



Information on Short-term Well Tests

Water Stewardship Information Series

What is the purpose of a short-term well test?

Adequate water supply is a fundamental component of a property's value. For example, a lending institution may require a well test to be done to ensure there is a reliable source of domestic water supply before approving a mortgage. In other situations, a prospective purchaser may arrange for a short-term well test prior to purchasing a property to ensure there will be adequate water supply.

Homeowners have complained that they have purchased a property based on the results of a cursory well test only to find that the well did not produce the flow of water (e.g., gallons per minute) stated on the well test report (or invoice). In some cases, the well did not produce enough water to meet the homeowner's basic needs. For some of these cursory well tests, the well had only been pumped for 1 to 1.5 hours, the water in the well measured only at the beginning (the static water level) and end of the pumping period and the flow rate just measured once. This type of test is not long enough and does not provide enough water level, pumping rate and well recovery information to reliably assess whether the well is likely to provide enough water for the intended use or not.

If a short-term well test is required, the methodology provided in this document can be considered a minimum standard of testing. This minimum standard was developed to improve the reliability of the short-term well test while maintaining affordability and promoting consistency in testing. The purpose of the minimum standard test is to determine the likelihood of the well meeting the homeowner's needs in terms of total gallons per day of water use, **not** rate the well yield in term of gallons per minute (gpm). Rating the well yield in terms of gpm yield requires a longer (12 to 72 hrs of pumping), more comprehensive (and more costly) constant rate pumping test. The well owner, purchaser or lending institution **must recognize** that no testing method (minimum standard or comprehensive constant rate pumping test) will explicitly guarantee the long term well yield with 100% certainty. Limitations of all well tests are further described in the Disclaimer.

How much Water do I need?

Typical indoor water use is 60 US gallons/person /day (227 L/day/person)¹. In 2009, the average daily residential water use across BC was 92 US gpd (350 L/day/person) with the Canadian average at 72 US gpd (274 L/day/person)². A daily volume of 600 US gallons per day (US gpd) is considered adequate to meet indoor needs and provide basic outdoor watering of a garden, small lawn or other landscaping. Six hundred US gpd is also equivalent to the daily volume granted in a domestic surface water licence.

Irrigation/lawn watering is commonly the largest domestic water use. Estimated water requirements for a family of four in an arid climate can range from 1,300 to 1,800 US gpd with roughly 80% or more of this water applied as irrigation. Alternatively, residents in northern or wet coastal climates may not irrigate at all with the daily water requirement for a family of four \leq 250 US gpd. There are also areas in the province such as the Gulf Islands where

¹ *Design Guidelines for Rural Residential Community Water Systems*, Ministry of Environment, Utility Regulation Section, 2007.
² *2011 Municipal Water Use Report, Municipal Water Use 2009 Statistics*, Environment Canada, 2011.

groundwater is scarce, well yields are low and a well capable of producing 300 US gpd is considered a good domestic well.

How do I complete the Minimum Standard Test?

The minimum test standard methodology is to estimate whether the well can reliably provide 600 US gpd, however, the testing volume can be increased or decreased depending on the customers anticipated needs or circumstances. Prior to completing any well test, the testing contractor³ should discuss with the customer, how much water they need and whether the minimum test standard is adequate or a longer term constant rate test is required. The minimum standard testing method includes:

- Obtaining the well record (if available – the well record helps in interpretation of the test results).
- Installing a sounding tube in the well for accurate water level measurements (if not already present).
- Leaving the well at rest for at least 12 hours prior to testing.
- Measuring the water level prior to pumping – this is the static water level (see well diagram in Example 1).
- Calculating the volume of water in the well (casing storage) based on the static water level, well depth to the pump intake and casing diameter (see example calculation in Example 1).
- Using the existing pumping system, pump out a measured 600 US gallons into a storage tank or a point on the ground at least 15 m downslope from the well (see Examples 2 and 3).
- The maximum allowable time to pump out the required volume i.e. 600 US gallons, is 8 hours.
- While pumping, record the time and drawdown water levels at the following time intervals:
 - every minute for first 10 minutes (after pumping started),
 - every 2 minutes from 10 to 20 minutes,
 - every 5 minutes from 20 minutes to 50 minutes,
 - every 10 minutes thereafter.
- After the required daily volume of water has been removed, stop pumping and immediately start recording recovery water levels at the same time intervals as noted above.
- Record recovery water levels until 90% of the drawdown has been recovered **or** 120 minutes has elapsed whichever occurs first. If not 90% recovered after 120 minutes collect an additional water level measurement at 24 hours from the start of the test (see Examples 2 and 3).
- Plot the drawdown and recovery data on a semi-log graph (see Examples 2 and 3).

