

DEPARTMENT OF NATURAL RESOURCES

Division of Water Resources

RULES AND REGULATIONS FOR WATER WELL CONSTRUCTION, PUMP INSTALLATION, CISTERN INSTALLATION, AND MONITORING AND OBSERVATION HOLE/WELL CONSTRUCTION

2 CCR 402-2

[Editor's Notes follow the text of the rules at the end of this CCR Document]

RULE 1 TITLE

- 1.1 The title of these rules and regulations is "Rules and Regulations for Water Well Construction, Pump Installation, Cistern Installation and Monitoring and Observation Hole/Well Construction." The short title for these rules and regulations is "Water Well Construction Rules" and they may be referred to herein collectively as the "Rules" or individually as a "Rule."

RULE 2 AUTHORITY

- 2.1 These Rules are promulgated pursuant to the authority granted the State Board of Examiners of Water Well Construction and Pump Installation Contractors (the Board or Board of Examiners) in Sections 37 91 104(1)(c), (j) and (k), 37 91 106(4) and 37 91 110(2), C.R.S.

RULE 3 SCOPE OF RULES

- 3.1 These Rules apply to the construction and repair of water wells, test holes, dewatering wells, monitoring and observation holes/wells, well plugging, sealing, and abandonment, and pump installation and cistern installation and repair as those terms are defined by these Rules and Section 37 91 102, C.R.S.
- 3.2 By statute, these Rules do not apply to excavations made for the purpose of obtaining or prospecting for minerals or to wells subject to the jurisdiction of the Oil and Gas Conservation Commission as provided in Article 60 of Title 34, C.R.S., or to wells subject to the jurisdiction of the Mined Land Reclamation Board as provided in Article 32 of Title 34, C.R.S. (Minerals), and Article 33 of Title 34, C.R.S. (Coal).
- 3.3 These Rules apply to well construction and pump installation contractors, private drillers, private pump installers, and any persons excluded from the licensing requirements as further described by these Rules in conjunction with Sections 37 91 102, 104(j) and (k), and 106(4), C.R.S.
- 3.4 **Reference Materials** - Information on examining or acquiring reference materials referred to in these rules, including American Society for Testing and Materials (ASTM) Designation: F480-95 (Standard Specification for Thermoplastic Well Casing), 1995; Examining Board of Plumbers Rules and Regulations, 3 CCR 720-1, 1996; Department of Agriculture, Colorado Chemigation Act, Article 11 of Title 35, C.R.S.; and National Electric Code (1999) of the National Fire Protection Association (NFPA), may be obtained from the Records Supervisor of the Division of Water Resources, 1313 Sherman Street, Denver Colorado, 80203. The reference materials also may be examined at any State Publication Depository Library. Any Rule that incorporates any of these reference materials does not include later amendments to or editions of the incorporated material. These Rules do not supersede the requirements that other enforcing agencies may establish.

RULE 4 PURPOSE OF RULES

- 4.1 To enable the Board to carry out the provisions of Article 91 of Title 37, C.R.S.
- 4.2 To safeguard the public health of the people of Colorado and to protect the ground waters of the State of Colorado.
- 4.3 To set minimum standards for the construction, repair, plugging, sealing, and abandonment of all wells, test holes, monitoring and observation holes/wells, and dewatering wells.
- 4.4 To allow certain types of monitoring and observation holes, monitoring and observation wells, temporary dewatering wells, and test holes to be constructed, utilized, and plugged, sealed, and abandoned by other than a licensed well construction contractor.
- 4.5 To set minimum standards for the installation and repair of pumping equipment and cisterns.

RULE 5 DEFINITIONS

- 5.1 **Statutory Definitions** - The following terms are defined in the statute, Section 37 91 102, C.R.S., and shall have identical meaning where used in these Rules:

Board, Construction of Wells, Dewatering Well, Directly Employed, Ground Water, Installation of Pumping Equipment, License, Monitoring and Observation Well, Person, Private Driller, Private Pump Installer, Pumping Equipment, Pump Installation Contractor, Repair, Supervision, Test Hole, Well, Well Construction Contractor, and Well Seal.

- 5.2 **Specific Definitions** - Unless expressly stated otherwise, the following terms when used in these Rules shall have the meaning indicated in this Rule. Words used in the singular shall include the plural. Words used in the masculine gender include the feminine and neuter.

- 5.2.1 "Annular Space" means the distance between the wall of the borehole or excavation and the casing, or the distance between two casings. Annular space is calculated as the difference in diameter of the borehole (Db) and the outside diameter of the casing (Dc) divided by two $[(Db-Dc)/2]$, or the difference in the inside diameter of a larger casing and the outside diameter of a smaller casing (Dc1 and Dc2) divided by two $[(Dc1-Dc2)/2]$, where Dc1 is the larger of the two casings.

- 5.2.2 "**Aquifer**" means a hydrogeologic unit consisting of an interval, or hydraulically connected intervals, of consolidated and/or unconsolidated rock material that is capable of storing and transmitting water. It includes both the saturated and unsaturated zone but does not include the confining layer that separates aquifers.

- 5.2.2.1 "**Type I Aquifer**" means a confined aquifer as defined in these Rules.

- 5.2.2.2 "**Type II Aquifer**" means an unconfined bedrock aquifer as defined in these Rules.

- 5.2.2.3 "**Type III Aquifer**" means an aquifer that consists of unconsolidated rock material including alluvial and/or colluvial deposits and severely weathered (decomposed) crystalline rocks.

- 5.2.3 "**Artificial Recharge**" means the intentional introduction of water into an aquifer.

- 5.2.4 "**Authorized Individual**" means a professional engineer registered in Colorado or a professional geologist as defined in section 34-1-201(3), C.R.S., who is qualified to do

the work, or anyone directly employed by or under the supervision of a registered professional engineer or professional geologist.

- 5.2.5 **"Bedrock"** means consolidated crystalline or sedimentary rock.
- 5.2.6 **"Board"** for statutory definition see Section 37-91-102(3), C.R.S.
- 5.2.7 **"Borehole"** means any excavation that is augered, drilled, bored, cored, washed, fractured, driven, dug, jetted, or otherwise constructed to access the subsurface for the purpose of constructing a hole or well under the jurisdiction of these Rules.
- 5.2.8 **"Casing"** means the pipe installed to prevent collapse of and provide access to the borehole. The term includes both nonperforated ("solid") pipe, perforated pipe, and screen.
- 5.2.9 **"Centralizer"** means a device attached to the outside of a pipe or liner for the purpose of centering it within a borehole or casing.
- 5.2.10 **"Cistern"** means an artificial reservoir or tank for storing water. Constructed to a size and of materials consistent with intended purpose and industry standards.
- 5.2.11 **"Completion of Pump Installation"** means that the production equipment has been installed in a well, all necessary equipment has been connected, the well has been disinfected, the production equipment has been tested, the well is ready to be placed into service, and the pump installation equipment has been removed from the well site.
- 5.2.12 **"Completion of Well Construction"** means that the well has been cased, developed, tested for yield, cleaned, disinfected, is ready for the installation of the production equipment, and the construction equipment has been removed from the well site.
- 5.2.13 **"Confined Aquifer"** means an aquifer consisting of unconsolidated or consolidated rock material or crystalline rocks below a confining layer. Confined aquifers are designated in these Rules as "Type I aquifers".
- 5.2.14 **"Confining Layer"** means a geologic zone that, because of its impermeability or low permeability, inhibits the flow of ground water to or from an adjacent aquifer.
- 5.2.15 **"Construction of Wells"** for statutory definition see Section 37-91-102(4), C.R.S.
- 5.2.16 **"Contaminant"** means any chemical or organic material, live organisms, radioactive material or heated or cooled water that will adversely affect the quality of water.
- 5.2.17 **"Contamination"** means the introduction of contaminants into ground water.
- 5.2.18 **"Contracting"** means undertaking, or offering, bartering, or bargaining to undertake the construction of a well or installation of pumping equipment, by any person, firm, corporation, partnership, association or other organization, for another.
- 5.2.19 **"Contractor"** means a person holding a license issued by the Board of Examiners.
- 5.2.20 **"Dewatering System"** means a permanent well, drain, sump or other excavation constructed for the purpose of keeping the water table below a desired level or elevation where the water produced is not put to beneficial use. Note: A dewatering system is not the same as a dewatering well defined by Section 37-91-102(4.5), C.R.S.

- 5.2.21 **"Dewatering Well"** for statutory definition see Section 37-91-102(4.5), C.R.S.
- 5.2.22 **"Directly Employed"** for statutory definition see Section 37-91-102(4.7), C.R.S.
- 5.2.23 **"Filter Pack"** , also referred to as "gravel pack", means selected granular materials placed in the annular space between the borehole wall and casing to reduce the amount of solid material entering the perforated casing or screen.
- 5.2.24 **"Ground Water"** for statutory definition see Section 37-91-102(7), C.R.S.
- 5.2.25 **"Grout"** means any material, approved by the Board, that is used to form a permanent impermeable seal in the annulus between the casing and the borehole wall or between two strings of casing, or that is used in plugging, sealing, and abandoning boreholes or wells.
- 5.2.26 **"Grouting"** means the process by which grout is placed in the borehole or casing.
- 5.2.27 **"Horizontal Drain"** means a well constructed to increase slope stability or as a permanent dewatering system.
- 5.2.28 **"Installation of Pumping Equipment"** for statutory definition see Section 37-91-102(8), C.R.S.
- 5.2.29 **"License"** for statutory definition see Section 37-91-102(10), C.R.S.
- 5.2.30 **"Liner"** means a casing installed in a well solely to protect pumping equipment, to repair a damaged well, or to improve performance of a well. A liner does not include casing that, once installed, requires the placement of grout to comply with construction standards of these Rules.
- 5.2.31 **"Lithologic log "** means a description of the type and character of the soil and rock materials penetrated by the borehole.
- 5.2.32 **"Monitoring and Observation Hole"** means a temporary monitoring and observation well. A monitoring and observation hole must be plugged, sealed, and abandoned in less than one (1) year from the date it was constructed unless a permit for a monitoring and observation well has been obtained from the State Engineer.
- 5.2.33 **"Monitoring and Observation Well"** for statutory definition see Section 37-91-102(10.5), C.R.S.
- 5.2.34 **"Nested Well"** means the installation of two or more casings in a single borehole or excavation.
- 5.2.35 **"Percolation Hole"** means a hole constructed in unsaturated material to determine the infiltration rate into the underlying or adjacent strata.
- 5.2.36 **"Person"** for statutory definition see Section 37-91-102(11.5), C.R.S.
- 5.2.37 **"Piezometer Hole"** means a monitoring and observation hole/well that is constructed for the purpose of monitoring or measuring water pressure, soil moisture tension or water level elevation.

- 5.2.38 **"Pitless Adapter"** means a device designed for attachment to a well casing that will permit water service pipes to pass through the wall of a well casing but prevent entrance of contaminants into the well or water supply.
- 5.2.39 **"Pitless Unit"** means a commercially manufactured steel assembly, or other pitless units as approved by the Board, designed to be attached to the well casing with an integral mechanical seal below ground level, that will permit water service pipes to be connected to the well but will prevent the entry of contaminants into the well or the water supply.
- 5.2.40 **"Plugged, Sealed, and Abandoned Well"** means a well that has been filled and grouted to prevent the entry of contaminants from the surface into the well and the movement of fluids between aquifers through the borehole. This definition is consistent with the statutory meaning of abandoning a well as referred to in Article 91 of Title 37, C.R.S.
- 5.2.41 **"Positive Displacement"** means a procedure whereby a material such as grout is first introduced at the bottom of an interval and is pumped or placed upward through the interval, displacing fluids within the interval.
- 5.2.42 **"Private Driller"** for statutory definition see Section 37-91-102(12), C.R.S.
- 5.2.43 **"Private Pump Installer"** for statutory definition see Section 37-91-102(12.5), C.R.S.
- 5.2.44 **"Producing aquifer"** means that portion of the permitted or authorized aquifer as stated on the well permit that consists of saturated aquifer material. The producing aquifer is also referred to in these Rules as the "zone of production" or "production zone".
- 5.2.45 **"Pumping Equipment"** for statutory definition see Section 37-91-102(13), C.R.S.
- 5.2.46 **"Pump Installation Contractor"** for statutory definition see Section 37-91-102(14), C.R.S.
- 5.2.47 **"PVC Casing"** means polyvinyl chloride casing as specified in ASTM Standard F480 95 (1995, Thermoplastic Well Casing Pipe) that is clearly marked by the manufacturer as "well casing". This definition does not include later amendments to or editions of the referenced ASTM standard.
- 5.2.48 **"Recovery Well"** means a well which is constructed specifically for the removal of contaminants from an aquifer (aquifer remediation).
- 5.2.49 **"Repair"** for statutory definition see Section 37-91-102(15), C.R.S.
- 5.2.50 **"Supervision"** for statutory definition see Section 37-91-102(15.5), C.R.S.
- 5.2.51 **"Test Hole"** for statutory definition see Section 37-91-102(15.7), C.R.S.
- 5.2.52 **"Three Days Notice"** means a 72 hour period that shall include not less than one standard eight (8) hour work day, as required by the State Engineer.
- 5.2.53 **"Unconfined Bedrock Aquifer"** means an aquifer consisting of consolidated rock material or crystalline rocks that is not overlain by a confining layer. Unconfined bedrock aquifers are designated in these Rules as "Type II aquifers".

- 5.2.54 **"Valid Permit"** means a well permit issued by the State Engineer that has not been cancelled or expired due to (1) non-construction (and, in some cases, failure to put to beneficial use) within the specified time, or (2) failure to construct the well in accordance with the terms of the well permit and file the required notices and/or reports with the State Engineer; or that has not otherwise been deemed to be of no force or effect as a result of a court action or order of the State Engineer. Only the State Engineer has the administrative authority to determine whether or not a well permit is valid.
- 5.2.55 **"Watertight"** means a condition that does not allow the entrance, passage or flow of water under normal operating conditions.
- 5.2.56 **"Well"** for statutory definition see Section 37-91-102(16), C.R.S.
- 5.2.57 **"Well Construction Contractor"** for statutory definition see Section 37-91-102(17), C.R.S.
- 5.2.58 **"Well Owner"** means any person, or his agent, who holds the title or other property rights in or to a well.
- 5.2.59 **"Well Pit"** means a structure for the underground installation of equipment and piping. If the well terminates in the pit, the structure shall be deemed to be a well vault.
- 5.2.60 **"Well Seal"** for statutory definition see Section 37-91-102(18), C.R.S.
- 5.2.61 **"Well Vault"** means an underground structure in which the well casing terminates below ground surface.
- 5.2.62 **"Well Yield Test"** means a procedure conducted to determine a stabilized drawdown and production rate of a well.
- 5.3 **Other Definitions** All other words used herein shall be given their usual, customary, and accepted meaning. Terms not defined in this Rule that are defined in the statutes or in rules of the State Engineer shall use the meaning given therein. All words of a technical nature specific to the water well industry shall be given the meaning generally accepted in said industry.

RULE 6 GENERAL RULES

- 6.1 The process for obtaining and maintaining a license to construct water wells, install pumping equipment and cisterns, or a special license is codified in the Board's Administration Rules, 2 CCR 402-14.
- 6.2 **Permit Requirement** A permit issued by the State Engineer is required prior to constructing a new well and prior to the repair, replacement, or modification of an existing well (see Sections 37-90-105(3)(a)(I), 37-90-108(1)(a), 37-90-137(1), 37-90-138(3), and 37-92-602(3)(a) C.R.S.).
- 6.2.1 The State Engineer requires that a new well permit be obtained prior to:
- a. changing the producing interval of an existing well,
 - b. installing certain dewatering systems as specified by the State Engineer,
 - c. installing pumping equipment that will withdraw ground water for beneficial use, or
 - d. installing pumping equipment having a sustained production rate in excess of the permitted production rate.

The extraction of casing or pumping equipment for the purpose of repair or replacement does not require a new permit if the interval of perforated casing is not altered and the production rate does not exceed the rate specified on the existing valid well permit.

6.2.2 As further defined in Rules 6.2.2.1 and 6.2.2.2, it is the responsibility of the private driller, private pump installer, and all persons licensed to construct or repair wells, or to install, repair, modify, or replace pumping equipment to determine that a valid permit issued by the State Engineer exists prior to and during all such work, if such well permit is required by the State Engineer.

6.2.2.1 A copy of the permit shall be available and posted at the well site at all times when working on a new well or when performing work in accordance with Rule 6.2.1. All such work shall comply with the conditions of approval of the valid well permit and all work shall be completed prior to the expiration of the permit.

6.2.2.2 When performing repairs on an existing well in accordance with Rule 6.2.2, the private driller, private pump installer, or licensed contractor shall make reasonable effort to comply with the requirements of Rule 6.2.2. If the private driller, private pump installer, or licensed contractor is unable to verify that a well permit exists or is required for the well, within thirty (30) days after performing the work, he/she shall notify the State Engineer of performing work on the well and shall provide information about the well on a form prescribed by the State Engineer.

6.2.3 Where a well has been constructed in accordance with a well permit issued by the State Engineer that authorized construction of the well at any point within a specified tract of land, the well construction contractor shall submit the Well Construction and Test Report and associated well location within sixty (60) days of completion of the well.

