A FIELD GUIDE FOR

CONSULTANTS & PUMPING TEST OPERATORS

For Small Production Wells
Serving Small Community Water Systems

NHDES

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I. INTRODUCTION

An extremely important part of the well siting process is the pumping test, which must be performed as outlined in New Hampshire Administrative Rules Env-Dw 301, *Small Production Wells for Small Community Water Systems.*

The purpose of the rules is to ensure that a small community water system can provide enough good quality water from its wells to meet a water system's needs. The pumping test provides the data needed to determine if a well can maintain a particular yield for long periods without rain, snowmelt or other recharge to the aquifer. This guide was created as a tool for pumping test operators and applicants to better understand how to satisfy the pumping test requirements in the rules.

When an applicant chooses to site a new well, a preliminary report including a pumping test proposal with water quality analysis must be submitted to DES. Either of two pumping tests may be required for the preliminary report, depending on the well siting application. The most common pumping test is the Standard Pumping Test, but under special situations the operator may need to perform a Non-Standard Pumping Test. Both pumping tests are explained in this guide and both the Standard and Non-Standard Pumping Test sections should be read to better determine your needs.

PLEASE NOTE: **A temporary groundwater discharge permit is required before a pumping test starts.** Contact Mitch Locker at (603) 271-2858 for a permit application form. There is no application fee associated with a temporary discharge permit, and the application can usually be completed and received within 10 days or less. Discharging water to a surface water body requires water quality sampling and analysis before a permit is issued.

II. STANDARD PUMPING TEST REQUIREMENTS OF ENV-DW 301

Before Starting the Test

The pumping test operator should **obtain a copy of the pumping test design**, which contains very important information the operator needs to know before beginning the test, including the proposed pumping rates for all wells being tested. This helps size the pumps and inline flow meters. It also tells if other wells or surface waters need to be monitored during the test; documents the type of water level monitoring equipment that should be used; how often water level measurements must be taken; describes water quality sampling; frequency of sampling; parameters to be sampled; which lab to use; and whether the operator or the consultant is expected to collect the samples. The pumping test proposal will also note if microscopic particulate analysis (MPA) sampling must be done. This sampling requires special plumbing for the filtration assembly that must be installed prior to starting the pumping test.

►If no pumping test design is available, be sure to ask the client if this is a community water supply well and remind the client that these supply wells must be approved by the state. Single family home developments (10 houses or more), condos, apartment complexes, mobile home parks, schools with dorms, and vacant acreage suitable for subdivision are examples of existing and potential housing that might use a community water supply system and require approval from DES.

Sometimes, non-standard pumping tests are required. The operator may be testing a well that is being reactivated, deepened, hydrofractured or replaced. These situations have different pumping test requirements and are dealt with in Section III of this guide. The operator needs to know whether the well is being tested as a new well, a replacement, or as a rehabbed existing well.

Replacement wells are drilled into the same aquifer type and in the same general area as an existing well that failed. When a replacement well is sited, the existing well must be abandoned, unless the water system obtains a waiver. Pumping test requirements for replacement wells are dealt with in Section III of this guide. Just because a well is newly drilled, do not assume it is a "new" well in relation to the pumping test requirements. If there is an existing well nearby, ask if the new one is replacing the old well before you charge the client for a standard pumping test.

Microscopic particulate analysis sampling will be required if surface water or an inundated wetland is within 200 feet of a new bedrock well or 100 feet of a new gravel well. MPA sampling analyzes the well water for biological indicators of surface water. Though the consultant may perform the MPA sampling, the operator will usually set up the plumbing for the filter device. Guidance on MPA sampling and the correct plumbing setup are included in Appendix D.

It may be necessary to measure water levels in neighboring wells. The applicant will have obtained written permission from the well owner prior to the pumping test. However, if possible, introduce yourself and tell the owner when visits to the property are planned. Avoid taking measurements after dark on private property. See Section C-3 for measurement equipment recommendations.

A. SETUP

Try to set up all pumps, plumbing, hoses, and other equipment at least a day in advance so any joint compounds or other materials are dry and do not affect water quality results. If the well is chlorinated after setting the pump, allow at least a day for the chlorine to dissipate. Detections of toluene, phthalates, and chloroform in the well water are common, even after two days of pumping. These contaminants are associated with electrical tape, PVC piping used for still water tubes, and chlorination. A well contaminated by these compounds cannot be approved without further sampling and analysis to demonstrate they no longer exist in the well water. Avoid using large quantities of electrical tape since that is the most common source of introduced contamination.

Setting up a day or two early also allows the operator to check all equipment to make sure it works. Delays in starting the test can cause a huge ripple effect that might cost the operator and the client time and money. Lab tests may need to be rescheduled, the consultant may have to spend more days in the field than budgeted, or the operator's time may be wasted chasing down replacement equipment. If equipment is not tested in advance and failure occurs after the test starts, the test may be stopped or even canceled, causing problems for both the operator and the client.

The equipment attached to the discharge line should include an in-line totalizing meter, a valve to control flow, a sampling tap for water quality samples, and, if necessary, the plumbing for MPA sampling. A separate tube should be inserted down the well for ease and accuracy of water level measurements (still water tube).

Plan to man the pumping test for the duration. Even if dataloggers are utilized for water level measurement, the test site should never be left unattended for long. Vandalism has occurred in the past at unattended sites, some severe enough to abort the test. In addition, meter readings and discharge rates must be recorded at regular intervals. Most dataloggers do not record this information.

1. Pump

The pump and electrical service must be able to run for the entire test without stopping. The pump should be sized correctly to pump at the rate designated in the pumping test design. Over or under-sized pumps can make it difficult to maintain a constant pumping rate. The pump should be located above a water-bearing fracture in the well so that water flows upward over the pump, cooling it. Be sure the electrical supply matches the pump. A two-phase generator won't run a three-phase pump without tripping the circuit breaker.

If using a portable generator, make sure there is enough fuel on hand to run it for the whole test. Store extra fuel away from the wellhead. Then if any spills occur they will not contaminate the well. If the operator leaves the test site for any reason, make sure the generator is adequately fueled before leaving. If refueling the generator during the test will be necessary, outfit it with a plastic "diaper" to catch any spills. Lay a large heavy mil plastic sheet or tarp flat on the ground and back the generator over it. Pull the sheeting up around the wheels and secure it with duct tape to form a catch basin under the generator. Set a five-gallon pail under the filler pipe as an extra spill catcher.

Spare equipment, such as an extra electronic water level measurement device or generator, should be on site or readily available in case of failure. Time spent searching for back-up equipment may result in repeating the pumping test.

Please note that if the pump will be permanently installed in the well, rather than temporarily for the pumping test only, that pump must be installed by a New Hampshire licensed pump installer and the still tube must remain in the well after testing is finished.

2. Discharge Setup and Location

The discharge pipe should be equipped with a gate valve or similar device to regulate and maintain a constant pumping rate. As water levels fall, the discharge rate will slow in response to hydraulic head loss. The operator must open the valve occasionally in order to maintain the constant pumping rate. An inline flow meter must be used to determine the rate. A bucket and stopwatch is not acceptable, though this method may be used as a rough check of meter accuracy. Choose a meter that reads in gallons rather than cubic feet to make recording flow rates easier. A cumulative or “totalizing” meter is recommended since the operator must record meter readings along with the pumping rate.

A water quality sampling tap is necessary. Locate the tap where it is least likely to be affected by turbulence in the pipe. Some of the sample bottles are small and require a slight but steady flow to fill. Make sure that the type of tap installed is capable of delivering this kind of flow. Water quality testing is very expensive and a sampling tap helps keep the water samples clean. Do not take water quality samples from the end of the discharge hose.

If MPA sampling is required, the operator must equip the discharge line with a diverter valve for the filter assembly before pumping is started. Very low flows (1-2 gpm) must be maintained through the filter assembly. Turbulence must be minimal in the filter, so pressure regulation is very important. See the diagram in Appendix D for a schematic of the diverter setup.

