Key Planning Factors

For Recovery from a Biological Terrorism Incident

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FOREWORD:

The "The Key Planning Factors for Recovery from a Biological Terrorism Incident is a draft document developed by Lawrence Livermore National Laboratories (LLNL) under contract to DHS S&T as a stand-alone deliverable to the Wide Area Resiliency and Recovery Program (WARRP). This document is part of the Response and Recovery Knowledge Products (RRKP) data transition agreement established between DHS S&T and FEMA in September 2011. It is designed to identify key planning factors that could substantially aid the recovery process by decreasing the recovery timeline and costs, improving public health and safety, and addressing major resource limitations and critical decisions.

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Key Planning Factors for Recovery from a Biological Terrorism Incident

Executive Summary

If a biological terrorism incident were to occur in a major U.S. city, current response and recovery planning would not support a rapid regional recovery. Identifying issues that should be examined and planned ahead of time will save time, resources, and lives. We have identified Key Planning Factors that will lead to knowledge or planning efforts with the potential to substantially influence the recovery process. Their influence extends to increasing the rate of recovery, reducing recovery costs, improving public health and safety, or addressing major resource limitations or critical decisions that may impact overall recovery success. This document does not provide solutions but lists areas local planners in conjunction with local federal experts (such as EPA On-Scene Coordinators (OSCs)) should consider in advance. Key Planning Factors describe some, but not all, areas where prior planning will significantly aid emergency operations in the event of an incident

Key Planning Factors fall into the following categories:

1. *Establish a Characterization Strategy*. Initially there will be limited knowledge of where the contamination may be and who may have been exposed. . A characterization strategy is required to pre-determine appropriate sampling methods, sampling numbers and locations, decision support and modeling tools, analytical methods and laboratories, and data quality objectives.

2. *Prepare a Medical Plan.* The magnitude of the contaminated area and sheer numbers of potentially exposed and symptomatic people will rapidly overwhelm public health and medical services. Failure to provide timely medical services could greatly increase mortality rates and the burden on the limited medical infrastructure. A Medical Plan will facilitate effective public health response and recovery, and minimize casualties by addressing epidemiological concerns, prophylaxis distribution and control, and medical care concerns.

3. *Establish Operational Guidelines*. During a wide-area biological release, the magnitude and complexity of the problem (indoors and outdoors) and competing interests (regulatory, economic, public safety), in combination with multiagency jurisdictions, will challenge existing operational frameworks and processes. Developing clear operational guidelines for recovery pre-incident will prevent delays and conflicts during high-stress response and recovery activities.

4. *Establish Debris Management Strategies*. Unprecedented quantities of waste and debris will be produced during an incident of this magnitude. A Debris Management Strategy describing waste will require staging areas, treatment areas, transportation, documentation, acceptance sampling, and agreements with facilities for ultimate disposal will facilitate recovery and reduce the extent of contamination.
5. *Establish Clearance Goals*. Clearance goals are imperative to all aspects of recovery, and lack of clear clean-up standards will cause extensive delays. Risk-based clearance goals must be established in order to proceed with characterization, decontamination, and waste management approaches, as well as to allow release of uncontaminated areas and define self-decontamination standards.

Recovery from a major disaster such as a biological warfare agent attack will challenge every level of government and all its citizens. Through careful planning activities, recovery processes may be improved with savings of time, funding, and the wellbeing of the public. This document identifies issues that, if addressed, will allow local, state, and Federal agencies to be better prepared to face a disaster of such magnitude. It should be noted that the discussion in this document is based on a *Bacillus Anthracis* incident, as this is a persistent biological agent and results in one of the most challenging recovery scenarios.

1 Introduction

Although significant progress in consequence management has been made recently, consequence management following a wide-area chemical, biological, or radiological (CBR) attack continues to pose an extreme challenge for rapid return to service and recovery. Emergency response activities will typically follow well-established principles; however, long-term recovery from acts of terrorism requires additional planning and includes a broad range of interests and stakeholders. Public safety is paramount, and economic factors will mandate a quick recovery.

In general CBR incidents are different than incidents that emergency managers regularly encounter. CBR incidents cause a different type of damage, require decontamination, cause heightened public anxiety, have a greater potential for casualties, and result in substantial disruption to citizens' lives and the economy.

Figure 1-1. Vehicle mounted decontamination application during IBRD Program 2010.

In this document, considerations for improved planning for consequence management after a biological attack are discussed, including determining what must be cleaned up, and selecting appropriate and effective decontamination processes and techniques (**Figure 1-1**) to meet specified clearance goals.

The purpose of this document is to identify key areas where pre-planning can have significant impact during response and recovery from a biological incident. It is a companion document to three other Key Planning Factors documents, two of which focus on key planning factors for radiological and chemical incidents while the third describes key planning factors for critical infrastructure and economic recovery. All four documents are built on numerous consequence management, response, and recovery technical and policy guidance documents, including the *National Disaster Recovery Framework (NDRF)* (FEMA 2011), *National Preparedness Goals* (NPG) (FEMA 2011), *Presidential Policy Directive 8: National Preparedness* (PPD-8, 2011), the *Interim Consequence Management Guidance for a Wide-Area Biological Attack (LLNL 2011)*, and the Federal Register Notice, *Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidences* (DHS 2008).

1.1 Key Planning Factors and Recovery Support Functions

The *whole community* concept described in the NDRF and NPG includes a recovery process where communities recognize that through pre-disaster planning they can address long-term recovery in a more effective and efficient manner. All stakeholders in a community (volunteer, faith and community-based organizations, the private sector, and the public) are needed to help plan a successful recovery from a catastrophic incident. The NDRF states that:

> "*Successful recovery depends on all recovery stakeholders having a clear understanding of pre- and post-disaster roles and responsibilities….*" (pg. 19)

This document identifies areas where a small preparedness and planning effort ***before*** the incident can greatly reduce cost and speed recovery. Although the focus of this activity is recovery, the scenario presented here also discusses response actions, as actions taken during response affect recovery. The document does not provide solutions but lists areas local planners in conjunction with local federal experts should consider in advance. A significant local resource is the EPA On-Scene Coordinator (OSC).

Key Planning Factors (KPFs) are those areas where preplanning activities have the potential to substantially influence the recovery process by increasing the rate of recovery, reducing recovery costs, improving public health and safety, or addressing major resource limitations or critical decisions with the potential to impact overall recovery success.

KPFs, therefore, are those issues that should be examined prior to an incident. The KPFs discussed are derived from considerations identified through the *Wide Area Recovery and Resiliency Program (WARRP) Systems Study* (SNL, 2012a), a WARRP CBR Workshop held in Denver, CO, on January 30 to 31, 2012, the four-year Interagency Biological Restoration Demonstration (IBRD) Program, the Interim Consequence Management Guidance for a Wide-Area Biological Attack prepared at the request of the Homeland Security Council (LLNL 2010), and several DHS facility studies. They are coordinated with the NDRF recovery support functions and NPG Recovery Mission Area Capabilities. These KPFs do not encompass the totality of the planning process nor all of the issues that need to be addressed, but instead they clarify some of those issues that will benefit most from pre-disaster planning.

A major recovery support function involving critical infrastructure cuts across all KPFs as well as all-hazards planning. A separate document, *Recovery from CBR Incidents: Critical Infrastructure and Economic Impact*

Considerations (SNL, 2012b) addresses processes for prioritizing critical infrastructure for characterization, decontamination, and clearance activities. Economic drivers will be crucial to prioritization and are discussed in that report.

NDRF Recovery Support Functions	**NPG Recovery Core Capabilities**	**Wide Area Recovery & Resiliency Program *Biological* Key Planning Factors**
Community Planning and Capacity Building	Planning	All KPFs
	Operational Coordination	Establish Operational Guidelines
		Establish Debris Management Strategies
Economic	Economic	*See Recovery from CBR Incident: Critical Infrastructure and Economic Impact Considerations (SNL, 2012b)*
Health and Social Services	Health and Social Services	Prepare Medical Plan
		Establish Clearance Goals
		Establish Characterization Strategy
Housing	Housing	*Not addressed in this document*
Infrastructure Systems	Infrastructure Systems	Establish Characterization Strategy
		Establish Clearance Goals
Natural and Cultural Resources	Natural and Cultural Resources	Establish Operational Guidelines
		Establish Characterization Strategy
		Establish Clearance Goals

Figure 1-2. Interrelationships between KPFs, NDRF RSFs and NPG Recovery Mission Area Capabilities.

1.2 KPFs in relationship to NDRF and NPG

In Figure 1-2, the KPFs discussed in this document are listed in relation to the NDRF recovery support functions and NPG Recovery Mission Area Capabilities, and show how they align.

Because consequence management for wide-area disasters can escalate quickly into a substantially unmanageable problem, the purpose of identifying KPFs is to prevent, to the extent possible, the multitude of consequence management issues from becoming intractable and limiting recovery success. The primary goal of KPF documents such as this one is to highlight a few of the crucial recovery issues in a manner that will re-energize and refocus pre-disaster planning efforts. Thus, the objective of this document is not to solve all the problems associated with biological incident recovery but instead to serve as a catalyst to plan for these problems well ahead of an incident.

The audience for the KPF documents consists of planners and stakeholders within the planning community who would be involved in CBR response and recovery activities, including as appropriate local, regional, state, and Federal partners. Through a narrative scenario, the documents attempt to illustrate the response and recovery process while identifying critical areas that will benefit from pre-planning.

This document provides general background on the phases of response and recovery during a biological incident in Section 2. The scenario in Section 3 illustrates considerations related to response and recovery, and is divided into short-term, intermediate-term, and long-term response and recovery phases consistent with the NDRF. KPFs are identified and then discussed in greater detail in Section 4. This discussion is followed by a summary of how a biological incident differs from chemical, radiological, and other all-hazards incidents. Differences between *Bacillus anthracis* and other biological agents are also briefly described. Finally, planning recommendations and conclusions are provided in Section 5.

