NRC Guidance Updates

Decommissioning Lessons Learned Meeting
January 15, 2025

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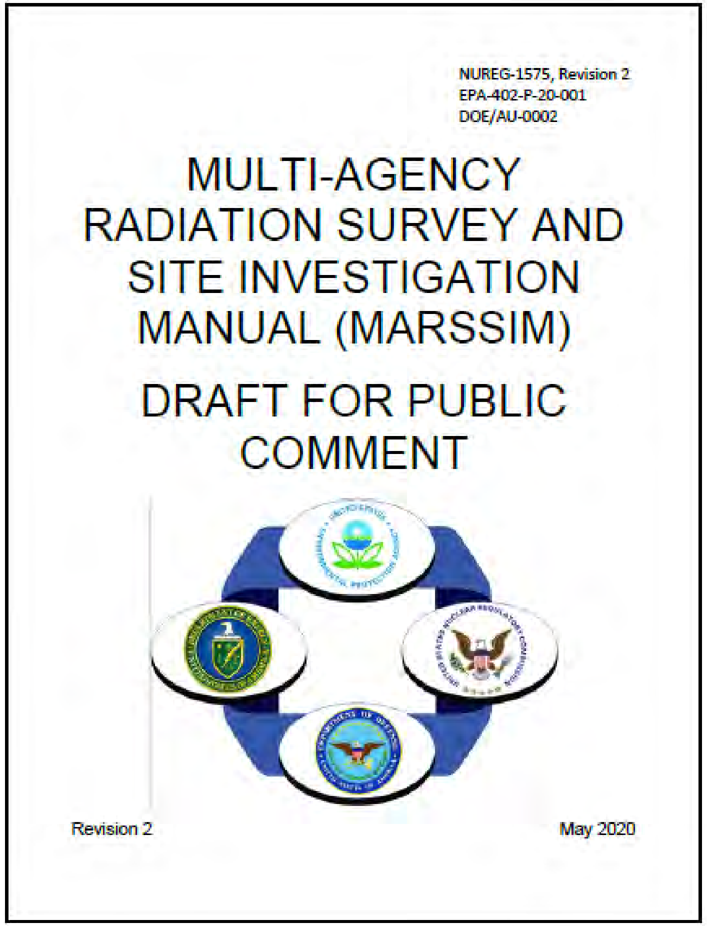
Guidance Updates

- Federal guidance updates
  - MARSSIM Rev. 2 (expected to be published in CY2025)
- NRC guidance updates
  - Interim Staff Guidance (DUWP-ISG-02) (final issued September 2024)
  - Update to NUREG/CR-7021 (updated draft in FY2025)
  - Update to NUREG-1507 (updated draft in FY2025)

Federal Radiological Survey Guidance—MARSSIM Rev. 2


NUREG-1575, Revision 2
EPA-402-P-20-001
DOE/AU-0002

MULTI-AGENCY RADIATION SURVEY AND SITE INVESTIGATION MANUAL (MARSSIM)

DRAFT FOR PUBLIC COMMENT

Revision 2

May 2020

Changes to MARSSIM—Site-specific Scanning Surveys

Image Credit: Oak Ridge Associated Universities.

Changes to MARSSIM—Continuously Collected Data (CCD)

