Radionuclide Questions for Soil Smarts Workshops (Revision A)

Given that the Soil Smarts workshops are focused on the background cleanup of chemicals by DOE and NASA, it is unlikely that the following questions/issues, that are focused on radionuclides, will be addressed. It is therefore hoped that they will be addressed in DTSC's new STREAM platform, and possibly addressed in future radionuclide background-focused workshops.

1. **What about Radionuclides?**

   Why are these workshops focused on *"background cleanup of chemical contaminants"* but not also background cleanup of radionuclides?

   When this question was asked during the November 20, 2024, Soil Smarts workshop, the response implied that the fewer radionuclides of concern compared to the number of chemicals of concern, made radionuclides less of an issue. However, the issues related to (1) laboratory detection levels, (2) single sample comparisons vs. more conventional non-parametric hypothesis testing, and (3) RBSLs exceeding LUTVs by large margins, apply equally to radionuclides. Perhaps DTSC, with limited staff with experience with radiological issues, just chose not to address radionuclides?

   The DTSC "draft provisional" radionuclide LUTV list contains a shortlist of 16 radionuclides.[1] In contrast, the EPA established background datasets for 57 radionuclides and classified 17 as "priority 1" radionuclides (detected above radionuclide reference concentrations (RRC) in Area IV) to be analyzed in future Area IV remediation/closure sampling projects.[2] Although both EPA and DTSC chose a shortlist of "radionuclides of concern", there are some inconsistencies between EPA's "priority 1" radionuclides and DTSC's "draft provisional" radionuclide LUTV list.

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[1] DTSC. "Draft Provisional Radiological Look-Up Table Values." January 30, 2013. https://www.dtsc-ssfl.com/files/lib_look-uptables/radiological/66513_65861_Draft_Provisional_Radiological_Look-Up_Table_Values_1-30-13.pdf.

[2] EPA/HGL. "Final Technical Memorandum Look-Up Table Recommendations, Santa Susana Field Laboratory, Area IV Radiological Study." November 27, 2012. https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/techdocs/65778_Final_Tech_Memo_Lookup_Table_Recommendations_112712.pdf.

Could DTSC please explain its rational for its "draft provisional" LUTV list, and does it imply that RPs (Boeing, DOE, NASA) need only analyze for these radionuclides during future remediation/closure activities?

Table 1 is an abridged version of the Table provided in my 2022 comments on the Settlement Agreement.[3] RBSLs are taken from Exhibit 5, Attachment 5, Table 1 of the Settlement Agreement.[4] BTVs are EPA's BTVs based on the USL95 of background. LUTVs are the lower of the EPA radionuclide reference concentrations (RRC) for Lab A and Lab B .

Table 1 shows that 18 radionuclides (shaded in green) have RBSLs (10^{-6} residential 100% garden produce consumption) that exceed the LUTV. The range of exceedances is wide ranging from a factor of 1.11 to a factor of 1.64E+24. Of particular note are Pu-238 and Pu-239/240, with RBSL/LUTV ratios of 3.85 and 3.74 respectively, and Eu-155 with a RBSL/LUTV ratio of 12.8.

The (lifetime cancer) risk associated with 26-year exposure to LUTV levels of all radionuclides is 8.64E-03 (almost 1%). The NORM LUTV levels of K-40, Ra-226, Th-230, Th-232, U-234 and U-238 are the dominant contributors at 7.9E-3 (again almost 1% or 1-in-100). Of course, the risk from a lifetime of exposure to LUTV levels of radionuclides in soil is more than 3 times these figures or approximately 2.5%. Perhaps DTSC should notify the public of this alarming fact? The exposure pathways are direct radiation, ingestion, inhalation and 100% garden produce consumption.

The risk contribution from 100% garden produce consumption is not an artifact of assuming that a resident family at SSFL would grow and eat all of its fruit and vegetable intake from its backyard at SSFL (a highly unlikely proposition). Since all our store-bought fruits and vegetables are also grown in soil with background levels of NORM, we all have a similar theoretical radiation risk from the food we eat, no matter where we

[3] Rutherford, "Opposition to the DTSC-Boeing Settlement Agreement." May 23, 2022. https://philrutherford.com/SSFL/Settlement_Agreement/DTSC-Boeing_Settlement_Agreement.pdf.

