Conducting Life Cycle Environmental Assessments for the Department of Defense on Emerging Non-Lethal Technologies

Oral Saulters

Urban Operations Laboratory

Non-lethal Environmental Evaluation & Remediation Center

Kansas State University & M2 Technologies, Inc.

2008 Institute of Biological Engineering Conference
Ecological Engineering Session
Chapel Hill, NC

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired™ Engineering

Presentation Overview

- NEER Background
- Military History and Environmental Need
- EKAT Software Tool
- NEER Methodology and Approaches
- NL Technologies & LCEA Efficacy
- Conclusions

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Non-lethal Environmental Evaluation & Remediation Center

- Background
  - Congressionally established
  - Analyze potential unintended human health & ecological impacts
- Regulatory/Policy Drivers
  - DoDI 5000.2 (Operation of the Defense Acquisition System, PESHE)
  - National Environmental Policy Act (NEPA)
  - Executive Orders (Greening the Government…)
- Approaches & Tools
  - Integrated Product Teams; Human Effects Review Board
  - Ecologists, Engineers, Geologists, Military, Toxicologists
  - EKAT, DoD databases, EPA models, Green Engineering
  - Air, water, soil, residue sampling and analysis

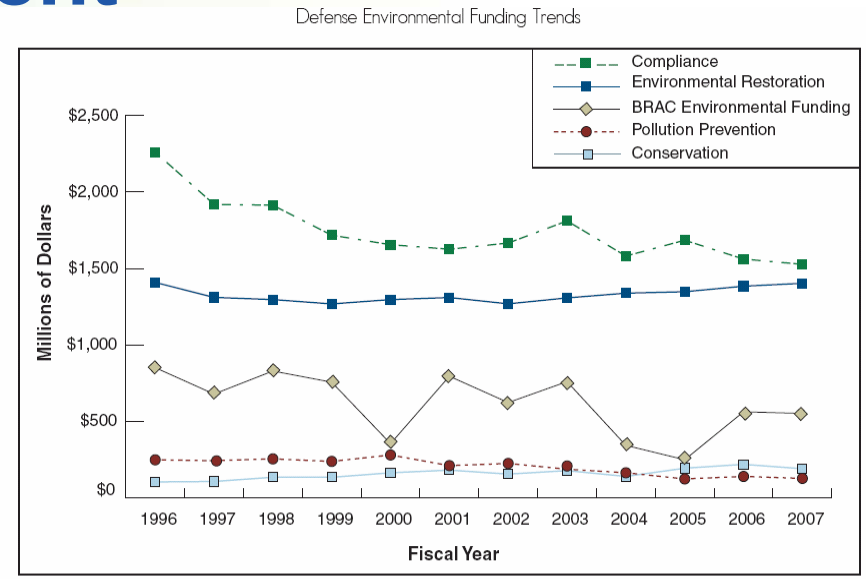
- Technologies/Capabilities
  - Over a dozen emerging systems, technologies, and training ranges
  - R&D through fielding and completion phases

UOL Urban Operations Laboratory

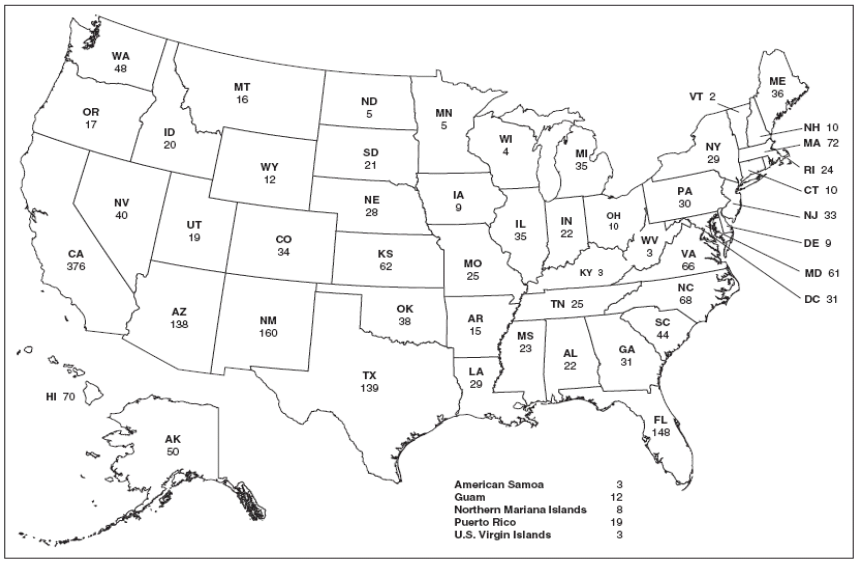
ibe Advancing Biology-Inspired Engineering

