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Standard Guide for Purging Methods for Wells Used for Groundwater Quality Investigations[1]

This standard is issued under the fixed designation D6452; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide covers methods for purging wells used for groundwater quality investigations and monitoring programs. These methods could be used for other types of programs but are not addressed in this guide.

1.2 This guide applies only to wells sampled at the wellhead.

1.3 *This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this documente be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this guide means only that the document has been approved through the ASTM consensus process.*

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4750 Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well) (Withdrawn 2010)[3]

D5088 Practice for Decontamination of Field Equipment Used at Waste Sites

D5092 Practice for Design and Installation of Ground Water Monitoring Wells

D5521 Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers

D6089 Guide for Documenting a Ground-Water Sampling Event

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *casing volume*—the quantity of water contained in the casing above the screen or open borehole.

3.1.2 *fixed volume purging*—removing a specified number of well volumes to achieve purging.

3.1.3 *flow-through cell (purging)*—a vessel that allows purge water to pass over sensors for continuous measurement of indicator parameters.

3.1.4 *flushing*—see *purging* .

3.1.5 *grab sampling device*—a bailer or similar device that removes an aliquot of water from the well with each insertion and removal from the well.

3.1.6 *indicator parameters (purging)*—those physical or chemical properties, or both, used as a correlative measure to determine when water to be sampled reflects ambient groundwater chemistry.

3.1.7 *low yield well*—a well that does not produce sufficient water such that the objectives of purging and sampling cannot be achieved without first removing all water from the well.

3.1.8 *packer (purging)*—an expandable device used to physically isolate one or more zones in a well.

3.1.9 *purge volume*—the quantity of water removed from the well to accomplish the objectives of purging.

3.1.10 *purging*—the practice of removing stagnant (standing) water from a well prior to sampling.

3.1.11 *purging rate*—the rate at which water is removed from a well or sampling point during purging.

3.1.12 *recovery rate (purging)*—the rate at which the water level in a well returns to equilibrium with the hydraulic conditions of the formation after the removal of water.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] The last approved version of this historical standard is referenced on www.astm.org.

3.1.13 *stabilization*—a decrease in the change between measured values to a specified range or percentage of the measured value over a selected number of consecutive readings.

3.1.13.1 *Discussion*—The interval between readings is chosen for either a given time period or volume of water removed.

3.1.14 *stagnant water*—the water contained in a well between sampling events that may have interacted with materials or the headspace in the well, or both, and thus may be different from ambient groundwater conditions.

3.1.15 *target analyte (purging)*—a chemical constituent or physical characteristic to be analyzed for the purpose of fulfilling program objectives.

3.1.16 *well volume*—the quantity of water contained in the casing and the screen for a screened well, or in the open borehole and casing in an unscreened well. For an unscreened well, this volume may also be referred to as a borehole volume.

3.1.16.1 *Discussion*—Regulations or guidance documents may contain other definitions of well volume and should be consulted.

4. Significance and Use

4.1 Wells used in groundwater quality investigations or monitoring programs are generally purged prior to sampling (Note 1). Purging is done to minimize the bias associated with stagnant water in the well, which generally does not accurately reflect ambient groundwater chemistry (Note 2).

NOTE 1—Some sampling methods, such as passive sampling, do not require the practice of purging prior to sample collection (**1**,**2**).[4]

NOTE 2—This guide does not address the practice of post-sample purging (purging again after sampling is completed), which is intended for purposes other than the minimization of bias associated with stagnant water in the well.

4.2 There are various methods for purging. Each purging method may have a different volume of influence within the aquifer or screened interval. Therefore, a sample collected after purging by any one method is not necessarily equivalent to samples collected after purging by the other methods. The selection of the appropriate method will be dependent on a number of factors, which should be defined during the development of the sampling and analysis plan. This guide describes the methods available and defines the circumstances under which each method may be appropriate.

5. Criteria and Considerations for Selecting an Appropriate Purging Method

5.1 *Regulations or Other Guidance*—Determine if any State or Federal regulations or guidance exist pertaining to purging monitoring wells. Purging may be addressed as part of a broader regulation or guidance document on field investigations or groundwater monitoring.

5.2 *Historical Data*—Review of historical data can provide the user with information about the chemical and physical behavior of the groundwater at the sampling point during purging and details regarding past purging practices.

5.3 *Well Design (Practice D5092)*—The design of the well must be considered to select an appropriate purging method. Refer to Section 7 for how specific well design details affect the selection of purging methods.

5.4 *Well Development (Guide D5521)*—Well development is part of the well construction or maintenance process and not part of a purging and sampling event. Information on well development can be found in Guide D5521.

NOTE 3—Improper or inadequate well development can affect the suitability of the well for use in the sampling program.

5.5 *Hydraulics of the Well*—Selection of a purging method should include an assessment of well-specific hydraulic conditions, which are directly related to formation transmissivity and well design, construction, development, and maintenance. Well and formation hydraulics (the 3-dimensional distribution of head) influence the rate at which water flows through or enters the well intake under laminar flow conditions. Purging strategies are commonly categorized as being suitable for high-yield wells or low-yield wells.

5.6 *Purge Water Management*—Manage purge water in accordance with the site-specific waste management provisions of the sampling and analysis plan. It may be preferable to select a purging method to minimize the purge volume, especially when purge water must be containerized. (See Note 1.)

5.7 *Physical Condition of the Wells*—The physical condition of a well may affect the purging method by limiting the choice of equipment. For example, physical aberrations of the sampling point such as a cracked casing or siltation could preclude the use of certain purging devices.

