

# **Contaminated Groundwater and Surface Water Intersection**

**Bureau of Environmental Remediation**

**Policy # BER-049**





Contaminated Groundwater and Surface Water Intersection

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## Contaminated Groundwater and Surface Water Intersection

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## Contaminated Groundwater and Surface Water Intersection

### Acronyms and Abbreviations

7Q10 Flow	The seven-day average low flow of a stream segment having a recurrence frequency of once in 10 years, as statistically determined from historical flow data
BER	Bureau of Environmental Remediation
BOW	Bureau of Water
COC	Chemical of Concern
CSM	Conceptual Site Model
HUC8	Eight Digit Hydrologic Unit Code
KDHE	Kansas Department of Health and Environment
KSWQS	Kansas Surface Water Quality Standards
NPDES	National Pollutant Discharge Elimination System
SOW	Scope of Work

## **1. Introduction**

Contaminated groundwater plumes sometimes discharge into a surface water body such as a river or stream. An analysis of the volume and flow of water in the stream mixed with the incoming groundwater contamination may determine there is no harmful effect to the surface water body. This document provides guidance and parameters for making such a determination.

It is not the intent of this policy to allow plumes to migrate until they reach a surface water body; nor is it to allow facilities located adjacent to surface water bodies avoid cleanup simply because their releases immediately reach surface water. Sources of contamination must be remediated in concert with this policy. Contaminated groundwater plumes that are expanding will remain a target of remedial measures, as well as those that affect human receptors (e.g. drinking water wells).

The contaminated groundwater plumes considered under this policy are those that have already migrated to a surface water body. The procedures in the policy shall be used to ensure that the contaminated groundwater plume causes no harmful effect to the designated uses of the surface water body, including aquatic life. The surface water bodies considered in this policy will be limited to rivers, streams, and creeks (hereinafter, jointly referred to as “streams”). Other types of surface water bodies, such as recreational ponds, lakes, wetlands, or intermittent streams, may be evaluated under site-specific conditions of risk to receptors at those sites.

## **2. Information about the contaminated groundwater plume and the stream**

The following documents shall be submitted to KDHE for its consideration under this policy: an investigation report; aquifer modeling, if undertaken; a Conceptual Site Model (CSM); a groundwater monitoring network plan; and a Water Quality Review Form. These documents shall be submitted concurrently, unless one or more has previously been submitted per the requirements of the applicable oversight program.

For a contaminated groundwater plume to be considered under this policy, an investigation of the plume and the stream must be performed pursuant to the applicable investigation scope of work (SOW) for the applicable Bureau of Environmental Remediation (BER) program (State Cooperative Program, Voluntary Cleanup and Property Redevelopment Program, etc.). The

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investigation should define the nature and extent of the contamination through soil and groundwater sampling, and consider groundwater flow and contaminant fate and transport in the groundwater plume. The investigation must identify the width and depth of the plume intersecting the stream and verify that the plume is not migrating under the stream to the other side.

The contaminants and their concentrations in the groundwater plume must be characterized to predict whether discharge of the plume into the stream will cause exceedance of the Kansas Surface Water Quality Standards (“KSWQS”). Basic parameters such as plume volume, rate of travel, and contaminant characteristics and toxicity are needed to predict the effects of the plume on the stream.

Aquifer modeling in accordance with KDHE/BER policy BER-RS-07 can supplement data collection and estimate the volume of groundwater contamination affecting the stream. Models do not replace field investigations, but can be useful for providing boundaries for actual conditions. Field conditions and field data must be collected to verify the model predictions.

A CSM developed from data collected in the investigation provides the basis for predicting the effects of the contaminated groundwater plume on the stream. Monitoring points for groundwater and the stream can then be established to verify the expected effect, or lack thereof, on the stream water quality.

A groundwater monitoring network should be developed to characterize and monitor plume migration and described in a groundwater monitoring network plan. The required elements of this plan are discussed in more detail below.

