

**DOD ENVIRONMENTAL TECHNOLOGY PROGRAM
RESEARCH AND DEVELOPMENT REQUIREMENTS REVIEW**



JULY 2008

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FOREWORD

On Behalf of the Department of Defense (DoD), I am pleased to provide the Department's Environmental Technology Requirements Report. I am particularly appreciative of the cooperative effort among all the major DoD Environmental Technology Programs represented by this report. With this report, we have a tool that provides the baseline of environmental technology requirements across DoD. The report demonstrates continuity among the Military Departments and helps validate resource requirements for research and development program plans. In addition, the report highlights the common and unique research needs across the DoD as well as identifies potential research gaps. The information found in this report will assist the DoD leadership in implementing our broad environmental technology policy objectives.

The environmental technology requirements process is a vital component of DoD's environmental program, and supports the Department's investment in science and technology, demonstration and validation, and technology transfer efforts. This report introduces an important evolution in our ability to manage our research efforts. It establishes an innovative framework for collecting and analyzing the requirements within common Mission Focus Areas, and with a comprehensive set of technical descriptors. This approach establishes consistency across the Department while providing focus on the warfighter's training and mission readiness needs.

Attention to sustainability and environmental stewardship is a reflection of the high ethical ideals of America's fighting men and women. The DoD Environmental Technology Program fully supports the operational readiness and mission capabilities of the Department's installations and weapon systems, and the safety and health of the men and women who operate and support them. We move forward in our ability to sustain a healthy and productive environment, a critical element necessary to raise, equip, and sustain forces in the field.

Thank you.



Alex A. Beehler

Assistant Deputy Under Secretary of Defense
Environment, Safety, and Occupational Health

TABLE OF CONTENTS

	Page
EXECUTIVE SUMMARY	EX-1
1.0 INTRODUCTION	1-1
1.1 PURPOSE OF THE REPORT	1-1
1.2 BACKGROUND	1-3
1.3 ENVIRONMENTAL TECHNOLOGY REQUIREMENTS REVIEW	1-4
1.3.1 Requirements Development Processes	1-5
1.4 TECHNICAL APPROACH FOR REQUIREMENTS COLLECTION AND REVIEW	1-7
1.4.1 Categorization Scheme	1-7
2.0 RESULTS AND FINDINGS	2-1
2.1 HIGH PRIORITY R&D NEEDS	2-1
2.2 COMMON AND UNIQUE REQUIREMENTS	2-1
3.0 SUMMARY AND RECOMMENDATIONS	3-1
APPENDIX A	Requirement Statements by R&D Need Areas
APPENDIX B	Air Force Requirements
APPENDIX C	Army Requirements
APPENDIX D	Navy Requirements
APPENDIX E	Requirements Category Assignments by Mission Focus Area and Pollutant/Stressor

LIST OF TABLES

	Page
Table 1.1	Mission Focus Areas..... 1-1
Table 1.2	Environmental Pollutants and Stressors..... 1-2
Table 2.1	Summary of Results..... 2-2

LIST OF ABBREVIATIONS AND ACRONYMS

ACSIM	Assistant Chief of Staff for Installation Management
AERTA	Army Environmental Requirements and Technology Assessments
ASA(ALT)	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASA(I&E)	Assistant Secretary of the Army for Installations & Environment
DoD	Department of Defense
DUSD(ES)	Deputy Under Secretary of Defense for Environmental Security
EC	emerging contaminant
EEC	Environmental Enabling Capabilities
EQ	Environmental Quality
EQT	Environmental Quality Technology
ESOH	Environment, Safety, and Occupational Health
ESTCP	Environmental Security Technology Certification Program
ETTC	Environmental Technology Technical Council
FWG	functional working group
MAJCOM	Major Command
MFA	Mission Focus Area
MILDEP	Military Department
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NCP	Naval Capability Pillars
NOC	Naval Operational Concept
NP21	Naval Power 21
OASA(ALT)	Office of the Assistant Secretary of the Army for Acquisitions, Logistics, and Technology
OASA(I&E)	Office of the Assistant Secretary of the Army (Installations & Environment)
ODDR&E	Office of the Director, Defense Research and Engineering
ODUSD(I&E)	Office of the Deputy Under Secretary of Defense (Installations & Environment)
P2	pollution prevention
POM	Program Objective Memorandum
R&D	research and development
RD&A	research, development, and acquisition
RDT&E	research, development, test, and evaluation

LIST OF ABBREVIATIONS AND ACRONYMS

SERDP	Strategic Environmental Research and Development Program
SG	Steering Group
UXO	unexploded ordnance
WS&P	Weapons Systems and Platforms

EXECUTIVE SUMMARY

The purpose of this report is to formally issue the Department of Defense (DoD) environmental technology requirements. This report provides the baseline of environmental technology requirements held across DoD, and the information is intended to assist DoD Environment, Safety, and Occupational Health (ESOH) executives in implementing broad environmental technology policy objectives. In addition, this report demonstrates continuity among the Military Departments' (MILDEPs) environmental technology programs and helps validate DoD resource requirements for research and development (R&D) program plans. The primary objectives of the DoD Requirements Review Initiative were to compile, consolidate, and review the MILDEPs' environmental technology requirements; identify requirements common across DoD or unique to a MILDEP; develop and demonstrate a common framework with concurrence across the MILDEPs; and disseminate the results in a DoD report.

The MILDEPs submitted two hundred twenty-nine (229) Requirements Statements: 127 from the Air Force, 46 from the Army, and 56 from the Navy. The 229 Requirements Statements expressed 376 individual R&D needs that are grouped into 62 R&D Need Areas, as developed by the ESOH Technology Requirements Steering Group. In short, this report:

- Presents all DoD's Requirements Statements (Appendices B, C, and D);
- Provides a numerical summary of requirements in each of the R&D Need Areas by MILDEP (Table 2.1);
- Presents a compilation and analysis of similar requirements for each R&D Need Area (Appendix A); and
- Identifies those unique requirements within each R&D Need Area (Appendix A).

Common environmental technology requirements will feed into Defense-wide R&D programs such as the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP), while the MILDEP-unique requirements will support each Program Objective Memorandum (POM). Senior DoD leadership, program and installation managers, and researchers can use this information in support of budget, investment, and research planning efforts.

This initiative establishes a new framework for managing environmental technology requirements that focuses on the mission and the warfighter while addressing environmental challenges. It represents an evolution from early environmental efforts that responded primarily to regulatory drivers. As a result, this effort also represents a transformation from a regulatory taxonomy to a requirements taxonomy based on military and environmental sustainability to meet the needs of the warfighter. Recommended follow-on efforts include developing a consistent, standard requirements collection process across the MILDEPs, conducting a comprehensive requirements gap analysis, mapping the requirements to existing and planned technology R&D projects and programs, and enabling a web-based data system to facilitate information exchange and maintenance of the requirements process.

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DOD ENVIRONMENTAL TECHNOLOGY PROGRAM RESEARCH AND DEVELOPMENT REQUIREMENTS REVIEW

1.0 INTRODUCTION

1.1 PURPOSE OF THE REPORT

The purpose of this report is to formally issue the Department of Defense (DoD) environmental technology requirements. This report provides the baseline of environmental technology requirements held across DoD. This information assists DoD Environment, Safety, and Occupational Health (ESOH) executives to implement broader policy objectives for oversight of the Military Departments (MILDEPs) and supports the validation of Defense resource requirements for research and development (R&D) program plans. The requirements highlight the most significant environmental challenges confronting DoD and were purposefully compiled to align with specific DoD Mission Focus Areas (MFAs) and applicable environmental pollutants and other stressors (Tables 1.1 and 1.2, respectively). The groundwork for this information was forwarded by DoD stakeholders that encompass DoD’s management of environmental programs, subordinate command organizations and system operators. A Steering Group (SG) led by the Office of the Deputy Under Secretary of Defense (Installations & Environment) (ODUSD(I&E)) and the Office of the Director, Defense Research and Engineering (ODDR&E); and supported by Senior Environmental Program Managers as designated from the MILDEPs, guided the activities necessary to develop this report. This report further assists DoD’s broader interest to implement Business Transformation objectives for tiered accountability at the Enterprise, MILDEP, and Program levels.

**Table 1.1
Mission Focus Areas**

Mission Focus Area	Sub-Focus Areas
Deployed Operations	None
Munitions Management	Operational Range
	Closed Range
Weapons Systems and Platforms	Production
	Operational Maintenance
	Disposal
Built Infrastructure	Mission Readiness
	Installation Sustainment
Natural Infrastructure	Base
	Ranges
Installation Restoration	None

Table 1.2
Environmental Pollutants and Stressors

Pollutants or Stressors	
Air Emissions	Organics
Cultural Resources	Other Inorganics (Asbestos, etc.)
Emerging Contaminants	Propellants, Pyrotechnics
Energy	Radiation
Habitat Disturbance	Solid Waste
Invasives	Stormwater Runoff, Non-Point Discharge
Metals	Sustainable Resources
Munitions Constituents (TNT, RDX, HMX, etc.)	UXO/Munitions
Noise	Waste Water, Point Discharge
Non-Point Discharge	

To comprehensively assess DoD-wide needs, the SG collected, consolidated, and reviewed more than 200 environmental technology requirements. The primary objective of this Requirements Review was to identify and differentiate environmental technology needs that are common across DoD from those needs that are significantly unique to a single MILDEP. Additionally, the SG identified 62 R&D Need Areas implicit in the requirements.

In short, this report:

- Presents all MILDEPs' Requirements Statements (Appendices B, C, and D);
- Provides a numerical summary of requirements in each of the R&D Need Areas by MILDEP (Table 2.1);
- Presents a compilation and analysis of similar requirements for each R&D Need Area (Appendix A); and
- Identifies those unique requirements within each R&D Need Area (Appendix A).

The information in this report can be used for several purposes. The Office of the Secretary of Defense (OSD) and the MILDEP leadership can use the requirements to support the development of R&D programs and plans, and to justify their respective technology investment strategies. Program managers from the MILDEPs will have visibility to Department-wide needs and identify areas in which to explore opportunities for collaboration or potential technology transfer. Researchers from within the MILDEPs and from other Federal agencies, academia, and industry can identify R&D requirements and potential funding opportunities in areas of their particular interests and/or disciplines. Installation managers also can benefit by reviewing the R&D Need Areas (which present a comprehensive set of environmental areas of concern) to perform gap analyses of their own particular installation programs.

1.2 BACKGROUND

The DoD's budget to address environmental program requirements is limited and assessed on an annual basis. Increasingly, as environmental laws and regulations at home and abroad grow more stringent, it is important that the MILDEPs flexibly evaluate and plan resources in support of the warfighter that do not constrain the operation and maintenance of weapon systems or training. To meet increased regulatory impacts within allowable budgets, it is imperative that DoD resources be directed toward the MILDEPs' most pressing environmental requirements. By identifying the MILDEP's high priority environmental requirements, DoD will be in the position to improve ESOH policy, develop mitigation strategies, and focus technology programs that address, eliminate, or minimize environmental issues while improving mission performance.

Identifying and validating high-priority user requirements are the initial steps in focusing Defense-wide science and technology programs. DoD last compiled a comprehensive list of environmental user requirements in 2001 as led by the then Deputy Under Secretary of Defense for Environmental Security (DUSD(ES)). To revitalize the requirements process, ODUSD(I&E) and the MILDEPs established a mechanism to collect, consolidate, and disseminate the Department's high-priority environmental requirements.

Reissuance of DoD Directive 4715.1E, "Environment, Safety, and Occupational Health" (March 2005) established policies for ESOH to sustain and improve the DoD mission. This action implements DoD policy that requires all organizations to plan, program, and budget to manage ESOH risks that their activities generate. To ensure coherent implementation of this action, ODUSD(I&E) directed the MILDEPs to participate in the selection and prioritization process for requirements in coordination among themselves and with other DoD relevant programs and offices. Accordingly, a SG of representatives from the MILDEPs, ODDR&E, and ODUSD (I&E) was established to help provide direction and DoD-wide cooperation in fulfillment of realizing an Environmental Technology program. Members of the SG include representatives from the following offices:

- Assistant Deputy Under Secretary of Defense (ESOH) – Chair
- Deputy Assistant Secretary of the Army (ESOH)
- Deputy Assistant Secretary of the Navy (Environment)
- Deputy Assistant Secretary of the Air Force (ESOH)
- Staff Director, Defense Logistics Agency (Environment & Safety Policy)
- Office of the Director, Emerging Contaminants (ODUSD[I&E])
- Office of the Director, Defense Research and Engineering (ODDR&E)
- Offices of the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP).

The primary purpose of the SG is to provide policy oversight, and coordination to environmental technology requirements and programs. The SG facilitates joint Service cooperation on

environmental technology initiatives, develops and continuously improves environmental technology processes and procedures, and supports more efficient implementation of environmental technologies at DoD installations and other defense operations. The SG will compile and review MILDEP's environmental requirements annually, and support the MILDEPs programs to assess the adequacy to fund technology program plans. The SG will also strive to identify emerging requirements (those issues that might affect the MILDEPs in the future) by working with environmental regulators, the Science and Technology communities, industry, and academia. In particular, within ODUSD (I&E), the Emerging Contaminants Directorate established a process that provides early warning to DoD of emerging contaminant (EC) issues. It allows DoD to corporately evaluate the degree of mission risk and, for high mission risk chemicals, enables corporate decisions on strategic risk management options. Findings of the EC Governance Council will be used to update the environmental technology requirements.

1.3 ENVIRONMENTAL TECHNOLOGY REQUIREMENTS REVIEW

Relevant to this environmental technology review, several meetings were held to develop the courses of action for the SG and to ensure a common framework. During those meetings, members agreed that the logical first steps were to collect and review ongoing (i.e., newly established and those carried forward from 2001) MILDEP technology requirements. Additionally, the SG recognized that an overlap of environmental, safety, and occupational health technology issues and functional responsibilities exists and that a future activity to sort through these considerations would be needed with assistance from the Safety and Occupational Health managers.

The SG's objectives for this review were to (1) compile the MILDEPs' current environmental technology requirements, (2) review and consolidate the list by identifying common and unique requirements, and (3) compile and disseminate the results of this effort in a DoD report. The common requirements will feed into Defense-wide R&D organizations such as SERDP and ESTCP, and the MILDEP-unique requirements will support each MILDEP's Program Objective Memorandum (POM). Follow-on efforts will include developing a consistent and standard requirements collection process across the MILDEPs to promote information exchange and technology transfer. This process will require establishing a data management system that can be accessible at the MILDEPs, Defense Agencies, and DoD field activity level. Safety and Occupational Health considerations are planned for consolidation with the Environmental Technology requirements during 2009.

The SG recognizes the cooperative effort of the MILDEPs in the collection and submission of their respective requirements as well as their invaluable input to and feedback on the development of the requirements compilation process. Each of the MILDEPs assessed their own requirements in concert with the categorization scheme developed for this review (see section 1.4). This cooperative effort provided a consistent data set from which the SG's review team could more effectively and efficiently contrast and compare the similar requirements. Furthermore, the consolidation of the MILDEPs' requirements into groupings with similar R&D needs will foster information exchange and technology transfer across DoD.

1.3.1 Requirements Development Processes

Each MILDEP employs rigorous use of a requirements development process that is unique to supporting its annual planning, programming, and budgeting activities. While each requirements identification process is unique, each MILDEP program shares common objectives and goals for developing a research, development, test, and evaluation (RDT&E) investment strategy plan.

Air Force

The environmental quality technology requirements identified in this report represent the most important environmental challenges facing the Air Force. The Major Commands (MAJCOMs) are surveyed and the identified needs are then reviewed and consolidated by Air Force Center for Engineering and the Environment and Air Staff. The Air Force Research Laboratory and Air Force Materiel Command Pollution Prevention (P2) Integrated Product Team assist in the review and consolidation. Industry and academia will participate in this assessment step as needed to determine whether needs can be addressed by non-material solutions, material solutions, off-the-shelf technology, or on-going programs which require research, development, and acquisition (RD&A). The complete list of the Air Force's requirements is presented in Appendix B.

Army

Army Environmental Requirements and Technology Assessments (AERTA) are the basis for identifying the needs that serve as the catalyst for technology development in the Army Environmental Quality Technology (EQT) process. By design, the AERTA process is user driven beginning with a definition phase of collecting and identifying needs from the user community. Two additional steps of the process include the documentation phase and validation/approval phase. The Assistant Chief of Staff for Installation Management (ACSIM) completes the process by forwarding the final AERTA to the Environmental Technology Technical Council (ETTC) for endorsement prior to ACSIM signature validating the AERTA.

The Assistant Secretary of the Army for Acquisition, Logistics, and Technology (ASA(ALT)) and the Assistant Secretary of the Army for Installations and Environment (ASA(I&E)) established the EQT management oversight process in May 1997. The management consists of the ETTC, the Environmental Technology Integrated Process Team supporting the ETTC, and Technology Teams representing each of the Army's environmental "pillars" (compliance, conservation, pollution prevention, and restoration). Members of the ETTC are senior Army leaders at the headquarters level. The ETTC is a program management council co-chaired by the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, Office of the Assistant Secretary of the Army (Installations & Environment) (OASA(I&E)), and the Director of Research and Lab Management, Office of the Assistant Secretary of the Army for Acquisitions, Logistics, and Technology (OASA(ALT)). The ETTC provides guidance and assistance to the materiel development community to ensure that environmental technology, including demonstration and validation programs, is coordinated, integrated, and defended.

The AERTA represents the critical environmental technology needs for accomplishing the Army's mission while minimizing impact to the environment. Review criteria for these requirements evaluate their impacts on readiness and quality of life, impact or threat to the

environment, and timeliness for the Army to maintain compliance with environmental regulations. These requirements provide the basis for preparing EQT program proposals, which are presented to the ETTC for prioritization. The complete list of the Army's requirements is presented in Appendix C.

Navy

The Secretary of Defense has directed the military Services to develop transformational strategies that will greatly expand U.S. options available to Command Authority across the full spectrum of warfare. The Naval Operational Concept (NOC), "Naval Power 21" (NP21) provides the transformational vision for the Navy and Marine Corps. Sea Power 21 is the Navy's transformational document and is based on four Naval Capability Pillars (NCP): SEA SHIELD, SEA STRIKE, SEA BASING AND FORCEnet and the supporting initiatives of SEA WARRIOR, SEA TRIAL AND SEA ENTERPRISE. As part of its integrated capabilities assessment process, the Navy adopted five Navy environmental RDT&E Environmental Enabling Capabilities (EEC) required to meet the objectives of Sea Power 21.

Through environmental functional working groups (FWGs), the Navy documents environmental requirements across the five EEC areas. Each FWG is comprised of fleet personnel or their representatives, subject matter experts and environmental managers that work to ensure Fleet operation readiness. The FWGs help to drive the Navy's environmental R&D Program by identifying requirements related to their specific area of fleet operations. Some of the Navy's FWGs that participate in the Environmental Quality (EQ) requirements process are listed along with the respective EEC:

- Fleet and Weapon System Operations
 - Marine Mammal (N456)
 - Shipboard Compliance (SEA 04R)
- Range Sustainment
 - Range Commanders Council
 - Range Support Group
 - Underwater Range Sustainment Group
- Weapons System Sustainment
 - Navy Aviation Technology Integration Program
 - Naval Sea Systems Command's (NAVSEA) Pollution Prevention (P2) Working Group
- Air and Port Operations/Ship-to-Shore Interface
 - Naval Facilities Engineering Command's (NAVFAC) Air, Water, Petroleum Oil and other hazardous substances, Solid and Hazardous Waste Media Field Teams, Risk Assessment Working Group, and the Alternative Restoration Technology Team
- Base and Regulatory Compliance
 - NAVFAC's Air, Water, Petroleum Oil and other hazardous substances, Solid and Hazardous Waste Media Field Teams, Risk Assessment Working Group, and the Alternative Restoration Technology Team

The Navy EQ requirements are documented by the Chief of Naval Operations (N45) through the use of a comprehensive website (www.nesdi.navy.mil). The Environmental Readiness Division (N451) directs the Navy Science and Technology community to develop proposals and execute projects that target high priority EQ requirements.

The requirements developed and presented in Appendix D reflect the Navy's EQ requirements that impact fleet readiness. By successfully addressing these needs, the Navy will minimize operational risks, constraints and costs while sustaining environmental quality, stewardship and regulatory compliance.

1.4 TECHNICAL APPROACH FOR REQUIREMENTS COLLECTION AND REVIEW

This section describes the technical approach and methods that were used to collect and review the environmental technology requirements. It also introduces a multi-functional management framework based on environmentally relevant characteristics for each mission area that allows requirements to be systematically compiled, categorized, managed, and reported. Benefits of this framework include consistency in categorizing the Services' requirements (despite differences in conventions) and improved accessibility and utility of this critical information for a broad audience of scientific and user communities.

1.4.1 Categorization Scheme

The Air Force, Army, and Navy provided their individual lists of environmental technology R&D Requirement Statements, which are found in Appendices B, C, and D, respectively. The SG performed preliminary review of the Services' requirements was at which point they developed a classification and categorization scheme that put them into smaller groupings of similar requirements. The SG decided on a scheme by which each requirement is assigned to one or more programmatic focus areas. These areas, termed MFAs, are provided in Table 1.1 (see page 1-1). The SG also determined that assigning one or more Pollutant or Stressor to each requirement would further narrow down the groupings. The final list of Pollutants and Stressors is presented in Table 1.2 (see page 1-2).

The Service representatives made the assignments of MFAs and Pollutants/Stressors for each Requirement Statement and returned the data to the SG for further review and analysis. Appendix E contains the complete list of requirements and the assignments of MFAs and Pollutants/Stressors for each Requirement Statement from the Services.

After preliminary review of the consolidated Requirement Statements, the SG review teams determined that each MFA should be further divided into subgroupings called R&D Need Areas. The SG review teams then placed each Requirement Statements into its appropriate R&D Need Area(s), recognizing that a single Requirement Statement can fall into one or more R&D Need Areas.

2.0 RESULTS AND FINDINGS

The Services submitted a total of 229 Requirement Statements were: 127 from the Air Force, 46 from the Army, and 56 from the Navy. The primary task for the SG review team was to develop MFA subgroups from their lists of requirements and place the requirements into the appropriate subgroup(s). These subgroups are termed the R&D Needs Areas. It is important to note that one Requirement Statement may fall into numerous R&D Need Areas. As a result of this methodology, the 229 Requirements Statements actually expressed 376 individual technology requirements in 62 R&D Need Areas. Table 2.1 presents the Summary of Results of the categorization, consolidation, and review with a count of the Requirement Statements that fall within each R&D Need Area for each Service. Appendix A provides full lists of Requirement Statements that fall within each R&D Need Area.

2.1 HIGH PRIORITY R&D NEEDS

The MFA presenting the largest number of individual requirements (148) is **Weapons Systems and Platforms (WS&P)**. Interestingly, nearly half of the R&D Need Areas identified in the review (26 of 62) are associated with WS&P Production, Operational Maintenance, and Disposal. Within WS&P, issues and concerns regarding **Coating/De-coating** processes have the largest number of requirements.

Built Infrastructure is the MFA presenting the second highest number of R&D Needs (87). Within this MFA, there is a clear need to address issues and concerns with **Facility Waste** and **Built-Range Maintenance**.

2.2 COMMON AND UNIQUE REQUIREMENTS

The primary objective of this review was to identify and distinguish the requirements that are common to the Services and those that are unique to one Service. In summary, the majority of the R&D needs are common to all Services. However, most of the R&D Need Areas also contain at least one unique requirement. The unique requirements are noted with a check mark (✓) in the “Unique” column as presented in Appendix A.

Note: It is important to note that many of the requirements marked as Unique in Appendix A represent very specific R&D needs. However, if viewed from a broader perspective, many of these requirements could be considered collectively to fall under a broader Common requirement. For example, in the **WS&P** MFA and **Coating/De-Coating** Need Area, the Air Force identifies numerous specific requirements that are marked as Unique. The Army and Navy requirements in this area are not as specific, yet collectively they all describe the need for better solutions to problems posed by **Coating/De-Coating** systems. In the future, more in-depth technical analysis is needed before these types of requirements can be definitively labeled Common to all Services or Unique to one Service.

Table 2.1
Summary of Results
(Numbering system corresponds to organization of Appendix A.)

Mission Focus Area and Definitions		R&D Need Areas	Number of Requirements		
			Air Force	Army	Navy
A.1 Deployed Operations					
Addresses issues and solutions for activity that relates to an environmental operational requirement while deployed.		A.1.1 Waste Management and Reduction - Hazardous, Solid, and Mixed Waste	1	6	2
		A.1.2 Air Emissions	0	0	2
		A.1.3 Risk Assessment and Management	0	3	0
		A.1.4 Environmental and Ecosystem Restoration	0	1	0
		A.1.5 Noise	0	0	1
		A.1.6 Water Management	0	1	0
		A.1.7 Energy Management	0	3	0
		A.1.8 Sustainable Resources	0	1	0
A.2 Munitions Management					
Operational Range: Addresses issues and solutions for testing and training range operations and management to reduce generation of unexploded ordnance (UXO) during live fire operations. Also addresses characterization and management of munitions and munitions constituents on active ranges.	Closed Range: Addresses issues and solutions for munitions response site preparation; munitions detection and discrimination; filler material identification; and range clearance from closed, transferred, and transferring ranges.	A.2.1 Detection and Discrimination	2	1	1
		A.2.2 Underwater UXO Technologies	2	1	1
		A.2.3 Planning and Support	0	1	0
		A.2.4 UXO Recovery and Disposal	1	1	1
		A.2.5 Range Characterization and Maintenance	8	3	3

Table 2.1 (continued)
Summary of Results
 (Numbering system corresponds to organization of Appendix A.)

Mission Focus Area and Definitions	R&D Need Areas	Number of Requirements		
		Air Force	Army	Navy
A.3 Weapons Systems and Platforms				
Production & Operational Maintenance & Disposal: Addresses issues associated with the design, manufacture, maintenance, and disposal of weapons systems and platforms at the DoD manufacturing, maintenance, and repair facilities such as depots, shipyards, and ammunition plants, as well as at original equipment manufacture facilities. Focuses on reducing the current and future environmental liabilities associated with DoD weapons and platforms. This area includes development of green energetics and reduction of pollutant emissions from the platforms, weapons, and industrial processes.	A.3.1 Coatings/De-Coatings			
	A.3.1.1 Solvents	6	1	2
	A.3.1.2 Primers	7	1	2
	A.3.1.3 Conversion Coatings	9	1	1
	A.3.1.4 Non-Solvent Decoatings	4	1	1
	A.3.1.5 Topcoats	5	1	1
	A.3.1.6 Other	3	0	3
	A.3.2 Heavy Metal Elimination			
	A.3.2.1 Batteries	2	0	0
	A.3.2.2 Plating	11	0	1
	A.3.2.3- Lead Solder	2	0	0
	A.3.2.4 Other	3	2	3
	A.3.3 Propellants, Explosives, and Pyrotechnics	5	2	2

Table 2.1 (continued)
Summary of Results
 (Numbering system corresponds to organization of Appendix A.)

