

**SUSTAINABLE WATER-SUPPLY EVALUATION UPDATE
AQUETONG CREEK DRAINAGE BASIN
SOLEBURY TOWNSHIP, PENNSYLVANIA**

PREPARED FOR
SOLEBURY TOWNSHIP
BUCKS COUNTY, PENNSYLVANIA

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1.0 INTRODUCTION

UHL & Associates, Inc. (UHL) was retained by Solebury Township to provide a current sustainable water-supply evaluation of the Aquetong Creek Drainage Basin (**Figure 1**). An initial evaluation developed in 2000 was previously updated in 2005 (VUA, 2000 & 2005). Current groundwater-level measurements will be presented, when available, in an addendum to this report.

The quantitative sustainable water-supply evaluation presented in this report addresses the concentrated area of groundwater pumping in the Solebury Township Route 202 Corridor and New Hope Borough. A comparison of groundwater recharge to withdrawal is derived for an approximately 3.123-square mile (sq. mi.) area underlain by the Brunswick Aquifer. This area (“the study area”), is outlined in yellow on **Figure 3**, and includes in whole or part, three small adjacent drainage basins, as well as part of the Aquetong Creek Drainage Basin, since they contain proximate major pumping centers in the same aquifer.

This report presents major pumping wells withdrawal and related wastewater data compiled for the years 2005 through 2019. The groundwater demand, calculated as the average annual usage for the years from 2012 to 2019, is compared to the estimated annual groundwater recharge during periods of normal precipitation, drought precipitation, and at the “potentially stressed” criterion as defined by the Delaware River Basin Commission (DRBC) for the SE Pennsylvania Groundwater Protected Area (*18 CFR § 430.13 - Protected area permits for new withdrawals*).

Residential developments of significant size were constructed between the mid to late 1990’s and 2005 in this area, including the Fox Run Preserve, North Pointe, New Hope Manor, and Riverwoods. Construction of new developments decreased thereafter.

2.0 BACKGROUND

Aquetong Creek flows from its principal source, Ingham Spring, eastward through New Hope to the Delaware River. Ingham Spring is located in proximity to the Furlong Fault, the contact between the higher groundwater yielding Carbonate Aquifer and the Brunswick Aquifer (**Figure 2**). Other tributaries to Aquetong Creek head in the northwest part of the basin near Upper York Road and in the southern part of the basin draining off Solebury Mountain.

The Aquetong Creek Drainage Basin is 8.0 square miles in area and is underlain by sedimentary rocks (Brunswick and Stockton Formations), carbonate rocks (Leithsville, Allentown, and Beekmantown Formations) and diabase (**Figure 2**). The Stockton Formation is present in the western part of the basin; the Carbonate rocks in the central part; and the Brunswick Formation in the eastern basin area. The diabase rocks form Solebury Mountain in the southeast part of the basin.

The most populated part of the Aquetong Creek Drainage Basin is along the Solebury Township Route 202 Corridor and in New Hope Borough that are underlain by the Brunswick Formation (Brunswick Aquifer) and most of the community, commercial, institutional, and public water system production wells are completed in this formation (**Figure 3**). Groundwater serves as the source of water supply in the Solebury Township Route 202 Corridor & New Hope Borough, except for the Water Works development in New Hope, which extracts surface water from the Delaware River

For the areas of the Aquetong Creek Drainage Basin underlain by the Stockton Aquifer, the Carbonate Rock Aquifer, and Diabase rocks, the principal groundwater withdrawals are for residential and farm use, and much of the water that is pumped is recharged back into the aquifer systems via on-site septic systems. For these aquifer units, groundwater recharge is significantly greater than groundwater withdrawals.

Therefore, the quantitative sustainable water-supply evaluation addresses the concentrated area of groundwater pumping in the Solebury Township Route 202 Corridor & New Hope Borough outlined in yellow on **Figure 3** as an approximately 3.123-square mile area, which is underlain by the Brunswick Aquifer. The largest portion of this area (~60%) lies within the Aquetong Creek Drainage Basin. Small adjacent drainage basins, part of Rabbit Run Drainage Basin to the north, and an unnamed basin and part of Dark Hollow Run Drainage Basin to the south, are also included in this area (see **Figure 3**). The inclusion of these basins is predicated on the fact that they contain major pumping centers: the Morrisey Wells which serve as New Hope production wells in the Rabbit Run basin, and the Riverwoods wells in the unnamed basin, and contribute to the overall pumping stress on the Brunswick Aquifer in this area.

Groundwater withdrawals (as presented in Section 3.0) are compared with the groundwater recharge estimates (as derived in Section 4.0) for periods of normal precipitation, drought and for the Delaware River Basin Commission (DRBC) definition of a “potentially stressed system” which is 75% of drought precipitation on an annual basis.

3.0 GROUNDWATER USAGE IN THE AQUETONG DRAINAGE BASIN

Major pumping centers in the Solebury Township Route 202 Corridor & New Hope Borough are discussed in Sections 3.1 and 3.2. Most of these wells/systems are owned and/or operated by the Bucks County Water & Sewer Authority (BCWSA) or the North Wales Water Authority (NWWA). These wells often supply individual developments, however, there are also production wells serving wider public systems (i.e., the BCWSA-operated Morrisey wells, the New Hope Manor well, and the Riverwoods wells in New Hope Borough).

Tables 1 and 2 provide compiled annual groundwater usage values for the years from 2005 through 2019 for major pumping centers in the Solebury Township Route 202 Corridor & New Hope Borough, respectively, and total annual usage in gallons per year (GPY) and conversions into million gallons per day (MGD). Compiled total wastewater, surface water and groundwater usage quantities are summarized in **Table 3**.

In addition to these major sources of groundwater withdrawal, there are hundreds of residential, commercial, and institutional wells in the Aquetong Creek Drainage Basin, and many wells are completed in the Brunswick Aquifer in the “study area”. Most of the properties with these wells in the Route 202 Corridor and New Hope Borough are connected to the sanitary sewer system. Therefore, the cumulative groundwater withdrawal from these wells can be estimated by a comparison of (a) the total groundwater withdrawal from documented water supply systems (**Tables 1 & 2**) and (b) total wastewater flow from the study area to the Lambertville Municipal Utility Authority (LMUA) treatment plant as discussed in Section 3.3.

3.1 Major Pumping Centers in the Solebury Township Route 202 Corridor

Major wells/water-supply systems in the Solebury Township Route 202 Corridor are shown on **Figure 3** and listed below.

The following eight production wells/systems are operated by NWWA:

- Hermitage residential community wells 1 & 2.
- Yorkshire Meadows residential community wells 1 & 2.
- Ingham Mews residential community wells 1 & 2.
- Logan Square commercial wells 1 & 2.

The following four production wells/systems are operated by BCWSA:

- Fieldstone and Wilshire Hunt residential community wells S-1 and S-2,
- North Pointe residential community well S-3,
- Fox Run Preserve residential community well.

