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3745-511-01 **Design - applicability.**

The rules in this multi-program chapter shall apply when referenced in either of the following:

(A) A rule in a program chapter.

(B) A rule in another multi-program chapter that was made applicable by a rule in a program chapter.

Program chapters are Chapters 3745-520 to 3745-599 of the Administrative Code.

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3745-511-02 **Design - definitions.**

If a term used in this chapter is defined in rule 3745-500-02 of the Administrative Code, that definition used in rule 3745-500-02 of the Administrative Code is applicable to this chapter unless the term is defined in this rule. As used in this chapter:

(A) [Reserved.]

(B) [Reserved.]

(C) "Compressible material" means in situ soils, added geologic material, structural fill, recompacted soil liner, recompacted soil barrier layer, or material comprised of soil, C&DD, or waste that may settle after being subjected to increased vertical compressive stress.

(D) [Reserved.]

(E) [Reserved.]

(F) [Reserved.]

(G) [Reserved.]

(H) "Hydrostatic surface" means the uppermost piezometric surface and potentiometric surface as those terms are defined in rule 3745-500-02 of the Administrative Code.

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3745-511-10 **Geotechnical and stability analyses and reporting.**

(A) The applicant shall comply with rules 3745-511-10 to 3745-511-72 of the Administrative Code, as applicable, to demonstrate the geotechnical performance and stability of the design and that the subsurface foundation can support the facility. The demonstration shall include analyses and a report that provide sufficient information to the permitting authority for a complete evaluation of the geotechnical performance of the design, the stability of the design, and the stability of the subsurface foundation of the facility. The geotechnical and stability analyses shall be based on the data collected in accordance with Chapter 3745-510 of the Administrative Code.

(B) Each section of the geotechnical and stability report shall be clearly labeled.

(C) The first section of the geotechnical and stability report shall be titled "Summary and Conclusions" and shall include at a minimum the following information:

(1) A summary of findings and conclusions, including slope limitations and criteria for removal of undesirable material, from the site investigation report that are pertinent to the geotechnical and stability analyses.

(2) A summary of findings and conclusions, including slope limitations and criteria for removal of undesirable material, from the geotechnical and stability analyses pertinent to the evaluation of the design of the facility.

(3) A table summarizing the field measurements, field test results, laboratory measurements, and laboratory test results pertinent to the geotechnical and stability analyses associated with the critical layers and compressible layers.

(4) For all values used in the geotechnical and stability analyses that were not based on field measurements, field test results, laboratory measurements, or laboratory test results, a table summarizing the values, the rationale used to determine the values, and references to any source material that was used to determine the values. These values include but are not limited to the following:

(a) Saturation levels.

(b) Phreatic and piezometric surfaces.

(c) Compressibility characteristics and shear strengths of non-critical layers.

(d) Non-compressible layers.

(e) Waste or C&DD layers that were not sampled and tested during the site investigation.

(5) A table summarizing the geotechnical and stability analyses that were conducted and the results of those analyses.

(D) The geotechnical and stability analyses report shall contain a certification statement and applicant's signature in accordance with rule 3745-500-50 of the Administrative Code.

(E) The geotechnical and stability analyses report shall be signed and, if appropriate, sealed by such professionals skilled in the appropriate disciplines as is necessary to comply with Ohio laws and rules.

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3745-511-20 **Hydrostatic uplift analysis and reporting.**

(A) The hydrostatic uplift analysis of the liner system shall demonstrate that the facility is designed to have a factor of safety of at least 1.4 against failure of any engineered component due to hydrostatic uplift at the surfaces described in paragraphs (B)(1) to (B)(3) of this rule and upon the structures described in paragraph (B)(4) of this rule. The factor of safety shall not be based on any influence or depression of the phreatic surface or peizometric surface caused by the operation or use of temporary or mechanical ground water control structures.

(B) Analysis for the hydrostatic uplift shall address the following:

(1) Critical locations along the surface where the liner system recompacted soil liner is to be placed.

(2) If no liner system recompacted soil liner will be used, the critical locations along the surface where the leachate collection system drainage layer will be placed.

(3) If no liner system recompacted soil liner and no leachate collection system drainage layer will be used, the critical locations located two feet below the basal elevations of the disposal limits.

(4) Underground structures at the facility.

(C) The geotechnical and stability analyses of the liner system shall not rely on any of the tensile qualities of any of the geosynthetic engineered components included in the design other than those engineered components used primarily for tensile reinforcement.

(D) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Hydrostatic Uplift Analysis" which shall include the following information:

(1) The scope, extent, and findings from the site investigation bearing on hydrostatic uplift.

(2) A description of the rationale used for the selection of the analysis input parameters.

(3) A description of the method used to calculate hydrostatic uplift.

(4) A description of the assessed conditions.

(5) A description of the rationale used for the selection of the critical cross section that, at a minimum, shall consider the worst case interaction of the highest

critical hydrostatic surface with the surfaces and structures identified in paragraphs (B)(1) to (B)(4) of this rule.

(6) An isopach map showing the differences between the highest critical hydrostatic surface and the top of the surfaces and basal elevations of the structures identified in paragraphs (B)(1) to (B)(4) of this rule.

(7) An isopach map of the thickness of material between the top of the surface identified in paragraphs (B)(1) to (B)(3) of this rule and the top of the zone of saturation.

(8) A drawing of each critical cross section that shows the details of the input information for the analysis model including the following:

(a) The material boundaries.

(b) The applicable dimensions, including the difference between the top of the highest critical hydrostatic surface and the top of the zone of saturation and the difference between the top of the surfaces identified in paragraphs (B)(1) to (B)(3) of this rule and the height, width, length, and diameter of the structures identified in paragraph (B)(4) of this rule.

