BUREAU OF ENVIRONMENTAL REMEDIATION/REMEDIAL SECTION
POLICY and SCOPE OF WORK

REMEDIATING SOIL FROM AGRICULTURAL CHEMICAL INCIDENTS BY EXCAVATION AND LAND APPLICATION INTERIM MEASURES

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BUREAU OF ENVIRONMENTAL REMEDIATION/REMEDIAL SECTION POLICY

REMEDIATING SOIL FROM AGRICULTURAL CHEMICAL INCIDENTS BY EXCAVATION AND LAND APPLICATION

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1.0 INTRODUCTION

Soil at facilities where agricultural chemicals are manufactured, stored, or sold may become contaminated due to accidental catastrophic releases or incremental releases over years of operation. This is especially true of nitrogen fertilizer that may be sold as dry pellets, aqueous solutions or anhydrous ammonia. Once in soil, the nitrogen from fertilizer may remain for long periods of time as nitrate or ammonium, subsequently releasing nitrate to the underlying ground water. Excessive nitrogen in soil or water is detrimental to human health and the environment and is considered a contaminant.

The Kansas Department of Health and Environment (KDHE) has established 10.0 mg/l nitrate plus ammonia nitrogen (N) as the maximum permissible level in drinking water for the human population and 40.0 mg/kg nitrate plus ammonia nitrogen (N) below 8 inches of soil in unvegetated areas and below 24 inches of soil in vegetated areas. Nitrogen fertilizer is present in soil and water as nitrate and ammonium. Analytical procedures convert ammonium to ammonia. By convention, the levels of both nitrate and ammonia are reported as nitrogen (N).

The KDHE/Bureau of Environmental Remediation (KDHE/BER) has gained experience with sites contaminated with nitrate and ammonium and has learned that certain approaches and technologies are more effective, expedient, and less costly than others for a particular contaminant and situation. A presumptive remedy is a preferred technology or cleanup process for a common category of contamination.

The threat of continuing contamination of ground water resources by nitrate leaching from contaminated soil at agricultural facilities leads KDHE to encourage use of the presumptive remedy of soil removal from such facilities as early in the cleanup process as possible. In KDHE's experience, the most satisfactory and cost-effective remedy for soil contaminated by fertilizer is excavation and application of the contaminated soil at agricultural rates to crop or grassland for a beneficial use. The advantages of using a presumptive remedy for nitrate contamination in soil instead of following the conventional remedial action selection process include:

- Saves time and money;
- Promotes consistency in the remedial action selection;
- Improves the predictability of the remedial action selection process;
- Encourages the reuse of nitrate for its originally intended beneficial purpose.

2.0 POLICY DEFINITION

This policy was developed based on past KDHE recommendations and suggested procedures from investigating and remediating fertilizer contaminated soil at agricultural facilities and at other release sites of agricultural fertilizer across the state. The policy incorporates the experiences learned at numerous completed excavated and land application sites. This policy provides guidance for the most efficient collection of necessary data, excavation techniques, backfilling requirements, and completion of the necessary documentation for land application.

There are two requirements that must be met before KDHE will consider a request for use of the presumptive remedy for soil contaminated by nitrate and ammonia.

- The contaminated site or facility must have been accepted into a KDHE environmental program to address the contamination under KDHE oversight prior to utilization of this policy.

- Alternative water supplies must be provided as necessary where drinking water wells are impacted or threatened.

Excavation and land application may be carried out as an "Interim Measure," with KDHE approval, immediately after the delineation of soil contamination during a KDHE approved investigation, or as part of a KDHE-approved Corrective Action Plan or Voluntary Cleanup Plan. Early removal of soil contaminated by nitrogen is encouraged to reduce impact to ground water. Costs associated with implementing a KDHE-approved presumptive remedy at qualifying agricultural service facilities may be partly reimbursable from the Kansas Agricultural Remediation Board (KARB) Reimbursement Program (http://www.karb.org).

This policy is an expansion of the document titled, "Scope of Work for a Nitrate Presumptive Remedy Plan," prepared by KDHE in August 2003. KDHE has also developed in coordination with the Kansas Department of Agriculture, a general guidance for land application including forms to be completed for each property where land application of nitrate and ammonia contaminated soil will take place (http://www.kdheks.gov/remedial/landapp/index_landapp.htm). This policy also references BER Policy #BER-RS-12 (revised in 2003) and the Risk-based Standards for Kansas (RSK) Manual which establishes the cleanup standards for nitrate and ammonia in soil and ground water (http://www.kdheks.gov/ber/policies.htm).

3.0 SCOPE OF WORK FOR IMPLEMENTING A PRESUMPTIVE REMEDY

The following Scope of Work contains general guidance for implementing the presumptive remedy for contamination by nitrate and ammonia in soil based on KDHE's experience at properties where the presumptive remedy has been applied. KDHE intends to update this guidance as additional experience is obtained.

