



BUREAU OF WATER QUALITY
PROGRAM GUIDANCE

WASTEWATER POLICY & MANAGEMENT TEAM

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Evaluating and Calculating Preventative Action Limits and Alternative Concentration Limits for Groundwater Discharges

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This document is intended solely as guidance and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

APPROVED:

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1.0 Definitions

Alternative Concentration Limit (ACL): the concentration of a substance in groundwater established by the department for a site to replace a preventive action limit or enforcement standard or both, from NR140 Table 1 or 2, when an exemption is granted in accordance with s. NR 140.28, Wis. Adm. Code. See s. NR 140.05(1m), Wis. Adm. Code.

Background groundwater quality or background concentration: groundwater quality at or near a facility, practice or activity which has not been affected by that facility, practice or activity. See s. NR. 140.05(3), Wis. Adm. Code.

Design Management Zone (DMZ): for wastewater land treatment systems this is 250 feet horizontally from the vertical wetted edge of a land disposal or land treatment system, unless this distance has been increased or decreased by the department under s. NR 140.22(3) Wis. Adm. Code. See ch. NR 140, Table 4, Wis. Adm. Code.

Enforcement Standard (ES): a numeric value expressing the concentration of a substance in groundwater which is adopted under s. 160.07, Stats. (establishment of enforcement standards; substances of public health concern), and s. NR 140.10, Wis. Adm. Code, (public health related groundwater standards) or s. 160.09, Stats. (establishment of enforcement standards; substances of public welfare concern), and s. NR 140.12, Wis. Adm. Code, (public welfare related groundwater standards).

Exemption: is a department approval action to relieve a facility of the responsibility found in ss. NR 140.24 and NR 140.26. Wis. Adm. Code due to elevated background data. An exemption may be approved in the form of a waiver or in the form of an alternative concentration limit (ACL).

Indicator parameter: a substance for which there is a PAL used to indicate the potential for an exceedance of a PAL or ES for another compound. See s. NR 140.20 Wis. Adm. Code

Limit of detection: means the lowest concentration level that can be determined to be statistically different from a blank. See s. NR 140.05(12), Wis. Adm. Code.

Limit of quantitation: the level above which quantitative results may be obtained with a specified degree of confidence. See s. NR 140.05(13), Wis. Adm. Code.

Mean: for a parameter at one well is the sum of the concentrations divided by the number of values used.

Preventive Action Limit (PAL): a numerical value expressing the concentration of a substance in groundwater which is adopted under s. 160.15, Stats. (establishment of PALs), and either listed in s. NR 140.10, Wis. Adm. Code (public health related groundwater standards), or s. NR 140.12, Wis. Adm. Code (public welfare related groundwater standards) or calculated under s. NR 140.20, Wis. Adm. Code (indicator parameter groundwater standards), Wis. Adm. Code. See s. NR 140.05(17), Wis. Adm. Code.

Point of Standards Application or Point of Standard: is a groundwater monitoring well or other sampling point to determine groundwater quality that complies with s. NR 140.22 Wis. Adm. Code.

Wisconsin Pollutant Discharge Elimination System (WPDES) permit: a water pollution control permit issued under ch. 283, Wis. Stats, which includes terms and conditions necessary to comply with surface water quality standards, groundwater standards, and federal regulations under the National Pollutant Discharge Elimination System (NPDES) and the Clean Water Act of 1972.

2.0 Overview

In order to establish PALs for indicator parameters and to evaluate and potentially establish ACLs for s. NR140.10 Table 1 Public Health Groundwater Quality Standards, Wis. Adm. Code (public health parameters) and s. NR140.12 Table 2 Public Welfare Groundwater Quality Standards, Wis. Adm. Code (public welfare parameters) in groundwater several steps must be taken. First the groundwater sampling data must be collected and evaluated to ensure the data is representative of the groundwater under the facility. Second would be to determine and evaluate the background data. The third step would be to calculate PALs for indicator parameters and ACLs where applicable. Once the PALs and ACLs are calculated the raw results are rounded to reflect significant figures.

