



California Groundwater Association

An NGWA Affiliate State

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Article 495 - WELL YIELD PUMPING FOR RESIDENTIAL PROPERTY TRANSFERS

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BACKGROUND

Real property purchase contracts often require pumping tests to demonstrate well yields. Very few jurisdictions have ordinances or specific testing requirements for these transactions; neither is there any statewide standard addressing these tests. A wide range of approaches and procedures may be employed in rendering test reports, depending on an individual groundwater contractor's expertise, experience, and interpretation of the actual test requests made by property buyers, sellers, and real estate agents.

Adding to the confusion is a lack of understanding of proper terminology when tests are requested. Often the testing done and the report prepared do not properly address the concerns of the interested parties because the requisition included incorrect terminology or incomplete information; and this error can be compounded when laymen do not understand the subsequent data or observations provided in the report.

Opinions on aquifer yield or future well production are far beyond the scope of any practical and reasonably priced well report for simple property transfers. However, buyers rightfully want to have at least some indication of water availability on the property they are considering and all the principals in a real estate transaction should reasonably expect well defined requisitions, uniform testing procedures which provide some basis for well comparisons, and standardized report forms.

See CGA Standard 490, WATER WELL TEST REPORTING FOR PROPERTY TRANSFERS for additional background information.

Discussion

Terminology

One of the primary causes of dispute in well reporting for property transactions is the confusion between the terms “well tests”, “well yield tests”, and “pump tests”. While each of these may be components of a well report, they imply different activities and should not be considered interchangeable.

A “well test” is an all encompassing term that leaves unanswered the question, “test which aspect of the well?” A well test may include evaluating the condition of the well itself, such as surface construction, casing condition, borehole integrity, etc; or, testing for water quality, such as potability, mineral content, bacteria, pH, etc. Additionally, although well testing can include well yield tests or pump tests, the term itself does not specify them and requesting only a well test does not insure either will be done.

“Well yield tests”, which may also be called “production tests” and are sometimes referred to as well “pumping tests”, imply data will be gathered by pumping the well and a statement offered describing the current rate of water production of the well itself at a specific time and date over a specific duration. In water scarce areas, well yield tests are the more valuable component of well test reporting and can aid a potential buyer of property in determining whether the volume of water available is adequate for his or her purposes.

“Pump tests”, more properly termed pump equipment tests, imply an evaluation of the well pump and (appurtenant) equipment and control devices. This evaluation would include pump performance, operation, and overall condition of the general water system. Any water flow data included with tests of these types only describe the current performance of the pump itself and should not be construed as having any bearing on well yield. Pump performance describes the volume of water at various pressures (head) the pump is capable of delivering regardless of how much water the well produces. Although this information is valuable to the buyer of real property, particularly if the test determines repairs may be imminent, pump equipment tests are generally of short duration and are not expected to demonstrate well yield.

When a report is stipulated in a standard real estate purchase contract form, the relevant contract section accurately states that wells are to be tested for potability and productivity. However, in many regions a subsequent request for the report is conveyed to the contractor verbally, using terms such as well test or pump test, without specifically and formally asking for a well yield test. The contractor is then likely to apply his own interpretation to the request. If a true well yield test is not performed, the report generated may be misleading to all parties to the real estate transaction as it may detail pumping rates and water volumes but not provide any useful information regarding the current production rate of the well.

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Limitations Of Test

The primary goal of a well yield pumping test for property transfers is to discover whether there is sufficient water available for the proposed uses of the intended buyer.

Test conclusions for these limited types of tests are intended for general comparisons of the well in its present condition and should not be relied upon to predict either the future quantity or quality of water that the well will produce. Sustained yield, which is the pumping rate at which long term pumping can be maintained, requires extended testing and analysis and is beyond the scope of practical pumping tests for property transfer reporting.

Potential seasonal differences in well yield should be communicated to the parties to the agreement. Similarly, impact on future yield caused by interference from neighboring wells is a potential factor in some wells and will seldom be discovered during short duration pumping tests.

