GUIDELINES FOR THE INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER CONTAMINATION

2020

This document provides instructions for those involved in the investigation and remediation of discharges or releases regulated by the North Carolina Department of Environmental Quality, Division of Water Resources, resulting in soil and groundwater contamination. Included is information on the statutes and rules governing groundwater investigations and the recommended process to comply with regulatory requirements

DEQ
Division of Water Resources

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GUIDELINES FOR THE

INVESTIGATION AND REMEDIATION OF SOIL AND GROUNDWATER CONTAMINATION

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ACRONYMS

CAP – Corrective Action Plan

CSA – Comprehensive Site Assessment

DEQ - North Carolina Department of Environmental Quality

DHHS - North Carolina Department of Health and Human Services

DWM – Division of Waste Management (under DEQ)

DWR - Division of Water Resources (under DEQ)

EMC- Environmental Management Commission

EPA - Environmental Protection Agency

G.S. – North Carolina General Statute

IHSB - Inactive Hazardous Sites Branch (under DWM)

K – Hydraulic Conductivity

MNA – Monitored Natural Attenuation

NCAC - North Carolina Administrative Code

NPDES – National Pollutant Discharge Elimination System

PAHs - Polynuclear Aromatic Hydrocarbons

PCBs - Polychlorinated Biphenyls

RP - Responsible Party

T - Transmissivity

WQROS – Water Quality Regional Operations Section (under DWR)

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GUIDELINES FOR THE
INVESTIGATION AND REMEDIATION OF
SOIL AND GROUNDWATER CONTAMINATION

1. INTRODUCTION

This document has been prepared with the intent of assisting the public and state agency staff with the regulatory expectations associated with soil and groundwater contamination incidents under the current purview of the DEQ Division of Water Resources (DWR). References to other agencies are given for contamination incidents for which the DWR is not responsible.

Applicable regulatory requirements are cited and include supplemental text that attempts to explain the regulatory expectations for helping responsible parties, environmental consultants, and others comply with those requirements. This document is non-binding, unenforceable, and subordinate to the applicable rules and statutes referenced herein.

This document was not designed as an instructional manual or step-by-step process guide. Rather, it was designed to be informative and to provide technical resources for implementing regulatory requirements. Subject matter expertise is necessary to conduct comprehensive site assessments (CSA) and implement corrective action plans (CAPs). The actions, criteria, procedures, and technical references in this document are provided to describe how the regulatory requirements may be met. They are based on similar guidance documents, common standards of practice, and scientific study. Alternative actions or procedures may also produce the intended results specified in the regulatory requirements.

Although these Guidelines provide comprehensive coverage of potential contamination incidents and responses for DWR program areas, there may be situations where this guidance may not be sufficient, or situations that may not be directly applicable. Please contact the DWR Water Quality Regional Operations Section (WQROS) for questions or additional information.

1.1 Background

The 15A NCAC 02L Classification and Water Quality Standards Applicable to the Groundwaters of North Carolina (2L Rules) were established to define the requirements that must be met when a discharge or release results in, or has the potential to result in, an increase in concentrations of contaminants above the state groundwater standards under 15A NCAC 02L .0202 (2L Standards). The rule applies to permitted and non-permitted facilities, and is administered by the Environmental Management Commission and the DWR[1]. Because the 2L Rules generally do not provide details on *how* to implement a given requirement, the DWR has developed this set of guidelines to assist the responsible party (RP).

1.2 Purpose and Scope

The purpose of this document is to provide guidance to RP involved in the investigation and remediation of discharges or releases regulated by the DWR, as indicated in the 2L Rules[2]. This document provides guidance for the sections of the 2L Rules that are related to soil and groundwater assessment and remediation, including Sections .0106 (Corrective Action), .0110 (Monitoring), .0111 (Reports), and .0114 (Notification Requirements). These guidelines are meant to serve as a supplement to the 02L Rules and outline DEQ's expectations of the work needed to comply with these rules. They are not a substitute for the 2L Rules, nor do they supersede the rules or any other relevant policy documents or memoranda.

The document is divided into eight sections: (1) Introduction; (2) Required Actions after a Discharge to Soil and Groundwater of the State; (3) Comprehensive Site Assessment; (4) Corrective Action; (5) Monitoring Plan; (6) Termination of Corrective Action; (7) Closure and Issuance of "No Further Action Required"; (8) External Resources; and (9) Exhibits (1, 2, and 3). Policies and Guidelines cited throughout this document are listed in Exhibit 3 and available at the Division of Water Resources website.

Guideline updates may be found at the DWR website: http://portal.ncdenr.org/web/wq/aps.

Questions about this document or requirements related to a specific release should be directed to the WQROS regional office that oversees the county in which the site is located (Table 1).

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[1] In 2006, the North Carolina Department of Environment and Natural Resources (now DEQ) revised the soil and groundwater contamination incident responsibilities of the Division of Water Quality (DWQ) and the Division of Waste Management (DWM). Those responsibilities were outlined in a Memorandum of Agreement signed in 2007 by both divisions. In 2013, DWQ was merged with the DWR.

[2] The 2L Rules establishes the notification, site assessment, corrective action, monitoring, and reporting requirements for permitted and non-permitted facilities at which a release has occurred. It also establishes groundwater quality standards; the data required for approval of alternate cleanup levels, natural attenuation, or termination of corrective actions; the conditions in which contaminated groundwater may be reclassified; and the conditions in which current remedial activities shall be abandoned in favor of new technologies.

Table 1. WQROS (Regional Office and Central Office Locations)

	**Address**	**Telephone Number**
Asheville	2090 U.S. 70 Highway, Swannanoa, NC 28778	(828) 296-4500
Fayetteville	225 Green Street, Suite 714 Fayetteville, NC 28301-5043	(910) 433-3300
Mooresville	610 East Center Avenue, Suite 301, Mooresville, NC 28115	(704) 663-1699
Raleigh	3800 Barrett Drive, Raleigh, NC 27609	(919) 791-4200
Washington	943 Washington Square Mall, Washington, NC 27889	(252) 946-6481
Wilmington	127 Cardinal Drive Extension, Wilmington, NC 28405	(910) 796-7215
Winston-Salem	450 West Hanes Mill Road, Suite 300, Winston-Salem, NC 27105	(336) 776-9800
Central Office	1636 Mail Service Center, Raleigh, NC 27699-1636	(919) 707-9129

1.3 Definition of Contamination Incidents

Rule 15A NCAC 02L .0102(4) defines "contaminant" as "*any substance occurring in groundwater in concentrations which exceed the groundwater quality standards specified in Rule 0202 of this Subchapter.*" Contamination incidents will be defined as events, activities, or other causes of increased concentrations of substances or water quality parameters above the 2L Standards. Such contamination incidents require assessment and corrective action to restore groundwater quality as described in 15A NCAC 02L .0106.

1.4 Contamination Incident Management

Contamination incidents requiring assessment and corrective action are managed by different state agencies depending on its origin and their classification as "permitted" or "not permitted" as described in 15A NCAC 02L .0106(c), (d), and (e). Table 2 lists examples of permitted and non-permitted activities where contamination incidents can arise that are managed by the DWR and are specifically addressed in this document. "Non-permitted" activities mean certain activities which may result in exceedances of 2L groundwater quality standards for which a permit has not been issued by the DEQ, or has been designated as "permitted by Rule" or has "deemed permitted" status under current North Carolina Rule or Statute.

Table 2. Examples of DWR Permitted and Non-Permitted Activities Addressed in this Document

Permitted Activities	Non-Permitted Activities
Animal Waste Management	Agricultural Operations - Chemical Fertilizer, Pesticide
Discharge (NPDES)	Naturally Occurring Contamination
Non-Discharge Land Application including Residuals and Spray Irrigation	
Underground Injection Control	
Well Construction	
Wastewater Collection Systems	

For guidance on assessment and remediation of sites under the purview of the DWM, refer to the Memorandum of Agreement of 2007 and to the following DWM websites:

- Contaminant Assessment and Remediation Guidance for Inactive Hazardous Sites - http://portal.ncdenr.org/web/wm/sf/ihs/ihsguide
- UST Section - http://portal.ncdenr.org/web/wm/ust/guidance
- Superfund Section - http://portal.ncdenr.org/web/wm/sf
- Solid Waste - http://portal.ncdenr.org/web/wm/sw
- Hazardous Waste - http://portal.ncdenr.org/web/wm/hw

2. REQUIRED ACTIONS AFTER A DISCHARGE TO SOIL & GROUNDWATER OF THE STATE

2.1 Compliance With 15A NCAC 02L .0106(b)

Rule 15A NCAC 02L .0106 (b) states, *"Any person conducting or controlling an activity that results in the discharge of a waste or hazardous substance or oil to the groundwaters of the State, or in proximity thereto, shall take action upon discovery to terminate and control the discharge, mitigate any hazards resulting from exposure to the pollutants and notify the Department, as defined in 15A NCAC 02C .0102, of the discharge."*

This rule is applicable **to both permitted and non-permitted activities** that result in, or has the potential to result in, an exceedance of the 2L Standards. As stated in 15A NCAC 02L .0106(b), following the discovery of a discharge, the RP is required to take action to terminate and control the discharge, prevent and mitigate any hazards, and notify the DWR of the discharge. For purposes of 15A NCAC 02L .0106 (b), the term "notify the Department" means notification within a 24-hour period unless there are extenuating circumstances documented by the RP. If the release occurs outside of normal business hours, the RP should call the after-hour emergency phone number: 1-800-858-0368 as soon as they can, but within 24 hours of the occurrence of the discharge.

Reporting requirements to the DWR are not a substitute for other reporting requirements by North Carolina General Statute, the Division of Emergency Management, or any other local, state, or federal agency. The procedures to report discharges of untreated wastewater and to publish the notice of discharge of untreated wastewater and waste can be found in G.S. § 143-215.1C The procedure to report discharges of pesticides regulated by the North Carolina Pesticide Board can be found in G.S. § 143-215.85.

After-hour Emergency phone number

1-800-858-0368

Notification of a Discharge to DWR

- Date and time of discovery;
- Phone number of person to be contacted concerning the release;
- Responsible party's name, address, location, phone number, and directions to site;
- Nature of release: type of substance released, quantity released and source of release;
- Document the presence of free product (if known);
- State how the release was discovered (e.g., odors, sample results, staining, etc.);
- Document the action taken to stop the release;
- Document the number of water supply wells within 1,500 feet of the release;
- Any other relevant information pertaining to the release or suspected release.
- Latitude and longitude of release with a precision level within 1 minute.

2.2 Compliance With 15A NCAC 02L .0106(c)

This rule is applicable to contamination incidents resulting from activities which **have not been permitted** by the DWR, including all non-permitted facilities. Non-permitted Incident sites managed by the DWR are those with contamination related to naturally occurring conditions and agricultural activities. All other non-permitted incidents are under the purview of the DWM, per Memorandum of Agreement signed in 2007.

If the release occurs at a time when it is not possible to report the release to the DWR within 24 hours due to weekends or holidays, the morning of the next business day may be acceptable. The RP shall also respond to the incident in accordance with 15A NCAC 02L .0106(f), which is discussed below. The site assessment required to be submitted to the DWR is discussed in Section 3 of this document.

The activities covered under this rule do not have permits and therefore do not have an established waste boundary with the associated review and compliance boundaries (as described under 15A NCAC 02L .0107 and .0108). Consequently, corrective action for groundwater restoration will be the entire site where exceedances of the 2L Standards occur including the source area. Corrective action options are discussed in Section 4 of this document.

Comprehensive Site Assessments (CSAs) and Corrective Action Plans (CAPs) are required to be submitted to the DEQ. However, for non-permitted activities, the RP is also required to submit the CAP to the Health Director and the Chief Administrative Officer of the political jurisdictions of the county or counties where the contamination has occurred in accordance with 15A NCAC 02L .0114. The Chief Administrative Officer would be the Mayor, Chairman of the County Commissioners, the County Manager, the City Manager, or other individual of equal or similar position as appropriate. Notification must be made by certified mail. Renotification will be required if subsequent CAPs or CAP addendums with significant changes to proposed site actions are submitted.

2.3 Compliance With 15A NCAC 02L .0106(d)

This rule is applicable to violations of the 2L Standards where activities are performed under the authority of a permit originally issued by the DWR **on or after December 30, 1983**. Permitted facilities have a defined waste disposal area and review and compliance boundaries that were established at the time of permitting by the DEQ Secretary or DWR Director per 15A NCAC 02L .0107 and .0108. To determine compliance with this rule, the RP may be required to establish a groundwater monitoring network that has a background well (or wells) and down-gradient wells placed at the review boundary and/or compliance boundary. Monitoring frequency of the review boundary wells should be at an appropriate interval to monitor contaminant movement, which is usually quarterly but not less than annually. Monitoring well locations and monitoring frequencies should be agreed upon by the permittee and the applicable DWR Regional Office.

If an exceedance of the 2L Standards is detected at or beyond the review boundary, *"the [RP] shall demonstrate, through predictive calculations or modeling, that natural site conditions, facility design, and operational controls will prevent a violation of standards at the compliance boundary."* The DWR provides

guidance through the Groundwater Modeling Policy regarding predictive calculations and modeling as it pertains to the 15A NCAC 02L and 15A NCAC 02T regulations. Alternately, the RP may submit a plan for alteration of existing site conditions, facility design, or operational controls that will prevent a violation at the compliance boundary, and implement that plan in consultation with the DWR regional office. Although it is not stated in the rule, the RP should notify the applicable DWR Regional Office within 24 hours of detecting the exceedance to coordinate the appropriate response. An exceedance at the review boundary may require additional down-gradient wells to be installed at the compliance boundary. Monitoring well locations and monitoring frequencies should be agreed upon by the permittee and the applicable DWR Regional Office.

If an exceedance occurs at or beyond the compliance boundary, the RP shall respond in accordance with 15A NCAC 02L .0106(f) either prior to or concurrently with the required CSA (discussed below and in Section 3 of this document). A CAP is required following the CSA and is discussed in further detail in Section 4 of this document.

2.4 Compliance With 15A NCAC 02L .0106(e)

This rule is applicable to violations of the 2L Standards at or beyond the compliance boundary where activities are performed under the authority of a permit originally issued by the DWR **prior to December 30, 1983**. The required actions are the same as in Rules 15A NCAC 02L .0106(c)(1) through (4). The activities covered under this Rule are afforded a review and compliance boundary and the focus of the groundwater restoration CAP is the area outside the compliance boundary where exceedances of the 2L Standards occur.

2.5 Compliance With 15A NCAC 02L .0106(f)

This rule describes the initial response actions for activities covered under 15A NCAC 02L .0106(c), (d), and (e). These actions are required to be conducted prior to or concurrent with the preparation of the CSA described in Section 3 of this report.

15A NCAC 02L .0106(f)(1) – Contact the local authorities and fire department immediately if there is a need for the prevention of fire, explosion, or the spread of noxious fumes due to the release.

15A NCAC 02L .0106(f)(2) – Abatement, containment, or control of the migration of contaminants would be to minimize the area of contamination and prevent runoff into surficial water bodies and migration into groundwater.

15A NCAC 02L .0106(f)(3) and (4) – The term “control” means demonstrating the physical ability to direct, restrain, or dominantly influence the contaminated media. In some cases where site conditions preclude the possibility of source remediation and an impermeable barrier exists, the impermeable barrier may be considered to provide control of the secondary contamination sources. It must be demonstrated that an engineered cap will prevent surface water from leaching contaminants from the source area resulting in 2L Standard violations. Conversely, demonstrating complete delineation of all soil contamination and providing an acceptable corrective action for its remediation may satisfy the meaning of control.

