APPENDIX K

POTENTIAL USES FOR ENVIRONMENTAL MONITORING DATA

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INTRODUCTION

The environmental monitoring data we have compiled have a number of potential uses during subsequent phases of the Savannah River Site (SRS) dose reconstruction project. These uses include source term verification, model validation and parameter development, and direct exposure assessment. Additionally, comparing monitoring data for different media can assist with establishing data quality and verifying reported values. This appendix discusses and illustrates some of the potential uses for the environmental monitoring data compiled, but it is not intended to include all potential uses. Other potential uses for specific media data are discussed in Chapters 8, 9, 10, 11, 12.1, 12.2, 13, and 14.

Varying temporal and spatial resolution for different media and for release estimates complicates comparisons and frequently limits the usefulness of the data. Another factor that complicates these types of comparisons is that the SRS is not the only source of environmental contamination. It is often difficult to conclusively identify the origin of environmental contamination, and background concentrations can be difficult to establish. In the context of historical dose reconstruction for the SRS, background refers to contaminants present in the environment that did not originate as a result of SRS activities. Other factors that may preclude or complicate data analyses for specific media are discussed in detail in Chapters 8, 9, 10, 11, 12.1, 12.2, 13, and 14.

ESTABLISHING THE SOURCE OF CONTAMINATION

Atmospheric weapons testing resulted in widespread deposition of radionuclides, particularly during the early 1960s, and it is often difficult to distinguish between contamination resulting from weapons testing and contamination resulting from SRS operations. Evaluating concentrations measured at different distances from the Site and comparing concentrations with deposition trends can help establish the source of contamination.

Figure K-1 shows ^{90}Sr deposition from atmospheric weapons testing fallout (discussed in Chapter 6) measured in Columbia, South Carolina, and ^{137}Cs concentrations measured in vegetation (Chapter 9) collected at the SRS plant perimeter and 25-mi radius locations. Fallout deposition was generally greatest between 1962 and 1964, and ^{137}Cs concentrations measured in vegetation follow the same general trend seen for ^{90}Sr deposition in Columbia, South Carolina, which would not have been impacted by Site releases. Vegetation concentrations are similar at the plant perimeter and 25-mi radius locations, which also suggests weapons testing as the primary source of the cesium.

Figure K-2 compares monthly average ^{131}I concentrations measured in air (Chapter 8) at the plant perimeter and 25-mi radius locations from 1959 through 1964. Concentrations at both locations appear generally well correlated throughout much of this time period. Concentrations at the plant perimeter are elevated compared to 25-mi radius locations during July 1959 and June 1961, suggesting impact from radioiodine releases from the Site extending to at least the plant perimeter during these time periods. Similar concentrations at plant perimeter and 25-mi radius

locations during certain months of 1961 and 1962 suggest that fallout from global nuclear weapons testing is the primary source of contamination.

