2019 SECRETARY OF DEFENSE

ENVIRONMENTAL AWARDS

FORT DRUM, NEW YORK

ENVIRONMENTAL RESTORATION, INSTALLATION

INTRODUCTION

Located in northern New York and situated between the Great Lakes and the Adirondack Mountains, Fort Drum is 10 miles northeast of the City of Watertown and approximately 30 miles from the Canadian border. As the home of the 10th Mountain Division (Light Infantry), one of the most deployed units in the Army, the installation's mission is to generate, rapidly deploy, and sustain ready forces to meet national security requirements while caring for Soldiers, Families, and Civilians. Consistent with this mission, Fort Drum, a power projection platform, has the capability to rapidly mobilize and deploy forces anywhere in the world.

The installation supports a population of 14,960 military personnel, 17,171 family members, 3,302 civilians and 824 contractors, and serves 3,184 military retirees living in the surrounding area.

Including more than 108,000 acres, Fort Drum is the largest Army training installation in the northeast and designated as a Department of the Army Regional Collective Training Center, providing full spectrum training and base operations support to 11 states and parts of Canada. With 47 live-fire facilities and more than 74,000 acres of training land, the installation offers training opportunities for 15,000 active duty service members and more than 26,000 National Guard and Reserve personnel.

To succeed in such a demanding training and operational environment, Fort Drum's Installation Restoration Program (IRP) uses an integrated team approach with the goal of synchronizing remedial strategies, which respond to changing site conditions, with the mission in a timely and cost-effective manner.

PROGRAM MANAGEMENT | ORIENTATION TO MISSION | IMPACT & OUTCOMES | TECHNICAL MERIT | STAKEHOLDER INTERACTION | TRANSFERABILITY

BACKGROUND

At Fort Drum, military operations, construction activities, and expansion efforts have resulted in a variety of contaminated sites. Early investigations identified 72 areas of concern (AOCs) including petroleum fueling and storage locations, sanitary landfills and waste dumps, pesticide and hazardous waste storage points, and vehicle maintenance facilities. The variety, geologic/hydrogeological conditions, extent, and associated contaminants of concern of the sites have challenged the Fort Drum IRP to develop and implement innovative, site-specific remediation solutions. As part of these tremendous efforts, Fort Drum IRP work today is focused on five remaining sites under a February 2014 Consent Order with the New York State Department of Environmental Conservation (NYSDEC). In addition, IRP work continues for the Oasis Jet-Fuel Spill under the April 2014 Remedial Action Selection (RAS) Report. All other sites require No Further Action (NFA) or have implemented remedial actions and are awaiting formal closure pending NYSDEC review. NYSDEC has primary regulatory authority for Fort Drum.

STAFFING AND MANAGEMENT APPROACH

Operating at the forefront of environmental restoration programs, the Fort Drum IRP is executed through the efforts of a diverse, knowledgeable, and experienced team of professionals:

- Installation Program Manager and Environmental Division Chief, Department of Army Civilians (DACs), Environmental Division of Public Works – Coordinate and oversee program implementation;
- Baltimore District Corps of Engineers (COE) – Coordinates COE oversight and review of activities and deliverables as well as provides technical expertise;
- PIKA-MP Joint Venture (JV) compromised of PIKA International Inc. and ARCADIS U.S. Inc. – Contractor performing the site remediation and monitoring work;
- NYSDEC and U.S. Army Environmental Command (USAEC) – Provide oversight on ongoing remediation efforts.

Current site remediation and monitoring efforts are being conducted under a 5-year, $13 million Performance Based Acquisition (PBA) contract. The Fort Drum IRP team relies strictly on PBA contracts to investigate and remediate sites. Using PBA contracting dramatically accelerates the site cleanup timeline, drives innovative and alternative remediation strategies, and saves significant money for the cleanup lifecycle of a site. Moreover, the use of PBAs allows for a breadth and depth of knowledge and experience that would otherwise be near impossible to achieve – elements critical to tackling the most technically complex sites on Fort Drum.

COMMUNITY INVOLVEMENT

Fort Drum strives to maintain program transparency by providing interested community members the opportunity to explore existing restoration activities as well as provide feedback through the following mechanisms:

- *Fort Drum Compatibility Committee* – This committee formed due to the efforts of a two-year Joint Land Use Study (JLUS) collaborative stakeholder process between Fort Drum and the surrounding tri-county area. Goals of the committee include sharing expertise and strengthening

Fort Drum Compatibility Committee – Tour Photo. (Photo credit: Michael Strasser, PAO)

communication. In September 2018, Fort Drum officials hosted a compatibility tour for community planners and leaders to meet with installation subject matter experts. The tour provided an opportunity to discuss common restoration challenges and issues faced as well as keys to success with local leaders.

