

## **Hydrogeological Investigations**

### **Illinois**

#### **Section 811.315 Hydrogeologic Site Investigations**

a) Purpose

The operator shall conduct a hydrogeologic investigation to develop hydrogeologic information for the following uses:

- 1) Provide information to perform a groundwater impact assessment; and
- 2) Provide information to establish a groundwater monitoring system.

b) General Requirements

- 1) The investigation shall be conducted in a minimum of three phases prior to submission of any application to the Agency for a permit to develop and operate a landfill facility.
- 2) The study area shall consist of the entire area occupied by the facility and any adjacent related areas, if necessary for the purposes of the hydrogeological investigation set forth in subsection (a).
- 3) All borings shall be sampled continuously at all recognizable points of geologic variation, except that where continuous sampling is impossible or where non-continuous sampling can provide equivalent information, samples shall be obtained at intervals no greater than 1.52 meters (five feet) in homogeneous strata.

c) Minimum Requirements For a Phase I Investigation

- 1) The operator shall conduct a Phase I Investigation to develop the following information:
  - A) Climatic aspects of the study area;
  - B) The regional and study area geologic setting, including a description of the geomorphology and stratigraphy of the area;
  - C) The regional groundwater regime including water table depths and aquifer characteristics; and
  - D) Information for the purpose of designing a Phase II Hydrogeologic Investigation.
- 2) Specific Requirements
  - A) The regional hydrogeologic setting of the unit shall be established by using material available from all possible sources, including, but not limited to, the Illinois Scientific Surveys, the Agency, other State and Federal organizations, water well drilling logs, and previous investigations.
  - B) A minimum of one continuously sampled boring shall be drilled on the site, as close as feasible to the geographic center, to determine if the available regional hydrogeologic setting information is accurate and to characterize the site-specific hydrogeology to the extent specified by this phase of the investigation. The boring shall extend at least 15.2 meters (50 feet) below the bottom of the uppermost aquifer or through the full depth of the confining layer below the uppermost aquifer, or to bedrock, if the bedrock is below the upper most aquifer, whichever elevation is higher. The locations of any additional

borings, required under this subsection, may be chosen by the investigator, but shall be sampled continuously.

d) Minimum Requirements For A Phase II Investigation

1) Information to be developed

Using the information developed in the Phase I survey, a Phase II study shall be conducted to collect the site-specific information listed below as needed to augment data collected during the Phase I investigation and to prepare for the Phase III investigation:

- A) Structural characteristics and distribution of underlying strata including bedrock;
- B) Chemical and physical properties including, but not limited to, lithology, mineralogy, and hydraulic characteristics of underlying strata including those below the uppermost aquifer;
- C) Soil characteristics, including soil types, distribution, geochemical and geophysical characteristics;
- D) The hydraulic conductivities of the uppermost aquifer and all strata above it;
- E) The vertical extent of the uppermost aquifer;
- F) The direction and rate of groundwater flow.

2) Specific Requirements

- A) One boring shall be located as close as feasible to the topographical high point, and another shall be located as close as feasible to the topographical low point of the study area.
- B) At least one boring shall be at or near each corner of the site. Where the property is irregularly shaped the borings shall be located near the boundary in a pattern and spacing necessary to obtain data over the entire study area.
- C) Additional borings may be located at intermediate points at locations and spacings necessary to establish the continuity of the stratigraphic units.
- D) Piezometers and groundwater monitoring wells shall be established to determine the direction and flow characteristics of the groundwater in all strata and extending down to the bottom of the uppermost aquifer. Groundwater samples taken from such monitoring wells shall be used to develop preliminary information needed for establishing background concentrations in accordance with subsection (e)(1)(G).
- E) Other methods may be utilized to confirm or accumulate additional information. Such methods may be used only as a supplement to, not in lieu of, site-specific boring information. Other methods include, but are not limited to, geophysical well logs, geophysical surveys, aerial photography, age dating, and test pits.

e) Minimum Standards For A Phase III Investigation

1) Using the information developed during the Phase I and Phase II

Investigations, the operator shall conduct a Phase III Investigation. This investigation shall be conducted to collect or augment the site-specific information needed to carry out the following:

- A) Verification and reconciliation of the information collected in the Phase I and II investigations;
  - B) Characterization of potential pathways for contaminant migration;
  - C) Correlation of stratigraphic units between borings;
  - D) Continuity of petrographic features including, but not limited to, sorting, grain size distribution, cementation and hydraulic conductivity;
  - E) Identification of zones of potentially high hydraulic conductivity;
  - F) Identification of the confining layer, if present;
  - G) Concentrations of chemical constituents present in the groundwater below the unit, down to the bottom of the uppermost aquifer, using a broad range of chemical analysis and detection procedures such as, gas chromatographic and mass spectrometric scanning. However, additional measurements and procedures shall be carried out to establish background concentrations, in accordance with Section 811.320(d), for:
    - i) Any constituent for which there is a public or food processing water supply standard at 35 Ill. Adm. Code 302 established by the Board and which is expected to appear in the leachate; and
    - ii) Any other constituent for which there is no Board-established standard, but which is expected to appear in the leachate at concentrations above PQL, as defined in Section 811.319(a)(4) for that constituent;
  - H) Characterization of the seasonal and temporal, naturally and artificially induced, variations in groundwater quality and groundwater flow; and
  - I) Identification of unusual or unpredicted geologic features, including: fault zones, fracture traces, facies changes, solution channels, buried stream deposits, cross cutting structures and other geologic features that may affect the ability of the operator to monitor the groundwater or predict the impact of the disposal facility on groundwater.
- 2) In addition to the specific requirements applicable to phase I and II investigations, the operator shall collect information needed to meet the minimum standards of a phase III investigation by using methods that may include, but not limited to excavation of test pits, additional borings located at intermediate points between boreholes placed during phase I and II investigations, placement of piezometers and monitoring wells, and institution of procedures for sampling and analysis.
- f) The operator may conduct the hydrogeologic investigation in any number of alternative ways provided that the necessary information is collected in a systematic sequence consisting of at least three phases that is equal to or superior to the investigation procedures of this Section.

## **Kansas**

### **(b) Hydrogeologic site investigations.**

- (1) The owner or operator of a proposed MSWLF unit shall conduct a hydrogeologic investigation to develop information for the following purposes:

- (A) providing information to determine an appropriate design for the unit; and
  - (B) providing information to establish a groundwater monitoring system.
- (2) Prior to submitting an application to the department for a permit to develop and operate a MSWLF or to design a groundwater monitoring system, the hydrogeologic site investigation shall be conducted in a minimum of two phases, unless the department approves conducting the two phases concurrently.
- (A) The purpose of the phased study shall be to allow for the consideration by the department of information gathered during phase I prior to proceeding with phase II.
  - (B) If the owner or operator of an existing MSWLF has already compiled sufficient data to fulfill the requirements of the hydrogeologic investigation, this information may be submitted to the department in lieu of conducting a new assessment.
- (3) For the purposes of the hydrogeologic investigation set forth in paragraph (b)(1), the area to be investigated shall consist of the entire area occupied by the facility and any adjacent areas, if necessary to fully characterize the site.
- (4) All borings shall be sampled continuously except where continuous sampling is impossible or where interval sampling or sampling at recognizable points of geologic variation will provide satisfactory information. Sampling intervals shall not exceed 1.52 vertical meters (5 feet).
- (5) The phase I hydrogeologic investigation shall consist of the following items.
- (A) A minimum of one continuously sampled boring shall be drilled on the site, as close as possible to the geographic center, to determine if available regional hydrogeologic setting information is accurate and to characterize the site-specific hydrogeology to the extent specified by this phase of the investigation. The boring shall extend to the bottom of the uppermost aquifer. This boring shall be constructed so that it will not provide a conduit for contaminant migration to a lower aquifer or formation.
  - (B) The following information shall be gathered by the owner or operator:
    - (i) climatic aspects of the study area;
    - (ii) the regional and study area geologic and hydrogeologic setting, including a description of the geomorphology and stratigraphy of the area and aquifer characteristics, including water table depths; and
    - (iii) any other information needed for the purpose of designing a phase II hydrogeologic investigation.
  - (C) The information from the phase I investigation shall be compiled in a report and submitted with evaluations and recommendations to the department for review and approval.
  - (D) The results and conclusions of the phase I report shall be certified by a qualified groundwater scientist.
- (6) The phase II hydrogeologic investigation shall consist of the following items.
- (A) One boring shall be located as close as possible to the topographical high point, and another shall be located as close as possible to the topographical low point of the study area.
  - (B) Additional borings shall be made in order to characterize the subsurface geology of the entire study area.
  - (C) Piezometers and groundwater monitoring wells shall be established to determine the direction and flow characteristics of the groundwater in all strata and

