APPENDIX G

PHASE 1 FINAL STATUS SURVEY CONCEPTUAL FRAMEWORK

PURPOSE OF THIS APPENDIX

The purpose of this appendix is to describe the conceptual basis for the Phase 1 Final Status Survey Plan.

INFORMATION IN THIS APPENDIX

This appendix describes the design basis for the Phase 1 Final Status Survey Plan, including the key assumptions, and then outlines the final status survey approach. It closes with a discussion of documentation requirements. Logic diagrams are provided to illustrate the processes involved.

RELATIONSHIP TO OTHER PARTS OF THE PLAN

The information in this appendix supplements the requirements for the Phase 1 Final Status Survey Plan described in Section 9.

1.0 Introduction

The purpose of this conceptual framework is to describe the design basis and general approach for the WVDP Phase 1 Final Status Survey Plan, thus augmenting the requirements outlined in Section 9 of this plan.

Section 7.2.2 of this plan provides for Phase 1 final status surveys in three types of areas:

(1) The major areas to be made inaccessible during Phase 1 decommissioning activities, that is, the bottom and sides of excavations for removal of key WVDP facilities and contaminated subsurface soil (i.e., the WMA 1 and WMA 2 large excavations);

(2) Excavated soil laydown areas after the soil and ground covering are removed; and

(3) Potentially impacted areas with no subsurface soil contamination that meet the unrestricted release criteria during Phase 1 of the decommissioning.

The primary objective of these surveys is to confirm that cleanup goals specified in Section 5 of this plan have been achieved. However, if an excavated soil laydown area is known to have subsurface contamination, then the objective of the survey of that area will be to determine the radiological status of the surface soil.

Note that the Characterization Sample and Analysis Plan, rather than the Phase 1 Final Status Survey Plan, will provide for radiological status surveys of:

(1) Soil in the footprints of structures, concrete slabs, asphalt pavement, and gravel pads outside of the WMA 1 and WMA 2 large excavations to be removed during Phase 1 decommissioning activities; and

(2) The interior of the HLW transfer trench following removal of piping and equipment in the trench and the associated pump pits and diversion pit.

If DOE chooses to demonstrate that soil in the footprints of selected structures, concrete slabs, asphalt pavement, or gravel pads outside of the WMA 1 and WMA 2 large excavations removed during Phase 1 decommissioning activities meets the unrestricted release criteria, then Phase 1 final status surveys will also be performed in those areas if the characterization data are not sufficient for final status survey purposes.

2.0 Final Status Survey Design Basis

As required by Section 9 of this plan, the Phase 1 Final Status Survey Plan will be consistent, to the extent possible, with the MARSSIM (NRC 2000). There are aspects of the WVDP project premises (e.g., buried subsurface soil contamination, etc.) that are beyond MARSSIM's scope. In those instances, the protocols will be consistent with the intent of MARSSIM.

2.1 Project Premises and Phase I Activities

As explained in Section 3 of this plan, the project premises comprise 156.4 acres. The major features of the project premises include existing facilities and associated above-ground and buried infrastructure, disposal areas, wastewater lagoons, roads, hardstands, paved parking lots, a railway spur, streams that drain the parcel, and open land. The

project premises were used for spent fuel reprocessing in the 1960s and early 1970s. Reprocessing activities resulted in environmental releases of radionuclides to surrounding soils, surface water, and groundwater as discussed in Section 2 of this plan.

To address known historical releases whose residual environmental contamination pose significant dose concerns, Phase 1 activities include the following planned environmental remediation activities:

(1) A deep (30 – 45 feet), extensive (approximately three acre) excavation of contaminated soils adjacent to and beneath the Main Plant Process Building (WMA 1);

(2) A deep (up to 14 feet), extensive (approximately four acre) excavation of contaminated soils adjacent to and beneath facilities and lagoons associated with the Low-Level Waste Treatment Facility (WMA 2); and

(3) Excavation of contaminated and uncontaminated near-surface soils (approximately two feet below grade) associated with selected building and infrastructure removal in WMA 1, WMA 3, WMA 5, WMA 6, WMA 7, WMA 9, and WMA 10.

In addition to these planned excavations, DOE may also choose to remove additional contaminated soils and/or sediments as part of Phase 1 decommissioning work. Any residual contamination within the project premises that still poses a dose concern will be addressed by Phase 2 decommissioning activities.

2.2 Cleanup Criteria

As indicated in Section 5 of this plan, there are 18 radionuclides of interest for the project premises. The DCGL values for each radionuclide are based on a 25 mrem/y dose requirement (incremental to background) assuming a goal of unrestricted release.

The DCGL requirements include a $DCGL_W$ value to be applied as an area-averaged goal to final status survey units and a $DCGL_{EMC}$ value applicable to 1-square meter (m^2) areas. Different DCGL values are provided for surface soils (defined as soils to a depth of 1 m), for subsurface soils (defined as soils at significant depth that will be temporarily exposed by Phase 1 excavation activities in WMA 1 and WMA 2), and for streambed sediments. These DCGL values were further refined to reflect cumulative dose concerns, resulting in a final set of cleanup goals reflected in Table 5-14 of this plan[1].

