UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
ARIZONA

CONSTRUCTION SPECIFICATION CS642
WATER WELL

1 SCOPE

The work shall consist of installing and developing water well for livestock use and irrigation purposes pursuant to conservation practice standard 642. Materials specification for the installation of this practice is covered in MS642 and is attached as an appendix to this specification.

2 PERMIT AND NOTIFICATION

Before any construction work begins, the owner/contractor shall obtain the necessary permit for drilling a well from the Arizona Department of Water Resources (ADWR). Pursuant to ARS § 45-596, the owner shall also file a Notice of Intent to Drill with the ADWR.

3 SITE PREPARATION AND LOCATION

After receiving the geologic report, if required for the project, clear all trees, brush, and obstacles from the well site prior to setting the drill rig. The area immediately surrounding the well site shall be smoothed and graded to allow for a safe and relatively dry working area. The well site shall not be located within 100 feet of any septic tank system or sewage disposal area. It shall also have a minimum 100 feet separation from any landfill, hazardous waste facility or storage areas for such materials and underground storage areas of petroleum products unless authorized in writing by the Director of ADWR.

4 INSTALLATION

4.1 Drilling: Only clean, potable water shall be used in drilling fluids whether employed alone or in combination with drilling additives. Whenever there is an interruption of work on the well, such as overnight shutdown, during inclement weather, or periods between testing, et cetera, the well opening shall be covered and secured (by tack welding or other acceptable means) to ensure the public safety, prevent damage to the well, and prevent introduction of unwanted materials into the well. The contractor is responsible for any objectionable material that may fall into the well and any effect it may have on water quality or quantity until completion and acceptance of the work by the land operator and NRCS.

All alloys/materials containing lead, and paints and coatings containing lead or mercury, shall be strictly prohibited from introduction into any new or existing water well.

4.2 Joining: To prevent galvanic corrosion, dissimilar metals shall not be joined or appropriate protective measures as recommended by the supplier/manufacturer shall be implemented.

4.3 Well Diameter: The diameter of the well shall be adequate to meet the yield capacity of the formation in relation to the nature and extent of the water bearing area and to permit the installation of a pump to deliver the needed amount of water to the projected lift elevation. The inside diameter of the casing shall be as shown in the approved construction plan. The well diameter shall provide for adequate annular space to permit the placement of the filter pack, if needed.

4.4 Alignment: Drilled vertical wells shall be round, plumb and aligned to permit satisfactory installation and operation of a pump of the proposed size and type to the greatest anticipated depth of setting. Additional information on well alignment and tolerance can be found in AWWA standard A100, section 4.7.9. If there is any concern for plumbness and alignment, information provided in Appendix D of AWWA standard A100 may be used to test for the same.

4.5 Casing: Casing and joints shall be of sufficient strength and wall thickness to hold the borehole open and survive any grouting work and to support the load of the casing material. The first 20 feet of the casing shall be steel casing and extend a minimum of 12 inches above ground level. All casing and joints shall be made continuous and watertight from the top to the bottom of installation (except well screens) to maintain the quality of the water. In a two-ply casing, any annular space between the outer casing and the inner casing shall be completely sealed to prevent contamination of the well. The well may be drilled up to an additional 20 feet below the bottom of the casing to act as a sump for collecting fines.

4.6 Screens: Screens can be (i) punched or louvered pipe screens, (ii) wire-wound continuous slot screens or (iii) perforated pipe base screens. Screen diameter shall be such that a vertical velocity of less than 5 feet/sec will always be maintained within the screen barrel. If the pump setting is anticipated to be within or below the screen, minimum inside diameter of screen shall be per Table 3 of AWWA standard A100. Joints between screen sections and blank casing shall be welded or threaded and coupled.

Pre-packed well screens shall consist of an inner and outer screen, which are completely filled with uniform, well-rounded, pre-washed grains of silica sand of a specified gradation. The screen slot size shall be based on a sieve analysis of the water-bearing aquifer materials; the slot size shall retain 100 percent of the filter pack's minimum size designation. No minimum annular space is required for a pre-packed well screen if its outside diameter is equal to or less than the casing to which it is attached. Perforation by any method is allowable with the following provisions:

- Screen openings, for uniform size aquifer material, are smaller than the average diameter of the aquifer material,
- Pipe is not damaged,
- Screen openings, for non-uniform aquifer material, are smaller than 60 percent of the aquifer material,
- Screen openings, for filter/gravel pack will exclude at least 85 percent of the filter pack material,
- Length and open area of the screen can be sized to limit average entrance velocity of water into the well to less than or equal to 0.1 foot per second, and
- The required strength can be maintained.

