UMATILLA CHEMICAL DEPOT

PERMIT ATTACHMENT 6

CLOSURE PLAN

All federal Title 40 CFR citations are citations to the Title 40 CFR adopted as Oregon rule by OAR 340-100-0002 and as altered by OAR Chapter 340, Divisions 100-106, 109, 111, 113, 120, 124, and 142. See the preface introduction for further explanation.

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VET-1604-PLN-003

RCRA Closure Plan for the

Umatilla Chemical Depot

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United States Army Umatilla Chemical Depot
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Executive Summary

The Umatilla Chemical Depot (UMCD) is a 19,729-acre military installation located in north-central Oregon. It is owned and operated by the permittee, the U.S. Army Chemical Materials Activity, as represented by UMCD. Storage facilities included in the permit (OR6 213 820 917, Resource Conservation and Recovery Act Permit for the Storage of Hazardous Waste – Umatilla Chemical Depot) are K-Block, J-Block, and the Building 203 Consolidation, Storage and Transfer Facility (CSF), Satellite Accumulation Areas (SAAs), and 90-Day Storage Areas. Other buildings known to have been involved in agent-related operations are also included in this closure plan.

The K-Block storage facilities include 90 individually operated storage units permitted for storage of chemical agent-filled munitions and bulk items in accordance with applicable requirements of 40 *Code of Federal Regulations* (CFR) 264, Subparts A through I and EE, and as amended and adopted in Oregon Administrative Rule (OAR) 340-104-1201 and other applicable OARs. The UMCD J-Block storage facilities include 14 individually operated storage units permitted for storage of agent-related solid waste(s) including spent decontamination solutions and all other operationally derived chemical agent-related solid waste in accordance with applicable requirements of 40 CFR 264, Subparts A through I, as adopted and amended in the OARs. The Building 203 CSF stores non-agent-related hazardous wastes in accordance with applicable requirements of 40 CFR 264, Subparts A through I, as adopted and amended in the OARs.

This Resource Conservation and Recovery Act (RCRA) closure plan provides the specific requirements, including methods for project execution and a schedule for the completion of the closure activities of the RCRA permitted units (in accordance with 40 CFR 264 Subpart G), as well as those activities that will be conducted at the SAAs, the 90-Day Storage Areas, and the other buildings known to have been involved in hazardous waste operations.

Also included in this closure plan is Toxic Substances Control Act (TSCA) closure activities in those permitted storage units identified to have contained items or waste with polychlorinated biphenyls (PCBs) during their operational history. These PCB sampling activities are being performed concurrent with RCRA closure sampling activities. Sampling results will be reported to the U.S. Environmental Protection Agency (EPA) under a separate submittal.

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1.0 INTRODUCTION

1.1 Purpose

This document is the *Resource Conservation and Recovery Act* (RCRA) closure plan for the Umatilla Chemical Depot (UMCD), located near Hermiston, Oregon. This closure plan includes permitted hazardous waste management units (HWMUs) including Satellite Accumulation Areas (SAAs) and 90-Day Storage Areas. Primary emphasis for this closure plan is the J- and K-Block storage facility igloos (also called magazines, bunkers, or storage units) and the Consolidation, Storage and Transfer Facility (CSF) located in Building 203. Also included in this closure plan is a section on the identification and investigation of solid waste management units (SWMUs) and areas of contamination (AOCs).

The storage areas are located on the UMCD and include 14 individually operated hazardous waste storage units in J-Block (igloos J-1797 through J-1810) and 90 individually operated hazardous waste storage units in K-Block (igloos K-1811 through K-1900). These igloos were permitted for the storage of chemical agent-filled munitions and bulk items and chemical agent-related solid waste in accordance with applicable requirements of 40 *Code of Federal Regulations* (CFR) 264 and as amended and adopted in Oregon Administrative Rule (OAR) 340-104-1201 and other applicable OARs. The J- and K-Block storage facilities are located near the center of the UMCD, a 19,729-acre military installation located in north-central Oregon (see Figure 1). The Building 203 CSF is located near the southwest corner of the UMCD and is permitted for the storage of non-agent-related hazardous wastes.

This closure plan is submitted by the UMCD in accordance with 40 CFR 264, Subpart G – "Closure and Post-Closure," and Section II.J of the UMCD Hazardous Waste Permit, Permit Number OR6 213 820 917 (Permit). The purpose of this closure plan is to ensure the UMCD site undergoes final closure in a manner consistent with applicable requirements.

This document is organized in the following manner:

- **Section 1.0** — The *Introduction* details the overall approaches and methods to be used in this closure project, and describes the requirements governing closure.
- **Section 2.0** — The *Environmental Setting* section details the regional climate, topography, geology, water resources and adjacent properties.
- **Section 3.0** — The *UMCD Facility and Operational History* section provides a top-level summary of the site and its operational history.
- **Sections 4.0 thru 13.0**— These sections describe the criteria necessary to support sound decision-making for each building, block of igloos, or area. Specific measures are developed to present a technically defensible decision analysis framework.
- **Section 14.0**— The *Solid Waste Management Units (SWMUs)* defines SWMUs and identifies the process for identification and assessment of these areas.

- **Section 15.0—** The *Sampling and Analysis Work Plan* provides the process and controls necessary to collect the data necessary to make closure decisions.
- **Section 16.0 —** The *Health and Safety Plan* describes the measures to be implemented in order to control and promote worker safety during closure activities.
- **Appendix A —** The *Closure Schedule* provides a schedule for the closure activities related to J-Block igloos, K-Block igloos, and Building 203.
- **Appendix B —** The *UMCD Maps* include various maps of the UMCD referenced in this closure plan.
- **Appendix C —** The *K-Block Operational History* captures the collection of inventory records and agent leaker reports for the 90 K-Block igloos.
- **Appendix D —** The *K-Block Storage Arrangements* illustrate the various munition and bulk container storage configurations used in the K-Block igloos.
- **Appendix E —** The *Project Quality Assurance Plan (PQAP)* describes the project-level measures to be implemented to assure quality decision-making and data collection.

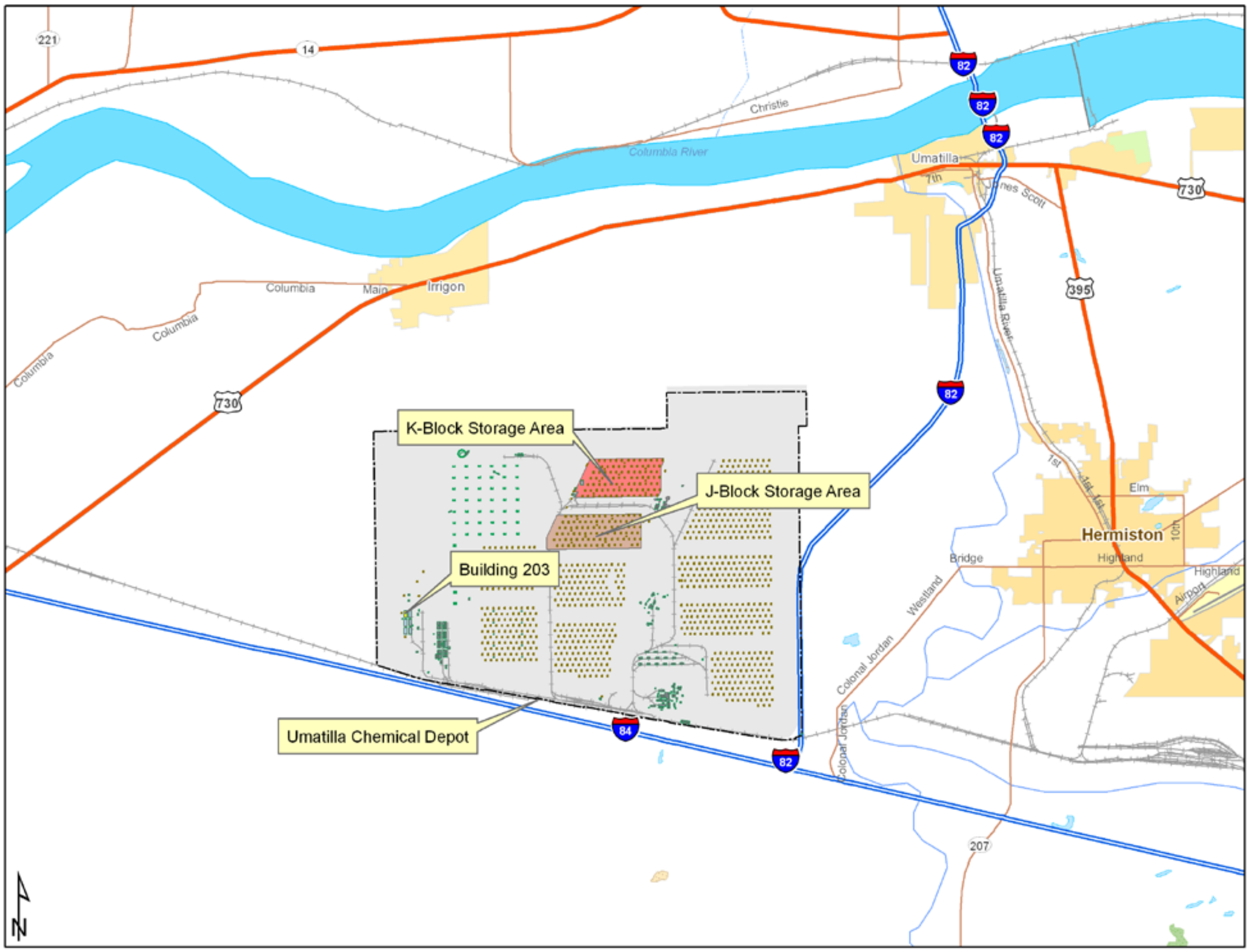

Figure 1. Location of Building 203 and the J- and K-Block Storage Areas

1.2 Scope

The scope of this closure plan addresses RCRA closure of 104 storage units (14 in J-Block and 90 in K-Block) permitted to store agent-contaminated hazardous wastes (J-Block) and agent-filled munitions and bulk items (K-Block). Also included is the Building 203 CSF which is permitted to store non-agent-related listed or characteristic hazardous wastes generated by UMCD activities or operations. Buildings located within the permitted K-Block area related to agent operations are included in the scope of this closure plan in addition to the Battery Shop (Building 27) in the Administrative Area, the old Laundry/Change House (Building 419), SAAs and 90-Day Storage Areas. A map of these units and areas is located in Appendix B. This plan also addresses Toxic Substances Control Act (TSCA) closure of those storage units identified to contain polychlorinated biphenyls (PCBs).

Closure activities for igloos will be conducted in groups of nominally six units per work package. This approach will increase the efficiency of closure planning, decontamination, sampling, and decision-making activities. While the work will be performed in work packages, decision-making and certification will be performed on an igloo-by-igloo basis; that is, each of the igloos will be closed and certified individually. Closure packages for certification will be produced as separate deliverables at the conclusion of field activities for that work package. Closure of the other buildings identified in this plan, as well as the SAAs and 90-Day Storage Areas will be done in a separate work package and certification package. The final facility closure report will be submitted once the closure activities, as defined herein, are completed and areas are certified as closed.

1.3 Applicability

Permitting, operation, and final closure of the UMCD site is governed by Federal and state of Oregon regulations. The RCRA requirements pertaining to the UMCD closure are promulgated in 40 CFR 264, Subpart G (which is also amended and adopted by reference in the OARs, specifically OAR 340-100 through 340-106). The TSCA requirements for PCBs are promulgated in 40 CFR 761, which is amended and adopted by reference in OAR 340-110.

The minimum national standards for acceptable management of hazardous waste defined in 40 CFR 264 applies to owners and operators of all facilities that treat or store hazardous waste. General requirements related to closure and post-closure of permitted facilities are found in Subpart G of 40 CFR 264, with additional requirements specific to operation and closure of hazardous waste munitions storage facilities in Subpart EE and hazardous waste container storage areas in Subpart I. Hazardous waste permit program requirements and permit conditions under RCRA, including signatories to permit applications and closure certification packages, are stated in 40 CFR 270.

1.4 Requirements

The activities described in this plan must ensure that the UMCD HWMUs are clean closed in accordance with the performance standard of 40 CFR 264.111. This requires closure to be achieved in a manner that:

1. Minimizes the need for future maintenance; and
2. Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, any post-closure escape of hazardous wastes or their hazardous constituents, leachate, contaminated runoff, or decomposition products to the ground or surface waters or to the atmosphere; and
3. Complies with the closure requirements of 40 CFR 264 Subpart G and other subparts as applicable (note: none are applicable with exception of Subparts G, EE, and I).

Sufficient sampling and analysis of each storage unit will be required, after waste removal, to verify that the closure performance standards are met. The baseline sampling design includes no demolition of igloos or buildings. Any deviations from the test protocol, as presented in this report, will be identified for DEQ approval prior to implementation. For further information regarding the basis of the sample design, refer to the conceptual model for each HWMU.

1.5 Closure Cost Estimate

A closure cost estimate is not required for the closure of the UMCD storage facilities as 40 CFR 264.140(c) and OAR 340-104-0001(2) exempts the federal government from the financial requirements of 40 CFR 264 Subpart H. This exemption also applies to the financial assurance mechanism for closure, a post-closure cost estimate, the financial assurance mechanism for post-closure care, and financial liability requirements.

1.6 Project Execution Plan

The project execution plan describes the overall process used for the closure of the UMCD. Generally, the process is presented in Figure 2 and includes the following steps:

- Closure Planning,
- Preparation for Closure,
- HWMU Closure Activities,
- Data Assessment, and
- Certification.

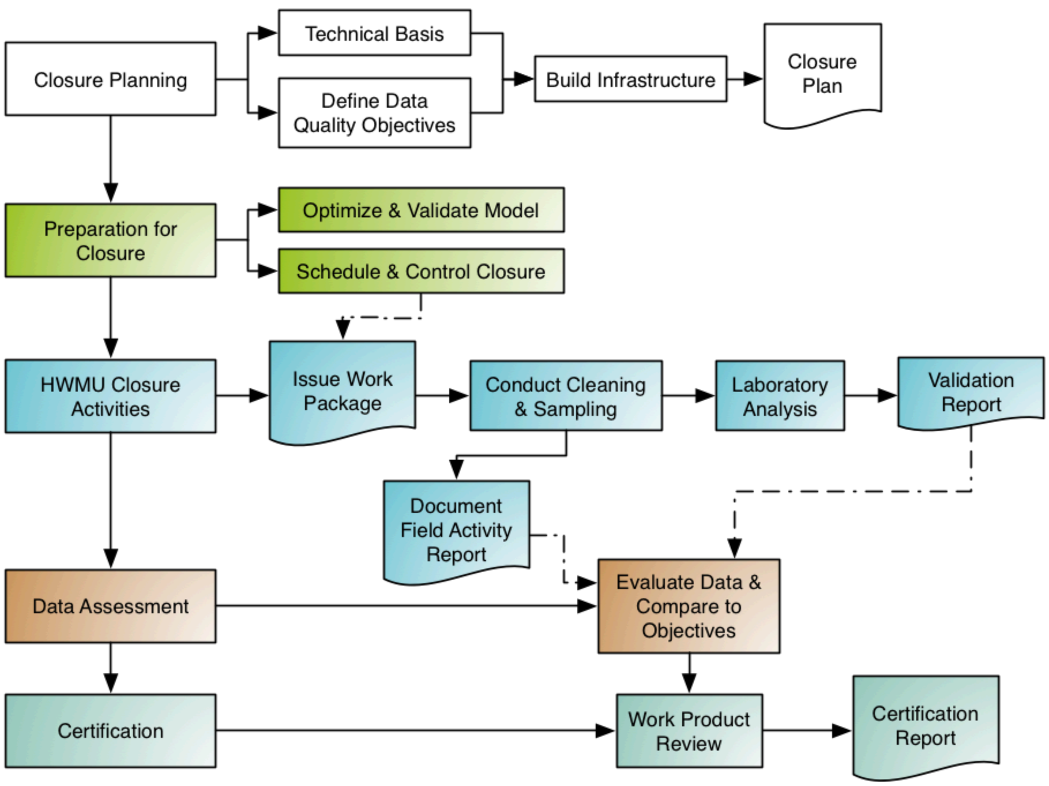

Figure 2. Overview of the UMCD Closure Process

1.6.1 Closure Planning

This plan addresses the following elements pursuant to 40 CFR 264.112(b):

- Facility operational history;
- Field activities;
- Closure performance standards;
- Sample analysis and data management;
- Data assessment;
- Closure certification;
- Project schedule and execution; and
- Project quality assurance, health, and safety provisions.

Above all, this plan provides a description of how each unit will be closed, and how closure of the UMCD storage facilities will be performed and documented. The UMCD storage units will be closed as part of the UMCD closure process. The operational history data for the UMCD Building 203 CSF and the J- and K-Block igloos supports an estimate of the maximum inventory of hazardous waste stored during each storage units' active life, as well as indicating potential residual contaminants. Field activities are described in detail, including steps required for waste removal in each unit, the removal, packaging, transport, and disposal of wastes existing in the facility or generated by field activities, and the sampling of debris, concrete, and other substrates to verify closure performance standards are met.

Closure performance standards are defined to justify the proposed sample size, number of samples per storage unit, and sample collection methods, as described in a sampling and analysis plan. Data quality objectives also provide the basis for sampling locations and closure decisions for each storage unit.

An estimated project timetable, including closure dates for the Building 203 CSF, the J-Block storage facility, and the K-Block storage facility, and schedule required for various closure activities, is presented in Appendix A. An estimated project timetable for closure of the UMCD support areas and buildings is also presented in Appendix A. These schedules may change due to constraints imposed throughout the project. These constraints might include changes to the operational record, efforts required to mobilize personnel, equipment, and laboratory services supporting closure. If this schedule changes, the Oregon Department of Environmental Quality (DEQ) will be consulted to determine if the change(s) necessitate a permit modification to revise this plan.

Upon approval of the closure plan and in accordance with 40 CFR 264.112(e), field closure activities began in the third quarter of 2011.

1.6.2 Preparation for Closure Activities

Igloos storing higher-level wastes will be monitored down to less than the WPL prior to commencement of sampling (see Section 15.7 for more detail). Higher-level waste indicates that the containerized waste has been partially decontaminated of chemical agent as specifically described in the 27 March 2002 revision of DA PAM 385-61 (U.S. Army 2002) and that chemical agent concentrations, as measured, in the headspace air, exceed the short-term exposure limit (STEL) (OR6 213 820 917).[1]

1.6.3 Field Closure Activities

For each storage unit (that is, Building 203, and the J-Block and K-Block igloos), field activities will consist of cleaning/decontamination, sampling, and documentation. Additional field activities will be necessary to manage, remove, and dispose of the associated wastes, and to ensure the health and safety of workers. Decontamination will consist of hand-removing larger debris, removing dirt and smaller debris by sweeping with a high-efficiency particulate air (HEPA)-filtered dry vacuum cleaner, and containerizing all removed material. After vacuuming, a visual inspection will be performed on the floors of each storage unit to identify any significant cracks and areas of staining or discoloration in the concrete. Findings will be documented (including photographs) and communicated to DEQ for assistance and concurrence in determining the need and extent of additional "biased" sampling efforts.

After conducting and documenting the visual inspection, sampling will be performed in accordance with Sections 4.0, 5.0, and 15.0 of this plan. Each storage unit has two strata requiring sampling:

1. Debris and dirt removed during decontamination activities and
2. Floors, ceilings, and walls inside the igloo or the floor of the building.

The igloos equipped with filter units and a history of vapor or liquid leaks will have a third stratum for sampling:

3. Filter housing units.

Igloos or buildings where contamination (agent or nonagent) outside the unit is known or suspected will have a fourth stratum for sampling:

4. Igloo/Building exterior.

[1] Waste designated as lower-level waste indicates the containerized waste has been surface decontaminated of chemical agent as specifically described in the 27 March 2002 revision of DA PAM 385-61 (U.S. Army 2002) and that chemical agent concentrations as measured in the headspace air do not exceed the STEL.

Representative random bulk samples will be taken from the first sampling stratum collected during decontamination using the incremental delimitation sampling method (as described in Section 15.2.1). After the unit is dry decontaminated and the resulting debris and dirt have been sampled, the concrete surfaces of the second stratum will be wipe-sampled. The passive breather filter assemblies on leaker igloos will also be wipe-sampled to verify that closure performance standards are met (some K-Block filter assemblies have already been sampled; see Section 4.2.2 and Table 8 for additional details). With the exception of the burial of the blue band tubes in the K-Block (as described in Section 14.2.1), there is no documented evidence to indicate potential contamination outside of the storage igloos. However, in order to confirm the absence of migration of contamination to the surrounding environment, soil samples will be collected from the exterior soils on both sides of the door/apron. Soils in the K-Block where blue band tubes may have been buried are addressed in Section 14.2.1.

After closure verification/confirmation sampling activities, the passive breather filter units from any igloos on which they are equipped will be dismantled, restoring the ventilation system for each storage unit to its original configuration. Dismantling of the passive breather filter units and restoration activities will include removal of the front and rear passive breather filter units, reinstallation of the original rear vent caps, and closing the monitoring ports. After removal of the filter units from any of the igloos, the filter media will be processed as secondary waste in accordance with the UMCD Waste Analysis Plan (WAP).

Field activities for the non-permitted buildings/areas may consist of sweeping/cleaning, sampling, and documentation. Descriptions of the areas and the corresponding strata requiring sampling are addressed in Sections 6.0 through 14.0 of this plan. Sampling of these areas will be performed in accordance with Section 15.0.

1.6.4 Data Assessment

Analytical data will be managed and evaluated, and a closure decision will be made based on results. Following the completion of field activities for each work package, the newly acquired data will be processed into the decision analysis framework and any necessary changes will be made to the sampling approach for the subsequent closure work packages.

1.6.5 Closure Certification

In accordance with the schedule, the UMCD shall submit to DEQ documentation that the HWMUs have been closed in accordance with the specifications in this approved closure plan, as described in the following sections.

1.6.5.1 Closure Certification Package

The UMCD will prepare and submit to DEQ a closure certification report for each work package undergoing closure. The closure certification package will document compliance with the approved closure plan and 40 CFR 264 Subpart G, as amended by OAR, and Subpart I, and will provide the following elements for each storage unit in the work package:

- Complete description of the field activities performed for storage unit closure, including decontamination, sampling, and waste management, with the following information for each unit closure:
    - Estimated volumes or weights of waste and residue removed,
    - Methods used for waste handling and transport,
    - Methods used for decontamination (wet or dry),
    - Methods of sampling and sample analysis used, b
    - Chronological summary of closure activities, and
    - Photographs documenting closure.
- Copies of field logs or field activity reports;
- Copies of laboratory results, analytical methods and chains-of-custody;
- Description of any modifications or deviations from the project Sampling and Analysis Plan (SAP) including documentation of DEQ concurrence prior to implementation;
- Data validation report in accordance with the PQAP; and
- Statement regarding status of facility after closure, and post-closure care including revised surveillance requirements, if applicable.

The above items will be evaluated, in conjunction with field sampling and characterization results, to provide the basis for certifying closure in accordance with applicable requirements.

1.6.5.2 Certification Letter and Approvals

An independent, registered professional engineer (IRPE) will approve each completed closure certification package. Approval by the IRPE will be documented by signature. The package will also be approved by the following UMCD entities:

- UMCD commanding officer/installation manager and
- RCRA program manager.

The package will be submitted to DEQ with a submittal letter and the aforementioned approvals. The IRPE stamp and signature sheet, submittal letter, and UMCD approval signatures will be presented at the front of the finished closure certification package. The submittal letter must also include a certification statement, signed by the UMCD commanding officer/installation manager, consisting of the following:

> "The UMCD Storage Units, {INSERT UNIT DESIGNATIONS}, have been closed in accordance with the specifications in its approved closure plan, Permit Attachment 6." *[as required by 40 CFR 264.115]*
>
> "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." *[as required by 40 CFR 270.11(d)(1)]*

NOTE: DEQ has final authority for approval of closure. DEQ will be consulted during the submission of individual certification (partial closure) of units as wells as prior to the request for final closure approval to ensure that all closure performance standards and requirements have been met.

1.6.5.3 Procedure for Certification

Closure certification will require the following steps:

- Submittal of closure certification package, including closure plan with any revisions, to UMCD;
- UMCD approval and signatures as defined above in Section 1.6.5.2;
- IRPE Certification;
- Preparation of documentation necessary to support the development of the permit modification request (PMR) to remove the Building 203 CSF and the J- and K-Block storage facilities from the Permit after successful closure certification of the units;
- Submittal of closure certification package, with original signatures, to DEQ; and
- Distribution of closure certification and related documentation, (including a survey platt as applicable), to local and state authorities.

The IRPE will base certification on inspection of site activities and review of logbooks, photographs, analytical data, data validation documents, procedures, and other materials contained in the closure package. The IRPE will be present to witness critical or major activities during closure. Frequency or extent of inspections and reviews by the IRPE must be sufficient to determine the adequacy of each critical activity.

The facility owner and operator (UMCD) must revise the Permit in accordance with 40 CFR 270 after submittal and approval of all closure certification packages. The PMR will reflect the removal of the Building 203 CSF and the J- and K-Block storage facilities from the permit. After closure of the remaining UMCD units and DEQ’s final certification approval, a PMR will be submitted to terminate the Permit.

1.6.5.4 TSCA Closeout Report

The certification packages will summarize the PCB laboratory results for the analogous work package. Once laboratory results have been received and validated for all those storage units identified to have contained PCBs, a separate report will be prepared and submitted to the EPA summarizing these results and evaluating them against the closure performance standards.

1.7 Post-Closure Plan

UMCD intends to achieve clean closure status following completion of closure activities, thus eliminating the requirement for post-closure activities. In the event that any HWMU used for munitions storage cannot be clean closed (as specified in this closure plan), that unit shall be closed as a landfill in accordance with the requirements of 40 CFR 264.310. In accordance with 40 CFR 264.1202(b), UMCD shall submit a modified closure and post-closure plan for that unit to DEQ (as a PMR) within 30 calendar days of the date that DEQ notifies UMCD in writing that the unit must be closed as a landfill.

1.8 Maximum Waste Inventory (40 CFR 264.112(b)(3); OAR 340-104-0001)

In accordance with 40 CFR 264.112(b)(3), an estimate of the maximum inventory of hazardous waste ever on site over the active life of the UMCD is provided as follows:

- J-Block Igloos (14 container storage units) – No more than 21,780 gallons of hazardous waste liquids in each J-Block igloo can be stored (total = 304,920 gallons).
    - Estimate of generated volume/amount (1991-2012) = 1,120,064 pounds
    - Disposal method: Incineration on-site or off-site disposal (incineration, landfill)
- K-Block Igloos (90 container storage units) – No more than 19,965 gallons of hazardous waste liquids in each K-Block igloo can be stored (total = 1,796,850 gallons).
    - Estimate of generated volume/amount (1991-2012) = 30,953,328 pounds
    - Disposal method = Incineration at UMCDF

- Building 203 (container storage unit) – The quantity of containerized hazardous waste that can be stored in Building 203 is limited to the design capacity of the facility as follows:
    - Northeast Quadrant – 9,240 gallons (not exceeding 168 55-gallon drums)
    - Southeast Quadrant – 9,240 gallons (not exceeding 168 55-gallon drums)
    - Northwest Quadrant – 8,910 gallons (not exceeding 162 55-gallon drums)
    - Southwest Quadrant – 8,.910 gallons (not exceeding 162 55-gallon drums)

  Total design capacity of Building 203 is 36,300 gallons (not exceeding 660 55-gallon drums). Estimate of generated volume/amount (1991-2012) = 163,279 pounds. Disposal method: Off-site disposal (incineration, neutralization, landfill).

At final closure, any remaining hazardous wastes stored in containers or waste piles in the HWMUs listed above will be removed and treated onsite, or transported to a permitted, offsite treatment, storage, and disposal facility (TSDF) for RCRA hazardous waste subtitle C disposal.

2.0 ENVIRONMENTAL SETTING

UMCD is located in northeastern Oregon, approximately 4 miles west of Hermiston, 6 miles southwest of Umatilla, and 3 miles south of the Columbia River, in both Umatilla and Morrow counties.

2.1 Climate

UMCD has a dry, continental climate with significant variation in temperature between summer and winter. Seasonal temperatures at UMCD average 75 °F in summer and 35 °F in winter, due to the moderating influence of the Pacific Ocean air. The maximum recorded temperature was 113 °F in 1982, and the minimum recorded temperature was -31 °F in 1985 (U.S. Army 2010).

The region surrounding UMCD is best described as dry, due largely to the influence of the Cascade and Coast mountain ranges west of the site. Once air from the Pacific Ocean contacts the western slopes of these two mountain ranges, it naturally cools, allowing moisture to be removed as precipitation. The effect, known as a rain shadow, results in UMCD receiving only 10 inches of annual rainfall. Peak precipitation occurs as snow in November, December, and January. Annual snowfall is approximately 10 inches, with the majority of this falling in the December-March window. Although summer precipitation is unusual, when it does occur, it is usually in the form of thunderstorms, which can sometimes cause flash flooding (U.S. Army 2010).

Wind in the UMCD vicinity tends to be channeled by the Columbia River system. Channeling of winds along the Columbia River valley, in conjunction with a prevailing westerly wind direction in the area, results in a prevailing west-southwest wind at UMCD. A minor, secondary peak in wind direction can occur from east-northeast, due to drainage of cold air down the river valley during night and early morning hours (U.S. Army 2010). A wind rose for the UMCD for the period of 01 July 2005 thru 30 June 2010 is shown in Figure 3. The wind rose indicates a prevailing wind speed from the west-southwest greater than 10 m/s (22.4 mph) for more than 20% of the recorded period.

2.2 Topography

The portion of Oregon within an approximate 50-mile radius of UMCD includes parts of two geomorphic regions, the Deschutes-Umatilla plateau and the Blue Mountains. Elevations on UMCD range from 400 to 677 feet above sea level (see Appendix B for a topography map). The north, west, and central portion of UMCD is generally flat to very gently rolling. A prominent surface feature, the Coyote Coulee, is a valley that cuts across the facility along a north 30 degrees east axis. The coulee is exceptional in size and is likely due to extraordinary river discharge during prehistoric catastrophic floods. The western edge of Coyote Coulee slopes at 5 to 10%. The eastern edge is an escarpment that rises 60 to 90 feet at a 30 to 45% slope. West of Coyote Coulee, the land surface consists largely of rolling hills. East of Coyote Coulee, the land slopes gently (U.S. Army 2010).

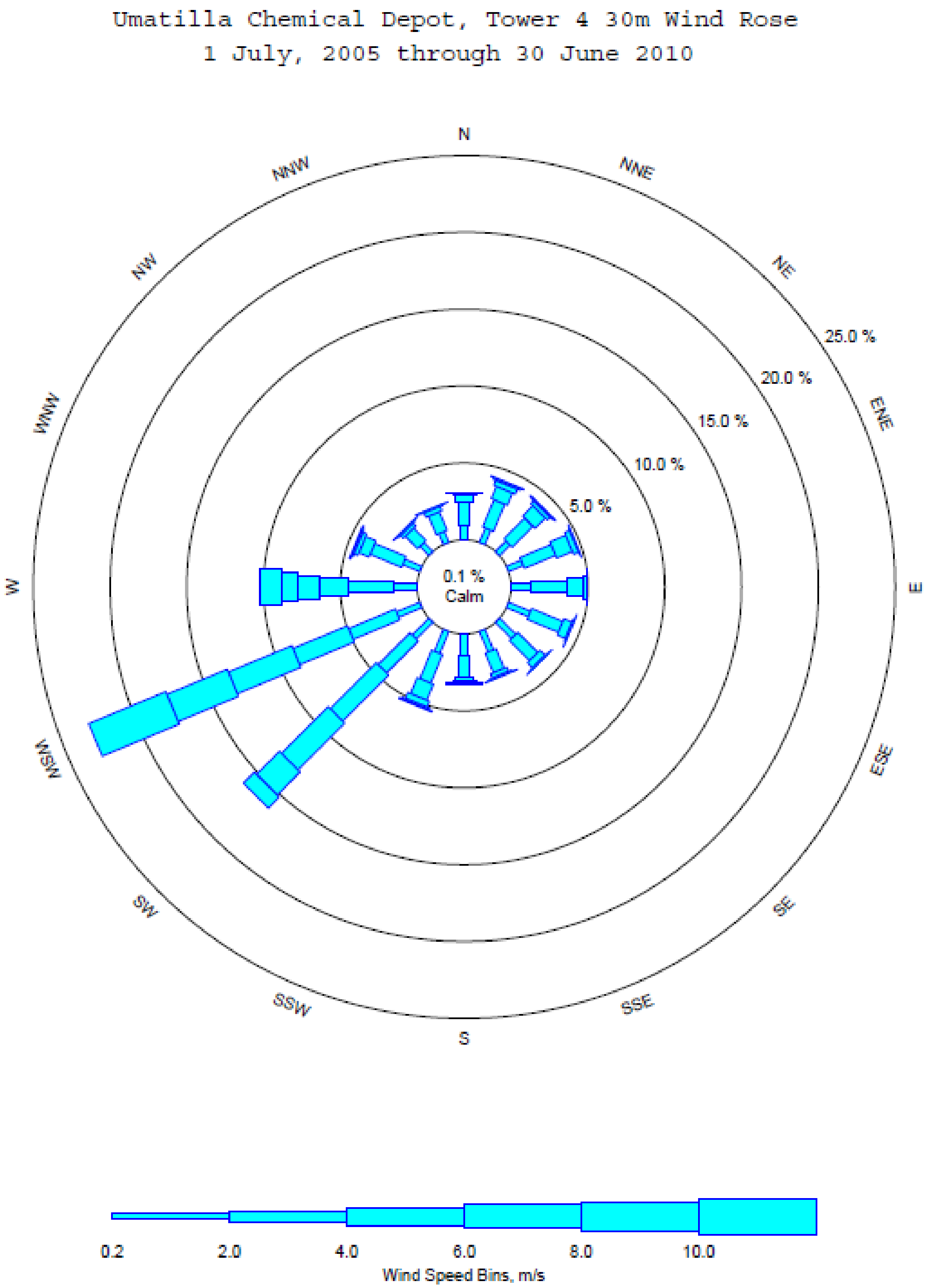

Figure 3. Wind Rose for UMCD Meteorological Tower

2.3 Demographics and Land Use

Towns near the UMCD include Hermiston, Umatilla, and Irrigon, Oregon, located 4, 6, and 8 miles from the site, respectively. UMCD is located approximately 3 miles south of the Columbia River and the border with Washington State. Nearby towns in Washington include Kennewick, Pasco, and Richland at approximately 22, 23, and 25 miles away, respectively. In 2005, within a 20-mile radius from UMCD, there was an estimated population of 53,318, which increases seven-fold with a radius of 50 miles. The majority of the population in the surrounding area of UMCD is within the age bracket of 21 to 64 years of age. This age distribution is consistent within a 50 to 150-mile radius (U.S. Army 2010).

The majority of the area surrounding UMCD is rural, agricultural cropland, paper pulp orchards, and pastures. Land use for the areas immediately adjacent to the installation are zoned agricultural (Umatilla and Morrow Counties). In recent years, local farmers and businesses have diversified the land use to include food processing. Important agricultural products include wheat, fruit, timber, and cattle (U.S. Army 2010).

2.4 Geology and Soils

Basaltic lava flows of the Columbia River Group, Miocene, and Pliocene in age and approximately 10,000 feet thick, underlie all of the lowlands areas and form the down-warped bedrock surface of the Dalles-Umatilla Syncline. UMCD is near the base of the south flanks of this broad syncline. The underlying basalt is composed of layers of separate basaltic lava flows, each of which is as much as 100 feet thick. Dense, hard olivine basalt at the base of each layer grades upward to softer, vesicular, and scoriaceous zones at the top. Some interlayers of clay, or clay and tuffaceous sand, up to 100 feet thick, are also present in the group (U.S. Army 2010).

Below the 751-foot elevation, which includes the entire UMCD, the basaltic bedrock is generally covered with as much as 200 feet of Pleistocene alluvial deposits. These surface deposits are generally permeable silts, sands, and gravels, with some cobbles to the west of Coyote Coulee. Much coarser permeable deposits containing considerable quantities of boulders occur along the east wall of the Coulee and toward the east side of the installation (U.S. Army 2010).

Soils at UMCD consist of sandy loam and coarse sand developed primarily from the alluvial deposits. The soils have been modified by wind action. The upper 8 inches of soil consist of a noncalcareous, loose, fine to medium-loamy sand. The 8 to 32-inch depths consist of fine-to-medium sand, which overlies 8 inches of sand containing no organic matter. Below 40 inches, the soil consists of gravel and gravelly sand with varying amounts of cobbles (U.S. Army 2010).

2.5 Water Resources

There are no surface water bodies on the installation; all waters infiltrate into the desert soils before running off onto lower surrounding lands. Because of the minimal amount of precipitation and very permeable soils at UMCD, there is little surface runoff. The closest surface water sources are the Columbia River, located 3 miles north of the site, and the Umatilla River, located approximately 2 miles to the east (U.S. Army 2010).

Groundwater occurs beneath the UMCD in a number of distinct hydrogeologic settings, in a series of relatively deep confined basalt aquifers and in a highly productive permeable unconfined aquifer to the south of UMCD (extending off-post). The unconfined aquifer at UMCD consists of the alluvial deposits and the weathered surface of the Elephant Mountain Member basalt, and is overlain by approximately 20 to 125 feet of unsaturated alluvial sand and gravel. Depth to groundwater ranges from 60 to 100 feet below ground surface. Three municipal water systems – Hermiston, Umatilla, and Irrigon – draw from groundwater within a 4-mile radius of UMCD. Approximately 1,500 wells were identified within this 4-mile radius, the majority of which are used for domestic and irrigation water. The Columbia River is a major source of potable and irrigation water in the region, and is also used for recreation, fishing, and the generation of hydroelectric power. The Umatilla River is a tributary to the Columbia River, and its principal use is for irrigation (U.S. Army 2010).

2.6 Water Systems

The water supply at UMCD is obtained from seven on-site deep wells installed into the basalt aquifers (see Appendix B for a well location map). The Administrative Area was supplied by Wells 1 and 2 (328 feet and 361 feet deep, respectively). Well 3 (453 feet deep) supplies the I-Block buildings. Wells 4 and 5 (both 600 feet deep) serve the west area. The north area is supplied from Wells 6 and 7 (709 and 679 feet deep, respectively). Analytical data show that the water is of excellent quality in all of the wells (U.S. Army 2010). Wells 1 and 2 have not been used for about 10 years; Wells 4 and 5 now also supply the Administrative Area.

From 1990 to 1993, 62 groundwater monitoring wells were installed throughout the facility, as part of the Remedial Investigation/Feasibility Study (RI/FS). Investigative and characterization activities subsequent to the RI/FS have added numerous additional wells to further characterize site conditions. To date, there have been a total of 120 groundwater monitoring wells installed at the facility. Data obtained from these wells suggest that the natural direction of groundwater flow is northward, toward the Columbia River. However, irrigation pumping of the shallow alluvial aquifer causes groundwater in the south and central part of UMCD to flow to the south during the summer and fall (U.S. Army 2010).

2.7 On-Site Drainage

The storage facility structures are located so that water does not run toward any buildings. The local relief is such that the UMCD generally sheds storm water to the south and east in the vicinity of J-Block and K-Block and to the southwest in the vicinity of Building 203. There is a large drainage feature running from north to south between J-Block and K-Block and E-Block and D-Block, through the center of the UMCD. This drainage does not normally contain surface water but might do so during periods of intense precipitation. However, none of the permitted storage igloos are in the low-lying areas. Due to the relative low mean annual precipitation, large storm water runoff events are uncommon (UMCD Permit Application).

Building 203 is at the upper end of a small (20 acre) drainage area, but the combination of the small drainage area size, building construction, surface drainage away from the building, and 6-inch curbs surrounding the CSF make flooding during a 100-year event improbable (UMCD Permit Application).

2.8 Adjacent Properties

The UMCD Environmental Condition of Property report (U.S. Army 2010) summarized two efforts to identify potential off-site contamination sources for the UMCD. These included a records search of Federal and Oregon State databases conducted as part of a 1994 Community Environmental Response Facilitation Act (CERFA) report and an Environmental Data Resources (EDR) Report compiled in May 2010. Key findings included:

- UMCD is included on the National Priorities List (NPL). No other NPL or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites are located within a 1-mile radius of the facility.
- UMCD is included as a RCRA treatment, storage, or disposal facility (RCRA-TSDF). There is one other RCRA-TSDF site, the UMCDF, located within a 1-mile radius of the facility.
- UMCD is included as a RCRA large quantity generator (RCRA-LQG). No other RCRA-LQG sites are located within a 1-mile radius of the facility.
- UMCD is included in the RCRA conditionally exempt small quantity generator (RCRA-CESQG) list. There is one other RCRA-CESQG site, Hermiston Generating Plant, located within a 1-mile radius of the facility.
- UMCD is included in the Leaking Underground Storage Tank (LUST) Incident Report. There are two other LUST sites located within a 1-mile radius of the facility which include: Hermiston Gas & Deli-Time Oil (Cleanup Complete 10 March 1999) and Umatilla Electric CO-OP (Cleanup Complete 21 September 1990).
- UMCD is included in the Underground Storage Tank (UST) database. There was one other UST site located within a 1-mile radius of the facility stated as “J. Aylett” (a gravel pit).
- UMCD is included in the MANIFEST list associated with hazardous waste. There was one other site, Hermiston Generating Plant, located within a 1-mile radius of the facility that was included in the MANIFEST list.
- No emergency response notification spills are reported within a 1-mile radius of the site.

2.8.1 Off-Post Sources of Contamination

Nitrate/nitrite contamination is common in groundwater of the Lower Umatilla Basin (LUB). In a 2003 DEQ LUB Ground Water Management Area (GWMA) Synoptic Sampling Event Report, nitrate concentrations from groundwater samples collected basin-wide were compared to samples collected in 1992. The report determined that nitrate concentrations in the LUB GWMA increased between 1992 and 2003, with more than one-third of the 2003 samples analyzed exceeding the 10 mg/L nitrate drinking water standard. Off-post nitrate/nitrite sources of contamination have likely impacted UMCD. Off-site sources of nitrate/nitrite in the vicinity of UMCD include fertilizer application/irrigation, livestock feedlots, fertilizer manufacturing (southwest of the installation), and private septic systems. Pesticide and herbicide use is likely due to the large amount of off-site agriculture. The report recommended that best management practices be continued and expanded in the basin to reduce the nitrate loading to the groundwater (U.S. Army 2010).

Crop Cultivation
Nitrate fertilizers are used on many of the crops grown in the irrigated areas surrounding UMCD. Nitrate leaching rates from soil to groundwater are likely to be high, and historical nitrate application rates are likely to have been much higher in the past than in recent years. It is estimated that 40 to 60 pounds of nitrates per acre per year may have leached into groundwater from the late 1960s to 1975 (U.S. Army 2010).

Potato Processing
Lamb-Weston of Hermiston operates a potato processing plant east of UMCD and disposes of process wastewater by irrigation in two areas. One area (1.5 square miles) is just east of the northeast corner of UMCD; the second area is approximately 1 mile south of the southeast corner of UMCD. Process wastewater from the plant is discharged first into a holding pond and then is used for irrigation. In the area east of UMCD, nitrate and groundwater elevations are being monitored by 10 wells located within and at the boundaries. Six of the ten wells had nitrate/nitrite levels generally above 10,000 μg/L during the period November 1986 to January 1991 (U.S. Army 2010).

Livestock Farming
A hog feedlot was operated immediately south of the UMCD Administrative Area until 1987. Operations began around 1965 based on signs of animals in 1965 aerial photographs. This farm corralled up to 20,000 hogs. Concentrations of farm animals are potential sources of nitrate due to their wastes (U.S. Army 2010).

3.0 UMCD FACILITY AND OPERATIONAL HISTORY

3.1 General Facility History

The facility was established as the Umatilla Ordnance Depot (Depot) in 1941 as an ordnance facility for storing conventional munitions in support of the United States' entry into World War II. Subsequently, the functions were extended to include ammunition demolition (1945), renovation (1947), and maintenance (1955).

The construction of 1,001 ammunition storage igloos began in February 1941. A total of 1,002 igloos were built over the life of UMCD. One of the original 1000 igloos (B-1014) exploded, and two new igloos (1901 and 1902) were constructed. By the end of 1941, the installation began functioning as an ammunition storage facility. In 1947, an ammunition renovation complex was constructed. Two ammunition maintenance buildings were added in 1955 and 1958. Between 1957 and 1960, approximately 4,000 additional acres of private and public lands around the Depot perimeter were annexed for safety zones.

In 1962, the Depot was renamed Umatilla Army Depot. The Army began storing chemical agent-filled munitions and 1-ton containers of chemical agents at K-Block in 1962.[2] However, no chemical weapons have been used, manufactured, or tested at the site. The chemical munitions were received for storage at the site from 1962 through 1969. The Depot became a reserve storage facility under the command of the Tooele Army Depot, and in 1973 was renamed Umatilla Depot Activity (UMDA). In October of 1995, the Depot was redesignated as the Umatilla Chemical Depot (UMCD).

UMCD's chemical stockpile consisted of projectiles, rockets, land mines, spray tanks, and bombs containing the nerve agents GB and VX. One-ton containers stored at the Depot were filled with GB, VX, and the blister agent mustard (HD). Chemical agent storage facilities were previously operated under the U.S. Army Chemical and Biological Defense Command, and now under the Chemical Materials Activity (CMA). At one time, approximately 12% of the nation's stockpiled chemical munitions were stored within UMCD.

3.2 General Operational History

A variety of activities involving the handling of hazardous substances and generation of listed hazardous wastes have occurred at UMCD through its history. These activities include fuel oil storage and distribution, motor pool and service station operations, munitions renovation, and ammunition maintenance. These activities generated waste petroleum, oil, and lubricants (POL), battery acid, solvents, paints, and pesticides.

[2] Ton containers of mustard (HD) were initially stored outside just north of K-Block in an area identified as Site 10 (part of the Miscellaneous Operable Unit) and later relocated to Building 659. Site 10 was sampled during a 1992 Remedial Investigation with no detection of agent or agent degradation products and no further action was recommended (U.S. Army 2010).

Renovation of conventional munitions also generated hazardous wastes, including red fuming nitric acid (RFNA), aniline, explosive contaminated rinse water, and solvents. Other wastes generated included expired ordnance and ordnance propellant. A timeline of operations follows:

Pre-1941 *Private, county, and Bureau of Land Management land*

- No hazardous substance activities

1941-1945 *Conventional ordnance storage*

- Ordnance storage area
- Vehicle maintenance
- Fuel/oil storage
- Landfills
- Ordnance demolition areas

1947-1962 *Conventional ordnance storage, renovation, and maintenance*

- Ordnance storage areas
- Vehicle maintenance
- Fuel/oil storage
- Landfills
- Ordnance demolition areas
- Ordnance renovation areas
- Ordnance maintenance areas
- Machine shop

1962-1994 *Conventional ordnance storage/demolition and chemical munitions storage and maintenance*

- Ordnance storage areas
- Vehicle maintenance
- Fuel/oil storage
- Landfills
- Ordnance demolition
- Chemical munitions storage areas

1994-Present *Depot realigned, storage and demilitarization of chemical agent*

- Vehicle maintenance
- Fuel/oil storage
- Chemical agent storage
- Chemical demilitarization

UMCD's present mission is the ongoing storage of chemical munitions and their destruction at the UMCDF. Table 1 lists the permitted waste codes that are used throughout the UMCD operations and maintenance activities. As leaks of hazardous waste (including chemical agent) are discovered, they were immediately contained and decontaminated using the appropriate military and UMCD standing operating procedures (SOPs), currently UM-0000-M-002 for GB/VX and UM-0000-M-003 for HD.

Table 1. EPA Waste Codes Used on UMCD

D001-D022	D026-D043	F001-F005	F027
F998 *	F999 *	P998 **	P999 **
U002	U014	U018	U019
U037	U044	U051	U056
U080	U088	U117	U122
U131	U134	U140	U154
U165	U210	U220	U227
U228	U239	U240	

* State of Oregon waste codes for agent residues, F998 for mustard (HD) and F999 for GB/VX.

** State of Oregon waste codes for agent product, P998 for mustard (HD) and P999 for GB/VX.

EPA – Environmental Protection Agency

Source – UMCD RCRA Permit, OR6 213 820 917

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4.0 J-BLOCK AND K-BLOCK IGLOOS

4.1 Unit Description

The J- and K-Block storage facilities consist of standalone magazines built in 1941 by Stevens & Koon, of Portland, Oregon, and J.A. Terteling & Sons, of Boise, Idaho (see Figure 4). The J-Block storage facility includes 88 storage units of which only 14 are permitted to UMCD for the storage of hazardous wastes. Other igloos located within J-Block are either unpermitted or permitted to the UMCDF.[3] The K-Block storage facility includes 90 UMCD-permitted units. The storage units in J- and K-Block each have interior dimensions of 81 ft (25 m) in length, 26 ft (8 m) in width and 13 ft (4 m) in height. All of the magazines are arch-earth-covered and were originally built for the purpose of sheltering and containing conventional weapons (see Figure 5).

When constructed, none of the igloos had electricity, water, temperature controls or other types of special fittings (Panamerican Consultants 2002). When necessary, power can be delivered by portable generator. The floor and walls of each igloo are concrete and meet in a fitted joint at floor level to prevent leakage into or from the igloo (UMCD Permit Application). The floor has a 1.5-inch (4 cm) slope from the floor centerline toward each sidewall. The concrete floor varies in thickness from 5 in. (12.7 cm) along the igloo centerline to 19.5 in. (49.5 cm) at the sidewalls. Gutters run the length of the igloo in the floor along each sidewall to a drain, see Figure 6. The igloos are not connected to any sumps and there have been no releases via the igloo drains. The igloo interior walls and ceiling (but not the floors) were painted white prior to 1980; the paint composition is unknown (possibly a two-part epoxy) and may contain lead.

All K-Block igloos were later retrofitted with drain plugs and monitoring tubes (Figure 7), sealing improvements around doors and vents and passive filters (Figure 8) as vapor containment devices utilized to maintain a “no migration” standard as required by OAR-340-104-1201(3) (OR6 213 820 917). Asphalt apron extensions in front of the K-Block igloos were added in 1998 to support category four traffic – 32,000 pounds for a dual axle tractor trailer (UMCD Permit Application). Exterior power receptacles were later added to each K-Block igloo in 2007.

[3] RCRA closure activities for the UMCDF-permitted J-Block igloos are described in the UMCDF Closure Plan (see Permit Number ORQ 000 009 431).

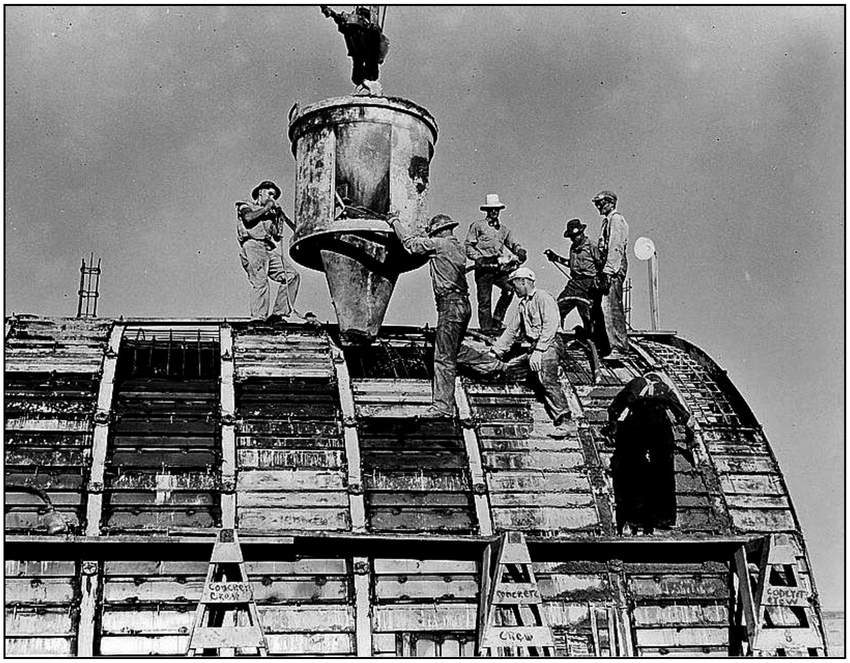

Figure 4. Construction of UMCD Igloos in 1941

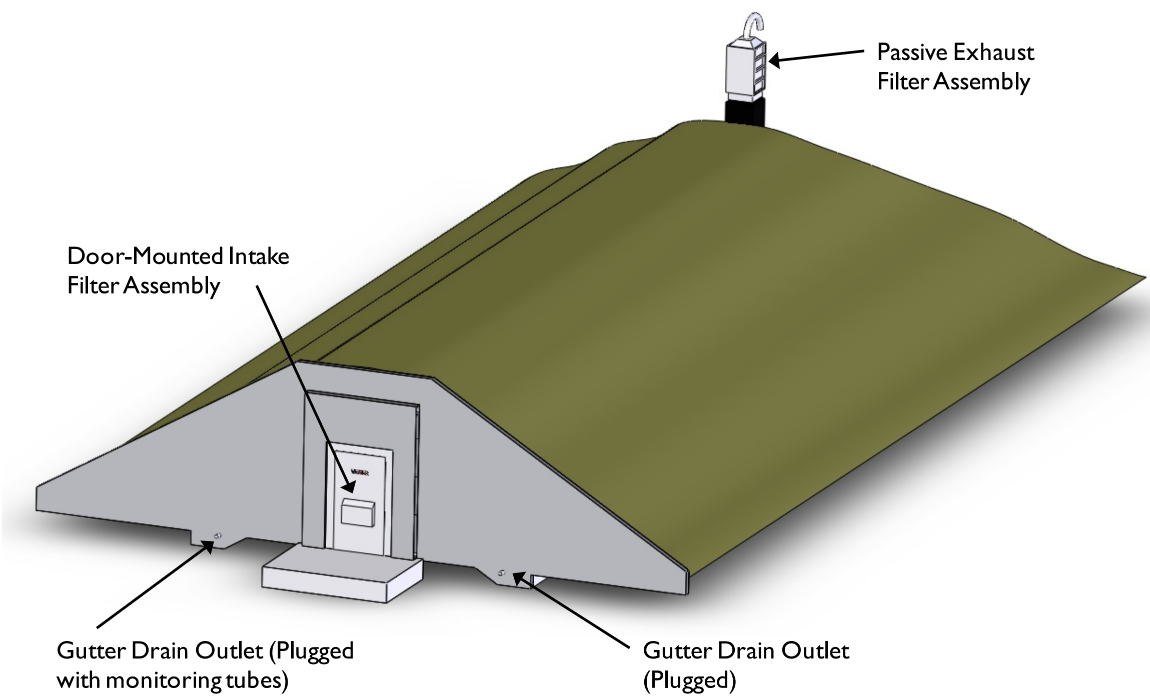

Figure 5. Typical Representation of a K-Block Storage Unit

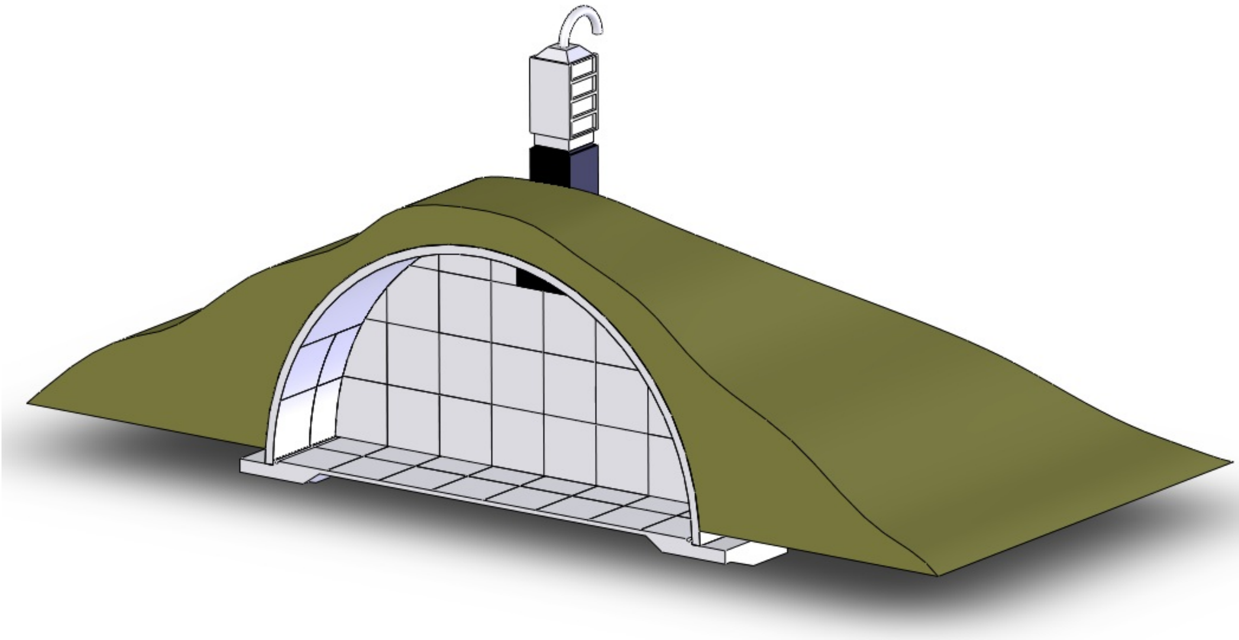

Figure 6. Cross Section through Storage Unit Depicting Gutters and a Gridded End-Wall

Figure 7. Storage Unit Drain Plug (Monitored Configuration)

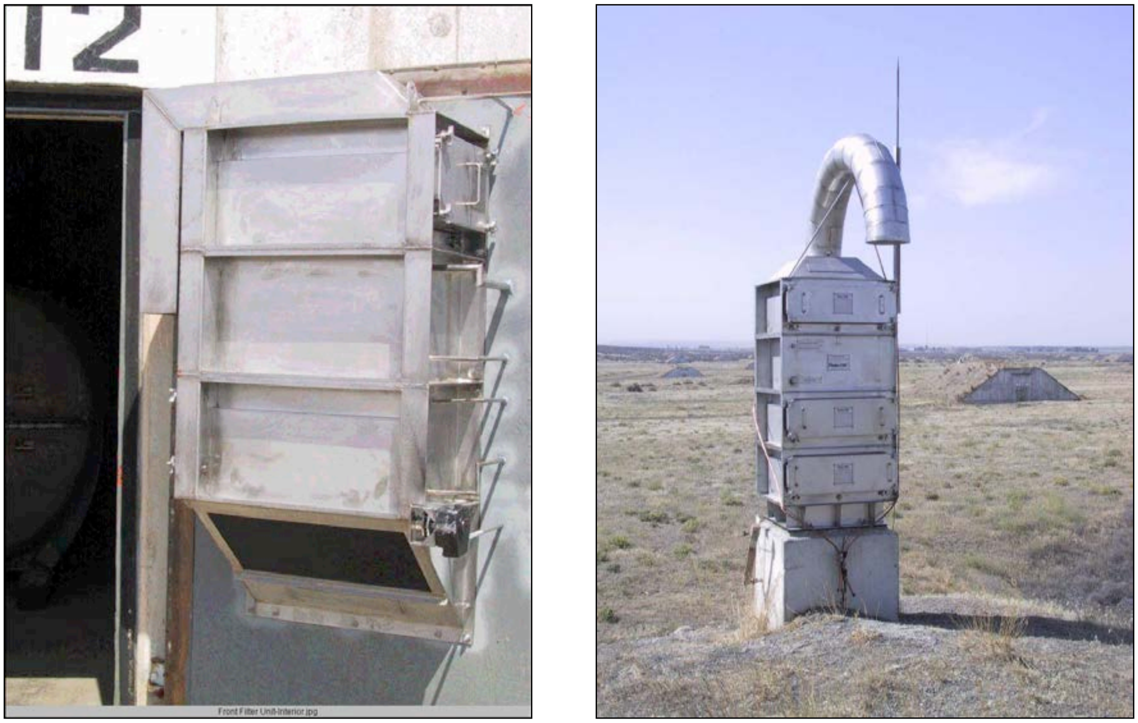

Figure 8. Front Passive Intake Filter and Rear Passive Exhaust Filters

4.2 Operational History

4.2.1 J-Block Igloos

As part of the original UMCD mission, the J-Block magazines were used for sheltering explosive components and conventional munitions (Panamerican Consultants 2002). Fourteen (14) J-Block magazines, J-1797 through J-1810, are permitted by UMCD as 40 CFR 264 Subpart I “container storage units” (see Figure 9). Each J-Block igloo is operated as an individual storage unit. The conventional munitions and components historically stored were removed several years prior to each igloo’s new mission as a hazardous waste storage unit.

