

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER PERMITTING DIVISION**

Subject: Guidance Memo No. 18-2013
VPDES Permits with Groundwater Monitoring Requirements

To: Regional Directors

From: Melanie D. Davenport, Director, Water Permitting Division



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Summary: This guidance covers groundwater monitoring actions associated with VPDES permits and replaces Guidance Memo No. 98-2010. This guidance addresses topics including: groundwater monitoring well network design, groundwater sampling constituents, laboratory analytical methods, the review of and response to groundwater analytical data, sets forth reporting requirements and also briefly discusses potential actions to address groundwater contamination as a result of a release from the monitored unit(s) on site.

Electronic Copy: An electronic (PDF) copy of this guidance is available on DEQ's website at: <http://www.deq.virginia.gov/Programs/Water>.

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Disclaimer: *This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate or prohibit any particular action not otherwise required or prohibited by law or regulation. If alternative proposals are made, such proposals will be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.*

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I. INTRODUCTION

The Department of Environmental Quality (DEQ) is charged with the protection of state waters which includes groundwater under § 62.1 – 44.3 of the Code of Virginia. DEQ issues VPDES permits to control the discharge of pollutants to state waters and the issuance of these permits is one way of accomplishing the goal of protecting the Commonwealth's groundwater resources for existing and future potential users.

When a VPDES permit includes a requirement to monitor groundwater quality, the Permittee will be responsible for implementing a site-specific groundwater quality monitoring (GQM) plan. This plan will define the design of the well network, describe installation of the wells, the specifics of how to sample the wells for a defined list of groundwater constituents, and the process of assessing the sampling results and reporting those results to the DEQ.

This guidance has been written to assist an owner/operator in understanding their responsibilities during implementation of a site-specific VPDES required GQM plan. This guidance includes technical checklists which can be used by the Permittee while developing groundwater related plans and reports. This guidance also describes the initial steps needed to address any recognized aquifer impacts at concentrations above natural site background as a result of a release of contaminants from a monitored unit(s) or regulated activity on site.

This Guidance represents replacement of the prior DEQ groundwater guidance (Water Guidance Memo No. 98-2010) released in 1998. Major modifications of the former guidance include changes to the technical content expected within a GQM plan, a new approach to assigning screened depths for monitoring wells in a network, a more comprehensive approach to determining an appropriate groundwater constituent sampling list, and a new requirement for the Permittee to assess the sampling results and report those results to the DEQ under a new standardized format. Because the content of this guidance differs from that of the former guidance, it is anticipated that owner/operators who undertake groundwater monitoring under an existing GQM plan will need to evaluate their existing plan to determine whether any revisions are necessary to bring the plan into conformance with the information contained in this revised guidance

II. DEQ COORDINATION

With the release of this guidance, DEQ is also implementing a new internal cross-media communication and review process. This new process will involve both DEQ Water Permitting staff (Water) and their groundwater program counterparts in Land Protection and Revitalization Division (Land) staff. The most significant change in this new process is the transfer of the responsibility for the technical reviews of GQM plans, quarterly, semi-annual or annual reports, site characterization reports (SCR), and corrective action plans (CAP) to Land staff, assisted, as needed by statisticians and risk assessors. Regional Office permit writers will continue to handle permit applications and renewals.

For Permittee's, this new coordination process will not change their point of contact in the Regional Office. This process is being implemented as an effort to achieve more consistent reviews of the VPDES groundwater data supplied to the DEQ which will in turn facilitate the timely review of VPDES permit applications/renewals. The Water point of contact in the Regional office will remain the same as it has traditionally been.

With the release of this guidance, submission of groundwater reports/data required by the VPDES permit and received by the Regional Office permit writer shall be:

1. forwarded to Land staff for technical review within 30 days of document receipt.

2. Land staff should complete their technical reviews within 90 days of the request for review assistance from the VPDES permit writer.
3. Upon completion of their technical review, Land staff will forward the review results to a centralized Groundwater Program Coordinator for peer review.
4. Final technical review results, to include any Coordinator comments, will be forwarded to the Regional Water permit writer in the form of a memorandum from the Land Division.
5. The Regional Water permit writer will retain the responsibility for adding these technical review comments to any correspondence directed back to the Permittee for review and revision.

While Regional Water staff will still retain responsibility over permit drafting, the development of any groundwater related condition language concerning monitoring requirements in the VPDES permit should take place via coordination with Land groundwater staff prior to the final draft permit being issued. In contrast to the former guidance, permit condition language is not included in this new guidance. For Regional Office permit writers, this language can be found in the Water permit Writers Manual.

III. AUTHORITY/LIMITATIONS

Groundwater monitoring activities will be most commonly required around unlined (or clay lined), in-ground wastewater units like domestic, industrial, or agricultural (animal) wastewater lagoons, pits or basins. Sites containing lined but uncapped wastewater units, as well as sites with inactive but unclosed units may also be subject to groundwater monitoring based on site specific circumstances or characteristics.

DEQ can require groundwater monitoring at VPDES sites based on authority provided within the Code of Virginia and Water Regulation as discussed separately below. This guidance, which represents a replacement of an existing guidance document, does not set or develop DEQ rule or policy and use of, or adherence to, this guidance is not mandated under the current regulation and none of the content contained within this guidance shall negate or supersede any of the regulatory requirements or Law.

CODE OF VIRGINIA

Several sections of the Code of Virginia provide the DEQ the authority to require groundwater monitoring in conjunction with a VPDES permit. § 62.1-44.3 of the Code of Virginia defines state waters and pollution:

"State waters" means all water, on the surface and under the ground, wholly or partially within or bordering the Commonwealth or within its jurisdiction, including wetlands.

"Pollution" means such alteration of the physical, chemical, or biological properties of any state waters as will or is likely to create a nuisance or render such waters (a) harmful or detrimental or injurious to the public health, safety, or welfare or to the health of animals, fish, or aquatic life; (b) unsuitable with reasonable treatment for use as present or possible future sources of public water supply; or (c) unsuitable for recreational, commercial, industrial, agricultural, or other reasonable uses, provided that (i) an alteration of the physical, chemical, or biological property of state waters or a discharge or deposit of sewage, industrial wastes or other wastes to state waters by any owner which by itself is not sufficient to cause pollution but which, in combination with such alteration of or discharge or deposit to state waters by other owners, is sufficient to cause pollution; (ii) the discharge of untreated

sewage by any owner into state waters; and (iii) contributing to the contravention of standards of water quality duly established by the Board, are "pollution" for the terms and purposes of this chapter.

§ 62.1-44.5.A. of the Code of Virginia states:

Except in compliance with a certificate or permit issued by the Board or other entity authorized by the Board to issue a certificate or permit pursuant to this chapter, it shall be unlawful for any person to:

1. Discharge into state waters sewage, industrial wastes, other wastes, or any noxious or deleterious substances;

[...]

3. Otherwise alter the physical, chemical or biological properties of state waters and make them detrimental to the public health, or to animal or aquatic life, or to the uses of such waters for domestic or industrial consumption, or for recreation, or for other uses.

§ 62.1-44.21 of the Code of Virginia sets forth the authority to require submission of monitoring plans and specifications:

The Board may require every owner to furnish when requested such plans, specifications, and other pertinent information as may be necessary to determine the effect of the wastes from his discharge on the quality of state waters, or such other information as may be necessary to accomplish the purposes of this chapter.

