

Chapter NR 635

GROUNDWATER AND LEACHATE MONITORING STANDARDS, CORRECTIVE ACTION REQUIREMENTS, AND SOILS AND GROUNDWATER INVESTIGATIONS

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**NR 635.01 Purpose.** The purpose of this chapter is to specify groundwater and leachate monitoring requirements and corrective action requirements that result from a monitoring program.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.02 Applicability. (1)** Except as provided in s. NR 635.04, the requirements of ss. NR 635.16 and 635.18 apply to all hazardous waste landfills and surface impoundments that accepted hazardous waste after November 19, 1980 but not after July 26, 1982 and the requirements of ss. NR 635.05 to 635.15 and 635.18 apply to all hazardous waste landfills, surface impoundments and waste piles that accepted hazardous waste after July 26, 1982. In addition, ss. NR 635.17 and 635.18 apply to any hazardous waste treatment, storage or disposal facility that had or should have had an interim license.

**(2)** This chapter does not apply to solid waste facilities that manage only non-hazardous solid waste or metallic mining wastes resulting from a mining operation as defined in s. 293.01 (5), Stats.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am., Register, May, 1995, No. 473, eff. 6-1-95; correction in (2) made under s. 13.93 (2m) (b) 7., Stats., Register, May, 1998, No. 509.

**NR 635.03 Definitions.** The definitions in s. NR 600.03 apply to this chapter.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.04 Exemptions.** The requirements of this chapter do not apply to the following:

**(1)** Solid waste disposal facilities licensed under chs. NR 500 to 522 provided that:

(a) The solid waste disposal facility has been approved under s. NR 506.15 to accept hazardous waste only from very small quantity generators; and

(b) The solid waste disposal facility does not meet the definition of a solid waste management unit.

**(2)** Only non-hazardous solid waste facilities that do not meet the definition of solid waste management unit.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.05 General. (1)** The owner or operator shall satisfy the following requirements for all wastes, or constituents thereof, contained in solid waste management units at the facility, regardless of the time at which waste was placed in the units:

(a) All solid waste management units shall comply with the requirements in ss. NR 635.17 and 635.18;

(b) A surface impoundment, waste pile or landfill that receives hazardous waste after July 26, 1982 or proposes to accept hazardous waste is a regulated unit and shall comply with the requirements of ss. NR 635.05 to 635.15 and 635.18 in lieu of s. NR

635.16 for purposes of detecting, characterizing and responding to releases to any underlying aquifer. The financial responsibility requirements of s. NR 635.17 apply to regulated units;

(c) A surface impoundment or landfill which accepted hazardous waste after November 19, 1980 but not after July 26, 1982 is an existing unit and shall comply with the requirements of ss. NR 635.16 and 635.18 and the financial responsibility requirements of s. NR 635.17; and

(d) The requirements of par. (b) may apply to miscellaneous units when necessary to comply with ch. NR 670.

**(2)** The requirements of this chapter apply during the active life of the regulated unit, including the closure period. After closure of the regulated unit, the requirements of this chapter:

(a) Do not apply if all waste, waste residues, contaminated containment system components and contaminated subsoils are removed or decontaminated at closure;

(b) Apply during the long-term care period under s. NR 685.06 if the owner or operator is conducting a detection monitoring program under s. NR 635.13; or

(c) Apply during the compliance period under s. NR 635.11 if the owner or operator is conducting a compliance monitoring program under s. NR 635.14 or a corrective action program under s. NR 635.17.

**(3)** The department may require the installation of a groundwater and leachate monitoring wells, suction lysimeters, moisture probes, collection basin lysimeters and similar water quality monitoring devices, and the implementation of a water quality sampling and analysis program to detect the effects of leachate on groundwater. The location of monitoring devices and the water quality monitoring program shall be approved in writing by the department.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (1) (b) and (2) (intro.), Register, August, 1992, No. 440, eff. 9-1-92; am. (1) (a) to (c), Register, May, 1995, No. 473, eff. 6-1-95.

**NR 635.06 Required programs.** Owners and operators subject to s. NR 635.05 (1) (b) shall conduct a monitoring and response program as follows:

**(1)** Except as provided in s. NR 635.13 (9), whenever hazardous constituents specified under s. NR 635.08 from a regulated unit are detected at or beyond the design management zone under s. NR 635.10, the owner or operator shall institute a compliance monitoring program under s. NR 635.14;

**(2)** Except as provided in s. NR 635.14 (10), whenever the groundwater protection standard under s. NR 635.07 is exceeded, the owner or operator shall institute a corrective action program under s. NR 635.15;

**(3)** Except as provided in s. NR 635.14 (10), whenever hazardous constituents under s. NR 635.08 from a regulated unit exceed concentration limits under s. NR 635.09 in groundwater

between the design management zone under s. NR 635.10 and the downgradient facility property boundary, the owner or operator shall institute a corrective action program under s. NR 635.15; or

(4) In all other cases, the owner or operator shall institute a detection monitoring program under s. NR 635.13.

(5) The department shall specify the specific elements of the monitoring and response program, which may include one or more of the programs identified in subs. (1) to (4) as may be necessary to protect human health and the environment. In deciding whether to require the owner or operator to be prepared to institute a particular program, the department shall consider the potential adverse effects on human health and the environment that might occur before final administrative action on a plan modification application to incorporate the program could be taken. The department shall specify the circumstances under which each of the programs shall be required.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.07 Groundwater protection standard.** The owner or operator subject to the provisions of s. NR 635.05 (1) (b) shall comply with conditions specified by the department that are designed to ensure that hazardous constituents under s. NR 635.08 detected in the groundwater from a regulated unit do not exceed the concentration limits under s. NR 635.09 in any aquifer at or beyond the point of standards application under s. NR 635.10 during the compliance period under s. NR 635.11. The department shall establish this groundwater protection standard when hazardous constituents have been detected in the groundwater from a regulated unit. In no case shall a standard established under this chapter be less stringent than an enforcement standard established under ch. NR 140.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.08 Hazardous constituents. (1)** For facilities subject to s. NR 635.05 (1) (b), the department shall specify the hazardous constituents to which the groundwater protection standard of s. NR 635.07 applies. Hazardous constituents are constituents identified in appendix I of ch. NR 635, that have been detected in groundwater in any aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit, unless the department has excluded them under sub (2).

(2) The department may exclude an appendix I constituent from the list of hazardous constituents specified in sub. (1) if it finds that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. In deciding whether to exclude a constituent, the department shall consider the following:

(a) Potential adverse effects on groundwater quality, considering:

1. The physical and chemical characteristics of the waste in the regulated unit, including its potential for migration;
2. The hydrogeological characteristics of the facility and surrounding land;
3. The quantity of groundwater and the direction of groundwater flow;
4. The proximity and withdrawal rates of groundwater users;
5. The current and future uses of groundwater in the area;
6. The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality;
7. The potential for health risks caused by human exposure to waste constituents;
8. The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constituents;
9. The persistence and permanence of the potential adverse effects; and

(b) Potential adverse effects on hydraulically connected surface water quality, considering:

1. The volume and physical and chemical characteristics of the waste in the regulated unit;
2. The hydrogeological characteristics of the facility and surrounding lands;
3. The quantity and quality of groundwater, and the direction of groundwater flow;
4. The patterns of rainfall in the region;
5. The proximity of the regulated unit to surface waters;
6. The current and future uses of surface waters in the area and any water quality standards established for those surface waters;
7. The existing quality of surface water, including other sources of contamination and the cumulative impact on surface water quality;
8. The potential for health risks caused by human exposure to waste constituents;
9. The potential damage to wildlife, crops, vegetation and physical structures caused by exposure to waste constituents; and
10. The persistence and permanence of potential adverse effects.

(c) Except as provided by s. NR 140.28, no other exemption may be granted to allow a violation of ch. NR 140 enforcement standards.

(3) In making any determination under sub. (2) about the use of groundwater in the area around the facility, the department may consider the uses and potential uses of any aquifers which could be impacted and the maintenance of the quality of the aquifers so those uses or potential uses are not threatened.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.09 Concentration limits. (1)** For facilities subject to s. NR 635.05 (1) (b), the department shall specify concentration limits in the groundwater for the hazardous constituents identified under s. NR 635.08. The concentration that is specified for a hazardous constituent:

(a) May not exceed the background level of the constituent in the groundwater at the time that limit is specified in the department approval;

(b) For any of the constituents listed in table I, may not exceed the respective value given in that table if the background level of the constituent is below the value given in table I; or

(c) May not exceed an alternate concentration limit established by the department under sub. (2); and

(d) Except as provided by s. NR 140.28, may not exceed the enforcement standards established under ch. NR 140.

**Table I  
MAXIMUM CONCENTRATION OF CONSTITUENTS  
FOR GROUNDWATER PROTECTION**

Arsenic	0.05 mg/l
Barium	2.0 mg/l
Benzene	0.005 mg/l
Cadmium	0.005 mg/l
Carbon Tetrachloride	0.005 mg/l
Chromium	0.05 mg/l
1,2 Dichloroethane	0.005 mg/l
1,1 Dichloroethylene	0.007 mg/l
para-Dichlorobenzene	0.075 mg/l
Lead	0.015 mg/l
Mercury	0.002 mg/l
Selenium	0.05 mg/l

Silver	0.05 mg/l
1,1,1 Trichloroethane	0.20 mg/l
Trichlorethylene	0.005 mg/l
Vinyl Chloride	0.0002 mg/l
Endrin (1,2,3,4,10,10-hexachloro-1,7-epoxy-1,4,4a,5,6,7,8,9a-octahydro-1,4-endo, endo-5,8,-dimethano naphthalene)	0.0002 mg/l
Lindane (1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer)	0.0002 mg/l
Methoxychlor(1,1,1-Trichloro-2,2-bis(p-methoxyphenylethane)	0.04 mg/l
Toxaphene (C10H10C6, Technical chlorinated camphene, 67-69 percentchlorine)	0.0003 mg/l
2,4-D (2,4-Dichlorophenoxyacetic acid)	0.07 mg/l
2,4,5-TP Silvex (2,4,5-Trichlorophenoxy propionic acid)	0.05 mg/l

(2) The department may establish an alternate concentration limit for a hazardous constituent if the department finds that the constituent may not pose a substantial present or potential hazard to human health or the environment if the alternate concentration limit is not exceeded. In establishing alternate concentration limits, the department shall consider the factors listed under s. NR 635.08 (2). In no case may an alternate concentration limit be established which is inconsistent with ch. NR 140.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. Table I, Register, May, 1995, No. 473, eff. 6-1-95.

**NR 635.10 Point of standards application.** The point of standards application for facilities subject to regulation under this chapter is specified in s. NR 140.22 (2) and (3).

(1) **DESIGN MANAGEMENT ZONE.** The design management zone and waste boundary are defined in s. NR 140.22 (3) (a). The design management zone extends horizontally 0 feet beyond the waste boundary for facilities subject to the requirements of ss. NR 635.05 to 635.15, and 300 feet beyond the waste boundary for facilities subject to the requirements of s. NR 635.16.

(2) **CHANGES TO THE DESIGN MANAGEMENT ZONE.** The department may consider an expansion or reduction of the design management zone for facilities subject to the requirements of s. NR 635.16 in accordance with s. NR 140.22 (3) (b). The factors that shall be considered by the department are listed in s. NR 140.22 (3) (c) and (d). An owner or operator of a facility may submit a written request for approval of an expansion or reduction of the design management zone. The request shall include an evaluation of the factors listed in s. NR 140.22 (3) (c) and (d).

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (1) and (2), Register, May, 1998, No. 509, eff. 6-1-98.