The following four production wells/systems are privately owned and operated:

- Clarion Inn & Suites wells 1 & 2.
- New Hope Star Diner well.
- Jamie Hollander / Enterprise et al. shopping plaza well.

In Solebury Township, NWWA assumed operation of the Hermitage, Ingham Mews, and Yorkshire Meadows well/water systems on January 1, 2015. According to NWWA, the decrease in water usage at these locations may be attributed to programs to detect and repair leaks in the

systems; installed individual residential meters; and efforts to raise conservation awareness (**Table 1**). NWWA commenced operating the Logan Square water system on February 1, 2016.

3.2 Major Pumping Centers in New Hope Borough

Major public and private water-supply water systems in New Hope Borough are shown on **Figure 3** and listed below.

The following five production wells/systems are operated by BCWSA:

- Riverwoods community wells 2C & 3B.
- New Hope Manor institutional and production well.
- Morrisey production wells B and C.

The following production wells/system is privately owned and operated:

- Village 2 residential community wells 1 & 2.

Major changes to the water-supply configuration have taken place within New Hope Borough since the last update in 2005. Most individual water users in New Hope have connected into the BCWSA public water-supply system. The CVS/Cornerstone/ McCaffrey's shopping plaza and the New Hope-Solebury School also ceased operating individual wells for potable water supply in 2006 and connected to the BCWSA system.

Pumpage from the New Hope Manor well, located at the northwest corner of the borough and utilized as a production well for New Hope, jumped from approximately 1,150,000 gallons per year (GPY) in 2005 and 2006 to 18,000,000 GPY in 2008, and continued to increase to over 20,000,000 in 2012, where it has remained since (**Table 2**).

BCWSA acquired two wells, Morrisey Wells B and C, located on the north end of New Hope (see **Figure 3**), that were previously privately owned by James D. Morrisey, Inc. for use in ready-mixed concrete manufacturing. BSWA put these wells into production in 2011, and the combined total pumpage increased over several years, as commercial and residential users in New Hope connected.

3.3 Wastewater Pumped from the Solebury Township Route 202 Corridor & New Hope Borough

Solebury Township along the Route 202 Corridor and New Hope Borough are connected to the BCWSA sanitary sewer system, and wastewater from these areas is pumped across the New Hope – Lambertville Delaware River Bridge to the Lambertville Municipal Utilities Authority sewage treatment plant. The area that is serviced by this sewer system is shown on **Figure 4**, overlaid on the Solebury Township Route 202 Corridor & New Hope Borough study area. The figure illustrates that the two areas are closely aligned, and therefore, the quantity of wastewater pumped from this area may be considered a good approximation of total water usage in the study area.

The total wastewater stream that is collected by the BCWSA sanitary sewer system in the study area includes: (a) the major groundwater pumping centers in the Solebury Township Route 202 Corridor and New Hope Borough, described in Sections 3.1 and 3.2, above, (b) additional groundwater usage by the many residences, commercial establishments and institutions that are on individual wells in the area, and (c) input from the surface-water supply operated by BCWSA for the New Hope Waterworks development.

The annual total wastewater volumes with surface-water and groundwater usage components, as well as the combined groundwater pumpage volumes from the major pumping centers from 2005 through 2019 are summarized on **Table 3**.

3.4 Groundwater Withdrawal Estimate for the Solebury Township Route 202 Corridor & New Hope Borough (Annual Average 2012 – 2019)

With respect to the major pumping centers in the study area, Tables 1 and 2 show a general transition period from 2005 to 2015, with the water-supply system changes discussed in Sections 3.1 and 3.2. The last eight years from 2012 to 2019 reflect a relatively stable period. This stable 8-year period was selected as the basis for the Groundwater Withdrawal estimate for the study area.

In these last eight years, the total combined annual pumpage even declined slightly from 151,202,311 GPY (0.414 MGD) in 2012 to 139,834,274 GPY (0.383 MGD) in 2019 (Table 3). On average, through these eight years, the major pumping centers in the Solebury Township Route 202 Corridor represented approximately 44% of the total pumpage, and New Hope Borough, 56%.

The total quantity of wastewater that was pumped from the study area to the LMUA facility in the years 2012 through 2019 ranged from 152,655,000 to 171,710,000 GPY (0.418 to 0.470 MGD). LMUA noted that groundwater is apt to leak into the wastewater piping system during years of high precipitation (for example, accounting for the highest volume of wastewater in 2018). Therefore, eliminating the year 2018, in which the groundwater usage component of the wastewater stream is likely overestimated, the average total wastewater volume is calculated to

be 161,071,018 GPY (0.441 MGD), and eliminating the surface water usage component, the average groundwater usage component is calculated to be 160,160,163 GPY (0.439 MGD).

As discussed above, the difference between (a) the total combined pumpage from the major pumping centers in the study area and (b) the higher groundwater usage component of the wastewater volume, covers the individual wells within the study area. The difference between the average total major pumping centers values of 148,684,337 GPY (0.407 MGD) and the average groundwater usage component of the wastewater volume of 160,160,163 GPY (0.439 MGD) for the years 2012 to 2019 is 0.032 MGD. It may be noted that this amount represents approximately 7.0 % of the average groundwater usage component.

This average groundwater usage component of the wastewater volume from 2012 to 2019 of 160,160,163 GPY (0.44 MGD), is conservatively taken as the total annual Groundwater Withdrawal estimate for the study area. In Section 5.0, it is compared to the estimated groundwater recharge for this area of the Brunswick Aquifer, as derived in Section 4.3.

Figure 5 is a plot of annual precipitation; groundwater withdrawals from major pumping centers, and wastewater flows to the LMUA facility from 2012 to 2019.

4.0 GROUNDWATER RECHARGE ESTIMATES FOR THE AQUETONG CREEK DRAINAGE BASIN

The groundwater recharge analysis developed for the Aquetong Creek Drainage Basin provides estimates of annual groundwater recharge during periods of normal precipitation and drought. This analysis provides an indication as to the sustainable limits of available groundwater that can be pumped from the aquifer systems in this drainage basin without having adverse impacts such as depletion of groundwater storage; reduction of stream baseflow that supports stream system ecological water needs; and the lowering of water levels in public and private water-supply wells utilized for domestic, commercial, and institutional purposes.

4.1 Recharge Evaluation Approach

In an unstressed drainage basin with minor groundwater withdrawals (e.g. in a basin with private well residential use only), the recharge that the aquifer system receives ultimately discharges to the stream or river systems in the basin. Therefore, groundwater recharge is essentially equivalent to stream baseflow (dry weather streamflow) in the basin.

The United States Geological Survey (USGS, 1996) studied the Neshaminy Creek drainage basin, and developed recharge estimates for various bedrock units using stream baseflow measurements under a wide range of climatic conditions from very dry periods (severe drought) to years of normal precipitation. The Neshaminy basin is just west of the Aquetong Creek basin and is characterized by similar geologic and aquifer units.