extending down to the bottom of the uppermost aquifer. Groundwater samples taken from the monitoring wells shall be used to develop preliminary information needed for establishing background concentrations.

(D) The owner or operator shall gather the following site-specific information, as necessary, to augment the data collected during the phase I investigation:

- (i) chemical and physical properties including, but not limited to, lithology, mineralogy, and hydraulic characteristics of underlying strata including those below the uppermost aquifer;
- (ii) soil characteristics, including soil types, distribution, geochemical and geophysical characteristics;
- (iii) hydraulic conductivities of the uppermost aquifer and all strata above it;
- (iv) vertical extent of the uppermost aquifer;
- (v) direction and rate of groundwater flow; and
- (vi) concentrations of chemical constituents present in the groundwater below the unit, down to the bottom of the uppermost aquifer, using a broad range of chemical analysis and detection procedures such as gas chromatographic and mass spectrometric scanning.

(E) The owner or operator shall evaluate the data gathered during the phase I and phase II investigations and prepare a report for submittal to the department that contains the following information:

- (i) structural characteristics and distribution of underlying strata, including bedrock;
- (ii) characterization of potential pathways for contaminant migration;
- (iii) correlation of stratigraphic units between borings;
- (iv) continuity of petrographic features including, but not limited to, sorting, grain size distribution, cementation and hydraulic conductivity;
- (v) identification of the confining layer, if present;
- (vi) characterization of the seasonal and temporal, naturally and artificially induced, variations in groundwater quality and groundwater flow;
- (vii) identification of unusual or unpredicted geologic features, including fault zones, fracture traces, facies changes, solution channels, buried stream deposits, cross cutting structures and other geologic features that may affect the ability of the owner or operator to monitor the groundwater or predict the impact of the disposal facility on groundwater; and
- (viii) recommendations for landfill siting and conceptual design for the department to review and approve.

(F) The results and conclusions of the phase II report shall be certified by a qualified groundwater scientist.

### **Minnesota**

Subp. 3. **Hydrogeologic evaluation.** The owner or operator must complete a hydrogeologic evaluation in accordance with items A to I.

- A. The owner or operator of a mixed municipal solid waste land disposal facility must investigate and define the hydrogeologic conditions at the facility. The hydrogeologic evaluation is required to obtain or retain a facility permit, and must be included in the application for a permit under parts 7001.3275,

7001.3300, and 7001.3475. The owner or operator must provide updates and revisions to the hydrogeologic evaluation as needed to clarify and define changes in the hydrogeologic conditions.

The owner or operator may use previous data and field installations to help fulfill the hydrogeologic evaluation requirements. If the commissioner determines that portions of this previous work are reliable, well-documented, and comparable in information content, they may be substituted for the corresponding type and number of work items required in this subpart.

