

Chapter NR 112

WELL CONSTRUCTION AND PUMP INSTALLATION

NR 112.01	Purpose (p. 227)	NR 112.16	Samples and reports (p. 265)
NR 112.02	Applicability (p. 227)	NR 112.17	Pump installation and construction (p. 265)
NR 112.03	Definitions (p. 227)	NR 112.18	Well construction equipment (p. 299)
NR 112.04	Approved comparable construction (p. 234)	NR 112.19	Concrete and grout mixtures (p. 299)
NR 112.05	Existing installations (p. 234)	NR 112.20	Well disposal of pollutants (p. 308)
NR 112.06	Contracts for nonconforming installations (p. 234)	NR 112.21	Abandonment of wells (p. 308)
NR 112.07	Well location (p. 234)	NR 112.22	Cooperation with the department (p. 309)
NR 112.08	Drilled type well design and construction (p. 237)	NR 112.23	Standards for existing installations (p. 309)
NR 112.09	Bored type well design and construction (p. 246)	NR 112.24	Severability (p. 312)
NR 112.10	Driven point type well design and construction (p. 247)	NR 112.26	Well and pump installation approvals (p. 312)
NR 112.11	Dug type well design and construction (p. 250)	NR 112.27	Drinking water standards (p. 316)
NR 112.12	Reconstructing dug type wells (p. 253)		
NR 112.13	Springs (p. 254)		
NR 112.14	Surface protection (p. 256)		
NR 112.15	Miscellaneous well construction and pump installation requirements (p. 262)		

History: Chapter NR 112 as it existed on September 30, 1975 was repealed and a new chapter NR 112 was created effective October 1, 1975.

NR 112.01 Purpose. The purpose of this chapter is to establish uniform minimum standards and methods of procuring and protecting an adequate supply of ground water safe and fit for human consumption and for the preparation of food products through adequate construction or reconstruction of wells and reservoirs, installation of pumping equipment, or other methods approved by the department, in conformity with chs. 144 and 162, Stats. This chapter shall govern the location, construction or reconstruction and maintenance of wells and reservoirs, the installation and maintenance of pumping and treatment equipment, and the supervision of well drillers and pumping equipment installers.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75; am. Register, April, 1978, No. 268, eff. 5-1-78.

NR 112.02 Applicability. The provisions of this chapter shall apply to all new and existing private water supplies, high capacity water systems, school water systems, and public water systems, except those for community water systems serving 15 or more living units.

Note: An approval from the department is required for high capacity water systems, school water systems and sewage treatment plant water systems pursuant to chs. 144 and 162, Wis. Stats., respectively, prior to construction of any well and installation of any pump. See NR 112.26.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75; am. Register, April, 1978, No. 268, eff. 5-1-78; am. Register, September, 1978, No. 273, eff. 10-1-78.

NR 112.03 Definitions. For the purpose of this chapter the following terms are defined as follows:

- (1) "Absorption pond" means an earth structure constructed for the purpose of slow disposal of treated sewage or other liquid wastes by soil seepage.
- (2) "Adequate water supply" means a water supply which has a yield, where obtainable, and the pump capacity to provide the quantity of water which the user has stated is necessary for drinking, culinary, food processing and other purposes for which the water is intended to be used.
- (3) "Animal enclosure" means a fenced yard or similar uncovered structure in which an area of 600 square feet or less is provided for each animal unit contained therein and in which animals are enclosed for any part of at least 30 separate days per year.
- (4) "Animal lot" means a fenced yard or similar uncovered structure in which the concentration of livestock or poultry is such that a vegetative cover is not maintained.
- (5) "Animal shelter" (paved) means a paved covered structure including but not limited to a house or barn in which animals are enclosed for at least any part of 30 separate days per year.
- (6) "Animal shelter" (unpaved) means unpaved covered structures including but not limited to houses or barns in which animals are enclosed for at least any part of 30 separate days per year.
- (7) "Animal unit" means an equivalent of 1,000 pounds of live animal weight.
- (8) "Animal yard" means fenced in dirt or concrete area in which cattle or other livestock or poultry are enclosed and includes animal enclosures, animal lots, and animal shelters defined in NR 112.03 (3), (4) and (5) above.
- (9) "Annular space" means the space between 2 concentric cylinders or circular objects, such as the space between an upper enlarged drillhole and initial protective casing pipe or between the initial protective casing pipe and an outer construction pipe or inner liner pipe or between an inner liner pipe and lower drillhole.
- (10) "Approval" means the written approval of the department.
- (11) "Cistern" means a covered tank in which rainwater from roof drains is stored.
- (12) "Clay slurry" means a fluid mixture of native clay formation or commercial clay or clay mineral products and water prepared with only the amount of water necessary to produce fluidity.
- (12m) "Community water system" means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.
- (13) "Contaminant" means any matter which may render water bacteriologically or chemically impure or turbid so as to make it unfit for human consumption.
- (14) "Clear water waste" means cooling water and condensate drainage from refrigeration compressors and air-conditioning equipment,

waste water drainage from equipment chilling processes, foundation drainage water and other water having no impurities or where impurities are of such minimum concentration as not to be considered harmful and cooled condensate from steam heating systems or other equipment.

(15) "Drainage system" means the piping within public or private premises, which conveys sewage, rainwater or other liquid wastes to the point of disposal, but does not include the mains of a public sewerage system or private or public sewage treatment plant.

(16) "Department" means the department of natural resources.

(17) "Drawdown" means the extent of lowering of the water level or water pressure in a well when water is pumped or flows from it.

(18) "Lower drillhole" means that part of a drillhole below the vertical zone of contamination.

(19) "Upper drillhole" means that part of the cased drillhole, augerhole or excavation constructed through the vertical zone of contamination.

(20) "Upper enlarged drillhole" means that portion of upper drillhole, larger in diameter than the protective well casing and extending through all or part of the vertical zone of contamination.

(20m) "Drinking water standards" means those standards listed in chapter NR 109, Wis. Adm. Code.

(21) "Driven point well" means a well constructed by joining a "drive point" with a length of pipe, extended as may be necessary, and driving the assembly into the ground, without a preliminary excavation in excess of 10 feet in depth. All other types of wells, including those constructed by a combination of jetting and driving, are drilled type wells.

(22) "Established grade" means the permanent point of contact of the ground or artificial surface with the casing pipe or curbing of the well.

(23) "Established ground surface" means the permanent elevation of the surface of the site of the well.

(24) "Existing installations" means those made prior to April 10, 1953.