The discharge line must be long enough so that the pumped water will not affect the aquifer’s response to pumping. A good rule of thumb is at least the length of the sanitary protective area radius, but it may need to be longer depending upon site conditions. A discharge location was proposed in the Preliminary Report, but the proposed location may not be practical on the day of the test. Onsite conditions may dictate a different site is necessary. Any change from the proposed discharge location requires DES approval. DES personnel will attend the pumping test to assess the discharge location and setup, and can approve changes at that time.

Wetlands, flat terrain, sandy soil, exposed bedrock, or an urban setting all offer challenges when choosing a discharge location that will not affect pumping test hydraulics. Most wetlands have a natural or man-made outlet. Try to set the discharge as close to this outlet as possible.

Water should easily flow away from the well site. Search out natural drainage areas and use them. For example, the well is located in a low spot. The 200-foot discharge line dumps the water uphill, but it runs back towards the wellhead, puddling there. The operator must add more lengths to the discharge line until the water flows down the other side of the hill and away from the well. If the land around the well site is extremely sandy or bedrock outcrops are noted, the discharge point must be set as far as possible from the well to prevent pumping test water being drawn back towards the well. Bring extra hose lengths (at lease 1,000 feet) in case the discharge location must be moved.

Urban settings pose different kinds of problems. Do not discharge pumping test water to storm drains or roadside ditches without permission from the regulating agency. The N.H. Department of Transportation frowns on discharging anything other than storm water onto state rights-of-way, especially when freezing can occur. Do not flood neighboring lots; the owners will not appreciate it. In this case a shorter discharge line or a change in location may be appropriate.

Monitor the discharge location periodically during the test to make sure no ponding occurs. Check for leaks in the line and fix them. Also, water should not cause erosion or scouring at the discharge point. Bring a large square of plywood or similar material to place under the hose end or set it on a large boulder to avoid soil erosion. NOTE: Unless a surface water discharge permit was obtained, water may not be pumped directly into a surface water body. Pumped water should be discharged onto the ground in an area where it will readily sink in and at least 75 feet back from the surface water body.

Discharging water from an unapproved source into the water system storage tank is usually not allowed, but in some cases may be necessary to adequately supply the water system. Obtain permission from the DES Drinking Water and Groundwater Bureau prior to discharging pumped water into a storage tank. Contact Cindy Klevens at (603) 271-3108 for further information. Please note, a flow meter, sampling tap, and a method for controlling the flow rate on the discharge line are all still necessary if pumped water is directed into the storage tank. An overflow line from the tank may also be necessary.

3. Water Level Measurement Equipment

Always measure water levels from the same point on the top of the casing. Water levels must be measured with a device capable of reading to less than an inch and recorded in either fractions of an inch or 100^{ths} of a foot (0.00). The reason for this is that DES defines stabilization as a water level that varies less than an inch in two hours for a 12-hour period. This means that for the entire 12 hours the water level cannot change more than an inch per each two-hour block of time. Electronic measurement equipment should be used. Make sure all personnel know how to read the tape on the electronic probe before starting the test. Some tapes read in inches, others in 10^{ths} of a foot. Others may only read in feet. Some equipment even reads in inches and 10^{ths} of a foot, one on either side of the tape. Know the equipment! Remember, water levels must be read and recorded at less than an inch. One inch equals 0.083 feet, so if an electronic tape is calibrated in 10ths of a foot, the operator needs to be able to determine a variation of 0.08 feet. This requires measuring to the nearest 100th of a foot.

If the scale on the tape does not read to 100ths of a foot, or if the scale is in inches, a metric rule or a carpenters tape is necessary to read 100ths of a foot or fractions of an inch between the tick marks on the tape. The easiest way to do this is to measure from the nearest foot mark on the probe tape. Remember to measure up from the lower foot mark, not down from the higher. It's easier to add than subtract.

Pressure transducers with dataloggers may be used, but should be checked often to avoid having to restart or repeat the test in case of a failure. Beware! These devices may appear to be recording water levels, but when downloaded the data is absent. If unfamiliar with dataloggers, make sure to get some training on setting up and running one. If multiple wells are being tested a multi-channel datalogger can be the most efficient measurement tool. However, these devices are complicated to set up and run. Thoroughly understand how the device works before using it. A trial run is advised a few days before starting the pumping test. Try to have a laptop computer in the field to periodically download data and check that the device is working.

A still water tube must be used for water level measurements to avoid getting the probe stuck in the well, and faulty readings caused by water cascading from fractures above the water level, or from pump turbulence. Be careful when choosing PVC pipe for the measurement tube. Some is coated with a resin that contaminates the water sample. Flexible tubing can kink, especially when used in very deep wells. Kinks or bends in the tube will make it impossible to lower the probe past the obstruction.

Make sure the diameter of the tube is large enough to accommodate the probe. One inch is usually large enough. Each well being tested should have its own water level monitoring device. Completely removing the tape from the well at each measurement is time consuming, can cause the tape to kink giving inaccurate readings, or may introduce contaminants into the well.

B. DISCHARGE

Note: If the wellhead is flooded or there is any ponded water within 20 feet of the wellhead, do not start the pumping test until the area is dry. If open slurry pits are located near the wellhead, they must be filled in before starting the test. The standing water may contain bacteria or microbes that might reach the well water and cause false positives in water quality analyses.

1. Constant Rate

The new well and all other wells needed to meet the system's source capacity requirements must be pumped together at a constant rate. System source capacity should be listed in the pumping test design submitted with the preliminary application. New wells must be pumped at their proposed permitted production volume (PPV). Existing wells, if not needed to demonstrate source capacity, should be shut off during the pumping test. If shutting down existing wells is impractical or the wells are needed to demonstrate source capacity, they must be pumped at either their PPV or the volume needed to supply the system, even if that means discharging excess water onto the ground. If not shut down or run at a constant rate, pumps cycling on and off can cause water levels in the new wells to jump around and a stable water level cannot be reached. However, if the existing wells are far enough away to not affect water levels in the wells being tested (1,000 ft.), they do not need to be shut down during the test. The pumping rates for all wells, new and existing, should be outlined in the pumping test design.

New wells may be pumped at volumes greater than the PPV as long as the total rate for all new wells does not exceed 40 gallons per minute (gpm), or a volume of 57,600 gallons over any 24-hour period. Wells that pump more than 40 gpm are regulated by rules requiring more technical analysis and involve longer, more sophisticated pumping tests. Divide the permitted production volume by 1,440 to get the discharge rate in gpm.

2. Measuring Discharge, Accuracy, & Equipment

Changing the pumping rate during the test causes water levels in the well to change too. The consultant uses these water levels to tell how the aquifer reacts when pumped. Changing the pumping rate clouds this picture, making it hard to assess aquifer conditions. For that reason, the pumping rate may not change more than +/- 5 percent after the first six hours of pumping. For a 10 gpm well this means +/- ½ gpm, +/- 1 gpm for a 20-gpm well, and +/- 2 gpm for a 40 gpm well. Discharge must be measured with a device that can give this kind of accuracy, preferably a non-digital inline cumulative water meter or the equivalent.

Discharge measurements must be taken every <u>15 minutes for the first 2 hours</u> and at least once every hour after that. Many operators fail to take this measurement often enough. Also record the meter reading before the start and after the end of the test and <u>once every hour</u> during the test.

Some meters read in gallons only, others in gallons per minute (gpm), and some may even read in cubic feet per second. Know the equipment! If a device reads in gallons only, usually a cumulative meter, the operator will need to determine gpm. The best method for doing this is to take two readings one minute apart and subtract the smaller reading from the larger one. Do this several times and average the results. If the meter reads in cubic ft/sec, note this on the log.

DES discourages the use of digital flow meters commonly used to measure flow in pumphouses. Unless these meters are routinely calibrated, they may give faulty readings and rarely provide the +/- 5 percent accuracy required. Although it makes for more work for the operator, a new in-line flow meter, which is properly calibrated, should provide accurate results.

