Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Army											Date: May 2017	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602784A *I Military Engineering Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**Cost To Complete**	**Total Cost**
Total Program Element	-	80.130	67.416	67.720	-	67.720	72.097	73.965	75.781	77.374	-	-
855: *Topographical, Image Intel & Space*	-	15.939	17.621	18.090	-	18.090	18.181	18.564	18.946	19.344	-	-
H71: *Meteorological Research For Battle Command*	-	6.351	6.476	6.628	-	6.628	5.676	5.812	5.950	6.070	-	-
T40: *Mob/Wpns Eff Tech*	-	26.196	28.142	27.955	-	27.955	32.567	33.768	34.556	35.290	-	-
T41: *Mil Facilities Eng Tec*	-	5.732	6.216	6.457	-	6.457	6.506	6.625	6.758	6.899	-	-
T42: *Terrestrial Science Applied Research*	-	5.120	5.152	5.120	-	5.120	5.167	5.277	5.417	5.534	-	-
T45: *Energy Tec Apl Mil Fac*	-	3.292	3.809	3.470	-	3.470	4.000	3.919	4.154	4.237	-	-
T53: *Military Engineering Applied Research (CA)*	-	17.500	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates and advances technologies, techniques, and tools for representation of the physical and human environment for use in military planning and operations; for characterizing geospatial, atmospheric, and weather conditions and impacts on systems and military missions; for conducting mobility, counter-mobility, survivability, and force protection planning and operations; and for enabling secure, sustainable, energy efficient facilities. Research focuses on special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Project 855 conducts geospatial research and development supporting a standard sharable geospatial foundation enabling a common operating environment across mission and command systems. Project H71 supports the materiel development, testing, and operations communities in evaluating the impacts of weather and atmospheric obscurants on military materiel and operations. Project T40 advances force protection technologies across the range of military operations, including expedient protection and hardened construction to defeat complex threats. This Project also designs and evaluates software and hardware to identify and mitigate ground obstacles for manned and unmanned vehicles; characterizes austere navigation environments, including complex urban environments, and designs and evaluates materiel solutions, including rapidly emplace bridging and expedient repair technologies, to allow austere port and airfield entry of forces; and builds and uses modeling and simulation tools to advance understanding of the interactions of weapons/munitions and novel defeat methodologies with buildings, shelters, bunkers, berms, and bridges. Project T41 investigates application of technologies to enable garrison/post commanders to plan, monitor, and operate facilities more efficiently, cost-effectively, securely, and sustainably; creates tools (including advanced models and simulations) that provide a framework for making trades and decisions; and supports research to evaluate non-combat population characteristics and status from social and cultural perspectives to achieve mission objectives. Project T42 develops and validates models and simulations to understand the impacts of the physical environment on the performance of forces, ground and air vehicles, and sensors; as well as the impact of natural and man-made changes in the environment on military operations. Project T45 investigates and evaluates materials, components, and systems that have potential

to reduce energy losses in buildings and shelters; and potential to detect and mitigate consequences of contaminants, such as bacteria and molds, in air handling equipment and building materials.

The cited work is consistent with the Assistant Secretary of Defense, Research Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Research is transitioned to PE 0603734A (Military Engineering Advanced Technology).

Work in this PE is led, managed, or performed by the Army Engineer Research and Development Center, Vicksburg, MS, and the Army Research Laboratory, Aberdeen Proving Ground, MD.

B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	80.909	67.416	70.683	-	70.683
Current President's Budget	80.130	67.416	67.720	-	67.720
Total Adjustments	-0.779	0.000	-2.963	-	-2.963
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.779	-			
• Adjustments to Budget Years	0.000	0.000	-3.250	-	-3.250
• Civ Pay Adjustments	0.000	0.000	0.287	-	0.287

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: T53: *Military Engineering Applied Research (CA)*		
Congressional Add: *Program Increase*	17.500	-
Congressional Add Subtotals for Project: T53	17.500	-
Congressional Add Totals for all Projects	17.500	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) 855 / *Topographical, Image Intel & Space*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
855: *Topographical, Image Intel & Space*	-	15.939	17.621	18.090	-	18.090	18.181	18.564	18.946	19.344	-	-

A. Mission Description and Budget Item Justification

This Project investigates and advances capabilities for collection, processing, and creation of data and information depicting physical and human terrain, environmental conditions, and relationships in time and space; digital map creation, transmission, and dissemination; and map-based analytics for planning, decision making, and execution. This Project uses non-traditional methods that exploit existing open source text, multi-media, and cartographic materials addressing social, cultural, and economic geography to advance the capability to produce and transmit high fidelity digital maps depicting the physical terrain, human terrain, and environmental conditions. This Project also develops software tools and methods for map-based analytics that allow deeper insights into the effects of the physical terrain, human terrain, and environmental conditions on military operations, to include tactics and effects upon equipment and Soldier performance. This Project explores and advances components and methods that optimize the utility of the Army Geospatial Enterprise (AGE) to the total Army, which provides map and geospatial data, information, and software services to the total force.

Work in this Project complements efforts in Program Element (PE) 0602784A, Project H71.