1.3 Assumptions and Limitations

This document does not describe how to prepare a plan for CBR response and recovery or provide a playbook on how to respond during a CBR incident. Planning guidance for regional recovery planning may be found in the *National Urban Area Recovery Planning Tools: Recommendations for Developing Regional Disaster Recovery Plans* (PNNL, 2012) prepared as a part of WARRP.

Instead, this document walks the reader through one possible scenario to provide the context and foundation for addressing the KPFs. Where appropriate, references are provided to other key resource documents that enable the reader to further research specific details of a particular subject.

2 Response and Recovery Phases

A common misconception is that recovery begins after the response phase. Recovery, however, actually begins during response with many initial recovery activities taking place in parallel with similar response activities. Recovery planning and recovery of certain critical facilities are both so important that they will begin early. Also, response actions taken will have a large impact on future recovery, thus both must be considered together. Key Federal documents that describes this include:

- *The National Disaster Recovery Framework*, (Federal Emergency Management Agency, September 2011)
- *Draft Planning Guidance for Recovery Following Biological Incidents* (DHS-EPA, 2009)

These documents describe similar phases; however, the focus and terminology are slightly different. As presented in *the 2011 National Disaster Recovery Framework* (NDRF), an incident can be divided into short-, intermediate, and long-term phases. The *Draft Planning Guidance for Recovery Following Biological Incidents* (DHS-EPA, 2009) divides the incident into Notification, First Response, Characterization, Decontamination, Clearance and Restoration/Reoccupancy. This guidance also has been applied to Chemical Incidents (LLNL, 2012), and has many similarities to Radiological Response and Recovery tasks.

The two approaches to the problem do not match exactly, as one is time based (Figure 2-1a from the NDRF) and the other is task base (Figure 2-1b from DHS/EPA, 2009). This comparison of the phases is useful to allow coordination between different entities with different responsibilities.

The following paragraphs describe the task-based phases as functions within a time-phase framework. It is understood that this is not a perfect correlation, but may be a useful comparison.

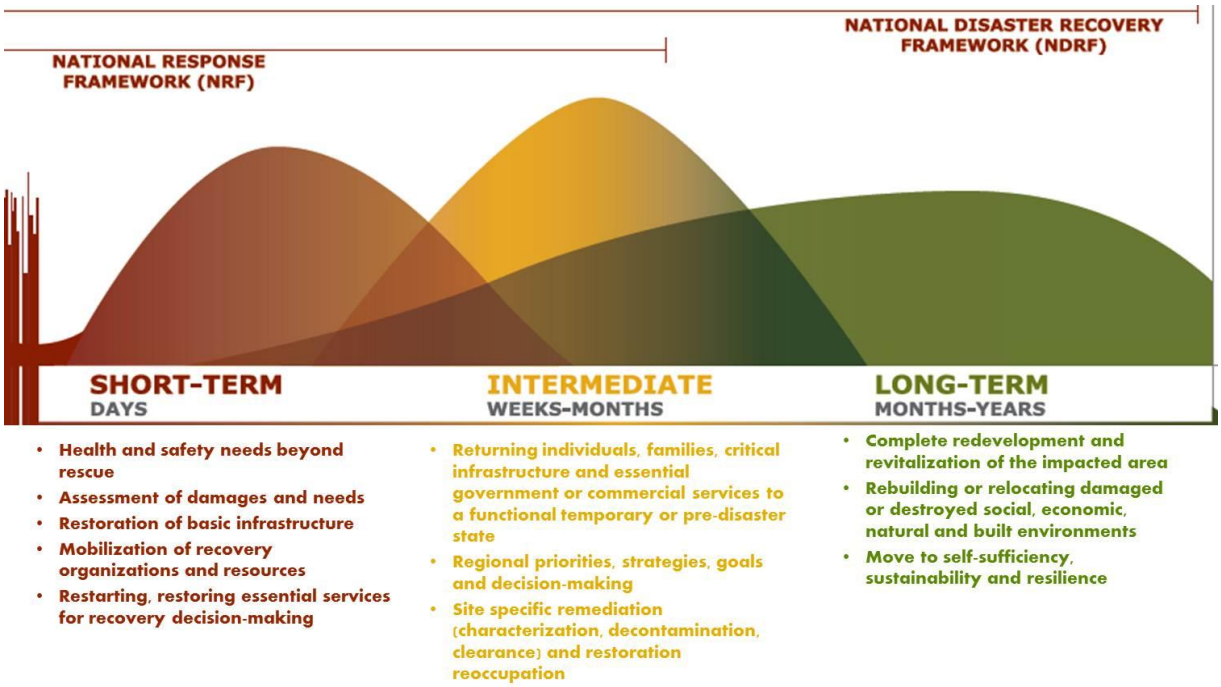

Figure 2-1a, Time-based Response and Recovery Phases (NDRF FEMA, 2011)

Response and Recovery*					
		Remediation/Cleanup			
Notification	First Response	Characterization	Decontamination	Clearance	Restoration/ Reoccupancy
Receive information on biological incident Identification of suspect release sites Notification of appropriate agencies	Initial threat assessment HazMat and emergency actions Forensic investigation Public health actions Screening sampling Determination of agent type, concentration, and viability Risk communication	Characterization of biological agent Characterization of affected site(s) Site containment Continue risk communication Characterization environmental sampling and analysis Initial risk assessment Clearance goals	Decontamination strategy Remediation Action Plan Worker health and safety Site preparation Source reduction Waste disposal Decontamination of sites or items Decontamination verification	Clearance environmental sampling and analysis Clearance decision	Renovation Reoccupation decision Long-term environmental and public health monitoring
*The optimization decision process is applicable to any phase					

Figure 2-1b, Tasked-based Response and Recovery Phases (DHS-EPA, 2009)

2.1 Short-Term Phase

The short-term phase initiates response, which begins with the identification of an incident, continues with notification and emergency first-response, and continues for as long as emergency personnel are present. It also includes initial recovery actions as described in the NDRF. "The short-term recovery phase addresses the health and safety needs beyond rescue, the assessment of the scope of damages and needs, the restoration of basic infrastructure and the mobilization of recovery organizations and resources including restarting and/or restoring essential services for recovery decision making." (FEMA, 2011).

2.2 Intermediate-Term Phase

The intermediate-term phase engages technical experts and stakeholders to perform on-going assessment and evaluation of risks, and to prioritize and make decisions for the wide-area context under the Incident/Unified Command (IC/UC) of the National Incident Management Structure (NIMS). The intermediate-term phase also begins site-specific remediation and restoration, which includes characterization, decontamination, and clearance, as well as restoration/reoccupation of individual indoor or outdoor sites. For simplicity, clearance and restoration/ reoccupation are discussed under the long-term phase, section 2.3.

2.2.1 Important Functions within the Intermediate Phase

Risk Assessment. This step focuses on performing environmental sampling to determine the extent of contamination; assessing environmental characteristics of the CBR agent that affect its subsequent spread, such as its survivability on surfaces and potential for tracking, vaporization, and reaerosolization.; and characterizing and communicating the impacts and risks in terms of the potential health consequences to humans and harm to the environment. An environmental risk assessment for remediation purposes is conducted. Collected information is evaluated to identify and evaluate risk-reduction options for indoors and outdoors. On-going risk assessment may include long-term environmental and public health monitoring.

Prioritization. During this activity, engaging stakeholders is crucial in order to develop regional recovery priorities and to prioritize the areas and facilities. Because of critical access issues and the likelihood of recontamination, certain outdoor areas may be given priority.

Characterization Phase. The focus in this phase is on planning and performing characterization environmental sampling to determine the extent of contamination at each particular site. Characterization may define broad bands for the hot/high concentration zone, cold (meets cleanup/acceptable) concentration

zone, and the middle zone. Collected information is evaluated to determine what types of decontamination are needed for each location within this site. Figure 2-2 shows a representative characterization team member recording a sample location.

Figure 2-2. Characterization team member recording sample location information.

Decontamination Phase. The decontamination phase, which begins in the intermediate phase and may continue into the long-term phase, focuses on preparing and implementing detailed plans for decontaminating those contaminated items, areas, and facilities deemed suitable for such treatment.

During this phase scenario- and site-specific decontamination reagents and delivery systems will be selected (figure 2-3), and all systems will be evaluated and tested if necessary before carrying out chemical treatments. Weathering/monitored natural attenuation may also be an adequate decontamination option. In cases where contamination is not extensive or the agent is not environmentally persistent, application of surface decontaminants or other methods of medical infection control may be effective. For extensive contamination, especially in indoor areas by agents such as *Bacillus anthracis*, fumigation is an option. In those cases, source reduction is considered, which involves removing salvageable and non-salvageable items, and pre-cleaning surfaces to reduce contaminant load Figure 2-3 shows an example of decontaminant application.

Figure 2-3. Hand-held decontamination application during IBRD Program 2010.

2.3 Long-Term Phase

In the case of a wide-area contamination involving potentially hundreds to thousands of buildings and outdoor sites, the remediation and restoration phases may stretch into the long term, particularly since the decontamination processes will likely require the use of scarce

resources. Waste management is also a major activity that bridges the intermediate- and longer-term recovery phases.

2.3.1 Important Functions within the Long-Term Phase

Clearance Phase. This phase, which begins in the intermediate phase, focuses on determining whether clearance goals have been met. Appropriate experts (generally the Technical Working Group and the Environmental Clearance Committee) review and evaluate key data, such as characterization and clearance environmental sampling results, decontamination process parameters and verification results, quality assurance and quality control (QA/QC) data, and other relevant information. Clearance criteria are applied to judge the effectiveness of any decontamination processes that may have been used. Final decisions on clearance are made by local, state, or Federal public health officials, or government agencies, depending on site-specific jurisdictional authorities.

Restoration & Reoccupation Phase. The focus for this phase is on preparing an area or facility for re-occupancy, reuse, or refurbishment, such as renovating indoor areas that have undergone fumigation. Restoration can include upgrading equipment in critical infrastructure to mitigate the effect of possible future attacks.

