Appendix VI

Corrective Action Strategy

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Federal Facility Agreement
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(FFACO)

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List of Acronyms and Abbreviations

CAB	Community Advisory Board
CADD	Corrective Action Decision Document
CAI	Corrective Action Investigation
CAIP	Corrective Action Investigation Plan
CAP	Corrective Action Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CNTA	Central Nevada Test Area
CR	Closure Report
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/DP	U.S. Department of Energy/Defense Program
DOE/EM	U.S. Department of Energy/Environmental Management
DOE/LM	U.S. Department of Energy/Office of Legacy Management
ER	Environmental Restoration
DQO	Data Quality Objective
FFACO	*Federal Facility Agreement and Consent Order*
ft	Foot
FY	Fiscal Year
HSU	Hydrostratigraphic unit
LTHMP	Long-Term Hydrologic Monitoring Program
m	Meter
NAC	*Nevada Administrative Code*
NDEP	Nevada Division of Environmental Protection
NNSA/NSO	National Nuclear Security Administration Nevada Site Office
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
PCB	Polychlorinated biphenyl
PSA	Project Shoal Area
RCRA	*Resource Conservation and Recovery Act*
SAFER	Streamlined Approach for Environmental Restoration
SDWA	*Safe Drinking Water Act*
TTR	Tonopah Test Range
UGTA	Underground Test Area

1.0 Introduction

Appendix VI to the *Federal Facility Agreement and Consent Order* (FFACO) describes the strategy that will be employed to plan, implement, and complete environmental corrective action activities at facilities where nuclear-related operations were conducted in Nevada. The nuclear tests and associated support activities were conducted at the Nevada Test Site (NTS); parts of the Tonopah Test Range (TTR) and Nevada Test and Training Range (NTTR); and at the Project Shoal Area (PSA) and the Central Nevada Test Area (CNTA), located in northern and central Nevada, respectively. Agencies, herein referred to as parties, responsible for the activities described in this appendix are the U.S. Department of Energy (DOE), National Nuclear Security Administration, Nevada Site Office (NNSA/NSO); the U.S. Department of Defense (DoD); and the DOE/Office of Legacy Management (LM). These agencies will follow this strategy to accomplish corrective action investigations (CAIs) and corrective actions at the facilities specified in Appendix I (Description of Facilities) of this Agreement, as overseen by the Nevada Division of Environmental Protection (NDEP). The DoD's responsibilities are limited to those areas at the NTS where DoD has conducted activities. The DOE/LM's responsibilities are limited to the Nevada Offsites, which are comprised of the CNTA and the PSA.

The corrective action strategy is based on four steps: (1) identifying corrective action sites (CASs), (2) grouping the CASs into corrective action units (CAUs), (3) prioritizing the CAUs for funding and work, and (4) implementing the CAIs and/or corrective actions, as applicable.

CASs are broadly organized into four categories based on the source of contamination: (1) Industrial Sites, (2) Underground Test Area (UGTA) Sites, (3) Soils Sites, and (4) Offsites. CASs located on the NTS and TTR where activities were conducted that supported nuclear testing activities are grouped as Industrial Sites. CASs associated with underground nuclear tests that have resulted or might result in local or regional impacts to groundwater resources are grouped as the UGTA CAUs. CASs where tests resulted in extensive surface and/or shallow subsurface contamination are grouped as Soils Sites. Additional CASs associated with underground nuclear testing at PSA and CNTA, located in northern and central Nevada respectively, are grouped as Nevada Offsites. All nuclear tests shall be addressed under the above categories (2), (3), or (4).

1.1 Identifying Corrective Action Sites

The first step in the strategy is to identify CASs potentially requiring CAIs and/or corrective actions and place them into Appendix II (Corrective Action Sites/Units) of the Agreement. As CASs are identified, a literature search may be completed, and each CAS will be verified on aerial photographs or in the field to confirm the condition and location of the CAS. A data repository has been created containing or referencing all information currently available for each CAS. It includes, at a minimum, the CAS location, waste description, responsible agency, and information presented in Appendix II (Corrective Action Sites/Units).

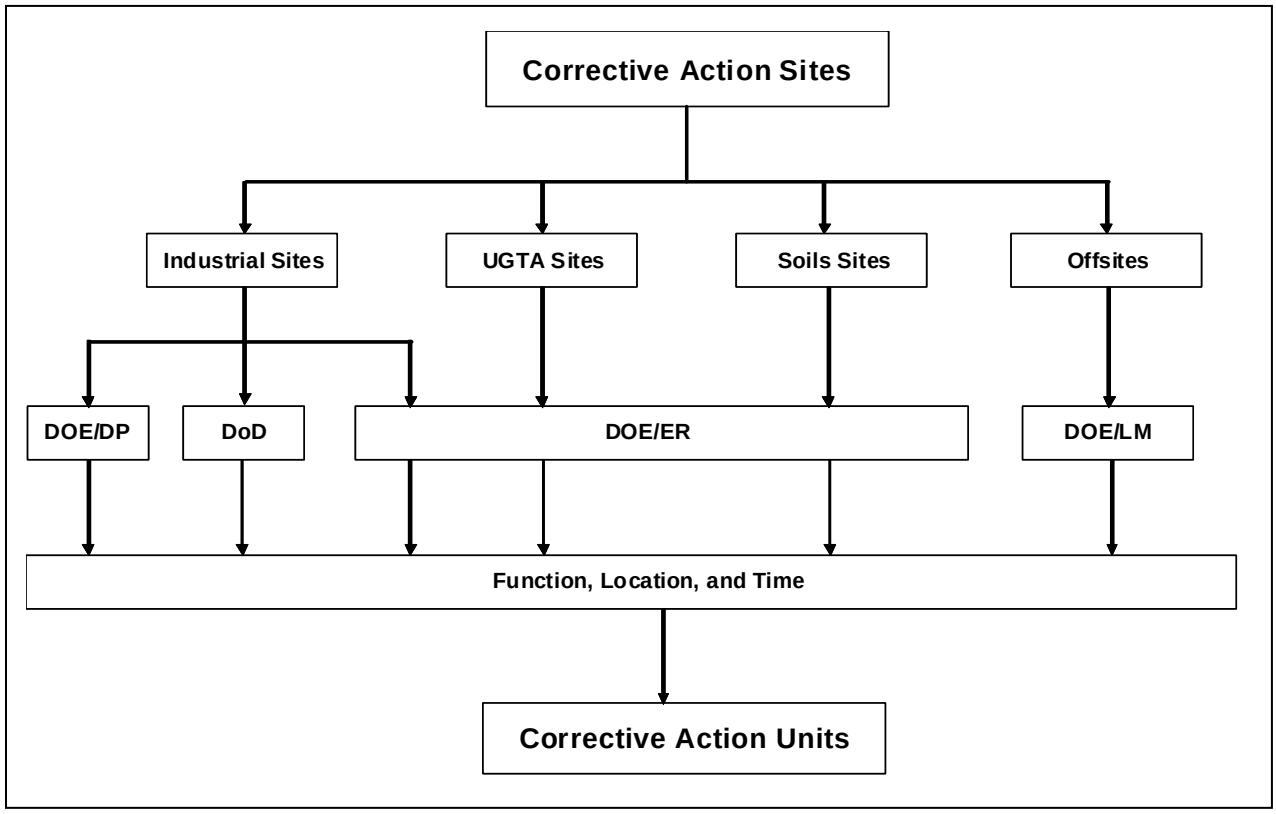

Figure 1-1
Assignment of Corrective Action Sites to Corrective Action Units

1.2 Grouping Corrective Action Sites

CASs will be grouped into CAUs following the process presented in Figure 1-1 and the criteria described below. Appendix II (Corrective Action Sites/Units) may contain CASs that have not

yet been grouped into CAUs, and it is possible that a CAU may contain only one CAS. Criteria for grouping CASs into CAUs include the following:

1. What is the potential source of contamination?
2. Which agency is responsible for cleanup of the CAS?
3. What was the function of the CAS and, therefore, the nature of the contamination?
4. Do the CASs have geographic commonality, or are the CASs located in close enough proximity to be investigated as a CAU?
5. Can investigation or cleanup of grouped CASs be accomplished within a similar time frame?

Appendix II (Corrective Action Sites/Units) of this Agreement will be reviewed periodically by NNSA/NSO, DoD, DOE/LM, and NDEP to determine whether CASs are appropriately organized into CAUs.

1.3 Prioritizing Corrective Action Units

Prioritization of CAUs will be proposed by NNSA/NSO, DoD, and DOE/LM, as appropriate. The proposed priorities and explicit justifications will be presented to NDEP for review; NDEP may agree with the basis for the prioritization and the criteria specified, or suggest alternatives. CAUs will be reprioritized as applicable per the results of the NDEP review and discussions on issues and priorities held during scheduled semi-annual meetings. During the first semi-annual meeting of each Federal fiscal year (FY), NNSA/NSO, DoD, DOE/LM, and NDEP will review and reconsider established priorities, milestones, and associated due dates and deadlines for the current FY.

At the second semi-annual meeting, the parties will address the development of proposed CAU priorities for FY +2. The proposal will include milestones with associated due dates and deadlines. The proposed prioritization will then be presented to the public and the Community Advisory Board (CAB) for input. The NNSA/NSO, DoD, DOE/LM, and NDEP will subsequently develop a final prioritization of CAUs scheduled for CAIs and corrective actions within 30 days of receipt of the final proposed NNSA/NSO, DoD, or DOE/LM milestones for all prioritized CAU activities that must be incorporated into the FY +2 Budget Request.

During the second semi-annual meeting, NNSA/NSO, DoD, DOE/LM, and NDEP will review and reconsider established priorities, milestones, and associated due dates and deadlines for CAUs for FY+1.

This entire process is pursuant to paragraph XII.4 of this Agreement.

A listing of criteria (arranged alphabetically) that may be used to prioritize CAUs is presented in Table 1-1.