- B. The hydrogeologic evaluation must be conducted in phases, in which the work done under each of the items E to I makes use of the results of the work required under the preceding items.
  - (1) Before conducting each phase, the owner or operator shall submit for the commissioner's approval a detailed description of the work proposed for that phase and a report of the findings from the previous phase, accompanied by documentation of information sources and methods and procedures used, boring and monitoring point logs, test data, and sample calculations. The commissioner may require additional work plans, if necessary, to enable review between successive stages of field and laboratory investigations.
  - (2) Soil and rock samples must be retained for at least 90 days after submittal of the report containing the boring logs.
- C. The owner or operator must define the hydrogeologic conditions within at least the following areas:
  - (1) beneath the waste fill area and leachate management system;
  - (2) sufficient distances beyond the waste fill area and leachate management system, based on the directions and rates of ground water flow, to define the soil and ground water conditions that would control pollutant migration from the facility;
  - (3) within areas in which corrective actions would be implemented to contain, recover, or treat leachate or polluted ground water; and
  - (4) within the following vertical zones:
    - (a) the unsaturated zone;
    - (b) any perched saturated zone;
    - (c) the zone of continuous saturation, from the water table, through the uppermost aquifer, the next aquifer below it, and any intervening units; and
    - (d) for facilities that have affected ground water quality to a depth greater than that given in unit (c), the zone of continuous saturation, from the water table to and including both the lowest affected aquifer and the next aquifer below it. As used in this item, the lowest affected aquifer means the lowest aquifer in which one or more pollutants originating from the facility exceed the intervention limits or alternative intervention limits under subpart 4; and
    - (e) any additional aquifers used locally as major sources of water supply. The commissioner may approve a minimum depth shallower than required in subitem (4) if there is little likelihood that ground water pollutants originating from the facility will migrate below this designated level.
- D. Where drilling methods, testing methods, minimum quantities or depths, and reporting requirements are specified in items E to I, the owner or operator may

propose alternative procedures if subsurface conditions indicate a need for these procedures. The commissioner may approve or require changes from the requirements in items E to I for good cause, including cases where:

- (1) subsurface conditions are shown to be uniform, or the requirements are otherwise unnecessary or excessive for site conditions;
  - (2) a requirement is infeasible for a particular site or hydrogeologic condition;
  - (3) an alternative procedure would produce more or better information or would reduce the chance of pollutant migration between connecting aquifers; or
  - (4) the required procedures are insufficient to produce the information required in item G. In all cases, alternative procedures are acceptable only if the subsurface conditions are thoroughly defined and the uncertainty of monitoring and corrective action is not increased.
- E. In the first phase of the hydrogeologic evaluation, the available published and unpublished information about the facility site and surrounding area must be evaluated. The report for this phase must include at least the following information wherever it is available or can be developed from available sources:
- (1) A description of previous investigations of the site and surrounding area, and a discussion of the reliability and completeness of this information.
  - (2) Descriptions, maps, and aerial photographs depicting the site and surrounding area's geologic history, stratigraphic sequence, soils, topography, vegetation, climate, surface water hydrology, area water usage, regional hydrogeologic setting, ground water occurrence at the site, aquifers and aquitards, hydrogeologic parameters such as transmissivity and storage coefficient, recharge and discharge areas, rates and directions of ground water movement, and water quality.
  - (3) One or more geologic columns or sections.
  - (4) Cross-sections, oriented along and perpendicular to the directions of ground water flow.
  - (5) An inventory and a plan map of all active, unused, and abandoned wells within one mile of the facility, and of high-capacity wells and community water supply wells within three miles of the facility. The inventory must include well logs and all other available information on well construction, water levels, and well usage, and it must be based on thorough reviews of state and local collections of water well logs and, if required by the commissioner, interviews or surveys of well owners. The commissioner may require interviews and surveys of well owners if needed well logs are not available through other sources.
  - (6) For existing facilities, preliminary evaluations of the adequacy of the water monitoring system; the monitoring points' compliance with chapter 4725, Department of Health Water Well Construction Code; and the water quality monitoring data.
- F. In the second phase of the hydrogeologic evaluation, the owner or operator must evaluate in detail the distribution and properties of the earth materials underlying the site and the ground water conditions beneath the site.
- (1) The investigation must be sufficient to identify the soil and bedrock units beneath the site, delineate their areal and vertical extent, determine their water

transmitting properties, identify perched saturated zones, define vertical and horizontal components of ground water flow, predict pollutant movement in the event of releases from the facility, and provide the information needed for the report under item G.