3 Illustrative Scenario

The biological scenario is presented in terms of the short-, intermediate-, and long-term recovery phases identified in the NDRF (FEMA 2011). Understanding the progression of the response and recovery phases provides a backdrop to demonstrate the significance of the KPFs.

3.1 Scenario Initiation, Agent Description, and Timeline

On an autumn Monday morning, a specially fitted truck drives north on I-25 near downtown Denver, Colorado. As the truck crosses the South Platt River on I-25 just north of exit 210A and the Auraria Parkway, the driver's companion turns on a concealed improvised spraying device with a conventional nozzle that rapidly aerosolizes a wet-fill slurry of *Bacillus anthracis* (which causes anthrax). The wind blowing out of the west moves the plume eastward over the Auraria campus, downtown Denver, and government buildings which include the state capitol as well as city and county buildings (Figure 3-1).

Figure 3-1. Schematic image of the *Bacillus anthracis* release point in this hypothetical scenario.

Approximately 50 minutes later, a second truck drives along E. Alameda Parkway in Aurora, CO, releasing a second cloud of *Bacillus anthracis*. The wind blows the cloud over Buckley Air Force Base (AFB) contaminating the airstrip. Both releases are covert. Two days later, analysis of Denver area BioWatch samples detects the presence of *Bacillus anthracis*, and it is determined that a bioterrorism incident has occurred. The appropriate notifications are made, while patients begin to report to metro area hospitals. The incident timeline is provided in Figure 3-2.

Figure 3-2, Timeline of major activities in the hypothetical scenario

3.1.1 Agent Description and Effects, Distribution, Fate, and Transport

Bacillus anthracis in spore form is very hardy and can live in the environment for many years. Anthrax is a bacterial disease caused by *Bacillus anthracis*. It is not contagious. Anthrax was described in the early literature of the Greeks, Romans, Egyptians, and Hindus. The term *anthrakis* means coal in Greek, and the disease is named after the black appearance of its cutaneous form (affecting the skin). There are three types of this disease: cutaneous anthrax, gastrointestinal anthrax, and inhalation anthrax. *Bacillus anthracis* spores delivered by aerosol spray result primarily in inhalation anthrax, which develops when the bacterial organisms are inhaled into the lungs. A progressive infection follows. In most people, a lethal infection is expected to result from inhalation of about 8,000 spores (NRC, 2005); however, a small number of people (particularly the elderly, very young, and immunocompromised) may become ill from an exposure as small as 2 to 4 spores (based of assessment of Sverdlovsk victims) (Wilkening, 2006), (HHS, 2011).

Respiratory infection in humans initially presents with cold or flu-like symptoms for several days, followed by severe (and often fatal) respiratory collapse. Mortality is very high with inhalation anthrax; however, particles must be aerosolized and within the proper size range (diameter of 1 to 10 microns) for adherence within the lungs. Historical mortality was 92%, but when treated early (as seen in the 2001 anthrax attacks) observed mortality was reduced to 45% Distinguishing pulmonary anthrax from more common respiratory illnesses is essential to avoiding delays in diagnosis and thereby improving outcomes. Illness progressing to the phase in which symptoms occur rapidly has a

97% mortality regardless of treatment. (NIH, 2006), (HHS, 2011).

Gastrointestinal anthrax requires spores to be ingested. If untreated, mortality also is very high, but with antibiotic treatment mortality rates are low. Cutaneous anthrax requires spores to enter through a break in the skin. This form is generally easily treated. Most cases from these airborne releases will be inhalation anthrax, however, medical care providers can also expect to see and should be prepared to identify gastrointestinal and cutaneous anthrax cases (although in fewer numbers). Prophylaxis (antibiotics) and vaccines are available for most strains of *Bacillus anthracis*.

The release in this hypothetical scenario would be expected to extend to tens of square miles at each release location. Various national assets would be activated, including the Interagency Modeling and Atmospheric Assessment Center (IMAAC), a DHS led interagency program. IMAAC would provide plume modeling incorporating meteorological, geographic, and demographic data, as well as hazardous material information to produce graphics similar to those shown in Figure 3-3.

Predicting the fate and transport—spore persistence and movement—of a biological agent like Bacillus anthracis can be a major challenge because the physical transport properties (e.g., particle size, adhesion, and agglomeration) depend on how the agent was formulated. Secondary aerosolization (reaerosolization or resuspension) of Bacillus anthracis spores also has the potential to increase exposure populations and the extent of contamination. Current scientific understanding of this process does not allow for detailed predictions of reaerosolization (Raber, 2011; Weis et al., 2002).

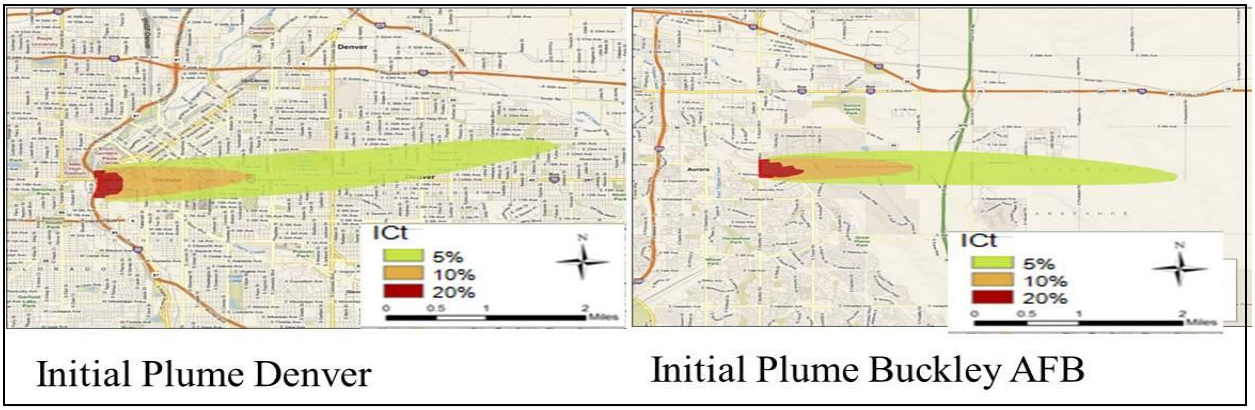

Figure 3-3. Examples of plume maps that may be generated to support response and recovery activities.

3.2 Short-Term Response and Recovery

This first phase is the first few hours or days of the incident when immediate actions may be required to save and sustain life, including actions to reduce or avoid exposure to the public and first responders. Actions in this period are likely to be conducted with minimal or incomplete information on the nature and extent of the incident.

> *NDRF: "Short-Term Phase of recovery which addresses the health and safety needs beyond rescue, the assessment of the scope of damages and needs, the restoration of basic infrastructure and the mobilization of recovery organizations and resources including restarting and/or restoring essential services for recovery decision-making."* (Pg. 81)

3.2.1 Early Response Actions

Over 1,000 people die within the initial few days. Tens of thousands of individuals are evacuated from the immediate area of assumed contamination and thousands seek temporary shelter necessitating a large scale security activity. The immediate evacuations require individual decontamination following Center for Disease Control (CDC) protocols to remove clothing and wash to remove residual spores (CDC, 1999).

Despite the potential for significant contamination in affected areas, including critical infrastructure and commercial, military, and private property (see Figure 3-4), there is little firm information. Other than the initial samples from detectors, the actual extent of the contamination is not known, as illustrated in Figure 3-5. As a result, a very large area has been cordoned off as probably contaminated, with much critical infrastructure and many transportation networks shut down, The large boundary of the potential contamination zone is requiring a large number of National Guardsmen to control. Sampling teams are currently attempting to better define the extent of contamination, however there is a shortage of trained teams with appropriate equipment and

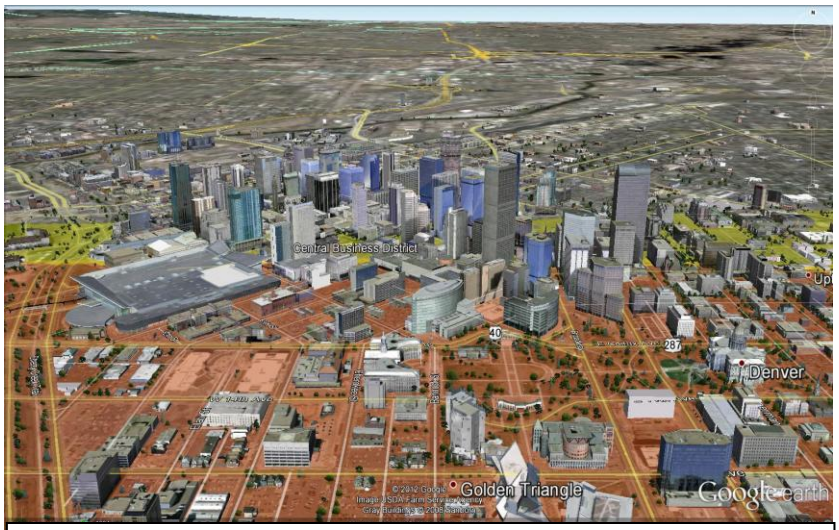

Figure 3-4. Downtown area contaminated with *Bacillus anthracis*.

also a shortage in the supporting laboratory analysis capability, so sampling is proceeding very slowly.

The need for clear information about contaminant concentration and extent is crucial for determining optimal response and recovery actions.

