Rules of
Department of Natural Resources
Division 23—Well Installation
Chapter 3—Water Well Construction Code

Title 10—DEPARTMENT OF NATURAL RESOURCES
Division 23—Well Installation
Chapter 3—Water Well Construction Code

10 CSR 23-3.010 Location of Wells

PURPOSE: This rule sets criteria for water well placement.

(1) High yield unconsolidated well location requirements are found in 10 CSR 23-3.010(F). All other well types shall be—

(A) Located on a site that has sufficient surface drainage to prevent the accumulation or ponding of surface water within ten feet (10') of the well and, if possible, at a higher elevation than possible sources of contamination. The top of the casing shall extend a minimum of twelve inches (12") above ground surface;

(B) Located a minimum setback distance from potential Pollution or Contamination Sources. See 10 CSR 23-3.010 Table 3.1 for specific distances to be followed; and

(C) High yield unconsolidated wells shall be a minimum of two hundred feet (200') from contamination sources unless greater distances are specified in 10 CSR 23-3.010(1) Table 3.1.

Table 3.1 Specific setback distances for wells from pollution or contamination sources.

Feature requiring setback	Minimum horizontal distance
Storage area for commercial fertilizers or chemicals	300'
Demolition landfill	300'
Wastewater treatment plant or lagoon that serves commercial facilities, subdivisions, or mobile home parks	300'
Above ground or underground storage tank[1, 2]	300'
Tank distribution lines for liquid petroleum, petroleum products, or chemicals[1, 2]	300'
Earthen, concrete, or other manure storage structures or lagoons	300'
Land application areas for domestic or animal waste	300'
Animal composting facilities	300'
Unplugged abandoned wells	100'
Subsurface wastewater disposal field, grave, residential lagoon, privy, lift station, or pressurized sewer line	100'
Animal Feeding Operation (AFO)[4]	100'
An animal composting facility constructed with a concrete floor cell design covered with a roof	100'
Dry litter storage within a building	100'
Other areas with contaminants that may leach into the groundwater	100'
Septic tank or wastewater holding tank	50'
Pit or cistern	50'
Existing operating well	50'
Non-pressurized buried sewer line	25'
Solid waste disposal area, sanitary landfill, special waste landfill, utility waste landfill, waste stabilization pond (lagoon), or hazardous waste treatment, storage, or disposal facility[3]	1000'

1. Any well that cannot meet setback distances for petroleum distribution site shall meet the well construction requirements for a High Yield Bedrock well pursuant to 10 CSR 23-3.030(3).
2. Petroleum or petroleum products that are not liquid at standard temperatures and pressures are exempt from these setback requirements.
3. A safe distance cannot be determined. Any well that intercepts leachates from a waste landfill or waste stabilization pond (lagoon) shall be plugged unless it is approved by the department for use as a monitoring well.
4. Has the same meaning as defined in 10 CSR 20-6.300.

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.020 General Protection of Groundwater Quality and Resources

PURPOSE: This rule is for the overall protection of groundwater resources in Missouri.

(1) Wells shall be constructed for their intended use in a manner that will protect groundwater resources and prevent contamination by surface and groundwater by ensuring the casing and wellhead completion are watertight and sealing off formations that are likely to pose a threat to groundwater.

(2) A person may not leave a well incomplete or a borehole open and shall plug or complete the well as directed by the department.

(3) A well previously used for storage or injection of gas, chemical, or any liquid shall not be converted to a well used for water supply.

(4) A person who converts a water well to an oil or gas well shall notify the department pursuant to section 256.614.2, RSMo.

(5) Maintenance and Repair of Wells.

(A) Wells shall be maintained by the owner in a condition where it will protect groundwater and not be a source of, or channel for, contamination or pollution to groundwater.

(B) All materials used in the construction, maintenance, or repair of any well shall meet the requirements in these rules.

(C) Broken, punctured, or damaged casing, or any part of the wellhead that is damaged or missing shall be repaired, replaced, or plugged pursuant to 10 CSR 23-3.110.

(D) Casing and/or drop pipe when being installed or replaced shall not come in direct contact with the ground surface.

(E) Major reconstruction of operational wells in existence on September 28, 1985 (pre-law wells) shall conform to minimum standards pursuant to 10 CSR 23-3. Major reconstruction of wells does not include pulling or setting a pump or plumbing alterations.

(6) Lubricants used during the drilling process shall not adversely affect the groundwater quality by entering the borehole.

(7) Water used in the drilling process or well development shall be of potable quality.

(8) Best management practices such as silt fences, straw bales, containment pits, or basins shall be used to contain drill cuttings, fluid, and foam resulting from drilling operations to minimize impact to land and prevent a discharge to waters of the state. If a discharge to a water of the state occurs, notify the department.

(9) Cross connections between wells and other systems or equipment containing water, chemicals, or substances of unknown risk to groundwater are prohibited, except when equipped with a suitable protective device such as a break tank or backflow prevention device. The owner shall test, retain all records of such tests, and maintain the backflow prevention device to ensure proper operation and protection of groundwater pursuant to 10 CSR 23-3.050(1)(C). Petroleum, fertilizer, and pesticide tanks will be allowed at the well site while irrigating and chemigating and be removed from the well site or emptied when not in use.

AUTHORITY: sections 256.606, 256.614, 256.615, and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991; 256.614, RSMo 1985, amended 1991; 256.615, RSMo 1991; and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.025 Public Water Supply—Notification to Division

(Rescinded August 30, 2018)

AUTHORITY: sections 256.606 and 256.628, RSMo Supp. 1991. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Rescinded: Filed Dec. 29, 2017, effective Aug. 30, 2018.

10 CSR 23-3.030 Standards for Construction of Water Wells

PURPOSE: This rule describes the minimum construction standards for water wells.

(1) Domestic Water Wells and Pilot Holes.

(A) Casing.

1. Steel well casing. The minimum standards for steel casing are found in Table 3.2.

Table 3.2 Minimum standards for steel casing.

Nominal Pipe (Inches)	Outside Diameter (Inches)	Wall Thickness (Inches)	(Weight/Foot)
6	6 5/8	0.188	13
8	8⅝	0.188	17
10	10¾	0.188	21
12	12¾	0.188	25
14	14	0.188	28
16	16	0.188	32

A. Joints. Joints shall be welded or threaded and be watertight. Recessed or reamed and drifted couplings shall be used on threaded casing. Other couplings may be used provided the design, taper, and type of thread of the coupling matches that of the pipe. Casing extension material shall be of similar material to the original casing. Other types of joints or devices used to join dissimilar casing extension materials may be used upon receiving prior written approval from the department.

B. Standards. Casing shall be new and meet American Society for Testing and Materials (ASTM), A53 grade A or B, A500 grade A or B, or A589 or other grade weldable new pipe having a quality equal to or greater than those specified. Used casing when salvaged within ninety (90) days of installation from a water supply well and is decontaminated is considered new pipe.

C. Drive shoe. In areas where steel casing is required, equip the well casing with a drive shoe or similar protective device to prevent damage to the well casing during construction of the well. If no drive shoe is used, follow the minimum grout cure times in Table 3.3.

Table 3.3 Minimum Cure Times for Grout

Grout Type	Minimum Cure Time (hours)
Hi early cement	12
Portland Type I cement	72
Chipped Bentonite	4
High Solids Bentonite Slurry	*

*Follow manufacturer's guidelines. Cure time will vary based on additives.

2. Plastic well casing. The minimum standards for plastic well casing are found in Table 3.4.

Table 3.4 Minimum standards for plastic casing.

Nominal Pipe (Inches)	Outside Diameter (Inches)	Standard Dimension Ratio (SDR)	Schedule (SCH)
6	6 5/8	26	40

A. Joints. Well casing joints shall be watertight and joined by solvent weld (glued) or mechanical. Casing extension material shall be of similar material to the original casing. Other types of joints or devices used to join dissimilar casing extension materials may be used upon receiving prior written approval from the department.

B. Standards. Casing shall be: new and meet ASTM standards, composed of polyvinyl chloride (PVC) or acrylonitrile-butadiene-styrene (ABS) thermoplastics and meet ASTM standards, marked "Well Casing" and have the specification number F-480 Standard for Plastic Well Casing. Used casing when salvaged within ninety (90) days of installation from a water supply well and is decontaminated is considered new pipe.

C. Packers. A packer, coupling, or inverted bell shall be secured at the bottom of the casing and hold the grout in place while drilling continues. No packer, coupling, or inverted bell is needed if grout is allowed to cure following minimum cure times in Table 3.3.

3. Concrete and fiberglass well casing—

A. May be used for unconsolidated wells greater than eighteen inches (18") in diameter; and

B. Shall be composed of non-toxic durable material designed for use in potable water wells.

4. Other materials may be used upon receiving prior written approval from the department.

(B) Borehole. For borehole size see 10 CSR 23-3.090.

(C) Grouting. It is the responsibility of the well installation contractor to ensure that the annular space is sealed and that the casing does not leak. This responsibility ends three (3) years after the approval date by the department unless it can be proven that the annular seal has been damaged by other persons.

1. Grouting installation methods.

A. Gravity method.

(I) Bentonite granules or bentonite slurry shall not be poured through standing water greater than one hundred feet (>100').

(II) Table 3.5 states the maximum depth that grout can be gravity fed into the well annulus.

(III) Gravity grouting greater than two hundred feet (200') in a four inch (4") annulus is not allowed.

Table 3.5 Maximum Gravity Grouting Depths

Borehole Size (inches)	Outside Diameter of Casing (inches)	Annular Space (inches)	Gravity Feed Depth (feet)
8 5/8	6 5/8	1	100
8 3/4	6 5/8	1 1/16	106
8 7/8	6 5/8	1 1/8	112
9	6 5/8	1 3/16	119
9 1/8	6 5/8	1 1/4	125
9 1/4	6 5/8	1 5/16	131
9 3/8	6 5/8	1 3/8	137
9 1/2	6 5/8	2 7/8	144
9 5/8	6 5/8	3	150
9 3/4	6 5/8	3 1/8	156
9 7/8	6 5/8	3 1/4	162
10	6 5/8	3 3/8	169
10 1/8	6 5/8	3 1/2	175
10 1/4	6 5/8	3 5/8	181
10 3/8	6 5/8	3 3/4	187
10 1/2	6 5/8	3 7/8	193
10 5/8	6 5/8	4	200

B. Tremie method. Tremie pipes shall be—

(I) Placed into the annulus and extend to no less than five feet (5') from the bottom of the interval to be grouted;

(II) Gradually withdrawn as the grouting material is emplaced; and

(III) No greater than ten feet (10') above the emplaced grouting material during the entire grouting process.

C. Tremie pressure method. The tremie pipe shall remain submerged in the grouting material during the entire grout pumping process.

D. Pressure method.

E. Open-hole method.

(I) Non-slurry bentonite may be poured from the surface and allowed to completely hydrate before the casing is installed.

(II) Bentonite slurry may be used in wells with more than one hundred feet (>100') of standing water only if the grout is emplaced by one (1) of the tremie grouting methods.

F. Positive displacement method.

(I) Bentonite slurry or cement slurry may be used in wells with more than one hundred feet (>100') of standing water only if the grout is emplaced by one (1) of the tremie grouting methods.

G. Other grouting methods may be used upon receiving prior written approval from the department.

2. Grout materials.

A. Cement slurry.

B. Bentonite slurry.

C. Bentonite non-slurry. If there is no water in the annular space, the bentonite shall be hydrated.

D. Other grout types may be used upon receiving prior written approval from the department.

(D) Driving Casing.

1. When geologic conditions require the casing to be driven, the casing may be driven to the casing depth without adding grout.

2. Once the casing is set, install liner pursuant to 10 CSR 23-3.080.

3. In addition to the liner, a top annular casing seal, at least ten feet (10') deep is required below the pitless connection.

4. A liner and top annular seal are not required when the open hole method or positive displacement grouting method is used.

(E) Wellhead Completion. Follow well casing seal and connection installation pursuant to 10 CSR 23-3.050(6).

(2) Multifamily Wells.

(A) Multifamily wells shall have no more than eight (8) connections, fewer than twenty-five (25) individuals, and have a pumping capacity of less than seventy gallons per minute (<70 gpm).

(B) Multifamily wells may be used to serve a charitable or benevolent organization pursuant to section 640.116, RSMo.

(C) Casing.

1. Follow 10 CSR 23-3.090 for minimum casing depths by Drilling Area for domestic water wells.

2. Install new steel casing that meets the minimum standards specified in Table 3.2 for size and weight.

3. Other casing design or materials may be used upon receiving prior written approval from the department.

4. Liners are not a substitute for casing.

(D) Joints. Well casing joints shall be welded or threaded and be watertight. Other types of joints may be used upon receiving advanced written approval by the department. Recessed or reamed and drifted couplings shall be used on threaded casing; other couplings may be used provided the design, taper, and type of thread matches that of the pipe.

(E) Standards. Pipe shall be new and meet the ASTM, A53 grade A or B, A500 grade A or B, or A589 or other grade weldable new pipe having a quality equal to or greater than those specified. Used pipe is considered new if it is salvaged within ninety (90) days of installation from a new water well.

(F) Drive shoe. Equip the well casing with a drive shoe or similar protective device to prevent damage to the well casing during construction of the well.

(G) Borehole. Construct the borehole a minimum of ten and five-eighths inches (10 5/8") in diameter to the casing depth. Larger casing may be installed provided the borehole is a minimum of four inches (4") larger in diameter.

(H) Grouting. Grout the annular space of the well full length. It is the responsibility of the well installation contractor to ensure that the annular space is sealed and that the casing does not leak. This responsibility ends three (3) years after the date of approval by the department unless it can be proven that the well seal has been damaged by another person.

1. Grouting installation methods.

A. Tremie method pursuant to 10 CSR 23-3.030(1)(C)1.B.

B. Tremie pressure method pursuant to 10 CSR 23-3.030(1)(C)1.C.

C. Pressure method pursuant to 10 CSR 23-3.030(1)(C)1.D.

2. Grout materials.

A. Grout types pursuant to 10 CSR 23-3.030(1)(C)2. may be used except powdered

or granular non-slurry bentonite.

B. Other grout types may be used upon receiving prior written approval from the department.

(I) Wellhead Completion. The wellhead shall be completed pursuant to 10 CSR 23-3.050(6).

(3) High yield bedrock wells or high yield unconsolidated wells two hundred feet (200') or more in depth.

(A) Casing.

1. The minimum amount of casing shall be determined by the department in advance.

2. Install new steel casing that meets the minimum standards specified in Table 3.6 for size and weight.

3. In lieu of steel casing, unconsolidated wells two hundred feet (200') or more in depth may use Schedule 80 or Standard Dimension Ratio 21 (SDR 21) plastic casing.

4. Liners are not a substitute for casing.

5. Other design or materials may be used upon receiving prior written approval from the department.

Table 3.6 Minimum steel casing requirements for high yield bedrock wells and high yield unconsolidated wells two hundred feet (200') or more in depth.

Nominal Pipe (inches)	Outside Diameter (inches)	Wall Thickness (inches)	Weight per foot (lbs.)
6	6 ⅝	0.280	19
8	8 ⅝	0.322	29
10	10 ¾	0.365	40
12	12 ¾	0.375	50
14	14	0.375	55
16	16	0.375	63
18	18	0.375	71
20	20	0.375	79
22	22	0.500	115
24	24	0.500	125
26	26	0.500	136
28	28	0.500	147
30	30	0.500	158
32	32	0.500	168
34	34	0.500	179
36	36	0.500	190

(B) Joints, Standards, Drive shoe, Borehole, Grouting, and Wellhead Completion shall be followed pursuant to 10 CSR 23-3.030(2)(D) to 10 CSR 23-3.030(2)(I).

(4) High yield unconsolidated wells less than two hundred feet (<200').

(A) High yield unconsolidated wells less than two hundred feet (<200') in depth.

1. Install a minimum of twenty feet (20') of casing.

2. Install new steel or plastic casing that meets the minimum standards specified in Table 3.2 or Table 3.4, respectively.

3. Other design or materials may be used upon receiving prior written approval from the department.

(B) Borehole. Construct the borehole pursuant to 10 CSR 23-3.030(2)(G).

(C) Grouting. Install a ten foot (10') minimum top grout seal. It is the responsibility of the well installation contractor to ensure that the annular space is sealed and that the casing does not leak. This responsibility ends three (3) years after the date of approval by the department unless it can be proven that the annular seal has been damaged by another person.

1. Grouting installation methods.

A. Gravity method pursuant to 10 CSR 23-3.030(1)(C)1.A.

B. Tremie method pursuant to 10 CSR 23-3.030(1)(C)1.B.

C. Tremie pressure method pursuant to 10 CSR 23-3.030(1)(C)1.C.

D. Pressure method pursuant to 10 CSR 23-3.030(1)(C)1.D.

2. Grout materials.

A. Cement slurry.

B. Non-slurry bentonite.

C. Other grout types may be used upon receiving prior written approval from the department.

(D) Gravel Pack. All gravel placed into the well shall be clean, washed, and disinfected prior to placement or provisions made for disinfection in place.

(E) Wellhead Completion. Follow well casing seal and connection installation pursuant to 10 CSR 23-3.050(6).

(F) Major water users are subject to requirements pursuant to section 256.410, RSMo.

(5) Oil and gas zones.

(A) Report oil or gas encounters and the conversion of water wells to oil or gas wells pursuant to section 256.614, RSMo.

(B) Any water well that encounters oil and/or gas shall have an annular or open hole grout plug from fifty feet (50') below the oil and/or gas bearing zone to fifty feet (50') above the oil and/or gas bearing zone.

(C) The grout plug shall be composed of cement slurry with a two to six percent (2–6%) bentonite additive.

(D) The grout plug shall be placed via one (1) of the tremie methods.