3.1 Initial Site Investigation Work Plan and Report

A work plan for the initial site investigation, including a quality assurance project plan must be submitted to the KDHE Project Manager and approved before the investigation is implemented. General guidance and program-specific scopes of work for preparation of site investigation work plans and reports should be obtained from the program responsible for providing site oversight. Sections 3.1.1 through 3.1.5 discuss some special considerations that may be applicable to the initial investigation at sites where a presumptive remedy is proposed.

3.1.1 Density of Soil Borings

Work plans developed for the investigation of sites where soil contamination by nitrate and/or ammonia is known or suspected should be prepared and implemented by qualified environmental consultants. The work plan must be drafted to provide sufficient detail to fully delineate the areal and vertical extent of soil contamination, and the amount of soil (volume) requiring excavation. If delineation is not accomplished during the initial investigation, then additional investigations will likely be required.

KDHE believes that continuous coring using direct push equipment works well in most soils and will provide a sufficient amount of soil information to determine excavation size and depth. Borings can be placed in a grid to sufficiently cover the area of concern. Boring spacing should be determined by the potential size of the area of concern and will likely be adjusted in the field. Borings should be collected to 15 or 20-foot depth (or to the water table) and sampled at a minimum of every 5 foot in depth. It may be advantageous to collect samples on closer horizontal or vertical spacing to limit the excavation size and depth. Nitrate levels in soil can be field screened using readily available field kits and confirmed by laboratory analysis at a minimum rate of 20 percent. Use of field screening can help determine the lateral and vertical limits of nitrate contamination at the site during the investigation and guide the collection of additional data points as needed during the investigation.

3.1.2 Soil Sampling Considerations

Field kits for on-site analysis of nitrate in soil are commercially available. They generally require extracting nitrate from a specified weight of soil by use of a potassium chloride solution or deionized water and testing of the extract with colorimetric test strips or other appropriate method. The extract may need to be filtered prior to nitrate determination. Consultants should choose the field kit most suitable to their needs and develop a standard operating procedure (SOP) for field analysis including laboratory confirmation and correlation. Actual field analyses utilizing a specific kit or sampling technique should be thoroughly calibrated by laboratory analyses before finalizing the SOP.

KDHE/BER has determined that composite sampling of soil may produce adequate results for nitrate-contaminated soil. A sample interval from a core or

several grab samples from an excavation face can be placed in a plastic bag and thoroughly mixed before the specified weight of sample is removed for field analysis or the laboratory sample is taken. This technique allows for an average nitrogen level of a volume of soil to be determined. Analyzing soil samples for ammonia in addition to nitrate is important since the nitrate converted from ammonium is also leaching to ground water. Composite sampling may also be necessary to calculate the average pounds of nitrogen being applied per acre.

3.1.3 Debris, Rocks or Contaminants in the Soil

Direct push borings may not indicate the presence of construction debris or rocks in the soil. Rocks and/or construction debris may render soil unsuitable for application to agricultural fields. Contaminated soil containing rocks or debris may need to be disposed of as a special waste at an appropriately licensed landfill that is willing to accept it. If shallow bedrock or construction debris is suspected at a property, test excavations may be necessary to confirm the suitability of the material for excavation. Soil contaminated with insecticide, herbicide, metals, chloride, volatile organic chemicals such as carbon tetrachloride, petroleum products, or other contaminants may also not be suitable for land application. If insecticides and/or herbicides are present, EPA label instructions for each chemical must be followed if land application is used. Several soil samples from each proposed excavation site should therefore be screened for non-fertilizer contamination.

3.1.4 Ground Water Investigation

Nitrate and ammonia impacts to ground water must also be delineated during the initial investigation. A presumptive remedy for remediating and monitoring nitrate-contaminated ground water has also been developed by KDHE. Sufficient information should be obtained during the initial investigation to determine flow direction and delineate the full extent of any ground water contamination plume, including off-site migration. The ground water data will be used to select locations for monitoring wells and ground water remediation wells, if needed.

3.1.5 Graphically Evaluating the Data

The investigation report should include a series of contoured site maps showing the concentration of nitrate nitrogen plus ammonia nitrogen at each 5-foot (or other selected) depth interval in the soil. The maps can be used to determine the total volume of removable soil and the weight (as pounds of nitrogen) potentially removable by excavation at each depth interval and in total. Ground water elevations and contaminant concentrations should also be presented as contour maps.

