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Pacific Northwest
National Laboratory
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Authorized Limits Request: Radiological Clearance of Select Hanford Reach National Monument Lands

B. A. Napier
W. M. Glines

April 2004

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RL01830

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Richland, Washington 99352

(a) U.S. Department of Energy
Richland Operations Office

Executive Summary

In June 2000, a Presidential Proclamation created the 195,000-acre Hanford Reach National Monument (HRNM) within the boundaries of the U.S. Department of Energy (DOE) Hanford Site. In July 2001, the DOE Office of Inspector General (OIG) issued Audit Report DOE/IG-0514, *Administrative Control of the Hanford Reach National Monument* (DOE 2001). This audit concluded that it was not in DOE's best interest to retain administrative control of all land within the HRNM, and identified approximately 143,000 acres of land within the HRNM that could be transferred to the U.S. Department of the Interior (DOI). The lands identified for transfer include land in the Wahluke Slope, Fitzner/Eberhardt Arid Lands Ecology Reserve, and McGee Ranch/Riverland areas.

The transfer of these lands would constitute a release from DOE control. Therefore, before these lands may be transferred to the DOI, the DOE Richland Operations Office (DOE-RL) must evaluate the potential for residual radioactive contamination on these lands, and demonstrate compliance with the requirements of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. For any potential residual radioactive contamination, DOE Order 5400.5 requires that radiological release criteria, i.e., Authorized Limits, be developed and submitted to the applicable DOE headquarters program office for approval, i.e., for Hanford, the DOE Office of Environmental Management. DOE Order 5400.5 requires that: "The authorized limits shall be established to 1) provide that, at a minimum, the basic dose limits … will not be exceeded, or 2) be consistent with applicable generic guidelines." Since generic guidelines have not been established for volumetric residual radioactivity for the radionuclides of concern for these select HRNM lands, the requested authorized limits have been established to ensure that the public dose limit of 100 mrem per year is not exceeded.

Accordingly, the goal of this effort was to produce Authorized Limits, in units of picocuries per gram in soil, for the HRNM that would result in radiation doses of less than 100 mrem per year to members of the public. These requested Authorized Limits were developed using "realistic," yet conservative, radiation dose analyses based on the "likely use" and "worst use" scenarios. The expected end-use, i.e., likely use scenario, for these HRNM lands is recreational use. In accordance with the guidance in DOE G 441.1-XX, *Implementation Guide: Control and Release of Property with Residual Radioactive Material for Use with DOE 5400.5, Radiation Protection of the Public and the Environment*, a dose constraint of 25 mrem per year is applied to this likely use scenario in developing Authorized Limits. The worst use scenario is considered to be a subsistence farmer, i.e., Agricultural Resident Scenario, for which the primary 100 mrem per year public dose limit is applied. The RESRAD Version 6.21 (Yu et al. 2001) computer program was used as the calculational model for translating these dose values into surface soil concentrations for each radionuclide of concern. Soil concentrations were developed for each identified radionuclide, each exposure scenario, and several geographical units of the HRNM. The final Authorized Limits were determined as the most limiting (smallest) soil concentrations for each radionuclide across scenarios and HRNM locations.

Although such activities would be precluded by the Presidential Proclamation and the expected terms and conditions of the transfer to DOI, the requested Authorized Limits shown in Table S.1 were based on

Table S.1. Authorized Limits for Soil on the Hanford Reach National Monument

Radionuclide	Authorized Limit, pCi/g
^{241}Am	420
^{60}Co	11
^{134}Cs	20
^{137}Cs	46
^{152}Eu	24
^{239}Pu	480
^{240}Pu	480
^{90}Sr	88
^{234}U	2400
^{235}U	190
^{238}U	770

the calculated soil concentrations by radionuclide for the Agricultural Resident Scenario. This scenario provides a conservative, bounding scenario to assure that DOE dose limits will not be exceeded by future users of these HRNM lands.

As part of the radiological clearance process for this property, a historical site assessment (HSA) was performed and documented. This HSA reviewed historical environmental data collected on and around these lands and developed a contaminant transport conceptual model. The HSA concluded that there is no reason to expect that soil contamination levels on this property are any different from the contamination levels found in areas of the Hanford Site where there have been no radiological operations. Based on these environmental data, the maximum dose to any member of the public would be less than or equal to 0.3 mrem per year for the expected end-use of these lands, i.e., recreational use, and the collective dose to the population potentially using the property is estimated to be no more than 5 person-rem per year.

