Change in Enforcement Status

690-225-060(1) In the interest of achieving compliance, the Director at any time may reevaluate the status of the violations and take appropriate action, including reduction of the enforcement level or remission of all or part of any civil penalties assessed.

(2) The Director may terminate proceedings against a well constructor if the constructor provides acceptable evidence that:

(a) The landowner does not permit the constructor to be present at any inspection made by the Director; or

(b) That the constructor is capable of complying with recommendations made by the Director, but the landowner does not permit the constructor to comply. In such cases, the landowner is responsible for bringing the well into compliance pursuant to ORS 537.535, and if the landowner was not a party to the original enforcement proceeding the Director may initiate a proceeding to ensure that the landowner does so.

CIVIL PENALTIES

Assessment of Civil Penalties

690-225-100 Under OAR 690-225-030(1) the Director may at any time select the most appropriate enforcement tool, including assessment of civil penalties, to gain compliance. However, the Director shall not impose a civil penalty if compliance has been achieved in another manner prior to final decision in the proceeding.

Schedule of Civil Penalties

690-225-110(1) The amount of civil penalty shall be determined consistent with the following schedule:

(a) Not less than twenty five dollars ($25) nor more than two hundred fifty ($250) for each occurrence defined in the rules as a minor violation.

(b) Not less than fifty dollars ($50) nor more than one thousand dollars ($1,000) for each occurrence defined in the rules as a major violation.

(c) First occurrence, in a calendar year, of a missing or late start card fee shall be one hundred fifty dollars ($150).

(d) Second occurrence, in a calendar year, of a missing or late start card fee shall be two hundred fifty dollars ($250).

(e) Third occurrence, in a calendar year, of a missing or late start card fee shall be two hundred fifty dollars ($250) and may include suspension of well constructors license, and any other action authorized by law.

(2) For purposes of assessing a civil penalty, the start card fee referred to inn (c), (d) and (e) above shall not be considered late if it is received in the Salem office of the Water Resources Department within five (5) days of the receipt of the start card.

(3) Table I located at the end of this Division, lists minor violations of well construction standards. All other violations are declared to be major.

TABLE I
(690-225-110(2))

Oregon Statute Reference	Value Assignment	Title
ORS 537.762	Minor	REPORT OF COMMENCEMENT OF CONSTRUCTION
ORS 537.765	Minor	WELL REPORT

Administrative Rule Reference	Value Assignment	Title
Rule 690-205-060	Minor	DRILLING MACHINE IDENTIFICATION
Rule 690-210-290	Minor	LINER PIPE
Rule 690-210-270	Minor	PITLESS WELL ADAPTERS and UNITS
Rule 690-210-370	Minor	WELL TEST
Rule 690-210-280	Minor	ACCESS PORT OR AIRLINE
Rule 690-205-080	Minor	WELL REPORT
Rule 690-230-050	Minor	DESCRIPTION OF PROPOSED USE
Rule 690-230-060	Minor	IDENTIFICATION OF INTENDED USE
Rule-690-230-080	Minor	PUMP TESTING OF LOW TEMPERATURE GEOTHERMAL REINJECTION WELLS
Rule 690-230-090	Minor	WATER TEMPERATURE MEASUREMENT

DIVISION 230

STANDARDS AND PROCEDURES FOR LOW-TEMPERATURE GEOTHERMAL PRODUCTION AND INJECTION WELLS AND EFFLUENT DISPOSAL SYSTEMS

Policy and Purpose

690-230-005 (1) All low-temperature geothermal fluids are part of the groundwater resources of the State of Oregon and shall be administered by the Water Resources Commission (Commission) under the provisions of ORS 537.010 to 537.796. The Commission recognizes that these fluids are developed primarily because of their thermal characteristics and that special management is necessary. Reservoir assessment of low-temperature geothermal fluids shall be conducted by the Commission in the same manner as groundwater investigations outlined in ORS 537.665 and ORS 537.685.

(2) In areas where substantial thermal alteration exists, the Commission may declare a critical groundwater area, or may otherwise control use of groundwater, or order the discontinued use, repair or permanent abandonment of a well(s) causing substantial thermal alteration, in order to protect the thermal characteristics of the groundwater resource. The Commission may also regulate appropriations to limit thermal interference between wells. Low-temperature geothermal appropriations with a bottom hole temperature less than 60 degrees F shall not be protected from thermal interference caused by groundwater appropriations for other purposes.

(3) The purpose of the following rules is to provide standards and procedures for the development, use and management of low-temperature geothermal fluids, while insuring proper management of all groundwater resources so maximum beneficial use of the resource will be most effectively attained.

(4) These rules supplement OAR 690-200-005 to 690-225-110.

Definitions

690-230-020 (1) "Bottom hole temperature" means the maximum temperature measured in the well or borehole. It is normally attained directly adjacent to the producing zone, commonly at or near the bottom of the borehole, and will in all cases be greater than or equal to the temperature of fluid produced from the borehole.

(2) "Low-temperature geothermal effluent" means the outflow, discharge or waste fluid, with its associated dissolved or suspended constituents (being original or introduced), that is produced by a low-temperature geothermal well and its utilization system.

(3) "Low-temperature geothermal fluid" means any groundwater used for its thermal characteristics that is encountered in a well with a bottom hole temperature of less than 250 degrees Fahrenheit (F), or any other fluid that is circulated within a well having a bottom hole temperature of less than 250 degrees F and used for its thermal characteristics.

(4) "Low-temperature geothermal injection well" means any well as defined under ORS 537.515(9) that is constructed or used for returning low-temperature geothermal effluent to a groundwater reservoir.

(5) "Low-temperature geothermal production well" means any well as defined under ORS 537.515(9) with a bottom hole temperature of less than 250 degrees F that is constructed or used for the thermal characteristics of the fluid contained within.

(6) "Nonstandard low-temperature geothermal effluent disposal system" means any low-temperature geothermal effluent disposal system in which one or more of the following conditions are met:

(a) Any portion of the effluent is disposed of in a manner considered non-beneficial by the Director. This includes, but is not limited to, disposal via storm sewer, drainage hole or direct discharge to land surface or a surface water body.

(b) The effluent contains contaminants, other than heat, that have been added to the low-temperature geothermal fluid.

(c) The effluent is injected into a groundwater reservoir that is not considered suitable by the Director. Factors which may render a groundwater reservoir unsuitable include, but are not limited to, chemical or physical incompatibility of the fluids involved or adverse hydraulic characteristics of the receiving reservoir.

(d) There are other existing or potential site specific problems or conditions, that require the nonstandard designation of effluent disposal. Examples include, but are not limited to, instability of near-surface earth materials, undue alteration of thermal characteristics of groundwater, unreasonable head changes or leakage of effluent back to the surface.

(7) "Secondary use" means the consumption of low-temperature geothermal effluent for beneficial use including, but not limited to, domestic, irrigation, stock watering, commercial and industrial uses.

(8) "Standard low-temperature geothermal effluent disposal system" means any low-temperature geothermal effluent disposal system in which one or more of the following conditions are met:

(a) No contaminants , other than heat, have been added to the low-temperature geothermal fluid and the effluent is put to a secondary use.

(b) No contaminants, other than heat, have been added to the low-temperature geothermal fluid and the effluent is returned to the producing groundwater reservoir or other suitable groundwater reservoir as determined by the Director. In addition there are no other existing or potential problems or special conditions, as determined by the Director, that include, but are not limited to, those factors, problems and conditions listed in subsections (6)(c) and (d) of this rule.

Construction of Low-Temperature Geothermal Production and Injection Wells

690-230-030 (1) Low-temperature geothermal production and injection wells shall be constructed in conformance with applicable rules (OAR 690-200-005 to 690-225-110) with specific additions and modifications as described in OAR 690-230-005 to 690-230-140.

(2) Low-temperature geothermal production and low-temperature geothermal injection wells shall be constructed in a manner that protects groundwater from contamination, waste and loss of artesian pressure, and substantial thermal alteration.

(3) If utilization of the well causes heating or cooling of the casing, resulting in thermal expansion or contraction of the casing to the point that adherence to the minimum well construction standards will not prevent or eliminate groundwater contamination, groundwater waste, loss of artesian pressure, or substantial thermal alteration, then the licensed well constructor shall submit a written request to the Director to use alternate construction methods and/or materials to prevent groundwater contamination, groundwater waste, loss of artesian pressure, and substantial thermal alteration. Written approval from the Director must be obtained prior to completion of the well.

(4) A well constructor or owner of a low-temperature geothermal production or injection well may submit well construction plans to the Department for assistance and review of construction details.

Location of Low-Temperature Geothermal Injection Wells Not Exceeding 15,000 Gallons Per Day

690-230-040 (1) No low-temperature geothermal injection well with an anticipated injection rate of less than 15,000 gallons per day shall be located within 75 feet of any existing low-temperature geothermal production well utilizing the same groundwater reservoir without authorization from the Director unless both the production and injection wells are owned or used by the same person.

(2) A request to construct a low-temperature geothermal injection well within 75 feet of a low-temperature geothermal production well shall be made in writing to the Director. The request shall list the names and addresses of the property owners, street addresses of the wells, and shall state the reason(s) for locating the injection well closer than 75 feet to the production well. The Director may approve construction of an injection well closer than 75 feet to a production well only if the Director determines that the hydrologic and thermal conditions described in OAR 690-230-110 (1) justify the closer spacing.

Location of Low-Temperature Geothermal Injection Wells Exceeding 15,000 Gallons Per Day

690-230-045 The owner of any low-temperature geothermal injection well having an anticipated injection rate of greater than 15,000 gallons per day is required to have a separation distance between the low-temperature geothermal injection and production wells that is adequate to protect the production wells from substantial thermal interference. The Director shall make a decision on the proposed separation distance based on information supplied by the owner as per OAR 690-230-115.

Description of Proposed Well Use (Start Card)

690-230-050 For any low-temperature geothermal production or injection well, the report required under ORS 537.762 prior to commencing well construction shall identify the intended use of the well, the owner's name and the owner's mailing address.

Identification of Intended Well Use (Well Log)

690-230-060 Any low-temperature geothermal production or injection well shall be clearly identified as such on the water well report filed with the Water Resources Department under ORS 537.765.

Well-Head Protection Equipment

690-230-070 Adequate well-head equipment to insure public safety and the protection of the groundwater resource shall be immediately installed on any low-temperature geothermal production well or low-temperature geothermal injection well when the temperature of the fluid being withdrawn from, being pumped from, or flowing from the well bore exceeds 65 degrees C (150 degrees F) A variance from the requirement for well-head protection equipment may be granted if a written request demonstrates that the equipment is not necessary to safely complete the well.

Disposal of Low-Temperature Geothermal Fluids Produced During Drilling and Testing

690-230-075 Low-temperature geothermal fluids produced during drilling or testing of a low-temperature geothermal production or injection well shall be disposed of in a manner that minimizes hazards. For additional requirements on the disposal of low-temperature geothermal fluids produced during well drilling or testing, contact the Oregon Department of Environmental Quality.

Pump Testing of Low-Temperature Geothermal Injection Wells With an Anticipated Injection Rate of Less Than 15,000 Gallons Per Day

690-230-080 (1) Low-temperature geothermal injection wells with an anticipated injection rate of less than 15,000 gallons per day shall be pump tested for a period of at least one hour. Test results must be recorded by the well constructor on the water well report. This minimum test shall be conducted as follows:

(a) Prior to testing, the static water level in the well shall be measured and recorded.

(b) The water shall be pumped into or from the well at a measured and steady rate. The pumping or withdrawal rate shall approximate the maximum anticipated injection rate.

(c) For tests that withdraw water from the well, only bailing or pumping the well is acceptable.

(d) At a minimum, the water level in the well shall be measured and recorded both at the end of pumping and after one hour of recovery.

(2) The Director may require the well owner to provide a more detailed test, separate from the water well report, that could include, but is not limited to, increased frequency of water level measurement, increased test duration and increased monitoring of observation wells. Such modifications will be required when possible impacts resulting from the development include, but are not limited to, thermal or hydrologic interference with existing water rights, water quality degradation or physical or mechanical failure of the well structure.

Pump Testing of Low-Temperature Geothermal Injection Wells With an Anticipated Injection Rate Exceeding 15,000 Gallons Per Day

690-230-085 (1) Low-temperature geothermal injection wells (other than flowing artesian wells) with an anticipated injection rate of greater than 15,000 gallons per day, shall be pump tested for a period of at least four hours. The pump test shall occur after the owner's pump test plan is approved by the Director, and prior to injecting into the well. The results of this test do not need to appear on the water well report. This test shall be in addition to the minimum one-hour test requirement under OAR 690-210-370. Requirements for conducting the minimum four-hour pump test as discussed in this section are as follows:

(a) Prior to testing, the well shall be idle for a period of at least four hours.

(b) The static water level in the well shall be measured at least three times, no less than twenty minutes apart, during the hour prior to pumping the well.

(c) The water shall be pumped into or from the well at a measured and steady rate. The rate shall approximate the maximum anticipated injection rate.

(d) The pump discharge shall be controlled as much as possible to maintain a constant rate during the test. The discharge rate shall be as close as reasonably possible to the anticipated injection rate during normal use of the well.

Discharge rate shall be recorded at the beginning of the test and once every hour thereafter.

(e) Water levels in the well shall be physically measured by a standard and acceptable method. Visual estimation of water level is not acceptable. Acceptable methods include:

(A) An electric water level measuring tape,

(B) An air line dedicated to the well,

(C) An acoustic sounder,

(D) An electronic pressure transducer, or

(E) Other water level measuring methods approved in advance by the Director.

