REQUEST FOR QUALIFICATIONS
ENGINEERING SERVICES
RFQ NO. 26-1011

catawba county
MAKING. LIVING. BETTER.

Date of Issue: February 24, 2026

Qualifications Statement Due Date: March 24, 2026

Time: 4:00 PM ET

Issued for:
Catawba County Utilities & Engineering
Solid Waste Division
25 Government Drive Newton,
North Carolina 28658 (828)
465-8261

Issued by:
Catawba County Purchasing Manager
25 Government Drive Newton,
North Carolina 28658 (828)
465-8224

INTRODUCTION

Catawba County (hereinafter "County") is soliciting the submittal of qualification statements from experienced Engineering Consulting Firms (hereinafter "Firm") interested in providing services to implement and maintain Catawba County's Water Quality Monitoring Plan for the Blackburn Resource Recovery Facility and the closed Bethany Church Road Landfill. The major activities that make up the scope of services include, but are not limited to, monitoring, sampling, testing, reporting, permitting, and updating the Water Quality Plan as needed. Eligible firms must have the ability to conduct all activities germane to Solid Waste Ground Water Monitoring Compliance.

Catawba County reserves the right to reject any and all submittals. This submittal request is neither a contractual offer nor a commitment to purchase services. The County assumes no contractual obligation as a result of the issuance of this request, the preparation or submission of a qualifications statement by a Firm, the evaluation of statements or final selection.

PURPOSE

This Request for Qualifications (RFQ) is being issued by the County for the purpose of soliciting Statements of Qualifications from Engineering Consulting firms for providing services including all aspects of sample collection, analysis, organization, and reporting in Solid Waste Ground Water Monitoring Compliance at the Blackburn Resource Recovery Facility and the closed Bethany Church Road Landfill for an initial term of three (3) years with the option to renew up to two (2) additional one (1) year terms, based on performance. Firms must show recent (last 5 years) and relevant experience in solid waste ground water monitoring compliance in North Carolina closed or active Subtitle D landfills, Pre Subtitle D landfills, and Construction & Demolition landfills.

RFQ SCHEDULE

The table below shows the *intended* schedule for this RFQ. Catawba County will make every effort to adhere to this schedule.

Event	Responsibility	Date and Time
Issue RFQ	County	February 24, 2026
Submit Written Questions	Firms	March 13, 2026 at 5:00 PM ET
Provide Responses to Questions	County	March 16, 2026 at 5:00 PM ET
Submit Proposals	Firms	March 24, 2026 at 4:00 PM ET
Contract Award	County	TBA
Contract Effective Date	County	Upon execution

Statements of Qualifications shall be submitted no later than 4:00 PM on March 24, 2026. No submittals will be accepted after the deadline.

Once the submittals have been reviewed, the County reserves the right to shortlist Firm(s) and request that the Firm(s) conduct a presentation and be interviewed by the selection committee.

RFQ QUESTIONS

Written questions shall be emailed to tinawright@catawbacountync.gov by the date and time specified above. Firms should enter "RFQ # 26-1011 – Questions" as the subject for the email. Questions received prior to the submission deadline date, the County's response, and any additional terms deemed necessary by the County will be posted in the form of an addendum to the Catawba

County website, https://www.catawbacountync.gov/county-services/purchasing/bid- notices/ and shall become an Addendum to this RFQ. No information, instruction or advice provided orally or informally by any County personnel, whether made in response to a question or otherwise in connection with this RFQ, shall be considered authoritative or binding. Firms shall rely *only* on written material contained in an Addendum to this RFQ.

SUBMISSION OF QUALIFICATIONS

Statements of Qualifications must be submitted with one (1) original, one (1) copy and one (1) electronic copy on flash drive. When responding to this RFQ, please follow all instructions carefully. Please submit proposal contents according to the outline specified. Failure to follow these instructions may be considered a non-responsive submission and may result in immediate elimination from further consideration. The qualifications statement should be sent to the address indicated in the table below.

Mailing address for delivery of proposal via US Postal Service	**Office Address of delivery by any other method (hand delivery, overnight, or any other carrier)**
RFQ Number: RFQ 26-1011 Catawba County Government Center Attn: Purchasing Department Post Office Box 389 Newton, North Carolina 28658	RFQ Number: RFQ 26-1011 Catawba County Government Center Attn: Purchasing Department 25 Government Drive Newton, North Carolina 28658

IMPORTANT NOTE: All qualifications shall be physically delivered to the office address listed above on or before the submission deadline in order to be considered timely, regardless of the method of delivery. **This is an absolute requirement.** All risk of late arrival due to unanticipated delay—whether delivered by U.S. Postal Service, courier or other delivery service is entirely on the Firm(s). It is the sole responsibility of the Firm to have the qualifications physically in this Office by the specified due date and time.

BACKGROUND

Blackburn Resource Recovery Facility

The Facility site is 567.95 acres and is located approximately 6 miles south of Hickory, along Rocky Ford Road. The Facility has an approved Permit 1803-MSWLF-1997, from the North Carolina Department of Environmental Quality (NCDEQ), Division of Solid Waste Management. Four (4) solid waste disposal facilities are maintained by Catawba County at the Blackburn site. The facilities are as follows:

- Blackburn Subtitle D Facility (Units 2, 3, and 4): an active MSW landfill on the south side of Rocky Ford Road.
- Blackburn Closed Pre-Subtitle D Facility (Unit 1): a closed MSW Landfill which is contiguous with the southeast side of Unit 2 and south side of Unit 3.
- Blackburn Closed C&D Facility (C&D Unit 2) a C&D Landfill located to the south of the active Subtitle D Unit 2 and west of the closed portion of Unit 1.
- Closed C&D Landfill (C&D Unit 1) located across Rocky Ford Road to the North of Unit 3 MSW.

The Blackburn Resource Recovery Facility also consists of the following additional active waste management operations: Residential drop off area, mulching and grinding treatment and processing facility, a small Type-1 composting facility, a scrap tire collection operation, a white goods collection area, and a covered paint and electronics storage/recycling area.

Bethany Church Road Landfill

The Bethany Church Road (Newton) Landfill site is approximately 163.99 acres of which, approximately 67.3 acres is Pre-Subtitle D Landfill that closed in 1990 and has an approved Permit 1801-MSWLF-1973 from the North Carolina Department of Environmental Quality (NCDEQ), Division of Solid Waste Management. The site is located approximately 2.5 miles southeast of Newton, along Bethany Church Road. The Facility is owned and managed by Catawba County.

SCOPE OF SERVICES

The Firm shall provide professional consulting services to include sample collection, analysis, organization, and reporting in accordance with site specific water quality plans and all applicable federal, state, and local regulations. Maintaining a historic database of water sampling constituents' exceedances to track trends is expected. Services will be for both sites, the Blackburn Resource Recovery Facility and the closed Bethany Church Road Landfill on a Semi-Annual basis. Sampling events will be performed in March and September unless directed otherwise by federal, state, or local regulations. Water Quality Plans for each site are included in Appendix 1 and 2. PFOS and PFOA sampling will be included in semi-annual events. Updating Groundwater Monitoring Plans as necessary due to MSW cell expansion or changes in State requirements.

Blackburn Groundwater Monitoring Wells:

Monitoring Well ID	Classification	Monitoring Program	Required Analyses
MW-20	Background (MSW Units 1,2,3,&4)	Assessment	NC Appendix I & 1,4 Dioxane
MW-5	MSW Unit 1 Compliance (Pre-Subtitle D)	Assessment	NC Appendix I & 1,4-Dioxane
MW-5A			
MW-6D			
MW-7			
MW-11			NC Appendix I
PZ-85B			
PZ-86B			
MW-12R	Sub-Title D MSW-Unit 2 Compliance	Detection	NC Appendix I & 1,4-Dioxane
MW-13			
MW-14			
MW-15			
MW-16			
MW-17			

MW-31R MW-32 MW-33R MW-35 MW-36	Sub-Title D MSW – Unit 3 Compliance	Detection	NC Appendix I & 1,4-Dioxane
MW-37 MW-38 MW-39A MW-40 MW-41 MW-42A MW-42C MW-43	Sub-Title D MSW- Unit 4 Compliance	Detection	NC Appendix I & 1,4-Dioxane
MW-2 MW-26 MW-27	C&D Unit 1 Compliance	Detection	NC Appendix I VOCs; 8 RCRA metals; THF; & 1,4 Dioxane
MW-21	Background (C&D Unit 2 only)	Detection	NC Appendix I VOCs; 8 RCRA metals; THF; & 1,4 Dioxane
MW-24 MW-25 MW-28 MW-29 MW-30	C&D Unit 2 Compliance		
Leachate	Sub-Title D MSW Facility		NC Appendix I, 1,4-Dioxane, COD, BOD, Nitrate, Sulfate, & Orthophosphate

Surface Water Monitoring Program

- MSW Unit 1 – Surface Water locations SW-1 and SW-3
- MSW Unit 2 – Underdrains U-1, U-2, and U3
- MSW-Unit 3 – SW-4, and SW-5

Bethany Church Road Landfill Monitoring Wells: Groundwater is monitored in accordance with NCSWMR 15A NCAC 13B Section .0601 for Landfills closed before October 9, 1993. Facility is currently in a Corrective Action Program.

Monitoring Well ID	Classification	Monitoring Program	Required Analyses
MW-23	Background Well	Assessment	NC Appendix I, VOC, 1,4-Dioxane, Total Chromium, Nickel, & Lead
MW-1, MW-3, MW-9, MW-10A, MW-10B, MW-11, MW-13, MW-14, MW-14A, MW-15, MW-16, MW-16A, MW-20, MW-21, MW-23, MW-24, MW-24D, OW-1, & OW-3, MW-25, MW-26, W-26D, & MW-27	Compliance	Assessment	NC Appendix I, VOC, 1,4-Dioxane, Total Chromium, Nickel, & Lead
MW-5, MW-6, MW-7A, MW-12, MW-18, MW-19	Monitoring		Groundwater Elevations

Surface Water Monitoring Program:

- **CR-1** and **SW-2** – Analyzed for NC Appendix I metals, VOC, and 1,4-dioxane

CONTENTS OF QUALIFICATIONS STATEMENT

Respondents must carefully read the information in this "Contents of Qualifications Statement" section and submit a complete Qualifications Statement responding to each request for information. Incomplete Qualifications Statements will be considered non-responsive and are subject to rejection.

Qualifications shall be submitted on 8-1/2 x 11 paper, side bound with Table of Contents and reference tabs for key sections. The qualification statement must be submitted with one (1) original, one (1) copy and one (1) electronic copy on flash drive.

Qualification Statement must include all of the following information:

1. **Introduction – Letter of Transmittal**
   - Summarize in a brief and concise manner the Firm's understanding of the scope of work and make a positive commitment to perform the work in a professional and timely manner.

2. Qualifications of Firm

Please provide:

- General work plan that demonstrates the consultant's complete understanding of the scope of work.
- Company's recent (last 5 years) relevant experience in water quality compliance in North Carolina closed or active pre and post Subtitle D landfills.

Previous project success for projects of same or similar scope as this project.

- Please list the North Carolina Certified lab that will be used for sample analysis and provide proof of lab certification.
- Overall qualifications of project managers and key personnel.
- Overall experience with:
  - Sampling monitoring wells
  - Reporting results
  - Water Quality monitoring plan development
- Provide a summary of any litigation, claim(s), or contract dispute(s) filed by or against the Firm in the past five (5) years that are related to the services that the Firm provides in the regular course of business. The summary shall state the nature of the litigation, claim, or contract dispute; a brief description of the case; the outcome or projected outcome; and the monetary amount involved. If no litigation claim(s) or contract dispute(s) have been filed by or against the Firm in the past five (5) years, please state that. List any regulatory or license agency sanctions. If no license sanctions against the Firm, please state that.

3. Project Management and Key Personnel

Please provide:

- Firm staff resumes that show experience in North Carolina for staff assigned to this project.
- Statement of qualifications of the firm and its key personnel who will be assigned to work with the County.
- List of personnel who will work on the project including their specific qualifications and experience on projects of similar scope.
- List any professional training and experience, especially in relation to the type and magnitude of work required for this particular scope of services.
- List any licenses or certifications related to the scope of work described in this Request for Qualifications
  .
- Describe the Firm's approach to and/or method of cost control and project scheduling.
- Current workload and percentage of availability of key personnel.
- Hourly billing rates charged by your Firm for each position type.

4. References – Past Performance and Existing Contracts

Please provide:

- List of previous and current clients for work similar to this scope of work within the past five (5) years. Include names and location of project, brief description and firm's key personnel's involvement, name of project manager and telephone number, date and value of project. In addition, please complete Attachment A: Reference Disclosure Form and submit it with qualifications.

EVALUATION METHOD - SELECTION PROCESS

Catawba County will use the following selection process. This process is designed to ensure that consultants are selected in a fair and uniform manner, those selected for work are qualified and experienced in the professional services desired, and to ensure that every qualified consultant has the opportunity to be considered for providing professional services to Catawba County.

A Selection Committee will evaluate responses to the Request for Qualifications and determine the most qualified applicants. Upon receipt of the packages from respondents, the Selection Committee will review using a scoring program that has been determined by the committee and detailed below. Past performance will be scored based on responses from the references submitted by the responder and/or the experience of Catawba County staff with particular firm's past performance. Only one reviewer will contact any given reference.

The Selection Committee will use the total point scores to rank the prospective Firms. The Selection Committee will determine a list of the most highly qualified Firms based upon the ranking scores. Once the Firms are selected, authorization will be sought from the Catawba County Board of Commissioners for contract award.

EVALUATION CRITERIA

The Content of Qualifications Statement, as referenced above, shall be evaluated as follows:

Description	Total Possible Points
Qualification of Firm:	
• Success of Previous Projects (i.e. still in operation, how long in operation, etc.). Have there ever been violations consent orders on sites where you have worked?	15
• Writing or updating Site Water Quality Monitoring Plans	15
• Project Understanding	5
• Water Quality sampling/reporting experience (NC Only)	10
• Previous/Pending Litigation	5
Project Management and Key Personnel:	
• Experience on similar projects (NC Only)	10
• Projects on time and on budget.	5
• Water Quality sampling and reporting experience (NC Only).	10
• Professional Training/Qualification	10
• Workload and Availability	5
• Cost Control/Scheduling	3
• Relevant Licenses/Certifications	3
References – Past Performance and Existing	4
	100

FIRM INSURANCE REQUIREMENTS

The successful Firm will be required to provide the County with Certificates of Insurance meeting the County's insurance requirements at the time of project award as specified below. Failure to provide the required insurance will result in cancellation of the selection and the County will have the right to enter into an agreement with the Firm with the next highest ranking. Firm shall maintain at all times during the term of this Agreement, at the Firm's sole expense:

I. Commercial General Liability Insurance

Firm shall maintain Commercial General Liability insurance written on an occurrence basis, including coverage for products and completed operations liability, contractual liability, liability from independent contractors, property damage liability, bodily injury liability, and personal injury liability with limits of not less than $1,000,000 per occurrence and $2,000,000 annual aggregate. The aggregate limit shall apply separately to each location. The limits may be satisfied by a combination of primary and excess insurance.

II. Professional Liability Insurance

Firm shall maintain Professional Liability insurance with limits of not less than $1,000,000 per claim and $2,000,000 aggregate.

III. Business Automobile Insurance

At all times while the Firm's representatives are conducting on-site work, the Firm shall maintain Automobile Liability insurance for any owned, hired, rented, or borrowed vehicle with a limit of not less than $1,000,000 per occurrence for bodily injury and property damage liability. The limit may be satisfied by a combination of primary and excess insurance.

IV. Workers Compensation & Employers Liability Insurance

At all times while the Firm's representatives are conducting on-site work, Firm shall maintain statutory Workers Compensation insurance in accordance with the laws of North Carolina. Firm shall also maintain Employers' Liability insurance with limits of not less than $500,000 per accident and $500,000 each employee for injury by disease.

V. General Requirements

1. Catawba County shall be named as an additional insured under Firm's automobile and general liability insurance. In the event of a loss arising out of, or related to the Firm's services performed under this Agreement, Firm's Liability insurance shall be primary (pay first) with respect to any other insurance which may be available to the County, regardless of how the "other insurance" provisions may read.
2. The Firm's Workers Compensation insurance must contain a waiver of subrogation in favor of the County.
3. Firm shall be responsible for insuring all of its own personal property, improvements, and betterments.
4. All insurance policies put forth to satisfy the above requirements shall require the insurer to provide a minimum of sixty (60) days' notice to the

County of any material change in coverage, cancellation, or non-renewal.

5. All insurance put forth to satisfy the above requirements shall be placed with insurance companies licensed to provide insurance in the state of North Carolina. Any deductibles or self-insured retentions in the required insurance shall be subject to approval by the County.

6. Prior to execution of contract, Firm shall provide written evidence of insurance as requested by the County to confirm that these insurance requirements are satisfied. Firm agrees to indemnify County if the insurance policy referenced in the COI does not contain, at a minimum, the coverage amounts listed on the COI. Firm agrees to provide complete copies of policies if requested. Failure of Firm to provide timely evidence of insurance, or to place coverage with insurance, or to place coverage with insurance companies acceptable to the County, shall be viewed as Firm's delaying performance entitling the County to all appropriate remedies under the law including termination of the contract.

ATTACHMENT A

REFERENCE DISCLOSURE FORM

Firm shall provide information regarding experience in work similar this scope of work by listing FIVE (5) RECENT CLIENTS, ONLY ONE OF WHICH MAY BE A CATAWBA COUNTY GOVERNMENT LISTING. References should be clients of a similar scale to the services requested in this RFQ.

1. COMPANY NAME: _____

   PERSON TO CONTACT: _____

   TELEPHONE NUMBER: _____

   TYPE OF SERVICE PROVIDED: _____

   SIZE: _____

   JOB DATES:
   BEGINNING_____ END_____

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2. COMPANY NAME: _____

   PERSON TO CONTACT: _____

   TELEPHONE NUMBER: _____

   TYPE OF SERVICE PROVIDED: _____

   SIZE: _____

   JOB DATES:
   BEGINNING_____ END_____

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3. COMPANY NAME: _____

   PERSON TO CONTACT: _____

   TELEPHONE NUMBER: _____

   TYPE OF SERVICE PROVIDED: _____

   SIZE: _____

   JOB DATES:
   BEGINNING_____ END_____

4. COMPANY NAME: _____

PERSON TO CONTACT: _____

TELEPHONE NUMBER: _____

TYPE OF SERVICE PROVIDED: _____

SIZE: _____

JOB DATES:
BEGINNING_____END_____

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5. COMPANY NAME: _____

PERSON TO CONTACT: _____

TELEPHONE NUMBER: _____

TYPE OF SERVICE PROVIDED: _____

SIZE: _____

JOB DATES:
BEGINNING_____END_____

Operation Plan

Appendix D – Water Quality Monitoring Plan

CERTIFICATION OF EFFECTIVENESS

The following statement is based on existing site conditions as of December 12, 2017 and data currently available on subsurface conditions and groundwater flow at the Blackburn Resource Recovery Facility – Unit 3 Phase 2 Expansion. Additionally, it is our professional opinion that construction of a landfill may alter subsurface conditions.

In accordance with North Carolina Solid Waste Management Rule .1631(d)1, I hereby state to the best of my knowledge, information and belief and in my professional opinion as a geological professional, that the water quality monitoring system will be effective in providing detection of a release of hazardous constituents from the Blackburn Resource Recovery Facility – Unit 3 Phase 2 Expansion to the uppermost aquifer, provided the system is operated and maintained properly.

12/12/2017

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Section 1
Introduction

1.1 Purpose

The purpose of this Water Quality Monitoring Plan is to address the requirements in Rule .1623(b)(3)(B), and to present a plan for groundwater and surface water monitoring for the Blackburn Resource Recovery Facility. The Water Quality Monitoring Plan includes information on the Unit 3 Phase 2 Expansion of the existing groundwater monitoring network, surface water monitoring plan, sampling and analysis requirements, and detection monitoring requirements. The groundwater monitoring network was designed based on information obtained from recent and previous subsurface investigations and a review of literature pertaining to regional geology and groundwater resources. A detailed discussion of the geologic and hydrogeologic conditions at the Blackburn Resource and Recovery Facility is presented in the Design Hydrogeologic Report for the Unit 3 Phase 2 area. A copy of the Solid Waste Section guidance document for Groundwater, Soil, and Surface Water Sampling is provided in Appendix A for reference purposes.

1.2 Scope

The Water Quality Monitoring Plan includes the following elements, in accordance with Rules .1630 through .1637 of the North Carolina Administrative Code:

- Design and installation of a groundwater monitoring system, based on site-specific information, to yield groundwater samples from the uppermost aquifer that represents the quality of the background groundwater that has not been affected by landfill activities or other man-made activities.
- Design and installation of groundwater monitoring system, based on site-specific information, to yield groundwater samples from the uppermost aquifer that represent the quality of groundwater passing the relevant point of compliance.
- Monitor wells designed and constructed in accordance with the applicable North Carolina Well Construction Standards as found in 15A NCAC 2C.
- A Sampling and Analysis Plan that includes procedures and techniques for sample collection, sample preservation and shipment, analytical procedures, chain-of-custody procedures, and quality assurance and quality control.
- A certification of effectiveness of the water quality monitoring plan is provided.

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Section 2
Geologic Setting

The Blackburn Resource Recovery Facility is located within the Inner Piedmont Belt of the Piedmont Physiographic Province. The Piedmont Physiographic Province in North Carolina is characterized by gentle to steep, hilly terrain with small quantities of alluvium. Bedrock outcroppings generally occur by regolith, which consists of residuum and saprolite. Beneath the saprolite is a transition zone of partially weathered bedrock. In the Piedmont, the thickness of regolith (residuum, saprolite, and partially weathered rock) above unweathered bedrock averages about 52 feet, and in some cases, may exceed depths of 100 feet (Daniel, 1990). The Inner Piedmont, is bounded on the northwest by the Brevard Fault zone and on the southeast by the Kings Mountain Belt and faults and shear zones that define the central Piedmont structure.

The topography at the site is typical of the Inner Piedmont with rolling hills and ridges intersected by smaller incised drainage features and larger stream valleys. Elevations at the site range from 800 feet msl near the southern portion of the site up to 900+ feet msl along the ridges and hilltops. Surface drainage for the entire Blackburn Resource Recovery Facility is dictated by several drainage features that ultimately discharge to the south, offsite to the South Fork of the Catawba River.

2.1 Regional and Local Geology

Detailed mapping and information regarding stratigraphy is somewhat lacking in many areas of the Inner Piedmont in North Carolina. Generally, the Inner Piedmont Belt is characterized by medium to high grade metamorphic rocks ranging from marble to schist to gneiss intruded by varying age plutons. The “parent” rocks of the existing rocks consisted mostly of greywacke sandstones and siltstones, and mafic lavas (Davis, 1993).

Rock units depicted on the North Carolina Geologic Survey - Geologic Map of North Carolina (1985) in the vicinity of the investigation area include interlayered; minor layers and lenses of hornblende gneiss, metagabbro, mica schist, and granitic rock of the Inner Piedmont, Chauga Belt, Smith River Allochthon, and Sauratown Mountain belts. The gneiss is described as gray to dark gray, thin to thick layered biotite-quartz-felspar gneiss, partly garnetiferous, locally inequigranular and porphyroblastic. The gneiss may be interlayered with mica schist, or amphibolite and locally contains small masses of granite.

Based on observations and data collection during this and the previous subsurface explorations at the site, the site geology appears to be consistent with the regional mapping described on the Geologic Map of North Carolina. Rock cores were all described as biotite gneiss with localized granite masses. No outcrop was encountered on the site.

Natural processes have weathered the bedrock by chemical alteration of the rock minerals to form saprolite that extends to varying depths below the ground surface. The texture and depth of saprolite development varies with the degree of weathering, which in turn, is related to the mineralogic composition and structure of the native material.

2.2 Regional and Local Hydrogeology

The transition zone beneath the saprolite is generally the zone in which most lateral groundwater flow takes place (Daniel, 1987). This zone has the permeability of the crystalline material enhanced by shrink and swell cracking caused by the hydration of mineral grains. Weathering of grains in the transition zone is much less than in the saprolite, where formation of clay minerals by weathering often inhibits groundwater flow. Groundwater flow in the transition zone generally mirrors surface topography, although the relief of the water table is usually less than that of the topography. The aquifer lithology at the facility consists of silty sand. It is unconfined and generally follows the topography. At the facility, the shallow aquifer is the most significant water-bearing zone.

The depth of the water table is also largely controlled by topography. The water table is generally close to the ground surface in valley bottoms, and at greatest depths beneath ridge tops. At the facility, water table divides often coincide with topographic divides, resulting in discharge at streams, where the water table intersects with the topographic low points in the area.

The occurrence and movement of groundwater in bedrock is generally restricted to fractures and other discontinuities as the crystalline minerals have little primary porosity. Bedrock fractures are generally most numerous and have the largest openings near the top of the transition zone. The amount and location of groundwater in the unweathered bedrock may vary greatly depending on the depth, openness, and degree of connection between fractures.

Section 3

Proposed Groundwater Monitoring Network

This section presents the groundwater monitoring network for the Blackburn Resource Recovery Facility and the proposed Unit 3 Phase 2 Expansion. Section 3.1 presents proposed monitoring well locations, Section 3.2 discusses monitoring well installation and construction specifications, Section 3.3 discusses hydraulic conductivity testing of the monitoring wells, Section 3.4 discusses the surface water quality monitoring, and Section 3.5 discusses leachate monitoring.

3.1 Monitoring Well Locations

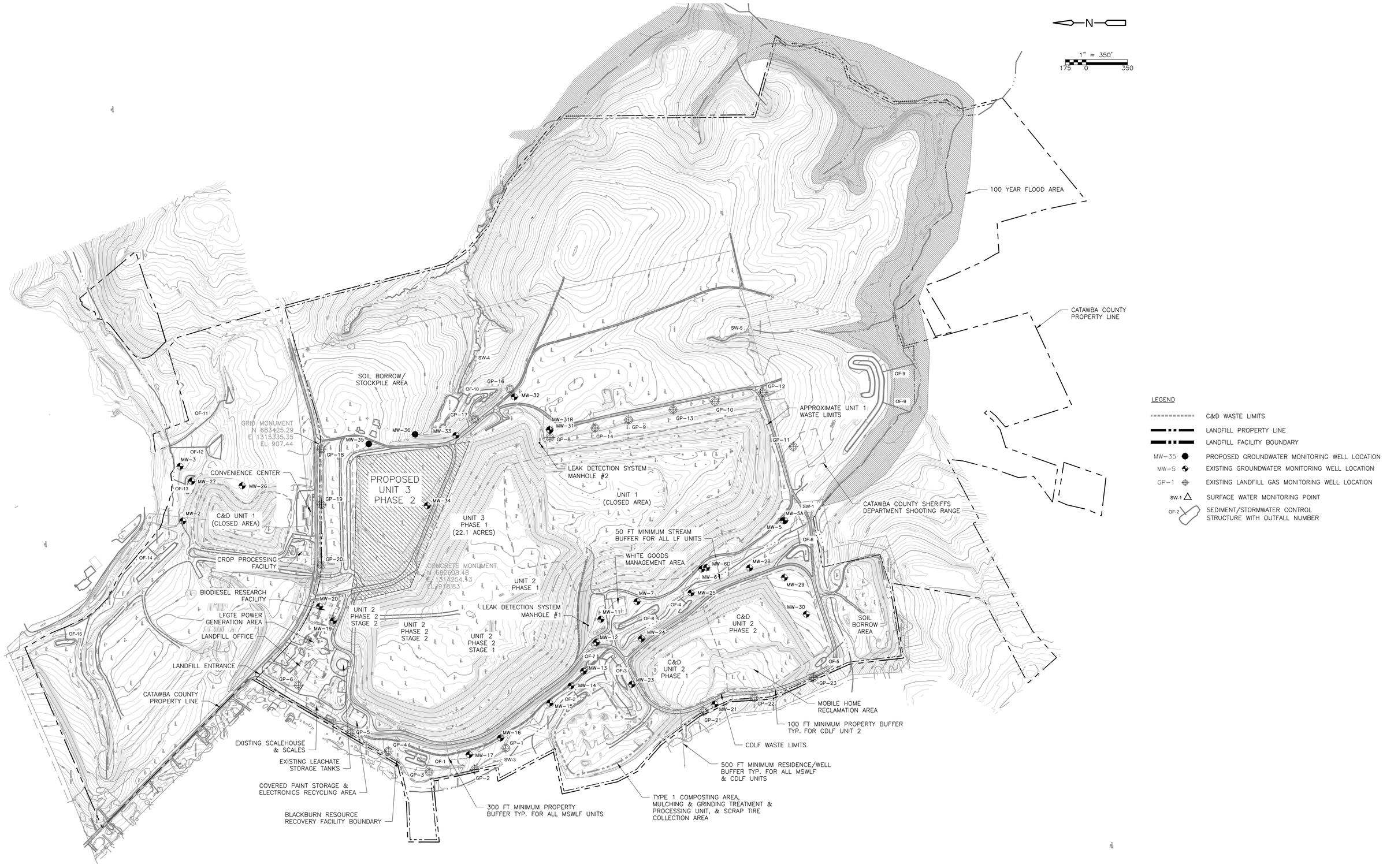
The Blackburn Resource and Recovery Facility consists of four landfill areas including a closed, unlined landfill designated as Unit 1, the Subtitle D Municipal Solid Waste (MSW) Landfills designated as Units 2 and 3, a closed Construction and Demolition (C&D) Landfill designated as C&D Unit 1, and an active C&D Landfill designated as C&D Unit 2.

The SWS regulations require that upgradient monitoring well(s) be located so that groundwater samples collected from the uppermost aquifer provide an indication of background groundwater quality. Existing background monitoring well MW-20 is located upgradient of the Unit 1, MSW Units 2 and 3, and C&D Unit 1 areas as well as the proposed expansion area in a location sufficient for background monitoring. Monitoring well MW-21 is located upgradient of C&D Unit 2 and serves as a background well for this area. No additional background wells are recommended at this time.

Catawba County maintains a system of groundwater monitoring wells to monitor water quality at the Blackburn Resource and Recovery Facility. The current wells included in each landfill area are listed below. The locations of the groundwater monitoring wells are shown on **Sheet 3-1**. This sheet shows the planned Unit 3 Phase 2 expansion, the existing conditions for the entire landfill, and the relationship of the monitoring wells to the phases.

- Unit 1: MW-5, -5A, -6, -6D, -7, -11, PZ-85B, and -86B
- MSW Unit 2: MW-12 through -17
- MSW Unit 3: MW-31 through -34
- C&D Unit 1: MW-2, -26, and -27
- C&D Unit 2: MW-21, -25, and -28 through -30

The downgradient monitoring wells must represent groundwater quality at the relevant point of compliance. The wells must be located in similar geologic units so that upgradient and downgradient groundwater quality data can be compared. Current downgradient wells MW-31 through -34 were installed as part of the Unit 3 Phase 1 Expansion. These wells are located to the south and southeast of the Unit 3 Phase 2 Expansion area and are shown on **Sheet 3-1** as follows.



CDM Smith

DATE: OCTOBER 2017

CATAWBA COUNTY
CATAWBA COUNTY, NORTH CAROLINA
BLACKBURN MSW LANDFILL
UNIT 3, PHASE 2

MONITORING PLAN MAP

PROJECT NO. 6717-115466
FILE NAME:

SHEET NO.
3-1

There are no existing compliance wells located east of the proposed Unit 3 Phase 2 Expansion boundary. Therefore, CDM Smith is proposing the installation of two additional compliance wells (MW-35 and -36) to target areas downgradient of the expansion area to the east. No additional wells will be required. **Table 3-1** shows the proposed monitoring well completion depths along with a construction summary for the existing groundwater monitoring wells at the facility. The proposed monitoring well locations were selected based on groundwater flow direction and are presented on Sheet 3-1.

3.2 Monitoring Well Installation and Construction

The new monitoring wells will be constructed in accordance with standard industry procedures and will meet the requirements of 15A NCAC 2C. An example of a typical shallow monitoring well is shown on **Figure 3-1**. The monitoring well will be installed by advancing the borehole through the water table using hollow-stem auger techniques. If running sands present a problem during drilling, mud rotary techniques will be used. Soil samples will be collected at five-foot intervals with a split spoon sampler in accordance with ASTM D-1586 in order to log the borehole. If possible, 1 Shelby Tube will be collected and analyzed for porosity and hydraulic conductivity. Soil lithology will be described in the field by an onsite geologist to develop a borehole log.

The monitoring wells will be constructed using 2-inch ID polyvinyl chloride (PVC) well casing with threaded flush joints. The shallow monitoring well will be constructed with fifteen feet of 0.010-inch slot screen at the end of the casing string placed so that it brackets the water table, if possible. The PVC casing string will extend approximately three feet above ground surface. A sand pack will be placed around the screen interval to a maximum of two feet above the top of the screen. A two foot thick bentonite seal consisting of hydrated bentonite pellets will be placed on top of the sand to hydraulically seal the completion interval. The remainder of the annulus will be sealed with a bentonite-Portland cement grout to ground surface. A protective outer casing with a lockable cap will be placed over the PVC casing and into the grout, extending 2.5 to 3 feet below ground surface.

Following completion, the monitoring wells will be developed to remove the residual effects of drilling. The wells will be developed using a combination of surging and over-pumping. All drilling and downhole equipment will be decontaminated by steam cleaning prior to use. Well development equipment will be decontaminated by washing in a non-phosphate detergent solution followed by a potable water rinse, then a distilled water rinse, and allowed to air dry.

The horizontal location of the new monitoring wells will be surveyed in State Plane Coordinates by a Registered Land Surveyor to the nearest 0.1 foot. The vertical control or elevation of the top of PVC casing (the well measuring point) will be surveyed to the nearest 0.01 foot accuracy to mean sea level. The height of the well measuring point above ground surface will be measured.

3.3 Hydraulic Conductivity Testing

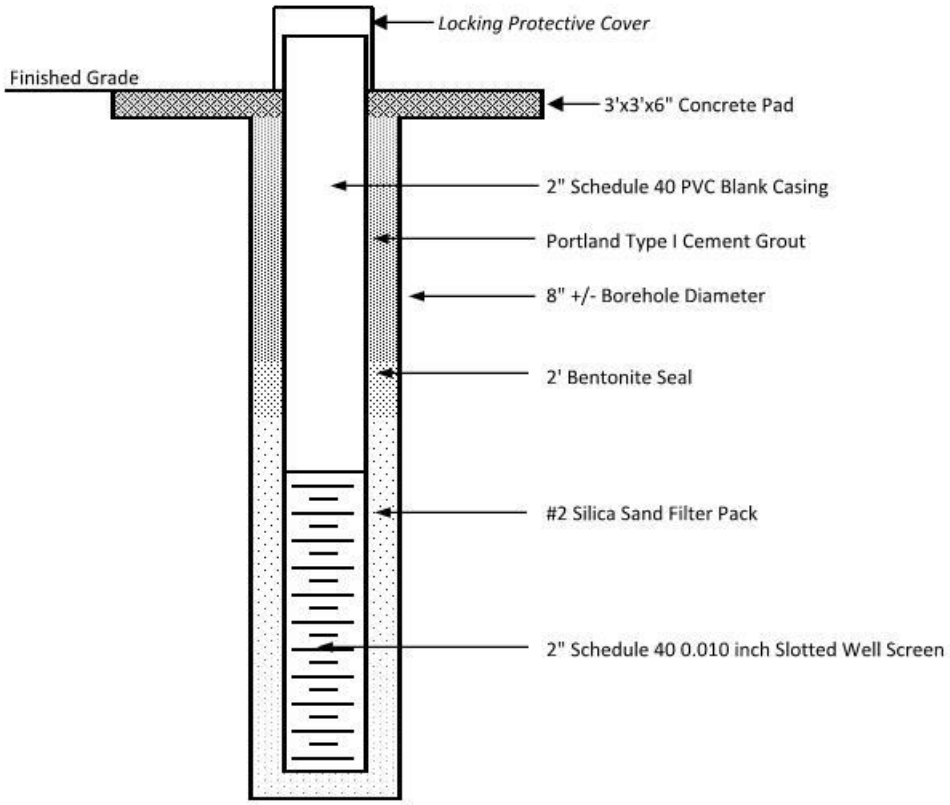
Following installation and development of the new monitoring wells, the hydraulic conductivity of the aquifer material surrounding each well will be determined by conducting slug falling head and/or recovery tests on each well. If possible, during drilling operations, 1 saturated sample will be collected for laboratory testing of porosity.

Table 3-1 Monitoring Well Construction Summary
Blackburn Resource and Recovery Facility
Water Quality Monitoring Plan

Monitoring Well Designation	Date of Installation	TOC Elevation (MSL)	Ground Elevation (MSL)	Depths (feet below ground surface)					Borehole Diameter (inches)	Casing Diameter (inches)
				Borehole Sampling Maximum Depth	Well Total Depth	Screen Interval	Filter Interval	Seal Interval		
Existing Closed Unit 1 Monitoring Wells										
MW-5	26-Aug-94	823.32	820.82	U	15.0	5.0 - 15.0	U	U	U	2.0
MW-5A	2-Jun-94	822.79	819.99	U	46.0	36.0 - 46.0	U	U	U	2.0
MW-6	23-Aug-94	829.36	827.35	U	15.0	5.0 - 15.0	U	U	U	2.0
MW-6D	U	829.93	826.66	U	50.3	40.3 - 50.3	U	U	U	2.0
MW-7	24-Aug-94	842.49	840.09	U	15.0	5.0 - 15.0	U	U	U	2.0
MW-11	9-Dec-97	852.25	850.75	U	25.0	10.0 - 25.0	U	U	U	2.0
PZ-85B	U	879.89	877.29	U	41.6	36.6 - 41.6	U	U	U	2.0
PZ-86B	U	867.24	864.54	U	54.9	49.9 - 54.9	U	U	U	2.0
Existing Subtitle D Unit 2 Monitoring Wells										
MW-12	25-Sep-95	852.89	847.50	U	17.0	7.0 - 10.0	U	U	U	2.0
MW-13	8-Dec-97	842.61	840.96	U	16.5	6.5 - 10.5	U	U	U	2.0
MW-14	8-Dec-97	844.52	842.82	U	13.0	5.0 - 13.0	U	U	U	2.0
MW-15	8-Dec-97	846.11	844.31	U	13.0	5.0 - 13.0	U	U	U	2.0
MW-16	9-Dec-97	857.16	854.96	U	20.0	5.0 - 20.0	U	U	U	2.0
MW-17	9-Dec-97	867.69	865.89	U	20.0	5.0 - 20.0	U	U	U	2.0
Existing Subtitle D Unit 3 Monitoring Wells										
MW-20	U	926.08	922.83	U	43.3	28.3 - 43.3	U	U	U	2.0
MW-31	23-Sep-16	887.50	884.90	30.0	29.3	14.3 - 29.3	12.4 - 29.3	6.5 - 12.4	8.0	2.0
MW-32	6-Nov-07	884.71	881.33	30.0	29.6	14.4 - 29.6	12.5 - 29.6	8.0 - 12.5	8.0	2.0
MW-33	22-Jul-08	882.08	879.41	30.0	27.1	11.8 - 27.1	9.0 - 27.1	6.8 - 9.0	8.0	2.0
MW-34	22-Jul-08	897.74	895.01	25.3	25.1	9.9 - 25.1	8.0 - 25.1	4.6 - 8.0	8.0	2.0
Existing C&D Unit 1 Monitoring Wells										
MW-2	U	866.65	864.30	U	21.6	U	U	U	U	2.0
MW-26	U	871.20	867.35	U	18.8	3.8 - 18.8	U	U	U	2.0
MW-27	U	862.08	858.48	U	24.4	9.4 - 24.4	U	U	U	2.0
Existing C&D Unit 2 Monitoring Wells										
MW-21	U	924.85	922.23	U	57.6	42.6 - 57.6	U	U	U	2.0
MW-25	U	830.31	827.51	U	12.8	1.8 - 12.8	U	U	U	2.0
MW-28	25-Jun-07	825.31	822.26	U	10.7	1.7 - 10.7	U	U	U	2.0
MW-29	25-Jun-07	839.26	836.33	U	19.8	4.8 - 19.8	U	U	U	2.0
MW-30	22-Jun-07	847.26	844.53	U	19.7	4.7 - 19.7	U	U	U	2.0
Proposed Unit 3 Phase 2 Monitoring Wells (anticipated construction)										
MW-35	TBD	TBD	TBD	25.0	25.0	10.0 - 25.0	8.0 - 25.0	6.0 - 8.0	8.0	2.0
MW-36	TBD	TBD	TBD	25.0	25.0	10.0 - 25.0	8.0 - 25.0	6.0 - 8.0	8.0	2.0

Notes:

1. Monitoring Well locations are shown on Sheet 3-1
2. TOC - Top of Casing
3. MSL - Mean Sea Level
4. U - Unknown
5. TBD - To Be Determined



Notes:
Stick-up will extend 3 feet above land surface.
Silica sand filter pack will extend at least 2 feet above top of screen elevation.
Shallow anticipated construction depth to 15-feet below land surface with 10 feet of screen.
Well depth and screen lengths will vary upon surficial clay elevations.

Figure 3-1 Anticipated Monitoring Well MW-35 and -36 Detail

3.4 Surface Water Quality Monitoring

The current surface water monitoring plan consists of SW-1, and -3 through -5. SW-1 and -3 are located in an unnamed stream southwest of Units 1 and 2 and northeast of C&D Unit 2. SW-4 is located in an unnamed stream east of MSW Unit 3 and SW-5 is located in an unnamed stream southeast of MSW Unit 3. No additional surface water sampling locations are recommended at this time. Surface water sampling locations are shown on Sheet 3-1.

Three underdrains (U-1 through -3) are sampled as part of the MSW Unit 2 surface water monitoring plan. No additional underdrain sampling locations are recommended at this time. Underdrain locations are shown on Sheet 3-1.

3.5 Leachate Monitoring

The current leachate monitoring plan consists of sampling the facility's two leachate tanks. The leachate tanks are located north of MSW Unit 2 and are shown on Sheet 3-1.

Section 4
Sampling and Analysis Plan

4.1 Introduction

Rule .1632 (a) specifies that the owner/operator must provide, as part of the groundwater monitoring program, a groundwater and surface water sampling and analysis (S&A) plan. The S&A plan should be designed to provide accurate results of groundwater quality at the upgradient and downgradient sampling locations. The S&A plan will address the following subjects:

- Groundwater sample collection
- Surface Water and Leachate sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain-of-custody
- Quality assurance/quality control (QA/QC)

4.2 Groundwater Collection

Groundwater samples will be collected from all of the proposed and existing monitoring wells. The proposed frequency of sampling for the Blackburn Resource Recovery Facility – Unit 3 Phase 2 Expansion will include one sample to be collected from each monitoring well prior to the Expansion receiving waste. Following the background sampling, groundwater samples from the new monitoring well will be sampled on a semi-annual basis, along with the existing wells. Additional samples may be collected following the initial sample in order to create a baseline for future statistical needs.

4.2.1 Static Water Level Measurements

Static water level elevations will be measured prior to any purging or sampling activities. Static water level data will be used to monitor changes in site hydrogeologic conditions. The following measurements will be recorded in a dedicated field book prior to sample collection:

- Height of the well measuring point above ground surface
- Depth of water in the well from the top of casing measuring point (to the nearest 0.01 foot)
- Total depth of the well
- Height of the water column in the well casing

An electronic water level indicator will be used to accurately measure water elevations to within 0.01 foot within the same day in as short a period of time as possible. Each well will have a permanent, easily identified reference point from which all water level measurements will be taken. The reference point will be marked and the elevation surveyed by a North Carolina Registered Land Surveyor.

4.2.2 Detection of Immiscible Layers

U.S. Environmental Protection Agency's (EPA) Technical Manual for Solid Waste Disposal Facility Criteria outlines specifications for groundwater sampling and analysis. One of these specifications outlines the establishment of provisions for detecting immiscible fluids, if applicable. Typically, immiscible fluids are categorized as either, (1) light, non-aqueous phase liquids (L-NAPLs), or (2) dense, non-aqueous phase liquids (D-NAPLs). L-NAPLs are more commonly referred to as "floaters" due to their relatively lighter specific gravity, while D-NAPLs are typically referred to as "sinkers" due to their relatively denser specific gravity.

In most instances, the probability of immiscible fluids being present and subsequently detected in groundwater monitoring wells surrounding sanitary landfills is somewhat remote because chemical products (such as industrial solvents) are not accepted for storage or disposal at Subtitle D solid waste management facilities. However, for those rare instances where a separate immiscible phase is believed to be present, the EPA suggests that provisions for detecting these types of fluids should be developed.

