DEPARTMENT OF HEALTH

Protecting, Maintaining and Improving the Health of All Minnesotans

June 23, 2020

Legislative Reference Library
645 State Office Building
100 Rev. Dr. Martin Luther King Jr. Blvd.
St. Paul, Minnesota 55155

Re: In The Matter of the Proposed Rules of the Department of Health Governing Bored Geothermal Heat Exchangers; Revisor's ID Number RD4192

Dear Librarian:

The Minnesota Department of Health intends to adopt rules governing bored geothermal heat exchangers. We plan to publish a Dual Notice in the June 29, 2020 State Register.

The Department has prepared a Statement of Need and Reasonableness. As required by Minnesota Statutes, sections 14.131 and 14.23, the Department is sending the Library an electronic copy of the Statement of Need and Reasonableness at the same time we are mailing our Notice of Intent to Adopt Rules.

If you have questions, please contact me at 651-201-3651.

Yours very truly,

Nancy Jo A. La Plante

Nancy Jo A. La Plante
Rules/Enforcement Coordinator
Well Management Section
P.O. Box 64975
St. Paul, Minnesota 55164-0975

Enclosure: Statement of Need and Reasonableness

STATEMENT OF NEED AND REASONABLENESS

In the Matter of Proposed Revisions of Minnesota Rules, chapter 4725, parts 4725.0100 to 4725.7050; Revisor ID No. R-4192

Environmental Health Division

June 2020

INTRODUCTION

The Minnesota Department of Health (MDH) regulates the construction, maintenance, repair, and sealing of wells and borings by implementing the Minnesota Well Code. The Well Code refers collectively to Minnesota Statutes, chapter 103I, and Minnesota Rules, chapter 4725. In 2013, the Minnesota Legislature clarified MDH's regulatory scope when it amended Minnesota Statutes, sections 103I.005, subdivision 1a; 103I.005, subdivisions 2 and 12; 103I.101, subdivisions 2 and 5; 103I.105; 103I.205, subdivision 4; 103I.208, subdivision 2; 103I.501; 103I.531, subdivision 5; and 103I.641, subdivisions 1, 2, and 3. The statutory changes replaced the term "vertical heat exchanger" with the term "bored geothermal heat exchanger" and defined a "bored geothermal heat exchanger" as a "closed-loop piping system, installed in a boring, which circulates a heat-transfer fluid to transfer heat to or from the earth for heating and cooling purposes."

A bored geothermal heat exchanger (BGHE) is a type of earth-coupled heat-transfer system generally designed to provide heating and cooling climate control for indoor spaces. Simply stated, BGHE systems control indoor temperatures by using the constant temperature of the earth to heat or cool. The system uses a heat pump to circulate fluid through piping loops so that the fluid exchanges temperature with the earth and the occupied space reaches the desired temperature.

BGHE systems can control indoor climates for domestic and commercial spaces, or may be used to provide heating and cooling capacity at an industrial or municipal scale. A basic BGHE system consists of a series of looped piping pairs placed in the ground with a U-shaped bend at the bottom. Supply and return lines are combined with multiple loops by connecting the lines to a header at the ground surface. The BGHE system is finished by plumbing all of the loops into a heat pump, resulting in a closed-loop system.

BGHE systems work by employing the relatively constant subsurface temperature of soil and groundwater, by treating the earth as a sink for excess heat or excess cold, depending on the season. In the summer, the warm interior space system heats the fluid within the BGHE piping, and in doing so, extracts excess heat from it. The warmed fluid is pumped through piping installed in a borehole where it begins losing heat to the subsurface. By the time the fluid returns to the surface, it has cooled significantly, and is ready to be re-heated by the excess heat in the indoor space. The opposite occurs in the winter; fluid is cooled by the indoor space, that fluid warms as it circulates, and it sheds excess heat into the indoor space.

Since 1989, MDH has regulated only geothermal heat exchanger systems installed in vertical borings. The 2013 legislative changes allow MDH to regulate all BGHE systems, regardless of the borehole orientation. Therefore, MDH must have rules that establish construction and materials requirements for geothermal heat exchanger systems that are installed using any drilling method, including directional drilling; license all BGHE contractors; and register all bored geothermal heat exchanger drilling equipment.

These proposed rule amendments modify the current rules as they pertain to BGHE systems; specifically they revise:

- licensing requirements;
- material standards for piping materials, heat-transfer fluids, and additives;
- testing requirements;
- grouting requirements;

- minimum required distances from contaminant sources, buildings, utilities, and property lines;
- requirements for marking the locations of BGHE systems;
- sealing requirements; and
- reporting requirements.

MDH published the Request for Comments in the Minnesota State Register on August 5, 2013, and republished on July 24, 2017. The comment period remained open until MDH published the Notice of Intent to Adopt Rules on June 29, 2020. We received no comments in response to these Requests.

MDH convened an eight-member BGHE advisory committee. MDH provided the committee opportunities to comment on the proposed rule amendments in September 2013, July 2014, and July 1, 2016.

The advisory committee members included:
- two licensed well contractors who install vertical BGHE systems and are regulated by MDH,
- five contractors who installed directional BGHE systems and were not subject to MDH's regulations at that time, and
- one electrical utility company representative.

MDH drafted proposed rules based on input from the advisory committee and other interested parties in 2013 and 2014. On July 1, 2016, MDH emailed an updated proposed rule draft to the advisory committee and asked them to review and provide comments. Committee members were also asked to inform MDH if any of them wanted to meet to discuss the updated proposed rules. Two committee members provided comments and MDH considered the comments in the final rule draft. None of the committee members expressed a need to meet again.

The Advisory Council on Wells and Borings is an advisory council to the commissioner established under Minnesota Statutes, section 103I.105. The advisory council received updates on the BGHE rulemaking at their quarterly meetings in 2014, 2015, and 2016, and reviewed and commented on the proposed rule changes on December 15, 2016. MDH considered their comments in the final rule draft.

History

MDH originally adopted Minnesota Rules, chapter 4725 in 1974.

In 1984, the Legislature added statutory authority to regulate vertical heat exchangers. Requirements for vertical heat exchangers were first established in 1984 in Minnesota Statutes, chapter 156A, and later expanded in 1993 in chapter 4725. In 1989, the legislature created a separate section for vertical heat exchangers in Minnesota Statutes, section 103I.641.[1] MDH last substantially amended chapter 4725 in 2008.

[1] Minnesota laws 1989, chapter 326, article 3, section 39

ALTERNATIVE FORMAT

Upon request, this information is available in an alternative format, such as large print, braille, or audio. To make a request, contact Nancy La Plante at Minnesota Department of Health, P.O. Box 64975, St. Paul, Minnesota 55164-0975; 651-201-3651; nancyjo.laplante@state.mn.us.

STATUTORY AUTHORITY

Under Minnesota Statutes, section 103I.101, subdivisions 1, 3, and 5, MDH has the necessary statutory authority to adopt the proposed rules, which provide:

Subdivision 1. **Powers of commissioner.** The commissioner has the powers reasonable and necessary to effectively exercise the authority granted by this chapter.

Subdivision 3. **Procedures for permits.** The commissioner shall establish procedures for application, approval, and issuance of permits by rule.

