

## **Purpose.**

The purpose of this ordinance is to implement Article I, Section 27, of the Constitution of the Commonwealth of Pennsylvania, which decrees that the people have a right to a reliable, safe and adequate water supplies to support the intended land uses within the capacity of available water resources; to assure that new groundwater withdrawals do not infringe upon the performance of existing groundwater supplies; and to provide for the collection of accurate groundwater information.

Our strategy seeks a simple and concise set of requirements that balance water usage trends with water availability. Additionally, we advocate an approach tiered based on anticipated water demand for applicants to demonstrate that their water supply can be delivered during a peak demand period without adversely impinging on other legitimate groundwater users.

## **1. Issue Statement/ Introduction**

The character and quality of life in the BNT setting depends on the availability of groundwater. The BNT jurisdiction lacks central water purveyance and sewer service; facts that require individual property owners to develop, manage, and maintain their own water supply and sanitary services. Because each property owner must source water to meet his own requirements, the demands of users can create conflicts, particularly during periods of intense demand or when natural conditions constrain the availability of groundwater.

Pennsylvania has Public Trust doctrine for its natural resources. The Pennsylvania Constitution, Article I, Section 27 states,

"Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people."

The adoption of Article I, Section 27, the Environmental Rights Amendment to the PA Constitution, in 1971 represents the culmination of a major change in attitude about the use and exploitation of natural resources. At the time the Commonwealth was founded, natural resources were abundant and seemingly inexhaustible. After two hundred years of population growth and industrial development, it became evident that unrestricted use of natural resources, while creating wealth and prosperity for some, had created many problems and environmental damage that would adversely affect future generations.

The Environmental Amendment clarifies that the Commonwealth is the trustee of Pennsylvania's public natural resources and must conserve them for the benefit of all the people. Water is a public natural resource that is required for the life and health of every person, a "vital resource." The "waters of the Commonwealth" are held in public trust by the Commonwealth. The right to "use" those waters is conferred by the state through a common law system of riparian rights. Pennsylvania water rights follow common law doctrine overall and Pennsylvania's groundwater law is based on "American Rule",

wherein a landowner can withdraw percolating groundwater for natural and ordinary uses on that land regardless of effect on neighbors (League of Women Voters of Pennsylvania 1998). Reasonable use is the threshold that justifies demand.

The Pennsylvania Municipal Planning Code (Section 604) directs municipalities to, "... provide a safe, reliable, and adequate water supply for domestic, commercial, agricultural or industrial use, and other public requirements; ...". The purpose of this groundwater management ordinance is to ensure that all legitimate users, including ecological services, are afforded access to the groundwater source and that the integrity (in terms of quantity and quality) of the groundwater source is maintained.

### **Hydrologic Cycle and Water Balance Overview**

A lack of knowledge and understanding about the water within a given setting is a primary constraint for planning and development of groundwater resources. To understand groundwater from a management perspective it is essential to recognize that water is dynamic. Water is constantly moving within the environment according to various inflow, outflow, and storage compartments. The hydrologic cycle describes the movement of water on Earth and a water balance (or water budget) accounts for the various components of the hydrologic cycle according to some defined spatial and temporal scale.

Inflows include terms such as precipitation, surface inputs, groundwater inputs, and wastewater returns. Outflows include evaporation and transpiration (evapotranspiration, ET), surface outputs, groundwater outputs, and diversions. Storage includes changes in water level in an aquifer, lake, or reservoir.

An effect on one particular component of the water system is balanced by changes elsewhere as the system reverts to a prior, or shifts toward a new, steady-state condition. Moreover, changes in one defined system may initiate changes in the equilibrium status of an adjacent system (as by induced exchange across a divide or through a leaky aquifer). Changes within a hydrologic system may not be revealed quickly, especially for groundwater components that tend to operate much more slowly than surface water components. It is important to note that groundwater is comprised of various subcomponents each with unique movement pathways and flow rates. In complicated and variable geologic settings such as northern Bucks County, multiple groundwater flow paths form a layered arrangement. Particular flow paths are shallow and short (i.e., exhibit brief residence time) and support hydroperiods of forested wetlands, vernal ponds, as well as seasonal seeps and headwaters streams. Other flow paths are deeper and longer; sustaining base flow hydrology to perennial streams, emergent marshes, as well as permanent springs, ponds, and lakes. Still other flows are even deeper and exhibit longer residence time; such flow paths recharge deep aquifer zones.

**FIGURE 1. Conceptual image of hydrologic cycle and annual water balance terms for typical Pennsylvania landscape scale. Source: PSU 2009.**

At a regional or landscape scale and for steady-state conditions in temperate settings, precipitation is the dominant inflow while ET is the dominant outflow. Seasonal variations in temperature and precipitation cycles over a year may compensate for short-term water availability constraints caused by drought and/or over-allocation. The long-term outcome of pronounced drought and/or over-allocation trends include all among the following: lowered water table elevation; reduced hydroperiod for wetlands; intermittent spring/stream flow status; reduced well yield; dry wells, and; water quality impairment.

### **Groundwater Availability**

The water budget approach is frequently invoked to estimate the quantity of water available to support non-ecosystem demands. In concept, the long-term water balance of a particular defined setting will answer the basic question, “how much water is available for human use without violating dependability for the system when stressed by drought?” At minimum the available quantity for non-ecosystem demands cannot exceed the excess net recharge quantity of the system (Sophocleous 2000). However, in the capacity limited fractured rock BNT aquifers, the capacity of the aquifer to supply water over a severe drought is a real and more stringent limitation.

Stream Flow  
Evapo-transpiration  
Net Aquifer Recharge  
Reserve capacity

USGS (Sloto and Schreffler 1994) applied a simple water balance approach to estimate that, in terms of annual precipitation in northern Bucks County during a two-year period of below-normal precipitation, approximately 2/3 of output was expressed as stream flow, roughly 1/3 became ET, and less than 1% of annual precipitation accounted for changes in groundwater storage. In the context of USGS’s water balance, to maintain sustainability, annual groundwater diversions must be less than 1% of annual precipitation. If groundwater diversions exceed aquifer recharge, then the aquifer will become depleted; leakage or capture across aquifer boundaries will be induced; and/or ecosystem demands will be compromised. Although it is a commonly-encountered viewpoint, groundwater is not an infinite resource.

ORDINANCE NO. \_\_\_\_\_

AN ORDINANCE OF THE TOWNSHIP OF BNT, BUCKS COUNTY,  
PENNSYLVANIA, REPEALING AND REPLACING CHAPTER 228 OF THE BNT  
TOWNSHIP CODE WITH AN ORDINANCE THAT PROTECTS THE QUALITY AND  
QUANTITY OF THE WATER RESOURCES OF BNT TOWNSHIP BY PLACING  
RESTRICTIONS ON CONSTRUCTION OF NEW WELLS AND MODIFICATIONS  
TO EXISTING WELLS.

WHEREAS, Section 603(d) of the Municipalities Planning Code (53 P.S. §10603(d))  
Section 503(10). Contents of Subdivision and Land Development Ordinance  
*Provisions and standards for insuring that new developments incorporate  
adequate provisions for a reliable, safe and adequate water supply to support  
intended uses within the capacity of available resources.*

*Section 603(d) Zoning ordinances may include provisions regulating the siting,  
density and design of residential, commercial, industrial and other developments  
in order to assure the availability of reliable, safe and adequate water supplies to  
support the intended land uses within the capacity of available water resources  
and*

WHEREAS, Section 1601 of the Second Class Township Code provides that the Board  
may adopt ordinances in which general or specific powers of the township may be  
exercised, and, by the enactment of subsequent ordinances, the Board may amend, repeal  
or revise existing ordinances (53 P.S. Section 66601);

WHEREAS, in order to provide a reliable, safe and adequate water supply for BNT  
Township and thereby protect the health, safety and welfare of the residents of BNT  
Township, the Board of Supervisors, with the assistance of its committees, have engaged  
in studies of the current factors affecting the Township's capacity of available water  
resources;

WHEREAS, the geologies underlying this municipality are hydrologically limiting  
through careful study, the Township has recognized the structure within various geologic  
formations that influence groundwater yields, recharge capabilities and aquifer storage  
capacities that are present in the Township.;

WHEREAS BNT township has determined that the wetlands are valuable for the flora  
and fauna, are an integral part of the ecological and water balance of the Township, and  
preserves the rural nature of the Township identified in the Township's Comprehensive  
Plan;

WHEREAS, the purpose of this ordinance is to implement Article I, Section 27, of the  
Constitution of the Commonwealth of Pennsylvania, to assure that new groundwater  
withdrawals do not infringe upon the performance of existing groundwater supplies nor  
of future supplies; and to provide for the collection of groundwater information to  
accurately implement these procedures,

NOW, THEREFORE, BE IT ENACTED AND ORDAINED, and it is hereby ENACTED AND ORDAINED by the Board of Supervisors of BNT Township, Bucks County, Pennsylvania.

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A. Definitions and Applicability

**§1. Definitions.**

- A. ADEQUATE WATER SUPPLY: That-the yield of a well shall be sufficient to meet the landowners requirements.
- B. APPROVED: sanctioned by BNT Township, in conformity with applicable laws and regulations.
- C. BASE SITE AREA: the site area (as determined by Deed or survey) minus existing street ultimate rights-of-way, utility rights-of-way, other public easements, land which is restricted due to easements or covenants, and land shown on previous subdivision or land development plans as reserved from development for recreation and/or open space preservation.
- D. CONE OF DEPRESSION (COD): Zone in which an incremental change in ground water level of 6 inches or more is expected.
- E. CONTAMINATION: any matter which will render water unsafe for human consumption.
- F. DRAWDOWN: extent of lowering of the water level or potentiometric level in a well when water flows or is pumped from it. Measured from the static water level prior to pumping.
- G. LAND DEVELOPMENT: any of the following activities:
  - a. The improvement of one or more contiguous lots, tracts or parcels of land for any purpose involving:
    - i. one or more residential or nonresidential buildings, whether proposed initially or cumulatively, or
    - ii. the division or allocation of land or space, whether initially or cumulatively, between or among two or more existing or prospective occupants by means of, or for the purpose of streets, common areas, leaseholds, condominiums, building groups or other features.
  - b. 2. A subdivision of land.
  - c. 3. Development in accordance with section 503(1.1) of the Municipalities Planning Code.
- H. MONITORING WELL: A well to be drilled and used solely for long term monitoring of the water level in a development.
- I. NEAR SURFACE WATER: water in the zone immediately below the ground surface. It may include seepage from barnyards, leaching pools and disposal beds or leakage from sewers, drains and similar sources of contaminated water.
- J. OBSERVATION WELL: A well to be used in an aquifer test to document the water level response of the aquifer to water withdrawal in a pumped well in the projected cone of depression.
- K. PA DEP: Pennsylvania Department of Environmental Protection
- L. POTABILITY: Fit or suitable for drinking. See SAFE WATER.

