Final Status Survey Plan

Gas Hills, Wyoming Site

FINAL

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Acronyms and Abbreviations

Acronym	Definition
AGTI	Above-Grade Tailings Impoundment
ALARA	As Low As Reasonably Achievable
ATV	All-Terrain Vehicle
BLM	Bureau of Land Management
ECC	East Canyon Creek
FSSP	Final Status Survey Plan
GPS	Global Positioning System
LC	License Condition
MBHFI	Migratory Birds of High Federal Interest
NORM	Naturally Occurring Radioactive Minerals
NRC	U. S. Nuclear Regulatory Commission
Ra-226	radium-226
RMGPS	Radiological Measurement Global Positioning System
SHPO	State Historic Preservation Office
SMI	Shepherd Miller, Inc.
T&E	Threatened and Endangered (species)
Th-230	thorium-230
UCC	Union Carbide Corporation
Umetco	Umetco Minerals Corporation
U-nat	Natural Uranium
USFWS	U.S. Fish and Wildlife Service

1.0 INTRODUCTION

1.1 Purpose and Objectives

This document provides a comprehensive approach for conducting the Final Status Survey at the Gas Hills, Wyoming site (Figure 1.1). As such, it amends and enhances the approved 1990 Decommissioning Plan authorized under Gas Hills License Condition (LC) 30. The Final Status Survey scope and approach documented herein has been designed to achieve the following primary objectives:

1) to ensure that the remedial action is directed at U. S. Nuclear Regulatory Commission (NRC) regulated materials, rather than the background environment and/or mining-disturbed areas;

2) to demonstrate cleanup of 11e.(2) byproduct material, herein referred to as byproduct material, to satisfy the requirements of 10 CFR 40, Appendix A; and

3) to determine the final condition of the site after cleanup activities are complete.

1.2 Conceptual Approach

Under NRC regulations and guidance (e.g., NUREG-1620), licensees are not responsible to reclaim *in situ* material that has not been processed, including naturally occurring ore (NRC 1999a). Consequently, areas adjacent to the Gas Hills site where residual impacts from prior mining disturbance and/or reclamation activities have been well established will not be characterized further. Nor will additional characterization be conducted in undisturbed areas where previous investigations have demonstrated the presence of elevated naturally occurring radioactive minerals (NORM). Rather, the Final Status Survey will focus on those areas potentially impacted by former milling activities that are not covered with an NRC-approved cover, in particular the area contaminated with windblown byproduct material located directly north and east of the above-grade tailings impoundment (AGTI).

The survey approach proposed herein is an enhancement of that provided in the approved decommissioning plan in that it utilizes a direct field survey technology (global positioning system) which was not available in 1990. This gamma survey technology will allow for more efficient and comprehensive identification of locations with soil radium-226 (Ra-226) concentrations exceeding the cleanup criterion of background plus 5 pCi/g, in accordance with Criterion 6(6) of Appendix A, 10 CFR 40.

This plan also includes methods for identifying the presence of byproduct material in soils, thus enabling better discrimination between affected and unaffected areas. These procedures include the visual examination of soil characteristics, assessments of vertical Ra-226 concentration gradients, and assessments of soil radionuclide equilibria.

1.3 Organization and Contents

Following this introduction, Section 2 presents pertinent background information related to site decommissioning activities and historical mining and milling practices. Section 3 discusses the salient factors and information underlying the development of the Final Status Survey Plan (FSSP), including the background levels and criteria to be applied in the soil cleanup and verification phases. Section 4 describes the general Final Status Survey approach for specific sub-areas of the site. Section 5 documents Final Status Survey methods for the northern windblown contaminated area and GHP-1. Section 6 describes the procedures to be used in conducting penetrating radiation surveys of the repositories. Section 7 describes radiation safety controls and monitoring procedures addressing health and safety concerns for the public, workers, and the environment. References are provided in Section 8.

2.0 BACKGROUND

2.1 Site Description

Gas Hills is located in Fremont and Natrona Counties, Wyoming, approximately 60 miles east of Riverton in a remote area of central Wyoming. The site is located within the Gas Hills Uranium District of the Wind River Basin, in portions of Sections 10, 15, 16, and 22, Township 33 North, Range 89 West. The restricted area, including the tailings disposal and heap leach areas, consists of approximately 542 acres, of which Umetco Minerals Corporation (Umetco) owns 280 acres.* Figure 1.1 shows the relevant site features, the current restricted area, and the proposed land transfer boundary.

2.2 Site History and Decommissioning Activities

Union Carbide Corporation (UCC) and its wholly owned subsidiary (Umetco) have conducted uranium milling operations at the Gas Hills site since 1960. Properties in the Gas Hills Mining District were acquired by UCC between 1956 and 1958; the mill was constructed in 1959. Mining operations began in 1959, with subsequent milling in 1960, and heap leaching in 1976. The mill ceased operations in 1984, at which time it was put on standby status. In 1987, the mill was shut down and decommissioning activities were initiated.

Planning associated with mill demolition and contaminated soil cleanup began in April 1990 when Umetco submitted a draft Decommissioning Plan to the NRC (Umetco 1990a). Umetco revised the plan through subsequent submissions to the NRC (Umetco 1990b, 1991a, 1991b, 1992, and 1995). This Final Status Survey Plan is a further revision to the 1990 decommissioning plan authorized under LC 30.

Decommissioning activities conducted to date include:

- Phase I windblown tailings and mill building decommissioning (1988-1993),
- partial decommissioning of North and South Evaporation Ponds (1991-1993),
- Phase II mill ancillary structure decommissioning (1993-1996),
- cleanup of windblown tailings near the AGTI (1993)†, and
- mill building area soil cleanup (1993, 1996).

These decommissioning activities have been performed in accordance with the following license conditions and plans, summarized in Table 2.1 (below).

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* The 280 acres owned by Umetco are located in the southern half of Section 15 (see Figure 1.1). The remaining 262 acres are located within the mining permit area that is federally owned and managed by the Bureau of Land Management (BLM).

† Since the 1993 AGTI cleanup, additional windblown deposits have been discovered north of the AGTI. These deposits, which consist of a thin surficial veneer (typically 0-1") of contaminated material, are the primary focus of the FSSP presented herein.

Table 2.1 Summary of Gas Hills Site License Conditions and Plans

License Condition	Description	Submittal Dates	Status
LC 30	Site decommissioning plan addressing demolition and disposal of mill facilities and contaminated soil cleanup	• May 2, 1990 • June 18, 1990 • December 21, 1990 • January 10, 1991	This *Final Soil Cleanup and Status Survey Plan* is a further revision to the site decommissioning plan. Approved (sequentially between 1990 and 1992).
LC 35	Groundwater Corrective Action Program	• December 4, 1989 • February 18, 1999	The 2/18/99 Alternate Concentration Limits (ACL) Application is currently under NRC review.
LC 54	Final Reclamation of the inactive, AGTI	• April 19, 1979 • December 18, 1980 • May 13, 1982 • October 6, 1997	Approved July 16, 1999.
LC 58	Final reclamation of the A-9 Pit area	• September 10, 1987 • September 16, 1987 • August 24, 1988 • August 29, 1988 • October 27, 1998	Approved December 9, 1999.
LC 61	Heap Leach area reclamation	-------	Approved May 28, 1998.

2.3 Impacts of Historical Mining Activities

The site is situated in a heterogeneously mineralized area that has been significantly impacted by historical open pit uranium mining and subsequent mined-land reclamation efforts. Consequently, adjacent lands to the west, south, and east of the mill site exhibit elevated radioactivity. This finding is particularly apparent for adjacent areas west of the site, coinciding with Pathfinder's prior mining and reclamation activities.

The mining-disturbed lands described above meet NRC's definition of naturally occurring unprocessed ore (NRC 1999a)—i.e., background radiation—and as such are considered unaffected by byproduct material. Consequently, the mining disturbance areas both on and adjacent to the site will not be included in the Final Status Survey.

Given the wide extent of mining disturbed material and its proximity to the site, mill-related (i.e., byproduct material) contamination may not be readily distinguishable from the naturally occurring mine spoil in areas where windblown deposits of mining-impacted soils contribute to the residual radioactivity. Consequently, a mechanism that allows for the identification of byproduct material in surface soil is critical to identifying the boundaries of the final soil cleanup and survey areas. This issue is addressed further in the following sections.

2.4 Impacts of Historical Mill Operations

Byproduct material contamination dispersal resulting from historical mill operations occurred through two primary transport mechanisms: windblown and waterborne pathways. Another contaminant transport mode warranting evaluation is that associated with the former A-9 haul route and the process water pipeline. This section presents pertinent historical information related to windblown contaminant transport and the former haul route and pipeline that influenced the Final Status Survey scope defined herein.

Impacts associated with waterborne pathways relate primarily to the East Canyon Creek (ECC) drainage. Due to the sensitive ecological environment that exists within this drainage, combined with other factors warranting special consideration (e.g., cultural resources and wetlands), ECC is discussed as a separate specific issue in Section 4.5.

2.4.1 Windblown Contamination

As shown in the East Gas Hills windrose (Figure 2.1), the moderately strong winds in the region reach velocities in excess of 32 miles per hour and prevail from the southwest. Based on this factor, combined with an evaluation of site features and the operational history of the mill, the primary source of windblown contamination is the AGTI.[‡] Although the heap leach facility and the A-9 Repository are other potential sources of windblown contamination (*e.g.*, for onsite areas), their contribution to any windblown contaminated residual in offsite areas is probably negligible in comparison to that contributed by the AGTI. Given these observations, corroborated by the survey and soils characterization data collected to date, this FSSP focuses on areas downwind of the primary contaminant source, i.e. the area north of the tailings impoundment.

2.4.2 Former Haul Roads and Pipelines

Regarding potential contamination on the haul roads in areas outside the restricted area boundary, vehicles transporting Residual Radioactive Materials (RRM, i.e. Title I materials), were scanned before leaving the Susquehanna site, and all of Umetco's byproduct material was transported in strong tight packaging. Consequently, there is no reason to suspect that there would be any contamination from such transport.

However, two areas in which byproduct material contamination may exist are the haul road between the A-9 tailings area and its exit from the site, and the former process water pipeline west of the site. The Susquehanna tailings were transported to the site and placed directly in the A-9 Repository. After placing those tailings, transport trucks left the A-9 Repository traveling along a haul road to the decontamination facilities located within the mill area where they were subsequently washed and scanned. Because residual contamination could exist on this haul route, this area will be included in the Final Status Survey as discussed in Section 4.3 (also see Figure 4.4).

[‡] Since removal from service, the AGTI has been stabilized and an engineered cover placed on the impoundment. A rock protective layer will be placed on the existing cover by December 2002 as part of Umetco's enhanced reclamation plan.

3.0 SALIENT DATA AND INFORMATION UNDERLYING THE FINAL STATUS SURVEY PLAN

The findings presented in this section are based largely on the results of the following three characterization investigations:

- the 1995-1996 Radiological Investigation Program, documented in *Background Land Conditions at the Gas Hills Uranium Project* (Umetco 1997a);
- the 1998 Background Investigation, documented in *Background Radionuclide Concentrations at the Umetco Gas Hills Site* (SMI 1999a), and superseded by the *Final Background Characterization Report*, Rev. 1 (Umetco 2000a); and
- the 1998 Gamma Survey of Windblown Deposition Areas, documented in *Gamma Survey of Windblown Deposition Areas, Gas Hills, Wyoming* (SMI 1999b).

Investigation details are not reiterated here; rather, only the results that are critical to the FSSP are presented. These results include the radionuclides distribution, in particular Ra-226 at and surrounding the Gas Hills site, and the background soil Ra-226 and exposure rate data that form the basis for the Final Status Survey cleanup objectives. The primary purpose of this section is to present supporting data that substantiates the Final Status Survey scope and approach proposed herein, in particular as it relates to the identification of soils contaminated with byproduct material. Again, the ECC drainage is discussed separately in Section 4.5.

3.1 Results of Previous Investigations

Figures 3.1 through 3.3 plot the Ra-226 results that were used to define the anticipated Final Status Survey and soil cleanup area proposed in the following section (see Figure 4.1). Figure 3.1 plots Ra-226 equivalents[§] reflecting the combined results of the three investigations cited above and also shows the windblown scoping survey grid locations. Figure 3.2, a smaller scale adaptation of Figure 3.1, shows the distribution of Ra-226 equivalents relative to historical mining and mine reclamation activities.

Figure 3.2 demonstrates that the most predominant areas of elevated radioactivity (e.g., where Ra-226 equivalents exceed 15 pCi/g) correspond to former mining areas and/or reclaimed mined lands, in particular the area west of the site. As stated in the conceptual approach, these areas will not be characterized further in the Final Status Survey. Regarding mill-related impacts, this figure shows that an area immediately north of the AGTI exhibits elevated Ra-226 activity, likely

[§] Equivalent radium-226 soil concentrations (pCieRa-226/g) are used to express gross, external, penetrating (i.e., gamma) radiation survey results of open land areas where the observed radiation is primarily from Ra-226 progeny, and to a lesser extent other isotopes, including Th-232 progeny and potassium-40 (DOE 1984). In this case, the gross gamma data were converted to equivalent Ra-226 concentrations using calibration equations from the DOE calibration pads at Walker Field in Grand Junction, CO, and are biased high due to Th-232 progeny and potassium-40 contributions to the gross radiation field which have not been deducted or stripped.

the result of windblown byproduct material.** This activity generally decreases to the north, with the exception of localized areas that are more likely the result of natural mineralization rather than deposits of byproduct material. An example of such an area is that coinciding with background sample BN-51 (Figure 3.3).

