Date Submitted: 1/10/08 Originator: L. M. Dittmer Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-FR-1 Waste Site Code: 100-F-26:13 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2005-011

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 100-F-26:13 waste site is the network of process sewer pipelines that received effluent from the 108-F Biological Laboratory and discharged it to the 188-F Ash Disposal Area (126-F-1 waste site). The pipelines included one 0.15-m (6-in.)-, two 0.2-m (8-in.)-, and one 0.31-m (12-in.)-diameter vitrified clay pipe segments encased in concrete. The site has been remediated and presently exists as an open excavation. Confirmatory evaluation, remediation, and verification sampling of this site have been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100 DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved: (1) evaluating the site using available process information and confirmatory sample data, (2) remediating the site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.

Basis for reclassification:

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD. The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. The 100-F-26:13 excavation area has a maximum depth of approximately 5.2 m (17 ft), which includes a shallow zone and a deep zone. However, the entire excavation area is considered one decision unit, and is closed out using the more restrictive shallow-zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-F-26:13, 108-F Drain Pipelines* (attached).

Waste Site Controls:
Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒
If any of the Waste Site Controls are checked Yes specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

S. L. Charboneau DOE Federal Project Director (printed)	Stacy Charboneau Signature	1/29/08 Date
N/A Ecology Project Manager (printed)	Signature	Date
R. A. Lobos EPA Project Manager (printed)	Signature	3-3-08 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-26:13, 108-F DRAIN PIPELINES

Attachment to Waste Site Reclassification Form 2005-011

January 2008

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-26:13, 108-F DRAIN PIPELINES

EXECUTIVE SUMMARY

The 100-F-26 waste site includes the underground process and sanitary sewer pipelines associated with the 100-F Area pre-reactor cooling water treatment facilities. The 100-F-26:13 subsite is a network of process sewer pipelines that received effluent from the 108-F Biological Laboratory and discharged to the 188-F Ash Disposal Area (126-F-1 waste site), and includes one 0.15-m (6-in.)-, two 0.2-m (8-in.)-, and one 0.31-m (12-in.)-diameter vitrified clay pipe (VCP) segments encased in concrete.

The 100-F-26:13 subsite was evaluated based on the December 29, 2004, to January 5, 2005, confirmatory sampling efforts to determine if remedial action would be required. The maximum detected results for each contaminant of potential concern (COPC) from the confirmatory samples were directly compared against the cleanup criteria to support decisions concerning waste site reclassification. The results from the confirmatory sampling effort for the 100-F-26:13 subsite indicated that residual concentrations of hexavalent chromium, lead, aroclor-1254, and aroclor-1260 in pipe sediment samples were at levels exceeding the direct exposure remedial action goals (RAGs). As a result, remedial action was necessary at this subsite.

Because a portion of the 100-F-26:13 pipeline was located under the main access road to the 100-F Area, remediation of this subsite was performed in two stages. The first stage was performed between February 5 and March 27, 2007, and consisted of excavating and removing all pipeline segments except the portion underlying the main access road. The second stage included excavation and removal of the pipeline segment under the 100-F Area access road and was performed on August 24, 2007.

During the first stage of remediation, overburden material and other soils presumed to contain no residual contamination above cleanup levels were stockpiled near the excavation for post-remediation verification sampling. Contaminated materials were stockpiled in a staged waste area before being transported to the Environmental Restoration Disposal Facility (ERDF). Approximately 580 bank cubic meters (BCM) [(760 bank cubic yards (BCY)] of pipeline material and suspect contaminated adjacent and underlying soils were removed and stockpiled in the staged waste area for later disposal to ERDF. The footprint of the staged waste area will be addressed with the 100-F-26:9 subsite. Excavation depths at the 100-F-26:13 subsite ranged from 4.3 m to 5.2 m (14 ft to 17 ft) below ground surface.

The second stage of remediation (excavation of the pipeline segment underlying the main access road) was scheduled to minimize disruption to 100-F Area activities and included verification sampling immediately following pipeline removal. After sampling was conducted, the excavation was backfilled and the road was reconstructed to allow access to the 100-F Area.

Verification sampling for the 100-F-26:13 subsite was performed in July and August 2007 (WCH 2007a) to collect data to determine if the RAGs had been met. The contaminants of concern (COCs) for verification sampling were determined based on the results of confirmatory sampling at the 100-F-26:13 subsite. The constituents that exceeded the direct exposure RAGs were carried forward as COCs for verification sampling. These include hexavalent chromium, lead, and polychlorinated biphenyls (PCBs) (aroclor-1254 and aroclor-1260). The remainder of the constituents detected from confirmatory sampling were retained as COPCs for verification sampling and include alpha-, beta-, and

gamma-emitting radionuclides, the expanded inductively coupled plasma metals (i.e., antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), and mercury.

A summary of the comparison of soil sampling results against the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the 100-F-26:13 subsite in accordance with the TPA-MP-14 (DOE-RL 2007) procedure.

Table ES-1. Summary of Remedial Action Goals for the 100-F-26:13 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years.	The maximum all pathways dose rate calculated by RESRAD is 12.2 mrem/yr at year zero (2007) from the excavation footprint.	Yes
Direct Exposure Nonradionuclides	Attain individual COC/COPC RAGs.	All individual COC/COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All individual hazard quotients are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (2.5×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk values for individual carcinogens are $<1 \times 10^{-6}$.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk value (1.1×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COC/COPC groundwater and river protection RAGs.	None of the radionuclide COC/COPCs are predicted to reach groundwater within 1,000 years.	Yes
	Attain national primary drinking water regulations:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	None of the radionuclide COC/COPCs are predicted to reach groundwater within 1,000 years.	
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5.[b]	None of the radionuclide COC/COPCs are predicted to reach groundwater within 1,000 years.	
	Meet total uranium standard of 21.2 pCi/L.[c]	Residual concentrations of uranium isotopes were detected below statistical background levels.	

Table ES-1. Summary of Remedial Action Goals for the 100-F-26:13 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of lead and aroclor-1254 are above the groundwater and river protection soil RAGs. However, RESRAD modeling predicts that these constituents will not reach groundwater (and, therefore, the Columbia River) within 1,000 years.[d]	Yes

[a] "National Primary Drinking Water Regulations" (40 Code of Federal Regulations 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).
[d] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), these constituents are not predicted to migrate more than 2 m (6.6 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient distribution [mercury] of 30 mL/g). The vadose zone underlying the remediation footprint is approximately 5 m (16 ft) thick.

COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999a). The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. The 100-F-26:13 excavation depths ranged from 4.3 m to 5.2 m (14 ft to 17 ft), which includes a shallow zone and a deep zone. However, the entire excavation area is considered one decision unit, and is interim closed out using the more restrictive shallow-zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999a) based, in part, on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern and other constituents. Screening levels were not exceeded for the site constituents, with the exception of arsenic, boron, lead, manganese, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of these constituents does not pose a risk to ecological receptors because concentrations of manganese and vanadium are below

site background levels and boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). The exceedance of soil screening values by arsenic and lead at the site will be evaluated in the context of additional lines of evidence for ecological effects. A more complete quantitative ecological risk assessment will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-26:13, 108-F DRAIN PIPELINES

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-F-26:13 waste site meets the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999a). The results of verification sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Excavation depths include both shallow-zone and deep-zone components. However, the excavation area is considered as one decision unit and is interim closed out using the more restrictive shallow-zone criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-F-26 waste site includes the underground process and sanitary sewer pipelines associated with the 100-F Area pre-reactor cooling water treatment facilities. For the confirmatory sampling effort, the 100-F-26 site was divided into 16 subsites based on the intended use of the pipe (e.g., sanitary sewers or process water supply), expected sources of contamination, and potential remedial actions. The 100-F-26:13 subsite is 1 of the 16 subsites associated with the 100-F-26 underground pipelines site and is the only subsite discussed in this report.

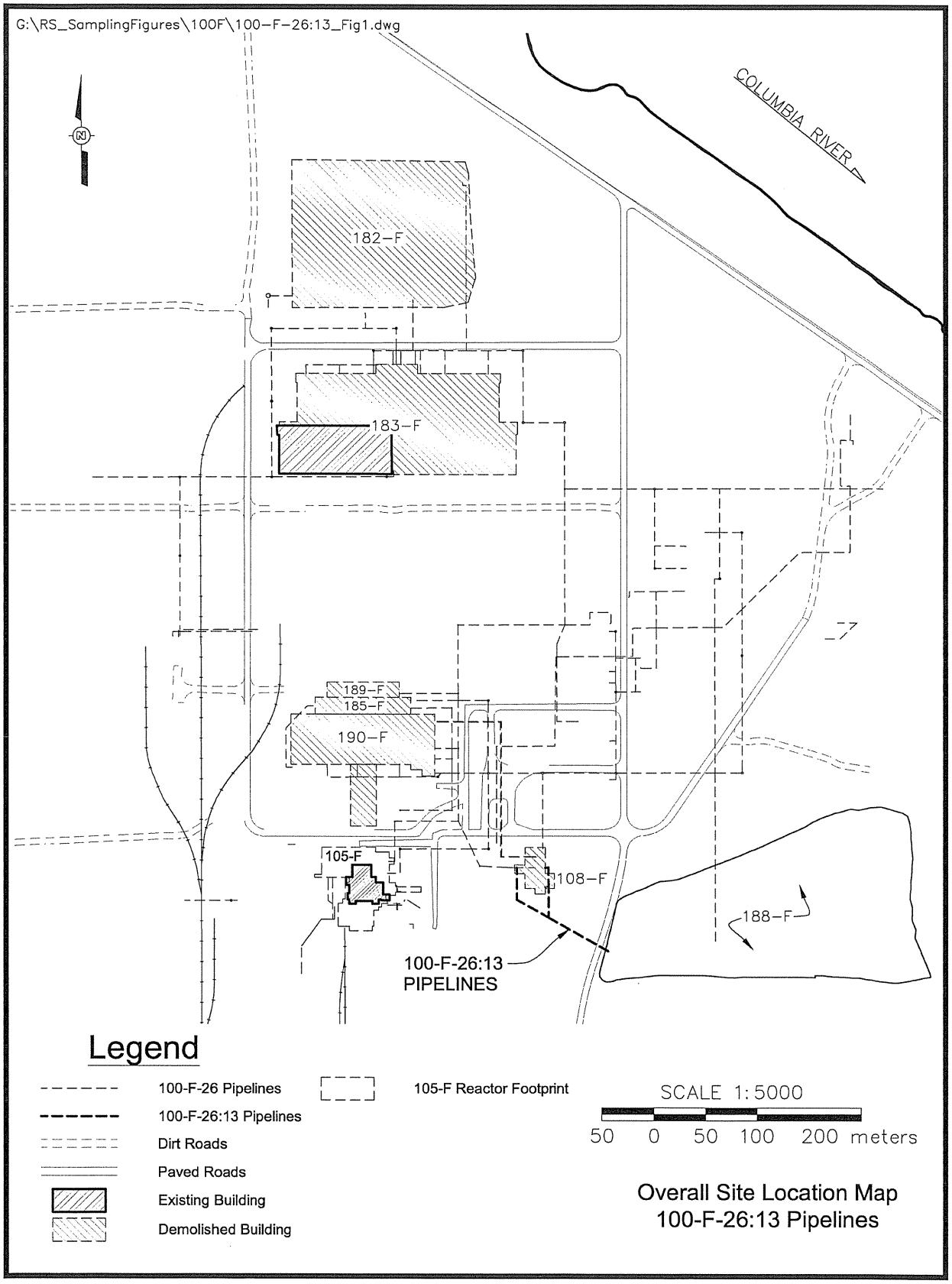
The Waste Information Data System (WIDS) describes this subsite as a network of process sewer pipelines that received effluent from the 108-F Biological Laboratory and then discharged it to the 188-F Ash Disposal Area (126-F-1 waste site) (Figure 1). This subsite includes one 0.15-m (6-in.)-, two 0.2-m (8-in.)-, and one 0.31-m (12-in.)-diameter vitrified clay pipe (VCP) segments encased in concrete.

The 100-F-26:13 subsite serviced the former 108-F Biological Laboratory, which was originally built in 1944 to support treatment of cooling water for use in the 105-F Reactor. In 1949, the 108-F Building was completely remodeled for use in life-science studies to test the effects of radiation and contamination on plant and animal life. In 1999, the 108-F Building was decontaminated, demolished, and removed (BHI 2000a); however, the 100-F-26:13 pipeline segments were left in place.

CONFIRMATORY SAMPLING ACTIVITIES

The 100-F-26:13 subsite was evaluated during the January 2005 confirmatory sampling effort to determine if remedial action would be required. The following subsections provide additional discussion of the confirmatory sample design details and the results of the confirmatory sampling activities.

Figure 1. 100-F-26:13 Pipelines Location Map.



Contaminants of Potential Concern for Confirmatory Sampling

The contaminants of potential concern (COPCs) for this site are identified in the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005a). The COPCs included cobalt-60, cesium-137, europium-152, europium-154, strontium-90, arsenic, barium, cadmium, chromium (total), hexavalent chromium, mercury, lead, selenium, and silver.

Historical information and process knowledge for the 108-F Biology Laboratory was used to further develop the COPCs for the 100-F-26:13 underground pipeline subsite. As a result, uranium-233/234, uranium-235, uranium-238, americium-241, plutonium-238, plutonium-239/240, inductively coupled plasma (ICP) metals, and polychlorinated biphenyls (PCBs) were included as COPCs. Sulfuric acid was used at the 108-F facilities; however, confirmatory samples did not require anion analysis because sulfate has not been detected in nearby groundwater monitoring wells and the groundwater protection value for sulfate is high (25,000 mg/kg) compared to other potential contaminants.

Confirmatory Sample Design and Sampling Activities

Historical drawings and process knowledge were used to develop a site-specific confirmatory sample design (BHI 2004b). Previous remediation activities in this area associated with the removal of the 100-F-19:2 effluent pipelines (BHI 2003) were also considered. The sample design included two pipeline locations that were most likely to have the greatest potential for encountering hazardous constituents. These two locations were investigated by excavating test pits to locate the pipes and sample the pipe contents and underlying soil. The confirmatory sampling locations, as well as previous remediation boundaries, are shown on Figure 2.

Excavation and confirmatory sampling was conducted from December 29, 2004, to January 5, 2005. Test pit 1 was excavated 5.2 m (17 ft) below ground surface (bgs) to the 0.31-m (12-in.)-diameter concrete-encased VCP. A section of the VCP was removed by using a hydraulic hammer attached to an excavator and samples of the sediment inside the pipe and the underlying soil were collected. Test pit 2 was excavated 4.3 m (14 ft) bgs to the 0.2-m (8-in.)-diameter concrete-encased VCP. A section of the VCP was removed and samples of the sediment inside the pipe and the underlying soil were collected. Field radiological surveys and monitoring for volatile organic compounds were conducted during excavation; no elevated detections were noted in the logbook (BHI 2004a).

A summary of the confirmatory samples collected and the laboratory analyses performed is provided in Table 1.

Figure 2. Confirmatory Sampling Locations at the 100-F-26:13 Subsite.

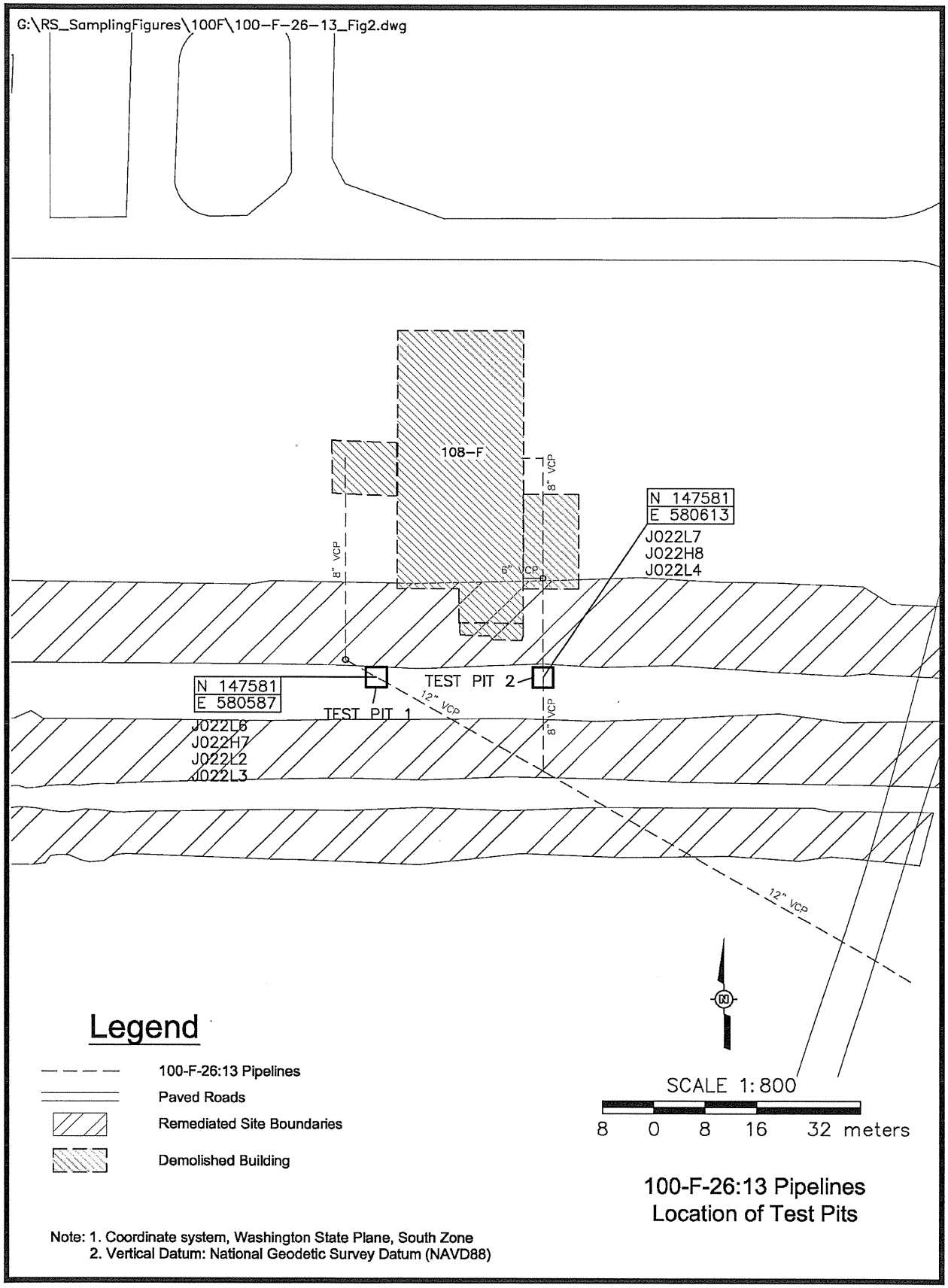


Table 1. Confirmatory Sample Summary for the 100-F-26:13 Subsite.

Sample Location	Sample Media	Sample Number	Coordinate Locations	Depth (m bgs)	Sample Analyses
Test pit 1	Pipe sediment	J022L6	N 147581 E 580587	5.2 m (17 ft)	GEA, gross alpha, gross beta, ICP metals[a], mercury, PCB
		J022H7			Hexavalent chromium
	Underlying soil	J022L2		5.2 m (17 ft)	GEA, gross alpha, gross beta, hexavalent chromium, ICP metals[a], mercury, PCB
Test pit 2	Pipe sediment	J022L7	N 147581 E 580613	4.3 m (14 ft)	GEA, gross alpha, gross beta, ICP metals[a], mercury, PCB
		J022H8			Hexavalent chromium
	Underlying soil	J022L4		4.3 m (14 ft)	GEA, gross alpha, gross beta, hexavalent chromium, ICP metals[a], mercury, PCB
Test pit 1 duplicate	Underlying soil	J022L3	N 147581 E 580587	5.2 m (17 ft)	GEA, gross alpha, gross beta, hexavalent chromium, ICP metals[a], mercury, PCB
Equipment blank	Silica sand	J022L5	N/A	N/A	ICP metals[a], mercury, PCB

[a] The expanded list of ICP metals include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, silver, selenium, vanadium, and zinc.

Source: *Remaining Sites Field Sampling*, Logbook EL-1578-5 (BHI 2004a).

bgs = below ground surface
GEA = gamma energy analysis
ICP = inductively coupled plasma
N/A = not applicable
PCB = polychlorinated biphenyl

Confirmatory Sample Results

All confirmatory samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency and the results compared to the cleanup criteria specified in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b). The results are stored in the Environmental Restoration (ENRE) project-specific database prior to being provided to the Hanford Environmental Information System (HEIS) and are included in Appendix A of this document.

The results from the confirmatory sampling effort for the 100-F-26:13 subsite indicated that residual concentrations of hexavalent chromium, lead, aroclor-1254, and aroclor-1260 in pipe sediment samples were at levels exceeding the direct exposure remedial action goals (RAGs). As a result, remedial action was necessary at this subsite (Feist 2005).

REMEDIAL ACTION SUMMARY

Because a portion of the 100-F-26:13 pipeline was located under the main access road to the 100-F Area, remediation of this subsite was performed in two stages. The first stage was performed between February 5 and March 27, 2007, and consisted of excavating and removing all pipeline segments except the portion underlying the main access road. This first stage of the excavation currently remains open. The second stage included excavation and removal of the pipeline segment under the 100-F Area access road and was performed on August 24, 2007.

For the first stage of remediation, overburden material and other soils presumed to contain no residual contamination above cleanup levels (referred to collectively as "below cleanup level" [BCL]) were stockpiled near the excavation for post-remediation verification sampling. Approximately 580 bank cubic meters (BCM) (760 bank cubic yards [BCY]) of pipeline material and suspect contaminated adjacent and underlying soils were removed and staged in a designated area for later disposal to the Environmental Restoration Disposal Facility. The footprint of the staged waste area will be addressed with the 100-F-26:9 subsite. Excavation depths at the 100-F-26:13 subsite ranged from 4.3 to 5.2 m (14 to 17 ft) bgs.

For the second stage of remediation, the pipeline excavation was scheduled to minimize disruption to 100-F Area activities and included verification sampling immediately following pipeline removal. Once sampling was conducted, the excavation was backfilled and the road reconstructed to allow access to the 100-F Area.

A post-excavation civil survey for the subsite is shown in Figure 3, and the results of systematic global-positioning radiological surveys are shown in Figures 4 and 5.

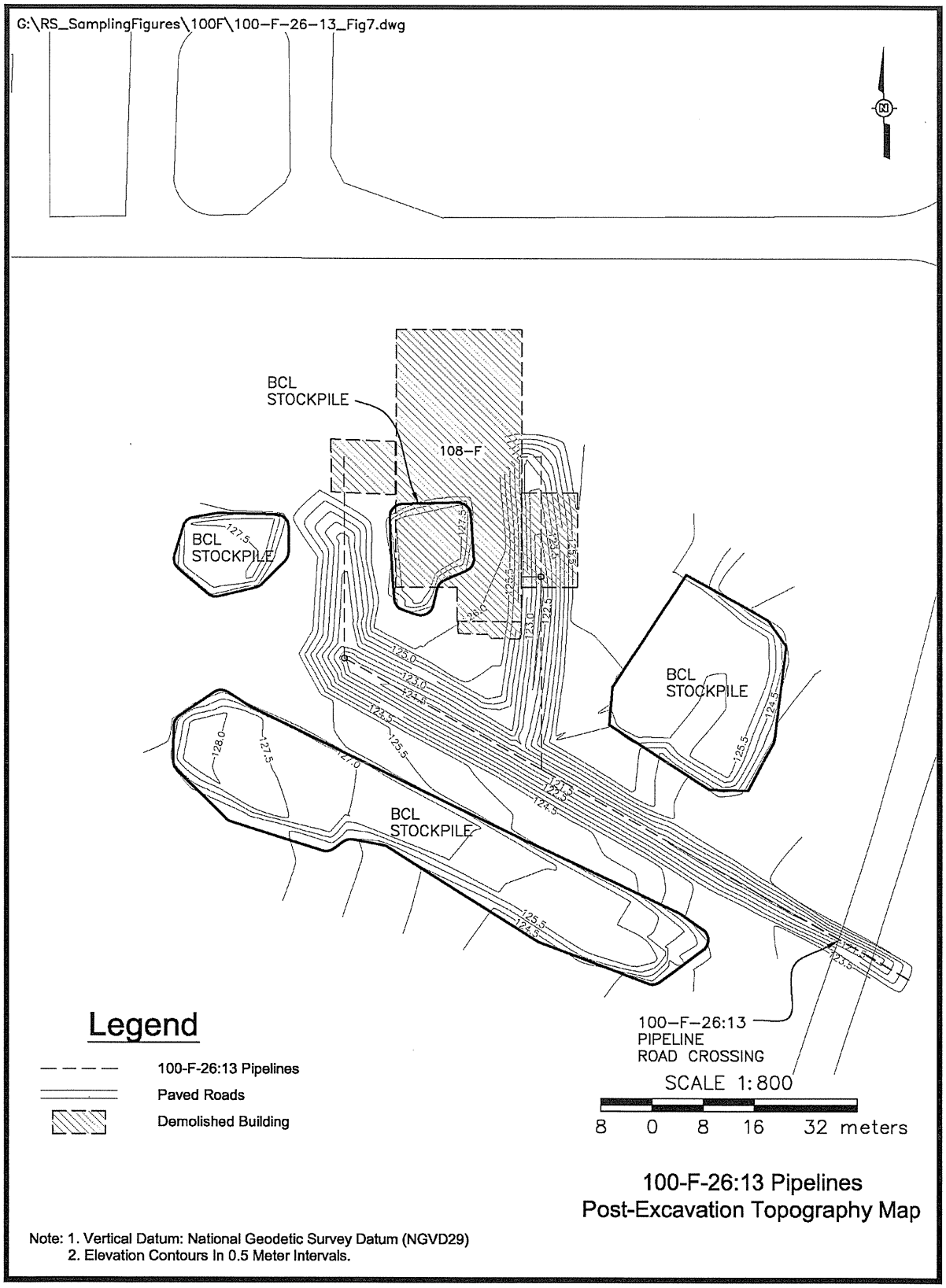
VERIFICATION SAMPLING ACTIVITIES

RAGs are the specific numeric goals against which the cleanup verification data are evaluated to demonstrate attainment of the remedial action objectives for the site. Verification sampling for the 100-F-26:13 subsite was performed in July and August 2007 (WCH 2007a) to collect data to determine if the RAGs had been met. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Concern for Verification Sampling

The contaminants of concern (COCs) and COPCs for verification sampling were determined based on the results of confirmatory sampling at the 100-F-26:13 subsite. The constituents from confirmatory sampling that exceeded the direct exposure RAGs were carried forward as COCs for verification sampling. These include hexavalent chromium, lead, and PCBs (i.e., aroclor-1254 and aroclor-1260). The remainder of the constituents detected during confirmatory sampling were retained as COPCs for verification sampling and include alpha-, beta-, and gamma-emitting radionuclide isotopes, the expanded inductively coupled plasma metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), and mercury.

