



## FREQUENTLY ASKED QUESTIONS (FAQ) & ANSWERS

Use of background as Groundwater Protection Standards (GPS) at solid waste landfills

**Division of Land Protection and Revitalization**

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### **Introduction**

The Virginia Solid Waste Management Regulations (VSWMR) allow landfill owner/operators the opportunity to establish Groundwater Protection Standards (GPS) using site background values. Use of background-based GPS in a groundwater program usually occurs when those values are greater than risk-based alternate concentration Limits (ACLs) or Federal Safe Drinking Water Act Maximum Contaminant Levels (MCLs). This allowance is based on the EPA (40 CFR 258) Subtitle D premise that remediation efforts at solid waste landfills will not be required to achieve endpoints which are less than those naturally present in the aquifer system.

This Frequently Asked Questions (FAQ) document is provided as a reference for owner/operators who may have questions on the development and application of background-based GPS in their groundwater monitoring program. The VSWMR separately define which wells are appropriate for use as data collection points during background development. This FAQ also references EPA guidance documents that deal with development and application of site background in groundwater monitoring programs. Owner/operators are encouraged to familiarize themselves with the existing EPA guidance.

If you need further assistance with statistical issues or application of background-based GPS in a facility's monitoring program, please contact the solid waste Groundwater Program Coordinator, Mr. Geoff Christe at (804) 698-4283 or via email at [geoff.christe@deq.virginia.gov](mailto:geoff.christe@deq.virginia.gov). The Department's Statistician, Mr. Hasan Keceli may be contacted at (804) 698-4246 or via email at [hasan.keceli@deq.virginia.gov](mailto:hasan.keceli@deq.virginia.gov). If you have site-specific questions on the application of background data, contact your Regional Office.

**1] When must a solid waste landfill go through the process of establishing groundwater protection standards (GPS)?**

**See 20-81-250.A.6**

*Once a site is monitoring groundwater in the Assessment or Phase II programs of the VSWMR, the owner/operator has already determined that some groundwater constituents have been identified at levels which are statistically above the natural background. Such levels could indicate a possible landfill impact on the aquifer system.*

*Once established, GPS are the site specific values used to determine if this impact (above background) will require remedial actions under 9 VAC 20-81-260.*

**2] Which constituents require GPS?**

**See 20-81-250.A.6.a**

*All Table 3.1 Column B constituents which have been detected on site (i.e., found above the laboratory limit of detection (LOD)) require GPS. Most commonly, owner/operators choose to set GPS for all Table 3.1 constituents at once to reduce the administrative burden/cost of establishing GPS each time additional detections of new constituents occur.*

**3] What are GPS based on?**

**See 20-81-250.A.6.b**

*GPS may be based on Federal MCLs where available, Department-approved, site-specific background concentration levels (when available), or risk-based ACLs.*

**4] Are GPS for detected groundwater constituents based on ‘total’ sample concentrations or ‘dissolved’ concentrations?**

*Federal MCL-based drinking water standards are based on ‘total’ concentrations, not dissolved (filtered) concentrations. As a result, 40 CFR 258 requires groundwater samples obtained under the RCRA Subtitle D program be obtained and analyzed without field filtering in order to allow unbiased sample result comparisons to MCL.*

*Because filtering is not allowed under the solid waste groundwater monitoring program, background-based GPS will also be based on unfiltered ‘total’ sampling results.*

**5] What site data can be used to set background-based GPS?**

*9 VAC 20-81-250.A.3.a.(1) requires an owner/operator have sampling point(s) that can represent the quality of groundwater not affected by a release from the landfill unit(s). 250.A.4.d requires these sampling points (background wells) be located in positions hydraulically upgradient from the landfill unit(s). An owner/operator must have at least one upgradient well designated onsite (9 VAC 20-81-250.A.3.f.(2)) while A.4.a requires the well be able to provide sampling results that are an accurate representation of groundwater quality.*

*It is very important to note that 9 VAC 20-81-250.A.4.e allows an owner/operator to determine background water quality in wells which are not upgradient of the landfill if site conditions do not allow well installation in an upgradient position and the data obtained from the alternate well(s) is as representative or more representative than that which could be provided by a well*

located in a conventional upgradient location. If you feel this allowance may come into play on site, please contact your Regional Office for further assistance.

**6] Can background sampling events be undertaken at wells not currently listed in the facility Permit as being part of the compliance network in Module X or XI?**

While the VSWMR (or 40 CFR 258 text) make no mention of the issue of ‘permitted’ monitoring points, the Department currently does not allow this practice.