- M. **POTENTIOMETRIC SURFACE:** The surface to which water in an aquifer can zone in which an incremental change in ground water level of 6 inches or more is expected rise by hydrostatic pressure. This fundamentally the same as the water table.
- N. **PUMPING WATER LEVEL:** that elevation of the surface of the water in a well when water flows or is pumped from it at a given rate.
- O. **Q750:** stream base flow during the driest week in 50 years. For the purposes of this Ordinance, Q750 within Diabase, Hornfels, and/or Lockatong geologic zones is equal to 160 gallons per day per acre and within the Brunswick geologic zone is equal to 200 gallons per day per acre. Refer map (attachment E) for determination of geologic zone(s).
- P. **REGULATED WELLS:** include all new wells and wells associated with new uses where there is a significant increase in water use. This term includes existing wells only when they are being reactivated or redrilled and there is an increase in water withdrawal.
- Q. **RELIABLE YIELD:** The limiting groundwater withdrawal rate from an aquifer which will not cause a season variation greater than 20 feet, nor cause an unacceptable loss of water quantity and quality for present and future users of water within the Zone of Influence during a 50 year drought.
- R. **SAFE WATER:** water that is sufficiently free from contamination to be safe for human consumption as defined by the Commonwealth of Pennsylvania or the U.S. D.E.P., which ever is more restrictive.
- S. **SANITARY CONDITION:**
- a. When referring to a well, it means that the construction of the well and the installation of the pumping equipment are such that the well is effectively protected against entrance of contaminating matter in the opinion of the Township.
  - b. When referring to the surrounding of a well, it means that the location and surrounding area are free from debris or filth of any character and not subject to flooding.
- T. **SEWER:** a conduit used or intended for conveying sewage or other wastes.
- U. **SIGNIFICANT INCREASE IN WATER USE:** the lessor of an increase in water use of 30% or more or an increase of 150 gallons per day or more, of average daily water withdraw.
- V. **SPECIFIC CAPACITY:** continuous yield of a well at a given drawdown expressed in gallons per minute per foot of drawdown.
- W. **STATIC LEVEL:** water level in a well before a pumping test when all effects of drilling and previous pumping on the aquifer have dissipated and the well is in equilibrium with atmospheric pressure.
- X. **STATIC WATER LEVEL:** means that elevation of the surface of the water in a well when no water flows or is being pumped therefrom.
- Y. **TOWNSHIP:** Board of Supervisors of BNT Township or any properly authorized official to BNT Township who may be designated to act for the Township by the Board.
- Z. **TRANSMISSIVITY:** A measure of the capability of the entire thickness of an aquifer to transmit water. Also known as the coefficient of transmissivity.

- AA. VERTICAL ZONE OF CONTAMINATION: vertical extent of groundwater containing contaminants at concentrations exceeding Federal or State water-quality standards.
- BB. WATER BODY Any surface water body such as wetlands, lake, reservoir, stream or river.
- a. WATER BUDGET
- i. LONG TERM WATER BUDGET- a budget based on the average (mean) precipitation and recharge rates over many years.
  - ii. ANNUAL WATER BUDGET – a budget over the hydrogeological year of May 1<sup>st</sup> to May 1<sup>st</sup> of the following year that accounts for groundwater capacity as reflected in changing static waster level for an average year's precipitation and recharge.
  - iii. SEASONAL WATER BUDGET – a budget over the summer season of May 1<sup>st</sup> to October 1<sup>st</sup> of an average summer season's precipitation and recharge that accounts for groundwater capacity as reflected in changing static waster level.
  - iv. DROUGHT SEASONAL WATER BALANCE - a budget over the summer season of May 1<sup>st</sup> to October 1<sup>st</sup> of the 50 year drought summer season's precipitation and recharge that includes the effect of groundwater capacity as reflected in changing static waster level.
- CC. WATER TABLE: The level below the land surface at which the subsurface material is fully saturated with water. The depth of the water table reflects the minimum level to which wells must be drilled for water extraction. The water table is the surface where the pressure head is equal to atmospheric pressure.
- DD. WELL: any excavation whether drilled, bored, driven, or cored that is less in its diameter then its depth.
- EE. YIELD: quantity of water per unit of time, which may flow or be pumped from a well at a constant specified drawdown.
- FF. ZONE OF CAPTURE (ZOC): aerial extent of the waters (i.e., ground water, surface water, etc.) captured by the pumping waters.

**§2. Applicability.**

A This ordinance applies to all new wells, modifications to existing wells and expanded use of existing wells. Applications such as subdivisions and land development, conditional use, variance, special exceptions and curative amendment applications shall be subject to this ordinance.

B No person within BNT Township shall drill a well or withdraw groundwater for any purpose except as permitted by this Ordinance and within the regulations herein set forth.

Prior to obtaining preliminary plan approval of a land development, an applicant shall satisfactorily complete all of the well testing and Groundwater Assessment studies required herein.

Exemptions - this Ordinance shall not apply to:

1. Geothermal wells utilizing a closed loop system with zero net water withdrawal.
2. Wells that are on a lot that is deed restricted against further subdivision and restricted against additional water extraction and consists of five acres or more and where the site water total withdrawal is predicted is less than those shown in Table 1.

### **§3. Defining Demand**

#### Anticipated Water Use

Estimation of proposed development groundwater withdrawal shall be determined by:

1. Water usage by a residential housing unit that shall be estimated to be 100 gallons per day (gpd) per person where two persons shall be assumed to occupy one bedroom and each additional bedroom is occupied by one person<sup>1</sup>, or
2. For a use that is regulated by PA DEP Regulations Title 25 Chapter § 73.17, the level cited in these waste water regulations shall be used as equivalent to the groundwater withdrawal with no more than 25 gpd/ per capita, added for external loss such as, but not restricted to, landscaping or other use that does not enter the waste water system, or
3. From documentation of typical usage which evidence the Township shall approve, or
4. An agreement with the Township to limit groundwater withdrawal consistent with the limits defined by this ordinance.

#### **Well Categorization**

This ordinance establishes four well class categories and identifies specific demonstration requirements in order to obtain a water supply permit for each. <sup>2</sup>

#### **Well Class Categories are based on estimated peak water demand.**

Class I: applies to single residential lot development with one dwelling and assumes typical peak water demand up to 1,000 gpd

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<sup>1</sup>

<sup>2</sup>

[Note: The intent herein is to scale applicant demonstration requirements that a user can meet expected peak water demand without harming other legitimate users. The **presumption** is that an applicant for development of a single lot dwelling can meet an assumed peak demand without harming another legitimate user. The details of required testing are subject to discussion and consensus or negotiation among BNT representatives. Penalties for future non-compliance with permit conditions are subject to discussion.]

Class II: applies to each lot subdivided or developed with two or more residential dwellings and estimated peak water demand from 1,000 up to 5,000 gpd

Class III: applies to any use with an estimated peak water demand from 5,000 up to 15,000 gpd

Class IV: applies to any use with estimated peak water demand greater than 15,000 gpd

### **Demonstration of Adequate Groundwater Yield and Estimate Zone of Influence**

To demonstrate the acceptability of a new or modified groundwater withdrawal, an applicant must submit a Groundwater Assessment Report (GAR). Each Groundwater Assessment Report will include the following:

1. Identify the potential water source(s) and location(s) of each intake/connection for the property
  - a. aquifer name, surface water name, rain bank, purveyor name
  - b. scaled site plan including topography (5-foot contour interval) depicting property boundaries, wellhead(s), water intake, structures and improvements, septic management features, streams, springs, wetlands, ponds, closed depressions
  - c. Bucks County Well Permit, driller's/geologist's boring log, well construction log, and well yield test information (method, static water level, post-test drawdown water level, pumping rate, test duration, yield)
2. Estimate the peak water demand and determine appropriate Well Class (I – IV)
  - a. for each residential usage, 75 gpd is considered the typical per capita daily demand – the peak water demand is calculated as follows: typical per capita daily demand x 2(multiplier to estimate peak demand) x no. of residents (no. bedrooms + 1; which assumes that 1st bedroom is double-occupancy and each successive bedroom is singly occupied)
  - b. for non-residential usages and usages supplemental to domestic residential needs (e.g., livestock, nursery, landscape/turf maintenance, etc), an applicant must document and cite the basis for typical and peak water demand estimates
3. Perform well aquifer test as described in Attachment A according to designated Well Class criteria
  - a. Class I Criteria: Well aquifer test not required – submit Groundwater Assessment Report.
  - b. Class II Criteria: If the projected withdrawal exceeds the Threshold rates shown in Table 1 then file an Aquifer Test Plan for review and authorization by Township<sup>3</sup>. For each proposed water supply well, conduct 2-hour (peak) demand single-well test and 4-hour (stress) demand single well test – submit Groundwater Assessment Report that includes: figure depicting well and

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3

Note: If the proposal meets the Safe Drought Withdrawal Criteria as shown in Table 1, then an actual aquifer test will not be required.

water discharge locations; well boring and construction logs; pumping rate and intake level; total volume pumped for each test; continuous water level monitoring data showing static pre-test level, drawdown throughout pumping phase, and recovery phase (recovery monitoring may be terminated when recovered water level is 95% of static pre-test or 24-hours following end of test, whichever occurs first; and laboratory analytical results of water quality test on water sample collected within final 30 minutes of each aquifer test <sup>4</sup> Electronic data files of continuous water level monitoring are required.

- c. Class III Criteria: File an Aquifer Test Plan for review and authorization by Township. For each proposed water supply well, conduct step-drawdown test followed by an 8-hour (peak) demand single-well test and a 24-hour (stress) demand single well test Groundwater Assessment Report that includes: figure depicting well and water discharge locations; well boring and construction logs; pumping rate and intake level; total volume pumped for each test; continuous water level monitoring data showing static pre-test level, drawdown throughout pumping phase, and recovery phase (recovery monitoring may be terminated when recovered water level is 95% of static pre-test or 24 hours following end of test, whichever occurs first; and laboratory analytical results of water quality test on water sample collected within final 30 minutes of each aquifer test. Electronic data files of continuous water level monitoring are required.
- d. Class IV Criteria: File an Aquifer Test Plan for review and authorization by Township. For each proposed water supply well, conduct step-drawdown test followed by an 16-hour (peak) demand single-well test and a 48-hour (stress) demand single well test with at least two observation wells in same water-bearing zone; additional observation points may be required to assess induced leakage from wetland, spring, and/or stream hydrology – submit Groundwater Assessment Report that includes: figure depicting well and water discharge locations; well boring and construction logs; pumping rate and intake level; total volume pumped for each test; continuous water level monitoring data showing static pre-test level, drawdown throughout pumping phase, and recovery phase (recovery monitoring may be terminated when recovered water level is 95% of static pre-test or 24 hours following end of test, whichever occurs first; and laboratory analytical results of water quality test on water sample collected within final 30 minutes of each aquifer test. Electronic data files of continuous water level monitoring are required.

#### 4. Well Yield Performance Standards

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<sup>4</sup>

At minimum, PH recommends that domestic water sources be sampled and analyzed by PA-certified laboratory for coliform bacteria, volatile organic compounds (VOC), arsenic, and hardness – the decision to require vs. recommend water testing requirements should be vetted through Township counsel.