Table 1-1
Potential Criteria for Prioritizing CAUs

Criteria	Description
Assessment of risk	Does the risk to workers, and/or the general public, and/or to the ecosystem require a CAI, a corrective action, or no further action?
Available technology	Are the technologies available for corrective action effective and not cost prohibitive?
Cost	Can the CASs within the CAUs be addressed within known or expected budget constraints?
Future use	What are the possible future land or resource uses?
Geographic location	Is the CAU located in an area that requires more immediate action than others?
Interdependency of action	Are planned or ongoing operations likely to have an effect on the priority of a CAI and/or corrective action?
Optimization of resources	Have all resources been analyzed and used to their fullest practical extent?
Priorities of the parties	What are the priorities of the parties for the CAUs?
Presence of cultural resources or sensitive species	Do CAUs contain CASs where cultural resources or sensitive species are known or expected to be encountered? Will these CAUs require additional time and cost for surveys and mitigation prior to or concurrently with the corrective action?
Regulatory requirements	Are some CAIs and/or corrective actions mandated by regulatory requirements to be accomplished first? Are there other regulatory requirements that must be met (for example, must a National Environmental Policy Act document be completed or a threatened and endangered species survey accomplished prior to the start of a CAI and/or corrective action)?
Schedule	Are CAIs and/or corrective actions scheduled to allow efficient utilization of resources such as labor and equipment?
Stakeholders' concerns	Do stakeholders have additional criteria, concerns, or alternatives to propose?
Time required to complete action	How long will it take to complete the CAI and/or corrective action?
Waste management concerns	Are facilities and technologies available to effectively manage the waste expected to be generated by corrective actions?

1.3.1 Public Involvement

The public, particularly through the CAB for NTS Programs, has the opportunity to become involved early in the CAI/corrective action process.

The CAB's comments will be strongly considered before final prioritization of corrective actions. In addition, a public participation working group made up of representatives from NNSA/NSO, DoD, the State of Nevada, and the CAB will meet two times a year to discuss upcoming environmental restoration activities and the level of public involvement required. These meetings will focus on the quarterly progress reports and priority-setting activities established under the Agreement. Detailed public involvement opportunities are outlined in Appendix V (Public Involvement Plan).

1.3.2 Historic CASs and New Releases

The historic *Resource Conservation and Recovery Act* (RCRA) sites governed by Section V of DOE's RCRA permit number NEV HW0021 will be prioritized with the CAUs regulated by this Agreement. However, closure of these sites shall be in accordance with the appropriate requirements of Title 40 *Code of Federal Regulations* (CFR) 265, as adopted by *Nevada Administrative Code* (NAC) 444.8632 and 444.8634, inclusive.

Contamination caused by new spills or releases from operational activities will not be covered under this Agreement. Priorities established in Appendix III (Corrective Action Investigations/ Corrective Actions) may be reconsidered based upon the circumstances involving new releases.

1.4 Corrective Action Investigation and Corrective Action Documents

A series of documents will be prepared to plan and guide CAI and corrective action activities.

- Corrective Action Investigation Plan (CAIP): A document that provides or references all the specific information for planning investigation activities associated with corrective action units. A CAIP may reference information in the optional CAU work plan or other applicable documents. If a CAU work plan is not developed, then the CAIP must include or reference all the management, technical, quality assurance, health and safety, public involvement, field sampling, and waste management information needed to conduct the investigations in compliance with established procedures and protocols.

- Corrective Action Unit Work Plan: An optional planning document that provides information for a CAU or a collection of CAUs where significant commonality exists. This plan may be developed to eliminate redundant CAU documentation and may contain management, technical, quality assurance, health and safety, public involvement, field sampling, and waste management information. This common information will be referenced in appropriate CAIPs.

- Corrective Action Decision Document (CADD): A document that provides the corrective action that is selected as the result of investigation activities and the rationale for its selection. The rationale consists of an analysis of the possible alternatives and may reflect a decision ranging from no action to clean closure.

- Corrective Action Plan (CAP): A document that provides the plan for implementing the selected corrective action alternative. This plan shall contain a detailed description of the proposed actions that will be taken to achieve the degree of containment set forth in the NDEP-approved CADD.

- Streamlined Approach for Environmental Restoration (SAFER) Plan: A document that provides a plan for initiating and completing corrective actions at CAUs where enough information exists to predict the appropriate corrective action before completing a CAI. The plan will incorporate the essential elements of the CAIP, the CADD, and the CAP to allow work to proceed directly from the CAI to the corrective action.

- Closure Report (CR): A document that states that the completed corrective action was conducted in accordance with the approved CAP and provides to NDEP all necessary support data to confirm that the appropriate corrective action took place.

- Notice of completion: An NDEP-issued document signifying the completion of the CAU corrective action in accordance with the approved plans.

1.5 Implementing Corrective Action Investigations and Corrective Actions

If a CAU is prioritized for a CAI or corrective action within the three-year planning window, that CAU and associated CASs will be transferred from Appendix II (Corrective Action Sites/Units), to Appendix III (Corrective Action Investigations/Corrective Actions). A preliminary characterization will be performed based on existing data. The data will be used to develop conceptual models to determine appropriate investigative and corrective action tasks, as well as to select a corrective action process.

Data Quality Objectives (DQOs) will be incorporated throughout the corrective action process. The DQO process is a series of planning steps designed to ensure that environmental data used in decision making are appropriate. The DQOs are qualitative and quantitative statements that help guide CAPs and decisions. These statements will help assure that data are of sufficient quality and quantity to support defensible decisions and at the same time reduce data collection costs by

eliminating unnecessary, duplicative, or overly precise data. The DQOs will be developed by the parties with NDEP participation, to assist in development of appropriate work scope.

Assessment of risk to the affected resource (a special application of environmental risk assessment) may be used as needed, along with other appropriate evaluations, to help in establishing appropriate action and/or cleanup levels, particularly where no regulatory levels have been established or where multiple contaminants complicate the evaluation.

When required, interim corrective actions will be carried out where immediate risk exists to workers, the public, and/or the environment. Sufficient data must exist at these CAUs to demonstrate that actions can be taken to stabilize, minimize, or mitigate the contamination until the final corrective action can be completed.

The process for implementing CAIs and/or corrective actions has been subdivided into three flowpaths that are based on the existing CAS data and on-site conditions: the housekeeping process, the SAFER process, and the complex process. Figure 1-2 describes the generic corrective action processes that will be used to determine appropriate CAU activities.

1.5.1 Housekeeping Process

The housekeeping process will be used for CASs that do not require further investigation prior to completing the corrective action. At these CASs, data gathered during records searches and field verification activities sanction the removal of source materials, directly impacted soil, and subsequent confirmatory sampling without additional investigation. A work plan containing developed procedures for conducting these activities will be written and revised as needed in coordination with NDEP. Documentation of the source removal and confirmation sampling, if required, will be through a CR.

1.5.2 SAFER Process

The SAFER process will be employed at CAUs where the parties agree that enough information exists about the nature and extent of contamination to propose an appropriate corrective action prior to the completion of a CAI. This process combines elements of the DQO process and the observational approach to help plan and conduct corrective actions. The DQOs will be used to define the type and quality of data needed to complete the investigation phase of the process. The observational approach will provide a framework for managing uncertainty and planning decision making.

The purpose of the investigation in the SAFER process will be to document and verify the adequacy of existing information; to affirm the decision for either clean closure, closure in place, or no further action; and to provide sufficient data to implement the corrective action. Actions and decisions for this process are governed by SAFER Plans. These plans incorporate the required elements of CAIPs, CADDs, and CAPs to allow work to proceed directly from the CAI to the corrective action. The plans will identify decision points where NNSA/NSO and/or DoD will reach consensus with NDEP prior to beginning the next phase. Following completion of SAFER activities, or if the selected remedy is no further action, a CR will be prepared and submitted to NDEP.

1.5.3 Complex Process

The complex process will be used for those CAUs where additional information is needed for the evaluation of possible corrective action alternatives. The CAIPs for CAUs following the complex process will focus on the investigation tasks required to prepare the CADD and will include the DQO process. As part of this process, conceptual models for CASs will evolve as data are collected and reviewed. When the investigation is complete, a CADD will be prepared to evaluate corrective action alternatives and to identify the selected corrective action.

Following NDEP approval of the selected corrective action outlined in the CADD, a CAP will be developed. This plan will be the document guiding the CAU corrective action. After completion of the corrective action, or if the selected corrective action is no further action, a CR will be developed and submitted to NDEP.

NDEP will issue a notice of completion upon approval of the completion of a corrective action, and the CAU may be transferred from Appendix III (Corrective Action Investigations/Corrective Actions) to Appendix IV (Closed Corrective Action Units). If long-term monitoring is necessary, the monitoring requirements for CASs or CAUs on facilities subject to the RCRA Permit will be incorporated into the Permit. Long-term monitoring requirements for CASs or CAUs on facilities not subject to the RCRA Permit will be outlined in CRs.

