OPPOSITION TO THE

DTSC-BOEING SETTLEMENT AGREEMENT

May 23, 2022

DTSC-Boeing Settlement Agreement

The following represents the views and opinions of the author and does not represent the views and opinions of The Boeing Company. The following is restricted to comments on the proposed radiological cleanup in the "Boeing Areas of Responsibility."

On May 9, 2022, DTSC issued another proclamation relating to a "Settlement Agreement" with The Boeing Company, following a 15-month secret "mediation" with Boeing. With its usual fanfare, DTSC issued a press release[1] with self-serving sound bites from Gavin Newsom, Jared Blumenfeld, Meredith Williams, and Renee Purdy. CalEPA reiterated the same with an identical press release.[2] DTSC emailed and mailed a Community Update,[3] and its website summarized the Settlement Agreement[4] and provided the Settlement Agreement itself.[5]

The Settlement Agreement was signed by,

- Lawrence Hafetz, Chief Counsel, DTSC (using digital font)
- Steven L. Shestag, Senior Director, The Boeing Company (using his real signature)

The press announcements and sound bites refer to delays in cleanup due to disputes over cleanup standards. With the exception of Boeing's successful SB 990 lawsuit against the State, all lawsuits have been initiated by Dan Hirsch and other activist organizations against the California Department of Public Health, DTSC itself, the Department of Energy, and Boeing. Added to this was the plethora of Senate Bills, directed against SSFL, that have also been initiated by Dan Hirsch using then State Senator Sheila Kuehl and her colleagues as proxies. This

[1] DTSC, "California holds Boeing accountable for cleanup at toxic Santa Susana Field Laboratory." May 23, 2022. Available at https://dtsc.ca.gov/2022/05/09/california-holds-boeing-accountable-for-cleanup-at-toxic-santa-susana-field-laboratory/. Accessed May 16, 2022.

[2] CalEPA, "California holds Boeing accountable for cleanup at toxic Santa Susana Field Laboratory." May 23, 2022. Available at https://calepa.ca.gov/2022/05/09/press-release-california-holds-boeing-accountable-for-cleanup-at-toxic-santa-susana-field-laboratory/. Accessed May 16, 2022.

[3] DTSC, "Community Update: Comprehensive Framework Holds Boeing Accountable for Cleanup at Santa Susana Field Laboratory." May 2022. Available at https://www.philrutherford.com/SSFL/Settlement_Agreement/Settlement_Agreement_Community_Update.pdf. Accessed May 23, 2022.

[4] DTSC, "Boeing Cleanup Settlement Agreement." Available at https://dtsc.ca.gov/boeing-cleanup-settlement-agreement/. Accessed May 23, 2022.

[5] DTSC, "Settlement Agreement." May 9, 2022. Available at https://www.envirostor.dtsc.ca.gov/public/deliverable_documents/5013550281/SSFL%20DTSC-Boeing%20Settlement%20Agreement%20%28Final%29.pdf. Accessed May 23, 2022.

activist led litigation and legislation is described in "Nuclear Decommissioning in California."[6] Since Dan Hirsch was not a party in the mediation and not a signatory to the Settlement Agreement, there is no guarantee that future lawsuits will not occur if things do not go as he wants.

Dissimilar Treatment of Radionuclides and Chemicals

The primary bullet of CalEPA's "comprehensive framework"[7] is,

- *"Boeing will clean up radionuclides in soil in its areas of responsibility to "background," i.e., levels that would exist locally without industrial activity."*

This same statement also appears in the forefront of the DTSC press release, CalEPA press release, DTSC Community Update and DTSC Settlement Agreement web page.

Interestingly, this statement does not appear at all in the 31-page main body of the Settlement Agreement, neither do the words "radionuclides" nor "background" appear. The requirement to cleanup radionuclides to background was banished to Exhibit 5, Attachment 5, page 179 of the 796-page document.

This aspect of the Settlement Agreement flies in the face of Boeing's refusal to sign up to the 2010 AOC cleanup-to-background protocols and Boeing's hard-fought and hard-won success in the SB 990 legal battle. What are the current decision makers in Boeing thinking? What has changed between 2010 and 2022? We will never know because the mediation talks were, and will continue to be, secret.

Why are cleanup goals for radionuclides different from cleanup goals for chemicals? Does DTSC regard radionuclides as more harmful than chemicals? EPA regulates both chemicals and radionuclides using the same risk assessment guidance. DTSC has chosen to require a cleanup-to-background philosophy for radionuclides, but a risk-based, residential/garden philosophy for chemicals. DTSC has limited the land-use options, for chemicals, ignoring the future realistic land use of open-space. However, DTSC may potentially follow EPA guidance, using EPCs, RMEs, and NCP risk management decisions to determine a risk goal between 10^{-6} and 10^{-4}. In contrast, DTSC will not allow EPA risk assessment guidance or risk management decision making for radionuclides. DTSC mandates cleanup to background for radionuclides for no good reason.

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[6] Rutherford, "Nuclear Decommissioning in California: 20+ Years of Politics vs. Science." Available at https://www.philrutherford.com/SSFL/Nuclear_Decommissioning_in_California.pdf. Accessed May 23, 2022.

[7] CalEPA, "Santa Susana Field Laboratory Cleanup Development." May 9, 2022. Available at https://calepa.ca.gov/sitecleanup/santa-susana-field-laboratory-cleanup-development/. Accessed May 23, 2022.

