

## Chapter NR 213

## LINING OF INDUSTRIAL LAGOONS AND DESIGN OF STORAGE STRUCTURES

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**Note:** Corrections made under s. 13.93 (2m) (b) 5. and 7., Stats., Register, September, 1997, No. 501.

**Subchapter I — General**

**NR 213.01 Purpose.** The purpose of this chapter is to protect public health and welfare by restoring, maintaining and protecting the physical, chemical and biological integrity of the waters of the state and all uses of state groundwaters and surface waters in accordance with the provisions of ch. NR 140, and chs. 160 and 283, Stats.; and to establish minimum design standards, material requirements and performance criteria for all lagoons, storage structures or treatment structures that are regulated under ss. 281.41 and 283.31, Stats., and ch. NR 108, except those storage structures or treatment structures listed in s. NR 213.02 (2).

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; r. and recr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.02 Applicability. (1) STRUCTURES REGULATED.** This chapter is applicable to all lagoons, tanks, stacking structures, and other storage or treatment structures that receive industrial, commercial or agricultural wastewaters, associated sludges from industrial, commercial or agricultural sources, by-product solids and any resulting leachates. The performance criteria of this chapter may also be applicable to facilities that store other materials such as coal and road salt and the resulting runoff or leachate.

**(2) STRUCTURES EXCLUDED.** This chapter is not applicable to:

(a) Land disposal systems, such as absorption ponds, which are regulated under ch. NR 214 or ch. 283, Stats.

(b) Lagoons licensed under ch. NR 132, 182, 500, 502, 504, or 660, or approved under subch. III of ch. 295, Stats.

(c) Lagoons used solely for research purposes under the direction of a Wisconsin registered professional engineer, soil scientist, geologist or a scientist employed by a university located within this state, if approved by the department and provided the following requirements are met.

1. The size of the lagoon does not exceed one acre.

2. The lagoon is developed, operated and maintained in a safe nuisance-free manner so that no pollutants enter waters of the state.

3. Copies of the research proposal are submitted to the department prior to initiating construction and any resulting reports or publications on the research are provided to the department.

(d) Lagoons and storage structures designed, constructed and used solely for the storage of animal wastes.

(e) Sweet corn silage stacks which are utilized for direct feeding of livestock, have less than 150 tons on a site at any one time and are located such that surface water or groundwater pollution do not occur.

(f) All existing above ground and in-ground storage structures constructed of concrete, glass reinforced plastic or steel which are watertight and are used for the treatment or storage of wastewater.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; r. and recr. Register, June, 1990, No. 414, eff. 7-1-90; CR 13-057: am. (2) (b) Register July 2015 No. 715, eff. 8-1-15.

**NR 213.03 Existing lagoons, storage structures and treatment structures. (1)** Owners and operators of lagoons, storage structures and treatment structures existing prior [to] July 1, 1990 shall demonstrate to the satisfaction of the department that all existing lagoons, storage structures and treatment structures, except those structures listed in s. NR 213.02 (2), meet the purpose of this chapter by as soon as reasonably possible but no later than 5 years from July 1, 1990 or as specified by a WPDES permit.

**(2)** A report evaluating compliance with the design standards, material specifications and performance criteria in this chapter shall be submitted to the department within 2 years of July 1, 1990 unless otherwise specified by a WPDES permit or other notification by the department.

(b) In the event that the owner cannot demonstrate compliance with all of the design standards and material requirements with the existing facility, the generator may request an exemption from the design standards and material requirements of this chapter in accordance with s. NR 213.06.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; r. and recr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.04 Definitions.** The following definitions apply to the terms used in this chapter. Definitions of other terms and meanings of abbreviations are set forth in ch. NR 205.

**(1)** “ASTM” means the American Society for Testing and Materials. Copies of ASTM standards referenced in this chapter are available for inspection at the offices of the department of natural resources, the secretary of state’s office and the legislative reference bureau. ASTM standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

**(2)** “Base course” means the layer or layers of specified or selected material of designed thickness placed on a subbase or subgrade to support a surface course.

**(3)** “Bedrock” means the rocks that underlie soil material or

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are at the earth's surface which are encountered when the weathered in-place consolidated material, larger than 2 mm in size, is greater than 50% by volume.

(4) "By-product solids" means waste solid products, including but not limited to cuttings or peelings generated at processing facilities, fresh or actively fermenting sweet corn silage, other food wastes and paunch manure.

(5) "Coefficient of permeability" means the rate of discharge of water under laminar flow conditions, through a unit cross-sectional area of porous medium, under a unit hydraulic gradient and standard temperature.