Figure 3. Post-Excavation Survey of the 100-F-26:13 Subsite.



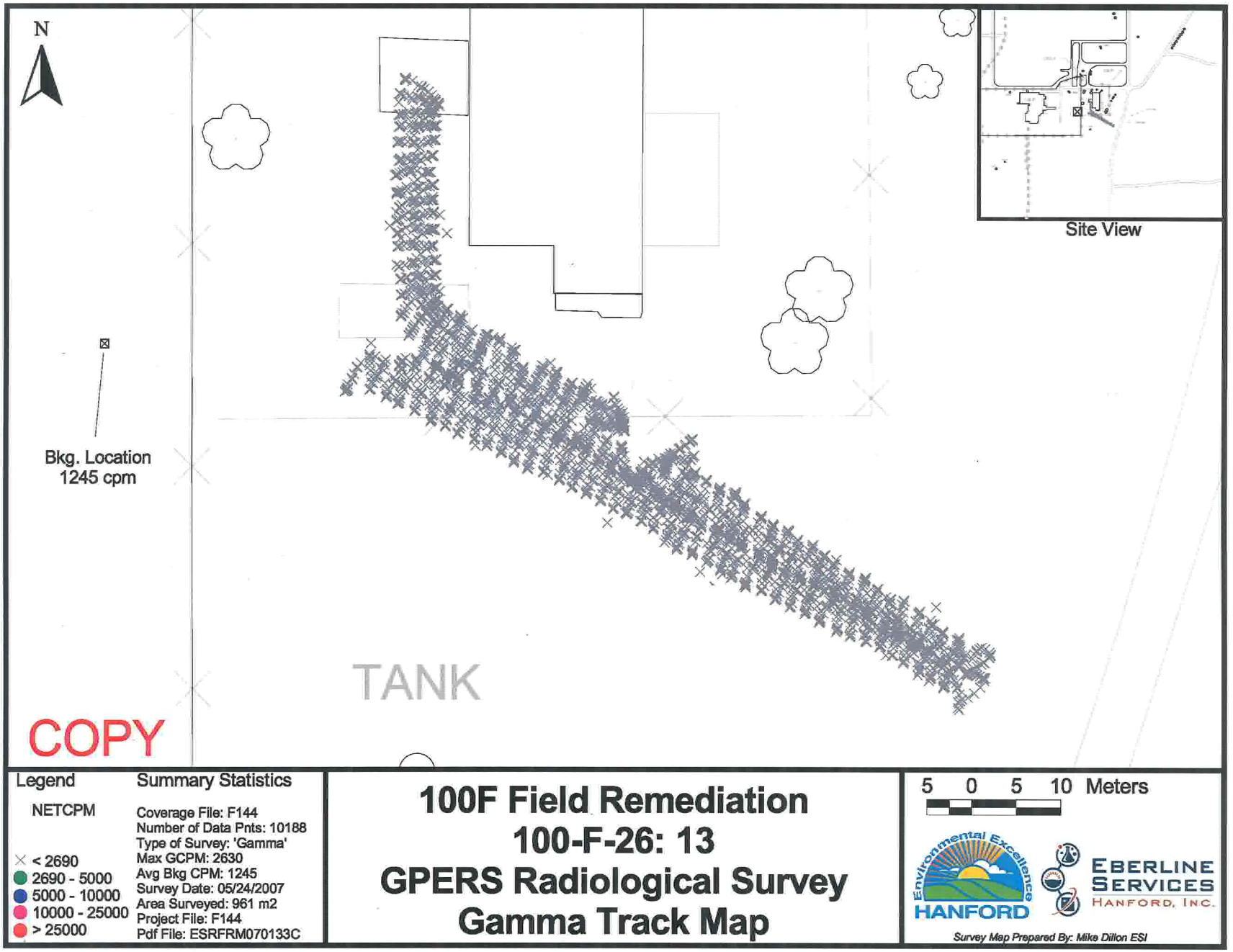
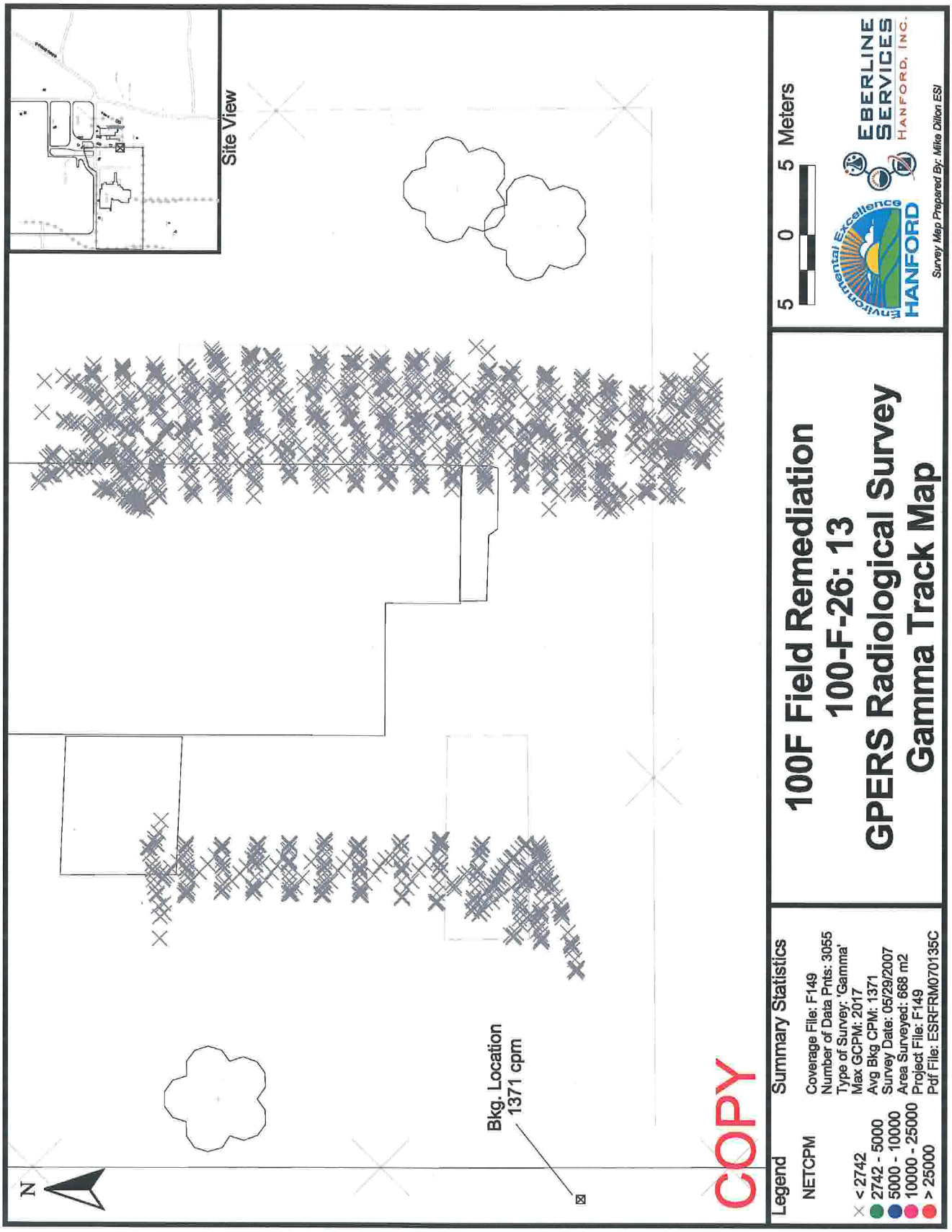


Figure 4. Radiological Survey of the 100-F-26:13 Subsite.

Figure 5. Radiological Survey of the 100-F-26:13 Subsite.



Verification Sampling Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples to collect. The 100-F-26:13 subsite was divided into three decision units for the purpose of verification sampling. The first unit consists of the stage one excavation shallow zone, the second unit consists of the BCL stockpiles from the stage one excavation as overburden, and the third consists of the stage two excavation shallow zone within the road-crossing area, and the BCL stockpile from the road-crossing area. The sample design selection and basis for each area is described below.

Verification Sampling – Stage One Excavation

The decision rule for demonstrating compliance with the cleanup criteria requires comparison of the true population mean, as estimated by the 95% upper confidence limit on the sample mean, with the cleanup level. Therefore, a statistical sampling design was selected as the verification sampling approach for the excavated trenches because the distribution of potential residual soil contamination over this area is uncertain. The Washington State Department of Ecology publication, *Guidance on Sampling and Data Analysis Methods* (Ecology 1995) recommends that systematic sampling with sample locations distributed over the entire study area be used. This sampling approach is referred to by the Washington State Department of Ecology as "area-wide sampling."

The base of the shallow-zone pipeline excavation was delineated in Visual Sample Plan[1] and used as the basis for location of a random-start systematic grid for verification soil sample collection locations. A total of 10 soil samples were collected on a random-start, triangular grid for this sampling area. A triangular grid was selected for this investigation based on studies that indicate triangular grids are superior to square grids (Gilbert 1987). Additional discussion of the development of the statistical verification design is provided in the 100-F-26:13 verification work instruction (WCH 2007a).

Verification Sampling – BCL Stockpiles

Verification sampling of the BCL stockpiles was performed to evaluate the suitability of the soil for designation as an overburden decision unit for site closure and for use as clean backfill for the excavation. Because this material consists of overburden from the site and was not believed to have received discharges from the pipelines, a statistical sampling design was not warranted, and professional judgment was used to develop the sampling design. Sampling at each of the four BCL stockpiles consisted of the collection of 25 aliquots of soil distributed across the surface of each pile and combining them into one sample per pile, for a total of four soil samples, for laboratory analysis.

Verification Sampling – Stage Two Excavation (Road-Crossing Area)

Verification sampling of the road-crossing area as a shallow zone was performed after removal of the pipeline from under the roadway and prior to backfilling the excavation. No staining or releases from the pipeline at this location were observed. Because this segment of the pipeline underlies the main access road to the 100-F Area, sampling was conducted immediately following remediation to limit disruption to transportation activities. Three soil samples were collected at approximately equidistant intervals along a transect below the removed pipeline in accordance with the work instruction

[1] Visual Sample Plan is a site map-based user-interface program that may be downloaded at http://dqo.pnl.gov.

(WCH 2007a). In addition, a BCL stockpile generated from excavated material was sampled prior to use as backfill. Sampling of the BCL stockpile consisted of collecting 25 aliquots of soil distributed across the surface of the pile and combining them into one sample. Once all samples were collected, the excavation was backfilled and the road reconstructed.

Summaries of the samples collected and the analyses performed for the verification sampling event are presented in Table 2 and the sample locations are shown in Figure 6. The soil sample locations were staked in the excavation footprint prior to sample collection. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a).

Table 2. Verification Sample Summary for the 100-F-26:13 Subsite.[a] (2 Pages)

Sample Location	Sample Number	Coordinate Locations (Washington State Plane)	Sample Analysis
Excavation area, location 1	J15748	N 147582.6 E 580637.3	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 2	J15749	N 147559.9 E 580624.8	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 3	J15750	N 147567.1 E 580612.2	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 4	J15751	N 147574.4 E 580599.7	GEA, gross alpha, gross beta,[b] ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 5	J15752	N 147581.6 E 580587.2	GEA, gross alpha,[b] gross beta,[b] ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 6	J15753	N 147581.6 E 580612.2	GEA, gross alpha, gross beta,[b] ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 7	J15755	N 147588.8 E 580583.0	GEA, gross alpha, gross beta,[b] ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 8	J15756	N 147596.1 E 580612.2	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 9	J15757	N 147603.3 E 580583.0	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Excavation area, location 10	J15758	N 147610.5 E 580612.2	GEA, gross alpha,[b] gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Equipment Blank	J15766	NA	ICP metals, PCBs
Duplicate of location 6	J15754	N 147581.6 E 580612.2	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
BCL 1 Stockpile	J15759	NA	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
BCL 2 Stockpile	J15760	NA	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
BCL 3 Stockpile	J15761	NA	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs

Table 2. Verification Sample Summary for the 100-F-26:13 Subsite.[a] (2 Pages)

Sample Location	Sample Number	Coordinate Locations (Washington State Plane)	Sample Analysis
BCL 4 Stockpile	J15762	NA	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Road crossing 1	J15763	N 147540.3 E 580659.6	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Road crossing 2	J15764	N 147536.5 E 580662.1	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Road crossing 3	J15765	N 147535.7 E 580665.6	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs
Road crossing BCL stockpile	J15F89	NA	GEA, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs

[a] Source: Field logbook EFL-1174-3 (WCH 2007b).
[b] Gross alpha and gross beta results were above screening levels; therefore, additional analyses were performed.

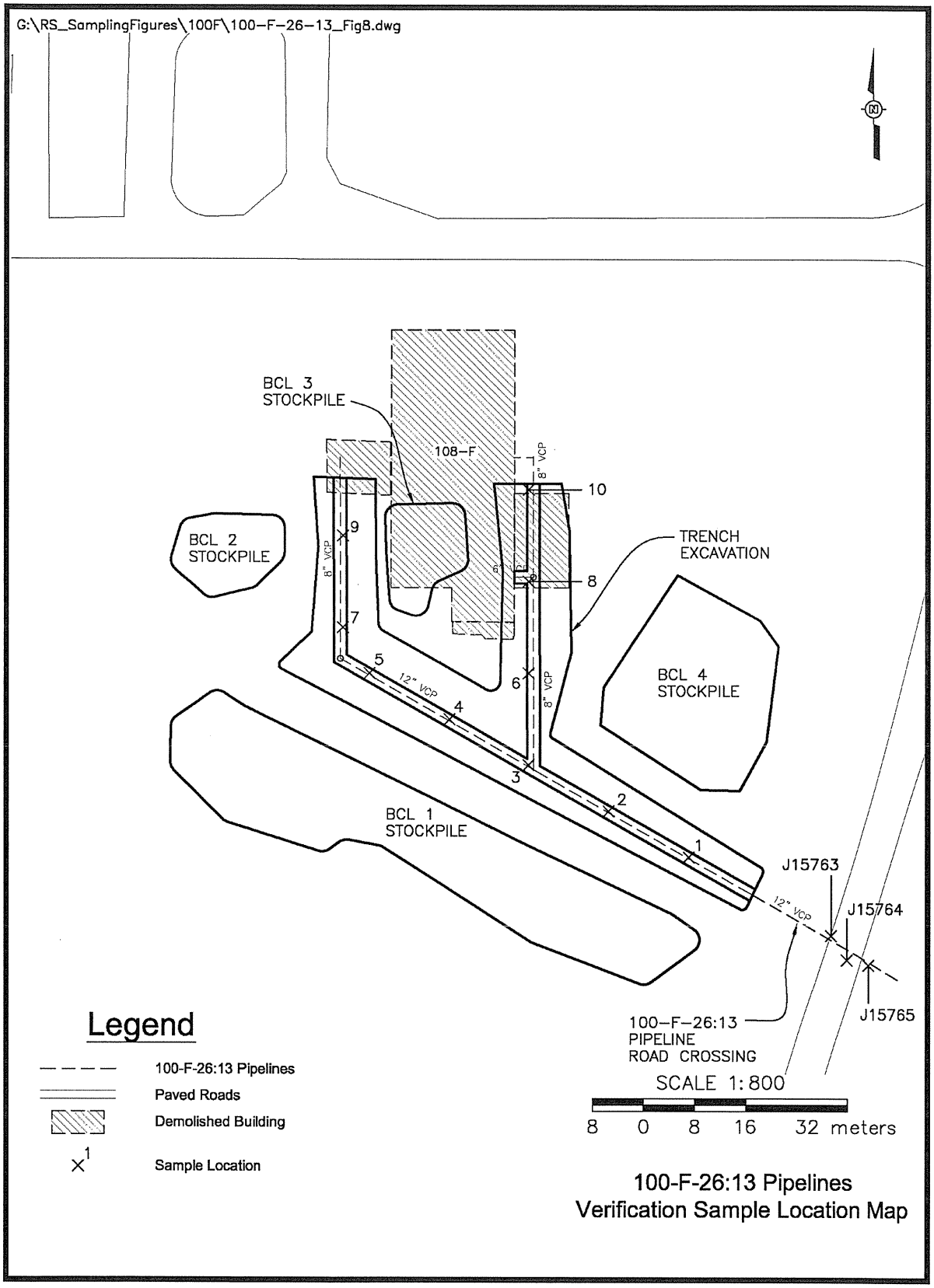
GEA = gamma spectroscopy
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl

Verification Sampling Results

Verification samples were analyzed using U.S. Environmental Protection Agency-approved analytical methods. The laboratory-reported data results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Appendix B of this document.

As noted earlier, the 100-F-26:13 subsite was divided into three decision units for verification sampling: (1) excavation footprint as a shallow zone, (2) BCL stockpiles as overburden, and (3) road-crossing area shallow zone and road-crossing overburden. Evaluation of the verification data from the excavation footprint was calculated using the 95% upper confidence limit on the true population mean for residual concentrations of COCs/COPCs as specified by the RDR/RAWP (DOE-RL 2005b). These calculations are provided in Appendix B. When a nonradionuclide COC/COPC was detected in fewer than 50% of the verification samples collected, the maximum detected value was used for comparison against the RAGs. If no detections for a given COC/COPC were reported in the data set, then no statistical evaluation or calculations were performed for that COC/COPC. Evaluation of the verification data from the BCL stockpiles and road-crossing areas was performed by direct comparison of the sample results against cleanup criteria.

Figure 6. Verification Sampling Locations at the 100-F-26:13 Subsite.



Comparisons of the statistical and maximum results for COCs/COPCs with the shallow-zone RAGs for the excavation footprint, BCL stockpiles, and road-crossing area are summarized in Tables 3a, 3b, and 3c, respectively. For nonradioactive analytes with ≤50% of the data below detection limits and all detected radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% upper confidence limit (UCL). For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results, the maximum detected value for the data set is used instead of the 95% UCL, and no further calculations are performed for those data sets. All three decision units are evaluated using the more restrictive shallow-zone cleanup criteria. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under *Washington Administrative Code* (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COCs/COPCs. Potassium-40, radium-226, radium-228, thorium-228, thorium-232, and uranium-233/234 were detected in samples collected at the site, but are not considered within statistical calculations or the following tables. These isotopes are excluded from consideration as COCs/COPCs based on natural occurrence and analogous site information and were detected below background levels (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

Table 3a. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 100-F-26:13 Shallow-Zone Pipeline Excavation Verification Sampling Event. (2 Pages)

COPC	Statistical Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Maximum Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Carbon-14	3.3	5.16	--[b]	--[b]	No	Yes[c]
Cesium-137	0.036	6.2	--[b]	--[b]	No	--
Strontium-90	2.010	4.5	--[b]	--[b]	No	--
COC	**Statistical Result (mg/kg)**	**Remedial Action Goals[a] (mg/kg)**			**Does the Maximum or Statistical Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	4.2 (< BG)	20	20	20	No	--
Barium	50.7 (< BG)	5,600	132[d]	224	No	--
Beryllium	0.33 (< BG)	10.4[e]	1.51[d]	1.51[d]	No	--
Boron[h]	1.33	16,000	320	--[f]	No	--
Chromium (total)	9.0 (< BG)	80,000	18.5[d]	18.5[d]	No	--
Cobalt	5.2 (< BG)	1,600	32	--[f]	No	--
Copper	11.1 (< BG)	2,960	59.2	22.0[d]	No	--

Table 3a. Comparison of Maximum or Statistical Contaminant Concentrations to Action Levels for the 100-F-26:13 Shallow-Zone Pipeline Excavation Verification Sampling Event. (2 Pages)

COC	Statistical Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum or Statistical Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Lead	11.0	353	10.2[d]	10.2[d]	Yes	Yes[g]
Manganese	228 (< BG)	11,200	512[d]	512[d]	No	--
Molybdenum[h]	0.46	400	8	--[f]	No	--
Nickel	9.0 (< BG)	1,600	19.1[d]	27.4	No	--
Vanadium	33.3 (< BG)	560	85.1[d]	--[f]	No	--
Zinc	34.9 (< BG)	24,000	480	67.8[d]	No	--
Aroclor-1254	0.0081	0.5	0.017[i]	0.017i	No	--
Aroclor-1260	0.015	0.5	0.017[i]	0.017[i]	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) or calculated per WAC-173-340-720, 173-340-730, and 173-340-740, Method B, 1996, unless otherwise noted.

[b] The 100 Area RDR/RAWP (DOE-RL 2005b) does not provide soil cleanup to be protective of groundwater and the Columbia River levels for this contaminant. Based on the lowest radionuclide soil partitioning distribution coefficient (for strontium-90 [25 mL/g]), this contaminant is not predicted to migrate more than 3 m (10 ft) vertically in 1,000 years (BHI 2005). The vadose zone underlying this waste site is approximately 5 m (16 ft) thick. Therefore, residual concentrations of this contaminant are predicted to be protective of groundwater and the Columbia River.

[c] 108-F- Drain Pipelines Cleanup Verification RESRAD Calculations (Appendix D).

[d] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996).

[e] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) and an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

[f] No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[g] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), residual concentrations are not expected to migrate more than 2 m (6.6 ft) vertically in 1,000 years based on the soil-partitioning coefficient distribution of lead (30 mL/g). The vadose zone underlying the remediation footprint is approximately 5 m (16 ft) thick.

[h] No Hanford Site-specific or Washington State background value available.

[i] Where cleanup levels are less than RDLs, cleanup levels default to RDLs (WAC 173-340-707(2), 1996 and DOE-RL, 2005b).

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 3b. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:13 BCL Stockpiles Verification Sampling Event.

COPC	Maximum Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Maximum Result Exceed Lookup Values?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Cesium-137	0.127	6.2	--[b]	--[b]	No	Yes[c]
COC	**Maximum Result (mg/kg)**	**Remedial Action Goals[a] (mg/kg)**			**Does the Maximum Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	9.6	20	20	20	No	--
Barium	92.8 (< BG)	5,600	132[d]	224	No	--
Beryllium	0.4 (< BG)	10.4[d]	1.51[d]	1.51[d]	No	--
Boron[e]	6.1	16,000	320	--[f]	No	--
Chromium (total)	11.6 (< BG)	80,000	18.5[d]	18.5[d]	No	--
Cobalt	6.4 (< BG)	1,600	32	--[f]	No	--
Copper	12.1 (< BG)	2,960	59.2	22.0[d]	No	--
Lead	29.6	353	10.2[d]	10.2[d]	Yes	Yes[g]
Manganese	295 (< BG)	11,200	512[d]	512[d]	No	--
Molybdenum[e]	0.52	400	8	--[f]	No	--
Nickel	10.2 (< BG)	1,600	19.1[d]	27.4	No	--
Vanadium	39.0 (< BG)	560	85.1[d]	--[f]	No	--
Zinc	44.9 (< BG)	24,000	480	67.8[d]	No	--
Aroclor-1254	0.038	0.5	0.017[h]	0.017[h]	Yes	Yes[g]
Aroclor-1260	0.014	0.5	0.017[h]	0.017[h]	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) or calculated per WAC-173-340-720, 173-340-730, and 173-340-740, Method B, 1996, unless otherwise noted.

[b] The 100 Area RDR/RAWP (DOE-RL 2005b) does not provide soil cleanup levels for cesium-137 to be protective of groundwater and the Columbia River. Given the soil-partitioning distribution coefficient for cesium-137 (50 mL/g), this contaminant is not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (BHI 2005). The vadose zone underlying this waste site is approximately 5 m (16 ft) thick. Therefore, residual concentrations of cesium-137 are predicted to be protective of groundwater and the Columbia River.

[c] 108-F- Drain Pipelines Cleanup Verification RESRAD Calculations (Appendix D).

[d] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996).

[e] No Hanford Site-specific or Washington State background value available.

[f] No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[g] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), residual concentrations are not expected to migrate more than 2 m (6.6 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient distribution [lead] of 30 mL/g). The vadose zone underlying the remediation footprint is approximately 5 m (16 ft) thick.

[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs (WAC 173-340-707(2), 1996) and DOE-RL, 2005b).

-- = not applicable
BG = background
BCL = below contaminant level
COC = contaminant of concern
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose assessment model)
RDL = required detection limit
WAC = *Washington Administrative Code*

Table 3c. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-26:13 Road Crossing Shallow Zone and Road Crossing Overburden Verification Sampling Event.