The cited work is consistent with the Assistant Secretary of Defense, Research Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

The work in this Project is performed by the Army Engineer Research and Development Center, Vicksburg, MS.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Terrain Analysis for Signal and Sensor Phenomenology	2.223	-	-
Description: This effort develops means to collect, process, and visualize very high-fidelity data and information to capture the dynamic effects of the physical and human terrain impacting military ground operations. The research focuses on tactical, rather than national or commercial, remote sensing of physical terrain to achieve the fidelity required for current and future operations. Research includes methods for radical, effective sensor systems and materials to 'tag' features, items, and people of interest; these capabilities are based upon novel and emerging light detection and ranging (LiDAR) sensor systems and an array of other sensor systems for intermittent and persistent optimal data collection, object identification, and classification for ground operations. Elements of this effort develop further in GeoIntelligence - Terrestrial Remote Sensing and Data Visualization in Fiscal Year (FY) 2017.			
FY 2016 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Developed initial algorithms to exploit three-dimensional (3D) terrain data using hyper-spectral data sources; analyzed existing algorithms for tactical terrestrial remote sensing capabilities to enhance geospatial 3D data for expanded awareness in the area of interest (AOI).			
Title: Imagery and GeoData Sciences ***Description:*** This effort advances map creation and content through both conventional and non-traditional methods. This research exploits existing open source text, leverages multi-media and cartographic materials, and investigates data collection methods to ingest geospatial data directly from soldiers (i.e., crowd sourcing) to characterize parameters of social, cultural, and economic geography. Results of this research augment existing conventional geospatial datasets by providing the rich context of the human dimension which offers a holistic view of the operational environment for the Warfighters. Elements of this effort develop further in Map-Based Planning Services (MBPS), and Human Geography - Spatial Reasoning, Analysis, and Visualization in FY17. ***FY 2016 Accomplishments:*** Investigated and developed geospatial analysis tools leveraging authoritative Department of Defense (DoD) databases to support military planning; developed methods to efficiently query databases in multiple Computing Environments to produce geospatial overlays depicting elements of sociocultural behavior; conducted research methods allowing Army planners to exploit the Standard, Shareable, Geospatial Foundation (SSGF) data and services to provide a common geospatial framework for commanders and their staff.	4.915	-	-
Title: Geospatial Reasoning ***Description:*** This effort develops and evaluates software analysis tools and methods to provide impact and context of the effects of the physical terrain, human terrain, and environmental conditions on military operations. This analysis examines and models these effects upon unit tactics, equipment, and Soldiers' performance. Elements of this effort develop further in GeoIntelligence - Terrestrial Remote Sensing and Data Visualization, GeoIntelligence – Geospatial Data Generation and Decision Support, and Army Terrestrial Environmental Modeling & Intelligence System (ARTEMIS) in FY17. ***FY 2016 Accomplishments:*** Developed methods to deliver and integrate novel geospatial products using open standards and formats into the AGE. Began research on information fusion to evaluate accuracy and relevance of dynamic terrain information layers that support the military decision making process; initiated methods to leverage and develop open source LiDAR processing capabilities to enhance feature classification and sensor exploitation. Developed stand-off soil moisture assessments and comparisons to further assist	6.014	-	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
real-time mapping of moisture levels, assisting in mobility forecasts. Began research on information fusion to evaluate accuracy and relevance of dynamic terrain information layers that support the military decision making process.			
Title: Geospatial and Temporal Information Structure and Framework ***Description:*** This effort designs and evaluates geospatial data and information architecture to ensure content and representation of data and actionable geospatial information for operational decision making. Research advances here allow for the automatic inference and correlation between events and objects (i.e., people, places) through space and time from massive datasets. Success in meeting these objectives advances the Army's ability to network the force to achieve information dominance. Elements of this effort develop further as GeoIntelligence - Geospatial Data Generation and Decision Support, and Human Geography - Spatial Reasoning, Analysis, and Visualization in FY17. ***FY 2016 Accomplishments:*** Developed data mining algorithms to support discovery of relevant information and patterns contained within large, multi-modal, and multi-scale spatially and temporally referenced datasets; explored new exploitation techniques and algorithms to characterize the urban operational environment and develop geospatial products focused on hazardous terrain identification; enhanced the capability to capture and visualize dynamic spatiotemporal narratives that describe relationships of people, events, and geographic locations through time; developed the capability to characterize the relationship between environment and conflict through systems models that demonstrate the impacts of environmental conditions on stability. Developed algorithms to incorporate sociocultural factors and data for more effective analysis of violent events.	2.787	-	-
Title: GeoIntelligence - Geospatial Data Generation and Decision Support ***Description:*** This effort investigates novel map content generation and geo-temporal analytics for the development of geospatially-based decision support tools. This research focuses on automatic inference and the correlation between events and objects (i.e., people, places) through space and time from massive data sets developed in the Geospatial and Temporal Information Structure and Framework effort. In addition, the effort investigates advanced models to forecast effects of the physical terrain, human terrain, and environment for applications to the Military Decision Making Process, an analysis that informs course of action development and evaluation of tactics, equipment, and mission risk. This item continues efforts from Geospatial Reasoning, and Geospatial and Temporal Information Structure and Framework. ***FY 2017 Plans:*** Will complete development of a new algorithm suite to enable rapid processing and searching of high volume multi-modal spatiotemporal datasets for revealing and illuminating relevant embedded relationships, spatiotemporal threads, and discoverable meaningful patterns associated with human geography (e.g., actors, places, events, and time); research new terrain analytics and tactical decision aids supporting Warfighter tactical operations in 3D dense urban terrain environments by providing hazard	-	4.940	2.489

