

# A MODERN APPROACH TO ACCELERATING HIGH-RESOLUTION SITE CHARACTERIZATION (HRSC) AND CONCEPTUAL SITE MODEL (CSM) DEVELOPMENT VIA TRIAD-LIKE STAKEHOLDER ENGAGEMENT STRATEGIES & TECHNOLOGIES



Arthur Wickham, MSc, PG, CHG  
Senior Project Manager | Senior Hydrogeologist  
BEM Systems, Inc. | Colorado

## THE DEPARTMENT OF DEFENSE (DoD) & PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

- **PFAS** are a class of man-made chemicals
- Thousands of variations exist in commerce; have been widely used in industrial processes and consumer products since 1940s.
- The DoD began using **aqueous film forming foam (AFFF)** that contained PFAS in 1970s.
- **EPA has published Draft Maximum Contaminant Limits (MCLs)** for several PFAS compounds
- Concerns with PFAS:
  - **Persistent** in the environment
  - **Bioaccumulative** in organisms
  - **Toxic** at relatively low levels (parts per trillion [ppt])

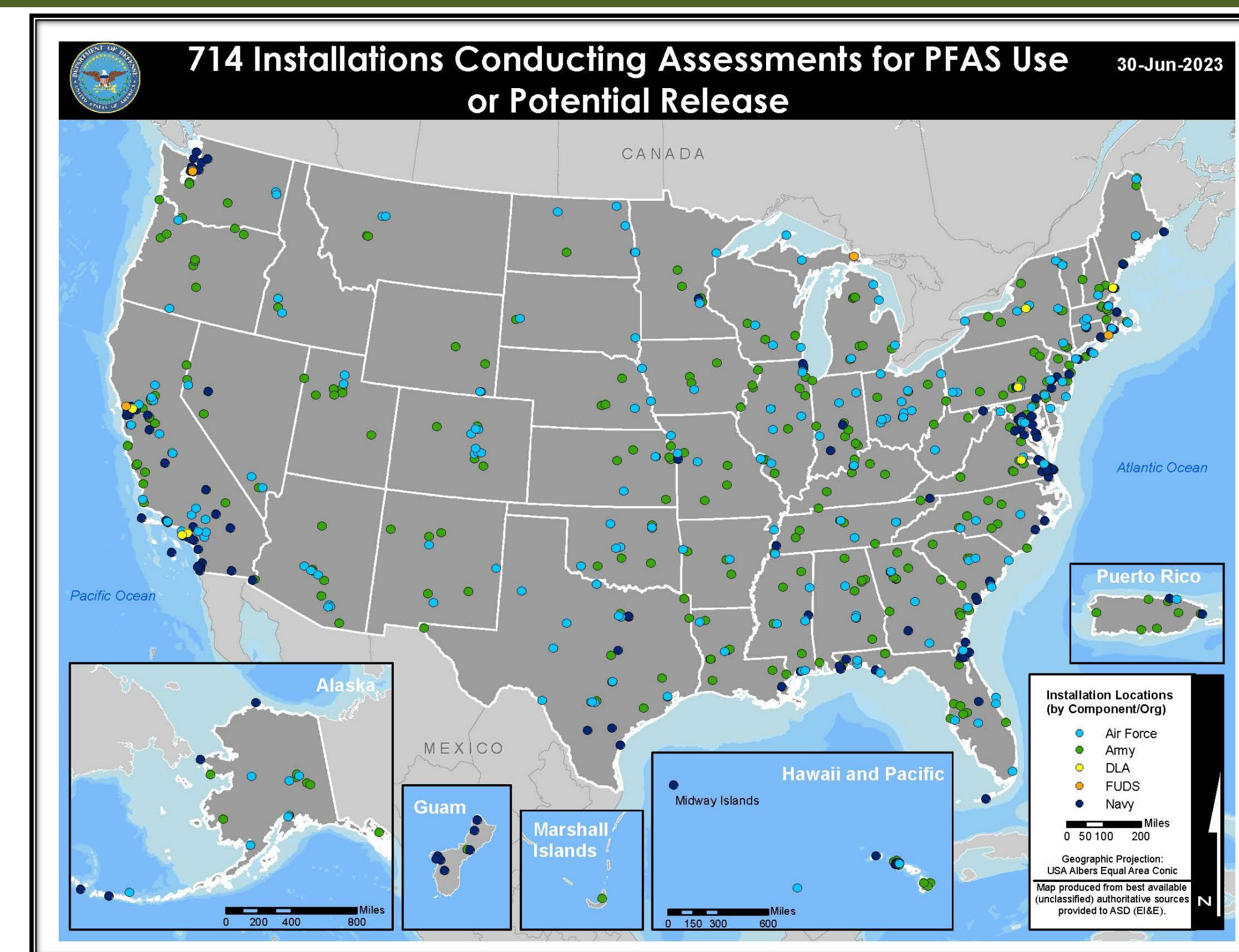
