DOCUMENTATION FOR THE FRAMES-HWIR TECHNOLOGY SOFTWARE SYSTEM, VOLUME 14: SITE LAYOUT PROCESSOR

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Summary

The U.S. Environmental Protection Agency (EPA) is developing a comprehensive environmental exposure and risk analysis software system for agency-wide application. This software system will be applied to the technical assessment of exposures and risks relevant to the Hazardous Waste Identification Rule (HWIR). The Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES), developed by the Pacific Northwest National Laboratory, is the software system adapted to automate this assessment. The process used to develop the FRAMES-HWIR Technology Software System includes steps for requirements analysis, design, specification, and development, with testing and quality assurance comprising a critical portion of each step. This volume documents that process for one of the system components: the Site Layout Processor (SLP).

The purpose of the SLP is to update air, human receptor, well, watershed, waterbody network, habitat, and farm sections of the Site-Based Database with spatial distribution data associated with the source, air, well, watershed, ecological habitats, and waterbody sections of the site layout data group network. The SLP also calculates the fraction of air concentration that is contributing to the receptor, given a percent of the total area to be covered and the total number of spatially distributed air points available for the site. This air concentration fraction for each medium (watershed, waterbody network, habitat, farm, and human receptor) is then used to simulate contaminant release, transport, and exposure, and to perform the hazard/risk assessment. The Site-Based Database contains all the site information needed to develop a risk simulation for the HWIR assessment strategy.

The SLP meets the following requirements:

1) Access the Site-Based Database that provides site-specific information and the scenarios for each assessment (allowing the SLP to both read and write to this database)

2) Read the Site-Delineation Database that contains spatial distribution data associated with the air, human receptor, well, watershed, waterbody network, habitat, and farm sections of the site layout data group in the Site-Based Database

3) Computes the appropriate fraction of air concentration contributing to each medium (watershed, waterbody network, habitat, farm, and human receptor)

4) Computes the correct number of air points to use for each site-layout component (e.g., watershed, waterbody network, habitat, farm, and human receptor)

5) Populates the coordinates of air points for the air data in the Site-Based Database

6) Populates the coordinates of the wells and waterbody networks in the Site-Based Database

7) Requires the user to enter the percentage of available spatial points for the site that will be used to calculate the contributing air fraction to each medium (watershed, waterbody network, habitat, farm, and human receptor)

8) Requires the user to enter a random seed value to initiate population of statistical distribution and allow for reproducibility of results

9) Reports any processor-specific warnings or errors to the screen or to an error file

10) Is testable independently of the other FRAMES-HWIR Technology Software System processors

The output from the SLP is a population of the Site Layout Data Group of the Site-Based Database. The Site-Based Database is accessed by the Site Definition Processor that creates the site simulation files. These SSFs, in turn, contain all the data required to conduct a risk simulation in the FRAMES-HWIR Technology Software System.

Acronyms and Abbreviations

ASCII	American Standard Code for Information Interchange
EPA	U.S. Environmental Protection Agency
FRAMES	Framework for Risk Analysis in Multimedia Environmental Systems
GIS	Geographic Information System
HWIR	Hazardous Waste Identification Rule
MMSP	Multimedia Multipathway Simulation Processor
OCRWM	Office of Civilian Radioactive Waste Management
RCRA	Resource Conservation and Recovery Act
SDP	Site Definition Processor
SLP	Site Layout Processor
SSF	Site Simulation File
WMU	waste management unit

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1.0 Introduction

The U.S. Environmental Protection Agency (EPA) is developing a comprehensive environmental exposure and risk analysis software system for agency-wide application. The software system will be applied to the technical assessment of exposures and risks relevant to the Hazardous Waste Identification Rule (HWIR). The HWIR is designed to determine quantitative criteria for allowing a specific class of industrial waste streams to no longer require disposal as a hazardous waste (that is, to exit Subtitle C) and to allow disposal in industrial Subtitle D facilities. Hazardous waste constituents with values less than these exit criteria levels would be reclassified as nonhazardous wastes under the Resource Conservation and Recovery Act (RCRA).

The software system adapted to automate this assessment is the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES), developed by the Pacific Northwest National Laboratory (PNNL). The FRAMES-HWIR Technology Software System consists of a series of components within a system framework (Figure 1.1). The process used to develop the FRAMES-HWIR Technology Software System includes steps for requirements analysis, design, specification, and development with testing and quality assurance composing a critical portion of each step.

The FRAMES-HWIR Technology Software System was developed to determine risks to human and ecological receptors caused by contaminant releases. These risks are assessed by modeling the transport of contaminants from their release at a source and through the environment, and their potential effects on human and ecological receptors. The EPA has compiled a list of approximately 200 sites that will be used for modeling and assessment purposes. Each site is characterized by a waste source, its surrounding environment, and human and ecological receptors that may be affected by contaminants released from the source. All of the data that characterize each site, its environment, and possible receptors must be collected and stored in databases before the FRAMES-HWIR Technology Software System can be used.

The FRAMES-HWIR Technology Software System obtains all data required to model contaminant transport and fate for each site from a set of databases that must contain complete information on each site. This information must be stored in an organized manner that allows easy access by a number of components within the system, including modules within the Multimedia Multipathway Simulation Processor (MMSP). This report documents the development process for one of those components, the Site Layout Processor (SLP). Because of the need to minimize the amount of data passed within the system, as well as to minimize computation time, the purpose of the SLP is to update the Site-Based Database with spatial distribution data associated with the air, well, and waterbody network sections of the Site Layout Data Group. To update the air concentration contributions to other mediums (watershed, waterbody network, habitat, farm, and human receptor), the SLP calculates the fraction of air points for spatially distributed site layout components (watershed, waterbody network, habitat, farm, and human receptor). The updated Site-Based Database provides input to the Site Definition Processor (SDP) and the Site Simulation Files (SSFs) (see Figure 1.1).

This report describes the requirements of the SLP and the design elements necessary to meet those requirements. It also describes the testing plan for the processor, the testing results, and the quality assurance program implemented. Specifications for the SLP are described in the document entitled *Documentation of the FRAMES-HWIR Technology Software System, Volume 8: Specifications*.

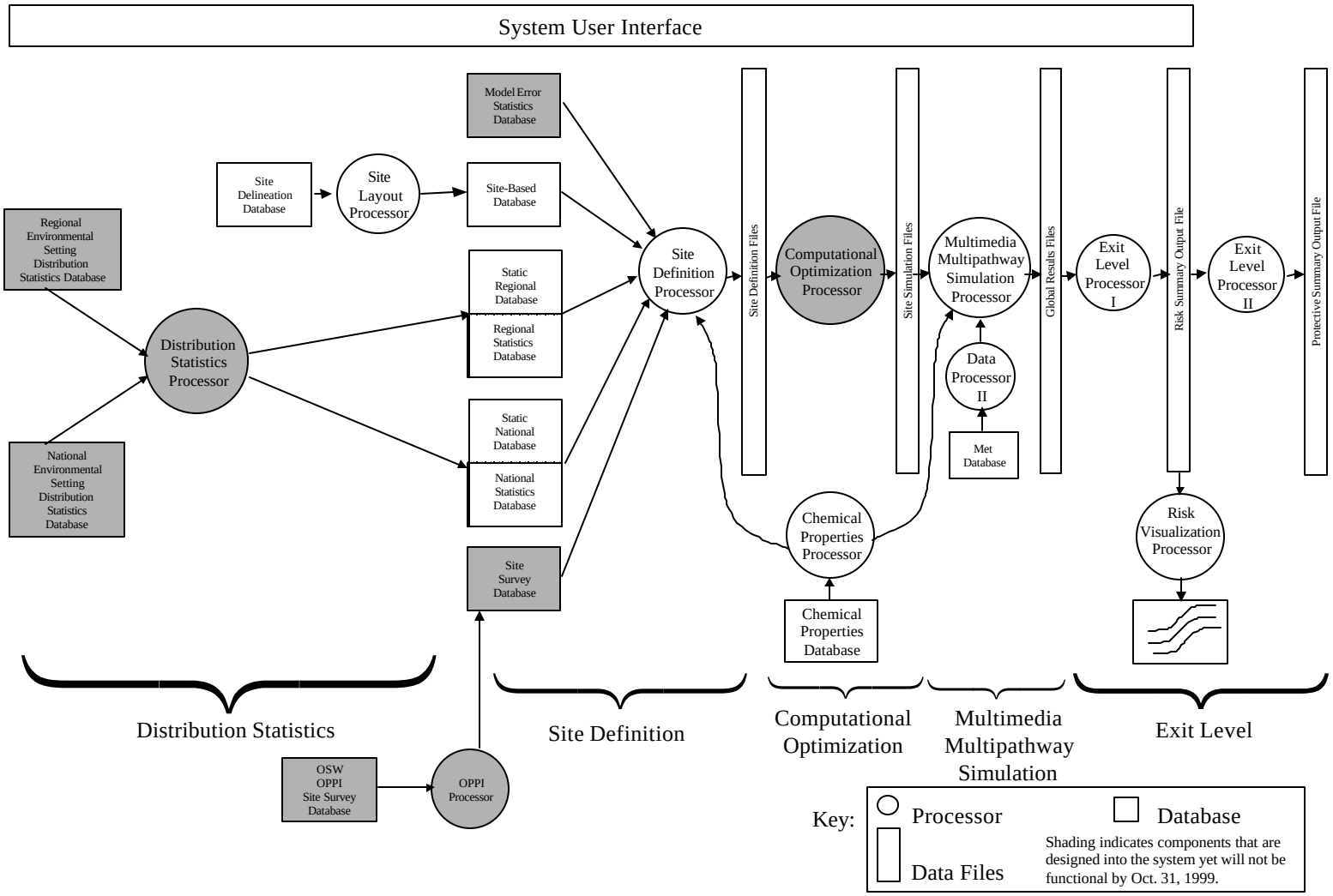

Figure 1.1 Overview of the FRAMES-HWIR Technology Software System

References cited in the text are listed in Section 6.0. Other components developed by PNNL are described in companion documents also listed in Section 6.0. The system itself is documented in a summary report entitled *Overview of the FRAMES-HWIR Technology Software System.*

The HWIR Assessment Strategy emphasizes the use of site-specific modeling to provide spatial distributions of contaminants in a pre-specified radius of interest around the center of industrial Type D facilities with land-based waste management units (WMU). To support this strategy, data were collected to provide a spatial frame of reference around each facility. A geographic information system (GIS) compiled these data to create several conceptual spatial data layers for each site, as shown in Figure 1.2. Each of these data layers spatially defines areas based on the data sources from which it was extracted (for example, human receptor areas or watersheds). The data associated with these layers are stored in two databases, the Site-Based Database and the Site-Delineation Database.

1.1 Site-Based Database

The Site-Based Database defines the spatial framework (number and type of sources, and available transport pathways) around the facility centroid for each component of site layout defined during data collection. Components can include lakes, streams, watersheds, farms, ecological habitats, or human populations. The specifications for the Site-Based Database can be found in the document entitled *Documentation for the FRAMES-HWIR Technology Software System, Volume 8: Specifications* (see Section 6.0).

This Site-Based Database contains the following data group sections:

- Source data, including WMU and waste characteristics
- Air data
- Vadose zone data
- Aquifer data
- Watershed subbasins data
- Waterbody networks data
- Terrestrial foodchain data
- Farm data
- Aquatic foodweb data
- Human receptor data
- Ecological receptor data
- Human risk data
- Ecological risk data.

1.2 Site-Delineation Database

This section is partially taken from the document *An Overview of the Spatial Aspects of the HWIR98 Data Collection and Processing* (RTI 1998). The Site-Delineation Database contains a gridded base, as shown in Figure 1.2. Five spatially described data layers must be combined to define the relationship between components for a site layout: farms, lakes, watersheds, habitats, and human receptor areas. Four of these five layers are depicted in Figure 1.2. The data in these data layers are read into the database by the SLP and processed to define the air concentration fractional relationships between the

appropriate data layers. The Site-Delineation Database provides the SLP with site-specific spatial information from the HWIR site-based data collection effort. The database contains tables for all site-layout components that are described spatially, including

- Farms
- Watersheds
- Habitats
- Human receptors
- Waterbody networks.

