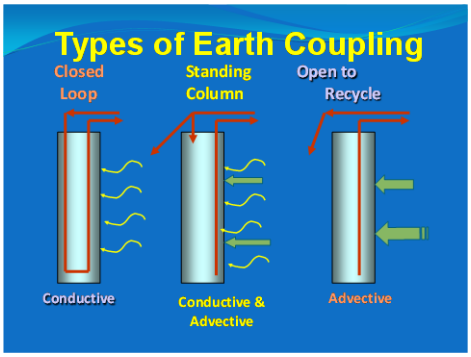
WATER ENERGY

NORTHEASTGEO.COM

EARTH-COUPLING OPTIONS SUMMARY

Three earth coupling methods are most commonly employed throughout the geothermal industry. **Water Energy will advocate for the "best bang for the buck", and provides "end-to-end" design support to our partners for all these methods.** All three options have advantages and disadvantages, they are summarized below.

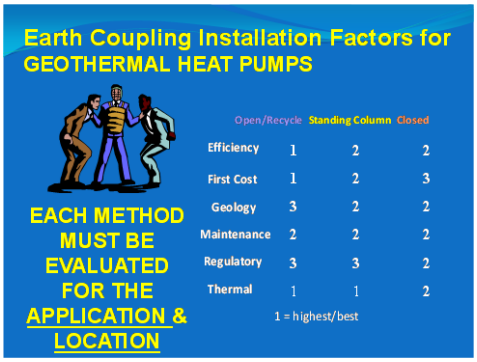


Closed Loops - Either horizontal or vertical loops (various deployment methods are used) employ an antifreeze and water solution circulated through high density polyethylene pipe to achieve a **100% CONDUCTIVE** energy transfer with the earth. It is critical to identify and deploy the proper amount required by the machinery as the closed loop field represents a finite thermal coupling that cannot be adjusted for capacity after deployment.

Standing Columns – This method takes advantage of **CONDUCTIVE** heat transfer by circulating from bottom to top in an open well. As this occurs in an open water environment however, (the water well itself) there is no thermal pipe interference (as compared to the closed loop method) and the resulting thermal efficiency and equipment capacity is approximately 20% higher. The SCW can also augment favorable energy transfer by diverting a small amount of the temperature affected water being circulated away from the borehole (either automated to a dry well or by using the same well for domestic purposes) which in turn recharges the well with water migrating in from outside the borehole exposed to the stable earth temperature (50°F) providing **ADVECTIVE** earth exchange as well.

Open to Recycle - Where a high production well is available, and there is a responsible method for returning the water to the local earth environment this method is best. The open well method takes advantage of the stable ground water temperature within rock fractures or in porous earth and depends solely upon a **100% ADVECTIVE** energy flow out of the borehole and through the heat pump. All of the temperature affected water in this method is returned to a different location from the source well and accordingly, provides a constant "one way street" of energy transfer.

ADVANTAGES AND DISADVANTAGES



Efficiency – The Open-Recycle well water is the most efficient as the year-round temperature is constant. Closed Loop is the least thermally efficient as it performs heat exchange at lower temperatures in winter & higher temperatures in summer compared to the open system due to the fact that it must make a heat transfer through the plastic pipe to and from the earth.

First Cost – The Open-Recycle is the lowest first cost at a factor of 30% of a closed loop; standing column is about a factor of 60%. Both are typical estimates in bedrock geology as we see in most of New England.

Geology – Both Closed Loops and Standing Columns are least sensitive to site geology than open – recycle earth coupling which must have adequate flow and a responsible method of return to earth.

Maintenance- All three methods require verification of water quality during installation, but when installed properly require minimal maintenance thereafter.

Regulatory – Although all three methods are legal and safe in New England, different states have varying regulations. For the most part these regulations exist for ground water protection. Some municipalities may also charge fees for earth-coupling development, or may not allow a given method in order to maintain infrastructure for the local water district the town has previously developed. Closed loop chemicals used for antifreeze and loop integrity are also regulated.

Thermal Stability- Both Open to Recycle and Standing Column Wells can be designed to compensate for under design and/or weather extremes. Closed loops must be able to respond to all heating or cooling load extremes as they represent a finite earth connection asset.

Geothermal with Confidence

Water Energy Distributors, Inc. 2 Starwood Drive Hampstead, NH 03841 P: 603-329-8122, F: 603-329-0285