Subdivision 5. **Commissioner to adopt rules.** The commissioner shall adopt rules including:

(1) issuing licenses for:
  (i) qualified well contractors;
  (ii) persons constructing, repairing, and sealing dewatering wells;
  (iii) persons sealing wells or borings;
  (iv) persons installing, modifying, or repairing well casings, well screens, well diameters, and well pumps or pumping equipment;
  (v) persons constructing, repairing, and sealing bored geothermal heat exchangers;
  (vi) persons constructing, repairing, and sealing elevator borings; and
  (vii) persons constructing, repairing, and sealing environmental wells;

(2) establishing:
  (i) conditions for examining and reviewing applications for license and certification;
  (ii) conditions for revoking and suspending licenses and certifications;
  (iii) minimum standards for designing, locating, constructing, repairing, and sealing wells and borings to implement the purpose and intent of this chapter;
  (iv) a system for reporting on wells and borings drilled and sealed;
  (v) standards for constructing, maintaining, sealing, and monitoring well water quality in areas of known or suspected contamination;
  (vi) wellhead protection measures for wells serving public water supplies;
  (vii) procedures to coordinate collecting well and boring data with other state and local governmental agencies;
  (viii) criteria and procedures for submitting well and boring logs, formation samples or well or boring cuttings, water samples, or other special information required for and water resource mapping; and
  (ix) minimum standards for designing, locating, constructing, maintaining, repairing, sealing, safety, and resource conservation related to borings, including exploratory borings as defined in section 103I.005, subdivision 9." [Emphasis supplied.]

Discussion: Chapter 4725 is an old rule. MDH has continuously regulated this well drilling community since the 1970s. MDH first adopted these rules in 1974. In 1989, the legislature added MDH's current rulemaking authority, Minnesota Statutes, section 103I.101. MDH substantially amended the 1974 rules in 1993 and last substantially amended them in 2008, all under the same rulemaking authority. In addition, specific provisions for bored geothermal heat exchangers appear in Minnesota Statutes, section 103I.641. The legislature has since updated these two statutes from time to time but has kept MDH's rulemaking authority in place.

This revision of Chapter 4725 is part of a continuous progression of bringing the rules up to date. At present, MDH is revising Minnesota Rules, chapter 4725, to make these rules consistent with recent changes in well-drilling technology used in the industry. It is changing its rules to comport with the statutory terminology changes that the Revisor's Office has already made per the Revisor's instructions. The legislature changed the wording of the statutes without altering MDH's statutory authority under Minnesota Statutes, section 103I.101, subdivision 5.

Specifically, Minnesota Laws 2013, chapter 108, article 12, section 11, added the definition of "bored geothermal heat exchanger" to Minnesota Statutes, section 103I.005, in subdivision 1a. It also instructed the Revisor's Office to substitute the term "bored geothermal heat exchanger" for "vertical geothermal heat exchanger" in the statutes wherever vertical geothermal heat exchanger appeared. Minnesota Laws 2013, chapter 108, article 12, section 108.

The following year, the legislature, in Laws 2014, chapter 275, article 1, section 136, amended the 2013 Revisor's instruction by adding "and Minnesota Rules" so that it read:

> "The revisor shall substitute the term "vertical heat exchangers" or "vertical heat exchanger" with "bored geothermal heat exchangers" or "bored geothermal heat exchanger" wherever it appears in Minnesota Statutes, sections 103I.005, subdivisions 2 and 12; 103I.101, subdivisions 2 and 5; 103I.105; 103I.205, subdivision 4; 103I.208, subdivision 2; 103I.501; 103I.531, subdivision 5; and 103I.641, subdivisions 1, 2, and 3; *and Minnesota Rules*." [Emphasis supplied.]

MINNESOTA STATUTES, SECTION 14.125 ANALYSIS

Minnesota Statutes, section 14.125 does not apply here for the following reasons:

MDH is now revising chapter 4725 rules to comport with the statutory terminology changes that the Revisor's Office has already made per the Revisor's instructions.[2] The legislature changed the wording of the statutes without altering MDH's statutory authority under Minnesota Statutes, section 103I.101, subdivision 5.

The class of affected persons are well drillers who drill deeply enough into the earth so that their drilling has the potential to reach drinking water. Thus, the State of Minnesota regulates this class of persons

[2] See last two paragraphs of Statutory Analysis on page 3, above.

because they could adversely affect public health. This class of persons remains the same as those regulated since 1974, though some new individuals might be added.

Section 14.125 applies only to laws that became effective for "laws authorizing or requiring rulemaking that are finally enacted after January 1, 1996." The affected heat exchanger rules took effect May 10, 1993. The legislature has neither granted MDH new rulemaking authority nor required MDH to amend the rules. The rules regulate no new classes of persons that are previously unregulated. Thus, section 14.125 has no applicability here.

REGULATORY ANALYSIS

Minnesota Statutes, section 14.131, sets out eight factors for a regulatory analysis that must be included in the SONAR. Paragraphs (1) through (8) below quote these factors and then gives MDH's response.

A. Description of the classes of persons who probably will be affected by the proposed rule, including classes that will bear the costs of the proposed rule and classes that will benefit from the proposed rule.

Classes of Affected Persons
The proposed rules cover contractors who install BGHEs, including both currently MDH-licensed contractors who install vertical BGHEs and contractors installing previously unregulated directionally drilled BGHEs. It is difficult to determine the number of additional contractors who may pursue licensure as BGHE contractors, but MDH estimates up to 100 companies. As of September 1, 2017, the Minnesota Geothermal Heat Pump Association (MNGHPA) has 52 contractor members. MDH already licenses eight of the 52 contractor members. MNGHPA also has eight utility contracting members, some of whom install BGHE systems.

Who Will Bear the Costs of the Proposed Rule
When the 2013 Minnesota Legislature amended Minnesota Statutes, chapter 103I to regulate all geothermal heat exchanger systems, it required some BGHE companies to:

- obtain an annual MDH contractor's license at $75,
- obtain a $10,000 corporate surety bond, and
- certify at least one representative at $75 annually.

These licensure and certification costs are set in Minnesota Statutes, section 103I.525. MDH does not expect the proposed rules to significantly change costs for contractors currently licensed to install vertical BGHE systems.

The proposed rules may increase costs for some unlicensed contractors who do not currently pump grout into the annular space[3] around the geothermal pipes in directionally drilled BGHE systems. These contractors may incur costs for acquiring grouting equipment. Several BGHE advisory

[3] 4725.0100, subp. 19, defines "annular space" as the space between two cylindrical objects one of which surrounds the other, such as the space between a borehole and casing pipe, or between a casing pipe and liner pipe. This term is used commonly in the drilling industry to describe the space between geologic formations and casing or other equipment lowered into a borehole. May also be used as the single noun form "annulus."

committee members told MDH that it is their standard practice to grout the annular space and thus they would not incur new equipment costs.

The proposed rules will increase the cost to install BGHE systems that were previously unregulated. Well contractors will likely pass the increase in costs through to BGHE systems purchasers. The additional cost will include the permit fee, which ranges from $275 for a typical residential system with less than 10 tons of heating/cooling capacity, up to $740 for a very large system designed for more than 50 tons of heating/cooling capacity. For systems installed by contractors who previously did not use grout, there will also be an added time-and materials cost for grouting.

Who will Benefit from the Proposed Rule
BGHE contractors will benefit from the more even playing field within the industry that these standardized installation rules will create. Minnesotans will benefit from the additional protection to groundwater and public health that establishing standards for constructing, maintaining, and sealing BGHE systems will provide. Individuals who purchase BGHE systems will benefit from the regulatory standards for construction, and having licensed contractors installing their systems who must comply with those standards.