The position of the screen in the well shall be determined by the depth of the aquifer below the ground surface and the thickness of aquifer to be penetrated by the well. The top of the screen shall be located below the lowest water level expected in the well. Well screens should be plugged at the bottom either by a plate made of the same material as the screen or by a self closing valve. The plate can be welded or threaded.

4.7 Filter/Gravel Pack: Filter pack material shall be carefully placed to prevent segregation and should extend a minimum of 10 feet above the top of the highest screened or perforated section and should extend through the entire length of the water-bearing formation penetrated by the well.

For naturally developed wells in which the screen is placed in direct contact with aquifer materials, the screen slot size should be based on the D40 size of the aquifer materials, so that 60 percent of the material

can pass and 40 percent will be retained. The D50 size is acceptable if the water is highly corrosive, or if there is doubt about the reliability of the sample. For wells in which a filter pack is used, the screen slot size should be such that 90 percent or more of the filter material is retained. The length and open area of the screen should be sized to restrict the entrance velocity of water into the well to less than or equal to 0.1 ft/sec.

Commercial pre-packed well screens may be substituted for a conventionally installed filter pack if one of the following conditions applies:

- Heaving or caving sands are present;
- The aquifer is silty or fine-grained;
- The well is horizontal or angled; or
- Appropriate materials are not available for a conventional filter/gravel pack.

Filter/Gravel pack can be installed by using any one of the methods listed in Appendix B of the AWWA standard A100. The contractor shall select the method best suited for the specific site conditions. When a gravel pack is installed, the annular space between the outer casing and the inner casing shall be sealed. Sealing can be achieved either by welding a cap at the top or by filling with cement grout from the bottom of the outer casing to the surface.

4.8 Grouting and Sealing: In constructing and developing a well, the contractor shall take all reasonable precautions to protect the production aquifer from contamination by drilling materials. All foreign materials, such as drilling fluids, filter cake, lost circulation materials or any other organic or inorganic material introduced into the aquifer during well construction shall be removed when the construction is completed.

The annulus surrounding the permanent well casing at the upper terminus of the well shall be filled with expansive hydraulic cement (ASTM C 845), shrinkage-compensating concrete, bentonite based grout, clay, or other material with similar sealing properties. The length of the grout seal shall be at least 19 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. A similar positive seal shall be provided to separate aquifers where co-mingling of waters is undesirable.

A packer or similar retaining device, or a small quantity of sealant that is allowed to set, shall be placed at the bottom of the interval to be sealed before final sealing operations begin to form a foundation for the seal.

4.9 Surface Seal: On completion, each well shall be provided with a surface seal which will consist of a steel casing, with 12 inch extended above the ground level and grouted with continuous cement grout from the bottom of the grout zone to the surface of the land. The minimum annular space between the casing and the borehole for placement of grout shall be one and one half inches.

If the water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions

Grouting and sealing can be installed by any one of the methods listed in Appendix C of the AWWA Standard A100. The contractor shall select the method best suited for the specific site conditions.

4.10 Foundation and Transition Seals: A transition seal shall be placed in the annular space to separate filter pack and cement-based sealing materials. The top of the transition seal shall be measured to ensure that no bridging has occurred during placement.

4.11 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.

4.12 Access Port: Every well shall be constructed with an opening of at least ½ inch in diameter in the casing and at least 12 inches above ground level, to allow a water level measuring line to be inserted between the outside casing and the pump column. A removable cap shall be provided for such openings.

4.13 Testing of Well: A non-flowing well shall be tested for its pumping capacity in gallons per minute. The pumping capacity shall be measured by the discharge of the pump after continuous operation for at least four (4) hours. For a flowing well (see special aquifer condition in section 7), the pumping capacity shall be measured as the natural flow at the land surface, averaged over four (4) hours.

4.14 Water Quality Testing: If required by the NRCS and/or the landowner, water quality testing for well water shall be per Conservation Practice Standard 355.