Mission Focus Area and Definitions	R&D Need Areas	Number of Requirements			
		Air Force	Army	Navy	
A.3 Weapons Systems and Platforms (continued) Production & Operational Maintenance & Disposal: Addresses issues associated with the design, manufacture, maintenance, and disposal of weapons systems and platforms at the DoD manufacturing, maintenance, and repair facilities such as depots, shipyards, and ammunition plants, as well as at original equipment manufacture facilities. Focuses on reducing the current and future environmental liabilities associated with DoD weapons and platforms. This area includes development of green energetics and reduction of pollutant emissions from the platforms, weapons, and industrial processes.	A.3.4 Air Emissions (HAPs, ODSs, VOCs, NOx, SOx, PM):				
	A.3.4.1 Engines	1	0	4	
	A.3.4.2 Solvents	7	1	1	
	A.3.4.3 General				
	VOC	2	0	1	
	ODS	3	0	2	
	General Air Emissions	0	3	2	
	PCBs	0	0	1	
	Metals Fumes	0	0	1	
	A.3.5 Noise	0	0	2	
	A.3.6 Waste Management and Reductions				
	A.3.6.1 Hazardous, Solid, and Mixed Waste				
	General Hazardous Waste	1	1	2	
	General Liquid Waste	2	1	8	
	Cutting Fluids	0	1	3	
	Deicing Fluids	3	0	1	
	Composite Materials	0	1	1	
Solid Waste	2	1	1		
A.3.6.2 Solvents	6	0	0		

Table 2.1 (continued)
Summary of Results
 (Numbering system corresponds to organization of Appendix A.)

Mission Focus Area and Definitions		R&D Need Areas	Number of Requirements		
			Air Force	Army	Navy
A.4 Built Infrastructure					
Mission Readiness: Addresses issues and solutions required to maintain built infrastructure directly related to mission readiness that includes testing and training facilities.	Installation Sustainment: Addresses issues and solutions required to maintain all other built (e.g., non-testing or training) infrastructure in a sustainable manner. Includes compliance with environmental media and energy requirements. Also includes monitoring and control of air emissions, and management of facility solid, mixed, and hazardous waste streams.	A.4.1 Air Quality	9	6	4
		A.4.2 Energy	0	3	0
		A.4.3 Facility Waste	17	11	9
		A.4.4 Noise	0	1	1
		A.4.5 Water Quality	3	0	3
		A.4.6 Cultural Resources	0	1	1
		A.4.7 Invasives	1	1	0
		A.4.8 Built-Range Maintenance	1	14	1
A.5 Natural Infrastructure					
Base: Addresses issues and solutions required to maintain and sustain natural and cultural resources including impact prediction, assessment, mitigation/prevention, and reclamation needs exclusive of the testing and training ranges. Includes regional and ecosystem-wide impacts as well.	Ranges: Addresses issues and solutions required to promote and sustain mission readiness on training and testing ranges including impact prediction, assessment, mitigation/prevention, and reclamation needs for natural resources and cultural resources on the ranges.	A.5.1 Ecosystem-Based Management	1	2	0
		A.5.2 Land Management/Watershed Protection	0	7	0
		A.5.3 Maritime Sustainability	0	0	4
		A.5.4 Threatened and Endangered Species	0	4	2
		A.5.5 Cultural Resources	0	1	1
		A.5.6 Noise	0	0	2
		A.5.7 Off-Range Migration	1	3	0

Table 2.1 (continued)
Summary of Results
 (Numbering system corresponds to organization of Appendix A.)

Mission Focus Area and Definitions	R&D Need Areas	Number of Requirements		
		Air Force	Army	Navy
A.6 Installation Restoration				
Addresses site characterization, risk assessment, remediation, long-term monitoring, and restoration/reclamation needs at potential and known contamination sites.	A.6.1 Site Characterization	12	3	6
	A.6.2 Risk Assessment	4	3	1
	A.6.3 Remediation:			
	A.6.3.1 Groundwater	6	2	3
	A.6.3.2 Soil	4	2	4
	A.6.3.3 Sediment	2	2	4
	A.6.3.4 General	1	0	0
	A.6.4 Containment	2	0	0
	A.6.5 Vapor Intrusion	5	0	0
A.7 All Mission Focus Areas				
Requirements listed here are categorized as having R&D needs in potentially all Mission Focus Areas.	No specific R&D Need Areas are identified	5	1	0

3.0 SUMMARY AND RECOMMENDATIONS

This review of environmental technology requirements is an important first step in a broader effort to monitor and improve the responsiveness of DoD's environmental technology investment programs. This report should be used as a tool by which all stakeholders can:

- Account for priority requirements and their relevancy to mission focus areas and pollutants and other stressors
- Compare and contrast individual Service needs against those reported by other Services
- Assist in performing technical gap analyses, eliminating potential programmatic overlaps, and identifying opportunities for collaboration in program investment strategies
- Aid Technology Transfer objectives to invest in solutions that promote innovation and cost-effective implementation across DoD user communities.

As a result of the review, the following recommendations are presented.

1. DoD should continue to refine and standardize methodologies for reporting environmental technology requirements. The development and use of a categorization scheme in this effort helped to normalize information expressed within individual Requirement Statements by assigning common descriptors (i.e., MFAs and Pollutant/Stressors) and placing them into R&D Need Areas.
2. The numerical summary of the Service requirements by MFAs and R&D Need Areas presented in Table 2.1 can inform a preliminary gap analysis for the Services. It provides a high-level summary of how the current requirements fall into a comprehensive, Mission-focused set of technology need areas. The SG should continue to lead a process that incorporates the Services' comprehensive review of the full set of R&D needs in an effort to identify technical gaps and commonalities in their individual lists of requirements.
3. Completed, ongoing, and proposed (anticipated) projects should be mapped to the requirements. This effort would entail analysis of the Services', SERDP's and ESTCP's technology project lists and connecting them back to the requirements.
4. A web-enabled, requirements database with report generation capabilities should be developed to facilitate continuous, real-time monitoring and updating as well as information exchanges on technology R&D needs and programs.

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APPENDIX A

REQUIREMENT STATEMENTS BY R&D NEED AREAS

TABLE OF CONTENTS

	Page
A.1	DEPLOYED OPERATIONS..... A-1
A.1.1	WASTE MANAGEMENT AND REDUCTION – HAZARDOUS, SOLID, AND MIXED WASTE..... A-1
A.1.2	AIR EMISSIONS..... A-3
A.1.3	RISK ASSESSMENT AND MANAGEMENT A-3
A.1.4	ENVIRONMENTAL AND ECOSYSTEM RESTORATION..... A-4
A.1.5	NOISE..... A-4
A.1.6	WATER MANAGEMENT A-4
A.1.7	ENERGY MANAGEMENT A-4
A.1.8	SUSTAINABLE RESOURCES A-5
A.2	MUNITIONS MANAGEMENT A-6
A.2.1	DETECTION AND DISCRIMINATION A-6
A.2.2	UNDERWATER UXO TECHNOLOGIES A-6
A.2.3	PLANNING AND SUPPORT A-7
A.2.4	UXO RECOVERY AND DISPOSAL A-7
A.2.5	RANGE CHARACTERIZATION AND MAINTENANCE A-8
A.3	WEAPONS SYSTEMS AND PLATFORMS A-10
A.3.1	COATINGS/DE-COATINGS A-10
A.3.1.1	Solvents..... A-10
A.3.1.2	Primers A-11
A.3.1.3	Conversion Coatings..... A-13
A.3.1.4	Non-Solvent Decoatings A-15
A.3.1.5	Topcoats..... A-16
A.3.1.6	Other A-17
A.3.2	HEAVY METAL ELIMINATION A-17
A.3.2.1	Batteries A-17
A.3.2.2	Plating..... A-18
A.3.2.3	Lead Solder A-20
A.3.2.4	Other A-20
A.3.3	PROPELLANTS, EXPLOSIVES, AND PYROTECHNICS..... A-21
A.3.4	AIR EMISSIONS (HAPS, ODSS, VOCS, NOX, SOX, PM) A-22
A.3.4.1	Engines..... A-22
A.3.4.2	Solvents..... A-23
A.3.4.3	General..... A-24
A.3.5	NOISE..... A-26
A.3.6	WASTE MANAGEMENT AND REDUCTION A-26
A.3.6.1	Hazardous, Solid, and Mixed Waste..... A-26
A.3.6.2	Solvents..... A-29
A.4	BUILT INFRASTRUCTURE A-31
A.4.1	AIR QUALITY..... A-31

TABLE OF CONTENTS (continued)

	Page
A.4.2 ENERGY	A-34
A.4.3 FACILITY WASTE.....	A-34
A.4.4 NOISE.....	A-39
A.4.5 WATER QUALITY.....	A-39
A.4.6 CULTURAL RESOURCES	A-40
A.4.7 INVASIVES	A-40
A.4.8 BUILT RANGE MAINTENANCE.....	A-41
A.5 NATURAL INFRASTRUCTURE.....	A-44
A.5.1 ECOSYSTEM-BASED MANAGEMENT	A-44
A.5.2 LAND MANAGEMENT/WATERSHED PROTECTION.....	A-44
A.5.3 MARITIME SUSTAINABILITY	A-46
A.5.4 THREATENED AND ENDANGERED SPECIES.....	A-46
A.5.5 CULTURAL RESOURCES	A-47
A.5.6 NOISE.....	A-47
A.5.7 OFF-RANGE MIGRATION	A-48
A.6 INSTALLATION RESTORATION.....	A-49
A.6.1 SITE CHARACTERIZATION.....	A-49
A.6.2 RISK ASSESSMENT.....	A-51
A.6.3 REMEDIATION.....	A-53
A.6.3.1 Groundwater	A-53
A.6.3.2 Soil	A-54
A.6.3.3 Sediment	A-55
A.6.3.4 General.....	A-56
A.6.4 CONTAINMENT	A-57
A.6.5 VAPOR INTRUSION	A-57
A.7 ALL MISSION FOCUS AREAS	A-57

APPENDIX A
Requirement Statements by R&D Need Areas

The following subsections contain the lists of Requirement Statements that fall within each of the 62 R&D Need Areas. It is important to note that any Requirements Statement can be assigned to more than one Mission Focus Area (MFA) or be associated with one or more Pollutant or Stressor (see Tables 1.1 and 1.2, respectively). The column “**Assigned MFAs – Pollutants/Stressors**” provides all of the Mission Focus Areas and Pollutants/Stressors to which the Requirements Statement was assigned.

A.1 DEPLOYED OPERATIONS

This MFA addresses issues and solutions for activity that relates to an environmental operational requirement while troops are deployed.

A.1.1 WASTE MANAGEMENT AND REDUCTION – HAZARDOUS, SOLID, AND MIXED WASTE

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	38	Reduce hazardous/solid waste at deployed sites (forward operating base)	Deployed Ops – Haz. Waste Deployed Ops – Mixed Waste Deployed Ops – Solid Waste	High	
Army PP-5	8	Zero Footprint Camp - CONOPS	Deployed Ops – Haz. Waste Deployed Ops – Mixed Waste Deployed Ops – Solid Res. Deployed Ops – Sust. Res.	High	
Army PP-6	9	Develop Sustainable Lubricants and Fluids	Built Infra-Sust – Haz. Waste Built Infra-Sust – Solid Waste Deployed Ops – Haz. Waste Deployed Ops – Solid Waste WS&P-Disp – Haz. Waste WS&P-Disp – Solid Waste WS&P-Disp – Sust. Res. WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Solid Waste WS&P-Mnt. – Sust. Res. WS&P-Prod – Haz. Waste WS&P-Prod – Solid Waste WS&P-Prod – Sust. Res.	High	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-6	33	Waste Management Utilizing Waste Characteristics - CONOPS	Built Infra-MR – Haz. Waste Built Infra-Sust – Mixed Waste Deployed Ops – Haz. Waste, Mixed Waste, Solid Waste, Sust. Res.	Medium	
Army ER-10	35	Avoidance of Environmental Risk During Contingency Operations	Deployed Ops – Haz. Waste Deployed Ops – Sust. Res.	Low	✓
Army PP-9	41	Compliant Electronics for Life Cycle Sustainment of Military Components and Systems	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals Deployed Ops – Haz. Waste Deployed Ops – Metals WS&P-Disp – Haz. Waste WS&P-Disp – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals WS&P-Prod – Haz. Waste WS&P-Prod – Metals	Low	
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	✓
Navy	31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for disposal.	Deployed Ops – Air Emissions Deployed Ops – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	✓
Navy	38	Develop shipboard technologies to treat oily waste to reduce ship-to-shore transfer and shoreside disposal.	Deployed Ops – Organics WS&P-Mnt. – Organics WS&P-Prod – Organics	High	✓

A.1.2 AIR EMISSIONS

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for disposal.	Deployed Ops – Air Emissions Deployed Ops – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	✓
Navy	34	Develop technologies to control or eliminate particulate and other air emission from tactical mobile and stationary sources.	Deployed Ops – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓

A.1.3 RISK ASSESSMENT AND MANAGEMENT

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-6	21	Environmental Restoration During Security, Stability, Transition, and Reconstruction (SSTR) Operations	Deployed Ops – All	Medium	✓
Army ER-10	35	Avoidance of Environmental Risk During Contingency Operations	Deployed Ops – Haz. Waste Deployed Ops – Sust. Res.	Low	✓
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	✓

A.1.4 ENVIRONMENTAL AND ECOSYSTEM RESTORATION

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-6	21	Environmental Restoration During Security, Stability, Transition, and Reconstruction (SSTR) Operations	Deployed Ops – All	Medium	✓

A.1.5 NOISE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	18	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on marine mammals.	Deployed Ops – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	✓

A.1.6 WATER MANAGEMENT

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-1	3	Sustainable Water Usage	Built Infra-Sust – Sust. Res. Deployed Ops – Sust. Res. Natural Infra-Base – Sust. Res. Natural Infra-Range – Sust. Res.	High	✓

A.1.7 ENERGY MANAGEMENT

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army PP-7	19	Joint Battlespace Use Fuel of the Future	Built Infra-MR – Air Emissions Built Infra-MR – Energy Deployed Ops – Energy	Medium	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-9	42	Sustainable Technologies for Military Facilities and Facility Systems	Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res. Natural Infra-Base – Energy Natural Infra-Range – Energy	Low	✓
Army CM-7	43	Waste Heat CONOPS	Built Infra-MR – Energy Built Infra-MR – Sust. Res. Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res.	Low	✓

A.1.8 SUSTAINABLE RESOURCES

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-9	42	Sustainable Technologies for Military Facilities and Facility Systems	Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res. Natural Infra-Base – Energy Natural Infra-Range – Energy	Low	✓

A.2 MUNITIONS MANAGEMENT

Operational Range

Addresses issues and solutions for testing and training range operations and management to reduce generation of UXO during live fire operations.

Closed Range

Addresses issues and solutions for (munitions response) site preparation, munitions detection and discrimination, filler material identification, and range clearance from closed, transferred, and transferring ranges.

A.2.1 DETECTION AND DISCRIMINATION

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	129	Technologies to Locate and Identify Unexploded Ordnance (UXO)	MM-AR – UXO/MC MM-C-O – UXO/MC	Medium	
Air Force	134	Effective method for subsurface detection of munitions which can effectively filter out interference from volcanic rock	MM-AR – UXO/MC MM-C-O – UXO/MC	Medium	✓
Army ER-11	36	Detection, Discrimination, Identification, and Render Safe of Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM)	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Sust. Res. MM-AR – UXO/MC MM-C-O – Sust. Res. MM-C-O – UXO/MC	Low	
Navy	15	Develop detection methods for locating Unexploded Ordnance (UXO) on Land, Underwater, and in Sediments to facilitate the recovery and removal of UXO from Navy ranges.	IRP – PEPs IRP – UXO/MC MM-AR – PEPs MM-AR – UXO/MC MM-C-O – PEPs MM-C-O – UXO/MC	High	

A.2.2 UNDERWATER UXO TECHNOLOGIES

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	122	Effective method for subsurface detection of munitions in ponds and other bodies of water	MM-AR – UXO/MC MM-C-O – UXO/MC	High	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	123	Technologies to locate and remove UXO from sediments in ponds and other bodies of water (AFSPC)	MM-AR – UXO/MC MM-C-O – UXO/MC	High	
Army ER-11	36	Detection, Discrimination, Identification, and Render Safe of Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM)	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Sust. Res. MM-AR – UXO/MC MM-C-O – Sust. Res. MM-C-O – UXO/MC	Low	
Navy	15	Develop detection methods for locating Unexploded Ordnance (UXO) on Land, Underwater, and in Sediments to facilitate the recovery and removal of UXO from Navy ranges.	IRP – PEPs IRP – UXO/MC MM-AR – PEPs MM-AR – UXO/MC MM-C-O – PEPs MM-C-O – UXO/MC	High	

A.2.3 PLANNING AND SUPPORT

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-2	13	Munitions and Explosives of Concern (MEC) Management Technologies for Operational Range Sustainability	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Haz. Waste MM-AR – PEPs MM-AR – Sust. Res. MM-AR – UXO/MC	High	✓

A.2.4 UXO RECOVERY AND DISPOSAL

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	132	Cost efficient and effective method for surface removal of broken target material from large skeet ranges (5-50 Acres) under two different sites conditions - little vegetation and heavy vegetation	MM-AR – Metals MM-C-O – Metals	Medium	✓

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-11	36	Detection, Discrimination, Identification, and Render Safe of Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM)	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Sust. Res. MM-AR – UXO/MC MM-C-O – Sust. Res. MM-C-O – UXO/MC	Low	
Navy	15	Develop detection methods for locating Unexploded Ordnance (UXO) on Land, Underwater, and in Sediments to facilitate the recovery and removal of UXO from Navy ranges.	IRP – PEPs IRP – UXO/MC MM-AR – PEPs MM-AR – UXO/MC MM-C-O – PEPs MM-C-O – UXO/MC	High	

A.2.5 RANGE CHARACTERIZATION AND MAINTENANCE

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	124	Fate of Smokes, Ordnance, and Obscurants on Ranges	MM-AR – Air Emissions MM-AR – PEPs	Medium	
Air Force	125	Identification and Fate of Ordnance on Ranges	MM-AR – UXO/MC MM-C-O – UXO/MC	Medium	
Air Force	126	Lead Migration Studies at Small Arms Ranges/Skeet Ranges	MM-AR – Metals	Medium	
Air Force	128	Remediation of Lead at Outdoor Firing Ranges	MM-AR – Metals	Medium	
Air Force	130	Low cost, environmentally benign, durable bombing targets	MM-AR – Metals	Medium	
Air Force	131	Feasibility of adding electronic ‘tags’ to small, difficult to locate, live ordnance for location of dud items (UXO) (ACMs/submunitions, 40mm grenades, 30mm HEI, etc.)	MM-AR – UXO/MC WS&P-Prod – UXO/MC	Medium	
Air Force	133	Cost efficient and effective method for In-situ stabilization of lead shot in soils at skeet ranges and firing ranges	MM-AR – Metals MM-C-O – Metals	Medium	
Air Force	136	Identification of components of clay targets on trap/skeet ranges and their fate/transport	MM-AR – Solid Waste MM-C-O – Solid Waste	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-2	13	Munitions and Explosives of Concern (MEC) Management Technologies for Operational Range Sustainability	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Haz. Waste MM-AR – PEPs MM-AR – Sust. Res. MM-AR – UXO/MC	High	
Army ER-3	14	Management of Munitions Constituents (MC) on Live Fire Training and Testing Ranges	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Haz. Waste MM-AR – Sust. Res. MM-AR – UXO/MC	High	
Army ER-8	23	Long-Term Monitoring of Regulated Constituents	Built Infra-MR – Haz. Waste, PEPs, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-AR – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-C-O – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, PEPs, Sust. Res., UXO/MC	Medium	
Navy	11	Develop treatment technologies and processes to remove munitions constituents and energetic materials from wastewaters at Navy ordnance manufacturing, testing, and demilitarization sites.	Built Infra-MR – PEPs Built Infra-Sust – Munit. Const. MM-AR – Munit. Const. MM-AR – PEPs MM-C-O – Munit. Const.	High	
Navy	16	Develop remediation technologies for soils contaminated with energetic materials at Navy manufacturing sites and ranges.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	
Navy	17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	

A.3 WEAPONS SYSTEMS AND PLATFORMS

Addresses issues associated with the design, manufacture, maintenance, and disposal of weapons systems and platforms at the DoD manufacturing, maintenance, and repair facilities such as depots, shipyards, and ammunition plants, as well as at original equipment manufacture facilities. Focuses on reducing the current and future environmental liabilities associated with DoD weapons and platforms. This area also includes the development and production of munitions and green energetics and emissions from the platforms, weapons, and industrial processes.

A.3.1 COATINGS/DE-COATINGS

A.3.1.1 Solvents

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	51	Alternative to Methylene Chloride, Immersion Chemical Stripping Process for Landing Gear, Wheels, and Other Small Components	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Air Force	70	Non-chromated Anodic Coating Stripper	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Medium	
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	84	Alternative Repair Technology for Printed Wiring Assemblies which Does Not Require Hazardous Solvents (Trichloroethane, Xylene, Methylene Chloride) to Remove Conformal Coatings	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles for ALCM and ACM	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	20	Develop objective measures for determining acceptable surface cleanliness in order to establish standards for approving alternatives to chlorinated cleaning solvents used to maintain Navy weapon systems.	WS&P-Mnt. – Chlor Solv	High	
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	

A.3.1.2 Primers

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	53	Develop environmentally compliant primer with high degree of flexibility for large aircraft, missiles, and ground equipment	Built Infra-Sust – Air Emissions WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	64	Develop Alternatives to Chromate-containing Paint Primers	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Air Force	74	Non-chromated Primers Are Required to Replace Zinc Chromate Primers Currently Used For Corrosion Protection on the Titan IV Launch Vehicle and Associated Ground Equipment	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles for ALCM and ACM	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	106	Mitigation and Control Technologies to Allow Continued Use of Existing (High VOC and AFMC 24 TRI Chemicals) Paints and Primers	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	23	Identify and qualify alternative adhesives, sealants, and primers that eliminate the use of hazardous materials and the release of VOCs and ODSs.	WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	

A.3.1.3 Conversion Coatings

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	55	Alternative to chromated Chemical Conversion Coatings for Aluminum and Magnesium Aircraft components	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	58	Develop alternative(s) to Chromated Chemical Conversion Coatings	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Air Force	67	Equivalent Replacement for Pre-paint Conversion Coating on Aircraft Structures	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	69	MIL-C-81706 Alternative for Alodine Coating	WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste WS&P-Prod – Haz. Waste	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	71	Non-chromated Conversion Coating for Aluminum Immersion	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	72	Non-chromated Conversion Coating for Aluminum Spraying	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles for ALCM and ACM	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	

A.3.1.4 Non-Solvent Decoatings

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	90	Determine Capabilities and Limitations for Broadest Possible Range of "Blast media" paint stripping Mediums; to give the field the most extensive "suite" of blast media painting stripping choices as possible	WS&P-Mnt. – Air Emissions	Low	
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles for ALCM and ACM	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	

A.3.1.5 Topcoats

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles for ALCM and ACM	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	106	Mitigation and Control Technologies to Allow Continued Use of Existing (High VOC and AFMC 24 TRI Chemicals) Paints and Primers	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Air Force	111	Replace Paints That Contain AFMC-24 TRI Chemicals and Change Technical Data Sheets	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	

A.3.1.6 Other

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	96	Environmentally Compliant Sealants	WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions	Low	
Air Force	97	Environmentally Compliant Temporary Coating	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	✓
Air Force	107	Need Durable Leading-edge Coating to Eliminate Paint-System Failures in Prone Areas on the Aircraft	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Navy	23	Identify and qualify alternative adhesives, sealants, and primers that eliminate the use of hazardous materials and the release of VOCs and ODSs.	WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	High	
Navy	26	Develop efficient paint application processes and disposal alternatives to minimize the amount hazardous wastes resulting from painting operations.	WS&P-Mnt. – Haz. Waste WS&P-Prod – Haz. Waste	High	
Navy	33	Develop coating and cleaning technologies that eliminate/minimize copper and zinc releases to the marine environment from ship antifouling/fouling release coating systems.	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Metals	High	✓

A.3.2 HEAVY METAL ELIMINATION

A.3.2.1 Batteries

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	40	Replacement for Lead-Acid Batteries in Support Equipment	Built Infra-MR – Haz. Waste Built Infra-Sust – Haz. Waste WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste	Medium	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	94	Disposal of Nickel-Cadmium (Ni-Cd) Battery and Identification of Replacement for Ni-Cd Battery	WS&P-Disp – Metals WS&P-Mnt. – Metals WS&P-Prod – Metals	Low	✓

A.3.2.2 Plating

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	54	Alternative for Nickel Plating and Electroless Plating	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	56	Develop alternative to IVD Aluminum to replace Cadmium Plating	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	59	Alternative(s) to Chromic Acid Anodizing of Magnesium and Aluminum Surfaces	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	60	An Alternative to Chrome Plating on Aircraft Components and/or Mitigation and Control Technologies for Chrome Plating.	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	61	Contain Cadmium and Chromium Plating on Jet Engine Compressor Parts (to control pollution during compressor washes)	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	62	Corrosion-protective Coatings for Fasteners Are Needed to Eliminate Heavy Metal HAZMATs	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	75	Non-dichromate Coatings for Magnesium	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	76	Replacement for Cadmium-Chromium plating on aircraft parts	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	77	Replacement for Chromic Acid Anodize	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	79	Substitution, Mitigation, or Control for Cadmium Plating on High-strength Steels	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	112	Replacement for Chromium Plating for the M61A1 Gun Barrel and/or Design Changes to the M61A1 System that would Extend Gun Barrel Lifetime while Doing Away with Chromium Plating of the Gun Barrel Interior	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	27	Identify and qualify alternative plating materials and processes that eliminate the use of hazardous materials (Cr+6, Cd) and the disposal of hazardous wastes.	WS&P-Disp – Metals WS&P-Mnt. – Metals WS&P-Prod – Metals	High	

A.3.2.3 Lead Solder

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	52	Alternative (Lead-free Solder and/or Nonsoldering Procedures and Materials) for Bonding Electronic Components and Assemblies During Repair	WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals	Medium	✓
Air Force	68	Lead-free Solder	WS&P-Disp – Metals WS&P-Mnt. – Metals WS&P-Prod – Metals	Medium	✓

A.3.2.4 Other

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	78	Replacement of Leaded Dry-Film Lubricants used in engine [Assembly and Manufacturing] Applications	WS&P-Prod – Metals	Medium	
Air Force	88	Beryllium-free Alloys for Bushings and Bearings, Etc.	WS&P-Disp – Metals WS&P-Mnt. – Metals WS&P-Prod – Metals	Low	
Air Force	110	Reclamation or Extension of the Life of Chromic-Phosphoric Acid Anodize Stripping Solutions	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	
Army PP-2	2	Heavy Metals Reductions in Surface Coating Processes	WS&P-Disp – Haz. Waste WS&P-Disp – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals WS&P-Prod – Haz. Waste WS&P-Prod – Metals	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army PP-9	41	Compliant Electronics for Life Cycle Sustainment of Military Components and Systems	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals Deployed Ops – Haz. Waste Deployed Ops – Metals WS&P-Disp – Haz. Waste WS&P-Disp – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals WS&P-Prod – Haz. Waste WS&P-Prod – Metals	Low	
Navy	22	Eliminate hazardous materials (Lead, VOCs, and HAPs) from the manufacturing and repair of optical and electronic devices	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	High	
Navy	29	Develop alternative welding and cutting materials and procedures to eliminate generation of hazardous wastes and toxic air emissions (heavy metal fume emissions).	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	
Navy	46	Develop technologies to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	Built Infra-MR – Metals Built Infra-MR – Organics WS&P-Mnt. – Metals WS&P-Mnt. – Organics	High	