While the historical file record shows the Department allowed this practice in the 1990’s, most of the landfills currently subject to groundwater monitoring requirements under Amendment 8 of the VSWMR have modern Permits with groundwater Modules. In the 1990’s there were a considerable number of owner/operators who still operated under an existing (pre-DEQ), ‘one page’ Department of Health solid waste permit. Such permits lacked groundwater Modules describing the groundwater monitoring network. Since no network was defined in those existing Permits, and the VSWMR doesn’t address the topic, use of non-network defined upgradient wells was allowed by the Department during that period of time.

Currently, if facilities that have Modules X or XI wish to add sampling data from an upgradient well not currently listed in the Permit, they should contact their respective Regional Office as soon as possible to review whether the installation and completion of the well meets regulatory standards and initiate the Permit modification process so that the requested sampling data may be added to the upgradient data set.

**7] How many sampling events are required before background can be initially established?**

9 VAC 20-81-250.A.4.f notes that the number of samples collected to establish groundwater quality data (including background) shall be consistent with appropriate statistical procedures and methods. As described under 9 VAC 20-81-250.B and C, a minimum of four independent samples must be collected before an initial determination of background can be completed. The requirement that a minimum of four independent samples be collected for background is consistent with Federal RCRA C and D program requirements. However, it is important to acknowledge that the number required is a minimum number, not a maximum number (issue addressed further below).

**8] How is sample independence determined?**

Groundwater is in constant horizontal and vertical motion within an aquifer system. In the example presented above, if four samples are required to establish initial background values, all the samples must be taken prior to the end of the VSWMR-defined background sampling period. In addition, because the intent of the regulation is to obtain groundwater samples which are independent from one another (i.e., they sample different slugs of groundwater passing through the well screen), sample collections must be appropriately spaced over the length of the background sampling period to avoid obtaining more than a single (i.e., duplicate) sample from the same slug of groundwater.

Because the timing of the sample collection hinges upon site-specific factors such as groundwater flow rate, the Department’s guidance is that no fewer than 30 days separate individual background sampling events as a means of ensuring sample independence is maintained. Samples collected less than 30 days apart will undergo more detailed Department review and the owner/operator may be asked to prove that sample independence was maintained during the sampling interval.

**9] Are background based GPS self-implementing or do I need Department approval?**

9 VAC 20-81-250.A.6.b.(2) requires written Department approval of the requested background value. To obtain such approval, the owner/operator will need to submit the sampling results from the applicable monitoring well(s) and the statistical calculations used to derive the requested value to their respective Regional Office groundwater contact for review and comment. The statistical calculations will typically also undergo statistician review at the Department's Central Office in Richmond, Virginia.

**10] Once background-based GPS are approved for use, are they treated as permanent values, or values subject to periodic review and revision?**

While the VSWMR only define the minimum number of data points used to calculate background, EPA's 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007] is quite clear when addressing the issue noting:

“All of the statistical tests listed in the RCRA regulations are predicated on having appropriate and representative background measurements.”

“In groundwater data collection and testing, background conditions may not be static over time.”

“Due to both the complex behavior of groundwater and the need for sufficiently large sample sizes, background once obtained, should not be regarded as a single fixed quantity. Background should be sampled regularly throughout the life of the facility, periodically reviewed, and revised as necessary.”

While EPA suggests review and update of background every two or three years for facilities sampling groundwater on a semi-annual basis, the actual optimal timeframe depends on aquifer type, groundwater flow rate on site, and potential interference from temporal (seasonal/climatic) variation which cannot be accounted for in simple FAQ guidance. In general, site conditions will typically lead to the need to revise background once every three to five years for those sites monitoring on a semi-annual basis.

**11] If background-based GPS are being revised, how many upgradient sampling events should be included in the review?**

While the VSWMR are silent on the issue, EPA's 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007] notes:

“Four observations from a population are rarely enough to adequately characterize its statistical features.”

“The Unified Guidance recommends that a minimum of at least 8 to 10 independent background observations be collected before running most statistical tests,” [and] “... it is feasible to obtain small sample sets of up to  $n = 20$  for individual background wells, and potentially

larger sample sizes if the data characteristics allow for pooling of multiple [upgradient] well data.”

Consistent with the EPA guidance noted above, the Department recommends background be based on no fewer than the last 10 sampling events undertaken at the upgradient well(s) at sites sampling semi-annually, and for sites sampling quarterly (if the data justify it), as many as the last 20 sampling event results. The use of the last 10 events is consistent with most statistical guidelines which note that it is difficult to interpret any trends in groundwater data when reviewing less than 10 independent sampling events.