Waste contaminated with liquid agent or potentially exposed to vapor-phase agent is stored in the UMCD J-Block igloos. These wastes were generated from the operational activities related to maintenance of the chemical agent items that were stored in K-Block and I-Block and are designated lower-level waste following decontamination as needed. These liquid or solid wastes could include, but are not limited to, personal protective equipment, used equipment (tools), and wooden dunnage. Only agent-contaminated hazardous wastes meeting criteria designation of lower-level wastes are permitted for storage in the J-Block igloos. These may include any of the listed or characteristic hazardous wastes generated by UMCD operation and maintenance activities (see waste codes in Table 1). All of the igloos are permitted for the applicable F999 or F998 waste codes (these are the Oregon waste codes for residues of Chemical Warfare Agents

[CWAs]). Secondary wastes in the igloos are stored in metal or plastic drums, wood/cardboard containers, and metal containers. Secondary containment for containers holding liquid wastes is provided by spill pallets capable of retaining at least 10% of the container capacity.

For conservatism, the maximum permitted inventory was assumed for each igloo. The maximum volume of hazardous waste permitted for each igloo was 21,780 gal (82,446 L) (OR6 213 820 917). It is also assumed that at some point lower-level wastes contaminated with one or a combination of the three chemical agents (GB, VX and HD) were stored in each J-Block igloo. Prior to the use of secondary spill containment (1998) there was no spill history maintained. There were no leaker reports generated for J-Block igloos; however, J-Block inventory records identify overpack containers in eight of the 14 igloos (J-1797, J-1799, J-1800, J-1801, J-1803, J-1804, J-1806 and J-1807) which would be indicative of potential liquid leaks. Overpacking was required for containers that failed inspection based on regulatory standards. Igloo J-1798 is used to store agent-related hazardous wastes that were also contaminated with PCBs. Igloo J-1805 is used for waste segregation prior to storage in other J-Block igloos and thus could also have stored agent-related hazardous wastes contaminated with PCBs. During a routine inventory taken on 8 February 2010, the contents of Igloo J-1801 included two drums of beryllium tools.

The secondary wastes stored in J-Block were segregated into fourteen (14) waste categories (Group I thru Group XIV). Extractive or wipe samples from each group of containers with similar waste streams were collected and analyzed for GB, HD and VX in accordance with the UMCD WAP. DEQ has concurred that these samples are agent-free hazardous waste via the following letters:

- DEQ Item No. 10-0960 (Potts 2010a) – Laundered unserviceable PPE after successful monitoring to below the vapor screening level (VSL) (no waste group assigned).
- DEQ Item No. 10-1122 (Potts 2010b) – Group I wastes.
- DEQ Item No. 10-1230 (Potts 2010c) – Laboratory liquids (Group XII wastes).
- DEQ Item No. 11-0056 (Potts 2011a) – Group II and III wastes.
- DEQ Item No. 11-0555 (Potts 2011b) – Dunnage (Group III wastes).
- DEQ Item No. 11-0757 (Potts 2011c) and 11-0759 (Potts 2011d) – Group IV, X and XI wastes.
- DEQ Item No. 11-0901 (Potts 2011e) – Dunnage (Group III wastes).
- DEQ Item No. 12-0230 (Potts 2012a) – Mask filter carbon (Group III wastes).
- DEQ Item No. 12-0232 (Potts 2012b) – Miscellaneous metal parts waste (Group II, IV, V and IX wastes).
- DEQ Item No. 12-0233 (Potts 2012c) – Stack carbon filters (Group VIII wastes) and wooden pallets (Group III wastes).

- DEQ Item No. 12-0262 (Druback 2012a) – Stack carbon filters (Group VIII wastes).
- DEQ Item No. 12-0263 (Druback 2012b) – HEPA filters (Group III wastes) and wooden table (Group II waste).
- DEQ Item No. 12-0275 (Druback 2012c) – 1000 cfm filters (Group VIII wastes).
- DEQ Item No. 12-0284 (Druback 2012d) – Pre-filters (Group III wastes).
- DEQ Item No. 12-0901 (Potts 2012d) – Real-time monitors (Group IX wastes) and aluminum (Group XIII wastes).

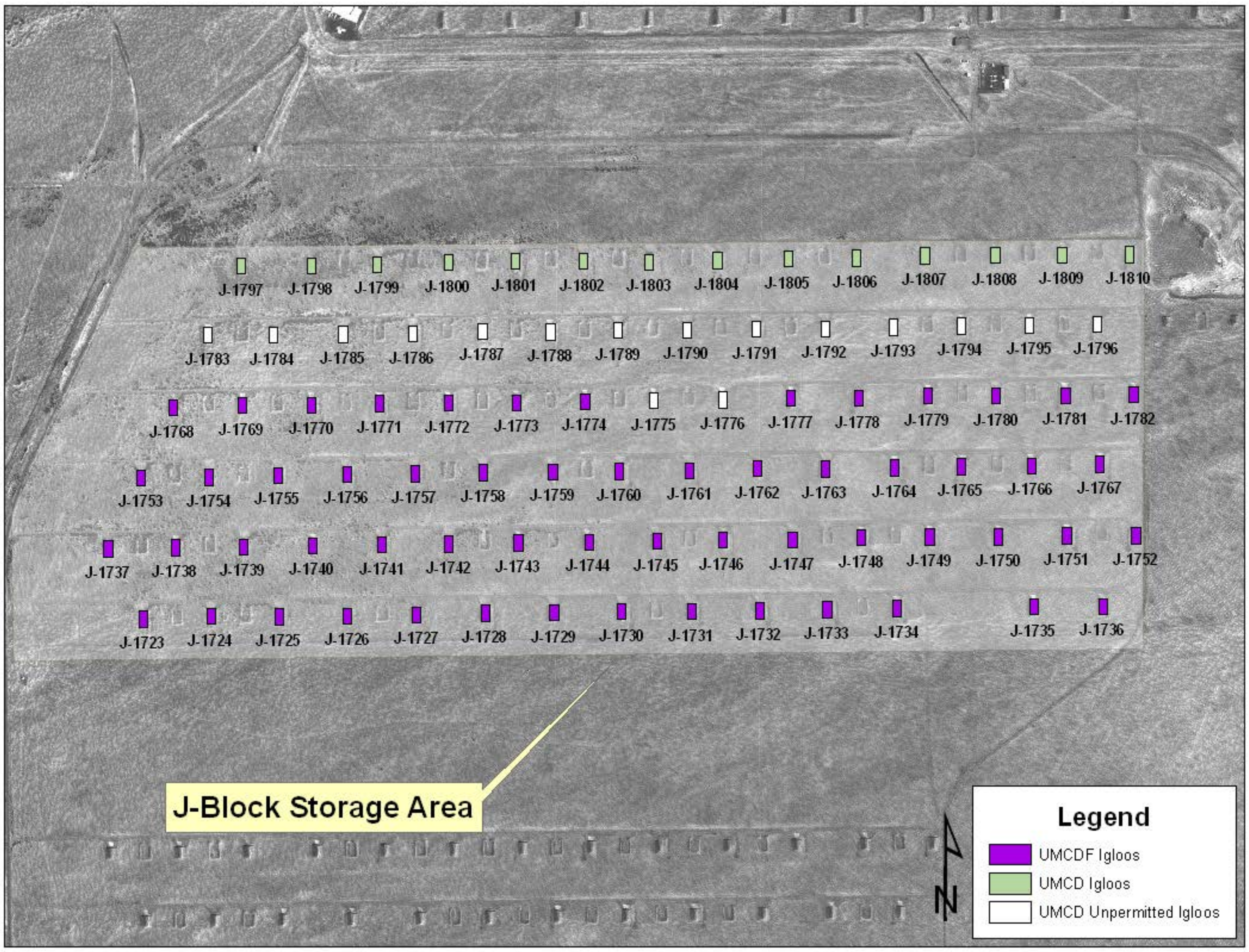

Figure 9. Permitted J-Block Storage Units

4.2.2 K-Block Igloos

As part of the original UMCD mission, the K-Block magazines were used for sheltering explosive components and conventional munitions (Panamerican Consultants 2002). Ninety (90)

K-Block magazines are permitted as 40 CFR 24 Subpart EE storage units, specifically units K-1811 through K-1900 (see Figure 10), each operated as an individual storage unit. Each igloo was operated for storage of munitions and bulk items containing nerve agents (GB and VX) and/or the blister agent mustard (HD) in accordance with 40 CFR 264 Subpart EE, as amended by OAR-340-104-1201 and other applicable Oregon Administrative Rules (OR6 213 820 917). An igloo could store more than one agent over time; however, simultaneous storage of multiple agents in an igloo was prohibited by the permit. During storage of agents, the igloos were maintained at a high security level, including separate double-fenced enclosures with locked gates, 24-hour armed guards and other U.S. Army security measures (OR6 213 820 917).

Operational history for the K-Block igloos is summarized by the table located in Appendix C. This summary includes the type of munition(s) stored within an igloo at various dates based on inventory reports and any leaker reports associated with that igloo. GB and VX munitions were moved into the igloos between 1962 and 1969; mustard (HD) ton containers were moved from I-Block into some of the K-Block igloos in 2006.
Table 2 identifies those K-Block igloos with no history of vapor, exudate (oozed liquid), or liquid leaks (38 igloos total). Table 3 summarizes those K-Block igloos with a history of vapor or exudate leaks (47 igloos total). Table 4 summarizes those K-Block igloos (17 total) with a history of liquid leaks or the leak type is not identified in the source document(s) and is thus labeled as “unknown.” Some igloos will appear in both Table 3 and Table 4 (i.e., the igloo has a history of both vapor and liquid leaks). These three groupings are illustrated in Figure 11.

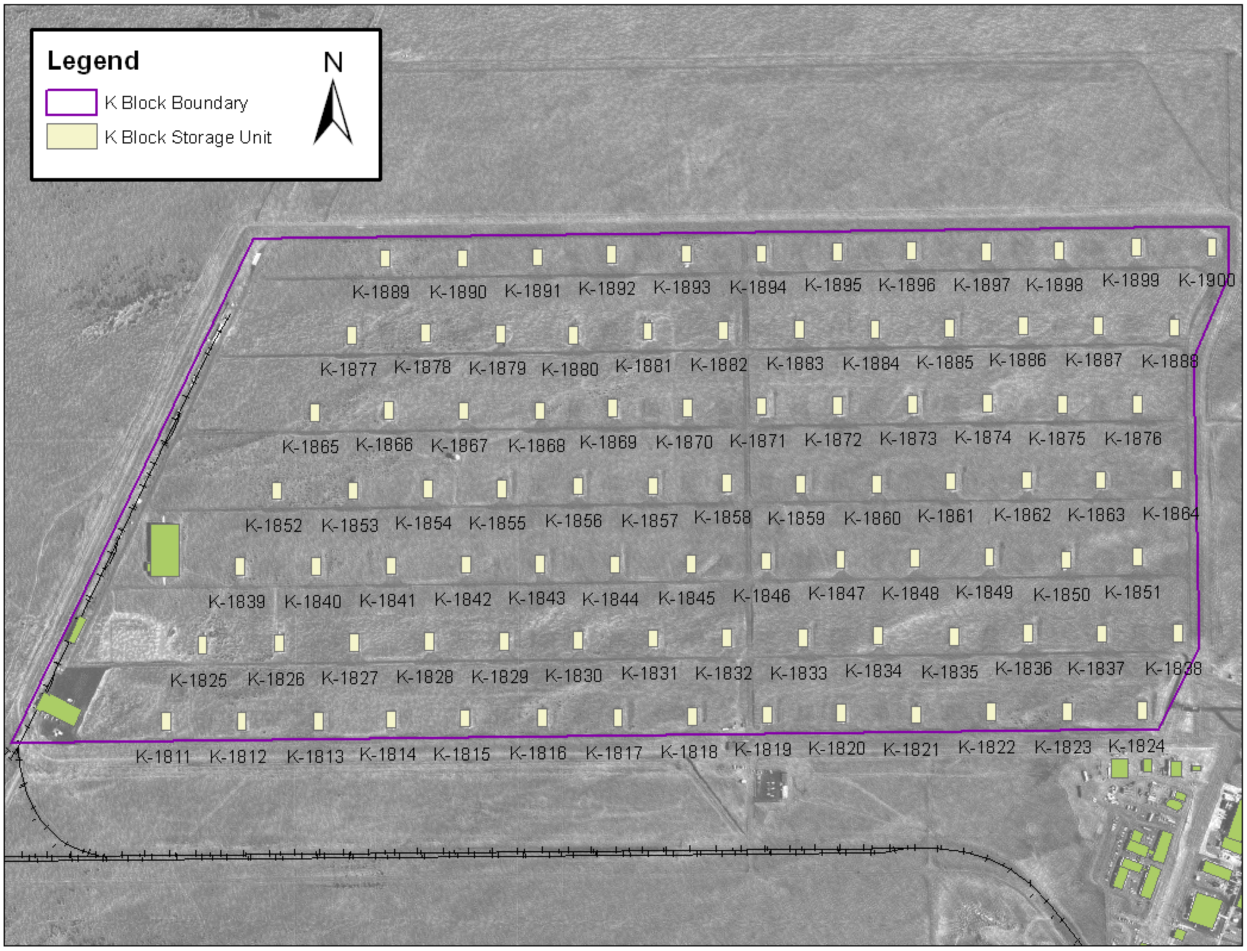

Figure 10. Permitted K-Block Storage Units

Table 2. K-Block Igloos with No Leak History

K-1811	K-1821	K-1857	K-1890
K-1812	K-1824	K-1859	K-1891
K-1813	K-1829	K-1862	K-1892
K-1814	K-1831	K-1867	K-1893
K-1815	K-1833	K-1868	K-1894
K-1816	K-1838	K-1870	K-1895
K-1817	K-1843	K-1872	K-1896
K-1818	K-1852	K-1874	K-1899
K-1819	K-1853	K-1875	
K-1820	K-1855	K-1887	

Table 3. K-Block Igloos with History of Vapor and/or Exudate Leaks

K-Block Igloo No.	Total No. of Vapor & Exudate Leaks Reported	Vapor & Exudate Agent Leaked	K-Block Igloo No.	Total No. of Vapor & Exudate Leaks Reported	Vapor & Exudate Agent Leaked
K-1822	Unknown	GB, VX	K-1861	2	GB
K-1823	1	GB	K-1863	2	HD
K-1825*	144	GB	K-1864	1	GB
K-1826*	25	GB, HD	K-1865*	Unknown	VX
K-1827	1	GB	K-1866	Unknown	GB, HD
K-1828	5	GB	K-1869*	4	GB
K-1834	7	GB	K-1871	1	GB
K-1835*	2	GB	K-1873*	23	GB
K-1836	5	GB, HD	K-1876	1	GB
K-1837	1	GB	K-1877	3	GB
K-1839	1	VX	K-1878	5	GB
K-1840*	Unknown	VX	K-1879*	1	GB
K-1841*	9	GB, VX, HD	K-1880*	1	VX
K-1842	Unknown	VX	K-1881*	88	GB
K-1845	1	GB	K-1882	1	GB
K-1846	2	HD	K-1883	1	GB
K-1848	2	GB	K-1884	3	GB
K-1849	2	GB, HD	K-1885	2	GB
K-1850	1	GB	K-1886	2	GB
K-1851	1	HD	K-1888	1	GB
K-1854	1	VX	K-1897	4	GB
K-1856	1	GB	K-1898	3	GB
K-1858	2	GB	K-1900	1	GB
K-1860	2	GB, HD			

* Along with vapor and/or exudate leakers, these igloos had liquid leaker reports.

Table 4. K-Block Igloos with History of Liquid and/or Unknown Leaks

K-Block Igloo No.	Total No. of Liquid & Unknown Leaks Reported	Liquid & Unknown Agent Leaked	K-Block Igloo No.	Total No. of Liquid & Unknown Leaks Reported	Liquid & Unknown Agent Leaked
K-1825*	18	GB	K-1847	2	HD
K-1826*	13	GB	K-1865*	Unknown	VX
K-1830	1	HD	K-1869*	1	GB
K-1832	1	VX	K-1873*	3	GB
K-1835*	2	HD	K-1879*	1	GB
K-1840*	7	VX	K-1880*	4	VX
K-1841*	10	GB, VX	K-1881*	8	GB
K-1844	1	HD	K-1889	2	GB
K-1846*	1	HD			

* These igloos have vapor and/or exudate leaker reports along with the liquid leaker reports.

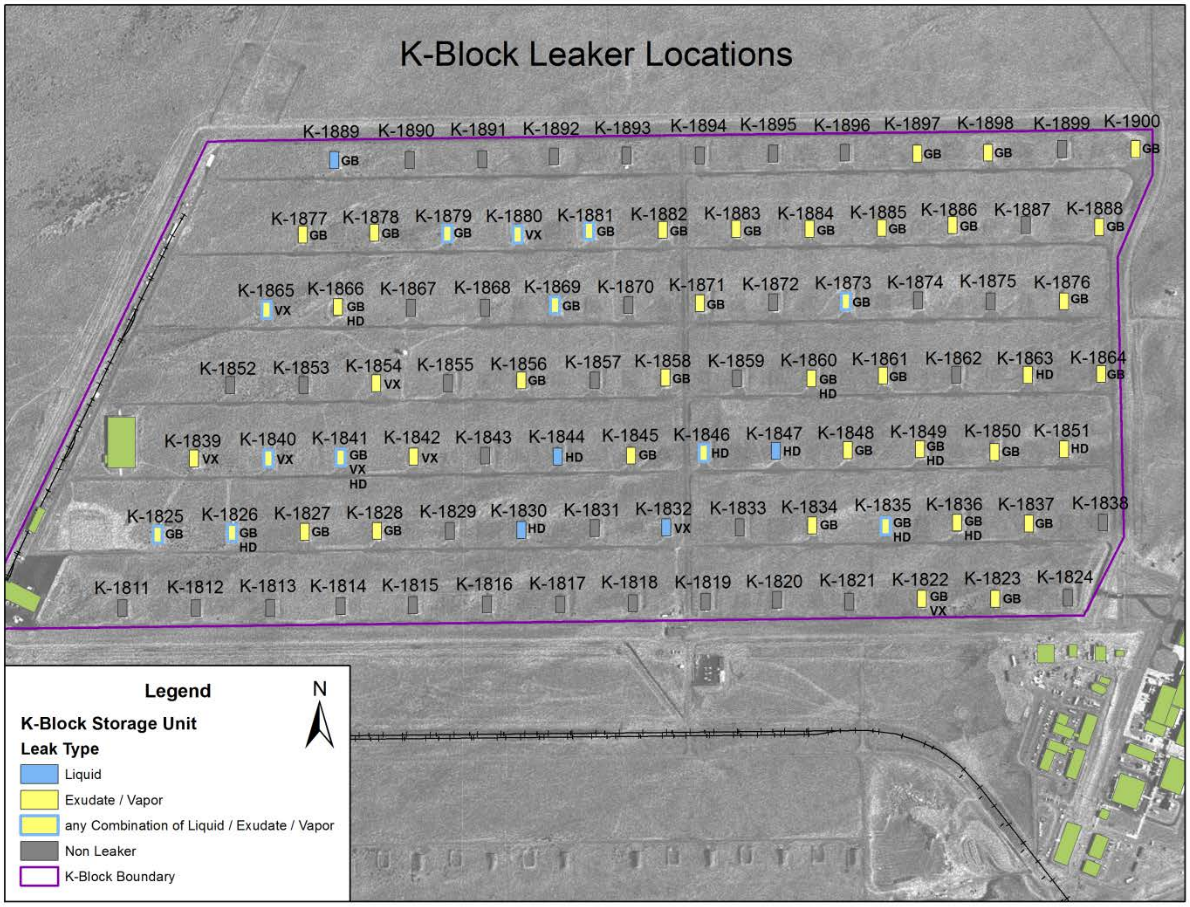

Figure 11. K-Block Leaker Locations

For conservatism, the maximum permitted inventory was assumed for each igloo: 19,965 gal (75,576 L) (UMCD Permit Application). The total munitions inventory for K-Block is given in Table 5. Storage configurations for various munitions and bulk containers are shown in Appendix D. Munitions and bulk items containing GB and VX have been destroyed (as of July 2007 and November 2008, respectively) and are no longer stored in K-Block igloos. Ton containers of mustard (HD) previously stored in 24 I-Block igloos were moved during 2006 into 27 K-Block igloos (see Table 6).[4] K-Block igloos containing the mustard (HD) ton containers were not air monitored to the lower-level waste criteria prior to moving in the ton containers from I-Block. The campaign to destroy the ton containers of mustard (HD) at the UMCDF was completed in October 2011.

[4] RCRA closure activities for the I-Block igloos were completed in early 2009. DEQ approved the RCRA closure of 24 I-Block igloos (I-1699 thru I-1722) on 7 December 2009 (Duval 2009).

Table 5. Total K-Block Munitions Inventory

Munitions Description	Quantity	Average Weight Each (pounds)	Total Weight (pounds)
Mustard (HD) Ton Containers	2,635	3,500.0	9,222,500
VX Ton Containers	1	3,500.0	3,500
GB Ton Containers	4	3,500.0	14,000
GB 155mm Projectiles	47,406	98.9	4,688,453
GB 8-inch Projectiles	14,246	203.0	2,891,938
GB M55 Rockets	91,375	74.0	6,761,750
GB M56 Warheads	67	13.9	931
GB 500-lb Bombs	27	441.0	11,907
GB 750-lb Bombs	2,418	725.0	1,753,050
VX 155mm Projectiles	32,313	99.0	3,198,987
VX 8-inch Projectiles	3,752	203.0	761,656
VX Mines	11,685	23.0	268,755
VX M55 Rockets	14,513	74.0	1,073,962
VX M56 Warheads	6	13.2	79
VX Spray Tanks	156	1,935.0	301,860
Total Munitions Inventory	**220,604**		**30,953,328**

Source: UMCD RCRA Permit (OR6 213 820 917), Attachment 1, Part A Form, Section XIV.

Table 6. K-Block Igloos That Contain Mustard (HD) Ton Containers

K-1825	K-1835	K-1848
K-1826	K-1836	K-1849
K-1827	K-1837	K-1850
K-1828	K-1841	K-1851
K-1829	K-1843	K-1856
K-1830	K-1844	K-1857
K-1831	K-1845	K-1860
K-1833	K-1846	K-1861
K-1834	K-1847	K-1863

The K-Block igloos also managed some PCB articles in the form of PCBs in the fiberglass matrix of the M441 shipping and firing tubes for the M55 rockets. About 75% of the M55 inventory was stored in shipping tubes with less than 50-ppm PCBs; the remaining shipping tubes contained 2,000- to 7,000-ppm PCBs (UMCD Permit Application). Those K-Block igloos that contained M55 rockets (total of 49) are listed in Table 7.

Table 7. K-Block Igloos That Contained M55 Rockets with PCBs

K-1825	K-1836	K-1851	K-1873	K-1890
K-1826	K-1837	K-1856	K-1876	K-1891
K-1827	K-1843	K-1857	K-1880	K-1892
K-1828	K-1844	K-1860	K-1881	K-1893
K-1829	K-1845	K-1861	K-1883	K-1894
K-1830	K-1846	K-1863	K-1884	K-1895
K-1831	K-1847	K-1864	K-1885	K-1897
K-1833	K-1848	K-1870	K-1886	K-1899
K-1834	K-1849	K-1871	K-1887	K-1900
K-1835	K-1850	K-1872	K-1888	

Starting in September of 2010 the passive breather filter units on empty Group D or E igloos (as categorized by the UMCD Storage Unit Operations and Management Plan [SUOMP])[5] were removed and transported to the Pueblo Chemical Depot in Colorado for reuse. Table 8 identifies those igloos from which the passive filter units were removed and the original rear vent caps reinstalled (as of 13 December 2010). Filter units removed from the following leaker igloos were wipe sampled by UMCD Environmental staff on 30 November 2010 prior to shipping to Pueblo: K-1823 (GB/HD), K-1826 (GB/HD), K-1846 (GB/HD), K-1864 (GB/HD), K-1869 (GB/HD), K-1873 (GB/HD), K-1880 (VX), K-1881 (GB/HD), and K-1889 (GB/HD). All wipe sample results for GB, VX, and mustard (HD) were nondetects below the agent-free permit criteria (Martinez 2011).

Table 8. K-Block Igloos With Passive Filter Units Removed

K-1811	K-1820	K-1842	K-1867	K-1876	K-1885	K-1894
K-1812	K-1821	K-1852	K-1868	K-1877	K-1886	K-1895
K-1813	K-1822	K-1853	K-1869	K-1878	K-1887	K-1896
K-1814	K-1823	K-1854	K-1870	K-1879	K-1888	K-1897
K-1815	K-1824	K-1855	K-1871	K-1880	K-1889	K-1898
K-1816	K-1832	K-1858	K-1872	K-1881	K-1890	K-1899
K-1817	K-1838	K-1859	K-1873	K-1882	K-1891	K-1900
K-1818	K-1839	K-1862	K-1874	K-1883	K-1892	
K-1819	K-1840	K-1864	K-1875	K-1884	K-1893	

[5] Group D igloos are empty igloos that have been monitored for 24 hours to the Reportable Limit (RL) defined in the SUOMP. Group E igloos are empty igloos that have been monitored for 24 hours with no detection at or above the RL and monitored quarterly for one year without agent detection at or above the RL (while in Group D status) (Permit Attachment 3).

Significant liquid agent releases in Igloos K-1841 and K-1869 are further described in the following subsections.

4.2.2.1 K-1841 Liquid Spill and Vapor Excursions

All data from the events in K-1841 were summarized from an interim progress report submitted to DEQ (Holliday 2004). On 1 October 2003, GB vapor was detected during routine headwall monitoring of chemical storage igloo K-1841, a storage igloo containing 750 lb. GB-filled bombs. The concentration detected was 0.278 TWA using a Hewlett Packard Dynatherm (HPD) and was confirmed at 0.29 TWA. No agent was detected as having broken through the passive filters. A 1000 cubic feet per minute (cfm) charcoal filter unit was attached to the igloo to prevent chemical agent from migrating to the atmosphere. No visible signs of munition leakage were observed. Due to other leaker isolation operations and additional constraints, the leaker isolation operation in K-1841 was not actively pursued on a daily basis until December 2003.

Leaker isolation activities on 1 December 2003 and 3 December 2003 determined that the leak was coming from the third stack of bombs, located about 21 feet from the igloo entry door. A stack or row consisted of approximately 36 bombs, two to a pallet with a total of 18 pallets. On 4 December 2003 crews separated Stack 3 into groups of 2 pallets totaling 9 groups and each group was tented. These groups were monitored with a high on group 3 at 20.4 TWA and a low on group 9 at 0.3 TWA.

On 8 December 2003, shortly after crews exited the igloo, GB agent was detected on the apron outside the igloo about 20 feet southeast of the igloo door (downwind) at 0.83 TWA; it was confirmed at 0.73 TWA. No agent was detected between the filters on the 1000 cfm unit and Perimeter Monitoring Network (PMN) results for this date showed no agent was detected. Leaker isolation activities for Stack 3 continued the following day (December 9). The leaking munition was identified and placed in an overpack container staged inside and to the right of the igloo door.

From December 10 to 16, crews continued to perform leaker isolation operations as described for December 8 due to elevated monitoring readings. On 17 December 2003, during continued leaker overpack operations, readings inside the igloo were constant at 300 TWA. Elevated readings were due to only partially torquing the bolts of an overpack container loaded on the previous day. The bolts were torqued and the container was decontaminated, wrapped and then loaded into a transport van for movement to the leaker isolation igloo (K-1881).

On 20 December 2003, isolation crews inside K-1841 discovered approximately 4 ounces of liquid GB agent inside a plastic bag that contained two suspect leaker bombs. As a second crew was moving the leaking bombs into an overpack container, a liquid puddle was discovered on the igloo floor under the leaking bomb pallet.[6] The puddle was estimated to cover an area of approximately 8 x 10 inches (about one-fourth cup of liquid). The crew decontaminated and

[6] The leaking munition was located in the third row from the entrance door (the location within the row was not identified). Standard munition storage layouts locate the leak area approximately 6.4 m (21 ft) north of the door.

neutralized the liquid agent inside the leaking bag and on the igloo floor. Of the two bombs on the original pallet, one bomb was visually identified as leaking when it was observed that liquid was dribbling out the rear fuze well. The leaking bomb was surface decontaminated, wrapped in a plastic bag, placed inside an overpack container located just inside the open door of the igloo and sealed. Approximately 5 minutes later, a reading of 1.93 TWA was detected 100 feet downwind (north) of K-1841. An additional 1000 cfm filter unit was attached to the front door filter and additional Real-Time Analytical Platforms (RTAPs) were dispatched downwind of the igloo. Subsequent readings that day were negative and all filter units were tested at mid-bed with negative results.

From 21 December 2003 through 15 January 2004, daily monitoring occurred with continuous active filtering of the igloo. Agent concentrations inside the igloo were greatly diminished and were consistent with what would be expected inside a structure that had experienced such high level concentrations. Continuous filtration and monitoring was maintained in K-1841. In September 2004, the igloo was monitored for three consecutive days without filtration with negative results. Active filtration with the 1000 cfm units ceased and the event was closed.

4.2.2.2 K-1869 Liquid Spray Event

Interviews with UMCD Chemical Operations personnel indicated that in K-1869, possibly during 1997, liquid agent sprayed from a munitions' lifting lug sampling port onto the sidewall of the igloo. Inventory records show that only 155-mm projectiles containing GB were stored in this igloo (see Appendix C). Decontamination activities were performed without delay according to existing UMCD SOPs. The leaker munition was located in the second row of munitions (from the entrance door) on the "B" or west side of the igloo. This locates the spray area along the igloo's western sidewall about 3.7 m (12 ft) north of the front end wall and door. The amount of GB sprayed onto the sidewall is unknown; however, the spray/decontaminated area may extend as high as 3.7 m (12 ft) up the sidewall.

4.3 Conceptual Model

The conceptual site model (CSM) is well defined for the J- and K-Block storage facilities. The CSM (as summarized below) suggests there is a moderate potential for GB, VX, or mustard (HD) to be present in the storage units above the permit compliance concentrations. During selection of potential contaminants of concern, consideration is given to munitions and explosive components historically stored, as well as the current storage of UMCD secondary waste (J-Block) or chemical agent (K-Block). Residual nonagent constituents are expected to be present at acceptable levels. This CSM also considers the data generated as a result of previous relevant sampling activities. Eight (8) significant factors strongly influence this CSM:

1. All 14 J-Block igloos were used for storing lower-level secondary waste.
2. Based on a lack of leaker reports and inventory overpack records, it is conservatively assumed (but unlikely) that liquid wastes were released in eight of the 14 J-Block storage units. However, based on the various agent-free waste determinations, the resulting potential for CWA contamination on the floor is highly unlikely and thus assumed to be approximately

the same for all 14 J-Block storage units. The nature and similarity of the floor is equivalent throughout each unit.

3. The K-Block igloos stored chemical agents in munitions or bulk storage containers.
4. Based upon a review of the operating records, no liquid or vapor CWAs were released in 38 of the 90 K-Block igloos. The resulting potential for CWA contamination on the floor is approximately the same for these storage units. The nature and similarity of the floor is equivalent throughout each unit.
5. In 35 K-Block igloos there is a history of CWA vapor detections. After mitigation, each igloo was successfully monitored to below the WPL. The resulting potential for CWA contamination on the floor is approximately the same for these storage units. The nature and similarity of the floor is equivalent throughout each unit.
6. In 17 K-Block igloos there is a history of CWA liquid releases. After leaker isolation and wet decontamination activities, each igloo was successfully monitored to below the WPL. The resulting potential for CWA contamination on the floor is approximately the same for these storage units; however, the nature and similarity of the floor may vary throughout each unit.
7. The K-Block igloos were regularly air monitored and visually inspected; any spills were immediately wet decontaminated until the unit was successfully monitored to below the WPL.
8. The J-Block igloos were regularly visually inspected; any spills were immediately wet decontaminated until the unit was successfully monitored to below the WPL. Air monitoring was performed only during waste segregation activities.

Considering these factors, it is evident from the diversity in igloo storage missions and history, that there is a need to identify subpopulations of igloos to determine the appropriate number of samples for closure verification sampling. This igloo categorization will support the development of the sampling regime. The following means of categorizing the igloo populations are utilized:

Category 0 — No history of CWA stored in the igloo.

Category 1 — No history of vapor or liquid CWA leaks and only wastes monitored to less than the WPL (or never exposed to agent) were stored in the igloo.

Category 2 — No history of vapor or liquid CWA leaks and wastes monitored above the WPL, or chemical agent munitions were stored in the igloo.

Category 3 — The igloo had a history of CWA vapor leaks.

Category 4 — The igloo had a history where liquid CWA was either confirmed or suspected on the floor.

Categories 0 thru 3 are identical to those identified for the closure of the UMCDF J-Block igloos; however, there are no Category 0 igloos in either K-Block or UMCD J-Block. Category 4 was added to capture those igloos where liquid releases had occurred (a scenario not found in the UMCDF J-Block igloos). A final assessment of the igloo categories will be conducted at the end of storage activities to include any vapor or liquid leaks not previously identified in Section 4.2.

As documented in the I-Block Closure Certification Packages (VET-1332-RPT-022), explosive and munitions components historically stored in these igloos likely contributed metals to the debris present in the igloos, but are not anticipated to pose a significant risk of contamination. The dust and debris collected during dry decontamination will be sampled and analyzed to support waste characterization.

Based on the details of the operational history evaluation, there is a moderate risk of surface contamination within the UMCD J- and K-Block storage igloos. The following items are to be considered when establishing a baseline characterization approach for the inner storage unit surfaces:

- The vapor densities of the CWAs were between 4.83 and 9.2, with moderate volatility (Refer to Section 4.4). These chemical properties indicate that GB, VX, and mustard (HD) will most likely settle in low areas (floors and lower walls), as opposed to rising to the ceiling in the storage magazine atmosphere; thus, only the lower 6.6 ft (2 m) of the domed ceiling (hereafter identified as the sidewalls) are sampled instead of the entire ceiling. Due to a known GB spray onto the sidewall of K-1869, wipe samples above 6.6 ft (2 m) are required in this igloo.
- In J-Block, solid waste containers were stacked two-high during storage in three rows; each row containing two drums (see Figure 12 for a full storage configuration of a UMCD J-Block igloo). Liquid waste containers in J-Block are only one container high and are placed on spill pallets. In K-Block, some munition containers are stacked as much as five units high. The various storage configurations for K-Block are located in Appendix D.
- Passive ventilation and airflow through the magazine was from front to back.
- Since liquids have been released to the inner concrete surfaces of the magazine, the risk of CWA persistence on interior surfaces is moderate. There is no evidence of liquid releases at the igloo entrance; therefore the igloo door seals will not be sampled. Since there have been no releases via the drains, this precludes the need to sample the igloo drains or sampling ports.
- Due to gravity, the risk of contamination from liquid leaks is higher for the floor (including gutters) than the end walls and sidewalls (with the exception of K-1869).
- The risk of contamination is approximately the same for the end walls (front and back) and sidewalls. However, the risk for the end walls was evaluated as slightly higher than that for the sidewalls because of the preferential front-to-back flow path established by the passive ventilation within the igloo.

While the CSM recognizes the potential for contamination above the permit compliance concentrations is moderate, it is anticipated that all igloos will be closed successfully utilizing this Closure Plan. The conceptual site model will be refined as more data becomes available.

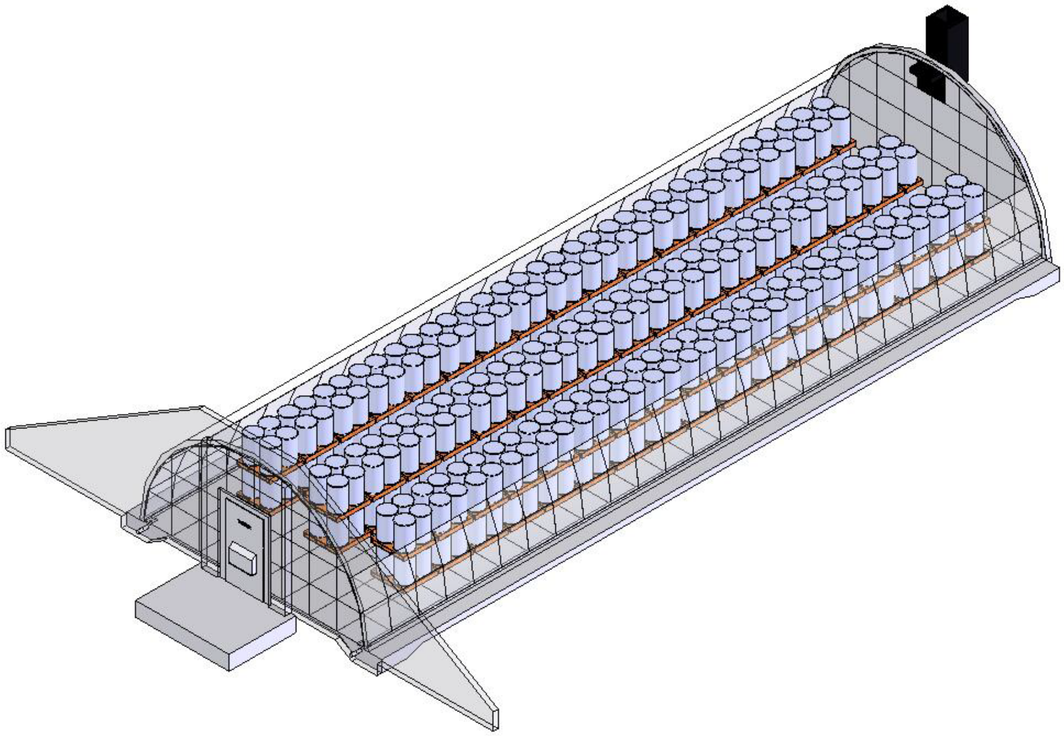

Figure 12. Depiction of a UMCD J-Block Storage Igloo at Maximum Capacity

4.4 Constituents of Concern

A list of potential constituents of concern (COCs) for the UMCD units was identified based on a review of the Permit, the Permit Application, and historical operations and storage records. The COCs can be categorized into groups:

1. Chemical warfare agents (GB, VX, and mustard [HD]).
2. Agent-degradation products,
3. RCRA metals,
4. Organic compounds,

5. Polychlorinated bipheynels (PCBs), and
6. Explosive component residues (Research Department Explosives [RDX] and 1,2,4-Trinitrotoluene [TNT]).

The CWAs potentially present as contaminants in the igloos would be derived from either the chemical agents stored (K-Block) or the secondary waste stored during UMCD activities (J-Block). See Table 9, Table 10, and Table 11 for the physical properties of mustard (HD), GB, and VX. The closure performance standards relevant to CWAs are the permit compliance concentrations ("agent-free criteria") for each agent (see Table 12).

Table 9. Mustard (HD) Physical Property Information

Physical Parameter	Results
Chemical Name	Sulfur Mustard
Chemical Formula	$C_4H_8Cl_2S$
Molecular Weight	159.08
Vapor Density (Air = 1 at STP)	5.5
Specific Gravity	1.27 at 25 °C
Volatility	600 mg/m^3 at 20 °C
Freezing Point	14.5 °C (58.1 °F)
Boiling Point	217.5 °C (423.5 °F)
Vapor Pressure	0.11 mm Hg at 25 °C
Flash Point	105 °C (221 °F)
Viscosity	5.17 centipoises at 25 °C
Color	Amber to Black (can be clear if purity is high)
Odor	Garlic or horseradish odor
Special Properties	Permeates ordinary rubber
Solubility Properties	Completely soluble in acetone, tetrachloroethane, ethyl benzoate, and ether
Physical State	Viscous Liquid

STP = Standard temperature and pressure
°C = degrees centigrade (Celsius)
°F = degrees Fahrenheit
mg = milligram
m^3 = cubic meter
mm Hg = millimeter mercury
Table adapted from UMCD Storage Unit Operations and Management Plan (Permit Attachment 3).

Table 10. GB Physical Property Information

Physical Parameter	Results
Chemical Name	Sarin
Chemical Formula	$C_4H_{10}FO_2P$
Molecular Weight	140.10
Vapor Density (Air = 1 at STP)	4.83
Specific Gravity	1.0919 at 25 ˚C
Volatility	22,000 mg/m^3 at 25 °C
Freezing Point	-56 °C (-69 °F)
Boiling Point	158 °C (316 °F)
Vapor Pressure	2.9 mm Hg at 25 °C
Flash Point	Does not Flash
Viscosity	1.283 centipoises at 25 °C
Color	Clear
Odor	None
Special Properties	None
Solubility Properties	Miscible with water and readily soluble in all organic solvents
Physical State	Viscous Liquid

STP = Standard temperature and pressure
°C = degrees centigrade (Celsius)
°F = degrees Fahrenheit
mg = milligram
m^3 = cubic meter
mm Hg = millimeter mercury
Table adapted from UMCD Storage Unit Operations and Management Plan (Permit Attachment 3).

Table 11. VX Physical Property Information

Physical Parameter	Results
Chemical Name	Methylphosphono-thiolate
Chemical Formula	$C_{11}H_{26}NO_2PS$
Molecular Weight	267.37
Vapor Density (Air = 1 at STP)	9.2
Specific Gravity	1.0113 at 25 °C
Volatility	8.9 mg/m^3 at 25 °C
Freezing Point	-50 °C (-58 °F)
Boiling Point	298 °C (568 °F)
Vapor Pressure	0.00063 mm Hg at 25 °C
Flash Point	159 °C (318 °F)
Viscosity	10 centipoises at 25 °C
Color	Clear to Straw
Odor	None
Special Properties	None
Solubility Properties	Best solvents are dilute mineral acids
Physical State	Viscous Liquid (similar to motor oil)

STP = Standard temperature and pressure
°C = degrees centigrade (Celsius)
°F = degrees Fahrenheit
mg = milligram
m^3 = cubic meter
mm Hg = millimeter mercury
Table adapted from UMCD Storage Unit Operations and Management Plan (Permit Attachment 3).

The primary pathways for degradation of CWAs in the environment are hydrolysis, oxidation, photolysis, and microbial degradation (VET-1604-RPT-001). Only hydrolysis and oxidation are potential pathways for degradation in this CSM, since they would occur as a result of decontamination efforts using Army protocols, or through contact with the atmosphere. Since there is evidence of liquid releases in some igloos, there is the potential for degradation product production through hydrolysis or oxidation. As a result, degradation products are considered constituents of concern for the K-Block igloos. The degradation products that will be sampled for, based on persistency, include:

- GB products – Isopropyl methylphosphonic acid (IMPA), methylphosphonic acid (MPA), diisopropyl methylphosphonate (DIMP) (an impurity), and dimethyl methyl phosphonate (DMMP) (a stimulant).
- VX products – S-(2-(diisopropylaminoethyl) methylphosphonothioate (EA2192), ethyl methylphosphonic acid (EMPA), and MPA.

- Mustard (HD) product – Thiodiglycol (TDG).

The current and reasonably likely future use of the UMCD, as identified by the Local Reuse Authority (LRA) in the US Army Umatilla Chemical Depot Base Redevelopment Plan (UMADRA 2010) is industrial; therefore, the closure performance standards for agent degradation products will be set at the industrial soil screening values (Table 12). These screening values will initially include the September 2009 DEQ Risk-Based Cleanup (RBC) values (DEQ 2009). For those constituents where there is not an DEQ RBC value, the June 2011 EPA Regional Screening Limit (RSL) value will be used (EPA 2011). The VX degradation products EA2192 and EMPA do not have either an DEQ RBC or an EPA RSL value and thus, will use the Health-Based Environmental Screening Levels (HBESLs) for outdoor worker/adult soil (ORNL 2007).

Prior I-Block data suggests that metals contamination would most likely result from natural materials in windblown dust or as scale and debris from past storage of conventional munitions and components. The igloo interiors will be sampled and analyzed for the RCRA metals most likely present from the previous storage history. The closure performance standards will be set at the industrial soil screening values (Table 12). These screening values will initially include the DEQ RBC values or the EPA RSL (for those constituents where there is not an DEQ RBC value).

Select HWMUs will also be sampled and analyzed for volatile and semi-volatile organic compounds based on the operational history data. The closure performance standards for organic compounds will be set at the industrial soil screening values (Table 12). These screening values will initially include the DEQ RBC values or the EPA RSL (for those constituents where there is not an DEQ RBC value).

PCB contamination is possible in the Building 203 CSF and in igloos that stored M55 rockets, specifically Arochlor 1016 and Arochlor 1254. The closure performance standards will be set at the DEQ RBC industrial soil screening values (Table 12). The DEQ RBC does not include Arochlor specific values, so the general PCB value is used.

Explosives residues are retained as COCs because sufficient data is unavailable to discount them as a potential contaminant where conventional munitions were stored. Therefore, concentrations of explosives components associated with previous storage missions will also be measured. As more data is collected, the CSM will be able to support making a determination as to whether the explosive residues will still be considered a COC. The closure performance standards for explosive residues will be set at the industrial soil screening values (Table 12).

A DEQ approved enforceable mechanism will be put in place to maintain the institutional controls at UMCD for all areas where the intended future use is industrial.

Table 12. Closure Performance Standards for Constituents of Concern

Group	Constituents of Concern (RCRA Waste Code)	CAS ID	Clean Closure Standard [1] (mg/kg)	Where Sampled?
RCRA Metals	Arsenic (D004)	7440-38-2	1.7E+00 (c)	Bldg 203 CSF, J-Block and K-Block Igloos
	Beryllium	7440-41-7	2.0E+03 (c)	J-1801 only
	Cadmium (D006)	7440-43-9	5.10E+02 (new)(c)	Bldg 203 CSF, J-Block and K-Block Igloos
	Chromium (D007)	7440-47-3	1.7E+02[2]	
	Copper	7440-50-8	4.1E+04 (n)	
	Lead (D008)	7439-92-1	8.0E+02 (NA)	
	Manganese	7439-96-5	2.3E+04 (n)	
	Mercury (D009/U151)	7439-97-6	3.1E+02 (n)	
	Nickel	7440-02-0	2.0E+04 (n)	
	Silver (D011)	7440-22-4	5.1E+03 (n)	
Organics	1,1,1-Trichloroethane (F001/F002/U226)	71-55-6	8.30E+05 (new)(n)	Bldg 203 CSF only
	1,1,2-Trichloro-1,2,2-Trifluoroethane (F002)	76-13-1	1.8E+05 (n) [3]	
	1,1,2-Trichloroethane (F002/U227)	79-00-5	2.5E+01(c)	
	1,1-Dichloroethylene (D029/U078)	75-35-4	2.7E+04 (n)	
	1,2-Dichloroethane (D028)	107-06-2	1.5E+01 (new) (c)	
	1,4-Dichlorobenzene (D027/U072)	106-46-7	6.3E+01 (c)	
	2,4,5-Trichlorophenol (D041/F027)	95-95-4	6.2E+04 (n) [3]	
	2,4,6-Trichlorophenol (D042/F027)	88-06-2	2.0E+02 (c)	
	2,4-Dinitrotoluene (U105)	121-14-2	5.5E+00 (c) [3]	
	2-Ethoxyethanol (F005/U359)	110-80-5	2.5E+05 (n) [3]	
	2-Nitropropane (F005/U171)	79-46-9	6.4E-02 (c) [3]	
	Acetone (F003/U002)	67-64-1	6.3E+05 (n) [3]	
	Benzene (D018/F005/U019)	71-43-2	3.4E+01 (c)	
	Carbon Disulfide (F005)	75-15-0	3.7E+03 (n) [3]	
	Carbon Tetrachloride (D019/F001)	56-23-5	3.10E+01 (new) (c)	
	Chlordane (D020/U036)	12789-03-6	7.00E+00 (new) (c)	
	Chlorobenzene (D021/F002/U037)	108-90-7	8.3E+03 (n)	

Table 12. Closure Performance Standards for Constituents of Concern

Group	Constituents of Concern (RCRA Waste Code)	CAS ID	Clean Closure Standard [1] (mg/kg)	Where Sampled?
	Chloroform (D022/U044)	67-66-3	2.5E+01 (c)	
	Cyclohexanone (F003/U057)	108-94-1	3.1E+06 (n) [3]	
	Endrin (D012) Ethyl Acetate (F003/U112)	72-20-8 141-78-6	2.3E+02 (n) 9.2E+05 (n) [3]	
	Ethyl Ether (F003/U117)	60-29-7	2.0E+05 (n) [3]	
	Ethylbenzene (F003)	100-41-4	1.4E+02 (n)	
	Heptachlor (D031)	76-44-8	4.60E-01 (new) (c)	
	Hexachlorobenzene (D032/U127)	118-74-1	1.20E+00 (new) (c)	
	Hexachlorobutadiene (D033/U128)	87-68-3	2.2E+01 (c) [3]	
	Hexachloroethane (D034/U131)	67-72-1	9.00E+01 (new) (c)	
	Isobutanol (F005/U140)	78-83-1	1.80E+05 (new) (n)	
	Methanol (F003/U154)	67-56-1	3.1E+05 (n) [3]	
	Methoxychlor (D014/U247)	72-43-5	3.1E+03 (n) [3]	
	Methyl Ethyl Ketone (D035/F005/U159)	78-93-3	2.0E+05 (n) [3]	
	Methyl Isobutyl Ketone (F003/U161)	108-10-1	5.3E+04 (n) [3]	
	Methylene Chloride (F001/F002/U080)	75-09-2	3.10E+02 (new) (c) [3]	
	n-Butyl Alcohol (F003/U031)	71-36-3	6.2E+04 (n) [3]	
	Nitrobenzene (D036/F004/U169)	98-95-3	2.4E+01 (c) [3]	
	Ortho-Dichlorobenzene (F002/U070)	95-50-1	3.5E+04 (n)	
	Pentachlorophenol (D037/F027)	87-86-5	3.90E+00 (new) (c)	
	Pyridine (D038/F005/U196)	110-86-1	1.0E+03 (n) [3]	
	Tetrachloroethylene (D039/F001/F002/U210)	127-18-4	9.40E+02 (new) (c)	
	Toluene (F005/U220)	108-88-3	7.7E+04 (n)	
	Toxaphene (D015)	8001-35-2	2.0E+00 (c)	
	Trichloroethylene (D040/F001/F002/U228)	79-01-6	4.60E+01 (new) (c)	
	Trichlorofluoromethane (F002/U121)	75-69-4	1.20E+05 (new) (n)	
	Vinyl Choride (D043/U043)	75-01-4	3.9E+00 (c)	

Table 12. Closure Performance Standards for Constituents of Concern

Group	Constituents of Concern (RCRA Waste Code)	CAS ID	Clean Closure Standard [1] (mg/kg)	Where Sampled?
	Xylenes (m-Xylene, p-Xylene and o-Xylene) (F003/U239)	1330-20-7	2.5E+04 (n)	
PCBs	Arochlor 1016	12674-11-2	2.1E+01 (new) (c) [4]	Bldg 203 CSF, J-1798, J-1805, and K-Block Igloos with M55 Rockets (see Table 7)
	Arochlor 1254	11097-69-1	7.4E-01 (new) (c) [4]	
Herbicides	2,4-Dichlorophenoxyacetic acid (D016/U240)	94-75-7	7.7E+03 (n)	Bldg 203 CSF only
Explosive Residues	Composition B	Composition B is a mixture of TNT, RDX, and desensitizer. As a result, there is no specific closure performance standard for Composition B; rather it will rely on the results for RDX and TNT.		
	2,4,6 Trinitrotoluene	118-96-7	7.9E+01 (c) [3]	J-Block and K-Block Igloos only
	RDX	121-82-4	2.4E+01 (c) [3]	
CWA and Agent Degradation Products	GB (F999/P999)	107-44-8	1.6E-02 [5]	J-Block and K-Block Igloos only
	VX (F999/P999)	50782-69-9	1.3E-02 [5]	
	Mustard (HD) (F998/P998)	505-60-2	1.52E-01(c) [5]	
	S-(2-(diisopropylaminoethyl) methylphosphonothioate (EA2192)	73207-98-4	6.8E-01 [6]	
	Methylphosphonic Acid (MPA)	993-13-5	3.7E+04 (n) [3]	
	Ethyl methylphosphonic Acid (EMPA)	1832-53-7	4.2E+03 [6]	
	Diisopropyl methylphosphonate (DIMP)	1445-75-6	8.2E+04 (n) [3]	
	Dimethyl methylphosphonate (DMMP)	756-79-6	1.0E+03 (c) [3]	
	Isopropyl methyl phosphonic acid (IMPA)	1832-54-8	6.2E+04 (n) [3]	
	Thiodiglycol (TDG)	111-48-8	6.8E+04 (n) [3]	

[1] These values were obtained from the Oregon Risk-Based Cleanup (RBC) occupational soil values (DEQ 2009). If an Oregon RBC did not exist for a given constituent, then the June 2011 EPA Regional Screening Levels (RSLs) for industrial soil (EPA 2011) were used. The 2012 updated RBCs and RSLs are designated as "(new)". The 2011 closure performance standards will be used for the closure certification evaluation of the igloos and Building 203 since these activities were initiated prior to the implementation of the newly revised RBCs/RSLs. Closure for the remaining non-HWMUs will be in accordance with the 2012 revised standards.

[2] The DEQ soil background concentration for total chromium for the Deschutes/Columbia Plateau soils was used for the clean closure standard. ODEQ Fact Sheet, Background Levels of Metals in Soils for Cleanups (3/20/2013).

[3] A calculated Oregon RBC was unavailable for this constituent; as a result the EPA RSL was used as an action limit.

[4] Utilized the June 2011 EPA Regional Screening Levels (RSLs) for industrial soil (EPA 2011), as the Arochlor specific values do not exist for Oregon RBC industrial soil values.

[5] This soil value is the agent-free criteria for the water-insoluble solid (WIS) for GB, HD, and VX. Reference is from the "Agent-Free Criteria" of UMCD Hazardous Waste Storage Permit, Waste Analysis Plan.

[6] Health-Based Environmental Screening Levels (HBESLs) for outdoor worker/adult soil (ORNL 2007).

c = carcinogen CWA = Chemical Warfare Agent n = noncarcinogen NA = Not Available new = June 2012 RBC / May 2013 RSL

4.4.1 Development of Performance Objectives for Wipe Samples

In order to compare the analytical results for wipe sampling to the clean closure objectives presented in Table 12, it is necessary to convert mass-per-wipe-area results (μg/cm^2) to a value compatible for use with the mg/kg values from Table 12. The normalization approach previously used in the RCRA closure of Building 659[7] and I-Block will be used. This approach is valid because wipe samples collect residues deposited on a surface (as opposed to destructive sampling of the surface itself). Over a sufficiently small sample area, the sediment on the wipe is representative of a very thin layer of sediment – the same as that removed by the wipe. By assuming a given thickness, and using soil densities typical for the material removed by the wipe, the mass/area results can be normalized as mass concentrations.

To complete this normalization, a 250 cm^2 wipe area, a soil layer thickness of 0.004 in (0.01 cm) and a soil density of 2.65 g/cm^3 will be used.[8] As described in the supporting calculation, VET-1604-CALC-001, "Contractually Required Quantitation Limits Calculations (CRQLs)," these values are consistent with the size and characteristics of local soils. The following conversion is used to complete the normalization:

$$\left(1\frac{mg}{kg}\right)\left(1{,}000\frac{\mu g}{mg}\right)\left(0.001\frac{kg}{g}\right)\left(2.65\frac{g}{cm^3}\right)(0.01\,cm)\left(250\frac{cm^2}{wipe}\right) = 6.625\frac{\mu g}{wipe}$$

To convert laboratory results given in μg/wipe to mg/kg to enable comparison to performance objectives the results are divided by 6.625 as shown below:

$$\left(1\ \frac{\mu g}{wipe}\right)\left(\frac{1\frac{mg}{kg}}{6.625\frac{\mu g}{wipe}}\right) = 0.1509\frac{mg}{kg}$$

4.5 Decision Analysis

Decision-making is usually made in the face of uncertainty. That is, uncertainty should be incorporated directly into the decision-making process. The optimal or best decision is the one for which the total benefits are maximized, and for which there is sufficient certainty in the decision that is made. This latter aspect is related to sample size. As more data are collected, the certainty in the decision increases (or, the uncertainty decreases). However, there are technical risk and costs associated with collecting data, in which case there is a trade-off between further data collection and the value of the information likely to be gained from the data (Black et al, 2007). The purpose of sample size calculations is to find the optimal sample size (i.e., the sample size that provides sufficient value to the decision making process).

[7] The RCRA closure of Building 659 was approved by DEQ on 24 January 2005 (Murphy 2005).
[8] The dominate soil types at UMCD are Quincy fine sand and Quincy loamy fine sand (Soil Survey for Morrow County by Natural Resources Conservation Service). Cited density is for quartz, the major component in sand (*Methods of Mathematical Modeling*, 1991, page 26).

The decision making process, including sample size calculations, follows the Scientific Method. There are several components that are important to the decision making process (Black et al, 2007). The first is a probability distribution to characterize what is known about the underlying process (e.g., the probability of the presence or absence of CWA, or, the average concentration of arsenic). Prior to collection of data, this is often called the prior distribution.

The second component is a functional form for describing data that are, or might be, collected. This is often termed the likelihood function. After data are collected, the data are used to update the prior distribution in order to generate what is often called a posterior distribution.

The third component to decision making is a set of functions that describe the consequences and value of taking a decision action given the true state of the decision parameter. In decision analysis, these are often called loss functions, or, equivalently, utility functions. This includes the consequences of taking further action when in fact a storage unit is clean, or the consequences of declaring the storage unit clean when in fact some contamination exists. The consequences can include economic (e.g., costs of remediation or data collection), environmental (e.g., human health risks), and socio-political (value judgment) factors. Armed with these inputs, the framework for a decision analysis is established (Black et al, 2007). As noted, this approach is consistent with the Scientific Method, which might be described as follows:

1. Ask a question or pose a problem.
2. Assemble and evaluate the relevant current information.
3. Based on current information, design an investigation (data collection) to address the question posed in Step 1. Consider costs and benefits of the investigation, including the value of any information (data) that might be collected in the context of the question posed in Step 1.
4. Recognize that Step 6 is coming.
5. Collect the data.
6. Use the evidence from Step 5 to update the previously available information.
7. Repeat steps 3 through 6 as necessary.

This approach is consistent with the intent of EPA's Quality System (including Data Quality Objectives [DQOs]), but provides a more flexible technical framework for supporting decision making than is traditionally offered (Black et al, 2007).

4.5.1 Principal Study Questions

For this closure project, the principal question asked during the project is:

> *Does verification sampling confirm that the storage unit is ready for RCRA closure? Specifically, are the closure performance standards in Table 12 achieved?*

4.5.2 Alternative Outcomes and Loss Functions

For the UMCD J- and K-Block igloo closure, the following decision possibilities are available when addressing the principal study question:

1. Decide that a storage unit is clean when it is in fact contaminated.
2. Decide that a storage unit is clean when it is in fact clean.
3. Decide that a storage unit is contaminated when it is in fact contaminated.
4. Decide that a storage unit is contaminated when it is in fact clean.

