

## **15A NCAC 18A .1942 SOIL WETNESS CONDITIONS**

(a) Soil wetness conditions caused by seasonal high-water table, perched water table, tidal water, seasonally saturated soil or by lateral water movement shall be determined by field evaluation for soil wetness colors and field observations, and may be assessed by well monitoring, computer modeling, or a combination of monitoring and modeling as required by this Rule. All sites shall be evaluated by an Authorized Agent of the Department using Basic Field Evaluation Procedures pursuant to Paragraph (b) of this Rule.

(b) Basic Field Evaluation Procedures:

- (1) A soil wetness condition shall be determined by the indication of colors of chroma 2 or less (Munsell Color Charts) at  $\geq 2\%$  of soil volume in mottles or matrix of a horizon or horizon subdivision. However, colors of chroma 2 or less which are relic from minerals of the parent material shall not be considered indicative of a soil wetness condition.
- (2) A Soil wetness condition shall also be determined by the periodic direct observation or indication of saturated soils or a perched water table, or lateral water movement flowing into a bore hole, monitoring well, or open excavation above a less permeable horizon or horizon subdivision, that may occur without the presence of colors of chroma 2 or less. A soil wetness condition caused by saturated soils or a perched water table shall be confirmed to extend for at least three consecutive days. The shallowest depth to soil wetness condition determined by Subparagraph (b)(1) or (b)(2) of this Rule shall take precedence.

(c) Site Suitability as to Soil Wetness: Initial suitability of the site as to soil wetness shall be determined based upon the findings of the Basic Field Evaluation Procedures made pursuant to Paragraph (b) of this Rule. Sites where soil wetness conditions are greater than 48 inches below the naturally occurring soil surface shall be considered SUITABLE with respect to soil wetness. Sites where soil wetness conditions are between 36 and 48 inches below the naturally occurring soil surface shall be considered PROVISIONALLY SUITABLE with respect to soil wetness. Sites where soil wetness conditions are less than 36 inches below the naturally occurring soil surface shall be considered UNSUITABLE with respect to soil wetness. Sites where a soil wetness condition is determined based upon the observation or indication of lateral water movement within 48 inches of the naturally occurring soil surface shall be considered UNSUITABLE, except when such water can be intercepted in accordance with 15A NCAC 18A .1956(4).

(d) Alternative Procedures for Soil Wetness Determination: The Owner or the Owner's Legal Representative (Applicant) shall have the opportunity to submit documentation that the soil wetness condition and resultant site classification be alternately determined and reclassified by direct monitoring, computer modeling, or a combination of monitoring and modeling, in accordance with a Direct Monitoring Procedure, Monitoring and Modeling Procedure, or Modeling Procedure made pursuant to Paragraphs (e), (f), or (g) of this Rule. This determination shall take precedence over the determination made pursuant to the Basic Field Evaluation Procedures [Paragraph (b) of this Rule], when the conditions of Paragraphs (e), (f), or (g) of this Rule are met. Determination by one of these Monitoring or Modeling procedures shall also be required when:

- (1) the Owner proposes to use a wastewater system requiring a deeper depth to a soil wetness condition than the depth determined by the Basic Field Evaluation Procedures pursuant to Paragraph (b) of this Rule; or
- (2) the Owner proposes to use sites with Group III or IV soil within 36 inches of the surface and where drainage modifications are proposed to be made, including the installation of subsurface drain tile, open drainage ditches, or surface landscape modifications, or on such sites when fill is proposed to be used in conjunction with existing or proposed drainage modifications. Final determination of soil wetness condition for these sites shall be made pursuant to the Modeling Procedure in Paragraph (g) of this Rule

(e) Direct Monitoring Procedure. Soil wetness conditions may be determined by direct observation of the water surface in wells during periods of typically high water elevations utilizing the following monitoring procedures and interpretation method.