(6) "Community public water supply system" means a water supply system having at least 15 service connections used by year-round residents or regularly serving at least 25 year-round residents. Any water supply system serving 7 or more homes, 10 or more mobile homes, 10 or more apartment units, or 10 or more condominium units shall be considered a community public water supply system unless information is available to indicate that 25 year-round residents will not be served.

(7) "Detrimental effect" means contamination of the lands or waters of the state, or making the same injurious to public health, harmful for commercial or agricultural use, or deleterious to animal or plant life.

(8) "Floodway" has the meaning specified under ch. NR 116.

(9) "Groundwater" means any of the waters of the state, as defined in s. 281.01 (18), Stats., occurring in a saturated subsurface geological formation of rock or soil.

(10) "Groundwater monitoring" means measuring the groundwater level and analyzing samples of water taken from the ground.

(11) "Lagoon" means a natural or human-made containment structure, constructed primarily of earthen materials and used for the treatment or storage of industrial, commercial or agricultural wastewater, biological fermentation leachates or sludge.

(12) "Pavement structure" means the combination of sub-base, base and surface courses placed on a subgrade.

(13) "Potable water supply well" means a well supplying water for human consumption, sanitary use or food product preparation.

(14) "Storage structure" means either an earthen containment structure or a storage tank used for the storage of wastewater or biological fermentation leachates or a structure constructed for stacking and storage of by-product solids or other material.

(15) "Storage tank" means a containment vessel fabricated of concrete, glass-reinforced plastic or steel for the purpose of storage or treatment of wastewater or biological fermentation leachates.

(16) "Subbase" means the layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

(17) "Subgrade" means the ground surface upon which the pavement structure is constructed.

(18) "Surface course" means the layer or layers of specified material of designed thickness placed on a base course and forming the upper portion of a pavement structure. If more than one layer is specified, the bottom layer is referred to as the binder course.

(19) "Treatment structure" means either an earthen treatment structure or a treatment tank used for the chemical, physical or biological treatment of wastewater or biological fermentation of leachates or a structure constructed for chemical, physical or biological treatment of by-product solids or other material.

(20) "Wetlands" has the meaning specified under s. 23.32, Stats.

(21) "WDOT standards for roads and bridge construction" means the Wisconsin department of transportation standard specifications for road and bridge construction, edition of 1989.

**Note:** Copies of the WDOT standards may be inspected at the offices of the department, the secretary of state and the legislative reference bureau.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; r. and recr. Register, June, 1990, No. 414, eff. 7-1-90; correction in (1) made under s. 13.92 (4) (b) 6., Stats.

**NR 213.05 Additional requirements.** The design standards, material requirements or performance criteria of this chapter may be supplemented or superseded by more stringent requirements, including pretreatment requirements, more stringent design limitations, and more frequent or stringent effluent or groundwater monitoring requirements, if:

(1) There is an increased possibility of groundwater contamination due to structure location, soil types, geologic condition or other conditions, or

(2) The stored or treated material may contain any substance or concentration of substances not normally associated with the type of discharges identified in s. NR 213.02 (1), such as toxic substances or hazardous wastes, or

(3) The storage structure or treatment unit may cause a public nuisance.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.06 Exemptions from ch. NR 213.** (1) The department may allow exemptions from the design standards and material requirements described in this chapter if the owner or operator can demonstrate that such design standards and material requirements are more stringent than necessary to comply with the provisions of ch. NR 140 and chs. 160 and 283, Stats. The owner or operator shall justify such an exemption from the design standards and material requirements of this chapter by demonstrating that the alternative design will comply with the following performance criteria:

(a) That pollutant dilution, dispersion or degradation will occur within the design management zone as defined in ch. NR 140;

(b) That increases of substances in the groundwater from lagoons, storage structures and treatment structures at the site will be minimized to the extent technically and economically feasible; and

(c) That applicable groundwater and surface water standards will not be exceeded.

(2) The department shall consider the following factors when reviewing an alternative design in consideration of granting an exemption:

(a) Physical characteristics of the site, such as soil texture, soil permeability, depth to groundwater and depth to and type of bedrock.

(b) Age and condition of an existing structure.

(c) Analytical data from existing groundwater monitoring wells or any that may be installed as part of the demonstration.

(d) The quantity and composition of the materials stored or treated at the facility.

(e) The compatibility between the materials stored or treated and the lining of the storage or treatment unit.

(f) Any other information relevant to the environmental impacts of the facility's operations.

(3) **SUBMITTING AN EXEMPTION REQUEST-NEW OR MODIFIED STRUCTURES.** The owner or operator of a new or modified lagoon, storage structure or treatment structure may request an ex-

emption from the design standards and material requirements of this chapter by submitting facts to the department:

(a) In the application for issuance, reissuance or modification of WPDES permit, or

(b) In plans and specifications for a new or expanded lagoon, storage structure or during the 90-day plan approval period as specified in s. 281.41, Stats., or

(c) During the 30-day public comment period following public notice by the department of intent to issue, reissue or modify a WPDES permit under s. 283.39, Stats., or

(d) At a public hearing held under s. 283.49 or 283.63, Stats.