[4] DTSC, "Settlement Agreement." May 9, 2022. Exhibit 5, Attachment 5, Table1. https://www.envirostor.dtsc.ca.gov/getfile?filename=/public%2Fdeliverable_documents%2F2026541471%2FSSFL%20DTSC-Boeing%20Settlement%20Agreement%20(Final).pdf.

live. The 2.5% number is actually somewhat higher since cows, pigs and chickens are also fed vegetation grown in soil with the same background levels of NORM radionuclides, and therefore the meat and poultry that we eat also adds to our theoretical radiation induced cancer risk.

This, of course, is one of many nonsensical consequences of EPA's implementation of the flawed linear no-threshold theory of radiation risk at and below background radiation levels and background radiation variability, in its PRG Calculator.[5] Perhaps people would quit worrying about "theoretical" incremental risks of 1-in-1,000,000 when their "theoretical" radiation risks from clean dirt are more than 2.5%. But I mis-speak. SSFL stakeholders (including DTSC and CalEPA) were not satisfied with a 1-in-1,000,000 incremental risk goal, as evidenced by their 2008 refusal to follow EPA's recommendation that SSFL be listed as a Superfund Site.[6] Instead the 2010 AOC demands a ZERO risk above the 2.5% background radiation risk.

Does DTSC have an opinion on this?

2. **Building Structural Debris**

Although the workshops are focused on soil cleanup, this question on structural debris may appear to be out of place.

The 2010 AOC focused on demonstrating cleanup to background in soil using soil lookup table values (LUTV) as the decision level (DL). However, the AOC also strangely defined soil to include *"debris, structures, and other anthropogenic materials,"* yet was silent on how to demonstrate background for such building structural debris. In 2021, DTSC challenged/demanded DOE to show that its demolition debris (concrete, steel, wood, drywall, asphalt, miscellaneous construction materials, etc.) from four non-

[5] EPA, "Preliminary Remediation Goals for Radionuclides (PRG)." https://epa-prgs.ornl.gov/radionuclides/.

[6] Rutherford, "Nuclear Decommissioning at SSFL: 20+ Years of Politics vs. Science," Section 12.0. June 9, 2022. Revised July 21, 2024. https://philrutherford.com/SSFL/Nuclear_Decommissioning_at_SSFL.pdf#page=41.

radiological buildings met the AOC soil LUTV requirements,[7] an impossible and scientifically meaningless objective. To quote DTSC,

"The proposed characterization shall demonstrate if the building materials have detectable radiological contamination above local background (<u>based on comparison with the Draft Provisional Radiological Look-Up Table Values</u> and following measurement quality objectives and data quality objectives consistent with those cited in Section 2.12 of the AOC)." [Underline added for emphasis]

The EPA's Radiological Background Study and Area IV Radiological Study focused on surface soil, sub-surface soil and sediment. EPA did not sample, analyze or establish LUTVs for any *"debris, structures, and other anthropogenic materials."*

DOE declined this impossible directive and consequently, DTSC forced DOE to send all clean building debris to a low-level radioactive waste disposal site. In doing so, DOE blew up a building that DTSC had declared to be radioactive waste, DOE falsified NRC radioactive waste manifests, and failed to respond to a FOIA for EM and Office of Inspector General records.

Can DTSC comment on its role in initiating this egregious overstepping of its regulatory authority?

3. **Cleanup to Background**

It has taken fourteen years for DTSC to recognize that implementing "cleanup to background" is an unattainable goal (*"potential challenges", "laboratory capabilities", "backfill availability"*). This is something that RPs have known since 2010 as evidenced

[7] Letter from Steven Becker (DTSC) to John Jones (DOE). "Revisions to Standard Operating Procedures and Associated Documents for Demolition of the Four Remaining Buildings at the Energy Technology Engineering Center, Santa Susana Field Laboratory. Simi Valley, California." February 11, 2021. https://www.envirostor.dtsc.ca.gov/getfile?filename=/public%2Fdeliverable_documents%2F6300267100%2FLetter%20to%20DOE%20Dated%2020210211%20Regarding%20SOP%20Revision%20for%20ETEC%20Buildings%204038%204057%204462%204463.pdf.
Highlighted version.
https://philrutherford.com/SSFL/doe_building_demolition/Letter_to_DOE_Dated_20210211_Regarding_SOP_Revision_for_ETEC_Buildings_4038_4057_4462_4463_highlighted.pdf

by DOE's and NASA's attempts to distance themselves from the 2010 AOC in their respective EISs. DOE's preferred alternative is a risk-based open-space land use scenario.[8] NASA's preferred alternative in its 2020 ROD is a risk-based suburban-residential land use scenario.[9] Neither of these preferred alternatives comply with the draconian requirements of the 2010 AOC. Does DTSC plan to acknowledge these documents and discuss the state of negotiations with DOE and NASA? Is it finally time for DTSC to throw out the 2010 AOC?

