United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WATER WELL

CODE 642

(no)

DEFINITION

A hole drilled, dug, driven, bored, jetted, or otherwise constructed into an aquifer for agricultural water supply.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Address the need for adequate livestock water quality and quantity
- Provide water for terrestrial wildlife
- Provide irrigation water

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all types of agricultural land where the quality and quantity of underground water is appropriate for the intended purpose.

This practice does not apply to—

- Wells constructed for domestic or public water supply.
- Monitoring wells, NRCS Conservation Practice Standard (CPS) Monitoring Well (353), injection wells, temporary test wells, or piezometers.
- Pumps, surface supply lines, storage facilities, and related appurtenances.

CRITERIA

General Criteria Applicable to All Purposes

Law and regulations

The investigation, design, and installation of an agricultural water supply well must comply with all applicable governmental regulations, laws, permits, licenses, and registrations according to NRCS Title 450, General Manual (GM), Part 405, Subpart A, "Compliance with Laws and Regulations." Follow Kentucky Revised Statutes (KRS) 223.400 through 223.460 and 223.991 and current Kentucky Administrative Regulations (KAR) 401 and KAR 6:310 Section 12. Where applicable laws and regulations do not exist, follow industry standards, such as—

- A proposed well must comply with criteria in the current version of American Water Works Association (AWWA), A100-15, "Water Well Standard."
- A proposed irrigation well must comply with criteria in the current version of American Society of Agricultural and Biological Engineers (ASABE or ASAE) EP400.3, "Designing and Constructing Irrigation Wells."

- The well design and installation must comply with criteria in the current version of National Ground Water Association (NGWA) 01, “Water Well Construction Standard.”

Roles and responsibilities
Licensed water well driller is responsible for drilling and installing the water well, according to State regulations.

The landowner is responsible for obtaining all necessary permits, rights, or approvals according to NRCS 450-GM-405 and applicable laws, rules, and regulations.Well-drilling contractors are required by the State to be licensed through the Kentucky Division of Water (DOW) Groundwater Branch. Well drillers must pass an examination before they can apply for a license from the DOW Groundwater Branch. Landowners are responsible for checking with the DOW Groundwater Branch to verify that their selected well driller holds a current license.

The landowner and/or licensed contractor are responsible for locating all buried utilities in the project area, including drainage tiles and other structural measures.

Site suitability
Use reliable local experience, and review all relevant geologic maps, reports,such as the Kentucky Groundwater Atlas, the Hydrologic Index maps and the county groundwater reports published by the Kentucky Geologic Survey; well records maintained by Kentucky Division of Water Groundwater Branch, Kentucky Geological Survey, the local county health department, and Federal agencies. Review design, construction, and maintenance records of nearby wells to evaluate ground water and help determine whether groundwater is available in sufficient quantity and of the desired qualityfor the intended use. If local hydrogeologic data are limited or if conditions are complex and uncertain, use additional expertise to conduct onsite evaluation to provide professional recommendations regarding the suitability of the site.

Locate the well according to the Occupational Safety and Health Administration (OSHA) Standard 1926.1408 (h), “Power line safety (up to 350 kV)–equipment operations” to comply with setback distances from overhead or underground utility lines or other safety hazards.

Locate the well away and upgradient from potential surface and subsurface contamination or pollution and areas subject to flooding, according to State regulations. In determining hydraulic gradient, consider both pumped and static water levels.

Laterally locate the well to comply with applicable conservation practice standards and State-specific water well setback zones and prohibitions.

Locate wells a safe distance from known sources of contamination. Consider the details pertaining to local water wells, such as depth, type of construction, and vertical zone of influence, together with data on the geological formations and porosity of subsoil strata when determining the safe allowable distances.

The recommended minimum distance between water supply and source of contamination is:

Description of Potential Contamination Source	Minimum Distance (ft)
Waste Storage Facilities	300
Waste Treatment Lagoons	300
Cesspool	150
Livestock and poultry yards	100
Silo pit, seepage pit	150
Septic tanks	50
Disposal fields	100

Clear the site of all trees, brush, and obstructions. Locate the drill rig, related equipment, and the well on relatively flat, reasonably dry, working surface for a safe and effective working environment.

Wellhead protection
Divert all surface runoff, precipitation, and drainage away from the wellhead. At the wellhead, compact, mound, and slope earth material away from the wellhead.

Protect the wellhead and associated appurtenances from contamination or damage by wildlife, livestock, farm machinery, vehicle parking, or other harmful human activity.

Locate the well at least 100 feet from potential sources of surface and subsurface pollution. The allowable distance shall be based on consideration of site-specific hydrogeologic factors and shall comply with requirements of all applicable Kentucky Department of Health, local regulations or construction codes.

Grouting and sealing the casing
When drilling into hard rock formations or physically stable geologic materials, install a minimum of 10 feet of casing.

For erodible, friable, or otherwise unstable materials, install watertight grouted casing throughout, except for the intake portions.