Military and Environment

- Long History
  - Including Lewis & Clark, 1803
  - control → prevention → sustainability
- Four Focus Areas
  - Conservation
  - Restoration
  - Compliance
  - Pollution Prevention (P2)
- Military Munitions Ex. (GAO, 2003)
  - 15 Million Acres, ~2300 sites
  - $8-35 billion
  - 75 years to cleanup
- Need for Environmental Tools



(Defense Environmental Programs, FY06 Annual Report to Congress)



(GAO, 2003)

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Environmental Knowledge & Assessment Tool

EKAT Background

•Program vision is to develop a Web-based software tool that provides environmental management and regulatory compliance guidance

•Designed for use by people with little or no environmental background, as well as for use by environmental professionals

•Funding agency for program development was the United States Marine Corps, Quantico, Virginia

•Development has been a collaborative effort

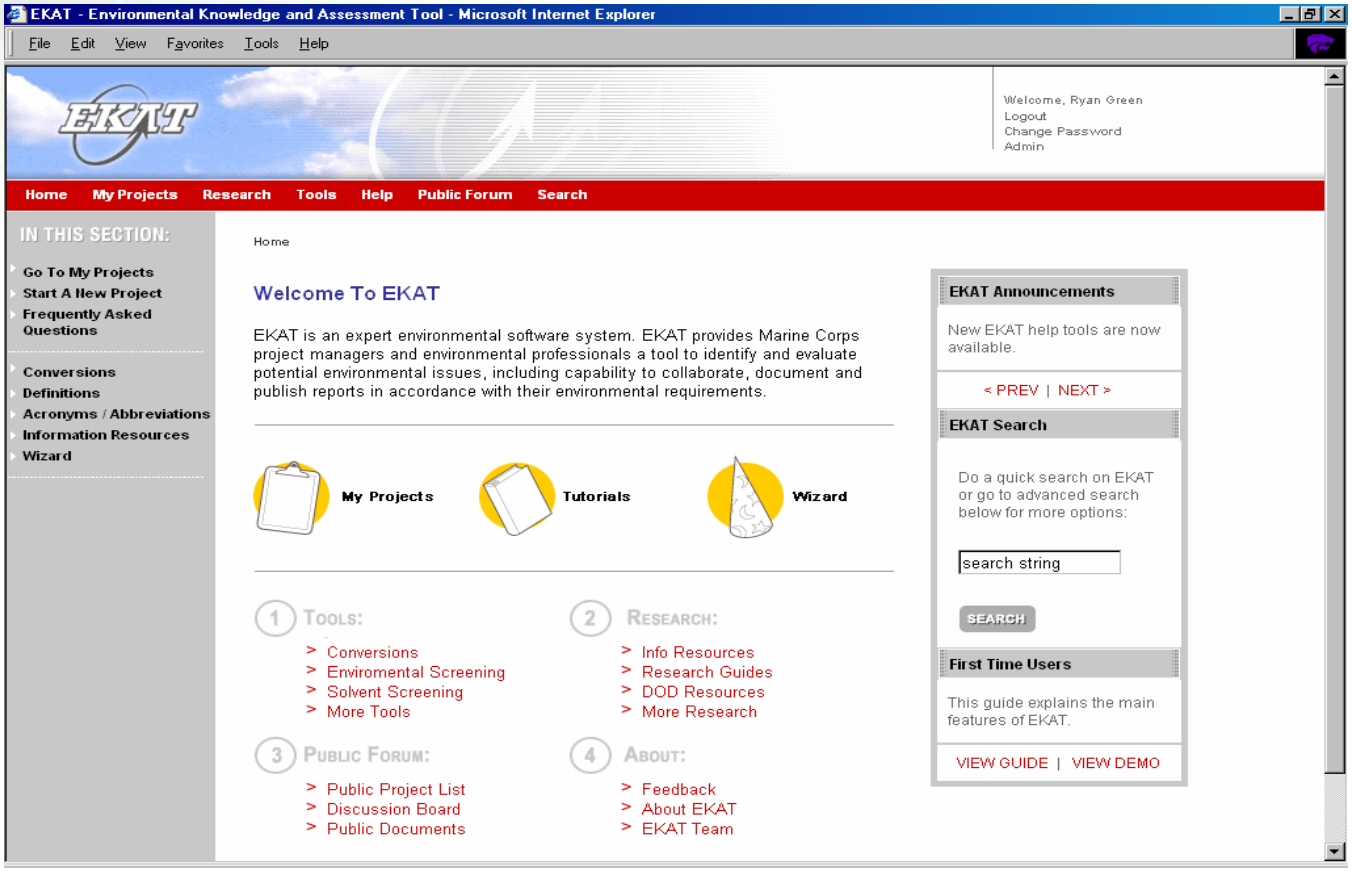
M2 Technologies, Inc.
Kansas State University
CABEM Technologies, Inc.