Implementation of these requested Authorized Limits would require development of a sampling and analysis plan for the collection and analyses of surface soil samples from the selected HRNM lands, collection and analyses of these samples, assessment of these data against the Authorized Limits, generation of a final report, and inclusion of all pertinent data and information into a formal records management system.

The collection and analysis of soil samples would be performed by the Pacific Northwest National Laboratory (PNNL) group currently providing environmental monitoring services for the Hanford Site. This collection and analysis of samples would be conducted in accordance with the PNNL procedures currently used for collecting and analyzing environmental soil samples.

The estimated cost associated with the radiological release of these select HRNM lands is approximately $216,000. The current annual costs associated with DOE control and management of these lands is approximately $100,000. In addition, DOE is currently making payments to local governments

of approximately $1,500,000 for payment in lieu of taxes. Accordingly, DOE could save as much as $1,600,000 per year by transferring this property to DOI.

Only a qualitative ALARA assessment was performed for these requested Authorized Limits. This assessment concluded that the requested Authorized Limits are ALARA for these reasons: 1) the expected doses would be very small; 2) there would be no practical alternative to the proposed release; and 3) there would be a significant economic advantage to DOE.

DOE-RL has discussed the proposed radiological clearance and transfer of these selected HRNM lands with staff representatives of the DOI Fish and Wildlife Service (USFWS) and the state of Washington Department of Health (WDOH). Both the USFWS and WDOH staff representatives are in agreement with the general approach and methodologies used to develop the requested Authorized Limits.

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1.0 Introduction

In June 2000, a Presidential Proclamation created the 195,000-acre Hanford Reach National Monument (HRNM) within the boundaries of the U.S. Department of Energy (DOE) Hanford Site (65 FR 144). Although the Department maintains administrative control and jurisdiction over the land within the HRNM, the U.S. Department of the Interior (DOI), U.S. Fish and Wildlife Service (USFWS), manages about 84% of the land. In July 2001, the DOE Office of Inspector General (OIG) issued Audit Report DOE/IG-0514, *Administrative Control of the Hanford Reach National Monument* (DOE 2001). This audit concluded that it was not in DOE's best interest to retain administrative control of all land within the HRNM, and identified approximately 143,000 acres that could be transferred to the DOI without adversely impacting operations at the Hanford Site. The lands identified for transfer include land in the Wahluke Slope, Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve, and McGee Ranch/Riverland areas, which had previously been identified as nonessential for carrying out DOE's mission at the Hanford Site. Subsequently, the DOE Richland Operations Office (DOE-RL) entered into discussions with the DOI regarding the terms and conditions for transferring these lands. In addition to being consistent with the DOE OIG audit report, transfer of these lands would support the primary DOE environmental management mission to remediate and/or release as much of the Hanford Site as possible.

The transfer of these lands would constitute a release from DOE control. Therefore, before these lands may be transferred to the DOI, DOE-RL must evaluate the potential for residual radioactive contamination on these lands, and demonstrate compliance with the requirements of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, (DOE 1993). For any land with the potential for residual radioactive contamination, DOE Order 5400.5 requires that radiological clearance or release criteria, i.e., Authorized Limits, be developed and submitted to the applicable DOE headquarters program office for approval. For the HRNM lands this would be the DOE Office of Environmental Management (DOE-EM). Authorized limits are defined as levels of residual radioactivity that shall not be exceeded if the property is to be released without restrictions on use due to residual radioactivity. Residual radioactivity is defined as any radioactive material that is in or on soil, air, equipment, or structures as a consequence of past DOE operations or activities. Authorized Limits act to control the amount of residual radioactivity on property that is released from DOE radiological controls.

DOE Order 5400.5 requires that: "The authorized limits shall be established to 1) provide that, at a minimum, the basic dose limits … will not be exceeded, or 2) be consistent with applicable generic guidelines." Since generic guidelines have not been established for volumetric residual radioactivity for the radionuclides of concern for these select HRNM lands, the requested Authorized Limits have been established to ensure that the public dose limit of 100 mrem per year is not exceeded.

The RESRAD Version 6.21 (Yu et al. 2001) computer program was used as the calculational model. The goal of this effort was to produce Authorized Limits, in units of picocuries per gram in soil, for the HRNM that would result in radiation doses less than 100 mrem per year to members of the public.