**NR 635.11 Compliance period.** (1) For facilities subject to s. NR 635.05 (1) (b), the department shall specify the compliance period during which the groundwater protection standard of s. NR 635.07 applies. The compliance period is the number of years equal to the active life of the facility, including any waste management activity prior to permitting and the closure period. The compliance period begins when the owner or operator initiates a compliance monitoring program which meet the requirements of s. NR 635.14.

(2) If the owner or operator is engaged in a corrective action program at the end of the compliance period specified in sub. (1), the compliance period is extended until the owner or operator can demonstrate that the groundwater protection standard of s. NR 635.07 has not been exceeded for a period of 3 consecutive years.

(3) If the compliance period ends before the long-term care period is completed, the owner or operator shall return to detection monitoring as outlined in s. NR 635.13.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91.

**NR 635.12 General groundwater monitoring requirements.** The following monitoring requirements apply to all hazardous waste landfills, surface impoundments, waste piles that accepted hazardous waste after July 26, 1982 and to other facilities where required under s. NR 600.07, 635.13 to 635.15, 635.18, 640.14, 645.12, 655.11 or 670.09.

(1) The number and construction specifications of required wells and other sampling devices shall be approved by the department based on the site size, waste type, site design and the hydrogeologic and geologic setting of the site and shall be capable of yielding groundwater samples for analysis. At a minimum, the system shall consist of:

(a) Two or more upgradient monitoring points at locations and depths sufficient to yield groundwater samples that are representative of background water quality in the uppermost aquifer near the facility and not affected by the facility.

(b) Unless otherwise specified in writing by the department, the owner or operator shall install 2 downgradient well nests, each consisting of at least a water table observation well and a piezometer. In addition, a single monitoring well shall be installed at each of 2 additional downgradient locations for a total of 6 downgradient monitoring wells. These monitoring wells shall be located between the hazardous waste boundary and the property boundary as close as practical to the design management zone.

(c) Except for lateral expansions of a facility, new facilities or replacement units, the facility owner or operator may demonstrate that an alternate hydraulically downgradient monitoring well location can be utilized if such demonstration is certified in writing by a hydrogeologist meeting the definition contained in s. NR 600.03, if the written demonstration is approved by the department, if the written demonstration is kept at the facility and if the demonstration establishes all of the following:

1. An existing physical obstacle prevents monitoring well installation at the hydraulically downgradient limit of the design management zone; and

2. The selected alternate downgradient location is as close to the limit of the waste management area as practical; and

3. The location ensures detection that, given the alternate location, is as early as possible of any statistically significant amounts of hazardous waste or hazardous waste constituents that migrate from the waste management area to the uppermost aquifer.

(2) The department may require 2 or more pore water sampling devices located vertically below the hazardous waste where monitoring of the unsaturated zone would aid in detecting the migration of contaminants into groundwater, and will not compromise the facility's containment capabilities.

(3) If a facility contains more than one regulated unit, separate groundwater monitoring systems are not required for each regulated unit if:

(a) The provisions for sampling groundwater in the uppermost aquifer will enable detection and measurement at the point of standards application of hazardous constituents from the regulated units that have entered the groundwater in the uppermost aquifer, and

(b) The sampling plan is approved in writing by the department.

(4) All groundwater wells and other groundwater sampling devices shall be properly developed in accordance with s. NR 660.09 (3) (j).

(5) Unless otherwise specified by the department, required routine monitoring at any hazardous waste facility shall be conducted quarterly, within 15 days of March 15, June 15, September 15 and December 15 of each year. Alternative dates to those specified may be utilized if approved by the department in writing.

(6) Unless otherwise specified by the department, required annual monitoring at any hazardous waste facility shall be conducted within 15 days of June 15 of each year. Alternative dates to that specified may be utilized if approved by the department in writing.

(7) A leachate monitoring system shall be installed, when required, within the fill area to provide accurate measurements of leachate levels and a means of obtaining representative samples of leachate quality, and shall be located and protected to minimize accidental damage during the operation.

(8) All groundwater and leachate monitoring wells and other sampling devices shall:

- (a) Be constructed of suitable inert and non-contaminating material;
- (b) Be constructed to prevent vertical movement of liquid along the well pipe;
- (c) Be properly protected, secured and properly labeled;
- (d) Have a minimum 2-inch inside diameter;
- (e) Be cased in a manner that maintains the integrity of the monitoring well bore hole;
- (f) Have a casing that is screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples, and
- (g) Have the space between the bore hole and well casing above the sampling depth sealed to prevent contamination of samples and the groundwater.

(9) Elevation of the groundwater surface at each monitoring well shall be determined at least quarterly and each time a sample is obtained. Leachate level elevations for any leachate monitoring system shall, at a minimum, be measured monthly and each time a sample is obtained.

(10) The department may require the operator to attempt to sample public or private wells as part of a regular monitoring program or to determine the extent of groundwater contamination.

(11) If for any reason a monitoring well or other monitoring device is destroyed or otherwise fails to properly function, the owner or operator of the facility shall immediately notify the department in writing. All devices shall be properly abandoned in accordance with s. NR 660.18 (27) and replaced, weather permitting, with another sampling device in accordance with this section within 60 days of notification to the department unless the operator is notified otherwise in writing by the department.

(12) The owner or operator shall obtain and analyze samples from the installed groundwater monitoring system. The owner or operator shall develop and follow a groundwater sampling and analysis plan and shall keep this plan at the facility. The groundwater sampling and analysis plan shall include measurement, sampling and analytical methods that are appropriate for groundwater sampling and that accurately assess groundwater quality and provide early detection of hazardous constituents entering the groundwater. The groundwater sampling and analysis plan shall be approved by the department. The groundwater sampling and analysis plan shall be a single document but shall be kept with and made a part of the facility operating record. The facility shall notify the department at least annually of any updated information that is added to or replaced in the groundwater sampling and analysis plan. At a minimum, the groundwater sampling and analysis plan shall include all of the following:

(a) Sample collection including a list of the chemical parameters to be analyzed and the respective analytical procedure to be used in the analysis for each parameter, field information for purging, water level measurements, depth of well measurements,

purge volume calculations, well evacuation procedures and associated documentation forms, lists of wells sampled with bailers, lists of wells using dedicated sampling equipment, types of bailers used, types of dedicated sampling equipment used, cleaning procedures for sampling equipment, field measurement procedures, sample bottle filling procedures, preservative requirements, field filtering equipment used and cleaning procedures, field measurements and associated equipment lists;

(b) Sample preservation and shipment including sampling container cleaning, sample dispatch, sample packing, shipping containers, temperature control, sample transport, sample custody, field custody, chain of custody control, laboratory custody, sample log-in and sample transport;

(c) Analytical procedures in accordance with standard methods for the examination of water and wastewater or other methods approved in writing by the department, analytical methods, analytical method modifications, glassware handling procedures, organics and inorganics glassware cleaning, reagent and chemical storage;

(d) Laboratory calibration procedures and frequency, standard sources and preparation, standard sources and preparation by instrument group, instrument calibration and preventive maintenance;

(e) Laboratory quality control information including checks and routines to assess precision, accuracy and method detection limits, quality control checks, routine quality control checks, specific laboratory criteria for organics and inorganics, routine methods used to assess precision and accuracy, procedures used to obtain precision and accuracy targets, formulas used to calculate less than precision and accuracy, method detection limits and practical quantitation limits and reporting limits;

(f) Field quality control information including the number of field blanks taken, trip blanks, duplicate sample frequency, field duplicates, split sample procedures and sequential sample procedures including identification of the alternate laboratory and that laboratory methods and procedures used in pars. (a) to (e);

(g) A description of the statistical analysis selected by the facility and all statistical calculations performed for the facility during the existing calendar year; and

(h) Other information as deemed necessary by the department on a case-by-case basis.

(13) The owner or operator shall develop and follow a groundwater monitoring plan and shall keep this plan at the facility. The groundwater monitoring plan shall be a single document but shall be kept with and made a part of the facility operating record. The facility shall notify the department at least annually of any updated information that is added to or replaced in the groundwater monitoring plan or sooner if required by statute or rule. The groundwater monitoring plan shall be approved by the department. At a minimum, the groundwater monitoring plan shall include all of the following:

(a) An annually updated topographic map of the facility illustrating any physical changes to the facility that may affect the stability of or viability of any monitoring well required by this chapter and the locations of all monitoring wells and other monitoring devices located on or off of the facility. If no physical changes have been made to the facility, the owner or operator may use an existing topographic map that includes a notation that no physical changes have been made at the facility;

(b) A groundwater contour map using 2 foot contour intervals that shows the direction of groundwater flow and a discussion of the rate and direction of groundwater flow as required by s. NR 635.13 (5). In addition, unless otherwise specified by the department, the groundwater contour map shall be constructed by using the most recent water levels recorded in each monitoring well located on or off the facility. The water level elevation for each monitoring well shall be superimposed on the groundwater contour map;

(c) A copy of the boring log for each groundwater monitoring well installed at the facility and completed DNR form 4400-122;

(d) A copy of the well construction report for each well required at the facility and completed DNR form 4400-113A;

(e) All hard data and descriptions of the well development procedures used to develop each monitoring well at the facility in accordance with s. NR 660.09 (3) (j) and completed DNR form 4400-113B for each well at the facility;

(f) A completed DNR groundwater monitoring well information form (WIF) 4400-89 for each monitoring well at the facility;

(g) A discussion that includes specific instructions on field measurements to be taken, sampling procedures and the sampling sequence required for the facility;

(h) A list of the chemical parameters that the facility is monitoring for as required by the department or the U.S. EPA;

(i) A historical tabulation of water levels measured in each monitoring well at the facility as referenced to mean sea level; and

(j) Other information as deemed necessary by the department on a case by case basis.

**(14)** An owner or operator who performs groundwater monitoring in accordance with this chapter satisfies the requirements of ch. NR 140, and is not required to evaluate groundwater monitoring through ch. NR 140, except as follows:

(a) If the background concentration established under s. NR 635.12 (13) or 635.16 (3), for a substance in table 1 or 2 of ch. NR 140, exceeds the ch. NR 140 preventive action limit or enforcement standards, the facility may apply for an exemption under s. NR 140.28.

(b) If a parameter identified under s. NR 635.13 (1) or 635.16 (2) is included in Table 1 or 2 of ch. NR 140, the notice required under ss. NR 635.13 (8) (a) and 635.16 (8) shall include a determination of whether or not the concentration exceeds the preventive action limit or the enforcement standard.

**(15)** Where appropriate, the groundwater monitoring program shall establish background groundwater quality for each of the hazardous constituents or monitoring parameters or constituents specified in the plan approval or license. The number and kinds of samples collected to establish background shall be appropriate for the form of statistical test employed, following generally accepted statistical principles. The sample size shall be as large as necessary to ensure with reasonable confidence that a contaminant release to groundwater from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility license or plan approval which shall be specified in the unit license or plan approval upon approval by the department.

(a) In the detection monitoring program under s. NR 635.13, background groundwater quality for a monitoring parameter or constituent shall be based on data from quarterly sampling of all wells required under this chapter for one year prior to accepting waste.

(b) In the compliance monitoring program under s. NR 635.14, background groundwater quality for a hazardous constituent shall be based on data from upgradient wells that:

1. Is available before the plan approval or license is issued;
2. Accounts for measurement errors in sampling and analysis; and

3. Accounts, to the extent feasible, for seasonal fluctuations in background groundwater quality if the fluctuations are expected to affect the concentration of the hazardous constituent.

4. Provide the proper number of samples collected to establish background that is appropriate for the form of statistical test employed. The sample size shall be as large as necessary to ensure with reasonable confidence that a contaminant release to groundwater from a facility will be detected.