B. The probable costs to the agency and to any other agency of the implementation and enforcement of the proposed rule and any anticipated effect on state revenues.

The Probable Costs to MDH to Implement and Enforce
MDH will incur additional costs to process new licenses and certifications for BGHE contractors not previously regulated. However, these costs will not be significant since MDH will also receive additional revenue from the new licensing and certification fees paid to cover MDH's costs.

MDH will also have additional cost for inspection and enforcement responsibilities due to the newly licensed BGHE contractors. MDH will use the same processes for conducting inspection and enforcement activities that it has used for vertical heat exchangers since 1984. The additional permitting fees paid to MDH for these systems will cover the inspection and enforcement activities.

The Probable Costs to any other Agency for Implementation and Enforcement
MDH is the sole state agency responsible for administering this rule. MDH foresees no additional implementation or enforcement costs for other agencies.

Anticipated Effects on State Revenues
Each BGHE company license requires an annual $75 license fee and an annual $75 certified representative fee. If the remaining 44 currently unlicensed MNGHPA members were to obtain new licenses and certifications, they would generate a total of $7800 per year in new fee revenues. This revenue will offset the additional licensing efforts that would be necessary.

New permit fees for directionally drilled BGHE systems would also be a new source of revenue. MDH anticipates that the total number of BGHE systems installed in any year will be approximately double the number of vertically drilled BGHE system in prior years. In 2017, licensed contractors installed 53 vertical BGHE systems. The 53 BGHE systems installed in 2017 generated $19,525 in new permit fees, with 38 permits at $275, nine at $515, and six at $740. MDH anticipates about $39,000 in additional revenue each year. This revenue will offset the additional regulatory efforts needed.

C. A determination of whether there are less costly methods or less intrusive methods for achieving the purpose of the proposed rule.

The proposed straightforward revisions correspond to the Legislature's revised BGHE definition, and thus expand existing rules for vertical BGHE systems to encompass BGHE systems that are drilled at an orientation other than vertical. These other systems include those with directional drilling and BGHE systems installed in angled borings. MDH knows of no other methods for expanding existing rules to include BGHE systems installed with borings of any orientation, making this the least costly and least intrusive method to achieve the purpose of the proposed rule.

D. A description of any alternative methods for achieving the purpose of the proposed rule that were seriously considered by the agency and the reasons why they were rejected in favor of the proposed rule.

The Legislature's 2013 changes to Minnesota Statutes, sections 103I.005 and 103I.641, make it clear that the regulations must apply to all BGHE systems, not just vertical BGHE systems. Thus, no alternatives exist for MDH to seriously consider.

E. The probable costs of complying with the proposed rule, including the portion of the total costs that will be borne by identifiable categories of affected parties, such as separate classes of governmental units, businesses, or individuals"

Newly regulated BGHE companies installing directionally drilled BGHE systems will need to pay an annual $250 licensure fee, which is the identical licensure fee currently regulated companies who install vertical BGHE systems already pay.

Newly regulated BGHE companies must have a certified representative. Certification requires a $75 annual fee; the same certification fee that company representatives who are currently certified already pay.

A certified representative must attend two contact hours of continuing education annually to maintain certification. MDH provides free continuing education that fulfills this requirement twice a year at its eight district offices. Certified representatives who obtain their continuing education at other venues may incur a cost. Traveling to the continuing education site may add additional costs.

Complying with current and proposed rules may add construction costs for newly regulated BGHE contractors, such as when installing their BGHE systems. One example is purchasing grouting equipment. The additional costs may vary greatly depending on how the newly regulated BGHE contractor currently installs their BGHE systems. These contractors are likely to pass these costs through to their customers.

Property owners who purchase a directionally drilled BGHE system must pay a construction permit fee based on the BGHE system's capacity, in tons. The fee schedule divides projects into three capacity categories with corresponding increasing fee amounts. A BGHE system less than 10 tons, between 10 and 50 tons, and greater than 50 tons require construction permit fees of $275, $515, and $740, respectively. This cost is the same as the permit fee required for vertical BGHE systems. These individuals may also incur additional costs for the contractors' time and materials to grout the annular space around piping of previously unregulated BGHE systems.

F. The probable costs or consequences of not adopting the proposed rule, including those costs or consequences borne by identifiable categories of affected parties, such as separate classes of government units, businesses, or individuals.

MDH is revising the BGHE rules due to changes made to Minnesota Statutes, chapter 103I. Wells, Borings and Underground Uses. The statute changed "vertical heat exchanger" to "bored geothermal heat exchanger." The statute change required MDH to make specific rule changes to cover the new BGHE contractors and BGHE systems that were not previously regulated.

Revising the rules is the only way for MDH to achieve the legislative intent to regulate BGHE contractors that construct directionally drilled BGHE systems and the public health protections would not be met.

G. An assessment of any differences between the proposed rule and existing federal regulations and a specific analysis of the need for and reasonableness of each difference.

There are no existing federal regulations for either credentialing BGHE contractors or regulating BGHE system installation.

H. An assessment of the cumulative effect of the rule with other federal and state regulations related to the specific purpose of the rule.

The proposed rules govern areas that neither federal nor other Minnesota state laws address. Therefore, our assessment is that there is no cumulative effect.

PERFORMANCE-BASED RULES

Minnesota Statutes, sections 14.002 and 14.131, require that the SONAR describe how the agency, in developing the rules, considered and implemented performance-based standards that emphasize superior achievement in meeting the agency's regulatory objectives and maximum flexibility for the regulated party and the agency in meeting those goals.

The proposed rule amendments will regulate all contractors who use drilling equipment to install closed loop geothermal heat exchangers systems, and not just contractors who install vertical heat exchanger systems. These proposed rules are to protect groundwater resources from any all BGHE systems.

Currently, contractors who install vertical heat exchangers must meet specific licensure qualifications, and they must construct BGHE systems to ensure the system:

- does not leak heat-transfer fluids,
- is not built too close to contamination sources, and
- does not end up with a borehole that acts as a pathway or conduit for contaminants to enter groundwater.

The proposed rules apply these same standards and protective measures to directionally drilled BGHE systems and the contractors who install them. These standards are simple and straightforward.

Since the proposed rules will be mandatory for all contractors installing BGHE systems, MDH must amend the rules to incorporate the expanded work included by the Legislature. Using the existing framework for currently regulated contractors that install vertical bored geothermal heat exchangers, maintains consistency and clarity for the industry as a whole and promotes better understanding of the rules they must comply with. MDH knows of no other way that would make these minimum standards more flexible yet continue to protect public health.

ADDITIONAL NOTICE

Minnesota Statutes, sections 14.131 and 14.23, require that the SONAR contain a description of MDH's efforts to provide additional notice to persons who might be affected by the proposed rules or explain why these efforts were not made. MDH did the following to provide additional notice to persons who might be affected by the proposed rules:

- posting the Request for Comments and the rule draft on the MDH Well Management Section's website.
- emailing the Request for Comments to the approximately 1,710 Listserv subscribers of the Well Management Section's GovDelivery system.
- emailing the Request for Comments to the eight-member Bored Geothermal Heat Exchanger Advisory Committee.
- emailing the Request for Comments to:
  - Well Management Section's interested party list, and
  - parties attending the Minnesota Geothermal Heat Pump Association Conference.
- emailing the Request for Comments to Well Management's Advisory Council on Wells and Borings.
- giving notice to everyone who has registered to be on the MDH's rulemaking mailing list under Minnesota Statutes, section 14.14, subdivision 1a.
- giving notice to the Legislature per Minnesota Statutes, section 14.116.