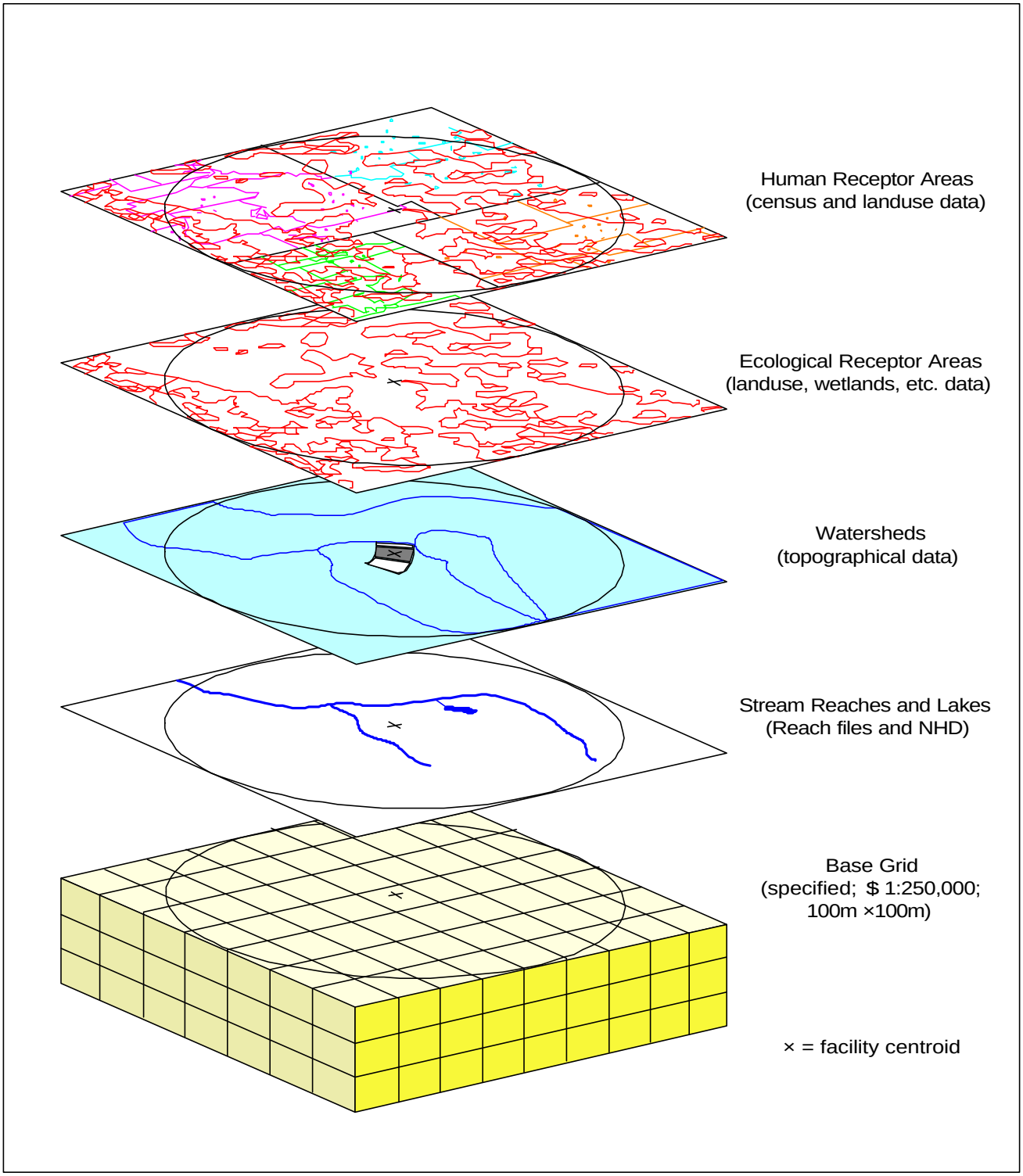

Figure 1.2 Spatial Delineation Layers and Grid

2.0 Requirements of the Site Layout Processor

Requirements are characteristics and behaviors that software must possess to function adequately for its intended purpose. As mentioned, the purpose of the SLP is to calculate the fractional relationships between two or more components of the site-layout information and to update the Site-Based Database by providing partial input to the Site Layout Data Group. These fractions are calculated by the SLP, based on data obtained from the Site-Delineation Database and the Site-Based Database (see Figure 1.1).

In summary, the SLP

1) Accesses the Site-Based Database that provides site-specific information and the scenarios for each assessment (allowing the SLP to both read and write to this database)

2) Reads the Site-Delineation Database that contains spatial distribution data associated with the air, human receptor, well, watershed, waterbody network, habitat, and farm sections of the Site Layout Data Group in the Site-Based Database

3) Computes the appropriate fraction of air concentration contributing to each medium (watershed, waterbody network, habitat, farm, and human receptor)

4) Computes the correct number of air points to use for each site-layout component (e.g., watershed, waterbody network, habitat, farm, and human receptor) and then randomly samples which points to use

5) Populates the coordinates of air points for the sampled air data points in the Site-Based Database

6) Populates the coordinates of the wells and waterbody networks in the Site-Based Database

7) Requires the user to enter the percentage of available spatial points for the site that will be used to calculate the contributing air fraction to each medium (watershed, waterbody network, habitat, farm, and human receptor)

8) Requires the user to enter a random seed value to initiate population of statistical distribution and allow for reproducibility of results

9) Reports any processor-specific warnings or errors to the screen or to an error file

10) Is testable independently of the other FRAMES-HWIR Technology Software System processors.

The following sections describe in more detail the input requirements, scientific requirements, and output requirements of the SLP.

2.1 Input Requirements

The SLP accesses the Site-Based Database and Site-Delineation Database to obtain the information it requires to calculate the air-concentration fractional relationships to various media (watershed, waterbody network, habitat, farm, and human receptor); these fractions and the sampled x, y

locations are then written to the Site-Based Database. These fractional-relationship values supply air concentration fraction information for each simulation conducted by the FRAMES-HWIR Technology Software System. The SLP also populates the coordinates for the waterbody network and well components of the Site Layout Data Group in the Site-Based Database with spatial and control information, as necessary. The locations of the Site-Based and Site-Delineation Databases are given through the SLP user interface.

2.2 Scientific Requirements

The SLP is responsible for computing the number of air points contained within the spatial boundary of each site layout component and then randomly choosing which points to use. The Number of Sampled Points to use is based on the total number of available air points contained within the spatial boundary of the site layout component and the percent to be sampled specified by the user at the "Percent Coverage." Equation 2.1 is used, where Number of Available Air Points is the total number of air points contained within the spatial boundary of each site layout component, and Percent Coverage is the percent to be sampled that has been specified by the user. The SLP also checks to ensure that no duplicate air points are selected.

$$Number\ of\ Sampled\ Points = Number\ of\ Available\ Air\ Points \times Percent\ Coverage \quad (2.1)$$

For example, if a watershed had 20 points and 25-percent coverage was entered, a set of 5 points would be randomly sampled. If the product of the number of sampled points is not an integer, it is rounded to the nearest integer.

The SLP is also responsible for calculating and updating the air fraction contributing to each medium (watershed, waterbody network, habitat, farm, and human receptor) that is required by the Site-Based Database. This process involves describing the air-concentration fractional contribution to a component of the site-layout information (that is, watershed subbasin, waterbody network, habitat, farm, and human receptor) from the air component of the site-layout information. For the air-component contribution to other components, the fractional contribution is calculated using Equation 2.2. In this equation, the number of sampled air points is the number of air points randomly selected, based on the percent coverage entered for contribution to the impacted component.

$$Contributing\ Air\ Fraction = \frac{1}{Number\ of\ Sampled\ Air\ Points} \quad (2.2)$$

For example, if a watershed subbasin contains 20 points and 25-percent coverage is entered, then 5 points are randomly sampled, and their locations are reported to the Site Layout Data Group in the Site-Based Database. The contributing air fraction reported then is 0.20 for each of those five points.

2.3 Output Requirements

Output from the SLP is the population of Site-Based Database with all spatial-distribution data associated with the air and well sections of the Site Layout Data Group and the contributing fractions of air points and their locations for spatially distributed site-layout components necessary for a FRAMES-HWIR Technology Software System simulation. The Site-Based Database is used as input to the SDP, as seen in Figure 1.1. The SLP also creates error messages that are available to the user through the SLP user interface or an error file. These files are in flat-ASCII format, as described in *Documentation for the FRAMES-HWIR Technology Software System, Volume 8: Specifications* (see Section 6.0).

3.0 Design Elements of the Site Layout Processor

The SLP is designed to meet the requirements identified in Section 2.0 of this document. Key to meeting those requirements is the linkage between the SLP and the Site-Based Database and the Site-Delineation Database. The following sections describe the databases and the implementation of the SLP.

3.1 Input Databases

The Site-Based Database provides the site-layout information for all site-layout components. The information on site-layout components reflects a conceptualization of a site, utilizing data specifically collected for the site to describe the layout of the physical WMU, environmental setting, and receptor distributions. These data are represented by discrete values without statistics. This Site-Based Database contains the following data group sections:

- Source data, including WMU and waste characteristics
- Air data
- Vadose zone data
- Aquifer data
- Watershed subbasins data
- Waterbody networks data
- Terrestrial foodchain data
- Farm data
- Aquatic foodweb data
- Human receptor data
- Ecological receptor data
- Human risk data
- Ecological risk data.

See *Documentation for the FRAMES-HWIR Technology Software System, Volume 8: Specifications* (Section 6.0) for details on the Site-Based Database.

The Site-Delineation Database provides the SLP with site-specific spatial information from the HWIR site-based data-collection effort. The database contains tables for all site-layout components that are described spatially, including

- Farms
- Watersheds
- Habitats
- Human receptors
- Waterbody networks.

Each table has eight fields with column headings: RowID, SettingID, LocX, LocY, LocZ, Index1, Index2, and Fraction. These fields specify the coordinates of the component of the site layout (relative to a specific Lat/Log location) and the waste site with which it is associated. See *Documentation for the FRAMES-HWIR Technology Software System, Volume 8: Specifications* (Section 6.0) for details on the Site-Delineation Database.

3.2 Implementation

The SLP accesses each of the data tables in the Site-Delineation Database, where appropriate, and then updates the Site-Based Database. As noted in the requirements section, one of the functions of the SLP is to calculate contributing fractions for site-layout components receiving contaminants via air deposition. These site-layout components are watershed subregions, waterbody network reaches (lakes only), farms, habitats, and human receptors. Equation 2.1, as described in Section 2.2, is used to calculate these contributing fractions.

One way to understand the implementation of the SLP is to use the following figures to describe a relatively simple site and how its features are labeled and divided into significant components. Only the components or features that are significant for modeling purposes are labeled or represented in the figures.

The basic approach to the SLP is to establish a fractional relationship that represents the particular contribution from air to other site-layout components (watershed, waterbody network, habitat, farm, and human receptor). This fraction and the associated X and Y points are passed through the system in the SSF rather than passing the entire data set grid available in the Site-Delineation Database.

Figure 3.1 shows an aerial view of a simple site and its considered area. The solid lines represent waterbody elements, such as streams, rivers, and lakes. As shown, the streams empty into a lake at the lower right. The dotted lines indicate ridges or areas of higher elevation. Because the ridges delineate the edges of the drainage area associated with a waterbody element, it is assumed that only precipitation that falls within the drainage area will contribute to the streams and local groundwater table. The large rectangle in the upper right represents a farm area, and the smaller rectangle near the center of the figure represents the actual WMU. The two "Xs" represent drinking water wells. The two fish represent aquatic foodweb, one that lives in the lake and another that lives in a river segment. The people scattered in the lower left represent a large number of people living in that area.

Although an illustration like Figure 3.1 describes all of the easily visible features of the site area, several more features need to be captured for modeling purposes. The first feature described is the watershed subbasin. As noted previously, the dotted lines in Figure 3.1 represent ridges or areas of higher elevation. These ridges divide the site area into three watershed subbasins. The large watershed subbasin that stretches from the waste site area to the lower left is divided into two subbasins by the stream that passes through it. Figure 3.2 shows the site area and four watershed subbasins without the source, farm, wells, and human receptors. This figure provides a clear picture of the four watershed subbasins.