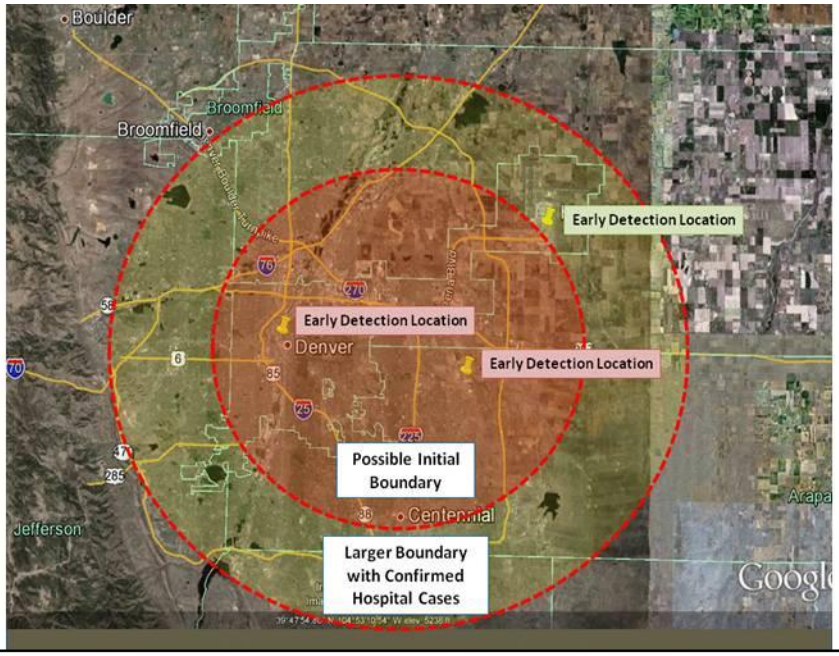

Figure 3-5. Possible initial boundaries drawn based on limited detection information from two positive detections (text in red boxes) and one non-detection (text in green box). The inner boundary is drawn from the detection results. The outer larger boundary is added as confirmed anthrax cases are reported at local hospitals.

KPF: Establish Characterization Strategy

A characterization strategy is required to pre-determine appropriate sampling methods, sampling numbers and locations, decision support and modeling tools, analytical methods and laboratories, and data quality objectives.

Public health and medical services are significantly challenged. Public health is attempting to determine locations where anthrax victims were exposed to assist IC/UC's characterization of the contaminated areas. A majority of victims to this point were reported in outlying medical centers near bedroom communities and interviewers are attempting to reconstruct their travel for the preceding several days to find common areas where they may have been infected. As the attack produced plumes, the location of the exposure from the airborne *Bacillus anthracis* is only loosely related to the residual surface contamination, and there are serious concerns over incorporating the epidemiological results with surface sampling results. Prophylaxis (Cipro and Doxy) have been provided to initial responders and are being

distributed to the population from the Strategic National Stockpile, but areal coverage is limited. Public Health officials are attempting to manage a fast and efficient prophylaxis distribution and control which has been trying to get antibiotics to potentially exposed personnel prior to the onset of anthrax symptoms, however there are many examples of unruly crowds gathering at distribution centers, theft of antibiotics and vaccines from centers and storage locations, and fraud as people attempt to pick up and hoard more than their share.

Medical resources are overwhelmed with worried-well, as well as with the necessity to provide aggressive supportive care for large numbers of patients with symptoms. This is particularly acute because of the possible contamination of large area hospitals and clinics. This has resulted in a shortfall in available critical equipment such as ventilators throughout the region and has required triage procedures to be implemented. Public health, medical, and government phone lines are congested with the large number of calls about medical symptoms, including those for pets.

KPF: Prepare a Medical Plan for Public Health and Medical Services

A Medical Plan will facilitate effective public health response and recovery, and will minimize casualties by addressing epidemiological concerns, prophylaxis distribution and control, and medical care concerns.

3.2.2 Early Recovery Actions

As planning begins for transition to recovery, the IC/UC has significant difficulty in specifying what levels of decontamination activities are necessary. The only available recommendation is ”No detection of viable spores” (EPA-CDC, 2012), which is an extremely challenging standard to attempt across the contaminated area. Community and business leaders are demanding definitive information on the time to clear their critical facilities for reoccupancy, which cannot be answered until acceptable methods of decontamination and the specific facility clearance requirements are determined. Economic concerns are dominating long-term priorities and planning. Local building owners have indicated that their limit for absorbing losses may be less than six months, meaning that if they are not earning rent after six months and are facing large decontamination costs, they are likely to abandon their businesses. Residents and businesses are indicating an unwillingness to return and reestablish in the area.

KPF: Establish Clearance Goals

Risk-based clearance goals must be established in order to proceed with characterization, decontamination, and waste management approaches, as well as to allow release of uncontaminated areas and define self-decontamination standards.

Other early response actions are taking place, including agriculture, where livestock has been moved out of the contaminated area, quarantined, and monitored for signs of infection. Any animal showing symptoms has been condemned. Animals with no symptoms identified after three weeks are approved for sale or slaughter. Contaminated feed lot areas are closed for decontamination 9CFR309.7 (2012).

3.3 Intermediate-Term Recovery

As the incident is stabilized and the initial response winds down, it will transition to the next phase (which typically occurs in the range of days to weeks). However, it can follow the early phase response within as little as a few hours. Although protective actions may still be required in the intermediate phase to reduce or avoid exposure, immediate threats to public safety have been controlled and the extent and nature of the incident has been largely established. Typical actions during the intermediate phase would be characterization and the initiation of decontamination processes.

> *NDRF: "Intermediate Phase of recovery which involves returning individuals, families, critical infrastructure and essential government or commercial services to a functional, if not pre-disaster, state. Such activities are often characterized by temporary actions that provide a bridge to permanent measures."* (Pg. 80)

3.2.3 Intermediate Recovery Actions

As the immediate response activities are completed, there was a significant reorganization for the IC/UC structure as it transitions to remediation. Bringing together technical experts took longer than expected and caused some delays. At this phase, sections of I-25 and major arterials have been decontaminated and the RTD Light Rail and bus service are reopened but on a limited schedule and in very limited areas (Figure 3-6). A number of hospital and public health facilities east of Downtown Denver, such as the Anschutz medical complex, have been sampled and found to be contaminated. Operational medical facilities are

Figure 3-6. Transportation corridors shut down by contamination.

responding to increasing numbers of patients with adverse reactions to prophylaxis, and are beginning to discover many have stopped taking antibiotics because of the reactions.

Only a few characterization and cleanup resources have been allocated to restore key economic functions as resources are focused on critical services (medical, police, and fire). Many critical infrastructure assets have been found to be contaminated including the fire and police department headquarters, as well as the Denver Emergency Operations Center. Following the additional environmental characterization efforts, the contamination boundary has expanded, doubling the area of contamination. Many people and businesses are attempting self-decon in the interest of getting their homes and businesses back to normal.

KPF: Establish Operational Guidelines

Developing clear operational guidelines for recovery pre-incident will prevent delays and conflicts during high-stress response and recovery activities.

Significant amounts of contaminated debris have accumulated in staging areas throughout the city, as waste management sites have refused to accept it. Debris management has become a major challenge and has significantly slowed decontamination efforts as staging areas become filled. The IC/UC are having to deal with additional risks from the staging sites from the prevailing west winds and from the transportation of waste materials to the sites, as well as difficulties in finding contractors willing to move waste from the contaminated areas.. As normal waste disposal avenues close, “Midnight dumping” and illicit roadside dumping has become widespread and a major problem.

KPF: Establish Debris Management Strategies

A Debris Management Strategy describing staging areas, treatment areas, transportation, documentation, acceptance sampling, and agreements with facilities for ultimate disposal will facilitate recovery and reduce the extent of contamination.

3.4 Long-Term Recovery

The objective of the last phase, long term recovery, is revitalizing, rebuilding, or relocating affected areas, including remediating contaminated areas using optimized decontamination processes. Appropriate cleanup (or clearance) levels and priorities will be established through a process that includes a broad community stakeholder input and sound risk management principles.

> *NDRF: “Long-Term phase of recovery that may continue for months or years and addresses complete redevelopment and revitalization of the impacted area, rebuilding or relocating damaged or destroyed social,*

> *economic, natural and built environments and a move to self-sufficiency, sustainability and resilience."* (Pg. 81)

As shown in Figure 2-1, some long-term activities begin quite early, even within the first few days after the incident. A good example of an early long-term activity is the activation of the Stakeholder Working Group and Technical Working Group, both of which help guide and prioritize the recovery process. These groups should include technically competent and trusted members to give the public confidence in their recommendations. During the long-term recovery phase, the challenge is to expedite decontamination (see Figure 3-7) and clearance to then allow for safe re-occupancy

Figure 3-7. Decontamination activities at the Brentwood Postal Facility.

3.4.1 Long-Term Recovery Actions

By this time, about 50% of the commercial assets that provide economic resources for the community have been restored, including postal, shipping, and industrial facilities (see Figure 3-7). The public remains wary of goods and products coming from the region, so trade remains slow. Agriculture, retail, and tourism industries continue to be depressed in the surrounding, uncontaminated areas. Waste disposal strategies have been identified and waste management plans developed, but disposal options are still limited. Public health functions have been restored and there is increasing demand for mental health services. Almost 40% of affected residences have been cleared for re-occupancy. All critical services have been restored, commercial infrastructure in the hot zone has been remediated and is open, and about 30% of the contaminated zone near Downtown Denver is ready for re-occupancy. A serious issue is the multiple abandoned properties that have not been decontaminated.

4 Key Planning Factors

As mentioned earlier, the KPFs are not a comprehensive guide for recovery planning, but include those areas where recovery preplanning will make the most difference.

4.1 Establish Characterization Strategy

KPF: Establish Characterization Strategy

Initially there will be limited knowledge of where the contamination may be and who may have been exposed. There will be a time lag in gathering this knowledge due to requirements for laboratory analyses, potential analytical capacity limits, and the limits of detection from complex environmental surfaces. This knowledge limitation will slow response and short-term recovery activities. A characterization strategy is required to pre-determine appropriate sampling methods, sampling numbers and locations, decision support and modeling tools, analytical methods and laboratories, and data quality objectives.

One of the major challenges associated with a covert biological release is a best case delay of one to two days between the moment of contamination and initial detection. Then, an additional period of hours to days will be required to confirm the detection and begin to identify the potential extent of the contamination. Given initial information about a wide-area release, but insufficient information about its extent, actions must be developed to establish an approximate idea of the extent of detectable levels of residual agent.