The potential consequences, in the form of benefits, costs, risks and value judgments, of each of these decision options must be characterized to complete the decision analysis. Collectively these form the “loss functions” associated with actions that might be taken. The goal of the decision analysis is to minimize expected losses, which is measured by balancing the characterized losses with their probability of happening. For the current application, these losses have been specified as follows (Black et al, 2007):

Table 13. Loss Functions Used In J- and K-Block Decision Analysis

	Decision	
Actual State	**Declare Unit Clean and propose RCRA Closure**	**Declare Unit Contaminated and Take Further Action**
Igloo is Contaminated	$v+nc$	$u+nc$
Igloo is Clean	nc	$u+nc$

Where:

v – the loss associated with mistakenly declaring an igloo clean when it is in fact contaminated.

u – the loss associated with taking further action.

c – the cost associated with taking and analyzing a single sample.

n – the sample size, or, the number of samples collected.

To simplify this analysis, a loss function is used that requires only three numbers to be assessed, and an assumption is made that, although the consequences are expressed in terms of dollars, other attributes have been incorporated implicitly and translated to dollars. The loss function is intended to capture the full utility of a decision and its outcome. Losses are ultimately measured using one metric, usually dollars. For example, suppose that a storage unit is contaminated, and the decision is made to declare it clean. The resulting loss or cost could ultimately be in terms of dollars incurred by fines or lawsuits and subsequent cleanup costs, in terms of damage or risk from exposure to harmful materials, in terms of reputation of the facility and its operators, and possibly many other terms.

Before addressing a method for assessing these loss functions, some simplifications that have been taken are worth noting. First, the loss function above assigns the same amount of loss to taking further action, regardless of the actual state of the storage unit. Realistically, these losses might differ. If the storage unit is in fact clean, the risk to workers performing the cleanup is probably less, and the cleanup might be quicker and cheaper. On the other hand, taking further action on a clean storage unit could possibly lead to a loss of credibility and divert resources from other useful endeavors (assuming that it is somehow determined that the storage unit is in fact clean). There is also a small chance that verification will lead to the need for further cleanup.

Second, the potential losses are not a function of concentration, and are not a function of the probability of contamination. It might be more reasonable to specify a loss function for which the potential losses increase with concentration if there are any reported detects, or, more specifically, for the potential losses to increase with the probability of contamination.

Third, the sampling costs are incorporated into the loss function as if there is no economy of scale with regard to the number of samples. Sampling costs are assumed to be linear with number of samples.

It is also worth noting that the decision to propose RCRA closure when the true state of the site is clean is considered a base case in this cost analysis. It is not that there are no costs associated with this decision option, but it is assumed that the costs associated with this action will apply equally to each of the decision options. That is, eventually remediation will be achieved that will lead to a proposal for RCRA closure. Consequently, this cost component is contained in each of the decision options, and can be considered in isolation to be the base case, and is assigned, without loss of generality, a value of zero (0) loss.

The values used in the I-Block closures were assessed and evaluated upon completion of that project. After consideration, the same values were adopted for this project, since they realistically reflect the potential losses addressed by the decision model. Table 14 presents these values.

Table 14. Loss Function Values Used to Support Decision Analysis

Loss Function Variable	Value Used	Description
c	$1,421	The baseline cost estimate for sample analysis.
v	$2,000,000	The potential loss from declaring the igloo clean when it is in fact, contaminated
u	$200,000	The potential loss from taking further action; the cost of corrective action.

4.5.3 Identification of Inputs Required to Make a Decision

Bulk samples will be required to analyze waste removed during dry decontamination of the storage units. These samples shall be analyzed for the metals, PCBs, explosives residues, organic chemicals, agent degradation products and applicable CWAs listed in Table 12. Analytical results from these samples will be used in support of waste designation. Wipe samples will be collected to verify that the decontamination from each storage unit was effective. Wipe samples will be collected from the study boundary strata including the floors, the end walls, and the lowest two meters of the ceiling (sidewalls). These verification samples shall be analyzed for the applicable COCs. In the event data derived from these wipe samples achieves the performance objectives, a clean-closure determination shall be made for that storage unit.

To verify the adequacy of wipe samples for the concrete floors and walls, a “Demonstration Plan” was submitted separately to DEQ for review and approval. This Demonstration Plan defined the process for collecting wipe samples, scabbling samples and core samples at selected known leaker locations in K-Block igloos. This test allowed for a comparison of surface (wipe), shallow zone concrete (scabble) and deep zone concrete (core) results. Results of the Demonstration Plan were approved by DEQ on June 25, 2013.

After dry decontamination, the passive filter units on igloos with vapor or liquid leaks will undergo verification sampling with wipes. These verification samples shall be analyzed for the CWAs only. In the event that all of the samples are below the performance objectives in Table 12, a clean closure determination shall be made for that passive filter unit.

4.6 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of the strata presented in Table 15. The floor debris, Stratum 1, will be collected during decontamination efforts, and will be sampled and analyzed for waste designation. A random selection of interior surfaces (floors, end walls, and sidewalls), Stratum 2, will be sampled with wipe samples in a grid pattern for analysis per Table 12. The sampling grid was applied over the interior surface of the storage magazine (see Figure 13). The grid pattern will encompass 3.3 ft (1 m) squares on interior surfaces, with grids selected randomly for sampling, see Figure 14. There are 200 floor grids (including gutters), defined as Section A. The floor is the most likely surface to contain residual contamination. There will be 30 end wall grids (including partial grids) and 16 full grids defined as Sections B and C, of which the entire surface will be subjected to random sampling. There are also 100 sidewall grids defined as Section D. The sidewalls will be randomly sampled up to 6.6 ft (2 m) from the floor with the exception of K-1869 due to a documented spray event. Samples from Stratum 2 will serve as the basis for making a clean closure decision. The number of samples expected to be collected for each storage unit is described in Section 4.8. Stratum 3 includes the igloo filter housing units. Stratum 4 includes concrete and soil outside a unit that may be contaminated based on operational history.

The front and rear filter housings on K-Block leaker igloos will be wipe sampled and analyzed. Two wipe samples for relevant CWAs will be collected from each filter-housing unit in vapor and liquid leaker igloos (total of four samples per igloo). Metals and explosive residues will not be evaluated for the filter units. This number of samples per filter unit is adequate in that the filter units will have been air monitored to the lower-level waste criteria prior to wipe sampling.

Table 15. Definition of Project Study Decision-Making Strata for J- and K-Block Units

Strata	Description	Contamination Potential	Sampling
1	Debris	Low	Vacuuming (dry decontamination) efforts of floor will be sampled and analyzed.
2	Interior floor, wall and ceiling surfaces (<2 m)*	Moderate	Selected areas will be subdivided into 1 m subdivisions to be randomly selected for wipe sampling.
3	Filter housing unit	Low	Sampling with wipes after removal.
4	Igloo exterior	Low	Soil sampling at targeted locations.

* In igloo K-1869, sidewall samples will be above 2 m at the previously identified GB spray location.

Sampling outside the igloos will be limited to the collection of surface soil samples located on both sides of the door/apron to the igloo. The soil samples will be analyzed for the CWAs, ADPs, explosives and RCRA metals. (See Figure 15 for sampling locations.) Soils in the K-Block where blue band tubes may have been buried are addressed in Section 14.2.1.

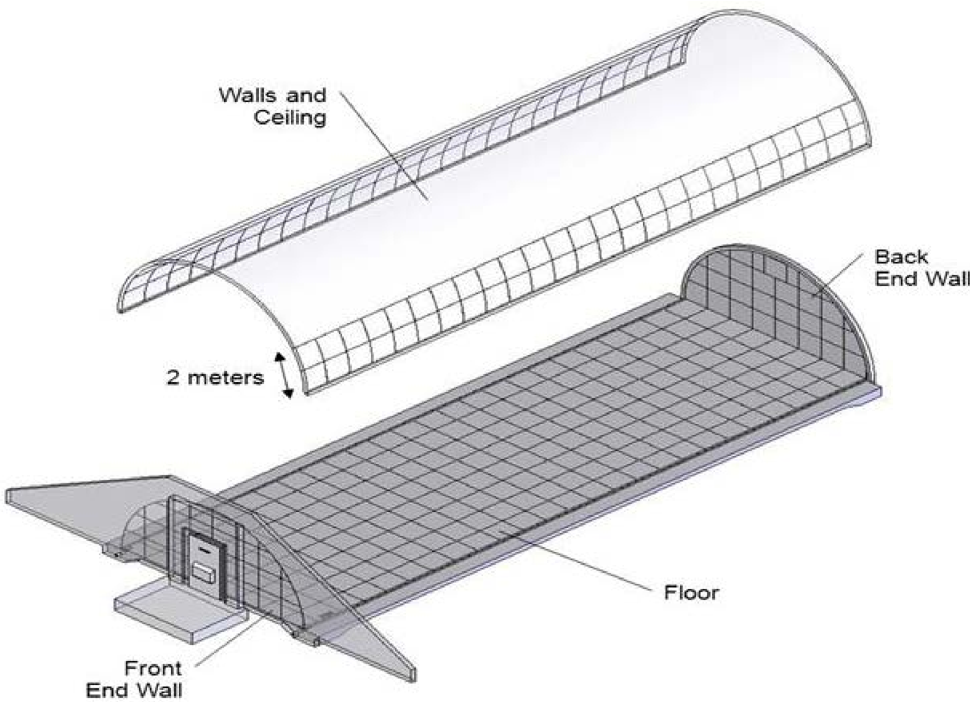

Figure 13. Exploded View of an Igloo Sampling Grid Pattern

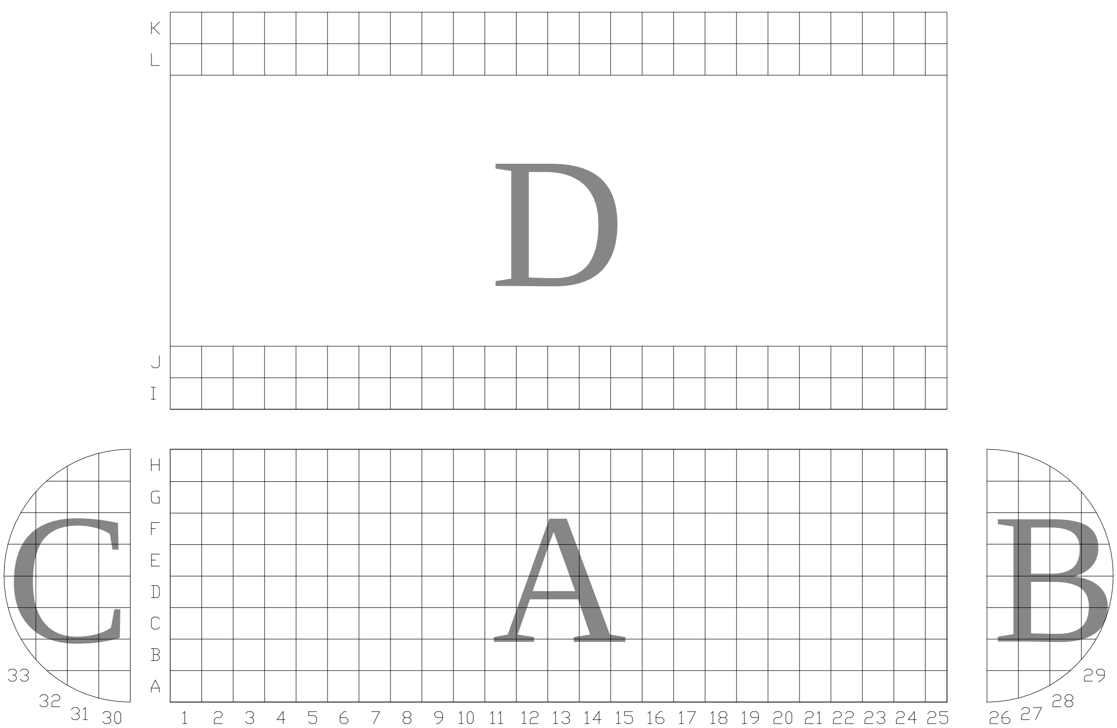

Figure 14. A Storage Unit Projected Sampling Grid

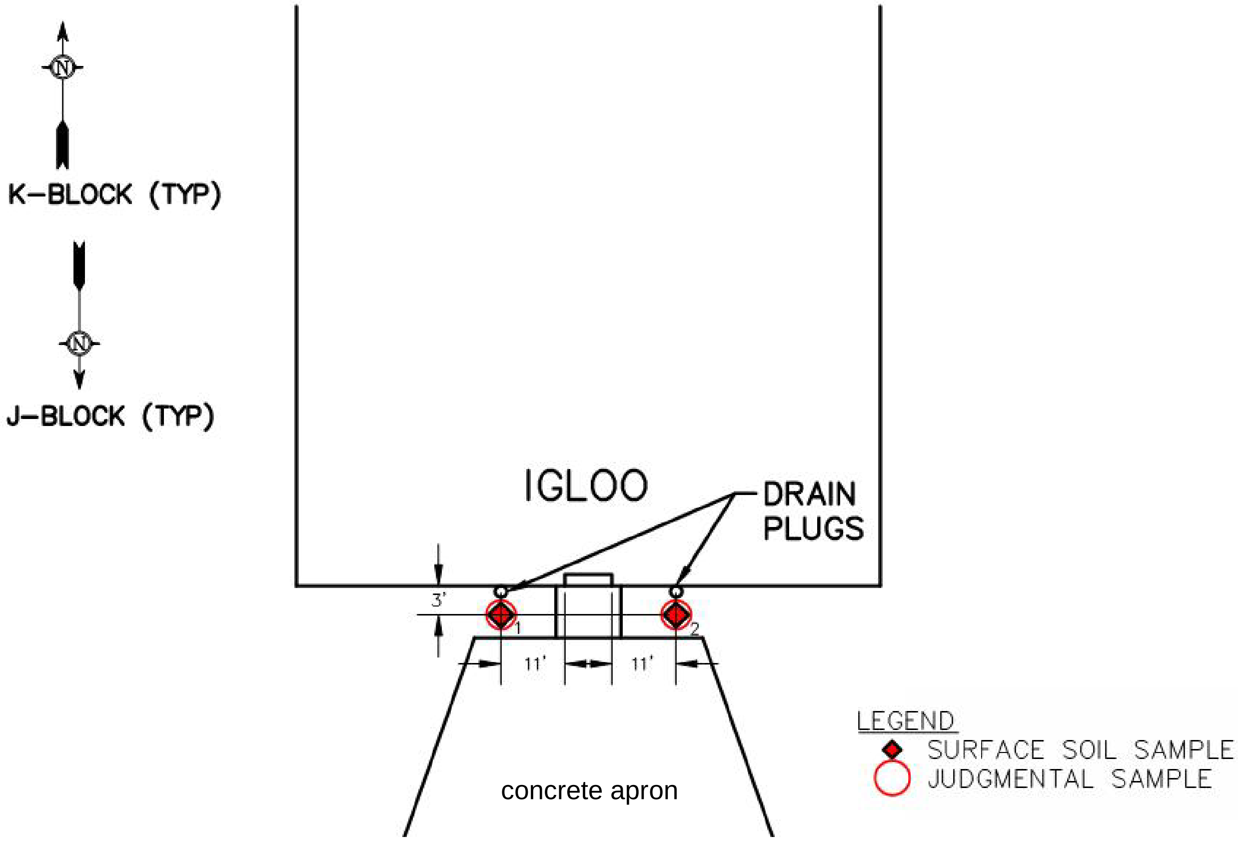

Figure 15. Soil Sampling Locations Outside of the Igloos

For samples collected from a given igloo and analyzed for CWA and agent-degradation products, decision-making will be performed using the individual sample results. This is necessitated by the performance objective for these COCs being set near the quantitation limit. For the other COCs, decision-making will be made using the mean concentration of the samples collected in each storage unit. A direct comparison of analytical results for a COC to the performance objective is adequate for one or two COCs above the performance objective value. If more than two COCs are above the performance objective values, then risk shall be evaluated in accordance with *Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites* (DEQ 2003). Decision-making is made in the context of each stratum. The floor debris may be contaminated, but as long as the interior surface wipe samples are not contaminated the igloo can be clean-closed. To reiterate, only the stratum consisting of the walls, ceiling (sidewalls), and floor serve to verify that a storage unit is clean. The igloo exterior stratum, such as soil samples outside the igloos, will serve to verify that the entire storage facility (e.g., K-Block) is clean. The K-Block storage facility includes the igloos and other agent operations buildings (e.g., Pier 37 and Buildings 654, 655, and 656).

4.7 Decision Making Approach

In the I-Block sample design document (Black et al, 2007) a Bayesian statistical approach was presented for sample size calculations for sequential sampling of the 24 storage igloos for I-Block at the UMCD. The approach taken for the J- and K-Block igloos mimics the same basic approach for I-Block, with consideration of the differences in the experience and history. Bayesian statistical decision analysis is a methodology for formalizing a decision-making process in the presence of uncertainty. Four items are needed for a statistical decision analysis: 1) the decision space – the set of possible decisions; 2) the loss (or utility) function – an assessment of the consequences of a particular decision in light of the true state of the process of interest (in this case: "igloo is clean" or "igloo is contaminated"); 3) the prior distribution – a probability distribution on the true states of the process of interest (e.g., probability that a sample will exhibit a detect of CWA, or the probability distribution of the mean concentration of a metal, prior to collecting site-specific data); and 4) the likelihood – a probability model for data that are collected. Components 2, 3, and 4 are combined to evaluate risk, or expected loss, for each decision identified in component 1. The optimal decision is then the decision that minimizes risk.

The details of the prior distributions and the likelihoods are combined to construct what is often called a posterior distribution which reflects the data-informed probability of contamination. That is, the prior information or opinions are updated with collected data. In turn, the posterior distribution is used in conjunction with the decision space and loss function discussed below to complete the decision analysis or to support decision-making. In the current context, the decision space is limited to two primary options: declare the igloo clean or take further action. In a more sophisticated decision analysis, one might also consider further options, such as specific alternatives for taking further action, delaying the decision, institutional controls, and different types of action taken for decontaminating the igloo depending on the level of contamination. In this document, the primary decision is limited to declaring the igloo clean and proposing RCRA closure, or declaring the igloo contaminated and taking some type of further action.

After data are collected, the *a priori* (passed on from before) information characterized by the prior distribution is updated to reflect the data in the posterior distribution. The posterior distribution may have several elements, but for purposes of this discussion, only one value from the posterior distribution is needed (the probability that the igloo is contaminated). Let π^*_n be the posterior probability of contamination after n samples have been acquired. The risk associated with the decision to "declare the igloo clean" is the probability-weighted average of the losses for the two possible states:

$$\text{Risk ("Declare igloo clean")} = \pi^*_n (v+nc)+(1-\pi^*_n)nc = \pi^*_n v+nc$$

The risk associated with the decision to "take further action" is:

$$\text{Risk ("Take further action")} = \pi^*_n (u+nc)+(1-\pi^*_n)(u+nc) = u+nc$$

Note that under the given loss function for this latter option, since the loss is identical regardless of the true state of the igloo (refer to Table 13), the risk is the same regardless of the data, and increases with the cost of collecting the data. The risk for declaring the site clean does however depend upon the data, since π^*_n will change with further data collection. The optimal decision is to declare the site clean whenever:

$$\pi^*_n\, v + nc < u + nc \quad \textbf{or} \quad \pi^*_n v < u$$

The 104 igloos (90 from K-Block, 14 from J-Block) used to store hazardous wastes have been classified into three groups of decision-making risk, based on the historical use of the igloo. The approach taken here is to first dry decontaminate and sample those igloos classified as having the greatest associated decision-making risk. The next lower category of risk can then incorporate information from those igloos, utilizing the constraint that this lower category should have risk no higher than the previously sampled category. These decision-making risk categories reflect the categories defined in Section 4.3. The 104 UMCD igloos are classified into four populations (or categories), representing potentially increasing levels of surface contamination.

Category 1 – igloos which stored only wastes whose decontamination level is reported as lower-level with agent-free waste determinations (regardless of potential vapor or liquid leaks). K-Block has zero igloos in this category. J-Block has 14 igloos in this category: J-1797 thru J-1810.

Category 2 – igloos which stored chemical agent munitions or whose decontamination level is reported as higher-level with no reported history of vapor leaks. K-Block has 38 igloos in this category: K-1811 thru K-1821, K-1824, K-1829, K-1831, K-1833, K-1838, K-1843, K-1852, K-1853, K-1855, K-1857, K-1859, K-1862, K-1867, K-1868, K-1870, K-1872, K-1874, K-1875, K-1887, K-1890 thru K-1896, and K-1899. J-Block has zero igloos in this category.

Category 3 – igloos which stored chemical agent munitions or whose decontamination level is reported as higher-level with a reported history of a vapor leak. These igloos have had at least one instance of vapor detections above the WPL. Corrective action was taken for such leaks, with the vapor levels subsequently monitored at levels below the WPL. K-Block has 35 igloos in this category: K-1822, K-1823, K-1827, K-1828, K-1834, K-1836, K-1837, K-1839, K-1842, K-1845, K-1848, K-1849, K-1850, K-1851, K-1854, K-1856, K-1858, K-1860, K-1861, K-1863, K-1864, K-1866, K-1871, K-1876, K-1877, K-1878, K-1882 thru K-1886, K-1888, K-1897, K-1898, and K-1900. J-Block has zero igloos in this category.

Category 4 – K-Block igloos which stored chemical agent munitions with a reported history of a liquid leak. These igloos have had at least one instance of vapor detections above the WPL. Corrective action was taken for such leaks, with the vapor levels subsequently monitored at levels below the WPL. K-Block has 17 igloos in this category: K-1825, K-1826, K-1830, K-1832, K-1835, K-1840, K-1841, K-1844, K-1846, K-1847, K-1865, K-1869, K-1873, K-1879 thru K-1881, and K-1889. J-Block has zero igloos in this category.

The sampling plan will utilize these categorizations, working from highest to lowest risk as feasible. Since secondary waste storage will be required through remaining UMCD operations and closure, two J-Block igloos will be closed last.

Since different target parameters will be used to make the closure decisions (refer to the previous section), separate sample size calculations are necessary for chemical agent decision-making and metals, explosive, and organics residue decision-making (a binomial approach is taken for GB, mustard [HD], and VX). For metals and explosives, a normal model approach is used to quantify the mean concentration. For organic chemicals, although a mean concentration is desirable for comparison to action limits, prior information and opinion suggests that organic chemicals are unlikely to be detected. Consequently, a simplified Bayesian approach is used for organics that addresses sample size for estimation of a mean concentration based on nondetected data. The following subsections describe the baseline sample-size calculations.

4.7.1 Technical Description Supporting Sample Size Calculations

The model for the J- and K-Block closure mimics the I-Block and UMCDF J-Block Closure Plans except for the addition of the igloo categories. The values used for I-Block are reused for the utility function on this project (Table 14). The igloo categories are ordered by decision-making risk, introducing a constraint on the model parameters. Using the notation of Black, 2011 the constraint can be viewed as:

$$\pi^{(\text{cat. }1)} \leq \pi^{(\text{cat. }2)} \leq \pi^{(\text{cat. }3)} \leq \pi^{(\text{cat. }4)}$$

Where $\pi^{(cat\ i)}$ represents the probability of contamination for a randomly chosen igloo from category *i* (either Category 1, 2, 3 or 4). Thus, if higher category igloos are demonstrated to be uncontaminated, it may provide evidence that lower category igloos are less likely to be contaminated than originally characterized, depending on the *a priori* characterization of each category. Likewise, if lower category igloos are found contaminated, then it may provide evidence that higher categories of igloos are more likely to be contaminated than originally thought.

For purposes here, the posterior distribution for $\pi^{(cat\ i)}$ is updated separately, based on only the igloos in category *i*. However, if the distribution for next category $\pi^{(cat\ i+1)}$ is stochastically smaller than the distribution for $\pi^{(cat\ i)}$, then the former is used when calculating sample size for subsequent igloos. Effectively, this approach means that as long as the higher category igloos are being decontaminated successfully, the lower category igloos benefit from the knowledge of successful decontamination. Likewise, if the distribution for $\pi^{(cat\ i\text{-}1)}$ is stochastically larger than the distribution for $\pi^{(cat\ i)}$, then it is used as the prior distribution for calculating sample size, so a failure of decontamination for a lower category penalizes all higher categories as well.

Using these methods, sample size calculations are made to estimate the number of samples required in each igloo. The following two subsections describe the approaches for making these calculations for both agent and nonagent COCs (metals and explosives residues).

4.7.2 Approach for Chemical Warfare Agent Constituents

Under the condition that an igloo is contaminated, there is some probability that a given sample will detect the contamination. This probability is modeled as a Beta(α,β) distribution. For purposes here, the probability of detection model is the same for each agent, setting α = 1, and β = 9, giving an average detection probability of 0.1 (see Table 16 for baseline parameters).

For mustard (HD), the I-Block igloos are considered to be equivalent to Category 2 igloos where no leak was detected. The prior distribution utilized in I-Block for π was Beta(0.5, 10.5). No contamination was found in the 24 igloos in I-Block, leading to a posterior distribution of Beta(0.5, 34.5), which is used as a starting point for mustard (HD) Category 2 in K-Block. Category 1 igloos are assigned the same starting prior distribution as Category 2, and since there were no Category 1 igloos in I-Block, the prior distribution for Category 1 remain equivalent to Category 2. There were seven I-Block igloos with reported vapor leaks that would be classified as Category 3, resulting in a posterior distribution of Beta(0.5, 16.5), which comes from updating the prior based on the Category 3 results only. Since the UCMDF J-Block closure has not yet started; successful decontamination of UCMDF J-Block is not assumed in the construction of sample size calculations for K-Block and UCMD J-Block (Black et al 2011).

GB and VX were not agents of concern for the I-Block closure. Thus, the priors for these two agents were established using a review of literature and available chemistry data. Based on these considerations, the likelihood of VX adhering to a surface after a vapor leak was deemed to be similar to the likelihood of mustard (HD) adherence. However, without the sampling experience of I-Block, it was deemed appropriate to treat VX similarly to the mustard (HD) prior to the I-Block experience, utilizing a prior of Beta(0.5, 10.5) for Category 1 and 2 igloos (roughly equivalent to sampling 10 igloos and finding no contamination). For Category 3 igloos, the *a priori* information was deemed to be smaller, and thus a prior of Beta(0.5, 5.5) is used instead (roughly equivalent to sampling five igloos and finding no contamination) (Black et al 2011).

Based on chemistry considerations, GB was deemed to be considerably less likely to adhere to a surface than VX. However, in order to establish sufficient field experience (and provide additional conservatism) GB will utilize the same priors as VX – Beta(0.5, 10.5) for Category 1 and 2, and Beta(0.5, 5.5) for Category 3. These priors will be revisited in subsequent analyses, as more information regarding the differences between VX and GB becomes available based on the analytical data (Black et al 2011).

Category 4 igloos were not present in either I-Block or UMCDF J-Block. Thus, prior distributions cannot be established for Category 4 igloos based on I-Block igloos. The Category 4 igloos are the first category for which the possibility of failure of the decontamination process is considered to be non-negligible. As such, the prior distribution for Category 4 was set to be the same as the initial Category 3 prior distribution updated based on one failed decontamination. This results in a prior distribution that is Beta(1.5, 5.5).

For CWAs, the minimum sample size per igloo was set to seven, based on considerations of adequate spatial coverage. Experience with I-Block igloos showed that for metals, concentrations were highest on the floor of the structure. Agent was not detected at levels that indicated presence, though for the degradation product TDG, the highest levels detected (while still below closure standards) were on the wall nearest the door. A reasonable set of locations would thus be four floor samples, one sample from the wall with the door, and two other wall samples. However, sample locations should be preferentially chosen in locations that are most likely to have been contaminated with agent, if any. The sample design is based on the premise that the decontamination is successful, and that there is no agent present (as opposed to common sample designs where estimating a mean concentration is the goal), and as such, biased sampling toward the worst case is preferred, for igloos where historical records of possible leaks are available.

When these parameters are used in the statistical model described in Black et al (2007), a series of sample sizes result. The resulting sample sizes calculated are described in Section 4.8.

After each round of sampling (i.e., a work package), analytical results will be returned to the statistical model and the prior distribution will be updated to form a new posterior distribution. This will generate a new set of sample size calculations, which incorporate new results, and reduce uncertainty in the closure decision-making. In the expected scenario where there are no detections of chemical agent, it is expected that the number of samples that are required to confirm clean-closure will decrease as more storage units are verified clean. These optimized sample sizes will be reflected in each new work package, and the certification report.

It's also noted that detections of chemical agent can have a reverse effect; as these new data are added to the model, the number of samples would *increase*. This is because the expected case is that there will be no chemical agents detected. The uncertainty added to decision-making by chemical agents detections would be managed by collecting additional samples.

Note that the recommended sample size for mustard (HD) and GB is always the same for cases where both agents were stored in the igloo. Because the laboratory measurements can generate mustard (HD) and GB concentrations with the same wipe sample, the higher of the two calculated sample sizes is used for both agents if they were both stored in the igloo. For some igloos, mustard (HD) was not stored, in which case its sample size is zero.

Table 16. Baseline CWA Sample Size Calculation Parameters

Model Parameter	Value Used	Comments
α	1	Parameters of the beta distribution that represent the proportion of the igloo that would be contaminated, if the igloo were contaminated. These values correspond to an average percent contamination of 10%.
β	9	
γ	Varies[1]	γ — can be interpreted in terms of the number of igloos that have previously (hypothetically) been declared contaminated (relative to η)
η	Varies[1]	η — can be interpreted in terms of the number of igloos that have previously (hypothetically) been declared clean (relative to γ)
c	$1,421	The baseline cost estimate for sample analysis.
v	$2,000,000	The potential losses from declaring the igloo clean when it is in fact, contaminated.
u	$200,000	The potential loss from taking further action; the cost of corrective action.

[1] As stated in the text, the input parameters for γ and η vary by category of igloo and the CWA being evaluated.
For HD, Category 1 and 2 igloos will use β(0.5, 34.5). For HD Category 3 igloos, β(0.5, 16.5) is used.
For GB and VX, Category 1 and 2 igloos will use β(0.5, 10.5). For GB and VX Category 3 igloos, β(0.5, 5.5) is used.
For HD, GB and VX, Category 4 igloos will use β(1.5, 5.5).

If CWA was leaked in an igloo, then degradation products might exist whether or not CWA is still present. Thus, the sample size for degradation products should use the same value as the highest value for CWA, because measurements of all degradation products are obtained from the same sample. Since it is unlikely to be the case that degradation product is present where CWA was not, there would be legitimate reason to reduce the number of samples for CWA and rely more extensively on the measurement of degradation product to indicate the presence of CWA. However, the decision context becomes more complex if a degradation product is detected at a location for which there was no CWA sample. Thus, it is recommended to keep the same sample sizes for both CWA and degradation products (Black et al 2011).

4.7.3 Approach for Non-CWA Constituents

4.7.3.1 Metals and Explosives Residues

For chemicals that are metals or explosive residues the basic approach is similar, but igloo-specific decisions are made based on average concentration instead of "per sample." Regardless of igloo category, the metals and explosives data from I-Block are representative of the conditions in J-and K-Block, since these compounds are derived from similar storage missions. Thus, the prior distributions for metals are based empirically on the I-Block metals data. This means that the initial starting parameters used for the metals case in the I-Block closure will not be used (because sufficient "real" data is already available).

The prior mean for the uncontaminated case, θ_u, is set to the mean of the I-Block data, with m_u set to 24, the number of igloos in I-Block. The variance for both the contaminated and uncontaminated case is assigned a distribution with v = 24 and mean equal to the variance of the I-Block data. The mean and variance of the I-Block data is estimated via maximum likelihood, treating nondetects as censored at their detection limit. The prior mean for the contaminated case is set at the performance criterion plus one standard deviation (using the square root of the mean of the prior for the variance). The parameters of the prior are given in Table 17, utilizing the notation of Black et al (2007). When these parameters are used in the statistical model described in Black et al (2007), a series of sample sizes result. The sample sizes calculated are presented in Section 4.8.

After each round of sampling (i.e., a work package), analytical results will be returned to the statistical model and the prior distribution will be updated to form a posterior distribution. This will generate a new set of sample size calculations, which incorporate new results, and reduce uncertainty in the closure decision-making. In the expected scenario where there are no detections of metals and explosive residues or where detected concentrations are very small compared to action limits, it is expected that the number of samples that are required to confirm clean-closure will decrease as more storage units are verified clean. These optimized sample sizes will be reflected in each new work package, and the certification report.

It's also noted that detections of metals and explosive residues can have a reverse effect; as these new data are added to the model, the number of samples would *increase*. This is because the expected case is that there will be no metals and explosive residues detected. The uncertainty added to decision-making by metals and explosive residues detections would be managed by collecting additional samples.

Table 17. Prior Parameters for Metals and Explosives for UMCD Igloos

Compound	θ_u	m_u	v	τ_u	θ_c
Arsenic	0.247	24	24	2.95	2.94
Cadmium	0.789	24	24	532.42	468.6
Chromium	3.683	24	24	180.84	1857.8
Copper	1.448	24	24	67.95	20539.2
Lead	19.641	24	24	7941.1	2668.6
Manganese	10.548	24	24	1466.6	11933
Mercury	0.008	24	24	0.001	28.49
Nickel	1.264	24	24	30.72	9938.7
RDX	0.086	24	24	0.050	36.48
TNT	0.051	24	24	0.019	125.9

θ_u = The prior mean for the "undisturbed" case
m_u = an "information-content" parameter for the distribution that represents the mean concentration
v = an "information-content" parameter for the distribution that represents the standard deviation
τ_u = the scale parameter for the standard deviation
θ_c = the prior mean for the contaminated case

4.7.3.2 Polychlorinated Biphenyls (PCBs)

PCBs were not previously considered for I-Block closure, but must be considered for K-Block in igloos where M55 rockets were stored, because of the presence of PCBs in the M55 fiberglass casings. Due to the solid form of the PCB medium, it is expected that PCB concentration levels will be similar to those for metals – i.e., have concentrations orders of magnitude below their action levels. Moderate sample sizes will be used initially to establish an expected range of PCB concentration levels, but the PCB sample size will be revisited as data is collected, to provide a better basis for sampling (Black et al 2011).

For PCBs, the prior distribution of the mean of a normal distribution is required, as established in Black et al (2007). There is little prior information on the expected levels of PCB concentrations, so a relatively low-information prior was used, with means set relatively near to the action level of 0.98 mg/kg, to require sufficient sample size to provide an adequate update after data collection. The prior distribution for the mean is a mixture of normal distributions: probability 5/6 of N(0.49, 0.245) and probability 1/6 of N(1.225, 0.245). The sampling standard deviation was assumed to be 0.49 (Black et al 2011).

For PCBs, sample sizes are given only for the first six igloos containing possible PCB contamination. After data from those igloos is analyzed, the sample sizes for PCBs shall be revisited and revised as necessary. If, as expected, PCB levels are orders of magnitude below the closure performance standard, then PCB sampling should mimic metals sampling and change to 2 samples per igloo, purely as a check against major anomalies (Black et al 2011).

4.8 Calculated Sampling Regime

Considering the CSMs described in Section 4.3, there are four regimes to be sampled as part of this closure project:

1. Igloos that stored chemical munitions and bulk items,
2. Igloos that stored agent-related hazardous wastes from UMCD activities,
3. Passive filter units equipped on known leaker igloos (Category 3 and 4 igloos), and
4. Igloo Exterior (load/unload pads and soils around/beneath the igloos).

These regimes are described below, and will require sampling as specified in Section 15.2.

4.8.1 UMCD K-Block Igloos

Category 4 igloos have not been addressed in previous closures, and thus the decontamination efforts need to be evaluated carefully before application to the full set of igloos. As such, the sample plan is based on the premise of reevaluation after each set of six igloos is sampled. Only two or three Category 4 igloos are included with each set, so that if problems are detected, they can be addressed (and sample sizes recalculated) prior to further decontamination and sampling.

Sampling will begin with the igloos known to have stored leaker materials: K-1841, K-1869, K-1880, K-1881, K-1825, and K-1826. If decontamination is effective for these igloos, then confidence should be built that the decontamination will be effective for igloos with fewer historical leaks. Subsequently, other Category 4 igloos are ordered based on the number of reported historical leaks (higher number of leaks first), and amongst those with the same number of leaks, igloos that stored a greater number of agents are chosen first. Ties in ordering are randomized. Remaining igloos are sampled with Category 3 igloos prior to Category 2, beginning with igloos with higher numbers of stored agents, and ties again broken by randomization (Black et al 2012).

This sample regime is executed in rounds (each as a work package), employing simultaneous closure of six igloos. The sample sizes presented for subsequent stages assume that no agent has been detected in prior stages. Evidence of COCs above the performance criteria in Table 12 will require reassessment of the sample size distribution. The actual igloos closed in each work package are dependent upon availability for closure (i.e., UMCDF operations may dictate the availability of an igloo for closure). As a result, the closure order in Table 18 may change.

Table 18. K-Block Baseline Wipe Sample Size Calculations per COC (4 Sheets)

Work Package No.	Igloo No.	Igloo Category	Number of Wipe Samples [1]					
			HD	GB	VX	Degradation Products	PCBs	Metals and Explosives
2 [2]	K-1841	4	40	40	40	40	0	2
	K-1869	4	0	38	0	38	0	2
	K-1881	4	0	36	0	36	9	2
	K-1877	3	0	22	0	22	0	2
	K-1828	3	20	20	0	20	8	2
	K-1836	3	19	19	0	19	6	2
3	K-1825	4	38	38	0	38	6	2
	K-1826	4	36	36	0	36	5	2
	K-1880	4	0	31	38	38	5	2
	K-1848	3	18	18	0	18	2	2
	K-1849	3	17	17	0	17	2	2
	K-1861	3	16	16	0	16	2	2

Table 18. K-Block Baseline Wipe Sample Size Calculations per COC (4 Sheets)

Work Package No.	Igloo No.	Igloo Category	Number of Wipe Samples [1]					
			HD	GB	VX	Degradation Products	PCBs	Metals and Explosives
4	K-1873	4	0	30	0	30	2	2
	K-1840	4	0	0	36	36	0	2
	K-1834	3	34	34	0	34	2	2
	K-1858	3	0	16	0	16	0	2
	K-1885	3	0	15	0	15	2	2
	K-1886	3	0	14	0	14	2	2
5	K-1842	3	0	0	34	34	0	2
	K-1878	3	0	28	0	28	0	2
	K-1839	3	0	0	33	33	0	2
	K-1889	4	0	26	0	26	0	2
	K-1827	3	14	14	22	22	2	2
	K-1856	3	13	13	20	20	2	2
6	K-1884	3	0	14	0	14	2	2
	K-1897	3	0	14	0	14	2	2
	K-1837	3	11	11	0	11	2	2
	K-1823	3	0	10	0	10	0	2
	K-1864	3	0	10	0	10	2	2
	K-1871	3	0	10	0	10	2	2
7	K-1835	4	34	34	0	34	2	2
	K-1846	4	33	33	0	33	2	2
	K-1876	3	0	10	0	10	2	2
	K-1882	3	0	10	0	10	0	2
	K-1888	3	0	9	0	9	2	2
	K-1900	3	0	9	0	9	2	2

Table 18. K-Block Baseline Wipe Sample Size Calculations per COC (4 Sheets)

Work Package No.	Igloo No.	Igloo Category	Number of Wipe Samples [1]					
			HD	GB	VX	Degradation Products	PCBs	Metals and Explosives
8	K-1850	3	11	11	0	11	2	2
	K-1879	4	0	26	0	26	0	2
	K-1833	2	7	7	0	7	2	2
	K-1838	2	0	7	11	11	0	2
	K-1843	2	7	7	0	7	2	2
	K-1866	3	9	9	0	9	0	2
9	K-1898	3	0	14	0	14	0	2
	K-1830	4	30	30	0	30	2	2
	K-1875	2	0	7	10	10	0	2
	K-1811	2	0	0	10	10	0	2
	K-1812	2	0	0	10	10	0	2
	K-1813	2	0	0	10	10	0	2
10	K-1845	3	11	11	0	11	2	2
	K-1847	4	31	31	0	31	2	2
	K-1814	2	0	0	9	9	0	2
	K-1815	2	0	0	9	9	0	2
	K-1816	2	0	0	9	9	0	2
	K-1817	2	0	0	9	9	0	2
11	K-1857	2	7	7	0	7	2	2
	K-1860	3	13	13	0	13	2	2
	K-1818	2	0	0	9	9	0	2
	K-1819	2	0	0	9	9	0	2
	K-1820	2	0	0	8	8	0	2
	K-1821	2	0	0	8	8	0	2
12	K-1863	3	13	13	0	13	2	2
	K-1854	3	0	0	17	17	0	2
	K-1824	2	0	7	0	7	0	2
	K-1852	2	0	0	8	8	0	2
	K-1853	2	0	0	8	8	0	2

Table 18. K-Block Baseline Wipe Sample Size Calculations per COC (4 Sheets)

Work Package No.	Igloo No.	Igloo Category	Number of Wipe Samples [1]					
			HD	GB	VX	Degradation Products	PCBs	Metals and Explosives
	K-1855	2	0	0	8	8	0	2
13	K-1829	2	7	7	0	7	2	2
	K-1831	2	7	7	0	7	2	2
	K-1859	2	0	7	0	7	0	2
	K-1862	2	0	7	0	7	0	2
	K-1867	2	0	7	0	7	0	2
	K-1868	2	0	7	0	7	0	2
14	K-1844	4	29	29	0	29	2	2
	K-1851	3	11	11	0	11	2	2
	K-1870	2	0	7	0	7	2	2
	K-1872	2	0	7	0	7	2	2
	K-1874	2	0	7	0	7	0	2
	K-1883	3	0	10	0	10	2	2
15	K-1832	4	0	0	34	34	0	2
	K-1894	2	0	0	7	7	2	2
	K-1887	2	0	7	0	7	2	2
	K-1890	2	0	0	8	8	2	2
	K-1891	2	0	0	8	8	2	2
	K-1892	2	0	0	8	8	2	2
16	K-1822	3	0	9	16	16	0	2
	K-1865	4	0	24	33	33	0	2
	K-1893	2	0	0	7	7	2	2
	K-1895	2	0	0	7	7	2	2
	K-1896	2	0	0	7	7	0	2
	K-1899	2	0	7	0	7	2	2

1. Indicates minimum number of random wipe samples; additional biased samples are not included. A zero (0) indicates those constituents are not present in that igloo (based on the operational history) and will not be wipe sampled.
2. Work Package No. 1 is used for the debris sampling of the ninety (90) K-Block igloos.

4.8.2 UMCD J-Block Igloos

The UMCD J-Block igloos should be sampled towards the end of the sampling effort; sampling concurrently with Category 2 K-Block igloos will occur as scheduling and Bayesian model updates permit. The history of these igloos is not well-documented. The presence of agent in these igloos in the past is unknown but unlikely as they stored only agent-related secondary wastes and not chemical munitions or bulk agent and waste group samples have been determined to be agent-free. Thus, for the purposes of sampling, all three agents will be tested for, and these igloos will be sampled as if they are non-leaker Category 1 igloos.

This sample regime is executed in rounds (each as a work package), employing simultaneous closure of up to six igloos. The sample sizes presented for subsequent stages assume that no agent has been detected in prior stages. Evidence of COCs above the performance criteria in Table 12 will require reassessment of the sample size distribution. The actual igloos closed in each work package are dependent upon availability for closure. As a result, the closure order described in Table 19 may change.

Table 19. J-Block Baseline Wipe Sample Size Calculations per COC

Work Package No.	Igloo No.	Igloo Category	Number of Wipe Samples [1]					
			HD	GB	VX	Degradation Products	PCBs	Metals and Explosives
17	J-1797	1	7	7	7	0	0	2
	J-1798	1	7	7	7	0	2	2
	J-1799	1	7	7	7	0	0	2
	J-1800	1	7	7	7	0	0	2
	J-1801	1	7	7	7	0	0	2
	J-1802	1	7	7	7	0	0	2
18	J-1803	1	7	7	7	0	0	2
	J-1804	1	7	7	7	0	0	2
	J-1805	1	7	7	7	0	2	2
	J-1806	1	7	7	7	0	0	2
	J-1807	1	7	7	7	0	0	2
	J-1808	1	7	7	7	0	0	2
19	J-1809	1	7	7	7	0	0	2
	J-1810	1	7	7	7	0	0	2

1. Indicates minimum number of random wipe samples; additional biased samples are not included. A zero (0) indicates those constituents are not present in that igloo (based on the operational history) and will not be wipe sampled.

4.8.3 Passive Filter Sampling

Wipe samples will be collected from all remaining passive filter units equipped on K-Block igloos where:

- Operation history identified a liquid or vapor leak of chemical agent (Category 3 or 4 igloos), OR
- Agent concentrations in the igloo atmosphere have exceeded the WPL.

Using the operational history in Appendix C and the list of filters removed (Table 8), this yields 26 pairs of filter units that require wipe sampling. Table 20 identifies those igloos that still have filter units installed and the agent(s) each unit will be sampled for.

Two wipe samples for each relevant CWA will be collected from each filter-housing unit for a total of four samples per igloo (GB and HD can be analyzed from a single wipe sample). Metals and explosive residues will not be evaluated.

Table 20. K-Block Igloos Requiring Filter Unit Wipe Sampling

1825 (GB/HD)	1830 (GB/HD)	1837 (GB/HD)	1846 (GB/HD)	1850 (GB/HD)	1861 (GB/HD)	
1826 (GB/HD)	1834 (GB/HD)	1841 (VX/GB/HD)	1847 (GB/HD)	1851 (GB/HD)	1863 (GB/HD)	
1827 (VX/GB/HD)	1835 (GB/HD)	1844 (GB/HD)	1848 (GB/HD)	1856 (VX/GB/HD)	1865 (VX/GB)	
1828 (GB/HD)	1836 (GB/HD)	1845 (GB/HD)	1849 (GB/HD)	1860 (GB/HD)	1866 (GB/HD)	

4.8.4 Igloo Exterior

Due to the well documented storage and contamination histories, sampling outside of the UMCD J- and K-Block igloos will be limited to the collection of two surface soil samples. The samples will be collected outside of each igloo, one (1) sample located on each side of the door/apron. The soil samples will be analyzed for the CWAs, ADPs, explosives, and RCRA metals. Soils in the K-Block where blue band tubes may have been buried are addressed in Section 14.2.1.

4.9 Additional Action Activities

Additional activities will need to be performed at units (igloos) where agent or agent degradation products have been detected at or above the closure performance standards in Table 12 during analysis of the concrete wipe samples. If agent confirmation analyses were performed, the results of these analyses were also detections at or above the closure performance standards. It is expected that these additional activities will most likely be sited at liquid leaker locations where evidence of staining is present. These additional activities will include scabbling, wet decontamination, and additional wipe sampling.

4.9.1 Scabbling

The concrete located at the 1-meter grid where the wipe sample was taken, or the extent of the stain (whichever is greater), will be scabbled down a uniform depth of ¼ inch. The debris generated during scabbling activities will be captured using a HEPA-type vacuum attached to the scabbling unit. This debris will be sampled using the incremental delimitation method described in Section 15.2.1 and analyzed for the appropriate chemical agent and its degradation product(s) in accordance with the method described in Section 15.4.

4.9.2 Wet Decontamination

After scabbling activities are complete, the newly revealed concrete surface will be wet decontaminated and rinsed in accordance with UMCD SOPs: UM-0000-M-002 for GB/VX and UM-0000-M-003 for mustard (HD). The decontamination solution used will be based upon which chemical agent was most recently handled within that storage unit (see Table 21). Only soap and water is used for decontamination of personnel. Temporary berms will be used to contain and minimize the spread of the decontamination and rinse solutions. All used decontamination and rinse solutions will be collected, sampled, and treated as hazardous waste, if required, in accordance with Section 15.3.2.

Table 21. Wet Decontamination Solutions

Process	**Type of Chemical Agent Most Recently Handled**		
	GB	**VX**	**Mustard (HD)**
Decontamination	Aqueous sodium hydroxide (NaOH) solution	Aqueous calcium hypochlorite (HTH) [$Ca(OCl)_2$] solution	Aqueous 5% sodium hypochlorite (NaOCl) solution (household bleach)[1]
Flushing	Process or Fresh Water		
	Non-Chemical Agent Decontamination		
General Purpose Decontamination [2]	Trisodium phosphate (TSP) wash (one pound of TSP per 10 gallons of water). Rinse with copious quantities of process or fresh water.		
Heavy Duty Cleaning [3]	Tetrasodium ethylenediamine tetraacetate (1-2%), sodium tripolyphosphate (2-3%), TSP (anhydrous) (1-3%), and water (balance). Rinse with copious quantities of process or fresh water.		

Notes:
1. Can also be used to decontaminate personal protective equipment for GB, VX and mustard (HD).
2. Used on metallic equipment and surfaces.
3. Used on nonmetallic surfaces (e.g., concrete) and equipment with prolonged contact with inorganic contaminates.

Source: UMCD Permit Application, Table I-2.

4.9.3 Wipe Sampling

After the concrete surface has dried following the wet decontamination activities, additional wipe samples will be taken from the newly scabbled surface and analyzed. At least one wipe sample will be collected from random sub-grid locations for each square meter of area scabbled. For areas larger than 1 m^2, the number of biased samples will be determined on a case-by-case basis with concurrence from DEQ prior to sampling. Wipe samples will be collected using the method described in Section 15.2.2 and analyzed for the appropriate chemical agent and its degradation product(s) in accordance with the method described in Section 15.4.

4.10 PCB Decontamination

For decontamination of units where PCB results exceed the closure performance standards in Table 12, a double wash/rinse method will be used. A commercial mechanical floor scrubber will be employed working in an overlapping front to back then side to side cleaning pattern. A spray bottle and hand brush will be used to wash and rinse the recessed gutter areas; a wet vacuum will collect the wash/rinse waters. Prevention measures will be taken to contain wash and rinse waters within the unit (dams, etc.). The wash water will be a mixture of 1 cup of Simple Green® industrial strength cleaner (or equivalent) to 1 gallon of water; rinse water will be fresh water. The floors will be allowed to dry overnight after the first rinse step (prior to a second wash). All waste and rinse waters will be captured in appropriately labeled poly drums and analyzed prior to disposal. Wipe samples will be collected from the newly cleaned surface using the technique described in Section 15.2.2 and analyzed for PCBs in accordance with the method described in Section 15.4. The number of wipe samples collected after decontamination will be determined on a case-by-case basis with concurrence from DEQ prior to sampling.

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5.0 BUILDING 203 CONSOLIDATION, STORAGE AND TRANSFER FACILITY

5.1 Unit Description and Operational History

The permitted area of the CSF (previously known as the Hazardous Waste Storage [HWS] Facility) is a 60 foot by 60 foot (3600 ft^2) section located in the northeast corner of Building 203. Building 203 was constructed in 1942 of wood framing with metal roof and siding and a concrete floor. The CSF stores non-agent-related hazardous wastes in Department of Transportation (DOT)-approved, RCRA-compliant containers. Containment is provided in four equal-sized quadrants by a series of 6-inch high concrete berms installed in 1996. These berms separate the CSF from other parts of the building and separate the four areas from each other, enabling separation of incompatible wastes (see Figure 16). A 6-foot high chain link fence with a locking gate provides further separation from the rest of the building and limits access (for clarity, only the fence posts are shown in the figure). Concrete ramps at the entrance and at the intersection of the quadrants allow for easier container movement over the berms. The floor was coated with urethane in all joints and corners to prevent leakage, and preexisting cracks and gaps in the concrete floor and curbs were sealed prior to storing hazardous waste to prevent liquid from seeping out of the building or beyond the facility curbing.

The quantity of containerized hazardous waste that can be stored in the CSF is physically limited by the design capacity to about 36,300 gallons or 660 55-gallon drums: 168 drums each in the Northeast and Southeast quadrants and 162 drums each in the Northwest and Southwest quadrants. The secondary containment system, consisting of the concrete floor and berms, has a 13,500-gallon capacity (exceeding the requirement to hold 10% of its storage capacity).

An adjacent equipment room provides access to a fire extinguisher, spill control materials, personal protective equipment (respirators, goggles, face shields, coveralls, boots, gloves, etc.) and a safety shower/eyewash station. Inventory sheets for the CSF are also located in this equipment room.

Building 203 does not have any forced ventilation devices or filter systems. The building’s passive vents are no longer operational, but the building may currently be ventilated when necessary by opening the 22, 12 x 12-foot doors (three doors at each end and eight along its sides).

In addition to agent and agent-related wastes, non-agent-related wastes are generated at UMCD. These wastes are generated in the performance of industrial support activities such as building and motor pool maintenance, small construction projects, and office operations. These wastes included battery acid, paints and thinners, and solvents. Non-agent-related hazardous wastes are accumulated in SAAs and in a 90-Day Storage Area before being transferred to the Building 203 CSF to await transfer to an approved off-site treatment, storage or disposal (TSD) facility.

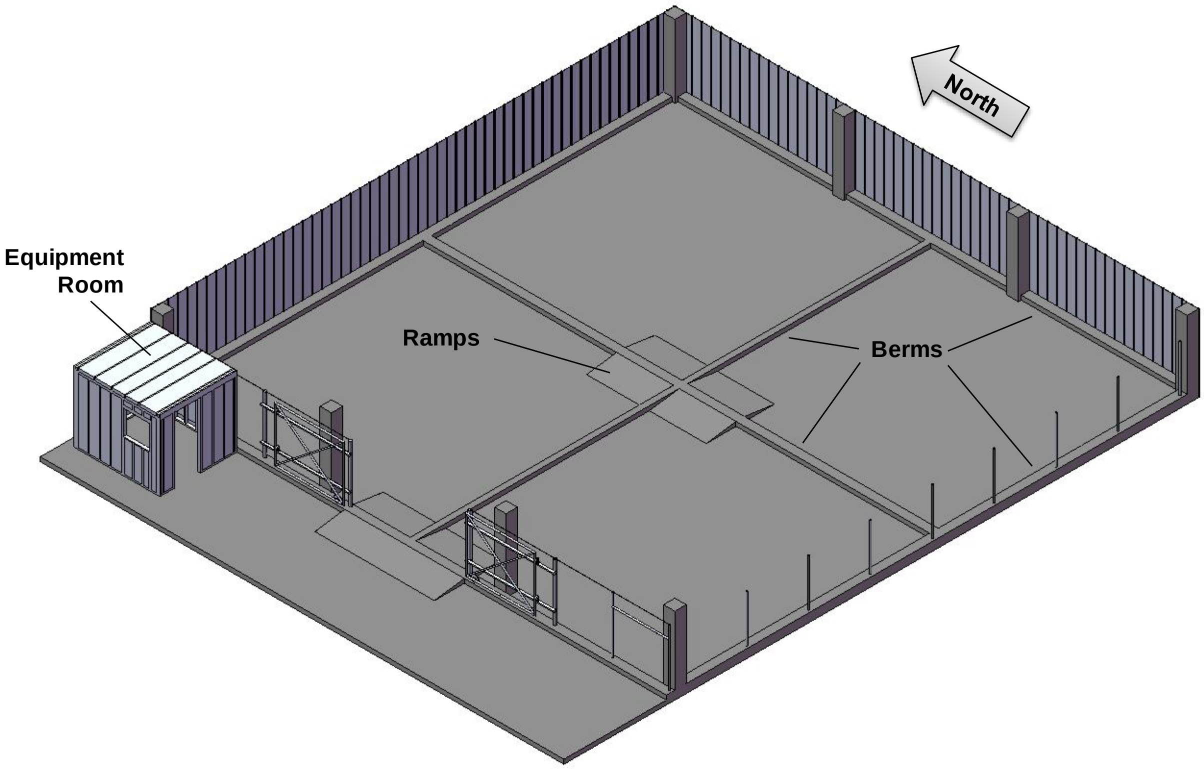


Figure 16. Representation of Consolidation, Storage, and Transfer Facility (CSF) in Building 203

Drums of Agent Orange were reportedly stored here and had leaked onto the concrete floor and were flushed out with water onto the soil. However, no record for such a spill exists. Four shallow soil samples were collected during the Remedial Investigation and analyzed for 2-4-D, 2,4,5-T and 2,3,7,8-TCDD. Analytical results did not detect any of the aforementioned analytes, thus No Further Action (NFA) was necessary per a 1994 Record of Decision (U.S. Army 2010).

Between 1990 and 1993, 25 offline transformers containing PCBs in excess of 50 ppm were stored in the Building 203 CSF (the exact date of removal is not documented). During a 1990 site reconnaissance, Dames and Moore observed appropriate use of containment and liners and no significant staining on the floor. During a 1993 Supplementary Remedial Investigation, it was stated that all units stored in the building had been removed and disposed of off-site according to regulatory requirements. The building was inspected and a wipe sample was taken from the only stain found; no PCBs were detected from this sample (U.S. Army 2010).

The only known spill in the CSF occurred in either 1986 or 1987 when battery acid was spilled in the Southwest quadrant covering an area about 8 ft x 8 ft. Significant amounts of baking soda were used to neutralize the battery acid and decontaminate the area. Note the lighter grey area in the foreground of Figure 17 that wraps around to the quadrant's southern berm and fence (Figure

18). The resultant waste was containerize and shipped for off-site disposal in accordance with the UMCD WAP. No sampling activities were performed at that time.

Figure 17. Building 203 CSF Battery Acid Spill Stain (Looking Southeast, March 2011)

Figure 18. Building 203 CSF Battery Acid Spill Stain (Looking Southwest, March 2011)

5.2 Conceptual Model

The CSM is well defined for the Building 203 CSF. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual nonagent constituents are expected to be present at acceptable levels. Four (4) significant factors strongly influence this CSM:

1. The Building 203 CSF stored non-agent-related hazardous waste.
2. All liquid wastes were stored on spill pallets.
3. Prior sampling at a stain revealed no PCB contamination.
4. The Building 203 CSF is visually inspected weekly; any spills are immediately contained and decontaminated.

It is anticipated that the Building 203 CSF will be closed successfully utilizing this closure plan.

5.3 Constituents of Concern

For the Building 203 CSF, COCs are RCRA metals (including mercury), pesticides, organics, and PCBs. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values (see Table 12).

5.4 Decision Analysis

Bulk samples will be required to analyze waste removed during dry decontamination of the storage unit. These samples shall be analyzed for the metals, PCBs, pesticides, and organic chemicals listed in Table 12. Analytical results from these samples will be used in support of waste designation. Wipe samples will be collected to verify that the decontamination of the storage unit was effective. Wipe samples will be collected from the study boundary strata (floors). These verification samples shall be analyzed for the applicable COCs. In the event data derived from these samples achieves the performance objectives, a clean-closure determination shall be made for that storage unit.

5.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of two strata presented in Table 22. The floor debris, Stratum 1, will be collected during decontamination efforts, and will be sampled and analyzed for waste designation. A random selection of the interior floor, Stratum 2, will be sampled with wipe samples in a grid pattern for analysis per Table 12. A 1 m (3.3 ft) sampling grid was applied over the interior surface of the CSF (see Figure 19) resulting in a total of 361 grids. The floor is the most likely surface to contain residual contamination. Samples from Stratum 2 will serve as the basis for making a clean closure decision. The number of wipe samples expected to be collected in this storage unit is described in Section 5.7.

Table 22. Definition of Project Study Decision-Making Strata for Building 203 CSF

Strata	Description	Contamination Potential	Sampling
1	Debris	Low	Vacuuming (dry decontamination) efforts of floor will be sampled and analyzed.
2	Interior floor	Low	Selected areas will be subdivided into 1 m grids to be randomly selected for wipe sampling.

