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Technical Report

Radiological Health Risks from Strontium-90 in the Runkle Canyon Development Simi Valley, California

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LIMITATIONS

This technical report was prepared in accordance with our signed agreement with Paul, Hastings, Janofsky, and Walker LLP. This report is based upon best information available at the time of document submittal.

Radiological Health Risks from Strontium-90 in the Runkle Canyon Development, Simi Valley, California

Executive Summary. Runkle Canyon is a proposed residential development adjacent to existing neighborhoods on the southern edge of Simi Valley, California. Soil sampling of the project area in 1999 – 2003 showed the presence of low levels of the radionuclide strontium-90 (^{90}Sr). Members of the public have expressed concerns over the presence of ^{90}Sr and the potential radiological risk by comparing soil sample concentrations to the U.S. Environmental Protection Agency's (EPA's) Preliminary Remediation Goals (PRGs), which are presented as the concentration of radionuclide in soil. The default PRG for ^{90}Sr in a residential soil scenario is 0.23 picocurie per gram (pCi/g) at a risk level of 1×10^{-6}, meaning that under the very conservative default assumptions, long-term exposure to a soil concentration of 0.23 pCi/g will result in an incremental cancer risk of 1×10^{-6}. EPA's PRG calculation tool, however, allows users to create site-specific PRGs by modifying input parameters to values that are more appropriate for the site and its likely actual exposure assumptions.

This report documents a technical evaluation of the potential radiological risks by developing PRGs for more reasonable exposure scenarios at Runkle Canyon. The evaluation indicates that soil concentrations of ^{90}Sr that would result in the same 1×10^{-6} risk are actually significantly higher than the 0.23 pCi/g default PRG. That is, given the actual exposure likely for persons at the site, there could be higher levels of ^{90}Sr in the environment without posing a cancer risk of greater than one in a million. The first scenario evaluated is for a Runkle Canyon resident exposed to ^{90}Sr in soil for 30 years (including 6 years as a child). The second scenario is that of frequent users of the open space areas – an adult for 15 years and a child for 6 years – as well as a combined child/adult scenario. These PRGs were developed using exposure parameter values that are more realistic for the Runkle Canyon neighborhood than the values of the default PRG, which can be applied generically across the United States. Parameter values were adjusted for inadvertent soil ingestion, ingestion of homegrown fruits and vegetables, external exposure, and exposure frequency in a year. Also evaluated was a scenario where a nearby resident could be exposed to ^{90}Sr in airborne dust during the initial grading and construction phase of Runkle Canyon development.

Results indicate the actual radiological risk of constructing, using, and residing at Runkle Canyon would be lower than indicated by the default PRG. The estimated site-specific PRG for a typical Runkle Canyon resident would be 18.6 pCi/g, while the PRG for an unlikely, more highly exposed resident would be 1.13 pCi/g. With an average soil concentration in proposed residential areas of 0.98 pCi/g, these calculated PRGs indicate the risk of exposure to ^{90}Sr in soil would be much less than 1×10^{-6} for typical residents of Runkle Canyon and near 1×10^{-6} for unlikely higher exposures. Risks to an open space user would be lower, even though soil concentrations in open space areas are higher and include the highest observed soil concentrations. The PRG for an open space user would be 89 pCi/g for a long-term child-to-adult scenario, and 117 pCi/g and 263 pCi/g for an adult and child, respectively, corresponding to a risk of less than 1×10^{-8}. The potential risk to a nearby neighbor from ^{90}Sr in airborne construction dust was also evaluated. Even using very conservative assumptions, the estimated risk to a nearby neighbor would be approximately 1×10^{-10}.

This technical evaluation indicates that construction and operation of Runkle Canyon would result in very low radiological health risk from ^{90}Sr exposure to residents, visitors, and neighbors. In all cases this risk would be less than the target risk level of 1×10^{-6}.

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Radiological Health Risks from Strontium-90 in the Runkle Canyon Development, Simi Valley, California

1.0 Introduction

This report provides a technical evaluation of the potential radiological health risks to residents and neighbors of the proposed Runkle Canyon development from exposure to the radionuclide strontium-90 (^{90}Sr), which has been identified in soil samples taken from the area. Section 2.0 provides a brief description of the background information leading to this evaluation. Section 3.0 contains a more detailed examination of the key soil sampling data from around the residential area than had been provided in earlier sampling reports. Section 4.0 examines and explains the potential radiological risks from exposure to ^{90}Sr. The residential soil scenario that has been the basis for previous risk discussions is examined in more detail, using information that is more realistic for the Runkle Canyon neighborhood than generic default assumptions. The report also helps explain how a Preliminary Remediation Goal (PRG) of a target soil concentration is used to make a radiological health risk estimate, and how important assumptions about exposure can be overlooked. Default assumptions are selected to apply to a broad range of exposure scenarios and can overestimate the risk for a specific site. Two additional Runkle Canyon exposure scenarios are also examined for potential radiological health impacts: a frequent user of the open space area in the development, and a current neighbor who could be exposed to blowing dust from the initial construction activities. Section 5.0 presents the conclusions of this report. Additional reference information is presented in the attachments to this report.

2.0 Background

Runkle Canyon is a proposed residential development adjacent to existing neighborhoods at the southern edge of Simi Valley, California. The project site consists of approximately 1,595 acres that would include a mix of residential types, open space, a neighborhood park, a multi-use trail system and an area for the potential future development of a golf course. Residential development is proposed on approximately 140 acres in the northern portion of the project area, leaving approximately 1,456 acres in open space and recreational uses. A total of 461 residences are proposed, including 138 senior housing units, 62 of which would be affordable housing, 298 single-family homes, and 25 single-family estate homes (City of Simi Valley 2004).

