

## Debbie Beadle

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**From:** Evan Maxim  
**Sent:** Thursday, May 03, 2012 9:08 AM  
**To:** Debbie Beadle  
**Cc:** Kamuron Gurol; Susan Cezar; Debbie Beadle; Carl de Simas; Kathy Curry  
**Subject:** FW: CARA standards, follow up to PC meeting  
**Attachments:** Ltr to E Maxim re April 5 Meeting.pdf; PC CARA-Seismic-FFA Recommendation memo addendum 4-19-12 RH2 edits.doc

**Follow Up Flag:** Follow up  
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Please post as public comment.

*Evan Maxim  
Senior Planner  
City of Sammamish  
425.295.0523*

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**From:** Laura Keough [<mailto:laura@nesswd.org>]  
**Sent:** Thursday, May 03, 2012 8:27 AM  
**To:** Evan Maxim  
**Cc:** 'Jay Regenstreif'  
**Subject:** FW: CARA standards, follow up to PC meeting

Here is some follow up info for you regarding the geothermal wells. Thanks.

*Laura Keough  
General Manager  
NE Sammamish Sewer & Water District  
425-868-1144*

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**From:** Steve Nelson [<mailto:snelson@rh2.com>]  
**Sent:** Thursday, April 26, 2012 4:37 PM  
**To:** Laura Keough  
**Subject:** RE: CARA standards, follow up to PC meeting

Laura,

Here is the letter for your review, which I can send directly to Evan if you have no changes.

And, I attached Evan's matrix with added comments, also for your review.

Steve

Steve Nelson, LG, LHG, LEG | RH2 Engineering, Inc.

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**From:** Evan Maxim [<mailto:emaxim@ci.sammamish.wa.us>]  
**Sent:** Thursday, April 26, 2012 3:10 PM  
**To:** Laura Keough ([laura@nesswd.org](mailto:laura@nesswd.org))  
**Cc:** Steve Nelson; Jay Regenstreif ([jay.regenstreif@sammplat.wa.org](mailto:jay.regenstreif@sammplat.wa.org))  
**Subject:** CARA standards, follow up to PC meeting

Good Afternoon,

We are working on following up on the questions from the PC on the CARA regulations; attached is the follow up matrix we are trying to complete for the Planning Commission.

I would greatly appreciate input from the two districts if you can help...

Regards,

*Evan Maxim  
Senior Planner  
City of Sammamish  
425.295.0523*

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April 26, 2012

Mr. Evan Maxim  
Senior Planner  
Community Development  
801 228<sup>th</sup> Avenue SE  
Sammamish, WA 98075

*Sent Via: U.S. Mail*

**Subject: Northeast Sammamish Sewer and Water District  
City Planning Commission Summary of April 5, 2012, Meeting**

Dear Mr. Maxim,

This memo is written on behalf of the Northeast Sammamish Sewer and Water District (District) to provide information and recommendations to the City of Sammamish (City) Planning Commission in support of potential regulation of geothermal wells constructed in the City's Environmentally Critical Areas. This memo summarizes the City Planning Commission meeting on April 5, 2012.

### **Summary of Wellhead Protection Areas**

Wellhead protection areas are established by the Washington Department of Health (DOH) to identify the land areas that may contribute potential sources of contamination to drinking water supply wells. Delineation of wellhead protection areas, which predict the time it would take for a contaminant to travel from a source location to the well, is based on the local geologic characteristics around the supply well and the operation of the well. Potential sources of contamination from activities that use or manage toxic or hazardous materials in the wellhead protection areas would then be identified in contaminant inventory for the wellhead protection area. Artificial conduits that may facilitate the migration of contaminants from the surface to groundwater, such as deep excavations, mines, and wells, are also identified and mapped with respect to the supply well. The risk of contamination by surface activities is based on the distance from potential contaminant sources to the supply well and any mechanism in the wellhead protection area that can increase this risk by accelerating the migration of contaminants towards the well.

