



Hydrogeological Study for Landfill Groundwater

Guidance

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Alaska Department of Environmental Conservation
Division of Environmental Health
Solid Waste Program

Conducting a regulatory-compliant groundwater monitoring program at a landfill requires installing a series of monitoring wells (the groundwater monitoring system) in accordance with the requirements in 18 AAC 60.825. At a minimum, the groundwater monitoring system must allow for the collection of groundwater samples from the uppermost aquifer both upgradient and downgradient of the landfill. Putting the monitoring wells in the correct locations requires some knowledge of the subsurface environment, including the direction of groundwater flow beneath the landfill. The hydrogeological study is the process through which this information is gathered, and the purpose of this document is to provide general guidance on how to conduct the study.

Methodology

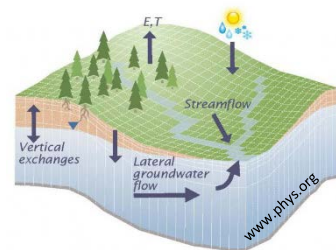
The hydrogeological study should begin with a literature search to find existing information about the subsurface environment in the vicinity of the landfill. It is important to pay attention to the scope of that information. Many hydrogeological studies are regional in scope and, although they can provide a general picture of subsurface conditions in the site vicinity, the local conditions beneath the landfill may not correspond exactly to that regional picture.

The detail available within the existing literature will help determine the exact scope of the site-specific hydrogeological study. However, the general procedure for characterizing the subsurface beneath a landfill is to drill a series of soil borings around and on the property and install temporary monitoring points in the soil borings. How many soil borings and wells are needed depends on the size of the facility and what is already known about the subsurface environment. Logging the materials encountered while drilling the soil borings will document the subsurface geology and the temporary monitoring points installed in the borings will provide information about groundwater. The temporary monitoring points can remain in place throughout the two years of preliminary data collection. At the end of the two years, permanent monitoring wells can be installed in selected and approved locations based on an assessment of groundwater flow patterns and other data acquired over the two years.

Saturated Zone Geologic Unit

An important goal of the hydrogeological study is to determine whether the saturated zone beneath the site consists of a single geologic unit or of different and distinct geologic units. One way to do this is to use the information in the soil boring logs to draw cross-section diagrams that help determine the approximate location of any boundaries between geologic units. This is important information because the natural chemistry of the groundwater is affected by the minerals in the geologic unit that comprises the aquifer. Since different geologic units contain different minerals, the chemistry of the groundwater can change as it flows through different units. If monitoring wells at the landfill will be located in different geologic units (i.e. different aquifers), the landfill operator may need to utilize an intrawell, rather than an interwell, groundwater monitoring program.

Groundwater may be shown to flow northwest across the larger region, it may be flowing more directly westward or northward beneath the landfill itself. Thus, a site-specific hydrogeological study is needed to characterize site-specific conditions at the landfill property.



Interwell vs. intrawell

Interwell tests are constructed by pooling upgradient well data for the purpose of creating limits for downgradient well comparisons. Intrawell tests, on the other hand, utilize historical data from within a given well for the construction of limits for comparison with more recent data from the same well.

Hydrogeological Study Goal

The goal of a hydrogeological study is to characterize the subsurface environment beneath the landfill property. The study must be conducted for at least two years to document any seasonal variability in groundwater flow or quality. The information and data collected during the hydrogeological study will be of value not only for designing the permanent groundwater monitoring system but also in evaluating the results of the monitoring program throughout the life of the facility. At the completion of the hydrogeological study, the following information (at a minimum) will be known about the landfill property:

Groundwater Depth

The depth to groundwater and the full range of seasonal fluctuations in that measurement.

Design Elevation

The minimum distance between the design elevation for the bottom of the landfill and the seasonal high water table.

Uppermost Aquifer

The total thickness of the uppermost aquifer and the potential for connections to any underlying aquifers.

Seasonal Variability

The average direction and the full range of seasonal variability in the flow direction of groundwater beneath the landfill.

Geological Materials

The types of geological materials comprising the upper most aquifer beneath the landfill property and any variability within those materials across the site.

Groundwater Characterization

Characterizing the groundwater beneath the site requires accurate measurement of the water table elevation at each monitoring point. This requires conducting a survey to establish the elevation of a designated point on the top of each well casing relative to a known benchmark. At each monitoring event, the depth to the water table is measured from the designated point on the well casing. Subtracting the depth-to-water measurement from the surveyed elevation of the well casing yields an accurate measurement of the water table elevation in the well. The surveyed elevations and the depth-to-water measurements must both be measured to the nearest hundredth of a foot.

The water table elevations collected during each monitoring event should be used to determine the probable flow direction of the groundwater beneath the site. The flow direction may naturally vary from event to event and any seasonally-dependent variations can be documented by monitoring in each season. Since groundwater does not always flow in a uniform direction across a particular site, care should be taken to evaluate the water table elevations for any anomalies that might be indicative of a geologic unit with reduced permeability or the presence of a groundwater divide. Consideration should also be given to the possible influence of pumping wells in the vicinity of the landfill.

Surface Hydrology

Although the focus of a hydrogeological study is on the subsurface environment, it is recommended that the study also include research about the surface hydrology around the landfill property. This information can be useful for future reference, and the following is necessary for completing the permit application:

- The distance to and the flow direction within surface water bodies and designated wetlands within 500 feet of the landfill property.
- The potential for connectivity between nearby surface water and groundwater beneath the landfill.
- The potential for flooding of the landfill, including the location of the 100-year floodplain boundaries relative to the landfill property.
- The distance to and location of public and private drinking water sources within 500 feet of the landfill property.

References

- USEPA, 1987. *Ground Water Handbook*. EPA/625/6-87/016
- USEPA, 1990. *Ground Water Handbook, Volume II: Methodology*. EPA/625/6-90/016b
- USEPA, 1993. *Solid Waste Disposal Facility Criteria Technical Manual*. EPA/530-R-93-017