A.3.3 PROPELLANTS, EXPLOSIVES, AND PYROTECHNICS

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	30	Technologies for treatment of perchlorate	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam. Natural Infra-Range – Emrg. Contam. WS&P-Disp – Emrg. Contam. WS&P-Mnt. – Emrg. Contam.	Low	
Air Force	91	Develop an Alternative Nontoxic Monopropellant for Hydrazine for the F-16 Emergency Power Unit (EPU)	WS&P-Mnt. – Organics WS&P-Prod – Organics	Low	
Air Force	127	Reclamation/Recycling/Disposal of Munitions	WS&P-Disp – UXO/MC WS&P-Prod – UXO/MC	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	131	Feasibility of adding electronic ‘tags’ to small, difficult to locate, live ordnance for location of dud items (UXO) (ACMs/submunitions, 40mm grenades, 30mm HEI, etc.)	MM-AR – UXO/MC WS&P-Prod – UXO/MC	Medium	✓
Air Force	135	Technology to Reclaim/Recycle Reactive Weapons Components	WS&P-Disp – UXO/MC WS&P-Prod – UXO/MC	Low	
Army PP-3	4	Compliant Ordnance Lifecycle for Readiness of the Transformation and Objective Forces	Built Infra-MR – Sust. Res. WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste WS&P-Prod – Haz. Waste	High	
Army CM-5	32	Management of Environmental Consequences of the Introduction of Insensitive Munitions Compounds to the DoD Inventory	Built Infra-MR – Haz. Waste, PEPs, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Disp – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Mnt. – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Prod – Haz. Waste, PEPs, Sust. Res., UXO/MC	Medium	
Navy	12	Develop Ammonium Perchlorate (AP)-Free propellants and treatment technologies for air emissions contaminated with energetic materials resulting from ordnance manufacturing, testing, and demilitarization.	Built Infra-Sust – Emrg. Contam. Built Infra-Sust – PEPs WS&P-Prod – Emrg. Contam. WS&P-Prod – PEPs	High	
Navy	13	Develop alternative ordnance disposal methods to reduce emissions from energetics production and demilitarization	Built Infra-Sust – Air Emissions Built Infra-Sust – PEPs WS&P-Disp – Air Emissions WS&P-Disp – PEPs	High	

A.3.4 AIR EMISSIONS (HAPS, ODSS, VOCS, NOX, SOX, PM)

A.3.4.1 Engines

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	11	Address the Scientific Basis for Determining the Carcinogenicity of Naphthalene and Other PAHs	Built Infra-Sust – Organics IRP – Organics WS&P-Disp – Organics WS&P-Mnt. – Organics WS&P-Prod – Organics	Low	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	7	Develop alternative engine technologies to reduce nitrogen and sulfur oxides emissions from marine diesel and gas turbine engines.	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓
Navy	8	Develop alternative engine technologies to reduce air emissions from aviation engines to allow continued operation and training of Naval aircraft.	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓
Navy	9	Develop alternative rocket engine emission control technologies to reduce particulate and gaseous air emitted during testing of rocket motors.	Built Infra-MR – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓
Navy	34	Develop technologies to control or eliminate particulate and other air emission from tactical mobile and stationary sources.	Deployed Ops – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓

A.3.4.2 Solvents

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	87	An Environmentally Acceptable Chemical Is Needed to Clean Liquid Oxygen (LOX), Gaseous Oxygen (GOX) and Liquid Nitrogen (LIN) Components in Aircraft, AGE, Production Plants and Storage Tanks	WS&P – Haz. Waste WS&P-Mnt. – Air Emissions	Low	✓
Air Force	99	Heavy Degreaser on Aluminum Surfaces, Carbon Removal, and a Pre-paint and Pre-adhesive Cleaner	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Air Force	103	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Solvents Used to Clean Metal Parts	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Air Force	114	Replacement for PD680 Type II	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	115	Replacement of chlorinated cleaners (MEK, Methylene Chloride, TCE) used to clean metal engine components	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Air Force	119	Solvent-free Solid State Metal Cleaning	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	
Army PP-4	5	Alternative Products in Cleaning and Degreasing Processes	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions	High	
Navy	21	Develop technologies for coating removal and cleaning operations that eliminate VOC, HAP, ODS, and toxic emissions/wastes during aircraft and ship maintenance.	WS&P-Mnt. – Air Emissions	High	

A.3.4.3 General

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
<i>Volatile Organic Compounds</i>					
Air Force	98	Flow Reduction and VOC Emissions Control for High-Volume/Low-Concentration Sources	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	✓
Air Force	104	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Lubricants	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Navy	28	Develop replacement machine cutting and grinding fluids that do not contain 1,1,1-TCA and other chlorinated compounds to eliminate the discharge chlorinated compounds to the atmosphere and incur high disposal costs.	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Organics	High	
<i>Ozone Depleting Substances</i>					
Air Force	109	R-22 Refrigerant Replacement and Methods to Modify Environmental Control Units (ECUs)	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	
Air Force	116	Replacement of AF Environmental Control Unit (ECU) Ozone depleting Refrigerant	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	118	Replacements for Ozone depleting Refrigerant Compounds	WS&P-Disp – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	
Navy	1	Develop alternative refrigerant and cooling systems that eliminate the use of ODS substances in mission-critical air-conditioning and refrigeration (AC&R) systems on aircraft, ships, and submarines.	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	10	Identify and qualify non-ODS and environmental benign fire-fighting agents and systems for ships and aircraft to ensure adequate fire protection capabilities are maintained.	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓
General Air Emissions					
Army CM-4	26	Facility Air Emissions Control	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions Natural Infra-Range – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Army PP-10	45	Reduce/Eliminate Pollution for Compliant Manufacture, Testing and Maintenance of Military Clothing and Textile Items	Built Infra-Sust – Sust. Res. WS&P-Prod – Air Emissions WS&P-Prod – Sust. Res.	Low	✓
Army PP-11	46	Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	
Navy	30	Eliminate hazardous wastes and toxic air emissions from aircraft and ship from manufacturing, maintenance, and repair operations of composite materials.	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	High	
Navy	31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for disposal.	Deployed Ops – Air Emissions Deployed Ops – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	✓
PCBs					
Navy	54	Develop alternatives to dispose of PCB contaminated equipment during Weapons System demilitarization	WS&P-Disp – Air Emissions WS&P-Disp – Organics	High	✓
Metals Fumes					

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	29	Develop alternative welding and cutting materials and procedures to eliminate generation of hazardous wastes and toxic air emissions (heavy metal fume emissions).	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	✓

A.3.5 NOISE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	18	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on marine mammals.	Deployed Ops – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	✓
Navy	19	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on terrestrial threatened/endangered species.	Natural Infra-Base – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	✓

A.3.6 WASTE MANAGEMENT AND REDUCTION

A.3.6.1 Hazardous, Solid, and Mixed Waste

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
<i>General Hazardous Waste</i>					
Air Force	102	Lightweight Non-Toxic Heat Sinking Material for Use in Aircraft Avionics systems	WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste WS&P-Prod – Haz. Waste	Low	✓
Army PP-10	45	Reduce/Eliminate Pollution for Compliant Manufacture, Testing and Maintenance of Military Clothing and Textile Items	Built Infra-Sust – Sust. Res. WS&P-Prod – Air Emissions WS&P-Prod – Sust. Res.	Low	✓
Navy	3	Develop alternatives to control, minimize, and manage the generation and disposal discharge of hazardous waste from ships.	WS&P-Mnt. – Haz. Waste	High	✓
Navy	31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for disposal.	Deployed Ops – Air Emissions Deployed Ops – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
<i>General Liquid Waste</i>					
Air Force	93	Development of Fluid System Nonvolatile Residue (NVR) Test Process	WS&P-Mnt. – Mixed Waste WS&P-Prod – Mixed Waste	Low	✓
Air Force	113	Replacement for Fuel-Cell Leak-Detection Substance	WS&P-Disp – Mixed Waste WS&P-Mnt. – Mixed Waste WS&P-Prod – Mixed Waste	Low	✓
Army PP-6	9	Develop Sustainable Lubricants and Fluids	Built Infra-Sust – Haz. Waste Built Infra-Sust – Solid Waste Deployed Ops – Haz. Waste Deployed Ops – Solid Waste WS&P-Disp – Haz. Waste WS&P-Disp – Solid Waste WS&P-Disp – Sust. Res. WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Solid Waste WS&P-Mnt. – Sust. Res. WS&P-Prod – Haz. Waste WS&P-Prod – Solid Waste WS&P-Prod – Sust. Res.	High	
Navy	4	Control and minimize the release of residual chlorine that is discharged into harbor waters due to biofouling suppression in shipboard seawater piping systems.	WS&P-Mnt. – Haz. Waste	High	✓
Navy	5	Control, minimize, and manage liquid wastes discharged overboard from ships in restricted waters during normal operation.	WS&P-Mnt. – Haz. Waste	High	✓
Navy	36	Develop technologies to prevent the transfer of Non-indigenous species between ports from ship ballast water systems.	Natural Infra-Base – Invasives Natural Infra-Range – Invasives WS&P-Mnt. – Invasives	High	✓
Navy	38	Develop shipboard technologies to treat oily waste to reduce ship-to-shore transfer and shoreside disposal.	Deployed Ops – Organics WS&P-Mnt. – Organics WS&P-Prod – Organics	High	✓
Navy	39	Develop technology to prevent, detect, and recover oil spilled in near-shore or open ocean environments.	Built Infra-MR – Organics WS&P-Mnt. – Organics	High	✓
Navy	46	Develop technologies to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	Built Infra-MR – Metals Built Infra-MR – Organics WS&P-Mnt. – Metals WS&P-Mnt. – Organics	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	54	Develop alternatives to dispose of PCB contaminated equipment during Weapons System demilitarization	WS&P-Disp – Air Emissions WS&P-Disp – Organics	High	✓
Cutting Fluids					
Army PP-6	9	Develop Sustainable Lubricants and Fluids	Built Infra-Sust – Haz. Waste Built Infra-Sust – Solid Waste Deployed Ops – Haz. Waste Deployed Ops – Solid Waste WS&P-Disp – Haz. Waste WS&P-Disp – Solid Waste WS&P-Disp – Sust. Res. WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Solid Waste WS&P-Mnt. – Sust. Res. WS&P-Prod – Haz. Waste WS&P-Prod – Solid Waste WS&P-Prod – Sust. Res.	High	
Navy	28	Develop replacement machine cutting and grinding fluids that do not contain 1,1,1-TCA and other chlorinated compounds to eliminate the discharge chlorinated compounds to the atmosphere and incur high disposal costs.	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Organics	High	
Navy	29	Develop alternative welding and cutting materials and procedures to eliminate generation of hazardous wastes and toxic air emissions (heavy metal fume emissions).	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	High	
Navy	35	Develop treatment and disposal process for drydock wastes generated during ship hull cleaning, painting, and cutting operations that are discharged either to the marine environment or IWTP during ship and submarine maintenance operations.	Built Infra-MR – Haz. Waste Built Infra-MR – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals	High	✓
Deicing Fluids					
Air Force	63	Degradation Rates and Products of De-icing Compounds	Built Infra-MR – Organics WS&P-Mnt. – Organics	Medium	✓
Air Force	65	Environmental Improvements to Aircraft De-icing Operations	Built Infra-MR – Organics WS&P-Mnt. – Organics	Medium	
Air Force	108	Provide an alternate means of removing and preventing aircraft icing other than using Ethylene/Propylene Glycol	Built Infra-MR – Organics WS&P-Mnt. – Organics	Low	
Navy	42	Develop alternative aircraft de-icing technologies to minimize the run-off of glycol water mixture from airfields.	Built Infra-MR – Organics WS&P-Mnt. – Organics	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Composite Materials					
Army PP-11	46	Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	
Navy	30	Eliminate hazardous wastes and toxic air emissions from aircraft and ship from manufacturing, maintenance, and repair operations of composite materials.	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	High	
Solid Waste					
Air Force	41	Cost effective method of recovering the aluminum from the road wheels of tracked vehicles due to the bonded rubber surface	Built Infra-MR – Metals WS&P-Disp – Metals WS&P-Mnt. – Metals	Low	✓
Air Force	92	Develop an Environmentally Compliant Test to Detect Dense Particles in Plastic Media	WS&P – Haz. Waste WS&P – Mixed Waste WS&P – Solid Waste	Low	✓
Army PP-8	24	Bio-based/Bio-degradable Consumable Commodities	WS&P-Disp – Sust. Res. WS&P-Mnt. – Sust. Res. WS&P-Prod – Sust. Res.	Medium	
Navy	2	Develop alternatives to control, minimize, and manage the generation and disposal discharge of solid waste from ships.	WS&P-Mnt. – Solid Waste	High	

A.3.6.2 Solvents

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	85	Alternative Thinners for Silicon-based Ablative Systems that Currently Require the Use of CFCs	WS&P-Mnt. – Air Emissions	Low	✓
Air Force	86	Alternative(s) for 1,1,1-Trichloroethane and MEK as Pre-coating Wipe Solvents and Inclusion into Tech Data and MIL-SPECs	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	
Air Force	100	Hydrogen Embrittlement Testing of Cleaners and Strippers on Substrates Other Than Cadmium	WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Low	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	114	Replacement for PD680 Type II	WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	✓
Air Force	115	Replacement of chlorinated cleaners (MEK, Methylene Chloride, TCE) used to clean metal engine components	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Low	
Air Force	119	Solvent-free Solid State Metal Cleaning	WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste	Low	

A.4 BUILT INFRASTRUCTURE

Develop and demonstrate technologies, techniques, and protocols for the environmentally sustainable and cost-effective life-cycle management of the built infrastructure on installations, including cantonment and range infrastructure.

Mission Readiness

Addresses issues and solutions required to maintain built infrastructure directly related to mission readiness that includes testing and training facilities.

Installation Sustainment

Addresses issues and solutions required to maintain all other built, support infrastructure that holistically address sustainability, including energy, land-use, resource recycling and waste minimization, ecosystem health, encroachment, and quality-of-life issues.

A.4.1 AIR QUALITY

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	17	BTEX in Relation to Health Effects and the Current Vapor Intrusion Model Changes as Compared to Indoor Air Sampling	Built Infra-Sust – Organics IRP – Organics	Low	
Air Force	24	Indoor Vapor Intrusion Differentiation between Volatile Organic Compounds	Built Infra-Sust – Air Emissions IRP – Air Emissions Natural Infra-Base – Air Emissions	Low	
Air Force	31	Vapor Intrusion Model for Pier and Beam Crawl Space Construction	Built Infra-Sust – Air Emissions IRP – Air Emissions	Low	
Air Force	36	Requirement to Evaluate Air Emission Control Technology to Comply with Maximum Achievable Control Technology Requirements of CAA for Engine Test Cells	Built Infra-MR – Air Emissions	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	45	Evaluate Air Emission Control Technology for Industrial Boilers that will enable compliance with NSPS Subpart Db and the forthcoming NESHAPs for Industrial Boilers	Built Infra-MR – Air Emissions	Low	
Air Force	46	Mitigation of NOx Emissions from Mobile Flight Line Service Equipment, Such as Power Carts	Built Infra-MR – Air Emissions	Low	
Air Force	48	New Technology to Meet CAA Requirements--Critical Source Monitoring Requirements for an Industrial Area Title V Operating Permit—to determine where and how this is needed for state air shed region complex	Built Infra-MR – Air Emissions	Low	
Air Force	53	Develop environmentally compliant primer with high degree of flexibility for large aircraft, missiles, and ground equipment	Built Infra-Sust – Air Emissions WS&P-Disp – Air Emissions WS&P-Disp – Haz. Waste WS&P-Mnt. – Air Emissions WS&P-Mnt. – Haz. Waste WS&P-Prod – Air Emissions WS&P-Prod – Haz. Waste	Medium	
Air Force	120	Treatment Technologies at the Source for Wastewater Generated at Fueling Facilities	Built Infra-MR – Air Emissions Built Infra-MR – Emrg. Contam.	Low	
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Army CM-2	15	Particulate Matter/Dust Control and Measurement for Training and Testing Lands	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions	High	
Army PP-7	19	Joint Battlespace Use Fuel of the Future	Built Infra-MR – Air Emissions Built Infra-MR – Energy Deployed Ops – Energy	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Built Infra-MR – Haz. Waste, Organics, Other Inorgs, Sust. Res. Built Infra-Sust – Haz. Waste, Organics, Other Inorgs, Sust. Res. IRP – Haz. Waste, Mixed Waste, Organics, Other Inorgs, Solid Waste, Sust. Res. Natural Infra-Base – Haz. Waste, Organics, Other Inorgs, Sust. Res. Natural Infra-Range – Haz. Waste, Organics, Other Inorgs, Sust. Res.	Medium	
Army CM-4	26	Facility Air Emissions Control	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions Natural Infra-Range – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	Medium	
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	
Navy	9	Develop alternative rocket engine emission control technologies to reduce particulate and gaseous air emitted during testing of rocket motors.	Built Infra-MR – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	
Navy	13	Develop alternative ordnance disposal methods to reduce emissions from energetics production and demilitarization	Built Infra-Sust – Air Emissions Built Infra-Sust – PEPs WS&P-Disp – Air Emissions WS&P-Disp – PEPs	High	
Navy	37	Develop control technologies to reduce air and water pollutants resulting from fire fighting training exercises	Built Infra-MR – Air Emissions Built Infra-MR – Haz. Waste	High	✓
Navy	56	Develop sensing and monitoring technologies for detecting toxic air emissions required to under the Clean Air Act.	Built Infra-MR – Air Emissions	High	

A.4.2 ENERGY

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army PP-7	19	Joint Battlespace Use Fuel of the Future	Built Infra-MR – Air Emissions Built Infra-MR – Energy Deployed Ops – Energy	Medium	✓
Army CM-9	42	Sustainable Technologies for Military Facilities and Facility Systems	Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res. Natural Infra-Base – Energy Natural Infra-Range – Energy	Low	✓
Army CM-7	43	Waste Heat CONOPS	Built Infra-MR – Energy Built Infra-MR – Sust. Res. Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res.	Low	✓

A.4.3 FACILITY WASTE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	11	Address the Scientific Basis for Determining the Carcinogenicity of Naphthalene and Other PAHs	Built Infra-Sust – Organics IRP – Organics WS&P-Disp – Organics WS&P-Mnt. – Organics WS&P-Prod – Organics	Low	
Air Force	14	Anthropogenic Background Levels of PAHs and Dioxin-Like Constituents in Shallow Soil at DoD Installations Using Geostatistical Methods and Geographic Information Systems (GIS)	Built Infra-Sust – Haz. Waste IRP – Haz. Waste IRP – Organics	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	16	Background Levels of Selected Metals in Groundwater and Soil, Including Arsenic, Manganese, Lead, Cadmium, Aluminum, Antimony, and Vanadium	Built Infra-Sust – Metals IRP – Metals	Low	
Air Force	20	Cleaning Petroleum-Soaked Absorbent Materials	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam.	Low	
Air Force	27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Built Infra-Sust – Mixed Waste IRP – Mixed Waste	Low	
Air Force	29	Stabilization Technologies for Eroding Landfills	Built Infra-Sust – Solid Waste IRP – Solid Waste	Low	✓
Air Force	30	Technologies for treatment of perchlorate	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam. Natural Infra-Range – Emrg. Contam. WS&P-Disp – Emrg. Contam. WS&P-Mnt. – Emrg. Contam.	Low	
Air Force	35	Recycling Machine Designed Specifically for Waste Antifreeze from Building Generator Units	Built Infra-MR – Mixed Waste Built Infra-Sust – Mixed Waste	High	
Air Force	37	Examine Health Impacts of Disturbing Asbestos-containing Soils	Built Infra-MR – Air Emissions	High	
Air Force	40	Replacement for Lead-Acid Batteries in Support Equipment	Built Infra-MR – Haz. Waste Built Infra-Sust – Haz. Waste WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste	Medium	
Air Force	47	Neutron Radiography Waste Reduction System	Built Infra-MR – Radiation	Low	
Air Force	49	Substitute for Fibrous Glass Insulation	Built Infra-MR – Solid Waste	Low	
Air Force	63	Degradation Rates and Products of De-icing Compounds	Built Infra-MR – Organics WS&P-Mnt. – Organics	Medium	
Air Force	65	Environmental Improvements to Aircraft De-icing Operations	Built Infra-MR – Organics WS&P-Mnt. – Organics	Medium	
Air Force	101	Improvements to Road De-icing Operations, Focusing on Collection, Treatment, and recycling/disposal.	Built Infra-MR – Haz. Waste	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	108	Provide an alternate means of removing and preventing aircraft icing other than using Ethylene/Propylene Glycol	Built Infra-MR – Organics WS&P-Mnt. – Organics	Low	
Air Force	121	Use of Sodium Formate for the De-icing of Pavements	Built Infra-MR – Haz. Waste	Low	
Army CM-1	3	Sustainable Water Usage	Built Infra-Sust – Sust. Res. Deployed Ops – Sust. Res. Natural Infra-Base – Sust. Res. Natural Infra-Range – Sust. Res.	High	✓
Army PP-4	5	Alternative Products in Cleaning and Degreasing Processes	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions	High	
Army PP-6	9	Develop Sustainable Lubricants and Fluids	Built Infra-Sust – Haz. Waste Built Infra-Sust – Solid Waste Deployed Ops – Haz. Waste Deployed Ops – Solid Waste WS&P-Disp – Haz. Waste WS&P-Disp – Solid Waste WS&P-Disp – Sust. Res. WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Solid Waste WS&P-Mnt. – Sust. Res. WS&P-Prod – Haz. Waste WS&P-Prod – Solid Waste WS&P-Prod – Sust. Res.	High	
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Built Infra-MR – Haz. Waste, Organics, Other Inorgs, Sust. Res. Built Infra-Sust – Haz. Waste, Organics, Other Inorgs, Sust. Res. IRP – Haz. Waste, Mixed Waste, Organics, Other Inorgs, Solid Waste, Sust. Res. Natural Infra-Base – Haz. Waste, Organics, Other Inorgs, Sust. Res. Natural Infra-Range – Haz. Waste, Organics, Other Inorgs, Sust. Res.	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-8	23	Long-Term Monitoring of Regulated Constituents	Built Infra-MR – Haz. Waste, PEPs, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-AR – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-C-O – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, PEPs, Sust. Res., UXO/MC	Medium	
Army CM-6	33	Waste Management Utilizing Waste Characteristics - CONOPS	Built Infra-MR – Haz. Waste Built Infra-Sust – Mixed Waste Deployed Ops – Haz. Waste Deployed Ops – Mixed Waste Deployed Ops – Solid Waste Deployed Ops – Sust. Res.	Medium	
Army ER-13	40	Heavy Metals Management and Remediation for Industrial Activities	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals IRP – Haz. Waste IRP – Metals	Low	
Army PP-9	41	Compliant Electronics for Life Cycle Sustainment of Military Components and Systems	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals Deployed Ops – Haz. Waste Deployed Ops – Metals WS&P-Disp – Haz. Waste WS&P-Disp – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals WS&P-Prod – Haz. Waste WS&P-Prod – Metals	Low	
Army CM-9	42	Sustainable Technologies for Military Facilities and Facility Systems	Built Infra-Sust – Energy Built Infra-Sust – Sust. Res. Deployed Ops – Energy Deployed Ops – Sust. Res. Natural Infra-Base – Energy Natural Infra-Range – Energy	Low	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	
Army PP-10	45	Reduce/Eliminate Pollution for Compliant Manufacture, Testing and Maintenance of Military Clothing and Textile Items	Built Infra-Sust – Sust. Res. WS&P-Prod – Air Emissions WS&P-Prod – Sust. Res.	Low	✓
Navy	11	Develop treatment technologies and processes to remove munitions constituents and energetic materials from wastewaters at Navy ordnance manufacturing, testing, and demilitarization sites.	Built Infra-MR – PEPs Built Infra-Sust – Munit. Const. MM-AR – Munit. Const. MM-AR – PEPs MM-C-O – Munit. Const.	High	
Navy	12	Develop Ammonium Perchlorate (AP)-Free propellants and treatment technologies for air emissions contaminated with energetic materials resulting from ordnance manufacturing, testing, and demilitarization.	Built Infra-Sust – Emrg. Contam. Built Infra-Sust – PEPs WS&P-Prod – Emrg. Contam. WS&P-Prod – PEPs	High	
Navy	32	Develop facility hazardous material alternative and recycling techniques to minimize the amount of hazardous waste disposed of by shore facilities.	Built Infra-MR – Haz. Waste	High	
Navy	35	Develop treatment and disposal process for drydock wastes generated during ship hull cleaning, painting, and cutting operations that are discharged either to the marine environment or IWTP during ship and submarine maintenance operations.	Built Infra-MR – Haz. Waste Built Infra-MR – Metals WS&P-Mnt. – Haz. Waste WS&P-Mnt. – Metals	High	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	37	Develop control technologies to reduce air and water pollutants resulting from fire fighting training exercises	Built Infra-MR – Air Emissions Built Infra-MR – Haz. Waste	High	
Navy	39	Develop technology to prevent, detect, and recover oil spilled in near-shore or open ocean environments.	Built Infra-MR – Organics WS&P-Mnt. – Organics	High	✓
Navy	42	Develop alternative aircraft de-icing technologies to minimize the run-off of glycol water mixture from airfields.	Built Infra-MR – Organics WS&P-Mnt. – Organics	High	
Navy	46	Develop technologies to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	Built Infra-MR – Metals Built Infra-MR – Organics WS&P-Mnt. – Metals WS&P-Mnt. – Organics	High	
Navy	55	Develop alternatives to reduce hazardous waste and material disposal and to relieve associated disposal costs, landfill constraints, and groundwater contamination.	Built Infra-MR – Haz. Waste Built Infra-MR – Solid Waste Built Infra-Sust – Haz. Waste	High	

A.4.4 NOISE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-3	20	Army Noise Impact Assessment and Control for Training and Testing	Built Infra-MR – Noise Built Infra-Sust – Noise	Medium	
Navy	41	Develop a comprehensive noise management and control system to minimize the impact of Navy operations on surrounding communities.	Built Infra-MR – Noise Natural Infra-Base – Noise Natural Infra-Range – Noise	High	

A.4.5 WATER QUALITY

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	4	Assessment and mitigation of hazards associated with vapor intrusion of volatilized groundwater contaminants	Built Infra-Sust – Air Emissions IRP – Air Emissions	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	39	Develop/enhance Technology to Automatically Measure Rainfall, Storm Water Discharge and to Collect, if applicable, Water-quality Samples to Meet EPA Storm Water Permit Monitoring Requirements	Built Infra-MR – Non-point Natural Infra-Range – Non-point	Medium	
Air Force	120	Treatment Technologies at the Source for Wastewater Generated at Fueling Facilities	Built Infra-MR – Air Emissions Built Infra-MR – Emrg. Contam.	Low	
Navy	39	Develop technology to prevent, detect, and recover oil spilled in near-shore or open ocean environments.	Built Infra-MR – Organics WS&P-Mnt. – Organics	High	
Navy	45	Develop effective identification, control, and treatment technologies for nonpoint source discharges (NPS) contaminated with metals, POLs, sediments, and nutrients that discharge to water bodies at Navy facilities.	Built Infra-MR – Non-point	High	
Navy	53	Develop fuel leak detection and prevention technologies for Underground Storage Tanks, Aboveground Storage Tanks, and Pipelines to prevent groundwater and soil contamination.	Built Infra-MR – Organics	High	

A.4.6 CULTURAL RESOURCES

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-10	31	Reduce the Effects of Archeological Resources on Training	Built Infra-MR – Cultural Res. Natural Infra-Base – Cultural Res. Natural Infra-Range – Cultural Res.	Medium	
Navy	44	Develop technologies for managing properties with threatened/endangered species or archeological / cultural / historical sites to ensure continued access to the sites for training and operations.	Built Infra-MR – Cultural Res. Built Infra-MR – Habitat Dist. Nat Infra-Base – Cultural Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Cultural Res. Natural Infra-Range – Habitat Dist.	High	