Figure 3.3 plots the Ra-226 soil concentration data for samples collected during the 1995-1996 characterization investigation (Umetco 1997), as well as the three-horizon (0-1", 1"-6", and 6"-12") soil sampling that was conducted as part of Shepherd Miller, Inc.'s (1999a) background characterization study. As discussed in the accompanying *Background Characterization Report* (Umetco 2000a), the background data set defined in Shepherd Miller's (1999a) background evaluation was found to be flawed because data from affected areas collected immediately north of the AGTI were erroneously included in their evaluation. [See the sample results listed in red directly north of the tailings impoundment in Figure 3.3.] Therefore, the background data set was re-defined and a more representative Ra-226 background level was derived (Umetco 2000a).

Although data for potentially affected samples were excluded from the background data set, these results can be used to delineate the approximate extent of the windblown contaminated area. For example, samples BN 1 through BN 5, BN 28 through BN 32, and BN 49 appear to exhibit byproduct material impacts, as a function of both the vertical Ra-226 distribution in the samples (where residual impacts are apparent only in the surficial 0-1" soil layer), as well as the proximal downwind location relative to the tailings impoundment (see Figure 3.3). The areas coinciding with these samples are thus likely candidates for soil cleanup in the Final Status Survey. The associated data were also useful in developing the byproduct material identification procedure, as discussed in Sections 3.4 and 5.3.

It is important to note that excluding a sample from the background database (as denoted by results listed in red in Figure 3.3) does not necessarily imply that the corresponding area is affected. For example, Ra-226 concentrations in samples BN 13 and BN 14, located west of the tailings impoundment, may be attributable to naturally occurring ore. As documented in Table 3.2 and Table 3.6 of the accompanying *Final Background Characterization Report* (Umetco 2000a), a conservative approach was used to determine which samples to retain in the background data set. This factor should be acknowledged when reviewing Figure 3.3 (and Figure 4.2) relative to the FSSP scope defined herein.

In summary, windblown byproduct material impacts are most apparent in the area immediately north/northeast (downwind) of the AGTI. Beyond this immediate downwind location, any samples or areas exhibiting elevated levels of radionuclides must be carefully evaluated to discern the radioactivity source, whether it is naturally occurring mineralization, reflective of a former mining disturbance, and/or byproduct material impacts. The FFSP approach described in Section 4 includes procedures that will assist in making these distinctions.

**The "cooler" area directly north of the tailings impoundment and east of Carbide Draw corresponds closely to the area of the windblown cleanup conducted in 1993.

3.2 Background Level and Cleanup Criteria Basis

Based on the investigations cited above and the associated statistical analyses (Umetco 1997, 2000), site-specific background concentrations were developed for Ra-226 and external radiation exposure rates (direct gamma). These background levels form the basis for the soil cleanup and Final Status Survey described herein, as summarized in Table 3.1 (below).

Table 3.1 Summary of Background Levels and Cleanup Criteria to be Applied in the Final Status Survey

Site Area	FSSP Endpoint	Background Value	Background Value Basis	Corresponding Cleanup Criterion
Northern windblown cleanup area	Soil Ra-226	6.1 pCi/g	99th upper confidence limit (UCL) on the geometric mean and median of the northern area background data set	11.1 pCi/g (background + 5 pCi/g), in accordance with 10 CFR 40, Appendix A, Criterion 6(6)
Site-wide (surrounding) soils, including GHP-1	Soil Ra-226	10 pCi/g	geometric mean (GM) plus the geometric standard deviation (GSD) of the site-wide data set	15 pCi/g (background + 5 pCi/g)
Repository covers	external exposure rate (direct gamma)	30 µR/hr	the background (geometric mean) direct gamma exposure rate derived in Appendix A of the accompanying *Final Background Characterization Report* (Umetco 2000a)	Reduction of direct gamma exposure to background levels, in accordance with 10 CFR 40, Appendix A, Criterion 6(1)

3.3 Basis for Excluding Th-230 and Natural Uranium from the General FSSP Analytical Program

3.3.1 Ra-226 and Th-230 Correlations

Previous soil sampling results indicate a strong correlation between Ra-226 and Thorium-230 (Th-230). This finding is demonstrated in Figure 3.4, which presents the correlation results for two data sets. The first data set corresponds to Umetco's 1995-1996 characterization investigation (Umetco 1997). Many of these samples were collected in mining-disturbed areas. The second plot in this figure is perhaps most relevant to the FSSP goals, in that it plots Ra-226 vs. Th-230 for the SMI background samples exhibiting apparent windblown byproduct material impacts. The r and r^2 values derived for this latter plot are 0.93 and 0.86, respectively, indicating a fairly strong correlation.

This strong correlation is also apparent when evaluating the Ra-226 and Th-230 results reported for byproduct material source area samples previously collected from the tailings impoundment (Umetco 1997). Consequently, any soil cleanup required to meet the Ra-226 criterion would remove residual Th-230 as well.

The conclusions drawn above regarding the strong Ra-226/Th-230 correlation apply to the majority of the final survey area addressed herein—i.e., the area contaminated with windblown byproduct material located directly north and east of the tailings impoundment. This assumption can not be made for GHP-1, however, given its location (coinciding with the former mill) and the nature of historical operations in this area. Consequently, Th-230 will be analyzed for in soil samples collected from GHP-1. However, it will not be analyzed for the remaining soil samples collected from windblown contaminated areas (i.e., the majority of the FSSP soil samples). The latter approach is reflected in the soil analytical program presented in Section 5.5.

3.3.2 Expected Distribution of Natural Uranium

As discussed in Section 1.2, the focus of this Final Status Survey Plan is on the windblown area downwind of the tailings pile, an area where significant natural uranium (U-nat) contamination is not expected to occur. Rather, the nature of historical site activities suggests that U-nat contamination would generally be limited to the former mill (processing and packaging) area. This area has been decommissioned and currently corresponds to GHP-1, which will be addressed as part of the Final Status Survey, and GHP-2, which will be covered. The tailings, however, would generally be uranium deplete—i.e., this material was extracted as part of previous milling activities. Consequently, it is unlikely that significant U-nat contamination would be present in the windblown area. In fact, historical background sampling results suggest that U-nat concentrations are generally higher in surrounding mineralized areas (e.g., east of the A-9 Pit) than in the windblown contaminated area downwind of the tailings impoundment (Umetco 1997a).

Given these findings, U-nat will only be analyzed for in selected soil samples—either samples collected from GHP-1 (which will be analyzed for Ra-226, Th-230, and U-nat) and/or samples requiring U-nat analysis as part of the byproduct material identification discussed below (Section 3.4.2) and in Section 5.3.

3.4 Data Related to the Identification of Byproduct Material Contaminated Soils

As discussed above, any cleanup and verification program undertaken at the site must take into account the presence of elevated naturally occurring radioactive minerals in the vicinity of the site, as well as the impacts of historical mining and mine reclamation activities. Therefore, the ability to identify byproduct material residuals in soils is critical to the implementing the FSSP. Based on the data presented in the reports discussed above, several factors can be used to assist in this identification. The first factor is the vertical soil Ra-226 concentration gradient, and a second possible factor is radionuclide equilibrium. These factors are discussed below and addressed further in Section 5.3.

3.4.1 Vertical Ra-226 Distribution

Based on the results of previous investigations, knowledge of contaminant mobility, and information related to historical contaminant deposition and soil cleanup efforts, windblown byproduct material contamination is currently limited to a thin (0-1") veneer. This finding is demonstrated in Figure 3.5, which plots the vertical Ra-226 distributions in potentially affected SMI (1999a) background samples.

The potentially affected SMI background samples (e.g., samples BN 1 through BN 5, BN 28 through BN 32, and BN 49) exhibit significantly higher concentrations of Ra-226 in the upper one inch of soil than at depths greater than one inch (see Figures 3.3 and 3.5). Therefore, examination of vertical Ra-226 gradients may be useful in identifying the potential presence of byproduct material in samples/areas where such contamination is not readily apparent (e.g., in highly mineralized areas further north of the tailings impoundment.

3.4.2 Isotopic Ratios

As discussed in Section 2.1.2 of the accompanying *Final Background Characterization Report* (Umetco 2000a), although using isotopic ratios was necessary in the initial data evaluation stages, examination of the associated results reveals that these ratios may not be useful for identifying windblown contaminated soil at the Gas Hills site. However, because examining isotopic ratios has been useful at other uranium milling sites (e.g., Edgemont, South Dakota), Umetco still intends to evaluate the Ra-226/U-nat ratios, but only in conjunction with the other byproduct material identification tools discussed in the following section (e.g., visual examination of soils, assessment of vertical Ra-266 gradients, etc.). Based on the isotopic ratios reported previously (e.g., Umetco 1997), a conservative ratio of 3.0 (Ra-226/0.5*U-nat) will be used to trigger further examination/review.[††]

[††] In lieu of isotopic data for U-238, Ra-226/U-238 equilibria are assessed by examining the ratios of Ra-226 to U-nat/2. This approach assumes that the U-nat source term is represented as percent activity by 49.2% U-238, 49.2% U-234, and 1.6% U-235. Consequently, the U-nat/2 ratios discussed above and referred to in the byproduct material identification procedure are assumed to represent the U-238 component.

4.0 FINAL STATUS SURVEY APPROACH

The Final Status Survey scope and approach documented herein has been designed to ensure that the remedial action is directed at NRC-regulated materials and to demonstrate cleanup of byproduct material to satisfy the requirements of 10 CFR 40, Appendix A. Given the distinct features of the Gas Hills site, the variable contamination sources and trends, as well as the anticipated future use and/or mitigative measures (e.g., long-term stabilization) planned for different areas, the Final Status Survey areas are categorized as follows:

- areas affected with byproduct material,
- repositories,
- former A-9 haul road and process water pipeline and trash pits,
- onsite mining areas affected with 11e.(2) solutions (evaporation ponds),
- on- and offsite mining disturbed areas, and
- the ECC drainage.

As discussed in the following sections and summarized in Table 4.1, the areas affected with byproduct material will receive the greatest focus in the Final Status Survey. These areas correspond primarily to the windblown byproduct material contaminated areas, located predominantly north and northeast (downwind) of the AGTI. Repositories will be subject to penetrating radiation exposure (direct gamma) scans only, and onsite and offsite mining disturbed areas (e.g., evaporation ponds and adjacent reclaimed areas) will not be characterized further. The applicable cleanup activities and the associated Final Status Survey scope proposed for each of the sub-areas defined above is shown graphically in Figure 4.1.

4.1 Areas Exhibiting Byproduct Material Impacts

4.1.1 Final Status Survey and Soil Cleanup Boundary

The anticipated boundary of windblown contamination that exceeds the regulatory cleanup criterion of 5 pCi/g above background (11.1 pCi/g) is shown on Figure 4.1 (blue shaded area). This boundary was established based on the characterization investigation results discussed in the previous section. Figure 4.2 shows the Final Status Survey area boundary relative to Ra-226 soil concentration data. Figure 4.3 shows the proposed Final Status Survey and anticipated cleanup areas and plots the corresponding distribution of Ra-226 equivalents.

The Final Status Survey will be performed over an area which extends a minimum of 100 meters outside (away from the center of the site) of the anticipated cleanup boundary or area in which soils contaminated with byproduct material are identified and removed. Final status survey grids are numbered as shown in Figure 4.1.

Table 4.1 Summary of Generalized Final Status Survey Approach

Category	Location and/or Description	Proposed Survey Approach/Action	Comment/Rationale
Areas contaminated with byproduct material (e.g., windblown contaminated areas)	North, east, and northwest of the AGTI and GHP-1, as shown in Figure 4.1	Gamma exposure survey followed by soil sampling in selected (5%) 10 m x 10 m ($100m^2$) sampling verification grids	Delimit areas contaminated with byproduct material in excess of 11.1 pCi/g soil cleanup criterion, perform soil removal where necessary, and verify that cleanup criterion is attained.
		Assumes a soil Ra-226 cleanup criterion of 11.1 pCi/g (5 pCi/g plus background)	The gamma guideline value will be developed using a site- and survey instrument-specific gamma/soil Ra-226 correlation.
Repositories (all areas slated to be covered for long-term stabilization)	AGTI, GHP-2, Heap Leach, A-9 Pit, and C-18 Pit	1-meter high bare gamma exposure reading per acre, assuming a site-wide background external radiation exposure rate of 30 μR/hour	Surveys will be made over the completed earthen cover, but prior to placing erosion protection materials.
Former A-9 haul road and process water pipeline; trash pits	See Figures 4.1 and 4.4	Direct gamma surveys along selected segments	The scope of this effort will be determined in an iterative fashion as discussed in Section 4.3.
Onsite mining areas affected with 11e.(2) solutions	North and South Evaporation Ponds	None	No further characterization is planned for these areas because the NRC has approved the previous characterization and decommissioning plan for these areas (NRC 1999b).
Mining disturbed areas (onsite and offsite)	Non-shaded areas within the restricted area boundary shown in Figure 4.1 (e.g., C-11 Pit) and adjacent surrounding mining-disturbed lands	None	With the exception of those areas exhibiting byproduct material contamination that is discernible from background and/or mining disturbed areas, these areas will not be included in the Final Status Survey.
East Canyon Creek (ECC) drainage	North and east of site (Figure 4.1)	None	Results of the risk assessment (SMI 1999c), combined with recent findings related to critical wetlands, ecological habitat, and archaeological resources, lead to a no-action recommendation for the ECC drainage; see Section 4.5.