(25) "Regional flood" means a flood determined by the department to be representative of large floods known to have generally occurred in Wisconsin and which may be expected to occur on a particular stream because of like physical characteristics. The regional flood generally has an average frequency of the 100-year recurrence interval flood.

(26) "Flood plain", for the purpose of this chapter, means the land adjacent to a body of water which has been or may be hereafter covered by the regional flood.

(27) "Floodway", for the purpose of this chapter, means the channel of a stream and those portions of the flood plain adjoining the channel that are required to carry and discharge the flood waters or flood flows of any river or stream associated with the regional flood.

(28) "Flushing" means the act of causing a rapid flow of water from a well by pumping, bailing or similar operation.

(29) "Grease basin" means a watertight tank installed underground for the collection and retention of grease from cooking or food processing and which is accessible for periodic removal of the contents.

(30) "Ground water" means that part of subsurface water which is in the zone of saturation.

(30m) "High capacity water supply or system" means one where new and existing wells to be constructed, reconstructed, rehabilitated, installed or operated on one property whose operating capacity singly or in the aggregate with that of other wells on the property will be in excess of 70 gallons per minute.

(31) "Holding tank" means a watertight receptacle approved by the department of health and social services for the retention of sewage.

(33) "Liner pipe" means either protective well casing pipe installed subsequent to initial construction to seal off a zone of bacterial or chemical contamination or casing pipe installed during or subsequent to the initial well construction to seal off a caving formation.

(34) "Liquid manure holding tank" means a completely fabricated structure with or without a cover either formed in place or transported to the site, used for containing animal wastes consisting of excreta, leachings, feed losses, litter, washwaters or other associated wastes.

(34m) "Living unit" means a domicile.

(35) "Near-surface water" means water in the zone immediately below the ground surface. It may include seepage from barnyards, leaching pools and disposal beds or leakage from sewers, drains and similar sources of contaminated water.

(35a) "Non-community water supply system" means a public water system that is not a community water system.

(35m) "One property" means all contiguous lands controlled by one owner, lessee, or any other person having a possessory interest. For the purposes of this chapter, lands under single ownership bisected by highways or railroad right-of-ways are considered contiguous.

(36) "Permit" means a written approval issued by the department.

(37) "Preparation of food products" means washing, cooling, cooking, pasteurizing, bottling, canning, or otherwise preparing food for human consumption, and including the washing of utensils and equipment used in production or preparation of food.

(38) "Private water supply" means one or more sources of ground water, including facilities for storage and conveyance thereof, such as wells, springs, pumps, pressure tanks and reservoirs, on one property, other than those serving a public water system.

(39) "Privy" means a building structure used for the deposition of human body wastes.

(40) "Protective well casing" means pipe meeting standards specified in NR 112.08(2), which is driven or set to seal off the vertical zone of contamination.

(40m) "Public water system" means a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. A public water system is either a "community water system" or a "non-community water system". Such system includes:

(a) Any collection, treatment, storage and distribution facilities under control of the operator of such system and used primarily in connection with such system, and

(b) Any collection or pretreatment storage facilities not under such control which are used primarily in connection with such system.

(41) "Pump installer" means any person, firm or corporation who is duly registered as such with the department, has paid the annual registration fee and has obtained a permit to engage in pump installing.

(42) "Pumping water level" means the elevation of the surface of the water in a well or water pressure at the top of a flowing artesian well after a period of pumping or flow at the customary rate.

(43) "Retention pond" means an excavated or diked structure or combination of structures designed for interception and temporary storage of runoff water contaminated by leachings, washwaters or similar liquid wastes on farms or on other property where cattle or other livestock are raised.

(44) "Reservoir" means a facility for storage of water for drinking or culinary purposes constructed entirely or partially below the ground surface.

(45) "Safe water" means water that is free from contaminating matter.

(46) "Sanitary condition" (a) When referring to a well or reservoir means that the construction of the well or reservoir and the installation of the pumping equipment are such that the well or reservoir is effectively protected against entrance of contaminating matter.

(b) When referring to the surroundings of a well or reservoir means that the location and the surrounding area are free from debris or filth of any character and not subject to flooding.

(46m) "School water supply or system" means a water system serving an educational institution.

(47) "Seepage bed" means an excavated area similar to a seepage trench but larger than 3 feet in width and containing more than one distribution line.

(48) "Seepage pit" means an underground receptacle so constructed as to permit disposal of septic tank effluent, milkhouse washwater, silage juices, clear water wastes and similar wastes by soil absorption through its walls and bottoms.

(49) "Seepage trench" means an area excavated 3 feet or less in width which contains a bedding of aggregate and a single distribution line.

(50) "Septic tank" means a watertight tank which receives sewage.

(51) "Sewage" means any water carried wastes created in and conducted away from residences, industrial establishments and public buildings with such surface or ground water as may be present and for the purpose of these rules includes any other liquid wastes except clear water wastes.

(51m) "Sewage treatment plant water supply or system" means a self-supplied water system for a sewage treatment plant for drinking, toilet, laboratory, showers, eye wash fountains, plant wash-down and sewage disinfection purposes.

(52) "Sewer" means any conduit used or intended to be used for conveying sewage.

(53) "Sanitary building sewer" means that part of the plumbing system beginning at the immediate outside foundation or proposed foundation wall and extending to its connection with the main of a public sewer, private sewer, private sewage disposal system or other point of disposal.

(54) "Sanitary building drain" means the lowest horizontal piping of a drainage system which receives the discharge from soil, waste and other drainage pipes inside any building and conveys same to the building sewer by gravity flow. The minimum building drain extends from the building sewer to all soil stacks.

(55) "Sanitary building subdrain" means the horizontal portion of a drainage system within a building which cannot flow by gravity to the building drain.

(56) "Solid manure storage structure" means a structure used for stacking or composting and containment of animal wastes consisting of excreta, feed losses, litter or associated soild wastes.

(57) "Specific capacity" means the continuous yield of a well at a given well water or pressure drawdown expressed in gallons per minute, per foot of drawdown.

(58) "Static water level" means that elevation of the surface of the water in a well or water pressure at the top of a well, in the case of some artesian wells, when no water is being pumped or flows therefrom. In the case of artesian wells with a positive water pressure at the top of the well, the static water elevation is determined either by a stilling pipe or pressure gauge and under either condition water elevations are referred to the elevation of the top of the well or the ground grade at the well.

(59) "Storm sewer" means any conduit used or intended to be used for conveying surface water runoff, clear water waste and subsoil drainage with such ground water as may be present.