3. COMPREHENSIVE SITE ASSESSMENT

A CSA is required for contamination incidents at permitted facilities when groundwater contamination occurs at or beyond a compliance boundary as specified in 15A NCAC 02L .0106(d) and (e), and for activities that result in exceedances of 2L Standards at non-permitted facilities as specified in 15A NCAC 02L .0106(c). For this requirement, the CSA shall follow the format in 15A NCAC 02L .0106 (g), which states that the CSA shall include*, "(1) The source and cause of contamination; (2) Any imminent hazards to public health and safety, as defined in G.S. 130A-2, and any actions taken to mitigate them in accordance with Paragraph (f) of this Rule; (3) All receptors and significant exposure pathways; (4) The horizontal and vertical extent of soil and groundwater contamination and all significant factors affecting contaminant transport; and (5) Geological and hydrogeological features influencing the movement, chemical, and physical character of the contaminants*." To comply with NCAC 02L .0106 (g), it is necessary that the CSA include, at a minimum, the requirements specified in the following sections. The specific format of the CSA is described in Section 3.6 of this document.

3.1 Determination of the Source and Cause of Contamination

15A NCAC 02L .0106 (g) (1) requires that the CSA must determine the source and cause of contamination. Specifically, the RP must determine the spatial extent and nature of the release, the period over which it occurred, and the total estimated mass or volume that entered the environment, including any degradation products. This initial step is an important and necessary part of the overall CSA, particularly in evaluating hazards, receptors, exposure pathways, and horizontal and vertical extent of contamination.

3.2 Actions to Mitigate Hazards to Public Health and Safety

15A NCAC 02L .0160(g)(2) requires that the CSA must include a description of the cause and extent of the release and the initial responses taken and/or intended to be taken to mitigate threats to human health. The objective is to ensure that the environment and the health and safety of all persons, on and off-site, will not be adversely affected by the release, and that corrective actions will be in conformity with all applicable federal and state regulations.

The following information should be included in the CSA:

- A description of the specific measures taken to comply with 15A NCAC 02L .0106(f).
- A copy of the notification of the release to the following:
  - ✓ the local health Director and the chief administrative officer of the local political jurisdictions specified in rule 15A NCAC 02L .0114 (Notification Requirements);
  - ✓ press release, or notification to nearby residents.

3.3 Identification of Receptors and Exposure Pathways

15A NCAC 02L .0106(g)(3) requires the RP to collect information on potential receptors. A receptor map typically includes all public and private water supply wells, public water supply lines, reservoirs, surface water intakes, surface waters, recharge areas, subsurface structures and designated wellhead protection areas within a 1,500-foot radius of the source area. If the map becomes too cluttered, a table listing the potential receptors should be compiled and keyed to their locations labeled on the receptor map.

3.4 Determination of the Extent of Contamination

15A NCAC 02L .0106(g)(4) requires a determination of the horizontal and vertical extent of soil and groundwater contamination. For groundwater, this requires delineation of contaminants to the concentrations specified in 15A NCAC 02L .0202, at a minimum. For soil, this requires delineation of contaminants using the Preliminary Soil Remediation Goals (PSRG) and Transport Model for the Protection of Groundwater[3].

3.4.1) Groundwater Contamination Delineation

Determination of the vertical and horizontal extent of groundwater contamination should begin with an understanding of the site geology and hydrogeology and the development of site conceptual model. It is important to know which way the groundwater is flowing to best positon the wells both up-gradient and down-gradient of the suspected contamination. A discussion of background wells is included in Section 3.4.1.1. Wells should be screened within the different flow regimes and aquifers depending on the geology and hydrogeology of the site (i.e. saprolite, transition zone, and bedrock). An appropriate number of wells should be installed to understand the subsurface heterogeneities and preferential pathways, especially if contamination is suspected in bedrock.

Ideally, to have a complete delineation of contamination, side-gradient and down-gradient well(s) will be placed where sampling demonstrates no detectible concentrations of the suspected contaminants. However, in some cases, the vertical and horizontal extent may not be able to be fully delineated due to obstructions such as buildings, water bodies, site conditions that prevent access with a drill rig, or site access restrictions. In these cases, it may be appropriate to estimate the extent of contamination via groundwater modeling. For more information on groundwater modeling policy and expectations, consult the DWRs Groundwater Modeling Policy.

Different approaches may be appropriate for different site conditions, contaminants, risk to receptors, etc. Final determination of the appropriate delineation option should be coordinated with DWR staff. The regional office may require additional monitoring wells to define the horizontal and vertical extent of contamination. Once determined, the horizontal and vertical extent of contamination is to be illustrated in plan-view and cross-section maps for each contaminant. Each map shall include the location, concentrations, and collection date of the sample collected. Section 3.6. 14 of this document provides information for the preparation of the figures to be included in the CSA.

[3] The PSRG document is listed among the Screening documents in the Risk Evaluation Resources website. Verify that the most updated version is used since the PSRG is updated periodically.

3.4.1.1) Determining Groundwater Background Concentrations

Groundwater at some sites may *naturally* contain constituents[4] at concentrations above the 2L Standards for Class GA, GSA, or GC groundwater. For this reason, it is important for the RP to assess the ambient groundwater quality and distinguish it from groundwater impacted by a site release. Ambient groundwater quality is controlled by local geology and geochemistry and may vary spatially across a site, area, or region. As such, "normal" background concentration ranges for a given constituent may vary considerably from site to site. While published background ranges are useful for general comparisons, the only sure way to determine local background conditions is to collect and analyze ambient samples that are unaffected by site-related or other anthropogenic releases. To the extent possible, background samples should be collected as follows:

- within a hydrogeologic unit similar to that found in the contaminated area,
- hydraulically upgradient and outside the influence of site activities or other contaminant sources,
- in immediate proximity to the site, and
- within the same groundwater horizon (depth/zone) as compliance data.

The number of background wells and samples will be driven in part by the size, geologic complexity, and hydrologic complexity of the site, the potential need for statistical analysis of compliance versus background well data, and (or) other goals of the CSA. Background should be established for each contaminant of concern.

Establishing Background Conditions

- Samples should be collected in immediate proximity to the site,
- A minimum of 10 sample events is recommended for background well datasets used for formal statistical comparison to compliance well datasets,
- Background should be established for each contaminant of concern.
- Background data should be collected and analyzed in a scientifically defensible manner to withstand technical and regulatory scrutiny.

Background conditions will normally be relatively easy to establish. However, at some sites the determination of background may be more difficult. These may include larger, complex sites, or sites where background concentrations are similar to or above the 2L Standards, or permit limits. They may also include sites where the local geology contains the same inorganic constituents as the permitted wastes.

Background data should be collected and analyzed in a scientifically defensible manner to withstand technical and regulatory scrutiny. The publication Evaluating Metals in Groundwater at DWQ Permitted Facilities: A Technical Assistance Document for DWQ Staff should be consulted when determining background concentrations in support of CSA, CAP, and (or) statistical analysis efforts, provided that, when calculating background concentrations, outliers should be treated as specified in ProUCL (2015)(https://19january2017snapshot.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-

[4] Naturally occurring constituents typically include inorganics such as iron, manganese, barium, zinc, strontium, vanadium, the "common ions", and others. Less common naturally occurring constituents include arsenic, uranium, and radium

guide.pdf). The DWR Director is responsible for making a final determination of local background concentrations based on data collected and provided by the RP[5].

3.4.2) Soil Contamination Delineation

Soils that are or were in contact with the waste source can become contaminated as well. Contaminated soil can be a secondary source of groundwater contamination. Hence, 15A NCAC 02L .0106(f) requires removal, treatment, or control of secondary pollution sources that would be potential continuing sources of pollutants to the groundwater, such as contaminated soils and non-aqueous phase liquids.

In addition to defining the lateral extent of contamination in soil, understanding the vertical extent of soil contamination is important for evaluating risks to human health and understanding the potential for soil contamination to leach to groundwater. In general, soil sample analysis for contaminants like some metals, polynuclear aromatic hydrocarbons (PAHs), dioxin, and pesticides should be collected in the top 3 or 4 inches, but most organics, especially volatile organics, and some metals should be collected at a depth of 9 to 12 inches for soils.

Different approaches may be appropriate for different site conditions, contaminants, risk to receptors, etc. Final determination of the appropriate delineation option should be coordinated with DWR staff. The regional office may require additional soil samples to define the horizontal and vertical extent of contamination. Once determined, the horizontal and vertical extent of contamination is to be illustrated in plan-view and cross-section maps for each contaminant. Each map shall include the location, concentrations, and collection date of the sample collected. Section 3.6.1.14 of this document provides information for the preparation of the figures to be included in the CSA.

3.4.2.1) Determining Soil Background Concentrations

Natural background data should be collected within a geologic unit and soil type similar to that found in the contaminated area, from a comparable soil profile depth, hydraulically upgradient and outside the influence of site activities or other contaminant sources, and close to the site.

The EPA publication "Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites" contains information for the characterization of background concentrations and the evaluation of background data sets in comparison to site contamination data that could also be applicable to DWR sites.

3.4.3) Surface Water and Sediment Contamination Delineation

Surface water quality must be adequately assessed to determine compliance with surface water quality standards. In accordance with G.S. 130A-310.68 (b)(2), *"The site-specific remediation standard for surface waters shall be the water quality standards adopted by the Commission"* (15A NCAC 02B "Surface Water and Wetland Standards" [2B Standards]). Consequently, all remedial measures, including risk-based

[5] Rule 15A NCAC 02L .0202(b)(3) indicates that *"Where naturally occurring substances exceed the established standard; the standard shall be the naturally occurring concentration as determined by the Director".*

remedies, need to be designed to ensure that surface water quality criteria are met, and the best uses of the surface waters are protected. For wetlands, both soil/sediment and standing water should be assessed. A "multiple lines of evidence" approach will help the RP assemble the appropriate information to demonstrate that proposed remedies are protective of the 2B Standards.

The RP needs a thorough understanding of the fate and transport of contamination in all media including any points or zones of contaminant discharge to surface water, including potential contaminant degradation products. A conceptual site model should be developed to convey a thorough understanding of the contaminants of concern and their source; the chemical, geological, and hydraulic characteristics of the aquifer; and the extent, transport, and current and future conditions of the contaminant plume to allow critical decision making regarding surface water protection.

If the lines of evidence comprising the conceptual site model suggest that contaminated groundwater has the potential to affect surface water or sediment, then the groundwater contaminant discharge zones and/or the surface water need to be sufficiently characterized as part of the conceptual site model. When such characterization becomes necessary, sampling of discharge zones or surface water and sediment should be of sufficient extent, frequency, and duration to determine, based on multiple lines of evidence, if surface water or sediment is contaminated. Contaminants in the discharging plume may have the potential to accumulate in the bottom sediment, the substrate, or the banks of a surface water body, by sorption, precipitation, accumulation in pore water, or biological activity. In such cases, the human health risks associated with sediment contamination are addressed in the same manner as risks from contaminated soil, whereas risks to ecological receptors will need to be characterized by other methodology.

Groundwater, pore water and sediment samples should be collected from locations spanning the full width of the area where a plume is known or predicted to discharge into a surface water body. In addition, surface water, pore water and sediment samples should be collected from a sufficient number of upstream, downstream or offshore locations to determine whether groundwater is contaminating the surface water and, if so, to understand any attenuation away from the seepage face. The number of samples should be statistically significant to support decisions regarding compliance with the 2B Standards. Seasonal variability in base flow, discharge conditions and potential tidal influences need to be considered when developing a sampling plan.

The DWR's internal guidance "Evaluating Impacts to Surface Water from Discharging Groundwater Plumes" describes a strategy to collect data for the evaluation of contaminated groundwater discharges to surface water. Characterization of the groundwater to surface water pathway at a site is necessary to:

- Determine if corrective action alternatives under 15A NCAC 02L .0106 (k), (l), and (m) may be pursued by evaluating by evaluating if 15A NCAC 02B .0200 (02B) regulatory standards are exceeded in surface water as the result of groundwater discharge, and
- Locate strategic groundwater and surface water sampling locations to support site assessment and remedial action performance monitoring networks.

3.4.3.1) Determining Surface Water and Sediment Background Concentrations

To meet CSA requirements in 15A NCAC 02L .0106(g), surface water sampling may be required by 15A NCAC 02L .0106(k)(5), l(6), and m(2)(c) to document conditions of potentially impacted surface waters. Sampling locations will include likely impacted areas as well as upstream and downstream areas. CSA sampling may include routine groundwater sampling at specified well locations to monitor potential impacts to surface water conditions over time. CSA sampling may also include a focused evaluation in specific areas of surface water that may be potentially impacted. Additional samples may be necessary for verification of surface water impacts. CSA sampling is continued until contamination is delineated and an understanding of site conditions is developed. For more information, refer to the DWR's internal guidance "Evaluating Impacts to Surface Water from Discharging Groundwater Plumes".

3.5 Features Affecting the Fate and Transport of Contaminants

15A NCAC 02L .0106(g)(5) requires identifying and understanding the geologic and hydrogeologic factors that affect contaminant fate and transport which is a critical component of any CSA and CAP. Subsurface contaminant movement depends on the chemical properties of the contaminants and the physical, chemical, and biological characteristics of the site. Fate and transport refers to the physical and chemical nature, solubility/mobility, and movement of a given constituent. Understanding fate and transport is particularly important since it may significantly affect the outcome of groundwater monitoring, groundwater and contaminant transport modeling, human and environmental risk assessment, and corrective action planning. The factors that affect contaminant fate and transport involve physical and (or) chemical processes and generally fall into one of three categories:

- Factors that affect whether the contaminant will be soluble/mobile or insoluble/immobile,
- Factors that affect the rate and direction of groundwater flow, and
- Factors that affect the migration of contaminant mass as it moves through the groundwater flow system.

Each factor affecting contaminant fate and transport is dependent upon local conditions and, to the extent possible, should be evaluated at a site scale and each constituent should be considered individually. The evaluation should be included as part of the CSA. The following publication should be consulted when identifying and evaluating factors that affect fate and transport: Evaluating Metals in Groundwater at DWQ Permitted Facilities: A Technical Assistance Document for DWQ Staff.

3.5.1) Factors that Affect the Solubility/Mobility of a Contaminant

The concentration of a groundwater contaminant will generally decrease as it migrates due to dilution, adsorption to matrix materials, or physical/chemical degradation. The distance over which contaminant concentrations decrease to acceptable levels will depend on the chemical properties of the contaminant, the physical properties of the saturated zone, and the magnitude of the contamination. The following lines of evidence should be used to evaluate groundwater contaminant plume behavior:

- The type of contaminant and its concentration and distribution. In some cases, a contaminant may occur at a high concentration that is saturated with respect to the groundwater system. In this case, the contaminant may precipitate out of solution and become immobile. Also, depending on the type of contaminant, it may degrade to a different "daughter" contaminant (tetrachloroethylene to vinyl chloride, for example) or change its oxidation state to a more mobile/toxic form of the same contaminant (chromium III to chromium VI, for example).
- The type of co-occurring constituents and their concentration and distribution. Co-occurring constituents may affect the contaminant of concern in various ways. Co-occurring constituents may vie for limited sorption sites and thereby result in the desorption and mobility of the contaminant of concern. A soluble co-occurring constituent may, in some cases, serve as a sorptive, mobile host for an otherwise insoluble contaminant that then becomes mobile in groundwater (a colloidal host is one example). And a precipitated co-occurring constituent may, in some cases, serve as a sorptive host for an otherwise soluble contaminant that then becomes immobile in groundwater. In each of these cases, the concentration and characteristics of the groundwater constituents play a role in mobility.
- The geochemical conditions in the subsurface (pH, redox potential, ionic strength, and others)
- The type of solid phase host surfaces available for contaminant retention and their amount and distribution

These factors may be measured and understood through source, leachate, groundwater, and surface water sampling, and sampling of the solid phase of soil, sediment, and core.

