

ANSI/ASAE EP400.3 OCT2007 (R2017)
Designing and Constructing Irrigation Wells



**American Society of
Agricultural and Biological Engineers**

STANDARD

ASABE is a professional and technical organization, of members worldwide, who are dedicated to advancement of engineering applicable to agricultural, food, and biological systems. ASABE Standards are consensus documents developed and adopted by the American Society of Agricultural and Biological Engineers to meet standardization needs within the scope of the Society; principally agricultural field equipment, farmstead equipment, structures, soil and water resource management, turf and landscape equipment, forest engineering, food and process engineering, electric power applications, plant and animal environment, and waste management.

NOTE: ASABE Standards, Engineering Practices, and Data are informational and advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. The ASABE assumes no responsibility for results attributable to the application of ASABE Standards, Engineering Practices, and Data. Conformity does not ensure compliance with applicable ordinances, laws and regulations. Prospective users are responsible for protecting themselves against liability for infringement of patents.

ASABE Standards, Engineering Practices, and Data initially approved prior to the society name change in July of 2005 are designated as "ASAE", regardless of the revision approval date. Newly developed Standards, Engineering Practices and Data approved after July of 2005 are designated as "ASABE".

Standards designated as "ANSI" are American National Standards as are all ISO adoptions published by ASABE. Adoption as an American National Standard requires verification by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by ASABE.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

CAUTION NOTICE: ASABE and ANSI standards may be revised or withdrawn at any time. Additionally, procedures of ASABE require that action be taken periodically to reaffirm, revise, or withdraw each standard.

Copyright American Society of Agricultural and Biological Engineers. All rights reserved.

ASABE, 2950 Niles Road, St. Joseph, MI 49085-9659, USA, phone 269-429-0300, fax 269-429-3852, hq@asabe.org

ANSI/ASAE EP400.3 OCT2007 (R2017)

Approved November 2007; reaffirmed November 2017 as an American National Standard

Designing and Constructing Irrigation Wells

Developed by the ASAE Irrigation Water Supply and Conveyance Committee; approved by the Soil and Water Division Standards Committee; adopted by ASAE September 1980; reconfirmed December 1985; revised February 1987; approved as an American National Standard July 1989; reconfirmed December 1991; reaffirmed by ANSI September 1992; reaffirmed by ASAE December 1992; revised as a Tentative Engineering Practice January 1994; reaffirmed by ASAE December 1994, December 1995, December 1996, December 1997, December 1998; December 1999, January 2001, December 2001; administratively withdrawn as an American National Standard September 2002; reaffirmed February 2003, February 2004; reaffirmed for one year February 2005; revised and approved as a full ASABE Engineering Practice October 2007; approved as an American National Standard November 2007; reaffirmed by ASABE December 2012; reaffirmed by ANSI February 2013; reaffirmed by ASABE and ANSI November 2017.

Keywords: Irrigation, Test, Wells

1 Purpose and scope

1.1 This Engineering Practice is intended as a guide for preparing specifications for irrigation well construction. The objective is to obtain economical wells of high productivity which are relatively sand free with a long projected life. In addition to this Engineering Practice, well design and construction should conform to all applicable local, state and federal health, safety, and other regulations.

1.2 The scope of this Engineering Practice is directed to wells constructed to obtain ground water for irrigation purposes; however, many of the details presented herein also are suitable for domestic, municipal, and industrial wells.

1.3 The pump, power unit, and irrigation systems are not part of this guide. However, because they are all interdependent, certain related factors are included.

2 Definitions

2.1 abandoned well: Well that has been decommissioned using procedures presented in clause 8, to eliminate the potential for contamination of the aquifer(s).

2.2 D_i size retained: The particle diameter such that $i\%$ (by mass) of a granular material is of larger diameter.

2.3 drawdown: The elevation of the static water level in a well minus the elevation of the pumping water level (at the well) at a given discharge.

2.4 filter pack: Sand, gravel, or fibrous materials artificially placed around a well screen or perforated casing to increase permeability near the well and prevent unwanted aquifer particles from entering the well.

2.5 pack material: Graded gravel and sand aggregates placed around a well screen to prevent infiltration of fine materials.

2.6 perforated casing: A section of commercial screen or machine perforated well casing with openings for water entry.

2.7 pump column: The pipe column through which water from well pumps is conveyed to the ground surface.

2.8 screen: An approved manufactured well casing including precisely dimensioned punches, louvers, continuous wound, stacked ring or reinforced wire-wrap designs.