Decision-making will be made using the mean concentration of the samples collected in the storage unit. Decision-making is made in the context of each stratum. The floor debris may be contaminated, but as long as the interior surface wipe samples are not contaminated the unit can be clean-closed. To reiterate, only the stratum consisting of the floor serves to verify that the storage unit is clean.

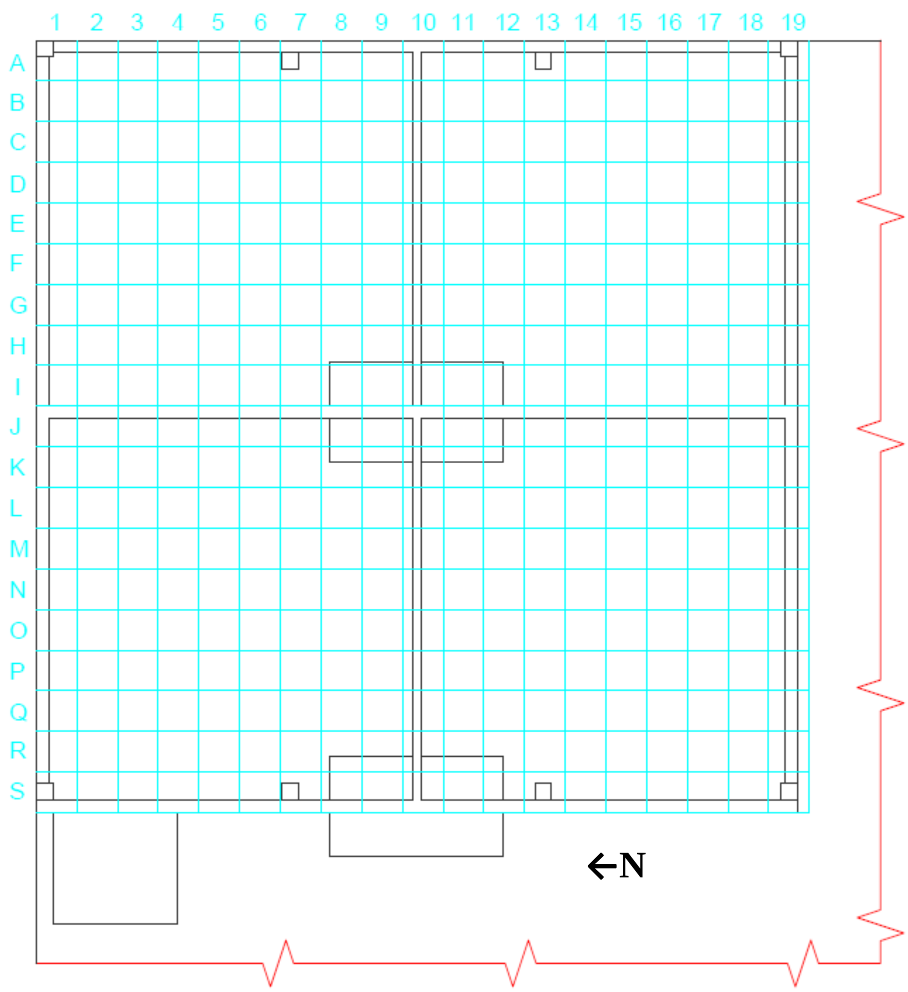


Figure 19. Sampling Grid for Building 203 CSF

5.6 Decision Making Approach

Using the category designations previously defined in Section 4.3, the Building 203 CSF is considered a Category 0 unit (no history of agent-related storage). There is little information regarding expected levels of the COCs for this unit; interest lies in the mean concentrations of the COCs. The sample size calculation was thus based on a rather broad prior distribution that was applied to all materials, except for metals that are potentially battery acid constituents. For these constituents, the prior distribution is a mixture of a normal distributions: probability *p* of N(0.5T, 0.25T) and probability (1-*p*) of N(1.5T, 0.25T), with a sampling standard deviation assuming to be 0.5T, where T is the action level. For the chemicals not associated with battery acid, *p*=0.5. For the chemicals associated with battery acid, *p*=0.2. This resulted in a sample size of 8, and a stratified sampling plan was constructed to randomly choose two locations in each quadrant of the building (Black et al 2011).

5.7 Calculated Sampling Regime

This sample regime is executed in a single work package for this unit. The required random wipe samples for this unit are eight each for metals, organics, PCBs, and herbicides (two samples from each quadrant). Two additional "biased" metal samples will be taken at the location of the battery acid spill (southwest quadrant). Additional "biased" samples will be taken at other areas of significant cracking and/or staining.

6.0 BUILDING 27 BATTERY SHOP

6.1 Unit Description and Operational History

Building 27 was constructed in 1988 on the original site of a check-in building with the same number, located in the Administrative Area (north of intersection of E Street and Elm Street and east of Building S-30). The building is approximately 1800 ft^2 with a concrete slab floor, concrete brick walls and a corrugated metal roof. A floor plan of building is shown in Figure 20 (see Appendix B for Building 27's location at the UMCD). Figure 21 looks north along the at-grade area showing universal waste storage while Figure 22 looks south back towards the entrance.

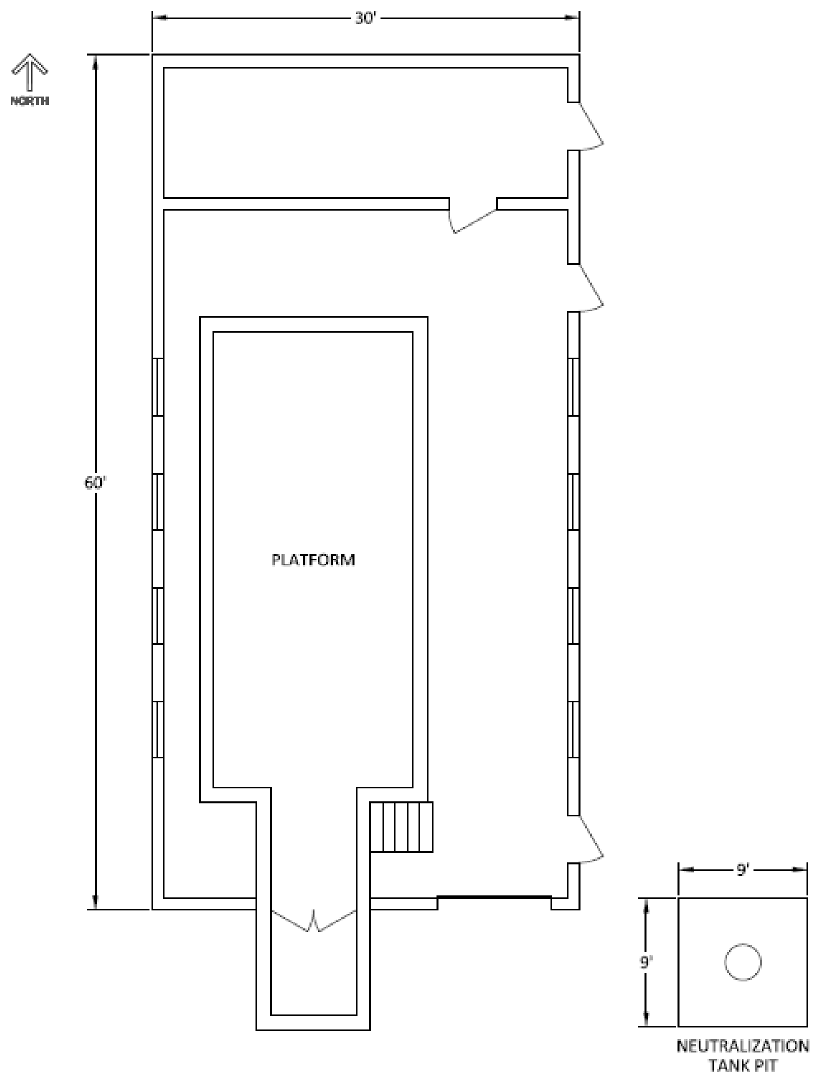


Figure 20. Floor Plan of Battery Shop (Bldg 27)

Figure 21. Bldg 27 – Battery Shop, East Wall, Looking North (March 2011)

Figure 22. Bldg 27 – Battery Shop, East Wall, Looking South (March 2011)

Activities in the Battery Shop include handling acidic electrolyte solutions. An elevated, bermed concrete platform in the center of the building is used for storage of large-equipment batteries (see Figure 23). Previously, floor drains in the elevated area directed spills and wash water via a pipe to a below-grade collection clear polyethylene tank. Spills and wash water were previously neutralized with bicarbonate soda and lime, and then rinsed into the floor drains. The 500-gallon (UST 63) circular collection tank was enclosed inside a concrete vault (see Figure 20), and was accessible on all sides; access to the collection tank was through a manhole. An overflow pipe from the tank connected to the sewer, which in turn goes to the Umatilla Imhoff Tank and Drainfield.

Figure 23. Bldg 27 – Battery Shop, Elevated Platform, Looking North (March 2011)

The collection tank was previously inspected and the liquid in the tank was tested for acidity and neutralized whenever the tank was used. Toxicity Characteristic Leaching Procedure (TCLP) testing of tank contents and at the sewage treatment drain was done in January 1992. Lead and selenium were detected in the tank contents (at levels of 0.15 mg/L and 0.2 mg/L, respectively), but below the regulatory levels for TCLP, thereby indicating non-hazardous. There were no detections at the sewage drain (McCune 1992). In 2006, this tank was removed and the drain was grouted (U.S. Army 2010). During the tank removal, a sample of the soil in the tank vault was collected and analyzed for lead; analytical results were nondetect. With the removal of the tank and the supporting analytical results to verify that no impact to the surrounding environment resulted from the utilization of this tank, the minimum standards pursuant to 40 CFR 264.197, *Closure and Post-Closure Care of Tank Systems*, have been met. Therefore, no additional consideration will be given to UST 63.

6.2 Conceptual Model

The CSM is well defined for Building 27. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual non-agent constituents are expected to be present at acceptable levels. Five (5) significant factors strongly influence this CSM:

1. Building 27 stored non-agent-related hazardous material.
2. The large-equipment batteries were stored on an elevated, bermed concrete platform whose floor drains directed spills and wash water to a below-grade, vaulted collection tank.
3. All spills and wash water were neutralized with bicarbonate soda and lime prior to being rinsed into the floor drains. The tank contents were also neutralized whenever the tank was used.
4. TCLP sampling of the tank vault contents and the sewage treatment drain (in 1992) revealed no detections above regulatory levels.
5. The vaulted tank was removed (in 2006) and the drain was grouted. Soils in the tank vault were analyzed for lead and determined to be non-detect. These steps meet the minimum standards for closure of a tank system in accordance with 40 CFR 264.197.

It is anticipated that Building 27 will be closed successfully utilizing this closure plan.

6.3 Constituents of Concern

For the Building 27, the COCs are RCRA metals and organics. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

6.4 Decision Analysis

Bulk samples will be required to analyze waste removed during sweeping/vacuuming of the building. These samples shall be analyzed for the COCs identified in Section 6.3. Analytical results from these samples will be used in support of waste designation. Wipe samples will be collected to verify that the cleaning/decontamination of the building was effective. Wipe samples will be collected from the study boundary strata (floors). These verification samples shall be analyzed for the applicable COCs. In the event data derived from these samples achieves the performance objectives, a clean-closure determination shall be made for this building.

6.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of two strata:

- Stratum 1, Floor Debris – Stratum 1 consists of a thin layer of dirt or debris which has been deposited on the floor of Building 27. Stratum 1 represents a low contamination potential and will be collected during decontamination efforts (that is, the debris will be collected during sweeping/vacuuming of the floors). Stratum 1 will be sampled and analyzed for waste designation only.
- Stratum 2, Interior Floor – Stratum 2 represents low contamination potential; however, it represents the most likely surface to contain residual contamination. Therefore, samples collected from Stratum 2 will be used to verify that the decontamination of the building was effective and that a clean closure decision can be made.

Wipe samples will be collected from Stratum 2 for the purpose of closure determination. A random selection of the interior floor will be sampled with wipe samples in a grid pattern for analysis per Table 12. The number of debris and wipe samples expected to be collected in this building is described in Section 6.7.

6.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, Building 27 is considered a Category 0 unit (no history of agent-related storage). Although some sampling has been conducted in this building, there is little information regarding expected levels for the COCs. As such, decision-making will be made using the mean concentration of the COCs of the samples collected from Building 27.

Decision-making is made in the context of each stratum. Bulk samples of debris (Stratum 1) will be required to analyze waste removed during sweeping/vacuuming of the building. These samples shall be analyzed for the COCs identified in Section 6.3. Analytical results from these samples will be used in support of waste designation only; whereas, the wipe samples of the interior floor (Stratum 2) will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. In short, only the stratum consisting of the floor (Stratum 2) serves to verify that the storage unit is clean. That is, the floor debris may be contaminated, but as long as the wipe samples from the floor areas are not contaminated, the unit can be clean-closed. Therefore, if all the sample results from Stratum 2 meet the closure performance standard, then Building 27 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% Upper Confidence Level (UCL) for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

6.7 Calculated Sampling Regime

A minimum of one representative sample of bulk waste will be collected for purposes of waste determination.

A statistical method called Acceptance Sampling was selected for the purpose of addressing potential residual contamination of the floor areas in Building 27. Acceptance Sampling is an unbiased statistical method used to ensure (with a high degree of confidence) that successful decontamination has been achieved in the area. The Visual Sample Plan (VSP) software (Pacific Northwest National Laboratory [PNNL], Version 6.3) was utilized in the development of this sampling strategy. Details are provided in the following paragraphs.

6.7.1 Basis and Assumptions for Sample Calculations

A number of samples are to be collected with the primary purpose of achieving high confidence that few grid cells on the selected surfaces contain contamination. The following basis and assumptions were made in developing the Acceptance Sampling strategy for Stratum 2 in Building 27:

1. No sample results to evaluate prior means or reference areas available at this time.
2. 90% of the study area is acceptable (that is, below the Action Level) prior to sampling.
3. Simple random sampling will be conducted.
4. Obtain at least 95% confidence that initial Assumption 2 is true.
5. Stratum 2 measures approximately 30’ x 60’.

6.7.2 Determination of Number of Samples and Sampling Locations

The following options were selected from the “Sampling Goals” menu using the General (All Inclusive) VSP Version:

- Sampling within a building (represents sampling within a building footprint)
- Compare measurements or UTL to a threshold
- Presence/absence measurements
- No sample exceedences permitted
- Ensure most of area is uncontaminated
- Length of grid size = 15 feet (Sampling grid is constructed on 15 ft centers, as no specific reports of spills are known. This results in 8 sample grid cells.)
- Action level (derived concentration guideline level) = 200 (Note: Action level has no influence on the determination of required number of samples)

- Minimum percentage of the decision area that does not contain contamination = 90 percent
- Confidence required that maximum percent is not exceeded = 95 percent.

Based on these settings, and the assumptions specified in Section 6.7.1, VSP determined that randomly sampling 5 grid cells (one sample per cell) may achieve a 95% confidence that Assumption 2 is true. If all the sample results from Stratum 2 meet the closure performance standard, then Building 27 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). (Additional sampling may also be required in order to properly evaluate the 95% UCL.) Per VSP analysis, a 99% confidence may be achieved with the collection of 7 random samples. Sampling should include random sampling of between 5 and 7 samples with a minimum number of 5 samples for 95% confidence.

The specific sampling locations for Building 27 are depicted in Figure 24.

Sample number	X (ft)	Y (ft)
A1	1.5	3.5
A2	23	16.4
A3	19.5	38.7
B1	1.1	14.8
B2	6.6	14
B3	13.6	14
C1	11.5	2.4

Figure 24. Sampling Locations for Building 27, Battery Shop

7.0 BUILDING 419 OLD LAUNDRY/CHANGE HOUSE

7.1 Unit Description and Operational History

Building 419 is located at the southwest corner of the intersection for East Center Road and Rim Road. Building 419 was constructed in 1942 using concrete, wood, asbestos cement and shingles siding (Panamerican Consultants 2002). It housed the chemical protective equipment (CPE) laundry, issue and storage until approximately 1983 when CPE laundry activities were moved to Building 655. All CPE used in K-Block that was laundered in this building was monitored to meet lower-level waste criteria prior to laundering. The building was used until 2001 as a change house, providing crews with areas for changing into CPE, showering and breaks (see Figure 25); see Appendix B for Building 419's location at the UMCD. The building is currently in use by the National Guard for training purposes. A 4000-gpd septic tank is located south of the building and receives waste water, which may be contaminated with explosives and propellant. This rectangular concrete tank is 20 feet long, 6 feet wide, and 7 feet deep (Dames and Moore 1990).

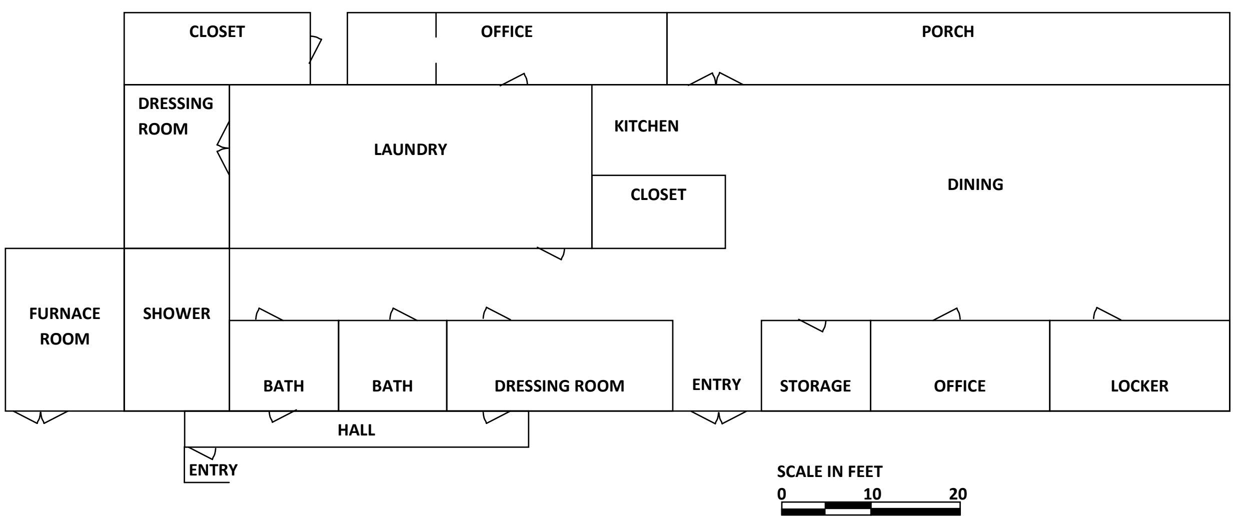


Figure 25. Floor Plan for Building 419, Old Laundry/Change House

Battelle reportedly collected a soil sample from the tank 419 tile field in 1981 at a depth of 2.5 feet below the soil surface. However, the exact location from which the sample was collected was not provided in the report. The sample was analyzed for the explosives 2,4-DNT, 2,6-DNT, 2,4,6-TNT, RDX, and tetryl. None of these analytes were detected in the soil sample. A second surface soil sample was collected from an area described as a "dead spot" near the tank (the precise sampling location was not indicated). The sample was analyzed for a number of BNAs including some pesticides. The only contaminant detected was dibutylphthalate, at a very low concentration of 0.06 μg/g (Dames and Moore 1990).

In 1988 the liquid in the tank was sampled and analyzed for explosives, Volatile Organic Analytes (VOAs), Base-neutral and Acid Extractable Organics (BNAs), metals, and cyanide. It exhibited very small concentrations of chloroform (6 μg/L) and toluene (3 μg/L), as well as six polynuclear aromatic compounds totaling 42.8 μg/L. In addition, the heavy metals contaminants cadmium (15 μg/L), copper (17.7 μg/L), nickel (30.1 μg/L), lead (280 μg/L), antimony (22.7 μg/L), and zinc (2,700 μg/L) were detected (Dames and Moore 1990).

As part of CERCLA remedial activities at UMCD during the early 1990's, soil samples were collected from test pits in the tile drain fields of the septic tank at Building 419. Test pit samples were collected from depths of 2.5, 5, 7.5, and 10 feet. Two borings were also drilled at Building 419. Samples were analyzed for Target Analyte List (TAL) metals, VOAs, BNAs, explosive constituents and nitrate/nitrite. Soil analytical results indicate chromium, nickel, and zinc were detected at levels exceeding the comparison criteria at a depth of 2.5 feet at one boring. No explosive constituents, VOAs, or BNAs were detected. Silver was detected in both test pits at a 5-foot depth, and in one pit at the 7.5-foot depth. No other metals or nitrate/nitrites were detected at levels above the comparison criteria (U.S. Army 2010). Further, according to the U.S. Army BRAC 2012 Environmental Condition of Property Report: Umatilla Chemical Depot – Oregon (U.S. Army 2012), with regards to the septic tank soil sampling (Study Site No. 29), "The 1994 Record of Decision (ROD), Miscellaneous Sites Operable Unit (OU), states that the potential risks associated with exposure to soil contamination by future residents are within or below acceptable carcinogenic risk range and non-carcinogenic hazard levels for the contamination found at the septic tank tile fields and recommended No Further Action (NFA)."

A 1-inch pipe (UST 101) runs above and below ground from Building 419 a distance of approximately 50 feet south of the building. This pipe was filled with oil from a hot oil boiler located in Building 419 (no tank was used to store the oil). During a 1995 UST investigation, a sample of the oil was collected and analyzed for PCBs; none were detected. Four soil borings were drilled along the pipeline; soil samples were taken from each boring at a depth of 6.5 feet and analyzed for TAL VOAs, TAL BNAs, and Total Petroleum Hydrocarbon Contents (TPHCs) with no detections. Potential contamination due to a leaking pipeline was not considered to be a concern and no further action was recommended (Dames and Moore 1995).

7.2 Conceptual Model

The CSM is well defined for Building 419. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and non-agent constituents are expected to be present at acceptable levels. Five (5) significant factors strongly influence this CSM:

1. Building 419 stored non-agent-related hazardous waste.
2. All CPE was pre-decontaminated and monitored to meet lower-level waste criteria prior to arrival at the laundry facility.

3. Soil sampling of the septic tank drain field in 1981 revealed no detections of explosives. However, sampling of liquid tank contents in 1988 revealed detectable concentrations of heavy metals (cadmium, copper, nickel, lead, antimony, and zinc), very small concentrations of chloroform and toluene, as well as six other polynuclear aromatic compounds.
4. Additional soil samples of the tank drain field were collected in the early 1990s as part of CERCLA remedial activities. No explosive constituents, VOAs, or BNAs were detected; however, one boring showed results for chromium, nickel, and zinc above comparison criteria. Silver was also detected in two of the test pits. EPA's Final ROD (June 30, 1994) states that the potential risks associated with exposure to soil contamination by future residents are within or below acceptable carcinogenic risk range and non-carcinogenic hazard levels for the contamination found at the septic tank tile fields and recommended No Further Action (NFA).
5. Results of the 1995 investigative sampling of the 1-inch pipe (UST-101) contents and surrounding soils revealed no detections of PCBs, TAL VOAs, TAL BNAs, and TPHCs.

It is anticipated that Building 419 will be closed successfully utilizing this closure plan.

7.3 Constituents of Concern

For the Building 419, the COCs are agent degradation products, RCRA metals and organics. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

7.4 Decision Analysis

Wipe samples of the main laundry room and showers will be collected to verify that the decontamination of the building was effective. Wipe samples will be collected from the study boundary strata (floors). These verification samples shall be analyzed for the applicable COCs, which include: ADPs, RCRA metals, and organics. In addition to the wipe samples, a visual inspection of the contents of the septic tank will be performed. If residues in the tank are present, they will be collected and analyzed for ADPs in order to ascertain potential contamination resulting from laundering of the CPE. Utilization of Building 419 may continue. As such, no sampling will be conducted in the drain field unless the results of the residue sampling have positive hits for ADPs. If the residues meet the closure performance standards, then the septic tank and associated drain field will remain as-is until the end of its useful life, at which time closure will be managed by DEQ's Water Quality Program.

In the event data derived from these samples achieves the performance objectives, a clean-closure determination shall be made for this building.

7.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of two strata:

- Stratum 1, Tank Contents – Stratum 1 consists of the contents of the septic tank, if present. A grab sample will be used to ascertain potential contamination outside of the building resulting from laundering of the CPE and whether soil samples of the drain field must be collected.
- Stratum 2, Interior Floor – Stratum 2, which consists of the floor areas of the main laundry room and shower area, represents the most likely surface to contain residual contamination. Therefore, samples collected from Stratum 2 will be used to verify that the decontamination of the building was effective and that a clean closure decision can be made. Wipe samples will be used to make this determination.

The number of samples expected to be collected in this building is described in Section 7.7.

7.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, Building 419 is considered a Category 1 unit (no history of vapor or liquid CWA leaks and only wastes monitored to less than the WPL, or never exposed to agent). Although some sampling has been conducted in this building, there is little information regarding expected levels for the COCs. As such, decision-making will be made using the mean concentration of the COCs of the samples collected from Building 419.

Decision-making is made in the context of each stratum. A grab sample(s) of the tank residues (Stratum 1) will be required to assess potential contamination outside of the building resulting from laundering of the CPE. The grab sample(s) will be analyzed for the COCs identified in Section 7.3 and will be used to determine whether soil samples of the drain field must be collected; whereas, the wipe samples of the interior floor (Stratum 2) will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. In short, only the stratum consisting of the floor (Stratum 2) serves to verify that the storage unit is clean. Therefore, if all the sample results from Stratum 2 meet the closure performance standard, then Building 419 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

7.7 Calculated Sampling Regime

The number of grab samples to be collected from the septic tank is dependent on the volume present. If residues in the septic tank are present, a minimum of one representative sample will be collected for purposes of waste determination.

Due to the small size of the shower area (approximately 10’ x 20’), a minimum of three wipe samples will be collected. Judgmental and random sampling techniques will be used for this small area.

Acceptance Sampling was selected for the purpose of addressing potential residual contamination of the main floor areas in Building 419. Acceptance Sampling is an unbiased statistical method used to ensure (with a high degree of confidence) that successful decontamination has been achieved in the area. The VSP software (PNNL, Version 6.3) was utilized in the development of this sampling strategy. Details of the Acceptance Sampling are provided in the following paragraphs.

7.7.1 Basis and Assumptions for Sample Calculations

A number of samples are to be collected with the primary purpose of achieving high confidence that few grid cells on the selected surfaces contain contamination. The following basis and assumptions were made in developing the Acceptance Sampling strategy for Stratum 2 in Building 419:

1. No sample results to evaluate prior means or reference areas available at this time.
2. 90% of the study area is acceptable (that is, below the Action Level) prior to sampling.
3. Simple random sampling will be conducted.
4. Obtain at least 95% confidence that initial Assumption 2 is true.
5. The main laundry area measures approximately 40’ x 20’.

7.7.2 Determination of Number of Samples and Sampling Locations

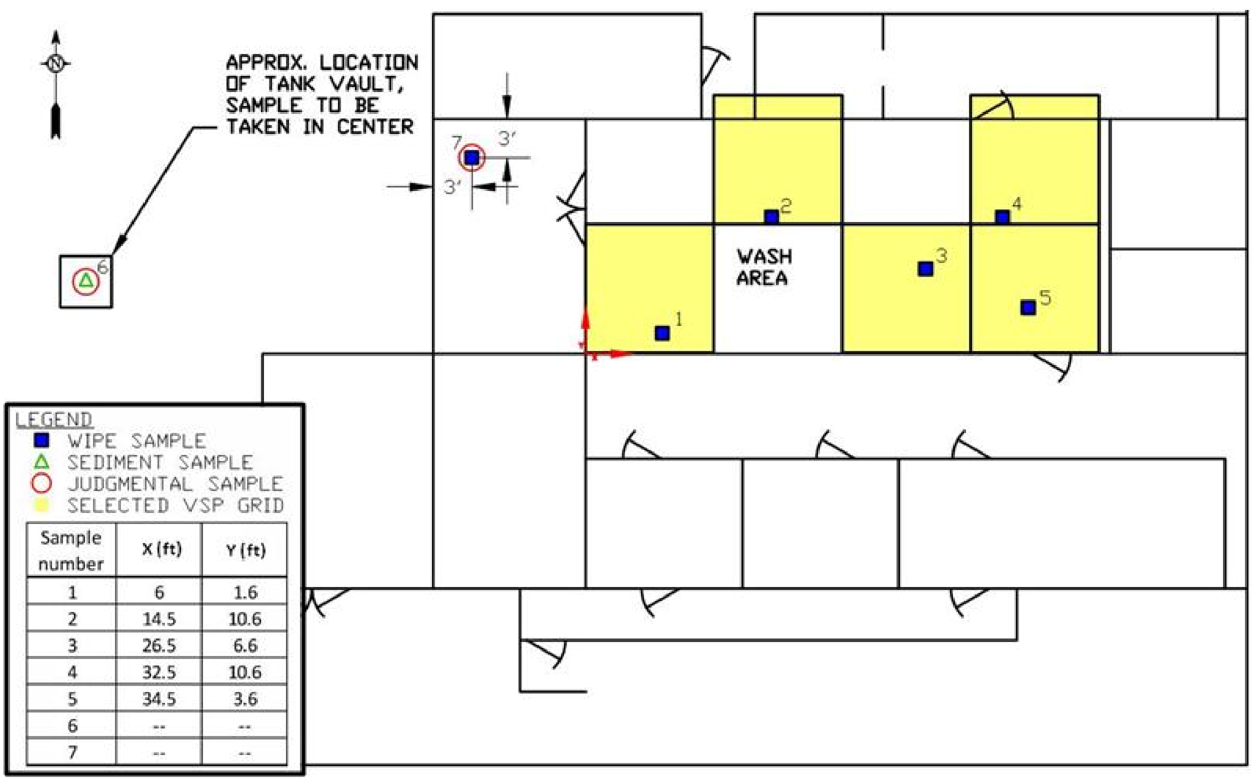
The following options were selected from the “Sampling Goals” menu using the General (All Inclusive) VSP Version:

- Sampling within a building (represents sampling within a building footprint)
- Compare measurements or UTL to a threshold
- Presence/absence measurements
- No sample exceedences permitted
- Ensure most of area is uncontaminated
- Length of grid size = 10 feet (Sampling grid is constructed on 10 ft centers, as no specific reports of spills are known. This results in 8 sample grid cells.)
- Action level (derived concentration guideline level) = 200 (Note: Action level has no influence on the determination of required number of samples)

- Minimum percentage of the decision area that does not contain contamination = 90 percent
- Confidence required that maximum percent is not exceeded = 95 percent.

Based on these settings, and the assumptions specified in Section 7.7.1, VSP determined that randomly sampling 5 grid cells (one sample per cell) may achieve a 95% confidence that Assumption 2 is true. If all the sample results from Stratum 2 meet the closure performance standard, then Building 419 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Per VSP analysis, a 99% confidence may be achieved with the collection of 7 random samples. Sampling should include random sampling of between 5 and 7 samples with a minimum number of 5 samples for 95% confidence.

The specific sampling locations for Building 419 are depicted in Figure 26



Sample number	X (ft)	Y (ft)
1	6	1.6
2	14.5	10.6
3	26.5	6.6
4	32.5	10.6
5	34.5	3.6
6	--	--
7	--	--

Figure 26. Sampling Locations for Building 419, Old Laundry/Change House

8.0 BUILDING 654 TOXIC CHEMICAL MUNITION (TCM) WORKSHOP

8.1 Unit Description and Operational History

Building 654 is located along the western edge of K-Block, southwest of the intersection between Road C and Ironwood Road (see Figure 27). The TCM workshop is a metal shell building (150'L x 40'W x 14.2'-16.7'H) on concrete foundation constructed in the early 1980s. All floors of the building are constructed of concrete. The southern interior of the building contains the Vapor Containment Room (VCR), which is approximately 17 ft x 30 ft. A floor drain, located in the VCR, drains to an underground sump which is linked to a 2,000 gallon fiberglass vaulted holding tank (vaulted tank) located outside the southeast corner of the building.

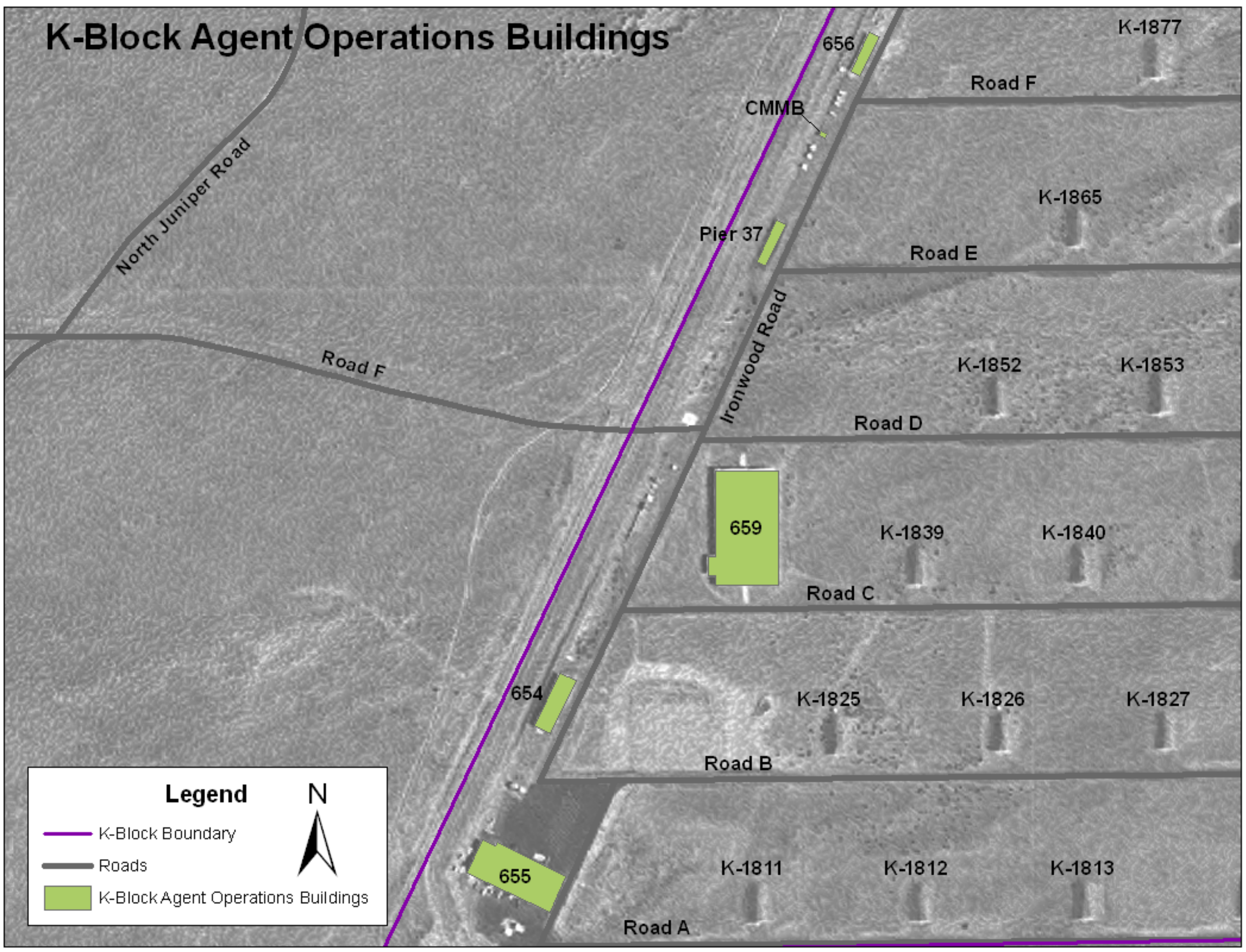


Figure 27. K-Block Agent Operations Buildings

The TCM Workshop was used for the chemical projectile upload program (1984 thru 1986), the rocket assessment program (March 1985 and December 1989), an MC-1 bomb program in 1990 and an M23 mine program in October 1992. As part of the various programs, the VCR was used to inspect, reconfigure and/or overpack leaking munitions. The VCR was disassembled in 2011. The metal components of the VCR (including, the VCR walls, roof, entry box, hoist/hoist stand, doors, conduit and miscellaneous metal parts) were sampled on March 6, 2012 in order to assess the agent-free status prior to shipment off-site. DEQ approval of the agent-free report and off-site disposal request was provided on April 18, 2012 (DEQ Item No. 12-0232). The collection drain leading to the sump was plugged prior to 2010 (UMCD 2010b).

The vaulted tank was used in a standby condition during chemical munitions maintenance and/or inspection activities as secondary containment of any liquid agent that might escape from the munitions. When used in the past, the holding tank contained mixtures of sodium carbonate, Na_2CO_3, or calcium hypochlorite, $Ca(ClO)_2$. No leaks to the holding tank had been reported as of 11 February 1993. The vaulted tank contents were analyzed after each program prior to removal from the tank. A laboratory analysis performed on 10 October 1989 of liquids in the holding tank showed GB and VX levels below 20 ng/ml (McCune 1993).

Leaker reports for Building 654 were reviewed and are summarized in Table 23. There were a total of 35 GB vapor, one VX liquid, and four GB liquid leaks. The exposure to the sump and associated vaulted tank after 1989 were unknown. Therefore, in support of facility closure, the liquid contents of the sump and associated vaulted tank were sampled on December 28, 2011. Contents were analyzed for CWAs and TCLP RCRA Metals. All results were ND (Test America, 2012).

Table 23. Summary of Building 654 Leaker Reports

Agent	Munition Type	No. and Type of Leaks	Reference Leaker Reports
GB	MC-1 750-lb Bomb	4 – Vapor	90-052 & 90-054
	8-inch Projectile	2 – Vapor 1 – Liquid	8-84, 13-84 & 15-84
	155-mm Projectile	29 – Vapor 3 – Liquid	18-84, 19-84, 23-84, 25-84, 28-84, 29-84, 32-84, 35-84, 37-84, 63-84, 65-84, 72-84, 77-84, 84-84, 85-84, 86-84, 87-84, 88-84, & 1-85
VX	155-mm Projectile	1 – Liquid	8-85

8.2 Conceptual Model

The CSM is well defined for Building 654. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and non-agent constituents are expected to be present at acceptable levels. Eight (8) significant factors strongly influence this CSM:

1. With the exception of one liquid agent spill, all chemical agent exposures occurred in the VCR.
2. One VX liquid agent exposure occurred on the conveyor belt on the west side of the main processing area of Building 654.
3. After disassembly of the VCR, walls were wipe sampled while in storage in J-Block. The wipe samples were used to determine agent free status. These results indicate that decontamination within the VCR was successfully conducted.
4. The drain to the VCR sump and associated vaulted tank was sealed. Contents of the sump and associated vaulted tank were sampled for CWAs. All results were nondetect. Air monitoring of the tank to the General Population Limit (GPL) was conducted. All results were less than (<) GPL.
5. The associated tank is situated in a concrete vault, over which lies an asphalt road. The concrete vault provides a barrier and minimizes exposure of potential contamination to the surrounding soils. Further, the asphalt road helps to minimize vertical penetration of surface waters, thereby also reducing exposure of potential contamination to surrounding soils.
6. The liquid contents of the sump and associated vaulted tank were sampled on December 28, 2011. Contents were analyzed for CWAs and TCLP RCRA Metals. All results were ND.
7. The tank and concrete vault were filled with non-reactive solid material. No residues or signs of leakage were noted in the vault by UMCD personnel prior to filling of the tank and tank vault.
8. No soil sampling around or below the vaulted tank have been collected to date.

It is anticipated that Building 654 will be closed successfully utilizing this closure plan.

8.3 Constituents of Concern

For the Building 654, the COCs are chemical agents GB and VX and their degradation products, explosive residues, and RCRA metals. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

8.4 Decision Analysis

Wipe samples of the floor will be done inside the building, focusing on the VCR and in the approximate location of where other spill was reported to have occurred. The wipe samples shall be analyzed for the applicable COCs, which include: CWAs (GB and VX); ADPs (for GB and

VX only); EXP; and RCRA metals. One wipe sample will also be collected from the remaining portion of the VCR duct work. This wipe sample will be analyzed for GB and VX and their associated ADPs. In the event data derived from these samples achieves the closure performance standard, this building will be recommended for clean closure.

Although the contents of the sump and tank were sampled (for CWAs and TCLP RCRA Metals), with results indicating no detections, the vaulted tank has not been removed. In order to meet the minimum standards set forth in 40 CFR 264.197, a determination of whether contamination is present in the surrounding environment must be made. As such, soil sampling along the side walls and/or below the vaulted tank will be conducted. The soils will be analyzed for GB and VX and their associated ADPs. If the data derived from these samples achieves the closure performance standard, the vaulted tank will be recommended for clean closure.

8.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of three strata:

- Stratum 1, Interior Floor – Stratum 1, which consists of the floor areas of the main room and approximate location of where the VX spill was reported to have occurred, represents the most likely surface to contain residual contamination. Therefore, samples collected from Stratum 1 will be used to verify that the decontamination of the building was effective and that a recommendation for clean closure can be made. Wipe samples will be used to make this determination.
- Stratum 2, VCR Duct Work – Stratum 2 represents the second most likely surface to contain residual contamination. Therefore, samples collected from Stratum 2 will also be used to verify that the decontamination of the building was effective and that a recommendation for clean closure can be made. Wipe samples will be used to make this determination.
- Stratum 3, Soils Surrounding the Tank Vault – Stratum 3 consists of the soils along the sides of the concrete tank vault and/or the soils below the concrete tank vault. Soil samples will be collected from this stratum in order to close the tank in accordance with 40 CFR 264.197.

The number of samples expected to be collected in and around this building is described in Section 8.7.

8.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, Building 654 is considered a Category 4 unit (unit had a history where liquid CWA was either confirmed or suspected on the floor). With the exception of the wipe sample of the walls of the VCRs to establish agent-free status, there is little information regarding expected levels for the COCs of the remaining areas. As such, decision-making will be made using the individual sample concentration for CWAs and the mean concentration of the non-CWA COCs of the samples collected from Building 654.

The wipe samples of the interior floor (Stratum 1) and the VCR duct work (Stratum 2) will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. Soil samples along the sides of the concrete tank vault and/or the soils below the concrete tank vault (Stratum 3) will be collected to verify that no exposures to the surrounding environment have occurred through the utilization of the sump and tank system.

All sample results will be compared to the closure performance standard. If the results from Stratum 1 and 2 meet the closure performance standard, then Building 654 will be recommended for clean closure. Similarly, if the results from Stratum 3 meet the closure performance standard, then the vaulted tank will be recommended for clean closure. However, if more than two individual sample result from these strata exceeds the performance criteria for CWAs, or if the mean concentration for the non-CWA constituents exceeds the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

8.7 Calculated Sampling Regime

Due to the limited surface area remaining of the duct work, a minimum of one wipe sample will be collected. Judgmental sampling techniques will be used for this small area.

Judgmental sampling techniques will also be utilized for assessing the VX spill location in the main processing area. A minimum of one (to a maximum of three) wipe sample will be collected for this assessment.

Before permanent closure of the vaulted tank can be achieved, a measure for the presence of a release where contamination is most likely to be present must be made. Based on the configuration of the sump and tank system, the most likely location of any potential leaks would be under the conveyance pipe of the sump that leads to the vaulted tank. A minimum of one sample will be collected at this location. An additional sample will be collected from the opposite side of the tank (in the direction of groundwater flow) at the approximate depth of the bottom of the concrete vault.

Acceptance Sampling was selected for the purpose of addressing potential residual contamination of the main floor areas in Building 654. Acceptance Sampling is an unbiased statistical method used to ensure (with a high degree of confidence) that successful decontamination has been achieved in the area. The VSP software (PNNL, Version 6.3) was utilized in the development of this sampling strategy. Details of the Acceptance Sampling are provided in the following paragraphs.

8.7.1 Basis and Assumptions for Sample Calculations

A number of samples are to be collected with the primary purpose of achieving high confidence that few grid cells on the selected surfaces contain contamination. The following basis and assumptions were made in developing the Acceptance Sampling strategy for Stratum 1 in Building 654:

1. No sample results to evaluate prior means or reference areas available at this time.
2. 90% of the study area is acceptable (that is, below the Action Level) prior to sampling.
3. Simple random sampling will be conducted.
4. Obtain at least 95% confidence that initial Assumption 2 is true.
5. The VCR area measured approximately 17’ x 30’.

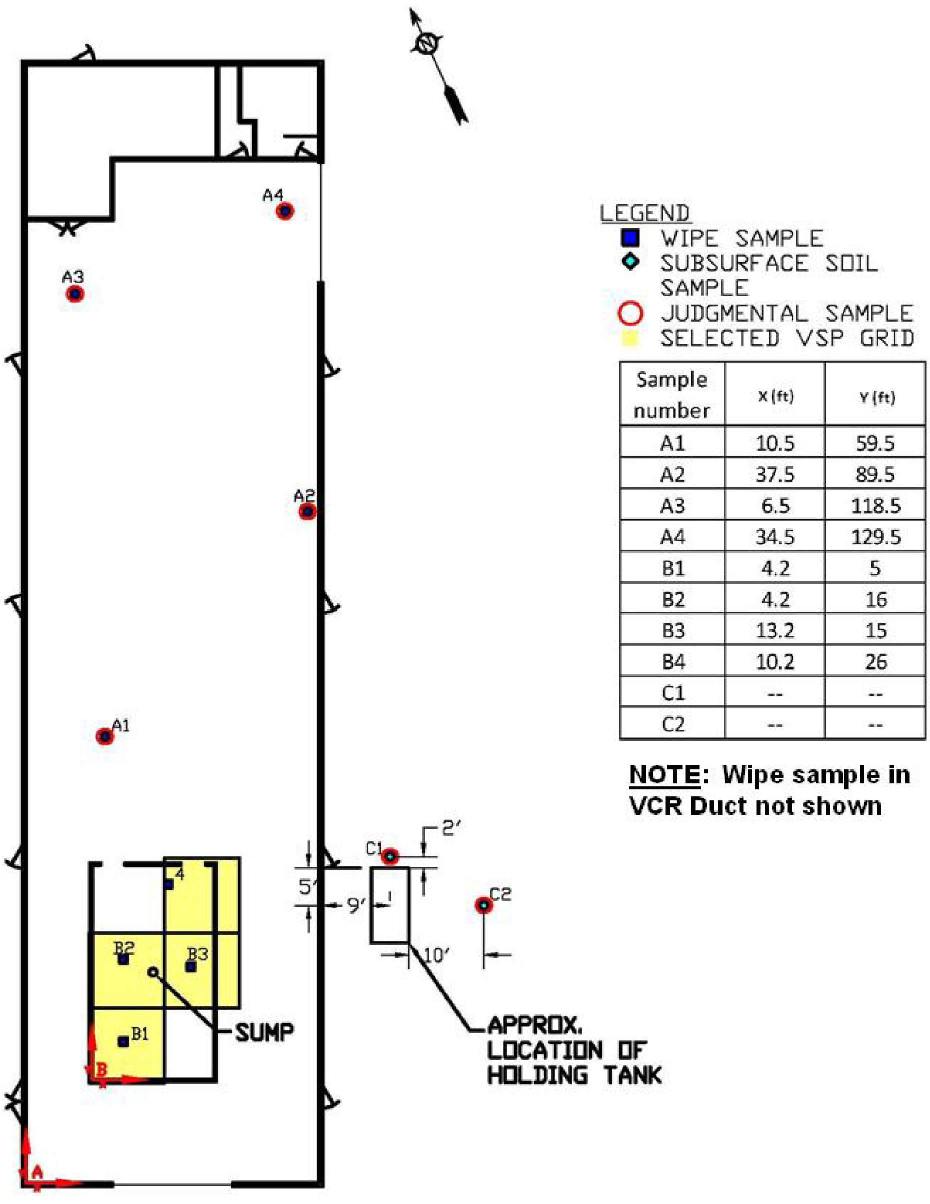
8.7.2 Determination of Number of Samples and Sampling Locations

The following options were selected from the “Sampling Goals” menu using the General (All Inclusive) VSP Version:

- Sampling within a building (represents sampling within a building footprint)
- Compare measurements or UTL to a threshold
- Presence/absence measurements
- No sample exceedences permitted
- Ensure most of area is uncontaminated
- Length of grid size = 10 feet (Sampling grid is constructed on 10 ft centers, as no specific reports of spills are known. This results in 5 sample grid cells.)
- Action level (derived concentration guideline level) = 200 (Note: Action level has no influence on the determination of required number of samples)
- Minimum percentage of the decision area that does not contain contamination = 90 percent
- Confidence required that maximum percent is not exceeded = 95 percent.

Based on these settings, and the assumptions specified in Section 8.7.1, VSP determined that randomly sampling 3 grid cells (one sample per cell) may achieve a 95% confidence that Assumption 2 is true. If all the sample results from Stratum 2 meet the closure performance standard, then Building 654 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Per VSP analysis, a 99% confidence may be achieved with the collection of 5 random samples. Sampling should include random sampling of between 3 and 5 samples with a minimum number of 3 samples for 95% confidence. Four samples will be collected.

The specific sampling locations for Building 654 are depicted in Figure 28



Sample number	X (ft)	Y (ft)
A1	10.5	59.5
A2	37.5	89.5
A3	6.5	118.5
A4	34.5	129.5
B1	4.2	5
B2	4.2	16
B3	13.2	15
B4	10.2	26
C1	--	--
C2	--	--

Figure 28. Sampling Locations for Building 654, TCM

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9.0 BUILDING 655 LAUNDRY/CHANGE HOUSE

9.1 Unit Description and Operational History

Building 655, Laundry/Change House, is located near the southwest corner of K-Block, along Ironwood Road between Road A and Road B (see Figure 27). Building 655 is used as a change house, break area, and outdoor smoking area (see floor plan in Figure 29). Building 655 serves as the issue point for CPE for chemical operations in K-Block, and as a maintenance facility for CPE since 1983 when the Old Laundry/Change House (Building 419) stopped being used. Protective masks are inspected and tested in Building 655, but are repaired off-site. Cotton CPE is inspected and laundered in Building 655. A 90-Day Storage Area is located adjacent to Building 655 (see Section 13.7).

Building 655 previously stored charcoal respiratory mask filters containing chromium. Chromium filters were expended from the government system; new filters are nonhazardous waste. Currently, the facility has an SAA set up to collect filters which have exceeded their shelf life. If masks have come into contact or have potentially come into contact with agent, they will be considered agent-related and transferred to secondary waste storage in J-Block. The filter waste stream from nonagent environments is transported to J-Block igloos pending disposal.

Building 655 includes a 1,500 gallon septic tank, dosing chamber, and three drain fields (average flow 5,100 gpd); an additional drain field (average flow 13,000 gpd per 10-hour shift) serves the Building 655 laundry wastewater system. All wastewater associated with these systems must be dissipated by subsurface soil absorption, and no discharges to state waters is permitted. UMCD is required to monitor the facilities and report to DEQ on a quarterly basis the following parameters: daily flow rate, Nitrate-N, Nitrite-N, Total Kjeldahl Nitrogen (TKN), and Ammonia-N (U.S. Army 2010).

Septic tank 655-1 (2,500 gpd) is used as a dosing tank for the sanitary sewer system, and septic tank 655-2 (1,000 gpd, consisting of two tanks) is used for the sewer system. Tank 655-1 is constructed of concrete and cylindrical in shape: 3-feet in diameter by 9.2 feet high. Both tanks are located east of Building 655. In 1988 both tanks were sampled and analyzed for metals and sulfides. Tank 655-1 had no detections of mercury, selenium, and thallium. Sulfides were detected in tank 655-1 at a concentration of 49,000 µg/L). Arsenic, beryllium, copper, nickel, and silver were detected in tank 655-1; however, the concentrations were less than the drinking water standards (EPA 1990). Antimony, cadmium, chromium, lead, and zinc were also detected in tank 655-1 at concentrations above drinking water standards. Only heavy metals were detected in the sample collected from tank 655-2. The metals detected included arsenic, beryllium, cadmium, copper, nickel, lead, and zinc; however, only beryllium had a concentration in excess of the drinking water standards (Dames and Moore 1990).

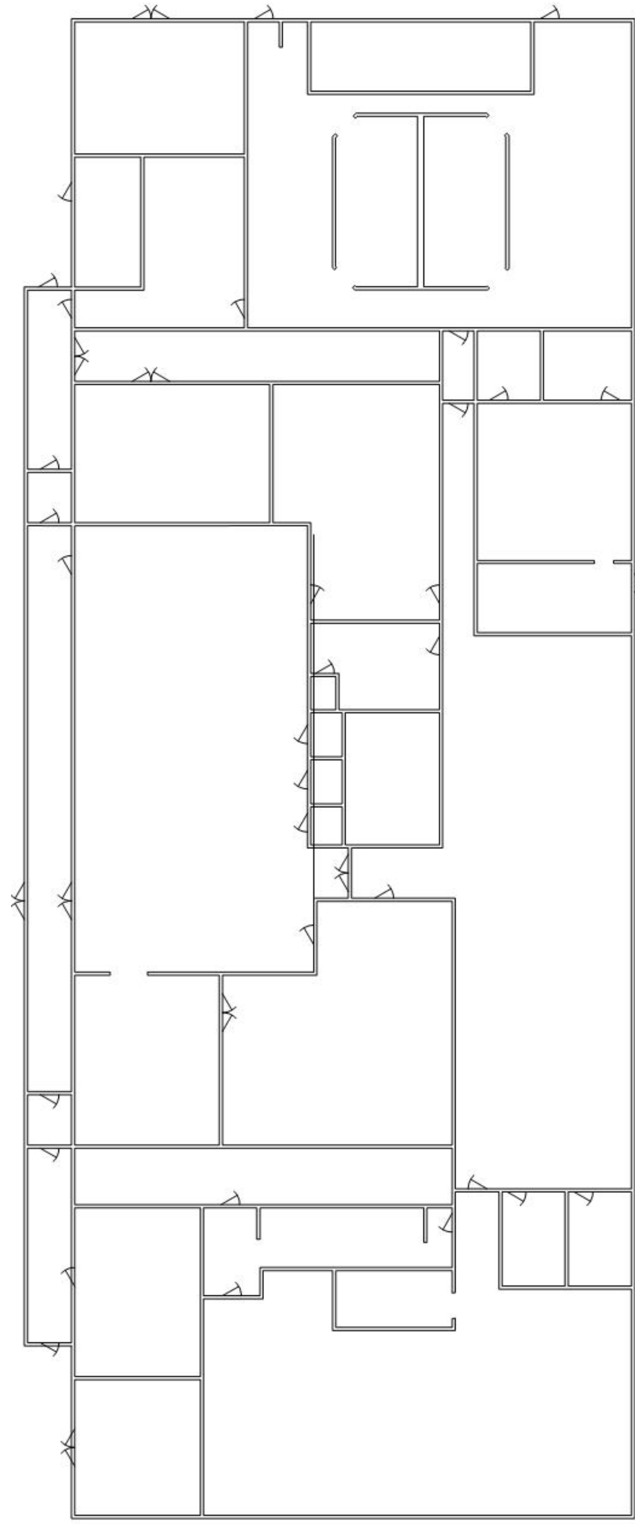

Figure 29. Floor Plan for Building 655, Laundry/Change House

As part of CERCLA remedial activities at UMCD during the early 1990's, soil samples were collected from test pits in the tile drain fields of the septic tanks at Building 655. Test pit samples were collected from depths of 2.5, 5, 7.5, and 10 feet. Samples were analyzed for VOAs, BNAs, explosive constituents, TDG, IMPA, EMPA, nitrate/nitrite, and sulfide at tank 655-1; and TAL VOAS, BNAs, TAL inorganics, explosive constituents, TDG, IMPA, EMPA, nitrate/nitrite and sulfide at tank 655-2 (U.S. Army 2010).

Results from tank 655-1 showed elevated concentration of silver at the 5-foot sample, one low-level VOA was detected in the 2.5-foot sample, and several unknown BNA Tentatively Identified Compounds (TICs). No explosive constituents, BNAs, GB, VX, mustard (HD) or degradation products (IMPA, EMPA, or TDG) were detected in these samples. Four soil samples from one test pit were collected at tank 655-2. One sample detected elevated levels of manganese and sulfide above the comparison criteria. No VOAs, explosive constituents, or BNAs were detected. No mustard (HD), GB, TDG, IMPA, or EMPA was detected in on-site screening of soil (U.S. Army 2010). According to BRAC 2012 Environmental Condition of Property Report (U.S. Army 2012), the 1994 ROD, Miscellaneous Sites OU, states that the potential risks associated with exposure to soil contamination by future residents are within or below acceptable carcinogenic risk range and non-carcinogenic hazard levels for the contamination found at the septic tank tile fields and recommended No Further Action (NFA).

Additionally, in 2006, in response to a one-time painting activity that took place elsewhere on the depot, the UMCD Risk Management Safety and Environmental group conducted sampling within Building 655. The sampling was conducted in order to assess whether the painting activities resulted in contaminated PPE and laundering equipment. Samples were taken from coveralls, a cart, lint traps of the dryers, dryer exhaust hoses and the HVAC system. RCRA metals (Cadmium, Chromium, and Lead) were found in the samples. Consequently, the contaminated laundry from the painting activities was no longer laundered at Building 655; rather, it was turned in and disposed of as hazardous waste. Additionally, UMCD CPE personnel were instructed to collect and dispose of all dryer lint as hazardous waste and clean out the dryer line trays, which they performed weekly, at a minimum. The resultant waste was containerized and shipped for off-site disposal in accordance with the UMCD WAP.

9.2 Conceptual Model

The CSM is well defined for Building 655. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and non-agent constituents are expected to be present at acceptable levels. Five (5) significant factors strongly influence this CSM:

1. Building 655 stored non-agent-related hazardous waste. The building previously stored charcoal respiratory mask filters containing chromium.
2. All CPE was pre-decontaminated and monitored to meet lower-level waste criteria prior to arrival at the laundry facility. Any equipment with detectable chemical agent was disposed of and not laundered.

3. Building 655 has two septic tanks (655-1 and 655-2). In 1988, both tanks were sampled and analyzed for metals and sulfides. Several metals and sulfides were detected in tank 655-1; however, only antimony, cadmium, chromium, lead, and zinc were detected at concentrations above drinking water standards. Tank 655-2 had detections of arsenic, beryllium, cadmium, copper, lead, nickel, and zinc; however, only beryllium exceeded the drinking water standards.
4. Additional soil samples of the tile drain field were collected in the early 1990s as part of CERCLA remedial activities. No explosive constituents, BNAs, GB, VX, mustard (HD) or degradation products (IMPA, EMPA, or TDG) were detected; however, tank 655-1 showed elevated concentration of silver at the 5-foot sample, one low-level VOA was detected in the 2.5-foot sample, and several unknown BNA TICs; and one sample at tank 655-2 detected elevated levels of manganese and sulfide above the comparison criteria. EPA's Final ROD (June 30, 1994) states that the potential risks associated with exposure to soil contamination by future residents are within or below acceptable carcinogenic risk range and non-carcinogenic hazard levels for the contamination found at the septic tank tile fields and recommended No Further Action (NFA).
5. Samples collected from areas within the dryer room of Building 655 showed elevated results for Cadmium, Chromium, and Lead.

It is anticipated that Building 655 will be closed successfully utilizing this closure plan.

9.3 Constituents of Concern

For the Building 655, the COCs are agent degradation products, RCRA metals and organics. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

9.4 Decision Analysis

Wipes samples from floors and bench areas of the main room where inspection and laundering activities occurred shall be analyzed for the applicable COCs, including: ADPs, RCRA metals, and organics. Lint from the exhaust duct with be collected and analyzed for metals (cadmium, chromium, and lead only). In the event data derived from these samples achieves the closure performance standard, this building will be recommended for clean closure.