6.3 Prior Notice of Dewatering Well, Monitoring and Observation Hole, and Test Hole - In accordance with the requirements of the State Engineer, the Division of Water Resources shall be notified not less than three (3) days (see Rule 5.2.51) prior to the construction of any test hole that will penetrate through a confining layer between aquifers. The State Engineer shall be notified not less than three (3) days prior to the construction of any dewatering well or monitoring and observation hole. Any test hole or monitoring and observation hole that penetrates a confining layer shall be constructed only by a licensed contractor (see Rule 9).

The State Engineer requires such notice be submitted in writing and contain the following information as a minimum:

Landowner's name, structure owner's name, name and professional discipline (engineer or geologist) of the authorized individual or name and license number of the well construction contractor, anticipated date of construction, location to the nearest 1/4 - 1/4 section, township and range, or GPS location (UTM in meters or latitude-longitude coordinates), number and type of holes to be constructed, estimated total depths and the purpose or intended use of the holes.

See Table 1 for a summary of notice, license, and permit requirements.

TABLE 1: SUMMARY OF LICENSE, PERMIT AND NOTICE REQUIREMENTS

STRUCTURE Type of Well or Borehole	WHO CAN CONSTRUCT			AUTHORIZATION	
	Licensed	Authorized Individual	Special License	Permit	Notice
Does not penetrate through a confining layer					
Water well	X			X	
M-O and recovery well & certain dewatering system	X	X	X	X	
M-O holes & dewatering wells	X	X	X		X
Test holes	X	X	X		
Penetrates through a confining layer					
Water well	X			X	
M-O and recovery well & certain dewatering system	X		X	X	
M-O hole and dewatering well	X		X		X
Test holes	X		X		X

Notes:

- 1) This table shows minimum requirements. A licensed contractor is authorized to construct, etc., all of the types wells or holes indicated. Holders of special licenses and authorized individuals are restricted to the type of work for which they are licensed or qualified.
- 2) Monitoring and observation holes constructed pursuant to notice as provided in Rule 6.3 shall not be converted into water wells (see Rule 14). Monitoring and observation holes shall be plugged and sealed within one (1) year after being constructed (see Rule 14.2.1). The requirements for monitoring and observation wells apply also to any borehole, which will remain in use for more than one year, e.g. long-term piezometers, etc.
- 3) The requirements for test holes apply also to percolation and piezometer holes, horizontal drains and sumps. Test holes shall not remain open more than twenty (20) days (see Rule 14.5).

6.3.1 The authorized individual (see Rules 5.2.4 and 9.1) is responsible for providing the necessary notice required for the construction of dewatering wells, test holes, and monitoring and observation holes.

6.3.2 A licensed well construction contractor, who is not under contract with, or supervised by, or employed by an authorized individual and who intends to construct temporary dewatering wells, test holes, or monitoring and observation holes, is responsible for providing the necessary notice.

6.3.3 The construction of any test hole, dewatering well, or monitoring and observation hole for which notice was given pursuant to this Rule (Rule 6.3) must be completed within ninety (90) days of the notice date. Construction of monitoring and observation holes and test holes must be completed within 72 hours after drilling the borehole (see Rule 14.2.1).

6.4 **Emergency Authorization** - Pursuant to the procedures of the State Engineer, the State Engineer or his designee may approve the construction of dewatering wells or monitoring and observation holes with less than the required notice upon the State Engineer's or his designee's determination that conditions such as public safety, practical difficulties or unusual hardship warrant such approval.

6.5 **Requests for Well Site Information** - Upon request by the State Engineer or his staff, all water well construction and pump installation contractors, and all authorized individuals, private drillers

and private pump installers shall identify the permit number or other authorization and the location of any well(s), test hole, or monitoring and observation hole which that person expects to work on within a specified three (3) day period.

- 6.6 Compliance with Regulations** - Construction of all wells, pump installation and cistern installation shall, at a minimum, comply with the standards in these Rules. Where federal, state, county, municipal or local government laws, regulations or codes are more stringent than these Rules, or contain standards not covered by these Rules, then the contractor shall comply with those laws, regulations, codes or standards. The licensed well construction or pump installation contractor, authorized individual, private driller, or private pump installer is responsible for determining if such laws, regulations, codes or other requirements exist and apply to the work being performed.
- 6.7 Products Containing Toxic Materials** - Products such as solder and fluxes containing more than two tenths (0.2) per cent lead, and materials such as pipes and fittings containing more than eight (8.0) per cent lead, or any mercury, are prohibited from being used in wells and holes.
- 6.8 Disposal of Fluids Resulting from Well Construction, Development and Disinfection** - Fluids resulting from well construction, development or disinfection shall not be discharged into the waters of the state without first obtaining a permit pursuant to the Colorado Discharge Permit System (CDPS) administered by the Colorado Department of Public Health and Environment. Fluid disposal by land application must not flow into or have the potential to flow into surface waters and must not impact aquatic life or ground water. Fluid wastes may be disposed of by other proper means such as off-site transport for treatment and final disposal, evaporation ponds, or pumping to a sanitary sewer system with permission from the appropriate authorities.
- 6.9 Water Used for Well Construction and Stimulation** - All water used during the construction, development, and stimulation, including formation fracturing, of a well shall be obtained from an approved public supply. If water is not readily available from such a public supply, the water may be obtained from a ground water source or from a flowing surface water supply under the following conditions:
- a. water obtained from a ground water source shall be disinfected with a minimum chlorine concentration of twenty five (25) mg/l (milligrams per liter);
 - b. in remote mountainous areas, where adequate public or ground water sources are not readily available, water may be obtained from flowing surface waters, provided that such waters are located upstream from any sewer plant, feedlot, chemical storage area or other known sources of contamination. These surface waters shall be disinfected by adding chlorine for a minimum concentration of one hundred (100) mg/l (Fifty (50) mg/l when polymer or bentonite is used), with a contact time of one (1) hour and a residual concentration of ten (10) mg/l; or
 - c. for reverse rotary construction, only when public or ground water sources cannot provide sufficient volumes of drilling water, water may be obtained from flowing surface water supplies provided that such water is disinfected to a minimum chlorine concentration of twenty five (25) mg/l or the well is disinfected in accordance with the provisions of Rule 6.9.1 (also see Rule 15.7).
- 6.9.1** Upon completion, all wells drilled, developed or stimulated without using water obtained from a public supply source shall be flushed and cleaned, and disinfected with a minimum chlorine concentration of five hundred (500) mg/l. This disinfectant must remain in the well for a minimum of twelve (12) hours.
- 6.9.2** The use of water from wetland areas, lakes, ponds, or known contaminated ground water sources is prohibited.

RULE 7 See “Licensing” ; BOE Rules, 2 CCR 402-14.

RULE 8 See “Financial Responsibility” ; BOE Rules 2 CCR 402-14.

RULE 9 WELLS AND HOLES WHICH MAY BE CONSTRUCTED BY OTHER THAN A WELL CONSTRUCTION CONTRACTOR

9.1 Unless otherwise specified, the order of responsibility for ensuring compliance with the provisions of this Rule 9 shall be:

- a. the authorized individual (see Rule 5.2.4)
- b. the licensed contractor if an authorized individual is not involved
- c. the private driller (see Section 37-91-102(12), C.R.S.) if an authorized individual or licensed contractor is not employed

9.2 **Excavations Authorized by this Rule** The following types of excavations that do not penetrate through a confining layer between aquifers recognized by the State Engineer may be designed, constructed, used, and plugged, sealed and abandoned by authorized individuals (see Table 1 for a summary of who is authorized to construct each type of well):

dewatering wells, horizontal drains, monitoring and observation holes/wells, percolation holes, piezometer holes, recovery wells, dewatering systems, and test holes

9.2.1 **Required Notice** - In accordance with the requirements of the State Engineer, the Division of Water Resources shall be notified not less than three (3) days (see Rule 5.2.51 and 6.3) prior to the construction of any dewatering well or monitoring and observation hole.

9.2.2 **Reporting Requirements** - A Well Construction and Test Report shall be submitted in accordance with the provisions of Rule 17 for each monitoring and observation hole constructed. A well construction report is not required for the construction of a dewatering well unless the well is permitted as a dewatering system.

9.3 **Construction Standards** The excavations authorized under this Rule 9 shall be constructed in accordance with the applicable Rules specified for such structure. Where construction standards for an excavation authorized by this Rule 9 are not specified in these Rules, the construction of the excavation shall comply with the standards and Rules applicable to water wells, unless a variance from those Rules is obtained pursuant to Rule 18.

9.3.1 **Monitoring and observation holes/wells and test holes** that do not penetrate a confining layer shall be constructed in accordance with the provisions of Rule 14.

9.4 If during construction of an excavation authorized by this Rule 9, the borehole penetrates a confining layer into a lower aquifer, the hole shall be plugged back through the confining layer with at least twenty (20) feet of cement or cement-bentonite grout or through the entire confining layer, whichever is greater, or the hole shall be plugged, sealed and abandoned pursuant to Rule 16 within twenty four (24) hours.

9.5 **Plugging, Sealing and Abandonment** - Excavations authorized by this Rule 9 shall be plugged, sealed and abandoned according to the provisions of Rule 16.

9.6 **Conversion to Water Wells Prohibited** - Monitoring and observation holes, dewatering wells, and other excavations constructed pursuant to notice as provided in Rule 6.3 and this Rule 9 shall not be converted to production water wells. Upon obtaining a permit from the State Engineer, a

monitoring and observation hole or dewatering well constructed in accordance with proper notice may be converted only to a monitoring and observation well, recovery well for purposes of aquifer remediation, or dewatering system for dewatering of the aquifer.

RULE 10 MINIMUM CONSTRUCTION STANDARDS FOR WATER WELLS

10.1 General - To assist in the orderly development of the ground water resources of Colorado, to insure the protection of the public health, and to prevent degradation of the ground water resource, all wells constructed to withdraw or inject water shall be constructed, maintained, or repaired in such a manner that will:

- a. maintain existing natural protection against contamination of aquifers;
- b. prevent the entry of contaminants through the borehole;
- c. limit ground water production to one aquifer unless otherwise permitted by the State Engineer; and
- d. prevent the intermingling of ground water from different sources through the borehole.

10.1.1 If site specific conditions indicate that adherence to the minimum standards will not ensure the adequate integrity of the well and protect the aquifer, the contractor shall be responsible for constructing the well using standards that are more stringent than the minimum specified in these Rules. If conditions on the well permit specify standards that exceed the minimum standards of these Rules, the well construction contractor shall comply with the conditions specified on the well permit.

10.1.2 Prior to starting construction, all persons authorized to construct wells shall investigate and become familiar with the geology of potential aquifers, anticipated water quality problems, and known contaminated water bearing zones that may be encountered in the area of the proposed drilling activity.

10.1.3 All wells and boreholes, when unattended, shall be securely sealed, capped or covered. It is the responsibility of the well construction contractor and pump installation contractor to ensure the well is securely covered while unattended during well construction and pump installation and securely sealed or capped upon completion of the well. Thereafter, it is the responsibility of the well owner to ensure that the well is securely sealed or capped.

10.1.4 When hazardous contaminants are known or suspected to be encountered during well construction, the contractor shall be responsible for ensuring that his personnel are adequately trained and that proper safety equipment is provided to handle and contain those substances.

10.1.5 Nested wells completed in different aquifers or production zones shall be grouted to prevent intermingling of ground water.

10.1.6 Gravel pit wells permitted pursuant to Sections 37-90-107(6) or 37-90-137(11), C.R.S. are exempt from the provisions of these minimum construction and location standards, except that the owner shall ensure that the gravel pit well is constructed in such a manner as to prevent contaminants from entering the gravel pit well.

10.2 **Well Location** - When selecting a well location, consideration shall be given to topography, drainage, sources of contaminants, and other on site conditions in order to promote sanitary conditions and prevent contamination of the well and aquifer.

- 10.2.1 When locating wells, well construction contractors and private drillers shall comply with the regulations of state, county, municipal or local governments, in determining the required distance from sources of contaminants, when those regulations are more stringent than the minimum standards of these Rules.
- 10.2.2 Wells shall not be located closer than one hundred (100) feet horizontally to the nearest existing source of contaminants or fifty (50) feet from a septic tank, sewer line or other vessel containing contaminants. A request for variance must be submitted and written approval from the Board must be obtained prior to the construction of a well that cannot meet this spacing requirement.
- 10.2.2.1 A request for variance from the location requirement of Rule 10.2.2, shall be prepared by a water well construction contractor, a registered professional engineer or a professional geologist, shall be based on hydrogeologic information, and shall comply with the minimum requirements shown in Figure 1a or 1b (whichever is applicable) to the greatest extent possible. In no case shall the horizontal distance of the well to the nearest existing source of contaminants be less than 25 feet.
- 10.2.3 In the event a well is constructed as a replacement for an existing well that is located less than one hundred (100) feet horizontally from a source of existing contaminants, the replacement well shall not be located closer to the source of contaminants. The distance between the perimeter of that source and the base of the grout seal shall not be less than 100 feet, as shown in Figure 1a (or not less than 50 feet as shown in Figure 1b), unless a variance request prepared in accordance with the provisions of Rule 10.2.2.1, is granted.
- 10.3 **Well Casing** Well casing shall consist of materials which will ensure adequate protection against failure for the intended use of the well.
- 10.3.1 All casing shall be new or unused pipe, except that casing recovered when a well is modified or replaced may be reused in the new well if it will ensure satisfactory well performance. All surface casing shall be steel pipe and may be used pipe if it is undamaged, free of pits and corrosion, and has been decontaminated. Used oilfield pipe shall not be installed in any well.
- 10.3.2 The well casing diameter shall be sufficient to accept a pump capable of producing the desired production rate. In no instance shall the outside diameter of the casing be less than four and one-half (4.5) inches.
- 10.3.3 All casing wall thickness shall be adequate to prevent collapse due to hydrostatic pressures. The following minimum wall thicknesses shall be applicable to well casings:
- a. Steel well casing: 0.188 inches
 - b. PVC well casing: 0.200 inches
 - c. Precast concrete rings: 3.00 inches

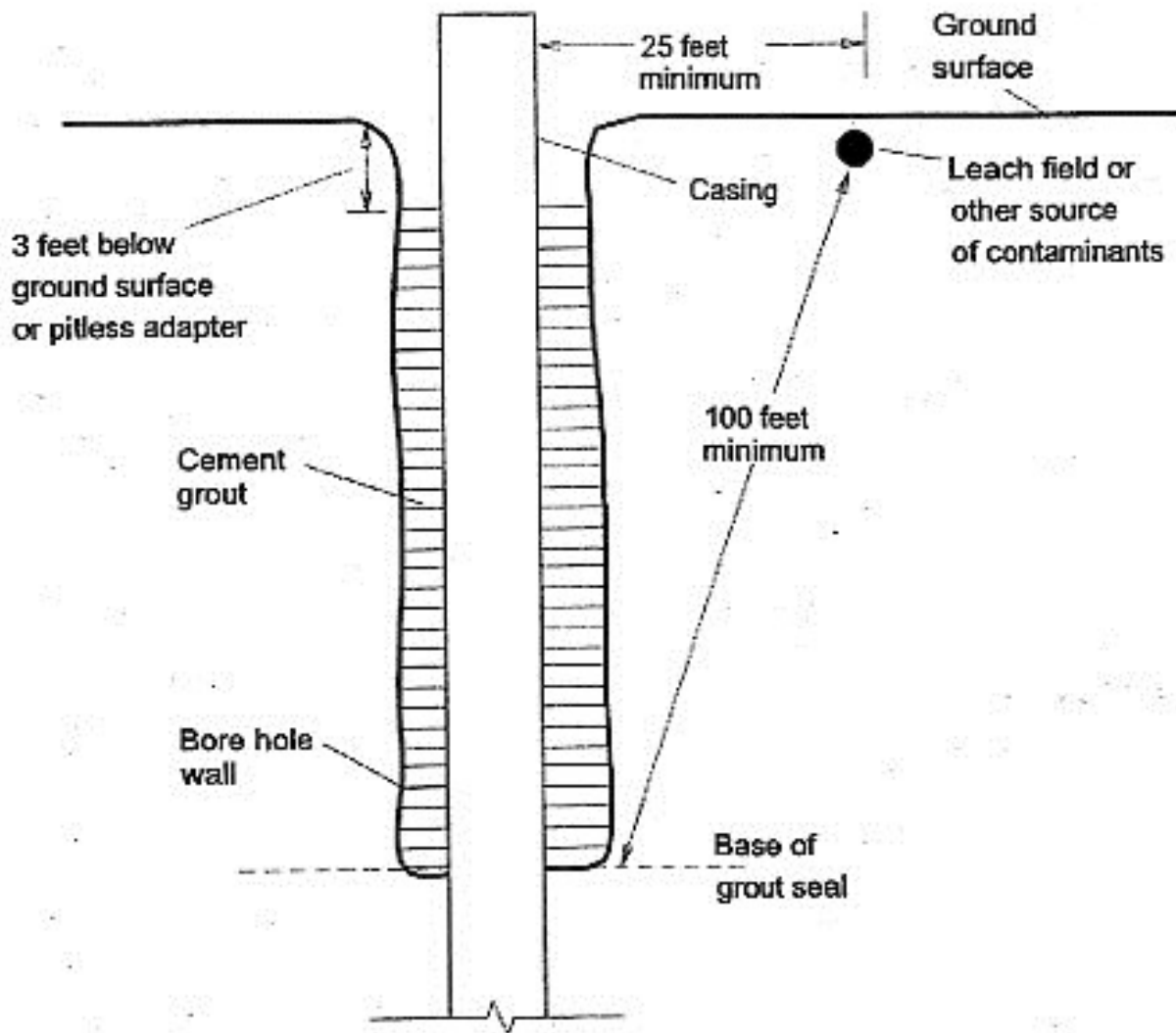


Figure 1a. Schematic minimum distance of a well from a leach field or other source of contaminants.