Use the Water Quality Review Form (Attachment 1) to document basic information for the receiving stream. The information should be based on and conform to the stream identification conventions of the Kansas Surface Water Register. The KDHE Bureau of Water (BOW) uses an 8-digit Hydrologic Unit Code (HUC8) denoting the location and size of the watershed and used as the index for records of the receiving stream network. These records include the stream name, the stream segment number, its state-designated uses, and the presence of sensitive and endangered species. If the receiving stream is an unclassified stream that is not listed in the Kansas Surface

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Water Register, note this on the form and provide the information for the first downstream classified stream in the watershed.

After BER receives a proposal to evaluate a discharge of impacted groundwater to a stream, BOW will identify existing surface water quality impairments, Clean Water Act Section 303(d) listings, Total Maximum Daily Loads, and critical low flow values for the receiving stream. KDHE will determine whether this policy is applicable to the site if there is a National Pollutant Discharge Elimination System (NPDES) permit for any facility associated with the contaminated groundwater plume. KDHE will additionally consider the location of surface water intakes for public use to make appropriate decisions regarding this policy.

### **3. Determining allowable contaminant concentrations**

KDHE will estimate the effects of a contaminated groundwater plume on a stream using calculations similar to those used for determining permitted discharges from municipal and industrial facilities. KDHE will not, however, issue a discharge permit for a contaminated groundwater plume unless otherwise required by the U.S. Environmental Protection Agency or NPDES permitting regulations.

For the stream, BOW will provide in-stream numeric surface water quality standards as a starting point. BER will set the In-stream Threshold concentrations at one-half of the most stringent KSWQS. General narrative surface water criteria shall also be met per K.A.R. 28-16-28e(b) (e.g. a sheen is not allowed).

For groundwater, BER will coordinate with BOW to develop chemical of concern (COC) thresholds that ensure compliance with the KSWQS. The potential effects of the plume on the stream will consider the 7Q10, as defined by K.A.R. 28-16-28b(fff) (a seven-day average low flow having a recurrence frequency of once in 10 years, as statistically determined from historical flow data). The COC thresholds for the contaminated groundwater plume (Groundwater Thresholds) will be derived using an equation that considers

1. the discharge flow of the contaminated groundwater,
2. the 7Q10 flow of the stream above the point of discharge,

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3. the portion of stream flow available for mixing with the groundwater, assumed to be 10 percent or less as determined by KDHE,
4. the background in-stream contaminant concentration, and
5. the in-stream numeric surface water quality standard for the COCs

### **4. Monitoring groundwater and confirmation sampling of the stream**

Sampling the contaminated groundwater plume is necessary to determine the potential to impair the designated uses of the stream. Sampling the stream is necessary to confirm whether concentrations in the stream exceed the In-stream Thresholds. A proposal for performance monitoring of groundwater and the stream must be submitted for KDHE approval. KDHE will review this proposal to ensure it includes installing wells to define the width of the plume where it intersects the stream; well screening that intercepts the depth where the COCs are most concentrated; and sampling groundwater and stream frequency.

Groundwater sampling should be conducted in accordance with SOP BER-01 and stream sampling with SOP BER-02. The stream should be sampled for the COCs identified in the groundwater plume and relevant water quality parameters as recommended by BOW. To account for uncertainty in plume distribution, sampling points may be needed at several locations in the stream relative to the location of the plume. Perform stream sampling at a minimum of three sampling locations: an upstream location to establish background, a location at or next to the potential impact area (in the zone of initial dilution, the region in the immediate vicinity of the groundwater interaction), and a location (a maximum of 300 meters) downstream of the potential impact area. Additional sampling locations may be required based on the sensitivity of the water body, the size and complexity of the plume, and other factors. Establish permanent sample collection locations to ensure comparable data collection during the scope of the project. Collect stream samples during low-flow conditions. Four (4) sampling events during low-flow conditions should be conducted during the first year of monitoring on a seasonal schedule. U.S. Geological Survey (USGS) stream gauging data (<https://waterdata.usgs.gov/ks/nwis/rt>) and rainfall records from the National Oceanographic and Atmosphere Administration (<https://www.climate.gov/maps-data/dataset/past-weather-zip-code-data-table>) are available to determine when low-flow conditions are most likely to occur. Monitoring requirements may be



modified based on site-specific conditions. Report all sampling results to BER, and provide USGS flow conditions, photographs of the stream conditions, and field notes for each sampling event. Reportable concentrations above the In-stream Thresholds or Groundwater Thresholds must be immediately called in to the BER project manager within one business day of receipt of sampling results. Collect duplicates for each sample to allow results confirmation without needing to remobilize.