**12] Won't this constant revising of background mean I'll lose previously collected sampling data? Some of that old data displays elevated metals concentrations I'm no longer seeing at the facility meaning my new background calculations may be lower than those previously.**

The intent of EPA's guidance on the issue of constantly updating your background data set within its 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007] was the recognition that:

“Any background sample should satisfy the key statistical assumptions ... [including]: statistical independence of the background measurement, temporal and spatial stationarity [i.e., lack of discernable trends], lack of statistical outliers, and correct distribution assumptions of the background sample when a parametric statistical approach is selected.”

EPA recognizes the common occurrence of elevated metals concentrations seen in samples obtained soon after monitoring well installation (i.e., early in the monitoring program) and notes in its 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007] that:

“Initial well measurements are sometimes highly variable during a ‘break in’ sampling period and potentially less trustworthy.”

While such sampling results were permissible for use in the early stages of the sites monitoring program (because all monitoring wells were similarly “new” at the time), the data is no longer be applicable for inclusion in a revised background data set at an established monitoring facility because the data does not accurately represent the current condition of the aquifer (i.e., one not disturbed by monitoring well installation activities). Because this older data records the short-term disturbance of the aquifer as a result of well boring and installation, it is only statistically valid to use when comparing it to other data obtained from recently installed wells.

To see an illustration of this effect EPA has recognized, the entire sampling history of a facility's upgradient well can be plotted over time. Result trends will likely become evident with steeply lower concentration results appearing soon after well installation, eventually leading to a neutral trend line. This neutral trend line is the actual background condition in the aquifer.

**13] Does the Department have guidance on how to screen background data for use in background based GPS calculations?**

No.

Owner/operators are referred to the very detailed discussions in Chapter 5 of EPA's 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007] for further information and guidelines on screening available background data sets for statistical outliers, temporal variation, etc.

**14] If I fail to update my background-based GPS during my monitoring program, could that be a VSWMR or Permit non-compliance issue?**

Potentially.

9 VAC 20-81-250.A.6.d defines the procedure for maintaining an up to date listing of MCL and background-based GPS, but does not define a mandatory review period. However, failure for the VSWMR to define a mandated review period (a task which would be difficult to do based on the great variety of aquifer types found within the Commonwealth) does not relieve the owner/operator from having background values that reflect the true condition of the aquifer system.

The Department may choose to review a site's approved background based GPS on a periodic basis during the Annual Report review. If background revisions should be considered, the Department will notify the owner/operator in writing.

**15] I've historically sampled more than a single background well to collect background data for use as GPS, but I'd like to reduce sampling cost by ceasing to sample this 'extra' well. Would I still be able to use its historical data as part of the GPS background 'pool'?**

The VSWMR only require a minimum one of upgradient well be included in the compliance network. Therefore, with Regional Office approval, dropping the 'extra' upgradient well may be possible. However, consistent with EPA's 2009 Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance [EPA/530/R-09/007], long-term continued use of the historical data obtained from the well will likely not be possible:

*“Due to both the complex behavior of groundwater and the need for sufficiently large sample sizes, background once obtained, should not be regarded as a single fixed quantity. Background should be sampled regularly throughout the life of the facility, periodically reviewed, and revised as necessary.”*

Consistent with the guidance noted above, once the 'extra' upgradient well is no longer routinely sampled for background, its historical data will likely be dropped from future background calculations the next time the background-based GPS are reviewed (i.e., within no more than five years from well abandonment) since the well will no longer be yielding sampling information reflecting current upgradient groundwater conditions.

**16] What happens when revised ACLs are issued for a constituent I formerly used background for GPS; and the new ACL value is found to be higher than the Department approved background value?**

The VSWMR do not prohibit the use of an ACL in lieu of current approved background as a GPS, ... as long as the ACL is current and approved for use on site.



*In those cases where a revised ACL value is higher than natural site background, the Department prefers that a landfill owner/operator continue to utilize the site background value for GPS comparison purposes until such time as a GPS exceedance over background is noted. The Department prefers this approach since site background will show less year-to-year variation than an ACL value may. In addition, because site background is a statistically calculated value, the sampling results may be compared directly to the background value when determining whether an SSI has occurred. Facilities which use the ACL instead, could be looking at the need to take three additional independent samples within the compliance period before determining whether or not an SSI has occurred.*

*If an exceedance is noted against the previously approved background based GPS, the facility may simply apply the most current revised ACL as the GPS for the constituent in question for that sampling event (as long as the GPS table for the facility is updated accordingly as required under A.6.d or e) and the action is appropriately described in the subsequent monitoring report submitted to the Department.*