CAN THE BLUFF POINT WATER SUPPLY PLAN MEET EPA REQUIREMENTS?

Bluff Point Water Supply Plan Requires EPA Approval

The developer of Bluff Point, a residential and resort complex to be constructed in Northumberland County, Virginia, has proposed to withdraw roughly 200,000 gallons of brackish groundwater a day from wells as deep as 1,200 feet, desalinate the water by reverse osmosis, and dispose of the residual brine by injecting it back into the subsurface. As described elsewhere on this site (*The Bluff Point Water Supply Is Bad Science*), the scheme is based on a hydrogeologic interpretation of the site that is unsupported by facts. This commentary describes requirements of the USEPA for deep well injection of hazardous wastes and evaluates the Bluff Point water supply plan in light of these requirements. Much of the language employed below is taken directly from the document *Class I Underground Injection Control Program: Study of the Risks Associated with Class I Underground Injection Wells (EPA 816-R-01-007).*

The U.S. Environmental Protection Agency regulates Class I underground injection wells under the Safe Drinking Water Act (SDWA) and the Hazardous and Solid Waste Amendments of the Resource Conservation and Recovery Act (RCRA). By definition, Class I wells inject industrial or municipal wastewater beneath the lowermost underground source of drinking water (USDW). An ***underground source of drinking water*** is an aquifer or portion of an aquifer that supplies a public water system (PWS) or contains enough water to supply a PWS, supplies drinking water for human consumption or contains water with less than 10,000 milligrams/liter of total dissolved solids (TDS).

EPA regulations establish siting, design, construction, and monitoring requirements for Class I injection wells to ensure protection of underground sources of drinking water (USDWs) from injected wastewater. HSWA prohibits injection of certain hazardous wastewater unless the well operator *can prove* that the injected wastewater will not migrate out of the injection zone for as long as the wastewater remains hazardous.

Geologic Safeguards to Pollution from Deep Well Injection

In addition to multiple environmental safeguards placed on the design and construction of injection wells, the geologic properties of the subsurface around the well offer a final safeguard against the movement of injected wastewaters to a USDW. Class I wells must be sited so that, should any of their components fail, the injected fluids would be confined to the intended subsurface layer. Therefore, the geologic character of the site must consist of two essential features. First, the geologic formation into which the wastewaters are injected, known as ***the injection zone***, must be sufficiently porous and permeable so that the wastewater can enter the rock formation without an excessive build up of pressure. Second, the injection zone must be overlain by a relatively nonpermeable layer of rock, known as ***the confining zone***, which will hold injected fluids in place and restrict them from moving vertically toward a USDW.

Well permitting decisions are based on whether the receiving formations of the injection zone are sufficiently permeable, porous, and thick to accept the injected fluids at the proposed injection rate without requiring excessive pressure. The injection zone should be homogeneous. It should also be of sufficient areal extent to minimize formation pressure buildup and to prevent injected fluids from reaching aquifer recharge areas. The confining zone should be of relatively low permeability to prevent upward movement of injected materials. A well-sorted sand layer makes an acceptable injection zone if its thick enough and regionally extensive, and thick and regionally extensive clay layers make an acceptable confining zone.

An additional requirement of the EPA is that Injected fluids must be geochemically compatible with the well materials and the rock and fluids in the injection and confining zones. The injection zone must have no economic value (i.e., be unfit for drinking or agricultural purposes and lack dissolved minerals in economically valuable quantities). Moreover, operators must demonstrate that the wastewater and its anticipated reaction products are compatible with both the geologic material of the injection zone and any native (naturally occurring) or previously injected fluids. Water analyses must be performed to characterize the geochemistry of the native water to predict potential interactions, and to provide a baseline to determine whether contamination has occurred

Responsibility to Conduct Geologic and Hydrogeologic Studies

It is the responsibility of Class I well operators to demonstrate by means of geologic and hydrogeologic studies that their proposed injection will not endanger USDWs. Extensive pre-siting geological tests must confirm that the injection zone is of sufficient lateral extent and thickness and is sufficiently porous and permeable so that the fluids injected through the well can enter the rock formation without an excessive build up of pressure and possible displacement of injected fluids outside of the intended zone. The pre-siting investigation must confirm that the injection zone is overlain by a confining zones, one or more layers of relatively impermeable rock that will hold injected fluids in place and not allow them to move vertically toward a USDW. The operator must demonstrate that there are no transmissive fractures or faults in the confining rock layer(s) through which injected fluids could travel to drinking water sources. Furthermore, well operators must show that there are no wells or other artificial pathways between the injection zone and USDWs through which fluids can travel.

In addition to the pre-siting geologic and hydrogeologic studies, Class I operators seeking to inject hazardous wastewaters must demonstrate by means of a ***no-migration petition*** that the hazardous constituents of wastewaters will not migrate from the disposal site for as long as the wastewaters remain hazardous. Site-specific computer modeling of wastewater migration is the foundation of a no-migration demonstration. The purpose of modeling is to provide long-term prediction of the extent of injected wastewater migration at great depths and demonstrate, using conservative assumptions, that the wastewater will remain contained or rendered nonhazardous. Models are constructed based on field observations and measurements of downhole pressure, surface injection pressure, geophysical logs, rock cores extracted from depth, injectivity tests, pressure fall-off test, tracer surveys, injection chemical concentration, and fluid density. Each petition is a multi-volume, complex technical analysis which describes the well construction, the injected wastewater, and the local and regional geology and hydrogeology. It relies on conservative mathematical models demonstrating that the hazardous wastewater will not migrate from the injection zone into USDWs. Preparing a no-migration petition is a lengthy process which typically costs several hundred thousand dollars and requires up to 11,000 hours of technical work by engineers, computer modelers, geochemists, geologists, and other scientists. Factoring in the cost of necessary geological testing and modeling, no-migration petitions can cost in excess of two million dollars.

Conclusion

It is clear from the discussion above that the developer of Bluff Point will be required to conduct rigorous and expensive scientific studies before the water supply facility can be constructed. The purpose of these studies is to ensure protection of the aquifer system that supplies drinking water to the residents of region. Only after the completion of these scientific studies can a judgment be made to go forward with the project or prohibit further action.

At the present time, no direct information of the geologic and hydrogeologic conditions beneath Bluff Point exists. No wells have yet been drilled to the depths identified in the developer's submittal documents to Northumberland County. No drill cuttings, no rock cores, no geophysical logs, no water analyses, no aquifer tests, and no computer models inform us of the hydrogeologic conditions of the site or its vicinity. In short, no data!

What's more, given the geologic information that we have about the Potomac aquifer (see: *The Buff Point Water Supply Plan Is Bad Science*), it is highly improbable that the hydrogeologic conditions of the site will meet the EPA criteria that the injected brine hold in place and be restricted from moving toward an underground source of drinking water. Even without the rigorous hydrogeologic study of the site required by EPA, knowledge of the extreme heterogeneity of the Potomac sediments on the Virginia Coastal Plain (see: *USGS Prof. Paper 1731*) is sufficient for discrediting the scheme. One can only wonder: *What the heck was the developer thinking?*

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