(c) The material types.

(d) The in situ unit weights and saturated unit weights of the materials.

(9) All inputs, outputs, and calculations used for the hydrostatic uplift analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

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3745-511-25 **Seepage force analysis and reporting.**

(A) The seepage force analysis shall determine whether seepage forces exist, and if present, analyze those phases where the hydrostatic surface is determined to be higher than the basal elevations of any excavations within and adjacent to the disposal limits. The analysis of seepage forces shall demonstrate that the facility is designed to meet the factors of safety in paragraph (B) of this rule against the critical hydraulic gradient of the recompacted soil liner and the foundation soils arising from seepage forces caused by reaching or exceeding the critical hydraulic gradient.

(B) The factors of safety against the critical hydraulic gradient shall be the following:

(1) The factor of safety shall be 1.5 at all points along the basal elevations of all excavations within and adjacent to the disposal limits.

(2) If temporary or mechanical ground water control structures are necessary to meet the factor of safety in paragraph (B)(1) of this rule and a recompacted soil liner is a component of the liner system, the factor of safety shall be 2.0 at all points along the surface of the recompacted soil liner. The factor of safety for this paragraph shall not be based on any influence or depression of the hydrostatic surface caused by the operation or use of the temporary or mechanical ground water control structures.

(C) The seepage force analysis shall assess sources and steady state conditions including but not limited to the following:

(1) Unlined sediment and storm water management basins with hydrostatic head at the designed maximum operating pool level.

(2) Unlined ditches with hydrostatic head from full flow conditions.

(3) Surface waters of the state.

(4) Aquifers.

(5) Significant zones of saturation.

(D) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Seepage Forces Analysis" which shall include the following information:

(1) The scope, extent, and findings from the site investigation bearing on seepage forces.

(2) A description of the rationale used for the selection of the analysis input parameters.

(3) A description of the method used to calculate the seepage gradients.

(4) A description of the assessed failure modes and conditions including at a minimum the surface and subsurface sources for seepage gradients.

(5) A description of the rationale used for the selection of the critical cross section analyzed. At a minimum, the location with the highest critical hydrostatic surface with the minimum distance between the effective source of seepage and the critical point being analyzed shall be included.

(6) An isopach map depicting the differences between the highest critical hydrostatic surface and the surfaces required to be analyzed in accordance with paragraph (B) of this rule.

(7) A drawing of each critical cross section that shows the details of the input information for the analysis model including the following:

(a) The material boundaries and the highest temporal hydrostatic surface.

(b) The applicable dimensions, including the depth of excavation, the depth to the top of the recompacted soil liner, the depth to saturation, the depth to the highest critical hydrostatic surface, and the depth to the top of the source of the hydrostatic head being analyzed.

(c) The material types.

(d) The in situ unit weight, saturated unit weight, specific gravity, and void ratio of the materials.

(8) All inputs, outputs, and calculations used for the seepage force analysis and a drawing of the critical cross section showing the following as appropriate for the analytical method used:

(a) Flow net with boundary flow and equipotential lines.

(b) Phreatic or piezometric lines.

(c) Boundary conditions.

(d) Flow vectors and areas with the highest flow velocities.

(e) Points of critical seepage identifying areas with the highest exiting gradient with the gradient listed.

(f) The in situ unit weight, saturated unit weight, specific gravity, and void ratio values used.

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3745-511-30 **Bearing capacity analysis and reporting.**

(A) A bearing capacity analysis shall be conducted for all vertical sump risers located on the liner system and shall demonstrate that the design of the liner system and the vertical sump risers provides a factor of safety of at least 3.0 against bearing capacity failure caused by the vertical sump risers.

(B) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Bearing Capacity Analysis of Vertical Sump Risers" which shall include the following information:

(1) The scope, extent, and findings of the site investigation bearing on the bearing capacity analysis.

(2) A description of the rationale used for the selection of the analysis input parameters.

(3) A description of the method used to calculate bearing capacity.

(4) A description of the assessed failure modes and conditions.

(5) A drawing of each critical cross section that fully depicts the analysis input model including the following:

(a) The material boundaries.

(b) The temporal high piezometric surface and temporal high phreatic surface.

(c) The material types.

(d) The in situ unit weights and saturated unit weights.

(6) A cross section of each vertical sump riser showing the liner system, subsurface, and failure surfaces.

(7) All inputs, outputs, and calculations used for the bearing capacity analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

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3745-511-40 **Static stability analysis and reporting.**

(A) The static analyses required by this rule shall be used to demonstrate the following:

(1) The minimum interface and internal shear strengths of engineered components and the materials will provide the factors of safety required by this rule.

(2) The minimum factors of safety are met using shear strengths for the in situ foundation materials. Shear strength is determined by the laboratory testing performed during the site investigation conducted in accordance with Chapter 3745-510 of the Administrative Code.

(B) An assessment using a two dimensional limit equilibrium method of failure modes and conditions that at a minimum shall include the following:

(1) Short-term deep-seated translational and rotational failure. This analysis shall demonstrate, using total stress shear strengths and appropriate pore water pressures, that the following slopes have a factor of safety of at least 1.30 against failure:

(a) Internal slopes.

(b) Excavated slopes.

(c) Interim slopes.

(d) Final slopes.

(2) Long-term deep-seated translational and rotational failure. This analysis shall demonstrate, using effective stress shear strengths, that the following slopes have a factor of safety of at least 1.50 against failure:

(a) Interim slopes.

(b) Final slopes.

