

Protecting Groundwater, Assisting with Energy Savings



Kevin McCray, CAE
Chief Executive Officer



Who we are

Founding date

1948 (as National Water Well Association — name changed in 1991)

11,000 U.S. and international groundwater professionals — contractors, scientists and engineers, equipment manufacturers, and suppliers.

Our purpose is to provide guidance to members, government representatives, and the public for sound scientific, economic, and beneficial development, protection, and management of the world's groundwater resources.



Who we are

Our mission

Dedicated to advancing groundwater knowledge.

Our vision

To be the leading groundwater association that advocates the responsible development, management, and use of water.

Our goals

- To further water knowledge and protection through education and outreach
- To use advocacy to advance the interests of our membership
- To serve members by creating community
- To develop and improve professional practices and procedures for the public's interest.



NGWA's ground source heat pump interests

- Protection of groundwater is NGWA's first concern
- Well-functioning ground source heat pump systems are NGWA's second concern so as to protect the future of this business diversification opportunity by way of quality water well and loop well drilling and construction



Contributing to the body of knowledge



NGWA technology transfer projects

Project	Synopsis
<p><i>Ground Water-Source Heat Pump Test Facility</i></p>	<p>Field evaluation of the effectiveness of groundwater heat pump technology for heating and cooling.</p>
<p><i>Ground Water Heat Pumps: An Examination of Hydrogeologic, Environmental, Legal, and Economic Factors Affecting Their Use</i></p>	<p>This report describes the results of the field studies and computer simulations of the applicability of groundwater heat pumps to different environments and different parts of the country, and compares the economics of installing groundwater heat pumps versus other means of space conditioning.</p>
<p><i>Computer Simulation to Assess the Environmental Impact of Residential Ground Water Geothermal Heat Pump Utilization</i></p>	<p>Objectives of this project included development of computer simulation designed to evaluate the effects of groundwater geothermal heat pump use under varying hydrogeologic, climatologic, and housing density conditions.</p>



NGWA technology transfer projects

<i>Preliminary Ground Water Heat Pump Study</i>	This report performed a preliminary study on existing data to show the energy efficiency for domestic heating and cooling by groundwater to air heat pumps.
<i>Water Well Drilling Cost Survey</i>	This survey evaluated the drilling costs of water wells to assist in determining the cost effectiveness of groundwater heat pumps and geothermal energy development.
<i>Single-Well Heat Pump Systems</i>	This was an investigation in o the feasibility of using a single well for the supply and return of groundwater utilized within a groundwater heat pump energy system.
<i>Sewells Point Naval Facility Ground Water Heat Pump Study</i>	This study by NGWA provided a computer simulation and evaluation of the cost effectiveness of using groundwater heat pumps to provide space conditioning to base residential housing facilities.

NGWA technology transfer projects

Guidelines for the Construction of Vertical Boreholes for Closed Heat Pump Systems

This project was guidance on appropriate vertical low-temperature geothermal borehole installation practices in varying geological and hydrological regimes. It identifies the fundamental issues related to the use of this technology: (1) appropriate vertical geothermal borehole installation practices in varying geological and hydrological regimes, and (2) the isolation of real environmental concerns from misconceptions.

Manual on Environmental Issues Related to Geothermal Heat Pump Systems

NGWA reviewed and approved this document, which was largely derivative of the *Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems*.



NGWA's body of knowledge

- *Guidelines for Construction of Loop Wells for Vertical Closed Loop Ground Source Heat Pump Systems, 3rd edition (2010)*
- *Geothermal Cost Calculator (2010)*
- *Drilling Cost Calculator (2006)*
- *Manual of Water Well Construction (1998)*
- *Development Methods for Water Wells (1991)*
- *Ground Water Hydrology for Water Well Contractors (1982)*
- *Corrosion and Incrustation of Water Wells (1991)*
- *Best Suggested Practices for Managing a Flowing Well (2010)*
- *Best Suggested Practices for Residential Well Cleaning (2008)*
- *Cable Tool Fishing (1968)*



NGWA's body of knowledge

- *Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes (2006)*
- *Illustrated Glossary of Driller's Terms (2003)*
- *Iron Bacteria Occurrence, Problems, and Potential Solutions in Water Wells (1986)*
- *Manual of Hydraulic Fracturing for Well Stimulation and Geologic Studies (1989)*
- *Manual of the Selection and Installation of Thermoplastic Water Well Casing (1980)*
- *Manual of Water Well Maintenance and Rehabilitation Technology (1982)*
- *Sealing Abandoned Wells (1994)*
- *Water Well Drilling Agreement and Instructions for Use (2010)*
- *Transfer of Technology (2003)*