REGULATION

Several provisions within Water regulation provide the DEQ the authority to require groundwater monitoring in conjunction with a VPDES permit. Under 9VAC25-31-100 (as part of the application for a VPDES permit), the DEQ may require the application include a groundwater monitoring plan. The plan shall include pertinent hydrological data to justify upgradient and downgradient well location and depth. Under 9VAC25-31-220, which governs the process of establishing limitations, standards, and other permit conditions, (1.2) allows for the requirement for monitoring be established, including type, intervals, and frequency sufficient to yield data which are representative of the monitored activity.

Under 9VAC25-31-547 and 9VAC25-32-480 concerning groundwater monitoring for land treatment sites, sludge lagoons, biosolids land application sites, or biosolids storage facilities, DEQ may require monitoring wells to monitor groundwater quality. In addition, 9VAC25-31-600 through 680 details requirements for surface disposal of sewage sludge including land application to dedicated non-agricultural land and disposal in sludge-only landfills. Found within 9VAC25-31-640.N is the provision that sewage sludge placed on an active sewage sludge unit shall not contaminate an aquifer. This performance standard is assessed via the results of a groundwater monitoring program developed by a qualified groundwater scientist or a certification by a qualified groundwater scientist. Finally, regarding land treatment (application) systems, 9VAC25-790-880.H.4 states that a groundwater monitoring system shall be provided in accordance with the permit or certificate requirements.

IV. PERMIT LANGUAGE

Commonly, Part I of the VPDES permit will define the required Groundwater sampling requirements including constituent name, limitations (if any), units the results must be reported in,

frequency of monitoring, and sample type. The sampling list in the VPDES permit should match the sampling list contained in the GQM plan and where conflicts are found to exist, the list in the permit shall take precedence.

The VPDES permit may contain additional groundwater related requirements such as: submission of the GQM plan or a revised plan (including technical content and submission timeframes), requirements for interim groundwater monitoring (upon permit issuance), data reporting, and future actions (as needed – on a site specific basis). If applicable, the permit may also contain a requirement for submission of a groundwater corrective action plan or reference to an existing plan.

In contrast to the former guidance, permit condition language is not included in this update. For the Regional Office permit writers, this condition language may be found in the VPDES Permit Manual. While the responsibility for developing groundwater related permit language remains the responsibility of the Regional Office permit writer, the proposed language should be routed through the Groundwater Program Coordinator for review prior to inclusion in the draft permit.

V. FACT SHEET LANGUAGE

The Fact Sheet is a document which gives pertinent information concerning the reissuance of a VPDES permit and defines the basis for each requirement. The Fact Sheet will cross-reference and describe any groundwater monitoring requirements to be contained in the (Draft) permit. The Fact Sheet will also provide the rationale for requiring groundwater monitoring. Most commonly, this language will resemble: *“State Water Control Law § 62.1-44.21 authorizes the Board to request information needed to determine the discharge’s impact on State Waters. The groundwater monitoring program will provide information needed to determine whether the monitored unit(s) are impacting groundwater quality on site. Revisions to the existing groundwater monitoring program should reflect revised VPDES guidance and include verification of the monitoring well network adequacy, adoption of a baseline sampling frequency which is consistent with EPA’s 2009 Unified Guidance document concerning the interpretation of groundwater data/trends, and a more robust list of sampling constituents [FOR MUNICIPAL WWTPS ONLY: based on EPA’s research on the composition of WWTP sludges FOR INDUSTRIALS ONLY: based on chemicals utilized on site during the manufacturing process]. The expanded constituent list replaces the historic indicator parameter approach to facilitate a more full and accurate characterization of groundwater and to inform appropriate decisions regarding possible corrective action when contamination is indicated. These revisions are necessary to accurately document protection of human health and the environment at VPDES sites with groundwater monitoring programs and achieve consistency in the approach to protecting aquifer resources across DEQ’s regulatory programs”.*

The Fact Sheet may also contain a summary of historical groundwater sampling results and a discussion of any recognized groundwater exceedances and corrective actions undertaken.

With the change in responsibilities previously described in this revised guidance, which transfer the responsibility of the evaluation of the groundwater data to the Permittee, instead of the DEQ, reference to groundwater evaluations (formerly conducted by DEQ) and placed as attachments to the Fact Sheet will no longer be part of the Fact Sheet.

Changes in the groundwater monitoring requirements triggered by this revised guidance should be listed in the Summary of Changes to the Permit section of the Fact Sheet. While the responsibility for developing groundwater related Fact Sheet language remains the responsibility of the Regional Office permit writer, the proposed language should be routed through the Groundwater Program Coordinator for review prior to inclusion in the Fact Sheet related to the draft permit.

VI. GROUNDWATER MONITORING REQUIREMENTS

Groundwater monitoring will be required as part of a VPDES permit if certain conditions are found on site. Most commonly, these will include:

1. the type(s) and characteristic(s) of the wastewater being managed on site,
2. the design specifics of the wastewater containment unit including its construction and whether a liner is present, and
3. risk receptor information such as the distance of the monitored unit(s) to groundwater receptors or discharge points (i.e., seeps/springs) and public water supply intakes, and public/private drinking water wells (including those for non-potable agricultural use).

With respect to unit construction, one important aspect that will be reviewed is whether the unit construction method is compatible with the characteristics of the wastewater contained within it and whether there is a long term Operations and Maintenance (O&M) plan in effect for the unit. In those cases where the wastewater containment unit is lined, documentation regarding the permeability of the liner should be provided and reviewed (i.e., 1×10^{-7} cm/sec or 1×10^{-6} cm/sec with proper documentation and pre-approval by DEQ).

While each VPDES site is unique, in general, the most likely scenario where groundwater monitoring may not be required as part of a VPDES permit is where the wastewater containment unit has been constructed with a liner (and the liner meets permeability performance standards noted above) and an active leak detection system and the site is also located in an area in which groundwater resources are not used as a potable water supply because municipal water is supplied (or available for hookup).

VII. GROUNDWATER PROTECTION

The purpose of any groundwater monitoring activities undertaken at VPDES sites is to detect whether the monitored unit(s) is impacting the underlying aquifer at concentrations which would exceed groundwater protection standards/limits set forth by Regulation (i.e., 9 VAC 25-280-40) or the Antidegradation provision found in 9 VAC 25-280-30. In contrast to some other DEQ programs, groundwater standards/limits established under Water Regulation are not risk-based (i.e., exposure-derived) values. Instead, the groundwater standards are determined in the following manner:

1. If the background concentration of any groundwater constituent is less than its concentration set forth under 9VAC25-280-40 (groundwater standards) or as promulgated as a Maximum Contaminant Level (MCL) under the Safe Drinking Water Act, the natural background concentration for that constituent shall be the groundwater protection standard (GPS).
2. If the background concentration of any groundwater constituent is found to naturally be higher than its concentration set forth in 9 VAC 25-280-40, or as promulgated as an MCL, the natural background concentration shall be the GPS (and the Permittee would not be required to remediate groundwater impacts down to the published standard or MCL).
3. In those cases where a sampled groundwater constituent or parameter lacks a concentration set forth in 9 VAC 25-280-40 or any promulgated MCL, the natural site background concentration shall be the GPS.

It is important to note that in those cases where published concentration standards under 9VAC25-280-40 are found to conflict with existing MCL values promulgated under the Federal Safe Drinking Water Act, the DEQ may apply the stricter of the two standards for the purpose of recognizing when corrective action may be required. Most commonly this will occur at sites located in areas not

served by an available municipal water supply meaning the aquifer is the only available potable water source.