(60) "Storm building sewer" means that part of the storm water system which receives the discharge from building storm drains and subdrains, parking lots, yard fountains and other similar sources, and conveys such waters to a public storm water system, private storm water system or other approved point of disposal.

(61) "Storm building drain" means the lowest horizontal piping which receives storm waters or other similar water from roofs, area ways, courtyards, canopies, enclosed parking ramps and other sources inside any building or structure and conveys same to the storm building sewer by gravity flow.

(62) "Storage pond" means an excavated or diked earthen structure including partially fabricated liquid manure holding tanks designed for containing animal wastes consisting of excreta, leachings, feed losses, litter, washwaters or other associated liquid wastes.

(63) "Stuffing box" means an approved receptacle in which packing may be compressed to form a watertight or airtight junction between 2 objects.

(64) "Subsoil drain" means that part of the drainage system which conveys the ground or seepage water from the footings of walls or below the basement floor under buildings to the storm sewer or other point of disposal.

(65) "Sump" means a tank or pit which receives sewage or other liquid wastes located below the normal grade of a gravity system and which must be emptied by mechanical means.

(66) "Treatment pond" means an earth structure with sealed bottom and walls constructed for the purpose of holding sewage or other liquid waste for a period of time to reduce BOD and suspended solids.

(67) "Vertical zone of contamination" means that depth of geologic formations, generally near the ground surface, containing connecting pore spaces, crevices or similar openings, including artificial channels, such as unprotected wells, through which contaminated water may gain access to a well or the ground water body.

(68) "Watertight construction" means cased and grouted construction through firm formations like clay or rock. Through granular material like sand or gravel, it means that the casing pipe is of approved quality and assembled watertight.

(69) "Well" means an excavation or opening into the ground made by digging, boring, drilling, driving or other methods for the purpose of obtaining ground water for human consumption.

(70) "Well cap" means an approved removable non-watertight apparatus or device used to cover a well.

(71) "Well driller" means any person, firm or corporation who has duly registered as such with the department, has paid the annual registration fee and has obtained a permit to construct wells.

(72) "Well seal" means an approved removable apparatus or device used as follows:

(a) To close the well opening watertight or to establish and maintain a watertight junction between the upper terminal of protective casing or curbing of a well and the piping or equipment installed therein, so as to prevent water from entering the well; or

NR 112

(b) To establish and maintain a watertight junction between the basement end of non-pressure pipe conduit, installed between a well and a building basement, and the pump piping installed within the conduit.

(73) "Well vent" means an outlet at the upper end of the well casing or basement end of a non-pressure conduit to allow equalization of air pressure in the well.

(74) "Yield" means the quantity of water which may flow or be pumped from the well per unit of time.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75; renum. (55) to (73) to be (56) to (74), cr. (55), Register, March, 1977, No. 255, eff. 4-1-77; cr. (12m), (20m), (30m), (34m), (35a), (35m), (40m), (46m) and (51m), am. (38) and r. (32), Register, April, 1978, No. 268, eff. 5-1-78.

NR 112.04 Approved comparable construction. When strict compliance with this chapter appears to be impracticable, the reasons therefor shall be communicated in writing to the department for advice and approval of comparable specifications.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75.

NR 112.05 Existing installations. Existing well, pump, pressure tank, pit, subsurface pumphoom and reservoir installations that conform to section NR 112.23 are acceptable. Noncomplying existing well, pump, pressure tank, pit, subsurface pumphoom and reservoir installations shall be corrected to comply with NR 112.23 or the specifications in this chapter for new construction.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75.

NR 112.06 Contracts for nonconforming installations. Well drillers and pump installers shall ensure that the construction and reconstruction of wells or appurtenances thereto or the installation of pumping equipment adheres to all the applicable provisions of this chapter or to approved comparable requirements. Well drillers and pump installers shall not enter into any agreement, written or oral, for such construction, reconstruction or installation which does not require compliance with all applicable provisions of this chapter or with approved comparable requirement.

History: Cr. Register, June, 1975, No. 234, eff. 10-1-75.

NR 112.07 Well location. (1) **GENERAL.** Where a well is constructed to supply ground water for human consumption and preparation of food products, such well shall be located:

(a) In such manner that the well and its surroundings can be kept in a sanitary condition.

(b) At the highest point on the premises consistent with the general layout and surroundings, but in any case protected against surface water flow and flooding.

(c) As far removed from any known or probable source of contamination as the general layout of the premises and the surroundings permit.

(2) **RELATION TO CONTAMINATION SOURCES.** Unless modified by written department approval under NR 112.04, minimum separating distances

between wells or reservoirs and sources of contamination shall be maintained as follows:

(a) Eight feet between well or reservoir and cast iron or equivalent sanitary or storm building sewer or sanitary or storm building drain or a basement floor drain connected to a cast iron or equivalent sanitary building sewer or sanitary building drain; cast iron or equivalent sub-drain; cast iron or equivalent sewage sump; cast iron or equivalent milkhouse floor drain; cast iron or equivalent drain from a conventional silo or glass lined storage facility, cast iron or equivalent sewer conducting manure juices to point of disposal.

(b) Ten feet between well and independent clear water waste drain, rainwater downspout outlet, cistern, hydrant drain, or similar unit; building foundation-drain connected to independent clear water waste drain or other subsoil drain; nonconforming existing or unapproved new well pit, pump pit, pressure-tank pit, pressure-tank access pit or subsurface pumproom; nonconforming reservoir except that for school water systems, high capacity water systems and sewage treatment plant water systems there shall be a minimum separating distance of 20 feet between a well or reservoir and a well pit, pump pit, pressure-tank pit, pressure-tank access pit, or subsurface pumproom.

(c) Fifteen feet between well and sewer-connected foundation drain.

(d) Twenty-five feet between well or reservoir and watertight grease basin, septic tank, holding tank, subdrain other than cast iron or equivalent pipe; sewage sump other than cast iron or equivalent material; sanitary building or storm building sewer other than cast iron or equivalent material; sanitary building or storm building drain other than cast iron or equivalent material; floor drain connected to sanitary building sewer or drain of other than cast iron or equivalent pipe material; lake or stream shoreline; below-ground swimming pool except that for school water systems and high capacity water systems the minimum separating distance between a well and a lake or stream shoreline shall be 60 feet.