Agreement Between Parties

The tested well yield for property transfers is generally not expected to meet any specific flow rate. Rather the test results are simply meant to be a report of observed production within the parameters of the test. The various testing procedures that may be employed should be communicated to both the buyer and seller and an agreement entered based upon that understanding.

Methodology

Several pumping test procedures have been established for this application, including:

- Total yield
- Constant yield
- Constant pumping level
- Water recovery

These will each be described in further detail.

The specific methodology used will be determined by any applicable ordinances where they exist, existing equipment in developed wells, the type of aquifer being tested, actual conditions encountered in the well before and during the test, and agreement between the parties, usually the seller and buyer of the property.

Pumping Time

In areas overlying unconfined aquifers with known water tables, or in areas where historical data has shown that the aquifer is a reliable source of water, then pumping tests to demonstrate well yield may be eliminated altogether. If done in conjunction with pump equipment tests or while gathering samples for water quality testing, then relatively short pumping times of 1-2 hours may be employed.

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For wells in areas where water availability is known or suspected to be limited then pumping should be done a minimum of 4 hours assuming an apparent constant yield has been observed.

A well that has not been in use within a reasonable length of time requires more pumping time than a well on inhabited property with an in-use water system. For wells that have been idle for some time, or for those that are undeveloped, test pumping time should be extended.

Seasonality may be an issue in determining pumping duration. Many wells, particularly those that are supplied from upper weathered or fracture zones, may show significant declines during late summer and fall dry seasons compared to production rates observed during spring or early summer months.*

** Dry season may be defined differently in desert regions*

Equipment

The equipment used for a well yield pumping test will depend on the actual methodology used. All will require a properly calibrated totalizing flow meter to accurately measure discharge rates and cumulative yield. Field calibration of flow meters is acceptable, with accuracy verified through the use of a bucket and stop watch during the test. Generally, water should be discharged far enough away from the well head so that data is not influenced. For the relatively short pumping durations required for these applications, 50 to 100 feet down gradient will normally be sufficient.

Measuring and tracking water level within the well significantly increases the value of the observed data and resolution of the test and therefore a water level sounder should be employed in any well that allows continuous access. However, while the well borehole and the installed pump, drop pipe, cable, and stabilizers may allow a sounder to be lowered; only a sounding tube will guarantee this access. Therefore, because sounding tubes are not generally in place in residential wells, observing water levels may be problematic. For this reason procedures requiring water level monitoring should be done with caution, or not chosen at all, unless a sounder can be lowered into the well throughout the column.

For constant pumping level tests a throttling valve may be necessary to restrict water flow.

It should be noted that if pump performance is tested, either as a component of a well report that includes a yield test or only as a pump equipment test, flow meters and water level sounders are essential. Pump performance cannot be accurately plotted unless pumping levels are known.

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Qualified Personnel

Testing should be done under the supervision of one of the following California professional licenses:

- C57 well drilling contractor
- C61/D21 pump contractor
- Professional Geologist, Certified Engineering Geologist, or Certified Hydrogeologist

METHODOLOGIES (DETAILED)

Total Yield

In this procedure the well is pumped continuously until it produces a specified volume of water within a specified time, as determined by the parties to the agreement. This is the least reliable procedure since borehole storage and pumping levels are not considered.

Total yield may be converted to average yield by dividing the gallons pumped by the time of pumping. If this is calculated over the entire time of the test then the computation will include the borehole storage as well as water inflow from the aquifer. Therefore to be at all meaningful the average yield should be computed over the final periods of the test after, at the very least, the volume of water stored in the borehole has been removed.

Constant Yield

Where water level cannot be measured, a constant yield test may provide adequate information to demonstrate well production. Pumping should continue without any pressure restriction imposed on the discharge for a minimum of 4 hours total pumping time and until a stable pumping rate has been reached for a minimum of 2 hours, or at least a rate that is only slightly declining. The theory here is that, based on pump hydraulics, if pumping flow rate has reached a steady state then pumping level must be more or less constant. The flow rate at the end of this time then is the constant yield.

