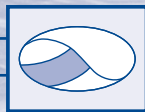


# Groundwater Reflections

Volume 9 Issue 2



Summer 2009

## Well Development (Money “Well” Spent)

By Max T. Wills

Drilling a well is an expensive undertaking and, like all construction projects, there is a tendency for well owners to try to minimize costs whenever possible. With well construction projects, development is typically one of the first things sacrificed. This is largely because the importance of well development is not fully recognized. Our experience has shown, however, that well development is one of the most important steps in constructing an efficient well. With increasing power costs and a general desire to be “green” and conserve energy, the up front costs of properly developing a well, particularly in a municipal or large production well setting, will most certainly be less significant than the long term problems and costs associated with operating an inefficient well (or drilling additional wells to meet demand).

Well development is essentially the process of maximizing well efficiency. By removing fine-grained material—whether naturally present in the formation or a product of the drilling process—from the aquifer surrounding the well screen, the porosity and permeability of the remaining material is increased. Because water can move more easily through this zone, the flow toward the well during pumping is both slower and less turbulent. This translates directly into higher potential production rates, reduced pumping lift (less drawdown), or a combination of the two, all of which are highly desirable.

Development may be necessary at several points throughout a well’s service life, however the most critical development activity is at the time of construction. This initial development effort establishes the maximum efficiency the well will achieve, and provides a benchmark for evaluating future performance. Well development can be accomplished using a number of techniques, with the specific method dictated largely by the nature of the formation that the well is completed in and the drilling method used to drill the well.

In the Puget Sound area, the majority of high-capacity wells are constructed in stratified glacial sediments (outwash). Because of the nature of the depositional environment associated with glacial outwash deposits, these sediments are usually somewhat poorly sorted, and they often include silt- and clay-sized material. As such, wells completed in these types of formations are prime candidates to benefit from an extended development program.

Where practical, large-capacity water wells in the Puget Sound region are typically drilled using the cable-tool drilling method and the most common technique used for development is referred to as the “surge and bail” method. With this technique, a surge block—consisting of several rubber disks sandwiched together and sized to fit fairly tightly within the screen like the plunger of a syringe—is attached to the end of the drilling stem. The drilling stem and surge block is then moved up and down through roughly two-foot sections of the screen, taking advantage of the cable-tool machine’s drilling motion. The effect is that water is “surged” in and out of the well with each stroke of the drilling stem. On the down stroke, water is pushed out of

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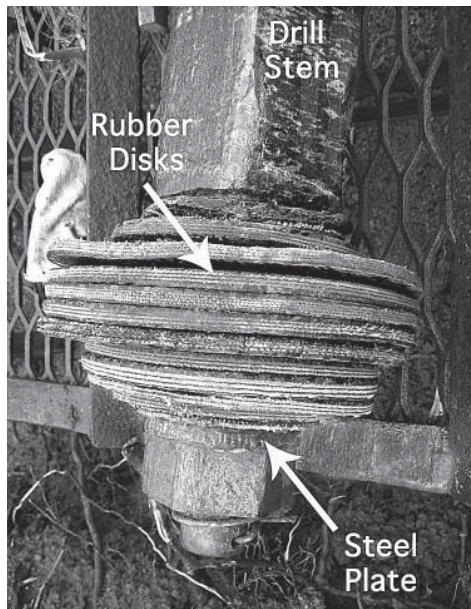
### New Bainbridge Island Office

Robinson, Noble & Saltbush now has a branch office on Bainbridge Island in order to better serve our clients throughout the Olympic Peninsula and northern Puget Sound. Doug Dow, a Senior Associate Hydrogeologist with over 30 years of professional experience, will manage the office. Feel free to contact us here—(206) 842-4443—or at our main office in Tacoma—(253) 475-7711.

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## Well Development

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*Typical surge block.*

the well into the formation, which locally pressurizes the envelope of material around the screen and causes individual sediment grains to separate slightly. On the up stroke, water is pulled into the well along with the loosened fine-grained material that is small enough to pass through the screen. Periodically, surging is paused and the well is bailed to remove the material that has accumulated in the well. Where the depth to water is shallow and water disposal constraints allow, the use of a centrifugal pump during surging to bias flow into the well is also very effective. (Other development methods, such as jetting, are much more common with rotary drilling methods. Although the mechanism is different, the intent of removing fine-grained material is the same.)