Because Water regulation relies so heavily on site background derived concentration values when setting groundwater standards, site background should be determined in an appropriate manner, using upgradient wells situated in appropriate locations isolated from any potential influence from the wastewater contained in the monitored unit. Unless otherwise specified in the permit, at VPDES sites just implementing groundwater monitoring (or at sites replacing older upgradient wells with new upgradient wells), or sites implementing a new sampling constituent list, background values should be determined after obtaining a minimum of four (4) independent samples from the upgradient monitoring well(s). This means that at sites where monitoring wells are sampled on a quarterly basis (i.e., sampling events spaced approximately 90-days apart), background values can be calculated after a single year of sampling actions. At sites sampling semiannually, background calculation would take place after two years of sampling activities have been completed.

For VPDES groundwater sites that have already implemented groundwater monitoring and are not undergoing a change in sampling constituent list, a statistically valid background concentration should be calculated using no fewer than the last eight (8) upgradient well sampling event results to best account for the seasonal variability (in precipitation) which affects some areas of the Commonwealth.

In either example described above any site background concentrations proposed by the Permittee for use in the groundwater monitoring program must be reported to DEQ in the Annual Report submission. In the rare cases where a sampling constituent is not found in the groundwater obtained from the site's upgradient well(s) (i.e., the constituent/parameter is non-detect), the lab Quantification Limit (QL) may serve as the "substitute" background concentration for that constituent for the purposes of assessing groundwater impacts. This approach is consistent with recent EPA groundwater guidance.

In contrast to the earlier guidance, once site background has been determined (and approved by the DEQ), it will be the primary responsibility of the Permittee to determine whether or not the sampling results from downgradient wells statistically exceed site background. The Permittee is encouraged to use the March 2009, EPA Unified Guidance, *"Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities"*, when determining whether the sampling results obtained from downgradient wells indicate an impact to the monitored aquifer from the wastewater unit. If the DEQ finds issue with the calculation of site background, you will be contacted by the Regional Office permit writer. For additional information regarding the calculation of or statistical analysis of background groundwater data, please refer to Chapter 5 of the March 2009, EPA Unified Guidance, *"Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities."*

Once an impact to downgradient groundwater quality on site has been recognized, it must be reported to the DEQ (within the Annual Report as discussed in more detail in a following section).

VIII. GROUNDWATER QUALITY MONITORING (GQM) PLAN

When groundwater monitoring is deemed appropriate for the site, the Permittee must develop a site-specific GQM plan. The purpose of the GQM plan is to describe the groundwater monitoring and sampling actions to be implemented on site as a means of identifying impact to the underlying aquifer. The technical checklist, provided as Attachment A to this guidance, should be used by the Permittee during development of the GQM plan. In contrast to the earlier version of this guidance, a full list of technical references is not included as an Attachment. Permittee s are encouraged to refer to groundwater monitoring guidance documents available from sources including:

- the EPA (www.epa.gov)
- the National Groundwater Association (www.ngwa.org)
- the Interstate Technology Regulatory Council (www.itrcweb.org)
- the American Society for Testing and Materials (www.astm.org) or
- other DEQ Land programs such as Solid Waste or Hazardous Waste that routinely require groundwater monitoring activities as part of the permitting process. These other DEQ programs have issued guidance documents covering groundwater monitoring activities (www.deq.virginia.gov).

The Permittee is responsible for preparing and submitting the GQM plan to DEQ for review, revision (if applicable) and/or approval. The timeframe for plan submission will be defined in the VPDES permit. In cases where additional assistance is needed, the Permittee should contact their regional permit writer for help. Any plan developed will undergo a technical evaluation by Land staff. Technical issues identified during DEQ review will be conveyed back to the owner/operator by the RO Water permit writer for review/revision. No GQM plan should be fully implemented prior to approval by the DEQ.

Once the plan is approved, it will be the responsibility of the Permittee to keep the GQM plan updated as needed to account for any changes in site activity or the groundwater monitoring program during the term of the VPDES permit. When such updates are recognized as needed, the Regional Office should be contacted as soon as possible to discuss the proposed changes and the timing required to update the plan.

This guidance defines the minimum content normally required of a GQM plan and also sets forth a common format for the organization of the plan. Utilization of a common format will assist in maintaining content consistency between all such plans submitted in the Commonwealth. The DEQ recognizes that the technical information described in this guidance may not be applicable to all sites in the Commonwealth. As a result, some adjustment to account for facility-specific geologic or hydrologic conditions is expected. It is expected that the final content of any GQM plan proposed based on the content of this revised guidance will likely include some site-specific considerations which are impossible to cover within this guidance.

Unless shown to be not applicable on site for specific reasons, the following sections should be part of a VPDES required GQM plan:

- I. General Site Information
- II. Geological and Hydrological Information
- III. Monitoring Well Network Description
- IV. Monitoring Well Installation, Construction, and Maintenance
- V. Groundwater Sampling Frequency
- VI. Groundwater Sampling Constituent List
- VII. Groundwater Sampling Methods
- VIII. Analytical Requirements
- IX. Data Reporting
- X. Record Retention
- XI. Data Evaluation

Each expected section of the GQM plan is described in more detail individually below to give a Permittee a better understanding of the technical content and site characteristics that are expected to be covered/discussed in the plan. Many of these topics may not have been covered in plans developed under the requirements of the former guidance.

GQM Section 1 - General Site Information

This section should provide general information about the site such as the owner/operator, location, and description of the site/facility. A description of the onsite waste or wastewater treatment systems including construction, dimensions, liner details, dates of operation, and historical performance; characterization of the waste or wastewater, etc., should be provided. This section should also contain a description of the land use on all properties that may be downgradient of the monitored unit(s) along with a site location map showing the in-ground monitored unit(s), appropriate scale and north arrow, as well any surface water features, access roads, and the facility/property boundary.

GQM Section 2 - Geologic and Hydrologic Information

If geologic and hydrologic information is not available at the time the GQM plan is initially developed, the plan must discuss the procedures that will be used to collect the data and note that an updated GQM plan will be submitted containing the new information. When the information is available, this section of the GQM should discuss the local geology, including formation name and lithologic descriptions of the soils and bedrock as determined from onsite geotechnical investigations or published geologic maps along with a description of the current site hydrology (i.e., a description of the uppermost aquifer and whether it is hydraulically connected to other aquifers or groundwater zones, whether zones of perched water are present, and whether there is any variability to the depth to groundwater on site due to seasonal influences). The plan should contain a groundwater contour map (i.e., potentiometric map) with appropriate scale, north arrow, surface features and location of the monitored unit, along with the potentiometric surface as defined by gathering groundwater elevation data from the monitoring wells installed on site. The purpose of this potentiometric surface map is to depict the general direction of groundwater flow in the vicinity of the monitored unit(s). Groundwater flow rate should be calculated using accepted industry practices and the calculations used should be provided in the plan.

This section of the plan should describe all potential groundwater receptors (i.e., surface water, springs, public water supply intakes, public and private drinking water wells, livestock or lawn watering or other non-potable water wells, and other groundwater receptors) located on site, or on nearby parcels of land located within 1,000 feet of the property containing the monitored unit(s). Please note that DEQ may require a larger radius to identify potential receptors if site conditions and/or waste or wastewater characteristics reflect the need for additional evaluation.