(e) Twenty-five feet between well or reservoir and watertight barn gutter; animal barn pen with concrete floor; glass-lined storage facility without pit; conventional silo without pit but with concrete floor and proper drain; watertight, milkhouse floor drain other than cast iron or equivalent material; watertight, conventional silo drain or glass-lined storage facility drain other than cast iron or equivalent material; watertight sewer other than cast iron or equivalent material conveying manure juices.

(f) Twenty-five feet between well or reservoir and a pressurized sewer, other than a street sanitary or storm sewer or similar sanitary or storm sewer piping comprising part of the drainage system on public or private property, for which the required minimum separating distance between a well or reservoir and such sewers is specified in NR 112.07 (2) (h).

(g) Fifty feet between well or reservoir and seepage pit, seepage bed, seepage trench or other similar sewage or waste water disposal unit; privy; pet-waste pit disposal unit; animal yard, animal shelter, animal enclosure or animal lot; conventional silo with pit; glass-lined storage

facility with pit; outlet of watertight milkhouse drain; seepage pit for drain of conventional silo or glass-lined storage facility; loose-jointed field-drain pipe lines except that for school water supply systems, there shall be a minimum separating distance of 200 feet between a well or reservoir and seepage pit, seepage bed, seepage trench or similar sewage or waste water disposal unit.

(h) Fifty feet between well or reservoir and street sanitary or storm sewer; similar sanitary or storm sewer piping comprising part of the drainage system on public or private property except that for sewage treatment plant wells, there shall be a minimum separating distance of 150 feet between a well or reservoir and a gravity or pressurized collector, branch or trunk sewer.

(i) One hundred feet between well or reservoir and a temporary manure stack; solid manure storage structure; watertight reinforced poured concrete or equivalent concrete fabricated liquid-manure holding tank; earthen silage storage trench or pit.

(j) One hundred feet between well or reservoir and bulk subsurface storage tanks for refined petroleum products such as gasoline and fuel oil, except in the case of fuel oil tanks for private residential use, in which case the separating distance shall be at least 25 feet or farther where practical.

(k) One hundred feet between well or reservoir and nearest existing or future grave sites in cemeteries.

(l) One hundred and fifty feet between well or reservoir and sewage treatment plant structures.

(m) Two hundred feet between well or reservoir and sludge disposal area on same property or adjoining property.

(n) Two hundred fifty feet between well or reservoir and an absorption, storage, retention or treatment pond; ridge and furrow waste disposal site; or a spray irrigation waste disposal site.

(o) Four hundred yards between well or reservoir and the nearest edge of an existing or proposed sanitary land fill disposal site.

(p) For the purpose of section NR 112.07 (2) (a), (d) and (e), the term "equivalent" means, as it pertains to a cast iron sewer, drain or subdrain, approved plastic pipe as listed and limited in Wis. Adm. Code chapter H 62 (State Plumbing Code) for specific uses and as it pertains to a sewage sump, a plastic sump fabricated from a plastic material approved by the division of health, department of health and social services.

(3) **RELATION TO BUILDINGS.** With respect to buildings the location of a well shall be as follows:

(a) When a well is located outside and adjacent to a building, it shall be located so that the center line of the well extended vertically will clear any projection from the building by not less than 2 feet.

(b) Every well shall be located so that it will be reasonably accessible with proper equipment for cleaning, treatment, repair, test, inspection, and such other maintenance as may be necessary.

(c) No well shall be located nor shall a building extension be constructed so that the top of the well will be within the basement of any building or building extension or under a building or building extension having no basement.

(4) **RELATION TO FLOOD PLAINS.** (a) Wells may be constructed and replaced on property on the flood plain outside of the floodway provided that the top of the well is terminated a minimum of 2 feet above the regional flood elevation for the well site.

(Note: This is the required minimum elevation of the first floor of any new building in the flood plain.)

(b) A well may be reconstructed or replaced on property in a floodway provided that a permit is first obtained from the department.

(c) No well may be constructed on floodway property that is either undeveloped or has building structures but no existing well.

Note: Attention of well drillers and pump installers is called to Volume I, of the Wisconsin State Electrical Code which can be found in Volume 4 of the Wisconsin Administrative Code, for restrictions on proximate locations of well drilling and pump installing equipment relative to electric power lines.

History: Cr. Register, May, 1975, No. 233, eff. 5-1-75; am. (2) (a), (b), (d) and (e), renun. (2) (f) to (m) to be (2) (g) to (n), cr. (2) (f) and (o), Register, March, 1977, No. 255, eff. 4-1-77; am. (2) (b), (d), (g), (h) and (j), renun. (2) (l) thru (o) to be (2) (m) thru (p), cr. (2) (l), Register, April, 1978, No. 268, eff. 5-1-78.

NR 112.08 Drilled type well design and construction. (1) **GENERAL.** The construction of every well shall be planned and carried out so that it will be:

(a) Adapted to the geologic (earth structure) and ground water conditions existing at the site of the well so as to insure full utilization of every natural protection afforded thereby against contamination of water bearing formations and to exclude known sources of contamination.

(b) Designed to permit such supplementary construction as may be required to provide a sufficient and safe water supply, where obtainable, and to conserve ground water.

(c) Capable of satisfying where obtainable, the yield requirements of an "adequate water supply".

(2) **SPECIFIC.** The requirements of NR 112.08 (1) for drilled-type wells for low capacity supplies, including community systems serving less than 15 living units and non-community systems, but excluding schools, shall be deemed to be fulfilled when minimum construction and material requirements set forth in table 1 and in paragraphs (a) through (i) below are met, and for high capacity water systems and school water systems when minimum construction and material requirements of table 3 and also paragraphs (a) through (i) are met, except for sewage treatment plant water systems, a minimum of 100 feet of well casing pipe shall be installed. (Note: See appendix figures A1 through A25 for low capacity water supply standards required by table 1.)