The following two requirements must be met for the well to pass the test (i.e., the well is likely capable of providing the tested volume on a daily basis).

1. The tested volume (i.e. 600 US gallons) can be pumped from the well within a maximum 8 hour period, **AND**
2. The water level in the well recovers at least 90% within 24 hours from the **start** of the test.

³ A well test is a flow test and is a restricted activity under Section 70 of the Water Act. Only Qualified Well Drillers or Qualified Well Pump Installers registered with the Province of BC or a Qualified Professional (P. Eng. Or P. Geo.) can do this work. Information on groundwater legislation, pumping tests, groundwater quality (brochures) and a registry of qualified contractors (QWPIs and QWDs) is available through the Province of British Columbia (BC)'s groundwater home page at http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/index.html.

The contractor responsible (Qualified Well Driller, Qualified Well Pump Installer or Qualified Professional) for completing the short-term well test should provide a report of the information that includes:

- The QWD's, QWPI's or QP's name and registration number.
- The date and time of the test.
- The civic address and /or legal description of the property and GPS location of the well.
- Available information on the well depth and type of aquifer i.e. sand and gravel, sand, fractured bedrock (the original driller's "well construction record" should be appended and should contain this information).
- The pre-test volume of casing storage.
- The time required to pump out the tested volume i.e. 600 US gallons.
- The time required for 90% of the drawdown distance to recover.
- All of the water level and pumping rate data collected during the well test.
- Whether the well will likely be capable of providing the tested volume on a daily basis or not.