A.4.7 INVASIVES

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	43	Detect Brown Tree Snakes in Cargo and Craft to Prevent Spread to Other Areas of the Pacific and the Mainland United States	Built Infra-MR – Invasives Built Infra-Sust – Invasives Natural Infra-Base – Invasives Natural Infra-Range – Invasives	Low	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-1	6	Mitigate Invasive Species Impacts on Army Training	Built Infra-MR – Invasives Natural Infra-Range – Invasives	High	✓

A.4.8 BUILT RANGE MAINTENANCE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	41	Cost effective method of recovering the aluminum from the road wheels of tracked vehicles due to the bonded rubber surface	Built Infra-MR – Metals WS&P-Disp – Metals WS&P-Mnt. – Metals	Low	✓
Army PP-3	4	Compliant Ordnance Lifecycle for Readiness of the Transformation and Objective Forces	Built Infra-MR – Sust. Res. WS&P-Disp – Haz. Waste WS&P-Mnt. – Haz. Waste WS&P-Prod – Haz. Waste	High	
Army ER-2	13	Munitions and Explosives of Concern (MEC) Management Technologies for Operational Range Sustainability	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Haz. Waste MM-AR – PEPs MM-AR – Sust. Res. MM-AR – UXO/MC	High	
Army ER-3	14	Management of Munitions Constituents (MC) on Live Fire Training and Testing Ranges	Built Infra-MR – Sust. Res. Built Infra-MR – UXO/MC MM-AR – Haz. Waste MM-AR – Sust. Res. MM-AR – UXO/MC	High	
Army CN-5	17	Managing Cumulative Impacts on Installation Lands	Built Infra-MR – Sust. Res. Natural Infra-Base – Habitat Dist. Natural Infra-Base – Sust. Res. Natural Infra-Range – Habitat Dist.	High	
Army ER-5	18	Management and Remediation of Heavy Metals on Live Fire Training and Test Ranges	Built Infra-MR – Metals IRP – Metals	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Built Infra-MR – Haz. Waste, Organics, Other Inorgs, Sust. Res. Built Infra-Sust – Haz. Waste, Organics, Other Inorgs, Sust. Res. IRP – Haz. Waste, Mixed Waste, Organics, Other Inorgs, Solid Waste, Sust. Res. Natural Infra-Base – Haz. Waste, Organics, Other Inorgs, Sust. Res. Natural Infra-Range – Haz. Waste, Organics, Other Inorgs, Sust. Res.	Medium	
Army ER-8	23	Long-Term Monitoring of Regulated Constituents	Built Infra-MR – Haz. Waste, PEPs, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-AR – Haz. Waste, PEPs, Sust. Res., UXO/MC MM-C-O – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, PEPs, Sust. Res., UXO/MC	Medium	
Army CN-6	27	Rehabilitation of Natural Resources (Land Conservation and Protection)	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Medium	
Army CN-8	29	Real-Time Monitoring of Land Use Conditions and Usage	Built Infra-MR – Habitat Dist. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Base – Sust. Res. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res. WS&P-Prod – Habitat Dist. WS&P-Prod – Sust. Res.	Medium	
Army CN-9	30	Reconfigurable Design of Training Landscapes	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Built Infra-Sust – Sust. Res. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Medium	
Army CM-5	32	Management of Environmental Consequences of the Introduction of Insensitive Munitions Compounds to the DoD Inventory	Built Infra-MR – Haz. Waste, PEPs, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Disp – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Mnt. – Haz. Waste, PEPs, Sust. Res., UXO/MC WS&P-Prod – Haz. Waste, PEPs, Sust. Res., UXO/MC	Medium	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-12	38	Arid Lands Utilization and Rehabilitation	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Low	
Army ER-12	39	Environmental Decision Analysis Under Uncertainty	Built Infra-MR – Dec/Analysis Built Infra-Sust – Dec/Analysis IRP – Dec/Analysis Natural Infra-Base – Dec/Analysis Natural Infra-Range – Dec/Analysis	Low	
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	
Navy	11	Develop treatment technologies and processes to remove munitions constituents and energetic materials from wastewaters at Navy ordnance manufacturing, testing, and demilitarization sites.	Built Infra-MR – PEPs Built Infra-Sust – Munit. Const. MM-AR – Munit. Const. MM-AR – PEPs MM-C-O – Munit. Const.	High	

A.5 NATURAL INFRASTRUCTURE

Base

Addresses issues and solutions required to maintain and sustain natural resources and cultural resources including impact prediction, assessment, mitigation/prevention, and reclamation needs exclusive of the testing and training ranges. Includes regional and ecosystem-wide impacts as well.

Ranges

Addresses issues and solutions required to promote and sustain mission readiness on training and testing ranges including impact prediction, assessment, mitigation/prevention, and reclamation needs for natural resources and cultural resources on the ranges.

A.5.1 ECOSYSTEM-BASED MANAGEMENT

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	43	Detect Brown Tree Snakes in Cargo and Craft to Prevent Spread to Other Areas of the Pacific and the Mainland United States	Built Infra-MR – Invasives Built Infra-Sust – Invasives Natural Infra-Base – Invasives Natural Infra-Range – Invasives	Low	✓
Army CN-1	6	Mitigate Invasive Species Impacts on Army Training	Built Infra-MR – Invasives Natural Infra-Range – Invasives	High	✓
Army ER-12	39	Environmental Decision Analysis Under Uncertainty	Built Infra-MR – Dec/Analysis Built Infra-Sust – Dec/Analysis IRP – Dec/Analysis Natural Infra-Base – Dec/Analysis Natural Infra-Range – Dec/Analysis	Low	✓

A.5.2 LAND MANAGEMENT/WATERSHED PROTECTION

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-6	27	Rehabilitation of Natural Resources (Land Conservation and Protection)	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Medium	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-7	28	Proactive Encroachment Management to Sustain Military Training and Testing Missions	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Built Infra-Sust – Sust. Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist.	Medium	✓
Army CN-8	29	Real-Time Monitoring of Land Use Conditions and Usage	Built Infra-MR – Habitat Dist. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Base – Sust. Res. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res. WS&P-Prod – Habitat Dist. WS&P-Prod – Sust. Res.	Medium	✓
Army CN-9	30	Reconfigurable Design of Training Landscapes	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Built Infra-Sust – Sust. Res. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Medium	✓
Army CN-11	37	Elements of Training-Compatible Vegetation	Built Infra-MR – Sust. Res. Natural Infra-Range – Sust. Res.	Low	✓
Army CN-12	38	Arid Lands Utilization and Rehabilitation	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist. Natural Infra-Range – Sust. Res.	Low	✓
Army ER-12	39	Environmental Decision Analysis Under Uncertainty	Built Infra-MR – Dec/Analysis Built Infra-Sust – Dec/Analysis IRP – Dec/Analysis Natural Infra-Base – Dec/Analysis Natural Infra-Range – Dec/Analysis	Low	✓

A.5.3 MARITIME SUSTAINABILITY

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	6	Develop technologies to locate, identify, track, and measure impact of Navy action on Marine Mammals/Threatened Endangered Species to minimize risk to the animal during Fleet operations and training exercises.	Natural Infra-Range – Noise	High	✓
Navy	14	Develop models to define the transport, fate, and effect of contaminants in the marine environment to predict the environmental impact of discharges and spills of hazardous pollutants.	Natural Infra-Base – Air Emissions Natural Infra-Base – Haz. Waste Natural Infra-Range – Air Emissions Natural Infra-Range – Haz. Waste	High	✓
Navy	18	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on marine mammals.	Deployed Ops – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	✓
Navy	36	Develop technologies to prevent the transfer of Non-indigenous species between ports from ship ballast water systems.	Natural Infra-Base – Invasives Natural Infra-Range – Invasives WS&P-Mnt. – Invasives	High	✓

A.5.4 THREATENED AND ENDANGERED SPECIES

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-2	7	Reducing Impacts of Threatened and Endangered (T&E) Species on Military Readiness	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist.	High	
Army CN-3	10	Military Operations in the Presence of Species at Risk	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist.	High	
Army CN-4	11	Maintaining Readiness by Improving Threatened & Endangered (T&E) Species Monitoring Capabilities	Built Infra-MR – Habitat Dist. Built Infra-MR – Sust. Res. Built Infra-Sust – Habitat Dist. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Habitat Dist.	High	

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-5	17	Managing Cumulative Impacts on Installation Lands	Built Infra-MR – Sust. Res. Natural Infra-Base – Habitat Dist. Natural Infra-Base – Sust. Res. Natural Infra-Range – Habitat Dist.	High	
Navy	19	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on terrestrial threatened/endangered species.	Natural Infra-Base – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	
Navy	44	Develop technologies for managing properties with threatened/endangered species or archeological/cultural/historical sites to ensure continued access to the sites for training and operations.	Built Infra-MR – Cultural Res. Built Infra-MR – Habitat Dist. Natural Infra-Base – Cultural Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Cultural Res. Natural Infra-Range – Habitat Dist.	High	

A.5.5 CULTURAL RESOURCES

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CN-10	31	Reduce the Effects of Archeological Resources on Training	Built Infra-MR – Cultural Res. Natural Infra-Base – Cultural Res. Natural Infra-Range – Cultural Res.	Medium	
Navy	44	Develop technologies for managing properties with threatened/endangered species or archeological/cultural/historical sites to ensure continued access to the sites for training and operations.	Built Infra-MR – Cultural Res. Built Infra-MR – Habitat Dist. Natural Infra-Base – Cultural Res. Natural Infra-Base – Habitat Dist. Natural Infra-Range – Cultural Res. Natural Infra-Range – Habitat Dist.	High	

A.5.6 NOISE

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	19	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on terrestrial threatened/endangered species.	Natural Infra-Base – Noise Natural Infra-Range – Noise WS&P-Mnt. – Noise	High	✓

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	41	Develop a comprehensive noise management and control system to minimize the impact of Navy operations on surrounding communities.	Built Infra-MR – Noise Natural Infra-Base – Noise Natural Infra-Range – Noise	High	✓

A.5.7 OFF-RANGE MIGRATION

Service	ID#	Description	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	30	Technologies for treatment of perchlorate	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam. Natural Infra-Range – Emrg. Contam. WS&P-Disp – Emrg. Contam. WS&P-Mnt. – Emrg. Contam.	Low	✓
Army PP-1	1	Sustainable Painting Operations for the Total Army	Built Infra-MR – Air Emissions Built Infra-Sust – Air Emissions Natural Infra-Base – Air Emissions WS&P-Mnt. – Air Emissions WS&P-Prod – Air Emissions	High	✓
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Built Infra-MR – Haz. Waste, Organics, Other Inorgs, Sust. Res. Built Infra-Sust – Haz. Waste, Organics, Other Inorgs, Sust. Res. IRP – Haz. Waste, Mixed Waste, Organics, Other Inorgs, Solid Waste, Sust. Res. Natural Infra-Base – Haz. Waste, Organics, Other Inorgs, Sust. Res. Natural Infra-Range – Haz. Waste, Organics, Other Inorgs, Sust. Res.	Medium	✓
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	✓

A.6 INSTALLATION RESTORATION

Addresses site characterization, risk assessment, remediation, long-term monitoring, and restoration/reclamation needs at potential and known contamination sites.

A.6.1 SITE CHARACTERIZATION

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	1	Effective DNAPL Characterization, Monitoring and Detection Technology	IRP – Chlor Solv	High	
Air Force	5	Enhance Implementability of Rapid Site Characterization Primarily through Development of Definitive Field-based Analytical Methods for VOCs, SVOCs, Other Common Contaminant Parameters	IRP – Air Emissions IRP – Metals	Medium	
Air Force	7	Evaluation of Emerging COCs in Groundwater and Soil at DoD Installations, e.g., Frequency of Occurrence, Spatial Distribution, and Concentrations Respective of Environmental Standards	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam. Natural Infra-Base – Emrg. Cont. Natural Infra-Range – Emrg. Cont.	Medium	
Air Force	8	Improve Understanding of DNAPL Groundwater Transport to Accurately Predict Fate of Contaminants	IRP – Organics Natural Infra-Base – Organics Natural Infra-Range – Organics	Medium	
Air Force	9	Improve/Optimize Remediation and Long-term Monitoring (LTM) Technologies	Built Infra-Sust – All IRP – All Natural Infra-Base – All Natural Infra-Range – All	Medium	
Air Force	14	Anthropogenic Background Levels of PAHs and Dioxin-Like Constituents in Shallow Soil at DoD Installations Using Geostatistical Methods and Geographic Information Systems (GIS)	Built Infra-Sust – Haz. Waste IRP – Haz. Waste IRP – Organics	Low	✓
Air Force	16	Background Levels of Selected Metals in Groundwater and Soil, Including Arsenic, Manganese, Lead, Cadmium, Aluminum, Antimony, and Vanadium	Built Infra-Sust – Metals IRP – Metals	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	23	Improve/Optimize Destructive/Ex Situ (Pump-and-Treat) Groundwater Treatment Systems	IRP – Organics	Low	
Air Force	26	Method to quantify mass flux of groundwater contaminants	IRP – Air Emission IRP – Metals IRP – Mixed Waste	Low	
Air Force	32	RPO initiative using diffusion bag samplers to reduce LTM costs	Built Infra-Sust – Mixed Waste IRP – Mixed Waste IRP – Organics Natural Infra-Base – Mixed Waste Natural Infra-Range – Mixed Waste	Low	
Air Force	33	Energy performance based contract concepts for RA-O and LTM	IRP – All	Low	✓
Air Force	34	Asbestos in soil from disposal	IRP – Other Inorganics	Low	
Army ER-1	12	Management and Remediation of Contaminated Groundwater	IRP – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Base – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Range – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC	High	
Army ER-9	34	Remediation and Management of Contaminated Sediments	IRP – Haz. Waste IRP – Non-point IRP – Sust. Res. Natural Infra-Base – Haz. Waste Natural Infra-Base – Non-point Natural Infra-Base – Sust. Res. Natural Infra-Range – Haz. Waste Natural Infra- Range – Non-point Natural Infra- Range – Sust. Res.	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Built Infra-MR – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Built Infra-Sust – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC Deployed Ops – Haz. Waste, PEPs, Radiation, Sust. Res., UXO/MC IRP – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Base – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC Natural Infra-Range – Haz. Waste, Organics, Other Inorganics, PEPs, Sust. Res., UXO/MC	Low	
Navy	47	Develop technologies for detection, remediation and management of metals and inorganics in groundwater.	IRP – Metals IRP – Other Inorganics	High	
Navy	48	Develop technologies for detection, remediation and management of organics in groundwater.	IRP – Organics	High	
Navy	49	Develop technologies for detection, remediation and management of organics in sediments.	IRP – Organics	High	
Navy	50	Develop technologies for detection, remediation and management of inorganics in sediments.	IRP – Other Inorganics	High	
Navy	51	Develop technologies for detection, remediation and management of inorganics in soils.	IRP – Other Inorganics	High	
Navy	52	Develop technologies for detection, remediation and management of organics in soils.	IRP – Organics	High	

A.6.2 RISK ASSESSMENT

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	4	Assessment and mitigation of hazards associated with vapor intrusion of volatilized groundwater contaminants	Built Infra-Sust – Air Emissions IRP – Air Emissions	Medium	✓

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	11	Address the Scientific Basis for Determining the Carcinogenicity of Naphthalene and Other PAHs	Built Infra-Sust – Organics IRP – Organics WS&P-Disp – Organics WS&P-Mnt. – Organics WS&P-Prod – Organics	Low	✓
Air Force	17	BTEX in Relation to Health Effects and the Current Vapor Intrusion Model Changes as Compared to Indoor Air Sampling	Built Infra-Sust – Organics IRP – Organics	Low	✓
Air Force	21	Health Effects Studies of Perfluorobromohydrocarbons	IRP – Organics	Low	✓
Army ER-1	12	Management and Remediation of Contaminated Groundwater	IRP – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Base – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Range – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC	High	
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Built Infra-MR – Haz. Waste, Organics, Other Inorgs, Sust. Res. Built Infra-Sust – Haz. Waste, Organics, Other Inorgs, Sust. Res. IRP – Haz. Waste, Mixed Waste, Organics, Other Inorgs, Solid Waste, Sust. Res. Natural Infra-Base – Haz. Waste, Organics, Other Inorgs, Sust. Res. Natural Infra-Range – Haz. Waste, Organics, Other Inorgs, Sust. Res.	Medium	
Army ER-9	34	Remediation and Management of Contaminated Sediments	IRP – Haz. Waste IRP – Non-point IRP – Sust. Res. Natural Infra-Base – Haz. Waste Natural Infra-Base – Non-point Natural Infra-Base – Sust. Res. Natural Infra-Range – Haz. Waste Natural Infra-Range – Non-point Natural Infra-Range – Sust. Res.	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Navy	43	Develop methods and protocols for conducting marine and terrestrial ecological risk assessments that are crucial in developing cost effective remedial actions and achievable cleanup levels at contaminated sites.	IRP – Metals IRP – Organics	High	

A.6.3 REMEDIATION

A.6.3.1 Groundwater

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	2	Technology to Remediate TCE DNAPL	IRP – Chlor Solv	High	
Air Force	10	Methods and Remedial Techniques are Needed to More Effectively Treat Soil and Groundwater Contaminated with Chlorinated Solvents (<i>e.g.</i> , TCE, TCA, and PCE)	IRP – Air Emissions Natural Infra-Base – Air Emissions Natural Infra-Range – Air Emissions	Medium	
Air Force	12	Alternative Containment of Chlorinated Organic Compound Contaminant Plumes in Groundwater	Built Infra-Sust – Chlor Solv IRP – Chlor Solv	Low	
Air Force	22	Improve Treatment Technologies for IRP Site Remediation of Heavy Metals in Soils, Sediment and Groundwater	IRP – Metals	Low	
Air Force	23	Improve/Optimize Destructive/Ex Situ (Pump-and-Treat) Groundwater Treatment Systems	IRP – Organics	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Built Infra-Sust – Mixed Waste IRP – Mixed Waste	Low	
Army ER-1	12	Management and Remediation of Contaminated Groundwater	IRP – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Base – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC Natural Infra-Range – Chlor Solv, Haz. Waste, Metals, Mixed Waste, Non-Point, Organics, Other Inorgs, PEPs, Solid Waste, Sust. Res., UXO/MC	High	
Army ER-13	40	Heavy Metals Management and Remediation for Industrial Activities	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals IRP – Haz. Waste IRP – Metals	Low	
Navy	17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	
Navy	47	Develop technologies for detection, remediation and management of metals and inorganics in groundwater.	IRP – Metals IRP – Other Inorganics	High	
Navy	48	Develop technologies for detection, remediation and management of organics in groundwater.	IRP – Organics	High	

A.6.3.2 Soil

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	10	Methods and Remedial Techniques are Needed to More Effectively Treat Soil and Groundwater Contaminated with Chlorinated Solvents (e.g., TCE, TCA, and PCE)	IRP – Air Emissions Natural Infra-Base – Air Emissions Natural Infra-Range – Air Emissions	Medium	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	22	Improve Treatment Technologies for IRP Site Remediation of Heavy Metals in Soils, Sediment and Groundwater	IRP – Metals	Low	
Air Force	27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Built Infra-Sust – Mixed Waste IRP – Mixed Waste	Low	
Air Force	34	Asbestos in soil from disposal	IRP – Other Inorganics	Low	✓
Army ER-5	18	Management and Remediation of Heavy Metals on Live Fire Training and Test Ranges	Built Infra-MR – Metals IRP – Metals	Medium	
Army ER-13	40	Heavy Metals Management and Remediation for Industrial Activities	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals IRP – Haz. Waste IRP – Metals	Low	
Navy	16	Develop remediation technologies for soils contaminated with energetic materials at Navy manufacturing sites and ranges.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	
Navy	17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	
Navy	51	Develop technologies for detection, remediation and management of inorganics in soils.	IRP – Other Inorganics	High	
Navy	52	Develop technologies for detection, remediation and management of organics in soils.	IRP – Organics	High	

A.6.3.3 Sediment

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	22	Improve Treatment Technologies for IRP Site Remediation of Heavy Metals in Soils, Sediment and Groundwater	IRP – Metals	Low	
Air Force	27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Built Infra-Sust – Mixed Waste IRP – Mixed Waste	Low	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Army ER-9	34	Remediation and Management of Contaminated Sediments	IRP – Haz. Waste IRP – Non-point IRP – Sust. Res. Natural Infra-Base – Haz. Waste Natural Infra-Base – Non-point Natural Infra-Base – Sust. Res. Natural Infra-Range – Haz. Waste Natural Infra- Range – Non-point Natural Infra- Range – Sust. Res.	Low	
Army ER-13	40	Heavy Metals Management and Remediation for Industrial Activities	Built Infra-Sust – Haz. Waste Built Infra-Sust – Metals IRP – Haz. Waste IRP – Metals	Low	
Navy	17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	IRP – PEPs MM-AR – PEPs MM-C-O – PEPs	High	
Navy	40	Develop technologies to remediate and decontaminate marine sediment and dredge spoil contaminated with metals, PCBs, PAHs, and VOCs to permit cost-effective Navy harbor maintenance activities.	IRP – Metals IRP – Organics	High	
Navy	49	Develop technologies for detection, remediation and management of organics in sediments.	IRP – Organics	High	
Navy	50	Develop technologies for detection, remediation and management of inorganics in sediments.	IRP – Other Inorganics	High	

A.6.3.4 General

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	30	Technologies for treatment of perchlorate	Built Infra-Sust – Emrg. Contam. IRP – Emrg. Contam. Natural Infra-Range – Emrg. Contam. WS&P-Disp – Emrg. Contam. WS&P-Mnt. – Emrg. Contam.	Low	✓

A.6.4 CONTAINMENT

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	12	Alternative Containment of Chlorinated Organic Compound Contaminant Plumes in Groundwater	Built Infra-Sust – Chlor Solv IRP – Chlor Solv	Low	
Air Force	29	Stabilization Technologies for Eroding Landfills	Built Infra-Sust – Solid Waste IRP – Solid Waste	Low	✓

A.6.5 VAPOR INTRUSION

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	4	Assessment and mitigation of hazards associated with vapor intrusion of volatilized groundwater contaminants	Built Infra-Sust – Air Emissions IRP – Air Emissions	Medium	✓
Air Force	13	Alternative Treatment of Off-Gasses from the Extraction of Chlorinated Solvents in the Subsurface	Built Infra-Sust – Air Emissions IRP – Air Emissions	Low	✓
Air Force	17	BTEX in Relation to Health Effects and the Current Vapor Intrusion Model Changes as Compared to Indoor Air Sampling	Built Infra-Sust – Organics IRP – Organics	Low	✓
Air Force	24	Indoor Vapor Intrusion Differentiation between Volatile Organic Compounds	Built Infra-Sust – Air Emissions IRP – Air Emissions Natural Infra-Base – Air Emissions	Low	✓
Air Force	31	Vapor Intrusion Model for Pier and Beam Crawl Space Construction	Built Infra-Sust – Air Emissions IRP – Air Emissions	Low	✓

A.7 ALL MISSION FOCUS AREAS

Requirements listed here are categorized as having R&D needs in potentially all Mission Focus Areas.

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	6	Enhance Technology Transfer within the Air Force	All – All Pollutant/Stressors	Medium	

Service	ID #	Requirement	Assigned MFAs – Pollutants/Stressors	Service Priority	Unique
Air Force	18	Capability to Characterize and Develop a 3-D Depiction of VOC Smear Zones	All – Air Emissions	Low	
Air Force	19	Characterize ESOH Impacts of DoD’s Identified Emerging Contaminants (MERIT)	All – Emerging Contaminants	Low	
Air Force	20	Cleaning Petroleum-Soaked Absorbent Materials	All – Air Emissions	Low	
Air Force	25	Investigate the Health Effects Level of Use and Operational Impacts of Military-specific Use of Nanotechnologies	All – Emerging Contaminants	Low	
Army ER-4	16	Environmental Attributes of Emerging Contaminants	All – Emerging Contaminants	High	

APPENDIX B

AIR FORCE REQUIREMENTS

APPENDIX B
Air Force Requirements

ID #	Requirement	Service Priority
1	Effective DNAPL Characterization, Monitoring and Detection Technology	High
2	Technology to Remediate TCE DNAPL	High
4	Assessment and mitigation of hazards associated with vapor intrusion of volatilized groundwater contaminants	Medium
5	Enhance Implementability of Rapid Site Characterization Primarily through Development of Definitive Field-based Analytical Methods for VOCs, SVOCs, Other Common Contaminant Parameters	Medium
6	Enhance Technology Transfer within the Air Force	Medium
7	Evaluation of Emerging COCs in Groundwater and Soil at DoD Installations, e.g., Frequency of Occurrence, Spatial Distribution, and Concentrations Respective of Environmental Standards	Medium
8	Improve Understanding of DNAPL Groundwater Transport to Accurately Predict Fate of Contaminants	Medium
9	Improve/Optimize Remediation and Long-term Monitoring (LTM) Technologies	Medium
10	Methods and Remedial Techniques are Needed to More Effectively Treat Soil and Groundwater Contaminated with Chlorinated Solvents (e.g., TCE, TCA, and PCE)	Medium
11	Address the Scientific Basis for Determining the Carcinogenicity of Naphthalene and Other PAHs	Low
12	Alternative Containment of Chlorinated Organic Compound Contaminant Plumes in Groundwater	Low
13	Alternative Treatment of Off-Gasses from the Extraction of Chlorinated Solvents in the Subsurface	Low
14	Anthropogenic Background Levels of PAHs and Dioxin-Like Constituents in Shallow Soil at DoD Installations Using Geostatistical Methods and Geographic Information Systems (GIS)	Low
15	Ascertain if Any Environmental Data on Perflourinated Compounds at Operational DoD Sites Exist in Existing Remedial Investigations. Data Mine Existing Lab Chromatograms for Data Before Re-sampling Various Media	Low
16	Background Levels of Selected Metals in Groundwater and Soil, Including Arsenic, Manganese, Lead, Cadmium, Aluminum, Antimony, and Vanadium	Low
17	BTEX in Relation to Health Effects and the Current Vapor Intrusion Model Changes as Compared to Indoor Air Sampling	Low
18	Capability to Characterize and Develop a 3-D Depiction of VOC Smear Zones	Low
19	Characterize ESOH Impacts of DoD's Identified Emerging Contaminants (MERIT)	Low
20	Cleaning Petroleum-Soaked Absorbent Materials	Low
21	Health Effects Studies of Perfluorobromohydrocarbons	Low
22	Improve Treatment Technologies for IRP Site Remediation of Heavy Metals in Soils, Sediment and Groundwater	Low
23	Improve/Optimize Destructive/Ex Situ (Pump-and-Treat) Groundwater Treatment Systems	Low
24	Indoor Vapor Intrusion Differentiation between Volatile Organic Compounds	Low
25	Investigate the Health Effects Level of Use and Operational Impacts of Military-specific Use of Nanotechnologies	Low
26	Method to quantify mass flux of groundwater contaminants	Low
27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Low
28	New Treatment Technologies for Removing Low-Level Emulsified Oils in Contaminated Wastewater from Point and Non-point Sources	Low

APPENDIX B
Air Force Requirements (continued)