As shown in the first panel of Figure 4-1, initial boundaries of contamination will be defined by very few detections, which can result in boundaries that are too large or small. For example, data on the hospitalization of victims over the days following exposure may cause the boundaries to be broadened, as illustrated in the second panel. This additional area could be large given that the commuter population returns home prior to becoming symptomatic. In the third panel, with additional characterization the general location of the two releases begins to take shape, with the red dots representing high concentrations, orange dots moderate concentrations, yellow lower concentrations, and the blue non-detection. Now the boundaries shown by the red line begin to resemble the actual release plumes. As data continues to be collected, it will be used to update contamination models.

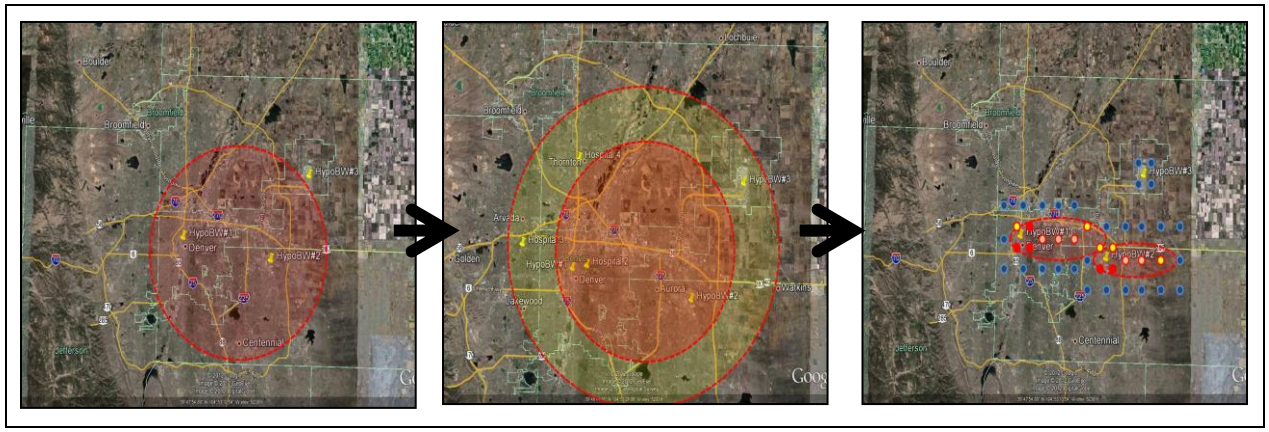

Figure 4-1. Examples of initial extent boundaries established with limited analytical information.

A well designed characterization strategy provides a means to appropriately establish initial contamination boundaries. This ensures that critical infrastructure is not unnecessarily taken out of service and that potentially exposed populations are identified. These decisions require careful consideration and time that is not available during an emergency. There will be competing demands between the need for public safety and the logistical realities of evacuation, suspension of public services, security requirements, and political will to implement emergency actions within a contaminated area. A community will have high expectations and little patience for conflicting or inconsistent information. Loss of public trust will significantly damage effective recovery. To combat this, the characterization process and related decisions must be transparent and application of that process must be consistent to prevent false perceptions of indecision or favoritism.

A characterization strategy must be prepared to address issues and avoid delays during characterization. The strategy should be broad enough to define the extent of contamination and also support decontamination activities throughout recovery. The strategy must include all information sources such as forensic information, epidemiology, surveillance data, and environmental sampling. Characterization will generate large amounts of data which must be managed. A data management strategy should be included as part of this characterization strategy. The data strategy should delineate between 'tactical/operational' data and 'public' data and articulate how and by whom this data shall be controlled.

The first issue that must be addressed involves using the limited information available to rapidly define the boundaries of contamination. While this is a challenging problem, there will be political and social pressures for an answer. Decisions will need to be made regarding factors of safety in defining the extent of contamination,

which will initially be conservative. The characterization strategy must then function to reduce the overall extent based on defendable methods.

For the environmental sampling component of the characterization strategy, the US EPA and CDC have standard operating procedures for sample collection and laboratory analyses (EPA, 2010), (CDC, 2002), (CDC, 2012). Figure 4-2 shows surface wipe sampling. The number of sampling teams and analytical laboratory capacity will be bottlenecks in the recovery process. Other Federal, private, and university laboratories could be called into service to increase analytical surge capacities.

Figure 4-2. Surface wipe sampling for *Bacillus anthracis*.

Statistical sampling, where a large number of samples are needed to give confidence in the results, requires an extremely large sampling and laboratory analysis effort in a wide-area incident, and will take a very long time. An alternative characterization strategy considers the use of both statistical and judgmental sampling methods to provide defensible results. Judgmental sampling is designed to find contamination by targeting areas more likely to contain spores. This approach assists rapid sampling and initial characterization. The sampling strategy employed is situation specific and may include targeted sampling, statistical sampling, or a mix of both. The EPA/CDC preference is for targeted sampling.

Other data sources such as medical surveillance, filter samples from building heating, ventilation, and air conditioning (HVAC) systems, and agriculture and wildlife information indicate where the plume has passed as well as where reaerosolization may be taking place. Developing this data is an important component of the characterization strategy.

4.1.1 Characterization Strategy Preplanning Summary

Preplanning activities for the data management component of the strategy should address what data will be gathered, how it is tracked, who will be allowed access, and what can be released to the public.

Developing contamination boundaries is a highly technical task, where the IC/UC will be advised by the TWG. Preplanning should address the use of the information. This would include: boundary control, release of contamination information, information release

and control to the general public, and procedures for adjusting boundaries.

Sampling plans for a wide area attack are incident specific, and will be developed by the IC/UC planning staff assisted by expert advisors (TWG and ECC) and the EPA. Preplanning should address local resources for sampling teams and laboratory support,

Preplanning activities also should include surveys of all possible alternative data sources.

Guidance for developing the characterization strategy should be obtained from the EPA On-Scene Coordinator.

Characterization Strategy Preplanning Summary

- Data Management
- Contamination Boundary Management
- Sampling Processes
- Alternative Data Sources

4.2 Public Health and Medical Priorities

KPF: Prepare a Medical Plan for Public Health and Medical Services

The magnitude of the contaminated area and sheer numbers of potentially exposed and symptomatic people will rapidly overwhelm public health and medical services. Failure to provide timely medical services could greatly increase mortality rates and the burden on the limited medical infrastructure. A Medical Plan will facilitate effective public health response and recovery, and minimize casualties, by addressing epidemiological concerns, prophylaxis distribution and control, and medical care concerns.

It is critical to begin prophylaxis prior to appearance of symptoms to prevent mortality; however, this requires both identification of the potentially exposed population and a detailed distribution plan tailored to the local area (along with multiple means of public messaging). As this must take place early, it is a critical part of a pre-planned Medical Plan. The safety and security of distribution centers and stocks must be a part of the plan, along with a method to ensure against hoarding.

Thousands of people may be exposed before any knowledge that a biological contamination incident has occurred. Once symptoms occur a patient will require aggressive supportive care (e.g., ventilators, round-the clock-observation, and intensive care). In addition many worried-well will overwhelm medical facilities. Prior planning for public health and medical services should address the following three significant areas: epidemiology, prophylaxis distribution and control, and medical care. These will be the major components in a Medical Plan.

4.2.1 Epidemiology Support

Because the time, location, and amount of the release is unknown, and detection will be delayed, the size and locations of the potentially exposed population are also unknown. The first public health challenge is determining the population at risk by determining the common exposure area.

Symptoms from initial exposure will begin after 1-2 days and patients will show up at medical facilities across the area. Symptoms of inhalational anthrax will be flu-like beginning one to two days after exposure, complaints of gastrointestinal symptoms within one to seven days, and cutaneous infections exhibiting black scabs within seven to ten days. The period to infection (incubation time) varies, with the overall exposure measured as total dose. As illustrated in Figure 4-3, larger doses result in shorter incubation periods of about two days and lower doses may result in incubation of more than ten days. As a result, patients will be reporting to emergency rooms over days to weeks after the initial exposure. Secondary exposure may extend this period considerably.

Epidemiology must assess hundreds to thousands of early cases to determine common locations to identify the potential release and area of contamination and to begin prophylaxis on probable exposed victims in the asymptomatic population before symptoms appear. Tens of thousands of people may have been exposed before the first victim is identified. New cases must be analyzed to determine if the origin is from the original exposure or a new one. The potential for secondary exposure caused by spore reaerosolization is not fully understood but should be expected to occur.

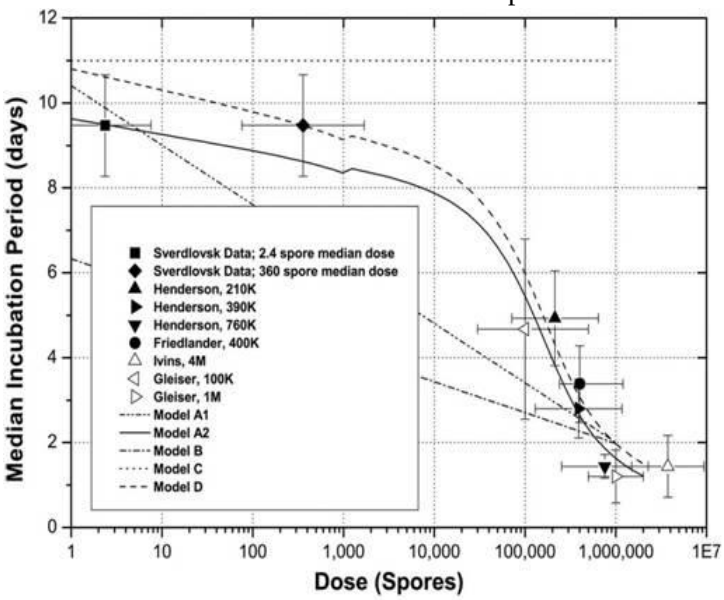

Figure 4-3. Incubation period in days versus exposure dose (Wilkening, 2006).

