DEPARTMENT OF NATURAL RESOURCES

Division of Water Resources
Board of Examiners of Water Well Construction and Pump Installation Contractors
RULES AND REGULATIONS FOR WATER WELL CONSTRUCTION, PUMP INSTALLATION, CISTERN INSTALLATION, AND MONITORING AND OBSERVATION HOLE/WELL CONSTRUCTION

2 CCR 402-2

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 "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)(b), (c), (j) & (k); 37-91-106(3) & (4); 37-91-109(1) & (2); and 37-91-110(1) & (2), C.R.S.

RULE 3 SCOPE OF RULES

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-102; 37- 91-104(1)(c), (j), & (k); 37-91-106(3) & (4); and 37-91-110(2), C.R.S. The purpose of this Rule is to identify the activities and individuals to which these Rules apply.

3.1 These Rules apply to the construction and repair of water wells, test holes, dewatering wells, monitoring and observation holes and wells; well plugging, sealing, and abandonment; and pump and cistern installation and repair, as those terms are defined by these Rules and section 37-91- 102, C.R.S.

3.2 These Rules do not apply to excavations made for the purpose of obtaining or prospecting for minerals or to those 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 those 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). *See* section 37-91-102(16)(b)(I), C.R.S.

3.3 These Rules apply to licensed well construction and pump installation contractors, private drillers, private pump installers, authorized individuals, any persons who undertake any activity described in Rule 3.1 or otherwise described by these Rules, and any persons excluded from the licensing requirements as described in section 37-91-106, C.R.S. *See* sections 37-91-102, 37-91-104(j) & (k), and 37-91-106, 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: F480-14 (Standard Specification for Thermoplastic Well Casing); Department of Agriculture, Colorado Chemigation Act, Article 11 of Title 35, C.R.S.; National Electric Code (2020~~2014~~) of the National Fire Protection Association (NFPA); Examining Board of Plumbers Rules and Regulations, 3 CCR 720-1; and National Ground Water Association ANSI/NGWA-01-14 Water Well Construction Standard (May 2014), Code of Federal Regulations, Title 40 Protection of the Environment Subpart H (2010), Rules Governing New Withdrawals of Ground Water in Water Division 3 Affecting the Rate or Direction of Movement of Water in the Confined Aquifer System (Confined Aquifer New Use Rules for Division 3) may be obtained from the ~~Records Supervisor of~~ the Division of Water Resources, 1313 Sherman Street, Denver Colorado, 80203. Any Rule that incorporates any of these reference materials does not include later amendments to or editions of the incorporated material. *See* § 24-4-103(12.5), C.R.S.

RULE 4 PURPOSE OF RULES

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-104(1)(c), (j), & (k); 37-91-106(3) & (4); and 37-91-110(2), C.R.S. The purpose of this Rule is to identify the broad purposes for the 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 the State of Colorado and to protect the groundwater resources 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 and 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, plugged, sealed, and abandoned by persons other than a licensed well construction contractor.

4.5 To set minimum standards for the installation and repair of pumping equipment and cisterns.

4.6 To set minimum standards for the reporting, testing, sampling, measuring, and disinfection of all wells and associated water well supply systems, to the extent such standards are required for the proper construction and repair of water wells.

RULE 5 DEFINITIONS

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-102; 37- 91-104(1)(c), (j), & (k); 37-91-106(3) & (4); and 37-91-110(2), C.R.S. The purpose of this Rule is to identify the terms used throughout the Rules.

5.1 **Statutory Definitions** - Certain terms used in these Rules have the identical meaning as provided in section 37-91-102, C.R.S., as quoted and cited in Rule 5.2.

5.2 **Specific Definitions** - Unless expressly stated otherwise, the following terms when used in these Rules have the meaning indicated in this Rule. Terms used in the singular include the plural.

5.2.1 **"Administrative Denver Basin"** means that geographic area overlying the base of the Laramie-Fox Hills aquifer as shown in Denver Basin Atlas No. 4, Plate 2, Figure 4B (2 CCR 402-6).

5.2.2 **"Annular space,"** or **"annulus"** means the space surrounding a cylindrical object within a cylinder, such as the space between the outermost drill pipe, ~~or~~ casing, or coupling and the borehole wall. For example, a borehole with a 10-inch diameter, and a 7-inch outer-diameter casing, will have a 1½-inch annular space. See Figure 1, below.

FIGURE 1 ANNULAR SPACE

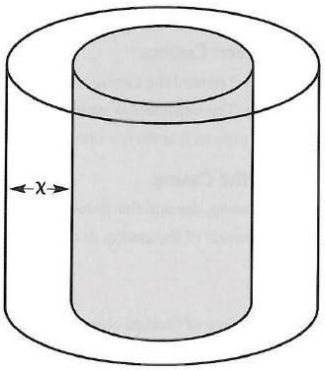


Figure 1: "Annular Space" is the distance marked "x"

5.2.3 **"Aquifer"** means a hydrogeologic unit or interval of consolidated and/or unconsolidated geologic material that is capable of storing and transmitting water. "Aquifer" includes both the saturated and unsaturated interval but does not include the confining layer that separates aquifers. These rules provide different construction requirements for three general classifications of aquifers (Types 1-3~~I-III~~) and one particular aquifer (Laramie-Fox Hills).

5.2.3.1 **"Administratively-defined aquifer"** means a hydrogeologic unit that has been defined in rules promulgated by the State Engineer, identified in a well permit or decree, or included in the list of aquifers by county maintained by the Division of Water Resources

5.2.3.2 **"Type 1~~I~~ aquifer"** means an aquifer that is overlain by a confining layer of relatively impermeable geologic material. A Type 1~~I~~ Aquifer may also be known as a confined aquifer, but the water level could potentially be lower than the top of the aquifer.

5.2.3.3 **"Type 2~~II~~ aquifer"** means an aquifer consisting of consolidated geologic material or crystalline rock that is not overlain by a confining layer. A Type 2~~II~~ Aquifer may also be known as an unconfined bedrock aquifer. Type 2 aquifers can be identified on geologic maps as outcropping or subcropping below unconsolidated units.

5.2.3.4 **"Type 3~~III~~ aquifer"** means an aquifer that consists of unconsolidated geologic material including alluvial, colluvial or other unconsolidated materials. Type 3~~III~~ aquifers may contain localized impermeable layers that do not act as hydraulic boundaries between distinct aquifers. A common example of a Type 3~~III~~ aquifer is an alluvial aquifer.

5.2.3.5 **"Laramie-Fox Hills aquifer"** means that aquifer found below the shales of the Laramie Formation and above the Pierre Shale, including the basal sandstone units of the Laramie Formation and the siltstones and sandstones of the Fox Hills Sandstone. The Laramie-Fox Hills aquifer exists both inside and outside the Administrative Denver Basin boundary.

5.2.3.6 **"Unconfined San Luis Valley aquifer"** means a geologic formation, groups of formations, or parts of formations underlying portions of Water Division No. 3 consisting in part of unconsolidated clays, silts, sands, gravels, interbedded volcanic rock, or other materials and containing saturated permeable materials that yields water under water table conditions that is or may be extracted and applied to beneficial use.

5.2.3.7 **"Confined San Luis Valley aquifer"** means the formations, groups of formations, or parts of formations underlying portions of Water Division 3 consisting in part of unconsolidated clays, silts, sands, gravels, and interbedded volcanic rock and containing saturated permeable material that yields water under artesian pressure that is or may be extracted and applied to a beneficial use. The Confined Aquifer includes any formation, group of formations, or part of a formation containing saturated permeable material that yielded water under artesian pressure during the period 1978-2000, whether or not the water level in the formation, group of formations, or part of a formation is under artesian pressure conditions at the time of the proposed new withdrawal of groundwater.

5.2.4 **"Authorized individual"** means a professional engineer registered in Colorado, a professional geologist as defined in section 23-41-208(b), C.R.S., or a person directly employed by or under the supervision of a registered professional engineer or professional geologist. Alternately, an individual may be designated an Authorized Individual by the Board upon presentation and approval of qualifications. "Professional geologist" is defined in section 23-41-208(b), C.R.S. as "a person engaged in the practice of geology who is a graduate of an institution of higher education which is accredited by a regional or national accrediting agency, with a minimum of thirty semester (forty-five quarter) hours of undergraduate or graduate work in a field of geology and whose post baccalaureate training has been in the field of geology with a specific record of an additional five years of geological experience to include no more than two years of graduate work."

5.2.5 **"Bedrock"** means consolidated crystalline or sedimentary rock.

5.2.6 **"Board"** means the state Board of Examiners of Water Well Construction and Pump Installation Contractors created by section 37-91-103. § 37-91-102(3), C.R.S.

5.2.7 **"Borehole"** means a cylindrical 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, liner, and screen.

5.2.8.1 "Conductor Casing/Pipe" is the outermost, temporary string of casing used to hold back zones of shallow, unconsolidated or unstable materials from the borehole to facilitate drilling and placement of other strings of casing. Conductor casing/pipe may be PVC or steel, typically consists of a short section of pipe, and is differentiated from Surface Casing or Production Casing in that it is not considered a permanent part of the well construction and thus not documented on the well construction report.

5.2.8.2 "Surface Casing" is a string of nonperforated, steel casing typically set to isolate or protect the borehole and other subsequent strings of casing from shallow unconsolidated or unstable materials, though surface casing may extend to significant depths. Surface casing provides for an outer annulus between the borehole and casing which can be grouted.

5.2.8.3 "Production Casing" is a string of casing that is set through the production zone. The production casing may extend to the ground surface and be the only casing string if no surface casing is used, or may be a liner that extends up and into the surface casing but not necessarily to the ground surface. Production casing can be nonperforated, perforated, PVC or steel pipe depending on its position within the well and the Aquifer type.

5.2.9 **"Centralizer"** means a sturdy device attached to the outside of casing for the purpose of setting the casing back from the ~~centering it within a~~ borehole wall or outer casing in a minimum of three equidistant planes (e.g. minimum 1 centralizing arm every 120 degrees around the casing; additional planes of centralization encouraged).

5.2.10 **"Cistern"** means an enclosed, unpressurized reservoir or tank for storing water as part of a water well supply system.

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, and the well is ready to be placed into service.

5.2.12 **"Completion of well construction"** means that the well has been cased, developed, tested for yield, cleaned, disinfected, and is ready for the installation of the production equipment.

5.2.13 **"Confining unit"** means a geologic formation, group of formations, or part of of a formation that separates or inhibits the flow of groundwater between distinct hydrogeologic units or administratively-defined aquifers because it is impermeable or distinctly less permeable than adjacent hydrogeologic units. Some confining units may contain geologic materials or intervals capable of yielding small amounts of water to wells. ~~"Confining layer" means a geologic zone that, because of its impermeability or low permeability, separates and inhibits the flow of groundwater between distinct or administratively-defined aquifers (aquifers identified in permits issued by the State Engineer).~~[4]

5.2.14 **"Construction of wells"** means "any act undertaken at the well site for the establishment or modification of a well, including, without limitation, the location of the well and the excavation or fracturing thereof but not including surveying or other acts preparatory thereto, site preparation and modification or site modification, or the installation of pumping equipment." § 37-91-102(4), C.R.S.

5.2.15 **"Contaminant"** means any chemical or organic material, live organisms, radioactive material or heated or cooled water that will adversely affect the quality of water.

5.2.16 **"Contamination"** means the introduction of contaminants.

~~**"Contracting"** means undertaking, offering, bartering, or bargaining to undertake for another any activity regulated by the Board under these Rules by any person, firm, corporation, partnership, association, or other organization.~~

5.2.17 **"Contractor"** means any person authorized to perform an activity regulated by the Board under these Rules.

5.2.18 **"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.

A dewatering system is not the same as a "dewatering well" defined by section 37-91-102(4.5), C.R.S.

5.2.19 **"Dewatering well"** "includes any excavation that is drilled, cored, bored, washed, fractured, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is for temporary dewatering purposes for construction only." § 37-91-102(4.5), C.R.S.

5.2.20 **"Directly employed"** means "engaged in employment where the employer is responsible for and directly controls the performance of the employee, and, where applicable, the employee is covered by workers' compensation and unemployment compensation. 'Directly employed' does not refer to independent contractors or subcontractors." § 37-91-102(4.7), C.R.S.

5.2.21 **"Dry Hole"** means a borehole that does not produce enough water for the permitted use(s). Dry hole reports may be submitted in lieu of well construction reports in order to continue to attempt to drill a successful well under the original permit.

Dry holes constructed under an active well permit are not Test Holes as defined in Rule 5.2.54.

5.2.22 **"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.

5.2.23 **"Groundwater" or "ground water"** means "any water not visible on the surface of the ground under natural conditions." § 37-91-102(7), C.R.S. In these Rules, the term "groundwater" has the same meaning as defined at section 37-91-102(7), C.R.S.

5.2.24 **"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 a borehole or well. See Rule 10.5.1.

5.2.25 **"Grouting"** means the process by which grout is placed in the borehole or casing.

5.2.26 **"Hydraulic fracturing of a water well"** means the treatment of a water well by the application of fluid or other substance or fluid additive under pressure that is expressly designed to initiate or propagate fractures in the permitted production interval to enhance the flow or production of water in that interval.

5.2.27 **"Hydrogeologic unit"** see Rule 5.2.3 "Aquifer."

5.2.28 **"Installation of pumping equipment"** means "the selection, placement, and preparation for operation of pumping equipment, including all construction involved in entering the well and establishing well seals and safeguards to protect groundwater from contamination." § 37-91-102(8), C.R.S.

5.2.29 **"Laramie-Fox Hills aquifer"** is defined above in Rule 5.2.2.4

5.2.30 **"License"** means "the document issued by the Board to qualified persons making application therefor, pursuant to section 37-91-105, authorizing such persons to engage in one or more methods of well construction or pump installation or any combination of such methods." § 37-91-102(10), C.R.S.

5.2.31 **"Lithologic log"** means a written geologic description of the type, color, and character of the soil and rock materials penetrated by the drilling procedure or activity.

5.2.32 **"Monitoring and observation hole"** means a temporary well constructed for the purpose of repeated observations, measurements, or samplings of groundwater. Temporary wells completed for environmental groundwater investigations are monitoring and observation holes. A monitoring and observation hole may only be constructed upon a notice of intent. *See* Rules 6.3 & 14.2.1. A monitoring and observation hole must be plugged, sealed, and abandoned in less than eighteen (18) months from the date it was constructed unless a permit for a monitoring and observation well has been obtained from the State Engineer. *See* Rule 14.2.1.

A monitoring and observation hole is not a test hole (see Rule 5.2.54 for definition of "test hole").

5.2.33 **"Monitoring and observation well"** "includes any excavation that is drilled, cored, bored, washed, fractured, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is for locating such well, pumping equipment or aquifer testing, monitoring groundwater, or collection of water quality samples." § 37-91-102(10.5), C.R.S.

A monitoring and observation well must be permitted by the State Engineer. *See* § 37-90-105(1)(d), C.R.S.; § 37-92-602(1)(f), C.R.S.; and Rule 14.2.2.

5.2.34 **"Nested well"** means the installation of two or more casings in a single borehole or excavation for completion of more than one interval.

5.2.35 **"Notice of intent"** refers to the forms of the State Engineer titled "Notice of Intent to Construct a Monitoring Hole(s)," and "Notice of Intent to Construct Dewatering Wells," which requires no less than three days ~~seventy-two (72) hours~~' notice, including one business day, for construction of certain types of structures. *See* Rule 6.3.

5.2.36 **"Person"** means "an individual, a partnership, a corporation, a municipality, the state, the United States, or any other legal entity, public or private."§ 37-91-102(11.5), C.R.S.

5.2.37 **"Piezometer hole"** means a small-diameter monitoring and observation hole or well that is constructed for the sole purpose of monitoring or measuring water pressure or water level elevation.

5.2.38 **"Pitless adapter"** means a device that is designed to attach to well casing in order to 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 assembly, or other unit 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 (1) prevent the entry of contaminants from the surface into the well, (2) prevent the movement of fluids between aquifers through the borehole, (3) maintain natural protection against pollution of water-bearing formations, and (4) exclude known sources of contamination, as required by section 37-91-110(1)(a)(III), C.R.S

5.2.41 **“Positive displacement”** means a procedure whereby a material such as grout is first introduced within five (5) feet of~~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”** means “any individual, corporation, partnership, association, political subdivision, or public agency, that uses equipment owned by it to dig, drill, redrill, case, recase, deepen, or excavate a well entirely for its own use upon property owned by it.” § 37-91-102(12), C.R.S. Private d~~D~~riller typically refers to a well owner or their direct employee(s) who use~~s~~ their~~his or her~~ own equipment (not rented or~~rented, leased, or~~ hired) to construct or repair a well located on land they~~he or she~~ own~~s~~ (not rent~~ed or leased~~).

5.2.43 **“Private pump installer”** means “any individual, corporation, partnership, association, political subdivision, or public agency that uses equipment owned by it to install pumping equipment on a well entirely for its own use on property owned by it.” § 37-91-102(12.5), C.R.S. Private pump installer typically refers to a well owner or their direct employee(s) who use their own equipment (not rented or hired) to install pumping equipment in a well on land they own (not rent).

5.2.44 **“Producing aquifer,” or “production zone”** means that portion of the hydrogeologic unit, permitted, or administratively-defined ~~authorized~~ aquifer ~~(as stated on the well permit)~~ that consists of permeable geologic material contributing flow to the well.

5.2.45 **“Pumping equipment”** means “any pump or related equipment used or intended for use in withdrawing or obtaining groundwater, including, but not limited to, well seals, pitless adapters, and other safeguards to protect the groundwater from contamination and any waterlines up to and including the pressure tank and any coupling appurtenant thereto.” § 37-91-102(13), C.R.S.

5.2.46 **“Pump installation contractor”** means “any person licensed to install, remove, modify, or repair pumping equipment for compensation.” § 37-91-102(14), C.R.S.

5.2.47 **“PVC casing”** means polyvinyl chloride casing as specified in ASTM Standard F480-14 (2014, Thermoplastic Well Casing Pipe) that is clearly marked by the manufacturer as “well casing”.

5.2.48 **“Recovery well”** means a well which is constructed specifically for aquifer remediation, or for the removal of contaminants from an aquifer.

5.2.49 **“Repair”** means “any change, replacement, or other alteration of any well or pumping equipment which requires a breaking or opening of the well seal or any waterlines up to and including the pressure tank and any coupling appurtenant thereto.” § 37-91-102(15), C.R.S.

5.2.50 **“Replacement well”** means “a new well which replaces an existing well and which shall be limited to the yield of the original well and shall take the date of priority of the original well, which shall be abandoned upon completion of the new well.” § 37-90-103(13), C.R.S. All replacement wells must be properly permitted by the State Engineer.

5.2.51 **“Static water level”** means the water level in a well when there is less than one (1) foot difference between two (2) consecutive water level measurements taken at least sixty (60) minutes apart.

5.2.52 **“Supervision”** means “personal and continuous on-the-site direction by a licensed well construction contractor or licensed pump installation contractor, unless the licensed contractor has applied for and received from the board an exemption from continuous on-the-site direction for a specific task.” § 37-91-102(15.5), C.R.S.

5.2.53 **“Surface Water”** New Definition - Do we need a “surface water’ definition? Waters of the State? -

5.2.54 **"Test hole"** "includes any excavation that is drilled, cored, bored, washed, fractured, driven, dug, jetted, or otherwise constructed when the intended use of such excavation is for geotechnical, geophysical, or geologic investigation or soil- or rock-sampling." § 37-91-102(15.7), C.R.S. Test holes must be properly plugged, sealed, and abandoned upon the completion of the geotechnical, geophysical, or geologic investigation or soil- or rock-sampling. Any test hole that penetrates through a confining layer between two distinct aquifers must be constructed by a licensed contractor pursuant to a Notice of Intent filed with the State Engineer. *See* Rule 6.3.

A "dry hole" or borehole not completed for its intended use as a production water well~~constructed with the intent of~~ constructed~~ing a well~~ pursuant to an issued well permit is not a Test hole (see Rule 5.2.21)

Any borehole constructed or used for environmental groundwater investigations, or repeated groundwater observations, measurements, or samplings, is a monitoring and observation hole or well (5.2.30 or 5.2.31), not a test hole, and may only be constructed under a notice of intent or well permit. *See* Rules 6.3 & 14.2.1.

5.2.55 **"Type 1~~I~~ aquifer"** is defined above at Rule 5.2.3~~2~~.2~~1~~.

5.2.56 **"Type 2~~II~~ aquifer"** is defined above at Rule 5.2.3~~2~~.3~~2~~.

5.2.57 **"Type 3~~III~~ aquifer"** is defined above at Rule 5.2.3~~2~~.4~~3~~.

5.2.58 **"Valid permit"** means a well permit issued by the State Engineer that has not been canceled and for which (1) when issued in accordance with section 37-92-602, C.R.S. (exempt wells) the completion of well construction is accomplished prior to the permit expiration date; or, (2) for all other wells (non-exempt wells), the completion of well construction or pump installation is accomplished on or before the permit expiration date. The State Engineer has the exclusive administrative authority to determine whether or not a well permit is valid.

5.2.59 **"Water well supply system"** includes all components of a groundwater well, pump, drop pipe, pitless adapters or units, other pumping equipment, storage tanks or cisterns, and piping and connections between the well and its point of discharge from the pressure tank, if such a tank is installed.

5.2.60 **"Watertight"** means a condition that does not allow the entrance, passage, or flow of water under normal operating conditions.

5.2.61 **"Well"** as used in these Rules, "means any test hole or other excavation that is drilled, cored, bored, washed, fractured, driven, dug, jetted, or otherwise constructed for the purpose of location, monitoring, dewatering, observation, diversion, artificial recharge, or acquisition of groundwater for beneficial use or for conducting pumping equipment or aquifer tests." § 37-91-102(16)(a), C.R.S.

5.2.61.1 **"Well"**, as used in these Rules, does not include "an excavation made for the purpose of obtaining or prospecting for minerals or those wells subject to the jurisdiction of the oil and gas conservation commission, as provided in article 60 of title 34, C.R.S., or those wells subject to the jurisdiction of the office of mined land reclamation, as provided in article 33 of title 34, C.R.S." § 37-91-102(16)(b)(I), C.R.S.

5.2.61.2 **"Well"**, as used in these Rules, "does not include a naturally flowing spring or springs where the natural spring discharge is captured or concentrated by installation of a near-surface structure or device less than ten feet in depth located at or within fifty feet of the spring or springs' natural discharge point and the water is conveyed directly by gravity flow or into a separate sump or storage, if the owner obtains a water right for such structure or device as a spring pursuant to article 92 of this title." § 37-91-102(16)(b)(II), C.R.S.

5.2.61.3 **"Well"**, as used in these Rules, does not include wells constructed specifically for cathodic protection, a technique to prevent corrosion of a metal surface by making that surface the cathode of an electrochemical cell, as provided in Department of Labor and Employment, Division of Oil and Public Safety, Underground Storage Tanks and Aboveground Storage Tanks (7 CCR 1101-14).

5.2.61.4 **"Well"** as used in these Rules, does not include "an injection well or wells used to emplace a carbon dioxide stream beneath the lowermost formation containing an underground source of drinking water (USDW); or wells used for geologic sequestration of carbon dioxide that have been granted a waiver of the injection depth requirements pursuant to requirements at § 146.95; or, wells used for geologic sequestration of carbon dioxide that have received an expansion to the areal extent of an existing Class II enhanced oil recovery or enhanced gas recovery aquifer exemption pursuant to §§ 146.4 and 144.7(d) of this chapter. It includes the subsurface three-dimensional extent of the carbon dioxide plume, associated area of elevated pressure, and displaced fluids, as well as the surface area above that delineated region (40 CFR 146 Subpart H - Criteria and Standards Applicable to Class VI Wells (2010)).

5.2.62 **"Well construction contractor"** means "any person licensed pursuant to this article and responsible for the construction, test-pumping, or development of wells, either by contract or for hire or for any consideration whatsoever." § 37-91-102(17), C.R.S.