The City of Simi Valley has prepared a Final Environmental Impact Report (EIR) in accordance with the California Environmental Quality Act, evaluating the potential environmental impacts of the development activities (City of Simi Valley 2004). The EIR was certified on April 26, 2004, and provides a detailed environmental characterization of the site and of proposed activities.

As part of the environmental characterization of the site, several soil sampling campaigns have been conducted (QST 1999; Foster Wheeler 1999; Harding ESE 2000; Miller Brooks 2003a,b,c).

The initial three campaigns provide the most useful data because of the lower levels of detection and more complete statistics reported; these data are the basis of the analysis of sample results in Section 3.0. The most recent investigation (Miller Brooks 2003a,b,c) was not included because the stated minimum detectable activity (MDA) was too high (approximately 2 picocuries per gram or pCi/g) to provide additional definitive information that could be used in conjunction with the more detailed results from the earlier investigations.

The initial exploratory sampling campaign consisted of only four samples (QST 1999). The detection of ^{90}Sr in these samples led to additional sampling. The most detailed and extensive investigation took surface soil samples from a 550-acre parcel containing the proposed residential area (Foster Wheeler 1999). The number and location of samples were taken using the methods directed by MARSSIM (Multi-Agency Radiation Survey and Site Investigation Manual), which is endorsed by the U.S. Environmental Protection Agency (EPA), U.S. Nuclear Regulatory Commission, and U.S. Department of Energy among numerous other Federal and state agencies (EPA 2001). An additional 17 soil samples were taken subsequently from other parcels in areas that would be open space with some portion available for recreational use (Harding ESE 2000). The surface soil sampling results showed the presence of low levels of ^{90}Sr. These data are the basis for the evaluations presented in the following sections of this report.

3.0 Soil Sampling Data

The three soil sampling campaigns noted above resulted in collection of 79 soil samples. The 1999 sampling campaign of the 550-acre parcel (Foster Wheeler 1999) collected 58 soil samples. This campaign determined the number of soil samples required to provide a statistically valid set of samples using the MARSSIM guidance (EPA 2001). The sample results from the other two campaigns (QST 1999; Harding ESE 2000) are included in this analysis to provide a larger sample set and more complete picture of the ^{90}Sr contamination in the Runkle Canyon area.

Figure 1 shows the sampling data from the lowest to highest concentration and also shows the uncertainty in the data as ± 2 standard deviations. This figure shows that most of the sample results (73, over 90 percent) are less than 2 pCi/g; the five lowest results are less than zero (net results, corrected for background). The six highest results appear to be inconsistent with the other results, as shown by the deviation from the apparent straight line of the other data. Because of this apparent inconsistency, additional evaluations were performed on the sampling data. The locations of the five highest results were not in the proposed residential area but are in the open space area; therefore, the possible differences between samples in the proposed residential area and the open space areas were evaluated.

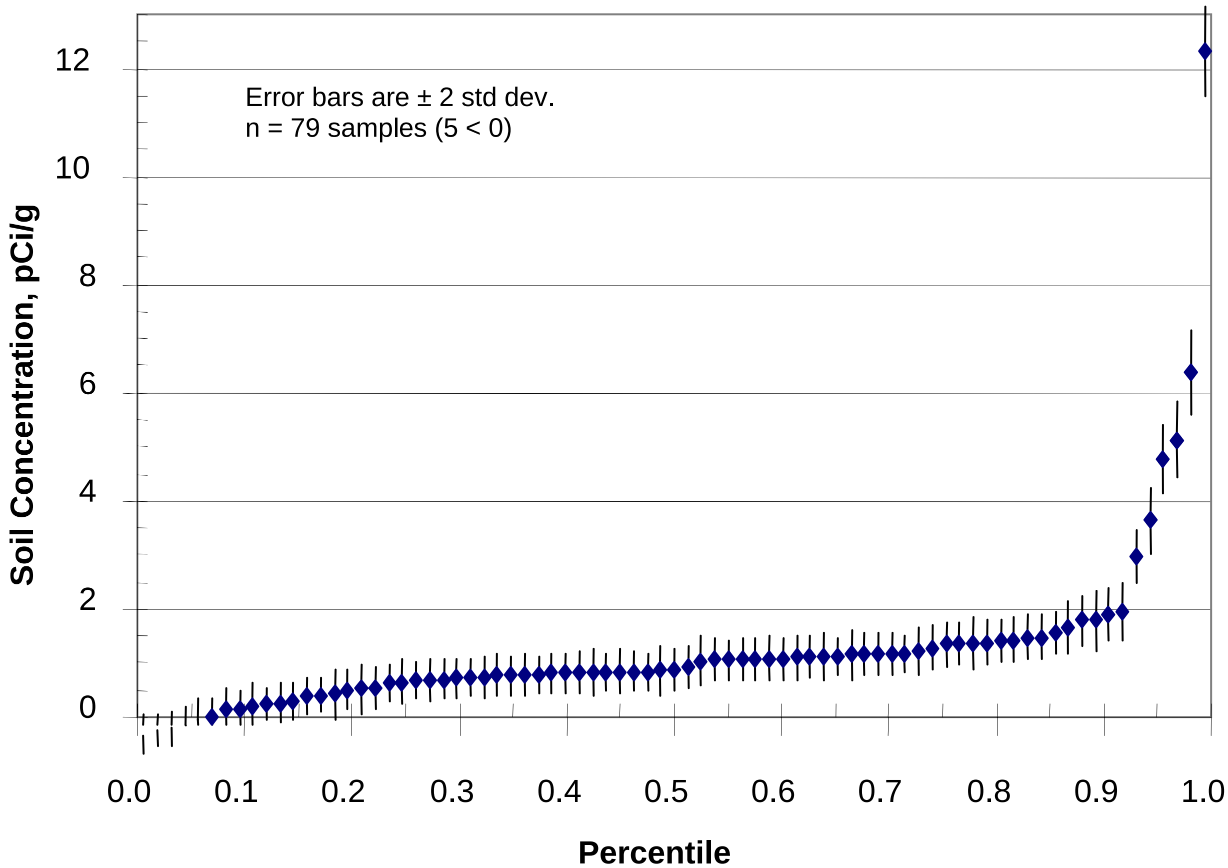

Figure 1. Distribution of Runkle Canyon ^{90}Sr Soil Sampling Results.