This analysis is not required if either the pore water pressure will dissipate within one year and the factor of safety of the static stability analysis described in paragraph (B)(1) of this rule is at least 1.50 or if the construction and filling sequence or features of the facility will buttress the slope.

(3) Shallow translational and rotational failure for drained conditions. This analysis shall demonstrate that the following slopes have a factor of safety of at least 1.50 against failure:

(a) If the design includes a liner system, internal slopes.

(b) Final slopes.

(4) Shallow translational and rotational failure of final slopes for saturated conditions. This analysis shall demonstrate that, with the head on the cap barrier layer equivalent to the thickness of the drainage layer, the cap system has a factor of safety of at least 1.10 against failure.

(5) Shallow translational and rotational failure of the leachate collection system drainage layer and protective layer and of the cap system drainage layer and cap system protection layer. This analysis shall demonstrate that these layers have a factor of safety of at least 1.10 against failure using residual shear strengths and static equipment loading.

(6) Dynamic loading on access roads built into or onto excavated slopes, internal slopes, or the cap system. This analysis shall demonstrate that the integrity of the liner system, leachate management system, and cap system will not be impaired using anticipated dynamic loading.

(C) For all slopes greater than 5.0 per cent that may be loaded with one thousand four hundred forty pounds per square foot or more of vertical compressive stress, the residual shear strength shall be used during the assessment of failure mechanisms for all interfaces between geosynthetics and for all interfaces between a geosynthetic and another material.

(D) The geotechnical and stability analyses of the liner system or the cap system shall not rely on any of the tensile strength properties of any of the geosynthetic engineered components included in the design other than those engineered components used primarily for tensile reinforcement.

(E) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Static Stability Analysis" which shall contain the following information:

(1) The scope, extent, and findings of the site investigation and earthen materials testing program bearing on static stability.

(2) A description of the rationale used for the selection of the analysis input parameters.

(3) A description of the method used to calculate static stability.

(4) For each of the failure modes and conditions assessed, a description of the rationale used for the selection of the critical cross sections for the excavated slopes, internal slopes, interim slopes, and final slopes.

(5) A drawing of each critical cross section that fully depicts the analysis input model including the following:

(a) The material boundaries.

(b) The highest temporal phreatic surfaces and highest temporal piezometric surfaces.

(c) The material types.

(d) The in situ weights and the saturated unit weights of the materials.

(e) The material shear strengths.

(6) The plan view showing the locations of the critical cross sections that includes the northings and eastings for the endpoints of the critical cross sections.

(7) A summary of the results using a two dimensional limit equilibrium method for each of the critical cross sections.

(8) All inputs, outputs, and calculations used for the static stability analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

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3745-511-50 **Seismic stability analysis and reporting.**

(A) The seismic analyses required by this rule shall be used to determine the minimum shear strengths of engineered components and materials necessary to provide the factors of safety required by this rule.

(B) The seismic stability analysis shall demonstrate that the facility is designed to have a factor of safety of at least 1.00 against failure using a two dimensional limit equilibrium method and using a return period of two thousand five hundred years. The seismic stability analysis shall include an assessment of failure modes and conditions that at a minimum shall include the following:

(1) If the design includes a liner system, long-term deep-seated translational and rotational failure mechanisms of the interim slopes using effective stress shear strengths.

(2) Long-term deep-seated translational and rotational failure mechanisms of the final slopes using effective stress shear strengths.

(3) Shallow translational and shallow rotational failure mechanisms of final slopes for unsaturated conditions.

(4) Liquefaction failure mechanisms.

[Comment: The return period of two thousand five hundred years is cited to allow use of different seismic hazards maps. Therefore, the map published by the U.S. geological survey depicting the peak horizontal acceleration with two per cent probability of exceedance in fifty years is acceptable.]

(C) For all slopes greater than 5.0 per cent that may be loaded with one thousand four hundred forty pounds per square foot or more of vertical compressive stress, the residual shear strength shall be used during the assessment of failure mechanisms for all interfaces between geosynthetics and for all interfaces between a geosynthetic and another material.

(D) The geotechnical and stability analyses of the liner system or the cap system shall not rely on any of the tensile qualities of any of the geosynthetic engineered components included in the design other than those engineered components used primarily for tensile reinforcement.

(E) The geotechnical and stability report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Seismic Stability Analysis" which shall contain the following information:

(1) The scope, extent, and findings of the site investigation and earthen materials testing program bearing on seismic stability.

(2) A description of the rationale used for the selection of the analysis input parameters.

(3) A description of the method used to calculate the seismic stability.

(4) For each of the failure modes and conditions, a description of the rationale used for the selection of the critical cross sections for the interim slopes and final slopes.

(5) A drawing of each critical cross section that fully depicts the analysis input model including the following:

(a) The material boundaries.

(b) The highest temporal phreatic surface and the highest temporal piezometric surface.

(c) The material types.

(d) The in situ unit weights and the saturated unit weights of the materials.

(e) The material shear strengths.

(6) A plan view showing the location of each critical cross section including the northings and eastings for the endpoints of each critical cross section.

(7) A summary of the results using a two dimensional limit equilibrium method for each of the critical cross sections.

(8) All inputs, outputs, and calculations used for the seismic stability analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

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3745-511-60 **Settlement analysis and reporting for the liner system and leachate management system.**

(A) The settlement analysis shall demonstrate that the liner system is designed to meet the design requirements for the liner system after accounting for the following:

(1) The total mass of materials above the liner system.

(2) One hundred per cent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the surface of the liner system. Secondary settlement shall be calculated using a one hundred-year time frame.

(B) The settlement analysis shall demonstrate that the leachate management system is designed to meet the design requirements for the leachate management system after accounting for the following:

(1) The total mass of materials above the leachate management system.