MDH created a website dedicated to BGHE rulemaking. All notices sent to parties listed above included the link to the MDH website: Rulemaking for Bored Geothermal Heat Exchangers (www.health.state.mn.us/communities/environment/water/wells/rules/bgherulemaking.html). The website provided electronic links to:

- the Request for Comments as published in the Minnesota State Register,
- directions on how to submit comments,
- the online comment page,
- the proposed rule draft,
- subscribe to the Well Management Section rulemaking listserv, and
- contact information to the Well Management Section rules coordinator.

MDH will provide all future notices required by statute. We will send the Notice of Intent to Adopt to all parties previously notified, currently licensed full well contractors, and BGHE contractors, and any additional parties, as requested. We will post the SONAR and proposed rules on MDH's website when the Notice of Intent to Adopt is published in the *State Register*.

Our Notice Plan does not include notifying the Commissioner of Agriculture because the rules do not affect farming operations per Minnesota Statutes, section 14.111.

MDH's plan is designed to provide affected and interested parties with many opportunities to know about MDH's rulemaking process and to voice their concerns.

CONSULTATION WITH MMB ON LOCAL GOVERNMENT IMPACT

As required by Minnesota Statutes, section 14.131, MDH will consult with the Minnesota Management and Budget (MMB). When MDH sends the documents listed below to the Governor's Office for review and approval, MDH will also send the same documents to MMB. We will do this before MDH publishes the Notice of Intent to Adopt. The documents are:

- the Governor's Office's Proposed Rule and SONAR Form,
- the proposed rules, and
- the SONAR.

MDH will submit a copy of the correspondence and any response received from MMB to the Minnesota Office of Administrative Hearings (OAH) at the hearing, or with the documents that it submits for Administrative Law Judge review.

DETERMINATION ABOUT RULES REQUIRING LOCAL IMPLEMENTATION

As required by Minnesota Statutes, section 14.128, subdivision 1, MDH considered whether the proposed rules would require a local government to adopt or amend any ordinance or other regulation to comply with them. MDH oversees regulatory compliance regarding the specific provisions of BGHE regulations within Minnesota Statutes, chapter 103I, for the entire state of Minnesota.

MDH has agreements with nine local boards of health that delegate all or part of the inspection, reporting, and enforcement duties authorized under Minnesota Statutes, chapter 103I, for permitting, construction, repair, and sealing of wells and elevator borings. These delegated programs have no authority over the provisions regarding BGHE regulations. Therefore, the proposed rule amendments would have no fiscal impact or any other impacts on any local governments. For these reasons, the proposed rules will not require a local government to adopt or amend any ordinance or other regulation to comply with them.

COST OF COMPLYING FOR SMALL BUSINESS OR CITY

Agency Determination of Cost

As required by Minnesota Statutes, section 14.127, MDH considered whether the cost of complying with the proposed rules in the first year after the rules take effect would exceed $25,000 for any small business or small city. MDH has determined that the cost of complying with the proposed rules in the first year after the rules take effect will most likely not exceed $25,000 for any small business or small city.

MDH asked the nine-member BGHE Advisory Committee, eight of whom are small business operators, whether these costs would exceed $25,000 during the first year for a small business. These members expressed mixed opinions, with some stating that they would incur no additional cost, others saying that the grouting equipment and resources needed to comply with the proposed rule can be obtained for less

than $25,000, and still others claiming that costs could be as high as $50,000. The members based the lower cost estimates on buying used grouting equipment or entry level grouting equipment; the higher cost estimates were for newer and more sophisticated grouting equipment. Cost estimates provided by Geo-Loop, Inc., a prominent grouting equipment manufacturer, and classified advertisements in trade publications, including "National Driller," indicates that contractors may purchase suitable new grouting equipment for less than $25,000.

The proposed rules would affect small cities only if the city already has or acquires a new a bored geothermal system installed on city property that would be directionally drilled at any angle other than vertical. The additional cost for compliance could include the permit fee ($275 to $740 per system) and some nominal construction cost increases, not exceeding $25,000.

LIST OF WITNESSES

MDH does not anticipate having any non-agency witnesses if a hearing is held. The only witnesses would be MDH staff who are involved in rulemaking for these proposed rules.

RULE-BY-RULE ANALYSIS

This section explains what each proposed rule change does and why the change is needed. Some proposed rule changes, which serve to maintain consistency throughout chapter 4725, are discussed only briefly.

Part 4725.0100 DEFINITIONS

Minnesota Rules, part 4725.0100 defines the terms used throughout the chapter.

Subpart 1a. **Absorption area.** We no longer need the deleted text here because the referenced definition in 7080.1100, subpart 2, has been adopted into rule.

Subpart 21e. **Bored geothermal heat exchanger**. MDH added this definition to accomplish three purposes:

First, it cited the new statutory definition in Minnesota Statutes, section 103I.005, subdivision 1a, which encompasses all forms of bored geothermal heat exchangers. The definition of "vertical heat exchanger" in 4725.0100, subpart 49e, becomes unnecessary and MDH is repealing that subpart.

Second, MDH expanded the statutory definition to clarify that it includes BGHE piping installed in a boring that is used only for thermal conductivity testing as a BGHE. Contractors often install a test loop to aid them in designing larger BGHE systems. If not properly constructed and sealed, the test loop may act as a conduit for contaminants to enter groundwater.

Third, MDH excludes closed-loop piping systems installed in borings 15 feet or less in depth from the definition. This exclusion is consistent with depth exclusions provided for other types of wells and borings. At that shallow depth, the closed loop system is much less likely to adversely affect groundwater resources. Furthermore, closed-loop systems installed in trenches excavated from the ground surface are typically 15 feet or less in depth, which MDH does not regulate.

For these reasons, this definition is needed and reasonable.

Subpart 21f. **Bored geothermal heat exchanger contractor.** MDH adapted the definition of "vertical heat exchanger contractor," found in subpart 49f of the current rule, by changing "sealing vertical heat exchanger" to "sealing bored geothermal heat exchangers." MDH proposes to repeal subpart 49f.

Subpart 21g. **Bored geothermal heat exchanger piping.** MDH also adapted the existing subpart 49g "vertical heat exchanger piping" definition to clarify that it regulates all buried piping and fittings of a geothermal system. MDH also proposes to repeal subpart 49g as it is no longer needed.

Subpart 23a. **Community water system.** The definition was modified by replacing the word "which" with "that" to correct a grammatical error.

Subpart 24h. **Directional drilling.** MDH created this definition to describe a commonly used drilling method for installing BGHE systems that use unique techniques, equipment, and materials when advancing vertical or angled boreholes. MDH needs specific terminology that considers these unique features when setting enforcement standards and inspecting new systems. This term appears in proposed 4725.7050, subpart 4, below.

Subpart 30h. **Interceptor**. MDH updated outdated plumbing code references.

Subpart 48b. **Thermally enhanced bentonite grout.** MDH added this definition to specify what the phrase "thermally enhance bentonite grout" means. This phrase appears in part 4725.7050, subpart 1, item C, where the mixture criteria are described. A heavy Bentonite grout containing a minimum of 30 percent solids[4] becomes thermally enhanced when either silica sand or graphite is added to it. Adding silica sand or graphite increases the grout's thermal efficiency and improves a bored geothermal heat exchanger system's working efficiency. Existing rule allows contractors to use silica sand in thermally enhanced bentonite grout. The proposed rule adds the use of graphite, a naturally occurring mineral made of carbon. These grout mixtures are only allowed in BGHE systems.

