

Leak Detection Groundwater Monitoring Parameters

Purpose

- Provide guidance on monitoring parameters required for leak detection groundwater monitoring at liquid manure storage facilities
- Ensure that appropriate parameters are analyzed
- Ensure that the performance of manure storage facilities accurately assessed

Audience

- Consultants or contractors conducting leak detection groundwater monitoring activities at confined feeding operations
- Operators of confined feeding operations with permits that require leak detection groundwater monitoring

Relevant Legislation

- *Agricultural Operation Practices Act* and Standards and Administration Regulation

Introduction

The Standards and Administration Regulation of the *Agricultural Operation Practices Act* (AOPA) gives the Natural Resources Conservation Board (NRCB) discretion to require an operator of a confined feeding operation (CFO) to install and maintain a leak detection system at a manure storage facility. A leak detection system is intended to assess the performance of the storage facility by identifying leakage or seepage that may be occurring through the use of groundwater monitoring wells. AOPA requires the quality of groundwater from the monitoring wells to be monitored at regular intervals to detect contamination from the facility. The act, however, does not specify the physical, chemical and microbial parameters to be monitored, or the sampling intervals.

This guideline outlines the groundwater monitoring parameters that typically will be assessed if the permit issued to the CFO requires a leak detection system. It

also identifies the baseline and indicator parameters that are used to measure changes in groundwater quality. These parameters may be adjusted by the NRCB for site-specific situations, and may be altered to include additional or alternative requirements for groundwater or water well monitoring.

In these cases, the NRCB will outline the requirements and provide reasons in a written decision. To confirm the monitoring requirements for a specific operation, please contact the NRCB office nearest to the operation.

This guideline does not provide information about how to conduct hydrogeological assessments; how or where to construct, install and develop groundwater monitoring wells; or how to sample groundwater. Information on these topics is available in other technical guidelines. For more information, see the end of this technical guideline.

Monitoring

Leakage from earthen liquid manure storage facilities is typically detected by monitoring, changes in groundwater levels and groundwater chemistry. Groundwater quality conditions in the vicinity of a manure storage facility, measured before or soon after the facility is in operation, can provide an effective baseline reference for future comparisons.

Baseline groundwater conditions are affected by geologic and hydrogeological factors, as well as any number of other activities from human sources that have the potential to affect groundwater. Groundwater levels and chemistry can also vary seasonally. A comprehensive understanding of the baseline groundwater conditions at a site is required to interpret the results of sampling over time, and to distinguish the source of changes in the conditions.

Changes to groundwater quality and level are detected by sampling and measuring indicator parameters after the baseline conditions have been established. Indicator parameters include constituents that are commonly present in relatively high concentrations in manure, and in relatively low concentrations in natural or background groundwater. If elevated or abnormal levels of indicator parameters are discovered during indicator sampling, comparison to baseline conditions will indicate the possibility of leakage from the manure storage facility. If the results differ from the baseline conditions, further evaluation may be required to confirm possible leakage, which may include additional analysis for any or all of the baseline parameters and may be followed by requirements for further action.

Sampling

Baseline sampling should preferably occur in the spring and fall, or as directed by the NRCB.

For new construction, baseline sampling must be conducted twice in the first year following facility construction. At least one sampling event must be conducted before a new facility becomes operational.

Indicator sampling will typically be completed annually, during the same month each year, and preferably in a month consistent with the baseline sampling. The frequency and timing of groundwater sampling for indicator parameters may be altered at the discretion and direction of the NRCB.

Additional sampling for baseline parameters may be required if subsequent indicator sampling indicates the possibility of manure leakage.

Parameters

1. Baseline parameters

Baseline parameters include major ions, nutrients and other parameters commonly found in manure. These parameters provide a reasonably comprehensive picture of baseline groundwater conditions in the vicinity of a facility, and can be used in the future to compare samples and interpret changes. Baseline parameters do not include all possible groundwater parameters that could be used to detect manure constituents. They do provide for a reasonable understanding of the groundwater conditions at a site at the particular point in time that they are measured, and allow for the detection of potential manure leakage.