**(4) SUBMITTING AN EXEMPTION REQUEST-EXISTING STRUCTURES.** The owner or operator of a lagoon, storage structure or treatment structure in existence prior to July 1, 1990 may request an exemption from the design standards and material requirements of this chapter. If an exemption is not granted, the department shall propose to issue a new WPDES permit or modify the existing WPDES permit to include a schedule of compliance to achieve the purpose of this chapter.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.07 Abandonment.** Lagoons, storage structures and treatment structures which will no longer be used, shall be properly abandoned within 2 years of the date on which waste material was last stored or treated. A plan outlining the proposed method of abandonment shall be submitted to the department for approval. This plan shall contain a procedure to properly identify the presence and characteristics of any accumulated solid waste and provide appropriate removal, disposal or recycling or treatment alternatives in accordance with applicable solid and hazardous waste laws. All recycling, treatment and disposal shall be conducted so as to protect public health and the environment. Unless otherwise directed by the department, all abandonment plans shall comply with ch. NR 720 for soils that have been contaminated by the contents of the lagoon, storage structure or treatment structure. The plan shall also address site restoration and any landscaping that will prevent accumulation of standing water or runoff. The department may require groundwater monitoring for a period of time after abandonment of the land treatment system to assess groundwater impacts. The design, installation, construction, abandonment and documentation of all monitoring wells shall be in accordance with the requirements of ch. NR 141.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90; am., Register, April, 1994, No. 460, eff. 5-1-94; am., Register, March, 1995, No. 471, eff. 4-1-95.

**NR 213.08 General design requirements. (1) LOCATION.** (a) Lagoons, storage structures and treatment structures may not be located closer than:

1. 1,000 feet from a well serving a community public water supply system.

2. 250 feet from other potable water supply wells.

3. 500 feet from an inhabited dwelling except that this distance may be reduced with written permission from the owner and occupants of the residence. The department may require a greater distance depending on the type of lagoon, storage structure or treatment structure and potential for aesthetic impacts and public health impacts.

(b) Lagoons, storage structures and treatment structures may not be located in the floodway and shall conform with the requirements of ch. NR 116.

(c) Lagoons, storage structures and treatment structures may not be located within wetlands.

(d) Lagoons, storage structures and treatment structures shall be designed and operated to minimize the level of substances in the groundwater and to prevent exceedance of the groundwater

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preventive action limits (PAL) to the extent technically and economically feasible. Groundwater preventive action limits are listed in ss. NR 140.10 and 140.12.

**(2) BASIC CONSTRUCTION DESIGN.** (a) Effective erosion protection of exterior slopes of lagoons shall be provided by appropriate means, such as riprap or seeding with grass.

(b) Lagoons shall be maintained as necessary to prevent scouring of the liner and liner cover, discourage vegetative growth, and avoid desiccation and cracking of the liner.

(c) A minimum separation of 5 feet shall be maintained between the bottom of the lagoon liner or subbase of a storage structure and either bedrock or the groundwater level, whichever is higher.

**(3) GROUNDWATER MONITORING.** (a) A groundwater monitoring system designed and constructed in accordance with ch. NR 141 may be required by the department to provide information on the long term effects of a lagoon, storage structure or treatment structure on groundwater.

(b) When a groundwater monitoring system is required, the parameters to be monitored and the monitoring frequency will be established on a case-by-case basis.

**(4) ADDITIONAL DESIGN REQUIREMENTS.** In cases where critical groundwater, geologic or construction conditions warrant, the department may require construction specifications or testing requirements more stringent than those described in this chapter if necessary to preclude detrimental effects to the groundwater.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; renum. from NR 213.05 and am. Register, June, 1990, No. 414, eff. 7-1-90.

## Subchapter II — Lining of Industrial Lagoons

**NR 213.09 General submittal requirements. (1) GENERAL.** An engineering report and plans and specifications shall be submitted to the department for approval in accordance with s. 281.41, Stats., prior to initiating construction.

(a) The department recommends, whenever possible, a preliminary engineering report outlining the project and including any available information required under par. (b) be made prior to submittal of final plans.

(b) The engineering report shall outline the entire project and include, at a minimum, the following information: subsurface site conditions, waste sources, waste analysis and waste volume; materials and specifications of the proposed liner required under ss. NR 213.10 and 213.11; compatibility of the waste and proposed liner and estimated life of the liner required under sub. (4); the proposed method of installation, and the equipment and testing methods to be used for quality control both during and after construction.

(c) The plans and specifications shall include the existing and finished elevations and adequate details to fully illustrate the proposed installation.