NOTE: In accordance with Figure 1 of the SUOMP, *Waste Determination Process for Agent – Exposed Equipment*, any equipment with detectable chemical agent was disposed of and not laundered. As such, potential contamination of the drain field resulting from the laundering of PPE is not likely. Further, in accordance with EPA's 1994 ROD, the drain field was issued a status of NFA. Consequently, the septic tanks and associated drain field will remain in use (as-is) until the end of its useful life, at which time closure will be managed by DEQ's Water Quality Program.

9.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of two strata:

- Stratum 1, Main Laundering Area – Stratum 1 consists of the floors and bench areas of the main room where laundering and inspection activities occurred. These areas represent the most likely surfaces to contain residual contamination; therefore, samples collected from Stratum 1 will be used to verify that the decontamination of the building was effective and that a clean closure decision can be made. Wipe samples will be used to make this determination.
- Stratum 2, Dryer Exhaust Duct – Stratum 2 represents another area with the potential to contain residual contamination. Therefore, samples collected from Stratum 2 will also be used to verify that the decontamination of the building was effective and that a recommendation for clean closure can be made. A grab sample of the remaining lint will be used to make this determination.

The number of samples expected to be collected in this building is described in Section 9.7.

9.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, Building 655 is considered a Category 1 unit (no history of vapor or liquid CWA leaks and only wastes monitored to less than the WPL, or never exposed to agent). Although some sampling has been conducted in association with this building, there is little information regarding expected levels for the COCs. As such, decision-making will be made using the mean concentration of the COCs of the samples collected from Building 655. The wipe samples of the interior floors and bench areas (Stratum 1) will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. A grab sample of the lint within the dryer exhaust duct (Stratum 2) will also be collected in support of this determination.

All sample results will be compared to the performance criteria. If the results from Stratum 1 and 2 meet the performance criteria, then Building 655 will be considered closed. However, if more than two individual sample result from these strata exceeds the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

9.7 Calculated Sampling Regime

Due to the limited amount of material anticipated to be present in the duct work of the dryer, a minimum of one grab sample will be collected. Judgmental sampling techniques will be used for this small area.

Acceptance Sampling was selected for the purpose of addressing potential residual contamination of the main floor areas in Building 655. Acceptance Sampling is an unbiased statistical method used to ensure (with a high degree of confidence) that successful decontamination has been achieved in the area. The VSP software (PNNL, Version 6.3) was utilized in the development of this sampling strategy. Details of the Acceptance Sampling are provided in the following paragraphs.

9.7.1 Basis and Assumptions for Sample Calculations

A number of samples are to be collected with the primary purpose of achieving high confidence that few grid cells on the selected surfaces contain contamination. The following basis and assumptions were made in developing the Acceptance Sampling strategy for the strata of Building 655:

1. No sample results to evaluate prior means or reference areas available at this time.
2. 90% of the study area is acceptable (that is, below the Action Level) prior to sampling.
3. Simple random sampling will be conducted.
4. Obtain at least 95% confidence that initial Assumption 2 is true.
5. The main laundry area measures approximately 60' x 30'.

9.7.2 Determination of Number of Samples and Sampling Locations

The following options were selected from the "Sampling Goals" menu using the General (All Inclusive) VSP Version:

- Sampling within a building (represents sampling within a building footprint)
- Compare measurements or UTL to a threshold
- Presence/absence measurements
- No sample exceedences permitted
- Ensure most of area is uncontaminated
- Length of grid size (main laundry area) = 15 feet (Sampling grid is constructed on 15 ft centers, as no specific reports of spills are known. This results in 8 sample grid cells.)
- Action level (derived concentration guideline level) = 200 (Note: Action level has no influence on the determination of required number of samples)
- Minimum percentage of the decision area that does not contain contamination = 90 percent
- Confidence required that maximum percent is not exceeded = 95 percent.

Based on these settings, and the assumptions specified in Section 9.7.1, VSP determined that randomly sampling 5 grid cells (one sample per cell) may achieve a 95% confidence that Assumption 2 is true for the Building. Per VSP analysis, a 99% confidence may be achieved with the collection of 7 random samples. Sampling should include random sampling of between 5 and 7 samples with a minimum number of 5 samples for 95% confidence.

If all the sample results from these strata meet the closure performance standard, then Building 655 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC).

Note: Due to operational history and potential exposures in Building 655, at least one wipe sample should be collected from the berm/sump area located behind the washing machine. If the random sample locations of Stratum 1 do not correspond to this location, then at least one (judgmentally located) wipe sample should be added to the sampling scheme.

The specific sampling locations for Building 654 are depicted in Figure 30.

Sample number	X (ft)	Y (ft)
1	2.4	31.6
2	12.4	6.6
3	22.4	12.6
4	27.4	24.6
5	44.4	27.6
6	53.4	23.6
7	57.4	37.6
8	64.4	4.6
9	-10.5	26.6
10	59.5	-11.3

Figure 30. Sampling Locations for Building 655, Laundry/Change House

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10.0 BUILDING 656 LABORATORY

10.1 Unit Description and Operational History

Building 656 is located along the western edge of K-Block, northwest of the intersection between Road F and Ironwood Road (see Figure 27). The laboratory building is a metal shell building constructed in 1980, measuring approximately 90 ft long x 20 ft wide x 9 ft high, which sits on a concrete floor and foundation (see floor plan in Figure 31). The laboratory portion of the building (about one-third of the building, 30 ft long x 20 ft wide) has tile flooring. The laboratory has been used for the chemical agent analysis of environmental samples. Agent standards were also made in the fume hoods (UMCD 2010b).

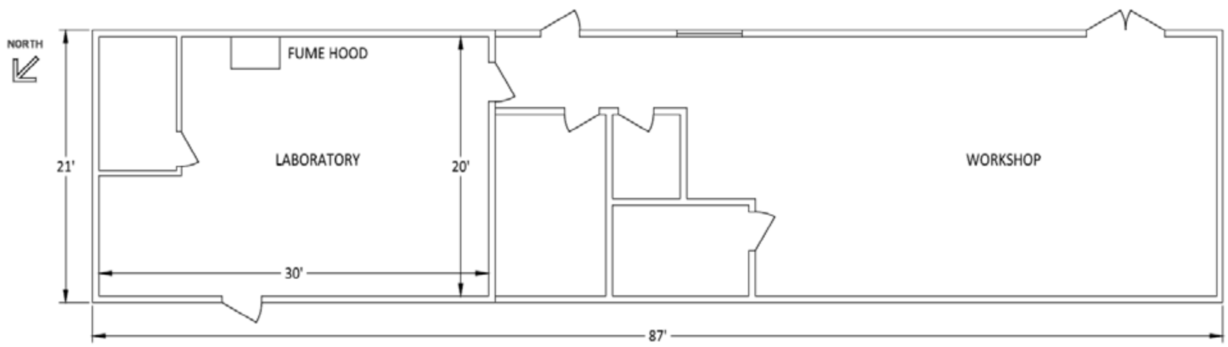

Figure 31. Floor Plan of Laboratory, Building 656

Building 656 is the monitoring facility that supports K-Block activities. Hazardous wastes generated in Building 656 include agent-related decontamination wastes from K-Block monitoring, agent-related laboratory wastes (i.e., chemical agent standards, glassware, personal protective equipment [PPE]), and non-agent-related laboratory wastes (i.e., glassware, solvents, acids, plastics, etc.). The laboratory maintains an SAA for these hazardous wastes; see Section 13.8 for additional details.

While moving from the refrigerator to the fume hood, up to 13 vials of Stock A Research, Development, Test, & Evaluation (RDTE) solution of GB were knocked off the countertop and on to the floor (UMCD 2010b) in early 2003. This occurred near the southern corner of the laboratory close to the door into the workshop area. Household bleach was immediately applied for decontamination.

Sealed source radiological materials are currently stored at Building 656 and include 25 Improved Chemical Agent Monitor (ICAM) Detectors with radionuclide Nickel-63 (Ni-63) sources used by the UMCDF. These devices are handled as specified in the NRC license (#12-00722-06) and will be returned or destroyed according to the manufacturer's instructions following completion of chemical agent disposal (U.S. Army 2010). Consequently, no further consideration will be given to the sealed radiological source.

A 1,000-gallon laboratory rinse tank, UST 54 (ORUM 056), was removed in 1992. The tank was found empty upon removal. The tank was cut up, placed into, and transferred to J-Block for storage. The surrounding concrete vault was broken up and removed for disposal at the on-base landfill. Thirty (30) cubic yards of backfill was replaced, and an additional 110 cubic yards of "fines" was spread over the area. No visual or olfactory signs of contamination were found during excavation and no soil samples were collected or analyzed (U.S. Army Corps 1992). Per UMCD personnel, this tank was later replaced by a new underground vault containing two 55 gallon drums intended to capture any liquid coming from the emergency shower and floor drains in the lab.

10.2 Conceptual Model

The CSM is well defined for Building 656. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and non-agent constituents are expected to be present at acceptable levels. Five (5) significant factors strongly influence this CSM:

1. Agent standards were made in the fume hood. (The fume hood is identified/addressed in Section 13.8.)
2. 13 vials of RDTE solution of GB spilled in 2003 on the southern corner of the laboratory close to the door into the workshop area, and household bleach was immediately applied for decontamination.
3. A bubbler unit was dropped in the main workshop area.
4. 1,000 gallon lab rinse tank (UST 54) was removed in 1992. The tank and surrounding concrete vault were broken up and removed for disposal. 30 yards of backfill were replaced and an additional 110 cubic yards of "fines" were spread over the area. No visual or olfactory signs of contamination were found during excavation; however, no soil samples were collected at the time of the tank pull.
5. No spills had occurred in the laboratory requiring the use of the use of the emergency shower. Consequently, the vault containing the 55 gallon drums was never used for its intended purpose.

It is anticipated that Building 656 will be closed successfully utilizing this closure plan.

10.3 Constituents of Concern

For the Building 656, the COCs are chemical agents (GB/VX/HD) and agent degradation products, explosive residues, RCRA metals and organics. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

10.4 Decision Analysis

Wipe sampling should be collected from the floors in area of the RDTE spill (inside lab), as well as in the approximate location of the drain area in the main workshop where a bubbler unit was spilled. The wipe samples shall be analyzed for the applicable COCs, which include: CWAs, ADPs, explosives, RCRA metals, VOCs, and SVOCs. In the event data derived from these samples achieves the performance objectives, a clean-closure determination shall be made for this building.

Although UST 54 and surrounding vault and soils were removed, no analytical data supporting closure in accordance with 40 CFR 264.197 has been found. Therefore, a determination of whether contamination is present in the surrounding environment will be made. In accordance with 40 CFR 264.197, soil sampling will be conducted in the approximate previous location of UST 54 and its associated piping (that is, the area of highest potential to have residual contamination). This soil sampling will be used to determine whether contamination is present in the surrounding environment. The soils will be analyzed for CWAs, ADPs, explosives, RCRA metals, VOCs, and SVOCs. If the data derived from these samples achieves the performance objectives, a clean-closure determination shall be made for the vaulted tank.

Note: Samples will be collected from the fume hood for purposes of a closure determination of that satellite accumulation area. (See Section 13.8 for additional information.)

10.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of two strata:

- Stratum 1, Interior Laboratory Floor – Stratum 1, which consists of the floor and drain areas of the main laboratory room where the13 vials of RDTE solution of GB were spilled and the approximate location of where the bubbler unit was reported to have spilled, represents the most likely surface to contain residual contamination. Therefore, samples collected from Stratum 1 will be used to verify that the decontamination of the building was effective and that a clean closure decision can be made. Wipe samples will be used to make this determination.
- Stratum 2, Soils Surrounding the Tank Vault – Stratum 2 consists of the soils in the approximate previous location of UST 54 and its associated piping. Soil samples will be collected from this stratum in order to close the tank.

The number of samples expected to be collected in this building is described in Section 10.7.

10.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, Building 656 is considered a Category 4 unit (the building had a history where liquid CWA was either confirmed or suspected on the floor). There is little information regarding expected levels for the COCs. As such, decision-making will be made using the individual sample concentration for CWAs and the mean concentration of the non-CWA COCs of the samples collected from Building 656.

The wipe samples of the interior floor (Stratum 1) will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. Soil sampling in the vicinity of the previously located UST and its associated piping (Stratum 2) will be collected to verify that no exposures to the surrounding environment have occurred through the utilization of the tank system.

All sample results will be compared to the closure performance standard. If the results from Stratum 1 meet the closure performance standard, then Building 656 will be recommended for clean closure. Similarly, if the results from Stratum 2 meet the closure performance standard, then the tank will be recommended for clean closure. However, if more than two individual sample result from these strata exceeds the performance criteria for CWAs, or if the mean concentration for the non-CWA constituents exceeds the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

10.7 Calculated Sampling Regime

Due to the small sizes of the locations where the RDTE and bubbler units were spilled (~10sf each), a minimum of one sample will be collected for each area. Judgmental and random sampling techniques will be used for these small areas.

Before permanent closure of UST 54 can be achieved, a measure for the presence of a release where contamination is most likely to be present must be made. Since the tank and concrete tank vault were removed and approximately 30 yards of backfill replaced, the most likely location for residual contamination is in the unaffected soils in the approximate previous location of the vaulted tank and its associated piping. Three soil samples (total) will be collected: (1) one soil sample will be collected from the approximate location of the tank itself; (2) one soil sample will be collected between the previous tank and Building 656 at the approximate location and depth of the conveyance piping; and (3) one soil sample will be collected at the approximate depth of the bottom of the concrete vault, approximately five feet from the original location, in the direction of groundwater flow.

The specific sampling locations for Building 656 are depicted in Figure 32.

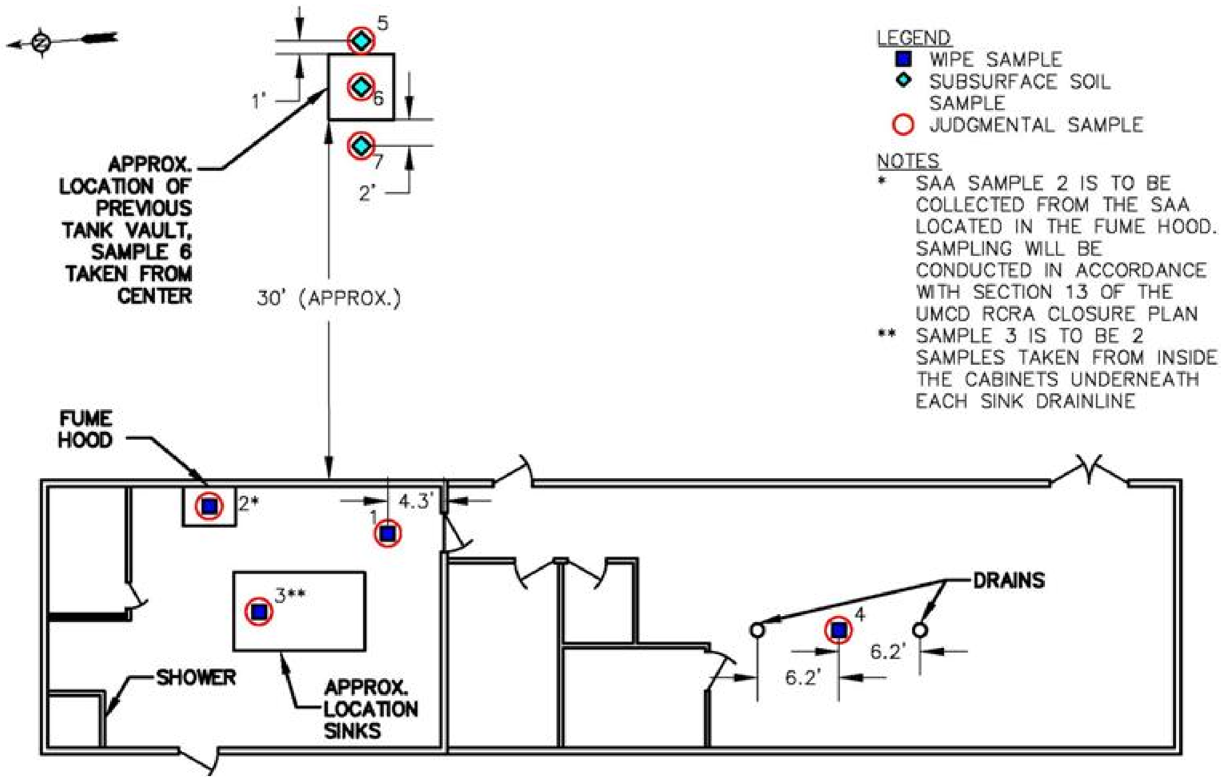

Figure 32. Sampling Locations for Building 656, Laboratory

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11.0 PIER 37 BUILDING

11.1 Unit Description and Operational History

The Pier 37 Building is located along the western edge of K-Block, northwest of the intersection between Road E and Ironwood Road (see Figure 27). The Pier 37 Building is a concrete structure, approximately 19 ft long x 8.7 ft wide x 7.8 ft high with a wooden entrance door. Agent-related liquid wastes with air monitoring results meeting the lower-level waste criteria were stored in a 90-Day Storage Area at Pier 37 (see Figure 33) until transferred to J-Block (for additional details about this 90-Day Storage Area see Section 13.11).

The Pier 37 Building was used to monitor items to the lower-level waste criteria until 2006. However, due to its small size, this activity now occurs in the CMMB (see Section 12.0). This building has potential vapor exposure to agents GB, VX, and mustard (HD) (UMCD 2010b).

Figure 33. Pier 37 (Left) and Adjacent 90-Day Liquid Storage Area (Right), March 2011

11.2 Conceptual Model

The CSM is well defined for Pier 37. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and non-agent constituents are expected to be present at acceptable levels. Three (3) significant factors strongly influence this CSM:

1. Agent-related liquid wastes with extractive analysis meeting the lower-level waste criteria were stored in a 90-Day Storage Area at Pier 37 until transferred to J-Block. (Pier 37's 90-Day Storage Area is addressed in Section 13.11.)

2. Pier 37 Building was used to monitor solid waste to the lower-level waste criteria. Potential exposure to agents GB, VX, and mustard (HD) have resulted from these operations.
3. All wastes were bagged prior to monitoring inside the building. However, on at least one occasion, the bagged waste caught fire. Specific contents of the bagged waste are unknown.

It is anticipated that Pier 37 will be closed successfully utilizing this closure plan.

11.3 Constituents of Concern

For the Pier 37, the COCs are chemical agents (GB/VX/HD), agent degradation products, explosive residues, RCRA metals, PCBs, and organics. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

11.4 Decision Analysis

Wipe sampling shall be done of floors that have the highest potential for contamination (inside Pier 37 Building). COCs to include: CWAs, ADPs, explosive residues, RCRA metals, PCBs, and organics. In the event data derived from these samples achieves the closure performance standard, this building will be recommended for clean closure.

11.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of one stratum, the interior floor of Pier 37. The stratum, which consists of the floor areas of the main building room, represents the most likely surface to contain residual contamination. Therefore, samples collected from this stratum will be used to verify that the decontamination of the building was effective and that a clean closure decision can be made. Wipe samples will be used to make this determination.

The number of samples expected to be collected in this building is described in Section 11.7.

11.6 Decision Making Approach

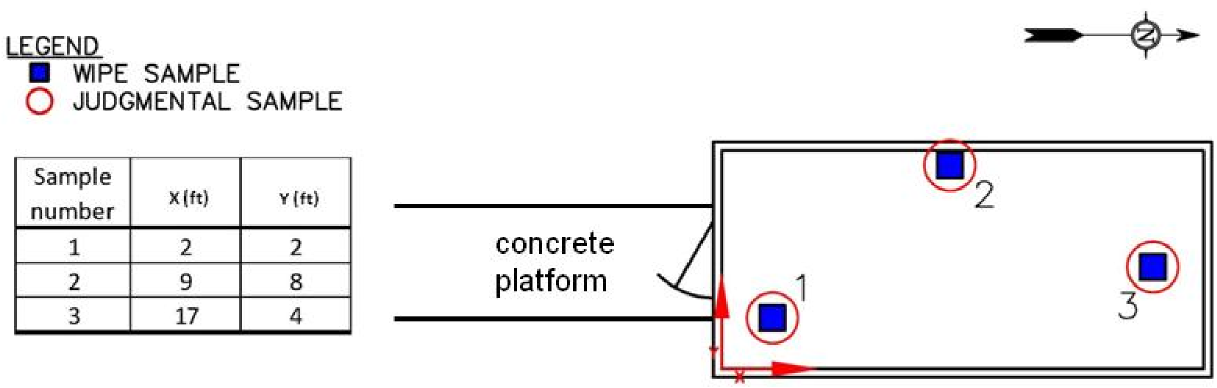
Using the category designation previously defined in Section 4.3, Pier 37 Building is considered a Category 3 unit (unit had a history of CWA vapor leaks). There is little information regarding expected levels for the COCs. As such, decision-making will be made using the individual sample concentration for CWAs and the mean concentration of the non-CWA COCs of the samples collected from the Pier 37 Building.

The wipe samples of the interior floor of Pier 37 will be collected to verify that the decontamination of the building was effective and a clean-closure determination can be made. All sample results will be compared to the performance criteria. If the results meet the closure performance standard, then Pier 37 will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria for CWAs, or if the mean concentration for the non-CWA constituents exceeds the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

11.7 Calculated Sampling Regime

Due to the small size of Pier 37 (approximately 19’ x 10’), a minimum of three wipe samples will be collected. Judgmental and random sampling techniques will be used for this small area.

The specific sampling locations for Building 656 are depicted in Figure 34



Sample number	X (ft)	Y (ft)
1	2	2
2	9	8
3	17	4

Figure 34. Sampling Locations for Pier 37

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12.0 CONTAINERIZED MATERIAL MONITORING BUILDING (CMMB) AND PICK-UP POINT (PUP) BUILDING

12.1 Unit Description and Operational History

The CMMB is located along the western edge of K-Block on Ironwood Road between Building 656 and Pier 37 (see Figure 27). The CMMB is a metal conex building; approximately 30 ft long x 11 ft wide x 10 ft high, with a wooden floor (see Figure 35). The conex is divided into roughly two equal rooms: a “hot” side on the north end for material entering for monitoring, and a “cold” side on the south end for the exit and storage of monitored wastes awaiting transfer to the pick-up point (PUP) building.

Figure 35. Containerize Material Monitoring Building, Looking Northwest (March 2011)

During K-Block operations there is the potential for generating agent-related wastes such as step pans, used filters from protective masks, storage unit ventilation filters, spent containers, personal protective equipment, tools, flashlights, and other items used when handling agent or potentially contaminated components. The CMMB is used to monitor solid wastes to the lower-level waste criteria that were generated during storage activities or by the Building 656 Laboratory (previously done at Pier 37). This building has potential vapor exposure to mustard (HD) agent (UMCD 2010b). Monitoring activities in the CMMB began in September 2006.

At 0830 on 20 September 2007, while monitoring bagged mustard (HD)-related items in the CMMB an HPD yielded positive results of 4.336 VSL. The north room (“hot side”) exterior doorway was covered in plastic sheeting. A hole cut in the sheeting allowed a filter hose to be inserted and connected to a 1000-cfm portable filter for active ventilation. Three entries in OSHA Level A PPE were made to place the bagged items into 85-gallon steel drums (11 total). The 1000-cfm filter unit was disconnected at 2350. By 0107 on 21 September 2007, readings were down to ≤ 0.25 VSL. Downwind RTAP monitoring (north and west of the CMMB) during the operations was negative. The drums were later relocated to igloo K-1866 for segregation and decontamination; two of the 11 drums were later determined to be lower-level waste and were transferred to J-Block for storage. On November 22, 2011, air monitoring to the GPL of the CMMB was conducted. The tests were conducted in accordance with U.S. Army Guidance (CMA 2010) in order to support reuse of the property at the Pueblo Chemical Depot (PCD). All results were less than (<) GPL, which supports an agent-free condition for property which will be reused and retained within Government control. Consequently, in 2012, the CMMB building was removed from the UMCD (shipped to PCD for reuse) and is no longer located on the facility's premises. Based on the analytical results, and its absence on the UMCD, no further consideration will be given to the CMMB.

The PUP building, located just south of the CMMB (see Figure 36), was added after the September 2007 event to temporarily hold monitored wastes until they are transported to J-Block for storage. The PUP is a metal conex building (approximately 5 ft by 8 ft) with a wooden floor. Transfer of the monitored waste allows entry into the PUP building without a mask. No agent exposures have occurred in the PUP building.

Figure 36. PUP Located South of CMMB (March 2011)

12.2 Conceptual Model

The CSM is well defined for the PUP Building. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent constituents are expected to be present at acceptable levels. Three (3) significant factors strongly influence this CSM:

1. The PUP was used to temporarily store bagged, low-level hazardous waste prior to shipment to J-Block for storage.
2. The PUP never stored liquid wastes.
3. No agent exposures have occurred in the PUP building.

12.3 Constituents of Concern

For the PUP, the COCs are chemical agents (GB/VX/HD) and agent degradation products only. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

12.4 Decision Analysis

A wipe sample will be collected from the floor area of the PUP and will be analyzed for the applicable COCs. In the event that the data derived from this sample achieves the closure performance standards, a recommendation for clean closure will be made.

12.5 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of one strata – the floor, which will be wipe sampled as it is the most likely surface to contain residual contamination. The sample from this stratum will serve as the basis for making a clean closure decision. The number of wipe samples expected to be collected per area are described in Section 12.7.

12.6 Decision Making Approach

Using the category designation previously defined in Section 4.3, the PUP is considered a Category 1 unit (no history of vapor or liquid CWA leaks and only wastes monitored to less than the WPL, or never exposed to agent). However, there is little information regarding expected levels for the COCs. As such, decision-making will be made using the individual sample concentration for CWAs and the mean concentration of the non-CWA COCs of the samples collected from this unit.

Due to the small size of the PUP, there is only area available for one wipe sample per group of constituents. This wipe sample will serve to verify that the storage unit is clean. If all the sample results from this wipe sample meet the closure performance standard, then the PUP will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria for CWAs, or if the mean concentration for the non-CWA constituents exceeds the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

12.7 Calculated Sampling Regime

Due to the small size of the PUP (approximately 5’ x 8’), only one wipe sample will be collected. Judgmental and/or random sampling techniques will be used for this small area.

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13.0 SATELLITE ACCUMULATION AND 90-DAY STORAGE AREAS

Satellite Accumulation Areas (SAAs) at waste generation sites can store up to 55 gallons of hazardous waste or one quart of acutely hazardous waste (including wastes with the F998 and F999 waste codes). At 90-Day Storage Areas, any volume of waste may be stored in containers for up to 90 days in accordance with 40 CFR 265 Subpart I. Each container at a 90-Day Storage Area is marked with an accumulation start date, name of the waste, and labeled “Hazardous Waste.”

These sites are either indoors or are located on concrete or asphalt flooring that is sufficiently impervious to contain leaks or spills until the collected material is detected and removed. Containers that hold liquid wastes are placed in drip pans or spill pallets that are capable of retaining at least 10% of the container capacity. Spill control equipment is stored at each of the sites/areas, and is readily available during loading and unloading operations.

90-Day Storage Areas are required to follow the closure requirements in 40 CFR 265.111 and 265.114 per 40 CFR 262.34(a)(1). SAA are exempt from closure requirements per 40 CFR 262.34(c). However, DEQ has required that each SAA be wipe-sampled for the appropriate COCs based on its operational history. Closure standards shall be those identified in Table 12. The Permit Application identified 14 SAAs and two 90-Day Storage Areas; a total of 20 SAAs and three 90-Day Storage Areas are addressed here (see map in Appendix B for locations).

13.1 Building 5 SAA

Building 5 is the motor pool for the UMCD and is a 23,000 ft^2 facility located in the Administrative Area. The Motor Pool is a fully equipped maintenance and repair facility for UMCD vehicles. Hazardous materials stored at the motor pool include paints, paint thinners, oils, lubricants and lubricating fluids, adhesives, sealants, cleaners, and solvents. Its activities generate waste including used oil, antifreeze, transmission fluid, hydraulic fluid, cleaning agents, paints, paint thinners, lubricants and lubricating fluids, adhesives and sealants, and solvents. Lead-acid batteries generated in Building 5 are removed and stored in Building 27 as universal waste. The facility is equipped with recycling systems for antifreeze, oil, transmission fluid, and hydraulic fluid. Aerosol cans are punctured in accordance with EPA requirements. The facility maintains a 55-gallon-capacity drum in four separate SAA locations within the shop area:

- 1005A stores waste paint, paint thinner and solvents,
- 1005B stores used filters from the parts washer and used solvent
- 1005C stores hydraulic oil, and
- 1005D was proposed to stores used brake fluid, but was not used due to the low number of brake repair jobs. Instead this SAA is for the accumulation of nonhazardous wastes.

SAAs 1005A and 1005B are located next to each other on the south wall of the shop (see Figure 37). SAA 1005C is located mid-shop (see Figure 38) and SAA 1005D is located on the north wall of the shop (see Figure 39)

Figure 37. SAA 1005A (Left) and 1005B (Right), Looking South (March 2011)

Figure 38. SAA 1005C (Drum At End of Row), Looking North (March 2011)

Figure 39. SAA 1005D, Looking North (March 2011)

13.2 Building 7 SAA

Building 7 is a 3,600 square foot facility housing the Carpenter Shop. It is located in the Administrative Area with the primary function of wood-working. It can potentially store adhesives/glues, alcohol, varathane, glazing compound, sealants, lubricates, lacquers, linseed oil, paints primer, retaining compound, thinners, varnish, caulking, cutting oil, degreasing solvent, and talcum powder. Aerosol can puncturing is also performed in this building in accordance with EPA requirements. The facility maintains six SAA locations:

- 1007A is a 35-gallon-capacity drum for storing flammable liquids,
- 1007B is a 35-gallon drums for storing cutting oil,
- 1007C is a 55-gallon drum for storing lacquer paints, thinner and solvents,
- 1007D is a 55-gallon drum for storing enamel paints,
- 1007E is a 12-gallon bucket for storing un-punctured aerosol cans, and
- 1007F is a 12-gallon bucket for storing un-punctured aerosol pesticide cans.

SAAs 1007E and 1007F have been added since the permit application. All of these sites are located in the southwest corner of the shop, just north of the supply cage. Figure 40 shows the posted sign for SAA 1007A with its drum located to the right. Figure 41 shows SAA 1007A thru 1007F, from left to right, along the shop's western wall. A 5-gallon bucket labeled "Recycle Metal" is located behind SAA 1007E for punctured aerosol cans.

Figure 40. SAA 1007A, Looking South (March 2011)

Figure 41. SAAs 1007A thru 1007F, Looking West (March 2011)

13.3 Building 11 SAA

Building 11 is a 33,150 ft^2 facility located in the Administrative Area that houses the Tool Crib, the Protective Mask Fit Area, and the Medical Clinic. The Tool Crib area is primarily used for storage of tools, hardware, and personal protective equipment. Protective masks are issued to UMCD personnel at the Protective Mask Fit area. The facility previously stored charcoal filters containing chromium. The SAA was set up to collect filters which had exceeded their shelf life and became hazardous waste. Removal of the filters from the masks is now performed at Building 655.

13.4 Building 14 SAA

Building 14 is a transformer house that supports the Public Works Directorate at UMCD (this SAA was originally proposed to be located at Building 4). The building is approximately 400 ft^2. This SAA is located in the southwest corner of the building. Used fluorescent lamps containing mercury are stored as universal waste in fiberboard containers (see Figure 42). Broken lamps are stored as hazardous waste. Nonhazardous wastes containing PCBs (e.g., used ballasts) are located in the wooden box at the left edge of figure.

Figure 42. Building 14 Universal Waste SAA, Looking West (March 2011)

13.5 Building 115 SAA

Building 115 housed the Oregon National Guard 3rd of the 116th Organization Maintenance Sub Shop (OMSS) until November 2004. This unit performed light maintenance to motor vehicles and M1A1 tanks. An area between two pillars had been fenced in (see Figure 43) and stored petroleum, oils, lubricants, flammables, and corrosives on spill pallets. It also housed an SAA for an aerosol can puncturing unit. This facility was equipped with a parts washer and recycling systems for used antifreeze, used oil, and oil filters. Figure 44 shows where the parts washer was located; sampling of other parts washers used at the UMCD has identified the wastes as nonhazardous. All universal and hazardous wastes generated at this site were managed and disposed of by the Oregon National Guard.

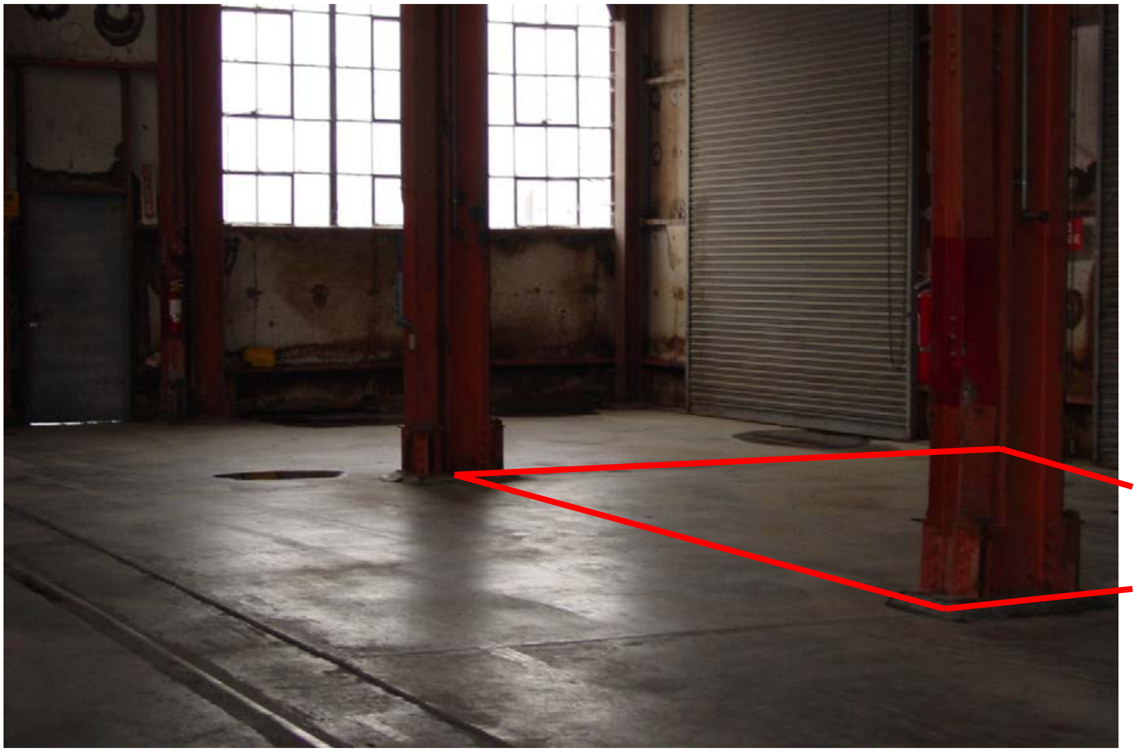

Figure 43. Building 115 – Former location of SAA between the Pillars (2004)

Figure 44. Building 115 – Former Location of Parts Washer (2004)

13.6 Building 419 SAA

Building 419 was proposed in the Permit Application as an additional SAA for the collection of chemical agent mask filters that have exceeded shelf life. This SAA was never put into use; therefore, no wipe samples are required for this SAA.

13.7 Building 655 SAA

There are five (5) SAA locations within Building 655 each consisting of a 5-gallon lidded bucket used for storing agent-contaminated laundered materials and laundry solids:

- Southwest wall in Rubber Inspection Room,
- Southwest wall in Washer/Dryer Room,
- Southwest wall in Mask Inspection Room,
- Northeast wall in Men's Rubber Room Entryway, and
- Northwest wall in Women's Shower Room Entryway.

A typical Building 655 SAA is shown in Figure 45 (the Mask Inspection Room) including a container for nonhazardous mask filters. SAA containers are emptied daily as agreed upon by DEQ.

Figure 45. Building 655 SAA in Mask Inspection Room (March 2011)

13.8 Building 656 SAA

Building 656 is the laboratory facility that supports K-Block activities. Hazardous wastes generated in Building 656 include agent-related decontamination wastes, such as solvents and acids, from K-Block monitoring, agent-related laboratory wastes (chemical agent standards, glassware, PPE, etc.), and nonagent laboratory wastes (glassware, solvents, acids, plastics, etc.). The laboratory maintains an SAA in the fume hood for these hazardous wastes (see Figure 46). Non-agent-related wastes generated by the laboratory include, but are not limited to: off-specification reagents and/or chemicals; and chemicals that have exceeded their shelf life.

Once the accumulation limits of the SAA have been reached, the liquid waste is transferred and consolidated at the 90-Day Storage Area currently located at Pier 37; solid wastes are transferred to the CMMB. Following air monitoring and any necessary decontamination to attain the Certified Reporting Limit (CRL), this waste is transferred to J-Block for storage. Non-agent-related wastes generated in the laboratory are sent directly to the Building 203 CSF for storage. Disposal of non-agent-related laboratory waste is processed through the Defense Logistics Agency – Disposition Services (DLA-DS).

Figure 46. Building 656 SAA in Laboratory Fume Hood, Looking East (March 2011)

13.9 Building 31 90-Day Storage Area

The 90-Day Storage Area in Building 31 was an exterior cage located at the southwest corner of the building (in the Administrative Area). The hazardous wastes stored here were non-agent-related waste from the shop areas transferred from SAAs. Facility records indicate this 90-Day Storage Area was used infrequently between 1993 and 1999. Wastes stored included used compressor, motor and transmission oils; soda lime solids; spent smoke pots; suspect asbestos items; and used motor oil possibly contaminated with gasoline. These wastes were transferred to the Building 203 CSF for storage. The cage has since been relocated to another location in the Administrative Area and is used by the Risk Management Environmental Division for the storage of empty drums. Figure 47 shows the approximate location of the cage outside Building 31 (at current site of wood framing).

Figure 47. Former Location of Bldg 31 90-Day Area, Looking Northeast (March 2011)

13.10 Building 655 90-Day Area

A 90-Day Storage Area is located in a metal conex box approximately 18 ft by 6 ft with a wooden floor located outside the southeast corner of Building 655 (see Figure 48). This area stores agent-contaminated laundered materials that have been monitored to the lower-level waste criteria. No liquids are stored at this location. Air monitoring to the GPL of the metal conex box was conducted in accordance with U.S. Army Guidance (CMA 2010) in order to support reuse of the property at the PCD. All results were less than (<) GPL, which supports an agent-free condition for property which will be reused and retained within Government control. Consequently, in 2012, the metal conex box was removed from the UMCD (shipped to PCD) and is no longer located on the facility's premises. Based on the analytical results, and its absence on the UMCD, no further consideration will be given to this 90-Day Area.

Figure 48. 90-Day Storage Area Next to Building 655 (March 2011)

13.11 Pier 37 90-Day Area

The 90-Day Storage Area located at the Pier 37 Building stores agent-related liquid wastes generated from decontamination operations or the Building 656 Laboratory (see Figure 49). Liquids are consolidated and sampled to determine appropriate disposal requirements.   Spill pallets are used for secondary containment.

Figure 49. 90-Day Liquid Storage Area at Pier 37 (March 2011)

13.12 Conceptual Model

The CSMs are well defined for the SAAs and the 90-Day Storage Areas. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent and nonagent constituents are expected to be present at acceptable levels. Three (3) significant factors strongly influence this CSM:

1. Agent-related hazardous waste was only stored at Buildings 655 and 656 and Pier 37; all other areas stored non-agent-related hazardous wastes.
2. All liquid wastes were stored on spill pallets or in bermed areas.
3. The SAAs and 90-Day Storage Areas are regularly visually inspected; spills are immediately contained and decontaminated.

It is anticipated that the SAAs and 90-Day Storage Areas will be closed successfully utilizing this closure plan.

13.13 Constituents of Concern

For the various SAAs and 90-Day Storage Areas, the COCs are chemical agents (GB/VX/HD), agent degradation products, explosive residues, organics and RCRA metals (including mercury) based on the RCRA waste codes specified in Table 24. The list of waste codes were identified from a review of the wastes stored, the UMCD Permit Application and UMCD WAP. The closure performance standards will be set at the agent-free criteria for CWAs; nonagent COCs are set at the industrial Oregon RBC or EPA RSL values (see Table 12).

Table 24. Applicable Waste Codes for SAAs and 90-Day Storage Areas

Building		**Applicable RCRA Waste Code**
Building 5 SAAs	1005A	D004, D006-D009, D011, D018-D022, D026-D029, D031-D036, D038, D039, D040, D043, F001-F005, U002, U019, U044, U056, U080, U088, U117, U122, U131, U140, U154, U165, U210, U220, U227, U228, U239
	1005B	D004, D006-D009, D011, D018, D038, D039, D040, F001- F005
	1005C	D004, D006-D009, D011, D018, D022, D028, D036, D043, F002- F005
	1005D	D036
Building 7 SAAs	1007A	D004, D006-D009, D011, D018, D035, D038, F002-F005
	1007B	D004, D006-D009, D011, D018, D022, D028, D036, D043, F002-F005
	1007C	D004, D006-D009, D011, D018, D035, D038, F002-F005
	1007D	D004, D006-D009, D011, D018-D022, D026-D029, D031-D036, D038, D039, D040, D043, F001-F005, U002, U019, U044, U056, U080, U088, U117, U122, U131, U140, U154, U165, U210, U220, U227, U228, U239
	1007E	D004, D006-D009, D011, D018, D035, D038, F002-F005
	1007F	D012, D014-D016, D020, D037, D041, D042, F002-F005, U240
Building 11 SAA		D007, D011
Building 14 SAA		D008, D009, PCBs
Building 115 SAA		D004, D006-D009, D011, D018, D022, D028, D036, D038, D039, D040, D043, F001-F005, U134
Building 655 SAA		D004, D006-D009, D011, D021, D022, D028, D043, U037, U210, U227
Building 656 SAA		D004, D006-D009, D011, D018-D022, D026-D029, D031-D036, D038, D039, D040, D043, F001-F005, F998, F999, P999, P998, U002, U014, U018, U019, U037, U044, U056, U080, U088, U117, U122, U131, U134, U140, U154, U165, U210, U220, U227, U228, U239
Building 31 90-Day		D004, D006-D009, D011-D022, D026-D029, D031-D043, F001-F004, F027, U019, U044, U051, U056, U080, U088, U117, U122, U131, U134, U140, U154, U165, U210, U220, U227, U228, U239, U240
Pier 37 90-Day		D004, D006-D009, D011, D021, D022, D028, D034, D039, D040, D043, F002, F003, F005, F998, F999, U037, U210, U227

13.14 Decision Analysis

Wipe samples will be collected from the floor of each area and analyzed for the applicable COCs. In the event that the data derived from these samples achieves the closure performance standards, a clean-closure determination shall be made for each SAA or 90-Day Storage Area.

13.15 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of one strata – the floor – which will be wipe sampled as it is the most likely surface to contain residual contamination. Samples from this stratum will serve as the basis for making a clean closure decision. The number of wipe samples expected to be collected per area are described in Section 13.17.

13.16 Decision Making Approach

Due to the small size of the SAAs, there may be area available for only one wipe sample per group of constituents. The decision making approach generated for the Building 203 CSF (see Section 5.6) is conservatively applied to the 90-Day Storage Areas. The sample size of eight will be divided into two locations within each quadrant of the area.

Decision-making for the SAAs will be made using each individual sample result. Decision-making for the 90-Day Storage Areas will be made using the mean concentration of the samples collected for that area.

13.17 Calculated Sampling Regime

One wipe sample from each SAA (except Building 419) will be collected for each group of constituents based on historical hazardous waste storage. A minimum of one wipe sample will be collected from the 90-Day Storage Areas located at Building 31 and Pier 37. If sufficient surface area is available, the 90-Day Storage Areas will be divided into four equal quadrants with a minimum of one wipe sample~~s~~ for each group of constituents taken from a random location within each quadrant. Additional wipe samples will be taken at areas of significant cracking or staining in the 90-Day Storage Areas. Judgmental samples (e.g., soil samples, scabbled samples or additional wipe samples) may be required at SAAs or 90-Day Storage Areas based upon DEQ surveys of each area.

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14.0 SOLID WASTE MANAGEMENT UNITS (SWMUS)

A solid waste management unit (SWMU) is any unit which has been used for the treatment, storage, or disposal of solid waste at any time, irrespective of whether the unit is or ever was intended for the management of solid waste. SWMUs include areas that have been contaminated by routine and systematic releases of hazardous waste or hazardous constituents. This excludes one-time accidental spills that are immediately remediated and cannot be linked to on-going solid waste management activities (e.g., product or process spills).

14.1 Federal Facilities Agreement

In October 1989, a Federal Facilities Agreement (FFA) was signed by EPA, DEQ, and the Army. The agreement required the Army to investigate and clean up the site in accordance with CERCLA and with DEQ's Environmental Cleanup Rules. Eight (8) operable units (study areas)[9] were designated:

- Unit 1 consists of the soil beneath the Explosive Washout Lagoons. The contaminated soils (15,000 tons) were excavated, biologically treated to remove TNT and RDX, and placed back into the excavation; this was completed in 1996 and the unit is closed out.
- Unit 2 is the groundwater beneath the Explosive Washout Lagoons. Three extraction wells were installed to pump 1,500 gallons per minute of contaminated groundwater through a granular activated carbon treatment system. Treated groundwater is reinjected into the ground. The groundwater treatment system began operating in 1997 and is expected to operate for up to 30 years (i.e., until 2027). Pumping of contaminated groundwater beneath Unit 2 has reduced the size of the groundwater plume from 350 to 180 acres.
- Unit 3 was the Explosives Washout Plant which processed munitions to remove and recover explosive using a high-pressured hot water system (mid-1950's to 1965). Water from the periodic flushing and draining of the washout system was discharged to two lagoons adjacent to the plant. The plant was steam cleaned to remove residues of explosives, then demolished in 1996. This unit is closed out.
- Unit 4 was the soil around the former small arms Deactivation Furnace located in the southwestern corner of the UMCD that operated from the late 1950's to 1988. Remedial actions included excavation of the contaminated soil, solidification/stabilization of the excavated soil with cement, and placement of the treated soil in the on-site active landfill (Unit 5). This cleanup was completed in early 1997 and the unit is closed out.
- Unit 5 is a 5-acre active landfill located in the northeastern portion of the UMCD. The landfill was closed and capped in accordance with RCRA requirements; DEQ issued a closure permit in August 2000. No further remedial action is necessary for this unit.

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[9] Operable unit details and status were obtained from the online Oregon DEQ Environmental Cleanup Site Information (ECSI) Database site summary report for the Umatilla Army Depot, Site ID 514 (http://www.deq.state.or.us/lq/ECSI/ecsidetail.asp?seqnbr=514).

- Unit 6 consists of six inactive landfills totaling approximately 8 acres located west of the Administrative Area. No further remedial action is necessary and this unit is closed out.
- Unit 7 was the 1,750-acre Ammunition Demolition Activity (ADA) Area located in the northwestern corner of the UMCD. Remedial actions included excavation of the contaminated soil, solidification/stabilization of the excavated soil with cement, and placement of the treated soil in the on-site active landfill (Unit 5). In addition, unexploded ordnance (UXO) was removed from the surface. This cleanup was completed in early 1997. However, subsurface clearance of UXO from Unit 7 has not been conducted as it is dependent on future use plans (that are not yet determined).
- Unit 8 was a catch-all unit consisting of 32 distinct sites where hazardous substances may have been disposed of or released. These sites served a variety of specific functions including: sewage treatment and storm water discharge, munitions disassembly, storage of raw materials, metal ingot storage, pesticide storage, paint spray and removal areas, paint sludge discharge areas, boiler/laundry waste water discharge areas, disposal pits, and hazardous waste storage. Most of these sites are clustered in the southwestern or southern portion of the UMCD. No groundwater cleanup was required under this unit. Remedial actions included excavation of the contaminated soil, solidification and stabilization of the excavated soil with cement, and placement of the treated soil in the on-site active landfill (Unit 5). This cleanup was completed in early 1997 and the unit is closed out. Site 39, Quality Assurance Function Range, was extracted from Unit 8 after the first Five-Year review. This site underwent additional remediation activities that were completed in 2009. There are no longer any hazardous substances remaining above levels that allow for unlimited use and unrestricted exposure, but this site has not yet achieved formal closure (U.S. Army Corps 2010).

Additional information on these operable units is found in Section 4.2.5 of “U.S. Army BRAC 2010 Environmental Condition of Property Report: Umatilla Chemical Depot – Oregon” (U.S. Army 2010).

14.2 Identifying SWMUs

Newly identified SWMUs/AOCs at UMCD are those areas/units not already captured in the 1986 UMCD RCRA Facility Assessment (NUS Corporation 1987). The new SWMU/AOC identification process is described in Module VII of the Permit; a simplified flow diagram of the process is shown in Figure 50.

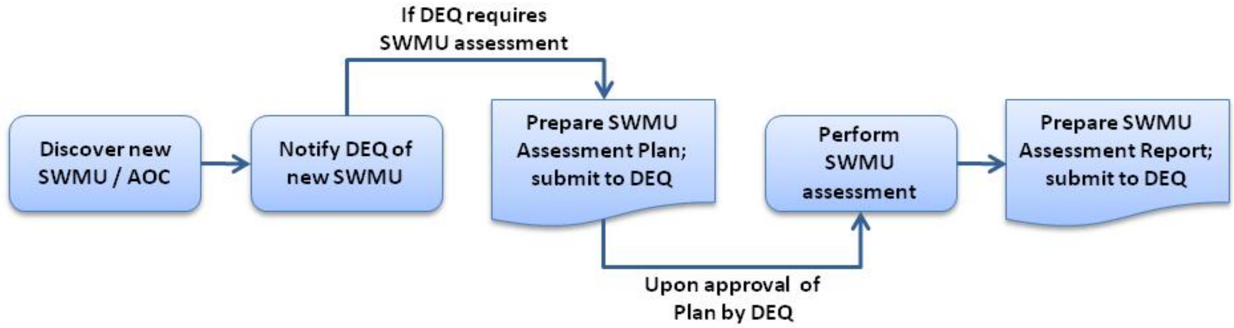


Figure 50. SWMU / AOC Identification Process

Based on reported results, DEQ shall determine the need for further investigations at specific unit(s) covered in the SWMU Assessment or classify the SWMU/AOC as "No Further Action" required. If the assessment determines that cleanup of the unit is needed, the SWMU/AOC will be integrated into the 1989 FFA. Clean closure standards will be the permit compliance concentrations for agent constituents; closure standards for nonagent constituents will be the industrial DEQ RBC values or the EPA RSL values (for those constituents where there is not an DEQ RBC value). While several SWMU Assessment Reports may be generated during UMCD closure activities, the final UMCD RCRA closure certification report will be used to document all SWMU/AOC assessment and cleanup results.

Known SWMUs/AOCs identified by UMCD or DEQ (not included in the 1989 FFA) at the UMCD are:

- J-Block exterior spills (see Section 4.2.1 for additional details),
- Building 654 sump and connected external UST (see Section 8.0 for additional details),
- Building 655 laundry leach field (see Section 9.0 for additional details),
- Building 656 UST [10] (see Section 10.0 for additional details),
- Areas where blue bands tubes were buried (see Section 14.2.1 for additional details), and
- Areas where "trainer" ton containers were washed out (see Section 14.2.2 for additional details).
- Administration Area leachfield (see Section 14.2.3 for additional details).

The schedule to further assess these SMWUs is to be developed and will be included in a future revision to this closure plan.

[10] This tank was closed under Oregon UST regulations, but surrounding soil may need to be sampled against the agent-free criteria.

14.2.1 Burial of Blue Band Tubes

Blue band tubes are a component of the Chemical Agent Detector Kit, ABC-M18A2 (Figure 51, tubes are circled in red). The M18A2 kit is designed primarily for detecting concentrations of vapors, aerosols, and liquid droplets of chemical agents. The blue band tube is glass, measuring approximately 3 inches long and 3/8 of an inch in diameter. The contents of each tube are:

- Silica gel (0.048 mg/tube),
- Mercuric cyanide (0.00057 g/tube), and
- 4-(4'Nitrobenzyl) pyridine (0.00036 g/tube).

The blue band tubes (individual item Number 6665-00-856-8236) are regulated by the EPA because mercuric cyanide carries a D009 waste code. Other hazardous waste items in the kit include the blue-capped bottle (sodium hydroxide) and the red dotted substrate dispenser (ligroin); the remainder of the kit is nonhazardous.

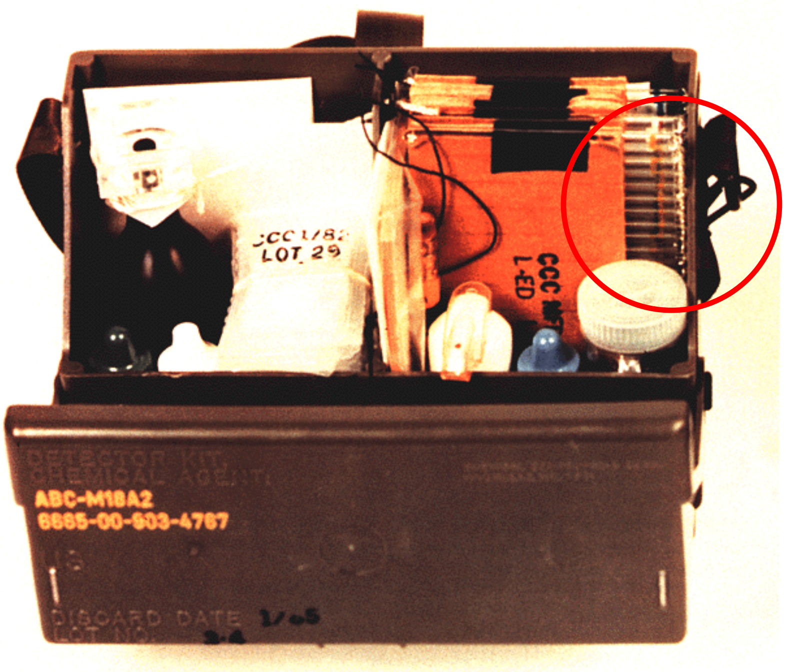


Photo courtesy of the U.S. Army ERDEC

Figure 51. ABC-M18A2 Chemical Agent Detection Kit

Blue band tubes were used by UMCD Chemical Operations Monitoring personnel for the detection of chemical agents during quarterly inspections in the Mustard Shed (Building 659) and the K-Block igloos. The tubes were in use from approximately 1972 into the early 1990s. Following the introduction of mechanical detection devices, use of the tubes for monitoring purposes was terminated. Depending on the level of surveillance activities and sample size requirements, 60 to 100 tubes were expended per day when monitoring. Used tubes were collected and co-mingled with other agent-related solid waste generated at each location.

The blue band tubes were used primarily for the detection of agent when monitoring GB rockets and projectiles and mustard (HD) ton containers. Interviews with Chemical Operations personnel revealed that blue band tubes were typically buried in the dirt outside of the igloos and Building 659 through the 1980s. It was common practice to kick shallow holes in the dirt outside the igloo and in the dirt south of the road where the vehicles were parked then bury the tubes. During the time period that the tubes were in use, leaker munitions were segregated in igloos K-1825 and K-1826. These igloos are expected to have a higher density of buried tubes.

Some blue band tubes were found during construction activities to upgrade the roads and parking aprons outside of the K-Block igloos. Those tubes were collected and are stored as agent-related waste in container number S-0315A located in igloo J-1799 (the contents of this container were consolidated from containers S-0154, S-0638, and S-0743). Any excess dirt from the upgrade was not removed, but pushed up to the sides of the igloo or south of the access road; crews have stated that small amounts of glass were visible in this excess dirt. It is safe to assume that what tubes remain are buried in those areas.

At Building 659, the area of concern is directly outside the man door, located on the south end of the building. The same practice was followed here – a shallow hole was kicked out and the tubes were buried. Because no modifications were made to the outside of this building, no tubes have been discovered.

Initial investigations to assess the presence/absence of blue band tubes in the likely areas within the K-Block (that is, the areas outside the Building 659 man door and igloos K-1825 and K-1826) began in February 2013. This initial assessment was the first step in evaluating the potential presence and magnitude of contamination resulting from the disposal of blue band tubes. The scope of this sampling endeavor was initially limited to the soils outside of igloos K-1825 and K-1826 and outside of Building 659; however, this scope increased to address other locations, including: K-1829, K-1835, K-1841, K-1873, and K-1881.) Three sampling/study areas were targeted at each of the sampling locations. These study areas included:

- Study Area A: Study Area A consisted of an approximately 10 feet (ft) by 80 feet section, located in front of each igloo and south of the access road. These study areas were selected based on historical knowledge of potential blue band tubes disposal practices at the site.
- Study Area B: Study Area B consisted of a small, unpaved rectangular area located in front of each igloo, north of the access road and west of the respective igloo. Study Area B measures approximately 10 ft by 15 ft.
- Study Area C: Study Area C consisted of a small, unpaved rectangular area located in front of each igloo, north of the access road and east of the respective igloo. Study Area C measures approximately 10 ft by 15 ft.

Based on site information, it was assumed that the likely burial depth of the blue band tubes was less than one foot below ground surface (bgs). Ideally, a surface sample, 0 to 12 inches bgs, as well as a subsurface soil sample, collected 24 to 36 inches bgs, was to be collected from the areas found to have evidence of blue band tube disposal. A backhoe was utilized to expose the soils at depths between 12 and 36 inches deep in the three study areas until the presence of glass is detected and a sample(s) could be collected. In most instances, six (6) samples were collected in Study Area A, two (2) in Study Area B, and two (2) in Study Area C. Glass tubes or portions of tubes were not found in most areas. At a few locations (such as igloo K-1829 and K-1881) some sections of asphalt were removed in order to expose underlying soils. These soils in these locations were sampled.

Overall, of the more than 50 samples, all but one (1) was reported as non-detect. The sample was located at an approximate 3-inch depth outside igloo K-1835. Concentration of the sample was 0.1mg/kg, which is significantly below the closure performance standards listed in Table 12 (U.S. Army CMA, 2013).

Based on the sampling that was conducted and the corresponding results, additional evaluation to assess contamination resulting from the usage of blue band tubes should not be considered further.

14.2.2 Trainer Ton Container Washout Areas

Eight empty ton containers have been used by UMCD as trainers for operations mock-up exercises. Prior to their use in training operations these containers may have held Lewisite, mustard (HD) and/or GB (see history summary in Table 25). Lewisite is another blister agent that was produced in limited quantities. No historical records could be found for one of the ton containers, D-26795. Only three of the containers (D-25658, D-27334, and D-38016) have good documentation to support thermal decontamination (all were previously used to store GB). There is no history of receipt for any of these ton containers at UMCD. They were possibly shipped to UMCD for use during the Drill and Transfer System (DATS) program (1983 – 1985). All eight containers were monitored using Depot Area Air Monitoring System (DAAMS) tubes to the GPL for GB, VX, and mustard (HD) prior to transfer to J-Block. The containers were later monitored for Lewisite using a miniature continuous air monitor (MINICAM) on 26-27 October 2009 with all results below the Worker Population Limit (WPL).

Table 25. History Summary for Trainer Ton Containers

Ton No.	D-26371	D-25658	D-23780	D-27334	D-14703	D-20436	D-26795	D-38016
Possible WWII Use [1]	Uncertain	Lewisite	HD	HD	HD	Lewisite	Uncertain	Uncertain
Filled with GB during 1950s [2]	1954-1956	1954-1956	1954-1956	1955	No Record for GB	No record	No record	No record. Possible GB
1,000° for 15 minutes [2]	Likely but no record	2 Feb 1970	Likely but no record	17 Mar 1970	No record	No record	No record	10 Jun 1970
Drained, Decontaminated, Hydro-statically tested [2]	No record	No record	No record	No record	1976	No record	No record	No record
Shipped [2]	No shipping record	No shipping record	No shipping record	No shipping record	Destination unknown 1983	No record	No record	No shipping record
Cleaned for Special Projects 1975 [3]	No record	No record	No record	No record	No record	Suspect Lewisite group	No record	No record

Data Sources:
1. Lewisite Stoplight Database.
2. Rocky Mountain Arsenal records.
3. Pine Bluff Arsenal records.