These intermediate-term exposures may demonstrate tracking or movement of the contamination into new areas. A process to document new cases of anthrax infections will be extremely helpful in identifying continued risks for population exposure. A system for hospitals to document and communicate cases will be invaluable.

4.2.2 Prophylaxis Distribution and Control

Prophylaxis distribution and control will be a significant public health challenge. Initially it must be provided to emergency responders. It may require population management and crowd control to ensure adequate distribution to potentially exposed people. It is critical to begin prophylaxis prior to the appearance of symptoms, which requires a detailed distribution plan with multiple means of public messaging. It is critical that plans are in place to receive and distribute prophylaxis from the Strategic National Stockpile. Distribution centers with adequate staff will be required. Records management systems will be essential for tracking and surveillance, and the number of homeless will increase the difficulty of this process. Along with staffing, safety and security for the distribution centers and stocks must be a part of the plan and a method to ensure against hoarding. The overall objective is to provide widespread coverage of the prophylaxis while maintaining control and records of the distribution to the maximum extent practical.

Figure 4-4. Mass prophylaxis training by the State of Florida Department of Health.

All of these prophylaxis distribution and control requirements need to be considered during pre-planning in conjunction with local public health plans (figure 4-4).

Based upon the published results, it may be expected that many individuals will experience serious side-effects from the prophylaxis (see more below), encouraging many people to stop taking their medication (NIH, 2002) (CDC, 2001). Irregular medication usage has a significant potential to produce antibiotic-resistant organisms. A strong medication campaign with public health messages and enforcement techniques will be necessary.

The valid use of long-term prophylaxis will need to be considered. Under what situations should antibiotics continue to be prescribed over vaccination? The resident population will likely require vaccination, but transient populations and visitors may consider antibiotics. Plans and medical criteria for continued medical care and surveillance will be required.

4.2.3 Medical Care

"Inhalational anthrax and subsequent systemic infection have a mortality rate approaching 100%. If treatment is initiated during the incubation period of one to six days and before the manifestation of symptoms" (Cunha, 2012), a significant number of lives can be saved (Figure 4-5). Aggressive supportive care requirements for large numbers of patients with

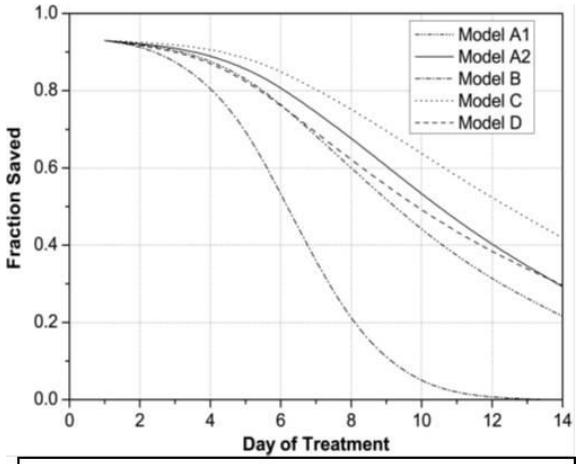

Figure 4-5. Fraction of population saved versus time until treatment (Wilkening, 2006).

symptoms may rapidly exceed capacity and require the use of triage.

Prophylaxis has serious side-effects in many people: Ciprofloxacin (Cipro) can cause moderate to severe nausea, diarrhea, vomiting, headache, stomach pain, skin rashes, mental confusion, tremors, seizures, hallucinations, and torn tendons, with 16 to 19% reporting adverse reactions and 2% having potentially life-threatening anaphylaxis. Doxycycline has been linked to nausea, vomiting, headache, chest pain, facial swelling, throat and tongue inflammation, genital and rectal itching, skin peeling, and hives. These side effects may cause significant medical services overload. For every 100,000 people on Cipro, medical institutions can expect approximately 16,000 cases with adverse reactions and 2,000 cases of anaphylaxis (NIH, 2002) (CDC, 2001).

Planning should also include the means to provide significant mental health support to potentially thousands of victims and concerned citizens. It also must address the worried-well.

4.2.4 Medical Plan Preplanning Summary

The Medical Plan should include the following major areas.

The guidelines for the epidemiological process should be developed during pre-planning activities. This should include a review of the current case reporting system to ensure it is adequate to support the extremely high numbers of expected patients, as well as the large numbers of public health interviews required to establish probable contamination locations.

Prophylaxis management and control is a critical preplanning area, as it is the single most important lifesaving process during the initial response phase. Public Health plans should be reviewed with a specific focus on support functions, such as transportation, security, record keeping, and public messaging.

Medical care preplanning must examine the requirement for hundreds of patients requiring comprehensive and aggressive care by a medical system with contaminated facilities. It also should address public messaging that includes when to seek medical attention.

Medical Plan Preplanning Summary

- Epidemiological Support
- Prophylaxis Management
- Medical Care

4.3 Establish Operational Guidelines

KPF: Establish Operational Guidelines

During a wide-area biological release, the magnitude and complexity of the problem (indoors and outdoors) and competing interests (regulatory, economic, public safety), in combination with multiagency jurisdictions, will challenge existing operational frameworks and processes. Developing clear operational guidelines for recovery pre-incident will prevent delays and conflicts during high-stress response and recovery activities.

An outdoor wide-area release will cover many square miles and cross multiple jurisdictional boundaries. As a result, there will be powerful competing interests, including public interest groups, multinational corporations, and local, state, and Federal governments. Operational guidelines are necessary to address many considerations, such as reducing the potential for secondary contamination, operation of critical infrastructure in a contaminated environment, and the difficulties created by transportation closures. Overall the roles and responsibilities for local, state, and Federal stakeholders must be clear. Without established roles and responsibilities and lacking consensus on operational guidelines, the conflict between competing interests will significantly slow decontamination (Figure 4-6) and recovery.

4.3.1 Roles and Responsibilities

As illustrated in Section 3, many decisions and processes are required during recovery which may leave decision-makers and citizens asking who will make decisions and what should be done. A great responsibility will be placed on those in the IC/UC to provide the processes and guidelines for decisions. There is a well-defined structure under the National Incident Management System (NIMS) with roles and responsibilities laid out that will guide response and extend into recovery (DHS, 2008). The unique nature of a wide-area biological incident will require continuation of the NIMS organizational structure further into recovery with some enhancements, including a significant need for coordination with private property owners.

Figure 4-6. Outdoor decontamination

The goals of this KPF come from both operational coordination response and recovery and the planning response and recovery capabilities and targets described in the NPG, which states the following objectives:

> "*Establish and maintain a unified and coordinated operational*

> *structure and process that appropriately integrates all critical stakeholders and supports the execution of core capabilities…."* [and]
>
> "*Conduct a systematic process engaging the whole community as appropriate in the development of executable strategic, operational, and/or community-based approaches to meet defined objectives*." (Pgs. 12, 16-17)

A Technical Working Group can provide critical technical support to the IC/UC. Given the specific expertise and critical importance of the group, the membership (by role) should be pre-established (Figure 4-7). Similarly, an independent Environmental Clearance Committee to verify facility suitability for reoccupancy should also be pre-established. A third critical group, the Stakeholder Working Group, would ensure that all private interests are considered. Participation in the Stakeholders Working Group should be pre-planned but may include members of existing community groups (e.g., Chambers of Commerce, neighborhood associations, environmental organizations).

4.3.2 Decontamination Activities

Previous anthrax incidents were largely contained indoors and generally could be managed using traditional regulatory standards. In contrast, a wide-area release will impact widespread outdoor areas where decontamination activities may involve regulated discharges to air, water, and ground that typically require extensive permitting processes. Dealing with the permitting process will significantly slow recovery activities. Appropriate guidance will be necessary to establish flexibility in these regulatory requirements. If the agencies involved can agree in advance that certain requirements may be expedited, exempted, or waived throughout recovery, the overall timeline can be greatly reduced. Guidance on this can be obtained from EPA (EPA, 2012).

Figure 4-7. A Technical Working Group.

Maintaining the health and safety of sampling and decontamination contractors will be essential, and training will be required (Figure 4-8). Initially these staff may be contractors approved by the IC/UC. However, as recovery continues, private property owners will begin to initiate cleanup activities at their own facilities. Guidelines will be required to ensure proper training, preparation, and implementation of health and safety plans. These guidelines will require some level of oversight to be provided

by government agencies or members of the IC/UC.

Figure 4-8. PPE training.

Government agencies will clean up critical infrastructure and key government facilities; however, many smaller government and private facilities will likely not be decontaminated within any reasonable timeframe. Clear guidance on facilities that will and will not be given high priorities for decontamination, (including privately owned critical infrastructure), is required. Guidance on prioritization of critical infrastructure is being provided in a related document (SNL, 2012b).

Operational guidance is also required for self-decontamination, or the application of cleanup activities by a private landowner or an agent of that landowner to private property. The potential for cross-contamination, individual exposure, improper waste handling, and environmental damage, make self-decontamination a high-risk activity. However, there will inevitably be individuals wanting to take action to clean up their property. Guidance will be required on approved decontamination methods, staff training, occupational health and safety, waste management, as well as verification and clearance activities. Studies on this topic have been done by EPA National Homeland Security Research Center.

Only two solutions, known as sterilants, have

Figure 4-9. Indoor surface decontamination using the Peridox system.

the required Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) registration for use against *Bacillus anthracis*. They are Peridox (Figure 4-9) and Steriplex Ultra (Campbell et al., 2012). However, these must be applied by trained staff. While the EPA may provide an exemption to FIFRA, there are still requirements for appropriate application and contact times. Without addressing these types of operational guideline questions prior to an incident, a significant amount of time will be lost in interagency discussions, delaying the recovery process.

Guidance will also be required to reduce the potential for secondary contamination (e.g., tracking contamination into a clean area or resuspension of spores back up in the air). For example, an overall decontamination strategy to clean up the contaminated area from the center outward could reduce the potential for secondary contamination from the high-concentration areas. At the same time, a simultaneous clean up from the outer edge in toward higher contamination areas could reduce the potential increase in the size of the impacted area. A coherent decontamination strategy established in advance of an incident will save critical time and allow for cleanup activities to begin quickly.