5.2.63 **"Well owner"** means any person or his or her agent who holds the title or other property rights in or to a well.

5.2.64 **"Well seal"** means "an approved arrangement or device used to cover a well or to establish and maintain a junction between the casing or curbing of a well and the piping or equipment installed therein, the purpose or function of which is to prevent contaminated water or other material from entering the well at the upper terminal." § 37- 91-102(18), C.R.S. (2014).

5.2.65 **"Well vault"** means an underground structure or pit in which the well casing terminates below ground surface.

5.2.66 **"Well yield estimate"** means a procedure designed to accurately estimate stabilized well production rate. Acceptable procedures include, but are not limited to, air-lifting or bailing.

5.2.67 **"Aquifer~~Well yield~~ test"** means a procedure conducted to determine a stabilized drawdown and production rate of a well, also known as a pumping test or well yield test.

5.3 **Other Definitions** All other words used herein must be given their usual, customary, and accepted meaning. Terms not defined in Rule 5.2 that are defined in other rules promulgated by the State Engineer must use the meaning given therein. All words of a technical nature specific to the water well construction industry must be given the meaning generally accepted in that industry.

RULE 6 GENERAL RULES

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-102; 37- 91-104(1)(c), (j), & (k); 37-91-106(3); and 37-91-110(2), C.R.S. The purpose of this Rule is to implement general statutory provisions that apply to well construction and the installation of pumping equipment. Rule 6 also advises contractors of certain State Engineer's notice and permitting requirements.

6.1 The process for obtaining and maintaining a license for the construction of wells or the installation of pumping equipment or cisterns, or any special licenses issued pursuant to the Board's authority in section 37-91-105(2.5), C.R.S., is codified in the Board's Rules and Regulations for Administration of Licensing, Financial Responsibility, Continuing Education and Remedial Action, 2 CCR 402-14.

6.2 Compliance with Well Permits

6.2.1 No well may be constructed, repaired, replaced, or modified, unless the well is associated with a valid well permit issued by the State Engineer. (*see* Sections 37-90-105(3)(a)(I), 37-90-107, 37-90-108, 37-90-137(1), 37-90-138(3), and 37-92-602(3)(a), C.R.S.). For those wells that are permitted, the State Engineer requires that a new well permit be obtained prior to:

a. changing the producing and/or grout interval of an existing well,

b. installing certain dewatering systems as specified by the State Engineer,

c. installing pumping equipment that will allow 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 well permit must be available and posted at the well site at all times when a contractor is working on a new well or when performing any work that requires a well permit as specified in Rule 6.2.1. All such work must comply with the conditions of approval of the valid well permit, including any applicable condition that the well construction and/or pump installation contractor provide advance notification to the State Engineer prior to well construction, the initial installation of the pump, or installation of a cistern connected to a water well supply system. All work must 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 must 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, the individual must notify the State Engineer of performing work on the well and must 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 location within a specified tract of land, the well construction contractor must submit the Well Construction and Test Report, including the as-built well location by UTM coordinates, within thirty-five~~sixty~~ (35~~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 must be provided with a Notice of Intent (see Rule 5.2.3533) no less than three (3) days~~72 hours~~, including at least one standard business day, prior to the construction of the following:

any dewatering well;

any monitoring and observation hole; or

any test hole that will penetrate through a confining layer between two distinct or administratively defined aquifers.

The State Engineer requires notice to be submittednotice be submitted in writing on through the Notice of Intent eForm~~following forms~~ available on the Division of Water Resources' website: ~~Notice of Intent to Construct Monitoring Hole(s) or Notice of Intent to Construct Dewatering Wells. Any test hole that will penetrate through a confining layer between two distinct or administratively defined aquifers must use the Notice of Intent to Construct Monitoring Hole(s) form.~~

Any test hole or monitoring and observation hole that penetrates through a confining layer between two distinct or administratively defined aquifers may only be constructed by a licensed contractor. See Table 1 for a summary of notice, license, and permit requirements.

6.3.1 The authorized individual (see Rules 5.2.43 and 9.1) or the licensed well construction contractor is responsible for providing the necessary notice required for the construction of dewatering wells, test holes, and monitoring and observation holes.

6.3.2 The construction of any test hole penetrating through a confining layer, dewatering well, or monitoring and observation hole for which a Notice of Intent form was provided to the State Engineer pursuant to Rule 6.3 must be completed within ninety (90) days of the notice date.

6.3.3 Construction of a monitoring and observation hole must be completed within 72 hours after drilling the borehole (*see* Rule 14.2.1.1).

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

6.5 **Requests for Well Site Information** - Upon request by the State Engineer or their~~his or her~~ staff, all water well construction and pump installation contractors, authorized individuals, private drillers, and private pump installers must identify the permit number or other authorization and the location of any wells, test holes, cisterns connected to a water well supply system, or monitoring and observation holes or wells which that person expects to work on within a specified five (5) day period.

6.6 **Compliance with Regulations** - All well construction and pump and cistern installation contractors must comply with the minimum standards in these Rules. There may be~~Where~~ federal, tribal, state, county, municipal or local government laws, regulations, or codes that are more stringent than these Rules, or contain standards not covered by these Rules~~, then the contractor must 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.

TABLE 1: SUMMARY OF LICENSING AND CONSTRUCTION AUTHORIZATION REQUIREMENTS

STRUCTURE	WHO MAY CONSTRUCT				REQUIRED AUTHORIZATION	
Type of Well or Borehole	**Licensed**	**Authorized Individual**	**Special License**		**Approved Well Permit**	**Approved Notice of Intent ~~Form~~**
BOREHOLE DOES NOT PENETRATE THROUGH A CONFINING LAYER*						
Water well	X				X	
Gallery/infiltration well	X		X		X	
Monit./observ. well, recovery well, & certain dewatering system	X	X	X		X	
Monit./observ. holes & dewatering wells	X	X	X			X
Test holes	X	X	X			
BOREHOLE DOES PENETRATE THROUGH A CONFINING LAYER*						
Water well	X				X	
Monit./observ. well, recovery well & certain dewatering system	X		X		X	
Monit./observ. hole and dewatering well	X		X			X
Test holes	X		X			X

*As defined in Rule 5.2.1312, a confining layer between two distinct or administratively defined aquifers.

Notes:

1) This table summarizes minimum licensing requirements. A licensed contractor is authorized to construct all of the types of wells or holes indicated above. Special licenses may be obtained for certain types of specialized work or well construction, as allowed in Rule 6.5 of the Board's Rules and Regulations for Administration of Licensing, Financial Responsibility, Continuing Education and Remedial Action, 2 CCR 402-14. Persons who obtain a special license 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, or under a special license issued by the Board, may not be converted into water wells (see Rule 14). Monitoring and observation holes must be plugged and sealed within eighteen (18) months after being constructed (see Rule 16.4). The requirement to permit a monitoring and observation well also applies to any borehole that will remain in use for more than eighteen (18) months (e.g., long-term piezometers).

3) The requirements for test holes only apply to geotechnical boreholes that are not used for repeated measurements, observations, and samplings of groundwater (see Rules 5.2.5451 & 14.5).

6.7 **Products Containing Toxic Materials** - Products, such as solder and fluxes, and materials, such as pipes and fittings, that contain any more than 0.25% lead are prohibited from being used in the construction, repair, rehabilitation, hydraulic fracturing of a water well, or abandonment of wells and holes. All pipe joint thread compounds must be lead-free. Known toxic materials must not be used in well construction.

Board-Approved thread Compounds? During Construction List and Permanent List
Address specific thread compounds for temporary drill pipe vs. permanent casing?
Subrule addressing hydrocarbon lubricants?

6.8 **Disposal of Fluids Resulting from Well Construction, Development and Disinfection** - Fluids resulting from well construction, development or disinfection must 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 groundwater, and must not leave the property the well is located. 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.

Could further define “waters of the state.” “Surface waters” as used here and Policy 2020-3 are not defined. Can improve definitions to describe these terms.

Can Policy 2020-3 Short-Term Discharges to Groundwater be incorporated into this rule?

6.9 **Water Used for Well Construction and Stimulation** - All water used during the construction, development, and stimulation, including hydraulic fracturing, of a well must 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 groundwater source or from a flowing surface water supply under the following conditions:

a. water obtained from a groundwater source must 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 groundwater 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 must 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 groundwater 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 must be disinfected in accordance with Rule 15. ~~drilled, developed, or stimulated without using water obtained from a public supply source must be flushed, 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 groundwater sources is prohibited.

6.10 Handling of Dust: Dust and other particles generated during the construction of a well must be controlled as to not be a nuisance. Air percussion drilling methods must include means to mitigate and control dust.

6.11 ~~Drilling~~ **Fluids and Additives**– The use of fluids and additives must comply with all manufacturers' safety guidelines and federal, state, and local laws, rules, regulations, and codes. The person using the materials is responsible for ensuring that the materials are used properly and do not cause any injury or contamination.

6.11.1 **Drilling Fluids:** All drilling fluids and drilling fluid additives must be appropriate for the purposes for which the well or hole will be constructed and must be specifically approved for use by the Board. A list of specifically approved drilling fluids and drilling fluid additives is available on the Board's website.

6.11.2 **Grout Additives:** All grout additives must be appropriate for the purposes for which the well or hole will be constructed and must be specifically approved for use by the Board. A list of specifically approved grout additives is available on the Board's website. ~~Lists~~

6.11.3 **Well Development and Rehabilitation Chemicals:** All well development and rehabilitation chemicals must be appropriate for the purposes for which the well or hole will be constructed or rehabilitated and must be specifically approved for use by the Board. A list of specifically approved well development and rehabilitation chemicals is available on the Board's website.

RULE 7 LICENSING

For rules and regulations concerning the Board's licensing procedures, see Rules and Regulations for Administration of Licensing, Financial Responsibility, Continuing Education and Remedial Action (BOE Rules) 2 CCR 402-14.

RULE 8 FINANCIAL RESPONSIBILITY

For rules and regulations concerning the Board's bonding and financial responsibility requirements, see Rules and Regulations for Administration of Licensing, Financial Responsibility, Continuing Education and Remedial Action (BOE Rules)2 CCR 402-14

RULE 9 WELLS AND HOLES WHICH MAY BE CONSTRUCTED BY PERSONS OTHER THAN LICENSED WELL CONSTRUCTION CONTRACTORS

Basis and Purpose: The statutory authority for this rule is found in sections 37-91-101(1); 37-91-104(1)(c), (j), & (k); 37-91-106(3); and 37-91-110(2), C.R.S. The Purpose of this Rule is to identify the basic types of activities that may be completed by persons that are not licensed for water well construction or pump installation, as well as notification and reporting requirements. Additionally, this Rule identifies certain structures that do not have minimum construction standards.

9.1 This Rule 9 applies to those wells and holes which may be constructed by persons that are not licensed for water well construction (or are not employed by or directly supervised by a licensed water well contractor). Table 1 summarizes the license requirements for construction of certain types of wells and holes. Unless otherwise specified, responsibility for ensuring compliance with the provisions of this Rule 9 is placed upon:

a. the authorized individual (see Rule 5.2.4~~3~~)

b. the contractor holding a special license, and/or

c. the private driller (see Section 37-91-102(12), C.R.S.) if an authorized individual or contractor holding a special license is not contracted for the work.

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, monitoring and observation holes and wells, piezometer holes, recovery wells, dewatering systems, pond and lake wells, and test holes

9.2.1 **Required Notice** - Test holes that penetrate a confining layer between two distinct aquifers, monitoring and observation holes and wells, and dewatering wells must be constructed pursuant to the Notice of Intent requirements stated in Rule 6.3.

9.2.2 **Reporting Requirements** - A Well Construction and Test Report must 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 must 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 must comply with the construction and grouting standards and Rules applicable to water wells (Rule 10), unless a variance from those Rules is obtained pursuant to Rule 18.

9.3.1 Monitoring and observation holes and wells, and test holes that do not penetrate through a confining layer between two distinct aquifers must be constructed in accordance with the provisions of Rule 14.

9.3.2 Dewatering wells and dewatering systems that

a. do not penetrate through a confining layer between two distinct aquifers and ~~(2)~~

b. are not constructed in a vertical borehole

must be constructed in accordance with all applicable municipal, county, state, and federal regulations and standards. No other minimum construction standards apply for such wells or holes, except that the well or hole must be constructed to prevent contamination of surface or groundwater. Such wells must be abandoned pursuant to the provisions of Rule 16.4.1.

9.3.3 Dewatering systems (excluding drains and sumps) constructed as wells must be constructed in accordance with the construction and grouting requirements of Rule 10 if:

a. the system penetrates through a confining layer between two distinct aquifers or

b. the system is constructed in a vertical borehole similar to a water well

9.3.4 Pond or lake wells (including gravel pit wells) permitted pursuant to sections 37-90-107 or 37-90-137, C.R.S. are exempt from the provisions of these minimum construction and location standards, except that the owner must ensure that the pond or lake well is constructed in such a manner as to prevent contaminants from entering the pond or lake well. A report documenting construction of a pond or lake well must be submitted upon completion of the well, as required by Rule 17.1.5.

9.4 If during construction of an excavation authorized by this Rule 9, the borehole penetrates through a confining layer into a lower aquifer, the hole must 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 must 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** - A monitoring and observation hole, dewatering well, and other excavation constructed pursuant to a Notice of Intent form provided to the State Engineer, as provided in Rule 6.3 and this Rule 9, may not be converted to a production water well for beneficial use. A monitoring and observation hole or dewatering well constructed in accordance with proper notice may only be converted to a monitoring and observation well, recovery well for purposes of aquifer remediation, or dewatering system for dewatering of the aquifer, if such conversion is approved and permitted by the State Engineer.

RULE 10 MINIMUM CONSTRUCTION STANDARDS FOR WATER WELLS

Basis and Purpose: The statutory authority for this rule is found in sections 37-91-101(1); 37-91-102; 37-91-104(1)(c), (j), & (k); 37-91-106(3); 37-91-109(1); and 37-91-110(2), C.R.S. The purpose of this Rule is to identify the minimum construction standards for water wells or other excavations constructed in different types of aquifers in Colorado, in order to ensure that such construction prevents harm to the public health, will not impair water quality or cause contamination of shared groundwater resources, and will ensure the safety of groundwater resources for Colorado's existing and future populations.

10.1 **General** - To assist in the orderly development of the groundwater resources of Colorado, to insure the protection of the public health, and to prevent degradation of the groundwater resource, all wells constructed to withdraw or inject water must 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 groundwater production to one aquifer unless otherwise permitted by the State Engineer; and

d. prevent the intermingling of groundwater from different sources through the borehole

10.1.1 The contractor is responsible for constructing the well using standards that are more stringent than the minimum specified in these Rules, if necessary to ensure the adequate integrity of the well and protection of the aquifer. If conditions on the well permit specify standards that exceed the minimum standards of these Rules, the well construction contractor must comply with the conditions specified on the well permit.

10.1.2 Prior to starting construction, all persons authorized to construct wells must investigate and become familiar with the geology of potential aquifers, confining layers, anticipated water quality problems, and known contaminated water-bearing zones that may be encountered in the area of the proposed drilling activity, and where necessary, must advise the well owner of the potential for poor water quality or contamination and plan for the resolution of such issues prior to beginning construction.

10.1.3 All wells and boreholes, when unattended, must 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.

a. A secure cover is intended as a temporary arrangement of materials or a device that must perform the function of preventing deleterious entry of objects, insects, animals or contaminants into the borehole or well while unattended and prior to completion of the well. The cover must not be easily removed, penetrated or bypassed by methods or processes other than those directed and performed by the well construction contractor. Unrestrained buckets or tape are not considered a secure cover and are specifically not allowed by the Rules.

b. A secure well seal or well cap shall consist of a "sanitary" cap or seal as commonly defined within the industry and must be properly sized for the casing. The sanitary well seal or well cap must be capable of preventing entry of contaminants, water, insects and animals into the well. A sanitary well cap or seal must be constructed of metal and may utilize gaskets or seals composed of rubber or other suitable materials.

c. Wells equipped with turbine pumps and diverters which are supported on the metal well casing or metal sole plates must also be arranged to promote sanitary conditions in the well and to prevent entry of contaminants, water, insects or animals into the well.

d. Requirements for venting are presented in Rule 11.5.2.

10.1.4 When hazardous contaminants are known or suspected to be encountered during well construction, the contractor is responsible for ensuring that his or her 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 must be grouted to prevent intermingling of groundwater and require a written variance..

10.1.6 Any hydraulic fracturing or stimulation of a well must be restricted to the permitted production interval and must not compromise the integrity of an adjoining confining layer or aquifer. (See Rule 6.2.1, 10.4.5.3) Upon request of the Chief Well Inspector or other staff of the State Engineer, the driller or authorized individual must provide reports or other data concerning the hydraulic fracturing of the water well. Such information may include, but is not limited to the interval within which hydraulic fracturing was performed, pressures used, duration, formation fractured, medium used to perform fracturing, additives used in the fracturing medium, production rate prior to fracturing and production rate after fracturing.

10.2 **Well Location** - When selecting a well location, consideration must be given to topography, drainage, sources of contaminants, underground utility locations, and other onsite conditions in order to promote sanitary conditions and prevent contamination of the well and aquifer. The ground surface in the vicinity of the well should be sloped to prevent the concentration of, and discourage the infiltration of, surface water at or near the wellhead.

10.2.1 When locating wells, well construction contractors and private drillers must comply with the regulations of federal, 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 must not be located closer than one-hundred (100) feet horizontally to the nearest existing source of contaminants (leach fields, contaminant plumes, chemical storage areas, stockyards, commercial feedlots, unlined solid or liquid waste facilities, waste transfer stations, etc) or fifty (50) feet horizontally from a septic tank, interior/exterior sewer lines, ~~or~~ other above or below ground vessels containing contaminants (including petroleum-based and other toxic products). A request for variance (as provided for in Rule 18) 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. The variance request must be prepared by a water well construction contractor or authorized individual, must be based on hydrogeologic information, and must comply with the minimum requirements shown in Figure 2a or 2b (whichever is applicable) to the greatest extent possible

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 must not be located closer to the source of contaminants. The distance between the perimeter of that source and the base of the grout seal must not be less than 100 feet, as shown in Figure 2a (or not less than 50 feet as shown in Figure 2b), unless a variance request prepared in accordance with the provisions of Rule 10.2.2, is granted.

FIGURE 2a
MINIMUM DISTANCE FROM A SOURCE OF CONTAMINATION

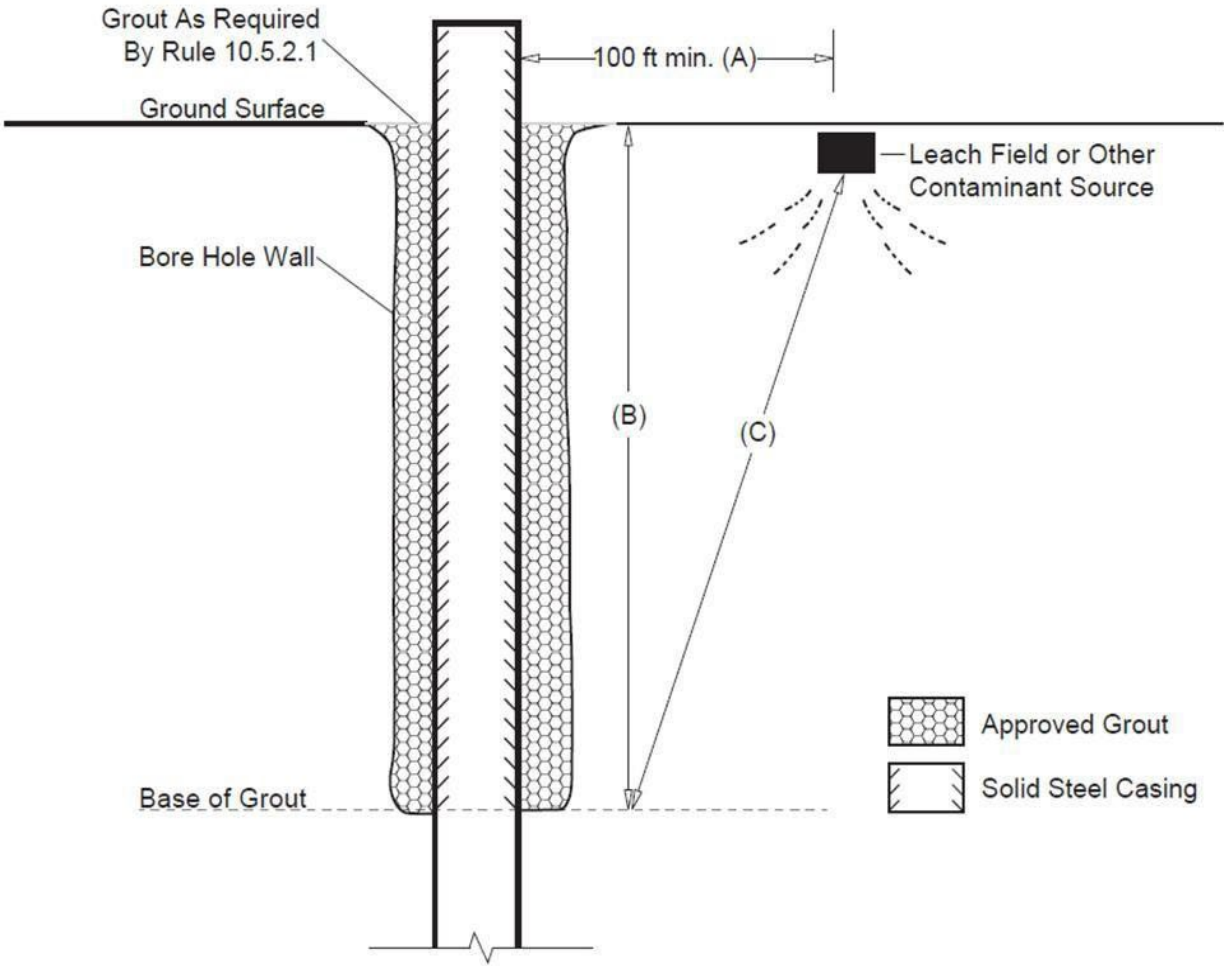


Figure 2a. Schematic of the minimum distance (A) to a well from a leach field or other source of contaminants (Rule 10.2.2). Exceptions to Rule 10.2.2 may be granted through a variance request; if distance A is less than 100 ft., distance C must equal 100 feet or more.