Possible reasons that DTSC mandates cleanup to background for radionuclides include,

- It is what Dan Hirsch wants.
- It is consistent with the 2010 AOCs.
- It is even more restrictive than SB 990.
- It is a recitation of EPA's 2013 flawed comment on the draft NASA EIS in which it claims, incorrectly, that both Hunters Point Naval Shipyard and McClellan Airforce Base cleanup radionuclides to background.[8] See Appendix A of this paper that describes the actual radiological cleanup at these two sites. Both sites use risk-based cleanup goals in excess of background, both use the NCP[9] risk management range of 10^{-6} to 10^{-4}, and neither allow home garden produce consumption because of deed restrictions.
- It is possible that DTSC recognizes that in "Boeing Areas of Responsibility," chemical contamination is the main issue. It may rationalize that since the potential for widespread and significant radiological contamination is so low in non-Area IV locations, that it (and Boeing) can afford to impose more restrictive goals on radionuclides than chemicals. See the following two sections.

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[8] EPA, "Comments on Draft [NASA] EIS for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory, Ventura and Los Angeles Counties, California (CEQ# 20130227)", September 30, 2013. https://www.philrutherford.com/SSFL/NASA/EPA_NASA_SSFL_DEIS_Comments_30Sep13.pdf. Accessed May 23, 2022.

[9] EPA, "National Oil and Hazardous Substances Pollution Contingency Plan: Remedial Investigation/Feasibility Study and Selection of Remedy." 40 CFR 300.430(e)(2)(i)(A)*(2)* and 300.430(e)(9)(iii). Available at https://www.law.cornell.edu/cfr/text/40/300.430. Accessed May 23, 2022.

Comparison of Radionuclide and Chemical Contamination in Area IV

Based on characterization soil sampling data, DOE estimated[10] the following areas and volume of soil exceeding background in Area IV.[11]

Classification based on exceeding LUT values	Soil Volume (cubic yards)	Area (acres)	Percent of total area of 472 acres[12]
Exceeding only chemical LUTs	1,506,000	204	43%
Exceeding both chemical and radionuclide LUTs	106,000	15	3.2%
Exceeding only radionuclide LUTs	4,000	3	0.66%

Clearly, these numbers dispel the long-standing myth of widespread radiological contamination in Area IV. To the contrary, chemical contamination in Area IV is a far greater issue.

Potential for Radionuclide Contamination in the Balance of SSFL

The potential for radiological contamination in the balance of SSFL, where no nuclear research occurred, is significantly smaller than even the low areal percentage in Area IV. Nevertheless, over the last 15 years, chemical sampling in non-Area IV locations, the northern drainage in Area I, NASA ISRA locations in Area II, and the Area I Burn Pit, and other locations has been accompanied by radionuclide sampling for the purposes of waste characterization. The Area IV Burn Pit is known to have radium-226 contamination due the incineration of radium-containing F1 engine igniters. Occasional LUT exceedances elsewhere are likely due to background variability.

Risk of Background Radionuclides

Table 1 of Attachment 5 of Exhibit 5 of the Settlement Agreement is titled "Radiological Risk-Based Screening Levels (RBSL), Background Threshold Values (BTV), and Lookup Table (LUT) Values." BTVs in this table are based on the UTL95-95 of the EPA background data set. This is contrary to the BTV's published by EPA themselves which were based on the USL95.[13] The LUT

[10] DOE, Final Environmental Impact Statement. Summary. Table 8-2. November 2018. https://www.energy.gov/sites/prod/files/2018/12/f58/final-eis-0402-etec-2018-12-summary.pdf. Accessed May 23, 2022.

[11] Defined as exceeding the 2010 AOC LUT values.

[12] Area IV (290 acres) plus NBZ (182 acres)

[13] EPA, "Final Technical Memorandum: Look-Up Table Recommendations, Santa Susana Field Laboratory, Area IV Radiological Study", November 27, 2012. Available at https://www.dtsc-ssfl.com/files/lib_doe_area_iv/epaareaivsurvey/techdocs/65778_Final_Tech_Memo_Lookup_Table_Recommendations_112712.pdf. Accessed May 23, 2022.

values given in Table 1 of the Agreement are identical to the DTSC draft provisional LUTs[14,15] that were based on the EPA's USL95 BTVs. The BTVs and LUTs in Table 1 of the Settlement Agreement are therefore internally inconsistent.

DTSC provides an extensive, well-written, discussion of the pros and cons of using UCL95, UPL95, UTL95-95 and USL95 as parametric estimates of background (BTV).[16] DTSC concludes that USL95 is appropriate for DOE and NASA AOC protocols that require single sample comparisons to a parametric upper estimate of background. In contrast, DTSC concludes that UTL95-95 is appropriate for Boeing areas in which excess risk above background is to be calculated. Since USL95 values always exceed UTL95-95 values, utilizing UTL95-95 will be conservative. Note however that this recommendation was made in 2013, when Boeing's intent was to conduct a risk-based cleanup for chemicals and radionuclides. Since the 2022 Settlement Agreement, mandates cleanup of radionuclides to background (i.e. zero risk), that is, more akin to the 2010 AOC, it would seem that using the USL95 for BTV would now be more appropriate for Boeing areas. The 2013 paper also states,

> *"[DTSC} HERO has previously supported and continues to support using [non-parametric] population-based tests such as the Wilcoxon Rank Sum test as a primary method to evaluate background-versus-site populations for COPC/COPEC selection on the Boeing portions of the SSFL site."*

This is consistent with MARSSIM[17] recommendations for radionuclide cleanup and would be a more appropriate background-versus-site non-parametric test for ROPCs in Boeing portions of SSFL.

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14 DTSC, "Draft Provisional Radiological Look-Up Table Values", January 30, 2013. Available at https://www.dtsc-ssfl.com/files/lib_look-uptables/radiological/66513_65861_Draft_Provisional_Radiological_Look-Up_Table_Values_1-30-13.pdf. Accessed May 23, 2022.