3.5.2) Factors Affecting Groundwater Movement

Groundwater movement is controlled by the distribution of hydraulic gradients, hydraulic conductivities, and porosities across the site in porous media, and by the morphology and degree of connectivity of fractures in fractured bedrock settings. Sufficient water level data should be collected to calculate horizontal and vertical gradients and groundwater flow velocities across the property. Consideration should be given to the following physical site characteristics that affect these properties, and thus affect groundwater behavior:

- Local geology and hydrogeology
    - ✓ groundwater flow system framework
    - ✓ groundwater flow horizons and their orientation, thickness, and properties
    - ✓ confining units, if present
    - ✓ basement of flow system
    - ✓ bedrock fractures and other preferential flow zones
    - ✓ lithology
    - ✓ geologic structures
    - ✓ geologic heterogeneities or anomalies
    - ✓

- Site features
  - ✓ Man-made utility conduits
  - ✓ Impervious cover
  - ✓ Surface water impoundments
- Geomorphology
  - ✓ Recharge and discharge environments
  - ✓ Tidal influences to coastal surface waters
- Pumping wells: past, current, future

These factors are important because they influence groundwater velocity, direction, and discharge location. They may be measured and understood by coring, geologic mapping, stream mapping, land use mapping, well installation, water level measurements, aquifer tests, solid phase sampling, and others.

For sites with potentially impacted receptors and sites where data is needed to properly design remediation systems, aquifer pumping tests may be required to determine values of aquifer parameters.

For sites where potential receptors have not been identified, an aquifer pumping test may not be required to obtain estimated values for hydraulic conductivity (K) and transmissivity (T). In these cases, an alternative means for estimating aquifer characteristics may be adequate. For example, it may be acceptable at some sites to perform textural analysis on soil samples collected from the zone(s) of contamination and to base conservative estimates of aquifer characteristics on published values of K corresponding to the soil types present. Any observed soil or relict rock structures should be considered for potential effects on contaminant transport. In addition, there are several sources of scientific literature that provide methodologies for estimating K from grain size distribution data.

Alternatively, or in addition to soil data, the use of slug test data may be used to estimate K in the immediate vicinity of the tested well. It is important to recognize for assessment and monitoring purposes that dissolved contamination generally migrates in the most transmissive media. Therefore, slug tests should be conducted in the zone(s) through which contamination is migrating. For aquifers with significant heterogeneity, several slug tests should be performed to obtain a range of values for contaminant transport rates.

3.5.3) Factors Affecting the Migration of Contaminant Mass

Factors that affect contaminant mass flow rate and direction as it moves through the groundwater system include:

- solubility/mobility of the contaminant along the flow path
- groundwater flow rate and direction
- distribution of the contaminant source and its release history
- the type and volume of contaminant released
- porosity, bulk density, and other properties of the subsurface

Each of these factors may influence contaminant mass and time it takes to reach a given receptor, such as a supply well or receiving stream. These factors may be understood by reviewing site records, collecting solid phase samples, conducting groundwater modeling, and others.

If natural attenuation is being considered as a possible remedial alternative, then the RP should collect all the necessary geochemical data during the site assessment phase of work. When groundwater monitoring wells are being installed, consider taking soil samples from the vadose zone and rock cores to have analyzed for geochemical parameters. Another consideration is collecting this data along groundwater flow paths or transects. This can aid in the development of groundwater models developed for the CAP and could save the RP from having to re-mobilize drilling rigs to the site later to collect data to support remedial design.

3.6 Deliverables: CSA

The elements to be included below are for CSAs required in response to any contamination incident resulting from a DWR permitted or non-permitted activity. CSAs in response to other DEQ permitted or non-permitted activities may be required by the individual agency to have different content.

The CSA Report must be submitted to the appropriate regional office as soon as practicable or in accordance with a schedule established by the DWR. The DWR Regional Offices will review the CSA and may request additional information be provided to support the CSA and aid in their review. Once the Regional Office has determined that the CSA is sufficient, the RP will be required to proceed with preparation and submission of the CAP, as appropriate.

For contamination incidents resulting from DWR permitted and non-permitted activities, the CSA must include, at a minimum, the information listed below.

3.6.1) Title Page

1. Site name, location, groundwater incident number (if assigned), permit number;
2. Date of report;
3. RP and/or permittee, including address and phone number;
4. Current property owner including address and phone number;
5. Consultant/contractor information including address and phone number;
6. Latitude and longitude of the contaminated site; and
7. Seal and signature of NC-certified P.E. or P.G., as appropriate.

3.6. 2) Executive Summary

The Executive Summary should provide an overview of the pertinent site information to acquaint the reader with the who, what, when, where, why and how for site activities to date.

1. Source information
    - Type of contaminants
    - Source of the release

- Amount of release (volume, estimated or known)

2. Initial abatement/emergency response information.
3. Receptor information
   - Water supply wells;
   - Public water supplies (wells, surface water intakes, supply lines);
   - Surface water bodies;
   - Wellhead protection areas;
   - Subsurface structures
   - Land use.
4. Sampling/investigation results:
   - Nature and extent of contamination;
   - Maximum contaminant concentrations;
   - Site hydrogeology.
5. Conclusions and recommendations.

3.6. 3) Table of Contents

1. First page number for each section listed.
2. List of figures (all referenced by number and placed in a single section following contents text).
3. List of tables (all referenced by number and placed in a single section following contents text).
4. List of appendices.

3.6. 4) Site History and Source Characterization

1. Provide a history of property ownership and use. Indicate dates of ownership, uses of the site, and potential sources of contaminants.
2. Discuss the source(s) of contamination, including primary and secondary sources.
3. Indicate the land use processes occurring onsite. (i.e. manufacturing, agricultural, or industrial)
4. For permitted activities, describe nature of activity, permitted waste, application of all instances of over-application/irrigation of wastes or water. If applicable, indicate the estimated volume of the release.
5. Summarize assessment activities and corrective actions performed to date including emergency response, initial abatement, primary and secondary source removal.
6. Discuss geographical setting and present/future surrounding land uses.

3.6. 5) Receptor Information

1. Provide a site map showing labeled well locations within a minimum of 1,500 feet of the known extent of contamination. Key to the table and maps described.

Note: *As the known extent of contamination changes, the receptor survey must be updated to reflect the change. This applies throughout the Receptor Information section.*

2. In table format, list all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1,500 feet of the known extent of contamination. Note whether well users are also served by a municipal water supply.
3. For each well, include:
    a. well owner and user names, addresses and telephone numbers,
    b. If known, indicate the well number (or name), use of the well, well depth, well casing depth, well screen interval, and distance from source of contamination.

Note: *It will often be necessary to conduct any or all of the following in order to ensure reliability in a water supply well survey:*

- Call the city/county water department to inquire about city water connections;
- Visit door-to-door (make sure that you introduce yourself and state your purpose to residents prior to examining their property) to obtain accurate description of water usage, and if some residents are not at home, ask surrounding neighbors about the water usage at those residences. Even if a public water line is available, some residents still use their well water and/or are not connected to the public water system; and
- Search for water meters and well houses.

4. Site map showing location of subsurface public and private structures (e.g., sewers, utilities, conduits, basements, septic tanks, drain fields, etc.) within a minimum of 1,500 feet of the known extent of contamination;
5. Table of surrounding property owner addresses;
6. Discuss the availability of public water supplies within a minimum of 1,500 feet of the source area, including the distance and location to the nearest public water lines and the source(s) of the public water supply;
7. Identify all surface water bodies (e.g., ditch, pond, stream, lake, river) within a minimum of 1,500 feet of the source of contamination;
8. Determine the location of any designated wellhead protection areas as defined in the Safe Drinking Water Act: 42 U.S. Code § 300h–7 within a minimum of 1,500 feet of the source of contamination. Identify and discuss the location of the water supply well(s) for which the area was designated a wellhead protection area, and the extent of the protected area. Include information about the well owner, well-construction specifications (especially at screened intervals), pumping rate and pumping schedule. Information regarding designated wellhead protection areas may be obtained by contacting the DWR's Public Water Supply Section at 919-707-9100;

9. Discuss the uses and activities (involving possible human exposure to contamination) that could occur at the site and adjacent properties. Examples of such activities and uses include but are not limited to use of a property for an office, manufacturing operation, residence, store, school, gardening or farming activities, recreational activities, or undeveloped land;
10. For contamination in the Coastal Plain, determine whether the incident is in an area where there is recharge to an unconfined or semi-confined aquifers that is being used or may be used as a source of drinking water. Identify and describe the aquifers below and, if applicable, above the source of contamination based on a review of scientific literature on the regional hydrogeology and well construction records and lithological logs for wells in the area. All aquifers below the surficial aquifer may not be necessary for analysis. DWR Regional Office Staff will provide specific guidance for the unique circumstances of each incident.
    - Include information on the depth of each aquifer below land surface, including the lithology, hydraulic conductivity, and the difference in hydraulic head between the surficial aquifer and each subsequently deeper aquifer as may be dictated by the scope of the investigation;
    - Include the occurrence and orientation of any preferred pathways that may influence contaminant migration;
    - Discuss the local and regional usage and the draw down from major pumping influences for each aquifer as may be dictated by the scope of the investigation;
    - Specify the distance from the source of contamination to major discharge areas such as streams and rivers. Cite all sources and references used for this discussion;
    - Specify if site is an area that may be effected by tidal influences.

3.6. 6) Regional Geology and Hydrogeology

Provide a brief overview of the regional geology and hydrogeology that includes details on major aquifers, confining units, hydraulic head, structural features like faults, intrusions, and subsurface geologic features. Cite all references.

3.6. 7) Site Geology and Hydrogeology

Describe the soil and geology encountered at the site. Use the information obtained during assessment activities such as lithological descriptions made during drilling, probe surveys, etc. This information should correspond to the geologic cross sections required in Section 3.6. 14 (Maps and Figures). Based on the results of the groundwater investigation, describe the site hydrogeology, including a discussion of groundwater flow direction, hydraulic gradient, hydraulic conductivity and groundwater velocity. Discuss the effects of the geologic and hydrogeological characteristics on the migration, retardation, and attenuation of contaminants.

3.6. 8) Soil and Sediment Sampling Results

Using figures and tables to the extent possible, describe all sampling performed to date and provide the rationale for sample locations, number of samples collected, etc. Include the following information:

1. Location of samples;
2. Date of sampling;
3. Type of samples (from excavation, borehole, Geoprobe, etc.);
4. Sample collection procedures (split spoon, grab, hand auger, etc.)
5. Depth of samples below land surface;
6. Sample identification
7. Types of sample analyses performed;
8. Sample laboratory analytical results (the laboratory reports should list any contaminant detected above the method detection limit and the laboratory detection limit); and
9. Identify any sample analytical results that exceed the applicable cleanup levels (refer to Preliminary Soil Remediation Goals (PSRG) and Transport Model for the Protection of Groundwater)

Note: *Information provided for this section should correspond to the sampling location and sampling results maps required in Section 3.6. 14 (Maps and Figures).*

3.6. 9) Groundwater and Surface Water Sampling Results

Using maps, figures and tables to the extent possible, describe the groundwater and surface water sampling performed to date and provide the rationale for sample locations based on source and contaminant type, number of samples collected, etc. Include the following information:

1. Location of water samples and monitoring wells;
2. Date of sampling;
3. Sample collection procedures (bailer, pump, etc.);
4. Sample identification and whether samples were collected during initial abatement, CSA, etc.;
5. Types of sample analyses performed;
6. Sample laboratory analytical results (the laboratory report should list any contaminant detected above the method detection limit and the laboratory detection limit; and
7. Identify all sample analytical results that exceed the (2L Standards and 2B Standards including any constituents with Interim Maximum Allowable Concentrations[IMACs]).

Note: *Information provided for this section should correspond to the sampling location and sampling results maps required in Section 3.6. 14 (Maps and Figures).*

3.6. 10) Hydrogeological Investigation

Describe the hydrogeological investigation performed including all methods, procedures and calculations used to characterize site hydrogeological conditions. The following information should be discussed (use maps, figures, and tables to the extent possible):

1. Groundwater flow direction;
2. Hydraulic gradient (horizontal and vertical);
3. Hydraulic conductivity;

4. Groundwater velocity;
5. Contaminant velocity;
6. Slug test results;
7. Aquifer test results;
8. Plume's physical and chemical characterization; and
9. Fracture-trace study if groundwater in bedrock is impacted.

3.6. 11) Groundwater Modeling Results

Groundwater modeling or predictive calculations may be necessary at some sites to verify, based on site specific hydrogeological conditions, whether groundwater contamination poses a risk to receptors and to determine an appropriate cleanup level. Modeling should illustrate the input data used to complete the model and will generally be required for natural attenuation proposals. The criteria to be used when modeling groundwater flow and contaminant transport can be found at the Division's Groundwater Modeling Policy and in Section 4.3.4 *(*Modeling of Contaminant Fate and Transport*).*

Note: *Input data for models should be derived from site specific information with limited assumptions or estimates. All assumptions and estimated values including degradation rates must be conservative (predict reasonable worst-case scenarios) and must be well documented.*

3.6. 12) Discussion

1. Nature and extent of contamination, including primary and secondary source areas, and impacted groundwater and surface water resources;
2. Maximum contaminant concentrations;
3. Contaminant migration and potentially affected receptors

3.6. 13) Conclusions and Recommendations

If corrective action will be necessary, provide a preliminary evaluation and discussion of remediation alternatives appropriate for the site. Note that for impacts to groundwater associated with permitted activities in paragraph 15A NCAC 2L .0106(d), corrective action pursuant to 15A NCAC 2L .0106(k), (l) and (m) may not be applicable, unless provided for pursuant to 15A NCAC 2L .0106(c) or through a variance from the Environmental Management Commission (EMC).

3.6. 14) Maps and Figures

1. A 7.5-minute USGS topographic quadrangle map showing an area within a minimum of a 1,500-foot radius of the source of contamination and depicting the site location, all water supply wells, public water supplies, surface water intakes, surface water bodies, designated well head protection areas, and areas of recharge to deeper aquifers in the Coastal Plain that are or may be used as a source for drinking water;

2. Site map identifying the locations of source areas, site boundaries, buildings, all water supply wells within a minimum of 1,500 feet, named roads/easements/right-of-way, subsurface utilities, product or chemical storage areas, basements and adjacent properties, scale and north arrow;
3. At least two geologic cross sections through the saturated and unsaturated zones intersecting at or near right angles through the contaminated area using a reasonable vertical exaggeration. Indicate monitoring well/sample boring/sample locations and analytical results for soil samples. Identify the depth to the water table. Provide a site plan showing the locations of the cross sections;

4. Site map(s) showing the monitoring wells.
5. Site map(s) showing the elevation of groundwater in the monitoring wells and the direction of groundwater flow. Contour the groundwater elevations. Identify and locate the vertical datum (arbitrary 100', USGS, NGVD) or benchmark. Indicate the dates that water level measurements were made. There should be one map for each series of water level measurements obtained;
6. Site map(s) showing the results of all soil sampling conducted. Indicate sampling identifications, sampling depths, locations and analytical results;
7. Site map(s) showing the results of all groundwater sampling conducted. Indicate sampling locations, monitoring well identifications, sample identifications, and analytical results;
8. Groundwater contaminant iso-concentration contour maps in plan view. Contour line for applicable 2L standard should be shown in bold; and
9. Groundwater contaminant iso-concentration contour cross-sections.

Note*: If possible, use a single base map to prepare site maps using a map scale of 1 inch = 40 feet (or a smaller scale for large sites, if necessary). Maps and figures should include conventional symbols, notations, labeling, legends, scales, and north arrows and should conform to generally accepted practices of map presentation such as those enumerated in the US Geological Survey pamphlet, "Topographic Maps".*

3.6. 15) Tables

1. List all water supply wells, public or private, including irrigation wells and unused wells, (omit those that have been properly abandoned in accordance with 15A NCAC 2C .0100) within a minimum of 1,500 feet of the known extent of contamination. For each well, include the well number (may use the tax map number), well owner and user names, addresses and telephone numbers, use of the well, well depth, well casing depth, well screen interval and distance from the source of contamination;
2. List the names and addresses of property owners and occupants within or contiguous to the area containing contamination and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate;
3. List for each monitoring well, the monitoring well identification numbers, date water levels were obtained, elevations of the water levels, the land surface, top of the well casing, screened interval and bottom of the well.