### **Different Types of Geothermal Wells**

The Washington State Department of Ecology (Ecology) permits the drilling of all vertical borings into the ground for the purpose of obtaining geologic information, investigating water resources, and obtaining drinking water supplies. Ecology also permits the drilling of geothermal heat source borings, which are vertical borings constructed to install a closed loop heat exchange system for a ground source heat pump. These systems use the ambient temperature of the earth as a heat source (in the winter) or a heat sink (in the summer) to boost efficiency and reduce the operational costs of heating and cooling systems. The temperature at depths below 20 feet is a relatively constant 50 to 60 °F. A heat pump



transfers heat from a cool space to a warm space, or vice versa, depending on the desired change in temperature of the structure. A ground source heat pump exchanges heat with the ground, extracting ground heat in the winter to heat structures and transfers heat from structures back into the ground in the summer for cooling.

The heat transfer may occur in either an open-loop or closed-loop system. Open-loop systems withdraw groundwater from a vertical well, use the groundwater for heat exchange, and re-inject the heated or cooled groundwater into an adjacent well.

Closed-loop systems use water or another fluid that is pumped through a loop system composed of pipes that run vertically in the ground. Constructing the system involves drilling a 200 to 300-foot-deep boring, lowering a set of pipes joined at the base at the bottom of the boring, and filling the boreholes to surround the pipe pairs with bentonite grout. The clay grout provides a thermal connection to the surrounding soil or rock to improve the heat transfer and minimize the potential for creating an artificial direct conduit from surface to the bottom of the borehole.

Heat exchange systems can also be constructed in a horizontal orientation. Horizontal closed-loop systems are composed of pipes that run horizontally within a long, horizontal trench, typically 4 feet deep. The trenches are filled with soil or other medium to facilitate the heat exchange in the loop system within the trench.

#### **Potential Risks Associated with Geothermal Wells**

Open-loop systems are directly connected to the aquifer and groundwater is directly injected into and withdrawn from the aquifer through the open-loop systems. Ecology requires a water right for these types of wells and rarely authorizes open-loop systems due to the inherent risk of groundwater contamination presented by direct injection of water into an aquifer.

Closed-loop systems are intended to reduce the risk of groundwater contamination by isolating the heat exchange fluid from the aquifer using bentonite grout. The effectiveness of this risk reduction is based on the performance of the well drilling contractor installing the system and the quality of the materials used to construct the system. There is no way to be sure of the integrity of the bentonite grout seal once installation is completed. Ecology does not oversee the construction or confirm the use of the boring. Improper use or construction of the system could result in breakage of the pipes creating open conduits from surface to the aquifer. This risk is increased if a fluid other than water, such as antifreeze, is used in the closed-loop system.

#### **Regulation and Maintenance of Geothermal Wells**

Ecology regulates the construction, use, and decommissioning of borings through Chapter 173-160 of the Washington Administrative Code (WAC), but the burden of the construction, integrity, and operation of the system is placed entirely on the well constructor and owner of the system with little or no oversight by Ecology. The following lists Ecology regulations from Chapter 173-160 WAC in italics and presents some concerns regarding the enforcement of the regulations.

- *Ground source heat pump borings cannot be used for any purpose other than heat exchange. After completion, ground source heat pump borings shall not be converted to any other type of well except by written approval by the department [of Ecology]. The operator shall ensure that the ground source heat pump boring is constructed according to this chapter [173-160].*



Concern: Without Ecology's knowledge, private owners may intentionally or inadvertently alter the use or operation of the ground source heat pump.

- *In a closed-loop ground source heat pump boring, the material used to make up the heat exchange loop that is placed into the ground must be able to withstand the typical forces which act upon it during and after construction. It shall be resistant to the corrosive effects of the surrounding formations, earth, water, and heat exchange fluids within the pipe.*

Concern: Ecology leaves the selection of the materials to the well contractor and owner.