2.3 Key Assumptions

This conceptual framework includes several key assumptions:

- ***Decommissioning Plan Changes.*** This conceptual framework is based on DCGLs in Revision 2 to the plan. Any changes in DCGL values or definitions may require changes to this framework.
- ***DCGL Definitions.*** The surface soil DCGLs apply to a vertical interval (contamination zone thickness) of one meter. The planned characterization work

[1] Section 5 of this plan explains the difference between the DCGLs developed to correspond to 25 mrem per year for individual areas and the cleanup goals to be used in remediation activities. As in Section 9 of this plan, the term *DCGL* as used in this appendix from this point on is understood to mean *cleanup goal*.

may identify project premises characteristics that are inconsistent with the conceptual site model used for DCGL derivation (e.g., surface contamination restricted to the top few inches of soil surface, subsurface contamination covered by a few inches of clean soil, or contaminated soils extending to a depth greater than one meter). To address this potential issue:

(1) Surface soil DCGL standards will only be applied when contamination impacts are less than one meter in depth;

(2) Surface soil DCGL standards will be applied separately to the top 15 cm (six inches) of soil and to the top one meter soil interval as part of the final status survey process; and

(3) The presence of thin, highly elevated zones overlain by clean surface soils will be evaluated by Characterization Sampling and Analysis Plan data collection. If near surface contaminated layers are encountered during this data collection effort that result in potential dose concerns but that would not have been identified by the Phase 1 Final Status Survey Plan data collection approach, the Final Status Survey Plan process will be modified to meet the specific needs of those areas.

- ***LBGR*.** MARSSIM's Lower Bound on the Grey Region (LBGR) corresponds to the average residual activity concentration that will be present when final status survey data collection activities begin. For areas that do not require remediation, the LBGR is the existing average level of contamination present. For areas requiring remediation, the LBGR is the cleanup level targeted by the remediation program. In combination with the Type II error rate and expected sample variability, the LBGR is an important determinant of the number of systematic samples required to demonstrate compliance with the $DCGL_W$ values.

- ***Data Gaps*.** There are key data gaps that will be addressed as part of the pre-design characterization work discussed in Section 9 of this plan. One example of these is the presence and spatial prevalence of the 18 radionuclides of interest. A second example is the presence and importance of radionuclides other than the 18 identified in this plan. While unlikely, the Final Status Survey Plan framework may need to be revisited if Phase 1 conditions encountered during characterization work are determined to be significantly different from the assumptions and conceptual site model in this plan.

- ***Chemical Contamination*.** Chemical contamination may exist for portions of the facility. Chemical contamination concerns will be addressed in compliance with RCRA requirements, and are not directly within the scope of the Final Status Survey Plan. Samples collected as part of the Final Status Survey Plan process may also be analyzed for chemical constituents as necessary for waste stream characterization needs, and/or to fulfill RCRA requirements.

- ***Scope of Phase 1 Final Status Survey Plan Data Collection*.** As part of Phase 1 decommissioning activities, data will be collected to demonstrate that the floors and the sides (at depths greater than three feet) of the WMA 1 and 2 excavations meet the appropriate DCGL requirements. In addition, DOE may also choose to collect

data to demonstrate that surface soils for other portions of the WVDP project premises also meet the Phase 1 cleanup goals for those situations where contamination is not present at depths greater than one meter. Examples of these areas include: (1) soils exposed by hardstand, pad, or foundation removal that are believed to be below DCGL requirements; (2) soils with surface contamination above DCGL goals that DOE chooses to remediate; and/or (3) other soils where there is no evidence of contamination above DCGL requirements. The Final Status Survey Plan framework as described applies to soils and does not apply to sediments, surface water or groundwater.

- ***Sign Test Applicability*.** Because all 18 radionuclides identified in the decommissioning plan are either not naturally occurring or have $DCGL_W$ requirements an order of magnitude or more above background levels, the Sign test is considered appropriate for demonstrating compliance with wide-area DCGL ($DCGL_W$) requirements. In the event that DCGL values are lowered it may be necessary to establish a background reference area and use the Wilcoxon Rank Sum (WRS) test instead to demonstrate compliance with the $DCGL_W$ requirements.
- ***$DCGL_{EMC}$ Applicability*.** The $DCGL_{EMC}$ is radionuclide-specific and applies to 1-m^2 areas. Gross gamma surveys will be used for demonstrating compliance with the $DCGL_{EMC}$ criteria where appropriate. In addition, appropriate $DCGL_{EMC}$ values will be calculated that correspond to the area represented by systematic samples collected to demonstrate $DCGL_W$ compliance using area factors provided in Tables 9-1 and 9-2 of Section 9 of this plan. The latter approach is intended to address the radionuclides of interest that are not detectable by gamma scans and that may exist in isolation for specific portions of the project premises (e.g., the floor of the WMA 1 dig where Sr-90 may be the principal radionuclide of interest).
- ***Radionuclides of Interest List.*** Because processes and contaminant release scenarios vary from location to location across the project premises, not all 18 radionuclides of interest may be pertinent to specific areas. The assumption is that Characterization Sample and Analysis Plan data collection may be used to determine which of the 18 radionuclides of interest are pertinent to specific areas and that final status survey sampling for those areas may be limited to the smaller set of the pertinent radionuclides of interest.
- ***Use of Sum-of-Ratios Calculations***. Because of the many radionuclides of interest, all final status survey determinations will be based on sample sum-of-ratios calculations. The sum-of-ratios calculation for any particular sample will be based on the radionuclides pertinent to the final status survey unit that was the source of the sample.
- ***Subsurface Soil Contamination*.** The Phase 1 Final Status Survey Plan is not applicable to areas outside the WMA 1 and 2 excavations where subsurface contamination exists at depths greater than one meter.
- ***Null Hypothesis and Acceptable Error Rates*.** For the Sign test, the null hypothesis will be that final status survey units are contaminated above $DCGL_W$ levels based on sample sum-of-ratios values. In this context, the acceptable Type I