COC	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	1.3 (< BG)	20	20	20	No	--
Barium	45.6 (< BG)	5,600	132[b]	224	No	--
Beryllium	0.2 (< BG)	10.4[c]	1.51[b]	1.51[b]	No	--
Boron[e]	1.4	16,000	320	--[d]	No	--
Chromium (total)	6.9 (< BG)	80,000	18.5[b]	18.5[b]	No	--
Cobalt	4.6 (< BG)	1,600	32	--[d]	No	--
Copper	10.8 (< BG)	2,960	59.2	22.0[b]	No	--
Lead	5.2 (< BG)	353	10.2[b]	10.2[b]	No	--
Manganese	217 (< BG)	11,200	512[b]	512[b]	No	--
Molybdenum[e]	0.48	400	8	--[d]	No	--
Nickel	8.3 (< BG)	1,600	19.1[b]	27.4	No	--
Vanadium	22.3 (< BG)	560	85.1[b]	--[d]	No	--
Zinc	27.2 (< BG)	24,000	480	67.8[b]	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) or calculated per WAC 173-340-720, 173-340-730, and 173-340-740, Method B, 1996, unless otherwise noted.
[b] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996).
[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], 1996) and an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).
[d] No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[e] No Hanford Site-specific or Washington State background value available.

-- = not applicable
BG = background
COC = contaminant of concern
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

DATA EVALUATION

Evaluation of the results listed in Table 3c indicate that residual concentrations of site COCs/COPCs in the road-crossing area are all below background values and/or below shallow-zone cleanup requirements. In the excavation footprint and the BCL stockpile areas (Tables 3a and 3b), however, residual concentrations of lead exceed the soil RAGs for the protection of groundwater and the Columbia River. In the BCL stockpile, concentrations of aroclor-1254 also exceed the soil RAGs for the protection of groundwater and the Columbia River. Data were not collected on the vertical extent of residual contamination, but, given the lowest soil-partitioning coefficient (lead is the lowest, at 30 mL/g), RESidual RADioactivity (RESRAD) modeling (BHI 2005) predicts that these contaminants will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. The vadose zone beneath the 100-F-26:13 excavation is approximately 5 m (16 ft) thick. Therefore, residual concentrations of these

COCs are protective of groundwater. The only pathway for contamination to reach the Columbia River is via groundwater migration, so these contaminant concentrations are also protective of river water. All other COCs/COPCs for the 100-F-26:13 excavation and the BCL stockpiles were either not detected or were quantified below RAGs and/or lookup values.

For radionuclide contaminants, RESRAD modeling (ANL 2005) is used to predict the dose rate, the excess lifetime cancer risk, and the impact on groundwater and the river from residual radionuclide COC concentrations (DOE-RL 2005b). For the 100-F-26:13 pipeline excavation, the maximum concentrations of individual radionuclides in Table 3a were entered into the RESRAD computer code with the results included in the RESRAD calculations in Appendix D. A maximum all-pathways dose of 12.2 mrem/yr was predicted to occur in the present year (2007), which is less than the RAG for the allowable radiation dose rate above background of 15 mrem/yr. For information only, the risk due to radionuclides is also presented. The dose rate corresponds to a carcinogenic risk of 1.03×10^{-4}. RESRAD predicts that both dose and risk will decline over time due to radioactive decay. The RESRAD model predicts that no radionuclide will reach groundwater (or the river) within the 1,000 years of the evaluation. Therefore, residual concentrations of radionuclides are protective of groundwater and the Columbia River.

Assessment of the risk requirements for the 100-F-26:13 subsite is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated for the entire waste site using the highest values from each of the three decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The results (Appendix C) indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-F-26:13 waste site is 2.5×10^{-2}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 1.1×10^{-7}. Therefore, nonradionuclide risk requirements are met.

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. The application of the three-part test for the 100-F-26:13 remediation footprint is included in the statistical calculations (Appendix B). The three-part test is not applicable to the BCL stockpile or the road crossing results because direct comparison of maximums of nonstatistical sampling results to cleanup levels was used as the compliance basis. All statistical calculations of residual COC/COPC concentrations for the 100-F-26:13 remediation footprint pass the three-part test, except for lead, which fails in comparison to the soil RAGs for groundwater and river protection. As noted above, lead is not predicted to migrate more than 2 m (6.6 ft) vertically in 1,000 years. Therefore, residual concentrations of lead are protective of groundwater and the Columbia River.

This section demonstrates that remedial actions at the 118-F-1 site have achieved the applicable RAGs. Sections 5.4 and 5.5 address attainment of direct exposure RAGs as well as groundwater and Columbia River protection RAGs, respectively. Section 5.6 summarizes the results of the WAC 173-340 three-part test performed in the 95% UCL calculation brief (Appendix B). This test is required for nonradionuclide COCs only and is based on the most restrictive RAG (defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs).

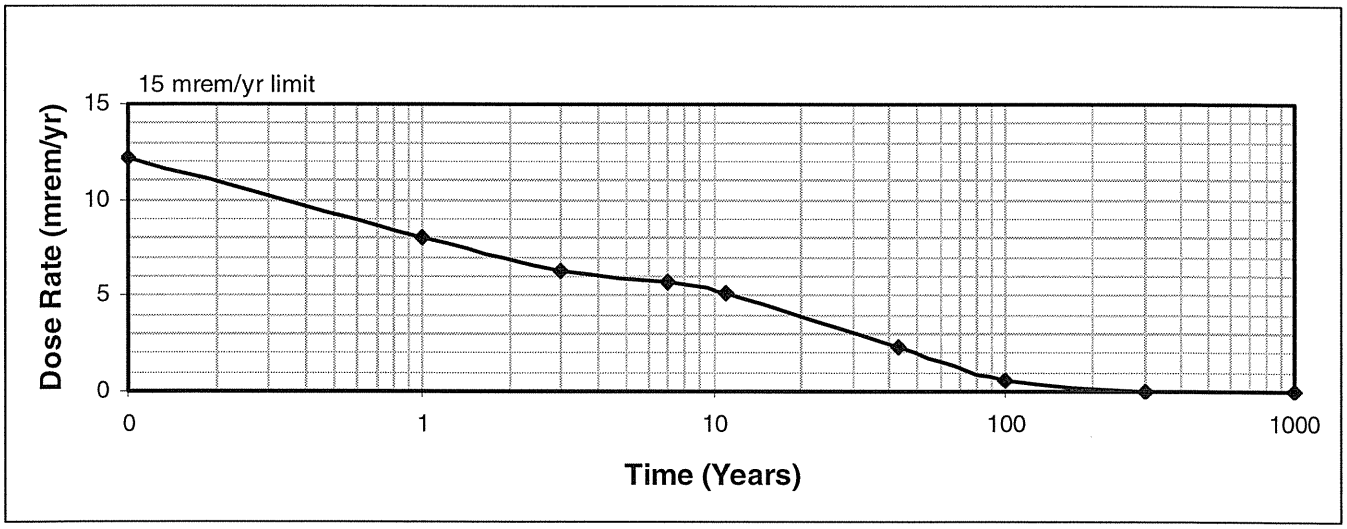
DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

Radionuclides

The individual radionuclide cleanup verification statistical values from the excavation shallow zone (Table 3a) were entered into the RESRAD computer code, Version 6.30 (ANL 2005), to estimate the dose rate and the impact on groundwater and the river from residual COC concentrations. A separate RESRAD run was not required for the overburden/BCL decision unit, as only one radionuclide was detected (cesium-137), and the maximum radionuclide concentration does not exceed the lookup value. A separate RESRAD run was not required for the road-crossing decision unit, as no radionuclides were detected.

The results of the 100-F-26:13 RESRAD dose rate estimates for the all-pathways scenarios for the excavation shallow zone are shown in Figure 7. These dose rates represent the dose contributions from soils at relevant time periods. The estimated maximum total all-pathways dose rate from the 100-F-26:13 pipeline remediation footprint is 12.2 mrem/yr at year zero (2007) and decreases to 2.04×10^{-10} mrem/yr in 1,000 years (Figure 4). The estimated dose rate in the year 2018 is 5.15 mrem/yr. The 2018 date corresponds to the 30-year site cleanup schedule of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989). All dose rate estimates are less than the 15 mrem/yr RAG. The RESRAD computations are shown in detail in the calculation brief presented in Appendix D.

Figure 7. RESRAD Analysis for the 100-F-26:13 Remediation Footprint – All Radionuclides, All-Pathways Dose Rate Estimate.

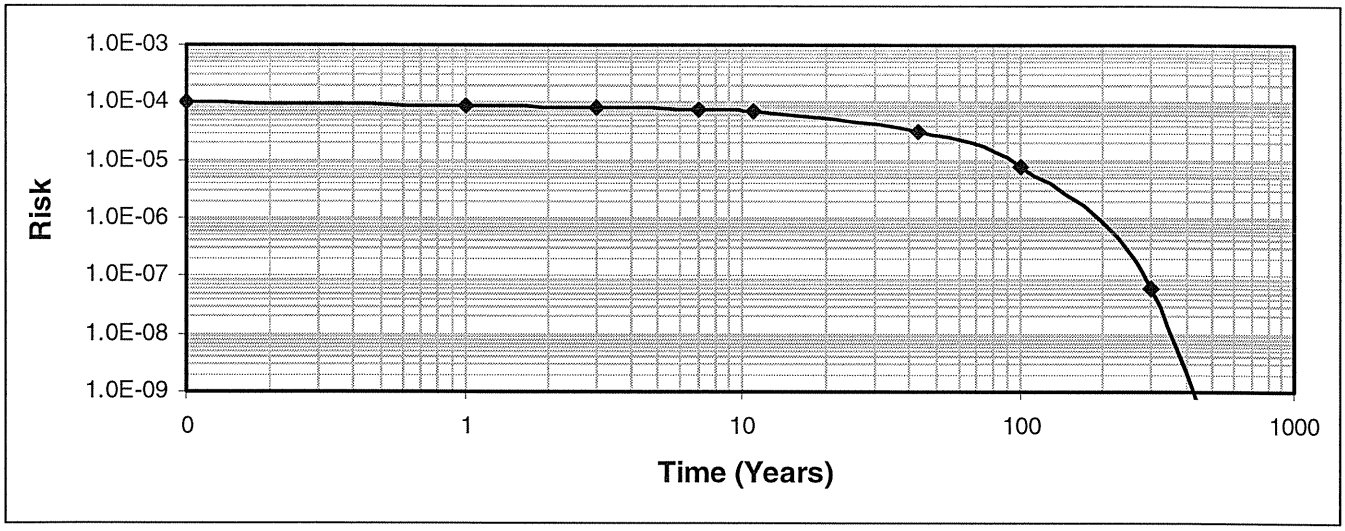


The radionuclide RAG for direct exposure is derived from the Remaining Sites ROD (EPA 1999a) and is expressed in terms of an allowable radiation dose rate above background (i.e., 15 mrem/yr). The RAG evaluation involved using the RESRAD model to estimate total annual radiation dose rates for 1,000 years for comparison to the RAG. Radiation presents a carcinogenic risk, and the RESRAD model also calculates the excess lifetime cancer risk (ELCR) associated with the estimated radiation dose rates using the U.S. Environmental Protection Agency's (EPA's) Health Effects Assessment

Summary Tables (update dated April 16, 2001, "Update of Radionuclide Carcinogenicity Slope Factors," available on the Internet at www.epa.gov/radiation/heast). The "National Oil and Hazardous Substances Pollution Contingency Plan" (40 Code of Federal Regulations 300) presents a target range for residual risk of 10^{-4} to 10^{-6} and establishes that *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) cleanups should generally achieve a level of risk within the 10^{-4} to 10^{-6} carcinogenic risk range based on the reasonable maximum exposure for an individual. Further EPA policy has noted that the upper boundary of the risk range is not a discrete line at 10^{-4} and that a specific risk estimate around 10^{-4} may be considered acceptable, if justified based on site-specific conditions (EPA 1999b). The goal of remediation is to achieve the 10^{-4} to 10^{-6} risk range, using a dose of 15 mrem/yr above background as an operational guideline to achieve this goal.

Figure 8 illustrates the ELCR for the remediation footprint as estimated using the RESRAD model. Because of radioactive decay, the risk decreases over time. The maximum predicted ELCR occurs at present (year 2007). The maximum ELCR is 1.03×10^{-4} for the remediation footprint, and the ELCR predicted for the year 2018 is 6.88×10^{-5}. The maximum ELCR of 1.03×10^{-4}, while slightly outside the target risk range of 10^{-4} to 10^{-6}, is considered acceptable because it is predicted for the plant ingestion pathway which is not predicted to occur on the Hanford Site in the foreseeable future.

Figure 8. RESRAD Analysis – Radionuclide Risk, All Pathways – Remediation Footprint.



DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (DOE-RL 2005a, WCH 2007a). This DQA was performed in accordance with site specific data quality objectives found in the SAP (DOE-RL 2005a).

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000b, 2000c) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the

intended use (i.e., evaluate against cleanup criteria to indicate if remedial action goals have been met). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

A review of the sample designs (DOE-RL 2005a and WCH 2007a), the field logbook (WCH 2007b), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. The sample design and samples collected are sufficient to indicate if all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met.

The verification sample data, collected at the 100-F-26:13 waste site, were provided by the laboratories in two sample delivery groups (SDGs): SDG K0879 and SDG K0931. SDG K0879 was submitted for third-party validation. No major deficiencies were identified in the analytical data. Minor deficiencies are discussed below.

In the 100-F-26:13 data set, samples J15752, J15753, J15755, and J15758 had inconsistent results between the initial gross alpha/gross beta analyses and the isotopic analyses. The laboratory reran the gross alpha/gross beta analyses. This produced two sets of data for gross alpha and gross beta analyses. An examination of the data determined that the second data set is more reliable than the first data set. The first gross alpha/gross beta data sets are excluded and the second data set has been used for the data quality assessment and for decision-making purposes. See author's note below.

SDG K0879

This SDG comprises 16 field samples from the 100-F-26:13 excavation area (J15748 – J15758) and the associated BCL stockpiles (J15759-J15762) and an equipment blank (J15766). Sample J15754 is the field duplicate of sample J15753.

The field samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polychlorinated biphenyls (PCBs), gross alpha, gross beta, nickel-63 by liquid scintillation counting (LSC), total strontium by beta counting, carbon-14, tritium, technecium-99, and by gamma spectroscopy. The equipment blank was analyzed for ICP metals and PCBs. SDG K0879 was submitted for third-party validation. No major deficiencies were found in SDG K0879. Minor deficiencies are as follows:

Matrix spikes (MSs) were not run for tritium or carbon-14 in SDG K0879. Copper-242 was not included in the laboratory control sample (LCS). Third-party validation qualified all of the tritium, carbon-14, and copper-242 data in SDG K0879 as estimated and flagged "J". Estimated data are useable for decision-making purposes.
A surrogate recovery in sample J15758 was above the acceptance criteria at 128%. Third-party validation qualified the aroclor-1260 result in sample J15758 as estimated with a "J" flag. Estimated data are useable for decision-making purposes.

Author's note:

Gross alpha and/or gross beta analyses are screening methods used to evaluate if additional isotopic analyses are required. The isotopic analyses then determine if specific Hanford-related contaminants are the source of the elevated gross alpha or gross beta results. Standard procedure is that elevated gross alpha results prompt additional analyses for isotopic forms of plutonium, americium, and uranium, and elevated gross beta results prompt additional analyses for strontium. Typically, the isotopic analyses will indicate the source of the elevated gross alpha or gross beta. However, additional isotopic analyses for Hanford-related contaminants were not successful in identifying the primary contributor for elevated gross alpha and/or gross beta results from the initial 100-F-26:13 data set. It is possible that variability in the background levels is responsible for the observed results. In instances without a clear explanation of the data, the laboratory is asked to rerun samples.

Examination of the original and duplicate data sets has consistently revealed that the elevated gross alpha/beta results are partially due to analytical variability in the gross alpha/beta counting methods. Because they are specific, the isotopic results are more reliable than the screening methods.

Where two sets of data are created during the investigation of the elevated gross alpha/beta results, an examination of both sets of data is made with priority given to the isotopic analyses. The data set most consistent with the isotopic analysis is considered more reliable. If the second data set is determined to be more reliable, the first data set is excluded and the second data set is used for decision-making purposes. If an evaluation of the two data sets is inconclusive, then the first (original) data set is retained and used for decision-making purposes, while the second data set is rejected. Duplicated data are accepted or rejected in sets. Individual results from multiple data sets are not mixed to create a desired result.

Additionally, in the ICP metals analysis, the MS recoveries for four ICP metals (aluminum, iron, antimony, and silicon) are out of acceptance criteria. For aluminum, iron, and silicon, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. For these analytes, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post digestion spikes (PDSs) and serial dilutions were prepared for all four analytes with acceptable results. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 59.1%. Antimony results for all samples in SDG K0879 are qualified as estimated and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

The relative percent difference (RPD) for silicon is outside quality control (QC) limits, at 30.8%. The results for silicon were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

SDG K0931

This SDG comprises eight field samples from the 100-F-26:13 waste site. Five of these samples were collected from the BCL stockpiles (J15759-J15762, J15F89), and three (J15763-J15765) from the road-crossing area of the 100-F-26:13 excavation shallow zone.

These samples were analyzed for ICP metals, mercury, hexavalent chromium, PCBs, semivolatile organic compounds (SVOCs), chlorinated pesticides, gross alpha, gross beta, and by gamma spectroscopy. No major deficiencies were found in SDG K0931. Minor deficiencies are as follows:

In the SVOC analysis, 2 of 48 surrogate recoveries are outside of the acceptance criteria. However, the secondary criteria for surrogates in the SVOC analysis allows for "no more than one outlier per sample" to the accepted recovery range. All of the samples in SDG K0931 meet either the primary or the secondary criteria for surrogate recovery. The data are useable for decision-making purposes.

In the SVOC analysis, 3 of 128 MS recoveries are below the acceptance criteria. The MSDs for 1,3-dichlorobenzene, 1,2-dichlorobenzene, and hexachloroethane are below the acceptance criteria at 48%, 47%, and 47%, respectively. The results for these analytes may be considered estimated. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the LCS recoveries for 2 of 64 analytes are below the QC limit. The LCS recoveries for 2,4-dinitrophenol and 4,6-dinitro-2-methylphenol are 16% and 24%, respectively. These recoveries are not low enough to force rejection of the associated data. The 2,4-dinitrophenol and 4,6-dinitro-2-methylphenol in SDG K0931 are, therefore, considered estimated. Estimated data are acceptable for decision-making purposes.

In the PCB analysis, 1 of 48 surrogate recoveries is outside of the acceptance criteria. However, the secondary criteria for surrogates in the SVOC analysis allows for "no more than one outlier per sample" to the accepted recovery range. All of the samples in SDG K0931 met either the primary or the secondary criteria for surrogate recovery. The data are useable for decision-making purposes.
Due to lack of an MS, MSD, or LCS analysis for toxaphene in the pesticide analysis, all toxaphene results for SDG K0931 may be considered estimated. Estimated data are acceptable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for three ICP metals (aluminum, iron, and silicon) are out of acceptance criteria. For these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, PDSs and serial dilutions were prepared for all three analytes with acceptable results. The data are useable for decision-making purposes.

The RPD for silicon is outside QC limits, at 45.6%. The elevated RPD is attributed to the natural heterogeneity of the sample matrix. The silicon data are usable for decision-making purposes.

In the ICP metals analysis, sodium and zinc are reported in the MB at concentrations above the contract-required quantitation limit. The sodium and zinc results for all samples in SDH K0931 may be considered estimated with reported values that are higher than the actual values in the samples. The data are acceptable for decision-making purposes.

Field Quality Assurance/Quality Control

RPD evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies shown in those calculations are reported by SDG in the previous sections.

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. The field QA/QC samples for the 100-F-26:13 site, listed in the field logbook (WCH 2007c), are primary and duplicate field samples from the excavation (J15753/J15574). Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process.

The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values above 5 times the detection limits for both the main and duplicate samples are compared. The 95% UCL calculation brief in Appendix B provides details on duplicate pair evaluation and RPD calculation. None of the RPDs calculated for the sample pair J15753/J15574)) are above the acceptance criteria (30%). The data are useable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than 5 times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. None of the 100-F-26:13 results required this check.

An overall visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are suitable for the intended purpose of cleanup verification.

Data Quality Assessment Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential concern for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-F-26:13 verification sampling data determined that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 100-F-26:13 waste site establishes that the data are of the right type, quality, and quantity to support the intended use. The verification sample analytical data are stored in the ENRE project-specific database prior to being submitted for inclusion in the HEIS database. The verification sample analytical data are also summarized in Appendix B of this document.

SUMMARY FOR INTERIM CLOSURE

The 100-F-26:13 waste site has been evaluated and remediated in accordance with the Remaining Sites ROD (EPA 1999a) and the RDR/RAWP (DOE-RL 2005b). Because of the results of the confirmatory sampling, approximately 580 BCM (760 BCY) of pipeline material and suspect contaminated adjacent and underlying soils were removed and staged in a designated area for later disposal to the Environmental Restoration Disposal Facility. Sampling to verify the completeness of remediation was

performed, and the analytical results indicated that the residual concentrations of COCs/COPCs at this site meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-F-26:13 waste site to Interim Closed Out. The 100-F-26:13 excavation depths ranged from 4.3 m to 5.2 m (14 ft to 17 ft), which includes a shallow zone and a deep zone. However, the entire excavation area is considered one decision unit, and is interim closed out using the more restrictive shallow-zone cleanup criteria; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

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APPENDIX A

CONFIRMATORY SAMPLING AND WASTE CHARACTERIZATION RESULTS

Table C-1. 100-F-26:13 Confirmatory Sampling Results. (4 Pages)

Sample Location	Sample Number	Sample Date	Americium-241 GEA			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1 Soil	J022L2	01/05/05	0.31	U	0.31	0.036	U	0.036	0.042	U	0.042	0.11	U	0.11	0.17	U	0.17	0.14	U	0.14
Duplicate of J022L2	J022L3	01/05/05	0.18	U	0.18	0.049	U	0.049	0.061	U	0.061	0.14	U	0.14	0.19	U	0.19	0.13	U	0.13
Test Pit 2 Soil	J022L4	01/05/05	0.3	U	0.3	0.032	U	0.032	0.038	U	0.038	0.094	U	0.094	0.14	U	0.14	0.13	U	0.13
Test Pit 1 Sediment	J022L6	01/05/05	0.2	U	0.2	1.5		0.069	0.064	U	0.064	0.412		0.12	0.187		0.16	0.14	U	0.14
Test Pit 2 Sediment	J022L7	01/05/05	0.39	U	0.39	1.07		0.053	0.047	U	0.047	0.13	U	0.13	0.14	U	0.14	0.17	U	0.17

Sample Location	Sample Number	Sample Date	Gross alpha			Gross beta			Potassium-40			Radium-226			Radium-228			Thorium-228 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1 Soil	J022L2	01/05/05	13.8		6.5	21.8		5.8	16.8		0.37	0.499		0.081	0.602		0.17	0.599		0.043
Duplicate of J022L2	J022L3	01/05/05	12.1		7.2	18.3		5.5	19.1		0.34	0.512		0.07	0.685		0.23	0.63		0.054
Test Pit 2 Soil	J022L4	01/05/05	11.3		6.1	18.6		5.6	15.8		0.36	0.498		0.077	0.657		0.18	0.529		0.04
Test Pit 1 Sediment	J022L6	01/05/05	5.38		4	11.5		5.3	4.8		0.55	0.378		0.096	0.345		0.2	0.274		0.067
Test Pit 2 Sediment	J022L7	01/05/05	18.3		4	20.9		5.4	12.6		0.48	0.883		0.089	1.3		0.2	1.05		0.061

Sample Location	Sample Number	Sample Date	Thorium-232 GEA			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1 Soil	J022L2	01/05/05	0.602		0.17	0.16	U	0.16	4.9	U	4.9
Duplicate of J022L2	J022L3	01/05/05	0.685		0.23	0.19	U	0.19	7.1	U	7.1
Test Pit 2 Soil	J022L4	01/05/05	0.657		0.18	0.14	U	0.14	4.7	U	4.7
Test Pit 1 Sediment	J022L6	01/05/05	0.345		0.2	0.2	U	0.2	5.9	U	5.9
Test Pit 2 Sediment	J022L7	01/05/05	1.3		0.2	0.2	U	0.2	5.3	U	5.3

Acronyms and notes apply to all tables in this appendix.
Note: Data qualified with C are considered acceptable values.
C = blank contamination (inorganic compounds)
GEA = gamma energy analysis
MDA = minimum detectable activity
PCB = polychlorinated biphenyls
PQL = practical quantitation limit
Q = qualifier
U = undetected

Table C-1. 100-F-26:13 Confirmatory Sampling Results. (4 Pages)

Sample Location	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1 Soil	J022L2	01/05/05	4400		3.3	0.37		0.29	1.6		0.27	28.8		0.04	0.38		0.01	0.45		0.31
Duplicate of J022L2	J022L3	01/05/05	5820		3.2	0.45		0.28	2.9		0.26	63.5		0.04	0.64		0.01	1.1		0.3
Test Pit 2 Soil	J022L4	01/05/05	4230		2.8	0.25	U	0.25	1.8		0.23	34.1		0.04	0.42		0.009	0.49		0.27
Equipment Blank	J022L5	01/05/05	48.4		2.6	0.23	U	0.23	0.21	U	0.21	0.95		0.03	0.01		0.009	0.25	U	0.25
Test Pit 1 Sediment	J022L6	01/05/05	8700		6.8	4.7		0.61	11.7		0.67	236		0.09	0.41		0.02	29.6		0.66
Test Pit 2 Sediment	J022L7	01/05/05	5450		2.5	106		0.26	11		0.24	169		0.04	0.53		0.009	2.5		0.27

Sample Location	Sample Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1 Soil	J022L2	01/05/05	0.03	U	0.03	5860		2.9	9.5		0.08	4.1		0.07	11.2		0.14	0.21	U	0.21
Duplicate of J022L2	J022L3	01/05/05	0.03	U	0.03	6640		2.8	10.3		0.08	6.2		0.07	15.5		0.14	0.22	U	0.22
Test Pit 2 Soil	J022L4	01/05/05	0.03	U	0.03	5580		2.5	9		0.07	4.3		0.06	10.9		0.13	0.21	U	0.21
Equipment Blank	J022L5	01/05/05	0.02	U	0.02	19.9		2.3	0.11		0.07	0.06	U	0.06	0.92		0.13			
Test Pit 1 Sediment	J022H7*	01/05/05																0.35	U	0.35
Test Pit 2 Sediment	J022H8*	01/05/05																49.4		0.35
Test Pit 1 Sediment	J022L6	01/05/05	6.6		0.07	19500		6.1	201		0.17	3.9		0.15	5680		0.3			
Test Pit 2 Sediment	J022L7	01/05/05	1.8		0.03	3020		2.5	329		0.07	6.9		0.06	1100		0.13			

Sample Location	Sample Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1 Soil	J022L2	01/05/05	12300		2.9	2.6		0.23	3540		0.71	230		0.03	0.04		0.01	0.31		0.24
Duplicate of J022L2	J022L3	01/05/05	18600		2.8	6.3		0.2	3990		0.7	332		0.03	0.32		0.02	0.59		0.23
Test Pit 2 Soil	J022L4	01/05/05	12900		2.5	3.6		0.2	3430		0.62	223		0.03	0.01	U	0.01	0.46		0.21
Equipment Blank	J022L5	01/05/05	108		2.3	0.53		0.18	10.1		0.57	2.5		0.02	0.02	U	0.02	0.19	U	0.19
Test Pit 1 Sediment	J022L6	01/05/05	22000		6.1	434		0.48	6040		1.5	161		0.07	29.3		0.55	5		0.5
Test Pit 2 Sediment	J022L7	01/05/05	59400		5.1	13900		0.2	3350		0.63	318		0.03	18		0.25	2.4		0.21

*Only analyte was hexavalent chromium.