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
identification and mitigation, remote feature classification, and 3D terrain analysis techniques; and develop rapid tools for characterization of hazardous urban terrain effects, the detection and identification of urban and peri-urban feature classes using remotely sensed data, and input layers for geospatial analytics enabling multi-source, urban-relevant data enterprise integration. ***FY 2018 Plans:*** Will investigate advanced analytical and streaming methods for geo-registering and provisioning critical infrastructure symbology to system displays supporting mounted and dismounted Warfighter situation awareness.			
Title: GeoIntelligence - Terrestrial Remote Sensing and Data Visualization ***Description:*** This effort develops means to collect, process, and visualize very high-fidelity data and information to capture the dynamic effects of the physical and human terrain impacting military ground operations. The research focuses on tactical, rather than national or commercial, remote sensing of physical terrain to achieve the fidelity required for current and future operations. Research includes investigating new methods for effective sensor systems and materials to 'tag' features, items, and people of interest based upon novel and emerging LiDAR sensor systems, innovative LiDAR collection and analysis techniques, and an array of other sensor systems for intermittent and persistent optimal data collection, object identification, and classification for ground operations. This item continues efforts from Terrain Analysis for Signal and Sensor Phenomenology, and Geospatial Reasoning. ***FY 2017 Plans:*** Will conduct research on terrain feature extraction important to mission planning to provide the terrain and image analyst access to surface roughness, vegetation density, characterization of built-up areas, and near ground obstacles; investigate laser detection and ranging (LADAR) sensors for base force protection through physical mounting integration, mast stabilization optimization, and software techniques enabling anomaly detection, change assessment, and sensor cueing capabilities. ***FY 2018 Plans:*** Will investigate new capabilities to characterize and extract (identify and map) features of interest under forest canopies such as encampments, small buildings, trails, etc. at high fidelity; develop algorithms and workflows to generate critical and accurate mapping data for units at the tactical level; and integrate frequency-modulated, continuous wave (FMCW) laser scanner into base security and defense sensor suite for 3D terrain rendition and persistent surveillance and target identification.	-	4.462	4.991
Title: Human Geography - Spatial Reasoning, Analysis, and Visualization ***Description:*** This effort investigates integration of behavior and population dynamics research and analysis into geospatial frameworks to depict the operational environment including culture, demographics, terrain, climate, and infrastructure. Research exploits existing open source text, leverages multi-media and cartographic materials, and investigates data collection methods to ingest geospatial data directly from the tactical edge to characterize parameters of social, cultural, and economic geography.	-	2.007	4.013

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Results of this research augment existing conventional geospatial datasets by providing the rich context of the human aspects of the operational environment, which offers a holistic understanding of the operational environment for the Warfighter. This item continues efforts from Imagery and GeoData Sciences, and Geospatial and Temporal Information Structure and Framework and complements the work in PE 0602784A/Project T41. ***FY 2017 Plans:*** Will research and design a framework to investigate the impacts of environmental stressors (e.g. water security) on populations and military operations. ***FY 2018 Plans:*** Will investigate means for a repeatable methodology to incorporate social-cultural influences (e.g., civil considerations) into the military decision making process by identifying the critical conduits through which actors exercise power; and research existing authoritative data sources and potential new sources for factoring environmental and climate-related risks into long range military planning scenarios supporting theater engagement plans.			
Title: Weather and Terrain Integration ***Description:*** This effort investigates innovative methods for integrating weather and physical terrain applications with geospatial systems compliant with the Army's Common Operating Environment approach to the Army Geospatial Enterprise thereby providing significant advancement to fused all-weather and all-season tactical decision aids supporting risk-based assessments. This item continues efforts from Geospatial Reasoning. ***FY 2017 Plans:*** Will complete uncertainty and sensitivity analysis of stand-off soil moisture assessments and comparisons to further mature real-time mapping of moisture levels and develop improved tactical mobility forecasts; and investigate new visibility algorithms based on dust, aerosol, and humidity fields for line of sight representation in a Situationally Aware Geospatially Enabled (SAGE) terrain analysis decision aid. ***FY 2018 Plans:*** Will investigate a risk-based, geospatially grounded decision support tool using multi-criteria decision analysis to facilitate a modeling environment that enables risk-informed mission decisions based on criteria including time available, physical distance, terrain or infrastructure requirement, and acceptable mission risk; and provide analytical tools that seamlessly integrate changes in the physical battlespace in near-real time with terrain based tactical decision aids, such as mounted and dismounted mobility, line of sight, and potential choke points.	-	2.455	2.599
Title: Map-Based Planning Services (MBPS)	-	3.757	3.998

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: This effort develops geospatially-enabled, collaborative mission planning capabilities providing services, data, and information to Army planners, staffs, and leaders. These mission planning capabilities will allow collecting, processing, storing, displaying, and sharing of authoritative data and information in a geo-temporal context. Work will leverage Army Geospatial Enterprise standard data sets and incorporate Geo-Enabled Mission Command tools and analytical capabilities. This item continues efforts from Imagery and GeoData Sciences. Resultant work products proceed into Program Element 0603734A, Project T08. ***FY 2017 Plans:*** Will develop approaches to enable Army planners at multiple echelons and at distributed locations to exploit a common geospatial framework within the planner enclave for concurrent planning; and investigate migration of planners' tools and services to a web-based capability ***FY 2018 Plans:*** Will develop a geospatially enabled collaborative mission planning environment that provides services, authoritative data access, and information to distributed Army planners, staffs, and leaders, to enable the collection, processing, storing, displaying, and sharing of authoritative data/information in a geo-temporal context; and investigate adaptation of existing and developed intelligence preparation of the battlefield and military decision making process capabilities into the digital planning process.			
Accomplishments/Planned Programs Subtotals	15.939	17.621	18.090

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) H71 / *Meteorological Research For Battle Command*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
H71: *Meteorological Research For Battle Command*	-	6.351	6.476	6.628	-	6.628	5.676	5.812	5.950	6.070	-	-