This request for Authorized Limits for residual radioactivity on the specified HRNM lands has been prepared in accordance with the requirements of DOE Order 5400.5 and the guidance in DOE G 441.1-XX.

2.0 Description of the Property

As shown in Figure 2.1, the HRNM includes approximately 306 square miles of the Hanford Site. The land for which these Authorized Limits are requested comprises three major management units included within the HRNM: the 1) Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve unit (a 120-square-mile tract in the southwestern portion of the Hanford Site); 2) combined Saddle Mountain unit (a 50-square-mile tract located north-northwest of the Columbia River and generally south and east of State Highway 24) and Wahluke unit (an 87-square-mile tract located north and east of both the Columbia River and the Saddle Mountain unit) (the Saddle Mountain unit and the Wahluke Unit together are referred to as the North Slope); plus 3) McGee Ranch/Riverlands unit (located on the western portion of the Hanford Site and bordered by State Highway 24, the Columbia River, private land in the Cold Creek Valley, and the Yakima Firing Center). These three units have been designated for transfer to DOI. A remaining portion of the HRNM will be administered only by DOE and includes the Columbia River islands of Benton County, the Columbia River Corridor (one-fourth mile inland from the river shoreline) on the Hanford (Benton County) side of the river, and the sand dunes area located along the Columbia River north of Energy Northwest. Approximately 400 acres along the north side of the Columbia River, west of the Vernita Bridge, and south of State Highway 243 are managed by the Washington State Department of Fish and Wildlife.

All structures on these lands and any associated equipment or materials are excluded from these requested Authorized Limits.