GQM Section 3 - Monitoring Well Network Description

This section of the GQM plan must define which well(s) will be considered upgradient for the purposes of developing site background concentrations to be used when evaluating the groundwater monitoring data. Background data will be used to determine whether detections of contaminants in groundwater can be related to site activities or attributable to off-site impact or background concentrations. The upgradient well(s) should be located away from the monitored unit so wastes or wastewater within the monitored unit cannot influence the groundwater sampled within the well. More than a single upgradient well may be needed to fully assess spatial variability (especially at large sites) in the natural concentrations of the sampled constituents, especially total metals. Upgradient wells should not be installed through or screened within historical waste.

The downgradient wells should be located as close as possible to the monitored unit boundary (i.e., outside edge of the berm, wall, embankment, etc.). If physical obstacles prevent the installation of wells within 25 feet of the monitored unit boundary, then wells should be installed at the closest unobstructed distance hydraulically downgradient from the boundary. If possible, downgradient wells should not be screened in horizons made up of historical sludge or waste.

In contrast to the earlier version of this guidance, a minimum of one (1) upgradient and three (3) downgradient monitoring wells will be required around wastewater containment units to adequately monitor groundwater on site. Consideration will be given to the size of all monitored unit(s) when deciding on whether additional monitoring wells would be needed. The larger the size of the unit and/or the more complicated the geology and hydrogeology, the greater the number of monitoring wells that may be required. Prior approvals of network design, when the network cannot meet the standard noted above, will not shield the Permittee from potentially having to update their monitoring network if requested by the DEQ.

The lateral spacing between individual downgradient monitoring wells around an individual monitored unit should not exceed 500 feet of linear distance, unless site conditions prohibit spacing at this distance. Monitoring wells must be extended into and completed within the uppermost aquifer but care should be taken in fractured bedrock to ensure that appropriate fracture systems are identified and monitored by wells screened at the appropriate depths to intercept the water bearing fractures. The requirement contained in the earlier version of this guidance mandating installation of monitoring wells completed in a zone of seasonally perched water is not carried over into this revision since production wells (potable or non-potable) are rarely if ever constructed within zones of perched water as the yield within a zone of perched groundwater would be insufficient to meet the demands of most users on a consistent basis. Final monitoring well location and installation depth should be based on the ability to identify all potential pathways of contaminant migration toward potential groundwater receptors.

In contrast to the requirement set in the earlier version of this guidance which noted that the screened interval of wells should intersect the (static) water table at all times during seasonal fluctuations, this new guidance recommends the screened intervals within each well used to collect groundwater samples be set such that they remain completely submerged below the top of the groundwater table during all times of the year. Such a performance standard is consistent with EPA's 1991 Groundwater Volume II: Methodology Handbook (EPA/625/6-90/016b) guidance; page 6 of which states:

*“Because of the chemical reactions that occur when groundwater contacts the atmosphere, particularly when dealing with volatile compounds, the screened section should not be aerated. Generally, well depth should assure that the screened section is **always** (emphasis added) fully submerged. The design should consider fluctuations in the elevation of the top of the saturated zone caused by seasonal variations or human-induced changes.”*

This performance standard is also consistent with EPA's 1986 RCRA C groundwater monitoring guidance (OSWER-9950.1 - Chapter 2) and EPA's 1985 Practical Guide for Groundwater Sampling (EPA/600/2-85/104) each of which additionally note that well screens should only be set across the top of the water table where the suspected groundwater contaminant class includes hydrocarbons or other constituents that are known to be less dense than groundwater. It is anticipated that most VPDES sites will not have a constituent class dominated by hydrocarbon-type contaminants. In those rare cases where permitted sites may have a mix of potential groundwater contaminants, the use of multi-zoned monitoring wells (both shallow set, and deeper set monitoring wells) may be required. The plan must define those wells set in the shallow aquifer and those wells screened into the deeper aquifer.

In contrast to the past guidance and practice, it is the sole responsibility of the Permittee to act in response to any evidence that the monitoring network has failed to perform as designed during the permit cycle. This includes, but is not limited to: the identification of damaged wells, dry wells, or any wells providing groundwater samples that are not representative of true aquifer conditions. Upon recognition of such conditions, the Permittee must propose changes to the network such that the

network will be able to adequately detect any contaminant released to the aquifer from the monitored unit(s) without delay. While the DEQ will review the site's groundwater monitoring network each year for adequacy, during the review of the groundwater Annual Report, if the DEQ recognizes a potential non-performance issue with any monitoring well and the record shows the Permittee has not proposed or taken any action to address this situation the Regional Office may request a meeting to discuss the issue in more detail.

GQM Section 4 - Monitoring Well Installation and Construction and Maintenance

This section of the GQM plan must describe the well drilling/installation process and include (as-built) construction information for all wells utilized for groundwater monitoring activities at the site. Procedures for well maintenance and abandonment must also be included in this section.

The GQM plan should describe the drilling method (i.e., hollow stem auger, air-rotary, "geoprobe", etc.), equipment decontamination procedures and any soil or rock sampling techniques that may be used. The drilling, decontamination and sampling methods should adhere to current industry standards/guidance. In general, DEQ pre-approval of any wells to be installed using "geoprobe"-type technology must be obtained from the Regional Office prior to beginning well installation.

The GQM plan must describe the casing and screen type, screen length, filter pack material, grouting procedure and the surface completion (i.e., concrete pad, etc.) and protective measures (i.e., barriers, pylons, etc.) that will be used for the wells at the site. The use of flush-to-ground surface completions should be avoided. Preference should instead be given to above-ground completions. The top of the well should extend far enough above ground to be visible above grass, weeds, or small shrubs. The use of well protectors with a lockable cap are recommended, (i.e., a larger diameter steel casing placed around the monitoring well at the ground surface and extending several feet below the frost line).

Well construction materials should be inert and must allow the well to operate throughout the required monitoring timeframe and allow the collection of representative groundwater samples. Most importantly, the well screen must be set below the lowest seasonal water table, should generally not exceed 10 feet in length, and be constructed with #10 slot screen. As discussed above, at no time during the year should the well screen extend above the top of the water table unless the sampling parameters include those that (because of their density with respect to water) partition to, or reside solely at the top of the groundwater table.

Appropriate well development procedures should be established to remove drilling fluid, fines and sediment from the wellbore and the filter pack as a means to ensure that representative groundwater samples can be collected after the well has been installed. The GQM plan must also describe the methods used to restore the natural hydraulic conductivity of the formation after well construction is complete. To be effective, the method used for well development should involve reversals or surges in flow to flush the well screen and filter pack. Please note that the Permittee must handle and dispose of well development water in an appropriate manner (e.g., contaminated groundwater must not be disposed of on the ground surface).

The GQM plan must describe routine well maintenance procedures and how these will be judged to be complete on site. In general, maintenance actions should include mowing grass around the wells, installation of a well pad to protect from surface water infiltration and flooding, periodically checking to ensure the well remains secured (locked) in between sampling events. Any wells installed in high traffic areas must be appropriately isolated from possible impact damage, and any wells installed within a 100-year Flood Zone must be adequately protected from damage due to inundation and impact from floating debris.

After installation actions have been completed, the wells should be labelled with a unique alpha/numeric identifier, and surveyed with an accuracy of 0.01 feet with a reference point established somewhere on the well casing. Well surveying must be conducted by a licensed or otherwise certified land surveyor and the well elevation data should be recorded within a table included on an appropriately scaled site plan which shows the position of each monitoring well in relation to the monitored unit(s).

Once monitoring well construction has been completed, a boring log and well construction diagram/information should be submitted to DEQ within 90 days of well installation. All boring logs must also be included as an appendix within the GQM plan.

