

## Virginia Household Water Quality Program: Fluoride in Household Water

*Erin James Ling, Water Quality Extension Associate, Biological Systems Engineering, Virginia Tech*  
*Brian Benham, Associate Professor and Extension Specialist, Biological Systems Engineering, Virginia Tech*  
*Jen Pollard Scott, Extension Staff, Biological Systems Engineering, Virginia Tech*  
*Kathryn Haering, Research Associate, Crop and Soil Environmental Sciences, Virginia Tech*

Private water sources, such as wells and springs, are not regulated by the U.S. Environmental Protection Agency (EPA). Although private well construction regulations exist in Virginia, private water supply owners are responsible for the maintenance of their water systems, for monitoring the quality of their drinking water, and for taking appropriate steps to address problems should they arise.

The EPA public drinking water standards are good guidelines for assessing your water quality. *Primary drinking water standards* apply to contaminants that can adversely affect health and are legally enforceable for public water systems. *Secondary drinking water standards* are non-regulatory guidelines for contaminants that may cause nuisance problems such as bad taste, foul odor, or staining.

Testing your water annually and routinely inspecting and maintaining your water supply system will help keep your water safe. For more information, visit the Virginia Household Water Quality Program website [www.wellwater.bse.vt.edu](http://www.wellwater.bse.vt.edu).

### Introduction

Fluoride is a naturally occurring element that is found in certain rocks and soils and can be dissolved in groundwater. Most groundwater naturally contains small amounts of fluoride; however, in some parts of eastern Virginia, levels of naturally occurring fluoride in the groundwater may be quite high. Low levels of fluoride in drinking water promote good dental health. The Dental Health Division of the Virginia Department of Health currently recommends that fluoride concentrations in public drinking water be between 0.8 and 1.2 milligrams/liter (mg/L). Many municipalities add fluoride to public drinking water supplies as a tooth decay preventative, and 95% of Virginia residents who rely on public water supplies drink fluoridated water.

### Problems Associated With Excess Fluoride in Drinking Water

The U.S. Environmental Protection Agency (EPA) has set two drinking water standards for fluoride in public water systems. The primary drinking water standard

limits fluoride to 4 mg/L to prevent possible bone disease due to excess fluoride, and the secondary drinking water standard sets a guideline of 2 mg/L fluoride or lower in order to prevent dental fluorosis (mottling of developing teeth enamel). Fluorosis usually occurs in children who are younger than 9 years old, and the effects can vary from barely perceptible off-white to light brown marks, pitting, enamel loss, and brown staining on permanent teeth.

In January 2011, the U.S. Department of Health and Human Services announced a proposal to lower the recommended fluoride level in public water supplies to 0.7 mg/L due to concerns about increasing dental fluorosis observed in children and young adults. The EPA also announced that it will conduct further scientific assessments of the benefits and risks associated with adding fluoride to public water supplies. These assessments may result in a change to the drinking water standards for fluoride. Any concerns about fluoride consumption should be discussed with a physician.

[www.ext.vt.edu](http://www.ext.vt.edu)

## Testing for Fluoride

Private water system users are responsible for testing fluoride levels in their own water supplies. Some areas in southeastern Virginia, including the cities of Franklin and Suffolk as well as the counties of Isle of Wight (including the town of Smithfield), Lancaster, Northumberland and Southampton tend to have naturally occurring high fluoride levels in groundwater. Water from private water systems in these areas may require treatment to reduce fluoride to levels safe for consumption (see Figure 1).

Fluoride does not noticeably alter the taste, color, or smell of water. Measurement of fluoride is most accurately made by a certified laboratory. When collecting

any water sample, follow the instructions for proper sample collection carefully. A list of certified laboratories maintained by the Virginia Division of Consolidated Laboratory Services is available at: [www.wellwater.bse.vt.edu/resources.php](http://www.wellwater.bse.vt.edu/resources.php).