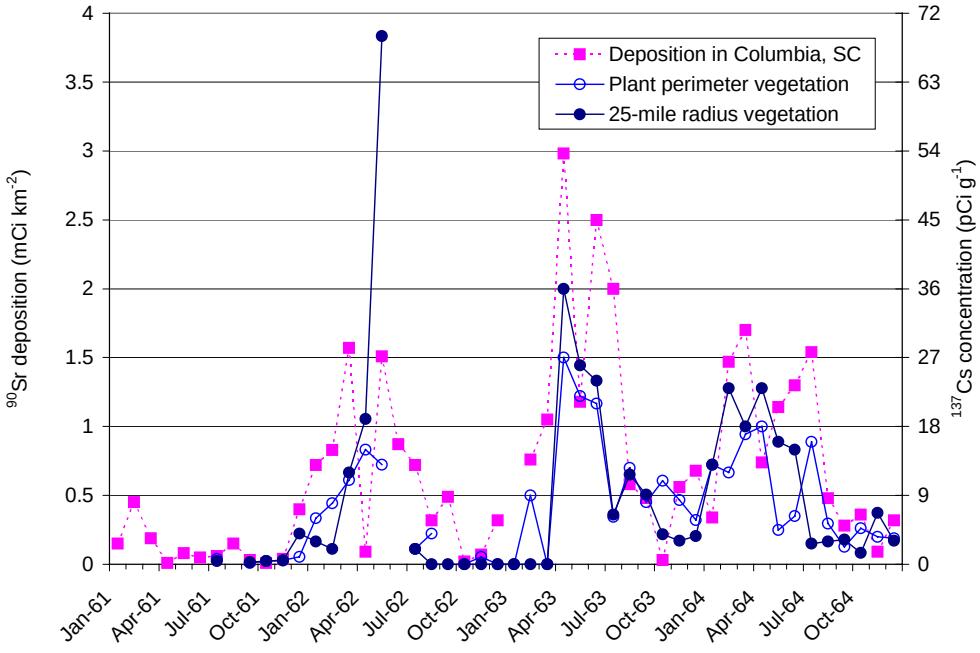

Figure K-1. Monthly average ^{90}Sr deposition in Columbia, South Carolina, and monthly average ^{137}Cs concentrations measured in vegetation at the plant perimeter and 25-mi radius locations from 1961 through 1964. Link to tabulated data.

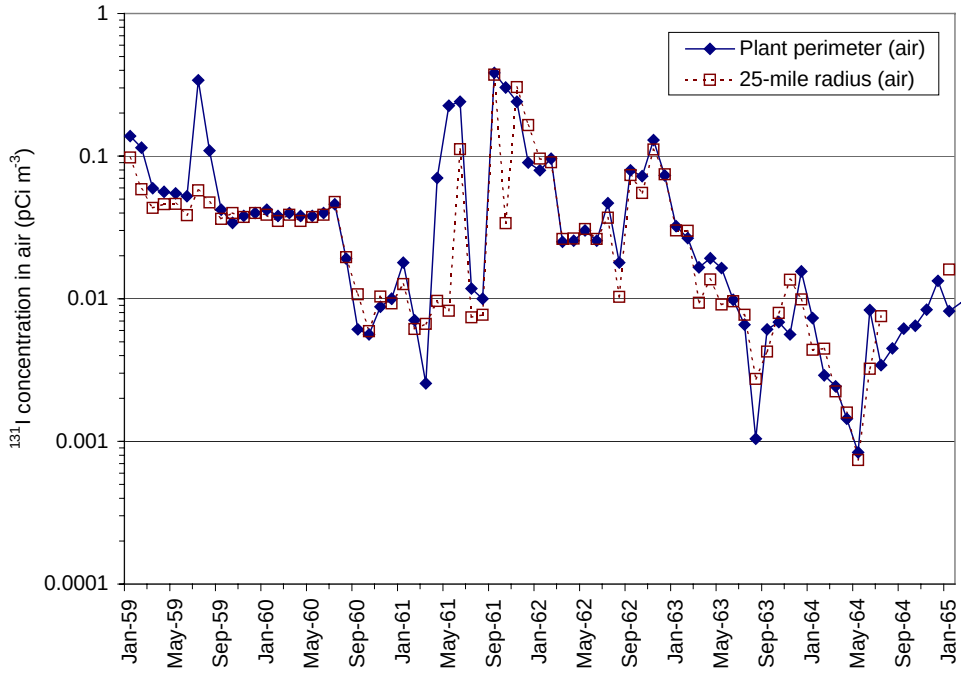

Figure K-2. Monthly average ^{131}I concentrations measured in air collected at plant perimeter and 25-mi radius locations from 1959 through 1964. Link to tabulated data.

Figure K-3 shows monthly average ^{131}I concentrations measured in vegetation at the plant perimeter and 25-mi radius locations from 1966 through 1973 (Chapter 9). Concentrations are similar at both locations and are near the detection limit since 1969, suggesting little Site impact beyond the plant perimeter during this time period. Concentrations near the detection limit are also seen during this time period for other media, such as air and milk (see Chapters 8 and 10).