- a. Class I Standards – submit administratively complete Groundwater Assessment Report
- b. Class II Standards - submit administratively complete Groundwater Assessment Report and demonstrate that estimated peak and stress demands were achieved and that post-test recovered water level was at least 90% of pre-test static water level.
- c. Class III/IV Standards - submit administratively complete Groundwater Assessment Report and demonstrate that estimated peak and stress demands were achieved, that post-test recovered water level was at least 90% of pre-test static within 96-hours following test, and that induce drawdown in observation wells was at least 95% of pre-test static within 96-hours following test. If hydrologic monitoring of wetland, spring, or stream features is required, then performance standards will be specified on case-by-case basis.

### **§6. Defining Class of Groundwater Withdrawal**

A. Class I Applicants – an applicant applying for a permit for an individual regulated withdrawal of equal to or less than 1000 gallons per day except if the well is a replacement for an existing well that will be abandoned and the new well use will have no increase in water withdrawal,:

1. Shall conduct a water quality analysis defined in Attachment B and
2. Shall conduct a Nitrate Evaluation analysis defined in Attachment C,
3. Shall be required to conduct an Aquifer Test if:
  - a. the withdrawal rate exceeds the withdrawal limits shown in the Geological Overlay Limits as shown in Table 1 or
  - b. If evidence of significant stress in the local aquifer is demonstrated to the satisfaction of the township Board of Supervisors, for example but not limited to neighboring well failing or a trend of year-to-year falling static water levels or drying of wetlands, seeps and springs or seasonal groundwater level within 2500 feet varies by more than 20 feet or other indicators of stress .

3. Submit a Groundwater Assessment Report as defined in Attachment A-I to the Township within 45 days of the completion of the above required test procedures,

B. Class II Applicants – an applicant seeking withdrawal of greater than 1000 and less than 5000 gallons per day:

1. Shall conduct a water quality analysis defined in Attachment B,
2. Shall conduct a Nitrate Evaluation analysis defined in Attachment C,

3. Shall be required to prepare an Aquifer Test Work Plan for approval by the Township if:
  - a) the withdrawal rate exceeds the withdrawal limits shown in the Geological Overlay Limits as shown in Table 1 or
  - b) the median yield of the closes 5 wells within 2500 feet of the site is less than or equal to 8 gpm, or
  - c) the median well depth of the closes 5 wells within 2500 feet of the site is greater than 300 feet, or
  - d) the seasonal groundwater level within 2500 feet varies by more than 20 feet, or
  - e) If evidence of significant stress in the local aquifer is demonstrated to the satisfaction of the township Board of Supervisors, for example but not limited to neighboring well failing or a trend of year-to-year falling static water levels or drying of wetlands, seeps and springs or seasonal groundwater level within 2500 feet varies by more than 20 feet or other indicators of stress.

then the applicant shall conduct a Class II aquifer test as defined in Attachment A-II.

4. Shall prepare and submit a Class II Groundwater Assessment Report as defined in Attachment A to the Township within 45 days of the completion of the test procedures,

C. Class III Applicants – an applicant seeking withdrawal of greater than 5000 gallons per day:

1. Shall conduct a water quality analysis defined in Attachment B,
2. Shall conduct a Nitrate Evaluation analysis defined in Attachment C,
3. Shall be required to prepare an Aquifer Test Work Plan for approval by the Township and shall conduct a Class III aquifer test as defined in Attachment A-II and
4. Shall prepare and submit a Class III Groundwater Assessment Report as defined in Attachment A-II to the Township within 45 days of the completion of the test procedures.

Table 1  
Safe Drought Withdrawal Limits  
Geographical Overlay Attachment E

Geological Overlay	Symbol	Withdrawal limit Gallons/day/acre
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Brunswick	Trblg	100 <sup>5</sup>
diabase/Hornfels	Jd/Trh	50 <sup>6</sup>
Delaware Alluvium	Qd	200 <sup>7</sup>
Locketong	Trl	75 <sup>8</sup>

### **§7 Approvable Well, Water Quality and Groundwater Withdrawal Criteria<sup>9</sup>**

In order to assure the availability of an reliable, safe and adequate water supplies to support the intended land uses within the capacity of available water resources and to protect the aquifer, no development or change in use which estimates a significant increase in water use, regardless of size, shall be approved which will:

Evaluation of a drilled well:

1. The well yield determined by an approved yield test<sup>10</sup> shall be equal to or greater than 5 gpm.
2. The Static Water Level equal to or less than 200 feet below the surface level shall be reviewed by the Township.
3. The construction standards as defined in Bucks County Well Drilling Standards have been satisfied.
4. The water quality shall be within both the State and Federal Water Quality Standards shown in Attachment B as determined by a Water Quality Laboratory certified by the Department of Environmental Protection of the Commonwealth of Pennsylvania according to the Township requirements.

5

See, The U.S. Army Corps of Engineers Philadelphia District/ Final Market Feasibility Study, Tinicum Township, Bucks County Pennsylvania, Alternative Wastewater Treatment Solutions for Hamlets and Villages and Groundwater Monitoring Options (MFS Study, October 1996).

6

See, Posten, Stephen E., 1984 Estimation of Mean Groundwater Runoff in Hard-Rock Aquifers of New Jersey. PP 109-154. in Halasi-Kun, G.J. (ed) Pollution and Water Resources, Columbia University Seminar Series, Vol. 26 new York: Pergamon Press.

7

Along the Delaware one can withdraw as much water as the Delaware River Basin Commission allows as long as they don't impact their neighbors?

8

We need to discuss this Locketong number. The Locketong in Tinicum is layered sandwiched between layers of Brunswick. In the South Ridings (So of Dark Hollow?), the layers of Trl are closer together and seem to indicate poorer aquifers. See ¶ 1(iv) above.

9

The approvable criteria mix the well drilling and aquifer tests. Suggestions as to how to address this?

10

See some state that defines yield test and obtain the defining document in digital form. See attached documents from New Hampshire for example. Yield\_Test\_NH.pdf Yield\_test\_log\_NH.pdf These are not the defining documents, but imply there is one behind these on-line pages. New Jersey?

The applicant shall demonstrate

5. The projected well withdrawal rates shall not exceed the drought compensated withdrawal rate of the underlying geology shown in Table 1 and Geology Map in Attachment E and water budget balance with a strong focus on recharge unless strong experimental evidence can demonstrate a reliable groundwater yield to the contrary, through an analysis by the Groundwater Assessment Report as defined in Attachment A.

If and only if an aquifer test is required, then Section A-II of the Groundwater Assessment Report shall be included.

1. The developer or the developer's contractor shall estimate the potential Cone of Depression of the pumping well(s). To pass the test, the calculated
  - a) Cone of Depression greater than 3 feet shall not extend beyond the site boundaries, or
  - b) drought analysis as described in Attachment A shall not depress the Static Water Level by the more restrictive of more 20% of the difference between the initial SWL to a 250 foot SWL<sup>11</sup> or
  - c) depress the six (6) month projected water level by more than 20 feet, or
- d) if the recovery phase level at the end of 7 days is less than 90% of the initial water level, a detailed calculation shall be made to estimate the sustainability of the well at end of 180 day, 1 year and 5 year droughts, ie the withdrawal shall not depress the Static Water Level by more than 20 feet.
2. The target nitrate concentration as described in Attachment C Trela-Douglas Nitrate of Existing Wells evaluation shall not be exceeded.
3. Impacts to Streams and Wetlands - If drawdown is measured or projected to induce leakage from streams or wetlands such that baseflow in these streams will be reduced or wetlands partially or entirely de-watered, then the demand and development shall be reduced to prevent adverse impacts to stream flow and wetlands.
4. Reduce the site's attributed stream base flow by more than 50% of the Q750 using the following formula:

$$\text{Allowable withdrawal}^{12} = \text{Base Site Area} \times \text{Q750} \times 0.5$$

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<sup>11</sup> A well at 250' SWL is already stressed and should have a smaller allowable drawdown. If an initial SWL were 50' – a drawdown of 40' would be the limit. Starting from 150' – only 20' would be allowed. At 250', no allowance at all. Reference to a bounded aquifer - yes

<sup>12</sup> Formula obtained from The U.S. Army Corps of Engineers Philadelphia District/ Final Market Feasibility Study, Tincum Township, Bucks County Pennsylvania, Alternative Wastewater Treatment Solutions for Hamlets and Villages and Groundwater Monitoring Options (MFS Study, October 1996).

**§8. Water Quality Analysis.**

A. Each applicant applying for a permit pertaining to a regulated well shall perform a water quality analysis. The groundwater quality analyses shall be conducted on a pumped water sample collected just prior to the completion of the aquifer test, as described Attachment A. of this Ordinance.

B. The analysis shall contain the values, range of values, and drinking water standard values as set forth in the Federal Safe Drinking Water Act and PA DEP Title 25 Chapter 93.. All laboratory analyses shall be performed by a PA DEP certified laboratory and their results shall be included in the study report.

C. The analysis shall contain any available water quality data that is obtained from nearby, adjacent groundwater sources including data collected by BNT Township or from other studies performed for other developments with the Township or within 1 mile of the perimeter of the site.

D. The analysis shall indicate the location and design of all existing and proposed on-site sewage disposal systems.

E. For Class II and III Applicants only, the analysis shall include a groundwater quality analysis for the dry year nitrate impact of onsite sewage disposal systems within the proposed subdivision as described in Attachment C. In particular, the analysis must include an estimate of the increase in nitrogen (nitrate, nitrite and ammonia) concentrations in the ground water and provide a discussion of background nitrogen concentrations. The analysis shall also include an estimate of the nitrogen concentration in the ground water beneath the downgradient property boundaries during the 50-year drought.

1. Nitrate Analysis Report: A Nitrogen Dilution Model (NDM) must be provided to predict the water quality impacts of onsite wastewater disposal systems. The model shall include an analysis of the nitrogen loading, the predicted concentration of nitrate at the property line, the septic effluent leach field area and precipitation input. Specific standards for this model are provided within the NDM of the New Jersey Department of Environmental Protection, and the NDM of the State of New Jersey Pinelands Commission. An Example of the use of such a model is the method of Trela-Douglas.<sup>(13)</sup> An equivalent Pennsylvania Department of Environmental Protection model may also be used.

a. In order to assure the availability of reliable and safe water supply to support the intended land uses and to protect the aquifer, no development, regardless of size, shall be approved which will increase nitrates by half the distance to 10 ppm from background nitrate <sup>(14)</sup> level as measured by a Water Quality Laboratory certified by the

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( ) Nitrate Dilution Modeling of Montgomery Township, Somerset County, NJ  
[www.giscenter.org/resources/library/montgom.nitrate.pdf](http://www.giscenter.org/resources/library/montgom.nitrate.pdf)

14

( ) A nitrogen dilution model as described in Attachment C is to be used.

