

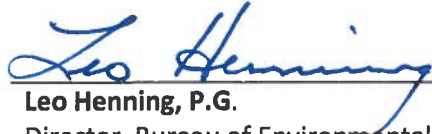
# Considerations for Groundwater Potability and Use Determinations



**BER Policy # BER-RS-045**

**April 2016**

## Concurrence



---

**Leo Henning, P.G.**  
Director, Bureau of Environmental  
Remediation

4-11-16

---

Date



---

**Chris Carey, P.G.**  
Remedial Section Chief

4/8/16

---

Date



---

**Bob Jurgens**  
Assessment and Restoration Section Chief

4/11/16

---

Date



---

**Randy Carlson, P.G.**  
Storage Tanks Section Chief

4/11/16

---

Date

## Table of Contents

|  |    |
|--|----|
| Acronyms and Abbreviations .....                                     | 4  |
| 1. Introduction and Purpose .....                                    | 6  |
| 2. Threshold Screening and Considerations .....                      | 6  |
| 3. Evaluation Process.....   | 8  |
| 3.1. Groundwater Quantity .....                                      | 8  |
| 3.2. Groundwater Quality.....  | 10 |
| 4. Groundwater Potability and Use Determination Implementation ..... | 11 |
| 5. Groundwater Potability Determination Report.....                  | 11 |
| 6. Long-Term Management.....   | 11 |
| 7. References.....   | 12 |

## Acronyms and Abbreviations

|      |   |
|------|---|
| BER  | Bureau of Environmental Remediation             |
| HPT  | Geoprobe Systems® Hydraulic Profiling Tool      |
| KDHE | Kansas Department of Health and Environment     |
| MCL  | Maximum Contaminant Level                       |
| mg/L | milligram per liter                             |
| RSK  | KDHE Risk-based Standards for Kansas RSK Manual |
| SMCL | Secondary Maximum Contaminant Level             |
| SOP  | Standard Operating Procedure                    |
| TDS  | Total Dissolved Solids                          |

## Glossary

**Aquifer** – An underground geologic formation that contains and is capable of transmitting or yielding water in sufficient quantities that can be extracted for beneficial purposes.

**Groundwater** – Subsurface water in the zone of saturation including water that does or can supply wells, springs, or seeps, or that is held in aquifers or the soil profile.

**Implementing Party** – The party involved with a contaminated site and responsible for cleanup.

**Licensed Professional** – For the purposes of this policy, an individual licensed by and in good standing with the Kansas Board of Technical Professions to practice geology with specific expertise in aquifer characterization. The Board maintains a database of licensed professionals available online at <https://www.ksbtp.ks.gov/>.

**Maximum Contaminant Levels** – The maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

**Potable Water** – Water suitable for drinking and cooking purposes in terms of both human health and aesthetic considerations.

**Receptor** – Human or environmental end receiver impacted by contaminated soils, groundwater, or surface water.

**RSK Manual** – The Risk-Based Standards for Kansas Manual 5<sup>th</sup> Version (October 2010, Revised September 2015) and any subsequent updates. The Manual provides guidance and calculated screening levels for specific contaminants.

**Secondary Maximum Contaminant Levels** – Standards that regulate contaminant levels based on aesthetics such as color and odor, but may not pose a risk.

**Vapor Intrusion** – The migration of volatile contaminants from the subsurface into overlying and/or adjacent buildings.

## 1. Introduction and Purpose

In Kansas, all groundwater is considered to be a potential source of potable water; that is, water that is acceptable for household purposes (e.g., drinking, cooking, bathing, etc.) in terms of both human health and aesthetic considerations.

In some cases, groundwater may not qualify as potable, which may warrant adjustments to site-specific remedial action objectives at a site/contaminated property located above such groundwater. This policy provides a framework for the Kansas Department of Health and Environment, Bureau of Environmental Remediation (KDHE-BER) to evaluate groundwater potability by outlining:

- the set of threshold criteria under which KDHE will consider an aquifer to be non-potable;
- the data and information necessary to evaluate potability; and,
- considerations for long-term management of aquifers that are deemed non-potable.

The potability evaluation process is intended to proceed concurrently with site investigation and/or remedial alternative evaluations conducted under state cleanup programs. Collecting data in order to support a potability determination should be considered when planning site investigation activities (i.e., development of the investigation work plan). Potability evaluations are not required at all sites. The potential value of a potability evaluation in selecting a remedial strategy should be considered very early in the process to make sure the analysis will add value to the project based on site-specific conditions; however, a potability evaluation can be proposed at any time in the investigation or cleanup process.