Much of the public discussion that has taken place since sampling was completed has focused on the arithmetic mean (about 1.5 pCi/g) and the maximum value (12.3 pCi/g) of the data. Implicit in these discussions is the assumption that the sample results are normally distributed – that is, they are distributed in a bell-shaped curve – and are adequately described using the arithmetic mean. However, many environmental samples are actually lognormally distributed, which is a distribution with a long tail on the upper end. A test of the Runkle Canyon soil sampling data did indeed show they are better described by a lognormal distribution. However, when the data are separated into sample sets from the proposed residential area and the open space area, the residential samples appear to be normally distributed, while the open space samples are an even more extreme lognormal distribution. Figure 2 shows the probability distributions of the three sample sets: all samples, residential area samples, and open space samples. The extreme upper tails of the lognormal distributions are not shown because the probabilities of these samples occurring are very low.

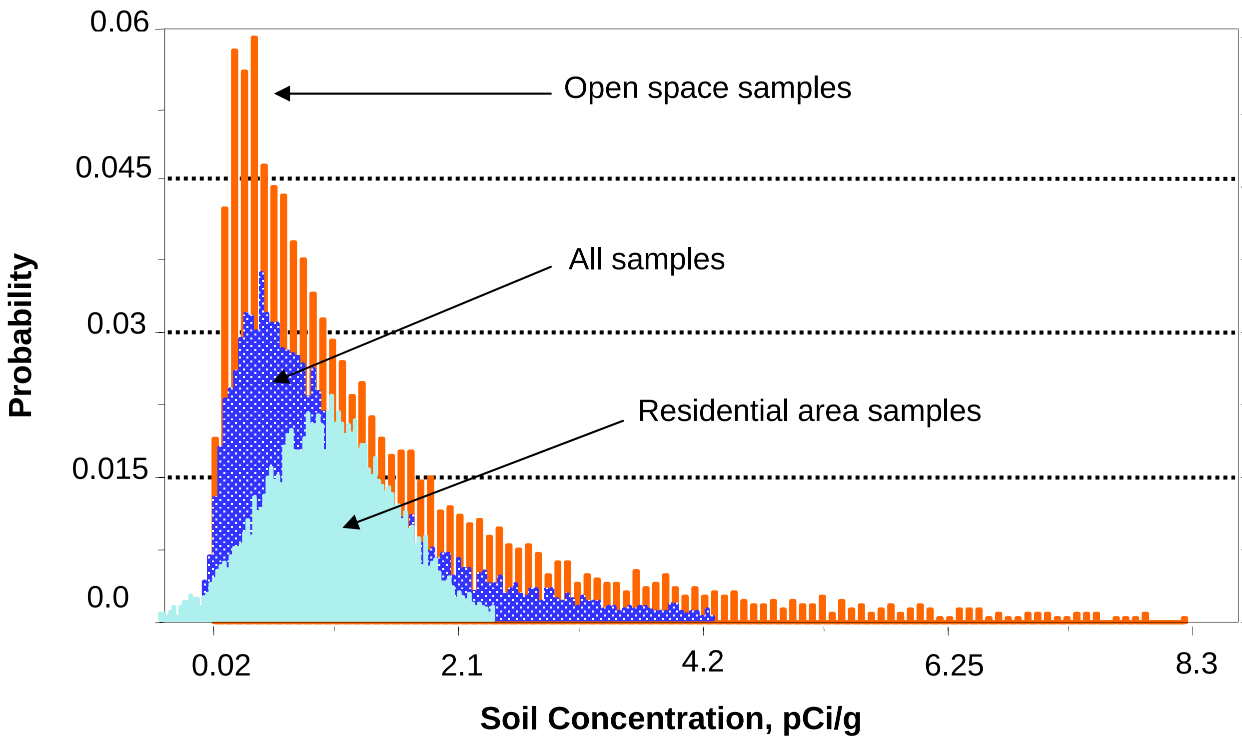

Figure 2. Probability Distributions of Runkle Canyon ^{90}Sr Soil Sample Data Sets.

Figure 2 shows interesting differences among the data, which can be further examined in the summary statistics listed in Table 1. Like much environmental data, the "all samples" data set shows a fairly typical lognormal distribution. The measure of central tendency of a lognormal distribution is not the arithmetic mean but rather the geometric mean (GM), also called the median. This is the point at which 50 percent of values lie above and 50 percent lie below. The measure of the spread of the distribution is the geometric standard deviation (GSD). The GM of this distribution is 0.82 pCi/g and the GSD of the distribution is 2.5. The 95th percentile value for this distribution – that is, that value that is higher than 95 percent of the population – is 5.1 pCi/g. The maximum sample result of 12.3 pCi/g is greater than 99 percent of values in this distribution.

Table 1. Summary Statistics for Runkle Canyon Sample Data Sets[1].

Sample Set	Number of Samples	Mean	Standard Deviation	Geometric Mean	Geometric Std. Dev.	95th Percentile
All samples	79	–[2]	–	0.82	2.5	5.1
Residential area	32	0.98	0.53	–	–	2.0
Open space area	47	–	–	0.78	3.25	8.2

1. Units are pCi/g for all data statistics except the number of samples and GSD.
2. A dash indicates "not applicable" for this data set.