Note: Approved variance required prior to construction (see Rule 10.2.2).

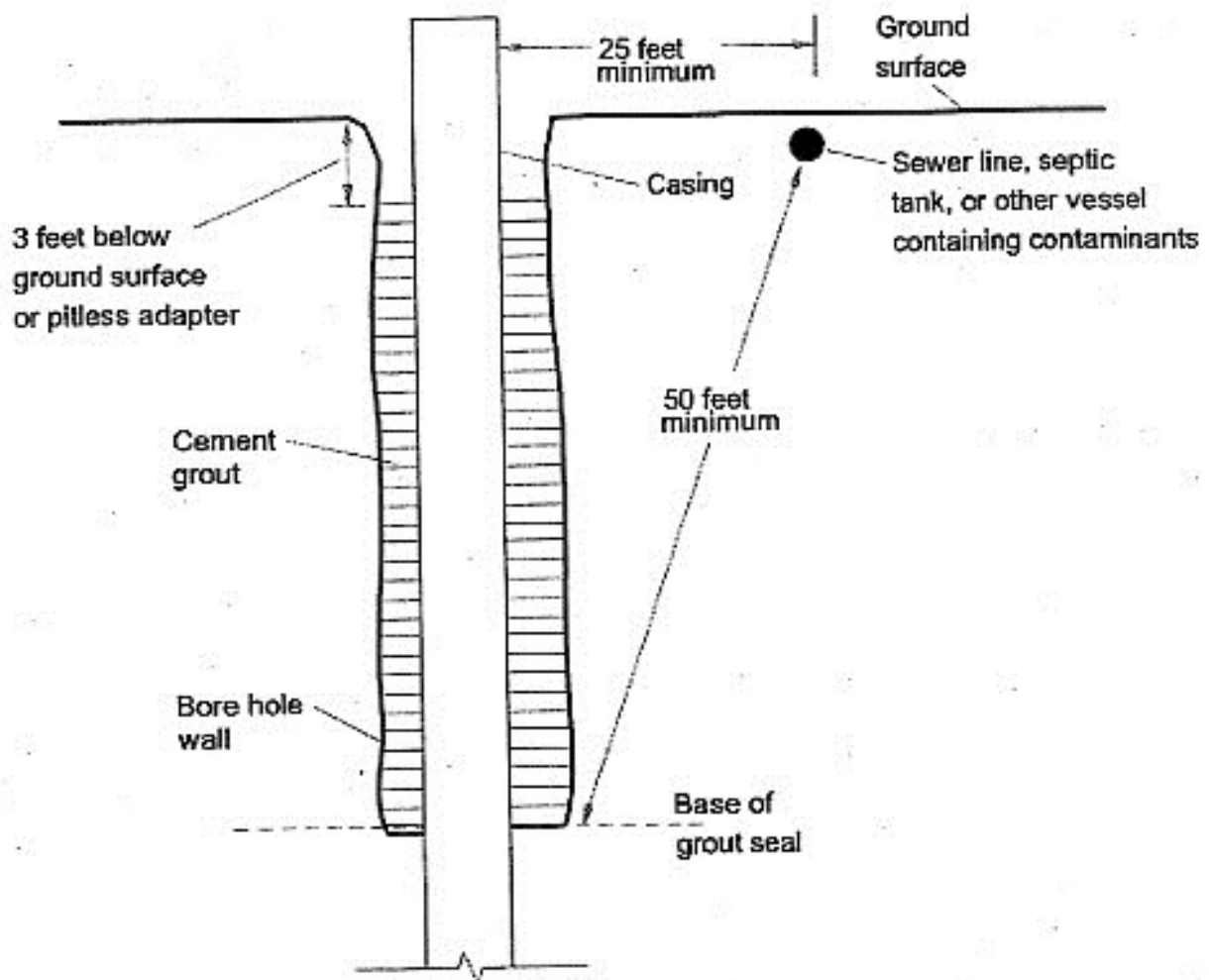


Figure 1b. Schematic minimum distance of a well from a sewer line, septic tank, or other vessel containing contaminants.

Note: Approved variance required prior to construction (see Rule 10.2.2).

10.4 **Construction Procedures** The excavation of the borehole, selection and installation of the casing, grouting, development and disinfection of a new well, and repair or deepening of an existing well, shall protect the health and safety of the public utilizing workmanship and materials that meet with the intended use of the well.

10.4.1 Casing shall be hung in tension during the placement of gravel pack and grout material. Approved centralizers shall be used on casing in the gravel pack and grouted interval of the well. The distance between centralizers shall not exceed 50 feet for wells constructed with PVC casing or 100 feet for wells constructed with steel casing that will be grouted for more than 80 feet.

10.4.2 Wells that will be constructed with a surface casing string shall have watertight steel casing and joints installed from a minimum of one (1) foot above to a minimum of nineteen (19) feet below ground level. The annulus between the borehole wall and surface casing string shall, at a minimum, be grouted in accordance with the requirements of Rule 10.5.

10.4.2.1 The annular space between surface casing that is driven and the production casing string shall be grouted with neat cement or cement-bentonite from at least ten (10) feet (wells in Type III aquifers) or twenty (20) feet (wells in Type II aquifers) below the base of the driven casing to not less than ten (10) feet above the base of the driven casing if such casing is to remain in the well (see Figure 3b). Additional grouting below the base of the driven surface casing may be necessary to comply with the requirements for a particular type of aquifer.

10.4.3 All wells that will be constructed without surface casing shall have watertight steel casing and joints installed from a minimum of one (1) foot above to a minimum of nineteen (19) feet below ground level (see Figure 3a). The annulus between the borehole wall and production casing string shall be grouted in accordance with grouting requirements for the particular type of aquifer in which the well is constructed and the requirements of Rule 10.5.2.1.

10.4.4 The borehole shall be constructed to provide sufficient annular space for the placement of grout.

10.4.4.1 The borehole diameter shall not be less than one and three-eighths (1.375) inches larger than the outside diameter of the casing if the annular space is grouted by a method of positive displacement through the casing.

10.4.4.2 If grout is poured from the surface, the annular space, as defined and calculated in Rule 5.2.1, shall not be less than two (2) inches, or one (1) inch if the casing is vibrated.

10.4.4.3 If grout is placed by tremie pipe outside the casing, the annular space shall not be less than the outside diameter of the tremie pipe. In no instance, when using a tremie pipe outside the casing, shall the annular space be less than one (1) inch. The diameter of flexible or collapsible tremie pipe is the outside diameter of the tremie pipe indicated by the manufacturer.

10.4.5 **Wells Constructed Into Confined Aquifers (Type I Aquifers):** Wells completed in a Type I aquifer (see Rule 5.2.2.1) that are constructed without surface casing shall have watertight (solid) casing with watertight joints installed from the base of the confining layer directly above the production zone to the top of the well. Wells completed in a Type I aquifer that are constructed with surface casing shall have solid casing with watertight joints installed from the base of the confining layer directly above the production zone to

at least ten (10) feet above the base of the surface casing (see Figure 2a). A summary of well construction requirements is presented in Table 2.

10.4.5.1 For wells constructed into Type I aquifers, where the borehole penetrates one (1) or more confining layers, the annulus between the borehole wall and the casing string shall be grouted with cement or cement-bentonite from the base of each confining layer back to a level that is not less than forty (40) feet above the base of the confining layer or to the level required to withstand the maximum potential hydrostatic pressure differential between the aquifers. The upper part of the well shall be grouted with cement to a minimum depth of thirty nine (39) feet as shown in Figures 2a and 2b, and in accordance with Rule 10.5.2.1. Grout shall also be placed between casing strings when fluctuating static or water table levels could cause interconnection or intermingling of water from different aquifers unless such interconnection or intermingling has been specifically permitted by the State Engineer.

10.4.6 **Wells Constructed Into Unconfined Bedrock Aquifers (Type II Aquifers):** Wells completed in a Type II aquifer (see Rule 5.2.2.2) that are constructed without surface casing shall have solid casing with watertight joints installed from the top of the production zone to the top of the well. Wells completed in a Type II aquifer that are constructed with surface casing shall have solid casing with watertight joints installed from the top of the zone of production to at least ten (10) feet above the base of the surface casing. In no instance shall less than forty (40) feet of solid casing, from at least one (1) foot above to at least thirty nine (39) feet below ground level, be installed in a well constructed into a Type II aquifer unless the Board of Examiners grants a variance from this Rule. See Table 2 for a summary of construction requirements.

10.4.6.1 If no surface casing is installed, grout shall be placed in the annulus between the production casing and the borehole wall from a depth of at least thirty nine (39) feet up to the level required by Rule 10.5.2.1 (see Figure 2c). If surface casing is installed to a depth less than thirty nine (39) feet below the land surface (see Figure 2b) and grouted up to the level required in Rule 10.5.2.1, the annulus between the borehole wall and the production casing string shall be grouted from a depth of at least thirty nine (39) feet below the surface back to a level that is at least four (4) feet above the base of the grouted interval of the surface casing (ten (10) feet above the base if the surface casing is driven - see Figure 3a and 3b). If surface casing is installed to at least thirty nine (39) feet below the surface, the annulus between the surface casing and the production casing string need not be grouted if the annular space between the borehole wall and the surface casing is grouted from a depth of at least thirty nine (39) feet back to the level required by Rule 10.5.2.1. In no instance shall a well completed in a Type II aquifer have less than thirty (30) feet of continuous grout, unless the Board of Examiners grants a variance from this Rule.

TABLE 2. WELL CONSTRUCTION REQUIREMENTS AND OPTIONS

TYPE I AQUIFER – well construction requirements					
Well Penetrating One Confining Layer					
	<u>Surface Casing (steel)</u>	<u>Grout</u> (Cement) for surface casing	<u>Solid Casing</u>	<u>Grout</u> (Cement) for solid casing near surface	<u>Grout</u> at confining layer (Cement or Cement-Bentonite)
Required at surface	20 feet 1 ft above – 19 ft below surface	From 19 ft up to level required by Rule 10.5.2.1	<u>REQUIRED</u> From top of well, or 10 ft above base of steel surface casing, to base of confining layer above production zone	From at least 39 ft up to level required by Rule 10.5.2.1 or 4ft above base of surface casing grout	<u>REQUIRED</u> From base of confining layer above production zone upward at least 40 ft
Optional at surface	40 feet 1 ft above – 39ft below surface	From 39 ft up to level required by Rule 10.5.2.1		Optional if surface casing is grouted to at least 39 ft	

TYPE I AQUIFER – well construction requirements					
Well Penetrating Two or More Confining Layers					
	<u>Steel Casing</u>	<u>Grout</u> (Cement) for surface casing	<u>Solid Casing</u>	<u>Grout</u> (Cement) for solid casing near surface	<u>Grout</u> at confining layer (Cement or Cement-Bentonite)
Required at surface	20 feet 1 ft above – 19 ft below surface	From 19 ft up to level required by Rule 10.5.2.1	<u>REQUIRED</u> From top of well, or 10 ft above base of steel surface casing to base of confining layer above production zone	From at least 39 ft up to level required by Rule 10.5.2.1 or 4ft above base of surface casing grout to 10 ft below bottom of surface casing.	<u>REQUIRED</u> From base of each confining layer upward to at least 40 ft above base of the confining layer.
Optional at surface	40 feet 1 ft above – 39 ft below surface	From 39 ft up to level required by Rule 10.5.2.1		Additional grout near the surface is optional if surface casing is grouted to at least 39 ft	

TYPE II AQUIFER – well construction requirements

	<u>Steel Casing</u>	<u>Grout</u> (Cement) for surface casing	<u>Solid Casing</u>	<u>Grout</u> (Cement) for solid casing near surface	<u>Grout</u> for Driven Steel Casing (20 ft minimum)
<u>Required</u> at surface	20 feet 1 ft above – 19 ft below surface	From 19 ft up to level required by Rule 10.5.2.1	<u>REQUIRED</u> From top of well, or from at least 10 ft above base of surface casing, to production zone	From at least 39 ft up to level required by Rule 10.5.2.1 or 4ft above base of surface casing grout	<u>REQUIRED</u> Cement or Cement-Bentonite between production and driven casing from 10 ft above to 20 ft below base of driven casing
Optional at surface	40 feet 1 ft above – 39 ft below surface	From 39 ft up to level required by Rule 10.5.2.1		Optional if surface casing is grouted to at least 39 ft	

TYPE III AQUIFER – well construction requirements

	<u>Steel Casing</u>	<u>Grout</u> (Cement) for surface casing	<u>Solid Casing</u>	<u>Grout</u> (Cement) for solid casing near surface	<u>Grout</u> for Driven Steel Casing (20 ft minimum)
<u>Required</u> at surface	20 feet 1 ft above – 19 ft below surface	Not less than 10 ft of continuous grout from the level required by Rule 10.5.2.1	<u>REQUIRED</u> From top of well, or 10 ft above base of surface casing, to production zone	From at least 19 ft up to level required by Rule 10.5.2.1.	<u>REQUIRED</u> Cement or Cement-Bentonite between production and driven casing from 10 ft above to 10 ft below base of driven casing
Optional at surface	Steel casing below 19 ft is optional	Additional grout is optional			

TYPE I AQUIFERS **SCHEMATIC DIAGRAM FOR WELLS** **PENETRATING ONE CONFINING LAYER**

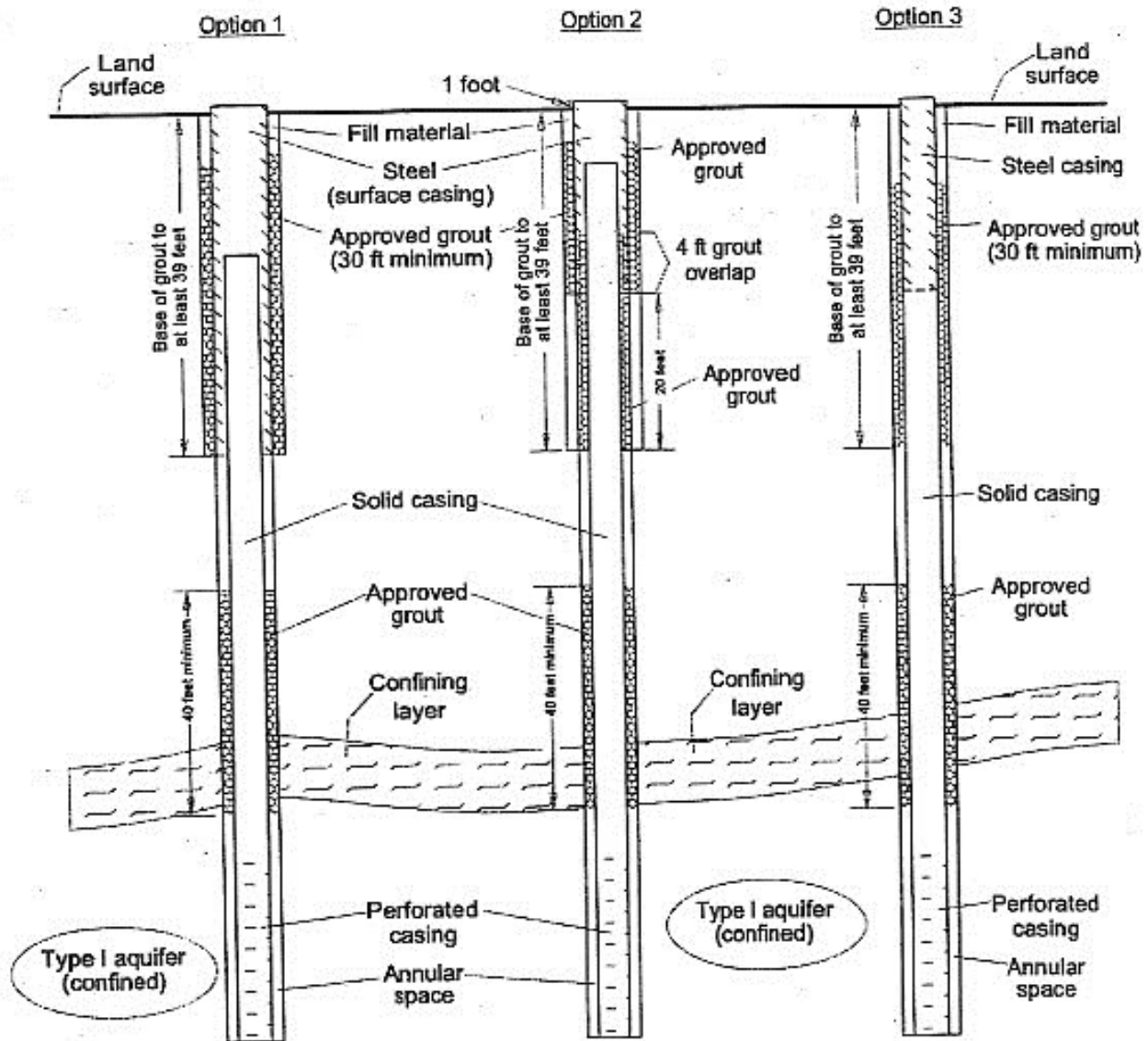


Figure 2a. Schematic diagram for wells that penetrate only one confining layer and are constructed into a Type I (confined) aquifer. Option 1 shows steel surface casing to 39 ft. Option 2 shows steel surface casing to the minimum depth of 19 ft. Option 3 is a well with minimum 20 ft of steel casing at top of well (without surface casing).