Subparts 49e. **Vertical heat exchanger;** 49f. **Vertical heat exchanger contractor**; and 49g. **Vertical heat exchanger piping** MDH proposes to repeal these three definitions of terms for "vertical systems." As explained above, MDH used these outdated terms as the basis for new definitions that align with the changes the Legislature made to Minnesota Statutes, chapter 103I. Specifically, the Legislature repealed the definition for vertical heat exchanger in Minnesota Statutes 2011, section 103I.005, subdivision 20 and replaced it with by Minnesota Statutes 2013, section 103I.005, subdivision 1a. Bored geothermal heat exchanger.

Part 4725.0150 INCORPORATION BY REFERENCE AND ABBREVIATIONS

MDH removed references to MDH's Barr Library and the Minitex interlibrary loan system. The Barr Library is no longer able to store, maintain, or loan resources to the public. The Mintex interlibrary loan system is available to Minnesota state agencies to obtain articles and references, but not to the public or

[4] Bentonite Grout, as defined in Minnesota Rules, part 4725.0100, contains a minimum 15 percent, by weight, bentonite slurry mixture. Thicker grouts are preferable in BGHE systems for thermal conductivity, but bentonite slurries become thicker and less pumpable as the ratio of bentonite to water increases. Bentonite grout slurry ratios are a balance between these material characteristics, and MDH understands that the proposed ratios are within standard ranges resulting in effective grout that can be reliably pumped into a borehole.

other interested parties. Due to copyrights, MDH may not provide these references in part or in full. To obtain copies of these references, individuals must contact the source directly.

When MDH brought this list of referenced materials up to date, we also rearranged and renumbered the items and subitems to retain proper alphabetic and numeric order.

Item C: MDH updated the references to current applicable American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), or National Science Foundation (NSF) standards.

Item E, subitems (8) and (11) through (16): MDH added ASTM standards used in the rule specifications for BGHE materials and methods.

Item E, subitem (9): MDH updated the reference to current applicable ANSI standard.

Item G: MDH added standards for flammable and combustible liquids used in rule specifications for heat-transfer fluids by incorporating the applicable National Fire Protection Association (NFPA) standard.

Item H, subitem (2): MDH updated references for ANSI and the NSF.

Item H, subitem (4): MDH provided a reference to the NSF White Book™—Nonfood Compounds Listing Directory, which appears in part 4725.7050, subpart 1, Item D, subitem (2), specifications for additives used in propylene glycol for BGHE systems.

Part 4725.0475 ACTIVITIES REQUIRING LICENSURE OR REGISTRATION

Subpart 1. **Activity requiring licensure or registration.** The proposed change makes it clear that the Commissioner of Health issues the licenses.

Part 4725.0650 EXPERIENCE REQUIREMENTS; CERTIFIED REPRESENTATIVE AND INDIVIDUAL WELL CONTRACTOR

These proposed changes update the BGHE contractors' requirements and maintain consistent language and requirements across limited-license categories described in Minnesota Rules, chapter 4725. These requirements set experience and licensure requirements so that the Commissioner may license only companies or individuals who have conducted satisfactory regulated work supervised by a licensed contractor. The rules provide an exception for counting experience gained on previously unregulated BGHE systems as qualifying experience, whether or not the work was done under the supervision of a licensed contractor.

Subpart 7a. **Limited well/boring contractor certified representative; bored geothermal heat exchanger.** MDH renumbered Item C to "subitem 2 under item B" to clarify that the applicant must meet the requirements of Item B subitem (1) and subitem (2).

Item A specifies that an applicant for a BGHE contractor certified representative must have three years of experience constructing, repairing, or sealing BGHE systems.

MDH modified Subitems (1), (2), and (3) to clarify and further define what is considered a year of experience. MDH's goal is to ensure a BGHE contractor certified representative possesses the necessary experience to safely and competently oversee construction, repair, and sealing of BGHE systems. MDH increased the number of years' experience required for a certified representative from two years to three years. The three-year requirement is consistent with the experience requirements for a monitoring/environmental well-certified representative. Both license categories require a comparable set of skills and experience.

Item A further limits that experience to the supervision of a licensed well contractor or licensed BGHE contractor, unless the applicant gained the experience before the proposed rules were implemented. In that case, experience gained before rule implementation counts towards minimum experience requirements. This exemption is necessary to provide a path to licensure for contractors who were installing previously unregulated directionally drilled BGHE systems.

In item B, subitem (1) MDH increased the required years of experience from two to three, to be consistent with Item A. The term "minimum" is not necessary and was removed.

Unit (a) increases the number of water-supply wells needed to qualify for a year of experience from five to ten, to be consistent with the number of water-supply wells that qualifies for a year of experience for a well-contractor certified-representative applicant.

Unit (b) clarifies and increases the number of hours required constructing, repairing, or sealing BGHE systems. MDH increased time requirements to reflect the additional challenges contractors encounter when constructing BGHE systems using the directionally drilled method.

In subitem (2) MDH corrected the reference to show that the International Ground Source Heat Pump Association (IGSHPA) provides an accreditation, not a certification. The National Ground Water Association (NGWA) certification program for ground source heat pump drillers and installers was included as an acceptable prerequisite.

Part 4725.1675 CRITERIA FOR CONTINUING EDUCATION

The proposed changes to Item A provide clarity and to include geothermal systems, dewatering, and elevator borings as additional topics eligible to be considered for continuing education credits. MDH wrote these rules to accept any activity regulated by this chapter as appropriate topics for continuing education credit.

Part 4725.1833 BORED GEOTHERMAL HEAT EXCHANGER CONSTRUCTION PERMITS

The proposed changes for this rule part clarify that any BGHE system requires a construction permit. This includes BGHE piping that contractors install for testing before designing and constructing a full-scale BGHE system.

Item A was revised to clarify that the commissioner may issue permits to work on BGHE systems only contractors who hold licenses under either of two license categories, a full well contractor and a BGHE contractor.

Item B requires applicants to submit permit applications to MDH to install BGHE systems. MDH moved the list of contents that an application must contain previously included in Item C to Item B to improve this rule part's organization.

Item C, which is new, requires that the contractor notify the commissioner of the proposed BGHE construction starting time at least 24 hours before starting work. The MDH Well Management Section must know when construction is occurring to have a reasonable opportunity to appear and inspect on site during critical parts of construction.

Part 4725.1851 WELL AND BORING RECORDS

Subpart 2. **Construction records.** MDH added a specific requirement that licensed contractors must submit well and boring construction records on commissioner-provided forms. Standard forms ensure consistent records; help manage the data-entry costs; and result in a uniform product for end users, including MDH, other agencies, and individuals.

MDH added item O to specify that BGHEs are borings that require a construction record and are subject to additional reporting requirements. The additional requirements for BGHE are detailed below:

Subitems (1), (2) and (3) require the contractor to accurately map the location of loop lines, provide a cross-section of directionally drilled systems, and the GPS (Global Positioning System) coordinates of the loop corners. A scaled map with properly surveyed property corners, property structures, and benchmarks, when available, help well contractors locate BGHE boreholes for maintenance or sealing, and may help others performing earth work to avoid damaging underground utilities. This additional documentation would be used to find the buried piping in the future. Most BGHE systems do not have piping or other visible indicators that show their location at or above the ground surface. A directionally drilled BGHE boring is not limited to a straight path and may cover wide distances both horizontally and vertically, similar to other utilities such as sewer, electrical, and telecommunications lines. Being able to determine the locations of BGHE borings and piping so other construction activities do not intersect them is important. Contractors performing BGHE system maintenance or sealing BGHE borings need accurate location information to correctly identify individual borings, and ensure that their activities affect the system as intended.