These watershed subbasins are referred to as WSSub1, WSSub2, WSSub3, and WSSub4. The farm and source are referred to as Farm1 and Src1, respectively. The number 1 is added because more than one farm and source can be located in a waste site area. The human receptor is referred to as HumRcp1 and HumRcp2, and so forth. The two fish represent aquatic foodwebs and are labeled AquaFW1 and AquaFW2. The streams and lake are considered part of the waterbody network in the waste site area. Each segment, or reach, is given its own label, as shown. They are labeled WBNRch1, WBNRch2, WBNRch3, WBNRch4. Additionally, SrcWS4 is divided into subbasins that are labeled SrcLWS4Sub1, and SrcLWS4Sub2.

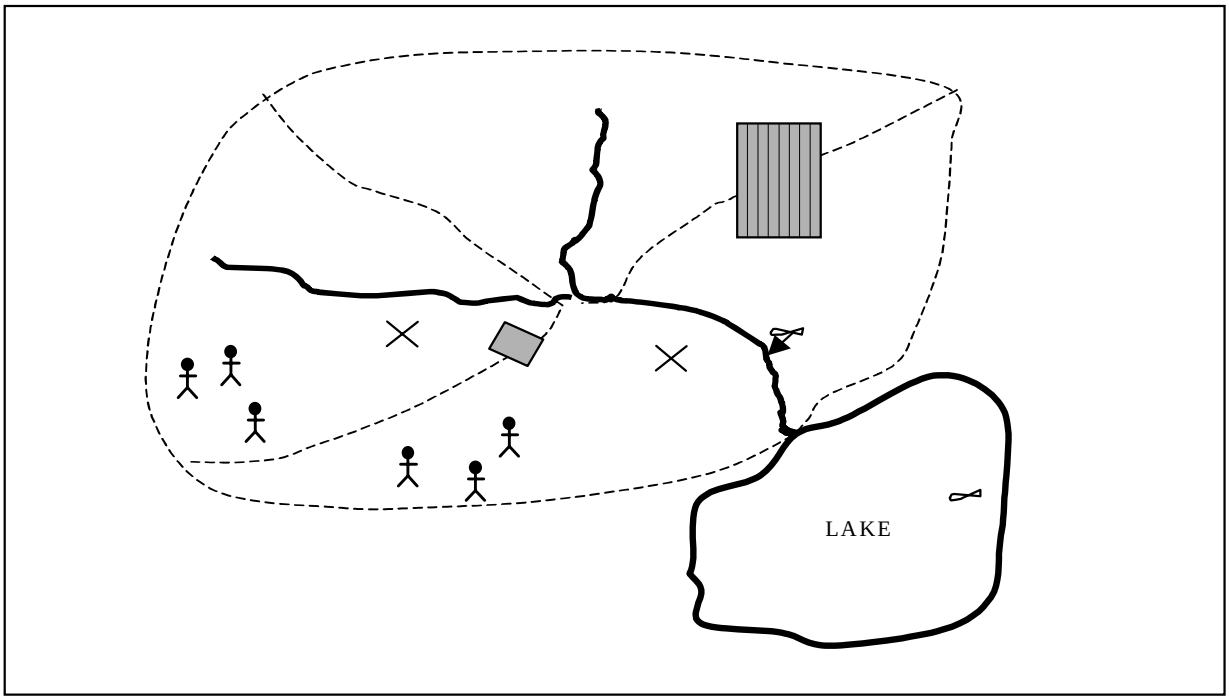

Figure 3.1 Aerial View of a Simple Site and Surrounding Area

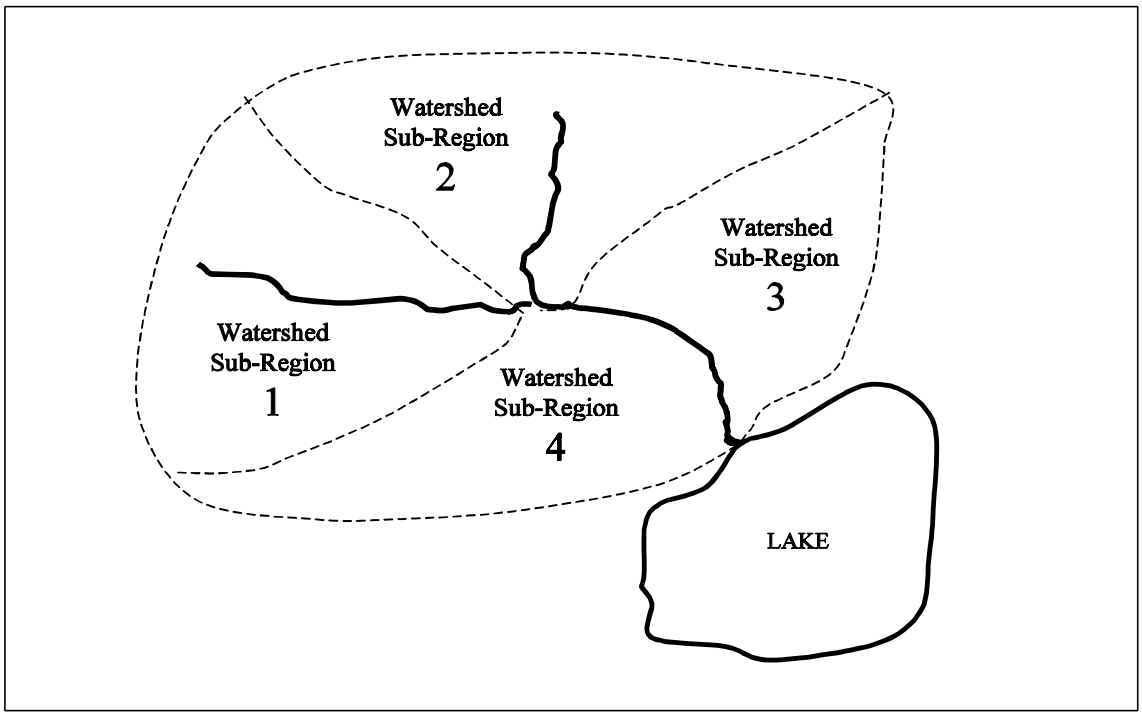

Figure 3.2 Aerial View of Watershed Subbasins Associated with the Site

After all of the components of a site layout have been identified, the description is stored in one of two databases. The Site-Delineation Database contains a set of x,y,z coordinates for all grid cells for farms, watershed subbasins, lakes, human receptors, and ecological habitat regions. Figure 3.3 shows these components with a grid overlay. Each grid cell is identified with an x, y, and z coordinate. A set of grid cells identifies the delineation of the components.

The remainder of the Site Layout description information is stored in the Site-Based Database. This information includes all the control information necessary for completing a simulation (for example, the number of waterbody networks of the type *stream* and the number of aquifers associated with the WMU). The SLP uses the site-layout information pertaining to the appropriate connections between components and the number of various media that are in the WMU currently being calculated.

Using this layout information, the SLP then calculates the fractional relationship between air and the appropriate component. These fractions are then used to update the Site-Based Database.

An example of how the fractional calculation is done for an air contribution can be demonstrated by using Figure 3.3. An appropriate relationship for this example would be the air and farm data layers. The calculation of the air-concentration fractional contribution would be calculated. The user specifies the percentage of points to be calculated in the SLP user interface or through the header file. For this example, assume the user has specified a 60-percent coverage area. The SLP, using Equation 2.2, calculates the fractional relationship from air at one over the total number of grid points sampled from Farm1. For this example, assume the total number of grid points for the farm is 20. Therefore, 60

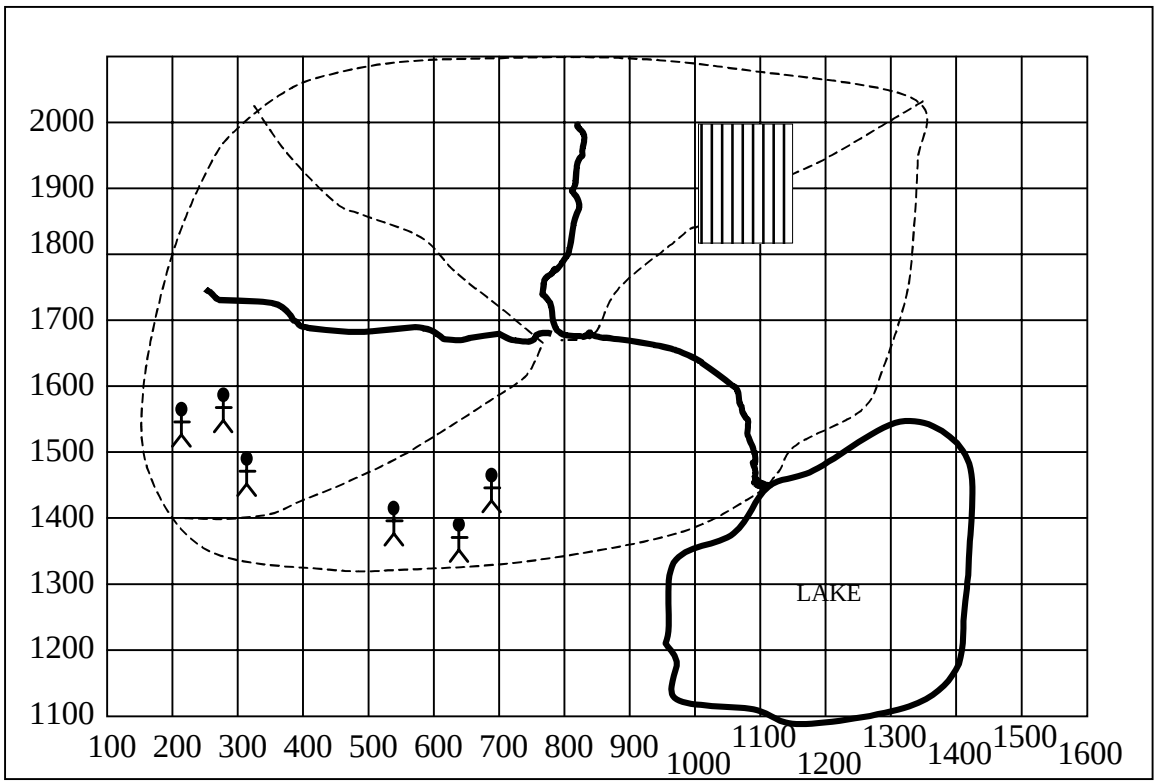

Figure 3.3 Gridded Overlay of Spatial Delineation Components of the Site Layout

percent of that 20 would mean that 12 air points are to be sampled. The X and Y locations would be recorded for these 12 points to the farm section of the site-layout data group in the Site-Based Database. In this example, the fractional contribution from air to the farm would be 0.08, and each of the 12 points would be assigned this fraction.

3.3 Outputs: Updated Site-Based Database

The output of SLP is an updated Site-Based Database, complete with the fractions discussed in Section 3.2. The SLP also appends air-deposition control information, as needed, to the Site-Based Database. All other parameters in the Site-Based Database remain unchanged. For details on the specifications for the Site-Based Database and the fractions created by the SLP, refer to *Documentation of the FRAMES-HWIR Technology Software System, Volume 8: Specifications* (see Section 6.0).

4.0 Testing and Verification Approach and Results

This section describes how the SLP is tested and verified to ensure that it meets its requirements. One purpose of the SLP is to update the Site-Based Database with spatial distribution data associated with the air and well sections of the Site Layout Data Group. A secondary purpose is to calculate the contributing fraction of air points for spatially distributed site-layout components that are used to simulate contaminant release, transport, and exposure, and to perform the hazard/risk assessment. The following sections summarize the requirements for the SLP in a form suitable for testing and verifying, show how the test cases that follow relate to these requirements, describe each test case, and describe the baseline results for each test case. The test cases address the basic functionality listed in the requirements (black box testing).

4.1 Summary of Requirements

Requirements for the SLP are described in Section 2.0; the design is described in Section 3.0. The requirements specified (or implied) in these sections are reworded in Table 4.1 to provide concise, fundamental requirements that are suitable for testing.