NGWA's body of knowledge

- *Basic Water Systems: A Pump and Hydraulic Training Manual (2002)*
- *Pump Installation Cost Calculator (2006)*
- *Water Well Pump Installation Agreement and Instructions for Use (2010).*

NGWA's monthly trade journal

- *Water Well Journal*[®] regularly reports on ground source heat pump technology





**Best practices and standards lead
to groundwater protection and
satisfied customers**



ANSI/NGWA-01-14 Water Well Construction Standard

An American National Standard
NGWA Standard Development Oversight Committee
May 2014



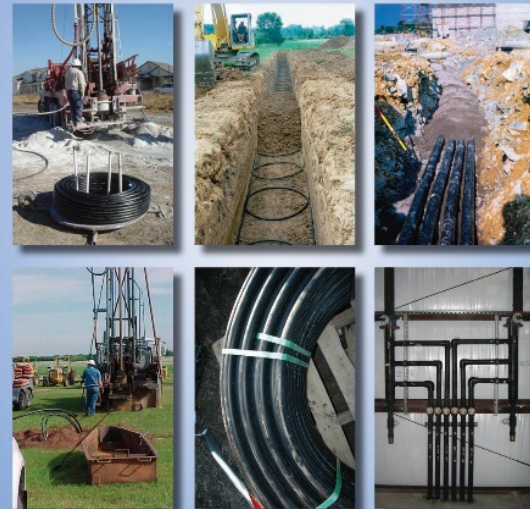
Water well construction standard encompasses municipal, residential, agricultural, monitoring, and industrial water production wells.

NGWA *Guidelines for Loop Well Construction*

- 1997 *Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems*
- Third edition released in 2010
- Free to state agencies with ground source heat pump oversight roles

Guidelines for the Construction of Loop Wells for Vertical Closed Loop Ground Source Heat Pump Systems

Third Edition



Edited by Jonathan T. Jenkins

White Paper¹: Grouting Variables and their Contribution to the Diameter of Ground Source Heat Pump Loop Wells

As a benefit to members of the National Ground Water Association and others, this document provides the ground source heat pump systems professional with basic knowledge of grouting practices related to loop wells. This document provides a basic understanding of the issues.

Definitions

ground source heat pump:

A heat pump that uses the earth itself as a heat source and heat sink. It is coupled to the ground by means of a closed-loop heat exchanger (ground coil) installed horizontally or vertically underground. Sometimes referred to as a geothermal heat pump.

grout:

A bentonite material or fluid mixture introduced into a borehole to seal between materials.

grouting:

The operation by which grout is placed, from bottom to top, in a borehole.

pumpability:

The quality, state, or degree of being pumpable.

tremie method:

Method whereby filter pack is emplaced or bentonite/cement slurries are pumped uniformly into the annular space of the borehole through the use of a tremie pipe.

tremie:

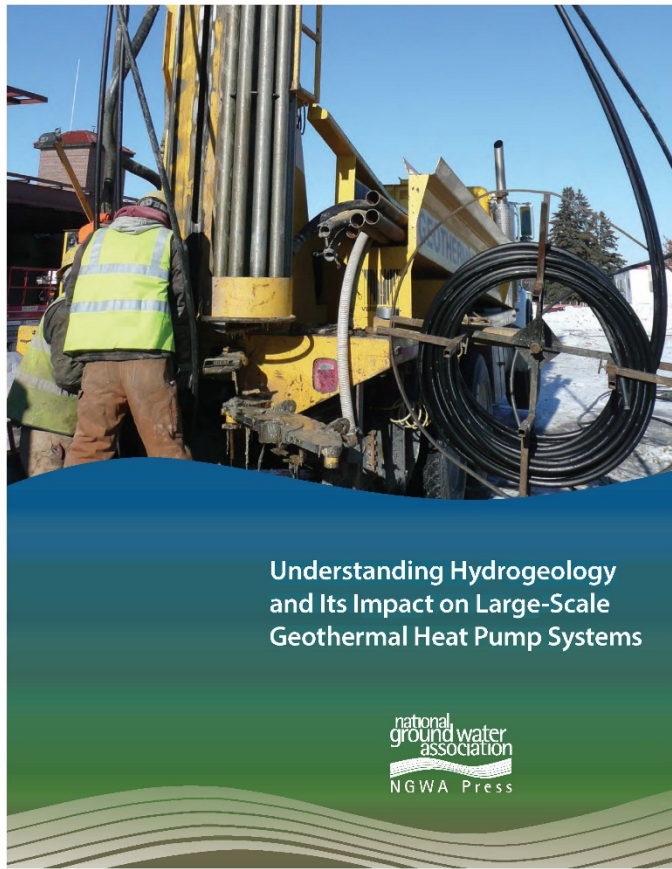
A pipe or hose of sufficient diameter to allow for the pumping of thermal grouts to the bottom of the loop well.