4. List the results for groundwater samples collected including sample location; date of sampling; sample collection procedures (bailer, pump, etc.); sample identifications; sample analyses; laboratory detection limits; and sample analytical results (list any contaminant detected above the method detection limit in bold);
5. For facilities with an existing monitoring well network sampled as part of permit requirements, include a table of all historical groundwater monitoring data;
6. List the results for soil samples collected including sample location; date of sampling; sample collection procedures; sample identifications; sample analyses; laboratory detection limits; and sample analytical results (list any contaminant detected above the method detection limit in bold);

3.6. 16) Appendices

1. Boring logs and lithological descriptions;
2. Well construction records;
3. Standard procedures used at site for sampling, field equipment decontamination, field screening, etc.;
4. Laboratory reports and chain-of-custody documents;
5. Copies of any permits or certificates obtained, permit number, permitting agency, and
6. Slug/pumping test data; and
7. Certification form for CSA (E3.1 Certification for the Submittal of a Site Assessment (CSA).

4. CORRECTIVE ACTION

The purpose of a CAP is to propose a remediation strategy for the cleanup of contaminated media based on the information gathered and knowledge gained from the CSA. Thus, it is extremely important to make sure that all of the site geologic, hydrogeologic, and geochemical information necessary to support the selected remedial option in the CAP was gathered and presented in the CSA.

4.1 Risk-Based vs. Non-Risk-Based Remediation

Selection of a path for remediation begins with a choice between pursuing a risk-based or non-risk-based approach. The RP should contact the appropriate DWR Regional Office to discuss these two options before proceeding with preparing the CAP.

4.1.1) Risk-Based Option

In 2015, House Bill 765 proposed amendments to many session laws, including G.S. 130A 310.68 through 310.77, that expanded the risk-based remediation option to include virtually all regulated sites, except those subject to remediation pursuant to the Coal Ash Management Act of 2014 and the requirements of animal waste management systems. Risk-based remediation allows calculation of site-specific cleanup levels that are designed to protect public health and the environment based on the current and anticipated future use of a property. A guidance document *"Technical Guidance for Risk-based Environmental Remediation of Sites"* has been prepared to assist the public and state agency staff with

the regulatory expectations associated with risk-based remediation of environmental contamination incidents.

It should be noted that, for risk-based remediation, a formal CAP is not required; however, certain documents will need to be submitted to DEQ such as:

- Owner permission forms
- Draft Notice of Intent to Remediate
- Mailing List
- Fee estimate worksheet
- A site map showing the extent of contamination, sample points, and owners and usage of adjoining properties.

Refer to the following DEQ website for more information on the risk-based remediation option: *https://deq.nc.gov/permits-regulations/risk-based-remediation*.

4.1.2) Non-Risk Based Option

The non-risk-based option requires site cleanup to the 2L Standards or natural background levels that will allow any future use of the property ("non-restrictive" use), including residential use. Corrective action for non-risk-based sites may include active remediation, passive remediation, MNA, or some combination of these. Active remediation includes methods such as groundwater extraction, pump and treat, or injection. Passive remediation includes methods such as permeable reactive barriers and grout curtains. The ultimate goal of corrective action under the 2L Rules, with the exception of corrective action under 15A NCAC 02L .0106(k), is to bring soil and groundwater contaminant concentrations to below applicable 2L standards ("non-restrictive" use of the resource), regardless of whether active or passive remediation is utilized.

Pursuing corrective action under the 2L Rules will require the submittal of a CAP. Requirements for a CAP are presented under Section *4.3* of this document.

4.2 Monitored Natural Attenuation (MNA)

MNA relies on natural processes to decrease or "attenuate" concentrations of contaminants in soil and groundwater. Those processes are different for organic and inorganic contaminants. *Organics* attenuate primarily through biodegradation to less toxic daughter constituents while *inorganic*s attenuate primarily through other mechanisms such as dispersion, sorption, and, in some cases precipitation or co-precipitation. MNA can be approved for bedrock and soil, but only under certain circumstances as discussed in the following subsections.

It is recommended that this section in MNA be consulted along with the following documents (Monitored Natural Attenuation Guidelines):

1) MNA for organic contaminants: The Division of Environmental Management "15A NCAC 2L Implementation Guidance" published in December 1995. This document provides direction on the implementation of selected sections of 02L, including 02L .0106 (l) (MNA) for organics.
2) MNA for inorganic contaminants: The Division of Water Resources "Monitored Natural Attenuation for Inorganic Contaminants in Groundwater: Guidance for Developing Corrective Action Plans Pursuant to NCAC 15A .0106 (l)", published in 2017.

4.2.1) MNA in Bedrock

Approval may be granted for some sites where no potential receptors are identified on a case-by case basis and if all of the following conditions are met:

- The CAP certifies that contamination exceeding the 2L Standards is not predicted to migrate beyond an established compliance boundary;
- Implementation of the CAP will not result in impacts to receptors or surface water;
- The CSA demonstrates a knowledge of where the contamination is located in the subsurface;
- The CAP proposes a monitoring plan sufficient to tract the migration of the plume and to sever as a warning system to protect potential receptors; and
- Public notification has been made to all owners and occupants of properties that could potentially impacted by the migration of the plume.

4.2.2) MNA of Soil

MNA of soil contamination may be approved if all of the following conditions apply:

- The soil contamination has not caused groundwater contamination concentrations to exceed the 2L Standards;
- Leachate from the contaminated soil is not predicted to create a 2L Standard violation at any time in the future;
- The contaminant has the capacity to degrade or attenuate under site specific conditions;
- Soil remediation by other methods is not economically reasonable or technically feasible due to site conditions and/or the nature of the contaminant; and
- The contaminated soil will not pose a threat to human health due to soil ingestion, inhalation, or absorption through skin contact.

4.3 Non-Risk-Based CAP Requirements Under the 2L Rules

Specific content of a CAP is presented in Section 4.6 of this document. However, in general, CAPs shall include:

- A description of the proposed corrective action and the reasons for its selection;
- Specific plans, including engineering details where applicable, for restoring groundwater quality;
- A schedule for the implementation and operation of the proposed plan; and

- A monitoring plan for evaluating the effectiveness of the proposed corrective action and the movement of the contaminant plume.

Once received, staff will review the CAP submittal for completeness and provide feedback if clarification or additional information is needed. The regional office may deny approval of the CAP if any of the elements specified have not been included or have not been adequately addressed. The regional office will not approve the CAP until it is determined that the report is complete. When a complete and appropriate CAP has been received, staff will recommend it to the Secretary of the DEQ, or his delegate, for approval. The approval of any CAP does not preclude the need to obtain permits for remedial actions, when applicable. Staff of the DWR can provide specific guidance as needed. Questions regarding technical aspects of CSA or CAP should be directed to the appropriate regional office or central office.

The DEQ Secretary must evaluate the CAP and consider the following:

- The extent of any violations,
- The extent of any threat to human health or safety,
- The extent of damage or potential adverse impact to the environment,
- The time and costs estimated to achieve groundwater quality restoration, and
- The public and economic benefits to be derived from groundwater quality restoration

The following subsections describe the requirements for CAPs submitted under the 2L Rules.

4.3.1)15A NCAC 02L .0106(j)

This rule applies to DWR permitted and non-permitted activities and allows for corrective action to be done by active or passive remediation. Corrective action shall be implemented using a remedial technology demonstrated to provide the most effective means for restoration of groundwater quality to the 2L Standards taking into consideration the site-specific geological and hydrogeological conditions. However, per 15A NCAC 02L .0106(o), if at any time the Secretary determines that a new technology is available that would remediate the contaminated groundwater to the 2L Standards, the Secretary may require the RP to evaluate the economic and technological feasibility of implementing the new technology in an active groundwater CAP in accordance with a schedule established by the Secretary.

4.3.2)15A NCAC 02L .0106(k)

This rule applies to non-permitted DWR activities and activities permitted prior to December 30, 1983 and provides a means by which a RP may seek approval to actively remediate groundwater to a level other than the 2L Standards. The CAP must present a listing of proposed alternate cleanup levels during the active remediation phase for all contaminants detected above the 2L Standards. Once these levels are achieved, active remedial actions may terminate.

The CAP submitted under this rule must include a description of site-specific conditions; however, reference to previously-submitted reports (such as the CSA) is acceptable. All historical sampling data should be summarized and presented in figures and tables. Documentation that groundwater in the area

of the plume has not been identified for future use or development by a state or local government planning process must be included. The CAP must also include information on the availability of public water supplies in the affected area can be obtained from the DWR Public Water Supply Section.

A CAP requested under this rule shall demonstrate all of the following:

- That all sources of contamination have been removed or controlled pursuant to 15A NCAC 02L .0106(f). Demonstrating complete delineation of the soil contamination and secondary sources of contamination and providing an acceptable plan for the remediation or control of all sources may satisfy the meaning of "controlled" as it pertains to this rule;
- That the time and direction of contaminant travel can be predicted with reasonable certainty. The technical basis for the determination of rate and direction of groundwater flow used in modeling and/or calculations must be provided. The direction of contaminant transport should be predicted based on groundwater hydraulic head measurements and should take all nearby pumping and recharge and discharge influences into account. The rate of contaminant transport should be estimated directly from empirical site data or predicted using an appropriate model following the guidance provided in the Division's Groundwater Modeling Policy and in Section 4.3.4 *(*Modeling of Contaminant Fate and Transport*)*. Site monitoring will be required to determine if natural attenuation is occurring and to test the validity of the site conceptual model;
- That the contaminants have and will not migrate onto adjacent properties unless the adjacent property owners have provided written consent for the trespass, or the adjacent properties are served by a public water supply system that is isolated from the contamination. To be considered for approval, the CAP must demonstrate that at least one of the three conditions described under 15A NCAC 02L .0106(k)(3) is true. The term "served" means connected to an approved public water supply. Suitable water supplies must meet the regulatory definition of a public water supply and be approved by the DWR Public Water Supply Section. Documentation, preferably a letter from the utility company, should be provided indicating which households are on public water. The CAP must certify that public water supply is dependent on surface waters or hydraulically isolated groundwater, as applicable.

  A map must be provided that shows the current plume boundary as well as all adjacent properties and those down gradient properties where the plume is expected to migrate. Any supply wells on those properties must be located on the map. An indication of which properties are predicted to be impacted and the technical basis for this determination must also be provided. In addition, a map must be provided that shows the predicted maximum extent of the contaminant plume. When applicable under 15A NCAC 02L .0106(k)(3)(B), the CAP must include documentation of the property owner's written consent allowing contamination to migrate onto their property;

- That the 2L Standards will be met at a location no closer than one year time of travel up-gradient of an existing or foreseeable receptor, based on travel time and the natural attenuation capacity of subsurface materials or on a physical barrier to groundwater migration that exists or will be installed by the RP. All existing and foreseeable receptors must be identified on the base map. Receptors may include but are not limited to utility lines, public and domestic water supply wells,

surface waters, and regions of groundwater that have been identified for planned resource development by state or local governments;

- That, if the contaminant plume is expected to intercept surface waters, the groundwater discharge will not possess contaminant concentrations that would result in 2B Standards violations. If the contaminated groundwater plume is predicted to discharge to surface waters, the CAP must document the technical basis for predicting that such discharge will not result in 2B Standards violations. The classification of the surface water body must also be included in the CAP. If the contaminant plume is already discharging to surface water, the CAP should include recent laboratory analytical results from that surface water body. Samples should be collected upstream and downstream of the discharge area, if applicable. All surface water quality data should be provided in table format with a map of sample locations, laboratory reports, and chain-of-custody forms attached;
- That public notice of the request has been provided in accordance with 15A NCAC 02L .0114; and
- That the proposed CAP would be consistent with all other environmental laws.

4.3.3)15A NCAC 02L .0106(l)

This rule applies to non-permitted DWR activities and activities permitted prior to December 30, 1983 and allows for natural attenuation of contaminated groundwater until the affected groundwater conforms to the 2L Standards. The rule does not apply to sites requiring any ongoing active groundwater remediation. However, for sites which have already undergone active groundwater remediation and which meet the criteria of this rule, approval may be requested to remediate the remaining contamination by natural attenuation.

Documentation that groundwater in the area of the plume has not been identified for future use or development by a state or local government planning process must be included. To be granted approval to remediate any site by natural attenuation, it must be demonstrated to the satisfaction of the Director that the contaminant(s) in question can be remediated to their 2L Standards within an acceptable period of time. The period of time considered acceptable for remediation will depend on a number of site-specific parameters; therefore, it will vary between sites. The CAP should include an estimate of the approximate amount of time it will take for natural attenuation to render groundwater quality at the site to achieve compliance with applicable 2L groundwater quality standards.

A CAP requested under this rule shall demonstrate all of the following:

- That all sources of contamination have been removed or controlled pursuant to 15A NCAC 02L .0106(f). Demonstrating complete delineation of the soil contamination and secondary sources of contamination and providing an acceptable plan for the remediation or control of all sources may satisfy the meaning of “controlled” as it pertains to this rule;
- That the contaminant has the capacity to degrade or attenuate under site-specific conditions. Please refer to the DWR’s Monitored Natural Attenuation Guidelines (1995 for organics and 2017 for inorganics).

- That the time and direction of contaminant travel can be predicted based on based on subsurface conditions and the contaminant's physical and chemical properties. The direction of contaminant transport should be predicted based on groundwater hydraulic head measurements and should consider all nearby pumping and recharge and discharge influences. The technical basis for determining values for aquifer parameters used in modeling of contaminant transport must be provided. The rate of contaminant transport should be estimated directly from empirical site data or predicted using an appropriate model. Please refer to the DWR's Groundwater Modeling Policy;
- That contaminant migration will not result in any violations of the 2L Standards at any existing or foreseeable receptors. All existing and foreseeable receptors must be identified on the base map. Receptors may include but are not limited to utility lines, public and domestic water supply wells, surface waters, and regions of groundwater that have been identified for planned resource development by state or local governments;
- That the contaminants have not and will not migrate onto adjacent properties. To be considered for approval, the CAP must demonstrate that at least one of the three conditions described under 15A NCAC 02L .0106(l)(5) is true. The term "served" means connected to an approved public water supply. Suitable water supplies must meet the regulatory definition of a public water supply and be approved by the DWR Public Water Supply Section. Documentation, preferably a letter from the utility company, should be provided indicating which households are on public water. The CAP must certify that public water supply is dependent on surface waters or hydraulically isolated groundwater, as applicable.

  Provide a map showing the current and predicted plume boundary as well as all adjacent properties and those down gradient properties where the plume is expected to migrate (the map shall depict the predicted maximum extent of the contaminant plume). Any supply wells on those properties must be located on the map. An indication of which properties are predicted to be impacted and the technical basis for this determination must also be provided. When applicable under 15A NCAC 02L .0106(k)(3)(B), the CAP must include documentation of the property owner's written consent allowing contamination to migrate onto their property;

- That, if the contaminant plume is expected to intercept surface waters, the groundwater discharge will not result in contaminant concentrations that would result in 2B Standards violations. If the contaminated groundwater plume is predicted to discharge to surface waters, the CAP must document the technical basis for predicting that such discharge will not result in 2B Standards violations. The classification of the surface water body must also be included in the CAP. If the contaminant plume is already discharging to surface water, the CAP should include recent laboratory analytical results from that surface water body. Samples should be collected upstream and downstream of the discharge area, if applicable. All surface water quality data should be provided in table format with a map of sample locations, laboratory reports, and chain-of-custody forms attached;

- That the person making the request will put in place a groundwater monitoring program that, based on subsurface conditions and the physical and chemical properties of the contaminant, will accurately track the degradation and attenuation of contaminants and contaminant by products within and down gradient of the plume and to detect contaminants and contaminant by products prior to their reaching any existing or foreseeable receptor at least one year's time of travel up-gradient of the receptor and no greater than the distance the groundwater at the contaminated site is predicted to travel in five years. Monitoring requirements are spelled out under 15A NCAC 02L .0110. A further discussion of monitoring plans is included in Section 5 of this document.
- That all necessary access agreements needed to monitor groundwater quality pursuant to 15A NCAC 02L .0106(l)(7) have been or can be obtained. If property owners will not grant access, please contact the applicable DWR Regional Office to determine how to proceed.
- That public notice of the request has been provided in accordance with 15A NCAC 02L .0114(b); and
- That the proposed CAP would be consistent with all other environmental laws.