(2) One hundred per cent of the primary consolidation settlement and the secondary consolidation settlement of the compressible materials beneath the leachate collection system. Secondary settlement shall be calculated using a one hundred-year time frame.

(C) The geotechnical and stability analyses of the liner system shall not rely on any of the tensile strength properties of any of the geosynthetic engineered components included in the design other than those engineered components used primarily for tensile reinforcement.

(D) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall include a section titled "Settlement Analysis of the Liner System and Leachate Management System" which shall include the following information:

(1) A description of the rationale used for the selection of the settlement analysis input parameters.

(2) A description of the method used to calculate settlement.

(3) A description of the assessed settlement modes and conditions.

(4) A drawing of each critical cross section that fully depicts the analysis input model including the following:

(a) The liner system.

(b) The leachate management system.

(c) The material boundaries.

(d) The material characteristics.

(e) The material types.

(f) The in situ unit weights and saturated unit weights of the materials.

(5) A plan view showing the location of each critical cross section including northings and eastings for the endpoints of each critical cross sections.

(6) A summary of the results.

(7) All inputs, outputs, and calculations used for the settlement analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

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3745-511-65 **Settlement analysis and reporting for the separatory leachate barrier and collection system.**

(A) The settlement analysis shall demonstrate that the design requirements for the separatory leachate barrier and collection system will be met after accounting for the following:

(1) The total mass of materials above the separatory leachate barrier and collection system.

(2) One hundred per cent of the initial consolidation settlement, primary consolidation settlement, and the secondary consolidation settlement of the compressible materials beneath the surface of the separatory leachate barrier and collection system. Secondary settlement shall be calculated using a one hundred-year time frame.

(B) The geotechnical and stability analyses of the separatory leachate barrier and collection system shall not rely on any of the tensile qualities of any of the geosynthetic engineered components included in the design other than those engineered components used primarily for tensile reinforcement.

(C) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall include a section titled "Settlement Analysis of the Separatory Leachate Barrier and Collection System" which shall include the following information:

(1) The scope, extent, and findings of the site investigation and earthen materials testing program bearing on the settlement analysis.

(2) A description of the rationale used for the selection of the settlement analysis input parameters.

(3) A description of the method used to calculate settlement.

(4) A description of the assessed settlement modes and conditions.

(5) A drawing of each critical cross section that fully depicts the analysis input model including the following:

(a) The liner system.

(b) The leachate management system.

(c) The material boundaries.

(d) The material characteristics.

(e) The material types.

(f) The in situ unit weights and saturated unit weights of the materials.

(6) A plan view showing the location of each critical cross section including northings and eastings for the endpoints of each critical cross sections.

(7) A summary of the results.

(8) All inputs, outputs, and calculations used for the settlement analysis. If a computer was used for any calculations, the computer inputs and outputs shall also be included.

3745-511-70 **Unstable areas.**

(A) The owner or operator shall demonstrate that the facility will not be affected by the inherent instability of the area and is designed to maintain the integrity of the engineered components. For the in situ foundation, the owner or operator shall demonstrate that the integrity is maintained within fifty feet of the basal elevations of the deepest excavation at the facility.

(B) The geotechnical and stability analyses report identified in rule 3745-511-10 of the Administrative Code shall include a section titled "Unstable Areas" which shall include the following information:

(1) The scope, extent, and findings of the site investigation bearing on unstable areas.

(2) Drawings, cross-sections, and calculations necessary to demonstrate compliance with paragraph (A) of this rule.

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3745-511-72 **Underground mines.**

(A) The owner or operator shall demonstrate that the facility will not be affected by any underground mines at the facility and that the facility is designed to maintain the integrity of the engineered components.

(B) The geotechnical and stability report identified in rule 3745-511-10 of the Administrative Code shall contain a section titled "Underground Mines" which shall include the following information:

(1) The location of any and all underground mines based on the findings of the site investigation and the letter required by rule 3745-510-335 of the Administrative Code from the Ohio department of natural resources division of mineral resources management or other appropriate agency regarding the respective underground mines.

(2) The angle of draw for the underground mines.

(3) The following, as appropriate:

(a) An analysis by a professional engineer, with at least five years of relevant experience in the abatement of mines, that demonstrates the facility will not be affected by the underground mines and the design of the facility will maintain the integrity of the engineered components. For the in situ foundation, the owner or operator shall demonstrate that the integrity will be maintained within fifty feet of the basal elevations of the deepest excavation at the facility.

(b) If any underground mine has been or will be removed, a description of how the mine has been or will be removed. The description shall include scale drawings showing the vertical and lateral extent of mine removal activities in relation to the boundary of the facility and the disposal limits.

(c) If any underground mine will be filled to eliminate the potential for subsidence, a description of the filling activities. The description shall include the grout mixes to be used, the rationale for selection of grout, and how the grout will be injected.

3745-511-120 **Access roads.**

(A) Access roads shall be designed to have grades of twelve per cent or less.

(B) For an access road located on internal slopes, the liner system, the leachate management system, or the cap system, the access road shall conform to the requirements to meet the static stability standards in rule 3745-511-40 of the Administrative Code.

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3745-511-210 **Ground water control structures.**

(A) Temporary and permanent ground water control structures shall be designed to meet the following criteria:

(1) Engineered components of the liner system shall not be used as ground water control structures.

(2) Maintenance of the ground water control structures is minimal.

(3) For permanent ground water control structures, control of ground water flow shall be through the use of non-mechanical means (such as impermeable barriers or permeable drainage structures) to prevent the following:

(a) Flow of ground water through the liner into the disposal limits.

(b) Damage to the liner system from seepage forces caused by high gradients.