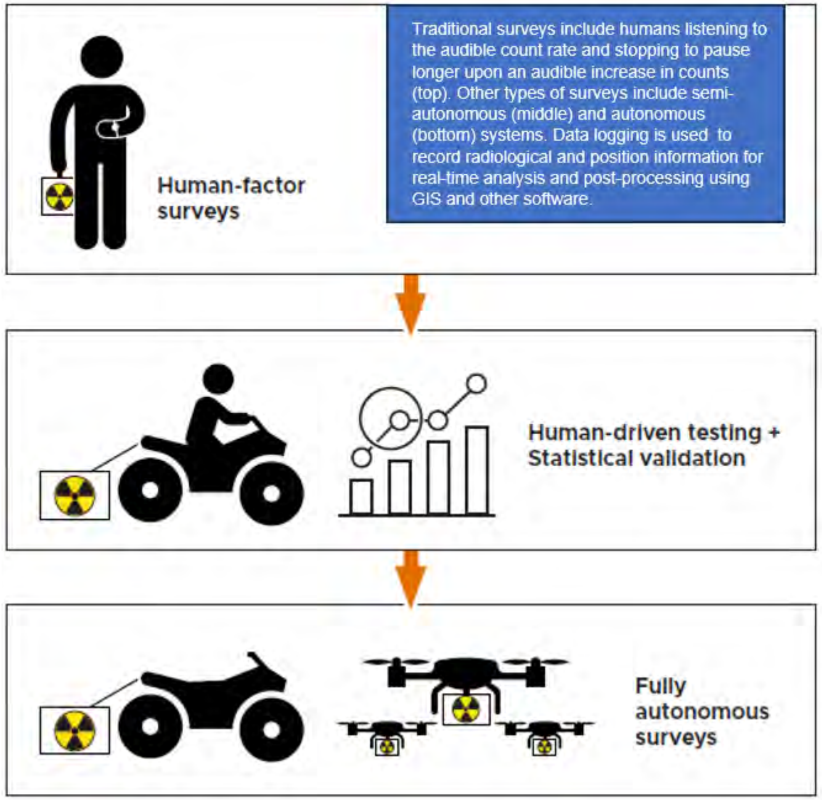


Image Credit: PNNL-SA-157412, Pacific Northwest National Laboratory.

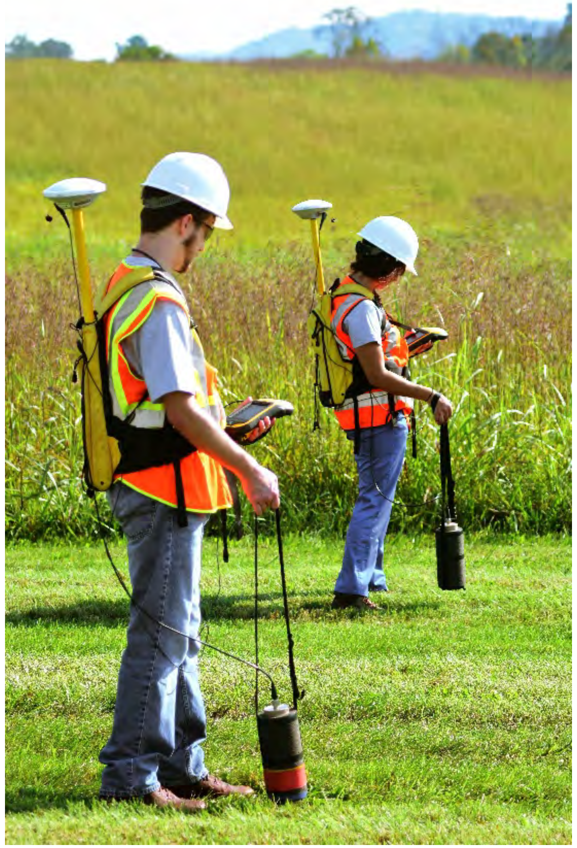
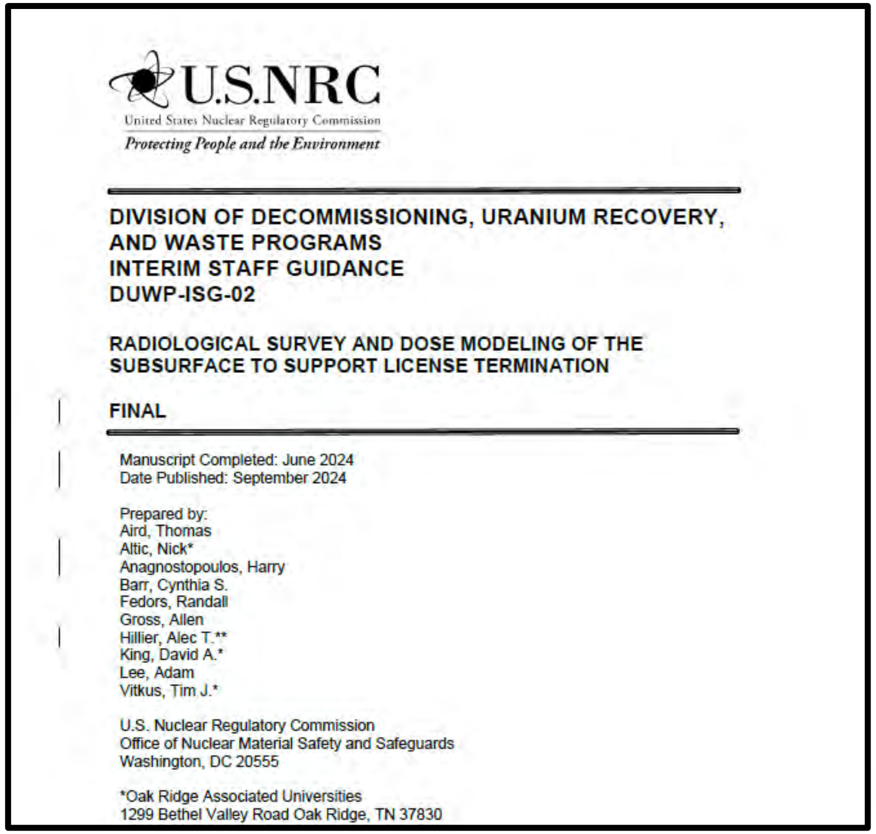