error rate (i.e., rejecting the null hypothesis when it should have been accepted) will be 0.05. The Type II error rate (i.e., accepting the null hypothesis when it should have been rejected) will be set based on an engineering cost analysis that weighs the potential for false contaminated conclusions with the costs of final status survey data collection. The Type I error rate establishes the minimum number of systematic samples required for Sign test implementation. In the case of an error rate of 0.05, the minimum number is five samples per survey unit; final status survey units, however, will likely require more systematic samples than this minimum number to meet Type II error rate needs.

- ***Role of Composite Sampling*.** While not discussed in MARSSIM, the use of composite samples is one means for attaining desired Type II error rates while controlling analytical costs when performing $DCGL_W$ evaluations. Composite sampling can also significantly increase the likelihood that $DCGL_{EMC}$ exceedances are identified for radionuclides that are not detectable by gross activity scans. Composite sampling combines soil increments systematically distributed across a portion of a final status survey unit into homogenized composite samples before analysis. The minimum number of composites per survey unit is determined by the desired Type I error rate. The minimum number of soil increments contributing to each composite sample is a function of the desired Type II error rate, the degree of heterogeneity expected within survey units, and the expected average residual activity concentration. Composite sampling will be used when appropriate during the final status survey process to improve overall decision-making performance. Sufficient composite samples are collected from each survey unit to satisfy Sign or WRS test requirements. The type of compositing proposed, and its advantages are well documented, have been used effectively within the RCRA and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) cleanup programs, and have regulatory support (see EPA 1995, EPA 2002a and EPA 2002b).

  NOTE

  There currently is insufficient soil characterization information available within the project premises to determine whether the use of composite soil sampling for FSS purposes is appropriate. A decision on whether the use of composite soil sampling for final status survey purposes is appropriate will be made once the soil sampling data collection and interpretation associated with the Characterization Sample and Analysis Plan is completed.

- ***Analytical Methods*.** Some of the radionuclides of interest have relatively low $DCGL_W$ values. The 18 radionuclides span a range of required analytical techniques, including gamma spectroscopy, alpha spectroscopy, liquid scintillation, and gas proportional counting. The Final Status Survey Plan will specify the analytical performance requirements expected for each radionuclide (Table 9-5 of this plan identifies target detection limits). In some cases (e.g., gamma spectroscopy and liquid scintillation), a field-based laboratory may prove

advantageous, particularly for those radionuclides that will likely be the primary decision drivers (e.g., Cs-137 and Sr-90). Whether data from field deployable techniques can be used for final status survey compliance demonstration purposes will depend on whether data quality standards can be achieved and documented. There may be cases where a particular field-deployable technique may not have sufficient data quality for final status survey purposes, but where the technique still serves an important and useful role as a screening tool for elevated area concerns, or as part of pre-final status survey/remedial support data collection to determine that an area is ready for final status survey data collection.

- ***Use of Pre-Design Investigation Data for Final Status Survey Purposes.*** The final status survey logic and Final Status Survey Plan were developed in tandem with the Characterization Sample and Analysis Plan for pre-design data collection. The intent is that pre-design data, if collected consistent with Final Status Survey Plan protocols and data quality standards, can potentially be used for final status survey purposes if contamination levels requiring remediation are not identified.

2.4 Role of Pre-Design Data Collection

The Characterization Sample and Analysis Plan will address key data gaps pertinent to decommissioning work. Some of those data gaps are also important from the perspective of designing and implementing the final status survey process for the project premises. These include:

- ***Determining whether the list of the 18 radionuclides of interest as identified by the DP is complete***. An additional 12 radionuclides have been identified as possibly (but unlikely to be) present at the site. In addition, the presence of progeny not in equilibrium with the 18 radionuclides of interest has also been identified as a possible concern. Both issues have the potential for requiring changes to the radionuclides of interest list. The Characterization Sample and Analysis Plan will determine whether this is necessary.
- ***Addressing the prevalence, spatial distribution, and potential collocation of the 18 radionuclides of interest***. There are several potential outcomes from this data collection. If particular radionuclides of interest are either not present to any significant degree or are always dominated from a sum-of-ratios perspective by other radionuclides, the analytical list for systematic samples may be reduced to those that are pertinent. The list of "pertinent" radionuclides of interest might vary with location. Alternatively, if a few readily measurable radionuclides of interest (e.g., Cs-137) are ubiquitous and at relatively stable ratios to other radionuclides of interest, a surrogate approach might be adopted for DCGL analysis.
- ***Determining the presence/absence and prevalence of near-surface subsurface soils (e.g., soils that are at depths just below one meter) that exceed DCGL standards***. The Phase 1 surface soil DCGL requirements are only applicable to areas where contamination is not present below a depth of one meter. The Characterization Sample and Analysis Plan will delineate where near-surface subsurface soil contamination is a concern.