Install a watertight seal in the annulus of all well casing. Acceptable sealants include mortar containing expansive hydraulic cement, bentonite-based grout, bentonite chips and pellets, sand-cement grout, neat cement, or concrete, in accordance with State requirements. The acceptable the length of the grout seal is no less than 10 feet and no less than the minimum specified in state or locally applicable construction codes.

If one or more zones are encountered that produce water of unacceptable quality, use grout or packers to prevent commingling of waters or cross-contamination of aquifers.

Use sealant, packers, or similar retaining device to isolate one or more aquifers or zones that produce poor ground water quality to prevent commingling or cross-contamination. Provide a similar positive seal to separate water-bearing zones where commingling of waters is not desirable.

For artesian wells (flowing and nonflowing), grout the casing and geologic units directly above and below the aquifer to retain its confining pressure.

When casing extends to the borehole bottom, install a watertight end cap or grout seal to prevent entry of geologic material. For designs requiring telescoped screen assemblies, install one or more sand-tight seals between the top of the telescoped screen assembly and the casing.

Do not design maximum drawdown to reach the top of the highest screen or pump intake.

After well completion, provide a suitably threaded, flanged, welded cap, or compression seal to prevent entry of contaminants into the well.

The casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions from the outside of the casing to prevent contamination. The slab shall slope away from well.

Casing materials
Acceptable materials for casing include steel, iron, stainless steel, copper alloys, plastic, fiberglass, concrete, or other material of equivalent strength, which have sufficient chemical resistance to the ground water for the design life of the well. To prevent galvanic corrosion, do not join dissimilar metals. Select a casing diameter to permit satisfactory installation and efficient operation of a submersible pump, if used. Typically, the casing diameter should be a minimum of 2 inches larger than the maximum outside diameter of the pump and pump column.

Select casing material that can withstand all anticipated static and dynamic pressures imposed on the casing while maintaining a watertight seal during installation, well development, and use throughout the design life of the well. When needed, mechanically support casing during installation to maintain joint integrity. Refer to NRCS National Engineering Handbook (NEH) (Title 210), Part 631, “Geology,” for guidance in determining proper differential head limitations for approved casing materials.

Screen and filter pack
Screen slot size and filter pack (artificial or natural) must conform to the characteristics listed in ASTM D5092, “Standard Practice for Design and Installation of Groundwater Monitoring Wells” and ASTM D6725, “Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers.” Use only manufactured well screen that consists of corrosion-resistant material.

Install a well screen and filter pack (artificial or natural) if any of the following conditions exist:

- Presence of a poorly graded, fine sand aquifer or heaving or caving sands;
- Presence of a highly variable aquifer, such as alternating sand and clay layers;
- Presence of a poorly cemented sandstone or other loosely compacted material;
- Requirement for maximum yield from a low-yielding aquifer;
- Hole drilled by reverse circulation.

Refer to ASTM D5092 for filter pack quality criteria and filter pack and well screen slot size compatibility with formation rock and soil.

Use a prepacked well screen for horizontal, vertical, or angled wells. Use an artificial filter pack if natural filter pack is unavailable.

If acceptable filter materials are unavailable, use a commercially manufactured, prepacked well screen. A prepacked well screen consists of inner and outer screens that contain the engineered filter material. The material must meet the following quality criteria:

- Less than five percent fines (the proportion that passes the number 200 sieve);
- Predominantly rounded, dense, siliceous materials;
- No angular particles, such as crushed rock, or flat particles, such as mica;
- No earthy or soft materials, such as clay, shale, silt, gypsum, or anhydrite;
- No organic matter, no other impurities or metallic substances;
- No material soluble in hydrochloric acid, such as limestone.

Screen and filter pack installation
Position the well screen according to the depth of the water-bearing zone(s) below the ground surface and the thickness of the water-bearing zone penetrated by the drill hole. Install a conventional filter pack from the bottom up and place in a manner that avoids segregation and bridging of particles. Install filter pack according to NRCS 210-NEH-631, and ASTM D5092.

When bentonite seals are allowed, hydrate bentonite to facilitate expansion and fill voids. Hydrate bentonite according to manufacturer’s recommendations.

Screen perforation by any method is allowable with the following provisions:

- For uniform size aquifer material, screen openings are smaller than the average diameter of aquifer material;

- For non-uniform aquifer material, screen openings are smaller than 60 percent of the aquifer material;
- Screen openings, for filter/gravel pack must exclude at least 85 percent of the filter pack material;
- Size the length and open area of the screen to keep entrance velocity or shear stress below the threshold for erosion of filter pack particles and transport into the well;
- Casing must not be functionally weakened or deformed.

For a screened well cased to the bottom of the well, install several extra feet of blank screen or casing at the bottom of the well to accommodate sediment that passes through the well screens and settles to the bottom of the well.

Access port
Install an access port with a minimum diameter of 0.5 inch to allow for unobstructed measurement of depth of the water surface, or for the installation of a pressure gage for measuring shut-in pressure of a flowing well.