The development process can take a few days or up to several weeks depending on the nature of the aquifer, the length of screen exposed, and how the well responds to development. A hydrogeologist will evaluate development progress in several ways. The efficiency of the well can be evaluated over time through a series of short tests, known as bailer tests, in which a known volume of

water (in gallons per minute or gpm) is withdrawn from the well with a bailer while monitoring the resulting drawdown (in feet) in the well. Dividing the production rate by the amount of drawdown yields the specific capacity (in gpm/ft of drawdown) of the well, which is a measure of efficiency. By performing bailer tests periodically throughout the development process, trends in well efficiency and development progress are revealed.

Development progress can also be gauged by the amount and character of material (“development spoils”) brought into the well during successive surging runs through each screen interval. Surging intervals are initiated at a short duration per screen interval (e.g., five minutes per two-foot interval) and generally progress to longer intervals (e.g., 15, 30, 60 minutes per two-foot interval or longer). This requires that careful notes be kept throughout the development process describing the amount of material that was accumulated after surging particular sections of the screen and the duration of time that was spent surging each section.

The addition of a non-phosphate dispersant to the well has been demonstrated to be very effective and

is increasingly becoming a standard part of the development process. This technique is often called “soaping” (which refers to the original use of a non-sudsing detergent such as automatic dishwasher detergent or other commercially available soap) and helps by loosening fine-grained particles in the formation and keeping them in suspension to facilitate their removal. Soap or detergents containing phosphates are no longer used because the phosphorus can serve as a food source for bacteria within the well and adjacent aquifer. Nowadays, the dispersants are NSF/ANSI-certified and developed specifically for this purpose, albeit without the lemony fresh scent.

In most situations, the final well development is accomplished with a pump, either as a distinct part of the development process or coincident with the pump testing necessary to rate the well. Pump development can be performed in a number of ways, ranging from very aggressive cycling of the pump to cause backwashing of the screen to simple variable-rate testing. In either case, close

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### Kittitas County Exempt Well Update

Readers may recall our Spring 2008 article on the exempt well issues developing in Kittitas County (DOE and Kittitas County Tackle Exempt Wells: When is an Exempt Well not Exempt?). Ecology subsequently adopted three temporary or “emergency” rules to govern water use and reduce development reliant on exempt wells while the permanent rule was negotiated with Kittitas County. When negotiations broke down recently, Ecology announced a fourth temporary rule closing upper Kittitas County to all new groundwater withdrawals, effective July 16, 2009. On July 24, Ecology announced that negotiations with Kittitas County would resume and clarified that building permits granted prior to July 16 would be allowed to proceed. Ecology is currently developing a fifth temporary rule to govern new water use in upper Kittitas County, which will go into effect on July 31, 2009.

Ecology maintains a web page dedicated to this issue:

[http://www.ecy.wa.gov/programs/wr/cro/kittitas\\_wp.html](http://www.ecy.wa.gov/programs/wr/cro/kittitas_wp.html)

## Noble's Notes: The Water Part of Green

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to fish for salmon in Elliot Bay near Fort Lawton in Seattle. The salmon were jumping all around us, but our interest was drawn to hundreds of turds mixed with flecks of toilet paper floating throughout the area we had drifted into. Salmon were jumping through the morass. We were rather disgusted and avoided splashing the oars. Seattle's major sewer outfall was beneath us and "sewage treatment" at that time was no treatment at all. There would have been more sewage present than there was, except those parts of the metropolitan area that had drainage running to Lake Washington were using the lake as a sewage settling basin. About twenty years later, Metro put together a regional sewer system that solved that whole mess. In fact, my first job as a consulting geologist was involved with the drilling exploration for a sewer tunnel in downtown Seattle. The desire for clean water provided many paychecks (including a portion of mine). And though citizens hated Metro's taxes, people once again went swimming in Lake Washington.