Groundwater cleanup and/or screening levels are typically based on the most beneficial past, present, and potential future use of the groundwater. Kansas considers drinking water to be the most beneficial use of groundwater due to the reliance on groundwater for public and private water supplies. Cleanup standards for potable aquifers are the federally promulgated Maximum Contaminant Levels (MCLs). In some areas, naturally occurring chemicals may exceed the Secondary MCLs (SMCLs). Although in most cases water that exceeds SMCLs does not pose a risk to human health, it can be an unpalatable or a nuisance to water users; therefore, SMCLs are considered essential to protection of public welfare. For constituents where federal MCLs and SMCLs have not been established, Risk-based Standards for Kansas (RSK) or site-specific levels established through risk assessment may apply as the screening or cleanup levels.

KDHE-BER may determine groundwater is non-potable due to natural conditions such as quality or quantity characteristics, or where the applicable exposure pathways are considered incomplete. In such cases it is critical to establish an appropriate long-term management program to facilitate site closure while protecting human health and the environment. Institutional controls or municipal ordinances that restrict or limit groundwater use may be components of site-specific remedial strategies. A groundwater use restriction in place does not imply that an aquifer is non-potable. Whether an aquifer is potable or not is based strictly on the groundwater quality and/or ability to extract groundwater for potable purposes as described herein.

## 2. Threshold Screening and Considerations

Potability Threshold Screening determines whether a Potability Evaluation is warranted. The

Threshold Screening should be completed as early in the investigation process as possible to prevent potential delays during evaluation of cleanup alternatives. The threshold criteria discussed below are applicable to both local and regional hydrogeology under current and future use of an aquifer, independent of the quality or quantity criteria specified herein.

The following threshold criteria must be evaluated before proceeding to a potability evaluation:

- identification of potential users;
- a general understanding of the nature, extent, and magnitude of contamination associated with a site/contaminated property;
- underlying groundwater bearing zones;
- exposure routes; and
- interactions between groundwater and surface waters.

#### *Identification of Potential Users*

Historical, current, or future use of groundwater as a source of potable water constitutes *use* under this policy. Groundwater that was or is used for household purposes is considered potable, notwithstanding the quantity or quality of the water produced. Potential or actual groundwater users must be identified and documented through a receptor survey such as the one outlined in BER-RS-056 - *Considerations for Performing Water Well Surveys near Contaminated Sites*<sup>1</sup>. In addition, other uses of groundwater in the site vicinity must be documented (e.g., lawn and garden) and evaluated with respect to current and future risk.

#### *General Understanding of the Nature, Extent, and Magnitude of Contamination*

Site characterization activities are performed in accordance with the relevant state program guidance (e.g., Voluntary Cleanup Investigation, Comprehensive Investigation, etc.). For the purposes of this policy, the nature, extent and magnitude of contamination must be understood to the extent necessary to define the areal extent of the area subject to the groundwater potability determination. Current and future risks to human and ecological receptors should be evaluated by identifying the current receptors, the proposed future uses of a contaminated property and surrounding properties, and the potential for contaminant migration to pose risk to receptors or adversely impact other waters of the State. For example, fate and transport mechanisms such as bioaccumulation, biomagnification, or contaminant migration may make a site ineligible for further consideration of potability.

#### *Groundwater Bearing Zones*

All groundwater-bearing zones that could reasonably be affected by site-related contamination and can practically be evaluated must be evaluated to determine their beneficial use. A non-potable groundwater-bearing zone may impact adjacent potable zones. Downward migration of groundwater or contaminants may affect underlying groundwater-bearing zones. Alternatively, confining or semi-confining conditions may allow a deep aquifer to impact shallow or perched zones. Data collected during the investigation phase must definitively demonstrate that the aquifer being evaluated is isolated and not in communication with any other water-bearing zones. The

---

<sup>1</sup> [BER-RS-056 - Considerations for Performing Water Well Surveys near Contaminated Sites](#)

Threshold Screening must consider geologic and hydrogeologic factors and the determination must be signed, stamped, and sealed by a Professional Geologist licensed by the Board to practice in the State of Kansas.

### *Exposure Routes*

All potential exposure routes, such as indoor air via the vapor intrusion pathway must be considered. RSK levels for groundwater and/or soil to groundwater protection (or alternate treatment goals) apply even to non-potable groundwater if there is a secondary pathway which could allow or enhance contaminant migration from groundwater to other media.