(c) Background quality may be based on sampling of wells that are not hydraulically upgradient from the waste boundary where:

1. Hydrogeologic conditions do not allow the owner or operator to determine what wells are upgradient; and

2. Sampling at other wells shall provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells.

(cm) Sampling at other wells shall allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the design management zone to the uppermost aquifer.

(d) In developing the data base used to determine a background value for each parameter or constituent, the owner or operator shall take a minimum of at least 4 samples from each monitoring well or device specified in the plan approval or license, taken at an interval that assures, to the greatest extent technically feasible, that an independent sample is obtained, by reference to the uppermost aquifer's effective porosity, hydraulic conductivity, and hydraulic gradient, and the fate and transport characteristics of the potential contaminants, or

(e) The owner or operator may propose an alternative background sampling procedure for department approval.

**(16)** (a) The owner or operator shall specify one of the following statistical methods to be used in evaluating groundwater monitoring data for each hazardous constituent which, upon approval by the department, will be specified in the unit plan approval. The statistical test chosen shall be conducted separately for each hazardous constituent in each well. Where practical quantification limits (pql's) are used in any of the following statistical procedures, the pql shall be proposed by the owner or operator and approved by the department. Use of any of the following statistical methods shall be protective of human health and the environment and shall comply with the performance standards outlined in par. (b).

1. A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method shall include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

2. An analysis of variance (ANOVA) based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method shall include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

3. A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

4. A control chart approach that gives control limits for each constituent.

5. The owner or operator may use an equivalent statistical procedure for determining whether a statistically significant change has occurred. The department shall specify a procedure if it finds that the alternative procedure reasonably balances the probability of falsely identifying a noncontaminating regulated unit and the probability of failing to identify a contaminating regulated unit in a manner that is comparable to that of the statistical procedure described in par. (b) 1.

(b) Any statistical method chosen under this subsection for specification in the unit plan approval shall comply with the following performance standards, as appropriate:

1. The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of chemical parameters or hazardous constituents. If the distribution of the chemical parameters or hazardous constituents is shown by the

owner or operator to be inappropriate for a normal theory test, then the data should be transformed or a distribution-free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.

2. If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparisons procedure is used, the Type I error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons shall be maintained. This performance standard does not apply to tolerance intervals, prediction intervals or control charts.

3. If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be proposed by the owner or operator and approved by the department if the department finds it to be protective of human health and the environment.

4. If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be proposed by the owner or operator and approved by the department if he or she finds these parameters to be protective of human health and the environment. These parameters will be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

5. The statistical method shall account for data below the limit of detection with one or more statistical procedures that are protective of human health and the environment. Any practical quantification limit (pql) approved by the department under s. NR 635.12 (16) that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

6. If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(c) Groundwater monitoring data collected in accordance with this subsection including actual levels of constituents shall be maintained in the facility operating record. The department shall specify in the plan approval or license when the data is to be submitted for review.

(d) In all other situations in a detection monitoring program and in a compliance monitoring program, the owner or operator shall use a statistical procedure providing reasonable confidence that the migration of hazardous constituents from a regulated unit into and through the aquifer shall be indicated. The department shall specify a statistical procedure that it finds:

1. Is appropriate for the distribution of the data used to establish background values or concentrations limits; and

2. Provides a reasonable balance between the probability of falsely identifying a noncontaminating regulated unit and the probability of failing to identify a contaminating regulated unit.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (14) (a) 1., Register, August, 1992, No. 440, eff. 9-1-92; correction in (4) made under s. 13.93 (2m) (b) 7., Stats., Register, August, 1992, No. 440; am. (intro.), (1) (intro.), (b), cr. (1) (c), (5), (6), (13), (15) (b) 4., (e), (16), renum. (5) to (10) to be (7) to (12) and am. (8) (d) and (12), r. (11), (14), renum. (12) and (13) to be (14) and (15), and am. (15) (intro.), (c) and (d), Register, May, 1995, No. 473, eff. 6-1-95; am. and renum. (15) (c) 3. to be (15) (cm), Register, May, 1998, No. 509, eff. 6-1-98.

**NR 635.13 Detection monitoring program.** The owner or operator of a facility subject to s. NR 635.05 (1) (b) shall establish a detection monitoring program which shall comply with the following requirements:

(1) The owner or operator shall monitor for indicator parameters, such as specific conductance, total organic carbon or total

organic halogen, for waste constituents, or reaction products, such as products produced by reactions between waste types and between leachate and soil, that provide a reliable indication of the presence of hazardous constituents in groundwater. The department shall specify the parameters or constituents to be monitored after considering the following factors:

(a) The types, quantities and concentrations of constituents in wastes managed at the regulated unit;

(b) The mobility, stability and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste boundary;

(c) The detectability of indicator parameters, waste constituents and reaction products in groundwater; and

(d) The concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the groundwater background.

(2) The owner or operator shall install a groundwater monitoring system at the design management zone as specified under s. NR 635.10. The groundwater monitoring system shall comply with s. NR 635.12.

(3) The owner or operator shall establish a background value for each monitoring parameter or constituent required under sub. (1). The owner or operator shall submit the background values to the department for approval.

(a) The owner or operator shall comply with s. NR 635.12 (13) in developing the data base used to determine background values.

(b) The owner or operator shall tabulate background values for the determination of statistically significant increases under s. NR 635.12 (16).

(c) In taking samples used in the determination of background values, the owner or operator shall use a groundwater monitoring system that complies with s. NR 635.12.

(4) The owner or operator shall determine groundwater quality at each monitoring well required by s. NR 635.12 at least quarterly according to the schedule contained in s. NR 635.12 (5) during the active life of a regulated unit, including the closure period and the long-term care period. The owner or operator shall tabulate the groundwater quality at each monitoring well for the determination of statistically significant increases under s. NR 635.12 (16).

(5) The owner or operator shall determine the groundwater flow rate and direction in the uppermost aquifer at least annually.

(6) The owner or operator shall use procedures and methods for sampling and analysis that meet the requirements of s. NR 635.12 (10).

(7) The owner or operator shall determine whether there is a statistically significant change in pH or increase over background values for any parameter or constituent specified in the license or plan approval each time the owner or operator determines groundwater quality under sub. (4).

(a) In determining whether a statistically significant change in pH or increase over background values has occurred, the owner or operator shall compare the groundwater quality at each monitoring well for each parameter or constituent to the background value for that parameter or constituent, according to the statistical procedure specified under s. NR 635.12 (16).

(b) The owner or operator shall determine whether there has been a statistically significant change in pH or increase over background values at each monitoring well at the design management zone within 60 days after completion of sampling. The department may specify a different time period after considering the complexity of the statistical test and the availability of laboratory facilities to perform the analysis of groundwater samples.

(8) If the owner or operator determines, pursuant to sub. (7), that there is a statistically significant increase for parameters or

constituents specified pursuant to sub. (1) at any monitoring well, the owner or operator shall:

(a) Notify the department of this finding in writing within 7 days. The notification shall indicate what parameters or constituents have shown statistically significant increases;

(b) Immediately sample the groundwater in all monitoring wells and determine the concentration of all constituents identified in appendix I that are present in groundwater;

(c) Establish a background value for each appendix I constituent that has been detected under par. (b) as follows:

1. The owner or operator shall comply with s. NR 635.12 (13) in developing the data base used to determine background values;

2. The owner or operator shall tabulate background values for the determination of statistically significant increases under s. NR 635.12 (16); and

3. The owner or operator shall use a groundwater monitoring system that complies with s. NR 635.12 in taking samples used in the determination of background values;

(d) Within 90 days, submit to the department an application for a plan modification to establish a compliance monitoring program meeting the requirements of s. NR 635.14. The application shall include the following information:

1. An identification of the concentration of any appendix I constituents found in the groundwater at each monitoring well;

2. Any proposed changes to the groundwater monitoring system at the facility necessary to meet the requirements of s. NR 635.14, including wells, monitoring frequency, sampling and analysis procedures or methods, or statistical procedures;

3. For each hazardous constituent found in groundwater, a proposed concentration limit required under s. NR 635.09 (1) (a) or (b) or a notice of intent to seek an alternative concentration limit under s. NR 635.09 (2); and

(e) Within 180 days, submit to the department all data necessary to justify an alternative concentration limit sought under s. NR 635.09 (2) and an engineering feasibility plan for a corrective action program necessary to meet the requirements of s. NR 635.15 unless:

1. Hazardous constituents identified under par. (b) are listed in table I and their concentrations do not exceed the respective values given in that table; or

2. The owner or operator has sought an alternative concentration limit under s. NR 635.09 (2) for every hazardous constituent identified under par. (b).

(9) If the owner or operator determines, pursuant to sub. (7), that there is a statistically significant change in pH or increase in the concentration of other parameters or constituents specified pursuant to sub. (1) at any monitoring well at the design management zone, the owner or operator may demonstrate that a source other than a regulated unit caused the increase or that the increase resulted from error in sampling, analysis, evaluation or natural variation in groundwater. While the owner or operator may make a demonstration under this subsection in addition to, or instead of, fulfilling the requirements under sub. (8) (d), the owner or operator is not relieved of the requirement to submit a plan modification application within the time specified in sub. (8) (d) unless the demonstration made under this subsection successfully shows that a source other than a regulated unit caused the increase or that the increase resulted from error in sampling, analysis or evaluation. In the event that the demonstration is unsuccessful, the owner or operator shall comply with sub. (8) (b) and (c). In making a demonstration under this subsection, the owner or operator shall:

(a) Notify the department in writing that the owner or operator intends to make a demonstration under this subsection, within 7 days after determining that a statistically significant increase of parameters or constituents occurred at a monitoring well;

(b) Submit, within 90 days, a report to the department which demonstrates that a source other than a regulated unit caused the increase, or that the increase resulted from the error in sampling, analysis or evaluation;

(c) Submit, within 90 days, to the department an application for a plan modification to make any appropriate changes to the detection monitoring program at the facility; and

(d) Continue to monitor in accordance with the detection monitoring program established under this section.

(10) If the owner or operator determines that the detection monitoring program no longer satisfies the requirements of this section, the owner or operator shall, within 90 days, submit an application for a plan modification to make any appropriate changes to the program.

(11) The owner or operator shall assure that monitoring and corrective action measures necessary to achieve compliance with the groundwater protection standard under s. NR 635.07 are taken during the term of any plan approval.

(12) The owner or operator shall comply with all requirements contained in s. NR 635.18.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (8) (e) 1., Register, August, 1992, No. 440, eff. 9-1-92; am. (2), (3) (b), (c), (4), (7) (intro.), (a), (8) (c) 2., 3., cr. (12), Register, May, 1995, No. 473, eff. 6-1-95.

**NR 635.14 Compliance monitoring program.** For facilities subject to s. NR 635.05 (1) (b), an owner or operator required to establish a compliance monitoring program under s. NR 635.13 shall, at a minimum, have the following responsibilities:

(1) The owner or operator shall monitor the groundwater to determine whether regulated units are in compliance with the groundwater protection standard under s. NR 635.07. The department shall specify the groundwater protection standard including:

(a) A list of the hazardous constituents under s. NR 635.08;

(b) Concentration limits under s. NR 635.09 for each of those hazardous constituents;

(c) The point of standards application under s. NR 635.10; and

(d) The compliance period under s. NR 635.11.

(2) The owner or operator shall install a groundwater monitoring system at the point of standards application as specified under s. NR 635.10. The groundwater monitoring system shall comply with s. NR 635.12 (1) to (11).

