Enter buffer distance

Miles

Layer to buffer

No layer

Create Buffer | Clear

**Buffer Sensitive Layer (Data Only)**

Buffer a

Point | Polyline | Polygon

Enter buffer distance

0.5 Miles

Layer to buffer

Groundwater Wells

Create Buffer | Clear

Extract Data

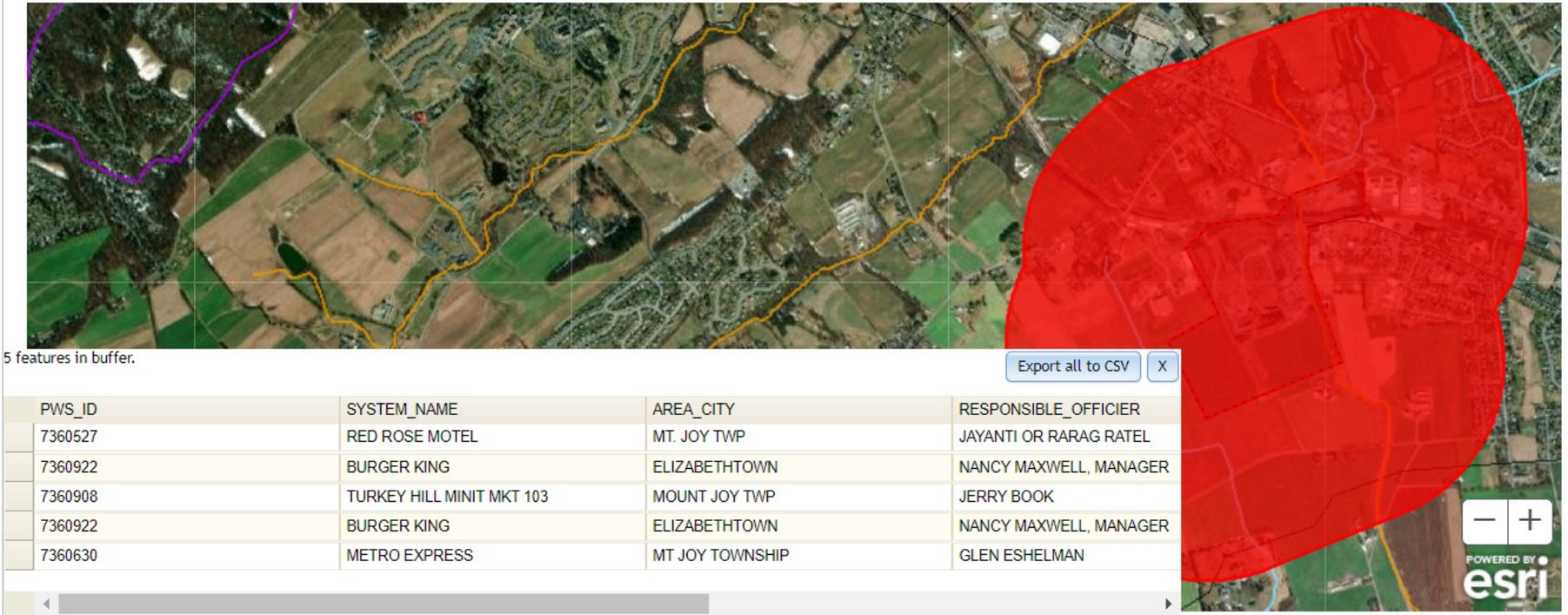
Locate

Measurement

Map | eFacts Query | Advanced Query

ESRI Streets & Imagery | Topographic | National Geographic

Streets Imagery



5 features in buffer.

Export all to CSV | X

| PWS_ID | SYSTEM_NAME | AREA_CITY | RESPONSIBLE_OFFICIER |
|---|---|---|---|
| 7360527 | RED ROSE MOTEL | MT. JOY TWP | JAYANTI OR RARAG RATEL |
| 7360922 | BURGER KING | ELIZABETHTOWN | NANCY MAXWELL, MANAGER |
| 7360908 | TURKEY HILL MINIT MKT 103 | MOUNT JOY TWP | JERRY BOOK |
| 7360922 | BURGER KING | ELIZABETHTOWN | NANCY MAXWELL, MANAGER |
| 7360630 | METRO EXPRESS | MT JOY TOWNSHIP | GLEN ESHELMAN |

pennsylvania DEPARTMENT OF ENVIRONMENTAL PROTECTION
eMapPA

Layers | Legend

- Land Reuse
- Mining
- Oil and Gas
- Radiation
- Sample Information
- Streams and Water
- Storage Tanks
- Waste
- Water
  - Encroachment L
  - Erosion and Sed
  - Mine Drainage Ti
  - Oil and Gas Encr
  - Oil and Gas Wate
  - Orphan Mine Di
  - Water Pollution
  - Water Resources
  - Public Water Su
- Areas POI - Geological
- Areas POI - Environme
- Areas POI - General
- Boundaries
  - Zip Code Points
  - DEP Regions
  - County Boundarie

Map | eFacts Query | Advanced Query

ESRI Streets & Imagery | Topographic | National Geographic

Streets — Imagery

pennsylvania DEPARTMENT OF ENVIRONMENTAL PROTECTION

**eMapPA**

Layers | Legend | Tasks | Links

- Buffer a Layer
- Buffer Sensitive Layer (Data Only)

Buffer a
Point | Polyline | Polygon

Enter buffer distance
0.5 Miles

Layer to buffer
Surface Water Intakes

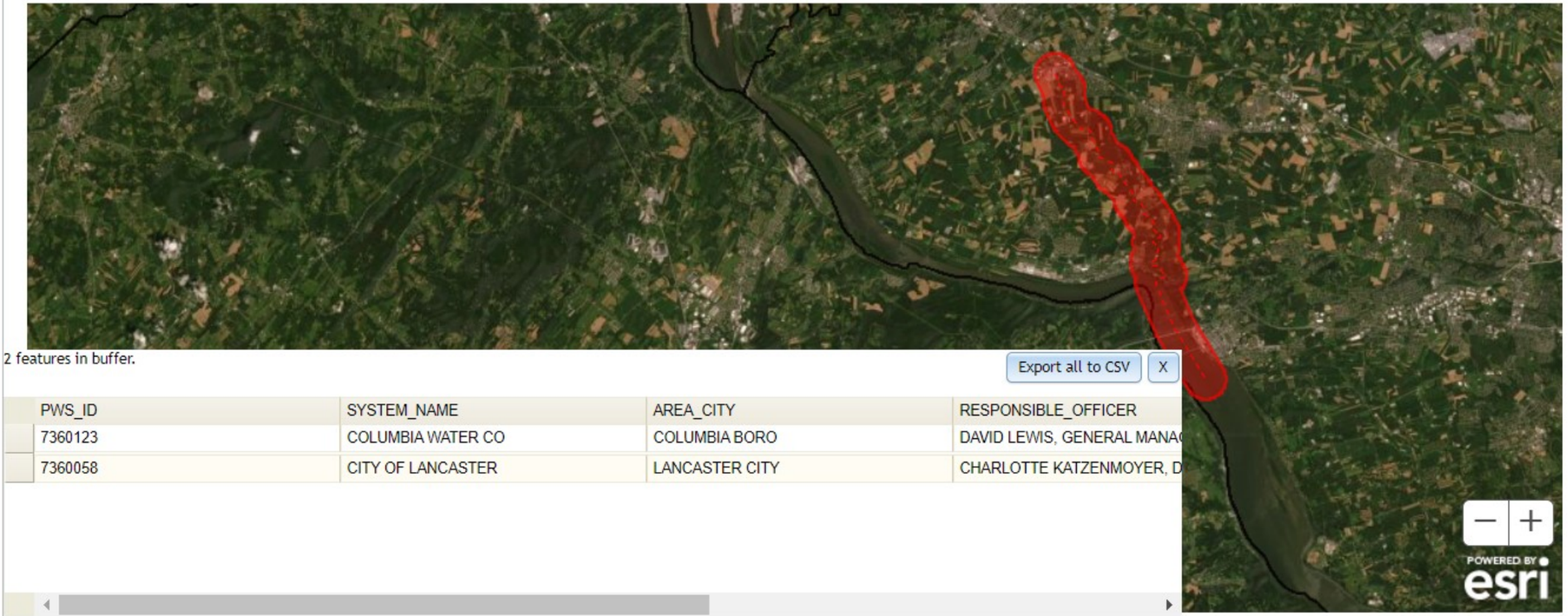
Create Buffer | Clear

- Extract Data
- Locate
- Measurement

Map | eFacts Query | Advanced Query

ESRI Streets & Imagery | Topographic | National Geographic

Streets — Imagery



2 features in buffer.

Export all to CSV | X

| PWS_ID | SYSTEM_NAME | AREA_CITY | RESPONSIBLE_OFFICER |
|---|---|---|---|
| 7360123 | COLUMBIA WATER CO | COLUMBIA BORO | DAVID LEWIS, GENERAL MANA |
| 7360058 | CITY OF LANCASTER | LANCASTER CITY | CHARLOTTE KATZENMOYER, D |

Imagery: undefined; ESRI Streets: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

**eMapPA**

Layers | Legend | Tasks | Links

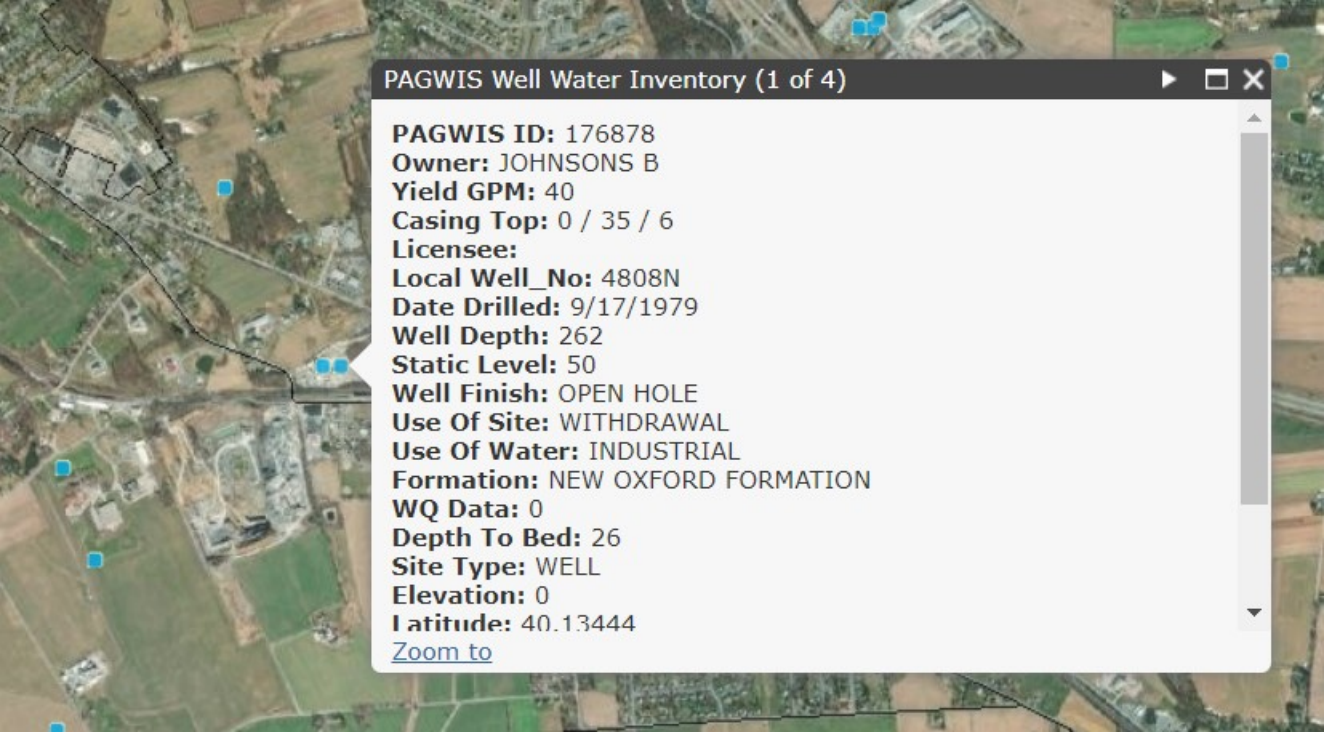
- Land Reuse
- Mining
- Oil and Gas
- Radiation
- Sample Information System
- Streams and Water Resources
  - Surface Water Related
    - PAGWIS Well Water Inventory
    - PA Historic Streams
    - Scenic Rivers
    - PA Water Plan
    - Stormwater 167
    - PA MD Instream Flow Study Ar
  - Fish Information
  - Flooding Information
  - NHD HUC (National Hydrography D
  - Water Monitoring
  - Water Quality
- Storage Tanks
- Waste
- Water
- Areas POI - Geological
- Areas POI - Environmental
- Areas POI - General

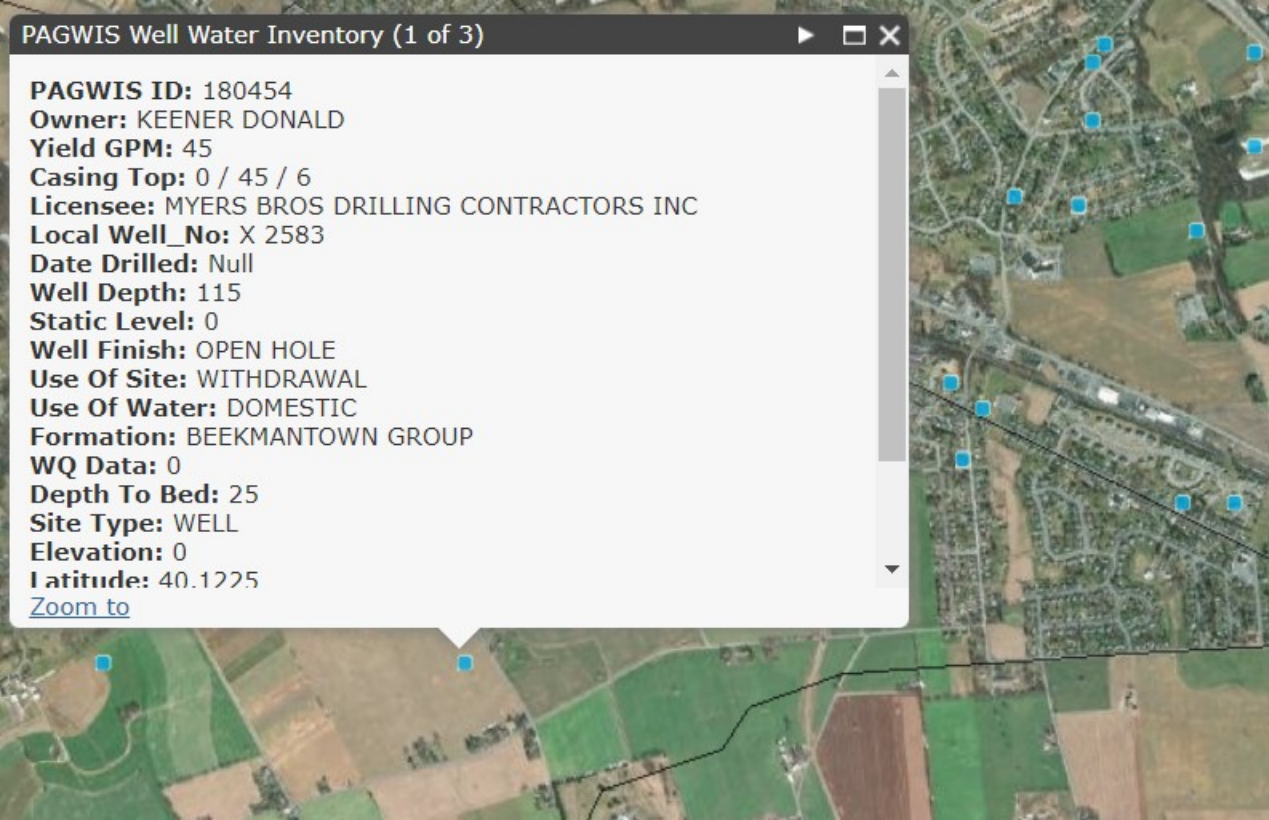
Map | eFacts Query | Advanced Query

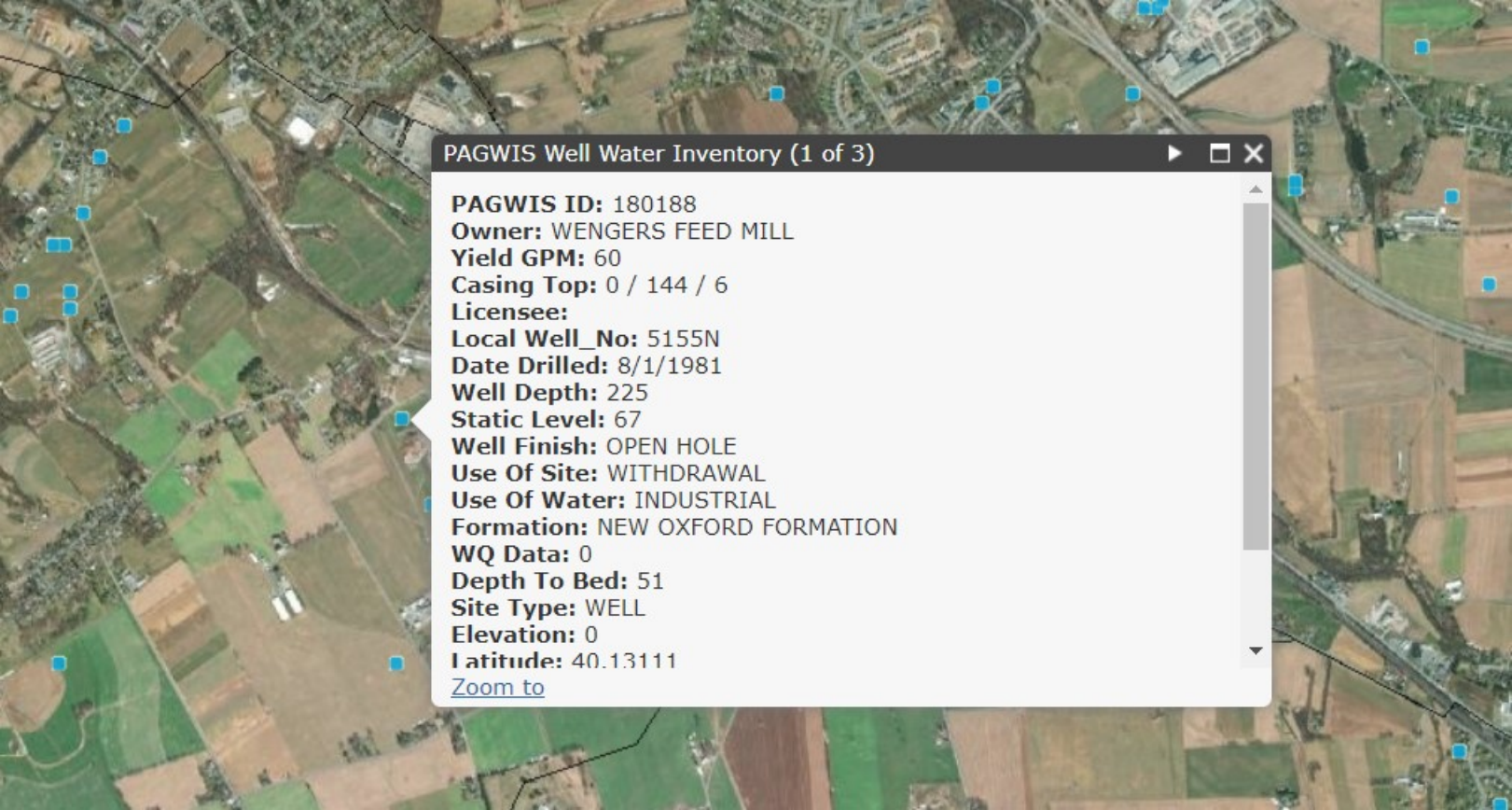
ESRI Streets & Imagery | Topographic | National Geographic

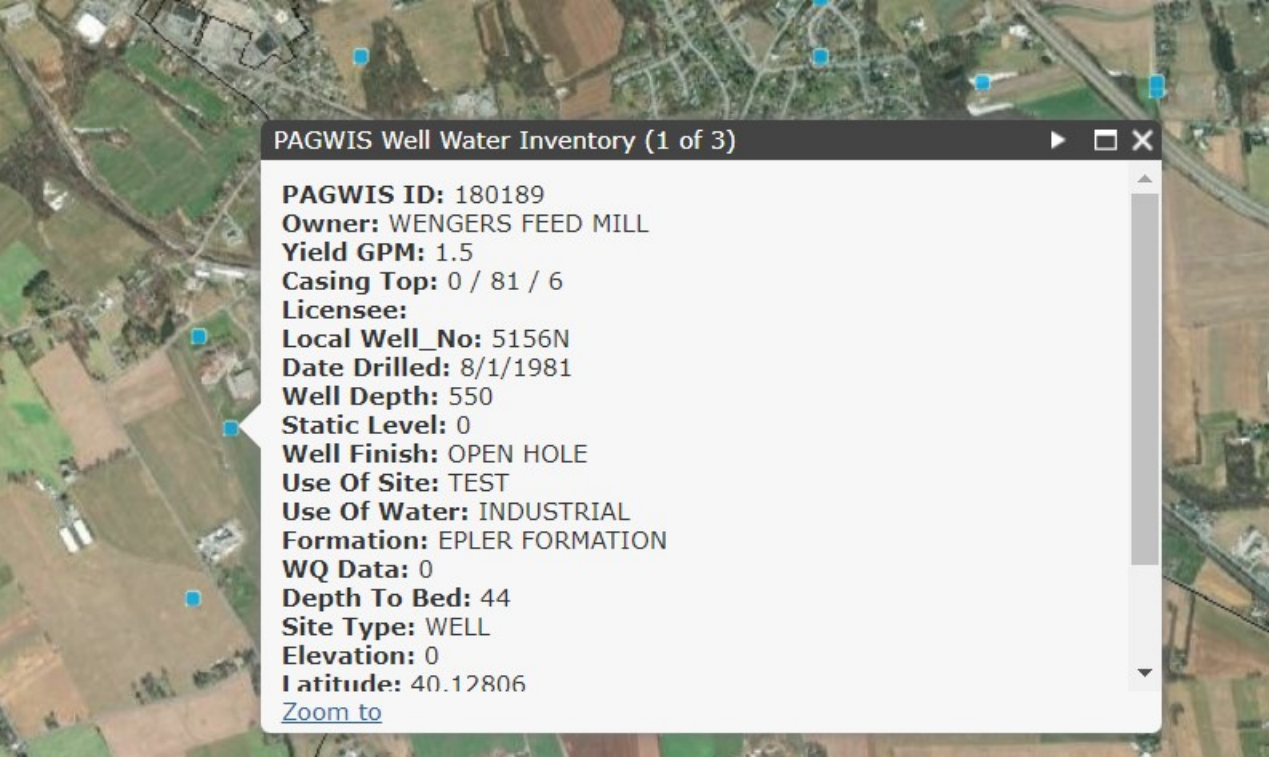
Streets Imagery


Imagery: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community; ESRI Streets: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community


PAGWIS Well Water Inventory (1 of 4)
PAGWIS ID: 176878
Owner: JOHNSONS B
Yield GPM: 40
Casing Top: 0 / 35 / 6
Licensee:
Local Well_No: 4808N
Date Drilled: 9/17/1979
Well Depth: 262
Static Level: 50
Well Finish: OPEN HOLE
Use Of Site: WITHDRAWAL
Use Of Water: INDUSTRIAL
Formation: NEW OXFORD FORMATION
WQ Data: 0
Depth To Bed: 26
Site Type: WELL
Elevation: 0
Latitude: 40.13444
Zoom to


PAGWIS Well Water Inventory (1 of 3)
PAGWIS ID: 180454
Owner: KEENER DONALD
Yield GPM: 45
Casing Top: 0 / 45 / 6
Licensee: MYERS BROS DRILLING CONTRACTORS INC
Local Well_No: X 2583
Date Drilled: Null
Well Depth: 115
Static Level: 0
Well Finish: OPEN HOLE
Use Of Site: WITHDRAWAL
Use Of Water: DOMESTIC
Formation: BEEKMANTOWN GROUP
WQ Data: 0
Depth To Bed: 25
Site Type: WELL
Elevation: 0
Latitude: 40.1225
Zoom to


PAGWIS Well Water Inventory (1 of 3)
PAGWIS ID: 180188
Owner: WENGERS FEED MILL
Yield GPM: 60
Casing Top: 0 / 144 / 6
Licensee:
Local Well_No: 5155N
Date Drilled: 8/1/1981
Well Depth: 225
Static Level: 67
Well Finish: OPEN HOLE
Use Of Site: WITHDRAWAL
Use Of Water: INDUSTRIAL
Formation: NEW OXFORD FORMATION
WQ Data: 0
Depth To Bed: 51
Site Type: WELL
Elevation: 0
Latitude: 40.13111
Zoom to


PAGWIS Well Water Inventory (1 of 3)
PAGWIS ID: 180189
Owner: WENGERS FEED MILL
Yield GPM: 1.5
Casing Top: 0 / 81 / 6
Licensee:
Local Well_No: 5156N
Date Drilled: 8/1/1981
Well Depth: 550
Static Level: 0
Well Finish: OPEN HOLE
Use Of Site: TEST
Use Of Water: INDUSTRIAL
Formation: EPLER FORMATION
WQ Data: 0
Depth To Bed: 44
Site Type: WELL
Elevation: 0
Latitude: 40.12806
Zoom to

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | SWL (AMSL) | Depth | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|---|---|---|---|
| | | | Shallow | | Medium | | Deep | | 452.09 |
| MW-A | 1/1/1995 | | DRY | | 391.33 | 60.8 | 361.25 | 90.8 | |
| MW-A | 4/1/1995 | | DRY | | 388.75 | 63.3 | 350.87 | 101.2 | |
| MW-A | 7/1/1995 | | DRY | | 388.94 | 63.2 | 348.00 | 104.1 | |
| MW-A | 10/1/1995 | | DRY | | 395.11 | 57.0 | 364.28 | 87.8 | |
| MW-A | 1/1/1996 | | 404.70 | 47.4 | 396.17 | 55.9 | 373.16 | 78.9 | |
| MW-A | 4/1/1996 | | 404.17 | 47.9 | 393.28 | 58.8 | 369.86 | 82.2 | |
| MW-A | 7/1/1996 | | 403.40 | 48.7 | 392.47 | 59.6 | 358.41 | 93.7 | |
| MW-A | 10/1/1996 | | 404.11 | 48.0 | 398.02 | 54.1 | 372.19 | 79.9 | |
| MW-A | 1/1/1997 | | 404.22 | 47.9 | 394.41 | 57.7 | 367.61 | 84.5 | |
| MW-A | 4/1/1997 | | 404.14 | 48.0 | 391.36 | 60.7 | 355.86 | 96.2 | |
| MW-A | 7/1/1997 | | 404.05 | 48.0 | 388.78 | 63.3 | 349.52 | 102.6 | |
| MW-A | 10/1/1997 | | 404.02 | 48.1 | 386.89 | 65.2 | 350.61 | 101.5 | |
| MW-A | 1/1/1998 | | 404.00 | 48.1 | 393.22 | 58.9 | 369.91 | 82.2 | |
| MW-A | 4/1/1998 | | 403.97 | 48.1 | 392.52 | 59.6 | 356.25 | 95.8 | |
| MW-A | 7/1/1998 | | 403.75 | 48.3 | 387.63 | 64.5 | 344.80 | 107.3 | |
| MW-A | 10/1/1998 | | 403.75 | 48.3 | 383.41 | 68.7 | 339.58 | 112.5 | |
| MW-A | 1/1/1999 | | 404.08 | 48.0 | 392.11 | 60.0 | 348.42 | 103.7 | |
| MW-A | 4/1/1999 | | 404.39 | 47.7 | 389.88 | 62.2 | 343.14 | 109.0 | |
| MW-A | 7/1/1999 | | | | NO RECORD | | | | |
| MW-A | 10/1/1999 | | 404.22 | 47.9 | 391.80 | 60.3 | 343.13 | 109.0 | |
| MW-A | 1/1/2000 | | 404.69 | 47.4 | 396.39 | 55.7 | 348.05 | 104.0 | |
| MW-A | 4/1/2000 | | 403.72 | 48.4 | 391.19 | 60.9 | 342.08 | 110.0 | |
| MW-A | 7/1/2000 | | 404.05 | 48.0 | 389.27 | 62.8 | 339.44 | 112.7 | |
| MW-A | 10/1/2000 | | 404.00 | 48.1 | 385.89 | 66.2 | 339.00 | 113.1 | |
| MW-A | 1/1/2001 | | 403.94 | 48.2 | 391.75 | 60.3 | 346.50 | 105.6 | |
| MW-A | 5/1/2001 | | 403.94 | 48.2 | 388.97 | 63.1 | 343.03 | 109.1 | |
| MW-A | 9/1/2001 | | 403.94 | 48.2 | 383.33 | 68.8 | 335.83 | 116.3 | |
| MW-A | 1/1/2002 | | 404.00 | 48.1 | 386.26 | 65.8 | 348.70 | 103.4 | |
| MW-A | 4/9/2002 | | 405.99 | 46.1 | 388.49 | 63.6 | 352.29 | 99.8 | |
| MW-A | 5/15/2002 | | 406.19 | 45.9 | 388.39 | 63.7 | 350.29 | 101.8 | |
| MW-A | 6/17/2002 | | 406.09 | 46.0 | 388.19 | 63.9 | 349.79 | 102.3 | |
| MW-A | 7/22/2002 | | 406.29 | 45.8 | 388.59 | 63.5 | 348.19 | 103.9 | |
| MW-A | 8/19/2002 | | 406.29 | 45.8 | 388.09 | 64.0 | 346.29 | 105.8 | |
| MW-A | 9/23/2002 | | 406.49 | 45.6 | 388.29 | 63.8 | 343.49 | 108.6 | |
| MW-A | 10/21/2002 | | 406.59 | 45.5 | 394.59 | 57.5 | 360.59 | 91.5 | |
| MW-A | 11/15/2002 | | 406.69 | 45.4 | 394.29 | 57.8 | 359.69 | 92.4 | |
| MW-A | 12/13/2002 | | 406.89 | 45.2 | 398.39 | 53.7 | 364.79 | 87.3 | |
| MW-A | 1/15/2003 | | 406.49 | 45.6 | 399.89 | 52.2 | 365.89 | 86.2 | |
| MW-A | 2/13/2003 | | 406.59 | 45.5 | 399.79 | 52.3 | 367.79 | 84.3 | |
| MW-A | 3/6/2003 | | 406.59 | 45.5 | 385.89 | 66.2 | 363.79 | 88.3 | |
| MW-A | 5/21/2003 | | 406.89 | 45.2 | 398.99 | 53.1 | 365.79 | 86.3 | |
| MW-A | 6/11/2003 | | 403.39 | 48.7 | 394.89 | 57.2 | 363.09 | 89.0 | |
| MW-A | 7/15/2003 | | 406.59 | 45.5 | 392.39 | 59.7 | 349.59 | 102.5 | |
| MW-A | 8/13/2003 | | 405.59 | 46.5 | 393.19 | 58.9 | 351.79 | 100.3 | |
| MW-A | 9/17/2003 | | 406.29 | 45.8 | 391.09 | 61.0 | 348.79 | 103.3 | |
| MW-A | 10/16/2003 | | 406.29 | 45.8 | 394.79 | 57.3 | 355.89 | 96.2 | |
| MW-A | 11/13/2003 | | 406.09 | 46.0 | 393.99 | 58.1 | 360.79 | 91.3 | |
| MW-A | 12/18/2003 | | 406.29 | 45.8 | 399.49 | 52.6 | 365.19 | 86.9 | |
| MW-A | 1/14/2004 | | 405.59 | 46.5 | 392.59 | 59.5 | 357.99 | 94.1 | |
| MW-A | 2/23/2004 | | 405.79 | 46.3 | 394.99 | 57.1 | 360.09 | 92.0 | |
| MW-A | 3/15/2004 | | 406.29 | 45.8 | 393.09 | 59.0 | 355.99 | 96.1 | |
| MW-A | 4/15/2004 | | 406.29 | 45.8 | 395.59 | 56.5 | 358.79 | 93.3 | |
| MW-A | 6/16/2004 | | 406.19 | 45.9 | 393.89 | 58.2 | 358.09 | 94.0 | |
| MW-A | 7/13/2004 | | 406.39 | 45.7 | 393.99 | 58.1 | 355.29 | 96.8 | |
| MW-A | 1/31/2007 | | 402.60 | 49.5 | 386.80 | 65.3 | 355.80 | 96.3 | |
| MW-A | 2/28/2007 | | 402.60 | 49.5 | 389.50 | 62.6 | 356.80 | 95.3 | |
| MW-A | 3/29/2007 | | 402.40 | 49.7 | 393.80 | 58.3 | 367.70 | 84.4 | |
| MW-A | 4/25/2007 | | 402.60 | 49.5 | 392.60 | 59.5 | 365.60 | 86.5 | |
| MW-A | 5/31/2007 | | 402.30 | 49.8 | 384.20 | 67.9 | 349.30 | 102.8 | |
| MW-A | 8/14/2007 | | 402.30 | 49.8 | 382.90 | 69.2 | 345.90 | 106.2 | |
| MW-A | 9/30/2007 | | 402.60 | 49.5 | 380.90 | 71.2 | 340.90 | 111.2 | |
| MW-A | 1/30/2008 | | 402.20 | 49.9 | 384.70 | 67.4 | 349.20 | 102.9 | |
| MW-A | 2/28/2008 | | 402.10 | 50.0 | 394.60 | 57.5 | 362.10 | 90.0 | |
| MW-A | 3/31/2008 | | 402.10 | 50.0 | 389.70 | 62.4 | 356.70 | 95.4 | |
| MW-A | 4/30/2008 | | 402.20 | 49.9 | 387.00 | 65.1 | 347.70 | 104.4 | |
| MW-A | 5/27/2008 | | 402.20 | 49.9 | 389.20 | 62.9 | 353.80 | 98.3 | |
| MW-A | 7/1/2008 | | 402.10 | 50.0 | 381.60 | 70.5 | 343.70 | 108.4 | |
| MW-A | 7/31/2008 | | 402.20 | 49.9 | 386.90 | 65.2 | 348.40 | 103.7 | |
| MW-A | 8/29/2008 | | 401.80 | 50.3 | 380.90 | 71.2 | 340.40 | 111.7 | |
| MW-A | 9/29/2008 | | 403.10 | 49.0 | 386.20 | 65.9 | 342.90 | 109.2 | |
| MW-A | 11/3/2008 | | 402.30 | 49.8 | 383.10 | 69.0 | 342.50 | 109.6 | |
| MW-A | 11/28/2008 | | 402.40 | 49.7 | 389.10 | 63.0 | 350.30 | 101.8 | |
| MW-A | 12/29/2008 | | 402.20 | 49.9 | 395.40 | 56.7 | 360.20 | 91.9 | |
| MW-A | 4/26/2010 | | 404.70 | 47.4 | 385.80 | 66.3 | 343.20 | 108.9 | |
| MW-A | 5/26/2010 | | 402.30 | 49.8 | 381.80 | 70.3 | 339.70 | 112.4 | |
| MW-A | 6/29/2010 | | 402.10 | 50.0 | 384.00 | 68.1 | 340.60 | 111.5 | |
| MW-A | 7/28/2010 | | 418.50 | 33.6 | 398.70 | 53.4 | 353.00 | 99.1 | |
| MW-A | 8/31/2010 | | 403.00 | 49.1 | 383.87 | 68.2 | 341.20 | 110.9 | |
| MW-A | 10/1/2010 | | 403.62 | 48.5 | 384.53 | 67.6 | 341.66 | 110.4 | |
| MW-A | 11/18/2010 | | 404.10 | 48.0 | 386.60 | 65.5 | 342.50 | 109.6 | |
| MW-A | 11/30/2010 | | 404.80 | 47.3 | 387.00 | 65.1 | 344.10 | 108.0 | |
| MW-A | 12/29/2010 | | 408.30 | 43.8 | 388.80 | 63.3 | 345.20 | 106.9 | |
| MW-A | 1/25/2011 | | 401.87 | 50.2 | 389.79 | 62.3 | 349.04 | 103.1 | |
| MW-A | 3/1/2011 | | 402.20 | 49.9 | 389.62 | 62.5 | 347.79 | 104.3 | |
| MW-A | 4/13/2011 | | 402.95 | 49.1 | 390.79 | 61.3 | 349.62 | 102.5 | |
| MW-A | 4/27/2011 | | 403.00 | 49.1 | 390.90 | 61.2 | 349.80 | 102.3 | |
| MW-A | 6/1/2011 | | 402.70 | 49.4 | 391.30 | 60.8 | 350.40 | 101.7 | |
| MW-A | 6/30/2011 | | 401.20 | 50.9 | 389.40 | 62.7 | 348.40 | 103.7 | |
| MW-A | 7/29/2011 | | 404.60 | 47.5 | 384.20 | 67.9 | 338.20 | 113.9 | |
| MW-A | 9/2/2011 | | 402.60 | 49.5 | 389.40 | 62.7 | 347.60 | 104.5 | |
| MW-A | 9/26/2011 | | 401.70 | 50.4 | 390.70 | 61.4 | 339.70 | 112.4 | |
| MW-A | 9/26/2011 | | 402.62 | 49.5 | 389.62 | 62.5 | 337.95 | 114.1 | |
| MW-A | 10/25/2011 | | 402.70 | 49.4 | 387.70 | 64.4 | 335.70 | 116.4 | |
| MW-A | 11/30/2011 | | 403.87 | 48.2 | 389.03 | 63.1 | 341.37 | 110.7 | |
| MW-A | 11/9/2021 | RC | 406.79 | 45.3 | 387.59 | 64.5 | 337.19 | 114.9 | |
| MW-A | 1/27/2022 | CB | 406.79 | 45.3 | 387.49 | 64.6 | 336.19 | 115.9 | |
| MW-A | 2/23/2022 | CB | | | 387.39 | 64.7 | 336.19 | 115.9 | |
| MW-A | 3/16/2022 | CB | 406.89 | 45.2 | 388.29 | 63.8 | 335.49 | 116.6 | |
| MW-A | 4/18/2022 | RC | | | 390.09 | 62.0 | 348.09 | 104.0 | |
| MW-A | 5/16/2022 | CB | | | 391.19 | 60.9 | | | |
| MW-A | 6/30/2022 | CB | | | 383.02 | 69.1 | | | |
| MW-A | 8/1/2022 | RC | 403.99 | 48.1 | 380.89 | 71.2 | | | |
| MW-A | 8/25/2022 | RC | 403.39 | 48.7 | 381.59 | 70.5 | 308.89 | 143.2 | |
| MW-A | 9/29/2022 | RC | 406.29 | 45.8 | 381.89 | 70.2 | 323.99 | 128.1 | |