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Environmental Knowledge & Assessment Tool

Image of Home Page



UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Environmental Knowledge & Assessment Tool

Key Features

- Environmental Screening
  - Evaluate chemicals for environmental compliance, and key health and safety concerns
- EmisCalc – Emissions Calculator
  - Calculates pollutant air emissions associated with process activities, using EPA-approved air pollution factors
- TRACI
  - Evaluate the environmental impact of chemical emissions over the multiple stages of a product's life
- EKAT Wizard
  - The Wizard feature is set up in a question/answer format to guide users to the sections of EKAT which may be of most use
    - Report and regulatory requirements
    - Handling wastes, calculating air emissions
    - General chemical information

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Environmental Knowledge & Assessment Tool

Key Features

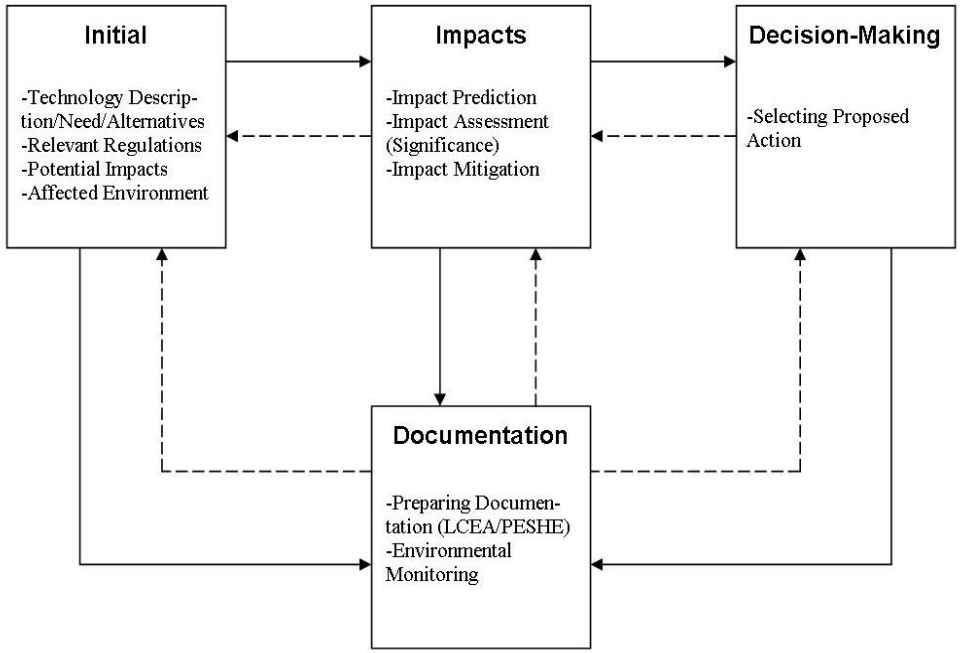
- NEPA Decision Tree
  - The NEPA assessment tool assists users in meeting federally- mandated requirements to consider environmental and other related issues for their proposed actions
- PESHE
  - Required by the Department of Defense for all programs
  - EKAT contains a template for the report, where different screenings and reviews done in EKAT can be inserted
- Additional Research Capabilities
  - Quick access to environmental resources for researching material properties, reviewing specific environmental regulations or health and safety issues, and finding pollution prevention alternatives

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Life Cycle Framework & Approach

- Initial Characteristics
  - Description/Rationale
  - EKAT Screening
  - Baseline
- Evaluating Impacts
  - Multidisciplinary
  - Models, Sampling
  - Modifications
- Decision-Making
  - IPT, PM, Leadership
- Documentation
  - Programmatic
  - Site-specific (public)