C. WATER LEVEL MEASUREMENTS

1. Measurement Frequency in New Wells

Record the water level measurements from the top of the well casing in feet, inches and fractions of an inch, or in feet, 10^{ths} and 100^{ths} of a foot, and write down the elapsed time in minutes from the start of the test for each water level measurement. Enter all data on a well log sheet. A sample log sheet, for your use, can be found in Appendix A. Each well should have its own log sheet. Putting several columns of water levels on one sheet leads to mistakes. It is very easy to record a water level in the wrong column. If you know when you should be taking water level and discharge measurements, you can fill in the elapsed time column before the pumping test to save time during it.

The pump should have been off for at least 24 hours before starting the test. This allows the well to fully recover if pump operation was tested during setup. Record the static water level just before starting the pump. Do not record the static water level earlier. Atmospheric pressure can affect water levels in non-pumping wells, so the static water level today is apt to differ from yesterday. Measure and record water levels every 5 minutes for the first hour of pumping. This may require some scrambling if several wells are being tested at once, since pumping rate must also be measured and regulated frequently during the first hour. Consider using extra helpers for the first hour, especially if testing more than one well. One person can regulate and record discharge rate while another is measuring and recording water levels.

After the first hour of testing, water levels must be taken at least every hour or at the frequency that was proposed in the approved pumping test design. If the person who designed the pumping test is not present during the test, the operator should have a copy of the pumping test design as approved in the preliminary report before beginning the test. Do not start the pumping test without knowing how it was proposed in the preliminary report. If the consultant does not supply you with a copy of the pumping test proposal, contact DES for one.

2. Other Water Level Measurements

If there is any surface water body or inundated wetland within 150 feet of the well(s), water levels must be measured there also. An inundated wetland is one that is flooded for at least 30 consecutive days. The pumping test proposal should note if surface water or wetlands must be monitored. Use a staff gauge or similar device to take readings before pumping starts and every 12 hours thereafter (or at the frequency stated in the pumping test design). The measurement device should be affixed to a stake driven into the bottom of the surface water body. Be sure the calibrated side of the device is facing the bank. A yard stick works well for this. However, be sure to record the pre-pumping water level regardless of the device used.

If MPA sampling is required, the pumping test operator may also be responsible for measuring pH, specific conductance, and temperature of the discharged well water and the nearest surface water. If so, make sure the equipment necessary for these measurements is on hand. Choose a measurement point on the surface water body that is both near and accessible. Put a stake with flagging at the measuring point. For safety reasons, DES does not expect the operator to take surface water measurements during nighttime hours. Though no requirements regarding the frequency of these measurements have been developed, DES recommends taking measurements at least hourly for the first eight hours. See Appendix D for complete directions for MPA sampling.

3. Accuracy & Equipment for Monitoring Non-System or Neighboring Wells

DES recommends electronic equipment for measuring water levels in these wells; however, to reduce operating costs, a tape and plopper can be used in private wells. When using one be careful not to tangle it in the pump wires. Always mark the tape with blue carpenter's chalk. Take at least three readings for each measurement and average them. Dry and re-chalk the tape between each reading. Read the tape to fractions of an inch. Whenever an invasive device is used in a non-system well, sample the well for bacteria prior to deploying the device.

Newer model non-invasive sonic meters, often called pingers, are allowed for all wells other than the production well being tested. Make sure the meter reads to 100^{ths} of a foot and was recently calibrated. DES recommends sonic water level devices for monitoring private wells, if possible, due to the non-invasive nature of the device. The device operates by bouncing sound waves off objects. The time it takes for the sound wave to leave and return to the meter is recorded and the distance to the object is calculated. However, be careful. They do not work on all wells.

For the sonic device to work properly, the sound wave must bounce off the water in the well. If there are any obstructions inside the casing, like wire guides, the meter may only be recording the depth to that object. Always test a sonic device on a well before utilizing one. Take a measurement, and then ask the homeowner to flush a toilet or turn on an outside spigot. The measurement should change. If it does not, try different spots inside the casing.

Once it has been determined that the device works for a particular well, mark the measuring point with an indelible marker and always use the same spot. That way the device is always bouncing sound waves off water and not something else like a wire guide.

Reality check the measurements you take in private wells. For instance, if you see steam coming from a dryer vent, it is safe to assume the homeowner has recently done a load of laundry. If your water level has not changed since the last reading something may not be working properly. Double-check your reading with another device or ask the homeowner to run water and check that the measurement changes.

Dataloggers are extremely useful for monitoring other system wells and neighboring non-system well. Make sure the probe will fit down the well and follow all disinfection protocols.

4. Weather Conditions

Precipitation data must be collected for one week prior to testing. The consultant may assume responsibility for this task, but find out if you are expected to do so. The operator must record on the log sheet all rain or snow events and other weather conditions at least twice daily throughout the testing and recovery period. Try to measure rainfall amounts using a rain gauge, and set one up even if fair weather is predicted. Also make notes describing the intensity, frequency and duration of all rain events. For instance, “off and on drizzle for 6 hours,” or “heavy downpour for 15 minutes followed by 2 hours of moderate rain.”

D. Troubleshooting the Pumping Test

Things can go wrong in a pumping test and frequently do. If water levels are dropping too fast and dewatering appears likely, throttle back the pumping rate. Do not wait until water levels drop to the elevation of the pump before taking action! The experienced operator can usually tell within the first hour if the well is being pumped at too high a rate. Water level changes of more than a couple feet every 5 minutes at the end of the first hour usually means the aquifer is being over-stressed and the well will probably not reach stabilization or, worse, dewater.

If anything affects pumping during the test, remember that pumping at a constant rate for at least 12 hours is needed to determine stabilization and pumping 24 hours at a rate that varies less than +/- 5 percent is required. Examples of events that may affect pumping are the generator running out of fuel and pump or electrical failures. **Note all changes made during the test on the log sheet and the reasons for the change.**

The test may run the entire 48 hours and not reach stabilization. If water levels do not meet the “less than an inch in any two-hour period” definition of stabilization at the end of 48 hours, either reduce the rate and continue pumping until stabilization is reached, or determine if the 180-day estimated water level meets stabilization requirements as defined by Env-Dw 301. Usually, the consultant will make this determination for you. See Appendix B for an explanation of how to determine the 180-day water level estimate, if necessary.

E. WATER QUALITY SAMPLING

1. Timing

Unless proposed differently in the pumping test design, the water samples must be taken right at the end of the test before shutting down the pump. A full Safe Drinking Water Act (SDWA) analysis must be done. A listing of the parameters for that analysis can be found in Appendix C. Check the DES website for the most current version of this list. (www.des.nh.gov. Go to the “A to Z LIST” and search for “Drinking Water and Groundwater Bureau,” and then search for “Analytical Requirements for Community Public Water Systems.”)

If using the DES Laboratory for the analyses, schedule the tests in advance ((603) 271-3445 or 3446). Be sure to coordinate the laboratory sample analysis with the timing of the pumping test. Commercial labs may also require scheduling of the tests. Make sure to check with any lab before assuming they will accept or be able to process the samples within the holding time. Generally water samples should not be taken on a Friday afternoon, since holding times on some parameters are less than 48 hours.

2. Lab

The laboratory chosen must be accredited by the state of New Hampshire for all drinking water categories being tested, use approved methods, and be able to meet required detection limits. A list of labs and the parameters they are accredited to analyze can be found at www.des.nh.gov . Go to the "A to Z LIST" and search for "Drinking Water and Groundwater Bureau," and then search for "Accredited Laboratories for Drinking Water Analysis."

3. Collection and Delivery

Be very careful when collecting water samples and always use a sampling tap. This will help ensure the sample is not contaminated during the collection process. If possible, wear latex gloves and avoid touching the insides of both the sample bottles and their caps. Directions for taking water samples can be found in Appendix C. Any contamination introduced into a water sample will make it useless, and additional testing will have to be performed. The full range of testing for SDWA costs over $1,000 for just one well, and this does not include the cost of MPA. Also, store the samples in a cooler with ice, not cold packs, while transporting them to the lab. Most labs will measure the temperature of the samples when they arrive and reject any sample warmer than 50° F.