(d) When a groundwater monitoring system is required under s. NR 213.08 (3), an engineering report and plans and specifications shall be submitted and shall include: a discussion of the installation, the proposed materials to be used, and the method of construction and location of all proposed wells.

**(2) SUBSURFACE INVESTIGATION.** (a) Reports on subsurface site conditions shall include boring logs, particle size distribution and soil classifications for each major lithologic unit and the depths to groundwater and bedrock when encountered. When on-site soil is proposed as the lining material, compaction curves, permeabilities and Atterberg limits shall be established for the soil proposed for the lining material.

(b) Sufficient soil borings shall be performed at each pro-

posed lagoon site to adequately define the subsurface soil conditions and depth to groundwater and bedrock at the site. A minimum of 3 borings for the first acre and one boring for each additional acre or portion of an acre shall be performed. The borings should be distributed in a grid pattern over the entire site. In no case may less than 3 borings be performed. The department may require additional borings depending upon the size of the lagoon, proposed liner, waste material, or known or anticipated critical hydrogeologic conditions at the site.

(c) All soil borings shall extend a minimum of 10 feet below the proposed base grade of the lagoon, or to groundwater or bedrock, whichever is less.

(d) Soil borings shall be performed by or under the supervision of a qualified soil testing laboratory, engineering firm, or other individual or firm which has demonstrated the capability to perform such work.

(e) Measurement of the resistance of the soil to penetration and the collection of soil samples shall be performed every 5 feet and at all significant changes in soil type or lithology in each soil boring.

(f) All soil samples shall be analyzed for particle size distribution and classified texturally.

(g) When required under s. NR 213.08 (3), groundwater monitoring wells may be installed in the soil boring holes provided these holes are located adequately to assure representative monitoring of both upgradient and downgradient groundwater conditions.

**(3) WASTE ANALYSIS.** (a) Representative samples of all wastewater, sludge or other materials to be placed in the lagoon shall be analyzed to determine the composition of the samples. Past analyses may be used, provided they are representative of the wastewater, sludge or other materials to be discharged to the lagoon.

(b) Sludge shall be analyzed on both a total solids and an extracted pore water basis.

(c) The parameters analyzed for may include BOD<sub>5</sub>, COD, pH, alkalinity, specific conductance, chloride, sulfate, sodium, calcium, magnesium, total dissolved solids, hardness, or any other constituents or properties known or suspected to be detrimental to the integrity of the proposed liner.

(d) For all facilities, estimated wastewater characterization shall be provided, along with the basis for the estimates.

**(4) WASTE AND LINER COMPATIBILITY.** (a) Compatibility between the waste and the proposed liner shall be addressed and documented. Prior research or data from similar existing sites shall be included when available. If specific testing is performed, all test procedures used shall be detailed and the results provided.

(b) For synthetic and soil-bentonite liners, written confirmation of compatibility, as well as the estimated design life of the liner against the waste in question, shall be provided by the manufacturer of the synthetic liner or bentonite.

(c) The department may require controlled long term compatibility testing such as column studies, permeability or immersion tests to determine long-term changes in permeability, soil structure or physical properties of the liner.

**(5) SAMPLING AND TESTING STANDARDS.** (a) Soil samples taken to determine soil classification, particle size distribution or permeability shall be taken in accordance with ASTM D1586 (1984), ASTM D1587 (1983) or ASTM D3550 (1984).

(b) Coefficient of permeability of the constructed soil or soil-bentonite liner shall be determined using a laboratory permeability test on hydrated and saturated specimens of the liner material, compacted at the same approximate density as exists in the in-

field condition. Tests may be performed on remolded or core samples. The permeability shall be based on stabilized inflow and outflow rates during the test. Separate tests shall be performed using tap water and the wastewater or sludge extract, and the results compared. All preparation work and information detailing the test apparatus shall be submitted along with all results obtained.

(c) Particle size analyses to determine particle size distribution of soil samples shall be performed in accordance with ASTM D422 (1972).

(d) Plasticity index shall be determined in accordance with ASTM D4318 (1984).

(e) Measurement of the resistance of soil to penetration shall be determined in accordance with ASTM D1558 (1984) or ASTM D1586 (1984).

(f) Standard proctor densities shall be determined in accordance with ASTM D698 (1978).

(g) Soils shall be classified texturally according to the Unified Classification System.

(h) In-place density may be determined in accordance with ASTM D2922 (1981) or ASTM D2937 (1983).

(i) Other methods of sampling and testing may be approved by the department on a case-by-case basis.