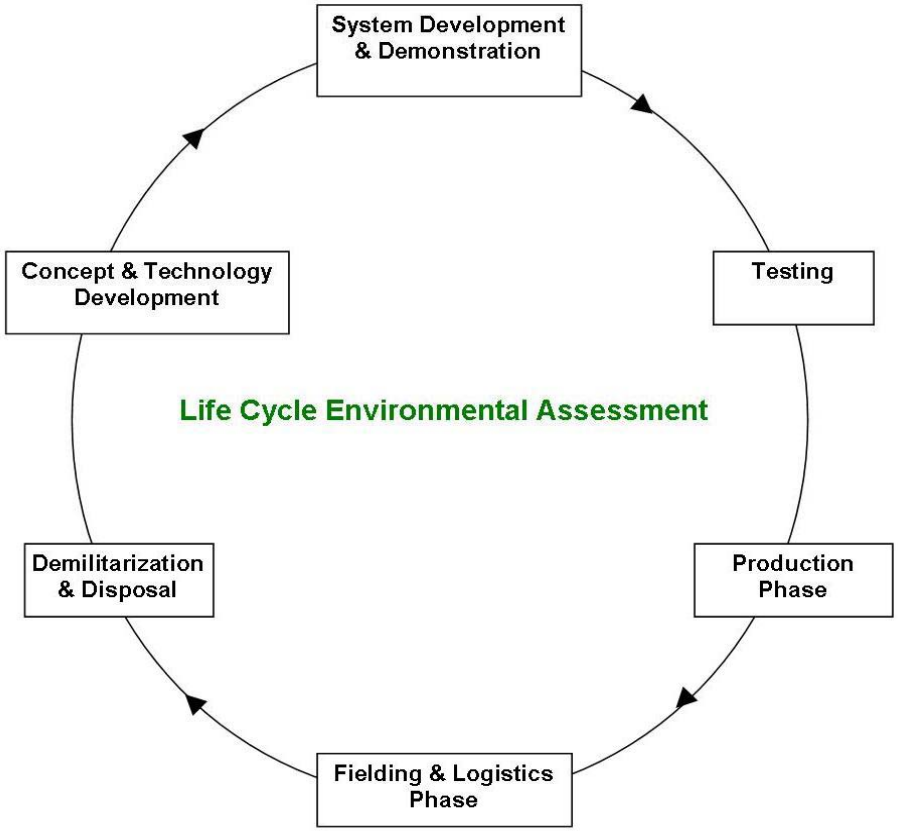
Urban Operations Laboratory
Conceptual Framework for Life Cycle Environmental Assessments
Department of Defense Non-Lethal Technologies

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Environmental Assessment & Acquisition

- Concept Development
  - Planning & Design
- System Demonstration
  - Laboratory & Engineering Tests
- Testing
  - Integrated Systems
- Production
  - Manufacturing Processes
- Fielding & Logistics
  - Deploy, Transport, Storage
- Demilitarization & Disposal
  - Disassemble, Reuse, Detonate

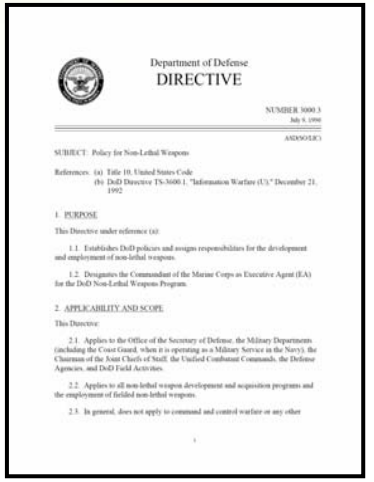


Urban Operations Laboratory
Acquisition Continuum & Life Cycle Environmental Assessments
Department of Defense Non-Lethal Technologies

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Non-Lethal Technologies



Department of Defense
DIRECTIVE

NUMBER 3000.3
July 9, 1996
ASD(SO/LIC)

SUBJECT: Policy for Non-Lethal Weapons

References: (a) Title 10, United States Code
(b) DoD Directive TS-3600.1, "Information Warfare (U)," December 21, 1992

1. PURPOSE

This Directive under reference (a):

1.1. Establishes DoD policies and assigns responsibilities for the development and employment of non-lethal weapons.

1.2. Designates the Commandant of the Marine Corps as Executive Agent (EA) for the DoD Non-Lethal Weapons Program.

2. APPLICABILITY AND SCOPE

This Directive:

2.1. Applies to the Office of the Secretary of Defense, the Military Departments (including the Coast Guard, when it is operating as a Military Service in the Navy), the Chairman of the Joint Chiefs of Staff, the Unified Combatant Commands, the Defense Agencies, and DoD Field Activities.