A. Mission Description and Budget Item Justification

This Project develops tactical weather and atmospheric effects/impacts algorithms for their integration into battlefield information products. Efforts include high-resolution, local assessments and forecasts of meteorological conditions in near real time including effects of urban and mountainous terrain; analytical tools to assess the impact of the atmosphere to optimize system performance and operations planning and advanced atmospheric sensing applications to characterize and mitigate wind and turbulence in complex terrain. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. This Project develops both physics-based decision aids and rule-based decision support systems for assessing the impacts of weather/ atmosphere across a spectrum of friendly and threat weapons systems, sensors, platforms, and operations. Information can be applied to mission planning and execution, battlefield visualization, reconnaissance surveillance and target acquisition, route planning to maximize stealth and efficiency, web enabled tactical decision aids, and also modeling of environmental impacts for combat simulations and war games.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

This work transitions technologies to the Department of Defense weather and operations modeling community, the US Air Force 557th Weather Wing to improve their operational weather support to the Army Project Leader-Fire Support Command and Control and Marine Corps Systems Command (MCSC) for field artillery systems, the Project Manager, Distributed Common Ground System-Army (DCGS-A), the Joint Improvised Threat Defeat Agency, the Program Executive Office Aviation/Tactical Airspace Integration System (TAIS).

Work in this Project is performed by the Army Research Laboratory located at Adelphi, MD and White Sands Missile Range, NM.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Atmospheric Characterization, Modeling, and Impacts (formerly Atmospheric Modeling)	2.443	5.126	5.622
Description: This effort develops high resolution, short-range forecasting, and high resolution atmospheric modeling capabilities for mountainous, urban, and forest complex terrain. ***FY 2016 Accomplishments:*** Completed “Weather Running Estimate-Nowcast” (WRE-N) tool accuracy assessments with applications to Army aviation, artillery, and dismounted operations; evaluated potential improvements to artillery firings by implementing three-dimensional forecast datasets into targeting solutions; developed a method in WRE-N that combines four-dimensional data assimilation and variational data assimilation methods to ingest remotely sensed indirect weather observations such as radar / light detection and			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** H71 / *Meteorological Research For Battle Command*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
ranging (LiDAR), global positional system (GPS) techniques, and satellite imagery or radiances; extended WRE-N's grid spacing resolution to hundreds of meters; and developed a method to assimilate Doppler wind LiDAR data into the microscale model for more accurate predictions of wind fields in the atmospheric boundary layer over complex terrain. ***FY 2017 Plans:*** Will refine and mature Meteorological Sensor Array (MSA) computer applications that provide non-standard sensing capabilities for the atmospheric boundary layer, including novel employment of weather sensing small unmanned aircraft systems (UAS) vehicles; develop MSA systems at multiple sites to study atmospheric characteristics in different microclimate/terrain regimes; conduct research to quantify climate and weather impacts on the design and deployment of renewable energy systems that are operationally relevant to the Army; conduct research, analysis, and software development to quantify the effects of weather on systems and operations; complete initial studies addressing integration of probabilistic and uncertainty forecasts into decision support tools (DSTs); fully-integrate various sources of observational data into the forecast model assessment processes, utilizing Geographic Information System-based and other advanced assessment techniques; fully evaluate the benefits of assimilated Doppler wind LIDAR data into microscale models to improve predictions of winds in the atmospheric boundary layer over complex terrain; conduct initial capability studies addressing high-resolution atmospheric model performance as related to sensor performance; conduct applied research to better characterize the impact of airborne aerosols on electro-optical propagation; apply appropriate techniques to the mitigation of atmospheric turbulence on the propagation of electro-optical signals; and improve the performance of DSTs for acoustics propagation and characterizing the state of the atmosphere. ***FY 2018 Plans:*** Will fully adapt a hybrid assimilation methodology by which meteorological data types representative of battlefield conditions may be ingested into numerical weather prediction models for enhanced forecast accuracy; demonstrate the efficacy of Geographic Information System (GIS) analytical techniques for forecast model accuracy assessments; apply intuitive, qualitative indicators of forecast confidence to meteorological data output and weather impacts displays; establish quantified performance criteria for an optical imaging system that mitigates image degradation due to atmospheric optical turbulence; enhance capabilities of route optimization tactical decision aid to minimize aircraft acoustic signatures and to account for soil type and terrain steepness affecting ground vehicle mobility and maneuver; and, implement parallel processing architectures in Personal Electronic Devices (PEDs) to allow mobile execution of weather forecast models; develop initial forward-deployed capability to integrate atmospheric prediction/weather decision aid applications into unified environmental awareness system supporting robotics and autonomous systems; and refine atmospheric acoustic signal propagation models with data collected at the MSA..			
Title: Atmospheric Diagnostics ***Description:*** This effort develops diagnostic technologies and methods to improve the acquisition of environmental data such as temperature, humidity, wind speed and direction for use in decision aids that enhance and protect autonomous and semi-	2.014	-	-