Table 4.1 Summary of the Requirements for the Site Layout Processor

Requirement Number	Requirement
1	Access the Site-Based Database that provides site-specific information and the scenarios for each assessment (allowing the SLP to both read and write to this database)
2	Read the Site-Delineation Database that contains spatial distribution data associated with the air, human receptor, well, watershed, waterbody network, habitat, and farm sections of the Site Layout Data Group in the Site-Based Database
3	Compute the appropriate fraction of air concentration contributing to each medium (watershed, waterbody network, habitat, farm, and human receptor)
4	Compute the correct number of air points to use for each site-layout component (e.g., watershed, waterbody network, habitat, farm, and human receptor) and then randomly sample which points to use
5	Populate the coordinates of air points for the sampled air data points in the Site-Based Database
6	Populate the coordinates of the wells and waterbody networks in the Site-Based Database
7	Require the user to enter the percentage of available spatial points for the site that will be used to calculate the contributing air fraction to each medium (watershed, waterbody network, habitat, farm, and human receptor)

Requirement Number	Requirement
8	Require the user to enter a random seed value to initiate the population of statistical distribution and allow for reproducibility of results
9	Report any processor-specific warnings or errors to the screen or to an error file
10	Is testable independently of the other FRAMES-HWIR Technology Software System processors

Table 4.2 shows the relationship between these requirements and the test and verification cases described in Section 4.2. Although some requirements apply to all test cases, this table shows which requirements are specifically evaluated by each case. Cases 10 through 15 are to satisfy verification requirement Number 11.

Table 4.2 Matrix of Requirements to Test Case for the Site Layout Processor

		Test Cases														
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Requirement	**1**	X														
	2	X														
	3	X	X													
	4	X	X													
	5	X	X													
	6	X														
	7	X	X													
	8	X	X							X						
	9			X	X	X	X	X	X							
	10	X	X	X	X	X	X	X	X	X						

4.2 Test and Verification Cases

Cases 1 through 9 use fabricated databases to confirm the correct movement and calculations required for requirements 1 through 10. The purpose of cases 10 thru 15 is to verify that the SLP operates as expected on Site 0223504 and Site 1632106. Following is a general description of the verification plan.

The Site-Based Database *BetaV22.mdb* contains all sites; however, only two will be analyzed for this verification, Site 0223504 and Site 1632106. Site 0223504 contains three source types: waste pile (WP0223504), land application unit (LA0223504), and landfill (LF0223504). Site 1632106 also contains three source types, land application unit (LA1632106), surface impoundment (SI1632106), and aerated tank (AT1632106). Data for these sites used in this verification are found in *VerificationDB.mdb*, the Site-Based Database, and in *GridOut.mdb*, the Site-Delineation Database. The two databases are too large to include in this document. Electronic versions are supplied with this document.

Each of the following six verification items is examined using a different source from the preceding six source options:

1) For wells, transfer the X-Y coordinates to the Site-Based Database.

2) For waterbody networks, transfer to the Site-Based Database all X-Y coordinates and population *WBNRchNumAir* and *WBNRchAirFrac*, based on 3-percent coverage.

3) For human receptors, populate *HumRcpNumAir* and *HumRcpAirFrac*, based on 3-percent coverage.

4) For farms, populate *FarmNumAir* and *FarmAirFrac*, based on 3-percent coverage.

5) For watershed subbasins, populate *WSSubNumAir* and *WSSubAirFrac*, based on 3-percent coverage.

6) For habitat ranges, populate *HabRangeNumAir* and *HabRangeAirFrac*, based on 3-percent coverage.

4.2.1 Test Case SLP_01

4.2.1.1 Description and Rationale

The SLP reads information from two databases (Site Delineation and Site-Based) and updates the Site Layout Data Group of the Site-Based Database. The purpose of this test is to verify that the SLP operates as expected when the maximum percent coverage allowable (100) is selected through the user interface. The SLP should 1) populate the Site-Based Database with the X-Y coordinates of the air points, 2) populate the Site-Based Database with the X-Y coordinates of the wells, 3) populate the parameter *NumAir* with the correct value, as determined by the percent coverage and the total number of air points available, 4) update the Site-Based Database parameters *FarmNumAir*, *HabRangeNumAir*, *WBNRchNumAir*, and *WSSubNumAir*, 5) compute contributing fractions related to air deposition, and 6) populate the Site-Based Database with the parameter *AquWellFracZ* as read from the Site-Delineation Database.

The Site-Based Database *demo.mdb* contains a complete data set for three sites. The data for all three sites is initially identical, except for the source types. The three source types used are LA1231234, LF1231234, and WP1231234. Only the updated results for LA1231234 are checked for this test case.

4.2.1.2 Input Data

Two databases are required to run the SLP, the Site-Delineation Database and the Site-Based Database. In this case, the Site-Delineation Database is called *SpatDel2.mdb*, and the Site-Based Database is called *demo.mdb*. Their file names and paths are passed to the SLP through the user interface. The two databases are too large to include in this document. Electronic copies can be supplied upon request.

The percent coverage for the site is also required by the SLP and is entered through the user interface. In this case, the percent coverage used is 100. The user must also provide a random-seed value, in this case a random-seed value of 1. The random seed value selection makes it possible to reproduce results from an SLP run.

4.2.1.3 Expected Results

The expected result for this test case is that SLP operates correctly as directed by user input and database entries. In this case, 100-percent coverage was chosen. Based on the data in the Site-Delineation Database, the SLP was expected to produce the results shown in Table 4.3.

Table 4.3 Expected Results Written to the Site-Based Database for Test Case SLP_01

Parameter	Value
Coordinates for air points [(336 WSSub) + (24 WBN Rch4) + (1 Hab2 Range2)]	361
Coordinates for well points	22
HumRcpAirIndex entries	20
NumAir	361
FarmNumAir for farm 1	8
FarmNumAir for farm 2	8
HabRangeNumAir for Habitat 1 Range 1	2
HabRangeNumAir for Habitat 1 Range 2	4
HabRangeNumAir for Habitat 1 Range 3	18
HabRangeNumAir for Habitat 2 Range 2	4
HabRangeNumAir for Habitat 2 Range 3	18
WBNRchNumAir for Reach 1	0
WBNRchNumAir for Reach 2	0
WBNRchNumAir for Reach 3	0

Parameter	Value
WBNRchNumAir for Reach 4	24
WSSubNumAir for Watershed Subregion 1	99
WSSubNumAir for Watershed Subregion 2	73
WSSubNumAir for Watershed Subregion 3	52
WSSubNumAir for Watershed Subregion 4	112
AquWellFracZ entries	22
FarmAirFrac for farm 1	0.125
FarmAirFrac for farm 2	0.125
HabRangeAirFrac for Habitat 1 Range 1	0.5
HabRangeAirFrac for Habitat 1 Range 2	0.25
HabRangeAirFrac for Habitat 1 Range 3	0.055556
HabRangeAirFrac for Habitat 2 Range 1	1
HabRangeAirFrac for Habitat 2 Range 2	0.25
HabRangeAirFrac for Habitat 2 Range 3	0.055556
WSSubAirFrac for Watershed Subregion 1	0.010101
WSSubAirFrac for Watershed Subregion 2	0.013699
WSSubAirFrac for Watershed Subregion 3	0.019231
WSSubAirFrac for Watershed Subregion 4	0.008929

4.2.1.4 Conducting the Test

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. A screen capture of the user interface and inputs for this case are shown in Figure 4.1. As noted in Section 4.2.1.2, the file names and paths of the Spatial-Delineation Database and the Site-Based Database must be entered. To specify the Spatial-Delineation Database, click on the button that is located to the right of its box. Find the database, in this case *D:\HWIR\SLP\SpatDel2.mdb*, and click on the *open* button. The file name and path are entered into the Spatial-Delineation Database window on the SLP user interface. Repeat this process to select the Site-Based Database. Then type in *100* for the percent coverage and type in *1* for the random seed value to be used. When all of the entries have been made, click on the *start* button to begin executing. When the SLP is finished executing, the message *Processing Complete* is written to the screen on the bottom portion of the user interface. In addition, the *start* button changes to an *exit* button.

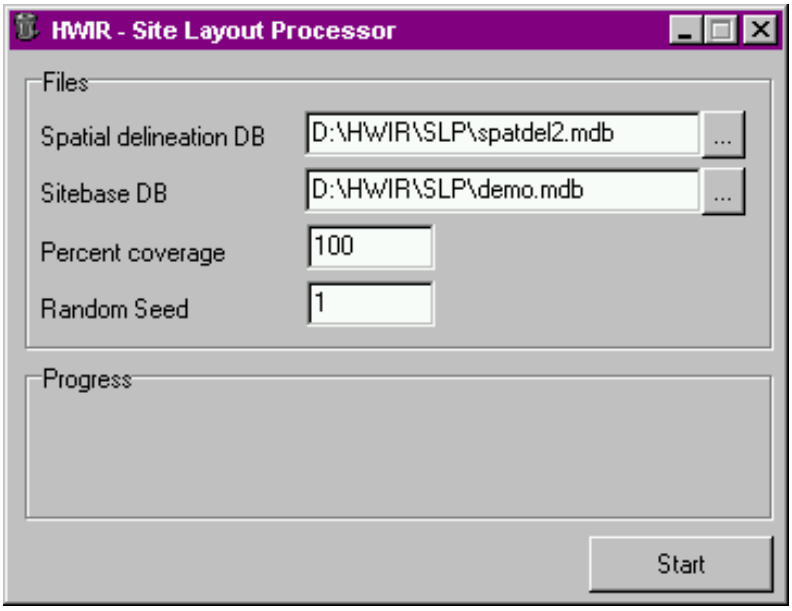

Figure 4.1 Screen Capture of User Interface and Inputs for SLP_01

After the run is complete, rename the Site-Based Database to *demo1.mdb* to preserve the results. This action is necessary because each time the SLP is run, the *demo.mdb* is updated. Create a new *demo.mdb* by making a copy of *demo_orig_empty.mdb* and renaming it *demo.mdb*. The file *demo_orig_empty.mdb* is the original *demo.mdb* that has not been updated by the SLP.

4.2.1.5 Baseline Testing Results

Table 4.4 presents the results found in the Site-Based Database after SLP execution.

Table 4.4 Results in the Site-Based Database After SLP Execution for Test Case SLP_01

Parameter	Value
Coordinates for air points	361
Coordinates for well points	22
HumRcAirIndex entries	20
NumAir	361
FarmNumAir for farm 1	8
FarmNumAir for farm 2	8
HabRangeNumAir for Habitat 1 Range 1	2
HabRangeNumAir for Habitat 1 Range 2	4
HabRangeNumAir for Habitat 1 Range 3	18

Parameter	Value
HabRangeNumAir for Habitat 1 Range 3	18
HabRangeNumAir for Habitat 2 Range 1	
HabRangeNumAir for Habitat 2 Range 2	4
HabRangeNumAir for Habitat 2 Range 3	18
WBNRchNumAir for Reach 1	0
WBNRchNumAir for Reach 2	0
WBNRchNumAir for Reach 3	0
WBNRchNumAir for Reach 4	24
WSSubNumAir for Watershed Subregion 1	99
WSSubNumAir for Watershed Subregion 2	73
*WSSubNumAi*r for Watershed Subregion 3	52
WSSubNumAir for Watershed Subregion 4	112
AquWellFracZ entries	22
FarmAirFrac for farm 1	0.125
FarmAirFrac for farm 2	0.125
HabRangeAirFrac for Habitat 1 Range 1	0.5
HabRangeAirFrac for Habitat 1 Range 2	0.25
HabRangeAirFrac for Habitat 1 Range 3	0.055556
HabRangeAirFrac for Habitat 2 Range 1	1
HabRangeAirFrac for Habitat 2 Range 2	0.25
HabRangeAirFrac for Habitat 2 Range 3	0.055556
WSSubAirFrac for Watershed Subregion 1	0.010101
WSSubAirFrac for Watershed Subregion 2	0.013699
WSSubAirFrac for Watershed Subregion 3	0.019231
WSSubAirFrac for Watershed Subregion 4	0.008929

4.2.2 Test Case SLP_02

4.2.2.1 Description and Rationale

The SLP reads information from two databases (the Site-Delineation Database and the Site-Based Database) and updates the Site Layout Data Group of the Site-Based Database. The purpose of this test is to verify that the SLP operates as expected when a percent coverage of 10 is selected through the user interface. The only difference between this case and test case SLP_01 is the percent of coverage.

The Site-Based Database *demo.mdb* contains a complete data set for three sites. The data for all three sites are initially identical, except for the source types. The three source types used are LA1231234, LF1231234, and WP1231234. Only the updated results for LA1231234 are checked for this test case.