The following procedure is proposed to address these concerns in the event that the Solid Waste Section (SWS) ever requires this test to be performed. In those instances where the monitoring well's screened interval encompasses the water table surface, the ability to detect and sample L-NAPLs prior to implementation of routine groundwater sampling activities may exist. To accomplish this objective, a transparent Teflon bailer will be lowered into the well to just below the water table surface. The bailer will then be removed from the well and the contents examined to identify if any immiscible fluids are present. If any immiscible fluids are determined to be potentially present, an interface probe is proposed to be used. The depth of the light phase immiscible layer, as determined by the interface probe, will then be recorded in a field logbook. The interface probe will continue to be lowered until it intersects the groundwater table surface. The depth of the organic/water interface zone also will be recorded. From these two measurements, the thickness of the light phase immiscible layer can be readily determined.

The potential presence of dense phase immiscible layer will be determined by the examination of laboratory analytical results. Analytical results above a percentage of a given chemicals solubility limit can indicate the potential presence of D-NAPLs.

As mentioned above, monitoring for immiscible phase fluids is not envisioned to be performed during typical sampling events, but is provided here to document how the test will be performed if the SWS requires it at a future date.

4.2.3 Monitoring Well Evacuation

Following measurement of the static water level in all of the wells, individual wells will be purged of all stagnant water. The stagnant water, which is not representative of true aquifer conditions, will be removed to ensure that fresh formation water can be sampled. A minimum of three well casing volumes will be removed prior to sampling the well. The well volume for 2-inch diameter wells will be calculated using the following equation: one well volume in gallons equals the height of the water column (in feet) times 0.1632 (slightly less than 0.5 gallons per foot water for 3 casing volumes). During the well purging process, field measurements (pH, temperature, and specific conductance) will be collected at regular intervals, and reported in a tabular format. The well will be purged until field measurements stabilize within approximately 10 percent between subsequent readings or until the well is dry. Stabilization of these measurements will indicate that fresh formation water is present in the well. Field measurements of pH, temperature, and conductivity should be obtained by using a YSI 556 Multiparameter Water Quality Meter or equivalent. Turbidity will also be monitored during purging. All attempts will be made to minimize turbidity in the well column and collect samples with turbidity reading less than 10 nephelometric turbidity units (NTU).

If a well is purged to dryness, the samples will be collected after a sufficient volume of water has entered the well to allow collection of the sample. Wells will be purged using a decontaminated Teflon bailer with new nylon rope or an acceptable pumping device approved by the SWS. Field measurements collected during purging activities will be recorded in the field logbook.

4.2.4 Groundwater Sample Collection

After purging activities are complete, groundwater samples will be collected for laboratory analysis. The wells will be sampled using laboratory decontaminated Teflon or polyethylene bailers equipped with new nylon rope or through SWS approved pumps. Bailers, if used, will be used for one well only. Field decontamination of bailers will not be completed. Disposable polyethylene bailers will only be used if laboratory decontaminated standard Teflon bailers or dedicated sampling systems are not available. The bailers will be lowered slowly into the well to minimize sample agitation. Sample water will be placed directly into sample bottles provided by the analytical laboratory, using the following method:

1. Retrieve bailer and slowly transfer sample water to the appropriate sample container. The bailer or pump tubing should not be allowed to touch the sample container.

2. The sample container for the volatile organic compounds should be filled first, leaving no headspace or air bubbles. The container should then be tightly sealed. The sample container will come with preservative already added by the laboratory.

3. The sample container for the metals should then be filled. This container will also come with preservative added by the laboratory. This container should be filled to the bottle shoulder.

The wells will be sampled in the order of potential for increasing contamination levels beginning with the upgradient (background) sampling locations. The collection order for the samples will be as follows:

- Total Metals,
- Dissolved Metals (if needed),
- Volatile organic compounds (VOCs).

The samples will be transferred from the sampling equipment directly into a prepared sample container provided by the laboratory. Field filtering of samples is not permitted. There will be a specific size and type of container provided for each constituent to be analyzed. For VOC analysis, the containers provided will be 40-ml glass vials. For metals analysis, the samples will be collected in 0.25 or 0.5-liter high density polyethylene bottles. Extra containers should be available in case of accidental breakage. All field personnel will wear protective latex or nitrile disposable gloves in order to prevent extrinsic contamination from clothing, body oils, dirt, and other various contaminants. Sample documentation requirements to ensure sample integrity, will included sample locations, date and time of sample collection, proper analysis, and preservative (if applicable).

4.2.5 Decontamination Procedures

All sampling and purging equipment that will come in contact with the well casing and water will be decontaminated. All sampling equipment will be laboratory cleaned. The following decontamination procedures will be used for sampling equipment, if needed:

1. Clean item with tap water and phosphate-free laboratory detergent (Liquinox or equivalent), using a brush if necessary to remove particulate matter and surface films,
2. Rinse thoroughly with tap water,
3. Rinse thoroughly with deionized or distilled water and allow to air dry,
4. Wrap with aluminum foil, if necessary, to prevent contamination of equipment during storage or transport.

4.3 Surface Water and Leachate Collection

Surface water and leachate samples will be collected on a semi-annual basis. Samples are collected directly from these locations into sample containers. At the stream and underdrain locations, grab samples are obtained from the main flow line of moving water at mid-depth. When flow is intermittent, grab samples are collected from available pools. Leachate samples are obtained directly from the leachate holding tanks via a valve on outlet piping.

4.4 Sample Preservation and Shipment

In order to ensure sample integrity, preservation and shipment procedures will be carefully monitored. Generally, ice and chemical additives will be used as sample preservatives, as recommended by the commercial laboratory. For VOC analysis, hydrochloric acid will be used as the preservation method as well as maintaining the samples at a temperature of 4°C. Nitric acid will be used as the preservative for samples needing total metals analysis. If the analytical laboratory is located some distance from the site, samples shall be shipped via a 24-hour delivery service to ensure holding times are not exceeded. Shipment of samples will be coordinated with the laboratory. Proper storage and transport conditions must be maintained in order to preserve

the integrity of the sample. Once taken, samples will be placed on ice and cooled to a temperature of 4°C. Samples are to be packed in iced coolers so as to inhibit breakage or accidental spills. Custody seals will be placed on the outside of the cooler, in a manner to detect tampering of the samples. The laboratory shall immediately notify the owner/operator of any samples that arrive with custody seals broken.

4.5 Analytical Procedures

The samples taken from each well associated with Unit 1 will be analyzed for the constituents listed in 40 CFR Part 258, Appendix II once per year. Any detected Appendix II constituents will be analyzed again during the following sampling event, in addition to Appendix I constituents. The samples taken from each well and from the surface water sampling locations associated with MSW Units 2 and 3 will be analyzed for the constituents listed in Appendix I, semi-annually. C&D Units 1 and 2 groundwater samples will be analyzed semi-annually for Appendix I VOCs, RCRA Metals, and tetrahydrofuran.

Leachate samples will be analyzed for the constituents listed in Appendix I plus biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrate, sulfate, and ortho-phosphate, semi-annually.

The analytical procedures for the indicated parameters will be conducted using the following methods:

- VOCs: EPA Method 8260D
- Metals: EPA Method 6020B
- BOD: Standard Method (SM) 5210B-2001
- COD: SM 5220D-1997
- Nitrate and sulfate: EPA 300.0
- Ortho-phosphate: EPA 365.1

All laboratory reporting limits, at a minimum, will be to the Solid Waste Section Limits. A link to the current SWS Limits for all parameters is located at:
http://portal.ncdenr.org/web/wm/sw/envmonitoringlist

4.6 Chain of Custody

It is imperative that an accurate record of sample collection, transport, analysis, and disposal be maintained and documented. Therefore, chain-of-custody procedures will be instituted and followed throughout the sampling program. It is necessary to establish documentation to trace sample possession from the time of collection until disposal. The chain-of-custody program shall include the following requirements:

- Samples shall be accompanied by a chain-of-custody record that notes the date and time of collection as well as sampling personnel.
- All samples shall be properly labeled to prevent misidentification of samples.

- Field notes shall be included to provide pertinent information about each sample.
- A sample analysis sheet shall accompany all samples to the laboratory.
- Sample custody seals shall be used to indicate any tampering of samples.
- All records pertaining to the shipment of a sample shall be retained (ie: freight bills, post office receipts, and bills of lading).

The laboratory shall not accept samples for analysis without a correctly prepared chain of custody form. The laboratory shall be responsible for maintaining chain-of-custody of the sample(s) from time of receipt to disposal. The chain-of-custody form shall be signed by each individual who possesses the samples.

To prevent sample misidentification, a label will be affixed to each sample container in a manner as to prevent the label from becoming dislodged during transport which will contain the following information:

- Sample identification number
- Name and signature of sample collector
- Date and time of collection
- Place of collection
- Parameters requested
- Type of preservative

In addition, the container itself should be labeled with the sample identification number (at a minimum) to allow for identification should the label fall off.

4.7 Quality Assurance/Quality Control

The reliability and validity of the field and analytical laboratory data will be monitored as part of the QA/QC program used in the laboratory. Field duplicates and sample blanks will be collected to check sampling protocol and to account for any changes that occur after sampling. The QA/QC program will stipulate the use of standards, laboratory blanks, and duplicates for identification of matrix interferences.

4.7.1 Field Duplicates

Field duplicates provide a measure of field and laboratory precision. Field duplicates will be collected from identical locations using proper sampling procedures. The duplicate samples will be collected at a frequency of one per day per sampling event.

4.7.2 Equipment Rinsate Blanks

To evaluate the effectiveness of the decontamination procedures, equipment rinsate blanks will be collected. The sample will be collected by passing distilled water through the sampling equipment after decontamination has been completed. Equipment blanks will be collected at a minimum of one per day of groundwater sampling activities.

4.7.3 Trip Blanks

A trip blank shall be prepared to account for any sample contamination that may occur during transport to and from the site. The sample will be prepared in the laboratory with deionized or distilled water and shall accompany the sample shipping container to the field. The trip/travel blank shall remain unopened until receipt by the lab for analysis. One trip blank per sampling event will be collected.

4.8 Reporting

Following semi-annual groundwater sample collection and analysis, a report shall be submitted to the SWS which includes the following information:

- Field observations related to the condition of the monitoring wells
- Field data
- Laboratory data including SWS Electronic Data Deliverable format
- Sampling methodologies
- Quality assurance/quality control data
- Information on groundwater flow. Including a map showing groundwater contours
- Wells with constituents exceeding groundwater standards
- A table summarizing well construction for monitoring wells at the site
- A signed Environmental Monitoring Reporting form
- Other pertinent information

Reports will be submitted to the SWS in electronic format only. Electronic reports will be titled according to the Facility Permit Number. Copies of the reports will be maintained at the facility as part of the operating record.

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Section 5
References

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Solid Waste Section
Guidelines for Groundwater, Soil, and Surface Water Sampling

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION

General Sampling Procedures

The following guidance is provided to insure a consistent sampling approach so that sample collection activities at solid waste management facilities provide reliable data. Sampling must begin with an evaluation of facility information, historical environmental data and site geologic and hydrogeologic conditions. General sampling procedures are described in this document.

Planning

Begin sampling activities with planning and coordination. The party contracting with the laboratory is responsible for effectively communicating reporting requirements and evaluating data reliability as it relates to specific monitoring activities.

Sample Collection

Contamination Prevention

a.) Take special effort to prevent cross contamination or environmental contamination when collecting samples.
    1. If possible, collect samples from the least contaminated sampling location (or background sampling location, if applicable) to the most contaminated sampling location.
    2. Collect the ambient or background samples first, and store them in separate ice chests or separate shipping containers within the same ice chest (e.g. untreated plastic bags).
    3. Collect samples in flowing water at designated locations from upstream to downstream.

b.) Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspect of containing high concentrations of contaminants in the same ice chest or shipping containers with other environmental samples.
    1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.
    2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

c.) All sampling equipment should be thoroughly decontaminated and transported in a manner that does not allow it to become contaminated. Arrangements should be made ahead of time to decontaminate any sampling or measuring equipment that will be reused when taking samples from more than one well. Field decontamination of

sampling equipment will be necessary before sampling each well to minimize the risk of cross contamination. Decontamination procedures should be included in reports as necessary. Certified pre-cleaned sampling equipment and containers may be used. When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil and grease, or containers with pre-measured preservatives, the sample containers cannot be rinsed.

d.) Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination).
    1. If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.
    2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves.
    3. Dispense all fuels downwind. Dispose of gloves well away from the sampling activities.

<u>Filling Out Sample Labels</u>

Fill out label, adhere to vial and collect sample. Print legibly with indelible ink. At a minimum, the label or tag should identify the sample with the following information:

1. Sample location and/or well number
2. Sample identification number
3. Date and time of collection
4. Analysis required/requested
5. Sampler's initials
6. Preservative(s) used, if any [i.e., HCl, $Na_2S_2O_3$, NO_3, ice, etc.]
7. Any other pertinent information for sample identification

<u>Sample Collection Order</u>

Unless field conditions justify other sampling regimens, collect samples in the following order:

1. Volatile Organics and Volatile Inorganics
2. Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease
3. Total Metals
4. Inorganic Nonmetallics, Physical and Aggregate Properties, and Biologicals
5. Microbiological

NOTE: *If the pump used to collect groundwater samples cannot be used to collect volatile or extractable organics then collect all other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.*

Health and Safety

Implement all local, state, and federal requirements relating to health and safety. Follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation derived wastes.

a.) The Solid Waste Section recommends wearing protective gloves when conducting all sampling activities.

1. Gloves serve to protect the sample collector from potential exposure to sample constituents, minimize accidental contamination of samples by the collector, and preserve accurate tare weights on preweighed sample containers.
2. Do not let gloves come into contact with the sample or with the interior or lip of the sample container. Use clean, new, unpowdered and disposable gloves. Various types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.
3. Note that certain materials that may potentially be present in concentrated effluent can pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable. The powder in powdered gloves can contribute significant contamination. Powdered gloves are not recommended unless it can be demonstrated that the powder does not interfere with the sample analysis.
4. Change gloves after preliminary activities, after collecting all the samples at a single sampling point, if torn or used to handle extremely dirty or highly contaminated surfaces. Properly dispose of all used gloves as investigation derived wastes.

b.) Properly manage all investigation derived waste (IDW).

5. To prevent contamination into previously uncontaminated areas, properly manage all IDW. This includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, abandonment, and other investigative activities. Manage all IDW that is determined to be RCRA-regulated hazardous waste according to the local, state and federal requirements.
6. Properly dispose of IDW that is not a RCRA-regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality. If the drill cuttings/mud orpurged well water is contaminated with hazardous waste, contact the DWM Hazardous Waste Section (919-508-8400) for disposal options. Maintain all containers holding IDW in good condition. Periodically inspect the containers for damage and ensure that all required labeling (DOT, RCRA, etc.) are clearly visible.

Sample Storage and Transport

Store samples for transport carefully. Pack samples to prevent from breaking and to maintain a temperature of approximately 4 degrees Celsius (°C), adding ice if necessary. Transport samples to a North Carolina-certified laboratory as soon as possible. Avoid unnecessary handling of sample containers. Avoid heating (room temperature or above, including exposure to sunlight) or freezing of the sample containers. Reduce the time between sample collection and delivery to a laboratory whenever possible and be sure that the analytical holding times of your samples can be met by the laboratory.

a.) A complete chain-of-custody (COC) form must be maintained to document all transfers and receipts of the samples. Be sure that the sample containers are labeled with the sample location and/or well number, sample identification, the date and time of collection, the analysis to be performed, the preservative added (if any), the sampler's initials, and any other pertinent information for sample identification. The labels should contain a unique identifier (i.e., unique well numbers) that can be traced to the COC form. The details of sample collection must be documented on the COC. The COC must include the following:

1. Description of each sample (including QA/QC samples) and the number of containers (sample location and identification)
2. Signature of the sampler
3. Date and time of sample collection
4. Analytical method to be performed
5. Sample type (i.e., water or soil)
6. Regulatory agency (i.e., NCDENR/DWM – SW Section)
7. Signatures of all persons relinquishing and receiving custody of the samples
8. Dates and times of custody transfers

b.) Pack samples so that they are segregated by site, sampling location or by sample analysis type. When COC samples are involved, segregate samples in coolers by site. If samples from multiple sites will fit in one cooler, they may be packed in the same cooler with the associated field sheets and a single COC form for all. Coolers should not exceed a maximum weight of 50 lbs. Use additional coolers as necessary. All sample containers should be placed in plastic bags (segregated by analysis and location) and completely surrounded by ice.

1. Prepare and place trip blanks in an ice filled cooler before leaving for the field.
2. Segregate samples by analysis and place in sealable plastic bags.
3. Pack samples carefully in the cooler placing ice around the samples.
4. Review the COC. The COC form must accompany the samples to the laboratory. The trip blank(s) must also be recorded on the COC form.
5. Place completed COC form in a waterproof bag, sealed and taped under the lid of the cooler.
6. Secure shipping containers with strapping tape to avoid accidental opening.
7. For COC samples, a tamper-proof seal may also be placed over the cooler lid or over a bag or container containing the samples inside the shipping cooler.

8. "COC" or "EMERG" should be written in indelible ink on the cooler seal to alert sample receipt technicians to priority or special handling samples.
9. The date and sample handler's signature must also be written on the COC seal.
10. Deliver the samples to the laboratory or ship by commercial courier.
    NOTE*: If transport time to the laboratory is not long enough to allow samples to be cooled to 4° C, a temperature reading of the sample source must be documented as the field temperature on the COC form. A downward trend in temperature will be adequate even if cooling to 4° C is not achieved. The field temperature should always be documented if there is any question as to whether samples will have time to cool to 4° C during shipment. Thermometers must be calibrated annually against an NIST traceable thermometer and documentation must be retained.*

Appendix A - Decontamination of Field Equipment

Decontamination of personnel, sampling equipment, and containers - before and after sampling - must be used to ensure collection of representative samples and to prevent the potential spread of contamination. Decontamination of personnel prevents ingestion and absorption of contaminants. It must be done with a soap and water wash and deionized or distilled water rinse. Certified pre-cleaned sampling equipment and containers may also be used.

All previously used sampling equipment must be properly decontaminated before sampling and between sampling locations. This prevents the introduction of contamination into uncontaminated samples and avoids cross-contamination of samples. Cross-contamination can be a significant problem when attempting to characterize extremely low concentrations of organic compounds or when working with soils that are highly contaminated.

Clean, solvent-resistant gloves and appropriate protective equipment must be worn by persons decontaminating tools and equipment.

Cleaning Reagents

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

a.) Detergents: Use Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). Liqui-Nox (or equivalent) is recommended by EPA, although Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus containing compounds.

b.) Solvents: Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor. Rubbing alcohol or other commonly available sources of isopropanol **are not acceptable**. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics.

1. **Do not** use acetone if volatile organics are of interest
2. Containerize all methanol wastes (including rinses) and dispose as a hazardous waste.

Pre-clean equipment that is heavily contaminated with organic analytes. Use reagent grade acetone and hexane or other suitable solvents. Use pesticide grade methylene chloride when cleaning sample containers. Store all solvents away from potential sources of contamination.

c.) Analyte-Free Water Sources: Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s). The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:

1. *Milli-Q (or equivalent polished water)*: suitable for all analyses.

2. *Organic-free*: suitable for volatile and extractable organics.
3. *Deionized water*: may not be suitable for volatile and extractable organics.
4. *Distilled water*: not suitable for volatile and extractable organics, metals or ultratrace metals.

Use analyte-free water for blank preparation and the final decontamination water rinse. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle or pump sprayer) at the end of each sampling day.

d.) Acids:

1. *Reagent Grade Nitric Acid*: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water). Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.
2. *Reagent Grade Hydrochloric Acid*: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water). Use when nitrogen components are to be sampled.
3. If samples for both metals and the nitrogen-containing components are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.
4. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose of any unused acids according to local ordinances.

Reagent Storage Containers

The contents of all containers must be clearly marked.

a.) Detergents:

1. Store in the original container or in a HDPE or PP container.

b.) Solvents:

1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, use either a glass or Teflon container.
2. Use dispensing containers constructed of glass, Teflon or stainless steel. Note: If stainless steel sprayers are used, any gaskets that contact the solvents must be constructed of inert materials.

c.) Analyte-Free Water:

1. Transport in containers appropriate for the type of water stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, Teflon, polypropylene or HDPE are acceptable.
2. Use glass or Teflon to transport organic-free sources of water on-site. Polypropylene or HDPE may be used, but are not recommended.

3. Dispense water from containers made of glass, Teflon, HDPE or polypropylene.
4. Do not store water in transport containers for more than three days before beginning a sampling event.
5. If working on a project that has oversight from EPA Region 4, use glass containers for the transport and storage of all water.
6. Store and dispense acids using containers made of glass, Teflon or plastic.

General Requirements

a.) Prior to use, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that will be exposed to the sample.

b.) Before installing, clean (or obtain as certified pre-cleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump). If you use certified pre-cleaned equipment no cleaning is necessary.
    1. Clean this equipment any time it is removed for maintenance or repair.
    2. Replace dedicated tubing if discolored or damaged.

c.) Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport it to the field, pre-cleaned and ready to use, unless otherwise justified.

d.) Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

e.) Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.

f.) Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.

g.) Protect decontaminated field equipment from environmental contamination by securely wrapping and sealing with one of the following:
    1. Aluminum foil (commercial grade is acceptable)
    2. Untreated butcher paper
    3. Clean, untreated, disposable plastic bags. Plastic bags may be used for all analyte groups except volatile and extractable organics. Plastic bags may be used for volatile and extractable organics, if the equipment is first wrapped in foil or butcher paper, or if the equipment is completely dry.

Cleaning Sample Collection Equipment

a.) <u>On-Site/In-Field Cleaning</u> – Cleaning equipment on-site is not recommended because environmental conditions cannot be controlled and wastes (solvents and acids) must be containerized for proper disposal.
    1. Ambient temperature water may be substituted in the hot, sudsy water bath and hot water rinses.

NOTE: Properly dispose of all solvents and acids.

2. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites.
3. Immediately rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples with water.

b.) Heavily Contaminated Equipment - In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

1. Has been used to collect samples from a source known to contain significantly higher levels than background.
2. Has been used to collect free product.
3. Has been used to collect industrial products (e.g., pesticides or solvents) or their byproducts.

NOTE: *Cleaning heavily contaminated equipment in the field is not recommended.*

c.) On-Site Procedures:

1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.
2. At a minimum, place the equipment in a tightly sealed, untreated, plastic bag.
3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.
4. Transport the equipment back to the base of operations for thorough decontamination.
5. If cleaning must occur in the field, document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment.

d.) Cleaning Procedures:

1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, pre-rinse equipment by thoroughly rinsing or soaking the equipment in acetone.
2. Use hexane only if preceded and followed by acetone.
3. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.
4. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure. Scrub, rather than soak, all equipment with sudsy water. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Since stainless steel equipment should not be exposed to acid rinses, do not use stainless steel equipment when heavy metal contamination is suspected or present.
5. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.
6. Clearly mark or disable all discarded equipment to discourage use.

e.) General Cleaning - Follow these procedures when cleaning equipment under controlled conditions. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

1. *Procedure for Teflon, stainless steel and glass sampling equipment*: This procedure must be used when sampling for ALL analyte groups. (Extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all Teflon, stainless steel and glass equipment.) Rinse equipment with hot tap water. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent). If necessary, use a brush to remove particulate matter or surface film. Rinse thoroughly with hot tap water. If samples for trace metals or inorganic analytes will be collected with the equipment that is not stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution. Rinse thoroughly with analyte-free water. Make sure that all equipment surfaces are thoroughly flushed with water. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water. Allow to air dry. Wrap and seal as soon as the equipment has air-dried. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse; however, the equipment must be completely dry before wrapping or use. Wrap clean sampling equipment according to the procedure described above.
2. *General Cleaning Procedure for Plastic Sampling Equipment*: Rinse equipment with hot tap water. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent). If necessary, use a brush to remove particulate matter or surface film. Rinse thoroughly with hot tap water. Thoroughly rinse (wet all surfaces) with the appropriate acid solution. Check manufacturer's instructions for cleaning restrictions and/or recommendations. Rinse thoroughly with analyte-free water. Be sure that all equipment surfaces are thoroughly flushed. Allow to air dry as long as possible. Wrap clean sampling equipment according to the procedure described above.

Appendix B - Collecting Soil Samples

Soil samples are collected for a variety of purposes. A methodical sampling approach must be used to assure that sample collection activities provide reliable data. Sampling must begin with an evaluation of background information, historical data and site conditions.

Soil Field Screening Procedures

Field screening is the use of portable devices capable of detecting petroleum contaminants on a real-time basis or by a rapid field analytical technique. Field screening should be used to help assess locations where contamination is most likely to be present.

When possible, field-screening samples should be collected directly from the excavation or from the excavation equipment's bucket. If field screening is conducted only from the equipment's bucket, then a minimum of one field screening sample should be collected from each 10 cubic yards of excavated soil. If instruments or other observations indicate contamination, soil should be separated into stockpiles based on apparent degrees of contamination. At a minimum, soil suspected of contamination must be segregated from soil observed to be free of contamination.

a.) Field screening devices – Many field screen instruments are available for detecting contaminants in the field on a rapid or real-time basis. Acceptable field screening instruments must be suitable for the contaminant being screened. The procdedure for field screening using photoionization detectors (PIDs) and flame ionization detectors (FIDs) is described below. If other instruments are used, a description of the instrument or method and its intended use must be provided to the Solid Waste Section. Whichever field screening method is chosen, its accuracy must be verified throughout the sampling process. Use appropriate standards that match the use intended for the data. Unless the Solid Waste Section indicates otherwise, wherever field screening is recommended in this document, instrumental or analytical methods of detection must be used, not olfactory or visual screening methods.

b.) Headspace analytical screening procedure for filed screening (semi-quantitative field screening) - The most commonly used field instruments for Solid Waste Section site assessments are FIDs and PIDs. When using FIDs and PIDs, use the following headspace screening procedure to obtain and analyze field-screening samples:

1. Partially fill (one-third to one-half) a clean jar or clean ziplock bag with the sample to be analyzed. The total capacity of the jar or bag may not be less than eight ounces (app. 250 ml), but the container should not be so large as to allow vapor diffusion and stratification effects to significantly affect the sample.
2. If the sample is collected from a spilt-spoon, it must be transferred to the jar or bag for headspace analysis immediately after opening the split-spoon. If the sample is collected from an excavation or soil pile, it must be collected from freshly uncovered soil.

3. If a jar is used, it must be quickly covered with clean aluminum foil or a jar lid; screw tops or thick rubber bands must be used to tightly seal the jar. If a zip lock bag is used, it must be quickly sealed shut.
4. Headspace vapors must be allowed to develop in the container for at least 10 minutes but no longer than one hour. Containers must be shaken or agitated for 15 seconds at the beginning and the end of the headspace development period to assist volatilization. Temperatures of the headspace must be warmed to at least 5° C (approximately 40° F) with instruments calibrated for the temperature used.
5. After headspace development, the instrument sampling probe must be inserted to a point about one-half the headspace depth. The container opening must be minimized and care must be taken to avoid the uptake of water droplets and soil particulates.
6. After probe insertion, the highest meter reading must be taken and recorded. This will normally occur between two and five seconds after probe insertion. If erratic meter response occurs at high organic vapor concentrations or conditions of elevated headspace moisture, a note to that effect must accompany the headspace data.
7. All field screening results must be documented in the field record or log book.

Soil Sample Collection Procedures for Laboratory Samples

The number and type of laboratory samples collected depends on the purpose of the sampling activity. Samples analyzed with field screening devices may not be substituted for required laboratory samples.

a.) General Sample Collection - When collecting samples from potentially contaminated soil, care should be taken to reduce contact with skin or other parts of the body. Disposable gloves should be worn by the sample collector and should be changed between samples to avoid cross-contamination. Soil samples should be collected in a manner that causes the least disturbance to the internal structure of the sample and reduces its exposure to heat, sunlight and open air. Likewise, care should be taken to keep the samples from being contaminated by other materials or other samples collected at the site. When sampling is to occur over an extended period of time, it is necessary to insure that the samples are collected in a comparable manner. All samples must be collected with disposable or clean tools that have been decontaminated. Disposable gloves must be worn and changed between sample collections. Sample containers must be filled quickly. Soil samples must be placed in containers in the order of volatility, for example, volatile organic aromatic samples must be taken first, organics next, then heavier range organics, and finally soil classification samples. Containers must be quickly and adequately sealed, and rims must be cleaned before tightening lids. Tape may be used only if known not to affect sample analysis. Sample containers must be clearly labeled. Containers must immediately be preserved according to procedures in this Section. Unless specified

otherwise, at a minimum, the samples must be immediately cooled to 4 ± 2°C and this temperature must be maintained throughout delivery to the laboratory.

b.) Surface Soil Sampling - Surface soil is generally classified as soil between the ground surface and 6-12 inches below ground surface. Remove leaves, grass and surface debris from the area to be sampled. Select an appropriate, pre-cleaned sampling device and collect the sample. Transfer the sample to the appropriate sample container. Clean the outside of the sample container to remove excess soil. Label the sample container, place on wet ice to preserve at 4°C, and complete the field notes.

c.) Subsurface Soil Sampling – The interval begins at approximately 12 inches below ground surface. Collect samples for volatile organic analyses. For other analyses, select an appropriate, pre-cleaned sampling device and collect the sample. Transfer the sample to the appropriate sample container. Clean the outside of the sample container to remove excess soil. Label the sample container, place on wet ice to preserve at 4°C, and complete field notes.

d.) Equipment for Reaching the Appropriate Soil Sampling Depth - Samples may be collected using a hollow stem soil auger, direct push, Shelby tube, split-spoon sampler, or core barrel. These sampling devices may be used as long as an effort is made to reduce the loss of contaminants through volatilization. In these situations, obtain a sufficient volume of so the samples can be collected without volatilization and disturbance to the internal structure of the samples. Samples should be collected from cores of the soil. Non-disposable sampling equipment must be decontaminated between each sample location. **NOTE:** *If a confining layer has been breached during sampling, grout the hole to land.*

e.) Equipment to Collect Soil Samples - Equipment and materials that may be used to collect soil samples include disposable plastic syringes and other "industry-standard" equipment and materials that are contaminant-free. Non-disposable sampling equipment must be decontaminated between each sample location.

Appendix C - Collecting Groundwater Samples

Groundwater samples are collected to identify, investigate, assess and monitor the concentration of dissolved contaminant constituents. To properly assess groundwater contamination, first install sampling points (monitoring wells, etc.) to collect groundwater samples and then perform specific laboratory analyses. All monitoring wells should be constructed in accordance with 15A NCAC 2C .0100 and sampled as outlined in this section. Groundwater monitoring is conducted using one of two methods:

1. Portable Monitoring: Monitoring that is conducted using sampling equipment that is discarded between sampling locations. Equipment used to collect a groundwater sample from a well such as bailers, tubing, gloves, and etc. are disposed of after sample collection. A new set of sampling equipment is used to collect a groundwater sample at the next monitor well.

2. Dedicated Monitoring: Monitoring that utilizes permanently affixed down-well and well head components that are capped after initial set-up. Most dedicated monitoring systems are comprised of an in-well submersible bladder pump, with air supply and sample discharge tubing, and an above-ground driver/controller for regulation of flow rates and volumes. The pump and all tubing housed within the well should be composed of Teflon or stainless steel components. This includes seals inside the pump, the pump body, and fittings used to connect tubing to the pump. Because ground water will not be in contact with incompatible constituents and because the well is sealed from the surface, virtually no contamination is possible from intrinsic sources during sampling and between sampling intervals. All dedicated monitoring systems must be approved by the Solid Waste Section before installation.

Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

1. Wells without Plumbing: These wells require equipment to be brought to the well to purge and sample unless dedicated equipment is placed in the well.

2. Wells with In-Place Plumbing: Wells with in-place plumbing do not require equipment to be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply.

3. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices.

Groundwater Sample Preparation

The type of sample containers used depends on the type of analysis performed. First, determine the type(s) of contaminants expected and the proper analytical method(s). Be sure to consult your selected laboratory for its specific needs and requirements prior to sampling.

Next, prepare the storage and transport containers (ice chest, etc.) before taking any samples so that each sample can be placed in a chilled environment immediately after collection.

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest. Additional supplies, such as reagents and preservatives, may be necessary.

All sampling equipment (bailers, tubing, containers, etc.) must be selected based on its chemical compatibility with the source being sampled (e.g., water supply well, monitoring well) and the contaminants potentially present.

a.) Pumps - All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface.

1. *Above-Ground Pumps*
    - Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20- 25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease. A variable speed peristaltic pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations. Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate.
    - Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. **Do not use** this type of pump to collect groundwater samples. When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing.
2. *Submersible Pumps*
    - Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells. A variable speed submersible pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations. The pump housing, fittings, check valves and associated hardware must be constructed of stainless steel. All other materials must be

compatible with the analytes of interest. Install a check valve at the output side of the pump to prevent backflow. If purging **and** sampling for organics, the entire length of the delivery tube must be Teflon, polyethylene or polypropylene (PP) tubing; the electrical cord must be sealed in Teflon, polyethylene or PP and any cabling must be sealed in Teflon, polyethylene or PP, or be constructed of stainless steel; and all interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

3. *Variable Speed Bladder Pump*: A variable speed, positive displacement, bladder pump can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.
    - A variable speed bladder pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations.
    - The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor, or a compressed gas supply.
    - The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, polyethylene, PP and stainless steel. Other materials must be compatible with the analytes of interest.
    - If purging and sampling for organics, the pump body must be constructed of stainless steel. The valves and bladder must be Teflon, polyethylene or PP; the entire length of the delivery tube must be Teflon, polyethylene or PP; and any cabling must be sealed in Teflon, polyethylene or PP, or be constructed of stainless steel.
    - Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

b.) <u>Bailers</u>

1. *Purging*: Bailers must be used with caution because improper bailing can cause changes in the chemistry of the water due to aeration and loosening particulate matter in the space around the well screen. Use a bailer if there is non-aqueous phase liquid (free product) in the well or if non-aqueous phase liquid is suspected to be in the well.
2. *Sampling*: Bailers must be used with caution.
3. *Construction and Type*: Bailers must be constructed of materials compatible with the analytes of interest. Stainless steel, Teflon, rigid medical grade PVC, polyethylene and PP bailers may be used to sample all analytes. Use disposable bailers when sampling grossly contaminated sample sources. NCDENR recommends using dual check valve bailers when collecting samples. Use bailers with a controlled flow bottom to collect volatile organic samples.

4. *Contamination Prevention*: Keep the bailer wrapped (foil, butcher paper, etc.) until just before use. Use protective gloves to handle the bailer once it is removed from its wrapping. Handle the bailer by the lanyard to minimize contact with the bailer surface.

c.) Lanyards

1. Lanyards must be made of non-reactive, non-leachable material. They may be cotton twine, nylon, stainless steel, or may be coated with Teflon, polyethylene or PP.
2. Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.
3. Decontaminate stainless steel, coated Teflon, polyethylene and PP lanyards between monitoring wells. They do not need to be decontaminated between purging and sampling operations.

Water Level and Purge Volume Determination

The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

a.) General Equipment Considerations - Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater, and other site conditions.

1. Use of a pump to purge the well is recommended unless no other equipment can be used or there is non-aqueous phase liquid in the well, or non-aqueous phase liquid is suspected to be in the well.
2. Bailers must be used with caution because improper bailing:
    - Introduces atmospheric oxygen, which may precipitate metals (i.e., iron) or cause other changes in the chemistry of the water in the sample (i.e., pH).
    - Agitates groundwater, which may bias volatile and semi-volatile organic analyses due to volatilization.
    - Agitates the water in the aquifer and resuspends fine particulate matter.
    - Surges the well, loosening particulate matter in the annular space around the well screen.
    - May introduce dirt into the water column if the sides of the casing wall are scraped.

NOTE: *It is critical for bailers to be slowly and gently immersed into the top of the water column, particularly during the final stages of purging. This minimizes turbidity and disturbance of volatile organic constituents.*

b.) Initial Inspection

1. Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well.
2. Inspect the exterior protective casing of the monitoring well for damage. Document the results of the inspection if there is a problem.
3. It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.

4. Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

c.) Water Level Measurements - Use an electronic probe or chalked tape to determine the water level. Decontaminate all equipment before use. Measure the depth to groundwater from the top of the well casing to the nearest 0.01 foot. Always measure from the same reference point or survey mark on the well casing. Record the measurement.

1. *Electronic Probe*: Decontaminate all equipment before use. Follow the manufacturer's instructions for use. Record the measurement.
2. *Chalked Line Method*: Decontaminate all equipment before use. Lower chalked tape into the well until the lower end is in the water. This is usually determined by the sound of the weight hitting the water. Record the length of the tape relative to the reference point. Remove the tape and note the length of the wetted portion. Record the length. Determine the depth to water by subtracting the length of the wetted portion from the total length. Record the result.

d.) Water Column Determination - To determine the length of the water column, subtract the depth to the top of the water column from the total well depth (or gauged well depth if silting has occurred). The total well depth depends on the well construction. If gauged well depth is used due to silting, report total well depth also. Some wells may be drilled in areas of sinkhole, karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

e.) Well Water Volume - Calculate the total volume of water, in gallons, in the well using the following equation:

$$V = (0.041)d \times d \times h$$

Where:

V = volume in gallons
d = well diameter in inches
h = height of the water column in feet

The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Gallons per Foot of Water) for the appropriate diameter well:

$$V = [\text{Gallons per Foot of Water}] \times h$$

Where:

V = volume in gallons
h = height of the water column in feet

Record all measurements and calculations in the field records.

f.) Purging Equipment Volume - Calculate the total volume of the pump, associated tubing and flow cell (if used), using the following equation:

$$V = p + ((0.041)d \times d \times l) + fc$$

Where:

V = volume in gallons
p = volume of pump in gallons
d = tubing diameter in inches
l = length of tubing in feet

fc = volume of flow cell in gallons

g.) If the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24 hour time interval when collecting samples from multiple wells on a site, unless a shorter time period is required. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

Well Purging Techniques

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity.

a.) Measuring the Purge Volume - The volume of water that is removed during purging must be recorded. Therefore, you must measure the volume during the purging operation.

1. Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, OR
2. Estimate the volume based on pumping rate. This technique may be used only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time, or use a flow meter.
    - Calculate the amount of water that is discharged per minute: D = Measured Amount/Total Time In Minutes
    - Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume: Time = V/D
      Where: V = well volume or purging equipment volume
      D = discharge rate
    - Make new measurements each time the pumping rate is changed.
3. Use a totalizing flow meter.
    - Record the reading on the totalizer prior to purging.
    - Record the reading on the totalizer at the end of purging.
    - To obtain the volume purged, subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging.
    - Record the times that purging begins and ends in the field records.

b.) Purging Measurement Frequency - When purging a well that has the well screen fully submerged and the pump or intake tubing is placed within the well casing above the well screen or open hole, purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements. When purging a well that has the pump or intake tubing placed within a fully submerged well screen or open hole, purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow cell (if used) prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart. Purge at least

three (3) volumes of the pump, associated tubing and flow cell, if used, prior to collecting a sample. When purging a well that has a partially submerged well screen, purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart.

c.) Purging Completion - Wells must be adequately purged prior to sample collection to ensure representation of the aquifer formation water, rather than stagnant well water. This may be achieved by purging three volumes from the well or by satisfying any one of the following three purge completion criteria:

1.) Three (3) consecutive measurements in which the three (3) parameters listed below are within the stated limits, dissolved oxygen is no greater than 20 percent of saturation at the field measured temperature, and turbidity is no greater than 20 Nephelometric Turbidity Units (NTUs).

- Temperature: + 0.2° C
- pH: + 0.2 Standard Units
- Specific Conductance: + 5.0% of reading

Document and report the following, as applicable. The last four items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

2.) If it is impossible to get dissolved oxygen at or below 20 percent of saturation at the field measured temperature or turbidity at or below 20 NTUs, then three (3) consecutive measurements of temperature, pH, specific conductance and the parameter(s) dissolved oxygen and/or turbidity that do not meet the requirements above must be within the limits below. The measurements are:

- Temperature: + 0.2° C
- pH: + 0.2 Standard Units
- Specific Conductance: + 5.0% of reading
- Dissolved Oxygen: + 0.2 mg/L or 10%, whichever is greater
- Turbidity: + 5 NTUs or 10%, whichever is greater

Additionally, document and report the following, as applicable, except that the last four(4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- A description of conditions at the site that may cause the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.

- A description of conditions at the site that may cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.) If after five (5) well volumes, three (3) consecutive measurements of the field parameters temperature, pH, specific conductance, dissolved oxygen, and turbidity are not within the limits stated above, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. It is at the discretion of the consultant/contractor whether or not to collect a sample or to continue purging. Further, the report in which the data are submitted must include the following, as applicable. The last four (4) items only need to be submitted once.

- Purging rate.
- Drawdown in the well, if any.
- A description of conditions at the site that may cause the Dissolved Oxygen to be high and/or Dissolved Oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that may cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If wells have previously and consistently purged dry, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

- Place the pump or tubing intake within the well screened interval.
- Use very small diameter Teflon, polyethylene or PP tubing and the smallest possible pump chamber volume. This will minimize the total volume of water pumped from the well and reduce drawdown.
- Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

- Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.
- Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).
- Measure pH, specific conductance, temperature, dissolved oxygen and turbidity, then begin to collect the samples.

Collect samples immediately after purging is complete. The time period between completing the purge and sampling cannot exceed six hours. If sample collection does not occur within one hour of purging completion, re-measure the five field parameters: temperature, pH, specific conductance, dissolved oxygen and turbidity, just prior to collecting the sample. If the measured values are not within 10 percent of the previous measurements, re-purge the well. The exception is "dry" wells.

d.) Lanyards

1. Securely fasten lanyards, if used, to any downhole equipment (bailers, pumps, etc.).
2. Use bailer lanyards in such a way that they do not touch the ground surface.

Wells Without Plumbing

a.) Tubing/Pump Placement

1. If attempting to minimize the volume of purge water, position the intake hose or pump at the midpoint of the screened or open hole interval.
2. If monitoring well conditions do not allow minimizing of the purge water volume, position the pump or intake hose near the top of the water column. This will ensure that all stagnant water in the casing is removed.
3. If the well screen or borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump midway between the measured water level and the bottom of the screen. Otherwise, position the pump or intake hose near the top of the water column.

b.) Non-dedicated (portable) pumps

1. *Variable Speed Peristaltic Pump*
   - Wear sampling gloves to position the decontaminated pump and tubing.
   - Attach a short section of tubing to the discharge side of the pump and into a graduated container.
   - Attach one end of a length of new or precleaned tubing to the pump head flexible hose.
   - Place the tubing as described in one of the options listed above.
   - Change gloves before beginning to purge.
   - Measure the depth to groundwater at frequent intervals.
   - Record these measurements.
   - Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
- If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that water is removed from the top of the water column.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.
- Decontaminate the pump and tubing between wells (see Appendix C) or if precleaned tubing is used for each well, only the pump.

2. *Variable Speed Centrifugal Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Place the decontaminated suction hose so that water is always pumped from the top of the water column.
    - Change gloves before beginning to purge.
    - Equip the suction hose with a foot valve to prevent purge water from re-entering the well.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
    - If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
    - Decontaminate the pump and tubing between wells or if precleaned tubing is used for each well, only the pump.
3. *Variable Speed Electric Submersible Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Carefully position the decontaminated pump.

- Change gloves before beginning to purge.
- Measure the depth to groundwater at frequent intervals.
- Record these measurements.
- To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
- If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that water is removed from the top of the water column.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.
- Decontaminate the pump and tubing between wells or only the pump if precleaned tubing is used for each well.

4. *Variable Speed Bladder Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Attach the tubing and carefully position the pump.
    - Change gloves before beginning purging.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
    - If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that water is removed from the top of the water column.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
    - Decontaminate the pump and tubing between wells or if precleaned tubing is used for each well, only the pump.

c.) <u>Dedicated Portable Pumps</u>

1. *Variable Speed Electric Submersible Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves.

- Measure the depth to groundwater at frequent intervals.
- Record these measurements.
- Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.

2. *Variable Speed Bladder Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
3. *Bailers* - Using bailers for purging is not recommended unless care is taken to use proper bailing technique, or if free product is present in the well or suspected to be in the well.
    - Minimize handling the bailer as much as possible.
    - Wear sampling gloves.
    - Remove the bailer from its protective wrapping just before use.
    - Attach a lanyard of appropriate material.
    - Use the lanyard to move and position the bailer.
    - Lower and retrieve the bailer slowly and smoothly.
    - Lower the bailer carefully into the well to a depth approximately a foot above the water column.
    - When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached.
    - Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.
    - Allow time for the bailer to fill with aquifer water as it descends into the water column.