### *Surface Water and Sediment*

Contaminant migration due to potential groundwater interactions with surface water (such as through seeps, springs, etc.) and sediment must be evaluated. Surface water quality standards as defined by K.A.R. 28-16-28b through K.A.R. 28-16-28f apply where contaminated groundwater may interact with surface water. KDHE's Sediment Policy may also apply depending on site conditions.

## **3. Evaluation Process**

After KDHE receives sufficient documentation that the Threshold Screening criteria have been met, the next step is to submit a Potability Evaluation Work Plan for KDHE's review and approval. The Work Plan may be submitted at any time in the investigation or cleanup process; however, this work is typically performed prior to KDHE's issuance of a decision document (e.g. Corrective Action Decision, Agency Decision Statement, Voluntary Cleanup Plan, or equivalent). The Work Plan may be combined with another deliverable if approved by KDHE.

The required information to begin the evaluation process includes, but is not limited to:

- the depth to groundwater;
- the saturated aquifer thickness for the aquifer(s) being evaluated;
- seasonal trends (e.g., water elevation, concentration, etc.);
- groundwater flow direction; and
- well construction and development for wells to be evaluated (if applicable).

Work Plan components may vary based on overall site-specific objectives, but will generally be consistent with State and Federal guidance, policies, and standard operating procedures. Upfront communication and coordination between the Implementing Party and KDHE will ensure that the Work Plan objectives are efficiently and effectively met. An example Potability Work Plan outline is provided in the Appendices.

The following sections describe conditions that may be considered when making the determination that groundwater is not suitable for potable use.

### **3.1. Groundwater Quantity**

There may not be enough water in the identified groundwater bearing zone for potable use.



National domestic per capita use is approximately 100 gallons of water per day<sup>2</sup>. Kansas estimates for domestic wells are 99 gallons per person per day according to *Estimated Use of Water in the United States 2010*<sup>3</sup>. Pumping tests are recommended for evaluating aquifer yield. Slug tests, while applicable under some circumstances, generally produce lower hydraulic conductivity results than pump tests due to vertical anisotropy, incomplete well development, and well design<sup>4</sup>.

The following may be considered when determining insufficient groundwater quantity for potable use.

- Using the Geoprobe Systems® Hydraulic Profiling Tool (HPT)<sup>™</sup> or equivalent to demonstrate beyond a reasonable doubt that the permeability of the unconsolidated formation is not capable of sustaining well yield greater than 100 gallons per day from a minimum of three locations (based on the saturated thickness of the aquifer subject to the potability evaluation). HPT operation must be conducted in accord with Geoprobe Systems® Standard Operating Procedure (SOP)<sup>5</sup> and with *Application of the Geoprobe® HPT Logging System for Geo-Environmental Investigations*<sup>6</sup> or other KDHE-approved procedure developed by a Kansas-Licensed Professional. If the HPT field data (e.g., electrical conductivity, flow rate, pressure, etc.) suggests geologic or hydraulic zone(s) capable of sustained yields of more than 100 gallons per day, additional efforts will be necessary to further investigate those zone(s) of interest.
- A constant-rate aquifer pumping test, based on the use of appropriate hydrogeologic equations accounting for aquifer condition (confined or unconfined) and saturated thickness, demonstrates the groundwater-bearing unit has a sustainable well yield less than 100 gallons per day. These equations must be applicable to the site-specific hydrogeologic conditions being evaluated. Aquifer pumping tests shall be conducted in a manner generally consistent to KDHE-BER SOPs BER-09 *Conducting a Step-Drawdown Test*, and/or BER-10 *Conducting a Constant-Rate Aquifer Test and Recovery Test*<sup>7</sup>.
- A constant-rate aquifer pumping test or step-drawdown test demonstrates that saturated soils and geologic material are not capable of recharging a well back to pre-pumping static within three times the active pumping duration and the boundaries of the water-bearing zone are determined to be localized and not continuous.
- The average of no less than three site-specific slug tests from each relevant groundwater-bearing unit demonstrate a hydraulic conductivity less than 0.1 feet per day (ft/day). Given the potential low bias of slug testing, all resulting hydraulic conductivity estimates must be multiplied by a safety factor of two for use under this policy. Slug test locations should be selected to provide information on spatial variations in hydraulic conductivity in the aquifer(s) being assessed. A reasonable estimate of the aquifer thickness must be ascertained and evaluated within the context of the slug test.