TABLE I
DRILLED TYPE WELL REQUIREMENTS

1 TYPE	2 NATURE OF WATER BEARING FORMATION (AQUIFER)	3 GEOLOGIC FORMATIONS OVERLYING AQUIFER	4 MINIMUM NOMINAL CASING DIAMETER INCHES	UPPER DRILLHOLE				9 LOWER DRILLHOLE MINIMUM WELL DIAMETER	10 MAXIMUM PROTECTIVE LINER DIAMETER	11 CONSTRUCTION CONDITIONS
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE				
				5 MINIMUM DIAMETER	6 MINIMUM DEPTH	7 MINIMUM DIAMETER	8 BOTTOM ELEVATION			
a.	Sand or gravel	Sand or mixture of sand and gravel.	2"	None required with cable tool drilling but shall be casing diameter plus 4" if one is constructed. See construction conditions. Casing diameter plus 2" with rotary drilling.	None required with cable tool drilling. To depth of casing setting with rotary drilling.	2"	See Construction Conditions		The depth of protective well casing pipe will be governed by the pumping level. For pumping levels 20' or less the casing shall extend 10' below the pumping level. For pumping levels 20' to 25' the casing shall extend to a depth of 30'. For pumping levels greater than 25' the casing shall extend 5' below the pumping level. When an enlarged upper drillhole is constructed with cable tool equipment, the annular space shall be filled with clay slurry or cement grout placed in an approved manner. See Note 2 below. With rotary drilling, the upper enlarged drillhole shall be maintained at full diameter with drilling mud and the annular space shall be permanently sealed with drilling mud or cement grout. See Note 1 below. Also see Appendix.	a,b,c Protective well casing placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, as is only permissible with rotary-air drilling, shall be assembled with welded joints and sealed in place with drilling mud or cement grout placed in the annular space by a suitable pump from the bottom of the casing upward.
b.	Sand or gravel	Clay or similar material to depth of 30' or more, containing layers of sand or gravel.	2"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	5' into clay below any sand or gravel above the 20' depth with cable tool drilling. To depth of casing placement with rotary drilling.	2"	See Construction Conditions		The protective well casing pipe shall extend 5' below the pumping level. With cable tool drilling the upper enlarged drillhole shall be kept open with temporary well casing and the upper drillhole shall be kept 1/3 filled with clay slurry throughout the driving of the permanent well casing. The balance of the annular space shall be filled with clay slurry or cement grout. With rotary drilling, the upper enlarged drillhole shall be maintained at full diameter with drilling mud and the annular space shall be permanently sealed with drilling mud or cement grout. See Note 1 below. Also see Appendix.	An adequate screen shall be provided where necessary. It shall be installed in such manner that removal or replacement can be accomplished without adversely affecting the watertight construction of the well.
c.	Sand or gravel	Clay or similar material from the ground surface to varying depths.	2"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	To the bottom of the clay or a minimum of 20' whichever is the lesser with cable tool drilling. To the depth of casing setting with rotary drilling.	2"	See Construction Conditions		See (a-b) above for minimum casing depth requirements. With cable tool drilling, the upper drillhole shall be kept 1/3 filled with clay slurry throughout the driving of the permanent well casing. The balance of the annular space shall be filled with clay slurry or cement grout. With rotary drilling the upper enlarged drillhole shall be maintained at full diameter with drilling mud and the annular space shall be permanently sealed with drilling mud or cement grout. See Note 1 below. Also see Appendix.	Approval from the Department is required for a gravel-pack well construction in conformance with Section NR 112.04.

NOTE 1. Greater depth of casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.

NOTE 2. Some drillers construct an enlarged upper drillhole to a depth of several feet with cable tool equipment by choice under geologic conditions of column 3, line a, to facilitate use of long lengths of pipe.

TABLE 1
DRILLED TYPE WELL REQUIREMENTS

1	2	3	4	5				6	7	8	9	10	11		
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE								LOWER DRILLHOLE	MAXIMUM NOMINAL PROTECTIVE LINER DIAMETER
				MINIMUM NOMINAL CASING DIAMETER	MINIMUM DIAMETER	DEPTH	MINIMUM DIAMETER							BOTTOM ELEVATION	MINIMUM WELL DIAMETER
CONSTRUCTION CONDITIONS															
d.	Limestone (See Note 3)	Unconsolidated materials, mainly sand or gravel, to depth of at least 40' to a radius of 1/4 mile. No record of sink holes, test holes, quarries or abandoned wells in above area.	6"	Casing diameter plus 1" if one is constructed with cable tool drilling. See construction conditions. Casing diameter plus 2" with rotary drilling.	None required with cable tool drilling. To rock with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the rock formation. When an upper enlarged drillhole is constructed with cable tool equipment, the annular space shall be filled with clay slurry or cement grout placed in an approved manner. See Note 2 below. With rotary drilling, the upper enlarged drillhole shall be maintained at full diameter with drilling mud or with temporary well casing and the annular space shall be permanently sealed with drilling mud or cement grout, except that only cement grout shall be used when the upper enlarged drillhole is constructed more than 2' into the limestone. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	d,e	Protective well casing pipe placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, as is only permissible with rotary-air drilling, shall be assembled with welded joints and sealed in place with drilling mud or cement grout placed in the annular space by a suitable pump from the bottom of the casing upward.			
e.	Limestone (See Note 3)	Clay or similar material or such materials with some sand and gravel zones to depth of at least 40' to a radius of 1/4 mile. No record of sink holes, test holes, quarries or abandoned wells in above area.	6"	Casing diameter plus 1" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	To the bottom of the clay or to the 20' depth, whichever is the lesser, with cable tool drilling. To rock with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the rock formation. With cable tool drilling, the upper enlarged drillhole shall be kept open by temporary well casing, when necessary and shall be kept 2/3 filled with clay slurry throughout driving of the protective well casing. The balance of the annular space shall be filled with clay slurry or cement grout applied in an approved manner. Construction conditions for drilling with rotary equipment are the same as above for line d. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	d,e,f	Protective liner pipe shall be assembled with welded joints, placed concentrically within the drillhole and sealed in place with cement grout placed by a suitable pump or other approved method from the bottom of the liner pipe upward.			
f.	Limestone (See Note 3)	Unconsolidated materials for depth less than 40' within a radius of 1/4 mile. No record of sink holes, test holes, quarries or abandoned wells in above area.	6"	Casing diameter plus 1" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	10' into unrecieved rock below 30'.	Not applicable.		6"	2" less than the lower drillhole diameter.	The upper enlarged drillhole through caving formations above the rock shall be kept open by temporary well casing with cable tool drilling and with such casing or drilling mud with rotary drilling. If the formation over the rock is clay or material which will similarly stand open, with rotary drilling the drill cuttings preferably shall be removed by driller mud but use of air will be permitted for such geologic formations. The annular space shall be permanently filled with cement grout. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	f	The upper enlarged drillhole diameter need be only 2" greater than the nominal well casing pipe diameter when the well casing pipe is assembled with welded joints and the cement grout is placed in the annular space by a suitable pump or other approved pressure method from the bottom of the casing upward.			