The following information should be recorded during well installation and included on the logs:

- Date/time of well installation;
- Drilling method and fluid (if used - including description of disposal method);
- Borehole diameter
- Subsurface boring log;
- Well depth (i.e., completed depth specified to within 0.01ft.);
- Casing type, size and screen joint type;
- Screen materials, size and length;
- Filter pack material and size, volume calculations and placement method;
- Annular seal materials, volume used, and method of placement;
- Type of protective well cap; and
- Surface completion design and construction;
- Well location specified to within 0.5 ft., and ground surface elevation, survey reference point elevation, top of monitoring well casing elevation ft. and top of protective steel casing elevation specified to within 0.01 ft.;
- Well development procedure;
- Well "as built" diagram.

If construction information and boring logs are not available for any of the existing wells covered by the GQM plan, the Permittee can employ geophysical techniques to determine well depth, screened interval(s) and basic construction materials. At a minimum, the Permittee must supply depth, surface elevation and the date of installation for any existing well that lacks detailed construction information. In cases where new wells are installed on site, the well construction diagrams and boring logs should be included in the next Annual Report submission and added into the GQM plan within 90 days.

The GQM plan must describe the procedures for abandoning (if needed) groundwater monitoring wells during the monitoring program. The procedures should adhere to industry standards and existing Virginia Department of Health regulatory requirements. Additional guidance may be obtained from DEQ's 2015 Hazardous Waste groundwater well abandonment guidance document. If monitoring wells are abandoned onsite, a report describing the actions taken may be required by the DEQ. In such cases, the report must be submitted within the defined timeframe.

GQM Section 5 - Groundwater Sampling Frequency

The GQM Plan must define the frequency of groundwater sampling events to be undertaken on site. Although semi-annual sampling will generally be required for most sites, the DEQ may require quarterly sampling during the first two years at any new sites, or any existing sites that are updating their monitoring well networks. After two years, the sampling frequency may be adjusted to semi-annual or annual if requested by the Permittee and as supported by the groundwater data, with DEQ approval. The minimum allowable groundwater sampling frequency will be annual, but approvals of such frequency will only be granted if based on site-specific hydrologic characteristics. Facilities

implementing such a frequency will have successfully demonstrated to the DEQ that annual sampling is appropriate to maintain protection of human health and the environment based on an extremely slow rate of groundwater migration on site such that acquisition of statistically independent samples of groundwater are not possible on a sampling frequency of approximately 180-days.

GQM Section 6 - Groundwater Sampling Constituent List

The GQM plan must define the water quality parameters and groundwater constituents to be sampled for on site. This revised guidance differs from the earlier guidance in no longer applying a common set of sampling constituents/parameters to all VPDES GW sites (e.g., pH, total dissolved solids, conductivity, total organic carbon, and static water level). The revision to the guidance establishes that a sampling list should be defined in a manner consistent with the types of contaminants that would have been managed within the monitored unit on site (currently and during its operational history) and the types of chemicals used/stored on site during any waste treatment processes. As a result, a review of the site’s operational history, types of waste managed, and a review of Material Safety Data Sheets related to any chemicals utilized onsite (based on prior purchasing records/inventory lists) should be completed when developing the final sampling list.

The final monitoring constituents/parameters set in the GQM plan will be facility-specific, based on the type of waste being managed/treated and may include industry-specific pollutants (i.e., refer to Federal effluent guidelines, the metals constituents of concern identified at hazardous waste sites under 40 CFR 264, and metals constituents of concern identified at municipal waste sites (Table 3.1 column A of 9 VAC 20-81-10) as needed). In some cases, volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC) may be required based on the waste or wastewater treatment technology applied on site. For VPDES groundwater sites falling in the municipal wastewater treatment category, an example sampling list of metals and water quality parameters is given in the table below which is based in part upon EPA’s available biosolids research which identified the most common metals found within the insoluble residuals making up WWTP sludge.

Sample Constituent
Total Arsenic
Total Cadmium
<i>*Total Chloride*</i>
Total Copper
Total Fluoride
<i>*Total Iron*</i>
Total Lead
Total Manganese
Total Mercury
Total Molybdenum
Total Nickel
Total Selenium
<i>*Total Sodium*</i>
<i>*Total Sulfate*</i>
Total Zinc
<i>*pH*</i>
E. coli
Ammonia Nitrogen
Nitrite Nitrogen
Nitrate Nitrogen

Additional metals, such as those listed in 9 VAC 25-280-40 and 60 with published groundwater standards, as well as other water quality indicator parameters, may be added by the Regional Water permit writer if applicable based on site-specific considerations including facility design and operational history. Those additional constituents or parameters identified by an asterisk (*) are ones which can be common indicator (tracers) of unit integrity problems and could be added to the sampling list on a site-specific basis by the permit writer. Lastly, additional constituents or parameters (e.g., **) could be added to this list based on the types of metals in the waste water, the treatment chemicals (and their composition) potentially utilized on site during the wastewater treatment process.

In some cases, it may be appropriate for Permittees to request DEQ approval to remove constituents during the permit renewal/reissuance process if the constituent has been demonstrated to not be reasonably expected within the wastewater being managed on site, or there has been a documented change in the waste handling process or the characteristics of the waste material remaining in the unit (i.e., has prior sludge material been excavated?). Any proposed reduction in the list of parameters/constituents may be approved by DEQ after review of existing sampling results. Once approval is obtained the GQM plan can be modified as needed. Additional parameters/constituents may also be added to the sampling list in the GQM plan during the permit reissuance process.

Once a sampling list has been identified, additional information including the associated CAS (Chemical Abstracts Service) Registry Number, the related method of laboratory analysis, the unit of measure the results will be reported in, and the laboratory detection and quantitation limits should be presented in the GQM plan. In cases where the sampling constituent is a metal, the analytical data must be reported as total recoverable, not as a dissolved fraction and the sample obtained from the monitoring wells must be unfiltered.

It is important to recognize that the list of groundwater sampling constituents may not be the same as the list of water quality parameters and constituents sampled at the VPDES point(s) of discharge. This is because insoluble residue (sludge) at the base of wastewater containment units may contain potential pollutants that differ from those which more easily remain in a dissolved or suspended state within the effluent. The purpose of the groundwater monitoring program is to assess the integrity of the monitored unit and the composition of the accumulated sludge within the unit is the primary potential pollutant source of concern when dealing with detecting leaks from the bottom of the monitored unit.

GQM Section 7 - Groundwater Sampling Methods

The GQM plan should include provisions for the measurement of static water elevations in each well immediately prior to purging and sampling. The accuracy of this measurement should be no less than 0.01 ft. The device to be used for water level measurements, as well as the procedure for measuring water levels, should be described. Groundwater elevations should be reported relative to a consistent site benchmark, most commonly in feet above mean sea level.

Because groundwater standing in a well, exposed to free (head space) oxygen within the well casing prior to sampling may not represent true (in-situ) groundwater quality, stagnant water should be purged from the well and filter pack prior to sampling. The GQM plan should describe the procedures for purging wells, including the type of equipment to be used, the volume and disposition of purge water, and the parameters that will be monitored during purging. Frequently monitoring indicator parameters, such as turbidity, dissolved oxygen, conductivity and temperature, during well purging to ensure that these parameters are stabilized within at least 10% over the last two measurements, provides greater assurance that representative groundwater samples can be collected. The equipment

used to determine the field parameters should be described, as well as equipment calibration and decontamination procedures.