AUTHORITY: sections 256.606, 256.614, 256.615, and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991; 256.614, RSMo 1985, amended 1991; 256.615, RSMo 1991; and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.040 Well Casing Seals and Connections

(Rescinded February 28, 2019)

AUTHORITY: sections 256.606 and 256.626, RSMo Supp. 1991. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Rescinded: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-3.050 Pump Installation and Wellhead Completion

PURPOSE: This rule sets specific standards as to the proper procedures for the installation of pumps, plumbing, and completion of the wellhead.

(1) Pumps and Pumping Equipment.

(A) All wells shall have a pump installed that is either surface mounted or submersible.

(B) A pump shall be constructed so that no unprotected openings into the well casing exist. A hand pump, hand pump head, stand or similar device shall have a closed spout directed downward and a pump rod that operates through a stuffing box. A power driven pump shall be attached to the casing or approved suction or discharge line by a watertight connection.

(C) Backflow Prevention.

1. A backflow prevention device shall be installed on all wells where agricultural chemical injection or other pressurized contaminant sources are used.

2. A double check-spring loaded backflow prevention device shall be installed between the point of chemical injection and the water well in accordance with the manufacturer's instructions and shall have the following:

A. A valve so that water can be drained from the system to prevent freezing;

B. A vacuum relief valve to prevent back-siphoning of chemicals into the well;

C. An automatic low pressure drain at least three-quarters inch (3/4") in diameter that drains the check valve body of water when operation of the pump is discontinued;

D. A watertight seal around the check valve;

E. An inspection port at least four inches (4") in diameter to allow inspections of the inside of the check valve; and

F. A check valve able to withstand a minimum hydraulic pressure of one hundred fifty (150) pounds per square inch (psi) without leaking and resistant to corrosion.

3. The well pump and the chemical injection pump shall be electrically or mechanically connected so that when the well pump stops, the chemical pump will shut off automatically.

(D) Electrical.

1. A permitted pump installation contractor shall perform all electrical wiring that impacts the operation of the pump or pressure system to the point of entry. Any person may perform electrical wiring on high yield wells.

2. The electric wire shall not be installed through the pitless connection and shall be grounded.

(E) Plumbing. A permitted pump installation contractor, except as exempted in section 256.607.2, RSMo, shall perform all plumbing which impacts the distribution of water from its source, through the pressure system to the point of entry. This includes, but is not limited to, pressure tanks, water treatment equipment and any other materials needed to complete the initial installation of the water system, inside and outside of the structure.

(2) Water suction lines for surface pumps shall be constructed of galvanized iron, steel, plastic, or aluminum. Other materials may be used provided advanced written approval is obtained from the department. A well seal or equivalent shall be installed between the well casing and suction pipe that is watertight.

(3) Frost proof yard hydrants shall not be installed directly on the wellhead and be securely anchored.

(4) Pump Discharge Lines.

(A) A buried discharge line from the well to the pressure tank shall not be under negative pressure during normal operation.

(B) Pump discharge ports on high yield wells shall be covered when not in use.

(5) Drop pipe shall be rigid, of sufficient strength to support the weight and torque of the pump, be able to withstand the operating water pressure, be impact and abrasion resistant, and not impart contaminants into the groundwater.

(6) Wellhead Completion.

(A) Above-ground connections shall—

1. Be a minimum of twelve inches (12") above ground surface or well house floor;

2. Have watertight piping and electrical connections that are mechanical or welded and sealed;

3. Have a protective well cap that seals tightly against the casing and has a screened vent or a casing seal that has a new rubber gasket. Cutting the rubber well seal for installation is not allowed;

4. When used, have surface driven pumps extending at least one inch (1") into the base of the motor;

5. Be provided with a minimum of one-half inch (½") diameter screened vent pointed downward;

6. Not use hubcap type well caps for permanent use; and

7. Use temporary caps until a permanent cap or well seal is installed.

(B) Below-ground connections shall—

1. Use a pitless adaptor or pitless unit of sufficient strength to withstand normal operating stress;

2. Construct the hole cut in the casing for the installation of the pitless adaptor/unit to ensure a watertight seal with the pitless adaptor/unit in place;

3. Use a protective well cap that seals tightly against the casing and has a screened vent; and

4. Have native or grout material packed tightly around the casing and discharge pipe after installation.

(7) Disinfection.

(A) The permittee shall be responsible for disinfecting a new, repaired, or reconstructed well or pump installation or replacement.

(B) The well, pressure tank, and pumping equipment shall be disinfected with chlorine to achieve a concentration of at least one hundred (100) parts per million (ppm) of chlorine.

(C) The minimum contact period before pumping the well to waste and flushing the chlorine solution from the distribution system is two (2) hours.

(D) When pulling a pump the electrical wire and drop pipe shall not touch the ground. If contamination occurs, disinfect all items prior to reinstallation.

(E) A discharge of chlorinated water to waters of the state shall be reported to the department.

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.060 Certification and Registration Reports

(Rescinded February 28, 2019)

AUTHORITY: sections 256.606, 256.614, 256.623 and 256.626, RSMo 2000. Original rule filed April 2, 1987, effective July 27, 1987. Emergency rescission and emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Rescinded and readopted: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed March 30, 2005, effective Oct. 30, 2005. Rescinded: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-3.070 Plastic Well Casing
(Rescinded February 28, 2019)

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10 CSR 23-3.080 Liners

PURPOSE: This rule sets guidelines for the use of liners in water wells.

(1) General specifications. All liners shall—

(A) Be new and follow minimum specifications in Table 3.8. Used pipe is considered new if it is salvaged within ninety (90) days of the installation of a new water well and is decontaminated.

Table 3.8 Minimum liner specifications.

Material	Wall thickness (inches)	Standard Dimension Ratio (SDR)	Schedule (SCH)
Steel	0.188	-	-
Plastic (PVC or ABS only)[1]	-	26	40

[1] Shall meet ASTM standards.

(B) Be suspended securely with a hanger or allowed to rest on bottom of the well;

(C) Be installed so that the top of the liner terminates within ten feet (10') of the top of the casing; and

(D) Be able to withstand forces encountered during installation.

(2) Packers or liner hangers when used shall be secured—

(A) For plastic liners, with screws that do not penetrate the inside of the liner; or

(B) For steel liners, with liner hangers welded or mechanically attached.

(3) Liners are used for three (3) general purposes. The following additional requirements apply based on the purpose of the liner:

(A) To hold the well bore open for any potential collapse or sloughing of loose material—

1. Grout material and packers are optional; and

2. Manufactured slotted liner, pipe-based screens, wire-wrapped liners, or manually perforated liners may be used;

(B) To prevent rust—

1. The liner shall extend from at least five feet (5') below the bottom of the casing to within ten feet (10') of the top of the casing; and

2. Shall have two (2) packers, with the first packer set within five feet (5') below the bottom of the casing and the second packer set inside the casing near the bottom; and

3. Grout material is optional; and

(C) To seal out undesirable conditions or to correct inadequate casing seals—

1. Have a minimum annular space of one-half inch (½"); and

2. Have a minimum of two (2) rubber packers secured below the bottom of the area of concern to be grouted; and

3. Have packers placed a maximum of ten feet (10') apart; and

4. Use one (1) of the following grout materials:

A. Cement slurry; or

B. Coated bentonite pellets; or

C. Other grout materials upon receiving advanced written approval by the department; and

5. Use one (1) of the following grout methods:

A. Gravity; or

B. Tremie; or

C. Other methods upon receiving advanced written approval by the department; and

6. Have a minimum thirty-foot (30') annular seal placed above the packers using specifications provided in Table 3.9; and

7. Have the top of the liner extend to within ten feet (10') of the top of casing; and

8. When used to correct inadequate casing seals, place the top packer twenty five feet (25') below the bottom of the casing. Emplace grout material from above the top packer to a minimum of five feet (5') into the casing for a total of thirty feet (30') of grout.

Table 3.9 Minimum number of bags of grout to achieve an annular grout seal of thirty feet (30') for lining water wells.

	Borehole Diameter (inches)					
	6	8	10	6	8	10
	Outer Diameter of Liner (inches)					
Type of Grout	4½"			5"		
CEMENT						
Portland Type I	2.2	6.1	11.2	1.5	5.5	10.5
Portland Type II	2.2	6.1	11.2	1.5	5.5	10.5
BENTONITE						
Pellets						
½" Baroid Pellets	3.5	9.7	17.8	2.5	8.7	16.7
⅜" Baroid Pellets	3.7	10.3	18.7	2.6	9.2	17.6
¼" Baroid Pellets	3.7	10.2	18.6	2.6	9.1	17.5
Wyo-bend Tablets	3.9	10.8	19.7	2.7	9.6	18.5
Volclay ½"	3.9	10.9	19.9	2.7	9.7	18.7
Volclay ⅜"	4.1	11.3	20.6	2.8	10.1	19.3
Volclay ¼"	4.2	11.6	21.2	2.9	10.4	20.0

(4) PVC or ABS liners are prohibited when known gasoline or solvent contamination exists within three hundred feet (300') of the well being repaired or drilled.

(5) It is the responsibility of the permittee to ensure the annulus between the borehole and liner is sealed for a period of three (3) years from the date the well construction or reconstruction is approved by the department, unless it can be proven that the annular seal has been damaged by another person. This applies to wells where the liner is installed to seal out undesirable conditions, correct inadequate grout seals of the casing annulus, and/or any other issue associated with the well casing.

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Emergency rescission and emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expire April 9, 1994. Rescinded and readopted: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.090 Drilling Areas

PURPOSE: This rule sets construction standards in addition to 10 CSR 23-3.030 Standards for Construction of Water Wells. These additional standards apply to domestic and multifamily wells and vary by geographic area based on geologic, hydrologic, and/or environmental factors (see Figure 3.1).

(1) Area 1. This area encompasses portions of southwestern, central, east central, and southeastern Missouri (see Figure 3.2).

(A) Bedrock wells.

1. A minimum of eighty feet (80') of casing shall be installed and extend a minimum of thirty feet (30') into solid bedrock. Example: if sixty feet (60') of residual material or broken rock is encountered during drilling above solid bedrock, then ninety feet (90') of casing will be installed.

2. The borehole for a domestic well shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to the casing depth.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. The annular space above the grouted interval shall be filled with clean fill.

(B) Unconsolidated material wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for a domestic well shall be a minimum of ten and five-eighths inches (10 ⅝") in diameter to the casing depth. The borehole shall be a minimum of four inches (4") larger in diameter than the casing being installed.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. Grouting Requirements.

A. The upper twenty feet (20') of casing shall be grouted. Table 3.11 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting methods and materials shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the well screen or perforated interval.

(2) Area 2. This area encompasses west central Missouri and is delineated separately because the bedrock has the potential to produce groundwater with high dissolved solids compared to other areas of the state (see Figure 3.3).

(A) Bedrock wells.

1. A minimum of forty feet (40') of casing shall be installed and extend a minimum of fifteen feet (15') into solid bedrock.

2. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to the casing depth.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(B) Unconsolidated material wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole shall be a minimum of ten and five-eighths inches (10 5/8") in diameter to the casing depth. The borehole for domestic wells shall be a minimum of four inches (4") larger in diameter.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. Grouting Requirements.

A. The upper twenty feet (20') of casing shall be grouted. Table 3.11 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the well screen or perforated interval.

(3) Area 3. This area encompasses northwestern and north central Missouri and is delineated separately because glacial till overlies bedrock that has the potential to produce groundwater with high dissolved solids compared to other areas of the state (see Figure 3.4).

(A) Bedrock wells.

1. A minimum of forty feet (40') of casing shall be installed and extend a minimum of fifteen feet (15') into solid bedrock.

2. Construct the borehole for domestic wells a minimum of eight and five-eighths inches (8 5/8") in diameter to casing depth.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. The casing shall be a minimum of five and one-half inches (5 1/2") in diameter and the borehole shall be a minimum of two inches (2") larger in diameter than the casing being installed.

5. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted. Table 3.12 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. The annular space above the grouted interval shall be filled with clean fill.

6. Shallow Bedrock Well—If usable quantities of water are not expected to be available in deeper bedrock horizons one (1) of the following construction methods may be used.

A. Method 1.

(I) A minimum of forty feet (40') of casing shall be installed pursuant to 10 CSR 23-3.030(1)(A).

(II) A minimum of one foot (1') of casing shall extend into solid bedrock.

(III) The borehole for domestic wells shall be a minimum of eight and five eighths (8 5/8") in diameter to the casing depth.

(IV) The casing shall be a minimum of five and one-half inches (5 1/2") in diameter and the borehole shall be a minimum of two inches (2") larger in diameter than the casing being installed.

(V) The lower thirty feet (30') of casing shall be grouted. Table 3.12 lists the minimum amount of grout required by type and size of annulus or open hole.

(VI) Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(VII) The annular space above the grouted interval shall be filled with clean fill.

B. Method 2.

(I) The casing shall be installed full-length pursuant to 10 CSR 23-3.030(1)(A) and perforated below twenty (20') feet across the producing horizon.

(II) The borehole for domestic wells shall be eight and five-eighths inches (8 5/8") in diameter with the upper twenty feet (20') reamed out to ten and five-eighths inches (10 5/8") in diameter.

(III) The casing shall be a minimum of five and one-half inches (5 1/2") in diameter.

(IV) The upper twenty feet (20') of annular space shall be grouted and the remainder of the borehole below the grout shall be gravel packed if a packer is not installed. Table 3.13 lists the minimum amount of grout required by type and size of annulus or open hole.

7. All construction requirements pursuant to 10 CSR 23-3.030 shall be met except as stated in 10 CSR 23-3.090(3)(A)6.

(B) Unconsolidated material wells and glacial drift wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for domestic wells shall be a minimum of ten and five-eighths inches (10 5/8") in diameter to casing depth. The borehole shall be a minimum of four inches (4") larger in diameter than the casing being installed.

3. Well casing shall be a minimum of five and one-half inches (5 1/2") in diameter.

4. Grouting Requirements.

A. The upper twenty feet (20') of casing shall be grouted. Table 3.13 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the screen or perforated interval.

(4) Area 4. This area encompasses northeastern Missouri and is delineated separately because the glacial till overlies bedrock that has the potential to produce groundwater with high dissolved solids compared to other areas of the state (see Figure 3.5).

(A) Bedrock wells.

1. A minimum of forty feet (40') of casing shall be installed and extend a minimum of fifteen feet (15') into bedrock.

2. Construct the borehole for domestic wells a minimum of eight and five-eighths inches (8 5/8") in diameter to the casing depth.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. The casing shall be a minimum of five and one-half inches (5 1/2") in diameter and the borehole shall be a minimum of two inches (2") larger in diameter than the casing being installed.

5. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. The annular space above the grouted interval shall be filled with clean fill.

6. Shallow bedrock wells - If usable quantities of water are not expected to be available in deeper bedrock horizons the following construction method may be used.

A. Method 1.

(I) A minimum of forty feet (40') of casing shall be installed pursuant to 10 CSR 23-3.030(1)(A).

(II) A minimum of one foot (1') of casing shall extend into solid bedrock.

(III) The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 5/8") in diameter to the casing depth.

(IV) The casing shall be a minimum of five and a half inches (5 1/2") in diameter and the borehole shall be a minimum of two inches (2") larger in diameter than the casing being installed.

(V) The lower thirty feet (30') of casing shall be grouted. Table 3.12 lists the minimum amount of grout required by type and size of annulus or open hole.

(VI) Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(VII) The annular space above the grouted interval shall be filled with clean fill.

7. All construction requirements pursuant to 10 CSR 23-3.030 shall be met except as stated in 10 CSR 23-3.090(4)(A)6.

(B) Unconsolidated material wells and glacial drift wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for domestic wells shall be a minimum of ten and five-eighths inches (10 ⅝") in diameter to casing depth. The borehole shall be a minimum of four inches (4") larger in diameter than the casing being installed.

3. Well casing shall be a minimum of five and one-half inches (5 ½") in diameter.

4. Grouting Requirements.

A. The upper twenty feet (20') of casing shall be grouted. Table 3.13 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the screen or perforated interval.

(5) Area 5. This area encompasses the Missouri and Mississippi River floodplains and is delineated separately because the uppermost aquifer consists of unconsolidated alluvium (see Figure 3.6).

(A) Bedrock wells.

1. A minimum of eighty feet (80') of casing shall extend a minimum of thirty feet (30') into bedrock.

2. Construct the borehole a minimum of eight and five-eighths inches (8 5/8") in diameter to the casing depth.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. The lowermost thirty feet (30') of casing shall be grouted pursuant to 10 CSR 23-3.030(1)(C). Table 3.10 lists the minimum amount of grout by type and size of annulus or open hole. The annular space above the grouted interval shall be filled with clean fill.

(B) Unconsolidated material wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for domestic wells shall be a minimum of four inches (4") larger than the casing diameter installed. Unconsolidated material wells that have a casing diameter less than four inches (<4") in diameter are exempt from these rules.

3. The upper twenty feet (20') of casing shall be grouted pursuant to 10 CSR 23-3.030(1)(C). Table 3.14 lists the minimum amount of grout required by type and size of annulus or open hole.

4. A chlorinated gravel pack may be placed into the annular space adjacent to the well screen or native materials may be allowed to collapse against the screen or perforated interval.

5. All construction requirements pursuant to 10 CSR 23-3.030 shall be met except as stated in 10 CSR 23-3.090(5)(B)2. and 3.

(6) Area 6. This area encompasses the St. Francois Mountains and is delineated separately because igneous bedrock, which has low permeability, occurs close to the ground surface (Figure 3.7).

(A) Bedrock wells.

1. Bedrock wells where granite is less than one hundred feet (<100') below the surface.

A. A minimum of forty feet (40') of casing shall be installed and extend a minimum of fifteen feet (15') into solid bedrock. Example: If sixty feet (60') of residual material or broken rock is encountered during drilling above solid bedrock, then seventy-five feet (75') of casing shall be installed.

B. Construct the borehole for domestic wells a minimum of eight and five-eighths inches (8 ⅝") in diameter to the casing depth.

C. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

D. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole. The annular space above the grouted interval shall be filled with clean fill.

E. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

2. Bedrock wells where granite is one hundred feet or more (≥100') below the surface.

A. A minimum of eighty feet (80') of casing shall be installed and shall extend a minimum of thirty feet (30') into solid bedrock.

B. Construct the borehole for domestic wells a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

C. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

D. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole. The annular space above the grouted interval shall be filled with clean fill.

E. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(B) Unconsolidated material wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for domestic wells shall be a minimum of ten and five-eighths inches (10 ⅝") in diameter. The borehole shall be a minimum of four inches (4") larger in diameter than the casing being installed.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. The upper twenty feet (20') of casing shall be grouted. Table 3.11 lists the minimum amount of grout required by type and size of annulus or open hole.

5. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

6. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the well screen or perforated interval.

(7) Area 7 (formerly Sensitive Area A). This area encompasses Osage, Gasconade, Maries, and parts of Phelps, Crawford, and Franklin counties and is delineated separately because it is overlain in part by Pennsylvanian-aged bedrock which is capable of producing groundwater with high dissolved solids (see Figure 3.2).

(A) Bedrock Wells.

1. A minimum of eighty feet (80') of casing shall be installed and extend a minimum of thirty feet (30') into solid bedrock. Example: If sixty feet (60') of residual material or broken rock is encountered during drilling above solid bedrock, then ninety feet (90') of casing shall be installed.

2. In areas where Pennsylvanian-age strata (shale, sandstone, and/or clay) are present, a minimum of one hundred fifty feet (150') of casing shall be installed and extend at least thirty feet (30') below the Pennsylvanian age strata (shale, sandstone, and/or clay).

3. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

4. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

5. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. The annular space above the grouted interval shall be filled with clean fill.

(B) Unconsolidated material wells.

1. A minimum of twenty feet (20') of casing shall be installed above the screened or perforated interval.

2. The borehole for domestic wells shall be a minimum of ten and five-eighths inches (10 ⅝") in diameter and a minimum of four inches (4") larger in diameter than the casing being installed.

3. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

4. Grouting Requirements.

A. The upper twenty feet (20') of casing shall be grouted. Table 3.11 lists the minimum amount of grout required by and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. A chlorinated gravel pack may be placed into the annular space or native materials may be allowed to collapse against the well screen or perforated interval.

(8) Area 8 (formerly Sensitive Area B). This area encompasses a one-quarter (¼) mile buffer from the twenty foot (20') water depth contour line of major lakes in Missouri (see Figure 3.2).

(A) The major lakes include:

1. Truman;
2. Stockton;
3. Table Rock;
4. Bull Shoals;
5. Lake of the Ozarks;
6. Pomme de Terre;
7. Norfolk; and
8. Clearwater.

(B) Bedrock Wells.

1. Casing shall be installed fifty feet (50') below the deepest point of the lake within one-quarter (¼) mile radius of the well location. Casing shall not be less than the minimum requirements outlined in Drill Area 1 (10 CSR 23.090(1)) a minimum of eighty feet (80') and extend thirty feet (30') into bedrock. Formula: well site elevation (feet) – deepest lake elevation within one-quarter (¼) mile (feet) + fifty feet (50') = casing depth. Example: 1000' (well site elevation) - 850' (deepest lake elevation within one-quarter (¼) mile) + 50' = 200' casing depth.

2. A casing point may be requested prior to drilling in Drill Area 8.

3. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

4. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

5. When plastic casing is used liner shall not be used in lieu of casing.

6. When steel casing is used and the minimum casing depth cannot be achieved due to geologic reasons, casing shall be installed to a minimum of eighty feet (80') extending a minimum of thirty feet (30') into bedrock and a liner used to achieve the remaining casing depth provided the following requirements are met:

A. Have a minimum annular space of one-half inch (½");

B. Have a minimum of two (2) three-(3-) ribbed rubber packers (K-packers) secured at or below the bottom of the minimum casing depth;

C. Have the top of the liner extend to within ten feet (10') of the top of casing;

D. Have packers placed a maximum of ten feet (10') apart;

E. Grout pursuant to 10 CSR 23-3.090(8)(B)7. using the gravity or tremie grouting method using cement slurry or coated bentonite pellets; and

F. Liner specifications shall be followed pursuant to 10 CSR 23-3.080(1), (2), (4), and (5).

7. Grouting Requirements.

A. The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

B. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

C. The annular space above the grouted interval shall be filled with clean fill.

(C) Unconsolidated material wells. The unconsolidated requirements for the Drill Area adjacent to the lake apply.

(9) Area 9 (formerly Sensitive Area C). This area encompasses Greene and parts of Christian county where rapid urbanization is occurring in a sensitive geologic and hydrologic setting. The upper aquifer (Springfield Plateau Aquifer) and lower aquifer (Ozark Aquifer) are separated by low-permeability bedrock (Ozark Confining Unit). This low-permeability bedrock limits migration of groundwater and any associated contamination from the upper aquifer to the lower aquifer (see Figure 3.2).

(A) Bedrock Wells.

1. The casing shall be installed a minimum of ten feet (10') below the Ozark Confining Unit or as indicated in the digital geospatial dataset "DRILL AREAS" developed by the Missouri Department of Natural Resources, Missouri Geological Survey. Hard copies may be obtained by contacting the Missouri Department of Natural Resources, Missouri Geological Survey, 111 Fairgrounds Road, Rolla, MO 65401.

2. A casing point request may be submitted to the department.

3. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

4. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

5. When plastic casing is used liner shall not be used in lieu of casing.

6. When steel casing is used and the minimum casing depth cannot be achieved due to geologic reasons, casing shall be installed to a minimum of one hundred feet (100') extending a minimum of thirty feet (30') into bedrock and a liner used to achieve the remaining casing depth provided the following requirements are met:

A. Have a minimum annular space of one-half inch (½");

B. Have a minimum of two (2) three-(3-) ribbed rubber packers (K-packers) secured at or below the bottom of the Ozark Confining Unit pursuant to 10 CSR 23-3.090(9)(A)1.;

C. Have the top of the liner extend to within ten feet (10') of the top of casing;

D. Have packers placed a maximum of ten feet (10') apart;

E. Grout pursuant to 10 CSR 23-3.090(9)(A)7. using the gravity or tremie grouting method using cement slurry or coated bentonite pellets; and

F. Liner specifications shall be followed pursuant to 10 CSR 23-3.080(1), (2), (4), and (5).

7. Grouting Requirements.

A. The Ozark Confining Unit shall be grouted from ten feet (10') below the formation to the top of the shale and at a minimum the lowermost thirty feet (30') of casing shall be grouted.

B. When the casing extends more than ten feet (10') below the bottom of the Ozark Confining Unit, more than thirty feet (30') of grout will be required to seal off the Ozark Confining Unit.

C. Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

D. The annular space above the grouted interval shall be filled with clean fill.

(B) Unconsolidated material wells. The unconsolidated requirements for Drill Area 1 apply.

(10) Area 10 (formerly Special Area 1). This area encompasses a portion of southeastern Missouri and is composed of deeply weathered and highly fractured bedrock where openings may be filled with mud extending deep into bedrock (see Figure 3.8).

(A) Bedrock Wells.

1. A minimum of eighty feet (80') of casing shall be installed and extend a minimum of fifteen feet (15') into solid bedrock. Example: If sixty feet (60') of residual material or broken rock is encountered during drilling above solid bedrock, then seventy five feet (75') of casing shall be installed. If solid bedrock is not encountered within one hundred and fifty feet (150') the contractor may consult the department for further instructions regarding a variance or install casing into deeper solid bedrock.

2. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

3. In areas where poor drilling conditions exist and it is necessary to drive multiple strings of smaller diameter casing through the surface casing, each succeeding smaller diameter casing shall extend into the preceding casing at least twenty feet (20').

4. Install new steel casing pursuant to 10 CSR 23-3.030(1)(A).

5. Grouting Requirements.

A. If casing is driven, see 10 CSR 23-3.030(1)(D) for liner and grouting requirements.

B. If casing is not driven, the lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

(I) Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(II) The annular space above the grouted interval shall be filled with clean fill.

(B) If unconsolidated material wells are drilled in Area 10, Drill Area 1 requirements for unconsolidated wells apply.

(11) Area 11 (formerly Special Area 2). This area encompasses Newton and Jasper County and is delineated separately due to the contamination of portions of the upper aquifer by one (1) or more of the following: lead, cadmium, chlorinated VOCs including TCE, TCE degradation products, or other contaminants pursuant to 10 CSR 60-4. The upper aquifer (Springfield Plateau Aquifer) and lower aquifer (Ozark Aquifer) are separated by low-permeability bedrock (Ozark Confining Unit). This low-permeability bedrock limits migration of groundwater and any associated contamination from the upper aquifer to the lower aquifer (see Figure 3.2).

(A) Bedrock Wells.

1. Consult the digital geospatial dataset "DRILL AREAS" developed by the Missouri Department of Natural Resources, Missouri Geological Survey. Hard copies may be obtained by contacting the Missouri Department of Natural Resources, Missouri Geological Survey, 111 Fairgrounds Road, Rolla, MO 65401. This dataset identifies the maximum well depth for wells completed in the upper aquifer; the required casing depth for a lower aquifer well; and Impact Areas.

2. Wells outside of Impact Areas may be installed in the upper aquifer provided they do not penetrate the Ozark Confining Unit; or wells may be installed and cased/sealed through the Ozark Confining Unit and open to only the lower aquifer.

3. New upper aquifer wells outside of Impact Areas.

A. Total depth of the well shall not penetrate the Ozark Confining Unit and not exceed the upper depth indicated digital geospatial dataset "DRILL AREAS".

B. A minimum of eighty feet (80') of casing shall be installed and extend a minimum of thirty feet (30') into solid bedrock. Example: If sixty feet (60') of residual material or broken rock is encountered during drilling above solid bedrock, then ninety feet (90') of casing will be installed.

C. The borehole for domestic wells shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

D. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

E. Grouting Requirements.

(I) The lowermost thirty feet (30') of casing shall be grouted. Table 3.10 lists the minimum amount of grout required by type and size of annulus or open hole.

(II) Grouting materials and methods shall be followed pursuant to 10 CSR 23-3.030(1)(C).

(III) The annular space above the grouted interval shall be filled with clean fill.

F. New upper aquifer wells shall follow sampling requirements pursuant to 10 CSR 23-3.090(11)(A)6.

4. New lower aquifer wells outside of the Impact Areas.

A. The casing shall be installed a minimum of ten feet (10') below the Ozark Confining Unit or to the lower depth indicated on the digital geospatial dataset "DRILL AREAS".

B. A casing point request may be submitted to the department.

C. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

D. If steel casing is used, the borehole shall be a minimum of eight and five-eighths inches (8 ⅝") in diameter to casing depth.

E. When steel casing is used and the minimum casing depth cannot be achieved due to geologic reasons, casing shall be installed to a minimum of eighty feet (80') extending thirty feet (30') into bedrock and a liner used to achieve the remaining casing depth provided the following requirements are met:

(I) Have a minimum annular space of one-half inch (½");

(II) Have a minimum of two (2) three- (3-) ribbed rubber packers (K-packers) secured at or below the bottom of the Ozark Confining Unit pursuant to 10 CSR 23-3.090(11)(A)4.A.;

(III) Have the top of the liner extend to within ten feet (10') of the top of casing;

(IV) Have packers placed a maximum of ten feet (10') apart;

(V) Grout pursuant to 10 CSR 23-3.090(11)(A)4.G. from the top packer to extend ten feet (10') inside the casing using the gravity or tremie grouting method using cement slurry or coated bentonite pellets; and

(VI) Liner specifications shall be followed pursuant to 10 CSR 23-3.080(1), (2), (4), and (5).

F. If plastic casing is used, the borehole shall be a minimum of ten inches (10") in diameter to the casing depth. When plastic casing is used liner shall not be used in lieu of casing.

G. Grouting Requirements.

(I) Full length grout is required.

(II) Grouting methods shall be Tremie Pressure, Pressure, or Positive Displacement pursuant to 10 CSR 23-3.030(1)(C)1.C., 10 CSR 23-3.030(1)(C)1.D., and 10 CSR 23-3.030(1)(C)1.F.

(III) Grouting materials shall be cement slurry or high-solids bentonite slurry.

(IV) Wells with eighty feet (80') of casing may use grouting materials and methods pursuant to 10 CSR 23-3.030(1)(C).

H. All construction requirements pursuant to 10 CSR 23-3.030 shall be met except as provided in 10 CSR 23-3.090(11)(A)4.G.

5. Major reconstruction of wells in Area 11 that involve exceeding the upper depth indicated in the digital geospatial dataset "DRILL AREAS" or penetrating the Ozark Confining Unit requires advanced written approval from the department.

6. Sampling Requirements for new upper aquifer wells.

A. Water sampling and analysis shall be performed for lead, cadmium, TCE and its degradation products for new wells.

B. Permitted pump installers and owners who self-install pumps are responsible for ensuring sampling is completed according to laboratory sampling protocol and submitting sample results within sixty (60) days of pump installation.

C. The laboratory that analyzes the sample shall be certified by the EPA or the department for such analyses.

D. Prior to sampling, the well shall be purged continuously for a minimum of two (2) hours and water samples collected from the tap closest to the well.

E. All new upper aquifer wells shall be constructed with a sampling port or tap within twenty feet (20') of the wellhead.

F. If an upper aquifer well contains levels of lead, cadmium, TCE or its degradation products that are above MCL or AL, the well shall—

(I) Be plugged full length with approved grout material; or

(II) Be reconstructed and sealed through the Ozark Confining Unit pursuant to 10 CSR 23-3.090(11)(A)5.

7. Well installation in Impact Areas.

A. The casing shall be installed a minimum of ten feet (10') below the Ozark Confining Unit or to the lower depth indicated in the digital geospatial dataset "DRILL AREAS".

B. A casing point request may be submitted to the department.

C. Install new casing pursuant to 10 CSR 23-3.030(1)(A).

D. The borehole shall be a minimum of ten inches (10") in diameter to casing depth.

E. Grouting Requirements.

(I) Full length grout is required.

(II) Grouting methods shall be Tremie Pressure, Pressure, or Positive Displacement pursuant to 10 CSR 23-3.030(1)(C)1.C., 10 CSR 23-3.030(1)(C)1.D., and 10 CSR 23-3.030(1)(C)1.F.

(III) Grouting materials shall be cement slurry or high-solids bentonite slurry.

(B) Unconsolidated Material Wells.

1. If unconsolidated material wells are drilled in Area 11 outside of Impact areas, Drill Area 1 requirements for unconsolidated wells apply.

2. Advanced written approval from the department is required if unconsolidated material wells are drilled in Impact Areas.

(12) Area 12 (formerly Special Area 3). This area encompasses portions of Franklin County within and south of the city of New Haven and is delineated separately due to the contamination of portions of the aquifer by one (1) or more of the following known contaminants: tetrachloroethylene or perchloroethylene (PCE), trichloroethylene (TCE), TCE degradation products, and may include other contaminants pursuant to 10 CSR 60-4. It is necessary to implement more stringent well construction standards for new wells that are drilled into the aquifer and to limit the deepening of existing upper aquifer wells (see Figure 3.9).

(A) New Wells.

1. Prior written approval and construction specifications shall be obtained from the department for any new wells constructed in Area 12.

2. Water sampling for contaminants will be required pursuant to 10 CSR 23-3.090(12)(C).

3. Drilling shall cease and the department is to be notified immediately if PCE or TCE is encountered above the maximum contaminant level (MCL) or action level (AL). The department will determine further action.

(B) Reconstruction of Existing Wells.

1. Prior written approval and reconstruction specifications shall be obtained from the department for any reconstructed wells in Area 12.

2. Water sampling for contaminants will be required pursuant to 10 CSR 23-3.090(12)(C). Wells that are contaminated at levels exceeding maximum contaminant levels (MCLs) and/or action levels (ALs) shall not be deepened.

3. Drilling shall cease and the department is to be notified immediately if PCE or TCE is encountered above the maximum contaminant level (MCL) or action level (AL) during reconstruction. The department will determine further action.

(C) Water Sampling.

1. Groundwater sampling for contaminants is required according to laboratory sampling protocol for any new well or reconstruction and methods will be established on a case-by-case basis by the department.

2. The well installation contractor is responsible for ensuring sampling is conducted throughout the drilling process and results submitted in accordance with pre-approved department sampling methods. Final sampling of the well shall be completed by the pump installation contractor within sixty (60) days of pump installation. Wells will not be certified or registered until all sampling has been completed.

3. Sampling and analysis shall be performed for known contaminants listed in 10 CSR 23-3.090(12) and other contaminants as determined by the department.

4. The laboratory that analyzes the sample shall be certified by the EPA or the department for analyses being requested.

5. All new and deepened wells shall be constructed with a sampling port or tap at or before the pressure tank within twenty feet (20') of the wellhead.

(D) Plugging.

1. Wells shall be plugged full length using bentonite slurry or cement grout via one (1) of the tremie methods.

2. All plugging requirements in 10 CSR 23-3.110 shall be met except as required in 10 CSR 23-3.090(12)(D).

(E) All drilling-derived fluids, displaced water, and solid materials shall be containerized and sampled before disposal in accordance with federal, state, and local regulations based on analytical results.

(F) Any completed (new or reconstructed) well in which PCE and/or TCE is encountered at levels above MCL and/or AL shall be plugged full-length pursuant to 10 CSR 23-3.090(12)(D).

(13) Area 13 (formerly Special Area 4). This area encompasses portions of St. Charles County west of the city of Weldon Spring and is delineated separately due to contamination of portions of the aquifer by one (1) or more of the following known contaminants listed by source in Table 3.15. In this area it is necessary to implement more stringent well construction standards for new wells that are drilled into the aquifer and to limit the deepening of existing upper aquifer wells (see Figure 3.10).