NOTE 1. Casing only to rock under conditions of column 3, lines d & e and to the depth indicated in column 6, line f for condition of column 3, line f, is only acceptable as a minimum when it is adequate to seal off the vertical zone of contamination. Greater depth of protective casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.

NOTE 2. Some drillers construct an enlarged upper drillhole with cable tool equipment by choice under geologic conditions of column 3, line d, to facilitate use of longer lengths of pipe.

NOTE 3. Although the carbonate rocks in this state are primarily dolomites, the term limestone has been given to them in the well construction specifications because it is the common term given to them by drillers.

TABLE I
DRILLED TYPE WELL REQUIREMENTS

1	2	3	4	UPPER DRILLHOLE				9	10	11		
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE					LOWER DRILLHOLE	MAXIMUM NOMINAL PROTECTIVE LINER
				5	6	7	8				WELL DIAMETER	DIAMETER
				MINIMUM DIAMETER	MINIMUM DEPTH	MINIMUM DIAMETER	BOTTOM ELEVATION	MINIMUM DIAMETER		CONSTRUCTION CONDITIONS		
g.	Shale (See Note 3)	Unconsolidated materials, mainly sand or gravel, to depth of at least 40' to a radius of 1/2 mile.	6"	Casing diameter plus 4" if one is constructed with cable tool drilling. See construction conditions. Casing diameter plus 2" with rotary drilling.	None required with cable tool drilling. To shale with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the shale formation. When an upper enlarged drillhole is constructed with cable tool equipment, the annular space shall be filled with clay slurry or cement grout placed in an approved manner. See Note 2 below. With rotary drilling, the upper enlarged drillhole shall be maintained at full diameter with drilling mud or temporary well casing and the annular space shall be permanently sealed with drilling mud or cement grout, except that only cement grout shall be used when the upper enlarged drillhole is constructed more than 2' into the shale. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	g,h Protective well casing pipe placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, as is only permissible with rotary-air drilling, shall be assembled with welded joints and sealed in place with drilling mud or cement grout placed in the annular space by a suitable pump from the bottom of the casing upward.	
h.	Shale (See Note 3)	Clay or similar material or such materials with some sand and gravel zones to a depth of at least 40 feet to a radius of 1/2 mile.	6"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	To the bottom of the clay or to the 20' depth whichever is the lesser, with cable tool drilling. To shale with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the shale formation. With cable tool drilling, the upper enlarged drillhole shall be kept open with temporary well casing, when necessary, and shall be kept 1/3 filled with clay slurry throughout the driving of the protective casing. The balance of the annular space shall be filled with clay slurry or cement grout applied in an approved manner. Construction conditions for drilling with rotary equipment are the same as above for line g. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	g,h,i Protective liner pipe shall be assembled with welded joints, placed concentrically within the drillhole and sealed in place with cement grout placed by a suitable pump or other approved method from the bottom of the liner pipe upward.	
i.	Shale (See Note 3)	Unconsolidated materials or limestone with or without unconsolidated formations above to a depth of less than 40' within a radius of 1/2 mile. No record of abandoned wells or test holes within the area.	6"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	40 feet	Not applicable	See construction conditions.	6"	2" less than the lower drillhole diameter.	The upper enlarged drillhole through caving formations above the rock shall be kept open by temporary well casing with cable tool drilling and by such casing or drilling mud with rotary drilling. If the unconsolidated formation over the rock is clay or material which will similarly stand open, with rotary drilling the drill cuttings preferably shall be removed by mud but use of air will be permitted for such geologic formations. The annular space surrounding the well casing shall be permanently filled with cement grout. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	i The upper enlarged drillhole diameter need be only 2" greater than the nominal well casing pipe diameter when the well casing pipe is assembled with welded joints and the cement grout is placed in the annular space by a suitable pump or other approved pressure method from the bottom of the casing upward.	

NOTE 1. Casing only to shale under conditions of column 3, lines g & h and to the depth indicated in column 6, line i, for condition of column 3, line i, is only acceptable as a minimum when adequate to seal off the vertical zone of contamination. Greater depth of protective casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.
 NOTE 2. Some drillers construct an enlarged upper drillhole with cable tool drilling equipment by choice under geologic conditions of column 3, line g, to facilitate use of longer lengths of pipe.
 NOTE 3. Wells normally shall not be developed into a shale formation. Such constructions are limited primarily to "Maquoketa" shale where the limestone is missing or very thin but only when the shale is known to be firm enough so that the drillhole will remain open and the water therefrom is not turbid. These wells may occur along the western edge of the Niagara dolomite extending from Door County to the Illinois border, at Blue Mound, at the Plateville Mound and in the Stinaswa area in Grant County. Shale wells under similar geologic conditions in other areas of the state where overlying rock is missing or thin will also be acceptable.