The residential area data set is much more compact and, as stated above, appears normally distributed. This might be because the environmental conditions and topography of the residential area are more uniform than those of the project area as a whole, and do not include the high and low extremes found on the hillsides and bottom of ravines. This could result in a more homogeneous data set. The mean of the residential area samples is 0.98 pCi/g with a standard deviation of 0.53 pCi/g. The 95th percentile is 2.0 pCi/g.

The GM of the open space distribution is 0.78 pCi/g and the GSD of the distribution is 3.25, indicating a more skewed distribution than the total sample set once the centrally oriented residential area samples are excluded. The 95th percentile value for this distribution – that is, the value that is higher than 95 percent of the population – is 8.2 pCi/g. The maximum single sample result of 12.3 pCi/g is from a remote open space location and would lie between the 95th and 99th percentiles of this distribution.

The central estimate of sampling results (the GM or mean for these data sets) is typically used as the mostly likely or most representative concentration, while the 95th percentile is used as a reasonably conservative representation of higher concentrations that could occur. Both of these concentrations will be addressed in considering the radiological health risk of ^{90}Sr in soil at Runkle Canyon.

4.0 Radiological Health Risk

This section provides estimates of the potential radiological risk from exposure to the radionuclide ^{90}Sr in the surface soil of the Runkle Canyon. Strontium-90, with a 29.1-year half-life, is typically present in equilibrium concentrations with its radioactive decay product yttrium-90 (^{90}Y; 64-hour half-life), so any evaluation includes the impacts of exposure to both these radionuclides. Both radionuclides emit beta radiation, which is a low-mass particle radiation (like an electron). There is no gamma, x-ray, or alpha radiation associated with either radionuclide. Beta radiation is only moderately penetrating, so ^{90}Sr is mainly of concern when taken into the body through ingestion or inhalation. External exposure from deposition on the ground or being in a plume of material is of less concern. The type of exposure scenario determines which exposure pathways are most important.

Public discussions of the risk from ^{90}Sr in the Runkle Canyon area have concentrated on the use of and comparison to the PRG. Therefore, the evaluations in this section will use the PRG as a basis where possible. However, it is important to realize what the PRGs are and how they are used. For the residential soil scenario that is applicable to Runkle Canyon, the PRG is an activity concentration in soil (e.g., pCi/g) that corresponds to a radiological risk, such as one in a million (a risk of 1×10^{-6}). For radiation exposure, this risk is the chance of incurring a radiation-induced fatal cancer. What are often omitted from discussions of PRGs, however, are the exposure parameters and assumptions that connect the radionuclide concentration in soil to the stated radiological risk. These are the basis of exposure and risk modeling, and are critical to the estimates of radiological risk. Figure 3 shows the types of factors that are considered in making a risk estimate from a radionuclide soil concentration, and indicates how going directly from PRG to risk can overlook many of these factors.

The standard approach to estimating risk is to begin with generic conservative parameters and assumptions that can be broadly applied to many different exposure scenarios. This is the case