Image Credit: Oak Ridge Associated Universities.

NRC Guidance Updates

- Following issuance of NUREG-1757, Volume 2, Rev. 2, in July 2022, NRC developed additional guidance to supplement gaps
- DUWP-ISG-02 was published in September 2024 and addresses surveys of open surfaces in the subsurface



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DIVISION OF DECOMMISSIONING, URANIUM RECOVERY, AND WASTE PROGRAMS
INTERIM STAFF GUIDANCE
DUWP-ISG-02

RADIOLOGICAL SURVEY AND DOSE MODELING OF THE SUBSURFACE TO SUPPORT LICENSE TERMINATION

FINAL

Manuscript Completed: June 2024
Date Published: September 2024

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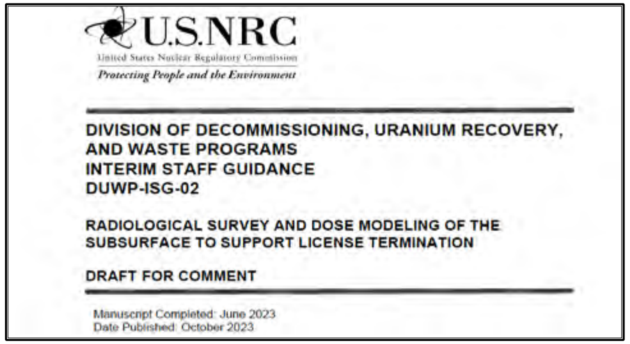
Interim Staff Guidance DUWP-ISG-02 *Radiological Surveys and Dose Modeling of the Subsurface to Support License Termination*

Extends NUREG-1575 "Multi-Agency Radiation Survey and Site Investigation" (MARSSIM) to the subsurface--addressing surveys of open excavations, reactor basement substructures, and materials planned for reuse among other topics.



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DUWP-ISG-02

RADIOLOGICAL SURVEY AND DOSE MODELING OF THE SUBSURFACE TO SUPPORT LICENSE TERMINATION

DRAFT FOR COMMENT

Manuscript Completed: June 2023
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Image Credit (top right): Eric Darois, Subsurface Workshop Presentation, ML22136A164

Image Credit (bottom right): DUWP-ISG-02, Figure 2.9 Example (Iso-Pacific S3) Soil Sorting System.

Updates to NUREG/CR-7021 and NUREG-1507

- *NUREG/CR-7021 subsurface guidance is being updated and focuses on use of improved geostatistical tools and methods to provide remedial and final status survey decision support*
- *PNNL's Visual Sample Plan is also being extended to three dimensions and updated to incorporate additional tools for complex subsurface problems*
- *An update to NUREG-1507 update will support future MARSSIM updates on CCD surveys*
- *Guidance updates will be incorporated into NUREG-1757, Volume 2, Revision 3 and MARSSIM, Revision 3*

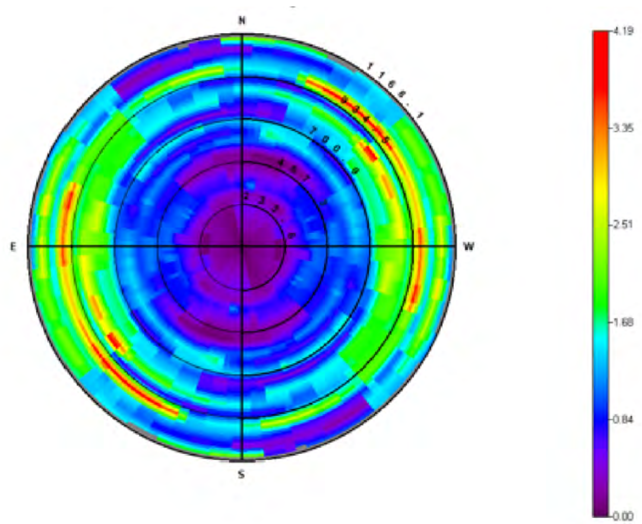

Image Credit: DUWP-ISG-02, Figure B.1, Variogram Surface from SADA.