Table 4 summarizes the findings of the USGS analysis. The 2-year base-flow recurrence interval of 0.314 million gallons per day per square mile (MGD/sq. mi.) for the Brunswick Aquifer represents the magnitude of groundwater baseflow (equivalent to groundwater recharge) that will occur in a year of average precipitation over a 1-square mile area. A 25-year base-flow recurrence interval of 0.154 MGD/sq. mi. represents the magnitude of groundwater baseflow (groundwater recharge) that will occur every 25 years. The 2-year baseflow quantity is the amount of groundwater recharge that occurs during a year of normal precipitation for the respective geologic units and the 25- and 50-year baseflow quantities represent groundwater recharge during dry (drought) and very dry (severe drought) periods.

Table 4: Baseflow Recurrence Intervals for Geologic Units in the Neshaminy Creek Basin (USGS, 1996)

Aquifer Type	Discharge in Million Gallons per Day per Square Mile (MGD/sq.mi.)				
	2-Year	5-Year	10-Year	25-Year	50-Year
Brunswick Aquifer	0.314	0.241	0.189	0.154	0.144
Stockton Aquifer	0.627	0.401	0.343	0.189	0.158
Carbonate Aquifer	0.706	0.481	0.408	0.289	0.278
Crystalline Rocks/ Diabase	0.524	0.381	0.302	0.299	0.206

Table 4 indicates that the shale/siltstone/mudstone rocks of the Brunswick Aquifer receive substantially less recharge than the Carbonate Rock and Stockton Sandstone Aquifers. These recharge values, in MGD of baseflow discharge per unit area, can be applied to the Aquetong Creek Drainage Basin.

4.2 Application by Rock Type to the Aquetong Creek Drainage Basin

Table 5 shows the percent of area underlain by each geologic/aquifer unit in the Aquetong Creek Drainage Basin, and groundwater recharge estimates for the areas of each unit for years of normal (2-year recurrence interval) and drought (25-year recurrence interval) precipitation.

Although it is not directly applicable to the study area, the last column in **Table 5** is included to provide a comparison to the Delaware River Basin Commission (DRBC) “Potentially Stressed” criterion for the “Southeast Pennsylvania Ground Water Protected Area” (SEPA-GWPA). The DRBC sets this at 75 percent of the 25-year recurrence interval values.

As per 18 CFR § 430.13 - Protected area permits for new withdrawals: “Baseflow frequency analyses shall be conducted for all subbasins in the Southeastern Pennsylvania [Ground Water Protected Area](#). The analyses shall determine the 1-year-in-25 average annual baseflow rate. The 1-year-in-25 average annual baseflow rate shall serve as the maximum withdrawal limit for

net annual ground water withdrawals for subbasins. If net annual ground water withdrawals exceed 75 percent of this rate for a subbasin, such a subbasin shall be deemed “potentially stressed.” The Commission shall maintain a current list of net annual ground water withdrawals for all subbasins. “Net” annual ground water withdrawals includes total ground water withdrawals less total water returned to the ground water system of the same subbasin.”

Table 5: Aquetong Creek Drainage Basin: Baseflow (Equivalent to Groundwater Recharge) for 2-Year, 25-Year, and 75% of 25-Year Recurrence Intervals

Geologic Unit/Group	Discharge in Million Gallons per Day per Square Mile (MGD/sq.mi.)			
	Area in square miles	2-Year	25-year	75 % of 25-year
Brunswick	3.0 (42%)	0.94	0.46	0.35
Stockton	2.1 (24%)	1.31	0.39	0.29
Carbonate	2.7 (31%)	1.91	0.78	0.59
Diabase	0.2 (3%)	0.10	0.06	0.045
Total	8.00 (100%)	4.27 MGD	1.69 MDG	1.27 MGD

4.3 Groundwater Recharge Estimates for the Brunswick Aquifer in the Solebury Township Route 202 Corridor & New Hope Borough

As discussed above, the quantitative sustainable water supply evaluation addresses the area of concentrated pumping along the Solebury Township Route 202 Corridor & New Hope Borough. This study area is the approximately 3.123 square mile area outlined by the yellow line on **Figure 3**.

Annual groundwater recharge to this area is estimated by applying the unit baseflow discharge (equivalent to groundwater recharge) for the Brunswick Aquifer derived from the 1996 USGS study to this area for periods of normal precipitation (2-Year Recurrence), drought (25-Year Recurrence), and the DRBC defined “potentially stressed system” value which is 75% of the 25-year recurrence value.

Table 6: Solebury Township Route 202 Corridor & New Hope Borough Study Area Groundwater Recharge Estimates for 2-Year, 25-Year, and 75% of 25-Year Recurrence Intervals

Study Area Underlain by The Brunswick Aquifer**	Groundwater Recharge Recurrence Interval		
	2-Year (MGD)	25-year (MGD)	75 percent of 25-year (MGD)
3.123 sq.mi.	0.98	0.48	0.36

** The Aquetong Creek Drainage Basin comprises 1.9 sq. mi.; the Rabbit Run drainage basin 0.8 sq. mi., and the unnamed and Dark Hollow drainage basins 0.3 sq. mi. of the Solebury Township Route 202 Corridor & New Hope Borough 3.123-sq. mi. study area.

5.0 COMPARISON OF THE RECHARGE ESTIMATES TO GROUNDWATER WITHDRAWAL

Table 7 provides a comparison of the total average annual groundwater withdrawal estimate for 2012 through 2019 (as calculated in Section 3.4) for the study area with the annual groundwater recharge estimates (as derived in Section 4.3) for periods of normal precipitation, drought, and the DRBC “potentially stressed system” value.

Table 7: Solebury Township Route 202 Corridor and New Hope Borough Study Area: Comparison of Groundwater Recharge Estimates and Groundwater Withdrawal

	Baseflow Recurrence Interval		
	2-Year (MGD)	25-year (MGD)	75 percent of 25-year (MGD)
Groundwater Recharge Estimate	0.98	0.48	0.36
Groundwater Withdrawal Estimate	0.44	0.44	0.44
Groundwater Surplus/ Deficit	+ 0.54	+ 0.04	- 0.08

According to the analysis, the level of groundwater withdrawal is at approximately 45% of the estimated annual groundwater recharge in years of normal precipitation, and at about 92% of the estimated annual recharge in years of below normal precipitation (drought).

