Guideline #1
(Groundwater Pollution Control Program)

Recommended Procedures for the Design, Construction and Installation of Monitoring Wells, Piezometers, Boreholes, Test Pits and Other Sub-surface Investigative Methods for Activities Which *Are Not* Regulated by WDEQ

Wyoming Department of Environmental Quality (WDEQ)
Water Quality Division (WQD)
(Version 1.1; December, 1996)

The protection of Wyoming's ground water quality for the use of this, and future generations is one of the Department of Environmental Quality's (WDEQ) fundamental goals. The old adage 'An ounce of prevention is worth a pound of cure' applies directly to groundwater protection, as evidenced by the amount of time and expense needed to restore contaminated groundwater sites, when it is possible and practicable to do so. Prevention efforts on the other hand, are relatively inexpensive to implement and can often avoid expensive cleanup later.

Improper design, construction, installation, plugging and abandonment of monitoring wells, piezometers, soil borings, test pits and similar sub-surface investigation activities may lead to groundwater quality degradation in many situations unless preventive measures are taken to protect the quality of the resource. These measures are intended to:

1. prevent the introduction of contaminants into groundwater from the surface by sealing around the well at the surface;

2. prevent co-mingling between aquifers; and

3. ensure that the facilities are properly plugged and abandoned after they have served the purpose(s) for which they were installed.

For many sub-surface investigation activities, the Department requires that the design, construction, installation, etc. of one or more these types of facilities be approved prior to their installation. Generally these activities include: Site Investigation/Characterization at sites where there is knowledge of groundwater contamination, or reason to believe that a release has, or may threaten groundwater quality; where sub-surface information is needed to fulfill permitting requirements for new facilities; and where monitoring wells are needed to monitor the performance of permitted facilities.

There are other types of sub-surface investigation activities where approval from the Department is not currently required. These may include geo-technical investigations for building construction; property assessments where the environmental condition of the site is poorly understood; and for general information purposes on behalf of private property owners and resource organizations, among others. For these activities, the Water Quality Division (WQD) has developed this guidance document to provide general recommended procedures that should be, and in some instances must be followed to assist Wyoming residents in protecting their groundwater resource and tracking groundwater quality conditions.

The nearest WDEQ/WQD office (Groundwater Section) should be contacted to determine if a planned activity at a particular facility or site is one that would require Department approval prior to proceeding with sub-surface investigation activities. Regional office contacts for additional information regarding this guideline are:

Cheyenne	*777-7781*
Lander	*332-2479*
Sheridan	*672-6457*

I. The State Engineer's Office (Groundwater Division) must be notified (777-7354) prior to installation of monitoring well(s); permits may be required.

II. All downhole drilling, monitoring and sampling equipment should be de-contaminated between boreholes, borings, monitoring well(s)/piezometer(s) to minimize the potential for cross-contamination.

III. Borehole cuttings should be screened and disposed of properly. Contaminated cuttings must be disposed of at a site approved by the WDEQ's Solid and Hazardous Waste Management Division.

IV. The results of any observations (e.g. visual, odor, etc.) or analyses (e.g. field instruments, laboratory, etc.) conducted on **soil** removed from boreholes, test pits or other sub-surface investigative methods which indicate the release of a hazardous substance or oil (as defined in Water Quality Rules and Regulations, Chapter IV[1]) *should be, and in some instances must be reported* to WDEQ. Contact the nearest Water Quality Division office (see preceding page) for reporting requirements.

The results of any observations (e.g. visual, odor, etc.) or analyses (e.g. field instruments, laboratory, etc.) conducted on **surface water or groundwater** removed from monitoring wells/piezometers, boreholes, test pits or other sub-surface investigative methods which indicate the release of a hazardous substance or oil (as defined in Water Quality Rules and Regulations, Chapter IV) *must be reported* to WDEQ. Contact the nearest Water Quality Division office (see preceding page) for applicable reporting requirements.

V. Measures should be taken during the design, construction and installation of monitoring wells, piezometers, boreholes, test pits, cone penetrometer holes etc. to prevent co-mingling between aquifers and to prevent contaminants from entering the annulus of the well. WDEQ/WQD recommends that you utilize standards within Sections 64 - 69 of Part G of Chapter XI of WDEQ/WQD rules and regulations when the well(s)/piezometer(s) are constructed, installed and developed:

A. The borehole diameter should be at least four (4) inches larger in diameter than the casing diameter.

B. When PVC casing is used, the casing should be installed using threaded joints, couplings, or mechanical connectors without the use of solvents or glues to hold the casing sections together.

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1 Chapter IV also contains a description of the requirements for reporting and responding to a release of oil or a hazardous substance; copies can be obtained free of charge by contacting the Wyoming Department of Environmental Quality, Water Quality Division.