(B) No permanent ground water control structures may be used to permanently dewater an aquifer system, except if the recharge and discharge zones of the aquifer system are located entirely within the facility boundary.

(C) Temporary ground water control structures using mechanical or non-mechanical means may be used to depress the phreatic or piezometric surface to address seepage or hydrostatic uplift below the liner system. Temporary ground water control structures may be in operation while the liner system is constructed and during operations of the facility. However, in accordance with rules 3745-511-20 and 3745-511-25 of the Administrative Code, the effects of depressing the phreatic or piezometric surface cannot be used in determining the factor of safety against hydrostatic uplift and seepage forces.

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3745-511-220 **Foundations.**

(A) This rule applies to in situ foundation, added geologic material, structural fill, and embankments.

(B) Foundations shall conform to the requirements to meet the stability standards in rules 3745-511-20 to 3745-511-72 of the Administrative Code.

(C) If the surface of the foundation is immediately beneath the liner system or cap system, the surface of the foundation shall have no abrupt changes in grade that may result in damage to the liner system or cap system.

(D) For structural fill and embankments, if the surface is vegetation, the surface shall have a maximum slope length between ditches that shall result in an erosion rate of not more than five tons per acre per year as calculated using the "Universal Soil Loss Equation," "Revised Universal Soil Loss Equation," or the "Water Erosion Prediction Project Model" as described in rule 3745-500-03 of the Administrative Code assuming disturbed soils and the soils are highly susceptible to rill erosion.

(E) For embankments, the interior and exterior slopes shall be protected from erosion. If an embankment supports a liner system, the surface of the liner system shall also be protected from erosion. Means of erosion protection shall include one or a combination of the following:

(1) Permanent vegetation.

(2) Pavement.

(3) Any alternative means that was approved by the permitting authority so long as the alternative means will protect the slope from erosion and discourage the growth of deep-rooted plants.

(F) For above ground embankments, also conform to both of the following:

(1) Have a width at the top that is not less than eight feet.

(2) Have slopes that shall not exceed twenty-five per cent provided the embankment will be protected from erosion by means specified in paragraph (E) of this rule.

3745-511-310 **Liner system.**

(A) This rule applies to recompacted soil liner, geosynthetic soil liner, and flexible membrane liner engineered components of the liner system.

(B) The liner system shall conform to the requirements to meet the stability standards in rules 3745-511-20 to 3745-511-72 of the Administrative Code.

(C) For recompacted soil liner, there shall be no abrupt changes in grade that may result in damage to any engineered geosynthetic components in the liner system or leachate collection system.

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3745-511-350 **Added geologic material layer, liner system, and leachate collection system drainage layer run-out.**

(A) Added geologic material shall extend beyond the construction phase limits, the liner system, or the leachate collection system drainage layer run-out by at least three times the depth of the added geologic material.

(B) The run-out of the liner system shall extend beyond the construction phase limits by at least five feet plus three times the thickness of the recompacted soil liner.

*** DRAFT – NOT FOR FILING ***

3745-511-410 **Leachate collection system drainage layer.**

(A) The leachate collection system drainage layer shall consist of one or more of the following engineered components:

(1) A granular drainage layer that conforms to paragraph (E) of this rule.

(2) A shredded tire layer that conforms to paragraph (F) of this rule.

(3) A geocomposite drainage layer, which shall also include an overlying permeable material layer. A leachate collection system drainage layer comprised of geocomposite shall be covered by not less than twelve inches of permeable material.

(4) Leachate collection system pipes that conform to rule 3745-511-432 of the Administrative Code. If leachate collection system pipes are not a component of the leachate drainage layer, another means to measure temperature at the base of the leachate drainage layer shall be provided.

(B) In addition to the engineered components listed in paragraph (A) of this rule, the leachate collection system drainage layer may include a filter layer. If included, the filter layer shall conform to rule 3745-511-440 of the Administrative Code.

(C) The basal elevation of the leachate collection system drainage layer shall have the following slopes:

(1) A slope not less than 0.5 per cent beneath leachate collection system pipes.

(2) A slope not less than 2.0 per cent in all other areas.

(D) The leachate collection system drainage layer shall conform to the requirements to meet the stability standards in rules 3745-511-20 to 3745-511-72 of the Administrative Code.

(E) A leachate collection system drainage layer comprised of granular materials shall be designed to have a thickness of not less than one foot. The permitting authority may approve use of an alternative thickness provided the applicant demonstrates that the depth of leachate above the basal elevations of the drainage layer will not exceed one foot at all times prior to the end of the post-closure care period in all areas other than in a sump.

(F) A leachate collection system drainage layer comprised of tire shreds shall be designed to meet the following criteria:

(1) Have a thickness not less than twelve inches and not more than twenty-four inches, accounting for compression due to the weight of waste or C&DD.

(2) If the drainage layer is placed above a flexible membrane liner, a cushion layer shall be placed between the flexible membrane liner and the drainage layer. The cushion layer shall consist of either of the following:

(a) A drainage layer comprised of granular material designed to have a thickness not less than ten inches.

(b) A geotextile or geocomposite.

3745-511-432 **Leachate collection system pipes.**

Leachate collection system pipes shall be designed to meet the following criteria:

(A) Be imbedded in the leachate collection system drainage layer.

(B) Have a slope not less than 0.5 per cent.

(C) Have access for cleanout and sampling devices. The access shall be protected from damage caused by differential settling and by vehicles.

(D) Have lengths and configurations that shall not exceed the capabilities of the cleanout devices.