Note: Regardless if stated or not in a WPDES permit, ch. NR 140.10 Table 1 and NR 140.12 Table 2 values are enforceable under the authority of that administrative code and applicable state statute.

3.0 Collecting and Evaluating Groundwater Data

Assemble the available groundwater monitoring data for the permitted monitoring parameters at each well. PALs and ACLs are evaluated prior to permit reissuance, therefore the data used is collected in the current permit term, typically 4 years of data.

*Note: According to s. NR 140.20, Wis. Adm. Code, you must have **a minimum of 8 sample results** from each background well to calculate PALs for indicator parameters. It is recommended that there should be no less than two years of quarterly data to be evaluated for initial ACLs. For second iteration ACLs (permit reissuance) or indicator parameter PALs, four years of semi-annual data may be used.*

Evaluate the data gathered and any supporting documentation to determine which data are usable for PAL/ACL calculations. Data used in the PAL/ACL calculations should have been collected using published sampling procedures and generated at a DNR certified lab using acceptable methods. Ensure the following:

1. Sample handling and preservation has not affected the data quality.

Wastewater facilities either have facility staff collect groundwater samples or the facility has contracted with a consultant/lab to collect the groundwater samples as a part of their permit. In either case the department should review the protocol for collection and handling of groundwater samples. It is not possible to quantify the inaccuracy of improperly handled samples. The errors could be amplified when the department uses this data to attempt to determine reasonable PAL/ACLs. Use *Groundwater Sampling Field Manual* (PUBL-DG-038 96, September 1996) for groundwater sampling protocol.

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2. The facility selected the appropriate methods of analysis.

The goal of analytic method selection, including the resolution; is to use a procedure that can reliably determine whether the concentrations in the groundwater exceed the PAL. Not all laboratories or methods/resolutions can be used to determine compliance with the NR 140 PALs. Particular attention should be given to the LOD and LOQ. If the resolution of the analytical method/resolution is too low, then a practical PAL/ACL will not be achievable.

3. The groundwater data has been reviewed for erroneous data, including:

Missing or Out-Of-Sequence Data:

Data may be missing in the event of a dry well or an obstruction preventing sample collection. If the missing data does not reduce the sample quantity below the minimum required 8 rounds, the available data can still be used.

Outliers:

Outliers are individual data points that are significantly higher or lower than the other data points. Determine whether there is valid justification for the elimination of any background data from the PAL or ACL calculations. Common causes for outliers include:

- Transcription errors, which can be resolved by reviewing the associated laboratory analytical reports, operator sample logs, or other source data reports,
- Changes observed in effluent loading during the period leading up to the groundwater sampling event,
- Significant (acute) fluctuations in groundwater elevations when compared to historic trends; this should not be confused with seasonal variations (discussed below).

Note: Omitting data from PAL/ACL calculations should be a last resort and only done if appropriately justified.

Significant Variation:

Significant variation does not include outliers but does include dramatic shifts in groundwater quality. The shifts include decreases and increases and are typically in an order of magnitude. If graphed, significant variance may give the appearance of steep peaks and valleys. This does not include gradual increases or decreases over time. Rationale should be investigated for these conditions. The drastic changes have appreciable influence on calculated PAL/ACLs because the standard deviation is larger.

Seasonable Variation:

Seasonable variation is a subset of significant variation and typically coincides with shifts in groundwater flow direction and/or groundwater elevations changes. The data should not be manipulated but the presence of seasonal shifts may require additional adjustment of calculated PAL/ACLs.

4.0 Determining Background Wells

The first step in evaluating background groundwater quality is to develop groundwater flow directions. Groundwater flow directions should never be assumed to be based solely on topography or proximity to surface waters. Groundwater flow directions can be variable. Ideally groundwater flows should be estimated for a large span of monitoring period including multiple years and different seasons. If the facility has a complex groundwater monitoring system (water table wells and piezometers) multiple groundwater flow directions may be necessary.