While this guidance does not prohibit the use of hand bailers in acquiring groundwater samples, to ensure that the samples most accurately reflect groundwater conditions at the site, use of dedicated pumps and low-flow purging and sampling is recommended. This requires purging and sampling the well at 0.2 to 0.3 L/min and periodically monitoring for indicator parameters (e.g., turbidity, dissolved oxygen, conductivity and temperature, etc.) to ensure that these parameters are stabilized within at least 10% over the last two measurements and turbidity is less than 10 NTU. If dedicated sampling equipment is not used at the site, the water level meter and all sampling equipment must be decontaminated prior to use at each well and the procedures used must be described within the GQM plan.

It is important to note that the evaluation of metals groundwater data must be based on unfiltered, total concentration data. Samples collected on site shall not be field filtered. If the network wells yield samples that are excessively turbid, non-representative sampling results may result and these may yield false exceedances when compared to groundwater protection standards so care should be taken to properly develop, purge and sample wells in use on site. In some cases, low-flow dedicated sampling equipment may be required. Any owner/operator that chooses to voluntarily sample for dissolved metals along with total metals may present that data to DEQ, but only total metals results shall be used for assessing groundwater quality.

The GQM plan must describe the type of sampling equipment used (bailers, bladder pumps, pneumatic pumps, etc.), the number of samples per well to be collected during each event, the sample collection order, the parameters to be sampled, and how the samples will be handled after collection. The depth of the each well should be measured each time the well is sampled. The upgradient or least contaminated wells should be sampled prior to downgradient or more contaminated wells to reduce the possibility of cross-contamination. The following information should be recorded during sampling:

- Well identification number;
- Total well depth;
- Static water level elevation and measurement technique used to obtain the data;
- Presence (and thickness) of immiscible layers (yes – no);
- Actual purge volume and purge pumping rate;
- Time well purge began and ended;
- Well purge/evacuation procedure and equipment;
- Field analysis data (e.g., turbidity, dissolved oxygen, conductivity, pH and temperature) and method of collection,
- Climatic conditions and field observations during sampling event, including air temperature;
- Name of collector;
- Date and time of sample collection;
- Sampling procedure;
- Sampling equipment used;
- Types of sample containers used;
- Preservative used (if applicable);

The order in which samples are collected should be described in the GQM plan, based on the volatilization sensitivity of the constituents/parameters. General water quality parameters such as pH and conductivity (specific conductance) should be collected first if they are part of the sampling list. The preferred collection order for some common constituent categories is listed below. In most cases, VPDES sites with groundwater

monitoring programs will be dealing mostly with inorganic constituents but a full list is provided as an example below:

- 1) Volatile organics (VOA)
- 2) Purgeable organic carbon (POC)
- 3) Purgeable organic halogens (POH)
- 4) Total organic halogens (TOX)
- 5) Total organic carbon (TOC)
- 6) Extractable organics
- 7) Total metals (unfiltered)
- 8) Phenols
- 9) Cyanide
- 10) Sulfate and chloride
- 11) Turbidity
- 12) Nitrate and ammonia
- 13) Radionuclides

The GQM plan must identify the type of sample containers, the procedures that the owner or operator will use to ensure that sample containers are free of contaminants prior to use, and the preservation techniques used (if applicable) on the samples. Methods of sample preservation are intended to: prohibit or at least retard biological action, restrict chemical reactions such as hydrolysis or oxidation, and reduce sorption effects. Preservation methods include pH control, chemical addition, refrigeration (cooler temperature kept at 4 degrees Celsius), and protection from light (UV radiation).

The GQM plan should ensure the reliability and validity of any data collected as part of a groundwater monitoring program. This may be accomplished by the collection and analysis of trip, field or equipment blanks. While one trip blank per sampling event is recommended, sites which do not have volatile organic compounds as part of the sampling list may not need to utilize a trip blank. Equipment blanks should be taken if the purging and/or sampling equipment is not dedicated. A minimum of one equipment blank is recommended for each day that groundwater monitoring wells are sampled.

To ensure that the sample is not held beyond the recommended holding time and to establish the documentation necessary to trace sample handling/possession from time of collection, an adequate chain of custody process should be defined in the GQM plan. Chain of custody paperwork should be maintained with the data for each sampling event. The chain of custody record should contain the following information:

- Sample ID number;
- Signature of collector;
- Date and time of collection;
- Sample type (i.e., grab, split, etc.);
- Well identification number;
- Number of sample containers used;
- Temperature within shipping container as it is sealed
- Parameters requested for analysis, or analytical methods requested;
- Signature of each person involved in completing the chain of custody record;
- Sample labels affixed to the samples should contain at least the:
 - Sample identification number;
 - Date and time of collection;
 - Facility name; and
 - Parameters to be analyzed.

A seal should be placed on the shipping container or individual sample bottles prior to samples leaving the collector's immediate control (such as shipment to a laboratory by a common carrier) to ensure that the samples have not been disturbed during transportation. Sample delivery times to the laboratory should comply with sample holding times and meet requirements of 40 CFR 136 and/or SW-846.

GQM Section 8 – Analytical Requirements

The GQM plan should describe the laboratory quality controls to be used (i.e., method blanks, equipment blanks, matrix spikes, etc.). Analytical methods used by the laboratory should be consistent with 40 CFR 136 and/or SW-846 (used in EPA's RCRA C and D groundwater monitoring programs). For constituents/parameters that lack a method specified within 40 CFR 136 or SW-846, the Permittee should notify the DEQ of the analytical method planned for use for DEQ review and approval.

All analytical work completed must be completed at laboratories that have achieved Virginia laboratory accreditation program (VELAP) benchmarks including accreditation for each method applied to the sampled constituents/parameters. Analytical data submitted for the purposes of demonstrating compliance with the Virginia Air Pollution Control Law, the Virginia Waste Management Act or the State Water Control Law (§ 10.1-1300 et seq., § 10.1-1400 et seq., and § 62.1-44.2 et seq., respectively, of the Code of Virginia) will not be accepted from non-VELAP-certified laboratories. Additional information regarding laboratory certification and its use in Virginia's regulatory programs can be found at <http://www.dgs.state.va.us/DivisionofConsolidatedLaboratoryServices/Services/EnvironmentalLaboratoryCertification2/tabid/1503/Default.aspx>.

GQM Section 9 – Data Reporting

The GQM plan should specify how groundwater data/results will be reported to the DEQ and identify the frequency upon which it will be submitted. The frequency of reporting should be consistent with that specified in the VPDES permit.

Reporting may be on a quarterly, semi-annual, or annual basis. For quarterly and semi-annual reporting, the VPDES permit may define the required content and required submission timeframes. Annual Reports should be submitted within 90-days of the close of the 2nd semiannual or 4th quarterly monitoring period. A checklist, which can be used to ensure the Annual Report contains the appropriate content, is included as Attachment C of this guidance. Attachment D of this guidance contains an example Annual Report Table of Contents (table format) which should assist in the design of the submission. Use of a common Table of Contents will ensure consistency in the VPDES groundwater submission across all regions of the Commonwealth.

Sections 4.0 through 7.0 are the most important within the Annual Report. The report should clearly show that all constituents/parameters specified in the permit were sampled, and sampled at the required frequency at each monitoring well within the network defined in the GQM plan during the calendar year covered by the Annual Report. Any sampling action deviations from sampling actions in the approved GQM plan should be discussed and addressed in the Annual Report to ensure future compliance with the requirements of that plan. The Annual Report should demonstrate that all necessary QLs and/or Detection Limits (DLs) were met during the laboratory analysis and should clearly specify if any groundwater data collected during the calendar year was compromised due to field sampling or laboratory analytical error. Any potential sampling or analysis errors should be addressed with the field and/or laboratory staff prior to the next groundwater event. The report should also discuss whether or not any verification sampling event was performed to mitigate the error. The DEQ will review the verification sampling data to ensure that similar laboratory detection and reporting limits were used for the verification sampling event as well as the initial sampling event.