## Treatment Options

The recommended level of fluoride in drinking water is currently between 0.7 and 1.2 mg/L, so treatment may be advisable for higher fluoride levels. It is only necessary to treat water used for drinking and cooking for high fluoride levels; water used for washing, showering and other uses need not be treated. If treatment is not desirable or an option, one may consider buying bottled

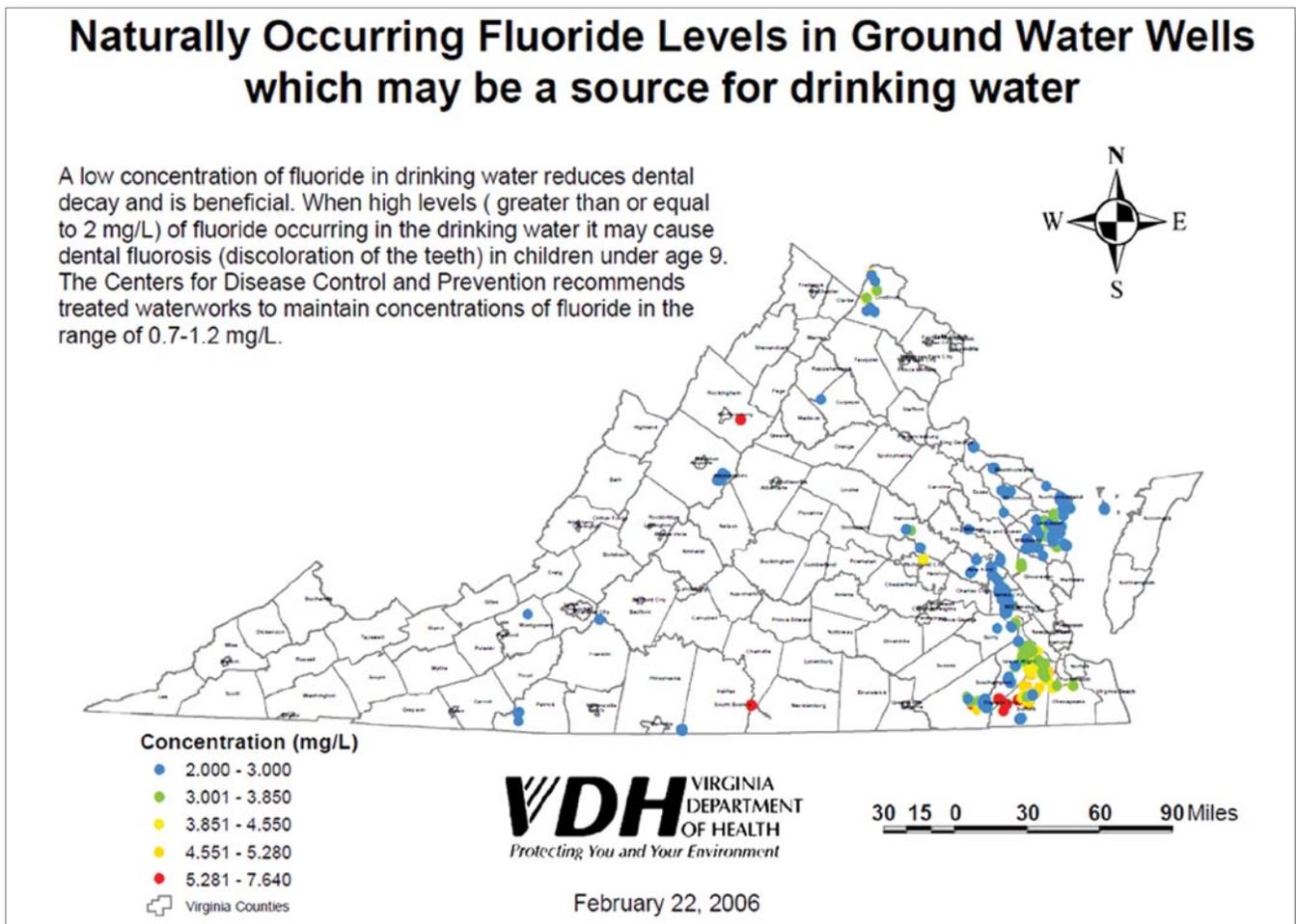


Figure 1. Areas of Virginia with naturally high levels of fluoride in groundwater.