Grout depth calculation: $B \geq \sqrt{100^2 - A^2}$

FIGURE 2b
MINIMUM DISTANCE FROM A VESSEL CONTAINING CONTAMINANTS

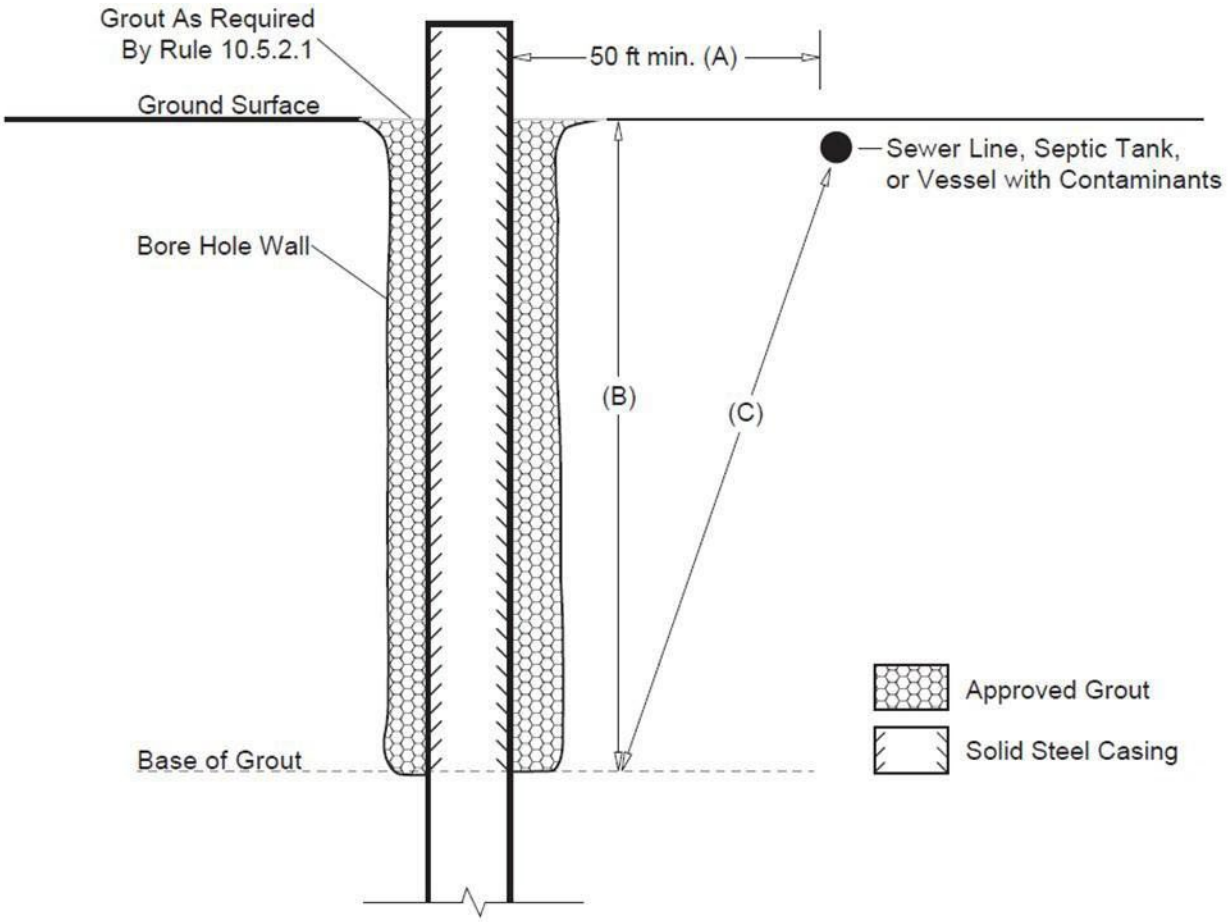


Figure 2b shows only a below ground storage tank. Above ground tanks and stockyard should also be considered. Rephrase or add note/drawing to 2b

Figure 2b. Schematic of the minimum distance (A) to a well from a sewer line, septic tank, or other vessel containing contaminants (Rule 10.2.2). Exceptions to Rule 10.2.2 may be granted through a variance request; if distance A is less than 50 ft., distance C must equal 50 feet or more.

Grout depth calculation: $B \geq \sqrt{50^2 - A^2}$

10.3 **Well Casing** Well casing must consist of materials that will ensure adequate protection against failure for the intended use of the well

10.3.2 All casing must 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. PVC casing must not be exposed above the ground surface. All surface casing must be steel pipe. All casing must ~~and be~~ undamaged, free of pits and corrosion, and free of contamination. Used oilfield pipe must not be installed in any well. Galvanized or corrugated steel casing must not be used in well construction.

10.3.3 Conductor casing/pipe should be removed from the borehole prior to or during grouting. Where ground conditions are such that removal of the conductor casing is not feasible, a variance request must be submitted to and written approval must be obtained from the Board prior to grouting of the annulus between the conductor casing/pipe and the surface or production casing. The variance request must be prepared by a water well construction contractor, must describe the conditions which prevent the conductor from being removed, and the annular space within the conductor must comply with the minimum requirements of Rule 10.4.4.

10.3.4 The well casing inside diameter (ID) or pitless adapter must be sufficient to accept a pump capable of producing the desired production rate. The following minimum ID (nominal) requirements apply to the specified type of well casing:

a. Steel well casing: 4.5 inch ID

b. PVC well casing: 4.0 inch ID

10.3.5 All casing wall thickness must be adequate to prevent collapse due to hydrostatic pressures. The following minimum wall thicknesses apply to the specified type of well casings:

a. Steel well casing: 0.188 inches

b. PVC well casing: 0.237 inches (Schedule 40)

c. Precast concrete rings: 3.00 inches

10.3.6 **Casing Perforation** – Casing perforation methods or designs must not result in inclusions or debris inside of the well casing. Any inclusions or debris must be removed after perforation. Oxygen-acetylene torch-cut perforations on well casing are prohibited on well casings less than 5 inches ID.

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, must protect the health and safety of the public utilizing workmanship and materials that match the intended use of the well.

10.4.1 Centralizers – Centralizer materials must be reasonably durable enough to survive the placement of the casing in the borehole, must be securely attached to the casing such that they are not dislodged and do not migrate along the casing, and must be rigid enough that they will provide the intended centralization for the casing. Plastic centralizers may only be attached to PVC casing; steel centralizers may be attached to steel or PVC casing. Other materials may not be used as centralizers. Centralizers must extend from the casing (nominal casing diameter or coupler diameter, whichever is larger) at least 1.5 inches beyond the casing and a minimum of 75% of the annular space, whichever is greater.

a. Centralizers must be installed in all grouted intervals of the surface casing and production casing of a well. The distance between centralizers must not exceed fifty (50) feet for intervals that will be grouted for more than fifty (50) feet.

b. If the grouted interval of the ~~production~~ casing is less than fifty (50) feet, centralizers must be installed ~~at the top and~~ within 5 feet of the top and bottom of the grouted interval.

c. Production casing must be hung in tension during the placement of grout material.

10.4.2 Wells with Surface Casing - Wells that will be constructed with a surface casing string must 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 annular space between the borehole wall and surface casing string must, at a minimum, be grouted in accordance with the requirements of Rule 10.5.

Some contractors use PVC conductor pipe to control caving near the ground surface for any type of aquifer not just Type II or III. Some contractors abandon the PVC conductor pipe in place. Doug allows this if the contractor grouts the conductor pipe like it is driven surface casing Rule 10.4.2.1. Rule 10.3.1 says that surface casing must be steel. There is a disconnect between the rules and this practice that if accepted should be addressed in the Rules. Also "Conductor pipe" is not defined in the rules. I'd prefer that all conductor pipe be removed prior to or during grouting…or that conductor be treated like surface casing and be steel with centralizers and adequate grouting or be driven (no annulus) and be grouted like driven casing.

10.4.2.1 **Driven Surface Casing for wells in Type 2~~II~~ and Type 3~~III~~ aquif~~ers~~** - The annular space between surface casing that is driven and the production casing string must be grouted in accordance with the following requirements for Type 2~~II~~ and ~~-~~Type 3~~III~~ aqu~~if~~ers. Additional grouting below the base of the driven surface casing may be necessary to comply with the requirements for a particular type of aquifer. See Figure 3.

a. For Type 2~~II~~ aquifers (unconfined bedrock aquifers) with driven surface casing, the grout interval must extend from at least twenty (20) feet below to at least ten (10) feet above the base of the surface casing.

b. For Type 3~~III~~ aquifers (unconsolidated aquifers) with driven surface casing, the grout interval must extend from at least ten (10) feet below to at least ten (10) feet above the base of the surface casing. See Figure 3.

FIGURE 3
WELLS WITH DRIVEN CASING

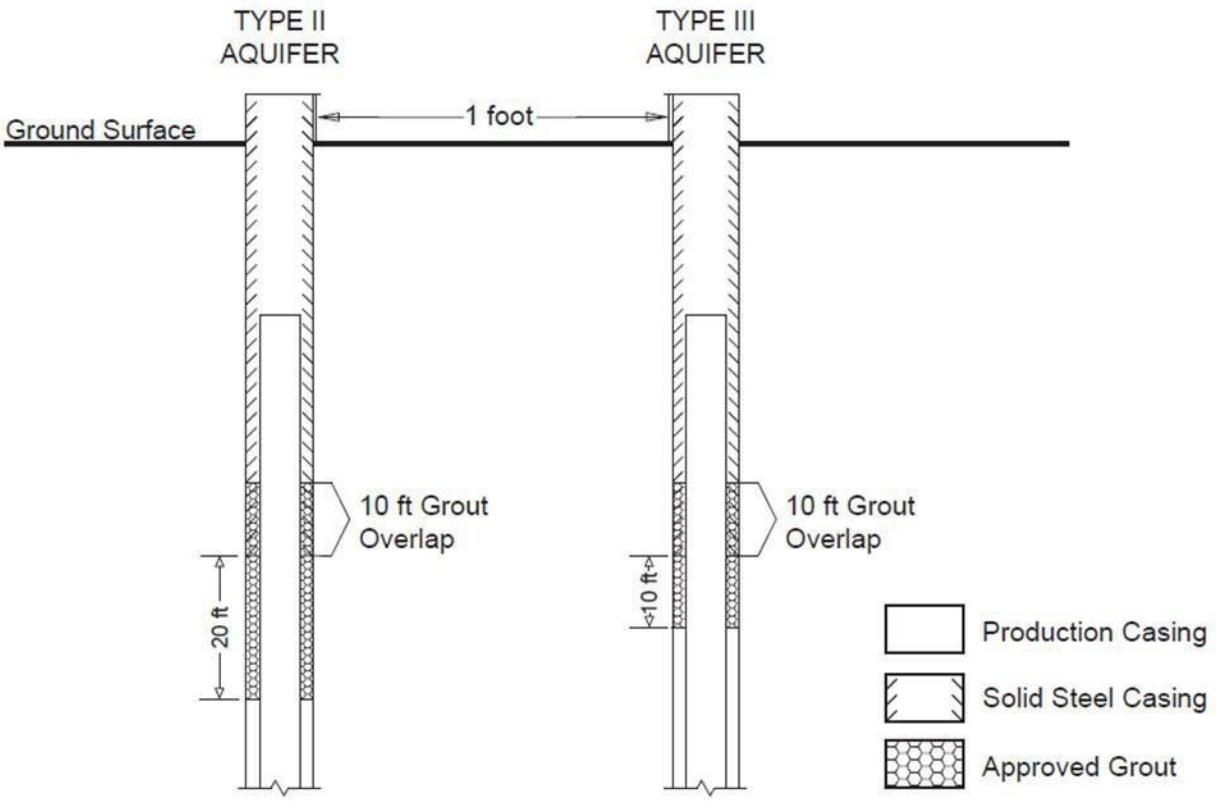


Figure 3. Schematic diagram for grout placement in wells with driven steel casing. In each aquifer type, the minimum continuous grout interval must extend a minimum of 10 feet into the annulus between the driven casing and the production casing.

Figure 3 could be improved by adding notation “Min 19’ bgs” at the base of the solid steel casing for each example well.

10.4.3 Wells without Surface Casing - All wells that will be constructed without surface casing must 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 annular space between the borehole wall and production casing string must 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 Annular Space Requirements for All Grouted Intervals - The borehole must be constructed to provide sufficient annular space for the placement of grout. Minimum annular space requirements apply only to intervals where the borehole must be grouted to meet minimum grouting requirements.

10.4.4.1 The borehole diameter for the grouted intervals between 0 and 39 feet below ground surface must not be less than two (2) inches larger than the outside diameter of the outermost casing or coupling (minimum one (1) inch of annular space, as defined in Rule 5.2.2).

10.4.4.2 The borehole diameter for every grouted interval ~~well~~ deeper than 39 feet below ground surface must not be less than ~~two~~ (3 ~~2~~) inches larger than the outside diameter of the outermost casing or coupling (minimum one and one-half (1.5) inch of annular space, as defined in Rule 5.2.2).

10.4.4.3 If grout is poured from the surface and the casing is not vibrated, the borehole diameter for the well must not be less than four (4) inches larger than the outside diameter of the casing (annular space of two (2) inches).

See Template: 10.4.4 Annular Space for Grouted Intervals

10.4.5 Wells Constructed Into Type 1~~I~~ Aquifers (Confined Aquifers):

See Template 10.4.5 Type 1 Aquifers Steel & Grout

See Template 10.4.5 Type 1 Aquifers Plain Casing & Grout

10.4.5.1 **Type 1~~I~~ Well P~~p~~enetrating Only One (1) Confining Layer Inside Administrative Denver Basin and Rio Grande Basin (Excluding Wells~~Those~~ Completed in~~Penetrating~~ the Laramie-Fox Hills Aquifer see Rule 10.4.8)** -

a. Wells completed in a Type 1~~I~~ aquifer (confined aquifer—see Rule 5.2.2.1), where the borehole penetrates **only one (1)** confining layer (see Rule 5.2.12), and are constructed without surface casing must have watertight solid casing with watertight joints installed from the base of the confining layer directly above the permitted production zone to the top of the well.

b. Wells completed in a Type 1~~I~~ aquifer (confined aquifer), where the borehole penetrates **only one (1)** confining layer, and are constructed with surface casing must have solid casing with watertight joints installed from the base of the confining layer directly above the permitted production zone to at least ten (10) feet above the base of the surface casing (see Figures 4a and 4b).

c. For wells constructed into Type 1~~I~~ aquifers, where the borehole penetrates **only one (1)** confining layer, the annulus between the borehole wall and the casing string must be grouted with cement or cement-bentonite from the base of the confining layer back to a level that is not less than sixty (60) feet above the base of the confining layer or to the level required to withstand the maximum potential hydrostatic pressure differential between the aquifers.

d. If the well is constructed with steel production casing, the interval from the base of the confining layer directly above the production zone to the depth required by Rule 10.5.2.1 must be grouted with approved grout (Table 2). If surface casing is used, the grout must extend 10 feet above the base of the grouted surface casing.

e. The upper part of the well must be grouted with cement to a minimum depth of thirty nine (39) feet as shown in Figures 4a and 4b, and in accordance with Rule 10.5.2.1. Grout must 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.

10.4.5.2 Type 1~~I~~ Well Penetrating More than One (1) Confining Layer –

a. Wells completed in a Type 1~~I~~ aquifer (confined aquifer—see Rule 5.2.2.1), where the borehole penetrates more than one (1) confining layer, and are constructed without surface casing must have watertight solid steel production casing with watertight joints installed from the base of the confining layer directly above the permitted production zone to the top of the well.

b. Wells completed in a Type 1~~I~~ aquifer (confined aquifer), where the borehole penetrates more than one (1) confining layer, and are constructed with surface casing that does not extend at least to the top of the production zone must have solid steel production casing with watertight joints installed from the base of the confining layer directly above the permitted production zone to at least ten (10) feet above the base of the surface casing (see Figures 4a and 4b).

c. Wells completed in a Type 1 aquifer (confined aquifer), where the borehole penetrates more than one (1) confining layer, and are constructed with surface casing that extends to the top of the production zone or deeper must have solid casing with watertight joints installed from the base of the confining layer directly above the permitted production zone but additional grout in the annulus between the production and surface casing is not required.

d. For wells constructed into Type 1~~I~~ aquifers (confined aquifers), where the borehole penetrates more than one (1) confining layer, the annular space between the borehole wall and the casing string must be grouted with approved grout using positive displacement from the base of the confining layer overlying the permitted production zone up to sixty (60) feet above the base of the uppermost confining layer, or to the depth required by Rule 10.5.2.1.

FIGURE 4a

TYPE I AQUIFER

WELLS PENETRATING ONE CONFINING LAYER

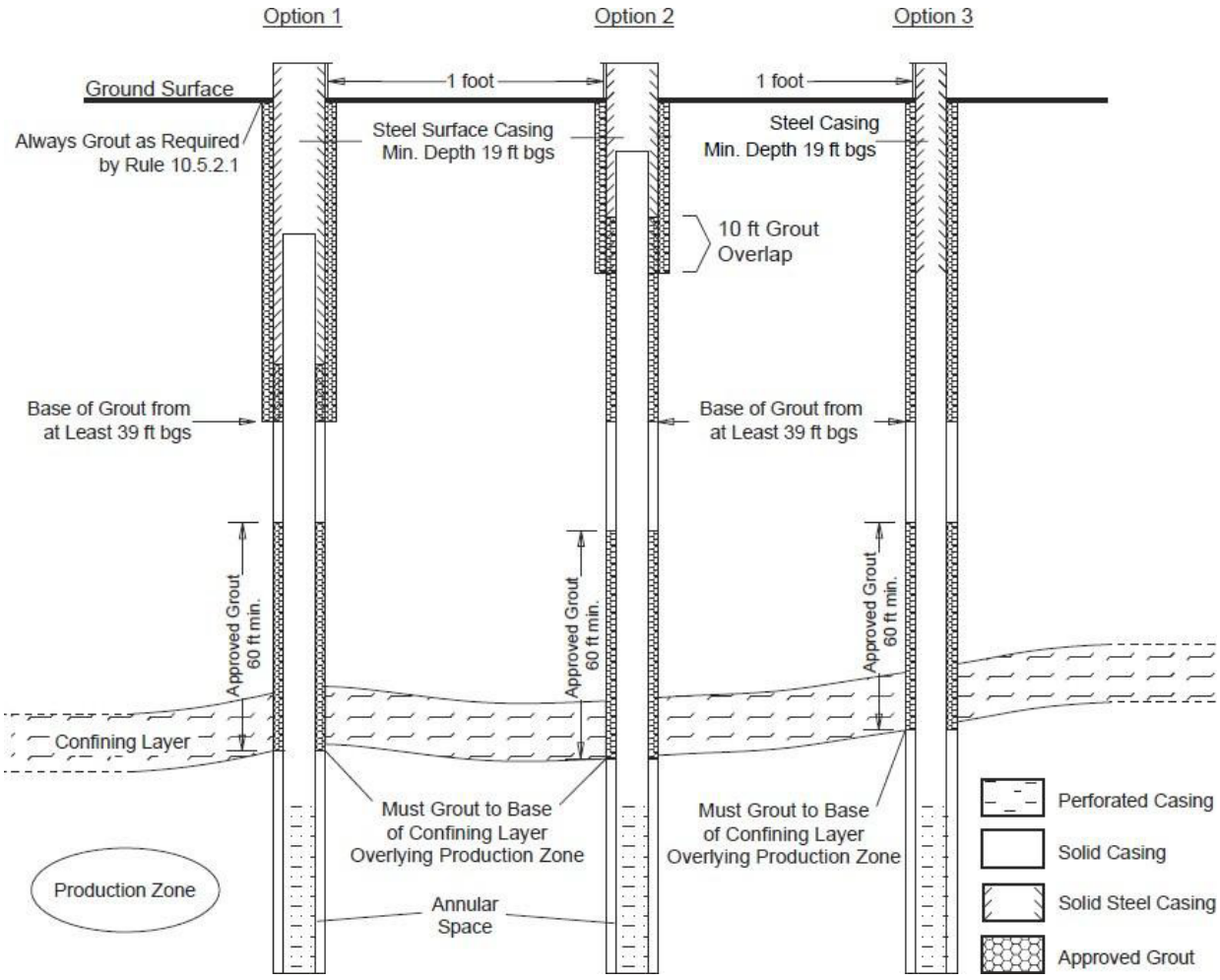


Figure 4a. Schematic diagram for wells that penetrate only one confining layer and are constructed into a Type I (confined) aquifer.

Note: *If the well is constructed with steel casing, the interval from the base of the confining layer directly above the production zone to the depth required by Rule 10.5.2.1 must be grouted with approved grout (Table 2). If surface casing is used, the grout must extend 10 feet above the base of the grouted surface casing.*

Suggest updating figure for instance where surface casing is min 39' + penetrates into bedrock where 10' grout overlap is not required. Could also add instance to illustrate Policy 2017-2.

FIGURE 4b

TYPE I AQUIFER

WELLS PENETRATING MORE THAN ONE CONFINING LAYER

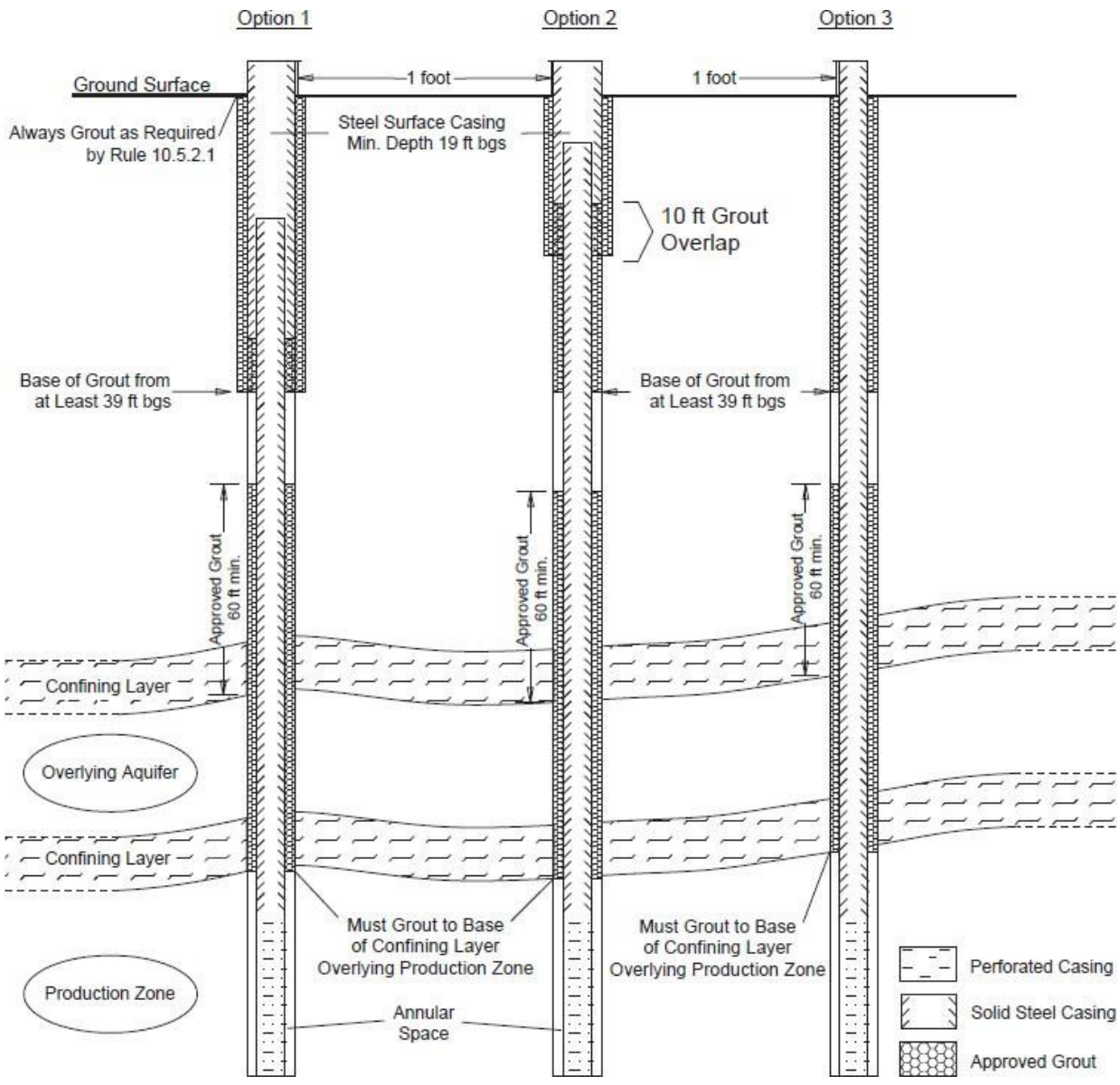


Figure 4b. Schematic diagram for wells that penetrate more than one confining layer and are constructed into a Type I (confined) aquifer.

Suggest updating figure for instance where surface casing is min 39' + penetrates into bedrock where 10' grout overlap is not required. Could also add an instance to illustrate Policy 2017-2.

10.4.5.3 **Hydraulic fracturing of a water well in Type 1I Aquifer**: Any hydraulic fracturing or stimulation of the producing interval of a water well drilled into a Type 1I Aquifer must not compromise the integrity of a confining layer. Before initiating any hydraulic fracturing operations in a water well drilled into a Type I Aquifer, the driller and/or consultant (Authorized Individual) must provide detailed plans for such operations to be reviewed by Board Staff at the State Engineer's Office, and may only initiate such operations upon (1) advance written approval of the Board, and (2) at least 24 hours advance notification of the initiation of such operations to the Chief Well Inspector by telephone or email. ~~Upon request of the Chief Well Inspector or other staff of the State Engineer, the driller or authorized individual must provide reports or other data concerning the hydraulic fracturing of the water well.~~

10.4.6 Wells Constructed Into Type 2II Aquifers (Unconfined Bedrock Aquifers): Wells constructed into a Type 2II Aquifer must have at least forty (40) feet of solid casing, from at least one (1) foot above to at least thirty nine (39) feet below ground level, and must have at least thirty (30) feet of continuous grout. The uppermost twenty (20) feet of solid casing (including surface or production) must be steel casing.