4.1.2 Establishment and Application of Gamma Guideline Level

The primary method that will be employed to demonstrate compliance with 10 CFR 40, Appendix A, Criterion 6(6) will be in situ determination of Ra-226 concentrations in soil through the use of a site-specific gamma-radium correlation. To ensure that the gamma survey data are representative of soil Ra-226 concentrations, correlations will be established for each verification survey technique to be used.

Given the variable terrain at and surrounding the site, the following three verification scanning survey techniques may be employed:

- scanning on foot with a collimated 2"x2" sodium iodide (NaI) detector carried at 12" above the land surface (anticipated to be the primary survey method),
- scanning from an all-terrain vehicle with a collimated 2"x2" NaI detector mounted 12" (1 ft) above the land surface, and
- traditional (NRC 1992) 100% coverage scanning of individual 100m^2 grid blocks on foot with a bare 2"x2" NaI detector, with the detector held as close as possible to the land surface.

These correlations will be established based on pilot studies that will be undertaken prior to conducting the Final Status Survey. Documentation supporting the gamma radium correlation developed for each survey technique will be provided to the NRC for review and approval prior to applying in the Final Status Survey.

4.1.3 General Survey and Soil Sampling Approach

As required by 10 CFR 40, Appendix A, Criterion 6(6), compliance with the regulatory limit will be assessed on a 100m^2 grid basis. Areas which are identified by gamma surveys as potentially having Ra-226 concentrations in excess of the 5 pCi/g Ra-226 plus background regulatory compliance limit will be remediated by removing surface soils and/or investigating to determine if the elevated activity is the result of windblown deposition of byproduct material. The general approach for conducting the Final Status Survey in windblown contaminated areas is summarized as follows:

- conduct gamma survey to identify locations where Ra-226 concentrations exceed the cleanup criterion of background plus 5 pCi/g,
- collect soil samples in five percent of the 10 x 10 meter (100m^2) Final Status Survey grid blocks exhibiting the highest gamma values to verify the efficacy of the gamma correlation, and
- utilize 11e.(2) byproduct material identification procedures (e.g., visually examine soils, assess vertical Ra-226 concentration gradients, and/or examine isotopic ratios; see Section 5.3) at locations where Ra-226 criteria are exceeded, but the presence of windblown contaminated material is not readily apparent.

The specific methods to be employed in conducting the Final Status Survey for windblown contaminated areas and GHP-1 are discussed in Section 5.

4.2 Repositories

10 CFR 40, Appendix A, Criterion 6(1) requires demonstrating that direct gamma exposure from tailings or wastes be reduced to background levels. To demonstrate compliance with this requirement, gamma exposure surveys will be made over all areas of the site that are to be covered for long-term stabilization. These areas include the AGTI, GHP-2, the Heap Leach facility, the A-9 Pit, the Solid Waste Disposal Site, and the C-18 Pit (Figure 4.1). As discussed in Section 3.2, results of previous site characterization efforts indicate a site-wide background external radiation exposure rate of 30 μR/hr.

Gamma exposure surveys will be made utilizing the procedures summarized in Section 6. These procedures provide for (1-meter high bare) gamma exposure surveys to be made over the completed earthen cover, but prior to placing rock (riprap) erosion protection materials. Surveys will be made using a vehicle mounted or backpack global positioning system (GPS) designed to simultaneously collect external gamma radiation measurements and location coordinates. The density of the gamma exposure readings will be one reading per acre.

4.3 Former Haul Road and Process Water Pipeline and Trash Pits

4.3.1 Former Haul Road and Process Water Pipeline

As discussed in Section 2.4, two areas in which potential byproduct material contamination may exist are the haul road between the A-9 tailings area and its exit from the site, and the former process water pipeline west of the site. Figure 4.4 shows the location of this haul route and the haul route portion that is not currently under the footprint of the Heap Leach or GHP-2 covers (denoted by the solid line between the A-9 repository and the heap leach). This latter area will be included in the Final Status Survey.

The former process water pipeline west of the site will also be investigated for potential byproduct material contamination. This pipeline is 6 inches in diameter, running from the site to a deep well approximately 6 miles west of the site. This pipeline is currently used to provide construction water for site reclamation activities, but it will be removed once construction water is no longer needed. Umetco has obtained anecdotal reports from former site employees that pipeline portions were embedded in tailings materials. However, no contaminated materials have been identified during previous reparation activities, which have been extensive. Approximately half of this pipeline has been replaced or repaired in recent years. As part of the Final Status Survey, Umetco will investigate and confirm that byproduct materials were not used for pipeline bedding or, if encountered, that byproduct materials are removed and areas are verified in accordance with the Final Status Survey Plan.

4.3.2 Trash Pits

During site reclamation activities conducted in July and August 2000, three small former trash pits were uncovered in the areas shown in Figure 4.1. One pit is located on the northern boundary of the north evaporation pond, a second is located southeast of the tailings impoundment along the restricted area boundary, and the third in the B-spoils area. The trash in these pits consisted of general refuse and laboratory waste (e.g., scrap metal, rusted barrels, and used gloves and protective Tyvek clothing). With few exceptions, gamma scans conducted in these areas were within background ranges. The trash pits were surveyed and soil samples were collected and analyzed for Ra-226, Th-230, and U-nat (results are still pending). The trash was removed and hauled to the A-9 pit; the pits were then backfilled with mine spoils.

Based on the nature of the refuse found in the pits and the associated gamma scan results, it is unlikely that significant byproduct material contamination exists in these areas. This assumption will be confirmed, however, as part of the Final Status Survey.

4.4 Final Status Survey for On- and Offsite Mining Disturbed Areas

Onsite mining areas affected with 11e.(2) solutions—i.e., the north and south evaporation ponds—will not be verified or characterized further because the NRC has approved the previous characterization and decommissioning plan for these areas (NRC 1999b). Mining disturbed areas located outside the restricted area boundary will also not be addressed, as these areas have been characterized at length, and impacts resulting from former mining and/or reclamation activities are already well established (Umetco 1997a, Umetco 1999, and Umetco 2000a).

4.5 East Canyon Creek Drainage

Review of UCC/NRC correspondence during the operational period of the mill indicates that from 1960 to 1962, process solutions from the mill operation were released to ECC through the drainage tributary located on the north side of the AGTI. Also, a 1972 breach of the AGTI occurred as a result of a broken discharge line, resulting in a release of tailings materials to the drainage. Although historic documentation indicates that the solids from this breach were recovered, potential impacts associated with the previous discharge of process solutions to the ECC drainage required further evaluation.

To assess that endpoint, a field investigation and associated ecological survey were conducted along ECC in the fall of 1998, and a human health and ecological risk assessment was then prepared to evaluate an appropriate action for the ECC drainage (SMI 1999c). Based on the results of this assessment, combined with the other factors discussed below, a no-action alternative is proposed for the ECC drainage area. This proposed alternative for mill cleanup is allowed under 10 CFR 40, Appendix A, which states that:

> *"The Commission may find that the proposed alternatives meet the Commission's requirements if the alternatives will achieve a level of stabilization and containment of the sites concerned, and a level of protection of public health, safety, and the environment from radiological and non-radiological hazards associated with the sites...."*

The following sections document the rationales supporting the proposed no-action alternative. Section 4.5.1 summarizes the results of the human health and ecological risk assessment prepared by SMI (1999c). Section 4.5.2 presents the salient findings of recent cultural resource and wetlands and wildlife surveys, as they relate to any potential future Final Status Survey activities in the ECC drainage area. Additional data and analyses supporting the no-action alternative for the ECC drainage are provided in the accompanying addendum to the East Canyon Creek Dose Assessment (SMI 2000). Appendix A presents the cost estimate for the East Canyon Creek soil cleanup and verification.

4.5.1 Human Health and Ecological Risk Assessment

This assessment and supporting documentation is presented under separate cover in the report entitled *Human Health and Ecological Risk Assessment, East Canyon Creek Streambed, Gas Hills, Wyoming* (SMI 1999c). Based on the results of the ECC field investigations and the associated ecological survey, as well as a previous gamma exposure and dose survey conducted by Umetco in 1997, SMI concluded that the radiological hazards associated with residual byproduct material contamination in the ECC drainage are negligible for both human health and ecological risk endpoints. A related finding was that the environmental impacts to vegetation (wetlands), wildlife, and channel stability associated with any major disturbance of the ECC drainage would be severe, and would far exceed any potential benefit of contaminant removal (SMI 1999c). The latter finding was corroborated in a recent report prepared by Intermountain Resources (2000), which documented the results of a Threatened and Endangered (T&E) species and wetlands survey conducted in May 2000. Recent uncovering of prehistoric cultural materials along the east bank of ECC (northern portion of cultural resource site 48NA465) further support a noninvasive approach to conducting Final Status Survey activities in the ECC drainage. The latter two issues are discussed in the following section.

4.5.2 Wildlife, Wetlands, and Cultural Resource Considerations

Wildlife, wetlands, and cultural resources were recently re-evaluated along the ECC drainage to assess the impacts of any potential cleanup, if required, on these endpoints (Intermountain Resources 2000; Pronghorn Archaeology 2000a, 2000b). The results of these recent surveys are summarized below.

T&E Species and Wetlands Considerations

Intermountain Resources (1998, 2000) evaluated the Gas Hills site for wildlife habitat and potential jurisdictional wetlands in 1998 and again in May 2000. The most recent survey concluded that any future mitigative activities conducted along the ECC drainage would greatly impact the natural stream channel and wetland habitats found throughout this area (Intermountain Resources 2000). Wetlands were identified along ECC for a distance of about 3.5 miles, coinciding with the perennial stream section and encompassing approximately 11 acres. This wetlands segment is shown in Figure 4.5.

A wide variety of plant and animal species inhabiting the ECC drainage area would also be affected (either permanently damaged and/or altered), including: several migratory birds of high federal interest (MBHFI) species (e.g., the northern harrier), as well as several T&E species

which have not been identified in previous surveys but for which habitat is present (e.g., the black-footed ferret). The three raptor species (golden eagle, red-tailed hawk, and prairie falcon) observed nesting at specific points along ECC would also be impacted by potential cleanup activities. Impacts to all plant and animal species inhabiting the site would be realized from habitat loss, human disturbances, and ecosystems alteration (Intermountain Resources 2000). Figure 4.5 shows the wetlands area and raptor nest sites identified in the ECC study area, along with adjacent cultural resource sites (discussed below). Related permitting and regulatory concerns are discussed in Section 4.6.

Cultural Resources

In May 2000, prehistoric hearth features and other buried cultural materials were unearthed during topsoil stripping activities conducted for the creek realignment project (Pronghorn Archaeological Services 2000a, 2000b). As a result of these discoveries, a portion of the site (48NA465) was recently re-designated as eligible for the National Register of Historic Places (Pronghorn 2000b; see Section 4.6). The terraces located within Site 48NA465 are typical of the numerous terraces identified along the creek. A recent report concluded that given the density of cultural materials within the region and at Site 48NA465, it is probable that the entire length of ECC would produce historical occupation areas of this caliber. That report also concluded that any disturbance in this area would destroy and/or severely impact the prehistoric context of the ECC terrace system area (Pronghorn Archaeology 2000a).

4.5.3 Summary

In summary, the ECC drainage is a valuable and sensitive ecological asset that provides excellent riparian habitat within a very limited growth region. The environmental impacts to ECC that would be incurred as a result of soil or sediment removal or other reclamation activities would cause severe damage to this ecological system, as well as to the cultural resources that exist in the ECC drainage. Given the latter finding, combined with the results of the Human Health and Ecological Risk Assessment (HH&ERA) indicating negligible impacts associated with residual contaminant levels, a no-action alternative is proposed for the ECC drainage area. Consequently, the HH&ERA and supporting documentation will serve as the Final Status Survey for the ECC drainage.

4.6 Special Considerations

Factors affecting the proposed plan for the ECC drainage—i.e., considering wetlands, T&E species, and cultural resources—apply to the soil cleanup as well. These considerations may apply to specific areas located within the Final Status Survey boundary and/or within the boundary of potential windblown soil cleanup, and must be addressed prior to and during work performance. The following sections expand upon the issues discussed in Section 4.5.2, focusing on the associated regulatory and permitting considerations as they apply to the Gas Hills site in general (vs. the ECC drainage alone).

4.6.1 Wetlands and T&E Species

As discussed previously, ECC field surveys and a one-half mile perimeter were completed in June and August of 1998 and May of 2000 (Intermountain Resources 1998, 2000). These

surveys were completed for wetlands, plant and animal T&E species, nesting raptors, MBHFI, and other species of state or federal interest, as required by License Condition 33. The most recent survey identified wetlands along ECC encompassing approximately 11 acres, from Carbide Draw to a point about 3.5 miles downstream. Additionally, three raptors species (golden eagle, red-tailed hawk, and prairie falcon) were observed nesting to the north and west of the site. Regulatory and permitting issues related to these findings include:

1) In the case of any future disturbance of the ECC drainage area, approval, permits, and mitigation plans would be required from the U. S. Army Corps of Engineers for any wetlands affected.

2) Mitigation plans will have to be developed and submitted to the U. S. Fish and Wildlife Service (USFWS) for approval and permitting if project activities occur within one-half mile of raptor nest sites—i.e., a one-half mile disturbance-free zone must be maintained during nesting periods.

The anticipated cleanup/Final Status Survey boundary, as currently proposed and shown in Figure 4.1, should provide the required one-half mile disturbance-free zone. However, any northern expansion of the cleanup/Final Status Survey boundary would require appropriate mitigation efforts. These efforts would be coordinated through the USFWS and would likely involve restricted seasonal work performance or raptor nest relocation. Nesting periods established for the red-tailed hawk, golden eagle, and prairie falcon are as follows, respectively: March 15-July 31, February 1 through July 31, and March 1-August 15.