2.9 specific capacity: Well discharge divided by the water level drawdown when the well has reached steady-state conditions.

2.10 stabilizer pack: Artificially placed material around a well casing as a formation and borehole stabilizer where the character of the aquifer does not require a filter.

2.11 test hole: A bore hole drilled through underground formations to map the geology of the area or to evaluate the site to determine if sufficient yield is present to meet irrigation well design requirements.

2.12 tremie: A temporary pipe used to artificially place grout or filter pack material which extends almost to the well bottom that is withdrawn as pack material is fed through it.

2.13 uniformity coefficient: The ratio of the D_{40} size to the D_{90} size of a granular material.

2.14 well abandonment: The process of decommissioning a well by sealing and filling the well bore so that contamination cannot occur between aquifers or from the land surface. Well abandonment procedures are necessary for test holes and wells no longer used.

2.15 well casing: A pipe installed within a borehole to prevent collapse of sidewall material, to receive and protect pump and pump column, or to isolate confined or under-producing aquifer zones.

2.16 well development: The process of removing fine formation materials or materials introduced during well construction from the well intake zone for the purpose of stabilizing and increasing permeability of the well intake zone.

2.17 well efficiency: Ratio of theoretical drawdown to measured drawdown. Theoretical drawdown is estimated from adjacent observation well data obtained during well test.

2.18 well decommissioning: Process of following approved governmental regulations for the placement of disinfected gravel or grout into well bore during well abandonment.

2.19 well inlet: That part of the well which has a screen or perforated casing through which water enters.

2.20 well intake zone: The portion of the well surrounding the well inlet that is modified by the well construction and development processes. This includes the space between the well inlet and the undisturbed aquifer (see 4.2 for details.)

2.21 well sealing: Process of artificially placing approved grout or filter pack material into the well annular space to prevent commingling of water between different aquifers and movement of water into an aquifer from the land surface.

2.22 well test: Determination of well yield vs. drawdown relationship with time.

2.23 well yield: Discharge rate that can be sustained from a well for some specified period of time.

3 General recommendations

3.1 Several factors are pertinent to irrigation well construction but are separate from the immediate design and construction details. The following factors should be included in the written contract(s):

3.1.1 Location and scope of work. The location of the proposed irrigation well work should be expressed as accurately as possible and practical. An accurate map of the well site should be drawn. The extent of the work should be clearly described with the understanding that the exact conditions under the ground surface are not completely known prior to commencement of work. It may be advisable to have separate contracts for test hole drilling and for the irrigation well itself since irrigation well specifications and contract should not be completed until test hole data have been analyzed.

3.1.2 Permits, licenses, and registration. All applicable governmental regulations regarding permits, licenses, and registration should be satisfied. A determination of who has the responsibility to furnish necessary information, submit the required forms to the proper agencies, and secure the appropriate documents should be made.

3.1.3 Insurance, health, and safety requirements. Adequate liability, personal, workman's compensation, and property insurance for drilling operations and a healthy and safe working environment should be maintained.

3.1.4 Access to the well construction site. After the final decision on exact location of site(s) is made, access to this land with sufficient working space for the drilling operations shall be granted.

3.1.5 Obstructions. The site should be investigated prior to start of drilling and the owner informed of any hazards or obstructions, such as overhead power lines, buried cables, and buried pipes, which may affect the location of the test or production well. Any known underground obstructions not readily visible should be identified.

3.1.6 Water supply for drilling. The source of the water for drilling and who is responsible for it should be clearly understood. The water should be analyzed for possible contaminants prior to use.

3.1.7 Records. A copy of the completed well construction details, well log, development record, and well test data and an "as-built drawing" should be supplied to the owner and appropriate governmental agency.

The information provided shall include:

- Global Position System coordinates of the well site;
- type and diameter of casing;
- length, diameter, and position of the screen;
- filter pack particle size analysis;
- position and intervals of annular space filter pack and grout seals or stabilizer blocks;
- the diameter of the well bore.

3.1.8 Water-level measurement access. When the permanent pump is installed in the well after completion, a sealed access to the well casing should be provided to allow future water level measurements. It is recommended that a permanent air or sounding tube be installed at the time the pump is set (see 9.3.1 for details).

4 Design

4.1 Test holes. Aquifers vary in areal extent, thickness, and composition. Several test holes may be required to locate a suitable aquifer(s) and obtain formation and water samples.

4.1.1 Number and location of test holes. The number of test holes required to properly select a production well location usually cannot be precisely determined before test drilling begins. Therefore, as the work