2.2. Applies to all non-lethal weapon development and acquisition programs and the employment of fielded non-lethal weapons.

2.3. In general, does not apply to command and control warfare or any other

- 1995 Somalia withdrawal of UN peacekeepers
- 1996 Policy, DoD Directive 3000.3
  - Development & Employment
  - Marine Corps as Executive Agent
- Definition

  "Weapons are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment."
  - Unlike conventional…means other than destruction, reversible effects, affect objects differently
- Policy
  - Deterrence, enhance capabilities, decrease post-conflict costs, retains/in conjunction with lethal option
- 1997 Formation of Joint Non-Lethal Weapons Directorate
- Task Force Recommendations
  - Expand deployment, range, ADS, aggressive funding/tech support

UOL
Urban Operations Laboratory

ibe
Advancing Biology-Inspired Engineering

Emerging Non-Lethal Systems Assessed

Munitions, Materials, Ranges

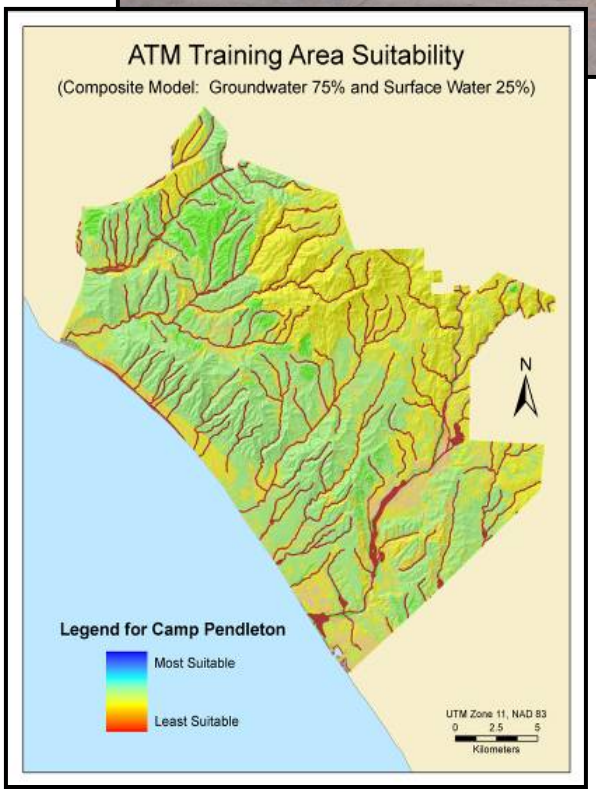
- **Anti-Traction Material**
- **Green Laser Dazzler**
- **Improved Flash-Bang Grenade**
- **Joint Nonlethal Warning Munition**
- **Malodorants and Irritants**
- **Mission Payload Module – Nonlethal Weapons System**
- **Nonlethal Airburst Munitions**
- **Nonlethal Thermobaric Technology**
- **Pulsed Energy Projectile**
- **Running Gear Entanglement System**
- **Testing and Training Range (Fort Leonard Wood, MO)**
- **Vehicle Nonlethal Munitions**

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Mobility Denial System/Anti-Traction Material

- Initial Characteristics
  - Slippery hydro-gel sprayed on surfaces
  - Identified benzene and acrylamide in initial design
  - GIS site suitability tool
- Evaluating Impacts
  - Sampling & analysis
  - Risk Assessment
  - Optimized formulation (removed benzene, min acrylamide)
  - PPE (two-tie dust masks, goggles, moisture resistant clothing)
  - BMP (cleanup, avoid water resources, tech manuals)
- Decision-Making
  - Evaluated site-specific NEPA (29 Palms, CA)
  - NEPA Decision-Memorandum
  - Programmatic FONSI
- Documentation
  - LCEA
  - PESHE