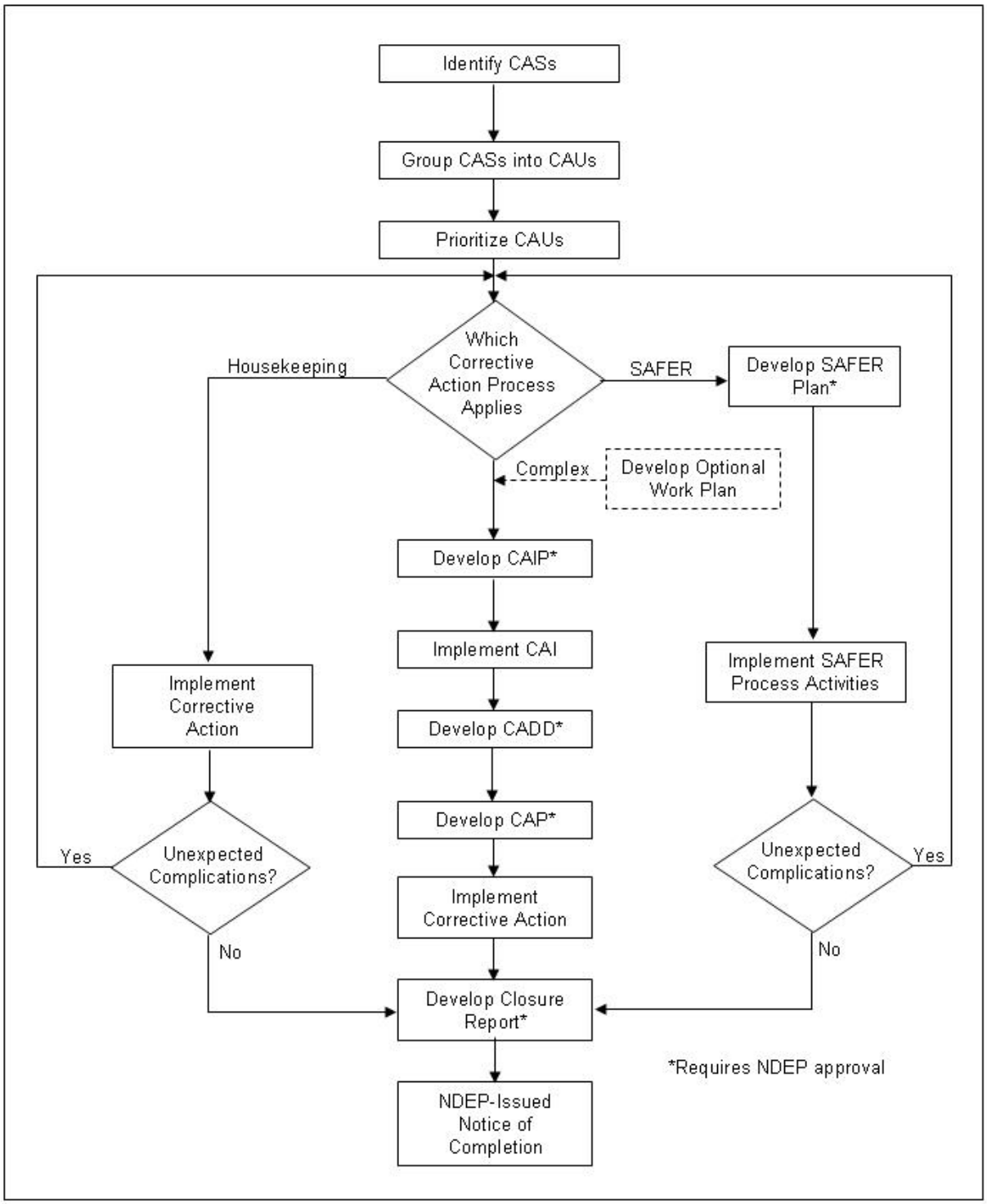

Figure 1-2
Generic Correction Action Process

2.0 Industrial Sites

The current inventory of environmental restoration CASs at the NTS, TTR, and NTTR indicates a widespread distribution of approximately 1,852 Industrial Sites that may require some level of investigation and corrective action.

2.1 Corrective Action Units

Industrial Sites CASs will be grouped into CAUs based on four criteria: (1) responsible party, (2) site function, (3) geographic location, and (4) length of time needed to complete the action. CASs will first be assigned to CAUs based on the agency responsible for the investigation and/or corrective action. CASs will then be grouped by function when they share similar technical issues and waste types. CASs with similar functions may be grouped geographically with other CASs to facilitate corrective actions. It is possible that the cleanup of a specific geographic area, such as a portal tunnel area, will be considered a priority, in which case a CAU may contain CASs with a variety of functions. Finally, CASs will be grouped into CAUs according to the length of time needed to complete the corrective actions.

Table 2-1 contains a listing of functional categories that represent the types of CASs normally considered as Industrial Sites. These categories range from landfills, mud pits, leachfields, etc., with or without radiological contamination, to discarded or abandoned materials such as drums, batteries, and lead materials. CASs with materials that are easily disposed of are considered to be housekeeping sites, and account for approximately one-third of all Industrial Sites CASs.

2.2 Corrective Action Strategy

Corrective actions for Industrial Sites CAUs will range from no action to clean closure. The types of corrective actions may be as simple as small, isolated housekeeping site source removals to large-scale, multi-faceted projects addressing shallow groundwater and subsurface soil contamination. To further define the corrective actions for the wide range of Industrial Sites, the overall corrective action process has been subdivided into three possible process flowpaths: (1) the housekeeping process, (2) the SAFER process, and (3) the complex process. Decisions to use specific processes are based on the complexity of the CAS conditions and the possibility of choosing corrective action alternatives before investigations are complete. Each of these processes and their respective flowpaths are described further in Section 2.3.

Table 2-1
Industrial Sites Functional Category

Functional Category	Functional Category
Aboveground Storage Tank	Mud Pit
Abandoned Chemicals	Oil/Fuel Spills (nonhousekeeping)
Boiler	Other Ponds/Lagoon
Building	Other Spill Sites
Buried Ordnance Site	Radiologically Contaminated Area
Burn Cage	Sanitary Landfill
Cable Hole	Septic Tank
Chemical Storage	Sewage Lagoon
Conditional Release Storage Yard	Shaft
Construction Waste Landfill	Shaker Plant
Decontamination Pad	Sludge Burial Pit
Decontamination & Decommissioning Facility	Solid Propellant Burn Site
Depleted Uranium Surface Debris Area	Steam Cleaning Facility
Drillback Sump/Cellar	Tunnel
Drillhole	Tunnel Pond
Fire Training Area	Tunnel Portal Area
Generator	Underground Discharge Point
Hazardous Waste Accumulation Site	Underground Storage Tank
Housekeeping Site[a]	Vent Hole
Injection Well	Waste Disposal Trench
Leachfield	Waste Disposal Site
Lead (nonhousekeeping)	Waste Dump
Magazine/Bunker	Miscellaneous
Muckpile	

[a]Examples of wastes at housekeeping sites are hazardous constituents such as abandoned chemicals, drums/barrels, lead shielding, other spill sites; petroleum sites such as epoxy tar sites, oil/fuel spills; others such as batteries, buckets/cans, compressed gas cylinders; miscellaneous; transformers/polychlorinated biphenyls (PCBs); trash/debris.

The preparation of plans and their contents will correspond with the complexity of each CAU and the chosen corrective action process. If appropriate, each CAS will have a CAIP. The CAIP will contain or reference all necessary management and technical information. Optional CAU work plans may be written and referenced if information applies to all CASs in a CAU, or if CAUs are sufficiently similar to facilitate the use of common information.

CADDs, CAPs, and CRs will be prepared, as necessary, to guide and document corrective action decisions and activities. If sufficient information exists at a particular CAU to plan the

corrective actions prior to completion of the investigation, a SAFER Plan may be prepared. This plan will contain all the necessary elements usually found in CAIPs, CADDs, and CAPs.

2.3 Implementing Corrective Action Investigations and Corrective Actions

CAUs will be prioritized for corrective action and listed in Appendix III (Corrective Action Investigations/Corrective Actions). A preliminary characterization will be performed based on existing data. These data will be used to develop conceptual models to determine appropriate investigation and corrective action tasks, as well as to select a corrective action process. DQOs will be developed by DOE and/or DoD as appropriate, with NDEP participation, to assist in the development of work scope. Stakeholder input may be required depending upon the nature of the work scope.

One of three corrective action processes will be selected as appropriate for the CAU based on site conditions. The following sections describe the work flow process and decision points necessary to implement corrective actions for Industrial Sites (Figure 2-1).

2.3.1 Housekeeping Process

CAUs that may be closed through the housekeeping process are distinguished from other Industrial Sites CAUs because they do not require further investigation prior to closure. Hundreds of housekeeping CASs are anticipated to have sufficient data, gathered during records searches and field verification activities, to warrant removal of source materials and confirmatory sampling or to warrant recommendation for closure, if materials have already been removed. Source removal, waste disposition, and appropriate confirmatory sampling will be conducted in accordance with established work plans.

Documentation of the source removal and confirmatory sampling, if required, will be through a CR, which will represent the formal, “no further action” recommendation for each CAS within a housekeeping site CAU. If a housekeeping CAS proves more complex than anticipated, such as finding an unexpected waste type, the CAS will be recommended for inclusion into a different CAU that will follow another process flowpath.

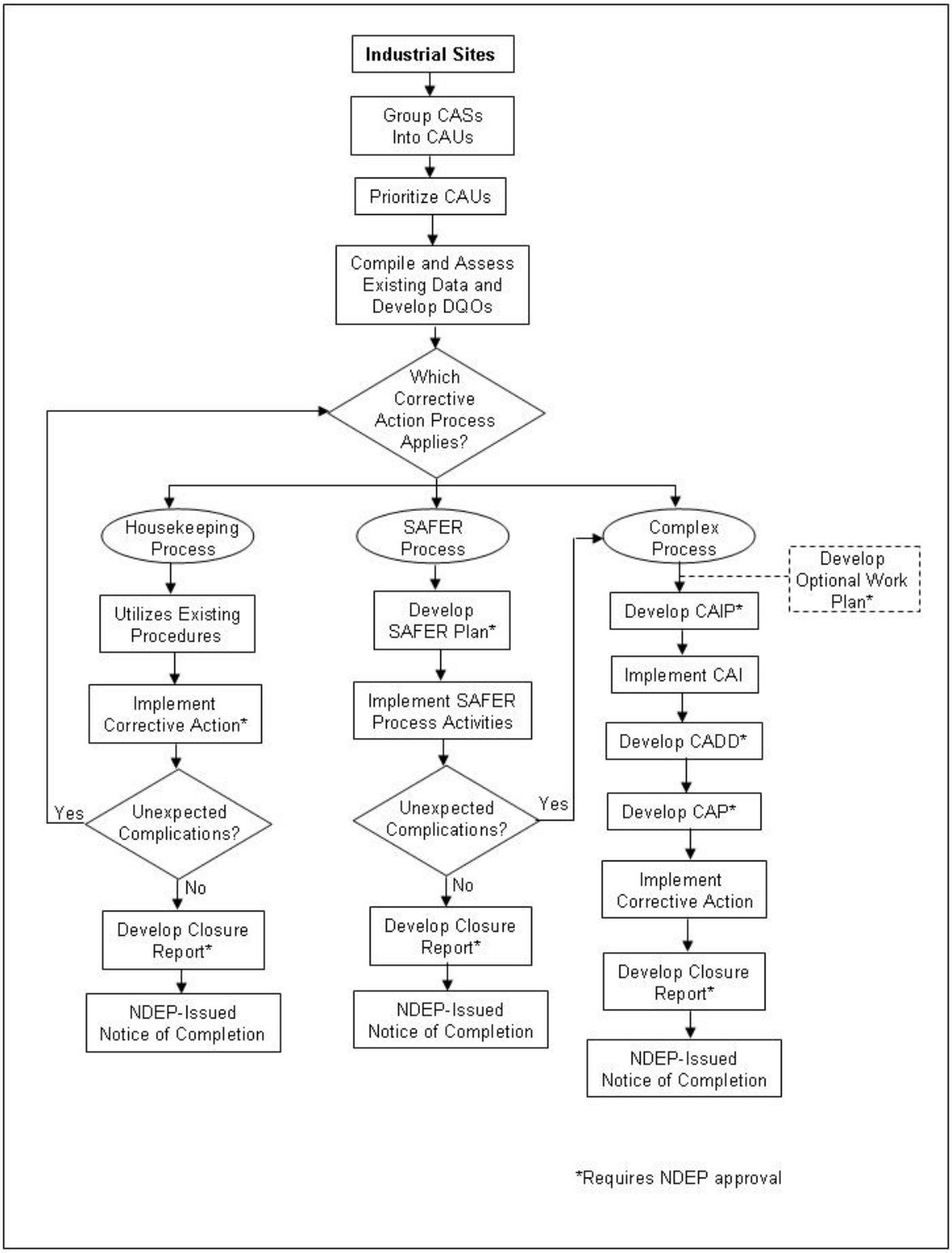

Figure 2-1
Industrial Sites Corrective Action Process

CASs falling into the housekeeping site functional category are widespread, especially at the NTS. Although many of these CASs have already been identified and are being closed through the housekeeping process as part of the Environmental Restoration Sites Inventory, new housekeeping CASs may regularly be identified as part of everyday operational activities at the NTS. When previously unidentified materials fitting into the housekeeping category are encountered in the field, they will be identified and marked as a new CAS and added to Appendix II (Corrective Action Sites/Units).