Although not directly applicable, the current estimated average annual groundwater withdrawal is 0.08 MGD (22%) greater than the “potentially stressed criterion” as defined by the DRBC for the SEPA-GWPA.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Pumpage Analysis

- In the Study Area (Route 202 Corridor and Borough of New Hope — both within the Brunswick Aquifer), groundwater pumpage is estimated at 0.44 MGD. This estimate is based on the previous eight-year average of wastewater flows to the Lambertville Sewage Authority treatment plant (2012 to 2019).
- This period has shown a very stable 8 years of pumping and groundwater use (2012 to 2019) primarily due to a lack of significant new development and improvements in the water systems that are managed by BCWSA and NWWA in Solebury Township and New Hope Borough.
- Since 2005, pumping from the major production wells in New Hope has increased due to connections into BCWSA system, but the wastewater component has been similar because of lack of new major developments.

Recharge Analysis

- In the entire Aquetong Creek Drainage Basin, groundwater withdrawal or pumpage is less than natural groundwater recharge during years of both normal and below-normal precipitation.
- For the Route 202 and New Hope Borough 3.123 Square Mile Study Area:
 - The net surplus of groundwater is estimated at 0.54 MGD during years of normal precipitation & recharge.
 - During drought periods (25-year recurrence interval), the groundwater surplus is estimated at 0.04 MGD indicating a slight drought buffer.
 - If the SEPA-GWPA “potentially stressed” criterion is applied, the study area is in deficit by 0.08 MGD.
 - The groundwater static reserve (storage in the groundwater reservoir which provides a drought buffer) is limited due to the low porosity of Brunswick Aquifer system.

Environmental (Ecological) Stream Flows

- The Aquetong Creek surface water flow is enhanced by the spring flow contribution from Ingham Spring. This spring forms the headwaters of the creek and draws from an approximate 6.32 square miles (sq. mi.) contribution area that extends beyond the surface water divide between Aquetong Creek and Lahaska Creek (into Buckingham Township) as shown by the green outline on **Figure 1** (VUA, 2007/8).

In 2007/08, an average 3.53 MGD of groundwater was measured to discharge from the Ingham Spring (VUA, 2008). This significant volume of spring water discharge includes components of flow from within the Aquetong Creek Basin and a few square miles outside of the basin from the adjoining western draining watershed and provides a consistent environmental/ecological flow buffer for the creek along the reach from Ingham Spring to the Delaware River.

Recommendations

- Develop a semi-annual groundwater level monitoring program (In coordination with BCWSA and NWWA)
- Use the collected water level measurement data to develop/update “Potentiometric Surface” maps (water-level contour maps) for the study area which can be used to demarcate pumping cones-of-depression. Explore coordinating with NWWA, BCWSA, and New Hope Borough in this monitoring and mapping initiative since both municipalities are withdrawing groundwater from the same aquifer.

7.0 REFERENCES

Delaware River Basin Commission (DRBC) - (*18 CFR § 430.13 - Protected area permits for new withdrawals*).

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TABLES

TABLE 1. MAJOR PUMPING CENTERS IN THE SOLEBURY TOWNSHIP ROUTE 202 CORRIDOR (2005 TO 2019)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GROUNDWATER WITHDRAWAL IN GALLONS PER YEAR (GPY)															
<i>WELLS / WATER SYSTEMS OPERATED BY NORTH WALES WATER AUTHORITY (NWWA)</i>															
Hermitage 1 & 2	1,465,000	1,496,800	1,662,700	1,674,450	1,527,000	1,404,000	1,505,000	1,599,000	1,488,000	1,411,000	1,411,000	1,351,000	1,360,000	1,299,000	1,234,000
Yorkshire Meadows 1 & 2	8,550,000	6,184,000	7,134,000	7,490,000	9,438,000	10,811,000	11,875,000	9,964,000	4,062,000	5,909,000	5,154,000	3,937,000	2,134,000	2,486,000	2,651,000
Ingham Mews 1 & 2	3,914,000	4,430,000	3,883,000	3,216,000	3,331,000	3,609,000	3,597,000	2,971,000	2,688,000	2,869,000	2,525,000	2,302,000	2,387,000	2,095,000	2,217,000
Logan Square 1 & 2	3,992,000	4,908,000	4,545,000	4,798,000	5,719,000	5,604,000	5,858,000	6,262,000	5,877,000	5,884,000	5,976,000	5,860,000	5,665,000	5,915,000	5,979,000
<i>WELLS / WATER SYSTEMS OPERATED BY BUCKS COUNTY WATER & SEWER AUTHORITY (BCWSA)</i>															
Fieldstone and Wilshire Hunt S-1 & S-2 *	13,152,522	16,527,777	19,903,031	16,443,058	10,372,022	12,187,839	16,530,635	14,244,074	15,608,337	17,540,790	19,179,035	19,970,837	18,603,041	19,030,298	18,353,621
North Pointe S-3 *	19,504,827	18,400,754	17,296,681	17,513,159	19,584,548	20,094,039	16,100,580	16,782,105	17,164,310	15,576,043	15,282,120	15,449,941	14,430,472	14,114,144	12,672,537
Fox Run Preserve	12,938,723	12,660,949	12,383,174	11,758,966	8,146,280	12,431,039	10,135,106	10,788,719	9,723,193	9,979,555	10,708,976	10,375,093	9,994,327	9,799,101	10,678,029
<i>PRIVATE WELLS / WATER SYSTEMS</i>															
Clarion Inn & Suites	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000	5,968,000
New Hope Star Diner	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000	1,825,000
Enterprise, Jamie Hollander et. al.	341,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
<i>TOTAL GROUNDWATER WITHDRAWAL BY MAJOR PUMPING CENTERS IN SOLEBURY TOWNSHIP ROUTE 202 CORRIDOR</i>															
GPY	71,651,072	72,901,279	75,100,586	71,186,633	66,410,850	74,433,917	73,894,321	70,903,898	64,903,840	67,462,388	68,529,131	67,538,871	62,866,840	63,031,543	62,078,187
MGD	0.196	0.200	0.206	0.195	0.182	0.204	0.202	0.194	0.178	0.185	0.188	0.185	0.172	0.173	0.170

GPY - GALLONS PER YEAR.
 MGD - MILLION GALLONS PER DAY.

NWWA started operating the Hermitage, Yorkshire Meadows, and Ingham Mews water systems in January 2015, and the Logan Square water system in February 2016.
 * The S-1, S-2, and S-3 wells/systems are interconnected and provide water to the Fieldstone, Wilshire Hunt and North Pointe developments.
 See Table Notes sheet for source or basis of Groundwater Withdrawal Values.