- (1) The applicant shall notify the local health department of the intent to monitor water surface elevations by submitting a proposal that includes a site plan, well and soil profile at each monitoring location, and a monitoring plan no later than 30 days prior to the monitoring period. An applicant other than the property owner shall have written authorization from the owner to be the owner's legal representative. Soil wetness and rainfall monitoring shall be conducted under the responsible charge of a third-party consultant or by the property owner or the owner's agent. A third party consultant is qualified when licensed or registered in accordance with G.S. 89C (Engineers), G.S. 89E (Geologists), G.S. 89F (Soil

- Scientists), or G.S. 90A Article 4 (Registered Sanitarians), if required. The Owner shall submit the name(s) of the consultant(s) performing any monitoring on their behalf to the local health department.
- (2) The applicant shall submit a site plan showing proposed sites for wastewater system, shall provide the longitude and latitude of the site, location of monitoring wells, and all drainage features that may influence the soil wetness conditions, and specify any proposed fill and drainage modifications.
  - (3) The applicant shall submit a monitoring plan indicating the proposed number, installation depth, screening depth, soil and well profile, materials and installation procedures for each monitoring well, and proposed method of analysis. A minimum of three water level monitoring wells shall be installed for water surface observation at each site. Additional wells shall be required for sites handling systems with a design flow greater than 600 gallons per day (minimum of one additional well per 600 gallons per day increment).
  - (4) The local health department shall be given the opportunity to conduct a site visit and verify the appropriateness of the proposed plan. Well locations shall include portions of the initial and replacement drainfield site(s) containing the most limiting soil/site conditions. Prior to installation of the wells the local health department shall approve the plan. If the plan is disapproved, the local health department shall include specific changes necessary for approval of the monitoring plan.
  - (5) Wells shall extend at least five feet below the natural soil surface, or existing soil surface for fill installed prior to July 1, 1977 meeting the requirements for consideration of a site with existing fill of G.S. 130A-341 and the rules adopted pursuant thereto. However, a well or wells which extend(s) down only 40 inches may be used if they provide a continuous record of the water table for at least half of the monitoring period, and one or more shallower wells may be required on sites where shallow lateral water movement or perched soil wetness conditions are anticipated.
  - (6) Water surface in the monitoring wells shall be recorded at least daily from January 1 to April 30, taken at the same time during the day (plus or minus three hours). A rain (precipitation) gauge is required within one-half mile of the site. At least daily rainfall shall be recorded beginning no later than December 1 through April 30 (the end of the well monitoring period).
  - (7) Interpretation Method for Direct Monitoring Procedure: The following method of determining depth to soil wetness condition from water surface observations in wells shall be used when the 60-day weighted rainfall index for the January through April monitoring period equals or exceeds the site's long-term (historic) 60-day weighted rainfall index for January to April rainfall with a 30 percent recurrence frequency (wetter than the 9th driest year of 30, on average). The 60-day weighted rainfall index for the monitoring period and historic rainfall record shall be computed as:

$$WRI_{60} = 0.5P_D + P_J + P_F + P_M + 0.5P_A$$

Where  $WRI_{60}$  = 60-day weighted rainfall index for January to April

$P_D$  = Total December rainfall

$P_J$  = Total January rainfall

$P_F$  = Total February rainfall

$P_M$  = Total March rainfall

$P_A$  = Total April rainfall

The Department shall prepare contour maps for each county where this interpretation procedure is proposed. Contours shall be prepared following standard interpolation procedures using normalized data collected from all National Weather Service Stations, or equivalent, from which appropriate data are available, at least prior to February 1 of the monitoring season. Data from each station shall be normalized by fitting a 2-parameter gamma distribution to the 60-day weighted rainfall index computed for at least the most recent three decades of historic data, in accordance with procedures outlined in Chapter 18 of the National Engineering Handbook, NRCS, USDA. From this fitted distribution, the 60-day weighted rainfall index for January through April rainfall with a 30%, 50%, 70% and 80% recurrence frequency shall be computed for each Station, to provide the raw data points from which the contour maps shall be prepared. From these maps, the site's 60-day weighted rainfall index for the January through April monitoring period shall be compared to the long-term (historic) January to April 60-day weighted rainfall index at different expected recurrence frequencies. The soil wetness condition shall be determined as the highest level that is continuously saturated for the number of consecutive days during the January through April monitoring period shown in the following table:

Recurrence Frequency Range January to April 60-Day Weighted Rainfall Index	Number of Consecutive Days of Continuous Saturation for Soil Wetness Condition
30% to 49.9%	3 days or 72 hours
50% to 69.9%	6 days or 144 hours
70% to 79.9%	9 days or 216 hours
80% to 100%	14 days or 336 hours

- (8) If monitoring well data is collected during monitoring periods that span multiple years, the year which yields the highest (shallowest) soil wetness condition shall be applicable.
- (f) Monitoring and Modeling Procedure: A combination of monitoring and modeling may be used to determine a soil wetness condition utilizing the following monitoring procedures and interpretation method.
- (1) The procedures described for the Direct Monitoring Procedure in Subparagraphs (e)(1), (2), (3), (4), (5), and (6) of this Rule shall be used to monitor water surface elevation and precipitation for determining soil wetness conditions by a combination of direct observation and modeling, except that the rainfall gauge and each monitoring well shall use a recording device and a data file (DRAINMOD-compatible) shall be submitted with the report to the local health department (devices shall record rainfall at least hourly and well water level at least daily).
  - (2) The ground water simulation model DRAINMOD shall be used to predict daily water levels over at least a 30 year historic time period after the model is calibrated using the water surface and rainfall observations made on-site during the monitoring period. The soil wetness condition shall be determined as the highest level predicted by the model to be saturated for a 14-day continuous period between January 1 and April 30 with a recurrence frequency of 30 percent (an average of at least 9 years in 30).
    - (A) Weather input files, required to run the DRAINMOD, shall be developed from hourly rainfall gauge data taken within a half-mile of the site and from daily temperature and hourly or daily rainfall data collected over a minimum 30-year period from the closest available National Weather Service, or equivalent, measuring station to the site. DRAINMOD weather data files on file with the Department shall be made available upon request to the applicant or applicant's consultants. Daily maximum and minimum temperature data for the January 1 through April 30 monitoring period, plus for at least 30 days prior to this period, shall be obtained from the closest available weather station.
    - (B) Soil and Site inputs for DRAINMOD, including a soils data file closest to the soil series identified, depths of soil horizons, estimated saturated hydraulic conductivity of each horizon, depth and spacing of drainage features and depression storage, shall be selected in accordance with procedures outlined in the DRAINMOD Users Guide, and guidance is also available in Reports 333 and 342 of the University of North Carolinas Water Resources Research Institute. DRAINMOD soils data files on file with the Department shall be made available upon request to the applicant or applicant's consultants.
    - (C) Inputs shall be based upon site specific soil profile descriptions. Soil and site input factors shall be adjusted during the model calibration process to achieve a best fit by least squares analysis of the daily observations over the whole monitoring period (mean absolute deviation between measured and predicted values no greater than eight inches), and to achieve the best possible match between the highest water table depth during the monitoring period (measured-vs-predicted) that is saturated for 14 consecutive days.
    - (D) For sites intended to receive over 1500 gallons per day, the soil wetness determination using DRAINMOD shall take into consideration the impact of wastewater application on the projected water table surface.
    - (E) The ground water simulation analysis shall be prepared and submitted to the local health department by individuals qualified to use DRAINMOD by training and experience and who are licensed or registered in North Carolina if required in G.S. 89C (Engineers), G.S. 89E (Geologists), and G.S. 89F (Soil Scientists). The local health department or Owner may

request a technical review by the Department prior to approval of the soil wetness condition determination.

(g) Modeling Procedure: A soil wetness condition may be determined by application of DRAINMOD to predict daily water levels over at least a 30 year historic time period after all site-specific input parameters have been obtained, as outlined in the DRAINMOD Users Guide. This modeling procedure shall be used when a ground water lowering system is proposed for a site with Group III or IV soils within 36 inches of the naturally occurring soil surface. This procedure shall also be used to evaluate sites with Group III or IV soils within 36 inches of the naturally occurring soil surface, where the soil wetness condition was initially determined using a procedure described in Paragraphs (e) or (f) of this Rule and where drainage modifications are proposed or when fill is proposed to be used in conjunction with existing or proposed drainage modifications. The soil wetness condition shall be determined as the highest level predicted by the model to be saturated for a 14-day continuous period between January 1 and April 30 with a recurrence frequency of 30 percent (an average of at least 9 years in 30).