**Note:** Copies of ASTM D1586, D1587, D3550, D422, D424, D15558, D698, D2922 and D2937 may be inspected at the office of the department, the secretary of state and the legislative reference bureau. Copies of ASTM standards may also be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; renum. from NR 213.06 and am. (1) (a), (b) and (d), (2) (g), (3) (a), (d) and (5) (i), Register, June, 1990, No. 414, eff. 7-1-90; am. (5) (a), (d), (e) and (h), Register, April, 1991, No. 424, eff. 5-1-91.

**NR 213.10 General liner specifications. (1) GENERAL.** (a) All lagoons shall be sealed to prevent excessive exfiltration.

1. Natural soil materials, soil-bentonite mixtures or synthetic liners approved by the department may be used as lagoon liners.

2. All liners shall be constructed with materials compatible with the wastewater to be contained by the lagoon.

3. Prior to installation of any type of liner, the lagoon bottom shall be compacted to a depth of 6 inches, at a minimum to 95% of the maximum standard proctor dry density, at or above optimum moisture.

4. All liners shall be constructed to provide a uniform barrier to exfiltration across the lagoon bottom, interior dike walls and extending up the dike wall to the berm.

5. The department may require a liner to be protected by an inorganic layer of soil or crushed stone if necessary to protect against such things as photochemical reaction, ice or wave action, freeze-thaw action, liner floatation or vehicular traffic on the liner. This layer shall have a minimum thickness of one foot and be uniformly graded and free from large rocks, soil clumps and sticks. If a granular noncohesive soil is used, the department may require that a soil fabric securely attached to the berm be placed between the liner and the cover material to prevent slumping of the cover material.

6. Riprap may be required along the air-water interface if necessary to minimize rodent activity or exposure and erosion of the liner or subgrade.

7. For lagoons which will be empty for extended periods of time, a synthetic lining material shall be used to prevent liner degradation as a result of desiccation.

(b) Soil or soil-bentonite liners. 1. The design standard for the co-efficient of permeability of soil or soil-bentonite liners may not exceed  $1 \times 10^{-7}$  cm/sec.

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2. The thickness of soil or soil-bentonite liners shall be determined according to Darcy's equation and shall include an appropriate safety factor for construction variability. See Table 1.

Table 1  
Minimum Required Liner Thickness (inches)  
For Natural Soil and Soil-Bentonite Liners

Coefficient of Permeability of the Liner cm/sec (ft/day)	Wastewater Depth (ft.)						
	4	6	8	10	12	14	16
$1 \times 10^{-7}$							
$(2.82 \times 10^{-4})$	12	16	20	25	29	34	38
$5 \times 10^{-8}$							
$(1.41 \times 10^{-4})$	12	12	12	13	16	18	20

For all permeabilities less than those shown above, regardless of the wastewater depth, the minimum liner thickness shall be 12 inches.

3. To a depth of 6 inches, a minimum of 15% of the unmodified soil upon which a soil or soil-bentonite liner is to be constructed shall pass a No. 200 sieve. If this requirement cannot be met, a soil filter fabric designed to retain those particles passing a No. 200 sieve shall be placed between the liner and the existing soil.

4. Soil or soil-bentonite liners shall be compacted at or above optimum moisture.

5. A means shall be provided to prevent soil or soil-bentonite liners from desiccating after completion of construction and prior to placing the lagoon into operation.

**(2) EXFILTRATION RATE.** (a) The design loss of wastewater or sludge from any lined lagoon may not exceed 500 gallons per acre per day.

(b) In circumstances where soil characteristics, groundwater quality, waste characteristics or concern with the liner-waste compatibility warrant, the department may require that more stringent exfiltration rates be met.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; renum. from NR 213.07 and am. (1) (b) 2. and (2) (b), Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.11 Specific liner specifications. (1) NATURAL SOIL LINER SPECIFICATIONS.** (a) Natural soil liners shall consist of soils of which a minimum of 50% of the soil particles pass a No. 200 sieve.

(b) Natural soil to be used as a liner shall contain less than 2% organic material, and less than 5% by weight of the natural soil to be used shall be retained on a No. 4 sieve.

(c) Natural soil to be used as a liner shall have a plasticity index of at least 15.

(d) Natural soil liners shall be compacted to at least 95% of the maximum standard proctor dry density.

(e) Natural soil liners shall be constructed and compacted in lifts. A lift may not exceed a compacted thickness of 6 inches.

(f) Frost susceptible soils may not be used to construct a natural soil liner. Silts and silty sands shall be considered frost susceptible.

(g) When constructing natural soil liners with native in-place soils, the subbase shall be scarified prior to compaction. Subsequently, the existing base shall be scarified prior to placement of each successive lift.

(h) Natural soil liners shall be constructed under the direct supervision of a qualified soils technician or engineer, or geotechnical engineer.