Department of Environmental Protection of the Commonwealth of Pennsylvania. The formula for calculating the maximum target nitrate concentration allowable is to subtract the background concentration of nitrate from 10 ppm and divide that number in half and add that to the background concentration of nitrate.

$$\text{Target nitrate concentration} = \text{Background conc.} + (10 \text{ ppm} - \text{Background conc.}) / 2$$

2. For Developments Proposing to use a Community Waste Disposal System with Stream Discharge: for surface water resources, the unit aerial pollutant budget analysis approach can be utilized to predict how much nitrogen is entering a given waterbody. An applicant proposing a community waste disposal system must first, delineate the watershed boundaries of the waterbody of concern. The waterbody could be a wetlands, lake, reservoir, stream or river.
  - a. Once delineated, all of the land use within the watershed is quantified in terms of surface area. Each land use category should have an ascribed surface area based on the most up-to-date map/digital data available.
  - b. Empirically derived pollutant loading coefficients can be assigned to each land use category. These coefficients provide an estimate of the amount of a given pollutant (i.e., nitrogen, phosphorus, suspended sediments, and lead) that is generated on an annual basis for each particular land use category. These coefficients shall either be obtained from the scientific literature or from field data collected at the site. The coefficients are multiplied by the surface area of its respective land use category to obtain an estimate of the pollutant generated by that land use category per year.
  - c. The data can then be used to develop a pollutant budget for the receiving waterbody. Current pollutant budgets shall be compared to future predictions of development to predict how such activities within the watershed will impact the water quality of the receiving waterbody. Predictions on future development shall be based on population data and projections that are readily available from regional, State, and local planning agencies.

F. The quality of the water produced by the well shall be tested as set forth in subsection A. and B. of this section to determine compliance with the following maximum contaminant limits<sup>15</sup> (as amended and/or updated by the Commonwealth or Federal standards) by a Water Quality Laboratory certified by the Department of Environmental Protection of the Commonwealth of Pennsylvania

### **§9. Water Shortages.**

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The maximum contamination

When the Township, Pennsylvania Department of Environmental Protection or Delaware River Basin Commission declare(s) a water shortage, the following water uses are declared nonessential and are prohibited within BNT Township:

- A. Watering of lawns.
- B. Watering of outdoor gardens, landscaped areas, trees, shrubs, and other outdoor plants, except between the hours of 5 p.m. and 9 a.m. by means of a bucket or pail at the minimum rate necessary.
- C. Washing of automobiles and trucks except when required for safety and operational purposes.
- D. Washing of streets, driveways, and sidewalks.
- E. Ornamental water use including, but not limited to, fountains, artificial waterfalls, and reflecting pools.
- F. Use of water for flushing sewers or hydrants by any public or private individual or entity except as deemed necessary and approved in the interest of public health or safety by health officials or the Board of Supervisors.
- G. Use of fire hydrants by fire companies for testing fire apparatus and for fire drills except as deemed necessary in the interest of public safety and specifically approved by the Township.
- H. Use of fire hydrants by municipal road departments, contractors, and all others except as necessary for firefighting or protection purposes.
- I. The use of water to fill and top off swimming pools.

#### **§10. Water Conservation.**

- A. Water saving fixtures and devices shall be required in all new construction regardless of public or private water supply in accord with the current unified building code regulations.
- B. The filling and/or replenishing of swimming pools, fish or decorative ponds, horse troughs or any other device that stores water requiring more than 500 gallons shall be by tanker truck taken from an acceptable source and not be included in water demand.

#### **§11. Responsibility for Adverse Effects to Nearby Wells.**

The applicant seeking approval of a permit for a well related to a large land development shall be responsible for any adverse effect caused by the applicant's well(s) to any residential domestic water supply well existing prior to the issuance of a well drilling permit; and shall establish financial security with the Township pursuant to Section 6 of this Ordinance.<sup>16</sup>

#### **§12. Security.**

- A. An applicant seeking approval of a permit for a well related to a large land development shall deposit with the Township at the time of the issuance of the well utilization permit, financial security in an amount listed in the BNT Township fee

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<sup>16</sup>

Well drilling permit ordinance

schedule times the number of all other groundwater wells located within 1,000 feet of the perimeter lot lines of the subdivision or land development. Without limitation as to other types of financial security which the Township may approve, which approval shall not be unreasonably withheld, Federal or Commonwealth chartered lending institution irrevocable letters of credit and restrictive or escrow accounts in such lending institutions shall be deemed acceptable financial security. Such financial security shall be posted with a bonding company or Federal or Commonwealth chartered lending institution chosen by the party posting the financial security, provided said bonding company or lending institution is authorized to conduct business within Pennsylvania.

B. An applicant seeking approval of a permit for a well related to a minor subdivision or small land development shall not be required to post financial security to ensure well loss protection to surrounding wells. However, minor subdivision and small land development applicants shall be responsible for remedying adverse effects to property owners when such adverse effects are established pursuant to sections 9 and 10. In addition, applicant shall be responsible for any additional expense including legal, engineering and administrative costs, which are incurred in curing the problem.

### **§13. Presumption of Responsibility for Adverse Effect.**

For a period of 60 months from the date any applicant's Class 3 land development final well(s) is/are put in full production, the applicant shall be presumed to be responsible for any adverse effect to any residential domestic water supply well within 2,500 feet of the perimeter lot lines of the subdivision or land development.

### **§14. Right to Hearing.**

Any owner of a residential domestic water supply well who experiences an adverse effect to their water supply due to the installation and/or use of production wells related to a minor subdivision, Class 3 land development shall have the right to request a hearing.

### **§15. Procedure for Hearing.**

Any party desiring a hearing pursuant to §8 of this Chapter shall make demand therefore to the Township Administrator in writing and with proof of service thereof on either the applicant or upon the owner of the residential domestic water supply well which is alleged to have suffered an adverse effect, as the case may be. The Board of Supervisors shall then schedule a hearing not less than 15 days or more than 90 days after receipt of the demand for hearing. Notice of the hearing shall be given to the applicant and the owner of the residential domestic water supply well which is alleged to have suffered an adverse effect. At the hearing, each party shall have the right to present evidence and to cross examine witnesses. The party making the demand for the hearing shall have the burden of proof. All testimony shall be stenographically recorded at the cost of the parties and a full and complete record shall be kept of the proceedings. The decision of the Board of Supervisors shall be in writing, shall contain findings and the reasons for the adjudication, and shall be served upon all parties or their counsel

personally or by mail. Any party aggrieved by the decision of the Board of Supervisors may appeal there from in accordance with 2 Pa.C.S.A. §751.

**§16. Applicant to Provide Remedy for Adversely Affected Wells.**

In the event that it is finally determined pursuant to the provisions hereof that applicant is responsible for an adverse effect to a residential domestic water supply well, then applicant shall alleviate the problem, at no expense to the affected property owner(s), so as to furnish reasonable quantity and quality of water. Applicant shall supply potable water to the property owner until the corrective work is completed and shall reimburse the property owner(s) for their cost of securing potable water prior to applicant doing so. The applicant shall alleviate the adversely affected water supply by deepening an existing well, drilling a new well or connecting the affected property owner to the public water supply (if available) so as to furnish reasonable quantity and quality of water for domestic use. The connection of an affected property owner to the public water supply shall be at the property owner's election, except where the adverse effect is determined to be the presence of hazardous materials that cannot be remedied by deepening or replacing the well, in which case the applicant shall connect the property owner's house to a public water supply (if available). If not available, water quality degradation must be corrected by the applicant by installation of appropriate treatment system to bring the water quality into compliance with this Ordinance.

**§17. Application of Security to Remedy Adversely Affected Wells.**

In the event applicant does not commence to remedy the adversely affected water supply within 5 days of when it is finally determined pursuant to the provisions hereof that applicant is responsible for an adverse effect to a residential domestic water supply well, BNT Township may draw down the financial security posted pursuant to §6 of this Chapter and apply such security to take whatever action the Township deems necessary to cure the problem. In the event that the financial security is not sufficient to cure the problem, applicant shall be responsible for any additional expense including legal, engineering and administrative costs, which are incurred in curing the problem.

**§18. Return of Applicant's Security.**

Sixty months after the date any applicant's final well(s) in land development reaches full production, the applicant, upon written request, shall have all financial security posted with the Township pursuant to this Chapter returned to the applicant, except such security as may be necessary to remedy any pending claims of adversely affected wells which have not been finally determined pursuant to the provisions hereof.

Any person who violates or permits a violation of this Chapter shall, upon conviction in a summary proceeding brought before a District Justice under the Commonwealth of Pennsylvania Rules of Criminal Procedure, be guilty of a summary offense and shall be punishable by a fine of not more than \$1,000, plus costs of prosecution. In default of payment thereof, the defendant may be sentenced to imprisonment for a term not exceeding 30 days. Each day or portion thereof that such

violation continues or is permitted to continue shall constitute a separate offense, and each section of this article that is violated shall also constitute a separate offense.

**H. Severability**

If any provision of this ordinance is invalid for any reason, including preemption by State or Federal law the remaining provisions of this ordinance shall nevertheless apply.

This amending Ordinance shall become effective on \_\_\_\_\_, five days after it is enacted by the BNT Township Board of Supervisors.

ENACTED AND ORDAINED this \_\_the day of \_\_\_\_\_, 2013, by the BNT Township Board of Supervisors.

Attachment F  
Approved Biographic References

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Sophocleous, M. 2000. From safe yield to sustainable development of water resources – the Kansas experience. *Journal of Hydrology*. 235: 27-43.

Stanfield, R.B. 2013. Sustainable/Dependable/Threshold Yield Fractured Bed Rock Geology. Essay prepared based on Bridgeton – Nockamixon – Tincum (BNT) Joint Groundwater Management Committee groundwater monitoring data sets.

## **Attachment A**

# **Groundwater Assessment Report**

### **A-I All wells**

The report shall contain:

- 1) Name and address of applicant,
- 2) A site plan, showing the size and location, tax parcel number(s), topography proposed lot plan(s), underlying bed rock geology, lot area(s), probable well locations and waste water disposal sites of the proposed construction as well as any existing buildings or structures, and showing the One-hundred (100) Year Flood Line, the Floodway and Floodplain.
- 3) The report shall include a detailed evaluation of the water supply demand for and average and peak day with supporting evidence as defined in Defining Demand.  
The report shall include a spreadsheet supporting<sup>1</sup>
  - a) the withdrawal rate exceeds the withdrawal limits shown in the Geological Overlay Limits as shown in Table 1 or
  - b) the median yield of the closes 5 wells within 2500 feet of the site is greater than or equal to 8 gpm, or
  - c) the median well depth of the closes 5 wells within 2500 feet of the site is less than 300 feet, or
  - d) the seasonal groundwater level within 2500 feet varies by less than 20 feet,
- 4) All water-quality sampling analysis data as required in §8 received from the analytical laboratory shall be included in this report.
- 5) The report shall include a detailed evaluation of the potential impacts from subsurface sewage disposal systems on groundwater quality. The treatment technologies shall provide adequate assurance that any and all groundwater pumped from the wells shall satisfy Federal and PADEP Drinking Water Standards and will not be adversely impacted by disposal field discharges. For **Class II** and **III** wells, a site plan depicting well, disposal field, at a minimum scale of 1-inch equals 200 feet shall be included.
- 6) The impacts to water quality shall include a detailed evaluation of nitrate loading on the aquifer using a peer-reviewed nitrate dilution model such as Trela-Douglas Nitrate Dilution Model, according to Attachment D. Groundwater recharge rates used in such a model shall reflect aquifer replenishment rates for prolonged drought conditions to ensure adequate dilution necessary to maintain safe drinking water during all climatic conditions.
- 7) The report and all data shall be submitted in an acceptable digital format.