4.2.2.2 Input Data

Two databases are required to run the SLP, the Site-Delineation Database and the Site-Based Database. In this case, the Site-Delineation Database is called *SpatDel2.mdb*, and the Site-Based Database is called *demo.mdb*. Their file names and paths are passed to the SLP through the user interface. The two databases are too large to include in this document. Electronic copies of each can be supplied upon request.

The percent coverage for the site is also required by the SLP and is entered through the user interface. In this case, 10 percent is chosen. The user must also provide a random seed value to be used, in this case, a random seed value of 1. The random seed-value selection makes it possible to reproduce results from an SLP run.

4.2.2.3 Expected Results

The expected results for this test case are that SLP operates correctly as directed by user input and database entries. In this case, the choice was 10-percent coverage. A check of the data in the Site-Delineation Database indicated the SLP is expected to produce the results shown in Table 4.5. It is also expected that all human receptor locations be used as air points and that the SLP not use any duplicate air points.

Table 4.5 Expected Results Written to the Site-Based Database for Test Case SLP_02

Parameter	Max Total	Value
Coordinates for air points	65	# 65
Coordinates for well points	22	22
HumRcpAirIndex entries	20	20
NumAir	45	# 65
WSSubNumAir for watershed 1	99	10

Parameter	Max Total	Value
WSSubNumAir for watershed 2	73	7
WSSubNumAir for watershed 3	52	5
WSSubNumAir for watershed 4	112	11
FarmNumAir for farm 1	8	1
FarmNumAir for farm 2	8	1
HabRangeNumAir for Habitat 1 Range 1	2	1
HabRangeNumAir for Habitat 1 Range 2	4	1
HabRangeNumAir for Habitat 1 Range 3	18	2
HabRangeNumAir for Habitat 2 Range 1	1	1
HabRangeNumAir for Habitat 2 Range 2	4	1
HabRangeNumAir for Habitat 2 Range 3	18	2
WBNRchNumAir for Reach 1	0	0
WBNRchNumAir for Reach 2	0	0
WBNRchNumAir for Reach 3	0	0
WBNRchNumAir for Reach 4	24	2
AquWellFracZ entries	22	22
FarmAirFrac for farm 1	1.0	1.0
FarmAirFrac for farm 2	1.0	1.0
HabRangeAirFrac for Habitat 1 Range 1	1.0	1.0
HabRangeAirFrac for Habitat 1 Range 2	1.0	1.0
HabRangeAirFrac for Habitat 1 Range 3	1.0	1.0
HabRangeAirFrac for Habitat 2 Range 1	1.0	1.0
HabRangeAirFrac for Habitat 2 Range 2	1.0	1.0
HabRangeAirFrac for Habitat 2 Range 3	1.0	0.5
WBNRchAirFrac for Reach 4	1.0	0.5
WSSubAirFrac for Watershed Subregion 1	1.0	0.1
WSSubAirFrac for Watershed Subregion 2	1.0	0.142857
WSSubAirFrac for Watershed Subregion 3	1.0	0.2
WSSubAirFrac for Watershed Subregion 4	1.0	0.090909

4.2.2.4 Conducting the Test

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. To specify the Spatial-Delineation Database, click on the button located to the right of its box. Find the database to be used, in this case *D:\HWIR\SLP\SpatDel2.mdb*, and click on the *open* button. The file name and path will enter into the Spatial-Delineation Database window on the SLP user interface. Repeat this process to select the Site-Based Database. Then type in *10* for the percent coverage and type in a *1* for the random seed value to be used. When all of the entries are made, click on the *start* button to begin executing. When the SLP is finished executing, the message *Processing Complete* writes to the screen on the bottom portion of the user interface. In addition to this, the *start* button will change to an *exit* button.

After the run is complete, rename the Site-Based Database to *demo2.mdb* to preserve the results. This renaming is necessary because each time the SLP runs, the *demo.mdb* is updated. Create a new *demo.mdb* by making a copy of *demo_orig_empty.mdb* and renaming it *demo.mdb*. The file *demo_orig_empty.mdb* is the original *demo.mdb* that has not been updated by an SLP.

4.2.2.5 Baseline Testing Results

Table 4.6 shows the results found in the Site-Based Database after the SLP was run. A check ensures that all human receptor locations were used as air points and the SLP did not use any duplicate air points.

4.2.3 Test Case SLP_03

4.2.3.1 Description and Rationale

The SLP reads information from two databases (Site Delineation Database and Site-Based Database). The names and locations of the databases are specified through the user interface. Error messages are produced if the SLP is unable to find the databases due to incorrect database names or locations. In this test, incorrect database names for both databases are entered.

Table 4.6 Results in the Site-Based Database After SLP Execution for Test Case SLP_02

Parameter	Value
Coordinates for air points (maximum of 65)	60
Coordinates for well points	22
HumRcpAirIndex entries	20
NumAir	60
WSSubNumAir for Watershed Subregion 1	10
WSSubNumAir for Watershed Subregion 2	7
WSSubNumAir for Watershed Subregion 3	5

Parameter	Value
WSSubNumAir for Watershed Subregion 4	11
FarmNumAir for farm 1	1
FarmNumAir for farm 2	1
HabRangeNumAir for Habitat 1 Range 1	1
HabRangeNumAir for Habitat 1 Range 2	1
HabRangeNumAir for Habitat 1 Range 3	2
HabRangeNumAir for Habitat 2 Range 1	1
HabRangeNumAir for Habitat 2 Range 2	1
HabRangeNumAir for Habitat 2 Range 3	2
WBNRchNumAir for Reach 1	0
WBNRchNumAir for Reach 2	0
WBNRchNumAir for Reach 3	0
WBNRchNumAir for Reach 4	2
AquWellFracZ entries	22
FarmAirFrac for farm 1	1
FarmAirFrac for farm 2	1
HabRangeAirFrac for Habitat 1 Range 1	1
HabRangeAirFrac for Habitat 1 Range 2	1
HabRangeAirFrac for Habitat 1 Range 3	0.5
HabRangeAirFrac for Habitat 1 Range 3	0.5
HabRangeAirFrac for Habitat 2 Range 1	1
HabRangeAirFrac for Habitat 2 Range 2	1
HabRangeAirFrac for Habitat 2 Range 3	0.5
WBNRchAirFrac for Reach 4	0.5
WSSubAirFrac for Watershed Subregion 1	0.1
WSSubAirFrac for Watershed Subregion 2	0.142857
WSSubAirFrac for Watershed Subregion 3	0.2
WSSubAirFrac for Watershed Subregion 4	0.090909

4.2.3.2 Input Data

The nonexistent file name and path *D:\HWIR\SLP\Spatial.mdb* is entered in the Spatial-Delineation Database box. The second nonexistent file name and path *D:\HWIR\SLP\demoA.mdb* is entered in the Site-Based Database box. A *1* is entered in the percent coverage box and also in the random-seed number box.

4.2.3.3 Expected Results

After clicking the start button, the execution stops, and an error message appears on the screen stating that an invalid database entry has been entered. This error message appears once for each invalid database entry.

4.2.3.4 Conducting the Test

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. In the correct directory, click on *SLP.EXE*. The user interface appears on the screen. Specify the Spatial-Delineation Database by typing in *D:\HWIR\SLP\Spatial.mdb*. Specify the Site-Based Database by typing in *D:\HWIR\SLP\DemoA.mdb*. Then type in *1* for the percent coverage and also for the random seed number to be used. When all of the entries have been made, click on the *start* button to begin execution. An error message appears stating that an invalid database entry has been made. Click *ok* in the error message window and then edit the Spatial-Delineation Database entry so that an existing database is specified. To do this, change *Spatial* to *SpatDel2*. After this change is made, click on the *start* button again. Again an error message appears because the Site-Based Database entry is still incorrect. Click *ok* in the error message window and then edit the Site-Based Database entry so that an existing database is specified. To do this, change *DemoA* to *Demo*. After this change is made, click on the *start* button again. This time, the SLP runs to completion. When the SLP is finished executing, the message *Processing Complete* appears on the screen in the bottom portion of the user interface.

4.2.3.5 Baseline Testing Results

An error window appeared stating *Invalid Database Input!* This error message appeared twice, as expected. When valid database entries are made, the SLP runs to completion, as expected.

4.2.4 Test Case SLP_04

4.2.4.1 Description and Rationale

The SLP requires four inputs to execute properly. These inputs are the name and location of the Site-Based Database, the name and location of the Spatial-Delineation Database, the percent coverage, and the random seed value. If any one of these entries is missing, the SLP does not execute. This case tests the behavior of the SLP when all four entries are left blank.

4.2.4.2 Input Data

Initially no input data are entered. As error messages appear, the following input is done: *D:\HWIR\SLP\SpatDel2.mdb* is entered for the Spatial-Delineation Database, *D:\HWIR\SLP\demo.mdb*

is entered for the Site-Based Database, a *1* is entered for the percent coverage, and a *1* is entered for the random seed value.

4.2.4.3 Expected Results

Four error messages appear (not simultaneously), indicating that invalid entries exist in each of the four required inputs. After valid entries are entered for each input, the SLP executes as expected.

4.2.4.4 Conducting the Test

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on *SLP.EXE*. The user interface appears on the screen. Click on the *start* button without entering any input. An error window appears, stating that an invalid entry for percent coverage has been entered. Click on *ok* and then enter a *1* for percent coverage. Click on the *start* button again. An error window appears, stating that an invalid entry for random seed value has been entered. Click on *ok* and then enter a *1* for random seed value. Click on the *start* button again. An error window appears stating that an invalid entry for a database has been entered. Click on *ok* and then enter *D:\HWIR\SLP\SpatDel2.mdb* for the Spatial-Delineation Database. Click on the *start* button again. An error window appears stating that an invalid entry for a database has been entered. Click on *ok* and then enter *D:\HWIR\SLP\demo.mdb* for the Site-Based Database. Click on the *start* button again. This time, the SLP executes without error. When the SLP is finished executing, the message *Processing Complete* will be written to the screen on the bottom portion of the user interface.

4.2.4.5 Baseline Testing Results

The following error messages appeared as expected.

1) *Invalid percent coverage input! Range: 0 < x <= 100*
2) *Invalid random seed input! Range 0 < x <= 100000*
3) *Invalid database path input!*
4) *Invalid database path input!*

After valid inputs are entered, the SLP executes as expected.

4.2.5 Test Case SLP_05

4.2.5.1 Description and Rationale

The SLP requires valid inputs for percent coverage and for the random seed value. Valid input for percent coverage is any value in the range 0 < X # 100. Valid input for random seed value is any value in the range 0 < X # 100,000. If the entries for these inputs are not in the valid range, the SLP does not execute. This case tests the behavior of the SLP when invalid entries are entered for percent coverage and random seed value.

4.2.5.2 Input Data

Initially, the following input is entered: *D:\HWIR\SLP\SpatDel2.mdb* is entered for the Spatial-Delineation Database, *D:\HWIR\SLP\demo.mdb* is entered for the Site-Based Database, *-1* is entered for the percent coverage, and 100001 (without the comma) is entered for the random seed value. After the error messages appear, *1* is entered for the percent coverage and also for random seed value.

4.2.5.3 Expected Results

Two error messages appear (not simultaneously) indicating that invalid entries are entered for the percent coverage and the random seed values. After valid entries are entered for each input, the SLP executes as expected.

4.2.5.4 Conducting the Test

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. Enter *D:\HWIR\SLP\SpatDel2.mdb* for the Spatial-Delineation Database, *D:\HWIR\SLP\demo.mdb* for the Site-Based Database, *-1* for percent coverage, and *100001* for random seed value. Then click on the *start* button. An error window appears stating that an invalid entry for percent coverage has been entered. Click on *ok* and then enter a *1* for percent coverage. Click on the *start* button again. An error window appears stating that an invalid entry for random seed value was entered. Click on *ok* and then enter a *1* for random seed value. Click on the *start* button again. This time, the SLP executes without error. When the SLP is finished executing, the message *Processing Complete* is written to the screen on the bottom portion of the user interface.

4.2.5.5 Baseline Testing Results

The following error messages appeared as expected.

1) *Invalid percent coverage input! Range: 0 < x <= 100*
2) *Invalid random seed input! Range 0 < x <= 100000*

After valid inputs are entered, the SLP executes as expected.