- *Community Relations Plan* – The plan provides points of contact, a community fact sheet, program webpage, and the locations of IRP Information Repositories for public access to existing work plans and documents.
- *Informational Documents* – The IRP team created the "*Fort Drum Installation Restoration Program: History, Success, and Way Forward*" tri-fold brochure to distribute up-to-date and accurate information about the IRP to the community.
- *Technical Review Board (TRB) Meetings* – To maintain information flow between the project stakeholders and regulators the IRP conducts regular TRB meetings. Since 2006, more than 100 TRBs have occurred to review cleanup progress, ideas for the path forward, and site exit strategies.

ACCOMPLISHMENTS

ACCELERATED ENVIRONMENTAL CLEANUP

At the beginning of this award period, the team implemented aggressive measures to expand remedial infrastructure and the radius of influence to increase physical mass removal and biological degradation. This resulted in three site closures with the remaining active sites in the advanced stages of remediation and the goal of requiring no further remedial action at all sites by 2020 well within reach.

PCE Site

In 2010, an investigation of historical groundwater chemistry associated with a fuel plume in the 3800 Area uncovered the presence of a dissolved-phase chlorinated solvent, tetrachloroethylene (PCE), in the aquifer below the existing contamination. Accordingly, the state established a new site, directly below an active military unit maintenance facility. In 2015, the IRP team executed a source area In Situ Chemical Oxidation (ISCO) pilot study followed by the preparation of a Feasibility Study (FS) Report recommending full-scale ISCO injection as the optimal site remedy. These efforts culminated in a Record of Decision signed by the NYSDEC in March 2016. Completed in 2017, the full-scale injection, the largest to date, used more than 290,000 gallons of 2.6 percent sodium permanganate.

2017 ISCO Injection Setup at 3800 Area.

In July 2018, with post-injection sampling showing a sharp decrease in contaminant concentration and the implementation of Monitored Natural Attenuation (MNA) coupled with Land Use Controls (LUCs), the team achieved State-closure of this State Superfund site. The closure of this site with an in-situ remedy supported the military readiness mission by allowing vehicle maintenance operations to continue within the unit's motor pool footprint with minimal interruption. In addition, achievement of Remedial Action Complete (RAC) with a single optimized full-scale injection event saved the Army more than $750,000 in continuing restoration costs.

Petroleum-Contaminated Sites

Historical leaking underground storage tanks (USTs) and piping resulted in several petroleum-contaminated sites that have undergone varying levels of investigation and remediation since the early 1990s. Five of these sites (Areas 1295, 1595, 1795, 3805/1995, and P-2140) were still active at the beginning of this award cycle, affecting more than 66 acres and 414 million gallons of groundwater.

At Area 1295 and P-2140, the IRP team installed additional remedial wells to fill system coverage gaps. Following successful responses to system optimization, the IRP team demonstrated to state regulators that remaining residual contaminant concentrations had stabilized and/or decreased. With conservative modeling indicating a lack of migration and risk potential that LUCs could mitigate, the team achieved State-closure of both sites in May 2018. By achieving closure ahead of the contract performance objective of 2020, the IRP team saved more than $300,000 in electrical and maintenance costs and ultimately eliminated the release of more than 230,000 pounds of carbon dioxide emissions. Moreover, accelerated cleanup and removal of remediation infrastructure at Area 1295 now provides unimpeded access to the Oneida Avenue railhead area – a critical component of Fort Drum's rapid deployment and mobilization mission.

The IRP team has also made significant progress toward reaching groundwater cleanup standards for the remaining petroleum-contaminated sites:

- *Area 1595* – To accommodate for system coverage gaps, the IRP team installed more than 38 additional remedial wells to accelerate cleanup efforts. In the final push to achieve site closure, ten locations have an inline water heater connected to enhance biodegradation and expedite the remediation timeframe. Since 2015, the team's efforts have resulted in the removal of 4,000 pounds of Volatile Organic Compound (VOC) mass.
- *Area 1795* – The IRP team designed, installed (December 216), and then upgraded (August 2017) a groundwater recirculation (GWRC) system to remediate a previously untreated area of the site. Combining the optimized GWRC system with Air Sparging (AS) and Bioventing (BV) has enhanced aerobic biodegradation and caused an overall decreasing trend of contamination with more than 3,750 pounds of mass removed since May 2015.
- *Area 3805/1995* – Despite more than 20 years of remedial efforts, light non-aqueous phase liquid (LNAPL), source mass, and a 50-acre dissolved phase plume still remained at Area 3805. While employing the appropriate technologies, existing remedial infrastructure was inadequate and operating in a reduced capacity. Following a comprehensive evaluation, the current IRP team installed more than 135 additional wells to accelerate site cleanup. These efforts have yielded significant mass removal (55,500 pounds) and dissolved phase concentration reductions over the past three years. Focus has now shifted to the optimization of persistent problem areas and the expansion of solar and waste heat from remediation equipment to enhance biodegradation.