15 DTSC, "Development of the Draft Provisional Radiological Look-Up Table", January 30, 2013. Available at https://www.philrutherford.com/SSFL/DTSC/65860_D-Provisional_Rad_LUT_final_1-30-13.pdf. Accessed May 23, 2022.

16 DTSC, "Statistical Methods for Application in the Chemical Soil Background Study for the Modified Site Evaluation Approach of the AOCs (DOE and NASA) and for Risk Assessment-Based Approach (Boeing) at the Santa Susana Field Laboratory, Ventura County, CA", May 9, 2013. Available at https://www.dtsc-ssfl.com/files/lib_look-uptables/chemical/66069_Statistical_Methods_for_Application_in_the_Chemical_Soil_background_Study.pdf. Accessed May 23, 2022.

17 EPA, NRC, DOE, and DoD, "Multi-Agency Radiation Survey and Site Investigation Manual." Available at https://www.epa.gov/radiation/multi-agency-radiation-survey-and-site-investigation-manual-marssim. Accessed May 23, 2022.

Suffice to say that the 15-page paper is a discussion of "what is background and what is not background," and loses sight of what the correct discussion that should be, "what is safe and what is not safe." The following paragraphs illustrate this.

Table 1 below provides both versions of BTVs plus LUTs and calculates the hypothetical risk of background soil radionuclides by dividing the BTVs and LUTs by the resident garden RBSL and multiplying by 10^{-6}. RBSLs, BTV (UTL95-95), and draft provisional LUT values are taken directly from Table 1 of the Settlement Agreement. BTV(USL95) values are taken from the previously referenced EPA LUT recommendation document.

Irrespective of which BTV or LUT is used, the total residential with garden produce consumption risk from background radionuclides is close to 1 in a hundred or 1% (0.8%, 0.68% and 0.86%), far above 10^{-6} or the 10^{-6} to 10^{-4} risk management range. The dominant contributors to background radionuclide risk are the naturally occurring radionuclides, lead-210, potassium-40, radium-226, thorium-230, thorium-232, uranium-233/234 and uranium-238. Radionuclides contributing more than 5% of total are highlighted in yellow.

It would be more correct to estimate risk from background radionuclides in soil based the means of the sample population or the UCL95 of the mean (as is done in the Silvernale risk assessment in Exhibit 20 of the Settlement Agreement). However DTSC's 2010 AOC protocols regard each individual site sample that meets the respective LUT, as having met the zero-excess risk, background goal, requiring no further remediation.

Over a dozen uranium and thorium decay products (progeny) were not evaluated in the EPA's background and Area IV study. The risk contributions of these additional radionuclides are therefore not included in the risk summation. The LUT values are always higher than corresponding BTVs (whether calculated by USL95 or UTL95-95). EPA included laboratory measurement uncertainty (Um) by adding 1.645*Um to the USL95 BTVs to derive LUTs. Table 1 of this paper shows the ratio of LUT to the EPA BTV. For easily detected NORM, and primary ROPCs, Cs-137, Sr-90, and Pu-239, the LUT exceeds the BTV by a modest 17% to 60 %. For less easily detected radionuclides, the additive laboratory uncertainty is more pronounced with LUT to BTV ratios of 2.5 to 8.

Table 1 also shows the ratio of DTSC BTV(UTL95-95) to the EPA BTV(USL95). The DTSC BTV is always less than the EPA BTV and therefore more conservative/restrictive, unless the BTV was based on the highest non-detect value, in which case the two BTVs are identical. The average BTV ratio is 0.83.

Individual Risk vs. Population Risk

When uncontaminated soil has a radiation risk of close to 0.01, does it make sense to set risk goals of 10^{-6}, 10^{-5} or even 10^{-4}? More to the point does it make sense to set a risk goal of zero, which is what cleanup-to-background seeks to achieve? Individual risk probabilities (ELCR) give the false impression that 10^{-6} is one hundred times "safer" than 10^{-4}. In reality, post-remedial individual radiation risk for risk-based and background cleanup programs would be …

Remedial Plan	**Post-remedial individual risk (Bkgd + RBSL)**
10^{-4} risk-based cleanup	0.01 + 0.000100 = 0.010100
10^{-5} risk-based cleanup	0.01 + 0.000010 = 0.010010
10^{-6} risk-based cleanup	0.01 + 0.000001 = 0.010001
Background cleanup	0.01 + 0.000000 = 0.010000

These risks are functionally equivalent. It can be better seen by calculating the population risks rather than individual risks using Area IV as an example since that is still subject to the 2010 AOC. The area of Area IV is 290 acres, some of which is rocky and inaccessible. Let us assume that 200 acres could be utilized for housing development. Typical home lots in the neighboring Bell Canyon, mountainous, gated community are 1 acre in size. Assume each home has 4 residents. The population of Area IV would be 200 x 4 = 800. Let us assume 1,000 to make the math easier. The above table now becomes …

Remedial Plan	**Post-remedial <u>individual</u> risk (probability of cancer)**	**<u>Population</u> risk (No. of expected cancers)**
10^{-4} risk-based cleanup	0.01 + 0.000100 = 0.010100	1,000 x 0.010100 = 10.100
10^{-5} risk-based cleanup	0.01 + 0.000010 = 0.010010	1,000 x 0.010010 = 10.010
10^{-6} risk-based cleanup	0.01 + 0.000001 = 0.010001	1,000 x 0.010001 = 10.001
Background cleanup	0.01 + 0.000000 = 0.010000	1,000 x 0.010000 = 10.000