The baseline parameters are ammonium-nitrogen, chloride, nitrate-nitrogen, nitrite-nitrogen, potassium, total dissolved phosphorus, pH, electrical conductivity, groundwater level elevation, bicarbonate, calcium, dissolved organic carbon, magnesium, sodium, sulphate, total dissolved solids, an ion balance, and *Escherichia coli* (see Table 1).

2. Indicator parameters

The indicator parameters include ammonium-nitrogen, chloride, nitrate-nitrogen, nitrite-nitrogen, potassium, total dissolved phosphorus, pH, electrical conductivity, and groundwater elevation (See Table 1).

Laboratories commonly offer analytical packages that include many of the indicator parameters, as well as additional parameters not required as part of the indicator analysis. The packages are often less costly than analyzing each indicator parameter individually. Use of the packages is acceptable, provided that all required indicator parameters are analyzed and reported on.

Table 1. Baseline and indicator groundwater monitoring parameters for leak detection.

| Baseline parameter | Indicator parameter |
|---|---|
| Ammonium-nitrogen (NH ₄ ⁺ -N) | Ammonium-nitrogen (NH ₄ ⁺ -N) |
| Chloride (Cl ⁻) | Chloride (Cl ⁻) |
| Nitrate-nitrogen (NO ₃ ⁻ -N) | Nitrate-nitrogen (NO ₃ ⁻ -N) |
| Nitrite-nitrogen (NO ₂ ⁻ -N) | Nitrite-nitrogen (NO ₂ ⁻ -N) |
| Potassium (K ⁺) | Potassium (K ⁺) |
| Total dissolved phosphorus (TDP) | Total dissolved phosphorus (TDP) |
| pH | pH |
| Electrical conductivity (EC) | Electrical conductivity (EC) |
| Groundwater level elevation | Groundwater level elevation |
| Bicarbonate (HCO ₃ ⁻) | |
| Calcium (Ca ²⁺) | |
| Dissolved organic carbon (DOC) | |
| Magnesium (Mg ²⁺) | |
| Sodium (Na ⁺) | |
| Sulphate (SO ₄ ²⁻) | |
| Total dissolved solids (TDS) | |
| Ion balance | |
| <i>Escherichia coli</i> (<i>E. coli</i>) | |

Assessment and analysis

All groundwater sample analysis must be performed by a laboratory that is accredited by the Canadian Association for Laboratory Accreditation (CALA). In addition, a suitably qualified and experienced third-party professional must be responsible for assessing the data.

Reporting

Leak detection groundwater monitoring reports must be submitted to the NRCB. Reports should consist of an overview of the CFO and the manure storage facility being monitored (for example land location, livestock numbers, date constructed), and a history of activities and assessments at the site. A description of the groundwater monitoring wells and locations should also be provided (including a site diagram), as well as a description of the sampling techniques and protocol followed for collection of the groundwater samples. Groundwater sample data and interpretations should be included as a summary of findings and should be compared to historical values. The report should also include any recommendations for future activities, and any follow up action required. The certificate of analysis from the laboratory should be attached to each report. The NRCB may require additional information as part of the monitoring report, depending on the results in the report and site specific conditions and requirements.

A checklist for report is provided below.

Report checklist

- overview of the CFO and the manure storage facility being monitored
- history of activities and assessments at the site
- description of the groundwater monitoring wells and locations (including a site diagram)
- description of the sampling techniques and protocol
- groundwater sample data and interpretations
 - summary of findings compared to historical values
- recommendations for future activities and follow up action required
- certificate of analysis from the laboratory
- any additional information required from the NRCB

For more information

Contact your nearest NRCB field office or an AF extension specialist (dial 310-0000 to be connected toll free)

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