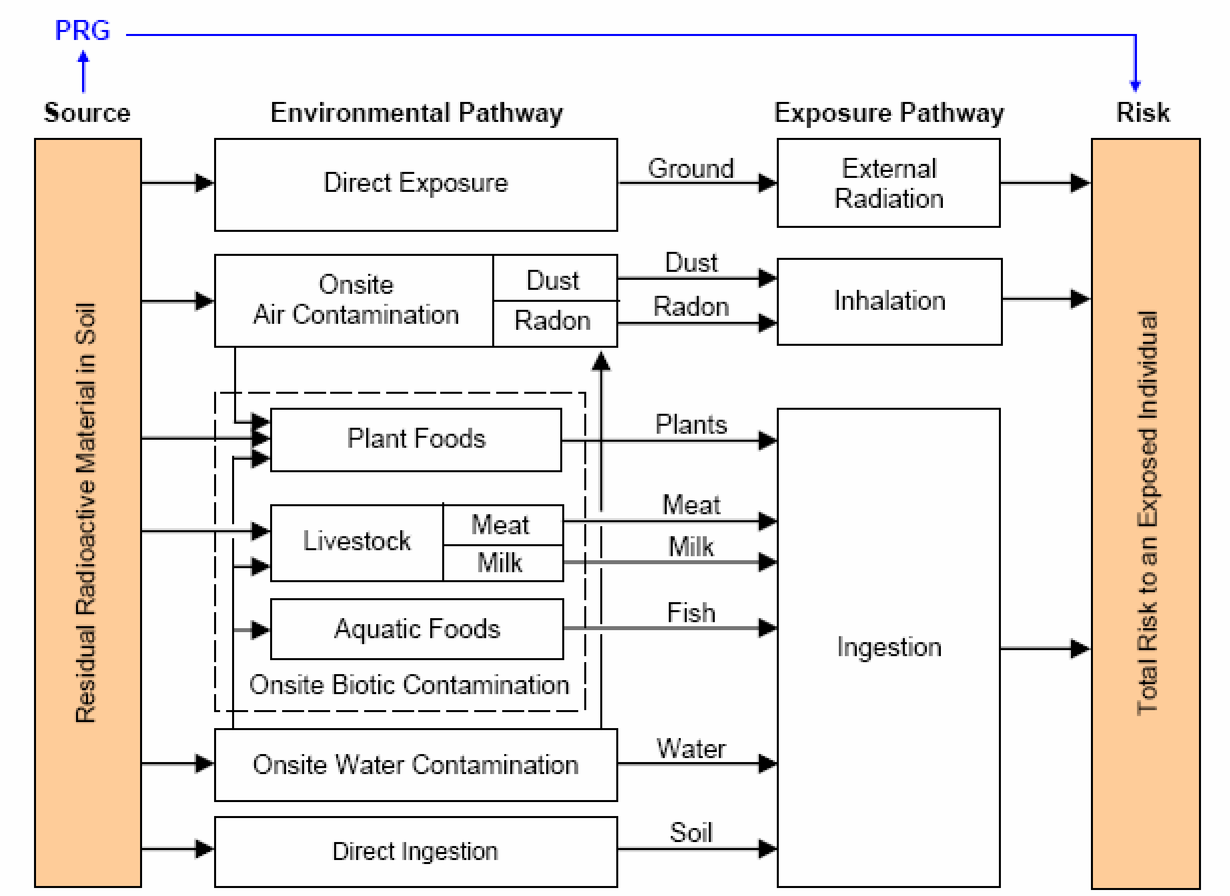

Figure 3. Representation of Typical Exposure Pathways Considered (adapted from ANL 2001)

for the 0.23-pCi/g PRG for ^{90}Sr that has been widely cited as corresponding to the 1×10^{-6} level of risk for Runkle Canyon. However, this is actually the conservative default PRG that applies equally well to a residential soil exposure scenario anywhere in the United States, be it Denver, Minneapolis, Philadelphia, or Atlanta. EPA's PRG calculation tool enables users to modify the input parameters to create site-specific PRGs (EPA 2004). Therefore, the purpose of this section is to develop site-specific PRGs that are more representative of the exposure conditions that would occur at Runkle Canyon and thus provide a more realistic estimate of the radiological risk to residents, visitors, and neighbors.

4.1 Runkle Canyon Resident Scenario

An individual with the potentially highest risk from exposure to ^{90}Sr in the surface soil is a long-term resident of the proposed Runkle Canyon neighborhood. This evaluation uses the EPA PRG calculator (EPA 2004) to make adjustments to exposure assumptions based on the living conditions that are likely to be present in the Runkle Canyon residential neighborhood. The PRG default is a 30-year resident who is a child for 6 years and an adult for 24 years.

As noted in Section 4.0, the potential risk from exposure to ^{90}Sr is determined mainly by the ingestion and inhalation pathways. Therefore, the evaluation of this scenario examines the parameters that control these exposure pathways and adjusts them as appropriate for a Runkle Canyon Resident.

The default PRG is based on several conservative assumptions about a resident:

- Twenty-five percent of consumed fruits and vegetables are home grown.
- Inadvertent soil ingestion is 200 milligrams per day (mg/d) for a child and 100 mg/d for an adult.
- Indoor residency shields external gamma exposure to 0.4 of the outdoor level.
- An individual is exposed for 350 days per year.

These assumptions are the focus of site-specific adjustments considered in calculating the radiological risk to a Runkle Canyon resident.

Homegrown fruits and vegetables could take up ^{90}Sr from the soil before being consumed by residents. It is highly unlikely a Runkle Canyon resident would produce 25 percent of their fruit and vegetable diet. An informal survey of backyards in the neighborhoods around Runkle Canyon showed little if any area devoted to backyard gardens. Lots in the development are expected to be fully landscaped; most are too small to support extensive gardens. Twenty-five of the 461 residences in the development would be estate lots of 1 acre or larger; these lots could support a garden. These 25 lots are about 5.4 percent of the total residences. The most likely case would be that a Runkle Canyon resident would have no or very small amounts of homegrown fruits or vegetables. Plants grown in pots or containers using potting soil or outside top soil would not take up ^{90}Sr from the soil. Any amendment of the existing soil, such as bringing in outside top soil or compost would reduce the concentration of ^{90}Sr in the soil. In calculations of screening dose factors, the National Council on Radiation Protection and Measurements (NCRP) estimates the percentage of homegrown fruits and vegetables for all residential soil scenarios to range from 5 to 25 percent, with the central estimate being 15 percent (NCRP 1999). Applying this range to the 5.4 percent of residences in Runkle Canyon that could have extensive gardens, a reasonable upper estimate of homegrown fruits and vegetables is 5 percent of the total annual fruit and vegetable diet.

Inadvertent soil ingestion occurs through transfer of soil from the hands or other items to the mouth, where it is ingested. Inadvertent soil ingestion is typically higher in children, and is potentially higher is areas where there is bare soil present. Most areas of the Runkle Canyon neighborhoods are expected to be fully hardscaped and/or landscaped by grass, ground cover, or ornamentals, providing less opportunity for inadvertent soil ingestion. The NCRP uses daily inadvertent soil ingestion for all residential soil scenarios of 50 mg/d for adults and 100 mg/d for children in its screening dose methods (NCRP 1999). The value of 100 mg/d is used as a reasonably conservative estimate for Runkle Canyon child residents in all cases. For adults, inadvertent soil ingestion is typically associated with consumption of homegrown produce. A value of 50 mg/d is used for a Runkle Canyon adult resident who consumes homegrown produce, while a value of 25 mg/d is used for an adult who does not consume homegrown produce.

External exposure to beta radiation from ^{90}Sr and especially its decay product ^{90}Y can be a source of radiation exposure if there is no shielding present. The EPA PRG calculator provides for a default 0.4 reduction factor in external exposure from being inside a residence. This is the same factor used for penetrating electromagnetic (gamma) radiation emitted by radionuclides such as cobalt-60 that have much greater penetrating ability. However, beta radiation is effectively shielded by the type of construction that will be used in Runkle Canyon residences, which is found in nearby residences such as those in the adjoining Sequoia Avenue neighborhoods. These include concrete slabs; stucco exterior walls; drywall interiors; concrete or stone paved driveways, sidewalks, and patios; sod laid over bare ground; and so on. All of these features provide effective shielding for beta radiation. Therefore, the external exposure inside a Runkle Canyon residence is taken to be zero for all cases. Outdoor external exposure remains the default value.