Section 6.0 of the Annual Report should demonstrate that all applicable groundwater standards, criteria or concentration levels (including approved background concentrations) were correctly used during the assessment of the groundwater sampling events completed during the calendar year. The Annual Report should clearly discuss the statistical evaluation that was used to compare the monitoring data to the applicable background values.

The Annual Report should also indicate if any updates to background concentrations are proposed for use. At a minimum, background should be updated if the permit is up for re-issuance in the next calendar year. Please note, the Permittee may choose to perform a simple comparison of each downgradient concentration value with its background value in lieu of a statistical comparison to background data. While this approach is a valid means of assessing a site's groundwater data, it has a higher likelihood of yielding a false positive GPS exceedance result. A determination of an exceedance of natural site background should be done using a statistical method referenced in EPA's 2009 Unified Statistical Guidance document (<https://archive.epa.gov/epawaste/hazard/web/html/index-12.html>).

For existing monitored units(s), Section 6.0 of the report should discuss whether there is a statistically significant difference between groundwater quality in the upgradient well (i.e., natural background) versus each individual downgradient well (i.e., interwell comparison). At new facilities, where pre-unit construction groundwater data may be available, a comparison of current groundwater quality and the groundwater quality prior to the permitted activity beginning (i.e., intrawell comparison) may be added to the routine interwell comparison noted above. If no background GPS concentration value is exceeded, no additional action is required. However, all detected constituents should be presented in a cumulative time-series graph to identify any potential concentration trends over time. If apparent increasing trends are identified, the Permittee should evaluate and discuss in the report.

If one or more background values are exceeded, and the exceedance has not been attributed to an error in field sampling, laboratory analysis or statistical calculations, or a different contaminant source unrelated to the waste contained in the monitored unit; Section 7.0 of the report should discuss the results of comparing the groundwater data from each well to applicable groundwater standards/criteria as listed within the GQM plan, and briefly discuss the actions to be taken to address the reported exceedance.

All analytical data released from the laboratory must be included in the Annual groundwater monitoring report submitted to the DEQ and the results for all detected constituents/parameters (i.e., those found above the LOD) should be summarized in table format. In those cases where the initial review of the analytical data suggests to the Permittee that an exceedance of a groundwater standard has taken place, but the analytical result is considered suspect and verification sampling is undertaken to verify the initial result, the analytical results presented in the example table above should be footnoted to clearly identify the verification event result. Please note, the DEQ expects verification sampling, if undertaken on site, should be completed at the well in question within 30 days of the receipt of the initial analytical lab report used to identify the suspect data exceedance. For further assistance with the use of verification samples, please contact the groundwater program coordinator at the number listed on the cover page of this guidance.

GQM Section 10 - Record Retention

All records associated with the groundwater monitoring and sampling activities completed on site including (at a minimum) well installation and abandonment records, field notes associated with groundwater purging and sampling actions, laboratory analytical results, and the statistical comparisons used to determine if groundwater impairment is indicated shall be retained by the Permittee in a manner consistent with the requirements defined within the associated VPDES permit. Copies of these recorded shall be forward to the DEQ if requested by the Director.

GQM Section 11 – Data Evaluation

The results of the groundwater sampling events shall be compared to site background to determine whether the monitored unit(s) has impacted groundwater at concentrations/levels that would trigger the need for corrective action. To determine this, the results of each sampled constituent/parameter for each sampling event at each downgradient well shall be compared to the established background value determined for that specific constituent/parameter. This section of the GQM should describe the statistical method to be used when evaluating the groundwater data collected onsite.

For sites which have to report groundwater data on a quarterly or semi-annual basis, this determination of groundwater impact(s) should be completed within 60-days of receiving the laboratory results of each sampling event (i.e., when the final results are released by the laboratory under signature). For sites which report groundwater data on an annual basis, the determination must be completed prior to the issuance of the Annual Report.

IX. CORRECTIVE ACTION

If the simple comparison of constituent concentrations in downgradient wells indicates an exceedance over site background has occurred, and the exceedance has not been tied to an error in field sampling or laboratory analysis, or attributed to another source separate and/or different from the monitored unit; then the Permittee should report the groundwater exceedance to the DEQ in Section 7.0 of the Annual Report (or in the next quarterly or semi-annual report if under those reporting schedules). Additionally, the Permittee should, prior to the next regularly scheduled sampling event, request a meeting with the Regional Office to discuss the appropriate response action(s) to maintain protection of human health and the environment.

Response actions to any recognition of a groundwater exceedance will be site specific and tailored to site location, conditions, and proximity to immediate receptors. Some appropriate response actions may include but are not limited to:

1. a request for variance,
2. use of a mixing zone allowance,
3. statistical comparison to State water quality standards, or
4. full site characterization work.

Variance Request

Water Regulation (9VAC25-280-30) allows the owner/operator to request a variance from having to address a groundwater exceedance. A variance may be granted where it has been affirmatively demonstrated that a groundwater impact is justifiable to provide the necessary economic or social development, that the degree of waste treatment necessary to preserve the existing (i.e., natural background) quality cannot be economically or socially justified, and that present and anticipated uses of such (ground) water will be preserved and protected (even at the level of impact identified by groundwater monitoring).

For VPDES sites opting for this action, but located in areas subject to groundwater withdrawal permits, the Variance review/approval must be discussed/coordinated with DEQ's Office of Water Supply.

Application of Mixing Zone Allowance

Language within 9VAC25-280-20, allow zones for mixing wastes and groundwater to be established at the request of the Permittee (and approval of DEQ). Such mixing zone allowance

approvals shall be determined on a case-by-case basis and kept as small as possible to minimize the area affected by impaired groundwater quality.

Comparison to State Water Quality Standards

If the exceedance over natural site background is for a constituent which also has a standard established under 9VAC25-280-40 or 50, the owner/operator may request the option to compare the sampling results observed in the exceeding well to the published standard in the Regulation. If the sampling result does not exceed the published standard set in the regulation, then DEQ may require no further immediate action other than additional monitoring well installations to document whether or not the area of impacted (i.e., exceeding) groundwater remains on site or not.

Site Characterization

In those cases where the GPS exceedance cannot be addressed by Variance, Mixing Zone, or (where applicable) comparison to available Water Quality Standards, further site characterization work may be required by the DEQ to define the horizontal and vertical extent of the impacted groundwater. The scope of the site characterization actions should be discussed with DEQ prior to initiation. DEQ will determine the appropriate timeframe for completion of the site characterization work.

In cases where further site characterization is required, any proposed work plan should address at least the following elements:

- Groundwater Characterization - A sufficient number of additional monitoring wells should be installed in order to delineate groundwater flow direction and both the horizontal and vertical extent of the contaminant plume. At a minimum, one of these wells shall be installed along (or as close to) the property line in the direction of groundwater flow. Any existing production/drinking water wells onsite or adjacent properties should be sampled to assess risk to receptors.
- Sediment and Surface Water Sampling - If the identified impacted groundwater is located proximal to a surface water body, such that groundwater may be discharging to surface water, then surface water samples should be collected from the receptor to evaluate potential impacts. Samples in cases like this should be run for both totals and dissolved fractions.
- Receptor Evaluations - Updated evaluations of potential risk to human health and environmental receptors should be completed as a means of identifying any immediate protective actions required to ensure the identified receptors do not come into contact with the impacted groundwater prior to corrective actions being implemented. If the exceeding groundwater constituents include volatile organic compounds, the receptor evaluation should take vapor impacts into consideration if occupied buildings are located above the area of impacted groundwater.