DoD's TOP ENVIRONMENTAL PRIORITY = INVESTIGATION AND REMEDIATION OF PFAS

**714** DoD Installations\* Requiring Assessment of PFAS Use or Potential Release

**107** DoD Installations Where No Further Action is Required

**466** DoD Installations with Completed Preliminary Assessment/ Site Inspection (PA/SI)

**359** DoD Installations Proceeding to Next Phase in CERCLA Process (e.g. Remedial Investigation (RI))



## PHASE I PFAS REMEDIAL INVESTIGATION (RI) CASE STUDIES

### OBJECTIVES

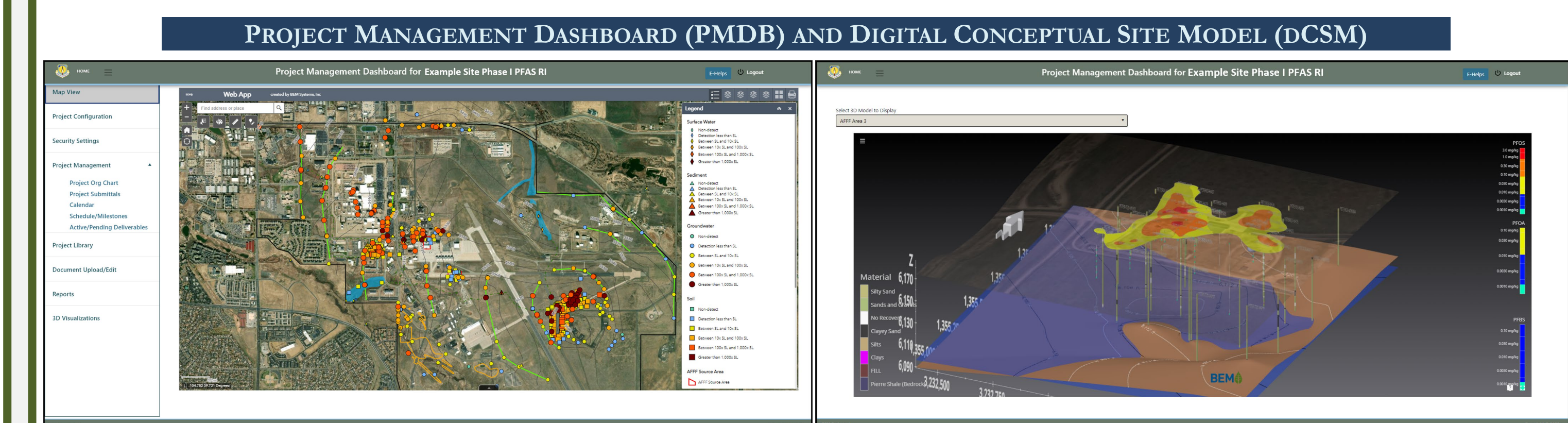
- **Characterize and delineate PFAS in multiple media** (groundwater, surface water/stormwater, pore water, sediment, soil, and biota) **on- and off-base**
- Develop/Update CSM for each PFAS validated source area
- **Rank & prioritize** source areas
- Provide high-quality / defensible data to support **ecological and human health risk assessment and remedial alternative evaluations**