The groundwater flow direction is used to determine the location or viability of a background well(s). When there are multiple background wells, two or more wells can be used to develop PAL /ACL. The proximity of the background well to land disposal/treatment system should be considered. For example, an up-gradient well directly adjacent to a land disposal/treatment system with high permeability soil may be influenced by the hydraulic loading. While a background well does not need to be at or outside of the DMZ, it would be a good placement.

If there is a *single background well* with an adequate number of sampling events, the well should be used to calculate the PALs for indicator parameters and evaluate whether there are appropriate ACLs for any public health and public welfare parameters.

If there are *multiple background wells* a weighted percentage of the background wells assigned by the groundwater flow direction and the distance to the land treatment system can be used to calculate a single facility PAL/ACL for each parameter. In this case, a calculation may be developed for each parameter and the background wells may be weighted based on the geographic, historic, geologic/hydrologic and/or topographic rationale.

Geographic rationale:

When the background wells are located adjacent to the facility or another regulated facility, there may be concern of impact from the regulated facility. For example, when spray irrigation fields are placed near each other, they could affect nearby background wells; or an up-gradient well could potentially be impacted slightly by a side-gradient field.

Historic rationale:

Frequently a known historic residual contamination could impact a well for its sampling parameter.

Geologic/Hydrologic rationale:

There are regions in Wisconsin where the groundwater flow direction changes significantly (vertical and horizontal flow) by season. The ACLs need to be adjusted to compensate for the natural mixing.

Topographic rationale:

There are facilities that have land disposal/treatment systems near areas of significant topographic relief.

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Example Calculation When Using Multiple Wells:

Well	Chloride ACLs	Weight	Value	Facility Chloride ACL
MW-A	130 mg/l	75%*	97.5	147.5
MW-B	200 mg/l	25%*	50.0	

*Weight percentages in this example are based on well MW-A being mostly up-gradient slightly side-gradient and MW-B being mostly side-gradient and slightly up-gradient.

Background well water quality data may support the establishment of an ACL if any of the following are observed in the background data:

- There are multiple ES exceedances.
- There are a high percentage of results that exceed the PAL.
- There is a pattern of PAL exceedances, such as seasonal variation.

Note: There are scenarios when ACLs should rarely be established, including:

- A community well for potable water is within 1,000 feet down-gradient.
- A private potable well is within 250 feet down-gradient.
- An inhabited dwelling is within 500 feet down-gradient.
- A significant water resource is directly down-gradient.
- A known aquifer recharge area is directly down-gradient.

It is not recommended to attempt to adjust a PAL or ACL to compensate for an increasing trend in background groundwater data if the facility is in compliance with the groundwater quality standards at the facilities point(s) of compliance, for example, the down-gradient/point of standard well(s). In other words, ACLs should not be granted because they can be.

5.0 Calculating PALs for Indicator Parameters

Indicator parameters are used to determine the quality of groundwater indirectly. They aid in the interpretation and prevention of exceedances of public health and public welfare parameter standards.

If the criteria in the previous sections have been satisfied and there are at least 8 rounds of valid background groundwater data from each well, department staff can calculate the PALs for indicator parameters. Specific instructions are detailed in s. NR 140.20 Wis. Adm. Code. Table 3 lists specific indicator parameters and the Minimum Increase for these parameters.

SD standard deviation
 Mean mean of groundwater data or results
 MI minimum increase (Table 3)

There are two identified calculations for parameters other than pH and temperature:

$$\sum (\text{Mean} + \text{MI})$$

and

$$\sum [(3) \times \text{SD} + \text{MI}]$$

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PAL for pH:

$$\Sigma [\text{Mean} \pm (1) \text{ pH unit}]$$

PAL for temperature:

$$\Sigma [\text{Mean} \pm (3) \times \text{SD}]$$

or

$$\Sigma (\text{Mean} \pm 10^\circ)$$

Whichever is greater

Note: Ammonia is listed under the nitrogen series in Table 3. This should not be used in place of the PAL and ES as found in s. NR 140.10 Table 1 Public Health Groundwater Quality Standards.