The USFWS has also identified the cleanup/Final Status Survey area as a potential habitat for the Mountain Plover. Although T&E species surveys within the project area have not identified this species, Umetco has committed to perform additional surveys in accordance with USFWS recommended guidance.

4.6.2 Cultural Resources

Results of cultural resource surveys, as required by License Condition 33, indicate that there are at least five localities within the anticipated Final Status Survey area boundary shown in Figure 4.1 that could be potentially impacted by project activities. These localities are listed in Table 4.2, which summarizes the evaluative testing status of cultural resource sites located within or intersecting the Final Status Survey boundary. The remaining cultural resource sites, i.e., those located outside of the anticipated survey boundary, are listed in Table 4.3. To date, evaluative testing has been conducted for Site 48NA465 only. This site is located within a dense landscape of archaeological sites that encompass the entire surveyed portion of the ECC drainage. Although evaluative testing conducted at Site 48NA465 in September 1999 identified no significant cultural materials, the northern portion of this site has recently been re-designated to an eligible status (i.e., eligible for the National Register of Historic Places), given the recent uncovering of significant buried cultural materials discussed in Section 4.5.2.

Table 4.2 Summary of Cultural Resources and Evaluative Testing Status – Cultural Sites Located Within or Intersecting the Final Status Survey Area Boundary

Site ID	Location/Description	Evaluative Testing Status †
48NA465	East of the tailings impoundment on the east bank of ECC, intersecting a portion of the Final Status Survey area boundary on the eastern edge of the anticipated windblown cleanup area This site also incorporates former Site 48NA540, a small area within the expected windblown contaminated area north of the tailings impoundment.	Evaluative testing conducted in September 1999 identified no significant cultural materials, resulting in an ineligible designation. However, the north portion of this site has recently been re-designated to an eligible status, given the recent (May 2000) uncovering of significant buried cultural materials, fulfilling Criterion D for the National Register of Historic Places (Pronghorn 2000b). This is the only site that has been evaluated.
48NA2632	Just north of the ECC drainage, east of Carbide Draw and intersecting the northernmost portion of the survey area boundary	Evaluative testing proposal currently under review by BLM/SHPO
48NA100	Intersects the northeastern section of the survey area boundary	Eligible pending evaluative testing; testing proposal currently under review by BLM/SHPO
48NA2630	Intersects northern survey area boundary	Evaluative testing proposal currently under review by BLM/SHPO
48NA174	Northernmost portion of survey area	Evaluative testing proposal currently under review by BLM/SHPO
48NA2627	In the ECC drainage east of Carbide Draw, within the survey area boundary	Not Eligible (per 1/23/98 SHPO letter)
48NA536	West of the tailings impoundment coinciding with local drainage, within the Final Status Survey area boundary	No further work and/or characterization has been recommended for this site.

Table 4.3 Summary of Cultural Resources and Evaluative Testing Status – Remaining Cultural Sites (Located Outside of the Anticipated Survey Area Boundary)

Site ID	Location/Description	Evaluative Testing Status†
48NA2629	East of tailings impoundment, east of 48NA465	Eligible pending evaluative testing; testing proposal currently under review by BLM/SHPO
48NA98	Just north of the survey area boundary	Eligible pending evaluative testing; testing proposal currently under review by BLM/SHPO
48NA457	East of tailings impoundment, east of Site 48NA465 and southeast of Site 48NA2629	Eligible
48NA2628	ECC drainage, northwest of the Final Status Survey area	Eligible pending evaluative testing; testing proposal currently under review by BLM/SHPO
48NA2624	ECC drainage, north of Site 48NA2625	Eligible
48NA2625	ECC drainage, south of Site 48NA2624	Unknown
48FR4037	ECC drainage, north of the prominent bend	Unknown
48NA2622	Northwest of tailings impoundment, south of ECC drainage	Not Eligible
48NA2623	Northwest of tailings impoundment, south of ECC drainage	Not Eligible (per 1/23/98 SHPO letter)
48NA2626	Northwest of tailings impoundment, south of ECC drainage	Not Eligible (per 1/23/98 SHPO letter)

† In this column, the terms eligible and not eligible refer to eligibility for the National Register of Historic Places.

Sources: Pronghorn Archaeology (2000a, 2000b), 1/23/98 SHPO letter, and 5/4/00 BLM letter

On March 15, 2000, Umetco submitted evaluative testing plans to the Bureau of Land Management (BLM) for review of six additional sites associated with the windblown cleanup area: 48NA2632, 48NA100, 48NA2630, 48NA174, 48NA2629, and 48NA98. The BLM has not yet approved these evaluative testing plans (no comments have been received to date), and approval by the Wyoming State Historic Preservation Office (SHPO) will also be required.

The Final Status Survey Plan will proceed as described in Section 4.1 for the potentially windblown contaminated area. However, any characterization or cleanup efforts potentially coinciding with cultural resource sites will be performed in a manner that would prevent or minimize any impacts to the site. Accordingly, the allowable extent of remedial actions undertaken, as well as the aggressiveness of such action, will be evaluated on a case-by-case basis and appropriately coordinated with the BLM and Wyoming SHPO.

5.0 FINAL STATUS SURVEY METHODS FOR WINDBLOWN CONTAMINATED AREA AND GHP-1

This section summarizes the methods and generalized procedures to be applied in the Final Status Survey for the final verification of areas contaminated with byproduct material—i.e., the windblown contaminated area and GHP-1. Supporting detailed information is provided in the procedures referenced in Table 5.1 and in Umetco's *Quality Control Program for Final Status Surveys* (Umetco 2000b).

5.1 Direct Radiation Verification Open Land Surveys

To the extent practicable, all onsite, or direct field, open land final status surveys will be conducted using a Radiological Measurement, Global Positioning System (RMGPS). The system is composed of a gamma scintillation radiation measurement system, coupled to a global positioning system, which is carried in a backpack or mounted on a suitable vehicle, *e.g.*, an all-terrain vehicle (ATV). Based on recent survey results and correlation assessments, it is anticipated that the backpack-mounted configuration will be employed as the primary means of GPS data collection. The ATV-mounted system may be used in some cases though its use would be limited to flat, or gently sloping, terrain. Both approaches may be used for either static (stationary, fixed-position) measurements or dynamic (in motion) scans, and both bare-detector and collimated-detector scans/measurements may be made with either system. In general, bare-detector scans will be used to determine exposure rates and collimated-detector scans will be used to determine Ra-226 soil concentrations. In areas where hills, trees, and the like interfere with earth-orbit satellite reception, and thus impede the RMGPS use, traditional survey methods (NRC 1992) will be used.

Prior to soil sampling, affected open land areas subject to final status surveys will be gamma scanned (dynamic, in motion), pursuant to Umetco procedure number R-16 (Table 5.1). Gamma scans are used to identify the presence of elevated direct radiation that might indicate residual gross activity or hot spots and to assess the average Ra-226 soil concentration in any $100m^2$ verification area. Soil activity scans for Ra-226 will be conducted with the detector at 12" above the surface, except for traditional scans which will be conducted with the detector kept as close to the surface as possible.

Scans will be conducted on approximately parallel offsetting traverses of the survey area while moving along the traverse at a speed of about 0.5 meters per second. For optimum detection sensitivity during scanning, changes in the instrument response will be monitored via the audible output to identify areas exhibiting elevated direct radiation levels. Scans will be conducted in a manner that results in the required minimum number of readings within any subject $100m^2$ Final Status Survey area as determined by the windblown correlation study.

Table 5.1 Summary of Procedures to be Applied in the Final Status Survey

Procedure	Title	Endpoint Addressed
R-16	*Direct Radiation Verification Surveys of Open Land Surface Soil*	Direct radiation surveys of open land
R-17	*Penetrating Radiation Surveys of Closed Byproduct Material Repositories*	Survey procedure for repositories (see Section 6.0)
R-18	*Final Status Survey Soil Sample Preparation Procedure*	Soil sample preparation
R-19	*Final Status Survey Surface Soil Sampling Procedure*	Surface soil sample collection
R-20	*Identification of 11e.(2) Byproduct Material in Soil (Draft)*	11e.(2) byproduct material identification
R-21	*Final Status Survey Soil Sample Management Procedure*	Soil sample management
R-22[†]	*Calibration Procedure for Portable Survey Instruments Used for Final Status Surveys of Open Lands*	Portable survey instrument calibration and gamma survey/soil Ra-226 correlation development
-----	*Gas Hills Site Revegetation Procedures*	Revegetation

[†] This procedure has recently been augmented to address in greater detail the development of site- and survey-specific gamma guideline values based on surface soil Ra-226 concentration correlations.

5.2 Surface Soil Sampling

After scanning and visual verification have indicated that the cleanup requirements have been satisfied, soil sampling will be conducted in 5 percent of the 10 x 10 meter ($100m^2$) Final Status Survey grid blocks exhibiting the highest gamma values. Soil samples will be obtained from nine locations within each block in the manner discussed below.

A decontaminated trowel, scoop, or the like will be used to hand excavate equally-sized 0-15 cm. (0-6 inch) depth-composite soil sample aliquots from each of the nine soil sample aliquot locations. The nine sub-sample aliquots will be combined and homogenized to form one composite soil sample from each $100m^2$ Final Status Survey block sampled. One aliquot of the homogenized composite sample will be placed into an appropriate sample container, placed under chain of custody control, and analyzed by the laboratory for Ra-226 by alpha or gamma spectrometry. One aliquot and all returned analytical laboratory rejects not affected by the analytical process will be archived until the NRC has approved the Final Status Survey Report.

As discussed in Section 3.3, Th-230 will be analyzed for in soil samples collected from GHP-1, but will not be analyzed for the remaining soil samples collected from windblown contaminated areas. U-nat will also only be analyzed for in selected soil samples—either samples collected from GHP-1 (to be analyzed for Ra-226, Th-230, and U-nat) and/or samples requiring U-nat analysis as part of the byproduct material identification discussed below. The necessity for additional soil samples to assess Ra-226 to U-nat ratios and/or vertical Ra-226 trends will be determined on a case-by-case basis as the Final Status Survey progresses.

5.3 General Byproduct Material Identification Procedures

It is anticipated that post-cleanup status surveys will encounter isolated areas of localized mineralization in which Ra-226 concentrations exceed the cleanup criterion of 5 pCi/g above background (11.1 pCi/g). As such, the following methodology has been developed to make the necessary distinction between naturally mineralized and/or mining-disturbed soils and soils contaminated with byproduct materials, to ensure that the remedial action is directed at NRC-regulated materials.

The byproduct material identification process may include one or more of the following investigative steps:

- visually examining general soil characteristics,
- determining soil Munsell color,
- assessing soil texture and reflective properties,
- examining microscopic soil particles,
- assessing vertical Ra-226 soil concentration gradients,
- assessing soil radionuclide equilibria, requiring analysis for U-nat in addition to Ra-226, and
- evaluating the environmental setting of the subject open land area.

These steps are addressed in detail in Procedure R-20. This byproduct material identification procedure will be applied when either the direct scan criterion, or the laboratory analysis Ra-226 concentration criterion, is not attained. The specific activities and analyses that will be performed when criteria are not attained are documented in Figure 5.1, which shows the decision tree to be applied in the byproduct material identification procedures. As shown in this figure, the identified presence of byproduct material will generally require additional remedial action and follow-up surveys until the area-weighted average Ra-226 concentration criterion is attained.

5.4 Laboratory Analyses

A contract laboratory will analyze soil samples for Ra-226 in accordance with standard analytical methods and procedures. As identified above and in Procedure R-20, selected samples exceeding either the direct scan or soil Ra-226 criterion may be analyzed for uranium to assist in byproduct material identification.

As discussed previously, soil samples collected from GHP-1 will be analyzed for uranium and thorium in addition to Ra-226. This analytical approach would also apply to any possible additional areas where uranium and/or thorium are expected at levels above background and/or where a strong correlation with Ra-226 can not be assumed and/or demonstrated.

6.0 PENETRATING RADIATION SURVEYS OF REPOSITORIES

Direct gamma radiation exposure rates on covered 11e.(2) waste repositories will be determined by conducting RMGPS scans prior to placing riprap erosion protection materials, pursuant to Umetco procedure number R-17. RMGPS scintillation exposure rate scans will be conducted with the detector at one-meter above the repository cover surface; the density of the gamma exposure readings will be one reading per acre. Scans will be conducted on approximately parallel offsetting traverses of the cover approximately 10 meters apart while moving along the traverse at a rate not to exceed 0.5 meters per second. Exposure scans will generally be conducted with a bare detector. However, if indications of shine from adjacent non-subject sources are observed, shadow-shielding or similar "collimation" methods may be used. Shine is indicated when exposure rates increase with elevation above, or distance from, the subject area, in this case a specific waste repository cover.

7.0 RADIATION SAFETY CONTROLS AND MONITORING

The prior site decommissioning activities (Umetco 1990a, 1990b, 1991a, 1991b, 1991c, 1992, and 1995) have removed and disposed of nearly all of the high concentration radioactive materials, including residual uranium product, mill process circuit waste, and north and south pond evaporites. This work, coupled with the extremely remote site location and Umetco's ongoing radiation safety controls (e.g. dust suppression, on-site vehicle speed limits, and sediment barriers/controls), has effectively eliminated decommissioning safety concerns for the public and the environment. The latter conclusion is evidenced by the very low airborne radionuclide concentrations currently measured at the site, as reported in the most recent and historical 10 CFR 40.65 reports. These low airborne concentrations were measured during Umetco's recent byproduct material repository cover placement operations which involved the controlled excavation of large quantities of soil and mine spoil, sometimes with naturally occurring radioactive material concentrations exceeding the concentrations in the residual windblown byproduct material at the site.