F. DURATION

A small production well pumping test must be run for at least 48 hours. A pumping test can be stopped after 48 hours only if stabilization has occurred. See Section II-A-3 for a definition of stabilization. DES urges the pumping test operator to contact the person who designed the pumping test before shutting down a well in which a water level has not stabilized. DES may also be contacted at (603) 271-2947 for advice.

G. RECOVERY

The small community well siting rules require the pumping test operator to record water levels during the recovery period. There is no set schedule for measuring water levels during recovery as long as at least 10 measurements are taken and recorded. The recovery period must last until the well has recovered 95 percent or 24 hours, whichever is shortest.

III. NON-STANDARD PUMPING TEST REQUIREMENTS

Before Starting the Test

Note: Pumping rates for some of these tests may exceed 40 gpm, if such a yield was originally approved for an existing well. If the owner of the well intends to use the increased yield to add service connections to the water system, then a full new community well and system design review approval must be obtained

The pumping test operator should obtain a copy of the pumping test design if he did not propose the test. The design contains very important information the operator needs to know before beginning the test, such as the proposed pumping rates for all wells being tested. This helps size the pumps, if necessary, and in-line flow meters. It also tells the length of the test, if other wells or surface waters need to be monitored during the test, the type of water level monitoring equipment that should be used, and how often water level measurements must be taken. The design also describes water quality sampling, frequency of sampling, parameters to be sampled, which lab is being used, and whether the operator or the consultant is expected to collect the samples. Refer to “Setup” in Section II for information on setting up the wellhead and discharge for the test.

A. Hydrofracture or Deepening to Regain Lost Well Capacity

The deepened or hydrofractured well must be pumped at a constant rate for at least six hours at the yield established when the well was originally approved, or the yield the rehabbed well is capable of producing, whichever is less. If the owner wishes to use the well at a higher yield than was originally established, then a standard pumping test must be performed and a new well siting application submitted. Water levels, discharge rate, and meter readings should be recorded at regular intervals during the pumping period. A water quality sample must be collected just prior to shut down, and analyzed for all current drinking water parameters. No recovery period is required, but is highly recommended.

B. Replacement Wells

The replacement well must be pumped at a constant rate for at least twelve hours. The pumping rate in the replacement well can be no greater than the approved yield of the existing well being replaced. Water level measurements must be taken in the same manner as outlined in Section II-C. A water quality sample must be collected just prior to shut down, and analyzed for all drinking water standards. No recovery period is required, but is highly recommended.

C. Demonstration of Source Capacity on Existing Inactive Wells

Typically these pumping tests follow the standard pumping test requirements outlined in Section II. Exceptions are made, so check with the client or DES prior to starting one of these tests. If a non-standard test is allowed, follow the requirements for Replacement Wells above.

For Further Information, visit www.des.nh.gov or call (603) 271-2947.

IV. Terms and Abbreviations

Aquifer – An underground water-bearing geologic formation; fractured rock or sand and gravel.

Community Water System – A public water system that serves 15 service connections or 25 residents, year-round.

Constant Pumping Rate – One that does not vary more than +/- 5 percent.

Discharge – The process of pumping water from a well and moving the water to another location.

Datalogger – A computerized electronic device that automatically records water levels.

DES – The New Hampshire Department of Environmental Services

DWGB – The DES Drinking Water and Groundwater Bureau.

Env-Dw 301– The Administrative Rules regulating the siting of wells pumping at a rate less than 40 gpm for small community water systems (small wells).

Groundwater – Water stored in water-bearing underground geologic formations.

Non-System Wells – Those not owned or utilized by the applicant's water system. May be public or private.

Microscopic Particulate Analysis (MPA) – Sampling that analyzes whether organisms common to surface water, but rare in groundwater, exist in the production well water.

Permitted Production Volume (PPV) – The maximum water volume permitted by DES that may be withdrawn from the well in any 24-hour period and determined by the pumping test.

Preliminary Report – Report submitted to DES by the applicant or consultant that outlines how the pumping test will be operated.

Private Wells – Those not owned by the system being tested or by another public water system.

Recovery – The period just after a pump is shut down when the water level in the well returns to a pre-pumping condition.

SDWA – The federal Safe Drinking Water Act

Still Water Tube – Any tube placed in a well through which water level measurements are taken.

Surface Water – Any body of standing or flowing water, such as a lake, pond, stream or wetland.

Wetland – Any area that is inundated for greater than 30 days and supports vegetation typically adapted for life in saturated soil conditions.

Appendix A

Pumping Test Log

Water System Name:______________________________________EPA ID#:________________________________

Description of Well Location:____

Well Depth: ________________Depth of Pump Intake/Screen: ____

Reference Point Used to Measure Depths:____________________ Casing Stick-up:_________________________

Test Performer Name:____

Date Test Started:________________________________ Static (No Pumping) Water Level:___________________

Day/Time	Elapsed Time	Depth to Water	Pumping Rate	Comments/Weather/Meter Reading

Appendix B

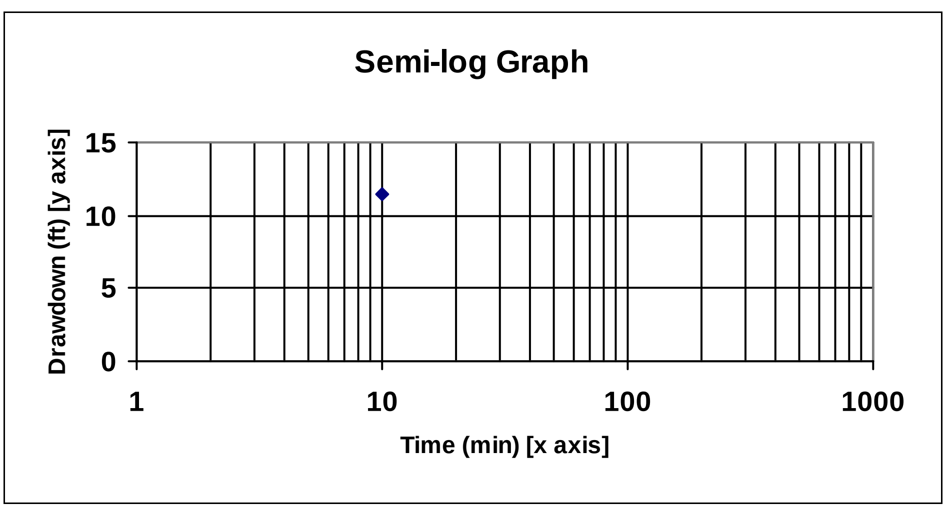
Guide for Creating a 180-Day Time/Drawdown Chart

The criterion for ending a pumping test after 48 hours is stabilization. The primary method for determining stabilization is reaching a water level that varies no more than one inch in two hours for a 12-hour period. Often a pumping test will not reach stabilization by this method.

Another means for determining stabilization is the 180-day time/drawdown chart. This is a semi-logarithmic graph that estimates what the water level in the well would be at 180 days. It assumes the drawdown trend at the end of the pumping test does not change and that pumping continues at a constant rate for 180 days with no recharge. If the resulting estimated water level is more than five feet above the level of the pump, there should be enough water available for the system's needs.