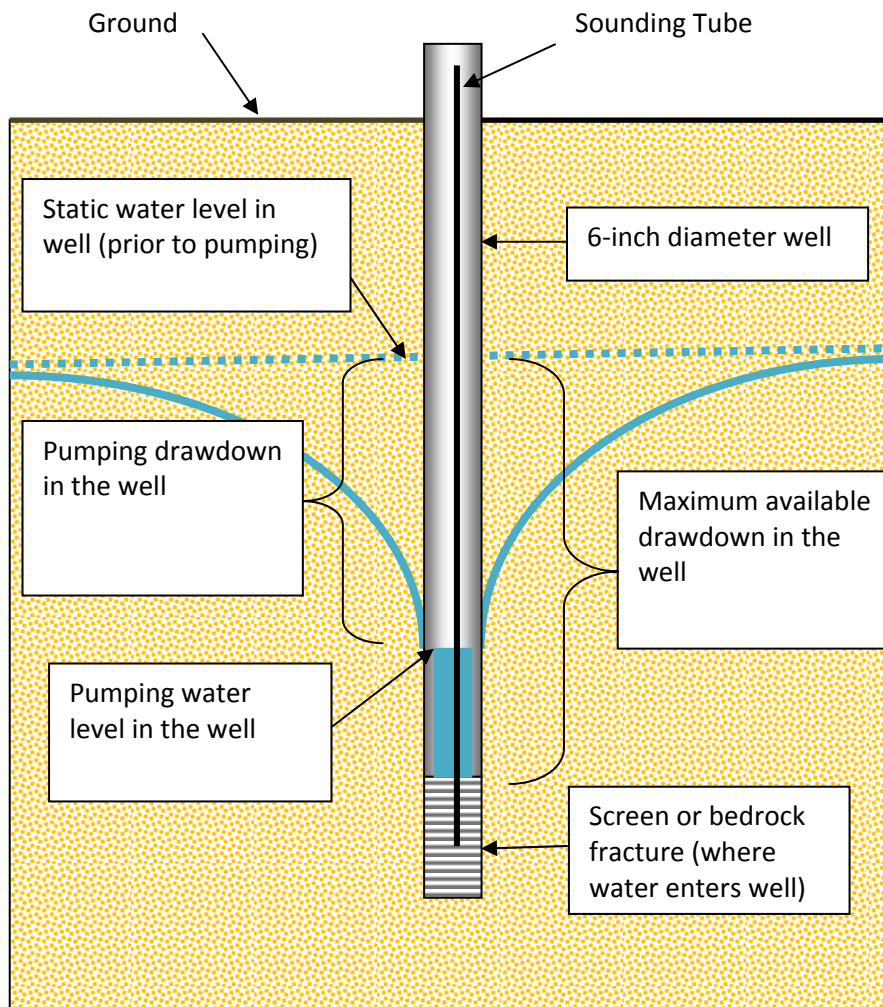
Well Testing Disclaimer

The recommended minimum standard test procedure is for testing a domestic well servicing a single family residential home. The information is provided as a public service to provide guidance on the methodology for testing groundwater supply for a single family domestic well. However, many factors may influence ground water supply availability. As a result, the information provided herein is of necessity general in nature. Water well drillers, pump installers, qualified professionals, well owners and landowners will have to review their own particular circumstances and then determine whether the methodology is appropriate to their circumstances. The information provided on the methodology should not be relied upon as specific advice for particular circumstances. Also, it is important to understand that a short-term test does not necessarily provide a reliable long term ground water supply assessment as it does not take into consideration the seasonal changes of water level in the well, natural recharge variations to the aquifer, interference from neighbouring pumping wells or interference from the installation of future wells in the same aquifer. This test or even a more comprehensive constant rate test is a **prediction** of the well's ability to supply water at the time of testing, **not a guarantee** that the tested well will provide that quantity of water, such as 600 US gpd for domestic purposes, in the long term.

Examples and Reference Materials

1. Examples of the minimum standard test completed on two low yielding wells are provided in the next section.
2. A form to record well and pumping test information and a blank semi-log graph to plot drawdown and recovery data are appended to this document. Well test information must be plotted on a semi-log graph for interpretation (Example 4).
3. Additional information on constant rate pumping tests is provided in a Province of BC brochure available at: http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/guide_to_conducting_pumping_tests.pdf

Example 1 – Well Diagram and Calculating Casing Storage



CASING STORAGE:

A 6-inch diameter well is 300 feet deep and has a static water level of 30 feet.

The volume of water in the well = height of water in the well (300 ft – 30 ft) × volume of water per foot of well bore.

