Drones, LiDAR, and 3D Models:
A New Paradigm for Data Visualization and Analysis and the Project Management Benefits for Large Hazardous Waste Remediation Projects

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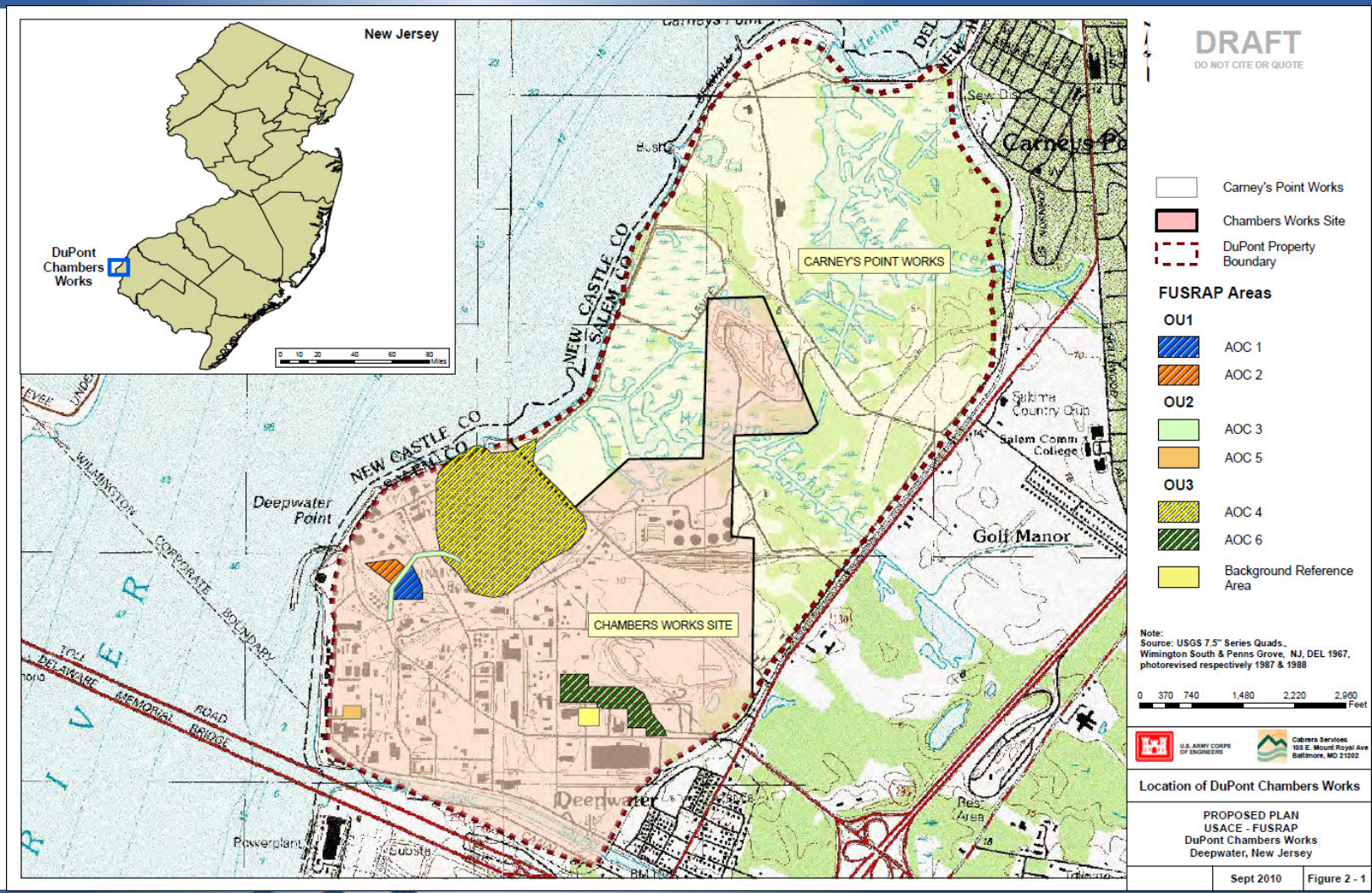
Site Location

The DuPont Chambers Works FUSRAP Site under remediation is a 6.5-acre area located within the 680-acre Chambers Works property, in Salem County, New Jersey.



Former Chambers Works FUSRAP Site History

- In the 1940s, U.S. Army Corps of Engineers (USACE) Manhattan Engineer District (MED) and Atomic Energy Commission (AEC) contracted E. I. du Pont de Nemours and Company (DuPont) to support the nation's atomic energy program.
- In 1997, USACE was directed by Congress to conduct assessment, remedial action, and site closure activities for FUSRAP sites.
- The USACE is currently addressing residual radiological contamination in multiple Areas of Concern (AOCs) under the Formerly Utilized Sites Remedial Action Program (FUSRAP).
- As lead agency for the response action, USACE selected a remedial action, consistent with CERCLA, that includes excavation and offsite disposal of contaminated soil (beginning in 2014).