(f) The water level measurements shall occur at least at the minimum frequency outlined below:

Time period	Water level measurement schedule
First 10 minutes	No more than 2 minutes apart
10 to 30 minutes	No more than 5 minutes apart
30 to 100 minutes	No more than 15 minutes apart
100 to 240 minutes	No more than 30 minutes apart

(g) After pumping stops, water level measurements shall be collected for a time equal to that of the pumping period, or until the well reaches 90 percent recovery from the maximum drawdown, whichever occurs first. Recovery water level measurements shall be collected on the same time schedule as described in OAR 690-230-085 (1)(f).

(h) The pump discharge shall be physically measured by a standard and acceptable method. Visual estimation of flow rate is not acceptable. Acceptable methods include:

(A) A properly installed flow meter, designed for geothermal use, which is functional and calibrated within reasonable limits for the type of meter,

(B) A properly installed weir or flume,

(C) A properly installed and calibrated orifice plate and manometer,

(D) Known volume/time calculations (including calibrated bucket and stopwatch up to 60 gallons per minute),

(E) Properly installed and used ultrasonic flow measuring devices, or

(F) Other discharge methods approved in advance by the Director.

(2) The owner may consult with the Department before selecting representative nearby wells for monitoring during the pump test. If monitoring wells are selected in absence of specific instructions from the Department, the measurement of water levels in each well shall adhere to the schedule established in OAR 690-230-085 (1) (f).

(3) The Director may require the owner of the well to have a pump test performed that is more detailed than the test requirements described in OAR 690-230-085(1)-(2). This more detailed test could include, but is not limited to, increased frequency of water level measurements, increased test duration and increased monitoring of observation wells. Such modifications will be required when possible impacts resulting from the proposed injection include, but are not limited to, thermal or hydrologic interference with existing water rights, water quality degradation or physical or mechanical failure of the well structure.

(4) For flowing artesian wells, pump test specifications shall be prescribed by the Department on a case-by-case basis.

Water Temperature Measurement

690-230-090 (1) The water well report prepared for any low-temperature geothermal well that is tested by pumping water from the well, shall include the temperature of the fluid, as measured at the discharge point at the beginning and end of a timed production test, as well as the maximum fluid temperature attained during the test. Bailing or pumping the well are acceptable methods of withdrawing water from the well during the test. Air testing is not acceptable.

(2) The well report prepared for any low-temperature geothermal well that is tested by pumping water into the well shall include the maximum temperature in the borehole and its corresponding depth.

(3) The well constructor is required to provide the temperature data on the water well report. The Director may use other temperature data in making the final determination of the bottom hole temperature.

Additional Standards for Low-Temperature Geothermal Injection Wells

690-230-100 Procedures required to inject effluent into a low-temperature geothermal injection well shall not cause failure of the well casing and/or seal materials or other components of the well structure, including but not limited to, movement, displacement or fracturing of the overburden.

LOW-TEMPERATURE GEOTHERMAL EFFLUENT DISPOSAL

Injection Plan For Wells With an Anticipated Injection Rate Not Exceeding 15,000 Gallons Per Day

690-230-110 No low-temperature geothermal injection well shall be used for injection without approval of the Director in accordance with OAR 690-210-070. The injection plan for the proposed injection of less than 15,000 gallons per day to a low-temperature geothermal injection well will consist of a water well report from both the injection and production wells. These well reports shall be sent to the Director for review. If the injection well has not yet been constructed, or if a water well report is not available from the injection or production well, acceptable data that shall be submitted as part of the injection plan include, but are not limited to, the following: geological information of the area, depth of the well(s) in question, water well reports from nearby wells, static water level data or water quality data from the well(s) in question. After review of the well reports, or other acceptable data, the Director may require water quality testing, as per OAR 690-230-115 (1)-(2), if the Director deems it necessary. The water quality testing may be required in the situations that include, but are not limited to, injection into a groundwater reservoir that is different from the producing groundwater reservoir, or when the well is of poor construction.

Injection Plan For Wells With an Anticipated Injection Rate Exceeding 15,000 Gallons Per Day

690-230-115 No low-temperature geothermal injection well shall be used for injection without approval of the Director in accordance with OAR 690-210-070. The injection plan for the proposed injection of greater than 15,000 gallons per day to a low-temperature geothermal injection well shall include, but is not limited to, the following:

(1) Details of well construction, including water well reports for the production well and the injection well,

(2) Description of the number and location of water bearing zones from both production and injection wells,

(3) Water temperature data from both the production and injection wells, and

(4) Water level data from both the production and injection wells. If information from the well report is not sufficient to determine the effects of injection, the Director may require additional geologic or hydrologic information, including but not limited to, temperature/depth logs of the wells.

(5) Water quality information including analysis by a laboratory certified by the Oregon Health Division for drinking water standards for the following parameters: arsenic, boron, calcium, carbonate or bicarbonate, chloride, fluoride, iron, magnesium, manganese, pH, potassium, silica, sodium, specific conductance, sulfate, suspended solids, total dissolved solids, and total coliform bacteria. If the low-temperature geothermal effluent is suspected to be of poor water quality or to be otherwise incompatible with the water in the receiving zone in the injection well, the Director may require additional specific water quality data. If the information on the well reports for the wells involved is not sufficient to determine the effects of injection, the Director may require additional geologic or hydrologic information, including but not limited to, temperature/ depth logs of the wells. The Director may waive the requirement for specific portions or all of the chemical analyses if the fluid quality is known to be suitable for the intended production and injection.

(6) A map indicating the location and elevation of both the production well and the injection well in accordance with OAR 690-230-045. All maps shall be drawn to a standard, even scale of not less than 4 inches = 1 mile. Small area maps may be more easily and clearly drawn to a larger scale, such as 1 inch = 400 feet. The well owner shall submit injection plans to the Director indicating proposed separation distances between production and injection wells on the parcel of land on which the production well is located, on the parcel of land on which the injection well is located, and on all adjacent parcels of land, as well as land surface elevation at each well head.

(7) Any planned safeguards to prevent substantial thermal or hydrologic interference with existing rights to appropriate groundwater and surface water and alteration of existing or potential drinking water supplies.

WATER RIGHTS PROCEDURE

Processing of Applications

690-230-120 The appropriator shall make application for a water right to appropriate low-temperature geothermal fluid unless an exemption is provided for under ORS 537.545.

Exemption From Water Right Permit Application/Use of Low-Temperature Geothermal Fluid

690-230-130 (1) Low-temperature geothermal fluid appropriation for single industrial or commercial use including, but not limited to, electrical, agricultural, aquacultural, heating and/or cooling in an amount not exceeding 5,000 gallons per day shall be exempt from application for a water right as provided for under ORS 537.545.

(2) Low-temperature geothermal fluid appropriation for single or group domestic purposes including household heating and/or cooling shall be exempt from being required to apply for a water right as provided for under ORS 537.545 when the combined amount of groundwater for single or group domestic purposes, including household heating and/or cooling, does not exceed 15,000 gallons per day. Construction must comply with well construction and maintenance rules as per OAR 690-200-230.

(3) The exemptions under subsections (1) and (2) of this section apply to the use of groundwater for any such purpose to the extent that it is beneficial and constitutes a right to appropriate groundwater equal to that established by a groundwater right certificate.

Water Right Limitation for Nonstandard Effluent Disposal Systems

690-230-140 If the low temperature geothermal effluent is disposed of by way of a nonstandard low-temperature geothermal effluent disposal system, the right to appropriate the low-temperature geothermal fluid shall be inferior to all subsequent rights for beneficial consumptive use and/or to the rights of those appropriators who make use of a standard low-temperature geothermal effluent disposal system. If a nonstandard low-temperature geothermal effluent disposal system is upgraded to a standard low-temperature geothermal effluent disposal system the associated water right retains the priority date established upon initial filing.

DIVISION 235

GROUND WATER ADVISORY COMMITTEE

Ground Water Advisory Committee: Appointments, Terms, and Qualifications

690-235-005(1) There is created the Ground Water Advisory Committee consisting of five members appointed by the Director: two of whom shall be individuals from the well industry, two of whom shall be ground water geologists or hydrologists, and one of whom shall represent the public-at-large. Members shall be citizens of the United States and residents of Oregon.

(2) Each member shall be appointed for a term of four years from the date of the expiration of the term for which the predecessor was appointed, except when a vacancy occurs before the expiration of a term shall be filled by appointment for the remainder of the unexpired term only.

(3) Members shall be appointed from different geographical areas, and shall receive neither compensation nor expenses in the performance of their duties as a member.

(4) Officers of Committee: the Committee shall select one of its members as Chairman and another as Vice-chairman. Maximum terms of officers shall be two years for each position.

(5) Meetings of the Committee: the Committee shall meet at least once every three months at locations specified by the Director.

Ground Water Advisory Committee Duties

690-235-020 The Committee shall consider and advise the Director on all matters relating to:

(1) Rules for the development, use, and protection of ground water aquifers.

(2) Rules for examining and issuing of licenses for well constructors.

APPENDIX 1

I. Recommendations For Disinfection of Wells (OAR 690-210-380)

Every newly constructed, altered, or repaired well should be assumed to be contaminated by micro-organisms. Before the initiation of use, each well must be thoroughly and carefully cleaned and treated to ensure that all disease carrying organisms are eliminated. Care should be exercised to make certain that all areas of the well come into contact with a solution containing enough available chlorine to completely destroy all harmful bacteria. An initial chlorine concentration of 50 parts per million (ppm) with a residual chlorine requirement of 25 ppm after 24 hours is considered adequate for this purpose. Either domestic laundry bleaches containing sodium hypochlorite, such as Clorox or Purex, or calcium hypochlorite in powder or tablet form (Olin HTH) may be used.

Hypochlorite solutions should be thoroughly mixed throughout the well either by the use of drilling tools, a pump, or by placing a calculated number of HTH tablets at regular intervals on a nylon string and dissolving them in places throughout the well. In all cases, the well casing and pump column standing above the water table should be thoroughly cleaned of all grease and oil and should be carefully washed down with the hypochlorite solution.

The well should be allowed to remain undisturbed after the treatment for a period of 24 hours. Then it is recommended that the well be tested for residual chlorine (at least 25 ppm must remain). After successful treatment, all water remaining in the well and supply system should be run to waste and a sample of fresh water from the well tested by the local county sanitarian for bacteriological purity.

SOLUTIONS CONTAINING HYPOCHLORITES

Laundry Bleach

Common domestic laundry bleaches contain from 5.25 percent to 6.00 percent sodium hypochlorite. These amounts are equivalent to approximately 2.5 percent available chlorine or about 25,000 ppm as originally purchased. A one gallon container of liquid bleach mixed with 500 gallons of water will dilute the original solution to approximately 50 ppm available chlorine.

High-Test Hypochlorite Compounds

Calcium hypochlorite (Olin HTH) in powder or tablet form contains about 50 percent active chlorine. One ounce of dry HTH powder mixed with 75 gallons of water will result in a solution containing approximately 50 ppm available chlorine. Eight tablets V(1/8 oz. each) of HTH are equivalent to one ounce of dry powder or granules.

QUANTITY OF HYPOCHLORITE NEEDED TO PROVIDE 50 PPM ACTIVE CHLORINE IN WELL WATER

(1) If using liquid bleaches, the following formula is applicable:

$$\text{Feet of water in well} \times \frac{\text{Gallons per foot}}{62} = \text{Pints of bleach needed}$$

Feet of water - Total depth of well minus static water level multiplied by gallons per foot (See Table II).

(2) If using HTH compounds, the following formula is applicable:

$$\text{Feet of water} \times \frac{\text{Gallons per foot}}{75} = \text{Ounces HTH needed}$$

(3) If HTH tablets are used:

$$\text{Feet of water} \times \frac{\text{Gallons per foot}}{9} = \text{Number of 1/8 oz. tablets needed}$$

TABLE II
CAPACITY OF DRILLHOLE OR CASING

Nominal size (inches)	Gallons per linear foot
2	0.163
4	0.653
5	1.020
6	1.469
7	1.999
8	2.611
9	3.305
10	4.080
11	4.937
12	5.875
14	7.997
16	10.445
18	13.219
20	16.320
24	23.501

Additional Requirements by Other State Agencies of Oregon

In the administration of ORS 537.505 to 537.795, the Director of the Water Resources Department has statutory authority under the provisions of ORS 537.780 "to prescribe and enforce general standards for the construction and maintenance of wells and their casings, fittings, valves, and pumps ..." Other agencies of the state have statutory responsibilities that relate either directly or indirectly to the construction and operation of public water supply systems and their source of water supply. These agencies and their responsibilities are listed as follows:

TABLE III

OREGON HEALTH DIVISION 1400 SW 5th Avenue Portland, OR 97201	ORS Chapter 448	Municipal water supply systems. Public water supply systems. Community water supply systems (serving more than three single residents)
BUILDING CODES AGENCY 403 L & I Bldg. Salem, Oregon 97310	ORS Chapter 446	Electrical and Plumbing for all Commercial Enterprises Mobile home park water supply systems.
OREGON PUBLIC UTILITY COMMISSIONER Labor and Industries Building Salem, OR 97310	ORS Chapter 757	Private owners (water supply systems, 200 homes or more).
DEPARTMENT OF ENVIRONMENTAL QUALITY 811 SW 6th Portland, OR 97204	ORS Chapter 468	Water quality monitoring 522 wells.
CORPORATION DIVISION Business Registry Section Commerce Bldg. 158 12th St. NE Salem, Or. 97310		Business Registry for Water Districts

All wells constructed in Oregon, including those to serve as a source of ground water to municipal, community, public, or public utility water supply systems, must be constructed in accordance with the rules and regulations prescribing general standards for the construction and maintenance of wells in Oregon (OAR 690 Divisions 205, 210, 215 and 220. Additional construction standards for water supply systems are required by the above listed agencies. Such rules and regulations generally include the source of water supply to the systems and may affect well construction requirements. Copies of the various agency rules may be obtained by contacting the responsible agency. Well constructors planning to construct a well as a source of water supply for any of the above systems are requested to contact the responsible agency prior to the beginning of well construction.