4. **Lack of a Single Set of Site-wide Final LUTVs**

On January 30, 2013, DTSC issued its Draft Provisional Look-up Table Values, for a short list of radionuclides.[10] These have been imposed on all the three RPs. Why are these still called *"draft provisional"* and not *"final*?" The reason is that these values were chosen by DTSC to be identical to the EPA's "radionuclide reference concentrations (RRC)" for Lab B established from the EPA Radiological Background Study and Area IV Radiological Characterization Survey.[11,12]

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[8] DOE, "Final Environmental Impact Statement for Remediation of Area IV and the Northern Buffer Zone of the Santa Susana Field Laboratory - Summary", DOE/EIS-0402, November 2018. https://www.energy.gov/sites/prod/files/2018/12/f58/final-eis-0402-etec-2018-12-summary.pdf.

[9] NASA. "Record of Decision – Supplemental Environmental Impact Statement for Soil Cleanup Activities at Santa Susana Field Laboratory, Ventura County, California." September 2020. https://www.nasa.gov/wp-content/uploads/2015/04/ssfl_soil_rod_final_signed.pdf?emrc=abd3a0.

[10] DTSC. "Draft Provisional Radiological Look-Up Table Values." January 30, 2013. https://www.dtsc-ssfl.com/files/lib_look-uptables/radiological/66513_65861_Draft_Provisional_Radiological_Look-Up_Table_Values_1-30-13.pdf.

[11] EPA/HGL. "Final Technical Memorandum Look-Up Table Recommendations, Santa Susana Field Laboratory, Area IV Radiological Study." November 27, 2012. https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/techdocs/65778_Final_Tech_Memo_Lookup_Table_Recommendations_112712.pdf.

[12] EPA/HGL. "Development and Use of Radionuclide Reference Concentrations." November 28, 2012. https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/techdocs/67106_EPA_Final_Radiological_Characterization_of_Soils_Report_-_Appendix_K_-_RRCs.pdf.
See Attachment B for two sets of RRCs for Lab A (GEL) and Lab B (TAL).

RRCs were calculated by EPA based on the results of its Radiological Background Study and the results of its Area IV Radiological Characterization Study. Numerical values may be found in Attachment B of the RRC document in footnote 12. Equations used to derive RRCs are,

$RRC = AL + 1.645U_M$
AL = Action Level = maximum (BTV : 2σ UCL MDC)

where U_M = method (measurement) uncertainty of EPA characterization data
MDC = minimum detectable concentration of EPA characterization data

EPA recommended calculation of the Look-Up Table Values (LUTV) based on the BTV, and the MDC and U_M of the laboratory used in the future remediation and closure phases. Of course, EPA was not able to provide numerical values of LUTVs but provided the relevant equations in Section 2.3 of the LUTV document in footnote 11,

$LUTV = CL + 1.645U_M$
CL = Cleanup Level = maximum (BTV : 2σ UCL MDC)

where U_M = method (measurement) uncertainty of future remediation/closure data
MDC = minimum detectable concentration of future remediation/closure data

Note the similarity of the equations. BTV is identical, however the MDC and U_M values will differ and be dependent on the laboratory(ies) used in future remediation and closure phases. For this reason, EPA was explicit that the numerical RRCs it provided should NOT be used for LUTVs.

However, DTSC correctly recognized that it and the RPs needed an immediate set of LUTVs for planning purposes and therefore deviated from EPA's recommendation by using the minimum of Lab A RRC and Lab B RRC as the "draft provisional" LUTV. This appeared reasonable at the time (almost twelve years ago). In both cited LUTV and RRC documents, EPA was clear that the RRCs should NOT be used for the "final" LUTVs. Final LUTVs would therefore differ from the "draft provisional" LUTVs proposed by DTSC in 2013. DTSC and the RPs appear to have conveniently overlooked this wrinkle.

EPA provided an impractical, unworkable recommendation for establishing cleanup goals (LUTVs). EPA actually recommended that DTSC procure a single laboratory for DOE's remedial/closure work in Area IV. Understandably, EPA failed to anticipate that DTSC would impose LUTVs on all three RPs, including Boeing, via the 2022 Settlement Agreement. In reality, all three RPs plan their remediation separately and could use different laboratories. Even if two RPs chose the same laboratory they could use differing DQOs and MQOs, resulting in differing MDCs, U_Ms and therefore different LUTVs. A single RP could also use more than one laboratory, resulting in multiple LUTVs.