Table 3.15. Known contaminants of Drill Area 13 by source.

Source	Known Contaminants[1]
U.S. Army	2,4,6-TNT, 2,4-DNT, 2,6-DNT, dinitrobenzene (1,3-DNB), nitrobenzene (NB), ortho-nitrotoluene (o-NT), meta-nitrotoluene (m-NT), para-nitrotoluene (p-NT)
Department of Energy Main Site	2,4,6-TNT, 2,4-DNT, 2,6-DNT, dinitrobenzene (1,3-DNB), nitrobenzene (NB), nitrate, uranium, and trichloroethylene (TCE)
Department of Energy Quarry	uranium and 2,4-DNT

[1]May also include other contaminants pursuant to 10 CSR 60-4.

(A) New Wells.

1. Prior written approval and construction specifications shall be obtained from the department for any wells constructed in Area 13.

2. Water sampling for contaminants will be required pursuant to 10 CSR 23-3.090(13)(C).

3. Drilling shall cease and the department is to be notified immediately if contaminants listed in Table 3.15 or other contaminants pursuant to 10 CSR 60-4 are encountered at levels above the maximum contaminant level (MCL), action level (AL), remedial goals stated in the Record of Decisions, and/or the risk-based value(s) calculated in the most recent site five- (5-) year review. The department will determine further action.

(B) Reconstruction of Existing Wells.

1. Prior written approval and construction specifications shall be obtained from the department for any reconstructed wells in Area 13.

2. Groundwater sampling for contaminants listed in Table 3.15 or other contaminants pursuant to 10 CSR 60-4 will be required in advance of any deepening. Wells that are contaminated at levels exceeding maximum contaminant level (MCL), action level (AL), remedial goals stated in the Record of Decisions, and/or the risk-based value(s) calculated in the most recent site five- (5-) year review shall not be deepened.

3. Any well approved to be deepened which encounters contaminants listed in Table 3.15 or other contaminants pursuant to 10 CSR 60-4 at levels above maximum contaminant level (MCL), action level (AL), remedial goals stated in the Record of Decisions, and/or the risk-based value(s) calculated in the most recent site five- (5-) year review, drilling shall cease and the department shall be notified immediately. The department will determine further action.

(C) Water Sampling.

1. Groundwater sampling for contaminants is required according to laboratory sampling protocol for any new well or reconstruction and methods will be established on a case-by-case basis by the department.

2. The well installation contractor is responsible for ensuring sampling is conducted throughout the drilling process and results submitted in accordance with pre-approved department sampling methods. Final sampling of the well shall be completed by the pump installation contractor within sixty (60) days of pump installation. Wells will not be certified or registered until all sampling has been completed.

3. Sampling and analysis shall be performed for contaminants listed in Table 3.15.

4. The laboratory that analyzes the sample shall be certified by the EPA or the department for such analyses.

5. All new and deepened wells shall be constructed with a sampling port or tap at or before the pressure tank within twenty feet (20') of the wellhead.

(D) Plugging.

1. Wells shall be plugged full length using bentonite slurry or cement grout via one (1) of the tremie methods.

2. All plugging requirements in 10 CSR 23-3.110 shall be met except as required in 10 CSR 23-3.090(13)(D).

(E) All drilling-derived fluids, displaced water, and solid materials shall be containerized and sampled before disposal in accordance with federal, state, and local regulations based on analytical results.

(F) Any completed (new or reconstructed) well in which contaminants listed in Table 3.15 or other contaminants pursuant to 10 CSR 60-4 are encountered at levels above the maximum contaminant level (MCL), action level (AL), remedial goals stated in the Record of Decisions, and/or the risk-based value(s) calculated in the most recent site five- (5-) year review shall be plugged full-length (10 CSR 23-3.090(13)(D)) or with approval from the department the well owner may be allowed to use the well provided groundwater quality will not be degraded further.

(G) Notwithstanding these provisions, the federal government does not waive its rights and authority under federal law, regulations, or executive order within the boundaries and applicable jurisdiction of federal property.

Table 3.10 All Drilling Areas (Bedrock Water Wells). Minimum Number of Bags of Grout Required in Annular Space (Ann.) or Open Hole (O.H.) for Sealing Casing with a Minimum Grout Seal of Thirty Feet (30').

CASING OUTER DIAMETER 6 5/8" (6" NOMINAL) -- APPLIES TO ALL DRILLING AREAS

Type of Grout	Borehole Diameter (inches)													
	8 5/8		8 3/4		9		9 1/2		10		10 5/8		12 5/8	
	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.
CEMENT														
Portland Type I	4.3	10.4	4.6	10.7	5.2	11.3	6.5	12.6	7.8	14.0	9.6	15.8	16.2	22.3
Portland Type III	4.3	10.4	4.6	10.7	5.2	11.3	6.5	12.6	7.8	14.0	9.6	15.8	16.2	22.3
BENTONITE														
Pellets														
½" Baroid Pellets	6.8	16.6	7.3	17.1	8.3	18.0	10.3	20.1	12.5	22.3	15.4	25.2	25.7	35.5
⅜" Baroid Pellets	7.2	17.5	7.7	18.0	8.7	19.0	10.9	21.2	13.2	23.5	16.2	26.5	27.1	37.4
¼"Baroid Pellets	7.1	17.4	7.6	17.9	8.7	18.9	10.8	21.1	13.1	23.4	16.1	26.4	27.0	37.3
Wyo-Bend Tablets	7.5	18.4	8.1	18.9	9.2	20.0	11.4	22.3	13.9	24.7	17.0	27.9	28.5	39.3
Volclay ½"	7.6	18.6	8.2	19.1	9.3	20.2	11.6	22.6	14.0	25.0	17.2	28.2	28.9	39.8
Volclay ⅜"	7.9	19.2	8.4	19.7	9.6	20.9	12.0	23.3	14.5	25.8	17.8	29.1	29.8	41.1
Volclay ¼"	8.1	19.8	8.7	20.4	9.9	21.6	12.3	24.0	14.9	26.6	18.4	30.0	30.8	42.4
Chips														
Baroid HolePlug	7.2	17.7	7.8	18.2	8.8	19.2	11.0	21.4	13.3	23.7	16.4	26.8	27.4	37.8
Wyo-Bend Coarse	6.1	14.8	6.5	15.2	7.4	16.1	9.2	18.0	11.2	19.9	13.7	22.5	23.0	31.7
Wyo-Bend Medium	6.3	15.3	6.7	15.7	7.6	16.7	9.5	18.6	11.5	20.6	14.2	23.2	23.8	32.8
Volclay Coarse	6.7	16.4	7.2	16.8	8.2	17.8	10.2	19.9	12.3	22.0	15.2	24.8	25.4	35.1
Volclay Medium	6.9	16.8	7.4	17.3	8.4	18.3	10.5	20.4	12.7	22.6	15.6	25.5	26.1	36.0
Granular														
Benseal	6.3	15.3	6.7	15.8	7.7	16.7	9.6	18.6	11.6	20.6	14.2	23.3	23.8	32.9
Wyo-bend No. 8	6.1	14.8	6.5	15.2	7.4	16.1	9.2	18.0	11.2	19.9	13.7	22.5	23.0	31.7
Wyo-bend No. 16	6.1	14.8	6.5	15.2	7.4	16.1	9.2	18.0	11.2	19.9	13.7	22.5	23.0	31.7
Slurry														
Baroid	1.5	3.6	1.6	3.7	1.8	3.9	2.3	4.4	2.7	4.9	3.4	5.5	5.6	7.7
Hi-yield	1.1	2.7	1.2	2.8	1.3	2.9	1.7	3.3	2.0	3.6	2.5	4.1	4.2	5.8
Wyo-bend	1.6	3.8	1.7	3.9	1.9	4.2	2.4	4.6	2.9	5.1	3.6	5.8	5.9	8.2
Volclay	1.4	3.5	1.5	3.6	1.7	3.8	2.2	4.2	2.6	4.6	3.2	5.3	5.4	7.4

Table 3.11 All Drilling Areas (Unconsolidated Water Wells). Minimum Number of Bags of Grout Required in Annular Space (Ann.) or Open Hole (O.H.) for Sealing Casing with a Minimum Upper Grout Seal of Twenty Feet (20').

CASING OUTER DIAMETER 6 ⅝" (6" NOMINAL) – APPLIES TO ALL DRILLING AREAS

Type of Grout	Borehole Diameter (inches)													
	10 ⅝		12 ⅝		14 ⅝		16		18		20		24	
	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.
CEMENT														
Portland Type I	6.4	10.5	10.8	14.9	15.9	20.0	19.8	23.9	26.1	30.2	33.2	37.3	49.6	53.7
Portland Type III	6.4	10.5	10.8	14.9	15.9	20.0	19.8	23.9	26.1	30.2	33.2	37.3	49.6	53.7
BENTONITE														
Pellets														
½" Baroid Pellets	10.3	16.8	17.2	23.7	25.3	31.8	31.5	38.0	41.6	48.1	52.9	59.4	79.0	85.6
⅜" Baroid Pellets	10.8	17.7	18.1	25.0	26.6	33.5	33.2	40.1	43.8	50.7	55.7	62.6	83.3	90.2
¼"Baroid Pellets	10.8	17.6	18.0	24.9	26.5	33.4	33.0	39.9	43.6	50.5	55.5	62.3	82.9	89.8
Wyo-Bend Tablets	11.4	18.6	19.0	26.3	28.0	35.2	34.9	42.1	46.1	53.3	58.6	65.8	87.6	94.8
Volclay ½"	11.5	18.8	19.3	26.6	28.3	35.7	35.3	42.7	46.7	54.0	59.3	66.7	88.7	96.0
Volclay ⅜"	11.9	19.4	19.9	27.4	29.2	36.8	36.4	44.0	48.1	55.7	61.2	68.8	91.4	99.0
Volclay ¼"	12.2	20.0	20.5	28.3	30.2	38.0	37.6	45.4	49.7	57.5	63.2	71.0	94.4	102.2
Chips														
Baroid HolePlug	10.9	17.9	18.3	25.2	26.9	33.9	33.6	40.5	44.3	51.3	56.3	63.3	84.2	91.1
Wyo-Bend Coarse	9.2	15.0	15.3	21.2	22.6	28.4	28.1	34.0	37.2	43.0	47.3	53.1	70.6	76.4
Wyo-Bend Medium	9.5	15.5	15.9	21.9	23.3	29.4	29.1	35.1	38.4	44.4	48.8	54.9	73.0	79.0
Volclay Coarse	10.1	16.6	17.0	23.4	24.9	31.4	31.1	37.5	41.1	47.5	52.2	58.7	78.0	84.5
Volclay Medium	10.4	17.0	17.4	24.0	25.6	32.3	32.0	38.6	42.2	48.8	53.7	60.3	80.2	86.8
Granular														
Benseal	9.5	15.5	15.9	21.9	23.4	29.4	29.2	35.2	38.5	44.6	49.0	55.0	73.2	79.2
Wyo-bend No. 8	9.2	15.0	15.3	21.2	22.6	28.4	28.1	34.0	37.2	43.0	47.3	53.1	70.6	76.4
Wyo-bend No. 16	9.2	15.0	15.3	21.2	22.6	28.4	28.1	34.0	37.2	43.0	47.3	53.1	70.6	76.4
Slurry														
Baroid	2.2	3.7	3.7	5.2	5.5	6.9	6.9	8.3	9.1	10.5	11.5	13.0	17.2	18.7
Hi-yield	1.7	2.7	2.8	3.9	4.1	5.2	5.1	6.2	6.8	7.8	8.6	9.7	12.9	13.9
Wyo-bend	2.4	3.9	4.0	5.5	5.8	7.3	7.3	8.8	9.6	11.1	12.2	13.7	18.2	19.7
Volclay	2.1	3.5	3.6	4.9	5.3	6.6	6.6	7.9	8.7	10.0	11.0	12.4	16.5	17.8

Table 3.12 Drilling Areas 3 and 4 (Bedrock or Shallow Bedrock Wells Method 1 Using Five and One-half Inch (5 ½") Casing Diameter). Minimum Number of Bags of Grout Required in Annular Space (Ann.) or Open Hole (O.H.) for Sealing Casing with a Minimum Grout Seal of Thirty Feet (30').

CASING OUTER DIAMETER 5 ½" (5" NOMINAL) – APPLIES TO DRILLING AREAS 3 AND 4 ONLY

Type of Grout	Borehole Diameter (inches)					
	9 ½		10		10 ⅝	
	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.
CEMENT						
Portland Type I	8.4	12.6	9.8	14.0	11.6	15.8
Portland Type III	8.4	12.6	9.8	14.0	11.6	15.8
BENTONITE						
Pellets						
½" Baroid Pellets	13.4	20.1	15.5	22.3	18.4	25.2
⅜" Baroid Pellets	14.1	21.2	16.4	23.5	19.4	26.5
¼" Baroid Pellets	14.0	21.1	16.3	23.4	19.3	26.4
Wyo-Bend Tablets	14.8	22.3	17.2	24.7	20.4	27.9
Volclay ½"	15.0	22.6	17.4	25.0	20.7	28.2
Volclay ⅜"	15.5	23.3	18.0	25.8	21.3	29.1
Volclay ¼"	16.0	24.0	18.6	26.6	22.0	30.1
Chips						
Baroid Hole Plug	14.2	21.4	16.6	23.7	19.6	26.8
Wyo-Bend Coarse	11.9	18.0	13.9	19.9	16.5	22.5
Wyo-Bend Medium	12.3	18.6	14.3	20.6	17.0	23.2
Volclay Coarse	13.2	19.9	15.3	22.0	18.2	24.9
Volclay Medium	13.6	20.4	15.8	22.6	18.7	25.5
Granular						
Benseal	12.4	18.6	14.4	20.6	17.1	23.3
Wyo-bend No. 8	11.9	18.0	13.9	19.9	16.5	22.5
Wyo-bend No. 16	11.9	18.0	13.9	19.9	16.5	22.5
Slurry						
Baroid	2.9	4.4	3.4	4.9	4.0	5.5
Hi-yield	2.2	3.3	2.5	3.6	3.0	4.1
Wyo-Bend	3.1	4.6	3.6	5.1	4.3	5.8
Volclay	2.8	4.2	3.2	4.6	3.8	5.3

Table 3.13 Drilling Areas 3 and 4 (Unconsolidated or Shallow Bedrock Water Wells Method 2 Using Five and One-half Inch (5 ½") Casing Diameter). Minimum Number of Bags of Grout Required in the Annular Space (Ann.) or Open Hole (O.H.) for Sealing Casing for with a Minimum Upper Grout Seal of Twenty (20').

CASING OUTER DIAMETER 5 ½" (5" NOMINAL) – APPLIES TO DRILLING AREAS 3 AND 4 ONLY.

Type of Grout	Borehole Diameter (inches)													
	10 ⅝		12 ⅝		14 ⅝		16		18		20		24	
	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.	Ann.	O.H.
CEMENT														
Portland Type I	7.7	10.5	12.1	14.9	17.1	20.0	20.0	23.9	27.4	30.2	34.5	37.3	50.9	53.7
Portland Type III	7.7	10.5	12.1	14.9	17.1	20.0	20.0	23.9	27.4	30.2	34.5	37.3	50.9	53.7
BENTONITE														
Pellets														
½" Baroid Pellets	12.3	16.8	19.2	23.7	27.3	31.8	31.5	38.0	43.6	48.1	54.9	59.4	81.1	85.6
⅜" Baroid Pellets	13.0	17.7	20.2	25.0	28.8	33.5	33.2	40.1	46.0	50.7	57.9	62.6	85.4	90.2
¼"Baroid Pellets	12.9	17.6	20.1	24.9	28.6	33.4	33.1	39.9	45.8	50.5	57.6	62.3	85.0	89.8
Wyo-Bend Tablets	13.6	18.6	21.3	26.3	30.2	35.2	34.9	42.1	48.3	53.3	60.8	65.8	89.8	94.8
Volclay ½"	13.8	18.8	21.5	26.6	30.6	35.7	35.4	42.7	49.0	54.0	61.6	66.7	91.0	96.0
Volclay ⅜"	14.2	19.4	22.2	27.4	31.6	36.8	36.5	44.0	50.5	55.7	63.6	68.8	93.8	99.0
Volclay ¼"	14.7	20.0	22.9	28.3	32.6	38.0	37.6	45.4	52.1	57.5	65.6	71.0	96.8	102
Chips														
Baroid HolePlug	13.1	17.9	20.5	25.2	29.1	33.9	33.6	40.5	46.5	51.3	58.5	63.3	86.4	91.1
Wyo-Bend Coarse	11.0	15.0	17.2	21.2	24.4	28.4	28.1	34.0	39.0	43.0	49.1	53.1	72.4	76.4
Wyo-Bend Medium	11.3	15.5	17.7	21.9	25.2	29.4	29.1	35.1	40.3	44.4	50.7	54.9	74.8	79.0
Volclay Coarse	12.1	16.6	19.0	23.4	27.0	31.4	31.1	37.5	43.1	47.5	54.2	58.7	80.0	84.5
Volclay Medium	12.5	17.0	19.5	24.0	27.7	32.3	32.0	38.6	44.3	48.8	55.7	60.3	82.2	86.8
Granular														
Benseal	11.4	15.5	17.8	21.9	25.3	29.4	29.2	35.2	40.4	44.6	50.8	55.0	75.0	79.2
Wyo-bend No. 8	11.0	15.0	17.2	21.2	24.4	28.4	28.1	34.0	39.0	43.0	49.1	53.1	72.4	76.4
Wyo-bend No. 16	11.0	15.0	17.2	21.2	24.4	28.4	28.1	34.0	39.0	43.0	49.1	53.1	72.4	76.4
Slurry														
Baroid	2.7	3.7	4.2	5.2	6.0	6.9	6.9	8.3	9.5	10.5	12.0	13.0	17.7	18.7
Hi-yield	2.0	2.7	3.1	3.9	4.4	5.2	5.1	6.2	7.1	7.8	8.9	9.7	13.2	13.9
Wyo-bend	2.8	3.9	4.4	5.5	6.3	7.3	7.3	8.8	10.1	11.1	12.7	13.7	18.7	19.7
Volclay	2.6	3.5	4.0	4.9	5.7	6.6	6.6	7.9	9.1	10.0	11.5	12.4	16.9	17.8

Table 3.14 Drill Area 5 (Unconsolidated Water Wells Using Four and One-half Inch (4 ½") Casing Diameter). Minimum Number of Bags of Grout Required in Annular Space (Ann.) or Open Hole (O.H.) for Sealing Casing with a Minimum Upper Grout Seal of Twenty Feet (20').