---

<sup>2</sup> <http://water.usgs.gov/edu/qa-home-percapita.html>

<sup>3</sup> <http://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf>

<sup>4</sup> <https://info.ngwa.org/GWOL/pdf/981063527.PDF>

<sup>5</sup> <http://geoprobe.com/literature/hpt-sop>

<sup>6</sup> <http://geoprobe.com/literature/mk3184-application-of-hpt-for-geo-environmental-investigations>

<sup>7</sup> [http://www.kdheks.gov/environment/qmp/download/BER\\_SOPs\\_Appendix\\_A.pdf](http://www.kdheks.gov/environment/qmp/download/BER_SOPs_Appendix_A.pdf)

- Other applicable methods: In special cases, where the methods described above are not applicable or practical, aquifer properties (hydraulic conductivity, transmissivity, specific yield or storativity, and well yield) may be estimated based on a combination of factors including but not limited to, published references, field observations, soil boring methods (direct push and/or Shelby tubes), permeability tests, and/or grain-size analysis. Multiple lines of evidence will be necessary to support the evaluation. Use of soil borings will require three or more spatially distributed samples that represent the entire saturated thickness. Any such methods must be approved by a Kansas Licensed Professional.

Due to the complex nature of many groundwater systems, KDHE-BER may require multiple lines of evidence and long term data to support a potability evaluation. If HPT testing, aquifer pumping test(s), or slug tests are not proposed, the Work Plan must provide a justification to exclude these tests.

It is important to consider long-term trends, rather than short-term fluctuations due to drought or wet conditions. All determinations regarding quantity must be made by a Kansas Licensed Professional and be properly documented.

### **3.2. Groundwater Quality**

Groundwater may be considered non-potable where naturally occurring levels of a constituent causes the groundwater to be unfit to drink or no practical treatment is available. For the purposes of this policy, potability is based on the natural, untreated state of groundwater. A groundwater quality evaluation must include sample results from multiple locations and effectively evaluate natural background conditions relative to the site. In some cases, multiple sampling events over a pre-determined time period may be necessary to support this determination. BER will base a groundwater quality determination on chemical concentrations and available technical information including SMCLs.

BER may determine that groundwater is non-potable if Total Dissolved Solids (TDS) concentrations from a natural source are greater than 10,000 milligrams per liter (mg/L). BER will consider TDS contributions from man-made sources, and may request this data from the Implementing Party.

Note: The TDS concentration is the sum of the cations (positively charged ions) and anions (negatively charged ions) in the water. Cations usually include calcium, magnesium, sodium, and potassium; and anions usually include carbonate, bicarbonate, chloride, and sulfate. Chloride and nitrate may come from man-made sources. The SMCL for TDS is 500 mg/L. Drinking water with TDS levels of 900 to 1,200 mg/L may be unpalatable, and levels greater than 1,200 mg/L are unacceptable. At concentrations less than 10,000 mg/L it is reasonable to assume that groundwater could be treated with readily available technology or methods to become a potable water source (EPA 1988). An elevated TDS concentration does not mean that the water is a health hazard, but it does mean the water may have aesthetic problems or cause a nuisance.

KDHE may consider other factors beyond the scope of this policy in evaluating groundwater quality. All such determinations must be approved by a Kansas-Licensed Professional.

#### **4. Groundwater Potability and Use Determination Implementation**

The Potability Evaluation Work Plan must be approved by KDHE prior to implementation. The Implementing Party must complete an online “Field Activities Notification Form” at least seven days before beginning work. The form is available on KDHE’s website at: [http://www.kdheks.gov/remedial/fieldactivities\\_notification.html](http://www.kdheks.gov/remedial/fieldactivities_notification.html).