### **A-II Only if the well classification requires an aquifer test then in addition:**

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<sup>1</sup> <http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm>

As part of the approval process for developments with

1. the withdrawal rate exceeds the withdrawal limits shown in the Geological Overlay Limits as shown in Table 1 or
2. the median yield of the closes 5 wells within 2500 feet of the site is less than or equal to 8 gpm, or
3. the median well depth of the closes 5 wells within 2500 feet of the site is greater than 300 feet, or
4. the seasonal groundwater level within 2500 feet varies by more than 20 feet,

a development-wide aquifer test must be performed. A work plan for the aquifer test must be submitted to BNT Township and written approval must be granted prior to the initiation of the test.

The purpose of the development-wide aquifer test is to determine

1. the long term sustainability of the aquifer,
2. Whether or not increased water usage will adversely impact off-site well water levels, and
3. stream flows and wetlands are not degraded.

The aquifer test must be conducted hydrogeologist licensed to do business in Pennsylvania using the procedures detailed below:

A The **working plan** prepared for township approval shall include

1. Applicants name, address and telephone number.
2. Location of the proposed well(s) and facility(ies) the well will serve.
3. Water demand documentation and calculation,
4. Map of the affected area with lot lines, roads, stream and contours,
5. Location of test and observation wells on the map and by GPS coordinates,
6. The pre, actual and post pumping protocol.

Design an appropriate pumping aquifer test using best professional judgment. The pumping rate should be sufficient to supply water to meet twice the total daily water demand for all the users in the development.

For example, if the development includes 10 dwellings housing units with a total of 35 bedrooms, the pumping rate must be at least 14,000 gallons per day or 9.75 gallons per minute (gpm). If one well cannot yield sufficient water, additional wells may be used for the test. The test should last for a minimum of 72 hours. or until equilibrium conditions are established or a minimum of 36 hours. Data

shall be collected following an interval equal to the time period of the pumping.

7. Estimates of initiation and completion dates of the tests,

8. Characterize the underlying geologic formation with available information, including literature, field observations and well logs to obtain the following:

- Water bearing zone with yield;
- Thickness of overburden and the rock types encountered<sup>2</sup>;
- Known hydraulic conditions of the aquifer such as confined, semi-confined or water-table;
- Depth to the static water table level or potentiometric surface;
- Known permeable and semi-permeable zones;
- Orientations of joints, fractures, and bedding planes and their yield;
- Recharge areas;<sup>3</sup>
- Anticipated values of well yield, hydraulic conductivity, transmissivity and<sup>4</sup> storage coefficient;
- Estimated ground-water flow direction<sup>5</sup>, and
- Locations of all potable wells within a 5,000-foot radius of the proposed development. See Well Class Cone of Depression Table below
- Locations of streams, ponds, wetlands and other surface water bodies within a 5,000 foot radius of the proposed development

a. Class 1 Well - A Class 1 well is a well or well cluster where the withdrawal is expected to not exceed 1,000gallons per day.

b. Class 2 well - A Class 2 well is a well or well cluster where the withdrawal is expected to be greater than 1,000 gallons per day and not to exceed 2500 gallons per day.

c. Class 3 well - A Class 3 well is a well or well cluster where the withdrawal is expected to be greater than 2500.

Well Class Cone of Depression (CoD)

Well Class	Distance (radius feet)
1	750
2	1500
3	2500

d. Standard plan submission.

e. Well Driller's name, address and telephone number.

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<sup>2</sup> Use this in defining the geological zone.

<sup>3</sup> I'm not sure well driller or hydrogeologists know anything about this in this area. A wild ass guess at best.

<sup>4</sup> These numbers are interesting technically, but I have not seen them used in any decision making process. I think they are red herrings/snow job. Finally, they are meaningless in fractured rock geologies.

<sup>5</sup> Again I'm not sure how they determine this without multiple well SWL measurements.

- f. Projected water quantity requirements for the proposed use.
  - g. A separate map shall be submitted showing the location of the production and of all applicable monitoring wells.
  - h. The location of all wells participating in the aquifer test will be recorded by latitude/longitude coordinates (NAD 83) together with the USGS Datum elevation of the well head casing. The horizontal location of the well should be accurate to within +/- ten (10) feet and the elevation above the USGS Datum to within one (1) foot. A full well drillers report including data on the rock strata depths, yield rates by depth and total yield will be reported. The total well depth of the applicant's test and observation wells will be reported.
  - i. When constructed, the test and observation wells will be drilled to the same base reference USGS Datum elevation and must have a minimum yield of five (5) gallons per minute. This is required to prevent measuring the static water levels from an aquifer different from the test aquifer.
  - j. The well driller's reports for the wells within the Well Class CoD feet of the proposed development including the total well depth, yield, characteristics, and history shall be provided. Where such information is not available, documentation to that effect shall be provided.
  - m. All measurements will be made with digital loggers. The data will be collected directly from loggers at the conclusion of the test jointly by the applicant's agent and an agent of BNT Township.
  - n. The applicant will submit precipitation data from a rain gage data logger in increments of 0.01 inches with the date and time recorded to the nearest minute. The test will not be considered valid if there is snow on the ground or there is a major rain event (greater or equal to one-half (1/2) inch within 3 days before or during the test.
  - o. Sonic static water level measurements in active wells shall be conducted in such a manner to assure that the measurement has not been influenced by a depression of the water level from a recent pump withdrawal. A spot tape may be used where it can be established that a sonic measurement cannot be obtained.
2. To determine ambient conditions, water-level measurements must be collected from the pumping well(s) and observation wells at one week prior to the initiation of the test;
  3. Water from the **aquifer** test must be discharged to an area away from the pumping well, preferably an off-site downgradient location which will not impact the result of the test;
  4. Well casings and ground surface elevations for the pumping well and observation wells shall be surveyed to a common datum. The latitude and longitude coordinates of the well head shall be reported with an accuracy of  $\pm 10$  feet.

**C. Participation of Neighboring Property Owners**

1. The work plan shall identify all abutting property owners so that they can be offered well data loggers to participate in monitoring of their well levels where desired.
2. The property owners of all wells within the Well Class CoD to the proposed development will be contacted by the applicant with a letter of encouragement from BNT Township to be informed of the opportunity to participate in the pump test for the proposed development and may request that the test include monitoring of their well levels.
3. Owners of existing wells and springs on lots located within Well Class CoD of the Lot in Question shall be given an opportunity to have their wells/springs monitored during the aquifer test.
4. Such opportunity shall be given by the applicant by notice via certified mail and shall state the time and place of the aquifer test. A notice acceptable to the municipality is included – Notice of Aquifer Test - Time and Place including a letter written by the township.
5. The notice shall indicate that such existing well may be monitored, if agreed to by the well owner, provided the well is readily accessible. Such notice shall indicate that the existing well owner must respond within twenty eight (28) days of notice receipt and the applicant's responsibility is to monitor up to three (3) wells on properties located within Well Class CoD of the boundaries of the Lot in Question.
6. The applicant shall provide a certificate of insurance for itself and all contractors utilized and pay all costs associated with the monitoring of any existing residential well.
7. Prior to monitoring, all buried wells must be raised to a minimum of twelve inches above grade to allow access and retrofitted with pitless well adapters etc. per N.J.A.C. 7:10-12.20 well head requirements.
8. All wells shall be chlorinated each time they are opened for service or monitoring, unless the owner specifically waives the requirement of chlorination in writing.
9. The costs of extending, restoring or replacing a well damaged as a result of testing shall be the responsibility of the applicant.
10. The applicant shall indemnify and hold the Township and its consultants and representatives harmless from any liability in connection with these testing requirements.

**D. Final Report Submission Requirements**

1. A geological map of the area within 1.0 mile radius of the site.

2. A map showing all water withdrawal points, surface-water bodies fault line, lineaments and fractures within 1/4 mile the Well Class CoD of the proposed development.
3. A scaled site map showing the locations of the pumping well and observation wells, and proposed locations of other wells expected to be installed in the development.
4. Well logs and well construction specifications;
5. Field data, including depth to water and discharge rate, the times the measurements were taken, and the methods of obtaining the measurements;
6. Plots of drawdown versus time for the pumping well(s) and observation wells;
7. Plots of drawdown versus distance for specific times during the test;
8. Plots comparing the drawdown phase to recovery phase from the initial condition to the end of the recovery phase of the test.
9. Method of analysis of data (such as Theis, Jacob or other applicable methodologies);
10. The zone of capture (ZOC) and Cone of Depression (CoD) of the pumping well(s);
11. Analytical results of the test and conclusions.

#### Pumping Test Criteria

The developer or the developer's contractor must calculate the potential **Cone of Depression** of the pumping well(s). To pass the test, the calculated **Cone of Depression** greater than 2 feet must not include any off-site potable wells.

The magnitude of water-level drawdown must be calculated for the downgradient edge of the development. To pass the test, a drawdown of less than 1 foot must be apparent at the downgradient property boundaries during the last hour of the pumping test.

Furthermore, if the recovery phase level at the end of 168 hours is less than 90% of the initial water level, a detailed calculation shall be made to estimate the sustainability of the well at end of 180 day, 1 year and 5 year droughts, ie the withdrawal shall not depress the Static Water Level by more than 20 feet.

#### Observation Well Requirements – Aquifer Testing

1. 1.The number of primary observation wells required per aquifer test will depend on the proposed number of new lots or dwelling units and/or proposed nonresidential or non-exempt agricultural water demand. New and existing observation wells may be located such that they

can be used as future water-supply wells but they shall be located in such a manner that they will yield the most accurate information concerning the aquifer.

2. Primary observation wells shall be completed to similar depths as the pumping well.
3. During all three phases of the aquifer test, water must not be withdrawn from a primary observation well. Primary observation wells shall not be pumped during the aquifer test.
4. When an existing well is to be used as an observation well to satisfy the requirements listed below, the pump in the well should preferably remain off during all three phases of testing. When it is infeasible to turn an existing well off, data processing to choose a maximum of a sliding set 1.5 hr readings may be used to determine the approaches to equilibrium for such wells.
5. Primary observation wells must be located parallel and perpendicular to strike of the primary regional fractures and those intersected by the tested well. Additional primary observation wells should be located to evaluate potential secondary fractures and impacts to adjacent properties.
6. A fracture trace analysis showing the location and orientation of fracture lineaments must be included with the Aquifer Test Plan. This same analysis with additional information regarding septic system locations must be included in the Final Hydrogeologic Report. The fracture trace analysis must be used to identify all primary observation wells on the Lot in Question and to identify existing neighboring property owner's wells to be monitored during the test.
7. All wells must be located in accordance with the minimum distances required by N.J.A.C. 7:10-12
8. One observation well shall be located within 200 feet of the test well and at least one observation well shall be located along a fracture trace or preferential fracture direction between 200 and 500 feet from the pumping well.
9. For nonresidential developments or expansions thereof leading to a total anticipated daily demand exceeding 800 gallons per day on the Lot in Question, or for non-exempt agricultural uses, the number of observation wells shall be as shown in Table VI-2. Although water levels will be measured and recorded in the pumping well, and these data must be submitted with the hydrogeologic report, the pumping well shall not serve as one of the observation wells required below.