C. For water table (unconfined) aquifers, the screened interval should extend at least two (2) feet above the highest expected groundwater level and five (5) feet below the lowest expected water table. Monitoring well(s)/piezometer(s) installed in confined and semi-confined aquifers should be constructed in accordance with Chapter XI, Section 68 of Water Quality Division Rules and Regulations. Factory screen or slotted casing is recommended for the perforated interval.

D. To minimize the entrance of fine grained material into the monitoring well/piezometer, the filter pack should be designed to be compatible with the perforation size and the geologic materials encountered within the perforated interval. The filter pack should extend to a minimum of one (1) foot above the screened interval.

E. Filter pack, annular seal, and surface seal material should be entered into the monitoring well/piezometer in a manner such that no voids or bridging occur.

F. A minimum two (2) foot thickness of bentonite or bentonite grout should be placed at the top of the filter pack to serve as an annular seal. After the bentonite has been placed in the annular space, it should be hydrated to insure a proper seal.

G. The annular space above the bentonite seal to within one foot (1') of the surface should be sealed with neat cement grout, sand-cement grout, bentonite, or concrete according to the specifications provided in WQD Chapter XI, Section 65(c)(i-viii).

H. A protective casing should be cemented into place with the upper one (1) foot of the annular space completed in cement, forming a concrete apron sloping away from the monitoring well/piezometer.

I. A top and bottom cap of the same material as the monitoring well/piezometer casing should be installed to prevent sediment and surface water from entering the monitoring well/piezometer.

VI. **Field Documentation of Design, Construction and Installation of Monitoring Well(s)/Piezometer(s):**

A. We recommend that you consider documenting the following information during actual construction and installation of monitoring well(s)/piezometer(s). The information should be retained for future reference.

1. Date/time of construction.
2. Person developing information/other person(s) on site and their association to the project.
3. Drilling method and if drilling fluid was used.
4. Well location (± 0.5 ft.).
5. Well depth (± 0.1 ft.).
6. Bore hole diameter and well casing diameter.
7. Drilling and lithologic logs (including visual, olfactory and vapor detection observations). *(See attached 'Borehole Installation Diagram').*
8. Casing material.
9. Screen materials and design/location.
10. Casing and screen joint type.
11. Screen slot size/length.
12. Filter pack material/size, grain analysis.
13. Filter pack volume calculated/actually installed.
14. Filter pack placement method/location.
15. Sealant (annular space) materials.
16. Sealant volume used.
17. Sealant placement method/location.
18. Surface seal design/construction.
19. Well development procedure used.
20. Type of protective well cap (top and bottom).
21. Surveyed elevation (± 0.01 ft. Mean Sea Level) of:
    a. ground surface
    b. surveyor's well reference point
    c. top of well casing
    d. top of protective structure
22. Location of well number stamp or identification marking.
23. Detailed 'as-built' construction drawing of well, including dimensions to all well features. *(See attached 'Monitor Well Installation Diagram')*
    NOTE: The detailed drawing(s) should indicate all well features with relation to stratigraphic sections and/or lithologic materials.
24. Method of down hole equipment decontamination between wells.

VII. Well caps should be kept locked at all times other than for monitoring purposes. The wells should be clearly numbered using either a stamp to permanently engrave the number into the steel top or by writing the number in the wet concrete of the base.

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VIII. Monitoring well(s)/piezometer(s) should be developed by the use of a pump or bailer so that representative groundwater samples can be collected.

IX. Water which is collected during monitoring well/piezometer development or sampling must be disposed of properly. If contaminants are believed to be present, contact the nearest WDEQ office for information regarding proper disposal.

X. Prior to sampling, monitoring well(s)/piezometer(s) should be purged until a minimum of three (3) casing volumes have been removed, or until purged dry, whichever occurs first.

XI. Sample collection, preservation, transportation and chemical analytical procedures should be completed in accordance with WQD and EPA standard procedures.

XII. Samples and measurements should be taken from the appropriate aquifer(s) and should be representative of the impact, or potential impact, from the monitored activity.

A. Records of all monitoring information should be maintained by the existing property owner(s).

B. Records of monitoring information should include:

1. The date, exact place, and time of sampling or measurements;

2. The name(s) of individual(s) who performed the sampling or measurements;

3. Sampling procedures and sample preservation accomplished;

4. The date(s) analyses were performed;

5. Names of individuals who performed the analyses;

6. The analytical techniques or methods used; and

7. The results of such analyses.

XIII. After the monitoring well(s)/piezometer(s) have fulfilled their useful purpose, they should be abandoned according to procedures specified in Chapter XI, Part G, Section 70 of Wyoming Water Quality Division Rules and Regulations. Boreholes, test pits, cone penetrometer holes and similar invasive borings should be, and in some instances must be properly plugged, sealed and abandoned to prevent co-mingling between contaminated and non-contaminated groundwaters and aquifers.