APPENDIX 2

I. Recommended Methods of Placement of Cement Grout (OAR 690-210-320)

Method A - The well bore shall be plugged with a drillable plug or bridge at the lowest point to be sealed. A well casing with a float shoe at its lower end shall be placed in the well and suspended slightly above the point of bearing. A grout pipe shall be run inside the casing to the check valve. The grout pipe shall be connected to a suitable pump and water or drilling fluid shall first be circulated to clear the annular space. Grout shall be pumped through the grout pipe until clean grout completely fills the interval to be sealed. The grout pipe shall then be removed and the cement allowed to set. (See Figure 2.)

Method B - Grout shall be placed by pumping or air pressure injection through a grout pipe installed inside the casing from the casing head to a point five (5) feet above the bottom of the casing. The grout pipe shall extend through an airtight sealed cap on the head of the well casing. The casing head shall be equipped with a relief valve and the grout pipe shall be equipped at the top with a valve permitting injection. The lower end of the grout pipe and the casing shall be open. Clean water shall be injected down the grout pipe until it returns through the casing head's relief valve. The relief valve is then closed and injection of water is continued to clean the hole until it flows from the bore hole outside the casing that is to be grouted in place. Without significant interruption, grout shall be substituted for water and, in a continuous manner, injected down the grout pipe until it returns to the surface outside of the casing. A small amount of water may be used to flush the grout pipe, but the pressure should remain constant on the inside of the grout pipe and the inside of the casing until the grout has set. Pressure shall be maintained for at least twenty-four (24) hours, or until such time as a sample of the grout indicates a satisfactory set. Cement grout shall be used for this procedure with a minimum annular space of one (1) inch completely surrounding the casing. (See Figure 2).

Method C - The well bore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. The well casing shall be firmly seated at the bottom of the drillhole. A grout pipe shall be run to the bottom of the hole through the annular space between the casing and the well bore. After water or any other drilling fluid has been circulated in the annular space sufficiently to clear obstructions, the grout pipe shall be connected to a suitable pump and grout shall be pumped through the grout pipe until clean grout is circulated to land surface, or until grout completely fills the interval to be sealed. The lower end of the grout pipe shall remain submerged in grout at all times during the period that grout is being placed. The grout pipe shall be withdrawn before the initial set of the grout. (See Figure 2.)

Method D - The well bore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. After the casing is run and landed, a casing plug, having a length greater than the diameter of the casing, shall be placed in the casing. If the drillhole is free of mud or water, this lower separation plug may be eliminated. A measured amount of cement grout necessary to completely fill the annular space of the interval to be grouted is pumped or placed by bailer in the casing. A second casing plug, having a length greater than the diameter of the casing, shall be placed in the casing above the grout, and the casing shall be capped with a pressure cap and shut-off valve, and shall be connected to a suitable pump. The casing shall then be raised far enough above the point of bearing to clear the first separation plug. Water or drilling mud shall then be pumped under pressure into the casing forcing the grout and upper casing plug down the casing. The position of the plug must be known at all times. A small amount of the grout shall be allowed to remain in the lower end of the casing. When the plug reaches the point desired above the bottom of the casing, the pump shall be stopped and the casing seated. (See Figure 2.)

Method E - The well bore shall be plugged with a drillable packer or bridge at the lowest point to be sealed. A sufficient amount of cement grout to completely fill the interval of the well to be sealed shall be placed at the bottom of the drillhole by dump bailer, grout pipe, or tremie pipe. The well casing shall have centering guides attached at appropriate intervals to keep the casing center in the bore hole. The bottom of the well casing shall be fitted with a tight drillable plug and shall be lowered into the drillhole forcing the grout upward into the annular space. Gravity installation without the aid of a tremie or grout pipe shall not be used. In no instance shall this method be used beyond a depth of thirty (30) feet and in no case for a municipal, community, or public water supply well. (See Figure 2.)

TABLE IV
(690-210-190)
(Minimum specifications for steel well casing)

Nominal Size (inches)	Outside Diameter (inches)	Wall Thickness (inches)	Weight Per Foot (pounds)
2	2.375	.154	3.56
2-1/2	2.875	.203	5.79
3	3.500	.216	7.58
3-1/2	4.000	.226	9.11
4	4.500	.237	10.79
5	5.563	.244	13.70
6	6.625	.250	17.02
8	8.625	.250	22.36
10	10.750	.250	28.04
* 12	12.750	.312	41.48
* 14	14.000	.312	45.68
* 16	16.000	.312	52.27
* 18	18.000	.375	70.59
* 20	20.000	.375	78.60

Note: Steel casing installed in a well greater than a nominal diameter of ten (10) inches, having a wall thickness of .250 inch and meeting ASTM A-120 specifications must not exceed the following depth limitations (Diameter - Maximum Depth, respectively):

(a) 12 inches - 250 feet;
(b) 14-16 inches - 150 feet;
(c) 18-20 inches - 100 feet;

TABLE V
(690-210-220)
(Set time for plastic casing joints)

Temperature Range During Initial Set Time	Set Time for Various Pipe Sizes In Hours					
	3"	4"	6"	8"	10"	12"
60 F - 100 F	1/2	1/2	1/2	3/4	3/4	1
40 F - 60 F	2	2	4	4	4	4
0 F - 40 F	6	6	8	10	12	12

NOTE: After the initial set, the joints will withstand the stress of a normal installation. However, considerable care should be employed in handling the string.

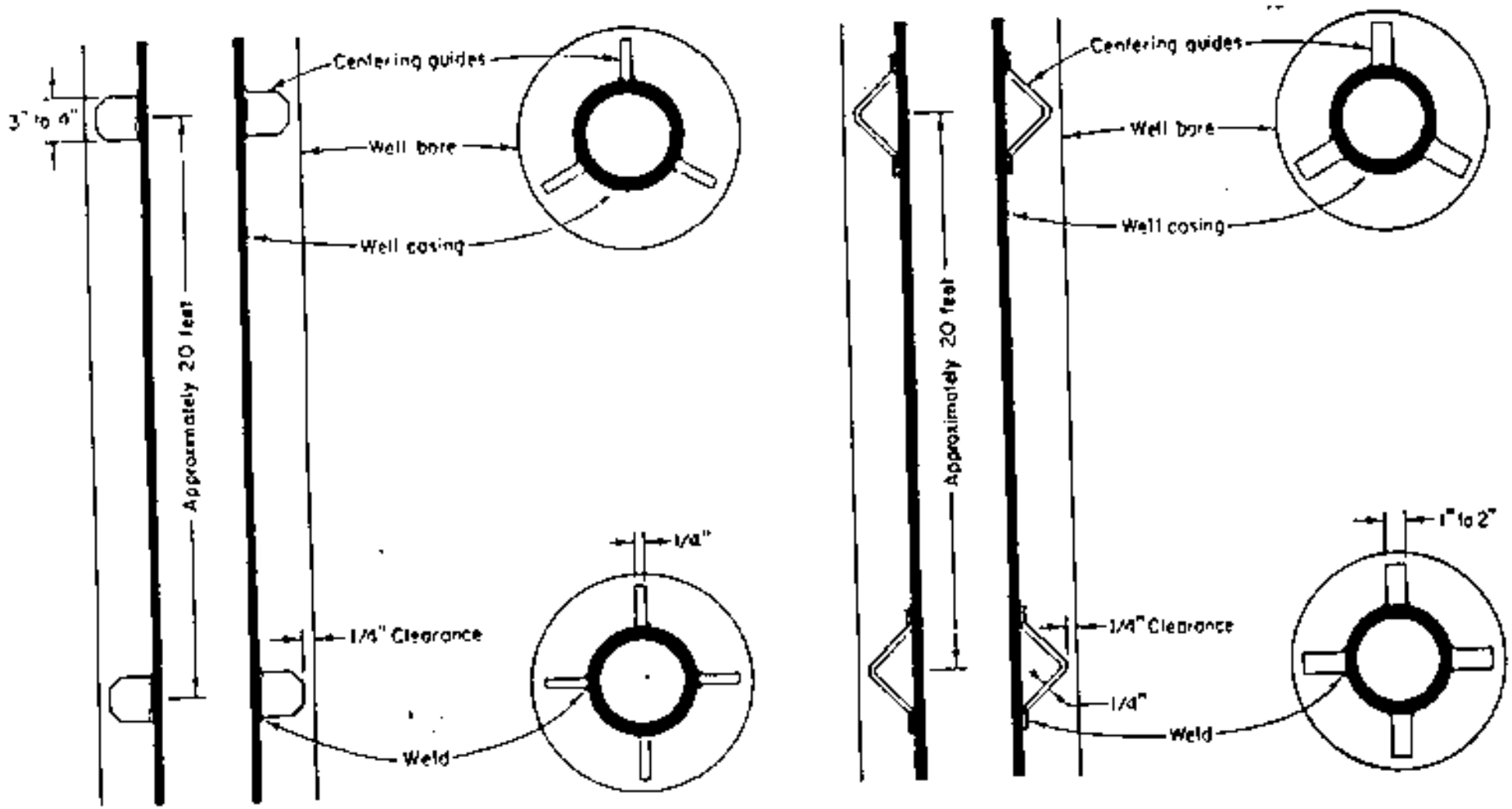
TABLE VI
(690-210-180)
(Specifications for Drive Pipe)

Nominal Size (inches)	Outside Diameter (inches)	Wall Thickness (inches)	Weight Per Foot (pounds)
1-1/2	1.900	0.145	2.72
2	2.375	0.154	3.65
2-1/2	2.875	0.203	5.79
3	3.500	0.216	7.58
3-1/2	4.000	0.226	9.11

4735D

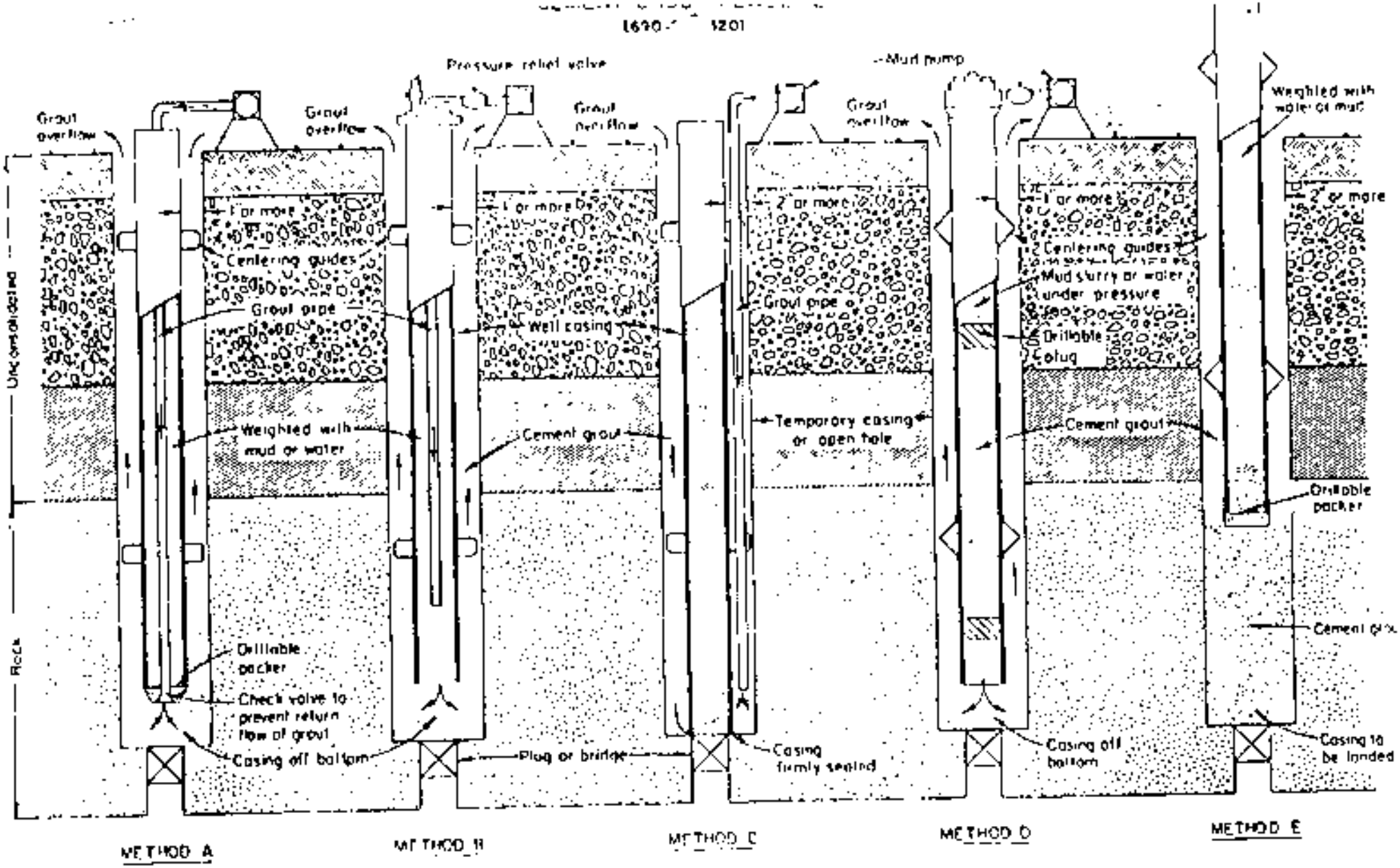
RECOMMENDED USE OF CENTERING GUIDES

(690-210-2401)



NOTE: Well casing, to be sealed into an oversize drillhole, should be equipped with a series of centering guides to insure proper centering of casing. Guides should be evenly spaced in groups of 3 or 4, and attached to the casing