EPA faced the same issue when it used two different labs (Lab A and Lab B) for its Area IV sampling and ended up with two sets of RRCs. This lesson-learned resulted in EPA's recommendation to use only one laboratory for remediation/closure sampling.

This overly complex process has arisen because of the 2010 AOC "cleanup-to-background" mandate. The process is unable to establish a single credible background cleanup goal. Cleanup goals that are dependent on which laboratory is doing the sample analysis, are untenable. For example, DTSC's draft provisional LUTV list includes two radionuclides that have LUTVs that are a factor of 10 different. Nickel-59 has LUTVs of 10.9 and 0.875 pCi/g. Strontium-90 (an important Area IV contaminant) has LUTVs of 1.02 and 0.117 pCi/g.[13] The cleanup question becomes "what is background?" not "what is safe?"

In recognition that the LUTV process is a mess, EPA judiciously distanced itself from any responsibility in Section 1.1 of its LUTV recommendation document. EPA stated,

"The AOC was issued under the regulatory authority of the DTSC and is a principal guiding document in the development of the Area IV Study Area remediation standards. The AOC is an agreement between DTSC and DOE. USEPA is not a party to the AOC but has agreed to assist with limited activities pending funding from DOE. USEPA agreed to provide DTSC assistance on the development of LUT values. DTSC has the authority and responsibility to develop and approve final LUT values." [Underlines added for emphasis]

[13] DTSC. "Draft Provisional Radiological Look-Up Table Values." January 30, 2013. https://www.dtsc-ssfl.com/files/lib_look-uptables/radiological/66513_65861_Draft_Provisional_Radiological_Look-Up_Table_Values_1-30-13.pdf.

Although the preceding has focused on the radionuclide LUTVs, it would seem likely that the same laboratory analysis issues would apply to chemical LUTVs.

DTSC needs to acknowledge its decision to not follow EPA's recommendations and justify its continued use of "draft provisional" LUTVs.

DTSC should make a public announcement that the 2010 AOC and LUTV process is unworkable. Instead, DTSC should adopt the EPA's established risk-based CERCLA protocols, and/or preferably for radionuclides, DOE's dose-based 25 mrem/y plus ALARA standard in DOE-STD-1241-2023.[14]

5. **Multi-Agency Radiation Survey and Site Investigation Manual**

The Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)[15] uses non-parametric methods (e.g. Wilcoxon Rank Sum test) to compare a site sample distribution to a background sample distribution. This avoids many of the problems comparing single sample data to a single parametric level (i.e., a single value LUTV) that were identified by Dr. Hanley in the November 20, 2024, Soil Smarts workshop.

Has DTSC considered using standard hypothesis testing methodology to determine if radionuclide background is achieved following remediation, rather than the flawed 2010 AOC single sample protocol?

[14] DOE Technical Standard. "Implementing Release and Clearance of Property Requirements." Section 4.7 Release of Real Property and Section 4.8 Release of Soils. March 2023. https://www.standards.doe.gov/standards-documents/1200/1241-AStd-2023/@@images/file.

[15] EPA, NRC, DOE, DOD, "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." August 2000. https://www.epa.gov/sites/default/files/2017-09/documents/marssim_manual_rev1.pdf.