4.3.3 Remediation Action Plan

A key operational document is a Remediation Action Plan (RAP). A RAP, or its equivalent, is critical for the planning and executing of the decontamination and clearance phases of recovery. Much of the RAP can be developed in advance. A RAP template has been developed as an example and is found in the Seattle Urban Area Consequence Management Guidance for a Wide-Area Biological Attack (LLNL 2011).

4.3.4 Operational Guidelines Preplanning Summary

Operational Guidelines preplanning should include the following major areas.

Specific roles and responsibilities under the IC/UC structure should be identified for the recovery period following response, and how the response organization will transition to this structure. Preplanning should also determine the membership in the TWG, the ECC, and the SWG – not by name but by organization and function.

Preplanning should also cover areas in support of decontamination activities. This includes developing plans to support the eventual decontamination processes, including an expedited process for regulatory permitting. Preplanning also should cover developing training requirements, plans and processes for contractor operations and safety. It also includes establishing policies and processes for selecting those facilities and areas that will be decontaminated by the government, and policies and processes for the facilities and areas that will not.

As much as possible, a partially completed remediation action plan should be completed in advance. Much of the required information is relatively scenario independent, and this partial plan will serve as a template for modification and early application in an actual incident.

Operational Guidelines Preplanning Summary

- Roles and Responsibilities
- Decontamination Activities
- Remediation Action Plan

4.4 Waste Management

KPF: Establish Debris Management Strategies
Unprecedented quantities of waste and debris will be produced during an incident of this magnitude. A majority of this waste will be contaminated, which may complicate handling and disposal. A Debris Management Strategy describing staging areas, treatment areas, transportation, documentation, acceptance sampling, and agreements with facilities for ultimate disposal will facilitate recovery and reduce the extent of contamination.

Debris management will be a major challenge during the intermediate recovery phase. An Emergency Debris Management Strategy will be required to describe controls on staging areas for containment, segregation, and decontamination. "Midnight dumping" and illicit or roadside dumping will likely be a problem following a biological incident, and plans should consider how to manage this activity. Waste disposal acceptance criteria and locations will need to be pre-identified and include both public and private sectors.

Decontamination of the Department of State Diplomatic Pouch and Mail Facility (SA-32) in Loudoun County, VA, generated more than 300 tons of debris waste and almost 79,000 gallons of wastewater from personnel decontamination (Canter, 2009). That was just a single facility. A wide-area incident may include hundreds of similar buildings. Piles of discarded debris will need to be staged at multiple sites throughout contaminated areas. Waste management questions at the time of the incident will constrain response and decontamination activities, which will affect recovery timelines. A well-designed Debris Management Strategy will increase the speed of recovery and reduce the potential for lingering or re-emerging contamination problems during the long-term recovery phase.

4.4.1 Waste Categorization

There are a number of regulations that will dictate where and how biologically contaminated waste may be disposed of, as well as regulations on how that waste may be transported to disposal areas. A major consideration is how the local jurisdiction categorizes waste containing *Bacillus anthracis* spores. Determining how waste generated during decontamination, as well as waste generated from personnel decontamination, sampling activities, and laboratory processes is categorized will have a major impact on waste disposal decisions.

4.4.2 Waste Processing

Potential waste accumulation and temporary storage (staging) areas should be designated in the Debris Management Strategy. For temporary storage (staging) areas, bio-security measures to minimize/mitigate release/spread of agent should be included. Waste accumulation areas should be located in the same area as, or next to,

possible decontamination areas. Such locations will allow waste management personnel to containerize both decontaminated and contaminated waste for transport to its final disposition. Nonessential items that will not be decontaminated, nonessential items to be stored until treatment capacity is available, or essential items that fail the clearance goal or waste acceptance criteria may need temporary storage. Siting waste management areas adjacent to decontamination areas will eliminate the need to transport the waste from its original location to a decontamination center. Double-handling of waste should be avoided if at all possible.

Given the magnitude of waste generation, large waste-storage areas should be established for long-term storage of items that are identified for treatment. Waste management accumulation areas should be protected from inclement weather; include security features to prevent unauthorized access by animals or humans; and make use of standard hot-zone, warm-zone, and cold-zone work practices to prevent the spread of contamination. Administrative and engineering controls will be required and should be outlined ahead of time in the Debris Management Strategy

4.4.3 Disposal Site Selection

Materials for disposal must meet acceptance criteria set by the specific waste management facility. Typically waste management facilities require verification data prior to waste acceptance. However, if a decontamination process has been demonstrated to be effective, acceptance could be based on certification that the decontamination approach had been followed. Pre-negotiating acceptance criteria with waste management facilities will prevent delays. Moreover, if it can be pre-negotiated that verification sampling is unnecessary if a standard decontamination process is employed, significant time will be saved.

Disposal of the waste may require the construction of designated waste cells at a landfill willing to accept the waste. There are no known landfills that currently have the capacity to address disposal of large quantities of waste contaminated with *Bacillus anthracis*. Given the amount of time required to construct a designated disposal cell, having agreements in place with local facilities to handle any *Bacillus anthracis* contaminated material would greatly accelerate the process.

4.4.4 Waste Tracking System

After achieving a waste acceptance criteria, tracking should be implemented to record the final waste disposition. Tracking information should include (at a minimum) waste type, generation location (i.e., where wastes were obtained), and final disposition (e.g., returned to service location, recycling center, or disposal facility). Material that does not meet waste acceptance criteria must be managed as *Bacillus anthracis*-contaminated. Figure 4-10 shows waste management for *Bacillus anthracis*-contaminated items. When possible,

decontamination options should employ a strategy to limit amounts of generated waste.

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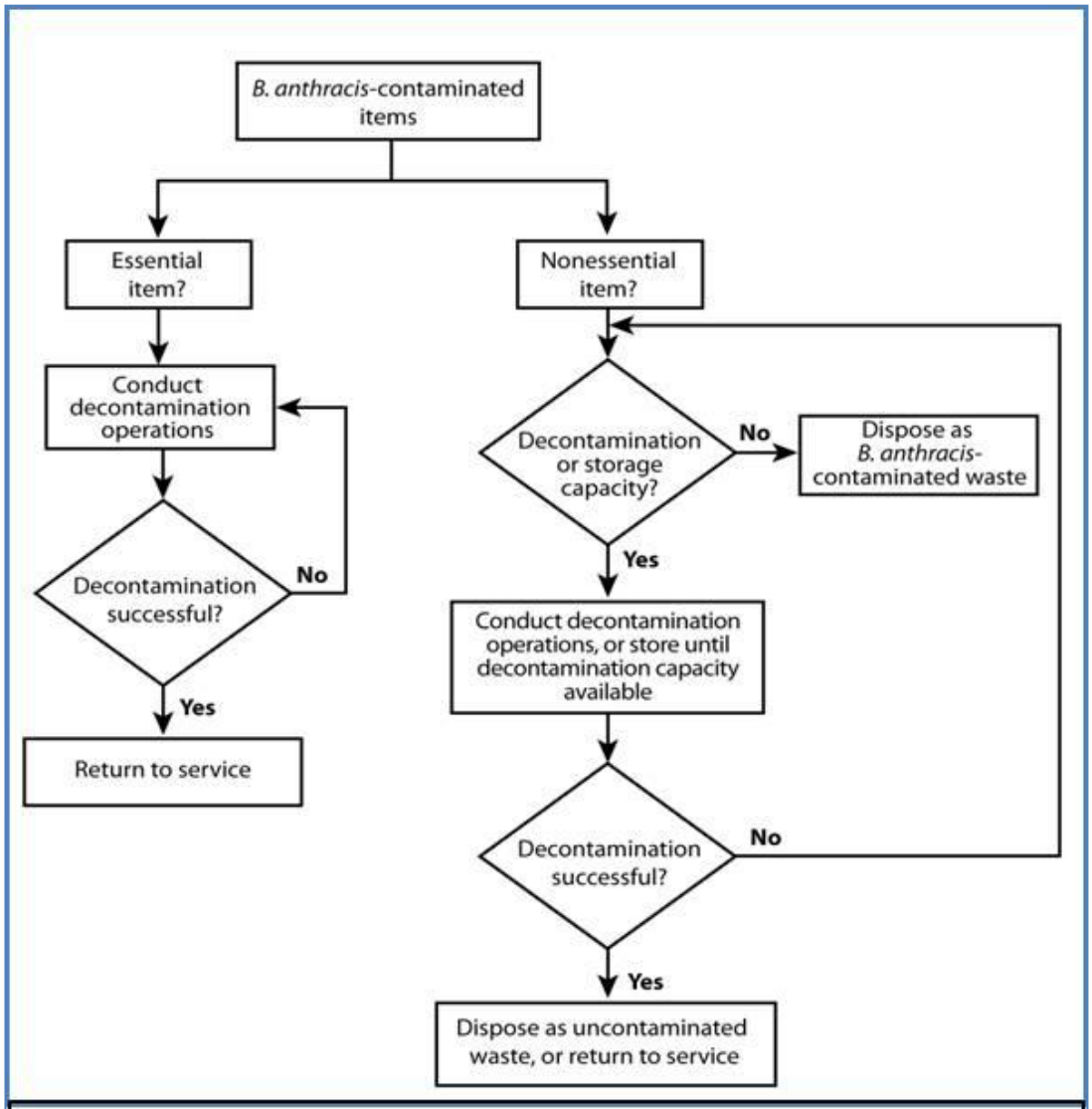

Figure 4-10. Waste management flowchart for *Bacillus anthracis* contaminated items

4.4.5 Waste Management Preplanning Summary

Determining in advance how the various types of waste contaminated with *Bacillus anthracis* are categorized will set the stage for all other waste disposal issues, and should be the initial component of a waste management plan.

