

**15A NCAC 13B .1623 GEOLOGIC AND HYDROGEOLOGIC INVESTIGATIONS FOR MSWLF FACILITIES**

(a) Site Hydrogeologic Report. In accordance with Rule .1618(c)(4) of this Section, a permit applicant shall conduct a hydrogeologic investigation and prepare a report. An investigation shall assess the geologic and hydrogeologic characteristics of the parcel on which the MSWLF unit is proposed to be constructed (hereinafter "site") to determine the suitability of the site for solid waste management activities; which areas of the site are most suitable for MSWLF units; and the general groundwater flow paths and rates for the uppermost aquifer. The report shall provide an understanding of the relationship of the site groundwater flow regime to local and regional hydrogeologic features with special emphasis on the relationship of MSWLF units to groundwater receptors such as drinking water wells, and to groundwater discharge features. Additionally, the scope of the investigation shall include the general geologic information necessary to address compliance with the location restrictions described in Rule .1622 of this Section. The Site Hydrogeologic Report shall provide the following information:

- (1) A report on local and regional geology and hydrogeology as defined in Rule .1618(c)(1) and (2) of this Section based on research of available literature for the area. This information is to be used in planning the field investigation. For sites located in piedmont or mountain regions, this report shall include a fracture trace analysis and Rose Diagram, based on an evaluation of structurally controlled features identified on a topographic map of the area.
- (2) A report on field observations of the site that includes information on the following:
  - (A) topographic setting, springs, streams, drainage features, existing or abandoned wells, rock outcrops including trends in strike and dip, and other features that may affect site suitability or the ability to effectively monitor the site;
  - (B) groundwater discharge features. For a proposed site where the owner or operator does not control the property from any landfill unit boundary to the controlling, downgradient, groundwater discharge features, additional borings, geophysical surveys, or other hydrogeological investigations shall be required to characterize the nature and extent of groundwater flow; and
  - (C) the hydrogeological properties of the bedrock, if the water table of the uppermost aquifer on any portion of the site is in the bedrock. For the purpose of this Rule, "bedrock" means material below auger refusal.
- (3) Borings for which the numbers, locations, and depths provide an understanding of the subsurface conditions and groundwater flow regime of the uppermost aquifer at the site. The number and depths of borings required shall depend on the hydrogeologic characteristics of the site. There shall be no less than an average of one boring for each 10 acres of the proposed landfill facility. All borings intersecting the water table shall be converted to piezometers or monitoring wells in accordance with 15A NCAC 02C .0108. Boring logs, field logs and notes, and well construction records for all onsite borings, wells, and piezometers shall be placed in the operating record, and shall also be provided to the Division upon request. Field logs and notes shall be legible; and may be typewritten.
- (4) A testing program for the borings that describes the frequency, distribution, and type of samples taken and the methods of analysis, such as ASTM Standards provided at <https://www.astm.org>, used to obtain the following information:
  - (A) standard penetration - resistance using a method such as ASTM D 1586;
  - (B) particle size analysis using a method such as ASTM D 6913;
  - (C) soil classification: Unified Soil Classification System using a method such as such as ASTM D 2487;
  - (D) formation descriptions; and
  - (E) saturated hydraulic conductivity, porosity, and effective porosity for each lithologic unit of the uppermost aquifer including the vadose zone.
- (5) In addition to borings, other investigation techniques may be used to obtain an understanding of the subsurface conditions at the site, including geophysical well logs, surface geophysical surveys, and tracer studies.
- (6) Stratigraphic cross-sections identifying hydrogeologic and lithologic units, and stabilized water table elevations.
- (7) Water table information, including:
  - (A) tabulations of water table elevations measured at the time of boring, 24 hours, and stabilized readings for all borings, measured within a period of time short enough to

- avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow direction and rate;
    - (B) tabulations of stabilized water table elevations over time to develop an understanding of seasonal fluctuations in the water table;
    - (C) an estimation of the long-term seasonal high groundwater table based on stabilized water table readings, hydrographs of wells in the area, precipitation and other meteorological and climatological data, and any other information available; and
    - (D) a discussion of any natural or man-made activities that have the potential for causing water table fluctuations, including tidal variations, river stage changes, flood pool changes of reservoirs, high volume production wells, and injection wells.
  - (8) The horizontal and vertical dimensions of groundwater flow, including flow directions, rates, and gradients.
  - (9) Groundwater contour map(s) to show the occurrence and direction of groundwater flow in the uppermost aquifer, and any other aquifers identified in the hydrogeologic investigation. The groundwater contours shall be superimposed on a topographic map. The location of all borings and rock cores and the water table elevations or potentiometric data at each location used to generate the groundwater contours shall be shown on the groundwater contour map(s).
  - (10) A topographic map of the site locating soil borings with accurate horizontal and vertical control which are tied to a permanent onsite benchmark.
  - (11) Information for public potable wells and public water supply surface water intakes, within the local study area in accordance with Rule .1618(c)(2) of this Section, including:
    - (A) available information and records for well construction, number and location served by wells, and production rates for public potable water wells; and
    - (B) available information for all surface water intakes, including location, use, and production rate.
  - (12) Identification of other geologic and hydrologic considerations, including slopes, streams, springs, gullies, trenches, solution features, karst terranes, sinkholes, dikes, sills, faults, mines, groundwater discharge features, and groundwater recharge and discharge areas.
  - (13) A report summarizing the geological and hydrogeological evaluation of the site that includes the following:
    - (A) a description of the relationship between the uppermost aquifer of the site to local and regional geologic and hydrogeologic features;
    - (B) a discussion of the groundwater flow regime of the site focusing on the relationship of MSWLF units to groundwater receptors and to groundwater discharge features;
    - (C) a discussion of the overall suitability of the proposed site for solid waste management activities and which areas of the site are most suitable for MSWLF units; and
    - (D) a discussion of the groundwater flow regime of the uppermost aquifer at the site and the ability to monitor the MSWLF units to ensure early detection of any release of monitored constituents to the uppermost aquifer.
- (b) Design Hydrogeologic Report. A geological and hydrogeological report shall be submitted in the application for the permit to construct in accordance with Rule .1617(a)(1) of this Section, and shall meet the following criteria.
- (1) The number and depths of borings required to characterize the geologic and hydrogeologic conditions of the site shall be based on the site-specific geologic and hydrogeologic characteristics of the site, and there shall be no less than an average of one boring for each acre of the area of investigation. The area of investigation shall be defined by the Division's review of the site study submitted in accordance with Rule .1618 of this Section. The scope and purpose of the investigation shall be as follows:
    - (A) The investigation shall provide information to demonstrate compliance with the vertical separation and foundation standards set forth in Rule .1624(b)(4) and (b)(7) of this Section, and Rule .1680(e) of this Section.
    - (B) The investigation shall provide detailed and localized data of the hydrogeologic characteristics of the uppermost aquifer for the proposed phase of MSWLF development and any leachate management systems to design an effective water quality monitoring system.
  - (2) The Design Hydrogeologic Report shall provide the following information:
    - (A) the information required in Subparagraphs (a)(4) through (a)(12) of this Rule;

