

LINE	NEAR DEPTH TO FIRM BEDROCK	SURFACE GEOLOGIC MATERIALS	UPPER ENLARGED DRILLHOLE REQUIREMENTS							WELL CASING PIPE REQUIREMENTS		ANNULAR SPACE SEALING REQUIREMENTS		LOWER DRILLHOLE REQUIREMENTS (IN BEDROCK)	
			PERCUSSION METHODS			ROTARY METHODS				MINIMUM DIAMETER	MINIMUM DEPTH	PERCUSSION METHODS	ROTARY METHODS	MIN. DIAM.	METHOD OF CUTTINGS REMOVAL
			MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH	MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH							
E.	Less than 40 feet; less than 30 feet for sandstone (except for condition in line F).	Material of any kind.	4" larger in* diameter than the nominal diameter of well casing pipe; or 2" larger in diameter than the nominal diameter of the well casing pipe if steel pipe is assembled with welded joints and the annular space sealing material is placed using an approved pressure method	Temporary outer casing if the material above bedrock is caving; otherwise the drillhole shall be filled up to within 10' of the ground surface with clay slurry during driving of the well casing pipe.	40 feet, except for sandstone; 30 feet for sandstone.	Same as above.	Caving formation above bedrock	Non-caving formation above bedrock.	To the depth of well casing pipe setting, but not less than 40', 30 feet for sandstone.	6"	40'; 30 feet for sandstone (set in upper enlarged drillhole and driven to a firm seat).	Neat cement grout only, mixed & placed according to the requirements of NR 112.20.	Neat cement grout only, mixed and placed according to the requirements of NR 112.20.	6"	Same as above.
F.	Less than 10 feet to Limestone (Dolomite)	Material of any kind.	Same as above.	Temporary outer casing if the material above the bedrock is caving.	60 feet	Same as above.	Circulated drilling mud	Air, an approved foam or drilling mud.	To the depth of well casing pipe setting, but not less than 60'.	6"	60' (set in upper enlarged drillhole and driven to a firm seat).	Neat cement grout only, mixed & placed according to the requirements of NR 112.20.	Neat cement grout only, mixed & placed according to the requirements of NR 112.20.	6"	Same as above.

* An upper enlarged drillhole is not required when approved granular (8-mesh) bentonite is either mounded around the top of the well casing pipe during driving, or is placed in a starter drillhole during driving.

TABLE III. DRILLED UNCONSOLIDATED FORMATION WELL CONSTRUCTION REQUIREMENTS FOR *POTABLE HIGH CAPACITY*, SCHOOL AND WASTEWATER TREATMENT PLANT WELLS

LINE	NEAR SURFACE GEOLOGIC MATERIALS	UPPER ENLARGED DRILLHOLE REQUIREMENTS						WELL CASING PIPE CASING REQUIREMENTS		ANNULAR SPACE SEALING REQUIREMENTS		SCREEN REQUIREMENTS (ONLY REQUIRED FOR WELLS THAT PUMP SAND)	
		PERCUSSION METHODS			ROTARY METHODS			MIN. DIAM.	MINIMUM DEPTH	PERCUSSION METHODS	ROTARY METHODS	TYPE / MATERIAL	METHOD OF PLACEMENT
		MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH	MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH						
G.	Caving material of any kind (usually sand)	3" larger in diameter than the outside diameter of the well casing pipe or the outside diameter of the casing couplings (if used).	Temporary outer casing which shall be removed during or following grouting of the annular space. The drillhole shall be kept filled up to within 10 feet of the ground surface with clay or sodium bentonite slurry during the driving of the well casing pipe.	60'	3" larger in diameter than the outside diameter of the well casing pipe or the outside diameter of the casing couplings (if used).	Circulated drilling mud to maintain drillhole at full diameter.	To the depth of well casing pipe setting.	4"	Whatever is greater: 60' depth; or 20' below static water level; and such that the pump is set at least 5' above the bottom of the casing pipe and does not break suction under normal operating conditions.	Neat cement grout <i>only</i> , placed by using an approved pressure method as specified by NR 112.20.	Neat cement grout <i>only</i> , placed by using an approved pressure method as specified by NR 112.20.	Continuous slot, V-shaped wound-wire wrap on a rod base type. Of stainless steel, everdur, monel or brass.	Bail-down or Pull-back (telescoping) method. The screen may also be permanently attached to the bottom of the string of well casing pipe.
H.	Non-caving material of any kind in the top 60 feet (usually clay, silt or hardpan).	Same as above.	The drillhole shall be kept filled up to within 10 feet of the ground surface with clay or sodium bentonite slurry during the driving of the permanent well casing pipe. When temporary outer casing is used, it shall be pulled during or following grouting of the annular space.	60'	Same as above.	Same as above.	Same as above.	4"	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.

NOTE: The 60-foot minimum requirement for the upper-enlarged drillhole depth and well casing pipe depth requirement shall be 100 feet rather than 60 feet (as in table above) whenever the well is installed for a wastewater treatment plant that has a lagoon or pond treatment system or sludge beds on the property.