Individual risk has units of probability and can vary between 0 and 1. If future regulators decide that 10^{-6} is not low enough, they could require 10^{-7}, 10^{-8}, or 10^{-9} as more politically correct, with the belief that each successive reduction in individual risk achieves an additional factor of safety of 10. DTSC has gone even further, requiring a zero-risk goal. However, what is not taken into account, is the population to be exposed to any residual contamination. Population risk is simply individual risk times population exposed. The unit of population risk is, "expected number of cancers in the exposed population." Expected cancers is not a probability constrained between 0 and 1. Expected cancers can only be an integer, 0, 1, 2, 3, etc. Expected cancers cannot be fractional. It is like pregnancy. You cannot be fractionally pregnant. You either are pregnant or not pregnant. You either have cancer or you do not have cancer. The population risk numbers in the example above are all functionally equivalent to 10 since fractional cancers are meaningless. If we just look at the excess cancers, 0.1, 0.01 and 0.001, these are all functional equivalent to zero. Contrary to the perceived geometrical achievement of successive levels of safety, cleanup to lower levels of excess individual risk, does not achieve any additional level of population risk (or safety). Note also that 10 expected cancers in a population of 1,000 from naturally occurring radionuclides in uncontaminated soil would be indistinguishable from the 40% individual risk or 400 expected cancers in a population of 1,000 according to US statistics.[18]

These risk estimates assume that the linear no-threshold theory of radiation risk is valid at and far below background radiation doses and background dose variability.

Ratio of RBSL to Background (LUT)

Any risk-based cleanup goal is in excess, or incremental to background. Hence a gross cleanup goal (GCG) is …

GCG = LUT + RBSL

Practicality of cleanup depends strongly on the relative magnitudes of LUT and RBSL. If the RBSL <<< LUT, then the RBSL will be indistinguishable from LUT (background). This is the case for uranium-238 where LUT = 1.96 pCi/g and the RBSL is 1.87E-3 pCi/g, 1,000 times smaller. The laboratory +/-2σ uncertainty for uranium alpha spectroscopy is typically 0.1 to 0.3 pCi/g, far in excess of the RBSL. Referring to the Table 1, this is equivalent to looking for an additive risk of 10^{-6} in a background risk of 10^{-3}. This is the classic "low signal to noise problem" and applies to a greater or lessor extent for all high-risk naturally occurring radionuclides where RBSL <<< LUT.

If the RBSL is <=> LUT then the RBSL will be distinguishable from LUT. This is the case for the primary anthropogenic radionuclides of concern observed by EPA in Area IV, namely cesium-137 (291 BTV exceedances), strontium-90 (153 BTV exceedances) and, to a lesser extent, plutonium-239 (14 BTV exceedances).[19]

The cesium-137 LUT is 0.225 pCi/g and the RBSL is 0.0472 pCi/g. If the risk goal were increased from 10^{-6} to 10^{-4}, consistent with cleanup at McClellan Airforce Base[20], the 10^{-4} PRG would be 4.72 pCi/g. Adding the LUT of 0.225 pCi/g will give a gross cleanup goal of 4.945 pCi/g. 4.72 pCi/g is close to the 2002 EPA/NRC Memorandum of Understanding (MOU) for residential cesium-137 of 6 pCi/g (See section below). It is apparent that when RBSL >> LUT, then precise knowledge and estimates of background becomes less important, since background can be

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[18] American Cancer Society, "Lifetime Risk of Developing or Dying of Cancer", https://www.cancer.org/healthy/cancer-causes/general-info/lifetime-probability-of-developing-or-dying-from-cancer.html. Accessed May 23, 2022.

[19] EPA, "Santa Susana Field Laboratory - EPA Radiological Characterization Study Results", November 2012. Available at https://www.boeing.com/resources/boeingdotcom/principles/environment/pdf/EPA_November_2012_Factsheet.pdf. Accessed May 23, 2022.

[20] See Appendix A

essentially ignored. The question then becomes more appropriately "what is safe and what is not safe," not "what is background and what is not background." Note that 6 pCi/g is the $\underline{10^{-4}}$ risk level of cesium-137 for residential with limited garden produce consumed, in Attachment 3 of Exhibit 5 in the Settlement Agreement.

The plutonium-239 LUT is 0.023 pCi/g and the RBSL is 0.086 pCi/g. Therefore cleaning to an excess 10^{-6} residential garden level would clean to 0.023 + 0.086 = 0.109 pCi/g. Cleaning to background would clean to 0.023 pCi/g or a 4 times lower gross concentration than the excess 10^{-6} level and achieve a total plutonium-239 residual risk level of $0.023 * 10^{-6} / 0.086 = 2.67 \times 10^{-7}$ risk level, well below the 10^{-6} to 10^{-4} NCP risk management range. Clearly, this is unreasonable.

EPA/NRC Memorandum of Understanding

The 2002 EPA/NRC Memorandum of Understanding (MOU)[21,22] provided radionuclide goals in soil at NRC-licensed decommissioned sites that would be acceptable to EPA under CERCLA. These goals were based on reasonably-anticipated, future land use, including residential and industrial/commercial at the $\underline{10^{-4}}$ risk level, not 10^{-6}, and not background.

The EPA/NRC MOU acceptable residential soil concentrations[23] for naturally occurring radionuclides and ROPCs include,

Radionuclide	**pCi/g**
Radium-226	5
Cesium-137	6
Strontium-90	23
Thorium-232	5
Uranium-238	74
Plutonium-239	259

These cleanup goals are acceptable to EPA and NRC and clearly exceed the more restrictive RBSLs, BTVs and LUTs discussed above relative to the DTSC-Boeing Settlement Agreement.