Table 1. Background Radionuclides, RBSLs, BTVs and LUTVs								
Analyte	Symbol	Man-made or NORM	BTV Basis[1]	Residential 100% Garden Produce Consumed 10^{-6} RBSL (pCi/g)[2]	BTV Based on EPA's USL95 or HNDV (pCi/g)	LUTV (pCi/g)[3]	Risk of LUTV[4]	Ratio of RBSL to LUTV[5]
Actinium-227	Ac-227	NORM	USL95	1.52E-02	1.27E-01	2.05E-01	1.35E-05	7.41E-02
Actinium-228	Ac-228	NORM	USL95	2.10E+02	2.30E+00	2.68E+00	1.28E-08	7.84E+01
Americium-241	Am-241	Man-made	USL95	1.10E-01	1.62E-02	**3.90E-02**	3.55E-07	2.82E+00
Americium-243	Am-243	Man-made	HNDV	6.39E-02	1.34E-02	2.52E-02	3.94E-07	2.54E+00
Antimony-125	Sb-125	Man-made	USL95	3.75E-01	3.21E-01	3.74E-01	9.97E-07	1.00E+00
Barium137m	Ba-137m	Man-made	USL95	6.03E+24	1.83E-01	-	-	-
Bismuth-212	Bi-212	NORM	USL95	1.22E+16	2.04E+00	2.38E+00	1.95E-22	5.13E+15
Bismuth-214	Bi-214	NORM	USL95	2.52E+03	1.57E+00	1.83E+00	7.26E-10	1.38E+03
Cadmium-113m	Cd-113m	Man-made	USL95	-	2.95E+03	3.44E+03	-	-
Carbon-14	C-14	MM and NORM	USL95	9.20E-01	2.54E+00	2.96E+00	3.22E-06	3.11E-01
Cesium-134	Cs-134	Man-made	USL95	1.25E-01	3.00E-02	8.01E-02	6.41E-07	1.56E+00
Cesium-137	Cs-137	Man-made	USL95	4.72E-02	1.93E-01	**2.25E-01**	4.77E-06	2.10E-01
Cobalt-60	Co-60	Man-made	HNDV	3.07E-02	5.56E-03	**3.63E-02**	1.18E-06	8.46E-01
Curium-243/244	Cm-243/244	Man-made	HNDV	1.10E-01	1.47E-02	3.96E-02	3.60E-07	2.78E+00
Curium-245/246	Cm-245/246	Man-made	USL95	5.46E-02	1.62E-02	3.46E-02	6.34E-07	1.58E+00
Curium-248	Cm-248	Man-made	HNDV	1.02E-02	2.34E-02	3.98E-02	3.90E-06	2.56E-01
Europium-152	Eu-152	Man-made	USL95	3.82E-02	1.69E-02	**7.39E-02**	1.93E-06	5.17E-01
Europium-154	Eu-154	Man-made	USL95	4.62E-02	2.51E-02	**1.98E-01**	4.29E-06	2.33E-01
Europium-155	Eu-155	Man-made	USL95	2.96E+00	1.98E-01	**2.31E-01**	7.80E-08	1.28E+01
Holmium-166m	Ho-166m	Man-made	USL95	1.61E-02	3.65E-02	5.14E-02	3.19E-06	3.13E-01
Iodine-129	I-129	Man-made	USL95	1.77E-02	1.54E+00	2.42E+00	1.37E-04	7.31E-03
Iron-55	Fe-55	Man-made	USL95	-	5.08E+00	-	-	-
Lead-210	Pb-210	NORM	USL95	4.30E-03	2.07E+00	-	-	-
Lead-212	Pb-212	NORM	USL95	9.12E+07	2.67E+00	3.11E+00	3.41E-14	2.93E+07
Lead-214	Pb-214	NORM	USL95	1.87E+03	1.68E+00	1.96E+00	1.05E-09	9.54E+02
Neptunium-236	Np-236	Man-made	USL95	-	3.14E-02	5.99E-02	-	-
Neptunium-237	Np-237	Man-made	USL95	-	1.09E-02	1.47E-01	-	-
Neptunium-239	Np-239	Man-made	HNDV	-	4.27E-02	1.67E-01	-	-
Nickel-59	Ni-59	Man-made	HNDV	-	3.44E-01	**8.75E-01**	-	-
Nickel-63	Ni-63	Man-made	HNDV	9.85E+00	4.52E-01	1.34E+00	1.36E-07	7.35E+00
Niobium-94	Nb-94	Man-made	USL95	1.57E-02	1.65E-02	2.74E-02	1.75E-06	5.73E-01
Plutonium-236	Pu-236	Man-made	USL95	-	1.84E-02	3.49E-02	-	-
Plutonium-238	Pu-238	Man-made	USL95	9.77E-02	4.25E-03	**2.54E-02**	2.60E-07	3.85E+00
Plutonium-239/240	Pu-239/240	Man-made	USL95	8.60E-02	1.42E-02	**2.30E-02**	2.67E-07	3.74E+00
Plutonium-241	Pu-241	Man-made	HNDV	-	3.49E-01	6.04E+00	-	-
Plutonium-242	Pu-242	Man-made	USL95	-	2.46E-03	-	-	-
Plutonium-244	Pu-244	Man-made	USL95	1.50E-02	1.56E-03	1.35E-02	9.00E-07	1.11E+00
Polonium-210	Po-210	NORM	USL95	2.90E-01	2.09E+00	-	-	-
Potassium-40	K-40	NORM	USL95	1.39E-02	3.05E+01	3.55E+01	2.55E-03	3.92E-04
Promethium-147	Pm-147	Man-made	USL95	-	4.96E+00	1.45E+01	-	-
Protactinium-231	Pa-231	NORM	USL95	8.12E-03	7.91E-01	1.22E+00	1.50E-04	6.66E-03