- Carefully raise the bailer. Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.
- Measure the purge volume.
- Record the volume of the bailer.
- Continue to carefully lower and retrieve the bailer as described above until the purging is considered complete, based on either the removal of 3 well volumes.
- Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

Groundwater Sampling Techniques

a.) Purge wells.

b.) Replace protective covering around the well if it is soiled or torn after completing purging operations.

c.) Equipment Considerations

1. The following pumps are approved to collect volatile organic samples:
    - Stainless steel and Teflon variable speed submersible pumps
    - Stainless steel and Teflon or polyethylene variable speed bladder pumps
    - Permanently installed PVC bodied pumps (As long as the pump remains in contact with the water in the well at all times)
2. Collect sample from the sampling device and store in sample container. Do not use intermediate containers.
3. To avoid contamination or loss of analytes from the sample, handle sampling equipment as little as possible and minimize equipment exposure to the sample.
4. To reduce chances of cross-contamination, use dedicated equipment whenever possible. "Dedicated" is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump). Purchase dedicated equipment with the most sensitive analyte of interest in mind.
    - Clean or make sure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use, but must be cleaned if they are withdrawn for repair or servicing.
    - Clean or make sure any permanently mounted tubing is clean before installation.
    - Change or clean tubing when the pump is withdrawn for servicing.
    - Clean any replaceable or temporary parts.

- Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.
- Clean or make sure dedicated bailers are clean before placing them into the well.
- Collect an equipment blank on dedicated bailers before introducing them into the water column.
- Suspend dedicated bailers above the water column if they are stored in the well.

Sampling Wells Without Plumbing

a.) Sampling with Pumps – The following pumps may be used to sample for organics:

- Peristaltic pumps
- Stainless steel, Teflon or polyethylene bladder pumps
- Variable speed stainless steel and Tefloṇ submersible pumps

1. *Peristaltic Pump*

- Volatile Organics: One of three methods may be used.
  - Remove the drop tubing from the inlet side of the pump; submerge the drop tubing into the water column; prevent the water in the tubing from flowing back into the well; remove the drop tubing from the well; carefully allow the groundwater to drain into the sample vials; avoid turbulence; do not aerate the sample; repeat steps until enough vials are filled. OR
  - Use the pump to fill the drop tubing; quickly remove the tubing from the pump; prevent the water in the tubing from flowing back into the well; remove the drop tubing from the well; carefully allow the groundwater to drain into the sample vials; avoid turbulence; do not aerate the sample; repeat steps until enough vials are filled. OR
  - Use the pump to fill the drop tubing; withdraw the tubing from the well; reverse the flow on the peristaltic pumps to deliver the sample into the vials at a slow, steady rate; repeat steps until enough vials are filled.
- Extractable Organics: If delivery tubing is not polyethylene or PP, or is not Teflon lined, use pump and vacuum trap method. Connect the outflow tubing from the container to the influent side of the peristaltic pump. Turn pump on and reduce flow until smooth and even. Discard a

small portion of the sample to allow for air space. Preserve (if required), label, and complete field notes.

- Inorganic samples: These samples may be collected from the effluent tubing. If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells. Preserve (if required), label, and complete field notes.

2. *Variable Speed Bladder Pump*
    - If sampling for organics, the pump body must be constructed of stainless steel and the valves and bladder must be Teflon. All tubing must be Teflon, polyethylene, or PP and any cabling must be sealed in Teflon, polyethylene or PP, or made of stainless steel.
    - After purging to a smooth even flow, reduce the flow rate.
    - When sampling for volatile organic compounds, reduce the flow rate to 100-200mL/minute, if possible.
3. *Variable Speed Submersible Pump*
    - The housing must be stainless steel.
    - If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon, polyethylene or PP. The delivery tubing must be Teflon, polyethylene or PP; the electrical cord must be sealed in Teflon; any cabling must be sealed in Teflon or constructed of stainless steel.
    - After purging to a smooth even flow, reduce the flow rate.
    - When sampling for volatile organic compounds, reduce the flow rate to 100-200mL/minute, if possible.

b.) Sampling with Bailers - A high degree of skill and coordination are necessary to collect representative samples with a bailer.

1. *General Considerations*
    - Minimize handling of bailer as much as possible.
    - Wear sampling gloves.
    - Remove bailer from protective wrapping just before use.
    - Attach a lanyard of appropriate material.
    - Use the lanyard to move and position the bailers.
    - Do not allow bailer or lanyard to touch the ground.
    - If bailer is certified precleaned, no rinsing is necessary.
    - If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.
    - If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer by collecting a single bailer of the groundwater to be sampled.
    - Discard the water appropriately.

- Do not rinse the bailer if Oil and Grease samples are to be collected.

2. *Bailing Technique*
    - Collect all samples that are required to be collected with a pump before collecting samples with the bailer.
    - Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column, which can increase sample turbidity.
    - Lower the bailer carefully into the well to a depth approximately a foot above the water column. When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached.
    - Do not lower the top of the bailer more than one foot below the top of the water table, so that water is removed from the top of the water column.
    - Allow time for the bailer to fill with aquifer water as it descends into the water column.
    - Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample. Carefully raise the bailer. Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.
    - Lower the bailer to approximately the same depth each time.
    - Collect the sample. Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Discard the last few inches of water in the bailer.
    - Repeat steps for additional samples.
    - As a final step measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected. Record all measurements and note the time that sampling was completed.

c.) <u>Sampling Low Permeability Aquifers or Wells that have Purged Dry</u>

1. Collect the sample(s) after the well has been purged. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available.
2. Measure the five field parameters temperature, pH, specific conductance, dissolved oxygen and turbidity at the time of sample collection.
3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

Appendix D - Collecting Samples from Wells with Plumbing in Place

In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply.

a.) Air Strippers or Remedial Systems - These types of systems are installed as remediation devices. Collect influent and effluent samples from air stripping units as described below.

1. Remove any tubing from the sampling port and flush for one to two minutes.
2. Remove all hoses, aerators and filters (if possible).
3. Open the spigot and purge sufficient volume to flush the spigot and lines and until the purging completion criteria have been met.
4. Reduce the flow rate to approximately 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples.
5. Follow procedures for collecting samples from water supply wells as outlined below.

b.) Water Supply Wells – Water supply wells with in-place plumbing do not require equipment to be brought to the well to purge and sample. Water supply wells at UST facilities must be sampled for volatile organic compounds (VOCs) and semivolatile compounds (SVOCs).

1. *Procedures for Sampling Water Supply Wells*
    - Label sample containers prior to sample collection.
    - Prepare the storage and transport containers (ice chest, etc.) before taking any samples so each collected sample can be placed in a chilled environment immediately after collection.
    - You must choose the tap closest to the well, preferably at the wellhead. The tap must be before any holding or pressurization tank, water softener, ion exchange, disinfection process or before the water line enters the residence, office or building. If no tap fits the above conditions, a new tap that does must be installed.
    - The well pump must not be lubricated with oil, as that may contaminate the samples.
    - The sampling tap must be protected from exterior contamination associated with being too close to a sink bottom or to the ground. If the tap is too close to the ground for direct collection into the appropriate container, it is acceptable to use a smaller (clean) container to transfer the sample to a larger container.
    - Leaking taps that allow water to discharge from around the valve stem handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations.

- Disconnect any hoses, filters, or aerators attached to the tap before sampling.
- Do not sample from a tap close to a gas pump. The gas fumes could contaminate the sample.

2. *Collecting Volatile Organic Samples*
    - Equipment Needed: VOC sample vials [40 milliliters, glass, may contain 3 to 4 drops of hydrochloric acid (HCl) as preservative]; Disposable gloves and protective goggles; Ice chest/cooler; Ice; Packing materials (sealable plastic bags, bubble wrap, etc.); and Lab forms.
    - Sampling Procedure: Run water from the well for at least 15 minutes. If the well is deep, run water longer (purging three well volumes is best). If tap or spigot is located directly before a holding tank, open a tap after the holding tank to prevent any backflow into the tap where you will take your sample. This will ensure that the water you collect is "fresh" from the well and not from the holding tank. After running the water for at least 15 minutes, reduce the flow of water. The flow should be reduced to a trickle but not so slow that it begins to drip. A smooth flow of water will make collection easier and more accurate. Remove the cap of a VOC vial and hold the vial under the stream of water to fill it. Be careful not to spill any acid that is in the vial. For best results use a low flow of water and angle the vial slightly so that the water runs down the inside of the vial. This will help keep the sample from being agitated, aerated or splashed out of the vial. It will also increase the accuracy of the sample. As the vial fills and is almost full, turn the vial until it is straight up and down so the water won't spill out. Fill the vial until the water is just about to spill over the lip of the vial. The surface of the water sample should become mounded. It is a good idea not to overfill the vial, especially if an acid preservative is present in the vial. Carefully replace and screw the cap onto the vial. Some water may overflow as the cap is put on. After the cap is secure, turn the vial upside down and gently tap the vial to see if any bubbles are present. If bubbles are present in the vial, remove the cap, add more water and check again to see if bubbles are present. Repeat as necessary. After two samples without bubbles have been collected, the samples should be labeled and prepared for shipment. Store samples at 4° C.

3. *Collecting Extractable Organic and/or Metals Samples*

- Equipment Needed: SVOC sample bottle [1 liter, amber glass] and/or Metals sample bottle [0.5 liter, polyethylene or glass, 5 milliliters of nitric acid (HNO3) preservative]; Disposable gloves and protective goggles; Ice Chest/Cooler; Ice; Packing materials (sealable plastic bags, bubble wrap, etc.); and Lab forms.
- Sampling Procedure: Run water from the well for at least 15 minutes. If the well is deep, run the water longer (purging three well volumes is best). If tap or spigot is located directly before a holding tank, open a tap after the holding tank to prevent any backflow into the tap where you will take your sample. This will ensure that the water you collect is "fresh" from the well and not from the holding tank. After running the water for at least 15 minutes, reduce the flow. Low water flow makes collection easier and more accurate. Remove the cap of a SVOC or metals bottle and hold it under the stream of water to fill it. The bottle does not have to be completely filled (i.e., you can leave an inch or so of headspace in the bottle). After filling, screw on the cap, label the bottle and prepare for shipment. Store samples at 4° C.

Appendix E - Collecting Surface Water Samples

The following topics include 1.) acceptable equipment selection and equipment construction materials and 2.) standard grab, depth-specific and depth-composited surface water sampling techniques.

Facilities which contain or border small rivers, streams or branches should include surface water sampling as part of the monitoring program for each sampling event. A simple procedure for selecting surface water monitoring sites is to locate a point on a stream where drainage leaves the site. This provides detection of contamination through, and possibly downstream of, site via discharge of surface waters. The sampling points selected should be downstream from any waste areas. An upstream sample should be obtained in order to determine water quality upstream of the influence of the site.

a.) General Cautions
    1. When using watercraft take samples near the bow away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.
    2. When wading, collect samples upstream from the body. Avoid disturbing sediments in the immediate area of sample collection.
    3. Collect water samples prior to taking sediment samples when obtaining both from the same area (site).
    4. Unless dictated by permit, program or order, sampling at or near man-made structures (e.g., dams, weirs or bridges) may not provide representative data because of unnatural flow patterns.
    5. Collect surface water samples from downstream towards upstream.

b.) Equipment and Supplies - Select equipment based on the analytes of interest, specific use, and availability.

c.) Surface Water Sampling Techniques - Adhere to all general protocols applicable to aqueous sampling when following the surface water sampling procedures addressed below.
    1. *Manual Sampling*: Use manual sampling for collecting grab samples for immediate in-situ field analyses. Use manual sampling in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to observe and/or note unusual conditions.
        - Surface Grab Samples - Do not use sample containers containing premeasured amounts of preservatives to collect grab samples. If the sample matrix is homogeneous, then the grab method is a simple and effective technique for collection purposes. If homogeneity is not apparent, based on flow or vertical variations (and should never be assumed), then use other collection protocols. Where practical, use the actual sample container submitted to the laboratory for collecting samples to be analyzed for oil and grease, volatile organic compounds (VOCs), and microbiological samples. This procedure eliminates the possibility of contaminating the sample with an intermediate collection container. The use of

unpreserved sample containers as direct grab samplers is encouraged since the same container can be submitted for laboratory analysis after appropriate preservation. This procedure reduces sample handling and eliminates potential contamination from other sources (e.g., additional sampling equipment, environment, etc.).

1. Grab directly into sample container.
2. Slowly submerge the container, opening neck first, into the water.
3. Invert the bottle so the neck is upright and pointing towards the direction of water flow (if applicable). Allow water to run slowly into the container until filled.
4. Return the filled container quickly to the surface.
5. Pour out a few mL of sample away from and downstream of the sampling location. This procedure allows for the addition of preservatives and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.
6. Add preservatives, securely cap container, label, and complete field notes. If sample containers are attached to a pole via a clamp, submerge the container and follow steps 3 – 5 but omit steps 1 and 2.

- Sampling with an Intermediate Vessel or Container: If the sample cannot be collected directly into the sample container to be submitted to the laboratory, or if the laboratory provides prepreserved sample containers, use an unpreserved sample container or an intermediate vessel (e.g., beakers, buckets or dippers) to obtain the sample. These vessels must be constructed appropriately, including any poles or extension arms used to access the sample location.
    1. Rinse the intermediate vessel with ample amounts of site water prior to collecting the first sample.
    2. Collect the sample as outlined above using the intermediate vessel.
    3. Use pole mounted containers of appropriate construction to sample at distances away from shore, boat, etc. Follow the protocols above to collect samples.
- Peristaltic Pump and Tubing: The most portable pump for this technique is a 12 volt peristaltic pump. Use appropriately precleaned, silastic tubing in the pump head and attach polyethylene, Tygon, etc. tubing to the pump. This technique is not acceptable for Oil and Grease, EPH, VPH or VOCs. Extractable organics can be collected through the pump if flexible interior-wall Teflon, polyethylene or PP tubing is used in the pump head or if used with the organic trap setup.

1. Lower appropriately precleaned tubing to a depth of 6 – 12 inches below water surface, where possible.
2. Pump 3 – 5 tube volumes through the system to acclimate the tubing before collecting the first sample.
3. Fill individual sample bottles via the discharge tubing. Be careful not to remove the inlet tubing from the water.
4. Add preservatives, securely cap container, label, and complete field notes.

- Mid-Depth Grab Samples: Mid-depth samples or samples taken at a specific depth can approximate the conditions throughout the entire water column. The equipment that may be used for this type of sampling consists of the following depth-specific sampling devices: Kemmerer, Niskin, Van Dorn type, etc. You may also use pumps with tubing or double check-valve bailers. Certain construction material details may preclude its use for certain analytes. Many Kemmerer samplers are constructed of plastic and rubber that preclude their use for all volatile and extractable organic sampling. Some newer devices are constructed of stainless steel or are all Teflon or Teflon-coated. These are acceptable for all analyte groups without restriction.
    1. Measure the water column to determine maximum depth and sampling depth prior to lowering the sampling device.
    2. Mark the line attached to the sampler with depth increments so that the sampling depth can be accurately recorded.
    3. Lower the sampler slowly to the appropriate sampling depth, taking care not to disturb the sediments.
    4. At the desired depth, send the messenger weight down to trip the closure mechanism.
    5. Retrieve the sampler slowly.
    6. Rinse the sampling device with ample amounts of site water prior to collecting the first sample. Discard rinsate away from and downstream of the sampling location.
    7. Fill the individual sample bottles via the discharge tube.
- Double Check-Valve Bailers: Collect samples using double check-valve bailers if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. Bailers with an upper and lower check-valve can be lowered through the water column. Water will continually be displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved. Sampling with this type of bailer must follow the same protocols outlined above, except that a messenger weight is not applicable. Although not designed specifically for this kind of sampling, a bailer is acceptable when a mid-depth sample is required

1. As the bailer is dropped through the water column, water is displaced through the body of the bailer. The degree of displacement depends upon the check-valve ball movement to allow water to flow freely through the bailer body.
2. Slowly lower the bailer to the appropriate depth. Upon retrieval, the two check valves seat, preventing water from escaping or entering the bailer.
3. Rinse the sampling device with ample amounts of site water prior to collecting the first sample.
4. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described above.

- Peristaltic Pump and Tubing: The most portable pump for this technique is a 12 volt peristaltic pump. Use appropriately precleaned, silastic tubing in the pump head and attach HDPE, Tygon, etc. tubing to the pump. This technique is not acceptable for Oil and Grease, EPH, VPH or VOCs. Extractable organics can be collected through the pump if flexible interior-wall Teflon, polyethylene or PP tubing is used in the pump head, or if used with an organic trap setup.
    1. Measure the water column to determine the maximum depth and the sampling depth.
    2. Tubing will need to be tied to a stiff pole or be weighted down so the tubing placement will be secure. Do not use a lead weight. Any dense, non-contaminating, non-interfering material will work (brick, stainless steel weight, etc.). Tie the weight with a lanyard (braided or monofilament nylon, etc.) so that it is located below the inlet of the tubing.
    3. Turn the pump on and allow several tubing volumes of water to be discharged before collecting the first sample.
    4. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described above.

Operation Plan

Appendix E – Composting Facility, Scrap Tire Collection Facility, and Treatment and Processing Facility Operation Plans

CDM Smith

RFQ Appendix 2

April 30, 2024

Ms. Connal Boyd
Compliance Hydrogeologist
Division of Waste Management/Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1646
Via Email: connal.boyd@deq.nc.gov.

RE: Catawba County Newton Landfill (Bethany Church Road Landfill), Permit # 18-01
Updated Water Quality Monitoring Plan (Revised April 2024)
LaBella Project No. 2233387, Phase 04

Dear Ms. Boyd:

On behalf of Catawba County, North Carolina, LaBella Associates is submitting the attached updated Water Quality Monitoring Plan for the Newton Landfill (AKA, the Bethany Church Road Landfill) Permit Number 18-01. This Water Quality Monitoring Plan updates the plan submitted by CDM Smith and approved by the Solid Waste Section on May 21, 2021. This plan summarizes analytical changes for the semiannual groundwater monitoring events.

If we can provide any additional information, please contact me at jwesterfield@labellapc.com or (804) 980-746.

Respectfully submitted,

LaBella Associates

John G. Westerfield, PG
Senior Technical Geologist

cc: Rodney Hamby, Catawba County

Prepared For:
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Utilities and Engineering Department
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LaBella
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WATER QUALITY MONITORING PLAN
NEWTON LANDFILL (BETHANY CHURCH ROAD LANDFILL)
Permit No. 18-01

NOVEMBER 2023 (REVISED APRIL 2024)
PROJECT NO. 2233387/04

Water Quality Monitoring Plan
Newton Landfill (Bethany Church Road Landfill), Permit No. 18-01
Catawba County, North Carolina

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1.0 INTRODUCTION

This Water Quality Monitoring Plan (WQMP) will serve as a guidance document for collecting and analyzing groundwater and surface water samples, managing the associated analytical results, and monitoring for any potential releases from the Catawba County Newton Landfill (the Facility). The WQMP complies with 15A NCAC 13B .1630 & .1633 of the North Carolina Solid Waste Management Rules (NCSWMR). It is also compliant with recent guidance and memoranda issued by the North Carolina Department of Environmental Quality (NCDEQ) Solid Waste Section (SWS), which are included in **Appendix A**.

1.1 Site Description and Regulatory Status

The Newton Landfill, also known as the Bethany Church Landfill, is a closed municipal solid waste (MSW) landfill maintained by Catawba County, North Carolina under solid waste permit No. 18-01. The Facility is located on Bethany Church Road, approximately three miles east-southeast of Newton, North Carolina. The approximate property boundary and disposal areas are indicated on a portion of the USGS 7½ minute topographic map for Newton, North Carolina (**Figure 1**).

Groundwater at the Newton Landfill is monitored in accordance with the NCSWMR 15A NCAC 13B Section .0601 for MSW landfills closed before October 9, 1993. Surface water is monitored semiannually in accordance with NCSWMR 15A NCAC 13B Section 0.602 in conjunction with groundwater monitoring events.

The Facility is currently the subject of a Corrective Action Program, as discussed in the Corrective Action Assessment Report dated January 27, 2021 (CDM Smith, 2021b). As part of that program, the County acquired additional property to the north of the landfill to provide an additional buffer between the edge of waste and the property boundary. Four new monitoring wells (MW-25, MW-26, MW-26D, and MW-27) were installed in this area approximately 250 feet from the edge of waste on the northwest side of the Facility. Monitoring well construction details are summarized in **Table 1**.

1.2 Site Geology and Hydrogeology

The Facility is located within the Inner Piedmont Belt of the Piedmont Physiographic Province. The bedrock of the Inner Piedmont Belt is characterized by medium to high grade metamorphic rocks ranging from marble to schist to gneiss, intruded by varying age plutons. A surface layer of saprolite over a transition zone of partially weathered bedrock covers most of the area. In the Piedmont, the thickness of saprolite averages about 52 feet, and in some cases, may exceed depths of 100 feet (Daniel, 1990). The Inner Piedmont is bounded on the northwest by the Brevard Fault zone and on the southeast by the Kings Mountain Belt and faults and shear zones that define the central Piedmont structure.

Groundwater flow at the Facility, as is typical for the Inner Piedmont Belt, is primarily within the saprolite and the partially weathered bedrock (transition zone); however, some flow also occurs along major fractures within the competent bedrock. The uppermost aquifer includes all three zones. The water table typically reflects topography, and groundwater flows from the higher topography (recharge areas) to the valleys where it discharges to perennial creeks, which flow southeast to Hagan Fork, located approximately 2,400 feet southeast of the Facility. Hagan Fork is classified as a Class C waterway that is protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture.

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2.0 GROUNDWATER AND SURFACE WATER MONITORING

2.1 Groundwater Monitoring Network

Water quality monitoring is conducted semiannually at the Facility, typically in March and September. The current monitoring well network consists of compliance monitoring wells MW-1, MW-3, MW-9, MW-10A, MW-10B, MW-11, MW-13, MW-14, MW-14A, MW-15, MW-16, MW-16A, MW-20, MW-23 (background well), MW-24, MW-24D, MW-25, MW-26, MW-26D, MW-27, OW-1, and OW-3. In Addition to the semiannually sampled wells, monitoring wells MW-7A and MW-18 are sampled every 18 months. The locations of the monitoring wells are shown on **Drawing 2** and the monitoring well construction data are included in **Table 1**.

2.1.1 Maintenance of the Groundwater Monitoring Network

The existing monitoring wells will be used and maintained in accordance with design specifications throughout the life of the monitoring program. Monitoring well specifications are outlined in 15A NCAC Subchapter 2C, Section .0100. Routine well maintenance will include inspection and correction/repair of, as necessary, identification labels, concrete apron condition, locking caps and locks, and access to the wells. The Facility will re-evaluate the monitoring network and provide recommendations to the NCDEQ-SWS for modifying, rehabilitating, abandoning, or installing replacement or additional monitoring wells, as appropriate.

2.1.2 Well Abandonment

Any monitoring wells at the site which need to be abandoned due to damage, construction activities, or approved changes in the monitoring network will be properly abandoned in accordance with the procedures for permanent abandonment, as described in 15A NCAC 2C Rule .0113(a)(2). No wells will be abandoned without prior approval from the NCDEQ-SWS.

2.2 Surface Water Monitoring Network

The surface water monitoring network for the Facility includes two sampling locations designated CR-1 and SW-2. Both locations are situated near the southeast corner of the landfill on an intermittent creek that flows southeast to Hagan Fork, which is located approximately 2,400 feet southeast of the Facility. Hagan Fork is classified as a Class C waterway that is protected for uses such as secondary recreation, fishing, wildlife, fish consumption, aquatic life including propagation, survival and maintenance of biological integrity, and agriculture. The locations of these sampling points are shown on **Drawing 2**.

3.0 SAMPLING AND ANALYSES

3.1 Groundwater Sampling Methodology

Groundwater samples will be collected in accordance with Solid Waste Management Rules 15A NCAC 13B .1632 and the Solid Waste Section: Guidelines for Groundwater, Soil, and Surface Water Sampling (NCDEQ_SWS, 2008). Copies of the documents, as well as additional guidelines and SWS memoranda are included in **Appendix A**. Details of well purging, sample withdrawal, and decontamination methods, as well as chain-of-custody procedures are outlined in the following sections.

3.1.1 Static Water Levels

Static water elevations and the total well depth will be measured to the nearest 0.01 foot in each well prior to the sampling of each well. An electronic water level meter will be used for the measurements.

Other measuring methods may be used if the depth to water can be measured to the nearest 0.01 of a foot (e.g., wetted-tape method). The distance from the top of the well casing to the water surface (and if not already known, the distance to the bottom of the well) will be measured using the tape attached to the probe. Between wells and following completion of the field sampling, the water level meter will be decontaminated using the following procedure:

1. Phosphate-free soap and distilled water wash;
2. Distilled water rinse; and
3. Air dry.

3.1.2 Monitoring Well Purging and Sampling Methodology

A low yield well (one that is incapable of yielding three well volumes within a reasonable time) will be purged so that water is removed from the bottom of the screened interval. Low yield wells will be evacuated until dry once. Minimum purge sampling could also be used as an alternate sampling method. The minimum purge approach requires the removal of the smallest possible purge volume prior to sampling, generally limited to three volumes of the sampling system. If the monitoring well is purged to dryness, within 24 hours of purging, the first sample will be field tested for at least pH, temperature, specific conductance, and turbidity. Samples will then be collected and containerized in the following order unless field conditions justify other sampling regimens:

1. Volatile Organics;
2. Extractable Organics, Petroleum Hydrocarbons, and Aggregate Organics;
3. Total Metals;
4. Nonmetallic Inorganics; and
5. Physical and Aggregate Properties.

A high yield well (one that is capable of yielding more than three well volumes during purging) will be purged so that water is drawn down from the uppermost part of the water column to ensure that fresh water from the formation will move upward in the screen. At no time will a well be evacuated to dryness if the recharge rate causes the formation water to vigorously cascade down the sides of the screen, which could cause an accelerated loss of volatiles.

A minimum of three well volumes will be evacuated from high-yield wells prior to sampling. A well volume is defined as the water contained within the well casing and pore spaces of the surrounding filter pack. The well volume will be calculated using the following formulas:

$V_c = (d_c^2/4) \times 3.14 \times h_w \times (7.48 \text{ gallons/cubic foot})$
$V_c \text{ (gallons)} = 0.163 \times h_w \text{ (for a 2-inch well)}$
where:
V_c = volume in the well casing in gallons
d_c = casing diameter in feet (d_c = 0.167 for a 2-inch well)
h_w = height of the water column in feet (i.e., well depth minus depth to water)

Each well will be purged and sampled with a disposable bailer or a sampling pump. The bailer or pump will be lowered gently into the well to minimize the possibility of causing degassing of the water. If sampled with a pump, flow rates will be regulated to minimize turbidity and degassing of the water.

Alternatively, low-flow sampling methods may be applied. Low-flow sampling is a purging method used to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns,

and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging to determine when sample collection may begin. The US EPA's *Region I - Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (USEPA, 2017) contains additional details on low-flow sampling procedures.

A pump with a flow regulator may be used to purge the wells. The pump should be lowered into the well slowly to minimize disturbing the water, and the pump should be set within the screened interval but at least 2-3 feet above the bottom of the well. The pump should be started at the lowest speed and slowly increased until discharge occurs, and then the pumping rate should be adjusted to minimize drawdown (ideally, to less than 0.3 feet), and then once the drawdown is stabilized, the pumping rate should remain constant.

Use of a transparent, small-volume flow-through cell with a multi-parameter meter capable of recording temperature, pH, specific conductance, dissolved oxygen (DO), and oxidation reduction potential (ORP) is recommended. A separate instrument can be used to measure turbidity. The instruments should be properly calibrated per manufacturer recommendations prior to each use. These parameters should be monitored continuously during pumping until they stabilize. Stabilization can be considered achieved when three consecutive readings are within the following limits:

- Turbidity: ± 10% (or less than 5 Nephelometric Turbidity Units (NTU)).
- DO: ± 10% (or less than 0.5 milligrams per liter (mg/L)).
- Specific Conductance: ± 3%.
- Temperature: ± 3%.
- pH: ± 1 unit.
- ORP: ± 10 mV.

Samples can then be collected for analysis by disconnecting the tubing from the flow-through cell (samples should <u>not</u> be collected from the flow-through cell) and carefully dispensing the water from the tubing directly into the sample containers.

All equipment used for sampling will be handled in such a manner to ensure that the equipment remains decontaminated prior to use. Clean disposable gloves will be worn by sampling personnel and changed between wells. Between wells and following completion of the field sampling, water level meters, sampling pumps, or any other reusable sampling equipment will be properly decontaminated using the following procedure:

1) Phosphate-free soap and distilled water wash;
2) Distilled water rinse; and
3) Air dry.

The upgradient/background well will be sampled first, followed by the downgradient wells. The order of sampling of the downgradient wells will be evaluated in each sampling event to provide a sequence going from less contaminated to more contaminated, if applicable, based on the previous sampling event.

Field measurements of temperature, pH, specific conductance, DO, ORP, and turbidity will be made before sample collection. The direct reading equipment used at each well will be calibrated according to the manufacturer's specifications prior to each sampling event. Groundwater samples will be collected and containerized in the order of volatilization sensitivity.

3.1.3 Surface Water Sampling Methodology

Surface water samples will only be taken if there is sufficient flowing water and not from stagnant pools. Surface water samples will be collected by carefully dipping a clean, unpreserved sampling container into the flow in such a way as to minimize sampling-induced turbidity or agitation of the sample, which could cause volatilization. Field measurements of temperature, pH, specific conductance, DO, ORP, and turbidity will be made before sample collection, and then the laboratory bottles will be carefully filled from the sampling container in the same order as described above for groundwater samples. Sampling equipment will be decontaminated between samples and sampling personnel will wear new, disposable, nitrile or latex gloves while handling samples.

3.1.4 Sample Collection, Bottling, and Transportation

Pre-preserved sample containers are properly prepared by the analytical laboratory scheduled to perform the analysis. No cleaning or preparation of sampling bottles by field personnel should be performed.

The volatile organic compound (VOC) vials will be filled in such a manner that no headspace remains after filling. Immediately upon collection, all samples will be placed in coolers on ice where they will be stored prior to and during transit to the laboratory.

Samples collected will be properly containerized, packed immediately into pre-cooled coolers and either hand-delivered or shipped via overnight courier to the laboratory for analysis. The chain-of-custody program will allow for tracing of possession and handling of samples from the time of field collection through laboratory analysis. The chain-of-custody program will include sample labels and seals, field logs, chain-of-custody records, shipping documents, and laboratory logs.

Labels sufficiently durable to remain legible when wet will contain the following information:

- Job and sample identification;
- Monitoring well number or other location;
- Date and time of collection;
- Name of collector;
- Parameter or method to be analyzed; and
- Preservative, if applicable.

The shipping container will be sealed to ensure that the samples have not been disturbed during transport to the laboratory. If the sample cannot be analyzed because of damage or disturbance, whenever possible, the damaged sample will be replaced during the same compliance period.

The field log will contain documentation of the following information:

- Identification of the well;
- Well depth;
- Static water level depth;
- Presence of immiscible layers, odors or other indications of potential contamination;
- Purge volume (given in gallons);
- Time well was purged;
- Date and time of collection;
- Well sampling sequence;
- Field analysis data and methods;

- Field observations on sampling event;
- Name of collector(s); and
- Climatic conditions (temperature, precipitation).

Sample field log forms for groundwater and surface water are provided in **Appendix B**.

The chain-of-custody record is required to establish the documentation necessary to trace sample possession from time of collection to time of receipt at destination. A chain-of-custody record will accompany each individual shipment. The record will contain the following information:

- Sample destination and transporter;
- Sample identification numbers;
- Signature of collector;
- Date and time of collection;
- Sample type;
- Identification of well;
- Number of sample containers in shipping container;
- Parameters requested for analysis;
- Signature of person(s) involved in the chain of possession;
- Inclusive dates of possession; and
- Internal temperature of shipping container upon opening (noted by the laboratory).

A copy of the completed chain-of-custody will accompany the shipment and will be returned to the shipper with the analytical results. The chain-of-custody may also be used as the analysis request sheet. A sample chain-of-custody form is included in **Appendix B**.

3.1.5 Field Blanks, Equipment Blanks, and Trip Blanks

A field blank and/or equipment blank will be collected and analyzed during each sampling event to verify that the sample collection and handling processes have not affected the integrity of the field samples. The field blank monitors for contamination that might occur between samples and sample containers as they are opened and exposed to the sampling environment and an equipment blank monitors for possible cross-contamination due to using the same equipment in multiple wells. The field blank will be prepared in the field from lab-pure water (Type II reagent-grade water) supplied by the laboratory. One field blank will be prepared for each sampling event. The field blank will be generated by exposing the lab-pure water to the sampling environment in the same manner as actual field samples being collected.

If a non-dedicated pump is used, an equipment blank should be collected by running the lab-pure water through the pump after completing all the well sampling. If the water is also exposed to the sampling environment as described above prior to running it through the pump, it can be considered both a field and an equipment blank.

The laboratory will provide appropriate sample containers for generation of the field or equipment blank(s). The field or equipment blank(s) will be subjected to the same analyses as the groundwater samples. As with all other samples, the time(s) of the blank collection will be recorded so that the sampling sequence is documented.

Whenever groundwater samples are being collected for volatiles analysis, a trip blank will be generated by the laboratory prior to shipment of sampling containers and coolers to the field, using lab-pure water as described above. The trip blank shall be transported with the empty sampling

containers to the field but will not be opened at any time prior to analysis at the laboratory. The trip blank will accompany the groundwater samples in the cooler(s) back to the laboratory and will be analyzed by the same volatile methods as the associated field samples. The trip blank monitors for potential cross-contamination that might occur between samples or that may be a result of the shipping environment.

Detectable levels of contaminants found in the field blanks or trip blanks will not be used to correct the groundwater data but will be noted accordingly. Detections of constituents in site groundwater or surface water samples may be blank-qualified if the concentration detected in the sample is less than 5 times (or 10 times, in the case of some common laboratory contaminants such as methylene chloride and some phthalates) the concentrations of that constituent detected in the field, trip, or method blanks. Contaminants present in trip blanks or field/equipment blanks at concentrations within an order of magnitude of those observed in the corresponding groundwater samples may be cause for resampling.

3.2 Sample Analytical Requirements

The analysis of groundwater and surface water samples from the Facility will be conducted by a laboratory certified by the NCDEQ. Analyses will be performed in accordance with U.S. Environmental Protection Agency (EPA) SW-846 methods, or other methods as approved by the NCDEQ.

Facility monitoring wells are currently monitored for North Carolina Appendix I volatile organic compounds (VOCs), and for total chromium, total nickel, and total lead, as well as for 1,4 dioxane per the SWS memorandum dated May 29, 2018. After July 1, 2023, groundwater samples will also be analyzed for per-and poly-fluoroalkyl substances (PFAS) per the SWS memoranda dated March 13 and July 17, 2023 (see **Appendix A**). Samples will be collected during two consecutive semiannual monitoring events, with additional PFAS monitoring, if any, to be determined by the NCDEQ. In addition, field readings for temperature, pH, specific conductance, DO, ORP, and turbidity will be collected for each sample.

On August 28, 2023, LaBella Associates submitted a request on behalf of the Facility to reduce 1,4-dioxane monitoring at 12 wells around the Facility. In a letter dated September 14, 2023, NCDEQ approved the following reductions in 1,4-dioxane monitoring at the Facility:

- Monitoring of 1,4-dioxane can be reduced from a semiannual schedule to semiannual monitoring every other year at monitoring wells MW-9, MW-14A, MW-15, MW-20, MW-23, MW-24, MW-24D, MW-25, MW-26, MW-27, OW-1, and OW-3.

- This schedule will go into effect after completion of the 2nd 2023 semiannual monitoring event. After 2023, the next scheduled monitoring events will be the 1st and 2nd 2025 semiannual monitoring events.

Surface water at the Facility is sampled semiannually in conjunction with the groundwater monitoring events. All surface water samples are analyzed for North Carolina Appendix I VOCs plus and North Carolina Appendix I metals, as well as for 1,4 dioxane per the SWS memorandum dated May 29, 2018. PFAS monitoring will also be conducted on a similar schedule to the groundwater monitoring wells above. In addition, field readings for temperature, pH, specific conductance, DO, ORP, and turbidity will be collected for each sample.

3.3 Reporting and Record Keeping

In accordance with NCSWMR 15A NCAC 13B.1632.(i), a semiannual Water Quality Monitoring Report (WQMR) shall be submitted to the NCDEQ-SWS within 120 days of the last day of each semiannual sampling event.

The NCDEQ issued a guidance document in November 2014 for the submittal of environmental monitoring reports. Based on this guidance and subsequent memoranda, the semiannual WQMRs will include the following:

- An Environmental Monitoring Reporting Form (EMRF), sealed by a professional engineer or geologist;
- A table of all constituents detected during the sampling event;
- A table of constituents detected above the appropriate groundwater or surface water protection standards;
- A table of field parameter data collected during sampling;
- A topographic map of the Facility with groundwater potentiometric contours showing groundwater flow direction;
- Calculation of groundwater flow rates;
- Evaluation, conclusions, and recommendations of a professional engineer or geologist; and
- Laboratory analytical reports, field data logs, and chains of custody.

In addition, NCDEQ requires the submittal of Laboratory Electronic Data Deliverables (EDDs) in an excel spreadsheet in the NCDEQ-required format with each semiannual WQMR. In a memorandum and guidance document dated July 20, 2020, NCDEQ required that EDDs be submitted in the North Carolina EQuIS database format.

4.0 COMPARISONS TO STANDARDS

4.1 Comparison to Groundwater Protection Standards (GPS)

Constituents detected in the groundwater samples collected from the compliance network shall be compared to the GPS as defined in 15A NCAC 13B.1634.(g). In general, the GPS will be equal to the NC2L Standards established by 15A NCAC 2L.0202. For constituents without NC2L Standards, the GPS shall be the Practical Quantitation Limit (PQL) or Method Reporting Limit (MRL). If the SWS approves a statistically determined background concentration for a constituent greater than the applicable NC2L, the background may be considered the GPS for comparison. The initial comparison will be performed using a value-to-value procedure. Relevant NC2L Standards are included in **Appendix C** and are current as of the submittal date of this WQMP.

If an analyte is detected above the GPS in a given sampling event, confidence limits may be calculated based on the most recent four sampling events. If the lower confidence limit is not above the GPS, the detection shall not be considered a statistically significant level compared to the GPS, even if it is a quantified concentration.

If a suspect GPS exceedance is noted during the value-to-value comparison, a confirmation sample may be collected. The results from a confirmation sample will be compared to the GPS in a value-to-value comparison, or the value may be statistically compared to background, as appropriate.

In accordance with 15A NCAC 13B.1633(c)(1) and the SWS memorandum dated August 8, 2016, if there is a confirmed exceedance of an analyte above the GPS in a given monitoring well during a sampling event, and if it is the first time that analyte has been detected in exceedance in that well, the exceedance shall be reported to the NCDEQ within 14 days of the date of the final laboratory report, or if there was a confirmation sampling, within 14 days of the date of the confirmation sample laboratory report.

4.2 Comparison to Surface Water Standards

Results for surface water samples will be compared to the surface water standards found in 15A NCAC 2B (NC2B Standards). The streams that receive runoff or groundwater discharge from the landfill property are all classified as Class C waters; therefore, the lowest of the applicable aquatic life and secondary recreation or the fish consumption standards will be used for comparison. For some metals, the NC2B Standards provide hardness-based standards. If hardness data is available, the standards for these metals will be calculated based on the hardness. If no hardness data is available, the default NC2B standards will be used.

For constituents that have no listed NC2B Standard, the results will be compared to North Carolina In-Stream Target Values (ISTV) values. If there is no NC2B Standard or ISTV listed, the result will be compared to the EPA Nationally Recommended Water Quality Criteria for Aquatic Life & Human Health (NRWQC) values. If none of these standards apply, the PQL or MRL will be the standard.

5.0 STATISTICAL ANALYSES

Per the April 2011 revision of the NCSWMR (rules .1632-.1637), statistical analysis of groundwater is not required; however, 15A NCAC 13B.1632.(g) allows for the use of statistical analyses to establish background values should the County elect to do so. If statistical analyses are used to determine a background value for any constituent, the statistical analyses will follow the guidelines set out in 15A NCAC 13B.1632.(g) and the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (USEPA, 2009).

In addition, the *NC Solid Waste Section Guidelines for Alternate Source Demonstration Submittals for Solid Waste Management Facilities* (NCDEQ, 2017) includes guidelines for use of statistical analyses to determine background concentrations of constituents. This document states that statistical background levels should be calculated using monitoring data where the turbidity values are less than 10 NTUs. Turbidity measurements must be submitted along with the sample data to demonstrate whether suspended sediments are playing a role. Statistical background concentrations should be calculated using analytical data from a minimum of ten groundwater samples with turbidity values less than 10 NTUs.

The current monitoring well MW-23 serves as the upgradient background monitoring well for the Facility. Background data from this well may be used in statistical calculations.

The background data are to be evaluated through the use of Parametric Prediction Limits, Parametric Tolerance Intervals, Non-Parametric Prediction Limits, Poisson Prediction Limits, or other methods as approved by the SWS. Selection of statistical methods will be based on the distribution of the data, the number of samples, the number of downgradient wells, and/or the percentage of the data that is censored (below detection limit). Tests for normality, outliers, Aitchison's adjustment, tolerance intervals, or prediction limits are to be included as appropriate based on the background data.

The statistical test by which downgradient data are compared to Facility background data is based upon the nature of the data and the number of data values that are less than the laboratory limit of detection. All statistical tests are evaluated at the 0.05 level of significance, 95% confidence level, and are conducted as one-tailed tests. These methods and the criteria for their use are discussed below.

5.1 Assumption of Normality

Prior to conducting statistical tests that are based on the assumption of normally distributed data, normality of the background data is evaluated using the Shapiro-Wilk statistic (W). Normality is assessed at the 95% confidence level. If the raw data fail to follow a normal distribution, the data are transformed using a base-10 logarithm. The transformed data are then tested for normality using the Shapiro-Wilk statistic. If the log-transformed data also fail to follow a normal distribution, a non-parametric approach is applied.

5.2 Parametric Upper Tolerance Limit

In some cases, the background data consist of a minimum of eight independent data values and less than or equal to 15% of the background data values are less than the RL for a given analyte. The downgradient values are then compared to the parametric upper tolerance limit in accordance with the procedure summarized in the US EPA guidance document *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009).

5.3 Aitchison's Adjusted Parametric Upper Prediction Limit

In those cases where the background data consist of a minimum of eight independent data values and more than 15%, but less than or equal to 50%, of the background data values are less than the detection limit (DL) for a given analyte, the mean and standard deviation are adjusted. This is done in accordance with the procedure described by Aitchison (1955) and summarized in the Unified Guidance (USEPA, 2009). After the adjustments are made, the downgradient values are compared to the Aitchison's adjusted parametric upper prediction limit in accordance with the procedures summarized in the Unified Guidance (USEPA, 2009).

5.4 Non-parametric Upper Tolerance Limit

In those cases where more than 50%, but less than or equal to 90%, of the background data values are less than the DL for a given analyte or the background data fail to follow a normal or log-normal distribution, downgradient values are compared to the non-parametric upper tolerance limit. This procedure is done in accordance with the procedures summarized in the Unified Guidance (USEPA, 2009).

5.5 Poisson Upper Prediction Limit

In those cases where more than 90% of the background data values are less than the RL for a given analyte, the downgradient values are compared to the Poisson upper prediction limit. These comparisons are made in accordance with the procedure summarized in the Unified Guidance (USEPA, 2009).

6.0 ABILITY TO EFFECTIVELY MONITOR RELEASES

There are no known conditions, physical or hydrogeologic, which will interfere with the effective monitoring of the Facility. Depths to groundwater and bedrock are well defined in and around the site, which provides a significant environmental advantage long term monitoring and the ability to detect migration of any potential releases of solid waste constituents from the Facility.

The proposed WQMP, when implemented, will be effective in providing early detection of releases from the Facility to the surficial aquifer below, thus providing protection to public health and the environment.