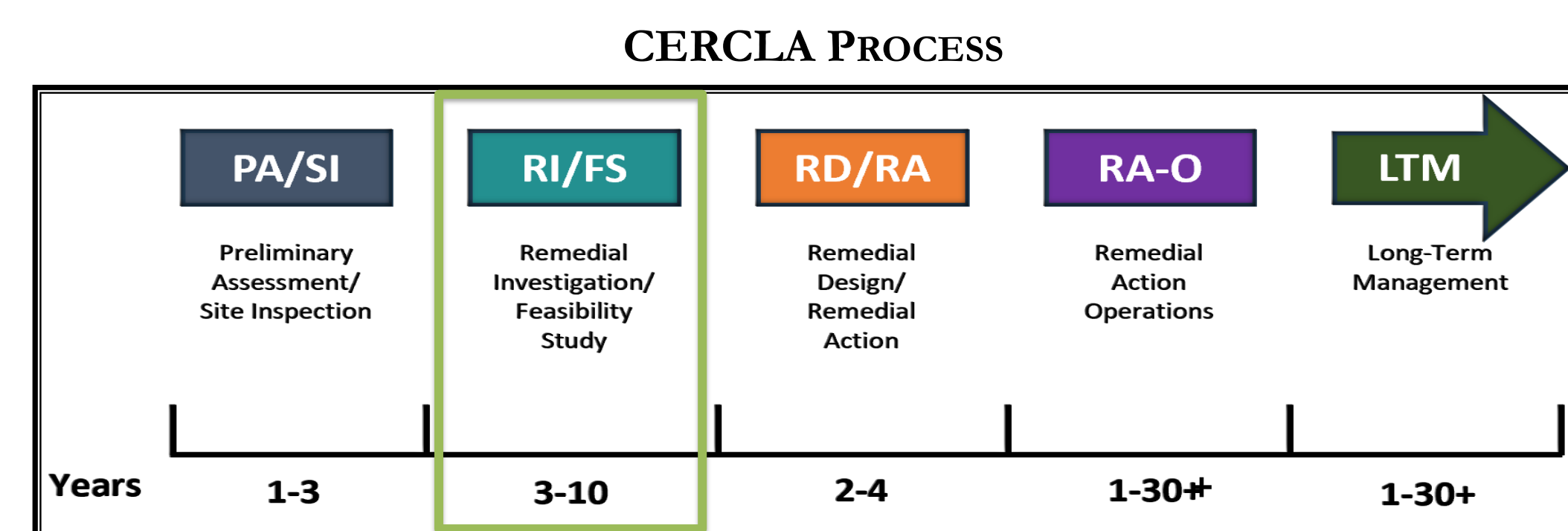
## COMMUNICATION & MANAGEMENT TECHNOLOGIES

The BEM Team developed a web-enabled project management dashboard to serve as the primary repository of all data generated during the life-cycle of the project and to facilitate communication and decision making among the project Team.

- Utilized by project team & stakeholders to obtain real-time data for monitoring the project's progress and schedule.
- Adaptable as new compounds or screening values are promulgated.
- Cybersecurity Maturity Model Certification (CMMC) compliant
- Supported generating and updating visuals of PFAS impacts in 2-D and 3-D CSM deliverables



## SITE INVESTIGATION CHALLENGES & NECESSARY IMPROVEMENTS



- **Remedial Investigation (RI)** is a critical step in CERCLA to support:
  - **Assessing risk** to human health and the environment, and,
  - Performing interim **remedial action**

### TRADITIONAL SITE INVESTIGATION APPROACH Management & Executional Challenges:

- Slow performance schedule
- Data collection & review is inefficiently iterative
- Costly extraneous mobilizations
- Dataset is often of coarse resolution
- Unable to quickly adapt to changing regulatory standards
- Stakeholder engagement slows progress and is limited to end of project

