DEPARTMENT OF AGRICULTURE

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Groundwater Cleanup Goals

Guidance Document 28

This guidance document describes the Minnesota Department of Agriculture's (MDA) approach to determining groundwater cleanup goals for agricultural chemical incident sites. In general, the MDA will require an evaluation of health risk-based groundwater values in situations where there is a direct or threatened impact to wells used for drinking water from an agricultural chemical contaminant plume. The MDA cleanup goals for groundwater contamination plumes will be based on applying Minnesota Department of Health (MDH) promulgated drinking water Health Risk Limits (HRLs) (Minn. Rules 4717.7500, 4717.7810-7900, or, if HRLs have not been promulgated, other drinking water guidance values developed by the MDH or the U. S. Environmental Protection Agency (EPA) for human receptors and Minnesota Pollution Control Agency (MPCA) promulgated aquatic life standards for environmental receptors.

Final groundwater cleanup goals for agricultural chemical incident sites are always site specific and are dependent upon the suite of groundwater contaminants at each site and the unique characteristics of each site. Groundwater containing contaminants at concentrations below final groundwater cleanup goals should not cause an unreasonable adverse effect on human health or the environment.

Drinking water guidance values have been compiled for certain pesticides, pesticide associated chemicals, and nitrogen compounds that may be monitored in soil and groundwater for agricultural chemical incident investigations. These values are available in a "Drinking Water Guidance Values" spreadsheet workbook that may be obtained from the website noted above or by contacting MDA at the above phone number.

Drinking water values for compounds not included in the "Drinking Water Guidance Values" spreadsheet are available from MDA staff. The MDH Health Risk Assessment Unit may also be contacted for more information on MDH health risk assessments and guidance.

1. Methods Used To Develop the Drinking Water Guidance Values

The drinking water guidance values were determined by selecting the promulgated HRL, or, where an HRL has not been promulgated, the Health Based Value (HBV), or Risk Assessment Advice (RAA)) developed by the MDH. These values are based on an evaluation of human health risk. In 2007, existing HRLs above the EPA established Maximum Contaminant Level (MCL) (40 C.F.R. pts 141-142) were statutorily set to the MCL.

These values may be replaced by HRLs established using the methods applied by MDH since 2008. EPA Lifetime Health Advisory or, for carcinogens, 10-4 Cancer Risk (U. S. EPA, 2018) are available where a HRL, HBV, RAA, MCL value is not available.

MCLs are the primary drinking water standards for public water supplies and are based on both human health risk assessment and best available treatment technology. Where public water-supply wells are impacted by a contaminant plume, cleanup goals should be based on the lower value of the HRL and MCL.

Also provided are Rapid Assessments for Pesticides developed by the MDH for selected chemicals with outdated guidance or where other MDH or EPA drinking water guidance are not available. If a concentration is higher than the Rapid Assessment, additional research may be necessary to make informed decisions about health risk.

Chemical breakdown products (degradates) of several pesticides have been detected in Minnesota groundwater and may be found at incident investigation sites. When no HRL or other health-based water value exists for a degradate, due to absence or paucity of toxicity information on the chemical breakdown product, the HRL specified for the parent chemical is the HRL for the degradate (Minn. Rule 4717.7900).

Based on the limited toxicity information for several pesticide degradates, the health risk of these degradates is treated as equivalent to the parent chemicals (See section 2 below for evaluation of health risk for multiple contaminants).

Carcinogenic polycyclic aromatic hydrocarbons (cPAH) and dioxins were considered as groups of chemicals, each with a calculated relative potency or toxicity equivalency because these chemicals are typically present as suites of similar compounds.

The relative potency evaluation method described in 2016 MDH guidance is used for cPAH (MDH, 2016). The cPAH criterion is calculated as relative potency to benzo[a]pyrene (BaP). Dioxins were considered together in a single value based on a calculation of 2,3,7,8-TCDD toxicity equivalence (Van den Berg et al., 2006).

2. **Calculation of Health Risk**

The individual drinking water guidance values have been derived to correspond to the target health risk levels. When multiple contaminants exist at a site, risk is evaluated by calculating a health risk index for each non-cancer health endpoint and for cancer (Minn. Rules 4717.7870, 4717.7880, and 4717.7890).

A non-cancer health risk index is determined for each group of two or more chemicals that have a common health endpoint using the following equation:

Health Risk Index = $C_1/nHRL_1 + C_2/nHRL_2 + ... + C_N/nHRL_N$

where:

C_N represents the concentration expressed as micrograms per liter (µg/L) of the first through Nth chemical (in the case of a chemical that has been detected but cannot be quantified, C_N is determined by standard statistical procedures used by MDH); and

$nHRL_N$ represents the chronic noncancer health risk limit expressed as µg/L for the first through Nth chemical. Values for other durations (e.g. acute or subchronic) may also be calculated using the corresponding HRLs. When a multiple chemical health risk index is greater than one, the multiple chemical health risk limit has been exceeded.

A cancer health risk index is calculated using the following equation:

Cancer Health Risk Index = $C_1/cHRL_1 + C_2/cHRL_2 + ... + C_N/cHRL_N$

where:

C_N represents the concentration expressed as µg/L of the first through Nth chemical (in the case of a chemical that has been detected but cannot be quantified, C_N is determined by standard statistical procedures used by MDH); and

$cHRL_N$ represents the cancer health risk limit for the first through Nth chemical. MDH applies an additional lifetime cancer risk of 10^{-5} in the calculation of cancer health risk limits and health-based values.