- (2) The work plan required for this phase must describe the methods and quality control measures to be used in drilling, logging, piezometer installation, boring and piezometer abandonment, and soils, bedrock, and ground water testing; and the hydrogeologic basis for the investigation, including specific subsurface conditions the investigations are likely to encounter and will seek to define. The work plan must describe the planned numbers, locations, depths and sequence of borings, test pits, geophysical or other measurements, sampling sites, and testing sites.
- (3) Sufficient soil borings must be done to define the soil and bedrock conditions within the areas required in item C. The initial drilling must include borings positioned throughout the site; within each geomorphic feature including ridges, knolls, depressions, and drainage swales; and within any geophysical anomalies already identified. The minimum required number of borings for this initial drilling is as follows:

Size of Site	Number of Borings
0-10 acres	15
10-20	Add one boring per additional acre
20	25
20-40	Add one boring per additional two acres
40	35
more than 40	Add one boring per additional four acres

Additional borings, geophysical investigations, or both must be done, where needed, to delineate the thickness, extent, and properties of the soil and bedrock units identified in the initial drilling. The commissioner may require test pits for examination of the near-surface soils. In bedrock, the commissioner shall require core samples if necessary to identify the stratigraphic position of the uppermost bedrock or to determine the water-bearing and water-transmitting properties of the bedrock.

- (4) Soil borings must comply with chapter 4725 and must not create pathways for pollutant migration. They must be permanently sealed using the procedures given in parts 4725.2700 to 4725.3100. Except where the soil boring is converted to an active piezometer or monitoring point or where the Minnesota Department of Health approves alternative methods, soil and bedrock borings must be sealed with grout, bentonite, or other impermeable material in a manner that minimizes the potential for future pollutant movement along the borehole.
- (5) Soil samples must be collected using procedures conforming to American Society for Testing and Materials (ASTM) standards D1586 (split-barrel), D1587 (thin-walled tube), D3550 (ring-lined barrel), or equivalent methods approved by the commissioner. Within each boring, soil samples must be collected at maximum five-foot intervals and at changes in soil type

distinguishable through changes in drilling characteristics, examination of cuttings, or other means. At least one boring per ten acres of proposed waste fill must be continuously sampled below the elevation of the base of the fill. Wherever necessary to determine detailed stratigraphy, the commissioner shall require smaller intervals between samples, additional continuously-sampled borings, borehole geophysical logging, or other procedures. Samples must be preserved and transported in accordance with ASTM standard D4220.

- (6) The soils and bedrock must be described and classified using information from field drilling observations, any geophysical logs, and laboratory examination and testing. Soil descriptions must include textural classification, primary and secondary structures, voids, and other properties that may affect soils correlations and influence pollutant movement. Rock cores or samples must be described and classified using accepted geologic classification systems and nomenclature.
- (7) Based on the descriptions and testing required in subitems (6), (8), and (9), the soils and bedrock must be classified and, to the extent feasible, correlated over the site.
- (8) For each soil unit identified on the site, a series of soil samples from different borings and elevations within the unit must be laboratory-tested. The owner or operator must develop a procedure and supporting rationale to select samples for this testing that are representative of the unit or are critically located within the unit. Together with the in-field testing required in subitem (9), the laboratory testing must determine the water-bearing and water-transmitting properties including, as appropriate, particle size distribution, porosity, vertical permeability, and clay mineral content or cation exchange capacity. Samples must not be combined into composites for classification or testing. Samples used to test permeability must not be compacted, and disturbance of samples must be minimized. Testing and quality assurance must conform with methods approved by the American Society for Testing and Materials or other standard methods.
- (9) A program to determine in-place permeabilities must be developed including criteria for the placement of test wells or piezometers. Test locations must be at or adjacent to logged borings and must be suitably distributed to characterize the variation in the permeabilities of soil or bedrock units.
- (10) Ground water flow conditions must be defined in detail within the zone specified in item C. A series of piezometers complying with subpart 10, item R, must be installed to map hydraulic head within this zone. The range of fluctuation in hydraulic head must be determined through historical records and a series of on-site measurements over time, unless the commissioner approves alternative methods to estimate the importance of fluctuations. The effects of pumping from high-capacity wells must be evaluated.
- (11) Logs of all soil and bedrock borings must be submitted to the commissioner. The soil and bedrock logs must contain the information generated under subitems (3) to (8) and a scale drawing of the soil types encountered. At a minimum, the logs must contain the following: date of the boring; name and address of the driller and testing firm; drilling and sampling methods; surveyed