The question remains … why is SSFL treated differently from other sites in the US?

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[21] EPA, "Memorandum of Understanding Between the Environmental Protection Agency and the Nuclear Regulatory Commission - Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites", October 9, 2002. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100K3YY.PDF?Dockey=P100K3YY.PDF. Accessed May 23, 2022.

[22] EPA, "Distribution of Memorandum of Understanding between EPA and Nuclear Regulatory Commission", OSWER 9295.8-06a, October 9, 2002. Available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100K3Z6.PDF?Dockey=P100K3Z6.PDF. Accessed May 23, 2022.

[23] MOU values are risk-based and therefore sum-of-fractions should be used for multiple contaminants

Table 1. Background Radionuclides

Analyte	Symbol	Anthropogenic or NORM	BTV Basis[1]	Resident with Garden 10^{-6} RBSL (pCi/g)[2]	BTV Based on EPA's USL95 or HNDV (pCi/g)	BTV Based on DTSC's UTL95-95 or HNDV (pCi/g)[2]	Risk of EPA's BTV	Risk of DTSC's BTV	% of Total Risk (EPA)	% of Total Risk (DTSC)	LUT Value (pCi/g)[3]	Risk of LUT	Ratio of LUT to EPA BTV	Ratio of RBSL to LUT	Ratio of DTSC BTV to EPA BTV
Actinium-227	Ac-227	NORM	USL95	1.52E-02	1.27E-01	9.52E-02	8.36E-06	6.26E-06	0.1%	0.1%	2.05E-01	1.35E-05	1.61E+00	7.41E-02	0.75
Actinium-228	Ac-228	NORM	USL95	2.10E+02	2.30E+00	2.10E+00	1.10E-08	1.00E-08	0.0%	0.0%	2.68E+00	1.28E-08	1.17E+00	7.84E+01	0.91
Americium-241	Am-241	Man-made	USL95	1.10E-01	1.62E-02	1.42E-02	1.47E-07	1.29E-07	0.0%	0.0%	**3.90E-02**	3.55E-07	2.41E+00	2.82E+00	0.88
Americium-243	Am-243	Man-made	HNDV	6.39E-02	1.34E-02	1.34E-02	2.10E-07	2.10E-07	0.0%	0.0%	2.52E-02	3.94E-07	1.88E+00	2.54E+00	1.00
Antimony-125	Sb-125	Man-made	USL95	3.75E-01	3.21E-01	2.54E-01	8.56E-07	6.77E-07	0.0%	0.0%	3.74E-01	9.97E-07	1.17E+00	1.00E+00	0.79
Barium137m	Ba-137m	Man-made	USL95	6.03E+24	1.83E-01	1.46E-01	3.03E-32	2.42E-32	0.0%	0.0%	-	-	-	-	0.80
Bismuth-212	Bi-212	NORM	USL95	1.22E+16	2.04E+00	1.67E+00	1.67E-22	1.37E-22	0.0%	0.0%	2.38E+00	1.95E-22	1.17E+00	5.13E+15	0.82
Bismuth-214	Bi-214	NORM	USL95	2.52E+03	1.57E+00	1.53E+00	6.23E-10	6.07E-10	0.0%	0.0%	1.83E+00	7.26E-10	1.17E+00	1.38E+03	0.97
Cadmium-113m	Cd-113m	Man-made	USL95	-	2.95E+03	2.66E+03	-	-	-	-	3.44E+03	-	1.17E+00	-	0.90
Carbon-14	C-14	MM and NORM	USL95	9.20E-01	2.54E+00	2.38E+00	2.76E-06	2.59E-06	0.0%	0.0%	2.96E+00	3.22E-06	1.17E+00	3.11E-01	0.94
Cesium-134	Cs-134	Man-made	USL95	1.25E-01	3.00E-02	2.30E-02	2.40E-07	1.84E-07	0.0%	0.0%	8.01E-02	6.41E-07	2.67E+00	1.56E+00	0.77
Cesium-137	Cs-137	Man-made	USL95	4.72E-02	1.93E-01	1.57E-01	4.09E-06	3.33E-06	0.1%	0.0%	**2.25E-01**	4.77E-06	1.17E+00	2.10E-01	0.81
Cobalt-60	Co-60	Man-made	HNDV	3.07E-02	5.56E-03	5.56E-03	1.81E-07	1.81E-07	0.0%	0.0%	**3.63E-02**	1.18E-06	6.53E+00	8.46E-01	1.00
Curium-243/244	Cm-243/244	Man-made	HNDV	1.10E-01	1.47E-02	1.47E-02	1.34E-07	1.34E-07	0.0%	0.0%	3.96E-02	3.60E-07	2.69E+00	2.78E+00	1.00