FIGURE 1



Note: If Method E is used to place the seal, centering guides must be attached to the casing

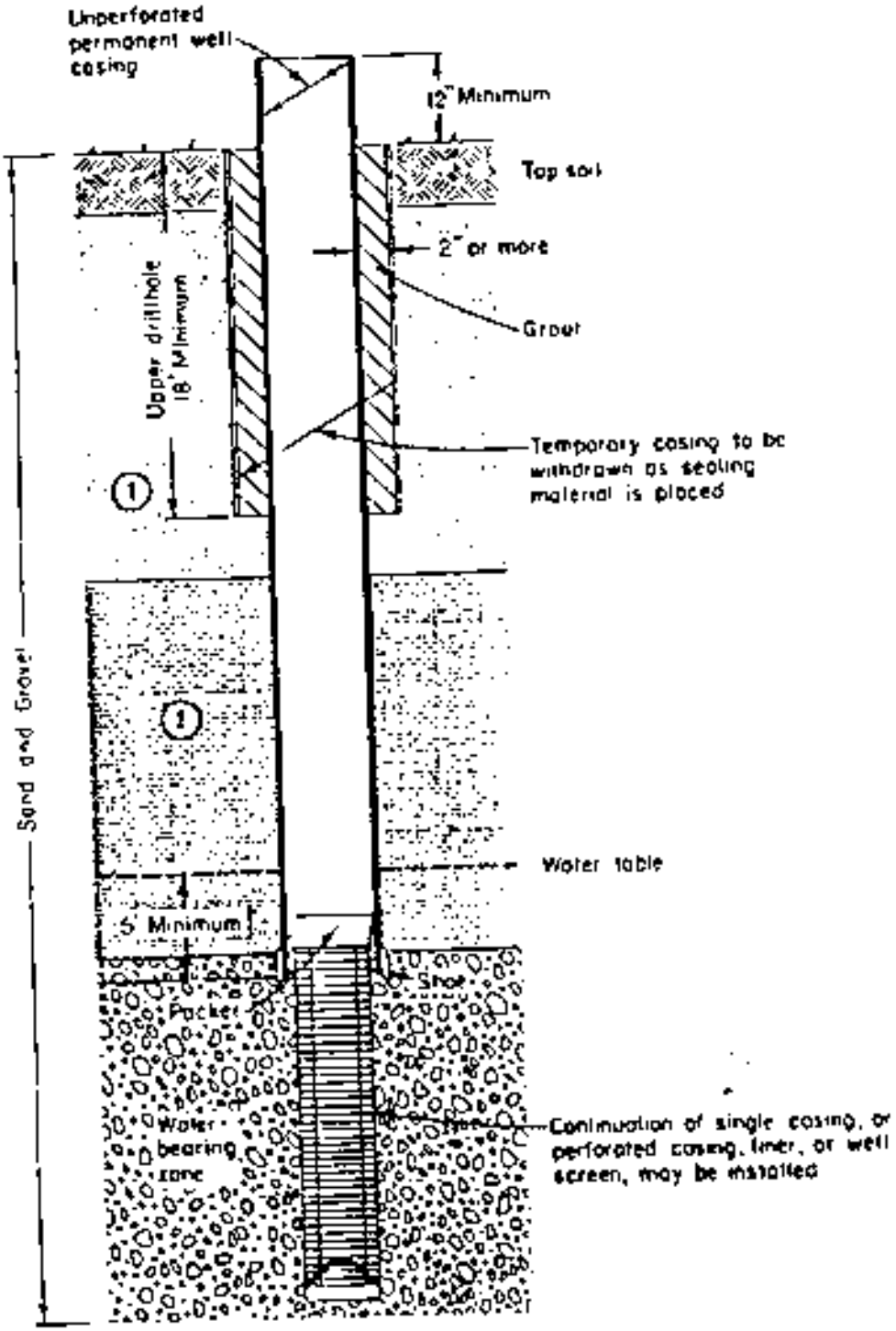
FIGURE 2

SEALING OF DRILLED WELL IN UNCONSOLIDATED FORMATION - WITHOUT SIGNIFICANT CLAY BEDS

(690-210-130)

Overlying Material - Sand and Gravel without Clay

Water-bearing Formation - Sand and Gravel or Similar



(1) Upper oversize drillhole and annular seal must extend to a depth of at least 18 feet

(2) Unperforated watertight well casing must extend at least 5 feet below the water table and to a minimum depth of 18 feet

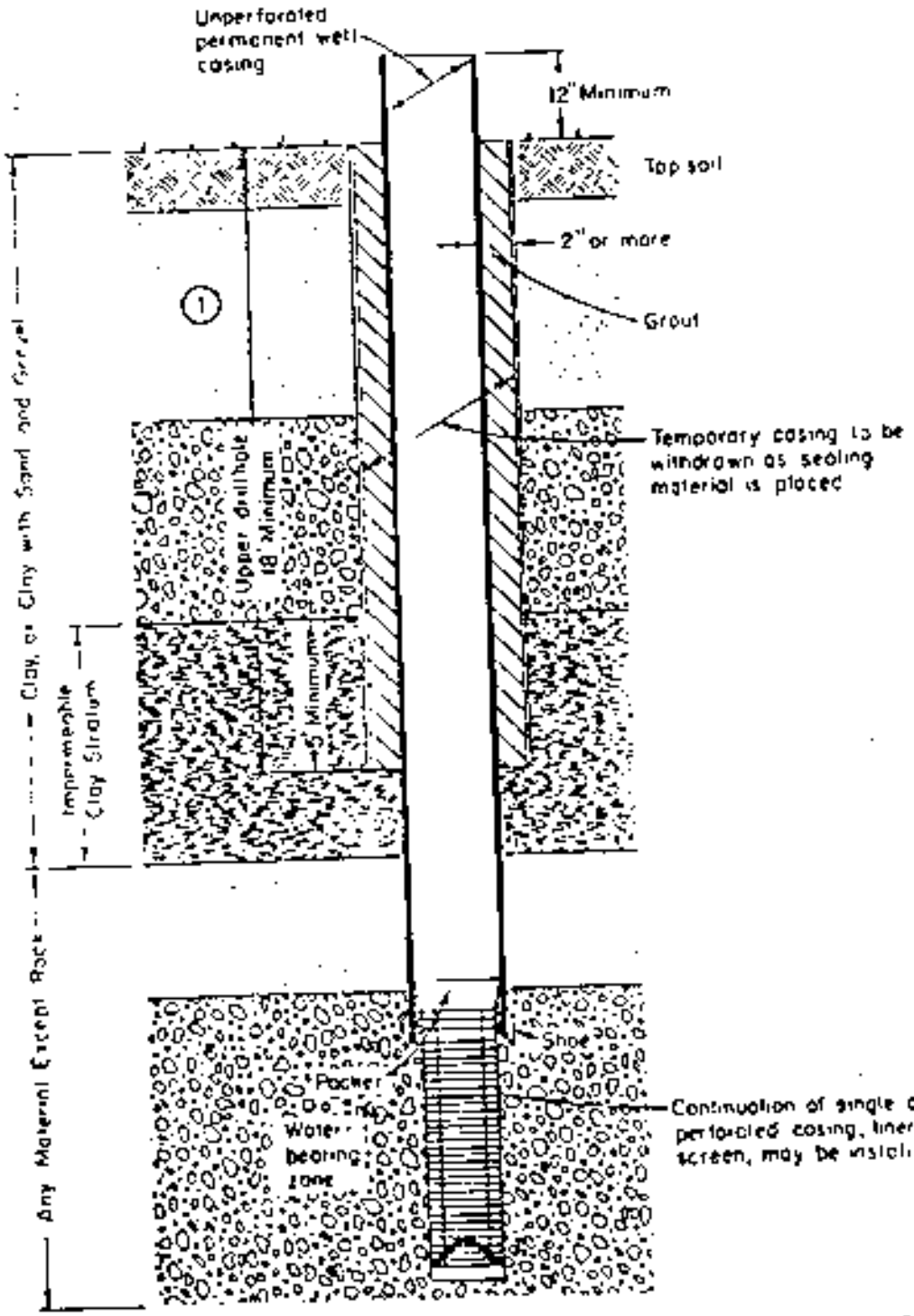
FIGURE 3

SEALING OF DRILLED WELL IN UNCONSOLIDATED FORMATION WITH SIGNIFICANT CLAY BEDS

(690-210-140)

Overlying Material - Clay, or Sand and Gravel with interbedded Clay

Water-bearing formation - Any Material Except Rock

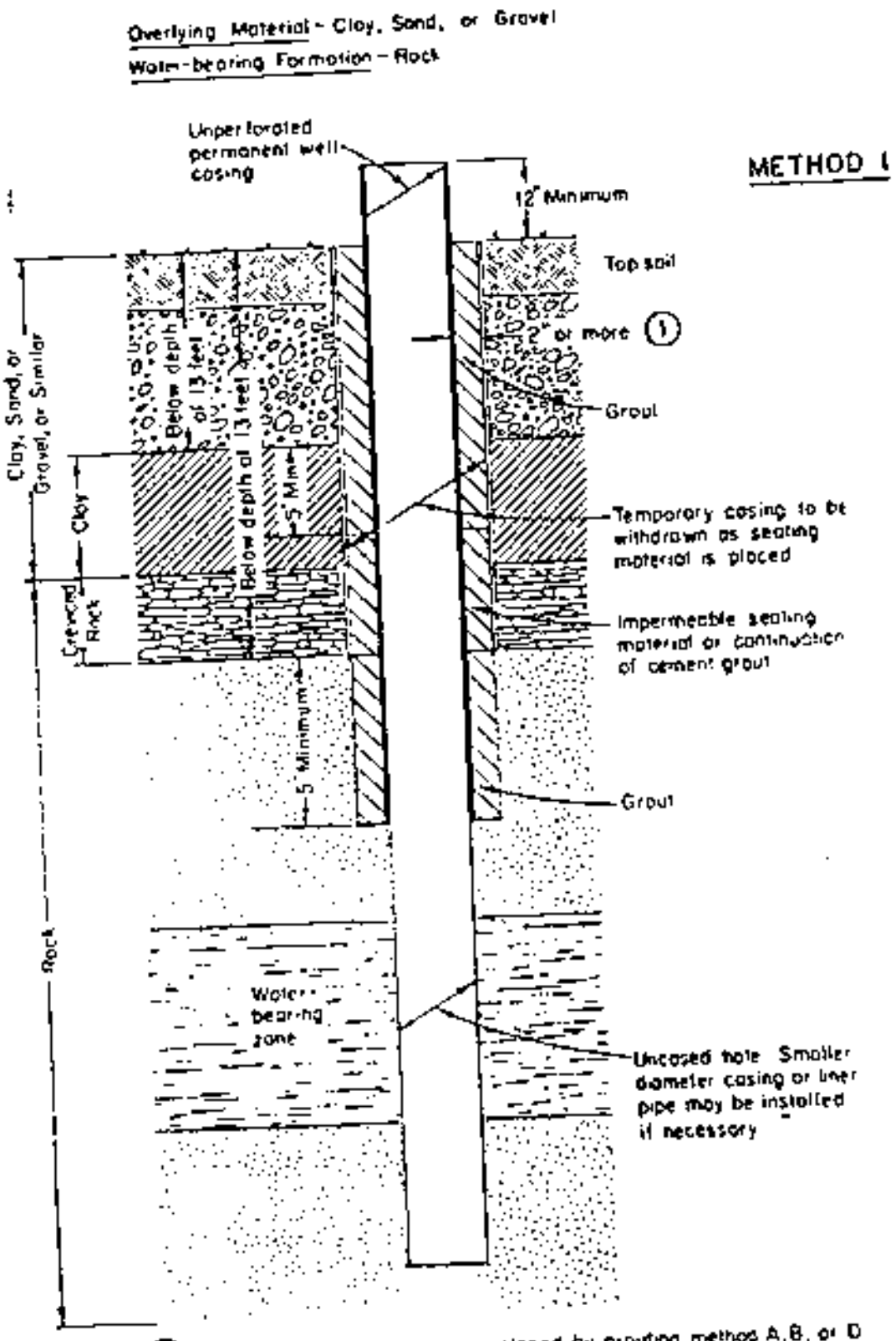


(1) Unperforated well casing and annular seal must extend at least 5 feet into impermeable stratum, and must extend at least 18 feet below land surface

FIGURE 4

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

(690-210-150)



(1) 2" or more if cement grout is placed by grouting methods A, B, or D

FIGURE 5

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

(690-210-150)