**(2) SOIL-BENTONITE LINERS.** (a) The soil to be mixed with the bentonite shall have a plasticity index of at least 12, a mini-

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mum of 30% of the soil by weight shall pass a No. 200 sieve, and less than 5% by weight shall be retained on a No. 4 sieve.

(b) Bentonite shall be applied at a rate recommended by the manufacturer or an independent soil expert. Completed soil-bentonite liners shall contain a minimum of 5% bentonite by dry weight.

(c) Ninety percent of the bentonite by weight shall pass a No. 80 sieve.

(d) Bentonite shall be thoroughly admixed with the soil throughout the entire thickness of each lift.

(e) Soil-bentonite liners shall be compacted to at least 85% of the maximum standard proctor dry density.

(f) Soil-bentonite liners shall be constructed under the direct supervision of a qualified representative of the bentonite manufacturer, soil technician or engineer, or geotechnical engineer.

**(3) SYNTHETIC LINERS.** (a) Synthetic liners shall have a minimum thickness of 30 mils.

(b) Synthetic liners shall be installed under the direct supervision of a qualified manufacturer's representative.

(c) To a depth of 6 inches below the bottom of synthetic liners, the soil shall be free from large rocks, angular stones, soil clumps, sticks or other material which may puncture the liner.

(d) Synthetic liners shall be securely anchored into the dike berm.

(e) Venting shall be provided beneath synthetic liners to prevent failure as a result of backpressure from gas accumulation or fluctuations in the watertable elevation. If a liner cover is provided, this requirement may be waived.

(f) Prior to constructing synthetic liners, the underlying soils shall be treated with an herbicide in accordance with the manufacturer's recommendations.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; renum. from NR 213.08, Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.12 Quality assurance and testing requirements. (1) GENERAL.**

(a) All liners shall be tested before the lagoons are put into operation to ensure that all performance standards and design specifications as approved have been met. A post-construction report shall be submitted to the department for approval prior to discharging any wastes into the lagoons. The report shall include: all material test results required under sub. (2) or (3); plan sheets illustrating final elevations, slopes and test locations; a discussion of weather conditions and any unexpected conditions encountered during construction.

(b) Testing shall be performed in accordance with sub. (2) or (3), or any other method approved by the department.

(c) All tests shall be performed under the direct supervision of the design engineer except for tests on synthetic or soil-bentonite liners, which shall be performed under the direct supervision of a representative of the manufacturer unless otherwise specified by the department in the plan approval.

**(2) SOIL OR SOIL-BENTONITE LINERS.** (a) Following completion of construction and prior to being put into use, core samples of soil or soil-bentonite liners shall be taken in accordance with ASTM D1587 (1983). A minimum of 5 samples per acre of liner surface shall be taken. The samples shall be split proportionately between the wetted areas of the bottom and interior walls of the dikes relative to the total area of each and spaced to provide representative samples of the liner. For lagoons less than one acre in size, a minimum of 5 samples shall be taken.

(b) The core samples shall be tested by a soil testing laboratory or engineering firm for the following parameters: dry unit weight density, moisture content, degree of compaction, liner thickness, particle size distribution and Atterberg limits. Addi-

tionally, permeability tests shall be performed on a minimum of 3 of every 5 core samples. The design standards for liner thickness and permeability shall be considered met if:

1. The average thickness of soil or soil-bentonite liners and cover samples, analyzed separately, are equal to or greater than the specified design thickness; and
2. An individual sample does not have a thickness which is less than the design thickness by more than 0.1 foot; and
3. The permeability of at least 60% of the liner samples tested are equal to or less than the design permeability; and
4. An individual sample does not have a permeability more than one order of magnitude greater than the design permeability.

(c) All test holes shall be backfilled using materials identical to the liner design materials and compacted.

**(3) SYNTHETIC LINERS.** Subsequent to installation of synthetic liners and prior to placement of the liner cover, all field constructed seams shall be tested in accordance with the manufacturer's recommendations to insure the integrity of the liner. All faulty seams shall be repaired and retested until a proper seal is obtained.

**Note:** Copies of ASTM D1587 may be inspected at the offices of the department, the secretary of state and the legislative reference bureau. Copies of ASTM standards may also be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

**History:** Cr. Register, July, 1984, No. 343, eff. 8-1-84; renum. from NR 213.09, Register, June, 1990, No. 414, eff. 7-1-90; am. (2) (a), Register, April, 1991, No. 424, eff. 5-1-91.

### Subchapter III — Design of Storage Structures

**NR 213.13 Requirements for sweet corn silage stacks of greater than 150 tons which do not exceed 1200 tons at any one time.** Sweet corn silage stacks which do not exceed 1200 tons per site at any one time are not required to meet the specifications of s. NR 213.14 if subs. (1), (2) and (3) are met. This section does not apply to sweet corn silage stacks of less than 150 tons per site at any one time.