CASING OUTER DIAMETER 4 ½" (4" NOMINAL) – APPLIES TO DRILLING AREA 5 ONLY

Type of Grout	Borehole Diameter (inches)			
	8 ½		9	
	Ann.	O.H.	Ann.	O.H.
CEMENT				
Portland Type I	4.8	6.7	5.7	7.6
Portland Type III	4.8	6.7	5.7	7.6
BENTONITE				
Pellets				
½" Baroid Pellets	7.7	10.7	9.0	12.0
⅜" Baroid Pellets	8.1	11.3	9.5	12.7
¼" Baroid Pellets	8.1	11.3	9.5	12.6
Wyo-Bend Tablets	8.6	11.9	10.0	13.3
Volclay ½"	8.7	12.0	10.1	13.5
Volclay ⅜"	8.9	12.4	10.4	13.9
Volclay ¼"	9.2	12.8	10.8	14.4
Chips				
Baroid Hole Plug	8.2	11.4	9.6	12.8
Wyo-Bend Coarse	6.9	9.6	8.1	10.7
Wyo-Bend Medium	7.1	9.9	8.3	11.1
Volclay Coarse	7.6	10.6	8.9	11.9
Volclay Medium	7.8	10.9	9.2	12.2
Granular				
Benseal	7.2	9.9	8.4	11.1
Wyo-bend No. 8	6.9	9.6	8.1	10.7
Wyo-bend No. 16	6.9	9.6	8.1	10.7
Slurry				
Baroid	1.7	2.3	2.0	2.6
Hi-yield	1.3	1.7	1.5	2.0
Wyo-Bend	1.8	2.5	2.1	2.8
Volclay	1.6	2.2	1.9	2.5

Figure 3.1 All Drilling Areas.

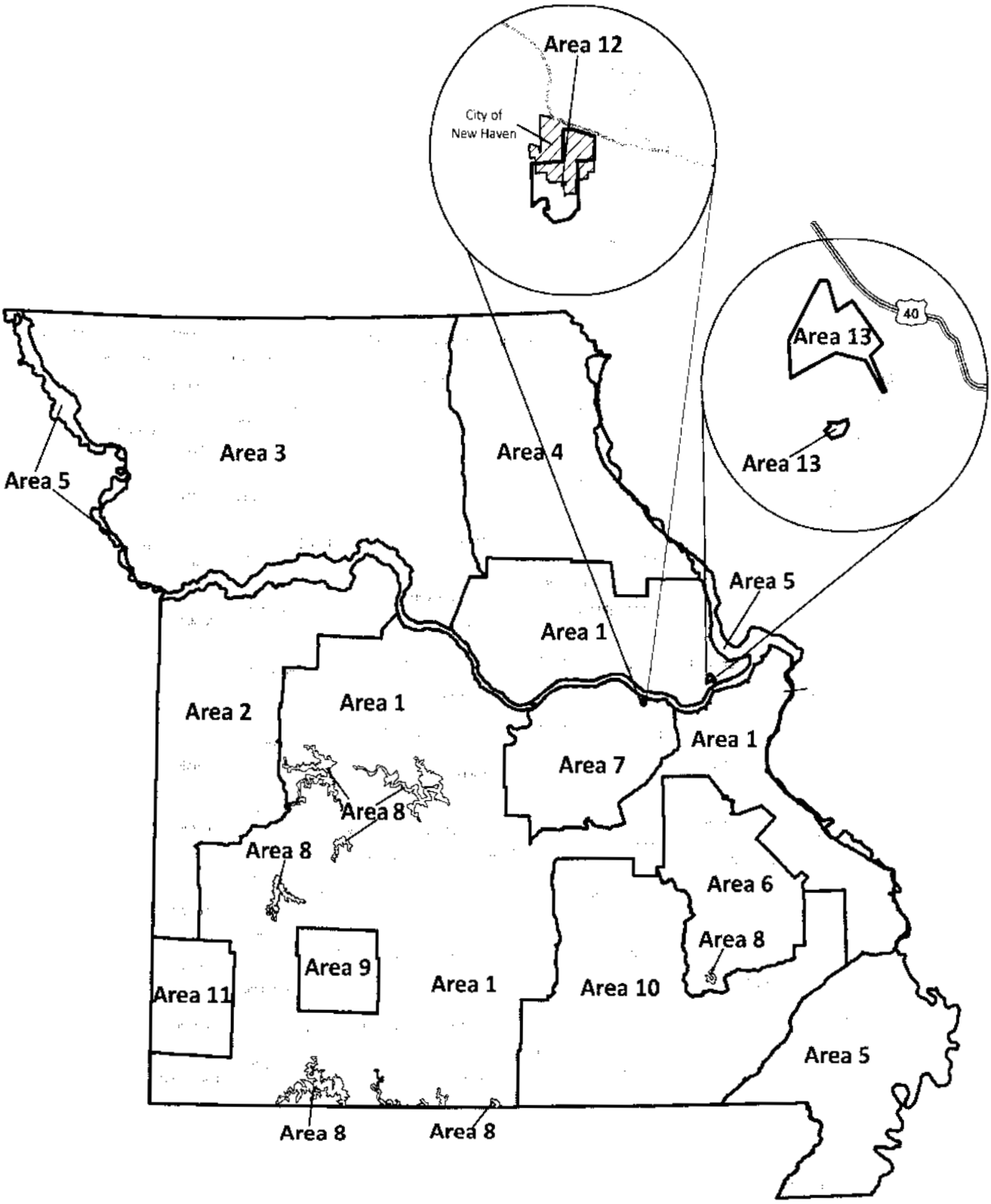


Figure 3.2 Drilling Areas 1, 7, 8, 9, and 11.

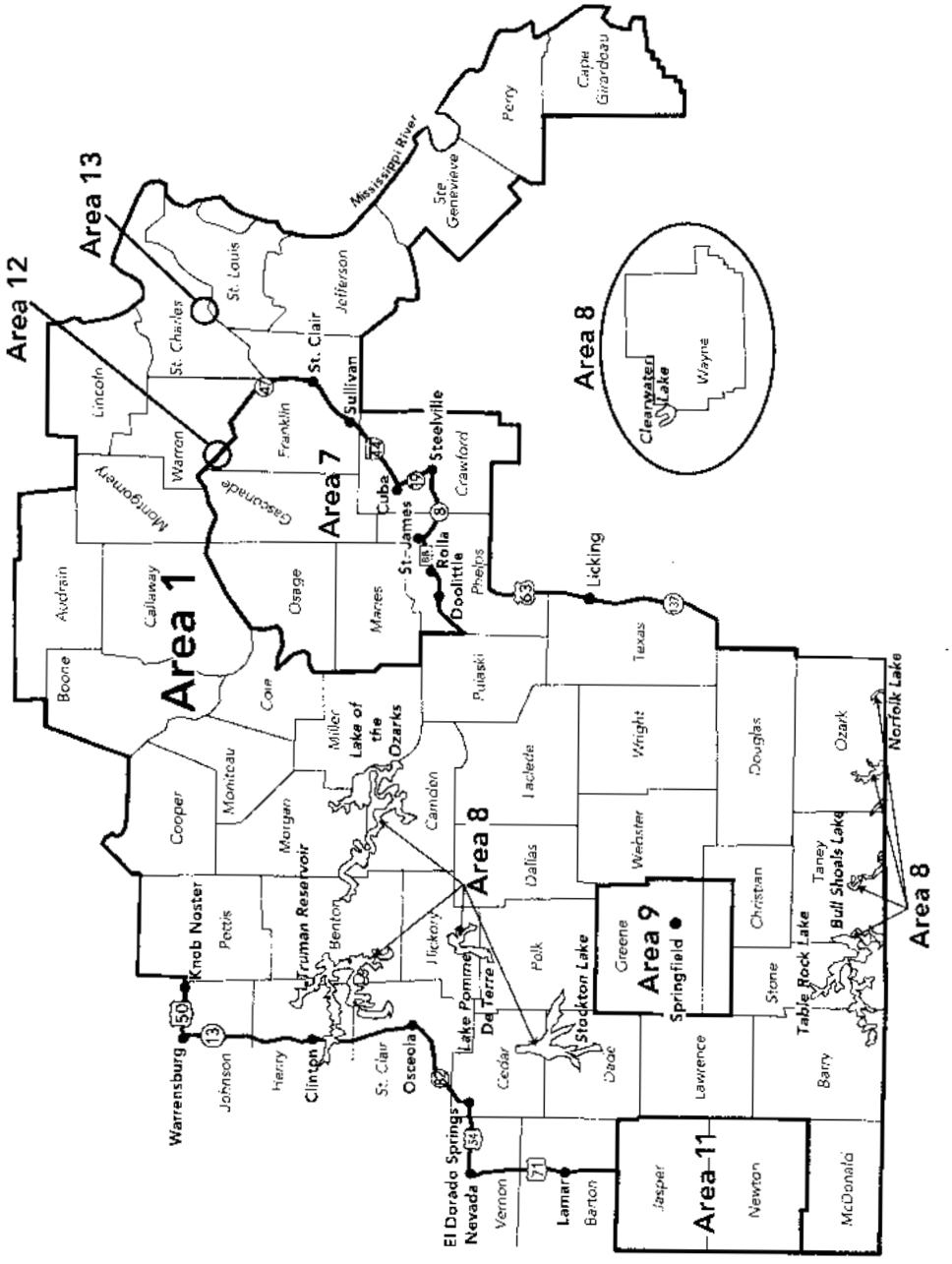


Figure 3.3 Drilling Area 2.

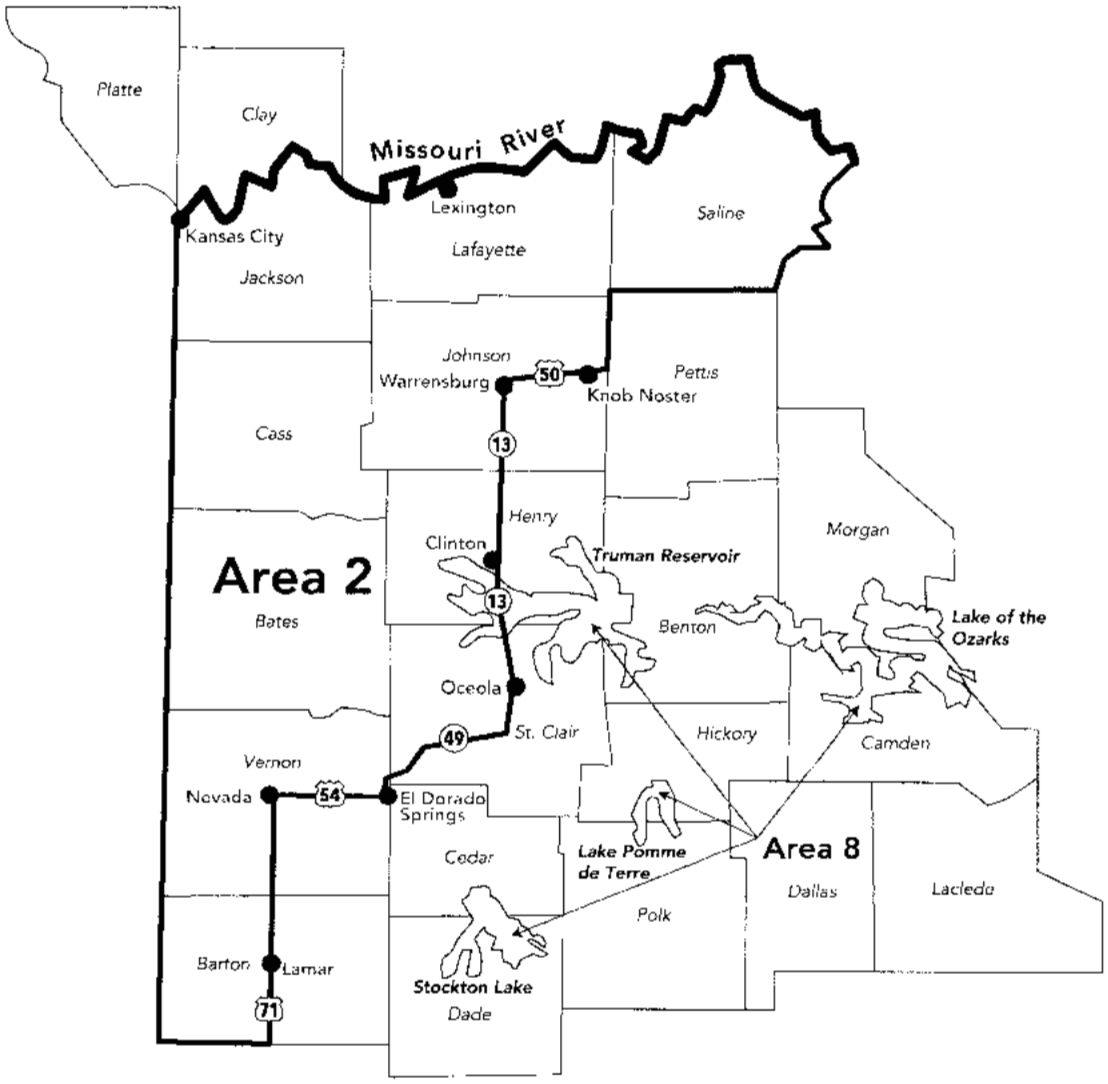


Figure 3.4 Drilling Area 3.

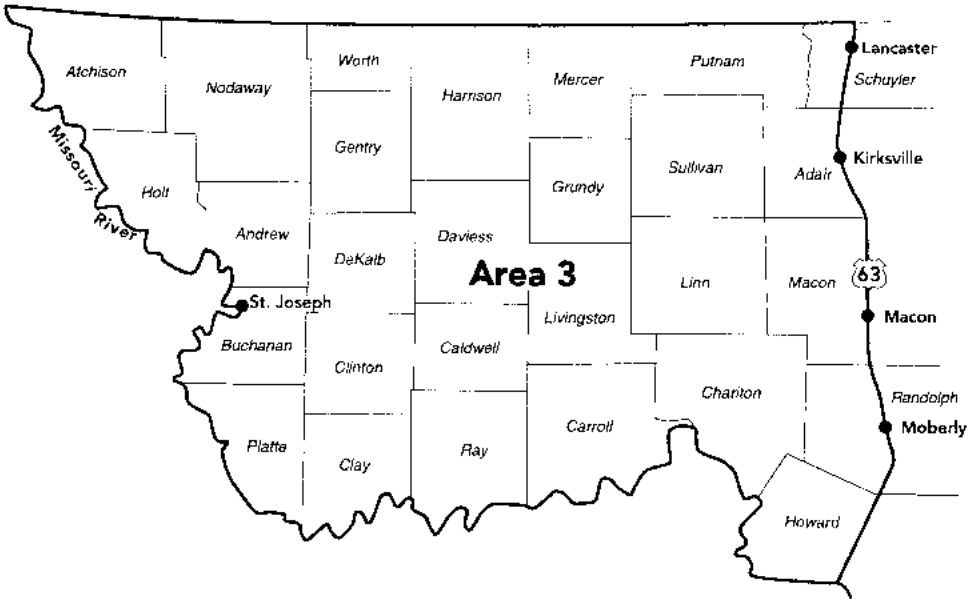


Figure 3.5 Drilling Area 4.

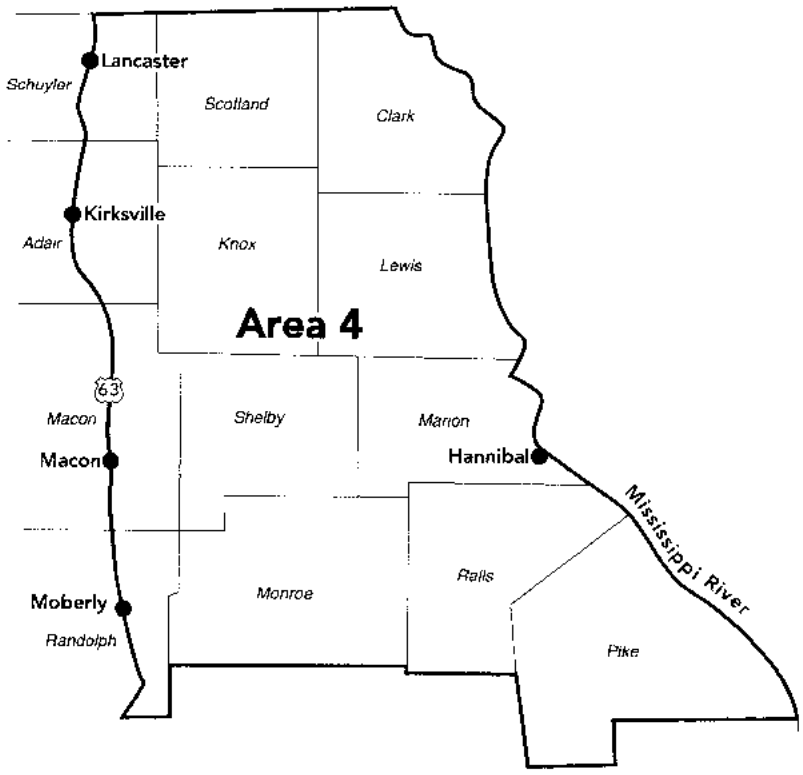


Figure 3.6 Drilling Area 5. This area includes the alluvial plains of the Missouri and Mississippi rivers.