The prior completed decommissioning work has also greatly reduced the potential radiological, chemical, and physical hazards that may be present for workers performing the Final Status Survey and decommissioning activities addressed herein (i.e., cleanup of windblown byproduct material). First, the radioactivity contained in the residual byproduct material on-site is too low to pose a significant threat to decommissioning safety. Second, decommissioning accidents involving chemical release, fire, and truck or other equipment accident are not expected because only very limited types and quantities of chemicals are maintained at the site. The most significant, in terms of accident potential for both chemical release and fire, are the gasoline and diesel fuels stored at the site. [The total on-site fuel storage capacity is 17,000 gallons in three above-ground storage tanks inside a 37,400 gallon capacity bermed containment.] The most significant potential consequence of a truck or heavy equipment accident is worker injury. However, Umetco maintains an appropriate inventory of emergency response equipment in accordance with our emergency response plan.

Consistent with previous decommissioning efforts, and in accordance with NUREG-1620, Umetco will continue to ensure worker safety during remediation and that any occupational exposures to radioactive materials will be kept within the limits of 10 CFR Part 20 and as low as reasonably achievable (ALARA). Again, public exposures are not anticipated based on the results of monitoring conducted for previous (and often more extensive) decommissioning efforts. In summary, the radiological protection program that is currently in place is considered adequate for the proposed decommissioning activities, so no changes in existing radiation safety control and monitoring procedures are necessary.

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Figures

FIG1-1.DWG

EAST CANYON
DRY CREEK ROAD
CREEK
CARBIDE DRAW

48FR4037
48NA2622
48NA2624
48NA2625
48NA2623
48NA2626
48NA2628
48NA2831
48NA98
48NA174
48NA2630
48NA2632
48NA100
48NA2627
48NA536
48NA2629
48NA457
48NA465

IF#1
IF#2
IF#3
IF#4
IF#5
IF#6
IF#7
IF#8
IF#9
IF#16

349C (EAST)

9
10
11
12
13
14
15
16
21
22
23
24

B-5 PIT
GHP#1
GHP#2
ABOVE-GRADE INACTIVE TAILINGS IMPOUNDMENT
HEAP LEACH
BORROW AREA RECLAIMED AS MINING DISTURBANCE
C-11 PIT
NORTH POND
A-9 PIT
SOUTH POND
AREA RECLAIMED AS MINING DISTURBANCE AFTER IIe.(2) REMOVAL
RESTRICTED AREA BOUNDARY
C-18

349C-A2

N 799000 + N 798000 + N 797000 + N 796000 + N 795000 + N 794000 + N 793000 + N 792000 + N 791000 + N 790000 + N 789000 + N 788000 + N 787000 + N 786000 + N 785000 + N 784000 +

E 832000 E 833000 E 834000 E 835000 E 836000 E 837000 E 838000 E 839000 E 840000 E 841000 E 842000 E 843000 E 844000 E 845000 E 846000

LEGEND:

- PERMIT BOUNDARY
- 349C-A2 – PERMIT BOUNDARY DESIGNATION
- PROPOSED LAND TRANSFER BOUNDARY
- ANTICIPATED FINAL STATUS SURVEY AREA (VERIFICATION) BOUNDARY
- RESTRICTED AREA BOUNDARY (FENCE)
- EXISTING SECTION LINE
- 23 – EXISTING SECTION DESIGNATION
- N 784000 + – 1000' UMETCO SITE GRID
- EXISTING TOPOGRAPHY (1997 AERIAL)
- 1997 GRADING PERFORMED BY UMETCO
- PROPOSED SITE GRADING
- BORROW AREA RECLAIMED AS MINING DISTURBANCE
- AREA RECLAIMED AS MINING DISTURBANCE AFTER IIe.(2) REMOVAL
- EXEMPTED AREAS
- CULTURAL LOCALITY (PRONGHORN ARCHAEOLOGICAL 1997, 1998)

EAST GAS HILLS PERMIT BOUNDARY DESCRIPTIONS:

349C (EAST) - S1/2 SEC 10, SEC 14, SEC 15 AND SEC 22, T33N R89W, 6TH P.M., NATRONA COUNTY, WYOMING. CONTAINS: 2240 ACRES ±.

349C-A2 - N1/2 NW1/4, SEC 23, T33N R89W, 6TH P.M., NATRONA COUNTY, WYOMING. CONTAINS: 80 ACRES ±.

PROPOSED LAND TRANSFER BOUNDARY DESCRIPTION:

ALL OF SEC 15, THE N1/2 OF SEC 22, THE NE1/4 OF SEC 21, THE E1/2 OF SEC 16, THE SE1/4 OF SEC 9 AND THE S1/2 OF SEC 10, ALL LOCATED IN TOWNSHIP 33 NORTH, RANGE 89 WEST OF THE 6TH PRINCIPAL MERIDIAN. CONTAINS: 1920 ACRES ±.

N

SCALE: 1" = 1500'
CONTOUR INTERVAL: 2'

UMETCO MINERALS CORPORATION

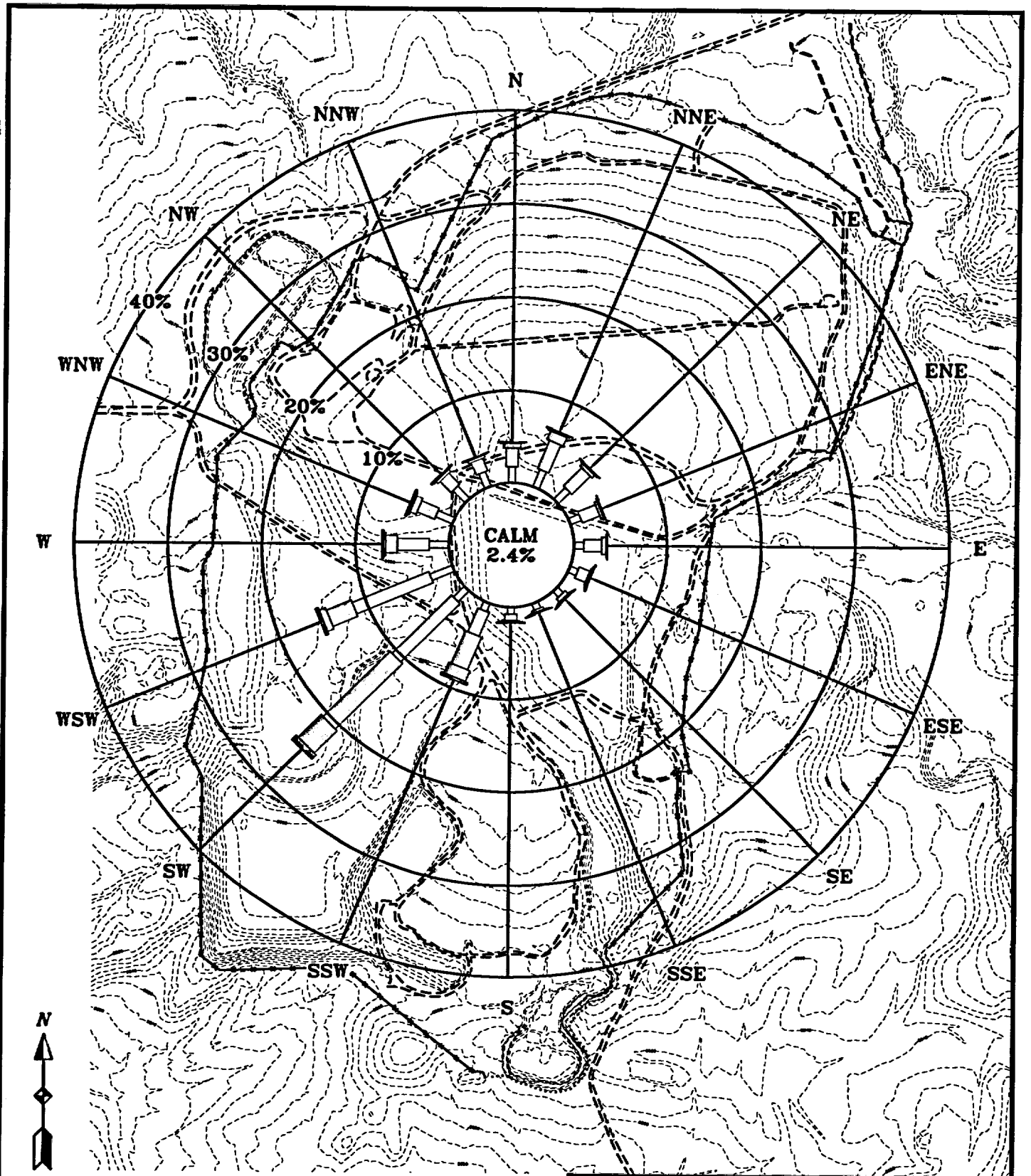
SITE PLAN MAP

GAS HILLS, WYOMING

C01

SEPTEMBER 2000

FIGURE 1.1



SOURCE:
EARTHINFO NATIONAL CLIMATIC DATA CENTER SURFACE AIRWAYS HOURLY CD.
CASPER, WYOMING (1964–1995)

500' 0 500'
SCALE IN FEET
SCALE: 1" = 1000'
CONTOUR INTERVAL: 10'

MILES PER HOUR
0–8 8–16 16–24 24–32 >32

UMETCO MINERALS CORPORATION

EAST GAS HILLS WINDROSE

JUNE 2000

FIGURE 2.1

FIG2-1.DWG

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED:

FIGURE 3.1:
MAP OF Ra-226 EQUIVALENTS SHOWING WINDBLOWN SCOPING SURVEY GRID LOCATIONS

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:
FIGURE 3.1

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

FIG3-2.DWG

LEGEND:

- MILLING RELATED AREAS
- MINING RELATED AREAS
- SOIL STOCKPILES
- RECLAIMED MINING RELATED AREAS
- AREA OF WINDBLOWN SCOPING SURVEY
- RESTRICTED AREA BOUNDARY (FENCE)
- E 836,000 + 1000' UMETCO COORDINATE GRID
- DOE PROPERTY TRANSFER BOUNDARY
- CONTOUR (10' INTERVAL)

N

SCALE: 1" = 1000'

E 833,000 E 834,000 E 835,000 E 836,000 E 837,000 E 838,000 E 839,000 E 840,000 E 841,000

N 799,000 N 798,000 N 797,000 N 796,000 N 795,000 N 794,000 N 793,000 N 792,000 N 791,000 N 790,000 N 789,000 N 788,000 N 787,000 N 786,000

EAST CANYON CREEK

DOE PROPERTY TRANSFER BOUNDARY

AREA OF WINDBLOWN SCOPING SURVEY

100 METER GAMMA SURVEY GRID

CARLYLE DRAW

ABOVE-GRADE INACTIVE TAILINGS IMPOUNDMENT

GHP-1

GHP-2

HEAP LEACH

A-9

C-18

NOTES:

1). DATA COLLECTED 7/95 TO 10/95 AND 9/98 TO 12/98.

2). ALL DATA FROM GEOGRAPHICAL POSITIONING SYSTEM AND SCINTILLATION MEASUREMENT SURVEYS.

3). BECAUSE OTHER TERRESTRIAL RADIONUCLIDES CONTRIBUTE TO THE OBSERVED GAMMA RADIATION LEVELS (e.g., Th-232 DECAY PRODUCTS AND K-40), THE Ra-226 EQUIVALENTS SHOWN HERE ARE EXPECTED TO BE OVERESTIMATED BY APPROXIMATELY 5 TO 6 pCi/g.