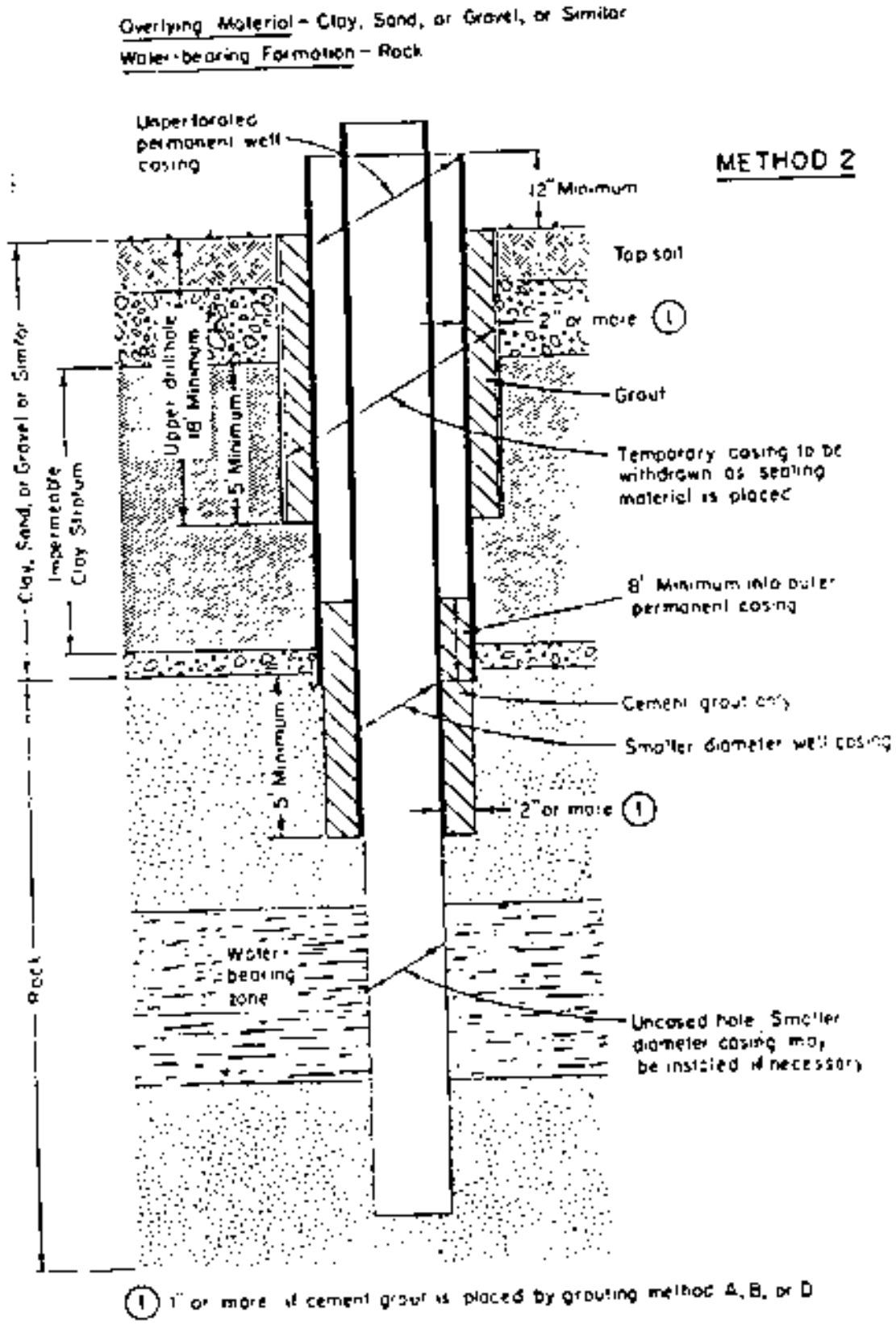


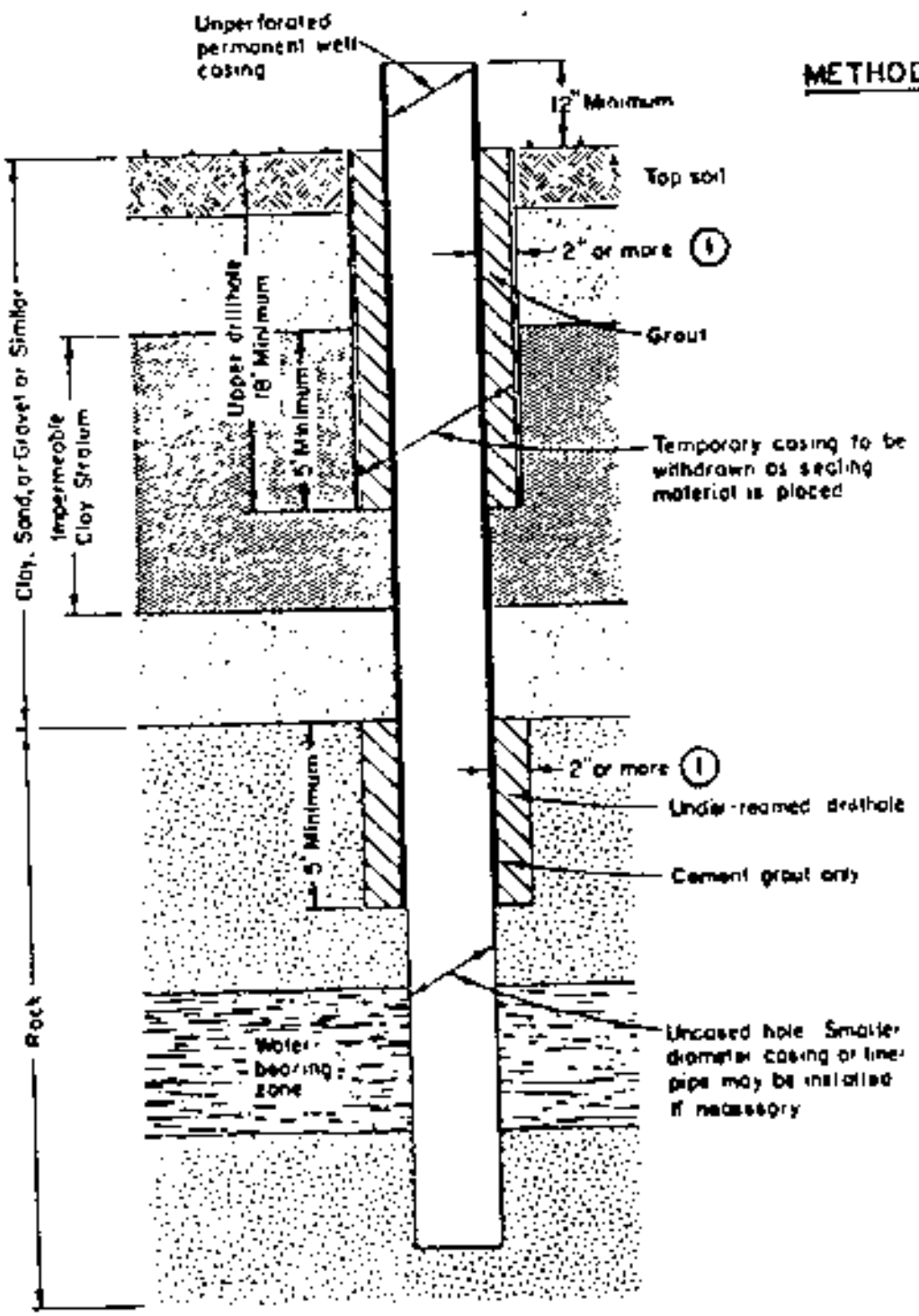
FIGURE 6

SEALING OF A DRILLED WELL IN CONSOLIDATED FORMATION

(690-210-650)

Overlying Material - Clay, Sand, or Gravel or Similar

Water-bearing Formation - Rock



(1) 2" or more if cement grout is placed by grouting method A, B, or D

FIGURE 7

SEALING OF A FILTER PACKED WELL WITH SURFACE CASING

(690-210-160)

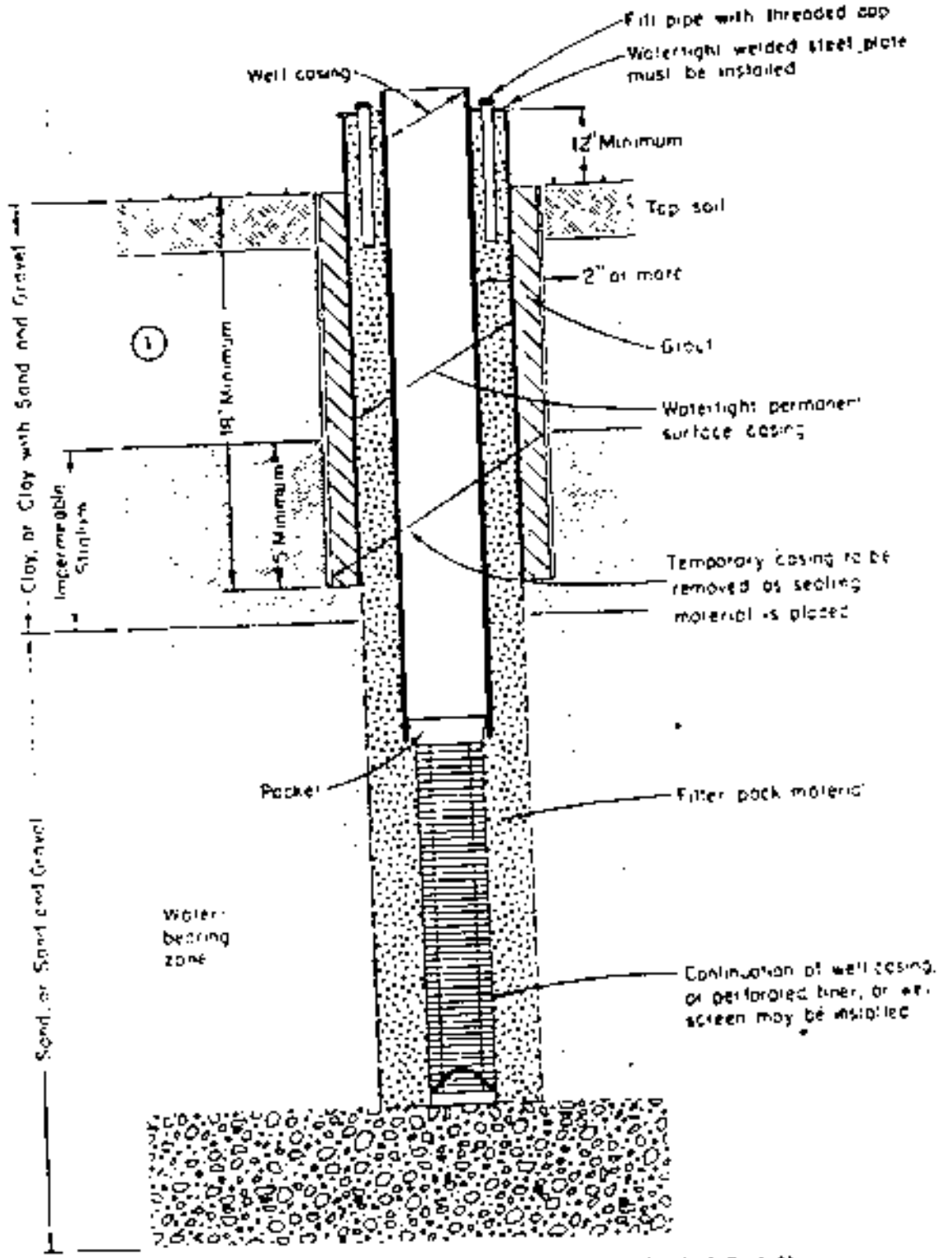


FIGURE 8

SEALING OF A FILTER-PACKED WELL WITHOUT SURFACE CASING

(690-210-170)