(3) Where a concentration limit established under par. (b) is based on background groundwater quality, the department shall specify the concentration limit as follows:

(a) If there is a high temporal correlation between upgradient and downgradient concentrations of the hazardous constituents, the owner or operator may establish the concentration limit for each chemical parameter or hazardous constituent through sampling at upgradient wells each time groundwater is sampled. The department shall specify the procedures used for determining the concentration limit in this manner. In all other cases, the concentration of the hazardous constituents shall be the mean of the pooled data on the concentration of the hazardous constituent.

(b) If a hazardous constituent is identified in appendix I and the difference between the concentration limit and the background value of that constituent under s. NR 635.12 (13) is not statistically significant, the owner or operator shall use the background value of the constituent as the concentration limit. In determining whether this difference is statistically significant, the owner or operator shall use a statistical procedure providing reasonable confidence that a real difference shall be indicated. The statistical procedure shall:

1. Be appropriate for the distribution of the data used to establish background values; and

2. Provide a reasonable balance between the probability of falsely identifying a significant difference and the probability of failing to identify a significant difference.

(c) The owner or operator shall:

1. Comply with s. NR 635.12 (13) in developing the data base used to determine background values;

2. Tabulate background values for the determination of statistically significant increases under s. NR 635.12 (16); and

3. Use a groundwater monitoring system that complies with s. NR 635.12.

(4) The owner or operator shall determine the concentration of hazardous constituents in groundwater at each monitoring well required by s. NR 635.12 at least quarterly during the compliance period. The owner or operator shall tabulate the concentration at each monitoring well for the determination of statistically significant increases under s. NR 635.12 (16).

(a) In determining whether statistically significant evidence of increased contamination exists, the owner or operator shall use the methods specified by the department under s. NR 635.12 (16). The methods shall compare data collected at the compliance points to a concentration limit developed in accordance with s. NR 635.09.

(b) The owner or operator shall determine whether there is statistically significant evidence of increased contamination at each monitoring well at the point of standards application within a reasonable time period after completion of sampling. The department shall specify that time period in the facility license, after considering the complexity of the statistical test and the availability of laboratory facilities to perform the analysis of groundwater samples.

(5) The owner or operator shall determine the groundwater velocity and direction using new water level measurements in the uppermost aquifer at least annually.

(6) The owner or operator shall analyze samples from all monitoring wells for all constituents contained in appendix I of ch. NR 635 as specified by the department at least annually to determine whether additional hazardous constituents are present in the uppermost aquifer and, if so, at what concentrations. If the owner or operator finds appendix I constituents in the groundwater that are not identified in the plan approval or license as hazardous constituents, the owner or operator shall report the concentrations of these additional constituents to the department within 7 days after completion of the analysis.

(7) The owner or operator shall use procedures and methods for sampling and analysis that meet the requirements of s. NR 635.12.

(8) The owner or operator shall determine whether there is a statistically significant increase over the concentration limits for any hazardous constituent specified under sub. (1) each time the owner or operator determines the concentration of hazardous constituents in groundwater.

(a) In determining whether a statistically significant increase has occurred, the owner or operator shall compare the groundwater quality at each monitoring well for each hazardous constituent to the concentration limit for that constituent according to the statistical procedures specified in the plan approval or license under s. NR 635.12 (16).

(b) The owner or operator shall determine whether there has been a statistically significant increase at each monitoring well within 60 days after the completion of sampling. The department may specify a different time period after considering the complexity of the statistical test and the availability of laboratory facilities to perform the analysis of groundwater samples.

(9) If the owner or operator determines, pursuant to sub. (8), that the groundwater protection standard is being exceeded at any monitoring well, the owner or operator shall:

(a) Notify the department of this finding in writing within 7 days. The notification shall indicate what concentration limits have been exceeded.

(b) Submit to the department an application for a plan modification to establish a corrective action program meeting the requirements of s. NR 635.15 within 180 days, or within 90 days if an engineering feasibility study has been previously submitted to the department under s. NR 635.13 (8) (e). The application shall at a minimum include the following information:

1. A detailed description of corrective actions that will achieve compliance with the groundwater protection standard specified under sub. (1); and

2. A plan for a groundwater monitoring program that demonstrates the effectiveness of the corrective action. A groundwater monitoring program may be based on a compliance monitoring program developed to meet the requirements of this section.

(10) If the owner or operator determines, pursuant to sub. (8), that the groundwater protection standard is being exceeded at any monitoring well, the owner or operator may demonstrate that a source other than a regulated unit caused the increase or that the increase resulted from error in sampling, analysis or evaluation. While the owner or operator may make a demonstration under this subsection in addition to, or in lieu of, submitting a plan modification application under sub. (9) (b), the owner or operator is not relieved of the requirement to submit a plan modification application within the time specified in sub. (9) (b), unless the department finds that the demonstration made under this subsection successfully shows that a source other than a regulated unit caused the increase or that the increase resulted from error in sampling, analysis or evaluation. In making a demonstration under this subsection, the owner or operator shall:

(a) Notify the department in writing that the owner or operator intends to make a demonstration under this subsection within 7 days after determining that the groundwater protection standard is being exceeded;

(b) Submit, within 90 days, a report to the department which demonstrates that a source other than a regulated unit caused the standard to be exceeded or that the apparent noncompliance with the standards resulted from error in sampling, analysis or evaluation;

(c) Submit, within 90 days, an application to the department for a plan modification to make any appropriate changes to the compliance monitoring program at the facility; and

(d) Continue to monitor in accordance with the compliance monitoring program established under this section.

(11) If the owner or operator determines that the compliance monitoring program no longer satisfies the requirements of this section, the owner or operator shall, within 90 days, submit an application for a plan modification to make any appropriate changes to the program.

(12) The owner or operator shall assure that monitoring and corrective action measures necessary to achieve compliance with the groundwater protection standard under s. NR 635.07 are taken during the term of the department approval or term of the license.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (3) (a), (c) 2. and 3., (4), (6) to (8) (a), Register, May, 1995, No. 473, eff. 6-1-95.

**NR 635.15 Corrective action program for hazardous waste units.** An owner or operator required to establish a corrective action program under s. NR 635.14 shall comply with the following requirements:

(1) The owner or operator shall take corrective action to ensure that regulated units are in compliance with the groundwater protection standard under s. NR 635.07. The department shall specify the groundwater protection standard including:

(a) The list of the hazardous constituents identified under s. NR 635.08;



(b) The concentration limits under s. NR 635.09 for each of those hazardous constituents;

(c) The point of standards application under s. NR 635.10; and

(d) The compliance period under s. NR 635.11.

(2) The owner or operator shall implement a corrective action program that prevents hazardous constituents from exceeding their respective concentration limits at or beyond the design management zone by removing the hazardous waste constituents or treating them in place. The department may approve, conditionally approve or deny an owner or operator's corrective action plan. In a conditional approval or denial, the department may specify the corrective action measures to be taken.

(3) The owner or operator shall begin corrective action within a reasonable time period after the groundwater protection standard is exceeded. The department may specify that time period. If a department approval includes a corrective action program in addition to a compliance monitoring program, the department shall specify when the corrective action program shall begin.

(4) In conjunction with a corrective action program, the owner or operator shall establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program. A monitoring program may be based on the requirements for a compliance monitoring program under s. NR 635.14 and shall be as effective as that program in determining compliance with the groundwater protection standard under s. NR 635.07 and in determining the success of a corrective action program under sub. (5) where appropriate.

(5) In addition to the other requirements of this section, the owner or operator shall conduct a corrective action program to remove or treat in place any hazardous constituents under s. NR 635.08 that exceed concentration limits under s. NR 635.09 in groundwater. The department shall specify the measures to be taken at the following locations:

(a) At or beyond the boundary of the design management zone under s. NR 635.10; and

(b) Beyond the facility boundary, where necessary to protect human health and the environment, unless the owner or operator demonstrates to the department that, despite the owner's or operator's best efforts, the owner or operator was unable to obtain the necessary permission to undertake the action. The owner or operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. The owner or operator is still required to take on-site measures to address the releases. The on-site measures shall be determined by the department on a case-by-case basis.

(c) Corrective action measures under this section shall be initiated and completed within a reasonable period of time considering the extent of contamination.

(d) Corrective action measures under this section may be terminated once the concentration of hazardous constituents under s. NR 635.08 is reduced to levels below their respective concentration limits under s. NR 635.09.

(6) The owner or operator shall continue corrective action measures during the compliance period to the extent necessary to ensure that the groundwater protection standard is not exceeded. If the owner or operator is conducting corrective action at the end of the compliance period, the owner or operator shall continue that corrective action for as long as necessary to achieve compliance with the groundwater protection standard. The owner or operator may terminate corrective action measures taken beyond the period equal to the active life of the facility, including the closure period, if the owner or operator can demonstrate, based on data from the groundwater monitoring program under sub. (4), that the groundwater protection standard of s. NR 635.07 has not been exceeded for a period of 3 consecutive years.

(7) The owner or operator shall report in writing to the department of the effectiveness of the corrective action program. The owner or operator shall submit these reports semi-annually.

(8) If the owner or operator determines that the corrective action program no longer satisfies the requirements of this section, the owner or operator shall, within 90 days, submit an application for a plan modification to make any appropriate changes to the program.

(9) The owner or operator shall establish proof of financial responsibility for corrective action in accordance with a department issued order or plan approval and the requirements of ch. NR 685 and s. NR 289.41, Stats.

(10) The owner or operator shall comply with all requirements of s. NR 635.18.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; cr. (10), Register, May, 1995, No. 473, eff. 6-1-95; **correction in (9) made under s. 13.93 (2m) (b) 7., Stats., Register, May, 1998, No. 509.**

### NR 635.16 Existing unit monitoring requirements.

The following monitoring requirements apply to all landfills and surface impoundments which accepted hazardous wastes after November 19, 1980, but not after July 26, 1982 and to other facilities where required under ss. NR 600.07, 640.15, 645.12, 655.11 and 670.09.

(1) The general monitoring requirements of s. NR 635.12 apply to facilities under this section.

(2) At a minimum, the owner or operator shall determine the concentration or value of the following parameters in groundwater samples in accordance with subs. (3) and (4).

(a) Parameters characterizing the suitability of the groundwater as a drinking water supply, as specified in ch. NR 809.

(b) Parameters establishing groundwater quality including chloride, iron, manganese, phenols, sodium and sulfate.

(c) Parameters used as indicators of groundwater contamination, including pH, specific conductance, total organic carbon and total organic halogen.

(d) In all cases, the physical characteristics of the water sample including odor, color and turbidity shall be recorded.

(e) Any other parameters required by the department, based on the waste types accepted or other factors as appropriate.

(3) At a minimum, initial background water quality shall be established as follows:

(a) For all monitoring devices, the owner or operator shall establish initial background concentrations or values of all parameters specified in sub. (2). The owner or operator shall do this by sampling each device quarterly for one year and analyzing samples for all parameters.

(b) For each of the indicator parameters specified in sub. (2) (c) at least 4 replicate measurements shall be obtained from each quarterly sample. The initial background arithmetic mean and variance shall be determined for each indicator parameter by pooling the replicate measurements for the respective parameter concentrations or values in samples obtained from ungradient wells during the first year.

(4) After the first year, all monitoring wells and other sampling devices shall be sampled and the samples analyzed with the following minimum frequencies:

(a) Samples collected to establish groundwater quality shall be obtained and analyzed for the parameters specified in sub. (2) (b), (d) and (e) at least quarterly.

(b) Samples collected to indicate groundwater contamination shall be obtained and analyzed for the parameters specified in sub. (2) (c) and (e) at least quarterly.

(5) The owner or operator shall:

(a) Prepare an outline of a groundwater quality assessment program. The outline shall describe a comprehensive groundwater monitoring program capable of determining:

1. Whether hazardous waste or hazardous waste constituents have entered the groundwater;
2. The rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater; and
3. The concentrations of hazardous waste or hazardous waste constituents in the groundwater.