There are many variables contributing to the interior diameter (ID) of a loop well borehole. They are all related to striving for groundwater protection and optimal geothermal heat pump system performance.

Some 12 variables interplay to lead to the pumpability of the grout through a tremie to result in proper grout emplacement that (a) creates an effective barrier from surface water intrusion and potential contamination of groundwater; (b) prevents intermingling of groundwater zones in the subsurface; and (c) serves as an effective medium for heat transfer, and thus, optimal system performance.

¹ "White Paper – An authoritative report or guide written for industry audiences that addresses issues and possibly options as to how to solve them. White papers are used to educate readers and help people make decisions for themselves." From NGWA Policy on Official Document Types, June 5, 2013.

Understanding Hydrogeology and Its Impact on Large-scale Geothermal Heat Pump Systems



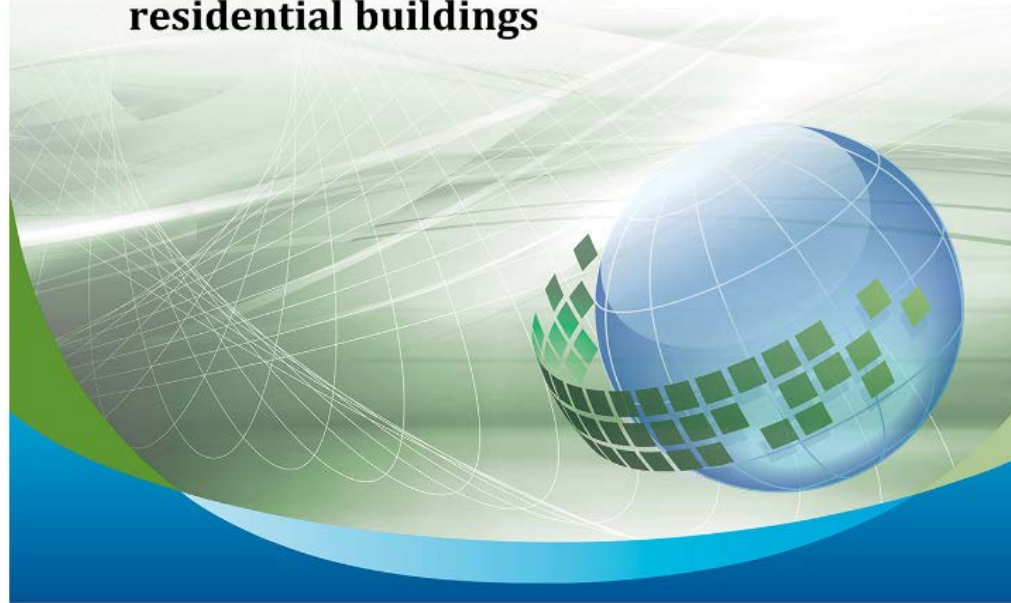
- Released in 2015
- Intended to help avoid unintended consequences from utilization of the technology



ANSI/CSA C448 Series-16

CSA-448

**Design and installation of ground source
heat pump systems for commercial and
residential buildings**



Endorsed by



International Ground Source Heat Pump Association



NGWA's Voluntary Certification Program and Designations



Pump and return systems

- So called “open loop” groundwater source heat pump installations are essentially water well systems, although there must be design specifications and construction application that anticipate the volume of water to be extracted, and if a return well (an injection well under federal rules) is used, the volume of water to be returned.

Standing column systems

- So called “standing column” groundwater source heat pump installations are essentially water well systems, although there must be design specifications and construction application that anticipate the volume of water to be extracted and returned. In some states, standing column wells for heat pump systems are seen as injection wells.