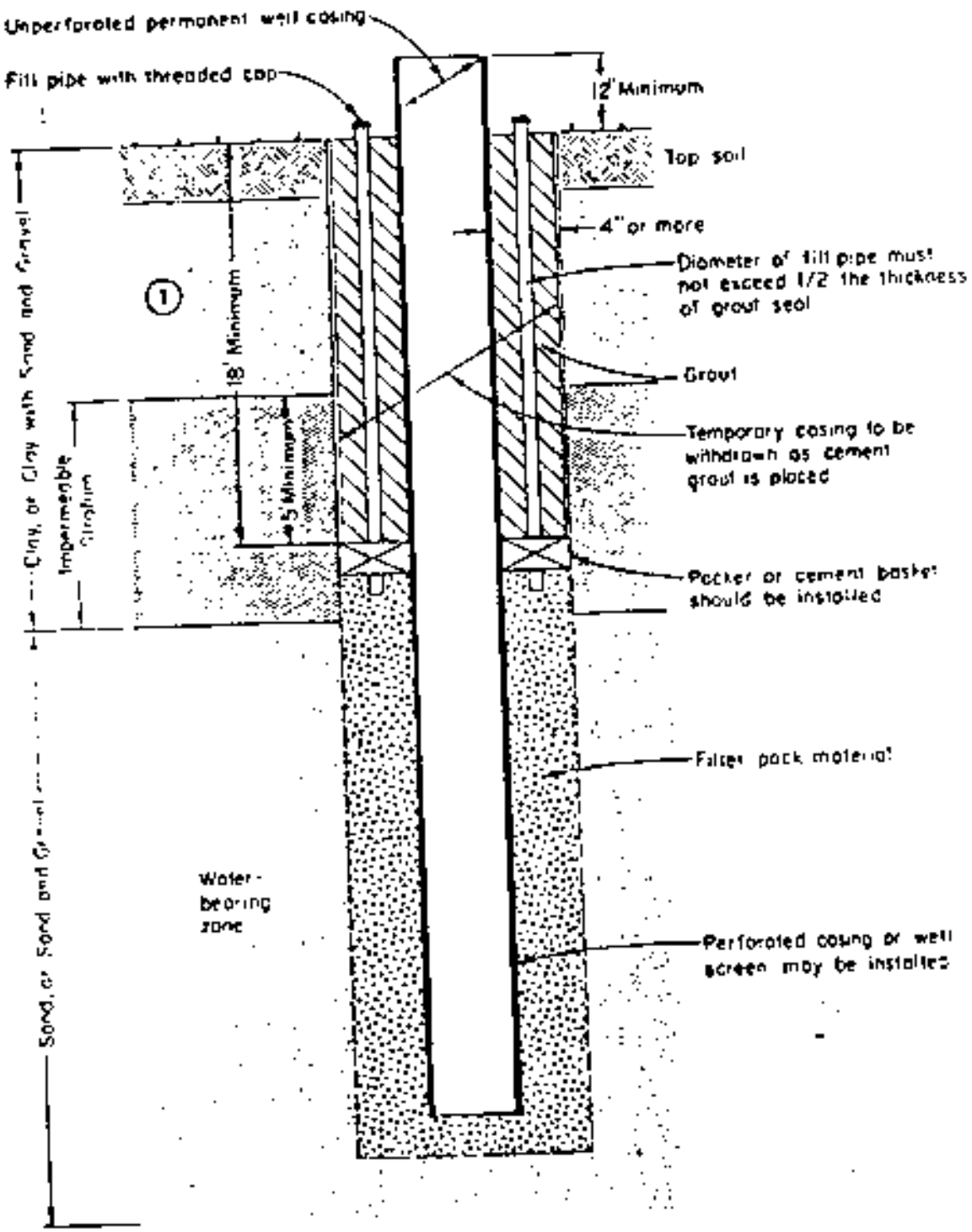
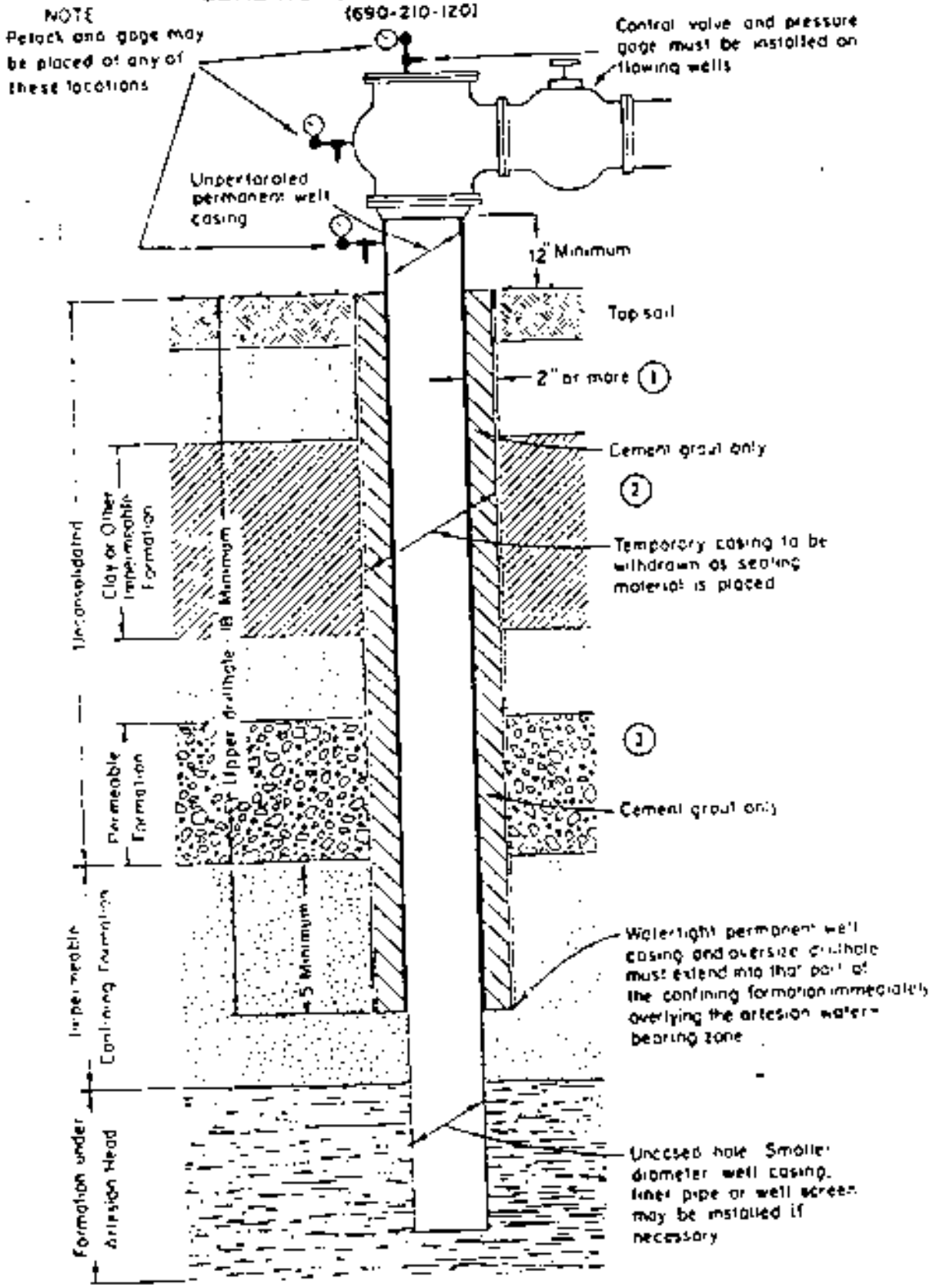


FIGURE 9

SEALING OF AN ARTESIAN WELL

(690-210-120)



(1) 1" or more if cement grout is placed by grouting method A, B, or D

(2) Well must not be constructed in a manner that will allow water from an artesian zone to commingle with other confined or unconfined water bearing zones

(3) Must be completed with the seals, packers, or casing necessary to eliminate subsurface or surface leakage

EXHIBIT 10

SEALING OF A DRIVEN OR JETTED WELL

(690-210-180)

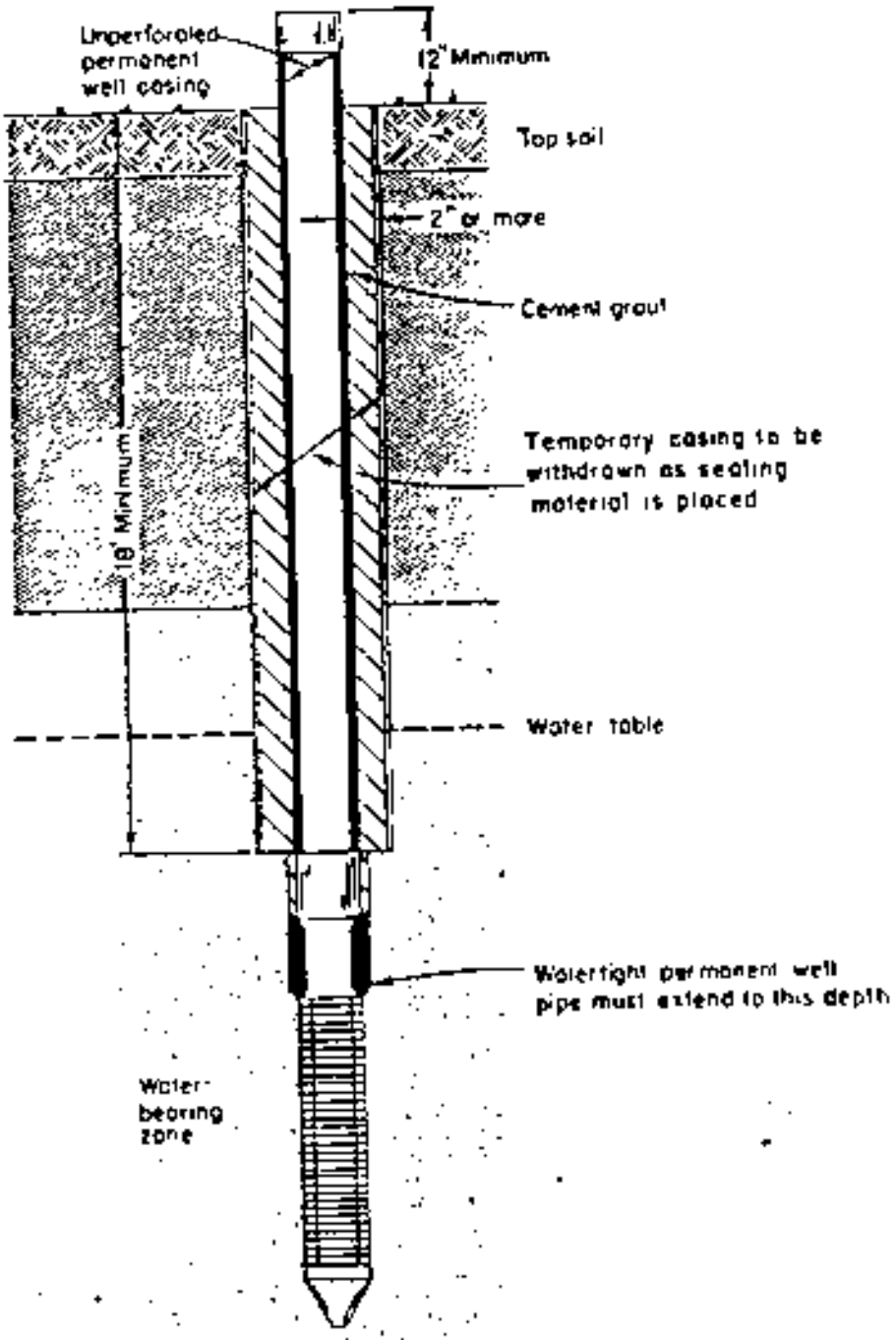


FIGURE 11

SEALING OF DUG WELLS

(690-210-410) (690-210-420)

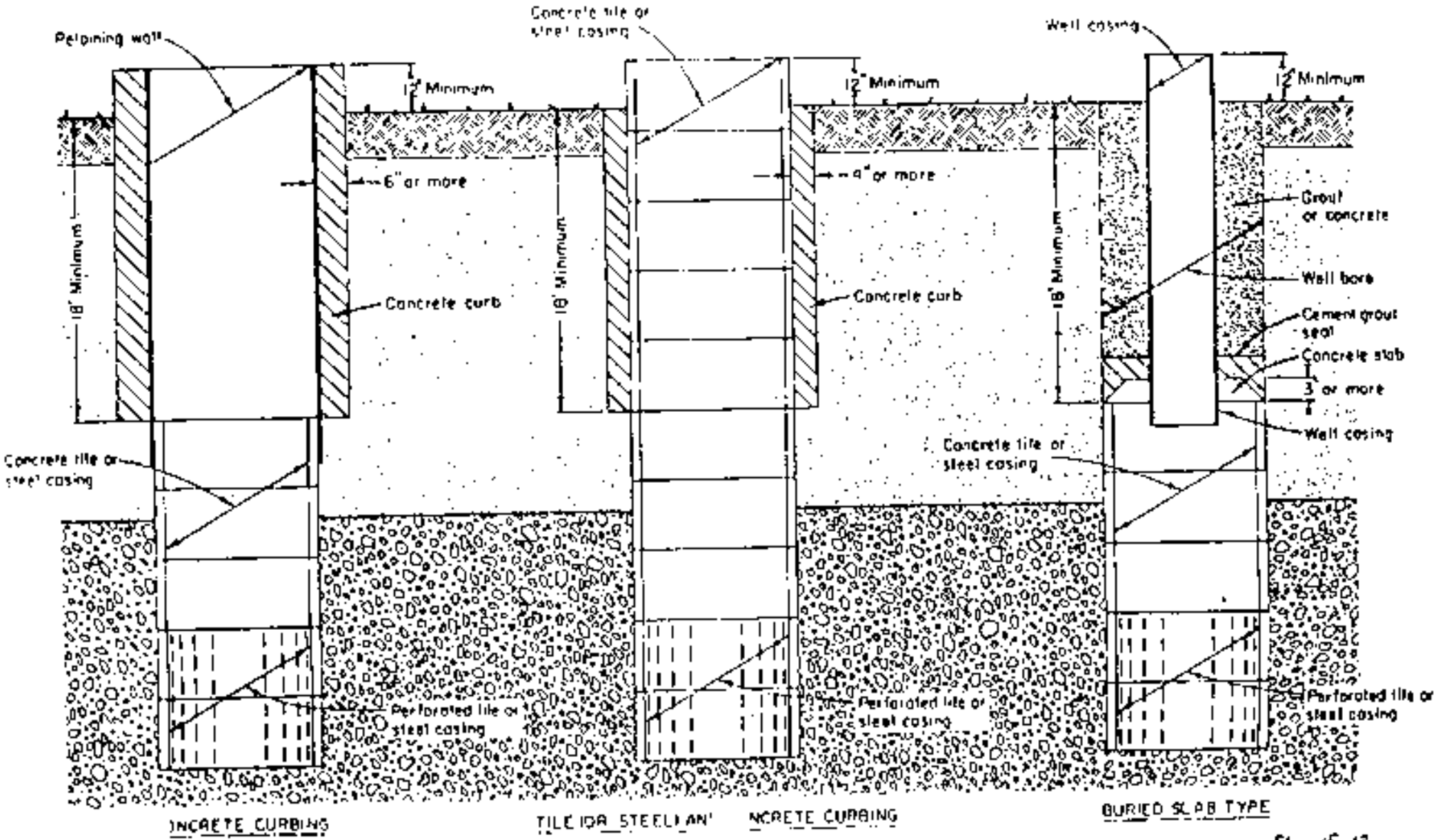
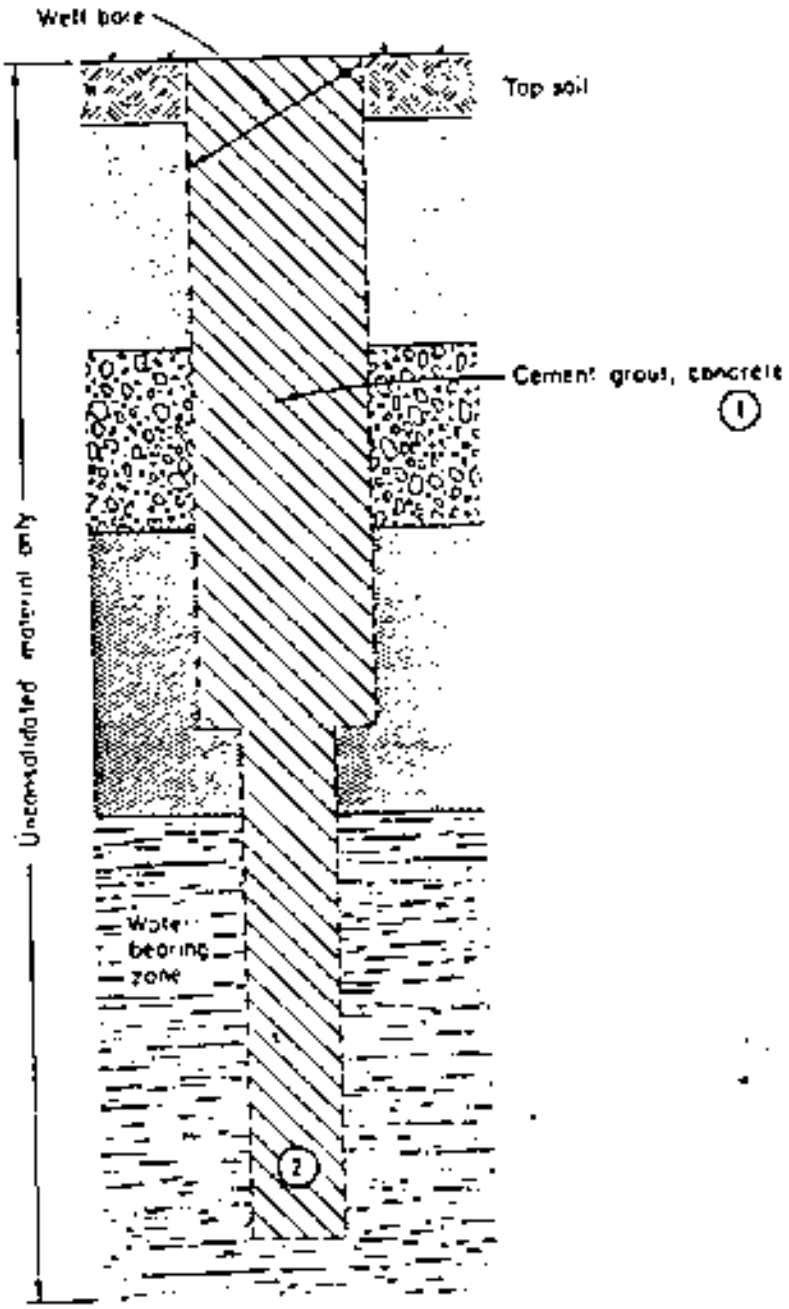


