Waste Age

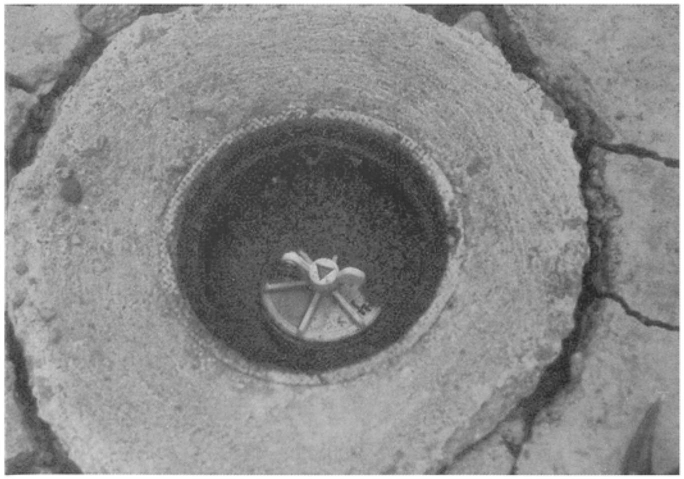
By Mark D. Varljen

Growing Old Gracefully

How to prevent your groundwater monitoring systems from failing as they age.

When maintaining a landfill, it's easy for groundwater monitoring equipment and procedures to fall off the radar. After all, once a system is set up, the equipment is not particularly visible, and it does not earn the facility money. Nevertheless, landfill owners who actively evaluate, maintain and update their groundwater monitoring systems can lower operating costs over their facility's lifetime, as well as during post-closure care.

True efficiency in groundwater monitoring is a balance between collecting samples inexpensively and maintaining high sample quality to detect problems early and accurately. It is important to recognize that an affordable, short-term shortcut could have long-term economic and environmental consequences.



ALL'S WELL: Inadequately maintaining groundwater monitoring systems and not maintaining wells can create operational difficulties and compromise data quality.

Valuable Data

Groundwater monitoring first was required at landfills more than 20 years ago. Since then, at many sites, components have failed, become outmoded or require maintenance. Technologies also have changed, rendering some earlier equipment and protocols obsolete. Sometimes, money spent on groundwater monitoring is unnecessary.

The primary goal of groundwater monitoring should always be to obtain the best data, which may be challenging. Nevertheless the benefits of good data far outweigh the obstacles. Bad data can zap the efficiency from many systems, especially when you factor in the cost and headaches of re-sampling caused by false data readings, unnecessary compliance activities and long debates with regulators regarding data.

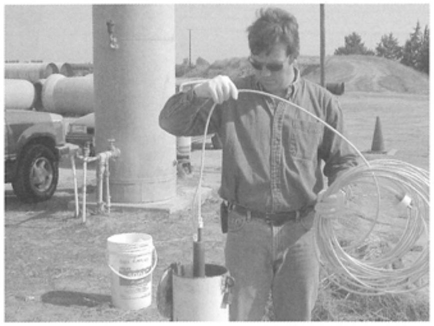
Collecting inaccurate data often results from poor maintenance of groundwater monitoring equipment. Inadequate maintenance also can slow down the sampling process. So to avoid inaccurate data and unnecessarily costly sampling efforts, landfill owners and operators should examine the following when developing a long-term maintenance approach for their groundwater systems.

Field Issues

Sampling Technique. Twenty years ago, most wells were sampled with a bailer. This involved purging three to five well volumes with the bailer prior to collecting samples for analysis. Unfortunately, this is time-consuming.

Bailing can produce false-positive results for metals and heavy organics, which means data quality may be poor. High-flow-rate pumping also can cause inaccurate readings.

As an alternative, landfill operators now can use low-flow sampling, in which groundwater is pumped at a slower rate and samples are collected when water quality parameters measured during purging have stabilized.



EARLY DETECTION: Modern groundwater monitoring pumps now can be easily removed for inspections.

In low-flow sampling, less purge water is produced, which can save money if special handling or treatment is required. Additionally, this graceful approach can be faster, cost less, produce better data and extend a well's lifetime by minimizing the stress that causes silt buildup and potential damage to the sand pack.

Pumping Equipment. At sites where dedicated equipment has been installed wisely, the type of device compared to the known chemical conditions can have a large effect on performance and maintenance requirements.

Steel pumps in corrosive environments can be problematic; noncorrosive materials, such as polyvinyl chloride (PVC) or DuPont Teflon, may be used for certain types of pumps, such as bladder or squeeze-type pumps. High-flow pumps may be unsuitable for low-flow sampling. Some electric and high-flow pumps get hot or cannot be run steadily when at low rates, and this can potentially influence sample chemistry.