4.3.4) Modeling of Contaminant Fate and Transport

Contaminant fate and transport calculations or computer modeling will often be necessary to predict plume migration. This is particularly important if it cannot be demonstrated that the rate at which contaminants are entering the dissolved phase has reached steady-state equilibrium with natural attenuation processes and that the plume is not expanding. Predictive calculation or modeling will be used to provide assurance that potential receptors will not be impacted, that monitoring plans are adequate to track plume migration, and that all potentially impacted parties are identified and notified as required under 15A NCAC 02L .0114.

The contaminants of concern must be chosen so that the behavior of the entire plume can be modeled conservatively based on those compounds. Modeling contaminant transport requires identification of the distribution and concentrations or mass fraction of the contaminants of concern for any residual contaminated soil, aquifer material, or free product present at the site. The concentration of the contaminants of concern may be used to calculate leachate concentrations and to predict contaminant fate and transport using analytical or numerical (computer) models. A decaying source may be used in numerical models to simulate a source area which is undergoing remediation.

Because all models are based on simplifying assumptions about the site, implementation of CAPs based on modeling will rely on site monitoring. The monitoring network will provide an early warning system and will provide data necessary to evaluate the accuracy of model predictions. Computer modeling efforts must be well documented to be considered acceptable. At a minimum, this documentation must include:

- The name, version, and developer of the model,
- The type of sites for which the model was designed and/or is applicable,
- Critical assumptions inherent to the model,
- Critical conceptual assumptions and estimates of input values made by the modeler,

- A description of the range of values used and the results of sensitivity analysis on critical data inputs to the model, and
- A graphical representation and narrative explanation of the modeling results.

***Note**: All assumptions and estimated values must be documented in the CAP to be conservative. Conservative estimates are values that predict worst-case scenarios. The RP is encouraged to obtain on-site measurements of as many model input parameters as possible.*

The DWR provides guidance through the Groundwater Modeling Policy regarding predictive calculations and modeling as it pertains to the 15A NCAC 02L and 15A NCAC 02T regulations. The policy has a dual purpose:

- Provide guidance to investigators in selecting and using appropriate groundwater models for both permitted sites and incident investigations; and
- Provide guidance for regulators to use in evaluating the adequacy of groundwater modeling results submitted by investigators.

4.4 Deliverables: CAP

The elements to be included below are for CAPs in response to any contamination incident resulting from a DWR permitted or non-permitted activity. CAPs in response to other DEQ permitted or non-permitted activities may be required by the individual agency to have different content.

4.4.1) Minimum Elements of the CAP Report

4.4.1.1) Title Page

1. Site name, location, and groundwater incident number (if assigned), permit number
2. Date of report;
3. RP and/or permittee including address and phone number;
4. Current property owner information, including address and phone number;
5. Consultant/contractor information, including address and phone number;
6. Contaminant release information including date discovered, estimated quantity, cause of release, and source of release;
7. Latitude and longitude of the contaminated site; and
8. Seal and signature of certifying P.E. or L.G., as appropriate.

4.4.1.2) Executive Summary

The Executive Summary should provide a brief overview of the pertinent site information (i.e., provide sufficient information to acquaint the reader with the who, what, when, where, why, and how for site activities to date).

1. Source information
    - Type of contaminants;
    - Source of contamination; and
    - Amount of contaminant release (volume, estimated or known).
2. Initial abatement/emergency response information:
    - How release was controlled;
    - Soil removal, quantity, and disposition; and
    - Free product removal.
3. Sampling/investigation results:
    - Nature and extent of contamination;
    - Maximum contaminant concentrations; and
    - Applicable soil cleanup levels.
4. Proposed remedy for soil and groundwater contamination
    - Selected remedy; and
    - Schedule for implementation.

4.4.1.3) Table of Contents

1. List each section with page numbers.
2. List of figures (all referenced by number and placed in a single section following content text).
3. List of tables (all referenced by number and placed in a single section following contents text).
4. List of appendices.

4.4.1.4) Introduction

1. Background, purpose, and scope of CAP (e.g., response to Notice of Violation (NOV), remediation of soil, groundwater, surface water, vapors, etc.)
    - State cause and source(s) of contamination;
    - Discuss the cleanup levels that apply to the discharge or release and describe how the cleanup levels were determined;
    - State the contaminants that exceed the cleanup levels; and
    - Indicate whether free product is present and include thickness.

2. Regulatory basis for corrective action (i.e. 2L requirements, other requirements, etc.)
3. Remediation goals for soils, groundwater, surface water, and sediments.
4. Criteria used to evaluate remediation alternatives (i.e. protection of human health and the environment, compliance with laws or legal settlement agreement, long term effectiveness and permanence, reduction of toxicity and mobility, cost, community acceptance, etc.)
5. Summary of initial remedial actions to date
   - Include soil treatment/disposal (quantities and methods);
   - Indicate disposal location for the contaminated soil;
   - Include free product recovery information (quantities and methods);
   - Include any other corrective actions taken; and
   - Specify additional quantities of soil, free product, etc. that need to be remediated.
6. Reference previous reports submitted (e.g., Site Assessment (CSA), etc.):
   - Cite titles, report dates, and dates that reports were submitted to the Regional Office;
   - From the CSA, attach the following as appendices:
     - ✓ Groundwater elevation maps;
     - ✓ Maps and cross sections indicating the horizontal and vertical extent of contamination for soil, free product and dissolved groundwater contamination;
     - ✓ Tables containing groundwater elevations and other field measurements (dissolved oxygen, pH, temperature, specific conductivity, etc.); and
     - ✓ Tables containing all previous sampling results for soil and groundwater.

Note: *Do not attach a copy of any report as an appendix*

Reference any previous permits and/or certificates (e.g., certificate of approval, soil remediation permits, interim discharge permits, etc.):

- Cite permit number and permitting agency; and
- Cite permit approval and issue dates.

4.4.1.5) Facility Description

1. History of land use and operations
2. Waste streams
3. Existing permits
4. History of groundwater and permitted effluent monitoring
5. Source areas that require corrective action: Provide an overview of source areas at a facility, including rationale for combining more than one source area because of proximity, similar waste characteristics, and common receptors that support development of the site conceptual model in this manner.

4.4.1.6) Background Conditions

Determine background conditions for soil, groundwater, and surface water

4.4.1.7) Receptor Information

1. Summarize information provided in the CSA on water supply wells, public water supplies, surface water, wellhead protection areas, deep aquifers in the Coastal Plains, subsurface structures, and land use; and
2. From the CSA report, attach the following, updating information as necessary:
   - Maps and figures of receptor locations; and
   - Table listing the names and addresses of property owners and occupants within or contiguous to the area containing contamination and all property owners and occupants within or contiguous to the area where the contamination is expected to migrate.

4.4.1.8) Site-Wide Conceptual Model of Groundwater Flow and Contaminant Transport

Provide a summary with maps and figures to describe site conditions at the facility.

4.4.1.9) Numerical Models

Provide a summary on numerical models used to assess groundwater flow, contaminant movement, and remediation alternatives. For each model used include: overview of model development, model assumptions and limitations, and conclusions. Model results should be included in the appendices.

4.4.1.10) Proposed Corrective Action

Each source should be described with respect to contaminant of concern distribution, migration pathways, and receptors related to its specific waste footprint to support evaluation of remedial alternatives.

1 . Objectives

- State goals and expected accomplishments of the CAP (e.g., free product recovery, containment or retardation of plume migration, reduction of contaminant concentrations, protection of nearby water supplies, etc.); and
- Specify cleanup levels for soil and/or groundwater and provide the basis for their determination.
- Describe how the proposed remedy will provide source removal and/or control to reduce COI concentrations within a reasonable timeframe and ultimately protect human health and the environment.

2. Evaluation of remediation alternatives, for each remedial option evaluated discuss:

- System process;
- Feasibility;

- Limitations;
- Options for discharge/disposal of groundwater following treatment including property access agreements, if applicable;
- Possibility of connecting adjacent property owners to municipal water as an alternative to groundwater remediation and provide cost comparison;
- Selected remedy and rationale for selection
  - ✓ Results of treatability studies, if applicable
  - ✓ How proposed remedy meet remediation goals
  - ✓ Estimate of time required to meet remediation goals
- Recommended interim activities to support implementation
- Detailed description of remedy
  - ✓ Conceptual model and design of the remedy (i.e. how will system reduce COI concentrations and protect human health and environment?)
    - COIs addressed by the remedy
    - COIs not addressed by the remedy
  - ✓ Process flow diagrams for all major components of remedy
  - ✓ Engineering designs with assumptions, calculations, specifications, etc.
  - ✓ For 2L (l) CAP, provide requirements outlined in DWR MNA guidelines
  - ✓ For 2L (k) CAP, provide requirements outlined in 02L rule
  - ✓ Proposed effectiveness sampling and reporting plan during remediation
    - Proposed wells for trend analysis
    - Proposed trend analysis (statistical method) and decision metrics
  - ✓ Permits needed for proposed remedy
  - ✓ Schedule and cost of implementation
- Additional site characterization needed to support proposed remedy
- Measures to ensure the health and safety of all persons on and off site
- Description of all other activities and notifications being conducted to ensure compliance with 2L, and other relevant laws and regulations
- Proposed progress (i.e. “effectiveness”) reports and schedule
- Contingency plan in case of insufficient remediation performance
  - ✓ Decision metrics (triggering events) for implementation
  - ✓ Description of contingency remediation plan and basis for its selection
  - ✓ Permits needed to implement contingency plan
  - ✓ Schedule and cost of implementation, if needed

- Certifications (sealed and notarized professional statements of "true, accurate, and complete")
- If relevant to discussion, costs including capital expenses, yearly operation, and maintenance and monitoring costs.

3. Proposed Remediation

Note: *Follow format below for soil, sediment, and groundwater remediation. Address remediation of other media (e.g. surface water, vapor) in similar format, as necessary.*

- Soil - Using figures, maps and tables as necessary, describe and provide specifications for the proposed remediation as appropriate including:
  - ✓ On-site Treatment
    - Estimated volume to be treated;
    - Additional site data needed;
    - Pilot tests to be performed (test results, if pilot test already completed);
    - System design and process;
    - Estimate of time required to achieve soil remediation goals;
    - Radius of influence of system and estimated rates of contaminant removal;
    - Anticipated flow rates and pressures for soil vapor extraction 9if ;
    - Anticipated effluent concentration after each unit of treatment;
    - Evaluation of effectiveness of remediation method;
    - Operation and maintenance plan (include schedule and discussion on measures to reduce operation and maintenance such as use of automated controls and remote telemetry);
    - Monitoring and sampling plans (include proposed sampling locations, analytical methods, sampling frequency and reporting frequency);
    - Limitations (including access issues, technological feasibility, etc.) and proposed measures for dealing with these limitations;
    - Disposal of any waste (e.g., spent carbon) generated; and
    - Permits needed (Attach copies of completed permit applications. Original permit applications should be submitted to the permitting agency and should not be attached to the CAP).
  - ✓ Off-site Treatment/Disposal
    - Treatment/disposal method;

- Estimated volume to be treated or disposed;
- Name and address of treatment/disposal facility;
- Analytical results for any pre-treatment/disposal samples; and
- Permits needed (Attach copies of completed permit applications. Original permit applications should be submitted to the permitting agency and should not be attached to the CAP).

✓ Soil Post Remediation Sampling/Monitoring

- Describe the sampling that will be performed to document that soil has been cleaned up to applicable cleanup levels.

- Groundwater - Using figures, maps and tables as necessary, describe and provide specifications for the proposed remediation action as appropriate, including:
  - ✓ Estimated volume to be treated;
  - ✓ Additional site data needed including proposed aquifer tests and sample collection for analysis of natural attenuation parameters, provide tests results if already complete;
  - ✓ Groundwater modeling (modeling results, if groundwater modeling already completed). The minimum documentation required for modeling includes:
    - Name, version and developer of the model;
    - Type of site for which the model is applicable;
    - Critical conceptual assumptions and estimates of input values;
    - Calibration process;
    - Range of values used and the results of sensitivity analysis on critical data inputs; and
    - Graphical representation and narrative explanation of the modeling results;
  - ✓ Pilot tests to be performed (test results, if pilot test already completed);
  - ✓ System design and process;
  - ✓ Estimate of time required to meet applicable groundwater quality standards;
  - ✓ Radius of influence of system and estimated rates of contaminant removal;
  - ✓ Anticipated flow rates and pressures for groundwater recovery (i.e., both after stripper and after carbon), air sparging, and groundwater injection;
    - Anticipated effluent concentration after each unit of treatment;
    - Evaluation of effectiveness of remediation method;
    - Operation and maintenance plan (include schedule and discussion on measures to reduce operation and maintenance such as use of automated controls and remote telemetry);

- Monitoring and sampling plans (include proposed sampling locations, analytical methods, sampling frequency, and reporting frequency);
- Options for discharging treated groundwater;
- Limitations (including access issues, technological feasibility, biofouling, etc.) and proposed measures for dealing with these limitations;
- Disposal of any waste (e.g., spent carbon) generated; and
- Permits needed (Attach copies of completed permit applications. Original permit applications should be submitted to the permitting agency and should not be attached to the CAP).

Note: *For a CAP proposing remediation by natural attenuation, a plan for monitoring the progress of the contaminant degradation process must be incorporated into the remediation proposal above.*

✓ Groundwater Post Remediation Sampling/Monitoring

- Describe the sampling plan that will be performed to document and verify that groundwater has been cleaned up to applicable cleanup levels.

- New and Emerging Technologies - Innovative strategies for soil and groundwater remediation may incorporate new and emerging technologies to meet corrective action goals as potentially more cost-effective, timely, and more efficient means of reducing contamination to the level of the acceptable standards. New and emerging remediation technologies may be considered when they can be demonstrated to be economically and technologically feasible as specified in 15A NCAC 02L .0106(o). The Director's determination for implementing new and emerging technologies must consider factors in Paragraph (h) of this Rule:
  - ✓ A description of the proposed corrective action and reasons for its selection.
  - ✓ Specific plans, including engineering details where applicable, for restoring groundwater quality.
  - ✓ A schedule for the implementation and operation of the proposed plan.
  - ✓ A monitoring plan for evaluating the effectiveness of the proposed corrective action and the movement of the contaminant plume.
  - ✓ The plans for implementation of a corrective action using new and emerging remediation technologies must identify well-defined and measurable remediation objectives, such as a reduction in mass discharge rate from a contaminant source. Other performance parameters should be developed to provide an evaluation of remediation objectives. These performance parameters should be used to establish baseline operating conditions, monitor the efficacy of a remediation system, and provide a strategy to potentially optimize operations. General information about the soil and water chemistry that may be useful when analyzing the results should be collected as part of the remediation system operation.

4. Cost Estimate

Provide a cost estimate for performing the proposed remediation including costs for labor, pilot tests, aquifer tests, sampling and monitoring, equipment, operation and maintenance, permits, waste disposal, etc.

5. Schedule

- Provide a detailed schedule for implementing the proposed remediation including but not limited to:
  - ✓ Collection of additional data (aquifer tests, natural attenuation parameters, etc.);
- Performance of any pilot tests:
  - ✓ Submittal of necessary permit applications;
  - ✓ Excavation of soil;
  - ✓ Treatment system installation and activation;
  - ✓ Operation and maintenance;
  - ✓ Monitoring;
  - ✓ Estimated time frame to achieve cleanup goals (include basis for this determination); and
  - ✓ Project completion.

4.4.1.11) Maps, Figures, Tables

Provide maps, figures, and tables as necessary to describe in detail the proposed remediation including, the area and volume of soil to be treated/excavated, the area and volume of groundwater to be remediated, and if applicable, the location of the treatment system and a detailed map of the system design and layout (include all major components of the system).

4.4.1.12) Appendices

1. Attach all figures, tables and maps from CSA (update as necessary); and

2. Provide the following, if applicable

- Cost estimates for remediation alternatives evaluated including estimates and quotes;
- Detailed design specifications of system components;
- Pump curves and performance charts;
- Design calculations;
- Pilot and aquifer test data/calculations (if already completed);
- Groundwater modeling results (if already completed); and
- Copies of completed permit applications.