Newly identified recyclable or sanitary waste materials, when not associated with visible staining and when not located in a known contamination area, will be noted and tallied. They will not be identified as a new CAS or marked in the field. A list of these sites will be compiled and updated regularly for inclusion in periodically scheduled NTS cleanup activities of nonhazardous waste types. Examples of the types of materials that will not be staked as new CASs include empty drums; empty cans or buckets; intact batteries, construction debris such as untreated lumber, rebar, or concrete; and recyclable materials such as cable, steel, drill pipe, empty gasoline cans, empty gas cylinders, and nuts and bolts.

2.3.2 SAFER Process

CAUs that may be closed through the SAFER process have conceptual corrective actions that are clearly identified. Consequently, corrective action alternatives can be chosen prior to the completion of an investigation given anticipated CAI results.

The SAFER process requires some degree of investigation to determine whether the appropriate corrective action will be a clean closure, closure in place, or no further action. The purpose of the investigation will be to document and verify the adequacy of existing information; to affirm the decision for either clean closure, closure in place, or no further action; and to provide sufficient data to implement the corrective action. Risk assessment requirements and criteria will be formulated by the parties with NDEP participation, prior to the submittal of the SAFER Plan.

The SAFER Plan will be the primary document governing actions and decisions at CAUs employing the SAFER process. The plan will incorporate required CAIP, CADD, and CAP elements to allow work to proceed directly from the CAI to the corrective action. The plans will identify decision points, developed in cooperation with NDEP, where DOE and/or DoD will reach consensus with NDEP prior to beginning the next phase of work. If specific conditions or findings fall outside the bounds of the SAFER Plan, the CAS will be transferred into an appropriate CAU and the complex process used. SAFER Plans may require stakeholder review

prior to implementation. Following the completion of SAFER activities, a CR will be prepared and submitted to NDEP.

2.3.3 Complex Process

The complex process differs from the SAFER process because the CAU corrective action alternatives cannot be chosen before the CAI has been completed. The CAIPs for these CAUs will focus on investigation tasks required to prepare CADDs and will include the DQO process. When data have been collected and the investigation is complete, a CADD will be prepared to evaluate corrective action alternatives and the selection of the appropriate corrective action.

Following NDEP approval of the CADD, a CAP will be developed and the corrective action initiated. A CR will be developed to document the completion of corrective action activities and submitted to NDEP. After approval of the corrective action, NDEP will issue a notice of completion and the CAU will be moved to Appendix IV (Closed Corrective Action Units).

Risk assessment requirements for CAUs which follow the complex process will be identified in the DQO process. Many of the CAUs following the complex process may be dominated by contaminants without established regulatory levels. In addition, the location of the site and intended future land use may require assessment of risk as an element in the evaluation of closure activities.

3.0 Underground Test Area

A total of 908 historical nuclear detonations occurred in shafts or tunnels at the NTS. They are categorized into 879 CASs assigned to the UGTA Project. These CASs are grouped into five CAUs. CASs in each CAU are located near each other, and CAUs are geographically distinct. CAUs have distinctly different contaminant source, geologic, and hydrogeologic characteristics related to their location.

3.1 Corrective Action Units

The CAUs, shown in Figure 3-1, are listed below:

- Frenchman Flat CAU consists of 11 CASs located in the northern part of Area 5 and the southern part of Area 11. These detonations were conducted in both vertical emplacement holes and mine shafts. The tests in Frenchman Flat were located in alluvium of great depth. The deeper geology is not well known. Lateral transport in the alluvium is very slow due to the low lateral gradient.

- Western Pahute Mesa CAU consists of 18 CASs along the western edge of Area 20. These detonations were conducted in vertical emplacement holes. This CAU is separated from Central Pahute Mesa by the Boxcar Fault and is distinguished by the relative abundance of tritium. Transport of contaminants on and from Western Pahute Mesa involves groundwater flow in both welded and vitric tuffs, both in the rock matrix and in the fracture system.

- Central Pahute Mesa CAU consists of 64 CASs in Areas 19 and 20 on Pahute Mesa. These detonations were all conducted in vertical emplacement holes. Transport of contaminants on and from Central Pahute Mesa involves groundwater flow in fractures and the rock matrix, in welded and vitric tuffs, and in lava flow aquifers.

- Yucca Flat/Climax Mine CAU consists of 717 CASs located in Areas 1, 2, 3, 4, 6, 7, 8, 9, 10, and 3 CASs located in Area 15. These detonations were conducted in vertical emplacement holes and tunnels. Contaminant transport in Yucca Flat/Climax Mine may involve alluvium, both welded and vitric tuffs, fractured granite, and carbonate rocks.

- Rainier Mesa/Shoshone Mountain CAU consists of 60 CASs on Rainier Mesa and 6 CASs on Shoshone Mountain, located in Areas 12 and 16. These detonations were all conducted above the water table in tunnels constructed in bedded and non-welded vitric and zeolitized volcanic tuffs.

The process outlined in Section 1.3 was used for the initial prioritization of UGTA CAUs.

3.2 Corrective Action Strategy

The corrective action strategy for UGTA is based on the complex corrective action process. The objective of the CAI process is to define boundaries around each UGTA CAU to establish areas that contain water that may be unsafe for domestic and municipal use. Any ambiguity resulting from different language used in this subpart of Appendix VI versus the body of the FFACO shall be resolved in favor of terms and conditions found in the body of the FFACO.

The UGTA Corrective Action Strategy was developed to address the contamination created by the testing of nuclear devices in shafts and tunnels at the NTS. The objective is to analyze and evaluate each UGTA CAU through a combination of data and information collection and evaluation, and modeling groundwater flow and contaminant transport. This analysis will estimate the vertical and horizontal extent of contaminant migration for each CAU in order to predict contaminant boundaries. A contaminant boundary is the model-predicted perimeter which defines the extent of radionuclide-contaminated groundwater from underground testing above background conditions exceeding the *Safe Drinking Water Act* (SDWA) standards. The contaminant boundary will be composed of both a perimeter boundary and a lower hydrostratigraphic unit (HSU) boundary. The computer model predicts the location of this boundary within 1,000 years and must do so at a 95% level of confidence. Additional results showing contaminant concentrations and the location of the contaminant boundary at selected times will also be presented. These times may include the verification period, the end of the five-year proof-of-concept period, as well as other times that are of specific interest.

From the contaminant boundary predicted by the computer model, a compliance boundary will be negotiated between NDEP and DOE. The compliance boundary will define the area within which the radiological contaminants above the SDWA standards relative to background are to remain. The DOE will be responsible for ensuring compliance with this boundary. The compliance boundary may or may not coincide with the contaminant boundary. If the predicted location of the contaminant boundary cannot be accepted as the compliance boundary, an alternate compliance boundary will be negotiated by both parties.

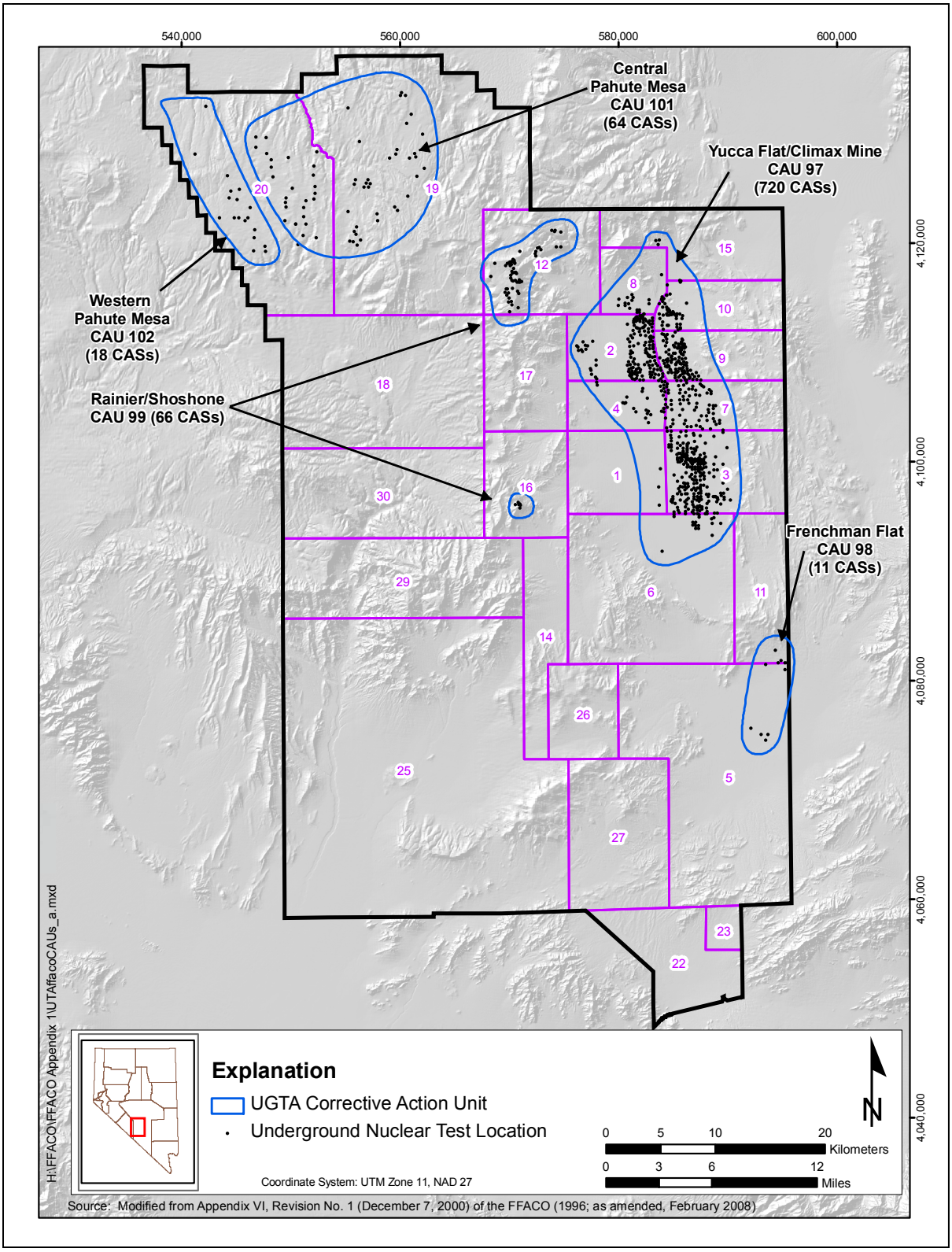

Figure 3-1
Underground Test Area Corrective Action Units

An initial assumption is that contaminant control will not be required. After establishing a compliance boundary for each CAU, an evaluation of remedial alternatives and a monitoring CAP will be developed. A five-year proof-of-concept period will follow using groundwater wells in a monitoring network to determine whether the monitoring network design will provide adequate CAU surveillance. If the monitoring network is found acceptable, a closure plan will then be developed, followed by implementation of a long-term closure monitoring program.