Subitem (4) requires that contractors record the number of loops within each borehole. When the BGHE system is decommissioned and the borings sealed, verifying that all BGHE borings are properly sealed will be important.

Subitem (5) requires that contractors include the documented BGHE system pressure test results with the record to preserve this important information. Including the pressure test results with the record is the only way the MDH would know a BGHE was successfully pressure tested.

Part 4725.2050 USE OF WELLS OR BORINGS FOR DISPOSAL OR INJECTION PROHIBITED

This proposed change specifies that pumping heat exchanger fluid into boreholes is allowed in the listed types of installations. The proposed change simply adds BGHE borings to the list of exceptions to the stated prohibitions. Only two types of heat exchanger fluids are approved for use in BGHE systems, propylene glycol and ethanol, as described in parts 4725.7050, subpart 1, item D. The allowed injection is limited to fluids contained within a closed loop BGHE system. Part 4725.1833 was added for reference. Thus adding BGHEs to this part is consistent with the other types stated in the existing rules and poses no threat to public health.

Part 4725.2150 REQUIRED DISTANCE FROM GAS PIPES, LIQUID PROPANE TANKS, AND ELECTRIC LINES

Subpart 3. Exceptions.
MDH added item F to exempt non-vertical BGHE borings from the required setback from a buried electric or gas utility as long as the requirements listed in subitems (1) and (2) below are met.

> Subitem (1) was added to ensure that the contractor complies with the notification and excavation requirements of Minnesota Statutes, chapter 216D (Gopher State One Call). This is a safety measure to help reduce the risk of intersecting underground utilities while conducting earthwork activities when installing BGHE systems.
>
> Subitem (2) was added to provide an exception for directionally drilled BGHE borings because there is no practical way to measure or enforce the setback between the buried utility and the BGHE boring. The BGHE contractor must maintain the required setback at the point where the borehole penetrates the ground surface.

Part 4725.2185 DISTANCE FROM A BUILDING

Ordinarily, BGHE systems, as well as other types of wells and borings, must have a minimum three-foot setback to a building so that the loop piping ends are accessible for repairs or sealing. For vertical boreholes, the location where the borehole penetrates the ground is the same horizontal location as the bottom of the boring. However, directionally drilled BGHE systems, can be installed in various orientations, including beneath a building. BGHE loop piping installed by directional drilling does not require the same accessibility as a vertical borings for two primary reasons:

1. BGHE systems are not installed with equipment (e.g. a pump) in the boring requiring future access for maintenance, repair, or sealing, and
2. sealing BGHE systems does not require access to the entire boring, but only the loop ends, through which an approved grout material can be pumped.

MDH proposes allowing contractors to make decisions about the best way to install a BGHE system, including installing loops beneath a building, given site-specific conditions so long as the construction meets the requirements of proposed 4725.7050, subpart 3. Proposed part 4725.7050, subpart 4, further specifies that a directionally drilled boring must maintain a minimum vertical separation of 10 feet between the boring and the lowest portion of a building or foundation. Furthermore, proposed part

4725.7050, subpart 9, requires that the ends of geothermal piping remain accessible so borings can be properly sealed at the end of their life.

Part 4725.2250 GENERAL CASING REQUIREMENTS

Subpart 7. **Temporary casing.** This subpart was revised for clarity.

Part 4725.2950 DRILLING FLUIDS

Subpart 2. **Drilling additives.** MDH revised this subpart to update one reference standard and remove an outdated reference standard.

Part 4725.3350 INTERCONNECTIONS AND CROSS CONNECTIONS

MDH revised items A and B to update outdated reference standards and incorporate proper references to Minnesota Rule, chapter 4714 (Minnesota Plumbing Code).

Part 4725.3450 FLOWING WELL OR BORING

Subpart 1a. **Low flow and low pressure.** The modifications in this subpart and items A and B were made to accommodate the addition of item C.

> Item C was added to clarify that BGHE systems installed in flowing artesian settings are subject to the same grouting requirements that apply to all other wells and borings installed in similar conditions. Flowing artesian conditions are those that have an aquifer that is confined and under pressure, resulting in water flowing to the surface naturally if the aquifer is penetrated by a boring or well. Flowing conditions can be hazardous and hard to control. Uncontrolled flow could lead to surface erosion that could damage structures, utilities, or other surface features. Uncontrolled flowing wells or borings can be very difficult or impossible to bring under control, even at great expense.
>
> MDH updated this part to ensure that BGHE systems meet additional requirements, which have been in place for other wells and borings, to avoid uncontrolled water flowing from the aquifer to the land surface through BGHE boreholes. Bentonite grout is not a suitable grout material where flowing conditions exist because the relatively low density and pliable nature of the grout puts it at risk of being washed out of the borehole by the artesian flow. Contractors must use neat-cement or cement-sand grout, with its higher density and rigid set, to provide an adequate and stable seal.

Subpart 2. **High flow, high pressure, or special construction area.** MDH revised item A to include BGHE borings.

Subpart 5. **Overflow discharge**. MDH updated an outdated Plumbing Code reference in Item A.

4725.3725 CHEMICAL TREATMENT AND REHABILITATION

Subpart 1. **Treatment chemicals**. MDH updated outdated standard references.

Part 4725.3750 REPAIR, CORRECTION, OR SEALING OF WELLS AND BORINGS.

Subpart 1. **Repair, correction, or sealing required.**

In item C, MDH updated outdated Minnesota Plumbing Code References.

Part 4725.4450 WATER-SUPPLY WELL DISTANCES FROM CONTAMINATION

This part sets minimum distances that water-supply wells must be located from potential sources of contamination to isolate the water-supply wells from the contamination. The subparts specify the various circumstances and applicable distances. MDH updated several items as follows to reflect the expanded scope of regulation and update references.

Subpart 1. **Isolation distances**.

The existing rule has minimum isolation distances of 10 and 35 feet between a water-supply well and BGHE piping based on whether the BGHE piping was oriented horizontally or vertically. This categorization is not adequate for describing required setbacks to directionally drilled BGHE piping, which may be installed at any orientation. The rules have been updated to establish setback distances of 10 and 35 feet based on the depth of the BGHE piping depth being less than or greater than 15 feet deep, respectively. A greater setback is required for deeper BGHE piping because that pipe may be in closer proximity to the intake of a water-supply well. The 15-foot depth was selected because it is the minimum construction depth for a water-supply well and it is consistent with depth exclusions provided for other types of wells and borings. An additional setback of 50 feet has been established between water-supply wells and existing BGHE system that are noncomplying with Minnesota Rules, chapter 4725.

The proposed isolation distances protect the water quality of nearby water-supply wells in the event of a BGHE pipe leak. The heat-exchanger fluids approved for use in BGHE systems include food-grade or United States Pharmacopeia (USP)-grade propylene glycol and ethanol in a concentration up to 20 percent. These two fluids have a relatively low toxicity, but could cause illness or injury if there was a leak that contaminated groundwater and wells.

Item E. 50 feet from:
MDH made two corrections in item E.