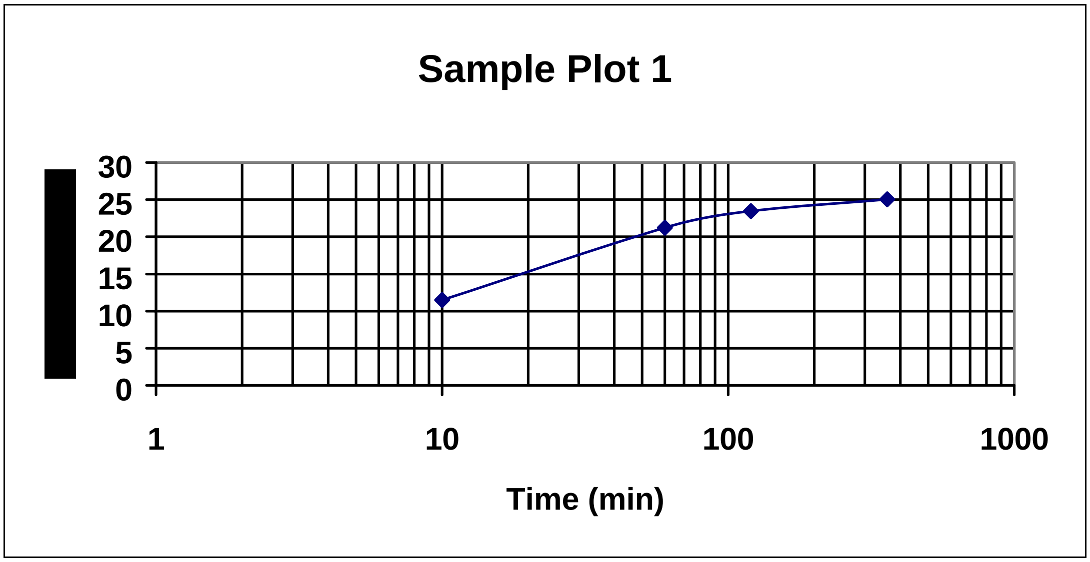
Begin by recording the pumping test water level measurements and the elapsed times at which the measurements were taken. These data points will be graphed on a semi-logarithmic plot. A semi-log plot has one axis in logarithmic scale and the other in normal scale. Each increment on a logarithmic axis is 10 times the previous one. For example, a log axis with a maximum of 1,000 would have the increments 1, 10, 100 and 1,000. The lines on the graph between 1 and 10 represent 2, 3, 4, …, and the ones between 10 and 100 are 20, 30, 40, …, etc. (See the semi-log graph below.) Plot the data on semi-log graph paper or by computer. Directions for creating a semi-log plot in *MS Excel* can be found in the next section of the Guide.

When creating the plot, time in minutes should be graphed on the logarithmic scale axis (usually the X axis) and drawdown in feet on the normal scale axis (usually the Y axis). Mark the points on the graph by matching the drawdown measurement on the Y axis to the elapsed time on the X axis. For example, the graph below shows one measurement of 11.51 feet taken at 10 minutes into the test.

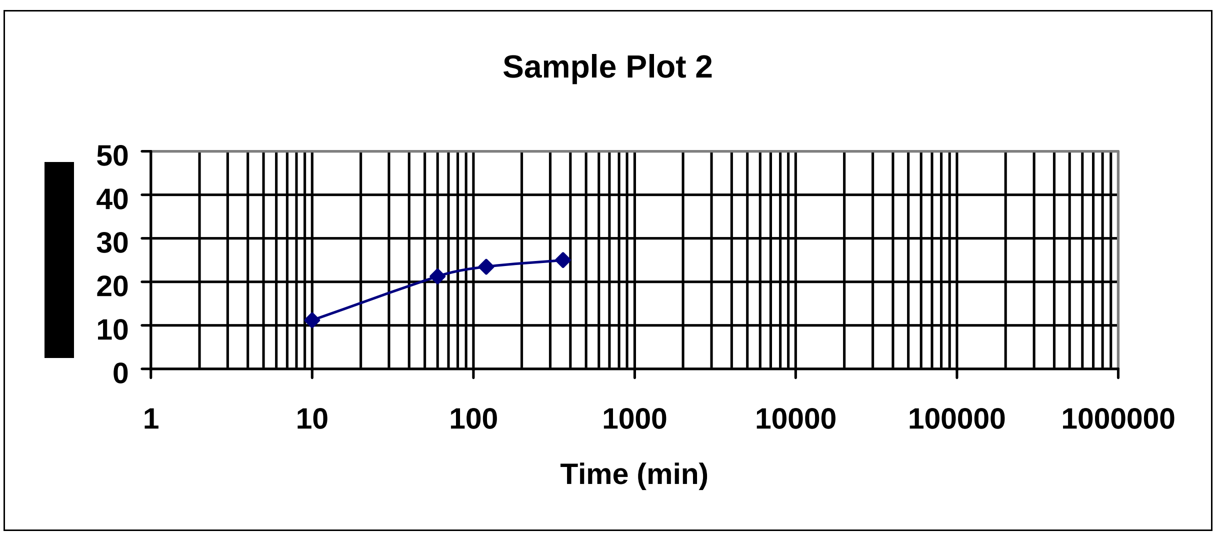


The rest of the measurements are then plotted the same way. Sample Plot 1 employs the data points listed in the table below. For simplicity, only four drawdown measurements are plotted. Use all the measurements taken during the pumping test.

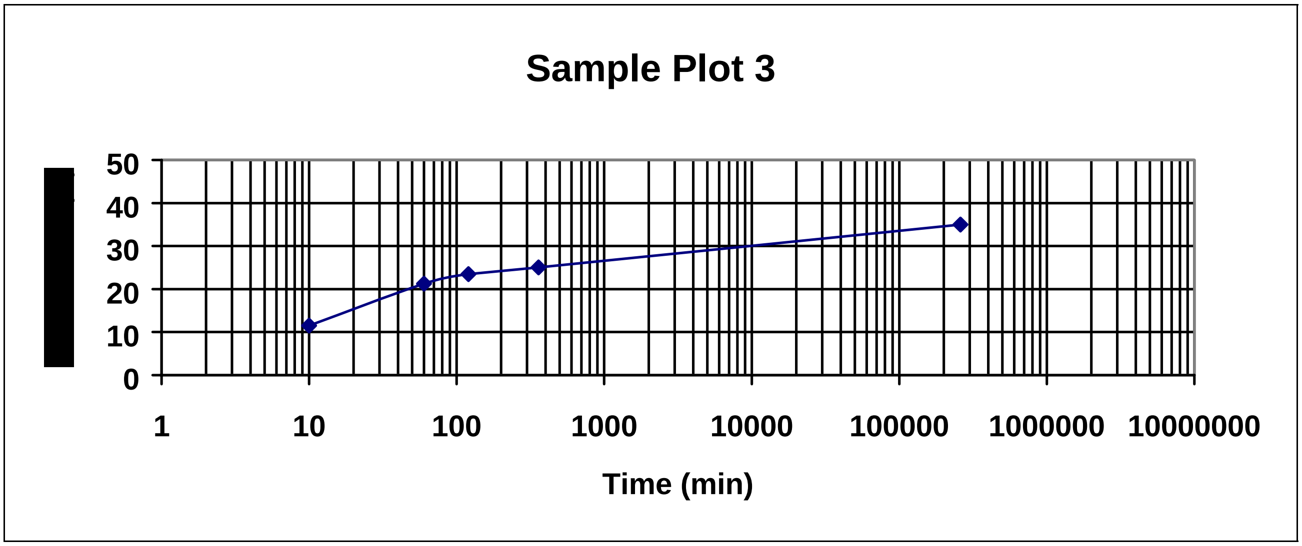
Time(min)	Drawdown(ft)
10	11.51
60	21.24
120	23.46
360	25.03



Now extend the time axis out to 180 days, or 259,200 minutes and the drawdown axis to 20 or 30 feet more than the largest drawdown measurement, as in Sample Plot 2.



Draw a best-fit line by laying a ruler along the data points taken from the last 12 to 36 hours of the test and marking a straight line through them. Extend the straight line out to the 180-day point, or 259,200 minutes, as shown in Sample Plot 3.