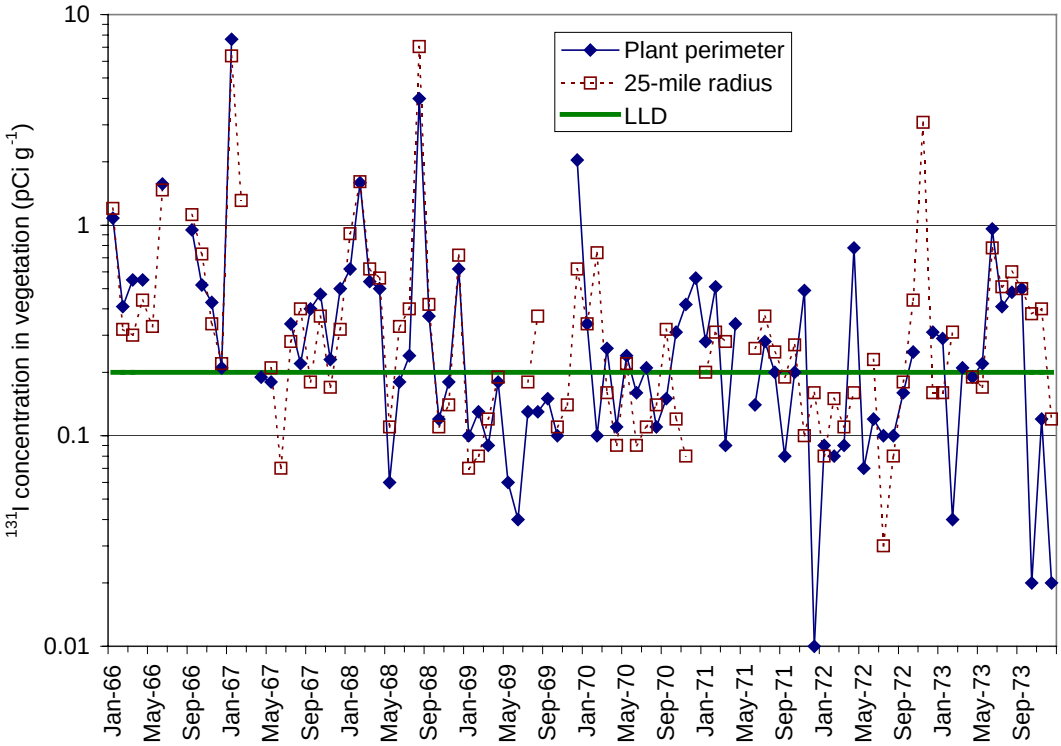

Figure K-3. Iodine-131 concentrations measured in vegetation collected from plant perimeter and 25-mi radius locations from 1966 through 1973 shown with the lower limit of detection (LLD). Link to tabulated data.

Figure K-3 shows the annual average tritium concentrations for the years 1974 through 1991. It appears clear that Site tritium releases have contributed to elevated concentrations measured in vegetation samples at offsite locations extending at least to the 25-mi radius locations. Concentrations measured at the F-Area and H-Area are clearly greater than those measured at the plant perimeter, 25-mi, and 100-mi locations. The plant perimeter concentrations are consistently higher than 25-mi radius concentrations, which are slightly higher than 100-mi radius concentrations. Concentrations for all locations decreased significantly from 1974 through 1977 and have fluctuated somewhat since that time.