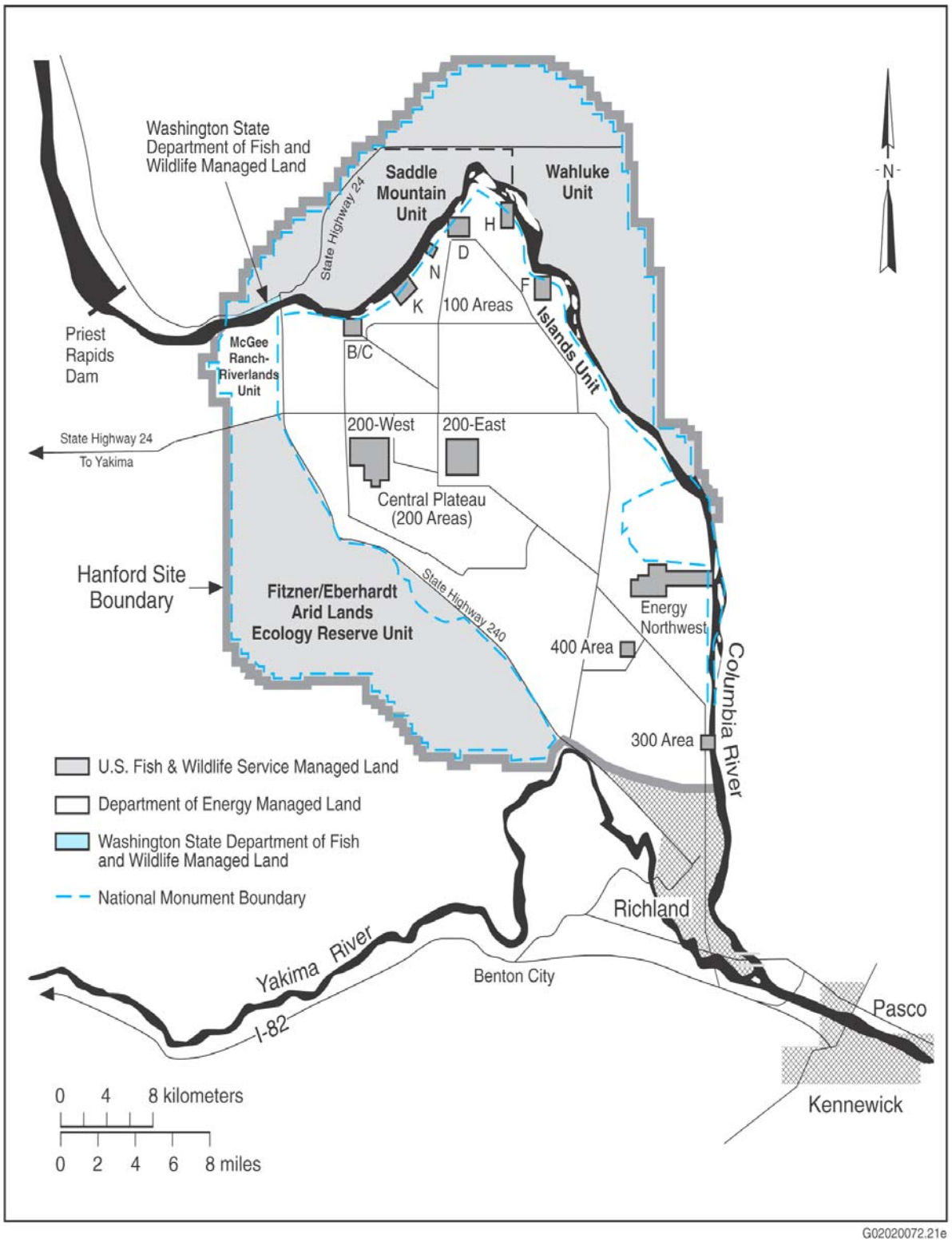

Figure 2.1. Hanford Reach National Monument Units

3.0 Expected Radiological Conditions of the Property

As part of the radiological clearance process for this property, an historical site assessment (HSA) was performed and documented as PNNL-13989, *Historical Site Assessment: Select Hanford Reach National Monument Lands-Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve, McGee Ranch, Riverlands, and Wahluke Slope* (Fritz et al. 2003). This HSA reviewed historical environmental data collected on and around these lands and developed a contaminant transport conceptual model. Interviews were conducted with people who are knowledgeable of past Hanford Site operations that may have contributed to residual contamination on this property.

The HSA concluded that: "In general, the data available indicate that the HRNM units of interest have very low concentrations of radionuclides. Radionuclide concentrations are very near the analytical detection levels for most media and locations… Further, the data do not indicate a strong likelihood of transport of significant amounts of long-lived radioactive material from Hanford operating areas to national monument lands … The median radionuclide concentrations in each media were generally similar at each unit. In addition, the majority of the observed concentrations on the ALE, McGee/ Riverlands and North Slope units were similar to the concentrations observed at reference locations. This implies that atmospheric fallout from above-ground weapons testing contributed significantly to the low levels of manmade radionuclides that were measured in the HRNM environs." Thus, the expected concentrations of residual radionuclides in the soil on the site are very low, in the range of background concentrations.

4.0 Expected End-Use of the Property

Under the Presidential Proclamation, the HRNM is withdrawn from all forms of entry and disposition under public land laws, and off-road vehicle traffic is prohibited except for emergencies and federally approved purposes. Accordingly, the expected end-use of these lands does not allow permanent residential, agricultural, or industrial activities, and is expected to be recreational uses only. For purposes of establishing Authorized Limits, two groups of potentially exposed individuals have been identified: 1) recreational visitors to the Monument (based on expected end-use of these lands), and 2) full-time residents engaged in subsistence farming, i.e., an agricultural resident (based on the assumption that restrictions that control end-use of these HRNM lands fail, or the actual end-use is different from the expected end-use).

5.0 Authorized Limits Requested

5.1 Statement of Authorized Limits

The basic concept upon which the requested Authorized Limits are developed is that (subject to an ALARA assessment) the concentration of any specific radionuclide in the residual radioactivity in the soil would not result in a dose in excess of 100 mrem per year to any member of the public under the assumed future uses of the property. DOE G 441.1-XX recommends establishing a dose constraint of 25 mrem per year to members of the public due to exposure to residual radioactivity in property released from DOE control. This dose constraint applies to likely future uses of the property.

The requested Authorized Limits for soils on the HRNM are shown in Table 5.1 in units of picocuries per gram in soil for radionuclides of concern as identified in the HSA.

For radionuclides with decay chains, e.g., uranium-238, all values are presented in terms of the activity of the parent and include contributions from the decay progeny. The derivation of these values is described in Napier et al. (2004). These Authorized Limits are to be applied to radionuclide concentrations above those occurring in natural and global anthropomorphic background. Background concentrations of radionuclides in soils are provided in DOE/RL-95-55, Rev. 0, *Hanford Site Background: Evaluation of Existing Soil Radionuclide Data*, and DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE 1995; DOE 1996). Consistent with Washington State guidance (WDOH 1997), the 90th percentile background radionuclide concentrations will be used when subtracting the background contribution from soil measurements. Soil background concentration subtraction will be performed on a radionuclide-specific basis.