elevation of the ground surface above mean sea level; surveyed location referenced to permanent benchmarks; soil and rock classifications and narrative descriptions, contacts between strata or units, sample depths, blow counts, and test data; observations during drilling; water level measurements; any geophysical logs; and sealing procedures.

- (12) The well inventory, plan map, and supporting information required under item E, subitem (5), must be field-checked and updated to include all wells within the prescribed distances. Owners of structures or facilities that may have wells must be contacted directly to supplement the information previously obtained.
- G. The report for the second phase of the hydrogeologic evaluation must contain at least the following information generated under item F:
- (1) logs developed under item F, subitem (11), for borings and under subpart 10, items O to R, for piezometers and monitoring wells;
  - (2) descriptions of the soil and bedrock units and of the properties that may influence water movement including:
    - (a) texture and classification;
    - (b) particle size distributions;
    - (c) mineral composition, cementation, and soil structure;
    - (d) geologic structure, including strike, dip, folding, faulting, and jointing;
    - (e) permeabilities, including vertical permeabilities, and porosity; and
    - (f) lenses and other discontinuous units, voids, solution openings, layering, fractures, other heterogeneity, and the scale or frequency of this heterogeneity;
  - (3) one or more detailed geologic columns;
  - (4) descriptions of the hydrologic units within the saturated zone, including their thicknesses; hydraulic properties; the role and effect of each as an aquifer, aquitard, or perched saturated zone; and the actual or potential use of the aquifers as water supplies;
  - (5) plan-view maps and a series of cross-sections, spaced no more than 500 feet apart, oriented at a minimum in directions parallel to and perpendicular to the predominant directions of ground water flow, and showing the areal and vertical extent of the soil and bedrock units, the position of the water table, measured values of hydraulic head, equipotential lines and inferred ground water streamlines, soil or bedrock borings, locations and construction of piezometers and monitoring points, and locations of any geophysical measurements used to prepare the cross-sections;
  - (6) description and evaluation of the ground water flow system, specifically addressing the following components and discussing their significance with respect to ground water and pollutant movement:
    - (a) local, intermediate, and regional flow systems;
    - (b) ground water recharge and discharge areas, interactions of ground water with perennial or intermittent surface waters, and how the facility affects recharge rates;
    - (c) existing or proposed ground water and surface water withdrawals;
    - (d) the effect of heterogeneity, fractures, or directional differences in permeability on ground water movement;
    - (e) directions of ground water movement including vertical components of flow,

- specific discharge rates, and average linear velocities within the hydrologic units described in subitem (4); and
- (f) seasonal or other temporal fluctuations in hydraulic head;
  - (7) an analysis of potential impacts on ground water quality, surface water quality, and water users in the event of a release from the facility including projected paths and rates of movement of both water-soluble and low-solubility components of leachate; and
  - (8) if mathematical or analog models are used to simulate ground water flow or contaminant migration, the report must thoroughly describe the model and its capabilities and limitations, state all assumptions or approximations made in using the model, identify quantities or values derived from the model that are not confirmed by direct measurement, and evaluate the reliability and accuracy of the results.
- H. In the third phase of the hydrogeologic evaluation, the water monitoring system must be designed and installed based on the information obtained under items E to G. The monitoring system must comply with the requirements of subpart 10.
- (1) The work plan for this phase must include:
    - (a) a description of the proposed monitoring system; monitoring point locations, design, and installation procedures; and a thorough evaluation of the suitability of any existing monitoring points proposed for inclusion in the monitoring system, including any deficiencies with respect to the requirements of subpart 10;
    - (b) an explanation of how the proposed monitoring system addresses the hydrogeologic conditions identified under items E to G; and
    - (c) a preliminary version of the monitoring protocol required under subpart 14.
  - (2) The report for this phase must include:
    - (a) the monitoring point construction and installation records required under subpart 10, items O to S;
    - (b) a description of any changes from the locations, design, and installation procedures identified in the work plan; and
    - (c) an evaluation of any differences from previously reported soils and bedrock conditions, water levels, or ground water flow conditions.
- I. In the fourth phase of the hydrogeologic evaluation, water quality information must be collected from the monitoring system and interpreted. Water quality monitoring must comply with the requirements of subpart 14.
- (1) The work plan for this phase must include the proposed monitoring protocol required in subpart 14; schedule of background or initial sampling dates; proposed analytical constituents and measurements; and methods of data analysis and interpretation.
  - (2) The report for this phase must contain the monitoring and quality assurance data, analysis of water quality trends, and identification of constituents that exceed ground water performance standards of subpart 4 or surface water quality standards of chapter 7050.