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** H71 / *Meteorological Research For Battle Command*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
autonomous systems. Work in this task is consolidated under Task 02, Atmospheric Characterization, Modeling, and Impacts, beginning in Fiscal Year (FY) 17. ***FY 2016 Accomplishments:*** Designed and developed MSA components that provide, non-standard sensing capabilities for the atmospheric boundary layer; investigated developing an array at an alternate site in order to study atmospheric characteristics in different climatic/ terrain regimes; and developed automated approaches to quality control, archiving, and ingest to microscale meteorological and turbulence models of MSA array data.			
Title: Local Area Atmospheric Prediction for Geospatial Applications (formerly Atmospheric Prediction for Local Areas) ***Description:*** This effort designs and evaluates software models and sensors to improve local characterization and prediction of atmospheric conditions in urban and complex terrain by directly integrating atmospheric boundary layer (the lowest part of the atmosphere in contact with the surface) meteorological measurements into high resolution models and decision aids and validates these improvements with field measurements. ***FY 2016 Accomplishments:*** Prepared the Atmospheric Boundary Layer Environments (ABLE) microscale model for transition into the DCGS-A architecture; researched and developed an initial capability to ingest and depict probabilistic forecast data into DCGS-A weather impacts DSTs; and matured automated algorithms and methods for the microscale model initial and boundary conditions using data from WRE-N mesoscale model results. The microscale and WRE-N nowcasting model results (rapidly updated local short-term predictions) were integrated with weather decision support tools for mission planning and execution ***FY 2017 Plans:*** Will conduct very fine-scale nowcast modeling research using the Weather Research and Forecasting (WRF) model, the WRF coupled with atmospheric chemistry (WRF-Chem) model, and other appropriate models to address dust lofting and model coupling to terrain/trafficability models; complete model resolution tests of acoustic sensor performance to determine optimized model configurations and resolutions for operational use; configure and complete acoustic sensor/atmospheric modeling field experiments to validate the model resolution conclusions; and design and complete sub-kilometer atmospheric modeling studies linking land surface models with WRF to improve soil strength and terrain trafficability models. ***FY 2018 Plans:*** Will conduct acoustic sensor/atmospheric modeling field experiments to validate model resolution results; assess validity of foundation model for use in elevated dust events; and deliver sub-kilometer model configuration options to effectively link coupled land-surface and atmospheric models for improved vehicle trafficability and routing models.	1.894	1.350	1.006
Accomplishments/Planned Programs Subtotals	6.351	6.476	6.628

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** H71 / *Meteorological Research For Battle Command*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T40 / *Mob/Wpns Eff Tech*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
T40: *Mob/Wpns Eff Tech*	-	26.196	28.142	27.955	-	27.955	32.567	33.768	34.556	35.290	-	-

A. Mission Description and Budget Item Justification

This Project investigates, evaluates, and develops technologies for adaptive and expedient force protection across the range of military operations. Focus areas include force projection and maneuver, including austere port and airfield entry; prediction, definition, avoidance, or defeat of natural and manmade gaps and obstacles; scalable weapons effects; and high-resolution representation of near-surface terrain and environment for use with sensor models for target detection and unmanned ground systems (UGS) navigation. This research also provides physics-based representations of ground vehicle mobility, obstacle and barrier placement, survivability, and weapons effects in complex and urban terrain modeling and simulation. Work in this Project increases the survivability of critical assets from conventional, unconventional, and emerging threats and enables maneuver support of deployed forces, while reducing their logistical footprint. This Project supports efforts for overcoming critical capability gaps for protecting troops operating in a number of environments, including smaller bases that are remote or integrated with local communities, and dismounted Soldiers conducting missions in urban environments.

Work in this Project supports the Army Science and Technology Ground Maneuver, Command, Control, Communications, and Intelligence (C3I), Innovation Enablers, and Soldier Portfolios.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

This work is fully coordinated with and complementary to Program Element (PE) 0603734A (Military Engineering Advanced Technology). Autonomous ground resupply activities are coordinated in collaboration with the Tank and Automotive Research, Development and Engineering Center (TARDEC) through PE 0603005A (Combat Vehicle and Automotive Advanced Tech) / Project 515 (Robotic Ground Systems), PE 0602601A (Combat Vehicle and Automotive Technology) / Project H77 (National Automotive Center), and PE 0602601A / Project H91 (Ground Vehicle Technology). Autonomous ground resupply activities are also coordinated in collaboration with the Armament Research Development and Engineering Center (ARDEC) through PEs 0603001A (Warfighter Advanced Technology) / Project 543 (Ammunition Logistics), PE 0603639A (Weapons and Munitions - Advanced Development) / EC3 (Ammunition Logistics Prototyping), and 0605805A (Munitions Standardization, Effectiveness and Safety) / Project 297 (Mun Survivability & Log).

Work in this Project is performed by the Army Engineer Research and Development Center, Vicksburg, MS.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Adaptive Protection	10.395	11.173	10.988
Description: This effort develops new analytical techniques, advanced materials, and integrated protection systems to support the protection of critical assets on the battlefield. Technology development efforts include techniques and materials to protect			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
small bases and soldiers in complex and urban environments; techniques to protect, conceal, or deter against advanced threats including missiles; and techniques to identify tunnels and subterranean activities. ***FY 2016 Accomplishments:*** Developed rapidly emplaced force protection technologies and survivability and planning tools to decrease required Soldiers needed for construction of Combat Outpost or Patrol Base (COP/PB). Developed force protection technologies to mitigate lethality of advanced threats in order to increase survivability of personnel, critical assets, and fixed facilities. Developed and improved modeling and simulation (M&S) capabilities to rapidly and comprehensively model the blast from a wide range of recent and emerging non-ideal homemade explosives (HME) in a variety of soil types and conditions. ***FY 2017 Plans:*** Will conduct experiments to determine the blast and penetration performance of cast-in-place protective structural components made with indigenous materials. Will develop geophysical linear sensor systems in support of tactical security systems. Will increase and refine blast prediction M&S capabilities of HMEs and expand soil and condition databases. Will develop technologies to detect tunnels and subterranean activities for protection of forces and critical assets. ***FY 2018 Plans:*** Will develop M&S tools to predict structural response/damage to support regional tradespace analysis; develop and improve the adaptive capabilities to rapidly and comprehensively model the blast from a wide-range of recent and emerging non-ideal HMEs in a variety of soil types and conditions; develop materials and advanced force protection decision support tools for use in complex and dense urban environments; develop advanced integrated camouflage, concealment, and deception (CCD) methods and materials to protect against advanced threat; and develop technologies to more accurately detect tunnels for protection of small distributed units.			
Title: Austere Entry and Maneuver ***Description:*** This effort investigates, designs, and creates tools and technologies that identify, assess, and monitor structural and functional suitability of theater access points and infrastructure, allow planning of tactical logistics resupply networks that enable planners to develop and compare courses of action, and simulate manned/unmanned tactical maneuver and mobility of small units in complex and urban terrains. This effort is coordinated with Program Element 0603005A. ***FY 2016 Accomplishments:*** Developed computational test bed applications to simulate the influence of dynamic environmental effects created by vehicles and humans on sensor-based perception. Completed modeling of dismounted operations and continued to develop the distribution management tool and provide systems integration to simulate the entire logistics distribution network. Completed development of	12.607	12.766	11.956