The long-term closure monitoring program will address any contamination left in place in a closed CAU. This program consists of all activities necessary to ensure protection of human health and the environment following the completion of corrective actions at a CAU. These activities will include periodic analysis of monitoring results, determining optimum performance indicators, evaluation of monitoring performance criteria, locating new monitoring wells, and replacing existing monitoring wells to support performance criteria evaluation at timed intervals of interest within the 1,000-year time period.

A model of regional flow encompassing the NTS and the groundwater flow systems extending to downgradient discharge has been completed. Regional modeling is a cross-cutting activity, supporting the entire UGTA Project, which provides the initial basis for assessing flowpaths from CAUs, determining potential receptors, evaluating isolation or interaction of CAUs, and creating a consistent hydrogeologic framework across all the CAUs. Regional transport modeling provides the initial basis for determining the magnitude of risk from the source to potential receptors and for scaling individual CAU work.

The CAI process will focus on refining CAU boundaries through CAU-specific models that include CAU-specific data. The CAU-specific modeling objectives are to estimate movement of contaminants utilizing the acquisition and evaluation of CAU-specific hydrogeologic data and to define boundaries that encompass the extent of contamination. If CAU-specific modeling is not successful in achieving CAU objectives, this strategy will be evaluated to determine whether it will allow the objectives to be reached. If it is not possible or feasible to achieve the objectives, it may be necessary to reevaluate and consider alternative approaches.

Figure 3-2 is a diagram of the generalized decision process leading to the closure of CAUs. The process contains five major decision points where data and/or data analysis are reviewed and consensus reached before proceeding with the next phase of corrective action activities. The first of these major decisions is the determination of data adequacy prior to developing the CAU flow and contaminant transport model. If the data are not adequate, alternatives will be evaluated, and the second major decision point, a decision on whether the UGTA strategy can be achieved will

be reached. If the strategy can be achieved, a revision to the CAIP will then be developed. If the strategy cannot be achieved, a new strategy will then be proposed. If the data are adequate, the CAU flow and transport model will be developed.

The third major decision concerns the acceptability of the CAU flow and transport model. If the CAU flow and transport model is not acceptable, the alternatives will be evaluated and, again, the second major decision point, a decision on whether the UGTA strategy can be achieved, will be reached. If the strategy can be achieved, a revision to the CAIP will then be developed. If the strategy cannot be achieved, a new strategy will then be proposed. If the CAU model is acceptable, the CAU boundaries will be defined.

The model results, along with the results of the CAI, will be utilized for an evaluation of remedial alternatives and a proposed remedial action. The fourth major decision is whether contaminant control is required. If contaminant control is required, then a CAP will be developed and implemented. If contaminant control is not required, then a monitoring CAP will be developed and a five-year proof-of-concept monitoring program will be initiated. The fifth and final major decision occurs after a review of the monitoring results. If DOE and NDEP are confident of the results, the closure process will begin. If the results at any of these decision points are not acceptable, then alternative activities will be initiated and evaluated, as appropriate, to correct the deficiencies.

For saturated conditions, a flow model of each CAU will be constructed to provide local three-dimensional flow, to evaluate the range of flow conditions in the CAU that may be important in determining maximum extent of transport, and to provide boundary conditions for modeling transport. Saturated conditions are planned to be modeled for Frenchman Flat, Yucca Flat/Climax Mine, Western Pahute Mesa, and Central Pahute Mesa CAUs.

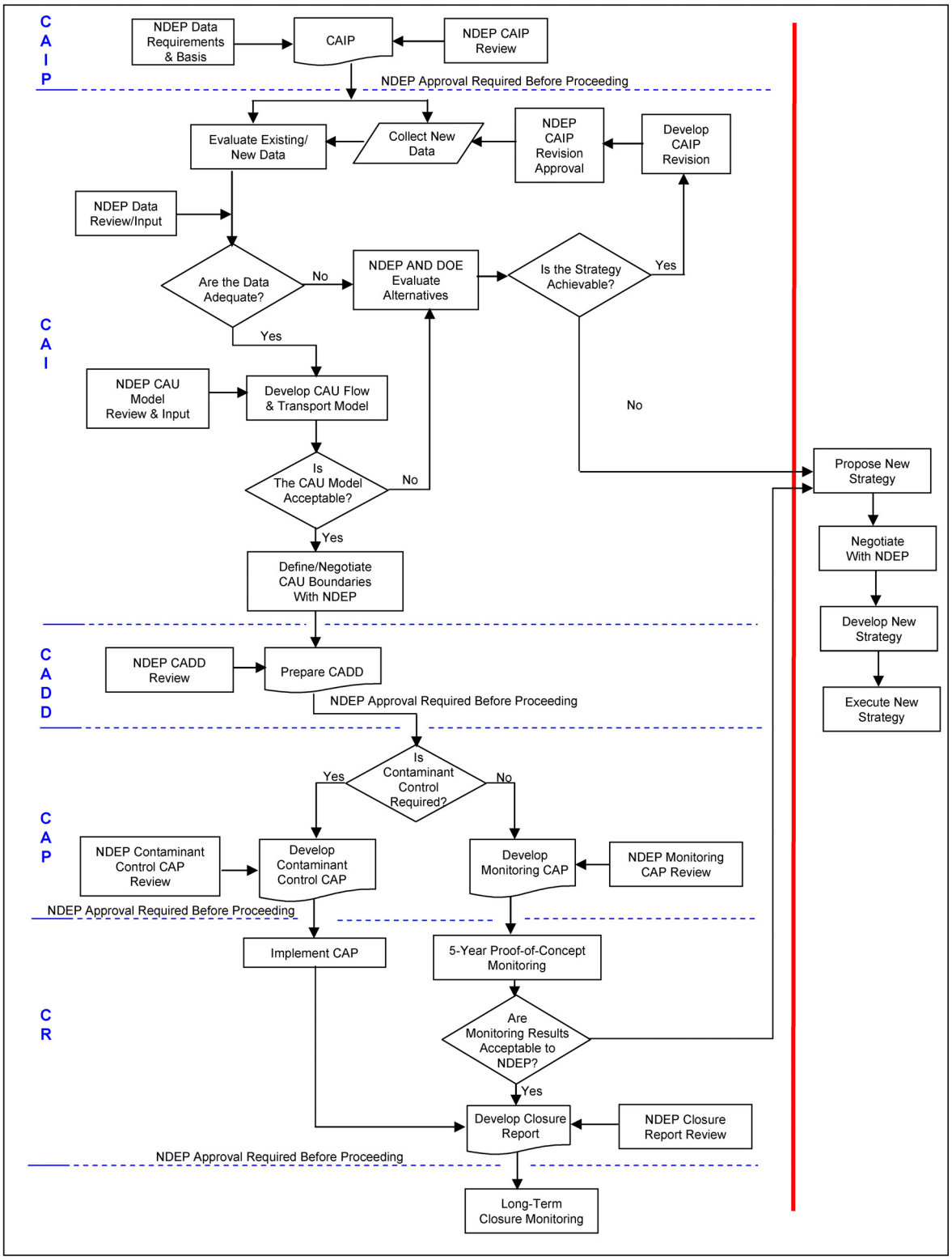

Figure 3-2
Process Flow Diagram for the Underground Test Area Corrective Action Units

For CAUs where unsaturated groundwater conditions prevail (Rainier Mesa/Shoshone Mountain CAU), saturated zone flow and transport modeling results, based on field data, will be evaluated to determine whether the saturated zone has been impacted. If the saturated zone has been impacted, then the need for further examination of the unsaturated zone will be evaluated.

CAU models utilizing tritium as the source term will be used to establish the contaminant boundary for each CAU. The boundary will be composed of a perimeter boundary and a lower HSU boundary. The perimeter boundary will define the aggregate maximum extent of contamination transport at or above the concentration of concern for the CAU. The lower HSU boundary will define the lowest aquifer unit affected by the contamination. Long-lived radionuclides, besides tritium, will also be included to evaluate the relative extent of migration of different radionuclides in the future. If it is predicted that another radionuclide will migrate farther than tritium at concentrations of concern, the contaminant boundary will include that prediction.

Figure 3-3 illustrates how modeling uncertainty can be expressed as confidence levels. Each contour reflects an increased level of confidence that no contaminants exceeding a given regulatory concentration will ever cross that boundary. As confidence increases, the distance from the CAU increases. The confidence levels could lead to the development of different contaminant boundaries, depending on the degree of certainty decision makers need to select appropriate controls.

Monitoring compliance with the CAU boundaries will be accomplished through measurement of appropriate physical and chemical parameters in wells within the modeled region. Appropriate physical and chemical parameters remaining within the range of measurements used in the flow model will be an indication that the conditions have not significantly changed. Sensitivity analysis of parameters relevant to the groundwater will indicate the extent that appropriate physical and chemical parameters can vary before the acceptable confidence limit for the model is exceeded.