NO SCALE

The diagram illustrates three different methods for installing well casing and grouting, labeled Option 1, Option 2, and Option 3. Each option shows a cross-section of the ground with the land surface at the top.

- Option 1:** Shows a steel casing (surface casing) installed in the ground. The casing is surrounded by fill material. Approved grout is placed around the casing, with a base of grout to at least 30 feet. A Type I aquifer (confined) is shown below the casing, separated by a confining layer. The casing is perforated, and the annular space is filled with approved grout.
- Option 2:** Shows a steel casing installed in the ground. The casing is surrounded by approved grout. A 4 ft grout overlap is indicated. The base of grout is to at least 39 feet. A Type I aquifer (confined) is shown below the casing, separated by a confining layer. The casing is perforated, and the annular space is filled with approved grout.
- Option 3:** Shows a solid casing installed in the ground. The casing is surrounded by approved grout. The base of grout is to at least 39 feet. A Type I aquifer (confined) is shown below the casing, separated by a confining layer. The casing is perforated, and the annular space is filled with approved grout.

Common labels across the options include: Land surface, Fill material, Steel casing, Approved grout, Base of grout to at least 30 feet, 40 feet minimum, Confining layer, Type I aquifer (confined), Perforated casing, and Annular space.

NO SCALE

TYPE II AQUIFERS SCHEMATIC DIAGRAM FOR WELLS

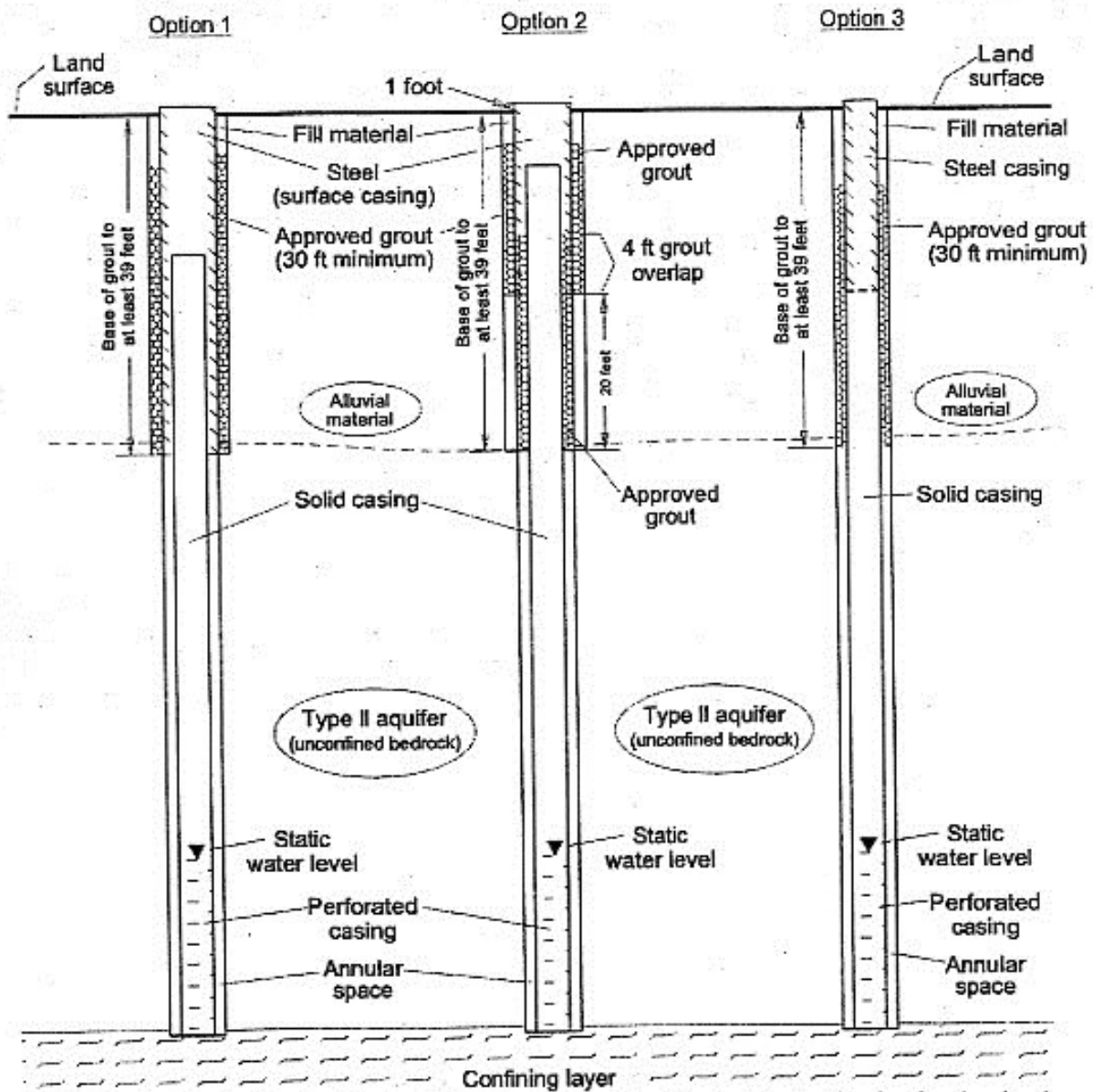


Figure 2c. Schematic diagram for wells constructed into Type II (unconfined bedrock) aquifers. Option 1 shows steel surface casing to 39 ft. Option 2 shows steel surface casing to the minimum depth of 19 ft. Option 3 is a well with 20 ft of steel casing at top of well (without surface casing) .

NO SCALE

TYPE III AQUIFERS SCHEMATIC DIAGRAM FOR WELLS

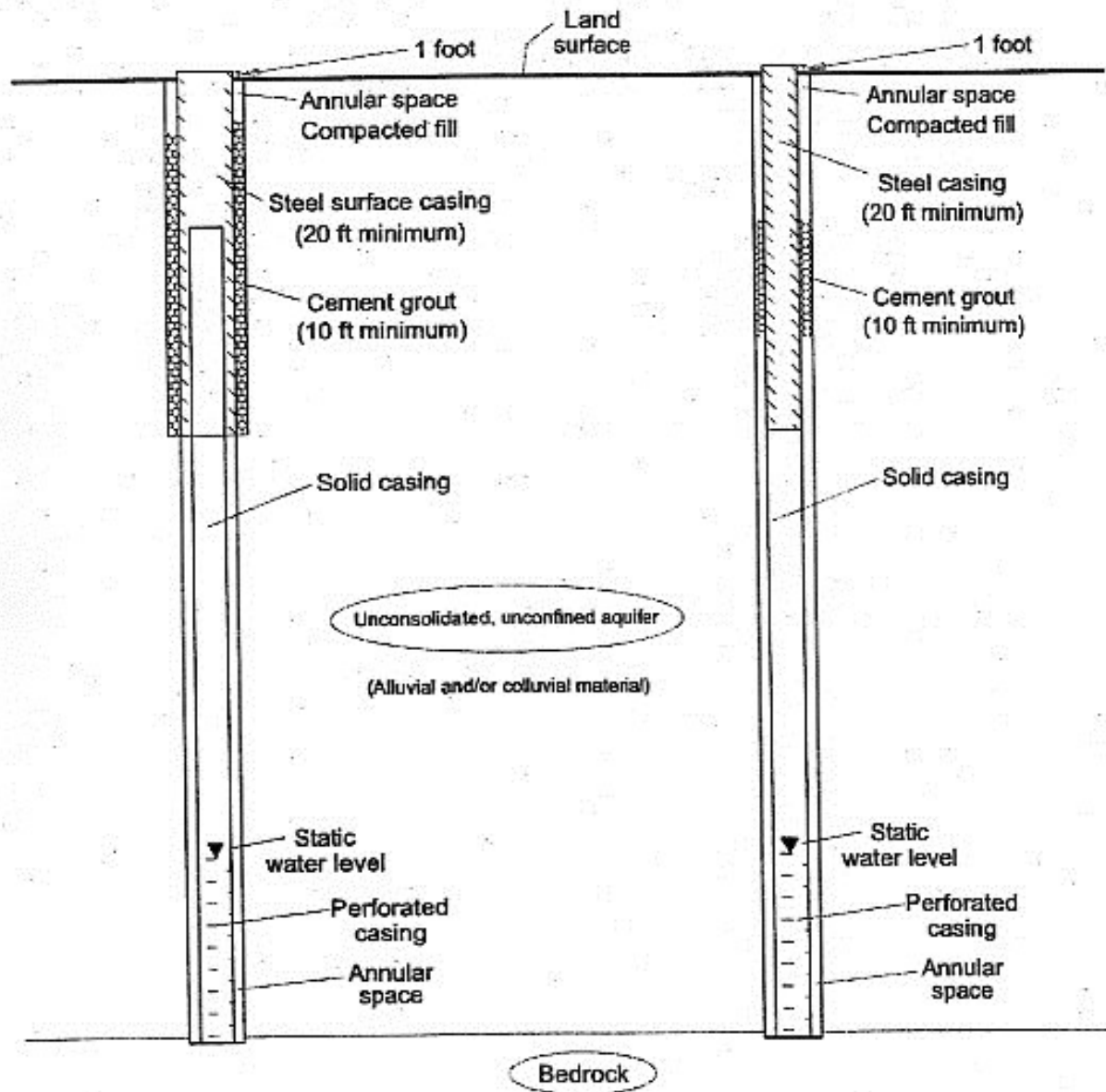
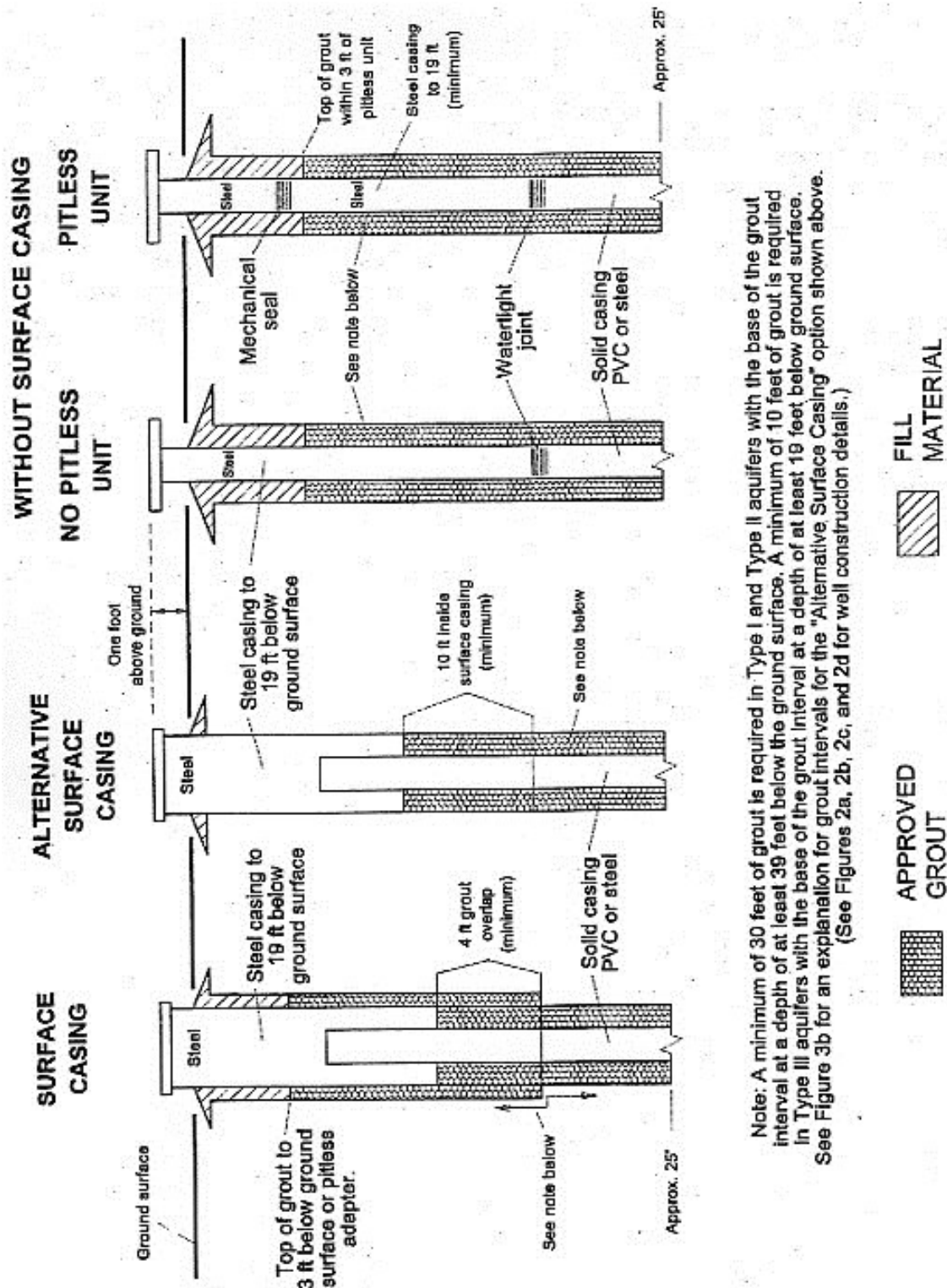


Figure 2d. Schematic diagram for wells constructed into Type III (unconfined, unconsolidated) aquifers.

NO SCALE



Note: A minimum of 30 feet of grout is required in Type I and Type II aquifers with the base of the grout interval at a depth of at least 39 feet below the ground surface. A minimum of 10 feet of grout is required in Type III aquifers with the base of the grout interval at a depth of at least 19 feet below ground surface. See Figure 3b for an explanation for grout intervals for the "Alternative Surface Casing" option shown above. (See Figures 2a, 2b, 2c, and 2d for well construction details.)

See Table 3 for explanation of fill material and approved grout.

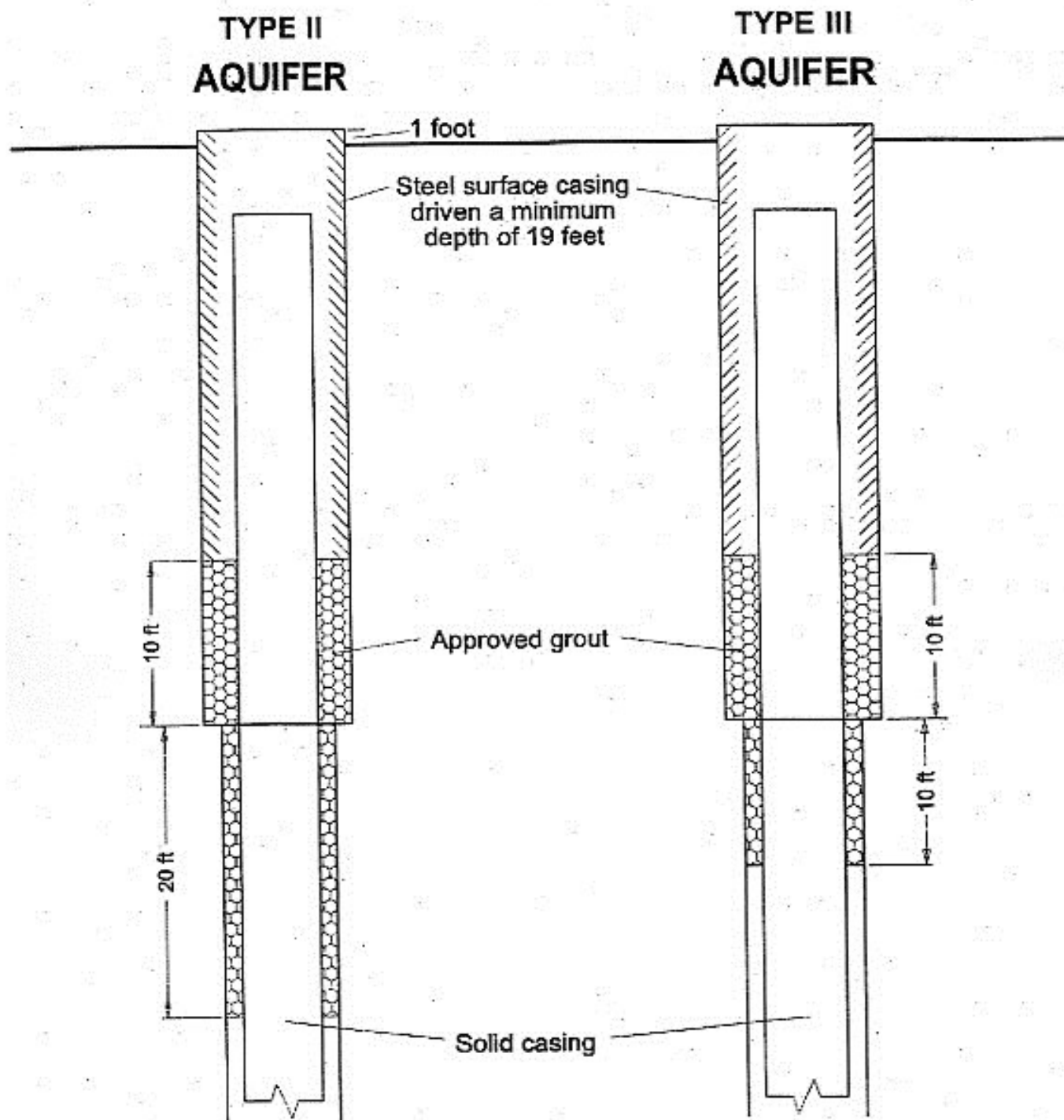


Figure 3b. Schematic diagram for grout placement in wells with driven steel casing as described in Rules 10.4.2.1 and 10.5.2.1(c).