The number of days of exposure per year can vary widely. The NCRP uses an exposure frequency of 270 days per year for soil ingestion, and notes a range from 180 to 360 days per year for screening dose factors (NCRP 1999). An exposure frequency of 270 days per year is used as a reasonably conservative estimate for Runkle Canyon residents.

Changes to these simple exposure parameters create a more realistic estimate of PRGs for future residents of the Runkle Canyon neighborhood. Estimates have been developed for a resident with no inadvertent soil or homegrown produce ingestion, a typical resident, and an unlikely, more highly exposed resident. All scenarios have 270 days of exposure per year and no indoor external radiation exposure. With no inadvertent soil ingestion and no ingestion of homegrown produce, the PRG corresponding to a 1×10^{-6} level of risk would be 49 pCi/g. The typical resident would inadvertently ingest 100 mg/d as a child and 25 mg/d as an adult, and would eat no homegrown produce that was grown in unamended Runkle Canyon surface soil. The PRG corresponding to a 1×10^{-6} level of risk would be 18.6 pCi/g. An unlikely, more highly exposed resident was assumed to have similar characteristics to the typical resident but gets 5 percent of his or her annual fruit and vegetable diet from homegrown produce in unamended surface soil. The PRG corresponding to a 1×10^{-6} level of risk would be 1.13 pCi/g. All estimates assume residency for 30 years, with 6 years as a child and 24 years as an adult, the same as the default PRG. Adult-only and child-only scenarios would result in higher (lower-risk) PRGs because of the reduced exposure duration. Figure 4 shows the typical resident PRG value plotted on a semilogarithmic plot and compared to the default PRG value of 0.23 pCi/g and the Runkle Canyon residential area soil sampling data plotted from low to high concentration.

As described in Section 3.0, the mean of the residential area soil sampling data was 0.98 pCi/g, while the 95th-percentile concentration was 2.0 pCi/g. Both of these levels are well below the typical resident PRG of 18.6 pCi/g. The highly exposed resident PRG of 1.13 pCi/g is higher than the mean but lower than the 95th-percentile concentration. This indicates the risk to a typical Runkle Canyon resident would be much less than the target 1×10^{-6} risk level and even less than 1×10^{-7}. The risk to an improbable, highly exposed resident would also be less than 1×10^{-6}; even at the 95th-percentile soil concentration an unlikely, more highly exposed resident