End

BOREHOLE INSTALLATION DIAGRAM

Project _____ Borehole No. _____
Location _____ Monitor Well No. _____
Contractor _____ Date _____
Driller _____ Logged by _____
Method _____ Checked by _____
Sheet _____ of _____

Depth	Description/Lithology	Blows/ Depth	Field Screening Method _____ Reading	Notes

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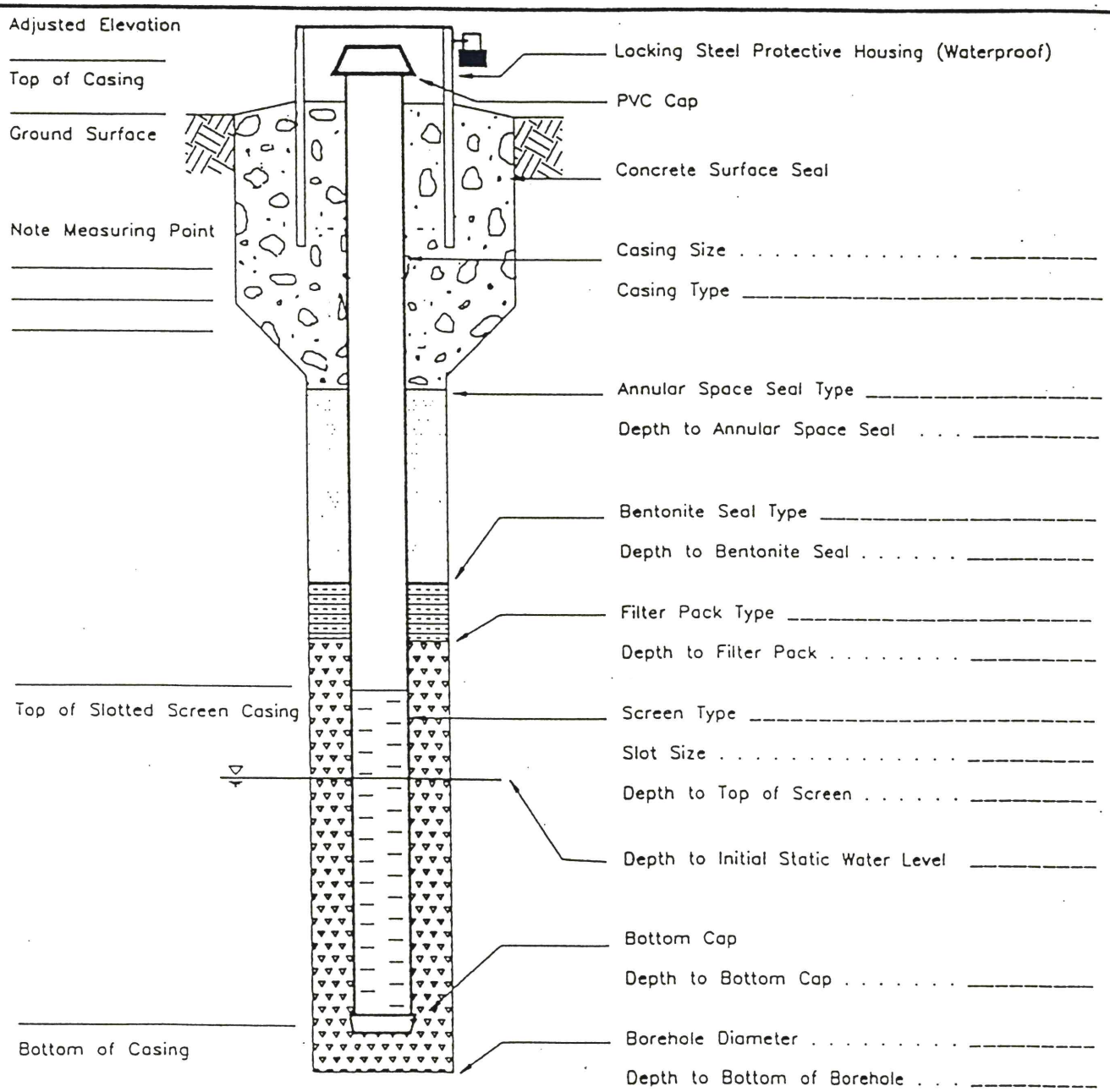
Depth to Water During Drilling, Ft. _____ Date _____
Static Water Level Depth, Ft. _____ Date _____
Measured From _____
Remarks _____

MONITOR WELL INSTALLATION DIAGRAM

Project _____ Monitor Well No. _____
Location _____ Borehole No. _____
Contractor _____ Date _____
Driller _____ Observed by _____
Method _____ Checked by _____
Sheet _____ of _____



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Surveyed by _____ Date _____
Remarks _____