5.8 *Subsurface Geochemistry*—Knowledge of the subsurface geochemistry can be useful in selecting a purge method that will best achieve the goal of removing stagnant water. It can also be useful in distinguishing between ambient formation water and stagnant water during the purging process. Chemical and biological interaction between formation water and the solid-phase materials in the aquifer, bacteria, or the well materials can modify the chemistry of water standing in the well or in the vicinity of the well. Dissolved gases can be transported into or out of the screened or open interval and added to or removed from the groundwater across the free surface of the water in the well.

5.9 *Hydrogeologic Setting*—Optimizing purging rates requires consideration of the hydrogeologic characteristics that control the direction and rate of water movement and the transport of dissolved and colloidal material. Constituents or concentrations of constituents not characteristic of the formation water chemistry at the well intake may be transported from distant areas to the well by induced flow or reversal of flow direction when purging rates are higher than optimal or when purging times are longer than optimal.

6. Equipment Used for Purging

6.1 A variety of devices are appropriate for purging wells. Consideration of the factors in Section 5 may also be useful in selecting purging devices.

[4] The boldface numbers given in parentheses refer to a list of references at the end of the text.

6.2 All of the purging methods described herein require water level measurements (see Guide D4750). For some of the purging methods, measurement of indicator parameters is also required. When pumping devices are used for purging, it is preferable to use a flow through cell for optimal measurement of indicator parameters.

7. Purging Methods

7.1 *Fixed Volume Purging:*

7.1.1 *Method Description*—This method involves the removal of a specified number of well volumes prior to sampling. The well volume is calculated in the field and multiplied by the specified number to be removed. The minimum number of well volumes to be removed should be prescribed in the sampling and analysis plan and is often selected based on regulatory guidance or requirements.

7.1.2 *Applicability*—Fixed well volume purging is best applied to wells that will yield multiple well volumes during purging without fully dewatering.

7.1.3 *Advantages:*

7.1.3.1 Can use a variety of pumps or grab sampling devices.

7.1.3.2 Does not require chemical measurements for determining when purging is complete.

7.1.4 *Limitations:*

7.1.4.1 May increase the cost associated with management of purge water.

7.1.4.2 Not practical for use in low yield wells.

7.1.4.3 Sometimes the number of well volumes is expressed as a range (for example, 3 to 5 volumes) making actual purge volume open to interpretation and potentially variable between sampling events.

7.1.4.4 There are no well-specific indicator parameter or target analyte data to determine when the well has been adequately purged.

7.1.4.5 The determination of an appropriate purging device, intake location, and rate of water removal are prerequisite to the effective use of this method.

7.2 *Purging Based on Stabilization of Indicator Parameters:*

7.2.1 *Method Description*—In this method, field measurements of selected parameters are taken to indicate when the well is sufficiently purged. The indicator parameters to be measured and frequency of measurements should be specified in the sampling and analysis plan. The most commonly measured parameters include (but are not limited to) pH, specific conductance, turbidity, temperature, dissolved oxygen, and oxidation-reduction potential. The parameters should be selected based on knowledge of water chemistry and analytes of interest, or regulatory requirements, or both. The frequency of measurement should be based on purging rate. The acceptable variation of parameter values to define stabilization and the minimum number of consecutive stable readings within the prescribed variation for each indicator parameter should be defined in the sampling and analysis plan (**3**,**4**). Once stabilization has been reached, purging is complete regardless of the volume of water removed.

7.2.2 *Applicability*—This method can be used in all wells where sufficient yield can be sustained to reliably measure field indicator parameter concentrations.

7.2.3 *Advantages:*

7.2.3.1 Can be performed using a variety of grab sampling and pumping devices.

7.2.3.2 May result in a lower total purge volume.

7.2.3.3 Provides well-specific chemical data to determine when the well has been adequately purged.

7.2.4 *Limitations.*

7.2.4.1 Requires the use and calibration of field parameter measurement instrumentation.

7.2.4.2 Requires knowledge of the instrumentation to be used.

7.2.4.3 Accurate measurement of indicator parameters may be difficult to accomplish when using a grab sampler for purging.

7.3 *Purging Based on Stabilization of Target Analytes:*

7.3.1 *Method Description*—This method uses concentrations of selected target analytes or their chemical analogs, instead of indicator parameters, to determine when a well is sufficiently purged. Data are produced by sequential analysis of the purge water during well purging. Analyte concentrations are determined at the site using a mobile field laboratory unit or smaller portable analytical equipment (Note 4). Depending on equipment capability, analyses may be run on continuous-flow samples or sample aliquots. The frequency of measurement should be based on purging rate. The acceptable variation of target analyte values to define stabilization and the minimum number of consecutive stable readings within the prescribed variation for each target analyte should be defined in the sampling and analysis plan (**3**,**5**).

NOTE 4—Examples of such equipment include field gas chromatographs (for organic compounds), field ion chromatographs (for anions), field spectrophotometers (for a large variety of chemical constituents and species), and ion-specific electrodes, colorimetric reagent kits, and titration reagent kits.

7.3.2 *Applicability*—This method can be used for wells where sufficient yield can be sustained to measure target analyte concentrations.

7.3.3 *Advantages:*

7.3.3.1 Can use a variety of grab sampling and pumping devices.

7.3.3.2 May result in a lower total purge volume.

7.3.3.3 Provides well-specific and analyte-specific chemical data to determine precisely when the well has been adequately purged.

7.3.4 *Limitations:*

7.3.4.1 Requires the use and calibration of target analyte measurement instrumentation.

7.3.4.2 Requires knowledge of the instrumentation to be used.

7.3.4.3 Different target analytes may stabilize at different times within the purging process.

7.3.4.4 Accurate measurement of target analytes may be difficult to accomplish when using a grab sampler for purging.

7.4 *Purging Based on Fixed Volume Combined with Indicator Parameter Stabilization:*