7.0 REFERENCES

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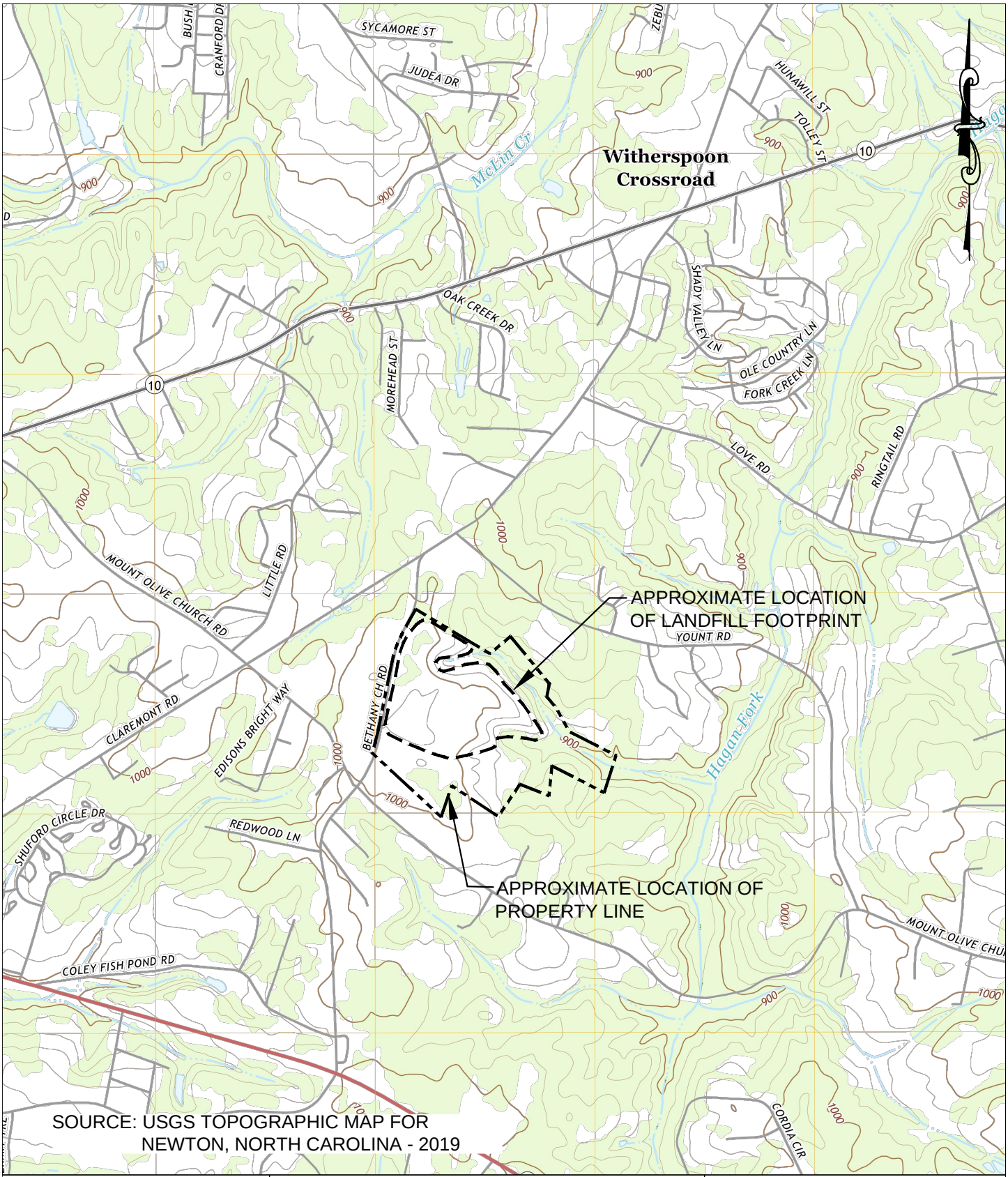
TABLES

TABLE 1: Monitoring Well Construction Data
Newton Landfill
Catawba County, North Carolina

Well ID	Installation Date	Northing Feet	Easting Feet	Drilling Method	Screened Lithology	Total Depth Ft-BTOC	Screen Interval Ft-BGS	Well Diameter Inches	TOC Elevation Ft-AMSL	GS Elevation Ft-AMSL
MW-1	NA	699254.60	1359287.60	NA	Saprolite	29.0	19.0 - 29.0	2.0	916.09	914.91
MW-3	NA	699465.40	1356838.90	NA	Saprolite	40.0	30.0 - 40.0	2.0	1021.81	1020.63
MW-5	NA	699060.60	1358748.90	NA	Saprolite	35.0	25.0 - 35.0	2.0	933.54	931.04
MW-6	NA	698947.70	1359162.50	NA	Saprolite	35.0	25.0 - 35.0	2.0	922.26	919.76
MW-7A	NA	699191.40	1359601.00	NA	Bedrock	78.0	66.0 - 78.0	2.0	912.48	909.48
MW-9	NA	699868.80	1358848.30	NA	Saprolite	46.0	34.0 - 46.0	2.0	949.58	948.08
MW-10A	NA	699576.50	1359040.10	NA	Saprolite	49.0	39.0 - 49.0	2.0	944.11	942.60
MW-10B	NA	699592.60	1359041.30	NA	Bedrock	88.0	78.0 - 88.0	2.0	945.93	942.60
MW-11	NA	700350.20	1358400.10	NA	Saprolite	36.0	26.0 - 36.0	2.0	944.70	942.70
MW-12	NA	699674.40	1359226.80	NA	Saprolite	35.0	25.0 - 35.0	2.0	924.55	923.00
MW-13	NA	699134.60	1359184.60	NA	PWR	78.0	68.0 - 78.0	2.0	923.19	921.70
MW-14	NA	698855.70	1357834.90	NA	Saprolite	35.0	25.0 - 35.0	2.0	1003.63	1002.10
MW-14A	NA	698861.10	1357821.20	NA	Bedrock	86.0	76.0 - 86.0	2.0	1004.46	1002.50
MW-15	NA	698848.20	1358150.40	NA	Saprolite	34.0	24.0 - 34.0	2.0	979.88	978.46
MW-16	NA	699085.70	1359385.20	NA	NA	20.0	10.0 - 20.0	2.0	907.13	905.60
MW-16A	NA	699074.50	1359395.60	NA	Bedrock	82.0	72.0 - 82.0	2.0	906.14	904.10
MW-18	NA	699470.90	1359350.70	NA	Bedrock	83.0	70.5 - 83.0	2.0	921.45	918.48
MW-19	NA	699201.90	1359617.60	NA	Bedrock	116.0	106.0 - 116.0	2.0	913.67	911.36
MW-20	NA	698842.20	1358421.20	NA	Saprolite	85.0	80.0 - 85.0	2.0	966.19	962.52
MW-21	NA	698544.10	1358174.10	NA	Saprolite	70.0	60.0 - 70.0	2.0	980.61	977.65
MW-23	NA	698941.40	1356756.10	NA	Saprolite	34.0	24.0 - 34.0	2.0	1016.50	1013.43
MW-24	NA	698582.70	1358715.00	NA	Saprolite	37.0	27.0 - 37.0	2.0	954.14	951.20
MW-24D	NA	698600.00	1358722.10	NA	PWR	86.0	76.0 - 86.0	2.0	953.64	950.93
MW-25	9/10/2020	701218.90	1357507.40	HSA	Saprolite	35.0	20.0 - 35.0	2.0	1003.30	1000.42
MW-26	9/9/2020	700918.40	1358025.50	HSA	Saprolite	20.0	5.0 - 20.0	2.0	963.87	960.97
MW-26D	9/9/2020	700923.90	1358021.10	HSA/Air	Bedrock	79.0	64.0 - 79.0	2.0	964.52	961.50
MW-27	9/10/2020	700663.20	1358444.80	HSA	Saprolite	35.0	20.0 - 35.0	2.0	956.18	953.13

Notes:
GS Elev. = Ground Surface Elevation
TOC Elev. = Top of Casing Elevation
DTW = Depth to Groundwater (Static)
GW Elev. = Groundwater Elevation
Ft-AMSL = Feet Above Mean Sea Level
Ft-BTOC = Feet Below Top of Casing
Ft-BGS = Feet Below Ground Surface
HSA - Hollow Stem Auger
Northing and Easting Coordinates - North American Datum 1983 State Plane Feet North Carolina

DRAWINGS



SOURCE: USGS TOPOGRAPHIC MAP FOR NEWTON, NORTH CAROLINA - 2019

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PHONE: (336) 323-0092

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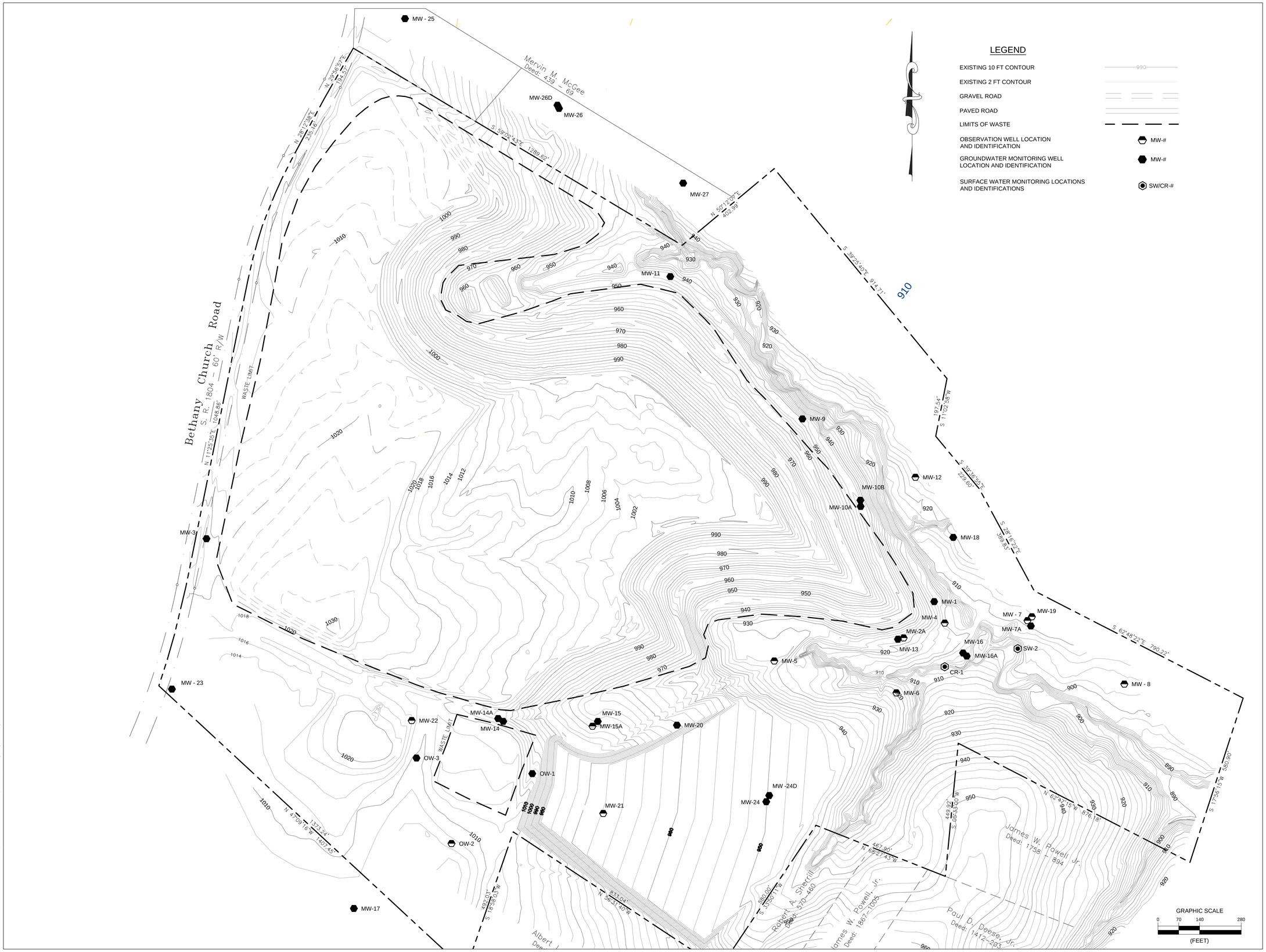
ISSUED FOR: WQMP			
DRAWING NAME: SITE LOCATION MAP	DRAWN BY: RWH	DATE: 11/9/23	PROJECT NO.: 223387.04
PROJECT NAME: **NEWTON LANDFILL #18-01** BETHANY CHURCH ROAD, NEWTON, NC	FIGURE NUMBER: 1		

L:\CATAWBA-NEWTON\SLM _USGS PDF\, 1 NEWTON SITE LOCATION MAP 2021.dwg



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CATAWBA COUNTY
NEWTON, NORTH CAROLINA

NEWTON LANDFILL PERMIT #18-01
BETHANY CHURCH ROAD, NEWTON, NC

NO:	DATE:	DESCRIPTION:
Revisions		

PROJECT NUMBER: 223387.04
DRAWN BY: RH
REVIEWED BY: SG
ISSUED FOR: WATER QUALITY MONITORING PLAN
DATE: 11/7/23
DRAWING NAME:

SITE PLAN

DRAWING NUMBER:

2

APPENDIX A

ENVIRONMENTAL MONITORING GUIDELINES AND MEMORANDA

North Carolina Department of Environment and Natural Resources
Dexter R. Matthews, Director Division of Waste Management Michael F. Easley, Governor
William G. Ross Jr., Secretary

October 27, 2006

To: SW Director/County Manager/Consultant/Laboratory

From: NC DENR-DWM, Solid Waste Section

Re: New Guidelines for Electronic Submittal of Environmental Monitoring Data

The Solid Waste Section receives and reviews a wide variety of environmental monitoring data from permitted solid waste management facilities, including the results from groundwater and surface water analyses, leachate samples, methane gas readings, potentiometric measurements, and corrective action data. We are in the process of developing a database to capture the large volume of data submitted by facilities.

To maintain the integrity of the database, it is critical that facilities, consultants, and laboratories work with the Solid Waste Section to ensure that environmental samples are collected and analyzed properly with the resulting data transferred to the Solid Waste Section in an accurate manner.

In order to better serve the public and to expedite our review process, the Solid Waste Section is requesting specific formatting for environmental monitoring data submittals for all solid waste management facilities.

Effective, December 1, 2006, please submit a Solid Waste Environmental Monitoring Data Form in addition to your environmental monitoring data report. This form will be sent in lieu of your current cover letter to the Solid Waste Section. The Solid Waste Environmental Monitoring Data Form must be filled out completely, signed, and stamped with a Board Certified North Carolina Geologist License Seal.

The solid waste environmental monitoring data form will include the following:

1. Contact Information
2. Facility Name
3. Facility Permit Number
4. Facility Address
5. Monitoring Event Date (MM/DD/YYYY)
6. Water Quality Status: Monitoring, Detection Monitoring, or Assessment Monitoring
7. Type of Data Submitted: Groundwater Monitoring Wells, Groundwater Potable Wells, Leachate, Methane Gas, or Corrective Action Data
8. Notification of Exceedance of Groundwater, Surface Water, or Methane Gas (in table form)
9. Signature
10. North Carolina Geologist Seal

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-508-8400 \ FAX: 919-733-4810 \ Internet http://wastenotnc.org

Most of these criteria are already being included or can be added with little effort. The Solid Waste Environmental Monitoring Data Form can be downloaded from our website: http://www.wastenotnc.org/swhome/enviro_monitoring.asp.

The Solid Waste Section is also requesting a new format for monitoring wells, potable wells, surface water sampling locations, and methane probes. This format is essential in the development and maintenance of the database. The Solid Waste Section is requesting that each sampling location at all North Carolina solid waste management facilities have its own unique identification number. We are simply asking for the permit number to be placed directly in front of the sampling location number (example: 9901-MW1 = Permit Number 99-01 and Monitoring Well MW-1). No changes will need to be made to the well tags, etc. This unique identification system will enable us to accurately report data not only to NCDENR, but to the public as well. We understand that this new identification system will take some time to implement, but we feel that this will be beneficial to everyone involved in the long term.

Additionally, effective December 1, 2006, the Practical Quantitation Limits (PQLs) established in 1994 will change. The Solid Waste Section is requiring that all solid waste management facilities use the new Solid Waste Reporting Limits (SWRL) for all groundwater analyses by a North Carolina Certified Laboratory. Laboratories must also report any detection of a constituent even it is detected below the new SWRL (e.g., J values where the constituent was detected above the detection limit, but below the quantitation limit).

PQLs are technology-based analytical levels that are considered achievable using the referenced analytical method. The PQL is considered the lowest concentration of a contaminant that the lab can accurately detect and quantify. PQLs provided consistency and available numbers that were achievable by the given analytical method. However, PQLs are not health-based, and analytical instruments have improved over the years resulting in lower achievable PQLs for many of the constituents. As a result, the Solid Waste Section has established the SWRLs as the new reporting limits eliminating the use of the PQLs.

We would also like to take this opportunity to encourage electronic submittal of the reports. This option is intended to save resources for both the public and private sectors. The Solid Waste Section will accept the entire report including narrative text, figures, tables, and maps on CD-ROM. The CD-ROM submittal shall contain a CD-ROM case and both CD-ROM and the case shall be labeled with the site name, site address, permit number, and the monitoring event date (MM/DD/YYYY). The files may be a .pdf, .txt, .csv, .xls, or .doc type. Also, analytical lab data should be reported in an .xls file. We have a template for analytical lab data available on the web at the address listed above.

If you have any questions or concerns, please call (919) 508-8400. Thank you for your anticipated cooperation in this matter.

North Carolina Department of Environment and Natural Resources

Dexter R. Matthews, Director | Division of Waste Management | Michael F. Easley, Governor
William G. Ross Jr., Secretary

February 23, 2007

MEMORANDUM

To: Solid Waste Directors, Landfill Operators, North Carolina Certified Laboratories, and Consultants

From: North Carolina Division of Waste Management, Solid Waste Section

Re: Addendum to October 27, 2006, North Carolina Solid Waste Section Memorandum Regarding New Guidelines for Electronic Submittal of Environmental Data.

The purpose of this addendum memorandum is to provide further clarification to the October 27, 2006, North Carolina Solid Waste Section memo titled, "New Guidelines for Electronic Submittal of Environmental Data."

The updated guidelines is in large part due to questions and concerns from laboratories, consultants, and the regulated community regarding the detection of constituents in groundwater at levels below the previous practical quantitation limits (PQLs). The North Carolina Solid Waste Section solicited feedback from the regulated community, and, in conjunction with the regulated community, developed new limits. The primary purpose of these changes was to improve the protection of public health and the environment. The North Carolina Solid Waste Section is concerned about analytical data at these low levels because the earliest possible detection of toxic or potentially carcinogenic chemicals in the environment is paramount in the North Carolina Solid Waste Section's mission to protect human health and the environment. Low level analytical data are critical for making the correct choices when designing site remediation strategies, alerting the public to health threats, and protecting the environment from toxic contaminants. The revised limits were updated based on readily available laboratory analytical methodology and current health-based groundwater protection standards.

Definitions

Many definitions relating to detection limits and quantitation limits are used in the literature and by government agencies, and commonly accepted procedures for calculating these limits exist. Except for the Solid Waste Section Limit and the North Carolina 2L Standards, the definitions listed below are referenced from the Environmental Protection Agency (EPA). The definitions are also an attempt to clarify the meaning of these terms as used by the North Carolina Solid Waste Section.

Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Method Reporting Limit or Method Quantitation Limit (MRL or MQL) is the minimum concentration of a target analyte that can be accurately determined by the referenced method.

Practical Quantitation Limit (PQL) is a quantitation limit that represents a practical and routinely achievable quantitation limit with a high degree of certainty (>99.9% confidence) in the results. Per EPA Publication Number SW-846, the PQL is the lowest concentration that can be reliably measured within specified limits of precision and accuracy for a specific laboratory analytical method during routine laboratory operating conditions in accordance with "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods. The PQL appears in older NCDENR literature; however, it is no longer being used by the North Carolina Solid Waste Section.

Solid Waste Section Limit (SWSL) is the lowest amount of analyte in a sample that can be quantitatively determined with suitable precision and accuracy. The SWSL is the concentration below which reported analytical results must be qualified as estimated. *The SWSL is the updated version of the PQL that appears in older North Carolina Solid Waste Section literature. The SWSL is the limit established by the laboratory survey conducted by the North Carolina Solid Waste Section. The nomenclature of the SWRL described in the October 27, 2006, memorandum has changed to the SWSL.*

North Carolina 2L Standards (2L) are water quality standards for the protection of groundwaters of North Carolina as specified in 15A NCAC 2L .0200, Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina.

Method Detection Limits (MDLs)

Clarification of detection limits referenced in the October 27, 2006, memorandum needed to be addressed because of concerns raised by the regulated community. The North Carolina Solid Waste Section is now requiring laboratories to report to the method detection limit.

Method detection limits are statistically determined values that define the concentration at which measurements of a substance by a specific analytical protocol can be distinguished from measurements of a blank (background noise). Method detection limits are matrix-specific and require a well defined analytical method. In the course of routine operations, laboratories generally report the highest method detection limit for all the instruments used for a specific method.

In many instances, the North Carolina Solid Waste Section gathers data from many sources prior to evaluating the data or making a compliance decision. Standardization in data reporting significantly enhances the ability to interpret and review data because the reporting formats are comparable. Reporting a method detection limit alerts data users of the known uncertainties and limitations associated with using the data. Data users must understand these limitations in order to minimize the risk of making poor environmental decisions. Censoring data below unspecified or non-statistical reporting limits severely biases data sets and restricts their usefulness.

Solid Waste Section Limits (SWSLs)

Due to comments from the regulated community, the North Carolina Solid Waste Section has changed the nomenclature of the new limits referenced on Page 2 of the October 27, 2006, memorandum, from the North Carolina Solid Waste Reporting Limits (SWRL) to the Solid Waste Section Limits (SWSL). Data must be reported to the laboratory specific method detection limits and must be quantifiable at or below the SWSL. The SWSLs must be used for both groundwater and surface water data reported to the North Carolina Solid Waste Section. The PQLs will no longer be used.

The North Carolina Solid Waste Section has considered further feedback from laboratories and the regulated community and has made some additional changes to the values of the SWSLs. These changes may be viewed on our webpage:
http://www.wastenotnc.org/sw/swenvmonitoringlist.asp

Analytical Data Reporting Requirements

The strategy for implementing the new analytical data reporting requirements involves reporting the actual laboratory method detection limit with all analytical laboratory results along with the following requirements:

1) Any analyte detected at a concentration greater than the MDL but less than the SWSL is known to be present, but the uncertainty in the value is higher than a value reported above the SWSL. As a result, the actual concentration is estimated. The estimated concentration is reported along with a qualifier ("J" flag) to alert data users that the result is between the MDL and the SWSL. Any analytical data below quantifiable levels should be examined closely to evaluate whether the analytical data should be included in any statistical analysis. A statistician should make this determination. If an analyte is detected below the North Carolina 2L Standards, even if it is a quantifiable concentration, compliance action may not be taken unless it is statistically significant increase over background.

These analytical results may require additional confirmation.

2) Any analyte detected at a concentration greater than the SWSL is present, and the quantitated value can be reported with a high degree of confidence. These analytes are reported without estimated qualification. The laboratory's MDL and SWSL must be included in the analytical laboratory report. Any reported concentration of an organic or inorganic constituent at or above the North Carolina 2L Standards will be used for compliance purposes, unless the inorganic constituent is not statistically significant). Exceedance of the North Carolina 2L Standards or a statistically significant increase over background concentrations define when a violation has occurred. Any reported concentration of an organic or inorganic constituent at or above the SWSL that is not above an North Carolina 2L Standard will be used as a tool to assess the integrity of the landfill system and predict the possibility that a constituent concentration may exceed the North Carolina 2L Standards in the future.

These analytical results may be used for compliance without further confirmation.

Failure to comply with the requirements described in the October 27, 2006, memorandum and this addendum to the October 27, 2006, memorandum will constitute a violation of 15A NCAC 13B .0601, .0602, or .1632(b), and the analytical data will be returned and deemed unacceptable. Submittal of unacceptable data may lead to enforcement action.

Electronic Data Deliverable (EDD) Submittal

The North Carolina Solid Waste Section would also like to take this opportunity to encourage electronic submittal of the reports in addition to the analytical laboratory data. This option is intended to save resources for both the public and private sectors.

The North Carolina Solid Waste Section will accept the entire report including narrative text, figures, tables, and maps on CD-ROM. Please separate the figures and tables from the report when saving in order to keep the

size of the files smaller. The CD-ROM submittal shall contain a CD-ROM case and both CD-ROM and the case shall be labeled with the site name, site address, permit number, and the monitoring event date (MM/DD/YYYY). The reporting files may be submitted as a .pdf, .txt, .csv, .xls,. or .doc type.

Also, analytical lab data and field data should be reported in .xls files. The North Carolina Solid Waste Section has a template for analytical lab data and field data. This template is available on our webpage: http://www.wastenotnc.org/swhome/enviro_monitoring.asp. Methane monitoring data may also be submitted electronically in this format.

Pursuant to the October 27, 2006, memorandum, please remember to submit a Solid Waste Section Environmental Monitoring Reporting Form in addition to your environmental monitoring data report. This form should be sealed by a geologist or engineer licensed in North Carolina if hydrogeologic or geologic calculations, maps, or interpretations are included with the report. Otherwise, any representative that the facility owner chooses may sign and submit the form. Also, if the concentration of methane generated by the facility exceeds 100% of the lower explosive limits (LEL) at the property boundary or exceeds 25% of the LEL in facility structures (excluding gas control or recovery system components), include the exceedance(s) on the North Carolina Solid Waste Section Environmental Monitoring Reporting Form.

If you have any questions or concerns, please feel free to contact Jaclynne Drummond (919-508-8500) or Ervin Lane (919-508-8520).

Thank you for your continued cooperation with this matter.

North Carolina Department of Environment and Natural Resources
Division of Waste Management

Pat McCrory
Governor

John E. Skvarla, III
Secretary

November 5, 2014

MEMORANDUM

To: **Solid Waste Directors, Public Works Directors, Landfill Operators, and Landfill Owners**

From: **Solid Waste Section**

Re: **Groundwater, Surface Water, Soil, Sediment, and Landfill Gas Electronic Document Submittal**

The Solid Waste Section is continuing its efforts to improve efficiencies in document management. All groundwater, surface water, soil, sediment, and landfill gas documents submitted to the Solid Waste Section are stored electronically and are made readily available for the public to view on our webpage. Please remember that hard copies/paper copies are not required, and should not be submitted. The submittal of these electronic documents following a consistent electronic document protocol will also assist us in our review. Please follow these procedures when submitting all groundwater, surface water, soil, sediment, and landfill gas documents to the Solid Waste Section.

Submittal Method and Formatting

- All files must be in portable document format (pdf) except for Electronic Data Deliverables (EDDs) unless otherwise specified by the Solid Waste Section. All pdf files should meet these requirements:
  - Optical Characteristic Recognition (OCR) applied;
  - Minimum of 300 dpi;
  - Free of password protections and/or encryptions (applies to EDDs as well);
  - Optimized to reduce file size; and
  - Please begin using the following naming convention when submitting all electronic files: Permit Number (00-00)_Date of Document (YYYYMMDD). For example: 00-00_20140101.
- Please submit all files via email or by file transfer protocol (FTP) via email to the appropriate Hydrogeologist unless otherwise specified by the Solid Waste Section. If the electronic file is greater than 20 MB, please submit the file via FTP or on a CD. If submitting a CD, please mail the CD to the appropriate Hydrogeologist. The CD should be labeled with the facility name, permit number, county, name of document, date of monitoring event (if applicable), and the date of document.
- Please be sure a signed Environmental Monitoring Data Form is submitted as part of the electronic file for all water quality and landfill gas documents (monitoring, alternate source demonstration, assessment, investigation, corrective action). This completed form should be the first page of the document before the cover/title page and should not be submitted as an individual file. Blank forms can be downloaded at http://www.wastenotnc.org/swhome/EnvMonitoring/NCEnvMonRptForm.pdf

Monitoring Data

Monitoring data documents may include any or all of the following: 1) groundwater and surface water monitoring; 2) soil and sediment, and 3) landfill gas monitoring. In addition to the above procedures, at a minimum, please include the following:

Groundwater and Surface Water Monitoring

- A copy of the laboratory report(s).
- A copy of the sampling log(s).
- A separate table of detections and exceedances for each monitoring location.

1646 Mail Service Center, Raleigh, North Carolina 27699-1646
Phone: 919-707-8200

2090 US Highway 70, Swannanoa, North Carolina 28778-82111
Phone: 828-296-4500

http://portal.ncdenr.org/web/wm/

    - All analytical results should be reported in micrograms per liter (ug/L) except for field parameters and specific Monitored Natural Attenuation (MNA) parameters.
    - Please also include the laboratory's method detection limit (MDL) in ug/L, the Solid Waste Section Limit (SWSL) in ug/L, the appropriate NC regulatory standard in ug/L (2L, 2B, GWPS, IMAC), and the Federal Maximum Contaminant Level (MCL) in ug/L.
    - Please **BOLD** each exceedance result.
- A separate table of field parameters for each monitoring location.
- An Electronic Data Deliverable (EDD) spreadsheet for each monitoring event submitted in the correct format. All analytical results should be reported in micrograms per liter (ug/L) except for field parameters and specific Monitored Natural Attenuation (MNA) parameters. The blank EDD template can be downloaded at http://www.wastenotnc.org/swhome/enviro_monitoring.asp. Please pay attention to the formats within the spreadsheet. Any EDD received that is not formatted correctly will be emailed back to be resubmitted via email within five (5) days.
- A separate groundwater monitoring well construction table.
    - Please also include the date the well was drilled, well diameter, total well depth, depth to top of screened interval (in feet), screened interval (in feet), geology of screened interval, TOC elevation, ground elevation, groundwater elevation, GPS coordinates (latitude and longitude), and depth to water (in feet).
- A separate groundwater table with groundwater flow rate(s).
- A recent facility figure that includes labeled groundwater and surface water monitoring locations.
- A groundwater flow map with an arrow(s) indicating flow direction(s), including date the measurements were taken.

Soil and Sediment Sampling

- A copy of the laboratory report(s).
- A copy of the sampling log(s).
- A separate table of detections and exceedances for each sampling location.
    - Please also include the results in micrograms per liter (ug/L), the laboratory's method detection limit (MDL) in ug/L, and the appropriate NC regulatory standard (PSRG) in ug/L.
    - Please **BOLD** each exceedance result.
- A separate table of soil and/or sediment characteristics.
- A recent facility figure that includes labeled sampling locations.

Landfill Gas Monitoring

- A blank Landfill Gas Monitoring Data Form can be found within the *Landfill Gas Monitoring Guidance* document and can be downloaded at http://portal.ncdenr.org/c/document_library/get_file?uuid=da699f7e-8c13-4249-9012-16af8aefdc7b&groupId=38361.
- A separate table of landfill gas detections and exceedances for each monitoring location. Please **BOLD** each exceedance result.
- A recent facility figure that includes labeled landfill gas monitoring locations (both permanent and temporary).

If you have any questions or concerns regarding electronic submittals, please feel free to contact the Hydrogeologist overseeing your facility. The Solid Waste Section greatly appreciates your assistance on this matter. Working together, we can continue to provide excellent customer service to you and to the public.

- Jackie Drummond, Asheville Regional Office, 828-296-4604, jaclynne.drummond@ncdenr.gov
- Ervin Lane, Raleigh Central Office, 919-707-8288, ervin.lane@ncdenr.gov
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1646 Mail Service Center, Raleigh, North Carolina 27699-1646
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2090 US Highway 70, Swannanoa, North Carolina 28778-82111
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http://portal.ncdenr.org/web/wm/

NEW EDD – SOLID WASTE

SPECIAL NOTE

Use of the new NCDEQ EDD is intended to replace existing Electronic Data Deliverables (EDD) or spreadsheets of field and lab analytical data. It is not intended to replace any reports or narratives that accompany this data. The new NCDEQ EDD is built to be comprehensive in the data that can be collected, but it does not mean that providing this data is required.

Data providers should consult with the NC DEQ Project Manager (PM) prior to preparing and submitting EDDs to verify what data will be submitted for their project. Communication with the PM can help to avoid unnecessary efforts. It is the responsibility of the data provider to coordinate with the NC DEQ to ensure that the data collected are submitted under the correct Facility/Site ID. Please verify the Facility/Site ID number information with your NC DEQ project manager.

NCDEQ EDD – SOLID WASTE VERSION

The NCDEQ EDD has been trimmed down to contain only the sections (tabs) of the NCDEQ EDD applicable for Solid Waste facilities. These tabs have been grouped by color based on submittal frequency. The yellow tabs: DataProvider_v1 and Location_v1 are submitted only once per facility/site prior to submittal of environmental monitoring data. The blue tabs: FieldResults_v1, Sample_v1, TestResultsQC_v1, and Batch_v1 are submitted during each sampling event.

Because our new data system is structured with certain business rules in place, it is necessary for data providers (facility contacts, consultants, or labs) to submit an Initial EDD (yellow tabs) prior to submitting any environmental monitoring data. An Initial EDD provides information about the data provider and sampling locations for a facility. This Initial EDD is only submitted once, unless there are changes, such as changing a contact name or an addition of a sampling site, which would require a resubmittal.

Sampling Event EDD (blue tabs) is submitted whenever sampling takes place. A Sampling Event EDD consists of data tables for analytical samples collected at a Facility and associated Locations. The FieldResults_v1 will contain field parameters collected during the sampling event. The Sample_v1 table will contain sample matrix, collection date and time, sample type, etc. The TestResultsQC_v1 table will contain analytical results, methods, detection limits, reporting limits, etc. This table also contains laboratory and validator quality control (QC) data.

Initial EDD Sections

Data Provider

Provides general information about the data provider and the site contact to be used by NC DEQ, if questions arise. This table need only be submitted once for each data provider. All subsequent EDD submissions to NC DEQ for any site by the same data provider will reference the Data Provider information originally submitted.

Location

Contains a record for each of the sampling locations for a facility. A Location table needs to be submitted for any and all locations that will have samples, water levels, well information, or any other EDD sections requiring the use of a Location ID.

This section may be submitted multiple times for a site if new locations are added to the site, or if additional information is added for existing locations. To ensure accurate location information, the following fields are required to be submitted with this section:

Sampling Event EDD Sections

Field Results

Contains data specific to the collection of field parameters (turbidity, temperature, specific conductance, pH, Eh, dissolved oxygen, etc.). Data providers are required to submit Location data first during the Initial EDD submittal process prior to submitting Field Results, so that presentation of information for duplicate locations does not present errors when loading data to the database.

Sample

Provides information for each sample collected at a site and location. The Sample ID (sys_sample_code) field is used to store a unique Sample ID assigned by either NC DEQ or a data provider that is independent of the Lab Sample ID. If the sample type is a duplicate or dup (e.g. matrix spike/matrix spike duplicate [MS/MSD], blind dup, lab dup, etc.), the Sample ID (sys_sample_code) of the original sample from which the duplicate is derived is required in the parent_sample_code field of the Sample_v1 EDD file. Otherwise, this field is left null for all non- duplicate samples. Data providers shall not use special characters (e.g. #, ', ", @, !) when naming samples. Inclusion of such characters in the sys_loc_codes and sys_sample_codes can be incompatible with the database.

The use of hyphens to separate segments of a sys_sample_code is beneficial for sample name readability. NC DEQ recommends including the sample date in the name in order to make it unique for each sampling event and unique from the location ID. It is beneficial to put the year first, followed by month, and then day in order for the dates to sort correctly in the database.

Example of Reporting Sample ID

Sys_sample_code	Sample_type_code	Sample_source	Parent Sample Required (Y/N)?	Parent_sample_code	Sample_date	Sys_loc_code
8003-MW1-20200618	N	Field	N		06/18/2020 12:01 PM	8003-MW1
MW-FB-20200618	FB	Field	N		06/18/2020 12:30 PM	
MW-TB-20200618	TB	Field	N		06/18/2020 7:00 AM	
8003-MW1-FD-20200618	FD	Field	Y	8003-MW1-20200618	06/18/2020 12:01 PM	8003-MW1
8003-MW1-MS-20200618	MS	Field	Y	8003-MW1-20200618	06/18/2020 12:01 PM	8003-MW1

N = normal FB = field blank TB = trip blank FD = field duplicate MS = matrix spike
Y = yes N = no

As identified in the table above, the sys_loc_codes for field QC samples, including trip blanks (TB) and field blanks (FB) must be null. The sys_sample_codes for QC samples must be consistent with the codes identified in the valid values file. Further, when identifying field QC samples, such as TBs and FBs, the data provider must include a unique identifier in the sample name, such as a sample date, so that the result is unique in the database. All normal, "N", environmental samples require a location. NC DEQ does not require locations for clean fill samples or waste characterization samples. Waste characterization samples use the sample_type_code "WC". Clean fill samples use the sample_type_code "CF". Generally, these samples are collected from drums, stockpiles, or a material source for which the location will change and therefore will not be representative of a given location on the site.

Test Results QC

Contains information pertaining to analytical tests performed on samples with laboratory QC data elements. This EDD section may also be used to capture data collected in the field with direct reading instruments such as water quality meters and from field test kits, however, it is preferred that data be submitted in the FieldResults_v1 EDD section.

Batch

The Batch_v1 EDD section contains data that relate the individual samples to their laboratory sample batch identifiers and laboratory sample delivery groups. The fields in this section need to match the data entered in corresponding fields in the TestResultQC_v1 section.

FURTHER INFORMATION

A detailed description of the data fields in each of the EDD sections can be found in the NCDEQ EDD Description File.

DEQ: Environmental Data Submissions

ELECTRONIC DATA DELIVERABLE (EDD) FORMAT INFORMATION FOR ELECTRONIC DATA PROVIDERS

The North Carolina Department of Environmental Quality (Department) has procured an environmental data management system to streamline the submittal, organization, and presentation of environmental data collected across the state. The new data management system uses the database software application EQuIS™ (EQuIS) from EarthSoft® Inc. (EarthSoft).

NC DEQ's Division of Water Resources (DWR) and the Division of Waste Management (DWM) are the first groups to begin using this new system. As part of this effort, DWR and DWM have adopted a standardized electronic data deliverable (EDD) format that is required for all data submitted. Data must be formatted to meet the guidelines specified by NC DEQ.

Data providers are responsible for submitting a complete data package. A lab or other subcontractor should provide their data to the primary consultant, who must ensure the supporting tables (such as sample location coordinates) are complete. Use of the new NCDEQ EDD is intended to replace existing Electronic Data Deliverables (EDD) or spreadsheets of field and lab analytical data. It is not intended to replace any reports or narratives that already accompany this data. The new NCDEQ EDD is built to be comprehensive in the data that can be collected, but it does not mean that providing this data is required. Data providers should consult with their NC DEQ Project Manager (PM) prior to preparing and submitting EDDs to verify what data is required for their project. Communication with the PM can help to avoid unnecessary efforts.

Follow the steps and links below to submit data in the EDD format:

Step 1: Initial Setup

Download the following files to prepare the data submission to produce a properly formatted EDD. User Manuals are available to provide detailed instructions on data preparation as well as identification of data fields that NC DEQ requires for data submittals.

- NC DEQ format files are templates in Microsoft Excel that are used to prepare the data submittal in the EDD format. Download the template appropriate to the type of data to be submitted.

- The Valid Value files are tables in Microsoft Excel that provide data for a number of the fields that make up the EDD format. If there is no appropriate value on the list of valid values, you can request that it be added by sending an email to your NC DEQ program manager contact. Please include your name and your company contact information, the name of the valid value reference list, the new value needed and any other information that you deem helpful. A notification containing an acceptance or rejection of your valid value request will be emailed back. Any changes accepted will be available in an updated .RVF file will be posted for all Data Providers to use.

Step 2: Check your EDD

Data providers must download and install the EQuIS Data Processor (EDP) to check their properly NC DEQ EDD formatted file. EDP's software was created by EarthSoft and you will be redirected to their site to download the EDP and NC DEQ EDD format file. An installation guide is available to assist you through the installation of EDP. EDP performs a series of formatting checks on the EDD and identifies a select group of errors in the data file prior to submission. EDP should streamline the process of preparing, reviewing, and finalizing EDD submissions to NC DEQ.

You will need to register the EDP software with EarthSoft (this is free), instructions on this are located in the EDP Installation Guide (PDF). You will typically receive an email within 5 business days from the NC DEQ EDAMS Administrator confirming the software registration and providing a user login id and password to submit the checked EDD. If you do not receive a confirmation email within 5 days, please do not attempt to reregister, contact your NC DEQ program manager contact.

The valid values used by the system are periodically updated for the EDP; therefore, it is important to use the most recent version of the EDP and NC DEQ format file. The NC DEQ website in conjunction with the EarthSoft website will have the most up-to-date EDP and format file. Please periodically check this website to verify that you are using the most current version of the EDP and format file. For further information covering the functions of the EDP program, please refer to EarthSoft's online Standalone EDP documentation.

Step 3: Submit your EDD

When the EDD has cleared the EDP checker, use “Save as…” to produce a properly named and formatted .ZIP file. The submission package should be transmitted along with any other reports, summaries, or narratives in a similar manner to previously submitted data.

Additional Guidance Information:

Additional guidance will be provided on this webpage as it becomes available. In addition, you can join the EarthSoft Community Center for announcements, training opportunities, and access to EQuIS forums and

online documentation. Updates to the NC DEQ format will be posted on the community center and you can subscribe to receive email notifications when updates are posted for the NC DEQ format files and Valid Values files.

Solid Waste Section
Guidelines for Groundwater, Soil, and Surface Water Sampling

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF WASTE MANAGEMENT
SOLID WASTE SECTION

General Sampling Procedures

The following guidance is provided to insure a consistent sampling approach so that sample collection activities at solid waste management facilities provide reliable data. Sampling must begin with an evaluation of facility information, historical environmental data and site geologic and hydrogeologic conditions. General sampling procedures are described in this document.

Planning

Begin sampling activities with planning and coordination. The party contracting with the laboratory is responsible for effectively communicating reporting requirements and evaluating data reliability as it relates to specific monitoring activities.

Sample Collection

Contamination Prevention

a.) Take special effort to prevent cross contamination or environmental contamination when collecting samples.
    1. If possible, collect samples from the least contaminated sampling location (or background sampling location, if applicable) to the most contaminated sampling location.
    2. Collect the ambient or background samples first, and store them in separate ice chests or separate shipping containers within the same ice chest (e.g. untreated plastic bags).
    3. Collect samples in flowing water at designated locations from upstream to downstream.

b.) Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspect of containing high concentrations of contaminants in the same ice chest or shipping containers with other environmental samples.
    1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.
    2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

c.) All sampling equipment should be thoroughly decontaminated and transported in a manner that does not allow it to become contaminated. Arrangements should be made ahead of time to decontaminate any sampling or measuring equipment that will be reused when taking samples from more than one well. Field decontamination of

sampling equipment will be necessary before sampling each well to minimize the risk of cross contamination. Decontamination procedures should be included in reports as necessary. Certified pre-cleaned sampling equipment and containers may be used. When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil and grease, or containers with pre-measured preservatives, the sample containers cannot be rinsed.

d.) Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination).
    1. If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.
    2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves.
    3. Dispense all fuels downwind. Dispose of gloves well away from the sampling activities.

<u>Filling Out Sample Labels</u>

Fill out label, adhere to vial and collect sample. Print legibly with indelible ink. At a minimum, the label or tag should identify the sample with the following information:

1. Sample location and/or well number
2. Sample identification number
3. Date and time of collection
4. Analysis required/requested
5. Sampler's initials
6. Preservative(s) used, if any [i.e., HCl, $Na_2S_2O_3$, NO_3, ice, etc.]
7. Any other pertinent information for sample identification

<u>Sample Collection Order</u>

Unless field conditions justify other sampling regimens, collect samples in the following order:

1. Volatile Organics and Volatile Inorganics
2. Extractable Organics, Petroleum Hydrocarbons, Aggregate Organics and Oil and Grease
3. Total Metals
4. Inorganic Nonmetallics, Physical and Aggregate Properties, and Biologicals
5. Microbiological

NOTE: *If the pump used to collect groundwater samples cannot be used to collect volatile or extractable organics then collect all other parameters and withdraw the pump and tubing. Then collect the volatile and extractable organics.*

Health and Safety

Implement all local, state, and federal requirements relating to health and safety. Follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation derived wastes.

a.) The Solid Waste Section recommends wearing protective gloves when conducting all sampling activities.

1. Gloves serve to protect the sample collector from potential exposure to sample constituents, minimize accidental contamination of samples by the collector, and preserve accurate tare weights on preweighed sample containers.
2. Do not let gloves come into contact with the sample or with the interior or lip of the sample container. Use clean, new, unpowdered and disposable gloves. Various types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.
3. Note that certain materials that may potentially be present in concentrated effluent can pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable. The powder in powdered gloves can contribute significant contamination. Powdered gloves are not recommended unless it can be demonstrated that the powder does not interfere with the sample analysis.
4. Change gloves after preliminary activities, after collecting all the samples at a single sampling point, if torn or used to handle extremely dirty or highly contaminated surfaces. Properly dispose of all used gloves as investigation derived wastes.

b.) Properly manage all investigation derived waste (IDW).

5. To prevent contamination into previously uncontaminated areas, properly manage all IDW. This includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, abandonment, and other investigative activities. Manage all IDW that is determined to be RCRA-regulated hazardous waste according to the local, state and federal requirements.
6. Properly dispose of IDW that is not a RCRA-regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality. If the drill cuttings/mud orpurged well water is contaminated with hazardous waste, contact the DWM Hazardous Waste Section (919-508-8400) for disposal options. Maintain all containers holding IDW in good condition. Periodically inspect the containers for damage and ensure that all required labeling (DOT, RCRA, etc.) are clearly visible.