TABLE 2. MAJOR PUMPING CENTERS IN NEW HOPE BOROUGH (2005 TO 2019)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
GROUNDWATER WITHDRAWAL IN GALLONS PER YEAR (GPY)															
<i>WELLS AND WATER SYSTEMS OPERATED BY BUCKS COUNTY WATER & SEWER AUTHORITY (BCWSA)</i>															
Riverwoods	18,445,871	19,316,426	18,094,804	9,542,646	15,952,608	14,103,086	15,628,306	11,383,326	14,511,723	11,088,611	10,651,149	14,354,542	13,816,812	14,664,707	12,331,571
New Hope Manor	1,115,982	1,180,187	12,724,508	18,096,277	18,579,511	18,972,684	18,972,684	20,455,828	19,879,901	23,853,958	24,982,982	22,170,401	20,802,751	21,037,611	22,372,625
Morrissey Well B	Unk-Private	Unk-Private	Unk-Private	Unk-Private	Unk-Private	Unk-Private	14,723,013	15,497,503	15,306,420	28,032,053	13,405,272	12,482,780	10,953,222	11,560,878	11,475,837
Morrissey Well C	Unk-Private	Unk-Private	Unk-Private	Unk-Private	Unk-Private	Unk-Private	6,874,084	9,849,756	11,325,157	7,619,947	11,639,431	12,028,507	12,244,926	12,863,759	12,508,324
CVS/ /McCaffreys/ Cornerstone Center	1,500,000	NA	Users connected to BCWSA Public Water Supply System												
New Hope-Solebury High School	1,068,000	NA	User connected to BCWSA Public Water Supply System												
<i>PRIVATE WELLS / WATER SYSTEM</i>															
Village 2 - 1 & 2 *	25,883,855	NA	NA	NA	NA	NA	NA	23,112,000	22,257,200	22,065,600	21,664,600	22,532,400	22,248,800	22,059,400	19,067,730
<i>TOTAL GROUNDWATER WITHDRAWAL BY MAJOR PUMPING CENTERS IN NEW HOPE BOROUGH</i>															
GPY	48,013,708	20,496,613	30,819,312	27,638,923	34,532,119	33,075,770	56,198,087	80,298,413	83,280,401	92,660,169	82,343,434	83,568,630	80,066,511	82,186,355	77,756,087
MGD	0.132	0.056	0.084	0.076	0.095	0.091	0.154	0.220	0.228	0.254	0.226	0.229	0.219	0.225	0.213

GPY - Gallons Per Year.

MGD - Million Gallons Per Day.

BCWS began operating the New Hope Manor Well as a production well for New Hope public water supply in 2007.

BCWSA began operating Morrissey Wells B & C as production wells for New Hope public water supply system in 2011. Previous private usage values of these wells for a concrete plant is unknown.

The CVS/McCaffreys/Cornerstone shopping center and the New Hope-Solebury High School connected into the BCWSA operated public water supply system for New Hope in 2007.

* Village 2 pumpage for 2005 was not available; the average of the reported values for 2003 and 2004 is shown.

See Table Notes sheet for source or basis of Groundwater Withdrawal Values.

**TABLE 3. TOTAL GROUNDWATER WITHDRAWAL FROM MAJOR PUMPING CENTERS IN SOLEBURY TOWNSHIP ROUTE 202 CORRIDOR AND NEW HOPE BOROUGH;
AND TOTAL WASTEWATER VOLUMES WITH SURFACE WATER AND GROUNDWATER COMPONENTS**

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TOTAL GROUNDWATER WITHDRAWAL FROM MAJOR PUMPING CENTERS IN SOLEBURY TOWNSHIP ROUTE 202 CORRIDOR															
GPY	71,651,072	72,901,279	75,100,586	71,186,633	66,410,850	74,433,917	73,894,321	70,903,898	64,903,840	67,462,388	68,529,131	67,538,871	62,866,840	63,031,543	62,078,187
MGD	0.196	0.200	0.206	0.195	0.182	0.204	0.202	0.194	0.178	0.185	0.188	0.185	0.172	0.173	0.170
TOTAL GROUNDWATER WITHDRAWAL FROM MAJOR PUMPING CENTERS IN NEW HOPE BOROUGH															
GPY	48,013,708	20,496,613	30,819,312	27,638,923	24,532,119	33,075,770	56,198,087	80,298,413	83,280,401	92,660,169	82,343,434	83,568,630	80,066,511	82,186,355	77,756,087
MGD	0.132	0.056	0.084	0.076	0.067	0.091	0.154	0.220	0.228	0.254	0.226	0.229	0.219	0.225	0.213
COMBINED TOTAL GROUNDWATER WITHDRAWAL FROM MAJOR PUMPING CENTERS IN SOLEBURY TOWNSHIP ROUTE 202 CORRIDOR AND NEW HOPE BOROUGH															
GPY	119,664,780	93,397,892	105,919,898	98,825,556	90,942,969	107,509,687	130,092,408	151,202,311	148,184,241	160,122,557	150,872,565	151,107,501	142,933,351	145,217,898	139,834,274
MGD	0.328	0.256	0.290	0.271	0.249	0.295	0.356	0.414	0.406	0.439	0.413	0.414	0.392	0.398	0.383
LAMBERTVILLE MUNICIPAL UTILITIES AUTHORITY (LMUA) TOTAL WASTEWATER VOLUME FROM SOLEBURY TOWNSHIP AND NEW HOPE COMBINED															
GPY	167,185,593	177,647,067	181,460,000	167,545,000	159,688,230	146,929,573	163,921,978	168,588,590	163,026,638	169,022,000	167,556,000	153,040,000	152,655,000	171,710,000	153,608,896
MGD	0.458	0.487	0.497	0.459	0.438	0.403	0.449	0.462	0.447	0.463	0.459	0.419	0.418	0.470	0.421
SURFACE WATER COMPONENT FROM BCWSA-OPERATED NEW HOPE WATERWORKS USAGE															
GPY	3,990,421	4,182,652	2,447,302	2,894,089	2,710,052	1,988,262	1,609,338	1,394,934	1,295,647	1,157,365	1,005,828	544,357	528,361	507,108	449,490
MGD	0.011	0.011	0.007	0.008	0.007	0.005	0.004	0.004	0.004	0.003	0.003	0.001	0.001	0.001	0.001
GROUNDWATER COMPONENT = TOTAL WASTEWATER VOLUME MINUS SURFACE WATER COMPONENT															
GPY	163,195,172	173,464,415	179,012,698	164,650,911	156,978,178	144,941,311	162,312,640	167,193,656	161,730,991	167,864,635	166,550,172	152,495,643	152,126,639	171,202,892	153,159,406
MGD	0.447	0.475	0.490	0.451	0.430	0.397	0.445	0.458	0.443	0.460	0.456	0.418	0.417	0.469	0.420

GPY - Gallons Per Year.

MGD - Million Gallons Per Day.

Sources and Explanations for Tables 1, 2 and 3

North Wales Water Authority (NWWA) values and information obtained from communications with NWWA Manager of Operations, Joseph Murphy; Director, Regulatory Affairs, Tom Bradbury; and Production Systems Coordinator, Kevin McLaughlin.

Bucks County Water & Sewer Authority (BCWSA) values obtained from communications with BCWSA Chief Operating Officer, John Butler.

Lambertville Municipal Utilities Authority (LMUA) values obtained from communications with Executive Director, Thomas Horn.

New Hope Waterworks surface water supply pumping values (surface–water component of wastewater) obtained from BCWSA.