Where a HRL is not available, the alternative drinking water value(s) for that chemical may be used in the appropriate equation(s) to determine the MDA groundwater cleanup goal. When chemicals are detected for which strictly health-based values and health endpoints have not been determined by MDH, contact MDA project staff before evaluating health risk.

The MDA "Drinking Water Guidance Values" spreadsheet workbook (which may be obtained from the website or by calling the telephone number referenced on the first page of this document) will make the appropriate calculations and identifies chemical-specific target endpoints for assessing site-specific mixtures, including carcinogenic PAH relative potency and dioxin toxic equivalency.

3. **Natural Attenuation**

Natural attenuation, or the reduction of contaminant concentrations in groundwater to the appropriate cleanup goals without artificial enhancement of the site conditions, may be an appropriate remediation technology for some sites. The requirements for natural attenuation proposals are described in MDA guidance document GD20 Natural Attenuation of Contaminated Soil and Ground Water at Agricultural Chemical Incident Sites.

4. Use of Background Values

In some instances, the levels of contaminants in groundwater adjoining the site may be equal to or exceed the levels of these same contaminants in groundwater on and/or down-gradient from an incident site. This may be the result of naturally occurring compounds, the legal application of similar products, other non-point sources of contamination, or off-site point sources of contamination. If you believe that background contaminant levels are appropriate groundwater cleanup goals for your site, then you should discuss your reasoning with MDA staff and propose that background contaminant levels be used as groundwater cleanup goals.

The information provided in the proposal to MDA staff shall include the use of the surrounding property and suspected sources of the background contamination. The proposal shall also describe the pathway of migration from the background contaminant source to the site and the leaching potential of contaminants from on-site soils. A background groundwater cleanup goal will generally be based on the mean value of the concentrations in at least two groundwater samples collected from each of at least two monitored wells up-gradient from all identified sources on the site. Alternative approaches such as the use of published regional background data for naturally occurring compounds will be considered on a site-specific basis.

5. Discharge of Contaminated Groundwater to Surface Water

In situations where surface water bodies or ecologically sensitive areas are impacted or potentially impacted by groundwater contamination, aquatic life standards (Minn. Rules 7050) are also appropriate guidance values to be considered for cleanup goals. Cleanup goals based on impacts to surface water will vary with the classification of the impacted surface-water body, and the appropriate standard is evaluated through Surface Water Toxic Impact Assessments performed by the MPCA.

See Attachment 2, Contamination Impacts Survey of MDA guidance document GD9 Remedial Investigation Work Plan for further guidance on investigation of the groundwater to surface water exposure pathway.

6. Final Groundwater Cleanup Goal Selection

The approach used by MDA to develop the preliminary groundwater cleanup goals does not specifically consider the initial concentration or volume of contaminated soil or groundwater, discharge of contaminated groundwater to surface water (See 5 above), or the results of the Contamination Impacts Survey (See Attachment 2, Contamination Impacts Survey of MDA guidance document GD9 Remedial Investigation Work Plan). These factors should also be considered when assigning final groundwater cleanup goals to sites.

In addition, you may request modification of the preliminary groundwater cleanup goals as appropriate, based on the following factors:

a. overall protection of human health and the environment;
b. long term effectiveness and permanence;
c. reduction in toxicity, mobility and volume;
d. short term effectiveness (impacts resulting from the cleanup);
e. implementability of the remedial action and technology limitations;
f. community acceptance;
g. practicability, and
h. cost.

Modification of the groundwater cleanup goals may or may not involve the calculation of a new cleanup goal:

For instance, if groundwater contamination is limited in extent, in a low risk area, and the contaminant plume has stabilized, then it may not be practical or cost effective to actively clean up all contaminated groundwater. The site cleanup approach may then focus instead on the groundwater contamination source(s) and/or those areas which pose the greatest risk. Cleanup of groundwater may also be limited by technological and practical cost constraints. Appropriate institutional controls or a local ordinance may be necessary, which would record the location of the contaminated groundwater and prevent installation of a water-supply well that may withdraw contaminated groundwater.

Finally, as mentioned previously in this guidance document, it may be appropriate to use an alternate groundwater cleanup goal in areas where background levels of a chemical exceed the preliminary groundwater cleanup goal for the site.

Any modification of the groundwater cleanup goals would require consideration of the factors a-h listed above.

REFERENCES

MDH, 2016. Guidance for Evaluating the Cancer Potency of Polycyclic Aromatic Hydrocarbon (PAH) Mixtures in Environmental Samples, February 8, 2016.

U.S. EPA. 2018. 2018 Edition of the Drinking Water Standards and Health Advisories Tables. Office of Water, Washington, DC. EPA 822-F-18-001.

Van den Berg, Martin, Linda S. Birnbaum, Michael Denison, Mike De Vito, William Farland, Mark Feeley, Heidelore Fiedler, Helen Hakansson, Annika Hanberg, Laurie Haws, Martin Rose, Stephen Safe, Dieter Schrenk, Chiharu Tohyama, Angelika Tritscher, Jouko Tuomisto, Mats Tysklind, Nigel Walker, and Richard E. Peterson. 2006. The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds. Toxicological Sciences, Vol. 93: 223 - 241.