During training scenarios, these ton containers were filled with water to simulate a full container. After training was completed, the water was dumped onto the ground. UMCD Chemical Operations personnel indicate that for several years, water from the ton containers have been dumped south of Building 419. Water was also dumped behind S-30 in the Administrative Area, K-Block, a pad in front of Igloo K-1870, and several other unknown places. Although complete documentation regarding the decontamination of all eight ton containers could not be located, the potential for contamination to have resulted from the use of these ton containers is remote, as Army regulations/guidance which require potentially contaminated property to be decontaminated prior to shipment have been in force long before the arrival of these ton containers to UMCD. At a minimum, these ton containers would have been triple rinsed with decontamination solution, thereby rendering the ton containers RCRA clean and the area not subject to contamination. Further, the repeated rinsing which was conducted innumerous times over several years is expected to have hydrolyzed any possible remaining agent.

14.2.2.1 Conceptual Model

The CSM is reasonably defined for the Ton Container Washout Area. The CSM (as summarized below) suggests that there is a low risk of surface contamination; residual agent constituents and non-agent constituents are expected to be present at acceptable levels. Two (2) significant factors strongly influence this CSM:

1. Decontamination records for the ton containers are incomplete. However, per Army regulation/guidance, the ton containers would have been decontaminated (for example, tripled rinsed and/or monitored) prior to shipment to UMCD and therefore do not pose a potential risk for contamination at the site.
2. The primary training activities were conducted in the vicinity of Building 419. The water-filled tons were dumped approximately 100 feet south of Building 419 in an open field measuring approximately 100’ x 100’. Training exercises with the ton containers were also conducted in the vicinity of S-30 in the Administrative Area and a pad in front of Igloo K-1870.

It is anticipated that the Ton Container Washout Area will be closed successfully utilizing this closure plan.

14.2.2.2 Constituents of Concern

For the ton container washout area, the COCs include the RCRA 8 metals. Closure performance standards will be set at the industrial Oregon RBC or EPA RSL values identified in Table 12.

14.2.2.3 Decision Analysis

The primary training activities were conducted about 100 feet south of Building 419 in an area measuring approximately 100’ x 100’. Although contamination in the area is unlikely, soils in the vicinity will be collected in order to confirm the absence of contamination to the surrounding environment. Soils from this area will be collected and will be analyzed for the RCRA 8 metals. This area represents the worst-case scenario related to potential contamination. Therefore, if the data derived from these samples achieves the closure performance standard, the ton container washout area will be recommended for clean closure.

14.2.2.4 Study Boundaries

The project study boundaries and decision-making are evaluated in terms of one stratum – the soils of the area located south of Building 419. This area represents the worst-case scenario related to potential contamination (that is, this area is the most likely surface to contain residual contamination, if present). Soils samples from this stratum will serve as the basis for making a clean closure decision for this area of concern. The number of soil samples expected to be collected in this area are described in Section 14.2.2.6.2.

14.2.2.5 Decision Making Approach

Using the category designation previously defined in Section 4.3, the ton container washout area is considered a Category 1 unit (no history of vapor or liquid CWA leaks and only wastes monitored to less than the WPL, or never exposed to agent, were stored in this location). No previous sampling has been conducted in association with this area, so there is no information regarding expected levels for the COCs. As such, decision-making will be made using the mean concentration of the COCs of the samples collected from this area.

Soil samples collected at varying depths throughout the washout area associated with Building 419 will be used to make the clean-closure determination for this unit/area of concern. All sample results will be compared to the closure performance standard. If the results meet the closure performance standard, then the ton container washout area will be recommended for clean closure. However, if more than two individual sample results exceed the performance criteria, additional decontamination or risk based analysis may be required (evaluate 95% UCL for the individual COC). Collection of additional samples may be required in order to properly evaluate the 95% UCL.

14.2.2.6 Calculated Sampling Regime

Acceptance Sampling was selected for the purpose of addressing potential residual contamination of the surface and subsurface soils of the ton container washout area associated with Building 419. Acceptance Sampling is an unbiased statistical method used to ensure (with a high degree of confidence) that successful decontamination has been achieved in the area. The VSP software (PNNL, Version 6.3) was utilized in the development of this sampling strategy. Details of the Acceptance Sampling are provided in the following paragraphs.

14.2.2.6.1 Basis and Assumptions for Sample Calculations

A number of samples are to be collected with the primary purpose of achieving high confidence that few grid cells on the selected surfaces contain contamination. The following basis and assumptions were made in developing the Acceptance Sampling strategy for ton container washout area stratum: No sample results to evaluate prior means or reference areas available at this time.

1. No sample results to evaluate prior means or reference areas available at this time.
2. 90% of the study area is acceptable (below the Action Level) prior to sampling.
3. Simple random sampling conducted.
4. Obtain at least 95% confidence that initial assumption 2 is true.
5. The ton container washout area associated with Building 419 measures approximately 100’ x 100’.

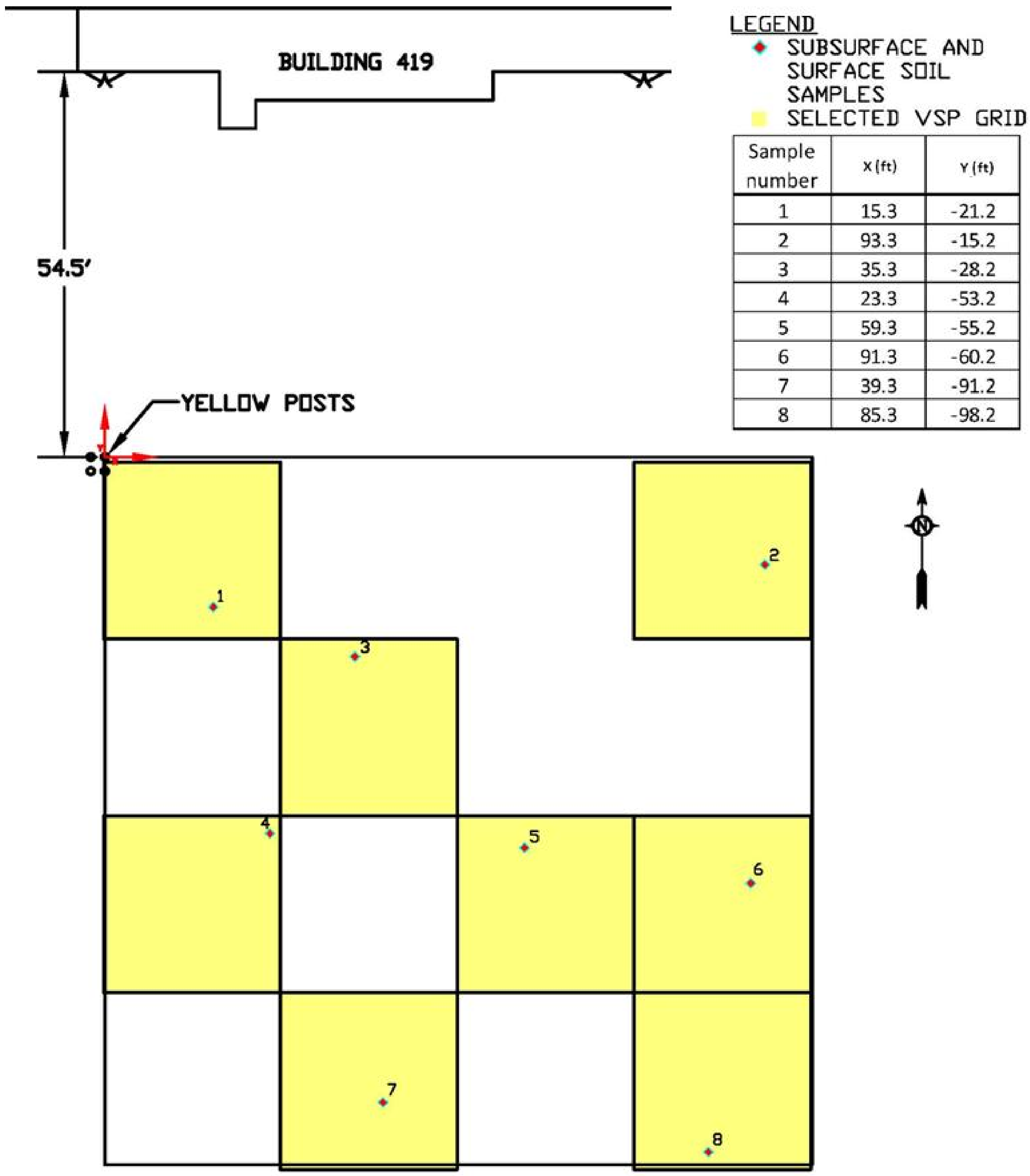
14.2.2.6.2 Determination of Number of Samples and Sampling Locations

The following options were selected from the "Sampling Goals" menu using the General (All Inclusive) VSP Version:

- Sampling within a building (represents sampling within a building footprint)
- Compare measurements or UTL to a threshold
- Presence/absence measurements
- No sample exceedences permitted
- Ensure most of area is uncontaminated
- Length of grid size = 25 feet (Sampling grid is constructed on 15 ft centers, as no specific reports of spills are known. This results in 16 sample grid cells.)
- Action level (derived concentration guideline level) = 200 (Note: Action level has no influence on the determination of required number of samples)
- Minimum percentage of the decision area that does not contain contamination = 90 percent
- Confidence required that maximum percent is not exceeded = 95 percent.

Based on these settings, and the assumptions specified in Section 9.7.1, VSP determined that randomly sampling 8 grid cells (two samples per cell, one sample at 0-6" and one sample at 12-18") may achieve a 95% confidence that Assumption 2 is true. Per VSP analysis, a 99% confidence may be achieved with the collection of soil from 12 random selected grids (for a total of 24 samples). Sampling should include random sampling of between 8 and 12 sample grids (for a total of 16 to 24 samples) with a minimum number of 8 selected grids (that is, 16 soil samples) for 95% confidence.

The specific sampling locations for the Ton Container Washout Area are depicted in Figure 52.



Sample number	X (ft)	Y (ft)
1	15.3	-21.2
2	93.3	-15.2
3	35.3	-28.2
4	23.3	-53.2
5	59.3	-55.2
6	91.3	-60.2
7	39.3	-91.2
8	85.3	-98.2

Figure 52. Sampling Locations for the Ton Container Washout Area

14.2.3 Administration Area Leachfield

UMCD operates the sewage treatment plant in accordance with the DEQ Water Pollution Control Facilities (WPCF) Permit Number 102031 (which expires in February 2015). Domestic wastewaters in the Administration Area, as well as all steam cleaning wastes, after being run through an oil separator, are routed to the sewage treatment plant, located in the south-central part of the Depot (about 2.5 miles west of the Administration Area). The wastewater treatment process consists of an Imhoff tank, standby Imhoff tank, sludge drying bed, and tile field percolation system (leachfield). The sewage treatment plant currently runs off of the Imhoff tank. The permitted average daily flow may not exceed 30,000 gallons per day. No direct discharge to waters of the state is permitted. All wastewater gets dissipated by evapotranspiration and controlled seepage to prevent surfacing of wastewater on the ground surface, the creation of odor or other nuisance conditions, and loading of nutrients or organics on the land (U.S. Army 2010).

During the 1992 RI, 18 subsurface soil samples were collected from five 10-foot borings and analyzed for TAL inorganics, TCL VOAs, TCL BNAs, TCL pesticides/PCBs, and explosive constituents. Three samples were analyzed for nitrate/nitrite. Results of the chemical analyses indicate elevated levels of silver and low levels of organic constituents at the near surface of the tile field. Concentrations exceeding the comparison criteria for metals, nitrate/nitrite, and low levels of dichlorodiphenyltrichloroethane (DDT) were reported for the samples from the sludge drying bed. An 8-inch diameter pipe from the sewage treatment plant Imhoff tank discharges into a long ravine. Discharge has not been used since the 1970s. Three shallow soil samples were collected at the pipe discharge, in the center of the ravine and ~150 feet from the discharge and analyzed for TAL inorganics, TCL BNAs, VOAs, pesticides/PCBs, and explosive constituents nitrate/nitrite. Results indicate that cadmium, copper, mercury, silver, zinc (above the comparison criteria), nitrate/nitrite, three pesticides, and five unknown BNA TICs were detected (U.S. Army 2010).

Operation of the Imhoff tank and associated leachfield will continue into the foreseeable future. Consequently, the system will remain operational (that is, as-is) until the end of its useful life, at which time closure will be managed by DEQ’s Water Quality Program.

15.0 SAMPLING AND ANALYSIS PLAN

This Sampling and Analysis Plan (SAP) presents the requirements and procedures for conducting field operations and investigations for the clean closure of the various UMCD HWMUs. Accordingly, this SAP has been prepared to ensure:

1. Data generated during this project are of sufficient quality to make the closure decision;
2. Field sampling protocols are documented and reviewed in a consistent manner; and
3. Data collected are scientifically valid and defensible.

The field-sampling program involves collecting the designated number of samples as determined by statistical analysis. Data will be used to determine the presence or absence of contamination in the unit, assess the extent and magnitude of any contamination, and assess the degree of potential risks posed to human and ecological receptors. In the event the quality parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) are not met, the analytical data in question will be further evaluated (including consultation with DEQ) in order to determine whether additional data are required. In this event, a second sampling event will be scheduled for sample collection and data generation, which will be used to augment the data generated to date. The field-sampling phase will include the actual collection of debris and wipe samples from each unit. A field sampling lead will maintain a bound field logbook to record all field measurements and sampling activities. UMCD will provide informal notice (via phone or email) to DEQ of scheduled sampling events, providing the opportunity for split samples.

NOTE: Due to unforeseen situations or changes in the site conditions, precise sample locations for all samples will be field verified and adjusted accordingly. All adjustments will be noted in the field sampling notebook. Further, deviations from the sampling protocol will be identified for and discussed with DEQ prior to implementation.

15.1 Work Control

To confirm clean closure it is necessary to have a comprehensive and verifiable sampling and analysis process, facilitated by planned work packages that control the field activities. There will be one work package prepared for each field mobilization; typically, each work package will address the sampling and decontamination at no more than six storage units. The contents of a work package will include:

- Field map, showing igloo/building number, number of samples to be collected, and sample locations;
- Narrative summary of work scope, methods, and considerations;
- Project procedures for sampling, record keeping, waste management, and other field activities;

- List of required equipment, materials, supplies, and personal protective equipment; and
- Standing job hazards analysis (JHA).

At the conclusion of field activities supporting each work package, data will be evaluated to support a closure decision for each storage unit. The igloo data will also be added to the statistical model to update the prior distribution for the next storage unit. This process will optimize work package preparation and sampling for the next and subsequent igloos.

A permanently bound field logbook with water resistant paper will be maintained to record all field measurements and sampling activities, separate from the work packages. All observations, particularly those that would affect the quality of the sample or subsequent interpretation of the data, will be recorded. All entries in the field logbook will be made in indelible ink and all corrections will follow error correction protocol of a single line through the error, the initials of the person performing the correction, and the date of the correction.

15.2 Sampling Process Design

Debris and surface wipe samples will be collected from each unit in an effort to assess whether the closure performance standards identified in Table 12 have been met. To facilitate sampling and evaluation of resultant analytical data, the Building 203 CSF and J- and K-Block storage units will be sampled using stratified random sampling (SRS). Stratification is an accepted way to incorporate prior knowledge and professional judgment into a probabilistic sampling design. The SRS scheme utilizes a random number generator to select specific sampling locations within a predefined area, or stratum.

A stratum consists of a number of nonoverlapping areas within which there is a reasonable expectation that physical samples will be more similar to each other than to samples obtained from other areas. Criteria used to establish strata include (listed from more significant to less significant):

- Facility operational history; and exposure to agent;
- Configuration of the storage unit;
- Materials of construction (e. g., poured concrete slabs, steel, or soil); and
- Areas where liquid or vapor would be expected to collect.

Stratified random sampling (SRS) ensures all areas and surfaces are adequately sampled, while avoiding the risk that a purely random sampling scheme results in certain areas not being sampled. The basic assumption in stratification is that the areas in a single stratum are relatively homogeneous with respect to physical and chemical characteristics. Therefore, segregating the areas based on these criteria will minimize the variability of the data. Four (4) strata were established for the sampling effort:

- Debris,
- Floor, wall, and ceiling surfaces (floor only in buildings),
- Passive filter units (if equipped), and
- Exterior concrete and soil (where contamination is known or suspected).

15.2.1 Debris Stratum

The floor of each storage unit is currently covered with a thin layer of debris or dirt, which must be collected, drummed, and designated. In the design of this procedure, the following conditions were considered:

- A portion of the debris in many storage units will consist of coarse material (rocks, wood or concrete chips, dead mice, etc.) over 0.5 in^3 (8.2 cm^3) in size that is unlikely to carry significant contamination and will not be conducive to sampling, or will interfere with proper vacuum sweeping and sampling of the finer materials.
- The large floor area (e.g., 2133 ft^2 [195 m^2] for igloos, 3600 ft^2 [335 m^2] for Building 203 CSF) may result in a correspondingly sizable amount of debris that may require multiple containers.

This task will start with the collection and containerization of all coarse, loose debris (rocks, wood or concrete chips, dead mice, etc.) of a size greater than 0.5 in^3 (8.2 cm^3) or an overall dimension greater than 0.75 in (5 cm). It is important that the coarse debris be removed before the vacuum sweeping process to ensure accurate sampling. All material removed will be weighed, or its volume estimated, then containerized and labeled as required.

After removal of the coarse debris, the entire floor will be dry vacuum-swept (dry decontamination). Wet decontamination is not performed at this time as this activity was done by UMCD Operations immediately following the discovery of a leak/spill in accordance with existing Department of Defense (DOD) practices and UMCD SOPs (currently UM-0000-M-002 for GB/VX and UM-0000-M-003 for mustard [HD]). The vacuum used must be of the “shop vac” type and must include a HEPA filter prior to the discharge air vent. The containment chamber will be lined; the HEPA filter and liner will be changed as necessary. To facilitate the collection of a representative sample, the vacuumed debris will be deposited on individual sheets of butcher type paper or plastic placed on the storage unit floor. A representative sample of this material will be taken with a clean, flat-bottom sampling spatula or scoop using an increment delimitation sampling method (EPA/600/R-92/128, *Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies*, by B. J. Mason, 1992), as illustrated in Figure 53.

Figure 53 shows how incremental delimitation sampling can be carried out in the field. The material is spread out to an even thickness to form an elongated pile on the paper or plastic sheet. One set of incremental samples is collected, then the pile is mixed and rearranged along a perpendicular axis, and a second set of increments is then collected. This procedure provides a representative sample of the bulk material provided the spatula or scoop is flat bottomed and is able to collect all material in the delineated increment.

Figure 53. An Example of Incremental Sub-sampling

Samples will be labeled appropriately (refer to Section 15.5.1) to give each sample a unique identification number. After sampling, the remaining vacuum-swept material will be weighed, or its volume estimated, then containerized and labeled as required.

15.2.2 Floor, Wall, and Ceiling Surfaces Stratum

For igloos, the concrete floor, the interior end walls and doors, and the bottom 6.6 ft (2 m) on either side of the arched ceiling consist of concrete surfaces that need to be wipe-sampled. In the various buildings, only the floor will be wipe sampled. After dry-vacuuming the floor, it will be visually inspected for areas that have an increased potential for contamination, such as areas with significant staining or cracking of the concrete, especially in storage units that have had known liquid leaking containers. If such areas are found, they will be photographed and delineated on the floor and on the floor plan (to scale). Extra “biased” samples will be taken from these areas as part of the overall sampling process, but will not be included in Bayesian statistical data analyses. Other than this possibility, sampling of the floor, walls, and ceiling stratum will be conducted in a random manner to support statistical data analysis.

The appropriate number of additional biased samples needed will be proportional to the size of the stain or crack and will require input from and concurrence by DEQ prior to biased sample collection. The need for and extent of intrusive sampling (e.g., sampling after performing concrete scabbling) will also be determined after conferring with DEQ (see Section 4.9 for additional details).

To facilitate data calculations (i.e., conversion of the analytical data to units of concentration), an area measuring a minimum of $100cm^2$ will be sampled. Samples for each agent and samples for agent degradation products, metals, explosives, PCBs, and organics will not be collected from the same area. Rather, the different samples will be collected from a grid area immediately adjacent to the areas sampled for GB, VX, and mustard (HD). To collect a wipe sample, the following equipment is needed:

- A premeasured template, or a ruler, to measure out the area to be wiped;
- Pencils or markers;
- Disposable gloves (nitrile, or equivalent) to be changed prior to handling clean swabs, sample bottles, or solvent;
- Sterile, wrapped gauze pads, swabs, or equivalent;
- Sterile, precleaned, bottles or equivalent;
- GB, VX, and mustard (HD) sampling solvents;
- RDX/TNT sampling solvents;
- Organic sampling solvents; and
- Metals sampling solvents.

The wipe sampling methodology is based on American Society for Testing and Materials (ASTM) D6966, *Standard Practice for Collection of Settled Dust Samples Using Wipe Sampling Methods for Subsequent Determination of Metals*. Per the ASTM standard, a 1-meter square template, lying flat on the floor or held up to a wall surface as applicable, is used (see Figure 54). Sub grid areas are then wipe sampled. The ASTM practice requires a minimum surface area collection of 100 cm^2 which will be used for wipe sample collection in this project. Wipe samples are collected by stroking firmly in an overlapping "S" pattern followed by an edge wipe to ensure the entire surface area is covered per Section 7.11 of D6966 (see Figure 55). The volume of solvent must be sufficient to wet the gauze pad or swab, which is wetted with clean solvent just before the collection of each sample. The gauze pad or swab shall not be presoaked.

Once the sample location has been determined, measured, and marked off, sample collection can begin. Wearing a new pair of gloves, remove the swab from its sterile wrapping or container and soak it briefly in the solvent, the swab must not be dripping. Wipe the entire area to be sampled, then place the swab into the sample bottle and secure the cap. Each sample will be appropriately given a unique identification number. The identification number shall be recorded in appropriate field and project documentation (i.e., field data sheets) with information describing the sample.

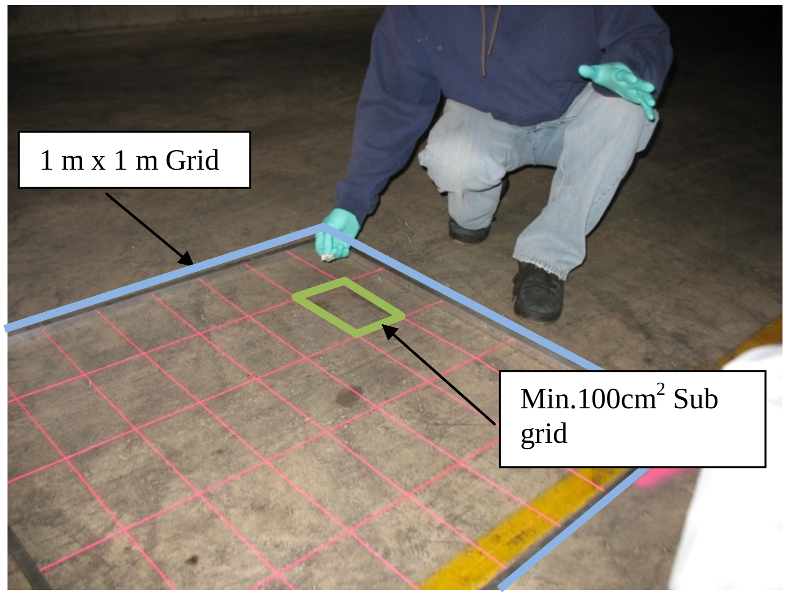


Figure 54. Grid and Sub-Grid Wipe Sample Template

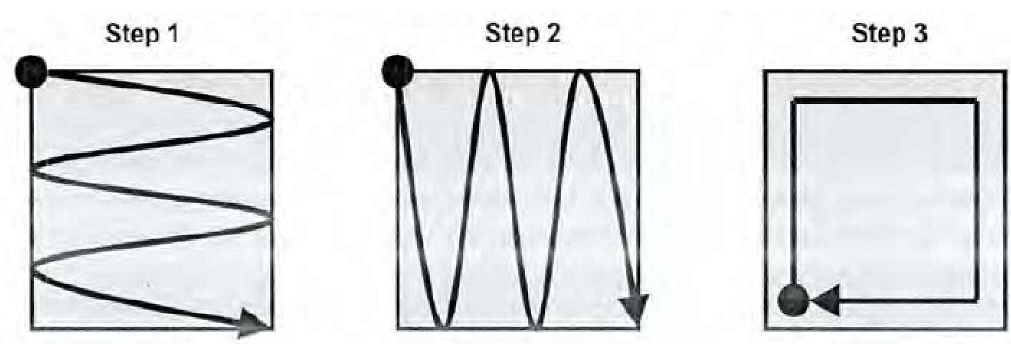


Figure 55. Direction of Wipe Sample Collection

15.2.3 Filter Housing Stratum

The interior of the passive breather filter housing outside the rear end wall of fitted storage units, as well as the door-mounted housing, consists of steel surfaces that need to be wipe-sampled. In the design and execution of this task, consideration is given to fact that any contamination is likely to have condensed from a vapor state (or precipitated from droplets) and coated the inside surfaces on the confinement side or “dirty” side of the housing, upstream of the filter media.

Wipe samples must cover the broad, flat areas of the housing sheet metal as well as corners and seams, and all samples shall be from the “dirty” side (upstream of the filter media). A minimum total area $100cm^2$ will be wiped for each sample for consistency with floor wipe samples. To collect a filter housing wipe sample, the same equipment, materials, and basic methodology is needed as was used for floor wipe samples, except that the sample areas are modified to follow the housing shape and limited to upstream of the filter media.

Each sample will be given a unique identification number, which shall be recorded in appropriate field and project documentation with information describing the sample. A label will be applied to the sample container containing the same information as the floor wipe samples, with the exception that the filter sample stratum will be denoted.

15.2.4 Soil Stratum

Soil sampling outside of igloos or buildings will be required to evaluate/quantify any potential contamination due to chemical agent releases to the surrounding soils, burial of blue band tubes, wastewater from laundering of CPE, and other agent-related operations. Soil sampling will be performed at either the surface (0 to 6 inches), the shallow subsurface (6 to 18 inches), or deep subsurface (greater than 4 feet below grade). Soil sampling underneath the igloos, if necessary, will be addressed in a future revision to this closure plan.

15.2.4.1 Surface Soil Sampling

A scoop sampler will be used to collect grab samples of surface soil. To collect a surface soil sample, the following equipment is needed:

- A precleaned or disposable scoop;
- Stainless steel bowl;
- Plastic sheeting;
- Pencils or markers;
- Disposable gloves (nitrile or equivalent) to be changed prior to handling clean sample bottles;
- Sterile, precleaned, sample bottles or equivalent; and
- Waste container(s).

Clear the sampling area surface of all loose debris (sticks, trash, pieces of metal, etc.). If desired, cut a 1-foot diameter hole in the center of the plastic sheeting and center the hole over the sampling point (the sheeting will help prevent the spread of any contamination); otherwise, mark designate/mark a circle that is about 12-inches in diameter. Apply downward pressure to the scoop until the desired sampling depth is reached, then lift the scoop. If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel bowl, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Remove any debris that is exposed during this process. (Debris consists of organic material, pieces of metal, wood, plastic, and other non-soil material that may have been deposited or incorporated into the soil.) Additionally, remove any large soil pieces that cannot be reduced to less than approximately ¼ inch in diameter. Place the homogenized sample into appropriate, labeled containers and secure the caps tightly.

Each sample will be appropriately given a unique identification number. The identification number shall be recorded in appropriate field and project documentation (i.e., field data sheets) with information describing the sample. A Global Positioning System (GPS) survey will be performed by reporting a sample’s X, Y, and Z coordinates accurate to the nearest 0.3 m (1 ft). Whenever possible, measured distances from identifying features will also be included to help define sample locations. Any leftover soil will be containerized and labeled as required. Waste soils collected at each location will be placed into separate bags and containerized, awaiting transportation and disposal. Waste soil will be characterized using the soil sample analytical data obtained from the investigation or characterized in accordance with the UMCD WAP. Decontamination fluids will also be containerized and labeled as required.

15.2.4.2 Shallow Subsurface Soil Sampling

A scoop sampler will also be used for grab sample collection of shallow subsurface soils. A shovel is used to get below the soil surface. To collect a shallow subsurface soil sample, the following equipment is needed:

- A precleaned shovel;
- Stainless steel bowl;
- A precleaned or disposable scoop;
- Plastic sheeting;
- Pencils or markers;
- Disposable gloves (nitrile or equivalent) to be changed prior to handling clean sample bottles;
- Sterile, precleaned, sample bottles or equivalent; and
- Waste container(s).

Insert the shovel vertically into the soil at the sampling point; applying downward pressure until the desired depth is reach, then lift the shovel and put the displaced soil onto the plastic sheeting (the sheeting will prevent the spread of any contamination). Horizontally insert the scoop into the newly revealed soil side wall at the desired depth, avoiding gravel clasts (if possible). If volatile organic analysis is to be performed, transfer the sample directly into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel bowl, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Remove any debris that is exposed during this process. (Debris consists of organic material, pieces of metal, wood, plastic, and other non-soil material that may have been deposited or incorporated into the soil.) Additionally, remove any large soil pieces that cannot be reduced to less than approximately ¼ inch in diameter. Place the homogenized sample into appropriate, labeled containers and secure the caps tightly.

If the soil proves to be too sandy (i.e., the side wall collapses), a hand auger may be used. A hand auger cannot be used for sampling VOCs as the augering motion facilitates volatilization. Because the auger rotation automatically homogenizes the sample, these are considered composite samples (Byrnes 2009). To collect a hand auger soil sample, the following equipment is needed:

- A precleaned auger;
- A precleaned or disposable scoop;
- Plastic sheeting;
- Pencils or markers;
- Disposable gloves (nitrile or equivalent) to be changed prior to handling clean sample bottles;
- Sterile, precleaned, sample bottles or equivalent; and
- Waste container(s).

Apply downward pressure while rotating the auger clockwise at the sampling point. When the auger cylinder is full of soil, remove it from the hole and transfer the soil into a waste container. Return the auger to the hole and refill the cylinder until the required depth is reached. Empty the desired batch of soil from the auger onto plastic sheeting. Use a scoop to transfer the soil directly into the sample bottle and secure the cap.

Each soil sample will be appropriately given a unique identification number. The identification number shall be recorded in appropriate field and project documentation (i.e., field data sheets) with information describing the sample. A GPS survey will be performed by reporting a sample's X, Y, and Z coordinates accurate to the nearest 0.3 m (1 ft). Whenever possible, measured distances from identifying features will also be included to help define sample locations. Any leftover soil (including that removed by a shovel) will be containerized and labeled as required. Waste soils collected at each location will be placed into separate bags and containerized, awaiting transportation and disposal. Waste soil will be characterized using the soil sample analytical data obtained from the investigation or characterized in accordance with the UMCD WAP. Decontamination fluids will also be containerized and labeled as required.

15.2.4.3 Deep Subsurface Soil Sampling

Deep subsurface soil sampling protocols apply to sampling efforts greater than 4 ft below the site surface. Deep subsurface soil sampling will employ mechanized sample retrieval using a Geoprobe® or similar sampling method. The Geoprobe® collects a 4-ft soil sample within a clear, acetate sleeve, which may be examined for the selective or discrete sampling. To collect a deep subsurface soil sample, the following equipment is needed:

- A Geoprobe® or comparable sampling device or method with precleaned sampling apparatus;
- A precleaned 4-ft sampler;
- A precleaned utility knife with hook-type blade;
- Plastic sheeting;
- Pencils or markers;
- Stainless steel bowl;
- Disposable gloves (nitrile or equivalent) to be changed prior to handling clean sample containers;
- Sterile, precleaned, sample bottles or equivalent; and
- Waste container(s).

Advance the Geoprobe® sampler to the predetermined sampling interval. Receive the 4-ft sample sleeve from the Geoprobe® operator. Cut the full length of the acetate sleeve with a precleaned utility knife. Note that a hook-type utility blade uses upward pressure to cut the acetate sleeve resulting in less disturbance to soil sample within the sleeve. Select the soil sample interval for discrete or composite sampling and pry open the acetate sleeve at the appropriate depth(s). For discrete soil samples, collect the soil sample and transfer directly into the sample bottle, and secure the cap. For composite samples, collect soil from the appropriate depths within the sample interval and transfer to the stainless steel bowl, lightly blend, transfer to the sample bottle and secure the cap. Sampling personnel will record a field log describing the soils and/or materials encountered throughout the sampling probe.

Three attempts will be made to collect the required samples at the planned soil boring locations. If unsuccessful, a new location will be selected, pending approval from DEQ. If a new successful location cannot be identified, other drilling techniques will be evaluated.

Similar to surficial and shallow soil sampling, each soil sample collected via Geoprobe® will be appropriately given a unique identification number. The identification number shall be recorded in appropriate field and project documentation (i.e., field data sheets) with information describing the sample. Photodocumentation references shall also be recorded in field documentation. A GPS survey will be performed by reporting a sample's X, Y, and Z coordinates accurate to the nearest 0.3 m (1 ft). Whenever possible, measured distances from identifying features will also be included to help define sample locations. Decontamination fluids will be containerized and labeled as required.

15.3 Waste Management During Sampling

The volume of wastes derived from sampling and other field activities will be kept to the minimum amount possible. Wastes that will be generated during this investigation include waste soil, filter waste, decontamination fluids, and trash resulting from the sampling activities. When possible, disposable precleaned sampling equipment will be used

15.3.1 Soil

The generation of soil waste (sweepings, coarse debris, etc.) will be the most significant in volume as described above in the debris stratum sampling and soil sampling sections. All soil will be containerized and labeled as required.

15.3.2 Decontamination Fluids

Waste fluids may be generated during the equipment decontamination. Wastewater will be containerized and labeled as required.

15.3.3 Waste Management

The wastes generated during closure activities will be sampled and managed in accordance with the UMCD Waste Analysis Plan.

15.4 Sample Analysis

Chemical agents, agent degradation products, metals, explosives, PCBs, and organics analysis of the collected samples will be performed in accordance with EPA-SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, or analytical procedures approved by DEQ. See *Table 26* for analytical methods, reporting limits (RLs), and quality control acceptance criteria. GB and mustard (HD) can be analyzed together from the same debris or wipe sample.

If chemical agent (or their degradation products) in wipe samples are detected by the laboratory at or above the closure performance standard, additional steps may be taken in accordance with approved analytical procedures. In igloos with confirmed liquid agent leaks onto the concrete floor, additional analyses may be skipped in favor of categorizing the igloo as requiring "additional action" and proceeding with the activities described in Section 4.9. Project management will make the initial determination; DEQ will be consulted as needed.

Table 26. Analytical Methods

Compounds	TAP #[1]	CAS ID	Reporting Limits by Media[2]			Accuracy (%R)[3]	Precision RPD (%)	Clean Closure Standard (mg/kg)[4]
			Solids (mg/kg)	**Wipes** (µg/wipe)	**Water** (µg/L)			
VX	01-0605-075 01-0605-091	50782-69-9	0.0065	0.0431	6.5	50%-150%	35%	0.013
GB	01-0605-075	107-44-8	0.008	0.02	8	60%-140%	35%	0.016
Mustard (HD)	01-0605-075	505-60-2	0.01	0.02	10	60%-140%	35%	0.152
EA2192	01-0605-094	73207-98-4	0.015	0.03	15	50%-150%	35%	0.68
MPA	01-0605-094	993-13-5	0.5	2	500	50%-150%	35%	37,000
EMPA	01-0605-094	1832-53-7	0.2	0.4	200	50%-150%	35%	4,200
DIMP	01-0605-094	1445-75-6	0.075	0.15	75	50%-150%	35%	82,000
DMMP	01-0605-094	756-79-6	0.5	2.0	500	50%-150%	35%	1,000
IMPA	01-0605-094	1832-54-8	0.25	0.5	250	50%-150%	35%	62,000
TDG	01-0605-094	111-48-8	0.08	0.16	80	50%-150%	35%	68,000
RDX	01-0408-019	121-82-4	0.10	0.2	-0.20	75%-125%	35%	24
TNT	01-0408-019	118-96-7	0.10	0.2	-0.20	75%-125%	35%	79
Arsenic	01-0406-046	7440-38-2	0.5	1.0	-0.5	75%-125%	20%	1.7
Beryllium	01-0406-046	7440-41-7	0.5	1.0	-0.5	75%-125%	20%	2,000
Cadmium	01-0406-046	7440-43-9	0.5	1.0	-0.5	75%-125%	20%	510
Chromium	01-0406-046	7440-47-3	0.5	1.0	-0.5	75%-125%	20%	170
Copper	01-0406-046	7440-50-8	0.5	1.0	-0.5	75%-125%	20%	41,000
Lead	01-0406-046	7439-92-1	0.5	1.0	-0.5	75%-125%	20%	800
Manganese	01-0406-046	7439-96-5	4	1.0	-0.5	75%-125%	20%	23,000
Mercury	01-0406-047	7439-97-6	0.02	0.01	-0.2	75%-125%	20%	310
Nickel	01-0406-046	7440-02-0	0.5	1.0	-0.5	75%-125%	20%	20,000
Silver	01-0406-046	7440-22-4	0.5	1.0	-0.5	75%-125%	20%	5,100
1,1,1-Trichloroethane	01-0404-043	71-55-6	0.02	0.5	-2.00	70%-130%	30%	830,000
1,1,2-Trichloro-1,2,2-Trifluoroethane	01-0404-043	76-13-1	0.02	0.5	-2.00	70%-130%	30%	180,000

Table 26. Analytical Methods

Compounds	TAP #[1]	CAS ID	Reporting Limits by Media[2]			Accuracy (%R)[3]	Precision RPD (%)	Clean Closure Standard (mg/kg)[4]
			Solids (mg/kg)	**Wipes** (µg/wipe)	**Water** (µg/L)			
1,1,2-Trichloroethane	01-0404-043	79-00-5	0.02	0.5	-2.00	70%-130%	30%	25
1,1-Dichloroethylene	01-0404-043	75-35-4	0.02	0.5	-2.00	70%-130%	30%	27,000
1,2-Dichloroethane	01-0404-043	107-06-2	0.02	0.5	-2.00	70%-130%	30%	15
1,4-Dichlorobenzene	01-0404-043	106-46-7	0.02	0.5	-2.00	70%-130%	30%	63
2,4,5-Trichlorophenol	01-0403-003	95-95-4	0.33	5.0	-5.0	20%-150%	50%	62,000
2,4,6-Trichlorophenol	01-0403-003	88-06-2	0.33	5.0	-5.0	20%-150%	50%	200
2,4-Dinitrotoluene	01-0403-003	121-14-2	0.33	5.0	-5.0	24%-96%	37%	5.5
2,4-Dichlorophenoxyacetic acid	01-0405-011	94-75-7	0.01	10	-1.56	50%-150%	50%	7,700
2-Ethoxyethanol	01-0405-039	110-80-5	200	200	-1000	50%-150%	50%	250,000
2-Nitropropane [5]	01-0404-043	79-46-9	0.02	0.4	-2.00	70%-130%	30%	0.064
Acetone	01-0404-043	67-64-1	0.02	25	-4.00	70%-130%	30%	630,000
Benzene	01-0404-043	71-43-2	0.02	0.5	-2.00	70%-130%	30%	34
Auramine	01-0408-146	492-80-8	N/A	0.026	-N/A	50%-150%	15%	2
Carbon Disulfide	01-0404-043	75-15-0	0.02	0.5	-2.00	70%-130%	30%	3,700
Carbon Tetrachloride	01-0404-043	56-23-5	0.02	0.5	-2.00	70%-130%	30%	31
Chlordane	01-0405-010	12789-03-6	1.0	1.3	-10	50%-150%	50%	7.0
Chlorobenzene	01-0404-043	108-90-7	0.02	0.5	-2.00	70%-130%	30%	8,300
Chloroform	01-0404-043	67-66-3	0.02	0.5	-2.00	70%-130%	30%	25
Cyclohexanone	01-0404-043	108-94-1	0.2	4.0	-20.00	70%-130%	30%	3,100,000
Endrin	01-0405-010	72-20-8	0.2	1.3	-1	50%-150%	50%	230
Ethyl Acetate	01-0404-043	141-78-6	0.02	10	-4.00	70%-130%	30%	920,000
Ethyl Ether	01-0404-043	60-29-7	0.02	0.5	-2.00	70%-130%	30%	200,000
Ethylbenzene	01-0404-043	100-41-4	0.02	0.5	-2.00	70%-130%	30%	140
Heptachlor	01-0405-010	76-44-8	0.2	1.3	-0.5	50%-150%	50%	0.46
Hexachlorobenzene	01-0403-003	118-74-1	0.33	5.0	-5.0	20%-150%	50%	1.2

Table 26. Analytical Methods

Compounds	TAP #[1]	CAS ID	Reporting Limits by Media[2]			Accuracy (%R)[3]	Precision RPD (%)	Clean Closure Standard (mg/kg)[4]
			Solids (mg/kg)	**Wipes** (µg/wipe)	**Water** (µg/L)			
Hexachlorobutadiene	01-0403-003	87-68-3	0.33	5.0	-5.0	20%-150%	50%	22
Hexachloroethane	01-0403-003	67-72-1	0.33	5.0	-5.0	20%-150%	50%	90
Isobutanol	01-0404-043	78-83-1	0.02	25	-20.00	70%-130%	30%	180,000
Methanol	01-0405-039	67-56-1	200	200	-1000	50%-150%	50%	310,000
Methoxychlor	01-0405-010	72-43-5	0.50	1.3	-5	50%-150%	50%	3,100
Methyl Ethyl Ketone	01-0404-043	78-93-3	0.02	1.0	-4.00	70%-130%	30%	200,000
Methyl Isobutyl Ketone	01-0404-043	108-10-1	0.02	1.0	-4.00	70%-130%	30%	53,000
Methylene Chloride	01-0404-043	75-09-2	0.02	0.5	-2.00	70%-130%	30%	310
n-Butyl Alcohol	01-0404-043	71-36-3	0.02	25	-20.00	70%-130%	30%	62,000
Nitrobenzene	01-0403-003	98-95-3	0.33	5.0	-5.0	20%-150%	50%	24
Ortho-Dichlorobenzene	01-0403-003	95-50-1	0.33	5.0	-5.0	36%-97%	28%	35,000
Pentachlorophenol	01-0403-003	87-86-5	0.33	5.0	-5.0	9%-103%	50%	3.9
PCB – Arochlor 1016	01-0405-010	12674-11-2	0.50	5	-10	50%-150%	50%	21
PCB – Arochlor 1254	01-0405-010	11097-69-1	0.50	5	-10	50%-150%	50%	0.74
Pyridine	01-0403-003	110-86-1	0.33	5.0	-5.0	20%-150%	50%	1,000
Tetrachloroethylene	01-0404-043	127-18-4	0.02	0.5	-2.00	70%-130%	30%	940
Toluene	01-0404-043	108-88-3	0.02	0.5	-2.00	70%-130%	30%	77,000
Toxaphene	01-0405-010	8001-35-2	1.0	1.3	-10	50%-150%	50%	2
Trichloroethylene	01-0404-043	79-01-6	0.02	0.5	-2.00	70%-130%	30%	46
Trichlorofluoromethane	01-0404-043	75-69-4	0.02	0.5	-2.00	70%-130%	30%	120,000
Vinyl Chloride	01-0404-043	75-01-4	0.02	0.5	-2.00	70%-130%	30%	3.9
Xylene	01-0404-043	1330-20-7	0.02	0.5	-2.00	70%-130%	30%	25,000

Table 26. Analytical Methods

Compounds	TAP #[1]	CAS ID	Reporting Limits by Media[2]			Accuracy (%R)[3]	Precision RPD (%)	Clean Closure Standard (mg/kg)[4]
			Solids (mg/kg)	**Wipes** (µg/wipe)	**Water** (µg/L)			

[1] Southwest Research Institute, San Antonio, Test/Analytical Procedures (TAPs).
[2] RLs (reporting limits) will be reported on a sample by sample basis after adjustment for sample volume, percent moisture and dilution factor.
[3] Laboratory-generated accuracy and precision limits may be used in lieu of the limits provided in this table for offsite sample analysis. Any deviations from the limits specified in this table will be noted in the analytical report and associated impacts evaluated.
[4] See **Error! Reference source not found.** for the source documents of the clean-closure standards
[5] Nitropropane will be reported to Method Detection Limit, Level of Detection, or Detection Limit.

CAS = Chemical Abstracts Service RL = Reporting Limit MDL = Method Detection Limit RPD = Relative Percent Difference

15.5 Sample Handling and Custody

15.5.1 Sample Labels

All samples will be labeled at the time of collection. At a minimum, the sample will include the following:

- Unique sample ID
- Sample date
- Sample time
- Initials of the sampler
- Media
- Requested analysis

15.5.2 Sample Release and Packaging

Prior to transporting off-site, all waste materials are sampled and analyzed for chemical agents to ensure agent-free criteria is met, in accordance with the UMCD WAP. Waste materials will be documented as meeting agent-free criteria. Samples are not considered waste and will take credit for air monitoring of the igloos down to the GPL (prior to sampling) for shipment to the approved off-site analytical laboratory for agent-free determination.

Integrity (custody) seals will be placed over the top of the labeled and surveyed sample containers to detect unauthorized sample handling. At a minimum, the seal will include the date and time the seal was affixed and the signature or initials of the person affixing the seal.

15.5.3 Chain-of-Custody Control

To establish the documentation necessary to trace sample possession from the time of collection through analysis and final disposition, a chain of custody (C-of-C) form will be filled out and must accompany every group of individually identified samples. The field sampling lead will initiate the C-of-C process after a sample is collected, and will be responsible for the sample until it is shipped, transferred or otherwise dispatched properly. The shipping agent will acknowledge receipt of the samples via waybill(s) or equivalent. The analytical laboratory sample custodian will acknowledge receipt of the samples on the C-of-C form upon opening the sealed shipping container. The original C-of-C form must be included with the shipping container and one copy must be retained in the project record.

The C-of-C form will include the necessary information to detail the required analyses for each sample listed and serve as the request for analysis. Each person who accepts custody must sign his or her name and record the date and time of transfer on the C-of-C form. The form will contain the following information:

- Sample identification number(s),
- Date and time of each sample collection,
- Signature or initials of sample collector (must be legible),
- Sample matrix type,
- Requested analysis, and
- Custody transfer signatures, including dates and times of sample transfer and bill of lading or transporter tracking number (if applicable).

15.5.4 Shipping

All samples will be shipped, by a method that allows electronic route tracking, with a C-of-C form to the appropriate analytical laboratory using the most expeditious manner possible to arrive at the laboratory within allowable holding times. All samples will be shipped cold to minimize biological or chemical alteration of the samples. Sample bottles or containers will be packaged in a manner that prevents breakage before being placed in coolers containing ice. A signed C-of-C form listing all samples in the cooler will be placed in the cooler and the cooler sealed with custody tape.

Shipping considerations include the following:

- All packing, labeling, and shipping will conform to International Air Transport Association (IATA) and DOT regulations for air shipment, as applicable.
- All samples for analysis will be shipped, chilled, and packed with ice to maintain the temperature of the samples at 4° ± 2°C.
- A dangerous goods form and the C-of-C form that inventories the contents of the shipping container will accompany shipped samples, as applicable.
- Each container of samples and associated paper work will be reviewed by the field sampling lead prior to release for shipment.
- Additionally, for each shipment of samples, the laboratory will receive a copy of the C-of-C forms and CWA screening results (as applicable) prior to receiving samples.
- All shipping containers will be assigned a unique identification code to assist in tracking shipment of samples.

When samples are received at the analytical laboratory, they will be brought to the sample custodian who will unpack them and immediately reconcile the sample counts with the COC documentation. All discrepancies will be reported immediately to the Point of Contact.

15.6 Quality Control

Quality control (QC) checks will be performed to ensure that representative samples are collected and analytical data collected are valid. The purpose of the QC program is to produce data of known quality that satisfy the project objectives and meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements using QC materials.

15.6.1 Quality Control Procedures for Data Collection and Sampling

The following standardized processes are incorporated in this SAP to adhere to quality control while performing sampling and analyses:

- Use of standardized data sheets, checklists, and field notebooks to ensure completeness, traceability, and comparability of the process information and samples collected and
- Strict adherence to the sample traceability procedures.

In support of the QC performance criteria, discrete quality control samples will be included with the field samples. To assess the quality of the field sampling techniques, field QC samples will be collected. Two (2) types of field quality control samples will be required: duplicate samples and equipment blanks.

15.6.1.1 Duplicate Samples

Field duplicates are used to assess the reproducibility of sample collection techniques (i.e., the precision of the collection process). A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. Field duplicates will be collected at a rate of 1:20.

15.6.1.2 Equipment Blanks

Equipment blanks will be collected once at each storage unit, only if nondisposable sampling tools (that would be decontaminated between each use) are employed. Equipment blanks will be used to assess the effectiveness of the equipment decontamination procedures and to verify that the sample collection and handling process has not affected the quality of the samples. Equipment blanks are collected by pouring analyte-free water into, over, or through the sampling device. The sample will be collected in a sample container and transported to the laboratory for analysis. Equipment blanks shall be collected immediately after the equipment has been decontaminated. Equipment blanks will not be collected for precleaned disposable sampling tools.

15.6.2 Analytical Quality Control Procedures

Quality control (QC) procedures will be followed by the laboratory during analysis of the samples. The laboratory will be required to monitor the precision and accuracy of their sample analyses. The laboratory will use high-purity, commercially available materials for their quality control procedures, such as:

- Standard reference materials,
- Calibration standards,
- Internal standards, and
- Surrogate compounds.

Using these materials, analytical precision and accuracy will be assessed by evaluating the results of the method blanks, laboratory blanks, and reagent blanks; duplicate samples; calibration check and internal standards (where appropriate); matrix or surrogate spiked samples. The QC checks and requirements are described in detail in the appropriate analytical reference methods.

15.6.2.1 Laboratory QC Samples

Blanks and laboratory control samples shall be included in the preparation of each analytical batch (not to exceed 20) of the field samples. Matrix spikes and matrix spike duplicates count as environmental samples. The identity of each analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples.

15.6.2.2 Limits and Limits of Quantitation

RLs have been established for each method and matrix for each instrument the laboratory plans to use for the project using the requirements given in *Table 26*. Chemical agent RLs shall not exceed 0.5 times the permit compliance concentration values for GB, VX, and mustard (HD).

15.6.2.3 Instrument Calibration

Equipment used for data collection and analysis must be controlled and, at specified periods, calibrated to maintain performance within specified limits. Chemical measurements are made using a system that includes sample preparation and measurement processes. Since accurate measurements are imperative to the sampling program, all aspects of the measurement process must be calibrated. Accordingly, any of the instruments, standards, and methods used for the sampling effort shall be calibrated to assure that their accuracy is within acceptable limits. The analytical calibration procedures, frequency, and acceptance criteria will be in accordance with the analytical method requirements and any laboratory specific procedures.

15.6.2.4 Calibration Records

The laboratory shall keep calibration records (initial calibration, initial calibration verification, and continuing calibration verification) that include the raw calibration data, associated reports, date of analysis, and analyst's name or initials, at a minimum. Calibration data shall be traceable to the standards used. All samples analyzed shall be traceable to the calibration under which the results were produced in accordance with the laboratory's quality assurance program.

15.7 Presampling Igloo Air Monitoring

Before decontamination and sampling field activities take place in each storage unit, the interior air must be monitored by UMCD Operations and declared to be at the lower-level (or lower concentration) as applicable. For instance, in igloos where lower-level waste is stored, there is no Army requirement to conduct air monitoring. The air will be monitored in accordance with UMCD SOP UM-0000-W-358, "Standing Operating Procedure for Air Monitoring Operations." The primary purpose of presampling igloo air monitoring is worker safety, but it also provides a strong indication of the environmental state of the specific igloo.

15.8 Sample Data Management

Sample data management consists of data review, field data validation, and reporting. The management of the data generated throughout the verification sampling effort is crucial to the closure process. Prudent data management is required in all areas where information will be collected, analyzed, and reported. Documentation shall include analytical laboratory data, field notes and observations, and C-of-C forms. These data will be collected and organized into the closure certification packages.

15.8.1 Data Review

The data review process will be initiated when data are received from the laboratory, and the data analyst verifies each sample was analyzed, and confirms that all laboratory quality controls were used, requested duplicate analyses were performed, and results were reported.

Data will be verified and resolution sought for any reported anomalies. This review will confirm that the data is usable for an assessment of closure performance. Verification activities shall include, but are not limited to:

- Verification that the amount of data requested matches the amount of data received (number of samples for requested methods and analytes);
- Verification of procedures and methods used;
- Verification that documentation and deliverables are complete;
- Verification that hardcopy and electronic versions of the data are identical; and
- Verification that data seem reasonable based on analytical methodologies.

15.8.2 Field Data Validation

When the data review process is complete, the certificates of analysis will be separated by type as either analytical or quality control results. Both the analytical and the quality control results will be summarized in tables for presentation in the closure packages and reduced into a format that is usable in the determination of the closure performance. The results will be evaluated to determine if the project and quality control objectives have been met. All data collected during this project will be validated in accordance with the EPA *National Functional Guidelines for Data Review* and relevant standards; if anomalous results are obtained, investigation will identify the reason for the anomaly in the sample collection, sample preparation, or analysis. If any anomalies have occurred, the closure report will include the results of the affected sample data, a thorough discussion of occurrence, and its impact on overall data usability. Validation activities shall include, but not be limited to, the following:

- Verification of required deliverables;
- Requested versus reported analyses;
- Evaluation and qualification of results based on holding times;
- Qualification of results based on method blank results;
- Matrix spike- matrix spike duplicate (MS/MSD) analysis;
- Surrogate recoveries;
- Internal standards performance;
- Initial and continuing instrument calibrations (standards and blanks); and
- Laboratory control samples.

The data collected throughout the closure verification sampling effort will be used to determine residual concentrations of chemical agent and all other COCs at each sampling site. Data that is determined to be invalid (and confirmed as such by DEQ), in accordance with the preceding validation activities, will not be included in statistical analyses. As noted previously, a discussion of these anomalies and their effect on sample data will be included in the closure report.

15.8.3 Reporting

A closure package will be prepared by UMCD and submitted to DEQ as described in Section 1.6.5.3. Content of the closure package is discussed in Section 1.6.5.1. The package will be submitted during the post-sampling phase for final closure of the Building 203 CSF and each J- and K-Block storage units. Any foreseen deviations from the test protocol, as presented in this report, will be identified for DEQ approval prior to implementation. The closure packages will undergo technical review by UMCD personnel prior to release to the DEQ, in accordance with project procedures.

16.0 HEALTH AND SAFETY PLAN

Worker health and safety control measures will be implemented in accordance with the Contractor's Safety and Health Plan as well as the UMCD Occupational Health and Safety program. Job hazard analyses and mitigation measures will be developed and incorporated into the work control process.

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17.0 REFERENCES

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18.0 ACRONYMS AND UNITS OF MEASURE

ADA	Ammunition Demolition Activity
AOC	Area of Concern
ASTM	American Society for Testing and Materials
BNA	Base-Neutral and Acid Extractable Organics
ºC	degrees centigrade (Celsius)
c	Carcinogen
CAS	Chemical Abstracts Service
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CERFA	*Community Environmental Response Facilitation Act*
cfm	cubic feet per minute
CFR	Code of Federal Regulations
cm	centimeter
cm^2	square centimeter
cm^3	cubic centimeter
CMA	Chemical Materials Activity
CMMB	Containerized Material Monitoring Building
COC	Constituent of Concern
C-of-C	Chain of Custody
CPE	Chemical Protective Equipment
CRL	Certified Reporting Limit
CSF	Consolidation, Storage and Transfer Facility
CSM	Conceptual Site Model
CWA	Chemical Warfare Agent
DAAMS	Depot Area Air Monitoring System
OATS	Drill and Transfer System
DEQ	Oregon Department of Environmental Quality
DIMP	Diisopropyl Methylphosphonate
DMMP	Dimethyl Methylphosphonate
DOD	Department of Defense
DOT	Department of Transportation
DLA-DS	Defense Logistics Agency Disposition Services
DQO	Data Quality Objective
EA2l92	S-(2-(diisopropylaminoethyl) methylphosphonothioate
EDR	Environmental Data Resources
EMPA	Ethyl Methylphosphonic Acid
EPA	Environmental Protection Agency
ºF	degrees Fahrenheit
FD	Field Duplicate
FFA	Federal Facilities Agreement
ft	feet
gal	gallon

GCIMS CI	Gas Chromatograph/Mass Spectrometer Chemical Ionization
GC/MS EI	Gas Chromatograph/Mass Spectrometer Electron Ionization
GB	Sarin (0-isopropyl methylphosphonofluoridate)
gpd	gallons per day
GPL	General Population Limit Global
GPS	Positioning System Ground Water
GWMA	Management Area
HBESL	Health-Based Environmental Screening Levels
HEPA	High-Efficiency Particulate Air filter
HD	Distilled Mustard [bis(2-chloroethyl) Sulfide]
HPD	Hewlett Packard Dynatherm
HTH	Calcium Hypochlorite
HWMU	Hazardous Waste Management Unit
HWS	Hazardous Waste Storage [Facility]
IATA	International Air Transport Association
ICAM	Improved Chemical Agent Monitor
IMPA	Isopropyl Methyl Phosphonic Acid
in.	Inch
IRPE	Independent Registered Professional Engineer
JHA	Job Hazard Analysis
kg	kilogram
L	liter
lb	pound
LC/MS	Liquid Chromatography/Mass Spectrometry
LCS	Laboratory Control Sample
LOQ	Limit of Quantitation
LUB	Lower Umatilla Basin
LUST	Leaking Underground Storage Tank
OMSS	Organization Maintenance Sub Shop
m	meter
m^3	cubic meter
m/s	meters per second
MB	Method Blank
MDL	Method Detection Limit
mg	milligram
MINICAM	Miniature Continuous Air Monitor
µg	microgram
mmHg	millimeter mercury
MPA	Methylphosphonic Acid
mph	miles per hour
MS	Matrix Spike
MSD	Matrix Spike Duplicate
n	Noncarcinogen
NFA	No Further Action

NPL	National Priorities List
OAR	Oregon Administrative Rule
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyl
PFS	Pollution Abatement System [PAS] Filter System
PMN	Perimeter Monitoring Network
PMR	Permit Modification Request
POL	Petroleum, Oil, and Lubricants
PPE	Personal Protective Equipment
ppm	parts per million
PQAP	Project Quality Assurance Plan
PUP	Pick Up Point
QC	Quality Control
RBC	Risk-Based Cleanup
RCRA	*Resource Conservation and Recovery Act of 1976*
RCRA-CESQG	RCRA Conditionally Exempt Small Quantity Generator
RCRA-LQG	RCRA Large Quantity Generator
RCRA-TSDF	RCRA Treatment, Storage, or Disposal Facility
RDTE	Research, Development, Test, & Evaluation
RDX	Research Department Explosive
RI/FS	Remedial Investigation/Feasibility Study
RFNA	Red Fuming Nitric Acid
RSL	Regional Screening Level
RTAP	Real-Time Analytical Platform
SAA	Satellite Accumulation Areas
SAP	Sampling and Analysis Plan
SOP	Standing Operating Procedure
SRS	Stratified Random Sampling
STEL	Short-Term Exposure Limit
STP	Standard Temperature and Pressure
SUOMP	Storage Unit Operations and Management Plan
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBD	To Be Determined
TCB	Trichlorobenzene
TCE	Tetrachloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TCM	Toxic Chemical Munition
TOG	Thiodiglycol
TIC	Tentatively Identified Compounds
TKN	Total Kjeldahl Nitrogen
TNT	2,4,6-Trinitrotoluene
TPHC	Total Petroleum Hydrocarbon Content

TSCA	*Toxic Substances Control Act of 1976*
TSD	Treatment, Storage or Disposal
TSP	Trisodium phosphate
TWA	Time Weighted Average
U.S.	United States
UMCD	Umatilla Chemical Depot
UMCDF	Umatilla Chemical Agent Disposal Facility
UMDA	Umatilla Depot Activity
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VCR	Vapor Containment Room
Vista Engineering	Vista Engineering Technologies, LLC
VOA	Volatile Organic Analytes
VSL	Vapor Screening Level
VX	0-ethyl-S-(2-diisopropyl-aminoethyl) Methyl-phosphonoothiolate
WAP	Waste Analysis Plan
WDC	Washington Demilitarization Company
WPL	Worker Population Limit

Trademarks

Simple Green® is a registered trademark of Sunshine Makers, Inc. (Huntington Harbour, CA)

19.0 GLOSSARY

Agent-Free- The condition of a material that, after being analyzed for all chemical agents, is determined to have chemical agent concentrations below the permit compliance concentrations (PCCs) identified in Section 5.0 of the UMCD Waste Analysis Plan.