- *Pressure testing will be done in accordance with manufacturer recommended specifications. The closed-loop assembly pipe within the bore hole shall not leak or cause contamination to the groundwater*

Concern: The well contractor or owner does not need to prove the performance of the system by submitting pressure testing to Ecology.

- *All fluids used in the construction and testing of ground source heat pump borings will be handled and utilized in a manner that does not contaminate the groundwater or surface water.*

Concern: Ecology does not inspect the construction, use, or testing of the borings.

- *If grouting is not successful, the department must preapprove an alternate completion of the ground source heat pump boring. If an alternate completion is not approved, the well must be properly decommissioned. It shall be the responsibility of the driller to properly construct the bore hole, pressure test the loop pipe, install the loop pipe, and grout the bore hole.*

Concern: Aside from well contractor judgment, there is no method to confirm the integrity of the bentonite grout or the system.

- *Chapter 18.104.180 RCW [Revised Code of Washington] exempts Washington State licensed engineers, architects, and land surveyors from further licensing requirements. They must directly supervise the work and comply with all other requirements of law and rule.*

Concern: Licensed professionals with little or no experience in geology, groundwater, or well construction may direct a well contractor to install a ground source heat pump.

- *The property owner is responsible for decommissioning the well.*

Concern: It is not reasonable to expect that a private homeowner will spend the thousands of dollars to decommission an unused or damaged ground source heat pump. Ecology does not monitor the use or discontinued use of ground source heat pumps.

## Summary

Ecology has the authority to permit ground source heat pump borings under Chapter 173-160 WAC and has established requirements, which are intended to protect groundwater, for drilling, construction, and decommissioning of these types of borings. However, even though such borings may be permissible, their ultimate use, monitoring, and decommissioning may be neglected over time as ownership and responsibility for the borings are transferred to subsequent property owners.

Therefore, the District suggests the following restrictions on geothermal/heat exchange wells:

- Open-loop geothermal wells that could be used to recirculate water or groundwater should be prohibited in all Class 1, Class 2, and Class 3 Wellhead Protection Zones established in the City.



- Closed-loop horizontal and vertical geothermal wells used to recirculate a chemical heat transfer fluid other than potable water should be prohibited in all Class 1, Class 2, and Class 3 Wellhead Protection Zones established in the City.
- Closed-loop vertical geothermal wells, also known as ground source heat pump borings, used to recirculate potable water for heat exchange should be prohibited in Class 1 and Class 2 Wellhead Protection Zones established in the City.
- Closed-loop geothermal wells, also known as ground source heat pump borings, may be allowed in Class 3 Wellhead Protection Zones established in the City if they are designed to comply with Chapter 173-160 WAC.

#### Additional Recommendations

The District recommends the City consider requiring some method to record the construction of ground source heat pump borings in Class 3 zones so that subsequent owners are aware of their responsibility to maintain the borings during use, and decommission the borings if no longer used per Chapter 173-160 WAC.

Horizontal heat exchange systems in shallow trenches are more accessible and easily repaired or decommissioned, and are less risky than vertical systems. The intervening soil layers between the horizontal system and drinking water supply aquifers provide substantially more protection than vertical systems. Horizontal systems offer an alternative to vertical systems that should be excluded from Class 1 and Class 2 Wellhead Protection Zones. Since Ecology does not regulate the construction of horizontal heat exchange systems, the City may consider the need to regulate the construction and operation of horizontal heat exchange systems to provide critical area protection.

If you have any questions, please do not hesitate to call me at (425) 951-5406, or email me at [snelson@rh2.com](mailto:snelson@rh2.com).

Sincerely,

**RH2 ENGINEERING, INC.**

Steve Nelson, L.G., L.H.G., L.E.G.

SN/jq/jp

cc: Laura Keough, General Manager, Northeast Sammamish Sewer and Water District