Table C-1. 100-F-26:13 Confirmatory Sampling Results. (4 Pages)

Sample Location	Sample Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1 Soil	J022L2	01/05/05	9.8		0.12	999		1.9	0.38	U	0.38	301		1.4	0.1	U	0.1	196		0.52
Duplicate of J022L2	J022L3	01/05/05	10.4		0.12	1310		1.9	0.37	U	0.37	505		1.4	0.1	U	0.1	214		0.52
Test Pit 2 Soil	J022L4	01/05/05	9.7		0.11	723		1.7	0.33	U	0.33	282		1.3	0.09	U	0.09	154		0.46
Equipment Blank	J022L5	01/05/05	0.1	U	0.1	19.6		1.6	0.31	U	0.31	40.2		1.2	0.08	U	0.08	5.8		0.42
Test Pit 1 Sediment	J022L6	01/05/05	29.2		0.26	2690		4.1	1.9		0.8	750		3	9.3		0.22	2330		1.1
Test Pit 2 Sediment	J022L7	01/05/05	38.1		0.11	930		1.7	2.5		0.34	185		1.3	5.3		0.09	332		0.47

Sample Location	Sample Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1 Soil	J022L2	01/05/05	28.3		0.07	26.1	C	0.13
Duplicate of J022L2	J022L3	01/05/05	46.8		0.07	56.7	C	0.13
Test Pit 2 Soil	J022L4	01/05/05	30.5		0.06	27.5	C	0.12
Equipment Blank	J022L5	01/05/05	0.06		0.06	1.1	C	0.11
Test Pit 1 Sediment	J022L6	01/05/05	48.5		0.15	1320	C	0.28
Test Pit 2 Sediment	J022L7	01/05/05	72		0.06	673	C	0.12

Table C-1. 100-F-26:13 Confirmatory Sampling Results. (4 Pages)

Constituent	J022L2 Test Pit 1 Soil Sample Date 01/05/05			J022L3 Duplicate of J022L2 Sample Date 01/05/05			J022L4 Test Pit 2 Soil Sample Date 01/05/05			J022L5 Equipment Blank Sample Date 01/05/05			J022L6 Test Pit 1 Sediment Sample Date 01/05/05			J022L7 Test Pit 2 Sediment Sample Date 01/05/05		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
PCBs (polychlorinated biphenyls)																		
Aroclor-1016	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	1700	U	1700
Aroclor-1221	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	1700	U	1700
Aroclor-1232	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	1700	U	1700
Aroclor-1242	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	1700	U	1700
Aroclor-1248	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	1700	U	1700
Aroclor-1254	34	U	34	36	U	36	35	U	35	33	U	33	11000		3800	1700	U	1700
Aroclor-1260	34	U	34	36	U	36	35	U	35	33	U	33	3800	U	3800	2900		1700

APPENDIX B

95% UCL CALCULATIONS AND VERIFICATION SAMPLING RESULTS

APPENDIX B

95% UCL CALCULATIONS AND VERIFICATION SAMPLING RESULTS

The calculation in this appendix is kept in the active Washington Closure Hanford project files and is available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

100-F-26:13 Subsite Cleanup Verification 95% UCL Calculations, 0100F-CA-V0324, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation that is provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-F Area Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0324

Subject: 100-F-26:13 Waste site Cleanup Verification 95% UCL Calculations

Computer Program: Excel Program No: Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 10 Attm. 1 = 7 Total = 18	E. J. Farris	S. W. Clark	J. M. Capron	S. W. Callison	11-19-07

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris **Date** 11/15/07 **Calc. No.** 0100F-CA-V0324 **Rev. No.** 0
Project Field Remediation **Job No.** 14655 **Checked** S. W. Clark **Date** 11/15/07
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 1 of 10

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the shallow zone excavation of the subject site. Also, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) 3-part test for nonradionuclide contaminants of concern (COCs) and contaminants of potential concern (COPCs) and calculate the relative percent difference (RPD) for primary-duplicate sample pairs, as necessary.

Table of Contents:

Given/References:
1) Sample Results (Attachment 1).
2) Background values and remedial action goals (RAGs) are from DOE-RL (2005b), DOE-RL (2001), and Ecology (2005).
3) DOE-RL, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
5) DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets),* Publication #92-54, Washington Department of Ecology, Olympia, Washington.
8) Ecology, 2005, *Cleanup Levels and Risk Calculations (CLARC) Database*, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
9) EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013. U.S. Environmental Protection Agency, Washington, D.C.
10) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

Solution:
Calculation methodology is described in Ecology publication #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2005b). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for primary-duplicate sample pairs, as required. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on data from soil verification samples (Attachment 1) from the subject waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005b) is documented by this calculation. In addition to the statistical soil samples collected at this site, nonstatistical data were collected, and the results are also included in Attachment 1. As the maximum detected values for these data sets are used instead of the 95% UCL (additional discussion is provided in the RSVP), calculations on these data sets are not included herein. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris Date 11/15/07 Calc. No. 0100F-CA-V0324 Rev. No. 0
Project Field Remediation Job No. 14655 Checked S. W. Clark Date 11/15/07
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations Sheet No. 2 of 10

Summary (continued)

Methodology:

For nonradioactive analytes with ≤50% of the data below detection limits and all detected radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set is used instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in Ecology (2005) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COCs/COPCs and are also not included in these calculations. The 95% UCL values were not calculated for radium-226, radium-228, thorium-228, thorium-232, and potassium-40, as these isotopes are excluded from consideration as COCs/COPCs based on natural occurrence and analogous site information.

All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets ($n < 10$) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing and calculation of the 95% UCL is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2005b) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.

The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed in Table II-1 of the SAP (DOE-RL 2005a). Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

$$RPD = [\,|M-S|/((M+S)/2)]*100$$

where, M = main sample value S = split (or duplicate) sample value

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for cleanup verification of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP, as necessary.

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris Date 11/15/07 Calc. No. 0100F-CA-V0324 Rev. No. 0
Project Field Remediation Job No. 14655 Checked S. W. Clark Date 11/15/07
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations Sheet No. 3 of 10

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations for the shallow zone excavation, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Results Summary - Shallow Zone Excavation

Analyte	Excavation Shallow Zone[a]	BCL Stockpiles[b]	Road Crossing[b]	Units
Arsenic	4.2	9.6	1.3	mg/kg
Barium	50.7	92.8	45.6	mg/kg
Beryllium	0.33	0.4	0.2	mg/kg
Boron	1.33	6.1	1.4	mg/kg
Chromium	9.0	11.6	6.9	mg/kg
Cobalt	5.2	6.4	4.6	mg/kg
Copper	11.1	12.1	10.8	mg/kg
Lead	11.0	29.6	5.2	mg/kg
Manganese	228	295	217	mg/kg
Nickel	9.0	10.2	8.3	mg/kg
Vanadium	33.3	39	22.3	mg/kg
Zinc	34.9	44.9	27.2	mg/kg
Molybdenum	0.46	0.52	0.48	mg/kg
Aroclor-1254	0.0081	0.038	-	mg/kg
Aroclor-1260	0.015	0.014	-	mg/kg
Carbon-14	3.3	-	-	pCi/g
Cesium-137	0.036	0.127	-	pCi/g
Strontium-90	2.010	-	-	pCi/g

WAC 173-340-740(7)(e) Evaluation:

WAC 173-340 3-Part Test for most stringent RAG:

95% UCL > Cleanup Limit?	YES
> 10% above Cleanup Limit?	YES
Any sample > 2x Cleanup Limit?	NO

Because of the "yes" answers to the WAC 173-340 3-part test for lead, additional evaluation of the attainment of cleanup criteria will be performed.

[a]The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.
[b]The maximum value

Relative Percent Difference Results[b] QA/QC Analysis

Analyte	Duplicate Analysis[c]
Aluminum	64.9%
Barium	53.5%
Calcium	50.3%
Chromium	69.2%
Copper	39.2%
Iron	64.3%
Magnesium	55.9%
Manganese	66.3%
Silicon	1.8%
Vanadium	77.3%
Zinc	57.5%
Potassium-40	9.0%
Radium-226	19.5%

[b]Relative percent difference evaluation was not required for analytes not included in this table.
[c]These values are discussed in the RSVP.

Abbreviations/Acronyms:
The following abbreviations and/or acronyms are used in this calculation:
B = blank contamination (organics)
BG = background
C = blank contamination (inorganics)
COC= contaminant of concern
COPC = contaminant of potential concern
GW = groundwater
J = estimate
MDA = minimal detectable activity
MTCA = *Model Toxics Control Act*
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
TDL = target detection limit
U = undetected
UCL = upper confidence limit
WAC = *Washington Administrative Code*

CALCULATION SHEET

Washington Closure Hanford
Originator E. J. Farris
Project Field Remediation
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/15/07
Job No. 14655

Calc. No. 0100F-CA-V0324
Checked S. W. Clark

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Shallow Zone Excavation Verification Data

Sample Area	Sample Number	Sample Date	Carbon-14 pCi/g	Carbon-14 Q	Carbon-14 MDA	Cesium-137 pCi/g	Cesium-137 Q	Cesium-137 MDA
6	J15753	7/19/2007	13.1		3.75	0.031	U	0.031
Duplicate of J15753	J15754	7/19/2007	0.000	U	3.17	0.046	U	0.046
1	J15748	7/19/2007	0.533	U	3.44	0.026	U	0.026
2	J15749	7/19/2007	9.12		3.19	0.039	U	0.039
3	J15750	7/19/2007	-0.230	U	3.39	0.036	U	0.036
4	J15751	7/19/2007	0.834	U	3.07	0.096	U	0.096
5	J15752	7/19/2007	-0.171	U	3.61	0.036		0.022
7	J15755	7/19/2007	-0.737	U	3.53	0.031	U	0.031
8	J15756	7/19/2007	-1.03	U	3.31	0.025	U	0.025
9	J15757	7/19/2007	0.122	U	3.15	0.038		0.024
10	J15758	7/19/2007	0.729	U	3.66	0.055		0.027

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Carbon-14 pCi/g			Cesium-137 pCi/g		
6	J15753/ J15754	7/19/2007	6.55			0.019		
1	J15748	7/19/2007	0.533			0.013		
2	J15749	7/19/2007	9.12			0.020		
3	J15750	7/19/2007	-0.230			0.018		
4	J15751	7/19/2007	0.834			0.048		
5	J15752	7/19/2007	-0.171			0.036		
7	J15755	7/19/2007	-0.737			0.016		
8	J15756	7/19/2007	-1.03			0.013		
9	J15757	7/19/2007	0.122			0.038		
10	J15758	7/19/2007	0.729			0.055		

Statistical Computations

	Carbon-14			Cesium-137		
95% UCL based on	Radionuclide data set. Use nonparametric z-stat.			Radionuclide data set. Use nonparametric z-stat.		
N	10			10		
% < Detection limit	80%			70%		
Mean	1.572			0.027		
Standard deviation	3.41			0.015		
95% UCL on mean	3.35			0.036		
Maximum detected value	13.1			0.055		
Background	NA			NA		
Statistical value above background	3.35			0.036		

Abreviation/Acronym definitions are given on Sheet No. 3

CALCULATION SHEET

Washington Closure Hanford
Originator E. J. Farris EJF
Project Field Remediation
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations

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Shallow Zone Excavation Verification Data

Sampling Area	Sample Number	Sample Date	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Boron mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL
6	J15753	7/19/2007	4.1		1.2	36.6	C	0.06	0.24		0.03	1.3		1.1	5.2		0.30	3.4		0.24
Duplicate of J15753	J15754	7/19/2007	5.5		1.2	63.3	C	0.06	0.40		0.03	1.5		1.1	10.7		0.30	5.7		0.24
1	J15748	7/19/2007	2.3		1.2	53.1	C	0.06	0.30		0.03	1.1		1.1	8.2		0.29	5.4		0.23
2	J15749	7/19/2007	2.4		1.2	36.5	C	0.06	0.23		0.03	1.0	U	1.0	6.5		0.29	4.1		0.23
3	J15750	7/19/2007	2.5		1.2	38.3	C	0.06	0.26		0.03	1.1	U	1.1	5.6		0.30	4.0		0.24
4	J15751	7/19/2007	4.8		1.2	49.1	C	0.06	0.29		0.03	1.1	U	1.1	7.3		0.29	4.3		0.23
5	J15752	7/19/2007	2.4		1.2	47.6	C	0.06	0.35		0.03	1.1		1.1	6.1		0.29	5.8		0.23
7	J15755	7/19/2007	5.0		1.2	40.0	C	0.06	0.27		0.03	1.0	U	1.0	7.5		0.29	4.2		0.23
8	J15756	7/19/2007	5.5		1.2	50.2	C	0.06	0.34		0.03	1.5		1.0	11.0		0.29	5.1		0.23
9	J15757	7/19/2007	2.7		1.2	43.8	C	0.06	0.30		0.03	1.5		1.0	9.6		0.29	4.6		0.23
10	J15758	7/19/2007	2.5		1.2	55.5	C	0.06	0.34		0.03	1.9		1.1	8.9		0.29	5.4		0.23

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Arsenic mg/kg			Barium mg/kg			Beryllium mg/kg			Boron mg/kg			Chromium mg/kg			Cobalt mg/kg		
6	J15753/ J15754	7/19/07	4.8			50.0			0.32			1.40			8.0			4.6		
1	J15748	7/19/07	2.3			53.1			0.30			1.1			8.2			5.4		
2	J15749	7/19/07	2.4			36.5			0.23			0.5			6.5			4.1		
3	J15750	7/19/07	2.5			38.3			0.26			0.6			5.6			4.0		
4	J15751	7/19/07	4.8			49.1			0.29			0.6			7.3			4.3		
5	J15752	7/19/07	2.4			47.6			0.35			1.1			6.1			5.8		
7	J15755	7/19/07	5.0			40.0			0.27			0.5			7.5			4.2		
8	J15756	7/19/07	5.5			50.2			0.34			1.5			11.0			5.1		
9	J15757	7/19/07	2.7			43.8			0.30			1.5			9.6			4.6		
10	J15758	7/19/07	2.5			55.5			0.34			1.9			8.9			5.4		

Statistical Computations

	Arsenic			Barium			Beryllium			Boron			Chromium			Cobalt		
95% UCL value based on	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.			Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.			Large data set (n ≥ 10), use MTCAStat lognormal distribution.		
N	10			10			10			10			10			10		
% < Detection limit	0%			0%			0%			40%			0%			0%		
Mean	3.5			46.4			0.30			1.06			7.9			4.7		
Standard deviation	1.3			6.5			0.04			0.51			1.7			0.6		
95% UCL on mean	4.2			50.7			0.33			1.33			9.0			5.2		
Maximum detected value	5.5			63.3			0.40			1.9			11.0			5.8		
Statistical value	4.2			50.7			0.33			1.33			9.0			5.2		
Most Stringent Cleanup Limit for nonradionuclide and RAG type	20	Direct Exposure/GW & River Protection		132	BG/GW Protection		1.51	BG/GW & River Protection		2	BG/GW & River Protection		18.5	BG/GW & River Protection		32	GW Protection	
WAC 173-340 3-PART TEST																		
95% UCL > Cleanup Limit?	NA			NA			NA			NA			NA			NA		
> 10% above Cleanup Limit?	NA			NA			NA			NA			NA			NA		
Any sample > 2X Cleanup Limit?	NA			NA			NA			NA			NA			NA		
WAC 173-340 Compliance? **Yes**	Because all values are below background (6.5 mg/kg), the WAC 173-340 3-part test is not required.			Because all values are below background (132 mg/kg), the WAC 173-340 3-part test is not required.			Because all values are below background (1.51 mg/kg), the WAC 173-340 3-part test is not required.			Because all values are below background (2 mg/kg), the WAC 173-340 3-part test is not required.			Because all values are below background (18.5 mg/kg), the WAC 173-340 3-part test is not required.			Because all values are below background (15.7 mg/kg), the WAC 173-340 3-part test is not required.		

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris EJF
Project Field Remediation
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations

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Checked S. W. Clark SWC

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Shallow Zone Excavation Verification Data (continued)

Sampling Area	Sample Number	Sample Date	Copper			Lead			Manganese			Molybdenum			Nickel			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
6	J15753	7/19/2007	8.0	C	0.27	11.1		0.98	139		0.21	0.53		0.47	6.7		0.8	16.2		0.24	22.2	C	0.12
Duplicate of	J15754	7/19/2007	11.9	C	0.27	16.7		0.98	277		0.21	0.65		0.47	10.0		0.8	36.6		0.24	40.1	C	0.12
1	J15748	7/19/2007	11.6	C	0.26	4.1		0.96	235		0.2	0.57		0.48	8.2		0.79	30.0		0.23	31.2	C	0.12
2	J15749	7/19/2007	9.4	C	0.26	4.4		0.96	204		0.2	0.48		0.46	8.9		0.79	21.9		0.23	25.2	C	0.12
3	J15750	7/19/2007	10.6	C	0.27	3.7		0.98	182		0.21	0.47		0.47	6.5		0.9	22.9		0.24	24.7	C	0.12
4	J15751	7/19/2007	10.5	C	0.26	7.6		0.95	201		0.2	0.53		0.48	8.0		0.78	23.4		0.23	29.9	C	0.12
5	J15752	7/19/2007	9.5	C	0.26	4.5		0.96	251		0.2	0.48	U	0.48	8.4		0.79	42.5		0.23	34.5	C	0.12
7	J15755	7/19/2007	10.6	C	0.26	18.9		0.95	187		0.2	0.46	U	0.46	7.9		0.78	26.1		0.23	27.7	C	0.12
8	J15756	7/19/2007	10.6	C	0.26	14.0		0.94	231		0.2	0.46	U	0.46	8.9		0.77	31.8		0.23	37.3	C	0.11
9	J15757	7/19/2007	10.4	C	0.26	5.6		0.95	202		0.2	0.46	U	0.46	9.1		0.78	31.8		0.23	32.9	C	0.12
10	J15758	7/19/2007	12.3	C	0.26	5.3		0.96	233		0.2	0.47	U	0.47	10.0		0.79	34.6		0.23	40.8	C	0.12

Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Copper mg/kg			Lead mg/kg			Manganese mg/kg			Molybdenum mg/kg			Nickel mg/kg			Vanadium mg/kg			Zinc mg/kg		
6	J15753/ J15754	7/19/07	10.0			13.9			208			0.59			8.4			26.4			31.2		
1	J15748	7/19/07	11.6			4.1			235			0.57			8.2			30.0			31.2		
2	J15749	7/19/07	9.4			4.4			204			0.48			8.9			21.9			25.2		
3	J15750	7/19/07	10.6			3.7			182			0.47			6.5			22.9			24.7		
4	J15751	7/19/07	10.5			7.6			201			0.53			8.0			23.4			29.9		
5	J15752	7/19/07	9.5			4.5			251			0.24			8.4			42.5			34.5		
7	J15755	7/19/07	10.6			18.9			187			0.23			7.9			26.1			27.7		
8	J15756	7/19/07	10.6			14.0			231			0.23			8.9			31.8			37.3		
9	J15757	7/19/07	10.4			5.6			202			0.23			9.1			31.8			32.9		
10	J15758	7/19/07	12.3			5.3			233			0.24			10.0			34.6			40.8		

Statistical Computations

	Copper	Lead	Manganese	Molybdenum	Nickel	Vanadium	Zinc
95% UCL value based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
N	10	10	10	10	10	10	10
% < Detection limit	0%	0%	0%	50%	0%	0%	0%
Mean	10.5	8.2	213	0.38	8.4	29.1	31.5
Standard deviation	0.9	5.4	22.8	0.16	0.9	6.4	5.1
95% UCL on mean	11.1	11.0	228	0.46	9.0	33.3	34.9
Maximum detected value	12.3	18.9	277	0.65	10.0	42.5	40.8
Statistical value	11.1	11.0	228	0.46	9.0	33.3	34.9
Most Stringent Cleanup Limit for nonradionuclide and RAG type	22.0 BG/River Protection	10.2 BG/GW & River Protection	512 BG/GW & River Protection	2 BG/GW & River Protection	19.1 BG/River Protection	85.1 BG/River Protection	67.8 BG/River Protection
WAC 173-340 3-PART TEST							
95% UCL > Cleanup Limit?	NA	YES	NA	NA	NA	NA	NA
> 10% above Cleanup Limit?	NA	YES	NA	NA	NA	NA	NA
Any sample > 2X Cleanup Limit?	NA	NO	NA	NA	NA	NA	NA
WAC 173-340 Compliance? Further Assessment Required	Because all values are below background (22.0 mg/kg), the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to direct exposure cleanup levels.	Because all values are below background (512 mg/kg), the WAC 173-340 3-part test is not required.	Because all values are below background (2 mg/kg), the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg), the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg), the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg), the WAC 173-340 3-part test is not required.