Sample Storage and Transport

Store samples for transport carefully. Pack samples to prevent from breaking and to maintain a temperature of approximately 4 degrees Celsius (°C), adding ice if necessary. Transport samples to a North Carolina-certified laboratory as soon as possible. Avoid unnecessary handling of sample containers. Avoid heating (room temperature or above, including exposure to sunlight) or freezing of the sample containers. Reduce the time between sample collection and delivery to a laboratory whenever possible and be sure that the analytical holding times of your samples can be met by the laboratory.

a.) A complete chain-of-custody (COC) form must be maintained to document all transfers and receipts of the samples. Be sure that the sample containers are labeled with the sample location and/or well number, sample identification, the date and time of collection, the analysis to be performed, the preservative added (if any), the sampler's initials, and any other pertinent information for sample identification. The labels should contain a unique identifier (i.e., unique well numbers) that can be traced to the COC form. The details of sample collection must be documented on the COC. The COC must include the following:

1. Description of each sample (including QA/QC samples) and the number of containers (sample location and identification)
2. Signature of the sampler
3. Date and time of sample collection
4. Analytical method to be performed
5. Sample type (i.e., water or soil)
6. Regulatory agency (i.e., NCDENR/DWM – SW Section)
7. Signatures of all persons relinquishing and receiving custody of the samples
8. Dates and times of custody transfers

b.) Pack samples so that they are segregated by site, sampling location or by sample analysis type. When COC samples are involved, segregate samples in coolers by site. If samples from multiple sites will fit in one cooler, they may be packed in the same cooler with the associated field sheets and a single COC form for all. Coolers should not exceed a maximum weight of 50 lbs. Use additional coolers as necessary. All sample containers should be placed in plastic bags (segregated by analysis and location) and completely surrounded by ice.

1. Prepare and place trip blanks in an ice filled cooler before leaving for the field.
2. Segregate samples by analysis and place in sealable plastic bags.
3. Pack samples carefully in the cooler placing ice around the samples.
4. Review the COC. The COC form must accompany the samples to the laboratory. The trip blank(s) must also be recorded on the COC form.
5. Place completed COC form in a waterproof bag, sealed and taped under the lid of the cooler.
6. Secure shipping containers with strapping tape to avoid accidental opening.
7. For COC samples, a tamper-proof seal may also be placed over the cooler lid or over a bag or container containing the samples inside the shipping cooler.

8. "COC" or "EMERG" should be written in indelible ink on the cooler seal to alert sample receipt technicians to priority or special handling samples.
9. The date and sample handler's signature must also be written on the COC seal.
10. Deliver the samples to the laboratory or ship by commercial courier.
    NOTE*: If transport time to the laboratory is not long enough to allow samples to be cooled to 4° C, a temperature reading of the sample source must be documented as the field temperature on the COC form. A downward trend in temperature will be adequate even if cooling to 4° C is not achieved. The field temperature should always be documented if there is any question as to whether samples will have time to cool to 4° C during shipment. Thermometers must be calibrated annually against an NIST traceable thermometer and documentation must be retained.*

Appendix A - Decontamination of Field Equipment

Decontamination of personnel, sampling equipment, and containers - before and after sampling - must be used to ensure collection of representative samples and to prevent the potential spread of contamination. Decontamination of personnel prevents ingestion and absorption of contaminants. It must be done with a soap and water wash and deionized or distilled water rinse. Certified pre-cleaned sampling equipment and containers may also be used.

All previously used sampling equipment must be properly decontaminated before sampling and between sampling locations. This prevents the introduction of contamination into uncontaminated samples and avoids cross-contamination of samples. Cross-contamination can be a significant problem when attempting to characterize extremely low concentrations of organic compounds or when working with soils that are highly contaminated.

Clean, solvent-resistant gloves and appropriate protective equipment must be worn by persons decontaminating tools and equipment.

Cleaning Reagents

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

a.) Detergents: Use Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). Liqui-Nox (or equivalent) is recommended by EPA, although Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus containing compounds.

b.) Solvents: Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor. Rubbing alcohol or other commonly available sources of isopropanol **are not acceptable**. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics.

1. **Do not** use acetone if volatile organics are of interest
2. Containerize all methanol wastes (including rinses) and dispose as a hazardous waste.

Pre-clean equipment that is heavily contaminated with organic analytes. Use reagent grade acetone and hexane or other suitable solvents. Use pesticide grade methylene chloride when cleaning sample containers. Store all solvents away from potential sources of contamination.

c.) Analyte-Free Water Sources: Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s). The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:

1. *Milli-Q (or equivalent polished water)*: suitable for all analyses.

2. *Organic-free*: suitable for volatile and extractable organics.
3. *Deionized water*: may not be suitable for volatile and extractable organics.
4. *Distilled water*: not suitable for volatile and extractable organics, metals or ultratrace metals.

Use analyte-free water for blank preparation and the final decontamination water rinse. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle or pump sprayer) at the end of each sampling day.

d.) Acids:

1. *Reagent Grade Nitric Acid*: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water). Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.
2. *Reagent Grade Hydrochloric Acid*: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water). Use when nitrogen components are to be sampled.
3. If samples for both metals and the nitrogen-containing components are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.
4. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose of any unused acids according to local ordinances.

Reagent Storage Containers

The contents of all containers must be clearly marked.

a.) Detergents:

1. Store in the original container or in a HDPE or PP container.

b.) Solvents:

1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, use either a glass or Teflon container.
2. Use dispensing containers constructed of glass, Teflon or stainless steel. Note: If stainless steel sprayers are used, any gaskets that contact the solvents must be constructed of inert materials.

c.) Analyte-Free Water:

1. Transport in containers appropriate for the type of water stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, Teflon, polypropylene or HDPE are acceptable.
2. Use glass or Teflon to transport organic-free sources of water on-site. Polypropylene or HDPE may be used, but are not recommended.

3. Dispense water from containers made of glass, Teflon, HDPE or polypropylene.
4. Do not store water in transport containers for more than three days before beginning a sampling event.
5. If working on a project that has oversight from EPA Region 4, use glass containers for the transport and storage of all water.
6. Store and dispense acids using containers made of glass, Teflon or plastic.

General Requirements

a.) Prior to use, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that will be exposed to the sample.

b.) Before installing, clean (or obtain as certified pre-cleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump). If you use certified pre-cleaned equipment no cleaning is necessary.
    1. Clean this equipment any time it is removed for maintenance or repair.
    2. Replace dedicated tubing if discolored or damaged.

c.) Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport it to the field, pre-cleaned and ready to use, unless otherwise justified.

d.) Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

e.) Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.

f.) Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.

g.) Protect decontaminated field equipment from environmental contamination by securely wrapping and sealing with one of the following:
    1. Aluminum foil (commercial grade is acceptable)
    2. Untreated butcher paper
    3. Clean, untreated, disposable plastic bags. Plastic bags may be used for all analyte groups except volatile and extractable organics. Plastic bags may be used for volatile and extractable organics, if the equipment is first wrapped in foil or butcher paper, or if the equipment is completely dry.

Cleaning Sample Collection Equipment

a.) <u>On-Site/In-Field Cleaning</u> – Cleaning equipment on-site is not recommended because environmental conditions cannot be controlled and wastes (solvents and acids) must be containerized for proper disposal.
    1. Ambient temperature water may be substituted in the hot, sudsy water bath and hot water rinses.

NOTE: Properly dispose of all solvents and acids.

2. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites.
3. Immediately rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples with water.

b.) Heavily Contaminated Equipment - In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

1. Has been used to collect samples from a source known to contain significantly higher levels than background.
2. Has been used to collect free product.
3. Has been used to collect industrial products (e.g., pesticides or solvents) or their byproducts.

NOTE: *Cleaning heavily contaminated equipment in the field is not recommended.*

c.) On-Site Procedures:

1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.
2. At a minimum, place the equipment in a tightly sealed, untreated, plastic bag.
3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.
4. Transport the equipment back to the base of operations for thorough decontamination.
5. If cleaning must occur in the field, document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment.

d.) Cleaning Procedures:

1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, pre-rinse equipment by thoroughly rinsing or soaking the equipment in acetone.
2. Use hexane only if preceded and followed by acetone.
3. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.
4. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure. Scrub, rather than soak, all equipment with sudsy water. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Since stainless steel equipment should not be exposed to acid rinses, do not use stainless steel equipment when heavy metal contamination is suspected or present.
5. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.
6. Clearly mark or disable all discarded equipment to discourage use.

e.) General Cleaning - Follow these procedures when cleaning equipment under controlled conditions. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

1. *Procedure for Teflon, stainless steel and glass sampling equipment*: This procedure must be used when sampling for ALL analyte groups. (Extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all Teflon, stainless steel and glass equipment.) Rinse equipment with hot tap water. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent). If necessary, use a brush to remove particulate matter or surface film. Rinse thoroughly with hot tap water. If samples for trace metals or inorganic analytes will be collected with the equipment that is not stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution. Rinse thoroughly with analyte-free water. Make sure that all equipment surfaces are thoroughly flushed with water. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water. Allow to air dry. Wrap and seal as soon as the equipment has air-dried. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse; however, the equipment must be completely dry before wrapping or use. Wrap clean sampling equipment according to the procedure described above.
2. *General Cleaning Procedure for Plastic Sampling Equipment*: Rinse equipment with hot tap water. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent). If necessary, use a brush to remove particulate matter or surface film. Rinse thoroughly with hot tap water. Thoroughly rinse (wet all surfaces) with the appropriate acid solution. Check manufacturer's instructions for cleaning restrictions and/or recommendations. Rinse thoroughly with analyte-free water. Be sure that all equipment surfaces are thoroughly flushed. Allow to air dry as long as possible. Wrap clean sampling equipment according to the procedure described above.

Appendix B - Collecting Soil Samples

Soil samples are collected for a variety of purposes. A methodical sampling approach must be used to assure that sample collection activities provide reliable data. Sampling must begin with an evaluation of background information, historical data and site conditions.

Soil Field Screening Procedures

Field screening is the use of portable devices capable of detecting petroleum contaminants on a real-time basis or by a rapid field analytical technique. Field screening should be used to help assess locations where contamination is most likely to be present.

When possible, field-screening samples should be collected directly from the excavation or from the excavation equipment's bucket. If field screening is conducted only from the equipment's bucket, then a minimum of one field screening sample should be collected from each 10 cubic yards of excavated soil. If instruments or other observations indicate contamination, soil should be separated into stockpiles based on apparent degrees of contamination. At a minimum, soil suspected of contamination must be segregated from soil observed to be free of contamination.

a.) Field screening devices – Many field screen instruments are available for detecting contaminants in the field on a rapid or real-time basis. Acceptable field screening instruments must be suitable for the contaminant being screened. The procdedure for field screening using photoionization detectors (PIDs) and flame ionization detectors (FIDs) is described below. If other instruments are used, a description of the instrument or method and its intended use must be provided to the Solid Waste Section. Whichever field screening method is chosen, its accuracy must be verified throughout the sampling process. Use appropriate standards that match the use intended for the data. Unless the Solid Waste Section indicates otherwise, wherever field screening is recommended in this document, instrumental or analytical methods of detection must be used, not olfactory or visual screening methods.

b.) Headspace analytical screening procedure for filed screening (semi-quantitative field screening) - The most commonly used field instruments for Solid Waste Section site assessments are FIDs and PIDs. When using FIDs and PIDs, use the following headspace screening procedure to obtain and analyze field-screening samples:

1. Partially fill (one-third to one-half) a clean jar or clean ziplock bag with the sample to be analyzed. The total capacity of the jar or bag may not be less than eight ounces (app. 250 ml), but the container should not be so large as to allow vapor diffusion and stratification effects to significantly affect the sample.
2. If the sample is collected from a spilt-spoon, it must be transferred to the jar or bag for headspace analysis immediately after opening the split-spoon. If the sample is collected from an excavation or soil pile, it must be collected from freshly uncovered soil.

3. If a jar is used, it must be quickly covered with clean aluminum foil or a jar lid; screw tops or thick rubber bands must be used to tightly seal the jar. If a zip lock bag is used, it must be quickly sealed shut.
4. Headspace vapors must be allowed to develop in the container for at least 10 minutes but no longer than one hour. Containers must be shaken or agitated for 15 seconds at the beginning and the end of the headspace development period to assist volatilization. Temperatures of the headspace must be warmed to at least 5° C (approximately 40° F) with instruments calibrated for the temperature used.
5. After headspace development, the instrument sampling probe must be inserted to a point about one-half the headspace depth. The container opening must be minimized and care must be taken to avoid the uptake of water droplets and soil particulates.
6. After probe insertion, the highest meter reading must be taken and recorded. This will normally occur between two and five seconds after probe insertion. If erratic meter response occurs at high organic vapor concentrations or conditions of elevated headspace moisture, a note to that effect must accompany the headspace data.
7. All field screening results must be documented in the field record or log book.

Soil Sample Collection Procedures for Laboratory Samples

The number and type of laboratory samples collected depends on the purpose of the sampling activity. Samples analyzed with field screening devices may not be substituted for required laboratory samples.

a.) General Sample Collection - When collecting samples from potentially contaminated soil, care should be taken to reduce contact with skin or other parts of the body. Disposable gloves should be worn by the sample collector and should be changed between samples to avoid cross-contamination. Soil samples should be collected in a manner that causes the least disturbance to the internal structure of the sample and reduces its exposure to heat, sunlight and open air. Likewise, care should be taken to keep the samples from being contaminated by other materials or other samples collected at the site. When sampling is to occur over an extended period of time, it is necessary to insure that the samples are collected in a comparable manner. All samples must be collected with disposable or clean tools that have been decontaminated. Disposable gloves must be worn and changed between sample collections. Sample containers must be filled quickly. Soil samples must be placed in containers in the order of volatility, for example, volatile organic aromatic samples must be taken first, organics next, then heavier range organics, and finally soil classification samples. Containers must be quickly and adequately sealed, and rims must be cleaned before tightening lids. Tape may be used only if known not to affect sample analysis. Sample containers must be clearly labeled. Containers must immediately be preserved according to procedures in this Section. Unless specified

otherwise, at a minimum, the samples must be immediately cooled to 4 ± 2°C and this temperature must be maintained throughout delivery to the laboratory.

b.) Surface Soil Sampling - Surface soil is generally classified as soil between the ground surface and 6-12 inches below ground surface. Remove leaves, grass and surface debris from the area to be sampled. Select an appropriate, pre-cleaned sampling device and collect the sample. Transfer the sample to the appropriate sample container. Clean the outside of the sample container to remove excess soil. Label the sample container, place on wet ice to preserve at 4°C, and complete the field notes.

c.) Subsurface Soil Sampling – The interval begins at approximately 12 inches below ground surface. Collect samples for volatile organic analyses. For other analyses, select an appropriate, pre-cleaned sampling device and collect the sample. Transfer the sample to the appropriate sample container. Clean the outside of the sample container to remove excess soil. Label the sample container, place on wet ice to preserve at 4°C, and complete field notes.

d.) Equipment for Reaching the Appropriate Soil Sampling Depth - Samples may be collected using a hollow stem soil auger, direct push, Shelby tube, split-spoon sampler, or core barrel. These sampling devices may be used as long as an effort is made to reduce the loss of contaminants through volatilization. In these situations, obtain a sufficient volume of so the samples can be collected without volatilization and disturbance to the internal structure of the samples. Samples should be collected from cores of the soil. Non-disposable sampling equipment must be decontaminated between each sample location. **NOTE:** *If a confining layer has been breached during sampling, grout the hole to land.*

e.) Equipment to Collect Soil Samples - Equipment and materials that may be used to collect soil samples include disposable plastic syringes and other “industry-standard” equipment and materials that are contaminant-free. Non-disposable sampling equipment must be decontaminated between each sample location.

Appendix C - Collecting Groundwater Samples

Groundwater samples are collected to identify, investigate, assess and monitor the concentration of dissolved contaminant constituents. To properly assess groundwater contamination, first install sampling points (monitoring wells, etc.) to collect groundwater samples and then perform specific laboratory analyses. All monitoring wells should be constructed in accordance with 15A NCAC 2C .0100 and sampled as outlined in this section. Groundwater monitoring is conducted using one of two methods:

1. Portable Monitoring: Monitoring that is conducted using sampling equipment that is discarded between sampling locations. Equipment used to collect a groundwater sample from a well such as bailers, tubing, gloves, and etc. are disposed of after sample collection. A new set of sampling equipment is used to collect a groundwater sample at the next monitor well.

2. Dedicated Monitoring: Monitoring that utilizes permanently affixed down-well and well head components that are capped after initial set-up. Most dedicated monitoring systems are comprised of an in-well submersible bladder pump, with air supply and sample discharge tubing, and an above-ground driver/controller for regulation of flow rates and volumes. The pump and all tubing housed within the well should be composed of Teflon or stainless steel components. This includes seals inside the pump, the pump body, and fittings used to connect tubing to the pump. Because ground water will not be in contact with incompatible constituents and because the well is sealed from the surface, virtually no contamination is possible from intrinsic sources during sampling and between sampling intervals. All dedicated monitoring systems must be approved by the Solid Waste Section before installation.

Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

1. Wells without Plumbing: These wells require equipment to be brought to the well to purge and sample unless dedicated equipment is placed in the well.

2. Wells with In-Place Plumbing: Wells with in-place plumbing do not require equipment to be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply.

3. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices.

Groundwater Sample Preparation

The type of sample containers used depends on the type of analysis performed. First, determine the type(s) of contaminants expected and the proper analytical method(s). Be sure to consult your selected laboratory for its specific needs and requirements prior to sampling.

Next, prepare the storage and transport containers (ice chest, etc.) before taking any samples so that each sample can be placed in a chilled environment immediately after collection.

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest. Additional supplies, such as reagents and preservatives, may be necessary.

All sampling equipment (bailers, tubing, containers, etc.) must be selected based on its chemical compatibility with the source being sampled (e.g., water supply well, monitoring well) and the contaminants potentially present.

a.) Pumps - All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface.

1. *Above-Ground Pumps*
    - Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20- 25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease. A variable speed peristaltic pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations. Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate.
    - Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. **Do not use** this type of pump to collect groundwater samples. When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing.
2. *Submersible Pumps*
    - Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells. A variable speed submersible pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations. The pump housing, fittings, check valves and associated hardware must be constructed of stainless steel. All other materials must be

compatible with the analytes of interest. Install a check valve at the output side of the pump to prevent backflow. If purging **and** sampling for organics, the entire length of the delivery tube must be Teflon, polyethylene or polypropylene (PP) tubing; the electrical cord must be sealed in Teflon, polyethylene or PP and any cabling must be sealed in Teflon, polyethylene or PP, or be constructed of stainless steel; and all interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

3. *Variable Speed Bladder Pump*: A variable speed, positive displacement, bladder pump can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.
    - A variable speed bladder pump can be used for normal purging and sampling, and sampling low permeability aquifers or formations.
    - The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor, or a compressed gas supply.
    - The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, polyethylene, PP and stainless steel. Other materials must be compatible with the analytes of interest.
    - If purging and sampling for organics, the pump body must be constructed of stainless steel. The valves and bladder must be Teflon, polyethylene or PP; the entire length of the delivery tube must be Teflon, polyethylene or PP; and any cabling must be sealed in Teflon, polyethylene or PP, or be constructed of stainless steel.
    - Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

b.) <u>Bailers</u>

1. *Purging*: Bailers must be used with caution because improper bailing can cause changes in the chemistry of the water due to aeration and loosening particulate matter in the space around the well screen. Use a bailer if there is non-aqueous phase liquid (free product) in the well or if non-aqueous phase liquid is suspected to be in the well.
2. *Sampling*: Bailers must be used with caution.
3. *Construction and Type*: Bailers must be constructed of materials compatible with the analytes of interest. Stainless steel, Teflon, rigid medical grade PVC, polyethylene and PP bailers may be used to sample all analytes. Use disposable bailers when sampling grossly contaminated sample sources. NCDENR recommends using dual check valve bailers when collecting samples. Use bailers with a controlled flow bottom to collect volatile organic samples.

4. *Contamination Prevention*: Keep the bailer wrapped (foil, butcher paper, etc.) until just before use. Use protective gloves to handle the bailer once it is removed from its wrapping. Handle the bailer by the lanyard to minimize contact with the bailer surface.

c.) Lanyards

1. Lanyards must be made of non-reactive, non-leachable material. They may be cotton twine, nylon, stainless steel, or may be coated with Teflon, polyethylene or PP.
2. Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.
3. Decontaminate stainless steel, coated Teflon, polyethylene and PP lanyards between monitoring wells. They do not need to be decontaminated between purging and sampling operations.

Water Level and Purge Volume Determination

The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

a.) General Equipment Considerations - Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater, and other site conditions.

1. Use of a pump to purge the well is recommended unless no other equipment can be used or there is non-aqueous phase liquid in the well, or non-aqueous phase liquid is suspected to be in the well.
2. Bailers must be used with caution because improper bailing:
    - Introduces atmospheric oxygen, which may precipitate metals (i.e., iron) or cause other changes in the chemistry of the water in the sample (i.e., pH).
    - Agitates groundwater, which may bias volatile and semi-volatile organic analyses due to volatilization.
    - Agitates the water in the aquifer and resuspends fine particulate matter.
    - Surges the well, loosening particulate matter in the annular space around the well screen.
    - May introduce dirt into the water column if the sides of the casing wall are scraped.

NOTE: *It is critical for bailers to be slowly and gently immersed into the top of the water column, particularly during the final stages of purging. This minimizes turbidity and disturbance of volatile organic constituents.*

b.) Initial Inspection

1. Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well.
2. Inspect the exterior protective casing of the monitoring well for damage. Document the results of the inspection if there is a problem.
3. It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.

4. Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

c.) Water Level Measurements - Use an electronic probe or chalked tape to determine the water level. Decontaminate all equipment before use. Measure the depth to groundwater from the top of the well casing to the nearest 0.01 foot. Always measure from the same reference point or survey mark on the well casing. Record the measurement.

1. *Electronic Probe*: Decontaminate all equipment before use. Follow the manufacturer's instructions for use. Record the measurement.
2. *Chalked Line Method*: Decontaminate all equipment before use. Lower chalked tape into the well until the lower end is in the water. This is usually determined by the sound of the weight hitting the water. Record the length of the tape relative to the reference point. Remove the tape and note the length of the wetted portion. Record the length. Determine the depth to water by subtracting the length of the wetted portion from the total length. Record the result.

d.) Water Column Determination - To determine the length of the water column, subtract the depth to the top of the water column from the total well depth (or gauged well depth if silting has occurred). The total well depth depends on the well construction. If gauged well depth is used due to silting, report total well depth also. Some wells may be drilled in areas of sinkhole, karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

e.) Well Water Volume - Calculate the total volume of water, in gallons, in the well using the following equation:

$$V = (0.041)d \times d \times h$$

Where:

V = volume in gallons
d = well diameter in inches
h = height of the water column in feet

The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Gallons per Foot of Water) for the appropriate diameter well:

$$V = [\text{Gallons per Foot of Water}] \times h$$

Where:

V = volume in gallons
h = height of the water column in feet

Record all measurements and calculations in the field records.

f.) Purging Equipment Volume - Calculate the total volume of the pump, associated tubing and flow cell (if used), using the following equation:

$$V = p + ((0.041)d \times d \times l) + fc$$

Where:

V = volume in gallons
p = volume of pump in gallons
d = tubing diameter in inches
l = length of tubing in feet

fc = volume of flow cell in gallons

g.) If the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24 hour time interval when collecting samples from multiple wells on a site, unless a shorter time period is required. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

Well Purging Techniques

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity.

a.) Measuring the Purge Volume - The volume of water that is removed during purging must be recorded. Therefore, you must measure the volume during the purging operation.

1. Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, OR
2. Estimate the volume based on pumping rate. This technique may be used only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time, or use a flow meter.
    - Calculate the amount of water that is discharged per minute: D = Measured Amount/Total Time In Minutes
    - Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume: Time = V/D
      Where: V = well volume or purging equipment volume
      D = discharge rate
    - Make new measurements each time the pumping rate is changed.
3. Use a totalizing flow meter.
    - Record the reading on the totalizer prior to purging.
    - Record the reading on the totalizer at the end of purging.
    - To obtain the volume purged, subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging.
    - Record the times that purging begins and ends in the field records.

b.) Purging Measurement Frequency - When purging a well that has the well screen fully submerged and the pump or intake tubing is placed within the well casing above the well screen or open hole, purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements. When purging a well that has the pump or intake tubing placed within a fully submerged well screen or open hole, purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow cell (if used) prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart. Purge at least

three (3) volumes of the pump, associated tubing and flow cell, if used, prior to collecting a sample. When purging a well that has a partially submerged well screen, purge a minimum of one (1) well volume prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two (2) to three (3) minutes apart.

c.) Purging Completion - Wells must be adequately purged prior to sample collection to ensure representation of the aquifer formation water, rather than stagnant well water. This may be achieved by purging three volumes from the well or by satisfying any one of the following three purge completion criteria:

1.) Three (3) consecutive measurements in which the three (3) parameters listed below are within the stated limits, dissolved oxygen is no greater than 20 percent of saturation at the field measured temperature, and turbidity is no greater than 20 Nephelometric Turbidity Units (NTUs).

- Temperature: + 0.2° C
- pH: + 0.2 Standard Units
- Specific Conductance: + 5.0% of reading

Document and report the following, as applicable. The last four items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

2.) If it is impossible to get dissolved oxygen at or below 20 percent of saturation at the field measured temperature or turbidity at or below 20 NTUs, then three (3) consecutive measurements of temperature, pH, specific conductance and the parameter(s) dissolved oxygen and/or turbidity that do not meet the requirements above must be within the limits below. The measurements are:

- Temperature: + 0.2° C
- pH: + 0.2 Standard Units
- Specific Conductance: + 5.0% of reading
- Dissolved Oxygen: + 0.2 mg/L or 10%, whichever is greater
- Turbidity: + 5 NTUs or 10%, whichever is greater

Additionally, document and report the following, as applicable, except that the last four(4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- A description of conditions at the site that may cause the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.

- A description of conditions at the site that may cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.) If after five (5) well volumes, three (3) consecutive measurements of the field parameters temperature, pH, specific conductance, dissolved oxygen, and turbidity are not within the limits stated above, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. It is at the discretion of the consultant/contractor whether or not to collect a sample or to continue purging. Further, the report in which the data are submitted must include the following, as applicable. The last four (4) items only need to be submitted once.

- Purging rate.
- Drawdown in the well, if any.
- A description of conditions at the site that may cause the Dissolved Oxygen to be high and/or Dissolved Oxygen measurements made within the screened or open hole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that may cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If wells have previously and consistently purged dry, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

- Place the pump or tubing intake within the well screened interval.
- Use very small diameter Teflon, polyethylene or PP tubing and the smallest possible pump chamber volume. This will minimize the total volume of water pumped from the well and reduce drawdown.
- Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

- Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.
- Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).
- Measure pH, specific conductance, temperature, dissolved oxygen and turbidity, then begin to collect the samples.

Collect samples immediately after purging is complete. The time period between completing the purge and sampling cannot exceed six hours. If sample collection does not occur within one hour of purging completion, re-measure the five field parameters: temperature, pH, specific conductance, dissolved oxygen and turbidity, just prior to collecting the sample. If the measured values are not within 10 percent of the previous measurements, re-purge the well. The exception is "dry" wells.

d.) Lanyards

1. Securely fasten lanyards, if used, to any downhole equipment (bailers, pumps, etc.).
2. Use bailer lanyards in such a way that they do not touch the ground surface.

Wells Without Plumbing

a.) Tubing/Pump Placement

1. If attempting to minimize the volume of purge water, position the intake hose or pump at the midpoint of the screened or open hole interval.
2. If monitoring well conditions do not allow minimizing of the purge water volume, position the pump or intake hose near the top of the water column. This will ensure that all stagnant water in the casing is removed.
3. If the well screen or borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump midway between the measured water level and the bottom of the screen. Otherwise, position the pump or intake hose near the top of the water column.

b.) Non-dedicated (portable) pumps

1. *Variable Speed Peristaltic Pump*
   - Wear sampling gloves to position the decontaminated pump and tubing.
   - Attach a short section of tubing to the discharge side of the pump and into a graduated container.
   - Attach one end of a length of new or precleaned tubing to the pump head flexible hose.
   - Place the tubing as described in one of the options listed above.
   - Change gloves before beginning to purge.
   - Measure the depth to groundwater at frequent intervals.
   - Record these measurements.
   - Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
- If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that water is removed from the top of the water column.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.
- Decontaminate the pump and tubing between wells (see Appendix C) or if precleaned tubing is used for each well, only the pump.

2. *Variable Speed Centrifugal Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Place the decontaminated suction hose so that water is always pumped from the top of the water column.
    - Change gloves before beginning to purge.
    - Equip the suction hose with a foot valve to prevent purge water from re-entering the well.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
    - If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
    - Decontaminate the pump and tubing between wells or if precleaned tubing is used for each well, only the pump.
3. *Variable Speed Electric Submersible Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Carefully position the decontaminated pump.

- Change gloves before beginning to purge.
- Measure the depth to groundwater at frequent intervals.
- Record these measurements.
- To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
- If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that water is removed from the top of the water column.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.
- Decontaminate the pump and tubing between wells or only the pump if precleaned tubing is used for each well.

4. *Variable Speed Bladder Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves to position the decontaminated pump and tubing.
    - Attach the tubing and carefully position the pump.
    - Change gloves before beginning purging.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - To minimize drawdown, adjust the purging rate so that it is equivalent to the well recovery rate.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.
    - If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that water is removed from the top of the water column.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
    - Decontaminate the pump and tubing between wells or if precleaned tubing is used for each well, only the pump.

c.) <u>Dedicated Portable Pumps</u>

1. *Variable Speed Electric Submersible Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves.

- Measure the depth to groundwater at frequent intervals.
- Record these measurements.
- Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
- If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.
- Record the purging rate each time the rate changes.
- Measure the purge volume.
- Record this measurement.

2. *Variable Speed Bladder Pump*
    - Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.
    - Wear sampling gloves.
    - Measure the depth to groundwater at frequent intervals.
    - Record these measurements.
    - Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.
    - If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdraw with the recharge rate.
    - Record the purging rate each time the rate changes.
    - Measure the purge volume.
    - Record this measurement.
3. *Bailers* - Using bailers for purging is not recommended unless care is taken to use proper bailing technique, or if free product is present in the well or suspected to be in the well.
    - Minimize handling the bailer as much as possible.
    - Wear sampling gloves.
    - Remove the bailer from its protective wrapping just before use.
    - Attach a lanyard of appropriate material.
    - Use the lanyard to move and position the bailer.
    - Lower and retrieve the bailer slowly and smoothly.
    - Lower the bailer carefully into the well to a depth approximately a foot above the water column.
    - When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached.
    - Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.
    - Allow time for the bailer to fill with aquifer water as it descends into the water column.

- Carefully raise the bailer. Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.
- Measure the purge volume.
- Record the volume of the bailer.
- Continue to carefully lower and retrieve the bailer as described above until the purging is considered complete, based on either the removal of 3 well volumes.
- Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

Groundwater Sampling Techniques

a.) Purge wells.

b.) Replace protective covering around the well if it is soiled or torn after completing purging operations.

c.) Equipment Considerations

1. The following pumps are approved to collect volatile organic samples:
    - Stainless steel and Teflon variable speed submersible pumps
    - Stainless steel and Teflon or polyethylene variable speed bladder pumps
    - Permanently installed PVC bodied pumps (As long as the pump remains in contact with the water in the well at all times)
2. Collect sample from the sampling device and store in sample container. Do not use intermediate containers.
3. To avoid contamination or loss of analytes from the sample, handle sampling equipment as little as possible and minimize equipment exposure to the sample.
4. To reduce chances of cross-contamination, use dedicated equipment whenever possible. "Dedicated" is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump). Purchase dedicated equipment with the most sensitive analyte of interest in mind.
    - Clean or make sure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use, but must be cleaned if they are withdrawn for repair or servicing.
    - Clean or make sure any permanently mounted tubing is clean before installation.
    - Change or clean tubing when the pump is withdrawn for servicing.
    - Clean any replaceable or temporary parts.

- Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.
- Clean or make sure dedicated bailers are clean before placing them into the well.
- Collect an equipment blank on dedicated bailers before introducing them into the water column.
- Suspend dedicated bailers above the water column if they are stored in the well.

Sampling Wells Without Plumbing

a.) Sampling with Pumps – The following pumps may be used to sample for organics:

- Peristaltic pumps
- Stainless steel, Teflon or polyethylene bladder pumps
- Variable speed stainless steel and Tefloṇ submersible pumps

1. *Peristaltic Pump*

- Volatile Organics: One of three methods may be used.
  - Remove the drop tubing from the inlet side of the pump; submerge the drop tubing into the water column; prevent the water in the tubing from flowing back into the well; remove the drop tubing from the well; carefully allow the groundwater to drain into the sample vials; avoid turbulence; do not aerate the sample; repeat steps until enough vials are filled. OR
  - Use the pump to fill the drop tubing; quickly remove the tubing from the pump; prevent the water in the tubing from flowing back into the well; remove the drop tubing from the well; carefully allow the groundwater to drain into the sample vials; avoid turbulence; do not aerate the sample; repeat steps until enough vials are filled. OR
  - Use the pump to fill the drop tubing; withdraw the tubing from the well; reverse the flow on the peristaltic pumps to deliver the sample into the vials at a slow, steady rate; repeat steps until enough vials are filled.
- Extractable Organics: If delivery tubing is not polyethylene or PP, or is not Teflon lined, use pump and vacuum trap method. Connect the outflow tubing from the container to the influent side of the peristaltic pump. Turn pump on and reduce flow until smooth and even. Discard a

small portion of the sample to allow for air space. Preserve (if required), label, and complete field notes.

- Inorganic samples: These samples may be collected from the effluent tubing. If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells. Preserve (if required), label, and complete field notes.

2. *Variable Speed Bladder Pump*
    - If sampling for organics, the pump body must be constructed of stainless steel and the valves and bladder must be Teflon. All tubing must be Teflon, polyethylene, or PP and any cabling must be sealed in Teflon, polyethylene or PP, or made of stainless steel.
    - After purging to a smooth even flow, reduce the flow rate.
    - When sampling for volatile organic compounds, reduce the flow rate to 100-200mL/minute, if possible.
3. *Variable Speed Submersible Pump*
    - The housing must be stainless steel.
    - If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon, polyethylene or PP. The delivery tubing must be Teflon, polyethylene or PP; the electrical cord must be sealed in Teflon; any cabling must be sealed in Teflon or constructed of stainless steel.
    - After purging to a smooth even flow, reduce the flow rate.
    - When sampling for volatile organic compounds, reduce the flow rate to 100-200mL/minute, if possible.

b.) Sampling with Bailers - A high degree of skill and coordination are necessary to collect representative samples with a bailer.

1. *General Considerations*
    - Minimize handling of bailer as much as possible.
    - Wear sampling gloves.
    - Remove bailer from protective wrapping just before use.
    - Attach a lanyard of appropriate material.
    - Use the lanyard to move and position the bailers.
    - Do not allow bailer or lanyard to touch the ground.
    - If bailer is certified precleaned, no rinsing is necessary.
    - If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.
    - If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer by collecting a single bailer of the groundwater to be sampled.
    - Discard the water appropriately.

- Do not rinse the bailer if Oil and Grease samples are to be collected.

2. *Bailing Technique*
    - Collect all samples that are required to be collected with a pump before collecting samples with the bailer.
    - Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column, which can increase sample turbidity.
    - Lower the bailer carefully into the well to a depth approximately a foot above the water column. When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached.
    - Do not lower the top of the bailer more than one foot below the top of the water table, so that water is removed from the top of the water column.
    - Allow time for the bailer to fill with aquifer water as it descends into the water column.
    - Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample. Carefully raise the bailer. Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.
    - Lower the bailer to approximately the same depth each time.
    - Collect the sample. Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Discard the last few inches of water in the bailer.
    - Repeat steps for additional samples.
    - As a final step measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected. Record all measurements and note the time that sampling was completed.

c.) <u>Sampling Low Permeability Aquifers or Wells that have Purged Dry</u>

1. Collect the sample(s) after the well has been purged. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available.
2. Measure the five field parameters temperature, pH, specific conductance, dissolved oxygen and turbidity at the time of sample collection.
3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

Appendix D - Collecting Samples from Wells with Plumbing in Place

In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply.

a.) Air Strippers or Remedial Systems - These types of systems are installed as remediation devices. Collect influent and effluent samples from air stripping units as described below.

1. Remove any tubing from the sampling port and flush for one to two minutes.
2. Remove all hoses, aerators and filters (if possible).
3. Open the spigot and purge sufficient volume to flush the spigot and lines and until the purging completion criteria have been met.
4. Reduce the flow rate to approximately 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples.
5. Follow procedures for collecting samples from water supply wells as outlined below.

b.) Water Supply Wells – Water supply wells with in-place plumbing do not require equipment to be brought to the well to purge and sample. Water supply wells at UST facilities must be sampled for volatile organic compounds (VOCs) and semivolatile compounds (SVOCs).

1. *Procedures for Sampling Water Supply Wells*
    - Label sample containers prior to sample collection.
    - Prepare the storage and transport containers (ice chest, etc.) before taking any samples so each collected sample can be placed in a chilled environment immediately after collection.
    - You must choose the tap closest to the well, preferably at the wellhead. The tap must be before any holding or pressurization tank, water softener, ion exchange, disinfection process or before the water line enters the residence, office or building. If no tap fits the above conditions, a new tap that does must be installed.
    - The well pump must not be lubricated with oil, as that may contaminate the samples.
    - The sampling tap must be protected from exterior contamination associated with being too close to a sink bottom or to the ground. If the tap is too close to the ground for direct collection into the appropriate container, it is acceptable to use a smaller (clean) container to transfer the sample to a larger container.
    - Leaking taps that allow water to discharge from around the valve stem handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations.

- Disconnect any hoses, filters, or aerators attached to the tap before sampling.
- Do not sample from a tap close to a gas pump. The gas fumes could contaminate the sample.

2. *Collecting Volatile Organic Samples*
    - Equipment Needed: VOC sample vials [40 milliliters, glass, may contain 3 to 4 drops of hydrochloric acid (HCl) as preservative]; Disposable gloves and protective goggles; Ice chest/cooler; Ice; Packing materials (sealable plastic bags, bubble wrap, etc.); and Lab forms.
    - Sampling Procedure: Run water from the well for at least 15 minutes. If the well is deep, run water longer (purging three well volumes is best). If tap or spigot is located directly before a holding tank, open a tap after the holding tank to prevent any backflow into the tap where you will take your sample. This will ensure that the water you collect is "fresh" from the well and not from the holding tank. After running the water for at least 15 minutes, reduce the flow of water. The flow should be reduced to a trickle but not so slow that it begins to drip. A smooth flow of water will make collection easier and more accurate. Remove the cap of a VOC vial and hold the vial under the stream of water to fill it. Be careful not to spill any acid that is in the vial. For best results use a low flow of water and angle the vial slightly so that the water runs down the inside of the vial. This will help keep the sample from being agitated, aerated or splashed out of the vial. It will also increase the accuracy of the sample. As the vial fills and is almost full, turn the vial until it is straight up and down so the water won't spill out. Fill the vial until the water is just about to spill over the lip of the vial. The surface of the water sample should become mounded. It is a good idea not to overfill the vial, especially if an acid preservative is present in the vial. Carefully replace and screw the cap onto the vial. Some water may overflow as the cap is put on. After the cap is secure, turn the vial upside down and gently tap the vial to see if any bubbles are present. If bubbles are present in the vial, remove the cap, add more water and check again to see if bubbles are present. Repeat as necessary. After two samples without bubbles have been collected, the samples should be labeled and prepared for shipment. Store samples at 4° C.

3. *Collecting Extractable Organic and/or Metals Samples*

- Equipment Needed: SVOC sample bottle [1 liter, amber glass] and/or Metals sample bottle [0.5 liter, polyethylene or glass, 5 milliliters of nitric acid (HNO3) preservative]; Disposable gloves and protective goggles; Ice Chest/Cooler; Ice; Packing materials (sealable plastic bags, bubble wrap, etc.); and Lab forms.
- Sampling Procedure: Run water from the well for at least 15 minutes. If the well is deep, run the water longer (purging three well volumes is best). If tap or spigot is located directly before a holding tank, open a tap after the holding tank to prevent any backflow into the tap where you will take your sample. This will ensure that the water you collect is "fresh" from the well and not from the holding tank. After running the water for at least 15 minutes, reduce the flow. Low water flow makes collection easier and more accurate. Remove the cap of a SVOC or metals bottle and hold it under the stream of water to fill it. The bottle does not have to be completely filled (i.e., you can leave an inch or so of headspace in the bottle). After filling, screw on the cap, label the bottle and prepare for shipment. Store samples at 4° C.

Appendix E - Collecting Surface Water Samples

The following topics include 1.) acceptable equipment selection and equipment construction materials and 2.) standard grab, depth-specific and depth-composited surface water sampling techniques.

Facilities which contain or border small rivers, streams or branches should include surface water sampling as part of the monitoring program for each sampling event. A simple procedure for selecting surface water monitoring sites is to locate a point on a stream where drainage leaves the site. This provides detection of contamination through, and possibly downstream of, site via discharge of surface waters. The sampling points selected should be downstream from any waste areas. An upstream sample should be obtained in order to determine water quality upstream of the influence of the site.

a.) General Cautions
    1. When using watercraft take samples near the bow away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.
    2. When wading, collect samples upstream from the body. Avoid disturbing sediments in the immediate area of sample collection.
    3. Collect water samples prior to taking sediment samples when obtaining both from the same area (site).
    4. Unless dictated by permit, program or order, sampling at or near man-made structures (e.g., dams, weirs or bridges) may not provide representative data because of unnatural flow patterns.
    5. Collect surface water samples from downstream towards upstream.

b.) Equipment and Supplies - Select equipment based on the analytes of interest, specific use, and availability.

c.) Surface Water Sampling Techniques - Adhere to all general protocols applicable to aqueous sampling when following the surface water sampling procedures addressed below.
    1. *Manual Sampling*: Use manual sampling for collecting grab samples for immediate in-situ field analyses. Use manual sampling in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to observe and/or note unusual conditions.
        - Surface Grab Samples - Do not use sample containers containing premeasured amounts of preservatives to collect grab samples. If the sample matrix is homogeneous, then the grab method is a simple and effective technique for collection purposes. If homogeneity is not apparent, based on flow or vertical variations (and should never be assumed), then use other collection protocols. Where practical, use the actual sample container submitted to the laboratory for collecting samples to be analyzed for oil and grease, volatile organic compounds (VOCs), and microbiological samples. This procedure eliminates the possibility of contaminating the sample with an intermediate collection container. The use of

unpreserved sample containers as direct grab samplers is encouraged since the same container can be submitted for laboratory analysis after appropriate preservation. This procedure reduces sample handling and eliminates potential contamination from other sources (e.g., additional sampling equipment, environment, etc.).

1. Grab directly into sample container.
2. Slowly submerge the container, opening neck first, into the water.
3. Invert the bottle so the neck is upright and pointing towards the direction of water flow (if applicable). Allow water to run slowly into the container until filled.
4. Return the filled container quickly to the surface.
5. Pour out a few mL of sample away from and downstream of the sampling location. This procedure allows for the addition of preservatives and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.
6. Add preservatives, securely cap container, label, and complete field notes. If sample containers are attached to a pole via a clamp, submerge the container and follow steps 3 – 5 but omit steps 1 and 2.

- Sampling with an Intermediate Vessel or Container: If the sample cannot be collected directly into the sample container to be submitted to the laboratory, or if the laboratory provides prepreserved sample containers, use an unpreserved sample container or an intermediate vessel (e.g., beakers, buckets or dippers) to obtain the sample. These vessels must be constructed appropriately, including any poles or extension arms used to access the sample location.
    1. Rinse the intermediate vessel with ample amounts of site water prior to collecting the first sample.
    2. Collect the sample as outlined above using the intermediate vessel.
    3. Use pole mounted containers of appropriate construction to sample at distances away from shore, boat, etc. Follow the protocols above to collect samples.
- Peristaltic Pump and Tubing: The most portable pump for this technique is a 12 volt peristaltic pump. Use appropriately precleaned, silastic tubing in the pump head and attach polyethylene, Tygon, etc. tubing to the pump. This technique is not acceptable for Oil and Grease, EPH, VPH or VOCs. Extractable organics can be collected through the pump if flexible interior-wall Teflon, polyethylene or PP tubing is used in the pump head or if used with the organic trap setup.

1. Lower appropriately precleaned tubing to a depth of 6 – 12 inches below water surface, where possible.
2. Pump 3 – 5 tube volumes through the system to acclimate the tubing before collecting the first sample.
3. Fill individual sample bottles via the discharge tubing. Be careful not to remove the inlet tubing from the water.
4. Add preservatives, securely cap container, label, and complete field notes.