10.4.6.1 **Casing Requirements** -

a. Wells completed in a Type 2II aquifer (unconfined bedrock aquifer—see Rule 5.2.2.2) that are constructed without surface casing must have solid casing with watertight joints installed from the top of the permitted production zone to the top of the well.

b. Wells completed in a Type 2II aquifer (unconfined bedrock aquifer) that are constructed with surface casing must have solid casing with watertight joints installed from the top of the permitted production zone to at least ten (10) feet above the base of the surface casing.

10.4.6.2 **Grouting Requirements for Type 2II Aquifer (unconfined bedrock aquifer) Not Overlain by another Type 2 aquifer or by a Type 3III Aquifer (alluvial/colluvial aquifer)** - Wells completed in a Type 2II aquifer (unconfined bedrock aquifer) that do not penetrate through a Type 2 or Type 3III aquifer (unconsolidated) must have at least thirty (30) feet of continuous grout and must be grouted in accordance with the following:

a. If no surface casing is installed, grout must be placed in the annular space between the production casing and the borehole wall from a depth of at least thirty-nine (39) feet up to the depth required by Rule 10.5.2.1. See Figure 4c.

b. If surface casing is installed to a depth less than thirty-nine (39) feet below the land surface and grouted to the depth required by Rule 10.5.2.1, the annulus between the borehole wall and the production casing string must be grouted from a depth of at least thirty nine (39) feet below the surface back to a level that is at least ten (10) feet above the base of the surface casing. See Figure 4c

c. 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 up to the depth required by Rule 10.5.2.1.

10.4.6.3 **Grouting Requirements for Type 2II Aquifer Overlain by a Type 3III Aquifer (Alluvial/Colluvial)** - Wells completed in a Type 2II aquifer (unconfined bedrock aquifer) that penetrate through a Type 3III aquifer (unconsolidated aquifer) must fully isolate the entire Type 3III aquifer interval from the Type 2 interval using:

a. driven steel casing through the entire Type 3 aquifer interval and ten (10) feet below the base of the Type 3 aquifer

or

b. grouted casing from ten (10) feet below the base of the Type 3 aquifer back to the top of the well

or

c. a minimum sixty (60) foot grout plug from ten (10) feet below the base of the Type 3 aquifer up to a level that is not less than fifty (50) feet above the base of the Type 3 aquifer.
~~The surface casing may extend down to the top of bedrock or a 60-foot grout plug must be placed from 10 feet below to 50 feet above the top of bedrock.~~ ~~with grout or driven steel casing.~~
See Figure 4d.

10.4.7 Wells Constructed Into Type 3III Aquifer (Unconsolidated Material) - Wells constructed into a Type 3III aquifer (unconsolidated aquifer) must have at least twenty (20) feet of solid steel casing in accordance with Rule 10.4.2 or Rule 10.4.3, and at least ten (10) feet of continuous grout.

10.4.7.1 **Casing Requirements** - All wells completed in a Type 3III Aquifer (unconsolidated aquifer--see Rule 5.2.2.3), with or without surface casing must have solid steel casing with watertight joints installed from a depth of at least nineteen (19) feet to the top of the well.

10.4.7.2 **Grouting Requirements** -

a. In wells constructed with surface casing into Type 3III aquifers (unconsolidated aquifer), the annulus between the borehole wall and the surface casing must be grouted from a depth of at least nineteen (19) feet up to the depth required by Rule 10.5.2.1. If the surface casing is driven, grout must 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 3). At least ten (10) feet of continuous grout is required.

b. If surface casing is not installed, the annulus between the borehole wall and the production casing string must be grouted from a depth of at least nineteen (19) feet up to the depth required by Rule 10.5.2.1. (see Figure 4e). At least ten (10) feet of continuous grout is required.

FIGURE 4c

TYPE 2~~II~~ AQUIFER

WELLS COMPLETED IN TYPE II AQUIFER(UNCONFINED BEDROCK)
NOT OVERLAIN BY TYPE III AQUIFER

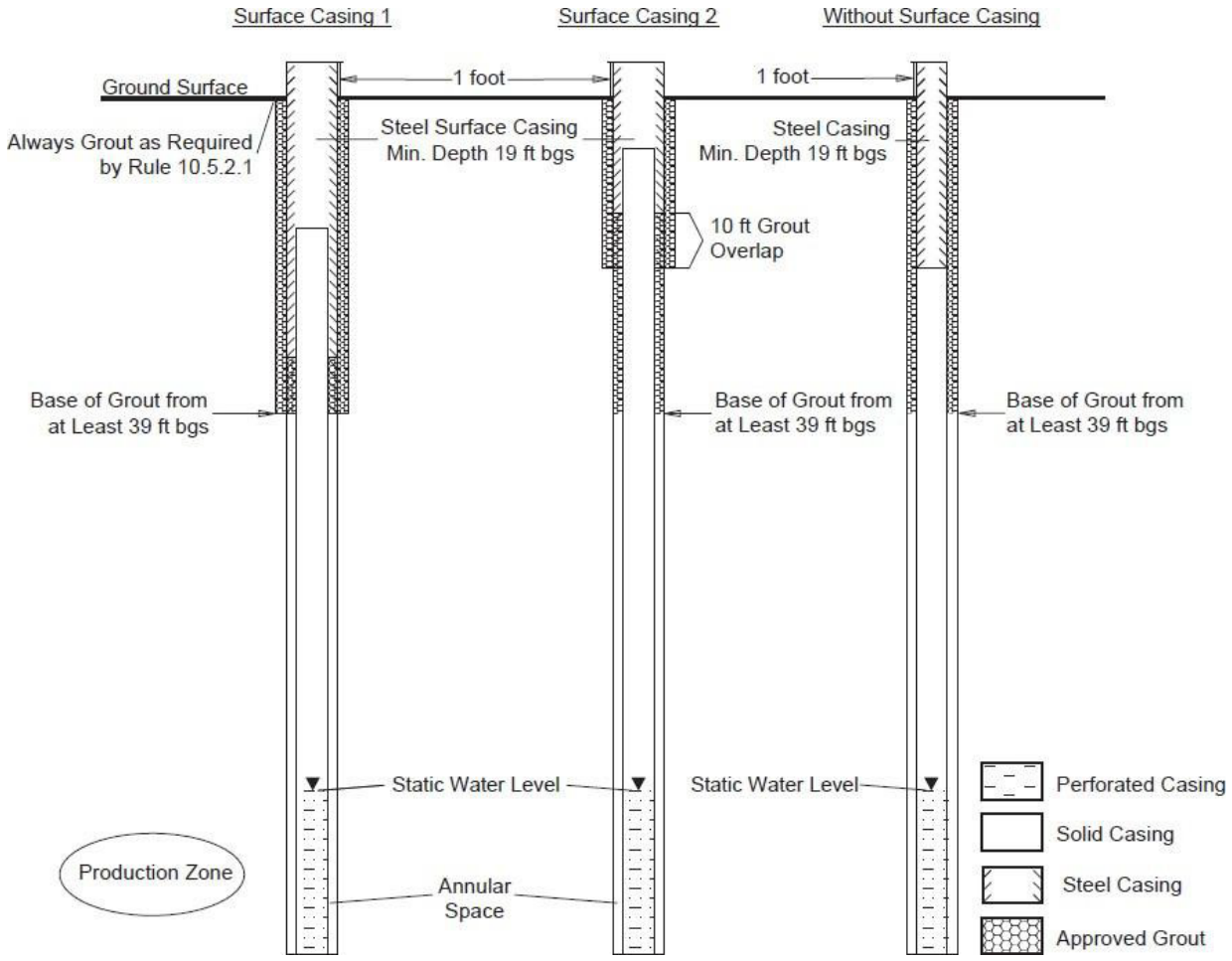


Figure 4c. Schematic diagram for wells constructed into Type 2~~II~~ (unconfined bedrock) aquifers, not overlain by a Type 3~~III~~ (unconsolidated) aquifer.

Suggest updating figure for instance where surface casing is min 39' + penetrates into bedrock where 10' grout overlap is not required. Could also add instance to illustrate Policy 2017-2

FIGURE 4d

TYPE 2~~II~~ AQUIFER

WELLS COMPLETED IN UNCONFINED BEDROCK AQUIFERS

(OVERLAIN BY TYPE 3~~III~~ AQUIFER)

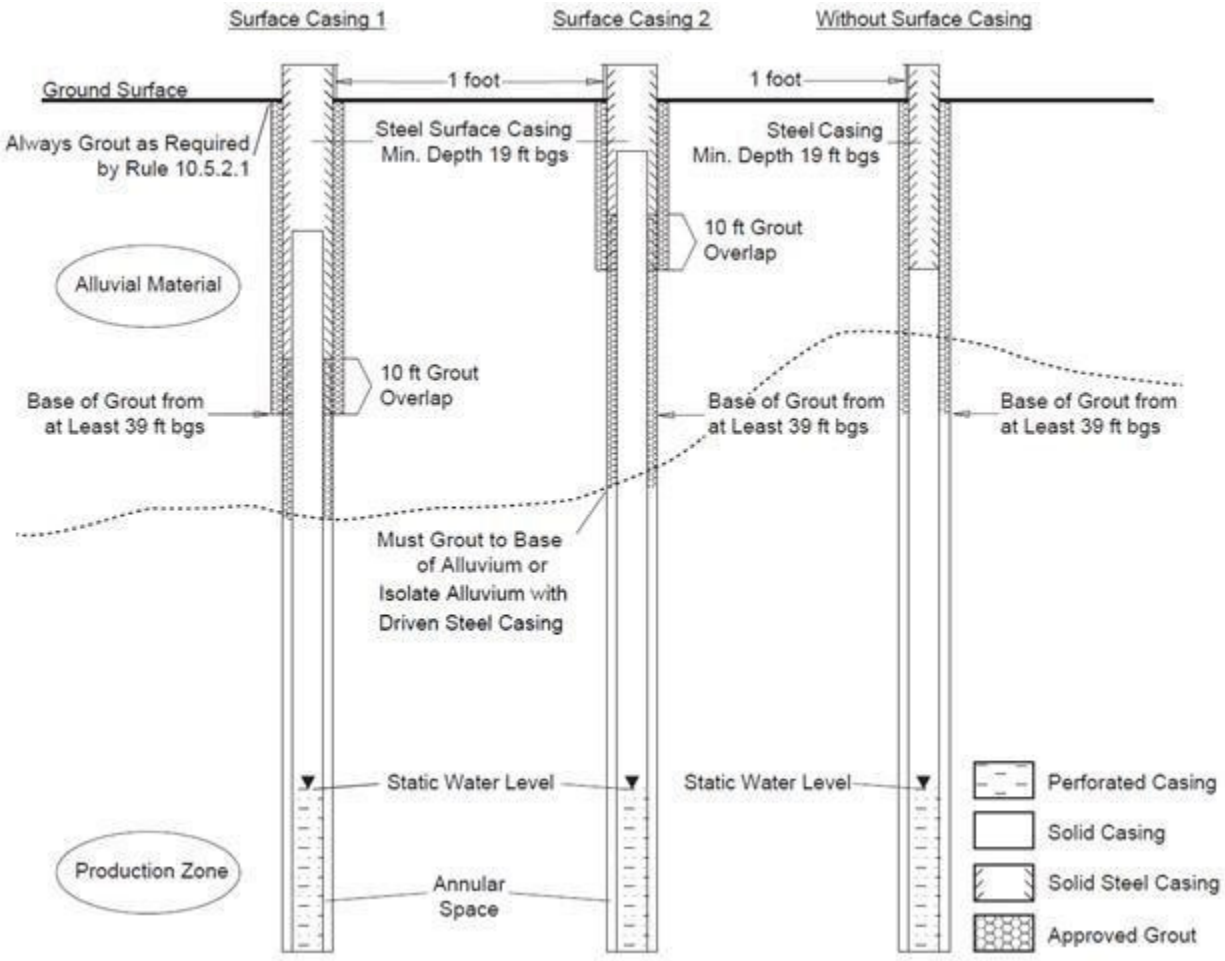


Figure 4d. Schematic diagram for wells constructed into Type II (unconfined bedrock) aquifers, overlain by a Type III (unconsolidated) aquifer.

Suggest updating figure for instance where surface casing is min 39' + penetrates into bedrock where 10' grout overlap is not required.

FIGURE 4e

TYPE 3~~III~~ AQUIFER

WELLS COMPLETED IN UNCONSOLIDATED

ALLUVIAL/COLLUVIAL MATERIALS

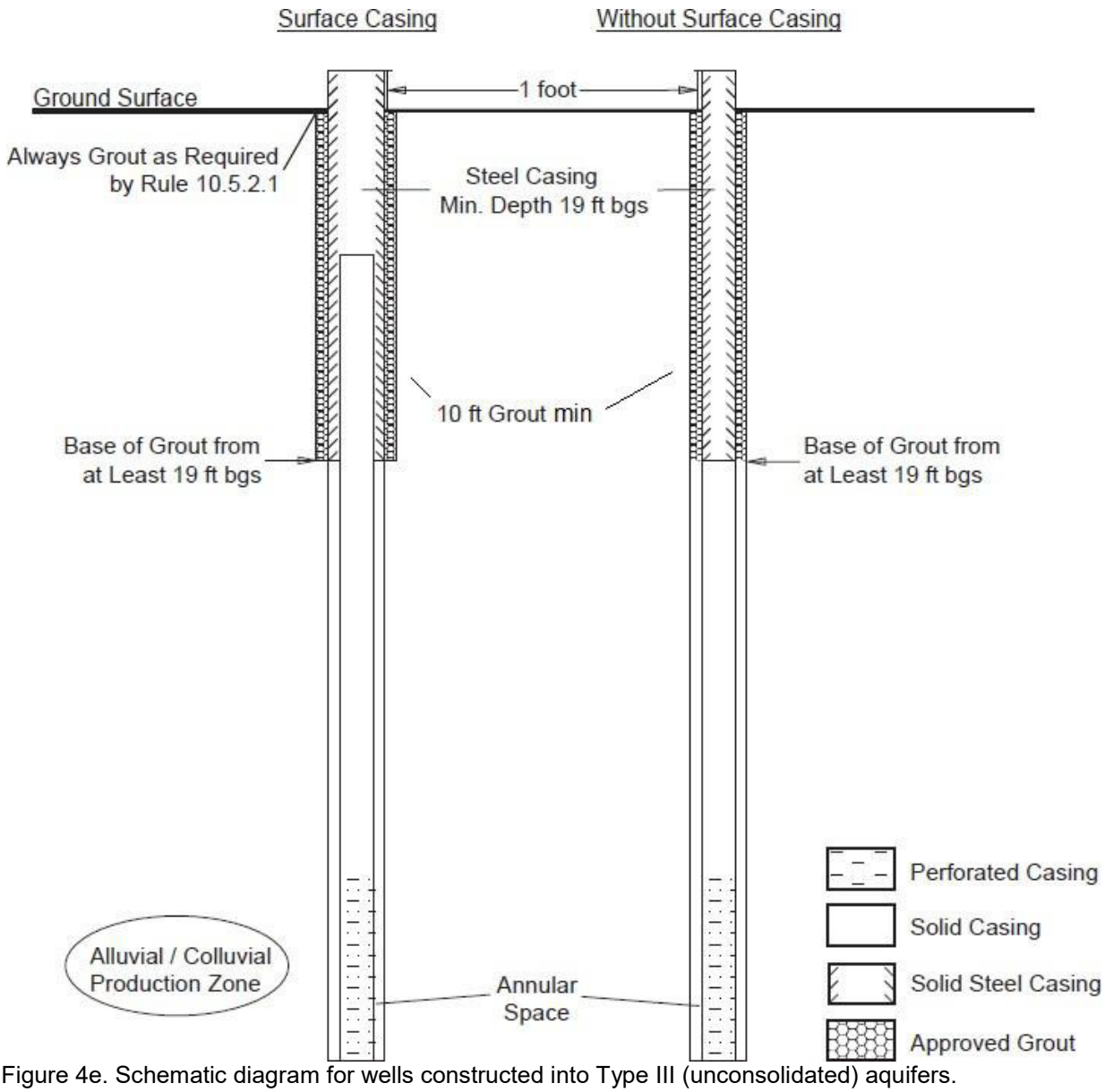


Figure 4e. Schematic diagram for wells constructed into Type III (unconsolidated) aquifers.

10.4.8 Wells Constructed into Laramie-Fox Hills Aquifer:

10.4.8.1 **Casing Requirements**:

Rule 10.4.8.1 needs a new figure (potentially 4F). That figure should indicate steel casing and grout from the top of the production zone to 10 feet into the surface casing or as required by 10.5.2.1

a. Wells completed in the Laramie-Fox Hills aquifer that are constructed without surface casing must have watertight solid steel casing with watertight joints installed from the top of the permitted production zone to the top of the well.

b. Wells completed in the Laramie-Fox Hills aquifer that are constructed with surface casing that does not extend to the top of or deeper than the top of the production zone must have solid steel casing with watertight joints installed from the top of the permitted production zone to at least ten (10) feet above the base of the surface casing (see Figure 4a). In wells where surface casing extends to the top of or deeper than the top of the production zone and the annulus between the borehole and the surface casing is grouted per Rule 10.4.8.2, the production casing need not be steel.

10.4.8.2 **Grouting Requirements** - For wells constructed into the Laramie-Fox Hills aquifer, the annular space between the borehole wall and the casing string(s) must be grouted with an approved or bulk grout (Table 2) cement ~~or cement-bentonite from the~~ top of the permitted production zone up to the depth required by Rule 10.5.2.1. If surface casing is used and does not extend down to or below the top of the production zone, approved or bulk grout meeting the requirements of Table 2 must also be placed in the annulus between the production casing and the surface casing up to at least ten (10) feet above the base of the surface casing~~, or to the depth required by Rule 10.5.2.1 if no surface casing is installed~~.

10.4.9 Wells Constructed Into the Unconfined San Luis Valley Aquifer - Wells constructed into the Unconfined San Luis Valley Aquifer must have at least twenty (20) feet of solid steel casing in accordance with Rule 10.4.2 or Rule 10.4.3, and at least ten (10) feet of continuous grout.

10.4.9.1 Casing Requirements - All wells completed in Unconfined San Luis Valley Aquifer, with or without surface casing must have solid steel casing with watertight joints installed from a depth of at least nineteen (19) feet to the top of the well.

10.4.9.2 Grouting Requirements -

a. In wells constructed with surface casing in the Unconfined San Luis Valley Aquifer, the annulus between the borehole wall and the surface casing must be grouted from a depth of at least nineteen (19) feet up to the depth required by Rule 10.5.2.1. If the surface casing is driven, grout must 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 3). At least ten (10) feet of continuous grout is required.

b. If surface casing is not installed, the annulus between the borehole wall and the production casing string must be grouted from a depth of at least nineteen (19) feet up to the depth required by Rule 10.5.2.1. (see Figure 4e). At least ten (10) feet of continuous grout is required.

10.4.10 Grouting Requirements for Wells Constructed into the Confined San Luis Valley Aquifer - Wells completed in the Confined San Luis Valley Aquifer must isolate the Unconfined San Luis Valley Aquifer interval from the Confined San Luis Valley Aquifer interval using

a. driven steel casing through the entire Unconfined San Luis Valley Aquifer interval and ten (10) feet below the base of the Unconfined San Luis Valley Aquifer

or

b. grouted casing from ten (10) feet below the base of the Unconfined San Luis Valley aquifer back to the top of the well

or

c. a minimum sixty (60) foot grout plug from ten (10) feet below the base of the Unconfined San Luis Valley Aquifer up to a level that is not less than fifty (50) feet above the base of the Unconfined San Luis Valley Aquifer.

See Figure 4d.

10.4.11 Grouting Requirements for Wells Completed in a Confining Layer Overlain by Another Aquifer - Wells completed in a confining unit that is overlain by another aquifer must fully isolate the overlying aquifer interval from the production zone in which the well will be completed by filling the annulus between the borehole wall and the outermost casing string with approved grout from the top of the production zone back to the top of the well.

10.4.12 Surface Completion - 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 extends above the surface must have a watertight mechanical seal (e.g, a welded seal) or be sealed with a minimum of ten (10) feet of cement grout up to the depth required by Rule 10.5.2.1. If additional filter pack materials are to be added after the well has been completed, those materials must be inserted through the use of a filler tube, as required by Rule 10.4.10.

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

a. Filler Tube - The portion of the filler tube above the production zone must be grouted in place up to the depth required by Rule 10.5.2.1. Filler tube exposed above the ground surface must be composed of or covered by steel pipe. The top of the filler tube must be covered by a metal water-tight sanitary seal

10.4.10.1 **Filter Packs in Type III aquifers with grouted surface casing and mechanical seal**: If a well in a Type III aquifer (unconsolidated) has surface casing properly grouted in accordance with Rule 10.4.7.2, and the annular space between the surface casing and production casing is sealed with a watertight mechanical seal (e.g., a welded seal), then a filter pack may be installed from the permitted production zone up to the mechanical seal. Under these circumstances, the filter pack may only be installed through a filler tube welded in place with a water-tight sanitary seal. The filler tube and seal must consist of steel pipe.

10.4.14 **Gallery Wells or Infiltration Galleries** - Prior to the construction of infiltration galleries or gallery type wells, a well construction variance must be obtained ~~submitted to~~ from the Board of Examiners. The variance request must include 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 must be submitted to the Board of Examiners~~. If the Board finds the proposed gallery acceptable, it will approve the well construction variance ~~construction plan~~ in writing and impose any conditions necessary to reduce the risk to public health by contamination of the aquifer. Acceptable examples of gallery type wells are shown in Figure 5.

a. Mastic and other waterproofing agents between components of the well must be suitable for use in potable-water systems

Figure 5 Comments

Details A, B and C indicate "impervious fill" is required above the washed rock. Soils typically have some permeability; define impervious or change to a more realistic description of materials.

Detail A shows a layer of compacted impervious fill between the excavation wall and the washed rock. This seems to defeat the purpose. Suggest removing the compacted impervoius fill between the washed rock and the excavation wall. Could replace with a filter cloth. Should consider specifying a type of filter cloth (woven vs unwoven, etc)

Filter Cloth arrow in Detail B and C appears to be pointing just to the line between the washed rock and impervious fill, but could also be interpreted as extending all the way around the wash rock because there is no separate line for filter cloth. Suggest adding a seperate line explicitly defining the location of filter cloth.

Labels for materials change from detail to detail. Example "Compacted Impervious Fill" used in Details A and B but "Compacted Backfill (native clay)" used in Detail C and "Compacted Clay Backfill" used in Details D, E and F. The hatch for each of those materials changes in Details D, E and F.

Filter Cloth arrow in Detail E points to nothing.