ID #	Requirement	Service Priority
29	Stabilization Technologies for Eroding Landfills	Low
30	Technologies for treatment of perchlorate	Low
31	Vapor Intrusion Model for Pier and Beam Crawl Space Construction	Low
32	RPO initiative using diffusion bag samplers to reduce LTM costs	Low
33	Energy performance based contract concepts for RA-O and LTM	Low
34	Asbestos in soil from disposal	Low
35	Recycling Machine Designed Specifically for Waste Antifreeze from Building Generator Units	High
36	Requirement to Evaluate Air Emission Control Technology to Comply with Maximum Achievable Control Technology Requirements of CAA for Engine Test Cells	High
37	Examine Health Impacts of Disturbing Asbestos-containing Soils	High
38	Reduce hazardous/solid waste at deployed sites (forward operating base)	High
39	Develop/enhance Technology to Automatically Measure Rainfall, Storm Water Discharge and to Collect, if applicable, Water-quality Samples to Meet EPA Storm Water Permit Monitoring Requirements	Medium
40	Replacement for Lead-Acid Batteries in Support Equipment	Medium
41	Cost effective method of recovering the aluminum from the road wheels of tracked vehicles due to the bonded rubber surface	Low
43	Detect Brown Tree Snakes in Cargo and Craft to Prevent Spread to Other Areas of the Pacific and the Mainland United States	Low
45	Evaluate Air Emission Control Technology for Industrial Boilers that will enable compliance with NSPS Subpart Db and the forthcoming NESHAPs for Industrial Boilers	Low
46	Mitigation of NOx Emissions from Mobile Flight Line Service Equipment, Such as Power Carts	Low
47	Neutron Radiography Waste Reduction System	Low
48	New Technology to Meet CAA Requirements--Critical Source Monitoring Requirements for an Industrial Area Title V Operating Permit—to determine where and how this is needed for state air shed region complex	Low
49	Substitute for Fibrous Glass Insulation	Low
51	Alternative to Methylene Chloride, Immersion Chemical Stripping Process for Landing Gear, Wheels, and Other Small Components	High
52	Alternative (Lead-free Solder and/or Nonsoldering Procedures and Materials) for Bonding Electronic Components and Assemblies During Repair	Medium
53	Alternative (non-chromated and environmentally compliant) to Koroflex Primer. Must possess a high degree of flexibility for use on large USAF aircraft	Medium
54	Alternative for Nickel Plating and Electroless Plating	Medium
55	Alternative to chromated Chemical Conversion Coatings for Aluminum and Magnesium Aircraft components	Medium
56	Alternative to IVD Aluminum to replace Cadmium Plating	Medium
58	Alternative(s) to Chromated Chemical Conversion Coatings	Medium
59	Alternative(s) to Chromic Acid Anodizing of Magnesium and Aluminum Surfaces	Medium
60	An Alternative to Chrome Plating on Aircraft Components and/or Mitigation and Control Technologies for Chrome Plating.	Medium

APPENDIX B
Air Force Requirements (continued)

ID #	Requirement	Service Priority
61	Contain Cadmium and Chromium Plating on Jet Engine Compressor Parts (to control pollution during compressor washes)	Medium
62	Corrosion-protective Coatings for Fasteners Are Needed to Eliminate Heavy Metal HAZMATs	Medium
63	Degradation Rates and Products of De-icing Compounds	Medium
64	Develop Alternatives to Chromate-containing Paint Primers	Medium
65	Environmental Improvements to Aircraft De-icing Operations	Medium
66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	Medium
67	Equivalent Replacement for Pre-paint Conversion Coating on Aircraft Structures	Medium
68	Lead-free Solder	Medium
69	MIL-C-81706 Alternative for Alodine Coating	Medium
70	Non-chromated Anodic Coating Stripper	Medium
71	Non-chromated Conversion Coating for Aluminum Immersion	Medium
72	Non-chromated Conversion Coating for Aluminum Spraying	Medium
74	Non-chromated Primers Are Required to Replace Zinc Chromate Primers Currently Used For Corrosion Protection on the Titan IV Launch Vehicle and Associated Ground Equipment	Medium
75	Non-dichromate Coatings for Magnesium	Medium
76	Replacement for Cadmium-Chromium plating on aircraft parts	Medium
77	Replacement for Chromic Acid Anodize	Medium
78	Replacement of Leaded Dry-Film Lubricants used in engine [Assembly and Manufacturing] Applications	Medium
79	Substitution, Mitigation, or Control for Cadmium Plating on High-strength Steels	Medium
80	To develop a safe and effective way to remove RADAR ABSORBING MATERIAL (RAM) from F-117A	Medium
81	Develop Treatment Technology at the Source for Wastewater Generated by Aircraft Engine Wash Racks	Medium
83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	Low
84	Alternative Repair Technology for Printed Wiring Assemblies which Does Not Require Hazardous Solvents (Trichloroethane, Xylene, Methylene Chloride) to Remove Conformal Coatings	Low
85	Alternative Thinners for Silicon-based Ablative Systems that Currently Require the Use of CFCs	Low
86	Alternative(s) for 1,1,1-Trichloroethane and MEK as Pre-coating Wipe Solvents and Inclusion into Tech Data and MIL-SPECs	Low
87	An Environmentally Acceptable Chemical Is Needed to Clean Liquid Oxygen (LOX), Gaseous Oxygen (GOX) and Liquid Nitrogen (LIN) Components in Aircraft, AGE, Production Plants and Storage Tanks	Low
88	Beryllium-free Alloys for Bushings and Bearings, Etc.	Low
89	Paint stripping without the Use of Toluene and MEK and Removal of Koroflex Primer without the Use of Methylene Chloride on Boeing 707 Fuselage (E-3, Joint Stars, KC-135)	Low

APPENDIX B
Air Force Requirements (continued)

ID #	Requirement	Service Priority
90	Determine Capabilities and Limitations for Broadest Possible Range of "Blast media" paint stripping Mediums; to give the field the most extensive "suite" of blast media painting stripping choices as possible	Low
91	Develop an Alternative Nontoxic Monopropellant for Hydrazine for the F-16 Emergency Power Unit (EPU)	Low
92	Develop an Environmentally Compliant Test to Detect Dense Particles in Plastic Media	Low
93	Development of Fluid System Nonvolatile Residue (NVR) Test Process	Low
94	Disposal of Nickel-Cadmium (Ni-Cd) Battery and Identification of Replacement for Ni-Cd Battery	Low
95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles. for ALCM and ACM	Low
96	Environmentally Compliant Sealants	Low
97	Environmentally Compliant Temporary Coating	Low
98	Flow Reduction and VOC Emissions Control for High-Volume/Low-Concentration Sources	Low
99	Heavy Degreaser on Aluminum Surfaces, Carbon Removal, and a Pre-paint and Pre-adhesive Cleaner	Low
100	Hydrogen Embrittlement Testing of Cleaners and Strippers on Substrates Other Than Cadmium	Low
101	Improvements to Road De-icing Operations, Focusing on Collection, Treatment, and recycling/disposal.	Low
102	Lightweight Non-Toxic Heat Sinking Material for Use in Aircraft Avionics systems	Low
103	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Solvents Used to Clean Metal Parts	Low
104	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Lubricants	Low
105	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Adhesives and Sealants	Low
106	Mitigation and Control Technologies to Allow Continued Use of Existing (High VOC and AFMC 24 TRI Chemicals) Paints and Primers	Low
107	Need Durable Leading-edge Coating to Eliminate Paint-System Failures in Prone Areas on the Aircraft	Low
108	Provide an alternate means of removing and preventing aircraft icing other than using Ethylene/Propylene Glycol	Low
109	R-22 Refrigerant Replacement and Methods to Modify Environmental Control Units (ECUs)	Low
110	Reclamation or Extension of the Life of Chromic-Phosphoric Acid Anodize Stripping Solutions	Low
111	Replace Paints That Contain AFMC-24 TRI Chemicals and Change Technical Data Sheets	Low
112	Replacement for Chromium Plating for the M61A1 Gun Barrel and/or Design Changes to the M61A1 System that would Extend Gun Barrel Lifetime while Doing Away with Chromium Plating of the Gun Barrel Interior	Low
113	Replacement for Fuel-Cell Leak-Detection Substance	Low
114	Replacement for PD680 Type II	Low
115	Replacement of chlorinated cleaners (MEK, Methylene Chloride, TCE) used to clean metal engine components	Low
116	Replacement of AF Environmental Control Unit (ECU) Ozone depleting Refrigerant	Low
117	Replacement Power Source for Standby Lead-Acid Batteries	Low

APPENDIX B
Air Force Requirements (continued)

ID #	Requirement	Service Priority
118	Replacements for Ozone depleting Refrigerant Compounds	Low
119	Solvent-free Solid State Metal Cleaning	Low
120	Treatment Technologies at the Source for Wastewater Generated at Fueling Facilities	Low
121	Use of Sodium Formate for the De-icing of Pavements	Low
122	Effective method for subsurface detection of munitions in ponds and other bodies of water	High
123	Technologies to locate and remove UXO from sediments in ponds and other bodies of water (AFSPC)	High
124	Fate of Smokes, Ordnance, and Obscurants on Ranges	Medium
125	Identification and Fate of Ordnance on Ranges	Medium
126	Lead Migration Studies at Small Arms Ranges/Skeet Ranges	Medium
127	Reclamation/Recycling/Disposal of Munitions	Medium
128	Remediation of Lead at Outdoor Firing Ranges	Medium
129	Technologies to Locate and Identify Unexploded Ordnance (UXO)	Medium
130	Low cost, environmentally benign, durable bombing targets	Medium
131	Feasibility of adding electronic 'tags' to small, difficult to locate, live ordnance for location of dud items (UXO) (ACMs/submunitions, 40mm grenades, 30mm HEI, etc.)	Medium
132	Cost efficient and effective method for surface removal of broken target material from large skeet ranges (5-50 Acres) under two different sites conditions - little vegetation and heavy vegetation	Medium
133	Cost efficient and effective method for In-situ stabilization of lead shot in soils at skeet ranges and firing ranges	Medium
134	Effective method for subsurface detection of munitions which can effectively filter out interference from volcanic rock	Medium
135	Technology to Reclaim/Recycle Reactive Weapons Components	Low
136	Identification of components of clay targets on trap/skeet ranges and their fate/transport	Low

APPENDIX C
ARMY REQUIREMENTS

APPENDIX C
Army Requirements

ID#	Requirement	Description	Priority
1	Sustainable Painting Operations for the Total Army [PP-1-02-04]	The Army requires the capability to perform surface coating operations on weapon systems as part of production and maintenance. Production and maintenance occur at government and commercial industrial facilities but also at motor pools, repair shops and in the field at troop installations. The U.S. Environmental Protection Agency (USEPA), under the Clean Air Act, has promulgated regulations for the surface coating of aerospace vehicles and watercraft on Army installations as well as numerous regulations applicable to the commercial industrial base.	High
2	Heavy Metal Reductions in Surface Finishing Processes [PP-2-02-03]	The Army requires the capability to protect its materiel from corrosion, wear, fatigue, and other harsh environments, while at the same assuring its facilities remain sustainable. To accomplish this, the Army needs affordable new inorganic coatings/processes and upgrades that meet performance requirements, and reduce/eliminate toxic and regulated materials. The highest priority is to reduce hard chrome, hexavalent chromium and cadmium used in hydraulic and pneumatic actuators, turbines engines, structural components; armaments (gun barrels, gun mounts, towed howitzer carriage and trail systems); small components (hinges, brackets, bushings, bearings, and pins), electrical connectors, and high strength steel fasteners.	High
3	Sustainable Water Usage [CM-1-02-02]	The Army requires the capability to recycle/reuse available water through a variety of innovative ideas and practical applications within buildings and processes including cascade recycle as well as water harvesting, with the ultimate purpose of increasing available supply. Water is often a limited, strategic resource and can impact whether an installation can expand or perform its assigned or additional missions and maintain quality of life. Communities surrounding, upstream and downstream of military installations are also expanding and can limit the amount of water available for installations. Additionally, there are demands within base camps and theater environments where the value of water may exceed that of fuel, encouraging the application of comprehensive recycle systems.	High
4	Compliant Ordnance Lifecycle for the Readiness of the Transformation and Objective Forces [PP-3-02-04]	The Army requires the capability to sustain warfighter training capabilities and the testing, production, storage and demil of munitions by preventing or controlling their environmental impacts. Hazardous and energetic materials contained in ordnance may affect human health and the environment at some point during their lifecycle (i.e., research, development, test and evaluation; manufacturing; use; demil; and cleanup as unexploded ordnance (UXO) or munitions constituents on ranges). This impacts all Army ammunition plants, live-fire ranges, static test facilities, and most arsenals and depots. In order to support the long-term sustainability of its operations, the Army needs to develop materials with reduced toxicity for munitions, improved weapon systems to support these materials, and environmentally sustainable manufacturing, demil, and recovery/recycling processes. These materials and processes must retain current performance and operational requirements and be insensitive-munition compliant.	High

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
5	Alternative Products in Cleaning and Degreasing Processes [PP-4-02-03]	The Army requires the capability to provide field test and evaluation of alternative cleaners to validate performance and logistics aspects in support of implementation. Traditionally, vehicle, equipment, aircraft, and ship maintenance operations have utilized organic solvents containing Hazardous Air Pollutant(s) (HAP) and Volatile Organic Compounds (VOC), to remove dirt, grease, soot, and burned-on carbon from various parts. Cleaning operations also cause worker safety and health issues in addition to environmental problems, because many of the chemical constituents are considered carcinogenic, flammable or otherwise dangerous. Many potential substitutes, e.g. aqueous-alkaline cleaners, provide substantial environmental benefits, but they can have materials compatibility issues including: surface corrosion of aluminum, steel, magnesium, copper and other alloys, hydrogen embrittlement of high strength steels, and stress corrosion cracking of susceptible alloys. Making environmentally friendly product substitutions to accepted and proven operation and maintenance procedures creates a potential readiness risk to some of our legacy systems.	High
6	Mitigate Invasive Species Impacts on Army Training [CN-1-02-03].	The Army requires capability to minimize invasive species impacts on training and operations. Capabilities related to four focus areas/issues are required: (1) Reduced carrying capacity – identification of knowledge gaps related to invasive species impacts on capacity, control and mitigation strategies to reduce the loss of training land availability and realism, e.g. avoidance of species (Scotch broom, giant reed, and yellow star thistle), and improved approaches to prioritize invasive species management; (2) Threats to long-term sustainability of training lands – knowledge of invasive species distributions, effects on native plant communities, and suitable management technologies; (3) Impacts on military operations – alternative methods for exclusion, detection, and cleaning of vehicles, equipment, and munitions to reduce delays and inspection costs in deployment and redeployment; and (4) Integration with T&E species conservation – control and mitigation methods to reduce invasive species impacts on T&E species and help relieve the associated land use burden.	High
7	Reducing Impacts of Threatened and Endangered (T&E) Species on Military Readiness [CN-2-02-03]	The Army requires capability to use installation training land that is unrestricted by T&E species. Military unique T&E species management problems need solutions, i.e. advanced knowledge of the impacts of noise, smokes and obscurants, maneuver, and environmental contaminants on T&E species to avoid unnecessary restrictions. With this knowledge installations can negotiate with regulators to reduce restrictions, effectively expanding land use. Many training restrictions have been imposed in compliance with the Endangered Species Act (ESA) due to a lack of knowledge of the effects of military activities on T&E species. Installations and G3 have indicated that compliance with the ESA is the number one environmental encroachment on training and readiness.	High

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
8	Zero Footprint Base Camps [PP-5-06-01]	The Army requires the capability to deliberately pre-plan waste management as an integral part of the overall concept of operations for contingency operations. Traditional, resource-intensive waste management methods create a substantial burden on base camp operations. Waste minimization through source reduction and packaging reconfiguration supports an agile force by reducing the quantity of material required for base camp operations. The Army needs to employ a multi-step process that utilizes waste as a resource through reduction of solid waste generation at the source and systems to treat, reduce, reuse, or reutilize waste materials in every stage of an operation.	High
9	Sustainable Lubricants and Fluids [PP-6-02-03]	The Army requires the capability to manage, recycle, and/or dispose many types of petroleum, oils, and lubricants (POLs) which contain components that are considered toxic or hazardous leading to increased disposal costs & health hazards. POL wastes result from both weapon system use and industrial operations.	High
10	Military Operations in the Presence of Species at Risk [CN-3-06-01]	Army requires the capability to minimize the need to list species at risk as Threatened and Endangered (T&E) which require protection under the Endangered Species Act (ESA). The results must be transferred to the field by demonstration/validation, fielding, support, and review and transfer of existing capabilities. Currently species at risk are not protected by ESA, and Army has more freedom in management and can avoid restrictions on military missions. If they are listed under the ESA, the Army loses freedom to manage and incurs more restrictions on land use, threatening warfighter readiness.	High
11	Maintaining Readiness by Improving Threatened and Endangered (T&E) Species Monitoring Capabilities [CN-4-02-03]	The Army requires capability for improved T&E species monitoring to help avoid loss of mission capability through inadequate monitoring on and near Army lands. Installations require cost effective, standard survey and monitoring protocols, population models, and ability to monitor inaccessible ranges. Standardization is essential to increase cost efficiency and ensure that Army and regulator standards are met.	High
12	Management and Remediation of Contaminated Groundwater [ER-1-02-02]	The Army requires a comprehensive approach to groundwater assessment, contaminant risk potential, remediation, and management of groundwater contamination caused by Army activities. Groundwater contamination exists as a ubiquitous problem around industrial complexes and many communities. The Army has similar groundwater contamination issues due to specific onsite activities. Improvements in knowledge, tactics, techniques and processes in groundwater assessment, contaminant risk potential, remediation, and management of groundwater contamination would decrease uncertainties and improve the accuracy of risk assessment predictions and the closure of existing remedial operations	High
13	Munitions and Explosives of Concern (MEC) Management Technologies for Operational Range Sustainability [ER-2-06-01]	The Army requires the capability to rapidly access operational (active) ranges and open burning/open detonation areas for uninhibited training and testing and for maintenance despite the presence of munitions and explosives of concern (MEC). Unmanaged MEC such as UXO, discarded military munitions (DMM), and munitions constituents (MC) present in high enough concentrations to pose an explosive hazard may inhibit unencumbered training and range reconfiguration activities. The system developed must provide guidance to enhance the Army's ability to prevent or respond to a release or substantial threat of a release of munitions constituents from an operation range to off-range areas.	High

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
14	Management of Munitions Constituents (MC) on Live Fire Training and Testing Ranges [ER-3-02-04]	The Army requires the capacity to assess the impacts of live fire training in regard to munitions constituents (MC) dispersed by low-order or dud fires. Data and knowledge is needed as to the fate and transport properties of MC deposited on live fire ranges, including, attenuating factors, vadose zone transport, biological pathways (bioavailability and uptake into plants and animals) and the ability to model and predict the associated risks. Pathways of interest include surface and subsurface transport routes through soil, sediment, water, and biota.	High
15	Particulate Matter/Dust Control and Measurement for Training and Testing Lands [CM-2-02-05]	The Army needs techniques and methods to satisfy regulators and achieve sustainability goals through military specific emission PM estimation methods, less costly field ready PM measurement systems, and improved modeling of atmospheric PM removal from vegetation. Military unique Particulate Matter (PM) emissions often create legal, regulatory, ecological and operational problems for Army installations. Since PM emissions can not be accurately estimated, cost effectively measured, or reliably modeled, this requirement aims at providing the Army significant information and tools needed to effectively respond to and negotiate with regulators.	High
16	Environmental Attributes of Emerging Contaminants [ER-4-06-01]	The Army requires the capability to rapidly assess previously unknown contaminants and to investigate all facets of emerging contaminants (chemical and non-chemical) environmental interactions. The evolution and use of novel technologies, materials and chemicals, (e.g. nanomaterials, new energetics, novel metal alloys) generates the necessity for early impact assessment often far beyond that normally performed during developmental testing and early acquisition phases. Many potential contaminants are not recognized as having an environmental impact until well after their original life-cycle testing or as new environmental research and regulations bring lower thresholds of impact. Recent examples of potential substantial liabilities resulting from an incomplete understanding of the interaction of materials and the environment include tungsten, perchlorate, and a variety of explosives and solvent degradation products.	High
17	Managing Cumulative Impacts on Installation Lands [CN-5-02-04]	The Army requires the capability to understand the cumulative impacts of non-military land uses as well as training and testing missions at a landscape level. Cumulative impacts result from incremental actions combined with past, present, and foreseeable future actions. Knowledge of cumulative impacts is needed to evaluate newly modified legacy and future weapon systems and mitigation options to alleviate their effects. The new knowledge is needed to improve carrying capacity and other land use models that simulate landscape conditions and are used to evaluate management activities on installation and surrounding resources. Army needs to take advantage of emerging technologies in simulated training programs, remote sensing, and land analysis to determine interactions and cumulative impacts to improve the Range and Training Land Assessment program ability to maximize the sustainability of land to meet training and testing missions. The impacts of wildland fire and prescribed burning need to be understood.	High

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
18	Management and Remediation of Heavy Metals on Live Fire Training and Test Ranges [ER-5-06-01]	The Army requires the capability of managing metals on its live fire testing/training activities. Cost effective range management approaches that reduce or eliminate the migration of heavy metals from ranges are needed in order to conserve both funds and useful range time if excavation can be avoided as a management tool. The environmental fate and transport properties and interactions of heavy metals with soils in a range environment are poorly understood, leading to substantial uncertainty in assessing and predicting the environmental risk associated with heavy metals on ranges. An understanding of the influence of geochemistry on migration of metals through all pathways is a particular need.	Medium
19	Joint Battlespace Use Fuel of the Future, Ultra Sustainable (JBUFF US) [PP-7-06-01]	The Army needs to develop renewable fuels suitable for training and combat. The single battlefield fuel, JP-8 is produced from crude oil and potentially shale oil which poses a national security threat via reliance on foreign, often unfriendly, sources. In order to develop fuels from renewable feedstocks to supplant our reliance on foreign crude oil, we must ensure any new fuel meets the Army performance requirements and supports world-wide engine reliability. In addition, the Army needs to leverage the current alternative fuels research on the Joint Battlespace Use Fuel of the Future by adding focused requirements to include conversion of biomass generated from Army operations at installations and camps to fuel, to further sustain the Army mission.	Medium
20	Army Noise Impact Assessment and Control for Training and Testing [CM-3-02-05]	The Army needs cost-effective technologies to predict, assess, control, and mitigate noise impacts. Encroachment and the resulting reductions in training throughput on ranges are real problems. Acoustic propagation models must accurately incorporate the statistical influence of weather on sound propagation and ensure that appropriate noise metrics are accurately calculated. New noise mitigation techniques need to be developed, particularly for blast noise. Scientifically and legally defensible community noise impact (annoyance) criteria are needed to guide installation noise management decisions. These noise impact criteria must be accurate and reliable, to minimally restrict training and testing, yet protect future capability. Improved noise impact criteria and assessment procedures are required to more accurately measure the true community response to noise and resulting risk to operational capability.	Medium
21	Environmental Restoration During Security, Stability, Transition, and Reconstruction (SSTR) Operations [ER-6-06-01]	The Army requires the capability to perform environmental risk assessments; conduct consequence management assessments; identify and quantify contamination; conduct environmental surveillance; dispose of unexploded ordnance (UXO); provide engineering construction support to restore the environment in STTR Operations. Neutralizing hazards and restoring the environment, consists of many military tasks, ranging from identifying and mitigating toxic substances, pollutants, and full spectrum Chemical Biological Radiological Nuclear (CBRN) hazards; to military construction and repairs; to clearing mines and other obstacles; to decontaminating vehicles, equipment, and infrastructure; and to destroying UXO. Capabilities and enablers must exist to avoid, mitigate effects, and neutralize hazards of all types, including industrial hazards, and WMD. Required capabilities include means to: perform environmental risk assessments; conduct consequence management assessments; identify and quantify contamination; conduct environmental surveillance; dispose of unexploded ordnance (UXO); provide engineering construction support to restore the environment.	Medium

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
22	Risk Assessment and Supporting Contaminant Toxicology [ER-7-02-04]	The Army requires the capability to accurately assess risk to human health and the environment resulting from the use of numerous military specific chemicals and materials. Army relevant contaminants are often unique from other industrial sources resulting in a decreased level of knowledge about the toxicological and physiological aspects of these compounds. Risk assessment models and data assessment tools are also a part of this requirement as very few integrated systems are available that are relevant to Army needs. This requirement addresses the need for toxicological and physiological profiles for Army relevant contaminants both chemical and non-chemical and integrated models and data management systems for improved application.	Medium
23	Long-Term Monitoring of Regulated Constituents [ER-8-02-02]	The Army requires improvement in procedures and technologies in order to avoid excessive costs of long-term monitoring. The Army faces continued operation of in-place remedies, proposed remedies, and the potential requirement for active environmental monitoring of continuing operations such as those associated with live fire training ranges. Groundwater monitoring can be required for 30 years or more before a remediated site can be closed by regulators. Monitoring of range activities may also become a continuous activity. Techniques and procedures must be cost effective and reliable, to enable the Army to use long-term groundwater monitoring devices, subsurface characterization techniques (geologic and chemical characterization); and/or rapid field analyses that are "real-time", reproducible, and acceptable by regulators for munitions constituents including military-unique compounds, chemical agents, pyrotechnics, propellants, and their degradation products.	Medium
24	Bio-based/Bio-degradable Consumable Commodities [PP-8-06-01]	The Army needs to identify biobased technologies and validate them for use in Army mission areas. Development, demonstration and validation is required in military unique mission areas. Bio-based and bio-degradable consumable commodities would improve mission capability in materiel production, operation and sustainment; force protection; food services, construction operations, installation maintenance, sanitation and personal hygiene, and environmental restoration.	Medium
26	Facility Air Emissions Control [CM-4-02-10]	The Army requires the capability of complying with all air pollution regulations through the development of effective and economical air pollution control technologies and tools. Pollutants addressed include criteria pollutants, HAPs, and VOCs. Significant non-painting sources of HAP emissions include fuel transfer operations, electroplating, metal polishing, boilers, and other combustion sources. For such federally regulated emissions, state and local laws may impose additional or stricter requirements. Standards may also be set on the control and/or elimination of fugitive emissions from these sources. Effective control technologies and tools are needed to reduce the amount of emissions released and to respond to the demands of regulatory entities.	Medium

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
27	Rehabilitation of Natural Resources (Land Conservation and Protection) [CN-6-02-03]	Army requires the capability to rehabilitate training and testing lands effectively and efficiently. Effectiveness needs to be measured in terms of cost per application, rehabilitation of training acreage related to erosion effects, ecological health, and increased training availability and opportunities. Army has a crucial ground mission. Accordingly, there is intensive land use and repeated impacts to the vegetation and soil surface. Training is more effective if lands provide an environment that is realistic and simulates the battlefield environment or theatre of operations. More, faster, and more flexible tactical vehicles; longer engagement distances; and brigade combat team tactics combine to increase the requirements for land and the stress on these lands. Impact is increased with concentration of training and testing activities on smaller land areas due to natural and cultural resource restrictions, and Base Realignment and Closure actions.	Medium
28	Proactive Encroachment Management to Sustain Military Training and Testing Missions [CN-7-06-01]	Army requires the capability to effectively minimize encroachment on installation operations. Installation challenges are recognized by the Senior Readiness Oversight Council and are documented in “320” (installation urban encroachment) and “366” (range encroachment) Congressional reports. Office of Economic Adjustment (OEA) Joint Land Use Studies continues to connect installation and local community planning.	Medium
29	Real-Time Monitoring of Land Use Conditions and Usage [CN-8-06-01]	The Army requires the capability to monitor, in real-time, the status of and impacts to natural and cultural resources on its training and testing lands. An ability to remotely monitor and access data on environmental condition and change over vast areas of installation lands is needed. Understanding the spatial and temporal characteristics of mission related impacts on environmental conditions is crucial to managing installation lands. This capability is needed to assess land condition, estimate land capacity, monitor, restore, and maintain lands, and manage ecological/archeological resources.	Medium
30	Reconfigurable Design of Training Landscapes [CN-9-06-01]	The Army requires the capability to modify and reconfigure training landscapes to meet current operational threats and commander intent. To meet changing training needs of today’s warfighter, Army requires increased training flexibility on ranges and training areas. Rapidly adjusting to new training scenarios necessitates techniques that accommodate reconfigurable landscapes. Methods are needed to rapidly assess and determine the re-configurability potential of training lands, design realistic training landscapes, accommodate rapid shifts in training needs, incorporate reconfigurable capabilities into construction of temporary and permanent range facilities, and reduce impacts to land resources by distributing utilization across the landscape.	Medium