- (B) any technical information that is necessary to determine the design of the monitoring system as required by Rule .1631(c) of this Section;
  - (C) any technical information that is necessary to determine the relevant point of compliance as required by Rule .1631(a)(2) of this Section;
  - (D) for sites located in the piedmont or mountain regions, rock cores of no less than the upper 10 feet of the bedrock to provide an understanding of the fractured bedrock conditions and groundwater flow characteristics of the area of investigation. Testing for the rock corings shall provide rock types; recovery values; rock quality designation (RQD) values; saturated hydraulic conductivity and secondary porosity values; and rock descriptions, including fracturing and jointing patterns;
  - (E) a groundwater contour map based on the estimated long-term seasonal high groundwater table that is superimposed on a topographic map and includes the location of all borings and rock cores and the water table elevations or potentiometric data at each location used to generate the groundwater contours;
  - (F) for sites located in piedmont or mountain regions, a bedrock contour map illustrating the contours of the upper surface of the bedrock that is superimposed on a topographic map and includes the location of all borings and rock cores and the top of rock elevations used to generate the upper surface of bedrock contours;
  - (G) a three-dimensional groundwater flow net or several hydrogeologic cross-sections that characterize the vertical groundwater flow regime for this area;
  - (H) a report on the groundwater flow regime for the area including groundwater flow paths for both horizontal and vertical components of groundwater flow, horizontal and vertical gradients, flow rates, and groundwater recharge areas and discharge areas; and
  - (I) if required by G.S. 89E, a certification by a licensed geologist that all borings that intersect the water table at the site have been constructed and maintained as permanent monitoring wells in accordance with 15A NCAC 02C .0108, or that the borings and temporary piezometers will be abandoned prior to landfill construction in accordance with the procedures for permanent abandonment of wells as delineated in 15A NCAC 02C .0113, except that at the time of abandonment, all piezometers within the MSWLF unit footprint area shall be overdrilled to the full depth of the boring or to the top of bedrock, whichever is encountered first, prior to grout placement. The level of the grout within the boring shall not exceed in height the elevation of the proposed base grade.
- (3) A water quality monitoring plan shall be submitted in the application for the permit to construct in accordance with Rule .1617(a)(1) of this Section, and shall include:
- (A) information on the proposed groundwater monitoring systems, sampling and analysis requirements, and detection monitoring requirements provided in Rules .1630 through .1637 of this Section. In addition to groundwater monitoring wells, the use of alternative monitoring systems may be required by the Division at sites where the owner or operator does not control the property from any landfill unit to the groundwater discharge features; or allowed by the Division at sites with hydrogeologic conditions favorable to detection monitoring by alternative methods. The number, spacing, and depths of groundwater monitoring points shall be determined based upon site-specific technical information that shall include an investigation of aquifer thickness, groundwater flow rate, and groundwater flow direction, including seasonal and temporal fluctuations in groundwater flow; and the thickness, stratigraphy, lithology, hydraulic conductivities, porosities, and effective porosities of the saturated and unsaturated geologic units, including fill materials, overlying and comprising the uppermost aquifer; and
  - (B) information on the surface water monitoring including:
    - (i) sample locations for surface water features on or bordering the facility property, including no less than one upstream and one downstream sample location;
    - (ii) sampling and analytical methods for surface water samples;
    - (iii) surface water samples shall be analyzed for constituents listed in Rule .1633(a) of this Section;
    - (iv) the monitoring frequency shall be no less than semiannual during the active life of the facility, and no less than semiannual during the closure and post-closure periods; and

- (v) information used for the development of the surface water monitoring system shall include drainage patterns and other hydrological conditions in the area; proximity of surface water to the facility; uses that are being or may be made of any surface water that may be affected by the facility; any other factors that relate to the potential for surface water impacts from the facility.
- (4) The MSWLF unit shall not cause an exceedance of the surface water standards established under 15A NCAC 02B .0200.
- (5) the final water quality monitoring plan shall be effective in providing early detection of any release of monitored constituents from any point in a MSWLF unit or leachate surface impoundment to the uppermost aquifer or surface waters, to be protective of public health and the environment; and
- (6) the final water quality monitoring plan shall be prepared under the charge of and bear the seal of a licensed professional engineer or licensed geologist, if required by G.S. 89C or 89E.

*History Note: Authority G.S. 130A-294;  
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