## **South Dakota**

**74:27:12:05. Hydrogeologic evaluation.** The applicant shall conduct a hydrogeologic evaluation at or near the site to determine, at a minimum, the groundwater flow direction, gradient, and ambient quality. Well construction must conform to the requirements of subdivision 74:54:02:06(9)(f). The applicant shall determine ambient groundwater quality before permit approval. The secretary shall approve the sampling parameters. Sampling results shall be compared to the groundwater quality standards of §§ 74:54:01:04 and 74:54:01:05.

Sampling and analytical techniques must conform to the requirements of § 74:54:01:06. Groundwater level measurements and water quality analyses of existing wells may also be used in determining the hydrogeologic conditions at the site.

**Source:** 17 SDR 8, effective July 26, 1990; 19 SDR 186, effective June 10, 1993.

**General Authority:** SDCL 34A-6-1.6.

**Law Implemented:** SDCL 34A-6-1.6.

## **Wisconsin**

**NR 507.01 Purpose.** The purpose of this chapter is to help ensure that efficient, nuisance-free and environmentally acceptable solid waste management procedures are practiced in this state, to outline environmental monitoring requirements at solid waste facilities and to implement groundwater standards according to ch. NR 140 and ch. 160, Stats. This chapter is adopted under ch. 289, Stats. and s. 227.11, Stats.

**History:** Cr. Register, June, 1996, No. 486, eff. 7-1-96.

### **NR 507.02 Applicability.**

**(1)** Except as otherwise provided, this chapter governs all environmental monitoring for solid waste disposal facilities as defined by s. 289.01 (35), Stats., except hazardous waste facilities as defined in s. 291.01 (8), Stats., and regulated under chs. NR 600 to 690, and metallic mining operations as defined in s. 293.01 (9), Stats., and regulated under ch. NR 182.

**(2)** This chapter does not apply to the design, construction or operation of industrial wastewater facilities, sewerage systems and waterworks treating liquid wastes approved under s. 281.41, Stats., or permitted under ch. 283, Stats., nor to facilities used solely for the disposal of liquid municipal or industrial wastes which have been approved under s. 281.41, Stats., or permitted under ch. 283, Stats., except for facilities used for the disposal of solid waste.

**(3)** This chapter applies to the owners and operators of solid waste disposal facilities regulated under chs. NR 500 to 538.

**History:** Cr. Register, June, 1996, No. 486, eff. 7-1-96; am. (3), Register, December, 1997, No. 504, eff. 1-1-98.

### **NR 507.04 General requirements for monitoring devices and geologic**

**sampling.** The department may require an owner or operator of a solid waste disposal facility to install, sample and document environmental monitoring devices in accordance with this chapter. All monitoring devices shall be designed, installed, maintained and

operated in accordance with the requirements of ss. NR 507.05 to 507.26, unless an alternate method is approved in writing by the department. All monitoring devices shall be constructed to minimize the potential for contaminants to enter the groundwater or to move from one major soil unit or rock formation to another. All monitoring devices shall be designed, located, installed and maintained so as to obtain reliable and representative information.

