

facility. The department shall specify sampling times and locations and all sampling shall be implemented in accordance with plans approved by the department.

(5) **OTHER MONITORING.** The department may require monitoring of landfill settlement; berm, sideslope and final cover stability; vegetative growth; drainage control structures; gradient control systems; or any other aspects of facility operation. All required monitoring shall be implemented in accordance with plans approved by the department. The department may require geophysical investigations to complement groundwater monitoring efforts.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.05 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.

Note: ch. NR 141 is currently being promulgated by the department and has not yet been printed in the administrative code.

(1) **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.

(2) **LABELING.** All monitoring devices shall be clearly and permanently labeled. At a minimum, the label shall include the well name and number.

(3) **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.

(a) 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.

(b) 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.

(c) 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.

(4) **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 s. NR 508.07.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.06 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 writing according to ss. NR 141.21 and 508.11.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.07 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 1×10^{-7} 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 ss. NR 141.25, 508.13 and this section.

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

(2) **ABANDONMENT OF WATER SUPPLY WELLS.** Water supply wells which are required to be abandoned shall be abandoned and documented according to s. NR 112.21.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.08 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 re-

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placement well. An additional "R" shall be added each time the well is replaced.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.09 Soil sampling. All soil samples collected from borings installed after submittal of a feasibility report shall be collected and tested in accordance with this section unless otherwise approved in writing by the department.

(1) **SAMPLE COLLECTION.** Where conditions permit, samples shall be collected using undisturbed soil sampling techniques. Samples shall not be composited for testing purposes. In fine-grained soil environments, continuous samples shall be collected from the land surface to at least 25 feet below the anticipated or existing sub-base grade for the purpose of field classification. In uniform, coarse-grained soil environments and 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. 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.

(2) **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.

(a) 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.

(b) An in-field test shall be conducted on 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. Boring logs shall be recorded for all borings. Each boring log shall include complete information as required in s. NR 508.11 (6).

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.10 Groundwater and leachate sampling and analysis. The owner or operator shall implement a monitoring program at a land disposal facility in accordance with this section and the approved plan of operation unless otherwise approved in writing by the department.

(1) **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 types, facility design and hydrogeologic and geologic setting of the facility. The monitoring program shall be adequate to determine upgradient and downgradient water quality, horizontal and vertical gradients and to detect any impacts from the facility on groundwater quality.

(2) **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

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groundwater monitoring program or to determine the extent of groundwater contamination unless permission cannot be obtained from the well owner.

(3) **SAMPLING FREQUENCY.** The minimum sampling frequency shall be according to this subsection unless otherwise specified in writing by the department. Routine monitoring at facilities having a design capacity of 50,000 cubic yards or less shall be conducted semiannually, within 15 days of March 15 and September 15. Routine monitoring at facilities having a design capacity of greater than 50,000 cubic yards 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. Leachate head wells shall be measured at least monthly for leachate level elevations.

(4) **SAMPLING PARAMETERS.** Unless otherwise specified in writing by the department the following parameters shall be monitored:

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

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

(c) Groundwater monitoring shall be conducted in accordance with Table 1. 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 depending on the characteristics of the waste, the raw process materials used, or the provisions of ch. NR 140.

Table 1

PARAMETERS			
Waste Type	Indicators	Public Welfare Standards	Public Health Standards
Municipal solid waste	Field temperature	Chloride	
	Field conductivity (uncorrected)	Dissolved iron	
	Field conductivity (at 25°C)		
	Field pH		
	Alkalinity		
	COD		
	Hardness		
Paper mill sludge	Field temperature	Chloride	Nitrate + Nitrite (as N)
	Field conductivity (uncorrected)	Dissolved iron	
	Field conductivity (at 25°C)	Sulfates	
	Field pH		
	Alkalinity		
	COD		
	Hardness		
Fly or bottom ash	Field temperature	Dissolved iron	Selenium
	Field conductivity (uncorrected)	Sulfates	
	Field conductivity (at 25°C)		
	Field pH		
	Alkalinity		
	Boron		
	COD		
Foundry waste	Field temperature		Fluoride
	Field conductivity (uncorrected)		
	Field conductivity (at 25°C)		
	Field pH		
	Alkalinity		
	COD		
	Hardness		
Other solid waste	As specified in writing by the department		

(5) **SAMPLING PLAN.** A sampling plan for all monitoring devices at the facility shall be submitted to the department as part of the feasibility report and shall be implemented as approved in writing by the department. The department may require that any existing facility prepare a sampling plan. The sampling plan should follow department guidelines for groundwater sampling and shall comply with the requirements in s. NR 140.16. At a minimum, the following items shall be addressed:

(a) Procedures to purge wells prior to collecting samples; calculations which determine the volume of water to be removed from each well; the amount of time between purging and sampling; the equipment used to purge wells, measure water levels, retrieve samples and measure temperature, conductivity and pH in the field; procedures to clean the purging and sampling equipment between wells; the order of well sampling; volume of sample needed; procedures and equipment to filter samples for

various parameters; procedures to physically and chemically preserve samples; quality assurance and quality control measures including blanks and duplicates; special procedures to sample leachate head wells or other devices; time to sample, filter, preserve and transport samples to the laboratory; chain of custody procedures, including persons responsible for sampling, methods for transporting samples to the laboratory, and the time elapsed before samples are analyzed in the laboratory. The plan shall specify the location where the in-field tests and sample preservation will be performed and the laboratory where the samples will be analyzed.

(b) A copy of the approved sampling plan shall be kept at the facility or at the office of the facility owner and a copy shall be provided to the sampling personnel for use during sampling. The sampling plan shall be followed unless a modification to the plan is approved in writing by the department.

(6) **ANALYTICAL METHODS.** All required chemical and physical groundwater and leachate analyses shall be conducted by a laboratory certified or registered under s. 144.95, 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 must be performed using standard methods or procedures, if they exist:

- (a) Physical tests of soil,
- (b) Physical tests of wastes,
- (c) Air quality tests,
- (d) Gas tests,
- (e) Field pH tests,
- (f) Field conductivity tests,
- (g) Product quality testing,
- (h) Nutrient testing of soils and waste,
- (i) Turbidity tests,
- (j) Water elevation,
- (k) Temperature,
- (l) Leachate-liner compatibility testing.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.11 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 major plan submittals including initial site reports, feasibility reports, plans of operation, construction documentation or in-field conditions reports. If no major plan is being prepared at the time of well installation, documentation shall be submitted to the department within 60 days of well installation. All ele-

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vations 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:

(1) **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.

(2) **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.

(3) **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.

(4) **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.

(5) **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.

(6) **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.

(7) **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.

(8) **MAP.** An 8½ by 11 inch map, drawn to scale, showing facility boundaries, the design management zone, the location of all monitoring devices and borings, landfill coordinate system, scale, north arrow and key.

(9) **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 Solid Waste Management, 101 South Webster Street, Natural Resources Building, P.O. Box 7921, Madison, WI 53707.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.12 Sampling and analysis documentation. Field records of all monitoring activities shall be prepared in sufficient detail to document whether the sampling 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.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

NR 508.13 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 major plan submittals including initial site reports, feasibility reports, plans of operation, construction documentation reports or in-field conditions reports. If no major plan 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 landfill 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 112.21, 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 Solid Waste Management, 101 South Webster Street, Natural Resources Building, P.O. Box 7921, Madison, WI 53707.

History: Cr. Register, January, 1988, No. 385, eff. 2-1-88.

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