The waste disposal process is composed of a number of discrete steps, and is highly dependent on the identification and availability of areas for staging, processing, and transportation. Developing a list of potential areas will greatly facilitate waste disposal during an incident. After the waste categories are determined, agreements with potential waste disposal sites should be negotiated in advance.

Developing a detailed tracking system in advance for all wastes (including contaminated and normal uncontaminated wastes) is an important component of the overall waste management system and will expedite its initiation.

Waste Management Preplanning Summary

- Waste Categorization
- Processing Site Selection
- Disposal Site Acquisition
- Waste Tracking System

4.5 Clearance Process

KPF: Establish Clearance Goals

Clearance goals are imperative to all aspects of recovery, and lack of clear clean-up standards will cause extensive delays. Risk-based clearance goals must be established in order to proceed with characterization, decontamination, and waste management approaches, as well as to allow release of uncontaminated areas and define self-decontamination standards. “No detection of viable spores” is currently the recommended clearance goal (EPA-CDC, 2012). This will be a challenging clearance goal and processes for demonstrating successful clearance will be required, which will lead to the preparation of a clearance sampling plan. Community engagement in a prioritization process for cleanup and clearance will be necessary.

Developing specific clearance goals is difficult, and research is ongoing to develop information helpful in this endeavor, however preplanning can still be extremely helpful to establish the mechanism to develop the goals at the time of an incident.

Economic concerns will dominate long-term priorities and planning, and will be strong drivers for rapid clearance and reoccupancy. For example, building owners have indicated that their limit for absorbing losses may be less than six months, meaning that if they are not earning rent after six months and are facing large decontamination costs, they are likely to abandon their businesses. This means that

clearance goals must balance clearance speed with public safety and risk.

Early decisions on clearance goals will ultimately drive the selection of decontamination processes and direct waste disposal activities. As a result, clearance goals have a major influence on the entire recovery process. Therefore, a robust clearance strategy is required to ensure that after decontamination is complete, agreed-on risk levels are met or optimized, and risks understood. This process will establish trust and willingness for residents to return home while understanding and accepting residual risks.

4.5.1 Clearance Goal Factors

Clearance goals should be based on risk to the individual resident or worker in the contaminated area. Different clearance goals for different areas based on type of area and usage may be established. For example, it may be expedient to set different clearance goals for indoor areas and outdoor areas. Different goals should be based on risk to citizens, and such goals will change based on their exposure in and usage of an area, and the type of area (indoor, outdoor, school, etc.). More stringent goals may be advised for areas where young children or people with compromised immune systems spend considerable time. Pre-planning for clearance goals should identify those areas that will potentially have different clearance standards based on the vulnerability category of people using the area and their typical residence time.

Clearance goals are needed to determine what level of cleanup is needed. Pre-defined, technically defendable goals prevent the decision process from succumbing to heightened political pressures during an incident. Setting clearance goals is difficult, but planning a clearance process pre-incident is very important. Currently there is no standard except “no detection of viable spores,” which will be difficult to achieve in a wide-area incident. Federal agencies continue to examine these problems, and clearance guidance will be published shortly (EPA-CDC, 2012). The clearance decision ultimately rests with local or state public health officials, with input from subject matter experts. These experts should be involved in the pre-planning process.

4.5.2 Goal Setting Participants

A Technical Working Group will provide advice in establishing the clearance goals. An Environmental Clearance Committee, established as an independent organization, will assess and provide recommendations to the IC/UC that the clearance goals are reasonable, that decontamination processes are adequate to meet those goals, and that clearance goals have been met. Membership roles of both groups should be determined prior to an incident. As noted earlier, these groups should include technically competent and trusted members to give the public confidence in their recommendations.

4.5.3 Unique Clearance Goal Requirements

A significant issue to be considered in advance is how to clear areas that were never believed to be contaminated. This will be an important facet of clearance. Planning needs to consider how to show the public that uncontaminated areas are safe, with clearly established sampling designs that verify this declaration to expedite the return to service of many buildings and outdoor areas

Many parts of the country have naturally-occurring *Bacillus anthracis*, which does not appear to pose an inhalation risk (CDC, 2009). For areas that were not contaminated during the release and therefore are not decontaminated, any clearance samples taken must consider the possibility of naturally-occurring *Bacillus anthracis*. Pre-planning may involve area sampling to establish a baseline for naturally-occurring spores.

Figure 4-13. Example analytical laboratory work in protective hoods.

Clearance goals should be site-specific and included in the Remediation Action Plan (or equivalent document) which is agreed upon by the Unified Command.

After clearance goals have been established, clearance sampling plans need to be developed and, and sampling teams and associated analytic laboratories identified. Clearance sampling will severely stress the analytic lab system (Figure 4-13). Options to reduce this load and speed up the clearance process should be considered. One option is to stringently define and monitor the decontamination process in order to provide assurance that it has been done properly. The Environmental Clearance Committee will use laboratory results to determine that clearance goals have been met, and make recommendations to the IC/UC.

4.5.4 Clearance Goals Preplanning Summary

Preplanning efforts should establish many of the factors required to develop goals. These include different risk populations, their locations, and different area utilizations within the region, Goal development must be done using the best available knowledge and advice. Preplanning should identify the participants in the technical clearance goal setting process.

There are at least two unique problem areas that must be addressed in setting clearance goals: areas thought to be uncontaminated, and areas that will be decontaminated by owner/occupants. The methods to deal with both cases should be developed in advance.

Clearance Goals
Preplanning Summary

- Identify specific factors
- Establish Goal-setting Participants
- Determine Clearance Goal process for unique requirements

5 Summary and Recommendations

A scenario-based review of recovery from a biological incident provided a set of Key Planning Factors that, if addressed prior to an incident, could greatly improve the recovery process. The KPFs presented in this document, however, do not represent all the major issues faced in a situation, but are significant problems worthy of focused time and effort. Pre-planning should also consider regional specific issues.

5.1 Biological Incident Compared to Other Incidents

A covert biological release incident will differ from other natural (all-hazards) or terrorist incidents in that it may not be immediately obvious that an incident has occurred and days may pass before the release is discovered. There also could be hysteria or panic created by having large populations that believe they were exposed. The boundaries of the contaminated areas will be unknown. In addition, the potentially exposed population will also be unknown, and the affected areas or potentially exposed population may change over time. This is in part due to the inability to detect biological contamination in real time and the potential for transport of the contamination into other areas, causing secondary exposure. As another difference, in a biological incident, the infrastructure will be intact. However, the functionally of the infrastructure will be limited by the potential for exposure and the requirements for personal protective equipment. Unique public health aspects will include the distribution and monitoring of prophylaxis and vaccination as well as managing shortages in medical resources. Medical services and resources will have reduced effectiveness due to required safety and protection processes (e.g. having to work in PPE). Active remediation is necessary prior to reoccupancy of facilities, and decontamination activities will affect property, facilities, and the environment.

A *Bacillus anthracis* incident differs from chemical and radiological incidents. *Bacillus anthracis* is more difficult to detect than either chemical or radiological agents. The spores are more persistent and wide-spread in the environment than most chemical agents. Symptoms following chemical agent exposure develop relatively rapidly compared to those resulting from biological and radiological incidents. Vaccination is available, however, for *Bacillus anthracis*. It is possible to decontaminate and kill the *Bacillus anthracis* spores thus removing the threat. This is not possible with radiological threats, where

radioactive isotopes must be physically removed, shielded, or allowed to decay.

5.2 Differences between *Bacillus anthracis* and Other Biological Agents

Bacillus anthracis was selected as the example biological agent in this scenario as a worst case given its persistence and virulence. Table 5-1 lists the general, qualitative characteristics of other biological agents. Exposure pathways as well as fate and transport will differ significantly between the agents. Specific comparisons depend on the details of the incident, for example agent persistence can be highly variable and depends on many agent and environmental factors.

Table 5-1. Biological warfare agents and general environmental persistence

Agent	Disease	Contagious	Environmental Persistence
Bacillus anthracis	Anthrax	no	>40 years
Francisella tularensis	Tularemia	no	hours-days
Yersina pestis	Plague	yes	minutes-hours
Vaccinia virus	Smallpox	yes	days-weeks
Arenaviridae/Flaviviridae/Filoviruses…	Hemorrhagic Fever	yes	hours-days
Clostridium botulinum toxin	Botulism	no	hours-days

Sources: Sinclair et al.,(2008); http://www.bt.cdc.gov/agent/agentlist.asp; http://www.aaep.org/pdfs/control_guidelines/Botulism.pdf

Less persistent agents are easier to decontaminate and natural attenuation may be used since the agents may be susceptible to sunlight and dehydration. (DHS-EPA, 2009). *Bacillus anthracis* as a spore is very difficult to kill and spores may be spread and therefore increase the extent of contamination. As shown in Table 5-1, other biological agents are contagious and may spread within human populations. Managing the public health problem with a communicable disease is different from managing exposure to *Bacillus*

anthracis. With contagious diseases, the goal is to minimize human contact, while anthrax may be prevented by limiting access to contaminated areas.

5.3 Planning Recommendations

Advanced planning focused on a few critical issues has the significant potential to improve recovery. While the KPFs discussed in this document are a starting point for pre-planning for effective recovery, they are not a complete road map for recovery. As illustrated in the scenario, examining each of the KPFs ahead of time will prevent the loss of precious time and resources when an actual incident occurs. These preplanning activities will require effort and consensus among agencies and stakeholders, but they will greatly enhance the rate and effectiveness of recovery.

Based on these KPFs, planning efforts need to focus on preparing the following strategies or guidance documents:

- Characterization Strategy.
- Medical Plan.
- Operational Guidance.
- Debris Management Strategy.
- Clearance Strategy.

5.4 Conclusions

Recovery from a major disaster like a bioterrorist attack will challenge every level of government and its citizens. Through careful planning, recovery processes may be improved with savings of time, money, and the wellbeing and trust of the public. By addressing the KPFs listed in this document, local, state, and Federal agencies will be better prepared to face a disaster of such magnitude.

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