10.4.7 **Wells Constructed Into Unconsolidated Aquifer Material (Type III Aquifers):** All wells completed in a Type III aquifer (see Rule 5.2.2.3) that are constructed without

surface casing shall have solid casing with watertight joints installed from at least the anticipated water level in the borehole to the top of the well. Wells constructed with surface casing shall have solid casing with watertight joints installed from the anticipated static water level in the well to at least ten (10) feet above the base of the surface casing. In no instance shall less than twenty (20) feet of solid casing, in accordance with Rule 10.4.2 or Rule 10.4.3, be installed in a well constructed into a Type III aquifer unless the Board of Examiners grants a variance from this Rule. See Table 2 for summary of well construction requirements.

10.4.7.1 In wells constructed with surface casing into Type III aquifers, the annulus between the borehole wall and the surface casing shall be grouted from a depth of at least nineteen (19) feet back to the level required by Rule 10.5.2.1. If the surface casing is driven, grout shall be placed between the production casing and driven casing from not less than ten (10) feet below to at least ten (10) feet above the base of the driven casing (see Figure 3b). If surface casing is not installed, the annulus between the borehole wall and the production casing string shall be grouted from a depth of at least nineteen (19) feet back to the level required by Rule 10.5.2.1 (see Figure 2d). In no instance shall a well completed in a Type III aquifer have less than ten (10) feet of continuous grout, unless the Board of Examiners grants a variance from this Rule.

10.4.8 In the event the outermost casing is cut off and does not extend more than one (1) foot above ground surface, the annulus between the outer casing and the casing that does extend above the surface shall have a watertight mechanical seal or shall be sealed with a minimum of ten (10) feet of cement grout. If the annulus between the casings is sealed with cement grout, the top of the seal shall not exceed the depth below ground level specified in item a. or b. of Rule 10.5.2.1.

10.4.9 It shall be the responsibility of all persons authorized to construct wells to ensure the well is completed in only one aquifer unless otherwise permitted by the State Engineer.

10.4.10 All wells intended for the withdrawal and beneficial use of ground water, or for the injection of water into an aquifer, shall be constructed to seal off known sources of contaminants.

10.4.10.1 Prior to construction, the drilling contractor shall advise the well owner, or his agent, that known zones of poor quality water may be penetrated by the borehole in the production zone of the aquifer.

10.4.11 If a filter pack is installed in a well, the interval of the filter pack materials shall be limited to the producing aquifer and shall not extend to the ground surface. If additional filter pack materials are to be added after the well has been completed, those materials shall be inserted through the use of a filler tube.

10.4.12 Prior to the construction of infiltration galleries or gallery type wells, written plans detailing the location and size of the proposed excavation, size and materials to be installed, amounts, types and placement method of grout and backfill materials to be used and other information pertinent to the construction and use shall be submitted to the Board of Examiners. If the Board finds the proposed gallery acceptable, it shall approve the construction plan in writing, imposing conditions necessary to reduce the risk to public health by contamination of the aquifer. Some acceptable examples of gallery type wells are shown in Figure 4.

10.4.13 Unless directional drilling has been specifically approved by the State Engineer, all wells shall be constructed so that the horizontal deviation of the borehole from its surface

location is a practical minimum at all times. An unintentional deviation of the borehole due to adverse drilling conditions shall not be considered directional drilling.

10.5 Grout and Grout Placement All wells shall be grouted to prevent contaminants from entering the borehole, to separate ground waters in different aquifers, and to seal off water bearing zones known or suspected to contain contaminants. To achieve these objectives, the selection, mixing and placement of all grout shall be the responsibility of the person authorized to construct the well. All grout seals shall be installed as a prerequisite to the completion of the well and the installation of the production equipment.

10.5.1 Only grout materials that meet the requirements set forth in Table 3 shall be used. Grout shall be uniformly mixed prior to placement in the well. The grout mixture density and the volume percent of each additive used in the grout mixture shall be reported on the well construction report.

10.5.2 The following minimum grout intervals shall apply to all wells intended for the withdrawal of ground water, or for the injection of water into an aquifer.

10.5.2.1 At or near ground surface, the annulus between the borehole and the outermost casing shall be sealed with at least the minimum amount of cement grout required for the particular type of aquifer in which the well is constructed (see Figure 3a). The top of this grout seal shall not exceed the depths below ground level as set forth below:

- a. not more than three (3) feet below ground level if no pitless connection is installed on the casing;
- b. not more than three (3) feet below any pitless adapter or pitless unit to be installed. The annulus above the pitless connection shall be filled with materials not more permeable than the surrounding ground that are adequately compacted; or
- c. not less than ten (10) feet above the base of the surface casing that has been driven, or when there are other practical reasons the surface casing cannot be grouted, when such casing is installed in Type II or Type III aquifers. If the well is constructed into a Type II aquifer, the grout interval shall extend at least twenty (20) feet below the base of the surface casing. If the well is constructed into a Type III aquifer, the grout interval shall extend at least ten (10) feet below the base of the surface casing. See Figure 3b.

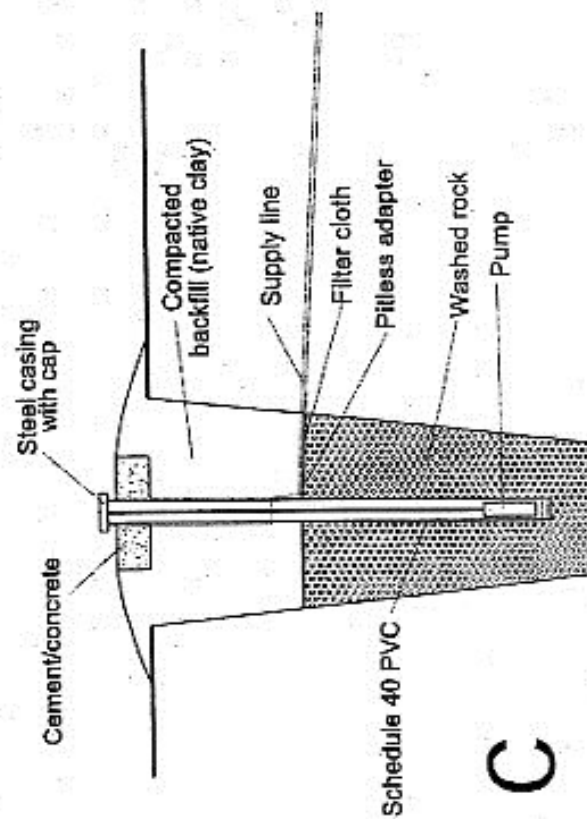
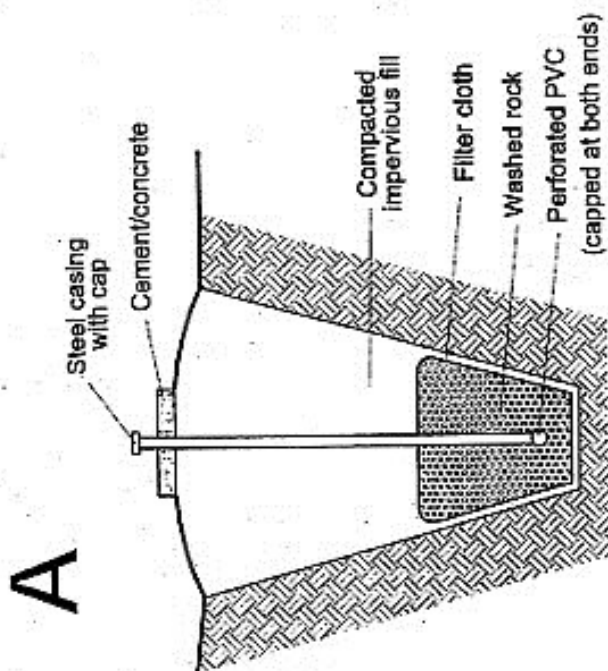
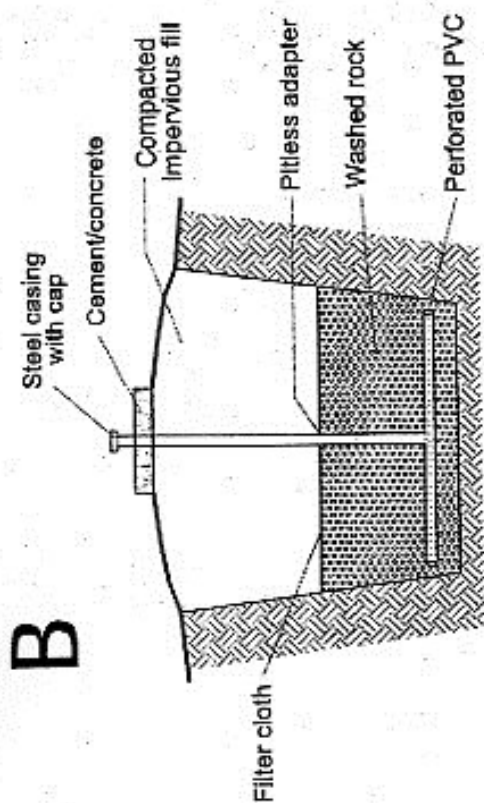
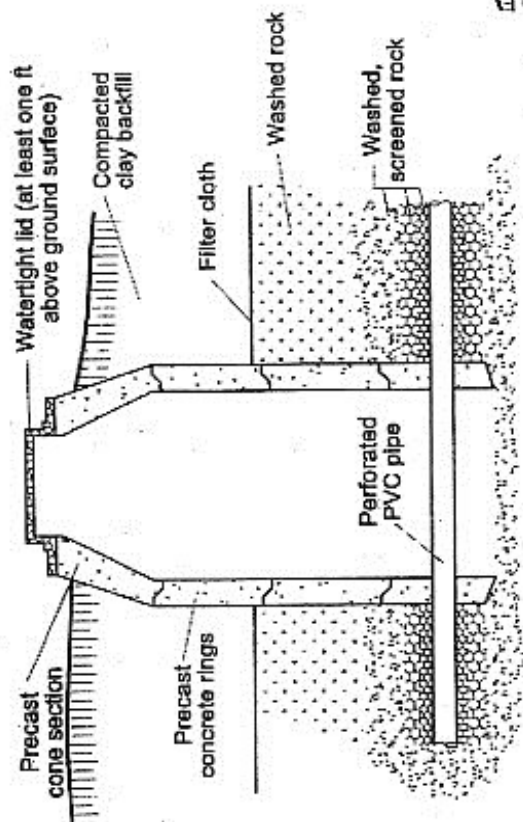


Figure 4. Schematic of various gallery-type well designs.
NO SCALE



D

E

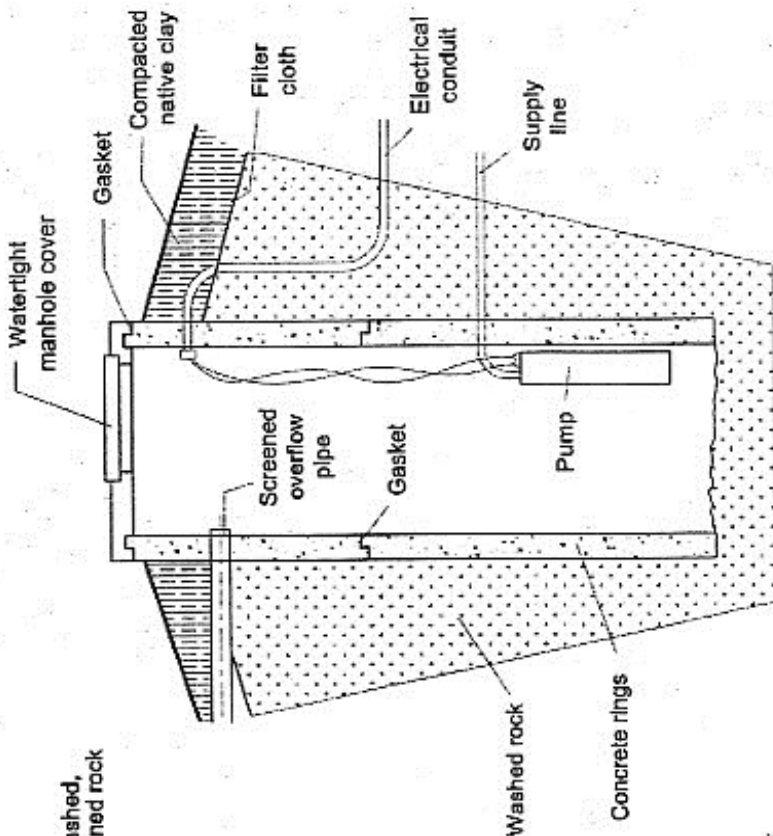


Figure 4(continued). Schematic of various gallery-type well designs.
NO SCALE

TABLE 3 - GROUTS

Approved Grouts

- A. Neat Cement:** a slurry of cement and water with the following mixing ratios:
- 7 gallons of water per 94 pound sack if the slurry is pumped into the well; or
 - 6 gallons of water per 94 pound sack if the slurry is poured into the annulus.

Fly ash may be blended with Portland cements for grouting wells. The water-cement ratio for these grout slurries shall not exceed 5 gallons of water per 86 pound sack of blended cement.

B. Cement-Bentonite: a slurry of cement, bentonite and water. The amount of bentonite added shall not exceed 8% bentonite per dry weight of cement. The volume of additional water used in preparing these slurries is limited to three quarters (0.75) of a gallon per 94 pound sack of cement for each 1% of bentonite added.

Bulk Grouts -restricted use (see Rule 10.5.3.3)

A. Cement-Sand: a slurry of cement, sand and water. The amount of sand added shall not exceed 140 pounds for each 94 pound sack of cement. Not more than seven (7) gallons of water per 94-pound sack of cement shall be used in the preparation of these slurries. These slurries should be used where extra strength or bulk is required.

B. Concrete: a slurry of cement, sand and gravel aggregate. The amount of aggregate added shall not exceed 400 pounds for each 94 pound sack of cement. Not more than seven (7) gallons of water per 94-pound sack of cement shall be used in the preparation of these slurries. These slurries should be used where extra strength and bulk is required and the annular space allows the placement of the slurry.

Bentonite - restricted use pursuant to Rule 10.5.3.4.
(Variance required prior to use in water wells)

Only high solids bentonite products that are clearly marked by the manufacturer as "grout" may be used. Mixing of bentonite grouts shall strictly adhere to the manufacturer's recommendations and shall achieve a slurry of not less than 20% solids by volume and a density of not less than 9.8 pounds per gallon.

A. Bentonite Slurry: a slurry of bentonite clay (chips and pellets) and water. Mixing of bentonite grouts shall strictly adhere to the manufacturer's recommendations and shall achieve a slurry of not less than 20% solids by volume and a density of not less than 9.8 pounds per gallon. The density shall be measured using a "mud balance" and reported on the well construction and test report.

B. Granular Bentonite: solid granular bentonite (pellets and chips) may be used as grout material only in saturated zones and shall be placed directly into the appropriate interval.

Prior to the use of other grout materials, a written request shall be submitted to and written approval obtained from the Board. (Table 3 continued on next page)

Fill Materials

Fill material, such as clean native clay, drill cuttings, or other inert rock material may be used to fill the annular space in any interval where grout is not required by these Rules. These materials are not grouts and shall not be placed where grout is required. Fill materials placed in the annulus near the land surface shall not be more permeable than the surrounding soil and shall be adequately compacted to prevent settling.

10.5.2.2 All known water bearing zones containing contaminants shall be sealed off by placing grout throughout the interval from twenty (20) feet below to twenty (20) feet above those zones.

10.5.3 The method of grout placement shall achieve a permanent watertight seal for the required interval(s). Grout shall be selected and placed to withstand the maximum potential hydrostatic pressure differential between aquifers.

10.5.3.1 Grout shall be placed by positive displacement using either the well casing or a tremie pipe, and grouting of each interval or stage shall be installed from the bottom up in one continuous operation unless placed in accordance with Rules 10.5.3.2 or 10.5.3.3.

10.5.3.2 Only neat cement or cement bentonite shall be used when the grout is poured from the surface except as provided in Rule 10.5.3.3. Grout may be poured only into a dry annulus where the annular space is not less than two (2) inches, or one (1) inch if the casing is vibrated, and the placement depth does not exceed forty (40) feet below the land surface.