FIGURE 5

GALLERY WELLS OR INFILTRATION GALLERIES

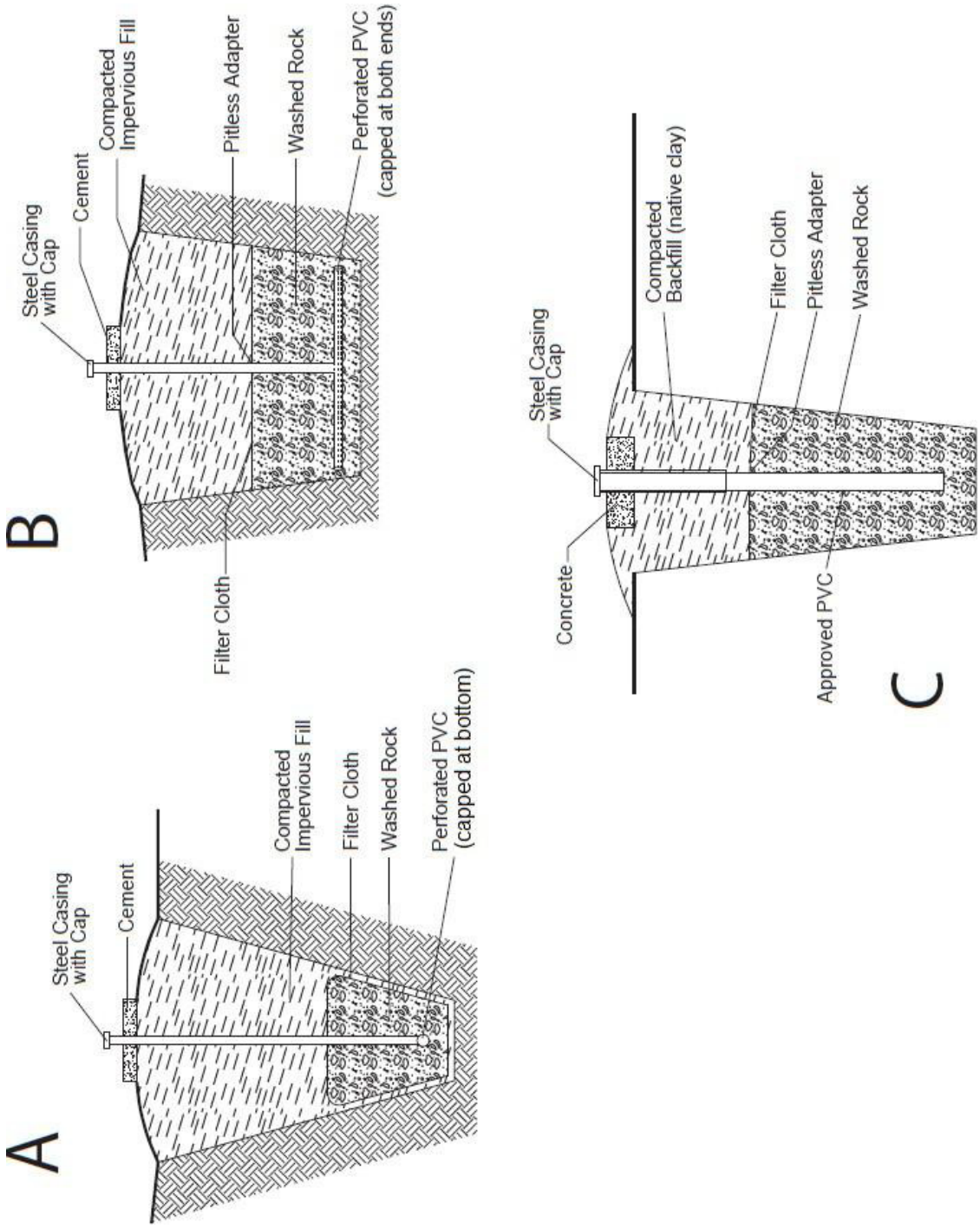


Figure 5. Schematic diagram of various gallery-type well designs

FIGURE 5 (CONTINUED)

GALLERY WELLS OR INFILTRATION GALLERIES

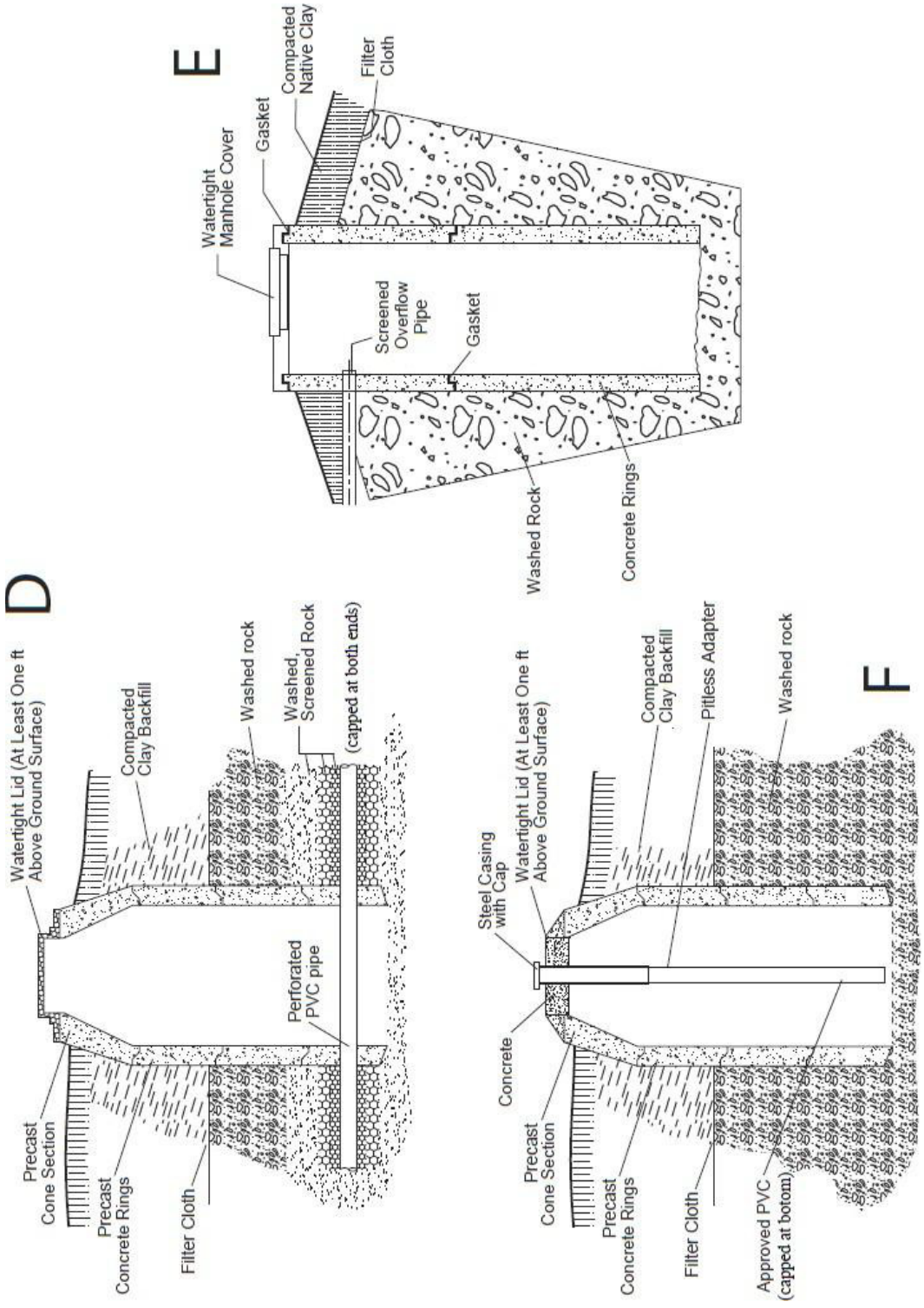


Figure 5 (continued). Schematic diagram of various gallery-type well designs.

10.4.15 **Directional Drilling** - All wells must be constructed vertically and in accordance with Rule 10.4.13, unless directional drilling has been specifically approved by the State Engineer in a well permit and a variance has been approved by the Board.

10.4.16 **Plumbness and Alignment** - All wells must 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 will not be considered directional drilling. The casing must be sufficiently plumb and straight so that it will not interfere with the installation and operation of the pump.

10.5 **Grout and Grout Placement** - All wells must be grouted to prevent contaminants from entering the borehole, to separate groundwater 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 is the responsibility of the person authorized to construct the well. All grout seals must be installed before completion of the well and the installation of the production equipment.

10.5.1 Only the grout materials that meet the requirements set forth in Table 2 may be used. Grout must 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 must be reported on the well construction report.

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

10.5.2.1 At or near the ground surface, the annulus between the borehole and the outermost casing must be sealed with at least the minimum amount of continuous cement grout required for the particular type of aquifer in which the well is constructed (see Rule 10.4), and considering whether a pitless adapter or unit will be installed. The top of the grout seal must 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. The annular space above the top of the grout must be backfilled with fill materials not more permeable than the surrounding ground that are adequately compacted.

b. Not more than three (3) feet below any pitless adapter or pitless unit to be installed. The annular space above the pitless connection must be backfilled with fill materials not more permeable than the surrounding ground that are adequately compacted.

c. Not less than ten (10) feet above the base of the surface casing that has been driven for a well in a Type II or Type III aquifer. If the well is constructed into a Type II aquifer, the grout interval must 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 must extend at least ten (10) feet below the base of surface casing. See Rule 10.4.2.1.

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

TABLE 2: GROUT MATERIALS

Approved Grouts

A. **Neat Cement**: a slurry of cement and water with no more than six (6) gallons of water per 94-pound sack (Portland cement ASTM C-150). Fly ash may be blended with Portland cements for grouting wells. The water-cement ratio for grout slurries blended with fly ash must 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 must 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.

C. **Non-shrinking Cementitious Grouts** of differing composition may be reviewed and approved by the Board.

D. Up to certain percent fly ash, certain percent bentonite, weight requirement not to exceed combined ingredient per sack?

Prior to the use of other grout materials or combination of the above approved grout materials, a written request must be submitted to and written approval obtained from the Board.

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 must not exceed 140 pounds for each 94-pound sack of cement. Not more than six (6) gallons of water per 94-pound sack of cement may 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 must 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 may 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. Before use in water well construction, a variance must be obtained from the Board. The Board may approve the following types of bentonite products.

Only high-solids bentonite products that are clearly marked by the manufacturer as “grout” may be used. Mixing of bentonite grouts must strictly adhere to the manufacturer's recommendations and must 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 must strictly adhere to the manufacturer's recommendations and must 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 must 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 only be used as grout material in saturated zones and must be placed directly into the appropriate interval.

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 must not be placed where grout is required. Fill materials placed in the annulus near the land surface must be less permeable than the surrounding soil and must be adequately compacted to prevent settling.

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

10.5.3.1 Grout placed by positive displacement must be placed through well casing or through a tremie pipe. Grouting of each interval or stage must 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. The outside diameter of the tremie pipe must not exceed the annular space between the casing and the borehole.

10.5.3.2 Positive displacement grouting must be performed through an opening or grout port in the casing or through a tremie pipe where the bottom of the tremie being no more than five (5) feet from the bottom of the interval to be grouted. The opening or grout port through the pipe is a penetration of the pipe and therefore must be located below the required grout interval.

10.5.3.3 Handling of the tremie pipe should not allow the tip of the tremie to be lifted above the top of the grout while grouting is actively being placed within the required grout interval.

10.5.3.4 In the event that a grouting interval requiring “continuous grout”, other than those intervals and instances allowed by Rule 10.5.3.6, is not completely filled in one stage, the contractor must tremie grout the remaining portion of the interval with approved grout. The contractor must “tag” the top of the grout with the tremie prior to grouting the remaining portion of the required interval. Cleaning or jetting of the annulus above the level of the grout may be necessary to establish positive contact between the stages of grouting. Noncontinuous grout placement in intervals requiring continuous grout must be identified on the well construction report.

10.5.3.5 One or more packers or shale traps may be placed at or below the base of the minimum required grouted interval to facilitate grout placement. Additional packers or shale traps placed above the base of the required grouted interval, and that are not associated with the base of another required grouted interval, which may obscure the actual top of grout placement may not be used.

10.5.3.6 Where grout is poured from the surface, only neat cement or cement-bentonite may be used except as provided in Rule 10.5.3.3. Grout may only be poured into a dry annulus where the placement depth does not exceed forty (40) feet below ground surface.

10.5.3.7 Cement-sand or concrete grout mixtures may only be poured into a dry annulus where the borehole diameter is at least twelve (12) inches larger than the outside diameter of the casing (at least six (6) inch annular space) and the placement depth does not exceed forty (40) feet.

10.5.3.8 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 Rule 10.5 and Table 2. Bentonite must not be used to seal the outermost casing of a well within forty (40) feet below ground surface. A fully-hydrated bentonite slurry must not be used as a grout where a difference in hydrostatic head exists across the grout interval or if the interval will not remain saturated.

10.5.4 It is the responsibility of the person authorized to construct the well to allow the grout to set before resuming construction or performing any development, cleaning or stimulation of the well. The minimum setting time is six (6) hours for cement grout with accelerators and twenty-four (24) hours for cement grout without accelerators.

Potentially allow pumping if grout is supported by shale trap/basket

10.6 **Well Development and Cleaning** All wells must be initially cleaned and developed by the person authorized to construct the well in order to establish proper conditions in the well for installation of the permanent pumping equipment. At a minimum, well development and cleaning must include removal of drill cuttings, drilling fluids, and any foreign materials introduced into the borehole as a result of the borehole drilling and well completion processes.

See Template: 10.6 Well Development and Cleaning

10.7 **Disinfection** Prior to leaving the well site, the person authorized to construct the well must disinfect the well according to the provisions of Rule 15.

10.8 **Static Water Level Measurement** The static water level in all newly-constructed or modified wells must be measured by the method described in Rule 5.2.49 by the well construction or pump installation contractor, private driller, private pump installer, or authorized individual, within seven (7) days after the well has been cleaned and developed and the well yield estimate performed (see Rule 12.2). Static water level measurements must be reported on the well construction and/or pump installation report.

10.9 **Flowing Wells** Flowing wells, and wells that can be reasonably assumed to develop flowing conditions, must be constructed to prevent leakage around the casing or adjacent to the well. Upon completion of grouting, flowing wells must be equipped with a device to completely control the flow from the well, or the well must 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 control equipment at the time of well construction. Thereafter, it is the responsibility of the well owner to ensure the control equipment is maintained and operational.

RULE 11 MINIMUM PUMP INSTALLATION AND CISTERN INSTALLATION STANDARDS

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1), 37-91-104(1)(c), 37-91-109(1) & (2), 37-91-110(2), C.R.S. The purpose of this Rule is to establish the minimum standards for installing pumping equipment and cisterns that are connected to water well supply systems in order ensure that such installation prevents harm to the public health, will not impair water quality or cause contamination of shared groundwater resources, and will ensure the safety of groundwater resources for Colorado's existing and future populations.

11.1 **General Rules**- All permanent pump installations and cistern installations in or connected to a new or existing water well supply system must be completed 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.). Pumping equipment may be installed in wells constructed and used solely for purposes of aquifer remediation (recovery well) or temporary dewatering (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 Licensed water well construction contractors who are not licensed as pump installation contractors may not install pumping equipment in a well, except for temporary pumps used only for well development and testing.

11.1.2 Licensed pump installation contractors may not remove casing or install casing except for:

a. removal, alteration, or repair of casing to install a pitless adapter or pitless unit,

b. the upward extension of existing casing from the pitless adapter or pitless unit, or

c. the installation or replacement of casing in a well constructed through a single aquifer where such installation or replacement does not require the placement of grout in the annulus to meet the standards of these Rules.

11.1.3 Licensed pump installation contractors may not install grout in the annular space of a well or between well casing as required by Rule 10. This prohibition does not apply to grout installation associated with the installation of a pitless adapter, or grout installed in a well to abandon the well pursuant to Rule 16.

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

11.1.5 Pump installation contractors and private pump installers must submit a pump installation report every time a pump is installed in a well or for any change in the pump depth setting. The report must describe the pump, date of installation, its depth setting, static water level, and the results from the production equipment test required by Rule 12.

11.2 **Installation Standards** - Pumps, cisterns, pitless units and adapters, and related equipment that will be installed as part of, or connected to, a water well supply system must be installed in such a manner that the well, pump, cistern, and surrounding area will 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 may not cut off or penetrate well casing below ground level except to install a pitless adapter or a pitless unit. Pitless adapters must be installed on steel casing that extends to a minimum of one (1) foot above the finished ground level and must be watertight. Pitless units must have steel extensions to a minimum of one (1) foot above the finished ground level. All connections to the pitless adapters or pitless units must be made with threaded, flanged, welded or mechanical joints. Mechanical joints must 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, the contractor must comply with the requirements of Rule 10.5.2.1.

11.2.2 A pump installation contractor may only install a pitless adapter or pitless unit if, after such installation, the minimum continuous grout interval required by Rule 10.4 and Rule 10.5 is maintained.

11.2.3 Flowing wells must 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.

11.2.4 Pump installation contractors may not cut off or penetrate cisterns below ground level except to install watertight devices for water line or electrical connections.

11.3 **Cistern Installation and Location** - When selecting a cistern location, consideration must be given to topography, drainage, sources of contaminants, and other onsite conditions in order to promote sanitary conditions and prevent contamination of the well and aquifer.

11.3.1 A cistern installed below ground level must be constructed and placed in such a manner to withstand saturated soil pressures when empty.

11.3.2 A cistern installed below ground level must be equipped with an ~~watertight and the~~ access portal that ~~must~~ extends to at least one foot above the ground surface. The backfill material must be sloped away from the access portal.

11.3.3 A cistern installed below ground level must be buried to an adequate depth to prevent freezing.

11.3.4 A cistern installed below ground level must be properly bedded and backfilled in accordance with the manufacturers recommendation.

11.3.5 All penetrations of a cistern and the access portal must be watertight.

11.3.6 A cistern placed in a building must be placed in an area that is adequate to support the anticipated loads of the cistern, full of water, all pumping equipment, and controls.

11.3.7 A cistern must be placed in an area accessible to service.

11.3.8 When an existing cistern is connected to a water well supply system, the installation or connection must be performed by a licensed pump installation contractor. See § 37-91-109(2), C.R.S. The cistern that is connected to the water well supply system must meet all of the requirements of Rules 11.3 and 11.4 and any relevant local regulation.

11.3.9 All above ground portions and appurtenances (lids, access portal, vents, etc) of the cistern must be constructed of either metal or concrete or be protected/covered by metal casing, ~~or~~ concrete rings, or other non-plastic structure~~.~~

11.3.10 Mastic and other waterproofing agents between components of the cistern must be suitable for use in potable-water systems,

11.4 **Location Variance** - A cistern installed below ground level must not be located closer than one hundred (100) feet horizontally to the nearest existing source of contaminants or fifty (50) feet horizontally 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. The variance request must be prepared in accordance with Rule 18.2 by a pump installation construction contractor or authorized individual, and must be based on hydrogeologic information.

11.5 **Seals and Vents** -

11.5.1 **Well Seals** - All pumping equipment must be installed with an effective metal well seal at the top of the casing that will prevent the entry of contaminants into the well. The pumping equipment must 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. Only metal well seals ~~(with metal caps and rubber gaskets~~) are approved well seals within ~~the meaning of this Rule and~~ section 37-91-102(18), C.R.S; additional requirements for well seals and caps are presented in Rule 10.1.3 .

11.5.2 **Well and cistern vents** - When needed or used, well or cistern vents must be connected with watertight joints and 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, be constructed of metal, and be screened to prevent entry of insects and rodents. Vents must be constructed to vent all gasses to the atmosphere outside of a building and to prevent gas accumulation that could produce a health or explosion hazard.

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

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

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

well owner is responsible for the costs associated with bringing an unacceptable well vault to compliance with these rules.

11.6.3 Add Rule - Require as-built data and comprehensive photographic documentation of installed well vaults. Photos must show 360° around the wellhead and the base of the vault including floor drain or sump pump location. If the vault includes a floor drain, a photo must document the surface outfall of the drain. Also in Rule 17

11.7 **Water Level Measurement Devices** - A water level sounding tube must be installed on all wells whenever the permit issued by the State Engineer requires installation of water level measuring equipment. The water level sounding tube must have a minimum inside diameter of 3/4 (.75) inch. It must extend from the well head to the top of the pump discharge equipment and must be securely attached to the column or drop pipe so that it hangs straight. All tubes must be equipped with a removable cap or plug to prevent entry of foreign material. The bottom of the tube must 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 must comply with applicable federal, state, county, municipal and local laws, regulations, and codes.

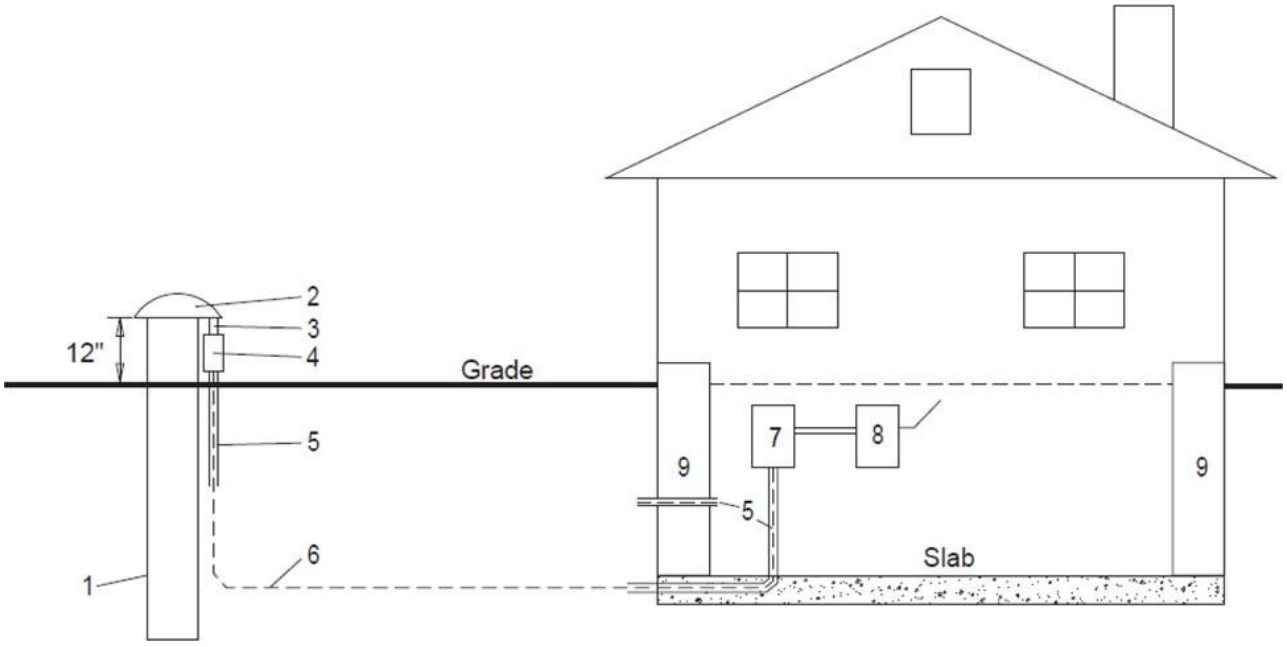
11.8.1 **Electrical Connection of Pumping Equipment** Only licensed pump installation contractors, private pump installers, or licensed electrical contractors, using appropriately licensed or supervised personnel, may install electrical materials and connections between the well head junction box and the pump service disconnect box (see Figure 6). The materials, fittings, and control assemblies used for this installation must meet the standards of the NFPA 70: National Electric Code (2020~~14~~), and are subject to permitting and inspection by the Colorado State Electrical Board. Electric power to the pump service disconnect box must be installed by either a licensed electrical contractor or the property owner.

a. Electrical junction between the electrical supply conductor and the pump wire must be made in a weatherproof junction box located at the well seal.

FIGURE 6

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 junction 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: Electrical c~~o~~nduit must extend 18 inches below finished grade from well junction box

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. All materials and fittings used to connect the well to the pressure tank must meet the standards of the Rules and Regulations of the Colorado State Plumbing Board, 3 CCR 720-1.

11.9 **Pressure Relief Valve** All water well supply systems capable of producing pressures greater than seventy-five (75) pounds per square inch must 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 installations must have check valves, backflow prevention devices or suitable air gap cross-connection controls, if necessary to prevent damage to the pumping equipment and contamination of the aquifer.

11.10.1 Pump installations and cisterns supplying irrigation water where fertilizers, insecticides, herbicides, or other chemicals are injected into the water must be equipped to prevent well or aquifer contamination. The installation must 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, promulgated by the Department of Agriculture pursuant to the Colorado Chemigation Act, Article 11 of Title 35, C.R.S.