Clarion Inn & Suites usage data from UHL 2005 report.

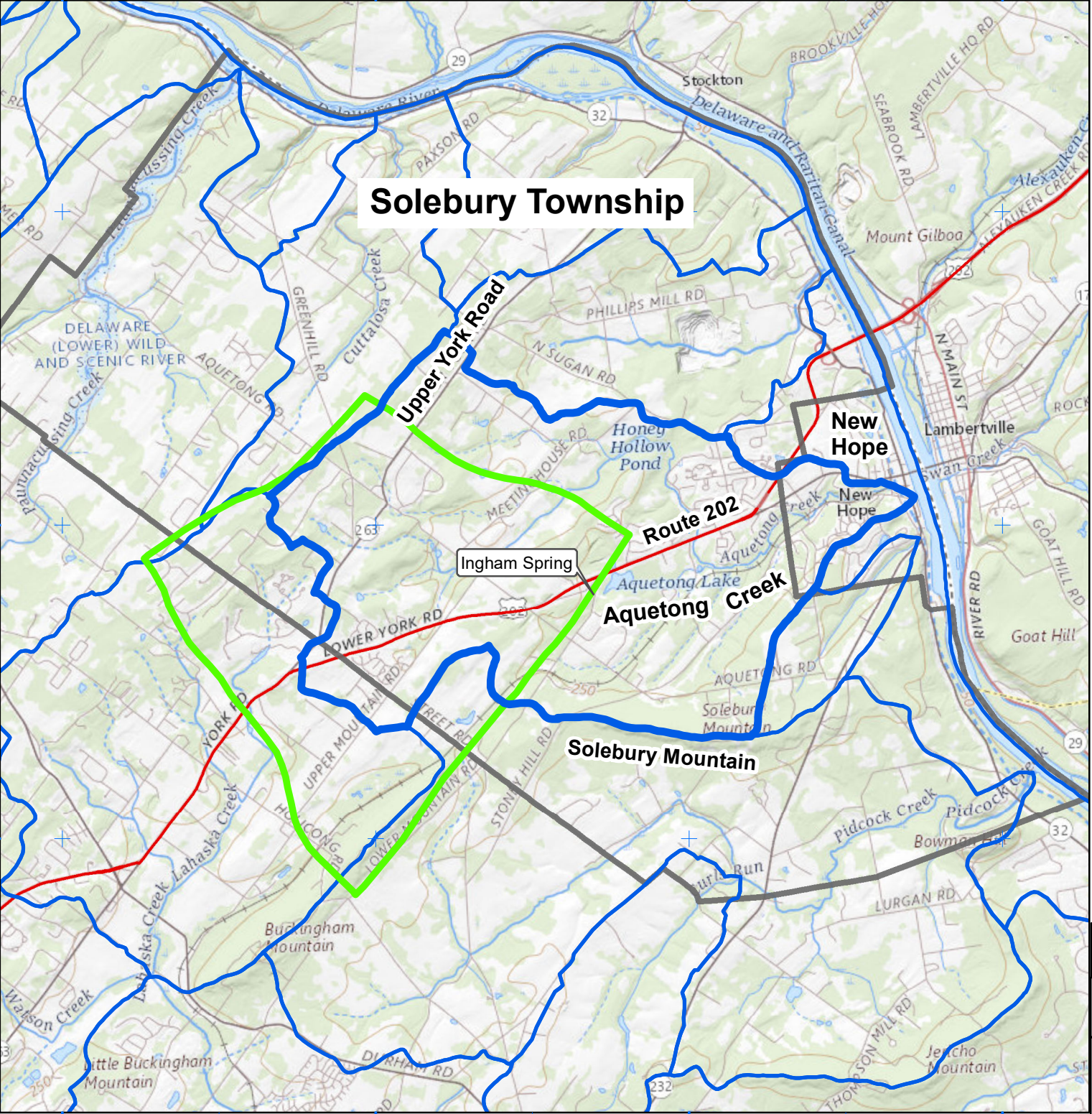
New Hope Star Diner usage was estimated on an estimated daily seating of 500 persons at 10 gallons per person (kitchen and sanitary demand).

Enterprise/Jamie Hollander shopping plaza data from UHL 2005 report with increase from 2006 onwards.

Village 2 values obtained from PADEP data base.

FIGURES

Solebury Township



Legend

- ▭ Aquetong Creek Drainage Basin
- ▭ Subwatershed
- ▭ Ingham Spring Contribution Area
- Solebury Boundary

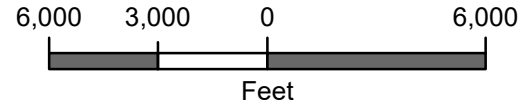
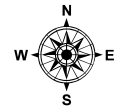
Transverse Mercator Projection - NAD 1983 (2011)
State Plane Pennsylvania South FIPS 3702 (US Feet)

Date: Apr. 2020.

This map was developed using:

USA Topo Maps, Copyright 2014 National Geographic Society, i-cubed
Delaware River Basin Commission watershed boundaries - HUC 11 2004

Basemap: USGS Quadrangles, Lambertville, NJ;
Buckingham, PA; Stockton, NJ; Lumberville, NJ