5. MONITORING PLAN

5.1 Selection and Approval of Monitoring Plan

Per 15A NCAC 02L .0110, a monitoring plan shall be developed and established that adequately assesses the progress of the approved corrective action plan and to verify that the remediation process is working as proposed. The monitoring plan shall include:

1. A sufficient number of monitoring points, including groundwater monitoring wells and surface water locations as appropriate, to detect and monitor the movement of contaminants;
2. A monitoring schedule based on the physical and chemical characteristics of the contaminants, reaction rates, discharge rates, and site-specific hydrogeology;
3. A list of constituents to be analyzed and the anticipated laboratory analytical methods. The list of constituents should include the target contaminants as well as any additional parameters that may provide an indication of the progress of remediation.

Monitoring of natural attenuation may be based on direct or indirect evidence. Direct evidence would include monitoring data which shows the plume decreasing in volume and concentration. Indirect evidence includes, but not limited to, a demonstration of the following:

- Decreases in terminal electron acceptors
- Increases in the byproducts of microbial respiration
- Increase in the presence of bacteria capable of degrading the contaminants

Specific groundwater parameters that may be appropriate to monitor natural attenuation (but are not required) include:

- Contaminant concentrations
- Concentrations in intermediate compounds formed by incomplete degradation of chemicals
- Nutrient concentrations
- pH
- Redox potential (EH)
- Terminal electron acceptors (e.g. oxygen, nitrate, sulfate, Iron (Fe^{3+}), Manganese (Mn^{4+} and Mn^{3+}), etc.)
- Byproducts of microbial respiration (e.g. carbon dioxide, methane, Iron (Fe^{2+}), Manganese (Mn^{2+}), etc.)

If the plume can be shown to be steadily decreasing, it may only be necessary to monitor for the contaminants of concern. If the plume is discharging, or is predicted to discharge, to surface water, then surface water samples must be collected and analyzed periodically to monitor for impacts. A description of the methods used for all analyses and field measurements and justification of their applicability to the site based on specific site conditions must also be provided. For field measurements, the instrument type and calibration method should also be provided.

Corrective action sites will generally be monitored quarterly for the first year followed by less frequent monitoring. The DEQ Director will consider all reasonable, site-specific monitoring proposals. The predicted rate of contaminant transport and proximity to potential receptors should be considered when proposing a monitoring schedule.

The monitoring plan shall be prepared under the responsible charge of a Professional Engineer or Licensed Geologist and submitted to the regional office for approval following acceptance of the corrective action plan.

5.2 Deliverables

5.2.1) Minimum Elements of the Monitoring Plan

5.2.1.1) Title Page

1. Site name, location, groundwater incident number (if assigned), permit number;
2. Date of report;
3. RP and/or permittee, including addresses and phone numbers;
4. Current property owner information, including address and phone number;
5. Consultant/contractor information, including address and phone number;
6. Contaminant release information including the date discovered, estimated quantity of release, cause of release, and source of release;
7. Latitude and longitude of the contaminated site; and
8. Seal and signature of certifying P.E. and L.G., as appropriate.

5.2.1.2) Discussion of Sampling Results

1. Summary of analytical results and free product thickness(s) (if applicable).
2. Description of current plume size and location (graphically illustrate changes in plume size or migration).

- Include the following for active remediation monitoring reports:
    - ✓ Summary of remediation activities to date;
    - ✓ Remediation system status (list dates of up-time and down-time);
    - ✓ Treatment system monthly sampling and operational data;
    - ✓ Total gallons of water treated during the period;
    - ✓ Monthly operation and maintenance costs;
    - ✓ Mass of contaminant removed (lbs/day for the system);
    - ✓ Future remediation activities;
    - ✓ Gallons of recovered product; and

- ✓ Discharge/non-discharge/POTW permit number, expiration date, updated permit, monitoring requirements, and schedule.

- Include the following in all monitoring reports:
  - ✓ Description of the proximity of the plume to the nearest potential receptor(s);
  - ✓ Groundwater flow direction;
  - ✓ Predictive rate of contaminant transport; and
  - ✓ Other field data obtained during monitoring (groundwater elevations, dissolved oxygen, temperature, pH, redox potential, conductivity, and other electron acceptors as required).

5.2.1.3) Conclusions and Recommendations

1. Monitoring reports during active remediation indicate the progress of cleanup, evaluate the performance and efficiency of the remediation system, and may indicate necessary changes or modifications to the system.
2. For a Pre-CAP Monitoring Report or a Natural Attenuation Monitoring Report, outline the attenuation progress and plume status (i.e., change in plume size, shape, etc.).
3. Include interpretations of submitted data.

5.2.1.4) Tables

Note: *Tables should list constituent concentrations in the same unit used in the 15A NCAC 02L .0202 (2L Standards) and indicate the respective 2L standard for listed analytes and laboratory detection limits.*

1. Table of sampling data for reported sampling event only;
2. Table of historical sampling data from the site, including data from reported sampling event;
3. Table of groundwater elevations obtained for reported sampling event;
4. Table of historical groundwater elevations;
5. Provide a free product recovery table which provides depth to free product and thickness for each well, and historical information (thickness of product in each well, total amount of product recovered);
6. Table of field measurements (e.g., dissolved oxygen, pH, temperature, redox potential, specific conductivity, etc.); and
7. Table of monitoring well construction data including date constructed, total depth, date of abandonment (if applicable), elevations of top of casing, land surface, water level, screened intervals, etc.

   NOTE: *The measured point at top of casing must be permanently marked or noted in the field. The table of groundwater elevations should be part of the groundwater elevation map, if space allows.*

5.2.1.5) Maps and Figures

All reports submitted to the DWR should use graphical methods of data presentation to the greatest extent possible. Furthermore, the text of reports should provide a concise synthesis of this graphical information that clearly communicates the professional's own interpretations of the data.

Note: *If possible, a single base map should be used to prepare potentiometric maps, iso-contour maps, etc. Maps and figures submitted to the DWR should include conventional symbols, notations, labeling, legends, scales, and north arrows. The map should use a scale of 1 inch = 40 feet (or smaller scale for larger sites, if necessary) feet and conform to generally accepted practices of map presentation such as a USGS Geological Survey pamphlet, "Topographic Maps".*

1. Base map (include bar scale and north arrow):

- Draw all elements of the map to scale;
- Identify property boundaries and all site features;
- Indicate potential receptors (existing or new);
- Label streets, highways, roads, etc.; and
- Label surface waters, creeks, etc.

2. Groundwater elevation map for reported sampling event:

- Draw all elements of the map to scale;
- Use data from groundwater monitoring wells;
- Indicate groundwater flow direction; and
- Plot elevations (in feet) of groundwater, corrected for presence of free product, if applicable.

3. Attach historical groundwater elevation maps.

4. Include a topographic map indicating the location of the site, contaminant plume, and the location of all water supply wells, surface water bodies, wellhead protection areas, etc. (indicate the 1,500-foot boundary with circle).

5. Dissolved-concentration map(s) and dissolved-concentration cross sections (vertical iso-concentration plots), for individual contaminants exceeding 2L Standards, if sufficient data exists.

Note: *For all applicable plots, a 15A NCAC 2L standard contour must be shown in bold. Constituent concentrations should be in the same unit used in the 15A NCAC 02L .0202 (2L Standards)*

6. Free product plume map measured in feet, if applicable.

7. Concentration versus water level (hydrograph to reveal groundwater fluctuation through the "smear" zone).

8. Concentration versus time graph(s)

    - Graph(s) showing contaminant concentrations versus time plotted for all wells sampled (for individual contaminants exceeding 2L Standards only); and
    - Graph that outlines free product thickness (if applicable).

Note: *Concentration should be expressed in the same unit in the 15A NCAC 02L .0202 (2L Standards), the respective 2L standard should be indicated. Time units should be months.*

9. Include the following for active remediation monitoring reports only:

- Graph showing total contaminant removal per monitoring well; and
- Graph showing total pounds recovered by means of groundwater recovery.

Note: *Calculations should be based on average pounds per hour.*

5.2.1.6) Survey of Potential Receptors

This section is required only for incident sites where receptors have been impacted or where receptors are threatened. Provide all data and status updates since the previous monitoring report was prepared for the following:

1. All water supply wells within 1,500 feet of the contaminant plume. Include historical and current sampling data;
2. Current information concerning provision of bottled water; point-of-entry treatment systems, and/or and connection of properties to municipal water line(s); and/or
3. Surface water bodies, wellhead protection areas, confined coastal plain aquifers, utility lines, vaults, basements, etc.

5.2.1.7) Appendices

1. Copies of laboratory analytical reports (laboratory name and certification number, well numbers, sampling date, analysis date, analytical methods, and method detection limits should be indicated on reports).

Note*: Field procedures relating to sample collection techniques, sample containers, sample preservation, equipment decontamination and field measurement procedures, should comply with the most current version of the U. S. Environmental Protection Agency (USEPA) Region IV Science and Ecosystem Support Division (SESD) Field Branches Quality System and Technical Procedures. This information is available from the USEPA Region IV SESD at: http://www.epa.gov/region4/sesd/fbqstp/.*

2. Chain-of-custody forms for all samples (all transfers).
3. Copies of field data sheets.
4. Calculations (if applicable).

6. Termination of Corrective Action

Corrective action may be terminated under the following conditions:

1. Groundwater has been restored to the appropriate 2L standards (Refer to Section 7.1).

2. Continued corrective action will not result in reduction of contaminant concentrations and the remaining contaminated groundwater can be rendered potable by treatment using readily available and economically reasonable technologies as provided for in rule 15A NCAC 02L .0106(n). For this option the Director may designate the remaining area of degraded groundwater (RS: Restricted Designation) as described in rule 15A NCAC 02L .0104.

3. When continued corrective action will not result in reduction of contaminant concentrations and the remaining contaminated groundwater cannot be rendered potable by treatment using readily available and economically reasonable technologies. As provided for in rule 15A NCAC 02L .0106(n), the Director may consider a request for reclassification of the groundwater to a GC classification as described in rules 15A NCAC 02L .0201(3) and 15A NCAC 02L .0319.

For condition 2 above, Rule 15A NCAC 02L .0.06(m) allows for any RP conducting an approved CAP to request termination of corrective action prior to achieving the 2L Standards. This rule applies to DWR non-permitted activities or DWR activities permitted prior to December 30, 1983. The CAP must demonstrate that continued operation of the remediation system will not result in a significant decrease in dissolved contaminant concentrations. The following is the minimum information needed to consider such a request:

- A discussion of the duration of the corrective action, the total project cost, projected annual cost for continuance and evaluation of the success of the corrective action;
- An evaluation of alternate treatment technologies that could result in further reduction of contaminant levels, projected capital, and annual operating costs for each technology;
- The effects, including health and safety impacts, on groundwater users if contaminant levels remain at levels existing at the time corrective action is terminated;
- A demonstration of the following:
    - That continuation of corrective action would not result in a significant reduction in the concentration of contaminants. This demonstration shall show the duration and degree of success of existing remedial efforts to attain standards. For this Part, a "significant reduction" is demonstrated by showing that the asymptotic slope of the contaminants curve of decontamination is less than a ratio of 1:40 over a term of one year based on quarterly sampling.

      The asymptotic slope is used as a means of determining the rate at which remediation is progressing. It must be demonstrated that current remedial efforts have produced their maximum result in terms of lowering the concentration of contaminants. The slope is

determined from the curve representing the concentration of the dissolved contaminant over time. Concentrations should be shown in milligrams per liter and time should be shown in months. The absolute value of the slope of the curve of decontamination (which is a negative slope) must be less than or equal to one unit of chemical contamination remediated during the course of 40 months, and greater than or equal to zero. Therefore, if the absolute value of the slope is calculated to be equal to or less than a ratio of 1:40, then the requirement has been met.

A minimum of four quarters of monitoring data must be used to graph and evaluate the curve. Using the ratio of one milligram per liter over 40 months, the decrease in concentration of a contaminant in groundwater cannot exceed 300 micrograms per liter in the previous 12-month period to eligible for approval. If a "best fit" curve is used to fit the data, the CAP must include an explanation of the type of statistical analysis performed.

The demonstration of asymptotic slope must be made for each contaminant detected above the 2L Standards. Additionally, the slope determination must be made for data from all existing monitoring wells which have contaminants above the 2L Standards. Groundwater samples used for determining the slope must be collected from properly constructed monitoring wells. Data collected from remediation wells cannot be used.

- That contaminants have not and will not migrate onto adjacent properties, or that such properties are served by an existing public water supply system dependent on surface waters or hydraulically isolated groundwater; or the owners of such properties have consented in writing to the request;

  The term "served" means connected to an approved public water supply. Suitable water supplies must meet the regulatory definition of a public water supply and be approved by the DWR Public Water Supply Section. Documentation, preferably a letter from the utility company, should be provided indicating which households are on public water. The CAP must certify that public water supply is dependent on surface waters or hydraulically isolated groundwater, as applicable.

  A map must be provided that shows the current plume boundary as well as all adjacent properties and those down gradient properties where the plume is expected to migrate. Any supply wells on those properties must be located on the map. An indication of which properties are predicted to be impacted and the technical basis for this determination must also be provided. In addition, a map must be provided that shows the predicted maximum extent of the contaminant plume. When applicable under 15A NCAC 02L .0106(k)(3)(B), the CAP must include documentation of the property owner's written consent allowing contamination to migrate onto their property;

- That, if the contaminant plumes are expected to intercept surface waters, the groundwater discharge will not possess contaminant concentrations that would result in violations of the 2B Standards. If the contaminated groundwater plume is predicted to discharge to surface waters, the CAP must document the technical basis for predicting that such discharge will not result in 2B Standards violations. The classification of the surface water body must also be included in the CAP. If the contaminant plume is already discharging to surface water, the CAP should include recent laboratory analytical results from that surface water body. Samples should be collected upstream and downstream of the discharge area, if applicable. All surface water quality data should be provided in table format with a map of sample locations, laboratory reports, and chain-of-custody forms attached;

- that public notice of the request has been provided in accordance with Rule .0114(b) of this Section; and

- that the proposed termination would be consistent with all other environmental laws.; and

- The Secretary shall not authorize termination of corrective action for any area that, at the time the request is made, has been identified by a state or local groundwater use planning process for resource development. Documentation that groundwater in the area of the plume has not been identified for future use or development by a state or local government planning process must be included.

The Secretary may authorize the termination of corrective action, or amend the corrective action plan after considering all the information in the request. In making the authorization, the Secretary shall consider health and safety impacts on all existing and foreseeable receptors and the impacts the contaminated plume may have if it reaches them. Upon termination of corrective action, the Secretary shall require implementation of a groundwater monitoring program that, based on subsurface conditions and the physical and chemical properties of the contaminants, will accurately track the degradation and attenuation of contaminants at a location of no less than one year's predicted time of travel up-gradient of any existing or foreseeable receptor. The monitoring program shall remain in effect until there is sufficient evidence that the contaminant concentrations have been reduced to the level of the appropriate standards. For the purpose of this Part, "sufficient evidence" means that sampling and analyses demonstrate that contaminant concentrations have been reduced to the level of the appropriate standards on multiple sampling events.

7. CLOSURE AND ISSUANCE OF "NO FURTHER ACTION REQUIRED".

7.1 Site Closure

Site Closure is the termination of regulatory oversight activities related to a discharge. It may occur when information is provided to document that site remediation has achieved the cleanup levels or appropriate standards specified by the DWR. When sites that have been undergoing active remediation can demonstrate that groundwater has been remediated to below the 2L Standards, the responsible parties may petition the Division for closure.

Analytical results of groundwater samples collected over four consecutive quarters documenting no contamination above the 2L Standards or IMACs while a remediation system is in operation, and four quarters after remediation has ceased are generally required.

Closure of sites with soil contamination may be approved by the appropriate DWR Regional Office if documentation indicates that no contamination in excess of the appropriate action or clean up levels remains in the ground. The DWR will then issue a "No Further Action Required" letter to the RP.