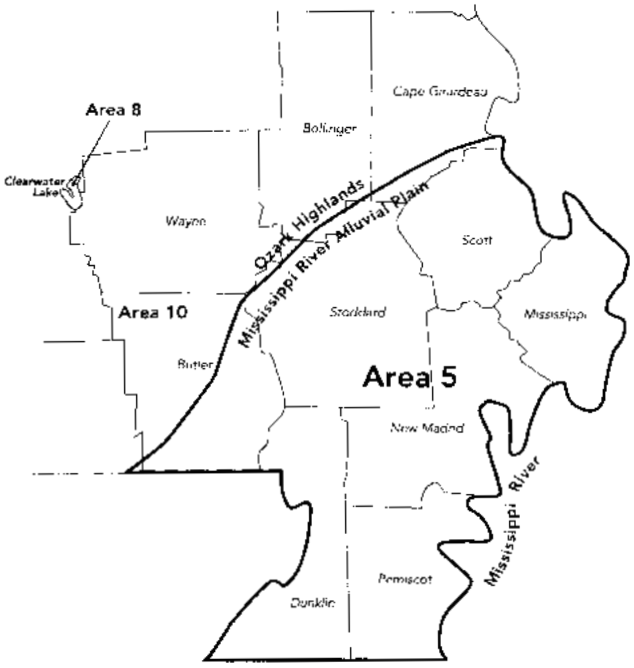


Figure 3.7 Drilling Area 6.

Figure 3.8 Drilling Area 10.

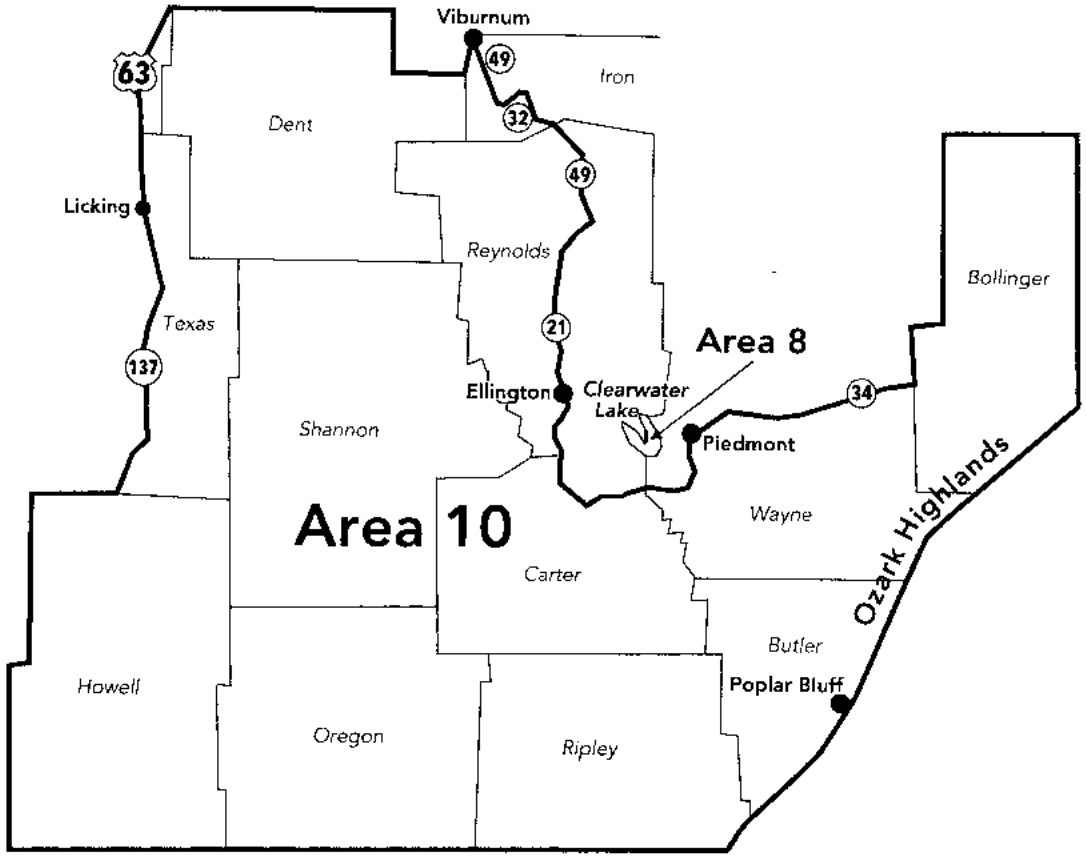


Figure 3.9 Drilling Area 12.

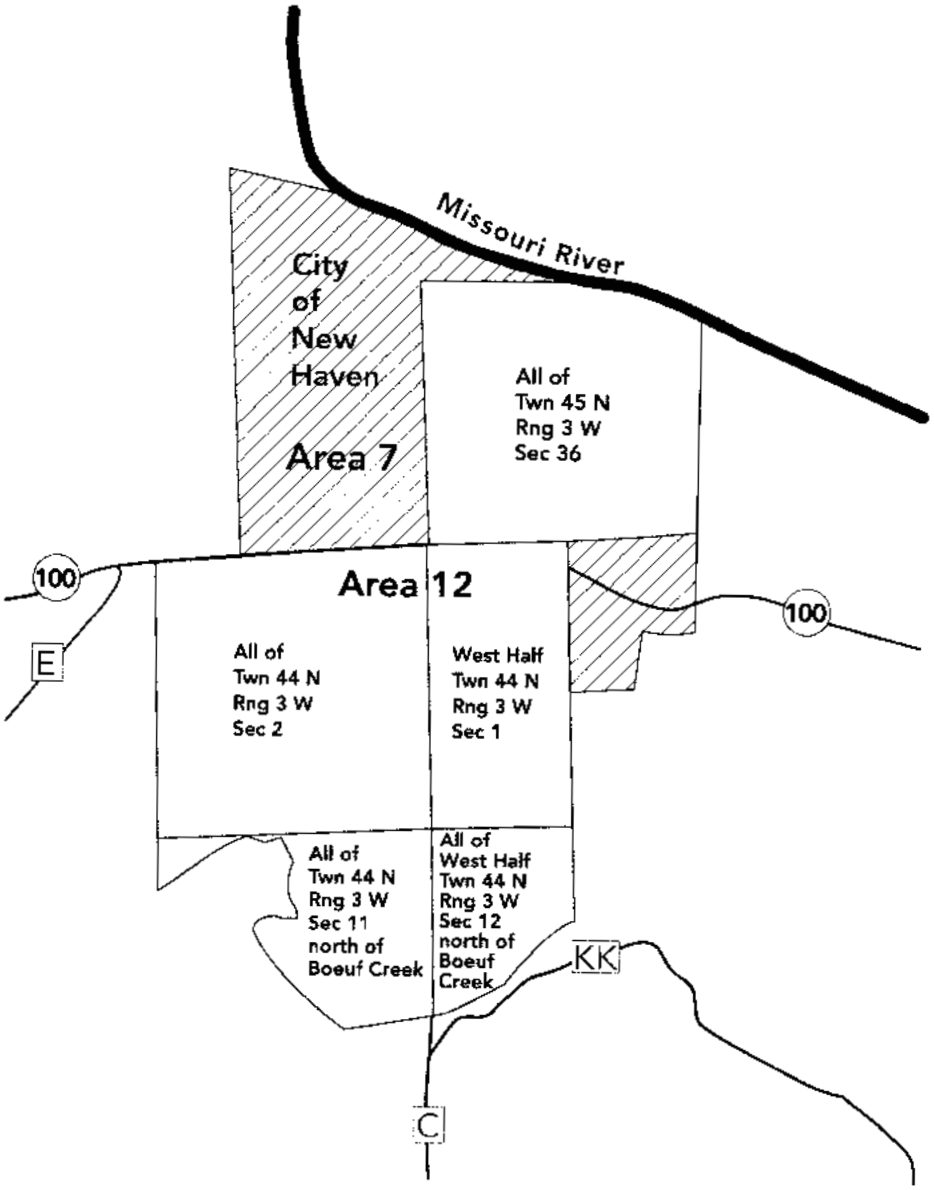
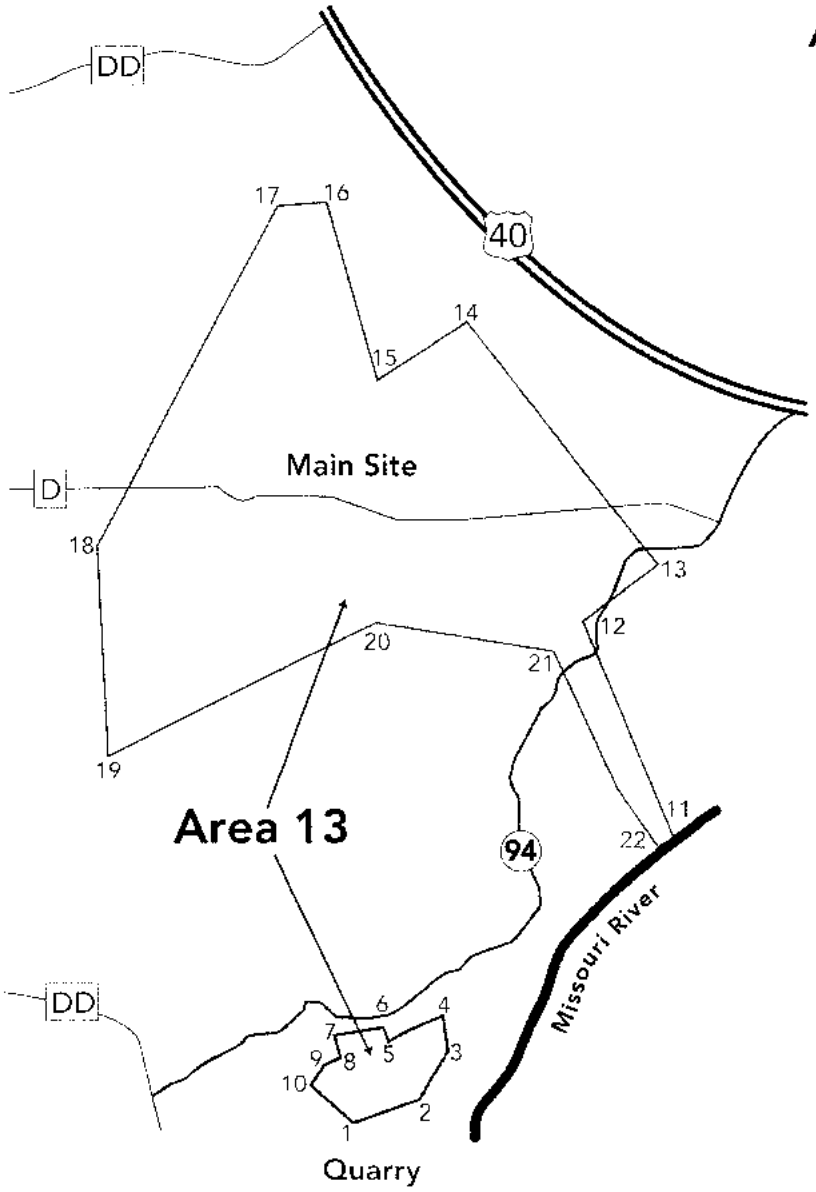


Figure 3.10 Drilling Area 13.



Area Boundary Points

	LAT	LONG
1	38 39' 03"	90 45' 13"
2	38 39' 10"	90 44' 44"
3	38 39' 26"	90 44' 32"
4	38 39' 37"	90 44' 33"
5	38 39' 30"	90 44' 58"
6	38 39' 33"	90 44' 59"
7	38 39' 32"	90 45' 19"
8	38 39' 25"	90 45' 16"
9	38 39' 22"	90 45' 22"
10	38 39' 18"	90 45' 29"
11	38 40' 28"	90 42' 58"
12	38 41' 31"	90 43' 32"
13	38 41' 52"	90 43' 02"
14	38 43' 11"	90 44' 15"
15	38 42' 53"	90 44' 54"
16	38 43' 49"	90 45' 13"
17	38 43' 50"	90 45' 33"
18	38 42' 02"	90 46' 52"
19	38 40' 53"	90 46' 49"
20	38 41' 37"	90 44' 57"
21	38 41' 22"	90 43' 44"
22	38 40' 24"	90 43' 04"

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-3.100 Sensitive Areas
(Rescinded February 28, 2019)

AUTHORITY: sections 256.606 and 256.626, RSMo 2000. Original rule filed April 2, 1987, effective July 27, 1987. Emergency amendment filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Amended: Filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed April 23, 2001, effective Dec. 30, 2001. Emergency amendment filed March 21, 2005, effective April 1, 2005, expired Sept. 27, 2005. Amended: Filed Sept. 27, 2005, effective April 30, 2006. Amended: Filed Jan. 4, 2007, effective Aug. 30, 2007. Amended: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-3.110 Plugging of Water Wells

PURPOSE: This rule establishes standards for plugging a water well.

(1) General Plugging Requirements for Water Wells.

(A) Abandoned wells shall be plugged in accordance with these rules pursuant to sections 256.603(1) and 256.615, RSMo. If a well presents a contamination threat to groundwater, the department may order that the well be plugged.

(B) A permittee shall report to the department any unplugged abandoned wells existing on property where the permittee performed work under these rules.

(C) The well owner shall be responsible for plugging abandoned wells or causing the well to be plugged, except as follows:

1. When the permittee improperly locates, constructs, or completes a well, then the permittee is be responsible for plugging the well unless the department has set a timeframe for remediation of the well;

2. A dry hole shall be plugged within thirty (30) days and a plugging registration record submitted. A certification record is not required; or

3. Wells that produce saline water shall be plugged within thirty (30) days and a plugging registration record submitted. A certification record is not required.

(2) General Plugging Methods.

(A) A well that is to be plugged shall be disconnected from the water distribution system and the borehole sealed to prevent contaminants from entering an aquifer or prevent aquifer mixing.

(B) Contaminated wells shall be plugged by a permitted contractor. The department shall be consulted for plugging specifications. Groundwater sampling may be required.

(C) Wells contaminated by bacteria only may be plugged by the well owner.

(D) Wells that have an unknown casing depth shall be plugged full length with grout materials pursuant to 10 CSR 23-3.110(2)(E).

(E) Grout Materials—

1. Cement slurry;
2. Bentonite;
3. Bentonite slurry; or
4. Other approved grout.

(F) Grout Placement Methods—

1. Tremie;
2. Reverse tremie;
3. Gravity; or
4. Pressure.

(G) The top portion of the casing shall be removed and the excavated area filled by well type pursuant to 10 CSR 23-3.110(3).

(H) New or existing wells that have unusual conditions, includes but not limited to, contamination, a liner, a foreign object, or pump stuck in the borehole shall be plugged full length by a permitted contractor using cement, emplacing the cement grout by one (1) of the following methods: tremie, tremie pressure, or reverse tremie. Alternate plugging methods may be used upon advanced written approval by the department.

(3) Domestic and Multifamily Water Well Plugging Requirements.

(A) Hand dug and augered wells less than eighty feet (< 80') in depth may be plugged by the landowner or a non-permitted person.

1. Remove the pump, pipe, debris, and surface covering.

2. Remove at a minimum the top one foot (1') of well lining unless the well is located in an agricultural setting where the removal of well lining shall be three feet (3') below ground surface. Lining may be composed of rock, brick, tile, tin, or clay pipe.

3. Disinfect the well. If water is in the well, add chlorine to the water pursuant to 10 CSR 23-3.050(7). If no water is in the well, disinfect the fill material as it is placed into the well.

4. Fill the well with clean fill from total depth to one foot (1') from ground surface or if in an agricultural setting three feet (3') from ground surface.

5. Fill the remaining hole with clay or clay-rich soil. Soil should be mounded slightly to help offset settling.

(B) Unconsolidated material wells.

1. Remove the pump, pipe, and any debris from the well.

2. Remove the top two feet (2') of casing. If well is located in an agricultural setting remove the top three feet (3') of casing below ground surface. Excavate the area at least two feet (2') in diameter larger than the existing casing. If the well casing is surrounded by a concrete pad or asphalt, the casing may be cut off flush.

3. Disinfect the well. If water is in the well, add chlorine to the water pursuant to 10 CSR 23-3.050(7). If no water is in the well, disinfect the fill material as it is placed into the well.

4. Add clean fill.

A. Wells less than or equal to two hundred feet (≤ 200') total depth, add clean fill from total depth to approximately twenty feet (20') below ground surface.

B. Wells greater than two hundred feet (200') total depth, add clean fill from total depth to approximately fifty feet (50') below ground surface.

5. Add grout plug.

A. Wells less than or equal to two hundred feet (≤200') total depth, add grout from top of clean fill to one foot (1') below ground surface in yard or non-agricultural setting or three feet (3') below ground surface in an agricultural setting. Grout plug shall total twenty feet (20').

B. Wells greater than two hundred feet (>200') total depth, add grout from top of fill to one foot (1') below ground surface in yard or non-agricultural setting or three feet (3') below ground surface in agricultural setting. Grout plug shall total fifty feet (50').

6. Add soil or clean fill.

A. Completely fill the excavated area above the grout plug with soil or clean fill.

B. If the well casing is surrounded by a concrete pad or asphalt, fill the top one foot (1') of casing above the grout plug with cement grout or quick-setting concrete.

7. If the well casing and screen are removed from the well, native material is allowed to collapse into the borehole; fill any remaining borehole with grout and add a minimum one foot (1') soil cap in a yard or non-agricultural setting or a three foot (3') soil cap in an agricultural setting.

(C) Bedrock wells.

1. Remove the pump, pipe, liner, and debris from well. If any item is left in the well, see 10 CSR 23-3.110(2)(H) for plugging requirements.