3.2 Soil Remediation Plan

Once KDHE has approved the Site Investigation Report and determined that cleanup is necessary, the Responsible (or Voluntary) Party should request use of the presumptive

remedy if it is appropriate. If KDHE approves use of the presumptive remedy, the Responsible (or Voluntary) Party should have their consultant prepare an Interim Soil Remediation Plan if the soil cleanup is intended to precede the development of a Corrective Action Study (or Voluntary Cleanup Proposal) and Corrective Action Plan (or Voluntary Cleanup Plan) for the property. Implementing the presumptive remedy on an interim basis is intended to expedite the removal of contaminated soil. Otherwise the Soil Remediation Plan would be part of the Corrective Action Plan or Voluntary Cleanup Plan.

3.3 Evaluation of Costs

An evaluation of costs verses benefits should be presented in the Soil Remediation Plan, as this is an important tool to evaluate the actual volume of soil to be excavated. Excavation costs are dependent on soil volume, depth of excavation, haulage distance, and land application. KDHE suggests that a table be prepared for each depth interval and contaminant concentration level that is demarked by the contour maps presented in the Soil Investigation Report. By doing so, costs for removal can be compared to the amount of nitrogen to be removed.

The Kansas risk-based cleanup goal for nitrate plus ammonia in soil is 40 mg/kg as nitrogen (N). It is unlikely to be cost effective to excavate all soil at a property having average nitrogen levels above 40 mg/kg. Therefore, the table will compare the costs of removing, hauling and land applying all soil that can reasonably be excavated from the 0-5 foot depth interval (or other selected depth interval) that has nitrate nitrogen plus ammonia nitrogen level above 40 mg/kg, above 100 mg/kg, above 200 mg/kg, above 400 mg/kg, etc. Using the total cost determined for the volume of soil in each concentration interval, a cost per pound of nitrogen removed can be determined. When results for each depth interval have been tabulated (the excavation costs per cubic yard of soil will increase with each deeper interval, while the haulage and land application costs remain the same) the data can be used to determine the most cost-effective excavation plan for each property.

KDHE expects that the above determinations will vary with the physical conditions and location of each property. Individual Responsible or Voluntary parties may choose different levels of excavation depending on their individual circumstances with KDHE approval. Experience to date indicates that, at some sites, it was cost effective to remove as much soil as possible above 200-400 mg/kg (N).

Many factors will affect the cost of excavation. Some factors are listed here for planning purposes.

- Choice or availability of equipment. Tractor-mounted backhoes may be useful for small excavations but may limit excavation depth to 10 or 12 feet. Larger track hoes increase the depth and speed of excavation. Other earth-moving equipment, such as front-end loaders, may be useful for large excavations.

- Minimizing handling of the soil and the avoidance of staging soil, either at the excavation site or in the field, will save costs. Using the backhoe to directly load an

application vehicle suitable for both hauling the soil to the application site and spreading soil on a field will generally result in the most economical operation. Vehicles used for spreading dry fertilizer or feedlot wastes on fields have proven to be practical in actual use.

If separate vehicles are used to haul the soil to the application site, staging at the site and reloading into application vehicles with a front-end loader will increase costs. Remember that, until the soil is applied to the land at agricultural rates, it is classified as a special waste and care, such as placing it on plastic sheets and surrounding it with berms of clean soil to control run-off, will be necessary to prevent contaminating clean soil or ground and surface water.

- Obviously, finding agricultural land suitable for land application with an owner willing to accept free fertilizer as close to the excavation as possible is imperative to keep haulage costs under control. Local road fees or weight limitations may limit access to some potential land application sites.

- Dry soil, dry fields, dry roads, and dry weather make soil-moving operations more practical. Unpredictable weather conditions, contractor availability and fluctuating fuel costs may be obstacles to planning and execution.

- The prime window of opportunity for land application of nitrogen-contaminated soil to row crops is in the spring when soil is being prepared for planting. Perhaps a more reliable window of opportunity exists for land application to winter wheat land between harvest and fall planting. The generally dryer conditions in July and August in Kansas favor use of wheat land for land application purposes over spring-planted crops. The generally accepted level of fertilization for wheat is 50 pounds of nitrogen per acre. Best management practices recommend other levels for corn, beans, milo, and pastureland. These values must be used along with agronomic assessment of the existing field-soil conditions in determining acreage needed to receive the excavated soil. The services of a Kansas Certified Crop Advisor may be obtained to assist with determining appropriate rates of application.

- The boundaries of the excavation should be set back from structures and rights-of-way to avoid damage to foundations, roads, and utilities. Deep excavations may need to be stepped for stability. The opinion of a Kansas Licensed Engineer may be necessary to prepare some excavation plans. Limit excavation depths to prevent infiltration of ground water into the pit.

- A Stormwater Construction permit maybe required by KDHE/Bureau of Water.