**(1) LOCATION.** The owner or operator shall submit, in writing, to the department for approval, the locations of all monitoring devices prior to installation, except for wells installed prior to a feasibility decision. The location and construction of any monitoring device installed prior to the feasibility decision may be submitted to the department for review and concurrence prior to installation.

**(2) FIELD DIRECTION.** A professional geologist or qualified technician who is directly supervised by a professional geologist shall observe and direct the drilling of all borings and the installation, development and abandonment of all wells. A professional geologist or qualified technician who is directly supervised by a professional geologist shall also conduct all in-field hydraulic conductivity tests and visually describe and classify all of the geologic samples.

**(3) PROTECTION.** All monitoring and sampling devices shall be sealed and locked to prevent contaminants from entering the monitoring device. All monitoring wells and gas probes shall have protective metal casings. All other monitoring devices shall be protected as necessary. The department may require additional protective devices such as a ring of brightly colored posts around any monitoring device. All leachate head wells shall be protected to prevent damage during facility operation.

**(4) LABELING.** All monitoring devices shall be clearly and permanently labeled on the outside of the monitoring device. At a minimum, the label shall include the device name and 3-digit identification number assigned to each well by the department.

**(5) ABANDONMENT.** For monitoring devices to be abandoned for any reason, an owner or operator shall contact the department. If monitoring devices are being replaced, they shall be properly abandoned in accordance with ss. NR 141.25 and 507.13.

**(6) DOCUMENTATION.** All activities required under ss. NR 507.05 to 507.13 shall be documented in accordance with ss. NR 141.23 and 507.14.

**History:** Cr. Register, June, 1996, No. 486, eff. 7-1-96.

**NR 507.05 Soil and rock sampling.** All soil and rock samples collected from borings shall be collected and tested in accordance with this section unless otherwise approved in writing by the department.

**(1) SOIL SAMPLE COLLECTION.** Soil samples shall be collected in accordance with all of the following:

(a) Where conditions permit, soil samples shall be collected using undisturbed soil sampling techniques. Samples may not be composited for testing purposes.

(b) In fine-grained soil environments, continuous samples shall be collected from the land surface to at least 25 feet below the anticipated, proposed or existing sub-base grade for the purpose of field classification. If a boring extends beyond 25 feet below the anticipated, proposed or existing sub-base grade, samples shall be collected from each major soil unit encountered and at maximum 5-foot intervals. If the boring is located outside the anticipated, proposed or existing limits of filling, the applicable sub-base

grade is the elevation of the bottom of the anticipated, proposed or existing liner system nearest to the borehole.

(c) In coarse-grained soil environments, samples shall be collected from each major soil unit encountered and at maximum 5-foot intervals.

(d) At least one soil sample shall be collected at the depth of the well screen of any subsequently placed monitoring well. The soil sample collected at the depth of the well screen shall be analyzed for grain size distribution using mechanical and hydrometer methods and Atterberg limits, as appropriate for the particular soil type.

(e) All soil samples shall be retained until the department approves the report that included documentation of the soil sampling.

**(2) BEDROCK SAMPLE COLLECTION.** If a boring is extended 5 feet or more into bedrock, continuous core samples of the bedrock shall be taken and the rock properties including fracture frequency, rock quality designation, and percent recovery shall be determined. All bedrock core samples shall be retained until the department approves the report that included documentation of the boring. After the approval, the owner or operator shall notify the WGNHS that all bedrock cores and their corresponding boring logs are available for study and possible retention. If the owner or operator has not been contacted by the WGNHS within 45 days after contacting the WGNHS, the owner or operator may discard the bedrock cores.

**Note:** Wisconsin geological and natural history survey, 3817 mineral point road, Madison, Wisconsin 53705. Phone (608) 263-7387.

**(3) BORING LOG.** A boring log shall be submitted for each boring in accordance with s. NR 507.14. For replacement wells, soil and bedrock samples shall be collected in accordance with subs. (1) and (2) unless the department approves a preexisting boring log for a boring within 10 feet of the replacement well. The owner or operator may request an exemption to the 10 foot distance.

**History:** Cr. Register, June, 1996, No. 486, eff. 7-1-96.