Curium-245/246	Cm-245/246	Man-made	USL95	5.46E-02	1.62E-02	1.47E-02	2.97E-07	2.69E-07	0.0%	0.0%	3.46E-02	6.34E-07	2.14E+00	1.58E+00	0.91
Curium-248	Cm-248	Man-made	HNDV	1.02E-02	2.34E-02	2.34E-02	2.29E-06	2.29E-06	0.0%	0.0%	3.98E-02	3.90E-06	1.70E+00	2.56E-01	1.00
Europium-152	Eu-152	Man-made	USL95	3.82E-02	1.69E-02	1.09E-02	4.42E-07	2.85E-07	0.0%	0.0%	**7.39E-02**	1.93E-06	4.37E+00	5.17E-01	0.64
Europium-154	Eu-154	Man-made	USL95	4.62E-02	2.51E-02	2.14E-02	5.43E-07	4.63E-07	0.0%	0.0%	**1.98E-01**	4.29E-06	7.89E+00	2.33E-01	0.85
Europium-155	Eu-155	Man-made	USL95	2.96E+00	1.98E-01	1.56E-01	6.69E-08	5.27E-08	0.0%	0.0%	**2.31E-01**	7.80E-08	1.17E+00	1.28E+01	0.79
Holmium-166m	Ho-166m	Man-made	USL95	1.61E-02	3.65E-02	2.35E-02	2.27E-06	1.46E-06	0.0%	0.0%	5.14E-02	3.19E-06	1.41E+00	3.13E-01	0.64
Iodine-129	I-129	Man-made	USL95	1.77E-02	1.54E+00	1.13E+00	8.70E-05	6.38E-05	1.1%	0.9%	2.42E+00	1.37E-04	1.57E+00	7.31E-03	0.73
Iron-55	Fe-55	Man-made	USL95	-	5.08E+00	4.34E+00	-	-	-	-	-	-	-	-	0.85
Lead-210	Pb-210	NORM	USL95	4.30E-03	2.07E+00	1.67E+00	4.81E-04	3.88E-04	6.0%	5.7%	-	-	-	-	0.81
Lead-212	Pb-212	NORM	USL95	9.12E+07	2.67E+00	2.48E+00	2.93E-14	2.72E-14	0.0%	0.0%	3.11E+00	3.41E-14	1.16E+00	2.93E+07	0.93
Lead-214	Pb-214	NORM	USL95	1.87E+03	1.68E+00	1.64E+00	8.98E-10	8.77E-10	0.0%	0.0%	1.96E+00	1.05E-09	1.17E+00	9.54E+02	0.98
Neptunium-236	Np-236	Man-made	USL95	-	3.14E-02	2.15E-02	-	-	-	-	5.99E-02	-	1.91E+00	-	0.68
Neptunium-237	Np-237	Man-made	USL95	-	1.09E-02	8.18E-03	-	-	-	-	1.47E-01	-	1.35E+01	-	0.75
Neptunium-239	Np-239	Man-made	HNDV	-	4.27E-02	4.27E-02	-	-	-	-	1.67E-01	-	3.91E+00	-	1.00
Nickel-59	Ni-59	Man-made	HNDV	-	3.44E-01	3.44E-01	-	-	-	-	**8.75E-01**	-	2.54E+00	-	1.00
Nickel-63	Ni-63	Man-made	HNDV	9.85E+00	4.52E-01	4.52E-01	4.59E-08	4.59E-08	0.0%	0.0%	1.34E+00	1.36E-07	2.96E+00	7.35E+00	1.00
Niobium-94	Nb-94	Man-made	USL95	1.57E-02	1.65E-02	1.21E-02	1.05E-06	7.71E-07	0.0%	0.0%	2.74E-02	1.75E-06	1.66E+00	5.73E-01	0.73
Plutonium-236	Pu-236	Man-made	USL95	-	1.84E-02	1.57E-02	-	-	-	-	3.49E-02	-	1.90E+00	-	0.85
Plutonium-238	Pu-238	Man-made	USL95	9.77E-02	4.25E-03	3.13E-03	4.35E-08	3.20E-08	0.0%	0.0%	**2.54E-02**	2.60E-07	5.98E+00	3.85E+00	0.74
Plutonium-239/240	Pu-239/240	Man-made	USL95	8.60E-02	1.42E-02	9.36E-03	1.65E-07	1.09E-07	0.0%	0.0%	**2.30E-02**	2.67E-07	1.62E+00	3.74E+00	0.66
Plutonium-241	Pu-241	Man-made	HNDV	-	3.49E-01	3.49E-01	-	-	-	-	6.04E+00	-	1.73E+01	-	1.00
Plutonium-242	Pu-242	Man-made	USL95	-	2.46E-03	1.92E-03	-	-	-	-	-	-	-	-	0.78
Plutonium-244	Pu-244	Man-made	USL95	1.50E-02	1.56E-03	1.40E-03	1.04E-07	9.33E-08	0.0%	0.0%	1.35E-02	9.00E-07	8.65E+00	1.11E+00	0.90
Polonium-210	Po-210	NORM	USL95	2.90E-01	2.09E+00	1.72E+00	7.21E-06	5.93E-06	0.1%	0.1%	-	-	-	-	0.82
Potassium-40	K-40	NORM	USL95	1.39E-02	3.05E+01	2.60E+01	2.19E-03	1.87E-03	27.3%	27.4%	3.55E+01	2.55E-03	1.16E+00	3.92E-04	0.85
Promethium-147	Pm-147	Man-made	USL95	-	4.96E+00	3.92E+00	-	-	-	-	1.45E+01	-	2.92E+00	-	0.79