FIGURE 12

ABANDONMENT OF UNCASED WELL IN UNCONSOLIDATED FORMATION

(690-220-040)



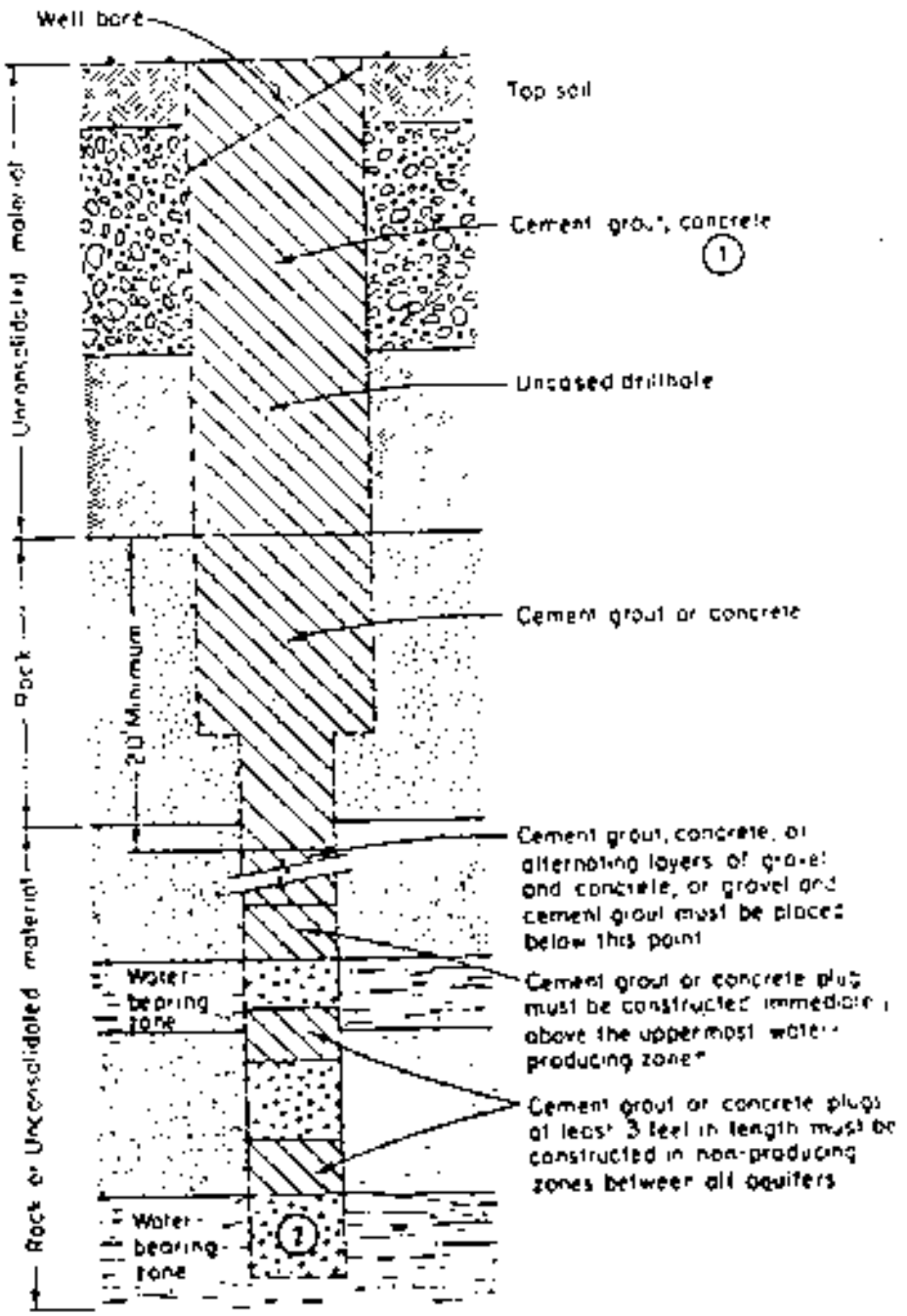
1 In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie, or dump bailer

2 In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward

FIGURE 13

ABANDONMENT OF UNCASED WELL IN CONSOLIDATED FORMATION

(690-220-030)



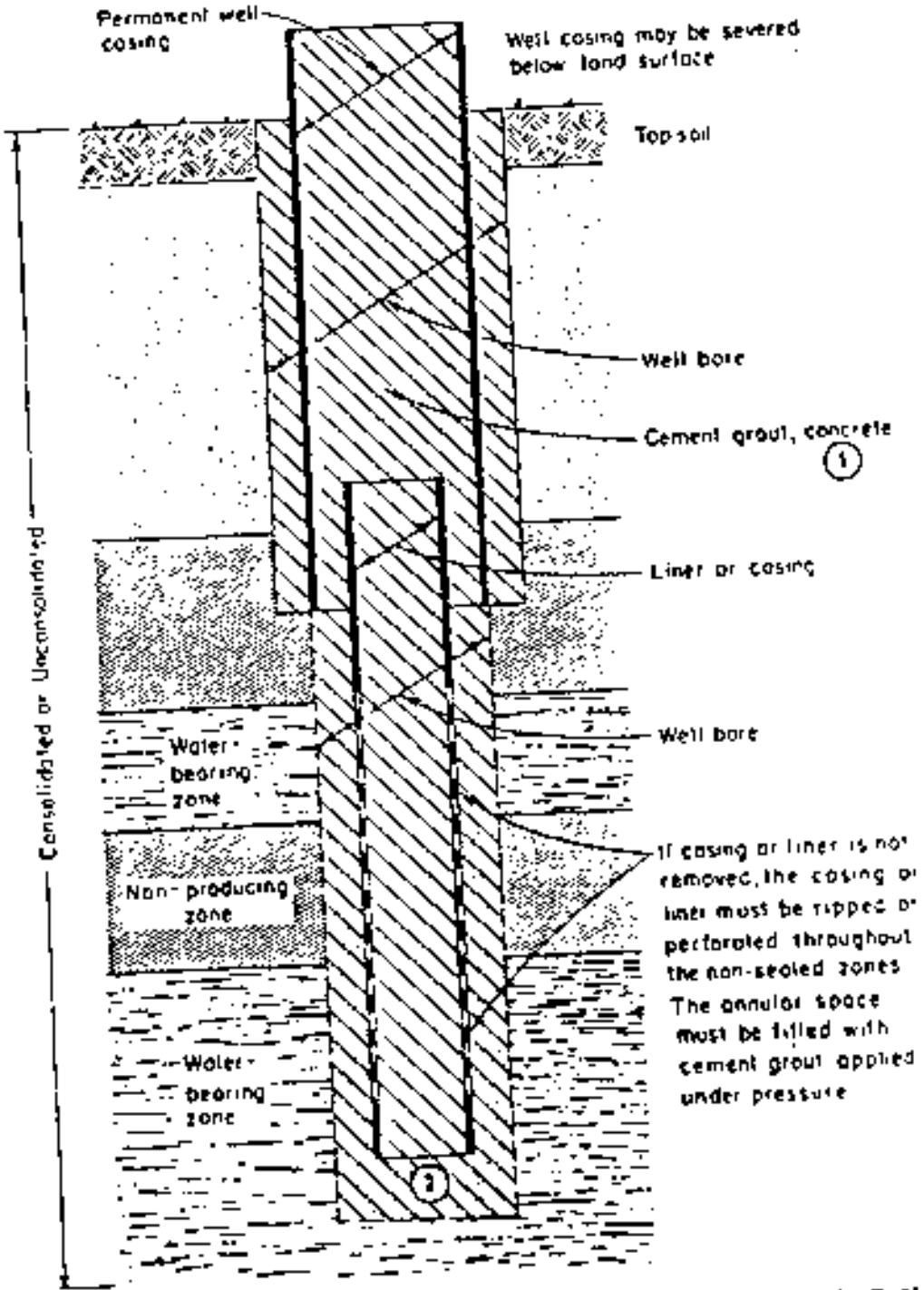
(1) In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie, or dump bailer

(2) In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward

FIGURE 14

ABANDONMENT OF CASED WELL

(690-220-080)

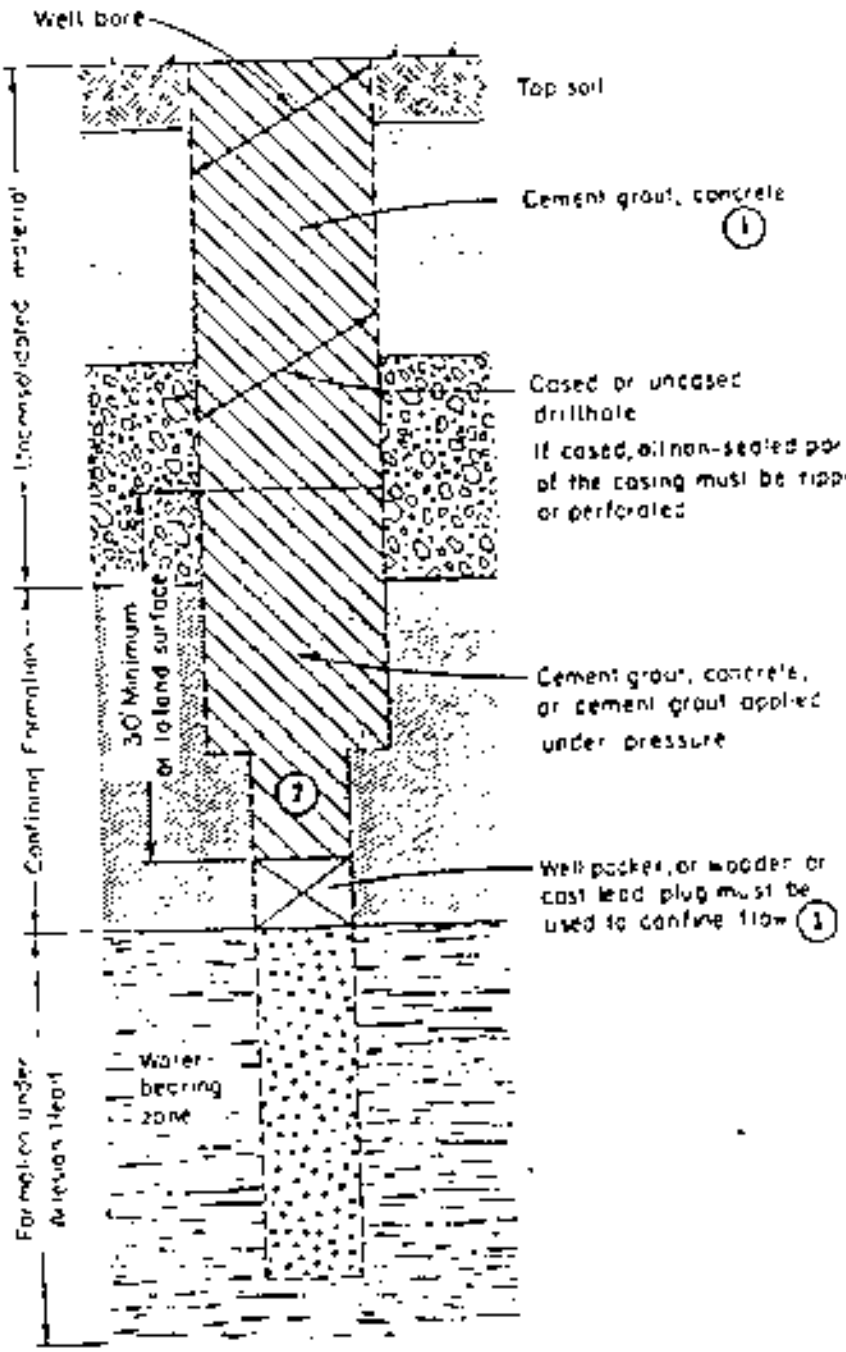


(1) In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie or dump bailer

(2) In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward

FIGURE 15

ABANDONMENT OF ARTESIAN WELL
(690-220-070)