- (1) Weather input files, required to run DRAINMOD, shall consist of hourly rainfall and daily temperature data collected over the entire period of record but for at least a 30-year period from the closest available National Weather Service, or equivalent, measuring station to the site. DRAINMOD weather data files on file with the Department shall be made available upon request to the applicant or applicant's consultants.
- (2) Soil and Site inputs for DRAINMOD, including a soils data file closest to the soil series identified, depths of soil horizons, hydraulic conductivity of each horizon, depth and spacing of proposed drainage features and surface storage and drainage parameters, shall be selected in accordance with procedures outlined in the DRAINMOD User's Guide. DRAINMOD soils data files on file with the Department shall be made available upon request to the applicant or applicant's consultants. Inputs shall include:
  - (A) Soil input file with the soil moisture characteristic curve and data for the soil profile that is closest to the described soil profile that is present on the site;
  - (B) Soil horizon depths determined on site;
  - (C) Site measured or proposed drain depth and spacing, and drain outlet elevation;
  - (D) In-situ saturated hydraulic conductivity measurements for at least three representative locations on the site and at each location for at least three most representative soil horizons within five feet of the surface. Conductivity measurements shall be for one representative soil horizon at or above redoximorphic depletion features and two representative soil horizons at and below redoximorphic concentration features at each location on the site;
  - (E) All other model parameters based upon the DRAINMOD User's Guide, or other accepted values consistent with the simulation model; and
  - (F) A sensitivity analysis shall be conducted for the following model parameters:
    - (i) Soil input files for at least two other most closely related soil profiles;
    - (ii) Saturated hydraulic conductivity of each of horizons measured on-site;
    - (iii) Drain depth and spacing; and
    - (iv) Surface storage and depth of surface flow inputs.

The sensitivity analysis shall be used to evaluate the range of soil and site characteristics for choosing input parameters related to the soil profiles, hydraulic conductivity input values based upon the range of hydraulic conductivity values measured on the site, and inputs for surface and subsurface drainage features based upon the range of possible elevations and distances that occur or may occur after installation of improvements. The sensitivity analysis shall establish which parameters are most critical for determination of the depth to soil wetness condition. Conservative values for the most critical parameters shall be used in applying the model to the site.

- (3) For sites designed to receive over 600 gallons per day, the soil wetness determination using DRAINMOD shall take into consideration the impact of wastewater application on the projected water table surface.
- (4) The ground water simulation analysis shall be prepared and submitted to the local health department by individuals qualified to use DRAINMOD by training and experience and who are licensed or registered in North Carolina if required in G.S. 89C (Engineers), G.S. 89E (Geologists), and G.S. 89F (Soil Scientists). The local health department shall submit the ground water simulation analysis to the Department for technical review prior to approval of the soil wetness condition determination.

(h) A report of the investigations made for the Direct Monitoring Procedure, Monitoring and Modeling Procedure or Modeling Procedure pursuant to Paragraphs (e), (f), or (g) of this Rule shall be prepared prior to approval of the soil wetness condition determination. Reports prepared by a licensed or registered professional shall bear the professional seal of the person(s) whom conducted the investigation (Engineer, Geologist, Soil Scientist or Registered Sanitarian). A request for technical review of the report by the Department shall include digital copies of monitoring data and digital copies of model inputs, output data, and graphic results, as applicable.

(j) Where the site is UNSUITABLE with respect to soil wetness conditions, it may be reclassified PROVISIONALLY SUITABLE if a modified, alternative or innovative system can be installed in accordance with 15A NCAC 18A .1956, .1957, or .1969.

*History Note: Authority G.S. 130A-335(e);  
Eff. July 1, 1982;  
Amended Eff. January 1, 1990;  
Temporary Amendment Eff. June 24, 2003; April 17, 2002;  
Amended Eff. May 1, 2004.*