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
the capability to numerically simulate infrasonic sources for regional assessment of infrastructures. Refined sensor evaluation of airports and seaports of debarkation and reduced order modeling for austere entry assessment. ***FY 2017 Plans:*** Will continue development of dynamic environmental vehicle simulation tools to support autonomous ground resupply operations. Will complete development of a planning tool for comparing early entry alternative courses of action for a logistics distribution network. Will continue refinement of remote and standoff assessment techniques for airports and seaports of debarkation for austere entry assessment. Will begin an effort to predict vehicle movement in complex and urban environments. ***FY 2018 Plans:*** Will complete development of technologies for planning and conducting Anti-Access/Area Denial (A2/AD) entry operations without airfields/ports and with damaged/destroyed airfields/ports; develop a fused multi-component imagery and infrasound data method for persistent critical infrastructure modeling in dynamic environments; and develop baseline model and simulation tools for autonomous ground resupply operations and will continue development of mobility decision support tools.			
Title: Environmental Impacts on Sensor Performance ***Description:*** This effort investigates, designs, and creates physics-based, multiscale numerical models of the geo-environment and synthetic environments representing geo-environment impacts on various sensor modalities and systems. These enable the development of sensors and sensor algorithms for object or target detection, sensor-target pairing, and autonomous navigation and tactical behaviors in unmanned ground systems. This effort further investigates the design of non-line-of-sight sensors for remote areas, including the investigation of coupling between sensors and their environment for understanding surface and subsurface activities. This effort supports persistent surveillance and detection capabilities. ***FY 2016 Accomplishments:*** Developed high performance computing (HPC)-enabled models that simulate the geo-environmental impact on performance of multi-modal imaging sensor combinations for threat scenarios. Developed three-dimensional, integrated surface evaporation/condensation algorithms for ground and vegetated surfaces and validate with ground truth characterization of the hydrodynamic and thermal processes in dense rainforest environments. ***FY 2017 Plans:*** Will integrate HPC-enabled models with Night Vision and Electronic Sensors Directorate's hyperspectral sensors to simulate the geo-environmental impact on performance of multi-modal imaging sensor combinations for threat scenarios. Will continue development of advanced analytic tools to determine detection performance of multi-modal and spectral sensor combinations. ***FY 2018 Plans:***	1.976	2.965	3.745

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will complete development of HPC-enabled models and advanced analytic tools combined in a simulation workflow manager; and investigate fusion of multi-sensor performance predictions and use of a tradespace framework to compare performance, cost, and availability for specific geo-environmental settings.			
Title: Materials Modeling ***Description:*** This effort investigates and leverages physics-based computational models and laboratory experiments to understand the relationships between the chemical and micro-structural composition of materials and their performance characteristics when used in protecting facilities. ***FY 2016 Accomplishments:*** Enhanced materials by design of cementitious and polymer composite protective materials through the continued development and validation of multi-scale predictive design tools; developed methods to control bonds between reinforcement and cementitious matrices at multiple scales to optimize composite performance; integrated novel processing and additive manufacturing methodologies into material system design and fabrication methods to support the maturation of advanced protective solutions. ***FY 2017 Plans:*** Will continue to develop and validate multi-scale high performance protective materials, predictive design tools, and material models; will continue to develop methods to predict constituent material properties of cementitious and polymeric materials at multiple scales to optimize performance; will continue to integrate novel processing and additive manufacturing methodologies into material system design and fabrication methods to support the maturation of advanced protective solutions; these efforts support the development of the next generation of high performance materials for force and critical asset protection against advanced threats. ***FY 2018 Plans:*** Will develop and validate advanced protective material solutions including novel composites, lightweight metals, ceramics, coatings, polymers, and other non-cementitious materials; continue virtual material by design development and advanced mico- and meso-scale simulations to predict engineering properties in the resultant macro-scale materials; and investigate material fabrication and manufacturing methods for layered protective systems.	1.218	1.238	1.266
Accomplishments/Planned Programs Subtotals	26.196	28.142	27.955

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T41 / *Mil Facilities Eng Tec*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
T41: *Mil Facilities Eng Tec*	-	5.732	6.216	6.457	-	6.457	6.506	6.625	6.758	6.899	-	-