Green Fill indicates part of background sampling program

| Monitoring Point # | Date of Sample | CollectedBy | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|
| | | | | | 411.20 |
| MW-B | 1/1/1995 | | 386.75 | 24.5 | |
| MW-B | 4/1/1995 | | 383.50 | 27.7 | |
| MW-B | 7/1/1995 | | 382.22 | 29.0 | |
| MW-B | 10/1/1995 | | 385.80 | 25.4 | |
| MW-B | 1/1/1996 | | 392.19 | 19.0 | |
| MW-B | 4/1/1996 | | 388.50 | 22.7 | |
| MW-B | 7/1/1996 | | 386.05 | 25.2 | |
| MW-B | 10/1/1996 | | 392.16 | 19.0 | |
| MW-B | 1/1/1997 | | 386.66 | 24.5 | |
| MW-B | 4/1/1997 | | 382.66 | 28.5 | |
| MW-B | 7/1/1997 | | 381.53 | 29.7 | |
| MW-B | 10/1/1997 | | 379.72 | 31.5 | |
| MW-B | 1/1/1998 | | 388.28 | 22.9 | |
| MW-B | 4/1/1998 | | 386.08 | 25.1 | |
| MW-B | 7/1/1998 | | 380.80 | 30.4 | |
| MW-B | 10/1/1998 | | 378.08 | 33.1 | |
| MW-B | 1/1/1999 | | 383.47 | 27.7 | |
| MW-B | 4/1/1999 | | 381.28 | 29.9 | |
| MW-B | 7/1/1999 | | NO RECORD | | |
| MW-B | 10/1/1999 | | 381.78 | 29.4 | |
| MW-B | 1/1/2000 | | 386.78 | 24.4 | |
| MW-B | 4/1/2000 | | 382.39 | 28.8 | |
| MW-B | 7/1/2000 | | 381.14 | 30.1 | |
| MW-B | 10/1/2000 | | 379.64 | 31.6 | |
| MW-B | 1/1/2001 | | 383.19 | 28.0 | |
| MW-B | 5/1/2001 | | 380.69 | 30.5 | |
| MW-B | 9/1/2001 | | 378.25 | 33.0 | |
| MW-B | 1/1/2002 | | 379.31 | 31.9 | |
| MW-B | 4/9/2002 | | 381.10 | 30.1 | |
| MW-B | 5/15/2002 | | 380.50 | 30.7 | |
| MW-B | 6/17/2002 | | 380.00 | 31.2 | |
| MW-B | 7/22/2002 | | 379.40 | 31.8 | |
| MW-B | 8/19/2002 | | 379.60 | 31.6 | |
| MW-B | 9/23/2002 | | 378.80 | 32.4 | |
| MW-B | 10/21/2002 | | 384.70 | 26.5 | |
| MW-B | 11/15/2002 | | 384.00 | 27.2 | |
| MW-B | 12/13/2002 | | 391.40 | 19.8 | |
| MW-B | 1/15/2003 | | 390.90 | 20.3 | |
| MW-B | 2/13/2003 | | 390.80 | 20.4 | |
| MW-B | 3/6/2003 | | 387.10 | 24.1 | |
| MW-B | 5/21/2003 | | 393.50 | 17.7 | |
| MW-B | 6/11/2003 | | 391.30 | 19.9 | |
| MW-B | 7/15/2003 | | 383.10 | 28.1 | |
| MW-B | 8/13/2003 | | 386.10 | 25.1 | |
| MW-B | 9/17/2003 | | 382.00 | 29.2 | |
| MW-B | 10/16/2003 | | 384.50 | 26.7 | |
| MW-B | 11/13/2003 | | 384.40 | 26.8 | |
| MW-B | 12/18/2003 | | 389.40 | 21.8 | |
| MW-B | 1/14/2004 | | 382.80 | 28.4 | |
| MW-B | 2/23/2004 | | 384.40 | 26.8 | |
| MW-B | 3/15/2004 | | 383.00 | 28.2 | |
| MW-B | 4/15/2004 | | 388.50 | 22.7 | |
| MW-B | 6/16/2004 | | 385.80 | 25.4 | |
| MW-B | 7/13/2004 | | 387.20 | 24.0 | |
| MW-B | 1/31/2007 | | 376.40 | 34.8 | |
| MW-B | 2/28/2007 | | 378.70 | 32.5 | |
| MW-B | 3/29/2007 | | 380.00 | 31.2 | |
| MW-B | 4/25/2007 | | 379.00 | 32.2 | |
| MW-B | 5/31/2007 | | 376.20 | 35.0 | |
| MW-B | 8/14/2007 | | 374.10 | 37.1 | |
| MW-B | 9/30/2007 | | 373.70 | 37.5 | |
| MW-B | 1/30/2008 | | 377.20 | 34.0 | |
| MW-B | 2/28/2008 | | 381.70 | 29.5 | |
| MW-B | 3/31/2008 | | 377.40 | 33.8 | |
| MW-B | 4/30/2008 | | 376.90 | 34.3 | |
| MW-B | 5/27/2008 | | 376.90 | 34.3 | |
| MW-B | 7/1/2008 | | 373.40 | 37.8 | |
| MW-B | 7/31/2008 | | 375.40 | 35.8 | |
| MW-B | 8/29/2008 | | 372.90 | 38.3 | |
| MW-B | 9/29/2008 | | 374.40 | 36.8 | |
| MW-B | 11/3/2008 | | 369.10 | 42.1 | |
| MW-B | 11/28/2008 | | 374.70 | 36.5 | |
| MW-B | 12/29/2008 | | 380.40 | 30.8 | |
| MW-B | 4/26/2010 | | 375.90 | 35.3 | |
| MW-B | 5/26/2010 | | 374.60 | 36.6 | |
| MW-B | 6/29/2010 | | 376.10 | 35.1 | |
| MW-B | 7/28/2010 | | 385.57 | 25.6 | |
| MW-B | 8/31/2010 | | 375.57 | 35.6 | |
| MW-B | 10/1/2010 | | 375.84 | 35.4 | |
| MW-B | 11/18/2010 | | 377.50 | 33.7 | |
| MW-B | 11/30/2010 | | 378.00 | 33.2 | |
| MW-B | 12/29/2010 | | 378.90 | 32.3 | |
| MW-B | 1/25/2011 | | 380.49 | 30.7 | |
| MW-B | 3/1/2011 | | 380.82 | 30.4 | |
| MW-B | 4/13/2011 | | 382.87 | 28.3 | |
| MW-B | 4/27/2011 | | 382.00 | 29.2 | |
| MW-B | 6/1/2011 | | 379.70 | 31.5 | |
| MW-B | 6/30/2011 | | 377.30 | 33.9 | |
| MW-B | 7/29/2011 | | 375.10 | 36.1 | |
| MW-B | 9/2/2011 | | 379.60 | 31.6 | |
| MW-B | 9/26/2011 | | 377.90 | 33.3 | |
| MW-B | 9/26/2011 | | 376.90 | 34.3 | |
| MW-B | 10/25/2011 | | 375.90 | 35.3 | |
| MW-B | 11/30/2011 | | 378.15 | 33.1 | |
| MW-B | 1/27/2022 | CB | 356.70 | 54.5 | |
| MW-B | 2/23/2022 | CB | 357.90 | 53.3 | |
| MW-B | 3/16/2022 | CB | 357.80 | 53.4 | |
| MW-B | 4/18/2022 | CB | 365.20 | 46.0 | |
| MW-B | 5/16/2022 | CB | 369.20 | 42.0 | |
| MW-B | 6/30/2022 | CB | 343.73 | 67.5 | |
| MW-B | 8/1/2022 | RC | 335.00 | 76.2 | |
| MW-B | 8/25/2022 | RC | 326.30 | 84.9 | |
| MW-B | 9/29/2022 | RC | 326.80 | 84.4 | |

Green Fill indicates part of background sampling program

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|---|---|
| | | | Shallow | | Medium | | 425.00 |
| MW-C | 1/1/1995 | | 387.75 | 37.3 | 369.00 | 56.0 | |
| MW-C | 4/1/1995 | | 385.75 | 39.3 | 365.13 | 59.9 | |
| MW-C | 7/1/1995 | | 387.50 | 37.5 | 363.45 | 61.6 | |
| MW-C | 10/1/1995 | | 387.47 | 37.5 | 376.39 | 48.6 | |
| MW-C | 1/1/1996 | | 388.33 | 36.7 | 375.38 | 49.6 | |
| MW-C | 4/1/1996 | | 387.69 | 37.3 | 369.33 | 55.7 | |
| MW-C | 7/1/1996 | | 388.05 | 37.0 | 363.33 | 61.7 | |
| MW-C | 10/1/1996 | | 387.94 | 37.1 | 370.06 | 54.9 | |
| MW-C | 1/1/1997 | | 387.75 | 37.3 | 363.13 | 61.9 | |
| MW-C | 4/1/1997 | | 387.08 | 37.9 | 355.86 | 69.1 | |
| MW-C | 7/1/1997 | | 386.41 | 38.6 | 352.02 | 73.0 | |
| MW-C | 10/1/1997 | | 384.83 | 40.2 | 352.00 | 73.0 | |
| MW-C | 1/1/1998 | | 388.05 | 37.0 | 363.69 | 61.3 | |
| MW-C | 4/1/1998 | | 388.00 | 37.0 | 364.80 | 60.2 | |
| MW-C | 7/1/1998 | | 386.97 | 38.0 | 352.00 | 73.0 | |
| MW-C | 10/1/1998 | | 384.16 | 40.8 | 352.00 | 73.0 | |
| MW-C | 1/1/1999 | | 381.55 | 43.5 | 352.00 | 73.0 | |
| MW-C | 4/1/1999 | | 387.08 | 37.9 | 352.86 | 72.1 | |
| MW-C | 7/1/1999 | | NO RECORD | | | | |
| MW-C | 10/1/1999 | | 387.05 | 38.0 | 352.00 | 73.0 | |
| MW-C | 1/1/2000 | | 388.39 | 36.6 | 352.83 | 72.2 | |
| MW-C | 4/1/2000 | | 387.8 | 37.2 | 352.33 | 72.7 | |
| MW-C | 7/1/2000 | | 386.55 | 38.5 | 352.00 | 73.0 | |
| MW-C | 10/1/2000 | | 386.69 | 38.3 | 352.00 | 73.0 | |
| MW-C | 1/1/2001 | | 387.72 | 37.3 | 352.00 | 73.0 | |
| MW-C | 5/1/2001 | | 386.97 | 38.0 | 352.00 | 73.0 | |
| MW-C | 9/1/2001 | | 384.50 | 40.5 | 352.00 | 73.0 | |
| MW-C | 1/1/2002 | | 381.32 | 43.7 | 351.63 | 73.4 | |
| MW-C | 4/9/2002 | | 381.00 | 44.0 | 351.60 | 73.4 | |
| MW-C | 5/15/2002 | | 381.40 | 43.6 | 351.80 | 73.2 | |
| MW-C | 6/17/2002 | | 381.60 | 43.4 | 351.40 | 73.6 | |
| MW-C | 7/22/2002 | | 382.10 | 42.9 | 351.60 | 73.4 | |
| MW-C | 8/19/2002 | | 383.50 | 41.5 | 351.10 | 73.9 | |
| MW-C | 9/23/2002 | | 384.10 | 40.9 | 351.00 | 74.0 | |
| MW-C | 10/21/2002 | | 384.70 | 40.3 | 351.60 | 73.4 | |
| MW-C | 11/15/2002 | | 386.60 | 38.4 | 351.60 | 73.4 | |
| MW-C | 12/13/2002 | | 384.80 | 40.2 | 351.60 | 73.4 | |
| MW-C | 1/15/2003 | | 388.90 | 36.1 | 354.60 | 70.4 | |
| MW-C | 2/13/2003 | | 389.90 | 35.1 | 353.50 | 71.5 | |
| MW-C | 3/6/2003 | | 387.80 | 37.2 | 352.20 | 72.8 | |
| MW-C | 5/21/2003 | | 384.80 | 40.2 | 337.20 | 87.8 | |
| MW-C | 6/11/2003 | | 381.20 | 43.8 | 333.70 | 91.3 | |
| MW-C | 7/15/2003 | | 386.40 | 38.6 | 351.80 | 73.2 | |
| MW-C | 8/13/2003 | | 383.00 | 42.0 | 352.50 | 72.5 | |
| MW-C | 9/17/2003 | | 383.20 | 41.8 | 352.00 | 73.0 | |
| MW-C | 10/16/2003 | | 387.00 | 38.0 | 352.00 | 73.0 | |
| MW-C | 11/13/2003 | | 383.00 | 42.0 | 352.50 | 72.5 | |
| MW-C | 12/18/2003 | | 382.90 | 42.1 | 352.00 | 73.0 | |
| MW-C | 1/14/2004 | | 382.40 | 42.6 | 352.00 | 73.0 | |
| MW-C | 2/23/2004 | | 382.50 | 42.5 | 352.00 | 73.0 | |
| MW-C | 3/15/2004 | | 382.40 | 42.6 | 352.00 | 73.0 | |
| MW-C | 4/15/2004 | | 381.90 | 43.1 | 352.00 | 73.0 | |
| MW-C | 6/16/2004 | | 380.90 | 44.1 | 352.00 | 73.0 | |
| MW-C | 7/13/2004 | | 380.70 | 44.3 | 352.00 | 73.0 | |
| MW-C | 1/31/2007 | | 377.70 | 47.30 | 338.40 | 86.60 | |
| MW-C | 2/28/2007 | | 378.50 | 46.50 | 341.60 | 83.40 | |
| MW-C | 3/29/2007 | | 377.80 | 47.20 | 343.10 | 81.90 | |
| MW-C | 4/25/2007 | | 378.00 | 47.00 | 341.90 | 83.10 | |
| MW-C | 5/31/2007 | | 377.00 | 48.00 | 341.70 | 83.30 | |
| MW-C | 8/14/2007 | | 376.60 | 48.40 | 341.80 | 83.20 | |
| MW-C | 9/30/2007 | | 376.10 | 48.90 | 341.50 | 83.50 | |
| MW-C | 1/30/2008 | | 376.70 | 48.30 | 341.50 | 83.50 | |
| MW-C | 2/28/2008 | | 377.00 | 48.00 | 341.60 | 83.40 | |
| MW-C | 3/31/2008 | | 377.30 | 47.70 | 341.80 | 83.20 | |
| MW-C | 4/30/2008 | | 376.90 | 48.10 | 341.50 | 83.50 | |
| MW-C | 5/27/2008 | | 377.00 | 48.00 | 341.10 | 83.90 | |
| MW-C | 7/1/2008 | | 376.60 | 48.40 | 341.80 | 83.20 | |
| MW-C | 7/31/2008 | | 377.40 | 47.60 | 341.70 | 83.30 | |
| MW-C | 8/29/2008 | | 376.50 | 48.50 | 341.70 | 83.30 | |
| MW-C | 9/29/2008 | | 376.80 | 48.20 | 343.50 | 81.50 | |
| MW-C | 11/3/2008 | | 376.00 | 49.00 | 341.70 | 83.30 | |
| MW-C | 11/28/2008 | | 376.70 | 48.30 | 341.70 | 83.30 | |
| MW-C | 12/29/2008 | | 377.80 | 47.20 | 341.80 | 83.20 | |
| MW-C | 4/26/2010 | | 404.50 | 20.50 | 348.00 | 77.00 | |
| MW-C | 5/26/2010 | | 408.00 | 17.00 | 349.90 | 75.10 | |
| MW-C | 6/29/2010 | | 404.00 | 21.00 | 345.90 | 79.10 | |
| MW-C | 7/28/2010 | | 415.00 | 10.00 | 336.92 | 88.08 | |
| MW-C | 8/31/2010 | | 405.50 | 19.50 | 347.92 | 77.08 | |
| MW-C | 10/1/2010 | | 405.71 | 19.29 | 348.08 | 76.92 | |
| MW-C | 11/18/2010 | | 410.90 | 14.10 | 350.30 | 74.70 | |
| MW-C | 11/30/2010 | | 412.20 | 12.80 | 352.10 | 72.90 | |
| MW-C | 12/29/2010 | | 405.50 | 19.50 | 344.30 | 80.70 | |
| MW-C | 1/25/2011 | | 403.92 | 21.08 | 403.92 | 21.08 | |
| MW-C | 3/1/2011 | | 404.34 | 20.66 | 404.59 | 20.41 | |
| MW-C | 4/13/2011 | | 408.50 | 16.50 | 408.92 | 16.08 | |
| MW-C | 4/27/2011 | | 409.00 | 16.00 | 409.20 | 15.80 | |
| MW-C | 6/1/2011 | | 411.00 | 14.00 | 408.50 | 16.50 | |
| MW-C | 6/30/2011 | | 408.50 | 16.50 | 408.30 | 16.70 | |
| MW-C | 7/29/2011 | | 409.80 | 15.20 | N/A | N/A | |
| MW-C | 9/2/2011 | | 407.70 | 17.30 | N/A | N/A | |
| MW-C | 9/26/2011 | | 410.00 | 15.00 | N/A | N/A | |
| MW-C | 9/26/2011 | | 408.85 | 16.15 | N/A | N/A | |
| MW-C | 10/25/2011 | | 410.00 | 15.00 | N/A | N/A | |
| MW-C | 11/30/2011 | | 410.08 | 14.92 | N/A | N/A | |

| Monitoring Point # | Date of Sample | CollectedBy | SWL (AMSL) | Depth | SWL (AMSL) | Depth | SWL (AMSL) | Depth | TOC | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Shallow | | Medium | | Deep | | 425.97 | |
| MW-D | 1/1/1995 | | 385.62 | 40.4 | 375.79 | 50.2 | 375.21 | 50.8 | | |
| MW-D | 4/1/1995 | | 377.71 | 48.3 | 371.08 | 54.9 | 369.79 | 56.2 | | |
| MW-D | 7/1/1995 | | 376.33 | 49.6 | 371.14 | 54.8 | 370.03 | 55.9 | | |
| MW-D | 10/1/1995 | | 380.00 | 46.0 | 375.47 | 50.5 | 375.52 | 50.5 | | |
| MW-D | 1/1/1996 | | 387.86 | 38.1 | 379.69 | 46.3 | 380.99 | 45.0 | | |
| MW-D | 4/1/1996 | | 387.72 | 38.3 | 378.31 | 47.7 | 377.83 | 48.1 | | |
| MW-D | 7/1/1996 | | 378.75 | 47.2 | 375.53 | 50.4 | 375.78 | 50.2 | | |
| MW-D | 10/1/1996 | | 383.56 | 42.4 | 378.67 | 47.3 | 381.77 | 44.2 | | |
| MW-D | 1/1/1997 | | 386.91 | 39.1 | 379.00 | 47.0 | 378.13 | 47.8 | | |
| MW-D | 4/1/1997 | | 387.80 | 38.2 | 374.83 | 51.1 | 373.47 | 52.5 | | |
| MW-D | 7/1/1997 | | 377.92 | 48.1 | 370.05 | 55.9 | 368.56 | 57.4 | | |
| MW-D | 10/1/1997 | | 376.08 | 49.9 | 371.52 | 54.5 | 367.67 | 58.3 | | |
| MW-D | 1/1/1998 | | 384.53 | 41.4 | 377.94 | 48.0 | 379.02 | 47.0 | | |
| MW-D | 4/1/1998 | | 388.52 | 37.5 | 379.08 | 46.9 | 377.00 | 49.0 | | |
| MW-D | 7/1/1998 | | 378.61 | 47.4 | 375.80 | 50.2 | 368.39 | 57.6 | | |
| MW-D | 10/1/1998 | | 363.72 | 62.3 | 373.66 | 52.3 | 363.72 | 62.3 | | |
| MW-D | 1/1/1999 | | 379.75 | 46.2 | 374.33 | 51.6 | 374.05 | 51.9 | | |
| MW-D | 4/1/1999 | | 385.97 | 40.0 | 375.50 | 50.5 | 369.55 | 56.4 | | |
| MW-D | 7/1/1999 | | NO RECORD | | | | | | | |
| MW-D | 10/1/1999 | | 376.28 | 49.7 | 374.72 | 51.3 | 370.55 | 55.4 | | |
| MW-D | 1/1/2000 | | 382.69 | 43.3 | 375.36 | 50.6 | 373.69 | 52.3 | | |
| MW-D | 4/1/2000 | | 386.27 | 39.7 | 375.94 | 50.0 | 370.11 | 55.9 | | |
| MW-D | 7/1/2000 | | 375.55 | 50.4 | 374.11 | 51.9 | 366.25 | 59.7 | | |
| MW-D | 10/1/2000 | | 374.94 | 51.0 | 373.69 | 52.3 | 365.94 | 60.0 | | |
| MW-D | 1/1/2001 | | 380.78 | 45.2 | 374.39 | 51.6 | 370.66 | 55.3 | | |
| MW-D | 5/1/2001 | | 386.27 | 39.7 | 375.11 | 50.9 | 366.81 | 59.2 | | |
| MW-D | 9/1/2001 | | 374.86 | 51.1 | 373.16 | 52.8 | 361.05 | 64.9 | | |
| MW-D | 1/1/2002 | | 374.76 | 51.2 | 373.86 | 52.1 | 366.11 | 59.9 | | |
| MW-D | 4/9/2002 | | 383.07 | 42.9 | 381.97 | 44.0 | 374.17 | 51.8 | | |
| MW-D | 5/15/2002 | | 382.77 | 43.2 | 381.77 | 44.2 | 374.07 | 51.9 | | |
| MW-D | 6/17/2002 | | 382.37 | 43.6 | 381.47 | 44.5 | 373.87 | 52.1 | | |
| MW-D | 7/22/2002 | | 382.77 | 43.2 | 381.97 | 44.0 | 373.17 | 52.8 | | |
| MW-D | 8/19/2002 | | 382.87 | 43.1 | 381.77 | 44.2 | 372.87 | 53.1 | | |
| MW-D | 9/23/2002 | | 382.97 | 43.0 | 381.97 | 44.0 | 372.37 | 53.6 | | |
| MW-D | 10/21/2002 | | 385.37 | 40.6 | 383.77 | 42.2 | 382.87 | 43.1 | | |
| MW-D | 11/15/2002 | | 384.87 | 41.1 | 384.17 | 41.8 | 384.17 | 41.8 | | |
| MW-D | 12/13/2002 | | 387.87 | 38.1 | 385.67 | 40.3 | 388.17 | 37.8 | | |
| MW-D | 1/15/2003 | | 394.47 | 31.5 | 385.67 | 40.3 | 394.27 | 31.7 | | |
| MW-D | 2/13/2003 | | 398.37 | 27.6 | 385.47 | 40.5 | 392.37 | 33.6 | | |
| MW-D | 3/6/2003 | | 398.87 | 27.1 | 385.87 | 40.1 | 393.67 | 32.3 | | |
| MW-D | 5/21/2003 | | 397.07 | 28.9 | 386.07 | 39.9 | 387.77 | 38.2 | | |
| MW-D | 6/11/2003 | | 387.97 | 38.0 | 382.27 | 43.7 | 383.87 | 42.1 | | |
| MW-D | 7/15/2003 | | 396.57 | 29.4 | 385.77 | 40.2 | 383.67 | 42.3 | | |
| MW-D | 8/13/2003 | | 396.97 | 29.0 | 384.87 | 41.1 | 380.87 | 45.1 | | |
| MW-D | 9/17/2003 | | 396.37 | 29.6 | 383.27 | 42.7 | 379.17 | 46.8 | | |
| MW-D | 10/16/2003 | | 396.47 | 29.5 | 384.27 | 41.7 | 381.77 | 44.2 | | |
| MW-D | 11/13/2003 | | 395.47 | 30.5 | 384.97 | 41.0 | 381.97 | 44.0 | | |
| MW-D | 12/18/2003 | | 397.27 | 28.7 | 385.47 | 40.5 | 386.37 | 39.6 | | |
| MW-D | 1/14/2004 | | 395.37 | 30.6 | 385.87 | 40.1 | 382.17 | 43.8 | | |
| MW-D | 2/23/2004 | | 397.17 | 28.8 | 385.47 | 40.5 | 383.57 | 42.4 | | |
| MW-D | 3/15/2004 | | 396.97 | 29.0 | 385.57 | 40.4 | 381.67 | 44.3 | | |
| MW-D | 4/15/2004 | | 397.17 | 28.8 | 385.67 | 40.3 | 384.37 | 41.6 | | |
| MW-D | 6/16/2004 | | 397.07 | 28.9 | 385.57 | 40.4 | 382.17 | 43.8 | | |
| MW-D | 7/13/2004 | | 397.07 | 28.9 | 385.97 | 40.0 | 380.07 | 45.9 | | |
| MW-D | 1/31/2007 | | 391.30 | 34.67 | 379.80 | 46.17 | 378.40 | 47.57 | | |
| MW-D | 2/28/2007 | | 392.00 | 33.97 | 379.00 | 46.97 | 377.70 | 48.27 | | |
| MW-D | 3/29/2007 | | 391.90 | 34.07 | 379.30 | 46.67 | 386.70 | 39.27 | | |
| MW-D | 4/25/2007 | | 392.00 | 33.97 | 379.30 | 46.67 | 384.80 | 41.17 | | |
| MW-D | 5/31/2007 | | 391.30 | 34.67 | 379.20 | 46.77 | 373.60 | 52.37 | | |
| MW-D | 8/14/2007 | | 387.21 | 38.76 | 377.20 | 48.77 | 371.60 | 54.37 | | |
| MW-D | 9/30/2007 | | 382.30 | 43.67 | 376.90 | 49.07 | 369.00 | 56.97 | | |
| MW-D | 1/30/2008 | | 390.90 | 35.07 | 378.00 | 47.97 | 373.50 | 52.47 | | |
| MW-D | 2/28/2008 | | 391.70 | 34.27 | 385.90 | 40.07 | 378.00 | 47.97 | | |
| MW-D | 3/31/2008 | | 391.50 | 34.47 | 380.40 | 45.57 | 380.00 | 45.97 | | |
| MW-D | 4/30/2008 | | 391.10 | 34.87 | 378.90 | 47.07 | 374.20 | 51.77 | | |
| MW-D | 5/27/2008 | | 391.30 | 34.67 | 378.80 | 47.17 | 382.20 | 43.77 | | |
| MW-D | 7/1/2008 | | 386.40 | 39.57 | 377.80 | 48.17 | 376.20 | 49.77 | | |
| MW-D | 7/31/2008 | | 391.20 | 34.77 | 375.50 | 50.47 | 378.40 | 47.57 | | |
| MW-D | 8/29/2008 | | 387.30 | 38.67 | 369.50 | 56.47 | 377.40 | 48.57 | | |
| MW-D | 9/29/2008 | | 382.70 | 43.27 | 376.50 | 49.47 | 370.50 | 55.47 | | |
| MW-D | 11/3/2008 | | 381.30 | 44.67 | 376.70 | 49.27 | 370.80 | 55.17 | | |
| MW-D | 11/28/2008 | | 385.10 | 40.87 | 378.70 | 47.27 | 377.40 | 48.57 | | |
| MW-D | 12/29/2008 | | 391.30 | 34.67 | 379.20 | 46.77 | 384.00 | 41.97 | | |
| MW-D | 4/26/2010 | | 390.50 | 35.47 | 378.90 | 47.07 | 373.00 | 52.97 | | |
| MW-D | 5/26/2010 | | 391.50 | 34.47 | 377.75 | 48.22 | 371.30 | 54.67 | | |
| MW-D | 6/29/2010 | | 391.40 | 34.57 | 377.60 | 48.37 | 372.50 | 53.47 | | |
| MW-D | 7/28/2010 | | 379.80 | 46.17 | 363.40 | 62.57 | 348.30 | 77.67 | | |
| MW-D | 8/31/2010 | | 391.17 | 34.80 | 378.08 | 47.89 | 372.42 | 53.55 | | |
| MW-D | 10/1/2010 | | 391.95 | 34.02 | 378.17 | 47.80 | 372.67 | 53.30 | | |
| MW-D | 11/18/2010 | | 393.89 | 32.08 | 380.40 | 45.57 | 373.00 | 52.97 | | |
| MW-D | 11/30/2010 | | 394.40 | 31.57 | 382.60 | 43.37 | 374.70 | 51.27 | | |
| MW-D | 12/29/2010 | | 387.60 | 38.37 | 373.10 | 52.87 | 364.40 | 61.57 | | |
| MW-D | 1/25/2011 | | 391.09 | 34.88 | 378.59 | 47.38 | 375.67 | 50.30 | | |
| MW-D | 3/1/2011 | | 391.50 | 34.47 | 378.34 | 47.63 | 374.59 | 51.38 | | |
| MW-D | 4/13/2011 | | 392.34 | 33.63 | 379.42 | 46.55 | 375.75 | 50.22 | | |
| MW-D | 4/27/2011 | | 392.50 | 33.47 | 379.50 | 46.47 | 375.00 | 50.97 | | |
| MW-D | 6/1/2011 | | 391.50 | 34.47 | 379.00 | 46.97 | 376.90 | 49.07 | | |
| MW-D | 6/30/2011 | | 389.70 | 36.27 | 376.50 | 49.47 | 375.00 | 50.97 | | |
| MW-D | 7/29/2011 | | 390.50 | 35.47 | 377.00 | 48.97 | 369.00 | 56.97 | | |
| MW-D | 9/2/2011 | | 391.30 | 34.67 | 378.40 | 47.57 | 374.40 | 51.57 | | |
| MW-D | 9/262011 | | 392.00 | 33.97 | 380.00 | 45.97 | 377.00 | 48.97 | | |
| MW-D | 9/26/2011 | | 390.75 | 35.22 | 380.00 | 45.97 | 371.40 | 54.57 | | |
| MW-D | 10/25/2011 | | 391.20 | 34.77 | 378.00 | 47.97 | 373.00 | 52.97 | | |
| MW-D | 11/30/2011 | | 392.25 | 33.72 | 379.42 | 46.55 | 374.42 | 51.55 | | |
| MW-D | 11/9/2021 | CB | 400.77 | 25.2 | 365.97 | 60.0 | 371.97 | 54.0 | | |
| MW-D | 1/27/2022 | CB | 396.87 | 29.1 | 370.07 | 55.9 | 366.77 | 59.2 | | |
| MW-D | 2/23/2022 | CB | 370.47 | 55.5 | 366.97 | 59.0 | | | | |
| MW-D | 3/16/2022 | CB | 397.17 | 28.8 | 365.37 | 60.6 | 370.47 | 55.5 | | |
| MW-D | 4/18/2022 | CB | | | 377.47 | 48.5 | | | | |
| MW-D | 5/16/2022 | CB | | | UNABLE TO ACCESS WELL | | | | | |
| MW-D | 6/30/2022 | CB | | | 366.19 | 59.8 | 359.57 | 66.4 | | dry |
| MW-D | 8/1/2022 | RC | 390.97 | 35.0 | 361.17 | 64.8 | | | | |
| MW-D | 8/25/2022 | RC | 393.37 | 32.6 | 362.37 | 63.6 | 360.57 | 65.4 | | dry |
| MW-D | 9/29/2022 | RC | 393.47 | 32.5 | 362.27 | 63.7 | 359.57 | 66.4 | | dry |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP#36080301

Background Water Quality Data

MW-22-1
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|
| | | | | | 406.32 |
| MW-22-1 | 1/27/2022 | CB | 297.82 | 108.5 | |
| MW-22-1 | 2/23/2022 | CB | 299.82 | 106.5 | |
| MW-22-1 | 3/16/2022 | CB | 300.02 | 106.3 | |
| MW-22-1 | 4/18/2022 | CB | 306.60 | 99.7 | |
| MW-22-1 | 5/16/2022 | CB | 309.62 | 96.7 | |
| MW-22-1 | 6/30/2022 | RC | 290.43 | 115.9 | |
| MW-22-1 | 8/1/2022 | RC | 270.42 | 135.9 | |
| MW-22-1 | 8/25/2022 | RC | 271.02 | 135.3 | |
| MW-22-1 | 9/29/2022 | RC | 270.82 | 135.5 | |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP#36080301

Background Water Quality Data

MW-22-2
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|
| | | | | | 413.42 |
| Well-22-2 | 1/27/2022 | CB | 313.22 | 100.2 | |
| Well-22-2 | 2/23/2022 | CB | 314.52 | 98.9 | |
| Well-22-2 | 3/16/2022 | CB | 315.22 | 98.2 | |
| Well-22-2 | 4/18/2022 | CB | 315.67 | 97.8 | |
| Well-22-2 | 5/16/2022 | CB | 316.02 | 97.4 | |
| Well-22-2 | 6/30/2022 | RC | 311.74 | 101.7 | |
| Well-22-2 | 8/1/2022 | RC | 308.62 | 104.8 | |
| Well-22-2 | 8/25/2022 | RC | 299.52 | 113.9 | |
| Well-22-2 | 9/29/2022 | RC | 294.02 | 119.4 | |