11.11 **Disinfection** After installing a pump or cistern, and prior to placing the well in service, the person authorized to install pumping equipment must disinfect the well, all pumping equipment, and the water supply system up to the pressure tank according to the provisions of Rule 15.

RULE 12 WELL TESTING

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-106(4), and 37-91-110(1)(b) & (2), C.R.S. The purpose of this Rule is to establish minimum standards for the testing of water wells.

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 groundwater must undergo:

a. A well yield estimate to determine a stabilized yield for the well (an aquifer~~well yield~~ test may be performed instead of a well yield estimate); and

b. A production equipment test to determine the production capacity of the equipment as actually installed in the well.

12.2 **Well Yield Estimate** - The yield of a well must be tested and estimated as a stabilized production rate where the withdrawal rate does not change by more than 10% during the last hour of the test. A well yield estimate may be established by procedures such as air-lifting or bailing. Well yield estimates may be performed at rates that exceed the permitted pumping rates.

12.3 **Responsibility for Well Yield Estimate** - Well construction contractors are responsible for performing the well yield estimate and submitting the data to the State Engineer on the Well Construction and Yield Estimate Report form.

12.4 **Production Equipment Test** - The permanent production equipment installed in wells must be tested to ensure it is functioning as designed. The test must demonstrate the production capacity of the equipment as actually installed in the well. The production equipment test must not be conducted at rates that exceed the permitted pumping rates.

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. The pump installation contractor is also responsible for ensuring that the production from the well complies with the conditions of the well permit. Production equipment test data must be submitted to the State Engineer on the Pump Installation and Production Equipment Test Report.

12.6 **Aquifer~~Well Yield~~ Test** - An aquifer~~well yield~~ test (also known as a pumping test or well yield~~aquifer~~ test) may be performed instead of, or in addition to, a well yield estimate. If an aquifer~~well yield~~ test is performed, the test must be performed with equipment that is capable of determining both drawdown and pumping/production rate. Aquifer~~Well yield~~ tests may be performed at rates that exceed the permitted pumping rates. If an aquifer~~well yield~~ test is performed, aquifer~~well yield~~ test data must be submitted to the State Engineer on the Aquifer~~Well Yield~~ Test Report form.

RULE 13 SAMPLING, MEASURING AND TEST PUMPING

Basis and Purpose: The statutory authority for this Rule is found in section 37-91-106(4), C.R.S. The purpose of this Rule is to provide minimum standards for sampling, measuring, or test pumping groundwater to ensure that shared groundwater resources are protected from contamination.

13.1 **Well Owner's Knowledge** Sampling, measuring, and test pumping must be conducted with the well owner's knowledge.

13.2 **Measuring Devices** All measuring and sampling devices and equipment must 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, or representatives of the State Engineer 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 must be disinfected according to Rule 15.3. The person removing the well seal is 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 or wells for scientific, engineering, or regulatory purposes. Such activities must be limited to measuring water levels, collecting water samples, and the installation of pumps dedicated solely to scientific, engineering, or regulatory purposes, provided all 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

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-104(1)(c), (j) & (k); 37-91-106(4). The purpose of this Rule is to establish minimum construction standards for certain types of holes and wells that may be constructed by authorized individuals who are not specifically licensed by the Board.

14.1 **General** - Monitoring and observation wells and monitoring and observation holes are primarily used for observing groundwater levels and flow conditions, obtaining samples for determining groundwater quality, and for evaluating hydraulic properties of water-bearing strata. Test holes are primarily used for conducting geotechnical or geological investigations. *See* Section 37-91- 102(10.5) and (15.7), C.R.S., and Rule 5.2 for definitions and authorized uses for each type of structure.

14.1.1 If the holes do not penetrate through a confining layer, monitoring and observation holes or wells, and test holes may be constructed by an authorized individual (see Rule 5.2.3 and Rule 9), a licensed well construction contractor, or a private driller (see Section 37-91-102(12), C.R.S). Rules 6, 7, 9, 14 and 17 for licensing, notification and reporting requirements (summarized in Table 1).

14.1.2 Monitoring and observation holes or wells and test holes that penetrate through a confining layer between two distinct aquifers may not be constructed by an authorized individual. All holes or wells that penetrate through a confining layer between two distinct aquifers must be drilled by a licensed contractor and must comply with the standards of Rule 10.

14.1.3 All monitoring and observation holes or wells and test holes must comply with the construction standards and plugging, sealing, and abandonment standards specified in these Rules. Notice and reporting requirements for compliance with this Rule 14 are stated in Rule 9.2. The person authorized to construct and to plug, seal, and abandon monitoring and observation holes and test holes must 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).

14.1.4 Prior to starting construction, all persons authorized to construct monitoring and observation holes or wells or test holes must investigate and become familiar with the geology and hydrogeology of the area, potential aquifers, confining layers, anticipated water quality problems, and known contaminated water-bearing zones which may be encountered in the area of the proposed drilling activity.

14.1.5 When hazardous contaminants are known or suspected to be encountered during construction, the authorized individual, licensed contractor, or private driller is responsible for ensuring that all personnel on site are adequately trained and that proper safety equipment is provided to handle and contain those substances.

14.1.6 Drill cuttings and wastewater from monitoring and observation wells/holes or test holes in areas of known or suspected contamination must be managed in accordance with all applicable federal, state, and local regulations or laws.

14.1.7 All wells and boreholes, when unattended, must be securely sealed, capped, or covered to ensure protection of the groundwater resource. During construction, it is the responsibility of the person constructing the hole or well to ensure the borehole is securely covered when unattended. Upon completion of construction, the hole or well must be securely sealed or capped by the person responsible for construction. Thereafter, it is the responsibility of the hole or well owner to ensure that the hole or well remains securely sealed or capped.

14.1.7.1 A secure cover is intended as a temporary arrangement of materials or a device that must perform the function of preventing deleterious entry of objects, insects, animals or contaminants into the borehole or well while unattended and prior to completion of the well. The cover must not be easily removed, penetrated or bypassed by methods or processes other than those directed and performed by the well construction contractor. Unrestrained buckets or tape are not considered a secure cover and are specifically not allowed by the Rules.

14.1.8 Authorized individuals and well construction or pump installation contractors who encounter a monitoring and observation hole or well that appears not to meet the standards of these Rules, or a damaged monitoring and observation hole or well, or an open and unattended hole or well, must 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 may only be used for those purposes described in Section 37-91-102(10.5) and may not be converted to production wells for beneficial use. A monitoring and observation well must be permitted by the State Engineer, and may be used for the purposes described in Rule 5.2.31 and section 37-91-102(10.5), C.R.S. A monitoring and observation hole may only be converted to a monitoring and observation well, recovery well for remediation of the aquifer, or a dewatering system for dewatering the aquifer, if such conversion is approved and permitted by the State Engineer.

14.2.1 **Monitoring and Observation Hole** - Prior to the start of construction of any monitoring and observation hole (see Rule 5.2.30 for definition), the State Engineer must be notified pursuant to Rule 6.3. 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. The monitoring and observation hole must be constructed within ninety (90) days of giving such notice.

14.2.1.1 Construction of a monitoring and observation hole 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.

14.2.1.2 A monitoring and observation hole that will exist for more than eighteen (18) months must be permitted by the State Engineer as a monitoring and observation well.

14.2.1.3 The individual who submitted the notice of intent for the monitoring and observation hole must 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 eighteen (18) months of the date the monitoring and observation hole is constructed. Evidence of the written notification must be submitted to the State, if requested.

14.2.2 **Monitoring and Observation Well** - All monitoring and observation wells must be permitted by the State Engineer. The well owner or the well owner’s authorized agent is responsible for obtaining the Monitoring/Observation Well Permit, and may obtain the 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 eighteen (18) months or expects that the structure will be converted to a production well.

14.2.2.1 A monitoring well constructed after obtaining the proper monitoring well permit from the State Engineer may only be converted to a production well if a permit to use groundwater has been obtained from the State Engineer and if the well was constructed by a licensed well construction contractor in accordance with the well construction standards of Rule 10.

14.2.2.2 A monitoring and observation well that was originally constructed under a notice of intent as a monitoring and observation hole may not be converted to a production well.

14.2.2.3 All monitoring and observation wells must be plugged, sealed, and abandoned upon completion of the intended purposes of the well.

14.2.3 A copy of the applicable notice or permit obtained from the State Engineer must be available at the construction site at all times during construction of a monitoring and observation hole or well. Monitoring and observation wells or holes may not be constructed without proper notice, a permit, or emergency approval from the State Engineer.

14.2.4 **Location** - Monitoring and observation holes or wells must be located to allow access for maintenance, modification, repair, and plugging, sealing and abandonment. When selecting the location, the contractor or authorized individual must consider the topography, drainage and other on-site conditions in order to promote groundwater protection and public safety.

14.2.5 **Damaged Holes or Wells** - The owner of the monitoring and observation hole or well is responsible for the repair, replacement or plugging, sealing and abandonment of any damaged monitoring and observation hole or well. Repair or plugging, sealing and abandonment of damaged monitoring and observation holes or wells must be performed within 60 days of the owner becoming aware of the damage.

14.2.6 The responsible individual (see Rule 9.1) must submit all work reports within thirty five~~sixty~~ (35~~60~~) days after completion of construction of the monitoring and observation well or hole in accordance with Rule 17.

14.3 **Monitoring and Observation Hole/Well Construction Standards** - Monitoring and observation holes or wells must be constructed to maintain existing natural protection against contamination of aquifers; prevent the entry of contaminants through the borehole; and prevent the intermingling of groundwater from different sources through the borehole. The construction of monitoring and observation holes or wells ~~or holes~~ which are not required to be constructed in accordance with the requirements of Rule 10, must be generally consistent with the examples of acceptable construction shown on Figure 7, 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 or well must be protected by a metal locking cover or equivalent level of protection to prevent unauthorized access. PVC casing may not be exposed above the ground surface.

14.3.2 **Casing** - Casing materials must meet the casing requirements presented in Rule 10.3.

14.3.3 **Casing Cap** - The top of a monitoring and observation hole or well must be fitted with a cap or “sanitary seal” to prevent surface water, pollutants, or contaminants from entering the hole or well. Openings or passages for water level measurement, venting, pump power cables, discharge tubing, and other access must prevent entry of surface water, pollutants, and contaminants.

14.3.4 **Monitoring or Observed Interval** - Monitoring and observation holes or wells must restrict the screened, open or filter packed interval to a single aquifer. Nested monitoring and observation holes or wells may only be constructed by a licensed contractor and in accordance with the requirements of Rule 10.

14.3.5 **Wellhead Completion** - The top of the well casing must terminate at least one (1) foot above ground surface, except where site conditions, such as vehicular traffic, will not allow. PVC casing must not be exposed above ground surface. Steel surface casing or well vaults are acceptable wellhead completion designs.

14.3.6 Filter Pack- Below the annular seal, the annular space between the well casing and the borehole may be filled with clean sand or gravel or other inert filter media.

14.3.7 **Annular Seal -** Beginning at the depth of the top of the filter pack or packer device, the annular space between the outermost casing and the borehole, must be filled with an approved grout, bulk grout or bentonite material meeting the requirements of Rule 10.5.1, Table 2. up to the depth of the ground surface or the base of the well vault or protective surface casing. The annulus in which the grout or bentonite material is placed must meet the size requirements of Rule 10.4.4.

14.3.7.1 **Shallow Seal** - At a minimum, the upper five (5) feet of annulus must be sealed. ~~**? Minimum surface annular seal for all m/o wells**~~

14.3.7.2 **Deep Seal** - Monitoring and observation holes or wells which penetrate through unconsolidated materials (Type III aquifer) and into bedrock must either abandon the portion of the hole or well in the bedrock in accordance with the requirements of Rule 16.4.1 prior to the construction of the monitoring and observation hole or well when the intent is to monitor or observe the groundwater in the unconsolidated materials, or must place annular seal materials beginning___feet below the top of the bedrock up to the depth required in Rule 14.3.7 if the intent is to monitor or observe the groundwater in the bedrock.

14.3.8 **Bases for Monitoring and Observation Wells** - A concrete base or pad must be constructed around the top of the casing of a monitoring and observation well 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 must be at least 4 inches thick and must slope to drain away from the well casing. The base must extend ~~**at least two feet**~~ laterally in all directions from the outside of the borehole and have minimum outside dimensions of 2 feet by 2 feet~~well boring~~.

~~**Contractors requesting for smaller pads, typically around 2' x 2' overall dimension**~~

14.3.8.1 The base must 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

14.3.8.2 Where cement-based annular sealing material is used, the concrete base must be poured before the annular seal has set.

14.3.9 **Vaults** - The top of the well or hole casing may be below ground surface if justified by traffic or other critical considerations. A structurally-sound watertight vault or equivalent structure must be installed to house the top of the annular seal to at least ground surface. The top of the annular seal must not be more than 4 feet below ground surface.

14.3.9.1 The vault must contact the annular seal in a manner to form a watertight and structurally-sound connection. Placement of the vault must not cause the failure of the well casing or annular seal.

14.3.9.2 Where cement-based annular seal materials are used, the vault must be set into or contact the annular seal material before it sets. If bentonite-based sealing material is used for the annular seal, the vault must be set into the bentonite before the bentonite is fully hydrated.

14.3.9.3 Cement-based sealing material must also meet the requirements of Rule 10.5.1, Table 2, must 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.

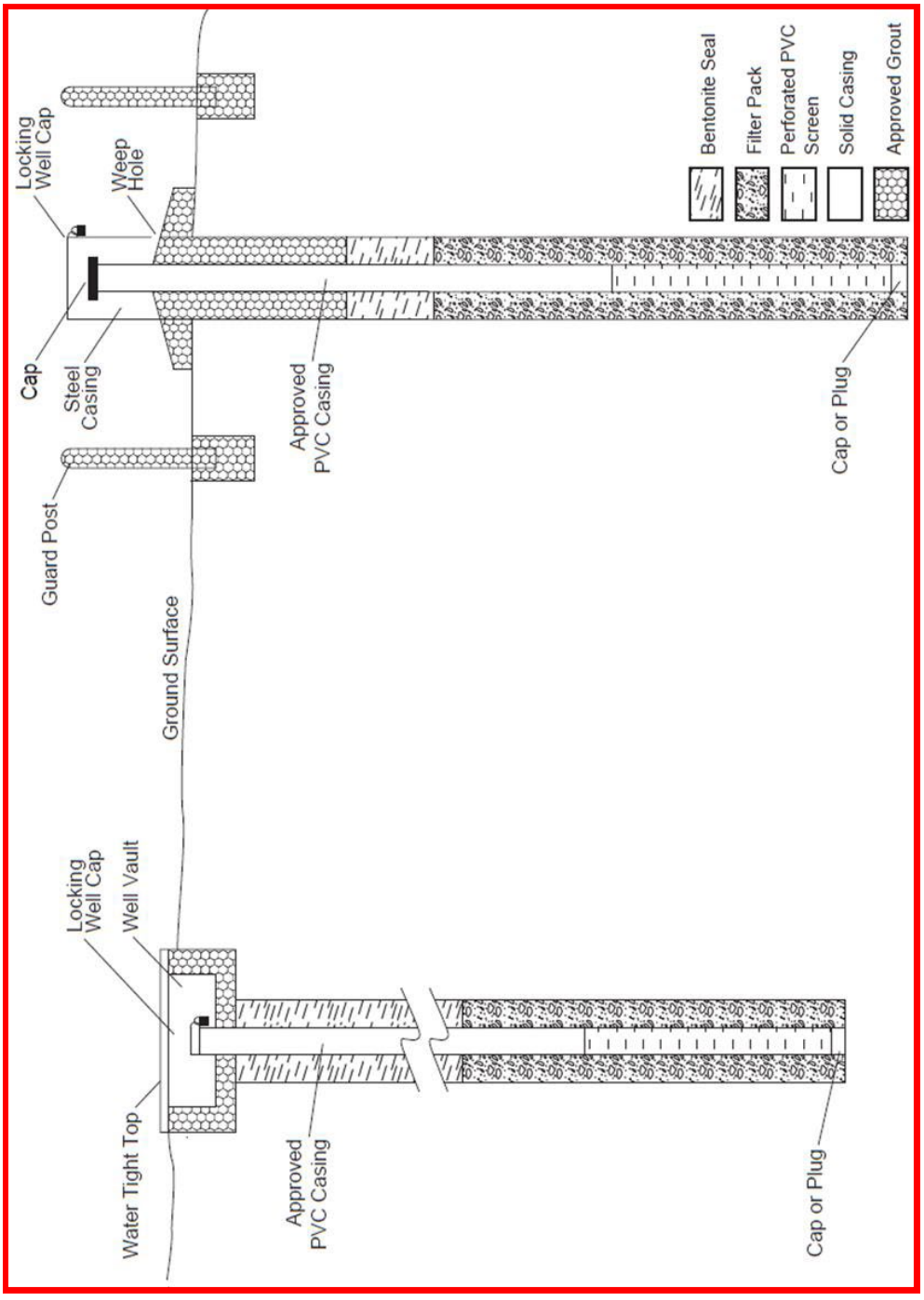
14.3.9.4 Sealing material surrounding a vault must extend from the top of the annular seal to ground surface. If cement-based sealing material is used for both the annular seal and the space between the excavation and vault, the sealing material must be placed in a continuous pour. In other words, cement-based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

14.3.9.5 The vault cover or lid must be watertight but must allow the venting of gasses. The lid must be fitted with a security device to prevent unauthorized access. The lid must be clearly and permanently marked “MONITORING WELL”. The vault and its lid must be strong enough to support vehicular traffic where such traffic might occur.

14.3.9.6 The top of the vault must be set at or above grade so drainage is away from the vault. The top of the well casing contained within the vault must 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.

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

FIGURE 7



MONITORING AND OBSERVATION HOLES/WELLS

Figure 7. Schematic diagrams of typical monitoring and observation hole/well designs.

FIGURE 7 (CONTINUED)

MONITORING AND OBSERVATION HOLES/WELLS

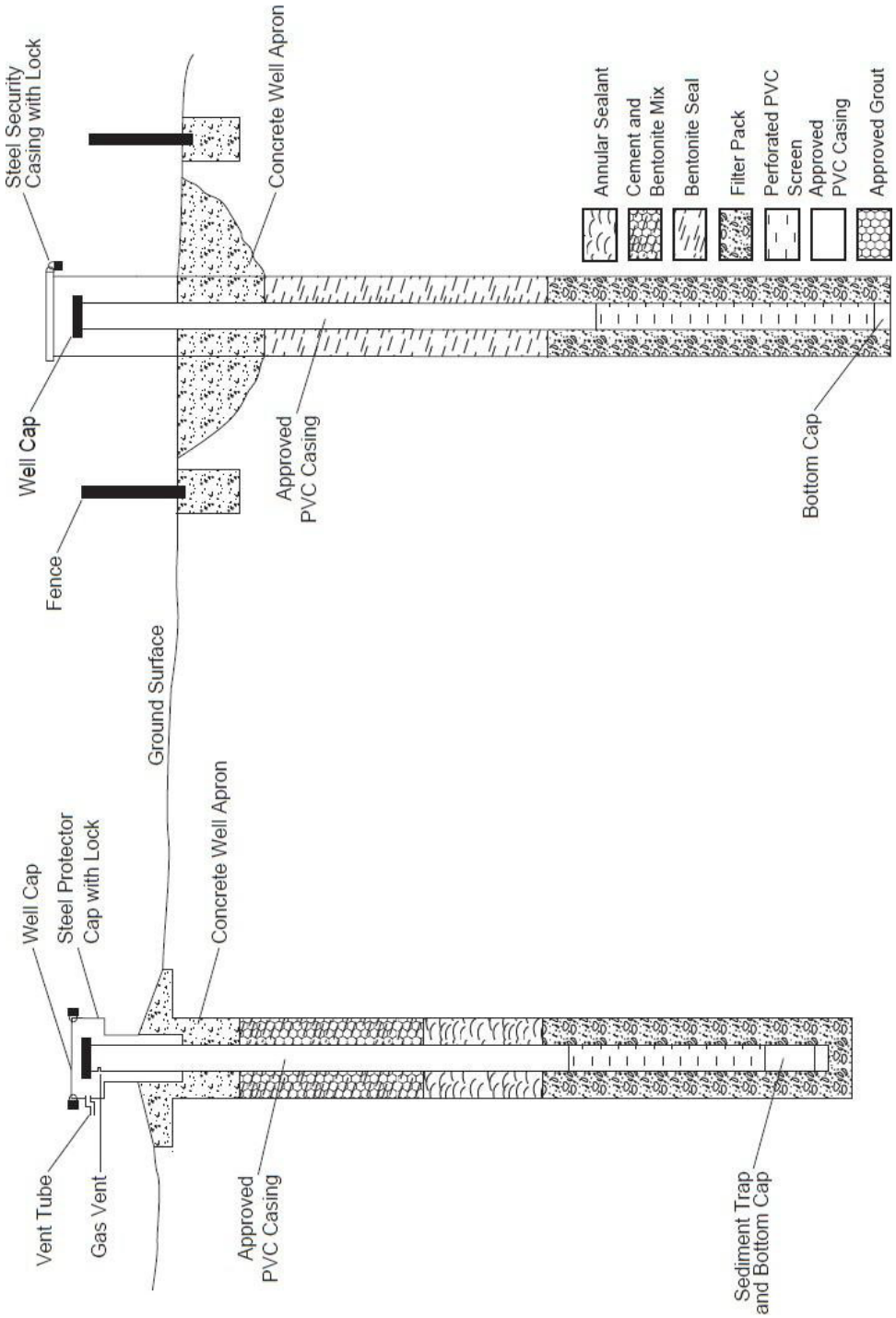


Figure 7 (continued) Schematic diagram of typical monitoring and observation hole/well designs

14.4 **Installation of Pumping Equipment** - Aquifer testing and/or test pumping of any monitoring and observation hole or well must not exceed a cumulative total of two hundred (200) hours unless prior written approval for additional testing is obtained from the State Engineer. Temporary test pumps must not remain in a monitoring and observation hole or well for more than ten (10) consecutive days. The well owner or his or her agent are responsible for obtaining appropriate 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 or well by an authorized individual, well construction or pump installation contractor, or well owner. The person installing the equipment must notify the State Engineer within three (3) days~~72 hours~~ of when pumping equipment is installed in a monitoring and observation hole or 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 or well must 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 or well must be submitted to the State Engineer upon request.

14.4.4 Monitoring and observation holes and wells, ~~dewatering wells, and recovery wells~~ are exempt from the disinfection standards of Rule 15 if disinfection conflicts with the purpose of the well.

14.5 **Test Holes** - Test holes are defined at section 37-91-102(15.7), C.R.S., in Rule 5.2.51, and Table 1 and are administered in accordance with the requirements of the State Engineer.

14.5.1 Test holes that penetrate through a confining layer between two distinct aquifers

a. Require a notice of intent be submitted to the State Engineer prior to construction

b. Require a lithologic log and construction report be submitted to the State Engineer

14.5.2 Test holes that do not penetrate through a confining layer

a. Do not require a notice of intent be submitted to the State Engineer prior to construction

b. Do not require a lithologic log and construction report be submitted to the State Engineer

14.5.3 When unattended, test holes must be securely sealed, capped, or covered. A secure cover is intended as a temporary arrangement of materials or a device that must perform the function of preventing deleterious entry of objects, insects, animals or contaminants into the test hole well while unattended and prior to abandonment. The cover must not be easily removed, penetrated or bypassed by methods or processes other than those directed and performed by the individual who constructed the test hole.

14.5.4 Test holes must be plugged, sealed, and abandoned upon completion of the intended purposes of the test hole.

RULE 15 MINIMUM DISINFECTION STANDARDS

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-104(1)(c); 37-91-106(3); and 37-91-110(1)(b) & (2), C.R.S. The purpose of this Rule is to require completed groundwater excavations be properly decontaminated for the use for which they were constructed.