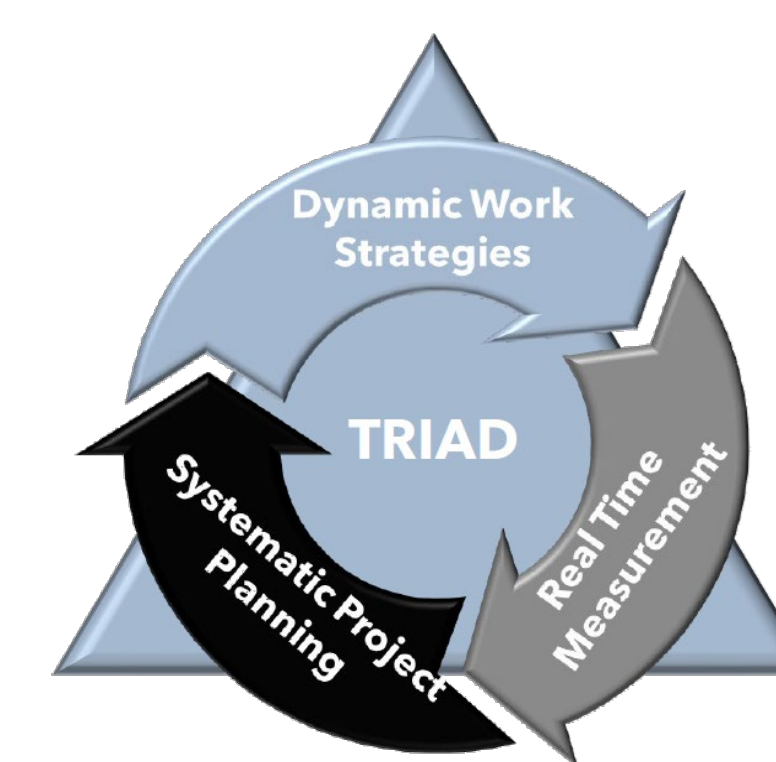
### Critical Future Needs

- **Accelerate** investigation schedules
- Leverage new **technologies** and strategies
- Build spatially (and ultimately temporally-) robust datasets to support:
  - **Risk assessment**
  - **Time-critical remedial action** (e.g., source removal)
- Adapt to changing regulatory standards (particularly emerging contaminants, e.g., PFAS)
- **Collaborate** transparently with regulatory agencies, communities and facilities

## TECHNICAL APPROACH

### TRIAD STRATEGY

- EPA-approved strategic process designed to **reduce decision uncertainty and improve data defensibility**
- Based upon science and technology utilizing an **adaptive process**