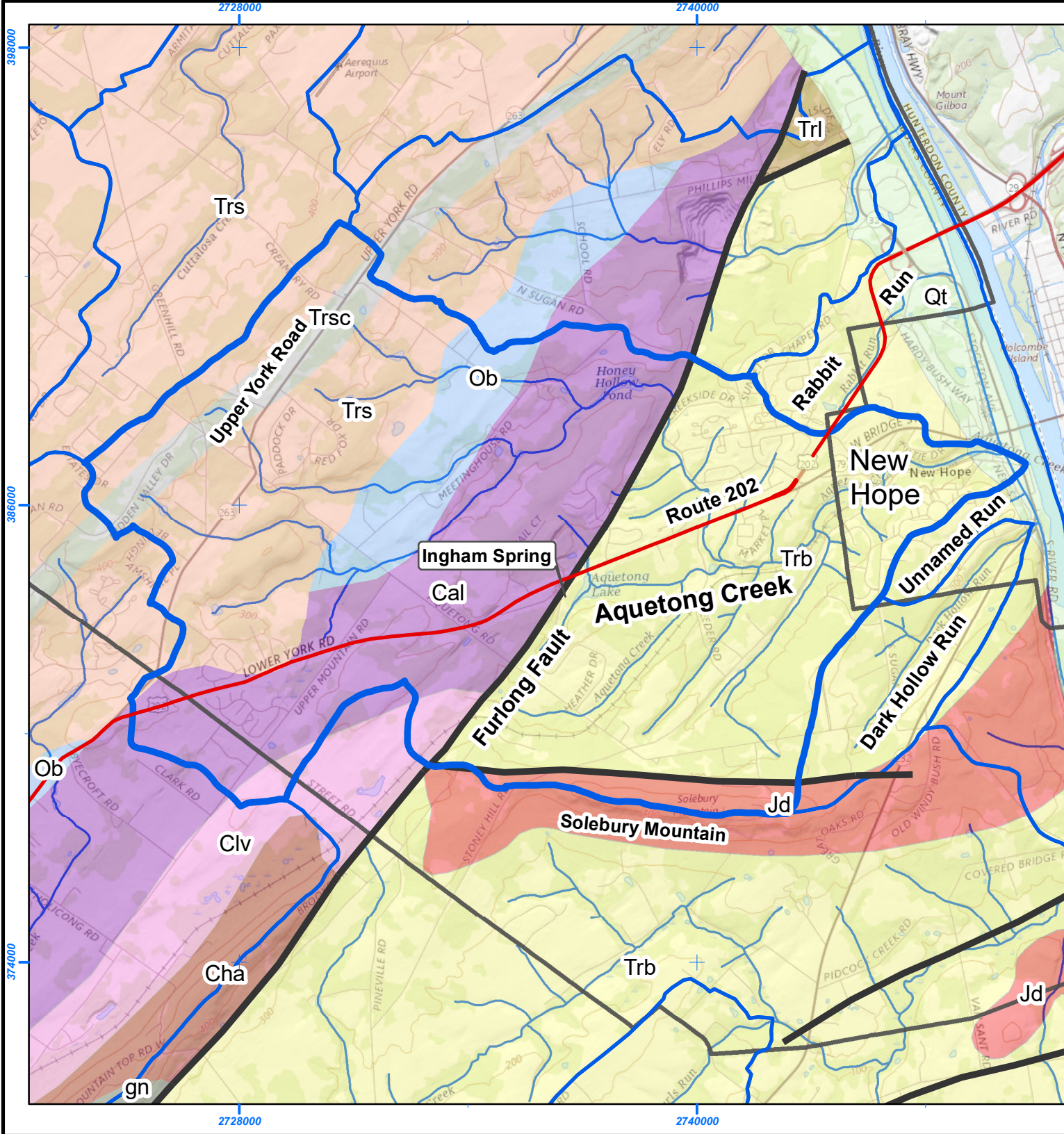


Aquetong Creek Drainage Basin

Solebury Township
Pennsylvania

UHL & Associates, Inc.
Lambertville, New Jersey

FIGURE
1



Legend

- Aquetong Creek Drainage Basin
- Subwatershed
- Fault

Geologic Units

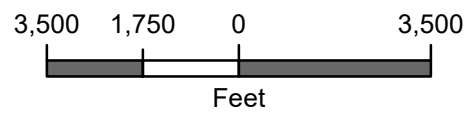
- Qt, Trenton Gravel
- Jd, Diabase
- Trb, Brunswick Fm
- Trl, Lockatong Fm
- Trs, Stockton Fm
- Trsc, Stockton conglomerate
- Ob, Beekmantown Group
- Cal, Allentown Fm
- Clv, Leithsville Fm
- Cha, Hardyston Fm
- gn, Precambrian - gneiss

Transverse Mercator Projection - NAD 1983 (2011)
 State Plane Pennsylvania South FIPS 3702 (US Feet)

Date: Apr. 2020.

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 Delaware River Basin Commission watershed boundaries - HUC 11 2004
 Basemap: USGS Quadrangles, Lambertville, NJ