(b) For each indicator parameter specified in sub. (2) (c) or (e) calculate the arithmetic mean and variance, based on at least 4 replicate measurements on each sample, for each sampling device monitored in accordance with sub. (4) (b) and compare these results with the initial background arithmetic mean for that parameter. This comparison shall be performed in accordance with the following requirements:

1. The owner or operator shall use the student's t-test to determine statistically significant changes in the concentration or value of an indicator parameter in periodic groundwater samples when compared to the initial background concentration or value of that indicator parameter. The comparison shall consider individually each of the wells in the monitoring system. For 3 of the indicator parameters, specific conductance, total organic carbon and total organic halogen, a single-tailed student's t-test shall be used to test at the 0.01 level of significance for significant increases over background. The difference test for pH shall be a 2-tailed student's t-test at the overall 0.01 level of significance.

**Note:** A description of the student's t-tests, formulae for calculation of the t-statistic and tables for comparison can be found in most introductory statistics texts.

2. The department may require different statistical tests and levels of significance based on site specific hydrogeologic conditions, groundwater quality, waste characteristics and facility design and operation.

**(6)** At a minimum, the comparisons for the downgradient and upgradient wells made under sub. (5) (b) shall be submitted to the department by the owner or operator annually.

**(7)** If the comparisons for downgradient and for upgradient wells made under sub. (5) (b) show a statistically significant increase, or pH change, the owner or operator shall then immediately obtain additional groundwater samples from the downgradient wells where a significant difference was detected, split the samples in 2 or more portions, and obtain analyses of all additional samples to determine whether the significant difference was a result of laboratory error.

**(8)** If the analyses performed under sub. (7) confirm the statistically significant increase or pH change, the owner or operator shall provide written notice with appropriate documentation to the department within 7 days of the date of a confirmation that the facility may be affecting groundwater quality.

**(9)** Within 15 days after the notification under sub. (8), the owner or operator shall develop and submit to the department a specific plan prepared under the direction of and signed by a qualified hydrogeologist, for a groundwater quality assessment program at the facility, based on determining: whether hazardous waste or hazardous waste constituents have entered the groundwater; the rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater; and the concentrations of hazardous waste or hazardous waste constituents in the groundwater.

**(10)** The plan to be submitted under sub. (9) shall specify the number, location and depth of wells; the number and analysis frequency of water quality parameters for those hazardous wastes or hazardous waste constituents in the facility; evaluation procedures and groundwater quality, sampling and analytical methods to be used for determining the source or cause of contamination, including use of any previously gathered groundwater quality information; facility design and construction reports, operating procedures and facility history; and a schedule of implementation.

**(11)** The owner or operator shall implement the groundwater quality assessment plan which satisfies the requirements of sub. (10) and department concerns and, at a minimum, determine: the source or cause of the contamination; the rate and extent of migration of the hazardous waste and hazardous waste constituents in the groundwater; the concentrations of the hazardous waste or hazardous waste constituents in the groundwater; and short and long-term potential impacts to drinking water supplies and the environment, and proposed conceptual solutions and action to bring under control and correct the environmental damage.

**(12)** The owner or operator shall make the determination under sub. (11) in accordance with the time schedule approved by the department; and, within 15 days after that determination, submit to the department a written report containing an assessment of the groundwater quality, cause and effect of contamination and conceptual solutions.

**(13)** If the owner or operator determines, based on the results of the determination under sub. (11), that no hazardous waste or hazardous waste constituents from the facility have entered the groundwater, then the owner may reinstate the indicator evaluation program described in subs. (4) and (5) (b) to (12). If the owner or operator reinstates the indicator evaluation program, the department shall be notified in the report submitted under sub. (12).

**(14)** If the owner or operator determines, based on the determination under sub. (11) that hazardous waste or hazardous waste constituents from the facility have entered the groundwater, then the owner or operator shall continue to make the determinations required under sub. (11) on a quarterly basis until the end of the long-term care period for the facility, or until the groundwater quality problems at the site have been corrected as provided for in the final plans; shall submit a final plan for solutions and corrective action to control and correct the environmental damage within 180 days after the department's review of submittals under sub. (12) and shall implement the final plans for solutions and corrective actions and other emergency procedures including department review comments within 45 days after the department's review of the final plans.

**(15)** Any groundwater quality assessment to satisfy the requirements of sub. (11) shall be completed and reported in accordance with sub. (12).

**(16)** At least annually the owner or operator shall evaluate the data on groundwater surface elevations obtained under s. NR 635.12 (7) to determine whether the requirements under s. NR 635.12 (1) and (5) for locating the monitoring system continue to be satisfied. If the evaluation shows that s. NR 635.12 (1) and (5) are no longer satisfied, the owner or operator shall immediately notify the department and submit for department approval a plan to bring the monitoring system into compliance with this requirement.

**(17)** The owner or operator of the site or facility shall comply with the following reporting and record keeping requirements:

(a) The owner or operator shall report to the department the results of the sampling from each groundwater monitoring well required under s. NR 635.12 (1) quarterly.

(b) The owner or operator shall annually report to the department the results of the statistical evaluation required under sub. (6) and groundwater surface elevation required under sub. (16) and a description of the response, where applicable.

(c) The owner or operator implementing a groundwater quality assessment plan under sub. (11), shall annually report to the department the results of the groundwater quality assessment program which includes, but is not limited to, the rate of contaminant migration during the reporting period.

(d) An owner or operator of a site or facility shall retain, until the end of the long-term care period, all records of monitoring and analytical activities and data, including all original strip chart recordings and instrumentation, calibration and maintenance

records. The owner or operator shall inform the department prior to discarding any groundwater information.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (2) (a), Register, May, 1995, No. 473, eff. 6-1-95.

**NR 635.17 Corrective action for solid waste management units.** (1) The owner or operator of a facility seeking a license for the treatment, storage or disposal of hazardous waste or seeking to close a hazardous waste treatment, storage or disposal facility shall institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste or hazardous waste constituents from any solid waste management unit at the facility, regardless of the time at which waste was placed in a unit. Corrective action under this section shall, at a minimum, restore contaminated groundwater in compliance with the requirements of ch. NR 140.

(2) Corrective action shall be specified in the license or plan approval in accordance with chs. NR 600 to 685. The license or plan approval shall contain schedules of compliance for corrective action where corrective action cannot be completed prior to issuance of the license and assurances of financial responsibility for completing corrective action.

(3) The owner or operator shall implement corrective actions beyond the facility property boundary, where necessary to protect human health and the environment, unless the owner or operator demonstrates to the satisfaction of the department that, despite the owner's or operator's best efforts, the owner or operator was unable to obtain the necessary permission to undertake actions. The owner or operator is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where offsite access is denied. On-site measures to address releases shall be determined by the department on a case-by-case basis. The owner or operator shall establish proof of financial responsibility for corrective action in accordance with a department issued order or plan approval and the requirements of ch. NR 685 and s. 289.41, Stats.

**History:** Cr. Register, February, 1991, No. 422, eff. 3-1-91; am. (1), Register, April, 1994, No. 460, eff. 5-1-94; am. (1), Register, March, 1995, No. 471, eff. 4-1-95; am. May, 1995, No. 473, eff. 6-1-95; correction in (3) made under s. 13.93 (2m) (b) 7., Stats., Register, May, 1998, No. 509.

**NR 635.18 Soils and groundwater investigations.** The department may require that owners or operators of waste piles, surface impoundments, landfills and solid waste management units subject to the requirements of s. NR 635.17 investigate whether a release of hazardous waste or hazardous waste constituents has occurred, submit a report that details the findings of the investigation for department approval and implement appropriate corrective actions as necessary to bring the facility into compliance with chs. NR 600 to 685. If such a soil and groundwater investigation is required, the owner or operator shall meet the following minimum requirements unless otherwise required by the department.

(1) **GROUNDWATER AND UNSATURATED ZONE MONITORING.** The department may require the installation of groundwater and leachate monitoring wells, suction lysimeters, moisture probes, collection basin lysimeters and similar monitoring devices, and the implementation of a water quality sampling and analysis program.

(a) All groundwater sampling devices shall be designed, located, installed and maintained so as to obtain reliable and representative information regarding aquifer characteristics, groundwater flow directions and chemical and physical characteristics of groundwater.

(b) All devices shall be constructed to minimize the potential for contaminants to enter the groundwater or to move from one major soil unit or bedrock formation to another.

(c) The locations of all borings and monitoring devices shall be approved by the department in writing prior to installation. The location and construction of any monitoring device may be sub-

mitted to the department for review and concurrence prior to installation.

(2) **GAS AND VAPOR PHASE MONITORING.** The department may require the installation of gas and vapor phase monitoring devices and sampling and analysis programs to monitor for gas and vapor phase migration. The gas and vapor phase monitoring program shall be implemented in accordance with plans approved by the department. If gas or vapor phase monitoring is required, the temperature, ground condition, barometric pressure and information as to whether the barometric pressure is rising or falling shall be recorded each time sampling is performed. Sample collection and analytical techniques shall be in accordance with standard methods.

(a) All gas and vapor phase monitoring probes shall be designed, located, installed and maintained so as to obtain reliable and representative information regarding soil conditions and gas and vapor phase concentrations.

(b) All gas and vapor phase monitoring probes shall be constructed with a shut-off valve to prevent the escape of gas from the sampling device and minimize the amount of inflow of air from the atmosphere.

(3) **SURFACE WATER MONITORING.** The department may require the monitoring of surface water runoff, leachate seeps, sumps, sedimentation ponds, any surface water bodies and other surface water discharges resulting from facility operation. The department shall specify sampling times and parameters and all sampling shall be implemented in accordance with plans or reports approved by the department. All surface water sampling locations shall be surveyed in and permanently and clearly marked.

(4) **AIR QUALITY MONITORING.** The department may require monitoring of air quality for particulates, toxics or other constituents in the ambient air, from point sources or in buildings at or associated with the facility. The department shall specify sampling times and locations and all sampling shall be implemented in accordance with plans or reports approved by the department.

(5) **OTHER MONITORING.** The department may require monitoring of any physical aspect of the facility operation including vegetative growth; drainage control structures; and gradient control systems. All required monitoring shall be implemented in accordance with plans or reports approved by the department. The department may require geophysical investigations to complement groundwater monitoring efforts.

(6) **GEOTECHNICAL INFORMATION.** The owner or operator shall perform field investigations to define the topography, subsurface soils, depth to bedrock, type of bedrock, depth to groundwater, groundwater flow direction and gradients at the facility. The results of this investigation shall be described in the narrative section of the investigation report. The owner or operator shall include all raw data such as boring logs, well construction diagrams, laboratory tests and field hydraulic conductivity test data and water level measurements in the report appendix. The following investigations at a minimum shall be performed unless an alternative geotechnical investigation program is approved by the department in writing.

(a) *Borings.* Borings sufficient to define sub-surface conditions shall be drilled as necessary to define the degree and extent of contamination at the facility.

1. At a minimum, a sufficient number of borings shall be drilled in all areas of known or suspected contamination so that the full degree and extent of the contamination can be determined. Borings shall also be drilled in uncontaminated areas at the facility for comparing clean versus contaminated soils. If at all possible, the borings shall be located on a grid pattern. The department may require more borings in complex hydrogeologic environments.

2. Borings shall extend a minimum of 10 feet below the lowest known contaminant source as measured in the field. Every attempt shall be made to locate this boring outside the proposed

limits of waste filling. Boring logs shall identify the lithology of the bedrock when it is encountered.