MDH updated subitem (12), unit (c) with a chapter change in the Minnesota Plumbing Code and includes new references. The references cite sections of the Minnesota Plumbing Code that describe approved materials and testing procedures.

In subitem (16), MDH clarified what the rules regulate by replacing the outdated "horizontal ground source closed loop" with the current "bored geothermal" heat exchanger and "any other bored closed loop geothermal heat exchanger." It also added updated citations for subsequent subitems that contain exceptions to these requirements.

Item F. 35 feet from:

Subitem (1) sets a minimum isolation distance of 35 feet between a water-supply well and a BGHE system that is installed deeper than 15 feet below ground provided that the heat exchanger conforms to the requirements of part 4725.7050, subpart 1. This requirement allows water-supply wells to be closer than 50 feet to conforming systems, but recognizes that, as the depth of the BGHE piping increases, the protection provided by the vertical separation to the intake point of the well decreases. Although the heat-transfer fluids approved in these proposed rules are of low or moderate toxicity, they are not considered non-toxic and therefore some isolation distance is required in the event of a pipe leak.

Item G. 20 feet from:

Subitem (1) was revised to update references to parts of the Minnesota Plumbing Code that describe approved materials and testing procedures.

Subitem (5) was revised to update references to parts of the Minnesota Plumbing Code that describe approved materials and testing procedures.

Item H. 10 feet from:

Subitem (2) sets a minimum isolation distance of 10 feet between a water-supply well and a BGHE system that is installed shallower than 15 feet below ground provided that the heat exchanger conforms to the requirements of part 4725.7050, subpart 1. This requirement recognizes that a BGHE system constructed to the standards of this chapter should pose little risk to water-supply wells and groundwater, and accommodates the installation of wells nearby.

4725.4825 NONPOTABLE WATER-SUPPLY WELLS.

Subpart 3. Identification required. MDH updated references to the correct Minnesota Plumbing Code rule parts.

4725.5150 WATER-SUPPLY WELL SUCTION LINE.

MDH updated references to the correct Minnesota Plumbing Code rule parts.

4725.5475 HYDROFRACTURING WATER-SUPPLY WELLS

Subpart 2. **Injection materials, water, and proppants**.

In item B, MDH updated references to correct ANSI standards.

4725.5550 WATER-SUPPLY WELL DISINFECTION

Subpart 4. **Disinfection materials.** MDH updated references to correct ANSI standards.

4725.6050 REMEDIAL WATER-SUPPLY WELLS.

Subpart 1. Additional requirements.

In item C, MDH updated references to parts of the Minnesota Plumbing Code that describe approved cross-connection backflow prevention devices.

4725.7050 BORED GEOTHERMAL HEAT EXCHANGERS

This rule part has expanded significantly, both to recognize directionally drilled BGHE systems, but also to expand the acceptable materials and practices for BGHE systems, generally. MDH updated the approved piping materials, grouting materials, heat-transfer fluids, loop marking methods, and general siting considerations, as explained in detail in the following paragraphs.

Subpart 1. **Construction.** This subpart provides the materials standards, pressure-testing requirements, grouting requirements, and heat-transfer fluid standards for constructing BGHEs. The standards and requirements are based on current industry practices, standards established in *Closed-Loop/Geothermal Heat Pump Systems Design and Installation Standards 2017*, published by the International Ground Source Heat Pump Association (IGSHPA), and existing rule requirements for other wells and borings.

Existing rule allows only high-density polyethylene (HDPE) pipe to construct BGHE systems. The proposed rule adds cross-linked polyethylene (PEX). Both materials, which contractors commonly use in plumbing and closed-loop geothermal system applications, have applicable ASTM standards. The proposed rules reference these standards. In addition, these materials are compatible with the approved heat-transfer fluids presented in subpart 1, item D; resist corrosion; are durable in buried applications; and are readily available. A minimum pressure rating of 160 pounds per square inch (psi) is required, which is the industry standard and takes into account both typical geothermal heat exchange system pressures and hydrostatic head pressure differences.

MDH re-lettered and renumbered items and subitems to accommodate insertions and deletions.

Item A, subitem 1, units (a) through (d) describe material standards for HDPE BGHE piping, including wall thickness, ASTM standards, joint and fusion methods, and fittings. MDH chose material characteristics consistent with standards that we know will result in leak-free piping that can withstand the BGHE system operating conditions.

Subitem 2, units (a) through (e) describe material standards for PEX BGHE piping, including manufacturing methods and ASTM standards. The standards specify that all PEX-system components must come from the same manufacturer to assure compatibility, define fitting ASTM standards, and prohibit fittings from being buried (unless they are installed in a vault) to make them accessible for inspection and repair.

Subitem 3 specifies that both HDPE and PEX piping must have a minimum pressure rating of 160 psi to accommodate BGHE systems. This simply expands the existing 160-psi pressure-rating requirement for HDPE piping to include PEX piping, too.

Item B requires that well contractors conduct a pressure test to ensure that the BGHE system, including buried piping and joints, is watertight. MDH revised this item to clarify that BGHEs are

closed-loop systems that should not leak under normal operation. Leaking heat-transfer fluid can contaminate soil and groundwater. We increased the required test pressure and duration from the existing 75 psi and 15 minutes. The specified test requires pressurizing all of the piping installed in the ground with water to a pressure of 1.5 times the operating pressure of the system, or 100 psi, whichever is greater. A successful test requires that the test pressure be held for 30 minutes with no loss in pressure[5].

Item C updates the grouting requirements for BGHEs, which are consistent with the grouting requirements for other wells and borings. It also applies the new definition of "thermally enhanced bentonite grout" found in Minnesota Rules, part 4725.0100, subpart 48b, which is a new material, to add the standards for using it. Grouting prevents the borehole from serving as a conduit for contaminants to move through the open space created by the borehole.

This item provides more stringent grout requirements for BGHEs that are installed in bedrock or in hydrogeologic settings where wells flow above the ground surface. MDH addressed the more challenging environments by dividing the standards into graduated levels that correspond to the level of difficulty involved. These more stringent standards are consistent with the standards required for other borings.

Subitem 1 text was moved from the first paragraph of Item C to improve readability.

Subitem 2 requires that contractors BGHE borings, when installing systems in geologic conditions where flowing conditions may exist, completely fill the annular space with neat-cement or sand-cement grout, as discussed in part 4725.3450. Here the standards exclude bentonite grout, because it does not cure to a solid form and may be washed out of borings by flowing groundwater.

Subitem 3 is the catch-all provision that applies to BGHE borings under all other conditions not addressed in subitems 1 and 2. Then bentonite grout or thermally enhanced bentonite grout may be used.

Thermally enhanced bentonite grout is a mixture of bentonite grout with the addition of either silica sand or graphite, or both. Adding silica sand to bentonite grout is allowed under existing rules for only BGHE systems. We added the definition, in Minnesota Rules, part 4725.0100, subpart 48b, to make this permission explicit. The proposed rule also allows using graphite, a naturally occurring mineral made up of carbon. Adding silica sand or graphite increases the grout's thermal efficiency and improves the bored geothermal heat exchanger system's working efficiency. These grouts are only allowed for use with BGHE systems.

The standard for creating thermally enhanced bentonite stated here is a ratio of adding a maximum of 17.5 gallons of water per 50 pounds of bentonite to make a slurry consisting of a minimum of 30-percent solids. In addition, the contractor may add silica sand and

5 The updated test requirements are consistent with the 2012 edition of the International Mechanical Code (IMC) section 1208.1, as amended by Minnesota Rules, chapter 1346.

graphite to the slurry. When installed, the slurry create a watertight seal, yet remains pliable to accommodate the natural movement of the earth.