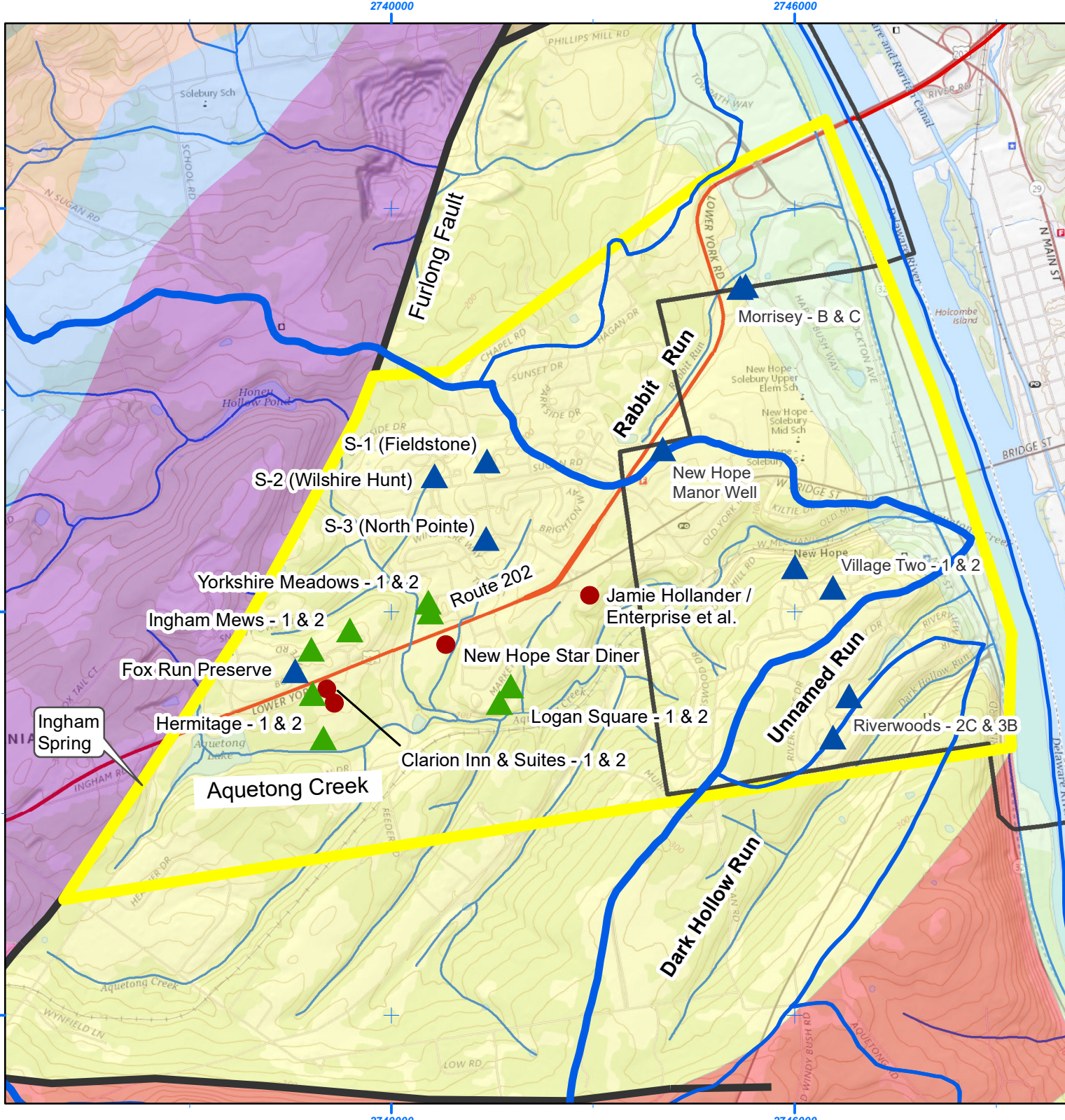


Bedrock Geology of Aquetong Creek Drainage Basin

Solebury Township
 Pennsylvania

UHL & Associates, Inc.
 Lambertville, New Jersey

FIGURE
2



Legend

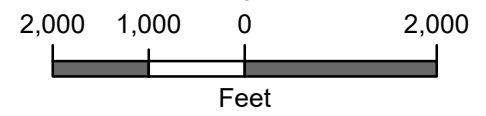
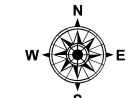
- ▲ BCWSA-Public Water Supply Well
- ▲ NWWA-Public Water Supply Well
- Private Well
- Brunswick Aquifer
- AquetongCreek
- Subwatershed
- Fault

Geologic Units

- Qt, Trenton Gravel
- Jd, Diabase
- Trb, Brunswick Fm
- Trl, Lockatong Fm
- Trs, Stockton Fm
- Trsc, Stockton conglomerate
- Ob, Beekmantown Group
- Cal, Allentown Fm
- Clv, Leithsville Fm

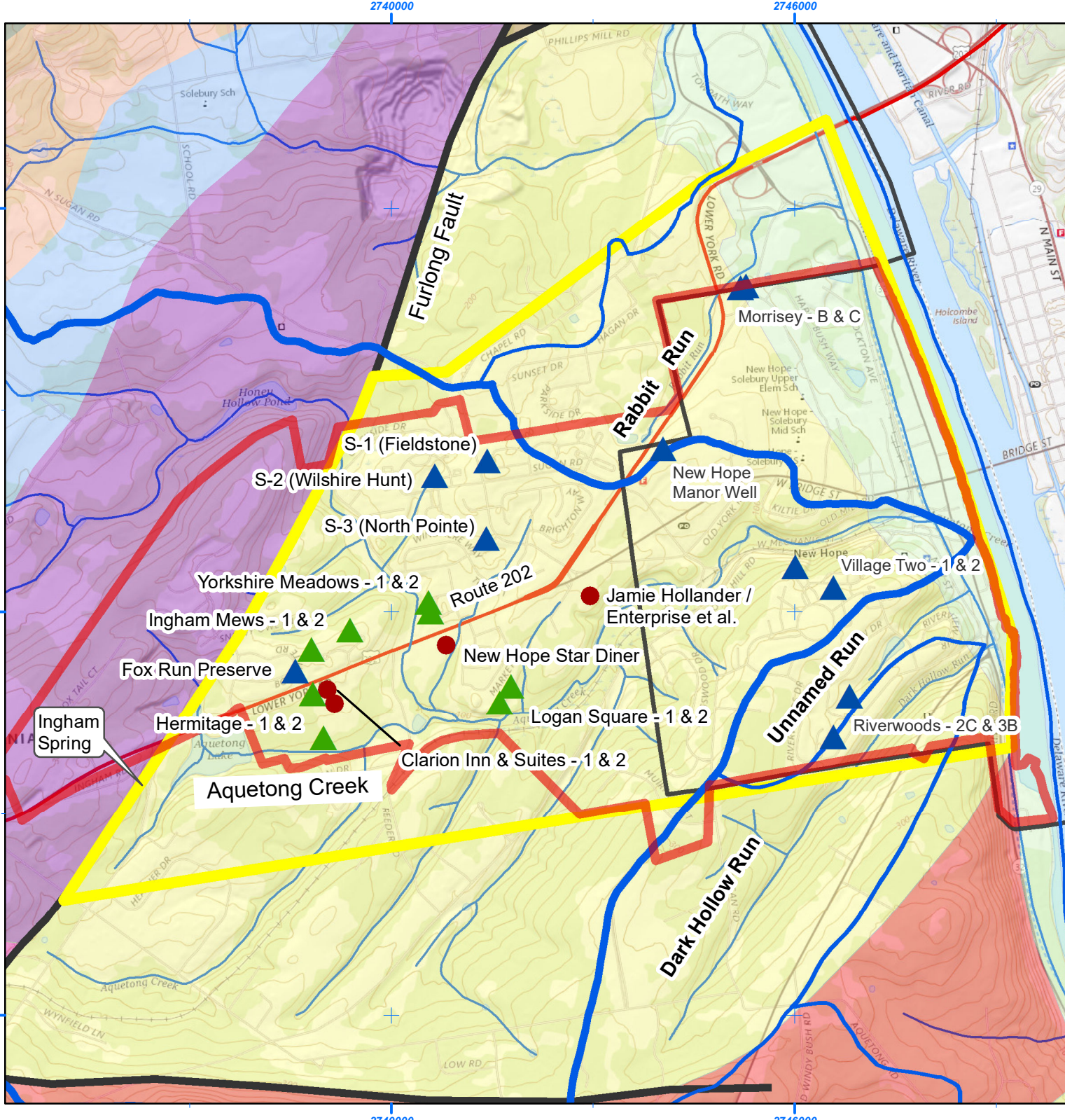
Transverse Mercator Projection - NAD 1983 (2011)
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Delaware River Basin Commission watershed boundaries - HUC 11 2004
Basemap: USGS Quadrangles, Lambertville, NJ



Location of Major Pumping Center Production Wells in the Brunswick Aquifer

Solebury Township
Pennsylvania



Legend

- BCWSA Service Area
- ▲ BCWSA-Public Water Supply Well
- ▲ NWWA-Public Water Supply Well
- Private Well
- Brunswick Aquifer
- AquetongCreek
- Subwatershed
- Fault

Geologic Units

- Qt, Trenton Gravel
- Jd, Diabase
- Trb, Brunswick Fm
- Trl, Lockatong Fm
- Trs, Stockton Fm
- Trsc, Stockton conglomerate
- Ob, Beekmantown Group
- Cal, Allentown Fm
- Clv, Leithsville Fm

Transverse Mercator Projection - NAD 1983 (2011)
 State Plane Pennsylvania South FIPS 3702 (US Feet)

Date: Apr. 2020.
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 Delaware River Basin Commission watershed boundaries - HUC 11 2004
 Basemap: USGS Quadrangles, Lambertville, NJ

2,000 1,000 0 2,000
Feet

BCWSA Sanitary Sewer System Service Areas

Solebury Township
Pennsylvania

UHL & Associates, Inc.
Lambertville, New Jersey

FIGURE
4

Figure 5: Annual Precipitation; Groundwater Withdrawal from Major Pumping Centers; and Groundwater Component of Wastewater Volume in the Solebury Township Route 202 Corridor & New Hope Borough Area