3.3 Implementing Corrective Action Investigation and Corrective Actions

Work elements expected to be required to conduct the CAI and corrective action process for each of the UGTA CAUs are identified in Figure 3-2 and described below. These descriptions form the basis for establishing due dates for milestones and deadlines for these CAUs. If activities other than those described herein are determined to be necessary to achieve closure of the CAUs, the milestones and schedule will be reevaluated in accordance with the terms and conditions

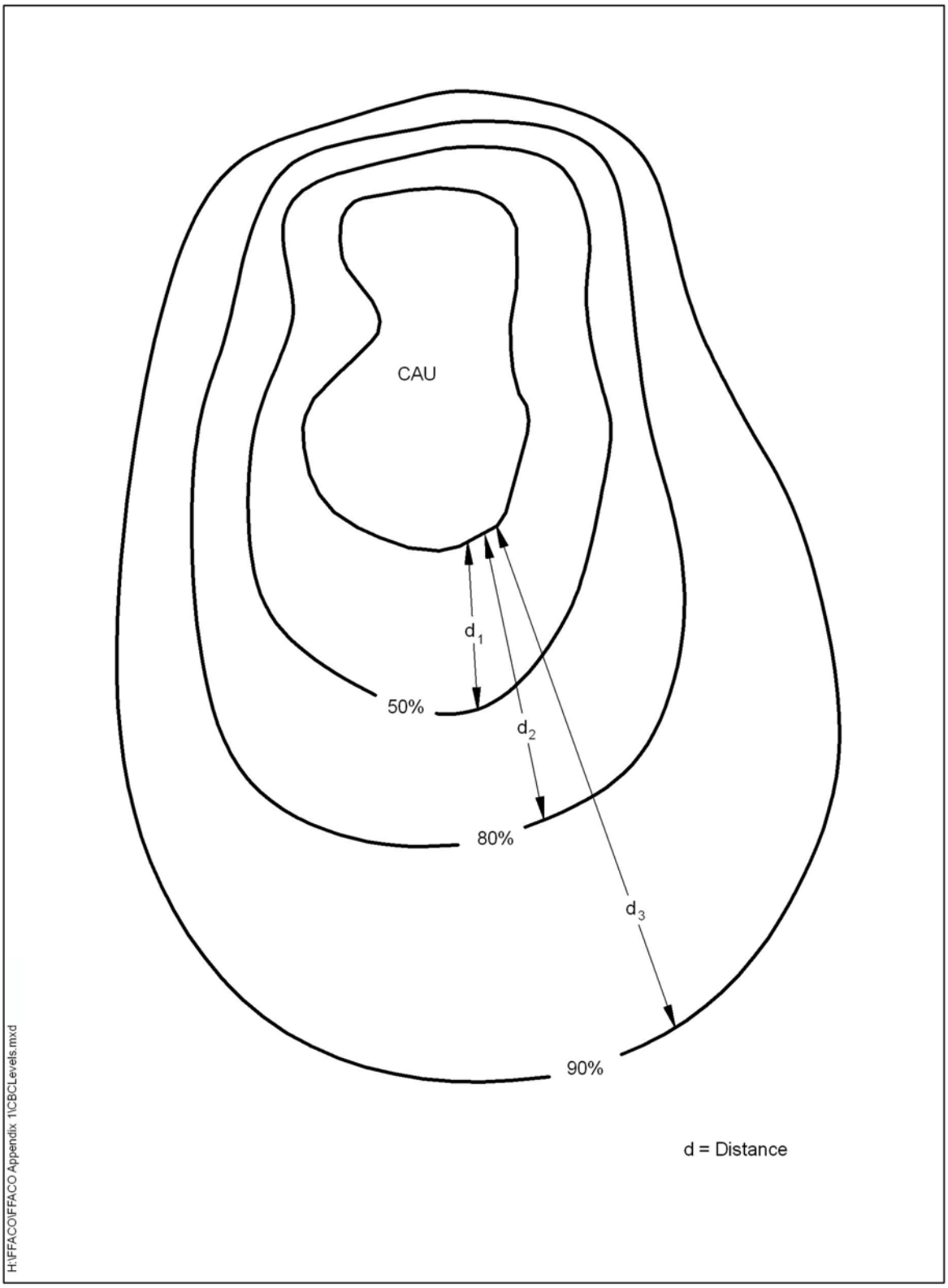

Figure 3-3
Example of Contaminant Boundary Confidence Levels

defined in the Agreement. As of the effective date of this Agreement, no specific, proven cost-effective technologies, as known by the parties individually, have been previously demonstrated to either remove radioactive contaminants from the groundwater, stabilize them, or remove the source of the contaminants at the CASs that are subject to that Agreement. Such technologies may be perfected in the future, which may perhaps alter the choice of corrective action at that time.

The following dictionary (Table 3-1) sets forth the meaning of each block/step of the Process Flow Diagram for Underground Test Area Corrective Action Units (see Figure 3-2) for achieving the UGTA Corrective Action strategy. The dictionary is presented in tabular form identifying each of the steps developed to implement the strategy. The table presents the process section that each block/step is in; the descriptor, or name, of each block/step; and a definition of the block/step.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 1 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CAIP	**CAIP**	DOE will develop and prepare the Corrective Action Investigation Plan (CAIP). The CAIP will be prepared in accordance with the FFACO and Data Quality Objective (DQO) process. The CAIP will meet the informational requirements of the "Annotated Outline for UGTA Corrective Action Investigation Plan," which includes a description of the CAU, a summary of the DQO process results, the proposed Corrective Action Investigation (CAI), and a description of and rationale for any planned field investigations. The description of the CAU will include the investigative background, which contains a summary of historical data and previous studies, operational history, physical setting, contaminants of concern, and a conceptual model of the CAU that will be proved or disproved by the CAI. The DQO process results provide problem identification, relate the conceptual model with contaminant migration scenarios, and the investigations aimed at satisfying the DQOs. The proposed CAI provides the plans for the conduct of the investigation that will be carried out, and the details of field investigations and data collection and data analysis activities identified as necessary to better model the physical system. The CAU-scale flow and contaminant transport modeling will also be planned and developed in the CAI, including the modeling steps, flow and transport code selection, and flow model calibration and verification. During the development of the CAIP, DOE will meet with and update NDEP. NDEP will then be given the opportunity to review the draft version of the CAIP and identify any deficiencies. Field investigations, data collections, and analyses identified during the development of the CAIP as part of the Corrective Action Investigation will not be initiated without NDEP approval.
	NDEP Data Requirements & Basis	During the development and preparation of the CAIP, NDEP will identify the specific data requirements and the basis for those data requirements which will be required for NDEP acceptance of the CAIP. These data requirements will be presented to DOE during the development of the CAIP.
	NDEP CAIP Review	NDEP reviews and prepares comments if appropriate. Review criteria are based on the informational requirements specified in the "Annotated Outline for UGTA Corrective Action Investigation Plan." NDEP approval is required prior to initiating any CAI-related activities.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 2 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CAI	**Collect New Data**	DOE will collect new data to address deficiencies in existing data, or to improve the assimilation and utilization of existing data. The data collection activities undertaken will be those specific tasks detailed in the CAIP or a revision to the CAIP.
	Evaluate Existing/New Data	DOE will evaluate new and existing data to determine whether this current dataset will allow for the development of an acceptable flow and contaminant transport model, and provide the data evaluation results to NDEP.
	NDEP Data Review/Input	NDEP reviews interim/final work products and supplemental materials, and attends presentations on the status of the investigation. NDEP then provides comments to DOE specifically aimed at data adequacy issues and the data evaluation process. NDEP input can take the form of identifying to DOE additional data collection activities that NDEP believes will be necessary to create an acceptable flow and contaminant transport model. After DOE completes its evaluation of existing and new data, and after NDEP has reviewed the information that was provided by DOE, NDEP will develop its determination concerning data adequacy.
	Are Data Adequate?	If both DOE and NDEP agree that the data are adequate, the answer to this question is yes. If either party determines that the data are not adequate, the answer is no.
	NDEP/DOE Evaluate Alternatives	If both parties cannot agree that data are adequate to develop a flow and contaminant transport model to meet the conditions of the strategy, or that the flow and contaminant transport model has not produced acceptable results, then NDEP and DOE will conduct an evaluation of the alternatives.
	Is The Strategy Achievable?	After NDEP and DOE have completed the evaluation of alternatives, the question “Is the Strategy Achievable?” can be answered.
	Develop CAIP Revision	If it is determined that the strategy is achievable, then DOE will develop and prepare a revision to the CAIP. The CAIP revision will address the identified needs, how these needs are translated to requirements, and what additional work activities will be conducted that are expected to address and/or satisfy these requirements. The CAIP revision will be structured as mutually agreed to by DOE and NDEP prior to document preparation. During the development and preparation of the CAIP revision, DOE will keep NDEP informed and updated in order to expedite NDEP’s review and approval.
	NDEP CAIP Revision Approval	NDEP reviews and provides comments if appropriate. NDEP approval of the CAIP revision is required prior to initiating CAI-related activities.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 3 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CAI	**Develop CAU Flow & Transport Model**	DOE will develop a flow and contaminant transport model for each CAU. The CAU-scale flow and contaminant transport model is a three-dimensional, mathematical representation of the important physical and chemical features of the flow system, and simulates the movement of a variety of radiological contaminants through the water-bearing units. First, a geologic model is constructed from surface and subsurface geologic and geophysical data. This geologic model is then used in conjunction with boundary fluxes, recharge and discharge data, hydraulic head data, and hydraulic conductivity data to develop a flow model. After completion of the flow model, the contaminant transport model is developed. The contaminant transport model will estimate the extent to which the migration of radionuclides exceeds the SDWA standards above background within 1,000 years, which will comprise the contaminant boundary. The contaminant boundary will be composed of a perimeter boundary and a lower hydrostratigraphic unit (HSU) boundary. As part of the contaminant transport modeling process, sensitivity and uncertainty analyses will be performed, which will include estimating the impacts of alternative models on flow and contaminant transport.
	NDEP Model Review & Input	The flow and contaminant transport model will be reviewed by DOE and presented to NDEP for review and evaluation. Both DOE and NDEP will evaluate the flow and contaminant transport model to determine whether it is acceptable for defining the contaminant boundary. Acceptance will only be granted for a fully calibrated and verified model. Calibration and verification are steps in the model validation process. Calibration refers to the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to achieve a desired degree of correspondence between the model simulation and observations of the groundwater flow system. Verification is using the set of parameter values and boundary conditions from the calibrated model of the CAU to approximate acceptably a second set of data measured under similar hydrologic conditions.
	Is the CAU Model Acceptable?	If both DOE and NDEP determine that the model is acceptable, the answer to this question is yes. If either party determines that the model is not acceptable, the answer is no.
	Define/Negotiate CAU Boundaries with NDEP	A CAU flow and contaminant transport model utilizing tritium and radionuclides with half-lives greater than tritium (12.32 years) as the source term will be used to estimate a contaminant boundary for each CAU. The boundary will be composed of a perimeter boundary and a lower HSU boundary. The accepted contaminant boundary and other considerations will form the basis for a negotiated compliance boundary.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 4 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CADD	**Prepare CADD**	The Corrective Action Decision Document (CADD) will present the results of the CAI along with an evaluation of the remedial alternatives being considered, and also provides the basis for recommending the proposed remedial alternative. The results of this evaluation will be presented with the CADD. The initial assumption is that long-term monitoring will be the accepted remedial action. The structure of the CADD is based on requirements specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation.
	NDEP CADD Review	NDEP reviews the preliminary draft along with the CADD and prepares comments, if appropriate. Review criteria are based on guidelines specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. NDEP approval of the CADD is required prior to initiating any Corrective Action Plan (CAP)-related activities.
CAP	**Is Contaminant Control Required?**	During the development of the CADD, a determination is made either that contaminant control will be required, or long-term monitoring will provide sufficient CAU surveillance. One of two separate courses of action will follow this juncture, as indicated on the process flow diagram.
	Develop Contaminant Control CAP	DOE prepares the Contaminant Control CAP, which specifies the corrective measures required to achieve contaminant control. The structure of the plan is based on requirements specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. The tasks to be implemented for contaminant control, and the engineering design and specifications for each corrective measure, are the focus of the document.
CAP	**NDEP Contaminant Control CAP Review**	NDEP reviews the preliminary draft along with the Contaminant Control CAP and prepares comments, if appropriate. Review criteria are based on guidelines specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. NDEP approval of the Contaminant Control CAP is required prior to initiating any elements of the CAP implementation or related activities.
	Implement CAP	Elements of the Contaminant Control CAP are carried out by DOE. This involves the implementation of each corrective measure task specified in the CAP. DOE develops the schedule and keeps NDEP informed of progress as the work continues. NDEP may inspect or review completed elements of the work at intervals deemed appropriate throughout the implementation of the CAP.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 5 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CAP	**Develop Monitoring CAP**	DOE prepares the Monitoring CAP which specifies the monitoring required. The structure of the plan is based on requirements specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. The plan outlines the monitoring strategy and its basis, the engineering design and specifications for the monitoring well network, the post-closure plan, and a 5-year proof-of-concept phase. Additionally, the planned monitoring and reporting procedures are specified including sampling frequency; analytes to be sampled for; and the data reporting, data validation, and analysis of results to be periodically performed.
	NDEP Monitoring CAP Review	NDEP reviews the preliminary draft along with the Monitoring CAP and prepares comments, if appropriate. Review criteria are based on guidelines specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. NDEP approval of the Monitoring CAP is required prior to initiating any elements of the Monitoring CAP implementation or related activities.
	5-Year Proof-of-Concept Monitoring	A 5-year proof-of-concept monitoring network will be developed in accordance with the CAP. This phase of monitoring will use groundwater wells in a monitoring network to determine whether the monitoring network design will provide adequate CAU surveillance. Measurements of field parameters will be used to demonstrate that the model is capable of making reasonable predictions that fall within an acceptable level of confidence. Model validation, to ensure fidelity of the model to the physical system, will utilize a ten-step protocol to demonstrate that a model has been developed which meets user needs. These ten steps are: 1) Establishment of model purpose, 2) Development of conceptual model, 3) Selection of a computer code and verification of code, 4) Model design, 5) Model calibration, 6) Sensitivity and uncertainty analyses, 7) Model verification, 8) Predictive simulations, 9) Presentation of model results, and 10) Post-audit. The validation post-audit step tests whether the model can predict future system behavior. The five-year proof of concept is the model post-audit to establish, within a longer time frame, that the model is capable of producing meaningful results with an acceptable degree of uncertainty. Model validation is substantiated once all ten steps are shown to have been acceptably completed.
	Are Monitoring Results Acceptable to NDEP?	NDEP reviews the results of the 5-year proof-of-concept monitoring and determines whether they are acceptable.