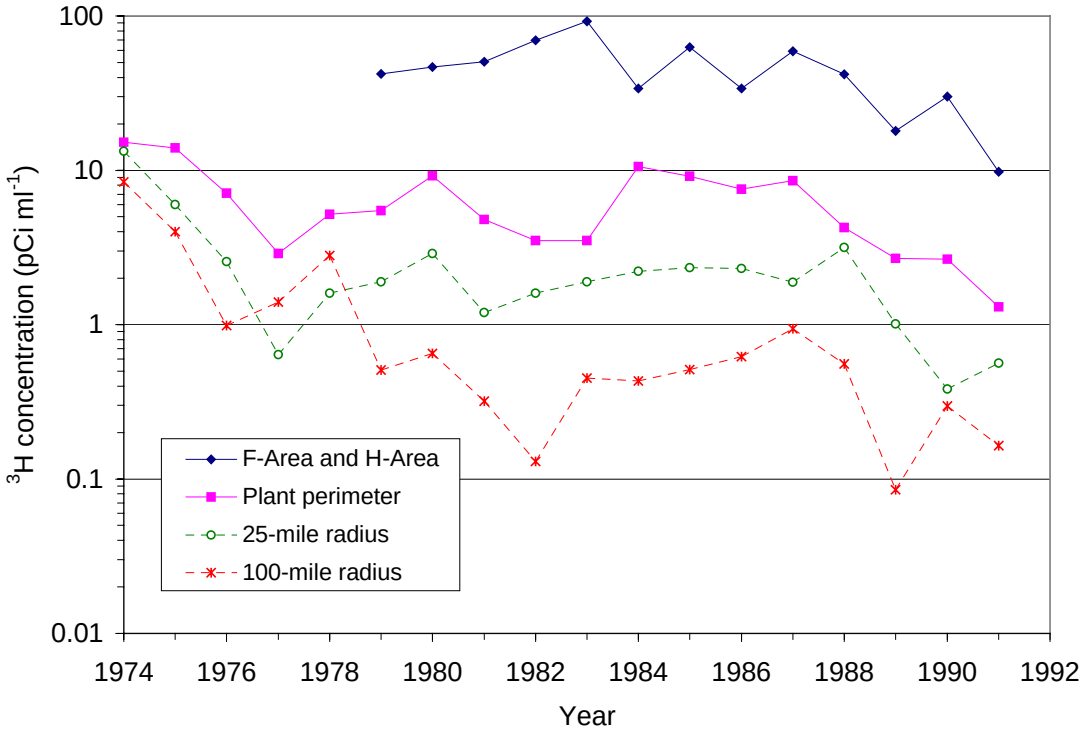

Figure K-3. Tritium concentrations measured in water extracted from vegetation at the F-Area and H-Area, plant perimeter, 25-mi radius, and 100-mi radius locations. Link to tabulated data.

In general, offsite (i.e., extending to at least the plant perimeter) impacts are consistently evident for atmospheric tritium releases. Potential offsite impacts resulting from radioiodine atmospheric releases are evident for several time periods before 1962. Fallout from global nuclear detonations appears to be the primary source for all other atmospherically deposited fission products beyond the plant perimeter. See Chapters 8, 9, 10, 11, 12.1, 12.2, 13, and 14 for additional details regarding concentrations measured in various environmental media.

VERIFYING SOURCE TERM ESTIMATES

Environmental data are useful for comparison to source term estimates and can assist with verifying the estimated release amounts. Figure K-5 compares atmospheric elemental ^{131}I release estimates (Chapter 4.2) with ^{131}I concentrations measure in air (Chapter 8) at onsite (F-Area and H-Area) and plant perimeter locations. Onsite air concentrations are clearly impacted during periods of increased releases, particularly during January, February, and July 1959; January 1960; June 1961; and May, June, and July 1962. Plant perimeter concentrations also appear to be impacted during July 1959 and June 1961, suggesting impact beyond the plant perimeter during these periods of elevated releases. Elevated concentrations are also evident during the latter part of 1961, but similar increases at both onsite and plant perimeter locations and lower release amounts during this time suggest increased weapons testing as the probable source of these elevated concentrations. Although monthly monitoring data are not available for air before 1959,

higher relative release amounts, particularly during 1956, suggest that offsite impact was likely. Some summary data are available (for example, see Chapter 8, Figure 8-5 and Table 8-6) that confirm the highest releases occurred before 1960, particularly during 1956.