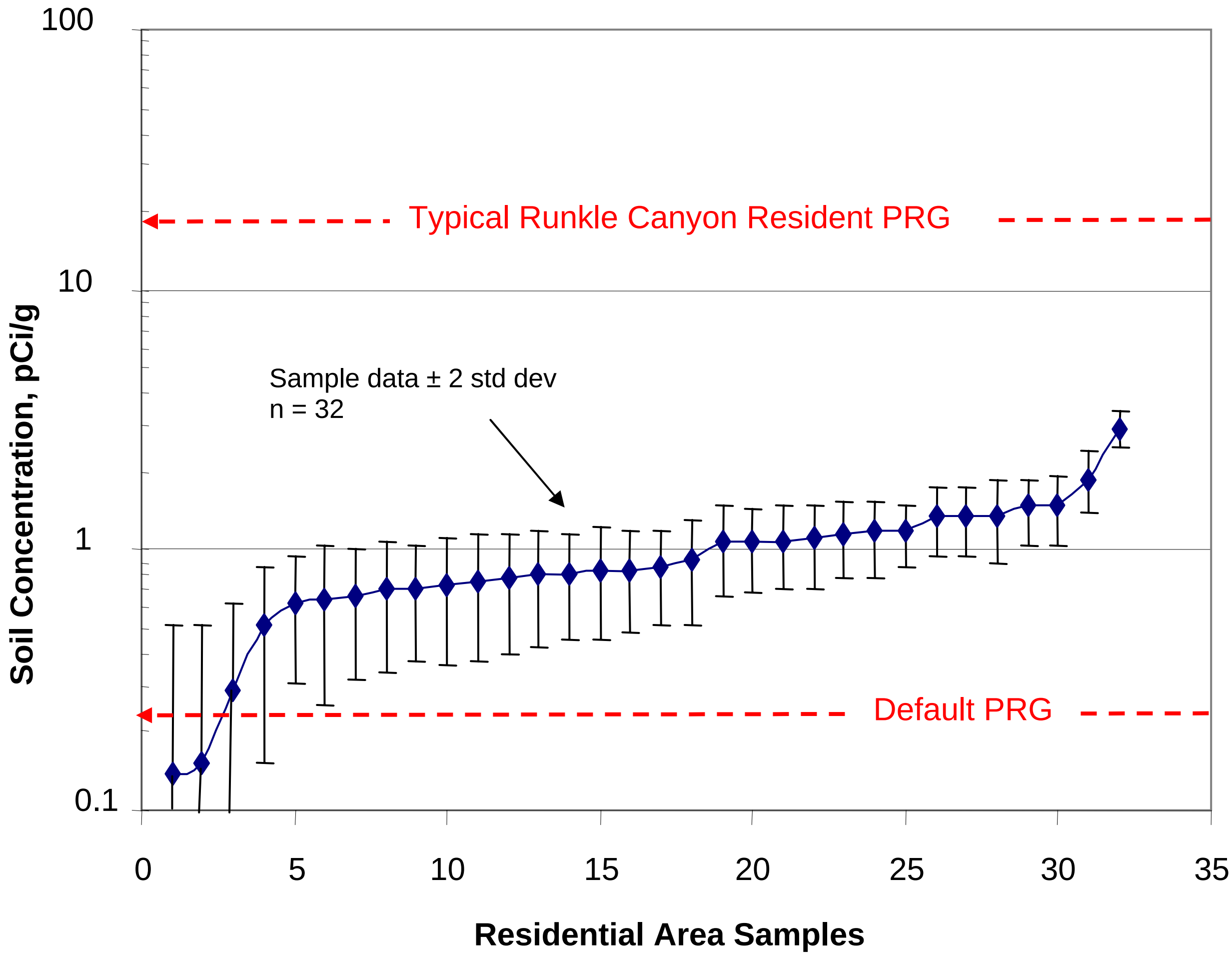

Figure 4. Typical Runkle Canyon Resident PRG and Default PRG for a Radiological Risk Level of 1×10^{-6} Compared to Residential Area Soil Sampling Data.

would experience radiological risk only slightly higher than 1×10^{-6}. A resident who did not ingest soil and did not grow and eat homegrown produce would have a potential risk much less than 1×10^{-6}, closer to 2×10^{-8}.

4.2 Open Space User Scenario

The Runkle Canyon development will include extensive areas of open space, some of which will be accessible for recreational opportunities including walking, running, hiking, biking, horseback riding, and others. This scenario looks at the potential exposure to users of this open space. Motorized vehicle users were not considered. The PRG calculator was used as the basis (EPA 2004).

This scenario examined impacts to an extensive user of the area who would be in the open space an average of 6.5 hours per week, 52 weeks per year (336 hours per year). An adult was assumed to use the open space at this level for 15 years, a child for 6 years. A combined 21-year scenario was also evaluated. There would be no homegrown fruit or vegetable ingestion; inadvertent soil ingestion was assumed to be minimal, about 1 mg/d for adults and 2 mg/d for children. External exposure would be characteristic of an outdoor environment, with no shielding.

The 1×10^{-6} risk level for this scenario corresponds to a PRG of 117 pCi/g ^{90}Sr in surface soil for an adult, and to a PRG of 263 pCi/g for a child. For the combined scenario of child-to-adult, the PRG would be 89 pCi/g. These PRG concentrations are well above the maximum observed concentrations in soil samples taken from the open space area. The PRG for a child is higher (indicating less risk) because of a 6-year exposure period rather than 15 years for an adult. Similarly, the combined scenario PRG is lower because of the longer 21-year exposure time. The potential risk to open space users would be much less than 1×10^{-6}; based on the median open space concentration of 0.78 pCi/g, the risk would be less than 1×10^{-8}. Figure 5 shows the open space user PRG values plotted on a semilogarithmic plot and compared to the Runkle Canyon soil open area sampling data plotted from low to high concentration.