Table 3-1
Process Flow Diagram Dictionary for the Underground Test Area Corrective Action Units
(Page 6 of 6)

PROCESS SECTION	BLOCK DESCRIPTOR	DEFINITION OF THE PROCESS STEP
CR	**Develop CR**	If the results of the pre-closure monitoring fall within limits previously defined in the Monitoring CAP, a CR will be prepared to propose that the CAU be designated a closed site. The CR will describe the results of closure, establish long-term monitoring requirements for the CAU, develop technical and administrative contingency plans for actions to be taken if long-term monitoring results are not acceptable, and define future land-use restrictions. The structure of the report is based on requirements specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation.
	NDEP CR Review	NDEP reviews the preliminary draft along with the CR and prepares comments, if appropriate. Review criteria are based on guidelines specified in the most recent document outline agreed to by DOE and NDEP prior to document preparation. NDEP approval of the CR is required prior to initiating any Long-Term Closure Monitoring-related activities.
	Long-Term Closure Monitoring	DOE performs long-term monitoring in accordance with the specific monitoring requirements stated in the CR. NDEP reviews periodic monitoring results and ensures that the monitoring provisions in the CR are followed.
	Propose New Strategy	If the current strategy is found not to be achievable, a new strategy will be proposed by DOE.
	Negotiate With NDEP	Following the proposal of a new strategy, NDEP will review the new strategy. NDEP and DOE will negotiate the overall approach and general conditions of the strategy.
	Develop New Strategy	Once a consensus regarding the general conditions of the strategy has been reached between DOE and NDEP, DOE will fully develop the details of the new strategy.
	Execute New Strategy	DOE and NDEP implement their respective tasks, as outlined in the new strategy.

4.0 Soils Sites

Soils Sites CAUs consist of surface and shallow subsurface soil contamination resulting from various types of nuclear experiments or testing. If a CAS contains significant quantities of contaminated debris in addition to soil, it will be investigated and remediated as an Industrial Sites CAS.

4.1 Corrective Action Units

The following CAUs have been identified as Soils Sites:

- Ninety-four of the atmospheric tests conducted at the NTS — including airburst, air drop, balloon, rocket, surface and tower types — are currently grouped into Atmospheric Test CAUs based on geographic location. Resolution of scientific and engineering corrective action issues for the Atmospheric Test CAUs will provide a technical basis to subdivide the CAU. The CAUs are:

  - Areas 1, 3, 4, 7 South Yucca Flat Atmospheric Sites
  - Areas 2, 8, 9, 10 North Yucca Flat Atmospheric Sites
  - Areas 5, 11 Frenchman Flat Atmospheric Sites
  - Area 18 Buckboard Mesa Atmospheric Sites
  - Small Boy

- Safety experiments and storage-transportation tests that produced no or very slight yield but created surface contamination were conducted at five locations on the NTTR, including the TTR; at Plutonium Valley in NTS Area 11; and at GMX in NTS Area 5. Contamination from these CAUs is limited to surface soils. The depth of contamination may vary among CASs, but it is not expected to exceed 1 foot at any site. The CAUs are:

  - Double Tracks Plutonium Dispersion (NTTR)
  - Clean Slate 1 Plutonium Dispersion (TTR)
  - Clean Slate 2 Plutonium Dispersion (TTR)
  - Clean Slate 3 Plutonium Dispersion (TTR)
  - Project 57 No. 1 Plutonium Dispersion (NTTR)
  - Area 11 Plutonium Valley Unit Safety Shots
  - Area 5 GMX Unit Safety Shots

- Six CAUs resulting from cratering and plowshare tests are included in the Soils Sites. The cratering and plowshare tests consisted of using nuclear devices to excavate large volumes of earth. Contamination from these tests includes subsurface impacts (less than

300 meters [m] [984 ft] deep) and impacts to surface soils caused by material expelled during testing. The CAUs are:

- Area 10 Sedan, ESS and Uncle Unit Craters
- Area 30 Buggy Unit Craters
- Area 20 Cabriolet/Palanquin Unit Craters
- Area 20 Schooner Unit Crater
- Area 18 Johnnie Boy Unit Crater
- Area 18 Danny Boy Unit Crater

- The Hydronuclear CAU consists of four CASs. Most of these CASs have impacted shallow subsurface soils of depths less than 30 m [98 ft]. No surface soil impacts are expected.

Figure 4-1 is a map of currently identified Soils Sites CAUs.

4.2 Corrective Action Strategy

The corrective action strategy for Soils Sites will be based on either the SAFER or complex corrective action process. The decision regarding which process is most appropriate depends on CAU DQOs and the amount of existing knowledge and data. If the existing knowledge is sufficient to allow the selection of a corrective action alternative before completing a CAI, then the SAFER process will be employed. If there is not enough knowledge to propose a corrective action, then the complex process will be used.

Corrective actions will be performed at surface and subsurface Soils Sites. Surface soil remedies will include removal of materials located in small selected areas following *in situ* identification. Larger areas will require the use of mechanical excavation devices to remove contaminated materials, such as size separators or other physical processes to reduce waste volumes. Subsurface remedies will range from clean closure to closure in place.

Corrective action alternatives will be based on applicable regulatory standards or proposed cleanup levels, if no standards apply. Proposed levels will be based on pertinent factors including but not limited to assessment of risk, current and projected land use, resource management, and technical feasibility.

4.3 Implementing Corrective Action Investigations and Corrective Actions

Figure 4-2 presents the corrective action approach for Soils Site CAUs. CASs will be grouped into manageable CAUs, prioritized for corrective action, and a preliminary characterization

performed based on existing data. These data will be used to guide appropriate investigation and corrective action tasks, as well as to select a corrective action process. The DQOs will be established by the parties with NDEP participation to assist in the development of work scope. Stakeholder input may be required depending on the nature of the work scope.

Either the SAFER or complex corrective action process will be selected for Soils Sites CAUs, based on site conditions. The following sections describe the work flow process and decision points necessary to implement corrective actions for Soils Sites.

4.3.1 SAFER Process

Many of the Soils Sites CAUs have a sufficient amount of historical data and contamination characterization available to provide adequate information to propose a corrective action alternative without completing a CAI. At these CAUs, the SAFER process may be employed. Investigation will be necessary at these CAUs to document and verify the adequacy of existing information, to affirm the selected corrective action, and to provide sufficient data to implement the corrective action. Corrective action activities may progress during the CAI.

If regulatory standards do not exist for the identified contaminants, it may be necessary to evaluate appropriate factors, including risk, to develop proposed cleanup levels. The pertinent factors and subsequent evaluation will be formulated in cooperation with NDEP prior to the completion of the SAFER Plan.

A SAFER Plan will be developed, incorporating the essential elements of a CAIP, CADD, and CAP and will be used to guide both CAU actions and decisions. The document will include contingency plans if site conditions are other than expected. If specific conditions or findings fall outside the bounds of the SAFER Plan, the CAS will be transferred to another CAU and the complex process used. Following completion of SAFER process activities, a CR will be prepared and submitted to NDEP.