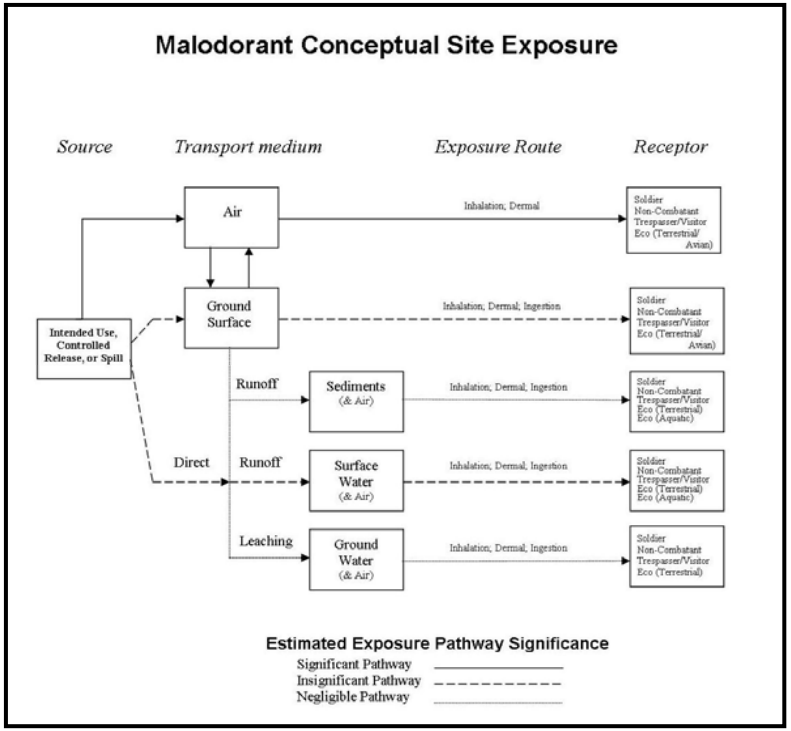


UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Malodorants and Irritants

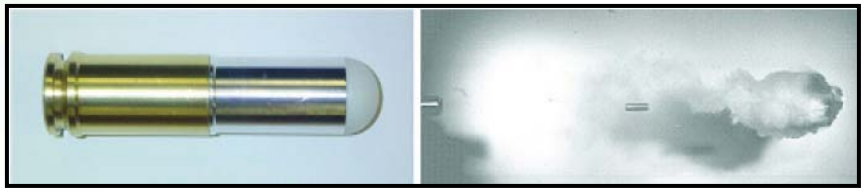
- Initial Characteristics
  - Foul-smelling payload delivered via nonlethal munitions
  - Identified thiophenol (highly toxic) in early formulation
- Evaluating Impacts
  - Toxicity assessment & predictive modeling
  - Down-selected formulation (removed thiophenol)
  - Evaluated conventional and novel components
  - Calculated release scenario impacts (dispersal)
  - Recommended ecotoxicity testing
  - PPE for certain phases
  - BMP (controlled release)
- Decision-Making
  - Programmatic FONSI
- Documentation
  - LCEA



UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Nonlethal Airburst Munitions



(JNLWD, 2006)

- Initial Characteristics
  - Various launch platforms and payloads considered (rubber balls, pyrotechnics, malodorants, etc) for small arms longer range
  - Identified tungsten ballast in initial design
- Evaluating Impacts
  - Literature review of tungsten compounds and particle size impacts
  - Down-selected payload & platform (eliminated tungsten and others)
  - Evaluated conventional and novel components
  - Limited field sampling
  - Integrated prototype being finalized
  - Additional environmental data collection planned
- Decision-Making
  - Programmatic FONSI
- Documentation
  - LCEA

(JNLWD, 2008)

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering

Conclusions & Contact Information

- *Early Involvement Key (Team & Tools)*
- *Improved Product Design/Selection*
- *Likely More NLW Use/Capabilities in Future*
- *Triple Bottom Line Savings (Environment, Economics, Social)*
- *Mission & Environmental Sustainment Interdependent*

- Oral Saulters osaulter@k-state.edu

- EKAT at **www.ekat-tool.com** is available for review and to obtain user feedback for further development
- For specific questions about EKAT, contact:

John Blair blairj@m2tech.us

Terrie Boguski tboguski@k-state.edu

Jay Fredkin jayfredkin@cabemtechnologies.com

UOL Urban Operations Laboratory

ibe Advancing Biology-Inspired Engineering