Table VI-2: Observation Well Requirements for Nonresidential and Non-Exempt Agricultural Uses

Average Demand	Number of Observation Wells	Cone of Depression (CoD)
Class 1 Equal to or less than 1000	2 (minimum of 1 new well within Lot in Question)	750 ft
Class 2 1,000 to 2,500	3 (minimum of 2 new wells within Lot in Question)	1500 ft
Class 3 Greater than 2,500	5 (minimum of 2 new wells within Lot in Question)	2500 ft

10. The observation wells and the pumping well must have a geologic log describing the depth and types of soils and rocks encountered and the depth and yields of all water-bearing fracture zones. The logs must include static water-level measurements and total yield estimates for each well as well as the geographical coordinates of the well head and elevation above USGS Mean Sea Level.
11. Pursuant to N.J.S.A. 58:4A, all observation wells installed as part of the aquifer testing shall be properly abandoned. A certified and licensed well driller shall abandon the wells in accordance with the requirements of N.J.A.C. 7:9D-3.1, et seq. The well abandonment forms shall be completed and submitted to the New Jersey Department of Environmental Protection, Bureau of Water Allocation (call 609-984-6831 for forms and information).

Notification Requirements and Procedures Nearby Well/Spring Owners

Notification:

**Response:**

1. If the owner of a lot within the distance defined by Well Class CoD of a boundary of the Lot in Question decides to participate by agreeing to have his/her existing well monitored, such owner shall notify the applicant by certified mail<sup>6</sup>.
2. Such response shall be provided within 28 days of receipt of the certified notice from the applicant.
3. If the applicant receives no response within the time provided, the response shall be deemed to be negative.
4. Protection of Monitored Wells and Selection of Observation Wells.
  - (a) All reasonable efforts must be made to protect the potability of water from the monitored well.
  - (b) In the case when more than three property owners within Well Class CoD of the boundaries of the Lot in Question decide to participate and to have their existing wells monitored, only three must be monitored.
  - (c) However, if any of the property owners requesting monitoring have wells completed to a depth less than 100 feet, these wells must also be monitored in addition to three other wells.
  - (d) A map depicting the location of all wells to be monitored and a list of all property owners within Well Class CoD of the boundaries of the Lot in Question that requested monitoring is to be submitted to the Board's hydrogeologist for review and approval prior to implementing the test.
  - (e) The observation wells on neighboring properties should be selected to assess whether water-

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<sup>6</sup> Certified mail – too awkward – notify the township.

level drawdown impacts from the pumping well will extend beyond the boundaries of the Lot in Question in any direction.

(f) The Board reserves the right to retain a qualified hydrogeologist to review the proposed monitoring locations and to make recommendations to revise the locations to be monitored.

Evaluation of a drilled well.

1. The well yield determined by an approved yield test<sup>7</sup> shall be equal or greater than 5 gpm.
2. The Static Water Level equal to or less than 200 feet below the surface level shall be reviewed by the Township.
3. The construction standards as defined in Bucks County Well Drilling Standards have been satisfied.
4. The water quality shall be within both the State and Federal Water Quality Standards shown in Appendices C and D as determined by a Water Quality Laboratory certified by the Department of Environmental Protection of the Commonwealth of Pennsylvania according to the Township requirements.
5. The applicant shall demonstrate
6. The projected well withdrawal rates shall not exceed rates of the underlying geology shown in Table 1 and Geology Map in Attachment F and water budget balance with a strong focus on recharge unless strong experimental evidence can demonstrate a sustainable groundwater yield to the contrary, through an analysis by the Water Resources Report as defined in Attachment A.

If and only if an aquifer test and a Water Resources Impact Report is required, then criteria 7 through 13 of the Aquifer Test Results shall be met

7. Precipitation - A test conducted during a period in which more than 0.25 inches of precipitation are recorded at or near the site, the test shall be repeated.
8. Background Phase-Antecedent influences such as seasonal change shall be determined, and, if necessary, pumping phase and recovery phase data must be corrected. Insufficient data to assess these influences will require repetition of all three phases of the aquifer test.
9. Pumping Phase
  - (a) The pumping phase of the aquifer test shall be at minimum 96 hours.
  - (b) If the pumping rate does not exceed the target of the twice average daily demand by 20 percent or the peak-day demand cannot be pumped within a 96-hour period, the aquifer beneath the site shall be deemed insufficient to meet the proposed demands and the applicant must reduce site demands and/or development units.
  - (c) If the mean of the pumping rate varies by more than 5 percent from the target flow rate for more than 6 hour, the entire test shall be repeated.
  - (d) The pumping rate shall be digitally recorded at 10 minute intervals,
  - (e) If water levels in the pumping and/or observation wells exceed the measurement capacity of the

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<sup>7</sup> See some state that defines yield test and obtain the defining document in digital form. See attached documents from New Hampshire for example. Yield\_Test\_NH.pdf Yield\_test\_log\_NH.pdf These are not the defining documents, but imply there is one behind these on-line pages. New Jersey?

devices used for measuring changes in water levels and measurements are not recorded with other devices, the test shall be repeated.

(f) The magnitude of water-level drawdown must be calculated for the downgradient edge of the development. To pass the test, a drawdown of less than 1 foot must be apparent at the downgradient property boundaries during the last hour of the pumping test.

## Attachment B Water Quality

### Water Quality Analysis.

- A. Each applicant applying for a permit pertaining to a regulated well shall perform a water quality analysis. The groundwater quality analyses shall be conducted on a pumped water sample collected just prior to the completion of the pump test, as described in §228-12.B. of this Ordinance.
- B. The analysis shall contain the interpolated (for the site) values, range of values, and drinking water standard values as set forth in the Federal Safe Drinking Water Act. All laboratory analyses shall be performed by a PA DEP certified laboratory and shall be included in the study.
- C. The analysis shall contain any available water quality data that is obtained from nearby, adjacent groundwater sources including data collected by Tinicum Township or from other studies performed for other developments with the Township or within 1 mile of the perimeter of the site.
- D. The analysis shall indicate the location and design of all on-site sewage disposal systems.
- E. For Class II and III Applicants, the analysis shall include a groundwater quality analysis for the dry year nitrate impact of on-site sewage disposal systems within the proposed subdivision. In particular, the analysis must include an estimate of the increase in nitrogen (nitrate, nitrite and ammonia) concentrations in the ground water and provide a discussion of background nitrogen concentrations. The analysis shall also include an estimate of the nitrogen concentration in the ground water beneath the downgradient property boundaries during the 50-year drought.

**1. Nitrate Analysis Report:** A Nitrogen Dilution Model (NDM) must be provided to predict the water quality impacts of on-site wastewater disposal systems. The model shall include an analysis of the nitrogen loading, the predicted concentration of nitrate at the property line, the septic effluent leach field area and precipitation input. Specific standards for this model are provided within the NDM of the New Jersey Department of Environmental Protection, and the NDM of the State of New Jersey Pinelands Commission. An Example of the use of such a model is the method of Trela-Douglas.<sup>1</sup> An equivalent Pennsylvania Department of Environmental Protection model may also be used.

*The NJDEP NDM uses GSR-32, a soil-based methodology for determining recharge. This is ruinous. The equation which follows seems great. To offer support for this new important step, we may to reference the anti-degradation levels the County has established for each of our streams, the TMDL's. Terry from the County told me about this, but I have yet to find them on*

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<sup>1</sup> () Nitrate Dilution Modeling of Montgomery Township, Somerset County, NJ  
[www.giscenter.org/resources/library/montgom.nitrate.pdf](http://www.giscenter.org/resources/library/montgom.nitrate.pdf)

the PADEP site.

a. In order to assure the availability of reliable and safe water supply to support the intended land uses and to protect the aquifer, no development, regardless of size, shall be approved which will increase nitrates by half the distance to 10 ppm from background nitrate <sup>(2)</sup> level as measured by a Water Quality Laboratory certified by the Department of Environmental Protection of the Commonwealth of Pennsylvania. The formula for calculating the maximum target nitrate concentration allowable is to subtract the background concentration of nitrate from 10 ppm and divide that number in half and add that to the background concentration of nitrate.

**Target nitrate concentration = Background conc. + (10 ppm – Background conc.) / 2**

*For background nitrate, we may wish to specify use of the number presented in Sloto (94-4109). Or do we want an applicant to test for nitrate, and use this number?*

b. The data prepared by the United States Geological Survey in the water study known as the Hydrogeology and Ground-Water Quality of Northern Bucks County, Pennsylvania, Water Resources Investigations Report 94-4109 and Hydrologic Data for Northern Bucks County, Pennsylvania, Open-File Report 94-381, and/or the U.S. Army Corps of Engineers Philadelphia District/ Final Market Feasibility Study, Tinicum Township, Bucks County Pennsylvania, Alternative Wastewater Treatment Solutions for Hamlets and Villages and Groundwater Monitoring Options, (MFS Study, October, 1996) shall be considered authoritative. The soils data provided by the United States National Resource Conservation Service, and the geologic data provided by the Pennsylvania Geological Survey, Map of Pennsylvania 1981 or more recent if available, shall be considered authoritative.

**2. For Developments Proposing to use a Community Waste Disposal System:** for surface water resources, the unit aerial pollutant budget analysis approach can be utilized to predict how much nitrogen is entering a given waterbody. An applicant proposing a community waste disposal system must first, delineate the watershed boundaries of the waterbody of concern. The waterbody could be a lake, reservoir, stream or river.

a. Once delineated, all of the land use within the watershed is quantified in terms of surface area. Each land use category should have an ascribed surface area based on the most up-to-date map/digital data available.

b. Empirically derived pollutant loading coefficients can be assigned to each land use category. These coefficients provide an estimate of the amount of a given pollutant (*i.e.*, nitrogen, phosphorus, suspended sediments, and lead) that is generated on an annual basis for each particular land use category. These coefficients shall either be obtained from the scientific literature or from field data collected at the site. The coefficients are multiplied by the surface area of its respective land use category to obtain an estimate of the pollutant generated by that land use category per year.

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2 () A nitrogen dilution model as described in Attachment B is to be used.

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c. The data can then be used to develop a pollutant budget for the receiving waterbody. Current pollutant budgets shall be compared to future predictions of development to predict how such activities within the watershed will impact the water quality of the receiving waterbody. Predictions on future development shall be based on population data and projections that are readily available from regional, State, and local planning agencies.