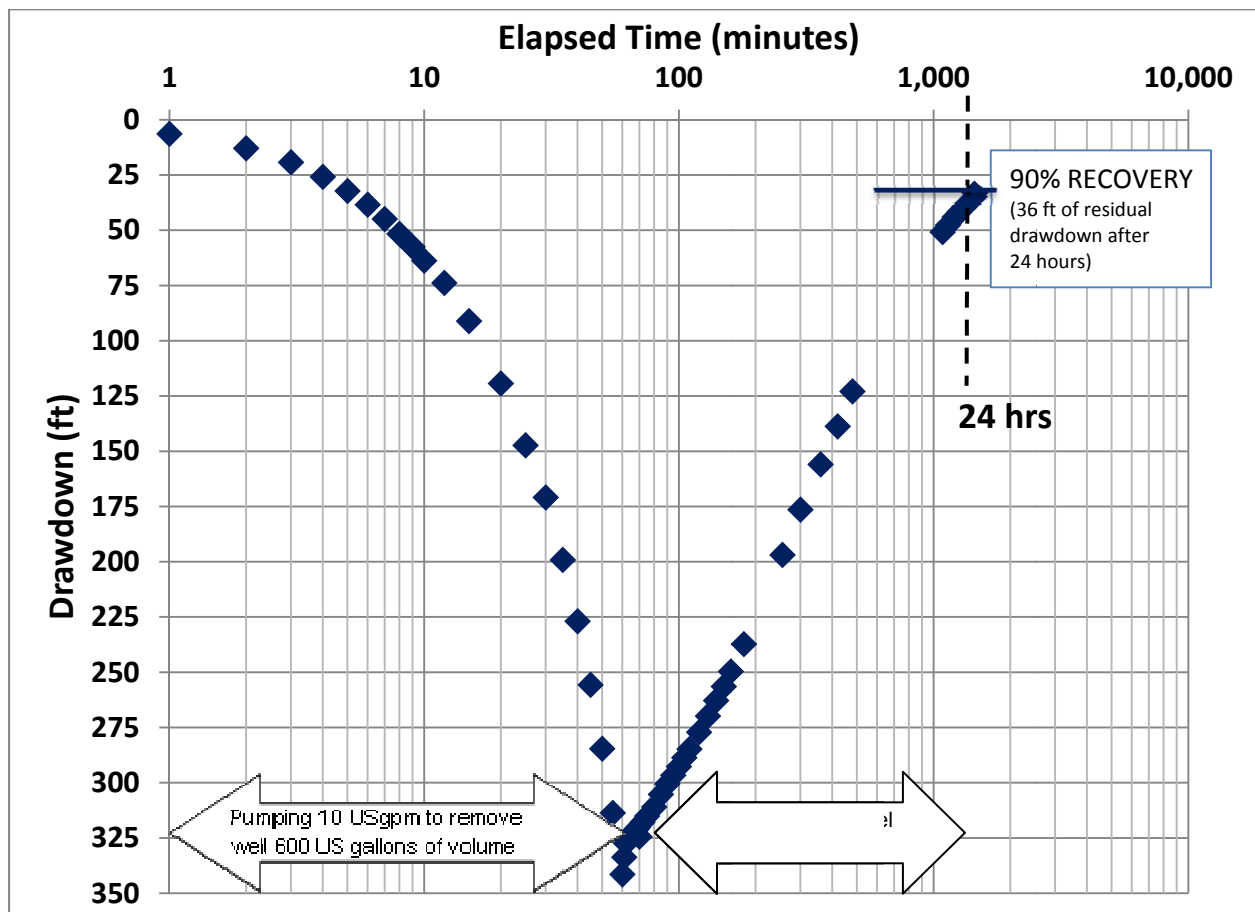
Volume = 270 feet × 1.5 US gallon/foot (for a 6-inch well bore) = 405 US gallons in the well.

Example 2 - 600 US gpd Pumping Test on a Low Yield Bedrock Well

- 383 ft deep, 6-inch diameter bedrock well.
- Depth of bedrock fractures not documented on well record.
- Estimated well yield at time of construction 1.5 US gpm (from the well record).
- Static Water Level (SWL) at 6 ft below ground.
- Casing storage volume 570 US gallons $(=(383 \text{ ft} - 6 \text{ ft}) \times 1.5 \text{ US gallon/foot} = 566 \text{ US gallons})$.
- Pumping test rate= 10 US gpm.
- Time to pump out 600 US Gallons = 60 minutes. ✓
- Water level at end of 60 minutes pumping period = 347 ft below ground.
- Drawdown at end of pumping period = 347 ft – 6 ft (SWL) = 341 ft.
- After 120 minutes of recovery water level at 243 ft below grade (residual drawdown = 237 ft).
- Percentage recovery after 120 minutes = $1 - (237 \div 341) = 0.3 (30\%)$.
- After 1440 minutes **from start of test** water level at 40 ft below grade (residual drawdown = ~~36 ft~~ **34 ft**)
- Percentage recovery after 1440 minutes (24 hrs) from start of test = $1 - (\frac{36}{341}) = 0.89 (89\%)$. ✓
34 0.90 (90%)

Message to Customer:

1. Based on the test the well is marginally capable of supplying 600 US gpd (because it just achieved 90% recovery at 24 hours from start of test).
2. Don't know where water bearing fractures are- pumping may aerate fracture(s) and reduce well yield over time.



Example 3 - 600 US gpd Pumping Test on a Low Yield Overburden Well

- 73 ft deep overburden well.
- Estimated well yield at time of construction 5 US gpm (from the well record).
- Static Water Level (SWL) at 15 ft below ground.
- Casing storage volume 90 US gallons (= (73 ft – 15 ft) × 1.5 US gallon/foot = 87 US gallons).
- Pumping test rate= variable 1.5 to 3.5 US gpm.
- Time to pump out 600 US Gallons = well dry (pumping water level at level of pump intake) after 90 minutes and only 135 US gallons pumped. **X**
- Drawdown at end of pumping period = 62 ft – 15 ft (SWL) = 47 ft.
- After 120 minutes of recovery water level at 42 ft below grade (residual drawdown = 27 ft).
- Method allows up to 8 hrs to produce 600 US gallons so project recovery water level to 8 hrs = 12 ft of residual drawdown, or approximately 35 ft of water above pump intake.
- 35 ft of water @ 1.5 US gallons/ft = 53 US gallons.