- ***Identifying whether thin layers of buried contamination exist within the top one meter of soils that might pose dose concerns if exposed but would be missed by the Final Status Survey Plan sampling logic***. The Characterization Sample and Analysis Plan will determine if this is the case, and if so, identify the areas where this will be a concern. If such areas exist, then the Final Status Survey Plan logic will be adjusted to address those concerns.
- ***Supporting layout of final status survey unit areas for the site***. The MARSSIM defines three different classifications of final status survey units that may potentially be applied to one or more areas of a site. The selection of the appropriate final status survey unit classification for a particular area depends on its expected contamination status relative to the DCGLs. The Characterization Sample and Analysis Plan will provide the data necessary for the correct classification and delineation of MARSSIM final status survey units.
- ***Estimating likely residual radionuclide activity concentrations to be encountered after Phase 1 activities are complete***. Expected average residual activity concentrations, in conjunction with expected heterogeneity and Type II error requirements, will affect final status survey sample numbers.

3.0 Final Status Survey Approach

Final status survey data collection will take place for soils within the project premises. In the case of soils, if the final status survey data collection conclusions are that DCGL standards have not been attained, DOE may remediate the area and collect additional final status survey data to demonstrate compliance with DCGL requirements.

For the deep excavated surfaces within WMA 1 and WMA 2, additional remediation will take place if subsurface DCGL requirements are not met. For areas outside the WMA 1 and WMA 2 deep excavations, if a final status unit fails the final status survey process, DOE may choose to remediate the affected area until DCGL requirements are met or to postpone remediation until Phase 2.

If DOE chooses to remediate soils exceeding DCGL standards and the original unit was a Class 1 unit, final status survey data collection will be repeated after additional remediation is complete. If the original unit was an unexcavated Class 2 or Class 3 unit, the affected area will be remediated, reclassified as one or more Class 1 units, and final status survey data collection repeated. DOE may defer remediating areas that are not currently identified as requiring excavation by the DP until Phase 2.

3.1 Surface Soils

A complete logged gamma walkover survey of accessible areas within the project premises using an appropriate detector (e.g., Field Instrument for Detecting Low Energy Radiation (FIDLER)) will be performed as part of Characterization Sample and Analysis Plan data collection activities. This walkover survey, in conjunction with biased surface soil sampling and intrusive GeoProbe® data collection, will be used to identify areas likely requiring remediation or impacted at levels approaching soil DCGL levels but not planned for remediation (Class 1 areas), areas impacted but with no evidence of soil DCGL exceedances (Class 2 areas), and areas within the WVDP project premises' boundary that

either show no evidence of impacts, or are minimally impacted at very low levels compared to soil DCGL standards (Class 3 areas). Based on data available to date, it is expected that the majority of the project premises will be classified as either Class 1 or Class 2 final status survey units.

As part of Characterization Sample and Analysis Plan data collection, a background reference area will be identified that can be used to assess the background response of the detector used and that can serve as a source of background samples if a WRS test is required to demonstrate $DCGL_W$ compliance. One outcome of reference area gross gamma data collection will be the identification of appropriate field investigation levels to be applied to gross gamma data during routine use of detectors for pre-design characterization, remediation support, and final status survey data collection.

An example of a field investigation level will be a detector response that is not statistically consistent with background readings (e.g., above the 95 percent upper tolerance limit for background data sets). Biased sampling, in conjunction with gamma walkover survey data and associated field investigation levels, will be used during pre-design data collection work in contaminated areas to develop additional field investigation levels that could potentially be used to reliably identify gross activity responses that might be indicative of soil DCGL exceedance concerns.

For areas that are excavated, the final exposed dig face (walls and floors) will be scanned using one or more logged detectors to evaluate the potential presence of either general contamination above soil $DCGL_W$ standards, or very localized contamination potentially associated with soil $DCGL_{EMC}$ concerns. Biased sampling will be used to further evaluate evidence of contamination potentially above soil DCGL standards if encountered by the detector. Detector data will be collected with the goal of complete spatial coverage at a density of one logged measurement per square meter, on average.

Prior to the initiation of final status survey sample collection, the layout of final status survey units will be finalized for surface soils that are considered ready for final status survey data collection. Areas that are candidates for Phase 1 final status survey data collection are areas where there is no evidence or concern about contamination deeper than one meter, and where Characterization Sample and Analysis Plan data indicate that residual contamination levels likely meet surface soil DCGL requirements. Soil Class 1 survey units will not exceed 2,000 m^2 in size. Soil Class 2 survey units will not exceed 10,000 m^2 in size. There is no size constraint for Class 3 survey units.

For each survey unit the pertinent radionuclides of interest subset will be defined based on historical information, Characterization Sample and Analysis Plan sampling results for that area, and remedial support data in the case of excavated area Class 1 units.

In all cases of sample collection and analysis (systematic and biased), the sum-of-ratios values calculated for samples will be used to test compliance with DCGL standards. Sum-of-ratios values will be calculated based on soil $DCGL_{EMC}$ requirements and based on soil $DCGL_W$ requirements. As part of the sum-of-ratios calculation, background will not be subtracted for those radionuclides that occur naturally. The radionuclides of interest subset used for sum-of-ratios calculation purposes may vary from survey unit to survey unit,

depending on which radionuclides of interest have been determined to be pertinent to the area of interest.