Read the drawdown at 180 days from the chart. In this instance that water level is approximately 35 feet. If this water level is below the pump, either lower the final elevation of the pump or continue the pumping test, using a slower pumping rate. After 12 hours of pumping at a constant rate, repeat the process above if stabilization is not reached by the primary method. Please note that the pumping rate may not vary more than +/- 5 percent for at least 24 consecutive hours. This may mean extending the test for another day or longer.

Creating A Semi-Log Plot in MS Excel

Step 1. Plot the data in two columns in an *MS Excel* spreadsheet. Head the columns with the titles of the X and Y axes, usually “elapsed time” in the X axis column and “water level” in the Y. If you want time on the X axis, be sure to list these data points in the first column. Highlight both columns including the headers.

Step 2. Click on “Insert” and then “Chart.”

Step 3. Choose “xy (scatter).”

Step 4. Choose the style you want by clicking on the appropriate box.

Step 5. Click “next” twice.

Step 6. Fill in the appropriate boxes for all the tabs. Check major and minor gridlines on the X axis values section of the gridlines tab. If plotting pumping test results for only one well, uncheck the “show legend” box on the legend tab.

Step 7. Click “next.”

Step 8. Click “finish.”

Step 9. Move the chart to its final location by clicking on it until the corner boxes show, and then drag the chart into position.

Step 10. Right click on the X axis data numbers.

Step 11. Choose “format axis” from the pop-up menu.

Step 12. Click the “scale” tab and click in the box labeled “logarithmic scale” at the bottom of the window. Change the maximum scale to 1,000,000. If necessary, change the “major” and “minor unit” to 10.

Appendix C

Guidance for Conducting and Reporting SDWA Analyses
For New Community Wells and Groundwater Sources of Bottled Water

The following parameters are required for water quality analysis of a new drinking water source for a community water supply system or source of bottled water. This guidance will be updated periodically. The applicant is responsible for obtaining and using up-to-date information. Contact DES at (603) 271-2947 with questions and for the most recent guidance.

The laboratory must:
- Apply EPA approved drinking water methods.
- Have current drinking water certification for all analyses.
- Identify all subcontracted analyses, laboratories and their certification.

Parameter	**Group**	**MCL (mg/l)**	**Trigger (mg/l)**
E. coli	Bio	Absent	Presence
Fecal Coliform	Bio	Absent	Presence
Total Coliform	Bio	Absent	Presence
Arsenic	IOC	0.010	0.005
Aluminum[e]	IOC	0.05[e] – 0.2	0.05
Barium	IOC	2	1
Cadmium	IOC	0.005	0.0025
Chloride[d]	IOC	250[d]	250
Chromium	IOC	0.1	0.05
Copper[c]	IOC	90% of trigger[c]	1.3
Copper[d]	IOC	1.0[d]	1.3
Cyanide (as free C)	IOC	0.2	0.1
Fluoride[a]	IOC	4.0[a]	2.0
Fluoride[d]	IOC	2.0[d]	2.0
Iron[d]	IOC	0.3[d]	0.3
Lead[c]	IOC	90% of trigger[e]	0.015
Manganese[d]	IOC	0.05[d]	0.05
Mercury	IOC	0.002	0.001
Nickel[n]	IOC	n.e.[n]	
Nitrate (as N)	IOC	10	5
Nitrite (as N)	IOC	1	0.5
Selenium	IOC	0.05	0.025
Silver [e]	IOC	0.1[e]	0.1
Sodium[e]	IOC	100-250[e]	250
Sulfate[d]	IOC	250[d]	250
Sulfide[e]	IOC	0.05[e]	0.05
Antimony	IOC	0.006	0.003
Beryllium	IOC	0.004	0.002

Parameter	Group	MCL (mg/l)	Trigger (mg/l)
Thallium	IOC	0.002	0.001
Zinc[d]	IOC	5[d]	5
pH[d]	IOC	6.5-8.5[d]	8.5
Uranium (Mass)	Rad	30 ug/L	If Detected
Radium 226 [e]	Rad	n.e.[e]	
Radium 228 [e]	Rad	n.e.[e]	
Radium 226 & 228 (Combined)	Rad	5 piC/l	If Detected
Analytical Gross Alpha[e]	Rad	n.e.[e]	
Radon [k]	Rad	n.e.[k]	
Compliance Gross Alpha	Rad	15 piC/l	If Detected
Beta Particles[i]	Rad	4 mrem/yr[i]	If Detected
Endrin	SOC	0.002	If Detected
Lindane	SOC	0.0002	If Detected
Methoxychlor (DMDT, Martate)	SOC	0.04	If Detected
Toxaphene	SOC	0.003	If Detected
Dalapon [h]	SOC	0.2[h]	If Detected
Diquat[h]	SOC	0.02[h]	0.02
Endothall[h]	SOC	0.1[h]	0.1
Glyphosate	SOC	0.7	If Detected
Di(2-ethylhexyl)adipate	SOC	0.4	If Detected
Oxamyl (Vydate)	SOC	0.2	If Detected
Simazine	SOC	0.004	If Detected
Di(2-ethylhexyl)phthalate	SOC	0.006	If Detected
Picloram	SOC	0.5	If Detected
Dinoseb	SOC	0.007	If Detected
Hexachlorocyclopentadiene	SOC	0.05	If Detected
Aldicarb sulfoxide	SOC	0.004	If Detected
Aldicarb sulfone (aldoxycarb)	SOC	0.002	If Detected
Carbofuran (Furadon, 4F)	SOC	0.04	If Detected
Aldicarb (Temik)	SOC	0.003	If Detected
Atrazine (Atranex, Crisazine)	SOC	0.003	If Detected
Alachlor (Lasso)	SOC	0.002	If Detected
2,3,7,8 TCDD (Dioxin) [h]	SOC	0.00000003[h]	If Detected
Heptachlor	SOC	0.0004	If Detected
Heptachlor epoxide	SOC	0.0002	If Detected
2,4-D	SOC	0.07	If Detected
2,4,5 TP (Silvex)	SOC	0.05	If Detected
Hexachlorobenzene	SOC	0.001	If Detected
Benzo (a) pyrene (PAHs)	SOC	0.0002	If Detected
Pentachlorophenol	SOC	0.001	If Detected
Polychlorinated biphenyls (PCB) [h]	SOC	0.0005[h]	If Detected
Dibromochloropropane (DBCP) [h]	SOC	0.0002[h]	If Detected
Ethylene dibromide (EDB) [h]	SOC	0.00005[h]	If Detected

Parameter	Group	MCL (mg/l)	Trigger (mg/l)
Chlordane	SOC	0.002	If Detected
Methyl tertiary-butyl ether (MtBE) [g] Methyl tertiary-butyl ether (MtBE)[d]	VOC VOC	0.013[g] 0.020[d]	If Detected 0.020
Tertiary amyl methyl ether (TAME) [e] (2-methoxy-2-methylbutane)	VOCU	n.e. [e]	
Tertiary butyl alcohol (TBA) [e]	VOCU	n.e.[e]	
Ethyl tertiary butyl ether (ETBE) [e]	VOCU	n.e.[e]	
Di-isopropyl ether (DIPE)[e]	VOCU	n.e.	
1,2,4-Trichlorobenzene	VOC	0.07	If Detected
1,2-Dichloroethylene (cis)	VOC	0.07	If Detected
Chloroform[f,m]	VOCU	n.e.[f,m]	
Bromoform[f,m]	VOCU	n.e. [f,m]	
Bromodichloromethane[f,m]	VOCU	n.e. [f,m]	
Chlorodibromomethane (Dibromochloromethane)[f,m]	VOCU	n.e. [f,m]	
Xylene (total)	VOC	10	If Detected
Dichloromethane (methylene chloride)	VOC	0.005	If Detected
1,2 Dichlorobenzene (o)	VOC	0.6	If Detected
1,4 Dichlorobenzene (para)	VOC	0.075	If Detected
Vinyl chloride	VOC	0.002	If detected
1,1-Dichloroethylene	VOC	0.007	If Detected
1,2-Dichloroethylene (trans)	VOC	0.1	If Detected
1,2 Dichloroethane	VOC	0.005	If Detected
1,1,1-Trichloroethane	VOC	0.2	If Detected
Carbon tetrachloride	VOC	0.005	If Detected
1,2-Dichloropropane	VOC	0.005	If Detected
Trichloroethylene	VOC	0.005	If Detected
1,1,2-Trichloroethane	VOC	0.005	If Detected
Tetrachloroethylene	VOC	0.005	If Detected
Monochlorobenzene (Chlorobenzene)	VOC	0.1	If Detected
Benzene	VOC	0.005	If Detected
Toluene	VOC	1	If Detected
Ethylbenzene	VOC	0.7	If Detected
Styrene	VOC	0.1	If Detected

