United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

MONITORING WELL

CODE 353

(no)

DEFINITION

A well designed and installed to obtain representative ground-water samples and hydrogeologic information.

PURPOSE

This practice is used to accomplish the following purposes.

- Provide controlled access to groundwater for measuring~~sampling~~ ground-water levels for groundwater depletion or groundwater recharge.
- ~~-~~Provide controlled access to groundwater for~~and sampling~~ groundwater quality sampling for nutrients, pesticides, salts, petroleum, heavy metals, pathogens and chemicals from manure, bio-solids, or compost applications.
- Detect seepage from possible contamination sources such as animal waste structures.
- Monitor groundwater quality and/or water levels over~~through~~ time.
- Monitor groundwater seepage through dams and embankments.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to the design, installation, and development of a monitoring well~~s~~ to monitor~~near components of an~~ agricultural waste management systems or other possible sources of groundwater contamination, groundwater levels for groundwater recharge, or seepage through an embankment or dam~~.~~

This practice does not apply to—

- Methods for developing a ground-water monitoring plan.
- Methods for collection of ground-water samples.
- Analysis or interpretation of laboratory test results.
- Monitoring of subsurface waters solely in the vadose (unsaturated) zone.

- Installation of wells for any other purpose.
- Temporary exploratory drill holes.

CRITERIA

General Criteria Applicable to All Purposes

~~Permits~~Laws and Regulations

Plan, design, and construct this practice to meet all federal, state, and local laws and regulations. The ~~landowner~~ landowner is responsible for obtaining all necessary permits for the work prior to construction.

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

Roles and responsibilities

A licensed well driller who is trained and equipped to safely install monitoring wells, decontaminate reusable equipment, and properly dispose of waste materials must do the work.

The licensed well driller is responsible for submitting the appropriate documentation to all applicable government entities.

Hydrogeologic Ssite Cc~~c~~haracterization

Use guidance provided in the ASTM ~~International, (ASTM)~~ D5092/D5092M, "Standard Practice for Design and Installation of Groundwater Monitoring Wells," and Title 210 National Engineering Handbook, Part 631, "Groundwater Investigations" ~~-~~to conduct surface and subsurface investigations within the area of concern prior to the design of a monitoring well or network of monitoring wells. ~~-~~Use this information to develop a conceptual hydrogeologic model of the site, identify probable ground-water flow paths, and determine the target monitoring zones~~.~~

Use Title 210 National Engineering Handbook, Part 651 "Agricultural Waste Management Field Handbook," Chapter 7 "Geologic and Groundwater Considerations"~~National Engineering Handbook (NEH) (Title 210), Part 631, Chapter 31, "Groundwater Investigations,"~~ and Title 210 National Engineering Handbook, Part 631, "Groundwater Investigations" for methodologies for identification, field-testing, and interpretation of geologic material and mass factors that affect movement and flow direction of ground-water within the area of concern.

Write a report of the hydrogeologic investigation and include a geologic evaluation map or sketches of all identified features and interpretations. This report is at least a reconnaissance level report but could be preliminary or detailed level geologic report. More than one investigation may be needed to plan the monitoring well and monitoring well network.

Planning

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 any available investigation and planning records for design and construction of the agricultural waste management system, dam or groundwater infiltration system being monitored.

Locate and describe any tile lines, subsurface drains, surface drains, irrigation ditches, irrigation wells, water supply wells, septic drain fields, infiltration strips, quarries, mines, and other water control/management features that influence the flow of local subsurface and surface water.

Identify and describe other relevant features that influence subsurface water flow such as hard

pans, sand boils, animal burrows, seasonal desiccation, high shrink/swell soils, dense till, depth of frost line, or permafrost.

Estimate the vertical and lateral seasonal variability in the water table using guidance provided in Title 210 National Engineering Handbook, Part 651 "Agricultural Waste Management Field Handbook," Chapter 7 "Geologic and Groundwater Considerations".~~210- NEH, Part 651, Chapter 7, "Geologic and Groundwater Considerations."~~

~~Write a report of the hydrogeologic investigation and include a geologic evaluation map or sketches of all identified features and interpretations.~~

Layout

Use the hydrogeologic investigation report and information gathered during planning to determine the optimum locations of monitoring wells, both up-gradient and down-gradient of ~~the waste storage facility or in~~ the area of concern.

~~When determining groundwater flow direction, place monitoring wells in any triangular arrangement.~~At least three monitoring wells in each aquifer of interest are needed to determine groundwater flow direction.

In highly fractured rock or~~and in~~ in karst aquifers, locate the monitoring wells in the zones of highest permeability.~~, even if locations are offsite.~~ Geophysics can be used to determine optimal locations for monitoring wells in these types of environments.

Survey the location of the wells to within one foot horizontally. Survey to within 0.01 ft elevation for wells used to determine water surface elevation and groundwater flow direction.

Design

The design of all components of the monitoring well must conform to state and local laws or criteria provided in ASTM D5092/D5092M.

Design the monitoring well to screen the entire thickness of the aquifer if possible. Screen across the water table allowing for seasonal-high water levels in unconfined aquifers. For confined aquifers, screen at least 80% of the water bearing zone. If screening the entire thickness of the aquifer is not possible, design the well to give the best chances of meeting the goals of monitoring.

Materials

~~Materials used for the construction of monitoring wells must not chemically react with the ground water and must not leach substances into the ground water.~~Use materials that will not chemically react with the groundwater nor leach substances into the groundwater. Avoid quick-setting cements containing additives that may leach from the cement and influence the chemistry of water samples collected from the monitoring well.