Area of Concern (AOC) An area of potential contamination at UMCD that might warrant further investigation or remediation, but which is not a solid waste management unit.

Bayesian Statistics- The premise of Bayesian statistics is to incorporate prior knowledge, along with a given set of current observations, in order to make statistical inferences. The prior information could come from operational or observational data, from previous comparable experiments or from engineering knowledge. By incorporating prior information about the parameter(s), a posterior distribution for the parameter(s) can be obtained and inferences on the model parameters and their functions can be made.

Chemical Agent- Chemical agent is a chemical compound which, through chemical prope1ties, produces lethal or damaging effects on humans. The three chemical agents present in the UMCD Storage Areas are nerve agent VX, nerve agent GB (Sarin), and blister agent mustard (HD). These chemical agents are contained in rockets, land mines, projectiles, bombs, spray tanks, and ton containers.

Clean Closure- Refers to the closure of a hazardous waste area in a manner that achieves the following: minimizes the need for further maintenance to control, minimize, or eliminate (to the extent necessary to protect human health and the environment) post-closure escape of hazardous waste/constituents/decomposition products, leachate, contaminated run-off to ground or surface waters or to the atmosphere; and complies with the closure requirements of 40 CFR 264, Subpart G, and 40 CFR 264.178 (containers).

Closure Plan- VET-1604-PLN-003, *RCRA Closure Plan for the Umatilla Chemical Depot* (this document), provides a methodology for project execution and a schedule for completion of activities related to the closure of the UMCD site. It includes the technical basis for conducting an optimized sampling strategy and presents a decision analysis framework for defending closure decisions.

Data Quality Objectives (DQOs)- A report of the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. This is qualitatively distinct from quality measurements such as precision, bias, and detection limit.

Data Validation- The process of evaluating the available data against the project DQOs to make sure that the objectives are met. There are three levels of data validation, *A/B/C* (with C being the more rigorous), depending on project DQOs. The available data reviewed will include analytical results, field QC data and lab QC data, and may also include field records.

Depot Area Air Monitoring System (DAAMS)- The DAAMS is a portable air-sampling unit that is designed to draw a controlled volume of air through a glass tube filled with a collection material. As the air is passed through the solid sorbent tube, agent is collected. After sampling for the predetermined period of time and flow rate, the tube is removed from the sample line and sent to a chemical laboratory for analysis (approximately 1-hour process time) to determine the presence, type, and quantity of agent collected in samples.

Distilled Mustard (HD)- Distilled mustard is a toxic liquid compound (chemical agent) categorized as a blister agent. HD is a liquid, oily substance that is amber to dark brown in color, with an odor similar to garlic or horseradish. Blister agents damage tissue they come into contact with by causing chemical burns or blisters. They can also destroy cells of living tissue, particularly in eyes and lungs. Blister agents cause no immediate symptoms upon contact; symptoms can be delayed from two to 24 hours after exposure. HD has the chemical name 2',2'-dichlorodiethyl sulfide ($C_4H_8C_{12}S$).

Field Duplicates (FDs) – Independent field samples which are collected as close as possible to the same point in space and time. Two separate samples are taken from the same source, stored in separate containers, and analyzed independently. Duplicates are useful in documenting the precision of the sampling process.

General Population Limit (GPL) – A time weighted average that represents the maximum concentration to which the general population may be exposed 24 hours per day, 7 days a week, for a 70-year lifetime. This applies to the entire general population, including all ages and medical conditions. For GB and VX, the GPL is a 24-hour TWA. For mustard (HD), the GPL is a 12-hour TWA. GPL values for the various agents are shown below (OR6 213 820 917, U.S. Army 2008); there is no value given for Lewisite.

GB	$1x10^{-6}$ mg/m^3
VX	$6x10^{-7}$ mg/m^3
HD	$2x10^{-5}$ mg/m^3

Hazardous Waste- This term shall mean substances that meet the definition of hazardous waste found in 40 CFR Part 261, and OAR 340-101.

Hazardous Waste Management Unit (HWMU) – a solid waste management unit permitted and used for the management of hazardous wastes, including the storage units operated under the terms and conditions of the UMCD storage permit (OR6 213 820 917).

Higher-level Waste – Indicates that the containerized waste has been partially decontaminated of chemical agent as specifically described in the 27 March 2002 revision of DA PAM 385-61 (U.S. Army 2002) and that chemical agent concentrations, as measured, in the headspace air, exceed the STEL (OR6 213 820 917).

Igloo – See "Magazine."

Laboratory Control Sample (LCS)- A known matrix spiked with compound(s) representative of the target analytes. This is used to document laboratory performance.

Leaker Magazine- A magazine in which there was a reported liquid or vapor leak of chemical agent from a ton container, munition, or secondary waste storage container.

Lewisite- Lewisite is a toxic liquid compound (chemical agent) categorized as a blister agent. Lewisite is a liquid, oily substance that is amber to dark brown in color, with an odor similar to geraniums. Blister agents damage tissue they come into contact with by causing chemical burns or blisters. They can also destroy cells of living tissue, particularly in eyes and lungs. Blister agents cause no immediate symptoms upon contact; symptoms can be delayed from two to 24 hours after exposure. Lewisite has the chemical name dichloro(2-chlorovinyl)arsine ($C_2H_2AsCl_3$). . Lewisite was not stored at UMCD but could be contaminant from the trainer ton containers (see Section 14.2.2).

Likelihood Function- A Bayesian term referring to a probability distribution expressing the probability of observing a piece of new information given that a particular prior belief is true.

Lower-level Waste -Indicates the containerized waste has been surface decontaminated of chemical agent as specifically described in the 27 March 2002 revision of DA PAM 385-61 (U.S. Army 2002) and that chemical agent concentrations as measured in the headspace air do not exceed the STEL (OR6 213 820 917).

M23 Mines- M23 chemical mines contain 10.5 lbs of VX nerve agent and burster explosive compounds sealed within their steel body. Each mine weighs about 23 pounds and is five inches tall with a 13.5-inch diameter. The mines are packed three to a 16-gallon steel drum container (mine drum). Drums are sealed with a locking ring fastened with a nut and bolt, similar to DOT-approved IA2-type containers.

M55 Rockets- The M55 rocket consists of a fin assembly, rocket motor, and agent-filled warhead with burster and fuze. Each rocket weighs about 58 lbs and is 78 inches long by 4.5 inches in diameter. Each rocket contains either 10.71bs of GB or 10.0 lbs of VX nerve agent. The M55 rockets are stored in M441 shipping and firing containers (or tubes), which are constructed of fiberglass reinforced with plastic. The containers are closed at each end with a removable cap. These caps can be removed to provide access for collecting air samples.

M56 Warheads- The M56 warhead is an M55 rocket without the rocket motor and propellant section. The warhead contains either 10.7lbs of GB or 10.0 lbs of VX nerve agent.

Magazine- A concrete arch-earth covered storage unit with interior dimensions of 81 ft (25 m) in length, 26 ft (8 m) in width and 13 ft (4 m) in height. The floor is sloped towards the sidewalls into a gutter that runs the length of each sidewall. These magazines were originally built in 1941 for sheltering and containing weapons. Magazines may also be referred to as "bunkers" or "igloos."

Matrix Spike (MS) – An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs in the laboratory prior to sample preparation and analysis. An MS documents the bias of a method in a given sample matrix.

Matrix Spike Duplicate (MSD)- Intra-laboratory split sample spiked with identical concentrations often·get analyte(s). The spiking occurs in the laboratory prior to sample preparation and analysis. An MSD documents the precision and bias of a method in a given sample matrix.

MC-1 (750-lb) Bomb-AnMC-1 750-lb chemical bomb consists of a steel body, fin assembly, and central bursting tube with nose and tail fuze wells. Each MC-1 bomb weighs 725 lbs and is 50 inches long with a 16 inch diameter. The bomb cavity is filled with 220 lbs of liquid GB sealed within the steel bomb body and against a base plate welded to the rear of the body to contain the agent. MC- 1 bombs contain no explosives.

Method Blank (MB)- An analyte-free matrix to which reagent(s) are added in the same volumes or proportions as used in sample processing. The MB should be carried through the complete sample preparation and analytical procedure. The MB is used to document contamination resulting from the analytical process. For a MB to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either: (1) the method detection limit, or (2) 5% of the regulatory limit for that analyte, or (3) 5% of the measured concentration in the sample.

Method Detection Limit (MDL)- The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte. The MDL is the lowest level at which an analyte may be reported using that method.

Miniature Continuous Air Monitor (MINICAM)- The MINICAM is an automatic air monitoring system that collects compounds on a solid sorbent trap, thermally desorbs them into a capillary gas chromatography column for separation, and detects the compounds with a flame-photometric detector. It is a lightweight, portable, real time, low-level monitor with alarm capability, designed to respond to 0.0001 mg/m^3 for GB in less than 5 minutes, 0.00001 mg/m^3 for VX in less than 15 minutes, and 0.003 mg/m^3 for mustard (HD) and Lewisite in less than 5 minutes.

MK94 (500-lb) Bomb- The MK94 500-lb chemical bombs are conventional bombs modified to contain chemical agents. Each MK94 bomb weighs 441 lbs and is 60 inches long with a 10.8 inch diameter. The bombs contain 108 pounds of liquid GB sealed within the steel body. No explosive compounds are contained in the MK94 bombs.

Polychlorinated Biphenyl (PCB)- PCBs belong to a broad family of man-made organic chemicals !mown as chlorinated hydrocarbons. PCBs were domestically manufactured from 1929 until their manufacture was banned in 1979. They have a range of toxicity and vary in consistency from thin, light-colored liquids to yellow or black waxy solids. Due to their nonflammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications including electrical, heat transfer, and hydraulic equipment; as plasticizers in paints, plastics, and rubber products; in pigments, dyes, and carbonless copy paper; and many other industrial applications. The most common U.S. industrial trade name for PCBs is Aroclor. PCBs are known to be a component of the M441 shipping and firing tubes that store M55 rockets.

Posterior Distribution- A Bayesian term referring to a probability distribution that has been updated with new information.

Prior Distribution- A Bayesian term referring to the hypothesized, expected, or calculated probability distribution for an event prior to the collection of new information.

Projectiles- The 155-mm M121/A1 projectiles contain either 6.5 lbs of GB or 6.3 lbs of VX nerve agents sealed in a cavity within the one-piece steel shell. Each projectile weighs about 99 lbs and is about 27 inches long. Explosive compounds are sealed within the burster tube or the steel projectile body. These include 0.3 lbs of TNT and 2.45 lbs of Composition B. The M426, 8-inch projectiles weigh about 203 lbs and are 35 inches long. They contain 14.5 lbs of GB or VX sealed within the steel projectile body, in addition to the 7.0 lbs of M83 explosive in the burster and a supplementary charge of 0.3 lbs of TNT.

Quantitation Limit - The minimum concentration of an analyte (substance) that can be measured with a high degree of confidence that the analyte is present at or above that concentration.

Resource Conservation and Recovery Act (RCRA)- The primary federal law governing the disposal of solid and hazardous waste. Congress passed RCRA on 21 October 1976 to address the increasing problems faced from the growing volume of municipal and industrial waste. RCRA, which amended the Solid Waste Disposal Act of 1965, set national goals for: protecting human health and the environment from the potential hazards of waste disposal, conserving energy and natural resources, reducing the amount of waste generated, and ensuring that wastes are managed in an environmentally-sound manner. Hazardous waste regulations are found in 40 CFR 260 through 40 CFR 282.

Sarin (GB)- A rapid-acting nerve agent that works by inactivating the body's cholinesterase. GB is a clear odorless viscous liquid with a chemical name of isopropyl methylphosphonofluoridate ($C_4 0_2 H_{10} FP$). The primary hazard from GB is that of vapor absorption through the respiratory tract, although it can be absorbed through any part of the skin, through the eyes, and through the gastrointestinal tract by ingestion. The nerve agent absorption rate is accelerated through cuts and abrasions in the skin. When dispersed as large droplets, GB is moderately persistent; it is nonpersistent when disseminated as a cloud of very fine particles.

Short-Term Exposure Limit (STEL)- The maximum chemical agent concentration to which unprotected workers may be exposed for time periods not exceeding 15 minutes in duration. The STELs for all chemical agents are based on a 15-minute TWA.

Soil Samples- Samples taken of a discrete solid media. The sample is then digested, and the resultant extract is measured for contaminants. Also known as "sediment" or "debris" samples.

Solid Waste- The term shall mean any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials, including solid, liquid, semisolid, or contained gaseous materials resulting from industrial, commercial, mining, and agriculture operations, and from community activities, but does not include solid or dissolved material in domestic sewage, or solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits.

Solid Waste Management Unit (SWMU)- Any unit which has been used for the treatment, storage, or disposal of solid waste at any time, irrespective of whether the unit is or ever was intended for the management of solid waste. SWMUs include areas that have been contaminated by routine and systematic releases of hazardous waste or hazardous constituents, excluding one-time accidental spills that are immediately remediated and cannot be linked to on-going solid waste management activities (e.g., product or process spills).

Split Samples- Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or com positing and are used to document intra- or inter-laboratory precision.

Spray Tanks- The TMU-28B spray tanks consist of an agent container, suspension system, tail cone section, cutter, and dissemination nozzle. Spray tanks hold 160 gallons (1350 lbs) of VX and weigh 1935 lbs assembled. The tanks may be packed in CNU-77/E23 containers for storage purposes. CNU-77/E23 containers are 193 x 62 x 73 inches in size and weigh approximately 6000 lbs.

Standing Operating Procedure (SOP)- A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the method for performing certain routine or repetitive tasks.

Time Weighted Average (TWA)- A maximum level or concentration of a chemical agent, averaged over a specified length of time, to which employees may be exposed.

Ton Container- Bulk storage containers made of steel and measuring about 7 feet in length and 30 inches in diameter. They weigh -1,600 pounds (725 kg) when empty and normally contain 170 gallons of agent (GB, VX, or HD). Ton containers are equipped with fittings to permit the closed-system transfer of chemical agents. The containers have been used since the 1930's to store and ship bulk chemicals including chemical agent at UMCD.

Toxic Substances Control Act (TCSA)- The *Toxic Substances Control Act of 1976* provides EPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. Certain substances are generally excluded from TSCA, including, among others, food, drugs, cosmetics and pesticides. TSCA addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon and lead-based paint. PCB regulations are contained in 40 CFR 761.

Vapor Screening Level (VSL)- A near-real-time airborne exposure limit (AEL) equivalent in concentration to the STEL, but independent of time. VSL values for the various agents are shown below (OR6 213 820 917).

GB	$1x10^{-4}$ mg/m^3
VX	$1x10^{-5}$ mg/m^3
HD	$3x10^{-3}$ mg/m^3

VX – VX is a rapid-acting chemical nerve agent with chemical name 0-ethyl S-(2-diisopropyl aminoethyl) methylphosphonothioate ($C_{11}H_{24}N0_2PS$). VX is an odorless viscous liquid that is clear to straw in color. The action within the body is the inactivation of cholinesterase. The hazard from VX is primarily that of liquid absorption through the skin, although it can be absorbed through the respiratory tract as a vapor or aerosol and through the gastrointestinal tract by ingestion. VX is slow to evaporate and may persist as a liquid for several days.

Waste Determination- The process of determining whether a waste is regulated under the requirements in OAR 340-102-0011, "Hazardous Waste Determination."

Wipe Sample- Samples used to measure the deposition of contaminants of concern on a selected surface. The methods typically involve taking a solvent-soaked wipe or paper filter, moving it along a surface, and then analyzing for contamination.

Worker Population Limit (WPL)- The maximum allowable 8-hour TWA concentration that an unmasked worker could be exposed to for an 8 hour workday and 40 hour week for 30 years without adverse effect. WPL values for the various agents are shown below (OR6 213 820 917, U.S. Army 2008).

GB	$3x10^{-5}$ mg/m^3
VX	$1x10^{-6}$ mg/m^3
HD	$4x10^{-4}$ mg/m^3
Lewisite	$3x10^{-3}$ mg/m^3

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APPENDIX A: CLOSURE SCHEDULE

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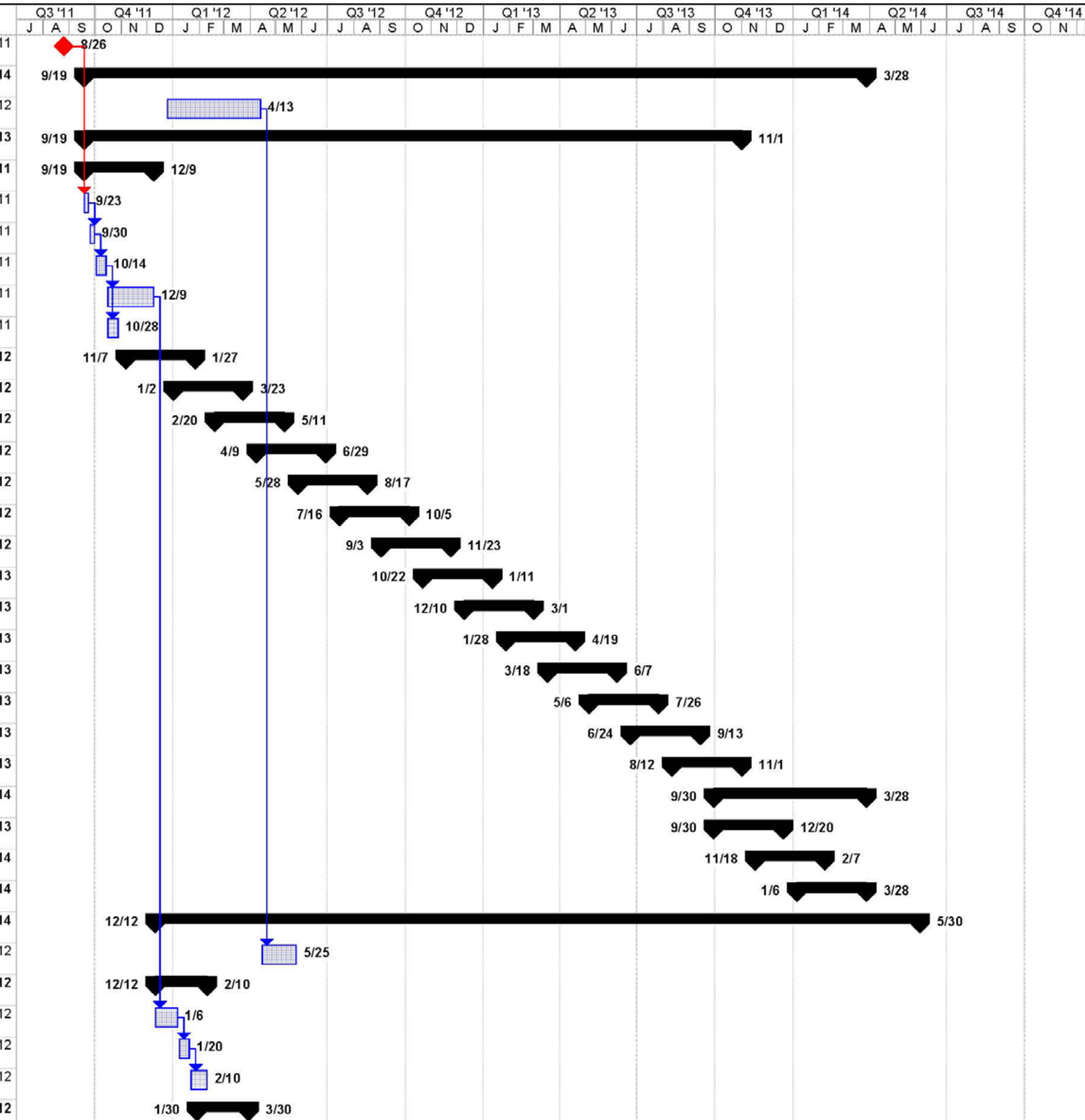
UMCD Closure Timeline for Building 203 CSF, J-Block and K-Block

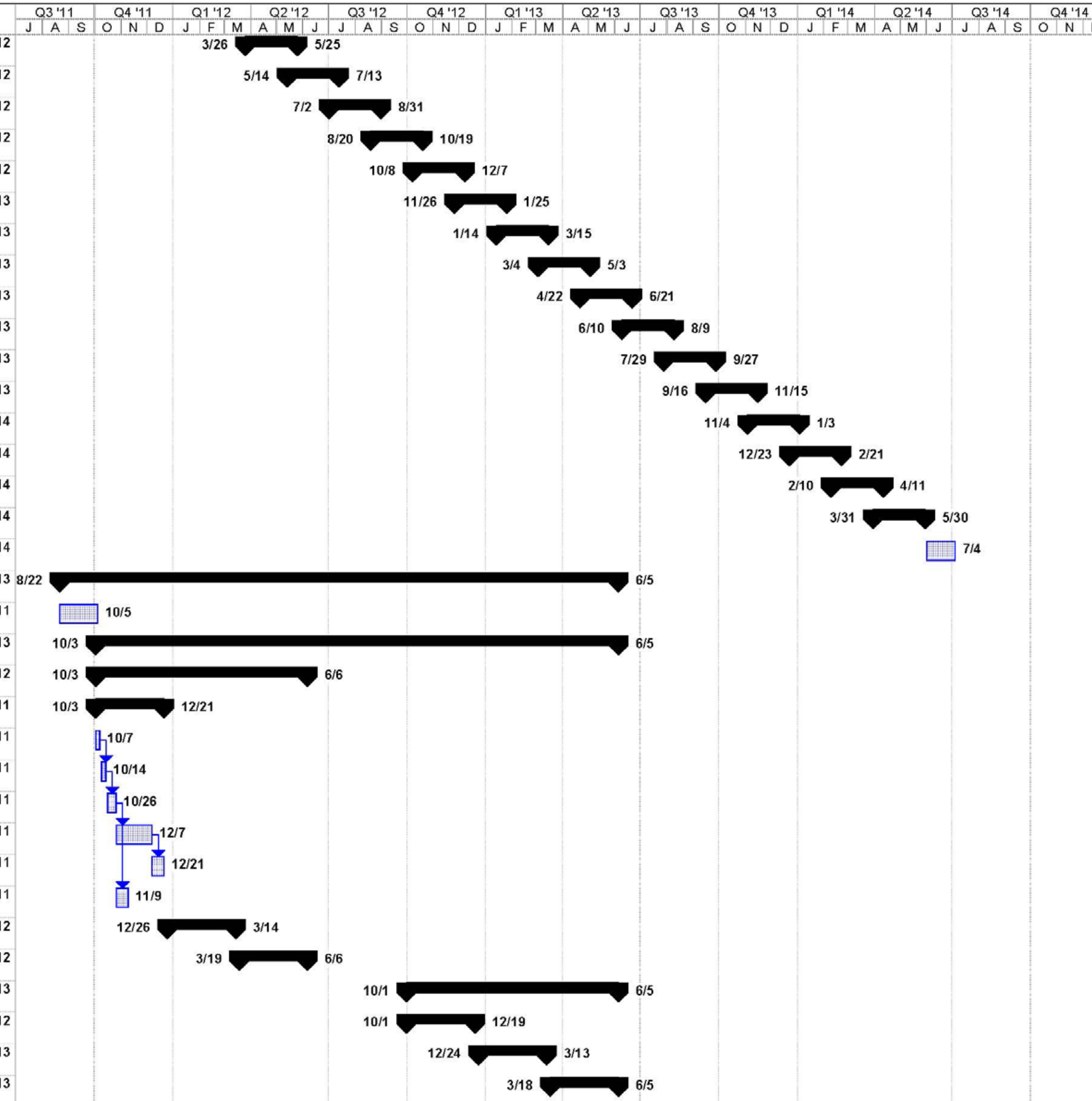
ID	WBS	Task Name	Duration	Start	Finish
1	1	Receive ODEQ Notice to Proceed	0 days	Fri 8/26/11	Fri 8/26/11
2	2	**HWMU Closure**	**660 days**	**Mon 9/19/11**	**Fri 3/28/14**
3	2.1	Building 203 CSF Closure	80 days	Mon 12/26/11	Fri 4/13/12
4	**2.2**	**K-Block Igloos (90)**	**555 days**	**Mon 9/19/11**	**Fri 11/1/13**
5	**2.2.1**	**Complete Work Package 1**	**60 days**	**Mon 9/19/11**	**Fri 12/9/11**
6	2.2.1.1	Field Mobilization	5 days	Mon 9/19/11	Fri 9/23/11
7	2.2.1.2	Waste Removal and Sampling	5 days	Mon 9/26/11	Fri 9/30/11
8	2.2.1.3	Field Sampling	10 days	Mon 10/3/11	Fri 10/14/11
9	2.2.1.4	Laboratory Analysis	40 days	Mon 10/17/11	Fri 12/9/11
10	2.2.1.5	Field Activity Reporting	10 days	Mon 10/17/11	Fri 10/28/11
11	**2.2.2**	**Complete Work Package 2**	**60 days**	**Mon 11/7/11**	**Fri 1/27/12**
17	**2.2.3**	**Complete Work Package 3**	**60 days**	**Mon 1/2/12**	**Fri 3/23/12**
23	**2.2.4**	**Complete Work Package 4**	**60 days**	**Mon 2/20/12**	**Fri 5/11/12**
29	**2.2.5**	**Complete Work Package 5**	**60 days**	**Mon 4/9/12**	**Fri 6/29/12**
35	**2.2.6**	**Complete Work Package 6**	**60 days**	**Mon 5/28/12**	**Fri 8/17/12**
41	**2.2.7**	**Complete Work Package 7**	**60 days**	**Mon 7/16/12**	**Fri 10/5/12**
47	**2.2.8**	**Complete Work Package 8**	**60 days**	**Mon 9/3/12**	**Fri 11/23/12**
53	**2.2.9**	**Complete Work Package 9**	**60 days**	**Mon 10/22/12**	**Fri 1/11/13**
59	**2.2.10**	**Complete Work Package 10**	**60 days**	**Mon 12/10/12**	**Fri 3/1/13**
65	**2.2.11**	**Complete Work Package 11**	**60 days**	**Mon 1/28/13**	**Fri 4/19/13**
71	**2.2.12**	**Complete Work Package 12**	**60 days**	**Mon 3/18/13**	**Fri 6/7/13**
77	**2.2.13**	**Complete Work Package 13**	**60 days**	**Mon 5/6/13**	**Fri 7/26/13**
83	**2.2.14**	**Complete Work Package 14**	**60 days**	**Mon 6/24/13**	**Fri 9/13/13**
89	**2.2.15**	**Complete Work Package 15**	**60 days**	**Mon 8/12/13**	**Fri 11/1/13**
95	**2.3**	**UMCD J-Block Igloos (14)**	**130 days**	**Mon 9/30/13**	**Fri 3/28/14**
96	**2.3.1**	**Complete Work Package 16**	**60 days**	**Mon 9/30/13**	**Fri 12/20/13**
102	**2.3.2**	**Complete Work Package 17**	**60 days**	**Mon 11/18/13**	**Fri 2/7/14**
108	**2.3.3**	**Complete Work Package 18**	**60 days**	**Mon 1/6/14**	**Fri 3/28/14**
114	3	**HWMU Certification**	**645 days**	**Mon 12/12/11**	**Fri 5/30/14**
115	3.1	Building 203 CSF Certification	30 days	Mon 4/16/12	Fri 5/25/12
116	**3.2**	**Complete Certification Package 1**	**45 days**	**Mon 12/12/11**	**Fri 2/10/12**
117	3.2.1	Data Validation and Assessment	20 days	Mon 12/12/11	Fri 1/6/12
118	3.2.2	Decision Making	10 days	Mon 1/9/12	Fri 1/20/12
119	3.2.3	Certification and Approval	15 days	Mon 1/23/12	Fri 2/10/12
120	**3.3**	**Complete Certification Package 2**	**45 days**	**Mon 1/30/12**	**Fri 3/30/12**



Page 1

UMCD Closure Timeline for Building 203 CSF, J-Block and K-Block

ID	WBS	Task Name	Duration	Start	Finish
124	3.4	Complete Certification Package 3	45 days	Mon 3/26/12	Fri 5/25/12
128	3.5	Complete Certification Package 4	45 days	Mon 5/14/12	Fri 7/13/12
132	3.6	Complete Certification Package 5	45 days	Mon 7/2/12	Fri 8/31/12
136	3.7	Complete Certification Package 6	45 days	Mon 8/20/12	Fri 10/19/12
140	3.8	Complete Certification Package 7	45 days	Mon 10/8/12	Fri 12/7/12
144	3.9	Complete Certification Package 8	45 days	Mon 11/26/12	Fri 1/25/13
148	3.10	Complete Certification Package 9	45 days	Mon 1/14/13	Fri 3/15/13
152	3.11	Complete Certification Package 10	45 days	Mon 3/4/13	Fri 5/3/13
156	3.12	Complete Certification Package 11	45 days	Mon 4/22/13	Fri 6/21/13
160	3.13	Complete Certification Package 12	45 days	Mon 6/10/13	Fri 8/9/13
164	3.14	Complete Certification Package 13	45 days	Mon 7/29/13	Fri 9/27/13
168	3.15	Complete Certification Package 14	45 days	Mon 9/16/13	Fri 11/15/13
172	3.16	Complete Certification Package 15	45 days	Mon 11/4/13	Fri 1/3/14
176	3.17	Complete Certification Package 16	45 days	Mon 12/23/13	Fri 2/21/14
180	3.18	Complete Certification Package 17	45 days	Mon 2/10/14	Fri 4/11/14
184	3.19	Complete Certification Package 18	45 days	Mon 3/31/14	Fri 5/30/14
188	4	TSCA Closeout Report	25 days	Mon 6/2/14	Fri 7/4/14
189	5	Additional Action Support	468 days	Mon 8/22/11	Wed 6/5/13
190	5.1	Prepare Additional Action Plan	32.5 days	Mon 8/22/11	Wed 10/5/11
191	5.2	Additional Action Sampling	438 days	Mon 10/3/11	Wed 6/5/13
192	5.2.1	FY12 Additional Action Sampling	178 days	Mon 10/3/11	Wed 6/6/12
193	5.2.1.1	Additional Action Sampling Package 1	58 days	Mon 10/3/11	Wed 12/21/11
194	5.2.1.1.1	Field Mobilization	5 days	Mon 10/3/11	Fri 10/7/11
195	5.2.1.1.2	Physical and Intrusive Sampling	5 days	Mon 10/10/11	Fri 10/14/11
196	5.2.1.1.3	Verification Sampling	8 days	Mon 10/17/11	Wed 10/26/11
197	5.2.1.1.4	Laboratory Analytical	30 days	Thu 10/27/11	Wed 12/7/11
198	5.2.1.1.5	Data Validation & Assessment	10 days	Thu 12/8/11	Wed 12/21/11
199	5.2.1.1.6	Field Reporting	10 days	Thu 10/27/11	Wed 11/9/11
200	5.2.1.2	Additional Action Sampling Package 2	58 days	Mon 12/26/11	Wed 3/14/12
207	5.2.1.3	Additional Action Sampling Package 3	58 days	Mon 3/19/12	Wed 6/6/12
214	5.2.2	FY13 Additional Action Sampling	178 days	Mon 10/1/12	Wed 6/5/13
215	5.2.2.1	Additional Action Sampling Package 4	58 days	Mon 10/1/12	Wed 12/19/12
222	5.2.2.2	Additional Action Sampling Package 5	58 days	Mon 12/24/12	Wed 3/13/13
229	5.2.2.3	Additional Action Sampling Package 6	58 days	Mon 3/18/13	Wed 6/5/13



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APPENDIX B: UMCD MAPS

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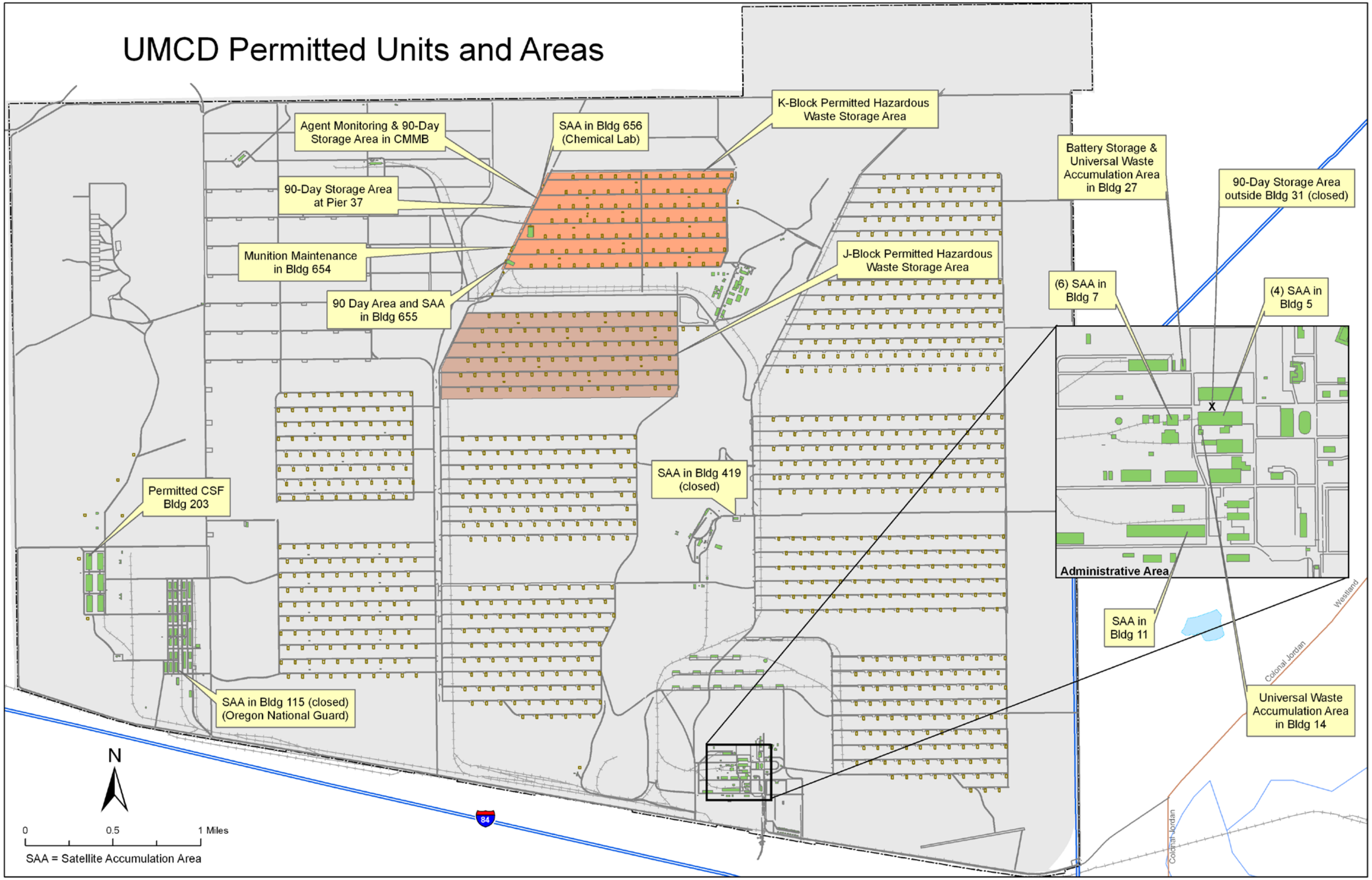
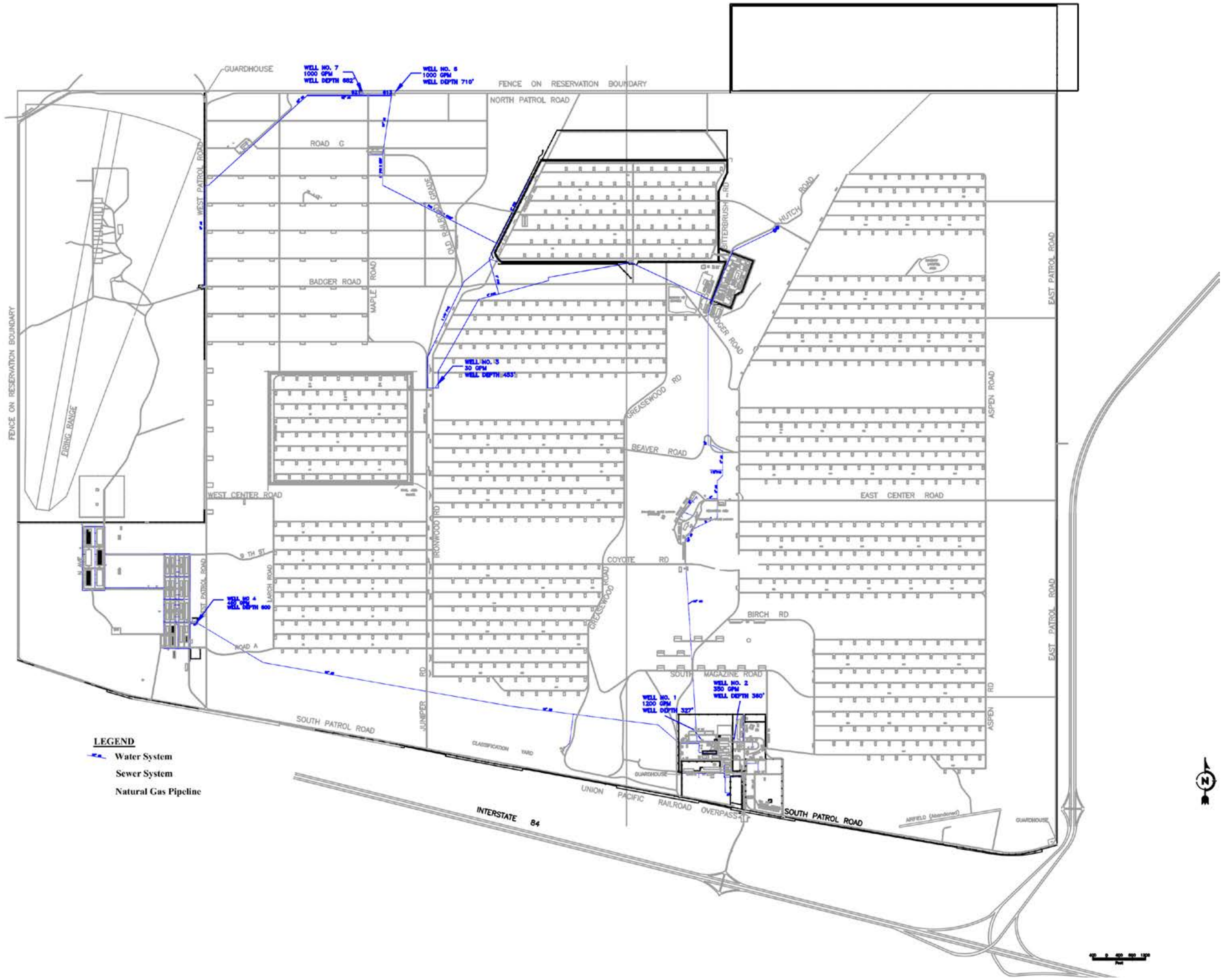

UMCD Permitted Units and Areas
Agent Monitoring & 90-Day Storage Area in CMMB
SAA in Bldg 656 (Chemical Lab)
K-Block Permitted Hazardous Waste Storage Area
Battery Storage & Universal Waste Accumulation Area in Bldg 27
90-Day Storage Area outside Bldg 31 (closed)
90-Day Storage Area at Pier 37
Munition Maintenance in Bldg 654
J-Block Permitted Hazardous Waste Storage Area
90 Day Area and SAA in Bldg 655
(6) SAA in Bldg 7
(4) SAA in Bldg 5
SAA in Bldg 419 (closed)
Permitted CSF Bldg 203
Administrative Area
SAA in Bldg 11
Universal Waste Accumulation Area in Bldg 14
SAA in Bldg 115 (closed) (Oregon National Guard)
N
0
0.5
1 Miles
SAA = Satellite Accumulation Area
84
Westland
Colonel Jordan

Topographic Map of Umatilla Chemical Depot, Measurements in Feet

Locations of Water Wells at the UMCD



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APPENDIX C: K-BLOCK OPERATIONAL HISTORY

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Igloo K-	Before 1984			1984		As of 01 January 2001		As of 13 June 2006		As of 05 November 2008		As of December 2011		No. Leakers	Leaker Report Numbers	Leak Type (Vapor or Liquid)	Igloo Category	Agent Leaked
	Date	Agent	Munition	Agent	Munition	Agent	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition					
1811				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/20/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1812				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/19/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1813				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/18/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1814				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/17/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1815				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/15/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1816				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/7/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1817				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/6/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1818				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	12/5/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1819				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	11/30/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1820				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	11/28/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1821				VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	11/26/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1822	9/27/1968 Apr-68	GB VX	750# BOMBS M23 MINES	VX	SPRAY TANKS	VX	SPRAY TANKS	VX	SPRAY TANKS	11/20/2007	EMPTY AND HLW		EMPTY AND LLW		No Leaker Reports but multiple from 1963-1980, Inspection Record (750lb Bomb)	Exudate Vapor	3	Exudate - VX Vapor - GB
1823	2/14/1964	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	3/19/2007	EMPTY AND HLW		EMPTY AND LLW	1	UMCD-04-07	Exudate	3	GB
1824	12/23/1963	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	2/20/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1825	Jul-68	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	10/17/2005	EMPTY AND LLW	HD	TON CNTRS	2/3/2011	EMPTY AND LLW	162	UMCD-02-06, UMCD-04-06, 93-038, 92-137, 92-138, 92-141, 90-051, 89-88, 89-87, 55-87, 89-10, 108-85, 88-53, 88-55, 88-58, 88-64, 89-07, 89-16, 73-093, 74-008, 74-020, 74-021, 74-026, 74-027, 74-028, 74-029, 74-031, 74-032, 74-034, 74-035, 81-031, 82-062, 84-020, 20-84, 21-84, 22-84, 24-84, 26-84, 27-84, 30-84, 31-84, 34-84, 36-84, 38-84, 39-84, 41-80, 41-84, 42-80, 42-84, 43-84, 44-84, 46-84, 47-84, ATR (13-Jan-82), Inspection Record (18-Feb-82), 42-81, 32-83, 3-83	142 - Vapor 18 - Liquid 2 - Exudate	4	GB
1826	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	8/18/2005	EMPTY AND LLW	HD	TON CNTRS	8/17/2010	EMPTY AND LLW	38	91-014, 90-070, 90-068, 53-87, UMCD-09-05, 22-85, 84-006, 10-84, 11-84, 12-84, 18-80, 31-79, 40-80, 6-84, 7-84, 80-84, 82-84, 9-84, ATR (10-Oct-73), ATR (14-May-79), ATR (19-Feb-82), ATR (15-May-80), ATR (24-Jul-73), 74-81	21 - Vapor 13 - Liquid - Exudate	4	Vapor, Liquid, Exudate - GB Liquid - HD
1827	7/10/1968 8/6/1969	GB VX	M55 ROCKETS 155MM PROJOS	GB	M55 ROCKETS	GB	M55 ROCKETS	12/28/2005	EMPTY AND LLW	HD	TON CNTRS	11/29/2010	EMPTY AND LLW	1	UMCD-00-01	Vapor	3	GB
1828	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	HD	TON CNTRS	5/26/2011	EMPTY AND LLW	5	1-86, 2-86, UMDA-94-02, 58-85	Vapor	3	GB
1829	8/29/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	11/9/2004	EMPTY AND LLW	HD	TON CNTRS	7/14/2011	EMPTY AND LLW				2	
1830	7/18/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	2/11/2005	EMPTY AND LLW	HD	TON CNTRS	4/21/2011	EMPTY AND LLW	1	UMCD-09-02	Liquid	4	HD
1831	8/14/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	1/18/2005	EMPTY AND LLW	HD	TON CNTRS	2/14/2011	EMPTY AND LLW				2	
1832	2/12/1965 Mar-81	VX VX	8" PROJOS *155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	4/7/2008	EMPTY AND HLW		EMPTY AND LLW	1	44-77	Liquid	4	VX
1833	8/14/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	11/30/2005	EMPTY AND LLW	HD	TON CNTRS	5/16/2011	EMPTY AND LLW				2	
1834	9/18/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	12/17/2005	EMPTY AND LLW	HD	TON CNTRS	8/4/2011	EMPTY AND LLW	7	UMCD-98-01, UMDA-95-002, 93-040, 92-015, 90-019, 90-018, 21-87	Vapor	3	GB
1835	9/18/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	12/16/2005	EMPTY AND HLW	HD	TON CNTRS	7/19/2011	EMPTY AND LLW	4	46-86, 83-001, UMCD-10-02	2 - Vapor 2 - Liquid	4	Vapor - GB Liquid - HD
1836	9/26/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	6/28/2005	EMPTY AND LLW	HD	TON CNTRS	8/24/2011	EMPTY AND LLW	5	UMCD-02-05, UMCD-99-03, UMCD-06-14, UMCD-06-13	2-Vapor 3-Exudate	3	Vapor-GB Exudate-HD
1837	7/18/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	8/16/2005	EMPTY AND LLW	HD	TON CNTRS	10/19/2011	EMPTY AND GPL	1	90-016	Vapor	3	GB
1838	10/28/1964	VX	155MM PROJOS	GB	750# BOMBS	GB	750# BOMBS	2/4/2006	EMPTY AND HLW	2/4/2006	EMPTY AND LLW		EMPTY AND LLW				2	
1839	Jun-65	VX	8" PROJOS	VX	M23 MINES	VX	M23 MINES	VX	M23 MINES	11/4/2008	EMPTY AND HLW		EMPTY AND LLW	1	7-78	Exudate	3	VX
1840	Apr-68	VX	M23 MINES	VX	M23 MINES	VX	M23 MINES	VX	M23 MINES	10/24/2008	EMPTY AND HLW		EMPTY AND LLW	11	73-037, 73-040, 73-041, 28-75, 72-053, 72-055, Inspection Record (22-Nov-71), ATR (29-Nov-79)	Vapor 7 - Liquid 4 - Exudate	4	VX

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	Date	Agent	Munition	Agent	Munition	Agent	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition					
1841	2/14/1964 Apr-68	GB VX	155MM PROJOS M23 MINES	GB	750# BOMBS	GB	750# BOMBS	2/25/2006	EMPTY AND HLW	HD	TON CNTRS	11/1/2010	EMPTY AND LLW	19	UMCD-03-08, 20-86, 22-86, 88-17, 72-057, 73-047, 74-041, 75-037, 75-038, 75-039, 75-040, 75-042, Inspection Record (11-Nov-71), 4-72	8 - Vapor 10 - Liquid 1 - Exudate	4	Liquid & Vapor - GB Liquid, Vapor, Exudate – VX Exudate - HD
1842	Apr-68	VX	M23 MINES	VX	M23 MINES	VX	M23 MINES	VX	M23 MINES	10/9/2008	EMPTY AND HLW		EMPTY AND LLW	5	30-75, 76-020, 72-060	Vapor 5 - Exudate	3	VX
1843	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	11/4/2005	EMPTY AND HLW	HD	TON CNTRS	7/21/2011	EMPTY AND LLW				2	
1844	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	11/30/2005	EMPTY AND HLW	HD	TON CNTRS	12/9/2010	EMPTY AND LLW	1	UMCD-08-01	Liquid	4	HD
1845				GB	M55 ROCKETS	GB	M55 ROCKETS	11/1/2005	EMPTY AND HLW	HD	TON CNTRS	3/17/2011	EMPTY AND LLW	1	84-095	Vapor	3	GB
1846	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	HD	TON CNTRS	8/19/2010	EMPTY AND LLW	3	UMCD-09-01, UMCD-07-06, UMCD-09-03	1 – Liquid 1 – Vapor 1 – Exudate	4	HD
1847	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	11/19/2005	EMPTY AND HLW	HD	TON CNTRS	7/14/2011	EMPTY AND LLW	2	UMCD-08-02, UMCD-09-06	Liquid	4	HD
1848	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	4/27/2006	EMPTY AND HLW	HD	TON CNTRS	10/4/2011	EMPTY AND GPL	2	UCA-96-01, 89-18	Vapor	3	GB
1849	7/10/1968	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	4/8/2005	EMPTY AND LLW	HD	TON CNTRS	4/4/2011	EMPTY AND LLW	2	UMCD-99-02, UMCD-06-10	1-Vapor 1-Exudate	3	Vapor - GB Exudate - HD
1850	8/14/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	3/22/2005	EMPTY AND LLW	HD	TON CNTRS	6/20/2011	EMPTY AND LLW	1	84-075	Vapor	3	GB
1851	8/7/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/11/2005	EMPTY AND LLW	HD	TON CNTRS	10/13/2011	EMPTY AND GPL	1	UMCD-09-04	Exudate	3	HD
1852	10/28/1964	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	6/24/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1853	10/28/1964	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	6/12/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1854	10/28/1964	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	5/9/2008	EMPTY AND HLW		EMPTY AND LLW	1	77-73	Vapor	3	VX
1855	6/11/1965	VX	8" PROJOS	VX	8" PROJOS	VX	8" PROJOS	VX	8" PROJOS	8/4/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1856	7/15/1968 Mar-81	GB VX	M55 ROCKETS *155MM PROJOS	GB	M55 ROCKETS	GB	M55 ROCKETS	6/20/2005	EMPTY AND LLW	HD	TON CNTRS	5/11/2011	EMPTY AND LLW	1	84-073	Vapor	3	GB
1857	8/6/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	10/20/2005	EMPTY AND HLW	HD	TON CNTRS	4/7/2011	EMPTY AND LLW				2	
1858	Mar-81	GB	8" PROJOS	GB GB GB GB	500# BOMBS 750# BOMBS 155MM PROJOS 8" PROJOS	GB GB GB GB	500# BOMBS 750# BOMBS 155MM PROJOS 8" PROJOS	GB	8" PROJOS	5/29/2007	EMPTY AND HLW		EMPTY AND LLW	2	91-031, 91-032	Vapor	3	GB
1859	9/19/1966	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	11/9/2006	EMPTY AND HLW		EMPTY AND LLW				2	
1860				GB	M55 ROCKETS	GB	M55 ROCKETS	4/28/2006	EMPTY AND HLW	HD	TON CNTRS	10/17/2011	EMPTY AND GPL	2	UMCD-09-08, 100-85	1-Exudate 1-Vapor	3	Exudate-HD Vapor-GB
1861	8/6/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	10/22/2005	EMPTY AND HLW	HD	TON CNTRS	2/9/2011	EMPTY AND LLW	2	84-016	Vapor	3	GB
1862	12/23/1963	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	4/4/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1863	8/6/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	8/17/2005	EMPTY AND HLW	HD	TON CNTRS	10/25/2011	EMPTY AND GPL	2	UMCD-09-07, UMCD-10-01	Exudate	3	HD
1864	8/7/1963	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	12/29/2005	EMPTY AND HLW	12/29/2005	EMPTY AND LLW		EMPTY AND LLW	1	UMCD-03-07	Vapor	3	GB
1865	Mar-81	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	12/27/2006	EMPTY AND HLW		EMPTY AND LLW		Used as TCM for VX Mines, 46-80, 65-80, 12-80, 58-80, 53-80, 62-80, 63-80	Liquid Vapor Exudate	4	VX
1866	2/14/1964	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	5/21/2007	EMPTY AND HLW	10/26/2011	EMPTY AND GPL		Chem. Ops. History Comparison	Vapor	3	Vapor-GB Vapor-HD
1867	9/15/1966 11/4/1968	GB GB	8" PROJOS 155MM PROJOS	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	12/4/2006	EMPTY AND HLW		EMPTY AND LLW				2	

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	Date	Agent	Munition	Agent	Munition	Agent	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition					
1868	Mar-81 11/4/1968	GB GB	8" PROJOS 155MM PROJOS	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	11/2/2006	EMPTY AND HLW		EMPTY AND LLW				2	
1869	12/23/1963	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	5/1/2007	EMPTY AND HLW		EMPTY AND LLW	5	UMCD-03-06, UCA-96-02, UCA-96-03, UMCD-06-04, UMCD-04-05	1-Liquid 4-Vapor	4	GB
1870	Apr-65	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	3/30/2006	EMPTY AND HLW	3/30/2006	EMPTY AND LLW		EMPTY AND LLW				2	
1871	Apr-65 Mar-81	GB GB	M55 ROCKETS 8" PROJOS	GB	M55 ROCKETS	GB	M55 ROCKETS	3/28/2006	EMPTY AND HLW	3/28/2006	EMPTY AND LLW		EMPTY AND LLW	1	84-069	Vapor	3	GB
1872	Apr-65	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	3/24/2006	EMPTY AND HLW	3/24/2006	EMPTY AND LLW		EMPTY AND LLW				2	
1873	Apr-65	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	10/14/2005	EMPTY AND LLW	10/14/2005	EMPTY AND LLW		EMPTY AND LLW	26	UMCD-00-02, UMCD-97-01, UMDA-95-003, UMCD-04-09, UMCD-05-08, 92-008, 92-143, 91-064, 89-04, 79-016, 79-050, 82-058, 95-85, 4-84, 95-005	22 - Vapor 1 - Exudate 3 - Liquid	4	GB
1874	9/19/1966	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	GB	8" PROJOS	10/16/2006	EMPTY AND HLW		EMPTY AND LLW				2	
1875	12/23/1963 Mar-81	GB VX	155MM PROJOS 8" PROJOS	VX	8" PROJOS	VX	8" PROJOS	VX	8" PROJOS	7/23/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1876	Nov-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	6/10/2006	EMPTY AND HLW	6/10/2006	EMPTY AND LLW		EMPTY AND LLW	1	88-54	Vapor	3	GB
1877	2/14/1964	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	6/11/2007	EMPTY AND HLW		EMPTY AND LLW	3	79-028, 84-049, ATR (28-Mar-79)	Vapor	3	GB
1878	9/30/1968 2/14/1964	GB GB	750# BOMBS 155MM PROJOS	GB	750# BOMBS	GB	750# BOMBS	2/6/2006	EMPTY AND HLW	2/6/2006	EMPTY AND HLW		EMPTY AND LLW	5	31-87, 72-032, 19-76, 73-052	4 - Vapor –1 - Exudate	3	GB
1879	9/30/1968 5/6/1964	GB GB	750# BOMBS 155MM PROJOS	GB	750# BOMBS	GB	750# BOMBS	5/26/2006	EMPTY AND HLW	5/26/2006	EMPTY AND HLW		EMPTY AND LLW	2	83-86, 85-86	1 - Liquid 1 - Vapor	4	GB
1880	6/11/1965 10/31/1962 9/27/1968 Apr-65	VX VX GB GB	8" PROJOS M55 ROCKETS 750# BOMBS M55 ROCKETS	VX VX VX VX VX VX	155MM PROJOS M23 MINES 8" PROJOS M55 ROCKETS M55 RKT WHDS TON CNTRS	VX VX VX VX VX VX	155MM PROJOS M23 MINES 8" PROJOS M55 ROCKETS M55 RKT WHDS TON CNTRS	VX	LEAKER IGLOO	10/21/2008	EMPTY AND HLW		EMPTY AND LLW	5	UMCD-01-07, 86-80, Chem. Ops. History Comparison	1 - Vapor 4 - Liquid	4	VX
1881	12/23/1963 10/25/1968 9/15/1966 9/26/1963	GB GB GB GB	155MM PROJOS 750# BOMBS 8" PROJOS M55 ROCKETS	GB GB GB GB GB GB GB	M55 ROCKETS 155MM PROJOS 8" PROJOS M55 RKT WHDS 500# BOMBS 750# BOMBS TON CNTRS.	GB GB GB GB GB GB GB	M55 ROCKETS 155MM PROJOS 8" PROJOS M55 RKT WHDS 500# BOMBS 750# BOMBS TON CNTRS.	GB	LEAKER IGLOO	6/27/2007	EMPTY AND HLW		EMPTY AND LLW	96	UMCD-02-01 thru UMCD-02-04, UMCD-03-01 Thru UMCD-03-04, UMCD-01-02 Thru UMCD-01-06, UMCD-00-NL-01, UMCD-99-NL-01, UMCD-97-01NL, UMCD-97-02NL, UMDA-95-001, UMCD-07-01 Thru UMCD-07-05, UMCD-06-08, UMCD-06-01 Thru UMCD-06-03, UMCD-04-10 Thru UMCD-04-13, UMCD-04-08, UMCD-04-01 Thru UMCD-04-04, UMCD-05-01 Thru UMCD-05-06, 91-029, 89-121, 88-11, 88-20, 88-21, 88-22, 89-11, 91-051(LR#51), 92-038, 93-01, UMDA-94-08, 84-052, 84-053, 84-055, 84-056, 84-057, 84-058, 84-059, 84-060, 85-80, 93-84, 92-84, 39-81, 38-81	8 - Liquid 88 - Vapor	4	GB
1882	11/7/1968	GB	750# BOMBS	GB	750# BOMBS	GB	750# BOMBS	6/1/2006	EMPTY AND HLW	6/1/2006	EMPTY AND HLW		EMPTY AND LLW	1	UMCD-01-01	Vapor	3	GB
1883				GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	8/1/2006	EMPTY AND HLW		EMPTY AND LLW	1	Chem. Ops. History Comparison	Vapor	3	GB
1884	Nov-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/18/2006	EMPTY AND HLW		EMPTY AND LLW	3	UMCD-99-01, 31-86, 90-055	Vapor	3	GB
1885	Oct-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/18/2006	EMPTY AND HLW		EMPTY AND LLW	2	UMCD-98-02, 84-067	Vapor	3	GB
1886	Oct-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/7/2006	EMPTY AND HLW		EMPTY AND LLW	2	88-1, 88-50	Vapor	3	GB
1887	Oct-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/7/2006	EMPTY AND HLW		EMPTY AND LLW				2	
1888	Oct-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	6/9/2006	EMPTY AND HLW	6/9/2006	EMPTY AND HLW		EMPTY AND LLW	1	UMCD-98-03	Vapor	3	GB
1889	4/5/1965 Lot Renovated 1984	GB GB	8" PROJOS 155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	GB	155MM PROJOS	7/1/2007	EMPTY AND HLW		EMPTY AND LLW	2	UMCD-06-12	Liquid	4	GB