Updated Guidance and Lessons Learned Related to Support for Risk-Significant Parameters

Updated Guidance on Selection of Deterministic Parameters

- NRC sponsored development of probabilistic RESRAD codes and associated parameter distributions for use in probabilistic sensitivity analyses
  - ANL's Data Collection Handbook (updated in 2015)
  - NUREG/CR-7267 *Default Parameter Values and Distribution in RESRAD-ONSITE V7.2, RESRAD-BUILD V3.5, and RESRAD-OFFSITE V4.0 Computer Codes* published in May 2024 (supersedes NUREG/CR-6697)
- However, some parameter distributions can vary several orders of magnitude and represent a large ranges of sites (e.g., distribution coefficients)
- Therefore, for especially risk-significant parameters, additional support for deterministic parameter values may be needed (i.e., use of the 25th and 75th percentile of the parameter distribution may not be reasonably conservative)

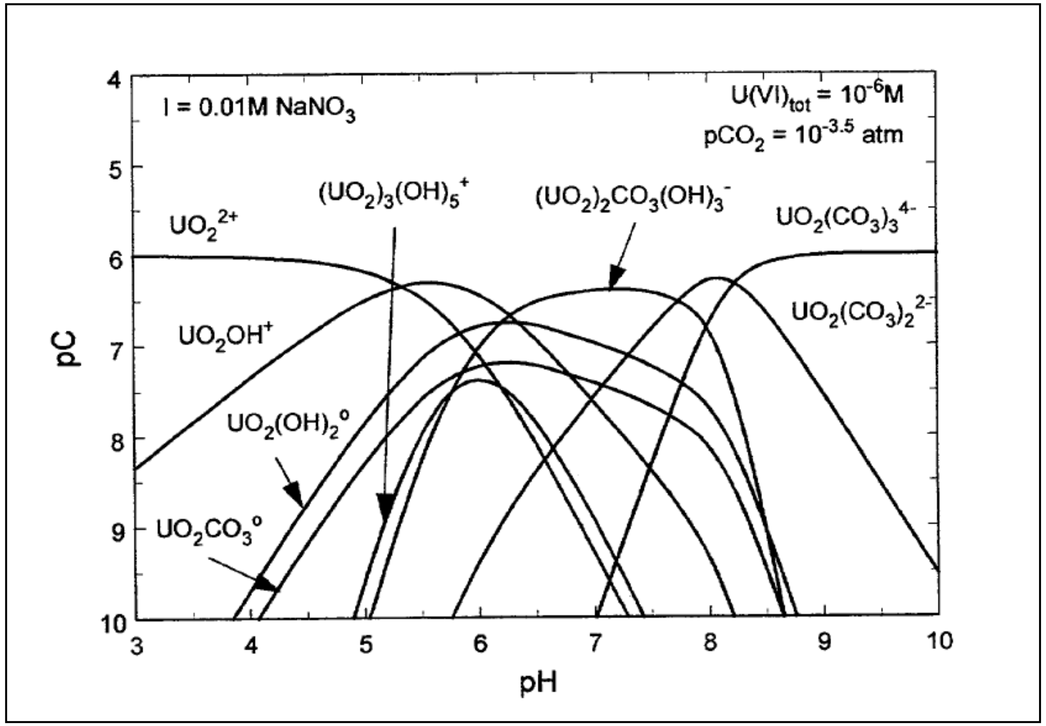

Image Credit: Figure 2-2B, NUREG/CR-6708, "Dissolved speciation of U(VI) as a function of total U(VI) concentration in an open atmosphere equilibrated with a partial pressure of CO_2 of $10^{-3.5}$ atm. Total dissolved U(VI) = 10^{-6} M".