The primary determinant of soil $DCGL_{EMC}$ compliance for each survey unit will be scanning results combined with associated biased sampling for radionuclides of interest that lend themselves to scanning, and systematic soil samples for radionuclides of interest that are not detectable via scans. All survey units (Class 1, Class 2, and Class 3) will have complete scanning coverage. Scanning data sets will be logged to allow for post-data collection mapping, analysis, presentation, and data preservation. Biased samples collected in response to scan results, or for any other reason, will be compared to 1-m^2 soil $DCGL_{EMC}$ requirements.

If biased soil samples are collected, two samples will be collected and analyzed for each biased sampling location: one that is representative of the top 15 cm of exposed soils, and one that is representative of a 1 m soil depth. Sample results (biased or systematic) that exceed soil $DCGL_{EMC}$ requirements indicate soil conditions requiring further remediation. In addition, appropriate $DCGL_{EMC}$ values will be calculated based on the areas represented by systematic samples collected for $DCGL_W$ purposes using area factors provided by the DP; systematic sample results will also be compared to these additional $DCGL_{EMC}$ values.

The primary determinant of soil $DCGL_W$ compliance will be systematic sample results. Systematic samples will be collected on a random start triangular grid. Systematic samples will be composite samples formed from soil increments distributed across the immediate area the systematic sample represents. Two composite samples will be formed from each grid node, one representative of soils to a depth of 15 cm and one representative of soils to a depth of one meter. The minimum number of systematic soil sample grid locations per survey unit will be five (consistent with achieving a Type I error rate of 0.05). In the case of each composite, sufficient soil mass will be collected to allow analysis for all 18 radionuclides of interest, if necessary.

Figure G-1 contains a decision logic flow diagram for surface soil final status survey units. Sum-of-ratios values for systematic sample results will first be calculated based on soil $DCGL_{EMC}$ requirements. There are two applicable $DCGL_{EMC}$ values of interest. The first is the 1-m^2 $DCGL_{EMC}$ value explicitly defined in this plan. This standard will be applied to biased soil sample results. The second is a $DCGL_{EMC}$ value determined from the $DCGL_W$ using area factors (provided in Section 9 of the plan) that are appropriate for the area the systematic sample represents. This approach will be applied to systematic soil sample results.

If there are no soil $DCGL_{EMC}$ concerns, sum-of-ratios values corresponding to soil $DCGL_W$ requirements will be calculated. Samples results representing depths of 15 cm will be evaluated separately from sample results representing a depth of one meter. In each case, if the average of the results is less than unity, the Sign test will be applied assuming a Type I error rate of 0.05. If the null hypothesis is rejected for both depth intervals, the unit will be considered compliant with all relevant soil DCGL standards.

3.2 Subsurface Soils

In the case of the final exposed soil surface for the WMA 1 and 2 deep excavations, the general final status survey process will mirror what has already been described in Section 3.1 utilizing the appropriate subsurface DCGL standards. (One exception is that the sample interval for subsurface soil will be 0-1 m; no 0-15 cm samples are required for subsurface soil.)

The primary differences in the case of WMA 1 are the foundation pilings that will remain in place after excavation is complete. There are some 476 pilings and there are concerns that they may have provided vertical preferential flow pathways for contaminated groundwater into the Lavery Till, resulting in soil contamination at levels of potential concern within the till. This issue will be addressed both by remedial support data collection described in the Characterization Sample and Analysis Plan, and by data collection as part of the final status survey process for final status survey units that include foundation pilings.

If foundation piles did serve as preferential pathways for contamination entry into the Lavery Till, the following conditions would be expected:

- Contamination would have occurred between the piling and surrounding soil,
- Contamination that penetrated into the till would have left evidence at the till/sand and gravel unit interface (i.e., soil contamination at that interface), and
- The possibility for till contamination to occur would have been greatest where groundwater contamination was the greatest – beneath the original release point and immediately down gradient.

Based on these assumptions, the final status survey process for demonstrating that there is no significant till contamination concerns associated with pilings would have the following components:

- Excavation work will identify the exact locations of pilings and remedial action support surveys will determine where contaminated soil at levels of concern existed immediately above the Lavery Till.
- Pilings will be considered in two groups: pilings that fell within the greater-than-DCGL footprint of contaminated soils immediately above the Lavery till, and pilings that did not – final status survey data collection will target those pilings falling within the greater-than-DCGL footprint.
- In this set of pilings, sampling will be a combination of biased and systematic data collection:
  - Ten piling locations will be selected for biased sampling to look for $DCGL_{EMC}$ exceedances. This selection will target those pilings most likely to exhibit till contamination, if it existed. The selection will be based on a combination of factors, including proximity to the original release event, level of soil contamination as identified by remedial support sampling immediately above the till, visual evidence of “spaces” between the till and pilings that might have provided preferential flow pathways, etc.
  - A minimum of eight of the pilings in the footprint will be selected for each final status survey unit, at random, for $DCGL_W$ sampling. In the event that this random

selection process identifies a piling already selected for biased sampling, the sample collected from that piling will be used for both $DCGL_{EMC}$ and $DCGL_W$ compliance demonstration purposes.