The Authorized Limits for any mixture of the radionuclides shown in Table 5.1 are found using the sum of fractions rule. A determination of whether a radionuclide mixture meets the Authorized Limits is

Table 5.1. Authorized Limits for Soil on the Hanford Reach National Monument

Radionuclide	Authorized Limit, pCi/g
^{241}Am	420
^{60}Co	11
^{134}Cs	20
^{137}Cs	46
^{152}Eu	24
^{239}Pu	480
^{240}Pu	480
^{90}Sr	88
^{234}U	2400
^{235}U	190
^{238}U	770

made if the sum, over all radionuclides in the mixture, of the measured concentration of each radionuclide divided by its specific Authorized Limit is less than or equal to one. Mathematically, the sum of fractions rule is as follows:

$$\sum_{i=1}^{n} C_i / AL_i \leq 1$$

where: C_i = the concentration of radionuclide i in soil,
AL_i = the Authorized Limit for radionuclide i, and
n = the number of radionuclides in the mixture.

5.2 Basis for Authorized Limits

The selection of radionuclides is based on an assessment of the radiological history of this property (as documented in the HSA) that concluded that there is no reason to expect that the soil contamination levels on the property are any different from the contamination levels found in areas of the Hanford Site where there have been no radiological operations. That is, the man-made radioactivity in the soil is expected to be primarily from global fallout.

These Authorized Limits were developed using "realistic," yet conservative, radiation dose analyses based on the "likely use" and "worst use" scenarios. As previously indicated, in accordance with the Presidential Proclamation that created the HRNM, the expected end-use, i.e., likely use scenario, for these HRNM lands is recreational use. In accordance with the guidance in DOE G 441.1-XX, *Implementation Guide: Control and Release of Property with Residual Radioactive Material for Use with DOE 5400.5, Radiation Protection of the Public and the Environment*, a dose constraint of 25 mrem/y is applied to this likely use scenario in developing Authorized Limits. A worst use scenario was developed specifically for these HRNM lands being transferred to DOI. This worst use scenario is considered to be a subsistence farmer. In accordance with DOE G 441.1-XX, this scenario represents the situation in which restrictions that control end-use of these HRNM lands fail, or the actual end-use is different from the expected end-use. Although the Presidential Proclamation and the expected terms and conditions of the transfer of these HRNM lands to DOI would preclude such a worst use scenario, it provides a conservative, bounding scenario to assure that DOE dose limits or constraints will not be exceeded by future users of these HRNM lands. Accordingly, for the radiation dose analyses used to develop these requested Authorized Limits, two types of exposed individuals were identified: 1) recreational users of the HRNM (Avid Recreational Use Scenario), and 2) agricultural residents (Agricultural Resident Scenario). Primary data for these individual types and the associated exposure scenarios, and the parameter and data used as input to the computer models, were obtained from the recent literature (Fritz et al. 2003; Napier and Snyder 2002; and WDOH 1997).

The RESRAD Version 6.21 (Yu et al. 2001) computer program was used as the calculational model. The goal of this effort was to produce Authorized Limits, in units of picocuries per gram in soil, for the HRNM that would result in radiation doses of less than 100 mrem per year to members of the public. The computer models and data were used to generate Authorized Limits, in units of picocuries per gram of soil, resulting in a dose of 25 mrem/y for the recreational user and 100 mrem/y for the agricultural

resident. Surface soil concentrations were developed for each identified radionuclide, each exposure scenario, and several geographical units of the HRNM. The final Authorized Limits were determined as the most limiting (smallest) soil concentrations for each radionuclide, across scenarios and HRNM locations.

The groundwater beneath these select HRNM lands does not contain any of the major Hanford contaminant plumes, and based on groundwater monitoring results, does not contain any radioactive contaminants in excess of National Primary Drinking Water Standards (EPA 2000). The depth to groundwater throughout most of the ALE unit (the closest to the existing Hanford groundwater plumes) is up to 200 ft. No drinking water wells exist or are planned for these select HRNM areas. Accordingly, no groundwater pathways were included in the Avid Recreational Use Scenario. However, groundwater pathways were included in the Agricultural Resident Scenario to ensure conservatism in the requested Authorized Limits.

The Authorized Limits shown in Table 5.1 are based on calculated soil concentrations by radionuclide for the Agricultural Resident Scenario (which was always the most restrictive). This approach to the derivation of these Authorized Limits was used in recognition of the uncertainties associated with defining the exact activities associated with future use of the HRNM. This approach was used to compensate for the uncertainties and to produce Authorized Limits such that it is unlikely that any user of the HRNM would receive a dose in excess of 100 mrem per year.