Green Fill indicates part of background sampling program

Pierson Rheems LLC
Quarry Operation
SMP#36080301

Background Water Quality Data

MW-22-3
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|
| | | | | | 408.55 |
| Well-22-3 | 1/27/2022 | CB | 302.75 | 105.8 | |
| Well-22-3 | 2/23/2022 | CB | 305.15 | 103.4 | |
| Well-22-3 | 3/16/2022 | CB | 305.15 | 103.4 | |
| Well-22-3 | 4/18/2022 | CB | 309.19 | 99.4 | |
| Well-22-3 | 5/16/2022 | CB | 315.75 | 92.8 | |
| Well-22-3 | 6/30/2022 | RC | 306.85 | 101.7 | |
| Well-22-3 | 8/1/2022 | RC | 301.25 | 107.3 | |
| Well-22-3 | 8/25/2022 | RC | 300.15 | 108.4 | |
| Well-22-3 | 9/29/2022 | RC | 298.55 | 110.0 | |

Green Fill indicates part of background sampling program

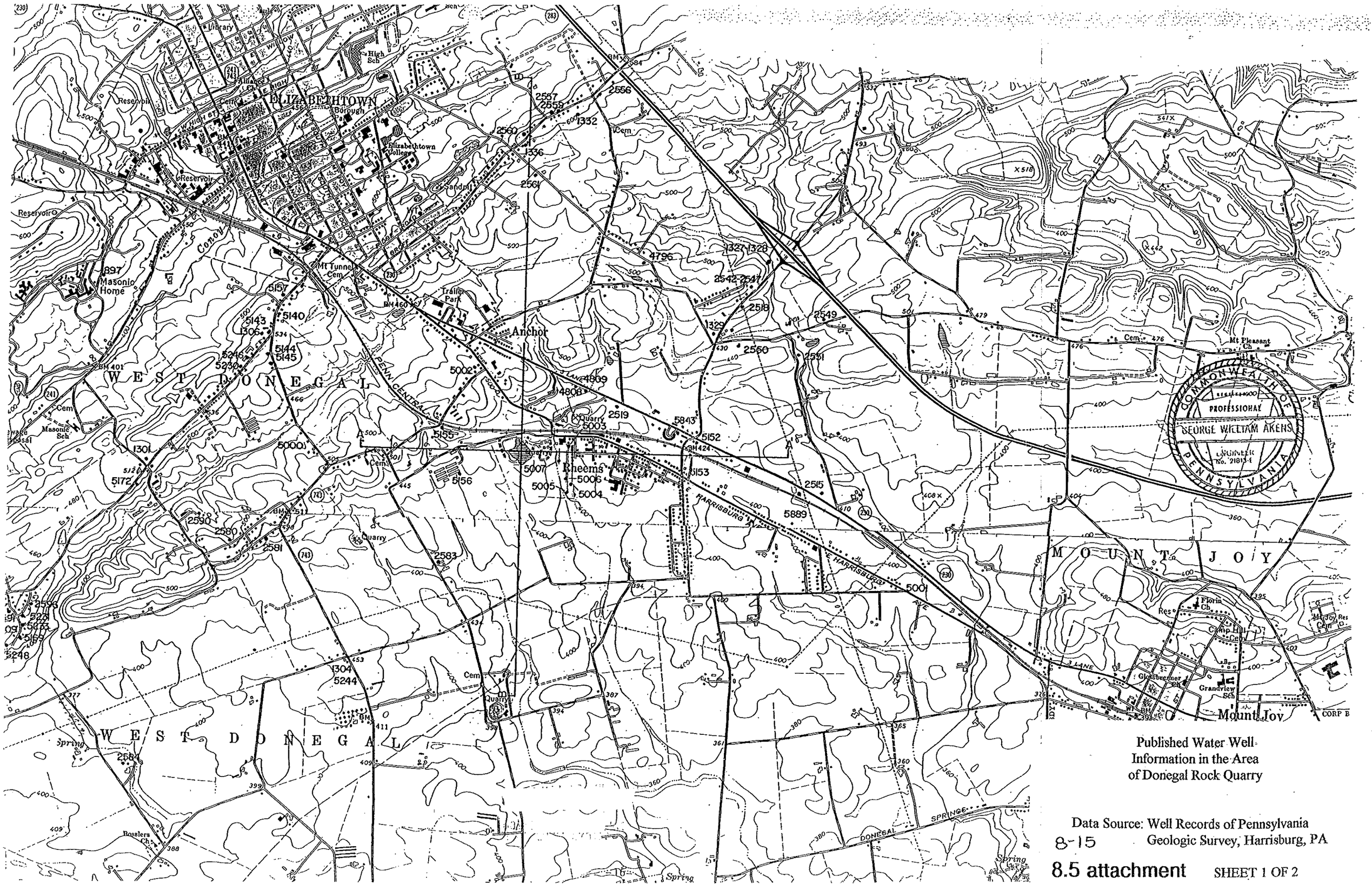
Pierson Rheems LLC
Quarry Operation
SMP#36080301

Background Water Quality Data

MW-22-4
West Donegal Mt. Joy Townships
Lancaster County, PA

| Monitoring Point # | Date of Sample | Collected By | SWL (AMSL) | Depth | TOC |
|---|---|---|---|---|---|
| | | | | | 407.31 |
| Well-22-4 | 1/27/2022 | CB | 385.71 | 21.6 | |
| Well-22-4 | 2/23/2022 | CB | 386.01 | 21.3 | |
| Well-22-4 | 3/16/2022 | CB | 384.91 | 22.4 | |
| Well-22-4 | 4/18/2022 | CB | 390.49 | 16.8 | |
| Well-22-4 | 5/16/2022 | CB | 392.21 | 15.1 | |
| Well-22-4 | 6/30/2022 | CB | 387.58 | 19.7 | |
| Well-22-4 | 8/1/2022 | RC | 386.31 | 21.0 | |
| Well-22-4 | 8/25/2022 | RC | 384.41 | 22.9 | |
| Well-22-4 | 9/29/2022 | RC | 382.41 | 24.9 | |

Green Fill indicates part of background sampling program

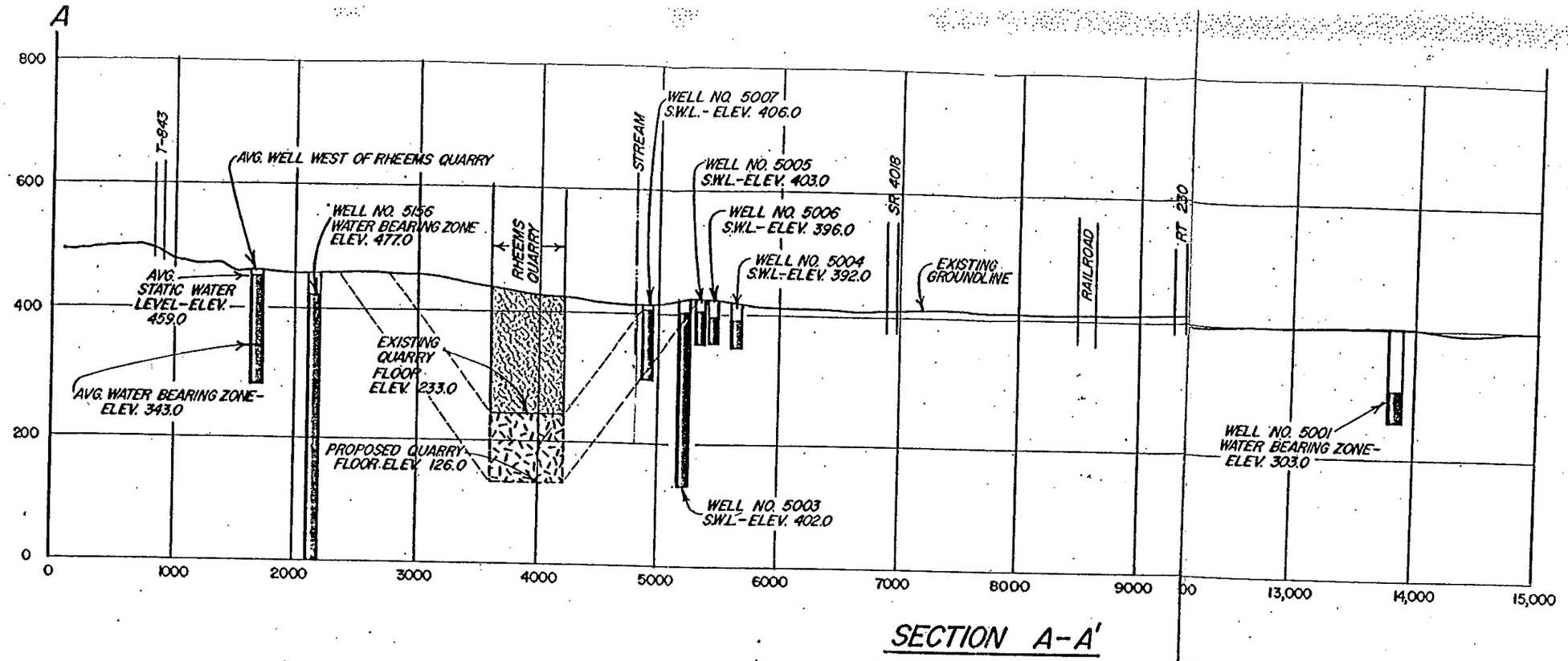



Published Water Well Information in the Area of Donegal Rock Quarry

Data Source: Well Records of Pennsylvania Geologic Survey, Harrisburg, PA

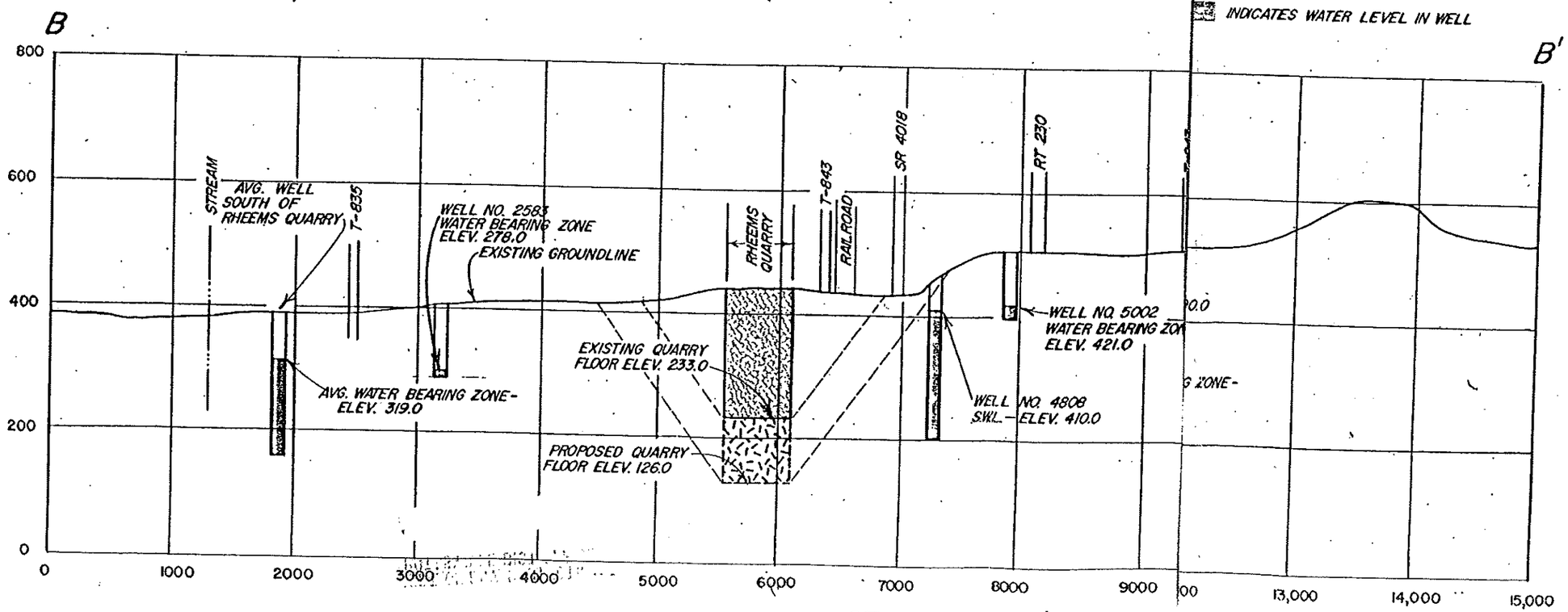
8-15

**8.5 attachment** SHEET 1 OF 2




SECTION A-A'

INDICATES WATER LEVEL IN WELL




SECTION B-B'

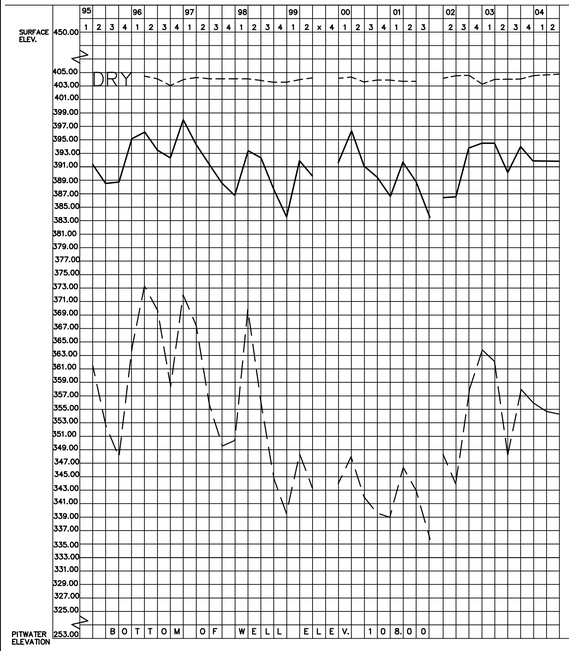
8-16

7.1(B) GEOLOGIC LOG DRILL HOLES

## GROUNDWATER MONITORING WELL A

SURFACE ELEV.=450.00
BOTTOM WELL =108.00
WELL DEPTH =342.00

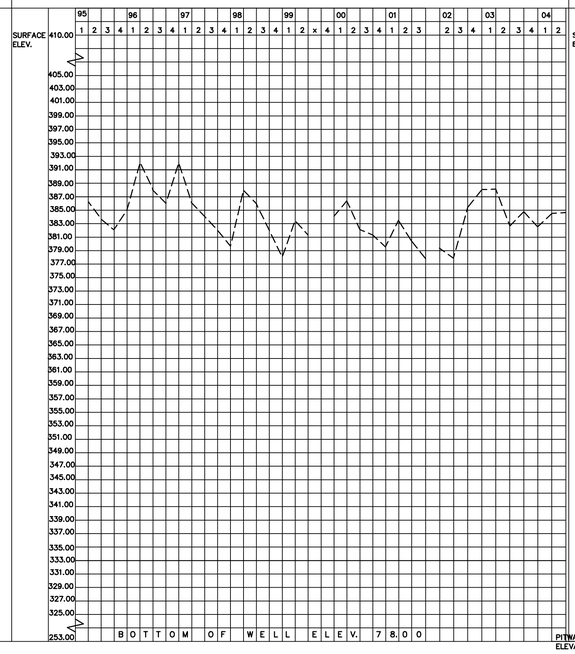
| YRS. | MAIN CASING QUARTERS | | SHALLOW TUBE QUARTERS | | DEEP TUBE QUARTERS | |
|---|---|---|---|---|---|---|
| 95 | 1 | DRY | 1 | 391.33 | 1 | 361.25 |
| | 2 | DRY | 2 | 388.75 | 2 | 350.87 |
| | 3 | DRY | 3 | 388.94 | 3 | 348.00 |
| | 4 | DRY | 4 | 395.11 | 4 | 364.28 |
| 96 | 1 | 404.70 | 1 | 396.17 | 1 | 373.16 |
| | 2 | 404.17 | 2 | 393.28 | 2 | 369.86 |
| | 3 | 403.40 | 3 | 292.47 | 3 | 358.41 |
| | 4 | 404.11 | 4 | 398.02 | 4 | 372.19 |
| 97 | 1 | 404.22 | 1 | 394.41 | 1 | 367.61 |
| | 2 | 404.14 | 2 | 391.36 | 2 | 355.86 |
| | 3 | 404.05 | 3 | 388.78 | 3 | 349.52 |
| | 4 | 404.02 | 4 | 386.89 | 4 | 350.61 |
| 98 | 1 | 404.00 | 1 | 393.22 | 1 | 369.91 |
| | 2 | 403.97 | 2 | 392.52 | 2 | 356.25 |
| | 3 | 403.75 | 3 | 387.63 | 3 | 344.80 |
| | 4 | 403.75 | 4 | 383.41 | 4 | 339.58 |
| 99 | 1 | 404.08 | 1 | 392.11 | 1 | 348.42 |
| | 2 | 404.39 | 2 | 389.88 | 2 | 343.14 |
| | 3 | NO RECORD | 3 | NO RECORD | 3 | NO RECORD |
| | 4 | 404.22 | 4 | 391.80 | 4 | 343.13 |
| 00 | 1 | 404.69 | 1 | 396.39 | 1 | 348.05 |
| | 2 | 403.72 | 2 | 391.19 | 2 | 342.08 |
| | 3 | 404.05 | 3 | 389.27 | 3 | 339.44 |
| | 4 | 404.00 | 4 | 385.89 | 4 | 339.00 |
| 01 | 2 | 403.94 | 2 | 391.75 | 2 | 346.50 |
| | 2 | 403.94 | 2 | 388.97 | 2 | 343.03 |
| | 3 | 403.94 | 3 | 383.33 | 3 | 335.83 |
| 02 | 2 | 404.00 | 2 | 386.26 | 2 | 348.70 |
| | 3 | 404.36 | 3 | 386.23 | 3 | 343.95 |
| | 4 | 404.65 | 4 | 393.67 | 4 | 359.60 |
| 03 | 1 | 404.51 | 1 | 394.77 | 1 | 363.73 |
| 02 | 2 | 403.12 | 2 | 394.85 | 2 | 362.35 |
| 02 | 3 | 404.15 | 3 | 390.13 | 3 | 347.97 |
| 02 | 4 | 403.89 | 4 | 394.00 | 4 | 358.53 |
| 04 | 1 | 403.86 | 1 | 391.47 | 1 | 355.93 |
| 02 | 2 | 404.22 | 2 | 391.80 | 2 | 355.03 |




## GROUNDWATER MONITORING WELL B

SURFACE ELEV.=410.00
BOTTOM WELL = 78.00
WELL DEPTH =332.00

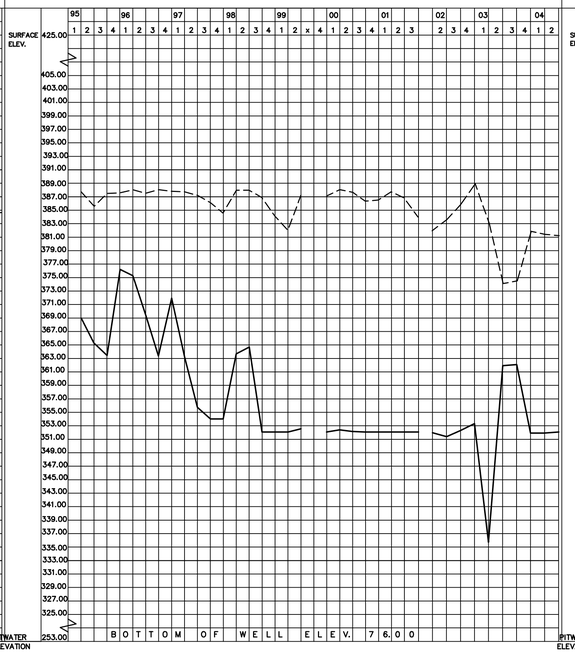
| YRS. | MAIN CASING QUARTERS | | SHALLOW TUBE QUARTERS | | DEEP TUBE QUARTERS | |
|---|---|---|---|---|---|---|
| 95 | 1 | 386.75 | 1 | N/A | 1 | N/A |
| | 2 | 383.5 | 2 | N/A | 2 | N/A |
| | 3 | 382.22 | 3 | N/A | 3 | N/A |
| | 4 | 385.80 | 4 | N/A | 4 | N/A |
| 96 | 1 | 392.19 | 1 | N/A | 1 | N/A |
| | 2 | 388.50 | 2 | N/A | 2 | N/A |
| | 3 | 386.05 | 3 | N/A | 3 | N/A |
| | 4 | 392.16 | 4 | N/A | 4 | N/A |
| 97 | 1 | 386.66 | 1 | N/A | 1 | N/A |
| | 2 | 382.66 | 2 | N/A | 2 | N/A |
| | 3 | 381.53 | 3 | N/A | 3 | N/A |
| | 4 | 379.72 | 4 | N/A | 4 | N/A |
| 98 | 1 | 388.28 | 1 | N/A | 1 | N/A |
| | 2 | 386.08 | 2 | N/A | 2 | N/A |
| | 3 | 380.80 | 3 | N/A | 3 | N/A |
| | 4 | 378.08 | 4 | N/A | 4 | N/A |
| 99 | 1 | 383.47 | 1 | N/A | 1 | N/A |
| | 2 | 381.28 | 2 | N/A | 2 | N/A |
| | 3 | NO RECORD | 3 | NO RECORD | 3 | NO RECORD |
| | 4 | 381.78 | 4 | N/A | 4 | N/A |
| 00 | 1 | 386.78 | 1 | N/A | 1 | N/A |
| | 2 | 382.39 | 2 | N/A | 2 | N/A |
| | 3 | 381.14 | 3 | N/A | 3 | N/A |
| | 4 | 379.64 | 4 | N/A | 4 | N/A |
| 01 | 1 | 383.19 | 1 | N/A | 1 | N/A |
| | 2 | 380.69 | 2 | N/A | 2 | N/A |
| | 3 | 378.25 | 3 | N/A | 3 | N/A |
| 02 | 2 | 379.31 | 2 | N/A | 2 | N/A |
| | 3 | 378.11 | 3 | N/A | 3 | N/A |
| | 4 | 385.50 | 4 | N/A | 4 | N/A |
| 03 | 1 | 388.48 | 1 | N/A | 1 | N/A |
| | 2 | 388.12 | 2 | N/A | 2 | N/A |
| | 3 | 382.50 | 3 | N/A | 3 | N/A |
| | 4 | 384.96 | 4 | N/A | 4 | N/A |
| 04 | 1 | 382.24 | 1 | N/A | 1 | N/A |
| | 2 | 384.32 | 2 | N/A | 2 | N/A |




## GROUNDWATER MONITORING WELL C

SURFACE ELEV.=425.00
BOTTOM WELL = 76.00
WELL DEPTH =349.00

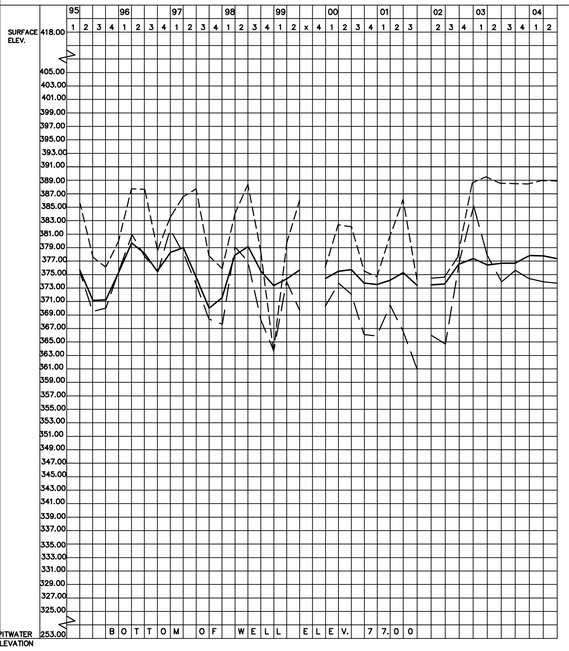
| YRS. | MAIN CASING QUARTERS | | SHALLOW TUBE QUARTERS | | DEEP TUBE QUARTERS | |
|---|---|---|---|---|---|---|
| 95 | 1 | 387.75 | 1 | 369.00 | 1 | N/A |
| | 2 | 385.75 | 2 | 365.13 | 2 | N/A |
| | 3 | 387.50 | 3 | 363.45 | 3 | N/A |
| | 4 | 387.47 | 4 | 376.39 | 4 | N/A |
| 96 | 1 | 388.33 | 1 | 375.38 | 1 | N/A |
| | 2 | 387.69 | 2 | 369.33 | 2 | N/A |
| | 3 | 388.05 | 3 | 363.33 | 3 | N/A |
| | 4 | 387.94 | 4 | 370.06 | 4 | N/A |
| 97 | 1 | 387.75 | 1 | 363.13 | 1 | N/A |
| | 2 | 387.08 | 2 | 355.86 | 2 | N/A |
| | 3 | 386.41 | 3 | 352.02 | 3 | N/A |
| | 4 | 384.83 | 4 | 352.00 | 4 | N/A |
| 98 | 1 | 388.05 | 1 | 363.69 | 1 | N/A |
| | 2 | 388.00 | 2 | 364.80 | 2 | N/A |
| | 3 | 386.97 | 3 | 352.00 | 3 | N/A |
| | 4 | 384.16 | 4 | 352.00 | 4 | N/A |
| 99 | 1 | 381.55 | 1 | 352.00 | 1 | N/A |
| | 2 | 387.08 | 2 | 352.86 | 2 | N/A |
| | 3 | NO RECORD | 3 | NO RECORD | 3 | NO RECORD |
| | 4 | 387.05 | 4 | 352.00 | 4 | N/A |
| 00 | 1 | 388.39 | 1 | 352.83 | 1 | N/A |
| | 2 | 387.80 | 2 | 352.33 | 2 | N/A |
| | 3 | 386.55 | 3 | 352.00 | 3 | N/A |
| | 4 | 386.69 | 4 | 352.00 | 4 | N/A |
| 01 | 1 | 387.72 | 1 | 352.00 | 1 | N/A |
| | 2 | 386.97 | 2 | 352.00 | 2 | N/A |
| | 3 | 384.50 | 3 | 352.00 | 3 | N/A |
| 02 | 2 | 381.32 | 2 | 351.63 | 2 | N/A |
| | 3 | 383.26 | 3 | 351.22 | 3 | N/A |
| | 4 | 385.46 | 4 | 351.63 | 4 | N/A |
| 03 | 1 | 388.90 | 1 | 353.49 | 1 | N/A |
| | 2 | 383.05 | 2 | 335.52 | 2 | N/A |
| | 3 | 374.00 | 3 | 362.39 | 3 | N/A |
| | 4 | 374.15 | 4 | 362.31 | 4 | N/A |
| 04 | 1 | 382.47 | 1 | 352.00 | 1 | N/A |
| | 2 | 381.79 | 2 | 352.01 | 2 | N/A |




## GROUNDWATER MONITORING WELL D

SURFACE ELEV.=418.00
BOTTOM WELL = 77.00
WELL DEPTH =341.00

| YRS. | MAIN CASING QUARTERS | | SHALLOW TUBE QUARTERS | | DEEP TUBE QUARTERS | |
|---|---|---|---|---|---|---|
| 95 | 1 | 385.62 | 1 | 375.79 | 1 | 375.21 |
| | 2 | 377.71 | 2 | 371.08 | 2 | 369.79 |
| | 3 | 376.33 | 3 | 371.14 | 3 | 370.03 |
| | 4 | 380.00 | 4 | 375.47 | 4 | 375.52 |
| 96 | 1 | 387.86 | 1 | 379.69 | 1 | 380.99 |
| | 2 | 387.72 | 2 | 378.31 | 2 | 377.83 |
| | 3 | 378.75 | 3 | 375.53 | 3 | 375.78 |
| | 4 | 383.56 | 4 | 378.67 | 4 | 381.77 |
| 97 | 1 | 386.91 | 1 | 379.00 | 1 | 378.13 |
| | 2 | 387.80 | 2 | 374.83 | 2 | 373.47 |
| | 3 | 377.92 | 3 | 370.05 | 3 | 368.56 |
| | 4 | 376.08 | 4 | 371.52 | 4 | 367.67 |
| 98 | 1 | 384.53 | 1 | 377.94 | 1 | 379.02 |
| | 2 | 388.52 | 2 | 379.08 | 2 | 377.00 |
| | 3 | 378.61 | 3 | 375.80 | 3 | 368.39 |
| | 4 | 363.72 | 4 | 373.66 | 4 | 363.72 |
| 99 | 1 | 379.75 | 1 | 374.33 | 1 | 374.05 |
| | 2 | 385.97 | 2 | 375.50 | 2 | 369.55 |
| | 3 | NO RECORD | 3 | NO RECORD | 3 | NO RECORD |
| | 4 | 376.28 | 4 | 374.72 | 4 | 370.55 |
| 00 | 1 | 382.69 | 1 | 375.36 | 1 | 373.69 |
| | 2 | 386.27 | 2 | 375.94 | 2 | 370.11 |
| | 3 | 375.55 | 3 | 374.11 | 3 | 366.25 |
| | 4 | 374.94 | 4 | 373.69 | 4 | 365.94 |
| 01 | 1 | 380.78 | 1 | 374.39 | 1 | 370.66 |
| | 2 | 386.27 | 2 | 375.11 | 2 | 366.81 |
| | 3 | 374.86 | 3 | 373.16 | 3 | 361.05 |
| 02 | 2 | 374.76 | 2 | 373.86 | 2 | 366.11 |
| | 3 | 374.92 | 3 | 373.91 | 3 | 364.87 |
| | 4 | 378.19 | 4 | 376.60 | 4 | 377.11 |
| 03 | 1 | 388.65 | 1 | 377.74 | 1 | 385.59 |
| | 2 | 389.11 | 2 | 376.22 | 2 | 377.97 |
| | 3 | 388.79 | 3 | 376.78 | 3 | 373.35 |
| | 4 | 388.41 | 4 | 376.92 | 4 | 375.41 |
| 04 | 1 | 388.52 | 1 | 377.74 | 1 | 374.52 |
| | 2 | 388.96 | 2 | 377.72 | 2 | 374.29 |




MAIN CASING ----------
SHALLOW TUBE ——————
DEEP TUBE — — — — — —

240-1-4.DWG,GRAPH

# RHEEMS QUARRY

GROUNDWATER MONITORING WELLS GRAPH

WEST DONEGAL TOWNSHIP LANCASTER COUNTY

SCALE: N/A
CONTOURS: N/A
DATE: 2/22/02


AKENS ENGINEERING ASSOCIATES, INC.
219 EAST MAIN ST.
SHIREMANSTOWN, PENNSYLVANIA 17011
(717) 975-9933


SHEET NO. 1 of 1

# Published Water Well Information in the Area of Donegal Rock Quarry

Data Source: Pennsylvania Geologic Survey, Harrisburg, PA

Well Number 897 is owned by Masonic Homes and was drilled in 1970. The well is for household use and is located in West Donegal Township. The well is drilled into diabase and is 70 feet deep with 20 feet of casing. The well had a static water level of 15 feet in 1970. The well yields 15 gpm and the water bearing zones are located at 36 feet and 54 feet.

Well Number 1301 is owned by Amos Landis and was drilled in 1972. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 116 feet deep with 38 feet of casing. The well yields 30 gpm and the water bearing zones are located at 52 feet, 64 feet, 74 feet and 92 feet.

Well Number 1304 is owned by Charles Goodling and was drilled in 1973. The well is for household use and is located in West Donegal Township. The well is drilled into the Beekmantown Group and is 400 feet deep with 63 feet of casing. The well's yield is unknown and the water bearing zones are also unknown.

Well Number 1306 is owned by Keith Allen and was drilled in 1973. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 140 feet deep with 40 feet of casing. The well had a static water level of 30 feet in 1973. The well yields 30 gpm and the water bearing zones are located at 60 feet and 130 feet.

Well Number 1309 is owned by David G. Heisey and was drilled in 1972. The well is for household use and is located in West Donegal Township. The well is drilled into diabase and is 170 feet deep with 100 feet of casing. The well yields 10 gpm and the water bearing zones are located at 127 feet and 166 feet.

Well Number 1327 is owned by Herbert Hoover and was drilled in 1974. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 210 feet deep with 61 feet of casing. The well's yield is unknown and the water bearing zones are located at 125 feet and 205 feet.

Well Number 1328 is owned by Herbert Hoover and was drilled in 1974. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 150 feet deep with 95 feet of casing. The well yields 10 gpm and the water bearing zones are located at 120 feet and 146 feet.

Well Number 1329 is owned by Marlin R. Longen and was drilled in 1974. The well is for public use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 75 feet deep with 65 feet of casing. The well yields 30 gpm and the water bearing zone is located at 70 feet.

Well Number 1332 is owned by Vern Zimmerman and was drilled in 1972. The well is for household use and is located in Mount Joy Township. The well is drilled into diabase and is 199 feet deep with 90 feet of casing. The well

yields 2 gpm and the water bearing zones are located at 95 feet and 180 feet.

Well Number 1336 is owned by Rich C. Shenk and was drilled in 1975. The well is for household use and is located in Mount Joy Township. The well is drilled into diabase and is 125 feet deep with 61 feet of casing. The well yields 5 gpm and the water bearing zones are located at 90 feet and 114 feet.

Well Number 2515 is owned by A & A Auto. The well is for commercial use and is located in Mount Joy Township. The well is drilled into the Beekmantown Group and is 300 feet deep with 41 feet of casing. The well yields 4 gpm and the water bearing zone is located at 50 feet.

Well Number 2518 is owned by Reist Mummau. The well is for household use and is located in Mount Joy Township. The well is drilled into the Beekmantown Group and is 125 feet deep with 81 feet of casing. The well yields 25 gpm and the water bearing zones are located at 93 feet and 119 feet.

Well Number 2519 is owned by Carter Lumber. The well is for household use and is located in Mount Joy Township. The well is drilled into the Beekmantown Group and is 275 feet deep with 41 feet of casing. The well's yield is unknown and the water bearing zone is located at 260 feet.

Well Number 2542 is owned by Herbert Hoover. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 250 feet deep with 102 feet of casing. The well yields 3 gpm and the water bearing zones are located at 214 feet and 240 feet.

Well Number 2543 is owned by Herbert Hoover. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 150 feet deep with 82 feet of casing. The well yields 30 gpm and the water bearing zone is located at 140 feet.

Well Number 2544 is owned by Joe Nolt. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 82 feet of casing. The well yields 30 gpm and the water bearing zones are located at 110 feet and 118 feet.

Well Number 2545 is owned by Catherine Brown. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 170 feet deep with 42 feet of casing. The well yields 15 gpm and the water bearing zones are located at 70 feet and 150 feet.

Well Number 2546 is owned by Herbert Hoover. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 82 feet of casing. The well yields 15 gpm and the water bearing zones are located at 97 feet and 114 feet.

Well Number 2547 is owned by Herbert Hoover. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 82 feet of casing. The well

yields 20 gpm and the water bearing zones are located at 93 feet and 115 feet.

Well Number 2549 is owned by Rheems Mennonite Church. The well is for household use and is located in Mount Joy Township. The well is drilled into the Cocalico Formation and is 300 feet deep with 35 feet of casing. The well yields 1 gpm and the water bearing zone is located at 93 feet.

Well Number 2550 is owned by Richard C. Shenk. The well is for household use and is located in Mount Joy Township. The well is drilled into the Cocalico Formation and is 400 feet deep with 65 feet of casing. The well yields .5 gpm and the water bearing zone is located at 350 feet.

Well Number 2551 is owned by Herbert Hoover. The well is for household use and is located in Mount Joy Township. The well is drilled into the Cocalico Formation and is 200 feet deep with 20 feet of casing. The well yields .5 gpm and the water bearing zone is located at 155 feet.

Well Number 2556 is owned by Blaine Miller. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 100 feet deep with 57 feet of casing. The well yields 20 gpm and the water bearing zones are located at 83 feet and 95 feet.

Well Number 2557 is owned by Hess Home Builders. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 81 feet of casing. The well yields 100 gpm and the water bearing zones are located at 91 feet, 112 feet and 122 feet.

Well Number 2559 is owned by Richard Grubb. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 175 feet deep with 49 feet of casing. The well yields 45 gpm and the water bearing zones are located at 95 feet and 160 feet.