#### **5. Groundwater Potability Determination Report**

Groundwater potability determinations must be supported by a comprehensive evaluation of current and historical site data. A Groundwater Potability Determination Report shall generally include the following components:

- Site Background – a summary of site history, location, ownership, and operations, including any known or suspected releases.
- Investigation Summary – a summary of past investigation activities and results including the nature and extent of contamination, migration pathways, and known or potential human health or ecological risks.
- Remediation and/or Risk Management – a discussion of any controls, remedial measures, and/or remedial actions taken to address environmental impacts or eliminate exposure pathways.
- Current Site Data and Justification/Considerations for Groundwater Potability Determination – a summary of the aquifer characteristics including but not limited to average hydraulic conductivity and saturated thickness; well construction; uncertainty analysis and current site data in the context of the groundwater use and potability.
- Well logs, boring logs, and/or stratigraphic cross sections that comprehensively document geologic and hydrogeologic conditions.
- Maps that identify groundwater elevations, surface elevations, flow direction(s), saturated thickness, surface water features, etc.
- The Groundwater Potability Determination Report shall be prepared and evaluated in accordance with all applicable statutes and regulations. All final potability determinations shall be signed, stamped, and sealed by a Kansas Licensed Professional. KDHE will notify the Implementing Party in writing whether it concurs with the Groundwater Potability Determination.

The Groundwater Potability Determination Report may be incorporated into another deliverable as approved by KDHE (e.g., Comprehensive Investigation Report, Voluntary Cleanup Investigation Report, Phase II Environmental Site Assessment, or equivalent).

#### **6. Long-Term Management**

The results of the potability evaluation will likely play a role in selecting the site remedial action

objectives and the overall proposed path for long-term site management. If groundwater is determined to have no potable use, program-specific criteria may allow the site to be resolved. In other cases, based on site conditions or anticipated future groundwater use, long-term monitoring, risk-management, Environmental Use Controls, and/or other response actions may be necessary components of the selected remedial strategy.

## 7. References

Kansas Board of Technical Professions. Enterprise Professional License Verification. Available online at [http://licensing.ks.gov/Verification\\_KBTP/](http://licensing.ks.gov/Verification_KBTP/)

Kansas Department of Health and Environment, Bureau of Environmental Remediation. 2010. Risk-based Standards for Kansas Manual. Available online at [http://www.kdheks.gov/remedial/rsk\\_manual\\_page.html](http://www.kdheks.gov/remedial/rsk_manual_page.html)

Kansas Department of Health and Environment, Bureau of Environmental Remediation. 2014. BER-RS-056—*Considerations for Performing Water Well Surveys near Contaminated Sites*. Available online at [http://www.kdheks.gov/ber/policies/BER\\_RS\\_056.pdf](http://www.kdheks.gov/ber/policies/BER_RS_056.pdf)

Kansas Administrative Regulations 28-16-28b through 28-16-28f. March 5, 2015. *Kansas Register* Vol. 34, No. 10, p 190. Available online at [https://www.kssos.org/pubs/register%5C2015%5CVol\\_34\\_No\\_10\\_March\\_5\\_2015\\_pages\\_181-204.pdf](https://www.kssos.org/pubs/register%5C2015%5CVol_34_No_10_March_5_2015_pages_181-204.pdf)

United States Geological Survey. Water Questions and Answers. Available online at <http://water.usgs.gov/edu/qa-home-percapita.html>

United States Geological Survey. Circular 1405, *Estimated Use of Water in the United States in 2010*. Available online at <http://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf>

Butler, J. J., and Healey, J. M. 1998. Relationship Between Pumping-Test and Slug-Test Parameters; Scale Effect or Artifact? *Ground Water*, Vol 36 No 2, p 305. Available online at <http://info.ngwa.org/GWOL/pdf/981063527.PDF>

Kjer, Inc. January 2015. Geoprobe Hydraulic Profiling Tool (HPT) System Standard Operating Procedure. Available online at <http://geoprobe.com/literature/hpt-sop>

McCall, W. February 2011. Application of the Geoprobe HPT Logging System for Geo-Environmental Investigations. Available online at <http://geoprobe.com/literature/mk3184-application-of-hpt-for-geo-environmental-investigations>

Kansas Department of Health and Environment, Bureau of Environmental Remediation. Bureau of Environmental Standard Operating Procedures. Available online at [http://www.kdheks.gov/environment/qmp/download/BER\\_SOPs\\_Appendix\\_A.pdf](http://www.kdheks.gov/environment/qmp/download/BER_SOPs_Appendix_A.pdf)

U.S. Environmental Protection Agency. June 1988. *Guidelines for Ground-Water Classification Under the EPA Ground-Water Protection Strategy*. U.S. Environmental Protection Agency, Office of Groundwater Protection, Washington DC. Available online from <http://www.epa.gov/nscep>

MDEQ, 1997, *Criteria to Eliminate the Potable Groundwater Pathway*, Operational Memorandum No. 11, Michigan Department of Environmental Quality, Lansing, MI, August 25.