6.0 Calculating ACLs

Groundwater quality standards have been developed for compounds of concern to public health and public welfare. These standards are found in Tables 1 and 2 of ch. NR 140, Wis. Adm. Code. In the absence of a department established alternative concentration limit (ACL) the Table 1 and 2 standards are the default groundwater quality standard. An ACL is developed at a site or facility where the background groundwater quality meets the criteria stated in Section 4.0 of this document.

If the background data supports an ACL, the more restrictive of the two following methods should be used to calculate the ACL.

- a. **Opt. 1** $\Sigma [\text{SD} + \text{Mean} + \text{PAL (Table 1 or Table 2)}]$
- b. **Opt. 2** $\Sigma [(3) \times \text{SD} + \text{PAL (Table 1 or Table 2)}]$

7.0 Rounding PALs and ACLs

Rounding is used to adjust calculated ACLs and PALs to an appropriate significant figure. The decimal place is determined by a combination of the resolution of the analytical testing method and the magnitude of the ES and/or PAL in ch. NR 140 Wis. Adm. Code. The rounding deviates from standard mathematical rounding as any fraction that exceeds the threshold set forth in this document will be rounded to the next higher value. Rounding is up and not down.

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Parameter	Round to:
Arsenic	Next higher hundredth 0.0X 0.142 → 0.15
Barium	
Cadmium	
Chromium	
Copper	
Iron	
Lead	
Manganese	
Magnesium	
Mercury	
Nickel	
Phosphorus	
Selenium	
Silver	
Zinc	

Parameter	Round to:
pH	Next higher tenth 0.X 7.13 → 7.2
Nitrogen series	
Nitrite + nitrate as nitrogen	
Ammonia	
Organic nitrogen	
Kjeldahl nitrogen	

Parameter	Round to:
BOD ₅	Next higher whole number X.0 14.2 → 15.0
COD	
Sodium	
Calcium	
Magnesium	
Potassium	

Parameter	Round to:
Alkalinity	Next higher multiple of five 5.0 361 → 365
Chloride	
Conductivity	
Hardness (CaCO ₃)	
Sulfate	
Total dissolved solids	
Total suspended solids	

8.0 Documenting Calculated PALs and ch. NR 140.28, Wis. Adm. Code Exemptions

The primary and public documentation for the calculated PALs and ACLs are the individual (specific) WPDES permit and fact sheet, which reference the appropriate sections of the attached groundwater evaluation. The groundwater evaluation for the facility should elaborate on the changes in PALs and ACLs, how they were calculated and any other information of note. It is not necessary to document PALs and ESs if there are no modifications (exemptions) to NR 140.10 Table 1 and NR 140.12 Table 2, Wis. Adm. Code.



WISCONSIN DEPARTMENT OF NATURAL RESOURCES NOTICE OF FINAL GUIDANCE & CERTIFICATION

Pursuant to ch. 227, Wis. Stats., the Wisconsin Department of Natural Resources has finalized and hereby certifies the following guidance document.

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WY-20-0021

DOCUMENT TITLE

Evaluating and Calculating Preventative Action Limits and Alternative Concentration Limits for Groundwater

PROGRAM/BUREAU

Water Quality

STATUTORY AUTHORITY OR LEGAL CITATION

Chapter NR 140, Wis. Adm. Code.

DATE SENT TO LEGISLATIVE REFERENCE BUREAU (FOR PUBLIC COMMENTS)

04/02/2020

DATE FINALIZED

05/18/2020

DNR CERTIFICATION

I have reviewed this guidance document or proposed guidance document and I certify that it complies with sections 227.10 and 227.11 of the Wisconsin Statutes. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is not explicitly required or explicitly permitted by a statute or a rule that has been lawfully promulgated. I further certify that the guidance document or proposed guidance document contains no standard, requirement, or threshold that is more restrictive than a standard, requirement, or threshold contained in the Wisconsin Statutes.

Adrian Stocks

6/5/2020

Signature

Date