Oasis Jet Fuel Spill

One of the IRP team's greatest accomplishments has been the rapid cleanup of a roughly 500,000-gallon jet-fuel spill to groundwater that occurred in 2006 at Wheeler-Sack Army Airfield's Oasis refueling point. Today, remediation efforts have removed 98 percent of the recoverable LNAPL and contaminant concentrations in groundwater are approaching state cleanup standard levels in most locations throughout the dissolved phase plume. In 2018, the team successfully demonstrated to state regulators that the Dual-Phase Extraction (DPE) and BV components of the site remedy had achieved their remedial end-points and recommended permanent shut down of these systems.

The comprehensive approach taken by the restoration team has accelerated the site's cleanup

Wheeler-Sack Army Airfield Oasis Fuel Point with remediation infrastructure.

timeline five years ahead of the NYSDEC-approved schedule, translating into a cost savings of $11.5 million. Moreover, with the imminent removal of the DPE and BV system infrastructure, the Oasis fueling area will once again be able to operate at full capacity – greatly enhancing the Combat Aviation Brigade's (CAB) fueling operations.

Per- and Polyfluoroalkyl Substances (PFAS)

The sourcing of drinking water from on-site wells and the Black River has made Fort Drum particularly sensitive to the emerging contaminants, Per- and Polyfluoroalkyl Substances (PFAS). Accordingly, Fort Drum completed a Preliminary Assessment (PA) in 2015, which identified several potential PFAS sources including the Fire Training Area (FTA), located in close proximity to the Black River. Historically, firefighters would practice extinguishing fires at the FTA utilizing a pit and employing the use of Aqueous Film-Forming Foam (AFFF), later known to contain PFAS. During subsequent site inspections of the pit in 2016, samples collected far exceeded the EPA's drinking water health advisory level of 70 parts per trillion. Based off these results, the Fort Drum IRP responded rapidly with in-house resources to remove all contaminated components. Completed the same year, these efforts resulted in significant cost savings while also reducing risk to human health and the environment.

In-house removal of training pit system components at the Fire Training Area.

Subsequently, the team has proceeded into a cutting-edge initiative of investigating the potential impacts associated with PFAS. This program includes sampling of the base water supply and distribution system; a multi-year subsurface investigation, well installation, and sampling program between the FTA and the base drinking water source areas (supply wells and Black River); and vertically integrated sampling of the Black River itself.

INNOVATIVE TECHNOLOGIES AND GREEN REMEDIATION

Enhancing Remediation with Solar and Waste Heat

As reported in the USACE quarterly newsletter, *The Corps Environment* (Vol. 19, Issue 3, July 2018), the Fort Drum IRP team successfully demonstrated the application of an innovative, inexpensive, and environmentally-sustainable remediation technology called Thermal In-Situ Sustainable Remediation (TISR) (US Patent pending). TISR utilizes solar energy to enhance the remediation of soil and groundwater via a closed-loop system consisting of: evacuated tube solar collectors, borehole heat exchangers (BHEs), heat-transfer fluid (glycol), insulated tubing, and a solar-powered pump to circulate the heat transfer fluid from the solar heaters to the subsurface. TISR offers the following: (1) increased bioremediation rates, (2) up to a 50 percent reduction in life-cycle costs, (3) potential for a ten-fold reduction in carbon dioxide emissions, and (4) effective in complex subsurface geology. Given the success of the pilot study at Area 3805, the IRP team transitioned the TISR system to a mobile platform to facilitate electricity-free application of solar heat to targeted problem areas.

Building off the success of the TISR implementation, the Fort Drum IRP team moved forward pilot testing another green remediation technology in 2017, using waste heat from equipment. Successful again, the IRP team now takes advantage of waste heat from system blowers to enhance remedial efforts at Area 3805. TISR, in combination with waste heat from system blowers, has:

- *Increased Biodegradation Rates* – Currently, applying nearly 400,000 BTUs per hour to the subsurface using 79 different BHEs, increases the average ambient temperature by 10°C, resulting in a two- to three-fold increase in biodegradation rates. This rate increase has the potential to shorten the remedial timeframe of this site by a year.
- *Reduced Capital Costs and Greenhouse Gas Emissions* – Utilizing green technologies, compared to non-renewable methods, reduces energy consumption, annually saving $100,000 in electrical costs and 540,000 pounds of greenhouse gas emissions.

TISR Components: Solar Panel on Mobile Platform (L) and Borehole Heat Exchanger (R).