F. The quality of the water produced by the well shall be tested as set forth in subsection A. and B. of this section to determine compliance with the following maximum contaminant limits<sup>3</sup> (as amended and/or updated by the Commonwealth or Federal standards) by a Water Quality Laboratory certified by the Department of Environmental Protection of the Commonwealth of Pennsylvania:

**PHYSICAL CHARACTERISTICS**

Turbidity.....	5 NTU units
Color.....	15 Color units
Threshold Odor Number .....	3 units
pH.....	6.5 - 8.5

**CHEMICAL CHARACTERISTICS**

Arsenic.....	10 micrograms/L (ppb) (As <sup>+3</sup> plus As <sup>+5</sup> )
Chloride.....	250 mg/L (ppm)
Nitrogen (as Nitrate + Nitrite).....	10 mg/L (ppm)
Iron.....	.3 mg/L (ppm)
Sodium.....	20 mg/L (ppm)
Manganese.....	50 micrograms/L (ppb)
Copper.....	1 mg/L (ppm)
Hardness.....	250 mg/L (ppm) as CaCO <sub>3</sub>
Detergent .....	0.5 mg/L (ppm) as MBAS
Total Dissolved Solids.....	500 mg/L (ppm)
Total of all chlorinated alkanes and alkenes	<b>4.5 micrograms/L (ppb)<sup>4</sup></b>
Lead.....	15 micrograms/L (ppb)
MTBE - methyl tertiary butyl ether .....	0.02 mg/l <b>20 (ppb)</b>
PCE - tetrachloroethylene.....	<b>0.005 mg/l 5 (ppb)</b>

3 The maximum contamination levels (MCL) are set by the U.S. Environmental Protection Agency drinking water standards (<http://www.epa.gov/safewater/contaminants/index.html#listmcl>) or the Pennsylvania DEP drinking water standards ([http://www.depweb.state.pa.us/watersupply/lib/watersupply/PA\\_MCLs\\_06.pdf](http://www.depweb.state.pa.us/watersupply/lib/watersupply/PA_MCLs_06.pdf)) whichever is more restrictive.

4 If you want to add PCE and TCE explicitly at 5 ppb, then it is in conflict with Total of all chlorinated alkanes and alkenes at 4.5 ppb. If you set the total of all chlorinated alkanes and alkenes at 5 ppb, you implicitly set the total of PCE + TCE + any chloroform + any methylene chloride + ... at 5 ppb. The chlorinated compounds are not found in isolation, but as a cocktail of related compounds.

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TCE - trichloroethylene..... 0.005 mg/l 5 (ppb)l

**BACTERIOLOGICAL CHARACTERISTICS**

Fecal Coliform..... Less than 1 colony per 100 ml  
Total Plate Count ..... Less than 500 counts per 100 ml

No building permit will be issued for any lot unless the water quality of the well meets these standards or unless the plans for the building include detailed plans for a treatment system which is certified by a professional engineer or other qualified individual to bring the water into compliance with these standards.

In addition, the applicant for a building permit must agree that in the event, the water is not in compliance with the aforementioned standards, that he will give the purchasers of the property (if different than the applicant) a copy of the water certification specifying each contaminant which does not comply with the standards and a written description (including plans) of the system which will be installed to bring the water quality into compliance together with instructions as to how the system must be maintained.

G. If the land to be developed was subject to any of the prior land uses listed below, the Township may require testing for the below listed corresponding potential groundwater contaminants.

**ABBREVIATIONS FOR POTENTIAL CONTAMINANTS**

- MP Microbiological Pathogens: Total/Fecal Coliform, Viruses, Protozoa
- NN Nitrate / Nitrite
- VOC Volatile Organic Compounds
- HM Heavy Metals
- M Metals
- SOC Synthetic Organic Compounds
- T Turbidity
- D Disinfection by product precursors
- TO Taste & Odor precursors
- R Radionuclides (anthropogenic)
- PH Petroleum Hydrocarbons

**AGRICULTURAL**

**Potential Contaminant**

<b>AGRICULTURAL</b>	<b>Potential Contaminant</b>
Animal feedlots	MP, NN, SOC, M
Dairy farms	MP, SOC, NN,
Fertilizer storage or use	SOC, NN
Manure-spreading or storage	MP, NN

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Pesticide storage or use	SOC
Silviculture	T, SOC
Slaughterhouses	MP, NN

<b>COMMERCIAL</b>	<b>Potential Contaminant</b>
Airports	VOC, M, HM, PH
Auto repair shops	VOC, HM, PH, M
Bus and Truck terminals	VOC, HM, SOC, PH
Construction areas	VOC, HM, M
Car washes	T, M
Dry cleaners	VOC
Funeral homes	VOC, SOC, MP
Furniture Refinishing	HM, VOC,
Gas/service stations	VOC, PH, M
Golf courses	SOC, NN, T, HM, M
Junk yards	VOC, HM, M, PH
Laundromats	T
Lumber yards	VOC, HM
Medical facilities	VOC, HM, M, SOC, R
On-lot Wastewater Disposal	MP, NN
Paint shops	VOC, HM
Photo processors	VOC, SOC, HM
Printer and Blueprint shops	VOC, SOC, HM,
Railroad tracks and Yards	VOC, SOC, HM, PH
Repair shops(engine, appliances, etc.)	VOC, HM, PH
Research laboratories	VOC, SOC, HM, M
Rust proofers	HM, VOC
Sand and gravel mining/ washing	T, M, VOC, HM

<b>INDUSTRIAL</b>	<b>Potential Contaminant</b>
Asphalt, Coal tar, and Concrete plants	VOC, PH
Chemical manufacture	VOC, SOC, HM, M
Deep Coal Mining	HM, M, T,
Deep Non-coal Mining	M, HM, T
Electronics manufacture	VOC, SOC, HM, M
Electroplaters	VOC, SOC, HM, M
Food processors	HM, VOC, M,
Foundries or Metal fabricators	HM, VOC, PH
Fuel oil distributors	PH, VOC
Hazardous materials storage, treatment and recycling	VOC, SOC
Industrial lagoons and pits	VOC, HM, M
Industrial parks	VOC, SOC, HM, M, PH, O
Jewelry or Metalplating	VOC, HM, M, SOC,

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Machine/metalworking shops	VOC, HM, M, SOC
Metal & Drum reconditioning	VOC, HM, M, SOC
Oil and gas wells/production	M, PH, VOC
Oil Refineries	VOC, PH, HM, M
Plastics Manufacturing	PH, VOC, SOC, HM
Power plants	HM, M
RCRA facilities	VOC, SOC
Storage facilities (petroleum and chemical)	VOC, SOC, PH
Surface Coal Mining	T, M, HM
Surface Non-coal Mining	T, M, HM
Tanneries	HM, M, VOC
Wood preserving facilities	SOC, HM
Quarries	T, M, VOC, HM

**RESIDENTIAL**

**Potential Contaminant**

Fuel oil storage	VOC, PH
Household hazardous materials	VOC, SOC
Lawn care	SOC, NN, M
On-lot waste disposal	MP, NN
Swimming Pools	VOC

**MISCELLANEOUS**

**Potential Contaminant**

Aboveground storage tanks	VOC, PH
Air Pollution/local sources	N, VOC, M
Aquatic wildlife	MP, NN
Combined sewer outfalls	VOC, SOC, MP, NN, HM, TO
Composting facilities	TO
Dredge disposal	T, VOC, SOC, M, HM
Fire training facilities	VOC, PH, M, HM
Boating yards and marinas	PH, VOC, SOC
Landfills and Dumps	VOC, HM, SOC, NN, MP, M
Land application of sewage sludge	MP, NN, M, HM
Large quantity hazardous waste generators	VOC, SOC, HM
Military facilities (past and present)	VOC, SOC, HM, R, PH
NPDES locations	MP, NN, HM
Pipelines - petroleum	VOC, PH
Pipelines - sewer	MP, NN, T
Recycling or Reduction facilities	VOC
River barges / shipping	VOC, SOC, PH
Road and Maintenance depots	VOC, SOC, M
Road Salt Storage	M
Small quantity hazardous waste generators	VOC, SOC, HM

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Snow dumps	M, T
Stormwater facilities	T, VOC, SOC, NN, M
Transportation corridors	SOC, M, T
Underground petroleum storage tank	VOC
Utility substation	SOC, VOC, HM
Waste incinerators	HM, VOC, SOC
Wastewater treatment plants	D, MP, NN, VOC, SOC, M
Road deicing	M
Abandoned wells	SOC, VOC
Wells/Borehole drilling	SOC, VOC, M, T

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## Attachment C Nitrate Evaluation

An applicants analysis shall include a groundwater quality analysis for the dry year nitrate impact of on-site sewage disposal systems within the proposed project. In particular, the analysis shall include an estimate of the increase in nitrogen (nitrate, nitrite and ammonia) concentrations in the ground water and provide a discussion of background nitrogen concentrations. The analysis shall also include an estimate of the nitrogen concentration in the ground water beneath the downgradient property boundaries during the 50-year drought.

1. Nitrate Analysis Report: A Nitrogen Dilution Model (NDM) shall be provided to predict the water quality impacts of on-site wastewater disposal systems. The model shall include an analysis of the nitrogen loading, the predicted concentration of nitrate at the property line, the septic effluent leach field area and precipitation input. Specific standards for this model are provided within the NDM of the New Jersey Department of Environmental Protection, and the NDM of the State of New Jersey Pinelands Commission. An Example of the use of such a model is the method of Trela-Douglas<sup>1</sup>. An equivalent Pennsylvania Department of Environmental Protection model may also be used<sup>2</sup>.

Target nitrate concentration = Background conc. + (10 ppm – Background conc.) / 2

The nitrate load in the model shall equal ten pounds per person per year. The background level shall be based on the analytical results from the aquifer testing. If the nitrate dilution analysis indicates that the target level will be exceeded at the property boundary, the number of units proposed for construction must be reduced sufficiently so that the target level will not be exceeded during all climatic conditions. If the nitrate dilution analysis indicates that the nitrate loading in any stream will exceed the target level, then the number of units shall be reduced sufficiently so that the target level will not be exceeded during all climatic conditions.

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1 Nitrate Dilution Modeling of Montgomery Township, Somerset County, NJ [NJ\\_Montgomery\\_nitrate.pdf](#)

2 For spray irrigation, a crop uptake credit may be allowed. See New Garden Spray irrigation USGS CL Schieffler. I think we are on thin ground for drip irrigation as well but there is no evidence.

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Attachment D  
Well Driller's Permit Requirements

Well drilling application

1. The following information shall be submitted with the well drilling permit application for all classes of wells.
  - a. Applicants name, address and telephone number.
  - b. Location of the proposed well and facility(ies) the well will serve.
  - c. A copy of the preliminary plan for the subdivision or land development for a Class II or III well, or a plot plan for a Class I well.
  - d. Standard plan submission.
  - e. Well Driller's name, address and telephone number and license number.
  - f. Projected water quantity requirements for the proposed use.
  - g. A separate map shall be submitted showing the location of the production and of all applicable monitoring wells with GPS coordinates.

