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Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities[1]

This standard is issued under the fixed designation D5299/D5299M; 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 procedures that are specifically related to permanent decommissioning (closure) of the following as applied to environmental activities. It is intended for use where solid or hazardous materials or wastes are found, or where conditions occur requiring the need for decommissioning. The following devices are considered in this guide:

1.1.1 A borehole used for geoenvironmental purposes (see Note 1),

1.1.2 Monitoring wells,

1.1.3 Observation wells,

1.1.4 Injection wells (see Note 2),

1.1.5 Piezometers,

1.1.6 Wells used for the extraction of contaminated groundwater, the removal of floating or submerged materials other than water such as gasoline or tetrachloroethylene, or other devices used for the extraction of soil gas,

1.1.7 A borehole used to construct a monitoring well, and

1.1.8 Any other well or boring that houses a vadose zone monitoring device.

1.2 Temporary decommissioning of the above is not covered in this guide.

NOTE 1—This guide may be used to decommission boreholes where no contamination is observed at a site (see Practice D420 for details); however, the primary use of the guide is to decommission boreholes and wells where solid or hazardous waste have been identified. Methods identified in this guide can also be used in other situations such as the decommissioning of water supply wells and boreholes where water contaminated with nonhazardous pollutants (such as nitrates or sulfates) are present. This guide should be consulted in the event that a routine geotechnical study indicates the presence of contamination at a site. Consult and follow national, state, or local regulations as they may control required decommissioning procedures.

NOTE 2—The term "well" is used in this guide to denote monitoring wells, piezometers, or other devices constructed in a manner similar to a well. Some of the devices listed such as injection and extraction wells can be decommissioned using this guide for information, but are not specifically covered in the text.

NOTE 3—Details on the decommissioning of multiple-screened wells are not provided in this guide due to the many methods used to construct these types of wells and the numerous types of commercially available multiple-screened well systems. However, in some instances, the methods presented in this guide may be used with few changes. An example of how this guide may be used is the complete removal of the multiple-screened wells by overdrilling.

1.3 Most monitoring wells and piezometers are intended primarily for water quality sampling, water level observation, or soil gas sampling, or combination thereof, to determine quality. Many wells are relatively small in diameter typically 2.5 to 20 cm [1 to 8 in.] and are used to monitor for hazardous chemicals in groundwater. Decommissioning of monitoring wells is necessary to:

1.3.1 Eliminate the possibility that the well is used for purposes other than intended,

1.3.2 Prevent migration of contaminants into an aquifer or between aquifers,

1.3.3 Prevent migration of contaminants in the vadose zone,

1.3.4 Reduce the potential for vertical or horizontal migration of fluids in the well or adjacent to the well, and

1.3.5 Remove the well from active use when the well is no longer capable of rehabilitation, or has failed structurally; is no longer needed for monitoring; is no longer capable of providing representative samples or is providing unreliable samples; is required to be decommissioned; or to meet regulatory requirements.

NOTE 4—The determination of whether a well is providing a representative water quality sample is not defined in this guide. Examples of when a representative water quality sample may not be collected include the biological or chemical clogging of well screens, a drop in water level to below the base of the well screen, or complete silting of the screen. These conditions may indicate that a well is not functioning correctly.

1.4 This guide is intended to provide information for effective permanent closure of wells so that the physical structure of the well does not provide a means of hydraulic communication between aquifers, with above surfaces, or react chemically in a detrimental way with the environment.

1.5 The intent of this guide is to provide procedures that when followed result in a reasonable level of confidence in the

[1] This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.21 on Groundwater and Vadose Zone Investigations.

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*A Summary of Changes section appears at the end of this standard

integrity of the decommissioning activity. However, it may not be practicable to verify the integrity of the decommissioning procedure. At this time, methods are not available to substantially determine the integrity of the decommissioning activity.

1.6 This guide may also be used for closure or decommissioning of other systems that could allow vertical or horizontal migration of contaminants or other cross-contamination of aquifers, or when ordered by regulatory agencies.

1.7 *Units*—The values stated in either SI units or inch-pound units (given in brackets) are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.8 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

1.9 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.10 *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 document be applied without consideration of a project's many unique aspects. The word" Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

NOTE 5—If state and local regulations are in effect where the decommissioning is to occur, the regulations take precedence over this guide.

1.11 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C150 Specification for Portland Cement

D420 Guide to Site Characterization for Engineering Design and Construction Purposes (Withdrawn 2011)[3]

D422 Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)[3]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D2487 Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedures)

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D4380 Test Method for Density of Bentonitic Slurries

D5088 Practice for Decontamination of Field Equipment Used at Waste Sites

D5092 Practice for Design and Installation of Groundwater Monitoring Wells

D5434 Guide for Field Logging of Subsurface Explorations of Soil and Rock

D5608 Practices for Decontamination of Sampling and Non Sample Contacting Equipment Used at Low Level Radioactive Waste Sites

D5753 Guide for Planning and Conducting Borehole Geophysical Logging

D5781 Guide for Use of Dual-Wall Reverse-Circulation Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5782 Guide for Use of Direct Air-Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5784 Guide for Use of Hollow-Stem Augers for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices

D5872 Guide for Use of Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices

D5875 Guide for Use of Cable-Tool Drilling and Sampling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices

D5876 Guide for Use of Direct Rotary Wireline Casing Advancement Drilling Methods for Geoenvironmental Exploration and Installation of Subsurface Water-Quality Monitoring Devices

D5978 Guide for Maintenance and Rehabilitation of Groundwater Monitoring Wells

D6026 Practice for Using Significant Digits in Geotechnical Data

D6151 Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling

D6167 Guide for Conducting Borehole Geophysical Logging: Mechanical Caliper

D6274 Guide for Conducting Borehole Geophysical Logging - Gamma

D6282 Guide for Direct Push Soil Sampling for Environmental Site Characterizations

D6286 Guide for Selection of Drilling Methods for Environmental Site Characterization

D6724 Guide for Installation of Direct Push Groundwater Monitoring Wells

D6725 Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers

[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.