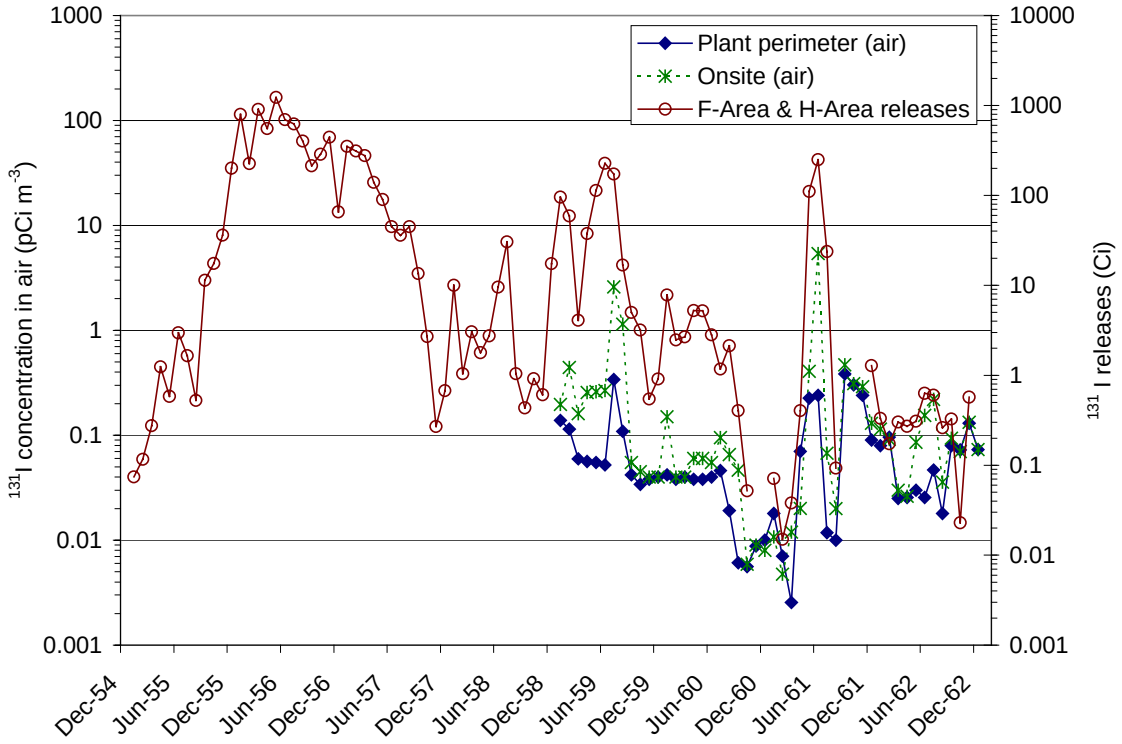

Figure K-5. Elemental ^{131}I release estimates from F-Area and H-Area and monthly average air concentrations measured at the plant perimeter and onsite (F-Area and H-Area) locations. Link to tabulated data.

Figure K-6 shows total annual atmospheric tritium release estimates (Chapter 4.1) from the reactor and separations areas from 1955 through 1991 compared to annual average tritium concentrations measured in vegetation and rainwater (Chapters 9 and 8). The vegetation concentrations depicted here before 1974 represent estimates made based on the ratio of atmospheric releases to vegetation concentrations measured from 1974 through 1991. This ratio was then used to estimate vegetation concentrations before 1974, based on atmospheric tritium releases between 1955 and 1973. Because vegetation concentrations and release estimates are well correlated between 1974 and 1991, this likely represents a good approximation of average vegetation concentrations that may have occurred before 1974.

Concentrations measured in rainwater and vegetation are well correlated at both onsite and plant perimeter locations from 1974 through 1991; however, data are limited for onsite rainwater concentrations. Additionally, estimated vegetation concentrations between 1955 and 1973 are generally well correlated with rainwater concentrations measured and reported for that time period.