Abbreviations:

MCL- The Maximum Contaminant Level allowed in drinking water
SDWIS – Safe Drinking Water Information System
Bio - biological
Rad - radiological parameter
IOC - inorganic compound
IOCU - inorganic compound - unregulated
SOC - synthetic organic compound
SOCU - synthetic organic compound - unregulated
VOC - volatile organic compound
VOCU - volatile organic compound - unregulated
n.e. - not established-reporting is required

Footnotes:

[a]Fluoride has a secondary MCL of 2.0 mg/L, and a primary MCL of 4.0 mg/L
[b]pH is expressed in units of hydrogen ion activity
[c]Lead and Copper samples are collected in tap water samples throughout the distribution system
[d]Aesthetic Regulated Secondary MCLs
[e]Recommended additional reporting parameters
[f] Total MCLs combined equals 0.100 mg/L
[g] MtBE has a secondary MCL of 0.020 mg/L and a primary MCL of 0.013 mg/L
[h] State waiver in place-sampling required for initial water quality testing only
[i] Beta particle testing required only for systems deemed vulnerable by the Department and notified that testing is mandatory.
[k] Radon testing only required for initial water quality of new wells

How to Take Water Quality Samples During Pumping Tests

This section describes the different bottles used for an initial water quality sampling of new community water supply wells. Samples should be taken at a sampling tap installed in the discharge pipe. Please read this information carefully since some of the bottles contain preservatives, which should not come in contact with eyes or skin. Keep in mind that the bottle descriptions are for bottles used by the New Hampshire Department of Environmental Services Lab; other labs may use different bottles. Please call the DES Lab at (603) 271-3445 with questions about how to take these samples. Hold times for the samples vary from as soon as possible to six months, depending on the test.

All samples must be kept on ice. Ice packs will not keep them cold enough.
Labs will reject all samples warmer than 50°F.

Inorganic Compounds (IOC) Sampling

Bottles used: 1 round plastic 125 mL bottle for bacteria.
1 square, 500 mL pre-cleaned bottle for metals.
1 pear shaped, 100 mL bottle for cyanide.
1 oblong shaped, 500 mL bottle for anions, alkalinity, and pH.

Preservatives in bottles: 5 mL of concentrated nitric acid added to metals container.
3 pellets of sodium hydroxide to cyanide container.
No preservative in anion container.
1 sodium thiosulphate pellet added to bacteria container.

Procedure for filling bottles: Turn on sampling tap and run water for four to five minutes or until the water temperature has stabilized, whichever is longer. Then reduce flow so that the stream of water is no greater than 1/8 inch in diameter. Remove container caps. Do not put caps face down or in pocket. Do not allow inside of caps, inside of container or bottle threads to be touched by any object. Use caution when filling these bottles. The square bottle contains acid. As the water comes in contact with the acid a white cloud will drift from the bottle. This is normal. Do not put your face within the cloud or inhale the fumes. Fill bottles to shoulder. Do not overflow. Screw caps on securely.

Nitrate and/or Nitrite Sampling

Bottle used: Pre-cleaned plastic or glass bottle (usually 40 mL), yellow cap.

Preservatives in bottle: None

Procedure for filling bottle: Same procedure as IOC sampling.

Radiological Sampling

Bottles Used: 1 pre-cleaned, 1-gallon plastic bottle and 1 40 mL glass vial with Teflon septa.

Preservatives in Bottles: There are no preservatives in either bottle.

Procedure for filling bottles: Same procedure as IOC sampling.

Synthetic Organic Compounds (SOC) Sampling:

Please note, if using the DES Lab, SOC samples must be scheduled prior to collection. Call the lab at (603) 271-3445 for an appointment. If using a private lab, call in advance for their policies regarding the scheduling of tests.

Bottles used: 2 pre-cleaned one-liter amber glass bottles with Teflon-lined caps.
6 pre-cleaned 40 mL glass vials with Teflon-lined caps.

Preservatives in Bottles: Both types of bottles contain chemical preservatives. Use caution when taking samples.

Procedure for filling bottles: Turn on sampling tap and run for four to five minutes or until the water temperature has stabilized, whichever is longer. Then reduce flow so that stream of water is no greater than 1/8 inch in diameter.

For each one-liter bottle: Remove container cap. Do not put cap face down or in pocket. Do not allow inside of cap, inside of bottle or bottle threads to be touched by any object. Do not rinse bottle. Use caution when filling these bottles, open them slowly and carefully to avoid acid burns. Fill to shoulder of the bottle. Screw on cap securely.

For each of the 40 mL vials: Remove container cap. Do not put cap face down or in pocket. Do not allow inside of cap, inside or vial or bottle threads to be touched by any object. Use caution when filling these bottles, open them slowly and carefully to avoid chemical burns. Do not rinse vial. Fill vial to the top creating a crown but do not overflow due to the preservative. Screw on cap securely. Check for air bubbles by inverting the vial and gently tapping the cap. If bubbles are present, add additional water.

VOC-MTBE-TTHM and HAAS:

Bottle used: 2 pre-cleaned, 40-mL glass septum vials with Teflon septa each sample site.

Preservatives in Bottles: 0.25 mL of 1:1 Hydrochloric acid.

Procedure for Filling Bottles: Turn on sampling tap and run for four to five minutes or until the water temperature has stabilized, whichever is longer. Then reduce flow so that stream of water is no greater than 1/8 inch in diameter. Remove container cap. Do not put cap face down or in pocket. Do not allow inside of cap, inside of bottle or bottle threads to be touched by any object. Do not rinse bottle. Use caution when filling these bottles, open them slowly and carefully to avoid acid burns. Fill to the top, creating a crown, but do not overflow due to preservatives in the bottle. Screw on cap securely. Check for air bubbles by inverting the vial and gently tapping the cap. If bubbles are present, add additional water.

Appendix D

Microscopic Particulate Analysis (MPA) Sampling Guidance

If the well is being approved as a new well, or an existing well being reactivated and a standard pumping test is required, the microscopic particulate analysis (MPA) sampling can be run either at the end of the test or during it, provided tasks a - k below are performed. These wells are typically not plumbed to a pumphouse.

If the well is an existing well and MPA sampling is required because the well is suspected of producing groundwater under direct influence of surface water (GWUDI), or if the well is already plumbed to a pumphouse, tasks l - t below should be performed.

The discharge flow rate for sampling is very low, only 1-2 gpm, so the sampling valve must be equipped with a meter to determine flow rate. Also the MPA sampler(s) must be able to measure the temperature, pH, and specific conductance of the discharged water, either through the diverter for the MPA analysis or from the discharge water that is to be pumped to waste.