10.5.3.3 Cement-sand or concrete grout mixtures can be poured only into a dry annulus where the borehole diameter is at least twelve (12) inches larger than the outside diameter of the casing and the placement depth does not exceed forty (40) feet.

10.5.3.4 Bentonite grout may be used in required grout intervals only pursuant to a variance from the Board and if its use is consistent with the requirements of this Rule and Table 3. Bentonite shall not be used to seal the outermost casing of a well within 40 feet below ground surface. Bentonite shall not be poured from the surface, but shall be placed directly into the appropriate interval. Introduction of sand, gravel, or other bulk material into the granular bentonite or bentonite slurry or interval of bentonite placement is prohibited. Bentonite should not be used as a grout in the presence of high concentrations of calcium, magnesium and salts. A fully hydrated bentonite slurry shall not be used as a grout where a difference in hydrostatic head exists across the grout interval.

10.5.4 It is the responsibility of the person authorized to construct the well to allow the grout to set before resuming construction. The minimum setting time shall be six (6) hours for cement grout with accelerators and twenty four (24) hours for cement grout without accelerators.

10.6 **Well Development and Cleaning** All wells shall be cleaned and developed to remove drilling fluids, drill cuttings, and foreign materials introduced into the borehole.

- 10.7 **Disinfection** Prior to leaving the well site, the person authorized to construct the well shall disinfect the well according to the provisions of Rule 15.
- 10.8 **Water Level Measurement** The static water level in all newly constructed or modified wells shall be measured by the well construction or pump installation contractor, private driller, private pump installer or authorized individual, within seven days after the well has been cleaned and developed. This measurement shall be reported on the well construction or pump installation report.
- 10.9 **Flowing Wells** Flowing wells shall be constructed to prevent leakage around the casing or adjacent to the well. Upon completion of grouting, flowing wells shall be equipped with either a valve, threaded coupling, or other suitable means to completely control the flow from the well, or the well shall be plugged, sealed and abandoned in accordance with Rule 16. It is the responsibility of the well construction contractor or private driller to install such equipment at the time of well construction. Thereafter, it is the responsibility of the well owner to ensure the equipment is maintained and operational.

RULE 11 MINIMUM PUMP INSTALLATION AND CISTERN INSTALLATION STANDARDS

- 11.1 **General** - All permanent pump installations and cistern installations shall be completed only by a licensed pump installation contractor or a private pump installer (see Sections 37-91-102(12.5) and 37-91-109(2), C.R.S. 2004). Pumping equipment may be installed in wells constructed and used solely for purposes of aquifer remediation (recovery well) or temporary dewatering of the aquifer (dewatering well) by authorized individuals or anyone directly employed by or under the supervision of an authorized individual. It is the responsibility of the person installing the pumping equipment to ensure that a valid well permit authorizing such installation exists in accordance with the requirements of Rule 6.2.2.1 and 6.2.2.2.
- 11.1.1 Well construction contractors who are not licensed pump installation contractors may install temporary pumps used for well development and testing only.
- 11.1.2 Pump installation contractors shall not remove and install casing except for the installation of pitless adapters or pitless units, the repair and upward extension of existing casing from the pitless adapter or unit, and the installation or replacement of liners through only one aquifer where the placement of grout in the annulus is not required to meet the standards of these Rules.
- 11.1.3 Temporary "test" pumps may be installed in monitoring and observation holes/wells for testing purposes only (see Rule 14.4).
- 11.2 **Installation Standards** - Pumps, cisterns and related equipment shall be installed in such a manner that the well, pump, cistern and surrounding area can be kept in a sanitary condition, and will provide adequate protection against contamination from any surface or subsurface source.
- 11.2.1 Pump installation contractors shall not cut off or penetrate well casing below ground level except to install a pitless adapter or a pitless unit. Pitless adapters shall be installed on steel casing that extends to a minimum of one (1) foot above the finished ground level and shall be watertight. Pitless units shall have steel extensions to a minimum of one (1) foot above the finished ground level. All connections to the pitless adapters or pitless units shall be made with threaded, flanged, welded or mechanical joints. Mechanical joints shall be rodded across the connection and secured to the body of the well casing or pitless assembly. In the event it is necessary to cut off the outermost casing below ground level in order to install a pitless unit on the inner casing, a water tight mechanical seal or a minimum of ten (10) feet of cement grout shall be installed in the annulus between the casings.

- 11.2.2 Pump installation contractors shall not cut off or penetrate cisterns below ground level except to install water lines or electric lines using only manufacturer approved watertight devices.
- 11.3 Cistern Location** - When selecting a cistern location, consideration shall be given to topography, drainage, sources of contaminants, and other on site conditions in order to promote sanitary conditions and prevent contamination of the well and aquifer.
- 11.3.1 A cistern installed below ground level shall be constructed and placed in such a manner to withstand saturated soil pressures when empty.
- 11.3.2 A cistern installed below ground level shall be watertight and the access portal shall extend to at least one foot above the ground surface. The backfill material shall be sloped away from the access portal.
- 11.3.3 A cistern installed below ground level shall be buried to an adequate depth to prevent freezing.
- 11.3.4 A cistern installed below ground level shall be properly bedded and backfilled in accordance with the manufacturers recommendation.
- 11.3.5 A cistern placed in a building shall be placed in an area that is adequate to support the anticipated loads of the cistern, full of water, all pumping equipment, and controls.
- 11.3.6 A cistern will be placed in an area accessible to service in the future.
- 11.4 Location Variance** - A cistern shall not be located closer than one hundred (100) feet horizontally to the nearest existing source of contaminants or fifty (50) feet from a septic tank, sewer line or other vessel containing contaminants. A request for variance must be submitted and written approval from the Board must be obtained prior to the construction of a cistern that cannot meet this spacing requirement.
- 11.4.1 A request for variance from the location requirement of Rule 11.4 shall be prepared in accordance with rule 18.2 by a pump installation construction contractor, a registered professional engineer or a professional geologist, shall be based on hydrogeologic information. In no case shall the horizontal distance of the cistern to the nearest existing source of contaminants be less than 25 feet.
- 11.5 Contamination Prevention** - All pumping equipment and cisterns shall be installed with an effective well seal at the top of the casing that will prevent the entry of contaminants into the well. The pumping equipment shall be designed to allow for its installation and removal through an approved well seal and to prevent unprotected openings from connecting with the interior of the pump or well.
- 11.5.1 Well and cistern vents, when needed or used, shall permit air to freely enter and exit the well with changing water levels in the casing. Vents may be an integral part of the well or cistern seal or be attached to the seal and terminate a minimum of one (1) foot above the finished ground level, be turned down, and screened to prevent entry of insects and rodents. Vents shall be constructed to vent all gases to the atmosphere outside of a building and to prevent gas accumulation that could produce a health or explosion hazard.
- 11.5.2 Flowing wells shall be equipped so that the discharge can be controlled or stopped at all times. It is the responsibility of the pump installation contractor or private pump installer

to install such equipment. Thereafter, it is the responsibility of the well owner to ensure the equipment is maintained and operational.

11.5.3 Pumping systems shall be designed to not exceed the permitted pumping rate at the point of delivery when operating under normal design conditions.

11.6 **Well Vaults** - New well vault installations are not permitted unless specifically approved pursuant to a variance granted by the Board. If a variance is granted by the Board, provisions shall be made to prevent contaminants from entering the well and for gravity drainage of the vault through a floor drain or to an automatic sump pump.

11.6.1 **Existing Well Vaults** The vault shall be structurally sound to support anticipated surface loads and the top shall be watertight including any manhole covers. The well casing shall extend at least one (1) foot above the floor of the vault and shall have a well seal to prevent contaminants from entering the well. Provisions shall be made for gravity drainage of the vault through a floor drain or to an automatic sump pump. All drain openings shall be screened to prevent the entry of rodents and insects.

11.6.2 Well construction or pump installation contractors encountering unacceptable well vaults shall make every effort to bring the well vault into compliance with these Rules. If it is not possible to correct the problems, the contractor shall notify the Board of Examiners.

11.7 **Water Level Measurement Access** - An air line, water level sounding tube or other method approved by the Board shall be installed on all wells whenever the permit issued by the State Engineer requires the installation of water level measuring equipment.

11.7.1 An air line tube shall consist of tubing extending from the well head to the top of the pump discharge case. This tubing shall be capable of withstanding the maximum pressures developed during use. The tube shall be securely fastened to the pump discharge case, column pipe or drop pipe. The depth of the air line shall be recorded on the Pump Installation Report.

11.7.2 The water level sounding tube shall have a minimum inside diameter of 3/4 inch. It shall extend from the well head to the top of the pump discharge case and shall be securely attached to the column or drop pipe so that it hangs straight. All tubes shall be equipped with a removable cap or plug to prevent entry of foreign material. The bottom of the tube shall be constructed to allow the free entry and exit of water and to prevent the measuring device from passing out of the bottom of the tube.

11.8 **Compliance with Applicable Law** All persons authorized to install pumps and cisterns shall comply with applicable federal, state, county, municipal, or local laws, regulations, and codes.

11.8.1 **Electrical Connection of Pumping Equipment** Only licensed pump installation contractors, private pump installers or licensed electrical contractors, using appropriately licensed personnel, may install electrical materials and connections between the well head junction box and the pump service disconnect box (see Figure 5). The materials, fittings, and control assemblies used for this installation shall meet the standards of the NFPA's National Electric Code (1999), and are subject to permitting and inspection by the Colorado State Electrical Board. Electric power to the pump service disconnect box shall be installed by either a licensed electrical contractor or the property owner. The referenced material incorporated into this Rule does not include later amendments to or editions of the incorporated material.

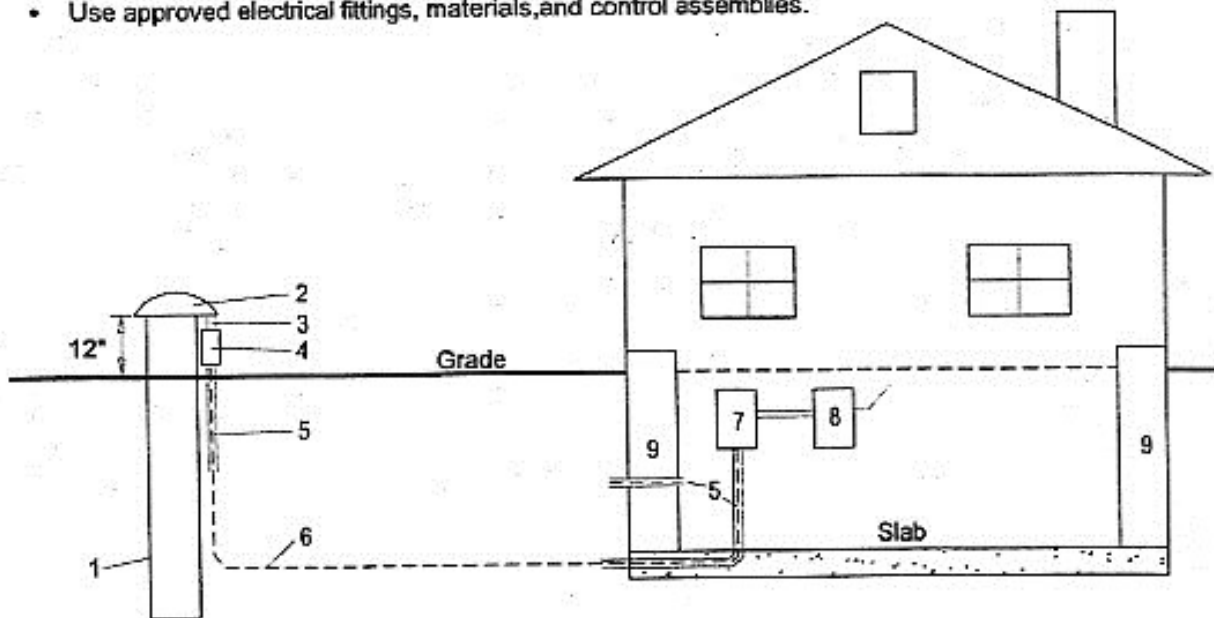
11.8.2 **Plumbing Connection of the Pumping Equipment** Only persons authorized to install pumps may install piping and connection between the well and the point of discharge

from the pressure tank, if such a tank is installed. As a minimum, all materials and fittings used to connect the well to the pressure tank shall meet the standards of the Rules and Regulations of the Colorado Examining Board of Plumbers, 3 CCR 720-1 (1996). The referenced material incorporated into this Rule does not include later amendments to or editions of the incorporated material.

- 11.9 **Pressure Relief Valve** All pumping systems capable of producing pressures greater than seventy five (75) pounds per square inch shall be equipped with a pressure relief valve sized to discharge the production rate of the pumping system.
- 11.10 **Backflow Prevention** Pump installations and cistern installation shall have check valves, backflow preventing devices or suitable air gap cross connection controls, if necessary to prevent damage to the pumping equipment and contamination of the aquifer. Pump installations supplying water where contaminants are injected into the water system shall be equipped with backflow prevention devices to prevent contaminated water from flowing into the well and aquifer.

FIGURE 5. REQUIREMENTS FOR WELL WIRING

- Electrical permit required prior to installation.
- Inspection required before concealment.
- Rejections require reinspection fee.
- Residential, domestic use only.
- Not over 300 volts single phase.
- Use approved electrical fittings, materials, and control assemblies.



1. Well casing.
2. Well head.
3. Metal nipple.
4. Approved weatherproof box. can be FS box or bell box.
5. Approved electrical conduit.
6. Conductors approved for direct burial. Size of conductors to be determined by size of pump motor and distance. Well casing shall be bonded to the pump circuit equipment grounding conductor in junction box on well casing.
7. Controller - licensed electrical contractor or licensed well contractor.
8. Disconnect - installed by licensed electrical contractor or licensed well contractor.
9. Foundation - all wiring through or under foundation, or under concrete floor, to be installed in approved electrical conduit.

* Note: Conduit must extend 18 inches below finished grade from well junction box.

11.10.1 Pump installations and cisterns supplying irrigation water where fertilizers, insecticides, herbicides or other chemicals are injected into the water shall be equipped to prevent well or aquifer contamination. The installation shall comply with Section 35 11 107, C.R.S. and the Rules and Regulations Pertaining to the Administration and Enforcement of the Colorado Chemigation Act, 8 CCR 1203-8 (1993), promulgated by the Department of Agriculture pursuant to the Colorado Chemigation Act, Article 11 of Title 35, C.R.S. The referenced material incorporated into this Rule does not include later amendments to or editions of the incorporated material.

11.10.2 Cisterns shall be equipped with anti-siphon device to prevent backflow or discharge from the cistern.

11.11 **Disinfection** After installing a pump or cistern and prior to leaving the well site, persons authorized to install pumps shall disinfect the well, pump, and accessible water supply system according to the Provisions of Rule 15. Monitoring and observation holes/wells, dewatering wells, and recovery wells are exempt from this standard if it conflicts with the purpose of the well.

RULE 12 WELL TESTING

12.1 **General** - The provisions of this Rule establish minimum standards for the testing of water wells. Every well constructed for the purpose of producing ground water shall be tested to determine:

- a. a stabilized yield for the well; and
- b. the production rate of the equipment installed when the well is placed into service.

12.2 **Well Yield Test** - The yield of a well shall be determined as a stabilized production rate where the withdrawal rate and the drawdown do not change by more than 10% during the last hour of the test. The test shall demonstrate that either:

- a. the well is capable of producing the permitted pumping rate; or
- b. that the maximum yield of the well is less than the permitted production rate.

12.3 **Responsibility for Well Yield Test** - Well construction contractors are responsible for performing the well yield test and submitting the test data to the State Engineer. If the construction contractor also installs the production equipment, the well yield test may be combined with the production equipment test, provided that the test meets the requirements of Rule 12.2. The construction contractor may forego the well yield test if he can show that a licensed pump installer will perform the well yield test with the permanent production equipment within thirty (30) days of completion of construction of the well. If the pump installation contractor performs the well yield test, he/she shall submit the test information on the Pump Installation and Test Report.

12.4 **Production Equipment Test** - The production equipment installed in wells shall be tested to ensure it is functioning as designed. The test shall demonstrate the production capacity of the equipment as actually installed in the well. It is the responsibility of the person installing the pumping system to ensure that the production from the well complies with the conditions of the well permit.

12.5 **Responsibility for Production Equipment Test** - Pump installation contractors are responsible for testing the production equipment installed in a well upon completion of their work. If the well construction contractor determined the well yield and submitted a report, the pump installer need not perform another well yield test. If the pump installer does not perform a well yield test with the permanent production equipment, he/she shall perform a production equipment test and report the data (results) to the State Engineer on the Pump Installation and Test Report.

RULE 13 SAMPLING, MEASURING AND TEST PUMPING

- 13.1 **Well Owner's Knowledge** Sampling, measuring and test pumping shall be conducted with the well owner's knowledge.
- 13.2 **Measuring Devices** All measuring and sampling devices and equipment shall be cleaned, decontaminated and disinfected in accordance with Rule 15.6 prior to being inserted into any well.
- 13.3 **Removal of Well Seal** Only a licensed well construction contractor, licensed pump installation contractor, authorized individual, or the well owner may remove a well seal. Whenever the seal is removed from a well and the equipment being used in the well is not disinfected pursuant to Rule 15.6, the well shall be disinfected according to Rule 15.3. The person removing the well seal shall be responsible for disinfecting the well and reinstallation of the seal.
- 13.4 **Measuring, Sampling and Test Pumping** Registered professional engineers, professional geologists or hydrologists, or anyone directly employed by or under the supervision of a registered professional engineer, professional geologist or hydrologist may measure, sample or test pump holes/wells for scientific, engineering and regulatory purposes. Such activities shall be limited to measuring water levels, collecting water samples and the installation of pumps dedicated solely to scientific, engineering or regulatory purposes, provided this work complies with the standards in these Rules.
- 13.5 **Lost Equipment** It is the responsibility of the person doing the testing, sampling, or measuring to inform the well owner in writing of any equipment malfunction, equipment loss in the well, or difficulties encountered.