Well Number 2560 is owned by George Day. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 70 feet of casing. The well yields 10 gpm and the water bearing zones are located at 74 feet and 117 feet.

Well Number 2561 is owned by Harold Reed. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 180 feet deep with 61 feet of casing. The well yields 50 gpm and the water bearing zones are located at 135 feet and 174 feet.

Well Number 2580 is owned by Karl Gelb. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 160 feet deep with 61 feet of casing. The well yields 25 gpm and the water bearing zones are located at 97 feet and 152 feet.

Well Number 2581 is owned by Statewide Construction. The well use is unknown and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 140 feet deep with 41 feet of casing. The well yields 25 gpm and the water bearing zone is located at 125 feet.

Well Number 2583 is owned by Donald Keener. The well is for household use and is located in West Donegal Township. The well is drilled into the Beekmantown Group and is 115 feet deep with 45 feet of casing. The well yields 45 gpm and the water bearing zone is located at 103 feet.

Well Number 2584 is owned by Steigel Builders. The well is for household use and is located in West Donegal Township. The well is drilled into the Beekmantown Group and is 100 feet deep with 40 feet of casing. The well yields 12 gpm.

Well Number 2590 is owned by W.D. Smolinski. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 150 feet deep with 61 feet of casing. The well yields 10 gpm and the water bearing zones are located at 97 feet and 133 feet.

Well Number 2591 is owned by Woodcrest. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 285 feet deep with 71 feet of casing. The well yields 4 gpm and the water bearing zones are located at 98 feet and 278 feet.

Well Number 2596 is owned by Hillcrest. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 149 feet deep with 75 feet of casing. The well yields 15 gpm and the water bearing zones are located at 117 feet and 143 feet.

Well Number 4796 is owned by Blain Miller and was drilled in 1986. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 325 feet deep with 82 feet of casing. The well yields 2.5 gpm and the water bearing zone is located at 122 feet.

Well Number 4808 is owned by B. Johnson and was drilled in 1979. The well is for industrial use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 262 feet deep with 35 feet of casing. The well had a static water level of 50 feet. The well yields 40 gpm and the water bearing zone is located at 250 feet.

Well Number 4809 is owned by G. Miller and was drilled in 1980. The well is for household use and is located in Mount Joy Township. The well is drilled into the New Oxford Formation and is 425 feet deep with 71 feet of casing. The well yield is unknown and the water bearing zones are also unknown.

Well Number 5000 is owned by B. Miller. The well is for household use and is located in West Donegal Township. The well is 150 feet deep with 55 feet of casing. The well yields 20 gpm and the water bearing zones are located at 20 feet and 140 feet.

Well Number 5001 is owned by National Utilities/Rheems Water Company. The well is for public use and is located in West Donegal Township. The well is 150 feet deep. The well yields 300 gpm and the water bearing zone is located at 100 feet. This is one of two wells which supply water to the town of Rheems.

Well Number 5002 is owned by National Utilities/Rheems Water Company. The well is for public use and is located in West Donegal Township. The well is 110 feet deep. The well yields 60 gpm and the water bearing zone is located at 84 feet. This is one of two wells which supply water to the town of Rheems.

Well Number 5003 is owned by John Cope's Food Products, Inc. The well is located in West Donegal Township and is used for monitoring purposes. The well is 300 feet deep with a 6 inch diameter and produces .37 gpm. The well has a static water level of 28 feet. The well was pumped for 1 hour at 150 gpm. At the end of the test the static water level in the well was 225 feet.

Well Number 5004 is owned by John Cope's Food Products, Inc. The well is used for monitoring purposes and is located in West Donegal Township. The well is 77.5 feet deep and has an 8 inch diameter and produces 150 gpm. The well has a normal static water level of 28 feet. After pumping the well for 1 hour at 150 gpm the static water level dropped to 29 feet.

Well Number 5005 is owned by John Cope's Food Products, Inc. The well is used for monitoring purposes and is located in West Donegal Township. The well is 75 feet deep and has a 6 inch diameter and produces 15 gpm. The well has a normal static water level of 27 feet. After pumping the well for 1 hour at 150 gpm, the static water level drops to 29 feet.

Well Number 5006 is owned by John Cope's Food Products, Inc. The well is located in West Donegal Township and is used for monitoring purposes. The well is 75 feet deep and has a 6 inch diameter and produces 60 gpm. The well has a normal static water level of 22 feet. After pumping the well for 1 hour at 150 gpm, the static water level dropped to 24 feet.

Well Number 5007 is owned by John Cope's Food Products, Inc. and is located in West Donegal Township. The well is 120 feet deep with a 6 inch diameter. The normal static water level was 12 feet. The well was pumped for 1 hour, which dropped the static water level to 94 feet. The well was used for monitoring purposes at one time but is now no longer used.

Well Number 5140 is owned by R. Farrey and was drilled in 1985. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 102 feet deep with 40 feet of casing. The well had a static water level of 45 feet. The well yields 25 gpm and the water bearing zones are unknown.

Well Number 5143 is owned by J. Moyer. The well is for household use and is located in West Donegal Township. The well is drilled into diabase and is 125 feet deep with 97 feet of casing. The well yields 5 gpm and the water bearing zones are located at 109 feet and 115 feet.

Well Number 5144 is owned by J. Farmer and was drilled in 1981. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 300 feet deep with 82 feet of casing. The well yields 3 gpm and the water bearing zones are located at 115 feet and 275 feet.

Well Number 5145 is owned by S. Snyder and was drilled in 1981. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 142 feet deep with 40 feet of

casing. The well had a static water level of 35 feet. The well yields 10 gpm and the water bearing zones are located at 70 feet and 125 feet.

Well Number 5152 is owned by R.E. Wright Associates and was drilled in 1980. The well is for industrial use and is located in Mount Joy Township. The well is drilled into the Epler Formation and is 325 feet deep with 40 feet of casing. The well had a static water level of 116 feet. The well yields 25 gpm and the water bearing zone is located at 217 feet.

Well Number 5153 is owned by R.E. Wright Associates and was drilled in 1980. The well is for industrial use and is located in Mount Joy Township. The well is drilled into the Epler Formation and is 550 feet deep with 40 feet of casing. The well had a static water level of 35 feet. The well yields 75 gpm and the water bearing zone is located at 68 feet.

Well Number 5155 is owned by Wengers Feed Mill and was drilled in 1981. The well is for industrial use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 225 feet deep with 144 feet of casing. The well had a static water level of 67 feet. The well yields 60 gpm and the water bearing zones are located at 190 feet, 206 feet and 214 feet.

Well Number 5156 is owned by Wenger's Feed Mill and was drilled in 1981. The well is for industrial use and is located in West Donegal Township. The well is drilled into the Epler Formation and is 550 feet deep with 81 feet of casing. The well yields 1.5 gpm and the water bearing zones are located at 33 feet, 59 feet and 130 feet.

Well Number 5157 is owned by J. Martin and was drilled in 1983. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 200 feet deep with 82 feet of casing. The well yields 25 gpm and the water bearing zones are located at 130 feet and 185 feet.

Well Number 5169 is owned by D. Heisey, Inc. and was drilled in 1985. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 250 feet deep with 71 feet of casing. The well yields 4 gpm and the water bearing zones are located at 147 feet and 238 feet.

Well Number 5172 is owned by W. Good and was drilled in 1983. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 227 feet deep with 73 feet of casing. The well had a static water level of 40 feet. The well yields 4 gpm and the water bearing zone is located at 218 feet.

Well Number 5230 is owned by R. Barth and was drilled in 1985. The well is for household use and is located in West Donegal Township. The well is drilled into diabase and is 200 feet deep with 41 feet of casing. The well had a static water level of 125 feet. The well yields 7 gpm and the water bearing zones are located at 125 feet and 190 feet.

Well Number 5231 is owned by D. Heisey and was drilled in 1978. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 200 feet deep with 61 feet of casing. The well yields 12 gpm and the water bearing zones are located at 93 feet, 127 feet and 183 feet.

Well Number 5233 is owned by D. Helsey and was drilled in 1979. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 125 feet deep with 61 feet of casing. The well yields 20 gpm and the water bearing zones are located at 98 feet and 111 feet.

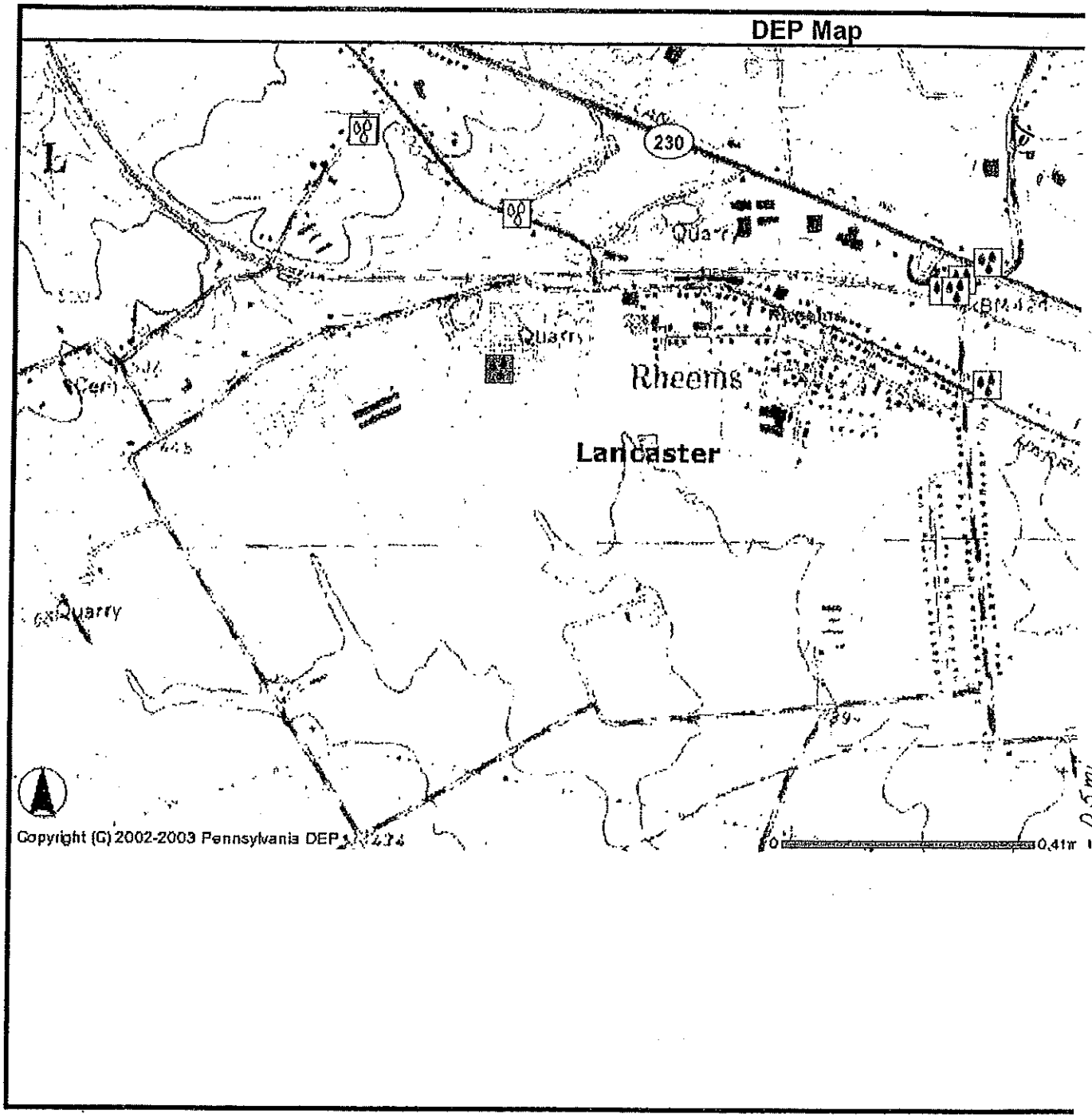
Well Number 5244 is owned by C. Zeiset and was drilled in 1979. The well is for household use and is located in West Donegal Township. The well is drilled into the Millbach Formation and is 200 feet deep with 41 feet of casing. The well yields 3.5 gpm and the water bearing zones are located at 74 feet, 86 feet and 163 feet.

Well Number 5246 is owned by K. Murphy and was drilled in 1986. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 225 feet deep with 76 feet of casing. The well yields 30 gpm and the water bearing zones are located at 160 feet and 182 feet.

Well Number 5248 is owned by M. Boyer and was drilled in 1980. The well is for household use and is located in West Donegal Township. The well is drilled into the New Oxford Formation and is 200 feet deep with 102 feet of casing. The well yields 8 gpm and the water bearing zones are located at 160 feet and 182 feet.

Well Number 5843 is owned by F. Hoover and was drilled in 1986. The well is for household use and is located in Mount Joy Township. The well is drilled into the Epler Formation and is 500 feet deep with 61 feet of casing. The well yields 30 gpm and the water bearing zones are located at 195 feet, 490 feet and 493 feet.

Well Number 5889 is owned by Joseph Groff and was drilled in 1977. The well is for household use and is located in Mount Joy Township. The well is drilled into the Stonehenge Formation and is 160 feet deep with 61 feet of casing. The well yields 12 gpm and the water bearing zones are located at 130 feet and 147 feet.




# PUBLIC WATER SUPPLY INFORMATION



8.5 Attachment

| NAME | FACILITY TYPE | DESIGNATION | RIVER MILE | LAT | LAT | LAT | LONG | LONG | LONG | FACILITY ID |
|---|---|---|---|---|---|---|---|---|---|---|
| WEST DONEGAL TWP AUTH | Water Purveyor | Authority | 7.65 | 40 | 7 | 46.1261 | 76 | 34 | 13.3665 | 19281 |
| WELL 2 (ABANDONED) | Ground Water Withdrawal | Well | 7.72 | 40 | 7 | 58 | 76 | 34 | 52 | 8747 |
| UNION QUARRIES INC - RHEEMS PLANT | Mineral Use | Quarry | 7.7 | 40 | 7 | 50.9001 | 76 | 34 | 43.8974 | 20596 |
| QUARRY WITHDRAWAL | Ground Water Withdrawal | Quarry | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 12174 |
| WELL | Ground Water Withdrawal | Well | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 12175 |
| CONCRETE PLANT QUARRY | Ground Water Withdrawal | Quarry | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 12176 |
| NEW STR POND | Storage | Pond | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 17511 |
| NEW STR TANK | Storage | Tank | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 17512 |
| POND | Surface Water Withdrawal | Pond | 7.7 | 40 | 7 | 51 | 76 | 34 | 44 | 48596 |
| JOHN F COPE CO INC | Industrial Use | Manufacture Facility | 7.68 | 40 | 7 | 50.978 | 76 | 34 | 14.3232 | 23920 |
| UNION QUARRY | Ground Water Withdrawal | Quarry | 7.68 | 40 | 7 | 51 | 76 | 34 | 14 | 4464 |

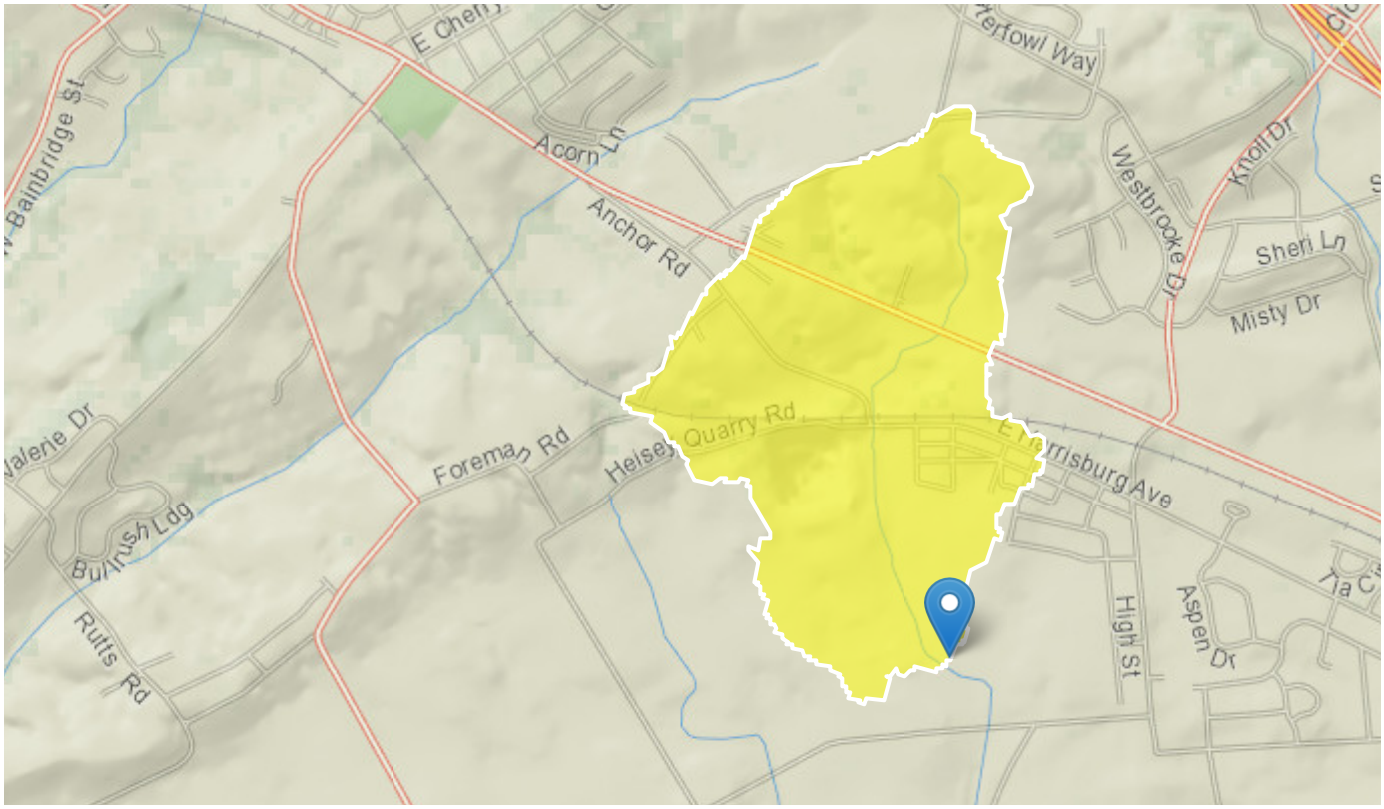
8-25



8.5 attachment

# StreamStats Report Rheems UNT East

**Region ID:** PA
**Workspace ID:** PA20220204130310117000
**Clicked Point (Latitude, Longitude):** 40.12344, -76.57273
**Time:** 2022-02-04 08:03:31 -0500




Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.73 | square miles |
| CARBON | Percentage of area of carbonate rock | 50.88 | percent |
| BSLOPD | Mean basin slope measured in degrees | 3.1833 | degrees |
| ROCKDEP | Depth to rock | 5.4 | feet |
| URBAN | Percentage of basin with urban development | 12.5211 | percent |
| ELEV | Mean Basin Elevation | 453 | feet |
| PRECIP | Mean Annual Precipitation | 41 | inches |
| FOREST | Percentage of area covered by forest | 5.5509 | percent |

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 1.2 | 512 |
| CARBON | Percent Carbonate | 50.88 | percent | 0 | 68.5 |

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

| Statistic | Value | Unit |
|---|---|---|
| 50-percent AEP flood | 129 | ft^3/s |
| 20-percent AEP flood | 233 | ft^3/s |
| 10-percent AEP flood | 322 | ft^3/s |
| 4-percent AEP flood | 455 | ft^3/s |
| 2-percent AEP flood | 568 | ft^3/s |
| 1-percent AEP flood | 694 | ft^3/s |
| 0.5-percent AEP flood | 832 | ft^3/s |
| 0.2-percent AEP flood | 1040 | ft^3/s |

*Peak-Flow Statistics Citations*

**Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133/sir20195094)**

Low-Flow Statistics Parameters [Low Flow Region 1]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 4.78 | 1150 |
| BSLOPD | Mean Basin Slope degrees | 3.1833 | degrees | 1.7 | 6.4 |
| ROCKDEP | Depth to Rock | 5.4 | feet | 4.13 | 5.21 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| URBAN | Percent Urban | 12.5211 | percent | 0 | 89 |

Low-Flow Statistics Disclaimers [Low Flow Region 1]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report [Low Flow Region 1]

| Statistic | Value | Unit |
|---|---|---|
| 7 Day 2 Year Low Flow | 0.192 | ft^3/s |
| 30 Day 2 Year Low Flow | 0.256 | ft^3/s |
| 7 Day 10 Year Low Flow | 0.0828 | ft^3/s |
| 30 Day 10 Year Low Flow | 0.114 | ft^3/s |
| 90 Day 10 Year Low Flow | 0.201 | ft^3/s |

*Low-Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Annual Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 2.26 | 1720 |
| ELEV | Mean Basin Elevation | 453 | feet | 130 | 2700 |
| PRECIP | Mean Annual Precipitation | 41 | inches | 33.1 | 50.4 |
| FOREST | Percent Forest | 5.5509 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 12.5211 | percent | 0 | 89 |

Annual Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Mean Annual Flow | 0.78 | ft^3/s |

*Annual Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

General Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 2.26 | 1720 |
| PRECIP | Mean Annual Precipitation | 41 | inches | 33.1 | 50.4 |
| CARBON | Percent Carbonate | 50.88 | percent | 0 | 99 |
| FOREST | Percent Forest | 5.5509 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 12.5211 | percent | 0 | 89 |

General Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Harmonic Mean Streamflow | 0.318 | ft^3/s |

*General Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 2.26 | 1720 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| PRECIP | Mean Annual Precipitation | 41 | inches | 33.1 | 50.4 |
| CARBON | Percent Carbonate | 50.88 | percent | 0 | 99 |
| FOREST | Percent Forest | 5.5509 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 12.5211 | percent | 0 | 89 |

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Base Flow 10 Year Recurrence Interval | 0.313 | ft^3/s |
| Base Flow 25 Year Recurrence Interval | 0.267 | ft^3/s |
| Base Flow 50 Year Recurrence Interval | 0.242 | ft^3/s |

*Base Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Bankfull Statistics Parameters [Statewide Bankfull Carbonate 2018 5066]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 18.9 | 213 |
| CARBON | Percent Carbonate | 50.88 | percent | | |

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 0.07722 | 940.1535 |

Bankfull Statistics Parameters [Piedmont P Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 0.289575 | 939.99906 |

Bankfull Statistics Parameters [USA Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.73 | square miles | 0.07722 | 59927.7393 |

Bankfull Statistics Disclaimers [Statewide Bankfull Carbonate 2018 5066]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [Statewide Bankfull Carbonate 2018 5066]

| Statistic | Value | Unit |
|---|---|---|
| Bankfull Area | 1.7 | ft^2 |
| Bankfull Streamflow | 3.37 | ft^3/s |
| Bankfull Width | 4.16 | ft |
| Bankfull Depth | 0.43 | ft |

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_D_channel_width | 13.3 | ft |
| Bieger_D_channel_depth | 1.02 | ft |
| Bieger_D_channel_cross_sectional_area | 13.8 | ft^2 |

Bankfull Statistics Flow Report [Piedmont P Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_P_channel_width | 12.1 | ft |
| Bieger_P_channel_depth | 1.04 | ft |
| Bieger_P_channel_cross_sectional_area | 12.3 | ft^2 |

Bankfull Statistics Flow Report [USA Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_USA_channel_width | 11.1 | ft |

| Statistic | Value | Unit |
|---|---|---|
| Bieger_USA_channel_depth | 1.13 | ft |
| Bieger_USA_channel_cross_sectional_area | 14.4 | ft^2 |

Bankfull Statistics Flow Report [Area-Averaged]

| Statistic | Value | Unit |
|---|---|---|
| Bankfull Area | 1.7 | ft^2 |
| Bankfull Streamflow | 3.37 | ft^3/s |
| Bankfull Width | 4.16 | ft |
| Bankfull Depth | 0.43 | ft |
| Bieger_D_channel_width | 13.3 | ft |
| Bieger_D_channel_depth | 1.02 | ft |
| Bieger_D_channel_cross_sectional_area | 13.8 | ft^2 |
| Bieger_P_channel_width | 12.1 | ft |
| Bieger_P_channel_depth | 1.04 | ft |
| Bieger_P_channel_cross_sectional_area | 12.3 | ft^2 |
| Bieger_USA_channel_width | 11.1 | ft |
| Bieger_USA_channel_depth | 1.13 | ft |
| Bieger_USA_channel_cross_sectional_area | 14.4 | ft^2 |

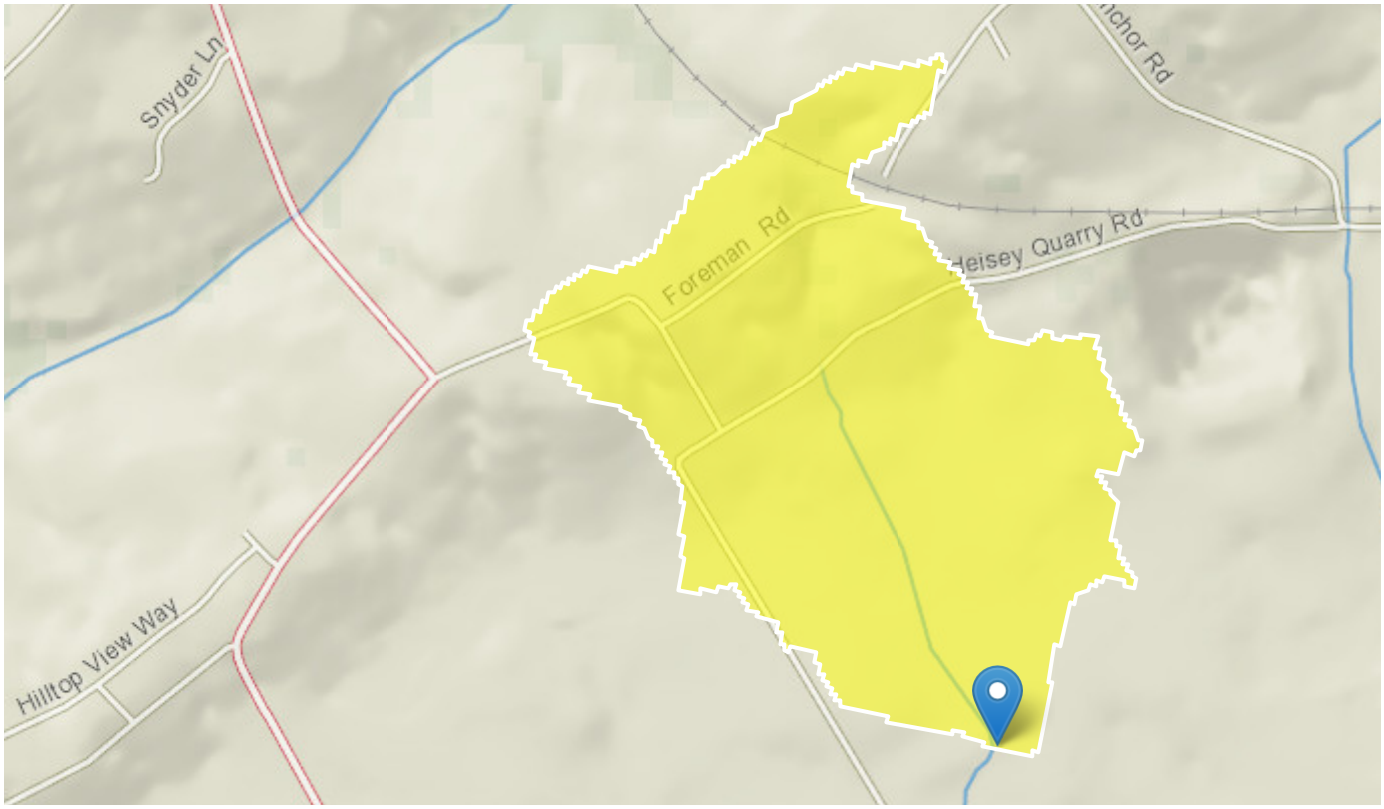
*Bankfull Statistics Citations*

**Clune, J.W., Chaplin, J.J., and White, K.E.,2018, Comparison of regression relations of bankfull discharge and channel geometry for the glaciated and nonglaciated settings of Pennsylvania and southern New York: U.S. Geological Survey Scientific Investigations Report 2018–5066, 20 p. (https://doi.org/10.3133/sir20185066)**
**Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can**

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

# StreamStats Report Rheems UNT West

**Region ID:** PA
**Workspace ID:** PA20220204125731315000
**Clicked Point (Latitude, Longitude):** 40.12265, -76.58368
**Time:** 2022-02-04 07:57:54 -0500




Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.29 | square miles |
| CARBON | Percentage of area of carbonate rock | 52.52 | percent |
| BSLOPD | Mean basin slope measured in degrees | 2.7075 | degrees |
| ROCKDEP | Depth to rock | 5 | feet |
| URBAN | Percentage of basin with urban development | 0.1218 | percent |
| ELEV | Mean Basin Elevation | 446 | feet |
| PRECIP | Mean Annual Precipitation | 39 | inches |
| FOREST | Percentage of area covered by forest | 4.6414 | percent |

Peak-Flow Statistics Parameters [Peak Flow Region 4 SIR 2019 5094]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 1.2 | 512 |
| CARBON | Percent Carbonate | 52.52 | percent | 0 | 68.5 |

Peak-Flow Statistics Disclaimers [Peak Flow Region 4 SIR 2019 5094]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Peak Flow Region 4 SIR 2019 5094]

| Statistic | Value | Unit |
|---|---|---|
| 50-percent AEP flood | 67.4 | ft^3/s |
| 20-percent AEP flood | 125 | ft^3/s |
| 10-percent AEP flood | 175 | ft^3/s |
| 4-percent AEP flood | 250 | ft^3/s |
| 2-percent AEP flood | 315 | ft^3/s |
| 1-percent AEP flood | 387 | ft^3/s |
| 0.5-percent AEP flood | 466 | ft^3/s |
| 0.2-percent AEP flood | 586 | ft^3/s |

*Peak-Flow Statistics Citations*

**Roland, M.A., and Stuckey, M.H.,2019, Development of regression equations for the estimation of flood flows at ungaged streams in Pennsylvania: U.S. Geological Survey Scientific Investigations Report 2019–5094, 36 p. (https:// doi.org/10.3133/sir20195094)**

Low-Flow Statistics Parameters [Low Flow Region 1]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 4.78 | 1150 |
| BSLOPD | Mean Basin Slope degrees | 2.7075 | degrees | 1.7 | 6.4 |
| ROCKDEP | Depth to Rock | 5 | feet | 4.13 | 5.21 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| URBAN | Percent Urban | 0.1218 | percent | 0 | 89 |

Low-Flow Statistics Disclaimers [Low Flow Region 1]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report [Low Flow Region 1]

| Statistic | Value | Unit |
|---|---|---|
| 7 Day 2 Year Low Flow | 0.0353 | ft^3/s |
| 30 Day 2 Year Low Flow | 0.0513 | ft^3/s |
| 7 Day 10 Year Low Flow | 0.012 | ft^3/s |
| 30 Day 10 Year Low Flow | 0.0187 | ft^3/s |
| 90 Day 10 Year Low Flow | 0.0386 | ft^3/s |

*Low-Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Annual Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 2.26 | 1720 |
| ELEV | Mean Basin Elevation | 446 | feet | 130 | 2700 |
| PRECIP | Mean Annual Precipitation | 39 | inches | 33.1 | 50.4 |
| FOREST | Percent Forest | 4.6414 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 0.1218 | percent | 0 | 89 |

Annual Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Mean Annual Flow | 0.266 | ft^3/s |

*Annual Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

General Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 2.26 | 1720 |
| PRECIP | Mean Annual Precipitation | 39 | inches | 33.1 | 50.4 |
| CARBON | Percent Carbonate | 52.52 | percent | 0 | 99 |
| FOREST | Percent Forest | 4.6414 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 0.1218 | percent | 0 | 89 |

General Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Harmonic Mean Streamflow | 0.0859 | ft^3/s |

*General Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Base Flow Statistics Parameters [Statewide Mean and Base Flow]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 2.26 | 1720 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| PRECIP | Mean Annual Precipitation | 39 | inches | 33.1 | 50.4 |
| CARBON | Percent Carbonate | 52.52 | percent | 0 | 99 |
| FOREST | Percent Forest | 4.6414 | percent | 5.1 | 100 |
| URBAN | Percent Urban | 0.1218 | percent | 0 | 89 |

Base Flow Statistics Disclaimers [Statewide Mean and Base Flow]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Base Flow Statistics Flow Report [Statewide Mean and Base Flow]

| Statistic | Value | Unit |
|---|---|---|
| Base Flow 10 Year Recurrence Interval | 0.104 | ft^3/s |
| Base Flow 25 Year Recurrence Interval | 0.0872 | ft^3/s |
| Base Flow 50 Year Recurrence Interval | 0.0782 | ft^3/s |

*Base Flow Statistics Citations*

**Stuckey, M.H.,2006, Low-flow, base-flow, and mean-flow regression equations for Pennsylvania streams: U.S. Geological Survey Scientific Investigations Report 2006-5130, 84 p. (http://pubs.usgs.gov/sir/2006/5130/)**

Bankfull Statistics Parameters [Statewide Bankfull Carbonate 2018 5066]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 18.9 | 213 |
| CARBON | Percent Carbonate | 52.52 | percent | | |

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 0.07722 | 940.1535 |

Bankfull Statistics Parameters [Piedmont P Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 0.289575 | 939.99906 |

Bankfull Statistics Parameters [USA Bieger 2015]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.29 | square miles | 0.07722 | 59927.7393 |

Bankfull Statistics Disclaimers [Statewide Bankfull Carbonate 2018 5066]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Bankfull Statistics Flow Report [Statewide Bankfull Carbonate 2018 5066]

| Statistic | Value | Unit |
|---|---|---|
| Bankfull Area | 0.659 | ft^2 |
| Bankfull Streamflow | 1.18 | ft^3/s |
| Bankfull Width | 2.39 | ft |
| Bankfull Depth | 0.292 | ft |

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_D_channel_width | 9.09 | ft |
| Bieger_D_channel_depth | 0.786 | ft |
| Bieger_D_channel_cross_sectional_area | 7.21 | ft^2 |

Bankfull Statistics Flow Report [Piedmont P Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_P_channel_width | 8.29 | ft |
| Bieger_P_channel_depth | 0.781 | ft |
| Bieger_P_channel_cross_sectional_area | 6.16 | ft^2 |

Bankfull Statistics Flow Report [USA Bieger 2015]

| Statistic | Value | Unit |
|---|---|---|
| Bieger_USA_channel_width | 8.01 | ft |

| Statistic | Value | Unit |
|---|---|---|
| Bieger_USA_channel_depth | 0.926 | ft |
| Bieger_USA_channel_cross_sectional_area | 8.76 | ft^2 |

Bankfull Statistics Flow Report [Area-Averaged]

| Statistic | Value | Unit |
|---|---|---|
| Bankfull Area | 0.659 | ft^2 |
| Bankfull Streamflow | 1.18 | ft^3/s |
| Bankfull Width | 2.39 | ft |
| Bankfull Depth | 0.292 | ft |
| Bieger_D_channel_width | 9.09 | ft |
| Bieger_D_channel_depth | 0.786 | ft |
| Bieger_D_channel_cross_sectional_area | 7.21 | ft^2 |
| Bieger_P_channel_width | 8.29 | ft |
| Bieger_P_channel_depth | 0.781 | ft |
| Bieger_P_channel_cross_sectional_area | 6.16 | ft^2 |
| Bieger_USA_channel_width | 8.01 | ft |
| Bieger_USA_channel_depth | 0.926 | ft |
| Bieger_USA_channel_cross_sectional_area | 8.76 | ft^2 |

*Bankfull Statistics Citations*

**Clune, J.W., Chaplin, J.J., and White, K.E.,2018, Comparison of regression relations of bankfull discharge and channel geometry for the glaciated and nonglaciated settings of Pennsylvania and southern New York: U.S. Geological Survey Scientific Investigations Report 2018–5066, 20 p. (https://doi.org/10.3133/sir20185066)**
**Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_can**

Application Version: 4.6.2
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

N

MOUNT JOY TOWNSHIP
WEST DONEGAL TOWNSHIP

TRACT #2
13.09 AC.