Protactinium-231	Pa-231	NORM	USL95	8.12E-03	7.91E-01	5.62E-01	9.74E-05	6.92E-05	1.2%	1.0%	1.22E+00	1.50E-04	1.54E+00	6.66E-03	0.71
Radium-226	Ra-226	NORM	USL95	2.10E-03	1.88E+00	1.82E+00	8.95E-04	8.67E-04	11.1%	12.7%	2.19E+00	1.04E-03	1.16E+00	9.59E-04	0.97
Radium-228	Ra-228	NORM	USL95	8.02E-03	2.30E+00	2.10E+00	2.87E-04	2.62E-04	3.6%	3.8%	-	-	-	-	0.91
Radon-220	Rn-220	NORM	USL95	6.28E+10	2.27E+00	2.01E+00	3.61E-17	3.20E-17	0.0%	0.0%	-	-	-	-	0.89
Radon-222	Rn-222	NORM	USL95	6.60E+00	1.61E+00	1.58E+00	2.44E-07	2.39E-07	0.0%	0.0%	-	-	-	-	0.98
Sodium-22	Na-22	Man-made	USL95	-	7.87E-03	6.61E-03	-	-	-	-	4.68E-02	-	5.95E+00	-	0.84
Strontium-90	Sr-90	Man-made	USL95	1.12E-02	7.50E-02	5.12E-02	6.70E-06	4.57E-06	0.1%	0.1%	**1.17E-01**	1.04E-05	1.56E+00	9.57E-02	0.68
Technetium-99	Tc-99	Man-made	USL95	2.29E-03	3.68E-01	2.65E-01	1.61E-04	1.16E-04	2.0%	1.7%	6.19E-01	2.70E-04	1.68E+00	3.70E-03	0.72
Tellurium-125m	Te-125m	Man-made	USL95	2.59E+01	7.61E-02	5.95E-02	2.94E-09	2.30E-09	0.0%	0.0%	-	-	-	-	0.78
Thallium-208	Tl-208	NORM	USL95	1.75E+24	9.23E-01	8.03E-01	5.27E-31	4.59E-31	0.0%	0.0%	1.07E+00	6.11E-31	1.16E+00	1.64E+24	0.87
Thorium-228	Th-228	NORM	USL95	7.73E-02	3.67E+00	3.00E+00	4.75E-05	3.88E-05	0.6%	0.6%	**4.27E+00**	5.52E-05	1.16E+00	1.81E-02	0.82
Thorium-229	Th-229	Man-made	USL95	1.30E-02	4.62E-02	3.33E-02	3.55E-06	2.56E-06	0.0%	0.0%	7.41E-02	5.70E-06	1.60E+00	1.75E-01	0.72
Thorium-230	Th-230	NORM	USL95	2.11E-03	2.04E+00	1.64E+00	9.67E-04	7.77E-04	12.0%	11.4%	**2.38E+00**	1.13E-03	1.17E+00	8.87E-04	0.80
Thorium-231		NORM	USL95	9.13E+04	1.30E+01	1.01E-01	1.42E-10	1.11E-12	0.0%	0.0%	-	-	-	-	0.01
Thorium-232	Th-232	NORM	USL95	2.38E-03	2.95E+00	2.36E+00	1.24E-03	9.92E-04	15.4%	14.6%	**3.44E+00**	1.45E-03	1.17E+00	6.92E-04	0.80
Thorium-234	Th-234	NORM	USL95	8.04E+01	3.04E+00	2.34E+00	3.78E-08	2.91E-08	0.0%	0.0%	3.54E+00	4.40E-08	1.16E+00	2.27E+01	0.77
Thulium-171	Tm-171	Man-made	HNDV	1.12E+02	6.59E+01	6.59E+01	5.88E-07	5.88E-07	0.0%	0.0%	7.67E+01	6.85E-07	1.16E+00	1.46E+00	1.00
Tin-126	Sn-126	Man-made	HNDV	-	4.90E-03	4.90E-03	-	-	-	-	3.09E-02	-	6.31E+00	-	1.00
Tritium	H-3	MM and NORM	USL95	1.68E-01	7.38E+00	4.89E+00	4.39E-05	2.91E-05	0.5%	0.4%	8.59E+00	5.11E-05	1.16E+00	1.96E-02	0.66
Uranium-232	U-232	Man-made	HNDV	-	5.65E-02	5.65E-02	-	-	-	-	-	-	-	-	1.00
Uranium-233/234	U-233/234	MM and NORM	USL95	3.22E-03	1.87E+00	1.55E+00	5.81E-04	4.81E-04	7.2%	7.1%	**2.18E+00**	6.77E-04	1.17E+00	1.48E-03	0.83
Uranium-235/236	U-235/236	MM and NORM	USL95	7.23E-03	1.30E-01	1.01E-01	1.80E-05	1.40E-05	0.2%	0.2%	**1.52E-01**	2.10E-05	1.17E+00	4.76E-02	0.78
Uranium-238	U-238	MM and NORM	USL95	1.87E-03	1.68E+00	1.52E+00	8.98E-04	8.13E-04	11.2%	11.9%	**1.96E+00**	1.05E-03	1.17E+00	9.54E-04	0.90
Uranium-240	U-240	Man-made	USL95	-	1.56E-03	1.40E-03	-	-	-	-	-	-	-	-	0.90
						Total Risk	8.04E-03	6.81E-03	100.0%	100.0%	Total Risk	8.64E-03			
												Average	2.81	Average	0.83