For those pilings selected for sampling (either biased or systematic) sampling focus on obtaining a soil sample from immediately along the piling at a depth of one meter below the excavation surface.

If any individual soil sample identifies contamination above $DCGL_{EMC}$ requirements, additional excavation will occur to identify the extent of contamination and remove it. Additional samples will be collected from the final exposed dig face to demonstrate that no further $DCGL_{EMC}$ exceedances exist.

For each final status survey unit that includes pilings falling within the greater-than-DCGL overburden footprint, the systematic sample results from pilings will be evaluated using the Sign test. If the pilings satisfy the Sign test and there are no biased piling samples with $DCGL_{EMC}$ exceedances, till contamination associated with pilings will not be considered an issue. If fewer than five systematic piling samples are available, rather than the Sign test all systematic piling samples will be compared to the $DCGL_W$ requirement. If none are above the $DCGL_W$ values, then till contamination associated with pilings will not be considered an issue.

Figure G-2 shows the decision flow logic for final status survey data collection from the deep excavations in WMA 1 and WMA 2 floors.

3.2 Sediments

NOTE

The initial issue of the Phase 1 Final Status Survey Plan will not provide for Phase 1 final status surveys of Erdman Brook and Franks Creek. If it is later determined that such surveys will be performed during Phase 1 of the decommissioning, the Phase 1 Final Status Survey Plan will be revised to address these surveys following the protocols described below.

For the purposes of this conceptual framework, sediments are defined as soil or sediment-like materials associated with the bed and banks of Erdman Brook and Franks Creek within the project premises.

Historical data have demonstrated that stream sediments in Erdman Brook and Franks Creek contained within the WVDP fence line are impacted by Phase 1 radionuclides. The Characterization Sample and Analysis Plan pre-design data collection will include stream sediment and stream bank sampling to determine if remediation may be required for portions of the stream within the WVDP fence line. Currently there is no remediation planned for sediments as part of the Phase 1 decommissioning activities. Because of the integrating nature of project premises drainage features, final status survey data collection for stream features will likely be one of the final activities to avoid the possibility of re-contamination occurring post-final status survey data collection due to soil erosion and deposition within drainage features.

However, to support overall final status survey planning, the delineation of final status survey unit areas for stream and drainage features within the WVDP fence line will occur as part of Phase 1 activities. All stream features will be classified as Class 1 areas. Consistent with the sediment DCGL derivation contained in the decommissioning plan, the definition of a stream final status survey unit includes sediments within the streambed itself and three m of bank on either side of the streambed. Each unit will be at most 333 m long, comprising an area of at most 2,000 m^2. Subsurface contamination deeper than the 1-m definition of sediments is not considered a plausible scenario for a stream setting; consequently final status survey data collection will focus on surface sediments and adjacent bank soils. This assumption will be tested by Characterization Sample and Analysis Plan data collection.

The decision logic for sediment survey units is identical to surface soils (Figure G-1). As with surface soils across the site, a complete gamma walkover of exposed sediments and associated banks will be performed using an appropriate detector. Biased samples will be collected to clarify scan results that might be indicative of DCGL excedances. For locations where biased samples are collected, two samples will be collected, one representative of a depth of 15 cm, and one representative of a depth of 1 m.

Biased samples collected in response to scan results or for any other reason from within sediment final status survey units will be compared to sediment 1-m^2 $DCGL_{EMC}$ requirements. In addition, appropriate $DCGL_{EMC}$ values will be calculated based on the areas represented by systematic samples collected for $DCGL_W$ purposes using area factors provided in Section 9 of this plan; systematic sample results will also be compared to these additional $DCGL_{EMC}$ values. Sample results (biased or systematic) that exceed sediment $DCGL_{EMC}$ requirements indicate conditions requiring remediation.

Sediment $DCGL_W$ compliance will be demonstrated through the use of systematic sediment samples. A minimum of five systematic composite samples will be collected and submitted for laboratory analysis. For each location where a composite sample is obtained, two samples will be formed, one representative of a depth of 15 cm and one representative of a depth of 1 m. The radionuclides of interest subset for the analyses will be determined based on historical data and Characterization Sample and Analysis Plan data collection results.

The systematic sediment sample locations will conform to a linear grid down the length of the survey unit with a fixed grid node separation distance but random start. At each grid node, the sample collected will be formed from three increments, one from the stream centerline, and two collected from randomly selected distances up the bank from the bank's edge. In the case of each composite, sufficient soil/sediment mass will be collected to allow analysis for all 18 radionuclides of interest, if necessary.

Systematic sediment samples will be submitted for analysis based on the radionuclides of interest subset pertinent to that final status survey unit. Sum-of-ratios values for systematic sample results will first be calculated based on sediment $DCGL_W$ requirements corrected by appropriate area factors contained in Section 9 of this plan and evaluated for $DCGL_{EMC}$ exceedances. If there are no sediment $DCGL_{EMC}$ exceedances, sum-of-ratios values corresponding to sediment $DCGL_W$ requirements will be calculated. If the average of these is less than unity, the Sign test will be applied assuming a Type I error rate of 0.05.

This will be done for both depth intervals. If the null hypothesis is rejected in both cases, the unit will be considered compliant with all relevant soil DCGL standards.