A water well pump is required

- Both open loop and standing column heat pump installations require a water pumping system, such as those typically used in a water well system.

NGWA definitions

- **Loop well:** The subsystem of a geothermal heat pump system that consists of the drilled vertical opening into the Earth that is equipped with a heat exchange media conveyance tube (loop), is grouted from well bottom to Earth's surface with a grout material, and then is connected to the heat exchange components of the geothermal heat pump system.
- Construction of a geothermal heat pump loop well includes, in continuous order, drilling of the loop well, placement of the loop to the bottom of the loop well with the grout tremie, grouting of the loop well from the bottom of the loop well to the surface, and finally, connecting the loop tube ends to the loop field assembly or to the heat exchanger.
- Loop emplacement and grouting should be performed in a timely manner to guarantee successful loop tube placement, grout installation, and environmental protection. The loop installation, grouting processes, and connection of the loop tubes to the loop field assembly shall be completed within a timeframe to ensure total loop well grouting and ensure aquifer protection.

NGWA definitions

- **Loop field:** A loop field is designed and built in a vertical configuration of one or more vertical loop wells, either free-standing or interconnected, that allows the heat transfer fluid circulated within the loop tube to exchange heat with the subsurface geologic environment.



NGWA definitions

- **Loop well driller:** Any person engaged in constructing, altering, testing, developing, or repairing a loop well.
- **Loop well contractor:** Any person or firm engaged in the business of contracting for constructing, altering, testing, developing, or repairing a loop well.

Our position

- Endorses the administration of a fair and equitable licensing program for water well drillers and water well pump installers that is properly enforced in order to assure:
 - Increased protection for the homeowner who uses groundwater as a drinking water source
 - A public that has confidence in the contractor as a licensed professional
 - The protection of the groundwater resource through adherence to proper water well construction and pump installation standards
 - A minimum level of competence among water well drilling and water well pump system contractors.



Our position...

- NGWA encourages states that have no water well or pump installer contractor licensing to investigate the public health and environmental benefits of instituting such a program.
- NGWA encourages states with licensing programs to adopt the tests administered in the Association's Voluntary Certification Program as part of their state requirements. The use of a national test provides a method of assuring a minimum level of competence throughout the industry, a standard of protection for the resource, equitable treatment for homeowners, and a pathway to reciprocity.
- In order to maintain the level of competence, as demonstrated by the successful completion of the initial license test and to assure that advances in technology and science are applied in the field, NGWA also endorses the concept of proof of continuing education as prerequisite to license renewal.



NGWA's Position: Closed Loop, Vertical Borehole Systems

- The National Ground Water Association believes the grout and the loop tubing that transports the heat exchange media of a geothermal heat pump system are integral parts of the loop well and that qualified individuals, such as a Certified Vertical Closed Loop Driller (CVCLD), should be authorized to construct a loop well. It is an expectation that qualified individuals will have third-party endorsed skills and competencies in the fusion of the loop tubing.

NGWA's voluntary certification program

- The NGWA Well Construction and Pump Installation Certification Program, which started in 1970, is a certification program for drilling contractors and pump installers in the groundwater industry.
- Through this program, you may earn the Certified Well Driller (CWD) and/or the Certified Vertical Closed Loop Driller (CVCLD) designation.





State government recognized

- The program is designed to demonstrate professionalism in the groundwater industry. It is recognized as the leading program in the industry by 17 U.S. state agencies, which have adopted the tests for their own programs.



Transitioning IGSHPA's Accredited Vertical Installers to NGWA's CVCLD Designation

- By formal agreement
- IGSHPA has ended its accreditation of vertical closed loop installers
- NGWA will transition those who wish to as Certified Vertical Closed Loop Drillers if they can meet the NGWA required 24 months of third-party attested drilling experience
- NGWA certifies for vertical closed loops only for tested knowledge of borehole drilling, insertion of the loop tubes, and grouting
- NGWA certifies open loop and standing column systems as Certified Well Drillers





NGWA's identified skills and competencies for ground source heat pump-related drilling

Vertical Well Construction Skills and Competencies Comparatives

Compiled: July 1, 2009

Amended: February 5, 2010

		Well or Loop Well System				
DACUM Research Chart Tasks for Drilling Contractors & Operators		Water well	Open-loop geothermal	Standing-column geothermal	Closed loop geothermal	Direct exchange geothermal
A	A-Assess Client Needs					
1	Respond to client inquiry	Yes	Yes	Yes	Yes	Yes
2	Collect client information	Yes	Yes	Yes	Yes	Yes
	Determine client					



Better qualifying vertical loop well installers to better protect groundwater

- Teams from each organization met in late June to draft additional questions for the NGWA Certified Vertical Closed Loop Driller voluntary certification examination
 - 50 new questions developed





NGWA Certified Well Driller (CWD)

- Certified Well Driller (CWD) designation reflects an individual who has passed a written examination administered by NGWA that evaluates an individual's knowledge of the skills and competencies associated with drilling a water well.
- A candidate must pass two exams – a general drilling examination, and then a drilling specialization exam.