**(1) GENERAL SITE CRITERIA.** Sites used for stacking of sweet corn silage which do not exceed 1200 tons per site at any one time shall meet the following conditions:

- (a) At least 50% of the natural soil in the upper 24 inches passes a No. 200 sieve.
- (b) No greater than 5% by weight of the upper 24 inches of the natural soil is retained on a No. 4 sieve.
- (c) The plasticity index of the natural soil is equal to or greater than 7.
- (d) The stack is located at least 1000 feet from any well serving a community public water supply system and at least 250 feet from any other potable water supply well.
- (e) The stack is located at least 500 feet from an inhabited dwelling except that this distance may be reduced with the written permission from the owner and occupants of the residence.
- (f) The stack is located at least 5 vertical feet from the groundwater or bedrock.
- (g) The base of the stack is located on a site that does not exceed 2% slope.
- (h) The stack is located at least 200 feet from the nearest surface water.

**(2) LEACHATE MANAGEMENT.** Leachate from the stack shall be collected and landspread in a manner that prevents surface water and groundwater pollution.

**(3) DOCUMENTATION OF COMPLIANCE.** Documentation of compliance with subs. (1) and (2) shall be submitted to the de-

partment for review and acceptance prior to use of the site for stacking of sweet corn silage.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.14 Stack structures for by-product solids.** This section shall be applicable to all by-product solids stacks except those stacks identified in s. NR 213.02 (2) (e) or those stacks which meet the requirements of s. NR 213.13.

**(1) GENERAL SUBMITTAL REQUIREMENTS.** (a) An engineering report and plans and specifications shall be submitted to the department for approval in accordance with s. 281.41, Stats., prior to initiating construction.

**Note:** The department recommends that whenever possible, a preliminary engineering report outlining the project and including any available information required under par. (b) be submitted prior to submittal of final plans.

(b) The engineering report shall outline the entire project and include, at a minimum, the following information: legal description of the site subgrade conditions, soil classification, percent soil passing a No. 200 sieve, soil plasticity index, depth to bedrock and to seasonal high groundwaters, waste sources, and waste volume and materials and specifications of the proposed structure.

**(2) GENERAL DESIGN AND CONSTRUCTION CRITERIA.** (a) The base, walls and joints of the by-product solids stack structure shall be constructed for maximum containment of any leachate generated such that all leachate is conveyed to and stored in an approved leachate storage facility.

(b) The minimum slope for the base of the structure shall be 2%.

(c) Construction of bituminous concrete structures and concrete structures shall comply with the WDOT standards for road and bridge construction. Other materials for stack structures may be proposed in the plans and specifications submitted to the department. Approval of any material shall be based on the capability of the material to meet the purpose of this chapter.

**Note:** Copies of WDOT standards may be inspected at the offices of the department, the secretary of state and the legislative reference bureau.

**(3) SITE PREPARATION.** (a) Prior to construction, the site area shall be cleared of all vegetation, brush, roots and stumps. Materials encountered above the required elevations shall be excavated and all depressions in the subgrade shall be filled. The subgrade shall be smoothed, shaped and compacted to the required grade, section and uniform density. The subgrade shall be scarified to the depth necessary for shaping and compaction. Stones over 6 inches in diameter shall be removed during site preparation.

**(4) BITUMINOUS CONCRETE STRUCTURE DESIGN AND CONSTRUCTION CRITERIA.** (a) The pavement structure shall consist of a minimum of 10 inches of well drained subgrade or subbase. A suitable subgrade is one with 35% or less passing a No. 200 sieve, and a plasticity index of 10 or less. The base course shall contain a minimum 8 inches of crushed aggregate and the surface course shall be 3 inches of bituminous concrete pavement in 2 layers.

(b) The aggregates of the base course shall conform to the gradation requirements for gradation No. 2 in accordance with sec. 304.2.6 WDOT standards for road and bridge construction.

(c) The aggregates of the bituminous concrete pavement may not be of dolomitic or limestone origin.

(d) The bituminous concrete pavement shall be laid in 2 lifts of a minimum 1¾ inch binder course and 1¼ inch surface course.

(e) The bituminous mix design laboratory sheet shall be submitted with the plans and specifications.

(f) Aggregates in the binder course shall conform to the gradation requirements for gradation No. 2. Aggregates in the sur-

face course shall conform to the gradation requirements for gradation No. 3, in accordance with sec. 304.2.6., WDOT standards for road and bridge construction.

(g) The asphalt shall meet the 120-150 penetration grade in accordance with AASHTO T49.

**Note:** Copies of AASHTO T49 may be inspected at the offices of the department, the secretary of state and the legislative reference bureau.

(h) The design mix of asphalt cement and aggregates shall yield a Marshall stability of no less than 1000 with an air void of the compacted mixture no more than 2%.

