

## Environmental Monitoring



by Thomas Kwader, Ph.D., P.G.

### Using the Natural Flow Patterns to Cleanup Groundwater Contamination

When contamination is released on or beneath the ground surface, it will tend to travel along the path of least resistance and flow in the direction of the natural groundwater flow, which has usually been established for many years.

As scientists attempting to assess the areal and vertical extent of contamination to remediate or clean it up, we often do not take advantage of the natural flow patterns and attempt to alter the flow patterns when designing a groundwater recovery system.

We all understand the urge to quickly respond and begin to cleanup a contaminated groundwater plume, but it is often more important to first understand the hydrogeologic framework in which the contamination is moving. For instance, it is important to know if the area is underlain by fractured rock or competent confining units at shallow depths, which may limit the depth of movement.

One interesting project showed a well located near a petroleum tank farm had been contaminated with petroleum type products. The initial reaction was to begin a large, comprehensive assessment at the perimeter of the tank farm and begin pumping around the farm, before knowing the depth or direction of impacted groundwater movement.

Now, a couple years later, we know the contaminated well was pulling water from a single fracture that happened to be oriented through the tank farm a half mile\* away. Very little or no contamination is present outside the fracture, and there is a very good confining unit limiting the contamination to a depth less than 35 feet\*. At first, what seemed to be a massive petroleum contamination plume was a plume shaped like a "needle" that could be managed by

pumping in and along the natural fracture. Additional pumping could have easily spread the contamination into other clean areas.

By first understanding the site's hydrogeologic conditions, we were able to utilize the natural flow conditions to manage an effective cleanup, which otherwise could have compounded a relatively simple problem.

\*(1 mile  $\approx$  1.61 kilometers)  
(1 foot  $\approx$  .304 meters)

Tom

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### Monitoreo Ambiental por Thomas Kwader, Ph.D., P.G.

### Usando Los Patrones de Flujo Natural Para Limpiar la Contaminación de Agua Subterráneas



Hector Leos Translator

Cuando la contaminación emana en la tierra o debajo de la superficie. Tiende a viajar por el camino de menor resistencia y fluye en la dirección del flujo natural del agua subterránea, lo cual ha sido establecido por muchos años.

Como los científicos han atentado evaluar la extensión arial y vertical de contaminación para remediar o limpiar, seguido no tomamos ventaja de los

patrones de flujo natural y atentamos alterar los patrones de flujo al diseñar un sistema de restablecimiento de sistema de agua subterránea.

Nosotros todos entendemos la importancia de responder rápidamente e iniciar a limpiar el agua subterránea contaminada, pero seguido es mas importante primero entender el cuadro de trabajo hidrogeológico en el cual la se mueve la contaminación. Por ejemplo es importante saber si el área contaminada esta debajo de rocas fracturadas o unidades restringidas a poca profundidad, lo cual limita la intensidad del movimiento.

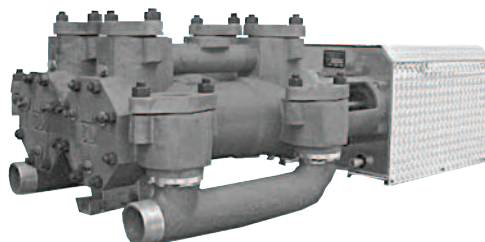
Un proyecto interesante mostró una noria situada cerca de un almacén de taques de petróleo había sido contaminada con productos de petróleo. La reacción inicial fue iniciar una evaluación comprensiva en el perímetro del almacén de tanques y comenzar a bombear alrededor del almacén, antes de saber la intensidad o dirección del movimiento del agua impactada.

Ahora un par de años mas tarde, sabemos que la noria contaminada estaba sacando agua de una fractura que estaba orientada hacia el almacén de taque que estaba a media milla\*. Muy poca o casi nada de contaminación se encuentra fuera de la fractura, y hay una muy buena unidad restringida limitando la contaminación a una profundidad de 35 pies\*. Al principio lo que parecía una contaminación masiva de petróleo era una nube de gas con

Kwader trans. cont'd on page 22.

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