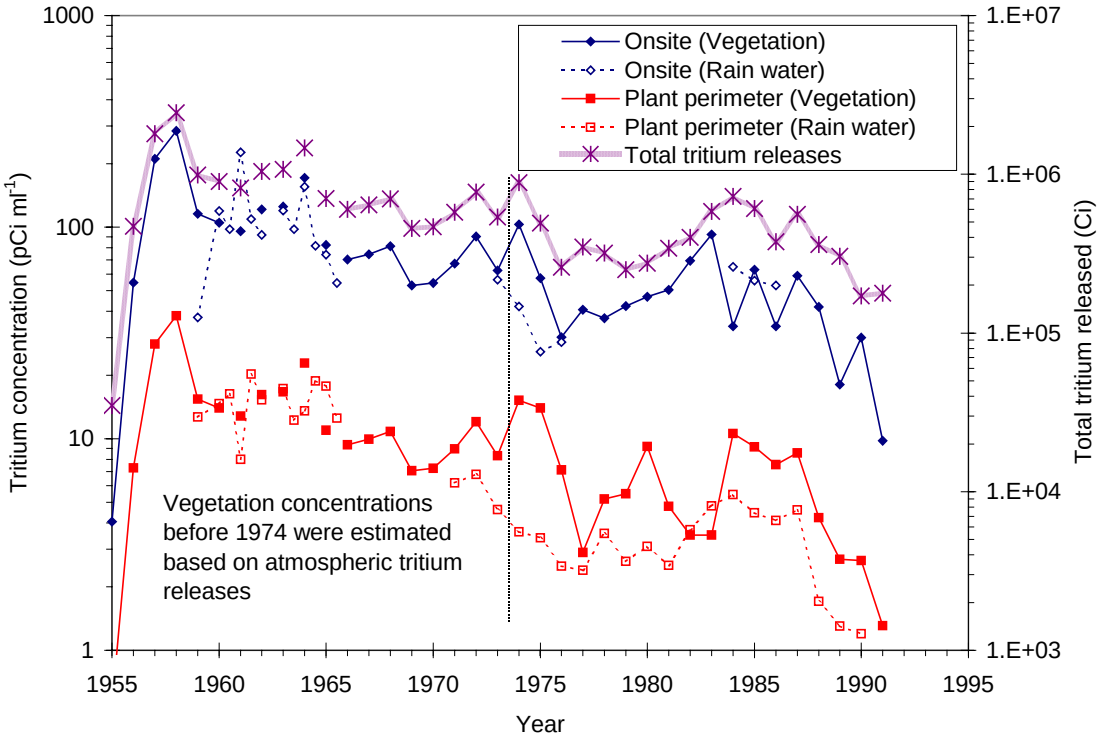

Figure K-6. Atmospheric tritium releases and annual average tritium concentrations measured in onsite and plant perimeter vegetation and rainwater. Tritium concentrations were not consistently reported for vegetation before 1974, and the concentrations shown here are estimated based on atmospheric tritium release estimates. Link to tabulated data.

Figure K-7 shows ^{137}Cs concentrations measured in water collected from Steel Creek at Road A from 1959 through 1976, which are the basis for surface water release estimates to Steel Creek (Chapter 5). Also shown are ^{137}Cs concentrations measured in fish collected from Steel Creek at Road A and at a location 2 mi downstream from Road A (Chapter 14). The concentrations reported for fish at both locations appear well correlated with water concentrations and, therefore, release estimates during this time period.

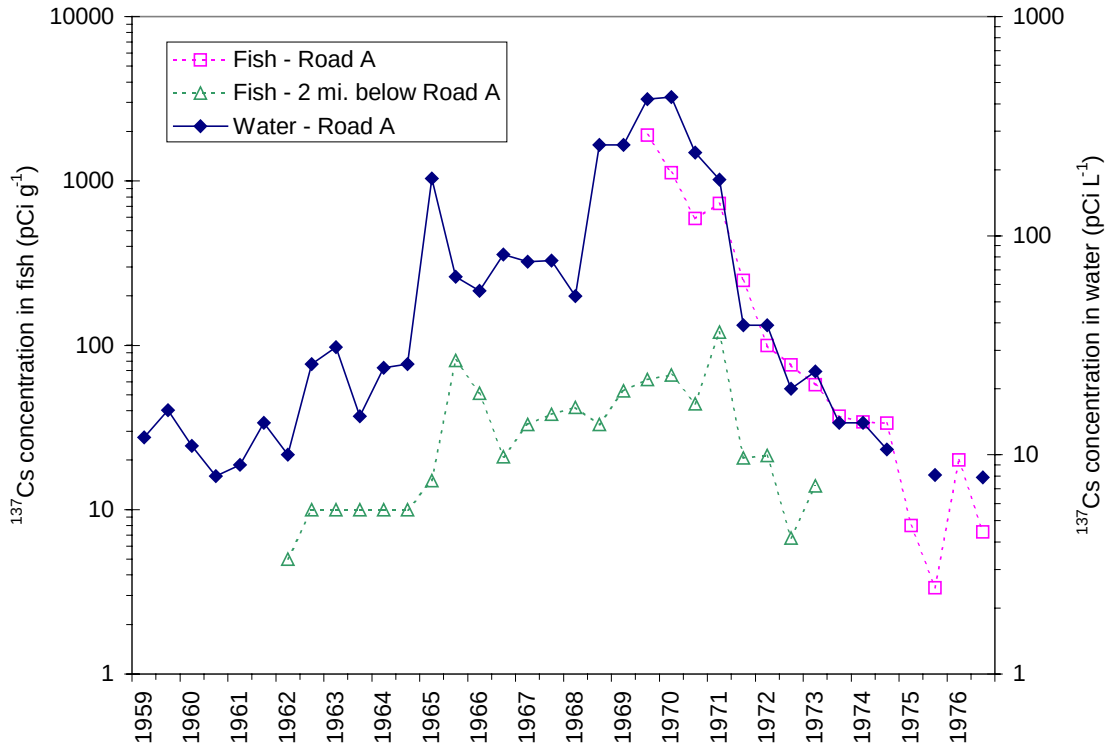

Figure K-7. Semiannual average ^{137}Cs concentrations measured in water and fish from Steel Creek at Road A and in fish from Steel Creek 2 mi below Road A. Link to tabulated data.