CALCULATION SHEET

Washington Closure Hanford
Originator E. J. Farris EJF
Project Field Remediation
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/15/07
Job No. 14655

Calc. No. 0100F-CA-V0324
Checked S. W. Clark SWC

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Sheet No. 7 of 10

Ecology Software (MTCAStat) Results

Arsenic 95% UCL Calculation

DATA	ID
4.8	J15753/ J15754
2.3	J15748
2.4	J15749
2.5	J15750
4.8	J15751
2.4	J15752
5	J15755
5.5	J15756
2.7	J15757
2.5	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	3.5
Censored		Lognormal mean	3.5
Detection limit or PQL		Std. devn.	1.3
Method detection limit		Median	2.6
TOTAL	10	Min.	2.3
		Max.	5.5

Lognormal distribution? Normal distribution?
r-squared is: 0.789 r-squared is: 0.781
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 4.2

Barium 95% UCL Calculation

DATA	ID
49.95	J15753/ J15754
53.1	J15748
36.5	J15749
38.3	J15750
49.1	J15751
47.6	J15752
40	J15755
50.2	J15756
43.8	J15757
55.5	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	46.4
Censored		Lognormal mean	46.5
Detection limit or PQL		Std. devn.	6.5
Method detection limit		Median	48.4
TOTAL	10	Min.	36.5
		Max.	55.5

Lognormal distribution? Normal distribution?
r-squared is: 0.943 r-squared is: 0.955
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 50.7

Beryllium 95% UCL Calculation

DATA	ID
0.32	J15753/ J15754
0.3	J15748
0.23	J15749
0.26	J15750
0.29	J15751
0.35	J15752
0.27	J15755
0.34	J15756
0.30	J15757
0.34	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	0.30
Censored		Lognormal mean	0.30
Detection limit or PQL		Std. devn.	0.04
Method detection limit		Median	0.30
TOTAL	10	Min.	0.23
		Max.	0.35

Lognormal distribution? Normal distribution?
r-squared is: 0.949 r-squared is: 0.963
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.33

Boron 95% UCL Calculation

DATA	ID
1.40	J15753/ J15754
1.1	J15748
0.5	J15749
0.55	J15750
0.55	J15751
1.1	J15752
0.5	J15755
1.5	J15756
1.50	J15757
1.9	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	1.1
Censored		Lognormal mean	1.1
Detection limit or PQL		Std. devn.	0.5
Method detection limit		Median	1.1
TOTAL	10	Min.	0.5
		Max.	1.9

Lognormal distribution? Normal distribution?
r-squared is: 0.871 r-squared is: 0.889
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1.3

Chromium 95% UCL Calculation

DATA	ID
8.0	J15753/ J15754
8.2	J15748
6.5	J15749
5.6	J15750
7.3	J15751
6.1	J15752
7.5	J15755
11	J15756
9.6	J15757
8.9	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	7.9
Censored		Lognormal mean	7.9
Detection limit or PQL		Std. devn.	1.7
Method detection limit		Median	7.7
TOTAL	10	Min.	5.6
		Max.	11.0

Lognormal distribution? Normal distribution?
r-squared is: 0.993 r-squared is: 0.976
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.0

Cobalt 95% UCL Calculation

DATA	ID
4.6	J15753/ J15754
5.4	J15748
4.1	J15749
4.0	J15750
4.3	J15751
5.8	J15752
4.2	J15755
5.1	J15756
4.6	J15757
5.4	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	4.8
Censored		Lognormal mean	4.8
Detection limit or PQL		Std. devn.	0.6
Method detection limit		Median	4.6
TOTAL	10	Min.	4.0
		Max.	5.8

Lognormal distribution? Normal distribution?
r-squared is: 0.939 r-squared is: 0.930
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 5.2

Copper 95% UCL Calculation

DATA	ID
10.0	J15753/ J15754
11.6	J15748
9.4	J15749
10.6	J15750
10.5	J15751
9.5	J15752
10.6	J15755
10.6	J15756
10.4	J15757
12.3	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	10.6
Censored		Lognormal mean	10.6
Detection limit or PQL		Std. devn.	0.9
Method detection limit		Median	10.6
TOTAL	10	Min.	9.4
		Max.	12.3

Lognormal distribution? Normal distribution?
r-squared is: 0.920 r-squared is: 0.907
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 11.1

Lead 95% UCL Calculation

DATA	ID
13.9	J15753/ J15754
4.1	J15748
4.4	J15749
3.7	J15750
7.6	J15751
4.5	J15752
18.9	J15755
14.0	J15756
5.6	J15757
5.3	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	8.2
Censored		Lognormal mean	8.3
Detection limit or PQL		Std. devn.	5.4
Method detection limit		Median	5.5
TOTAL	10	Min.	3.7
		Max.	18.9

Lognormal distribution? Normal distribution?
r-squared is: 0.878 r-squared is: 0.802
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 11.0

Manganese 95% UCL Calculation

DATA	ID
208	J15753/ J15754
235	J15748
204	J15749
182	J15750
201	J15751
251	J15752
187	J15755
231	J15756
202	J15757
233	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	213
Censored		Lognormal mean	214
Detection limit or PQL		Std. devn.	22.8
Method detection limit		Median	206
TOTAL	10	Min.	182
		Max.	251

Lognormal distribution? Normal distribution?
r-squared is: 0.949 r-squared is: 0.944
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 228

CALCULATION SHEET

Washington Closure Hanford
Originator E. J. Farris
Project Field Remediation
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations

Date 11/15/07
Job No. 14655

Calc. No. 0100F-CA-V0324
Checked S. W. Clark

Rev. No. 0
Date 11/15/07
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Ecology Software (MTCAStat) Results

Molybdenum 95% UCL Calculation

DATA	ID
0.59	J15753/ J15754
0.57	J15748
0.48	J15749
0.47	J15750
0.53	J15751
0.24	J15752
0.23	J15755
0	J15756
0.23	J15757
0.235	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	0.4
Censored		Lognormal mean	0.4
Detection limit or PQL		Std. devn.	0.2
Method detection limit		Median	0.3
TOTAL	10	Min.	0.2
		Max.	0.59

Lognormal distribution? Normal distribution?
r-squared is: 0.787 r-squared is: 0.809
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.5

Nickel 95% UCL Calculation

DATA	ID
8.35	J15753/ J15754
8.2	J15748
8.9	J15749
6.5	J15750
8	J15751
8.4	J15752
7.9	J15755
8.9	J15756
9.1	J15757
10	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	8.4
Censored		Lognormal mean	8.4
Detection limit or PQL		Std. devn.	0.9
Method detection limit		Median	8.4
TOTAL	10	Min.	6.5
		Max.	10

Lognormal distribution? Normal distribution?
r-squared is: 0.896 r-squared is: 0.923
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 9.0

Vanadium 95% UCL Calculation

DATA	ID
26.4	J15753/ J15754
30	J15748
21.9	J15749
22.9	J15750
23.4	J15751
42.5	J15752
26.1	J15755
31.8	J15756
31.8	J15757
34.6	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	29.1
Censored		Lognormal mean	29.2
Detection limit or PQL		Std. devn.	6.4
Method detection limit		Median	28.2
TOTAL	10	Min.	21.9
		Max.	42.5

Lognormal distribution? Normal distribution?
r-squared is: 0.955 r-squared is: 0.921
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 33.3

Zinc 95% UCL Calculation

DATA	ID
31.2	J15753/ J15754
31.2	J15748
25.2	J15749
24.7	J15750
29.9	J15751
34.5	J15752
27.7	J15755
37.3	J15756
32.9	J15757
40.8	J15758

Number of samples		Uncensored values	
Uncensored	10	Mean	31.6
Censored		Lognormal mean	31.6
Detection limit or PQL		Std. devn.	5.1
Method detection limit		Median	31.2
TOTAL	10	Min.	24.7
		Max.	40.8

Lognormal distribution? Normal distribution?
r-squared is: 0.981 r-squared is: 0.974
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (Land's method) is 34.9

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris EJF | Date 11/15/07 | Calc. No. 0100F-CA-V0324 | Rev. No. 0
Project Field Remediation | Job No. 14655 | Checked S. W. Clark SWC | Date 11/15/07
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations | Sheet No. 9 of 10

Duplicate Analysis

Sampling Area	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Calcium			Total Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
6	J15753	7/19/2007	3540	C	4.9	0.66	U	0.66	4.1		1.2	36.6	C	0.06	0.24		0.03	1.1	U	1.1	2440	C	2.1	5.2		0.3
Duplicate of J15753	J15754	7/19/2007	6940	C	4.9	0.65	U	0.65	5.5		1.2	63.3	C	0.06	0.4		0.03	1.1		1.1	4080	C	2.1	10.7		0.3

Analysis:

	TDL	5	0.6	10	2	0.5	2	100	1
Duplicate Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**	No-Stop (acceptable)		**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	*64.9%*			*53.5%*			*50.3%*	*69.2%*
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable

Sampling Area	HEIS Number	Sample Date	Cobalt			Copper			Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
10	J15F31	08/07/07	3.4		0.24	8	C	0.27	0.2	U	0.2	8570	C	7.1	11.1		0.98	2150	C	2.4	139		0.21	0.02	U	0.02
Duplicate of J15F31	J15F20	08/07/07	5.7		0.24	11.9	C	0.27	0.2	U	0.2	16700	C	7.1	16.7		0.98	3820	C	2.4	277		0.21	0.02	U	0.02

Analysis:

	TDL	2	1	0.5	5	5	75	5	5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	**Yes (calc RPD)**		**Yes (calc RPD)**	No-Stop (acceptable)	**Yes (calc RPD)**	**Yes (calc RPD)**	
	RPD		*39.2%*		*64.3%*		*55.9%*	*66.3%*	
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

Sampling Area	HEIS Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
10	J15F31	08/07/07	0.53		0.48	6.7		0.8	586	C	9.5	1.3	U	1.3	1100	C	2.6	0.27	U	0.27	113	C	2.1	16.2		0.24
Duplicate of J15F31	J15F20	08/07/07	0.48	U	0.48	10		0.8	1240	C	9.5	1.3	U	1.3	1120	C	2.6	0.27	U	0.27	150	C	2.1	36.6		0.24

Analysis:

	TDL	2	4	400	1	2	0.2	50	2.5
Duplicate Analysis	Both > PQL?	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?		No-Stop (acceptable)	No-Stop (acceptable)		**Yes (calc RPD)**		No-Stop (acceptable)	**Yes (calc RPD)**
	RPD					1.8%			*77.3%*
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable

CALCULATION SHEET

Washington Closure Hanford

Originator E. J. Farris EJF **Date** 11/15/07 **Calc. No.** 0100F-CA-V0324 **Rev. No.** 0
Project Field Remediation **Job No.** 14655 **Checked** S. W. Clark SWC **Date** 11/15/07
Subject 100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculations **Sheet No.** 10 of 10

Split/Duplicate Analysis

Sample Area	Sample Number	Sample Date	Zinc			Americium-241			Carbon-14			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
6	J15753	7/19/2007	22.2	C	0.12	0.099	U	0.099	13.1		3.75	0.031	U	0.031	0.033	U	0.033	0.089	U	0.089	0.118	U	0.118	0.086	U	0.086
Duplicate of J15753	J15754	7/19/2007	40.1	C	0.12	0.337	U	0.337	0	U	3.17	0.046	U	0.046	0.05	U	0.05	0.103	U	0.103	0.169	U	0.169	0.123	U	0.123

Analysis:

TDL		1	1	1	0.1	0.05	0.1	0.1	0.1
Duplicate Analysis	Both > MDA?	**Yes (continue)**	No - evaluate	No - evaluate	No - evaluate	No - evaluate	No - evaluate	No - evaluate	No - evaluate
	Both >5xTDL?	**Yes (calc RPD)**							
	RPD	*57.5%*							
	Difference >2xTDL?	Not applicable	No - acceptable	***Yes - assess***	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sample Area	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Thorium-228			Thorium-232			Uranium-235 GEA			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
6	J15753	7/19/2007	14.9		0.334	0.514		0.049	0.81		0.127	0.964		0.053	0.81		0.127	0.137	U	0.137	0.137	U	0.137
Duplicate of J15753	J15754	7/19/2007	16.3		0.484	0.625		0.077	0.72		0.194	0.777		0.054	0.72		0.194	0.192	U	0.192	0.192	U	0.192

Analysis:

TDL		0.5	0.1	0.2	1	1	0.5	1
Duplicate Analysis	Both > PQL/MDA?	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	**Yes (continue)**	No - evaluate	No - evaluate
	Both >5xTDL?	**Yes (calc RPD)**	**Yes (calc RPD)**	No - evaluate	No - evaluate	No - evaluate		
	RPD	9.0%	19.5%					
	Difference >2xTDL?	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable

-- = not reported
B* =estimate
C = method blank contamination
J = estimate
MDA = minimum detectable activity
N = spiked analyte recovery outside control limits
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

Attachment 1. 100-F-26:13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Americium-241			Americium-241 GEA			Barium-133			Carbon-14			Cesium-134		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007				0.085	U	0.085	0.036	U	0.036	0.533	U	3.44	0.036	U	0.036
2	J15749	7/19/2007				0.298	U	0.298	0.046	U	0.046	9.12		3.19	0.049	U	0.049
3	J15750	7/19/2007				0.044	U	0.044	0.038	U	0.038	-0.23	U	3.39	0.046	U	0.046
4	J15751	7/19/2007				0.045	U	0.045	0.056	U	0.056	0.834	U	3.07	0.032	U	0.032
5	J15752	7/19/2007	0.003	U	0.034	0.114	U	0.114	0.027	U	0.027	-0.171	U	3.61	0.03	U	0.03
6	J15753	7/19/2007				0.099	U	0.099	0.042	U	0.042	13.1		3.75	0.042	U	0.042
Duplicate of J15753	J15754	7/19/2007				0.337	U	0.337	0.052	U	0.052	0	U	3.17	0.051	U	0.051
7	J15755	7/19/2007				0.041	U	0.041	0.034	U	0.034	-0.737	U	3.53	0.042	U	0.042
8	J15756	7/19/2007				0.043	U	0.043	0.053	U	0.053	-1.03	U	3.31	0.033	U	0.033
9	J15757	7/19/2007				0.121	U	0.121	0.028	U	0.028	0.122	U	3.15	0.031	U	0.031
10	J15758	7/19/2007	0.016	U	0.024	0.092	U	0.092	0.037	U	0.037	0.729	U	3.66	0.037	U	0.037
BCL 1	J15759	7/19/2007				0.05	U	0.05	0.042	U	0.042	-0.585	U	3.17	0.051	U	0.051
BCL 2	J15760	7/19/2007				0.05	U	0.05	0.065	U	0.065	-0.358	U	3.36	0.037	U	0.037
BCL 3	J15761	7/19/2007				0.134	U	0.134	0.03	U	0.03	-0.677	U	3.18	0.032	U	0.032
BCL 4	J15762	7/19/2007				0.099	U	0.099	0.041	U	0.041	0.575	U	3.12	0.11	U	0.11
Equipment Blank	J15766	7/19/2007															
Road Cross 1	J15763	8/24/2007	0.253	U	0.253				0.066	U	0.066						
Road Cross 2	J15764	8/24/2007	0.308	U	0.308				0.077	U	0.077						
Road Cross 3	J15765	8/24/2007	0.062	U	0.062				0.05	U	0.05						
Road Cross BCL	J15F89	8/24/2007	0.266	U	0.266				0.067	U	0.067						

Sample Location	Sample Number	Sample Date	Cesium-137			Cobalt-60			Curium-242			Curium-243/244			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007	0.026	U	0.026	0.029	U	0.029							0.075	U	0.075
2	J15749	7/19/2007	0.039	U	0.039	0.039	U	0.039							0.094	U	0.094
3	J15750	7/19/2007	0.036	U	0.036	0.032	U	0.032							0.095	U	0.095
4	J15751	7/19/2007	0.096	U	0.096	0.028	U	0.028							0.086	U	0.086
5	J15752	7/19/2007	0.036		0.022	0.022	U	0.022	-0.004	U	0.034	0	U	0.034	0.058	U	0.058
6	J15753	7/19/2007	0.031	U	0.031	0.033	U	0.033							0.089	U	0.089
Duplicate of J15753	J15754	7/19/2007	0.046	U	0.046	0.05	U	0.05							0.103	U	0.103
7	J15755	7/19/2007	0.031	U	0.031	0.03	U	0.03							0.08	U	0.08
8	J15756	7/19/2007	0.025	U	0.025	0.027	U	0.027							0.071	U	0.071
9	J15757	7/19/2007	0.038		0.024	0.023	U	0.023							0.064	U	0.064
10	J15758	7/19/2007	0.055		0.027	0.031	U	0.031	0.011	U	0.028	-0.006	U	0.035	0.082	U	0.082
BCL 1	J15759	7/19/2007	0.039	U	0.039	0.041	U	0.041							0.105	U	0.105
BCL 2	J15760	7/19/2007	0.127		0.033	0.032	U	0.032							0.086	U	0.086
BCL 3	J15761	7/19/2007	0.105		0.027	0.025	U	0.025							0.118	U	0.118
BCL 4	J15762	7/19/2007	0.054		0.029	0.033	U	0.033							0.085	U	0.085
Equipment Blank	J15766	7/19/2007															
Road Cross 1	J15763	8/24/2007	0.06	U	0.06	0.058	U	0.058							0.163	U	0.163
Road Cross 2	J15764	8/24/2007	0.075	U	0.075	0.068	U	0.068							0.197	U	0.197
Road Cross 3	J15765	8/24/2007	0.055	U	0.055	0.051	U	0.051							0.127	U	0.127
Road Cross BCL	J15F89	8/24/2007	0.063	U	0.063	0.06	U	0.06							0.166	U	0.166

Note: The following abbreviations apply to all Attachment 1 tables. Data qualified with B, C, D, I, and/or J are considered acceptable values.

B = blank contamination (organics)
BCL = below cleanup level
C = blank contamination (inorganics)
D = diluted
GEA = gamma energy analysis
I = interference
J = estimated
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
U = undetected

Attachment	1	Sheet No.	1 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

Sample Location	Sample Number	Sample Date	Europium-154			Europium-155			Gross Alpha			Gross Beta			Neptunium-237		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007	0.099	U	0.099	0.072	U	0.072	15.1		9.39	17.6		6.34			
2	J15749	7/19/2007	0.155	U	0.155	0.114	U	0.114	14.5		8.32	13.9		9.28			
3	J15750	7/19/2007	0.12	U	0.12	0.08	U	0.08	11.2		7.42	14.6		6.47			
4	J15751	7/19/2007	0.096	U	0.096	0.069	U	0.069	9.02	U	9.22	31.5		6.32			
5	J15752	7/19/2007	0.073	U	0.073	0.123	U	0.123	20		6.08	38.5		5.68	0.072	U	0.108
6	J15753	7/19/2007	0.118	U	0.118	0.086	U	0.086	12.3		9.53	65.3		6.57			
Duplicate of	J15754	7/19/2007	0.169	U	0.169	0.123	U	0.123	14.4		9.26	17.6		8.84			
7	J15755	7/19/2007	0.107	U	0.107	0.074	U	0.074	7.19	U	9.7	116		8.7			
8	J15756	7/19/2007	0.095	U	0.095	0.065	U	0.065	17		8.78	21		5.43			
9	J15757	7/19/2007	0.082	U	0.082	0.072	U	0.072	10.7	U	12.9	19.9		6.06			
10	J15758	7/19/2007	0.103	U	0.103	0.078	U	0.078	36.4		8.94	24		9.37	0	U	0.154
BCL 1	J15759	7/19/2007	0.136	U	0.136	0.093	U	0.093	17.8		6.16	19.7		6.44			
BCL 2	J15760	7/19/2007	0.106	U	0.106	0.076	U	0.076	13.9		7.46	20		5.76			
BCL 3	J15761	7/19/2007	0.086	U	0.086	0.081	U	0.081	19.3		8.57	29.6		6.42			
BCL 4	J15762	7/19/2007	0.118	U	0.118	0.082	U	0.082	15.2		8.06	21.8		5.43			
Equipment Blank	J15766	7/19/2007															
Road Cross 1	J15763	8/24/2007	0.184	U	0.184	0.163	U	0.163	5.44	U	9.61	16.6		5.68			
Road Cross 2	J15764	8/24/2007	0.208	U	0.208	0.195	U	0.195	18.7		8.2	14.9		5.65			
Road Cross 3	J15765	8/24/2007	0.189	U	0.189	0.12	U	0.12	6.1	U	7.63	18.4		5.56			
Road Cross BCL	J15F89	8/24/2007	0.183	U	0.183	0.17	U	0.17	9.12		6.88	19.8		6.09			

Sample Location	Sample Number	Sample Date	Nickel-63			Plutonium-238			Plutonium-239/240			Potassium-40			Radium-226		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007										13.3		0.267	0.453		0.044
2	J15749	7/19/2007										14.6		0.429	0.493		0.074
3	J15750	7/19/2007										14.8		0.308	0.469		0.048
4	J15751	7/19/2007										15.9		0.244	0.534		0.055
5	J15752	7/19/2007	1.72	U	2.63							13		0.232	0.434		0.042
6	J15753	7/19/2007	1.07	U	2.89							14.9		0.334	0.514		0.049
Duplicate of	J15754	7/19/2007										16.3		0.484	0.625		0.077
7	J15755	7/19/2007	0.441	U	3.09							14		0.36	0.412		0.052
8	J15756	7/19/2007										15.2		0.217	0.464		0.042
9	J15757	7/19/2007										13.2		0.275	0.398		0.045
10	J15758	7/19/2007	0.305	U	2.85	0	U	0.194	0.126	U	0.194	13.6		0.291	0.436		0.052
BCL 1	J15759	7/19/2007										15.6		0.28	0.537		0.068
BCL 2	J15760	7/19/2007										14		0.273	0.506		0.061
BCL 3	J15761	7/19/2007										13.4		0.269	0.467		0.047
BCL 4	J15762	7/19/2007										14.9		0.314	0.493		0.053
Equipment Blank	J15766	7/19/2007															
Road Cross 1	J15763	8/24/2007										11.8		0.548	0.289		0.107
Road Cross 2	J15764	8/24/2007										10.3		0.608	0.289		0.151
Road Cross 3	J15765	8/24/2007										14.1		0.563	0.437		0.1
Road Cross BCL	J15F89	8/24/2007										9.52		0.419	0.322		0.132

Note: The following abbreviations apply to all Attachment 1 tables. Data qualified with B, C, D, I, and/or J are considered acceptable values.

B = blank contamination (organics)
BCL = below cleanup level
C = blank contamination (inorganics)
D = diluted
GEA = gamma energy analysis
I = interference
J = estimated
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
U = undetected

Attachment	1	Sheet No.	2 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

Sample Location	Sample Number	Sample Date	[illegible]			[illegible]			Technetium-99			Thorium-228 GEA			Thorium-232 GEA			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007	0.645		0.109	0.02	U	0.02				0.749		0.047	0.645		0.109			
2	J15749	7/19/2007	0.606		0.198	0.026	U	0.026				0.681		0.05	0.606		0.198			
3	J15750	7/19/2007	0.608		0.132	0.025	U	0.025				0.663		0.042	0.608		0.132			
4	J15751	7/19/2007	0.694		0.115	0.02	U	0.02				0.772		0.036	0.694		0.115	0.018	U	0.257
5	J15752	7/19/2007	0.615		0.083	0.015	U	0.015	0.155	U	0.519	0.594		0.031	0.615		0.083	0.113	U	0.226
6	J15753	7/19/2007	0.81		0.127	0.024	U	0.024	0.022	U	0.614	0.964		0.053	0.81		0.127	2.01		0.203
Duplicate of	J15754	7/19/2007	0.72		0.194	0.032	U	0.032				0.777		0.054	0.72		0.194			
7	J15755	7/19/2007	0.607		0.141	0.022	U	0.022	0.108	U	0.5	0.652		0.038	0.607		0.141	-0.024	U	0.233
8	J15756	7/19/2007	0.676		0.099	0.018	U	0.018				0.659		0.035	0.676		0.099			
9	J15757	7/19/2007	0.547		0.11	0.016	U	0.016				0.509		0.031	0.547		0.11			
10	J15758	7/19/2007	0.63		0.107	0.021	U	0.021				0.757		0.051	0.63		0.107			
BCL 1	J15759	7/19/2007	0.848		0.159	0.028	U	0.028				0.811		0.047	0.848		0.159			
BCL 2	J15760	7/19/2007	0.771		0.131	0.022	U	0.022				0.756		0.039	0.771		0.131			
BCL 3	J15761	7/19/2007	0.686		0.106	0.018	U	0.018				0.636		0.035	0.686		0.106			
BCL 4	J15762	7/19/2007	0.747		0.131	0.022	U	0.022				0.947		0.054	0.747		0.131			
Equipment Blank	J15766	7/19/2007																		
Road Cross 1	J15763	8/24/2007	0.438		0.254	0.045	U	0.045				0.331		0.085	0.438		0.254			
Road Cross 2	J15764	8/24/2007	0.531		0.289	0.055	U	0.055				0.37		0.095	0.531		0.289			
Road Cross 3	J15765	8/24/2007	0.454		0.195	0.037	U	0.037				0.49		0.098	0.454		0.195			
Road Cross BCL	J15F89	8/24/2007	0.516		0.254	0.045	U	0.045				0.573		0.08	0.516		0.254			

Sample Location	Sample Number	Sample Date	Tritium			Uranium-233/234			Uranium-235			Uranium-235 GEA			Uranium-238			Uranium-238 GEA		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
1	J15748	7/19/2007										0.114	U	0.114				0.114	U	0.114
2	J15749	7/19/2007										0.172	U	0.172				0.172	U	0.172
3	J15750	7/19/2007										0.133	U	0.133				0.133	U	0.133
4	J15751	7/19/2007										0.115	U	0.115				0.115	U	0.115
5	J15752	7/19/2007	-0.058	U	4.12	0.285		0.156	0	U	0.188	0.104	U	0.104	0	U	0.188	0.104	U	0.104
6	J15753	7/19/2007	1.56	U	4.58	0.655		0.179	0.085	U	0.217	0.137	U	0.137	0.085	U	0.217	0.137	U	0.137
Duplicate of	J15754	7/19/2007										0.192	U	0.192				0.192	U	0.192
7	J15755	7/19/2007	1.42	U	4.17	0.306		0.167	0	U	0.202	0.124	U	0.124	0	U	0.202	0.124	U	0.124
8	J15756	7/19/2007										0.109	U	0.109				0.109	U	0.109
9	J15757	7/19/2007										0.109	U	0.109				0.109	U	0.109
10	J15758	7/19/2007	0.303	U	4.27	0.562		0.159	0.025	U	0.193	0.176	U	0.176	0.025	U	0.193	0.176	U	0.176
BCL 1	J15759	7/19/2007										0.157	U	0.157				0.157	U	0.157
BCL 2	J15760	7/19/2007										0.126	U	0.126				0.126	U	0.126
BCL 3	J15761	7/19/2007										0.12	U	0.12				0.12	U	0.12
BCL 4	J15762	7/19/2007										0.132	U	0.132				0.132	U	0.132
Equipment Blank	J15766	7/19/2007																		
Road Cross 1	J15763	8/24/2007										0.246	U	0.246				0.246	U	0.246
Road Cross 2	J15764	8/24/2007										0.293	U	0.293				0.293	U	0.293
Road Cross 3	J15765	8/24/2007										0.191	U	0.191				0.191	U	0.191
Road Cross BCL	J15F89	8/24/2007										0.249	U	0.249				0.249	U	0.249

Note: The following abbreviations apply to all Attachment 1 tables. Data qualified with B, C, D, I, and/or J are considered acceptable values.