In the event that the radionuclides of interest subset does not include all 18 radionuclides, one composite sample per survey unit will be formed by sub-sampling all individual systematic composite samples (after homogenization) representative of a depth of one meter from a survey unit and submitted for a complete analysis of all 18 radionuclides. If the resulting sediment $DCGL_W$ sum-of-ratios value exceeds unity, then the unit will require additional remediation. If the sum-of-ratios value is significantly influenced by radionuclides that were originally not considered pertinent to that final status survey unit, the remaining composite soil mass for each radionuclide will be analyzed for the balance of the 18 radionuclides not already analyzed, $DCGL_W$ sum-of-ratios values recalculated, and compliance with $DCGL_W$ standards re-evaluated.

4.0 Documentation Requirements

Due to the complexity and time span of the Phase 1 decommissioning activities, it is expected that multiple Final Status Survey Reports will be prepared in accordance with Section 9.8 of this plan. Such reports, for example, may address a group of related survey units, such as those associated with the WMA 1 excavation, or a particular excavated soil laydown area. The use of multiple Final Status Survey Reports will facilitate independent confirmatory surveys and support periodic progress reports to interested stakeholders as the Phase 1 decommissioning activities take place.

Technical data packages will be prepared for individual survey units. Each Final Status Survey Report together with the related technical data packages will contain the information specified in Section 9.8 of this plan, including:

- An overview of the final status survey results;
- A description of the final status survey units comprising the area being evaluated, including any changes from what had been originally planned;
- A summary of the pertinent radionuclides of interest subset and the appropriate $DCGL_W$ and $DCGL_{EMC}$ standards;
- A description of the basis for sample numbers and the analyses used to support sample number determinations for each survey unit;
- A presentation of the gamma scan data for each survey unit, including a map showing the extent of coverage and discussion of the scan data;
- A presentation of the data collected for each survey unit, including a map or drawing of the survey units illustrating the random start systematic sample locations and the location of other samples (i.e., judgmental, biased, and miscellaneous sample data sets which will be reported separately from those samples collected for performing the statistical evaluation);
- A review of quality control parameters associated with data sets;
- A statistical analysis of the data sets with respect to the $DCGL_W$ values in the context of MARSSIM final status survey guidance;

- An evaluation of survey and sampling data to address $DCGL_{EMC}$ standards;
- A conclusion about whether $DCGL_W$ and $DCGL_{EMC}$ requirements have been met;
- A description of how ALARA practices were employed to achieve final activity levels; and
- If a unit fails to meet DCGL requirements, the reason for the failure, the implications for other final status survey units, the actions taken to correct the failure, and/or the implications for Phase II activities