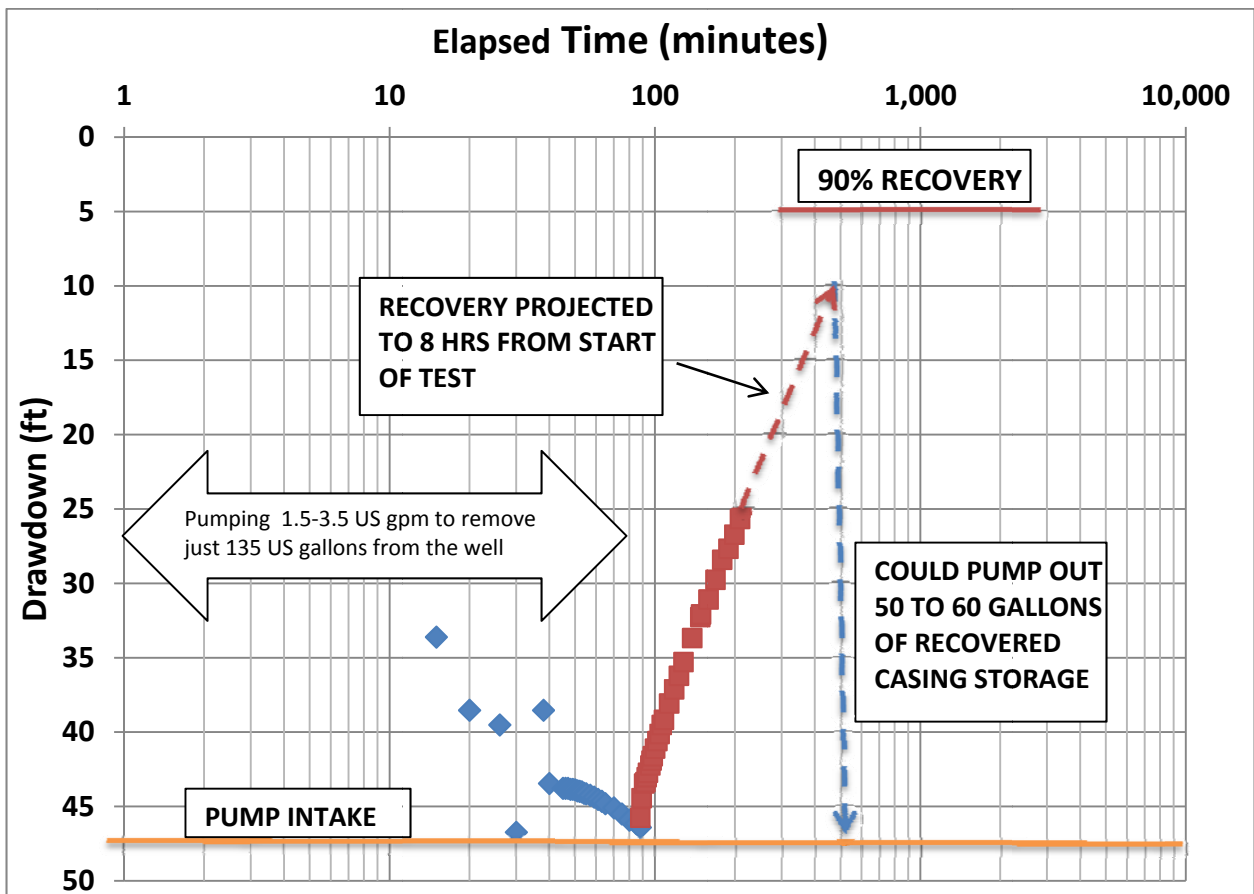
Conclusions:

1. In 8 hours well could produce roughly 135 + 53 = 188 US gallons.
2. Well fails test as cannot provide 600 US gallons in 8-hour pumping period.