TABLE 1
DREADED TYPE WELL REQUIREMENTS

1	2	3	4 MINIMUM NOMINAL CASING DIAMETER INCHES	UPPER DRILLHOLE				9 LOWER DRILLHOLE DIAMETER	10 MAXIMUM PROTECTIVE LAYER DIAMETER	11 CONSTRUCTION CONDITIONS	
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE					
				5 MINIMUM DIAMETER	6 MINIMUM DEPTH	7 MINIMUM DIAMETER	8 BOTTOM ELEVATION				
j	Granite or Quartzite (See Note 1)	Unconsolidated materials mainly sand or gravel, to depth of at least 40' to a radius of 1/2 mile.	6"	Casing diam- eter plus 4" if one is con- structed with cable tool drilling. See construction conditions. Casing diam- eter plus 2" with rotary drilling.	None required with cable tool. To rock with rotary drills.	6" with cable tool drilling. Not applica- ble with rotary drilling.	See con- struction condi- tions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the rock formation. When an enlarged upper drillhole is constructed with cable tool equipment, the annular space shall be filled with clay slurry or cement grout placed in an approved manner. See Note 2 below. With rotary drilling equipment, the upper enlarged drillhole shall be maintained at full diameter with drilling mud or temporary well casing and the annular space shall be permanently sealed with drilling mud or cement grout, except that only cement grout shall be used when the upper enlarged drillhole is constructed more than 2' into the granite. The vertical zone of contamination must be sealed off. See Note 3 below. Also see Appendix.	J,k Protective well casing pipe placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, as is only permissible with rotary-air drilling, shall be assembled with welded joints and sealed in place with drilling mud or cement grout placed in the annular space by a suitable pump from the bottom of the casing upward.
k	Granite or Quartzite (See Note 1)	Clay or similar materials with some sand and gravel zones to a depth of at least 40' to a radius of 1/2 mile.	6"	Casing diam- eter plus 4" with cable tool drilling. Casing diam- eter plus 2" with rotary drilling. See construction conditions.	To the bottom of the clay or to the 20' depth, whichever is the lesser with cable tool drilling. To rock with rotary drilling.	6" with cable tool drilling. Not applica- ble with rotary drilling.	See con- struction condi- tions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated into the rock formation. With cable tool drilling the upper enlarged drillhole shall be kept open with temporary well casing, when necessary, and shall be kept 1/3 filled with clay slurry throughout the driving of the protective casing. The balance of the annular space shall be filled with clay slurry or cement grout applied in an approved manner. Construction conditions for drilling with rotary equipment are the same as above for line j. The vertical zone of contamination must be sealed off. See Note 3 below. Also see Appendix.	J,k,l Protective liner pipe shall be assembled with welded joints, placed concentrically within the drillhole and sealed in place with cement grout placed by a suitable pump or other approved method from the bottom of the liner pipe upward.
l	Granite or Quartzite (See Note 1)	Unconsolidated materials for depth less than 40' within a radius of 1/2 mile.	6"	Casing diam- eter plus 4" with cable tool drilling. Casing diam- eter plus 2" with rotary drilling. See construction conditions.	40' See construction conditions for exceptions.	Not applica- ble.		6"	2" less than the lower drillhole diameter.	Normally 40' of pipe is required to seal off the vertical zone of contamination. An attempt shall be made to obtain water below 40' and at least to a depth of 75' even though water in quantity may be encountered during drilling at a depth above 40'. Should an adequate water producing zone not be encountered below 40' and down to a depth of 75' or lower, consideration may be given by the Department to permit production of the water above 40'. Department approval is required for such well. Other construction conditions are the same as for line j. The vertical zone of contamination must be sealed off. See Note 3 below. Also see Appendix.	l The upper enlarged drillhole diameter need be only 2" greater than the nominal well casing pipe diameter when the well casing pipe is assembled with welded joints and the cement grout is placed in the annular space by a suitable pump or other approved pressure method from the bottom of the casing upward.

NOTE 1. Crystalline rocks are classed as granite because they are commonly referred to as granite by drillers regardless of their true rock type. This includes trap rock.

NOTE 2. Some drillers construct an enlarged upper drillhole with cable tool equipment by choice under geologic conditions of column 3, line j, to facilitate use of longer lengths of pipe.

NOTE 3. Casing only to rock under conditions of column 3, lines j & k and to the depth indicated in column 6, line l, for condition of column 3, line l, is only acceptable as a minimum when it is adequate to seal off the vertical zone of contamination. Greater depth of protective casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.

TABLE 1
DRILLED TYPE WELL REQUIREMENTS

1	2	3	4	UPPER DRILLHOLE					6	7	8	9	10	11		
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE		MINIMUM BOTTOM DIAMETER							MINIMUM WELL DIAMETER	MAXIMUM PROTECTIVE LINER DIAMETER
				MINIMUM DIAMETER	MINIMUM DEPTH	MINIMUM DIAMETER	MINIMUM DEPTH									
CONSTRUCTION CONDITIONS																
m. Sandstone	Unconsolidated materials mainly sand and gravel to a depth of 25' or more.		6"	Casing diameter plus 4" with cable tool drilling. See construction conditions. Casing diameter plus 2" with rotary drilling.	None required with cable tool. Into firm sandstone with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the rock formation. When an upper enlarged drillhole is constructed with cable tool equipment, the annular space shall be filled with clay slurry or cement grout placed in an approved manner. See Note 2 below. With rotary drilling, the upper enlarged drillhole shall be maintained at full diameter with drilling mud or with temporary well casing and the annular space shall be permanently sealed with drilling mud or cement grout, except that only cement grout shall be used when the upper enlarged drillhole is constructed more than 2' into the sandstone. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	m,n	Protective well casing placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, as is only permissible with rotary-air drilling, shall be assembled with welded joints and sealed in place with drilling mud or cement grout placed in the annular space by a suitable pump from the bottom of the casing upward.				
n. Sandstone	Clay or similar material or such material with some sand and gravel to depth of 25' or more.		6"	Casing diameter plus 4" with cable tool drilling, whichever is the casing diameter plus 2" with rotary drilling. See construction conditions.	To the bottom of the clay or to the 20' depth, whichever is the lesser, with cable tool drilling. Into firm sandstone with rotary drilling.	6" with cable tool drilling. Not applicable with rotary drilling.	See construction conditions.	6"	2" less than the lower drillhole diameter.	The protective well casing pipe shall be firmly seated in the rock formation. With cable tool drilling, the upper enlarged drillhole shall be kept open by temporary well casing, when necessary and shall be kept 1/3 filled with clay slurry throughout the duration of the protective casing. The balance of the annular space shall be filled with clay slurry or cement grout applied in an approved manner. Construction conditions for drilling with rotary equipment are the same as above for line m. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	m,p,q	Protective liner pipe shall be assembled with welded joints, placed concentrically within the drillhole and sealed in place with cement grout placed by a suitable pump or other approved method from the bottom of the liner pipe upward.				
o. Sandstone	Any material except limestone to a depth of less than 25'.		6"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	Into firm sandstone or to the 30' depth whichever is greater.	Not applicable.	6"	2" less than the lower drillhole diameter.	The upper enlarged drillhole through caving formations above the rock shall be kept open by temporary well casing with cable tool drilling and by such casing or drilling mud with rotary drilling. If the formation over the rock is clay or material which will similarly stand open, with rotary drilling the drill cuttings preferably shall be removed by mud but use of air will be permitted for such geologic formations. The annular space surrounding the protective well casing shall be permanently filled with cement grout. The vertical zone of contamination must be sealed off. See Note 1 below. Also see Appendix.	o	The upper enlarged drillhole diameter need be only 2" greater than the nominal well casing pipe diameter when the well casing pipe is assembled with welded joints and the cement grout is placed in the annular space by a suitable pump or other approved pressure method from the bottom of the casing upward.					

NOTE 1. Casing only to the depth indicated in column 6, lines m, n & o, for conditions of column 3, lines m, n & o, is only acceptable as a minimum when it is adequate to seal off the vertical zone of contamination. Greater depth of protective casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.

NOTE 2. Some drillers construct enlarged upper drillholes to a depth of several feet with cable tool equipment by choice under geologic conditions of column 3, line m, to facilitate use of longer lengths of pipe.