TABLE IV. DRILLED *BEDROCK WELL* CONSTRUCTION REQUIREMENTS FOR POTABLE HIGH CAPACITY, SCHOOL AND WASTEWATER TREATMENT PLANT WELLS

LINE	DEPTH TO FIRM BEDROCK	NEAR SURFACE GEOLOGIC MATERIALS	UPPER ENLARGED DRILLHOLE REQUIREMENTS						CASING PIPE REQUIREMENTS (STEEL ONLY)		WELL ANNULAR SPACE SEALING REQUIREMENTS		LOWER DRILLHOLE REQUIREMENTS (IN BEDROCK)	
			PERCUSSION METHODS			ROTARY METHODS			MINIMUM DIAMETER	MINIMUM DEPTH	PERCUSSION METHODS	ROTARY METHODS	MIN. DIAM.	METHOD OF CUTTINGS REMOVAL
			MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH	MINIMUM DIAMETER	METHOD OF KEEPING HOLE OPEN	MINIMUM DEPTH						
I.	60 feet or more	Caving material of any kind (usually sand)	3" larger in diameter than the outside diameter of the well casing pipe or the outside diameter of the casing couplings (if used.)	Temporary outer casing; which shall be removed during or following the grouting of the annular space. The drillhole shall be kept filled up to within 10 feet of the ground surface with clay or sodium bentonite slurry during driving of the well casing pipe.	60'	3" larger in diameter than the outside diameter of the well casing pipe or the outside diameter of the casing couplings (if used).	Circulated drilling mud to maintain the drillhole at full diameter.	To the top of firm bedrock, but not less than the casing depth	6"	To a firm seat in bedrock.	Neat cement grout <i>only</i> . Placed by using an approved pressure method as specified in NR 112.20.	Neat cement grout <i>only</i> . Placed by using an approved pressure method as specified in NR 112.20.	6"	Air or an approved foam, by bailing, or by circulated drilling mud.
J.	60 feet or more	Non-caving material of any kind in the top 60 feet (usually clay, silt or hardpan).	Same as above.	The drillhole shall be kept filled up to within 10 feet of the ground surface with clay or sodium bentonite slurry during the driving of the well casing pipe.	60'	Same as above.	Same as above.	Same as above.	6"	To a firm seat in bedrock.	Same as above.	Same as above.	6"	Same as above.
K.	Less than 60'	Caving material of any kind (usually sand).	Same as above.	Temporary outer casing through any unconsolidated material. It shall be removed during or following the grouting of the annular space.	60'	Same as above.	Circulated drilling mud through unconsolidated material; air or an approved foam in bedrock.	60'	6"	60' ; set in the upper enlarged drillhole and driven to a firm seat.	Same as above.	Same as above.	6"	Same as above.
L.	Less than 60'	Non-caving material of any kind in the top 60 feet (usually clay, silt or hardpan).	Same as above.	The drillhole shall be kept filled up to within 10 feet of the ground surface with clay or sodium bentonite slurry during the driving of the well casing pipe.	60'	Same as above.	Circulated drilling mud, air, or an approved foam.	60'	6"	Same as above.	Same as above.	Same as above.	6"	Same as above.

NOTE: The 60-foot minimum requirement for the upper-enlarged drillhole depth and well casing pipe depth requirement shall be 100 feet rather than 60 feet (as in table above) whenever the well is installed for a wastewater treatment plant that has a lagoon or pond treatment system or sludge beds on the property.

(3) A greater depth of well casing pipe shall be provided in special well casing pipe depth areas designated by the department where well histories show contamination extends to a greater depth.

Note: A list of special well casing pipe depth areas and the required depths may be obtained from the department upon request. Greater depth of well casing pipe is recommended for wells constructed on high density tiered lots where possible contamination sources exist on neighboring up-slope lots.

(4) Steel well casing pipe shall meet the requirements of s. NR 112.17. Steel well casing pipe assembled with welded joints shall have beveled ends and all joints shall be welded according to the welding requirements outlined in s. NR 112.18.

(5) A drive-shoe shall be welded or threaded to the bottom of any string of well casing pipe to be driven including driving to a firm seat in bedrock when well casing pipe is set in an upper enlarged drillhole, except when the upper enlarged drillhole extends 20 feet or more into bedrock and the annular space is cement grouted before the lower drillhole is constructed, the use of a drive-shoe is optional. A drive-shoe is not required for any temporary outer casing. Thermoplastic well casing pipe may not be driven.

(6) The well driller or well constructor shall complete the well construction such that the well casing pipe extends at least 12 inches above the final ground grade, above a pumphouse or building floor or above any concrete or asphalt platform installed at or above the established ground surface. In addition, for wells in floodplains, the top of the well casing pipe shall terminate at least 2 feet above the regional flood elevation. A well may not be constructed in a floodway on property that is either undeveloped or on property that has buildings but no existing potable well.

(7) Well plumbness and alignment shall conform to the requirements of s. NR 112.19.

(8) Liners shall meet the requirements of s. NR 112.21.

(9) Grouting and sealing requirements shall conform to s. NR 112.20.

(10) The construction of flowing wells shall also comply with the construction requirements of s. NR 112.15.

(11) Water used in the construction, reconstruction or redevelopment of wells shall be clear water obtained from an uncontaminated source. The water shall be disinfected with chlorine with a residual of 100 mg/l (parts per million) to reduce the effort involved in the final disinfection of the well and to reduce the possibility of groundwater contamination. The chlorine concentration may be mixed according to Table B in s. NR 112.22 (4) (d). The drilling fluid shall be maintained with a free-chlorine residual of 10 mg/l (parts per million) during drilling.

(12) Well construction shall be interrupted for at least 12 hours following placement of cement grout in the annular space between the well casing pipe and the upper enlarged drillhole or between a liner pipe and a lower drillhole and the well casing pipe.

(13) Nonpotable wells shall be constructed according to the requirements for low capacity potable wells, except that the well casing pipe may have a lesser wall thickness than is required by Table V for the diameter of the well casing pipe used. Well casing pipe 12 inches in diame-