A. Mission Description and Budget Item Justification

This Project investigates and evaluates technologies and techniques to ensure sustainable, cost efficient, and effective facilities, and to achieve resilient and sustainable installation and base operations. The project focuses on facilities and operations technologies directly supporting training, readiness, force projection, force protection, homeland security, and forward base operations. Facility enhancement technologies contribute to cost reductions in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. This work improves the ability of installations to support forces to meet transformation goals, improves designs for close battle training facilities, and enhances security of Soldiers, families, and civilians. Technologies evolving from this work include integrated planning and design tools for United States (U.S.) facilities and forward bases, models predicting water dispersed contaminant effects on facilities and occupants; sustainable facility and base management; collaborative decision support tools; and advanced materials. In addition, technologies from this work will support analysis of socio-cultural and facility issues in forward base operations, including urban environments.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the Army Engineer Research and Development Center, Vicksburg, MS.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Adaptive and Resilient Installations	3.062	3.620	3.806
Description: This effort develops technologies and techniques to enable sustainable, cost efficient, and effective facilities; and provides technologies and techniques for achieving resilient and sustainable installation and base operations.			
FY 2016 Accomplishments: Researched the necessary mixture design and admixtures requisite to allow additive construction using cementitious materials across the broadest possible locations and operating environments. Determined the correct formulations to adapt locally available cementitious materials to required rheology, curing time, and strength for automated additive construction of expeditionary structures. Determined the serviceability of other native materials (such as soils, clay, and sand mixtures like adobe) for use as extrudable building materials.			
FY 2017 Plans: Will develop a suite of physics-based models and simulations to perform structural, energy, and protection analysis of digital designs used for automated construction of expeditionary structures. Will conduct simulations to generate tradespace analyses			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T41 / *Mil Facilities Eng Tec*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
for prototype model development. Will develop a prototype tool to assess the impact of physical, ecological, and sociocultural environments relative to contingency base site selection, design, operations, and maintenance to support operational planning. ***FY 2018 Plans:*** Will investigate potential impacts to contingency basing operational effectiveness due to location, duration, size (area and population), effects on sociocultural context, and changes in mission; and investigate and design a systematic approach to identify and model current and future permafrost and ground ice impacts on built infrastructure, operational training, and deployment design considerations in arctic and sub-arctic environments.			
Title: Human Geography – Fundamentals of Behavior and Population Dynamics (Previously titled Social/Cultural Behavior) ***Description:*** This effort researches population dynamics including physical, cultural, psychological, and behavioral attributes critical to U.S. Army engagement activities in an area of operations, including urban environments. Technology development efforts include means to identify dynamic indicators in the socio-cultural realm to assist in estimating or predicting behavioral response to operations and to display indicators in spatial-temporal views for the Warfighter. This effort complements the work in Program Element 0602784A (Military Engineering Technology) / Project 855 (Topographical, Image Intel & Space). ***FY 2016 Accomplishments:*** Investigated capability to integrate existing information about population and knowledge of the theater environment into urban condition monitoring capabilities and drive assessment of strengths and deficiencies of host-nation areas; developed methods to produce composite geospatial products from multiple human and environmental data inputs and semi-automated analytic tools; investigated approaches to display socio-cultural data markers in spatial-temporal views for the Warfighter to incorporate into Military Decision Making Process (MDMP) and Troop Leading Procedures (TLP) products. ***FY 2017 Plans:*** Will investigate and design a framework for integrating social-cultural dynamics (human aspects of the operational environment) encountered in dense urban environments into mission planning and execution.. ***FY 2018 Plans:*** Will investigate methods for military assessment of population vulnerability and resilience disruptors as a result of combat, disasters, disease, etc., within dense urban and complex environments; and research computational models to support a federated model approach for complex urban systems; and develop methodologies to support the military decision making process addressing the impacts of the physical, ecological, and sociocultural environments relative to contingency base site selection, design, operations and maintenance.	2.670	2.596	2.651
Accomplishments/Planned Programs Subtotals	5.732	6.216	6.457

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T41 / *Mil Facilities Eng Tec*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T42 / *Terrestrial Science Applied Research*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
T42: *Terrestrial Science Applied Research*	-	5.120	5.152	5.120	-	5.120	5.167	5.277	5.417	5.534	-	-

A. Mission Description and Budget Item Justification

This Project investigates and advances technologies to characterize and respond to impacts of the terrestrial environment on the performance of emerging and deployed Army systems, as well as the impact of natural and man-made changes in the environment on all phases of unified land operations. Research efforts model the dynamics of electromagnetic, acoustic, and seismic propagation in response to changing terrain state and complex terrain features and geometry, and their depiction in geospatial information and mission command systems. Numerical modeling of weather effects on terrain properties supports intelligence preparation of the battlefield products, including mobility estimates and intelligence, surveillance, and reconnaissance planning. This effort integrates terrain knowledge and weather forecast in a mission context to provide geospatial information and mission command-delivered solutions to the Soldier. The understanding gained and products developed improve the ability to predict signature (emitter) behavior and sensor performance in complex operational environments, and support materiel development, sensor performance products for tactical decision-making, and visualization for mission command.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the Army Engineer Research and Development Center, Vicksburg, MS.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Analysis for Signal & Signature Phenomenology	1.646	-	-
Description: This effort investigates the dynamics of electromagnetic, acoustic, and seismic signatures in response to changing terrain state and complex terrain features and geometry. Research results improve sensor employment tactics, techniques, and procedures, and numerical modeling of terrain properties for tactical advantage and geospatial tactical decision aids. This work continues as GeoIntelligence - Terrestrial Phenomenology Characterization for Geospatial Applications. ***FY 2016 Accomplishments:*** Investigated methods and advanced tools for storing, indexing, and managing raw light detection and ranging (LiDAR) sensor data in a geospatial database enabling immediate remote processing and exploitation for tactical terrain analysis; developed techniques for fusing disparate data sources and types (e.g. point clouds and imagery) by retaining all critical collection attributes, thus providing significant military utility of terrain information and features for high fidelity mission planning and execution.			
Title: Army Terrestrial Environmental Modeling & Intelligence System (ARTEMIS)	3.474	3.500	3.619