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
31	Reduce the Effects of Archeological Resources on Training [CN-10-06-01]	The Army requires the capability to understand the actual effects of various types of training on archeological sites in order to reduce the restrictions on training that result from known sites. State Historic Preservation Offices typically assume that military training adversely impacts archeological sites. By better understanding the actual effects, it is likely many aspects of training will be found to have negligible impacts, thereby creating a potential for avoiding substantial restrictions, mitigation costs, and expanding acres available for training. The Army needs methods to identify training, testing and other impacts on identified (thus legally protected) sites, models to predict the actual occurrence and intensity of impacts, guidelines that identify training that can be conducted in various settings with minimal risk, and monitoring techniques to assure compliance with legal requirements.	Medium
32	Management of Environmental Consequences of the Introduction of Insensitive Munitions Compounds to the DoD Inventory [CM-5-02-04]	The Army requires the capability to control waste streams from its Load, Assemble and Pack facilities that handle new generation munitions which meet insensitive munitions requirements. Waste effluents generated during the load, assemble and pack of these new munitions will likely contain small amounts of the munitions compounds. Regardless of the munition compound, wastewaters from these operations will fall under K044 as a hazardous waste, and must be controlled.	Medium
33	Waste Management Utilizing Waste Characteristics [CM-6-06-02]	The Army needs the capability to better manage waste during contingency operations. This requirement deals with the elimination of waste that is generated regardless of the source. Contingency operations waste (solid, hazardous, and sanitary) should be evaluated as an operational resource. Waste management systems that take advantage of the inherent characteristics of the contingency operations base camp waste streams should be developed. Improved composting systems, waste to energy systems, recaptured waste water (black and grey water systems) or other uses for waste resources need to be developed in order to maximize the lift and load outlays for getting materials into theaters of operation minimize the handling of waste streams once in theater. Whatever comes into the theater of operations must be completely consumed, reused, or benign if left behind. In the future deployed environment, the Army can no longer afford to transport materials whose end value is simply waste.	Medium
34	Remediation and Management of Contaminated Sediments [ER-9-06-01]	The Army requires the capability to assess fate and transport and impacts of contaminants in sediment environments. Army lands include vast areas of wetlands, ponds, lakes, creeks and streams that are parts of ranges, training areas, buffer zones and other uses. Live fire and industrial operations have resulted in contamination of these freshwater sediments and wetlands. Conflicting results and inaccurate perceptions have led to little consensus about what is known about the role of wetlands and sediments in contaminant transport and binding yet the potential exists for significant differences from soil models. This requirement addresses all aspects of wetlands and sediments in contaminant fate and transport, impacts on benthic freshwater and wetland habitat, and potential for contaminant removal or stabilization via the unique sediment chemistry.	Low

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
35	Avoidance of Environmental Risk During Contingency Operations [ER-10-06-01]	The Army requires the capability to 1) avoid self inflicted environmental consequences resulting from the unintentional release of toxic industrial chemicals (TICs) and toxic industrial materials (TIMs) by U.S. forces and 2) ensure that operational maneuver is not compromised by release of TICs and TIMs. The clandestine use TICs and TIMs offers a convenient, readily available, and cost effective weapon for disrupting and hazarding human health and the environment. New tactics, techniques, and procedures are required to ensure the Army's ability to maneuver without disruption in the face of the TIC and TIM threat. Of prime interest is the avoidance of self inflicted environmental consequences resulting from the unintentional release of TICs and TIMs by U.S. forces.	Low
36	Detection, Discrimination, Identification, and Render Safe of Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM) [ER-11-02-05]	The Army requires the capability to detect, discriminate, and manage UXO. The DoD requires the restoration of Army properties contaminated with UXO and rapid access / maintenance of operational ranges. Army restoration of UXO on closing ranges must meet stringent regulatory and stakeholder standards for terrestrial, wetland, and shallow water sites (including underlying sediments) and must address detection, discrimination, coordinate location, recovery, and disposal of UXO. The effectiveness of UXO characterization and remediation efforts must meet regulatory standards and stakeholder concerns, and as part of the DoD UXO Environmental Restoration Mission, the Army has the responsibility to insure that a significant number of these sites are fully characterized and remediated to a condition that is consistent with the intended future use.	Low
37	Elements of Training-Compatible Vegetation [CN-11-02-04]	The Army requires the capability to sustain stable soils and vegetation to keep lands in a condition suitable for training and testing. Explicit vegetation management technologies are required to overcome unique and diverse challenges imposed by ground and vegetation disturbance associated with testing and training. New knowledge is required to identify physiological characteristics and traits of plants to withstand military training, improve rehabilitation success on disturbed lands, and promote and enhance training realism. Knowledge of operational use of native plant communities and resilience to impacts is required. The ability to incorporate plant species to improve training scenarios, yet sustain resources is required.	Low
38	Arid Lands Utilization and Rehabilitation [CN-12-06-01]	The Army requires the capability to sustain arid and semiarid lands impacted by unique military uses. Capabilities are needed to: (1) characterize land resources and levels of disturbance; (2) restore critical soil ecosystem structure and function; (3) provide land rehabilitation practices that are sustainable, cost effective, and compatible with military missions; and (4) assess, mitigate, and sustain critical riparian habitats which provide high conservation value for threatened, endangered, and other species.	Low

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
39	Environmental Decision Analysis Under Uncertainty [ER-12-06-01]	The Army requires capabilities to effectively, transparently and scientifically make sound environmental decisions for assessment, remediation and management of Army property. In general, environmental decision-making tends to be significantly complex in nature. The complexity can be the result of multiple lines of data with inherent uncertainties and potential conflicts of results or minimal available quantitative data with data gaps and significant assumptions. Currently decisions are often made on an ad hoc basis due to overwhelming or conflicting data, opinion, and goals, which can be difficult to ground in scientific basis and non-transparent. A well defined and documented decision process is needed to assemble and assess data with integrated uncertainties which should include non-numerical input such as stakeholder assessments and/or public opinion input.	Low
40	Heavy Metals Management and Remediation for Industrial Activities [ER-13-02-03]	The Army requires the capability to avoid or reduce the environmental impact of metals remediation costs. Soils, and underlying ground waters, upon which industrial activities take place or have taken place can become contaminated with heavy metals. Metals of concern include arsenic, cadmium, chromium, lead, mercury, zinc, and others introduced in soils as a result of industrial activity. As disposal restrictions become stricter, current approaches become increasingly more difficult and expensive to implement. Innovative and cost-effective technologies that eliminate the need for excavation, transportation and disposal as hazardous waste are required.	Low
41	Compliant Electronics for Life Cycle Sustainment of Military Components and Systems [PP-9-06-01]	The Army requires the capability to sustain the critical electronics used by the warfighter in training and in mission environments. Hazardous materials contained in equipment may affect human health and the environment at some point during their lifecycle (i.e. manufacturing, use, maintenance and disposal of military electronic systems). Printed circuit boards are a common component of many electronic systems built for both military and commercial applications. Depending upon the use and design of the particular printed circuit board, various materials may be used in the manufacturing process, including lead, silver, gold, platinum, and mercury. Environmental regulations may impact the ability of the Army to continue operations in many parts of the world and force the conversion to new environmentally compliant electronics.	Low
42	Sustainable Technologies for Military Facilities [CM-9-06-01]	Sustainable design of facilities is required by Army policies. However, sustainable facilities are not yet standard on military installations for three reasons: (1) design of sustainable buildings requires fundamental "re-thinking" of standard design practices, and knowledge of whole building design concepts; data validating the reliability and effectiveness of new stormwater and wastewater management techniques, water conservation techniques, energy conservation equipment and design elements, and new building materials is unavailable; and lack of readily available generalized data on first cost, life cycle cost, quality of life improvements, and environmental benefits impacts all design phases but most importantly the crucial initial project programming phase. As a result, the benefits of sustainable approaches are not given due consideration as design decisions are made, project budgets are prepared, and final designs approved.	Low

**APPENDIX C
Army Requirements (continued)**

ID#	Requirement	Description	Priority
43	Waste Heat [CM-7-06-02]	The Army requires the capability to maximize is fuel use value. Capturing waste heat and from various systems will allow for better utilization of fuel sources. Waste heat generation for contingency operations remains an area with a need for additional RDT&E solutions. The value of fuel during contingency operations has been determined to be approximately \$6.00/gallon, based on transportation and storage costs. These costs do not include the “security” requirements associated with transportation during “hot” deployments. Deployed operations can not afford to waste any BTU values. Systems put in place in a base camp operations should seek to minimize its waste heat generation and to utilize the captured waste heat (heating water, heating air, power). This will facilitate lower energy requirements and provide greater force protection by reducing the “heat” signatures of base camps. As new systems are developed, the capture of waste heat should be included as a perfunctory requirement. Likewise, existing or “legacy” systems should be evaluated in order to modify or adapt them to systems that allow for the capture of any waste heat.	Low
44	Develop Quick Analysis Sensors for Compounds of Military Interest [CM-8-02-06]	The Army requires the capability for rapid, real-time, sensing of toxic chemical and biological contaminants, anywhere at any time. Frequently, there are no available sensing and detection devices to conduct rapid field analysis of chemical or biological compounds of military interest. This requirement aims at enabling the Army users – including personnel in theatre - to detect and obtain a quick hazard analysis that applies to a broad range of outcomes from classifying non-hazardous materials as hazardous waste, to identifying inefficient or non-operational compliance technologies incidents, to the border objective of protecting Army Users from sickness or possibly death. Immediate areas of interest include, but are not limited to, assessment of breathing air and drinking water, wastewater, effluents from Army industrial processes, assessment of range scrap, groundwater monitoring, soil contamination, and disposal of unknown materials. Current methods for acquiring physicochemical information are slow and costly, since they typically require samples to be collected and shipped to laboratories for analysis and quantitative results.	Low
45	Reduce/Eliminate Pollution for Compliant Manufacturing, Testing, and Maintenance of Military Clothing and Textile Items [PP-10-02-02]	The Army requires the capability to manufacture, fabricate, and evaluate individual soldier clothing items with minimal use of solvents and other hazardous chemicals. The manufacture, fabrication, and test and evaluation of individual soldier items of clothing and textile products, chemical protective clothing, and equipment involves use of heavy metals and solvents, which generate costly waste streams and air emissions. The use of these hazardous and toxic materials exposes workers to health and safety risks and unnecessarily increases procurement costs for these items. The high performance fabrics used by the military, such as Nomex, Kevlar, and PTFE, require the use of harsh chemicals. New processes are needed for manufacturing and testing which results in lower costs while meeting applicable standards.	Low

APPENDIX C
Army Requirements (continued)

ID#	Requirement	Description	Priority
46	Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair [PP-11-02-02]	The Army requires the capability to manufacture, maintain, and repair equipment and weapons platforms using composite resins and adhesives. Composite materials are used in a broad variety of commodities, including aircraft, watercraft, ground vehicles, and individual soldier items of equipment (i.e., helmets, body armor, etc.). Adhesives and sealants are used in essentially all weapons platforms and much equipment. The manufacture of composites and repair or metals, ceramics, and composites involves the use of hazardous materials. These materials pose health risks to workers and generate hazardous waste streams requiring management in compliance with RCRA. The specific needs are for low HAP resins, adhesives, sealants, zero HAP repair resins, high shelf-life materials and environmentally friendly fire retardant composites.	Low

APPENDIX D
NAVY REQUIREMENTS

**APPENDIX D
Navy Requirements**

ID#	Requirement	Description	Priority
1	Develop alternative refrigerant and cooling systems that eliminate the use of ODS substances in mission-critical air-conditioning and refrigeration (AC&R) systems on aircraft, ships, and submarines.	Every Navy ship and submarine uses ODSs in mission-critical air conditioning and refrigeration (AC&R) systems. In response to the CAA and EO 12843, the Navy must design and develop low and non-ODS AC&R systems that do not adversely impact cooling capacity, space, weight, reliability, safety, control, manning, or other operational concerns.	High
2	Develop alternatives to control, minimize, and manage the generation and disposal discharge of solid waste from ships.	In order to comply with existing and anticipated international, Federal, State, and local maritime environmental laws, while also responding to shipboard safety, health, manning, and public image issues, the Navy must develop specialized systems, equipment, and procedures to enable ship crews to efficiently manage, and preferably destroy, shipboard generated solid wastes in order to protect the ocean environment.	High
3	Develop alternatives to control, minimize, and manage the generation and disposal discharge of hazardous waste from ships.	Each year the Navy generates several million gallons of hazardous waste, which is typically disposed of at a considerable financial cost and at the risk of continuing liability. The MARPOL international maritime treaty dictates that no discharge of hazardous waste will be made into designated special areas. In response, the Navy must develop specialized systems, equipment, and procedures to enable ship crews to efficiently manage, and preferably destroy, shipboard generated hazardous wastes in a cost-effective manner.	High
4	Control and minimize the release of residual chlorine that is discharged into harbor waters due to biofouling suppression in shipboard seawater piping systems.	Seawater is used by several ships and submarine classes to remove heat from propulsion plants, electrical generating plants, air-conditioning plants, and other machinery and equipment requiring cooling. Chlorine is added to the seawater to control biofouling, thereby maintaining heat transfer rates and minimizing maintenance. In order to meet chlorine-related water quality standards in ports and harbors, and to address concerns regarding the effectiveness of current dechlorination efforts, the Navy is investigating alternative biofouling processes and techniques which minimize residual chlorine discharge.	High
5	Control, minimize, and manage liquid wastes discharged overboard from ships in restricted waters during normal operation.	Shipboard controls are needed for non-oily wastewaters (blackwater, graywater, and nine other regulated effluents) and oily wastes (bilgewater, waste oil, and ten other regulated effluents) on surface ships and/or submarines to comply with a wide range of legal requirements. All Navy vessels generate bilgewater and other oily wastes that cannot be held onboard while at sea and in port. All Navy and private port authorities must be ready to handle oily waste effluents that are offloaded or discharged from Navy ships. Without shipboard systems and practices to avoid the overboard discharge of blackwater, graywater, and other UNDS regulated effluents, Navy ships will encounter legal restrictions on their operations, exercises, and transits within 12 nm of land. Fleet operations have been hampered by bilgewater discharges exceeding 15 ppm, especially in ports and territorial waters around the world.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
6	Develop technologies to locate, identify, track, and measure impact of Navy action on Marine Mammals/Threatened Endangered Species to minimize risk to the animal during Fleet operations and training exercises.	Navy activities produce underwater acoustic emissions which could affect marine mammals and other marine animals identified under the MMPA. To ensure compliance with MMPA and ESA and to prevent restrictions on Navy operations and exercises, the Navy needs to develop technologies, processes, and procedures to: locate and identify protected marine animals; track and predict movements of marine animals so that Fleet operations and exercises pose a minimal risk; and develop criteria for defining the effects of different types of acoustic emissions on specific species of marine mammals and other protected marine animals; and develop population databases for avoiding vulnerable marine animals and their habitats.	High
7	Develop alternative engine technologies to reduce nitrogen and sulfur oxides emissions from marine diesel and gas turbine engines.	Restrictions on NOx and SOx emissions from Navy ship engines would severely impact fleet operations in terms of both propulsion and auxiliary engine operation and could limit access by Navy ships to many domestic ports and waterways. When the costs of these actions (including legal expenses) are considered, the potential cost to the Navy will be high. In response, the Navy needs to develop technologies, processes, and equipment to monitor and control gaseous emissions from Navy ship propulsion and auxiliary power systems to facilitate compliance with anticipated regulations.	High
8	Develop alternative engine technologies to reduce air emissions from aviation engines to allow continued operation and training of Naval aircraft.	Volatile Organic Compounds (VOCs) and oxides of nitrogen (NOx) are precursors to ground level ozone or smog, and emissions from aircraft engines contribute to smog problems that occur in much of the country. CO2 and NO2 are global warming gases and aircraft emissions of these gases contribute to the global warming process. Furthermore, particulate matter from aircraft engine emissions contributes to respiratory and other health problems. Failure to comply with the Clean Air Act could result in a lower level of operations and training of the aircraft, which would affect readiness. Furthermore, a failure to comply may affect deployment, operational tempo, readiness, flight mission profile, test locations and procedures. Affected weapon systems include the Joint Strike Fighter, FIA-I8WF (growth engine) and V-22 and affected facilities include AIMD & NADEP engine test cells.	High
9	Develop alternative rocket engine emission control technologies to reduce particulate and gaseous air emitted during testing of rocket motors.	The problem of toxic emissions such as PM and VOCs from the combustion of rockets is a cross service and NASA issue that test, train or otherwise use rocket propellants. Advanced technology rocket engines, fuels and test cells are needed to reduce the amount of exhaust emissions to levels which meet or exceed the CAA requirements. A strong cross service effort is necessary for this need, as Air Force, Army, as well as agencies like NASA have requirements in this area. Therefore, all development efforts must show coordination with the other Services.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
10	Identify and qualify non-ODS and environmental benign fire-fighting agents and systems for ships and aircraft to ensure adequate fire protection capabilities are maintained.	The Navy uses Halon 1301 in mission-critical shipboard fire protection systems. There are no drop-in non-ODS fire suppression agents for these systems without performance, space, weight, or other penalties. Navy ships cannot operate with adequate fire protection capabilities without severely compromising ship safety, damage control, and survivability. The Navy must identify and qualify alternative fire suppression agents and fire-fighting systems to continue to operating its ships as Halon supplies disappear. The Navy must identify, test, and qualify alternative low-ODSs fire suppressants for use in Halon-like delivery systems for near-term implementation as well as develop new non-ODSs fire protection systems Navy ships and aircraft.	High
11	Develop treatment technologies and processes to remove munitions constituents and energetic materials from wastewaters at Navy ordnance manufacturing, testing, and demilitarization sites.	The Navy has identified a number of explosive waste sites at many of its manufacturing, testing, and demilitarization locations that have energetics-contaminated aquifers, which are being cleaned as part of the Installation Restoration Program. These sites are a result of the previous common practice of direct discharge of untreated, explosives-and solvent-contaminated waste waters into unlined drainage ditches and evaporation ponds. The usual effective treatment method is incineration, otherwise excavation and land disposal, neither of which are cost effective. New treatment technologies need to be developed, tested, and implemented that cost effectively address the problem of toxic degradation of munitions constituents and energetic materials in groundwater.	High
12	Develop Ammonium Perchlorate (AP)-Free propellants and treatment technologies for air emissions contaminated with energetic materials resulting from ordnance manufacturing, testing, and demilitarization.	The manufacture, testing, and demilitarization of energetic materials for ordnance items results in large amounts of air emissions, especially EPCRA TRI regulated pollutants and energetic materials. The Navy must adapt and modify current technology for the treatment of emissions (VOCs, energetics) to allow safe application of explosive manufacture and demilitarization operations.	High
13	Develop alternative ordnance disposal methods to reduce emissions from energetics production and demilitarization	Navy and Marine ordnance disposal methods produce large quantities of reclaimed energetic material that is primarily disposed of through open burning/open detonation (OB/OD). This method is under considerable controversy due to the environmental safety and health effects attributed to the amount of VOCs released. The Navy must design, develop, and test alternative ordnance disposal methods to reduce air emissions.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
14	Develop models to define the transport, fate, and effect of contaminants in the marine environment to predict the environmental impact of discharges and spills of hazardous pollutants.	Predictability of environmental consequences of pollution depends on robust multi-dimensional models that can define transport, fate and effects of contaminants. The Navy needs to develop improved fate and transport that better capture the highly non-linear interactions of physical, chemical, and biological processes. The primary benefit from such models lies in their ability to predict potential affects resulting from remediation action or lack of action. These models should also be directly applicable to compliance issues, predicting the affects of marine discharges and sediment removals, dispersion and effects of point and non-point sources, ship effluents, oil spills and dredging.	High
15	Develop detection methods for locating Unexploded Ordnance (UXO) on Land, Underwater, and in Sediments to facilitate the recovery and removal of UXO from Navy ranges.	The presence of unexploded ordnance (UXO) creates complex human safety, operational, and environmental problems and makes military base closures difficult. Each munitions type poses different challenges for detection and clearance, as they can be found on the surface, buried underground, underwater, or in sediments in the ocean floor. To ensure sustainability of its active ranges, new and improved technologies are needed to improve UXO detection capabilities both at current and historical ranges.	High
16	Develop remediation technologies for soils contaminated with energetic materials at Navy manufacturing sites and ranges.	Many facilities used for the synthesis and manufacturing of energetic materials are currently listed on the EPAA's Superfund National Priority List and require extensive and costly remediation. The direct discharge of untreated, explosives and solvent-contaminated waste waters into unlined drainage ditches and evaporation ponds was a common practice in the past, and has resulted in the contamination of soils and aquifers underlying many manufacturing facilities with energetic materials. New treatment technologies must address the problem of toxic intermediate degradation products and provide a significant cost advantage to incineration or address a unique problem for which no alternatives currently exist. Furthermore, development studies are needed in order to perform proper risk assessments and environmental analyses for active and closing ranges.	High
17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	Ordnance manufacturing and demilitarization activities by the Navy generate a significant quantity of range residue each year, which represents a significant environmental contamination issue and can result in base closure and delays in range operations. This scrap metal must be decontaminated and deemed "clean" of all energetic material before it can be sent off-site for reclamation. New methods and procedures need to be developed that ensure that the level of decontamination is at the highest standard (5x), which would allow reclamation by any general recycling contractor.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
18	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on marine mammals.	The routine operation of Navy ships and submarines, as well as training and testing activities, emit noise that has the potential to adversely affect the behavior of marine mammals in their natural ocean environment. This problem is prevalent in shore bombardment ranges and commercial activities where underwater detonations may occur. The ongoing concerns and legal challenges of the public and environmental groups can interrupt, delay, or even cancel important Navy activities. As a result, criteria need to be developed and established for risk assessments to determine the acceptable take of marine mammals due to underwater explosions.	High
19	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on terrestrial threatened/endangered species.	The routine operation of Navy ships and submarines, as well as training and testing activities, emit noise that has the potential to adversely affect the behavior of land and marine animals, particularly the growing number of threatened and endangered species (TES) found on military lands. This adverse affect on TES is causing constraints on testing and training which degrades mission readiness. The Navy needs to develop noise and mitigation technologies to assess the effects of noise on TES, as various species may experience changes in their behavior and reproduction due to military operations.	High
20	Develop objective measures for determining acceptable surface cleanliness in order to establish standards for approving alternatives to chlorinated cleaning solvents used to maintain Navy weapon systems.	Chlorinated solvents are used extensively to maintain various Navy weapon systems. However, because of recent environmental and human health problems associated with chlorinated solvents, the Navy needs to find both alternative cleaners as well as establish objective surface cleaning standards from which to measure and manage acceptable alternatives. The R&D funding requested here will assist in the development of cleanliness standards by which alternative, acceptable cleaners can be used on various Navy weapon systems.	High
21	Develop technologies for coating removal and cleaning operations that eliminate VOC, HAP, ODS, and toxic emissions/wastes during aircraft and ship maintenance.	Within the Navy maintenance function, a wide variety of paint removal practices (mechanical blast, solvent stripping, sanding, water jet) exist for ships, aircraft, and other systems that results in the release of volatile organic compounds (VOCs), toxic metals (chromates) and hazardous air pollutants (HAPs) to the atmosphere, with both global (ozone layer depletion) and local (forest and agricultural damage, human health) effects. The Navy needs to develop comprehensive, non-polluting stripping and cleaning processes that utilize low or non VOC and HAPs.	High
22	Eliminate hazardous materials (Lead, VOCs, and HAPs) from the manufacturing and repair of optical and electronic devices	Navy depots are involved in the manufacture and/or repair of a variety of optical and electronic devices for use aboard Navy ships, aircraft, missiles, and ground-based systems. While a depot's conventional manufacturing and repair operations include products (solder, conformal coatings) which are extensively used because of their traditional reliability and performance characteristics, they also contribute to the hazardous waste stream (lead, antimony, VOCs). Therefore, the Navy needs to develop solder technology, optical and electronic materials technology, and new conformal coating technology that have low or no VOCs or HAPs.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
23	Identify and qualify alternative adhesives, sealants, and primers that eliminate the use of hazardous materials and the release of VOCs and ODSs.	The Navy uses adhesives and sealants for a variety of applications ranging from ships and aircraft maintenance to ordnance. Many of the current products, however, are considered environmentally hazardous, including: solvent-borne elastomer adhesives (VOCs and ODSs), Polyamide adhesives (methylene dianiline (MDA)) and many structural adhesive primers (chromates and high VOC solvents). Federal and local environmental regulations classify these materials as hazardous and closely regulate their use and disposal. As a result, the Navy needs to develop new formulations for adhesives, primers and sealants that are both compliant and meet or exceed the quality and performance requirements for any given application.	High
24	Develop alternative non-destructive inspection technologies to replace Fluorescent Penetrant Inspections (FPI) that eliminate the generation of hazardous wastes.	Fluorescent penetrant inspections (FPI), which are performed at all levels of naval aviation, generate contaminants which contribute both to Toxic Release Inventory (TRI) emissions and hazardous waste streams. FPI effluent presents biological oxygen demand (BOD); chemical oxygen demand (COD); fat, oil and grease (FOG); surfactant, and color disposal concerns that require pre-treatment prior to release to a POTW. The Navy needs to develop and test FPI alternatives which can meet naval aviation specifications while reducing VOCs and HW.	High
25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	The Navy must identify/develop and qualify new shipboard and aircraft paint and coating systems that meet all environmental restrictions without compromising Navy paint/coating performance, service life, maintenance, health, or safety requirements. U.S. Navy shipboard applied paints and coatings represent the single largest source of air pollution emissions at shipbuilding and ship repair activities. New advanced paint system technologies are critical for: complying with current and pending environmental regulations in their HAP content of current Navy marine paints; extending material service life performance beyond current maintenance periods; and addressing reduced Navy maintenance and manning budgets.	High
26	Develop efficient paint application processes and disposal alternatives to minimize the amount hazardous wastes resulting from painting operations.	Coating and paint application operations at Naval shipyards and maintenance depots are a major contributor to Hazardous Waste (HW) generation throughout the DOD. The transfer efficiency of paint sprays from conventional air spray applications can be as low as 28% where as the other 72% is emitted into the environment. The organic paints used aboard Navy ships and on aircraft and ground support equipment contain toxic inhibitors and volatile organic carbons (VOCs), which are regulated by increasingly restrictive Federal, State, and local environmental regulations. Advanced paint application equipment and processes are needed to reduce paint overspray, improve efficiency, and reduce handling and disposal costs, while also meeting critical operational requirements.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
27	Identify and qualify alternative plating materials and processes that eliminate the use of hazardous materials (Cr+6, Cd) and the disposal of hazardous wastes.	The current metal finishing and surface treatment and pre-treatment processes, which rely on the use of heavy metals, cyanides, acids, caustics, and solvents, has come under strict regulation by numerous environmental regulations. Chromium (a human carcinogen), cadmium (a toxic heavy metal), and cyanide are some of the contaminants generated from these widely used processes. Compliance with personnel exposure limits (PEL) of 0.5 micrograms per cubic meter for hexavalent chromium is estimated at \$46M/yr. The Navy needs to develop alternative technologies and processes that minimize the generation of hazardous waste or produce inherently non-toxic waste.	High
28	Develop replacement machine cutting and grinding fluids that do not contain 1,1,1-TCA and other chlorinated compounds to eliminate the discharge chlorinated compounds to the atmosphere and incur high disposal costs.	Handling spent cutting fluids are a problem throughout both the Navy depot community and the metalworking industry at large. While both petroleum and aqueous systems lubricate and cool the work-piece and tools during metalworking operations, they both generate hazardous air emissions and collect metals which contribute to the hazardous waste steam. Improving the availability and handling of cutting fluids that do not contain 1,1,1-TCA and other chlorinated compounds would reduce the Navy's hazardous waste disposal costs, reduce hazardous air emissions, and benefit both public and private industry.	High
29	Develop alternative welding and cutting materials and procedures to eliminate generation of hazardous wastes and toxic air emissions (heavy metal fume emissions).	Many alloys used in ship construction and renovation contain high heavy metal contents which contain excessive levels of HAPs (i.e. chromium, chromium oxides, and nickel) which can harm workers. Navy R&D support is needed to develop new welding and cutting materials and processes that will provide the same performance as current materials without generating hazardous wastes or toxic air emissions. Additionally, fume and filler material residue collection techniques must be identified and developed to ensure Navy's compliance with federal and state regulations while also continuing to use necessary materials containing chromium, manganese and nickel.	High
30	Eliminate hazardous wastes and toxic air emissions from aircraft and ship from manufacturing, maintenance, and repair operations of composite materials.	The Navy generates hazardous and toxic materials and wastes from the manufacture, maintenance, and repair of composite materials. Typical structural uses of composite materials include wing/fuselage skins, sub-structure members, stiffeners, structural patches, access panels, speed brakes, control surfaces pressure vessels, rocket motor cases, rotor blades, fuel tanks and probes. Material compositional issues, however, include the HAPs and VOC solvents used in curing agents, adhesives and resins as well as the large amount of hazardous waste (scrap prepare, trim and flash) associated with manufacture and repair of composites. The Navy needs to identify alternative composite materials and processes that minimize or eliminate environmental hazards in critical repair and maintenance operations both ashore and afloat.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for disposal.	A wide variety of hazardous materials are used on Navy ships and/or submarines, including paints, solvents/degreasers, cleaning agents, adhesives, sealants, lubricants, hydraulic fluids, rust/corrosion inhibitors, acids, alkalis, ethylene glycol, and various miscellaneous maintenance materials. These hazardous materials are currently critical for the proper operation, maintenance, repair, and cleaning of ship and aviation systems. The Navy needs to minimize hazardous material use via substitution and/or process modifications, and develop recycling techniques to maintain high standards of health and safety aboard ship and to reduce the burden of hazardous material disposal on shore facilities.	High
32	Develop facility hazardous material alternative and recycling techniques to minimize the amount of hazardous waste disposed of by shore facilities.	Although shipboard used/excess hazardous materials are not considered hazardous waste from a regulatory standpoint, they become hazardous waste by definition as soon as they are transferred ashore for disposal or other management measures. The Navy does not have any shipboard technology for destroying hazardous materials at sea and cannot discharge hazardous materials overboard. Therefore, the Navy must develop facility hazardous material alternative and recycling techniques to minimize the amount of hazardous waste disposed of by shore facilities.	High
33	Develop coating and cleaning technologies that eliminate/minimize copper and zinc releases to the marine environment from ship antifouling/fouling release coating systems.	Current Navy hull antifouling coatings (ablative and non-ablative) rely on the toxicity of copper to inhibit the accumulation and growth of marine organisms on the hull. The inherent properties of these coatings, however, also create an unintended environmental issue in ports and coastal waters, including the leaching of copper and zinc into the marine environment. Restrictions on the use of copper-based hull antifouling coatings will only limit port access by Navy ships. The Navy needs to develop anti-fouling coatings that eliminate or minimize copper and zinc releases into the marine environment.	High
34	Develop technologies to control or eliminate particulate and other air emission from tactical mobile and stationary sources.	Increasingly stringent regulations for the emission of particulate, nitrogen oxides (NOx) and other emissions from power generating units (such as Mobile Utilities Support Equipment), stationary boilers, and other diesel engine sources are being enacted at both the federal and local levels. The Navy must be able to move MUSE units into any given location to provide emergency electrical power and steam for periods that sometimes exceed 1 year. However, the Navy's MUSE equipment does not meet current NOx emission regulations in several areas of the country, and new particulate emission regulations (PM2.5) are also in the process of being imposed. The Navy needs to develop new control technologies for limiting NOx and particulate emissions to permitted levels in order to support emergency power needs.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
35	Develop treatment and disposal process for drydock wastes generated during ship hull cleaning, painting, and cutting operations that are discharged either to the marine environment or IWTP during ship and submarine maintenance operations.	All drydock operations, including floating drydocks, generate varied types of hazardous wastes. Operations usually allow the release of all the water from the drydock except for the bottom one foot which contains most of the sludge and contaminants which are sent to the Industrial Wastewater Treatment Plan (IWTP). The Navy needs to develop alternative treatment and disposal processes for these wastes that are discharged to the marine environment and to the IWTP in order to reduce metal or heavy metal contaminants and to be in compliance with the Clean Water Act (CWA) and Resource Conservation and Recovery Act (RCRA).	High
36	Develop technologies to prevent the transfer of Non-indigenous species between ports from ship ballast water systems.	As Navy ships take on ballast water in different areas, especially in port and near shore, a wide variety of organisms can be taken into ballast tanks. When Navy ships discharge ballast water in another location, these organisms can be introduced into marine environments where they can function as predators, diseases, or other types of nuisances, to the detriment of local native aquatic species and human populations. This is a worldwide problem affecting all commercial and military shipping operations. The Navy must determine the nature and extent of its ballast water problem in terms of non-indigenous species and develop appropriate measures to minimize these problems without jeopardizing Fleet operations or ship safety.	High
37	Develop control technologies to reduce air and water pollutants resulting from fire fighting training exercises	Navy Fire Fighting Training (FFT) facilities simulate submarine compartments, surface ship spaces, and open decks. In the past, this training was conducted at shore based facilities by burning fossil fuels with associated environmental problems. The current FFT facilities use propane fuel in place of fossil fuels and surrogate Aqueous Film Forming Foam (AFFF), which still present unique environmental problems. Operations of these facilities produces large amounts of air and water pollutants and all such facilities will be in violation of provisions of the Clean Air Act and Clean Water Act unless specific waivers are granted. Therefore, the Navy needs to develop control technologies to reduce air and water pollutants resulting from fire fighting training exercises.	High
38	Develop shipboard technologies to treat oily waste to reduce ship-to-shore transfer and shoreside disposal.	The Navy generates about one thousand tons of oily sludges per year from oily waste treatment plants, fuel barges, and lift-stations. Federal and local regulations prohibit the discharge of oily waste from ships and hazardous oily waste generated from shoreside oily waste treatment plants into sewer or local water bodies because of the significant negative environmental impacts. Although some discharges are managed using shipboard equipment, a number of processes require shoreside treatment or control systems, which puts added pressure on Navy shoreside facilities. Therefore, the Navy needs to develop shipboard technologies to treat oily waste to reduce ship-to-shore transfer and shoreside disposal.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
39	Develop technology to prevent, detect, and recover oil spilled in near-shore or open ocean environments.	Numerous Navy oil spills occur annually during refueling and other transfer operations. Oil spills are extremely visible, and, if released into the environment, can cause potentially difficult cleanup as well as generating adverse public reaction towards the Navy community. State and Federal regulations, including the Oil Pollution Act of 1990 (OPA 90), mandate quick and effective action to attempt cleanup and reclamation of petroleum spills with strong penalties levied against noncompliance. There is a need for the Navy to develop new technology to prevent oil spills, provide early warning of accidental discharges, and upgrade oil spill cleanup technology.	High
40	Develop technologies to remediate and decontaminate marine sediment and dredge spoil contaminated with metals, PCBs, PAHs, and VOCs to permit cost-effective Navy harbor maintenance activities.	Contaminated marine sediments threaten ecosystems, marine resources, and human health. Furthermore, contaminated sediments pose a growing fiscal and regulatory burden on the Navy, as the Navy must comply with existing or pending state and Federal Sediment Management Standards as well as stringent sediment disposal regulations. Therefore, the Navy must develop technologies to remediate and decontaminate marine sediment and dredge spoil contaminated with metals.	High
41	Develop a comprehensive noise management and control system to minimize the impact of Navy operations on surrounding communities.	Demographic changes have reduced the amount of sparsely populated land, and increased encroachment around Navy installations and ranges, creating a growing issue regarding aircraft noise. Inadequate methodology or data currently exists to defend range operations or mitigate the noise impacts. To address these issues and to remain in compliance with the National Environmental Policy Act (NEPA), the Navy needs to develop techniques to minimize noise due to aircraft operations, particularly at and near airfields and test ranges where the noise impacts are the greatest.	High
42	Develop alternative aircraft de-icing technologies to minimize the run-off of glycol water mixture from airfields.	Deicing is the removal of snow, frost, and ice from surfaces. Under certain weather conditions, all aircraft need to be deiced. The current process is to deice aircraft using a glycol water mixture, resulting in large amount of fluid runoff. Ethylene glycol is a highly water-soluble chemical that exerts a high biochemical oxygen demand (BOD) on receiving waters and can be harmful to wildlife and humans. Therefore, the Navy needs to develop alternative aircraft deicing technologies to minimize the run-off of glycol water mixture from airfields.	High
43	Develop methods and protocols for conducting marine and terrestrial ecological risk assessments that are crucial in developing cost effective remedial actions and achievable cleanup levels at contaminated sites.	The Navy's daily operations result in contamination of coastal and estuarine areas. Ecological risk assessment is required under CERCLA and is being used by the EPA as a unifying framework for regulating environmental cleanup. Currently, codified ecological risk assessment methodologies are not available and existing guidance is vague and open-ended. Knowledge of the ecological risk of Navy contaminants, including the sources, routes of transport, bioavailability, fate and degradation potential, and effects on the ecosystem are crucial in developing cost effective remedial actions and maintaining a positive public image. Therefore, the Navy needs to develop methods and protocols for conducting marine and terrestrial ecological risk assessments.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
44	Develop technologies for managing properties with threatened/endangered species or archeological/cultural/historical sites to ensure continued access to the sites for training and operations.	Navy operations, particularly on tests ranges, can have negative impacts on T&E species, natural resources, or cultural resources. Conducting surveys and monitoring studies for sensitive habitats and natural and cultural resources is required under Federal, state and local laws and regulations. Therefore, the Navy needs to develop cost-effective, large area survey/inventory technologies for its tests ranges and sustainable training areas for sensitive habitats, natural and cultural resources.	High
45	Develop effective identification, control, and treatment technologies for nonpoint source discharges (NPS) contaminated with metals, POLs, sediments, and nutrients that discharge to water bodies at Navy facilities.	Non-point Source pollution at Navy facilities from road grit, erosion, fertilizers, pesticides, residential runoff and atmospheric deposition can potentially degrade the water quality of receiving waters. Clean Water Act regulations required reductions in nonpoint source pollution and some States require Navy installations to assess their nonpoint source pollution contributions to a water body. Therefore the Navy needs to develop effective identification, control, and treatment technologies for nonpoint source discharges contaminated with metals, POLs, sediments, and nutrients.	High
46	Develop technologies to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	Industrial wastewaters from metal finishing operations are treated at Navy Industrial Waste Treatment Plants (IWTP). IWTPs receive industrial wastewaters from a variety of maintenance and repair operations including cleaning, coating, stripping, and plating of aircraft, ships, vehicles, and weapons systems and components. To maintain fleet readiness, it is necessary to keep IWTPs in full compliance with EPA and local regulations. Therefore, technologies are needed to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	High
47	Develop technologies for detection, remediation and management of metals and inorganics in groundwater.	Military and industrial activities such as landfills, small arms range, sites used for the disposal of metal finishing waste, and the use of leaded gasoline have resulted in the contamination of groundwater with metals and inorganics. Contaminated groundwater can transport these contaminants to streams and aquifers used for drinking water, posing a threat to human health and wildlife. In certain cases elevated levels of heavy metals can be a violation of the Clean Water Act and may be categorized as a reportable release under CERCLA. Therefore, there is a need to develop technologies for the detection, remediation, and management of metals and inorganics in groundwater	High
48	Develop technologies for detection, remediation and management of organics in groundwater.	Past studies revealed that the Navy and Marine Corps had 1021 sites with groundwater contaminated with organics. The problem occurs mostly at Navy coastal sites, where the proximity to marine wetlands or water facilitates the contamination of groundwater. Conventional methods of remediation have proven to be inefficient in producing a clean solution and groundwater contaminated with organics continues to cause concerns due to the harmful effects that some organics and cause to humans and wildlife. The Navy needs to develop technologies for the detection, remediation and management of organics in groundwater.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
49	Develop technologies for detection, remediation and management of organics in sediments.	Numerous Navy facilities located in harbors and estuaries have significant levels of sediment contamination which require assessment prior to developing remedial cleanup strategies. Improper disposal of hazardous wastes, nonpoint source runoff, permit mandated monitoring, and accidental spills can all result in sediment contamination. Contaminated sediments threaten ecosystems, marine resources, and human health. Sediments typically contain mixed contaminant types, such as metals and organics, which requires simultaneous use of different analytical methods. The Navy needs to develop technologies to detect, remediate, and manage organics in sediments.	High
50	Develop technologies for detection, remediation and management of inorganics in sediments.	Numerous Navy facilities located in harbors and estuaries have significant levels of sediment contamination which require assessment prior to developing remedial cleanup strategies. Improper disposal of hazardous wastes, nonpoint source runoff, permit mandated monitoring, and accidental spills can all result in sediment contamination. Contaminated sediments threaten ecosystems, marine resources, and human health. Sediments typically contain mixed contaminant types, such as metals and organics, which requires simultaneous use of different analytical methods. The Navy needs to develop technologies to detect, remediate, and manage organics in sediments.	High
51	Develop technologies for detection, remediation and management of inorganics in soils.	In the past, the Navy had over 1170 installation restoration sites with heavy metals and other contaminants. Effective methods are urgently needed to remove or immobilize metals and other inorganic contaminants from soils at sites such as small arms ranges and IR sites used for the disposal of metal finishing wastes and other items. Contaminated soils can leach inorganic contaminants in to ground and surface waters and potentially contaminate drinking water. The Navy needs to develop technologies for the detection, remediation and management of inorganics in soils.	High
52	Develop technologies for detection, remediation and management of organics in soils.	Many Navy facilities have soils contaminated with organic contaminants due to years of uncontrolled disposal practices. These contaminated soils represent a potential hazard to underlying aquifers and must be remediated prior to any BRAC related transfers to the private sector. The Navy must develop technologies for detection, remediation and management of organics in soils in order to reduce the cost of remediation and the risk to human and wildlife.	High
53	Develop fuel leak detection and prevention technologies for Underground Storage Tanks, Aboveground Storage Tanks, and Pipelines to prevent groundwater and soil contamination.	The Navy owns and maintains some of the world's largest underground storage tanks. Due to the large sizes of these tanks, the current fuel inventory system cannot distinguish tank level changes caused by leaks and level changes caused by temperature fluctuations. In addition, Navy field activities have extensive underground fuel pipelines for bulk fuel and aircraft refueling. Due to high operating pressures and high throughput, large quantities of fuel are released even from small leaks. Therefore, the Navy needs to develop fuel leak detection and prevention technologies for Underground Storage Tanks, Aboveground Storage Tanks, and Pipelines in order to prevent groundwater and soil contamination.	High