B = blank contamination (organics)
BCL = below cleanup level
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GEA = gamma energy analysis
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PQL = practical quantitation limit
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Attachment	1	Sheet No.	3 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

Attachment 1: 100-F-26:13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15748	7/19/2007	4720	C	4.8	0.64	U	0.64	2.3		1.2	53.1	C	0.06	0.3		0.03
2	J15749	7/19/2007	3900	C	4.8	0.64	U	0.64	2.4		1.2	36.5	C	0.06	0.23		0.03
3	J15750	7/19/2007	4020	C	4.9	0.65	U	0.65	2.5		1.2	38.3	C	0.06	0.26		0.03
4	J15751	7/19/2007	4700	C	4.8	0.64	U	0.64	4.8		1.2	49.1	C	0.06	0.29		0.03
5	J15752	7/19/2007	4330	C	4.8	0.64	U	0.64	2.4		1.2	47.6	C	0.06	0.35		0.03
6	J15753	7/19/2007	3540	C	4.9	0.66	U	0.66	4.1		1.2	36.6	C	0.06	0.24		0.03
Duplicate of J15753	J15754	7/19/2007	6940	C	4.9	0.65	U	0.65	5.5		1.2	63.3	C	0.06	0.4		0.03
7	J15755	7/19/2007	4580	C	4.8	0.64	U	0.64	5		1.2	40	C	0.06	0.27		0.03
8	J15756	7/19/2007	5500	C	4.7	0.63	U	0.63	5.5		1.2	50.2	C	0.06	0.34		0.03
9	J15757	7/19/2007	4610	C	4.8	0.63	U	0.63	2.7		1.2	43.8	C	0.06	0.3		0.03
10	J15758	7/19/2007	5160	C	4.8	0.64	U	0.64	2.5		1.2	55.5	C	0.06	0.34		0.03
BCL 1	J15759	7/19/2007	5600	C	4.8	0.64	U	0.64	2.5		1.2	52.6	C	0.06	0.33		0.03
BCL 2	J15760	7/19/2007	5470	C	4.9	0.65	U	0.65	2.7		1.2	92.8	C	0.06	0.4		0.03
BCL 3	J15761	7/19/2007	5670	C	4.8	0.65	U	0.65	5.7		1.2	74.2	C	0.06	0.37		0.03
BCL 4	J15762	7/19/2007	5760	C	4.8	0.64	U	0.64	9.6		1.2	60	C	0.06	0.32		0.03
Equipment Blank	J15766	7/19/2007	60.3	C	1.6	0.21	U	0.21	0.4	U	0.4	1.4	C	0.02	0.02		0.01
Road Cross 1	J15763	8/24/2007	3620	C	4.9	0.65	U	0.65	1.2	U	1.2	34	C	0.06	0.11		0.03
Road Cross 2	J15764	8/24/2007	3660	C	5	0.66	U	0.66	1.2	U	1.2	44.5	C	0.06	0.16		0.03
Road Cross 3	J15765	8/24/2007	3420	C	5	0.66	U	0.66	1.2	U	1.2	32.5	C	0.06	0.14		0.03
Road Cross BCL	J15F89	8/24/2007	4260	C	5.1	0.68	U	0.68	1.3		1.3	45.6	C	0.06	0.2		0.03

Sample Location	Sample Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15748	7/19/2007	1.3		1.1	0.15	U	0.15	5050	C	2.1	8.2		0.29	5.4		0.23
2	J15749	7/19/2007	1.5		1.1	0.15	U	0.15	2880	C	2.1	6.5		0.29	4.1		0.23
3	J15750	7/19/2007	1.1		1.1	0.15	U	0.15	3050	C	2.1	5.6		0.3	4		0.24
4	J15751	7/19/2007	1	U	1	0.14	U	0.14	2880	C	2.1	7.3		0.29	4.3		0.23
5	J15752	7/19/2007	1.1	U	1.1	0.15	U	0.15	4070	C	2.1	6.1		0.29	5.8		0.23
6	J15753	7/19/2007	1.1	U	1.1	0.15	U	0.15	2440	C	2.1	5.2		0.3	3.4		0.24
Duplicate of J15753	J15754	7/19/2007	1.1		1.1	0.15	U	0.15	4080	C	2.1	10.7		0.3	5.7		0.24
7	J15755	7/19/2007	1	U	1	0.14	U	0.14	3870	C	2.1	7.5		0.29	4.2		0.23
8	J15756	7/19/2007	1.5		1	0.14	U	0.14	4710	C	2	11		0.29	5.1		0.23
9	J15757	7/19/2007	1.5		1	0.14	U	0.14	4340	C	2	9.6		0.29	4.6		0.23
10	J15758	7/19/2007	1.9		1.1	0.15	U	0.15	5520	C	2.1	8.9		0.29	5.4		0.23
BCL 1	J15759	7/19/2007	1	U	1	0.15	U	0.15	4150	C	2.1	9.3		0.29	5.5		0.23
BCL 2	J15760	7/19/2007	6.1		1.1	0.15	U	0.15	5050	C	2.1	9.1		0.3	6.4		0.24
BCL 3	J15761	7/19/2007	2.3		1.1	0.15	U	0.15	5390	C	2.1	11.6		0.29	6.1		0.24
BCL 4	J15762	7/19/2007	1	U	1	0.15	U	0.15	4470	C	2.1	9.1		0.29	5		0.23
Equipment Blank	J15766	7/19/2007	0.35	U	0.35	0.05	U	0.05	24.7	C	0.69	0.16		0.1	0.08	U	0.08
Road Cross 1	J15763	8/24/2007	1.2	C	1.1	0.15	U	0.15	7980	C	2.1	6.9	C	0.3	3.7		0.24
Road Cross 2	J15764	8/24/2007	1.4	C	1.1	0.15	U	0.15	5740	C	2.1	6.1	C	0.3	4.3		0.24
Road Cross 3	J15765	8/24/2007	1.1	U	1.1	0.15	U	0.15	4500	C	2.1	5.6	C	0.3	3.3		0.24
Road Cross BCL	J15F89	8/24/2007	1.1	U	1.1	0.16	U	0.16	3650	C	2.2	6	C	0.31	4.6		0.25

Attachment	1	Sheet No.	4 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
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			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15748	7/19/2007	11.6	C	0.26	0.2	U	0.2	13400	C	7	4.1		0.96	3410	C	2.4
2	J15749	7/19/2007	9.4	C	0.26	0.2	U	0.2	9880	C	7	4.4		0.96	2610	C	2.4
3	J15750	7/19/2007	10.6	C	0.27	0.2	U	0.2	10500	C	7.1	3.7		0.98	2700	C	2.4
4	J15751	7/19/2007	10.5	C	0.26	0.2	U	0.2	11200	C	6.9	7.6		0.95	2920	C	2.3
5	J15752	7/19/2007	9.5	C	0.26	0.2	U	0.2	16700	C	7	4.5		0.96	3490	C	2.4
6	J15753	7/19/2007	8	C	0.27	0.2	U	0.2	8570	C	7.1	11.1		0.98	2150	C	2.4
Duplicate of J15753	J15754	7/19/2007	11.9	C	0.27	0.2	U	0.2	16700	C	7.1	16.7		0.98	3820	C	2.4
7	J15755	7/19/2007	10.6	C	0.26	0.2	U	0.2	11300	C	6.9	18.9		0.95	3040	C	2.3
8	J15756	7/19/2007	10.6	C	0.26	0.2	U	0.2	13700	C	6.8	14		0.94	3410	C	2.3
9	J15757	7/19/2007	10.4	C	0.26	0.2	U	0.2	12400	C	6.9	5.6		0.95	3340	C	2.3
10	J15758	7/19/2007	12.3	C	0.26	0.2	U	0.2	13900	C	7	5.3		0.96	3620	C	2.4
BCL 1	J15759	7/19/2007	12.1	C	0.26	0.2	U	0.2	14100	C	7	5.6		0.96	3720	C	2.4
BCL 2	J15760	7/19/2007	12.1	C	0.27	0.2	U	0.2	16600	C	7.1	7.5		0.98	3590	C	2.4
BCL 3	J15761	7/19/2007	12	C	0.26	0.2	U	0.2	16300	C	7	17.7		0.98	3590	C	2.4
BCL 4	J15762	7/19/2007	10.8	C	0.26	0.2	U	0.2	13200	C	7	29.6		0.96	3420	C	2.4
Equipment Blank	J15766	7/19/2007	0.15	C	0.09				101	C	2.3	0.32	U	0.32	8.2	C	0.79
Road Cross 1	J15763	8/24/2007	10.1		0.27	0.2	U	0.2	8870		7.1	2.4		0.98	3010	C	2.4
Road Cross 2	J15764	8/24/2007	9.8		0.27	0.21	U	0.21	9760		7.1	2.4		0.99	2800	C	2.4
Road Cross 3	J15765	8/24/2007	10.3		0.27	0.2	U	0.2	8300		7.1	2.2		0.99	2670	C	2.4
Road Cross BCL	J15F89	8/24/2007	10.8		0.28	0.21	U	0.21	10200		7.4	5.2		1	2820	C	2.5

Sample Location	Sample Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15748	7/19/2007	235		0.2	0.01	U	0.01	0.53		0.47	8.2		0.79	830	C	9.3
2	J15749	7/19/2007	204		0.2	0.02	U	0.02	0.65		0.47	8.9		0.79	656	C	9.3
3	J15750	7/19/2007	182		0.21	0.01	U	0.01	0.57		0.48	6.5		0.9	494	C	9.5
4	J15751	7/19/2007	201		0.2	0.02	U	0.02	0.48		0.46	8.0		0.78	869	C	9.3
5	J15752	7/19/2007	251		0.2	0.02	U	0.02	0.47		0.47	8.4		0.79	770	C	9.3
6	J15753	7/19/2007	139		0.21	0.02	U	0.02	0.53		0.48	6.7		0.8	586	C	9.5
Duplicate of J15753	J15754	7/19/2007	277		0.21	0.02	U	0.02	0.48	U	0.48	10		0.8	1240	C	9.5
7	J15755	7/19/2007	187		0.2	0.02	U	0.02	0.46	U	0.46	7.9		0.78	706	C	9.3
8	J15756	7/19/2007	231		0.2	0.01	U	0.01	0.46	U	0.46	8.9		0.77	880	C	9.1
9	J15757	7/19/2007	202		0.2	0.01	U	0.01	0.46	U	0.46	9.1		0.78	607	C	9.2
10	J15758	7/19/2007	233		0.2	0.02	U	0.02	0.47	U	0.47	10		0.79	761	C	9.3
BCL 1	J15759	7/19/2007	255		0.2	0.02	U	0.02	0.47	U	0.47	10.1		0.79	821	C	9.3
BCL 2	J15760	7/19/2007	295		0.21	0.01	U	0.01	0.48	U	0.48	9.7		0.8	1120	C	9.5
BCL 3	J15761	7/19/2007	261		0.21	0.01	U	0.01	0.52		0.47	9.8		0.79	942	C	9.4
BCL 4	J15762	7/19/2007	243		0.2	0.01	U	0.01	0.51		0.47	10.2		0.79	1080	C	9.3
Equipment Blank	J15766	7/19/2007	2.6		0.07	0.02	U	0.02	0.16		0.16	0.26	U	0.26	31.1	C	3.1
Road Cross 1	J15763	8/24/2007	195		0.21	0.01	U	0.01	0.47	U	0.47	8.3		0.8	553		9.5
Road Cross 2	J15764	8/24/2007	201		0.21	0.02	U	0.02	0.48		0.48	7.1		0.81	730		9.6
Road Cross 3	J15765	8/24/2007	170		0.21	0.02	U	0.02	0.48	U	0.48	7.2		0.81	445		9.6
Road Cross BCL	J15F89	8/24/2007	217		0.22	0.01	U	0.01	0.5	U	0.5	7.9		0.84	844		9.9

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Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

Attachment 1. 100-F-26:13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
1	J15748	7/19/2007	1.3	U	1.3	1490	C	2.5	0.26	U	0.26	173	C	2	30		0.23
2	J15749	7/19/2007	1.3	U	1.3	1110	C	2.5	0.26	U	0.26	91.7	C	2	21.9		0.23
3	J15750	7/19/2007	1.3	U	1.3	1360	C	2.6	0.27	U	0.27	110	C	2.1	22.9		0.24
4	J15751	7/19/2007	1.2	U	1.2	1560	C	2.5	0.26	U	0.26	98.4	C	2	23.4		0.23
5	J15752	7/19/2007	1.3	U	1.3	1790	C	2.5	0.26	U	0.26	133	C	2	42.5		0.23
6	J15753	7/19/2007	1.3	U	1.3	1100	C	2.6	0.27	U	0.27	113	C	2.1	16.2		0.24
Duplicate of J15753	J15754	7/19/2007	1.3	U	1.3	1120	C	2.6	0.27	U	0.27	150	C	2.1	36.6		0.24
7	J15755	7/19/2007	1.2	U	1.2	1270	C	2.5	0.26	U	0.26	107	C	2	26.1		0.23
8	J15756	7/19/2007	1.2	U	1.2	1110	C	2.5	0.26	U	0.26	175	C	2	31.8		0.23
9	J15757	7/19/2007	1.2	U	1.2	1070	C	2.5	0.26	U	0.26	122	C	2	31.8		0.23
10	J15758	7/19/2007	1.3	U	1.3	1150	C	2.5	0.26	U	0.26	159	C	2	34.6		0.23
BCL 1	J15759	7/19/2007	1.3	U	1.3	1220	C	2.5	0.26	U	0.26	126	C	2	32.5		0.23
BCL 2	J15760	7/19/2007	1.3	U	1.3	1410	C	2.6	0.27	U	0.27	143	C	2.1	38.4		0.24
BCL 3	J15761	7/19/2007	1.3	U	1.3	1100	C	2.5	0.26	U	0.26	199	C	2.1	39		0.24
BCL 4	J15762	7/19/2007	1.3	U	1.3	1400	C	2.5	0.26	U	0.26	112	C	2	26.7		0.23
Equipment Blank	J15766	7/19/2007	0.42	U	0.42	86.5	C	0.84	0.09	U	0.09	12.9	C	0.68	0.08	U	0.08
Road Cross 1	J15763	8/24/2007	1.3	U	1.3	1340	C	2.5	0.27	U	0.27	104	C	2.1	20		0.24
Road Cross 2	J15764	8/24/2007	1.3	U	1.3	1070	C	2.6	0.27	U	0.27	129	C	2.1	22.3		0.24
Road Cross 3	J15765	8/24/2007	1.3	U	1.3	858	C	2.6	0.27	U	0.27	141	C	2.1	19.4		0.24
Road Cross BCL	J15F89	8/24/2007	1.3	U	1.3	1480	C	2.7	0.28	U	0.28	103	C	2.2	21.7		0.25

Sample Location	Sample Number	Sample Date	Zinc		
			mg/kg	Q	PQL
1	J15748	7/19/2007	31.2	C	0.12
2	J15749	7/19/2007	25.2	C	0.12
3	J15750	7/19/2007	24.7	C	0.12
4	J15751	7/19/2007	29.9	C	0.12
5	J15752	7/19/2007	34.5	C	0.12
6	J15753	7/19/2007	22.2	C	0.12
Duplicate of J15753	J15754	7/19/2007	40.1	C	0.12
7	J15755	7/19/2007	27.7	C	0.12
8	J15756	7/19/2007	37.3	C	0.11
9	J15757	7/19/2007	32.9	C	0.12
10	J15758	7/19/2007	40.8	C	0.12
BCL 1	J15759	7/19/2007	34.3	C	0.12
BCL 2	J15760	7/19/2007	44.9	C	0.12
BCL 3	J15761	7/19/2007	44.8	C	0.12
BCL 4	J15762	7/19/2007	35	C	0.12
Equipment Blank	J15766	7/19/2007	4	C	0.04
Road Cross 1	J15763	8/24/2007	26.7	C	0.12
Road Cross 2	J15764	8/24/2007	26.3	C	0.12
Road Cross 3	J15765	8/24/2007	25.3	C	0.12
Road Cross BCL	J15F89	8/24/2007	27.2	C	0.12

Attachment	1	Sheet No.	6 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

Attachment 1. 100-F-26:13 Verification Sampling Results.

Sample Location	Sample Number	Sample Date	Aroclor-1016			Aroclor-1221			Aroclor-1232			Aroclor-1242			Aroclor-1248		
			µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
1	J15748	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
2	J15749	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
3	J15750	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
4	J15751	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
5	J15752	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
6	J15753	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Duplicate of J15753	J15754	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
7	J15755	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
8	J15756	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
9	J15757	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
10	J15758	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
BCL 1	J15759	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
BCL 2	J15760	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
BCL 3	J15761	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
BCL 4	J15762	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Equipment Blank	J15766	7/19/2007	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Road Cross 1	J15763	8/24/2007	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Road Cross 2	J15764	8/24/2007	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Road Cross 3	J15765	8/24/2007	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Road Cross BCL	J15F89	8/24/2007	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14

Sample Location	Sample Number	Sample Date	Aroclor-1254			Aroclor-1260		
			µg/kg	Q	PQL	µg/kg	Q	PQL
1	J15748	7/19/2007	13	U	13	13	U	13
2	J15749	7/19/2007	13	U	13	13	U	13
3.	J15750	7/19/2007	13	U	13	13	U	13
4	J15751	7/19/2007	13	U	13	13	U	13
5	J15752	7/19/2007	13	U	13	13	U	13
6	J15753	7/19/2007	13	U	13	13	U	13
Duplicate of J15753	J15754	7/19/2007	13	U	13	13	U	13
7	J15755	7/19/2007	13	U	13	13	U	13
8	J15756	7/19/2007	13	U	13	15		13
9	J15757	7/19/2007	8.1	J	13	13	U	13
10	J15758	7/19/2007	13	U	13	6.8	J	13
BCL 1	J15759	7/19/2007	13	U	13	13	U	13
BCL 2	J15760	7/19/2007	13	U	13	14		13
BCL 3	J15761	7/19/2007	38		13	13	U	13
BCL 4	J15762	7/19/2007	13	U	13	13	U	13
Equipment Blank	J15766	7/19/2007	13	U	13	13	U	13
Road Cross 1	J15763	8/24/2007	14	U	14	14	U	14
Road Cross 2	J15764	8/24/2007	14	U	14	14	U	14
Road Cross 3	J15765	8/24/2007	14	U	14	14	U	14
Road Cross BCL	J15F89	8/24/2007	14	U	14	14	U	14

Attachment	1	Sheet No.	7 of 7
Originator	E. J. Farris	Date	11/15/07
Checked	S. W. Clark	Date	11/15/07
Calc. No.	0100F-CA-V0324	Rev. No.	0

APPENDIX C

HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS

APPENDIX C

HAZARD QUOTIENT AND CARCINOGENICRISK CALCULATIONS

The calculation in this appendix is kept in the active Washington Closure Hanford project files and is available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

100-F-26:13 Subsite Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation, 0100F-CA-V0325, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

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CALCULATION COVER SHEET

Project Title: 100-F Area Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0325

Subject: 100-F-26:13 Waste site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3	E. J. Farris	S. W. Clark	N/A	S. W. Callison	11-19-07

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	E. J. Farris	Date:	11/15/07	Calc. No.:	0100F-CA-V0325	Rev.:	0
Project:	100-F Area Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	11/15/07
Subject:	100-F-26:13 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk for the 100-F-26:13 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

1) DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

3) WCH, 2007, *Remaining Sites Verification Package for the 100-F-26:13 108-F Drain Pipelines*, Attachment to Waste Site Reclassification Form 2005-011, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2005).

2) Sum the HQs and compare this value to the cumulative HQ of <1.0.

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2005).

4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of $<1 \times 10^{-5}$.

METHODOLOGY:

The 100-F-26:13 waste site was divided into three areas for the purpose of verification sampling. The first area consisted of the excavation footprint of the 108-F- pipeline, the second area consisted of the BCL stockpiles, and the third area consisted of the pipeline segment underlying the 100-F Area access

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	E. J. Farris	Date:	11/15/07	Calc. No.:	0100F-CA-V0325	Rev.:	0
Project:	100-F Area Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	11/15/07
Subject:	100-F-26:13 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 3

road (road-crossing area). Hazard quotient and carcinogenic risk calculations for the 100-F-26:13 waste site were conservatively calculated for the entire waste site using the highest of the focused and statistically calculated results from these three areas for each analyte (WCH 2007). Boron and molybdenum require the HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Aroclor-1254 and Aroclor-1260 are included because they were detected by laboratory analysis and cannot be attributed to natural occurrence. All other site nonradionuclide COCs were not detected or were quantified below background levels, with the exception of lead. Lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. As a result, the maximum lead concentration is reported but not included in the hazard quotient calculation. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 6.1 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (boron is identified as a noncarcinogen in WAC 173-340-740[3]), is 3.8×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criteria is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. The sum of the HQ values is 2.5×10^{-2}. Comparing this value to the requirement of <1.0, this criteria is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum value for Aroclor-1254 is 0.038 mg/kg; divided by 0.5 mg/kg, and multiplied as indicated, is 7.6×10^{-8}. Comparing this value and all other individual values to the requirement of $<1 \times 10^{-6}$, this criteria is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. The sum of the excess cancer risk values is 1.1×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None.

Table 1 shows the results of the calculations.

Washington Closure Hanford, Inc.		CALCULATION SHEET					
Originator:	E. J. Farris	Date:	11/15/07	Calc. No.:	0100F-CA-V0325	Rev.:	0
Project:	100-F Area Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	11/15/07
Subject:	100-F-26:13 Waste Site Cleanup Verification Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 3

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-F-26:13 Waste Site.

Contaminants of Potential Concern	Statistical or Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	6.1	16,000	3.8E-04	--	--
Molybdenum	0.52	400	1.3E-03	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.038	1.6	2.4E-02	0.5	7.6E-08
Aroclor-1260	0.015	--	--	0.5	3.0E-08
Totals					
Cumulative Hazard Quotient:			**2.5E-02**		
Cumulative Excess Cancer Risk:					**1.1E-07**

Notes:
[a] = From WCH (2007).
[b] = Value obtained from the RDR/RAWP (DOE-RL 2005) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-F-26:13 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).

APPENDIX D

RESRAD CALCULATIONS

APPENDIX D

RESRAD CALCULATIONS

The calculation in this appendix is kept in the active Washington Closure Hanford project files and is available upon request. When the project is completed, the file will be stored in a U.S. Department of Energy, Richland Operations Office, repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculation is provided in this appendix:

100-F-26:13 108-F- Drain Pipelines Cleanup Verification RESRAD Calculations, 0100F-CA-V0329, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation that is provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0329

Subject: 100-F-26:13 108-F Drain Pipelines Cleanup Verification RESRAD Calc Brief

Computer Program: RESRAD Program No: Version 6.3

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 4 pg Attm. 1 - 1 pg Attm. 2 - ~~20~~ pg 19 Attm. 3 - ~~21~~ pg 20 Attm. 4 - 10 pg Total – ~~57~~ pages 55 mc 4/28/07	S. W. Clark	H. M. Sulloway	N/A	S. W. Callison	11-27-07

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	11/15/07	Calc. No.:	0100F-CA-V0329	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	11/15/07
Subject:	100-F-26:13 108-F Drain Pipelines Cleanup Verification RESRAD Calculation Brief					Sheet No.	1 of 4

PURPOSE:

Calculate the soil and groundwater concentrations, dose, and risk contributions over a period of 1,000 years from the maximum activities of radionuclides in the overburden/below cleanup level soil to be used to backfill the 100-F-26:13 Main Process Sewer Pipeline excavation areas.

GIVEN/REFERENCES:

1) Cleanup verification data from *100-F-26:13 Waste Site Cleanup Verification 95% UCL Calculation*, Calculation No. 0100F-CA-V0324, Rev. 0, Washington Closure Hanford, Richland, Washington (100-F-26:13 95% UCL Calculation).
2) *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) For the purpose of these RESRAD calculations, the radioactive contaminants of concern (COCs) established in the 100-F-26:13 95% UCL Calculation are carbon-14, cesium-137, and strontium-90.
4) The nonradionuclide COCs include barium, hexavalent chromium, lead, and mercury. The full suite of nonradionuclide contaminants of potential concern (COPCs) and attainment of their remediation goals are discussed in the 100-F-26:13 95% UCL Calculation. All nonradionuclide direct exposure RAGs are met and protection of groundwater and the river can be demonstrated by the results of vertical migration modeling in the *100 Area Analogous Sites RESRAD Calculations*, 0100X-CA-V0050, Rev. 0, Bechtel Hanford, Inc., Richland, Washington, which predicts that the nonradionuclides will not migrate to groundwater (and thus the Columbia River) within 1,000 years.
5) RESidual RADioactivity (RESRAD) computer code, version 6.3, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.

SOLUTION:

1) A single RESRAD run was performed for the 100-F-26:13 108-F Sewer Pipeline Excavation soils that are to be used to backfill the 100-F-26:13 excavation. Table 1 shows the elevations (NAVD88) and thickness of each soil horizon. Attachment 1 shows representative dimensions of soil horizons and contaminant pathways considered for dose, risk, and groundwater protection. Input factors for each run are shown in the "Summary" section of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	11/15/07	Calc. No.:	0100F-CA-V0329	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	11/18/07
Subject:	100-F-26:13 108-F Drain Pipelines Cleanup Verification RESRAD Calculation Brief					Sheet No.	2 of 4

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	OB/BCL
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	9,600
Length Parallel to Aquifer Flow	m	40
Elevations of Vadose Zone Horizons		
Elevation: Surface	m	123.6
Elevation: Groundwater	m	114
Thickness: Contaminated Zone	m	4.6
Thickness: Unsaturated Zone	m	5.0

2) The year where the peak dose (or concentration) occurs from each individual radionuclide COC and layer is determined by a preliminary run. This year is then added for all horizons for the final RESRAD runs. For the direct exposure pathway (i.e. soil ingestion and inhalation and external radiation), the peak year occurred at year zero (year 2007) for all COCs. For the water pathways (i.e. drinking water and food ingestion) none of the COCs are predicted to reach groundwater within 1,000 years.