Source: Virginia Department of Health, accessed online August 2011: ([http://www.vahealth.org/dental/communitywaterfluoridation/documents/2008/pdfs/naturally\\_occurring\\_fluoride\\_levels.pdf](http://www.vahealth.org/dental/communitywaterfluoridation/documents/2008/pdfs/naturally_occurring_fluoride_levels.pdf))

The Virginia Household Water Quality Program, offered through Virginia Cooperative Extension (VCE), periodically conducts county-based household water sampling clinics where you can learn about the quality of your water supply, proper water supply system maintenance, and, if needed, possible water treatment options. Please contact your local Extension office or visit [www.wellwater.bse.vt.edu](http://www.wellwater.bse.vt.edu) for more information.

water or using water from an alternate source for drinking and cooking.

Treatment methods to remove fluoride from drinking water include activated alumina filters, distillation, reverse osmosis, and ion exchange. Because the activated alumina filters, distillation and reverse osmosis treatment options treat a relatively small volume of water at any one time, they can be costly, and storage space for treated water may be required. As a result, these devices are typically considered point-of-use treatment options and may only be practical for installation at one faucet. Ion exchange treatment systems can be either point-of-use or they can be installed where the water enters the house (point-of-entry).

**Activated alumina filters** adsorb contaminants onto a packed bed of activated alumina granules enclosed within a cartridge. The capacity of the alumina to adsorb contaminants may be “used up” depending on the other contaminants present in the water supply. These devices work in water with a pH less than 8.5, and pretreatment (filtering) is required if sediment is present. Maintenance involves replacing the cartridge and monitoring treated water quality. Used cartridges can be sent to water treatment professionals for regeneration.

**Distillation** devices involve boiling water in a special device, collecting the resulting steam, and cooling it in a separate chamber. One of the benefits of distillation is that it uses no chemicals. Distillation, however, takes longer to produce processed water than other methods, units can be expensive to operate, and the length of time distilled water is stored can affect its quality. In addition, distilled water has a very “flat” taste, because minerals naturally present in water are also removed during the process.

**Reverse osmosis (RO)** devices reduce many dissolved contaminants in water, including fluoride. Water molecules are forced through a semi-permeable, cellophane-like membrane, which allows water to pass through, but not most contaminants. Ten to twenty percent of the water entering the RO system exits as treated water, and the other 80 to 90 percent is wastewater, and is diverted to a drain. RO units can be wasteful unless equipped with an automatic shut-off valve. These systems work best with higher water pressure and often require pretreatment and post-treatment systems to work properly. They have an average lifetime of 3-5 years at which point the membrane must be replaced. These devices can be expensive to purchase and maintain.

**Ion exchange** devices exchange unwanted constituents in water with less objectionable ones. To remove fluoride, anion exchange units contain resin beads that are covered with chloride; as water passes through the device, the resin adsorbs the fluoride and releases chloride into the water. Similar to the action of activated alumina, removal of fluoride may be influenced by what other contaminants are present in a water supply, as resins adsorb anions preferentially. Ion exchange system maintenance involves periodically regenerating the resin with a brine solution, which replaces the adsorbed contaminants with chloride ions. The contaminants are discarded with the recharge wastewater. Ion exchange treatment may result in lower pH and therefore slightly more corrosive water.

Note that the use of these methods may remove almost all the fluoride from your drinking water. A complete water analysis for contaminants and/or the advice of a certified water treatment professional will help in selecting the specific treatment method appropriate for each application. Consumers should verify manufacturer claims before purchasing any water treatment device by contacting the National Sanitation Foundation ([www.nsf.org](http://www.nsf.org)), or the Water Quality Association at [www.wqa.org](http://www.wqa.org). If you are concerned about the health effects of either high or low fluoride levels in your family’s drinking water, consult your physician.

