APPENDIX

DRAINAGE TO MANAGE THE LEVEL OF SEASONAL WATER IN SOILS

I. Introduction

The design, installation and maintenance of engineered drainage systems shall comply with the requirements of rule 3701-29-16 of the Administrative Code and this appendix. Engineered drainage systems consist of uniformly spaced drains placed at a depth to lower seasonal saturation in the soil throughout the year to provide a sufficient thickness of unsaturated soil to meet the vertical separation distance requirements at a site. Engineered drainage systems can be designed using analytical solutions with confirmation monitoring or computer simulation models to determine the drain configuration to achieve the amount of drawdown of the seasonal water table required.

II. Siting Limitations and Conditions for use

(A) Engineered drainage systems may be designed and installed on sites where analytical models with confirmation monitoring or computer simulation models demonstrate that the drainage systems can lower the seasonal water table the minimum number of days each year to the depth necessary to provide a thickness of unsaturated soil beneath the soil absorption area to meet the vertical separation distances required.

(B) The design and performance of the engineered drainage system must meet the specifications of paragraphs (E) and (F) of rule 3701-29-16 of the Administrative Code.

III. Engineered drainage system design options.

(A) Analytical solution with confirmation monitoring procedure. A system owner may present a design plan for constructing an engineered drainage system based on an analytical solution combined with water level monitoring during periods of typically high soil water elevations over a period of time to demonstrate the drawdown achieved by using the following procedures and interpretation method:

(1) The proposed STS design shall include the design plan and specifications of the engineered drainage system using an analytical solution including but not limited to the ellipse equation or Hooghoudt's modification of the ellipse equation as defined in Chapters 4 of Section 16, NRCS National Engineering Handbook

(1971), Chapter 14 of Part 650, NRCS National Engineering Handbook (2001), or other equivalent drainage calculations.

(2) The design plan shall include the supporting engineering calculations of drain spacing and drawdown, the methodology and process to monitor water surface elevations by submitting a design that includes a soil evaluation, the monitoring well location, well and soil profile at each proposed monitoring location, and a monitoring plan.

(3) The design plan shall include the materials, drainage construction specifications and layout of the engineered drainage system.

(4) The monitoring plan shall include:

(a) The proposed number, installation depth, screening depth, soil and well profile, materials and installation procedures for each monitoring well, and proposed method of measurement.

(b) A minimum of three water level monitoring wells shall be installed for water surface observation at each site.

(c) Monitoring well locations shall include portions of the soil absorption areas containing the most limiting soil/site conditions.

(d) Monitoring wells shall extend at least four feet below the natural soil surface, or to the top of the limiting condition, whichever is shallower.

(e) Additional monitoring wells shall be required for sites handling systems with a design flow greater than six-hundred gallons per day with a minimum of one additional monitoring well per six hundred gallons per day increment.

(5) Local conditions may require the evaluation of the proposed loading rates from the STS as part of the direct monitoring procedures as determined by the designer or the board of health.

(6) Measurements of seasonal saturation in the soil and rainfall monitoring shall be conducted under the responsible charge of a third-party consultant with assistance by the property owner or the owner's agent. A third party consultant is qualified when registered as a professional engineer in the state of Ohio, American Institute of Professional Geologists certified professional geologist, or Soil

Science Society of America certified soil scientist, or other individuals approved by the department. The property owner may collect the measurements under the supervision of the third-party consultant. The property owner shall submit the name(s) of the consultant(s) performing any monitoring on their behalf to the board of health.

(7) The 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. An on-site rain 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. National Weather Service or Ohio Department of Natural Resources, Division of Soil and Water Resources rainfall data may be used in lieu of an on-site rain gauge if available within ten miles of the site. If rainfall for the monitoring period differs by more than twenty-five per cent of normal rainfall for the area based on National Weather Service records, then additional monitoring for a longer period of time may be required.

(8) The interpretation of the well monitoring data, precipitation and drainage drawdown and probability determinations of drainage performance will follow guidance prepared by the department or standards of practice as described in the NRCS National Engineering Handbook (2001).

(B) Computer simulation models. Two and three dimensional computer simulation models may be used to design an engineered drainage system for a site and predict the performance of the system. The computer model must be capable of simulating a water balance for the soil profile including infiltration of precipitation, evapotranspiration, and drainage and provide a prediction for seasonal water table levels in the soil. Computer simulation models may include but are not limited to DRAINMOD, HYDRUS2 or other computer simulation models approved by the director.

(1) The depth to seasonal saturation with engineered drainage installed may be determined by application of computer simulation models to predict daily water levels over at least a thirty year historic time period. The output of results from the model shall be used to evaluate where the seasonal saturation in the soil horizon is present based on a proposed drainage modification to the site.

(a) The seasonal saturation in the soil with drainage modifications shall be determined as the highest level predicted by the model to

be saturated for thirty day continuous period annually with a recurrence frequency of thirty per cent.

(b) Drainage modifications to a site must successfully achieve no less than the elevation, duration of days of saturation, and the frequency of occurrence as cited above and as required in rule 3701-29-16 of the Administrative Code.

(c) For sites designed to receive over six-hundred gallons per day, the computer simulation model shall take into consideration the impact of effluent application on the projected water table surface. Local conditions may require the evaluation of the proposed loading rates from the STS as part of the modeling procedures as determined by the designer or the board of health.

(d) The ground water simulation analysis shall be prepared and submitted to the board of health by individuals that can demonstrate competency in the use of the computer simulation models by training and experience and who are registered professional engineers in Ohio, American Institute of Professional Geologists certified professional geologist, Soil Science Society of America certified soil scientist, or other individuals approved by the department.

(e) Data inputs for the computer simulation models shall follow all applicable requirements of the user's guide for the model including, but not limited to long term precipitation data, soil and site data most applicable to the conditions determined at the site being modeled, hydraulic conductivity of each soil horizon, depth and spacing of proposed drainage features and surface storage and drainage parameters.

(f) A sensitivity analysis shall be performed 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 on 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.