RADIOLOGICAL LEGEND:

- > 20 pCie Ra-226/g
- > 15 ≤ 20 pCie Ra-226/g
- > 10 ≤ 15 pCie Ra-226/g
- > 5 ≤ 10 pCie Ra-226/g
- ≤ 5 pCie Ra-226/g

UMETCO MINERALS CORPORATION

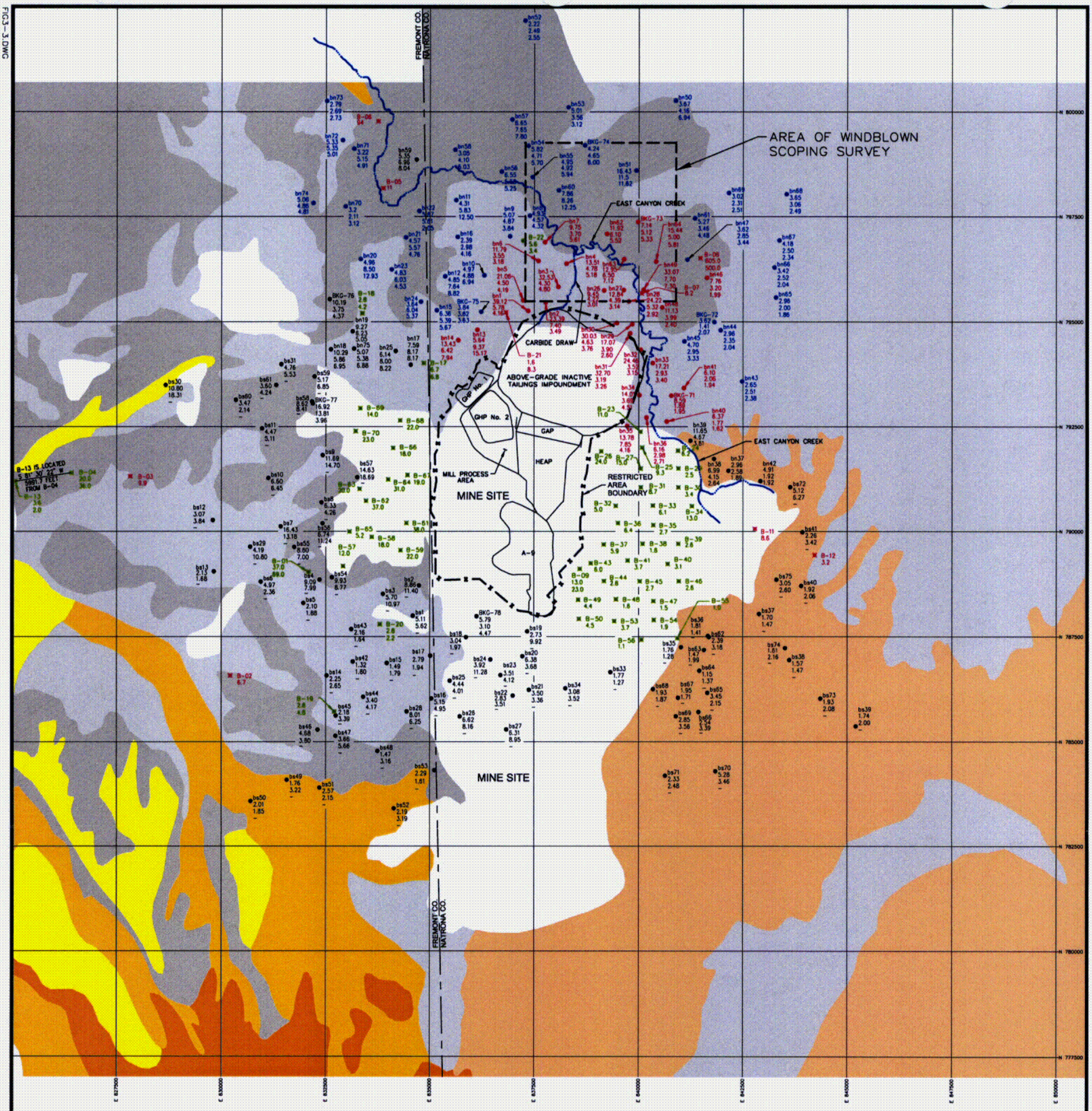
DISTRIBUTION OF Ra-226 EQUIVALENTS RELATIVE TO HISTORICAL MINING ACTIVITIES

GAS HILLS, WYOMING C02

JUNE 2000

FIGURE 3.2

FIG3-3.DWG



SOILS LEGEND

- SMI Soil Group 1- Terraces, Fans, Gently Sloping Hillsides, and Plateaus
- SMI Soil Group 2 - Gullies, Steep Hills, and Ridges, Entisol order
- SMI Soil Group 3 - Ridges and Steep Hills, Aridisol order
- SMI Soil Group 4 - Floodplains
- SMI Soil Group 5 - Rock Outcrop, Rubble, and Thin Colluvial Soils
- Other Minor Soil Types
- Mine Areas
- RESTRICTED AREA BOUNDARY
- AREA OF WINDBLOWN SCOPING SURVEY

N

SCALE: 1" = 2500'

LEGEND:

- ●BKG-75 SMI 1998 BACKGROUND INVESTIGATION SAMPLE LOCATION
  - 3.84 - Ra226 IN 0-1 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
  - 3.84 - Ra226 IN 1-6 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
  - 3.84 - Ra226 IN 6-12 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
- ● OR ✖ SAMPLE INCLUDED IN NORTHERN BACKGROUND DATABASE
- ● OR ✖ SAMPLE EXCLUDED FROM FINAL BACKGROUND DATA SET (SEE UMETCO 2000 FOR SUPPORTING RATIONALES)
- ✖ B-13 UMETCO 1995 - 1996 SAMPLE LOCATION
  - 3.6 Ra226 IN 0-2 INCH SAMPLE (pCi/g)
  - 2.0 *Ra226 IN 2-6 INCH SAMPLE (pCi/g)

*Where only one value is shown, and it is in the 0-2 inch position, the value represents a sample depth of 0-6 inches. With the exception of B-08, samples excluded from this data set correspond to outcrops.

NOTE:

FIGURE ADAPTED FROM DRAWING 4.2 OF SMI 1999 BACKGROUND REPORT.

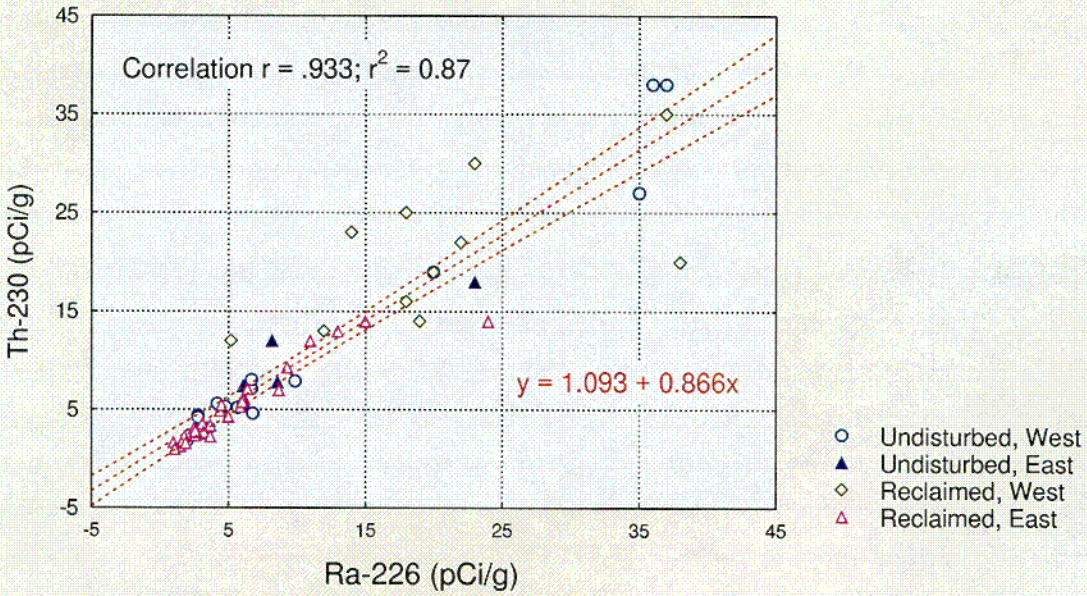
UMETCO MINERALS CORPORATION

BACKGROUND SAMPLE LOCATIONS AND CORRESPONDING Ra-226 CONCENTRATIONS

GAS HILLS, WYOMING C03

JUNE 2000 FIGURE 3.3

1995-1996 Investigation Correlation Results:
Ra-226 < 50 pCi/g



Correlations in Potentially Affected SMI Background Samples

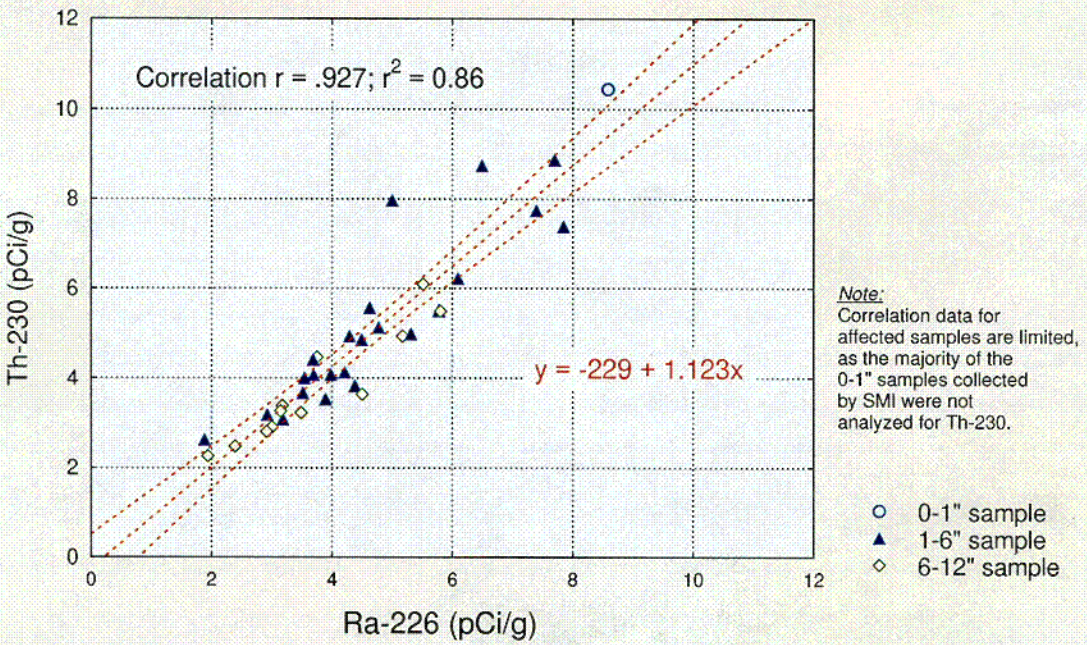


Figure 3.4 Soil Ra-226 vs. Th-230 in Previous Site Characterization Samples, Gas Hills, Wyoming Site

C04

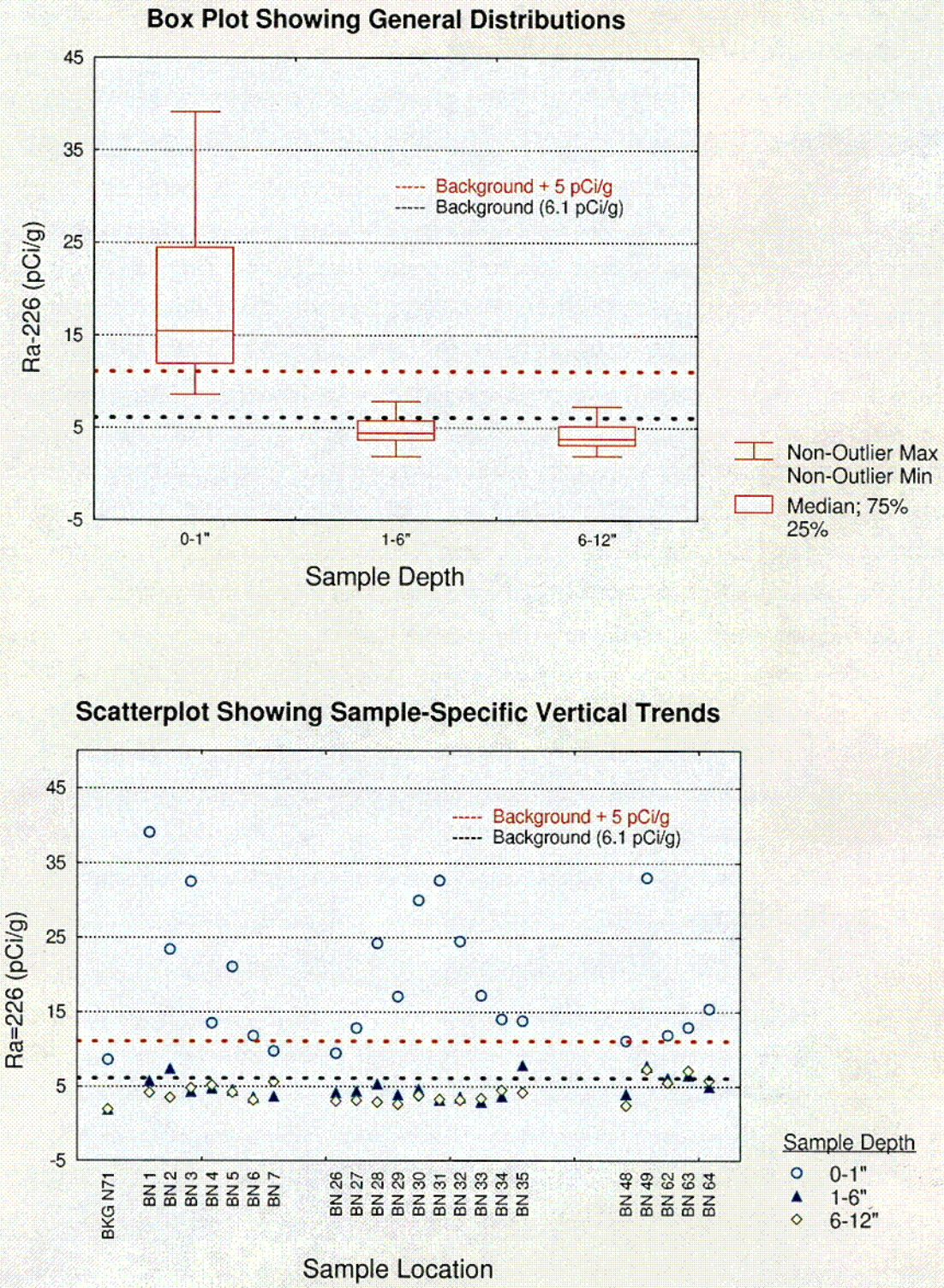


Figure 3.5 Vertical Ra-226 Distributions in Potentially Affected SMI Background Samples, Gas Hills, Wyoming Site