COMPARING CONCENTRATIONS MEASURED IN DIFFERENT MEDIA

Comparing concentrations measured in different environmental media can assist with filling existing data gaps or holes and help verify reported values, which provide confidence in the data. These comparisons are often difficult to interpret because of varying degrees of temporal and spatial resolution. However, correlation is evident for concentrations measured in different media. Figure K-6 demonstrates the correlation between vegetation and rainwater, and Figure K-7 demonstrates the correlation between fish and surface water.

Figure K-8 illustrates the general agreement between ^{131}I concentrations measured between 1959 and 1966 in air and vegetation samples collected at the plant perimeter. The air and vegetation concentrations show the same general trends, with peaks in concentration evident during July 1959 and June 1961 that are likely related to elevated Site releases (see Figure K-5). As previously discussed, the higher concentrations measured during the latter part of 1961 are likely the result of increased weapons testing during that time period. Vegetation concentrations were reported on a wet weight basis before 1961; however, beginning in 1961, concentrations were reported on a dry weight basis. This helps account for the relatively lower vegetation concentrations observed before 1961.

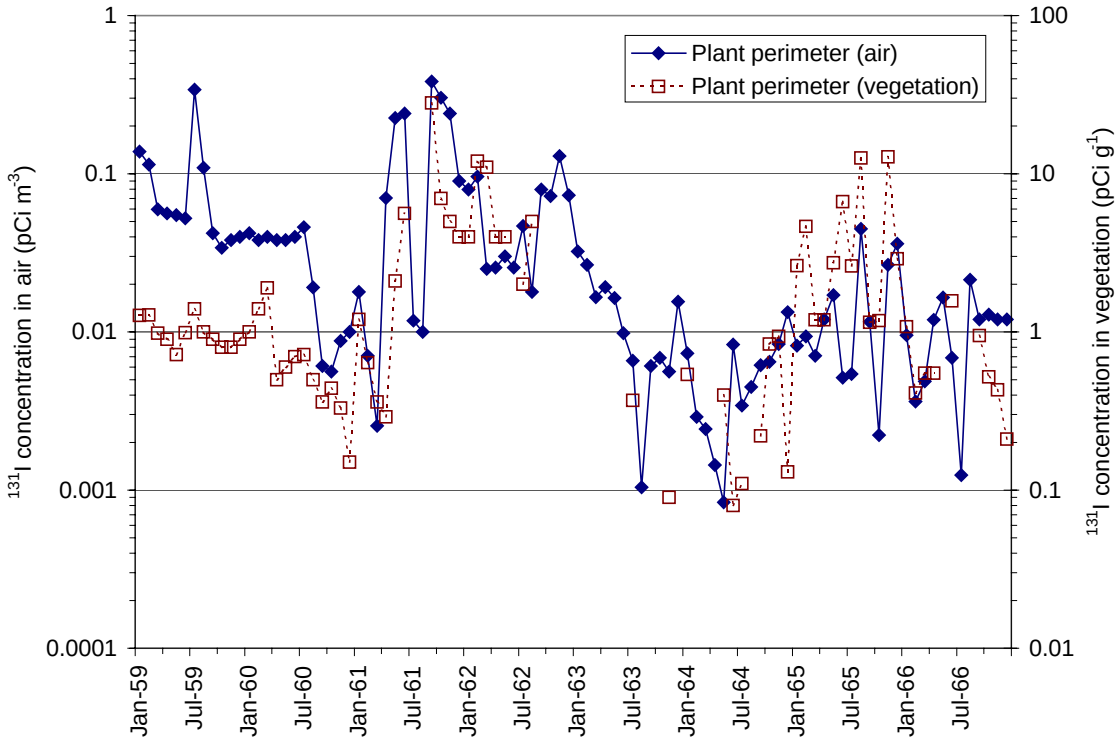

Figure K-8. Monthly average ^{131}I concentrations measured in vegetation and air at the plant perimeter locations from 1959 through 1966. Link to tabulated data.