Non-permitted sites (only pesticide-contaminated sites) have two additional options for site closure:

- Responsible Parties which have documented violation of the 2L Standards may seek approval to terminate active remediation, prior to achieving the 2L Standards. 15A NCAC 2L .0106(m) outlines this procedure.
- Responsible parties which have documented violation of the 2L Standards may seek a variance to corrective action requirements, as outlined in 15A NCAC 2L .0113.

7.2 Reclassification of Groundwater

All groundwater in North Carolina is classified as "GA" or "GSA" in which the best usage is a potential source of drinking water supply for humans. The only distinction between the two classifications is the amount of natural chloride concentrations; GA is less than 250 milligrams per liter and GSA is greater than 250 milligrams per liter and may require treatment before consumption. The "GC" classification is for groundwater that is unsuitable for human consumption, does not meet the criteria for GA or GSA, and for which efforts to improve groundwater quality would not be technologically feasible, or in the best interest of the public. The GC classification can only be established by the Environmental Management Commission.

15A NCAC 02L .0104 establishes a temporary groundwater restricted designation of "RS" that is intended to warn the public that the groundwater may not be suitable for use as a source of drinking water without treatment. When groundwater has been contaminated by human activities, the DWR Director may designate an area of groundwater as RS under any of the following conditions:

- The DWR Director has approved a CAP or termination of corrective action and it is evident that the approved plan(s) will not result in restoration of the resource without an extended period of time; or

- A statutory variance to the 2L Standards has been granted in accordance with 15A NCAC 02L .0113.

It should be noted that groundwater occurring within a compliance boundary is deemed RS per 15A NCAC 02L .0104(b).

The RP can submit an application to designate contaminated groundwater outside the compliance boundary as RS. In this case, the RP must provide written verification that all property owners within and adjacent to the proposed RS area have been notified of the requested RS designation. Determination of the RS boundary must be performed using predictive calculations or contaminant fate and transport modeling. A description of the methodology used, assumptions made, and a discussion of the applicability of the modeling to the site are required. The boundary shall also be located at least 250 feet away from the predicted edge of the contaminant plume and shall include any areas into which the plume is expected to migrate. The RP should also provide a monitoring plan (as described in Section 5 of this document) for approval.

Once the application is received, the DWR must provide public notice of the intent to designate any groundwater as RS per 15A NCAC 02L .0104(f). If the DWR Director determines there is a need for a public hearing, they must issue a public notice and hold a public hearing in accordance with G.S. 143-215.4(b) and 15A NCAC 02L .0113(e).

If the RS designation is approved, the RP must establish the monitoring program. If during the monitoring period, contaminant concentrations increase, additional remedial actions or monitoring may be required. The term “increase” refers to an increase in concentration levels at the time the RS designation was approved.

8. EXTERNAL RESOURCES

8.1 Soils: Remediation Goals- Soil Screening- Background Concentrations

- Preliminary Soil Remediation Goals (PSRG) and Transport Model for the Protection of Groundwater (Verify that the most updated version is used since the PSRG is updated periodically.
- *Soil Screening Guidance (EPA):* https://www.epa.gov/superfund/superfund-soil-screening-guidance
- Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites

8.2 Pesticides

- *Guidance for Evaluating Residual Pesticides on Lands Formerly Used for Agricultural Production:* https://www.oregon.gov/deq/FilterDocs/GuidanceEvalResidualPesticides.pdf
- *California's Interim Guidance for Sampling Agricultural Properties (Third Revision):* http://www.energy.ca.gov/sitingcases/palmdale/documents/2011-02-02_Exhibits_FSA_TN-59585.pdf
- *Nitrate contamination in groundwater on an urbanized dairy farm:* http://pubs.acs.org/doi/abs/10.1021/es071551t
- *Guidance for Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan EPA QA/G-5S:* https://www.epa.gov/sites/production/files/2015-06/documents/g5s-final.pdf
- *The Quality of Our Nation's Waters – Nutrients and Pesticides: U.S. Geological Survey Circular 1225, U.S. Geological Survey, 1999.* https://pubs.er.usgs.gov/publication/cir1225
- *Area-Wide Contamination Task Force Report, Washington State Department of Ecology, June 30, 2000,* http://www.ecy.wa.gov/programs/tcp/area_wide/Final-Report/PDF/TF-Report-final.pdf
- *Findings and Recommendation for the Remediation of Historical Pesticide Contamination, New Jersey Dept. of Environmental Protection.* http://www.state.nj.us/dep/special/hpctf/final/hpctf99.pdf

8.3 ASTM Standards

List of ASTM Standards Related to Environmental Site Characterization:
https://www.astm.org/BOOKSTORE/COMPS/PDFS/ENVSIT06.pdf

8.3.1) Site Characterization

5878 – 08 - Standard Guides for Using Rock-Mass Classification Systems for Engineering Purposes

E1689 – 95 (Reapproved 2014) - Standard Guide for Developing Conceptual Site Models for Contaminated Sites

E1528 – 14 - Standard Practice for Limited Environmental Due Diligence: Transaction Screen Process

D6312 – 98 (Reapproved 2012) - Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs

D6235 – 04 (Reapproved 2010) - Standard Practice for Expedited Site Characterization of Vadose Zone and Groundwater Contamination at Hazardous Waste Contaminated Sites

D6032 – 08 - Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core

D5979 – 96 (Reapproved 2014) - Standard Guide for Conceptualization and Characterization of Groundwater Systems

D5921 – 96 (Reapproved 2010) - Standard Practice for Subsurface Site Characterization of Test Pits for On-Site Septic Systems

D5745 – 09- Standard Guide for Developing and Implementing Short-Term Measures or Early Actions for Site Remediation

D5730 – 04 – Standard Guide for Site Characterization for Environmental Purposes with Emphasis on Soil, Rock, the Vadose Zone and Groundwater

D 5717 – 95e1- Standard Guide for Design of Ground-Water Monitoring Systems in Karst and Fractured-Rock Aquifers

D5408 – 93 (Reapproved 2010) - Standard Guide for Set of Data Elements to Describe a Groundwater Site; Part One—Additional Identification Descriptors

D5409/D5409M – 93 (Reapproved 2010)- Standard Guide for Set of Data Elements to Describe a Groundwater Site; Part Two—Physical Descriptors

D5410 – 93 (Reapproved 2007) - Standard Guide for Set of Data Elements to Describe a Groundwater Site; Part Three—Usage Descriptors

D5254/D5254M – 92 (Reapproved 2010) - Standard Practice for Minimum Set of Data Elements to Identify a Groundwater Site

D5092 – 04 (Reapproved 2010) - Standard Practice for Design and Installation of Groundwater Monitoring Wells

D2113 – 14 - Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration

D653 – 14 - Standard Terminology Relating to Soil, Rock, and Contained Fluids

D 420 – 98 (Reapproved 2003) - Standard Guide to Site Characterization for Engineering Design and Construction Purposes

8.3.2) Site Assessment

D 6233 – 98 (Reapproved 2003) - Standard Guide for Data Assessment for Environmental Waste Management Activities

E1527 – 13 - Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process

E1903 – 11 - Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment Process

8.3.3) Environmental Sampling

D4448 – 01 (Reapproved 2013) - Standard Guide for Sampling Ground-Water Monitoring Wells

9. EXHIBITS

Exhibit 1. Facility-Specific Requirements for Soil and Groundwater Assessment and Remediation

E1.1) Pesticides or Agricultural Chemical Operations

E1.2) Facilities Permitted under G.S.87-88 (Well Construction Act)

E1.3) Non-Discharge, Discharge (NPDES), Residual Solids Facilities, Animal Waste Facilities

E1.4) Other

Exhibit 2. Regulations and Policies

Exhibit 3. Certifications, Forms

E3.1) Certification for the Submittal of a Site Assessment (CSA)

E3.2) Certification for the Submittal of a Corrective Action Plan (CAP)

E3.3) Certification for the Request to Terminate a Corrective Action Plan

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EXHIBIT 1. FACILITY-SPECIFIC REQUIREMENTS FOR SOIL AND GROUNDWATER ASSESSMENT AND REMEDIATION

E1.1 Pesticides or Agricultural Chemical Operations

E1.1.1) General

Soil and groundwater assessments in North Carolina indicate that lands formerly used for agricultural purposes have the potential to be impacted with metals, nutrients, pesticides, herbicides, solvents, and petroleum products at levels that may pose an unacceptable risk to human health and the environment. Although limited in extent, the NCAC provides the regulatory basis to require assessment and risk abatement where necessary. Regarding pesticides, the application rate associated with some crops (i.e., fruit) coupled with the persistent nature or half-life can increase the probability of impact and retention onsite.

E1.1.2) Regulatory Framework

The DWR has the responsibility and regulatory authority for managing incidents resulting from the application of agricultural chemicals or other agricultural by-products, excluding impacts resulting from spills, pesticide mixing areas, improper application or disposal of such chemicals. Incidents not under the jurisdiction of the DWR are managed by the DWM's IHSB or EPA.

Incident types managed by the DWR are typically initiated by the detection of metals, pesticides or nitrates in supply wells and/or by a planned change in land use such as the residential development of land formerly used for agriculture. Agricultural land uses where soil or groundwater impacts have been observed in North Carolina include fruit orchards, row crop cultivation fields, greenhouses, nurseries, dairies, etc. As a result, the release types (e.g., application of pesticides in a manner prescribed) the identification of a RP is often either difficult or irrelevant due to exemptions in rule. The fundamental goal of addressing legacy pesticides, metals and other wastes associated with former agricultural operations in the existing regulatory framework is risk exposure abatement.

Pursuant to NCAC, agricultural operations are afforded certain exemptions. Agricultural operations are exempt from assessment and certain types of corrective action as required in 15A NCAC 02L .0106(c) if the impacts to soil and groundwater are the result of normal (i.e., no spills, no over-application, and in accordance with manufacturer's or USDA recommendations, etc.) application or deposition of agricultural chemicals. The **mitigation of hazards**, however, can be required under 15A NCAC 02L .0106(b) for applicable contaminants.

Per 15A NCAC 02L .0106(b), any person conducting or controlling an activity which results in the discharge of a waste or hazardous substance or oil to groundwater of the State, or in proximity thereto, shall take immediate action to terminate and control the discharge, **mitigate any hazards resulting from exposure to the pollutants** and notify the DWR of the discharge. Mitigation of hazards may range from soil removal, providing an alternative source of potable water, deed recordation or restrictions, homeowner notification, etc.

The DWR will also partner with appropriate agencies in the investigation of legacy agricultural chemical impacts such as DHHS, DWM, EPA and the Department of Agriculture. In that regard, 15A NCAC 02L .0106(p) states that where the 2L Standards are exceeded because of the application of pesticides or other agricultural chemicals, the DWR Director or his designee shall request the Pesticide Board or the Department of Agriculture to assist the DWR in determining the cause of the violation. If the violation is determined to have resulted from the use of pesticides, the DWR Director shall request the Pesticide Board to take appropriate regulatory action to control the use of the chemical or chemicals responsible for, or contributing to, such violations, or to discontinue their use.

Although not regulatory driven, developers and buyers of land formerly used for agricultural operations should evaluate their potential liability regarding the potential presence of former agricultural chemicals. Adequate due diligence should include, at a minimum, a thorough review of historic land use coupled with soil sampling, especially in those areas where planned land use may result in human exposure to soil and/or groundwater such as residential, recreational, educational or day care development.

Contaminant Types Associated with former Agricultural Lands

In North Carolina, a range of contaminant types have been identified at former agricultural lands including, but not limited to the following:

- Nitrates associated with former dairy operation;
- Chlorinated solvents and petroleum constituents used to dissolve and disseminate pesticides and herbicides;
- Inorganics including pesticides containing arsenic, lead, and copper;
- Organochlorines and associated metabolites including DDT, chlordane, dieldrin, endrin, aldrin, lindane (gamma-BHC), toxaphene, DDD, DDE, endosulfan I, endosulfan II, endosulfan sulfate, endrin aldehyde, endrin ketone, heptachlor, heptachlor epoxide, 1,2 dichloropropane, etc.
- Organophosphates including malathion, parathinon, methyl parathion, and diazinon;
- Others including atrazine, paraquat and carbaryl.

When evaluating land for assessment, consider the above-listed contaminants as well as a review of the literature associated with the former land use.

E1.1.3) Addressing Contaminated Sites

Due to the varied nature of historical site use, the range of potential agricultural chemicals that may be present, specific guidance regarding assessment and risk abatement is developed on a site-specific basis under the review of the DWR if necessary. Below are several key considerations when evaluating land formerly used for agriculture purposes:

- Thoroughly research historic land use of the property. Sources of information that may be of assistance include USGS topographic maps that can indicate locations with possible agricultural use, historic aerial photos often available through various agencies such as your local Soil and Water Conservation office, interviews with local people familiar with the property, contacting local extension agents, regulatory agencies such as the DWR, local health departments, etc. Careful review of historic aerial photos will assist in locating potential mixing areas and identify other important features to consider when sampling such as drip lines in former orchards.

- Soil, stream , stream sediment, drainage ditch sediment and groundwater sampling should be consider if legacy or persistent pesticides were thought to have been used on the property, animal waste or animal activity was concentrated in certain areas of the property, relict piping or other signs of pesticide mixing are present, pesticides are present in similarly used or situated property in the area or the property was known to have been used for row crop cultivation, fruit orchards, nurseries, greenhouses, etc.

- Collect representative soil samples consistent with the historical land use which may include a wide range of pesticides, herbicides, and metals for some land use types such as fruit orchards. Other former agricultural sites such as dairies may necessitate a narrower range of analyses such as nitrates only. Metals to be sampled for include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, nickel, mercury, molybdenum, selenium, silver, thallium, vanadium and zinc. When sampling metals, some of which are naturally occurring, it is imperative to collect background samples to determine the level of naturally occurring metals. Background samples should be collected in an area offsite or an area where agricultural chemicals or wastes were not applied. Specific methods of grid sampling, composite sampling, etc. may be discussed with regional office staff prior to assessment to ensure sampling adequacy (Refer to Section 3.4.1).

- Analytical methods required for soil and sediment include SW-846 Method 8260 for VOCs, SW-846 Method 8270 for SVOCs, and EPA method or methods published in Standard Methods for the Examination of Water and Wastewater having the lowest detection limits for metals, pesticides and herbicides.

- Analytical results of soil sampling may be evaluated using EPA Region 3 or 9 Screening Level Tables and/or DWM's IHSB preliminary soil remediation goals (PSRG): Preliminary Soil Remediation Goals (PSRG) and Transport Model for the Protection of Groundwater (The PSRG document is listed among the Screening documents in the Risk Evaluation Resources website. Verify that the most updated version is used since the PSRG is updated periodically). When evaluating soil results, compare to appropriate proposed land use (i.e. residential or industrial). Secondly, results should be compared to soil-to-groundwater maximum contaminant concentration (see table below and DWM's IHSB). The DWR Regional Office incident manager will provide additional guidance on a site-by-site basis. The DWR may also have the results reviewed by the DHHS Division of Environmental Health for analysis and recommendations. If soil results are greater than soil-to-groundwater MSCC, then an assessment of groundwater should be undertaken and results compared to the 2L Standards and reviewed by DHHS staff.

- If soil results are greater than EPA Screening Levels for intended land use, mitigation of hazards may be required.

- Groundwater sampling should be considered and may be required by the DWR if soil contaminant levels exceed the soil-to-groundwater values. If a water supply well is already present on the property, the well should be sampled. As with any groundwater assessment, a representative number of wells may be necessary to accurately characterize groundwater conditions. Groundwater evaluation is critically important in areas where water supply wells will be used as the sole potable water source. When sampling groundwater, apply standard well sampling procedures for purging and collecting field parameters. Contact your DWR Regional Office for additional guidance. Groundwater analytical results should be compared to the 2L Standards. If the groundwater results exceed the 2L Standards, report the results to the DWR. In some cases, if the water samples are collected from a water supply well, the results may be provided to the DHHS Division of Environmental Health by the DWR Regional Office for evaluation.

- References included in Section 8.2: Pesticides may be applicable to address your site.