APPENDIX D
Navy Requirements (continued)

ID#	Requirement	Description	Priority
54	Develop alternatives to dispose of PCB contaminated equipment during Weapons System demilitarization	Although PCBs are no longer manufactured or used, significant amounts of PCB and PCB / heavy metal contaminated materials are generated during the dismantling of ships. Removal, handling, treatment, and disposal of these materials is regulated under the Toxic Substance Control Act (40 CFR 761) and the Resource Conservation and Recovery Act. PCB contaminated equipment is currently handled through incineration or disposed of in approved landfills, which can lead to negative impacts on the environment in the form of hazardous air pollutants and groundwater contamination. The Navy needs to develop alternatives to dispose of PCB contaminated equipment during weapons system demilitarization.	High
55	Develop alternatives to reduce hazardous waste and material disposal and to relieve associated disposal costs, landfill constraints, and groundwater contamination.	The Navy generates several million gallons of liquid HW, such as used POL, paint, solvents, and energetics and millions of pounds of solid HW each year as a result of depot and intermediate maintenance at Naval Shipyards, Shore Intermediate Maintenance Activities, Naval Aviation Depots, Naval Air Stations, and Naval Weapons Centers. The Navy needs to develop alternatives to reduce hazardous waste and material disposal and to relieve associated disposal costs, landfill constraints, and groundwater contamination.	High
56	Develop sensing and monitoring technologies for detecting toxic air emissions required to under the Clean Air Act.	Monitoring/sensing of toxic air emissions is required to comply with the CAA. Sensor arrays and pattern recognition techniques have been successfully combined to measure vapors in air, but none can be considered universal detectors. The other sensor arrays use only one sensor type, greatly limiting the diversity of the toxic hazard information provided. Improved monitoring and sensing technology is needed to reduce the cost of the analysis requirements under the CAA. Outstanding technical issues which need to be addressed are how to validate results, use of controls, from large area sensors such as FTIR, and how to maximize coverage to minimize costs.	High

APPENDIX E

REQUIREMENTS CATEGORY ASSIGNMENTS BY MISSION FOCUS AREA AND POLLUTANT/STRESSOR

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor

E-1

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Air Force	1	Effective DNAPL Characterization, Monitoring and Detection Technology	Chlor Solv					1										1
Air Force	2	Technology to Remediate TCE DNAPL	Chlor Solv					1										1
Air Force	4	Assessment and mitigation of hazards associated with vapor intrusion of volatilized groundwater contaminants	Air Emissions			1		1										2
Air Force	5	Enhance Implementability of Rapid Site Characterization Primarily through Development of Definitive Field-based Analytical Methods for VOCs, SVOCs, Other Common Contaminant Parameters	Air Emissions					1										1
			Metals					1										1
Air Force	6	Enhance Technology Transfer within the Air Force	All	1														1
Air Force	7	Evaluation of Emerging COCs in Groundwater and Soil at DoD Installations, e.g., Frequency of Occurrence, Spatial Distribution, and Concentrations Respective of Environmental Standards	Emerging Contaminants			1		1			1	1						4
Air Force	8	Improve Understanding of DNAPL Groundwater Transport to Accurately Predict Fate of Contaminants	Organics					1			1	1						3
Air Force	9	Improve/Optimize Remediation and Long-term Monitoring (LTM) Technologies	All			1		1			1	1						4
Air Force	10	Methods and Remedial Techniques are Needed to More Effectively Treat Soil and Groundwater Contaminated with Chlorinated Solvents (e.g., TCE, TCA, and PCE)	Air Emissions					1			1	1						3
Air Force	11	Address the Scientific Basis for Determining the Carcinogenicity of Naphthalene and Other PAHs	Organics			1		1						1	1	1		5

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod	
Air Force	12	Alternative Containment of Chlorinated Organic Compound Contaminant Plumes in Groundwater	Chlor Solv			1		1									2
Air Force	13	Alternative Treatment of Off-Gasses from the Extraction of Chlorinated Solvents in the Subsurface	Air Emissions			1		1									2
Air Force	14	Anthropogenic Background Levels of PAHs and Dioxin-Like Constituents in Shallow Soil at DoD Installations Using Geostatistical Methods and Geographic Information Systems (GIS)	Hazardous Waste			1		1									2
			Organics					1									1
Air Force	15	Ascertain if Any Environmental Data on Perfluorinated Compounds at Operational DoD Sites Exist in Existing Remedial Investigations. Data Mine Existing Lab Chromatograms for Data Before Re-sampling Various Media	Hazardous Waste					1									1
Air Force	16	Background Levels of Selected Metals in Groundwater and Soil, Including Arsenic, Manganese, Lead, Cadmium, Aluminum, Antimony, and Vanadium	Metals			1		1									2
Air Force	17	BTEX in Relation to Health Effects and the Current Vapor Intrusion Model Changes as Compared to Indoor Air Sampling	Organics			1		1									2
Air Force	18	Capability to Characterize and Develop a 3-D Depiction of VOC Smear Zones	Air Emissions	1													1
Air Force	19	Characterize ESOH impacts of DoD's Identified Emerging Contaminants (MERIT)	Emerging Contaminants	1													1
Air Force	20	Cleaning Petroleum-Soaked Absorbent Materials	Air Emissions	1													1

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
			Emerging Contaminants			1		1										2
Air Force	21	Health Effects Studies of Perfluorobromohydrocarbons	Organics					1										1
Air Force	22	Improve Treatment Technologies for IRP Site Remediation of Heavy Metals in Soils, Sediment and Groundwater	Metals					1										1
Air Force	23	Improve/Optimize Destructive/Ex Situ (Pump-and-Treat) Groundwater Treatment Systems	Organics					1										1
Air Force	24	Indoor Vapor Intrusion Differentiation between Volatile Organic Compounds	Air Emissions			1		1			1							3
Air Force	25	Investigate the Health Effects Level of Use and Operational Impacts of Military-specific Use of Nanotechnologies	Emerging Contaminants	1														1
Air Force	26	Method to quantify mass flux of groundwater contaminants	Air Emissions					1										1
			Metals					1									1	
			Mixed waste					1									1	
Air Force	27	Methods Are Needed to Effectively Remove or Destroy Mixed Waste Contaminants (e.g., Metals and Organic Compounds) in Soil and Water	Mixed waste			1		1										2
Air Force	28	New Treatment Technologies for Removing Low-Level Emulsified Oils in Contaminated Wastewater from Point and Non-point Sources	Non-point					1										1
			Organics					1										1
Air Force	29	Stabilization Technologies for Eroding Landfills	Solid waste			1		1										2
Air Force	30	Technologies for treatment of perchlorate	Emerging Contaminants			1		1				1		1	1			5

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod	
Air Force	31	Vapor Intrusion Model for Pier and Beam Crawl Space Construction	Air Emissions			1		1									2
Air Force	32	RPO initiative using diffusion bag samplers to reduce LTM costs	Mixed waste		1			1			1	1					4
			Organics				1										1
Air Force	33	Energy performance based contract concepts for RA-O and LTM	All					1									1
Air Force	34	Asbestos in soil from disposal	Other Inorganics					1									1
Air Force	35	Recycling Machine Designed Specifically for Waste Antifreeze from Building Generator Units	Mixed waste		1	1											2
Air Force	36	Requirement to Evaluate Air Emission Control Technology to Comply with Maximum Achievable Control Technology Requirements of CAA for Engine Test Cells	Air Emissions		1												1
Air Force	37	Examine Health Impacts of Disturbing Asbestos-containing Soils	Air Emissions		1												1
Air Force	38	Reduce hazardous/solid waste at deployed sites (forward operating base)	Hazardous Waste				1										1
			Mixed waste				1										1
			Solid waste				1										
Air Force	39	Develop/enhance Technology to Automatically Measure Rainfall, Storm Water Discharge and to Collect, if applicable, Water-quality Samples to Meet EPA Storm Water Permit Monitoring Requirements	Non-point		1							1					2
Air Force	40	Replacement for Lead-Acid Batteries in Support Equipment	Hazardous Waste		1	1								1	1		4

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Air Force	41	Cost effective method of recovering the aluminum from the road wheels of tracked vehicles due to the bonded rubber surface	Metals		1									1	1			3
Air Force	43	Detect Brown Tree Snakes in Cargo and Craft to Prevent Spread to Other Areas of the Pacific and the Mainland United States	Invasives		1	1					1	1						4
Air Force	45	Evaluate Air Emission Control Technology for Industrial Boilers that will enable compliance with NSPS Subpart Db and the forthcoming NESHAPs for Industrial Boilers	Air Emissions		1													1
Air Force	46	Mitigation of NOx Emissions from Mobile Flight Line Service Equipment, Such as Power Carts	Air Emissions		1													1
Air Force	47	Neutron Radiography Waste Reduction System	Radiation		1													1
Air Force	48	New Technology to Meet CAA Requirements--Critical Source Monitoring Requirements for an Industrial Area Title V Operating Permit—to determine where and how this is needed for state air shed region complex	Air Emissions		1													1
Air Force	49	Substitute for Fibrous Glass Insulation	Solid waste		1													1
Air Force	51	Alternative to Methylene Chloride, Immersion Chemical Stripping Process for Landing Gear, Wheels, and Other Small Components	Air Emissions													1		1
			Hazardous Waste													1		1
Air Force	52	Alternative (Lead-free Solder and/or Nonsoldering Procedures and Materials) for Bonding Electronic Components and Assemblies During Repair	Hazardous Waste													1		1
			Metals													1		1
Air Force	53	Develop environmentally compliant primer with high	Air Emissions			1								1	1	1		4

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total			
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod				
		degree of flexibility for large aircraft, missiles, and ground equipment	Hazardous Waste														1	1	1	3
Air Force	54	Alternative for Nickel Plating and Electroless Plating	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	55	Alternative to chromated Chemical Conversion Coatings for Aluminum and Magnesium Aircraft components	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	56	Develop alternative to IVD Aluminum to replace Cadmium Plating	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	58	Develop alternative(s) to Chromated Chemical Conversion Coatings	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	59	Alternative(s) to Chromic Acid Anodizing of Magnesium and Aluminum Surfaces	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	60	An Alternative to Chrome Plating on Aircraft Components and/or Mitigation and Control Technologies for Chrome Plating.	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	61	Contain Cadmium and Chromium Plating on Jet Engine Compressor Parts (to control pollution during compressor washes)	Air Emissions															1		1
			Hazardous Waste																1	
Air Force	62	Corrosion-protective Coatings for Fasteners Are Needed to Eliminate Heavy Metal HAZMATs	Air Emissions														1	1	1	3
			Hazardous Waste															1	1	1
Air Force	63	Degradation Rates and Products of De-icing Compounds	Organics		1													1		2
Air Force	64	Develop Alternatives to Chromate-containing Paint	Air Emissions														1	1	1	3

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod	
		Primers	Hazardous Waste											1	1	1	3
Air Force	65	Environmental Improvements to Aircraft De-icing Operations	Organics		1										1		2
Air Force	66	Develop for F16 an environmentally compliant protective coating that will include reductions in environmental impacts from preparation, removal, and cleanup methods. (An overarching need encompassing the broad spectrum of paint/paint stripping operations)	Air Emissions												1	1	2
			Hazardous Waste												1	1	2
Air Force	67	Equivalent Replacement for Pre-paint Conversion Coating on Aircraft Structures	Air Emissions											1	1	1	3
			Hazardous Waste												1	1	1
Air Force	68	Lead-free Solder	Metals											1	1	1	3
Air Force	69	MIL-C-81706 Alternative for Alodine Coating	Hazardous Waste											1	1	1	3
Air Force	70	Non-chromated Anodic Coating Stripper	Air Emissions											1	1		2
			Hazardous Waste												1	1	
Air Force	71	Non-chromated Conversion Coating for Aluminum Immersion	Air Emissions											1	1	1	3
			Hazardous Waste												1	1	1
Air Force	72	Non-chromated Conversion Coating for Aluminum Spraying	Air Emissions											1	1	1	3
			Hazardous Waste												1	1	1
Air Force	74	Non-chromated Primers Are Required to Replace Zinc Chromate Primers Currently Used For Corrosion Protection on the Titan IV Launch Vehicle and Associated Ground Equipment	Air Emissions											1	1	1	3
			Hazardous Waste												1	1	1