DELAWARE VALLEY CONCRETE

1990 PIT EXTENTS

19.7 ACRES
PIT FLOOR 233 MSL

RECLAMATION
WATER ELEV = 389.0

EXISTING
PIT FLOOR
ELEV.=200.00

PROPOSED
30-ACRE QUARRY
EXPANSION AREA

PROPOSED
PIT FLOOR
ELEV.=126.00

PARCEL A
1,306,800 S.F.
30.0 Acres

AREA AFFECTED PRIOR TO & NOT REAFFECTED SINCE 1-1-72

PENN CENTRAL RAILROAD

TO ELIZABETHTOWN

TO RHEEMS

QUARRY ROAD

TTA-4

TTA-3
444.95

PA POWER & LIGHT CO
UNITED TEL. CO

B.M. #1

1000 PIT SUMP

EXISTING QUARRY FLOOR ELEV. 233

PRIMARY CRUSHER

PROPOSED EXISTING PERMITTED

DISCHARGE POINT

UNDERGROUND PIPE

TOPSOIL STORAGE AREA

EXISTING STOCKPILE AREA

VARIANCE FOR PERMIT

DRAINAGE AREA TO POND 1

MINING BLOCK 1

MINING BLOCK 2

MINING BLOCK 3

POND 1

POND 2

POND 3

DRAINAGE AREA TO POND 3

PIT SUMP 100' x 100' x 10.6' deep

BENCH

18"Ø CMP

DISCHARGE POINT 003

DWELLING SETBACK

EXISTING BARN

UNDER BERM EVERY 40' VERTICAL

BERM (SEE DETAIL THIS SHEET)

DEP AND WEST DONEGAL TWP. SETBACK

OVERBURDEN STORAGE PILE

LIMIT OF HIGHWALL

0 300' 600'

# HISTORIC OPERATIONS EXHIBIT - 1990


Akens Engineering Associates, Inc.
219 EAST MAIN STREET
SHIREMANSTOWN, PA 17011


PIERSON RHEEMS LLC
QUARRY OPERATION
LANCASTER COUNTY, WEST DONEGAL & MT JOY TOWNSHIPS

| | |
|---|---|
| DATE: | MAY 10, 2022 |
| DRAWN BY: | MSI |
| SCALE: | 1" = 300' |
| SHEET: | 1 OF 1 |

X:\240-1-51 Expansion\Drawing\240-1-51 Base.dwg

# PIERSON RHEEMS LLC

# RHEEMS QUARRY

# 30 ACRE EXPANSION HYDROGEOLOGIC STUDY

West Donegal & Mt. Joy Township
Lancaster County, PA

April 26, 2023

*Prepared By:*
*Akens Engineering Associates, Inc.*
*219 East Main Street*
*Shiremanstown, PA 17011*

Mark Foerster., P.G.
P.G. #PG003946


*SEAL*

## TABLE OF CONTENTS



## LIST OF APPENDICES

## EXECUTIVE SUMMARY

Akens Engineering Associates, Inc. (AKENS) has prepared the following document for Pierson Rheems LLC (PIERSON) for their Rheems, PA Quarry operation SMP 36080301. PIERSON currently operates a 102.64-acre (30 acres of mining) noncoal surface mine operation and is looking to expand the SMP by 30 acres and pit by approximately 20 acres. Currently, the mine floor is at ~200 feet Above Mean Sea Level (AMSL) with an ultimate depth of 126 feet AMSL. The site was previously operated by Union Quarries, then Donegal Rock before changing hands to PIERSON in 2008.

This report is a compilation of multiple decades worth of previously completed studies, as well as more recent site work. The site already has a Module 8 and hydrogeologic study on file at the Pennsylvania Department of Environmental Protection (PADEP). This has enabled the completion of a three-dimensional groundwater model, establishment of a Zone of Influence (ZOI), and a proposed future monitoring network to assess current and future impacts caused by the dewatering activities associated with mining. This report will detail all the work performed at this quarry and will highlight all pertinent hydrogeologic data necessary to evaluate any impacts from the expansion of this mining operation and provide information to the PADEP that would allow for the pit expansion of the requested 20 acres (30 acres total, 20 additional for mining).

For mining to occur at the Rheems Quarry, dewatering of the pit will be required. Dewatering can be accomplished through the installation of a sump, with pumps installed, to remove the water from the pit area. As water is removed from the pit, this dewatering will also impact the area surrounding the pit. To assess the impacts of the necessary pumping, a series of four groundwater monitoring wells equipped with pressure transducers were installed around the perimeter of the quarry. Data loggers were also installed in three of the previously installed monitoring wells at the site, along with a permanent flow meter with data logger. These wells served as a source for water level monitoring during aquifer testing and will function as future groundwater monitoring wells. The data collected from these wells was used to develop the three-dimensional groundwater model and associated ZOI. The data also helped establish groundwater contour mapping, groundwater flow direction, and gradient.

Contained herein is a comprehensive and detailed report explaining all of the items addressed in this Executive Summary, focusing on the hydrogeologic data in and around the Pierson Rheems

Quarry. The interaction between quarry dewatering and the surrounding aquifer is understood, and predictions for future pumping have been calculated. The quarry pumping will have minimal impact to the surrounding aquifer and a sinkhole mitigation plan has been prepared deal with future sinkholes that may occur. The overall results of this study have determined that mining to the permitted depth of 126 feet AMSL, including the 20-acre expansion, will not cause any deleterious impacts to the surrounding aquifer and/or environment.

This document was prepared by Charles Brown and Rick Caranfa, under the supervision of Mark Forester, P.G, and of Mr. James Rumbaugh, P.G., for groundwater modeling and accompanies the PADEP Surface Mine Module 8.

**Geology:**

The Rheems Quarry is located within the Piedmont Lowland Section near the boundary with the Piedmont Upland Section of the Piedmont Physiographic Province. The Piedmont Lowland Section consists of broad, moderately dissected valleys separated by broad low hills. The Section is developed primarily on limestone and dolomite rock. Karst topography is common. Local relief in the Section is generally less than 100 feet but may be as much as 300 feet. Elevations in the Section range from 60 feet to 700 feet. Drainage is basically dendritic in pattern, but some areas have virtually no pattern because of the well-developed subsurface drainage. The limestone and dolomite bedrock in and around the Limestone Quarry generally have a strike to the East/West and dip to the North at 45˚.

The Village of Rheems lies in the carbonate valley of northern Lancaster County, in southeastern Pennsylvania. Rheems is two miles east of Elizabethtown, shown on the 7-minute quadrangle bearing that town's name. The quarry is a short distance west of the village, adjacent to Harrisburg Avenue in West Donegal Township.

The quarry exposes only the Lower Ordovician Epler Formation, an approximately 2,500 feet thick carbonate unit within the Beekmantown Group (Meisler and Becher, 1971) present throughout the entire Lebanon Valley nappe from Reading to Harrisburg. Perhaps the most distinctive aspect of the Epler is the interbedding of limestone and dolomite, which on weathered surfaces provides striking displays of mesoscale structures. The limestone is mostly medium to medium-light gray (locally light pinkish gray) and weather to a light olive-gray or light gray. The finely crystalline beds contain very fine dark gray laminations. The medium crystalline dolomite beds are medium gray in color, and weather to a yellowish gray. The dolomite is also laminated, and both lithologies tend to be medium to thick bedded. Chert, occurring as dark gray to black nodules, lenses, and stringers, is scattered throughout the Epler Formation.

The quarry highwalls provide excellent exposures of the mesoscale structures that comprise the local tectonic grain. The north and south highwalls approximately parallel the 75-azimuth trend of the folds and display the change along the grain; the east and west walls exhibit good cross sections of the structures.

The dominant tectonic factor was the northward transport of the nappe; all other Taconian structures in this quarry are derived from this fundamental movement (Wise, 1958, 1960). A consequence of this movement is that most of the rocks in this underlying limb have undergone, to varying degrees, an extension in the north-south direction. Most of the mesostructures in the quarry amply demonstrate this strain.

The two most dramatic structures are the two recumbent folds in the east wall. No evidence of depositional tops of beds has been found in this quarry, so which fold is the anticline, and which is the syncline cannot be determined from the sedimentary criteria. However, because the quarry is in the lower limb of the nappe, one can presume that the stratigraphic section is probably inverted. If so, then the upper fold, the one that is concave toward the north, has younger beds in the core, and thus it is the syncline. Similarly, the lower fold, the one that is convex toward the north, should have older beds in the core, and so it is the anticline. The axial surfaces of both the anticline and the higher syncline persist across the east wall with a 15 to 25 feet separation, extending horizontally though at least 650 feet of rock. This is an average dip of 3˚, not quite a perfect recumbent fold. This exposure also enables one to see that the folds possess a similar geometry.

The highwall exposure in the west wall at is in distinct contrast to the east wall; no recumbent folds disturb the gentle south dip of the (presumably) overturned beds, The relation between the different structures displayed in the two walls can be determined from the folds in the north highwall. The 5˚ to 15˚ plunge of the folds at the entrance ramp to the east-northeast demonstrate that the western highwall exposure is structurally below the folds in the eastern wall, This can be verified by examining the east highwall. No folds are present; only the fairly constant gentle south dip is present, similar to that in western part of the quarry.

The important faults present in this quarry occur in two orientations - parallel and transverse to the fold trends (Faill. 1983). Both types of faults, a steeply north-dipping parallel fault and a steeply west-dipping transverse fault, are present at the south wall. They are both post folding because they offset parts of a fold. Another steeply west-dipping transverse fault along the southeast wall has an apparent offset of 6 feet down on the west, but its gently south-plunging slickenslides indicate strike-slip movement. This fault extends northward across the quarry to the

northeast wall where the slickenslides plunge steeply (obliquely) to the northwest. These complex fault movements may represent a late stage of the Taconian deformation, effects of the late Paleozoic Alleghenian orogeny, or they may even be of Jurassic age and be a consequence of the Mesozoic rifting and opening of the Atlantic Ocean.

It is evident from published literature and numerous field views that Rheems Quarry is so intensely folded and faulted that a single strike and dip reading could not adequately describe the attitude of the rock units exposed here.

**Regional Geologic Structure:**

The Piedmont Province where Rheems Quarry is located is an extensive, gently undulating province which in general slopes southeastward. It has undergone prolonged erosion so that much of its former plateau-like appearance has been modified to slopes and gently rounded hills. It comprises a southeastern belt, adjacent to the Coastal Plain, which is underlain chiefly by Precambrian crystalline rocks but in some places by Ordovician limestone.

The Taconian Orogeny during the Ordovician Period produced the alpine-style Lebanon Valley nappe in south-central Pennsylvania. Weathering and erosion have reduced this enormous recumbent anticlinorium to a humble topography, with complexities and grandeur.

The sedimentary rocks at Rheems Quarry were deposited on the carbonate shelf on the edge of the Laurentian continent, the Precambrian core of what is now North America. During the Middle and Late Ordovician, the continental convergence and closing of the proto-Atlantic Ocean created the Taconian orogeny. During this diastrophism, enormous blocks of the sedimentary shelf and large fragments of the underlying Precambrian rocks were forced up and into a younger shale basin to the (then?) northwest, which contained sediments of the present Martinsburg Formation. In the course of this (presently) northward movement, some of the blocks overrode their leading edge, forming recumbent anticlinoria of considerable complexity. The Lebanon Valley nappe is one of these thrust blocks.

The Lebanon Valley nappe contains rocks of Precambrian, Cambrian, and Ordovician age. The nappe is more than 60 miles in width and extends across the regional trend for at least 30 miles

from the Great Valley north of Lebanon well into the Piedmont terrane south of Lancaster. Although the nappe was modified, mostly by faulting, during the late Paleozoic Alleghenian deformation, the structures in the quarry are almost entirely of Taconian age. The southeastern edge of the Mesozoic basin lies only 1,000 feet to the north of the quarry, but the extent to which the quarry was affected by the Jurassic (?) Deformation, if at all, is unknown.

**Hydrogeology:**

The climate of Lancaster County is considered humid continental. On average, there is approximately 44 inches of precipitation throughout the year, most of which falls in the form of rainfall. May-August is typically the period of the highest precipitation. Average snowfall is 27 inches per winter. Of the 44 inches of annual precipitation, on average, 10 inches goes to surface runoff, 11 inches to groundwater discharge and 23 inches to evapotranspiration (Royer 1983).

**Surface Water:**

The Rheems Quarry discharges into an Unnamed Tributary to Donegal Creek. This Unnamed Tributary's headwaters are not far from the quarry and during most times has very little flow, less than 75 gallons per minute (gpm). This Unnamed Tributary is located to the east of the operation. The quarry discharge is the main component of flow for the Unnamed Tributary immediately downstream from the quarry. Water sampling analysis demonstrates that quarry dewatering activities are having no deleterious impact to this Unnamed Tributary and the added discharge to the creek is an overall benefit.

It is worth noting that there is another mapped Unnamed Tributary west of the quarry operation. This Unnamed Tributary no longer exists at the surface over the extent of the mining project. Many years ago, the farmer that owns the land installed an underground piping system that carries this water across the property. This piping system keeps the surface dry and will not allow for this water to enter the quarry dewatering system.

**Groundwater:**

The Epler Formation is also considered an excellent source of water. It is capable of producing an adequate water supply for industrial and municipal needs. Reported yields from the Epler Formation range from 3 to 1,800 gpm with a non-domestic median yield of 265 gpm. Specific Capacity values also vary greatly, but the median is around 9 gpm. As is the case with the other carbonate rocks, the water is very hard with a median hardness of 291 mg/L. In addition, the unit has a high median specific conductance, which means that there is an abundance of dissolved solids.

The Stonehenge Formation is also an excellent source of groundwater. The formation has a high permeability and well-developed secondary porosity. Nondomestic well yields range from 10 to 225 gpm with a median yield of 20 gpm. Specific capacities range from 0.03 to 250 gpm/foot. The water in the Stonehenge Formation is also hard and nitrates can be an issue. This formation is geographically south of the quarry.

The Annville Formation is generally not considered an important aquifer because it has a limited areal extent due to the fact that the formation usually is found in thin bands. However, reported yields in the Annville Formation range from 28 to 200 gpm with a median reported yield of 30 gpm. The median specific capacity calculated for a limited number of wells is 0.21 gpm/foot. The water is considered very hard.

As part of the previously submitted Hydrogeologic Study, a comprehensive water well inventory was performed. While some of the homeowner names may have changed, this data is still valuable and therefore included in this report. This report gives the details of approximately 50 wells within the vicinity of the quarry.

The quarry is a relatively dry quarry, which is to say that there is not a lot of discharge associated with the mining activities. Also, there are not a lot of water inflows within the quarry. The one notable inflow is what the quarry operators refer to as the “red bed”. This is a thin band of red clay that appears within the quarry. It is 6-18 inches in thickness and has some associated flow. This is a bedding feature and is relatively small. While there is not any current visible flow from this zone, quarry personnel reported that there was some flow from this feature in the past. This red bed is visible and dips to the south. It was also encountered in Wells MW22-2 and MW22-3.

**Site Specific Data:**

In order to better assess the effects of the dewatering activities associated with the Rheems Quarry, a series of monitoring wells were installed at the site. As stated previously, this site already has a previous Module 8 and Hydrogeologic Study prepared. As part of that study, a series of wells were installed around the then active pit. Of those wells previously installed, three were used as part of the permanent monitoring system. These wells, in addition to the newly installed wells, are detailed below.

To function properly, monitoring wells need to be adequately connected to the underlying aquifer. The best way to ensure that these wells are connected to the aquifer is to have them drilled on a secondary porosity feature, such as a fracture. Akens used fracture trace analysis (FTA) to aid in the location of the wells. FTA involves analyzing paired stereoscopic photographs to locate potential fractures on the land surface. The stereoscopic photographs appear 3-dimensional when viewed through stereographic glasses. The surface expressions of the fractures are identified on the photos. In addition to FTA, fractures were also located by identifying them in the quarry high walls, surveying them and projecting them out from the quarry.

In January 2022, a series of four groundwater monitoring wells were installed around the Rheems Quarry. The monitoring wells were installed by Myers Brothers Well Drilling, from Salunga, Pennsylvania. The wells were installed using an 8-foot stabilizer was used to assure the wells stayed properly aligned. All wells were properly cased and sealed with bentonite pellets. All wells were drilled using a nominal 6-inch (6 5/8”) drilling bit with the top hole being drilled with a nominal 10-inch bit. Each well was properly developed by using water injection and air lift. An estimated blown yield for each well was determined using air lift and a weir, at the completion of development. Well logs for each well are included.

Monitoring well MW22-1 was drilled on the southeast corner of the site. The well was installed with 40 feet of casing and was drilled to a total depth of 350 feet. The well encountered water bearing zones at depths of 168 and 240 and yielded a total of 4-5 gpm. This well provides information on the aquifer to the southeast of the operation.

MW22-2 was installed along the south side of the active pit. It was drilled to a total depth of 350 feet, with 20 feet of casing. The water bearing zone was located at 330 feet and the total yield was 4 gpm.

MW22-3 was drilled at the southern extent of the permit line. This well was drilled to a total depth of 350 feet, with 40 feet of casing and encountered no discernable water bearing zones and yielded a total of 1 gpm. This well was located in this direction to give detail as the drawdown gradient to the south.

MW22-4 was installed near the Wolgemuth farmhouse, to the west of the proposed expansion operation. This well was drilled to a total depth of 350 feet, with 40 feet of casing and encountered water bearing zones at 290 and 295 depth and yielded a total of 1 gpm. This well has a static water level less than 20 feet from the ground surface and will be an excellent monitoring point as mining proceeds to the west.

All well drilling activities were completed by the end of January 2022 with permanent pressure transducers installed within each well, along with a flow meter and datalogger installed at the site. The pressure transducers collect continuous data and allow this data to be compared to precipitation and quarry pumping data. In addition, data loggers were installed in three of the previously drilled wells (Wells A, B, and D).

The well logs are attached for Wells A, B, C and D. Monitoring Well C has been mined through and no longer exists. Wells A and D were converted to multi-level piezometers after they were drilled in the 1990's. For our monitoring purposes, the data loggers were installed into the deep monitoring point. All referenced data within this report pertains to the deep monitoring point within these two wells.

As part of the background data, water quality samples were obtained on the Unnamed Tributary to Donegal Creek, the quarry discharge, and numerous homeowner wells around the quarry that were willing to participate in the study. It should be noted that well sampling was also done as part of the previously submitted Module 8. Again, all sampling is in line with expected groundwater quality. Also, every home that participated in this study has some form of filtration system installed. These systems are for sediment and not any chemical analyte. This water

quality data is attached and detailed in Module 8: Hydrology, which is also attached to this report.

**Quarry Pumping and Discharge:**

In June of 2022, a permanent flow meter was installed on the discharge line from the Rheems Quarry to the Unnamed Tributary. This meter is a Seametrics EX253B-127 Mag Meter and collects continuous discharge data. This discharge data is included in the application.

Akens was able to obtain discharge records, collected by quarry personnel from 2010 through 2017. This data was based upon rating curves and hours pumped. Starting in June 2022, the data should be considered much more accurate and was collected with the aforementioned flow meter. Interestingly, the data shows a slight decrease in quarry discharge over the 12-year period. While this is likely due to the accuracy of the equipment, what we can discern is that quarry discharge likely remained the same over this 12-year period. This indicates stabilization of the aquifer in relationship to the quarry activities. The stabilized conditions around the site would mean that the data acquired would be excellent for calibrating a groundwater model.

Overall, quarry discharge averages just over one million gallons per day. Monthly fluctuations will be dependent upon precipitation, with maximum monthly discharge of 2.8 MGD to not needing to pump during drought conditions.

The quarry discharge operates on a 2-stage discharge system. This means that water is pumped from a “lower” sump, which is located on the floor of the active mining level (~200 AMSL), and is temporarily discharged to “transfer” sump, which is located at the ~250 AMSL bench. This system improves the quality of the discharge water by allowing solids to settle. It also offers the quarry more control and stability over the discharge.

**Permanent Monitoring Network:**

To help assess any future impacts the mining and associated dewatering may have, an extensive permanent monitoring network was established around the quarry. The monitoring network should include the following wells:

| | |
|---|---|
| Well A | Monitoring |
| Well B | Monitoring |
| Well D | Monitoring |
| MW22-1 | Monitoring |
| MW22-2 | Monitoring |
| MW22-3 | Monitoring |
| MW22-4 | Monitoring |

These wells are located on the attached 6.2 Environmental Resources Map. These wells have permanent data loggers installed, which collect data daily. This extensive list of monitoring wells will provide an indication as to how the various aquifers/formations are responding to the dewatering activities of the quarry. These wells also help to protect the surrounding environment from any negative impacts. If the water level within any of these wells takes a sudden drop, the incident will be investigated. The water level readings should also help to protect the quarry from unnecessary liability for problems that may arise that were not caused by dewatering activities.

In addition to the groundwater monitoring network, a series of two surface water monitoring points have been established on the Unnamed Tributary to Donegal Creek. These surface water points are also labeled on the 6.2 Environmental Resources Map as SW-1 and SW-2. These monitoring points will be sampled on a quarterly basis and stream flow monitored.

The six groundwater monitoring wells and two surface water monitoring points will adequately detail any potential quarry impacts to the surrounding aquifer system. In addition to these monitoring points, a permanent flow meter has been installed.

**Groundwater Model and Zone of Influence:**

To properly calibrate a groundwater model, representative hydraulic conductivity values need to be entered for the various formations across the project area. This is done so that the model can more accurately predict future impacts from the quarry dewatering activities. The calculation of these parameters can be achieved in various ways. There is currently an active pit sump established at the Rheems site. This pit sump is used on an "as-needed" basis to keep the mining operation dry.

To assess the quarry's impact on the surrounding aquifer, permanent data loggers were installed in monitoring wells MW22-1, MW22-2, MW22-3, MW22-4, MW-A, MW-B, and MW-D. Data was collected over a 6-month period from these wells. The correlation between pumping and water level fluctuations within the monitoring wells provides excellent data on the surrounding aquifers. This data was analyzed by Environmental Simulations, Inc. (ESI), of Reinholds, Pennsylvania. The data from the testing is summarized below:

| **Formation** | Horizontal K | Vertical K |
|---|---|---|
| Epler | 0.5 | 0.2 |
| Stonehenge | 0.5 | 0.05 |
| Millbach | 5.0 | 0.5 |
| Annville | 2.0 | 0.2 |
| Hershey | 2.0 | 0.2 |
| Cocalico | 2.0 | 0.2 |
| New Oxford | 1.0 | 0.1 |
| New Oxford Congl | 0.2 | 0.02 |

A groundwater model was constructed and calibrated for the Rheems Quarry by Environmental Simulations, Inc. (ESI), of Reinholds, Pennsylvania. The purpose of the model is to help predict any future impacts caused by mining and the associated dewatering activities. The model was constructed using the MODFLOW2000 model (Harbaugh et al, 2000) developed by the United States Geological Survey (USGS). The model was designed using Groundwater Vistas software developed by ESI.

Model parameters required by MODFLOW2000 for the model include horizontal and vertical hydraulic conductivity values (K) for each cell in the model. Hydraulic conductivity determines the ease with which groundwater flows through the aquifer. To calculate the K values for each

boundary or zone, data was used from the onsite sump testing explained previously. The modeling parameters are explained in great detail in the attached modeling report. Because the geologic formations around the quarry have such varying values for K, the geologic units were divided into different hydraulic conductivity zones. The data is summarized in *TABLE 2.1* of the attached Model report.

Model calibration is the process of adjusting parameters in the model so that the model-computed water levels match water levels measured in the wells. During calibration, the model-computed water levels are compared to those water levels measured in wells. These measured water levels are called calibration targets or just targets. The targets represent water levels measured at a particular time during the simulation or they can represent steady-state conditions. In the case of the current model, steady-state conditions represent average water levels measured in 2022 for the seven monitoring wells and three additional homeowner wells, coupled with the long-term average pumping from the quarry. The computer model then compares predicted water levels to the actual readings and the calibration was complete.

Typically, a groundwater model is used to predict a Zone of Influence (ZOI) as well as future impacts from the quarry. This model predicts the current mining operation, expansion, and future mining at deeper levels. This quarry has a geologic setting in which the geologic formation being mined is somewhat pinched on all sides, and small in extent to the North and South. Because of this geologic setting, one would predict the ZOI for this operation to be relatively small. The model predicts exactly this, and the impacts expected from mining will be limited to a small area. The 10’ drawdown line acts as the ultimate ZOI and is shown on several maps found herein. It should be noted that in the case of well replacement, the 25’ drawdown line is more indicative of wells that could potentially be impacted by mining. The attached well survey indicates depths of wells and should be taken into consideration.

The ZOI for the current mining pit, as shown delineated on the attached 6.2 Environmental Resources Map, was predicted to be a total of 346 acres. The computer modeling for the site over-predicted the current pumping by 25%, resulting in a ZOI too large for actual site conditions. Akens adapted the ZOI based on specific site conditions (geologic formations and structure, groundwater levels, quarry pumping and discharge, etc.) as represented on the map.

The quarry discharge happens to be lower than the model capabilities to calibrate this difference is in the conservative direction.

The model also predicted the ZOI at complete buildout of the quarry. This includes the western expansion and the deepening to level 126 AMSL. The ZOI almost doubles in size to ~680 acres. Again, because the original calibration was overpredicting the flow, the predicted future model is likely overpredicting the size of the ZOI. The ZOI was slightly adjusted from the original computer model to account for this factor, as well as the geology in the area.

The ZOI predicts some impacts on eight private wells surrounding the quarry. These eight wells and predicted impact are listed below:

| Private Well | Predicted Impact |
|---|---|
| PW-1 | ~25 feet |
| PW-2 | ~100 feet |
| PW-3 | ~50 feet |
| PW-4 | ~70 feet |
| PW-18 | ~25 feet |
| PW-20 | ~50 feet |
| PW-21 | ~50 feet |
| PW-22 | ~50 feet |

It should be noted that Well PW-20 was previously replaced (paid for by Pierson) and deepened with a new pump installed. This occurred during this study and therefore the associated cost of replacement is known (~$11,000). There was significantly more casing installed than was required, resulting in a slightly increased cost. The well was originally ~118 feet deep as drilled, with the pump set at ~100 feet. It is known that mining activities did impact this well due to its shallow nature. The neighboring wells do not appear to have been impacted.

Akens personnel will request meetings with the owners of Wells PW-21 and PW-22 to further assess. These wells will be assessed for depth and production to ensure that these homes do not face any interruption of their water service.

The predicted ZOI, at final buildout shows a potential 100 foot impact to Well PW-2 located at the Sweigart Farm. This impact is NOT associated with the expansion to the west but is associated with mining deeper. It is Akens' recommendation that this well be replaced prior to any advancement in depth of the quarry. Again, moving to the west will not impact this well, as

that is moving further away than the current mining activities. However, if this well has any issues, they will be investigated immediately and well replacement will occur as needed.

Records indicate that the other private wells are quite deep and likely will not be impacted, even with a small increased drawdown.

Again, we know that the model has overpredicted flow, which in turn will overpredict the ZOI. We know that the geologic contact to the north between the Epler Formation and the New Oxford Formation will limit the extent of the real ZOI in that direction. The proposed monitoring network will allow for early detection of impacts to the aquifer.

There is currently one known sinkhole currently being investigated by the PADEP. We shall revise the Karst Supplement once we receive the report for that sinkhole. While the Epler Formation is known to be susceptible to sinkhole development, there are only two mapped historic sinkholes in the vicinity of the operation. These are shown on the 6.2 Environmental Resources Map and are located on the Wolgemuth farm. There is a sinkhole mitigation plan at the end of this document in the event that any sinkhole activity occurs.

Quarries are unique in their water handling operations. When there are drought conditions, quarries pumping rates are reduced in response to the drought conditions. Conversely, if rainfall is above average, then pumping rates will tend to be above average. Quarry pumping in general will usually be maintained at a steady rate with only modifications to coincide with precipitation amounts. Discharge data shows stable pumping rates for many years. The measured pumping rates indicate a very steady consistent pumping rate of around 1 MGD. Continued monitoring of this parameter, along with the continuous logging of the monitoring wells will provide adequate information to monitor the effects of the quarry on the karst features. No changes are required to the NPDES Permit discharge rate.

**Conclusions:**

This report has detailed the hydrogeologic data collected in the field and published in and around the Rheems Quarry. Quarry operations have been determined to have caused minimal impact to the surrounding aquifer through drawdown associated with quarry dewatering. Listed below is a summary of findings:

- Mining operations began at this site over 85 years ago. The mine has progressed to its current size and depth with no major reported impacts to the surrounding environment. The mining operations discharge helps supplement the Unnamed Tributary to Donegal Creek with water of good quality.
- An excellent groundwater monitoring network, surrounding the quarry, has been established. This network is comprised of seven strategically placed wells, all of which are equipped with pressure transducers. In addition, a permanent flow meter, with data logger was installed at the site. The flow data combined with the water level monitoring network will serve as an early detection system for any potential off-site impacts. This monitoring network will take daily readings of the groundwater system and they will be reviewed and submitted to PADEP on a quarterly basis. The flow monitoring will also serve as an early alert to any potential increase in pumping, which could indicate a migration of the ZOI. This system will ensure protection to the surrounding aquifer and associated homeowner wells.
- The eight private wells listed as potential to be impacted can be further investigated. Also, the Sweigart well should be replaced prior to any deepening activities.
- The surrounding geology will limit the size, shape, and extent of the ZOI. The quarry is mining the Epler Formation, which is limited in extent to the north and south.
- Current pumping averages just over 1 million gallons per day (mgpd) and is predicted to double to 2.1 mgpd at maximum buildout. Again, the expansion to the west will not increase the ZOI or discharge much as this area has already been dewatered to some extent. Also, the fact that the surface water feature in this area is now piped underground will limit the amount of recharge. This requested expansion does not require any increase in the NPDES discharge permit.

- Discharge from the quarry has remained stable since 2010 and is expected to continue as mining progresses.
- Sinkholes have been minimal surrounding the site for the last ~85 years. However, the Epler Formation is known to be prone to sinkhole development. Therefore, a Sinkhole Mitigation Plan is at the end of this document and should be followed in the event that a sinkhole develops and is associated with the mining activities.

This hydrogeologic study incorporated new data as well as historical reports to form the aforementioned conclusions. Predictive three-dimensional groundwater modeling indicates that minimal impacts have been exhibited on the surrounding aquifer and that this minimal impact trend will continue as mining progresses. Proper monitoring of the groundwater and surface water will ensure against any future impacts. This report and accompanying groundwater model have assessed conditions to the 126 AMSL lift, however, after the completion of each lift, or if there is any drastic deviation, the model should be reviewed and updated, as necessary.

# Groundwater Flow Model for the Pierson Rheems Quarry, Lancaster County, Pennsylvania

**March 17, 2023**

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# CONTENTS

# 1.0 Introduction

A groundwater model was constructed and calibrated for the Pierson Rheems Quarry in Lancaster County, Pennsylvania. The quarry is operated under mining permit 36080301. The model was created to predict future impacts as quarry development continues and is being submitted to Pennsylvania Department of Environmental Protection as a file update.

The model was calibrated to steady-state conditions assumed to be prevailing currently at the site. Both water levels measured in wells and discharges from quarry dewatering were matched during model calibration. The calibrated model was then used to predict the impacts and inflows to the quarry from the last lift at an elevation of 126 ft above mean sea level (msl).

The construction and calibration of the model is documented in Chapters 2 and 3. Predictions of future impacts from mining are presented in Chapter 4.

# 2.0 Model Construction

## 2.1 Code Selection

The groundwater model for the Pierson Rheems Quarry was constructed using the MODFLOW-USG model (Panday et al, 2013) developed by the United States Geological Survey (USGS). The MODFLOW family of models (MODFLOW88, MODFLOW96, MODFLOW2000, MODFLOW2005, MODFLOW-NWT, and MODFLOW-USG) is the most popular groundwater flow model used in the U.S. and has become the standard for groundwater flow modeling in the country. The model was designed using Environmental Simulations' Groundwater Vistas software (ESI, 2007), which creates the MODFLOW-USG input files and allows for analysis of the results. MODFLOW-USG is the latest version of MODFLOW from the USGS and was chosen for this project primarily for its capability of simulating subsurface conduits and fractures.

MODFLOW is capable of simulating steady-state or transient groundwater flow in one, two, or three dimensions. A wide variety of boundary conditions may be simulated, including constant head, constant flux (wells, recharge), and head-dependent flux (evapotranspiration, drains, rivers, streams, and general head) boundaries. The types of boundaries used in this model will be described below. MODFLOW can simulate aquifer systems that are unconfined, confined, or a combination of confined and unconfined.

MODFLOW was chosen for this study because it has most of the requisite capabilities to simulate flow in the Pierson Rheems Quarry. MODFLOW is also thoroughly documented (McDonald and Harbaugh, 1988, Harbaugh et al. 2000, and Panday et al. 2013), and has been extensively tested (see for example Andersen, 1993).

MODFLOW is not specifically designed to simulate flow in fractured rock. However, MODFLOW-USG does have the capability of simulating discrete fracture and conduit features through the use of its Connected Linear Network (CLN) Package. CLNs were used to simulate inflow to the Pierson Rheems pit from an inferred fracture zone south of the pit. For the rest of

the model area, a fundamental assumption in the current modeling is that the fractures behave as a porous medium at the scale of a model grid block. This is a common assumption in groundwater modeling.

## 2.2 The Model Grid

The flow of groundwater can be described using mathematical equations that form the basis for all computer models used in the field of hydrogeology. Computer models may be subdivided into two broad categories, called numerical and analytical models. Analytical models are exact solutions of the groundwater flow equations, and numerical models are approximate solutions. Given the choice between an exact solution and an approximate one, it seems logical that one would choose an analytical model over a numerical model. However, analytical models are limited to ideal aquifers that are homogeneous with simple boundaries. Most real world aquifers are not that simple. Consequently, numerical models are used most often in practice.

Because numerical models are approximate, they typically compute hydraulic head (water levels) at fixed points within the aquifer. These points are called nodes, and are often arranged in a rectangular pattern called a grid. There are many different types of numerical techniques that are used to solve the groundwater flow equations. MODFLOW-USG uses a technique called the control volume finite-difference method.

The finite-difference technique requires that the aquifer system be divided into a set of discrete blocks or cells. These blocks are rectangular in shape in the current model and form the model grid. The process of creating the grid is call discretization. Water levels computed for a block represent the average water level over that rectangular region of the aquifer. Thus, adequate discretization is required to resolve features of interest, such as the location of the wells, faults, and hydrologic boundaries in the vicinity of the quarry.

An algebraic equation that describes groundwater flow is written for each block in terms of the surrounding blocks, and the complete set of linear equations is iteratively solved until the change

in head between iterations meets a set criterion. An iterative solution is required because the model is an approximate solution to the groundwater flow equations.

The model grid developed for the Pierson Rheems Quarry covers approximately 16 square miles. The model domain measures approximately 5 miles from west to east and 4 miles from north to south. The southwest corner of the model grid is located at Easting 2,279,174 ft and Northing 279,583 ft. These coordinates are in Pennsylvania State Plane Coordinate System South, NAD 1983, in units of US survey feet.

The model grid spacings vary from 40 feet to 200 ft. The model grid was finer in the vicinity of the quarry. The model grid contains 111 rows, 147 columns, and 5 layers. Some of the cells in the new pit area were further subdivided into a nested grid with 40 ft grid spacings. This allows an area of refinement only where needed (in this case the pit) and is a more efficient gridding technique. A total of 134,385 cells were used in the final model. There are 108,885 active cells. The model area is shown in Figure 2-1.

The model was divided into 5 layers to facilitate making predictions down to an elevation of -600 ft relative to mean sea level. The proposed lifts for this permit are contained in the upper 2 model layers. Additional layers were added below the active quarry so that vertical flows into the pit can be computed. The base of the model in the vicinity of the quarry is at an elevation of -600 ft msl.