E1.2 Facilities Permitted under G.S.87-88 (Well Construction Act)

E1.2.1) General

Wells are built to establish a connection between the subsurface and the land surface for a variety of purposes. Wells may be used to supply potable water for drinking or to test for contaminated water as part of a groundwater remediation strategy. Wells may also be used to inject fluids into the subsurface to learn how water moves in the subsurface or to restore the quality of contaminated groundwater. Contamination incidents may be associated with wells due to improper construction methods, inappropriate use such as waste disposal, or deterioration of materials over time.

E1.2.2) Regulatory Framework

The NC Well Construction Act (General Statute Chapter 87, Article 7) provides the regulatory authority and framework for establishing well construction standards for the protection of public health and groundwater resources. Well Construction Standards are given in the 15A NCAC 02C .0100 and .0200 Rules. Both rules require wells to be maintained and abandoned if they are not properly maintained.

E1.2.3) Addressing Contaminated Sites

The NC Well Construction Act provides the authority to require remedial action for any violations of the Act or rules adopted pursuant to it. Section 87-91 – Notice of Violation; Remedial Action Order states, in part, that "*An order requiring remedial action shall specify the action to be taken, the date by which the action must be completed, the possible consequences of failing to comply with the order, and the procedure by which the alleged violator may seek review of the order.*" Such remedial or corrective action may vary according the specific instances, but injection well rule 15A NCAC 02C .0206(b) may be a useful starting point.

For injection wells, rule 15A NCAC 02C .0210 specifically addresses waste disposal via wells, which refers to rule 15A NCAC 02C .0206(b) for corrective action. This corrective action rule specifically addresses noncompliance with well construction standards or 2L or 2B Standards caused by the operation of injection wells. The requirements are basically a condensed version of the requirements specified in 15A NCAC 02L .0106.

E1.3 Non-Discharge, Discharge (NPDES), Residual Solids, and Animal Waste Facilities, and Other Activities Permitted by DWR

E1.3.1) General

This Exhibit addresses contamination incidents occurred from conducting or controlling an activity which is performed under the authority of Non-Discharge, Discharge (NPDES), Residual Solids, and Animal Waste permits (refer to Section 1.3 for a list of activities permitted by the DWR).

E1.3.2) Regulatory Framework

1. Compliance with the 15A NCAC 02L requirements described in Sections 1 through 6.
2. Compliance with rule 15A NCAC 02T .0105(j) for the closure permitted facilities (except animal waste operations which are described in item 3, below). 15A NCAC 02T .0105(j) requires the "proper closure" of permitted waste treatment systems (or parts thereof, such as lagoons, storage ponds, etc) before that permit (or parts thereof) can become inactive. The following guidelines provide clarification of what "proper closure" entails:
    - ✓ Guidelines for the Closure of Permitted Wastewater Ponds and Lagoons: http://portal.ncdenr.org/c/document_library/get_file?uuid=edc99438-42a1-4e53-b3ae-bb6768d7a557&groupId=38364
    - ✓ Guidelines for the Closure and Abandonment of Single Family Residence Irrigation Facilities: http://portal.ncdenr.org/c/document_library/get_file?uuid=f1c083fe-25dc-482d-aa67-7d3f722ed81f&groupId=38364
3. Compliance with rule 15A NCAC 02T .1306 for the closure of animal waste facilities.
    - ✓ Natural Resources Conservation Service Conservation Practice Standard Waste Facility Closure CODE 360: http://efotg.sc.egov.usda.gov/references/public/NC/NC360Closure_04-2012.pdf

E1.3.3) Addressing Contaminated Sites

Contamination from permitted facilities requires the installation of monitoring wells on the review and compliance boundaries. If exceedances are detected between the review and compliance boundaries, then 15A NCAC 02L .0106(d)(1) applies. If exceedances are detected at or beyond the compliance boundary, then 15A NCAC 02L .0106(d)(2) applies and a CSA must be done and a CAP must be implemented (refer to sections 1 through 6). For permitted facilities with no prior groundwater monitoring requirements, consult with the Policy for Compliance Evaluation of Long-Term Permitted Facilities with no Prior Groundwater Monitoring Requirements.

E1.4 Other

If you are unsure if regulatory oversight for a contamination incident lies with the DWR, contact your DWR Regional Office for guidance regarding assessment and corrective action requirements. Refer to Section 1 for a summary of the DWR's regulatory oversight and to the Memorandum of Agreement (Transfer of Incident Management Responsibilities from the Division of Water Quality to the DWM).

EXHIBIT 2. REGULATIONS AND POLICIES

Statutes

G.S. 87, Article 7 – NC Well Construction Act

G.S. 87, Article 7A – NC Well Contractors Certification Act

G.S. 143-215.1 – Control of sources of water pollution; permits required

G.S. 143-215.1A – Closed-loop groundwater remediation systems allowed

G.S. 143-214.1 – Water; water quality standards and classifications; duties of Commission

G.S. 143-214.2 – Prohibited discharges

G.S. 143-215.1C - Report to wastewater system customers on system performance; report discharge of untreated wastewater to the Department; publication of notice of discharge of untreated wastewater and waste.

G.S. 143-215.85 – Procedure to report oil discharges or discharges of pesticides regulated by the North Carolina Pesticide Board

Coal Ash Related Regulations- General Assembly of North Carolina Session 2013. Senate Bill 729. Information on requirements for closure plans begins on page 16 (§ 130A-309.212. Closure of coal combustion residuals surface impoundments).

Rules

15A NCAC 02B—Surface Water and Wetland Standards

15A NCAC 02C – Well construction standards

.0100 – criteria applicable to water supply and certain other wells

.0200 – criteria applicable to injection wells

15A NCAC 02H—Procedures for Permit: Approvals

15A NCAC 02L .0100-.0300 – Groundwater quality classifications and standards

15A NCAC 02T – Waste not discharged to surface water

15A NCAC 02U – Reclaimed water

Policies and Guidelines

The following policies are found on the Division of Water Resources website unless otherwise noted:

Memorandum of Agreement between the Division of Water Quality and the Division of Waste Management (MOA) In 2006, NCDENR (now DEQ) revised the soil and groundwater contamination incident responsibilities of the Division of Water Quality (DWQ) and the Division of Waste Management (DWM). Those responsibilities were outlined in a Memorandum of Agreement signed in 2007 by both divisions.

Hydrogeologic Investigations and Reporting Policy: This policy describes how to conduct hydrogeologic investigations and report the results. This document is applicable regardless of any references to a specific regulatory program, permit, or rule.

Performance and Analysis of Aquifer Slug Tests and Pumping Tests Policy: This policy describes how to collect information about aquifer hydraulic properties and includes guidance on selecting the most appropriate method as well as conducting and evaluating such tests. This document is applicable regardless of any references to a specific regulatory program, permit, or rule.

Groundwater Modeling Policy: This policy describes the criteria to be used when modeling groundwater flow, contaminant transport, and other aspects of conducting CSA and evaluating the effectiveness of CAPs. This document is applicable regardless of any references to a specific regulatory program, permit, or rule.

Policy for Compliance Evaluation of Long-Term Permitted Facilities with no Prior Groundwater Monitoring Requirements: This policy is used to determine whether 2L Standards have been exceeded at the compliance boundary for facilities with no prior groundwater quality requirements. If the permitted facility is determined to be in non-compliance, adherence to the corrective action requirements specified in 15A NCAC 02L .0106 is required.

Guidelines for the Closure of Treatment Ponds and Lagoons: This policy describes closure requirements for waste treatment and storage impoundments except those used for the management of coal ash and animal waste. The closure of animal waste lagoons must be done in accordance with the NC NRCS Standard No. 360.

Recommended Well Purge Volumes: This policy describes procedures for obtaining fresh groundwater from wells in a way that increases the likelihood of obtaining good samples and obtaining accurate analytical results.

Metals Determinations Required By 15A NCAC 02L: This policy describes the procedures for preparing and analyzing water samples for metals analyses to determine compliance with the requirements of the 2L Standards.

Evaluating Impacts to Surface Water from Discharging Groundwater Plumes**:** This guidance document is intended to aid WQROS staff in developing a strategy to collect data for the evaluation of potentially contaminated groundwater discharges to surface water.

Monitored Natural Attenuation Guidelines: (1) 15A NCAC 2L Implementation Guidance', Division of Environmental Management, December, 1995; and (2) Monitored Natural Attenuation for Inorganic Contaminants in Groundwater: Guidance for Developing Corrective Action Plans Pursuant to NCAC 15A .0106 (l), 2017.

EXHIBIT 3. CERTIFICATIONS, FORMS

E3.1 Certification for the Submittal of a Site Assessment (CSA)

DIVISION OF WATER RESOURCES

Certification for the Submittal of a Site Assessment

Responsible Party and/or Permittee: _____

Contact Person: _____

Address: _____

City: _____ State:_____ Zip Code: _____

Site Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Groundwater Incident Number (applicable): _____

I,_____, a NC-Licensed Professional Engineer/Professional Geologist (circle one) for _____(firm or company of employment) do hereby certify that the information indicated below is enclosed as part of the required Site Assessment (CSA) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _____ The source of the contamination has been identified. A list of all potential sources of the contamination is attached.
2. _____ Imminent hazards to public health and safety have been identified.
3. _____ Potential receptors and significant exposure pathways have been identified.
4. _____ Geological and hydrogeological features influencing the movement of groundwater have been identified. The chemical and physical characters of the contaminants have been identified.
5. _____ The CSA sufficiently characterizes the cause, significance and extent of groundwater and soil contamination such that a Corrective Action Plan can be developed. If any of the above statements have been altered or items not initialed, provide a detailed explanation. Failure to initial any item or to provide written justification for the lack thereof will result in immediate return of the CSA to the responsible party.

(Affix Seal, Sign, and Date)

E3.2 Certification for the Submittal of a Corrective Action Plan (CAP)

DIVISION OF WATER RESOURCES

Certification for the Submittal of a Corrective Action Plan Under 15A NCAC 02L .0106(d)(e)

Responsible Party and/or Permittee: _____

Contact Person: _____

Address: _____

City: _____ State:_____ Zip Code: _____

Site Name: _____

Address: _____

City: _____ State: _____ Zip Code: _____

Groundwater Incident Number (if applicable): _____

I,_____, a NC-Licensed Professional Engineer/Professional Geologist (circle one) for _____(firm or company of employment) do hereby certify that the information indicated below is enclosed as part of the required Corrective Action Plan (CAP) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _____ A description of the proposed CAP is provided and reasons for its selection.
2. _____ Specific plans for restoring groundwater quality to the level of the standards, including engineering details, where applicable, and identification of any permits that may be needed.
3. _____ A schedule for the implementation and operation of the proposed plan.
4. _____ A monitoring plan capable of evaluating the effectiveness of the proposed corrective action and the movement of contamination in the subsurface.

(Affix Seal, Sign, and Date)

E3.3 Certification for the Request to Terminate a Corrective Action Plan

E3.3.1) Groundwater Restored to the Level of the Standards

DIVISION OF WATER RESOURCES
Certification for the Request to Terminate a Corrective Action Plan
Groundwater Restored to the Level of the Standards

Responsible Party and/or Permittee: _____

Contact Person: _____

Address: _____

City: _____ State:_____ Zip Code:_____

Site Name: _____

Address: _____

City: _____ State:_____ Zip Code: _____

Groundwater Incident Number (if applicable): _____

I,_____, a NC-Licensed Professional Engineer/Professional Geologist (circle one) for _____(firm or company of employment) do hereby certify that the information indicated below supports termination of the required Corrective Action Plan (CAP) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _____ A demonstration that corrective action was implemented in accordance with the approved CAP.
2. _____ Analytical data demonstrating that contaminant concentrations in all monitoring wells have decreased to concentrations at or below the level of the standards for at least four consecutive quarters.

(Affix Seal, Sign, and Date)

E3.3.2) No Significant Contaminant Reduction and Groundwater Can Be Rendered Potable

DIVISION OF WATER RESOURCES

Certification for Request to Terminate a Corrective Action Plan Under 15A NCAC 02L .0106(n)

No Significant Contaminant Reduction and Groundwater Can Be Rendered Potable

Responsible Party and/or Permittee: _____

Contact Person: _____

Address: _____

City: _____ State:_____ Zip Code:_____

Site Name: _____

Address: _____

City: _____ State:_____ Zip Code: _____

Groundwater Incident Number (if applicable): _____

I,_____, a NC-Licensed Professional Engineer/Professional Geologist (circle one) for _____(firm or company of employment) do hereby certify that the information indicated below supports termination of the required Corrective Action Plan (CAP) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _____ A demonstration that corrective action has been implemented in accordance with the approved CAP.

2. _____ A discussion of the duration of the corrective action currently in progress, the total project cost, projected annual cost for continuance, and an evaluation of the success of the corrective action.

3. _____ An evaluation of alternate treatment technologies that could result in further reduction of contaminant levels at the site. Projected capital and annual operating costs for each technology are included.

4. _____ Potential problems generated if contaminant levels are allowed to remain at current levels. The discussion includes human health and safety as well as environmental concerns.

5._____ Demonstration that continuation of corrective action will not result in a significant reduction in the concentration of contaminants using the criteria specified in rule 15A NCAC 02L .0106(m)(2)(A). Data showing the degree of success of remedial efforts are enclosed. A plot of the curve of decontamination (contaminant concentration versus time) that shows an asymptotic slope and calculations that demonstrate the slope to be less than 1:40 are also included.

6 ._____ A demonstration that the remaining contaminated groundwater can be rendered potable by treatment using readily available and economically reasonable technologies. Such treatment technologies and representative costs are also included.

7._____ A request that the Director of the Division of Water Resources reclassify as RS the groundwater that is the subject of this CAP termination request. The reclassification request meets the criteria specified in rule 15A NCAC 02L .0104.

(Affix Seal, Sign, and Date)

E3.3.3) No Significant Contaminant Reduction and Groundwater Cannot Be Rendered Potable

DIVISION OF WATER RESOURCES

Certification for Request to Terminate a Corrective Action Plan Under 15A NCAC 02L .0106(n)

No Significant Contaminant Reduction and Groundwater Cannot Be Rendered Potable

Responsible Party and/or Permittee: _____

Contact Person: _____

Address: _____

City: _____ State:_____ Zip Code:_____

Site Name: _____

Address: _____

City: _____ State:_____ Zip Code: _____

Groundwater Incident Number (if applicable): _____

I,_____, a NC-Licensed Professional Engineer/Professional Geologist (circle one) for _____(firm or company of employment) do hereby certify that the information indicated below supports termination of the required Corrective Action Plan (CAP) and that to the best of my knowledge the data, assessments, conclusions, recommendations and other associated materials are correct, complete and accurate.

(Each item must be initialed by the certifying licensed professional)

1. _____ A demonstration that corrective action has been implemented in accordance with the approved CAP.

2. _____ A discussion of the duration of the corrective action currently in progress, the total project cost, projected annual cost for continuance, and an evaluation of the success of the corrective action.

3. _____ An evaluation of alternate treatment technologies that could result in further reduction of contaminant levels at the site. Projected capital and annual operating costs for each technology are included.

4. _____ Potential problems generated if contaminant levels are allowed to remain at current levels. The discussion includes human health and safety as well as environmental concerns.

5._____ Demonstration that continuation of corrective action will not result in a significant reduction in the concentration of contaminants using the criteria specified in rule 15A NCAC 02L .0106(m)(2)(A). Data showing the degree of success of remedial efforts are enclosed. A plot of the curve of decontamination (contaminant concentration versus time) that shows an asymptotic slope and calculations that demonstrate the slope to be less than 1:40 are also included.

6 ._____ A demonstration that the remaining contaminated groundwater cannot be rendered potable by treatment using readily available and economically reasonable technologies. Such treatment technologies and representative costs are also included.

7._____ A request that the Director of the Division of Water Resources reclassify the groundwater that is the subject of this CAP termination request as GC as described in rules 15A NCAC 02L .0201(3)(c) and 15A NCAC 02L .0319. This reclassification request includes documentation, data, analysis, and other information justifying the request.

(Affix Seal, Sign, and Date)

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