4.2.6 Test Case SLP_06

4.2.6.1 Description and Rationale

The SLP requires the Site-Based Database to contain certain parameters (NumWSSub, NumWBN, NumFarm, NumHab, NumHumRcp, WBNNumRch, and HabNumRange) to execute properly. If any one of these entries is missing, the SLP does not execute. This case tests the behavior of the SLP when the parameters NumWSSub, NumWBN, NumFarm, NumHab, and NumHumRcp are missing. Test case SLP_07 tests the SLP behavior when WBNNumRch and HabNumRange are missing.

4.2.6.2 Input Data

The following input is entered: *D:\HWIR\SLP\SpatDel2.mdb* is entered for the Spatial-Delineation Database, *D:\HWIR\SLP\demo6.mdb* is entered for the Site-Based Database, *1* is entered for the percent coverage, and *1* is entered for the random seed value.

The Site-Based Database used (*demo6.mdb*) has been edited so the parameters NumWSSub, NumWBN, NumFarm, NumHab, and NumHumRcp are missing.

4.2.6.3 Expected Results

Error messages appear (not simultaneously), indicating that each of the five required inputs is missing.

4.2.6.4 Conducting the Test

Copy the database file *demo_orig_empty.mdb*, rename it *demo6.mdb*, edit the database by removing the parameters NumWSSub, NumWBN, NumFarm, NumHab, and NumHumRcp, save, and exit.

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. Specify the Spatial-Delineation Database by entering *D:\HWIR\SLP\SpatDel2.mdb*. Then specify the Site-Based Database by entering *D:\HWIR\SLP\demo6.mdb*. Then enter a *1* for the percent coverage and for the random seed value. Click on the *start* button to execute the SLP. The SLP executes, terminates, and writes an error message to the screen, indicating that an error has occurred, and prompts the user to check the *error.slp* file. The *error.slp* file is located in the same directory as the Site-Based Database.

4.2.6.5 Baseline Testing Results

The following error message appears upon the termination of the SLP run.

1) *There were errors! Please view the ERROR.SLP file.*

The following list shows the content of the *error.slp* file. The error messages are as expected. Each message appears three times because the Site-Based Database contains data for three sites.

ERROR.SLP

Parameter not found for setting_id:LA1231234 NumWSSub(0,0,0)
Parameter not found for setting_id:LA1231234 NumWBN(0,0,0)
Parameter not found for setting_id:LA1231234 NumFarm(0,0,0)
Parameter not found for setting_id:LA1231234 NumHab(0,0,0)
Parameter not found for setting_id:LA1231234 NumHumRcp(0,0,0)
Parameter not found for setting_id:LF1231234 NumWSSub(0,0,0)
Parameter not found for setting_id:LF1231234 NumWBN(0,0,0)
Parameter not found for setting_id:LF1231234 NumFarm(0,0,0)
Parameter not found for setting_id:LF1231234 NumHab(0,0,0)
Parameter not found for setting_id:LF1231234 NumHumRcp(0,0,0)

Parameter not found for setting_id:WP1231234 NumWSSub(0,0,0)
Parameter not found for setting_id:WP1231234 NumWBN(0,0,0)
Parameter not found for setting_id:WP1231234 NumFarm(0,0,0)
Parameter not found for setting_id:WP1231234 NumHab(0,0,0)
Parameter not found for setting_id:WP1231234 NumHumRcp(0,0,0)

4.2.7 Test Case SLP_07

4.2.7.1 Description and Rationale

The SLP requires the Site-Based Database to contain certain parameters (NumWSSub, NumWBN, NumFarm, NumHab, NumHumRcp, WBNNumRch, and HabNumRange) to execute properly. If any one of these entries is missing, the SLP does not execute. This case tests the behavior of the SLP when the parameters WBNNumRch and HabNumRange are missing.

4.2.7.2 Input Data

The following input is entered: *D:\HWIR\SLP\SpatDel2.mdb* is entered for the Spatial-Delineation Database, *dD:\HWIR\SLP\demo7.mdb* is entered for the Site-Based Database, *1* is entered for the percent coverage, and *1* is entered for the random seed value.

The Site-Based Database that is used (*demo7.mdb*) is edited so the parameters WBNNumRch and HabNumRange are missing.

4.2.7.3 Expected Results

Error messages appear (not simultaneously), indicating that each of the two required inputs is missing.

4.2.7.4 Conducting the Test

Copy the database file *demo_orig_empty.mdb*, rename it *demo7.mdb*, edit the database by removing the parameters WBNNumRch and HabNumRange, save, and exit.

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. Specify the Spatial-Delineation Database by entering *D:\HWIR\SLP\SpatDel2.mdb*. Then specify the Site-Based Database by entering *D:\HWIR\SLP\demo7.mdb*. Then enter a *1* for the percent coverage and for the random seed value. Click on the *start* button to execute the SLP. The SLP executes, terminates, and writes an error message to the screen, indicating that an error has occurred, and prompts the user to check the *error.slp* file. The *error.slp* file is located in the same directory as the Site-Based Database.

4.2.7.5 Baseline Testing Results

The following error message is the one that appears upon the termination of the SLP run.

1) *There were errors! Please view the ERROR.SLP file.*

The following list shows the content of the *error.slp* file. The error messages are as expected. The message stating that *WBNNumRch* is not found appears three times because the Site-Based Database contains data for three sites. The message stating that *HabNumRange* is not found appears six times because each of the three sites contains two habitat ranges.

ERROR.SLP

Parameter not found for setting_id:LA1231234 WBNNumRch(1,0,0)
Parameter not found for setting_id:LA1231234 HabNumRange(1,0,0)
Parameter not found for setting_id:LA1231234 HabNumRange(2,0,0)
Parameter not found for setting_id:LF1231234 WBNNumRch(1,0,0)
Parameter not found for setting_id:LF1231234 HabNumRange(1,0,0)
Parameter not found for setting_id:LF1231234 HabNumRange(2,0,0)
Parameter not found for setting_id:WP1231234 WBNNumRch(1,0,0)
Parameter not found for setting_id:WP1231234 HabNumRange(1,0,0)
Parameter not found for setting_id:WP1231234 HabNumRange(2,0,0)

4.2.8 Test Case SLP_08

4.2.8.1 Description and Rationale

The SLP requires that all tables in both the Spatial-Delineation Database and the Site-Based Database are properly labeled in order to execute properly. If any one of these tables is mislabeled, the SLP does not execute. This case tests the behavior of the SLP when one table in each database is not labeled correctly.

4.2.8.2 Input Data

The following input is entered: *D:\HWIR\SLP\SpatDel8.mdb* is entered for the Spatial-Delineation Database, *D:\HWIR\SLP\demo8.mdb* is entered for the Site-Based Database, *1* is entered for the percent coverage, and *1* is entered for the random seed value.

4.2.8.3 Expected Results

Error messages appear (not simultaneously), indicating that there are not two databases. After valid entries are entered for each input, the SLP executes as expected.

4.2.8.4 Conducting the Test

Copy the database file *demo_orig_empty.mdb*, rename it *demo8.mdb*, edit the database by changing the name of the *facility* table to *sites* and the name of the *Site_Variable_Distribution_Data* table to *Site_Data*, save, and exit. Then copy the database file *SpatDel2_orig.mdb*, rename it *SpatDel8.mdb*, edit the database by changing the name of the *AquWell* table to *Aquifers*, save, and exit.

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. Specify the Spatial-Delineation Database by entering *D:\HWIR\SLP\SpatDel8.mdb*. Then specify the Site-Based

Database by entering *D:\HWIR\SLP\demo8.mdb*. Then enter a *1* for the percent coverage and for the random seed value. Click on the *start* button to execute the SLP. The SLP executes, terminates, and writes an error message to the screen. Click on *ok*. Then check the file *error.slp*. The error message *should* indicate that the *Setting Id Query failed*. This error is because the SLP could not find the table named *facility*. Re-edit *demo8.mdb* by changing the name of table *sites* back to *facility*. Run the SLP again using the same input. The SLP executes, terminates, and writes an error message to the screen. Click on *ok*. Then check the file *error.slp*. The error message indicates that the queries for the required Site-Based Database parameters failed. This error is because the SLP could not find the table *Site_Variable_Distribution_Data*. Re-edit *demo8.mdb* by changing the name of table *Site_Data* back to *Site_Variable_Distribution_Data*. Run the SLP again using the same input. The SLP executes, terminates, and writes an error message to the screen. Click on *ok*. Then check the file *error.slp*. The error message indicates that the queries for the *AquWell* parameters failed. This error is because the SLP could not find the table *AquWell*. Re-edit *SpatDel8.mdb* by changing the name of table *Aquifers* back to *AquWel*l. Run the SLP again using the same input. This time, the SLP executes without error. When the SLP is finished executing, the message *Processing Complete* is written to the screen on the bottom portion of the user interface.

4.2.8.5 Baseline Testing Results

The following error message is written to the *error.slp* file, as expected, after the first attempt to execute the SLP.

ERROR.SLP

Setting Id query failed.

The following error message is written to the error.slp file, as expected, after the second attempt to execute the SLP.

ERROR.SLP

Failed delete: delete from Site_Variable_Distribution_Data where Data_Group_Name='Site Layout' and (Variable_Name='WSSubNumAir' or Variable_Name='WSSubAirIndex' or Variable_Name='WSSubAirFrac' or Variable_Name='WBNRchNumAir' or Variable_Name='WBNRchAirIndex' or Variable_Name='WBNRchAirFrac')
Failed delete: delete from Site_Variable_Distribution_Data where Data_Group_Name='Site Layout' and (Variable_Name='FarmNumAir' or Variable_Name='FarmAirIndex' or Variable_Name='FarmAirFrac' or Variable_Name='HabRangeNumAir' or Variable_Name='HabRangeAirIndex' or Variable_Name='HabRangeAirFrac')
Failed delete: delete from Site_Variable_Distribution_Data where Data_Group_Name='Site Layout' and (Variable_Name='HumRcpNumAir' or Variable_Name='HumRcpAirIndex' or Variable_Name='HumRcpAirFrac' or Variable_Name='NumAir' or Variable_Name='AirLocX' or Variable_Name='AirLocY')
Failed delete: delete from Site_Variable_Distribution_Data where Data_Group_Name='Site Layout' and (Variable_Name='NumAquWell' or Variable_Name='AquWellLocX' or Variable_Name='AquWellLocY' or Variable_Name='AquWellFracZ')
Failed select: select * from Site_Variable_Distribution_Data where Data_Group_Name='Site Layout' and (Variable_Name='NumWSSub' or Variable_Name='NumWBN' or Variable_Name='WBNNumRch'

or Variable_Name='NumFarm' or Variable_Name='NumHab' or Variable_Name='HabNumRange' or Variable_Name='NumHumRcp' or Variable_Name='WBNRchBodyType')

The following error message is written to the error.slp file, as expected, after the third attempt to execute the SLP.

ERROR.SLP

Failed query: select * from AquWell where Setting_Id=*LA1231234*
Failed query: select * from AquWell where Setting_Id=*LF1231234*
Failed query: select * from AquWell where Setting_Id=*WP1231234*

The fourth attempt to execute the SLP is successful, and no error.slp file is created.

4.2.9 Test Case SLP_09

4.2.9.1 Description and Rationale

The SLP requires the user to enter in a random seed value for each SLP run. This action enables a user to reproduce results for a run if the exact same databases, percent coverage, and random seed value are entered. The purpose of this test is to verify that the functionality of the random seed value is working properly. An SLP run is made with a particular random seed value, and the results are saved. Another SLP run is made with the same input, except the random seed value is changed. Again, the results are saved. A comparison of updated site-based databases from each run is made to determine if the results are different. The SLP then is run again using the same input and the original random seed value. Again the results are saved. A comparison of updated site-based databases from the first and third run is made to determine if the results are the same.

The Site-Based Database *demo.mdb* contains a complete data set for three sites. The data for all three sites are initially identical, except for the source types. The three source types used are *LA1231234*, *LF1231234*, and *WP1231234*. Only the updated results for *LA1231234* are checked for this test case.