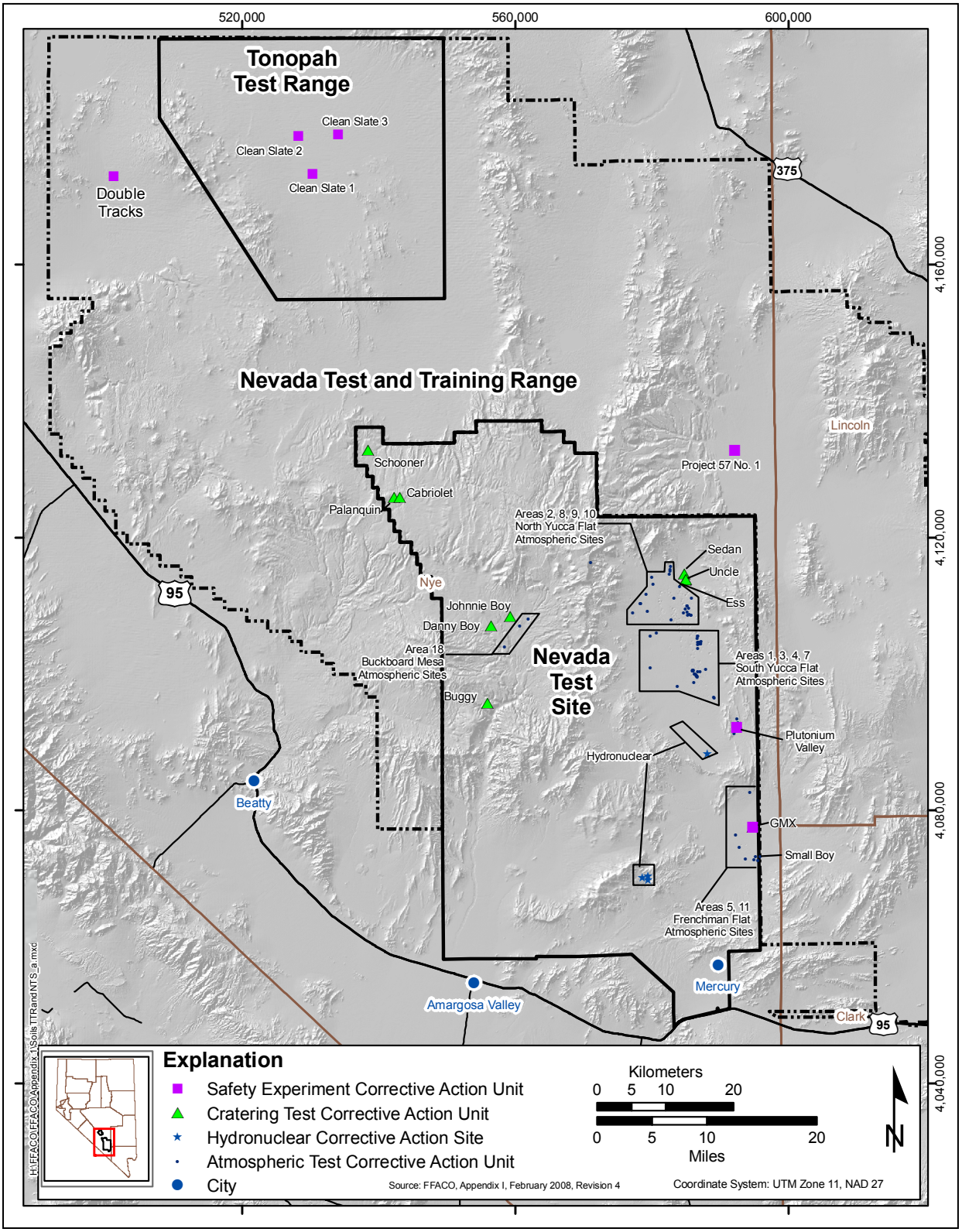

Figure 4-1
Soils Sites Corrective Action Units

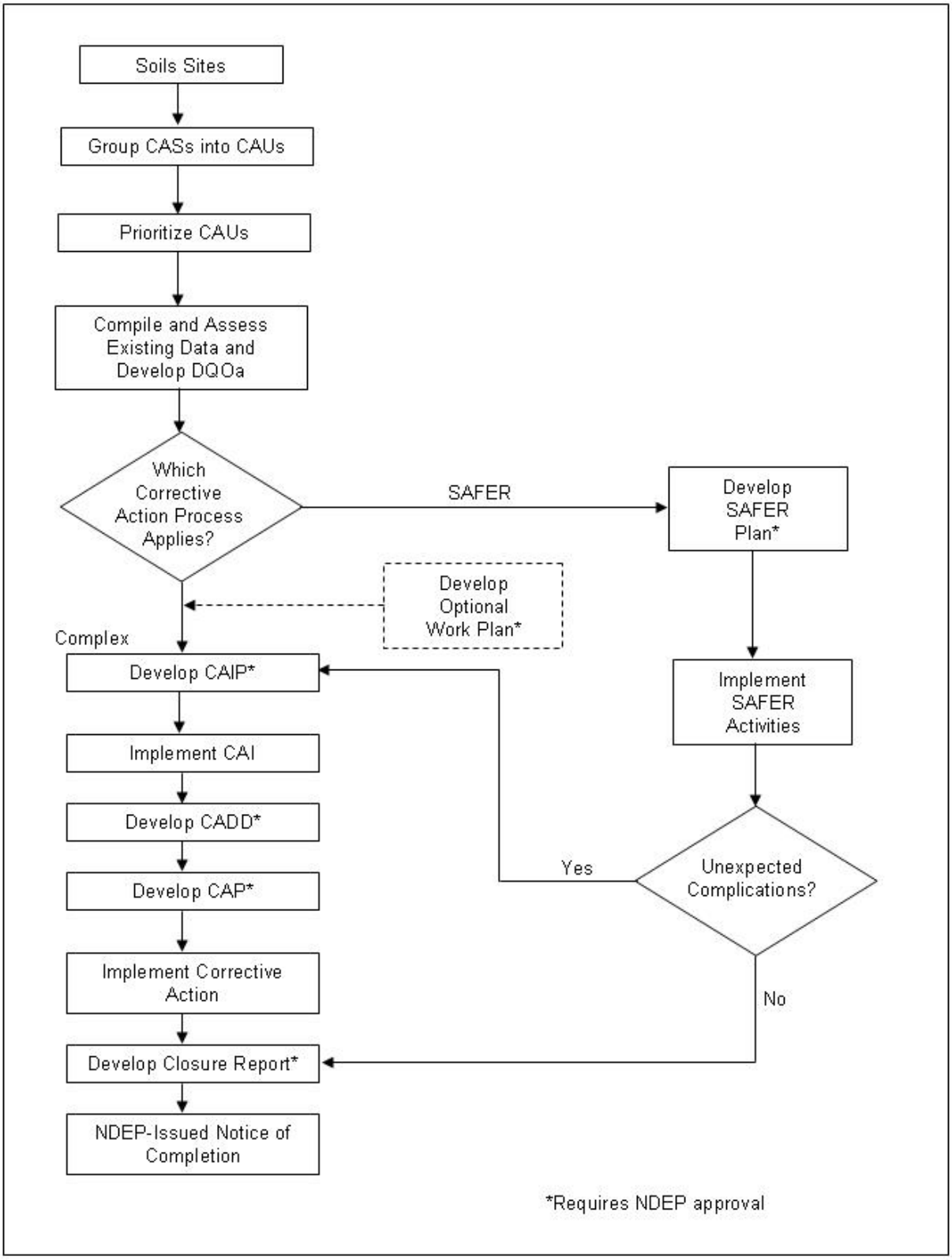

Figure 4-2
Soils Sites Corrective Action Process

4.3.2 Complex Process

If existing CAU knowledge is inadequate to propose a corrective action alternative, the complex process will be used. A CAIP will be prepared to guide investigative tasks to acquire necessary data to complete a CADD. The DQOs will be incorporated into the CAIP to ensure that collected data will be used in evaluating corrective action alternatives.

Corrective action alternatives will be evaluated in a CADD and a corrective action proposed. The development of the CAP and the implementation of the corrective action will begin after NDEP approval of the CADD. A CR will document the completion of corrective action activities and submitted to NDEP. After approval of the completion of the corrective action, NDEP will issue a notice of completion and the CAU will be moved to Appendix IV (Closed Corrective Action Units).

5.0 Offsites

Offsites within the State of Nevada consist of the PSA and the CNTA, each considered a separate CAU based on geographic location. In August 2006, a modification to the FFACO was completed to transfer the responsibility for the Nevada Offsites from the DOE/Environmental Management (EM) to the DOE/LM. Starting on October 1, 2006 (FY 2007), all responsibility was assumed by LM for future work done at the Nevada Offsites.

5.1 Corrective Action Units

CASs associated with the PSA and the CNTA include an underground nuclear test and sites associated with drilling activities.

5.2 Corrective Action Strategy

Corrective action strategies for surface and shallow subsurface sites at the PSA and the CNTA CAUs are identical to the Industrial Sites corrective action process, as shown in Figure 2-1. Efforts to compile existing data at these CAUs are under way, and these data will be used to develop conceptual models and provide the basis to apply DQOs for data collection and evaluation. The selection of a corrective action process will be based on site-specific information and conditions.

The concepts being developed for the UGTA CAUs will be applied on a more limited scale to groundwater at the Offsites. Each was the site of one underground nuclear test. The strategy will be to characterize groundwater flow and contamination transport through modeling utilizing CAU-specific hydrologic data. The focus will be on tritium, because based on presently available data, it is the most mobile of the potential radiological contaminants. Maximum use will be made of existing data, including monitoring data collected from the Long-Term Hydrologic Monitoring Program (LTHMP) well networks at each area. If the results of the hydrologic studies so indicate, then a decision will be made to evaluate the need for source control or containment and implement as appropriate, or continue the monitoring program. If the modeling results are acceptable, then the monitoring program will be continued. LTHMP sampling has been performed annually at the PSA and the CNTA since 1972.

5.3 Implementing Corrective Action Investigations and Corrective Actions

Surface and shallow subsurface CASs will follow the corrective action processes described in Section 2.3.

If the areas of potential groundwater contamination are not adequately bounded by the present LTHMP networks, or if there are potential exposure pathways not presently monitored, additional sampling points could be added to the LTHMP networks. As of the effective date of this Agreement, no specific, proven cost-effective technologies, as known by the parties individually, have been previously demonstrated to either remove radioactive contaminants from the groundwater, stabilize them, or remove the source of the contaminants. Such technologies may be perfected in the future, which may perhaps alter the choice of corrective actions at that time. In addition it may be necessary to institute use restrictions on groundwater in a buffer zone surrounding the CAS to further protect against potential human exposure. The CR will also establish long-term monitoring requirements for the CAU, including contingency plans for actions to be taken if long-term monitoring results are not acceptable.