## 2.3 Boundary Conditions

Once the aquifer system has been discretized, it is implicitly assumed that groundwater outside the model grid can be ignored. The model, however, must account for areas where groundwater enters or leaves the system. These effects are included in a model using boundary conditions. Ideally, boundary conditions should represent identifiable regional hydrologic features at which some characteristic of groundwater flow is easily described (Franke et al. 1984).

In the case of the current model, the hydrologic boundaries for the model were inferred from surface watershed boundaries. The main assumption is that any activity at the quarry will not affect the location of these small water shed divides. Based on observed patterns of drawdown at the quarry, this appears to be a reasonable assumption. However, by simulating these divides as no-flow boundaries, any drawdown that might be computed at these locations will be greater than if the boundaries were further away. Thus, these are conservative with respect to quarry impact predictions.

The outer edges of the active model thus consist of groundwater divides and river or drain cells where the outer boundary coincides with a stream as shown in Figure 2-2. Cells outside these boundaries are considered inactive and shown as no-flow cells on Figure 2-2.

Numerical groundwater models, such as MODFLOW, use three types of boundary conditions to model ways in which water may enter or leave the model domain. These include the specified-head, specified-flux, and head-dependent flux boundaries. A description of each type is given below as applied in the current model. Boundary conditions are shown in Figure 2-2 for Layer 1 of the entire model domain.

The specified-head boundary condition is called a constant head in MODFLOW. The head or water level at a constant head boundary is specified independently of the simulation results and is fixed at the specified elevation throughout the simulation. Constant head boundaries were not used in the current model.

Specified flux boundary conditions are implemented in MODFLOW to represent wells, recharge, or no-flow (i.e., flux equals zero) cells. Constant flux boundary conditions were used in the model to simulate infiltration of recharge from precipitation. The recharge rate in this model was assumed to be 5.7 inches per year (0.0013 ft/d). This value was determined through calibration to quarry sump pumping rates.

No-flow boundaries are placed in a model where the aquifer is not present or where leakage of water into the model is negligible. No-flow boundaries were placed at the outer edges of the model outside the flowlines and divides, as described above and shown on Figure 2-2. Also, implicit in the model construction is that the base of the model is no-flow. That is, groundwater inflow and outflow below an elevation of about -600 ft msl is considered negligible.

Head-dependent flux boundary conditions are a hybrid between the specified head and specified flux boundary conditions. In a head-dependent flux boundary, the flux (flow rate) of water into or out of the cell is computed by the model based upon the head calculated for the cell, the head specified for the boundary, and a conductance term. The flow rate into or out of a head-dependent flux boundary cell is computed by multiplying the difference in head between the boundary and the cell times the conductance term.

MODFLOW offers many different types of head-dependent flux boundary conditions, including the drain, river, stream, general-head, and evapotranspiration packages. Each type is slightly different. River and drain boundary conditions were used in the current model and are described below.

Drain boundary conditions were used to simulate quarry dewatering and also were placed along the western edge of the model to keep water levels from going above land surface. Since no data exist in this area and it is far from the quarry, these drain locations would not effect the model predictions.

River boundary conditions are similar to drains except that rivers can recharge the aquifer if the water level in the aquifer is lower than the river water level. Creeks in the vicinity of the quarry were simulated using this type of boundary condition.

Drain and river elevations were obtained from topographic maps of the area for the streams. The conductance value assigned to each drain and river boundary cell is computed using the following equation:

$$C = (K\ W\ L)/T$$

Where C is the conductance value in units of $ft^2/d$, K is the hydraulic conductivity of the stream bed, or quarry interface in units of ft/d, W is the width of the hydrologic feature (or width of cell for the quarry drains), L is the length of the hydrologic feature within the cell (or cell length for quarry drains), and T is the thickness of the bed or interface material (ft). The width and length terms were defined from a Geographic Information System (GIS) for each grid cell containing a river or drain. The thickness of the bed material was assigned a uniform value of 1 ft because no direct measurements were made in the area. The hydraulic conductivity was generally assigned a value of 1.0 ft/d. Since most of these boundary conditions were located far from quarry impacts, the boundary conductance was not a sensitive parameter during calibration.

## 2.4 Model Parameters

Model parameters required by MODFLOW for the model include horizontal and vertical hydraulic conductivity values for each cell in the model. Hydraulic conductivity determines the ease with which groundwater flows through the aquifer. This section describes the final distribution of parameters in the model derived during calibration. The calibration process will be described in the next chapter.

The usual philosophy in model construction and calibration is to start with a simple distribution of parameters and add complexity (heterogeneity) as required during calibration. In calibrating the model, the hydraulic conductivity distribution was homogeneous by geologic formation.

A digital version of the Pennsylvania geologic map was obtained from the Pennsylvania Geologic Survey and overlain on the model grid. The area was divided into eight main hydraulic conductivity zones representing the Epler Formation (zone 1), Stonehenge Formation (zone 2), Millbach Formation (zone 3), Annville Formation Formation (zone 4), Hershey Formation (zone 5), Cocalico Formation (zone 6), New Oxford Formation (zone 7), and New Oxford Conglomerate (zone 8). Another zone (10) was added to represent an inferred fractured zone

trending to the south from the current pit location. This area was interpreted to have a higher hydraulic conductivity because of the very flat gradient in this direction.

Representative values of hydraulic conductivity were obtained from other models created in the area and these values were further adjusted during model calibration. Table 2-1 shows the final hydraulic conductivity values for each formation. Each layer in the model was assigned the same hydraulic conductivity values.

### 2.5 Fracture Zones in the Model

Connected linear networks (CLNs) were added to the model in the area south of the current pit. These are shown in Figure 2-1. These were used because it was not possible to obtain a flat enough gradient using hydraulic conductivity increases alone. The CLNs can be thought of as discrete fractures or fracture zones.

# 3.0 Model Calibration

## 3.1 Calibration Concepts

Calibration is the process of adjusting parameters in the model so that the model-computed water levels match water levels measured in wells. Calibrating a groundwater model is difficult because there is relatively little information on subsurface conditions in most groundwater models. Most of the parameters in a model, such as hydraulic conductivity, are only known at a few points where measurements have been taken. Even at those "known" points, the measurement of subsurface properties is an inexact science. Thus, calibration is a necessary part of groundwater modeling where the initial estimates of aquifer properties, entered when the model is first created, are changed so that the model computes more realistic water level elevations and, in the current model, quarry inflow rates.

During calibration, the model-computed water levels are compared to those water levels measured in wells. These measured water levels are called calibration targets or just targets. The targets represent water levels measured at a particular time during the simulation or they can represent steady-state conditions. In the case of the current model, steady-state conditions represent average water levels measured in 2022 for the seven monitoring wells and two home-owner wells. Table 3-1 shows the wells used in the calibration of the Pierson Rheems Quarry model.

In addition to water level measurements, the model was also calibrated to the long-term average discharge rate for the quarry in 2022. The 2022 average pumping rate from the quarry is about 1 million gallons per day.

During calibration, the target water levels are compared to model-computed water levels. The model-computed water levels are subtracted from the field measurements to produce a residual. Positive residuals represent computed water levels that are lower than those measured in the field. Conversely, negative residuals are those where the model is computing water levels higher than the measured ones.

A statistical analysis is performed on the collection of residuals from all targets used in the model (Konikow 1978). Simple statistics such as the mean, standard deviation (sometimes called root-mean-square or RMS error), and absolute mean are commonly used. The mean residual should be close to zero, indicating that the positive and negative residuals are balanced. The absolute mean is computed by making all residuals positive and thus represents the average error in the calibration. These statistical measures are used to determine the quality of the calibration. Goals should be established for acceptable values of the mean, standard deviation, and absolute mean residual. These goals are discussed later in this chapter.

In addition to statistics computed for residuals, the distribution of residuals should be analyzed during calibration. It is desirable to have positive and negative residuals randomly scattered throughout the model. Clustering of positive or negative residuals over large areas is called spatial bias. One goal of calibration is to reduce spatial bias as much as possible. It is virtually impossible, however, to eliminate spatial bias because of the lack of subsurface data.

## 3.2 Calibration Results

There are many ways to assess the quality of a calibration. The Pierson Rheems Quarry model calibration was assessed by comparing the calibration statistics to the goals used by ESI in all company modeling projects. In addition, the degree of spatial bias was assessed.

What constitutes an acceptable calibration is very subjective. Woessner and Anderson (1992) suggest that goals should be established before the calibration starts. However, no standards have ever been put forth by ASTM or in the scientific literature that describe what these goals should be. Goals were established in the protocol for this model, and are based on goals used by ESI in all models and which have undergone peer review from U.S. Environmental Protection Agency and many state government agencies. These goals are summarized as follows:

- Residual standard deviation divided by range in head for all targets should be less than 0.10 (10%)

- Absolute residual mean divided by range in head for all targets should be less than 0.10 (10%)
- Residual mean divided by range in head for all targets should be less than 0.05 (5 %)
- There will be limited spatial bias in the distribution of residuals.

As previously discussed, a residual is the difference between a measured water level and the model-computed water level. The residual is calculated as the observed head minus the model-computed head. Thus, a negative residual occurs where the model-computed head is too high and a positive residual is where the model-computed head is too low.

The statistical analysis of the regional calibration is provided in Table 3-2 for the steady-state calibration. The table shows the residual mean, residual standard deviation and absolute residual mean. The residual mean uses both positive and negative residuals and thus should be close to zero if the positive and negative residuals balance each other. The absolute residual mean is computed after all residuals are made positive and is thus an average error in the model.

The statistics for the current model calibration meet the calibration goals described above. The residual mean, residual standard deviation, and absolute residual mean were -4.39 ft, 8.82 ft, and 7.94 ft, respectively. The residual mean divided by range in head is 3.3%, well below the goal of 5%. The standard deviation divided by range in head was 6.6%, again well below the goal of 10%. The absolute residual mean divided by range in head was 6.0%, significantly less than the goal of 10%. Therefore, all of these statistical measures are substantially better than the established goals.

Another aspect of the calibration compared the model-computed flow rate of the quarry discharge. As mentioned previously, the average flow is about 1 million gallons per day. The predicted flow rate of the quarry is 1.2 million gallons per day in the model. This rate is about 20% higher than current pumping.

## 3.3 Groundwater Flow in Quarry Area

Monitoring well locations are shown in Figure 3-1 and the water table map computed by the model is shown in Figure 3-2. This simulation also has a global mass balance error of 0.00%.

The calibrated water table map for the quarry shows a cone of depression caused by quarry dewatering around the current sump. This cone of depression is elongated to the south following the fracture zones inferred for that area. Away from the quarry, groundwater flows from topographic highs to the streams surrounding the quarry property.

## 4.0 Predictions of Future Impacts

The mine plan calls for mining to an elevation of 126 ft above sea level. Drains were set in the model in layer 1 to simulate mine dewatering. Drawdown contours were produced for these simulations, along with a prediction of quarry inflow rate. The drawdown contours are provided in Figures 4-1 for the current operations and in Figure 4-2 for the 126 ft elevation. The model predicts that drawdown will expand as the quarry is mined to deeper levels as one might expect. The 10 ft drawdown contour shown in these figures equates to the new zone of influence for the quarry at these depths. The 10 ft contour was chosen because an impact of 10 ft is unlikely to cause significant harm to local well owners.

Predicted quarry inflow rates are predicted to increase to 2.1 million gallons per day at the 126 ft level. Since the calibration over-predicted the inflow rate, this new rate is also likely on the high side.

## 5.0 References

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Konikow, L.F., 1978. Calibration of groundwater models, in Proceedings of the Specialty Conferences on Verification of Mathematical and Physical Models in Hydraulic Engineering, College Park, Maryland, August 9-11, 1978.

McDonald, M.G. and A.W. Harbaugh, 1988, A modular three-dimensional finite-difference ground-water flow model, U.S. Geological Survey TWRI, Book 6, Chapter A1.

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Risser, D.W., R.W. Conger, J.E. Ulrich, and M.P. Asmussen, 2005, Estimates of Ground-Water Recharge Based on Streamflow-Hydrograph Methods: Pennsylvania, USGS Open-File Report 2005-1333.

Woessner, W.W. and M.P. Anderson, 1992. Selecting calibration values and formulating calibration targets for groundwater flow simulations, Proceedings of the NWWA Conference on Solving Ground-Water Problems with Models.

**Table 2-1. Hydraulic Conductivity Zones in the Calibrated Model.**

| *Formation* | *Location* | *Zone* | *Horizontal Hydraulic Conductivity (ft/d)* | *Vertical Hydraulic Conductivity (ft/d)* |
|---|---|---|---|---|
| Epler Fm | Regional | 1 | 0.5 | 0.2 |
| Stonehenge Fm | Regional | 2 | 0.50 | 0.05 |
| Millbach Fm | Regional | 3 | 5.0 | 0.5 |
| Annville Fm | Regional | 4 | 2.0 | 0.2 |
| Hershey Fm | Regional | 5 | 2.0 | 0.2 |
| Cocalico Fm | Regional | 6 | 2.0 | 0.2 |
| New Oxford Fm | Regional | 7 | 1.0 | 0.1 |
| New Oxford Conglomerate | Regional | 8 | 0.2 | 0.02 |

## Table 3-1. Monitoring Well Locations for the Pierson Rheems Model.

| Name | X | Y | Layer | Water Level (ft msl) |
|---|---|---|---|---|
| A | 2,295,327 | 292,742 | 1 | 385.90 |
| B | 2,296,765 | 292,430 | 1 | 349.40 |
| D | 2,295,241 | 291,761 | 1 | 366.68 |
| 22-1 | 2,296,913 | 291,513 | 1 | 300.00 |
| 22-2 | 2,295,992 | 290,929 | 1 | 308.50 |
| 22-3 | 2,296,335 | 290,040 | 1 | 304.90 |
| 22-4 | 2,294,307 | 288,983 | 1 | 386.80 |
| North | 2,293,244 | 291,886 | 1 | 433.00 |
| Bossler | 2,297,245 | 289,122 | 1 | 315.00 |

## Table 3-2. Calibration Results for the Pierson Rheems Model.

| Name | X | Y | Layer | Observed | Computed | Residual |
|---|---|---|---|---|---|---|
| A | 2,295,327 | 292,742 | 1 | 385.90 | 387.24 | -1.34 |
| B | 2,296,765 | 292,430 | 1 | 349.40 | 355.19 | -5.79 |
| D | 2,295,241 | 291,761 | 1 | 366.68 | 362.17 | 4.51 |
| 22-1 | 2,296,913 | 291,513 | 1 | 300.00 | 320.44 | -20.44 |
| 22-2 | 2,295,992 | 290,929 | 1 | 308.50 | 312.55 | -4.05 |
| 22-3 | 2,296,335 | 290,040 | 1 | 304.90 | 314.83 | -9.93 |
| 22-4 | 2,294,307 | 288,983 | 1 | 386.80 | 388.47 | -1.67 |
| North | 2,293,244 | 291,886 | 1 | 433.00 | 421.53 | 11.47 |
| Bossler | 2,297,245 | 289,122 | 1 | 315.00 | 327.29 | -12.29 |

***Statistical Analysis:***

| | |
|---|---|
| Residual Mean | -4.39 |
| Absolute Residual Mean | 7.94 |
| Residual Std. Deviation | 9.36 |
| | |
| Range in Observations | 133.00 |
| Scaled Residual Std. Deviation | 7.0% |
| Scaled Absolute Residual Mean | 6.0% |
| Scaled Residual Mean | -3.3% |

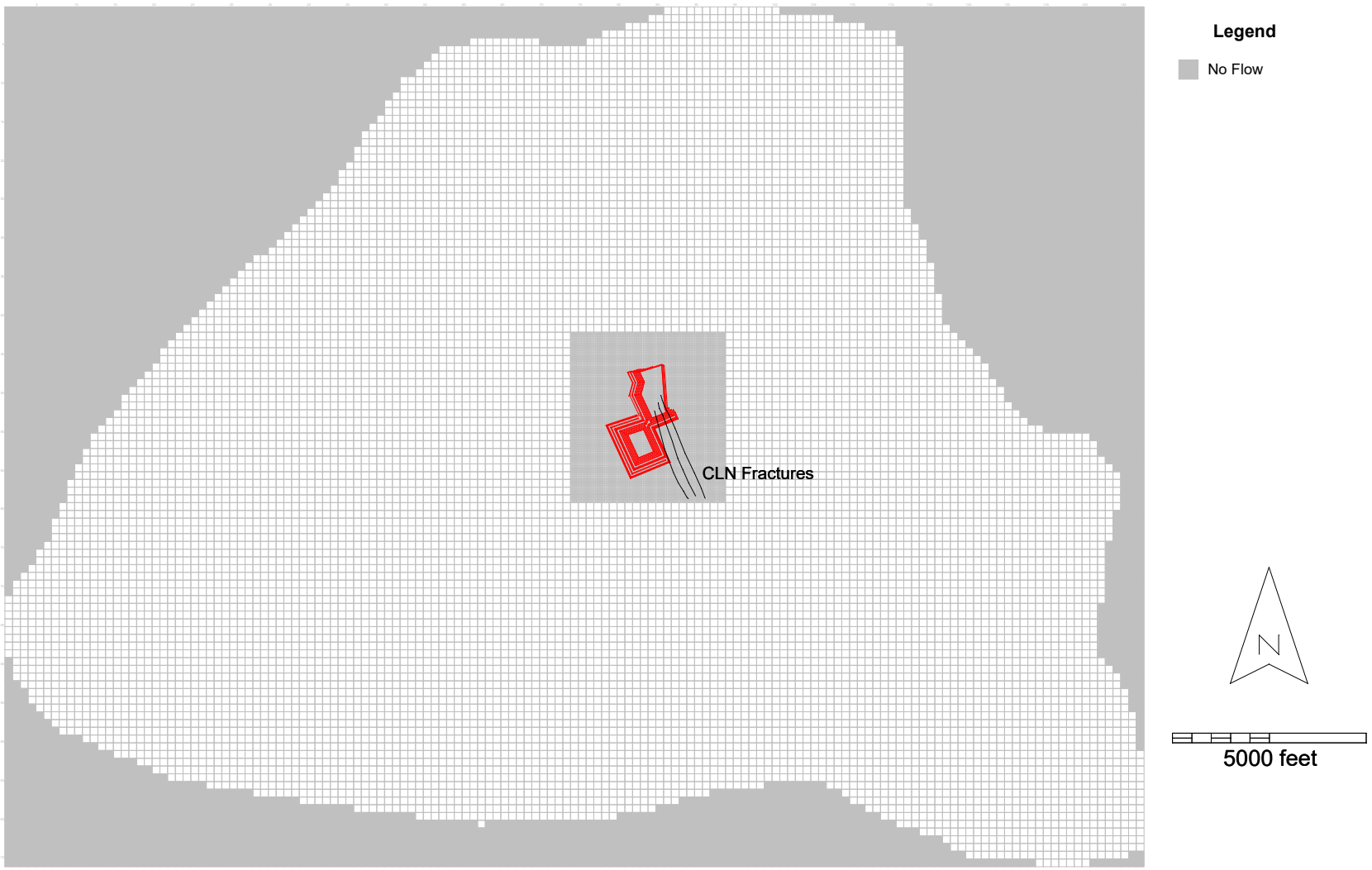



Figure 2-1 Model Grid for the Pierson Rheems Groundwater Model.

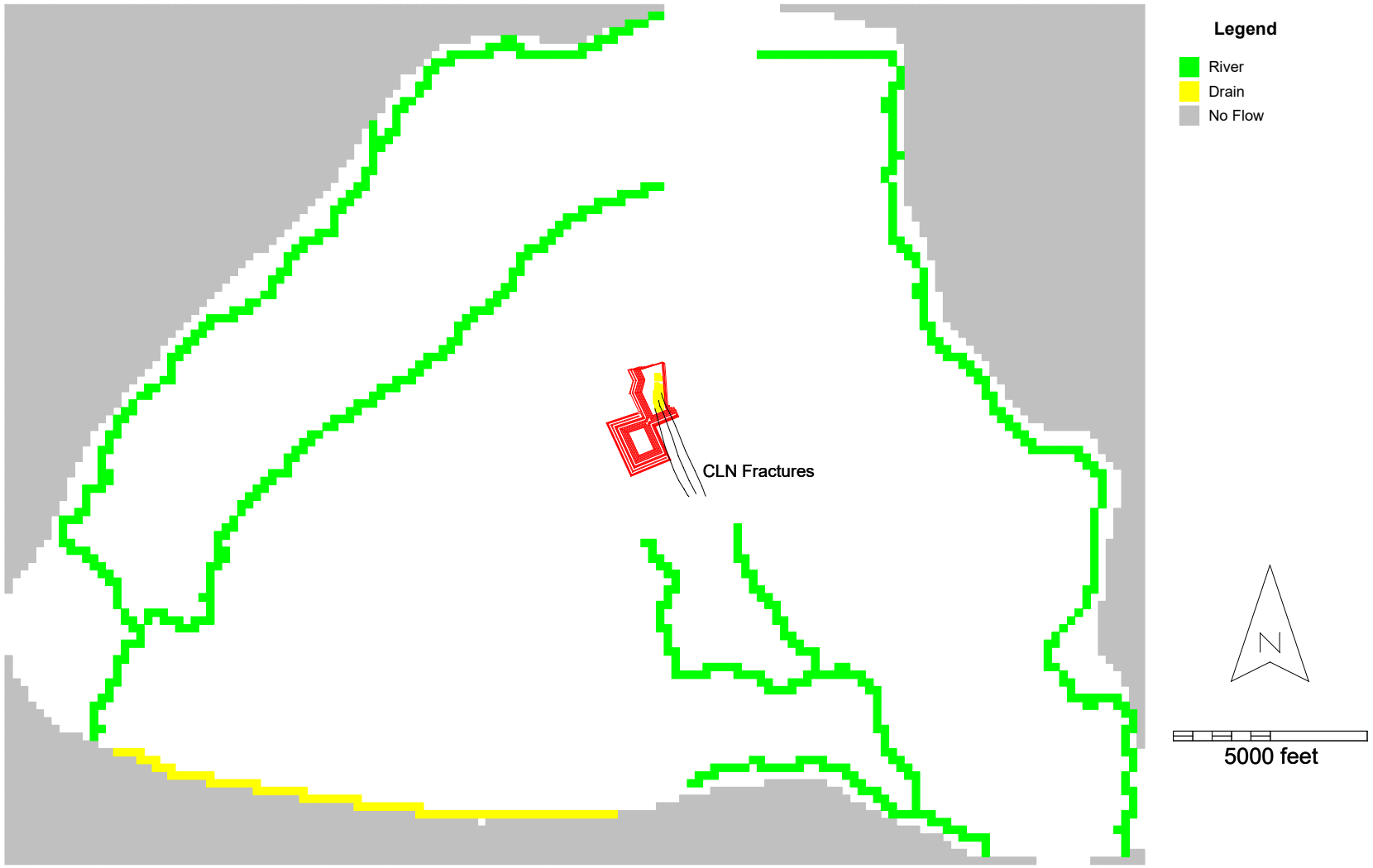



Figure 2-2 Boundary Conditions for the Pierson Rheems Groundwater Model.

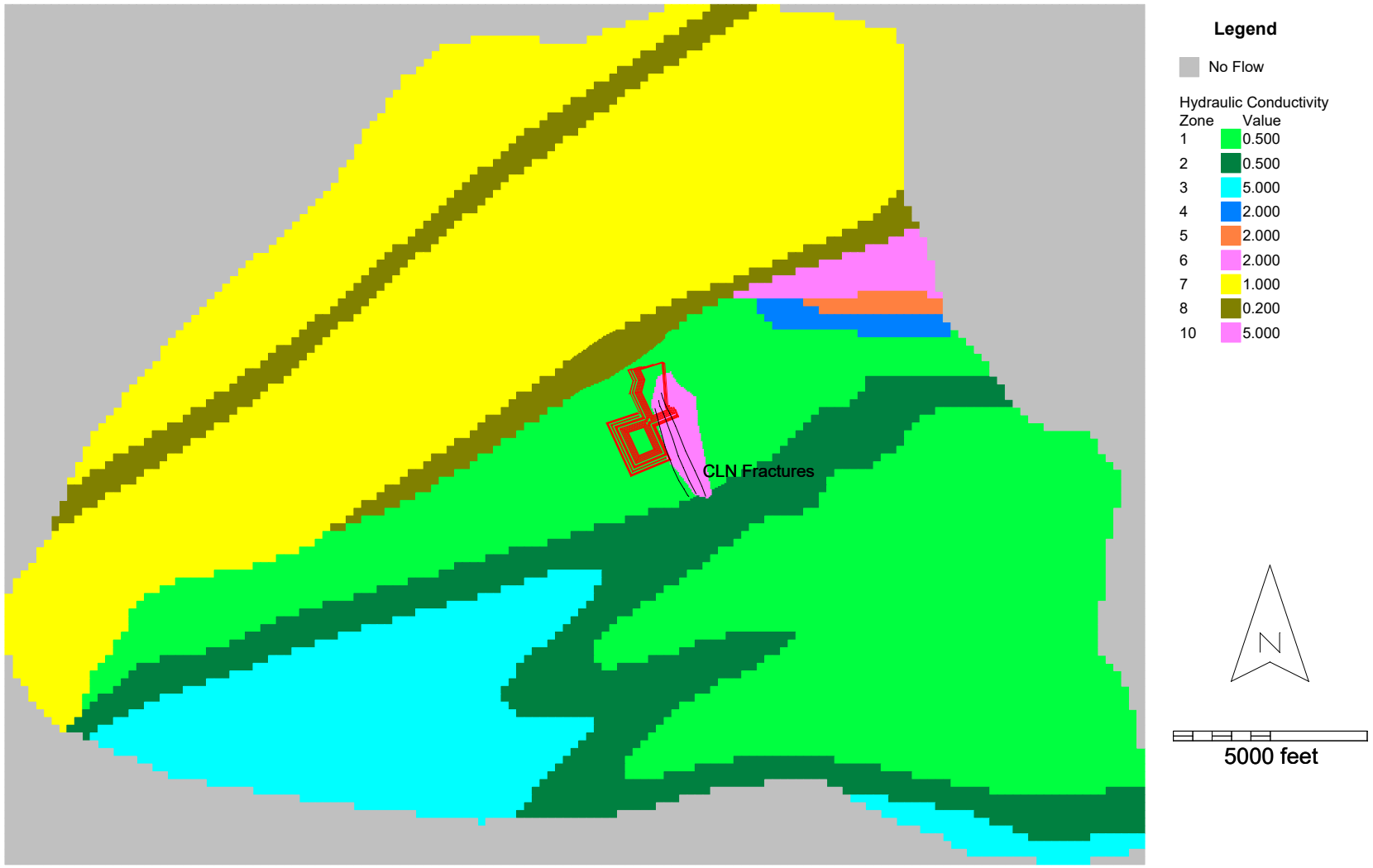



Figure 2-3 Hydraulic Conductivity Zones for the Pierson Rheems Groundwater Model.

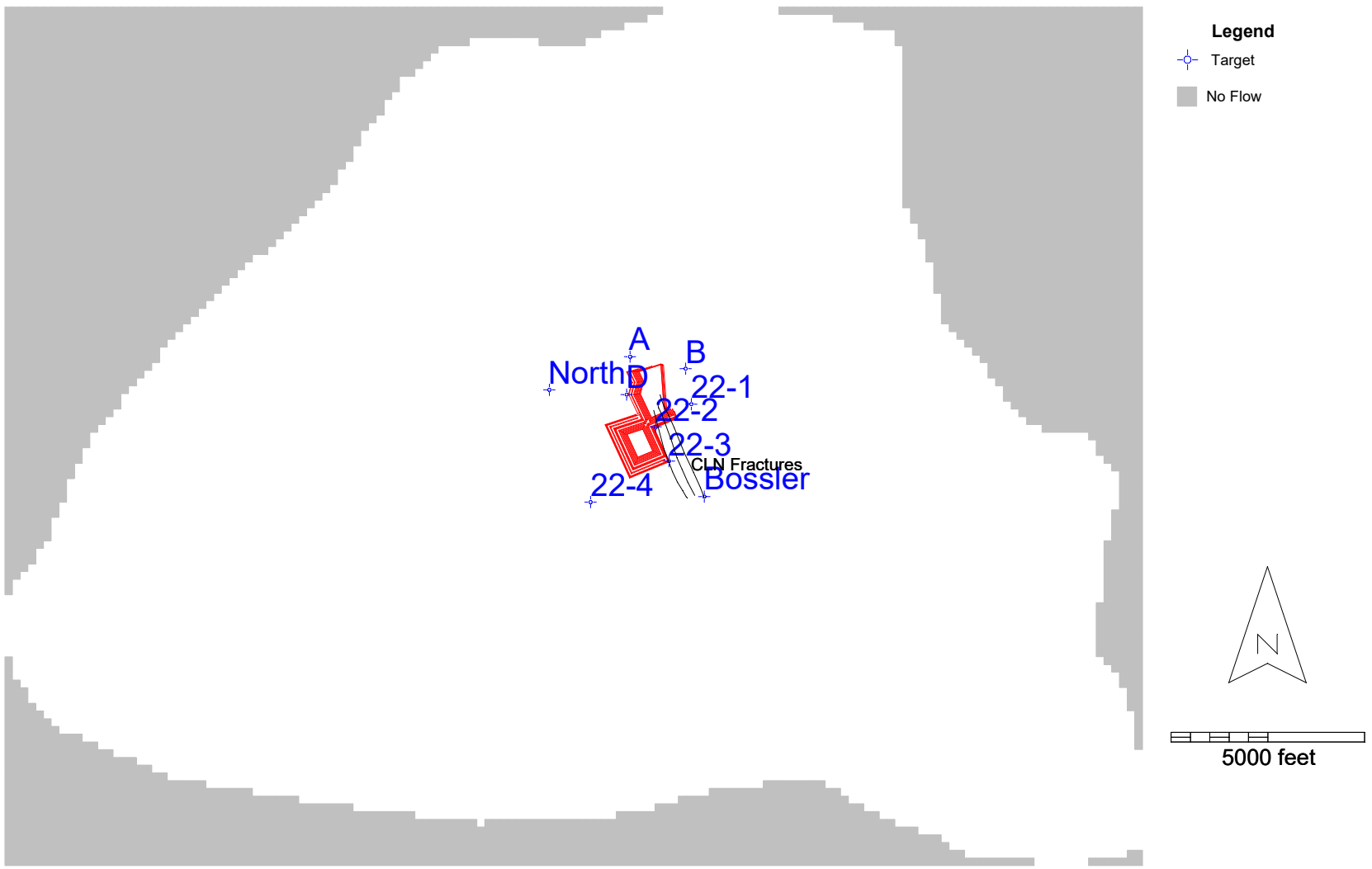



Figure 3-1 Monitoring Well Locations in the Pierson Rheems Groundwater Model.

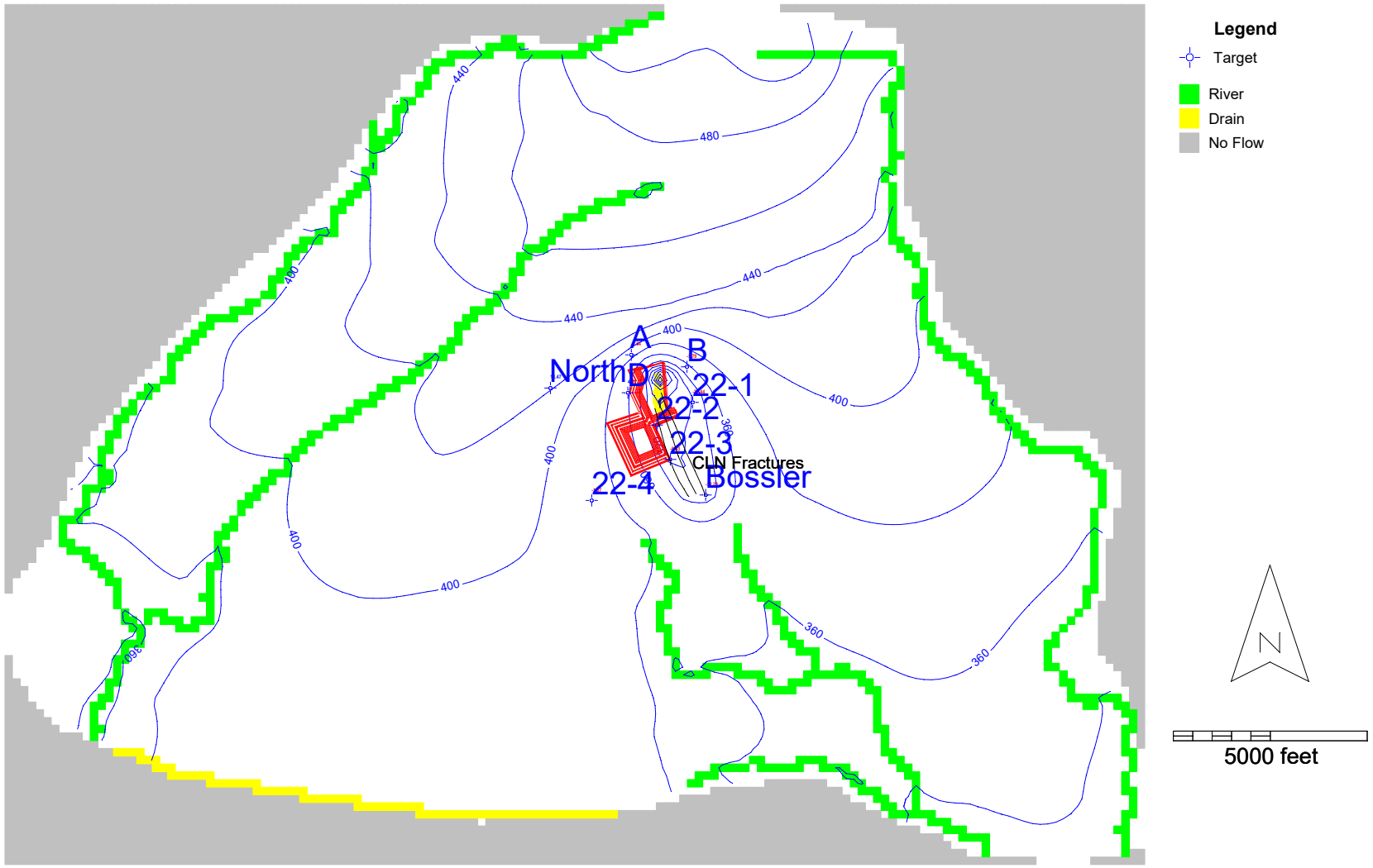



Figure 3-2 Calibrated Water Table in the Pierson Rheems Groundwater Model.