15.1 **General Rule** - All materials installed in wells or cistern must be thoroughly and carefully cleaned and disinfected to ensure that all harmful or disease-carrying or causing organisms are eliminated. All areas of the well or cistern, including the full casing length and filter pack, must come in contact with the disinfecting solution as provided for in this Rule. Gravel pit or pond/lake wells, dewatering wells, and recovery wells are exempt from this disinfection requirement. Monitoring and observation holes and wells, where the use of a disinfectant may interfere with the purpose of the hole or well, are exempt from this Rule.

15.2 Disinfection Solution

a. Disinfection of wells must be accomplished with chlorine solution or chlorine compounds in solution.

b. Compressed or pelletized chlorine tablets must not be introduced directly into the well or cistern. Such tablets may be used if mixed into a liquid solution prior to placement into the well or cistern. After initial well disinfection, chlorine tablets may be used as part of regular disinfection or maintenance of the well.

c. Prior to the use of other disinfectants, a written request must be submitted and written approval obtained from the Board.

d. Sufficient disinfectant must be used to produce a minimum concentration of one hundred (100) mg/l (milligrams per liter or parts per million) chlorine in the newly constructed well or after the initial pump installation (see Table 3).

e. Dry disinfectants used in the preparation of solutions must not be outdated, must be full strength, and must be prepared to the required concentration in accordance with the manufacturer's directions for mixing.

TABLE 3
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	1/4	3
6	147	1/2	5
8	261	3/4	9
10	408	1	14
12	587	1-1/2	19

1) The volume of dry powder, based on 70% available chlorine, has been rounded up to the next 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 1-1/4 cup of dry powder or 16 cups of liquid bleach per 500 gallons

15.3 **Placement** All wells and cisterns must be disinfected after completion of well construction, cistern installation, and after 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 must be used. After installation of the pumping equipment, the disinfectant solution must be thoroughly circulated through the entire well and installed water well supply system. When a new pump or well water supply system is connected to, or a replacement pump is installed in, an existing municipal or commercial water distribution system that has been disinfected in the past, the disinfection solution must be distributed up to the point of isolation between the new/replacement pump and the rest of the system.

15.4 **Contact Time** The disinfection solution must be in contact with the well, cistern, pump and distribution system for sufficient time to eliminate any harmful bacteria.

15.4.1 Decontamination of newly-installed wells and cisterns constructed using water from a public supply source must be accomplished by adding and mixing enough disinfectant to reach a concentration of at least one hundred (100) milligrams per liter. The disinfectant must be left in the well for a minimum ten (10) hours, and must not be intentionally disturbed after that time until the pump is installed.

15.4.2 Upon completion, all wells drilled, developed, or stimulated without using water obtained from a public supply source must be flushed, 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.

15.4.3 Following the installation of the initial pump in a well or cistern, the well, cistern, pump, and the distribution system must be disinfected. The concentration of disinfectant must reach at least one hundred (100) milligrams per liter. After placement, mixing, and circulation, the disinfectant solution must remain undisturbed in the well and distribution system for as long as possible, but not less than ten (10) hours.

15.4.4 Following the installation of a replacement~~new~~ pump in an existing well or cistern, the well, cistern, pump, and the distribution system must be disinfected. After placement, mixing, and circulation, the disinfectant solution must 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 must 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 must be thoroughly flushed from the well and water supply system and disposed of properly. The disinfectant solution must 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 must 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 must 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 must be constructed of a material approved for use with potable water and must be regularly decontaminated. Tanks or vessels used for hauling and/or storage of hydrocarbons, waste materials, chemicals, or other contaminants may not be used for hauling or storing water for drilling purposes.

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

Basis and Purpose: The statutory authority for this Rule is found in sections 37-91-101(1); 37-91-104(1)(c), (j), & (k); 37-91-106(3); 37-91-109(1); and 37-91-110(2), C.R.S. The purpose of this Rule is to identify the minimum standards for the proper abandonment of water wells and other excavations constructed into the ground that, if not adequately sealed and abandoned, present a risk to the health and safety of Colorado's shared groundwater resources.

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 collapsed or unusable boreholes, and other incomplete wells or excavations is necessary to prevent contamination of groundwater 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. Proof of this written notification must be provided to the State Engineer, if requested.

16.1.1 Pumping equipment must be removed from the well prior to plugging, sealing and abandonment of the borehole.

16.1.2 In the event a borehole(s) is not completed for the intended purpose, the contractor will notify the well owner, in writing, of the well owner's responsibility for the proper abandonment of the borehole(s) according to Rule 16.1. Proof of this written notification must be provided to the State Engineer, if requested. If the well owner does not agree to allow the contractor to abandon the borehole(s), the contractor must 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

16.1.3 **Persons Authorized to Plug, Seal, and Abandon Wells**:

16.1.3.1 Licensed water well construction contractors are authorized to plug, seal, and abandon all types of wells or holes.

16.1.3.2 Licensed pump installation contractors may plug, seal and abandon only those 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.

16.1.3.3 Authorized individuals may plug, seal, and abandon only those monitoring and observation wells and holes, dewatering wells, piezometer holes, and test holes that do not penetrate through a confining layer.

16.1.3.4 Well owners may plug, seal, and abandon only those wells they own that do not require the removal, ripping, or perforating of casing in accordance with this Rule 16. Well owners abandoning their own wells must consult with a licensed water well construction contractor or Board staff prior to abandoning their well.

16.1.4 Materials used for backfilling must 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 must be filled with grout or a watertight cover must be permanently attached to the remaining casing and the excavation filled with materials that are not more permeable than the surrounding soils and adequately compacted to prevent settling.

16.2 **Abandonment of Wells, or Boreholes in Type 1~~I~~ Aquifers (confined aquifers)** Wells or Dry Holes which were constructed through more than one aquifer must be plugged and sealed by placing ~~a~~ cement grout ~~plug at~~ in the well or borehole throughout each~~the~~ confining layer interval ~~above each aquifer~~. If well construction records do not show that the casing opposite each confining layer was grouted when originally installed, the casing must be either completely removed from the hole, or perforated or ripped opposite such layer prior to placing the grout plug. Plugs must be no less than sixty (60) feet in length and must be designed to withstand the maximum potential hydrostatic pressure differential between the aquifers. The well casing, except for the grout plug intervals, must be completely filled to the land surface with clean native clays, cement, or high-solid bentonite grout. A watertight cover must be permanently welded or attached to the top of the casing.

-Rule 10.4.5.1c requires neat cement or cement-bentonite grout, however Rule 16.2 requires cement grout. Should Rule 16.2 say "approved grout" instead?
-Update rule to reflect Policy 2018-2.
-Does grout need to meet all requirements of Rule 10.5? specifically the mix ratios and the requirement for continuous grout for the required intervals.
-Allow gravel in aquifer intervals?

16.3 **Abandonment of Wells or Boreholes in Type 2~~II~~ (unconfined bedrock aquifers) and Type 3~~III~~ Aquifers (unconsolidated aquifers)** - Wells completed into, or Dry Holes terminated in, unconfined bedrock aquifers and unconsolidated aquifers must be plugged, sealed, and abandoned by filling the well to the static water level with clean sand or clean gravel. Between the static water level and the ground surface, the borehole must be filled with clean native clays, cement, drill cuttings, or high solid bentonite grout to the ground surface. The uppermost five (5) feet of casing must be filled with grout or a permanent watertight cover must be installed at the top of the casing. If casing is removed, the hole must be filled as described above to within five (5) feet of the ground surface. The top five (5) feet of the hole must be filled with materials that are not more permeable than the surrounding soils that are adequately compacted to prevent settling.

Does grout need to meet all requirements of Rule 10.5? specifically the mix ratios and the requirement for continuous grout for the required intervals.

Its acceptable to start the grouted interval below the static water level (instead of placing granular backfill in that interval); rule should reflect that.

16.4 **Abandonment of Other Structures**:

16.4.1 **Abandonment of Dewatering Wells, Monitoring and Observation Holes, and Piezometer Holes** - Dewatering wells, monitoring and observation holes, and piezometer holes must be plugged, sealed, and abandoned ~~either (1)~~ pursuant to Rules 16.2 or 16.3, as appropriate per the Aquifer Type completed in.~~, or (2) by removing all casing that was installed and by filling the hole(s) with clean native clays, cement, or high solid bentonite grout to within five (5) feet of the ground surface. If the casing cannot be removed, the top five (5) feet of the hole must be filled with materials that are not more permeable than the surrounding soils that are adequately compacted to prevent settling.~~

16.4.2 **Abandonment of Test Holes** – Test holes that penetrate a through confining layer must be abandoned per Rule 16.2. Test holes that do not penetrate a confining layer must be plugged, sealed, and abandoned pursuant to the requirements of Rule 16.4.1 or by removing any casing or equipment from the hole and backfilling the hole with drill cuttings, clean native clays, cement, or high solid bentonite grout to the ground surface, and adequately compact the material to prevent settling

16.5 A well for which a replacement well has been permitted and constructed must be plugged, sealed, and abandoned within sixty (60) days after the completion of the replacement well, unless otherwise re-permitted by the State Engineer.

Well needs to be abandoned within 60 days (current Rules) or 91 days (permit condition).

Non-exempt wells must be abandoned within 60 days per Rule 16.5 (no statutory requirement)

Need to reference 37-92-602(3)(c)(II)(a): If such relocated well will not change substantially the usage of water which can lawfully be made by means of the existing well, a permit to construct and use the relocated well shall be issued, and the existing well shall be abandoned within ninety-one days after the completion of the relocated well.

RULE 17 REPORTING REQUIREMENTS

Basis and Purpose: The statutory authority for this Rule is found in section 37-91-110(2), C.R.S. The purpose of this Rule is to require the submittal of reports concerning the construction of certain excavations as necessary for documenting the location of such excavations, gathering information about hydrogeological conditions of Colorado, and for ensuring compliance with permits and water rights requirements.

17.1 **Work Reports** Reports must 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 and Yield Estimate Report** - Well construction contractors, authorized individuals, or private drillers must report where, how, and when a test hole penetrating a confining layer between two distinct aquifers, a well, or a monitoring and observation hole/well was drilled. The report must 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 or otherwise obtained from the borehole. The report must also contain detailed information from the well yield estimate in accordance with Rule 12.

17.1.2 **Dry Hole Report -** A Dry Hole Report must be submitted for each borehole that was not completed as a well due to insufficient water for the permitted use(s). The report must describe the specifics of each borehole, a lithologic log of the geology and a description of any partial well construction. The report must also contain a detailed description of how the dry hole was abandoned, if abandonment was performed. A Dry Hole Report is intended to provide information for the borehole and abandonment of the attempted well and will not prevent additional attempts to construct a well under the same valid permit.

17.1.3 **Pump Installation Report** - Pump installation contractors and private pump installers must submit a pump installation report every time a new pump is installed in a well or for any change in the pump depth setting. The report must describe the pump, date of installation, its depth setting, static water level, and the results from the production equipment test required by Rule 12.

17.1.4 **Aquifer~~Well Yield~~ Test Report** – Well construction contractors, pump installation contractors, authorized individuals, and private drillers/pump installers must submit an aquifer~~well yield~~ test report if an aquifer~~well yield~~ test (pumping or well yield~~aquifer~~ test) is performed in accordance with Rule 12.6

17.1.5 **Well Abandonment Report** - A Well Abandonment Report must be submitted for each test hole penetrating a confining layer between two distinct aquifers, well,incomplete well/dry hole, monitoring and observation hole or well, or dewatering system that has been plugged, sealed, and abandoned. The report must identify the abandoned well or hole by location and permit number, monitoring hole number, or other official identification of location. The report must 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 must be submitted to the State Engineer upon the cessation of use of test holes penetrating a confining layer between two distinct aquifers, monitoring and observation wells or holes, or dewatering wells.

17.1.6 **Gravel Pit, Pond, or Lake Well Construction Report**: After initiating the construction of gravel pit, pond, or lake well permitted pursuant to Sections 37-90-107(6), -137(2), 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 or pond, the initial static water level, and the date of initial groundwater exposure to the atmosphere.

17.1.7 **Cistern Installation Report** – Pump installation contractors or private pump installers must submit documentation that a cistern connected to a new or existing water well supply system was installed.

17.1.8 **Post-Construction Well Inspection Report** – When a Well Construction and Yield Estimate Report has not been submitted for a well constructed on or after May 8, 1972, the owner must provide a Post-Construction Well Inspection Report. The Post-Construction Well Inspection Report for production water wells, or monitoring and observation wells which penetrate a confining layer must be signed by a licensed contractor. The Post-Construction Well Inspection Report for monitoring and observation holes or monitoring and observation wells that do not penetrate a confining layer must be signed by either a licensed contractor or authorized individual.

17.2 **Format of Reports** Work reports must 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 must be on sheets no larger than 8½ x 11 inches. All data requested on the form must be reported accurately.

17.3 **Timely Submittal** Work reports must be submitted to the State Engineer within thirty-five (35)~~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 must 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 are deemed to be completed, signed and certified under oath.

17.5 **Unsanitary or Non Compliant Conditions** A licensed contractor who repairs an existing well or pump must report to the Board of Examiners any unsanitary or noncompliant conditions that he or she is unable to correct.

17.6 **Copy of Report to Owner** Well construction and pump installation contractors must 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 must be provided to the State Engineer upon request by the State Engineer. The well location, date of analysis, and the permit number or other identifying authorization must 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 will be kept confidential pursuant to Section 24-72-204(3)(a)(IV), C.R.S.

RULE 18 VARIANCES

Basis and Purpose: The statutory authority for this rule is found in sections 37-91-101(1); 37-91-104(1)(c), (j), (k) & (2); 37-91-106(3); 37-91-109(1); and 37-91-110(2), C.R.S. The purpose of this Rule is to allow the Board to approve alternate methods of construction or abandonment of an excavation over which it has jurisdiction, in the event that the individual requesting such alternative to the minimum standards can adequately demonstrate that the variance will protect the health and safety of the public and prevent contamination to Colorado's groundwater.

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 may impose any conditions deemed necessary to protect the groundwater and aquifers from contamination.

18.2 **Written Request Required** - Any request for a variance must be submitted to the Board of Examiners in writing and must be signed by the well owner or his or her agent. Such request must 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 must be submitted to the Board and approval of the variance 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, AskDWR~~fax~~, or email and must obtain approval for the variance prior to completing construction of the well.

18.2.2 Pursuant to section 37-91-104(2), C.R.S., the Board may delegate to Staff of the State Engineer the authority to review and approve or deny certain requests for variances from these Rules. Where Staff acts on behalf of the Board under this Rule pursuant to the Board's delegation of authority, the individual requesting the variance may appeal the Staff's decision to the Board at the next regularly-scheduled Board meeting.

18.3 **Written Decision** - The Board will respond in writing to each variance request, and must include reasons for its decision. The Board may impose terms and conditions to protect public health and safety or prevent aquifer contamination.

18.4 **Appeal** - The Board's written decision on the request for variance is final agency action. The individual who requested the variance may request the Board's reconsideration of the Board's written decision at the next regularly scheduled Board meeting following issuance of the written decision. Any appeal of the Board's written decision must be pursuant to the State Administrative Procedures Act, Article 4 of title 24, C.R.S.

RULE 19 EMERGENCIES

Basis and Purpose: The statutory authority for this rule is found in sections 37-91-101(1); 37-91-102; 37-91-104(1)(c), (j), & (k); 37-91-106(3); 37-91-109(1); and 37-91-110(2), C.R.S. The purpose of this Rule is to ensure that, even in the case of an emergency, excavations under the Board's jurisdiction must still be constructed upon approval of the State Engineer.

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 begin only after approval has been granted by the State Engineer. The well construction contractor or authorized individual that has received approval from the State Engineer must comply with all conditions of such approval.

RULE 20 PETITIONS FOR DECLARATORY ORDERS

Basis and Purpose: The statutory authority for this rule is found in section 24-4-105(11). The purpose of this Rule is to comply with the requirement of section 24-4-105(11) and provide the Board's procedures for entertaining, in its discretion, any petitions for declaratory orders to terminate controversies or to remove uncertainties as to the applicability to the petitioners of any statutory provision or of any rule or order of the agency.

20.1 **General** – pursuant to section 24-4-105(11), C.R.S., this rule provides procedures for the Board's entertaining of petitions for declaratory orders to terminate controversies or to remove uncertainties as to the applicability to the petitioner of any statutory provision or of any rule or order of the agency. The order disposing of the petition constitutes agency action subject to judicial review. The Board retains the right to determine, in its sound discretion, whether to entertain any such petition submitted pursuant to this Rule. See § 24-4-105(11), C.R.S.

20.2 **Petition for Statement of Position** – Any person may petition the Staff for a statement of position concerning the applicability to the petitioner of any provision of these Construction Rules, or any regulation of the Board. The Staff shall respond with a written statement of position within 30 days of receiving a proper petition.

20.3 **Petition for Declaratory Order** – Any person who has properly petitioned the Staff for a statement of position, and who is dissatisfied with the statement of position, or who has not received a response within 30 days of the petition, may petition the Board for a declaratory order pursuant to section 24-4-105(11), C.R.S. Such petition must be submitted to the Chief Well Inspector or a member of his or her staff within 30 days of the date of the Staff's written statement of position. A petition for declaratory order must include the following:

a. The name and address of the petitioner.

b. Whether the petitioner holds an active license issued by the Board.

c. Whether the petitioner is involved in any pending administrative hearings with the Board.

d. The language of the statute, rule, or order of the Board to which the petition relates.

e. A concise statement of all facts necessary to show the nature of the controversy or the uncertainty as to the applicability of the statute, rule, or order of the Board to which the petition relates.

f. A concise statement of the legal authorities, if any, and other reasons or authorities upon which the petitioner relies.

g. A concise statement of the declaratory order sought by the petitioner.

20.4 **Board's Exercise of its Discretion to Entertain a Petition** – The Board will determine, in its discretion and with no prior notice to the petitioner, whether to entertain any petition. If the Board decides it will not entertain a petition, it shall promptly notify the petitioner in writing of its decision and the reasons for that decision. Any of the following grounds are sufficient reason to refuse to entertain a petition:

a. The petitioner failed to properly petition the Staff for a statement of position, or if a statement of position was issued, the petition for declaratory order was filed with the Board more than 30 days after the Staff issued its statement of position.

b. A ruling on the petition will neither terminate the controversy nor remove uncertainties concerning the applicability to petitioner of the statute, rule, or order in question.

c. The petition involves a subject, question, or issue that is currently involved in a pending hearing before the Board or the State Engineer's Office, or that is involved in an on-going investigation conducted by the Board, or that is involved in a written complaint previously filed in any state court or with the State Engineer's Office.

d. The petition seeks an order on a moot or hypothetical question.

e. The petitioner has some other adequate legal remedy, other than an action for declaratory relief pursuant to C.R.C.P. 57, that will terminate the controversy or remove any uncertainty concerning applicability of the statute, rule, or order.

20.5 **If Board Entertains a Petition** – If the Board determines that it will entertain the petition for declaratory order, it must notify the petitioner within 30 days of making such determination, and the following procedures will apply:

a. The Board may expedite the hearing, so long as the interests of the petitioner will not be substantially prejudiced thereby, by ruling on the basis of the facts and legal authority presented in the petition, or by requesting the petitioner or the Staff to submit additional evidence and legal argument in writing.

b. In the event the Board determines that an evidentiary hearing or legal argument is necessary to a ruling on the petition, a hearing must be conducted in accordance with the state Administrative Procedures Act. The petitioner will be identified as Respondent.

c. The parties to any proceeding pursuant to this rule shall be the petitioner/Respondent and the Staff. Any other interested person may seek leave of the Board to intervene in the proceeding and such leave may be granted if the Board determined that such intervention will make unnecessary a separate petition for declaratory order by the interested person.

d. The declaratory order shall constitute a Final Agency Action subject to judicial review pursuant to section 24-4-106, C.R.S.

20.6 **Records of Petitions and Declaratory Orders** – Files of all petitions, requests, statements of position, and declaratory order will be maintained by the Board. Such files will be available for public inspection, except for any material required by law to be kept confidential. The Board will post a copy of all statements of position and declaratory orders constituting Final Agency Action on the Board's web site.

RULE 21 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 22 REVISIONS

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

RULE 23 EFFECTIVE DATE

These revised Rules shall become effective September 1, 2016.

RULE 24 STATEMENT 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.

Entire rule eff. 09/01/2016.

Rule 6.3 eff. 07/01/2018.

RULES ADDRESSED: **10.4.4 Annular Space for All Grouted Intervals**

CURRENT RULE LANGUAGE:

10.4.4 The borehole must be constructed to provide sufficient annular space for the placement of grout. The borehole diameter for every well must not be less than two (2) inches larger than the outside diameter of the casing (minimum one (1) inch of annular space, as defined in Rule 5.2.1). If grout is poured from the surface and the casing is not vibrated, the borehole diameter for the well must not be less than four (4) inches larger than the outside diameter of the casing (annular space of two (2) inches).

PROBLEM WITH RULE/HOW TO IMPROVE:

- 1 inch annular space may be too small for grouting with a tremie pipe
- ANSI-NGWA-01-14 Water Well Construction Standard (See References)
    - **4.4.1.1. Grouting with a Tremie Pipe**

      When grouting the annular space using a tremie pipe, the annular space shall accommodate the diameter size of tremie required to emplace the grout from the bottom to the top of the annular space. The borehole required to create the annular space shall be a minimum of three (3) inches (7.62 cm) in diameter greater than the outer diameter of the casing or coupling.
    - **4.4.2 Placement of Grout from Inside the Casing**

      When the grout is pumped from inside the casing, the annular space shall be a minimum of three (3) inches (7 .62 cm) greater in diameter than the outer diameter of the casing or coupling.
- Groundwater and Wells, edited by Robert J. Sterrett, 3rd ed, pg 447, 2007.
    - "Typically, to achieve the desired result of a uniform sheath of cement around the casing for the vertical distance to be grouted, the borehole diameter should be (at minimum) 4 inches larger than the casing. Tight places and "dead spots" result where casing that is not properly centered touches the wall of the hole, and causes channeling of the slurry."
- Annular space definition should include casing and coupling (Rule 5)

PROPOSED RULE LANGUAGE:

10.4.4 Annular Space Requirements for All Grouted Intervals - The borehole must be constructed to provide sufficient annular space for the placement of grout. Minimum annular space requirements apply only to intervals where the borehole must be grouted to meet minimum grouting requirements.

10.4.4.1 The borehole diameter for the grouted intervals between 0 and 39 feet below ground surface must not be less than two (2) inches larger than the outside diameter of the outermost casing or coupling (minimum one (1) inch of annular space, as defined in Rule 5.2.2).

10.4.4.2 The borehole diameter for every grouted interval ~~well~~ deeper than 39 feet below ground surface must not be less than three t~~wo~~ (3 ~~2~~) inches larger than the outside diameter of the outermost casing or coupling (minimum one and one-half (1.5) inch of annular space, as defined in Rule 5.2.2).

10.4.4.3 If grout is poured from the surface and the casing is not vibrated, the borehole diameter for the well must not be less than four (4) inches larger than the outside diameter of the casing (annular space of two (2) inches).

PROPOSED ALTERNATIVES TO EXPLORE

Potentially remain at 1 inch annular space for Haliburton method, but increase to 1.5 inches for tremie. This could be an issue if the Haliburton and Tremie annular spaces are different and both methods need to be used.

BASIS AND PURPOSE

Rule 10.4.4 discusses minimum annular space requirements for grouted intervals of wells. The size of the annular space is an important factor in obtaining an effective and permanent seal in a well. In general, a larger annular space, in conjunction with the use of casing centralizers, is much more likely to result in an effective seal in the borehole than a smaller annular space that allows the casing to be in contact with the borehole wall during grouting. Different methods of grout placement require smaller or larger annular spaces in order to accommodate the specifics to that method.