METHODOLOGY:

1) Runs of RESRAD version 6.3 were completed for the 100-F-26:13 108-F Drain Pipelines Excavation soils using the maximum radionuclide activities from the 100-F-26:13 95% UCL Calculation shown in Table 2. RESRAD numerical output reports for dose, risk, and concentration are presented in the Attachments to this calculation summary.

Table 2. Maximum Radionuclide Activities of the 100-F-26:13 108-F Drain Pipelines Excavation Soils (from the 100-F-26:13 95% UCL Calculation)

COCs	Excavation Soils
Radionuclide Activity (pCi/g)	
Carbon-14	5.1
Cesium-137	0.079
Strontium-90	0.563

COCs = Contaminants of Concern

RESULTS:

1) Radionuclide "All Pathways" Dose Rate

The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate from the radionuclides in the excavation soil is 12.2 mrem/yr at year zero (2007).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	11/15/07	Calc. No.:	0100F-CA-V0329	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sullaway	Date:	11/15/07
Subject:	100-F-26:13 108-F Drain Pipelines Cleanup Verification RESRAD Calculation Brief					Sheet No.	3 of 4

Table 3. All Pathways Dose Rate (mrem/yr)

RESRAD Run	Vadose Zone Horizons	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)								
		0	1	3	7	11	43	100	300	1000
Excavation	Shallow Zone	1.22E+01	8.00E+00	6.33E+00	5.67E+00	5.15E+00	2.37E+00	5.96E-01	4.69E-03	2.04E-10

2) Radionuclide Excess Lifetime Cancer Risk

The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the radionuclides in the 100-F-26:13 108-F Drain Pipelines excavation areas is 1.03×10^{-4} at year zero (2007).

Table 4. Radionuclide Excess Lifetime Cancer Risk

RESRAD Run	Vadose Zone Horizons	Excess Cancer Risk at Each Time Slice (yr)								
		0	1	3	7	11	43	100	300	1000
Excavation	Shallow Zone	1.03E-04	9.11E-05	8.37E-05	7.58E-05	6.88E-05	3.17E-05	7.97E-06	6.28E-08	2.74E-15

3) Radionuclide Groundwater Protection

The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 5. None of the radionuclide contaminants of concern are calculated to reach groundwater in the 1,000 years of the RESRAD model evaluation. Therefore calculation of organ specific dose via the groundwater (and river) pathway is not necessary to determine that the 4 mrem/yr drinking water dose limitation is met.

Table 5. Predicted Groundwater (Well Water/Drinking Water) Concentrations

Radio-nuclides	RESRAD Run	Groundwater Concentrations in pCi/L at Each Time Slice (yr)									RAGs, pCi/L
		0	1	3	7	11	43	100	300	1000	
C-14	Excavation	0	0	0	0	0	0	0	0	0	2,000
Cs-137	Excavation	0	0	0	0	0	0	0	0	0	60
Sr-90	Excavation	0	0	0	0	0	0	0	0	0	8

RAGs = Remedial action goals from the 100 Area RDR/RAWP

CONCLUSIONS:

- The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate from the radionuclides in the excavation soil is 12.2 mrem/yr at year zero (2007).
- The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the radionuclides in the 100-F-26:13 108-F Drain Pipelines excavation areas is 1.03×10^{-4} at year zero (2007).
- The dominant pathway for the RESRAD evaluations dose rate for the 100-F-26:13 108-F Drain Pipelines excavation areas soil is plant ingestion due to carbon-14.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	11/15/07	Calc. No.:	0100F-CA-V0329	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	11/15/07
Subject:	100-F-26:13 108-F Drain Pipelines Cleanup Verification RESRAD Calculation Brief					Sheet No.	4 of 4

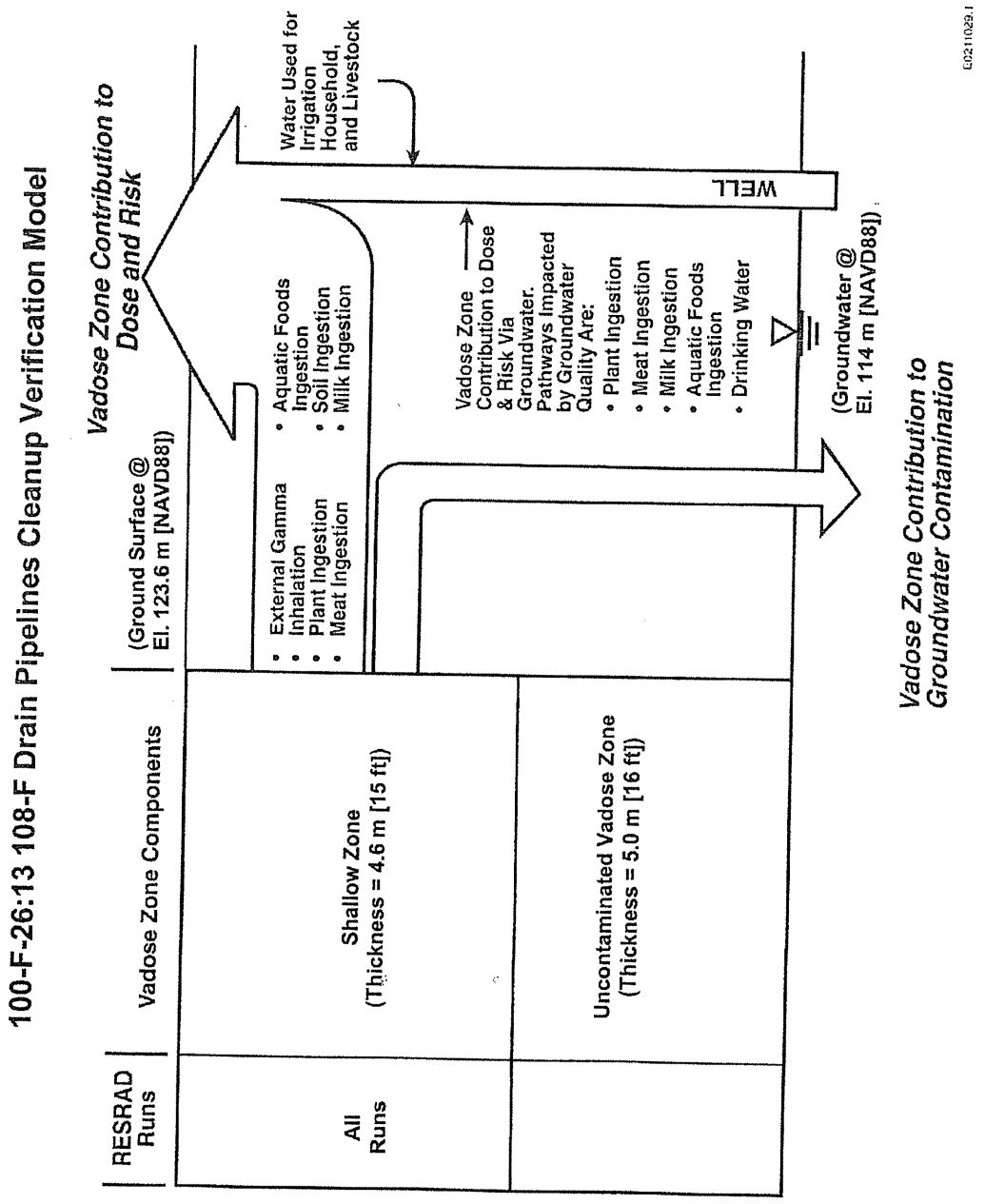
- None of the site COCs are projected to exceed remedial action goals (RAGs).

- The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 5. None of the radionuclide contaminants of concern are calculated to reach groundwater in the 1,000 years of the RESRAD model evaluation. Therefore calculation of organ specific dose via the groundwater (and river) pathway is not necessary to determine that the 4 mrem/yr drinking water dose limitation is met.

ATTACHMENTS:

1. Graphic showing 100-F-26:13 Cleanup Verification Model (1 page)
2. RESRAD Output: 100-F-26:13 Excavation Radionuclide Activities – Mixture Sums and Single Radionuclide Guidelines (20 pages)
3. RESRAD Output: 100-F-26:13 Excavation Radionuclide Activities – Intake Quantities and Health Risk Factors (21 pages)
4. RESRAD Output: 100-F-26:13 Excavation Radionuclide Activities – Concentration of Radionuclides, (10 pages)

ATTACHMENT 1



Attachment 1 Sheet No. 1 of 1
Originator: S. W. Clark Date 11/15/07
Chk'd By H. M. Sulloway Date 11/15/07
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Attachment 2 Sheet No. 1 of 19
Originator: S. W. Clark Date 11/15/07
Chk'd By H. M. Sulloway Date 11/15/07
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 2
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Dose Conversion Factor (and Related) Parameter Summary
File: HEAST 2001 MORBIDITY

Menu	Parameter	Current Value	Base Case*	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14	2.090E-06	2.090E-06	DCF2(1)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(2)
B-1	Sr-90+D	1.308E-03	1.300E-03	DCF2(3)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(2)
D-1	Sr-90+D	1.528E-04	1.420E-04	DCF3(3)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(2,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(2,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(3,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(3,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(2,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(2,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(3,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 2 Sheet No. 2 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 3
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	9.600E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.600E+00	2.000E+00	---	THICKO
R011	Length parallel to aquifer flow (m)	4.000E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	7.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.100E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	4.300E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	3.300E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Cs-137	3.600E-02	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Sr-90	2.010E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT

Attachment 2 Sheet No. 3 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 4
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	5.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	1.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.426E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.166E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Sr-90				
R016	Contaminated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	2.500E+01	3.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.323E-04	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.000E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS

Attachment 2 Sheet No. 4 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 5
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	1.970E+01	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.480E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.480E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI

Attachment 2 Sheet No. 5 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 6
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
C14	DCF correction factor for gaseous forms of C14	8.894E+01	0.000E+00	---	CO2F
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV

Attachment 2 Sheet No. 6 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 7
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	active
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Attachment 2 Sheet No. 7 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

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1RESRAD, Version 6.3      T« Limit = 180 days       11/15/2007  11:42  Page   8
 Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
 File    : 100-F-26-13_Excavation.RAD