In conducting these analyses, attempts were made to "realistically," yet conservatively, model the end-use conditions of the HRNM, given the uncertainty associated with potential future activities. However, it should be noted that conservative assumptions were used in several cases to assure that the resulting Authorized Limits would be protective of 100 mrem per year. Some of the more important assumptions contributing to the conservative nature of the results include the following:

- Assuming uniform distributions of radioactive contamination to a depth of 15 cm. Since for most areas of the HRNM atmospheric deposition was the primary origin of the residual radioactive contamination, and since it is unlikely that uniform mixing could occur to this depth, this assumption would cause a conservative treatment of the external exposure pathway and contribute to the development of conservative Authorized Limits for photon-emitting radionuclides.

- Uniform spatial distributions of radionuclides across the HRNM lands, since many areas have no, or non-detectable levels of, radionuclides.

- Although there is no mechanism apart from atmospheric deposition for establishing residual contaminations in the surface water ponds at the HRNM, a pathway was established for purposes of analysis. (This pathway was not an important contributor for any of the modeled radionuclides.)

- Inclusion of relatively high ingestion rates for game for the Avid Recreational User (e.g., 22 kg per year) and farm crops for the Agricultural Resident (e.g., nearly 120 kg per year of local produce and 110 L per year of local milk) scenarios contributed to the conservative treatment of the ingestion pathway and were a contributor to the determination of the HRNM Authorized Limits for several radionuclides.

Finally, as described in Napier et al. (2004), two alternative methods for the derivation of radiation doses from soil concentrations were identified and evaluated. These are the methods underlying the Memorandum of Understanding between the U.S. Environmental Protection Agency (EPA) and the U.S. Nuclear Regulatory Commission regarding *Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites* (EPA 2002), and Report No. 129 by the National Council on Radiation Protection and Measurements (NCRP) on *Recommended Screening Limits for Contaminated Surface Soil and Review of Factors Relevant to Site-Specific Studies* (NCRP 1999), using the sparsely vegetated, rural scenario. Scenario comparisons show the requested HRNM Authorized Limits developed using the RESRAD code are remarkably close to those developed using alternative methods (see Table 5.2), using different models, scenarios, and assumptions, and that the requested HRNM Authorized Limits would be protective of the primary 100 mrem per year public dose limit.

Table 5.2. Comparison of HRNM Authorized Limits with Alternative Models/Methods

Radionuclide	Agricultural Resident	EPA/NRC Trigger Values		NCRP No. 129	
	Authorized Limit, pCi/g	pCi/g at 100 mrem/year	Ratio HRNM to NRC	pCi/g at 100 mrem/year	Ratio HRNM to NCRP
^{241}Am	420	748	0.6	142	3.0
^{60}Co	11	16	0.7	7.9	1.4
^{134}Cs	20	64	0.3	17	1.2
^{137}Cs	46	24	1.9	36	1.3
^{152}Eu	24	16	1.5	22	1.1
^{239}Pu	480	1040	0.5	130	3.7
^{240}P	480	1040	0.5	120	4.0
^{90}Sr	88	92	1.0	7.9	11
^{234}U	2400	1600	1.5	370	6.5
^{235}U	190	80	2.4	61	3.1
^{238}U	770	296	2.6	270	2.9

6.0 ALARA Assessment

As previously stated, the expected concentrations of residual radionuclides in the soil on these HRNM lands are very low, in the range of background concentrations. Using the largest measured values from the existing monitoring data for these HRNM lands, the doses to recreational users are calculated to be below 0.3 mrem per year and to any potential agricultural residents to be below 3 mrem per year. Based on the guidance in DOE G 441.1-XX, a quantitative ALARA (as low as reasonably achievable) assessment is not required if the expected doses are a small fraction of the dose constraint, as is the case for these HRNM lands.

There is no practical alternative for these HRNM lands other than transfer to the DOI. Retention of these lands under DOE control would be inconsistent with the DOE environmental management mission at the Hanford Site, and the conclusion of the DOE OIG. Any remediation of these lands to lower the potential dose would be impractical, since it would involve removing large quantities of soil from an ecologically sensitive area with very little dose reduction. The cost and environmental effect of such a remediation has not been estimated, but it would be much more than the benefit of the fraction of a person-rem per year of dose that it might save.