COST/BENEFIT

- **Costs**
  - May increase the cost of wells due to drilling larger borehole
  - Costs to retool
  - Increased volume of grout needed due to large space
- **Benefits**
  - Ensures a better seal to protect groundwater from migrating between aquifers

- Ensures adequate protection of groundwater from the surface
- gets the casing in the hole easier/won't lose hole

IMPACTS TO OTHER RULES

- May need additional rule describing the placement of bentonite chips or pellets
- Table 2 Grout Materials

REFERENCES

ANSI/NGWA-01-14 Water Well Construction Standard

NGWA is a community of groundwater professionals working together to advance groundwater knowledge and the success of our members through education and outreach; advocacy; cooperation and information exchange; and enhancement of professional practices. These procedures are for use in the development of recognized American National Standards Institute (ANSI) standards. These procedures shall ensure established ANSI standard developer requirements are followed. All standard development activities must comply with the most current version of the ANSI Essential Requirements.

https://www.ngwa.org/publications-and-news/NGWA-standards-development

https://www.ngwa.org/docs/default-source/default-document-library/publications/stndrd_dev_op_procedures.pdf?sfvrsn=6382613a_2

Groundwater & Wells, Third Edition, Edited by Robert J. Sterrett, PhD, RG. Johnson Screens 2007

NGWA Standard Comments, NGWA - Background Information for Colorado.docx

RULES ADDRESSED: **10.4.5 Wells Constructed into Type I Aquifers (Confined Aquifers)**

CURRENT RULE LANGUAGE:

For wells constructed into Type I aquifers, where the borehole penetrates **only one (1)** confining layer, the annulus between the borehole wall and the casing string must be grouted with cement or cement-bentonite from the base of the confining layer back to a level that is not less than sixty (60) feet above the base of the confining layer or to the level required to withstand the maximum potential hydrostatic pressure differential between the aquifers.

For wells constructed into Type I aquifers (confined aquifers), where the borehole penetrates **more than one (1) confining layer**, the annular space between the borehole wall and the casing string must be grouted with approved grout using positive displacement from the base of the confining layer overlying the permitted production zone up to sixty (60) feet above the base of the uppermost confining layer, or to the depth required by Rule 10.5.2.1.

PROBLEM WITH RULE/HOW TO IMPROVE:

- Outside of the Denver Basin and Rio Grande Basin (Water Division 3), aquifer and confining layer depths are not determined by Rule. This is causing confusion and inequity among contractors, particularly those constructing wells in the Cheyenne Basin (Northern Colorado) and where the Dakota Group Aquifer is present in Division 2 (Arkansas Basin). Hydrogeo Staff are also attempting to provide aquifer depths and types for all applications in these regions. This is slowing down the time it takes to issue a permit as well as overwhelming Hydrogeo Staff time. Contractors are also reporting improper construction reports to Staff and forcing staff to review well construction after the fact. Standardizing well construction would reduce both of these reviews.
- Keep Type 1 rules intact within the Denver Basin because it's easy to determine the aquifer type and location of confining layers
- Propose a rule for Type 1 wells for the rest of the state. This may still cause confusion if there is a question of Type 2 or Type 1.
- ANSI/NGWA-01-14 Water Well Construction Standard (See References)
    - 4.2 Well Grouting

      Well grouting consists of completely filling the annular space between a casing and the formation, or outer casing, with a low permeability (not to exceed 1 x 10^{-7} cm/sec) grout from the bottom of the annular space to the top of the annular space.

PROPOSED RULE LANGUAGE: TYPE 1 STEEL CASING & GROUT

For wells constructed into Type I aquifers (Outside Administrative Denver Basin and excluding Confined San Luis Valley aquifer), where the borehole penetrates **one (1) or more** confining layers, the annulus between the borehole wall and the outermost casing string (must be steel) must be grouted with approved grout from the top of the production zone (i.e. the bottom of the lowest confining layer or just above the well screen) back to the top of the well. The grout interval and material must be sufficient to withstand the maximum potential hydrostatic pressure differential and seal all potential cross connections with overlying aquifers or zones with poor water quality.

PROPOSED ALTERNATIVES TO EXPLORE

See 10.4.5 Type 1 Aquifers Plain Casing & Grout

All wells completed in Type 1 aquifers (aquifer not present/mapped at ground surface) must be steel cased and grouted with approved grout from the top of the production zone to the top of the well, unless the driller can provide a construction plan that will protect communication between aquifers. This requirement will increase the cost of wells substantially in some locations.

All wells completed in Type 1 aquifers (aquifer not present/mapped at ground surface) must be **plain** cased and grouted from the top of the production zone to the top of the well. Could require a neat cement plug at the top of the production zone and bentonite chips/pellets to the top of the well. May also require additional annulus space to allow for bentonite placement and research if chips/pellets would appropriately separate aquifers.

BASIS AND PURPOSE

Pro: Neat cement doesn't adhere well to PVC and can create a microannulus

Must be neat cement or cement bentonite because bentonite slurries dehydrate in unsaturated zones causing failure of the annular seal

Neat cement can crack, so longer intervals could provide better seal

Avoids worry that heat of hydration and/or weight can cause PVC collapse

Eliminates disparity of bids from contractors, no confusion to well owners

Easy to inspect with steel casing indicator or sonic log

Grouting the full length ensures all zones of poor quality are sealed off

Con: Steel casing can be expensive

Potential water quality impacts where artesian conditions bring water level up into blank steel casing above the production zone.

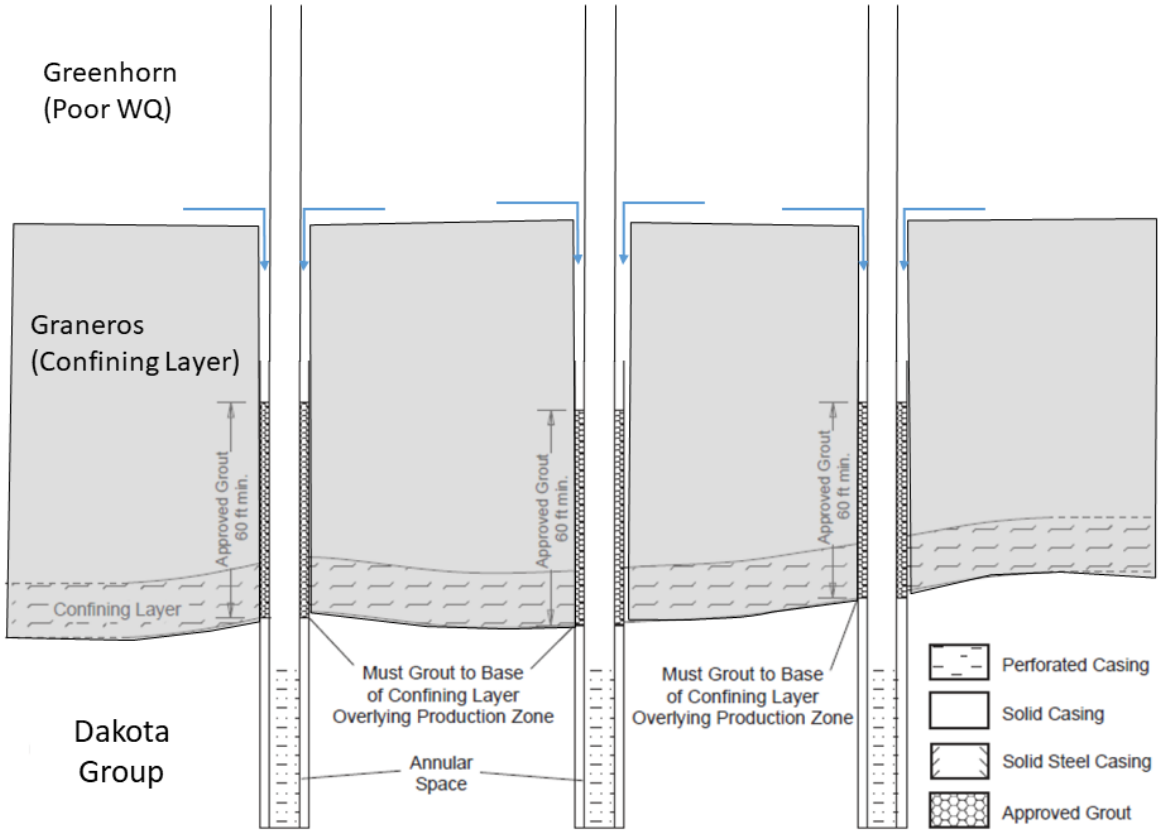
Could this be improved by using PVC in the production zone and grout the PVC up into steel so that artesian water only exists inside PVC casing

Plains Area

Groundwater is available from several of the bedrock formations that underlie the plains area east of the hogbacks. The location of selected wells tapping bedrock aquifers is shown on Plate 1. The depths of these wells range from 60 to 570 feet.

Bedrock formations above the Dakota Group seldom produce significant quantities of water with good quality. The Greenhorn Limestone may yield 10 to 50 g.p.m. of hard, iron water which usually contains high concentrations of sulfate and some hydrogen sulfide. No wells are known to tap the Greenhorn in the area of this study, however, it has been drilled for stock water in other parts of Pueblo County.

Geology and Evaluation of Ground-water Resources of Beulah and Vicinity prepared by Hershey, Woodserson & Lipp for Pueblo Regional Planning Commission, 1974.



Rule 10.4.5 establishes minimum standards for the intervals of grout and watertight casing in wells constructed into Type I (confined) aquifers. Continued and accelerated development of groundwater resources of deeper, confined aquifers require minimum construction standards that will ensure that wells are constructed to withdraw water from only the authorized zone of production and to prevent leakage to and from the surface and between aquifers/units through the borehole. Different ownership of waters in adjacent aquifers, the associated administration of separate water sources, and the potential for cross contamination of adjacent aquifers through the borehole dictate that the construction of wells into and through Type I aquifers must be accomplished using appropriate materials installed according to specified procedures. Obtaining a permanent grout seal between aquifers is essential in preventing the unnecessary loss of hydrostatic pressure in a confined aquifer and is necessary for the administration of water rights from the confined aquifer.

In addition to the larger annular space explained above, grouting materials and intervals are specified in this Rule to achieve the necessary separation of aquifers. Information that would allow drillers to accurately determine the depth of confining layers is not always available, therefore the best approach to protect groundwater resources is to grout from the top of the production zone back up to the depth required by Rule 10.4.5.2. In addition, grouting through overlying aquifers and confining layers protects the integrity of the casing from poor water quality and corrosion. Figures 4a and 4b are included in this Rule to illustrate the necessary elements of well construction in Type I aquifers.

COST/BENEFIT

- **Costs**
  - May increase costs of some Type 1 single wells where previously a 60 foot plug was required
  - Additional Steel Costs
  - Decrease costs of having to fix improperly constructed wells
  - Decreased well owner water treatment costs if contaminated by other units
  - Compare cost of well to new water tap from a provider
- **Benefits**
  - The rule is simpler to understand than having separate grouting requirements for Type 1 single vs. Type 1 multiple
  - The rule is simpler to inspect in the field and enforce by the Board
  - Provides a more equitable bidding process such that a driller who believes a well to be a Type 1 single would be able to bid it cheaper than one who interprets it to be a Type 1 multiple
  - Ensures there is no production from any overlying aquifer or geologic unit that may contain water of poor quality
  - Ensures there is no contamination of the well owner’s well
  - Faster well permit turnaround when no Hydrogeo Review is required
  - Some hydrogeologic reviews are based on limited geologic information and could potentially lead the driller towards an inappropriate well construction method

IMPACTS TO OTHER RULES

- Rule 5 Definitions
    - Type 1 multiple specific to Denver Basin
    - Type 1 for outside of Denver basin regardless of how many confining layers
- 10.4.4 Annular Space requirements
- Rule 10.4.6 Type 2 Construction Requirements
- Rule 10.4.8 Laramie-Fox Hills Construction Requirements (would we change for KLF?)
- Table 2 Grout Materials

REFERENCES

ANSI/NGWA-01-14 Water Well Construction Standard

NGWA is a community of groundwater professionals working together to advance groundwater knowledge and the success of our members through education and outreach; advocacy; cooperation and information exchange; and enhancement of professional practices. These procedures are for use in the development of recognized American National Standards Institute (ANSI) standards. These procedures shall ensure established ANSI standard developer requirements are followed. All standard development activities must comply with the most current version of the ANSI Essential Requirements.

https://www.ngwa.org/publications-and-news/NGWA-standards-development

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Nebraska Grout Study McEllhiney Video, McEllhiney Lecture Video NE Grout Study

Grouting PVC Casing with Neat Cement,
Grouting PVC Casing with Neat Cement Grout – Water Well Journal.pdf

Minimum Grouting Standards, A View On Minimum Grouting Standards – Water Well Journal.pdf

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For wells constructed into Type I aquifers (confined aquifers), where the borehole penetrates **more than one (1) confining layer**, the annular space between the borehole wall and the casing string must be grouted with approved grout using positive displacement from the base of the confining layer overlying the permitted production zone up to sixty (60) feet above the base of the uppermost confining layer, or to the depth required by Rule 10.5.2.1.

PROBLEM WITH RULE/HOW TO IMPROVE:

- Outside of the Denver Basin and Rio Grande Basin, aquifer and confining layer depths are not determined by Rule. This is causing confusion and inequity among contractors, particularly those constructing wells in the Cheyenne Basin (Northern Colorado) and where the Dakota Group Aquifer is present in Division 2 (Arkansas Basin). Hydrogeo Staff are attempting to provide aquifer depths and types for all applications in these regions. This is slowing down the time it takes to issue a permit as well as overwhelming Hydrogeo Staff time. Contractors are also reporting improper construction reports to Staff and forcing staff to review well construction after the fact. Standardizing well construction would reduce both of these reviews.
- Keep Type 1 multiple rule intact within the Denver Basin because it's easy to determine the aquifer type and location of confining layers
- Propose a rule for Type 1 wells for the rest of the state. This may still cause confusion if there is a question of Type 2 or Type 1.
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    - 4.2 Well Grouting

      Well grouting consists of completely filling the annular space between a casing and the formation, or outer casing, with a low permeability (not to exceed 1 x 10^{-7} cm/sec) grout from the bottom of the annular space to the top of the annular space.

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For wells constructed into Type I aquifers (Outside Denver Basin and excluding Confined San Luis Valley aquifer), where the borehole penetrates **one (1) or more** confining layers, the annulus between the borehole wall and the outermost casing string (steel or PVC) must be grouted with approved grout from the top of the production zone (i.e. the bottom of the lowest confining layer or just above the well screen) back to the top of the well. The grout interval and material must be sufficient to withstand the maximum potential hydrostatic pressure differential and seal all potential cross connections with overlying aquifers or zones with poor water quality.

PROPOSED ALTERNATIVES TO EXPLORE

See 10.4.5 Wells Constructed into Type 1 Aquifers Steel & Grout

All wells completed in Type 1 aquifers (aquifer not present/mapped at ground surface) must be plain cased and grouted from the top of the production zone to the top of the well. Could require a neat cement plug at the top of the production zone and bentonite chips/pellets to the top of the well. May also require additional annulus space to allow for bentonite placement and research if chips/pellets would appropriately separate aquifers.

Two part grout placement gets away from “one continuous pour/placement”, allows the borehole to change over time between grouts

Can bentonite chips be placed adequately at great depths, takes extra time and effort

Grouting the full length ensures all zones of poor quality are sealed off

Are neat cement or cement-bentonite the only grouts capable of sealing the annular space for the full length of the borehole? Different annular fill material?

BASIS AND PURPOSE

Pro: Must be neat cement or cement bentonite because bentonite slurries dehydrate in unsaturated zones causing failure of the annular seal

Neat cement can crack, so longer intervals could provide better seal

Steel casing can be expensive so this allows contractors to evaluate if PVC is viable

PVC Casing could improve water quality where artesian conditions bring water level up into blank casing above the production zone.

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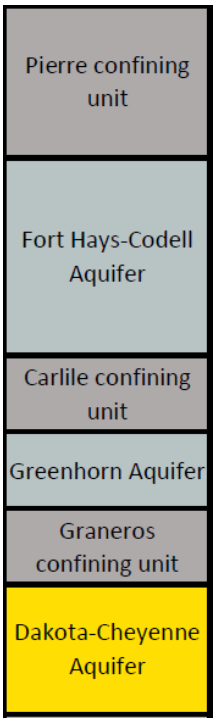
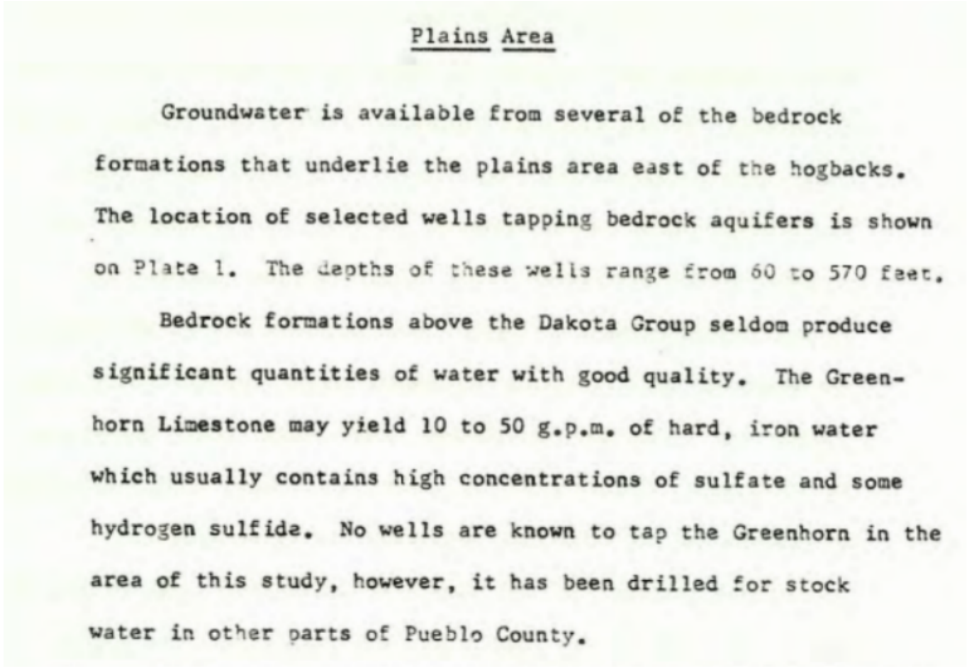
Heat of hydration and/or weight can cause PVC collapse

Continues disparity of bids from contractors, confusion to well owners





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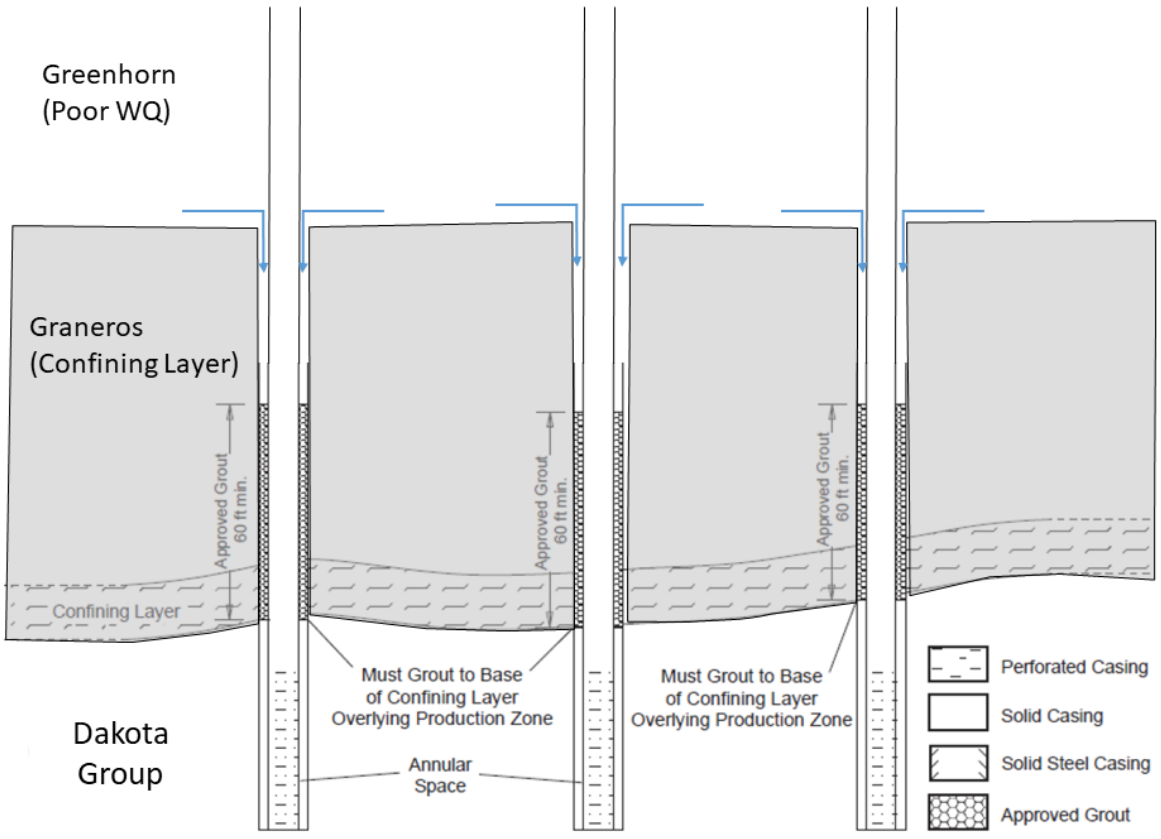

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COST/BENEFIT

- **Costs**
    - May increase costs of some Type 1 single wells where previously a 60 foot plug was required
    - May decrease costs of some Type 1 multiple wells were steel casing was previously required
    - Bentonite pellets cheaper than grout?
    - Decrease costs of having to fix improperly constructed wells
    - Decreased well owner water treatment costs if contaminated by other units
- **Benefits**
    - The rule is simpler to understand than having separate grouting requirements for Type 1 single vs. Type 1 multiple
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    - Provides a slightly more equitable bidding process such that a driller who believes a well to be a Type 1 single would be able to bid it cheaper than one who interprets it to be a Type 1 multiple
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Nebraska Grout Study, Nebraska Grout Task Force In-Situ Study of Grout Material 2001 -.pdf

Nebraska Grout Study McEllhiney Video, McEllhiney Lecture Video NE Grout Study

Grouting PVC Casing with Neat Cement,
Grouting PVC Casing with Neat Cement Grout – Water Well Journal.pdf

Minimum Grouting Standards, A View On Minimum Grouting Standards – Water Well Journal.pdf

RULES ADDRESSED: **10.6 Well Development and Cleaning**

CURRENT RULE LANGUAGE:

All wells must be initially cleaned and developed by the person authorized to construct the well in order to establish proper conditions in the well for installation of the permanent pumping equipment. At a minimum, well development and cleaning must include removal of drill cuttings, drilling fluids, and any foreign materials introduced into the borehole as a result of the borehole drilling and well completion processes.

PROBLEM WITH RULE/HOW TO IMPROVE:

- Does there need to be a total suspended solids (by volume) requirement?
- What if well is pumping sand and damages pump

PROPOSED RULE LANGUAGE:

Insert Proposed Rule Language

PROPOSED ALTERNATIVES TO EXPLORE

ANSI/NGWA-01-14 Well is considered developed when the following goals are met:

1) removes drilling fluids and formation damage
2) removes formation fines near the wellbore to increase hydraulic conductivity
3) establishes optimal hydraulic contact between the well and the formation
4) provides for acceptable level of sand and turbidity
5) provides appropriate level of drawdown at the production pumping rate

AWWA (2006) < 5 ppm total suspended solids by volume

Pump manufacturers suggest less than 1 ppm by volume

NGWA Manual of Water Well Construction Practices (2018)

< 1 ppm: water in direct contact with food or beverages
< 2 ppm: discharging to municipal water-treatment or distribution mains
< 5 ppm: homes, institutions, municipalities, industries
< 10 ppm: sprinkler irrigation, evaporative cooling,
< 15 ppm: flood type irrigation or where sand won't impact pump

BASIS AND PURPOSE

- *Insert proposed basis and purpose for amending the Rule*

COST/BENEFIT

- **Costs**
    - ***List potential costs associated with changing the Rule***
- **Benefits**
    - ***List benefits to changing the Rule***

IMPACTS TO OTHER RULES

List impacts to other Rules