3. Where conditions permit, samples shall be collected using undisturbed sampling techniques. Samples may not be composited for testing purposes. In fine-grained soil environments, continuous samples shall be collected. In uniform, coarse-grained soil environments or following the continuous sampling in fine-grained soil environments, samples shall be collected from each major soil unit encountered and at maximum 5-foot intervals. Each soil sample shall be described including its structure, mottling, voids, layering, lenses and geologic origin and visually classified according to the unified soil classification system and Munsell color chart. Continuous core samples of the bedrock shall be taken and the rock properties including fracture frequency, RQD and percent recovery shall be determined for the borings extended into bedrock.

4. Borings not converted to wells shall be abandoned in accordance with subs. (8) and (17).

5. A boring log shall be submitted for each boring. Each boring log shall include soil and rock descriptions, methods of sampling, sample depths and elevations, date of boring, land surface elevation, bottom of boring elevation, moisture content, and consolidation test results such as blow counts, vane shear or pocket penetrometer. All elevations shall be corrected to USGS datum. If the boring is converted to a well, include the water level at time of drilling, dates of water level measurements and a well construction diagram on the log.

(b) *Wells.* Groundwater monitoring wells sufficient to define the hydrogeologic and groundwater quality conditions shall be installed. At a minimum, this includes:

1. Water table observation wells shall be installed to adequately define the water table surface, horizontal gradients and lateral extent of contamination at the facility. If necessary to define the extent of contamination beyond the facility property, the owner or operator shall make every attempt to secure permission from adjacent land owners for this purpose. All water table observation wells shall be constructed so that the screens intersect the water table at all times during the year. If necessary to define the vertical extent of contamination, one or more piezometers shall be installed adjacent to water table observation wells to create well nests.

2. All wells shall be designed, installed, developed, sampled and documented in accordance with this chapter. Alternative methods of well design and installation shall be approved prior to well construction.

(7) **WELL DESIGN AND INSTALLATION.** All monitoring devices shall be designed and installed in accordance with ch. NR 141 and the following requirements unless an alternate method is approved in writing by the department.

(a) *Protective devices.* All groundwater monitoring wells, leachate head wells, suction lysimeters, moisture probes and other sampling devices shall have a cap to prevent contaminants from entering the monitoring device. All monitoring devices except leachate head wells in the active area of the facility shall have protective metal casings and locking lids. The lids shall be kept locked. The department may require additional protective devices such as rings of brightly colored posts around any monitoring device. All leachate head wells shall be protected to prevent damage during facility operation.

(b) *Labelling.* All monitoring devices shall be clearly and permanently labelled. At a minimum, the label shall include the well name and number.

(c) *Drilling method.* Drilling shall be performed in accordance with ss. NR 141.15, 141.17 and the requirements of this section. The drilling method shall allow the driller to obtain undisturbed soil samples and perform standard penetration tests while drilling. If a drilling method using continuous sampling does not allow for

standard penetration tests, then the consolidation of the recovered samples shall be measured in the field with a vane shear or pocket penetrometer.

1. If the drilling method does not allow the required soil sampling to be performed, a separate boring shall be drilled adjacent to the monitoring well to provide the necessary information.

2. Drilling fluids and water may be used to drill monitoring wells only when there are no reasonable alternatives. If drilling fluids are used, the driller shall document the type of fluids, any additives used and the chemical constituents of the mixture. If water is used, the source of the water shall be identified.

3. When drilling equipment comes into contact with contaminants in the borehole or above ground, the driller shall clean the equipment thoroughly prior to any additional drilling.

(d) *Borehole abandonment.* If any borehole is deeper than the well to be placed in it, the portions of the borehole below the well screen shall be properly sealed according to subs. (8) and (17).

(e) *Well development.* All groundwater monitoring wells shall be properly developed following installation. The development process shall cause water to flow rapidly into and out of the well screen for the purpose of dislodging and removing fine soil particles, drill cuttings and drilling fluids. Well development shall be considered complete when the water extracted from the well is chemically stable, and as free of sediment as possible. Well development shall follow the procedures in s. NR 141.19 and the requirements of this section.

1. Sampling after development. Once the water being extracted from the well is stabilized, a sample shall be tested for total suspended solids. If drilling fluids were used during well construction, the sample shall also be tested for COD.

2. Water level measurements. After development, all wells shall be pumped and successive water level measurements shall be taken until stabilized readings are obtained.

3. Documentation. All well development techniques shall be documented in accordance with s. NR 141.21 and this section.

(8) **BORING AND WELL ABANDONMENT.** Proper abandonment of borings and monitoring devices shall seal the well or borehole completely in order to prevent future contamination of groundwater. The sealing materials used shall be continuous, physically and chemically stable and have a hydraulic conductivity of less than 1 x 10 cm/sec. The exact location of abandoned wells and borings and the date and the method of abandonment shall be documented in writing. The abandonment method shall also be documented by photographs. All monitoring wells and boreholes shall be abandoned and documented in accordance with s. NR 141.25 and this section.

(a) *Timeline.* All boreholes not instrumented with a well shall be abandoned immediately after drilling and completion of soil testing.

(b) *Abandonment of water supply wells.* Water supply wells which are required to be abandoned shall be abandoned and documented according to s. NR 812.21.

(9) **INSPECTIONS.** The facility owner or operator shall inspect all monitoring devices at least annually. Sampling personnel shall inspect all monitoring devices each time the device is sampled or a water level elevation is measured. If for any reason a monitoring device is destroyed or otherwise fails to function properly, the facility operator shall notify the department in writing within 10 days after discovery. The device shall be repaired if possible. If the device cannot be repaired, it shall be properly abandoned and replaced within 60 days unless otherwise approved in writing by the department. Unless otherwise approved, if a device is replaced, the replacement well shall be given the same number as the well it replaced followed by the letter "R" to indicate it is a replacement well. An additional "R" shall be added each time the well is replaced.

**(10) SOIL SAMPLING.** All soil samples collected from borings installed on or off the facility property shall be collected and tested in accordance with this section unless otherwise approved in writing by the department.

(a) *Sample collection.* Where conditions permit, samples shall be collected using undisturbed soil sampling techniques. Samples may not be composited for testing purposes. In fine-grained soil environments, continuous samples shall be collected. In uniform, coarse-grained soil environments samples shall be collected from each major soil unit encountered and at maximum 5-foot intervals. At least one soil sample shall be collected at the depth of any subsequently placed monitoring well screen. If borings are extended 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.

(b) *Laboratory and field testing.* Laboratory and field analysis shall be conducted to identify the specific geologic and hydrogeologic conditions in the vicinity of the boring or monitoring well.

1. The soil sample collected at the depth of any subsequently placed monitoring well screen shall be analyzed for grain size distribution by mechanical and hydrometer test and Atterberg limits, as appropriate for the particular soil type. Each soil sample shall be described according to its physical texture, color, geologic origin and visually classified according to the unified soil classification system.

2. An in-field test shall be conducted on monitoring each well to determine the in-situ hydraulic conductivity. The test shall be of long enough duration and include a sufficient amount of data to provide a representative estimate of the actual hydraulic conductivity.

3. Laboratory hydraulic conductivity tests shall be conducted on at least 2 representative samples from each major soil unit. Tests shall be run on undisturbed samples when conditions allow.

4. The department may require that other tests be conducted as appropriate for the particular type of material.

5. After each well has been properly developed, successive water level measurements shall be taken until stabilized readings are obtained. In addition, stabilized water level measurements shall be obtained on a quarterly basis from surface water bodies including streams, lakes, ponds, drainage ditches and wetlands located within 1,200 feet of the proposed facility. Where public or private wells are present, stabilized water level readings from these wells may be required if access can be obtained from the owner.

6. The department may require other work such as pump tests, geophysical investigations, isopach maps or a fence diagram to assess the hydrogeologic conditions at the proposed facility.

**(11) FIELD DIRECTION.** A hydrogeologist meeting the definition of s. NR 600.03 or other equally qualified person shall observe and direct the drilling of all borings, the installation and development of all wells and all in-field hydraulic conductivity tests. The hydrogeologist shall also visually describe and classify all of the geologic samples.

**(12) SUBSURFACE DATA ANALYSIS.** Data on subsurface investigations shall be presented in the narrative section of the report as follows:

(a) *Soil and bedrock descriptions.* Each major soil unit and bedrock formation shall be described using data from both subsurface investigations and regional information. The descriptions shall include:

1. Grain size distribution, geologic origin and classification of materials using the USCS system and Muncell color chart.

2. The lateral and vertical extent of each major soil unit including description of lenses or other heterogeneities and the strike and dip of rock formations.

3. The presence and frequency of joints, fractures, voids, solution openings, faults or other structural features.

4. Testing data shall be summarized by major soil unit in a table in all reports. The table shall contain the following information: geologic origin, sample ID number, percentages of gravel, sand, silt and clay-sized materials, P200 content, liquid limit, plasticity index, and lab and field hydraulic conductivity. If average values are calculated for any of these test results, a range and standard deviation shall also be presented.

(b) *Hydrogeologic properties.* The properties of each saturated soil unit or rock formation and its function in the groundwater flow system shall be described including the following:

1. Hydraulic conductivity.

2. Role as a confining unit.

3. Hydraulic connection to other units.

4. Actual or potential use as a water supply.

5. Depth to groundwater and seasonal variations in groundwater elevation.

6. Location and extent of any perched groundwater systems.

7. Local and regional flow directions including the location of groundwater divides.

8. Horizontal and vertical gradients, particularly between soil units of differing hydraulic conductivity and between unconsolidated deposits and bedrock.

9. The saturated thickness of the uppermost aquifer at the facility boundary which can be expected to attenuate contaminants which may enter the flow system and estimates of the quantity of flow passing under the facility boundaries.

(c) *Appendix.* All raw data including boring logs, well construction diagrams, soil tests and water level measurements shall be included in the appendices of all reports.

**(13) DATA PRESENTATION.** The results from the subsurface investigations shall be presented on 24 inch x 36 inch plan sheets, unless an alternative size is approved by the department in writing, as follows:

(a) *Existing conditions.* A detailed topographic survey of the facility and all areas within a distance of 1,500 feet from the facility boundaries. The minimum scale shall be one inch = 200 feet with a maximum 2 foot contour interval. The contour interval selected shall be sufficiently small to clearly show surface water flow patterns within and around the facility. This plan sheet shall show the following features:

1. 100-year floodplain area.

2. Surface waters, including intermittent and ephemeral streams and wetlands.

3. Homes, buildings, man-made features and utility lines.

4. Surrounding land uses, such as residential, commercial, agricultural and recreational.

5. Property boundaries, waste handling areas and product handling areas.

6. Access control, such as fences and gates.

7. Water supply wells including irrigation and stock wells, as well as public and private water supply wells.

8. Boring, test pit and well locations.

9. Other structures including runoff control systems, agricultural drain tile systems, access and internal roads, and storm and sanitary sewerage systems.

(b) *Geologic cross-sections.* Cross-sections shall be constructed through all borings, both perpendicular and parallel to the facility baseline, as well as along and across transects which include major geologic and geomorphic features such as ridges, valleys and buried bedrock valleys. At least one cross-section shall be constructed parallel to groundwater flow. Where more than one interpretation can be reasonably made, conservative assumptions shall be used when evaluating heterogeneities within

the unconsolidated deposits. The following information shall be presented on the geologic cross-sections:

1. Inferred or questionable lithostatigraphic boundaries shall be shown with a dashed line or question mark.

2. For clarity, a number or symbol shall be used to label major soil units instead of extensive shading. A key shall be provided which contains a description of each major soil unit including geologic description and origin, USCS classification and color.

3. Boring logs showing the USCS classification of each major soil unit, the results of grain size analyses, Atterberg limits, and lab and field hydraulic conductivity tests. The data shall be correlated to the sample location.