The additives carry their own maximum-weights ratios for the amount that may be added. Silica sand is less expensive and has less of an effect on the thermal efficiency of the mixture. Up to 200 pounds of sand may be added per 50 pounds of bentonite. Graphite is more expensive than sand, has a greater effect on the thermal efficiency of the mixture, must meet ANSI/NSF Standard 60-2016[6]. Up to 20 pounds of graphite may be added per 50 pounds of bentonite.

Common practice is adding one of the two permitted additives, but not both. MDH's proposed rule does not preclude using both silica sand and bentonite in a thermally enhanced bentonite mixture.

Item D identifies the heat-transfer fluids, which include food-grade or USP-grade propylene glycol, ethanol, and potable water that are approved for BGHE systems. MDH completely revised the existing requirements. Existing rule allows both propylene glycol and potable water. The revision added ethanol. All are common heat-transfer fluids in closed-loop geothermal systems and are necessary to provide freeze protection.

Because BGHE systems have the potential to leak heat-transfer fluid into soil and groundwater, we require that heat-transfer fluid contents meet certain standards to minimize toxicity. We allow additives in propylene glycol products only if the additives are food-grade or USP grade, and the product is NSF-listed.

Ethanol, also known as ethyl alcohol, is the alcohol used in alcoholic beverages. To prevent the human consumption of ethanol used in heat-transfer fluids, manufacturers add denaturants to the ethanol to make it unpalatable. Some denaturants are highly toxic and unsuitable for use in BGHE systems. Therefore, item D requires that the commissioner review and approve product ingredients in ethanol-based heat-transfer fluids to ensure they do not pose an environmental or health risk. To eliminate danger of ethanol igniting at higher concentrations, ethanol may only be used in water solution of up to 20 percent ethanol. Contractors must also comply with additional cited safety requirements.

Item E removes details of heat-transfer fluids that are now incorporated into Item D. We slightly revised the requirement for the permanent sign to require that signs identify the heat-transfer fluid being used and that the fluid be approved.

Item F contains updated references to parts of the Minnesota Plumbing Code.

Item G cites part 4725.4450 to clarify that BGHE systems cannot be installed within the required isolation distances between a BGHE system and an existing water-supply well.

6 ANSI is an independent, third-party organization overseeing the development and implementation of standards and guidelines for various industry sectors. Specifically, ANSI/NSF Standard 60 has been developed to evaluate and certify drinking water treatment chemicals, such that products earning this certification have been tested and determined to be safe when used as a part of a drinking water system.

Subpart 2. **Notice of loss or leak.** MDH proposes to repeal subpart 2 and replace it with subpart 10.

Subpart 3. **Marking locations**. This new subpart requires contractors to mark all BGHE piping locations so that observers can detect each pipe from the ground surface, similar to how other buried utilities are marked. Therefore, MDH proposes provisions that provide three marking options consistent with what utilities use: tracer wire, underground marking tape, or a ferromagnetic metal marker that a metal detector could detect.

Subpart 4. **Separation under buildings**. Using directional drilling equipment means that BGHE piping can be installed beneath buildings or other structures. This proposed rule part establishes the permitted location of the piping. The boring must penetrate the ground surface at least 3 feet from a building (see part 4725.2185); and any piping underneath the building must be at least 10 feet deeper than the building's foundation or footings. This separation prevents unintentional damage to buildings and isolates the system from potential contamination sources that may exist in the building's lowest portions, including sewers. MDH determined that BGHE systems designed so that piping loop ends penetrate building walls or floors may be exempt from the building separation requirements as long as the loop ends remain accessible.

Subpart 5. **Isolation distances from contaminant sources**. This proposed subpart establishes a 10-foot minimum isolation distance between BGHE boreholes and contamination sources that are designed to leach contamination into the ground. The most common examples of these systems is septic system drain field. The subpart lists other examples. This minimum isolation distance only applies to the distance between the contaminant source and the point where the boring penetrates the ground surface. For enforcement purposes, MDH can easily verify this measurement. This measurement also works for verifying the isolation distances for a directionally drilled borehole. Boreholes, whether vertical or directionally drilled, have the potential to provide a pathway for contaminants to reach groundwater supplies. The isolation distance establishes a minimal separation distance to minimize the possibility that contaminants might move through the borehole. The isolation distance is less than what a water-supply well must have because the BGHE borehole will be completed as a closed system and will not be pumping groundwater.

Subpart 6. **Bored geothermal heat exchangers borings onto the property of another.** This subpart prohibits contractors from directionally drilling BGHE borings across property boundary lines unless either the affected property owner gives its prior written consent or other legal authority exists. The rule and permit issued under this rule do not provide property access or use rights beyond those that already exist. MDH will enforce violations, most likely by ordering the borehole be sealed, as authorized by Minnesota Statutes, section 144.99.

Subpart 7, **Accessibility**. Having access to the two ends of each pipe loop, both the supply end and return end, is critical for maintaining and sealing a BGHE system. Contractors can achieve accessibility by either extending the pipe ends into a building or by burying them at a depth of 10 feet or less. Common excavation equipment can typically excavate 10 feet down. Deeper excavations may require more specialized or larger equipment that may be less available. This accessibility requirement does not apply to the loop U-bend, which is generally installed at the bottom or termination of a borehole, because grout can be pumped through the entire loop from the accessible ends.

Subpart 8. **Pipe loop not connected to a geothermal heat exchanger system.** This new subpart requires contractors to protect any pipe loop is not directly connected to the BGHE system and spells out the methods that may be used. The pipe ends therefore must be extended above grade and protected from damage. This requirement will typically apply to a single loop installed during the design phase for thermal conductivity testing. A single loop is easily damaged or lost during the BGHE system's construction. Therefore, the loop must remain protected and accessible until it is removed from service and permanently sealed with grout.

Subpart 9. **Sealing of bored geothermal heat exchangers**. When a BGHE system is permanently removed from service, the contractor must properly dispose of the heat-transfer fluid and seal the pipe loops to prevent soil and groundwater contamination. Unsealed heat loop piping may serve as a conduit for contaminating soil and groundwater. Over time, piping degrades and may leak. Therefore, filling the pipe with a low-permeability grout is important to assure that the piping cannot contribute to contaminant movement. The required grouting materials and methods are comparable to the grouting requirements for other wells and borings.

Subpart 10. **Notice of loss or leak**. MDH placed these notice requirements here for logical organization. Item A exists in the current part 4725.7050, subpart 2, (see repealer discussion above). Item B, which is new, specifies that the system owner must also notify the Minnesota duty officer of any leak, according to Minnesota Statutes, section 115.061. We added this item to remind installers and property owners who may be familiar with BGHE rules, but not know about the leak notification requirements in statute.

In conclusion: These proposed rules establish the minimum construction standards for bored geothermal heat exchangers, including drilling methods, materials, thermal-exchange fluids, marking requirements, and notification requirements for known leaks or pressure losses. MDH drafted these rules by incorporating comments from industry professionals and trade organizations, considering standard acceptable practices, and considering MDH's mission and existing requirements in chapter 4725. They are necessary and reasonable.

CONCLUSION

Based on the foregoing, the proposed rules are both needed and reasonable.

June 15, 2020
Date

Jan K. Malcolm
Commissioner
Minnesota Department of Health