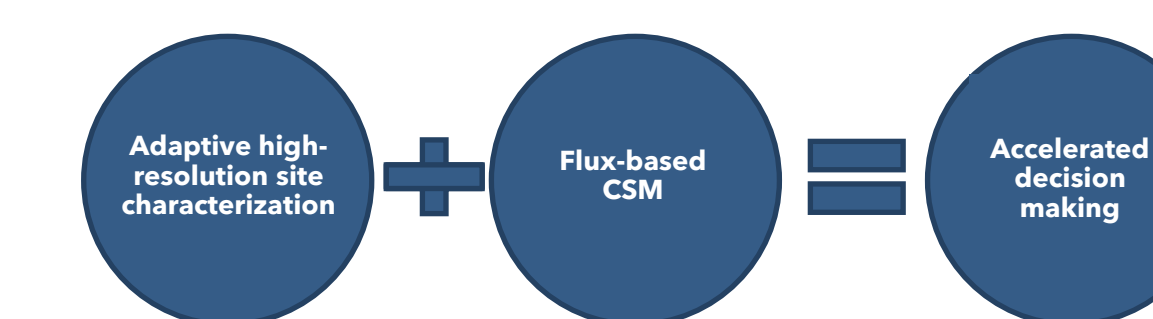
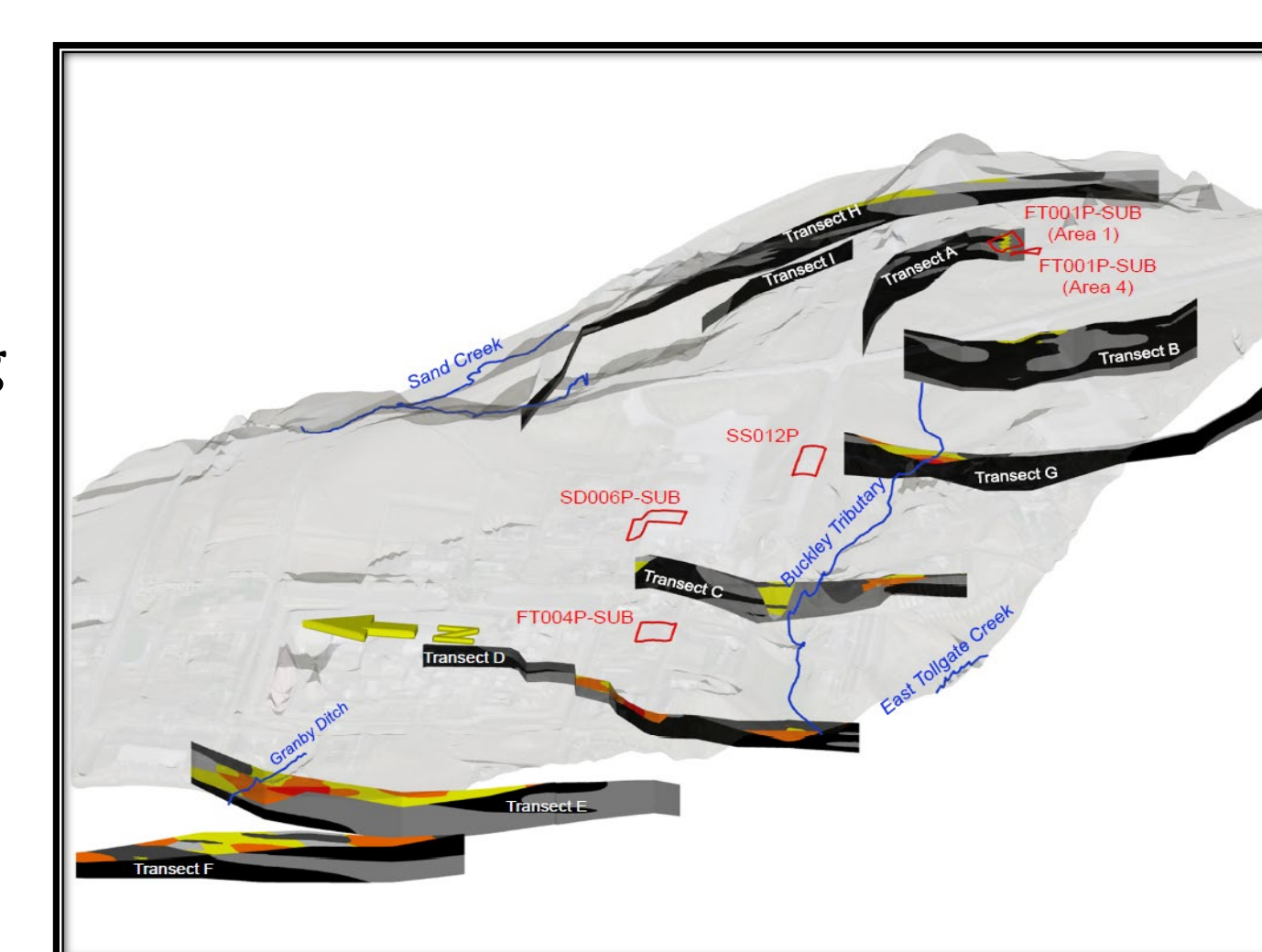