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Air Force	75	Non-dichromate Coatings for Magnesium	Air Emissions												1	1	1	3
			Hazardous Waste													1	1	1
Air Force	76	Replacement for Cadmium-Chromium plating on aircraft parts	Air Emissions												1	1	1	3
			Hazardous Waste													1	1	1
Air Force	77	Replacement for Chromic Acid Anodize	Air Emissions												1	1	1	3
			Hazardous Waste													1	1	1
Air Force	78	Replacement of Leaded Dry-Film Lubricants used in engine [Assembly and Manufacturing] Applications	Metals														1	1
Air Force	79	Substitution, Mitigation, or Control for Cadmium Plating on High-strength Steels	Air Emissions												1	1	1	3
			Hazardous Waste													1	1	1
Air Force	83	Alternative Paint/Coating System (with no EPA 17 materials and no/low VOC) In Lieu of Current Paint/Coating Systems for ALCM and ACM Cruise Missiles (contains isocyanides & requires MEK)	Air Emissions												1	1	1	3
			Hazardous Waste													1	1	1
Air Force	84	Alternative Repair Technology for Printed Wiring Assemblies which Does Not Require Hazardous Solvents (Trichloroethane, Xylene, Methylene Chloride) to Remove Conformal Coatings	Air Emissions														1	1
			Hazardous Waste															1
Air Force	85	Alternative Thinners for Silicon-based Ablative Systems that Currently Require the Use of CFCs	Air Emissions														1	1
Air Force	86	Alternative(s) for 1,1,1-Trichloroethane and MEK as	Air Emissions														1	1

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total				
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod					
		Pre-coating Wipe Solvents and Inclusion into Tech Data and MIL-SPECS	Hazardous Waste														1		1		
Air Force	87	An Environmentally Acceptable Chemical Is Needed to Clean Liquid Oxygen (LOX), Gaseous Oxygen (GOX) and Liquid Nitrogen (LIN) Components in Aircraft, AGE, Production Plants and Storage Tanks	Air Emissions															1		1	
			Hazardous Waste												1						1
Air Force	88	Beryllium-free Alloys for Bushings and Bearings, Etc.	Metals													1	1	1		3	
Air Force	90	Determine Capabilities and Limitations for Broadest Possible Range of "Blast media" paint stripping Mediums; to give the field the most extensive "suite" of blast media painting stripping choices as possible	Air Emissions															1		1	
Air Force	91	Develop an Alternative Nontoxic Monopropellant for Hydrazine for the F-16 Emergency Power Unit (EPU)	Organics														1	1		2	
Air Force	92	Develop an Environmentally Compliant Test to Detect Dense Particles in Plastic Media	Hazardous Waste													1				1	
			Mixed waste													1					1
			Solid waste													1					
Air Force	93	Development of Fluid System Nonvolatile Residue (NVR) Test Process	Mixed waste															1	1	2	
Air Force	94	Disposal of Nickel-Cadmium (Ni-Cd) Battery and Identification of Replacement for Ni-Cd Battery	Metals														1	1	1	3	
Air Force	95	Environmentally Compliant Paint System alternative for current system (containing isocyanates & requiring MEK) on Cruise Missiles. for ALCM and ACM	Air Emissions															1	1	2	
			Hazardous Waste																1	1	2
Air Force	96	Environmentally Compliant Sealants	Air Emissions																1	1	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
			Hazardous Waste													1		1
Air Force	97	Environmentally Compliant Temporary Coating	Air Emissions													1		1
			Hazardous Waste														1	
Air Force	98	Flow Reduction and VOC Emissions Control for High-Volume/Low-Concentration Sources	Air Emissions													1	1	2
Air Force	99	Heavy Degreaser on Aluminum Surfaces, Carbon Removal, and a Pre-paint and Pre-adhesive Cleaner	Air Emissions													1	1	2
			Hazardous Waste														1	1
Air Force	100	Hydrogen Embrittlement Testing of Cleaners and Strippers on Substrates Other Than Cadmium	Air Emissions													1	1	2
Air Force	101	Improvements to Road De-icing Operations, Focusing on Collection, Treatment, and recycling/disposal.	Hazardous Waste		1													1
Air Force	102	Lightweight Non-Toxic Heat Sinking Material for Use in Aircraft Avionics systems	Hazardous Waste											1	1	1	1	3
Air Force	103	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Solvents Used to Clean Metal Parts	Air Emissions													1	1	2
			Hazardous Waste														1	1
Air Force	104	Methods or Chemical Substitutions to Eliminate or Reduce Volatile Organic Compound Emissions and/or Hazardous Waste Generation from the Application and Use of Lubricants	Air Emissions													1	1	2
			Hazardous Waste														1	1
Air Force	106	Mitigation and Control Technologies to Allow	Air Emissions													1	1	2

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total		
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod			
		Continued Use of Existing (High VOC and AFMC 24 TRI Chemicals) Paints and Primers	Hazardous Waste													1	1	2	
Air Force	107	Need Durable Leading-edge Coating to Eliminate Paint-System Failures in Prone Areas on the Aircraft	Air Emissions													1	1	1	3
			Hazardous Waste													1	1	1	3
Air Force	108	Provide an alternate means of removing and preventing aircraft icing other than using Ethylene/Propylene Glycol	Organics		1											1		2	
Air Force	109	R-22 Refrigerant Replacement and Methods to Modify Environmental Control Units (ECUs)	Air Emissions												1	1	1	3	
Air Force	110	Reclamation or Extension of the Life of Chromic-Phosphoric Acid Anodize Stripping Solutions	Air Emissions													1		1	
			Hazardous Waste													1		1	
Air Force	111	Replace Paints That Contain AFMC-24 TRI Chemicals and Change Technical Data Sheets	Air Emissions												1	1	1	3	
			Hazardous Waste												1	1	1	3	
Air Force	112	Replacement for Chromium Plating for the M61A1 Gun Barrel and/or Design Changes to the M61A1 System that would Extend Gun Barrel Lifetime while Doing Away with Chromium Plating of the Gun Barrel Interior	Air Emissions												1	1	1	3	
			Hazardous Waste												1	1	1	3	
Air Force	113	Replacement for Fuel-Cell Leak-Detection Substance	Mixed waste												1	1	1	3	
Air Force	114	Replacement for PD680 Type II	Air Emissions												1	1	1	3	
			Hazardous Waste												1	1	1	3	
Air Force	115	Replacement of chlorinated cleaners (MEK, Methylene Chloride, TCE) used to clean metal engine components	Air Emissions													1	1	2	
			Hazardous Waste													1	1	2	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod	
Air Force	116	Replacement of AF Environmental Control Unit (ECU) Ozone depleting Refrigerant	Air Emissions											1	1	1	3
Air Force	118	Replacements for Ozone depleting Refrigerant Compounds	Air Emissions											1	1	1	3
Air Force	119	Solvent-free Solid State Metal Cleaning	Air Emissions												1		1
			Hazardous Waste												1		1
Air Force	120	Treatment Technologies at the Source for Wastewater Generated at Fueling Facilities	Air Emissions		1												1
			Emerging Contaminants		1												
Air Force	121	Use of Sodium Formate for the De-icing of Pavements	Hazardous Waste		1												1
Air Force	122	Effective method for subsurface detection of munitions in ponds and other bodies of water	UXO/MC							1	1						2
Air Force	123	Technologies to locate and remove UXO from sediments in ponds and other bodies of water (AFSPC)	UXO/MC							1	1						2
Air Force	124	Fate of Smokes, Ordnance, and Obscurants on Ranges	Air Emissions							1							1
			PEPs							1							1
Air Force	125	Identification and Fate of Ordnance on Ranges	UXO/MC							1	1						2
Air Force	126	Lead Migration Studies at Small Arms Ranges/Skeet Ranges	Metals							1							1
Air Force	127	Reclamation/Recycling/Disposal of Munitions	UXO/MC											1		1	2
Air Force	128	Remediation of Lead at Outdoor Firing Ranges	Metals							1							1
Air Force	129	Technologies to Locate and Identify Unexploded Ordnance (UXO)	UXO/MC							1	1						2
Air Force	130	Low cost, environmentally benign, durable bombing targets	Metals							1							1

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Air Force	131	Feasibility of adding electronic 'tags' to small, difficult to locate, live ordnance for location of dud items (UXO) (ACMs/submunitions, 40mm grenades, 30mm HEI, etc.)	UXO/MC							1							1	2
Air Force	132	Cost efficient and effective method for surface removal of broken target material from large skeet ranges (5-50 Acres) under two different sites conditions - little vegetation and heavy vegetation	Metals							1	1							2
Air Force	133	Cost efficient and effective method for In-situ stabilization of lead shot in soils at skeet ranges and firing ranges	Metals							1	1							2
Air Force	134	Effective method for subsurface detection of munitions which can effectively filter out interference from volcanic rock	UXO/MC							1	1							2
Air Force	135	Technology to Reclaim/Recycle Reactive Weapons Components	UXO/MC											1			1	2
Air Force	136	Identification of components of clay targets on trap/skeet ranges and their fate/transport	Solid waste							1	1							2
Air Force Total				5	19	20	3	35	14	8	7	8	4	61	100	77	361	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total		
				AI	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod			
Army CM-1	3	Sustainable Water Usage	Sustainable Resources			1	1					1	1					4	
Army CM-2	15	Particulate Matter/Dust Control and Measurement for Training and Testing Lands	Air Emissions		1	1												2	
Army CM-3	20	Army Noise Impact Assessment and Control for Training and Testing	Noise		1	1												2	
Army CM-4	26	Facility Air Emissions Control	Air Emissions		1	1						1	1			1	1	6	
Army CM-5	32	Management of Environmental Consequences of the Introduction of Insensitive Munitions Compounds to the DoD Inventory	Hazardous Waste		1	1									1	1	1	5	
			PEPs		1	1									1	1	1	5	
			Sustainable Resources		1	1										1	1	1	5
			UXO/MC		1	1										1	1	1	5
Army CM-6	33	Waste Management Utilizing Waste Characteristics - CONOPS	Hazardous Waste		1	1	1											3	
			Mixed waste				1											1	
			Solid waste				1											1	
			Sustainable Resources				1											1	
Army CM-7	43	Waste Heat CONOPS	Energy		1	1	1											3	
			Sustainable Resources		1	1	1												3
Army CM-8	44	Develop Quick Analysis Sensors for Compounds of Military Interest	Hazardous Waste		1	1	1	1				1	1					6	
			Organics					1				1	1					3	
			Other Inorganics					1				1	1					3	
			PEPs		1	1	1	1				1	1					6	
			Radiation		1	1	1											3	
			Sustainable Resources		1	1	1	1				1	1					6	
			UXO/MC		1	1	1	1				1	1					6	
Army CM-9	42	Sustainable Technologies for Military Facilities and Facility Systems	Energy			1	1				1	1					4		
			Sustainable Resources			1	1										2		

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI	Built Infra-MR	Built Infra-Sust	Deployed Ops	IRP	MM-AR	MM-C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P-Disp	WS&P-Mnt.	WS&P-Prod		
Army CN-1	6	Mitigate Invasive Species Impacts on Army Training	Invasives		1								1					2
Army CN-10	31	Reduce the Effects of Archeological Resources on Training	Cultural Resources		1							1	1					3
Army CN-11	37	Elements of Training-Compatible Vegetation	Sustainable Resources		1								1					2
Army CN-12	38	Arid Lands Utilization and Rehabilitation	Habitat Disturbance		1	1						1	1					4
			Sustainable Resources		1								1					2
Army CN-2	7	Reducing Impacts of Threatened and Endangered (T&E) Species on Military Readiness	Habitat Disturbance		1	1						1	1					4
			Sustainable Resources		1													
Army CN-3	10	Military Operations in the Presence of Species at Risk	Habitat Disturbance		1	1						1	1					4
			Sustainable Resources		1													
Army CN-4	11	Maintaining Readiness by Improving Threatened & Endangered (T&E) Species Monitoring Capabilities	Habitat Disturbance		1	1						1	1					4
			Sustainable Resources		1													
Army CN-5	17	Managing Cumulative Impacts on Installation Lands	Habitat Disturbance									1	1					2
			Sustainable Resources		1							1						
Army CN-6	27	Rehabilitation of Natural Resources (Land Conservation and Protection)	Habitat Disturbance		1							1	1					3
			Sustainable Resources		1									1				
Army CN-7	28	Proactive Encroachment Management to Sustain Military Training and Testing Missions	Habitat Disturbance		1	1						1	1					4
			Sustainable Resources		1	1												
Army CN-8	29	Real-Time Monitoring of Land Use Conditions and Usage	Habitat Disturbance		1	1						1	1				1	5
			Sustainable Resources									1	1				1	
Army CN-9	30	Reconfigurable Design of Training Landscapes	Habitat Disturbance		1	1							1					3

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total		
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod			
			Sustainable Resources		1	1							1					3	
Army ER-1	12	Management and Remediation of Contaminated Groundwater	Chlor Solv					1				1	1					3	
			Hazardous Waste					1				1	1					3	
			Metals					1				1	1						3
			Mixed waste					1				1	1						3
			Non-point					1				1	1						3
			Organics					1				1	1						3
			Other Inorganics					1				1	1						3
			PEPs					1				1	1						3
			Solid waste					1				1	1						3
			Sustainable Resources					1				1	1						3
UXO/MC					1				1	1						3			
Army ER-10	35	Avoidance of Environmental Risk During Contingency Operations	Hazardous Waste				1											1	
			Sustainable Resources				1											1	
Army ER-11	36	Detection, Discrimination, Identification, and Render Safe of Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM)	Sustainable Resources		1					1	1							3	
			UXO/MC		1						1	1						3	
Army ER-12	39	Environmental Decision Analysis Under Uncertainty	Decision/Analysis		1	1		1				1	1					5	
Army ER-13	40	Heavy Metals Management and Remediation for Industrial Activities	Hazardous Waste			1		1										2	
			Metals			1		1										2	
Army ER-2	13	Munitions and Explosives of Concern (MEC) Management Technologies for Operational Range Sustainability	Hazardous Waste						1									1	
			PEPs						1									1	
			Sustainable Resources		1					1								2	
			UXO/MC		1					1								2	
Army ER-3	14	Management of Munitions Constituents (MC) on Live Fire Training and Testing Range	Hazardous Waste						1									1	
			Sustainable Resources		1					1								2	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
			UXO/MC		1					1								2
Army ER-4	16	Environmental Attributes of Emerging Contaminants	Emerging Contaminants	1														1
Army ER-5	18	Management and Remediation of Heavy Metals on Live Fire Training and Test Ranges	Metals		1			1										2
Army ER-6	21	Environmental Restoration During Security, Stability, Transition, and Reconstruction (SSTR) Operations	All				1											1
Army ER-7	22	Risk Assessment and Supporting Contaminant Toxicology	Hazardous Waste		1	1		1			1	1						5
			Mixed waste					1										1
			Organics		1	1		1			1	1						5
			Other Inorganics		1	1		1			1	1						5
			Solid waste					1										1
			Sustainable Resources		1	1		1			1	1						5
Army ER-8	23	Long-Term Monitoring of Regulated Constituents	Hazardous Waste		1	1			1	1	1	1						6
			PEPs		1	1			1	1	1	1					6	
			Sustainable Resources		1	1			1	1	1	1					6	
			UXO/MC		1	1			1	1	1	1					6	
Army ER-9	34	Remediation and Management of Contaminated Sediments	Hazardous Waste					1			1	1					3	
			Non-point					1			1	1				3		
			Sustainable Resources					1			1	1				3		
Army PP-1	1	Sustainable Painting Operations for the Total Army	Air Emissions		1	1					1				1	1	5	
Army PP-10	45	Reduce/Eliminate Pollution for Compliant Manufacture, Testing and Maintenance of Military Clothing and Textile Items	Air Emissions														1	1
			Sustainable Resources			1											1	2
Army PP-11	46	Reduce/Eliminate Pollution for Compliant Composite Manufacturing and Repair	Air Emissions												1	1	2	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total			
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod				
Army PP-2	2	Heavy Metals Reductions in Surface Coating Processes	Hazardous Waste												1	1	1	3		
			Metals													1	1	1	3	
Army PP-3	4	Compliant Ordnance Lifecycle for Readiness of the Transformation and Objective Forces	Hazardous Waste												1	1	1	3		
			Sustainable Resources		1														1	
			UXO/MC													1	1	1	3	
Army PP-4	5	Alternative Products in Cleaning and Degreasing Processes	Air Emissions		1	1						1				1		4		
Army PP-5	8	Zero Footprint Camp CONOPS	Hazardous Waste				1											1		
			Mixed waste				1												1	
			Solid waste				1													1
			Sustainable Resources				1													1
Army PP-6	9	Develop Sustainable Lubricants and Fluids	Hazardous Waste			1	1								1	1	1	5		
			Solid waste			1	1									1	1	1	5	
			Sustainable Resources													1	1	1	3	
Army PP-7	19	Joint Battlespace Use Fuel of the Future	Air Emissions		1													1		
			Energy		1		1												2	
			Sustainable Resources				1													1
Army PP-8	24	Bio-based/Bio-degradable Consumable Commodities	Sustainable Resources												1	1	1	3		
Army PP-9	41	Compliant Electronics for Life Cycle Sustainment of Military Components and Systems	Hazardous Waste			1	1								1	1	1	5		
			Metals			1	1									1	1	1	5	

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Navy	1	Develop alternative refrigerant and cooling systems that eliminate the use of ODS substances in mission-critical air-conditioning and refrigeration (AC&R) systems on aircraft, ships, and submarines.	Air Emissions													1	1	2
Navy	2	Develop alternatives to control, minimize, and manage the generation and disposal discharge of solid waste from ships.	Solid waste													1		1
Navy	3	Develop alternatives to control, minimize, and manage the generation and disposal discharge of hazardous waste from ships.	Hazardous Waste													1		1
Navy	4	Control and minimize the release of residual chlorine that is discharged into harbor waters due to biofouling suppression in shipboard seawater piping systems.	Hazardous Waste													1		1
Navy	5	Control, minimize, and manage liquid wastes discharged overboard from ships in restricted waters during normal operation.	Hazardous Waste													1		1
Navy	6	Develop technologies to locate, identify, track, and measure impact of Navy action on Marine Mammals/Threatened Endangered Species to minimize risk to the animal during Fleet operations and training exercises.	Noise										1					1
Navy	7	Develop alternative engine technologies to reduce nitrogen and sulfur oxides emissions from marine diesel and gas turbine engines.	Air Emissions													1	1	2

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Navy	8	Develop alternative engine technologies to reduce air emissions from aviation engines to allow continued operation and training of Naval aircraft.	Air Emissions													1	1	2
Navy	9	Develop alternative rocket engine emission control technologies to reduce particulate and gaseous air emitted during testing of rocket motors.	Air Emissions		1											1	1	3
Navy	10	Identify and qualify non-ODS and environmental benign fire-fighting agents and systems for ships and aircraft to ensure adequate fire protection capabilities are maintained.	Air Emissions													1	1	2
Navy	11	Develop treatment technologies and processes to remove munitions constituents and energetic materials from wastewaters at Navy ordnance manufacturing, testing, and demilitarization sites.	Munitions Constituents			1		1	1	1								4
			PEPs		1			1										
Navy	12	Develop Ammonium Perchlorate (AP)-Free propellants and treatment technologies for air emissions contaminated with energetic materials resulting from ordnance manufacturing, testing, and demilitarization.	Emerging Contaminants			1											1	2
			PEPs			1												1
Navy	13	Develop alternative ordnance disposal methods to reduce emissions from energetics production and demilitarization	Air Emissions			1									1			2
			PEPs			1									1			
Navy	14	Develop models to define the transport, fate, and effect of contaminants in the marine environment to predict the environmental impact of discharges and spills of hazardous pollutants.	Air Emissions								1	1						2
			Hazardous Waste									1	1					

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Navy	15	Develop detection methods for locating Unexploded Ordnance (UXO) on Land, Underwater, and in Sediments to facilitate the recovery and removal of UXO from Navy ranges.	PEPs					1	1	1							3	
			UXO/MC					1	1	1								3
Navy	16	Develop remediation technologies for soils contaminated with energetic materials at Navy manufacturing sites and ranges.	PEPs					1	1	1							3	
Navy	17	Reduce air, soil, and water contamination by developing technologies to clean up ranges and decontaminate range residue contaminated with energetic material.	PEPs					1	1	1							3	
Navy	18	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on marine mammals.	Noise				1					1				1	3	
Navy	19	Develop noise assessment and mitigation technologies to limit the impact of Military Operations on terrestrial threatened/endangered species.	Noise								1	1				1	3	
Navy	20	Develop objective measures for determining acceptable surface cleanliness in order to establish standards for approving alternatives to chlorinated cleaning solvents used to maintain Navy weapon systems.	Chlor Solv													1	1	
Navy	21	Develop technologies for coating removal and cleaning operations that eliminate VOC, HAP, ODS, and toxic emissions/wastes during aircraft and ship maintenance.	Air Emissions													1	1	
Navy	22	Eliminate hazardous materials (Lead, VOCs, and HAPs) from	Air Emissions													1	1	2

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total		
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod			
		the manufacturing and repair of optical and electronic devices	Hazardous Waste													1	1	2	
Navy	23	Identify and qualify alternative adhesives, sealants, and primers that eliminate the use of hazardous materials and the release of VOCs and ODSs.	Air Emissions													1	1	2	
			Hazardous Waste												1	1	1	3	
Navy	25	Develop low VOC, HAP-free, non-hazardous shipboard and aircraft paint and coating systems to reduce air emissions during application, maintenance, and repair activities	Air Emissions												1	1	1	3	
Navy	26	Develop efficient paint application processes and disposal alternatives to minimize the amount hazardous wastes resulting from painting operations.	Hazardous Waste														1	1	2
Navy	27	Identify and qualify alternative plating materials and processes that eliminate the use of hazardous materials (Cr+6, Cd) and the disposal of hazardous wastes.	Metals													1	1	1	3
Navy	28	Develop replacement machine cutting and grinding fluids that do not contain 1,1,1-TCA and other chlorinated compounds to eliminate the discharge chlorinated compounds to the atmosphere and incur high disposal costs.	Air Emissions														1		1
			Organics																1
Navy	29	Develop alternative welding and cutting materials and procedures to eliminate generation of hazardous wastes and toxic air emissions (heavy metal fume emissions).	Air Emissions													1	1		2
			Hazardous Waste														1	1	
Navy	30	Eliminate hazardous wastes and toxic air emissions from aircraft	Air Emissions													1	1	1	3

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod	
		and ship from manufacturing, maintenance, and repair operations of composite materials.	Hazardous Waste											1	1	1	3
Navy	31	Develop material alternative and recycling techniques for hazardous materials used during operation, maintenance, repair, and cleaning of ship and aircraft onboard vessels to minimize the amount of hazardous waste offloaded to shore facilities for dispos	Air Emissions				1								1		2
			Hazardous Waste				1								1		2
Navy	32	Develop facility hazardous material alternative and recycling techniques to minimize the amount of hazardous waste disposed of by shore facilities.	Hazardous Waste		1												1
Navy	33	Develop coating and cleaning technologies that eliminate/minimize copper and zinc releases to the marine environment from ship antifouling/fouling release coating systems.	Air Emissions												1		1
			Metals												1		1
Navy	34	Develop technologies to control or eliminate particulate and other air emission from tactical mobile and stationary sources.	Air Emissions				1								1	1	3
Navy	35	Develop treatment and disposal process for drydock wastes generated during ship hull cleaning, painting, and cutting operations that are discharged either to the marine environment or IWTP during ship and submarine maintenance operations.	Hazardous Waste		1										1		2
			Metals		1										1		2
Navy	36	Develop technologies to prevent the transfer of Non-indigenous species between ports from ship ballast water systems.	Invasives								1	1			1		3

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total		
				AI	Built Infra-MR	Built Infra-Sust	Deployed Ops	IRP	MM-AR	MM-C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P-Disp	WS&P-Mnt.	WS&P-Prod			
Navy	37	Develop control technologies to reduce air and water pollutants resulting from fire fighting training exercises	Air Emissions		1													1	
			Hazardous Waste		1														1
Navy	38	Develop shipboard technologies to treat oily waste to reduce ship-to-shore transfer and shoreside disposal.	Organics				1										1	1	3
Navy	39	Develop technology to prevent, detect, and recover oil spilled in near-shore or open ocean environments.	Organics		1												1		2
Navy	40	Develop technologies to remediate and decontaminate marine sediment and dredge spoil contaminated with metals, PCBs, PAHs, and VOCs to permit cost-effective Navy harbor maintenance activities.	Metals					1											1
			Organics					1											
Navy	41	Develop a comprehensive noise management and control system to minimize the impact of Navy operations on surrounding communities.	Noise		1							1	1						3
Navy	42	Develop alternative aircraft de-icing technologies to minimize the run-off of glycol water mixture from airfields.	Organics		1												1		2
Navy	43	Develop methods and protocols for conducting marine and terrestrial ecological risk assessments that are crucial in developing cost effective remedial actions and achievable cleanup levels at contaminated sites.	Metals					1											1
			Organics					1											
Navy	44	Develop technologies for managing properties with threatened/endangered species or	Cultural Resources		1							1	1						3

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI	Built Infra-MR	Built Infra-Sust	Deployed Ops	IRP	MM-AR	MM-C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P-Disp	WS&P-Mnt.	WS&P-Prod		
		archeological/cultural/ historical sites to ensure continued access to the sites for training and operations.	Habitat Disturbance		1							1	1					3
Navy	45	Develop effective identification, control, and treatment technologies for nonpoint source discharges (NPS) contaminated with metals, POLs, sediments, and nutrients that discharge to water bodies at Navy facilities.	Non-point		1													1
Navy	46	Develop technologies to reduce and recycle industrial wastewaters and sludge produced during maintenance and repair operations.	Metals		1											1		2
			Organics		1										1			2
Navy	47	Develop technologies for detection, remediation and management of metals and inorganics in groundwater.	Metals					1										1
			Other Inorganics					1										
Navy	48	Develop technologies for detection, remediation and management of organics in groundwater.	Organics					1										1
Navy	49	Develop technologies for detection, remediation and management of organics in sediments.	Organics					1										1
Navy	50	Develop technologies for detection, remediation and management of inorganics in sediments.	Other Inorganics					1										1
Navy	51	Develop technologies for detection, remediation and management of inorganics in soils.	Other Inorganics					1										1
Navy	52	Develop technologies for detection, remediation and management of organics in soils.	Organics					1										1

APPENDIX E
Requirements Category Assignments
by Mission Focus Area and Pollutant/Stressor (continued)

Service	Serv. ID #	Requirement	Pollutant or Stressor	Mission Focus Area													Grand Total	
				AI 1	Built Infra-MR	Built Infra-Sust	Deployed Ops	IR P	MM -AR	MM -C-O	Natural Infra-Base	Natural Infra-Range	WS&P	WS&P -Disp	WS&P -Mnt.	WS&P -Prod		
Navy	53	Develop fuel leak detection and prevention technologies for Underground Storage Tanks, Aboveground Storage Tanks, and Pipelines to prevent groundwater and soil contamination.	Organics		1													1
Navy	54	Develop alternatives to dispose of PCB contaminated equipment during Weapons System demilitarization	Air Emissions											1				1
			Organics											1				1
Navy	55	Develop alternatives to reduce hazardous waste and material disposal and to relieve associated disposal costs, landfill constraints, and groundwater contamination.	Hazardous Waste		1	1												2
			Solid waste		1													
Navy	56	Develop sensing and monitoring technologies for detecting toxic air emissions required to under the Clean Air Act.	Air Emissions		1													1
Navy Total					19	6	5	16	6	5	7	9		11	39	18	141	
Grand Total				6	93	71	35	81	33	19	59	65	4	86	157	116	825	