The results from the completed site characterization work should be provided to DEQ under separate cover within the timeframes set by DEQ, and shall include groundwater plume maps in both the horizontal and vertical dimension, full analytical results, and recommendations for follow up actions. This submission should be titled the Groundwater Characterization Report (GCR). The owner/operator may request to meet with the DEQ RO to discuss the results of the GCR prior to its final submission.

After review of the GCR, DEQ may request to meet with the Permittee to explore potential remedial options. Such options would be focused on ending the release from the monitored unit(s) by lining the unit or establishing a new unit, in-situ or ex-situ groundwater treatment, installation of hydrologic barriers or plume migration controls (including phytoremediation methods in areas of shallow groundwater table), making available a temporary or permanent alternate water supply to human receptors, or closure of the groundwater-impacting monitored unit with appropriate engineered

capping. Utilization of a Uniform Environmental Covenant may also be possible in conjunction with some of the above described actions if the site groundwater data indicates the plume has not migrated off site, or has entered (or is likely to enter) surface water. DEQ may require immediate actions of the owner or operator in those cases where the groundwater plume extends off site or is discharging to surface water.

Attachment A – Groundwater Quality Monitoring (GQM) Plan Content Checklist
 (Permittee should complete this form prior to submitting GQM plan to DEQ)

Groundwater Monitoring Plan Review Checklist – Site ID:				
Yes	No	N/A	Page	Items Related to Site Monitoring Well Network
				Is a general description of the site and its use included?
				Is land use on the surrounding properties summarized?
				Is a site map provided locating all MWs around the unit(s)?
				Is development/submission of a potentiometric surface map discussed?
				Is the length and placement of the screened interval discussed?
				Are MW installation and construction details discussed?
				Are the well development procedures discussed?
				Is the submission of MW boring logs and construction data defined?
				Is the MW abandonment procedure discussed?
				Are MW O&M procedures defined?
				Are MW replacement actions discussed if wells go dry or are damaged?
Yes	No	N/A	Page	Items Related to Aquifer Recognition/Description
				Are site soil and bedrock types making up the monitored aquifer discussed?
				Is the composition and characteristics of the monitored aquifer discussed?
				Is the calculated rate and direction of groundwater flow discussed?
				Does the potentiometric surface map support the locations of the MWs?
Yes	No	N/A	Page	Items Related to Sample Collection
				Are the MW purging, sampling and field analysis procedures discussed?
				Is the acquisition of GW elevation data at each well discussed?
				Is the MW sampling procedure identified?
				Is the decontamination of sampling equipment discussed?
				Is the MW sampling order discussed?
				Is the order of constituent/parameter sampling identified?
				Are the types of sample containers to be used identified?
				Is the sample quantity required per analytical method identified?
				Are sample preservation actions (required per parameter) identified?
				Is sample security prior to shipment and Chain-of-Custody discussed?
				Is the field QA/QC program discussed?
Yes	No	N/A	Page	Items Related to Analytical Procedures
				Are the analytical methods to be used and DL and LOQ identified?
				Is the VELAP accredited lab to be used identified?
				Are the statistical methods to be applied to GW data discussed?
				Is the use of verification samples discussed?
				Is the use of data validation methods discussed?
Yes	No	N/A	Page	Items Related to Monitoring Program
				Is the GW sampling constituent list identified?
				Is the sampling frequency identified?
				Is the process to determine background concentrations identified?
				Are the annual reporting requirements discussed?
				Is the process to evaluate groundwater data against GPS discussed?
				If GPS are exceeded, are additional characterization actions discussed?
				Are groundwater monitoring record keeping requirements discussed?

Attachment B – Groundwater Annual Report Technical Content Checklist
 (Permittee should complete this form prior to submitting AR to DEQ)

Page	Yes	No	N/A	Groundwater Monitoring Report Review Checklist – Permit # _____
				Report submitted within the permit-required timeframe?
				Report contained signature page?
				Facility name, type, permit #, and owner/operator were identified in text?
				Facility location shown on a USGS topographic map?
				Summary of design type (i.e. lined or unlined), operational history, size (acres), dates of beginning and end of disposal (if applicable) included in text
				Summary description of physical setting, uppermost aquifer, surface water?
				Adjacent land use described noting any groundwater use?
				History of groundwater monitoring activity on site?
				Monitoring network description and review included?
				List of the sampling events undertaken in the calendar year included?
				<ul style="list-style-type: none"> • GW elevations measured at each well during each event? • Each GW well was sampled during each monitoring event? • – If a well was not sampled, does report discuss why? • Was complete sampling constituent list used each event? • Was lab QL and DL adequate? • Were unfiltered groundwater samples collected for total metals? • VELAP certification included? • Were any QA/QC issues with lab data noted? • Final metals concentrations reported as totals?
				Historical table of detected constituent concentrations included?
				Evaluations – Groundwater Flow:
				<ul style="list-style-type: none"> • Groundwater flow rate calculations included? • Groundwater flow direction, (potentiometric map) acceptable? • (if applicable) Isoconcentration maps for contaminants acceptable? • Table with depth to groundwater data for each well present?
				Evaluations – Groundwater Quality:
				<ul style="list-style-type: none"> • Comparison to applicable groundwater standards included? • Discussion of verified groundwater exceedances included? • Discussion of the statistical evaluation incl. apparent trends included?
				Conclusions (including recommended actions if applicable) included?
Yes	No		N/A	Other Technical Concerns / Special Compliance Topics

Attachment C – Groundwater Annual Report Table of Contents Example

ANNUAL REPORT TABLE OF CONTENTS
1.0 EXECUTIVE SUMMARY
2.0 INTRODUCTION
3.0 SITE DESCRIPTION
3.1 Facility Type and History of Activity
3.2 Physical Setting (incl. adjacent land use)
3.3 Aquifer Description
3.4 Review of Monitoring History and Well Network
4.0 SAMPLING EVENTS (including any verification events)
4.1 Event Dates and Field Sampling Procedures Utilized
4.2 Laboratory Procedures
5.0 GROUNDWATER FLOW EVALUATION
5.1 Groundwater Flow Rate & Direction Discussion
5.2 Contaminant Plume Migration Discussion (if applicable)
6.0 GROUNDWATER QUALITY EVALUATION
6.1 Comparison to Background
6.2 Comparison to Applicable Standards, Criteria and Levels
6.3 Discussion of Groundwater Exceedances (if applicable)
6.4 Discussion of Apparent Trends (if applicable)
7.0 CONCLUSIONS
7.1 Summary of Findings
7.2 Planned Actions
<p>FIGURES (no larger than 11 x 17", color preferred, include scale, north arrow, facility boundary):</p> <ul style="list-style-type: none"> *Topo map with site location identified *Well network map including footprints of monitored unit(s) * Potentiometric surface map * Time-series plots of detected constituents showing statistical trend line(s)
<p>TABLES:</p> <ul style="list-style-type: none"> * Monitoring results tables for each well (including applicable standards, QL and DL) * Historical monitoring results for each constituent

ATTACHMENTS:

- * Field data sheets
- * Certificates of analysis
- * Statistical calculations
- * Groundwater flow rate calculations