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
F480 Specification for Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of common technical terms in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *blowout, n—in drilling*, a sudden or violent uncontrolled escape of fluids or gas, or both, from a borehole.

3.2.2 *caliper log, n—in drilling*, a geophysical borehole log that shows to scale the variations with depth in the mean diameter of a cased or uncased borehole.

3.2.3 *cement bond (sonic) log, n—in drilling*, a borehole geophysical log that can be used to determine the effectiveness of a cement seal of the annular space of a well.

3.2.4 *channeling, n—in drilling*, the process of forming a vertical cavity resulting from a faulty cement job in the annular space.

3.2.5 *curing accelerator, n—in grouting*, a material added to cement to decrease the time for curing.

3.2.5.1 *Discussion*—Examples are sodium chloride, calcium sulfate (gypsum), and aluminum powder.

3.2.6 *curing retarder, n—in grouting*, a material added to cement to increase the time for curing.

3.2.6.1 *Discussion*—Sodium chloride in high concentrations is an example.

3.2.7 *decommissioning (closure), n—in drilling*, the engineered closure of a well, borehole, or other subsurface monitoring device sealed with plugging materials.

3.2.7.1 *Discussion*—Decommissioning also includes the planning and documenting of associated activities.

3.2.8 *fire clay, n—in grouting*, a silicious clay rich in hydrous aluminum silicates.

3.2.9 *flow log, n—in drilling*, a borehole geophysical log used to record vertical movement of groundwater and movement of water into or out of a well or borehole and between formations within a well.

3.2.10 *geophysical borehole log, n*—a log obtained by lowering an instrument into a borehole and continuously recording a physical property of native or backfill material and contained fluids.

3.2.10.1 *Discussion*—Examples include resistivity, induction, caliper, sonic, and natural gamma logs.

3.2.11 *grout pipe, n—in drilling*, a pipe or tube that is used to transport cement, bentonite, or other plugging materials from the ground surface to a specified depth in a well or borehole.

3.2.11.1 *Discussion*—The material may be allowed to flow freely or it may be injected under pressure. The term tremie pipe is frequently used interchangeably.

3.2.12 *hydraulic communication, n—in drilling*, the migration of fluids from one zone to another, with reference to this guide; especially along a casing, grout plug, or through backfill materials.

3.2.13 *multiple-screened wells, n—in drilling*, two or more monitoring wells situated in the same borehole. These devices can be either individual casing strings and screen set at a specific depth, a well with screens in more than one zone, or can consist of devices with screens with tubing or other collecting devices attached that can collect a discrete sample.

3.2.14 *neat cement, n—in grouting*, a mixture of Portland Cement (C150) and water and is not extended with sand or other aggregate.

3.2.15 *native material, n—in drilling*, in place geologic (or soil) materials encountered at a site.

3.2.16 *overdrilling, n—in drilling*, the process of drilling out a well casing and any material placed in the annular space.

3.2.17 *perforation, n—in drilling*, a slot or hole made in a well casing to allow for communication of fluids between the well and the annular space.

3.2.18 *permanent plugging (Closing) (Sealing), n—in grouting*, a seal that has a hydraulic conductivity that is equivalent or less than the hydraulic conductivity of the geologic formation. This term is often used with uncased boreholes.

3.2.19 *plow layer, n—in drilling*, the depth typically reached by a plow or other commonly used earth turning device used in agriculture.

3.2.19.1 *Discussion*—This depth is commonly one to two feet (.3 m to .6 m) below land surface.

3.2.20 *plugging material, n—in grouting*, a material that has a hydraulic conductivity equal to or less than that of the geologic formation(s) to be sealed.

3.2.20.1 *Discussion*—Typical materials include portland cement and bentonite.

3.2.21 *pre-conditioning, n—in drilling*, an activity conducted prior to placing plugging material into a borehole in order to stabilize the hole.

3.2.22 *temporary decommissioning, n—in drilling*, the engineered closure of a well intended to be returned to service at some later date (generally no more than six months to one year).

3.2.22.1 *Discussion*—Temporary plugging should not damage the structural integrity of the well. Plugging materials consist of sand, bentonite, or other easily removed materials.

3.3 The following terms used in this standard are available in Terminology D653 and are presented here for the convenience of the user.

3.3.1 *bleeding*—the autogenous flow of mixing water within, or its emergence from, newly placed grout caused by the settlement of the solid materials within the mass.

4. Summary of Guide

4.1 Information is provided on the significance of correctly decommissioning boreholes and wells at sites containing or formerly containing solid or hazardous waste or hazardous