3.4 Backfilling Considerations

Only clean natural soil containing less than 40 mg/kg of nitrogen is suitable for backfilling an excavation. Refer to BER Policy Number BER-RS-047, "Consideration and Selection of Borrow Sites," to determine appropriate backfill material. Backfilling with gravel, sand, or waste material must be approved on a project-specific basis by the KDHE project manager. Backfill must be sampled for nitrate and ammonia before use. *Note: Soil*

removed from ponds during cleaning or enlarging may contain high nitrogen levels and may not be suitable backfill material (sample first). Leaving excavations open invites injury, unauthorized waste disposal or the accumulation of water. Backfilling should begin as soon as the excavation is completed and verification samples taken.

3.5 Report Format for a Soil Remediation Plan

The Soil Remediation Plan should address, at a minimum, the following items:

A. Introduction (Note, items A, B, and C may be compiled from the site investigation report(s):
- Site vicinity map
- Summary of previous investigations

B. Summary of site geology and hydrogeology taken from the investigation report:
- Summary of geological setting
- Summary of site geology (lithologic logs and cross sections as necessary)

C. Summary of existing site data:
- How and when were site data gathered. Types of data with tables and detailed site maps showing sampling locations, monitoring wells, and other features and data, as necessary.
- Soil contamination, soil sample location maps and maps and tables of results, as necessary. Includes contamination contour maps for each depth interval sampled;
- Ground water contamination including: a) ground water sample location, probes and monitoring wells; b) water table elevation map(s) and tables, as necessary; and c) cumulative ground water analytical results in tabular format.
- Proposed soil remediation options including a) Estimated total nitrogen mass (above 40 mg/kg) compared to average concentration for the entire contaminated area and the same values for the portion selected for removal; and b) Comparison of costs and impacts for various excavation, transport, land application/disposal and backfill options. Justification for selection of the preferred options.
- Plan details for the preferred option including a description of excavation, transportation, land application and selection of backfill material.
- Schedule of activities.
- Soil Sampling Plan including a description of: a) field and laboratory procedures; b) sampling the excavated soil (to determine loading rates); c) verification sampling of the floor and sidewalls of the excavation before backfilling; and d) sampling the backfill soil.
- Required permits, permissions and approvals including: a) site access; b) utility locates; c) transport approvals, if required; d)

approval to disposal of soil at a permitted landfill (if used); e) approvals for land application including signed forms.

D. References cited

E. Appendices

- SOP for field screening of nitrate in soil;
- KDHE BWM Special Waste Disposal Request (if needed);
- KDHE Land Application forms

4.0 KDHE Land Application Approval Process

Land Application work plan forms are available from the KDHE Website (**http://www.kdheks.gov/remedial/landapp/index_landapp.htm**). A separate land application work plan must be completed for each land parcel to which soil will be applied. The land application work plans must be submitted to the KDHE Project Manager and approved before excavation begins. Generally, the selection of the location for land application will be finalized and the forms submitted at the same time as the Soil Remediation Plan. Facility owners and their consultants and contractors should ensure that they have obtained access to a sufficient area of land to receive the estimated volume of soil to be excavated and have obtained the KDHE project managers pre-approval. In KDHE's experience, locating land suitable for land application and obtaining landowner/operator approval is best accomplished by local people familiar with agriculture in the area of the facility.

Each land application work plan contains a section requiring calculation of application rates for the expected crop based on analyses contained in the Soil Remediation Plan. If the soil is heterogeneous, average values may not be very useful. Blending at the application site may be needed to get a relatively uniform application rate otherwise several different application rates may be needed to get a relatively uniform application.

The land application work plan requires the approval and signature of the landowner where the nitrate enriched soil is to be applied. All requirements described in the land application form package must be satisfied. The completed and signed Land Application Work Plan form(s) may be submitted to the KDHE Project Manager simultaneously with the Soil Remediation Plan or after plan approval but prior to any excavation activities.

5.0 Soil Excavation Report

Upon completion of excavation, land application, and backfilling activities, a Soil Excavation Report shall be prepared and submitted to KDHE. The Soil Excavation Report should, at a minimum, contain the following:

A. An introduction summarizing the execution of the approved Soil Remediation Plan and Land Application Plans.

B. Soil excavation results (use tables and maps as needed).

- Nitrogen concentrations of pre-excavation samples and their locations from the Soil Remediation Plan.

- Extent of actual excavations and the nitrogen concentrations of excavated soils.

- Total volume of soil removed and a calculation of the total mass of nitrogen removed. (The total pounds of nitrogen removed by excavation is the most important number in evaluating the total impact of the removal action).

- Nitrogen concentrations of soil remaining in the excavations before backfilling (verification samples).

- Nitrogen concentrations of the soil used for backfill.

- Problems and solutions implemented, if any.

C. Land application procedures and results.

- Description of the process and results at each land application property.

- Determination of the actual soil application rates (pounds of nitrogen/acre) at each land application property based on the concentration values obtained by sampling during excavation or during the land application process.

- Total mass of nitrogen and soil volumes applied at each property.

D. References cited

E. Appendices

- Excavation and land application photographs

- Copies of the completed land application forms