2. Remove the top two feet (2') of casing. If well is located in an agricultural setting remove the top three feet (3') of casing below ground surface. Excavate the area at least two feet (2') in diameter larger than the existing casing. If the well casing is surrounded by a concrete pad or asphalt, the casing may be cut off flush. If the top two feet (2') of casing cannot be removed due to encountering bedrock or hard impervious material when digging around the casing, cut the casing flush with the top of bedrock or impervious material.

3. Disinfect the well. If water is in the well, add chlorine to the water pursuant to 10 CSR 23-3.050(7). If no water is in the well, disinfect the fill material as it is placed into the well.

4. Add clean fill. If the well is not filled full length with grout, then fill the well from total depth to fifty feet (50') below the bottom of the casing with clean fill.

5. Add a grout plug. Place a grout plug on top of clean fill from a point fifty feet (50') below the bottom of the casing completely filling the casing to one foot (1') below ground surface.

6. Add soil or clean fill. Fill the excavated area above the grout plug and with soil. Clean fill may be used to fill the excavated area above the grout plug if the well site is to be paved. If the well casing is surrounded by a concrete pad or asphalt, then fill the top one foot (1') of casing with cement grout or quick-setting concrete.

7. For a well with greater than eighty feet (>80') of casing the well may be plugged as follows.

A. Add clean fill. Fill the well with clean fill from total depth to fifty feet (50') below the bottom of the casing.

B. Add a lower grout plug. The lower grout plug shall extend from fifty feet (50') below the bottom of the casing to at least thirty feet (30') into the casing.

C. Add clean fill. Clean fill may be added on top of the lower grout plug and extend to fifty feet (50') below ground surface.

D. Add an upper grout plug. The upper grout plug shall extend from the top of clean fill (fifty feet (50') below ground surface) to one foot (1') below ground surface.

E. Add soil or clean fill pursuant to 10 CSR 23-3.110(3)(C)6.

8. For a well that has greater than one hundred feet (>100') of standing water, the grout plug shall be emplaced by one (1) of the following methods: tremie, tremie pressure, reverse tremie, or gravity. If the gravity method is used only bentonite chips or pellets are allowed and shall be added slowly to avoid bridging. For reverse tremie, pour the cement slurry in one (1) continuous operation. For all methods, the tremie pipe shall be no greater than twenty feet (20') from the bottom of the well or the top of the fill material.

9. If the borehole does not have casing, the borehole may be filled with clean fill from total depth to fifty feet (50') below ground surface. From fifty feet (50') to within one foot (1') of ground surface, the borehole shall be filled with grout. Fill the top one foot (1') with soil or clean fill pursuant to 10 CSR 23-3.110(3)(C)6.

(4) High Yield Well Plugging Requirements.

(A) Bedrock Wells.

1. All high yield wells may be plugged using the following method without prior approval from the department.

A. Remove all materials from the well prior to plugging.

B. Cut the casing two feet (2') below ground surface or flush with bedrock if encountered. If the well is located in an agricultural setting remove the top three feet (3') of casing below ground surface.

C. Disinfect the well. If water is in the well, add chlorine to the water pursuant to 10 CSR 23-3.050(7).

D. Fill the well full length from total depth to the top of casing with cement slurry using one (1) of the tremie or reverse tremie methods.

E. Fill the remaining hole above the cut off casing with soil or fill material.

2. Other methods including the use of fill material may be used upon receiving advanced written approval by the department.

(B) Unconsolidated wells.

1. Wells two hundred feet or less (≤200') in total depth may be plugged as follows:

A. Remove all materials prior to plugging;

B. Cut the casing two feet (2') below ground surface. If well is located in an agricultural setting remove the top three feet (3') of casing below ground surface;

C. Fill the well from total depth to twenty feet (20') from surface with disinfected clean fill;

D. Plug the upper twenty feet (20') with bentonite or cement grout; and

E. Fill the remaining hole above the cut off casing with soil or fill material.

2. Wells greater than two hundred feet (>200') total depth may be plugged pursuant to 10 CSR 23-3.110(3)(B).

3. Other plugging materials and methods may be used upon receiving advanced written approval by the department.

(5) Inactive Water Wells may remain unplugged for a period no longer than five (5) years from the date the well became inactive provided the well owner obtains written approval from the department.

(A) Certified wells. Upon approval of inactive water well status, the pump must be removed and the wellhead provided with a permanent steel plate welded or a PVC cap glued. At the end of the five (5) year period, the well is considered abandoned and shall be plugged if not in service pursuant to 10 CSR 23-3.110.

(B) Noncertified wells. Prior to approval of inactive water well status, the following shall be completed:

1. The well owner or permitted pump installation contractor shall remove the pump;

2. Allow the department to inspect the well by use of a downhole camera;

3. Protect the wellhead by a permanent steel plate welded or a PVC cap glued; and

4. The well casing length shall meet the construction requirement for the drill area the well is located in.

(C) The department will deny the request for inactive status if any of the requirements listed under 10 CSR 23-3.110(4)(B) are not met, the well does not meet minimum construction standards, or the well is found to be in a state of disrepair.

1. The well owner may reconstruct the well to meet minimum construction standards. Once the reconstruction report is approved, the well owner may reapply for inactive well status.

2. If the well is not operational at the end of the five (5) year period, the well is considered abandoned and shall be plugged if not in service pursuant to 10 CSR 23-3.110.

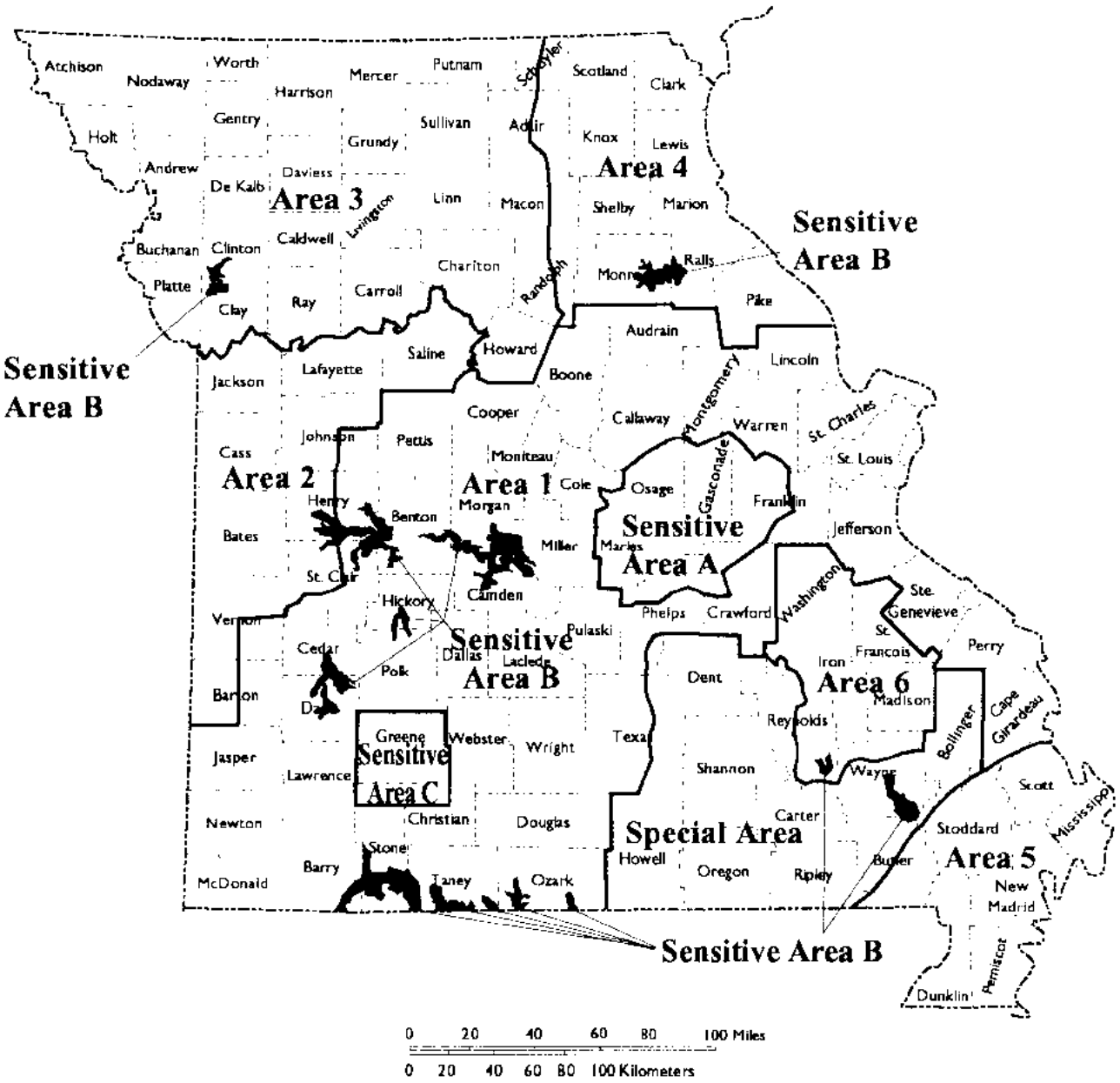


Figure 1. Map showing drilling areas for private well construction regulations. Areas are enlarged in maps on following pages.

Area 2

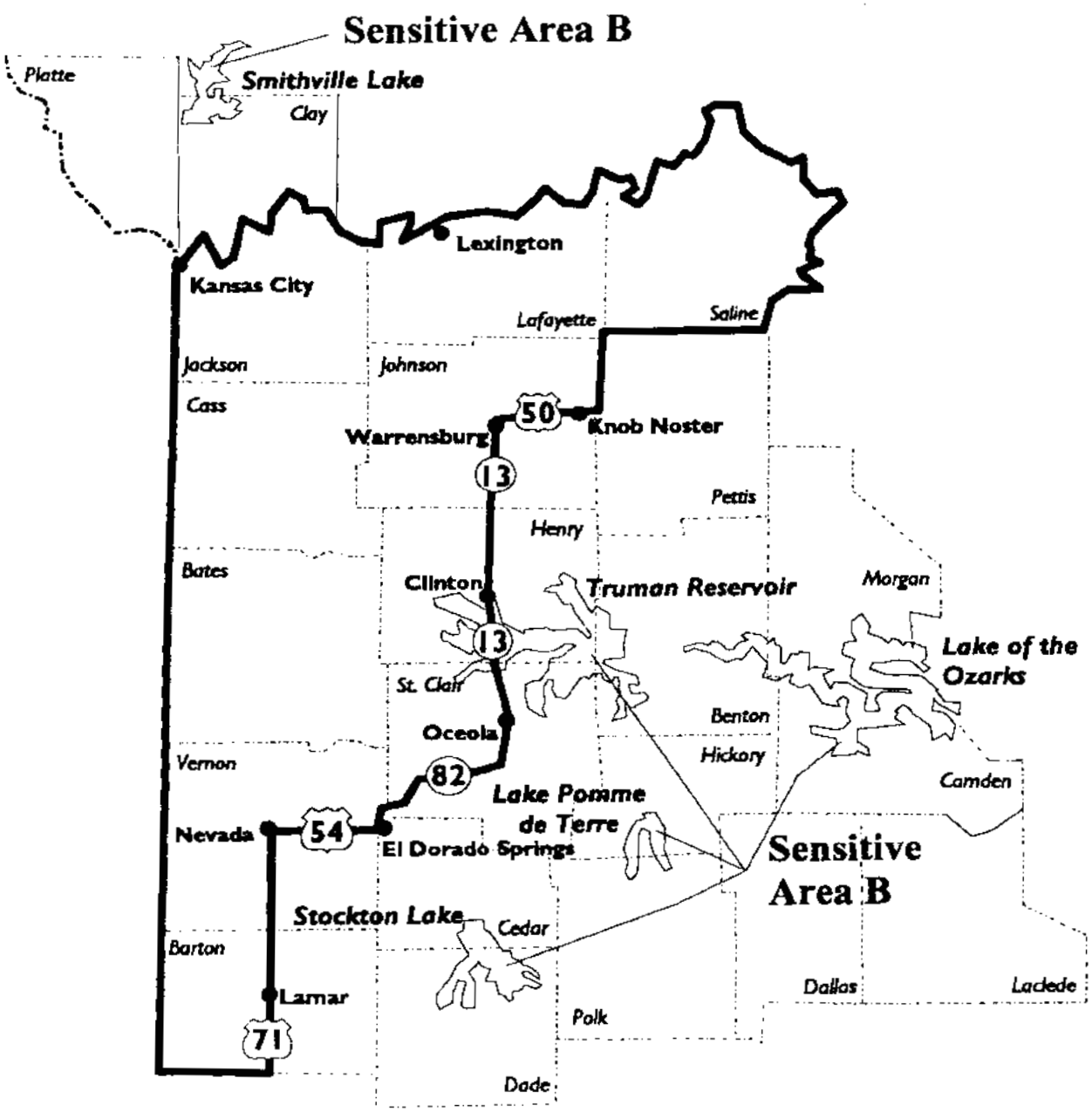


Figure 2. Enlargement of Area 2 and Sensitive Area B map.

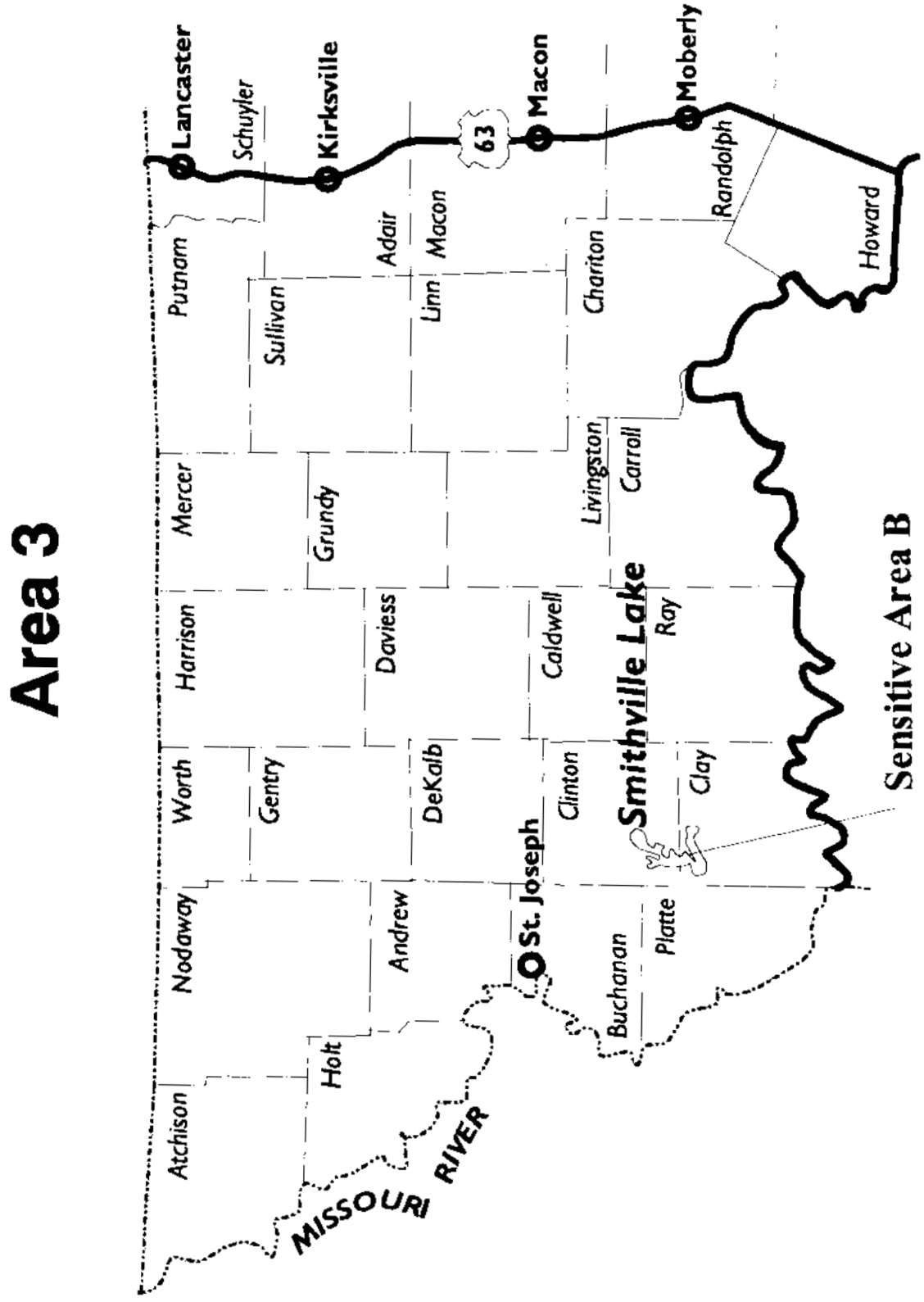


Figure 3. Enlargement of Area 3 and part of Sensitive Area B map.