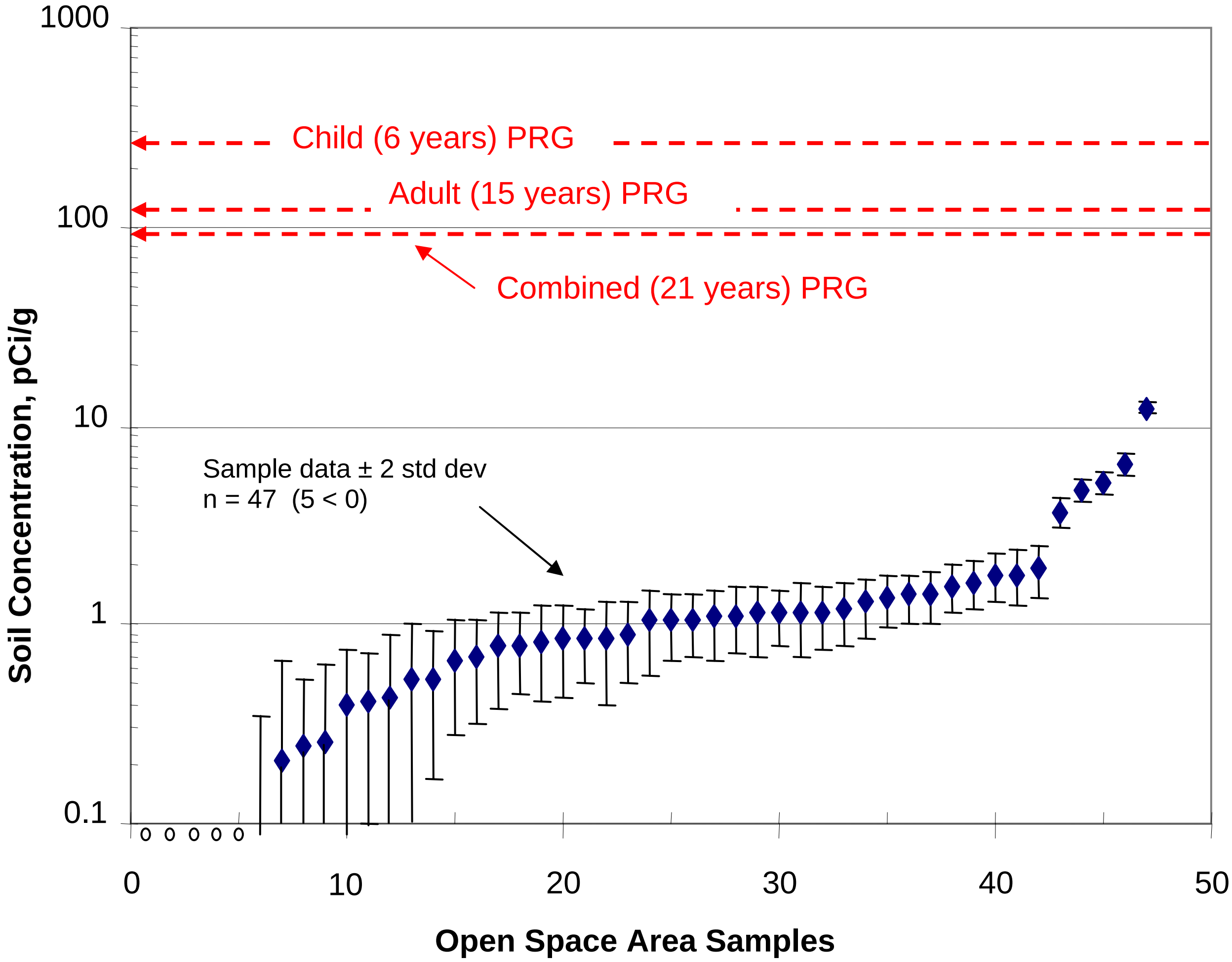

Figure 5. Runkle Canyon Open Space User PRGs for a Radiological Risk Level of 1×10^{-6} Compared to the Open Space Soil Sampling Data.

4.3 Neighbor Exposure to Construction Dust Scenario

Residents of Simi Valley who live in neighborhoods adjacent to the Runkle Canyon development could be exposed to fugitive dust during the initial grading and ground construction activities. This scenario estimates the potential radiological risk from exposure to ^{90}Sr that could be in airborne dust. The PRG calculator could not be used effectively for this scenario because it cannot calculate the atmospheric dispersion of the dust, so other methods described below were used.

Appendix C of the Runkle Canyon Final EIR contains estimates of the quantity of PM_{10} (particulate matter less than 10 microns in diameter) that could be generated during construction. The initial ground construction period would be the largest – grading and disturbing 142.8 acres – and last the longest – 9 months. The estimated daily maximum quantity of fugitive dust generated would be 1,094.5 pounds per day [496.5 kilograms per day (kg/d)]. Through mitigation measures the estimated daily maximum would be reduced to 250.19 pounds per day (113.5 kg/d).

The initial graded screening approach to this scenario was to assume the entire acreage was disturbed for the entire construction period and to calculate the maximum hourly dust concentration that could occur in any direction from the disturbed area. A neighborhood resident was assumed to be exposed to this maximum hourly concentration while outside engaged in light activity, without any shielding from being in a residence, for 8 hours per day while construction was ongoing. Fugitive dust mitigation measures were assumed to be taken at the construction site, so the emission rate would be 250.19 pounds per day.

The maximum hourly dust concentration was estimated using the EPA SCREEN3 computer code (EPA 1995) to be 357 micrograms per cubic meter, or 3.57×10^{-4} grams per cubic meter. The dust was assumed to have a ^{90}Sr concentration of 0.82 pCi/g, assuming the geometric mean of all samples is characteristic of the entire development area as discussed in Section 3.0. The radiological risk from inhalation of ^{90}Sr in airborne dust was estimated by using the most conservative radiation risk coefficients for ^{90}Sr from Federal Guidance Report 13 (EPA 1999). The most conservative risk coefficient was used because the actual chemical form of the ^{90}Sr in soil and dust at Runkle Canyon is not known.

The estimated risk of cancer mortality from this exposure to airborne construction dust would be 3.1×10^{-10}; the estimated risk of a cancer occurrence from this exposure would be 3.3×10^{-10}. This conservative screening calculation indicates the radiological risk from dust exposure would be very low. Therefore, no detailed calculations were performed for this scenario and no additional calculations were performed for other construction activities that would be smaller, generate less dust, and take place farther from the existing neighborhoods.

Similarly, the potential deposition of dust on neighborhood soil and surfaces would result in negligible quantities of ^{90}Sr and negligible risk to neighborhood residents.

5.0 Conclusions

The approach recommended by the EPA is to identify the PRG during scoping and then modify it as needed based on site-specific information (EPA 2004). The default ^{90}Sr PRG of 0.23 pCi/g was used during the preliminary scoping of radiological health risks from ^{90}Sr in soil of Runkle Canyon. In accordance with EPA recommendations, site-specific evaluations included modifications of the PRG parameter values to provide a more realistic estimate of the radiological health risks at Runkle Canyon. This report documents the site-specific evaluations.

Evaluation of several Runkle Canyon resident scenarios indicated PRGs that are all higher than the default PRG, with corresponding radiological risks that were below the 1×10^{-6} lower limit of the EPA's target risk range. Evaluation of Runkle Canyon open space user scenarios revealed the site-specific PRG to be even higher and the potential radiological risk even lower, on the order of 1×10^{-8}. Finally, evaluation of an exposure scenario for nearby residents during Runkle Canyon grading and initial construction indicated the radiological risk was even lower than that for residents and open space users, around 1×10^{-10} even using conservative assumptions.

The most limiting scenario is for a Runkle Canyon resident and depends on the level of inadvertent soil ingestion and on the quantity of homegrown fruits and vegetables produced and consumed. In general, it was assumed that Runkle Canyon residents would not grow a significant fraction of their diets due to the nature of the development. Other factors not considered would also reduce potential exposure, including the mixing of surface soil with clean deeper soil during initial excavating and grading, and amendment of the Runkle Canyon surface soil with topsoil and compost brought from outside the area.

Continued development of Runkle Canyon would result in very low radiological risk from ^{90}Sr exposure to residents, visitors, and neighbors. In all cases this risk would be less than the target risk level of 1×10^{-6}.

6.0 References

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Attachments

Attachment 1. EPA Facts about Strontium-90.

Attachment 2. Regional Aerial Map.

Attachment 3. Environmental Sample Locations.

Attachment 4. Historical Progression of Runkle Ranch Development.

Attachment 5. Site Plan.