      Contaminated Zone Dimensions           Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ           ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:   9600.00 square meters              C-14        3.300E+00
   Thickness:      4.60 meters                     Cs-137      3.600E-02
 Cover Depth:      0.00 meters                     Sr-90       2.010E+00
0
                                            Total Dose TDOSE(t), mrem/yr
                                      Basic Radiation Dose Limit = 1.500E+01 mrem/yr
                     Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
                     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  3.000E+00  7.000E+00  1.100E+01  4.300E+01  1.000E+02  3.000E+02  1.000E+03
     TDOSE(t):  1.224E+01  8.000E+00  6.327E+00  5.670E+00  5.146E+00  2.371E+00  5.960E-01  4.692E-03  2.043E-10
         M(t):  8.161E-01  5.333E-01  4.218E-01  3.780E-01  3.431E-01  1.580E-01  3.973E-02  3.128E-04  1.362E-11
0Maximum TDOSE(t):  1.224E+01 mrem/yr    at t = 0.000E+00 years
```

Attachment 2 Sheet No. 8 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 9
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	2.958E-05	0.0000	1.097E-03	0.0001	0.000E+00	0.0000	4.123E+00	0.3368	7.731E-01	0.0632	6.263E-01	0.0512	4.028E-04	0.0000
Cs-137	7.808E-02	0.0064	4.618E-08	0.0000	0.000E+00	0.0000	4.057E-03	0.0003	3.005E-03	0.0002	1.866E-03	0.0002	1.051E-04	0.0000
Sr-90	3.157E-02	0.0026	1.058E-04	0.0000	0.000E+00	0.0000	5.192E+00	0.4241	8.874E-01	0.0725	5.012E-01	0.0409	1.794E-02	0.0015
Total	1.097E-01	0.0090	1.202E-03	0.0001	0.000E+00	0.0000	9.319E+00	0.7613	1.663E+00	0.1359	1.129E+00	0.0923	1.844E-02	0.0015

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.524E+00	0.4513
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.711E-02	0.0071
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.630E+00	0.5416
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.224E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 9 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 10
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	6.986E-06	0.0000	2.590E-04	0.0000	0.000E+00	0.0000	1.029E+00	0.1287	2.361E-01	0.0295	1.774E-01	0.0222	9.514E-05	0.0000
Cs-137	7.628E-02	0.0095	4.511E-08	0.0000	0.000E+00	0.0000	3.964E-03	0.0005	2.936E-03	0.0004	1.823E-03	0.0002	1.027E-04	0.0000
Sr-90	3.082E-02	0.0039	1.032E-04	0.0000	0.000E+00	0.0000	5.068E+00	0.6335	8.662E-01	0.1083	4.893E-01	0.0612	1.751E-02	0.0022
Total	1.071E-01	0.0134	3.623E-04	0.0000	0.000E+00	0.0000	6.101E+00	0.7626	1.105E+00	0.1382	6.684E-01	0.0836	1.770E-02	0.0022

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.443E+00	0.1804
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.510E-02	0.0106
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.472E+00	0.8090
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.000E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 10 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 11
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	3.890E-07	0.0000	1.442E-05	0.0000	0.000E+00	0.0000	5.732E-02	0.0091	1.315E-02	0.0021	9.877E-03	0.0016	5.297E-06	0.0000
Cs-137	7.280E-02	0.0115	4.306E-08	0.0000	0.000E+00	0.0000	3.783E-03	0.0006	2.802E-03	0.0004	1.740E-03	0.0003	9.802E-05	0.0000
Sr-90	2.936E-02	0.0046	9.834E-05	0.0000	0.000E+00	0.0000	4.828E+00	0.7631	8.252E-01	0.1304	4.661E-01	0.0737	1.668E-02	0.0026
Total	1.022E-01	0.0161	1.128E-04	0.0000	0.000E+00	0.0000	4.889E+00	0.7727	8.412E-01	0.1329	4.777E-01	0.0755	1.678E-02	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.036E-02	0.0127
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.123E-02	0.0128
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.165E+00	0.9745
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.327E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 11 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 12
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	1.197E-09	0.0000	4.438E-08	0.0000	0.000E+00	0.0000	1.764E-04	0.0000	4.048E-05	0.0000	3.040E-05	0.0000	1.630E-08	0.0000
Cs-137	6.632E-02	0.0117	3.922E-08	0.0000	0.000E+00	0.0000	3.446E-03	0.0006	2.552E-03	0.0005	1.585E-03	0.0003	8.929E-05	0.0000
Sr-90	2.665E-02	0.0047	8.925E-05	0.0000	0.000E+00	0.0000	4.382E+00	0.7728	7.490E-01	0.1321	4.230E-01	0.0746	1.514E-02	0.0027
Total	9.297E-02	0.0164	8.933E-05	0.0000	0.000E+00	0.0000	4.386E+00	0.7735	7.516E-01	0.1325	4.247E-01	0.0749	1.523E-02	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 7.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.473E-04	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.399E-02	0.0130
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.596E+00	0.9869
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.670E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 12 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.3      T« Limit = 180 days        11/15/2007  11:42  Page  13
 Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
 File    : 100-F-26-13_Excavation.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                As mrem/yr and Fraction of Total Dose At t = 1.100E+01 years
0                                  Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon           Plant           Meat            Milk            Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
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 C-14    3.647E-12 0.0000  1.352E-10 0.0000  0.000E+00 0.0000  5.374E-07 0.0000  1.234E-07 0.0000  9.265E-08 0.0000  4.966E-11 0.0000
 Cs-137  6.041E-02 0.0117  3.573E-08 0.0000  0.000E+00 0.0000  3.139E-03 0.0006  2.325E-03 0.0005  1.444E-03 0.0003  8.133E-05 0.0000
 Sr-90   2.418E-02 0.0047  8.100E-05 0.0000  0.000E+00 0.0000  3.977E+00 0.7728  6.798E-01 0.1321  3.840E-01 0.0746  1.374E-02 0.0027
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 Total   8.460E-02 0.0164  8.104E-05 0.0000  0.000E+00 0.0000  3.980E+00 0.7734  6.821E-01 0.1325  3.854E-01 0.0749  1.382E-02 0.0027
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                As mrem/yr and Fraction of Total Dose At t = 1.100E+01 years
0                                  Water Dependent Pathways
0             Water            Fish            Radon           Plant           Meat            Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 C-14    0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  7.536E-07 0.0000
 Cs-137  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  6.740E-02 0.0131
 Sr-90   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.079E+00 0.9869
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  5.146E+00 1.0000
0*Sum of all water independent and dependent pathways.
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Attachment 2 Sheet No. 13 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 14
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.300E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.767E-27	0.0000	6.369E-28	0.0000	4.779E-28	0.0000	0.000E+00	0.0000
Cs-137	2.864E-02	0.0121	1.694E-08	0.0000	0.000E+00	0.0000	1.488E-03	0.0006	1.102E-03	0.0005	6.847E-04	0.0003	3.856E-05	0.0000
Sr-90	1.114E-02	0.0047	3.730E-05	0.0000	0.000E+00	0.0000	1.831E+00	0.7725	3.130E-01	0.1320	1.768E-01	0.0746	6.326E-03	0.0027
Total	3.978E-02	0.0168	3.732E-05	0.0000	0.000E+00	0.0000	1.833E+00	0.7731	3.141E-01	0.1325	1.775E-01	0.0749	6.365E-03	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 4.300E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.882E-27	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.196E-02	0.0135
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.339E+00	0.9865
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.371E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 14 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 15
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	7.580E-03	0.0127	4.483E-09	0.0000	0.000E+00	0.0000	3.939E-04	0.0007	2.917E-04	0.0005	1.812E-04	0.0003	1.021E-05	0.0000
Sr-90	2.798E-03	0.0047	9.370E-06	0.0000	0.000E+00	0.0000	4.601E-01	0.7720	7.863E-02	0.1319	4.442E-02	0.0745	1.589E-03	0.0027
Total	1.038E-02	0.0174	9.375E-06	0.0000	0.000E+00	0.0000	4.605E-01	0.7726	7.893E-02	0.1324	4.460E-02	0.0748	1.599E-03	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.457E-03	0.0142
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.875E-01	0.9858
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.960E-01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 15 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 16
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	7.145E-05	0.0152	4.226E-11	0.0000	0.000E+00	0.0000	3.713E-06	0.0008	2.750E-06	0.0006	1.708E-06	0.0004	9.620E-08	0.0000
Sr-90	2.197E-05	0.0047	7.357E-08	0.0000	0.000E+00	0.0000	3.612E-03	0.7698	6.174E-04	0.1316	3.487E-04	0.0743	1.248E-05	0.0027
Total	9.342E-05	0.0199	7.361E-08	0.0000	0.000E+00	0.0000	3.616E-03	0.7706	6.201E-04	0.1322	3.504E-04	0.0747	1.257E-05	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.972E-05	0.0170
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.613E-03	0.9830
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.692E-03	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 16 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 17
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	5.809E-12	0.0284	3.436E-18	0.0000	0.000E+00	0.0000	3.019E-13	0.0015	2.236E-13	0.0011	1.389E-13	0.0007	7.821E-15	0.0000
Sr-90	9.420E-13	0.0046	3.155E-15	0.0000	0.000E+00	0.0000	1.549E-10	0.7582	2.648E-11	0.1296	1.495E-11	0.0732	5.351E-13	0.0026
Total	6.751E-12	0.0330	3.158E-15	0.0000	0.000E+00	0.0000	1.552E-10	0.7597	2.670E-11	0.1307	1.509E-11	0.0739	5.429E-13	0.0027

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.481E-12	0.0317
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.978E-10	0.9683
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.043E-10	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 17 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 18
Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.100E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.674E+00	4.373E-01	2.435E-02	7.495E-05	2.284E-07	1.177E-27	0.000E+00	0.000E+00	0.000E+00
0Cs-137+D	Cs-137+D	1.000E+00	2.420E+00	2.364E+00	2.256E+00	2.055E+00	1.872E+00	8.877E-01	2.349E-01	2.214E-03	1.800E-10
0Sr-90+D	Sr-90+D	1.000E+00	3.299E+00	3.220E+00	3.067E+00	2.784E+00	2.527E+00	1.163E+00	2.923E-01	2.295E-03	9.841E-11

The DSR includes contributions from associated (half-life ó 180 days) daughters.

0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.100E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
C-14	8.961E+00	3.430E+01	6.160E+02	2.001E+05	6.568E+07	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
Cs-137	6.199E+00	6.345E+00	6.648E+00	7.298E+00	8.012E+00	1.690E+01	6.385E+01	6.774E+03	8.332E+10
Sr-90	4.547E+00	4.659E+00	4.890E+00	5.388E+00	5.936E+00	1.289E+01	5.132E+01	6.536E+03	1.524E+11

*At specific activity limit

0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	3.300E+00	0.000E+00	1.674E+00	8.961E+00	1.674E+00	8.961E+00
Cs-137	3.600E-02	0.000E+00	2.420E+00	6.199E+00	2.420E+00	6.199E+00
Sr-90	2.010E+00	0.000E+00	3.299E+00	4.547E+00	3.299E+00	4.547E+00

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Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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1RESRAD, Version 6.3      T« Limit = 180 days        11/15/2007  11:42  Page  19
 Summary : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
 File    : 100-F-26-13_Excavation.RAD

                                  Individual Nuclide Dose Summed Over All Pathways
                                    Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   THF(i)                                          DOSE(j,t), mrem/yr
   (j)     (i)             t= 0.000E+00 1.000E+00 3.000E+00 7.000E+00 1.100E+01 4.300E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 C-14    C-14    1.000E+00    5.524E+00 1.443E+00 8.036E-02 2.473E-04 7.536E-07 3.882E-27 0.000E+00 0.000E+00 0.000E+00
OCs-137  Cs-137  1.000E+00    8.711E-02 8.510E-02 8.123E-02 7.399E-02 6.740E-02 3.196E-02 8.457E-03 7.972E-05 6.481E-12
OSr-90   Sr-90   1.000E+00    6.630E+00 6.472E+00 6.165E+00 5.596E+00 5.079E+00 2.339E+00 5.875E-01 4.613E-03 1.978E-10
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.


                                     Individual Nuclide Soil Concentration
                                    Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   THF(i)                                            S(j,t), pCi/g
   (j)     (i)             t= 0.000E+00 1.000E+00 3.000E+00 7.000E+00 1.100E+01 4.300E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 C-14    C-14    1.000E+00    3.300E+00 7.794E-01 4.340E-02 1.336E-04 4.069E-07 2.093E-27 0.000E+00 0.000E+00 0.000E+00
OCs-137  Cs-137  1.000E+00    3.600E-02 3.517E-02 3.357E-02 3.058E-02 2.785E-02 1.321E-02 3.495E-03 3.294E-05 2.678E-12
OSr-90   Sr-90   1.000E+00    2.010E+00 1.962E+00 1.869E+00 1.696E+00 1.540E+00 7.089E-01 1.781E-01 1.398E-03 5.997E-11
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ   ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.
ORESCALC.EXE execution time =    9.69 seconds
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Attachment 2 Sheet No. 19 of 19
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
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ATTACHMENT 3

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1RESRAD, Version 6.3      T« Limit = 180 days        11/15/2007  11:42  Page   1
 Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
 File    : 100-F-26-13_Excavation.RAD

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                    ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
   Part III: Intake Quantities and Health Risk Factors
   ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Cancer Risk Slope Factors ..............................   2
 Risk Slope and ETFG for the Ground Pathway ..............   2
 Amount of Intake Quantities and Excess Cancer Risks
      Time= 0.000E+00 ...................................   3
      Time= 1.000E+00 ...................................   5
      Time= 3.000E+00 ...................................   7
      Time= 7.000E+00 ...................................   9
      Time= 1.100E+01 ...................................  11
      Time= 4.300E+01 ...................................  13
      Time= 1.000E+02 ...................................  15
      Time= 3.000E+02 ...................................  17
      Time= 1.000E+03 ...................................  19
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Attachment 3 Sheet No. 1 of 20
Originator: S. W. Clark Date 11/15/07
Chk'd By H. M. Sulloway Date 11/15/07
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1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 2
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Cancer Risk Slope Factors Summary Table
Risk Library: HEAST 2001 Morbidity

Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	C-14	7.83E-12	7.83E-12	SLPF(1,1)
Sf-1	Cs-137+D	2.55E-06	5.32E-10	SLPF(2,1)
Sf-1	Sr-90+D	1.96E-08	4.82E-10	SLPF(3,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	C-14	7.07E-12	7.07E-12	SLPF(1,2)
Sf-2	Cs-137+D	1.19E-11	1.19E-11	SLPF(2,2)
Sf-2	Sr-90+D	1.13E-10	1.05E-10	SLPF(3,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	C-14	2.00E-12	2.00E-12	SLPF(1,3)
Sf-3	Cs-137+D	3.74E-11	3.74E-11	SLPF(2,3)
Sf-3	Sr-90+D	9.53E-11	6.88E-11	SLPF(3,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	C-14	1.55E-12	1.55E-12	SLPF(1,4)
Sf-3	Cs-137+D	3.04E-11	3.04E-11	SLPF(2,4)
Sf-3	Sr-90+D	7.40E-11	5.59E-11	SLPF(3,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	C-14	2.79E-12	2.79E-12	SLPF(1,5)
Sf-3	Cs-137+D	4.33E-11	4.33E-11	SLPF(2,5)
Sf-3	Sr-90+D	1.44E-10	9.18E-11	SLPF(3,5)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Risk Slope and Environmental Transport Factors for the Ground Pathway

Nuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless) t= 0.000E+00	1.000E+00	3.000E+00	7.000E+00	1.100E+01	4.300E+01	1.000E+02	3.000E+02	1.000E+03
Ba-137m	2.690E-06	6.358E-01	6.358E-01	6.358E-01	6.358E-01	6.358E-01	6.358E-01	6.358E-01	6.358E-01	6.358E-01
C-14	7.830E-12	6.664E-01	6.664E-01	6.664E-01	6.664E-01	6.664E-01	6.664E-01	6.664E-01	6.664E-01	6.664E-01
Cs-137	5.320E-10	6.456E-01	6.456E-01	6.456E-01	6.456E-01	6.456E-01	6.456E-01	6.456E-01	6.456E-01	6.456E-01
Sr-90	4.820E-10	6.468E-01	6.468E-01	6.468E-01	6.468E-01	6.468E-01	6.468E-01	6.468E-01	6.468E-01	6.468E-01
Y-90	1.910E-08	6.379E-01	6.379E-01	6.379E-01	6.379E-01	6.379E-01	6.379E-01	6.379E-01	6.379E-01	6.379E-01

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Attachment 3 Sheet No. 2 of 20
Originator: S. W. Clark Date
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ATTACHMENT 3

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Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
C-14	5.247E+02	1.973E+06	3.699E+05	2.997E+05	1.927E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.643E+06
Cs-137	1.448E-03	8.115E+01	6.010E+01	3.733E+01	2.102E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.807E+02
Sr-90	8.082E-02	3.398E+04	5.807E+03	3.280E+03	1.174E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.318E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	4.305E-11	0.0000	9.274E-09	0.0001	9.865E-06	0.0958	1.850E-06	0.0180	1.498E-06	0.0145	1.344E-09	0.0000
Cs-137	1.257E-06	0.0122	3.717E-13	0.0000	6.549E-08	0.0006	4.850E-08	0.0005	3.013E-08	0.0003	1.964E-09	0.0000
Sr-90	5.355E-07	0.0052	1.954E-10	0.0000	6.904E-05	0.6701	1.180E-05	0.1145	6.665E-06	0.0647	3.611E-07	0.0035
Total	1.793E-06	0.0174	9.470E-09	0.0001	7.897E-05	0.7665	1.370E-05	0.1330	8.194E-06	0.0795	3.644E-07	0.0035

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.322E-05	0.1284
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.403E-06	0.0136
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.840E-05	0.8580
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.030E-04	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

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Chk'd By H. M. Sulloway Date
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ATTACHMENT 3

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Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	4.305E-11	0.0000	9.274E-09	0.0001	0.000E+00	0.0000	9.865E-06	0.0958	1.850E-06	0.0180	1.498E-06	0.0145	1.344E-09	0.0000
Cs-137	1.257E-06	0.0122	3.717E-13	0.0000	0.000E+00	0.0000	6.549E-08	0.0006	4.850E-08	0.0005	3.013E-08	0.0003	1.964E-09	0.0000
Sr-90	5.355E-07	0.0052	1.954E-10	0.0000	0.000E+00	0.0000	6.904E-05	0.6701	1.180E-05	0.1145	6.665E-06	0.0647	3.611E-07	0.0035
Total	1.793E-06	0.0174	9.470E-09	0.0001	0.000E+00	0.0000	7.897E-05	0.7665	1.370E-05	0.1330	8.194E-06	0.0795	3.644E-07	0.0035

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.322E-05	0.1284
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.403E-06	0.0136
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.840E-05	0.8580
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.030E-04	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 4 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 5
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
C-14	1.239E+02	4.925E+05	1.129E+05	8.486E+04	4.552E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.903E+05
Cs-137	1.414E-03	7.928E+01	5.871E+01	3.647E+01	2.054E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.765E+02
Sr-90	7.889E-02	3.317E+04	5.669E+03	3.202E+03	1.146E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.215E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	1.017E-11	0.0000	2.190E-09	0.0000	2.463E-06	0.0270	5.648E-07	0.0062	4.243E-07	0.0047	3.175E-10	0.0000
Cs-137	1.228E-06	0.0135	3.631E-13	0.0000	6.398E-08	0.0007	4.738E-08	0.0005	2.943E-08	0.0003	1.919E-09	0.0000
Sr-90	5.226E-07	0.0057	1.907E-10	0.0000	6.738E-05	0.7396	1.152E-05	0.1264	6.505E-06	0.0714	3.525E-07	0.0039
Total	1.751E-06	0.0192	2.382E-09	0.0000	6.991E-05	0.7673	1.213E-05	0.1331	6.959E-06	0.0764	3.547E-07	0.0039

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.454E-06	0.0379
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.371E-06	0.0150
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.628E-05	0.9470
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.111E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 5 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 6
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	1.017E-11	0.0000	2.190E-09	0.0000	0.000E+00	0.0000	2.463E-06	0.0270	5.648E-07	0.0062	4.243E-07	0.0047	3.175E-10	0.0000
Cs-137	1.228E-06	0.0135	3.631E-13	0.0000	0.000E+00	0.0000	6.398E-08	0.0007	4.738E-08	0.0005	2.943E-08	0.0003	1.919E-09	0.0000
Sr-90	5.226E-07	0.0057	1.907E-10	0.0000	0.000E+00	0.0000	6.738E-05	0.7396	1.152E-05	0.1264	6.505E-06	0.0714	3.525E-07	0.0039
Total	1.751E-06	0.0192	2.382E-09	0.0000	0.000E+00	0.0000	6.991E-05	0.7673	1.213E-05	0.1331	6.959E-06	0.0764	3.547E-07	0.0039

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.454E-06	0.0379
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.371E-06	0.0150
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.628E-05	0.9470
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.111E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 6 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 7
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon) Inhalation	Plant	Meat	Milk	Soil	Water Dependent Pathways Water	Fish	Plant	Meat	Milk	Total Ingestion*
C-14	6.900E+00	2.742E+04	6.291E+03	4.726E+03	2.535E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.844E+04
Cs-137	1.350E-03	7.566E+01	5.604E+01	3.481E+01	1.960E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.685E+02
Sr-90	7.515E-02	3.160E+04	5.401E+03	3.050E+03	1.092E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.016E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	5.662E-13	0.0000	1.220E-10	0.0000	1.371E-07	0.0016	3.146E-08	0.0004	2.363E-08	0.0003	1.768E-11	0.0000
Cs-137	1.172E-06	0.0140	3.466E-13	0.0000	6.106E-08	0.0007	4.522E-08	0.0005	2.809E-08	0.0003	1.832E-09	0.0000
Sr-90	4.979E-07	0.0059	1.817E-10	0.0000	6.420E-05	0.7670	1.097E-05	0.1311	6.198E-06	0.0740	3.358E-07	0.0040
Total	1.670E-06	0.0200	3.040E-10	0.0000	6.439E-05	0.7693	1.105E-05	0.1320	6.249E-06	0.0747	3.376E-07	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All Pathways** risk	All Pathways** fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.924E-07	0.0023
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.308E-06	0.0156
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.220E-05	0.9821
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.370E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 7 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 8
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	5.662E-13	0.0000	1.220E-10	0.0000	0.000E+00	0.0000	1.371E-07	0.0016	3.146E-08	0.0004	2.363E-08	0.0003	1.768E-11	0.0000
Cs-137	1.172E-06	0.0140	3.466E-13	0.0000	0.000E+00	0.0000	6.106E-08	0.0007	4.522E-08	0.0005	2.809E-08	0.0003	1.832E-09	0.0000
Sr-90	4.979E-07	0.0059	1.817E-10	0.0000	0.000E+00	0.0000	6.420E-05	0.7670	1.097E-05	0.1311	6.198E-06	0.0740	3.358E-07	0.0040
Total	1.670E-06	0.0200	3.040E-10	0.0000	0.000E+00	0.0000	6.439E-05	0.7693	1.105E-05	0.1320	6.249E-06	0.0747	3.376E-07	0.0040

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.924E-07	0.0023
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.308E-06	0.0156
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.220E-05	0.9821
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.370E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 8 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 9
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 7.000E+00 years

	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Radio-Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
C-14	2.123E-02	8.440E+01	1.937E+01	1.455E+01	7.800E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.183E+02
Cs-137	1.230E-03	6.892E+01	5.105E+01	3.171E+01	1.786E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.535E+02
Sr-90	6.821E-02	2.868E+04	4.902E+03	2.769E+03	9.907E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.645E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	1.742E-15	0.0000	3.753E-13	0.0000	4.220E-10	0.0000	9.684E-11	0.0000	7.274E-11	0.0000	5.441E-14	0.0000
Cs-137	1.068E-06	0.0141	3.157E-13	0.0000	5.562E-08	0.0007	4.120E-08	0.0005	2.559E-08	0.0003	1.668E-09	0.0000
Sr-90	4.519E-07	0.0060	1.649E-10	0.0000	5.826E-05	0.7687	9.959E-06	0.1314	5.625E-06	0.0742	3.048E-07	0.0040
Total	1.520E-06	0.0200	1.656E-10	0.0000	5.832E-05	0.7694	1.000E-05	0.1319	5.651E-06	0.0746	3.064E-07	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

Water Dependent Pathways

	Water		Fish		Plant		Meat		Milk		All Pathways**	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.920E-10	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.192E-06	0.0157
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.460E-05	0.9843
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.580E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 9 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 10
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	1.742E-15	0.0000	3.753E-13	0.0000	0.000E+00	0.0000	4.220E-10	0.0000	9.684E-11	0.0000	7.274E-11	0.0000	5.441E-14	0.0000
Cs-137	1.068E-06	0.0141	3.157E-13	0.0000	0.000E+00	0.0000	5.562E-08	0.0007	4.120E-08	0.0005	2.559E-08	0.0003	1.668E-09	0.0000
Sr-90	4.519E-07	0.0060	1.649E-10	0.0000	0.000E+00	0.0000	5.826E-05	0.7687	9.959E-06	0.1314	5.625E-06	0.0742	3.048E-07	0.0040
Total	1.520E-06	0.0200	1.656E-10	0.0000	0.000E+00	0.0000	5.832E-05	0.7694	1.000E-05	0.1319	5.651E-06	0.0746	3.064E-07	0.0040

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 7.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.920E-10	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.192E-06	0.0157
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.460E-05	0.9843
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.580E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 10 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 11
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.100E+01 years

	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Radio-Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
C-14	6.469E-05	2.571E-01	5.903E-02	4.433E-02	2.376E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.605E-01
Cs-137	1.120E-03	6.278E+01	4.650E+01	2.888E+01	1.627E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.398E+02
Sr-90	6.191E-02	2.603E+04	4.449E+03	2.513E+03	8.991E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.308E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.100E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0

	Ground		Inhalation		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	5.308E-18	0.0000	1.143E-15	0.0000	1.286E-12	0.0000	2.952E-13	0.0000	2.217E-13	0.0000	1.658E-16	0.0000
Cs-137	9.726E-07	0.0141	2.876E-13	0.0000	5.067E-08	0.0007	3.753E-08	0.0005	2.331E-08	0.0003	1.520E-09	0.0000
Sr-90	4.102E-07	0.0060	1.497E-10	0.0000	5.288E-05	0.7686	9.039E-06	0.1314	5.105E-06	0.0742	2.766E-07	0.0040
Total	1.383E-06	0.0201	1.500E-10	0.0000	5.293E-05	0.7694	9.076E-06	0.1319	5.129E-06	0.0745	2.781E-07	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.100E+01 years

Water Dependent Pathways

	Water		Fish		Plant		Meat		Milk		All Pathways**	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.804E-12	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-06	0.0158
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.771E-05	0.9842
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.880E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 11 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 12
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.100E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	5.308E-18	0.0000	1.143E-15	0.0000	0.000E+00	0.0000	1.286E-12	0.0000	2.952E-13	0.0000	2.217E-13	0.0000	1.658E-16	0.0000
Cs-137	9.726E-07	0.0141	2.876E-13	0.0000	0.000E+00	0.0000	5.067E-08	0.0007	3.753E-08	0.0005	2.331E-08	0.0003	1.520E-09	0.0000
Sr-90	4.102E-07	0.0060	1.497E-10	0.0000	0.000E+00	0.0000	5.288E-05	0.7686	9.039E-06	0.1314	5.105E-06	0.0742	2.766E-07	0.0040
Total	1.383E-06	0.0201	1.500E-10	0.0000	0.000E+00	0.0000	5.293E-05	0.7694	9.076E-06	0.1319	5.129E-06	0.0745	2.781E-07	0.0040

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.100E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.804E-12	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.086E-06	0.0158
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.771E-05	0.9842
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.880E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 12 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 13
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 4.300E+01 years

	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Radio-Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
C-14	3.328E-25	1.324E-21	3.048E-22	2.286E-22	1.222E-25	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.857E-21
Cs-137	5.310E-04	2.977E+01	2.205E+01	1.369E+01	7.712E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.628E+01
Sr-90	2.851E-02	1.198E+04	2.048E+03	1.157E+03	4.140E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.523E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.300E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Ground		Inhalation		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	4.612E-07	0.0146	1.364E-13	0.0000	2.402E-08	0.0008	1.779E-08	0.0006	1.105E-08	0.0003	7.206E-10	0.0000
Sr-90	1.889E-07	0.0060	6.892E-11	0.0000	2.435E-05	0.7683	4.162E-06	0.1313	2.351E-06	0.0742	1.274E-07	0.0040
Total	6.500E-07	0.0205	6.905E-11	0.0000	2.437E-05	0.7690	4.180E-06	0.1319	2.362E-06	0.0745	1.281E-07	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.300E+01 years

Water Dependent Pathways

	Water		Fish		Plant		Meat		Milk		All Pathways**	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.147E-07	0.0162
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.118E-05	0.9838
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.169E-05	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 13 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 14
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.300E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	4.612E-07	0.0146	1.364E-13	0.0000	0.000E+00	0.0000	2.402E-08	0.0008	1.779E-08	0.0006	1.105E-08	0.0003	7.206E-10	0.0000
Sr-90	1.889E-07	0.0060	6.892E-11	0.0000	0.000E+00	0.0000	2.435E-05	0.7683	4.162E-06	0.1313	2.351E-06	0.0742	1.274E-07	0.0040
Total	6.500E-07	0.0205	6.905E-11	0.0000	0.000E+00	0.0000	2.437E-05	0.7690	4.180E-06	0.1319	2.362E-06	0.0745	1.281E-07	0.0040

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.300E+01 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.147E-07	0.0162
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.118E-05	0.9838
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.169E-05	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 14 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 15
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.405E-04	7.878E+00	5.835E+00	3.624E+00	2.041E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.754E+01
Sr-90	7.161E-03	3.011E+03	5.146E+02	2.907E+02	1.040E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.827E+03

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.220E-07	0.0153	3.609E-14	0.0000	6.358E-09	0.0008	4.709E-09	0.0006	2.925E-09	0.0004	1.907E-10	0.0000
Sr-90	4.745E-08	0.0060	1.731E-11	0.0000	6.117E-06	0.7676	1.046E-06	0.1312	5.906E-07	0.0741	3.200E-08	0.0040
Total	1.695E-07	0.0213	1.735E-11	0.0000	6.124E-06	0.7684	1.050E-06	0.1318	5.935E-07	0.0745	3.219E-08	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.362E-07	0.0171
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.833E-06	0.9829
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.969E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 15 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 16
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0
Water Independent Pathways (Inhalation excludes radon)

0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.220E-07	0.0153	3.609E-14	0.0000	0.000E+00	0.0000	6.358E-09	0.0008	4.709E-09	0.0006	2.925E-09	0.0004	1.907E-10	0.0000
Sr-90	4.745E-08	0.0060	1.731E-11	0.0000	0.000E+00	0.0000	6.117E-06	0.7676	1.046E-06	0.1312	5.906E-07	0.0741	3.200E-08	0.0040
Total	1.695E-07	0.0213	1.735E-11	0.0000	0.000E+00	0.0000	6.124E-06	0.7684	1.050E-06	0.1318	5.935E-07	0.0745	3.219E-08	0.0040

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.362E-07	0.0171
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.833E-06	0.9829
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.969E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 16 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 17
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.325E-06	7.426E-02	5.500E-02	3.416E-02	1.924E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.653E-01
Sr-90	5.623E-05	2.364E+01	4.040E+00	2.282E+00	8.166E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.004E+01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.150E-09	0.0183	3.402E-16	0.0000	5.993E-11	0.0010	4.438E-11	0.0007	2.757E-11	0.0004	1.798E-12	0.0000
Sr-90	3.725E-10	0.0059	1.359E-13	0.0000	4.803E-08	0.7650	8.209E-09	0.1308	4.637E-09	0.0739	2.512E-10	0.0040
Total	1.523E-09	0.0243	1.363E-13	0.0000	4.809E-08	0.7660	8.253E-09	0.1315	4.664E-09	0.0743	2.530E-10	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-09	0.0205
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.150E-08	0.9795
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.278E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 17 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 18
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	1.150E-09	0.0183	3.402E-16	0.0000	0.000E+00	0.0000	5.993E-11	0.0010	4.438E-11	0.0007	2.757E-11	0.0004	1.798E-12	0.0000
Sr-90	3.725E-10	0.0059	1.359E-13	0.0000	0.000E+00	0.0000	4.803E-08	0.7650	8.209E-09	0.1308	4.637E-09	0.0739	2.512E-10	0.0040
Total	1.523E-09	0.0243	1.363E-13	0.0000	0.000E+00	0.0000	4.809E-08	0.7660	8.253E-09	0.1315	4.664E-09	0.0743	2.530E-10	0.0040

0

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.284E-09	0.0205
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.150E-08	0.9795
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.278E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 18 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 19
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.077E-13	6.037E-09	4.471E-09	2.777E-09	1.564E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.344E-08
Sr-90	2.411E-12	1.014E-06	1.733E-07	9.787E-08	3.502E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.288E-06

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

0 Water Independent Pathways (Inhalation excludes radon)

0

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	9.353E-17	0.0341	2.766E-23	0.0000	4.872E-18	0.0018	3.609E-18	0.0013	2.241E-18	0.0008	1.462E-19	0.0001
Sr-90	1.597E-17	0.0058	5.829E-21	0.0000	2.060E-15	0.7512	3.520E-16	0.1284	1.988E-16	0.0725	1.077E-17	0.0039
Total	1.095E-16	0.0399	5.857E-21	0.0000	2.064E-15	0.7530	3.556E-16	0.1297	2.011E-16	0.0733	1.092E-17	0.0040

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.044E-16	0.0381
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.637E-15	0.9619
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.742E-15	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Attachment 3 Sheet No. 19 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 20
Intrisk : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground risk	Ground fract.	Inhalation risk	Inhalation fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	Soil risk	Soil fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	9.353E-17	0.0341	2.766E-23	0.0000	0.000E+00	0.0000	4.872E-18	0.0018	3.609E-18	0.0013	2.241E-18	0.0008	1.462E-19	0.0001
Sr-90	1.597E-17	0.0058	5.829E-21	0.0000	0.000E+00	0.0000	2.060E-15	0.7512	3.520E-16	0.1284	1.988E-16	0.0725	1.077E-17	0.0039
Total	1.095E-16	0.0399	5.857E-21	0.0000	0.000E+00	0.0000	2.064E-15	0.7530	3.556E-16	0.1297	2.011E-16	0.0733	1.092E-17	0.0040

Total Excess Cancer Risk CNRSI(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water risk	Water fract.	Fish risk	Fish fract.	Radon risk	Radon fract.	Plant risk	Plant fract.	Meat risk	Meat fract.	Milk risk	Milk fract.	All pathways risk	All pathways fract.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.044E-16	0.0381
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.637E-15	0.9619
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.742E-15	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 20 of 20
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

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1RESRAD, Version 6.3      T« Limit = 180 days        11/15/2007  11:42  Page   1
 Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
 File    : 100-F-26-13_Excavation.RAD

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           Part IV: Concentration of Radionuclides
           ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Concentration of radionuclides in different media
      Time= 0.000E+00 .....................................   2
      Time= 1.000E+00 .....................................   3
      Time= 3.000E+00 .....................................   4
      Time= 7.000E+00 .....................................   5
      Time= 1.100E+01 .....................................   6
      Time= 4.300E+01 .....................................   7
      Time= 1.000E+02 .....................................   8
      Time= 3.000E+02 .....................................   9
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Attachment 4 Sheet No. 1 of 10
Originator: S. W. Clark Date 11/15/07
Chk'd By H. M. Sulloway Date 11/15/07
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 2
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	3.300E+00	3.300E+00	4.131E-05	0.000E+00	0.000E+00
Cs-137	3.600E-02	3.600E-02	4.507E-07	0.000E+00	0.000E+00
Sr-90	2.010E+00	2.010E+00	2.516E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 1.598E+01 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	3.567E+04	8.026E+03	3.014E+04	1.356E+04	2.141E+04	6.243E+03	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.440E+00	1.440E+00	1.440E+00	1.440E+00	3.478E+00	7.777E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	6.030E+02	6.030E+02	6.030E+02	6.030E+02	3.361E+02	6.834E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 2 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 3
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	7.794E-01	7.794E-01	9.758E-06	0.000E+00	0.000E+00
Cs-137	3.517E-02	3.517E-02	4.403E-07	0.000E+00	0.000E+00
Sr-90	1.962E+00	1.962E+00	2.456E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 3.774E+00 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 1.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	8.907E+03	1.903E+03	9.206E+03	3.840E+03	6.536E+03	1.768E+03	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.407E+00	1.407E+00	1.409E+00	1.407E+00	3.398E+00	7.597E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	5.886E+02	5.886E+02	5.894E+02	5.886E+02	3.281E+02	6.671E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 3 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 4
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 3.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	4.340E-02	4.340E-02	5.433E-07	0.000E+00	0.000E+00
Cs-137	3.357E-02	3.357E-02	4.202E-07	0.000E+00	0.000E+00
Sr-90	1.869E+00	1.869E+00	2.340E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 2.101E-01 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 3.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	4.960E+02	1.060E+02	5.127E+02	2.139E+02	3.640E+02	9.846E+01	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.343E+00	1.343E+00	1.345E+00	1.343E+00	3.243E+00	7.251E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	5.607E+02	5.607E+02	5.615E+02	5.608E+02	3.125E+02	6.355E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 4 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 5
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 7.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	1.336E-04	1.336E-04	1.672E-09	0.000E+00	0.000E+00
Cs-137	3.058E-02	3.058E-02	3.828E-07	0.000E+00	0.000E+00
Sr-90	1.696E+00	1.696E+00	2.124E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 6.466E-04 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 7.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	1.527E+00	3.262E-01	1.578E+00	6.583E-01	1.121E+00	3.031E-01	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.223E+00	1.223E+00	1.225E+00	1.223E+00	2.954E+00	6.605E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	5.089E+02	5.089E+02	5.096E+02	5.090E+02	2.837E+02	5.768E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 5 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 6
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 1.100E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	4.069E-07	4.069E-07	5.094E-12	0.000E+00	0.000E+00
Cs-137	2.785E-02	2.785E-02	3.487E-07	0.000E+00	0.000E+00
Sr-90	1.540E+00	1.540E+00	1.927E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 1.970E-06 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 1.100E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	4.651E-03	9.937E-04	4.811E-03	2.006E-03	3.416E-03	9.236E-04	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.114E+00	1.114E+00	1.116E+00	1.114E+00	2.691E+00	6.017E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	4.619E+02	4.619E+02	4.625E+02	4.620E+02	2.574E+02	5.235E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 6 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 7
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 4.300E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	2.093E-27	2.093E-27	2.620E-32	0.000E+00	0.000E+00
Cs-137	1.321E-02	1.321E-02	1.653E-07	0.000E+00	0.000E+00
Sr-90	7.089E-01	7.089E-01	8.875E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 1.013E-26 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 4.300E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	2.394E-23	5.112E-24	2.484E-23	1.035E-23	1.764E-23	4.763E-24	0.000E+00	0.000E+00
Cs-137	0.000E+00	5.283E-01	5.283E-01	5.290E-01	5.283E-01	1.276E+00	2.853E-01	0.000E+00	0.000E+00
Sr-90	0.000E+00	2.127E+02	2.127E+02	2.130E+02	2.127E+02	1.185E+02	2.411E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 7 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 8
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	3.495E-03	3.495E-03	4.375E-08	0.000E+00	0.000E+00
Sr-90	1.781E-01	1.781E-01	2.230E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 1.000E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.398E-01	1.398E-01	1.400E-01	1.398E-01	3.377E-01	7.550E-02	0.000E+00	0.000E+00
Sr-90	0.000E+00	5.343E+01	5.343E+01	5.350E+01	5.344E+01	2.978E+01	6.056E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 8 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 9
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 3.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	3.294E-05	3.294E-05	4.124E-10	0.000E+00	0.000E+00
Sr-90	1.398E-03	1.398E-03	1.751E-08	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 3.000E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.318E-03	1.318E-03	1.320E-03	1.318E-03	3.183E-03	7.117E-04	0.000E+00	0.000E+00
Sr-90	0.000E+00	4.195E-01	4.195E-01	4.201E-01	4.196E-01	2.338E-01	4.755E-02	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 9 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0

ATTACHMENT 4

1RESRAD, Version 6.3 T« Limit = 180 days 11/15/2007 11:42 Page 10
Concent : 100-F-26:13 108-F Drain Pipelines RESRAD Calculation
File : 100-F-26-13_Excavation.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+03 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	2.678E-12	2.678E-12	3.353E-17	0.000E+00	0.000E+00
Sr-90	5.997E-11	5.997E-11	7.507E-16	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 1.000E+03 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	1.071E-10	1.071E-10	1.073E-10	1.072E-10	2.588E-10	5.786E-11	0.000E+00	0.000E+00
Sr-90	0.000E+00	1.799E-08	1.799E-08	1.801E-08	1.799E-08	1.003E-08	2.039E-09	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 4 Sheet No. 10 of 10
Originator: S. W. Clark Date
Chk'd By H. M. Sulloway Date
Calc. No. 0100F-CA-V0329 Rev. No. 0