4. Well construction details shown to scale including the well screen and filter pack length, the location of the upper and lower seals and stabilized water level elevations measured on the same day. Where 2 or more water table observation wells are presented on a cross-section, a line representing the water table shall be drawn. The date the measurements were taken shall be specified in the key.

(c) *Water table maps.* At least 2 water table contour maps shall be presented. The maps shall be based on monthly water table elevations documenting the seasonal high and low water table. For each sampling round, all water level elevations shall be measured on the same day. The water table maps shall show all wells and the measured water level elevation at each well. If 3 or more bedrock wells are installed, a bedrock piezometric map shall be prepared.

(d) *Bedrock map.* Where at least 3 borings to bedrock are required, a bedrock contour map shall be prepared from specific and regional data.

(e) *Flow net.* A flow net shall be constructed parallel to the direction of groundwater flow to show the distribution of recharge and discharge.

**(14) GROUNDWATER SAMPLING AND ANALYSIS.** The owner or operator shall implement a monitoring program at the facility in accordance with this section unless otherwise approved in writing by the department.

(a) *Number of required monitoring points.* The number of required monitoring points and the monitoring program shall be approved in writing by the department based on the facility size, waste and product types handled by the facility, facility design and hydrogeologic and geologic setting of the facility. The monitoring program shall be adequate to determine the horizontal and vertical degree and extent of contamination, horizontal and vertical gradients and to detect any impacts from the facility on groundwater quality within and beyond the property boundaries.

(b) *Sampling of water supply wells.* The department may require the owner or operator to sample public or private water supply wells and to determine water level elevations in such wells as part of a routine groundwater monitoring program or to determine the extent of groundwater contamination unless permission cannot be obtained from the well owner.

(c) *Sampling frequency.* The minimum sampling frequency shall be according to this subsection unless otherwise specified in writing by the department. Routine monitoring at facilities shall be conducted quarterly, within 15 days of March 15, June 15, September 15 and December 15. Alternative dates to those specified may be utilized if approved by the department in writing.

(d) *Sampling parameters.* Unless otherwise specified in writing by the department, the following parameters shall be monitored:

1. Water level elevation shall be measured and recorded to the nearest 0.01 foot in each groundwater monitoring well or other monitoring device prior to sampling. The elevation shall be corrected to USGS datum. The measuring point shall be a specific point at the top of the well casing. The specific measurement point shall be identified on the well itself if the top of the casing is not level.

2. The physical appearance of the water sample, including color, odor and turbidity, shall be recorded at the time of sampling of each monitoring device.

3. Groundwater monitoring shall be conducted based on the characteristics of hazardous waste handled or managed at the facility, the raw process materials used or as required by the department. Both the uncorrected field conductivity and the field conductivity at 25°C shall be reported. Uncorrected field conductivity does not need to be reported if a meter which automatically corrects to 25°C is used for sampling. The department may require analysis of additional parameters.

(e) *Sampling and analysis plan.* A groundwater sampling and analysis plan for all monitoring devices at the facility shall be prepared and submitted to the department for approval. The sampling and analysis plan shall be consistent with s. NR 635.12 (12).

(f) *Groundwater monitoring plan.* A groundwater monitoring plan for the facility shall be prepared and submitted to the department for approval. The groundwater monitoring plan shall be consistent with s. NR 635.12 (13).

(g) *Analytical methods.* All required chemical and physical groundwater analyses shall be conducted by a laboratory certified or registered under s. 299.11, Stats., and ch. NR 149. The laboratory shall use the analytical methods referenced in ch. NR 149 unless alternative methods are approved by the department in writing. Detection limits for all chemical analyses shall be in accordance with s. NR 140.16 (2). The following tests are excluded from the requirements of ch. NR 149 but shall be performed using standard methods or procedures, if they exist.

1. Physical tests of soil,
2. Physical tests of wastes,
3. Air quality tests,
4. Gas and vapor phase tests,
5. Field pH tests,
6. Field conductivity tests,
7. Nutrient testing of soils and waste,
8. Turbidity tests,
9. Water elevation,
10. Temperature,
11. Leachate-liner compatibility testing.

**(15) WELL CONSTRUCTION DOCUMENTATION.** The facility owner or operator shall document all well construction activities and report the information to the department as required in s. NR 141.21 and this section. Well construction shall be documented in all plan submittals, reports or in-field conditions reports. If no plan submittal or report is being prepared at the time of well installation, documentation shall be submitted to the department within 60 days of well installation. All elevations shall be corrected to USGS datum. Elevations shall be recorded to the nearest 0.01 foot. The documentation shall be submitted on forms provided by the department which are supplemented by written descriptions. Documentation of well construction shall include the following information:

(a) *Well protection.* The type of protective casing; the diameter, length and elevation of the top of the protective casing; the grout used between the well casing and the protective casing; the depth and width of surface plug below the land surface; the height of the plug above the land surface; and the type of cap and lock.

(b) *Well design.* The well casing type, length, diameter and schedule; the type of joints used; the screen type, length, diameter and schedule; the screen slot type and size; the percent open area of the screen; the type of screen bottom; the distance the filter pack extends above the screen; elevations of the top of casing and land surface; depth from the land surface to and elevation of the bottom of the borehole, the bottom of the well screen, and top and bottom of all seals; and well locations identified by the landfill coordinate system to the nearest foot.

(c) *Materials used.* A description of the filter pack material, including grain size analysis, quantity used, and manufacturer and product name or number; the well seal including the physical characteristics of the material; the type and quantity of annular space sealant including percentages of each specific material used for each well; drilling fluid including additives; and water added including the source and the results of the water quality analysis for parameters in Table 1 of s. NR 635.09.

(d) *Installation techniques.* The drilling method used; type of drill rig; borehole diameter; inside diameter of the hollow stem auger, if used; cleaning procedures; sealing method; time between sealing the annular space and constructing well protection; and the date the well was drilled.

(e) *Well development.* The date the well was developed; the date, time and the water level in the well both before and after development; the development method; time spent developing the well; volume of water removed and added; source of water; clarity of water before and after development; presence of sediment at the bottom of the well before and after development; volume of water purged; all readings of field temperature, field specific conductance, field pH and the times at which they were measured; analysis of total suspended solids and analysis of COD if drilling fluids were used during well construction.

(f) *Soils information.* Boring logs, soil testing results and driller's observations including any problems encountered or conditions that may affect the performance of the monitoring device or that may help in planning future well installations. Each boring log shall include soil and rock descriptions, method of sampling, sample depths and elevations, date of boring, land surface elevation, water level elevations and depths, elevation and depth of the bottom of the boring, the location of the well screen and soil test data. Soil and rock descriptions shall include geologic origin and any heterogeneities, soil structure, soil color, mottling, moisture, blow counts, layering, jointing, lenses, fractures, organic matter or voids. Each soil layer shall be classified according to the unified soil classification system. All elevations shall be corrected to USGS datum.

(g) *Miscellaneous.* The raw data and calculated results of in-situ hydraulic conductivity tests; water level measurements and dates; computations of well yield, if determined; any changes in well construction, casing elevation or other features subsequent to drilling.

(h) *Map.* An 8 1/2 by 11 inch map, drawn to scale, showing facility boundaries, the design management zone, the location of all monitoring devices and borings, facility coordinate system, scale, north arrow and key.

(i) *Forms.* Groundwater monitoring well information form 4400-89, groundwater monitoring well construction form, boring log information form and other forms as required by the department completed as instructed.

**Note:** Copies of these forms may be obtained from the Department of Natural Resources, Bureau of Waste Management, P.O. Box 7921, Madison, WI 53707.

**(16) SAMPLING AND ANALYSIS DOCUMENTATION.** Field records of all monitoring activities shall be prepared in sufficient detail to document whether the sampling and analysis plan has been followed and should follow department guidelines for groundwater sampling. The facility owner or operator shall retain all field records until the end of the long-term care period for the facility. Field records shall be available for department inspection on request. The owner or operator shall submit sampling results and water elevation data on forms supplied by the department within 60 days from the end of the sampling period. Forms designed by the facility owner may be approved by the department for use in submitting sampling results. Explanation of any deviation from the approved sampling plan or analytical procedures shall be submitted at the same time.

**(17) BORING AND WELL ABANDONMENT DOCUMENTATION.** Boring and well abandonment activities shall be documented in

accordance with s. NR 141.25 (4) and this section on forms provided by the department in all plan submittals, reports and in-field conditions reports. If no plan submittal or report is being prepared at the time of boring or well abandonment, documentation shall be submitted by the facility owner or operator to the department within 60 days of boring or well abandonment. Documentation shall include the exact location of the well or boring by facility coordinate system, total depth of the well, date and method of abandonment, materials and volumes of backfill used, status of well casing removal and any special precautions taken. The method used to abandon the wells shall be documented using photographs. If the well is a public or private well, any forms required under s. NR 812.21, such as well abandonment report form 3300-5, shall be submitted. In any case, other forms previously submitted to the department, such as the groundwater monitoring well information form 4400-89, shall be revised to reflect the current condition of the monitoring system.

**Note:** These forms may be obtained from the Department of Natural Resources, Bureau of Waste Management, P.O. Box 7921, Madison, WI 53707.

**(18) BACKGROUND GROUNDWATER QUALITY.** The owner or operator shall establish background groundwater quality in accordance with s. NR 635.12 (15).

**(19) POINT OF STANDARDS APPLICATION.** The points of standards application to determine if a preventive action limit or enforcement standard has been attained or exceeded are specified in s. NR 140.22 (2) and (3).

(a) *Design management zone.* The design management zone and waste boundary are defined in s. NR 140.22 (5) (a). The design management zone extends horizontally zero feet beyond the waste boundary for hazardous waste facilities subject to the requirements of ss. NR 635.05 to 635.15 and 635.18. For all other solid waste disposal facilities the design management zone extends horizontally 300 feet beyond the waste boundary.

(b) *Changes to the design management zone.* Except for those facilities subject to the requirements of ss. NR 635.05 to 635.15, the department may consider an expansion or reduction of the design management zone in accordance with s. NR 140.22 (5) (b). The factors which shall be considered by the department are listed in s. NR 140.22 (5) (c) and (d). An owner or operator of a facility may submit a written request for approval of an expansion or reduction of the design management zone. The request shall include an evaluation of the factors listed in s. NR 140.22 (5) (c) and (d).

**(20) NOTIFICATION PROCEDURES FOR EXCEEDANCES OF ENFORCEMENT STANDARDS AND PREVENTIVE ACTION LIMITS.** The owner or operator of a facility required to monitor under this section shall notify the department in writing if an enforcement standard, preventive action limit or alternative concentration limit has been attained or exceeded at the point of standards application. This notification shall be given within 60 days from the end of the sampling period and shall be attached to the sampling results as specified in ss. NR 140.24 (1) (a) and 140.26 (1) (a). The notification shall specify the parameters for which standards have been exceeded, the wells at which the exceedance occurred and provide a preliminary analysis of the cause and significance of the concentration.

**(21) RESPONSES WHEN A GROUNDWATER STANDARD IS EXCEEDED.** Upon receipt of a notification that an enforcement standard or preventive action limit has been attained or exceeded, the department shall evaluate the information. If further information is necessary to assess the cause and significance of the concentration, the department may require the owner or operator to prepare and submit a report within 60 days unless an alternative deadline is specified in writing by the department. The report shall assess the cause and significance of the exceedance based on consideration of the factors listed in s. NR 140.24 (1) (c) and shall propose a response to meet the objectives of s. NR 140.24 (2) or 140.26 (2). The department may also require that the report

include any of the information contained in sub. (22). The department shall respond to the report within 65 business days of receipt. Based on the evaluation of the report, if one is required, and the factors listed in s. NR 140.24 (1) (c), the department shall specify responses to be implemented by the owner or operator of the facility in accordance with s. NR 140.24 (2) or 140.26 (2).