Area 4

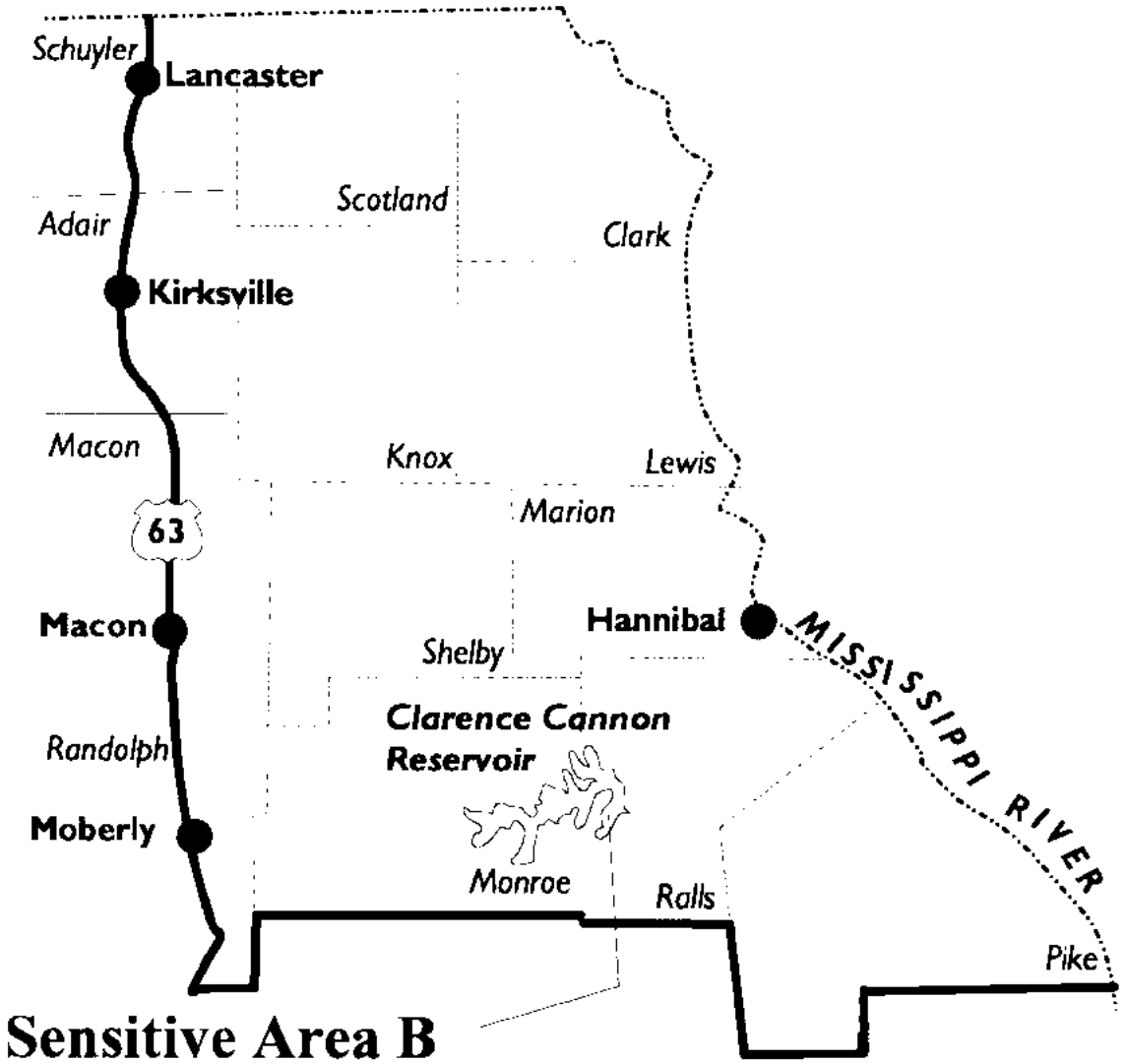


Figure 4. Enlargement of Area 4 and part of Sensitive Area B map.

Area 5

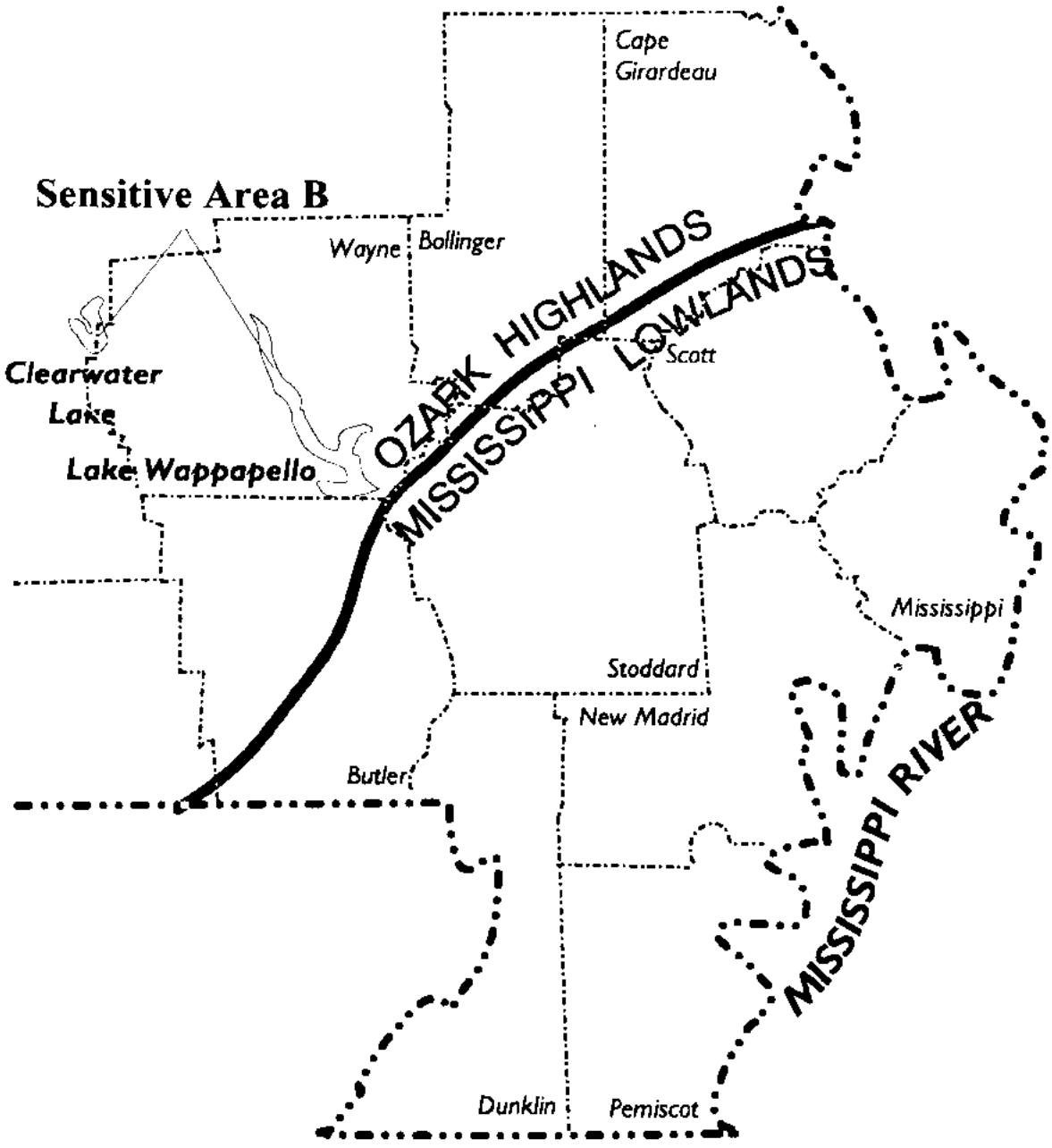


Figure 5. Enlargement of Area 5 and part of Sensitive Area B map.

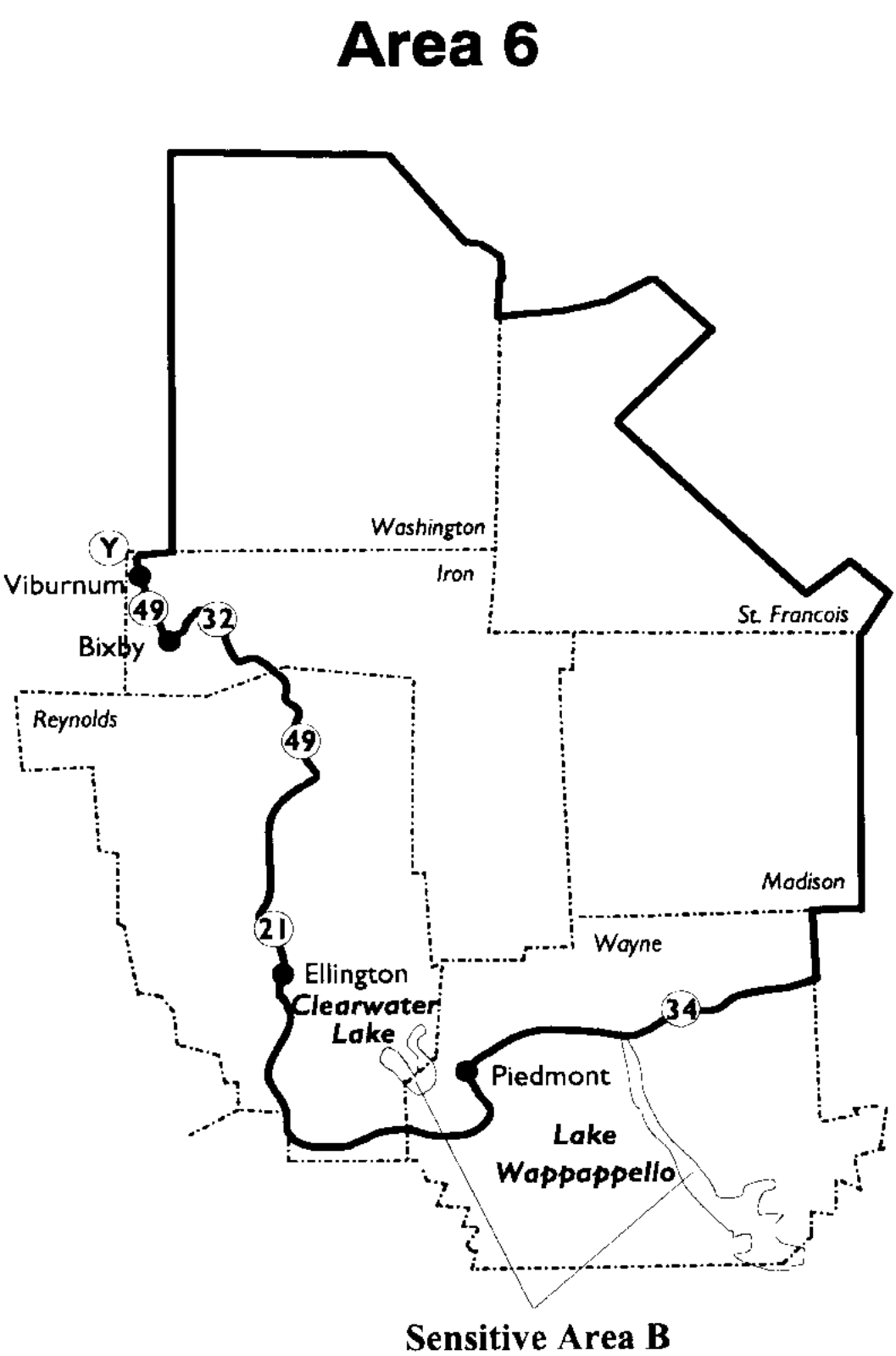


Figure 6. Enlargement of Area 6 and part of Sensitive Area B map.

Special Area

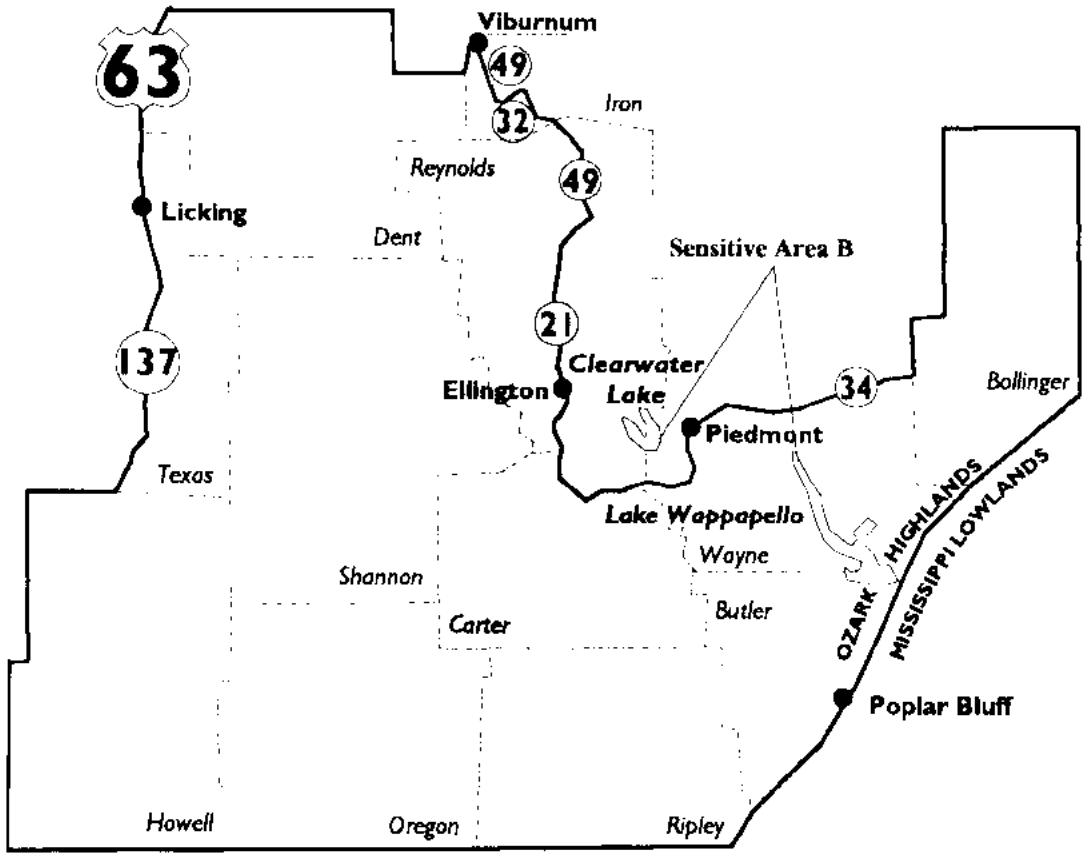


Figure 7. Enlargement of Special Area and part of Sensitive Area B map.

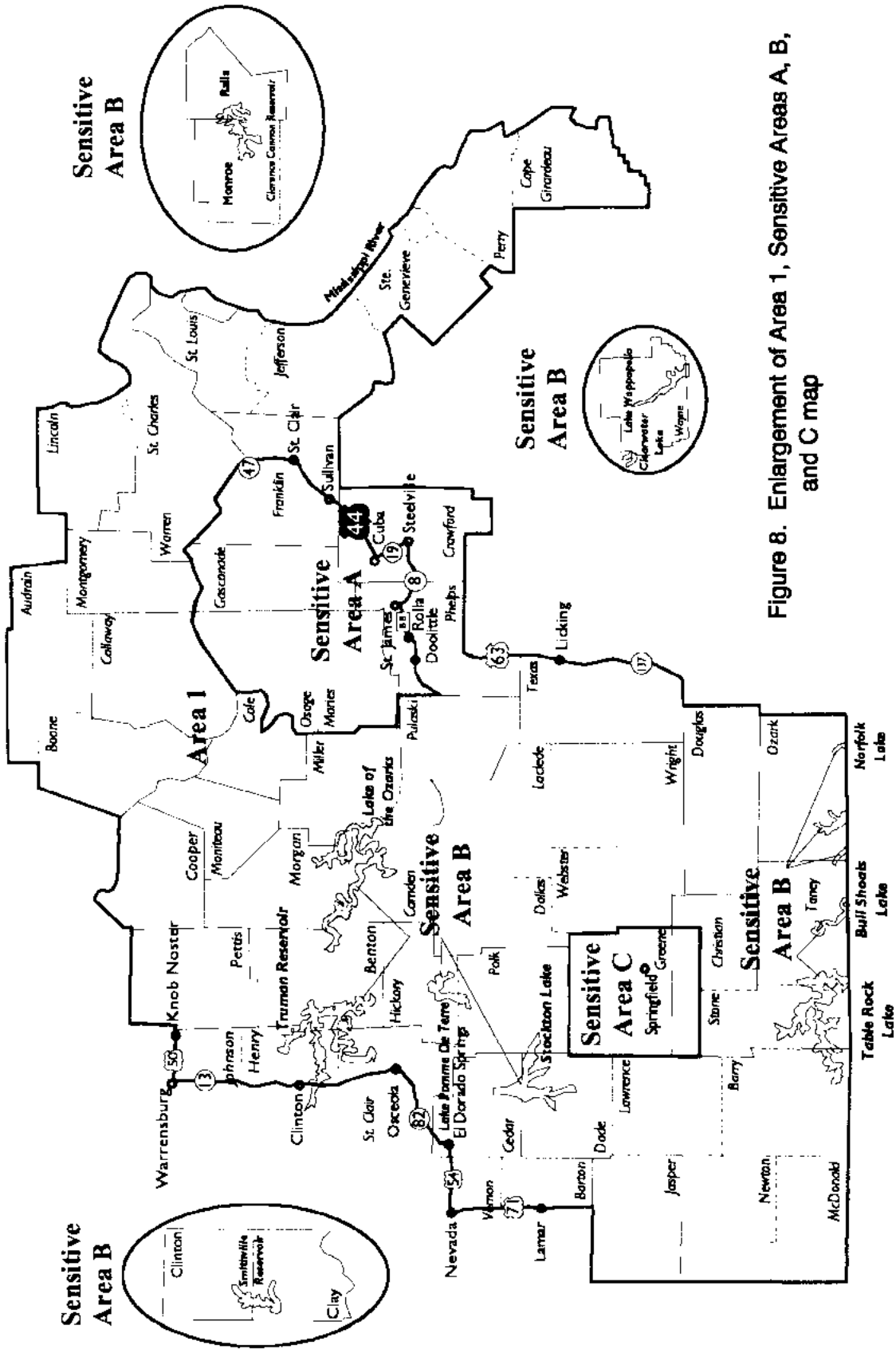


Figure 8. Enlargement of Area 1, Sensitive Areas A, B, and C map

AUTHORITY: sections 256.606, 256.614, 256.615, and 256.626, RSMo 2016. This rule was previously filed as 10 CSR 23-3.020(3)–(9). Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991; 256.614, RSMo 1985, amended 1991; 256.615, RSMo 1991; and 256.626, RSMo 1985, amended 1991.*