NGWA Certified Vertical Closed Loop Driller

- This Certified Vertical Closed Loop Driller (CVCLD) designation reflects an individual who has passed a written examination administered by NGWA that evaluates an individual's knowledge of the skills and competencies associated with constructing a loop well
- Candidate must pass one exam composed of 75 multiple-choice questions



NGWA Certified Pump Installer (CPI)

- This Certified Pump Installer (CPI) designation reflects an individual who has passed a written examination administered by NGWA that evaluates an individual's knowledge of the skills and competencies associated with water well pump installation. A candidate must pass two exams – a general water systems examination, and then a water systems specialization exam.



Who is eligible?

- An individual is eligible to apply for the CWD, CPI, or CVCLD designation if he or she:
 - is at least 20 years old
 - has at least 24 consecutive months of full-time drilling experience
 - submits written references verifying their experience from two professional contacts who are not affiliated with a current company.

How to keep NGWA designation

- To sustain the CWD, CPI, or CVCLD designations requires the completion and reporting of at least seven (7) hours of annual continuing education.
- 7 points (hours) must be reported to NGWA by December 31 for the year.
- Must maintain a high standard of work as agreed to in the "Certification Agreement" signed by the certification candidate when he or she took the exam.
- Sign an affidavit each year verifying that he or she has no pending legal action against them for failure to properly construct wells and that he or she has maintained the qualified licenses to operate in their state or province.

Training and education

NGWA EVENT	PRIMARY TARGET
NGWA Geothermal Drilling Mud and Grouting School	Drilling Contractors
Webinar: Basic Geothermal Operations	Drilling Contractors
Course: What Water Well Drilling Contractors Need to Know to Install Geothermal Wells	Drilling Contractors
Brown Bag/Webinar: Making the Most of the NGWA Cost Calculators (including Geothermal Cost Calculator)	Drilling Contractors
<i>Water Well Journal</i> – Geothermal Focus Issue	Drilling Contractors

Training and education

NGWA EVENT	PRIMARY TARGET
Course: Geothermal Design for Groundwater Consulting Firms	Groundwater Consultants
NGWA Geothermal Drilling Mud and Grouting School	Drilling Contractors
Course: Geothermal Design for Groundwater Consultants	Groundwater Consultants Consulting Firms
Session/Panel: Interrelationship of Energy and Groundwater	Groundwater Consultants Regulators
Publication: <i>Geothermal Well Installation 101</i>	Drilling Contractors



Advocacy for the technology

A voice with federal government

- Secured federal tax credits
- Work so technology is recognized by Congress as part of energy and climate change solutions
- Assisted DOE in drafting technology roadmap
- Served on DOE group examining environmental impacts of ground source heat pump installations
- Commented on Energy Star specification for ground source heat pumps
- Submitted comments to the National Science Board on the role for ground source heat pumps in a sustainable energy future
- Assist state and local regulatory agencies with requested information





Understanding state regulatory oversight

- NGWA collaborated in an effort with the Ground Water Protection Council, the International Ground Source Heat Pump Association, and the Geothermal Heat Pump Consortium to conduct a comprehensive assessment of how the various states apply their regulatory roles