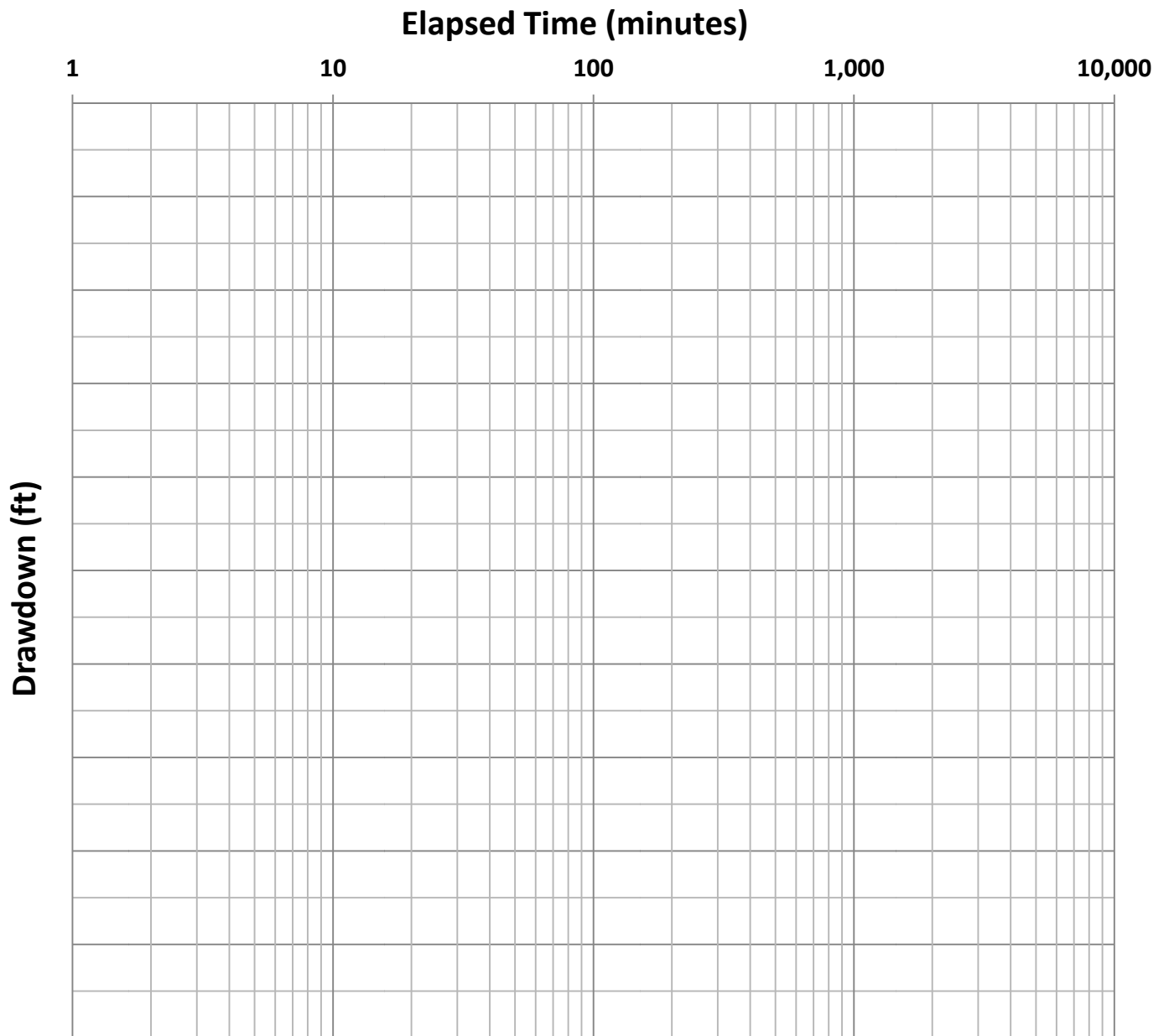
(After 120 minutes of recovery monitoring plotted on the semi-log graph, I could project/predict where the water level would be 8 hrs from start of test and would not need further recovery monitoring to assess well)

Message to Customer:

1. Well fails 600 US gpd test and is not suitable for domestic supply.



Example 4 – Example Semi-Log Graph for Plotting Drawdown and Recovery Water Levels



¹ This document reflects the industry's standard use of US units for flow rate (US gpm), well depth (feet) and water levels (feet).