**Note:** The range of responses for an exceedance of a preventive action limit is specified in Table 5 of s. NR 140.24 (4). The range of responses for an exceedance of an enforcement standard is listed in Table 6 of s. NR 140.26 (2). The criteria the department must use to determine which responses are appropriate are included in ss. NR 140.24 (2) to (6) and 140.26 (2), (4), (5) and (6).

**(22) IN-FIELD CONDITIONS REPORT.** The department, for good cause shown, may require pursuant to s. 291.95, Stats., or as a condition of a plan approval under ch. 291, Stats., the owner or operator of any facility that has improperly managed hazardous waste, or any person who permits the use of property for such purpose, to submit an in-field conditions report to the department to determine if the facility poses a potential hazard to public health, safety or welfare, or the environment. All in-field conditions reports shall contain the following minimum information unless otherwise approved by the department in writing. Additional information contained in ch. NR 635 may also be required by the department.

(a) *General facility information.* An in-field conditions report shall identify the project title; name, address and phone number of the primary contacts including the facility owner and any consultants; present property owner; a general description of the facility location; the facility location by quarter-quarter section, township, range, town and county; total acreage of the property; existing hazardous waste solid waste management units; product management areas; all public and private wells within one-half mile of the facility and the owners of all public and private wells within 1,200 feet of the limits of the facility. Well logs for all wells within 1,200 feet shall be included in the appendix of the report.

(b) *Facility history.* An in-field conditions report shall identify the dates the facility began generating hazardous waste; the type and volume of hazardous waste known to have been released, spilled or stored; the potential for the hazardous waste to biologically decompose and generate gas; the area utilized and disturbed by hazardous waste handling and disposal; the overall operation of the facility; any facility engineering controls which were installed to prevent the generation of hazardous waste through releases, spills or discharges; the history of how the hazardous waste was generated; and any adjoining active or closed facilities or activities which may contribute to environmental contamination.

(c) *Land use information.* The in-field conditions report shall discuss the present and former land uses at the facility and the surrounding area. A thorough discussion of land uses which may have affected groundwater or surface water quality shall be included. The report shall address all areas that may affect or be affected by the facility. At a minimum, this will be the area within one mile of the facility. The discussions shall be supplemented with land use maps. At a minimum, the following items shall be addressed:

1. Identification and location of the adjacent land owners. This information may be presented on a plat map. However, current ownership conditions shall be verified and any changes noted.

2. A description of the present land uses in the area shall be included. Particular emphasis shall be placed on the discussion of known recreational, historical, archaeological or environmentally unique areas including natural or scientific areas, county forest lands and critical habitat. A letter from the department's bureau of endangered resources addressing the known presence of any endangered or threatened species, critical habitat and natural or scientific areas shall be included.

3. The present or proposed transportation routes and access roads including any weight restrictions shall be delineated.

(d) *Regional geotechnical information.* An in-field conditions report shall discuss the regional setting of the facility to provide a basis for comparison and interpretation of information obtained through field investigations. This discussion may be limited to information available from publications such as a hydrologic investigations atlas, water supply papers, informational circulars and technical bulletins published by the Wisconsin state geologic and natural history survey, the United States geological survey, the Wisconsin department of natural resources, U.W.-extension, regional planning commissions and the soil conservation service. The regional setting to be described is the area which may affect or be affected by the facility. At a minimum, this will be the area within 5 miles of the limits of filling. The discussions shall be supplemented with available regional bedrock and glacial geology maps, USGS topographic maps, SCS soil maps and regional water table maps. The following items shall be specifically addressed:

1. The existing topography including predominant topographic features.

2. The surface water drainage patterns and significant hydrologic features such as surface waters, springs, surface water drainage basins, divides and wetlands.

3. The origin, texture, nature and distribution of bedrock; the origin, texture, thickness and distribution of the unconsolidated units; and the texture and classification of the surficial soils.

4. The depth to groundwater, groundwater flow directions and gradients, recharge and discharge areas, groundwater divides, aquifers and identification of the aquifers used by public and private wells in the region. An indication of which aquifer systems are most susceptible to contamination shall be made.

5. Information on groundwater and surface water quality which is available from the USGS, WSGNHS, DNR, UW-Extension and regional planning commissions.

(e) *Specific facility investigations.* An in-field conditions report shall contain the results of field inspections and investigations which define the topography, subsurface soils, depth to bedrock, type of bedrock, depth to groundwater, groundwater flow direction and gradients at the facility, the horizontal and vertical extent of contamination, background groundwater quality, surface water quality and the degree and extent of groundwater and surface water contamination. The results of this investigation shall be described in the narrative section of the in-field conditions report. All raw data such as boring logs, well construction diagrams, laboratory tests, field hydraulic conductivity test data, water quality information and water level measurements shall be included in the report appendix. At a minimum, the following investigations shall be performed unless an alternative geotechnical investigation program is approved by the department in writing:

1. Borings shall be drilled at a sufficient number of separate locations to define the site geology and to define the degree and extent of soil contamination within and beyond the facility boundaries. All borings shall be extended a minimum of 10 feet below the lowest elevation below ground surface where documented evidence of contamination has been found. If regional information suggests that bedrock is within 75 feet of the land surface, a minimum of one boring shall be extended to bedrock. The borings shall be distributed so that requirements of this section are met. Samples shall be collected and boring logs prepared in accordance with subs. (10) and (17). Borings not converted to wells shall be abandoned in accordance with subs. (8) and (17).

2. A sufficient number of water table observation wells shall be installed to adequately define the depth to groundwater, horizontal gradients and horizontal degree and extent of contamination at the facility. The wells shall be constructed such that the water table intersects the well screen at all times during the year. A sufficient number of piezometers shall be installed adjacent to water table observation well to create a well nest for the purpose



of defining vertical gradients and vertical degree and extent of contamination. In addition, in fine-grained soil environments, a well nest consisting of at least 2 piezometers shall be installed adjacent to a water table observation well. All wells shall be constructed, developed and documented in accordance with subs. (7) and (15).

3. A hydrogeologist meeting the definition of s. NR 600.03 or other equally qualified person shall observe and direct the drilling of all borings; the installation, development and abandonment of all wells and all in-field hydraulic conductivity tests. The hydrogeologist or other equally qualified person shall also visually describe and classify all geologic samples. Any odor associated with the samples shall also be noted.

4. Laboratory and field analyses shall be conducted to identify the specific geologic and hydrogeologic conditions at the facility in accordance with subs. (10) to (16).

5. Once the groundwater monitoring wells have been installed and properly developed, at least 3 rounds of water quality sampling shall be performed with a minimum of one month between sampling rounds. At a minimum, the samples shall be analyzed for the parameters listed in Table I and any other parameters that are effective for monitoring the type of hazardous waste that was handled by the facility. Unless otherwise approved by the department, at the same time the first round of sampling is undertaken a sample from each well shall be analyzed for all volatile organic compounds listed in Table 1 of s. NR 140.10 and any additional compounds specified by the department. The testing shall be done using a gas chromatograph/mass spectrophotometer in accordance with SW 846 method 8240 or EPA wastewater method 624. As an alternative the analysis may be performed using a gas chromatograph/photoionization detector/Hall detector in accordance with SW 846 methods 8010/8020 or EPA wastewater methods 601/602. Any wells which have concentrations of VOC's above the limits of quantification shall be resampled during the following 2 sampling rounds. Any private wells within 1,200 feet of the facility shall be sampled at the same time as the monitoring wells and for the same parameters.

6. The hazardous waste types known to have been generated, discharged, released or spilled at the facility shall be evaluated for the potential for gas or vapor phase migration. Any facility which contains or is thought to contain hazardous wastes which can biologically decompose shall be instrumented with gas or vapor phase monitoring probes. The probes shall be installed to define the concentration and lateral degree and extent of gas or vapor phase migration. The probes shall be installed in the soil units most likely to allow gas or vapor phase migration. The probes shall be sampled a minimum of 3 times for methane and any other appropriate gases that are by-products or chemical breakdown products of the hazardous waste being evaluated by the facility. The department shall be notified immediately if any gas or vapor phase probe exceeds the lower explosive limit for the particular gas or vapor tested.

(f) *Data presentation.* The results of the subsurface investigations and water quality sampling shall be presented on 24 inch x 36 inch plan sheets unless an alternative size is approved by the department in writing, as follows:

1. A topographic map of the area showing where any product storage tanks are located, areas where hazardous waste generation, spills, releases or discharges occurred, property boundaries, fencing, major utility corridors, homes, buildings, man-made features, adjacent or nearby wetlands, public and private water supply wells, the location of soil borings and groundwater monitoring wells and the location of all other monitoring devices at the facil-

ity. The base map shall consist of a map having a minimum scale of one-inch equals 200 feet with a 2 foot contour interval sufficient to show relief and drainage features. The map shall contain a local grid system with the location of the origin identified according to latitude and longitude or the state plane coordinate system.

2. Geologic cross-sections shall be constructed through all borings both perpendicular and parallel to the facility baseline as well as along transects which include major geologic and geomorphic features. At least one cross-section shall be constructed parallel to groundwater flow. Where more than one interpretation can be reasonably made, conservative assumptions shall be used when evaluating heterogeneities within the unconsolidated deposits. Information on the geologic cross-sections shall be presented in accordance with sub. (13).

3. At least one water table contour map shall be included. The maps shall be based on stabilized water levels recorded on a single day from all observation wells at the facility. All the wells and the measured water level at each well shall be shown on the water table maps. The topographic map shall be used as a base map. If more than one set of water levels has been taken, the water table map shall be based on the set of data which indicates the highest water table.

4. At least 3 iso-concentration maps shall be presented for the parameters which most accurately depict the degree and extent of contamination. The concentration of the particular parameter shall be presented for each well.

(g) *Map.* An 8 1/2 by 11 inch map shall be submitted. The map shall be drawn to scale and show the facility boundaries, the design management zone, the location of all monitoring devices and borings, the facility coordinate system, the scale, a north arrow and a key.

(h) *Forms.* The groundwater monitoring well information form 4400-89, the groundwater monitoring well construction form, the boring log information form and other forms as required by the department shall be completed as instructed.

(i) *Data analysis.* The results from the sub-surface investigations, water quality sampling, gas monitoring and regional geotechnical information shall be evaluated to determine:

1. Whether any groundwater standards have been attained or exceeded. If any preventive action limits or enforcement standards established under s. NR 140.10 or 140.12 have been exceeded, the cause and significance of the exceedances shall be addressed. If significant contamination appears to be present, the factors listed in s. NR 140.24 (1) (c) shall be addressed.

2. Whether surface water quality has been impacted by the facility.

3. Whether gas or vapor phase migration is occurring. If it is determined that gas or vapor phase migration is occurring, any residences, businesses, industries or other structures which have or may be affected by gas migration shall be identified.

(j) *Proposed remedial actions.* Based on an evaluation of the data generated, the types of remedial actions necessary to return the facility to compliance with the requirements of chs. NR 600 to 685 shall be proposed. Sections NR 140.24 (4) and 140.26 (2) outline the required set of remedial actions depending on what parameters are affected and whether or not a preventive action limit or enforcement standard has been exceeded. A long-term environmental monitoring program shall be proposed so the performance of the facility and the effects of any remedial action can be evaluated.

**History:** Cr. Register, May, 1995, No. 473, eff. 6-1-95; corrections in (14) (g), (17) and (22) (intro.) made under s. 13.93 (2m) (b), Register, May, 1998, No. 509, eff. 6-1-98.