DOE Order 5400.5 requires that certain factors be considered in ALARA assessments. Most of these factors address the comparison of alternatives for the proposed action. Since there is no reasonable alternative to the proposed action—release and transfer of the property using the requested Authorized Limits—this ALARA assessment will consider only two of the factors: 1) maximum dose to members of the public, and 2) collective dose to the population.

6.1 Maximum Dose to Members of the Public

As discussed above, the maximum dose to members of the public would be less than or equal to 0.3 mrem per year for the expected end-use of these lands. This maximum expected dose is only 0.3% of the DOE dose limit (100 mrem per year) for members of the public, and only 1.2% of the DOE dose constraint (25 mrem per year) for likely future use of the property. This value of 0.3 mrem per year is also well below the dose value given by the NCRP as a Negligible Individual Dose. NCRP Report 116, *Limitation of Exposure to Ionizing Radiation* (NCRP 1993), states: "The Council, therefore, recommends that an annual effective dose of 0.01 mSv be considered a Negligible Individual Dose (NID) per source or practice." (**Note**: 0.01 mSv = 1 mrem.)

6.2 Collective Dose to the Population

The collective dose to the population potentially using the property is estimated to be no more than 5 person-rem per year. This total collective dose estimate is based on a 15,000-person recreational use population with each person receiving the maximum 0.3 mrem per year. Based on the HSA, the actual collective dose to this population would likely to be considerably less than this value. Furthermore, doses to members of the public off the property would be even less. This can be seen by comparison to the doses for airborne radionuclides, including blowing dust, to members of the public calculated annually for Hanford. (Doses to members of the public off the property would be due to windblown transport of

radionuclides in blowing dust.). As documented in the *Hanford Site Environmental Report for Calendar Year 2002* (Poston et al. 2003), the maximum dose to a non-DOE worker on-site was calculated to be 79 micro-rem, and the maximum dose to an off-site exposed individual was 22 micro-rem. The exposure due to the airborne radionuclides (dust blowing) from the HRNM lands would be a small fraction of these values. Also, for the year 2002, the total cumulative population dose from all Hanford effluents and emissions was 0.3 person-rem; the collective dose from blowing dust from the HRNM lands would be a very small fraction of this value.

Implementation of these requested Authorized Limits would require development of a sampling and analysis plan for the collection and analyses of surface soil samples from the selected HRNM lands, collection and analyses of these samples, assessment of these data against the Authorized Limits, generation of a final report, and inclusion of all pertinent data and information into a formal records management system. The estimated cost of these activities associated with the radiological clearance and release of these select HRNM lands is approximately $216,000. The current annual costs associated with DOE control and management of these lands is approximately $100,000. In addition, DOE is currently making payments to local governments of approximately $1,500,000 for payment in lieu of taxes. Accordingly, DOE could save as much as $1,600,000 per year by transferring this property to DOI. At this rate, the costs associated with the radiological clearance would be amortized in less than two months.

6.2.1 Other Applicable Federal and State Laws

DOE Order 5400.5 requires that "authorized limits be consistent with limits and guidelines established by other applicable Federal and State laws." This property is not currently under a state of Washington (State) license, and would not be required to be under a state license upon transfer to the DOI. However, the Washington Administrative Code (WAC 246-246-020) section that governs the termination of state licenses requires that: "1) The residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 0.25 mSv (25 mrem) per year, including that from ground water sources of drinking water; and 2) The residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)." Thus, the state's basic requirements for its own licensees would be met, since based on the discussion above, the maximum dose to members of the public would not be expected to exceed the state's limit, and would be ALARA.

In summary, these requested Authorized Limits are ALARA for these reasons: 1) the expected doses would be very small; 2) there would be no practical alternative to the proposed release; and 3) there would be a significant economic advantage to DOE.

7.0 Implementation of Requested Authorized Limits

Compliance with the requested Authorized Limits would be demonstrated by the collection and analyses of surface soil samples from the selected HRNM lands. The collection, analyses, data assessment, and reporting of results would be conducted in accordance with a DOE-RL-approved sampling and analysis plan. The specific locations for these soil samples would be determined by a combination of randomly selected locations using established methodologies and additional judgmental sampling in areas with a higher potential for residual radioactivity, e.g., sites of former lysimeter plots. The soil samples would be analyzed for all the radionuclides specified in the requested Authorized Limits, and the analysis protocols would be specific detection limits well below the requested Authorized Limits.