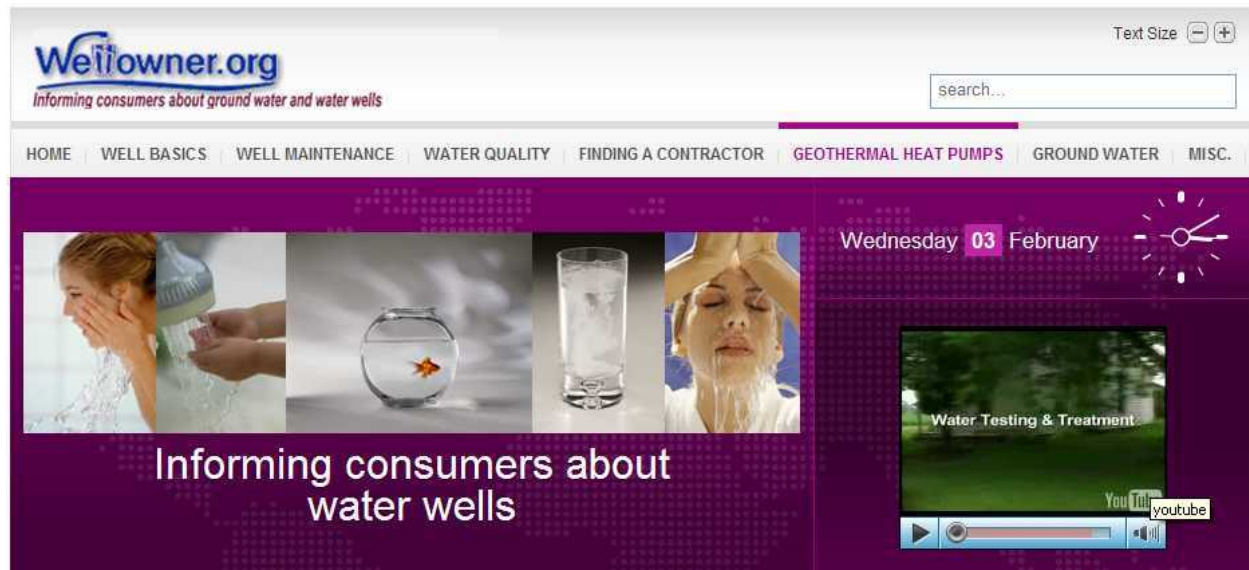


Adding to broader understanding

- NGWA free national online town halls featuring a panel of experts
- Thirty-five percent of those registered to the session were state regulators

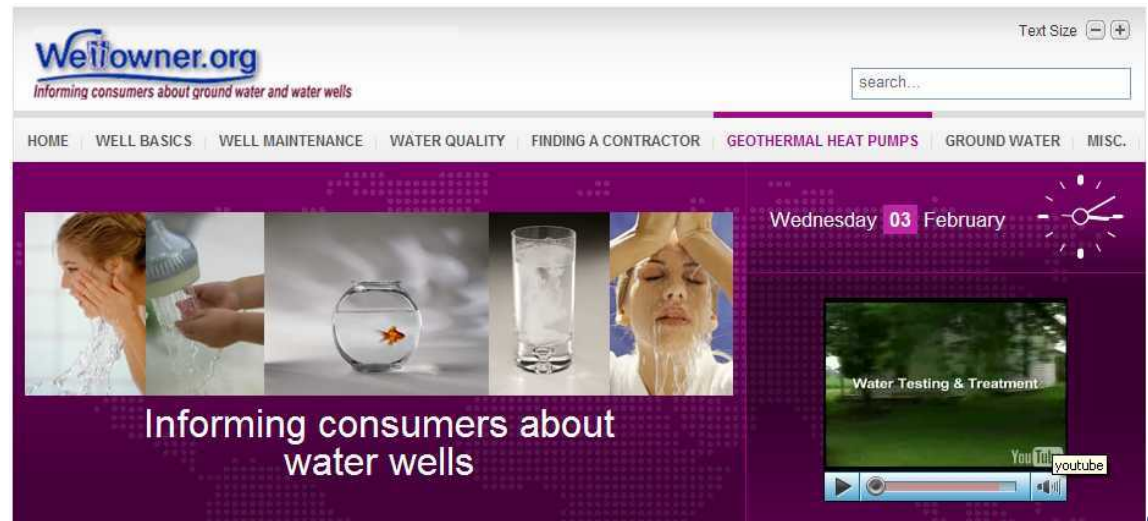
Market promotion

- www.wellowner.org, NGWA's consumer information Web site, features an extensive explanation of geothermal heating and cooling for the general public.



Market promotion

- www.wellowner.org also features **“Contractor Lookup”** where consumers locate NGWA members and NGWA-certified contractors doing geothermal system work.





Business tools



NGWA tool for profitable ground source heat pump drilling

- To help each NGWA member firm independently determine geothermal drilling profitably, volunteers have developed a **ground source heat pump drilling cost calculator** to complement the water well drilling and well pump installation cost calculators already available to members
- Free to NGWA members





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