For conventionally screened and filter-packed ground-water monitoring wells located in sand and gravel aquifers and other granular materials, ensure the grain size distribution of the filter pack contains less than 50 percent finer than the #200 sieve and less than 20 percent clay-sized material. See ASTM D5092/D5092M, "Standard Practice for Design and Installation of Groundwater Monitoring Wells" for guidance on how to design an effective filter pack.

Ensure all materials used in construction, development, and sealing are free of contaminants prior to installation.

Use only ~~commercial~~ manufactured well screens or slotted pipe.

Use only threaded jointed pipe or casing. Do not use glued or solvent-welded joints.

Use only materials of adequate strength to withstand the forces of installation and well

development.

Installation

Select the ~~design protocol and~~ installation method according to site-specific conditions identified during the hydrogeologic investigation. Installation methods must conform to ASTM D5092/D5092M

~~Use only drilling or digging equipment capable of creating a stable, open, vertical hole for proper installation of the monitoring well.~~

~~Installation methods must conform to ASTM D5092/D5092M, and ASTM D5787, "Standard Practice for Monitoring Well Protection."~~

Direct push methods for installation are allowable provided they are consistent with guidance provided in ASTM D6724/D6724M, "Standard Guide for Installation of Direct Push Groundwater Monitoring Wells," and ASTM D6725/D6725M, "Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers."

Well protection

Protect the monitoring well from damage from hazards such as frost jacking or frost heave~~action~~, surface drainage, and animal or equipment traffic~~, and lack of visibility~~. See ASTM D5787, "Standard Practice for Monitoring Well Protection at or Near Land Surface" for discussion and guidance.

Establish positive surface drainage away from the wellhead for a radius of at least five feet.

~~Establish a buffer zone with a minimum radius of 30 feet around the wellhead of the monitoring well. Use fencing or other types of protection that excludes motorized vehicle access and livestock.~~

~~Ensure that no storage, handling, mixing, or application of fertilizers, pesticides, or other agricultural chemicals or cleaning of equipment used in the handling or application of such items occurs within the buffer zone at any time.~~

If installed in areas prone or subject to flooding, take appropriate measures to prevent~~reduce~~ surface water and sediment or debris from entering the monitoring well.

Development

Well development procedures must target the most productive hydrogeologic zones penetrated by the monitoring well. Seal the annular spaces adjacent to nonproductive zones to prevent cross contamination and commingling of chemically or biologically different zones of underground or surface waters. Refer to ASTM D5521/D5221M, "Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers," for a description of the various development methods. Conduct the development process only after completion of well installation, fill and sealing operations, and wellhead protection measures.

Final report

Prepare a detailed report after the installation of the monitoring wells including boring logs, well diagrams included screened intervals, and exact locations of the wells. Include at least one cross-section depicting the aquifer and wells including screened intervals.

~~**Recordkeeping**~~

~~When writing records to describe a ground water site, refer to guidance provided in 210-NEH, Part 631, Chapter 31, "Groundwater Investigation."~~

CONSIDERATIONS

In developing the conceptual hydrogeologic model, consider effects of geomorphic processes, geologic structures, regional stratigraphy, and soil and rock properties on subsurface flow patterns, location of ground-water recharge, and pollution potential. Consider the physical properties and methods of movement in the environment of solutes and pollutants of interest and potential impact of relevant soil properties (clay content, organic matter) when designing and locating the physical position and depth of a monitoring well.

Consider inherent physical and conductive properties of relevant soil horizons including but not limited to (particle size, structure, and saturated hydraulic conductivity).

Consider using geophysical tools in conjunction with penetrative exploratory techniques to improve and refine the mapping of the location, shape, orientation, and extent of subsurface hydrogeologic units.

Consider installing additional monitoring wells at other locations and at appropriate depths to ensure identification of the location and direction of movement of any potential contaminant plume. Consider nested wells when the system needs to monitor water quality at different depths without cross-contamination.

When wells protrude from the ground surface, consider using bollards, fencing or other types of protection that prevents mowers and other motorized equipment, vehicles and livestock from damaging the well, protective casing, and well pad.

Consider flush mount wells when stick-up wells are not practical for the location.

Consider painting bollards and/or protective casing a bright color to increase visibility. When the risk of vandalism outweighs the risk of vehicle traffic damage to the well consider painting the protective casing and bollards in a way to blend into the environment.

Consider alternative drilling or digging methods for installing monitoring wells as provided in ASTM D6286, ~~"Standard Guide for Selection of Drilling Methods for Environmental Site Characterization."~~ "Standard Guide for Selection of Drilling and Direct Push Methods for Geotechnical and Environmental Subsurface Site Characterization."

~~Where frost heave is a concern, consider design alternatives that reduce the potential for frost heave damage of the monitoring wells.~~

PLANS AND SPECIFICATIONS

Prepare plans and specifications for constructing, installing, completing, and developing monitoring wells that describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

~~Operation and maintenance requirements must comply with the purpose of this standard.~~

Establish a buffer zone for protection of the well from possible sources of contamination with a minimum radius of 30 feet around the wellhead of the monitoring well. Ensure that no storage, handling, mixing, or application of fertilizers, pesticides, or other agricultural chemicals or cleaning of equipment used in the handling or application of such items occurs within the buffer zone at any time.

Maintenance and rehabilitation procedures must comply with criteria in ASTM D5978/D5978M, "Standard Guide for Maintenance and Rehabilitation of Groundwater Monitoring Wells" to ensure acquisition of ground water samples free of artificial turbidity,

eliminate siltation of wells between sampling events, and permit acquisition of accurate ground water levels and hydraulic conductivity test data from the zone screened by the well.

When no longer needed for the intended purpose or when the monitoring well no longer functions properly due to factors such as damage, encrustation, or groundwater depletion, close the well according to NRCS Conservation Practice Standard Well Decommissioning (Code 351).

REFERENCES

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