4.2.9.2 Input Data

Two databases are required to run the SLP, the Spatial-Delineation Database and the Site-Based Database. In this case, the Spatial-Delineation Database is called *SpatDel2.mdb* and the Site-Based Database is called *Demo.mdb*. Their file names and paths will be passed to the SLP through the user interface. The two databases are too large to include in this document. Electronic copies of each database can be supplied upon request.

The percent coverage for the site is also required by the SLP and is entered through the user interface. In this case, 10 percent is chosen. The user must also provide a random seed value to be used. In this case, a random seed value of 1 is used for the first and third runs, and a value of 2 is used for the second run.

4.2.9.3 Expected Results

The expected result for this test case is that the updated Site-Based Databases for the first and third runs will be identical, and the updated Site-Based Database for the second run will be different.

4.2.9.4 Conducting the Test

Two results from test case SLP_02 will be used as the results for the first run. The following instructions are used to obtain the results for the second and third run.

Using Windows® Explorer, find the directory where the program *SLP.EXE* is located. When in the correct directory, click on the *SLP.EXE*. The user interface appears on the screen. To specify the Spatial-Delineation Database, click on the button that is located to the right of its box. Find the database to be used, in this case *D:\HWIR\SLP\SpatDel2.mdb*, and click on the *open* button. The filename and path are entered into the Spatial-Delineation Database window on the SLP user interface. Repeat this process to select the Site-Based Database. Then type in *10* for the percent coverage and type in *2* for the random seed value used. When all of the entries are made, click on the *start* button to begin executing. When the SLP is finished executing, the message *Processing Complete* is written to the screen on the bottom portion of the user interface. In addition, the *start* button will change to an *exit* button.

After the run is complete, rename the Site-Based Database to *demo9a.mdb* to preserve the results. Then create a new *demo.mdb* by creating a copy of *demo_orig_empty.mdb* and renaming it *demo.mdb*. The file *demo_orig_empty.mdb* is the original *demo.mdb* that has not been updated by an SLP.

Follow the preceding procedure again to obtain the results for the third run. The only difference is that a random seed value of *1* is entered. After the run is complete, rename the Site-Based Database to *demo9b.mdb* to preserve the results.

Next, compare the results in the databases *demo2.mdb, demo9a.mdb, and demo9b.mdb*. In particular, check the results in the *Site_Variable_Distribution_Data* table.

4.2.9.5 Baseline Testing Results

A visual inspection of the databases is made. Differences exist between *demo2.mdb* and *demo9a.mdb*, as expected, because of the different random seed values used. As expected, no differences are found between *demo2.mdb* and *demo9b.mdb* because the same random seed values are used.

4.2.10 Verification Case SLP_10

4.2.10.1 Description and Rationale

This verification case examines the transfer of the X and Y coordinates of well locations from the Site-Delineation Database, *GridOut.mdb*, to the Site-Based Database, *VerificationDB.mdb*. The SLP reads all locations for X and Y locations and directly transfers them. This verification test is done by

graphing the x and y coordinates in a spreadsheet and confirming that all points in the Site-Based Database *VerificationDB.mdb* correspond exactly to points in the Site-Delineation Database, *GridOut.mdb*. For this case, Site 1632106 surface impoundment source is evaluated.

4.2.10.2 Expected Results

From the AquWell table found in the Site-Delineation Database, *GridOut.mdb*, the SLP transfers the data for variables LocX and LocY. These data are the same as the variables AquWellLocX and AquWellLocY in the Site-Based Database, *VerificationDB.mdb*, for the same indexes and a Setting_ID of SI1632106.

4.2.10.3 Verification Results

The file AquWellSI1632106.XLS contains the results for the database comparison for this verification case. This spreadsheet contains a worksheet and two graphs. The worksheet contains the X and Y locations from both the *GridOut.mdb* and the *VerificationDB.mdb*. The first graph is of the GridOut locations only. This graph shows the initial well locations found in the Site-Delineation Database. The second graph contains two data series. The first series represents the *GridOut.mdb* and the second the *VerificationDB.mdb*. Note that all points correspond exactly, with no outlier.

4.2.11 Verification Case SLP_11

4.2.11.1 Description and Rationale

This verification case examines the transfer of the X and Y coordinates of waterbody network reach locations from the Site-Delineation Database, *GridOut.mdb*, to the Site-Based Database, *VerificationDB.mdb*. The SLP reads all locations for X and Y locations and directly transfers them. This verification test is done by graphing the x and y coordinates in a spreadsheet and confirming that all points in the Site-Based Database, *VerificationDB.mdb*, correspond exactly to points in the Site-Delineation Database, *GridOut.mdb*. For this case, Site 0223504, landfill, is evaluated.

This case also examines the 3-percent sampling and fraction calculation for the air fraction as it relates to the waterbody network reaches. For each unique waterbody network reach index_1 in the Site-Delineation Database, *GridOut.mdb*, the SLP samples 3 percent of the available points for that index, then records the X and Y coordinates for the points sampled and calculates the air fraction (1 divided by the number sampled). All of this information updates the Site-Based Database, *VerificationDB.mdb*.

4.2.11.2 Expected Results

From the WBNRch table found in the Site-Delineation Database, *GridOut.mdb*, the SLP transfers the data for variables LocX and LocY. These data are the same as the variables WBNRchLocX and WBNRchLocY in the Site-Based Database, *VerificationDB.mdb*, for the same indexes and a Setting_ID of LF0223504.

No air locations are sampled for the Setting_ID LF0223504; therefore, no air fractions are examined for this case.

4.2.11.3 Verification Results

The file WBNRchLF0223504.XLS contains the results for the database comparison for this verification case. This spreadsheet contains a worksheet and two graphs. The worksheet contains the X and Y locations from both the *GridOut.mdb* and the *VerificationDB.mdb*. The first graph is of the GridOut locations only. This graph shows the initial well locations found in the Site-Delineation Database. The second graph contains two data series. The first series represents the *GridOut.mdb* and the second the *VerificationDB.mdb*. Note that all points correspond exactly, with no outlier.

4.2.12 Verification Case SLP_12

4.2.12.1 Description and Rationale

This verification case examines the 3-percent sampling and fraction calculation for the air fraction, as it relates to the human receptors. For each unique human receptor index_1 in the Site-Delineation Database, *GridOut.mdb*, the SLP samples 3 percent of the available points for that index, then records the X and Y coordinates for the points sampled and calculates the air fraction (1 divided by the number sampled). All of this information updates the Site-Based Database, *VerificationDB.mdb*. For this case, Site 0223504, waste pile, is evaluated.

This verification case is done by counting the number points found in each unique index in the Site-Delineation Database, *GridOut.mdb*, multiplying each number by 0.03 and confirming that the correct number of locations were sampled. Then the fraction calculation, 1 divided by the sampled number, is hand-calculated and compared to the air fraction recorded in the Site-Based Database, *VerificationDB.mdb*. A few specific indexes are selected to confirm that the sampled points found in the Site-Based Database, *VerificationDB.mdb*, do indeed match with available points in the Site-Delineation Database, *GridOut.mdb*.

4.2.12.2 Expected Results

Because every human receptor in the HumRcp table found in *GridOut.mdb*, the Site-Delineation Database, contains a unique index, the sampling number for each is 1. Therefore, the fraction assigned to each HumRecAirFrac is 1/1 or 1 also.

The effect of each human receptor having a unique index is that all human receptor points are transferred from the HumRcp table in *GridOut.mdb*, the Site-Delineation Database, and match the variables HumRcpAirLocX and HumRcpAirLocY in *VerificationDB.mdb*, the Site-Based Database, for the same indexes and a Setting_ID of WP0223504.

4.2.12.3 Verification Results

The file HumRcpWP0223504.XLS contains the results for the database comparison for this verification case. This spreadsheet contains a worksheet and two graphs. The worksheet contains the X and Y locations from the *GridOut.mdb* and the *VerificationDB.mdb*. The first graph is of the GridOut locations only. This graph shows the initial well locations found in the Site-Delineation Database. The second graph contains two data series. The first series represents the *GridOut.mdb* and the second the *VerificationDB.mdb*. Note that all points correspond exactly, with no outlier.

4.2.13 Verification Case SLP_13

4.2.13.1 Description and Rationale

This verification case examines the 3-percent sampling and fraction calculation for the air fraction as it relates to the farm. For each unique Farm index_1 in *GridOut.mdb*, the Site-Delineation Database, the SLP samples 3 percent of the available points for that index, then records the X and Y coordinates for the points sampled and calculates the air fraction (1 divided by the number sampled). All of this information updates the Site-Based Database *VerificationDB.mdb*. For this case, site 0223504, land application unit, is evaluated.

This verification case is done by counting the number points found in each unique index in the Site-Delineation Database, *GridOut.mdb*, multiplying each number by 0.03, and confirming that the correct number of locations are sampled. Then the fraction calculation, 1 divided by the sampled number, is hand-calculated and compared to the air fraction recorded in the Site-Based Database *VerificationDB.mdb*. A few specific indexes are selected to confirm that the sampled points found in the Site-Based Database, *VerificationDB.mdb,* do indeed match available points in the Site-Delineation Database, *GridOut.mdb*.

4.2.13.2 Expected Results

The farm table found in *GridOut.mdb*, the Site-Delineation Database, contains only one farm index containing 38 points. The sampling number for each is 1. Therefore, the fraction assigned to the FarmAirFrac is 1/1 or 1 also. The point selected is contained in the points available in *GridOut.mdb,* the Site-Delineation Database.

4.2.13.3 Verification Results

The file FarmLA0223504.XLS contains the results for the database comparison for this verification case. This spreadsheet contains two worksheets and two graphs. The FarmSample worksheet contains the 3-percent sampling and fraction calculations for each index. For this case, Farm (1,1) was selected for further analysis of the points selected; the data for plotting are in the second graph. For this analysis, the X and Y locations from the *GridOut.mdb* and the *VerificationDB.mdb* are plotted to ensure that the sampled point did match with an available point. The two graphs included in this file demonstrate the available farm points found in *GridOut.mdb* and the sampled point from the *Verification DB.mdb*. All sampled points matched with an available point.

4.2.14 SLP_14

4.2.14.1 Description and Rationale

This verification case examines the 3-percent sampling and fraction calculation for the air fraction as it relates to the habitat range. For each unique habitat range index_1 in *GridOut.mdb*, the Site-Delineation Database, the SLP samples 3 percent of the available points for that index, then records the X and Y coordinates for the points sampled and calculates the air fraction (1 divided by the number sampled). All of this information updates *VerificationDB.mdb*, the Site-Based Database. For this case, Site 1632106, Aerated Tank, is evaluated.

This verification case is done by counting the number points found in each unique index in *GridOut.mdb*, the Site-Delineation Database, multiplying each number by 0.03 and confirming that the correct number of locations are sampled. Then the fraction calculation, 1 divided by the sampled number, is hand-calculated and compared to the air fraction recorded in *VerificationDB.mdb*, the Site-Based Database. A few specific indexes are selected to confirm that the sampled points found in *VerificationDB.mdb*, the Site-Based Database, do indeed match available points in *GridOut.mdb*, the Site-Delineation Database.

4.2.14.2 Expected Results

The habitat table found in *GridOut.mdb*, the Site-Delineation Database, contains eight habitats, each with a variable number of ranges. For this verification case, Habitats 1, 3, and 8 are analyzed for the sampling number and air-fraction calculations. Habitat 1 Range 1, Habitat 3 Range 8, and Habitat 8 Range 15 are analyzed to confirm that the sample points selected are contained in the points available from the *GridOut.mdb*, the Site-Delineation Database.

4.2.14.3 Verification Results

The file HabAT1632106.XLS contains the results for the database comparison for this verification case. This spreadsheet contains two worksheets and multiple graphs. The AirSample worksheet contains the 3-percent sampling and fraction calculations for indexes 1, 3, and 8. Habitat 1 Range 1, Habitat 3 Range 8, and Habitat 8 Range 15 are selected for further analysis of the points selected; the data for plotting are in the second spreadsheet. For this analysis, the X and Y locations from the *GridOut.mdb* and the *VerificationDB.mdb* are plotted to ensure that the sampled point did match an available point. The six graphs in this file demonstrate the available habitat range points found in the *GridOut.mdb* and the sampled point from the *Verification DB.mdb*. All sampled points matched with an available point.