Figure K-9 compares monthly average ^{131}I concentrations measured in vegetation (Chapter 9) and air (Chapter 8) at the plant perimeter and in milk (Chapter 10) from the Aiken, South Carolina, dairy during 1961 and 1962. Similar trends are evident for the three media, with peaks in concentration during May and June 1961 likely the result of increased separations area releases following the inadvertent reprocessing of short-cooled fuel.

The figures in this appendix are examples of the ways in which the environmental monitoring data may be useful during subsequent phases of this dose reconstruction project. Although they do not necessarily tell the whole story, they are important pieces of the puzzle and can often help identify the source of contamination and assist with quantifying potential offsite impacts related to Site releases. However, inadequate temporal or spatial resolution may limit the usefulness of the various data, particularly during time periods before 1959.

Using the data for model validation is not yet possible and will be part of subsequent phases of the dose reconstruction project following selection of appropriate dispersion models. It may also be possible to use the environmental monitoring data to develop site-specific model parameters. For example, concentration ratios can be calculated using fish and water concentrations. Calculation and selection of appropriate concentration ratios are discussed in greater detail in Chapter 14. Some of the data may also be useful for direct exposure assessment. This is likely possible for wild game and fish data, which are discussed in detail in Chapters 11 and 14, respectively.

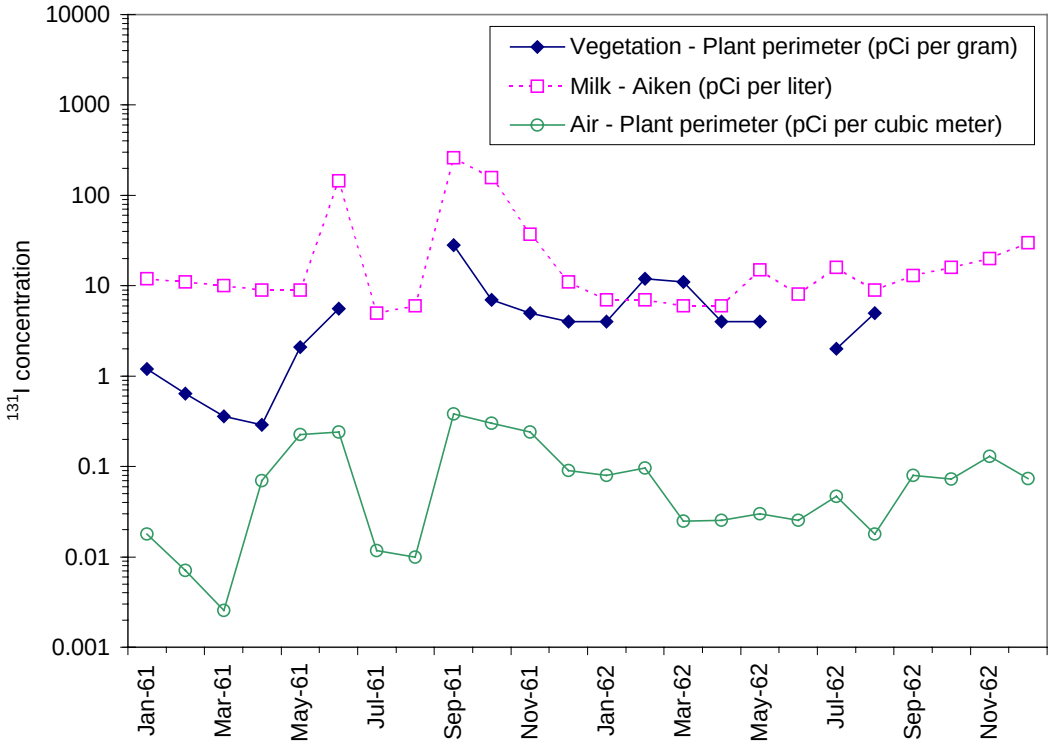

Figure K-9. Monthly average ^{131}I concentrations measured in vegetation and air collected at plant perimeter locations and in milk collected at the Aiken, South Carolina, dairy. Link to tabulated data.

The data compiled for developing the figures in this appendix are described in detail and provided in various other chapters of this report, identified separately for each figure in this appendix. The tabular data used to produce the figures depicted in this appendix can be accessed directly by readers of the electronic version of this document by clicking on the following hyperlink: AppK-Figure_data.xls.