Purging Rate and Drawdown. In the early days when standard groundwater-sampling protocols called for purging three to five well volumes, it was common to use pumps with the fastest purging rate to reduce sampling time. However, the stress caused by high-rate purging can cause damage to a sampling point through siltation. Depending on geochemical conditions, high-rate purging also could encourage corrosion and encrustation, which could lead to pump failure, reduced sampling efficiency and unrepresentative results. This is especially true if high-flow rate pumping causes the pumping water level to drop to the point where air may be drawn in or to where wet surfaces are exposed to air intermittently.

Well Access. Any sampling crew that has had to fight a thicket of blackberries to get to a well or was forced to drive back to town to rent a bolt cutter for a rusted-shut lock will emphasize the value of easy well access. Clearing access to a well with small, routine efforts is always easier than large brush-cutting endeavors. Moreover, routine maintenance can save sampling time, which will lower sampling costs. Of course, using a chemical herbicide to keep vegetation clear of the well head is not wise.

Pump Drainback. Many pumps, such as electric submersible pumps and suction-pump intake pipes, are not fitted with check valves. The drainback following shutoff of a pump without a check valve can create fairly high exit velocities from the well screen. This high-velocity surge may dislodge sediment that normally would not be mobile, and can create sampling artifacts and potential false-positives. For pumps such as bladder pumps that always have a check valve, drainback can occur from faulty check valves or weep holes that sometimes are used to drain a discharge line for fear of freezing.

Drainback during low-flow sampling can be problematic because it can cause air to be sucked into the flow-through cell used to measure indicator parameters, and the air may cause inaccurate readings. Finally, purging time often is unnecessarily lengthened during low-flow sampling if there is pump drainback.

To reduce drainback, check valves are available to retrofit any pump system. The valves should be installed if any amount of drainback is observed between discharge cycles or after the pump is shut off. Freezing generally is not a concern because the sampling discharge tube is not a closed system, so expansion is unlikely to cause tubing failure. But if operators anticipate freezing, the upper few feet of tubing may be evacuated by extending a small-diameter tube down the discharge line and applying compressed air.

Well Integrity. Long-term monitoring installations at landfills can be exposed to several threats: heavy equipment, differential waste material settlement, heat, corrosive gases and sometimes vandals — well protectors apparently are good for target practice. Water ponding near a well head or, even worse, in a well-casing protector, always is cause for concern from a data-quality or interference standpoint. Also, ponding can slow a sampling crew.

Air Entrainment. A general rule in groundwater sampling is to acknowledge air as the enemy because it can change a sample's chemical constituents. Damaged, degraded or improperly installed fittings often cause air entrainment. So to prevent air from being drawn into the system during purging, periodic equipment checks and replacements should be performed.

Mechanical Failures. All down-hole pumping devices — electric submersibles, pistons or bladder pumps — may fail. Although this may occur to differing degrees and frequency, failure can reduce sampling efficiency or alter sample quality. Thus, sampling crews should understand the operating principals of all pumps and learn to identify symptoms and diagnostic techniques to prevent problems from occurring before they cause damage. Preventive steps are useful in ensuring devices continue to operate as if they were new.

Debris Protection. Debris is a frequent cause of sampling-pump failure. So monitoring wells should be evaluated for the presence of sand and other materials. Protective devices, such as inlet screens for bladder pumps, should be installed whenever available. Extra effort in developing a monitoring well in the first year of a groundwater monitoring program can pay-off by extending the longevity of sampling devices and eliminating costly "missed sample" failures. Periodically, wells should be examined for debris and cleaned out or redeveloped, if necessary.

AIR IS THE ENEMY: Air can adversely affect a sample. The pictured bladder pump has oxidized because of air intrusion.

Program Issues

Analysis, Sampling Frequency and Number of Wells. Operating permit and closure plan provisions for groundwater monitoring should not be considered unchangeable. Careful data analyses coupled with a solid hydrogeologic understanding often can be used to successfully negotiate reductions in the number and frequency of wells to be sampled.

For example, if operators observe a low-level leachate effect from a closed landfill that has remained relatively constant for 10 years and has slow groundwater velocity, it probably is excessive to evaluate the effect every three months.

Generally, a sampling program should be a dynamic strategy that can change as the facility ages and more information about groundwater characteristics is gathered. Of course, using data analysis to modify the monitoring program depends on getting good samples first. A high level of data variability makes identifying true geochemical trends difficult or impossible.

Laboratory Management, Data Handling and Reporting. Standing, site-specific laboratory contracts can be useful in ensuring laboratory performance does not affect efficiency. Laboratory performance includes turnaround time, quality assurance/quality control (QA/QC) and detection limits. A standing contract also can simplify the effort associated with laboratory coordination for every sampling event and guarantee deliverables are identical every time so that data management procedures do not have to be reinvented.

Electronic deliverables are particularly useful when loading data into relational database management software, which greatly reduces analysis and reporting time, and minimizes the likelihood of transcription errors.

Although it is easy to forget routine maintenance procedures when groundwater sampling only is conducted every three months at most, taking proactive steps to correct problems before they occur can ensure groundwater monitoring systems keep performing into their old age. WA

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