The collection and analysis of soil samples would be performed by the Pacific Northwest National Laboratory (PNNL) group currently providing environmental monitoring services for the Hanford Site. This collection and analysis of samples would be conducted in accordance with the PNNL procedures currently used for collection and analyzing environmental soil samples. Specific PNNL procedures that would be applicable include the following:

- PNNL, 2000, *Surface Environmental Surveillance Procedures Manual*, PNL-MA-580, Rev. 3, Pacific Northwest National Laboratory, Richland, Washington, specifically:
  Section 5.1 Surface Soil Samples
  Section 8.1 Trip Sheets (Chain of Custody)
  Section 8.6 Geographic Positioning with Trimble Explorer II
  Section 9.0 Radiation Survey Procedures
  Section 10.0 Job Safety Analysis

- PNNL, 2003, *Quality Assurance Project Plan for the Hanford Site Surface Environmental Surveillance Project (SESP) and the Drinking Water Monitoring Project (DWMP)*, ETD-011, Rev. 5, Pacific Northwest National Laboratory, Richland, Washington.

Samples will be scheduled and tracked from collection to receipt of the results from the analytical laboratory and validated using procedures described in the *Hanford Site Environmental Monitoring Plan* (DOE/RL-91-90, Rev. 4, in press). All results will be stored in the Hanford Environmental Information System (HEIS).

The actual analyses of the soil samples would be conducted using the same contract laboratory currently used for analyses of environmental samples at Hanford. The results of these analyses would be corrected for background radioactivity and the net results compared with the Authorized Limits. If unexpectedly high levels of residual radioactivity were found (e.g., greater than the Authorized Limits), the sampling and analysis plan would be revised and additional samples collected and analyzed. Decisions on any remediation or other controls needed would be made following the assessment of these additional analyses. The final determination of whether the Authorized Limits for soil have been met would be based on a documented review of all the information available, including the HSA and the results of sample analyses.

7.1 Area Averaging/Hot-Spot Criterion

DOE Order 5400.5 states: "Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 m^2" (5400.5, IV, 4.a.).

The HSA concluded that the concentrations in the soil of the HRNM lands are expected to be at (or very near) background levels, and that there is no reason to believe that there are significant variations in the concentrations across these lands. Thus, there is no reason to adopt a minimum survey area of 100 m^2 to ensure the sampling method is representative. Therefore, since the expected soil concentrations on this site are far below those that would result in a dose equal to the dose limit (100 mrem per year), and since there is no need to adopt the 100 m^2 averaging area to ensure representativeness, the 100 m^2 averaging area would not be used in developing a survey plan to demonstrate compliance with the Authorized Limits.

DOE Order 5400.5 states: "If the average concentration of any surface or below-surface area less than or equal to 25 m^2, exceeds the limit or guideline by a factor of $(100/A)^{0.5}$, [where A is the area (in square meters) of the region in which concentrations are elevated], limits for "hot-spots" shall also be developed and applied" (5400.5, IV, 4.a.(1)).

Section 5.2.2 of DOE G 441.1-XX discusses the rationale for this hotspot criterion. The hot spot criterion is used to supplement Authorized Limits for larger areas and is intended to prevent excessive exposures from a small contaminated area that is within a larger area that meets the basic Authorized Limits. Thus, it is intended for use in areas where the residual radioactive material concentrations are not uniform. Also, the above hotspot criterion was derived conservatively, assuming the Authorized Limits were based on a dose constraint of 25 mrem per year and selected to ensure unlikely exposure conditions would not cause the primary dose limit (100 mrem per year) to be exceeded. In the case of the HRNM units, the HSA concluded that the concentrations would be at essentially background levels. There was no indication of hot spots being present. Thus, since the residual radioactive material would be expected to be reasonably uniform, there would be no reason to establish a hot spot criterion.

8.0 Coordination with Other State and Federal Agencies

DOE-RL has discussed the proposed radiological clearance and transfer of these selected HRNM lands with staff representatives of the USFWS and WDOH. As the receiving agency, the USFWS would need to approve the radiological clearance before the transfer could be affected. Although these lands would remain under federal jurisdiction after transfer to the USFWS, the WDOH is an interested party in that the majority of HRNM land users would be state of Washington residents. Both the USFWS and WDOH staff representatives are in agreement with the general approach and methodologies used to develop the requested Authorized Limits.

9.0 References

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