## Additional Information

For more information on fluoride in household water, see the Virginia Cooperative Extension publications listed here:

Virginia Household Water Quality Program website: [www.wellwater.bse.vt.edu/resources.php](http://www.wellwater.bse.vt.edu/resources.php).

Virginia Cooperative Extension website: <http://pubs.ext.vt.edu/category/home-water-quality.html>.

## Acknowledgments

The authors wish to thank the following individuals who reviewed this publication: George Harlow, supervisory hydrologist, U.S. Geological Survey, Richmond, Va.; Billie Jean Elmer, 4-H youth development Extension agent, VCE Surry County Office; and Erica Moore, TMDL technician, Mountain Castles Soil and Water Conservation District.

## References

- Centers for Disease Control and Prevention. 2001. Recommendations for using fluoride to prevent and control dental caries in the United States. *Morbidity and Mortality Weekly Report* 50 (RR14): 1-42. Centers for Disease Control and Prevention, Atlanta, GA. Accessed online August 2011 at: <http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5014a1.htm>
- Centers for Disease Control and Prevention. 2010. 2004 Water Fluoridation Statistics. Centers for Disease Control and Prevention, Atlanta, GA. Accessed online August 2011 at: <http://www.cdc.gov/fluoridation/statistics/2004stats.htm>
- Hairston, James E., Leigh Stribling, and John M. Beck. 2001. Fluoride. Alabama Cooperative Extension System. Alabama A&M and Auburn Universities, Alabama. Accessed online August 2011 at: <http://www.aces.edu/waterquality/articles/0311002/0311002.pdf>
- National Academy of Sciences. 2006. Fluoride in drinking water: A scientific review of EPA's standards. Report in Brief. National Research Council, National Academy of Sciences, Washington, DC. Accessed online August 2011 at: <http://dels.nas.edu/Report/Fluoride-Drinking-Water-Scientific/11571>
- Skipton, Sharon, Bruce Dvorak, Andy Kahle, and Wayne Woldt. 2008. Drinking water: Fluoride. *NebGuide* (G1376). Institute of Agriculture and Natural Resources, University of Nebraska- Lincoln Extension, Lincoln, NE. Accessed online August 2011 at: <http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=406>
- U.S. Environmental Protection Agency. 2009. National Primary Drinking Water Regulations. EPA 816-F-09-004. U.S. Environmental Protection Agency, Washington, DC. Accessed online August 2011 at: <http://www.epa.gov/safewater/consumer/pdf/mcl.pdf>
- U.S. Environmental Protection Agency. 2011. Secondary Drinking Water Regulations: Guidance for Nuisance Chemicals. EPA 816-F-10-079. U.S. Environmental Protection Agency, Washington, DC. Accessed online August 2011 at: <http://www.epa.gov/safewater/consumer/2ndstandards.html>
- U.S. Environmental Protection Agency. News Releases-Water. Release date: 1/7/11. EPA and HHS Announce New Scientific Assessments and Actions on Fluoride / Agencies working together to maintain benefits of preventing tooth decay while preventing excessive exposure. Accessed online August 2011 at: <http://yosemite.epa.gov/opa/advpress.nsf/3881d73f4d4aaa0b85257359003f5348/86964af577c37ab285257811005a8417>
- Virginia Department of Health. 2009. Community water fluoridation. Division of Dental Health, Virginia Department of Health, Richmond, VA. Accessed online August 2011 at: <http://www.vahealth.org/teeth/CommunityWaterFluoridation.asp>
- Wagenet, L., K. Mancl, and M. Sailus. 1995. Home Water Treatment (NRAES-48). Natural Resource, Agriculture, and Engineering Service (NRAES), Cornell University Cooperative Extension Service, 120 p.