4.15 Capping/Abandonment of Open Wells: If the drilling of a well site results in a non producing well or a so called dry hole, the contractor shall either install a cap on the well per Arizona Administrative Code, Title 12, Chapter 15, Article 8, Section R12-15-822 or abandon the well in compliance with ADWR requirements. Abandonment of a well is covered in the Conservation Practice Standard 351, "Well Decommissioning". The contractor shall also comply with the requirements in the "Well Abandonment Handbook" published by ADWR and made an integral part of Practice Standard 351. If the requirements in Practice Standard 351 and ADWR Handbook are in conflict, the more restrictive requirement shall govern.

Appendix H of AWWA standard A100 provides additional information on the decommissioning of test holes, partially completed wells, and abandoned completed wells.

5 WELL AND AQUIFER DEVELOPMENT

Wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers. The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

For massive, un-fractured rock formations unresponsive to water well development procedures, the use of aquifer stimulation techniques may be considered in order to improve well efficiency and specific capacity. Depending on the composition and structure of the formation, techniques may include dry ice, acid, explosives, or hydro fracturing.

Upon completion of the well and before conducting the yield and drawdown tests, the contractor shall develop the well to remove fines, drill cuttings, drilling fluids, and additives deposited on the borehole face and in adjacent portions of the aquifer during the drilling process. If organic drilling fluids are used, they must be broken down chemically according to the manufacturer's recommendations before or during development.

After aquifer development is complete, the accumulated sediment shall be removed from the bottom of the well bore by pumping or bailing. The well shall be developed at 120 percent normal anticipated production until it stops producing excessive quantities of solid particles. The permanent pump shall not be used for either of these purposes.

Section 4.8 and Appendix E of AWWA standard A100 provide additional information Well Development.

6. DISINFECTION

All water wells shall be disinfected immediately following their construction or repair to remove bacteriological contamination that may be unsafe for consumption by livestock. Prior to final disinfection, the well shall be cleaned thoroughly to remove all foreign substances, such as grease, soil, sediment, joint dope, and scum. All pump parts shall be thoroughly cleaned before being placed in the well. Surfaces of all components above the static water level as well as the entire pumping system, and all storage tanks, pipes, faucets, valves, and hydrants must be flushed or washed down with a sterilizing solution.

Disinfection of well water shall be in accordance with the procedures prescribed in AWWA standard C654. Sampling and testing shall be per ASTM D 6771.

7. SPECIAL AQUIFER CONDITION (ARTESIAN WELL)

Construction of artesian wells shall be in accordance with Arizona Administrative Code, Title 12, Article 8, Section R12-15-812 “Special Aquifer Conditions” which is incorporated by reference in this specification.

8. OTHER REQUIREMENTS

The owner/contractor shall comply with the following additional requirements to be in compliance with A.R.S. Title 45, Chapter 2, Article 10 and the rules adopted by ADWR.

a. The contractor undertaking the well construction work must have a current and active well drilling license issued by ADWR.

b. The well drilling operation shall be under the direct supervision of a qualified representative of the well drilling contractor.

c. The drill rig shall not be removed from the well site unless one of the following two conditions is satisfied:

   i. The well is constructed in full compliance with the Arizona Administrative Code, Title 12, Article 8, Section R12-15-811 and R12-15-812 with either a sealed cap or equipped with a pump, or

   ii. The well is abandoned in compliance with Arizona Administrative Code, Title 12, Article 8, Section R12-15-816.

d. The well shall not be used as a storage or disposal site for sewage, or other toxic materials that have potential for polluting the ground water.

e. The owner/contractor shall provide a Notification of Well Drilling Commencement to the ADWR in accordance with the Arizona Administrative Code, Title 12, Article 8, Section R12-15-851.

f. When the construction is completed, the owner shall file a well completion report with the Director of ADWR pursuant to A.R.S. § 45-600(B).

g. For wells drilled in tribal areas, the owner/contractor shall obtain all necessary permits for well drilling from the respective tribal administration and also comply with other requirements before and after the drilling of the well.

9. MEASUREMENT

This work shall be complete according to these specifications and shall include all necessary materials for service and operation of this Practice. Necessary components to the completion of this practice includes and are not limited to; disinfection, sampling, water quality testing, grouting, sealing, well caps and all other materials and labor used to install the well.

The final well depth shall be as determined by the well driller. Depth of the well shall be equivalent to 150–feet below the draw down level which is established at the end of a 24 hour pump draw down test. Discharge rate for the pump test shall correspond to the designed well production rate.

10 ITEMS OF WORK AND CONSTRUCTION DETAILS FOR THIS PROJECT: