



September 15, 2009

NCDENR-DWM
Solid Waste Section
1646 Mail Service Center
Raleigh, NC 27699-1646

Attention: Ms. Jaclynne Drummond
Compliance Hydrogeologist

Reference: **Work Plan – Additional Landfill Assessment**
Davie County Landfill
Davie County, North Carolina
S&ME Project No. 1584-03-109

Dear Ms. Drummond;

At the request of the Davie County, S&ME has prepared this Work Plan for additional assessment activities at the Davie County Landfill, located off Dalton Road, in Davie County, North Carolina. The following provides a limited project background and a summary of work planned at the closed municipal solid waste (MSW) and closed Construction & Demolition Debris (C&D) landfill.

Background

Davie County was the operator of the closed MSW landfill (Permit # 30-01), the closed C&D landfill (Permit # 30-03), and the closed solid waste transfer station located at the subject facility. Currently a total of 17 monitoring wells comprise the compliance monitoring network for both the closed MSW and C&D landfills.

To initiate an assessment of groundwater quality non-compliance issues at the facility, during 2003, Davie County installed and sampled four monitoring wells at locations requested by the North Carolina Department of Environment and Natural Resources, Division of Waste Management, Solid Waste Section (NCDENR-DMW). Since 2004, S&ME has provided the groundwater and surface water sampling services required for the semi-annual post closure monitoring of the Davie County Landfill, with Grey Engineering preparing the associated semi-annual water quality monitoring reports.

In accordance with 15A NCAC 13B .0545 the documented detection of several volatile organic compounds at compliance wells MW-1, MW-4, MW-5, MW-10, MW-15, and MW-16D, at concentrations which exceedance the 15A NCAC 2L (2L) groundwater quality standards, require Davie County to complete the characterization of the nature and extent of the release. As part of the characterization of the nature and extent of the release,

Davie County will re-examine the condition of the landfill CAP by way of a visual inspection as required under 15A NCAC 13B .0543, Post Closure Criteria. It is recognized that compromises in the integrity of the CAP may contribute to the groundwater exceedances discussed above.

Davie County will also re-evaluate potential landfill gas management as part of post closure care and the potential benefits passive landfill gas venting may provide as part of future landfill corrective measures.

As recently required by the NCDENR, Davie County will review, assess as needed, and prepare a "Limits of Waste" map for the closed MSW and C&D landfills.

Based on the above understanding, the following Work Plan is proposed.

WORK PLAN

Task 1: Review Historic Data

S&ME and Grey Engineering staff will review readily available historic landfill operations documents, NCDENR correspondence, and permitting data to the extent needed to affectively perform the following tasks.

Task 2: Receptor Survey

The receptor survey will include an examination of properties located within 1,500 of the landfill, to assess if occupants of the properties rely on water wells for potable water, or if the occupants rely on water provided by the local public water system. At a minimum, the survey will include a visual examination of the properties located within 1,500 feet of closed landfill, from public accessible areas, and a review of local public water utility accounts for the occupied properties located within the searched radii.

Task 3: Landfill CAP Inspection

During the July 17, 2009, landfill inspection with Grey Engineering staff, S&ME staff, and NCDENR staff, it was not practical to inspect the condition of the landfill CAP due to the existence of significant vegetative cover. A private hunting club currently uses the landfill and surrounding areas, and they have planted certain cover crops. The hunting club has requested that cutting of the landfill cover for CAP inspections be conducted outside of the hunting season, if possible. In an attempt to respect their land use, Davie County proposes a visual inspection of the CAP sometime after March 2010, after the close of hunting season, and a cutting of the CAP cover materials. Any identified needs for CAP repair or maintenance will be reported following the completion of this inspection.

Task 4: Determination of Limits of Waste

Grey Engineering previously assisted Davie County with the closure of the C&D landfill. As such, the limits of waste for the C&D landfill are reasonable well known. A map of the limits of waste for the C&D landfill will be prepared, depicting both the limits of waste and the associated compliance boundary.

Based on our current knowledge of the historic MSW landfill operations, the limits of waste on the western side of the MSW are believed to be reasonably defined; however, the following areas may need further review:

- To the north between the closed C&D landfill and the MSW landfill
- To the east between the MSW landfill and the pre-regulation private landfill
- To the south of the current landfill access road, generally north of well MW-1.

In order to further assess the limits of waste S&ME proposes to supplement the limits of waste knowledge with a more thorough review of historic landfill information, by conducting interviews with those involved in historic operations, and a visual examination of the landfill. If it is determined that additional assessment is needed to reasonably define the limits of waste, geophysical methods will be employed, and test pits or soil boring may also be used to confirm the limits of waste.

Therefore, if required, frequency domain electromagnetics (FDEM) will be used to delineate the lateral extents of the landfill. FDEM is a fast data acquisition method allowing for significant site coverage. FDEM measurements provide a non-invasive method for the measurement of subsurface conductivity and magnetic susceptibility. Lateral changes in conductivity of the subsurface typically indicate lateral changes in the subsurface materials. Assuming a substantial conductivity contrast exists between the in-situ subsurface soils and the landfill materials, the mapped conductivity contrast will delineate the lateral extent of each debris sites.

We estimate two days of data collection; however, after the first days' data collection, the data will be post-processed and reviewed to confirm the success of the FDEM survey at delineating the limits of waste. If site specific conditions suggest that the FDEM is not detecting sufficient contrast needed to delineate the limits of waste, other methods may be employed. Based on the FDEM findings, it may be appropriate to complete several test pits with a backhoe, or several solid stem auger boreholes to confirm the FDEM findings.

A scaled map will be prepared depicting the limits of waste for the closed MSW landfill, along with a letter documenting the methods used to prepare the map. The map will also depict the facility's compliance boundary based on the limits of waste and property boundaries.

Task 5: Additional Groundwater Assessment Activities

At well compliance monitoring wells MW-1, MW-4, MW-5, MW-10, MW-15, and MW-16D, groundwater has been documented to contain certain targeted constituents at concentrations that exceed corresponding 2L groundwater quality standards. In accordance Solid Waste Sections requirements outlined in 15A NCAC 13B .0545, the owner or operator of the landfill must conduct a nature and extent study (NES), to define the extent of these impacts. It is our current understanding that existing wells MW-17 and MW-18 should be sufficient to delineate the known impacts at well MW-15; and that no additional assessment for MW-15 is warranted at this time. However, to initiate an assessment of the groundwater quality impacts currently document at wells MW-1, MW-4, MW-5, MW-10, and MW16D, S&ME proposes the following scope of work.

- Review if available, the well construction logs for each of the impacted wells listed above, and the nearest adjoining compliance monitoring wells, in order to confirm the hydrogeologic units being monitored.
- Review published geologic maps for the study area, as wells as conduct field mapping of rock types, fractures, and joints observable within approximately 500 feet of the closed MSW landfill.
- S&ME will subcontract *The Hutchinson Group* to provide a VLF survey of the County owned property north of the closed MSW and C&D landfill. Very Low Frequency (VLF) surveys can be employed quickly and used to detect fractures in bedrock. VLF methods of geophysics utilize very low frequency radio communications signals to determine the electrical properties of near surface soil and shallow bedrock. VLF is used to collect conductivity data, then by comparing and contrasting the electrical conductivities present between underlying geologic units, identify more conductive zones (e.g. suspect fracture zones) in the underlying bedrock.

The resultant VLF findings and imaged fractures will be overlain on a site vicinity map depicting the landfill, monitoring wells, and approximate location of any nearby, off-site water supply wells. The resultant map will be used to examine potential spatial correlations between the VLF imaged fractures, known dissolved phase groundwater contaminants and their distribution, and the receptor survey identified water supply wells. This spatial data analysis will be used as a first order assessment of off-site water supply wells that may be considered at risk due to the known groundwater contamination at the subject site. The VLF survey data will also be used to select the location of shallow and bedrock well pairs to be installed to further delineate the extent of the groundwater impacts, as discussed further below.

- At this time we proposing the installation of two well pairs. One down gradient of monitor well MW-16D, one down gradient of monitor well MW-10. One shallow aquifer well is proposed down-gradient of monitor well MW-1. Each well pair will consist of a shallow well targeting the saprolite aquifer and a deeper

well completed in the underlying fractured bedrock. Specific locations have not been selected, pending the results for the VLF survey; however, we anticipate locations near Leonard Creek. The use of well pairs will permit an assessment of water quality, as well an assessment of Leonard Creek as a local discharge point for the monitored aquifers.

The proposed wells will be Type II PVC monitor wells designed to monitor the shallow aquifer. The wells will be constructed in accordance with the Solid Waste Sections requirement and the requirements specified under NCAC 2C.

- Upon installation of the proposed wells, each well will be properly developed. Following development, each well will be sampled and submitted for laboratory analysis using the North Carolina Appendix I target compound list.
- Slug tests will be performed to estimate the hydraulic conductivity of the aquifer units monitored by the new monitor wells.
- If sufficient data exists, the BIOCHLOR model will be used to examine aquifer conditions relative to the potential for natural attenuation to reduce the concentrations of detected contaminants of concern, and the associated migration of these contaminants over time.
- Our assessment findings will be summarized in a letter report, which will include our recommendations for additional assessment needed to comply with the Solid Waste Sections requirements outlined in 15A NCAC 13B .0545. If the additional assessment activities outlined herein provide sufficient data, a Nature and Extent Study report will be prepared.

Task 6: Landfill Gas Management

Decomposition methane gas can have a direct effect on groundwater quality. Volatile organic constituents in the decomposition gas can be phase transferred along subsurface gas migration pathways where decomposition gas comes in contact with the surface of the water table aquifer at interaction zones. Volatile organic constituents in gas molecules can be transferred to aqueous phase at these interaction zones. The Davie County Landfill Facility does not currently have any passive or active gas extraction system installed at the landfill

By reducing the interaction of decomposition methane gas with the surface of the uppermost aquifer (phase transfer zone) groundwater quality may be improved over time especially if decomposition gas is the primary source of the VOCs being detected in the monitoring wells. Reducing the phase transfer of VOCs to the groundwater, not only reduces the mass of VOCs in the shallow aquifer, but it will reduce the mass of VOCs available to migrate from the shallow aquifer into the deeper bedrock aquifer.

S&ME will prepare a Gas Remediation Plan which will call for a phased approach to reduce the phase transfer of VOCs to the groundwater. The Gas Remediation Plan will be prepared in accordance with 15A NCAC 13B .0503 (2)(a).

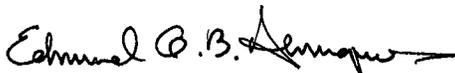
SCHEDULE

The attached schedule is provided as an estimate of the time frame needed to complete the proposed activities. The schedule accounts for expected time frames needed to arrange and schedule the subcontract geophysical survey services, time needed to complete the historical data review, the need to obtain interviews with individuals knowledgeable about historic landfill operations, and giving consideration to the current recreational users of the landfill property. The drilling schedule considers the need to conduct and review findings for the proposed geophysical surveys before selecting appropriate monitor well locations. The drilling schedule also considers the predicted challenges to access for air-drilling rigs during winter months, for the installation of bedrock monitoring wells proposed herein. As such and in the absence of knowledge of off-site receptors at risk to the contamination, we propose drilling to commence in April 2010. If the receptor survey reveals potential receptors at risk, the schedule and work plan may require adjustments.

CLOSURE

Please review the proposed scope of work and provide S&ME and Davie County with your comments and/or authorization to proceed with the scope of work outlined above. Please contact us at (336) 288-7180 if you have any questions regarding this proposed work plan. We appreciate your assistance in this matter.

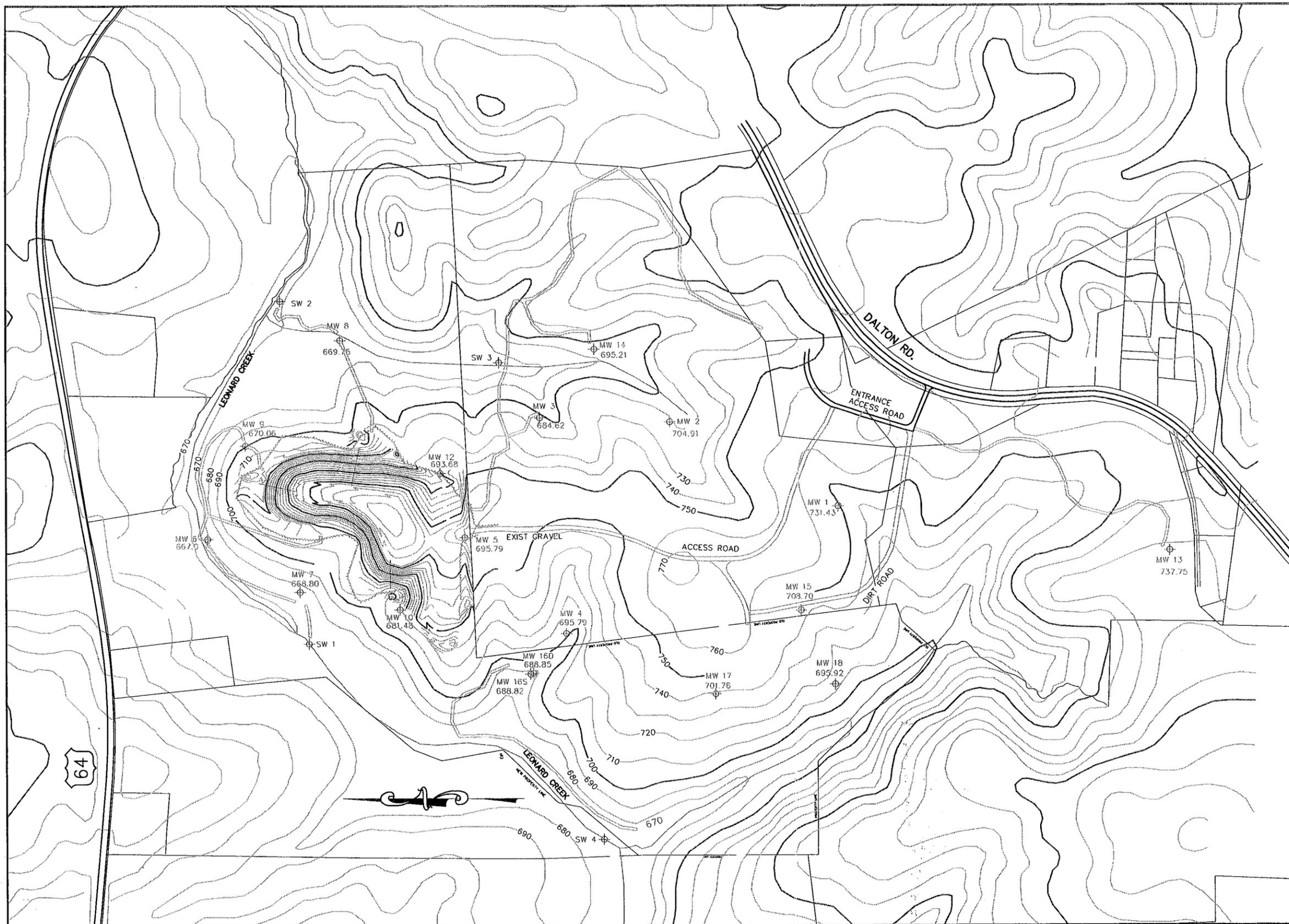
Sincerely,
S&ME, Inc.


Edmund Q.B. Henriques, P.G.
Environmental Department Manager


Wayne H. Watterson, P.E.
Senior Engineer

Attachments: Proposed Project Schedule
Monitoring Well and Surface Water Sampling Locations

cc: Grey Engineering
Davie County



0 200 400 600 800
 SCALE: 1" = 200'
 400'
 CONTOURS AT 10'

MONITORING WELL AND SURFACE WATER SAMPLING LOCATIONS

**Proposed Project Schedule
 Davie County Landfill
 Davie County, North Carolina
 S&ME Project No. 1584-03-109**

Task Name	Duration	2009	2009	2009	2009	2010	2010	2010	2010	2010	2010	2010
		September	October	November	December	January	February	March	April	May	June	July
Work Plan												
1 Review Available Historic Landfill Information	1-4 weeks	█	█	█	█							
2 Prepare Work Plan	1 week	█										
3 NCDENR Review of Work Plan	1-3 weeks	█	█	█								
4 NCDENR Approval of Work Plan	TBD		█									
Receptor Survey (Grey Engineering)												
1 Conduct Survey of Water Well Users	4-8 weeks		█	█	█	█						
2 Prepare a Receptor Survey Map and Well User Table	1-2 weeks				█	█						
Landfill CAP Inspection												
1 Cut Cover Crop & Inspect CAP *	1-2 days							█	█	█		
2 Prepare Inspection Report	1 day								█	█		
3 Address Action Items (TBD)	TBD											
Determination of Limits of Waste												
1 Review Historic Aerials and Interview Key Individuals	1-8 weeks	█	█	█	█							
2 Visual Reconnaissance of Landfill for Limits of Waste	1-2 days		█	█	█	█						
3 Conduct FDEM Geophysical Survey in select areas	2 days		█	█	█	█						
4 Conduct Test Pits to confirm limits of waste (if needed)	1-2 weeks				█	█	█					
5 Obtain GPS coordinates for Limits of Waste	1 day				█	█	█					
6 Prepare Limits of Waste Map	1 week					█	█	█				
Additional Groundwater Assessment Activities												
1 Conduct VLF Survey (image bedrock fractures)	3-5 days		█	█	█	█						
2 Field Reconnaissance - Geologic Mapping	1-2 days		█	█	█	█						
3 Select Final Monitor Well Locations	1-2 weeks					█	█					
4 Develop Drill Rig Access to New Well Locations	2-4 weeks							█	█	█		
5 Install Monitoring Wells	2-4 weeks							█	█	█		
6 Sample Additional Monitoring Wells	1-2 weeks								█	█	█	
7 Slug Test Additional Monitoring Wells	1-2 weeks									█	█	█
8 Survey New Monitoring Well Locations & TOC	2 days									█	█	█
9 Run Preliminary "BIOCHLOR" Model (MNA test)	1 week										█	█
10 Nature & Extent Report or Work Plan for additional work	4-8 weeks										█	█
Landfill Gas Management Plan												
1 Prepare a Landfill Gas Management Plan	2-4 weeks				█	█	█					
2 Submit Plan to NCDENR						█						

* = Work to be performed post hunting season

█ = Shaded cells represent the range of time in which it is anticipated that a task will be completed. Actual dates for field work will be coordinated with Davie County and the recreational land users of the property.