(i) The binder course shall be compacted to at least 93% 50 blow Marshall. The surface course shall be compacted to at least 95% 50 blow Marshall.

(j) The surface course shall be applied such that a minimum 2 foot overlap is to be provided over the binder course joints.

(k) Curbing or side walls shall be provided at the perimeter of the base and be sealed to prevent exfiltration at the seams and undercutting by rainfall. Dumping pads shall be paved and contiguous with the structure.

(L) A qualified inspector shall be on site during construction to document compaction measurements. Compaction shall be measured with a nuclear density meter, or other approved method.

**Note:** The department believes that properly mixed and applied bituminous concrete is a suitable construction material for by-product stacking structures. However, since longer-term studies have not yet been performed, the long-term performance of this material with this particular use cannot be predicted at this time.

**Note:** Copies of WDOT standard 304.2.6 may be inspected at the offices of the department, the secretary of state and the legislative reference bureau.

**(5) CONCRETE STRUCTURE DESIGN AND CONSTRUCTION CRITERIA.** (a) The pavement structure shall consist of a minimum of 10 inches of well drained soil subgrade or subbase. A suitable subgrade is one with 35% or less passing a No. 200 sieve and a plasticity index of 10 or less. The base course shall contain a minimum 4 inches of crushed aggregate and the surface course shall be 6 inches of concrete.

(b) Curbing or side walls shall surround the base and be sealed to prevent exfiltration at the seams and undercutting by rainfall. Dumping areas shall be paved and contiguous with the structure.

(c) The surface course curbing and walls shall be protected from chemical and biological decomposition with an appropriate sealant which is resistant to degradation from sunlight.

(d) The aggregates of the base course shall conform to the gradation requirements for gradation no. 2 in accordance with sec. 304.2.6, WDOT standards for road and bridge construction.

(e) Coarse aggregates of the concrete mixture shall be well graded between the limits specified in size no. 1 gradation in accordance with sec. 501.3.6.4.5 WDOT standards for road and bridge construction.

(f) The concrete shall meet the mix grade A air-entrained concrete classification and a water to cement ratio of no greater than 0.45 with 6% air plus or minus 1%.

(g) Metal reinforcing rods or mesh shall be provided in the pavement structure.

(h) Contraction joints shall be placed no greater than 20 feet apart in all directions.

(i) Contraction and construction joints shall be sealed with appropriate caulk or sealant to prevent leakage. The proposed sealant shall be specified in the plans and specifications.

**Note:** Copies of WDOT standards 304.2.6 and 501.3.6.4.5 may be inspected at the offices of the department, the secretary of state and the legislative reference bureau.

**(6) ANNUAL INSPECTION AND MAINTENANCE.** All visible cracks shall be cleaned and sealed. A report summarizing the inspection and maintenance performed to the by-product solids stack structure shall be prepared and submitted to the department in accordance with the WPDES permit. An operation and maintenance plan shall also be included in the plans and specifications.

**(7) LEACHATE COLLECTION SYSTEMS.** (a) Design and construction criteria for a leachate collection system, consisting of conveyance and storage, shall be included with the plans and specifications. The system shall be totally contained and constructed in accordance with subch. II or s. NR 213.15.

(b) The leachate storage structure shall be sized to provide adequate capacity to store the leachate generated between disposal events and normal rainfall as well as the larger volume generated by a 10-year, 24 hour rainfall event. The length of time between disposal events shall be specified in the management plan required in ch. NR 214, and shall take into account such factors as availability of labor, leachate disposal equipment, and availability of leachate disposal sites.

**(8) SURFACE WATER RUNOFF DIVERSION STRUCTURES.** A surface water runoff diversion system shall be provided in the storage structure design.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90.

**NR 213.15 Storage tanks.** Storage tanks shall be designed, installed and maintained to prevent leaks due to corrosion or structural failure.

**(1) Underground storage tanks shall be designed such that:**

(a) They are cathodically protected against corrosion, constructed of noncorrosive material, constructed of coated steel with noncorrosive material or its equivalent.

(b) The materials of the tank or liner are compatible with the stored substance.

(c) An inspection manhole, vent and high water alarm are provided.

(d) Periodic testing shall be performed, such as pressure testing, to ensure the integrity of the tank is maintained.

**(2) Above-ground storage tanks shall be designed such that:**

(a) They are constructed of noncorrosive material, steel lined with noncorrosive material, or its equivalent.

(b) The materials of the tank or liner are compatible with the stored substance.

(c) An inspection manhole, vent and high water alarm are provided.

(d) The department may require a containment dike around storage tanks in locations where water pollution would potentially be caused by a spill or overflow.

**History:** Cr. Register, June, 1990, No. 414, eff. 7-1-90.