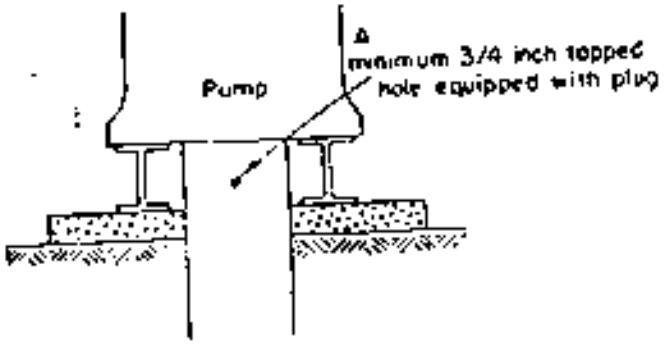
(1) In all wells to be abandoned, cement grout and concrete must be placed by grout pipe, tremie or dump bailer

(2) In all wells to be abandoned, sealing material must be introduced at the bottom of the well and placed progressively upward

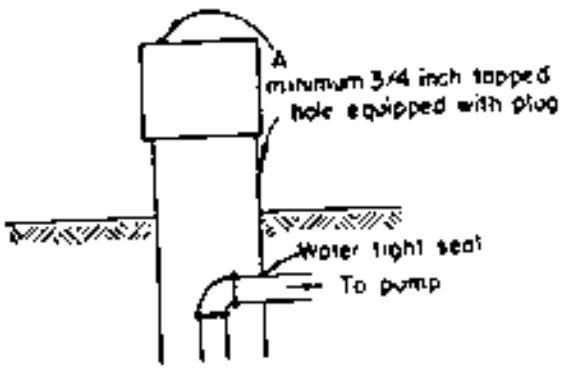
(3) Preshaped or precast plugs should be several times longer than the diameter of the well to prevent tilting

SUGGESTED METHODS OF INSTALLING ACCESS PORTS, PRESSURE GAUGES, AND AIR LINES FOR MEASURING WATER LEVELS IN WELLS

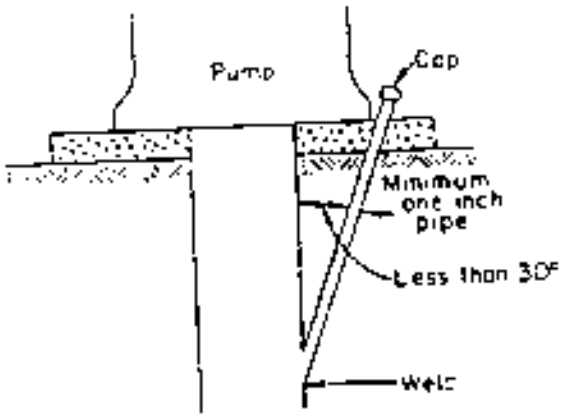
(690-210-280)



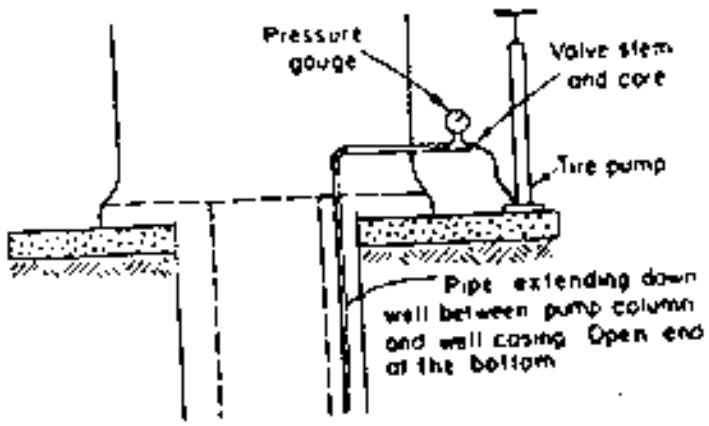
ACCESS PORT FOR MEASURING DEVICE



ACCESS PORT FOR MEASURING DEVICE



ACCESS PORT FOR MEASURING DEVICE

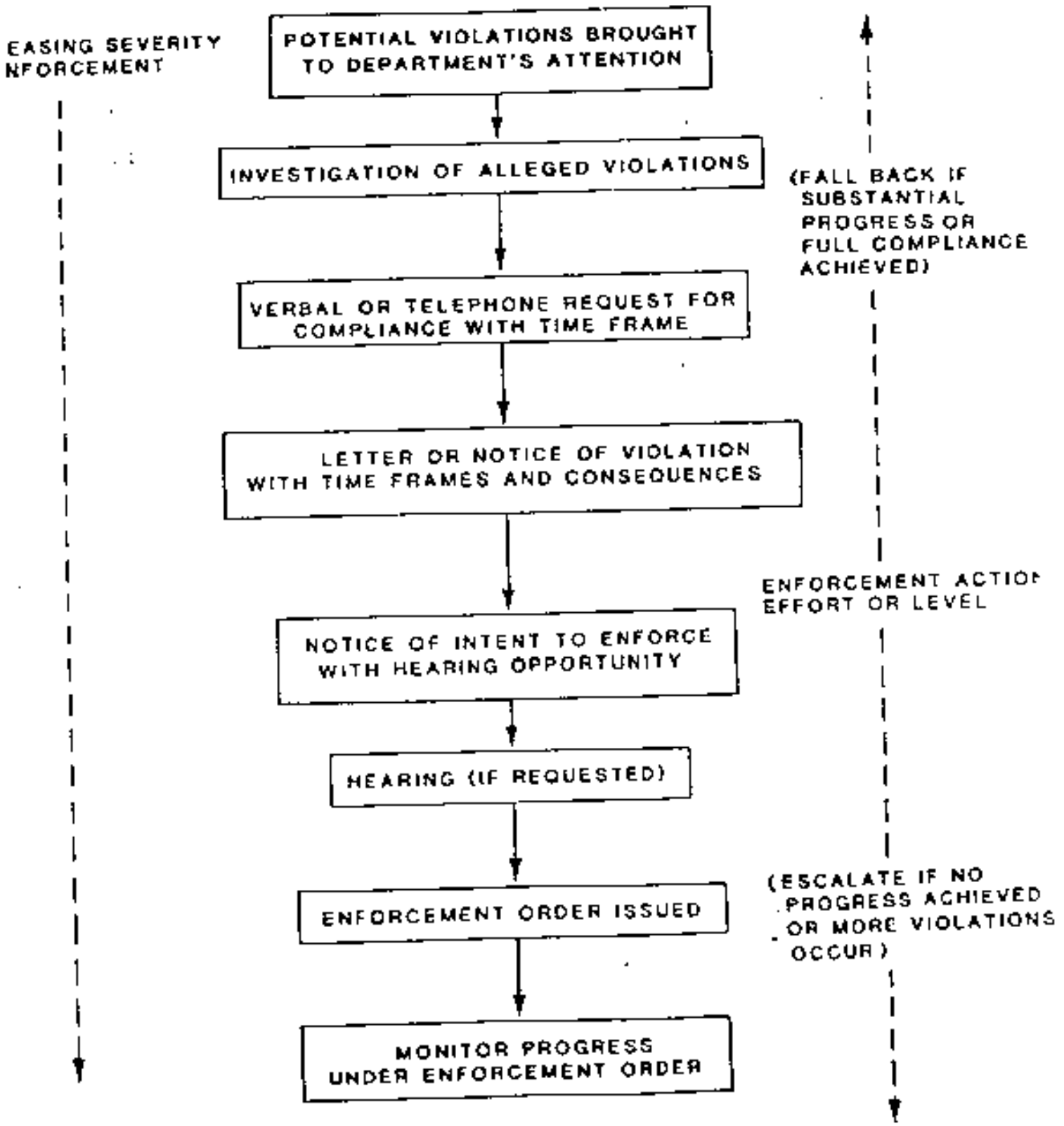


AIR LINE INSTALLATION

An air line installation is recommended where the water level lies at a considerable depth below land surface The amount of air pressure that can be built up inside the air line will be equal to the depth of water standing above the bottom of the air line The exact depth to the bottom of the air line is required to obtain an accurate measurement of the water level in the well One pound per square inch pressure equals 2.31 feet of water

EXAMPLE OF WELL STANDARDS ENFORCEMENT PROCESS

(690-225)



It is desirable to achieve compliance at the lowest possible level of enforcement. Escalation of enforcement can be expected if compliance does not result at the next lower level. Reduction of enforcement effort can be expected if substantial progress towards compliance is achieved.

FIGURE 16

OWRD '86

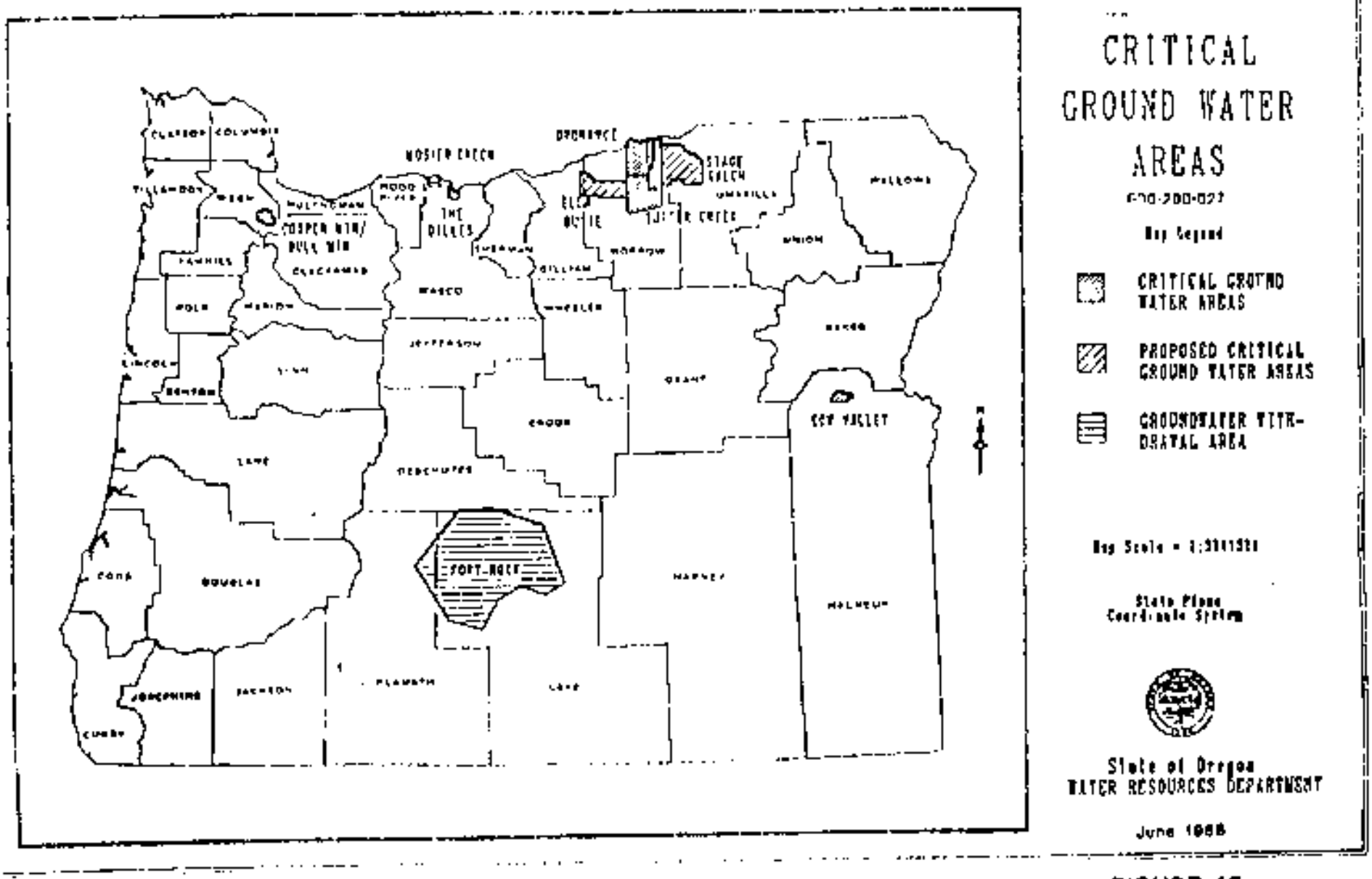

CRITICAL
GROUND WATER
AREAS
Key Legend
CRITICAL GROUND WATER AREAS
PROPOSED CRITICAL GROUND WATER AREAS
GROUNDWATER WITHDRAWAL AREA
Map Scale = 1:3141531
State Plane Coordinate System
State of Oregon
WATER RESOURCES DEPARTMENT
June 1988
FORT ROCK
DESCHUTES
LAKE
HARNEY
MALHEUR
GRANT
WHEELER
JEFFERSON
WASCO
MORROW
UMATILLA
UNION
WALLOWA
BAKER
KLAMATH
JOSEPHINE
JACKSON
CURRY
COOS
DOUGLAS
LINCOLN
BENTON
LINN
POLK
MARION
YAMHILL
CLACKAMAS
TILLAMOOK
CLATSOP
COLUMBIA
HOOD RIVER
THE DALLES
JOHN DAY
PRINEVILLE
STAGE GULCH

FIGURE 19