Using Plants to Clean Up Contamination

Phytoremediation, another green technology, uses vegetation to soak up and metabolize contaminants from soil, sediment, groundwater, and surface water. To implement phytoremediation technology at the now closed Old Sanitary Landfill (OSL), 1.9 acres of willow trees in a raised bed configuration are planted, mostly within delineated wetland areas. Water samples demonstrate significant reductions in petroleum-related organic constituents, while biomass samples have demonstrated contaminant uptake by the trees. After 14 years, this technology continues to reduce contaminant flux from the landfill to waterways. The team maintains this site through a collaborative partnership with SUNY College of Environmental Science and Forestry (ESF).

Willow Tree Planting at the Old Sanitary Landfill – Design (L) and Extent (R).

Elsewhere on Fort Drum, the USACE Engineering Research and Development Center – Cold Regions Research and Engineering Laboratory (ERDC-CRREL) is studying the effects of using phytoremediation to clean up contaminants on military training ranges. Live-fire activities can result in the contamination of soil and groundwater by explosive residues and their chemical by-products. Currently, there are 2,700 switchgrass plant seedlings growing in plots located across the installation's training area with known residue concentration rates. Throughout the summer, sampling takes place to evaluate the plants ability to absorb and break down contaminants. This technology has the potential to provide a self-sustaining, cost-effective, and environmentally friendly method to restore large areas of contaminated military training ranges.

Emerging Technologies for the Remediation of PFAS

The Fort Drum IRP team is actively supporting the development of cutting-edge science associated with the assessment, transport mechanics, and remediation of PFAS:

- *Evaluating Performance of a Specialized Microcosm in Enhanced Biodegradation of PFAS* – One of the hallmarks of the Fort Drum IRP is providing encouragement and opportunity to

innovate. This is exemplified by this joint project, which developed out of the potential need for alternative PFAS remedial solutions associated with the Fire Training Area (FTA), and is being completed as a cooperative effort between Fort Drum, the Baltimore COE, and USGS. The project team is evaluating a specialized microcosm (WBC-2) for potential use in enhanced biodegradation of PFAS using soil and groundwater samples collected from the FTA. WBC-2 is unique in its composition, and preliminary results are encouraging, indicating potential for biodegradation of PFAS. With future study, this biological technology may represent a green and sustainable way to mitigate PFAS-contamination.

★ *Establishment of Fate and Transport Mechanics for PFAS under controlled Aquifer Conditions and Correlation to Existing Data* – This DoD Strategic Environmental Research and Development Program (SERDP) funded project, involving multiple federal and public agencies, has utilized soil and groundwater from Fort Drum in the development of a scaled aquifer testing facility at the Baltimore District COE Fort McHenry location. The scaled aquifer will help determine fate and transport parameters such as dispersivity, diffusion, and sorption of PFAS; further our understanding of temporal source-zone depletion; and guide future assessment and remediation efforts across the industry. Other components of the project involve behavior studies of dissolved phase PFAS relative to preferential partitioning at the air/water interface, and performance/retardation data relating to how groundwater flow pathways affect the fate of PFAS transport in the subsurface. Results of the study will be published in peer-reviewed journals; presented at industry conferences; and a workshop will be held to convey the study results to interested stakeholders, including local, state, and federal regulatory personnel as well as the general public.

PARTNERSHIPS

Recognizing that regulator engagement is fundamental to achieving program objectives, the Fort Drum IRP established a robust communication plan to engage all stakeholders and NYSDEC regulators meaningfully with regular and frequent communication. This approach streamlines the cleanup process by enhancing stakeholder ownership and allowing for the efficient implementation of adaptive remedies through early involvement and continuous evaluation.

Moreover, collaborative partnerships with research-based organizations like the Baltimore COE, SUNY-ESF, and ERDC-CRREL provide an ideal platform for innovation in remedial technology development as well as a mechanism for knowledge transfer across the restoration community.

REDUCING RISK TO HUMAN HEALTH AND THE ENVIRONMENT

Reducing risk to human health and the natural environmental underlies every Fort Drum IRP initiative. Using an array of remediation technologies prevents the migration of contamination and removes contamination from the subsurface. For example, at the Oasis fuel spill site, the IRP team's proactive, aggressive response to remediation, rendered the groundwater aquifer, that services more than 40,000 installation customers, safe for use. LUCs, whether administrative or physical, minimize the potential for exposure and disturbance of contaminated media. Conducting an investigation to determine the vertical and horizontal extent of PFAS contamination provides insight on the impacts to potential receptors and a way forward for further action.

CONCLUSION

Through an integrated team approach, the Fort Drum IRP has made tremendous advances during this award period. The installation is committed to accelerate site closures, reduce cleanup costs, and protect human health and the environment. The IRP team's use of innovative and green technologies, fostering of robust partnerships, and supporting the development of new technologies for assessment and remediation all contribute to the success of the IRP program at Fort Drum.