C05

FIG4-1.DWG

EAST CANYON CREEK
48NA2624
48NA2622
48NA2625
48FR4037
48NA2623
48NA2628
48NA2831
48NA98
48NA2630
48NA2626
IF#16
IF#1
IF#2
48NA174
IF#9
CREEK ROAD
48NA2632
IF#3
IE#8
48NA100
DRY
IF#6
48NA2627
CABIN DRAW
IF#5
IF#7
IF#4
48NA536
48NA2629
48NA457
48NA465
B-5 PIT
GHP#1
ABOVE-GRADE INACTIVE TAILINGS IMPOUNDMENT
GHP#2
TRASH PIT
HEAP LEACH
TRASH PIT
C-11 PIT
NORTH EVAPORATION POND
SOUTH EVAPORATION POND
A-9 PIT
SOLID WASTE DISPOSAL SITE
C-18 PIT
RESTRICTED AREA BOUNDARY
9
10
11
14
15
16
21
22
23
N 799000
N 798000
N 797000
N 796000
N 795000
N 794000
N 793000
N 792000
N 791000
N 790000
N 789000
N 788000
N 787000
E 834000
E 835000
E 836000
E 837000
E 838000
E 839000
E 840000
E 841000
E 842000
E 843000

LEGEND:

- RESTRICTED AREA BOUNDARY
- EXISTING SECTION LINE
- 23 - EXISTING SECTION DESIGNATION
- N 784000 + - 1000' UMETCO SITE GRID
- ANTICIPATED FINAL STATUS SURVEY AREA (VERIFICATION) BOUNDARY
- 107 | 108 — 100m x 100m SURVEY GRID WITH GRID DESIGNATION. GRID DESIGNATION STARTS AT THE NORTHWEST GRID AND MOVES LEFT TO RIGHT TO THE SOUTH.
- 48NA98 — CULTURAL LOCALITY (PRONGHORN ARCHAEOLOGICAL 1997, 1998)
- ANTICIPATED FINAL STATUS SURVEY (VERIFICATION) AREA
- ANTICIPATED PARTIAL SOIL CLEANUP AREA (SUBSET OF ABOVE)
- AREA OF GAMMA EXPOSURE SURVEY
- 1993 WINDBLOWN AREA
- TRASH PIT LOCATIONS

N

SCALE: 1" = 1000'

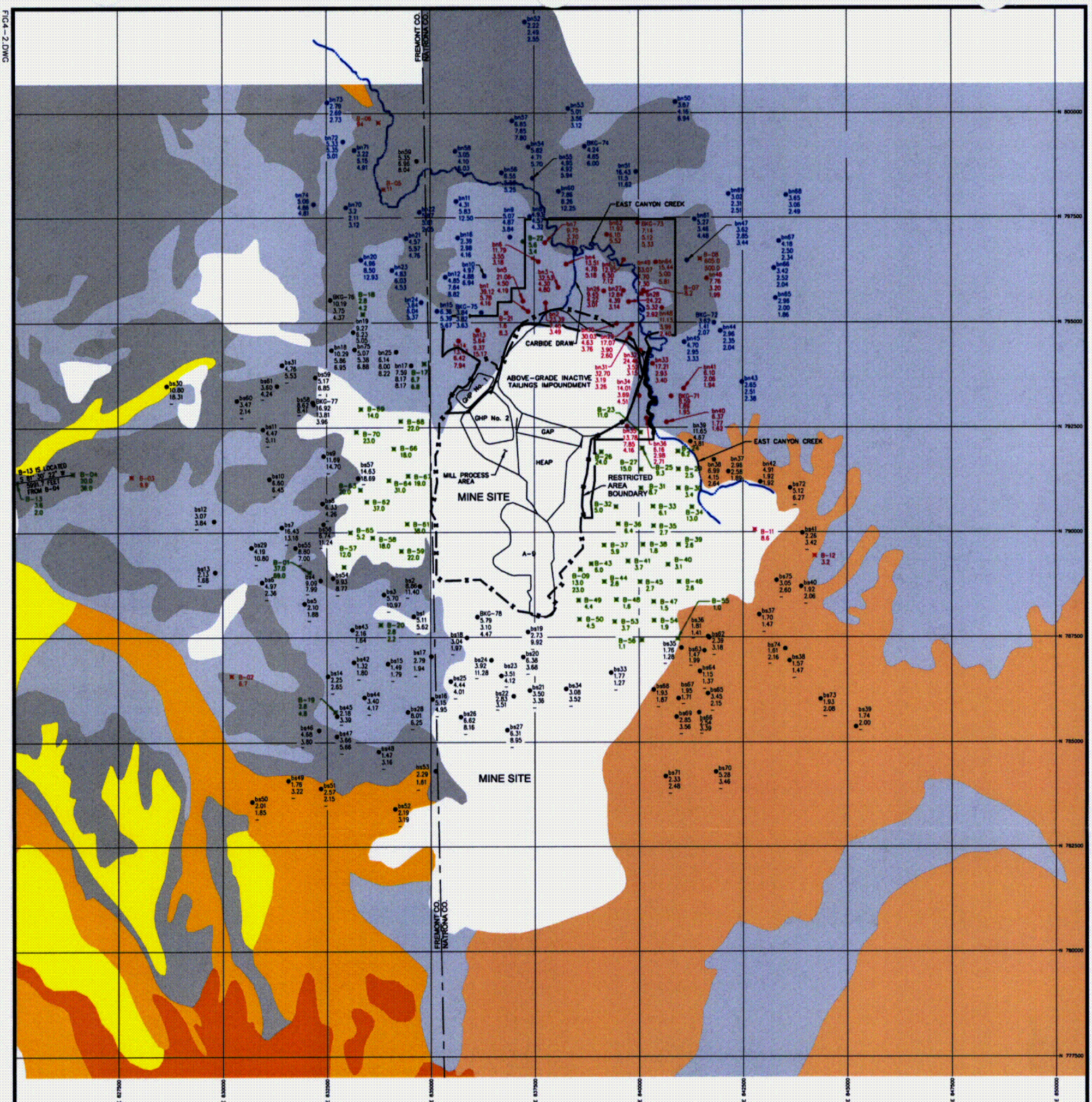
UMETCO MINERALS CORPORATION

SITE MAP SHOWING GENERALIZED FINAL SOIL CLEANUP AND STATUS SURVEY SCOPE

GAS HILLS SITE C06

SEPTEMBER 2000 FIGURE 4.1

FIG4-2.DWG



SOILS LEGEND

- SMI Soil Group 1- Terraces, Fans, Gently Sloping Hillsides, and Plateaus
- SMI Soil Group 2 - Gullies, Steep Hills, and Ridges, Entisol order
- SMI Soil Group 3 - Ridges and Steep Hills, Aridisol order
- SMI Soil Group 4 - Floodplains
- SMI Soil Group 5 - Rock Outcrop, Rubble, and Thin Colluvial Soils
- Other Minor Soil Types
- Mine Areas
- RESTRICTED AREA BOUNDARY
- ANTICIPATED FINAL STATUS SURVEY AREA (VERIFICATION) BOUNDARY

N

SCALE: 1" = 2500'

LEGEND:

- ● BKG-75 SMI 1998 BACKGROUND INVESTIGATION SAMPLE LOCATION
- 3.84 - Ra226 IN 0-1 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
- 3.84 - Ra226 IN 1-6 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
- 3.84 - Ra226 IN 6-12 INCH SAMPLE (pCi/g) (Typical for all sample locations unless otherwise noted)
- ● OR ✖ SAMPLE INCLUDED IN NORTHERN BACKGROUND DATABASE
- ● OR ✖ SAMPLE EXCLUDED FROM FINAL BACKGROUND DATA SET (SEE UMETCO 2000 FOR SUPPORTING RATIONALES)
- ✖ B-13 UMETCO 1995 - 1996 SAMPLE LOCATION
  3.6 Ra226 IN 0-2 INCH SAMPLE (pCi/g)
  2.0 *Ra226 IN 2-6 INCH SAMPLE (pCi/g)
  *Where only one value is shown, and it is in the 0-2 inch position, the value represents a sample depth of 0-6 inches. With the exception of B-08, samples excluded from this data set correspond to outcrops.

NOTE:

FIGURE ADAPTED FROM DRAWING 4.2 OF SMI 1999 BACKGROUND REPORT.

UMETCO MINERALS CORPORATION

SITE MAP SHOWING FINAL STATUS SURVEY SCOPE AND Ra-226 SOIL CONCENTRATIONS

GAS HILLS, WYOMING C07

SEPTEMBER 2000 FIGURE 4.2

FIG4-3.DWG

LEGEND:

- ANTICIPATED FINAL STATUS SURVEY AREA (VERIFICATION) BOUNDARY (SEE FIGURE 4.1 FOR REVISED BOUNDARY)
- ANTICIPATED PARTIAL SOIL CLEANUP AREA
- RESTRICTED AREA BOUNDARY (FENCE)
- E 836,000 + 1000' UMETCO COORDINATE GRID
- DOE PROPERTY TRANSFER BOUNDARY
- CONTOUR (10' INTERVAL)

N

100m x 100m SURVEY GRID

SCALE: 1" = 1000'

E 833,000 E 834,000 E 835,000 E 836,000 E 837,000 E 838,000 E 839,000 E 840,000 E 841,000

N 799,000 N 798,000 N 797,000 N 796,000 N 795,000 N 794,000 N 793,000 N 792,000 N 791,000 N 790,000 N 789,000 N 788,000 N 787,000 N 786,000

EAST CANYON CREEK

CARBIDE DITCH

DOE PROPERTY TRANSFER BOUNDARY

GHP-1

GHP-2

ABOVE-GRADE INACTIVE TAILINGS IMPOUNDMENT

HEAP LEACH

A-9

C-18

NOTES:

1). DATA COLLECTED 7/95 TO 10/95 AND 9/98 TO 12/98.

2). ALL DATA FROM GEOGRAPHICAL POSITIONING SYSTEM AND SCINTILLATION MEASUREMENT SURVEYS.

3). BECAUSE OTHER TERRESTRIAL RADIONUCLIDES CONTRIBUTE TO THE OBSERVED GAMMA RADIATION LEVELS (e.g., Th-232 DECAY PRODUCTS AND K-40), THE Ra-226 EQUIVALENTS SHOWN HERE ARE EXPECTED TO BE OVERESTIMATED BY APPROXIMATELY 5 TO 6 pCi/g.

RADIOLOGICAL LEGEND:

- > 20 pCie Ra-226/g
- > 15 ≤ 20 pCie Ra-226/g
- > 10 ≤ 15 pCie Ra-226/g
- > 5 ≤ 10 pCie Ra-226/g
- ≤ 5 pCie Ra-226/g

UMETCO MINERALS CORPORATION

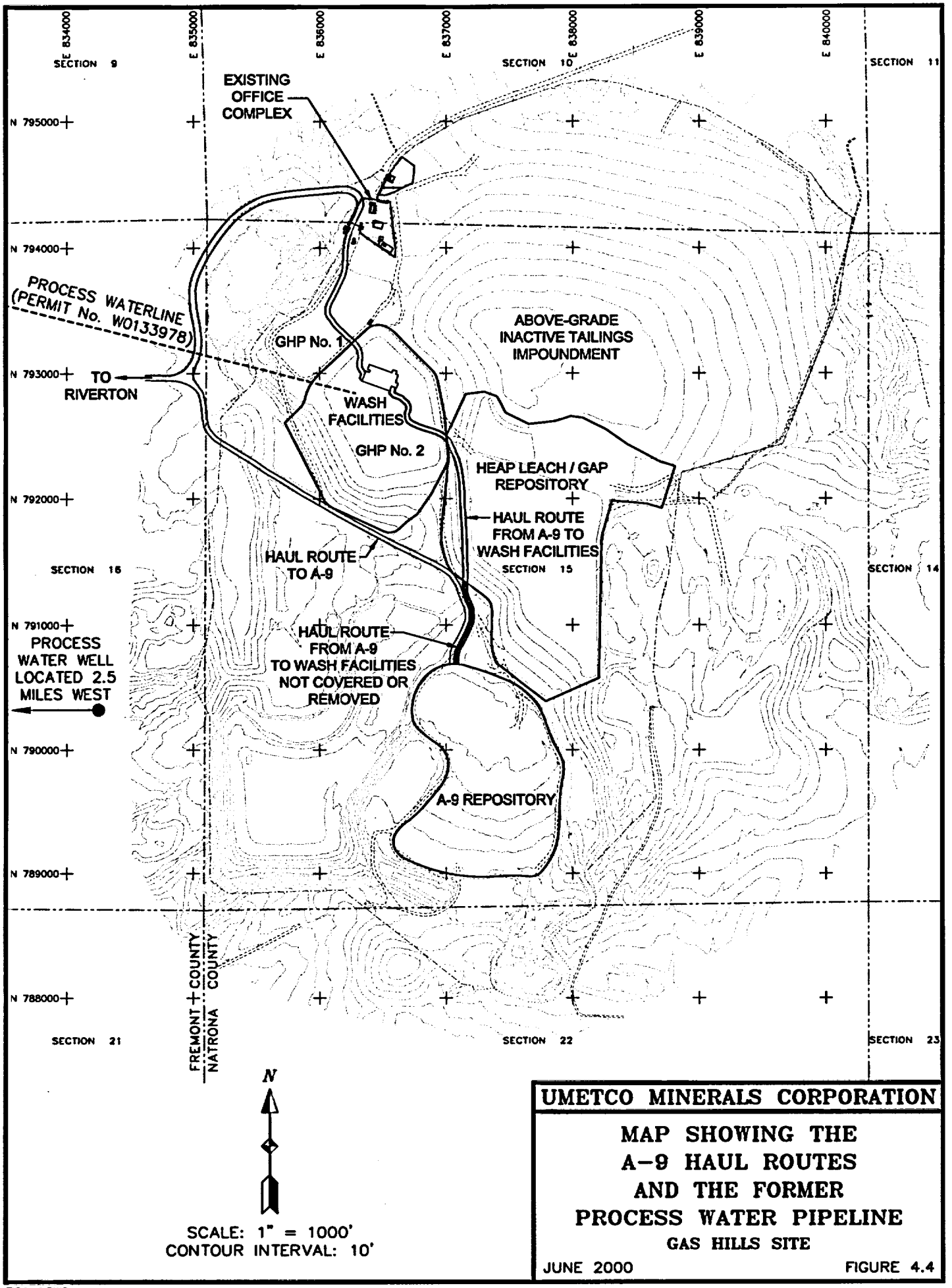
DISTRIBUTION OF Ra-226 EQUIVALENTS RELATIVE TO PROPOSED SURVEY, VERIFICATION, AND CLEANUP AREAS