Igloo K-	Before 1984			1984		As of 01 January 2001		As of 13 June 2006		As of 05 November 2008		As of December 2011		No. Leakers	Leaker Report Numbers	Leak Type (Vapor or Liquid)	Igloo Category	Agent Leaked
	Date	Agent	Munition	Agent	Munition	Agent	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition	Agent or Date Emptied	Munition					
1890	9/12/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	1/18/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1891	9/12/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	1/14/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1892	8/31/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	1/9/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1893	8/31/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	11/8/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1894	10/31/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	1/2/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1895	10/4/1962	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	VX	M55 ROCKETS	12/10/2007	EMPTY AND HLW		EMPTY AND LLW				2	
1896	10/28/1964	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	VX	155MM PROJOS	4/24/2008	EMPTY AND HLW		EMPTY AND LLW				2	
1897	Sep-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	5/8/2006	EMPTY AND HLW	5/8/2006	EMPTY AND HLW		EMPTY AND LLW	4	82-025, 88-44, 88-45	Vapor	3	GB
1898	11/7/1968	GB	750# BOMBS		EMPTY		EMPTY		EMPTY AND LLW		EMPTY AND LLW		EMPTY AND LLW	3	75-44, 88-37, 73-011	1 - Vapor 1 - Exudate	3	GB
	11/5/1968	GB	500# BOMBS															
1899	Sep-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	5/11/2006	EMPTY AND HLW	5/11/2006	EMPTY AND HLW		EMPTY AND LLW				2	
1900	Sep-63	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	GB	M55 ROCKETS	7/11/2006	EMPTY AND HLW		EMPTY AND LLW	1	UMCD-97-02	Vapor	3	GB

*All 155MM Projectile leakers consolidated into K-1856 and K-1832 in 1981.
Exudate (weepage) is considered a Vapor Igloo

Igloo Categories:
0 - No history of CWA stored in igloo
1 - No history of vapor or liquid CWA leaks and only wastes monitored to less than WPL (or never exposed to agent)
2 - No history of vapor or liquid leaks, chemical munitions stored in igloo
3 - Vapor leaks
4 - Liquid leaks confirmed or suspected on the floor

Breakdown of Igloos per Category:
0 Igloos - Category 0
0 Igloos - Category 1
38 Igloos - Category 2
35 Igloos - Category 3
17 Igloos - Category 4

Acronyms:
HLW - Higher-Level Waste (Previously 1X)
LLW - Lower-Level Waste (Previously 3X)

APPENDIX D: K-BLOCK STORAGE ARRANGEMENTS

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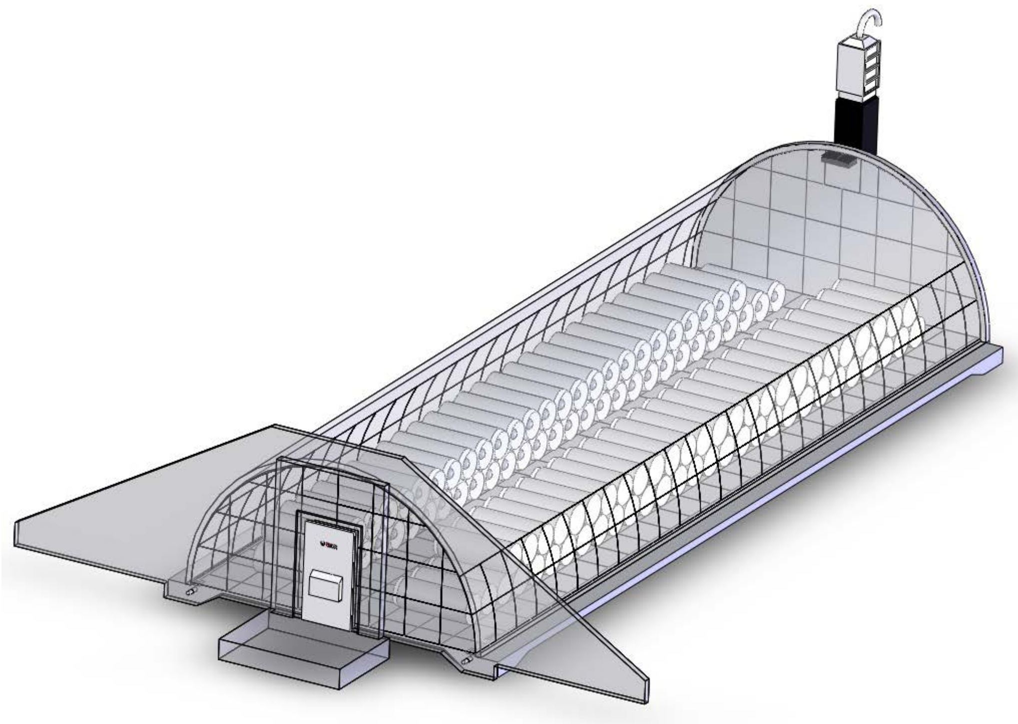
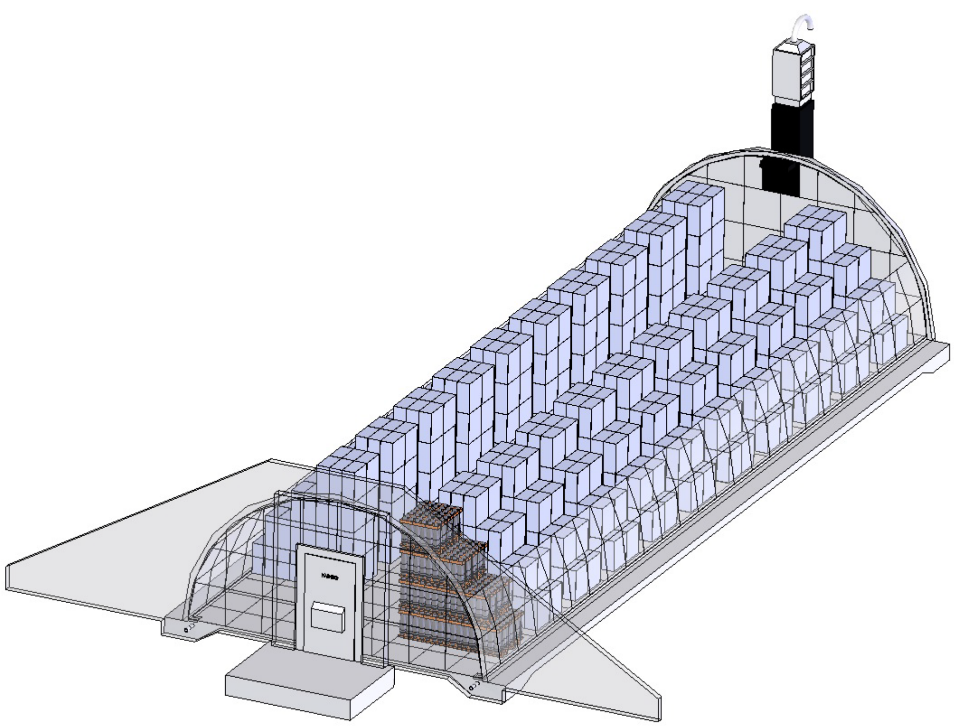
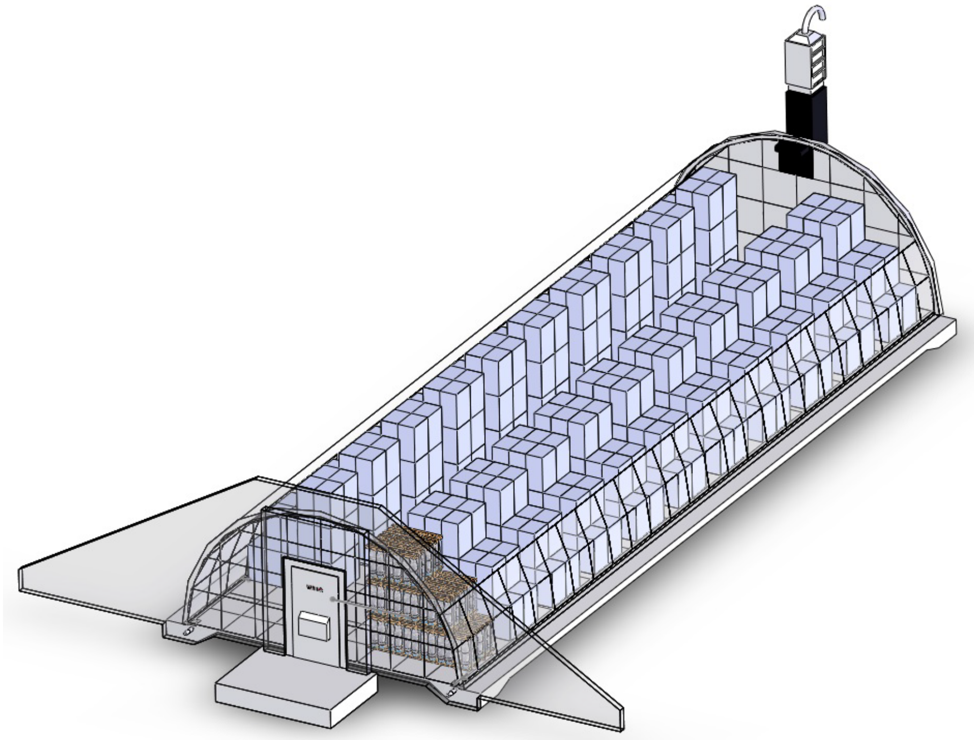


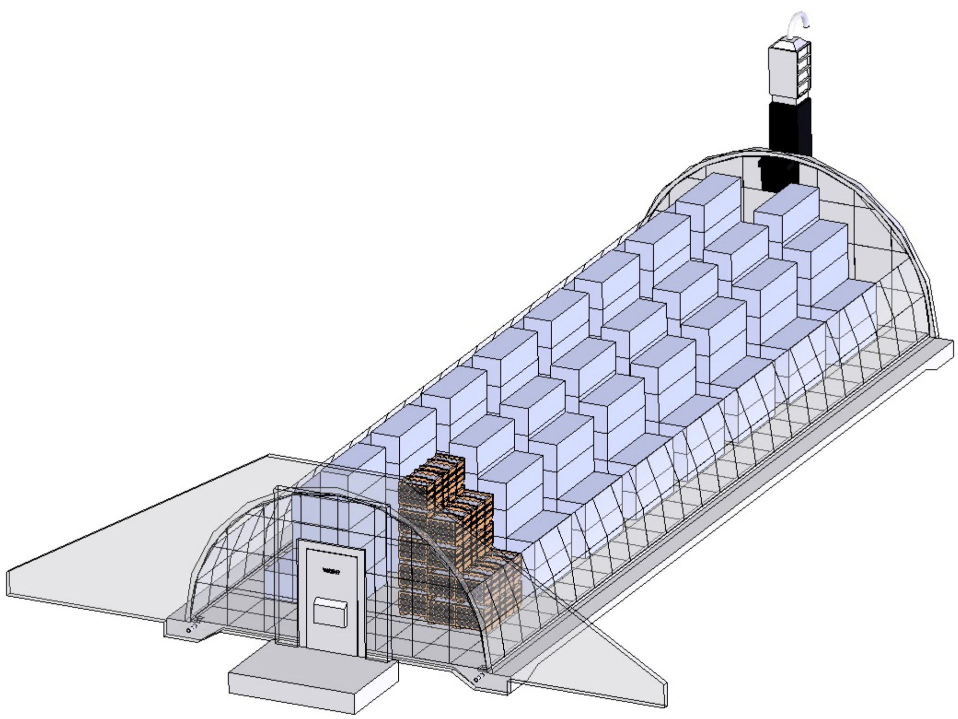
Ton Containers



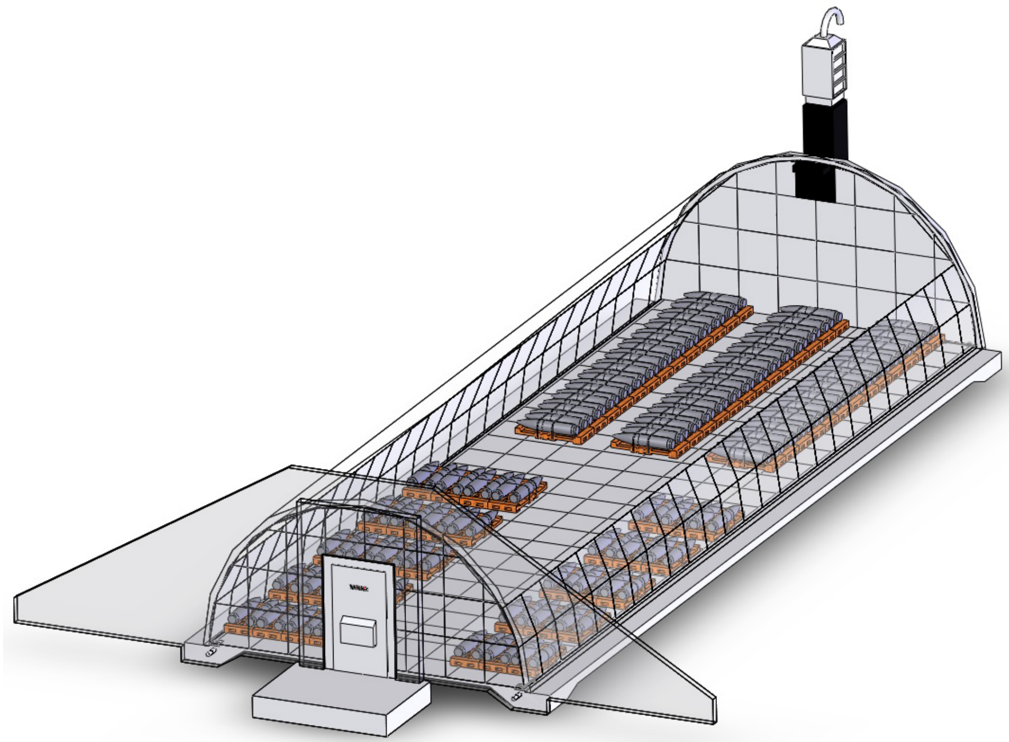
155-mm M121/A1 Projectiles



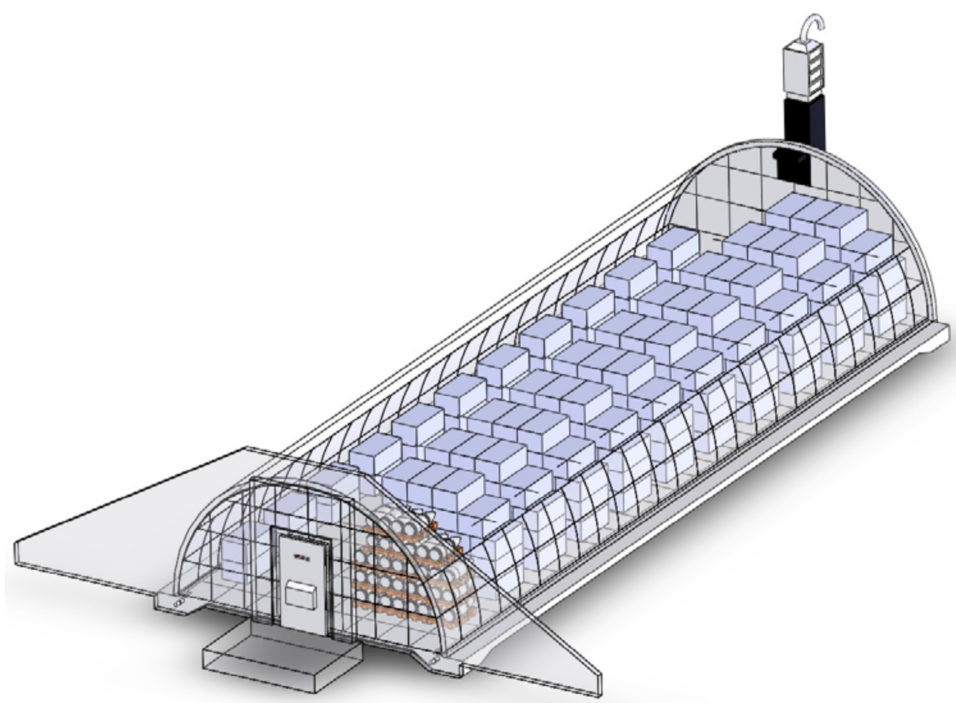
8-inch M426 Projectiles



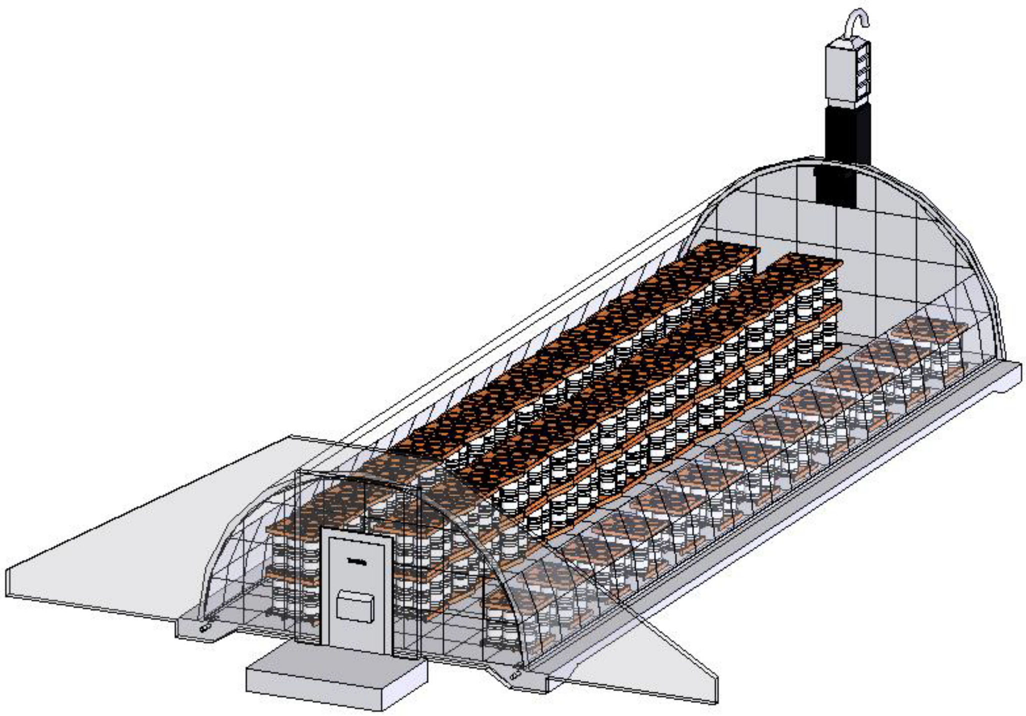
M55 Rockets



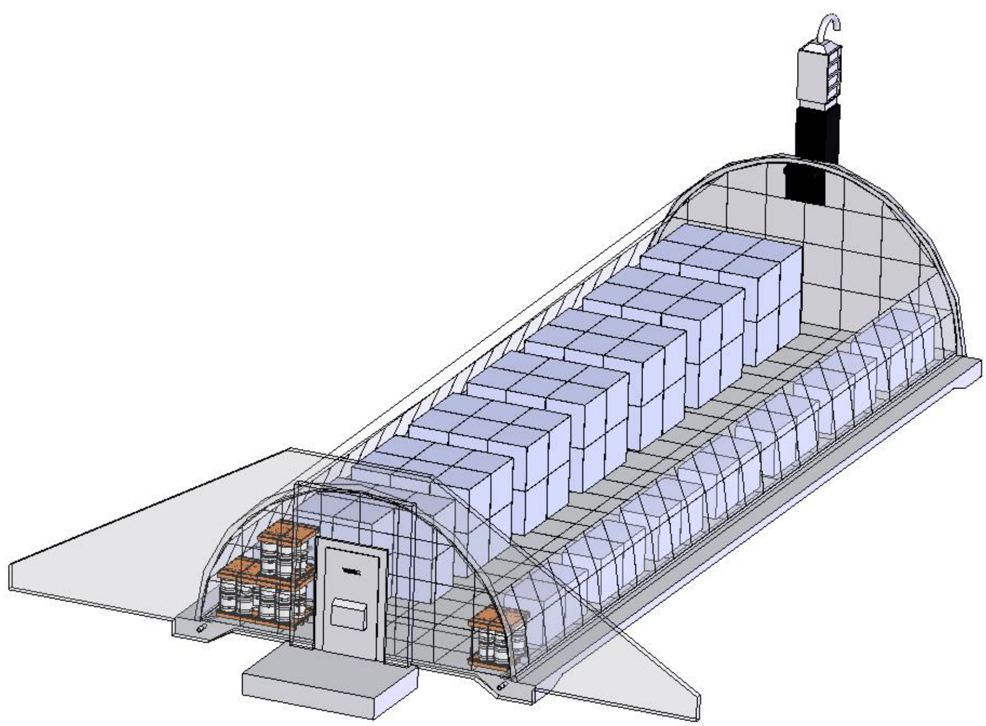
MK94 (500-lb) Bombs



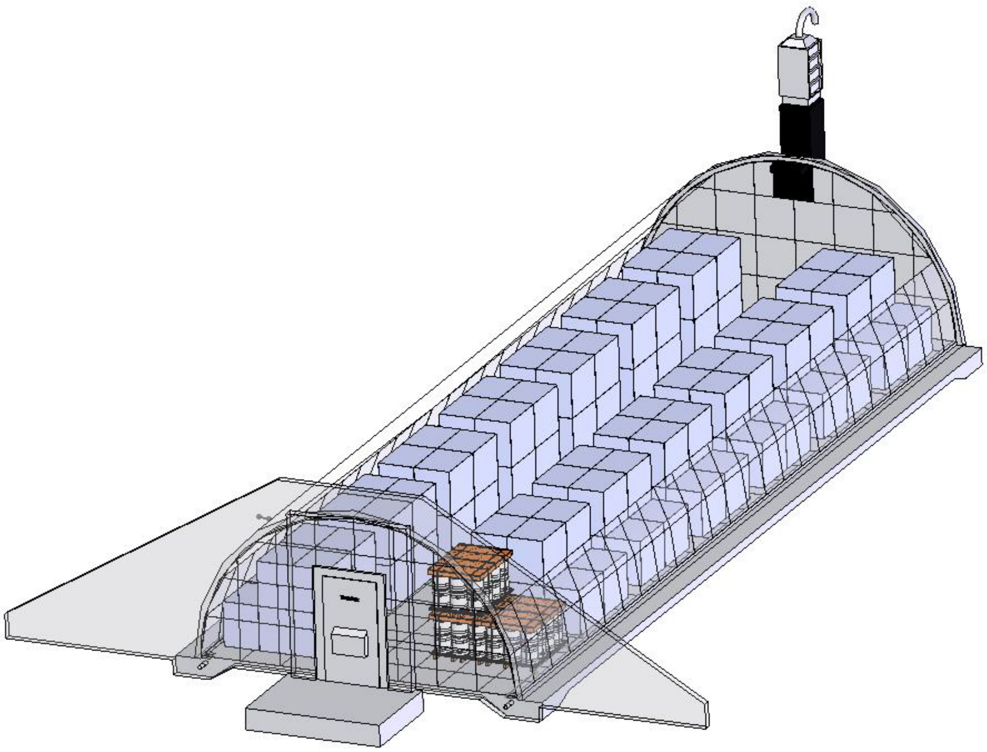
MC-1 (750-lb) Bombs



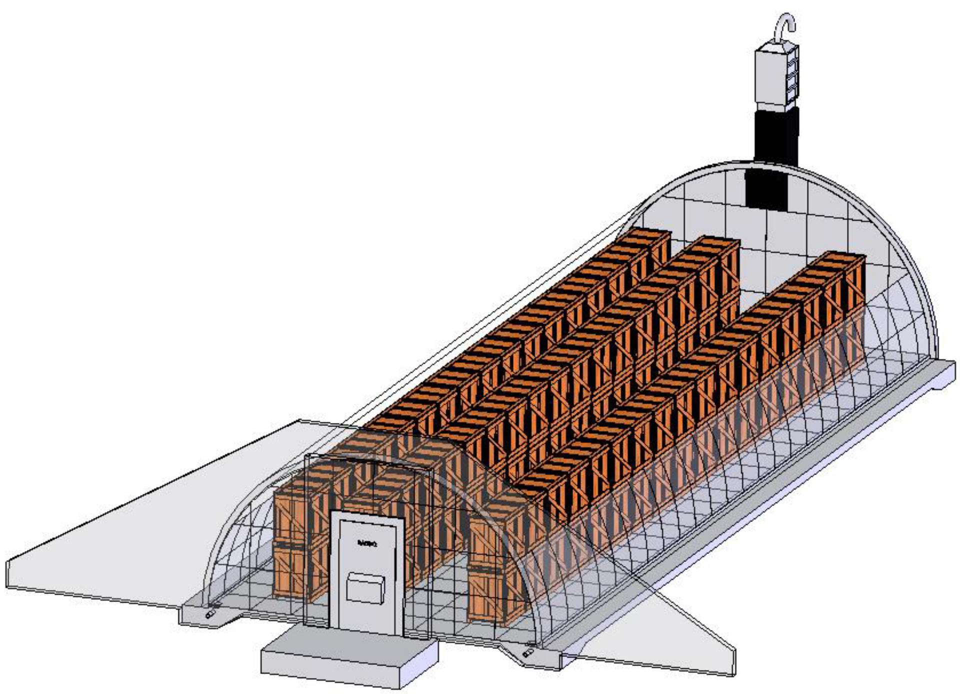
M23 Mines (16-Drum Pallets)



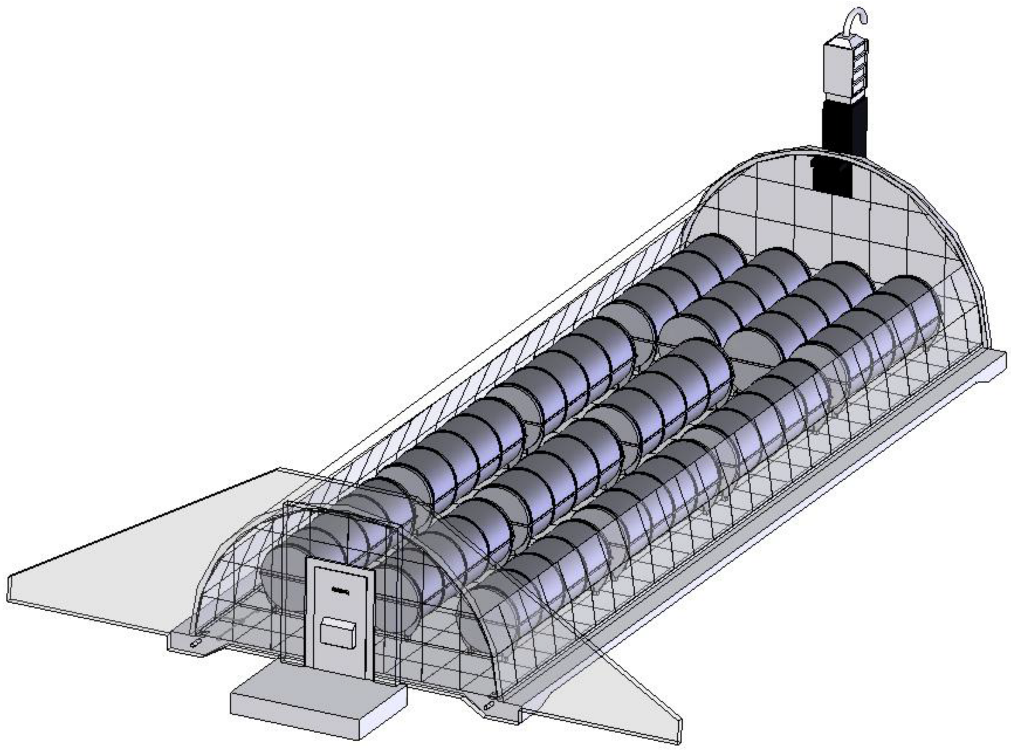
M23 Mines (12-Drum 40" x 48" Pallets)



M23 Mines (12-Drum 35½” x 52¼” Pallets)



M23 Mines (12-Drum Crates)



TMU-28B Spray Tanks (Packed in CNU-77/E23 Containers)

APPENDIX E: PROJECT QUALITY ASSURANCE PLAN

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VET-1604-PQAP-002

RCRA Support for UMCD Closure

Project Quality Assurance Plan

Revision: 1

Issue Date: 6 September 2011

Prepared for:

Risk Management Directorate
United States Army Umatilla Chemical Depot
Hermiston OR 97838

Prepared by:

Vista Engineering Technologies, LLC
1355 Columbia Park Trail
Richland, WA 99352

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VET-1604-PQAP-002

RCRA Support for UMCD Closure

Project Quality Assurance Plan

Revision: 1

Issue Date: 6 September 2011

Approved By:

Hank M. Chafin, Quality Assurance Manager — Date: 09-06-2011

Cary Ervin, Project Manager — Date: 9/6/2011

Risk Management Directorate
United States Army Umatilla Chemical Depot
Hermiston OR 97838

Vista Engineering Technologies, LLC
1355 Columbia Park Trail
Richland, WA 99352

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Executive Summary

This Project Quality Assurance Plan (PQAP) details the quality assurance requirements for the *Resource Conservation and Recovery Act* (RCRA) Support for Umatilla Chemical Depot (UMCD) Closure Project. The primary goals of the UMCD Closure Project are to achieve:

- Closure of 90 UMCD-permitted K-Block storage magazines,
- Closure of 14 UMCD-permitted J-Block magazines,
- Closure of Building 203, and
- Support in addressing corrective action for newly identified solid waste management units (SWMUs).

This PQAP was designed to provide specific quality assurance/quality control guidelines for the implementation of the UMCD Closure Plan to meet the project performance objectives and to ensure precision, accuracy, completeness, comparability, and representativeness of all analytical data.

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Revision History

Revision	Change Description
A	Issued for Client Review.
0	Initial release.
1	Revised Table 1 in Appendix A to correct PQAP document number.

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Contents

Appendices

Figures

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1.0 INTRODUCTION

This is the Project Quality Assurance Plan (PQAP) for the Resource Conservation and Recovery Act (RCRA) support for Umatilla Chemical Depot (UMCD) Closure Project. The requirements herein are defined by Vista Engineering internal standards and client needs. The Vista Engineering Corporate Quality Assurance Program (CQAP), VET-QA-PLN-001, is based upon the 18 basic requirements of ANSI/ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*. The CQAP also meets selected requirements defined in ISO 9001:2000, *Quality Management Systems – Requirements*. This PQAP follows the general format given in EPA QA/G-5, *Guidance for Quality Assurance Project Plans* (see Appendix A for an elements crosswalk table).

Together, the Vista Engineering CQAP and this PQAP address the Quality Assurance (QA) program needs of the project. Program requirements are those essential to QA while reflecting prudent business management practices. The CQAP and PQAP provide a systematic means to manage project activities to ensure success and client satisfaction.

2.0 ORGANIZATIONAL RESPONSIBILITIES

Vista Engineering maintains a written CQAP supplemented by this PQAP for this project. All work on the project will be performed under a contract between the client and Vista Engineering. The Vista Engineering President is responsible for projects and assigns a Project Manager to each project. This project matrix organization allows work to be performed at one or more of the four Vista Engineering offices. For this project, the work will be conducted out of the offices in Hermiston, Oregon and Richland, Washington. See Figure 1 for a functional organization chart. The analytical laboratories will be added to Vista Engineering's Evaluated Suppliers List.

The executive management at Vista Engineering is fully committed to maintaining a system of quality that will meet or exceed client expectations. The Vista Engineering President has the ultimate responsibility for implementation of the CQAP and this PQAP. The President is responsible for the implementation of the CQAP and project-specific QA requirements dealing with contracts, procurement, finance, record keeping, technical editing, and document control functions. Technical or progress reviews will be scheduled periodically by the President to monitor project quality and performance. The results of these reviews will be documented in the corporate records for the project.

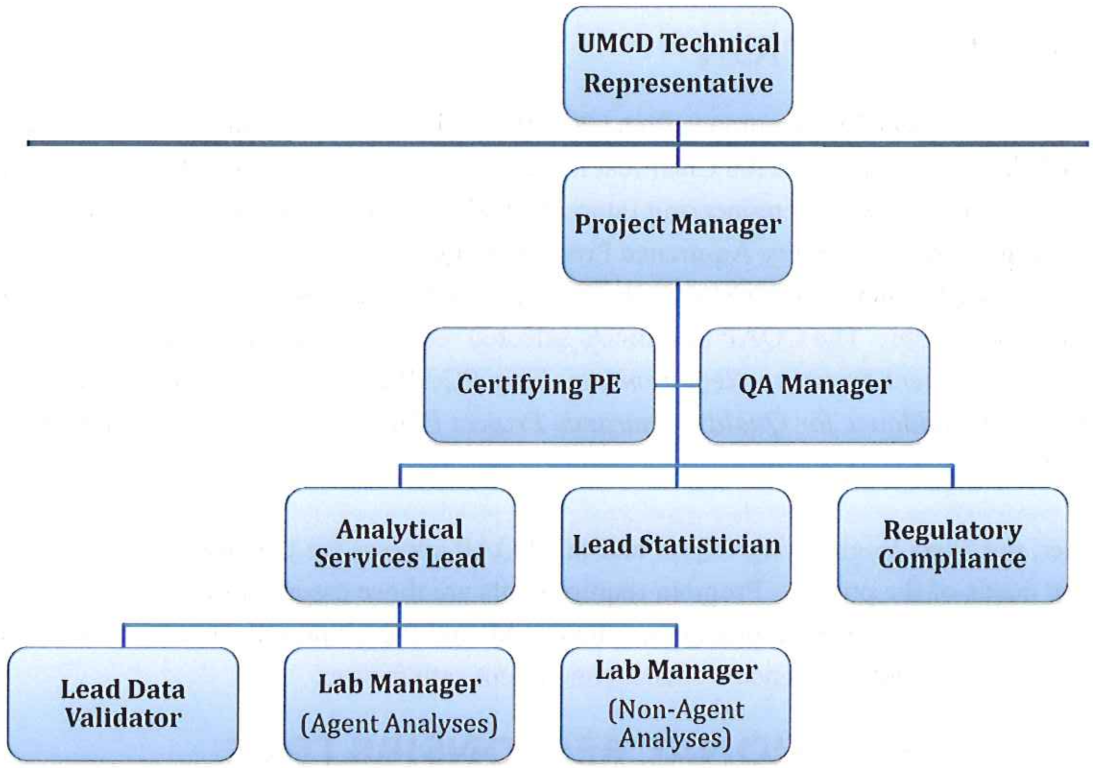

Figure 1 – UMCD Closure Project Functional Organization Chart

The Vista Engineering QA Manager is delegated the responsibility of developing and recommending quality policy for management approval and for providing guidance and oversight for quality implementation. The QA Manager interfaces with the President and project managers for the functions of implementing, assessing, and revising the CQAP and project-specific QA plans. The QA Manager has the authority to report directly to the Company President on any unresolved QA issues and nonconformance. The QA Manager arranges for independent assessments of projects to assure 1) the quality and adequacy of work performed, and 2) compliance with procedures governing record keeping and other QA functions, as appropriate. Independent assessments will be conducted by the QA Manager or an independent party, as appropriate, to meet client and project-specific QA requirements (VET-QA-PRO-034, *Assessments and Surveillances*).

The Project Manager for the UMCD Closure Project will provide senior guidance to ensure the successful completion of the project. The Project Manager will also coordinate the work to ensure that the organization matrix, levels of authority, and resource allocation meet project-specific QA requirements. The Project Manager will interface with the UMCD Technical Representative. The assigned project technical support staff will support the Project Manager and will be responsible for the performance of project work and for routine compliance with the CQAP and this PQAP. Quality control (QC) checks, technical reviews, and documentation will be initiated and conducted at the project level.

The responsibility for implementing good quality practices and for adhering to quality systems is ultimately delegated through the management organization to all employees. Every employee has the authority to stop work for QA or environmental, health, and safety reasons and can report directly to the QA Manager, or to any senior manager, regarding any QA concerns or unresolved QA issues.

3.0 PROBLEM DEFINITION/BACKGROUND

J- and K-Block storage magazines (also known as igloos) are concrete structures that were used to store munitions and ton containers containing various chemical warfare agents (both nerve and blister) and secondary wastes. Each magazine is permitted as a separate RCRA containment building or Hazardous Waste Management Unit (HWMU). Removal of the munitions and/or bulk waste containers from J- and K-Block, via incineration activities at the Umatilla Chemical Agent Disposal Facility (UMCDF), triggers requirements (40 CFR 264.113, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*) mandating the closure of these HWMUs under RCRA. Possible constituents of concern (COCs) in the various magazines include:

- Sarin (GB) or O-isopropyl methylphosphonofluoridate,
- VX or O-ethyl-S-(2-diisopropyl-aminoethyl) methyl-phosphonothiolate,
- Distilled Mustard (HD) or bis-(2-chloroethyl)sulfide,
- Agent degradation products,
- RCRA metals,
- Organic compounds,
- Research Department Explosives (RDX) or cyclonitehexahydro-1,3,5-trinitro-1,3,5-triazine,
- 2,4,6-trinitrotoluene (TNT), and
- Poly-chlorinated biphenyls (PCBs).

Operational histories will be reviewed to determine the appropriate minimum sampling set for each magazine. The primary goal of the UMCD Closure Project is to achieve RCRA clean closure of:

- 90 UMCD-permitted K-Block storage magazines,
- 14 UMCD-permitted J-Block magazines,
- Building 203, and
- Support in addressing investigation, closure, or corrective action for newly identified solid waste management units (SWMUs).

The project will employ a single closure methodology utilizing standardized procedures, analyses, and certification processes for each magazine. Closure Verification Packages will provide documentary evidence to the Oregon Department of Environmental Quality (ODEQ) of closure completion. This PQAP describes procedures that will be implemented during sampling and analysis to demonstrate that all of the sampling data are of sufficient quality to serve as the basis for regulatory decisions concerning closure of Building 203 and the UMCD J- and K-Block igloos.

4.0 PROJECT DESCRIPTION

The purpose of this document is to establish the processes and criteria for the closure verification sampling and analysis. There are five major tasks to be performed: 1) field sampling; 2) laboratory analyses; 3) data validation; 4) statistical optimization; and 5) closure certification.

4.1 Field Sampling

Field sampling activities will be conducted in order to verify the effectiveness of closure activities and to provide the basis for certifying clean closure in accordance with RCRA regulations. Analytical data generated from the samples will be assessed to determine whether or not closure performance objectives were met. Details surrounding the sampling program (data collection design, sampling locations, sampling methods, equipment decontamination, etc.) are provided in the appropriate Closure Plan (VET-1604-PLN-003) and a Standing Operating Procedure (SOP) for sampling activities, VET-1604-SOP-001.

4.2 Laboratory Analyses

Laboratory analyses will be done on all media for the specified analytes. An approved subcontracted laboratory will perform all analyses in their facilities. Appropriate QA/QC protocols will be followed as discussed later in this PQAP. Laboratory requirements will be identified in the individual subcontractor procurement documents (see VET-QA-PRO-023, *Procurement Documentation*).

4.3 Data Validation

Data validation is the process of evaluating data and accepting or rejecting it on the basis of sound technical criteria. Validation methods and criteria appropriate to the type of data and the purpose of the measurement will be used (see VET-1604-SOP-003). The person(s) validating the data will have sufficient knowledge of the technical work to identify questionable values.

Field sampling data will be validated based on the representativeness of the sample, maintenance and cleanliness of sampling equipment and the adherence to an approved, written sample collection procedure. The following criteria will be used to evaluate the field sampling data:

- Use of approved test procedures,
- Proper operation of the process being tested,
- Use of properly operating and calibrated equipment,

- Use of reagents that have conformed to QC specified criteria, and
- Proper traceability maintained.

Analytical data will be validated using criteria established in the data validation protocol in the Sampling and Analysis Plan (SAP)[1] and associated SOP. Results from the field and laboratory method blanks, replicate samples, and internal QC samples are used to further validate analytical results. Analytical results for field blanks and replicate field samples, as applicable, are valuable for validation of sample collection also. The following criteria will be used to evaluate the data:

- Use of approved analytical procedures,
- Use of properly operating and calibrated instrumentation, and
- Precision and accuracy achieved should be comparable to that achieved in previous analytical programs and consistent with objectives stated in this PQAP.

4.4 Statistical Analyses

Statistical analyses are used to demonstrate that the closure verification sampling was representative and met closure performance objectives critical to achieving the purpose of the SAP and this PQAP. In addition, statistical analysis will be used to optimize the sampling approach for each magazine.

4.5 Closure Certification

Closure certification packages will be prepared and submitted to the UMCD Contracting Officer Representative. The closure certification packages will:

- Summarize the field activities (i.e., outline the goals and methods for achieving the Data Quality Objectives [DQO])
- Identify any modifications or deviations to the SAP
- Include documentation of ODEQ's concurrence to any SAP modifications or deviations prior to implementation
- Identify any corrective action(s) performed at the site
- Provide a summary of the laboratory results
- Provide a summary of the data validation reports
- Compare results to closure performance objectives and determine if objectives were satisfied.

The certification packages will be submitted during the post-sampling phase for final closure of the RCRA permit. The closure certification packages will be certified by the Independent

[1] All SAP references in this document refer to Section 15.0 of VET-1604-PLN-003, *RCRA Closure Plan for the Umatilla Chemical Depot.*

Registered Professional Engineer (IRPE) prior to release to the UMCD, and subsequent submittal to the ODEQ.

5.0 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are a description of the quality of data required to support closure of the RCRA units. The DQOs (as detailed in the SAP) provide the mechanism for ongoing control and evaluation of measurement data quality throughout the course of the project. The QA/QC effort will focus on controlling measurement error within the established limits of the SAP (i.e., will identify the target precision and accuracy limits that are used to assess the data quality). All persons involved with the closure of UMCD will follow the requirements specified in the SAP. If for any reason the DQOs have not been met, the data will be evaluated as to whether or not the data should be accepted as is and qualified in some manner, or if additional sampling is needed to augment the existing data package. ODEQ concurrence on any deviations from the SAP is required to ensure that the proposed changes do not require a permit modification.

Several procedures will be used for monitoring both the precision and accuracy objectives of the sampling and analytical program. Sampling and analytical activities will follow standard referenced procedures whenever possible. Standard reference materials, calibration standards, internal standards, and surrogate compounds will be high-purity materials that are commercially available. Typically, these materials are greater than 99% pure and have a concentration that has been certified by the manufacturer. Analytical instruments used will be calibrated per the reference method requirements prior to sample analysis in order to demonstrate that accurate performance levels are being met. Data precision and accuracy will be assessed by evaluating the results from the analysis of internal standards, surrogate compounds, laboratory blanks, calibration check standards, reagent blanks, method blanks, field and trip blanks, duplicate samples, and matrix or surrogate spiked samples.

When analytical QC procedures reveal that a measurement's error has exceeded the target criterion, the source of the deviation will be identified, and corrective action will be taken. If data fall outside the acceptable range of precision and accuracy, even after corrective action has been taken, those data points will be flagged and discussed specifically in the report. Whenever possible, alternative procedures (either sampling or analytical) will be considered and recommended to UMCD. Any modifications to standard methods, or changes from SOPs will be submitted to the UMCD and ODEQ for approval before final implementation. ODEQ approval is required prior to implementation in order to determine if a permit modification is necessary.

6.0 SPECIAL TRAINING AND CERTIFICATION

To execute the project effectively, all personnel must be capable of performing their assigned tasks. Qualification and training processes ensure that personnel achieve and maintain the required capabilities. The Project Manager will be responsible for ensuring that personnel are trained and qualified to perform assigned tasks (VET-QA-PRO-022, *Training and Qualification of Project Personnel*). Training and qualifications will be completed before personnel are permitted to perform an operation. The Project Manager will ensure that the required level of competence for the qualified individual is maintained throughout the life of the project.

Before personnel are allowed to work independently, the Project Manager will ensure those personnel have the necessary experience, knowledge, skills, and abilities. Personnel will be qualified based on one or more of the following:

- Previous experience, education, and training.
- A performance demonstration or test to verify previously acquired skills.
- Completion of a training or qualification program.
- On-the-job training.

Qualified indicates that personnel have been evaluated with respect to performance-based standards and that documentation issued by their supervisor is available to attest to this fact. *Certified* indicates that personnel have been evaluated with respect to performance-based requirements for a particular function. At a minimum, all project personnel will be qualified; some personnel, such as registered professional engineers, are considered qualified and certified if working within their field of competence.

The Project Manager will be responsible for assuring that personnel assigned to the project have the appropriate educational background in engineering and scientific analysis, as well as the requisite experience to conduct the required work activities of the project. Personnel working on the project will be required to read this PQAP, the SAP, and associated SOPs including any modification or revisions. Documentation verifying this activity will be maintained in the project files.

7.0 DOCUMENTS AND RECORDS

Vista Engineering's existing document control system (VET-QA-PRO-001, *Document Control*) will be used for timely preparation, review, approval, issuance, use, control, revision, and maintenance of documents that prescribe work activities and specify requirements. The Project Manager is expected to identify and control documents and records that affect the quality of products or services.

This PQAP further defines the extent of document control as applicable to the project. Documents of particular interest to the project include:

- Project Closure Plans
- Sampling and Analysis Plans
- Contract Information
- Procurement Documentation
- Field Data
- Field Activity Reports
- Chain of Custody Forms
- Waste Inventory Sheets
- Data Validation Reports
- Standing Operating Procedures
- Drawings and Maps
- Photographs
- Analytical Data & Results
- Spreadsheets & Calculations
- Project Assessments/Surveillances
- Project Status Reports
- Closure Verification Packages

Appropriate project documents will be prepared in accordance either with applicable Vista Engineering document procedures or with specific document guidelines provided by UMCD or ODEQ. Appropriate project reports will be assigned unique identifiers. Revised documents shall be reviewed and approved by the appropriate organizations that participated in the original review and approval, unless designated otherwise. The nature of the change(s) shall be identified within the document or in appropriate attachments. Appropriate project data, drawings, maps, plans, procedures, instructions, reports, contracts, and accounting information will be kept in Vista Engineering's project files.

8.0 DATA GENERATION AND ACQUISITION

The SAP addresses the following topics: sampling process design, sampling methods, sample handling and custody, analytical methods, and sample quality control. The SAP will be reviewed and approved by both the UMCD and ODEQ.

8.1 Instrument and Equipment Testing, Inspection and Maintenance

The only instruments that would require testing, inspection and maintenance would be at the subcontracted laboratory that analyzes the samples. The instruments will be tested, inspected and maintained in accordance with the laboratory's approved QA program. Routine inspections (e.g., daily, weekly, or as needed) should be based on the manufacturer's recommendations, performed by the responsible staff, and followed by corrective actions, if necessary. All instrumentation/equipment subject to maintenance or repair shall be recalibrated, as necessary, before use.

8.2 Instrument and Equipment Calibration and Frequency

The only instruments that would require calibration would be at the contracted laboratory that analyzes the samples. The instruments will be calibrated in accordance with the laboratory's approved QA program. Standards used for calibration of measurement systems shall be traceable to a nationally or internationally recognized standard agency source or measurement system, if available.

The laboratory shall keep a record of raw calibration data for all methods. Calibration records (initial calibration, initial calibration verification, and continuing calibration verification) shall include the raw calibration data, associated reports, date of analysis, and analyst's name or initials, at a minimum. Calibration data shall be traceable to the standards used. All samples analyzed shall be traceable to the calibration under which the results were produced. Sample analysis can only proceed when measurement systems are accurately calibrated.

8.3 Inspection and Acceptance of Supplies and Consumables

Qualified suppliers and, as necessary, sub-tier suppliers will be monitored periodically to ensure that acceptable items and services continue to be supplied. Procurement documents will contain information clearly describing the item or service needed and associated technical and quality requirements. Procurement documents will specify the quality requirements for which the supplier is responsible. Qualified personnel will review procurement documents for accuracy and completeness before release. Changes to procurement documents shall receive the same level of review and approval as the original documents.

Supplies critical to the project are associated with sampling activities (sample wipes, reagent water, sample bottles, etc.). The necessary personal protective equipment (PPE) for workers is also critical to the project. The Project Manager (or a designee) is responsible for identifying, tracking, storing, and retrieving these supplies. Identification of and acceptance criteria for these supplies are detailed in the project's SAP.

8.4 Data Management

Five areas where information will be collected, analyzed, and reported, and where prudent data management is required, include: field sampling, laboratory analyses, data validation, statistical analyses reports, and closure certification reports. Documentation will include, but is not limited to: analytical laboratory data, instrument printouts, field notes and observations, chain-of-custody forms and request for analyses. These data will be collected and organized into a central file for future reference in accordance with Vista Engineering's procedures VET-QA-PRO-001, *Document Control*, and VET-QA-PRO-017, *Quality Records*. The documentation will be turned over to UMCD.

9.0 ASSESSMENT AND OVERSIGHT

9.1 Assessments and Response Actions

Assessments are evaluations intended to provide an increased understanding of the program or system being evaluated and to provide a basis for improving such programs or systems. Assessments will be documented including

- A summary of the results of the assessment,
- A discussion of the deficiencies, observations, and concerns that were identified as a result of the assessment,
- Action owner(s), and
- Associated dates for follow-up actions.

Management Assessments are performed by the Project Manager to evaluate some or all of the following topics:

- Effectiveness of management control systems,
- Adequacy of resources and personnel,
- Effectiveness of training and assessment,
- Applicability of data quality requirements,
- Measuring and testing equipment calibration or control procedures,
- Document control procedures,
- Technical procedure compliance,
- Adherence to data quality requirements, and
- Identification, control, storage, and preservation of samples or standards.

Management assessments will be performed at least once per calendar year throughout the duration of the project.

External assessments will be performed by agencies or groups not under the control of management. External assessments may consist of inspections, interviews, and/or evaluations that focus on the ability to meet program requirements. The Project Manager will be responsible for initiating, tracking, following up on, and documenting all corrective actions that are required as a result of external assessments. At least one external assessment will be performed during the life of the project.

Items, services, and processes that do not meet established requirements will be identified, controlled, and corrected according to the importance of the problem and the work affected. For significant problems, correction will include identifying the causes of problem(s) and working to prevent their recurrence. Vista Engineering's existing system for Non-Conformance Reports (NCRs) and Corrective Action Reports (CARs) will be used to document nonconforming items and/or processes (see Vista Engineering procedures VET-QA-PRO-033, *Corrective Action*, and VET-QA-PRO-035, *Identification and Control of Nonconforming Items*).

9.2 Reports to Management

Monthly reports prepared by the Project Manager will be submitted to UMCD and ODEQ providing current project status for the entire project duration. Once UMCD closure field activities commence, daily status updates to ODEQ will be required. The Project Manager will immediately notify the UMCD and ODEQ of any event or occurrence that could have a significant effect on the validity of the analytical results. Notification will be verbal, followed by a written memorandum, which includes the proposed corrective action.

10.0 DATA VALIDATION AND USEABILITY

This section of the PQAP describes the approach used to report, review, and validate the field and laboratory data into an appropriate presentation format. The raw data will be generated as field sampling documentation, sample traceability documentation, laboratory processing documentation, and raw data from analytical instruments. The most significant aspect of data reporting will be the compilation of the analytical results from the laboratory. Analytical results will be compiled into analytical data package(s) by the laboratory(s). Following the delivery of the analytical results to the Project Manager, a data verification effort will be undertaken (see VET-1604-SOP-003) to review the content of these deliverables for compliance with the SAP specifications required of the laboratory. The reported data also will be evaluated for compliance with the DQOs. If the data are determined to have met the analytical requirements, they will then be used to assess the closure status of the magazines.

10.1 Data Review, Verification and Validation

The data review process will be initiated when the Project Manager receives analytical data packages from the laboratory(s) and verifies that each sample was analyzed and confirms that all laboratory quality controls (e.g., matrix spike/matrix spike duplicate (MS/MSD) and duplicate analyses requested were performed, and the results reported.

If, during the review process, any errors or deficiencies are found in the analytical data packages, they will be noted by the reviewer, and the Laboratory Manager (or designee) will be notified so that corrected pages can be issued for inclusion into the final report. The corrected pages are then reviewed upon submittal for accuracy before incorporation into the data package or certificate set.

10.2 Verification and Validation Methods

The Project Manager will prepare and implement procedures for the verification of supplied data and resolution of anomalies. Data anomalies shall be reported to ODEQ as soon as possible in order to discuss data validity (including using or discarding data) and any possible corrective actions. Verification activities include, but are not limited to the following:

- Verification that the amount of data requested matches the amount of data received (number of samples for requested methods and analytes),
- Verification of procedures/methods used,
- Verification that documentation/deliverables are complete,
- Verification that hardcopy and electronic versions of the data are identical, and
- Verification that data seem reasonable based on analytical methodologies.

This review will confirm that the data are usable for an assessment of closure performance. Validation activities shall include, but not be limited to, the following:

- Verification of required deliverables,
- Requested versus reported analyses,
- Evaluation and qualification of results based on holding times,
- Qualification of results based on method blank results,
- Matrix spike/matrix spike duplicate (MS/MSD) analysis,
- Surrogate recoveries,
- Internal standards performance,
- Initial and continuing instrument calibrations (standards and blanks), and
- Laboratory control samples.

10.3 Reconciliation and User Requirements

When the data review process is complete, the data will be separated by type as either analytical or quality control results. Both the analytical and the QC results will be summarized in tables for presentation in the closure packages and reduced into a form that is usable in the determination of the closure performance. The results will be evaluated to determine if the project and QC objectives have been met. All data collected during this project will be validated and if anomalous results are obtained, every effort will be made to identify the reason for the anomaly in the sample collection, sample preparation, or analysis. If any anomalies have occurred, the closure report will include the results of the affected sample data, a thorough discussion of occurrence, and its impact on overall data usability.

11.0 REFERENCES

40 CFR 264, *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities*, Code of Federal Regulations, as amended.

ANSI/ASME NQA-1, *Quality Assurance Standards for Nuclear Facility Applications*, American National Standards Institute and American Society of Mechanical Engineers, New York, New York, 1997.

EPA QA/G-5, *Guidance for Quality Assurance Project Plans*, Environmental Protection Agency, Washington, D.C., 2006.

ISO 9001, *Quality Management Systems – Requirements*, 3rd Edition, International Organization for Standardization, Geneva, Switzerland, 2000.

VET-1604-PLN-003, *RCRA Closure Plan for the Umatilla Chemical Depot*, Vista Engineering Technologies LLC, Richland, WA.

VET-1604-SOP-001, *Standing Operation Procedure for Sampling on the J- and K-Block Closure Project*, Vista Engineering Technologies LLC, Richland, WA.

VET-1604-SOP-002, *Standing Operation Procedure for Record Keeping on the J- and K-Block Closure Project*, Vista Engineering Technologies LLC, Richland, WA.

VET-1604-SOP-003, *Standing Operation Procedure for Data Assessment and Validation on the J- and K-Block Closure Project*, Vista Engineering Technologies LLC, Richland, WA.

VET-1604-SOP-004, *Standing Operation Procedure for Professional Engineer's Certification on the J- and K-Block Closure Project*, Vista Engineering Technologies LLC, Richland, WA.

VET-ENG-PRO-002, *Engineering Change Control*, Vista Engineering Technologies LLC, Richland, WA.

VET-ENG-PRO-006, *Calculations*, Vista Engineering Technologies LLC, Richland, WA.

VET-ENG-PRO-013, *OTS Software Maintenance*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PLN-001, *Vista Engineering Technologies LLC Corporate Quality Assurance Program*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-001, *Document Control*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-008, *Quality-Affecting Procedures and Instructions*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-017, *Quality Records*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-022, *Training and Qualification of Project Personnel*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-023, *Procurement Documentation*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-025, *Control of Purchased Items and Services*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-026, *Identification and Control of Items*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-033, *Corrective Action*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-034, *Assessments and Surveillances*, Vista Engineering Technologies LLC, Richland, WA.

VET-QA-PRO-035, *Identification and Control of Nonconforming Items*, Vista Engineering Technologies LLC, Richland, WA.

12.0 ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CAR	Corrective Action Report
CFR	Code of Federal Regulations
COC	Constituent of Concern
CQAP	Corporate Quality Assurance Program
DQO	Data Quality Objective
EPA	Environmental Protection Agency
GB	Sarin (O-isopropyl methylphosphonofluoridate)
HD	Distilled Mustard [bis(2-chloroethyl) Sulfide]
HWMU	Hazardous Waste Management Unit
IRPE	Independent Registered Professional Engineer
ISO	International Standards Organization
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCR	Non-Conformance Report
ODEQ	Oregon Department of Environmental Quality
PCB	Polychlorinated Biphenyl
PPE	Personal Protective Equipment
PQAP	Project Quality Assurance Plan
QA	Quality Assurance
QC	Quality Control
RCRA	*Resource Conservation and Recovery Act of 1976*
RDX	Research Department Explosives (or cyclonitehexahydro-1,3,5-trinitro-1,3,5-triazine)
SAP	Sampling and Analysis Plan
SOP	Standing Operating Procedure
SWMU	Solid Waste Management Unit
TNT	2,4,6-trinitrotoluene
UMCD	Umatilla Chemical Depot
UMCDF	Umatilla Chemical Agent Disposal Facility
Vista Engineering	Vista Engineering Technologies, LLC
VX	O-ethyl-S-(2-diisopropyl-aminoethyl) methyl-phosphonoothiolate

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APPENDIX A: QAP CROSSWALK

The following table provides a crosswalk between the QA Project Plan elements listed in EPA QA/R-5 and their location in the various project and Vista Engineering documents.

Table 1 – Crosswalk of QA Project Plan Elements

EPA QA/R-5 QA Project Plan Elements	Project Document Number
GROUP A: PROJECT MANAGEMENT	
A1 Title and Approval Sheet	VET-1604-PQAP-002; VET-1604-PLN-003
A2 Table of Contents	VET-1604-PQAP-002; VET-1604-PLN-003
A3 Distribution List	VET-1604-PQAP-002; VET-1604-PLN-003
A4 Project/Task Organization	VET-1604-PQAP-002, §2.0
A5 Problem Definition/Background	VET-1604-PQAP-002, §3.0
A6 Project/Task Description	VET-1604-PQAP-002, §4.0
A7 Quality Objectives and Criteria	VET-1604-PQAP-002, §5.0
A8 Special Training/Certification	VET-1604-PQAP-002, §6.0; VET-QA-PRO-022
A9 Documents and Records	VET-1604-PQAP-002, §7.0; VET-1604-SOP-002; VET-QA-PRO-001; VET-ENG-PRO-002; VET-QA-PRO-008; VET-QA-PRO-017
GROUP B: DATA GENERATION AND ACQUISITION	
B1 Sampling Process Design (Experimental Design)	VET-1604-PLN-003
B2 Sampling Methods	VET-1604-PLN-003; VET-1604-SOP-001
B3 Sample Handling and Custody	VET-1604-PLN-003; VET-1604-SOP-001
B4 Analytical Methods	VET-1604-PLN-003; VET-ENG-PRO-006
B5 Quality Control	VET-1604-PLN-003; VET-QA-PRO-017
B6 Instrument/Equipment Testing, Inspection, and Maintenance	VET-1604-PQAP-002, §8.1
B7 Instrument/Equipment Calibration and Frequency	VET-1604-PQAP-002, §8.2
B8 Inspection/Acceptance of Supplies and Consumables	VET-1604-PQAP-002, §8.3; VET-QA-PRO-023; VET-QA-PRO-025; VET-QA-PRO-026
B9 Non-direct Measurements	Not applicable
B10 Data Management	VET-1604-PQAP-002, §8.4; VET-1604-PLN-003; VET-ENG-PRO-013

EPA QA/R-5 QA Project Plan Elements	Project Document Number
GROUP C: ASSESSMENT AND OVERSIGHT	
C1 Assessments and Response Actions	VET-1604-PQAP-002, §9.1; VET-QA-PRO-033; VET-QA-PRO-034; VET-QA-PRO-035
C2 Reports to Management	VET-1604-PQAP-002, §9.2
GROUP D: DATA VALIDATION AND USABILITY	
D1 Data Review, Verification, and Validation	VET-1604-PQAP-002, §10.1; VET-1604-SOP-003
D2 Verification and Validation Methods	VET-1604-PQAP-002, §10.2; VET-1604-SOP-003
D3 Reconciliation with User Requirements	VET-1604-PQAP-002, §10.3