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Updated Guidance on Selection of Deterministic Parameters (continued)

- DUWP-ISG-02 provides examples of how literature values for distribution coefficients or K_ds can vary substantially leading to large differences in results
- While soil type may provide a first order approximation of the parameter value, other geochemical factors can be important (e.g., pH, Eh, complexing ions, solid minerals/coatings)
- DUWP-ISG-02 provides a new Table 3.6 listing factors important to distribution coefficients for radionuclides of interest to reactor decommissioning
- This information is expected to assist licensees in selection and support for deterministic parameter values

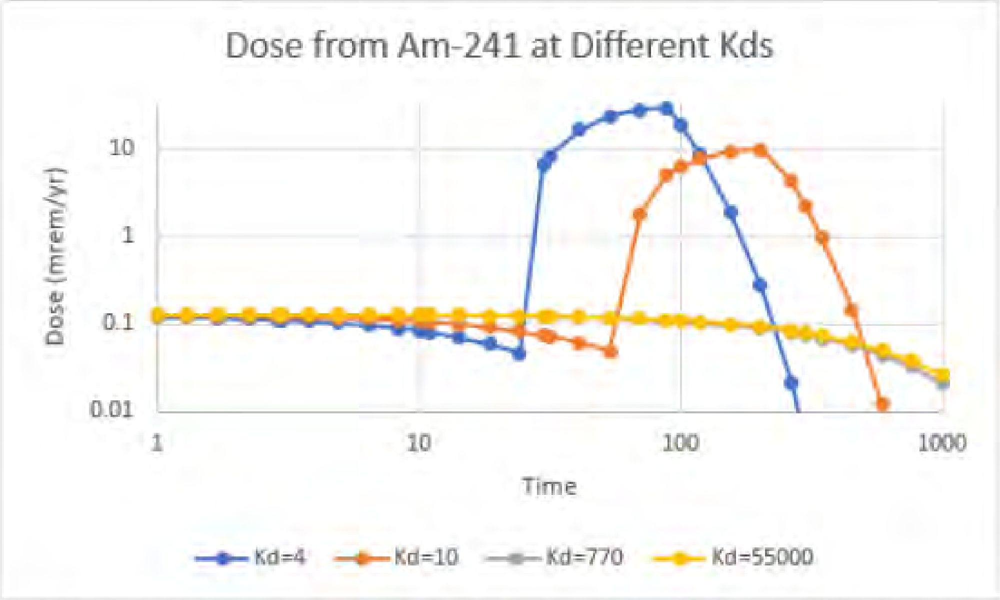


Figure 3.10 Am-241 Dose for Different Values of K_d Using All RESRAD-ONSITE Default Values for Other Parameters
(Note: 1 mrem/yr = 0.01 mSv/yr)

Lessons Learned 1: Selection of K_ds based on soil type

- Compilations of K_d values use soil texture categories which may differ from licensee data
  - Licensee borehole or geotechnical data on soil texture may not align with K_d soil texture
- Additionally, licensees should select soil types that are representative of flow pathways from source areas to groundwater
- In some cases, higher K_d s are more conservative (when surface dose pathways dominate) while in other cases lower K_d s are more conservative (when the groundwater pathway dominates)