*** DRAFT – NOT FOR FILING ***

3745-511-434 **Sumps.**

(A) The leachate management system shall incorporate an adequate number of sumps to serve as transfer points for leachate removal so that the depth of leachate does not exceed one foot at all times prior to the end of the post-closure care period in all areas other than in a sump.

(B) Sumps shall be equipped with automatic high level alarms. The position of the high level alarms shall be established at not greater than one foot above the top elevation of the lateral limits of the sump.

(C) Sumps with vertical risers shall meet the bearing capacity standards in rule 3745-511-30 of the Administrative Code.

(D) Sumps with pumps shall be designed so pumps can be accessed for maintenance and replacement.

(E) Sumps above a flexible membrane liner shall incorporate a second flexible membrane liner under the sump.

3745-511-436 **Pumps.**

(A) The leachate management system shall incorporate an adequate number of automated pumps so that the depth of leachate does not exceed one foot at all times prior to the end of the post-closure care period in all areas other than in a sump.

(B) Pumps shall have sufficient capacity to convey the anticipated daily amount of leachate to be removed during normal operations. The anticipated daily amount does not include surface water diverted to the leachate collection system during construction of the contiguous leachate management system engineered components.

3745-511-440 **Leachate collection system filter layer.**

(A) The leachate collection system filter layer shall be placed above the leachate collection system drainage layer and the leachate collection system pipes.

(B) The leachate collection system filter layer shall be designed to minimize clogging in the leachate collection system drainage layer, leachate collection system pipes, and sumps at all times prior to the end of the post-closure care period.

3745-511-450 **Conveyance pipes.**

(A) Conveyance pipes shall be designed to meet the following criteria:

(1) Have a diameter and schedule capable of conveying the anticipated amount of fluid under anticipated operating pressures.

(2) Be protected from damage caused by freezing temperatures, crushing, and deflection.

(3) Be capable of being inspected for leaks.

(B) For conveyance pipes that penetrate the liner system, a seepage control device shall be included.

(C) For conveyance pipes that penetrate a flexible membrane liner, the penetration shall be booted.

*** DRAFT – NOT FOR FILING ***

3745-511-460 **Leachate holding tanks.**

[Comment: Pursuant to rule 3745-42-11 of the Administrative Code, industrial waste holding tanks, including leachate holding tanks, are also required to obtain a permit through Ohio EPA, division of surface water.]

(A) Leachate holding tanks shall be designed to have a minimum storage capacity of ten times the anticipated daily amount of leachate to be removed during normal operations. The anticipated daily amount does not include surface water diverted to the leachate collection system during construction of the contiguous leachate management system engineered components.

(B) Metal leachate holding tanks shall incorporate cathodic protection.

(C) The foundation of an above-ground holding tank shall be capable of supporting the holding tank when the tank is full of leachate without compromising the integrity of any engineered component.

(D) Leachate load-out facilities shall be designed to meet the following:

(1) Be protected from damage caused by freezing and facility operations.

(2) Prevent releases of leachate from load-out facilities.

(3) Contain spills and facilitate spill cleanup.

3745-511-605 **Transitional cover.**

(A) The transitional cover shall have a maximum slope length between ditches that shall result in an erosion rate of not more than five tons per acre per year as calculated using the "Universal Soil Loss Equation," "Revised Universal Soil Loss Equation," or the "Water Erosion Prediction Project Model" as described in rule 3745-500-03 of the Administrative Code assuming disturbed soils and the soils are highly susceptible to rill erosion.

(B) The slope of the surface of the transitional cover shall have a minimum slope to prevent ponding.

3745-511-610 **Cap system barrier layer.**

(A) This rule applies to cap system recompacted soil layer, geosynthetic soil liner, and flexible membrane liner engineered components of the cap system barrier layer.

(B) The cap system barrier layer shall conform to the requirements to meet the stability standards in rules 3745-511-40 to 3745-511-50 of the Administrative Code.

(C) For recompacted soil layer, there shall be no abrupt changes in grade that may result in damage to any engineered geosynthetic components in the cap system.

*** DRAFT – NOT FOR FILING ***

3745-511-620 **Cap system drainage layer.**

(A) The cap system drainage layer shall consist of either of the following engineered components:

(1) A granular drainage layer that conforms to paragraph (D) of this rule.

(2) A geocomposite drainage layer.

(B) The cap system drainage layer shall conform to the requirements to meet the stability standards in rules 3745-511-40 and 3745-511-50 of the Administrative Code.

(C) The cap system drainage layer may include a pipe system. If included, the pipe system shall conform to rule 3745-511-630 of the Administrative Code.

(D) A cap system drainage layer comprised of granular materials shall be designed to meet the following criteria:

(1) Have a thickness not less than one foot. The permitting authority may approve use of an alternative thickness provided the applicant demonstrates that infiltration of surface water is minimized.

(2) Not clog or freeze.

(3) Prevent damage to the underlying flexible membrane liner.

*** DRAFT – NOT FOR FILING ***

3745-511-630 **Cap system collection pipes and outlets.**

(A) Cap system collection pipes shall be designed to meet the following criteria:

(1) Be imbedded in the cap system drainage layer.

(2) Have a slope not less than 0.5 per cent.

(3) Be sized and spaced to safely pass the calculated maximum flow from the drainage layer.

(4) Be accessible for use of cleanout devices. The access shall be protected from damage caused by differential settling.

(5) Have lengths and configurations that shall not exceed the capabilities of the cleanout devices.

(B) Cap system collection pipe outlets shall be designed to meet the following criteria:

(1) Be sized and spaced to safely convey the calculated maximum flow of liquids from the cap system drainage layer to the surface water management system.

(2) Not clog or freeze.