Table 1. Background Radionuclides, RBSLs, BTVs and LUTVs								
Analyte	**Symbol**	**Man-made or NORM**	**BTV Basis[1]**	**Residential 100% Garden Produce Consumed 10^{-6} RBSL (pCi/g)[2]**	**BTV Based on EPA's USL95 or HNDV (pCi/g)**	**LUTV (pCi/g)[3]**	**Risk of LUTV[4]**	**Ratio of RBSL to LUTV[5]**
Radium-226	Ra-226	NORM	USL95	2.10E-03	1.88E+00	2.19E+00	1.04E-03	9.59E-04
Radium-228	Ra-228	NORM	USL95	8.02E-03	2.30E+00	-	-	-
Radon-220	Rn-220	NORM	USL95	6.28E+10	2.27E+00	-	-	-
Radon-222	Rn-222	NORM	USL95	6.60E+00	1.61E+00	-	-	-
Sodium-22	Na-22	Man-made	USL95	-	7.87E-03	4.68E-02	-	-
Strontium-90	Sr-90	Man-made	USL95	1.12E-02	7.50E-02	**1.17E-01**	1.04E-05	9.57E-02
Technetium-99	Tc-99	Man-made	USL95	2.29E-03	3.68E-01	6.19E-01	2.70E-04	3.70E-03
Tellurium-125m	Te-125m	Man-made	USL95	2.59E+01	7.61E-02	-	-	-
Thallium-208	Tl-208	NORM	USL95	1.75E+24	9.23E-01	1.07E+00	6.11E-31	1.64E+24
Thorium-228	Th-228	NORM	USL95	7.73E-02	3.67E+00	**4.27E+00**	5.52E-05	1.81E-02
Thorium-229	Th-229	Man-made	USL95	1.30E-02	4.62E-02	7.41E-02	5.70E-06	1.75E-01
Thorium-230	Th-230	NORM	USL95	2.11E-03	2.04E+00	**2.38E+00**	1.13E-03	8.87E-04
Thorium-231	Th-231	NORM	USL95	9.13E+04	1.30E+01	-	-	-
Thorium-232	Th-232	NORM	USL95	2.38E-03	2.95E+00	**3.44E+00**	1.45E-03	6.92E-04
Thorium-234	Th-234	NORM	USL95	8.04E+01	3.04E+00	3.54E+00	4.40E-08	2.27E+01
Thulium-171	Tm-171	Man-made	HNDV	1.12E+02	6.59E+01	7.67E+01	6.85E-07	1.46E+00
Tin-126	Sn-126	Man-made	HNDV	-	4.90E-03	3.09E-02	-	-
Tritium	H-3	MM and NORM	USL95	1.68E-01	7.38E+00	8.59E+00	5.11E-05	1.96E-02
Uranium-232	U-232	Man-made	HNDV	-	5.65E-02	-	-	-
Uranium-233/234	U-233/234	MM and NORM	USL95	3.22E-03	1.87E+00	**2.18E+00**	6.77E-04	1.48E-03
Uranium-235/236	U-235/236	MM and NORM	USL95	7.23E-03	1.30E-01	**1.52E-01**	2.10E-05	4.76E-02
Uranium-238	U-238	MM and NORM	USL95	1.87E-03	1.68E+00	**1.96E+00**	1.05E-03	9.54E-04
Uranium-240	U-240	Man-made	USL95	-	1.56E-03	-	-	-

Total LUTV Risk **8.64E-03**

1 BTV based on USL95 or the highest non-detect value (HNDV) for radionuclides with fewer than five detections (2011 EPA Background Study).

2 Residential with 10% garden garden produce consumed 10^{-6} RBSL taken from Exhibit 5, Attachment 5, Table 1 of the Settlement Agreement.

3 Red bold data are DTSC's draft provisional LUTs identical to those in Exhibit 5, Attachment 5, Table 1 of the Settlement Agreement. Other LUTV data based on the same criterion, namely the lowest radiological reference concentration between Lab A and Lab B, usually Lab B unless Lab B has no data in which case it is Lab A.

4 Dominant contributors to cancer risk from naturally-occurring radionuclides in background soil

5 10^{-6} Residential 100% Garden Produce Consumptionn RBSL exceeds LUTV. RBSL/LUTV exceeds 1.0.