- Mid-Depth Grab Samples: Mid-depth samples or samples taken at a specific depth can approximate the conditions throughout the entire water column. The equipment that may be used for this type of sampling consists of the following depth-specific sampling devices: Kemmerer, Niskin, Van Dorn type, etc. You may also use pumps with tubing or double check-valve bailers. Certain construction material details may preclude its use for certain analytes. Many Kemmerer samplers are constructed of plastic and rubber that preclude their use for all volatile and extractable organic sampling. Some newer devices are constructed of stainless steel or are all Teflon or Teflon-coated. These are acceptable for all analyte groups without restriction.
    1. Measure the water column to determine maximum depth and sampling depth prior to lowering the sampling device.
    2. Mark the line attached to the sampler with depth increments so that the sampling depth can be accurately recorded.
    3. Lower the sampler slowly to the appropriate sampling depth, taking care not to disturb the sediments.
    4. At the desired depth, send the messenger weight down to trip the closure mechanism.
    5. Retrieve the sampler slowly.
    6. Rinse the sampling device with ample amounts of site water prior to collecting the first sample. Discard rinsate away from and downstream of the sampling location.
    7. Fill the individual sample bottles via the discharge tube.
- Double Check-Valve Bailers: Collect samples using double check-valve bailers if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. Bailers with an upper and lower check-valve can be lowered through the water column. Water will continually be displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved. Sampling with this type of bailer must follow the same protocols outlined above, except that a messenger weight is not applicable. Although not designed specifically for this kind of sampling, a bailer is acceptable when a mid-depth sample is required

1. As the bailer is dropped through the water column, water is displaced through the body of the bailer. The degree of displacement depends upon the check-valve ball movement to allow water to flow freely through the bailer body.
2. Slowly lower the bailer to the appropriate depth. Upon retrieval, the two check valves seat, preventing water from escaping or entering the bailer.
3. Rinse the sampling device with ample amounts of site water prior to collecting the first sample.
4. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described above.

- Peristaltic Pump and Tubing: The most portable pump for this technique is a 12 volt peristaltic pump. Use appropriately precleaned, silastic tubing in the pump head and attach HDPE, Tygon, etc. tubing to the pump. This technique is not acceptable for Oil and Grease, EPH, VPH or VOCs. Extractable organics can be collected through the pump if flexible interior-wall Teflon, polyethylene or PP tubing is used in the pump head, or if used with an organic trap setup.
    1. Measure the water column to determine the maximum depth and the sampling depth.
    2. Tubing will need to be tied to a stiff pole or be weighted down so the tubing placement will be secure. Do not use a lead weight. Any dense, non-contaminating, non-interfering material will work (brick, stainless steel weight, etc.). Tie the weight with a lanyard (braided or monofilament nylon, etc.) so that it is located below the inlet of the tubing.
    3. Turn the pump on and allow several tubing volumes of water to be discharged before collecting the first sample.
    4. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described above.

Waste Management
ENVIRONMENTAL QUALITY

PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

MICHAEL SCOTT
Director

September 9, 2016

MEMORANDUM

To: Solid Waste Directors, Public Works Directors, Landfill Operators, and Landfill Owners

From: The Solid Waste Section

Reference: Guidelines for 14-Day Notification of Groundwater Exceedances Form Submittal per rule: 15A NCAC 13B .1633(c)(1)

- The 14-day notification form should be submitted whenever a groundwater protection standard (GWPS) is exceeded for the first time.
    - As defined in 13B .1634(g)(h), a GWPS will be either of the following: the 2L standard (most cases); 2L Interim Maximum Allowable Concentration; a groundwater protection standard calculated by the SWS; or a site-specific statistical background level approved by the SWS.
- If a facility is undergoing assessment or corrective action, the 14-day notification form should be submitted **ONLY** when the constituent with the reported exceedance is not being addressed through assessment or corrective action.
- If a facility plans to conduct a re-sampling event to confirm the initial exceedance, the 14-day notification form should be submitted **ONLY** when the re-sampling event analytical data confirms the initial exceedance.

NC DEQ
Division of Waste Management - Solid Waste

14-Day Notification of Groundwater Protection Standard Exceedance(s)

per rule: 15A NCAC 13B .1633(c)(1)

Notice: This form and any information attached to it are "Public Records" as defined in NC General Statute 132-1. As such, these documents are available for inspection and examination by any person upon request (NC General Statute 132-6).

Instructions:

- **Prepare one form for each individually monitored unit.**
- **Please type or print legibly.**
- Attach a notification table with values that attain or exceed applicable groundwater protection standards.
- Send the original signed and sealed form, any tables, and Electronic Data Deliverable to: Compliance Unit, NCDEQ-DWM, Solid Waste Section, 1646 Mail Service Center, Raleigh, NC 27699-1646.

Solid Waste Monitoring Data Submittal Information

Name of entity submitting data (laboratory, consultant, facility owner):

Contact for questions about data formatting. Include data preparer's name, telephone number and E-mail address:

Name: _____ Phone: _____

E-mail: _____

Facility name:	Facility Address:	Facility Permit #	Actual sampling dates (e.g., October 20-24, 2006)

Environmental Status: (Check all that apply)

☐ Initial/Background Monitoring ☐ Detection Monitoring ☐ Assessment Monitoring ☐ Corrective Action

Additional Information:

☐ A notification of values exceeding a groundwater protection standard as defined in 15A NCAC 13B .1634(g)(h) is attached. It includes a list of groundwater monitoring points, dates, analytical values, NC 2L groundwater standard, NC Solid Waste GWPS and preliminary analysis of the cause and significance of any concentration.

☐ A re-sampling event was conducted to confirm the exceedances.

☐ Alternate Source Demonstration(s) have been approved for the following constituents with report date: _____

_____

Certification

To the best of my knowledge, the information reported and statements made on this data submittal and attachments are true and correct. Furthermore, I have attached complete notification of any sampling values meeting or exceeding groundwater standards or explosive gas levels, and a preliminary analysis of the cause and significance of concentrations exceeding groundwater standards. I am aware that there are significant penalties for making any false statement, representation, or certification including the possibility of a fine and imprisonment.

Facility Representative Name (Print) | Title | (Area Code) Telephone Number

Affix NC Licensed/Professional Geologist or Professional Engineer Seal

Signature | Date

Facility Representative Address

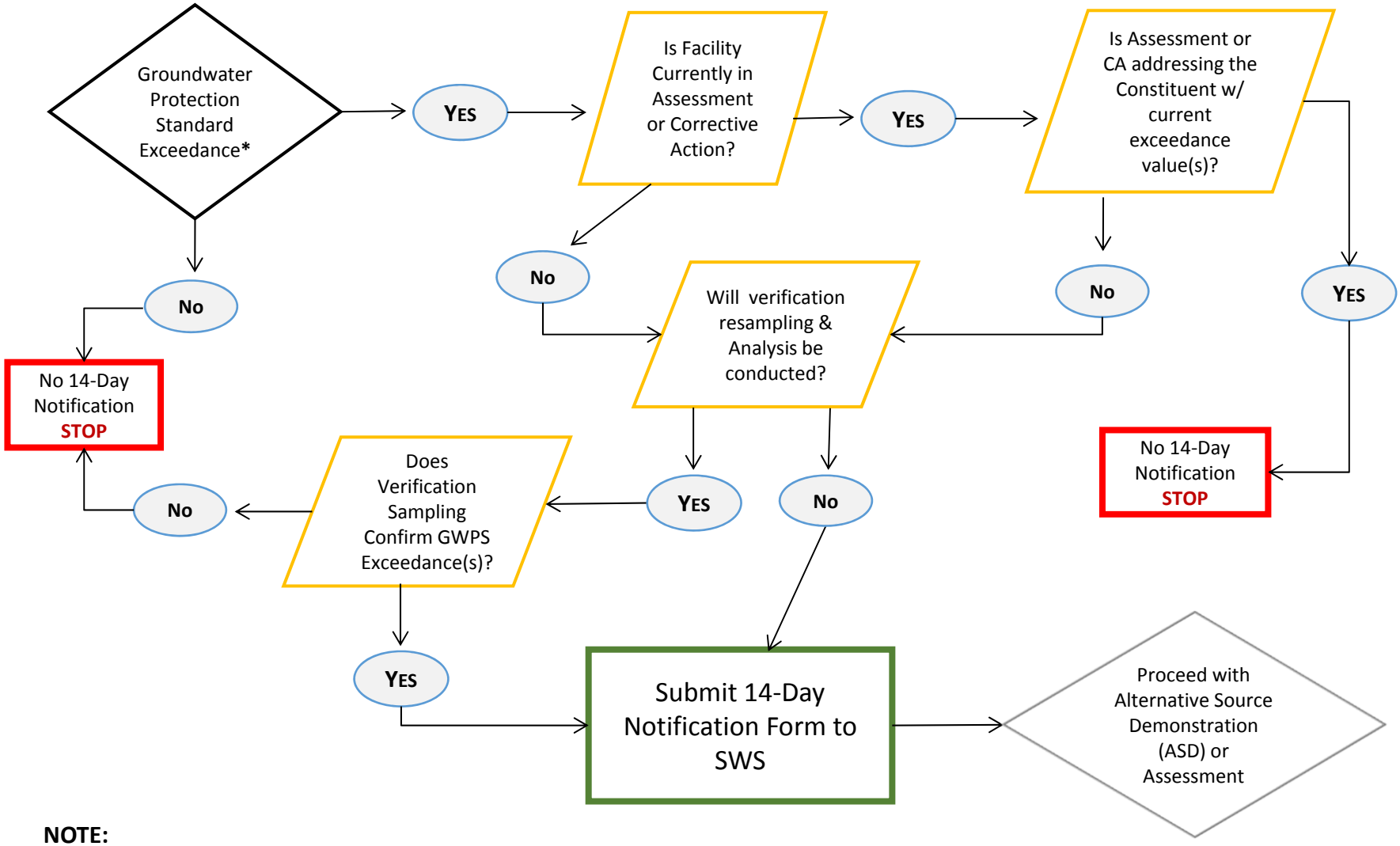
NC PG/PE Firm License Number (if applicable effective May 1, 2009)

Revised 6/2016

NCDWM Solid Waste Section

14-Day Notification of GWPS Exceedances Flowchart

[per Rule 15A NCAC 13B .1633(c)(1)]



NOTE:

***GWPS = see Rule 15A NCAC 13B .1634(g)(h)**

August 2016

MEMO

Date: June 14, 2016

To: Stakeholders

From: NC DWM Solid Waste Section Hydrogeologists

Reference: Draft 14-Day Notification Form for GW Monitoring Exceedances
Response to Comments

Thank you all for submitting comments and questions regarding the proposed 14-Day Notification form for groundwater exceedances at relevant permitted solid waste facilities. Below is a compilation of these comments and the SWS responses.

14-Day Notification Timeline

Comment: Regarding the 14-day notification: Since rule .1634.g.5 includes the possibility of using the statistical background as the GPS, how will this impact the need for a 14-day notification? If we have an exceedance of the NC 2L Standard or SWS GWPS for a metal, but it is not in exceedance of the statistical background, do we need so submit a 14-day notification?

Response: If a facility has received approval from the Section to establish a statistical background level as a groundwater protection standard for one or more constituents, the 14-day notification form should only be submitted if the reported concentration(s) exceeds the approved background level for the respective constituent(s).

Comment: I noticed there are boxes to check in the "Environmental Status" Section. Does DEQ want to be notified of any new exceedances within 14 days even if the site is already in Assessment Monitoring or already in Corrective Action?

Response: The Section wants to be notified of any new exceedances for constituents that are not being addressed by ongoing Assessment or Corrective Action.

Comment: It is vague on what defines "determines" in regards to when the 14-day clock starts. Is it when the exceedance is identified internally? Is it when the client (site) is notified and has a chance to review? Is it within 14-days of receiving the lab results? This is interpreted differently in many States (though usually not specifically defined).

Response: The 14 day clock starts once laboratory results have been received if the facility does not plan to re-sample, or it starts once the laboratory results from the re-sampling event have been received if the exceedance was confirmed.

Comment: Also, are you planning to include clarification on when to submit the forms either on the form itself or as part of an accompanying guidance document?

Response: We plan to include language on our website to clarify when the form should be submitted. In addition, we will include similar language in the forthcoming Alternate Source Demonstration Guidance Document.

Verification Sampling

Comment: If verification sampling is performed but the exceedance does not confirm the original detection, does a form have to be submitted for the original exceedance?

Response: The form will not need to be submitted if the original exceedance is not confirmed after verification sampling.

Certification

Comment: I had a look at the form with your e-mail of June 10, 2016 and Rachel's e-mail, and the only other item I had was the inclusion of "Professional Engineer" in the lower right corner with the "NC Licensed/Professional Geologist Seal".

Response: We will include "Professional Engineer" in the lower right corner with the "NC Licensed/Professional Geologist Seal".

Statistical Background for GWPS

Comment: Will the use of statistical background as the GPS be addressed on the form or in your guidance?

Response: The use of statistical background as a GPS will be addressed in our guidance and we will edit the form distinguish a 2L Standard exceedance from a statistical background exceedance.

Other

Comment: Hopefully we will also have a chance to review the draft language you plan to use on our website to clarify when the form should be submitted.

Response: Yes, the shareholders will have the opportunity to review the draft language before it is published on our website.

MEMO

Date: August 8, 2016

To: Stakeholders

From: NC DWM Solid Waste Section Hydrogeologists

Reference: Draft 14-Day Notification Form Guidance and Flowchart

Thank you all for submitting comments and questions regarding the proposed 14-Day Notification form guidance and flowchart. Below is a compilation of these comments and the SWS responses.

14-Day Notification Timeline

Comment: What is the best procedure for requesting to use a statistical background as the groundwater protection standard (GWPS)?

Can the request be made be done by email, or does it need to be a formal document?
Can the request be made in conjunction with the 14-day notification?
Can the request be made in the Semiannual Water Quality Monitoring Report?

Response: The request should be submitted as a formal document since supporting information will need to be included in the request as with an ASD.

Comment: Once approval is given for use of a background value as the GWPS for a given constituent, is that approval good for all future monitoring events?

Response: Once a statistically calculated background value is approved as a GWPS, that value serves as the GWPS for all future monitoring events.

Comment: Does the background need to be recalculated for each subsequent monitoring event based on updated statistical data, or do we continue to use the initially-approved background value for all future events, unless there is a special need to recalculate it?

Response: The background does not need to be recalculated during subsequent monitoring events since the initially approved background value will serve as the GWPS for all future monitoring events.

Comment: If a site is in Detection Monitoring, an ASD could include statistical analyses, but would ASD addendums need to be submitted as needed to address future exceedances, or would the statistically calculated background become a site specific GPS as it would in an Assessment Monitoring Program?

Response: An ASD addendum does not need to be submitted for sites in detection monitoring if a regulatory standard (i.e. 2L Standard) is exceeded since the approved GWPS would serve as the site specific GWPS.

Comment: When does the 14-day clock start?

For instance, I usually submit my reports (which note any exceedances) within 14 days from when I determine an exceedance. So would I need to submit the Form AND my report separately? Or could I just submit them together?

Response: The 14-day clock starts once the exceedance has been determined.

The form should be submitted separately from the report, but they can be submitted at the same time within the 14-day window.

Waste Management
ENVIRONMENTAL QUALITY

ROY COOPER
Governor
MICHAEL S. REGAN
Secretary
MICHAEL SCOTT
Director

May 29, 2018

MEMORANDUM

To: Solid Waste Directors, Landfill Owners/Operators, and North Carolina Certified Laboratories

From: Ed Mussler, Section Chief
North Carolina Division of Waste Management, Solid Waste Section

Re: 1,4-Dioxane Analysis, Solid Waste Section Limits, and Laboratory Analytical Methods

1,4-Dioxane Sampling

In accordance with 15A NCAC 13B .0601, .0544, and .1632, the Solid Waste Section (Section) is requiring that all groundwater and surface water samples collected at landfills after July 1, 2018 be analyzed for the constituent 1,4-Dioxane. It is primarily used as a stabilizer for chlorinated solvents, however also used in many products including paint strippers, dyes, greases, varnishes and waxes. Additionally, it is found in a variety of consumer products such as detergents, shampoos, deodorants, and cosmetics. **The current 15A NCAC 02L .0202 Standard for 1,4-Dioxane is 3.0 µg/l.** Due to the potential health hazards associated with 1,4-Dioxane, the Section has determined that all landfills should begin analyzing groundwater and surface water samples for 1,4-Dioxane to ensure protection of human health and the environment. A USEPA Technical Fact Sheet for 1,4-Dioxane is provided in Appendix A of this Memorandum.

Solid Waste Section Limits & Laboratory Analytical Methods

In 2006, the Solid Waste Section made a policy decision to develop and use Solid Waste Section Limits (SWSLs). The purpose for this policy decision was to ensure that low level analytical data was consistently being reported for the purpose of making the correct choices when designing site remediation strategies, alerting the public to health threats, and protecting the environment from toxic contaminants. Over the past 12 years, technologies have advanced such that the majority of the SWSLs are outdated. Given the rapid pace of technology, the need for the Section to attempt to continuously update and/or maintain the SWSLs is not warranted.

Although the use of the SWSLs will be discontinued, facilities should choose EPA approved analytical methods sufficiently sensitive to quantify the presence of a pollutant at or below applicable standards. Consistently achieving low level data is key for the continued purpose of making the correct choices when designing site remediation strategies, alerting the public to health threats, and protecting the environment from toxic contaminants. Facilities should communicate and coordinate with their analytical laboratory(s) to use sufficiently sensitive analytical methods to achieve analytical results with detection limits below the applicable groundwater standards and surface water standards. For guidance purposes, the Section recommends the use of the following analytical methods for groundwater and surface water samples.

Volatile Organic Compounds	SW 846 Method 8260
1,4-Dioxane	SW 846 Method 8260 SIM SW 846 Method 8270 SIM
Semi-Volatile Organic Compounds	SW 846 Method 8270
Metals, Pesticides, PCBs, Dioxins, Cyanide, Formaldehyde, and any other constituents not covered by above methods	SW 846 Methods, USEPA methods, or method published in *Standard Methods for the Examination of Water and Wastewater* having the lowest detection limits or having detection limits below applicable standards

Notes:

- *The analytical methods should be the most recent versions of the analytical methods tabulated above. For SW- 846 Methods, the latest edition of SW-846, including any subsequent updates which have been incorporated into the edition, must be used. Sampling must be planned so that required holding times for analytical methods are met.*

- *Select Ion Monitoring (SIM) is recommended when analyzing for 1,4-Dioxane in order to achieve applicable detection limits. SIM may be useful for other VOCs/SVOC constituents.*

- *SW-846 Method 1610 does not have detection limits below the 15A NCAC 2L standards for all of the hazardous substance list metals.*

- *The Section considers "J" flag values valid and relevant in the decision making process and hence all "J" flag values should be reported.*

If you have any questions, please contact Adam Ulishney at (919) 707-8210 or via email at adam.ulishney@ncdenr.gov. Thank you for your cooperation in this matter.

United States Environmental Protection Agency

Technical Fact Sheet – 1,4-Dioxane

January 2014

At a Glance

- Flammable liquid and a fire hazard. Potentially explosive if exposed to light or air.
- Found at many federal facilities because of its widespread use as a stabilizer in certain chlorinated solvents, paint strippers, greases and waxes.
- Short-lived in the atmosphere, may leach readily from soil to groundwater, migrates rapidly in groundwater and is relatively resistant to biodegradation in the subsurface.
- Classified by the EPA as "likely to be carcinogenic to humans" by all routes of exposure.
- Short-term exposure may cause eye, nose and throat irritation; long-term exposure may cause kidney and liver damage.
- No federal maximum contaminant level (MCL) has been established for 1,4-dioxane in drinking water.
- Federal screening levels, state health-based drinking water guidance values and federal occupational exposure limits have been established.
- Modifications to existing sample preparation procedures may be required to achieve the increased sensitivity needed for detection of 1,4-dioxane.
- Common treatment technologies include advanced oxidation processes and bioremediation.

Introduction

This fact sheet, developed by the U.S. Environmental Protection Agency (EPA) Federal Facilities Restoration and Reuse Office (FFRRO), provides a summary of the contaminant 1,4-dioxane, including physical and chemical properties; environmental and health impacts; existing federal and state guidelines; detection and treatment methods; and additional sources of information. This fact sheet is intended for use by site managers who may address 1,4-dioxane at cleanup sites or in drinking water supplies and for those in a position to consider whether 1,4-dioxane should be added to the analytical suite for site investigations.

1,4-Dioxane is a likely human carcinogen and has been found in groundwater at sites throughout the United States. The physical and chemical properties and behavior of 1,4-dioxane create challenges for its characterization and treatment. It is highly mobile and has not been shown to readily biodegrade in the environment.

What is 1,4-dioxane?

- 1,4-Dioxane is a synthetic industrial chemical that is completely miscible in water (EPA 2006).
- Synonyms include dioxane, dioxan, p-dioxane, diethylene dioxide, diethylene oxide, diethylene ether and glycol ethylene ether (EPA 2006; Mohr 2001).
- 1,4-Dioxane is unstable at elevated temperatures and pressures and may form explosive mixtures with prolonged exposure to light or air (DHHS 2011; HSDB 2011).
- 1,4-Dioxane is a likely contaminant at many sites contaminated with certain chlorinated solvents (particularly 1,1,1-trichloroethane [TCA]) because of its widespread use as a stabilizer for chlorinated solvents (EPA 2013a; Mohr 2001)
- It is used as: a stabilizer for chlorinated solvents such as TCA; a solvent for impregnating cellulose acetate membrane filters; a wetting and dispersing agent in textile processes; and a laboratory cryoscopic solvent for molecular mass determinations (ATSDR 2012; DHHS 2011; EPA 2006).
- It is used in many products, including paint strippers, dyes, greases, varnishes and waxes. 1,4-Dioxane is also found as an impurity in antifreeze and aircraft deicing fluids and in some consumer products (deodorants, shampoos and cosmetics) (ATSDR 2012; EPA 2006; Mohr 2001).

What is 1,4-dioxane? (continued)

- 1,4-Dioxane is used as a purifying agent in the manufacture of pharmaceuticals and is a by-product in the manufacture of polyethylene terephthalate (PET) plastic (Mohr 2001).
- Traces of 1,4-dioxane may be present in some food supplements, food containing residues from packaging adhesives or on food crops treated with pesticides that contain 1,4-dioxane as a solvent or inert ingredient (ATSDR 2012; DHHS 2011).

Exhibit 1: Physical and Chemical Properties of 1,4-Dioxane
(ATSDR 2012; Howard 1990; HSDB 2011)

Property	Value
Chemical Abstracts Service (CAS) Number	123-91-1
Physical Description (physical state at room temperature)	Clear, flammable liquid with a faint, pleasant odor
Molecular weight (g/mol)	88.11
Water solubility	Miscible
Melting point (^{o}C)	11.8
Boiling point (^{o}C) at 760 mm Hg	101.1 ^{o}C
Vapor pressure at 25^{o}C (mm Hg)	38.1
Specific gravity	1.033
Octanol-water partition coefficient (log K_{ow})	-0.27
Organic carbon partition coefficient (log K_{oc})	1.23
Henry's law constant at 25 ^{o}C (atm-m^{3}/mol)	4.80 X 10^{-6}

Abbreviations: g/mol – grams per mole; ^{o}C – degrees Celsius; mm Hg – millimeters of mercury; atm-m^{3}/mol – atmosphere-cubic meters per mole.

What are the environmental impacts of 1,4-dioxane?

- 1,4-Dioxane is released into the environment during its production, the processing of other chemicals, its use and its generation as an impurity during the manufacture of some consumer products. It is typically found at some solvent release sites and PET manufacturing facilities (ATSDR 2012; Mohr 2001).
- It is short-lived in the atmosphere, with an estimated 1- to 3-day half-life as a result of its reaction with photochemically produced hydroxyl radicals (ATSDR 2012; DHHS 2011). Breakdown products include aldehydes and ketones (Graedel 1986).
- It may migrate rapidly in groundwater, ahead of other contaminants and does not volatilize rapidly from surface water bodies (DHHS 2011; EPA 2006).
- Migration to groundwater is weakly retarded by sorption of 1,4-dioxane to soil particles; it is expected to move rapidly from soil to groundwater (EPA 2006; ATSDR 2012).
- It is relatively resistant to biodegradation in water and soil and does not bioconcentrate in the food chain (ATSDR 2012; Mohr 2001).
- As of 2007, 1,4-dioxane had been identified at more than 31 sites on the EPA National Priorities List (NPL); it may be present (but samples were not analyzed for it) at many other sites (HazDat 2007).

What are the routes of exposure and the health effects of 1,4-dioxane?

- Potential exposure could occur during production and use of 1,4-dioxane as a stabilizer or solvent (DHHS 2011).
- Exposure may occur through inhalation of vapors, ingestion of contaminated food and water or dermal contact (ATSDR 2012; DHHS 2011).
- Inhalation is the most common route of human exposure, and workers at industrial sites are at greatest risk of repeated inhalation exposure (ATSDR 2012; DHHS 2011).

What are the routes of exposure and the health effects of 1,4-dioxane? (continued)

- 1,4-Dioxane is readily adsorbed through the lungs and gastrointestinal tract. Some 1,4-dioxane may also pass through the skin, but studies indicate that much of it will evaporate before it is absorbed. Distribution is rapid and uniform in the lung, liver, kidney, spleen, colon and skeletal muscle tissue (ATSDR 2012).
- Short-term exposure to high levels of 1,4-dioxane may result in nausea, drowsiness, headache, and irritation of the eyes, nose and throat (ATSDR 2012; EPA 2013b; NIOSH 2010).
- Chronic exposure may result in dermatitis, eczema, drying and cracking of skin and liver and kidney damage (ATSDR 2012; HSDB 2011).
- 1,4-Dioxane is weakly genotoxic and reproductive effects in humans are unknown; however, a developmental study on rats indicated that 1,4-dioxane may be slightly toxic to the developing fetus (ATSDR 2012; Giavini and others 1985).
- Animal studies showed increased incidences of nasal cavity, liver and gall bladder tumors after exposure to 1,4-dioxane (DHHS 2011; EPA IRIS 2013).
- EPA has classified 1,4-dioxane as “likely to be carcinogenic to humans” by all routes of exposure (EPA IRIS 2013).
- The U.S. Department of Health and Human Services states that 1,4-dioxane is reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity from studies in experimental animals (DHHS 2011).
- The American Conference of Governmental Industrial Hygienists (ACGIH) has classified 1,4-dioxane as a Group A3 carcinogen — confirmed animal carcinogen with unknown relevance to humans (ACGIH 2011).
- The National Institute for Occupational Safety and Health (NIOSH) considers 1,4-dioxane a potential occupational carcinogen (NIOSH 2010).

Are there any federal and state guidelines and health standards for 1,4-dioxane?

- Federal and State Standards and Guidelines:
  - EPA’s Integrated Risk Information System (IRIS) database includes a chronic oral reference dose (RfD) of 0.03 milligrams per kilogram per day (mg/kg/day) based on liver and kidney toxicity in animals and a chronic inhalation reference dose (RfC) of 0.03 milligrams per cubic meter (mg/m^3) based on atrophy and respiratory metaplasia inside the nasal cavity of animals (EPA IRIS 2013).
  - The Agency for Toxic Substances and Disease Registry (ATSDR) has established minimal risk levels (MRLs) for inhalation exposure to 1,4-dioxane : 2 parts per million (ppm) for acute-duration (14 days or less) inhalation exposure; 0.2 ppm for intermediate-duration (15 to 364 days) inhalation exposure; and 0.03 ppm for chronic-duration (365 days or more) inhalation exposure (ATSDR 2012).
  - Oral exposure MRLs have been identified as 5 mg/kg/day for acute-duration oral exposure; 0.5 mg/kg/day for intermediate-duration oral exposure; and 0.1 mg/kg/day for chronic-duration oral exposure (ATSDR 2012).
  - The cancer risk assessment for 1,4-dioxane is based on an oral slope factor of 0.1 mg/kg/day and the drinking water unit risk is 2.9×10^{-6} micrograms per liter (µg/L) (EPA IRIS 2013).
  - EPA risk assessments indicate that the drinking water concentration representing a 1×10^{-6} cancer risk level for 1,4-dioxane is 0.35 µg/L (EPA IRIS 2013).
  - 1,4-Dioxane may be regulated as hazardous waste when waste is generated through use as a solvent stabilizer (EPA 1996b).
  - No federal maximum contaminant level (MCL) for drinking water has been established; however, an MCL is not necessary to determine a cleanup level (EPA 2012).
  - 1,4-Dioxane was included on the third drinking water contaminant candidate list, which is a list of unregulated contaminants that are known to, or anticipated to, occur in public water systems and may require regulation under the Safe Drinking Water Act (EPA 2009).

Are there any federal and state guidelines and health standards for 1,4-dioxane? (continued)

- Federal and State Standards and Guidelines (continued):
  - The EPA has established drinking water health advisories for 1,4-dioxane, which are drinking water-specific risk level concentrations for cancer (10^{-4} cancer risk) and concentrations of drinking water contaminants at which noncancer adverse health effects are not anticipated to occur over specific exposure durations. The EPA established a 1-day health advisory of 4.0 milligrams per liter (mg/L) and a 10-day health advisory of 0.4 mg/L for 1,4-dioxane in drinking water for a 10-kilogram child. EPA also established a lifetime health advisory of 0.2 mg/L for 1,4-dioxane in drinking water (EPA 2012).
  - The EPA's drinking water equivalent level for 1,4-dioxane is 1 mg/L (EPA 2012).
  - EPA has calculated a screening level of 0.67 µg/L for 1,4-dioxane in tap water, based on a 1 in 10^{-6} lifetime excess cancer risk (EPA 2013c). [1, 2]
  - EPA has calculated a residential soil screening level (SSL) of 4.9 milligrams per kilogram (mg/kg) and an industrial SSL of 17 mg/kg. The soil-to-groundwater risk-based SSL is 1.4 x10^{-4} mg/kg (EPA 2013c).
  - EPA has also calculated a residential air screening level of 0.49 micrograms per cubic meter (µg/m^3) and an industrial air screening level of 2.5 µg/m^3 (EPA 2013c).
- Workplace Exposure Limits:
  - The Occupational Safety and Health Administration set a general industry permissible exposure limit of 360 mg/m^3 or 100 ppm based on a time-weighted average (TWA) over an 8-hour workday for airborne exposure to 1,4-dioxane (OSHA 2013).
  - The ACGIH set a threshold limit value of 72 mg/m^3 or 20 ppm based on a TWA over an 8-hour workday for airborne exposure to 1,4-dioxane (ACGIH 2011).
  - The NIOSH has set a ceiling recommended exposure limit of 3.6 mg/m^3 or 1 ppm based on a 30-minute airborne exposure to 1,4-dioxane (NIOSH 2010).
  - NIOSH also has established an immediately dangerous to life or health concentration of 500 ppm for 1,4-dioxane (NIOSH 2010).
- Other State and Federal Standards and Guidelines:
  - Various states have established drinking water and groundwater guidelines, including the following:
    - Colorado has established an interim groundwater quality cleanup standard of 0.35 µg/L (CDPHE 2012);
    - California has established a notification level of 1 µg/L for drinking water (CDPH 2011);
    - New Hampshire has established a reporting limit of 0.25 µg/L for all public water supplies (NH DES 2011); and
    - Massachusetts has established a drinking water guideline level of 0.3 µg/L (Mass DEP 2012).
  - The Food and Drug Administration set 10 mg/kg as the limit for 1-4-dioxane in glycerides and polyglycerides for use in products such as dietary supplements. FDA also surveys raw material and products contaminated with 1,4-dioxane (FDA 2006).
  - 1,4-Dioxane is listed as a hazardous air pollutant under the Clean Air Act (CAA) (CAA 1990).
  - A reportable quantity of 100 pounds has been established under the Comprehensive Environmental Response, Compensation, and Liability Act (EPA 2011).

[1] Screening Levels are developed using risk assessment guidance from the EPA Superfund program. These risk-based concentrations are derived from standardized equations combining exposure information assumptions with EPA toxicity data. These calculated screening levels are generic and not enforceable cleanup standards but provide a useful gauge of relative toxicity.

[2] Tap water screening levels differ from the IRIS drinking water concentrations because the tap water screening levels account for dermal, inhalation and ingestion exposure routes; age-adjust the intake rates for children and adults based on body weight; and time-adjust for exposure duration or days per year. The IRIS drinking water concentrations consider only the ingestion route, account only for adult-intake rates and do not time-adjust for exposure duration or days per year.

What detection and site characterization methods are available for 1,4-dioxane?

- As a result of the limitations in the analytical methods to detect 1,4-dioxane, it has been difficult to identify its occurrence in the environment. The miscibility of 1,4-dioxane in water causes poor purging efficiency and results in high detection limits (ATSDR 2012; EPA 2006).
- Conventional analytical methods can detect 1,4-dioxane only at concentrations 100 times greater than the concentrations of volatile organic compounds (EPA 2006; Mohr 2001).
- Modifications of existing analytical methods and their sample preparation procedures may be needed to achieve lower detection limits for 1,4-dioxane (EPA 2006; Mohr 2001).
- High-temperature sample preparation techniques improve the recovery of 1,4-dioxane. These techniques include purging at elevated temperature (EPA SW-846 Method 5030); equilibrium headspace analysis (EPA SW-846 Method 5021); vacuum distillation (EPA SW-846 Method 8261); and azeotrophic distillation (EPA SW-846 Method 5031) (EPA 2006).
- The presence of 1,4-dioxane may be expected at sites with extensive TCA contamination; therefore, some experts recommend that groundwater samples be analyzed for 1,4-dioxane where TCA is a known contaminant (Mohr 2001).
- NIOSH Method 1602 uses gas chromatography – flame ionization detection (GC-FID) to determine the concentration of 1,4-dioxane in air. The detection limit is 0.01 milligram per sample (ATSDR 2012; NIOSH 2010).
- EPA SW-846 Method 8015D uses gas chromatography (GC) to determine the concentration of 1,4-dioxane in environmental samples. Samples may be introduced into the GC column by a variety of techniques including the injection of the concentrate from azeotropic distillation (EPA SW-846 Method 5031). The detection limits for 1,4-dioxane in aqueous matrices by azeotropic microdistillation are 12 µg/L (reagent water), 15 µg/L (groundwater) and 16 µg/L (leachate) (EPA 2003).
- EPA SW-846 Method 8260B detects 1,4-dioxane in a variety of solid waste matrices using GC and mass spectrometry (MS). The detection limit depends on the instrument and choice of sample preparation method (ATSDR 2012; EPA 1996a).
- A laboratory study is underway to develop a passive flux meter (PFM) approach to enhance the capture of 1,4-dioxane in the PFM sorbent to improve accuracy. The selected PFM approach will be field tested at 1,4-dioxane contaminated sites. The anticipated projection completion date is 2014 (DoD SERDP 2013b).
- EPA Method 1624 uses isotopic dilution gas chromatography – mass spectrometry (GC-MS) to detect 1,4-dioxane in water, soil and municipal sludges. The detection limit for this method is 10 µg/L (ATSDR 2012; EPA 2001b).
- EPA SW-846 Method 8270 uses liquid-liquid extraction and isotope dilution by capillary column GC-MS. This method is often modified for the detection of low levels of 1,4-dioxane in water (EPA 2007, 2013a)
- GC-MS detection methods using solid phase extraction followed by desorption with an organic solvent have been developed to remove 1,4-dioxane from the aqueous phase. Detection limits as low as 0.024 µg/L have been achieved by passing the aqueous sample through an activated carbon column, following by elution with acetone-dichlormethane (ATSDR 2012; Kadokami and others 1990).
- EPA Method 522 uses solid phase extraction and GC/MS with selected ion monitoring for the detection of 1,4-dioxane in drinking water with detection limits ranging from 0.02 to 0.026 µg/L (EPA 2008).

What technologies are being used to treat 1,4-dioxane?

- Pump-and-treat remediation can treat dissolved 1,4-dioxane in groundwater and control groundwater plume migration, but requires ex situ treatment tailored for the unique properties of 1,4-dioxane (such as, a low octanol-water partition coefficient that makes 1,4-dioxane hydrophilic) (EPA 2006; Kiker and others 2010).
- Commercially available advanced oxidation processes using hydrogen peroxide with ultraviolet light or ozone is used to treat 1,4-dioxane in wastewater (Asano and others 2012; EPA 2006).
- A study is under way to investigate facilitated-transport enabled in situ chemical oxidation to treat 1,4-dioxane-contamined source zones and groundwater plumes effectively. The technical approach consists of the co-injection of strong oxidants (such as ozone) with chemical agents that facilitate the transport of the oxidant (DoD SERDP 2013d).

What technologies are being used to treat 1,4-dioxane? (continued)

- Ex situ bioremediation using a fixed-film, moving-bed biological treatment system is also used to treat 1,4-dioxane in groundwater (EPA 2006).
- Phytoremediation is being explored as a means to remove the compound from shallow groundwater. Pilot-scale studies have demonstrated the ability of hybrid poplars to take up and effectively degrade or deactivate 1,4-dioxane (EPA 2001a, 2013a; Ferro and others 2013).
- Microbial degradation in engineered bioreactors has been documented under enhanced conditions or where selected strains of bacteria capable of degrading 1,4-dioxane are cultured, but the impact of the presence of chlorinated solvent co-contaminants on biodegradation of 1,4-dioxane needs to be further investigated (EPA 2006, 2013a; Mahendra and others 2013).
- Results from a 2012 laboratory study found 1,4-dioxane-transforming activity to be relatively common among monooxygenase-expressing bacteria; however, both TCA and 1,1-dichloroethene inhibited 1,4-dioxane degradation by bacterial isolates (DoD SERDP 2012).
- Several Department of Defense Strategic Environmental Research and Development Program (DoD SERDP) projects are under way to investigate 1,4-dioxane biodegradation in the presence of chlorinated solvents or metals. Laboratory studies will (1) identify microbial cultures as well as biogeochemistry, which generate desirable enzymatic activity for 1,4-dioxane biodegradation; (2) assess biodegradation by methane oxidizing bacteria in coupled anaerobic-aerobic zones; (3) and evaluate branched hydrocarbons as stimulants for the in situ cometabolic biodegradation of 1,4-dioxane and its associated co-contaminants (DoD SERDP 2013c, e and f).
- Photocatalysis has been shown to remove 1,4-dioxane in aqueous solutions. Laboratory studies documented that the surface plasmon resonance of gold nanoparticles on titanium dioxide (Au – TiO_2) promotes the photocatalytic degradation of 1,4-dioxane (Min and others 2009; Vescovi and others 2010).
- Other in-well combined treatment technologies being assessed include air sparging; soil vapor extraction (SVE); and dynamic subsurface groundwater circulation (Odah and others 2005).
- SVE is known to remove some 1,4-dioxane, but substantial residual contamination is usually left behind because of 1,4-dioxane's high solubility, which leads to preferential partitioning into pore water rather than vapor. The DoD SERDP is conducting a project to evaluate and demonstrate the efficacy of enhanced or extreme SVE, which uses a combination of increased air flow, sweeping with drier air, increased temperature, decreased infiltration and more focused vapor extraction to enhance 1,4-dioxane remediation in soils (DoD SERDP 2013a).

Where can I find more information about 1,4-dioxane?

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- California Department of Public Health (CDPH). 2011. "1,4-Dioxane." Drinking Water Systems. www.cdph.ca.gov/certlic/drinkingwater/Pages/1,4-dioxane.aspx
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Where can I find more information about 1,4-dioxane? (continued)

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- Kiker, J.H., Connolly, J.B., Murray, W.A., Pearson, S.C.; Reed, S.E., and R.J. Robert. 2010. "Ex-Situ Wellhead Treatment of 1,4-Dioxane Using Fenton's Reagent." Proceedings of the Annual International Conference on Soils, Sediments, Water and Energy. Volume 15, Article 18.
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Where can I find more information about 1,4-dioxane? (continued)

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Additional information on 1,4-dioxane can be found at www.cluin.org/contaminantfocus/default.focus/sec/1,4-Dioxane/cat/Overview

Contact Information

If you have any questions or comments on this fact sheet, please contact: Mary Cooke, FFRRO, by phone at (703) 603-8712 or by email at cooke.maryt@epa.gov.

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
MICHAEL SCOTT
Director

NORTH CAROLINA
Environmental Quality

March 13, 2023

MEMORANDUM

To: Solid Waste Directors and Landfill Owners/Operators
From: Ed Mussler, Section Chief
NC Division of Waste Management, Solid Waste Section
Re: PFAS Monitoring Requirements for Solid Waste Sanitary Landfills

Background

Per-and polyfluoroalkyl substances (PFAS) are a group of manufactured compounds used in a variety of industries, such as aerospace, automotive, textiles, and electronics, and are widely used in commercial and consumer products such as food packaging, water- and stain-repellent fabrics, nonstick products, and firefighting foams. Many of these products and by-products are commonly disposed in solid waste landfills. PFAS, including perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), are a concern because they:

- do not break down in the environment,
- can move through soils and contaminate drinking water sources,
- build up (bioaccumulate) in fish and wildlife, and
- have been linked to adverse health effects in humans and animals.

PFAS Sampling

The Solid Waste Section (Section) is requiring that all groundwater, surface water, and leachate samples collected at solid waste sanitary landfills **after July 1, 2023** be analyzed for p**er- and polyfluorinated substances (PFAS)**, in accordance with the requirements and procedures for groundwater and surface water monitoring established under 15A NCAC 13B Rules .0601, .0602, .0544, .0545, .1623, and .1630 through .1637, 15A NCAC 02L, and the provisions of G.S. 143-215.1(a). This includes any active, inactive, or closed sanitary landfill currently conducting and reporting water quality and/or leachate sampling results to the Section.

The Section has determined that all sanitary landfills analyze groundwater, surface water, and leachate samples for PFAS to ensure protection of human health and the environment due to the potential health hazards associated with PFAS. This requirement is in conjunction with the NC DEQ's Action Strategy for PFAS to manage the risks of PFAS in the State. Landfills are one of several priority areas in the plan and sampling will help to identify possible PFAS associated with the regulated management of solid waste and to evaluate the presence of PFAS in the environment from these managed activities. Collection and evaluation of this information will also assist the Department in developing sound policies with respect to PFAS in the environment.

Sampling Frequency and Laboratory Analytical Methods for PFAS

Collection of samples for PFAS analysis should be conducted for all monitoring locations (groundwater, surface water, underdrain, and leachate) and during the landfill facility's regular compliance monitoring schedule as required by the facility permit and/or most current approved water quality monitoring plan.

The Section is requiring groundwater, surface water, and leachate samples to be analyzed using EPA (Draft) Method 1633 for the full list of PFAS compounds for the method. Please note that specific considerations and protocols are required to avoid cross-contamination and minimize sample bias for PFAS.

A current listing of laboratories accredited to perform EPA Draft Method 1633 can be found here: https://www.denix.osd.mil/edqw/accreditation/accreditedlabs/index.html. To view the labs, search for 'Draft EPA Method 1633' under Methods. Please note that different labs are accredited for different matrices.

NOTES - Sampling and Analytical:

- *The analytical methods should be the most recent versions of the analytical method(s) stated above. Sampling must be planned so that required holding times for analytical methods are met.*
- *EPA Draft Method 1633 is currently single-lab validated and is expected to soon become multi-lab validated. The method will undergo QC with a current expected time to be Final in 2023 or 2024.*
- *The Section considers "J" flag values valid and relevant in the decision-making process and hence all "J" flag values should be reported.*
- *Online technical resources on PFAS sampling protocols, fact sheets, analytical methods, and other issues, can be found here: Interstate Technology and Regulatory Council (ITRC) PFAS Website*

Reporting

PFAS analytical results must be reported as part of the regularly submitted monitoring report along with the laboratory data report (electronic format pdf copy). Laboratory data must be submitted in accordance with the most current DEQ electronic data deliverable format (EQUIS).

If you have any questions, please contact Perry Sugg, Environmental Compliance Branch Head, at (919) 707-8258 or via email at perry.sugg@ncdenr.gov.
Thank you for your cooperation in this matter.

ROY COOPER
Governor
ELIZABETH S. BISER
Secretary
MICHAEL SCOTT
Director

NORTH CAROLINA
Environmental Quality

July 17, 2023

MEMORANDUM

To: Solid Waste Directors and Landfill Owners/Operators

From: Ed Mussler, Section Chief
NC Division of Waste Management, Solid Waste Section

Re: Clarification of PFAS Monitoring Requirements for Solid Waste Sanitary Landfills

The Solid Waste Section (Section) has received feedback and questions concerning PFAS monitoring requirements for solid waste sanitary landfills per a March 13, 2023 memo sent to all solid waste facilities. Based on this feedback, the Section is providing the following clarifications on the requirements for the requested PFAS monitoring and to assist landfill facilities in the preparation and planning for this monitoring.

Sanitary Landfills

Sanitary landfills are defined in 15A NCAC 13B .0101 (49) and G.S. 130A-290(31) and include all municipal solid waste (MSW) landfills, construction & demolition (C&D) landfills, industrial landfills (including coal ash), and tire monofils.

Monitoring Frequency

PFAS samples should be collected from each specified monitoring location for two consecutive sample events based on the facility's current water quality monitoring schedule. The initial PFAS sampling should occur with the first regularly scheduled monitoring event after July 1, 2023. However, if site-specific constraints or approvals for site-specific modification requests require a delay in meeting this initially scheduled sample event, the Section will work with the facility on a schedule for the PFAS sampling.

As analytical results for these two PFAS monitoring events are reported, the data will be evaluated by the Section. The Section will work with the facilities on any additional monitoring requirements beyond this effort and decisions on further monitoring will be site-specific and depend on several factors including the results reported, the need for further confirmation or source determination, potential offsite receptors (for protection of human health & the environment), and/or regulatory developments such as new rules or Department policies.

Please notify the Section hydrogeologist assigned to your facility on any PFAS monitoring schedule delays. Section hydrogeologist facility assignments can be found on our webpage here:
SWS Hydrogeologist Facility Assignments

Sampling Methodology

As stated in the March 2023 memo, sampling protocol should follow your approved Water Quality Monitoring Plan (with special considerations for PFAS sampling) which should be in line with EPA Sampling Procedures & Protocols. An appropriate number of field QA/QC samples should be included based on site-specific considerations, the current water quality monitoring plan, as well as professional judgement. Resources on sampling precautions for PFAS and more can be found on ITRC's PFAS Webpage: https://pfas-1.itrcweb.org/. Additionally, several state and industry resources on PFAS sampling protocols are readily available on the web.

Many facilities utilize dedicated pumps and Teflon bailers for sample collection, however, there is no clear consensus on what degree use of this equipment is a contributing source for PFAS in sample results. At this time, the Section is not requiring any change to a facility's sample collection methods, and facilities should evaluate on their own whether to replace existing sample equipment at this time. Evaluation of the results will take in account sample method equipment used in factoring in potential sources if detected.

Analytical Method and Laboratories

The Section is requiring groundwater, surface water, underdrain, and leachate samples to be analyzed using EPA (Draft) Method 1633 for the full list of PFAS compounds for the method. This method can be used to test for 40 PFAS compounds in groundwater, surface water, and landfill leachate samples.

Multiple EPA programs have reviewed this draft method and DoD has begun a multi-laboratory validation study of the procedure, which is expected to be completed sometime this year. In the March 2023 memo, the Section also provided a link to a current listing of laboratories accredited by DoD to perform EPA Draft Method 1633. It is the Section's recommendation that facilities use one of the analytical laboratories included on this list for consistency in analytical method and in anticipation of a final method with QC derived from the multi-lab validation study.

Please note that the lab used does not have to be physically located in the State of North Carolina.

Monitoring Locations

As stated in the March memo, samples for PFAS should be collected from all current monitoring locations (groundwater, surface water, underdrain, and leachate) during the landfill facility's regular water quality monitoring schedule as required by the facility permit and/or most current approved water quality monitoring plan. This is in line with DEQ's comprehensive approach to evaluating the presence of PFAS in the environment from managed solid waste landfill facilities.

Groundwater. Collect PFAS samples from each detection monitoring well as identified in the facility's water quality monitoring plan. The detection monitoring well network is designed for early detection of any contaminants from the landfill. Facilities currently under groundwater assessment or corrective action have additional assessment monitoring and corrective action monitoring wells. For these wells, the facility may propose to sample a representative subset of the assessment/CA wells for Section review and approval.

Surface Water. Facilities may propose to collect samples from a subset of the facility's current surface water sample locations. The proposed locations must include at least one upstream and one downstream surface water sample location.

Underdrains. Some facilities may have groundwater underdrain control systems. Collect samples from each underdrain outfall per the facility's water quality monitoring plan.

Leachate. For facilities with active leachate management systems, collect one representative leachate sample from each permitted landfill unit at the facility with a leachate collection system for that unit. If leachate treatment is conducted on-site (e.g., aeration, filtration), samples should be collected prior to any treatment.

Please contact the Section hydrogeologist assigned to your facility for review and approval of any proposed modifications on sample locations (as discussed above) prior to conducting any PFAS monitoring.

Reporting

The Section memo requests that facilities report PFAS results as part of the regularly scheduled monitoring report submittal. The Section recognizes that laboratory turnaround times for PFAS analytical results may be longer than standard lab turnaround times due to several factors. Every effort should be made to include the PFAS results with the routine monitoring report submittal schedule, however, if this is not possible, the PFAS results may be submitted as a separate report as soon as practical upon receiving the lab reports. Note that all laboratory data must be submitted in accordance with the most current DEQ electronic data deliverable format (EQUIS).

Please notify the Section hydrogeologist assigned to your facility on any PFAS reporting submittal delays that may arise.

If you have any questions on this matter, please contact the Section hydrogeologist for your facility or feel free to contact Perry Sugg, Environmental Compliance Branch Head, at (919) 707-8258 or perry.sugg@ncdenr.gov. Thank you for your cooperation.

APPENDIX B

SAMPLE FIELD FORM LOGS AND CHAIN OF CUSTODY

DATE:_____

LaBella
Powered by partnership.

GROUND WATER SAMPLING LOG

Project Name: _____ **Permit #:**_____

Project No. /Task No.: _____

Well ID: _____ **Sampler(s):**_____

Well Location: _____

Well Diameter: _____inches

Initial Depth to Water (DTW): _____feet

Depth to Bottom (DTB): _____feet

Water Column Thickness (WCT): _____feet [DTB-DTW]

Calculation for One Well Volume (WV):

For 2" Well: WCT X 0.163 = _____gallons

For 4" Well: WCT X 0.653 = _____gallons

For THREE Well Volumes: WV X 3 = _____gallons

Actual Amount Purged/Bailed: _____gallons

Purged with: _____

Sampled with: _____

Depth to Water before Sampling: _____feet

Gallons	Time	Temp (°C)	pH	Conductivity (µS/cm)	Turbidity (NTU)	Initials
Before Sampling						

Comments (weather conditions, odor, color, silt, etc.): _____

_____

Signature: _____ **Date:** _____

QA/QC Sign Off: _____ **Date:** _____

DATE:_____

LaBella
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SURFACE WATER MONITORING LOG

Project Name: _____ **Permit #:**_____

Project No. /Task No.: _____
Surface Point ID:_____**Sampler(s):**_____

Location:_____

Field Parameters:

Time of Sampling: _____

pH: _____

Temperature: _____**(°C)**

Conductivity: _____**(µS/cm)**

Turbidity: _____**(NTU)**

Comments/Sample Description (weather conditions, odor, color, silt, etc.):_____
_____
_____

Signature:_____ **Date:**_____

QA/QC Sign Off: _____ **Date:** _____

Pace Analytical®
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request Document

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

Page: of

2001776

Section A Required Client Information:	Section B Required Project Information:	Section C Invoice Information:
Company:	Report To:	Attention:
Address:	Copy To:	Company Name:
		Address:
Email To:	Purchase Order No.:	Pace Quote Reference:
Phone: Fax:	Project Name:	Pace Project Manager:
Requested Due Date/TAT:	Project Number:	Pace Profile #:

REGULATORY AGENCY

☐ NPDES ☐ GROUND WATER ☐ DRINKING WATER

☐ UST ☐ RCRA ☐ OTHER _____

Site Location STATE: _____

Requested Analysis Filtered (Y/N)

ITEM #	Section D Required Client Information — SAMPLE ID (A-Z, 0-9 / ,-) Sample IDs MUST BE UNIQUE	Matrix Codes: Drinking Water DW; Water WT; Waste Water WW; Product P; Soil/Solid SL; Oil OL; Wipe WP; Air AR; Tissue TS; Other OT	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED: COMPOSITE START DATE	COMPOSITE START TIME	COMPOSITE END/GRAB DATE	COMPOSITE END/GRAB TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Preservatives: Unpreserved	H_2SO_4	HNO_3	HCl	NaOH	$Na_2S_2O_3$	Methanol	Other	Analysis Test Y/N	Residual Chlorine (Y/N)	Pace Project No./ Lab I.D.
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS

ORIGINAL

SAMPLER NAME AND SIGNATURE

PRINT Name of SAMPLER:

SIGNATURE of SAMPLER: DATE Signed (MM/DD/YY):

Temp in °C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.

APPENDIX C

APPENDIX I CONSTITUENTS AND GROUNDWATER STANDARDS

NC Appendix I and Appnedix II Groundwater Constituents

NC App. I & II - Total Metals

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L GROUNDWATER STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. I	Antimony	5	3.87	1	
App. I	Arsenic	10	5	10	(RCRA METAL)
App. I	Barium	5	2.5	700	(RCRA METAL)
App. I	Beryllium	1	0.5	4	
App. I	Cadmium	1	0.5	2	(RCRA METAL)
App. I	Chromium	5	2.5	10	(RCRA METAL)
App. I	Cobalt	5	2.5	1	
App. I	Copper	5	2.5	1,000	EPA MCL is a secondary standard.
App. I	Lead	5	2.5	15	EPA MCL is an action level. (RCRA METAL)
App. I	Nickel	5	2.5	100	
App. I	Selenium	10	5	20	(RCRA METAL)
App. I	Silver	5	2.5	20	EPA MCL is a secondary standard. (RCRA METAL).
App. I	Thallium	10	5	2	
App. I	Vanadium	5	2.5	7	
App. I	Zinc	10	5	1,000	EPA MCL is a secondary standard. *(AL)* = NC2B Action Level
App. II	Mercury	0.2	0.1	1	(RCRA METAL)
App. II	Tin	5	2.5	2,000	

NC App. II - Cyanide/ Sulfide

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Cyanide	0.008	0.004	-	
App. II	Sulfide	0.1	0.1	-	

NC - Additional Constituents for C&D Landfills

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
C&D	Alkalinity			-	
C&D	Chloride			250,000	
C&D	Iron			300	
C&D	Manganese			50	
C&D	Mercury			1	(RCRA Metal)
C&D	Sulfate			250,000	
C&D	Total Dissolved Solids (TDS)			500,000	
C&D	Tetrahydrofuran (THF)			-	Per NCDEQ Memo dated June 25, 2010.
C&D	pH			-	
C&D	Temperature			-	
C&D	Specific Conductance			-	

NC App. I & II - Method 8260

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. I	Acetone	25	10	6,000	
App. I	Acrylonitrile	10	1.88	-	
App. I	Benzene	1	0.25	1	
App. I	Bromochloromethane	1	0.17	-	
App. I	Bromodichloromethane	1	0.18	0.6	*MCL for total trihalomethanes
App. I	Bromoform	1	0.26	4	*MCL for total trihalomethanes
App. I	Carbon disulfide	2	1.15	700	
App. I	Carbon tetrachloride	1	0.25	0.3	
App. I	Chlorobenzene	1	0.23	50	
App. I	Chloroethane	1	0.54	3,000	
App. I	Chloroform	1	0.14	70	*MCL for total trihalomethanes
App. I	Dibromochloromethane	1	0.21	0.4	*MCL for total trihalomethanes
App. I	1,2-Dibromo-3-chloropropane (DBCP)	2	2	0.04	
App. I	1,2-Dibromoethane (EDB)	1	0.27	0.02	
App. I	o-Dichlorobenzene / 1,2-Dichlorobenzene	1	0.3	20	
App. I	p-Dichlorobenzene / 1,4-Dichlorobenzene	1	0.33	6	
App. I	trans-1,4-Dichloro-2-butene	1	1	-	
App. I	1,1-Dichloroethane	1	0.32	6	
App. I	1,2-Dichloroethane	1	0.24	0.4	
App. I	1,1-Dichloroethylene	1	0.56	350	Changed from 7 (MCL) to 350 µg/L in April 2013 (for public water supplies or drinking wells, the MCL = 7 µg/L still applies.)
App. I	cis-1,2-Dichloroethylene	1	0.19	70	
App. I	trans-1,2-Dichloroethylene	1	0.49	100	
App. I	1,2-Dichloropropane	1	0.27	0.6	
App. I	cis-1,3-Dichloropropene	1	0.13	0.4	
App. I	trans-1,3-Dichloropropene	1	0.26	0.4	
App. I	Ethylbenzene	1	0.3	600	
App. I	2-Hexanone / Methyl butyl ketone (MBK)	5	0.46	40	
App. I	Methyl bromide / Bromomethane	2	0.29	10	
App. I	Methyl chloride / Chloromethane	1	0.11	3	
App. I	Methylene bromide / Dibromomethane	1	0.21	-	
App. I	Methylene chloride / Dichloromethane	1	0.97	5	
App. I	Methyl ethyl ketone / 2-Butanone (MEK)	5	0.96	4,000	
App. I	Methyl iodide / Iodomethane	5	0.32	-	
App. I	4-Methyl-2-pentanone / Methyl isobutyl ketone	5	0.33	100	
App. I	Styrene	1	0.26	70	
App. I	1,1,1,2-Tetrachloroethane	1	0.33	1	
App. I	1,1,2,2-Tetrachloroethane	1	0.4	0.2	
App. I	Tetrachloroethylene (PCE)	1	0.46	0.7	
App. I	Toluene	1	0.26	600	

NC Appendix I and Appnedix II Groundwater Constituents

App. I	1,1,1-Trichloroethane	1	0.48	200	
App. I	1,1,2-Trichloroethane	1	0.29	0.6	
App. I	Trichloroethylene	1	0.47	3	
App. I	Trichlorofluoromethane (CFC-11)	1	0.2	2,000	
App. I	1,2,3-Trichloropropane	1	0.41	0.005	
App. I	Vinyl acetate	2	0.35	-	
App. I	Vinyl chloride	1	0.62	0.03	
App. I	Xylenes (total)	1	0.66	500	Includes o-xylene, p-xylene, and unspecified xylenes [dimethyl benzenes (CAS RN 1330-20-7].
*	1,4-Dioxane			3	Method 8260MOD

NC App. II - Method 8260

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Acetonitrile (methyl cyanide)	50	2.21	-	
App. II	Acrolein	10	1.59	-	
App. II	Allyl chloride (3-chloroprene)	2	1.54	-	
App. II	Chloroprene	5	0.27	-	
App. II	m-Dichlorobenzene / 1,3-Dichlorobenzene	1	0.24	200	
App. II	Dichlorodifluoromethane	1	0.21	1,000	
App. II	1,3-Dichloropropane	1	0.28	-	
App. II	2,2-Dichloropropane	1	0.13	-	
App. II	1,1-Dichloropropene	1	0.49	-	
App. II	Isobutyl alcohol / Isobutanol	100	35	-	
App. II	Methacrylonitrile	10	0.93	-	
App. II	Methyl methacrylate	1	1.96	-	
App. II	Propionitrile	20	3.65	-	
App. II	1,2,4-Trichlorobenzene	1	0.35	70	
App. II	Naphthalene	1	0.24	6	
App. II	Hexachlorobutadiene	1	0.71	0.4	
App. II	Ethyl methacrylate	1	0.2	-	

NC App. II - Method 8270

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Acenaphthene	10	1.6	80	
App. II	Acenaphthylene	10	1.48	200	
App. II	Acetophenone	10	1.93	-	
App. II	2-Acetylaminofluorene	20	1.64	-	
App. II	4-Aminobiphenyl	10	1.69	-	
App. II	Anthracene	10	1.71	2,000	
App. II	Benzo[a]anthracene; Benzanthracene	10	2.11	0.05	
App. II	Benzo[b]fluoranthene	10	2.19	0.05	
App. II	Benzo[k]fluoranthene	10	1.99	0.5	
App. II	Benzo[g,h,i]perylene	10	2.08	200	
App. II	Benzo[a]pyrene	10	2.21	0.005	
App. II	Benzyl alcohol	20	3.08	-	
App. II	Bis(2-chloroethoxy)methane	10	1.62	-	
App. II	Bis(2-chloroethyl)ether	10	1.71	-	
App. II	Bis(2-chloro-1-methylethyl)ether	10	1.62	-	Bis (2-chloroisopropyl) ether
App. II	Bis(2-ethylhexyl)phthalate	6	2.3	3	
App. II	4-Bromophenyl phenyl ether	10	1.49	-	
App. II	Butyl benzyl phthalate	10	2.49	1,000	
App. II	p-Chloroaniline (4-Chloroaniline)	20	2.81	-	
App. II	Chlorobenzilate	10	2.22	-	
App. II	p-Chloro-m-cresol (4-chloro-3-methylphenol)	20	2.84	-	
App. II	2-Chloronaphthalene	10	1.63	-	
App. II	2-Chlorophenol	10	1.51	0.4	
App. II	4-Chlorophenyl phenyl ether	10	1.55	-	
App. II	Chrysene	10	2.09	5	
App. II	m-Cresol (3-Methylphenol)	10	1.43	400	PQL & MDL for m&p Cresol (combined)
App. II	o-Cresol	10	1.61	-	
App. II	p-Cresol (4-Methylphenol)	10	1.43	40	PQL & MDL for m&p Cresol (combined)
App. II	Diallate	10	1.61	-	
App. II	Dibenz[a,h]anthracene	10	2.03	0.005	
App. II	Dibenzofuran	10	1.68	-	
App. II	Di-n-butyl phthalate	10	1.98	700	
App. II	3,3'-Dichlorobenzidine	20	3.86	-	
App. II	2,4-Dichlorophenol	50	5.08	-	
App. II	2,6-Dichlorophenol	10	1.53	-	
App. II	Diethyl phthalate	10	2	6,000	
App. II	0,0-Diethyl 0-2-pyrazinyl phosphorothioate	20	1.68	-	Thionazine / Thionazin
App. II	Dimethoate	10	1.84	-	
App. II	p-(Dimethylamino)azobenzene	5	1.03	-	
App. II	7,12-Dimethylbenz[a]anthracene	10	2.38	-	
App. II	3,3'-Dimethylbenzidine	20	3.86	-	
App. II	2,4-Dimethylphenol (M-xylenol)	10	1.61	100	
App. II	Dimethyl phthalate	10	1.41	-	
App. II	m-Dinitrobenzene / 1,3-Dinitrobenzene	20	1.26	-	
App. II	4,6-Dinitro-o-cresol (2-methyl 4,6-dinitrolphenol)	20	2.25	-	4,6-Dinitro-2-methylphenol
App. II	2,4-Dinitrophenol	50	5.08	-	
App. II	2,4-Dinitrotoluene	10	1.53	-	
App. II	2,6-Dinitrotoluene	10	1.38	-	
App. II	Di-n-octyl phthalate	10	1.49	100	
App. II	Diphenylamine	10	1.45	-	
App. II	Disulfoton	10	1.52	0.3	
App. II	Ethyl methanesulfonate	20	1.57	-	
App. II	Famphur	10	5.66	-	

NC Appendix I and Appnedix II Groundwater Constituents

App. II	Fluoranthene	10	2.22	300	
App. II	Fluorene	10	1.56	300	

NC App. II - Method 8270

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Hexachlorobenzene	10	1.66	0.02	
App. II	Hexachlorocylopentadiene	10	1.34	-	
App. II	Hexachloroethane	10	1.84	-	
App. II	Hexachloropropene	10	1.17	-	
App. II	Indeno[1,2,3-cd]pyrene	10	2.05	0.05	
App. II	Isodrin	20	2.5	-	
App. II	Isophorone	10	1.5	40	
App. II	Isosafrole	10	1.48	-	
App. II	Kepone	10	4.47	-	
App. II	Methapyrilene	50	3.03	-	
App. II	3-Methylcholanthrene	10	2.68	-	
App. II	Methyl methanesulfonate	5	1.09	-	
App. II	2-Methylnaphthalene	10	1.42	30	
App. II	Methyl parathion	10	1.6	-	
App. II	1,4-Naphthoquinone	5	0.99	-	
App. II	1-Naphthylamine	5	1.32	-	
App. II	2-Naphthylamine	5	2.18	-	
App. II	o-Nitroaniline (2-Nitroaniline)	50	2.26	-	
App. II	m-Nitroaniline (3-Nitroaniline)	50	2.66	-	
App. II	p-Nitroaniline (4-Nitroaniline)	20	3.37	-	
App. II	Nitrobenzene	10	1.61	-	
App. II	5-Nitro-o-toluidine	10	1.89	-	
App. II	o-Nitrophenol (2-Nitrophenol)	10	1.65	-	
App. II	p-Nitrophenol (4-Nitrophenol)	50	4.26	-	
App. II	N-Nitrosodiethylamine	20	1.35	-	
App. II	N-Nitrosodimethylamine	10	1.59	0.0007	
App. II	N-Nitrosodi-n-butylamine	10	1.57	-	
App. II	N-Nitrosodiphenylamine	10	1.71	-	
App. II	N-Nitrosodipropylamine	10	1.45	-	
App. II	N-Nitrosomethylethylamine	10	1.37	-	
App. II	N-Nitrosopiperidine	20	1.68	-	
App. II	N-Nitrosopyrrolidine	10	1.67	-	
App. II	Parathion	10	1.54	-	
App. II	Pentachlorobenzene	10	1.46	-	
App. II	Pentachloronitrobenzene	20	1.66	-	
App. II	Phenacetin	20	1.91	-	
App. II	Phenanthrene	10	1.59	200	
App. II	Phenol	10	1.29	30	
App. II	p-Phenylenediamine	10	2.24	-	
App. II	Phorate	10	1.72	1	
App. II	Pronamide	10	1.98	-	
App. II	Pyrene	10	2.2	200	
App. II	Safrole	10	1.3	-	
App. II	1,2,4,5-Tetrachlorobenzene	10	1.3	-	
App. II	2,3,4,6-Tetrachlorophenol	10	2.92	200	
App. II	o-Toluidine	10	1.69	-	
App. II	2,4,5-Trichlorophenol	10	1.5	-	
App. II	2,4,6-Trichlorophenol	10	1.44	-	
App. II	0,0,0-Triethyl phosphorothioate	10	1.7	-	
App. II	1,3,5-Trinitrobenzene	10	1.18	-	
App. II	Hexachlorobutadiene	1	0.71	0.4	
App. II	Ethyl methacrylate	1	1.96	-	
App. II	Naphthalene	1	0.24	6	
App. II	Pentachlorophenol	25	3.52	0.3	

NC App. II - Pesticides Method 8081

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Aldrin	0.05	0.05	-	
App. II	alpha-BHC	0.05	0.05	-	
App. II	beta-BHC	0.05	0.05	-	
App. II	delta-BHC			-	
App. II	gamma-BHC (Lindane)	0.05	0.05	0.03	
App. II	Chlordane	0.2	0.2	0.1	This entry includes alpha-chlordane (CAS RN 5103-71-9), beta chlordane (CAS RN 5103-74-2), gamma-chlordane (CAS RN 566-34-7), and constituents of chlordane (CAS RN 57-74-9 and 12672-29-6).
App. II	4,4'-DDD	0.05	0.05	0.1	
App. II	4,4'-DDE	0.05	0.05	-	Listed as "DDE" in IMAC table
App. II	4-4'-DDT	0.05	0.05	0.1	
App. II	Dieldrin	0.05	0.05	0.002	
App. II	Endosulfan I	0.05	0.05	40	
App. II	Endosulfan II	0.05	0.05	42	
App. II	Endosulfan sulfate	0.05	0.05	-	
App. II	Endrin	0.05	0.05	2	
App. II	Endrin aldehyde	0.05	0.05	2	
App. II	Heptachlor	0.05	0.05	0.008	
App. II	Heptachlor epoxide	0.05	0.05	0.004	
App. II	Methoxychlor	0.15	0.15	40	
App. II	Toxaphene	0.2	0.2	0.03	Includes congener chemicals contained in technical toxaphene (CAS RN 8001-35-2) such as chlorinated camphene.

NC Appendix I and Appnedix II Groundwater Constituents

NC App. II - PCB's Method 8082

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	Polychlorinated Biphenyls (PCBs)	0.5	0.5	-	This category contains congener chemicals, including constituents of Aroclor 1016 (CAS RN 12674-11-2), Aroclor 1221 (CAS RN 11104-28-2), Aroclor 1232 (CAS RN 11141-16-5), Aroclor 1242 (CAS RN 53469-21-9), Aroclor 1248 (CAS RN 12672-29-6), Aroclor 1254 (CAS RN 11097-69-1)).

NC App. II - Herbicides 8151

NC App. #	ANALYTE	LAB. LIMITS (µg/l) (Typical)		NC 2L STANDARDS (µg/L)	NOTES
		PQL	MDL		
App. II	2,4-Dichlorophenoxyacetic acid (2,4-D)	0.9403	0.224	70	
App. II	Dinoseb (DNBP); 2-sec-Butyl-4,6-dinitrophenol	0.1889	0.057	-	
App. II	Silvex (2,4,5-TP)	0.1901	0.049	50	
App. II	2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)	0.1895	0.042	-	
App. II	Pentachlorophenol	0.0284	0.017	0.3	

Notes:

Color denotes NC App. I Constituents.

Color denotes remaining NC App. II Constituents.

Color denotes C&D Constituents.

Color denotes constituents that can be analyzed by more than one method.

* 1,4-Dioxane analysis is required for all landfills effective July 1, 2018, per the NCDEQ Solid Waste Section memorandum dated May 29, 2018.

" - " = not available/not applicable

Last update of NC2L was April 2022.

North Carolina Division of Water Resources
Surface Water Quality Standards, Criteria & In-Stream Target Values

Introduction

The tables in this workbook detail the various water body classifications, surface water quality standards, criteria, and in-stream target values that the State of North Carolina employs to protect the designated uses of its surface waters.

You will find five separate tables in the worksheet tabs below. These tables are:

1 - North Carolina Designated Uses for Surface Waters (Designated Uses - orange tab)
2 - North Carolina 15A NCAC 02B Water Quality Standards for Surface Waters (02B Standards - green tab)
3 - Environmental Protection Agency Nationally Recommended Water Quality Criteria (EPA-NRWQC - yellow tab)
4 - North Carolina In-Stream Target Surface Waters (In-Stream Target Values - blue tab)
5 - Supporting information such as footnotes, descriptions of acronyms, and references (Supporting Info - bright yellow tab)

1- Determine the designated use(s) for the water body of concern.

1.1 - Identify the classification associated with the water body of concern by referring to the NC Surface Water Classifications interactive map, river basin classification schedules, and any NC Title 15A rules associated with the water body of concern.

NC DWR Surface Water Classifications Map
River Basin Classification Schedules
15A NCAC 02B rules

1.2 - Identify all designated uses associated with the classification identified in step 1.1 by referring to the North Carolina Designated Uses for Surface Waters table (orange tab in this workbook):

North Carolina Designated Uses for Surface Waters

2 -Search the NC 02B Standards (green tab), EPA NRWQC (yellow tab), and NC In-Stream Target Values (blue tab) tables for the parameter(s) of concern.

2.1 - Search for chemicals by Chemical Abstracts Service (CAS) number. If you do not know the CAS number for the chemical of concern, a simple google search should provide it.
2.2 - Chemicals can be searched for by name, but be advised that all known synonyms are not included in these tables. Searching by chemical name may miss important information.
2.3 - Search for non-chemical parameters (pH, temperature, etc.) by name as they do not have CAS numbers.
2.4 - Search all tables for each chemical or non-chemical parameter as different water quality standards, EPA recommended criteria, or NC in-stream target values may apply for different designated uses.

3 - Read across the table to identify the available standards, criteria or in-stream target values once a parameter has been located.

3.1 - The most sensitive use must be protected. Refer to the designated uses table when deciding which standard, criteria, or in-stream target values to apply.

3.2 - North Carolina Standards are established in rule (15A NCAC 02B) and take precedence over EPA national criteria. EPA national criteria have undergone thorough scientific and national stakeholder evaluation, but have not been through the NC rule making process. EPA national criteria take precedence over NC in-stream target values. NC in-stream target values are determined based on available toxicological data for chemicals per language in Title 15A the North Carolin Administrative Code (15A NCAC 02B .0202 and .0208). Classifications & Standards staff should be contacted for guidance on the use of these values.

Click here for an example of this process

4 - The standards, criteria, and in-stream target values in these tables do not substitute for any written regulations, nor are they themselves regulations.

Contacts - We are here to help. Please contact us with any questions and comments.

Name	For questions concerning:	Email	Phone
Connie Brower	Standards, standards tables	connie.brower@ncdenr.gov	919-707-3686
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Elizabeth Kountis	Classifications, reclassifications	elizabeth.kountis@ncdenr.gov	919-707-3685
Adriene Weaver	Classifications, reclassifications	adriene.weaver@ncdenr.gov	919-707-3692
Bridget Flaherty	Groundwater standards	bridget.flaherty@ncdenr.gov	919-707-9022

Designated Uses for North Carolina Surface Water Classifications

Notes on Classifications & Designated Uses

1 - Refer to the NC Division of Water Resources Classifications webpage for information on how to determine water body classifications.

(http://deq.nc.gov/about/divisions/water-resources/planning/classification-standards/classifications)

2 - **Class C** (for freshwater) and **Class SC** (for saltwater) provide basic levels of protection for aquatic life, recreation and consumption of fish and apply to all freshwater and saltwater classifications, respectively. For example, a Class WS (Water Supply) water must meet all of the standards for Class C waters in addition to those standards specifically described in the Class WS description.

3 - The NC 02B Standards (green tab) and NC In-Stream Target Values (blue tab) tables show Designated Uses for the Class C, Class B, Class WS, Class SC, Class SB, and Class SA primary classifications as well as the Trout, Swamp, and HQW supplemental classifications. The EPA Nationally Recommended Water Quality Criteria (yellow tab) apply only to the aquatic life, fish consumption, and water supply Designated Uses. Designated Uses for the ORW, HQW, WL, UWL, and NSW classifications do not appear in these tables, however the Class C or SC uses must be maintained at a minimum. These classifications may have additional water quality requirements which can be determined by referencing the classification in rule. The 15A NCAC 02B rules can be found here:

15A NCAC 02B rules

Freshwater

Primary Classifications	Designated Uses that Apply	Associated Rules
Class C	Freshwater Aquatic Life, Secondary Recreation and Fish Consumption. **Apply to all freshwater classifications**.	15A NCAC 02B .0208 & .0211
Class B (Primary Recreation)	Primary Recreation and all Class C uses	15A NCAC 02B .0219 (Class B) and .0208 & .0211 (Class C)
Class WL (Wetlands)	Wetlands and all Class C uses	15A NCAC 02B .0230 & .0231 (Class WL) and .0208 & .0211 (Class C)
Class WS (Water Supply I-V)	Water Supply and all Class C uses	15A NCAC 02B .0212, .0214, .0215, .0216, & .0218 (Class WS) and .0208 & .0211 (Class C)
Supplemental Classifications	**Designated Uses that Apply**	**Associated Rules**
Class HQW (High Quality Waters)	High Quality Waters, any special considerations and permit requirements as described in rule, and all Class C uses.	15A NCAC 02B .0224 (Class HQW) and .0208 & .0211
Class NSW (Nutrient Sensitive waters)	Nutrient Sensitive Water, any considerations for specific NSW waters as described in rule, and all Class C uses.	15A NCAC 02B .0223 (Class NSW) and .0208 & .0211 (Class C)
Class ORW (Outstanding Resource Waters)	Outstanding Resource Waters uses as well as any specific actions assigned to individual ORWs as described in rule 15A NCAC 02B .0225, High Quality Waters, and all Class C uses. Rule 15A NCAC 02B .0225 has a list of waters classified as ORWs with specific actions.	15A NCAC 02B .0225 (Class ORW) and .0208 & .0211 (Class C)
Class Sw (Swamp)	Swamp and all Class C uses	15A NCAC 02B .0101 & .0202 (Swamp) and .0208 & .0211 (Class C)
Class Tr (Trout)	Trout, High Quality Water, and all Class C uses	15A NCAC 02B .0101 & .0202 (Trout) and .0208, & .0211 (Class C)
Class UWL (Unique Wetlands)	Unique Wetlands and all Class C uses	15A NCAC 02B .0101 & .0202 (UWL) and .0208, & .0211 (Class C)

Saltwater

Primary Classifications	Designated Uses that Apply	Associated Rules
Class SC	Saltwater Aquatic Life, Secondary Recreation and Fish Consumption. **Apply to all saltwater classifications**.	15A NCAC 02B .0208 & .0220
Class SA (Shellfish)	Shellfishing and all Class SC uses	15A NCAC 02B .0221 (Class SA) & .0208 & .0220 (Class SC)
Class SB (Primary Recreation)	Primary Recreation and all Class SC uses	15A NCAC 02B .0222 (Class SB) & .0208 & .0220 (Class SC)
Class SWL (Wetlands)	Wetlands and all Class SC uses	15A NCAC 02B .0230 & .0231 (Class WL) & .0208 & .0220 (Class SC)
Supplemental Classifications	**Designated Uses that Apply**	**Associated Rules**
Class HQW (High Quality Waters)	High Quality Waters, any special considerations and permit requirements as described in rule, and all Class SC uses.	15A NCAC 02B .0224 (Class HQW) & .0208 & .0220 (Class SC)
Class NSW (Nutrient Sensitive waters)	Nutrient Sensitive Water, any considerations for specific NSW waters as described in rule, and all Class SC uses.	15A NCAC 02B .0223 (Class NSW) and .0208 & .0220 (Class SC)
Class ORW (Outstanding Resource Waters)	Outstanding Resource Waters uses as well as any specific actions assigned to individual ORWs as described in rule 15A NCAC 02B .0225, High Quality Waters, and all Class SC uses. Rule 15A NCAC 02B .0225 has a list of waters classified as ORWs with specific actions.	15A NCAC 02B .0225 (Class ORW) & .0208 & .0220 (Class SC)
Class Sw (Swamp)	Swamp and all Class SC uses	15A NCAC 02B .0101 & .0202 (Swamp) and .0208 & .0220 (Class SC)
Class UWL (Unique Wetlands)	Unique Wetlands and all Class SC uses	15A NCAC 02B .0101 & .0202 (UWL) and .0208, & .0220 (Class SC)

North Carolina 15A NCAC 02B Water Quality Standards for Surface Waters

		Freshwater			Fresh & Salt	Saltwater			Supplemental Classifications					
		Class B	Class WS (I - V)	All waters (Class C)	All waters (Class C & SC)	All waters (Class SC)	Class SB	Class SA						
Pollutant or Parameter	**CAS #**	**Primary Recreation[8]**	**Water Supply[6]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Fish Consumption[3]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Primary Recreation[8]**	**Shellfish[9]**	**Trout[2]**	**Swamp Waters[5]**	**High Quality Waters[7]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Reference Source** (See supporting info tab)
		All values reported as ug/L unless labeled otherwise.												
Aldrin	309-00-2		0.00005	0.002	0.00005	0.003							Yes	EPA QCW 1986; EPA HHCCM 2002
Ammonia											2000 (E)	As Total Ammonia Nitrogen (TAN) Effluent Limit.	NA	NC
Arsenic[11]	7440-38-2		10 (t)	Acute: 340 (d) Chronic: 150 (d)	10 (t)	Acute: 69 (d) Chronic: 36 (d)						Dissolved metal for aquatic life, Total metal for HH & WS	Yes	EPA NRWQC (AL); EPA NPDWR 2006
Barium	7440-39-3		1000 (t)										No	IRIS & RAIS 11/08
Benzene	71-43-2		1.19		51								Yes	IRIS 2000
Beryllium[11]	7440-41-7			Acute: 65 (d) Chronic: 6.5 (d)								Dissolved metal for aquatic life	NA	NC calculation. Based on LC50 data from EPA AWQC 1980
Biological Oxygen Demand (BOD)											5000 (E)	Effluent Limit	NA	NC
Cadmium[11]	7440-43-9			Acute: Calc (d,h) Chronic: Calc (d,h)		Acute: 40 (d) Chronic: 8.8 (d)			Acute: Calc (d,h)			Click to calculate freshwater aquatic life standard	NA	EPA AWQC 2001 + GEI CED recalculation
Carbon Tetrachloride	56-23-5		0.254		1.6							Benzinoform, Carbon Chloride	Yes	EPA NRWQC(HH) 2002
Chlordane	57-74-9		0.0008	0.004	0.0008	0.004							Yes	EPA NRWQC(HH) 2002; EPA AWQC 1980
Chloride	16887-00-6		250000	230000									No	EPA NRWQC(AL); EPA NSDWR
Chlorine, Total Residual	7782-50-5			17					(N, Tr + HQW)			TRC. For trout, see entry for "Disinfection" in 15A NCAC 02B .0224	NA	EPA QCW 1986
Chlorinated Benzenes	NA		488 (total)									Total of all Chlorinated Benzenes	NA	EPA AWQC 1980
Chlorinated Phenols	NA		1.0 (N) aesthetic									Aesthetic standard. See 15A NCAC 02B .0211 and .0212	NA	EPA AWQC 1980 & EPA QCW 1976
Chlorophyll-a, Corrected	479-61-8			40 (N)		40 (N)			15 (N)			See 15A NCAC 02B .0211, .0220, and .0223	NA	NC
Chromium III[11]	16065-83-1			Acute: Calc (d,h) Chronic: Calc (d,h)								Click to calculate freshwater aquatic life standard	NA	EPA NRWQC-Correction 1999
Chromium VI[11]	18540-29-9			Acute: 16 (d) Chronic: 11 (d)		Acute: 1100 (d) Chronic: 50 (d)						Hexavalent Chromium; Dissolved metal for aquatic life	NA	EPA NRWQC-Correction 1999
Coliform Bacteria, Fecal	NA	≤ 200/100 mL		≤ 200/100 mL				≤ 14/100 mL and ≤ 43/100 mL				See 15A NCAC 02B .0211, .0219 & .0222 for additional requirements	NA	NC; EPA NRWQC 1986; FDA NSSP for SA waters
Copper[11]	7440-50-8			Acute: Calc (d,h) Chronic: Calc (d,h)		Acute: 4.8 (d) Chronic: 3.1 (d)						Click to calculate freshwater aquatic life standard	NA	EPA NRWQC-Correction 1999
Cyanide, Total	57-12-5			5		1							NA	EPA NRWQC 2009
2,4-D	94-75-7		70									2,4-Dichlorophenoxy Acetic Acid, Chlorophenoxy Herbicide	No	40 CFR 141.50
4,4'-DDT	50-29-3		0.0002	0.001	0.0002	0.001						Dichlorodiphenyltrichloroethane	Yes	EPA AWQC 1980 (AL); NRWQC 2002 (HHCCM)
Demeton	8065-48-3			0.1		0.1							NA	EPA QCW 1986
Dieldrin	60-57-1		0.00005	0.002	0.00005	0.002							Yes	EPA QCW 1986
Dioxin (2,3,7,8-TCDD)	1746-01-6		0.000005 ng/L		0.000005 ng/L							2,3,7,8-Tetrachlorodibenzo-p-dioxin	Yes	EPA NRWQC 2002 (HHCCM)
Dissolved Gases	NA			110% sat (N)		110% sat (N)						Measured as % saturation. See 15A NCAC 02B .0211 and .0220	NA	EPA QCW 1986
Dissolved Oxygen	NA			(N)		(N)			≥6.0 mg/L (N)	(N)	6 mg/L (E)	See 15A NCAC 02B .0211 and .0220 for additional requirements. Effluent Limit for HQW	NA	EPA QCW 1986, NC for HQW
Dissolved Solids	NA		500000									Total dissolved solids	NA	EPA QCW 1986
Endosulfan	115-29-7			0.05		0.009							NA	EPA AWQC 1980
Endrin	72-20-8			0.002		0.002							NA	EPA AWQC 1980
Enterococcus Bacteria	NA					≤ 35/100 mL	≤ 35/100 mL					See 15A NCAC 02B .0220 & .0222 for additional requirements	NA	BEACH Act 2000
Fluoride	16984-48-8			1800									NA	ECOTOX
Guthion	86-50-0			0.01		0.01							NA	EPA QCW 1986
Hardness	NA		100 mg/L									As CaCO3 or Ca & Mg	NA	EPA QCW 1963
Heptachlor	76-44-8		0.00008	0.004	0.00008	0.004							Yes	EPA NRWQC(HH) 2002; EPA AWQC 1980
Hexachlorobutadiene	87-68-3		0.44		18							HCBD	Yes	EPA NRWQC 2002 (HHCCM)
Lead[11]	7439-92-1			Acute: Calc (d,h) Chronic: Calc (d,h)		Acute: 210 (d) Chronic: 8.1 (d)						Click to calculate freshwater aquatic life standard	NA	EPA AWQC - Lead 1984; EPA NRWQC-Correction 1999
Lindane, g-BHC	58-89-9			0.01		0.004						Gamma-BHC, g-HCH	NA	EPA QCW 1976
Mercury	7439-97-6			0.012 (t)		0.025 (t)							NA	EPA QCW - Mercury 1986; Based on Final Residual Value (fish tissue)
Methoxychlor	72-43-5			0.03		0.03							NA	EPA QCW 1986
Methylene-blue Active Substances (MBAS)	61-73-4		500 (N) aesthetic									See 15A NCAC 02B .0212, .0214, .0215, .0216, and .0218	NA	EMC adopted for aesthetics in 2003
Mirex	2385-85-5			0.001		0.001							NA	EPA QCW 1986
Nickel[11]	744-02-0		25 (t)	Acute: Calc (d,h) Chronic: Calc (d,h)		Acute: 74 (d) Chronic: 8.2 (d)						Click to calculate freshwater aquatic life standard	No	EPA NRWQC-Correction 1999
Nitrate nitrogen	14797-55-8		10000										No	EPA QCW 1986
Non-point Source	NA		(N)									See 15A NCAC 02B .0212. Includes stormwater.	NA	NC
Nutrients											(N)	Nitrogen & Phosphorus. See 15A NCAC 02B .0223 & .0224.	NA	NC
Oil and Grease	NA			(N)		(N)						See 15A NCAC 02B .0211 and .0220.	NA	EPA QCW 1976

North Carolina 15A NCAC 02B Water Quality Standards for Surface Waters

		Freshwater			Fresh & Salt	Saltwater								
		Class B	Class WS (I - V)	All waters (Class C)	All waters (Class C & SC)	All waters (Class SC)	Class SB	Class SA	Supplemental Classifications					
Pollutant or Parameter	**CAS #**	**Primary Recreation[8]**	**Water Supply[6]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Fish Consumption[3]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Primary Recreation[8]**	**Shellfish[9]**	**Trout[2]**	**Swamp Waters[5]**	**High Quality Waters[7]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Reference Source** (See supporting info tab)
		All values reported as ug/L unless labeled otherwise.												
Parathion	56-38-2			0.013		0.178							NA	EPA AWQC 1986
PCB, Total	NA			0.001 (total)	0.000064 (total)	0.001 (total)						Total of all polychlorinated biphenyls (PCBs) and all congeners.	Yes	EPA QCW 1976; EPA NRWQC 2002 (HHCCM)
pH	NA			6.0-9.0 (N)		6.8-8.5 (N)				(N)		See 15A NCAC 02B .0211 and .0220 for addition requirements	NA	EPA QCW 1976
Phenolic Compounds	NA			300 (P) aesthetic		300 (P) aesthetic						Aesthetic narrative standard for taste & odor in fish tissue. Based on public policy document.	NA	EPA QCW 1976
Polynuclear Aromatic Hydrocarbons (PAH), Total	NA		0.0028 (total)		0.0311 (total)							Total of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene	Yes	EPA QCW 1986
Radioactive Substances	NA			(N)		(N)						See 15A NCAC 02B .0211 and .0220 for details	NA	40 CFR 141.26 (adopted by reference)
Salinity	NA					(N)						See 15A NCAC 02B.0220	NA	EPA QCW 1986
Selenium	7782-49-2			5 (t)		71 (t)							NA	EPA AWQC 1987
Sewage & other wastes	NA		(N)	(N)		(N)		(N)				See 15A NCAC 02B .0211, .0220 & .0221. Includes sewage, industrial wastes, non-process industrial waste, or other wastes	NA	
Silver[11]	7440-22-4			Acute: Calc (d,h) Chronic: 0.06 (d)		Acute: 1.9 (d) Chronic: 0.1 (d)						Click to calculate acute freshwater aquatic life standard	NA	EPA AWQC 1980
Silvex	93-72-1		10									2,4,5-TP, 2,4,5-Trichlorophenoxypropionoic Acid	No	EPA QCW 1986
Solids	NA			(N)		(N)		(N)				See 15A NCAC 02B .0211, .0220 & .0221. Includes floating, settleable & sludge solids.	NA	EPA QCW 1986
Sulfates	NA		250000										NA	NSDWR 2003
Suspended Solids	NA								10000 (E, Tr+ HQW)		20000 (E)	Total suspended solids Effluent Limit. See 15A NCAC 02B .0224	NA	EPA QCW 1986
Temperature	NA			(N)		(N)						NCAC 02B .0208, .0211, and .0220 for details	NA	EPA QCW 1986
1,1,2,2-Tetrachloroethane	79-34-5		0.17		4							Acetosol, Acetylene Tetrachloride	Yes	EPA NRWQC(HH) 2006
Tetrachloroethylene	127-18-4		0.7		3.3							PERC, PCE, Perchloroethylene	Yes	EPA NRWQC(HH) 2006
Toluene	108-88-3			11					0.36			Methyl Benzene, Phenyl Methane	NA	NC Dept. of Natural Resources and Community Development study 1986
Toxaphene	8001-35-2			0.0002		0.0002							NA	EPA AWQC 1986
Toxic Substances											(E)	Effluent Limit. See 15A NCAC 02B .0224 for additional requirements	NA	NC
Trialkyltin compounds	NA			0.07		0.007						Expressed as Tributyltin	NA	EPA NRWQC 2004
Trichloroethylene	79-01-6		2.5		30							TCE	Yes	EPA NRWQC(HH) 2002
Turbidity	NA			Streams ≤ 50 NTU, Lakes & Reservoirs ≤ 25 NTU (N)		≤ 25 NTU (N)			≤ 10 NTU (N)			See 15A NCAC 02B .0211 and .0220 for more details. NTU = Nephelometric Turbidity Units	NA	EPA QCW 1972
Vinyl Chloride	75-01-4		0.025		2.4							Chloroethylene	Yes	EPA NRWQC(HH) 2006
Zinc[11]	7440-66-6			Acute: Calc (d,h) Chronic: Calc (d,h)		Acute: 90 (d) Chronic: 81 (d)						Click to calculate freshwater aquatic life standard	NA	EPA NRWQC-Correction 1999

The values in these tables do not substitute for any written regulations, nor are they themselves regulations

Hardness-Dependent Metal Calculations

Metal	Equations for Hardness-Dependent Metals (ug/L)	Enter in-stream hardness (mg/L)	Calculated standard (ug/L)
Cadmium, acute	WER*[{1.136672-[*ln* hardness](0.041838)}*e^{0.9151[*ln* hardness]-3.1485}]	25	0.82
Cadmium, chronic	WER*[{1.101672-[ln hardness](0.041838)}*e^{0.7998[ln hardness]-4.4451}]	25	0.15
Cadmium, acute, trout waters	WER*[{1.136672-[*ln* hardness](0.041838)}*e^{0.9151[*ln* hardness]- 3.6236}]	25	0.51
Chromium III, acute	WER*[0.316*e^{0.8190[*ln* hardness]+3.7256}]	25	183.07
Chromium III, chronic	WER*[0.860*e^{0.8190[*ln* hardness]+0.6848}]	25	23.81
Copper, acute	WER*[0.960*e^{0.9422[*ln* hardness]-1.700}]	25	3.64
Copper, chronic	WER*[0.960*e^{0.8545[*ln* hardness]-1.702}]	25	2.74
Lead, acute	WER*[{1.46203-[*ln* hardness](0.145712)}*e^{1.273[*ln* hardness]-1.460}]	25	13.88
Lead, chronic	WER*[{1.46203-[*ln* hardness](0.145712)}*e^{1.273[*ln* hardness]-4.705}]	25	0.54
Nickel, acute	WER*[0.998*e^{0.8460[*ln* hardness]+2.255}]	25	144.92
Nickel, chronic	WER*[0.997*e^{0.8460[*ln* hardness]+0.0584}]	25	16.10
Silver, acute	WER*[0.85*e^{1.72[*ln* hardness]-6.59}]	25	0.30
Zinc, acute	WER*[0.978*e^{0.8473[*ln* hardness]+0.884}]	25	36.20
Zinc, chronic	WER*[0.986*e^{0.8473[*ln* hardness]+0.884}]	25	36.50

See the Supporting Info tab for information on all footnotes, notes, and abbreviations

North Carolina In-Stream Target Values for Surface Waters

Established per language in 15A NCAC 02B .0202 & .0208. Contact DWR staff for further information.