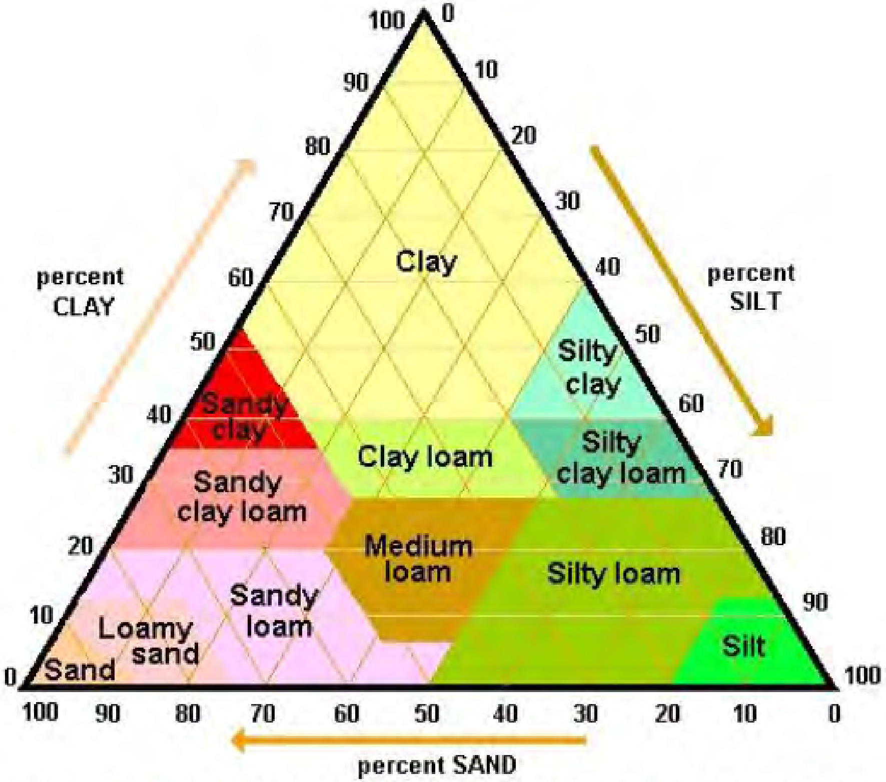
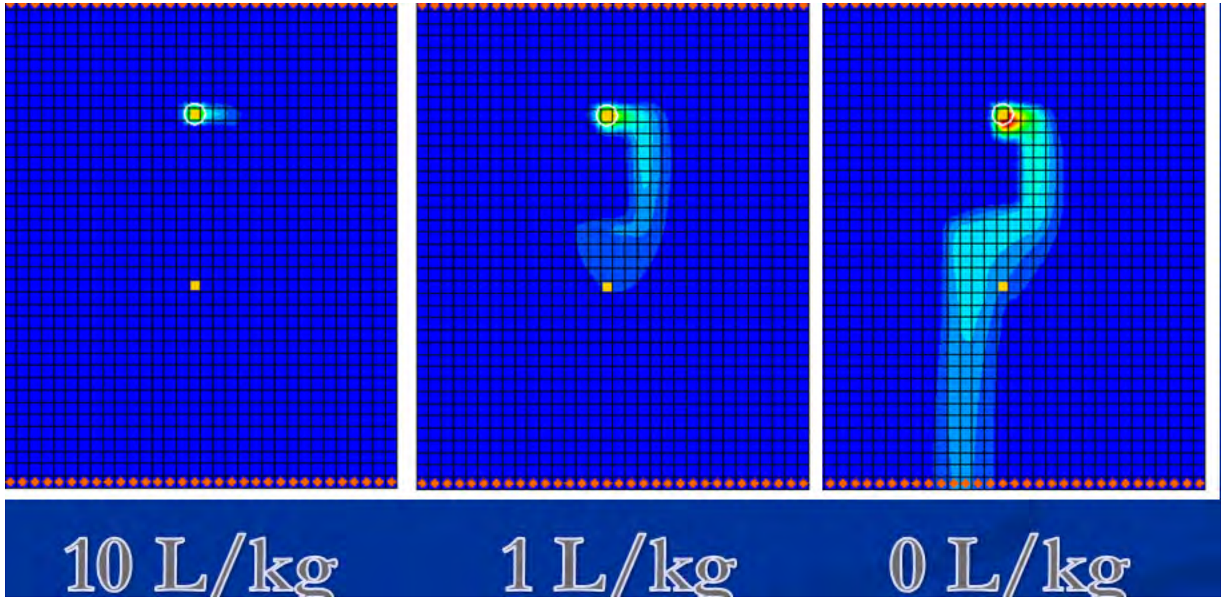


Figure 3.13 USDA Soil Texture Classification Chart

Lessons Learned 2: Benefit and difficulty of obtaining site-specific K_ds

- Site-specific laboratory studies are not always needed, particularly if the radionuclide has low uncertainty regarding its high mobility or low mobility (i.e., reasonably conservative values can be justified). See Table 3.6 in DUWP-ISG-02.
- Multiple lines of evidence to support the values selected may be needed commensurate with risk-significance
- Site-specific K_ds may be beneficial considering costs of justifying selected values or costs associated with clean-up to lower DCGLs