Seal or cap access ports, pressure gages, and all other openings in the well cover to prevent entry of unwanted materials and to discourage tampering. A removable cap is acceptable for an access port.

Well development
After completing well construction, but before conducting well performance (aquifer) tests, develop the well to remove fines, drill cuttings, mud, drilling fluids, and additives. Well development is required for all water wells. For screened zones, the development technique must collapse sand bridges and remove fines outside the screen. Following the development process, remove accumulated sediment at the bottom of the well bore by bailing or pumping. Pump the well at approximately 120 percent of the anticipated normal production rate until suspended sediment and associated turbidity clears. Do not use the permanent pump to conduct any well development work. Refer to NRCS 210-NEH-631.32 and ASTM 5521 “Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers” for well development procedure.

Water quality testing
If local water quality conditions are unknown or questionable, test the well water using parameters that pertain to well performance or the suitability of the water for its intended usage. Test well water according to NRCS CPS Groundwater Testing (355).

Disinfection
Prior to final chemical disinfection, remove foreign substances, such as grease, soil, sediment, joint dope, and scum from the well and near the wellhead. Clean all pump parts before placing them into the well. Disinfect the well using a chlorine compound at a concentration of a minimum 50 mg/L (50 ppm).

Well performance (aquifer) testing
Design the well so at maximum drawdown, the water surface does not drop to the top of the highest screen or pump intake. Wait no less than 24 hrs after well development is completed and the water level has stabilized, to conduct a pumping test for determining specific capacity and dynamic water levels. Refer to NRCS 210-NEH-631 and 210-NEH, Part 650, Chapter 12, Section 650.1205, “Wells” for guidance on conducting, recording, and analyzing pumping tests.

Discharge water a minimum of 300 feet from the well and in such a way that reduces erosion to the land surface and prevents potential artificial recharge during the test.

Take all measurements from the top of well casing.

CONSIDERATIONS

Consider the following when planning and designing a water well:

- Evaluating the potential for adverse interference with existing nearby production wells when planning and designing the water well
- Health impacts of nitrates in groundwater used for livestock consumption. In areas of nitrogen fertilizer use, consider checking with the local Health Department for excess nitrogen levels in ground water
- Health impacts of ground water mineral content used for irrigation or animal watering. Minerals contained in ground water, such as selenium, sodium, sulfate, and others have the potential to negatively impact soil, plant and animal health
- For (aquifer) testing, consider the potential for ground water overdraft and the long-term, safe aquifer yield

PLANS AND SPECIFICATIONS

Develop plans and specifications that clearly describe requirements for applying the practice to achieve its intended purposes. If not already specified in the documentation required by the State regulatory authority, record the following information in the installation record:

- Location of water well by Global Positioning System (GPS) coordinates or in a sufficiently detailed narrative description to readily locate the well.
- Name of well owner.
- Type of casing material or schedule, and whether new or used.
- Height of casing extending aboveground surface.
- Static water level measured from top edge of casing or from ground surface.
- Well diameter, total well depth, and screened depth/interval.
- Notification of whether aquifer is artesian or non-artesian. If well is flowing artesian, provide flow rate and pressure.
- Screen slot size and filter gradation (if used).
- Drilling method and bore hole diameter.
- Well development methods used.
- Results of pump test, including length of test, stability of water level, pumping rate, specific capacity after water level had stabilized, and well efficiency.
- Driller’s log for water-bearing and dry holes.
- If water quality was tested, record the parameters and test results, date of sampling, name of person who took sample, and name of laboratory that conducted tests.
- Schematic drawing of well construction showing well diameter and depth, casing and liner diameters, fill, bentonite, or grouting surface elevation, and top of well head elevation.
- Disinfection method and solution used, and date the well is disinfected.

OPERATION AND MAINTENANCE

Prepare a site-specific plan for operation and maintenance of the water well. The owner is responsible for keeping and maintaining well construction records with the maintenance plan. The owner must ensure periodic inspection of the well for proper functioning and water quality.

Do not store or mix agricultural chemicals, such as fertilizers and pesticides, or rinse containers within a 100-foot radius of the wellhead.

Regular inspection must include conditions that affect well performance, based upon the well’s intended use. As a minimum, these conditions include—

- Declines in discharge, static level, maximum pumping level, and pressure (for artesian wells) that are outside acceptable limits for the well design.

- Appearance of sediment that may damage the well, pump, or appurtenances.
- Changes in water quality including odor, color, taste, and chemistry.
- Presence of algae or iron bacteria.

For wells that have blank casing installed below the screen, periodically bail or flush the well to remove excessive, accumulated sediment.

In the maintenance record, include statements describing identified problems, corrective action taken and date, and specific capacity of well before and after corrective action. The owner must remedy unacceptable conditions in a timely manner.

In the event the well becomes unserviceable, it may be decommissioned according to the Kentucky NRCS CPS Well Decommissioning (351).

REFERENCES

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