[1] BTV based on USL95 or the highest non-detect value (HNDV) for radionuclides with fewer than five detections.

[2] Resident with garden RBSL and DTSC BTV taken from Table 1, Attahment 5, Exhibit 5.

[3] Red bold data are DTSC's draft provisional LUTs identical to those in Table 1, Attachment 5, Exhibit 5 of the Settlement Agreement. Other 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.

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

APPENDIX A

RADIOLOGICAL CLEANUP AT

HUNTERS POINT NAVAL SHIPYARD AND

MCCLELLAN AIR FORCE BASE

Risk-Based Radiological Cleanup at Hunters Pont Naval Shipyard and McClellan Air Force Base

In 2013, EPA commented on the draft NASA EIS.[24]

> *"We agree that cleanup of radioactively contaminated soil to background is imperative. EPA and DTSC have cooperatively overseen the cleanup of radioactive contamination to background at, for example, Hunter's Point Naval Shipyard and McClellan Airforce Base. For chemical contamination sites , EPA, as well as DTSC, typically performs soil cleanups to health-based levels, unless background concentrations exceed those health-based levels."*

This statement by Tom Kelly of EPA is absurd on several levels.

- EPA's well known preliminary remediation goals (PRG)[25] establish a process to calculate net risk-based cleanup goals in excess of background. Why would Mr. Kelly dispense with his own agency's established protocols? Why would cleanup of radioactively contaminated soils to background at SSFL be imperative?

- The statement that Hunters Pont uses radiological background as a cleanup goal is incorrect. At Hunter's Point, risk-based residential remedial goals, incremental above background, have been selected. Excess cancer risks from these remedial goals have been shown to meet the NCP's risk management range of 10^{-6} to 10^{-4}.[26,27,28] Gross cleanup levels would therefore be background plus net risk-based remedial goals.

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[24] EPA, "Comments on Draft EIS for Proposed Demolition and Environmental Cleanup Activities at Santa Susana Field Laboratory, Ventura and Los Angeles Counties, California (CEQ# 20130227)", September 30, 2013. https://www.philrutherford.com/SSFL/NASA/EPA_NASA_SSFL_DEIS_Comments_30Sep13.pdf. Accessed May 23, 2022.

[25] EPA, "Preliminary Remediation Goals for Radionuclides." Available at https://epa-prgs.ornl.gov/radionuclides/. Accessed May 23, 2022.

[26] Department of Navy, "Final Basewide Radiological Removal Action - Action Plan Memorandum - Revision 2006 - Hunters Point Shipyard, San Francisco, California", Table 1. April 21, 2006. Available at https://www.philrutherford.com/Hunters_Point/hps_200604_memo_rad.pdf. Accessed May 23, 2022.

[27] Department of Navy, "Draft Addendum to the Five-Year Review, Evaluation of Radiological Remedial Goals for Soil, Hunters Point Naval Shipyard, San Francisco, CA" including enclosure "Estimated Excess Cancer Risks and Dose Equivalent Rates from Resident Exposures to Radionuclide-Containing Soils Report", August 8, 2019. Available at https://www.philrutherford.com/Hunters_Point/HPNS_20190808_Draft_Evaluation_of_Soil_Radiological_Remedial_Goals.pdf. Accessed May 23, 2022.

[28] Navy Base Realignment and Closure (BRAC), Hunters Point Naval Shipyard - Environmental Program Update", Extracted slide showing selected background and cleanup goals. July 2020. Available at https://www.philrutherford.com/Hunters_Point/Extract_from_HPNS_07292020_Navy_Update_Presentation.pdf. Accessed May 23, 2022.

Hunters Point residential land use also does NOT include home garden produce consumption because of deed restrictions.

- The statement that McClellan uses background as a radiological cleanup goal is incorrect. The Administrative Record for McClellan AFB contains numerous references to the risk basis for radiological cleanup levels.

    - Table 80 of the 2014 McClellan Record of Decision (ROD)[29] provides the residential cleanup level for the only radionuclide of concern, namely radium-226. The cleanup level is 2.0 pCi/g, based on an incremental carcinogenic risk (i.e., risk in excess of background) of 1×10^{-4} (Table 80 footnote d). The 1×10^{-4} risk level for residential exposure was selected because the 1×10^{-6} risk level (for both industrial and residential) would be indistinguishable from background for most (though not all) radionuclides. Under CERCLA, cleanup levels are generally not set at concentrations below natural background values (Section 2.8.3 Basis of Cleanup Levels).

    - The Air Force provided a basis for its cleanup goals in a 2010 position statement.[30] Table 4-1 provides radium-226 95th percentile of background of 0.78 pCi/g, and a residential $\underline{10^{-4}}$ PRG of 1.21 pCi/g (net). Background plus net PRG = 0.78 + 1.21 = 1.99 pCi/g. The McClellan (gross) risk-based cleanup level was therefore chosen to be 2.0 pCi/g.

    - Section 4 observes that EPA commonly employs standards for radium-226 in soil based on 40 CFR 192[31] and dose standards in 10 CFR 61[32] as applicable or relevant and appropriate requirements (ARARs) for EPA CERCLA cleanups. These standards are 5 pCi/g in excess of background. As a result post-cleanup risk levels

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[29] Department of the Air Force, "Follow-on Strategic Sites Record of Decision - McClellan Air Force Base", Section 2.8.3 "Basis of Cleanup Levels" and Table 80. July 1, 2014. Available at https://www.philrutherford.com/McClellan/ROD_2014-04.pdf. Accessed May 23, 2022.

[30] Noblis, "Air Force Real Property Agency Position On Radiation Background Levels and Cleanup Goals at the Former McClellan Air Force Base", Section 4 and Table 4-1, October 2010. Available at https://www.philrutherford.com/McClellan/S1693_Position_Paper_on_Radiation_Background_Levels_McClellan_Oct2010.pdf. Accessed May 23, 2022.

[31] EPA, 40 CFR 192, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings", Available at https://www.govinfo.gov/content/pkg/CFR-2018-title40-vol27/pdf/CFR-2018-title40-vol27-part192.pdf. Accessed May 23, 2022.

[32] NRC, 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." Available at https://www.nrc.gov/reading-rm/doc-collections/cfr/part061/full-text.html. Accessed May 23, 2022.

at EPA led CERCLA sites are frequently in the range 10^{-4} to 10^{-3}.

- McClellan has imposed institutional controls via deed restrictions that prohibit residential development and therefore consuming residential garden produce is not a viable land use option.

To summarize, both Hunters Point and McClellan use risk-based cleanup goals, use the full range of the NCP risk management range of 10^{-6} to 10^{-4}, and neither allow nor model home garden produce consumption because of deed restrictions.