RULE 14 MINIMUM CONSTRUCTION STANDARDS FOR MONITORING AND OBSERVATION WELLS, MONITORING AND OBSERVATION HOLES, AND TEST HOLES

- 14.1 General - Monitoring and observation wells, monitoring and observation holes, and test holes are primarily used for observing ground water levels and flow conditions, obtaining samples for determining ground water quality, for conducting geotechnical investigations, and for evaluating hydraulic properties of water-bearing strata. See Section 37-91-102(10.5) and (15.7), C.R.S., and Rule 5.2.31 for definitions and authorized uses for each type of structure.
- 14.1.1 If the holes do not penetrate a confining layer, monitoring and observation holes/wells, and test holes may be constructed by an authorized individual (see Rule 5.2.4 and Rule 9), a licensed well construction contractor, or a private driller (see Section 37-91-102(12), C.R.S). See Rules 6, 7, 9, 14 and 17, and summarization in Table 1 for licensing, notification and reporting requirements. Monitoring and observation holes/wells and test holes that penetrate a confining layer shall not be constructed by an authorized individual. Holes that penetrate a confining layer must be drilled by a licensed contractor and shall comply with the standards of Rule 10.
- 14.1.2 All monitoring and observation holes/wells and test holes shall comply with the construction standards and plugging, sealing and abandonment standards specified in these Rules. The order of responsibility for notice and reporting requirements and for ensuring compliance with this Rule 14 is as stated in Rule 9.1. The person authorized to construct and to plug, seal and abandon monitoring and observation holes and test holes shall ensure that the proper notice has been provided to the State Engineer pursuant to Rule 6.3, keep accurate records of work performed, and submit the required reports to the State Engineer (see Rule 17).

- 14.1.3 Prior to starting construction, all persons authorized to construct monitoring and observation holes/wells or test holes shall investigate and become familiar with the geology of potential aquifers, anticipated water quality problems, and known contaminated water bearing zones which may be encountered in the area of the proposed drilling activity.
- 14.1.4 When hazardous contaminants are known or suspected to be encountered during construction, the authorized individual, licensed contractor, or private driller shall be responsible for ensuring that all personnel on site are adequately trained and that proper safety equipment is provided to handle and contain those substances.
- 14.1.5 Drill cuttings and wastewater from monitoring and observation wells/holes or test holes in areas of known or suspected contamination shall be disposed of in accordance with all applicable federal, State, and local requirements.
- 14.1.6 All wells and boreholes, when unattended, shall be securely sealed, capped, or covered. It is the responsibility of the person constructing the hole or well to ensure the borehole is securely covered, when unattended, during construction and to ensure the hole or well is securely sealed or capped upon completion of construction. Thereafter, it is the responsibility of the hole/well owner to ensure that the hole or well remains securely sealed or capped.
- 14.1.7 Authorized individuals and well construction or pump installation contractors encountering a monitoring and observation hole/well that apparently does not meet the standards of these Rules, or a damaged monitoring and observation hole/well, or an open and unattended hole/well, shall notify the Board of Examiners in writing of the location of such holes or wells.
- 14.2 **Monitoring and Observation Holes/Wells** - Monitoring and observation holes constructed pursuant to notice as provided in Rule 6.3 and in accordance with the standards of this Rule 14 shall be used only for those purposes described in Section 37-91-102(10.5) and shall not be converted to production wells. Upon obtaining a permit from the State Engineer a monitoring and observation hole may be converted to a monitoring and observation well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer.
 - 14.2.1 **Monitoring and Observation Hole** - Prior to the start of construction of any monitoring and observation hole (see Rule 5.2.31 for definition), the State Engineer shall be notified pursuant to Rule 6.3. The monitoring and observation hole must be constructed within ninety (90) days of giving such notice, and construction must be completed within 72 hours after drilling the borehole, unless the contractor or authorized individual has obtained approval from the Board of Examiners for an extension of time to complete the construction. The authorized individual, owner of the monitoring and observation hole, or the owner's technical representative (i.e. consultant) is responsible for providing the required notice. A monitoring and observation hole which would exist for more than one year must be permitted by the State Engineer as a monitoring and observation well prior to the end of the year.
 - 14.2.2 **Monitoring and Observation Well** - The well owner is responsible for obtaining a Monitoring/Observation Well permit from the State Engineer. The well owner may obtain a Monitoring/Observation Well permit from the State Engineer prior to the construction of a monitoring and observation well, if the owner expects or knows that the structure will exist for more than one (1) year or expects that the structure will be converted to a production well. A monitoring well constructed subsequent to obtaining the proper monitoring well permit from the State Engineer may only be converted to a production well if a permit to use ground water has been obtained from the State Engineer and if the

well is constructed by a licensed well construction contractor and is constructed in accordance with the standards of these Rules for water wells.

- 14.2.3 The authorized individual or individual contracting for construction of a monitoring and observation hole shall notify the owner, in writing, that a permit from the State Engineer must be obtained for the monitoring and observation hole or that the hole must be properly plugged, sealed, and abandoned within one year of the date the monitoring and observation hole is constructed.
 - 14.2.4 A copy of the applicable notice or permit obtained from the State Engineer shall be available at the construction site at all times during construction of a monitoring and observation hole/well. Monitoring and observation wells or holes shall not be constructed without proper notice, a permit, or emergency approval from the State Engineer.
 - 14.2.5 Monitoring and observation holes/wells shall be located to allow access for maintenance, modification, repair, and plugging, sealing and abandonment. When selecting the location, the contractor or authorized individual shall consider the topography, drainage and other on-site conditions in order to promote ground water protection and public safety. The owner of the monitoring and observation hole/well is responsible for the repair, replacement or plugging, sealing and abandonment of any damaged monitoring and observation hole or well.
 - 14.2.6 The responsible individual (see Rule 9.1) shall submit all work reports within sixty (60) days after completion of construction of the monitoring and observation well or hole in accordance with Rule 17.
 - 14.2.7 All monitoring and observation wells that are not used for a period of two (2) years must be properly abandoned pursuant to the standards of Rule 16. If the sampling or monitoring frequency of a monitoring and observation well exceeds two (2) years, a variance from this Rule must be obtained from the Board.
- 14.3 **Monitoring and Observation Hole/Well Construction Standards** - The construction of monitoring and observation wells or holes shall be generally consistent with the examples of acceptable construction shown on Figure 6, unless the monitoring and observation well will be converted to a production well (see Rule 14.2.2) .
- 14.3.1 **Locking Cover** - The top of a monitoring and observation hole/well shall be protected by a locking cover or equivalent level of protection to prevent unauthorized access.
 - 14.3.2 **Casing Cap** - The top of a monitoring and observation hole/well shall be fitted with a cap or "sanitary seal" to prevent surface water, pollutants, or contaminants from entering the hole/well. Openings or passages for water level measurement, venting, pump power cables, discharge tubing, and other access shall be protected against entry of surface water, pollutants, and contaminants.
 - 14.3.3 **Flooding** - The top of the well casing shall terminate at least one (1) foot above ground surface and anticipated levels of flooding, except where site conditions, such as vehicular traffic, will not allow.
 - 14.3.4 **Bases** - Unless otherwise approved by the Board of Examiners, a concrete base or pad shall be constructed around the top of a monitoring and observation well casing at ground surface and contact the annular seal, unless the top of the casing is below ground surface as provided by Rule 14.3.5. The base shall be at least 4 inches thick and shall slope to drain away from the well casing. The base shall extend at least two feet laterally

in all directions from the outside of the well boring, unless otherwise approved by the Board of Examiners.

- 14.3.4.1 The base shall be free of cracks, voids, and other significant defects likely to prevent water tightness. Contacts between the base and the annular seal, and the base and the well casing must be watertight and must not cause the failure of the well casing or annular seal.

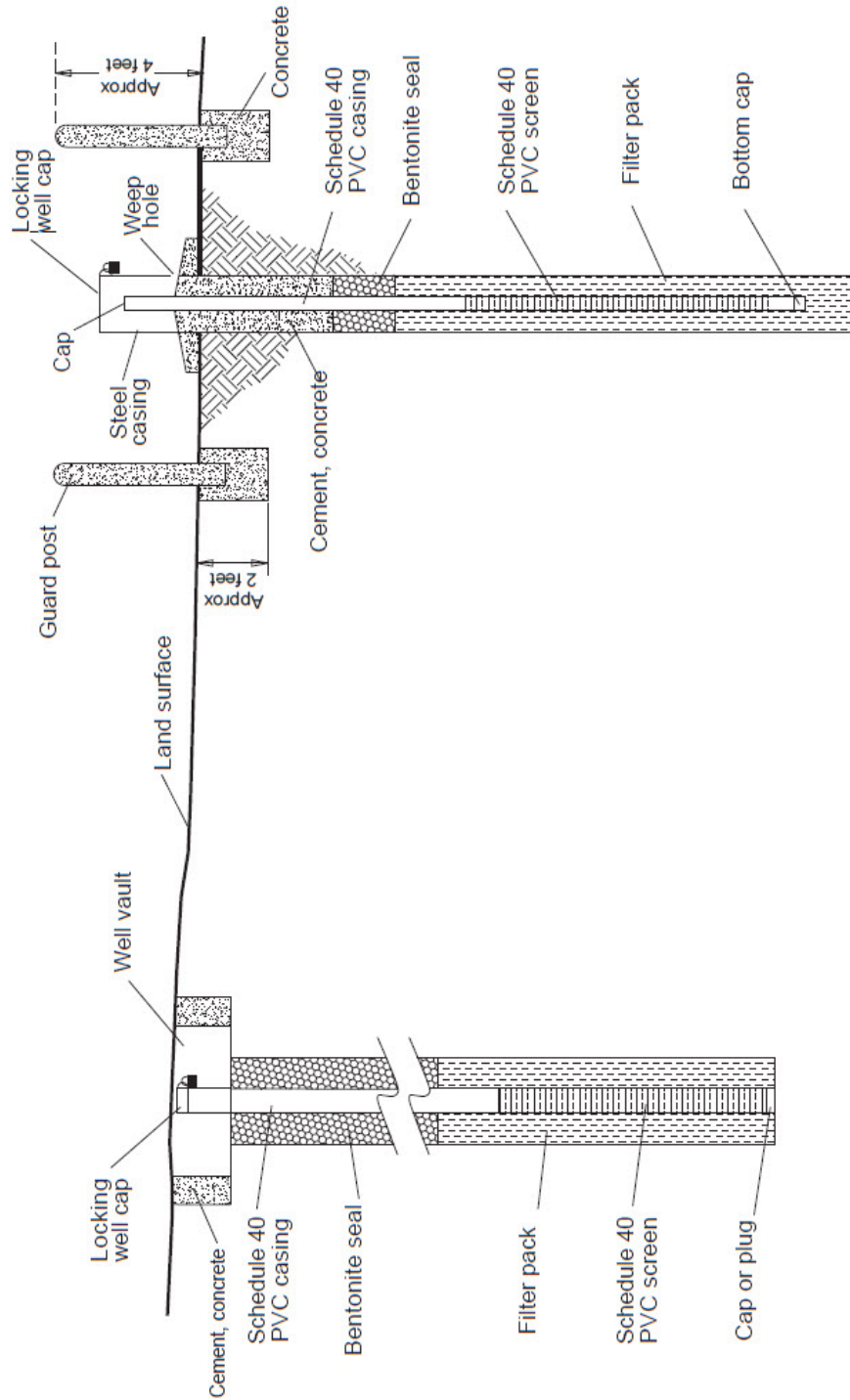


Figure 6a. Flush mount - Schematic diagram of typical monitoring and observation hole/well.

NO SCALE

Figure 6b. Above grade - Schematic diagram of typical monitoring and observation hole/well with protective steel posts.

NO SCALE

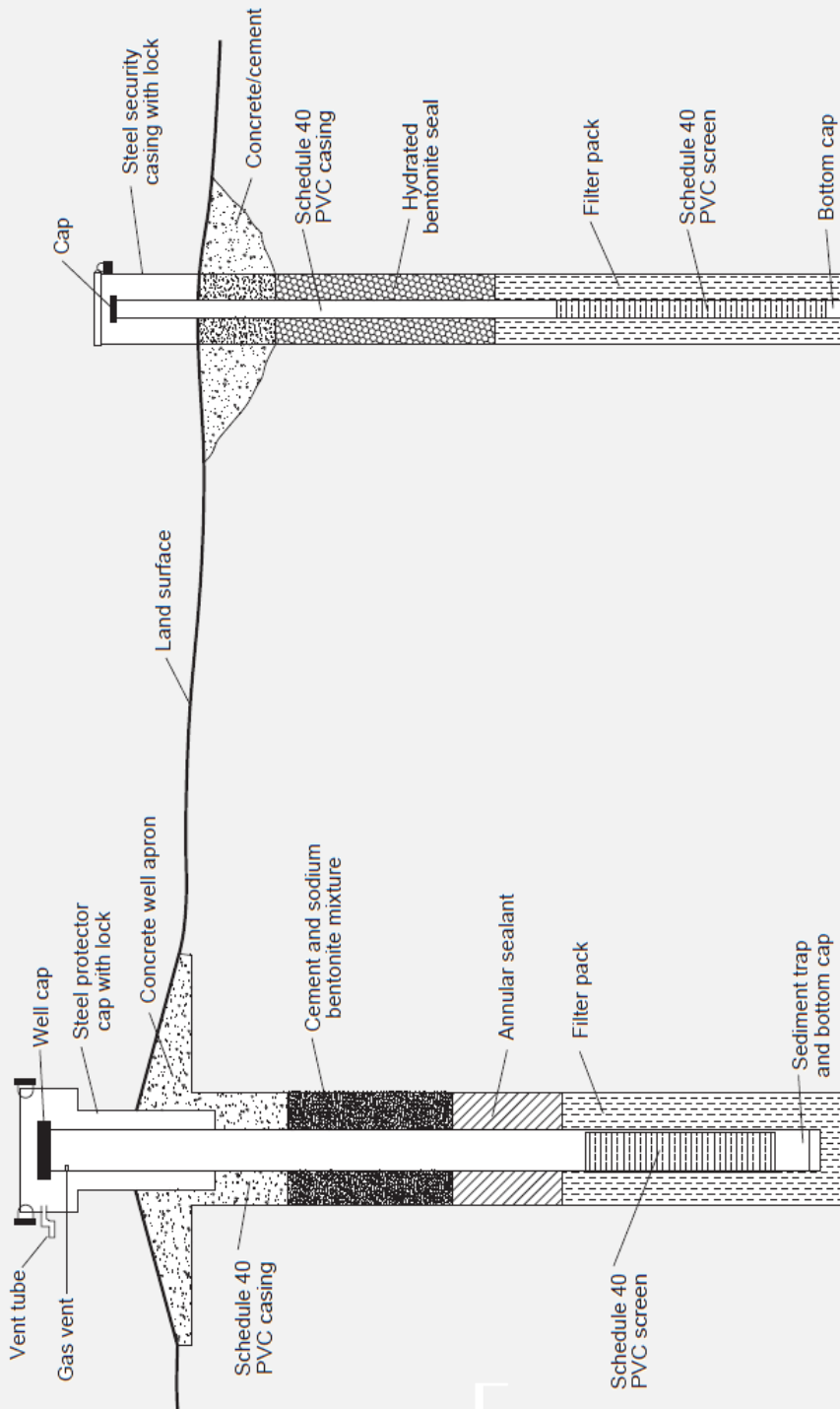


Figure 6c. Above grade - Schematic diagram of typical monitoring and observation hole/well with vent.
NO SCALE

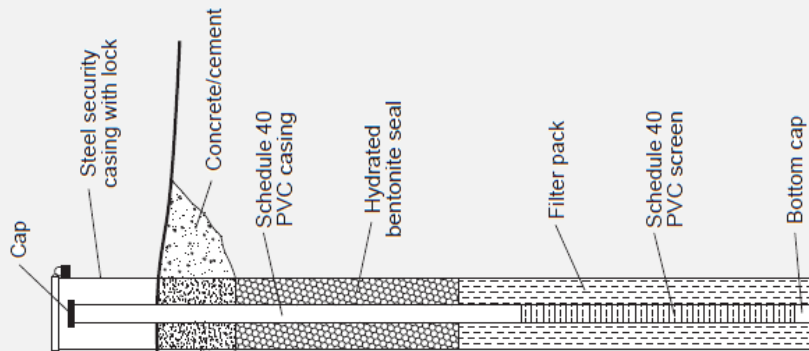


Figure 6d. Above grade - Schematic diagram of typical monitoring and observation hole/well.
NO SCALE

14.3.4.2 Where cement-based annular sealing material is used, the concrete base shall be poured before the annular seal has set, unless otherwise approved by the Board of Examiners.