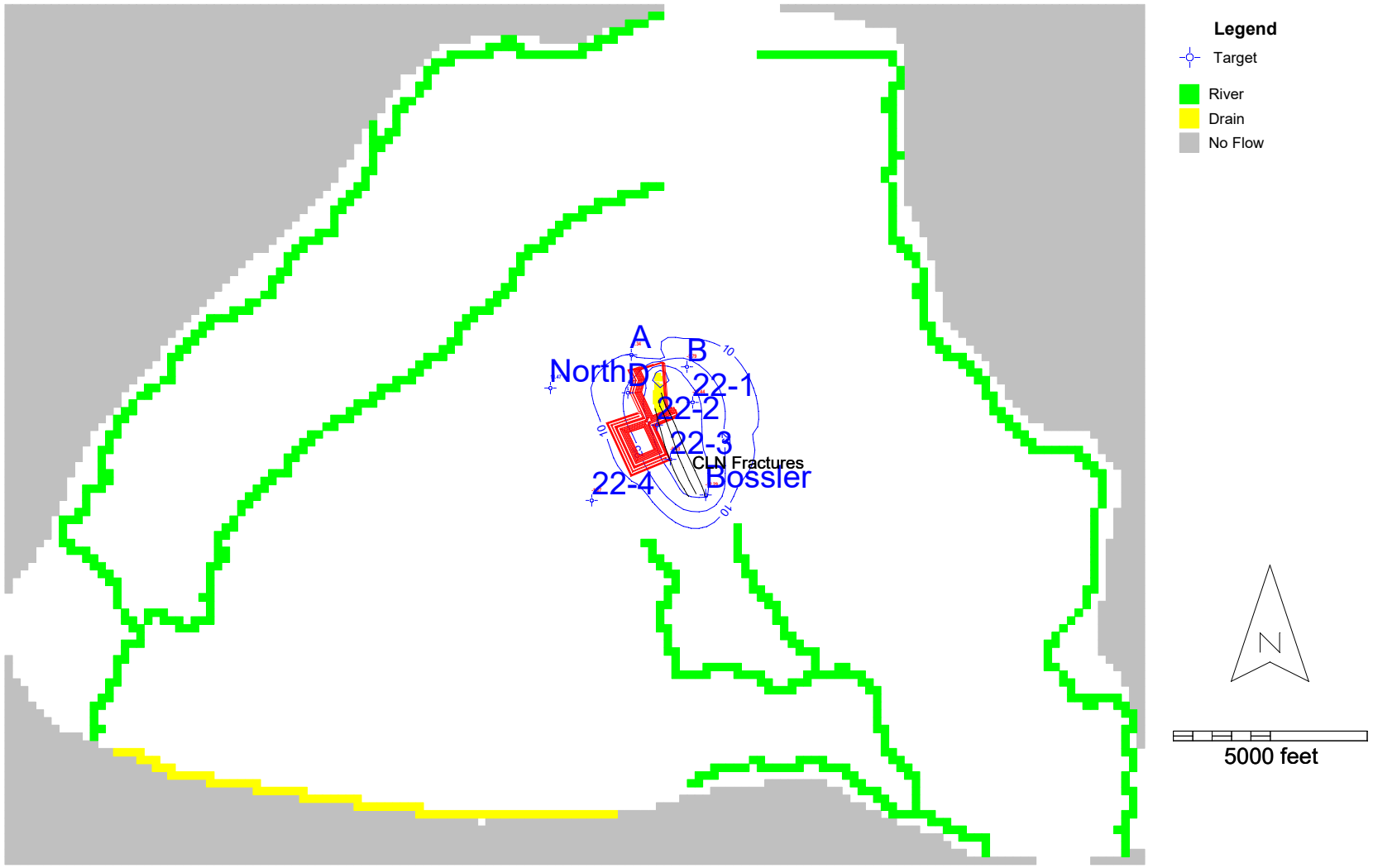



Figure 4-1 Zone of Influence Under Current Conditions.

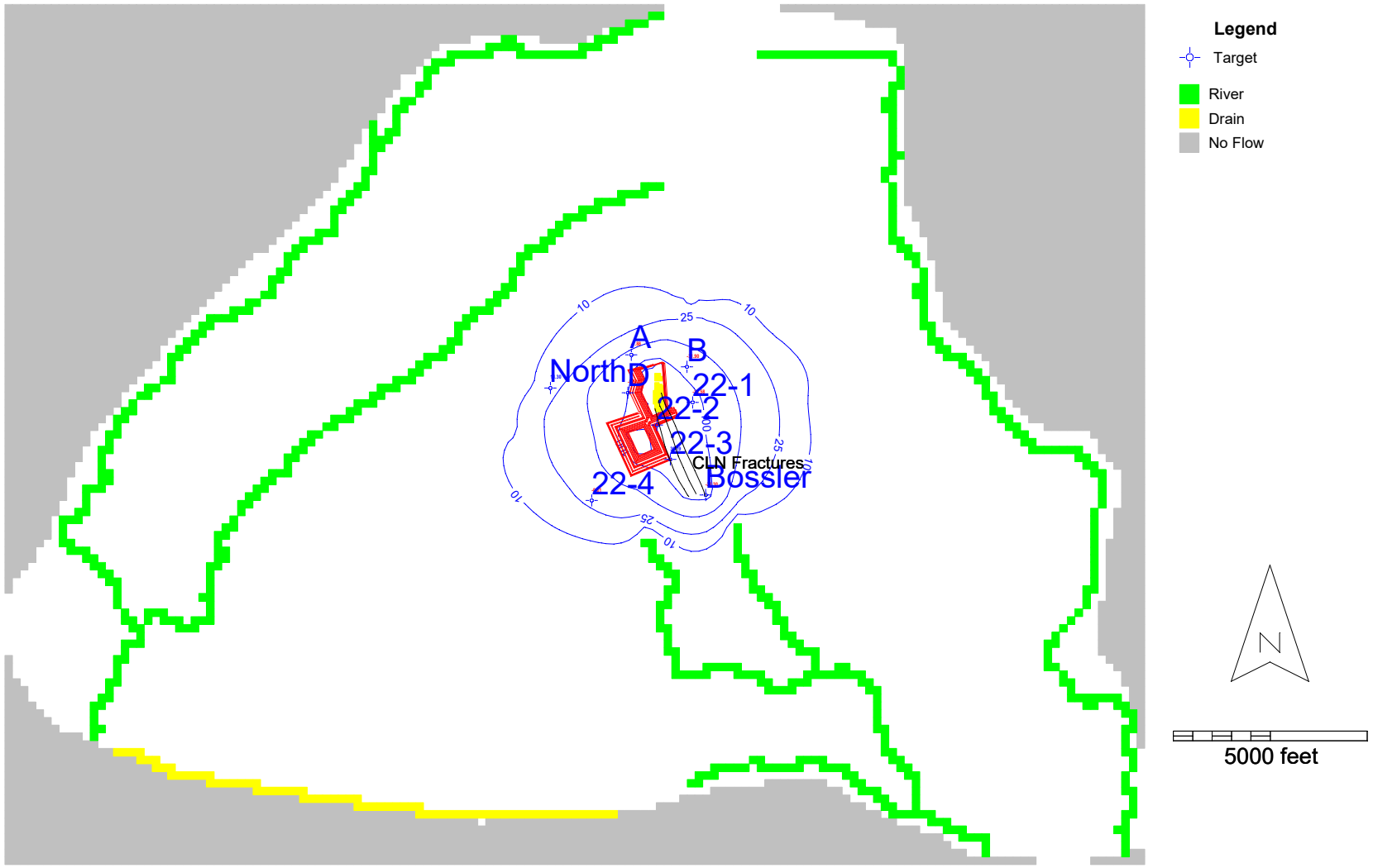



Figure 4-1 Zone of Influence with Pit Floor at 126 Ft. msl.

# SINKHOLE MITIGATION PLAN

The area generally south of Heisey Quarry Road near the Rheems Quarry is karstic and prone to sinkhole development. In the event of an active sinkhole located within the zone of influence (a noticeable surface depression caused by the collapse of soil or rock material below it, where, due to its particular location, directly threatens public health or safety, a private dwelling, structure or the environment) the Quarry shall take action to repair it, unless it can be shown that the sinkhole(s) is/are related to some other factor, a man-made feature or activity, or significant overlap of the hydrologic zones of influence of adjacent water withdrawal sources. The quarry shall report to the PADEP within 24 hours of any known sinkhole or reported sinkhole. The PADEP will be notified with a schedule for repair within three (3) business days of identification of the problem. Repair of the sinkhole shall begin immediately upon Department approval after meeting any other governmental permitting requirements, if applicable, and after obtaining required third-party access needed to affect the work. The permitee will notify the Department of any problems it is experiencing in its efforts to obtain access to private property. The department will consider any disputes or alternative plans with regards to the permitee fulfilling obligations of this condition, including any arrangement between the permitee and the third-party property owner with respect to the disposition of the sinkhole in question. A third-party utility contact list is included in this report.

Any sinkholes that occur within 100 feet of a stream channel including within the stream channel shall follow the emergency permit conditions listed below:

Emergency Permit Conditions

1. No change in the proposed work shall be made except with the written consent of the Department. Minor field adjustments or additions to the erosion and sediment pollution controls shall be made, as necessary, to ensure that runoff from all affected, unstabilized areas passes through an adequate erosion and sediment pollution control device prior to exiting the site; that runoff from off-site, unaffected areas is properly diverted around or through the site without coming into contact with sediment-laden on-site runoff, and drainage areas to controls or other facilities, as designed, are maintained.

2. The permittee shall notify the Surface Mine Conservation Inspector when work is commenced to implement the plan and after completion of work.

3. All disturbed areas not draining to some type of sediment-removal facility shall be stabilized within twenty (20) days of affecting these areas, weather permitting.

4. Within thirty (30) days after completion of work authorized in the approved plan, permittee shall file with the Department a statement certifying that work has been performed in accordance with the approved plan.

5. The erosion and sediment pollution controls must be properly implemented, closely monitored and revised, as conditions warrant, to minimize erosion and to prevent excessive sedimentation in the receiving stream channel.

6. The Pennsylvania Fish and Boat Commission and the local County Conservation District shall be notified prior to beginning of construction.

7. The permitee shall exercise caution during the proposed work to eliminate excessive turbidity and sedimentation of the stream channel downstream and shall immediately stabilize all excavated areas by seeding and mulching or other approved means.

8. All material and debris removed from the stream bed shall be moved entirely out of the flood plain area.

9. Care shall be taken so as not to discharge construction materials or sediment into stream waters. No waste construction materials or pollutants may be disposed of into the waters of the Commonwealth (i.e., concrete, gravel, washings, sediment, etc.).

10. The proposed work shall be timed, if possible, during low-flow periods. Any flow during construction must be diverted around the work area. Work within the stream must be minimized (i.e., from the top of bank whenever possible) and completed as quickly as possible, but in no case extending for more than 24 hours.

11. All material and equipment necessary to construct, complete and stabilize work areas and channel must be readily available or on-site prior to beginning of work to avoid unnecessary delays. All disturbed areas within or flowing into the relocated channel shall be stabilized prior to diverting flow into the channel.

12. Any area which is disturbed during this operation shall be stabilized within three (3) weeks of the most recent earth-moving activity in that area, or as soon as weather or seasonal constraints permit. Individual erosion and sediment pollution controls must be maintained until the areas draining to each control are permanently stabilized.

13. Prior to repairing any sinkhole which involves digging a Pennsylvania One Call must be made to 811. The Pennsylvania One Call is how sinkhole repair shall be coordinated with adjacent utilities.

We have made a “Design” One Call and the Utility Contact List has been developed:

Company: Elizabethtown Area Water Authority
Address: 211 W Hummelstown Street
Elizabethtown, Pa. 17022
Contact: Del Becker

Company: Elizabethtown Regional Sewer Authority
Address: 235 Ersa Dr
Elizabethtown, Pa. 17022
Contact: Steven Rettew
Email: Steve@Ersapa.Com

Company: First Energy Penelec
Address: 21 S Main St
Akron, Oh. 44308
Contact: Cara Warren
Email: Carawarren@Firstenergycorp.Com

Company: Ppl Electric Utilities Corporation
Address: 434 Susquehanna Trl
Northumberland, Pa. 17857
Contact: Doug Haupt
Email: Dlhaupt@Pplweb.Com

Company: Lumen/Centurylink
Address: 200 Technology Drive
Pittsburgh, Pa. 15219
Contact: Dan Shento
Email: Dan.Shento@Lumen.Com

Company: David Miller Associates Inc.
Address: 1076 Centerville Road
Lancaster, Pa. 17601
Contact: Scott Hain
Email: Shain@Dmai.Com

Company: UGI Utilities Inc
Address: 1301 AIP DR
Middletown, PA 17057-5987
Contact: Stephen Bateman
Email: sbateman@ugi.com

In Addition to the One Call List we have added the following relevant contact information

West Donegal Township
John O. Yoder III, RA
Township Manager
One Municipal Drive
Elizabethtown, PA 17022
717-367-7178
jyoder@wdtwp.com
www.wdtwp.com

Mount Joy Township
Justin S. Evans, AICP
Township Manager/Zoning Officer
8853 Elizabethtown Road
Elizabethtown, PA 17022
717-367-8917 x.207 (office)
717-719-2089 (cell)
www.mtjoytwp.org

Pennsylvania Department of Transportation
District 8 Office
2140 Herr Street
Harrisburg, PA 17103
Main Phone 717-787-6653
Highway Occupancy Permits 717-787-8789
Mazhar Malik 717-787-8789
Email: mmalik@pa.gov

Amtrak
Krista Keene, Senior Manager
30th Street Station
2955 Market Street, Box 25
Philadelphia, Pennsylvania 19104
Office: (215) 349-3446
Fax: (215) 349-1983
Email: krista.keene@amtrak.com

Utility & Right-of-Way, Occupations, Policies and Procedures, dated 9/30/2020 or latest version should be followed for any work within the Amtrak Right of Way.

***Entering any railroad right-of-way or other railroad property without the written permission of the railroad is trespassing and illegal. Violators will be prosecuted, and they risk the possibility of serious, even fatal, injury.***

## GENERAL SINKHOLE REMEDIATION

When sinkholes require repairs all construction techniques should be in accordance with a geotechnical engineer's report and specifications or as per the attached Chapter 17 of the Erosion and Sedimentation Pollution Control Manual March 2012. Figures 17.1 through 17.4 which provide guidance based on varying conditions that may be encountered in completing the repairs.

If any conditions are encountered that are not specified in these figures, a geotechnical engineer should review the conditions and develop alternative remediation.

SINKHOLE REPAIR

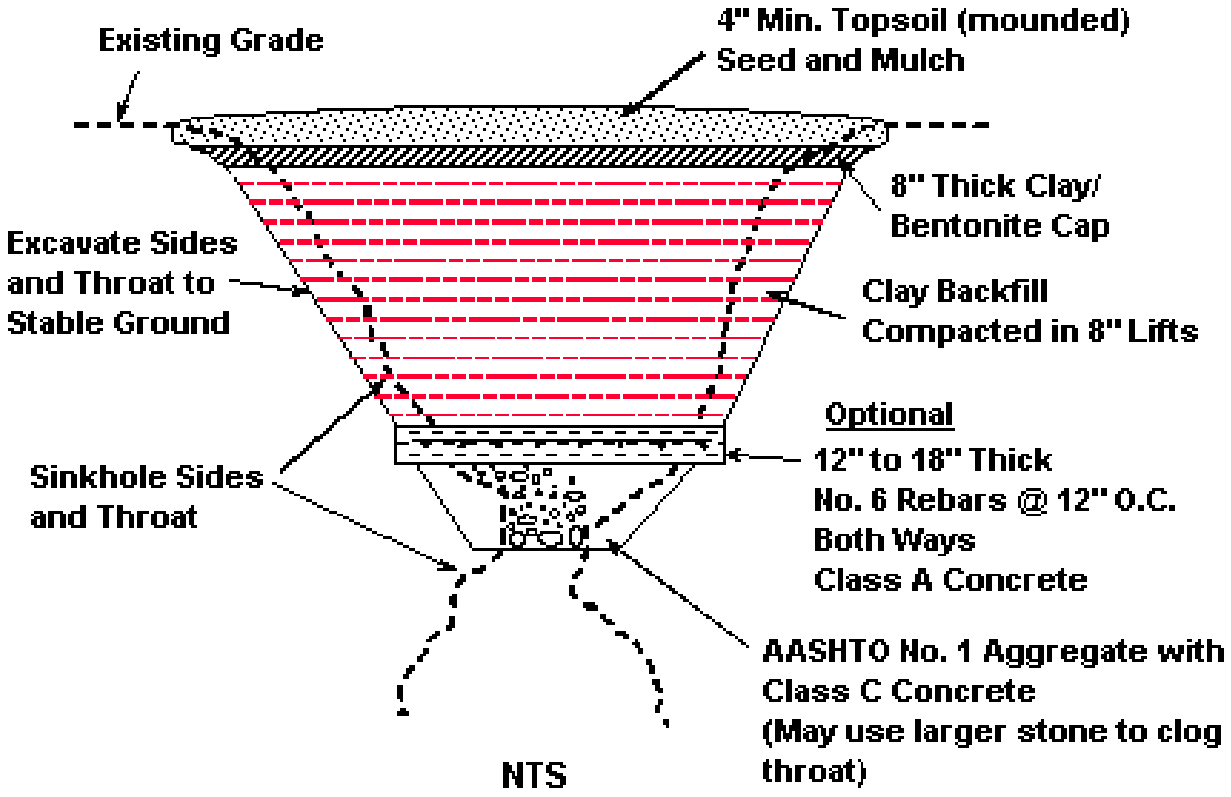
Source Unknown

Sinkholes vary greatly in size and nature. Therefore, specific methods of repairing sinkholes will depend on site conditions including but not necessarily limited to:

- Sinkhole diameter and depth
- Surface slope
- Presence or absence of surface runoff
- Soil type
- Connectivity to public or private water supplies
- Proximity of surface waters
- Ease of access by construction equipment
- Potential danger to the public or damage to structures

Due to the variable nature of sinkholes, they should be repaired under the direct observation and supervision of a professional geologist or licensed geotechnical engineer. Figures 17.1 through 17.4 are provided as general guidelines for the repair of sinkholes. They may be modified as necessary to accommodate specific site conditions. Site specific sinkhole repair plans will be reviewed on a case-by-case basis.

**FIGURE 17.1**
**Sinkhole Repair with a Bentonite Cap**

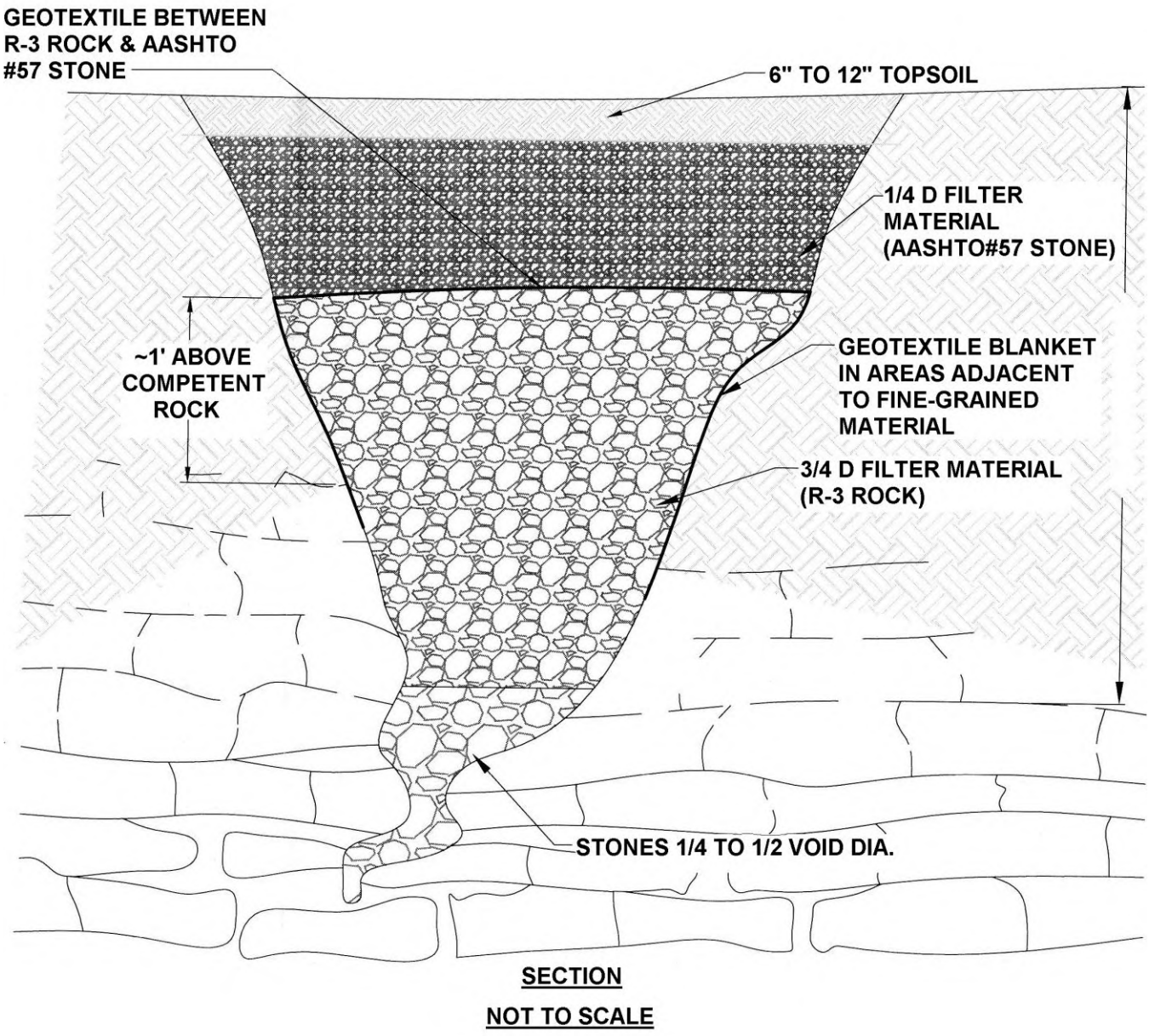



PA DEP

**Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. Occupational Safety and Health Administration (OSHA) regulations must be followed at all times during excavation.**

**Stones used for the "bridge" and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.**

**FIGURE 17.2**
**Sinkhole Repair with a Pervious Cover**

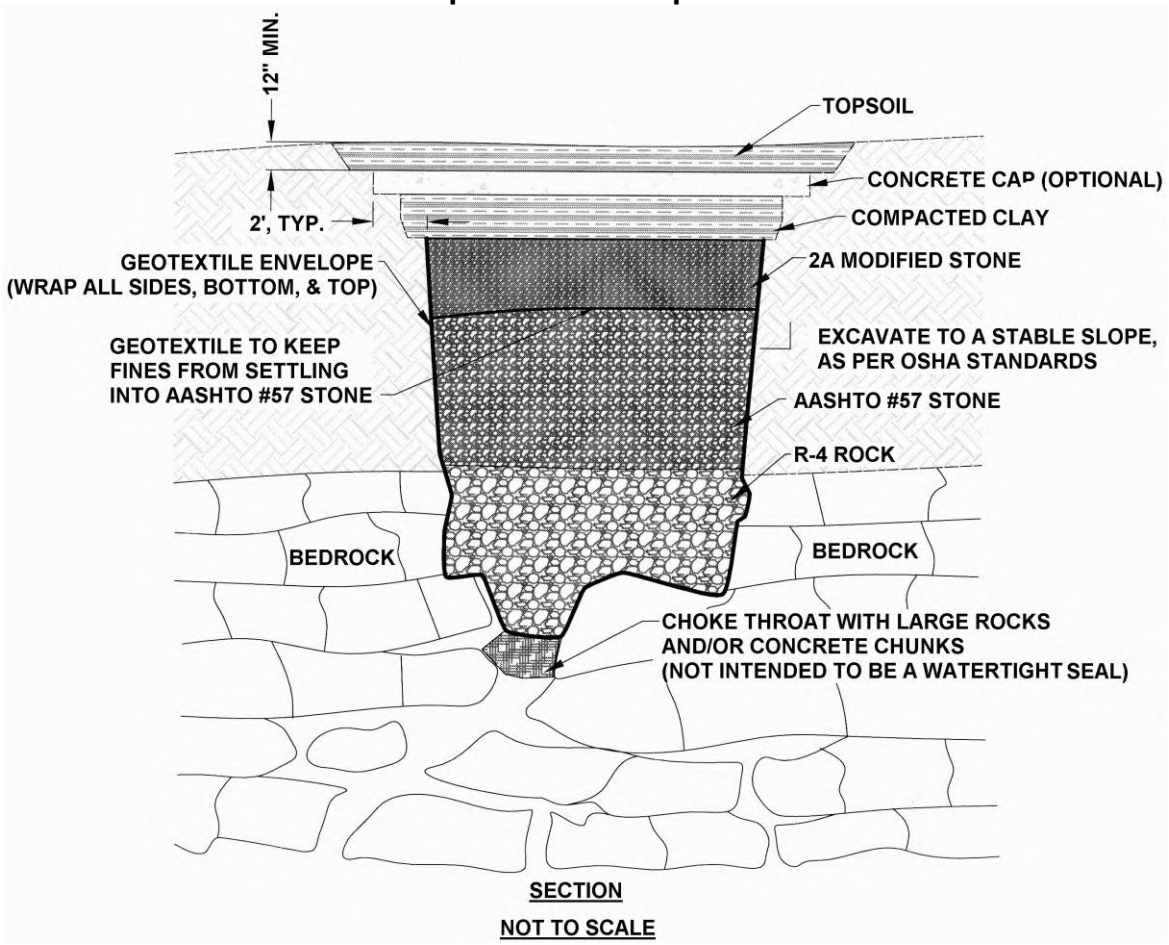



Adapted from USDA NRCS

**Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. OSHA regulations must be followed at all times during excavation.**

**Stones used for the "bridge" and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.**

**FIGURE 17.3**
**Sinkhole Repair with an Impervious Cover**




Adapted from USDA NRCS

**Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. OSHA regulations must be followed at all times during excavation.**

**Geotextile shall be non-woven with a burst strength between 100 and 200 psi.**

**Select field stone(s) about 1.5 times larger than solution void(s) to form "bridge." Place rock(s) so no large openings exist along the sides. Stones used for the "bridge" and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.**

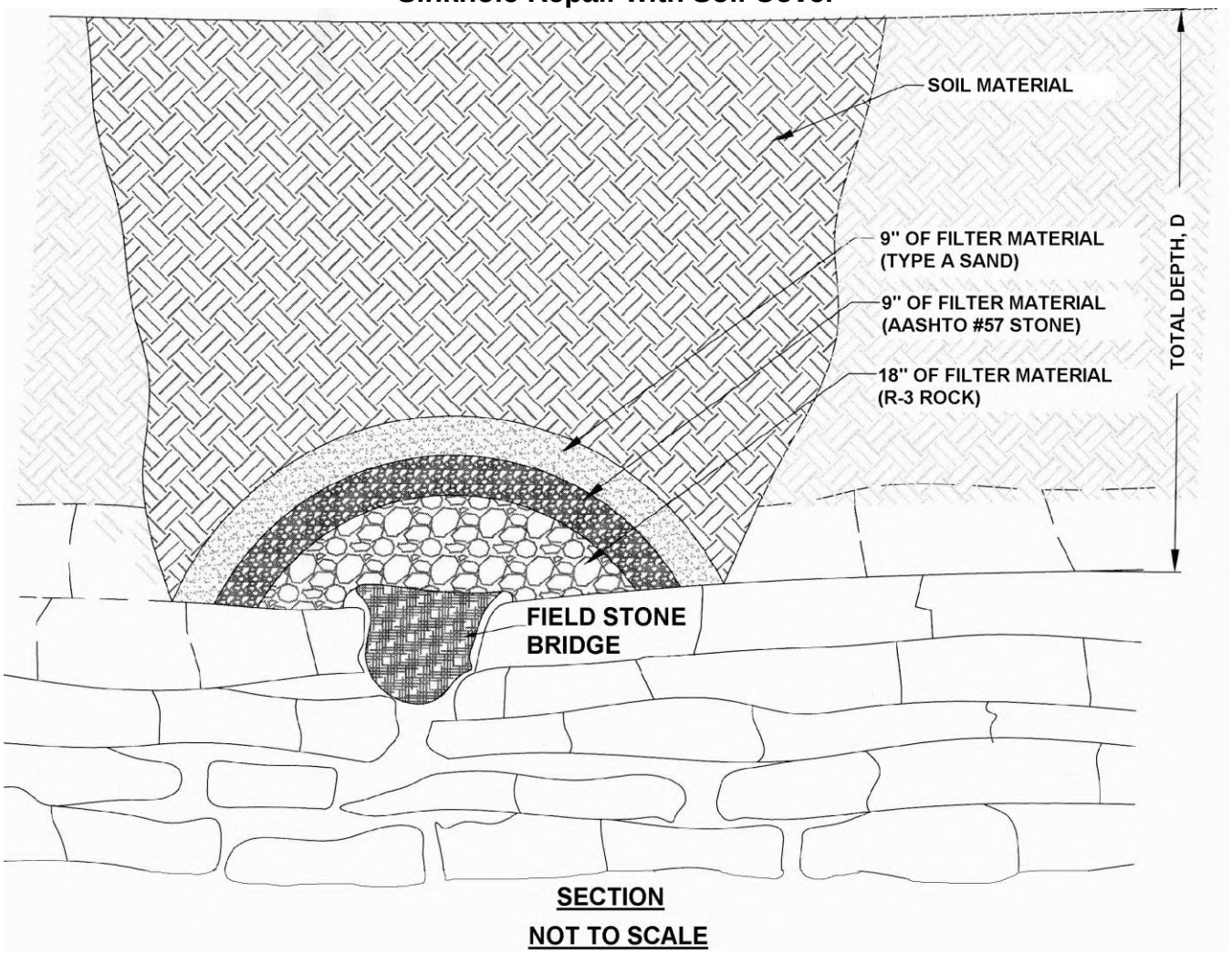
**Minimum thickness of R-4 rock is 18." AASHTO #57 stone thickness shall be ¼ to ½ that of the R-4 rock. Minimum thickness of 2A modified crushed stone shall be 9". AASHTO #57 stone and 2A modified crushed stone shall be compacted after each placement.**

**Compacted clay seal shall be a minimum of 12" thick. Clay shall be placed in 6" to 9" lifts and thoroughly compacted.**

**Concrete cap, which is optional, shall be a minimum of 8" thick. Use 4,000 psi concrete with 6" X 6" - 6 gauge welded wire fabric, or # 3 rebar on 18" O.C. both ways.**

**Topsoil shall be a minimum of 12" thick. Grade for positive drainage away from sinkhole area.**

**FIGURE 17.4**
**Sinkhole Repair with Soil Cover**




Adapted from USDA NRCS

**Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. OSHA regulations must be followed at all times during excavation.**

**Select field stone(s) about 1.5 times larger than solution void(s) to form "bridge." Place rock(s) so no large openings exist along the sides. Stones used for the "bridge" and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.**

**Minimum thickness of R-3 rock is 18." AASHTO #57 stone thickness shall be a minimum of 9" thick. Minimum thickness of type A sand shall be 9". NOTE: A non-woven geotextile with a burst strength between 100 and 200 psi may be substituted for the AASHTO#57 stone and type A sand.**

**Soil shall be mineral soil with at least 12 % fines and overfilled by 5% to allow for settlement. Suitable soil from the excavation may be used. Any available topsoil shall be placed on top surface.**

PLEASE DETACH AND RETURN TOP PORTION WITH YOUR PAYMENT.

| Phone # |
| --- |
| [redacted] |

| P.O. No. | Terms | Project | Rep |
| --- | --- | --- | --- |
| | Due on receipt | | |

| Description | Qty | Rate | Amount |
| --- | --- | --- | --- |
| mobilization and demobilization | 1 | 500.00 | 500.00 |
| Six inch drilling | 300 | 11.00 | 3,300.00 |
| Six inch steel casing | 100 | 29.00 | 2,900.00 |
| Standard PVC/Steel Well cap | 1 | 60.00 | 60.00 |
| Six inch drive shoe | 1 | 82.00 | 82.00 |
| 3/4 HP 10 GPM FPS pump | 1 | 1,303.96 | 1,303.96 |
| wire 12/2 | 315 | 1.33 | 418.95 |
| Coil Pipe 1" | 300 | 1.30 | 390.00 |
| pitless1' | 1 | 122.20 | 122.20 |
| 1' x 1 brass barb adaptor | 3 | 13.40 | 40.20 |
| 1' brass tee X flip | 1 | 28.74 | 28.74 |
| 1'x1' barb coupling brass | 1 | 15.22 | 15.22 |
| 1 1/4' mip 1 fip c/v | 1 | 71.07 | 71.07 |
| Gear clamps 1' | 10 | 2.58 | 25.80 |
| tape | 5 | 4.61 | 23.05 |
| cable guards | 14 | 2.30 | 32.20 |
| splice kit | 1 | 3.70 | 3.70 |
| torque arres. | 1 | 13.91 | 13.91 |
| accessories | 1 | 30.00 | 30.00 |
| service charge | 1 | 120.00 | 120.00 |
| Mechanic labor | 5 | 100.00 | 500.00 |
| Helper Labor | 5 | 90.00 | 450.00 |
| Trench/ backfill removal of drillings from site | 4 | 90.00 | 360.00 |
| Bacteria Nitrate testing/ Total Coliform, E Coli, Nitrate | 1 | 115.00 | 115.00 |

| | |
| --- | --- |
| **Total** | $10,906.00 |
| **Payments/Credits** | -$6,700.00 |
| **Balance Due** | $4,206.00 |

2.7% Surcharge will be added to invoice if paid by credit card.

# KARST PERMITTING SUPPLEMENT

Date: April 25, 2023

Carbonate rock (limestone or dolomite) often has associated karst features that complicate the hydrogeological regime. This form is intended to supply additional information on karst features existing in the general permit area and an assessment specific to potential karst impacts from the proposed mining activities in order to allow the Department to evaluate the hydrologic impacts. This supplement is applicable only for those operations where the permit area or general area has karst geology and must be submitted by a licensed professional geologist (P.G.).

Operations that do not include groundwater pumping in karst geology areas may not need to complete these items if the District Mining Operation waives this informational requirement. The operator is encouraged to consult with their respective DMO prior to submitting this supplemental information.

"General area" is defined in § 77.1 as the topographic and groundwater basin, with respect to hydrology, surrounding a permit area which is of sufficient size, including areal extent and depth, to include one or more watersheds containing perennial streams and groundwater zones.