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T42 / *Terrestrial Science Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Description: This effort integrates terrain knowledge and the dynamic effects of weather and mission to provide geospatial reasoning solutions to the Soldier. The understanding gained and products developed improve the ability to predict signature behavior and sensor performance in complex operational environments, improve sensor performance products for tactical decision-making, and improve visualization for mission command. ***FY 2016 Accomplishments:*** Initiated development of digital product layers that reflect land-atmosphere impacts on mobility, austere entry, and sensor performance and research risk-based analysis of terrestrial processes on military operations. Initiated evaluation of acoustic, seismic, and radiofrequency (RF) modeling complexities in complex urban and terrain environments where signals are impacted by scattering objects. Conducted research of time-sensitive activity within the soil as shaped by dynamic soil descriptors to support enhanced predictive analysis of soil-weather-terrain governed maneuver and sensor constraints. Investigated remote and automated analysis methods for identifying and locating areas suitable for aircraft landing or drop zones. ***FY 2017 Plans:*** Will complete development of remote assessment of landing zones and drop zones capability for Intelligence Preparation of the Battlefield products; integrate and validate the utility of high resolution weather data in signal propagation prediction software; complete initial development of a fused and synchronized dynamic geospatial framework for understanding, through risk-based applications, the effect of weather-impacted terrestrial processes on military operations at all echelons. ***FY 2018 Plans:*** Will mature a dynamic, coupled land-atmosphere modeling and simulation capability to inform military mission planning by providing fused all-weather and all-season tactical decision aids, delivering risk-based assessments for mission specific terrain analysis, tactical movement and maneuver, and sensor planning.			
Title: GeoIntelligence - Terrestrial Phenomenology Characterization for Geospatial Applications (Formerly Analysis for Signal & Signature Phenomenology) ***Description:*** This effort investigates the dynamics of electromagnetic, acoustic, and seismic signatures in response to changing terrain state and complex terrain geometry. Research results improve sensor employment tactics, techniques and procedures, and numerical modeling of terrain properties for tactical advantage and geospatial tactical decision aids. ***FY 2017 Plans:***	-	1.652	1.501

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T42 / *Terrestrial Science Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will research web-based three-dimensional (3D) visualization of tactical decision aids to enhance point cloud analytics in bandwidth limited environments and mobile applications; investigate utility of LiDAR and terrain based 3D products through new algorithms and processes to access and reuse level zero (raw) data collections preserving sensor calibration and error meta-data. ***FY 2018 Plans:*** Will develop algorithms for rapidly indexing and provisioning very large LiDAR point cloud collections, greatly simplifying the analyst's access to 3D terrain data; and mature new web based 3D point cloud visualization and analysis capability greatly extending the data utility to the terrain analyst and image analyst.			
Accomplishments/Planned Programs Subtotals	5.120	5.152	5.120

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T45 / *Energy Tec Apl Mil Fac*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
T45: *Energy Tec Apl Mil Fac*	-	3.292	3.809	3.470	-	3.470	4.000	3.919	4.154	4.237	-	-

A. Mission Description and Budget Item Justification

This Project investigates and evaluates technologies necessary for secure, efficient, sustainable military installations and contingency bases, emphasizing facility systems protection in response to evolving needs. Technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness for munitions production and training, and in the theater of operations to reduce logistical footprint. This effort investigates technologies to protect facility indoor air quality from contaminants such as mold, bacteria, and viruses in work and living spaces, as well as develops methods to optimize sustainable operations and maintenance to minimize lifecycle costs. In addition, technologies from this work mature a better understanding of critical infrastructure interdependencies to support sustainable and flexible facility operations and evolving mission requirements.

Work in this Project supports the Army Science and Technology Innovation Enablers Portfolio.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the Army Engineer Research and Development Center, Vicksburg, MS.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Adaptive and Resilient Installations	3.292	3.809	3.470
Description: This effort investigates and develops technologies necessary for energy efficient and sustainable military installations, emphasizing energy and utility systems.			
FY 2016 Accomplishments: Investigated the impacts on energy efficiency and lifecycle sustainability of contingency basing structures constructed with cementitious materials assembled via an additive process for construction. Investigated the impacts on construction geometries of the structures along with the physical attributes of the supporting pad, walls, and ceiling. Evaluated material mixtures and additives, as well as nozzle shapes and combinations, to allow complex wall configurations for improvement of thermal characteristics while maintaining structural integrity.			
FY 2017 Plans:			

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army		Date: May 2017
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T45 / *Energy Tec Apl Mil Fac*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Will validate simulations for a prototype automated construction capability for expeditionary structures and assess modified designs to allow for improved thermal characteristics and structural integrity. Will investigate methods for rapid and automated acquisition of existing facility information in remote environments. ***FY 2018 Plans:*** Will develop a tool for efficient siting of contingency bases, informing real estate decisions made between the United States (U.S.) and a host nation during Phase Zero operations to inform military planners of potential impacts to operational effectiveness due to location, duration, size (area and population), effects on sociocultural context, and changes in mission; and assess the relative risk associated with contingency construction activities and investigate risk mitigation frameworks through the employment of autonomous construction methods.			
Accomplishments/Planned Programs Subtotals	3.292	3.809	3.470

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: FY 2018 Army			Date: May 2017
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T53 / *Military Engineering Applied Research (CA)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
T53: *Military Engineering Applied Research (CA)*	-	17.500	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	-	-

Note

Not applicable for this item

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Military Engineering applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Program Increase	17.500	-
FY 2016 Accomplishments: Program increase for military engineering applied research		
Congressional Adds Subtotals	17.500	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A