Construction Standards:

In the construction of wells, Bucks County Well Drilling Standards shall be used with further standards satisfactory to the Board shall be employed and monitored. To the extent an analysis depends on water conservation and recycling, the standards shall include guarantees of implementation, well construction data and maintenance satisfactory to the Township shall be provided.

All well drillers are required to obtain an annual permit from the Zoning Officer.

**Well caps** will require an air vent. The purpose of the vent is to equalize the air pressure between the inside of the casing and the atmosphere, and to release unpleasant or explosive lighter than air gases. If such gases are present and the well is enclosed in a building or confined space, the air vent should always be extended to the outside atmosphere. The vent pipe must shall be shielded and screened to prevent the entry of foreign material such as insects into the well.

Two Part Yield/Constant Head Test

Definitions specific to Two Part Yield/Constant Head Test

1. **AQUIFER CONTRIBUTION RATES:** the maximum rate at which water can flow from an aquifer to a well. Here assumed to equal the pumping rate measured in the constant head test.
2. **AQUIFER CONTRIBUTION VOLUMN:** the total volume of water which flows from the aquifer to the well during the shortfall time.
3. **ASSURED TIME:** the time it will take to pump the assured volume from the well at the peak demand rate.
4. **ASSURED VOLUME:** the volume of water in a well below the static level and above the constant head level.
5. **CONSTANT HEAD:** a stable water level attained under a constant pumping rate. For this application a rate of change of less than 0.5 feet (6 inches) per hour is taken as stable.

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6. CONSTANT HEAD DRAWDOWN: the drawdown in a well when a constant head condition has been attained, measured from the static water level at the end of the constant head test.
7. CONSTANT HEAD LEVEL: the water level in a well at the end of the constant head test. Measured from the top of the casing.
8. PUMPING RATE: a constant pumping rate at which a stable water level is attained. The pumping rate during the constant head test.
9. CONSTANT HEAD TEST: a pumping test in which pumping rate and drawdown are kept constant with time to determine well yield only. For this application a rate of change of less than 0.5 feet (6 inches) per hour is taken as constant. This term is not applicable to an aquifer test.
10. PEAK DEMAND RATE: the average rate of water use during peak demand periods.
11. PEAK DEMAND TEST: a pumping test conducted to evaluate the capability of a well to supply peak demand needs of a use. The test is conducted at a rate equal to or greater than the peak demand rate for the peak time.
12. PEAK LOAD: the volume of water required by a use during each peak demand period. In this application the peak load is assumed to be half the estimated total daily use water consumption.
13. PEAK TIME: the length in minutes of each of two daily peak demand periods.
14. SHORTFALL TIME: the time needed to pump the shortfall volume from a well at the peak demand pumping rate.
15. SHORTFALL VOLUME: the volume of water needed in addition to the assured volume to make up the peak load.

The **Two Part Yield Test** is meant to assure the well will adequately serve the intended use. In particular its will document the yield and storage capacity will meet the normal peak daily demand. The depth goal is assure that there is sufficient well depth to provide a settling region below the pump, provide sufficient head above the pump to prevent cavitation and bore hole storage capacity to meet drawdown during the pumping phase.

1. Calculate the Peak Demand Rate and Peak Time according to the following formula:

Minimum Well Formula Assumptions:

Water usage is 100 gallons per day (gpd) per person;

Two persons occupy one bedroom; additional bedrooms are occupied by one person;

Two Peak Water Use Periods per day, and

Flow through plumbing fixtures = 3 gallons per minute (gpm) in bathrooms.

Peak Load = (no. of bedrooms) (no. of persons/bedroom) (gpd/person)

peak periods/day= (no. of bedrooms) (2) (100) = (no. of bedrooms)(100 gallons)

Peak Demand Rate = (gpm/bathroom)(no. of Minimum Well Formula Assumptions:  
bathrooms) = (3 gpm)(no. of bathrooms) = (3 gpm)(no. of bathrooms)

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Peak Time = peak load peak demand rate

2. Perform peak demand pumping test:

Measure static water level in the well prior to the initiation of pumping;

Pump at peak demand rate for peak time, and

Measure the water level in the well at the completion of the test.

\*To pass, the well must be able to supply water at the peak demand rate for the peak time.

3. Perform the constant head pumping test immediately upon completion of the peak demand test, regardless of whether or not the test was passed. The water level must not be allowed to recover from the first test. The constant head pumping test must be completed under the procedures detailed below:

Adjust the pumping rate to a constant head pumping rate.

The change in head must be less than 0.50 feet per hour;

Convert the constant head pumping rate to gpd and compare to total household demand, and;

\*To pass the test, the constant head pumping rate must equal the total demand.

4. All wells must meet the five (5) gpm minimum as specified in the well construction standards.

Flushing and testing. The well shall be flushed at a rate at least equal to 200 percent of the expected pump capacity for a minimum of two (2) hours, or until the water discharging is clear and free from sand. During the flushing operation the amount of drawdown and stability of the yield shall be determined.

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TINICUM TOWNSHIP  
163 Municipal Rd.  
Pipersville, PA 18947  
610-294-8076  
Well Permit Application

PERMIT #

Date: \_\_\_\_\_ Tax Parcel No: \_\_\_\_\_

Applicant's Name: \_\_\_\_\_ Phone No: \_\_\_\_\_

Applicant's Address: \_\_\_\_\_

Owner's Name: \_\_\_\_\_ Phone No: \_\_\_\_\_

Physical Location: \_\_\_\_\_

GPS Coordinates: \_40o \_\_\_\_\_ N \_75o \_\_\_\_\_ W

Well Driller: Phone No: \_\_\_\_\_

Projected Well Daily Draw: \_\_\_ Gallons per Day Well Yield : \_\_\_ Gallons per Minute

Well Class: 1 \_\_\_ 2 \_\_\_ 3 \_\_\_ (Check one)

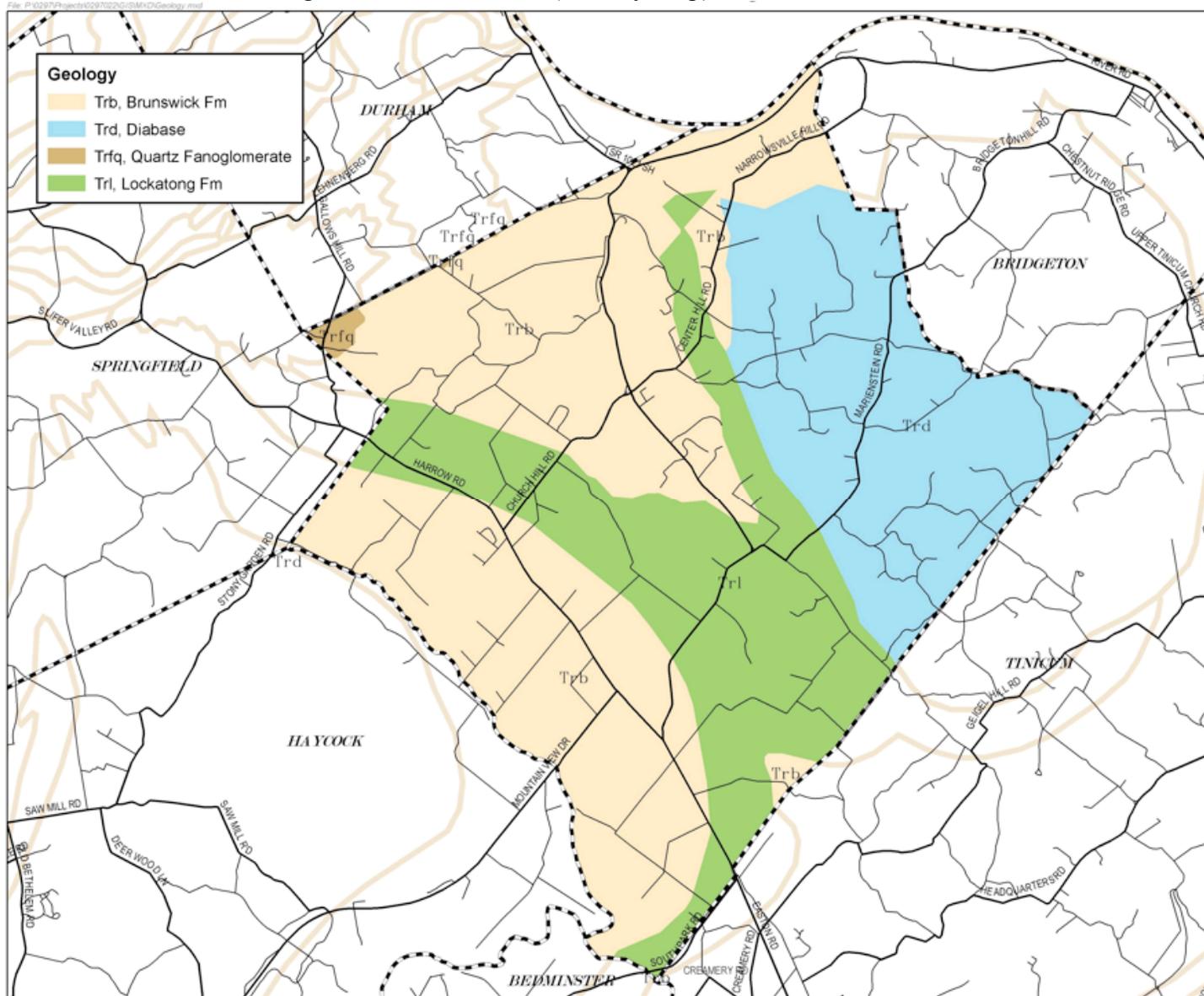
Applicant hereby certifies the foregoing statements and data to be true and complete and if approved, agrees to abide by all rules and regulations contained in the Tinicum Township Zoning Ordinance.

Fee: \$ 75.00 Signature: \_\_\_\_\_

Please be aware that Tinicum Township will not be able to issue a well permit until you have contacted, applied and received approval for a well permit from the Bucks County Health Department 215-536-6500. Please submit a copy of your approved permit to use this application.

All applications must be accompanied by a scale or sketch of the property showing the proposed location of the well. Boundary lines and adjacent boundary lines must be shown. In addition, the plot plan must show the location or proposed location of all buildings, septic tanks and drain fields within a 200 foot (200') radius of the proposed well site:

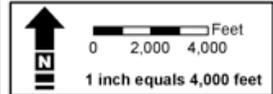
Attachment F  
 Groundwater – Geological Zone Boundaries (Overlay Map)



PENNSYLVANIA COUNTY MAP



PRINCETON HYDRO, LLC.  
 1108 OLD YORK ROAD  
 P.O. BOX 720  
 RINGOES, NJ 08551



- SOURCES:
1. Township boundaries and road data obtained from the PADOT
  2. Geologic Data obtained from the PA Bureau of Topographic and Geologic Survey, Dept. of Conservation and Natural Resources

**GEOLOGY**

**NOCKAMIXON TOWNSHIP  
 BUCKS COUNTY  
 PENNSYLVANIA**

**Legend**

- Local Roads
- State Roads
- - - Township Boundary

Princeton Hydro