(C) The permitting authority may approve a cap system without collection pipes and outlets provided the applicant demonstrates that the cap system conforms to the requirements to meet the stability standards in rules 3745-511-40 and 3745-511-50 of the Administrative Code.

3745-511-640 **Cap system filter layer.**

(A) The cap system filter layer shall be placed above the cap system drainage layer or the gas collection layer and, if present, above the cap system collection pipe system.

(B) The cap system filter layer shall conform to the requirements to meet the stability standards in rules 3745-511-40 and 3745-511-50 of the Administrative Code.

(C) The cap system filter layer shall be designed to minimize clogging of the cap system drainage layer at all times prior to the end of the post-closure care period.

*** DRAFT – NOT FOR FILING ***

3745-511-650 **Cap system protection layer.**

(A) The cap system protection layer shall conform to the requirements to meet the stability standards in rules 3745-511-40 and 3745-511-50 of the Administrative Code.

(B) The thickness of the cap system protection layer shall be either of the following:

(1) Not less than thirty-six inches for a facility located in Ashtabula, Cuyahoga, Erie, Fulton, Geauga, Lake, Lorain, Lucas, Ottawa, or Williams county.

(2) Not less than thirty inches for a facility located in an Ohio county other than those listed in paragraph (B)(1) of this rule.

(C) The thickness of the cap system drainage layer may be used to satisfy the thickness requirement of the cap system protection layer specified in paragraph (B) of this rule.

(D) The slope of the surface of the cap system protection layer shall conform to the following:

(1) Have at least a 5.0 per cent slope in all areas other than where surface water control structures are located.

(2) Not exceed compaction equipment limitations.

(3) Not exceed maintenance equipment limitations.

(4) Have a maximum slope length between ditches that shall result in an erosion rate of not more than five tons per acre per year as calculated using the "Universal Soil Loss Equation," "Revised Universal Soil Loss Equation," or the "Water Erosion Prediction Project Model" as described in rule 3745-500-03 of the Administrative Code assuming disturbed soils and assuming the soil is highly susceptible to rill erosion.

3745-511-680 **Cap system and gas collection layer run-out.**

The run-out of the components of the cap system and gas collection layer shall extend beyond the construction phase limits by at least five feet plus three times the thickness of the cap system recompacted soil layer.

*** DRAFT – NOT FOR FILING ***

3745-511-750 **Gas collection and conveyance system.**

(A) The gas collection and conveyance system shall be designed to meet the following criteria:

(1) Consist of one or more of the following:

(a) A gas collection layer that conforms to paragraph (B) of this rule. Gas collected in the gas collection layer shall be directed to a gas vent or gas well or other gas collection device.

(b) Gas vents.

(c) Gas wells, which can be vertical or horizontal and conform to paragraph (C) of this rule.

(d) Gas collection devices other than a collection layer, vent, or well, including elements of the leachate collection system.

(e) A gas mover system. The gas mover system shall have the capacity to manage the maximum gas generation flow rate expected over the intended use period of the gas mover system.

(f) A gas conveyance system.

(2) Either vent collected gas to the atmosphere or convey collected gas to one or more gas control devices.

(3) Not compromise the integrity of the cap system, the leachate management system, the liner system, or the separatory leachate barrier and collection system. At a minimum, the design of the gas collection and conveyance system shall meet the following criteria:

(a) Gas vents and gas wells that are installed through waste or C&DD shall not be installed within ten feet of the top of the liner system or separatory leachate barrier and collection system.

(b) Any penetrations through the cap system shall account for settlement of the waste or C&DD relative to the respective gas vent, gas well, or gas conveyance system component.

(4) Not cause fires within the disposal limits. At a minimum, perforations in any gas wells shall not occur within twenty feet of the surface.

(5) Prevent restricted gas flow due to accumulation of leachate or condensate.

(6) Be capable of isolating any individual gas vents and any individual gas wells and any portions of the gas conveyance system for maintenance and repair.

[Comment: Certain municipal solid waste landfills are required to control air emissions. Permits for gas collection and control systems are obtained through Ohio EPA, division of air pollution control.]

(B) The gas collection layer shall be designed to meet the following criteria:

(1) As a component of a cap system, be as close as possible to the surface of C&DD or waste.

(2) Either remain dry or be oversized to accommodate leachate and condensate. If oversized to accommodate leachate and condensate, the gas collection system shall direct the leachate and condensate to the waste or C&DD mass or to the leachate collection system.

(3) If below a flexible membrane liner or geosynthetic clay liner, also meet the following criteria:

(a) Provide sufficient flow capacity to reduce the gas pressure sufficiently to conform to the requirements to meet the stability standards in rules 3745-511-40 and 3745-511-50 of the Administrative Code.

(b) Have a surface without abrupt changes in grade that may result in damage to the flexible membrane liner or geosynthetic clay liner.

(C) Gas wells shall be designed to obtain gas samples, control flow, accommodate the withdrawal of leachate and condensate, and measure the following:

(1) Temperatures at different locations down the well.

(2) Water level in the well.

(3) Gas pressure.

(4) Gas composition.

(5) Gas flow.

(D) Condensate collected in the gas collection and conveyance system shall be directed to one or more of the following:

(1) The leachate management system.

(2) A condensate storage tank that conforms to rule 3745-511-755 of the Administrative Code.

(3) A public sewerage system.

(4) A wastewater treatment works permitted in accordance with Chapter 6111. of the Revised Code.

(5) The waste or C&DD mass provided the following are true:

(a) The condensate is collected from within or above the disposal limits.

(b) The waste or C&DD mass is above a leachate collection system.

(E) Any conveyance pipes used to convey condensate shall conform to rule 3745-511-450 of the Administrative Code.