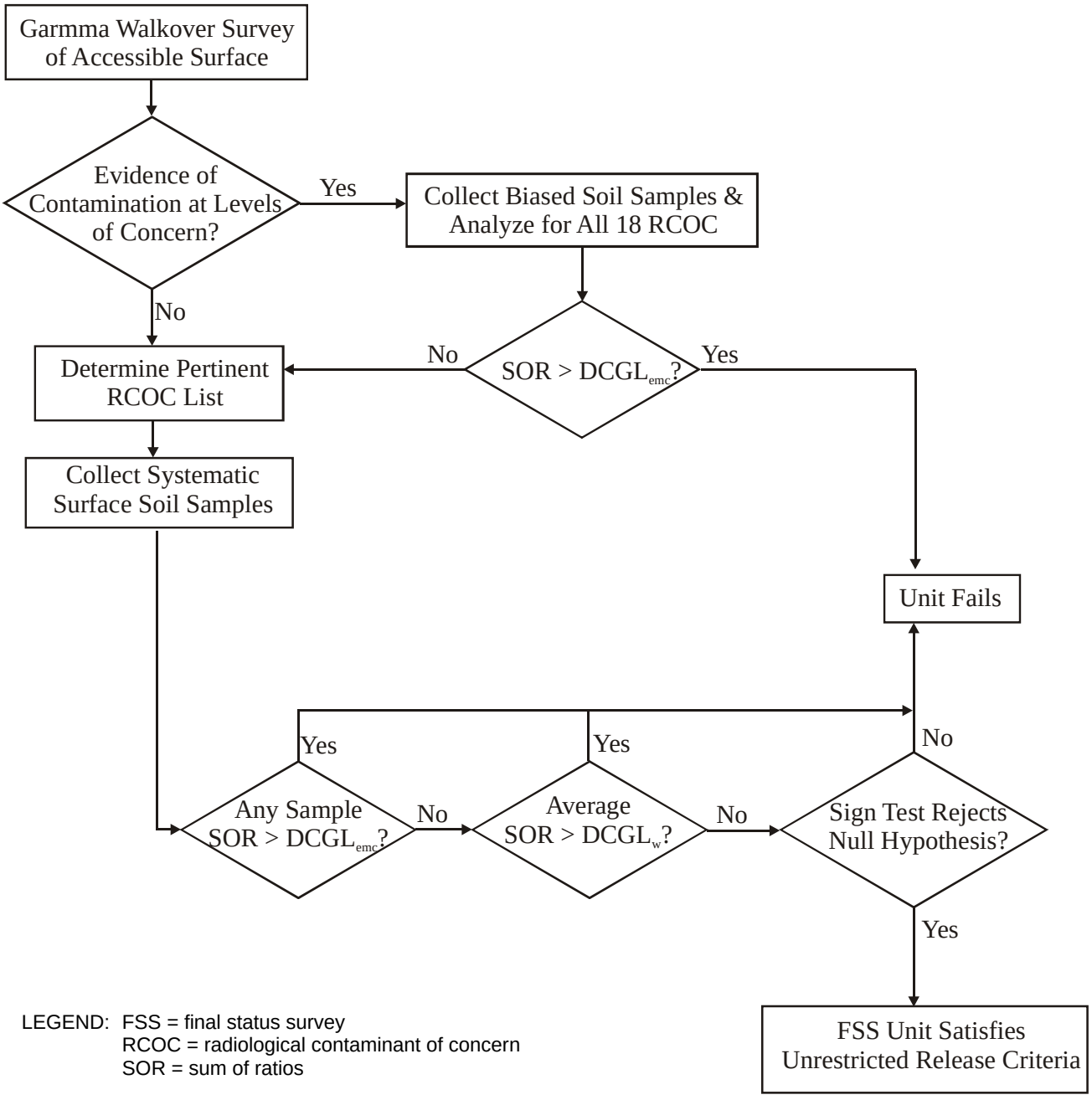

Figure G-1. Decision Logic for Surface Soil and Sediment Survey Units

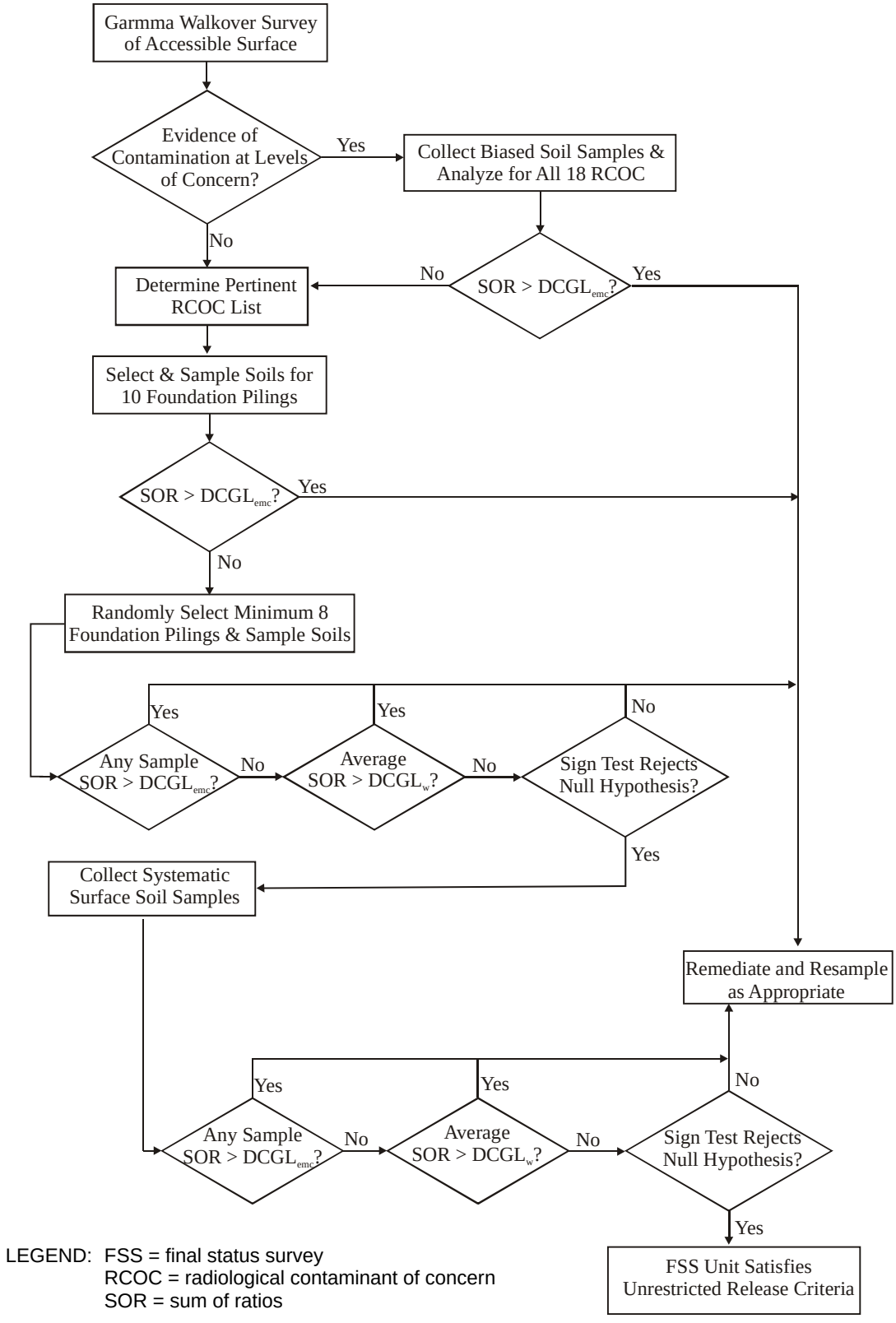

Figure G-2. Decision Logic for WMA 1 and WMA 2 Subsurface Soils