14.3.5 Vaults - The top of the well casing may be below ground surface because of traffic or other critical considerations. A structurally-sound watertight vault or equivalent structure shall be installed to house the top of the annular seal to at least ground surface. In no instance shall the top of the annular seal be more than 4 feet below ground surface.

14.3.5.1 The vault shall contact the annular seal in a manner to form a watertight and structurally sound connection. Contacts between the vault and the annular seal, and the vault and the well casing if any, shall not fail or cause the failure of the well casing or annular seal.

14.3.5.2 Where cement-based annular seal materials are used, the vault shall be set into or contact the annular seal material before it sets, unless otherwise approved by the Board of Examiners. If bentonite-based sealing material is used for the annular seal, the vault should be set into the bentonite before it is fully hydrated.

14.3.5.3 Cement-based sealing material shall be placed between the outer wall of the vault and the excavation into which it is placed to form a structurally sound foundation for the vault, and to seal the space between the vault and excavation. Upon approval by the Board of Examiners, bentonite-based sealing material may be used between the vault and excavation.

14.3.5.4 Sealing material surrounding a vault shall extend from the top of the annular seal to ground surface unless precluded in areas of freezing. If cement-based sealing material is used for both the annular seal and the space between the excavation and vault, the sealing material shall be placed in a continuous pour. In other words, cement-based sealing material shall be placed between the vault and excavation and contact the cement-based annular seal before the annular seal has set.

14.3.5.5 The vault cover or lid shall be watertight but shall allow the venting of gases, unless otherwise approved by the Board of Examiners. The lid shall be fitted with a security device to prevent unauthorized access. The lid shall be clearly and permanently marked "MONITORING WELL". The vault and its lid shall be strong enough to support vehicular traffic where such traffic might occur.

14.3.5.6 The top of the vault shall be set at or above grade so drainage is away from the vault. The top of the well casing contained within the vault shall be covered in accordance with requirements of Rules 14.3.1 and 14.3.2 so that water, contaminants, or pollutants will not enter the well casing.

14.3.6 Protection from Vehicles and Livestock - Protective steel posts, or the equivalent, shall be installed around a monitoring and observation hole/well casing where it is terminated above ground surface in areas of vehicular traffic. The posts shall be easily seen and shall protect the hole/well from vehicular impact. At locations where livestock have access to the hole/well site, monitoring and observation holes and wells shall be enclosed by fencing or structure adequate to prevent livestock from contacting and damaging the hole/well.

14.4 Installation of Pumping Equipment - Aquifer testing and/or test pumping of any monitoring and observation hole/well shall not exceed a cumulative total of two hundred (200) hours unless prior written approval for additional testing is obtained from the State Engineer. The well owner or his agent shall be responsible for obtaining permits and complying with all rules and regulations pertaining to the discharge of all fluids produced during the testing.

- 14.4.1 Test pumping equipment may be installed in a monitoring and observation hole/well by an authorized individual, well construction or pump installation contractor, or well owner. The person installing the equipment shall notify the State Engineer within 72 hours of when pumping equipment is installed in a monitoring and observation hole/well if such equipment is to remain in the hole/well for a period exceeding 72 hours.
- 14.4.2 The installation of test pumping equipment in a monitoring and observation hole/well shall comply with the applicable provisions of Rule 13 and Rule 15.
- 14.4.3 Water level data and/or water sample analyses obtained from a monitoring and observation hole/well shall be submitted to the State Engineer upon request.
- 14.5 **Test Holes** - In accordance with the requirements of the State Engineer, notice of the intent to construct a test hole shall be submitted to the State Engineer for test holes that are expected to penetrate through a confining layer. Notice is not required for test holes that are not expected to penetrate a confining layer (see Table 1).
- 14.5.1 Test holes shall be plugged, sealed, and abandoned within twenty (20) days after their construction unless approval has been obtained from the Board of Examiners to keep the hole open for a longer period of time.
- 14.5.2 Submittal to the State Engineer of a lithologic log or construction report is not required unless the test hole penetrates through a confining layer between aquifers, but shall be provided to the State Engineer upon request.

RULE 15 MINIMUM DISINFECTION STANDARDS

- 15.1 **Purpose** All materials installed in wells or cistern shall be thoroughly and carefully cleaned and disinfected to ensure that all harmful or disease carrying or causing organisms are eliminated. Care should be exercised to make certain that all areas of the well or cistern, including the filter pack, come in contact with the disinfecting solution as provided for in this Rule. Gravel pit wells, dewatering wells and recovery wells are exempt from this disinfection requirement. Monitoring and observation holes/wells, where the use of a disinfectant may interfere with the purpose of the hole/well, are exempt from this Rule.
- 15.2 **Disinfection Solution** Disinfection of wells shall be accomplished with chlorine or chlorine compounds. Other disinfecting agents may only be used upon written approval by the Board. Sufficient disinfectant shall be used to produce a minimum concentration of one hundred (100) mg/l (milligrams per liter or parts per million) chlorine in the well (see Table 4). Dry disinfectants used in the preparation of solutions shall not be outdated, shall be full strength, and shall be prepared to the required concentration in accordance with the manufacturer's directions for mixing.
- 15.3 **Placement** All wells and cisterns shall be disinfected after completion of well construction, or cistern installation and after the installation of production equipment. After completion of construction of the well, agitation of the solution is best accomplished through use of a pump and recirculation. If no pump is available, a bailer or plunger shall be used. After installation of the pumping equipment, the disinfectant solution shall be thoroughly circulated through the entire well and installed water system.
- 15.4 **Contact Time** The disinfection solution shall be in contact with the well, cistern, pump and distribution system for sufficient time to eliminate any harmful bacteria.
- 15.4.1 Decontamination of wells, cisterns where a pump will not be installed in the immediate future, can be accomplished by adding and mixing enough disinfectant to reach a

concentration of at least one hundred (100) milligrams per liter. The disinfectant shall be left in the well to await pump installation at a later date.

15.4.2 Following the installation of a pump in a well or cistern, it is necessary to disinfect the well cistern, pump, and the distribution system. After placement, mixing and circulation, the disinfectant solution shall remain undisturbed in the well and distribution system for as long as possible, but not less than three (3) hours, after which time, the residual chlorine concentration shall be at least twenty five (25) milligrams per liter.

15.5 **Flushing of Disinfectant** After disinfection of the entire water system by the pump installer and prior to the use of water, the remaining disinfectant solution shall be thoroughly flushed from the well and water supply system and disposed of properly. The disinfectant solution shall not be discharged into the surface waters of the State (see Rule 6.8).

15.6 **Test Equipment Disinfection** All equipment inserted into wells for sampling, measuring, and test-pumping shall be disinfected prior to being used in a well unless the entire well will be disinfected after completion of the testing operations. Disinfection of the test equipment shall consist of contact with a solution having a minimum concentration of three hundred (300) milligrams per liter total chlorine for a period of not less than fifteen (15) minutes.

15.7 **Tanks and Vessels for Hauling and Storing Water for Drilling** - Tanks used for hauling water to the drilling site and any vessel used to store water for drilling purposes shall be constructed of a material approved for use with potable water and shall be regularly decontaminated. Tanks or vessels used for hauling and/or storage of hydrocarbons, waste materials, chemicals, or other contaminants shall not be used for hauling or storing water for drilling purposes.

TABLE 4: APPROXIMATE QUANTITIES OF CHLORINE FOR PREPARING DISINFECTING SOLUTIONS

One ounce of dry HTH or equal powder (70 % available Chlorine) dissolved in 52.2 gallons of water makes a 100 ppm strength disinfectant solution. One cup of liquid household bleach (5% available chlorine) mixed into 31.2 gallons of water makes a 100 ppm strength disinfectant solution. Various proportions can be calculated using the following approximate quantities:

Approximate amount of dry powder or liquid bleach required for a 100 ppm chlorine solution			
Diameter of water column (inches)	Volume of water in 100 feet of column (gallons)	Cups of dry powder 1)	Cups of liquid bleach 2)
4	65.5	$\frac{1}{4}$	3
6	147	$\frac{1}{2}$	5
8	261	$\frac{3}{4}$	9
10	408	1	14
12	587	1 $\frac{1}{2}$	19

- 1) The volume of dry powder, based on 70% available chlorine, has been rounded up to the next $\frac{1}{4}$ cup marking on a standard measuring cup.
- 2) The volume of liquid bleach, based on 5% available chlorine, has been rounded up to the next full cup marking on a standard measuring cup.

Cistern Disinfecting Solution

The approximate amount of dry powder or liquid bleach required for a 100 ppm chlorine solution consists of 11/4 cup of dry powder or 16 cups of liquid bleach per 500 gallons.

RULE 16 STANDARDS FOR PLUGGING, SEALING, AND ABANDONING WELLS AND BOREHOLES

16.1 General - The plugging, sealing and abandonment of all wells, monitoring and observation wells, monitoring and observation holes and test holes that are no longer intended for use, and the plugging, sealing, and abandonment of dry holes, collapsed or unusable boreholes, and other incomplete wells or excavations is necessary to prevent contamination of ground water and the migration of water through the borehole. It is the ultimate responsibility of the well owner to have an existing well properly plugged, sealed and abandoned. The well construction contractor or authorized individual is responsible for notifying the well owner in writing of these plugging requirements.

16.1.1 In the event a borehole(s) is not completed for the intended purpose, the contractor will notify the well owner of the well owner's responsibility for the proper abandonment of the borehole(s) according to Rule 16.1. If the well owner does not agree to allow the contractor to abandon the borehole(s), the contractor shall notify the Board of Examiners, in writing, of the existence of the borehole(s) and the contractor's effort to notify the well owner of the well owner's abandonment responsibilities under Rule 16.1

16.1.2 Persons authorized to install pumping equipment may plug, seal and abandon wells that do not require the removal of casing that penetrates more than one aquifer or the ripping or perforating of casing opposite confining layers.

16.1.3 Materials used for backfilling shall be clean, inert, and free from contaminants. The well casing may be cut off below land surface so that it will not interfere with the anticipated use of the land. If the casing is cut off below land surface, the uppermost five (5) feet of the remaining casing shall be filled with grout or a watertight cover shall be permanently attached to the remaining casing and the excavation shall be filled with materials that are not more permeable than the surrounding soils and adequately compacted to prevent settling.

16.2 Wells or Boreholes in Type II and Type III Aquifers Wells completed into unconfined aquifers and unconsolidated aquifers shall be plugged, sealed and abandoned by filling the well to the static water level with drill cuttings, clean sand or clean gravel, then with clean native clays, cement or high solid bentonite grout to the ground surface. The uppermost five (5) feet of casing shall be filled with grout or a permanent watertight cover shall be installed at the top of the casing. If casing is removed, the hole shall be filled as described above to within five (5) feet of the ground surface. The top five (5) feet of the hole shall be filled with materials less permeable than the surrounding soils that are adequately compacted to prevent settling.

16.2.1 Dewatering wells, horizontal drains, monitoring and observation holes, percolation holes, piezometer holes, sumps, test holes and dry holes shall be plugged, sealed, and abandoned either pursuant to Rule 16.2 or by removing all casing that was installed and by filling the hole(s) with drill cuttings, clean native clays, cement or high solid bentonite grout to within five (5) feet of the ground surface. The top five (5) feet of the hole shall be filled with materials less permeable than the surrounding soils that are adequately compacted to prevent settling.

16.3 Wells or Boreholes in Type I Aquifers - Wells which were constructed through more than one aquifer shall be plugged and sealed by placing a cement grout plug at the confining layer above each aquifer. If records do not show that the casing opposite each confining layer has been grouted when originally installed, the casing shall be either completely removed from the hole, or perforated or ripped opposite such layer prior to placing the grout plug. Plugs shall be no less than forty (40) feet in length and shall be designed to withstand the maximum potential hydrostatic pressure differential between the aquifers. The well casing, except for the grout plug intervals, shall be completely filled to the land surface with clean native clays, cement or high solid bentonite grout. A watertight cover shall be permanently welded or attached to the top of the casing.

RULE 17 REPORTING REQUIREMENTS

17.1 Work Reports Reports shall be submitted to the State Engineer on prescribed forms that describe where, when and how all wells have been constructed, the pumping equipment has been installed in water wells, and a description of how boreholes, wells, dry holes, and incomplete wells are plugged, sealed and abandoned.

17.1.1 Well construction contractors, authorized individuals, or private drillers shall report where, how and when a test hole penetrating a confining layer, a well, or a monitoring and observation hole/well was drilled. They shall also describe the specifics of each well or hole construction and include a lithologic log of the geology, and a geophysical log if required by the permit. The report shall also contain detailed information from the well test in accordance with Rule 12.

17.1.2 Pump installation contractors and private pump installers shall submit a report when the permanent pump is originally installed that describes the pump, date of installation, its depth setting and results from the production equipment test pursuant to Rule 12.

17.1.3 A Well Abandonment Report shall be submitted for each test hole penetrating a confining layer, well, monitoring and observation hole/well, or dewatering well that has been

plugged, sealed and abandoned. The report shall identify the well or hole that was plugged by location and permit number, monitoring hole number, or other authorization of construction. The report shall contain a detailed description of how the well or hole was plugged, including types and amounts of materials used, and the placement method and intervals of those materials. A Well Abandonment Report shall be submitted to the State Engineer when the use of test holes penetrating a confining layer, monitoring and observation wells or holes, or dewatering wells ceases.

- 17.1.4 After initiating the construction of gravel pit wells permitted pursuant to Sections 37-90-107(6) or 137(11), C.R.S., and in lieu of a well construction report form prescribed by the State Engineer, the owner shall submit site plan and cross section drawings showing the extent of the intended excavation, the maximum depth of the pit and the initial static water level.
- 17.2 **Format of Reports** Work reports shall be submitted on forms provided by the State Engineer or on computer generated forms that have been previously approved by the State Engineer. Incorporation of as built drawings is encouraged, but shall be on sheets no larger than 8 1/2 x 11 inches. All of the data requested on the form shall be accurately reported if applicable.
- 17.3 **Timely Submittal** Work reports shall be submitted to the State Engineer within sixty (60) days after completion of the well construction, pump installation or other work required to be reported or within seven (7) days after the expiration of the permit or other authorization, whichever is sooner.
- 17.4 **Certification** Work reports shall be signed and certified as to accuracy and truthfulness of the information on the report by the well construction or pump installation contractors or authorized individuals responsible for the work performed by them or under their direction or supervision, or by the private driller or private pump installer if the work was performed by them. Such reports shall be deemed to be completed, signed and certified under oath.
- 17.5 **Unsanitary or Non Compliant Conditions** Licensed contractors repairing an existing well or pump shall report to the Board of Examiners any unsanitary or non compliant conditions that they are unable to correct.
- 17.6 **Copy of Report to Owner** Well construction and pump installation contractors shall provide a copy of all work reports to the well owner in accordance with Rule 17.3.
- 17.7 **Water Quality Reports** If water quality analyses for newly constructed wells are obtained by or are available to the well or pump installation contractor, a copy of that analysis shall be provided to the State Engineer. The well location, date of analysis and the permit number or other authorization shall be shown on the report.
- 17.8. **Data Confidentiality** In the event that the information provided contains trade secrets, privileged information, or confidential commercial, financial, geological, or geophysical data, and upon written request by the well owner, the information shall be kept confidential pursuant to Section 24 72 204(3)(a)(IV), C.R.S.

RULE 18 VARIANCES

- 18.1 **General** When the strict application of any provision of these Rules presents practical difficulties or unusual hardship, the Board may grant a variance for a specific instance or method of construction, and shall impose any conditions deemed necessary to protect the ground water and aquifers from contamination.

18.2 **Written Request Required** - Any request for a variance shall be submitted to the Board of Examiners in writing and shall be signed by the well owner or his agent. Such request shall specify:

- a. the nature and reason for seeking the variance,
- b. the proposed construction details (diagram of proposed structure), and
- c. special precautions that will be taken to protect the well from contamination.

18.2.1 A written request for a variance from the Rules shall be submitted to the Board and approval of the variance must be obtained prior to construction of the well. During the construction of a well, if circumstances or conditions at the well site require variance from these Rules, the contractor may request a variance from the Board of Examiners by telephone or fax and must obtain approval for the variance prior to completing construction of the well.

18.3 **Written Decision** - The Board shall respond in writing to a variance request. It shall give reasons for its decision and may impose terms and conditions to protect public health and safety or prevent aquifer contamination.

RULE 19 EMERGENCIES

In accordance with the procedures of the State Engineer, in the event of an emergency, construction of replacement wells, monitoring and observation holes, temporary dewatering wells, or recovery wells may only begin after approval has been granted by the State Engineer. The well construction contractor or authorized individual that has received approval from the State Engineer shall comply with all conditions of such approval.

RULE 20 SEVERABILITY

If any portion of these Rules is found to be invalid, the remaining portion of the Rules shall remain in force and unaffected.

RULE 21 REVISIONS

The Board may revise these Rules in accordance with Section 24 4 103, C.R.S.

RULE 22 EFFECTIVE DATE

These revised Rules shall become effective January 1, 2005.

RULE 23 STATEMENTS OF BASIS AND PURPOSE

The Statement of Basis and Purpose for these Rules is incorporated herein by this reference.

Editor's Notes

History

Entire rule eff. 01/01/2005.