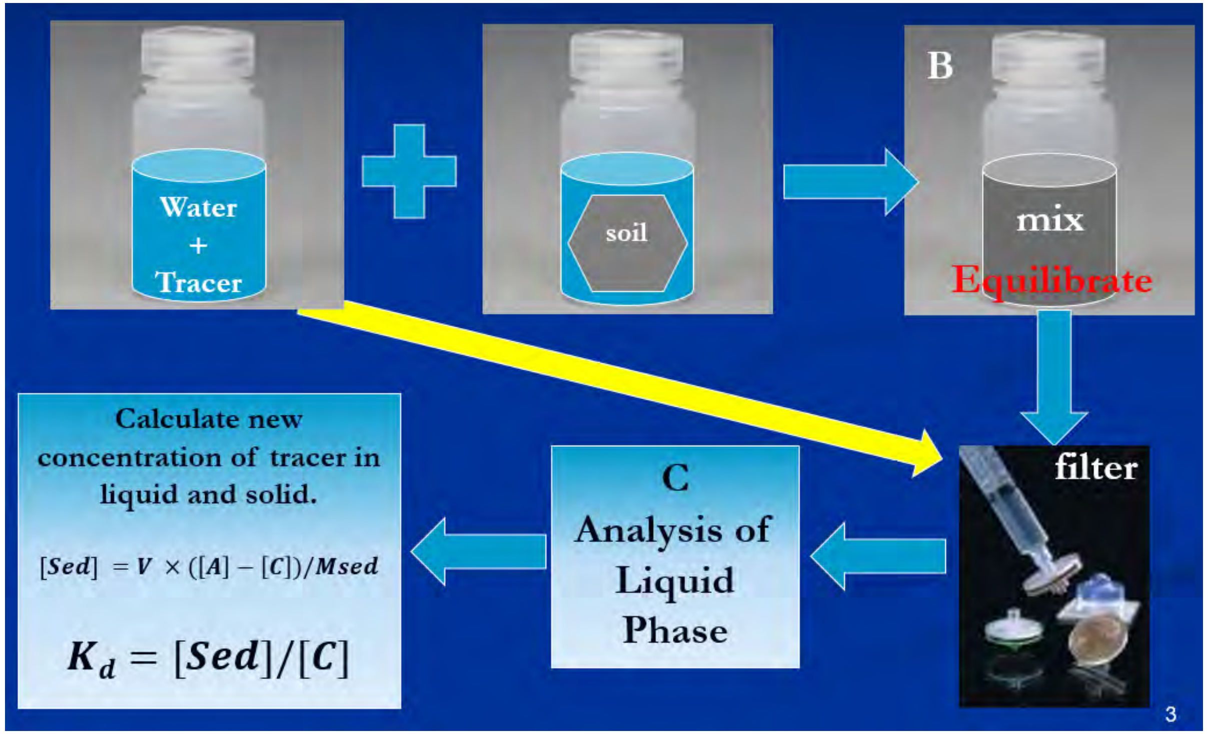
DCGLs=Derived Concentration Guidelines Levels (or clean-up levels)

Types of Methods to Obtain Additional Support

- Look-up tables with site-specific information on soil type and geochemical conditions
- In situ batch method (i.e., matched pore water, solids field or laboratory analysis)
- Field modeling method (e.g., migration rate observations)
- K_{oc} method (empirical equations using organic carbon percent)
- Laboratory batch test, use representative subsurface materials and geochemical conditions
- Laboratory flow through (or column) method
- Geochemical modeling

Summary of Guidance on Support for Risk-Significant Parameters

- Licensees can use probabilistic sensitivity analysis to identify risk-significant radionuclides, pathways, and parameters
- Default parameter distributions in RESRAD-ONSITE and -BUILD can be used to perform probabilistic sensitivity analysis
- If a parameter is found to be risk-significant, multiple lines of evidence may be needed to support selection of deterministic parameters
- Representative site materials/conditions should be considered in selecting or estimating values
- Site-specific values may lead to overall lower costs (e.g., less conservative K_ds and DCGLs given large uncertainty or less time justifying values selected)

