Water Well (NO) 642

DEFINITION

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

PURPOSES

- *Provide water for livestock, wildlife, irrigation, and other agricultural uses*
- *Facilitate proper use of vegetation, such as keeping animals on rangeland and pastures and away from streams, and providing water for wildlife*

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all land uses where the underground supply of water is sufficient in quantity and quality for the intended purpose.

This practice applies only to production *water* wells. Specifically excluded are any types of wells installed solely for monitoring or observation purposes; injection wells; and piezometers.

The standard does not apply to pumps installed in wells. Refer to NRCS practice standard Pumping Plant for Water Control (533) for pump requirements and installation. The standard does not apply to above ground installations, such as pumping plants, pipelines, and tanks; temporary test wells; and decommissioning of wells (*refer to NRCS practice standard Water Well Decommissioning (351*)).

Water well construction and pump installation practices are regulated in Michigan by the State Well Code. This conservation practice standard may be used as an adjunct to, but not as a replacement for, the State Well Code. Deviation from the provisions of any well construction rule must be approved by the county or district health department.

CRITERIA

Water wells shall be planned, designed, and installed in accordance with all federal, state, local, and tribal laws and regulations.

Local ordinances may require that a permit be obtained from the county or district health department before constructing a well for conservation purposes.

Suitability of Site. The availability of ground water for its intended use at the site shall be determined by using reliable local experience and reviewing all available relevant geologic maps and reports; well records maintained by state and federal agencies; and design, construction, and maintenance records of nearby wells. An appropriate level of investigation, including test well drilling, is conducted on-site, as needed, prior to well construction to determine site-specific hydrogeologic conditions.

The site shall be suitable for safe operation of the drilling equipment.

Well Head Protection. Wells shall be located at safe distances from potential sources of pollution, including unsealed abandoned wells. The allowable distance shall be based on consideration of site-specific hydrogeologic factors, and shall comply with requirements of all applicable state or local regulations or construction codes.

Surface runoff and drainage that might reach the wellhead from potential areas of contamination, such as those used by livestock, shall be diverted.

Refer to NRCS practice standards Agrichemical Containment Facility (702) and Waste Storage Facility (313) for separation distances between water wells and these facilities.

Wells shall be located a safe distance from both overhead and underground utility lines and other safety hazards.

Borehole. Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and of adequate diameter to permit satisfactory installation of inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used.

Use of Casing. Casing shall be installed to seal out undesirable surface water or shallow ground water and to support the side of the hole through unstable earth materials. The intake portion of a well through stable geologic materials may not require casing.

Casing Diameter. Casing diameter shall be sized to permit satisfactory installation and efficient operation of the pump, and large enough to assure that uphole velocity is 5 feet per second or less *for the designed discharge* to protect against excessive head loss.

Materials. Casings may be of steel, iron, stainless steel, or plastic of strength and durability consistent with the intended use of the water, and the maximum anticipated differential head between the inside and outside of the casing.

Steel well casings shall meet or exceed requirements specified in ASTM A 589. Steel pipe manufactured for other purposes may be used if the quality of the pipe conforms to either ASTM A 589.

Only steel pipe casings shall be used in driven wells.

To prevent galvanic corrosion, dissimilar metals shall not be joined.

Plastic casings shall be made of polyvinyl chloride (PVC) and shall conform to material, dimensional, and quality requirements specified in ASTM F 480.

Plastic pipe manufactured for water or irrigation pipelines may be used if the quality equals or exceeds requirements specified in ASTM F 480.

Casing Strength. Well casing wall thickness shall be sufficient to withstand all anticipated static and dynamic pressures imposed on the casing during installation, well development, and use. Required casing strength shall be determined as shown in NEH, Part 631, *Chapter 32, Well Design and Spring Development.*

Joint Strength. Joints for well casings shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen. Well screens shall be installed in any aquifer material likely to produce silt or sand. Well screens may be constructed of commercially manufactured screen sections, well points, or field-perforated sections.

The screen shall be constructed with the slot width determined from aquifer samples. Perforation by any method is allowable provided proper slot size and entrance velocity limits can be met. Screen open areas can range from 1 percent for field-perforated screens to 25 percent or more for continuous wire-wrapped screens. To assure good well efficiency, open areas should be designed to approximate aquifer porosity. High open area percentages also make well development more effective. The length and open area of the screen shall be sized to limit entrance velocity of water into the well to less than or equal to 0.7 foot per second.

Depth of the aquifer below ground surface and the thickness of aquifer to be penetrated by the well shall govern the position of the screen in the well.

Maximum drawdown shall not be permitted below the top of the highest screen or pump intake.

Seals (Packers). Telescoped screen assemblies shall be provided with one or more sand-tight seals between the top of the telescoped screen assembly and casing.

Filter Pack. Installation of a filter pack around the well screen shall be considered under the following conditions: presence of a poorly graded, fine sand aquifer; presence of a highly variable aquifer, such as alternating sand and clay layers; presence of a poorly cemented sandstone or similar aquifer; a requirement for maximum yield from a low-yielding aquifer; and holes drilled by reverse circulation.

Pre-packed Well Screens. For heaving or caving sands, silty or fine-grained aquifers, and horizontal or angled wells, a commercial pre-packed well screen may be substituted for a conventionally installed (by tremie) filter pack.

Installation. Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

All wells shall be cased to a sufficient height (minimum of 12 inches) above the ground surface to prevent entry of surface and near-surface water.

Casing for artesian aquifers shall be sealed into overlying, impermeable formations in such a manner as to retain confining pressure.

If a zone is penetrated that is determined or suspected to contain water of quality unsuitable for the intended use, the zone shall be sealed to prevent infiltration of the poor quality water into the well and the developed portion of the aquifer.

Well Development. Well development shall be performed to repair damage done to the formation by the drilling process, and to alter the physical characteristics of the aquifer surrounding the borehole so that water will flow more freely to the well.

The method of well development used shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development. For massive, unfractured rock that is unresponsive to well development procedures, the use of aquifer stimulation techniques may be considered to improve well efficiency and specific capacity *upon written approval from the health officer*. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation.

Grouting and Sealing. The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with mortar containing expansive hydraulic cement (ASTM C 845), or bentonite-based grout. The length of the grout seal shall be no less than 10 feet and not less than the minimum specified in state or locally applicable construction codes.

A positive seal (grouted in place) or packer shall be provided between the casing and the less pervious material overlying the aquifer of artesian wells, and in all aquifers where co-mingling of waters is undesirable.

Access Port. An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Disinfection. Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, or surface drainage introduced during construction. The disinfection process shall comply with all local or state requirements.

Water Quality Testing. Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water.

CONSIDERATIONS

Consider the potential for adverse interference with existing nearby production wells.

Consider the potential for ground water overdraft and the long-term safe yield of the aquifer.

If practicable, locate wells in higher ground and up gradient from surface sources of contamination or flooding. In determining gradient, consider both pumped and unpumped conditions.

Consider the potential effects of installation and operation of water wells on the cultural, archeological, historic, and economic resources.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Conservation Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey
- Design records
  - Physical data, functional requirements, and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations

- Construction drawings/specifications with:
  - Location map
  - "Designed by" and "Checked by" names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Conservation Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable
- Record of approvals of in-field changes affecting function and/or job class, where applicable
- Well isolation distance documentation, where appropriate

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.

REFERENCES

Michigan Water Well Construction and Pump Installation Code, Ground Water Quality Control, Part 127 - Act 368 of the Public Acts of 1978, as amended, Rules 101-161.

National Engineering Handbook, Part 631, Geology, *Chapter 32, Well Design and Spring Development*.