### Real-Time Measurement Technologies:



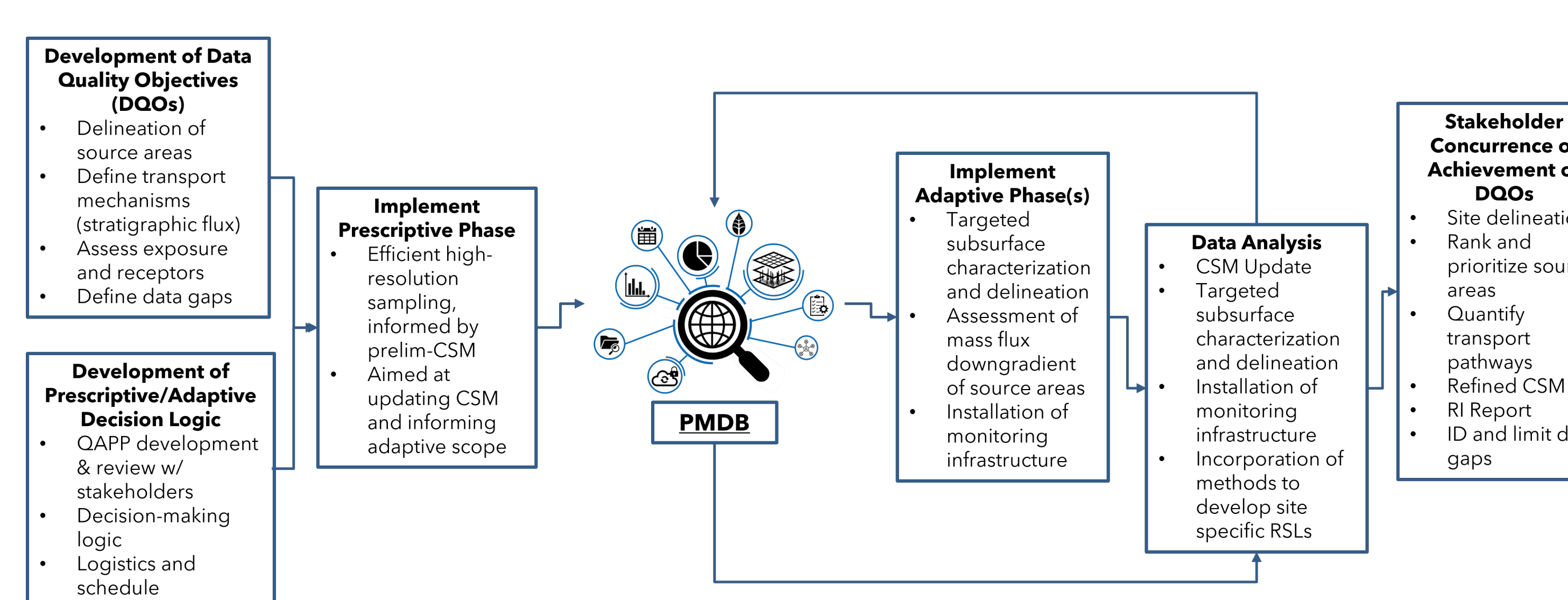
### TECHNICAL APPROACH

- **TRIAD-like HRSC approach**
- **Stratigraphic flux-based CSMs**
- Multiple AFFF **source-strength leaching evaluations** (including lysimeter installation & monitoring)
- Downgradient groundwater **vertical aquifer profiling (VAP)** transects to map PFAS mass flux migration pathways
- Groundwater-surface water interaction assessments
- Phase I Human Health & Ecological Risk Assessments
- Bench- and field-scale in-situ stabilization (ISS) treatability studies



### STAKEHOLDER ENGAGEMENT STRATEGIES

- **Adaptive logic defined and approved in Work Plan**
- **Real-time data review & CSM updates**
- Interim scoping decisions and concurrence on achievement of DQOs were made **collaboratively** with stakeholders
- Supported by **PMDB+dCSM**
  - Allowed DoD & regulatory stakeholders to track project progress and review interim data and deliverables
- Interim decisions and work plan deviations efficiently documented



## RECOGNIZED BENEFITS

- Accelerating RI process
- Refining CSMs and building robust, defensible datasets
- Increasing collaboration and data transparency with multiple regulatory (EPA & State) and public stakeholders
- Prioritizing source areas and assessing risk
- Quantifying off-site migration (current or potential)
- Identifying data gaps
- DoD-programming of interim remedial action and supplemental investigation
- Coordination with MILCON activities

## CONSIDERATIONS

- Identification of key stakeholders to advocate for adapting to new workflows for interim decision-making and documentation approval
- Instilling accountability and proactivity in data review in accordance with accelerated sampling and scoping schedules
- Coordination across multiple entities (e.g., between Installation MILCON & Environmental Restoration programs)
- Securing access to confidential or preliminary info (CUI, PII, etc.)
- Quality and format of third-party data sources ingested into CSM
- DoD-Consultant contracting limitations

## CONTACT INFORMATION & ACKNOWLEDGEMENTS

awickham@bemsys.com | 303.895.1486  
BEM Colorado Office  
12265 W Bayaud Ave, Suite 235  
Lakewood, CO  
www.bemsys.com



Acknowledgements:  
Air Force Civil Engineering Center (AFCEC)  
Arcadis (Task Orders/Teaming Partner)  
Pace Analytical (PFAS Mobile Lab)  
ARCADIS  
Pace Analytical