*** DRAFT – NOT FOR FILING ***

3745-511-755 **Condensate holding tank.**

[Comment: Pursuant to rule 3745-42-11 of the Administrative Code, industrial waste holding tanks, including condensate holding tanks, are required to obtain a permit through Ohio EPA, division of surface water.]

(A) Condensate holding tanks shall be designed to have a minimum storage capacity of ten times the anticipated daily amount of condensate generated from continuous operation of the gas collection and conveyance system.

(B) Metal condensate holding tanks shall incorporate cathodic protection.

(C) The foundation of an above-ground holding tank shall be capable of supporting the holding tank when the tank is full of condensate without compromising the integrity of any engineered components.

(D) Condensate load-out facilities shall be designed to meet the following:

(1) Be protected from damage caused by freezing and facility operations.

(2) Prevent releases of leachate from load-out facilities.

(3) Contain spills and facilitate spill cleanup.

*** DRAFT – NOT FOR FILING ***

3745-511-810 **Ditches.**

(A) Ditches shall be designed to accommodate the peak flow from the twenty-five-year, twenty-four-hour storm event.

(B) Ditches shall be designed to minimize silting, scouring, and erosion.

(C) The slope of ditches along flow lines shall be a minimum of two per cent.

*** DRAFT – NOT FOR FILING ***

3745-511-820 **Sediment and storm water management basin system.**

(A) Sediment and storm water management basin systems shall be designed to meet the following criteria:

(1) Incorporate at least three ponds or cells, as described in paragraphs (A)(2) to (A)(4) of this rule, placed in series. Each pond or cell shall be designed to meet the following:

(a) Minimize short circuiting and dead storage areas.

(b) Be capable of being dewatered to a level below the desired operational level.

(c) Have primary outlets or water passageways that shall safely convey the surface water flow from a ten-year, twenty-four-hour storm event using non-mechanical means.

(d) Have an emergency spillway that shall, in combination with the primary outlet, safely discharge the surface water flow from a one hundred-year, twenty-four-hour storm event using non-mechanical means.

(2) Have a primary settling pond or cell, also known as a forebay, that shall be designed to meet the following criteria:

(a) Be capable of removing medium sand sized particles.

(b) If the length to width ratio is less than four to one, use baffles or other means to increase the flow path between the inlet and the outlet.

(c) Be capable of being easily cleaned out at any time of the year.

(3) Have a secondary settling pond or cell that shall be designed to meet the following criteria:

(a) Be capable of settling a particle with a settling velocity of 0.0009 feet per second.

(b) If the length to width ratio is less than four to one, use baffles or other means to increase the flow path between the inlet and the outlet.

(c) Be capable of storing the volume of run off from a ten-year, twenty-four-hour storm event.

(d) Contain an inlet of the emergency spillway that shall be at an elevation that will not allow surface water flow into the emergency spillway until the twenty-five-year, twenty-four-hour storm event.

(e) Be equipped to prevent floatables from being discharged through the outlet.

(f) Be equipped with a dewatering device that draws from the surface of the pooled water.

(4) Have a third pond or cell, also known as a discharge control pond, that shall be designed to discharge the volume of runoff from a 0.75-inch rainfall in not less than twenty-four hours.

(B) The containment structures of the sediment and storm water management basin shall be designed to meet the following criteria:

(1) Provide not less than one foot of freeboard above the designed maximum operating pool level after accounting for settlement.

(2) Have a slope that does not exceed compaction and maintenance equipment limitations.

(3) Use a seepage control device for any penetrations through the liner system.

(4) If structural fill is used, use structural fill that conforms to the design standards in rule 3745-511-220 of the Administrative Code.

(5) If the embankment is above ground, the embankment shall conform to the design standards in rule 3745-511-220 of the Administrative Code.

(C) The surface of discharge points of the sediment and storm water management basin system shall have rip rap. Rip rap shall extend as far as necessary to provide erosion protection and re-aeration of discharge water.

*** DRAFT – NOT FOR FILING ***

3745-511-870 **Level and flow control structures.**

(A) The sediment and storm water management basin system or lagoon shall be designed with as many multi-purpose level and flow control structures as necessary for the purposes of drawdown, flow distribution, flow and depth measuring, sampling, and pumping.

(B) Level and flow control structures shall be designed to meet the following criteria:

(1) Be accessible for maintenance and adjustment of controls.

(2) Be located to avoid freezing and ice damage to the control structures.

(3) Be able to be preset to prevent the liquid elevation from dropping below the desired operational level.

(4) Not use stop logs.

(5) For level control structures, include valves, slide tubes, or dual slide gates.

(6) For flow control structures, be able to immediately stop flow of liquid into the sediment and storm water management basin system pond or cell, or lagoon.

(C) An above-ground sediment and storm water management basin system pond or cell, or lagoon shall have an overflow device to prevent overfilling during operations. The elevation of the overflow device shall be not more than 0.5 feet above the designed maximum operating pool level of the pond or lagoon. The overflow device shall be able to accommodate peak instantaneous flow. The permitting authority may approve use of a device other than an overflow device to preclude overfilling provided the applicant demonstrates that the device will prevent the liquid level from rising 0.5 feet above the designed maximum operating pool level.

[Comment: Existence of an overflow device or an alternative does not constitute authorization to discharge pursuant to Chapter 6111. of the Revised Code. Authorization to discharge is obtained through a national pollutant discharge elimination system (NPDES) permit from Ohio EPA, division of surface water.]

(D) Discharge structures shall be able to accommodate two hundred fifty per cent of the maximum flow through the sediment and storm water management basin system pond or cell, or lagoon.

(E) Any pipe intake or riser spillway shall have an anti-vortex device.