During the 1960s, there was an increasing interest in caring for Planet

Earth in general and contamination of water resources in particular. The federal government took notice and the EPA was established in 1970 during the Nixon Administration. (Ironically, our military was concurrently raining "Agent Orange"—a derivative of dioxin, an extreme toxin—on the forests of Vietnam to defoliate them and better see the enemy.) In 1978 and 1982, two domestic events became national news. They were Love Canal and Times Beach. Industrial chemicals of an extremely toxic nature were found in the soils and the shallow waters. The outcry was principally focused on Cancer and Birth Defects. Emotions ran high, logical analysis ran low and propaganda reigned for years. Industry was innocent. Industry was a cabal of greedy murderers. A very strong environmental movement began. In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (commonly known as "Superfund") was signed into law by President Carter, followed by the Superfund Amendments and Reauthorization Act of 1986, signed by President Reagan.

Now things got serious. The Federal Government had money and authority to clean up contaminations throughout the nation. They hired contractors, engineers and scientists to get to work. I would guess that half of those workers that remain in the environmental trades and professions today received their training in the 1980s or later.

The Superfund was designed to clean specific sites of pollution, usually industrial, and held industries responsible, if possible. It is virtually military in its operations and I always considered it to be extremely heavy handed. However, sites did and do get cleaned. I think what was even more important than the Superfund cleanups themselves, was the resulting spinoff of a plethora of rules, state and federal, that control pollution potential. Simply, since then, people have been dumping less crud into our soils and waters. They do this because of rules and altruism. They are Greener in their behavior. The cynic in me still sees overkill and misinformation on the scale of danger. The realist in me recognizes that the process has been successful in bringing us out of the mid-twentieth century. The process is massively inefficient and costly, however it can only be achieved through government policy. The free market has no power or even desire in handling the basics in improving and guarding our water quality.

Water quantity (or supply) is where I started my career. Quality kind of snuck up on me. Water supply will remain as a priority in civil structure. The beauty of water resources is that they are essentially limitless, unlike any other basic resource. We can run out of oil, coal or nickel. We will never run out of water (quality aside) or the need for water management.

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## Well Development

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observations of water quality (e.g., turbidity and sand content) and water level response will reveal development progress.

The general outline of development activities is similar from well to well, whether at the time of construction or many years down the line. The specific approach will vary based upon the volume of water needed, the well construction, the character of

the formation material (sand vs. sand and gravel, clean vs. dirty), the depth to water, the proximity of other active wells, and any number of water system constraints. But whatever its form, proper well development is just as much a part of a well construction project as drilling the hole in the first place. After all, well efficiency only declines with time and effective well development may be the difference between success and failure in the long term.

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Questions or comments concerning specific articles can be addressed to the authors.

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## The Water Part of Green

By John B. Noble

There is no shortage of bad news going around these days so I thought I might express some good news about the state of our water resources. Today, common wisdom believes that water quality was pristine back in the good old days and is bad today; but the opposite may be true. Water, especially its quality, was probably the first driving force in the environmental movement that began taking shape in the mid 20th century. Now we simply call it being “Green”. Today, Green has become huge, and I think that the water part of Green may be considered a reasonable success in winning many major battles.

When I started my professional career, I worked for the State Department of Conservation and Development. Note the emphasis. One of my jobs was to prepare water rights for anybody who wanted one for good cause and had the ten dollar application fee. Our agency soon dropped that last word because “conservation” sounded

### Noble’s Notes:

*“A quarterly recollection from 40 years of service to the groundwater community.”*

nicer and I think the Democrats had moved in. By the mid 1960s, the state changed the whole focus and started the Department of Water Resources. That, in turn, soon morphed into the Department of Ecology. I thought that last one was a bit of a reach because “ecology” is the science of the interaction of all living things plus everything else. However, no one asked for my opinion and I had moved on to the water well consulting industry to provide water to the people. Groundwater quality was excellent by definition. And, in my part of the world groundwater quality truly was quite good, with the possible exception of some organic chemicals that nobody even tested for anyway.

However, now looking back on it, surface water quality had gone to hell long before those times. When I was still in high school, my friend and I took his rowboat out

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