		Freshwater			Fresh & Salt	Saltwater			Supplemental Classifications					
		Class B	Class WS (I - V)	All waters (Class C)	All waters (Class C & SC)	All waters (Class SC)	Class SB	Class SA						
Pollutant or Parameter	**CAS #**	**Primary Recreation[8]**	**Water Supply[6]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Fish Consumption[3]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Primary Recreation[8]**	**Shellfish[9]**	**Trout[2]**	**Swamp Waters[5]**	**High Quality Waters[7]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Reference Source** (See supporting info tab)
		All values reported as ug/L unless labeled otherwise.												
Acenaphthene	83-32-9			60		20			29			1,2-Dihydro-acenaphthylene (non-carcinogen PAH)	NA	ECOTOX 1/07
Acetaldehyde	75-07-0			970		1400						Acetic Aldehyde, Ethanal	NA	ECOTOX 6/05
Acephate	30560-19-1		4	70	140	150000							Yes	ECOTOX & RAIS 2/07
Acetochlor	34256-82-1		510	23	1900								No	IRIS 1/07; HHWSSA 1989 & 1994
Acetone	67-64-1		3100	2000	1100000	300000						2-Propanone	No	IRIS & ECOTOX 1/07
Acetophenone	98-86-2		3500	8100	850000								No	IRIS & ECOTOX 8/07
Acrolein	107-02-8					1						2-Propenal	NA	ECOTOX 7/16
Acrylamide	79-06-1		0.008	2800	0.3	1500						2-Propenamide	Yes	IRIS & ECOTOX 10/07
Acrylonotrile	107-13-1			420		290						2-Propenenitrile; ACN; AN; Acrylonitrile; Cyanoethylene; Fumigrain; Vinyl Cyanide	NA	ECOTOX 2/07
Aluminum	7429-90-5		6500		8000								No	RAIS 1/09
Aluminum Sulfate	10043-01-3			12		2.2							NA	ECOTOX 2/07
2-Amino-4,6-Dinitrotoluene	35572-78-2		7	10	150							2A-DNT	No	ECOTOX 2/07 & RAIS 2/16
4-Amino-2,6-Dinitrotoluene	19406-51-0		7	350	150							4A-DNT	No	ECOTOX 2/07 & RAIS 2/16
Ammonium Sulfate	7783-20-2			1900		20							NA	ECOTOX 2/07
Anthracene	120-12-7			0.05								Non-carcinogen PAH	NA	ECOTOX 3/05
Antimony	7440-36-0			5300									NA	ECOTOX 6/12
Atrazine	1912-24-9		640		8200								No	OPPT 2003; RAIS 3/09
Barium	7440-39-3			21000	200000 (t)	25000							No	ECOTOX 9/15 & IRIS 11/08
Benefin	1861-40-1		340	12	350								No	IRIS & ECOTOX 1/07
Bentazon	25057-89-0		920	3000	7400	1000							No	IRIS & ECOTOX 10/10
Benz(a)anthracene	56-55-3			0.1								Also see the NC 02B Standards table for Total PAHs	NA	ECOTOX 7/16
Benzo(a)pyrene	50-32-8			0.05								Also see the NC 02B Standards table for Total PAHs	NA	ECOTOX 7/16
Benzoic Acid	65-85-0		140000	9000	5000000								No	ECOTOX 9/15 & RAIS 2/16
Benzyl Alcohol	100-51-6		3500	500	290000	750						Benzene Methanol	No	ECOTOX & RAIS 6/12
Benzyl Chloride	100-44-7		0.2		2							Alpha-chlorotoluene, Chloromethyl Benzene	Yes	ECOTOX & IRIS 6/12
1,1-Biphenyl	92-52-4		580	20	860	230						Diphenyl, Phenylbenzene, Bibenzene	No	IRIS & ECOTOX 7/09
Bis(2-Chloroethoxy)Methane	111-91-1		100	9200	6000							Dichloromethoxy Ethane	No	ECOTOX 9/15 & RAIS 1/07
Bis(2-Ethylhexyl)Phthalate	117-81-7			5		10						DEHP	NA	ECOTOX 9/15
Boron, total recoverable	multiple			Chronic = 7300 (t) Acute = 34000 (t)								Boron typically occurs in combined form in surface waters and shall be analyzed as total recoverable boron	NA	State of Illinois & State of Michigan studies 7/2021
p-Bromo-diphenyl Ether	101-55-3			2		0.4						4-Bromo-diphenyl Ether	NA	ECOTOX 6/12
2-Butanone	78-93-3		20000	26000	750000	20000						Methyl Ethyl Ketone, MEK	No	IRIS & ECOTOX 7/11
Butylate	2008-41-5		470	610	650							Sutan	No	IRIS, ECOTOX & RAIS 1/07
n-Butyl Benzene	104-51-8		420	3.9	550							1-Phenylbutane	No	ECOTOX 9/15 & RAIS 2/11
Butylbenzene Phthalate	85-68-7			19		5.1			8.2			Butylbenzyl Phthalate	NA	ECOTOX 1/07
C5-C8 Aliphatic	NA		600 (S)	125 (S)	900 (S)							Total Petroleum Hydrocarbon (TPH); n-Hexane as surrogate for aquatic life, water supply & human health. See "Supporting Info" tab for information on (S).	No	ECOTOX 1/10; MADEP toxicity studies 2004, Connecticut technical support document 2012
C9-C12 Aliphatic	NA		3000 (S)	180 (S)	10000 (S)	5000 (S)						Total Petroleum Hydrocarbon (TPH); Decane as surrogate for aquatic life, water supply & human health. See "Supporting Info" tab for information on (S).	No	MADEP toxicity studies 2004 & EPIWIN 7/03
C9-C18 Aliphatic	NA		3000 (S)	180 (S)	10000 (S)	5000 (S)						Total Petroleum Hydrocarbon (TPH); Decane as surrogate for aquatic life, water supply & human health. See "Supporting Info" tab for information on (S).	No	MADEP toxicity studies 2004 & EPIWIN 7/03
C9-C32 Aromatic	NA		830 (S)		4000 (S)							Total Petroleum Hydrocarbon (TPH); pyrene as surrogate. See "Supporting Info" tab for information on (S).	No	RAIS 2/07; surrogate from MADEP studies
C19-C36 Aliphatic	NA			210 (S)								Total Petroleum Hydrocarbon (TPH); Cyclododecane as surrogate. See "Supporting Info" tab for information on (S).	No	MADEP toxicity studies 2004 & EPIWIN 7/03
Carbaryl	63-25-2		3100	0.67	31000	0.35						Formerly Sevin 1-Naphtalenol, Methylcarbamate	No	ECOTOX & RAIS 1/07
Carbazole	86-74-8		0.7		1.2								Yes	IRIS, ECOTOX & RAIS 8/12
Carbofuran	1563-66-2			9.7		0.46							NA	ECOTOX 1/07
Carbon Disulfide	75-15-0		3000	100	20000	3300						Dithiocarbonic Anhydride	No	ECOTOX 9/15 & RAIS 6/12
Carbon Tetrachloride	56-23-5			560		2500						Benzinoform, Carbon Chloride	NA	ECOTOX 1/07
	108-90-7			140		500						Chlorinated Benzene, Phenyl Chloride	NA	ECOTOX 2/11
2-Chloronaphthalene	91-58-7			110									NA	ECOTOX 1/07

North Carolina In-Stream Target Values for Surface Waters

Established per language in 15A NCAC 02B .0202 & .0208. Contact DWR staff for further information.

		Freshwater			Fresh & Salt	Saltwater							
		Class B	Class WS (I - V)	All waters (Class C)	All waters (Class C & SC)	All waters (Class SC)	Class SB	Class SA	Supplemental Classifications				
Pollutant or Parameter	**CAS #**	**Primary Recreation[8]**	**Water Supply[6]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Fish Consumption[3]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Primary Recreation[8]**	**Shellfish[9]**	**Trout[2]**	**Swamp Waters[5]**	**High Quality Waters[7]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Reference Source** (See supporting info tab)
		All values reported as ug/L unless labeled otherwise.												
Chlorothalonil	1897-45-6		7	1.3	20	1.6			0.8				Yes	IRIS & ECOTOX 10/10
Chrysene	218-01-9					10						Also see the NC 02B Standards table for Total PAHs	NA	ECOTOX 7/16
Cobalt	7440-48-4		3	Acute: 16 Chronic: 1.6	4							Fish consumption and water supply values based on pRfD (PPRTV)	No	ECOTOX 01/18 & PPRTV 6/09
Cyclohexane	110-82-7			230		12							NA	ECOTOX 1/07
2,4-D	94-75-7			60									No	IRIS & ECOTOX 1/07
Dacthal	1861-32-1		79		100								No	IRIS 7/07
2,4-DB	94-82-6		270		10000								No	IRIS 8/07
4,4'-DDD	72-54-8		0.00031		0.00031							4,4'Dichlorodiphenyldichloroethane	Yes	RAIS 1/07
4,4'-DDE	72-55-9		0.00022		0.00022							P,p'-Dichlorodiphenyldochloroethylene	Yes	RAIS 1/07
Demeton	8065-48-3			0.1		0.1							NA	EPA QCW 1986
Diazinon	333-41-5			0.17					0.82				NA	EPA AWQC 2005
Dibenz(a,h)anthracene	53-70-3			5								Also see the NC 02B Standards table for Total PAHs	NA	ECOTOX 1/07
1,2-Dibromo-3-chloropropane	96-12-8		0.033		0.13							Nemagon	Yes	IRIS 1/07
1,2 –Dibromomethane	106-93-4		0.02		0.1							EDB, Ethylene Dibromide	Yes	IRIS 8/10
Dicamba	1918-00-9		1000	200	38000							2,5-Dichloro-6-methoxybenzoic acid	No	IRIS & ECOTOX 10/10
Dichloroacetic Acid	79-43-6		0.68		25							DCAA, DCA	Yes	IRIS 1/07
1,2-(o)-Dichlorobenzene	95-50-1			470		370			79			Chlorinated Benzene	NA	ECOTOX 1/07
1,3-(m)-Dichlorobenzene	541-73-1			390		390						Chlorinated Benzene	NA	ECOTOX & RAIS 1/07
1,4-(p)-Dichlorobenzene	541-73-1			100					56			Chlorinated Benzene	NA	ECOTOX & RAIS 1/07
Dichlorobromomethane	75-27-4		0.55		17								Yes	RAIS 1/07
1,1-Dichloroethane	75-34-3		6		100								Yes	Handbook of Environmental Data-Vershauen/RAIS 6/10
1,2-cis-Dichloroethylene	156-59-2		60		720							Cis-1,2-dichloroethene	No	IRIS 7/11
1,2-Dichloroethylene Mixed Isomers	540-59-0		290		3200								No	RAIS 8/12
Dichlorvos	62-73-7					0.12						Breakdown Product of Naled	NA	ECOTOX 1/07
Diethyl Ether	60-29-7		6800	130000	250000							Ethyl Ether	No	ECOTOX & RAIS 1/07
Diethyl Phthalate	84-66-2			1200		15000			600			DEP	NA	ECOTOX 1/07
Dimethoate	60-51-5			0.3		1.6						Cygon, o,o-Dimethyl s-(N-methyl)-carbamoylmethyl Dithiophosphate	NA	ECOTOX 10/10
Dimethyl Phthalate	131-11-3			3400		2900			2800			DMP, Benzenedicarboxylic Acid, Dimethyl Ester	NA	ECOTOX 1/07
Dimethylformamide	66-12-2		3400		130000							DMF, DMFA	No	RAIS 1/07
Di-n-butyl Pthalate	84-74-2			9.5		4.5						DBP	NA	ECOTOX 1/07
1,3-Dinitrobenzene	99-65-0		3.4		140								No	RAIS 1/07
2,6-Dinitrotoluene	606-20-2		0.048		0.71							2,6-DNT	Yes	RAIS 2/07
Dinoseb	88-85-7		20	3	65	12							No	ECOTOX & IRIS 6/12
1,4-Dioxane	123-91-1		0.35		80							1,4-Diethylene Dioxide	Yes	IRIS 8/10
Endosulfan, beta	33213-65-9			0.05		0.009							No	EPA AWQC 1980
Endosulfan Sulfate	1031-07-8			0.05		0.009							No	EPA AWQC 1980
Endothall	145-73-3		680	3900	25000	12000							No	ECOTOX & RAIS 2/07
EPTC	759-94-4		580	1200	1700	32						s-Ethyl Propylthiocarbamate	No	IRIS 4/07
Ethanol	64-17-5			5000		390						Ethyl Alcohol	NA	ECOTOX 12/10
Ethylbenzene	100-41-4			97		25						Phenyl Ethane	NA	ECOTOX 8/10
Fluoranthene	206-44-0			0.11		0.22						1,2-Benzacenaphthene	NA	ECOTOX 2/07
Fluorene	86-73-7			30		50							NA	ECOTOX 9/10 (freshwater), ECOTOX 9/15 (saltwater)
Fluridone	59756-60-4			90		170						Avast, Sonar	NA	ECOTOX 4/07
Fonofos	944-22-9			0.27		17							NA	ECOTOX 4/07
Formaldehyde	50-00-0			1200		620						Formalin	NA	ECOTOX 2/07
a- Hexachlorocyclohexane	319-84-6			23		66						Alpha-BHC, a-HCH, Hexachlorocyclohexanes	NA	ECOTOX 1/07
b- Hexachlorocyclohexane	319-85-7			55								Beta-BHC, b-HCH, Hexachlorocyclohexanes	NA	ECOTOX 7/16
d- Hexachlorocyclohexane	319-86-8			40		0.6						Delta-BHC, d-HCH, Hexachlorocyclohexanes	NA	ECOTOX 9/15 (freshwater), ECOTOX 1/07 (saltwater)
Hexachlorocyclohexane, Technical	608-73-1			0.3		0.02						HCH, Hexachlorocyclohexanes	Yes	ECOTOX 9/15
Hexachlorocyclo-pentadiene	77-47-4			0.07								HCCP, Perchlorocyclopentadiene	NA	ECOTOX 2/07
Hexahydro-1,3,5-Trinitro-1,3,5-Triazine	121-82-4		0.31		11							RDX	Yes	RAIS 2/07
Hexamine	100-97-0			2500		2500							NA	ECOTOX 2/07
HMX	2691-41-0			1400	63000	1700						Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	No	ECOTOX & RAIS 2/07
Hydrogen Sulfide	6/4/7783			0.21		7.8							NA	ECOTOX 2/07
Iodine	755-35-62			35					27				NA	ECOTOX 12/15
Isopropyl Benzene	98-82-8		2700	250	11000	8000						Cumene, Cumol	No	IRIS & ECOTOX 8/10
Isopropyl Ether	108-20-3			20000		330000						2,2'-Oxybispropane	NA	ECOTOX 8/10
Isopropyl Toluene, p	99-87-6			320		2400						4-Cymene	NA	ECOTOX 1/10
Mancozeb	2234562		1000	10	38000							Carbamic Acid, Ethylene-bis	No	ECOTOX & RAIS 2/07
Methanol	67-56-1		17000		630000							Methyl Alcohol	No	RAIS 12/08
Methyl Acetate	79-20-9			19000									NA	ECOTOX 3/08
Methyl Bromide	74-83-9			0.04		600						Bromomethane	NA	ECOTOX 9/15
Methyl Chloride	74-87-3		2.6		96							Chloromethane	No	IRIS 2/07
Methyl Methacrylate	80-62-6			9600									NA	ECOTOX 2/09
Methylene Chloride	75-09-2			11000		17000						Dichloromethane	NA	ECOTOX 9/15
1-Methylnaphthalene	90-12-0		0.8	450	2.6	95							Yes	ECOTOX 9/15 & RAIS 4/10
2-Methylnaphthalene	91-57-6		90	85	200	30							No	ECOTOX & IRIS 9/15

North Carolina In-Stream Target Values for Surface Waters

Established per language in 15A NCAC 02B .0202 & .0208. Contact DWR staff for further information.

		Freshwater			Fresh & Salt	Saltwater			Supplemental Classifications					
		Class B	Class WS (I - V)	All waters (Class C)	All waters (Class C & SC)	All waters (Class SC)	Class SB	Class SA						
Pollutant or Parameter	**CAS #**	**Primary Recreation[8]**	**Water Supply[6]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Fish Consumption[3]**	**Aquatic Life[1] & Secondary Recreation[4]**	**Primary Recreation[8]**	**Shellfish[9]**	**Trout[2]**	**Swamp Waters[5]**	**High Quality Waters[7]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Reference Source** (See supporting info tab)
		All values reported as ug/L unless labeled otherwise.												
4-Methyl-2-pentinone	108-10-1		2800	26000	160000							Methyl Isobutyl Ketone	No	ECOTOX & RAIS 2/07
Metolochlor	51218-45-2			240		240			200				NA	ECOTOX 10/10
Metribuzin	21087-64-9		840	170	24000								No	IRIS & ECOTOX 2/07
Molybdenum	7439-98-7		160	51000	2000	980							No	IRIS & ECOTOX 6/09
MTBE	1634-04-4		19	34000	1500	50000						Methyl Tertiary-butyl Ether	Yes	ECOTOX 9/15 & CALEPA 1999
Naphthalene	91-20-3		400	12	950	52						Mothballs	NA	IRIS & ECOTOX 8/10
Nitrite	14797-65-0		1000									Set to federal MCL	No	EPA NPDWR 2012
Nitrobenzene	98-95-3			4600		400						Mirbane Oil	NA	ECOTOX 2/07 & 7/16
Nitroglycerin	55-63-0		2	84	67							1,2,3-Propanetriol Trinitrate	Yes	ECOTOX 2/07 & RAIS 2/07
Nitrosamines	55-18-5			25000								(N-nitrosodiethyl-amine as surrogate)	NA	ECOTOX 2/07
N-Nitrosodiethyl-amine	55-18-5			25000								(N-nitrosodiethyl-amine as surrogate)	NA	ECOTOX 2/07
N-Nitrosodimethyl-amine	62-75-9			17000		170000							NA	ECOTOX 2/07
N-Nitrosodiphenylamine	86-30-6			290									NA	ECOTOX 2/07
2-Nitrotoluene	88-72-2		0.14	1500	1.5							o-Nitrotoluene	Yes	ECOTOX & RAIS 2/07
3-Nitrotoluene	99-08-1		5300	1600	620							m-Nitrotoluene	No	ECOTOX & RAIS 2/07
4-Nitrotoluene	99-99-0		18	2500	1.8							p-Nitrotoluene	Yes	ECOTOX & RAIS 2/07
n-Propyl Benzene	103-65-1		1500	80	2700	4600							No	ECOTOX & RAIS 9/15
Pentachlorobenzene	608-93-5			0.51								Chlorinated Benzene	NA	ECOTOX 1/07
Perchlorate & Salts	14797-73-0		2.5		2.8								No	IRIS 4/07
Phenanthrene	85-01-8			0.7					0.3				NA	ECOTOX 4/10
Propenoic Acid	79-10-7		17000	270000	630000								No	ECOTOX & IRIS 11/09
Pyridine	110-86-1		34	5000	1300	2500							No	ECOTOX 9/15 & IRIS 11/09
Silvex	93-72-1			17		1500						2,4,5-TP, 2,4,5-Trichlorophenoxypropionoic Acid	NA	ECOTOX 9/15
Strontium	7440-24-6		14000		40000								No	IRIS 2/07
Sulfide-Hydrogen Sulfide	2148878			0.21		2							NA	ECOTOX 2/07
Terbacil	5902-51-2		430		9100								No	IRIS 4/07
1,1,2,2,-Tetrachloroethane	79-34-5			1000		600						acetosol, acetylene tetrachloride	NA	ECOTOX 7/16
Tetrachloroethylene (PERC)	127-18-4			120		65						PERC, PCE, Perchloroethylene	NA	ECOTOX 2/07
Tetrahydrofuran	109-99-9		3100	110000	110000								No	ECOTOX 3/08 & IRIS 12/16
Tin	7440-31-5		770		800								No	HEAST 2/14
Thallium	7440-28-0		2		2							Set to federal MCL	No	EPA NPDWR 2012
Toluene	108-88-3					370							NA	ECOTOX 8/07
1,2,4-Trichlorobenzene	120-82-1			61		27						Chlorinated Benzene	NA	ECOTOX & RAIS 1/07
2,4,5-Trichlorophenoxyacteic Acid	93-76-5		68	5500	2500	1400						2,4,5-T	No	ECOTOX 2/07; EPA Gold Book 1986
1,1,1-Trichloroethane	71-55-6			2500		3600						Ethane Trichloride, Vinyl Trichloride	NA	ECOTOX 9/15
1,1,2-Trichloroethane	79-00-5			2300		9500							NA	ECOTOX 2/07
Trichlorofluoromethane	75-69-4		9100		67000							Freon 11, Frigen 11, Arcton 11	No	IRIS 2/07
1,1,2-Trichloro-1,2,2,-trifluoroethane	76-13-1		710000		2200000							Freon 113	No	IRIS 1/07
1,2,3-Trichloropropane	96-18-4		0.01		0.001							1,2,3-TCP	Yes	IRIS 6/12
1,2,4-Trimethylbenzene	95-63-6			390		220							NA	ECOTOX 8/10
1,3,5- Trimethylbenzene	108-67-8		130	630	215	220						Mesitylene	No	ECOTOX 9/15 & RAIS 8/10
Trinitrophenylmethylnitramine	479-45-8		140		4300								No	RAIS 2/07
2,4,6-Trinitrotoluene	118-96-7		1.1		39							TNT	Yes	RAIS 2/07
Xylene Mixture	1330-20-7		6200	670	57000	370			450				No	IRIS & ECOTOX 6/12
m-Xylene	108-38-3		6200	420	54000	180			420			1,3-Dimethylbenzene, Human Health and Water Supply use Xylene Mixture as surrogate	NA	ECOTOX 6/12
p-Xylene	106-42-3		6200	420	54000	100			130			1,4-Dimethylbenzene, Human Health and Water Supply use Xylene Mixture as surrogate	NA	ECOTOX 6/12
o-Xylene	95-47-6		6200	600	57000	60			400			1,2-Dimethylbenzene, Human Health and Water Supply use Xylene Mixture as surrogate	NA	ECOTOX 6/12

See the Supporting Info tab for information on all footnotes, notes, and abbreviations

EPA National Recommended Water Quality Criteria for Aquatic Life & Human Health

Below are all Nationally Recommended Water Quality Criteria for which NC does not have a Water Quality Standard for one or more uses

		Freshwater		Fresh & Salt	Saltwater						
		Class WS (I - V)	Class C	Class C & SC	Class SC						
Pollutant or Parameter	**CAS #**	**Water Supply[6] (WS)**	**Aquatic Life[1]**	**Fish Consumption[3] (FC)**	**Aquatic Life[1]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Most Recent EPA Criterion Publication Year**	**Is there an NC Aquatic Life Standard?**	**Is there an NC FC or WS Standard?**	**Is the EPA Criterion being reviewed for adoption as a NC Standard?**
		All values reported as ug/L unless labeled otherwise.									
Acenaphthene	83-32-9	70		90				2015	No	No	Reviewing 2015 Criterion for FC & WS
Acrolein	107-02-8	3	3	400				2015	No	No	Reviewing 2015 Criterion for FC & WS
Acrylonitrile	107-13-1	0.061		7			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
alpha-Hexachlorocyclohexane (HCH)	319-84-6	0.00036		0.00039				2015	No	No	Reviewing 2015 Criterion for FC & WS
Alkalinity	NA		20000			The CCC of 20 mg/L is a minimum value except where alkalinity is naturally lower, in which case the criterion cannot be lower than 25% of the natural level.		1986	No	No	No
alpha-Endosulfan	959-98-8	20	See NC standard for Endosulfan	30	See NC standard for Endosulfan			1980	Yes	No	No
Aluminum	7429-90-5		dissolved organic carbin, hardness & pH dependent			See EPA 2018 Aquatic Life Ambient Water Quality Criteria for Aluminum in Freshwaters (EPA-822-R-18-001)		2018	No	No	Yes
Ammonia	7664-41-7		pH & temp dependent		pH, temp & salinity dependent	See EPA Ammonia criteria guidelines for criteria		2013 (freshwater) 1989 (saltwater)	Only for effluent in high quality waters	No	Yes
Anthracene	120-12-7	300		400				2015	No	No	Reviewing 2015 Criterion for FC & WS
Antimony	7440-36-0	5.6		640				2002	No	No	No
Asbestos	1332-21-4	7000000 Fibers/L						1991	No	No	No
Benzidine	92-87-5	0.00014		0.011			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Benzo(a)anthracene	65-55-3	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
Benzo(a)pyrene	50-32-8	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
Benzo(b)fluoranthene	205-99-2	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
Benzo(k)fluoranthene	207-08-9	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
beta-Endosulfan	Use NC standard for Endosulfan							1980	Yes	No	No
beta-Hexachlorocyclohexane	319-85-7	0.008		0.014			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Bis(2-Chloro-1-methylethyl) Ether	108-60-1	200		4000				2015	No	No	Reviewing 2015 Criterion for FC & WS
Bis(2-Chloroethyl) Ether	111-44-4	0.03		2.2			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Bis(2-Ethylhexyl) Phthalate	117-81-7	0.32		0.37			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Bis(Chloromethyl) Ether	542-88-1	0.00015		0.017				2015	No	No	Reviewing 2015 Criterion for FC & WS
Bromoform	75-25-2	7		120			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Butylbenzyl Phthalate	85-68-7	0.1		0.1				2015	No	No	Reviewing 2015 Criterion for FC & WS
Cadmium	Refer to current NC standard for acute & chronic Cadmium established January 2015. Currently reviewing EPA's 2016 criteria.							2016	Yes	No	Reviewing for Aquatic Life
Carbaryl	63-25-2		2.1		1.6			2012	No	No	No
Carbon Tetrachloride	56-23-5	See NC standard		See NC standard			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
Chlordane	57-74-9	See NC standard	See NC standard	See NC standard	See NC standard			2015	Yes	Yes	Reviewing 2015 Criterion for FC & WS
Chlorine	7782-50-5		See NC standard		Acute: 13 Chronic: 7.5			1986	Yes, for Freshwater	No	No
Chlorobenzene	108-90-7	See NC standard for Chlorinated Benzenes		800				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Chlorodibromomethane	124-48-1	0.8		21			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Chloroform	67-66-3	60		2000				2015	No	No	Reviewing 2015 Criterion for FC & WS
2-Chloronaphthalene	91-58-7	800		1000				2015	No	No	Reviewing 2015 Criterion for FC & WS
2-Chlorophenol	95-57-8	See NC standard for Chlorinated Phenols		800				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Chlorpyrifos	2921-88-2		Acute: 0.083 Chronic: 0.041		acute: 0.011 chronic: 0.0056			1986	No	No	No
Chrysene	218-01-9	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS

EPA National Recommended Water Quality Criteria for Aquatic Life & Human Health

Below are all Nationally Recommended Water Quality Criteria for which NC does not have a Water Quality Standard for one or more uses

		Freshwater		Fresh & Salt	Saltwater						
		Class WS (I - V)	Class C	Class C & SC	Class SC						
Pollutant or Parameter	**CAS #**	**Water Supply[6] (WS)**	**Aquatic Life[1]**	**Fish Consumption[3] (FC)**	**Aquatic Life[1]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Most Recent EPA Criterion Publication Year**	**Is there an NC Aquatic Life Standard?**	**Is there an NC FC or WS Standard?**	**Is the EPA Criterion being reviewed for adoption as a NC Standard?**
		All values reported as ug/L unless labeled otherwise.									
Copper, Total	744-05-08	1300	NC has aquatic life standards for Dissolved Copper		NC has aquatic life standards for Dissolved Copper	Based on EPA Drinking Water Maximum Contaminant Level Goal (MCLG)	Yes	1992	Yes	No	No
Cyanide, Free	57-12-5	4		400		NC has aquatic life standards for Total Cyanide		2015	No	No	Reviewing 2015 Criterion for FC & WS
2,4-D	94-75-7	See NC Standard		12000		Dichlorophenoxy acetic acid, Chlorophenoxy Herbicide		2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
4,4'-DDD	72-54-8	0.00012		0.00012		4,4'-Dichlorodiphenyldichloroethane	Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
4,4'-DDE	72-55-9	0.000018		0.000018		p,p'-Dichlorodiphenyldichloroethylene	Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Diazinon	333-41-5		0.17		0.82			2005	No	No	No
Dibenzo(a,h)anthracene	53-70-3	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
1,2-Dichlorobenzene	95-50-1	See NC standard for Chlorinated Benzenes		3000				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
1,3-Dichlorobenzene	541-73-1	See NC standard for Chlorinated Benzenes		10				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
1,4-Dichlorobenzene	106-46-7	See NC standard for Chlorinated Benzenes		900				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
3,3-Dichlorobenzidine	91-94-1	0.049		0.15			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
1,2-Dichloroethane	107-06-2	9.9		650			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Dichlorobromomethane	75-27-4	0.95		27			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
1,1-Dichloroethylene	75-35-4	300		20000				2015	No	No	Reviewing 2015 Criterion for FC & WS
2,4-Dichlorophenol	120-83-2	See NC standard for Chlorinated Phenols		60				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
1,2-Dichloropropane	78-87-5	0.9		31			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
1,3-Dichloropropene	542-75-6	0.27		12			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Diethyl Phthalate	84-66-2	600		600				2015	No	No	Reviewing 2015 Criterion for FC & WS
2,4-Dimethylphenol	105-67-9	100	See NC Standard for Total Phenolic Compounds	3000	See NC Standard for Total Phenolic Compounds			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
Dimethyl Phthalate	131-11-3	2000		2000				2015	No	No	Reviewing 2015 Criterion for FC & WS
Di-n-Butyl Phthalate	84-74-2	20		30				2015	No	No	Reviewing 2015 Criterion for FC & WS
2,4-Dinitrophenol	51-28-5	10	See NC Standard for Total Phenolic Compounds	300	See NC Standard for Total Phenolic Compounds			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
Dinitrophenol	25550-58-7	10	See NC Standard for Total Phenolic Compounds	1000	See NC Standard for Total Phenolic Compounds			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
2,4-Dinitrotoluene	121-14-2	0.049		1.7			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
1,2-Diphenylhydrazine	122-66-7	0.03		0.2			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Trans-1,2-Dichloroethylene	156-60-5	100		4000				2015	No	No	Reviewing 2015 Criterion for FC & WS
Endosulfan Sulfate	1031-07-8	20		40				2015	No	No	Reviewing 2015 Criterion for FC & WS
Endrin Aldehyde	7421-93-4	1		1				2015	No	No	Reviewing 2015 Criterion for FC & WS
Ethylbenzene	100-41-4	68		130				2015	No	No	Reviewing 2015 Criterion for FC & WS
Fluoranthene	206-44-0	20		20				2015	No	No	Reviewing 2015 Criterion for FC & WS
Fluorene	86-73-7	50		70				2015	No	No	Reviewing 2015 Criterion for FC & WS
gamma-Hexachlorocyclohexane (HCH)	58-89-9	4.2	See NC Standard	4.4	See NC Standard	Lindane		2015	Yes	No	Reviewing 2015 Criterion for FC & WS
Heptachlor Epoxide	1024-57-3	0.000032	acute: 0.52 chronic: 0.0038	0.000032	acute: 0.053 chronic: 0.0036		Yes	1981 aquatic life, 2015 human health	No	No	Reviewing 2015 Criterion for FC & WS
Hexachlorobenzene	118-74-1	See NC standard for Chlorinated Benzenes		0.000079			Yes	2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Hexachlorocyclohexane, Technical	608-73-1	0.0066		0.01				2015	No	No	Reviewing 2015 Criterion for FC & WS

EPA National Recommended Water Quality Criteria for Aquatic Life & Human Health

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		Freshwater		Fresh & Salt	Saltwater						
		Class WS (I - V)	Class C	Class C & SC	Class SC						
Pollutant or Parameter	**CAS #**	**Water Supply[6] (WS)**	**Aquatic Life[1]**	**Fish Consumption[3] (FC)**	**Aquatic Life[1]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Most Recent EPA Criterion Publication Year**	**Is there an NC Aquatic Life Standard?**	**Is there an NC FC or WS Standard?**	**Is the EPA Criterion being reviewed for adoption as a NC Standard?**
		All values reported as ug/L unless labeled otherwise.									
Hexachlorocyclopentadiene	77-47-4	4		4				2015	No	No	Reviewing 2015 Criterion for FC & WS
Hexachloroethane	67-72-1	0.1		0.1			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Indeno(1,2,3-cd)Pyrene	193-39-5	See NC Standard for Total PAHs		See NC Standard for Total PAHs			Yes	2015	No	Yes	Reviewing 2015 Criterion for FC & WS
Iron	7439-89-6		1000			EPA approved removal of NC aquatic life standard as part of 2007-2016 Triennial review due to high natural occurrence in NC surface waters. The EPA NRWQC remains here as guidance for instances when toxicity information is needed.		1986	No	No	No
Isophorone	78-59-1	34		1800			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Manganese	7439-96-5	50		100		EPA approved removal of NC human health standards as part of 2007-2016 Triennial review due to high natural occurrence in NC surface waters. The EPA NRWQC remains here as guidance for instances when toxicity information is needed.		1993	No	No	No
Malathion	121-75-5		0.1		0.1			1986	No	No	No
2-Methyl-4,6-Dinitrophenol	534-52-1	2	See NC Standard for Total Phenolic Compounds	30	See NC Standard for Total Phenolic Compounds			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
3-Methyl-4-Chlorophenol	59-50-7	See NC standard for Chlorinated Phenols		2000				2015	No	No	Reviewing 2015 Criterion for FC & WS
Methylmercury	22967-92-6			0.3 mg/kg fish tissue		Fish tissue criterion		2001	No	No	No
Methoxychlor	72-43-5	0.02	See NC Standard	0.02	See NC Standard			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
Methyl Bromide	74-83-9	100		10000				2015	No	No	Reviewing 2015 Criterion for FC & WS
Methylene Chloride	75-09-2	20		1000			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Nickel	7440-02-0	See NC Standard	See NC Standard	4600	See NC Standard			1998	Yes	No	No
Nitrobenzene	98-95-3	10		600				2015	No	No	Reviewing 2015 Criterion for FC & WS
Nitrosamines	NA	0.0008		1.24				1980	No	No	No
Nitrosodibutylamine	924-16-3	0.0063		0.22			Yes	2002	No	No	No
Nitrosodiethylamine	55-18-5	0.0008		1.24			Yes	2002	No	No	No
Nitrosopyrrolidine	930-55-2	0.016		34			Yes	2002	No	No	No
N-Nitrosodimethylamine	86-30-6	0.00069		3			Yes	2002	No	No	No
N-Nitrosodi-n-Propylamine	621-64-7	0.005		0.51			Yes	2002	No	No	No
N-Nitrosodiphenylamine	86-30-6	3.3		6			Yes	2002	No	No	No
Nonylphenols	Multiple		See NC Standard for Total Phenolic Compounds		See NC Standard for Total Phenolic Compounds				Yes	No	No
Pentachlorobenzene	608-93-5	See NC standard for Chlorinated Benzenes		0.1				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Pentachlorophenol	87-86-5	See NC standard for Chlorinated Phenols	See NC Standard for Total Phenolic Compounds	0.04	See NC Standard for Total Phenolic Compounds		Yes	2015	Yes	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Phenol	108-95-2	4000	See NC Standard for Total Phenolic Compounds	300000	See NC Standard for Total Phenolic Compounds			2015	Yes	No	Reviewing 2015 Criterion for FC & WS
Polychlorinated Biphenols (PCBs)	NA	0.000064	See NC Standard for Total PCB	See NC Standard for Total PCB	See NC Standard for Total PCB			2002	Yes	Yes, for FC	No
Pyrene	129-00-0	20		30				2015	No	No	Reviewing 2015 Criterion for FC & WS
Selenium	7782-49-2	170	See NC Standard	4200	See NC Standard			2002	Yes	No	No
Silvex	93-72-1	See NC Standard		400		2,4,5-TP		2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Hydrogen Sulfide	7783-06-4		2		2			1986	No	No	No

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		Freshwater		Fresh & Salt	Saltwater						
		Class WS (I - V)	Class C	Class C & SC	Class SC						
Pollutant or Parameter	**CAS #**	**Water Supply[6] (WS)**	**Aquatic Life[1]**	**Fish Consumption[3] (FC)**	**Aquatic Life[1]**	**Synonyms & Other Information**	**Cancer Endpoint[10]** (FC & WS)	**Most Recent EPA Criterion Publication Year**	**Is there an NC Aquatic Life Standard?**	**Is there an NC FC or WS Standard?**	**Is the EPA Criterion being reviewed for adoption as a NC Standard?**
		All values reported as ug/L unless labeled otherwise.									
1,2,4,5-Tetrachlorobenzene	95-94-3	See NC standard for Chlorinated Benzenes		0.03				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
Toluene	108-88-3	57	See NC Standard	520				2015	Yes, for Freshwater	No	Reviewing 2015 Criterion for FC & WS
Toxaphene	8001-35-2	0.0007	See NC Standard	0.00071	See NC Standard		Yes	2015	Yes	No	Reviewing 2015 Criterion for FC & WS
1,2,4-Trichlorobenzene	120-82-1	See NC standard for Chlorinated Benzenes		0.076				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
1,1,1-Trichloroethane	71-55-6	10000		200000				2015	No	No	Reviewing 2015 Criterion for FC & WS
1,1,2-Trichloroethane	79-00-5	0.55		8.9			Yes	2015	No	No	Reviewing 2015 Criterion for FC & WS
Trichloroethylene	79-01-6	See NC Standard		See NC Standard				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
2,4,5-Trichlorophenol	95-95-4	See NC standard for Chlorinated Phenols		600				2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS
2,4,6-Trichlorophenol	88-06-2	See NC standard for Chlorinated Phenols		2.8			Yes	2015	No	Yes, for WS	Reviewing 2015 Criterion for FC & WS

The Nationally Recommended Water Quality Criteria values presented in this table are based on the values reported on EPA's Nationally Recommended Water Quality Criteria website as of 7/22/2016.

See the Supporting Info tab for information on all footnotes, notes, and abbreviations

Supporting Information

Notes & Descriptors

Calc = hardness-dependent metal standards are calculated based on in-stream hardness
(d) = dissolved metal standard. See 15A NCAC 02B .0211 for more information.
(E) = effluent limit for High Quality Waters. See 15A NCAC 02B .0224.
(h) = hardness-dependent dissolved metal standard. See below for hardness-dependent dissolved metal equations. See 15A NCAC 02B .0211 for more information.
(FC) = Fish Consumption
(LD) = limited data.
(N) = narrative standard.
(P) = public policy document.
(S) = toxicity exceeds solubility, no visible sheen or free product in water or on sediment or shoreline per 15A NCAC 02B .0211 & .0220
(t) = based upon measurement of total recoverable metal. See 15A NCAC 02B .0211 for more information.
(Tr + HQW) = trout waters also listed ar High Quality Waters.
WER = Water Effects Ratio. See 15A NCAC 02B .0211 for more information.
(WS) = Water Supply.

Designated Use Definitions

(1) Aquatic Life standards protect both fresh and saltwater aquatic organisms to promote biological integrity. See 15A NCAC 02B .0211 and .0220.
(2) Trout Waters are protected for natural trout propagation and survival of stocked trout. See 15A NCAC 02B .0101 and .0301 as well as .0224 for trout waters that are also HQW.
(3) Fish Consumption standards are based on consumption of fish (including shellfish) tissue. These standards are commonly referred to as "Human Health" standards. See 15A NCAC 02B .0208.
(4) Secondary Recreation standards apply to activities in surface waters that result in incidental body contact. See 15A NCAC 02B .0211 and .0220.
(5) Swamp Waters have low velocities and other natural characteristics which are different from adjacent streams. See 15A NCAC 02B .0101.
(6) Water Supply standards are applicable to all Water Supply Classifications (WS I-V) and are based on consumption of fish and water. See 15A NCAC 02B .0208, .0212, .0214, .0215, .0216, and .0218.
(7) High Quality Waters are a subset of waters with quality higher than the standards and are described in 15A NCAC 02B .0101 and .0224.
(8) Primary Recreation standards apply to activities in surface waters that result in full-body contact. See 15A NCAC 02B .0219 and .0222.
(9) Shellfish Area standards apply to surface waters that are used for shellfishing for market purposes. See 15A NCAC 02B .0221.
(10) Carcinogens are listed in 15A NCAC 02B .0208 and relate to Human Health water quality standards which include fish consumption and water supply. All standards in this table that are designated as carcinogens were calculated from oral cancer slope values obtained through EPA's Integrated Risk Information System (IRIS).
(11) Acute & chronic values for all metals on the NC 02B Standards table are based on the following language in 15A NCAC 02B .0211: **Acute** = "*Compliance with acute instream metals standards shall only be evaluated using an average of two or more samples collected with one hour.*" **Chronic** = "*Compliance with chronic instream metals standards shall only be evaluated using averages of a minimum of four samples taken on consecutive days, or as a 96-hour average*"

Reference Sources

40 CFR = Code of Federal Regulations - Title 40
EPA AWQC = Enviromental Protection Agency Ambient Water Quality Criteria
EPA QCW = Enviromental Protection Agency Quality Criteria for Water
EPA NRWQC = Environmental Protection Agency Nationally Recommended Water Quality Criteria. (FC) denotes Fish consumption, (WS) denotes water supply, and (AL) denotes aquatic life Water Quality Criteria.
ECOTOX = The ECOTOXicology knowledgebase.
FDA NSSP = US Food & Drug Administration National Shellfish Sanitation Program.
GEI-CED = GEI Consultants-Chadwick Ecological Division. Reviewed EPA 2001 Update of Ambient Water Quality Criteria for Cadmium.
IRIS = Integrated Risk Information System.
NPDWR = National Primary Drinking Water Regulations (EPA)
NSDWR = National Secondary Drinking Water Regulations (EPA)
RAIS = The Risk Assessment Information System