GAS HILLS SITE

C08

SEPTEMBER 2000

FIGURE 4.3



UMETCO MINERALS CORPORATION

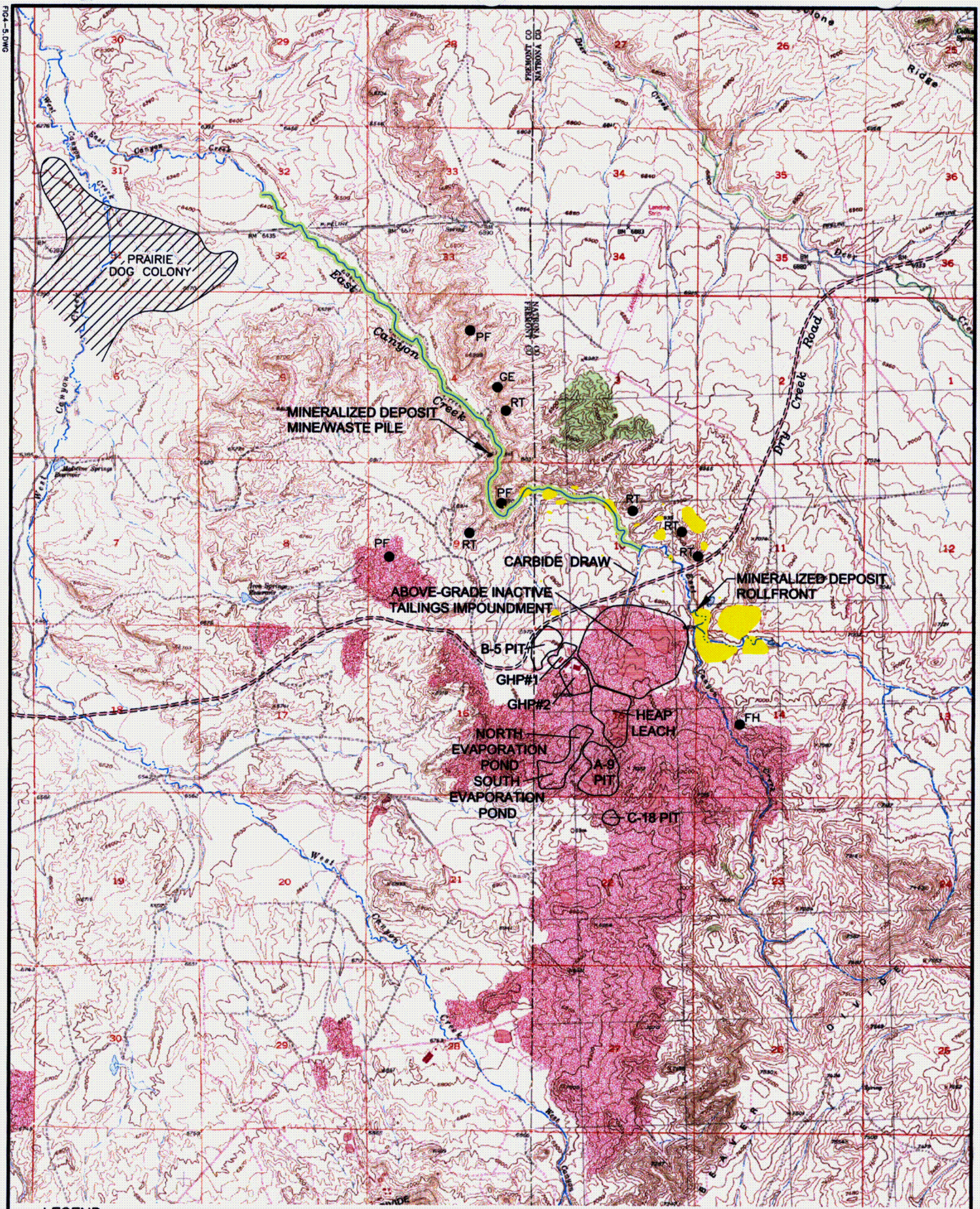
MAP SHOWING THE A–9 HAUL ROUTES AND THE FORMER PROCESS WATER PIPELINE

GAS HILLS SITE

JUNE 2000 FIGURE 4.4

FIG4–4.DWG

FIG4-5.DWG



LEGEND:

WETLANDS (APPROXIMATE 3.5 MILE STRETCH, ENCOMPASSING APPROXIMATELY 11 ACRES)

EPHEMERAL STREAM SECTION

PERENNIAL STREAM SECTION

DRY CREEK ROAD

RT ● – RAPTOR NEST SITE (AS NOTED):
GE = GOLDEN EAGLE RT = RED TAILED HAWK
PF = PRAIRIE FALCON FH = FERRUGINOUS HAWK

CULTURAL LOCALITY (PRONGHORN ARCHEOLOGICAL 1997, 1998) SEE FIGURE 1.1 FOR DESIGNATIONS

PRAIRIE DOG COLONY

MINERALIZED DEPOSIT – AS STATED

NOTES:

1). FIGURE ADAPTED FROM INTERMOUNTAIN RESOURCES, INC. (2000); MAP A.

2). ALL LOCATIONS ARE APPROXIMATE.

3). BACKGROUND MAP SCANNED FROM THE ERVAY BASIN SW, THE ERVAY BASIN, THE GAS HILLS AND THE MILLS RANCH WYOMING U.S.G.S. 7.5 MINUTE QUADRANGLE MAPS.

4). SOURCES: INTERMOUNTAIN RESOURCES (2000)
PRONGHORN ARCHEOLOGICAL (2000)

N

SCALE: 1" ≃ 3000'

UMETCO MINERALS CORPORATION

MAP OF EAST CANYON CREEK DRAINAGE SHOWING WETLANDS AREA, RAPTOR NEST SITES, MINERALIZED DEPOSITS, AND CULTURAL RESOURCES

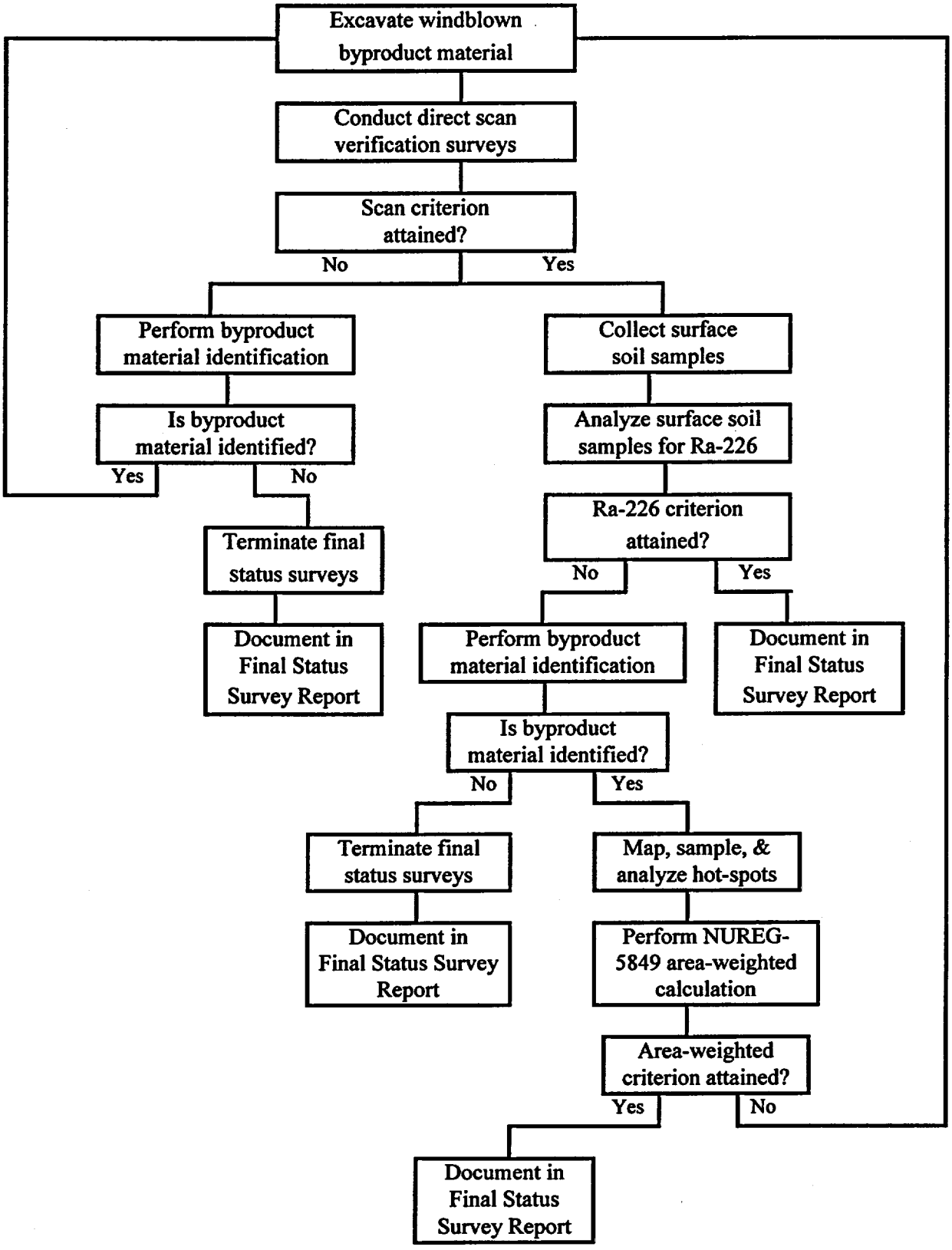
GAS HILLS, WYOMING

C09

SEPTEMBER 2000

FIGURE 4.5

Figure 5.1 Byproduct Material Identification Decision Tree



APPENDIX A

Cost Estimate for East Canyon Creek Soil Cleanup and Verification

Cost Estimate for East Canyon Creek (ECC) Soil Cleanup and Verification

COST ITEMS:

- Cultural Resource - Treatment/Mitigation
- Initial Gamma Survey to Establish Areas of Soil Cleanup/Removal
- COE 404 Permit Application
- Access Road Construction/Removal
- Wetlands Replacement
- Channel Reconstruction
- Verification Survey

➢ Cultural Resource - Treatment/Mitigation

Based on the cultural resource treatment/mitigation costs and findings associated with site 48NA465, the occurrence of high-density sites along the entire subject length of ECC are likely. The significance of site 48NA465 is such that archeological monitoring of any and all excavation/disturbance will be required. Approximately $100,000 has been spent to date on 48NA465. The anticipated cost to complete the mitigation of this site is $200,000. Site 48NA465 extends about 1000 LF along the ECC streambed: ▪ $200,000/1000 = $200/LF (unit cost also includes areas within 48NA465 where artifacts have not been found. ▪ (5 x 5280) @ $200/LF = $5,280,000	
Subtotal =	$5,280,000

➢ Initial Gamma Survey to Establish Areas of Soil Cleanup/Removal

Assume an average 100 ft. survey with along the 5 mile length of the ECC streambed: (5 x 5280 x 100)/43,560 = 61 acres 61 acres @ $200/acre = $12,200 Mapping = $1500	
Subtotal =	$27,400

➢ COE 404 Permit Application

Preparation of application and administration of COE 404 Permit	
Subtotal =	$40,000

➢ Access Road Construction/Removal

Assume a minimum 3 miles of access road will be constructed to access the streambed: ▪ 3 miles @ 22ft. width (3 x 5280 x 22) / 43,560 = 8 acres 8 acres @ $10,000/acre = $80,000 (unit cost includes access road construction, removal and seeding of disturbed access road areas) ▪ Cultural resource treatment/mitigation for access road construction. Assume ¼ cost of streambed since road can be constructed to avoid sensitive areas: 3 miles x 5280 x $37.5/LF = $594,000	
Subtotal =	$674,000

➢ Streambed Soil Removal

Assume average excavation volume of 3" depth, 50' width, 5 mile length: ▪ (5 x 5280 x 0.25 x 50) / 27 = 12,222 say 15,000 CY ▪ 15,000 CY @ $30/CY = $450,000	
Subtotal =	$450,000

➢ Wetlands Replacement

Assume 2/3 of subject streambed by average 50' width for replacement/reconstruction of jurisdictional wetlands. ▪ (0.67 x 5 x 5280 x 50) / 43,560 = 20.3 acres ▪ 20.3 acres @ $4000/acre = $81,200	
Subtotal =	$81,200

➢ Channel Reconstruction

▪ oil Backfill - 1500 CY @ $20/CY = $300,000 ▪ Riprap - 10,000 CY @ $40/CY = $400,000	
Subtotal =	$700,000

➢ Verification Survey

▪ Gamma Survey - 61 acres @ 200/acre = $12,200 ▪ Mapping - $1500 ▪ Soil Sampling - 100 samples @ $105/sample = $10,500 ▪ Sample Analysis - 100 samples @ $152/sample = $15,200	
Subtotal =	$39,400

Total Estimated Cost for ECC Soil Cleanup and Verification = $7,292,000