### **5. Compliance points**

Compliance for groundwater will be based on the average concentration of COCs in the monitoring wells established within the plume where it intersects the stream. The compliance point for the stream will be site specific and determined in concert with BOW. The maximum compliance distance will be 300 meters downstream of the intersection of the plume and the stream.

### **6. Contingency plan**

Detections of COCs that exceed Groundwater Thresholds or In-stream Thresholds indicate the inflow of the contaminant plume has significant potential to cause a water quality impact and impairment to the designated uses of the stream. The responsible party must expediently implement active groundwater remediation to prevent further stream degradation. For any monitoring event, if the average concentration of a COC in the monitoring wells exceeds its Groundwater Threshold, or if a COC at the stream compliance point exceeds its In-stream Threshold, active remediation of the plume may be warranted. In either case, the Respondent shall submit a remedial measure design within 90 days of receipt of the sample results by the Respondent so that it can be implemented without delay. Remedial measures suitable for the contingency plan include pump and treat, cutoff trenching, injection up-gradient, or other strategies, and are subject to approval by KDHE. KDHE shall issue a schedule for implementation of the remedial measure design.

**REQUEST FOR BER GROUNDWATER/SURFACE WATER INTERACTION WATER QUALITY REVIEW**

**Instructions:** This form is to be completed by the BER representative submitting the certification review request or by their contractor.

Facility/Site:  City:  County:

BER Project Code:

Plume Description:

Ground Water Plume Flow (cfs):

Parameter(s) of Concern:

Parameter	Groundwater Concentration
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>

Source Area Treatment Process:

**RECEIVING STREAM INFORMATION**

Receiving Stream Network:

First Listed/Classified Stream in receiving stream network:  7Q10:  cfs

HUC8:  Segment:

Designated Uses (drop down list, click in field for list):

- 
- 
- 
- 
- 

Classification of Waterbody:

Endangered Species, if Present:

Potential Interaction Area	Latitude	Longitude	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

**NOTES and SPECIAL INSTRUCTIONS:**

Requested By:

Date:

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### Attachment 2: Calculation of Groundwater Thresholds

$$C_d = \frac{(C_r(Q_d + Q_s MZ) - (C_s(Q_s MZ)))}{Q_d}$$

Where:

$Q_d$  = plume discharge flow

$Q_s$  = 7Q10 stream flow above location of plume discharge

$Q_s MZ$  = stream flow available for mixing (10% of 7Q10)

$C_s$  = background in-stream COC concentration

$C_r$  = Kansas Surface Water Quality COC standard

$C_d$  = Groundwater Threshold

## References

BER-RS-007: Minimum Standards for Model Use, Bureau of Environmental Remediation, Kansas Department of Health and Environment. December 14, 2005

<https://www.kdhe.ks.gov/DocumentCenter/View/300/BER-RS-007-Minimum-Standards-for-Model-Use-PDF>

Kansas Surface Water Quality Standards, Tables of Numeric Criteria, Bureau of Water, Kansas Department of Health and Environment. January 21, 2015.

<https://www.kdhe.ks.gov/DocumentCenter/View/13295>

Risk-based Standards for Kansas, RSK Manual, 5<sup>th</sup> Version, Bureau of Environmental Remediation, Kansas Department of Health and Environment. October 2010.

SOP BER-01: Collection of Groundwater Samples at Known or Suspected Groundwater Contamination Sites. Bureau of Environmental Remediation, Kansas Department of Health and Environment. <https://www.kdhe.ks.gov/DocumentCenter/View/14368/Appendix-A---Standard-Operating-Procedures-PDF>.

SOP BER-02 Collection of Surface Water Samples at Suspected or Known Contaminated Sites. Bureau of Environmental Remediation, Kansas Department of Health and Environment.

<https://www.kdhe.ks.gov/DocumentCenter/View/14368/Appendix-A---Standard-Operating-Procedures-PDF>