4.2.15 SLP_15

4.2.15.1 Description and Rationale

This verification case examines the 3-percent sampling and fraction calculation for the air fraction as it relates to the watershed subbasins. For each unique Watershed Subbasin index_1 in GridOut.mdb, the Site-Delineation Database, the SLP samples 3 percent of the available points for that index, then records the X and Y coordinates for the points sampled and calculates the air fraction (1 divided by the number sampled). All of this information updates the Site-Based Database *VerificationDB.mdb*. For this case, Site 1632106, land application unit, will be evaluated.

This verification case is done by counting the number points found in each unique index in *GridOut.mdb*, the Site-Delineation Database, multiplying each number by 0.03 and confirming that the correct number of locations are sampled. Then the fraction calculation, 1 divided by the sampled number, is hand-calculated and compared to the air fraction recorded in the Site-Based Database, V*erificationDB.mdb*. A few specific indexes are selected to confirm that the sampled points found in the Site-Based Database, *VerificationDB.mdb*, do indeed match available points in *GridOut.mdb*, the Site-Delineation Database.

4.2.15.2 Expected Results

The WSSub table found in *GridOut.mdb*, the Site Delineation Database, contains 10 watershed subbasins. For this verification case, Watershed Subbasins 2 and 5 are analyzed to confirm that the sample points selected are contained in the points available from *GridOut.mdb,* the Site-Delineation Database.

4.2.15.3 Verification Results

The file WSSubLA1632106.XLS contains the results for the database comparison for this verification case. This spreadsheet contains two worksheets and multiple graphs. The WSSubSample worksheet contains the 3 percent sampling and fraction calculations. Watershed Subbasins 2 and 5 are selected for further analysis of the points selected; the data for plotting are in the second spreadsheet. For this analysis, the X and Y locations from the *GridOut.mdb* and the *VerificationDB.mdb* are plotted to ensure that the sampled point did match an available point. The four graphs included in this file demonstrate the available watershed subbasin points found in the *GridOut.mdb* and the sampled point from the *Verification DB.mdb*. All sampled points matched an available point.

5.0 Quality Assurance Program

The SLP was developed under a quality assurance program documented in Gelston et al. (1998). In that program, quality is defined as the ability of the software to meet client needs. Meeting client needs starts with a shared understanding of how the software must perform and continues throughout the software life cycle of design, development, testing, and implementation through attention to details.

Figure 5.1 outlines the software development process used for the SLP, highlighting the quality check points (note that the SLP activities flow down the left side of the figure because it is software developed for the first time, as opposed to a modification to existing software). The process shown is designed for compatibility with similar processes used by other government agencies. For example, this quality process compares favorably with that in the EPA Directive 2182, *System Design and Development Guidance* (EPA 1997). It also compares favorably with the Office of Civilian Radioactive Waste Management *Quality Assurance Requirements and Description, Supplement I, Software* (OCRWM 1995). Activities roughly equivalent across these processes are shown in Table 5.1.

Development of the SLP included the implementation of a quality assurance checklist (see Figure 5.2). An understanding of this checklist by all team members resulted in the shared understanding of component requirements and design necessary to ensure quality. Completion of this checklist verified that all documentation was completed for transfer of the software to client use.

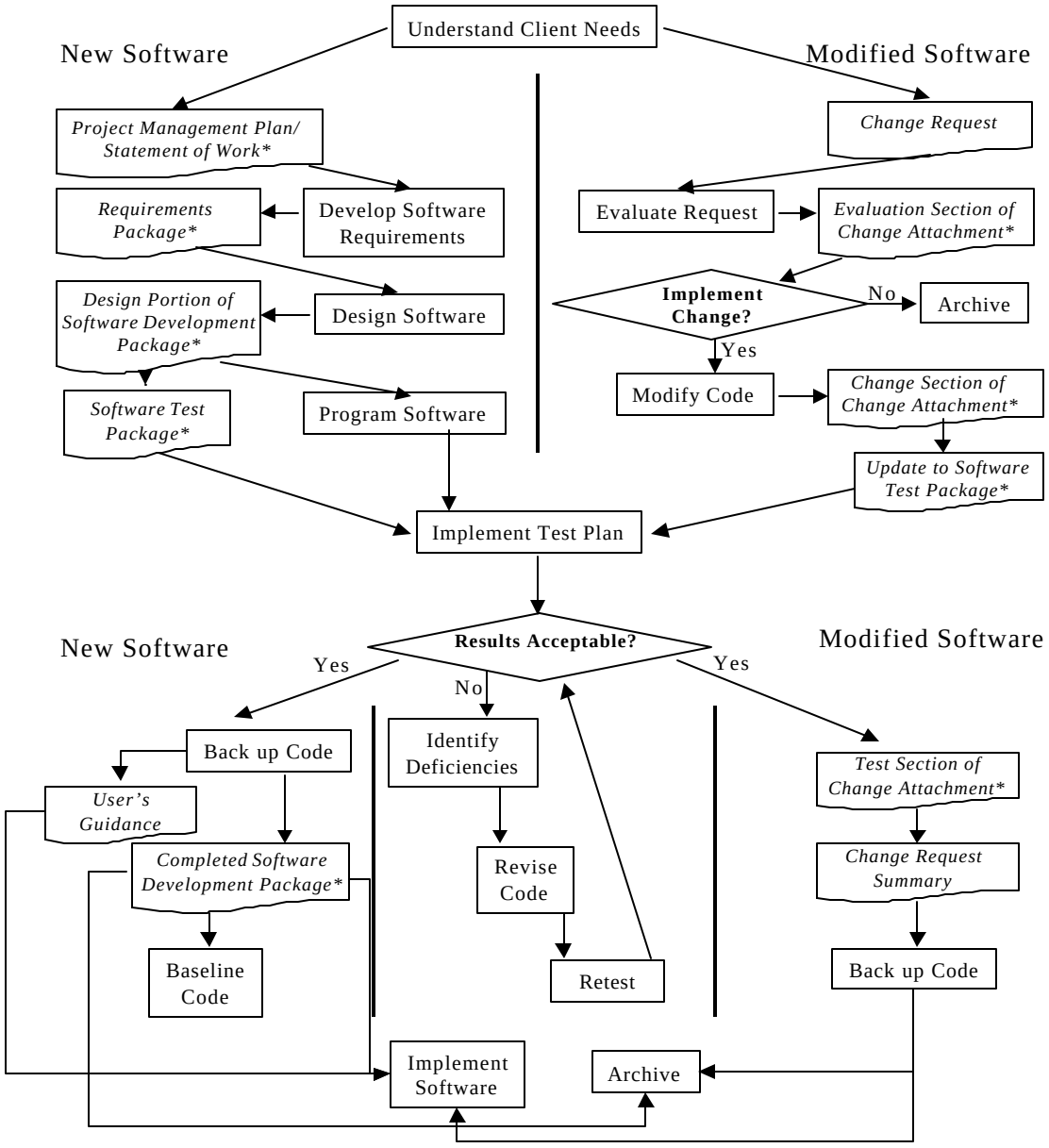

Figure 5.1 Ensuring Quality in the Environmental Software Development Process
(* indicates quality review stage; box with wavy bottom line and italics font indicates document versus activity)

Table 5.1 Relationship of PNNL Environmental Software Development Process to Quality Assurance Requirements (OCRWM 1995, EPA 1997)

OCRWM Quality Assurance Requirement[a]	**EPA Essential Element of Information[b]**	**Environmental Software Process Equivalent (Section)**
	4—System Implementation Plan	Project Management Plan or Statement of Work
I.2.5A Functional Requirements Information Documentation; I.2.5C Requirements and Design Documentation	5—System Detailed Requirements Document	Requirements Package
I.2.1 Software Life Cycles, Baselines (see Appendix C), and Controls	6—Software Management Plan	Project Management Plan or Statement of Work and Gelston et al. (1998)
I.2.2 Software Verification[c] and Software Validation; I.2.4 Software Validation[d]	7—Software Test and Acceptance Plan	Software Test Package
I.2.3 Software Verification; I.2.5C Requirements and Design Information Documentation	8—Software Design Document	Design Portion of Software Development Package
I.2.6A Configuration Identification		Completed Software Development Package
I.2.6B Configuration Control; I.2.6C Configuration Status; I.2.7 Defect Reporting and Resolution[e]	9—Software Maintenance Document	Modification Documentation
	10—Software Operations Document	User's Guidance and Training
I.2.5B User Information Documentation	11—Software User's Reference Guide	User's Guidance and Training
	12—System Integration Test Reports	Software Test Package

(a) Note that OCRWM requirement I.2.8, Control of the Use of Software, is the responsibility of the OCRWM-related client.

(b) Elements 1 through 3 are generally completed by clients in EPA before contract initiation with the project team.

(c) Verification includes informal code testing by software engineers (see Appendix C) to ensure that the code functions as required.

(d) Validation includes testing by those other than the software engineers who developed the code to provide an independent confirmation that the software functions as required.

(e) Note that some changes requested by clients may not be made in the software unless funding has been allocated for such modifications.

A. General Requirements Analysis
--Documented in
__X__Statement of Work (stored in project file; see Gene Whelan, Gariann Gelston, or current Integration Leader)
--Contains information on (all of the following)
__X__problem description
__X__deliverables
__X__project team
__X__capabilities to be used
__X__restrictions
__X__difficulties envisioned
__X__compatibilities with existing software/hardware
__X__scope of the project

B. Specific Requirements Analysis
--Documented in
__X__requirements section of documentation (PNNL-11914, Volume 14, Section 2.0)
--Contains information on (all of the following)
__X__purpose of the software
__X__structure of the software
__X__hardware and software requirements
__X__input and output requirements
__X__scientific basis
__X__assumptions
__X__limitations
__X__post-October 31 requirements

C. Design Documentation
--Documented in
__X__design portion of documentation (PNNL-11914, Volume 14, Section 3.0)
__X__team task plans/Project Management Plan (stored in project file; see Gene Whelan, Gariann Gelston, or current Integration Leader)
--Contains information on (all of the following)
__X__code type and description
__X__development team members
__X__specifications
__X__logic diagrams
__X__"help" descriptions
__X__methods to ensure consistency in components
__X__mathematical formulations
__X__need for pre/post-processors
__X__post-October 31 design elements

D. Development Documentation
--Documented in
__X__Specifications Document (PNNL-11914, Volume 8)
__X__Quality Assurance Archive (see Gariann Gelston or current Integration Leader)
--Contains information on (all of the following)
__X__baseline hard copy of the source code
__X__diskette copy
__X__name of computer language(s) used

Figure 5.2 Quality Assurance Implementation Checklist for the Site Layout Processor

E. Testing Documentation
--Documented in
__X__test plan that meets quality assurance requirements (PNNL-11914, Volume 14, Section 4.0)
--Contains information on (all of the following)
__X__description of software
__X__testing scope
__X__relationship between test cases and requirements
__X__test activity description
__X__hardware and software needed to implement plan
__X__test case specifications
__X__expected results

F. User's Guidance
--Documented in
__X__hard-copy printout of user's guidance for system (PNNL-11914, Volume 11)
--Contains information on (all of the following)
__X__description of software
__X__description of use of user interface
__X__mathematical formulations
__X__example problems
__X__explanation of modules included

G. General Quality Assurance Documentation
--Documented in
__X__Quality Assurance Program Document (PNNL-11880)
__X__Quality Assurance Software-Specific Checklist (PNNL-11914, Volume 14, Section 5.0)
--Contains information on (all of the following)
__X__purpose of quality assurance program
__X__client-specified activities
__X__activities required to ensure quality in software

H. Quality Assurance Archive
--Documented in
__X__hard-copy files (see Gariann Gelston or current Integration Leader)
__X__back up disk files in multiple storage locations (see Gariann Gelston or current Integration Leader)
--Contains information on (all of the following)
__X__all quality assurance documentation
__X__client correspondence regarding software
__X__modifications made to baselined software
__X__disk copy back ups
_____reproducibility of code (check code for comments)

Completed by _____ Date _____

Approved by
System/Module Manager _____ Date _____

Figure 5.2 (cont)

6.0 References

Documentation for the FRAMES-HWIR Technology Software System

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Volume 2: System User Interface Documentation. 1998. PNNL-11914, Vol. 2, Pacific Northwest National Laboratory, Richland, Washington.

Volume 3: Distribution Statistics Processor Documentation. 1998. TetraTech, Lafayette, California.

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