**1. Location of Karst Features** [§§ 77.403-406, 77.410, 77.521]

*Provide a map labeled "Karst Features" showing karst features (sinkholes, closed depressions, major solution features, cave entrances, extent of cave systems, karst-related springs) for the proposed permit area, and within 1000' of the proposed (or existing + proposed) permit area or within the expected quarry zone of influence, whichever is greater. Integrate with a groundwater contour map or model projection.*

**We have attached mapping with the karst features/Environmental Resources (Module 6.2). The karst dataset was obtained using the PAGEODE website which represents a partial inventory of karst features (herein limited to sinkholes and surface depressions) that have been cataloged in Pennsylvania by the staff of the Pennsylvania Geological Survey since 1985. Karst-feature inventories for fourteen counties (Adams, Berks, Bucks, Centre, Chester, Cumberland, Dauphin, Franklin, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, and York) were originally released as hard-copy open-file reports by the agency. In the dataset, this original data has been supplemented by the results of reconnaissance surveys of eight additional counties (Bedford, Blair, Clinton, Fulton, Huntingdon, Juniata, Lycoming, and Mifflin). There is one mapped sinkhole within the 1,000-foot setback from the proposed SMP area and one just outside of the 1,000-foot limit. In addition to the PAGEODE dataset, we reviewed the permit information and maps for this site for any indication of sinkholes. AEA has reviewed published information on sinkholes mapped by DCNR, in addition to historic aerial photos on Google Earth, historical aerial photographs on Penn Pilot, visual field observations, and previous permit drawings; we have mapped any identified sinkholes or sinkhole-related depressions in the vicinity of Rheems Quarry. Attached are historical aerial photographs from 1940 through 2015, showing the mining site and surrounding area. These photos were also digitally viewed in detail to determine previous karst activity. Currently there are approximately 32 acres of exposed quarry excavation at the Rheems Quarry with one visible void which became visible after a shot during the first quarter of 2023. The feature is approximately 10 diameter and estimated 10 feet deep in the west face at approximately elevation 350. There is no water associated with the void. The void is vertical.**

**2. Description of features** [§§ 77.403-406, 77.410, 77.521]

*Describe the depth, characteristics, and extent of karst features. (Examples: Depth of epikarst and soil/rock interface, presence of karst features in existing boreholes, outcrops and quarry walls, known cave systems, distribution of sinkholes and closed depressions, location volume of karst springs.) If features can be correlated with groundwater levels and gradients, pre-mining conditions, and groundwater pumping records, please describe as applicable.*

**Surface Mining began at the Rheems Quarry site prior to 1940. The mining activities from the 1940's to approximately the 1980's consisted of mining above the groundwater table. This can be identified through examination of aerial photo images from "Penn Pilot" dated 1940, 1947 and 1957, 1971, and images from Google Earth timeline dated from 1992, 1999, 2004, 2010, and 2015.**

**The DCNR website PaGeode was used to download cave systems, sinkholes, and depressions from the "Digital Data Set of Mapped Karst Features in South-Central and Southeastern Pennsylvania 2007 - Pennsylvania Department of Conservation and Natural Resources". These are all shown on the Karst Features Map (6.2).**

**The sinkholes mapped from DCNR have been supplemented with additional points from various timelines on Google Earth, visual observations, and previous permit drawings.**

**The attached Hydrogeologic Study includes discussions regarding fracture-trace-analysis (FTA) to aid in the location of the wells. FTA involves analyzing paired stereoscopic photographs to locate potential fractures on the land surface. The stereoscopic photographs appear 3-dimensional when viewed through stereographic glasses. The surface expressions of the fractures are identified on the photos. In addition to FTA, fractures were also located by identifying them in the quarry high walls, surveying them and projecting them out from the quarry. These have been shown on the Karst Features Map (6.2).**

**The current permit was previously owned and operated by Donegal Rock and prior to them Union Quarries, Inc. We have reviewed that data prepared for previous Surface Mine Permits. Boreholes conducted on the expansion area and also south of the existing pit are shown in detail on the Karst Features Map (6.2).**

**The soil/rock interface is detailed in borings and indicated a varying contact as shallow as 3.5 feet to 22.5 feet in depth in the expansion area which was conducted in 2003. Borehole W-4 indicated a 7-foot void at 13 feet, W-7 has a 3-foot void at 19.5 feet deep, and W-8 had a 5-foot void at 17.5 feet deep. MW-B indicated a 15-foot void at 32 feet and MW-C indicated a 4-foot void at 22 feet. The four monitoring wells drilled in 2022 indicated no voids. In 1990 soils borings were conducted on Sweigerts property directly south of the current SMP and east of the expansion area. No voids were indicated with this drilling program and the soil rock interface varied from 12.5 feet to 45 feet.**

**3. Existing karst impacts** [§§ 77.403-406, 77.410, 77.457, 77.521]

*Discuss the current state of karst issues (sinkholes, ground subsidence, water pollution) in the general area of the proposed permit, their possible cause, and any historical sinkholes. If a pre-existing quarry has karst-related inflows, characterize this flow during both wet and dry conditions, including any data such as temperature, turbidity, conductivity, and water chemistry of the inflow. If dye/tracer tests, geophysical surveys, fracture trace analysis, or other studies were done related to the karst features, discuss these results in context.*

**Quarries are unique in their water handling operations. When there are drought conditions, quarries pumping rates are reduced in response to the drought conditions. Conversely, if rainfall is above average, then pumping rates will tend to be above average. Quarry pumping in general will usually be maintained at a steady rate with only modifications to coincide with precipitation amounts. Discharge data shows the stable pumping rates for many years. The measured pumping rates indicate a very steady consistent pumping rate of around 1 MGD. Continued monitoring of this parameter, along with the continuous logging of the monitoring wells will provide adequate information to monitor the effects of the quarry on the karst features. No changes are required to the NPDES Permit discharge rate.**

**4. Analysis of potential karst impacts** [§§ 77.457(b), 77.521, 77.532(b-c) and 52 P.S. § 3311(b)]

a. *Describe the effects mining will have on movement of subsurface unconsolidated material (karst void filling) and sinkhole development. Include a description of the extent to which the proposed mining may result in the drawdown of groundwater and the effects to surface water recharge rates. Note and consider current land uses, existing ground and surface water uses, and any known or planned development of the adjacent areas that may influence the potential development of future karst hazards that could affect health and safety of the public and land/stream uses. Relate this information to that provided in items #2 and #3 as applicable.*

**A model has been attached for current and future impacts supporting the request mining to elevation 126 MSL. The model analyzes and predicts the future impacts on the surrounding aquifer and karst development.**

**The quarry pumping has the potential to increase karst development. The monitoring systems in place will be adequate to evaluate and protect the surrounding aquifer and its uses from mining impacts.**

b. *Is groundwater injection or infiltration proposed within the permit area?*

☐ Injection ☐ Infiltration ☒ Neither

*If injection or infiltration is proposed, discuss the potential hydrologic impacts on both quantity and quality of the groundwater within and hydrologically connected to the proposed mining area and relate this activity to the information provided in items #2 and #3. Include supporting information associated with any EPA Underground Injection permit.*

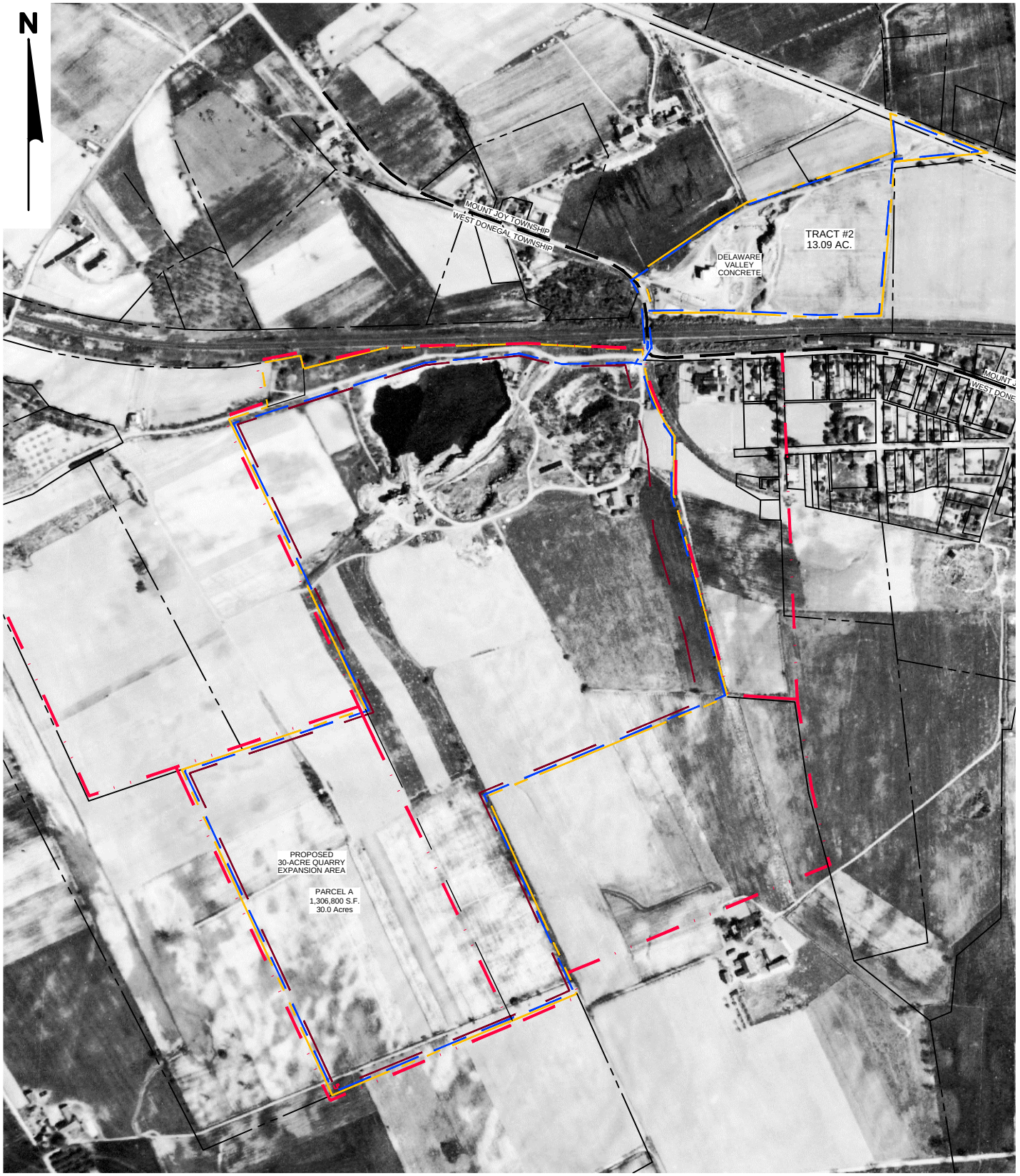
**N/A**

**5. Sinkhole Monitoring and Mitigation Plan** [§§ 77.457(b), 77.521, 77.532(b-c) and 52 P.S. § 3311(b)]

*Provide a general plan for sinkhole monitoring, response, and repair which includes detailed steps to address sinkholes that occur on land, in streams, or along roadways.*

- *Note that additional permits may be needed to conduct operations within a stream and coordination of repairs is necessary for roads or other rights of way.*
- *Include as part of this plan a section on monitoring for signals that a hydrologic disturbance has been observed in the quarry (increase in groundwater infiltration/pumping rates, dirty water inflow, subsidence, stream flow loss, etc.)*
- *Karst features must be documented on the map in Item 1. This map should be updated with data collected under the monitoring plan.*

**Please see attached Sinkhole Mitigation Plan.**




# HISTORIC AERIAL EXHIBIT - 1940

Akens Engineering Associates, Inc.
219 EAST MAIN STREET
SHIREMANSTOWN, PA 17011

## PIERSON RHEEMS LLC
## QUARRY OPERATION
LANCASTER COUNTY, WEST DONEGAL & MT JOY TOWNSHIPS

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| DRAWN BY: | MSI |
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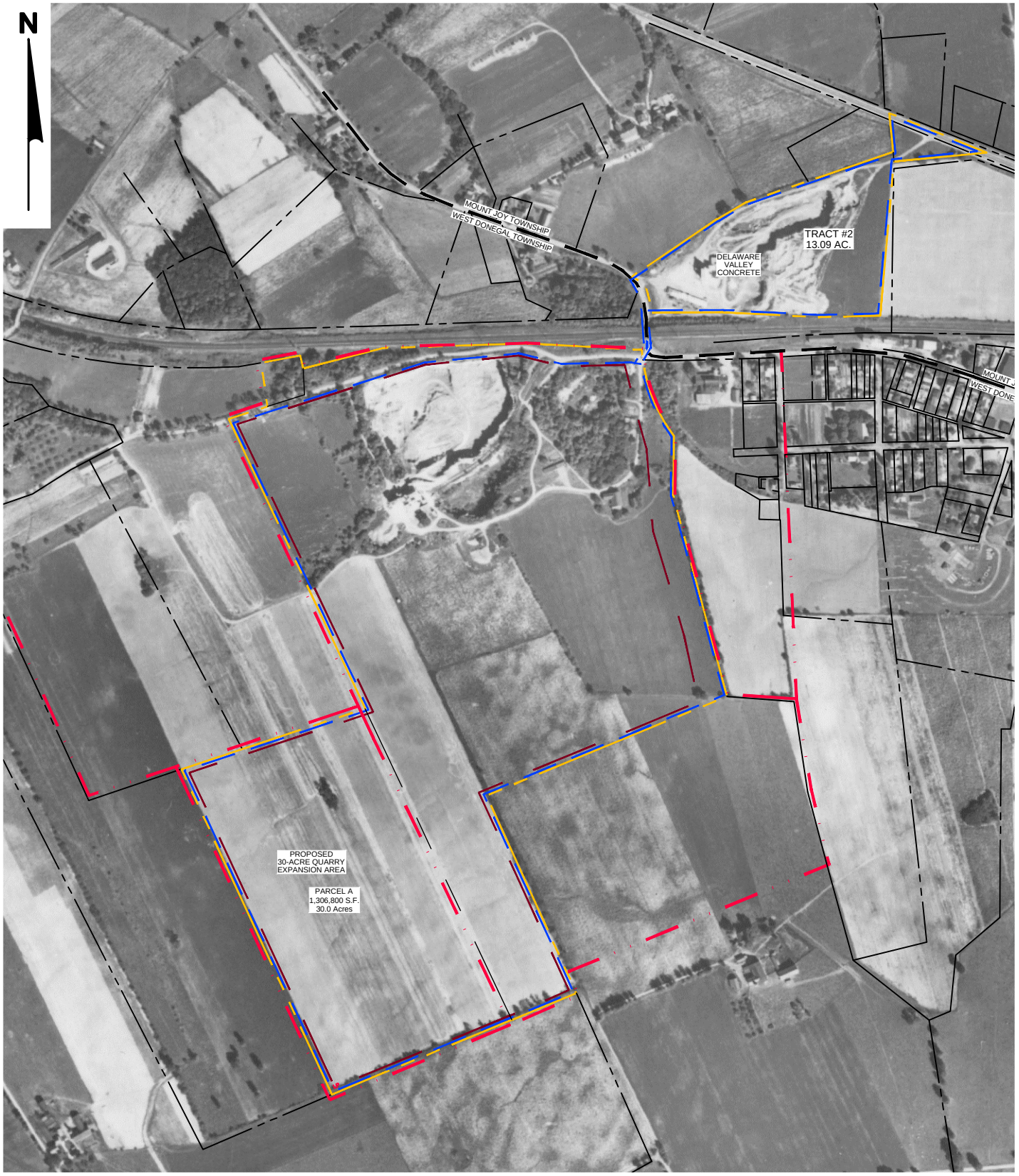


# HISTORIC AERIAL EXHIBIT - 1947

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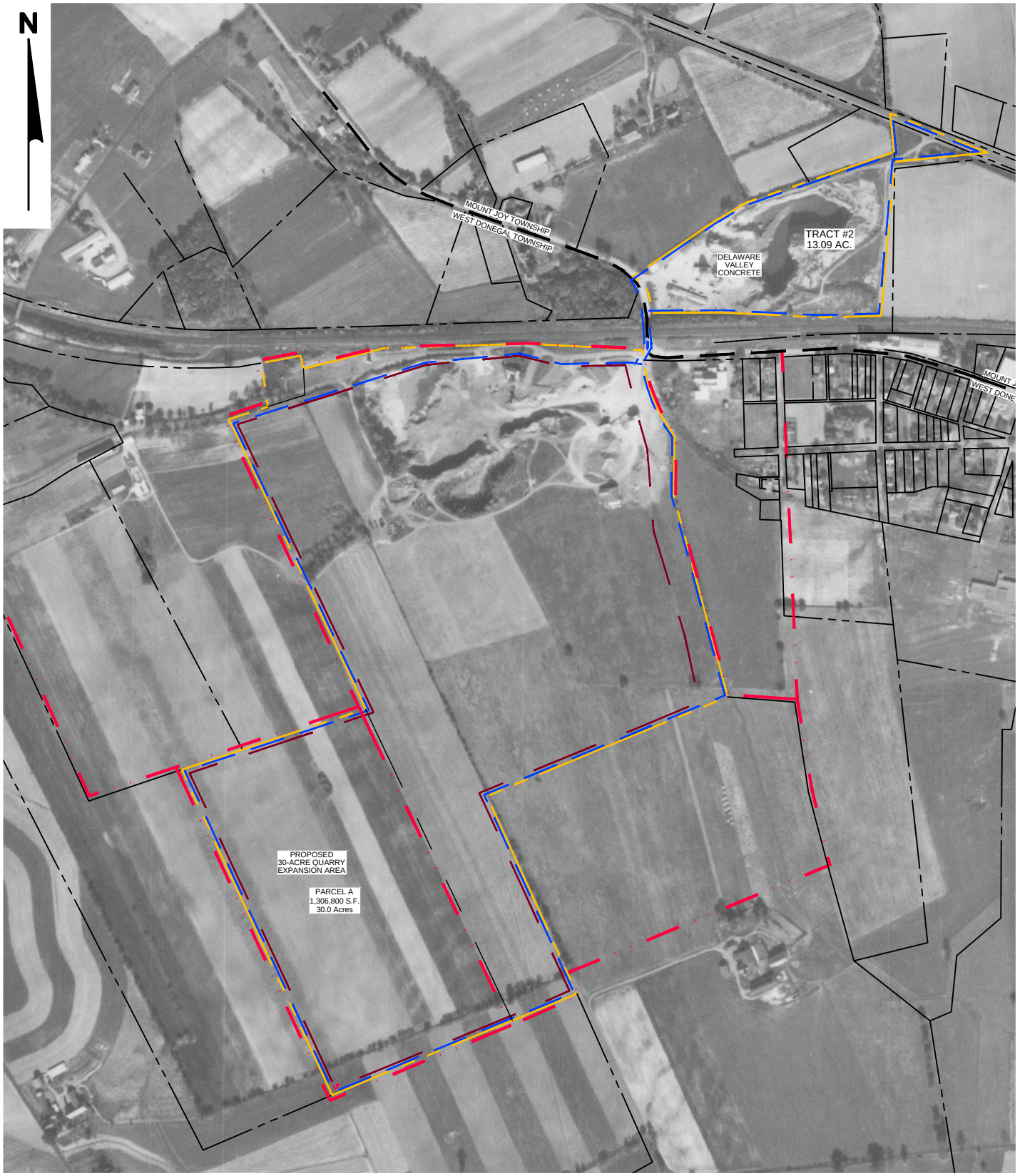


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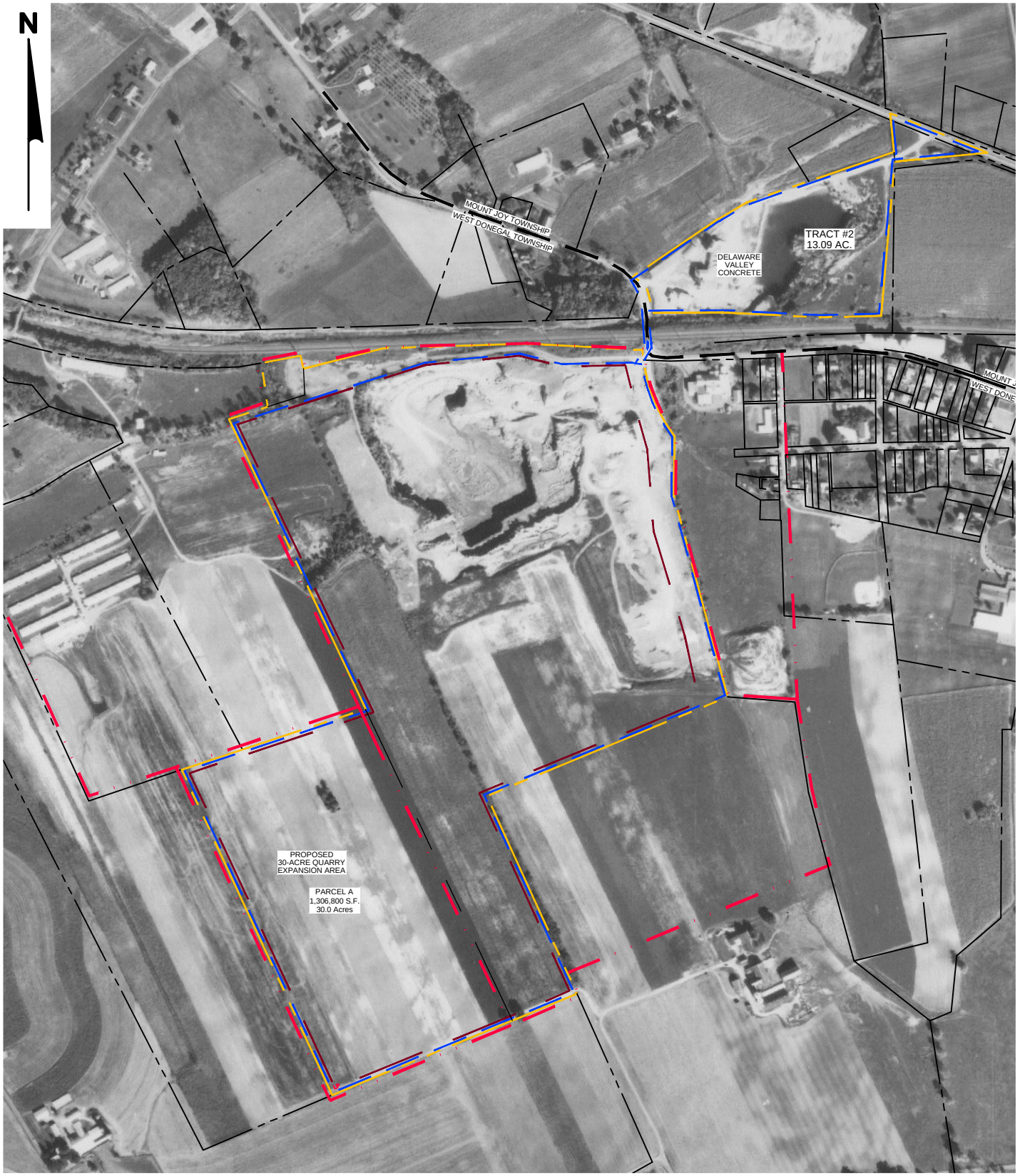


# HISTORIC AERIAL EXHIBIT - 1971

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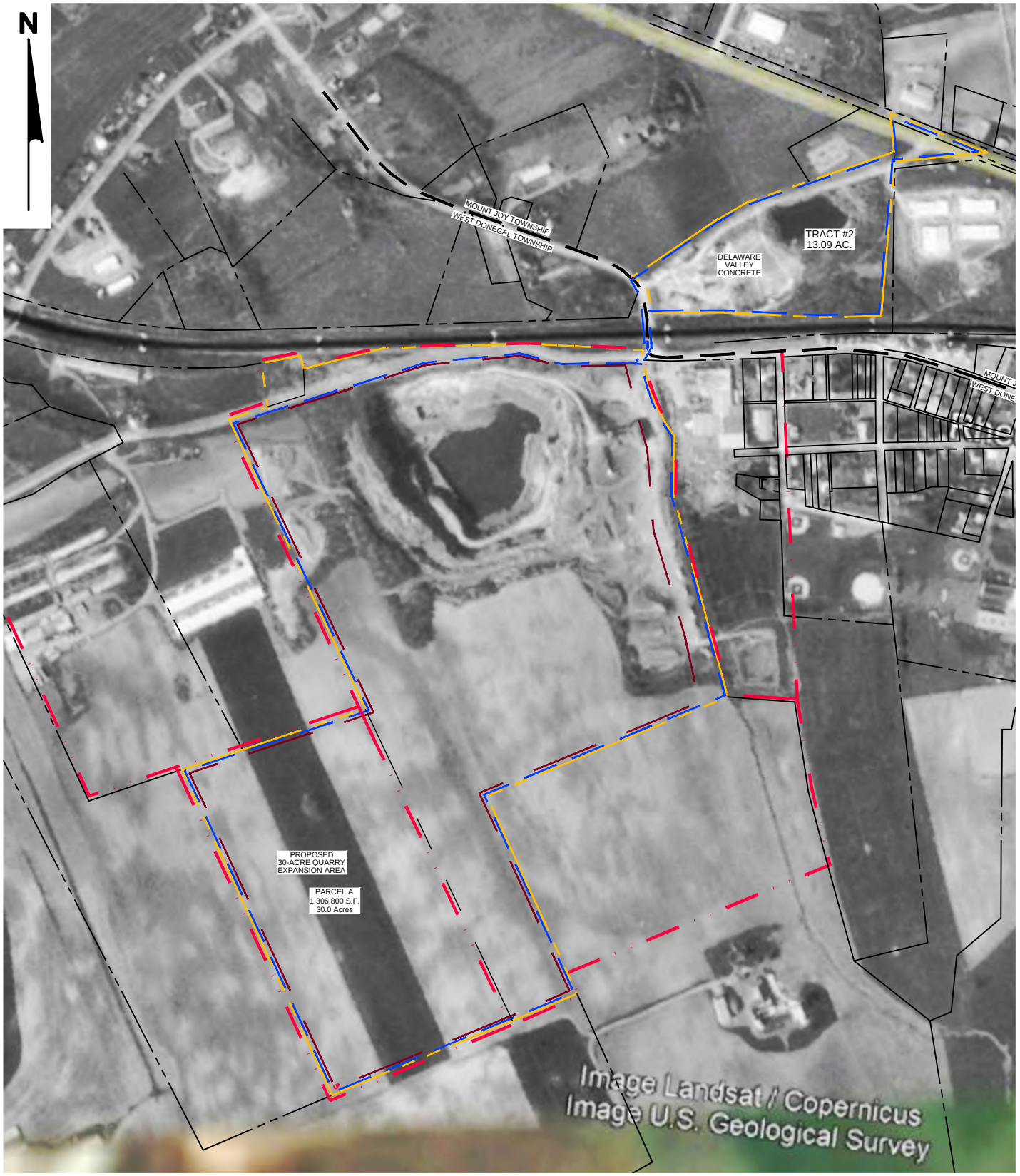


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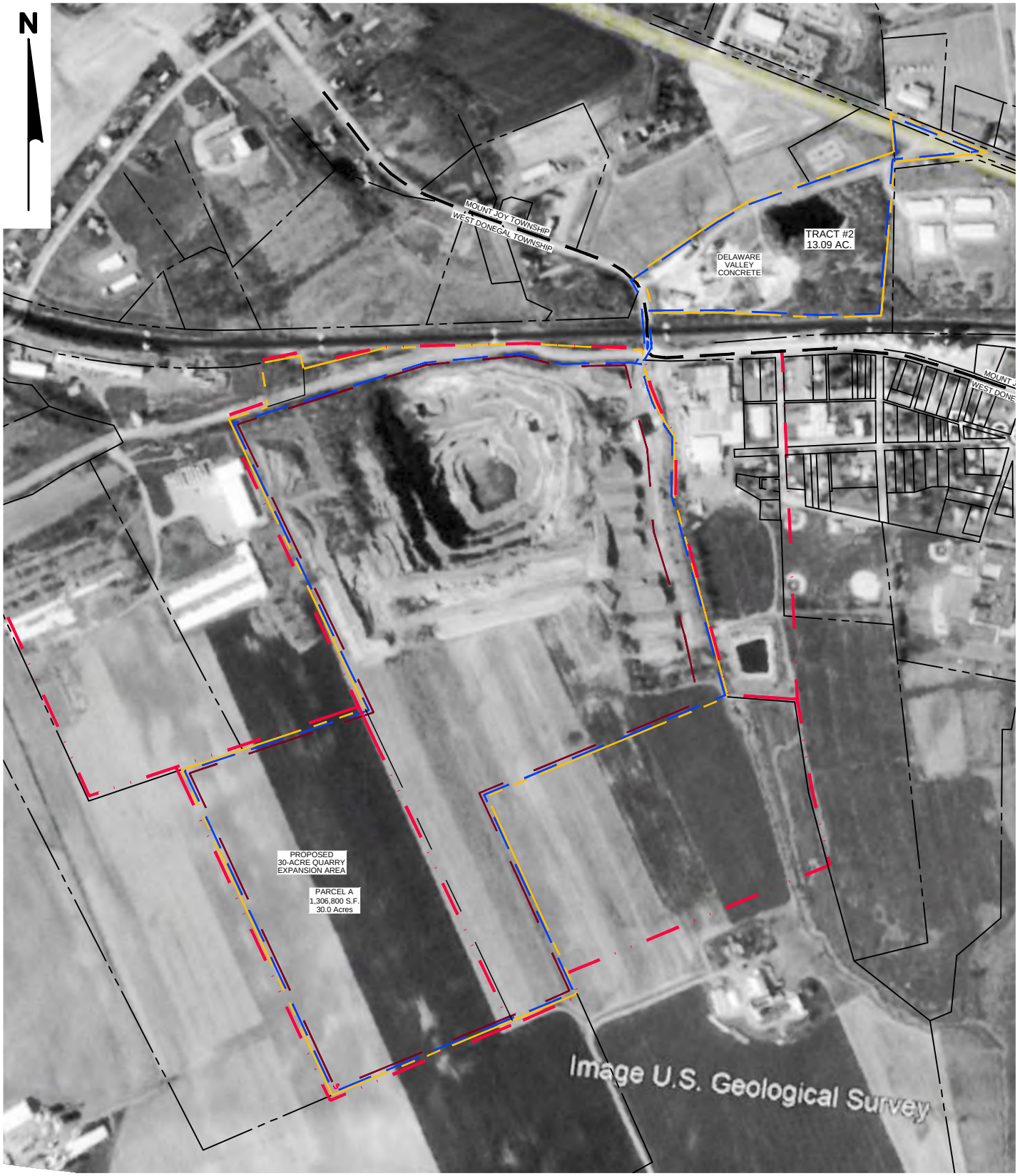


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# HISTORIC AERIAL EXHIBIT - 2004

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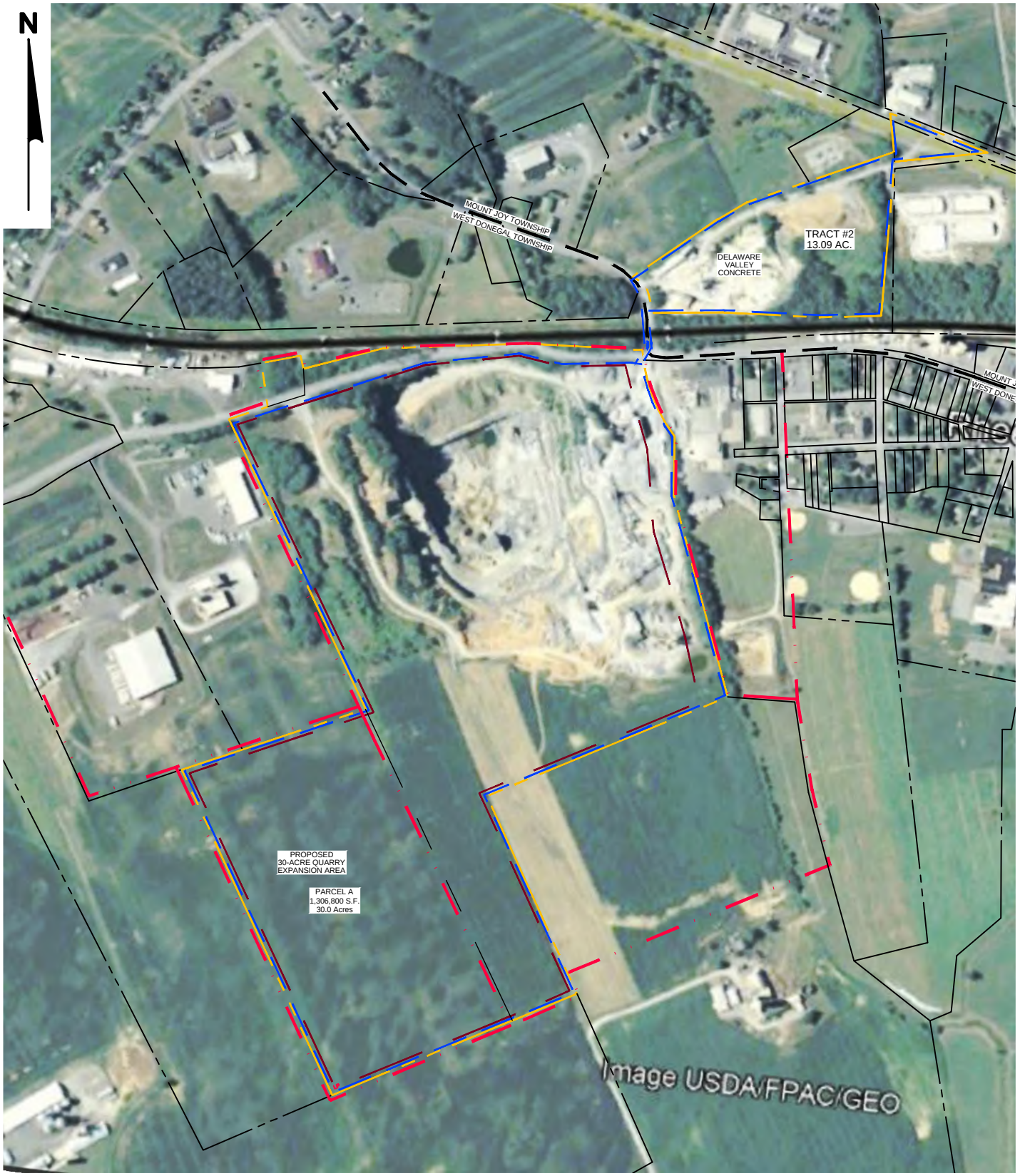


# HISTORIC AERIAL EXHIBIT - 2010


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LANCASTER COUNTY, WEST DONEGAL & MT JOY TOWNSHIPS

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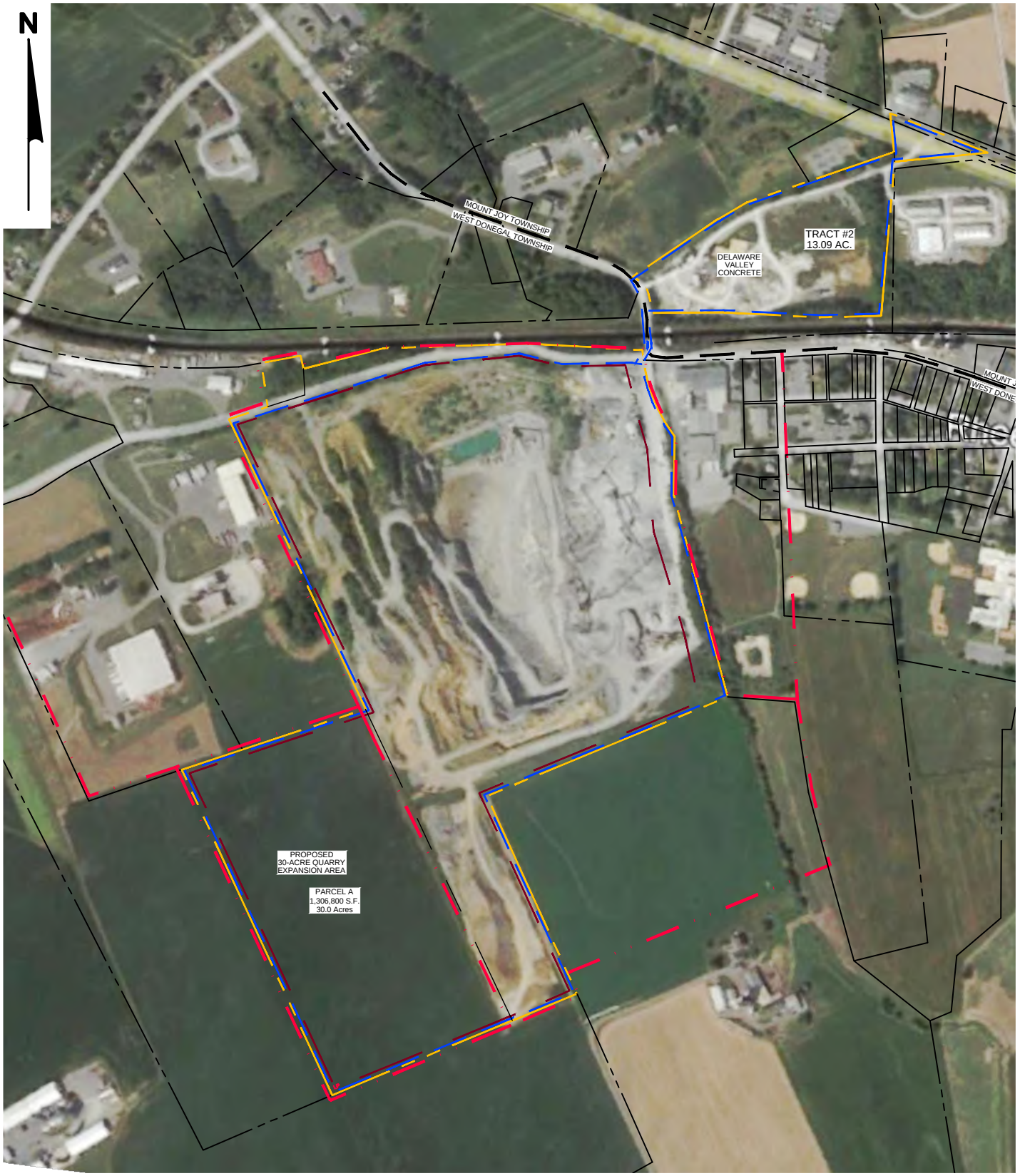


# HISTORIC AERIAL EXHIBIT - 2015

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## QUARRY OPERATION
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