Constant Pumping Level

This test requires the water level to be measured in the well. The water should be pumped down until a stable pumping level is established, either by reaching the performance limit of the pump or by throttling the discharge piping. Pumping should continue until a minimum total pumping time of 4 hours has been reached. The flow rate that maintains this constant pumping level is the constant well yield. If at the end of the pumping period the pumping level cannot be maintained without further throttling the pump discharge, then the pumping time should be extended and perhaps a lower pumping level established. This is potentially the most accurate test procedure for this application.

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Water Recovery

In this test all of the stored water in the borehole is pumped out and interval testing is begun following suction break. When the pump breaks suction it is turned off and the exact time is recorded. After a 1 to 15 minute off time the pump is restarted with pumping continuing until suction break occurs again. The volume of water pumped and the exact time of the second suction break are recorded. The yield is the volume pumped divided by the total time interval between the two suction breaks. This cycle is repeated with varying off times for the duration of the test period and until a consistent yield has been determined. The well yield is the yield recorded in the last cycle.

By varying the off times the influence of column water on artesian pressure and subsequent recovery rates at rising water levels may determine the optimum reset time for a pump protection switch to realize maximum daily yield from the well.

This test is very accurate for low production wells with less than 3 gpm yield that are equipped with a pump capable of over pumping the well.

Large Diameter Wells

Large diameter hand dug wells or lined cisterns, 36" to 60", present a special set of problems and often cannot be practically tested for yield using the listed methodologies as described. The large volumes of stored water associated with these wells may preclude dewatering the reservoir within pumping durations used for drilled wells of smaller diameter. With large surface areas drawdown may be so minimal within limited pumping times that pump performance appears stable throughout the test. Because drawdown may be slow, establishing a constant pumping level may be difficult to judge.

In these situations, a modified test may be employed. Cistern volume should be effectively dewatered either by extending pumping times or by installing a higher volume test pump. Water level measurements should be taken up to 24 hours following dewatering and compared to initial measurements. If initial water levels have been reached it may be assumed that the total yield removed during the test has been replenished.

Pump Equipment Test

In this test only the performance capability of the pump in the well is to be determined and well yield is unknown and not relevant to the test. This test requires the water level to be measured in the well.

Water is pumped against varying discharge pressures, with pumping level, applied pressure, and discharge rate recorded. By plotting or at least comparing the data points against published manufacturer's curves, pump wear can be determined. Data comparison is most accurate if pump brand and model, pump setting, and drop pipe diameter are known. If pump brand or model is unknown, comparison against various pump series of the same horsepower will provide parameters sufficient to make an assumption regarding pump wear.

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RECOMMENDATIONS

1. Well yield pumping tests for property transfers should be done under the supervision of one of the following California professional licenses:
 - C57 well drilling contractor
 - C61/D21 pump contractor
 - Professional Geologist, Certified Engineering Geologist, or Certified Hydrogeologist
2. When meant to be a component of a well test or report, well yield tests for property transfers should be specifically requested.
3. When meant to be a component of a well test or report, pump equipment tests for property transfers should be specifically requested.
4. Well yield testing should be undertaken with a written contract that addresses what information is solicited, the methodology to be used, or methodologies that may be used as determined by the well dynamics, and anticipated pumping duration.
5. Pumping tests to demonstrate well yield should be run a minimum of 4 hours. Pumping time should be extended if stabilization has not been reached or if the well has been idle for more than 30 days.
6. For any well yield pumping test or pump equipment test, a totalizing flow meter, installed as per manufacturer's recommendations, shall be used to record discharge rate from a pumped well.
7. For any well yield pumping test or pump equipment test, a water level sounder shall be used to track pumping levels during testing, wherever there is access for the sounding device. If designated methodology requires water level measurement and sounder access is not available, then a sounding tube should be installed in the well prior to the test.
8. Flow rates, total gallons pumped, and water levels (where applicable) shall be recorded at regular intervals.
9. CGA Standard Form 490-1 is recommended for well yield reporting. All data that is gathered during the testing procedure should be submitted as an attachment to this report form.

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Adopted by the CGA Board of Directors on October 14, 2006

NOTE: This Standard, Article 460 & Standard Article 495 replace existing article 450 -production testing-small capacity wells, adopted in 1992. Any copy of Article 450 should be destroyed, as it is now obsolete.