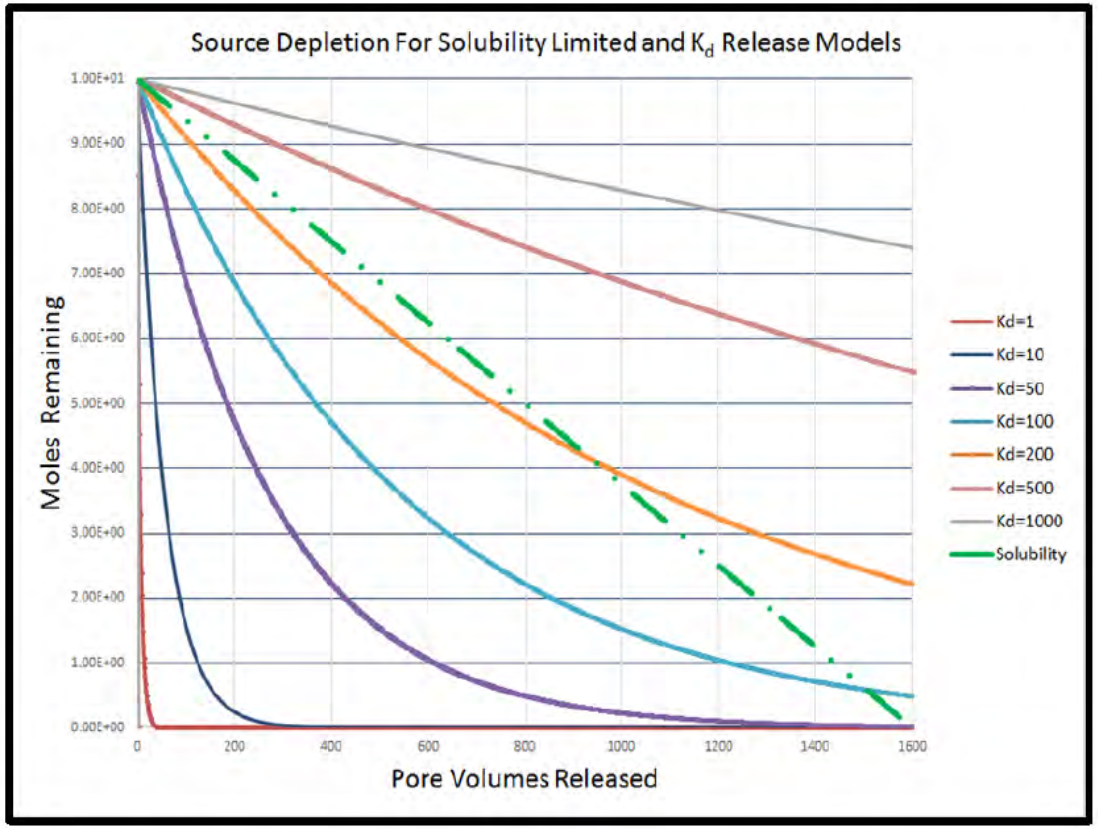


See https://www.nrc.gov/waste/decommissioning/whats-new.html for up-to-date information on guidance updates and development

Back-up Slides

Support for Risk-Significant Parameters

- NUREG-1757, Volume 2, Revision 1 allowed use of
  - 25th percentile values (if lower values of the parameter value resulted in higher doses) or
  - 75th percentile values (if higher values of the parameter value resulted in higher doses)
- Changes were made in Revision 2 such that licensees may need to provide additional support for risk-significant parameters such as distribution coefficients or K_ds (i.e., 25th or 75th percentile of the RESRAD parameter distribution are not automatically approved for use)



Factors Important to K_d for Reactor ROCs

- Table 3.6 provides information on typical radionuclides of concern for reactors
- The table lists important geochemical factors influencing Kd for those radionuclides
- Qualitative information about the importance of sorption and degree of uncertainty is provided
- Information on available look-up tables is also provided

Radionuclide of Concern	Factors Important to Sorption	Notes Regarding Uncertainty in Parameter Values
Cobalt (Co)	• Exists as a cation in natural systems. • Sorption increases with increasing clay content. • pH dependent (higher sorption with higher pH).	• Moderate sorption. • Moderate uncertainty. • Lookup tables available by pH and soil type in Gil-García *et al.* (2008b).
Iron (Fe)	• Higher clay content can increase sorption.	• Moderate sorption. • Medium to high uncertainty • Parameter distribution information available by soil type in Gil-García *et al.* (2008b) and Sheppard *et al.* (2009).
Iodine (I)	• Present as an anion in most natural systems. • Sorption increases with decreasing pH. • Presence of organic matter or iron or aluminum oxides can decrease mobility due to surface complexation. • Presence of iodate species in strongly oxidizing conditions can lead to formation of more sorptive conditions.	• Low to moderate mobility. • EPA (2004) recommends a screening value of 0 to 0.6 L/kg with lower values at moderate to alkaline pH and higher values at lower pH. • Iodate and organo-iodine can be more sorptive. • Moderate uncertainty (can manage with conservative assumptions). • Site-specific information would be needed to justify higher values.