New Well or Reactivated Well With Pumping Test:

a. DES generally follows USEPA's *Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)*. The method constitutes diverting 500-1,000 gallons of source water through a synthetic filter over an approximate 8 to 24-hour period at a flow rate of between 1-2 gpm.

b. Equip the pump discharge piping with a diverter valve that is to be used with the filter assembly before the start of pumping. See Figure 1 for an example of the type of set-up needed, per the guideline in item a. above. Please note that the valve/faucet control can be either on the inlet or outlet line. It is more commonly located on the inlet line.

c. If the filter canister is clear plastic it should be protected from sunlight. Wrap the canister with any material that will exclude light. Sunlight causes some surface water organisms to multiply, resulting in a false high count. If testing is performed in cold weather, the canister must be protected from freezing.

d. Begin pumping the production well at the constant rate required for new well approval and start monitoring pH, conductivity and temperature in both the discharge water and the nearby surface water feature(s). Preferably, monitoring for these parameters should begin as soon as feasible during the pumping test, however; an acceptable minimum monitoring period prior to MPA sample collection is 8 to 10 hours.

e. The stabilization criteria for discharge water screening parameters is considered the following:

   i. **pH**: +/- 0.2 standard units
   ii. **Specific Conductance**: +/-3 percent
   iii. **Temperature**: +/- 2 degrees Celsius (about 3° F to 4° F)
   iv. Minimum stabilization time for the parameters i. – iii. above that need to be demonstrated prior to sample collection: **8 to 10 hours**

f. After 8 to 10 hours of demonstrated stability for pH, specific conductance, and temperature, the MPA sampling should commence. If the parameters in e. above vary widely or do not converge then screening shall continue until screening parameters meet the stabilization criteria and then MPA sampling should commence. If convergence has not occurred prior to the end of the standard pumping test, contact DES for further guidance.

g. Divert water through the MPA filter apparatus <u>only</u> after field parameters have stabilized [see e. above].

h. Prior to starting the MPA sampling, run pump discharge water through the <u>empty</u> canister for several minutes to rinse it. After rinsing, turn off water to the canister, pour out the rinse water and insert the filter. Use latex gloves when handling the filter. Reassemble the canister.

i. Continue to monitor pH, specific conductance and temperature throughout sampling.

j. When sampling is complete, carefully remove the filter from the canister, again using latex gloves, and package according to the directions received with the unit, as provided by your analytical laboratory.

k. Please note that the stabilization criteria listed above are general guidelines and are not "fixed"; DES recognizes that site-specific issues and professional judgment play a role in determination of stabilization, and encourage the sampler to contact this office and discuss the issue should it arise.

Existing or New Well Plumbed to a Pumphouse:

l. DES generally follows USEPA's *Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis (MPA)*. The method constitutes diverting 500-1,000 gallons of source water through a synthetic filter over an approximate 8 to 24-hour period at a flow rate of between 1-2 gpm.

m. Equip the pump discharge piping with a diverter valve that is to be used with the filter assembly. With an existing source that is on-line and hooked to the system, this location will most likely be the source tap on the incoming supply line from the well. Please note that attention should be given to the need for backflow prevention between the inlet line of the sampling apparatus (shown in Figure 1) and both the source and distribution system.

n. If the filter canister is clear plastic, it should be protected from sunlight. Wrap the canister with any material that will exclude light. Sunlight causes some surface water organisms to multiply, resulting in a false high count. If testing is performed in cold weather, the canister must be protected from freezing.

o. Set the production well for "hand" or "manual" operation and begin pumping at a constant rate. The pumped water can be directed into the storage tank or discharged to waste. Start monitoring pH, conductivity and temperature immediately in both the discharge water and a nearby surface water location. These parameters should be monitored for at least 2 hours before starting the MPA.

p. If the pumped water will be directed into the storage tank, excess water should be diverted from the tank to avoid overflow. In some cases temporarily shutting down other system wells so that they do not contribute water to the tank can help reduce overflow. If it is not possible to divert enough water from the storage tank to avoid overflow, care should be taken that overflow of the tank does not cause soil erosion outside the pumphouse, or flooding inside the pumphouse itself.

q. After the 2-hour pumping period divert water through the MPA filter and begin the sampling process. Prior to starting the MPA sampling, run pump discharge water through the empty canister for several minutes to rinse it. After rinsing, turn off water to the canister, dump out the rinse water and insert the filter. Use latex gloves when handling the filter. Reassemble the canister.

r. If the well is equipped with a high capacity pump, it may be difficult to maintain a 1-2 gpm flow through the filter assembly. In these cases a splitter should be attached to the discharge tap used to divert water through the filter. A garden hose can be attached to one arm of the splitter and the filter assembly attached to the other.

s. Continue to monitor pH, specific conductance and temperature throughout sampling for the entire duration it takes to collect a sample (8-24 hours).

t. When sampling is complete, carefully remove the filter from the canister, again using latex gloves, and package according to the directions provided by your analytical laboratory with the unit.

Laboratory Considerations and MPA Sampling Materials:

When your project needs to collect an MPA sample, you should plan to contact your lab well in advance of the pumping test. Since most labs do not perform MPA in-house, they will need extra time to arrange the analysis with a separate lab and order your sample containers and filter. If your regular lab does not subcontract MPA, contact DES for assistance in locating a laboratory that performs MPA.

Figure 1

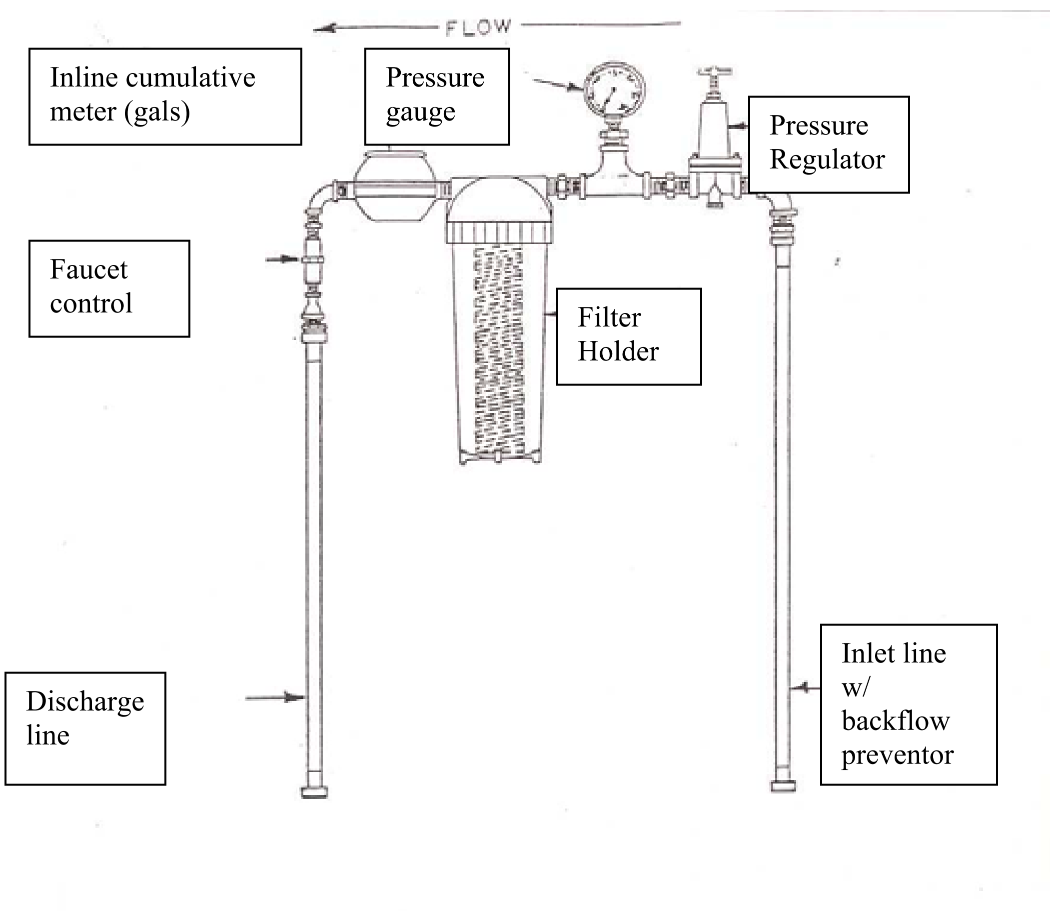


Figure from "Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis." USEPA, October 1992. Find the complete document online at http://www.doh.wa.gov/ehp/dw/GWI.htm.