**TABLE I
DRILLED TYPE WELL REQUIREMENTS**

1 TYPE	2 NATURE OF WATER BEARING FORMATION (AQUIFER)	3 GEOLOGIC FORMATIONS OVERLYING AQUIFER	4 MINIMUM NOMINAL CASING DIAMETER INCHES	UPPER DRILLHOLE				9 LOWER DRILLHOLE MINIMUM WELL DIAMETER	10 MAXIMUM NOMINAL PROTECTIVE LINER DIAMETER	11 CONSTRUCTION CONDITIONS	
				UPPER ENLARGED DRILLHOLE		REGULAR DRILLHOLE					
				5 MINIMUM DIAMETER	6 MINIMUM DEPTH	7 MINIMUM DIAMETER	8 BOTTOM ELEVATION				
p.	Sandstone	Limestone to depth of 40' or less with or without unconsolidated overburden over the limestone.	6"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	15' into firm sandstone.	Not applicable		6"	2" less than the lower drillhole diameter.	The upper enlarged drillhole through caving formations above the rock shall be kept open by temporary well casing with cable tool drilling and by such casing or drilling mud with rotary drilling. If the formation over the rock is clay or material which will similarly stand open, with rotary drilling the drill cuttings preferably shall be removed by mud but use of air will be permitted for such geologic formation. The annular space surrounding the protective well casing shall be permanently filled with cement grout. The vertical zone of contamination must be sealed off. See Note 2 below. Also see Appendix.	p9 Protective well casing pipe placed in an upper enlarged drillhole only 2" greater in diameter than the nominal well casing pipe diameter, shall be assembled with welded joints and sealed in place with cement grout placed by a suitable pump from the bottom of the casing upward. Protective liner pipe shall be assembled with welded joints, placed concentrically within the drillhole and sealed in place with cement grout placed by a suitable pump or other approved method from the bottom of the liner pipe upward.
q.	Sandstone	Limestone extending to a depth greater than 40' with or without unconsolidated overburden over the limestone.	6"	Casing diameter plus 4" with cable tool drilling. Casing diameter plus 2" with rotary drilling. See construction conditions.	40' or 10" into unconsolidated rock below 30'	Not applicable		6"	2" less than the lower drillhole diameter.	The upper enlarged drillhole diameter need be only 2" greater than the nominal well casing pipe diameter when the well casing pipe is assembled with welded joints and the cement grout is placed in the annular space by a suitable pump or other approved pressure method from the bottom of the casing upward.	

NOTE 1: Although the carbonate rocks in this state are primarily dolomites, the term limestone has been given to them in the well construction specifications because it is the common term given to them by the drillers.

NOTE 2: Casing only to the depth indicated in column 6, lines p & q, for conditions of column 3, lines p & q, is only acceptable as a minimum when it is adequate to seal off the vertical zone of contamination. Greater depth of protective casing is required in areas where well histories show that the vertical zone of contamination extends to a greater depth.

(a) *Well casing pipe.* The protective well casing pipe materials shall be steel pipe having the nominal diameters and the weights as specified in table 2, except that for wells for potable school water systems and high capacity water systems, the minimum wall thickness for 8-inch, 10-inch, and 12-inch diameter pipe shall be 0.322-inch, 0.365-inch, and 0.375-inch, respectively, and for non-potable systems pipe of any diameter used shall have an adequate wall thickness to make the well structurally sound.

TABLE 2
MINIMUM
CASING PIPE AND COUPLING
WEIGHTS AND DIMENSIONS

Size in Inches	Wgt. Lbs. Per Ft.		Thickness in Inches	Pipe		Threads Per Inch	Couplings	
	Threads & Coupling	Plain End		Diameter - External	Inches Internal		External Diameter Inches	Length in Inches
1	1.70	1.68	.133	1.315	1.049	11-1/2	1.576	2-5/8
1-1/4	2.30	2.27	.140	1.660	1.380	11-1/2	1.900	2-3/4
1-1/2	2.75	2.72	.145	1.900	1.610	11-1/2	2.200	2-3/4
2	3.75	3.65	.154	2.375	2.067	11-1/2	2.750	2-7/8
2-1/2	5.90	5.79	.203	2.875	2.469	8	3.250	2-15/16
3	7.70	7.58	.216	3.500	3.068	8	4.000	4-1/16
3-1/2	9.25	9.11	.226	4.000	3.548	8	4.625	4-3/16
4	11.00	10.79	.237	4.500	4.026	8	5.200	4-5/16
5	15.00	14.62	.258	5.563	5.047	8	6.296	4-1/2
6	19.45	18.97	.280	6.625	6.065	8	7.390	4-11/16
6-5/8 OD	20.00	19.49	.288	6.625	6.049	8 R	7.390	7-1/4
7 OD	23.00	22.63	.317	7.000	6.366	8 R	7.657	7-1/4
8	25.55	24.70	.277	8.625	8.071	8	9.625	5-1/16
10	35.75	34.25	.307	10.750	10.136	8	11.750	5-9/16
12	45.45	43.77	.330	12.750	12.090	8	14.000	5-15/16
14 OD	57.00	54.57	.375	14.000	13.250	8	15.000	6-3/8
16 OD	65.30	62.58	.375	16.000	15.250	8	17.000	6-3/4
18 OD	73.00	70.59	.375	18.000	17.250	8	19.000	7-1/8
20 OD	81.00	78.60	.375	20.000	19.250	8	21.000	7-5/8
22 OD		114.81	.500	22.000	21.000			
24 OD		125.49	.500	24.000	23.000			
26 OD		136.17	.500	26.000	25.000			
28 OD		146.85	.500	28.000	27.000			
30 OD		157.53	.500	30.000	29.000			
32 OD		168.21	.500	32.000	31.000			
34 OD		178.89	.500	34.000	33.000			
36 OD		189.57	.500	36.000	35.000			

R = Round Threads

(b) *Assembly.* Well casing pipe shall be assembled watertight by means of joints welded in accordance with the standard welding procedure specifications of the department of industry, labor and human relations, Ind 53.53 (3), Wis. Adm. Code or by correctly mated, recessed type couplings as used on drill pipe, line pipe or reamed and drifted pipe and having weights and being threaded as indicated in table 2.

(c) *Pipe installation.* Well casing pipe shall be driven or installed so that no injury to the pipe results which may affect the quality of the water supply.

(d) *Pipe specifications.* 1. No used pipe may be installed as the protective well casing in the permanent construction of a well or for other