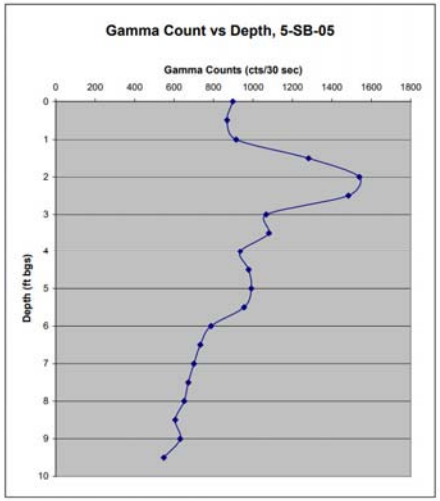
The Challenge

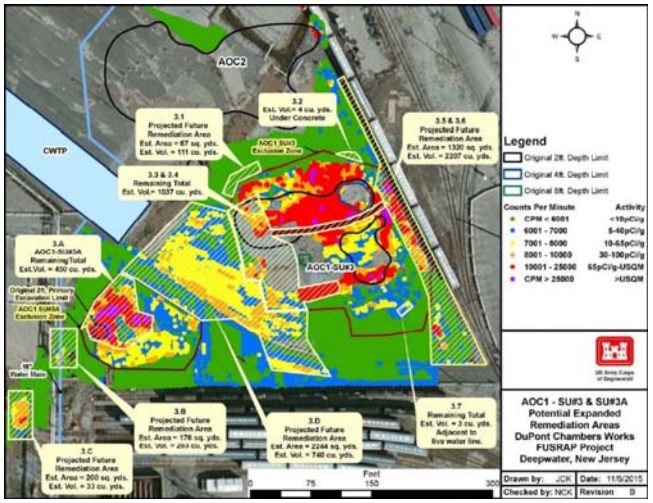
- Improve upon the conventional radiological data collection techniques and rudimentary 2D data representations.
- Find a better way to collect, process, and utilize the remedial action radiological data that would enable the project team to optimize operations, perform predictive planning and document expectations.
- Develop a more precise and robust visualization of radiological contamination, to support remediation efforts.
- Enable real-time decision-making, with real-time data. Avoid very expensive stand by time for contractors.

Date: 9/5/2003
Location: 5-SB-05
Stickup Height (ft): 3

BORING DEPTH (ft FTOC)	BORING DEPTH (ft bgs)	GAMMA COUNTS (cts/30 sec)
0	--	--
0.5	--	--
1	--	--
1.5	--	--
2	--	--
2.5	--	--
3	0	898
3.5	0.5	869
4	1	915
4.5	1.5	1282
5	2	1539
5.5	2.5	1484
6	3	1067
6.5	3.5	1081
7	4	936
7.5	4.5	978
8	5	991
8.5	5.5	955
9	6	787
9.5	6.5	733
10	7	700
10.5	7.5	672
11	8	651
11.5	8.5	606
12	9	631
12.5	9.5	548

Mean	916
σ	276
2σ	552
3σ	828
Mean + 3σ	1744





Solution 1: Geographic Information Systems

REMEDY MOSAIC BASEMAP

SPATIAL ANALYSIS RESULTS

DEPTH OF CONTAMINATION

ANALYTICAL INTERPOLATIONS

AVERAGE CONCENTRATION

REMEDIAL DESIGN (CAD DATA)

EXCLUSION ZONES

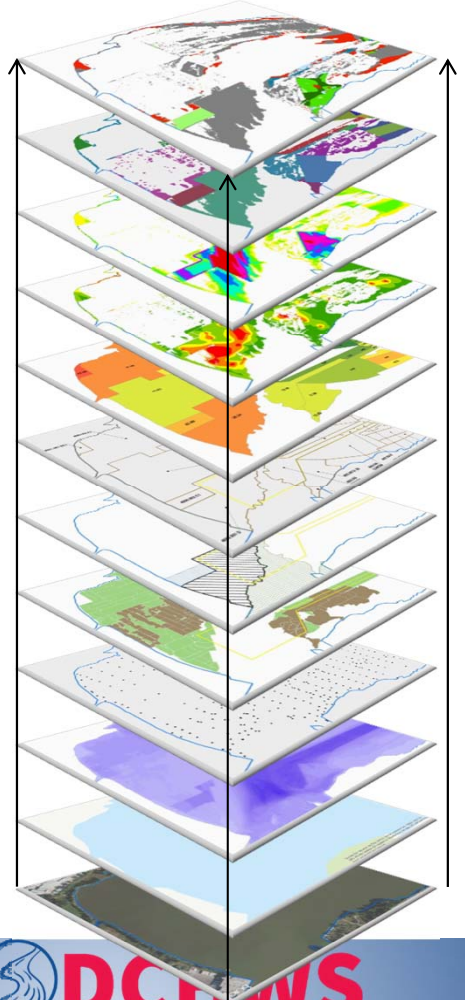
EXCAVATION AREAS

BORING LOCATIONS (GPS)

LIDAR-DERIVED DIGITAL ELEVATION MODEL

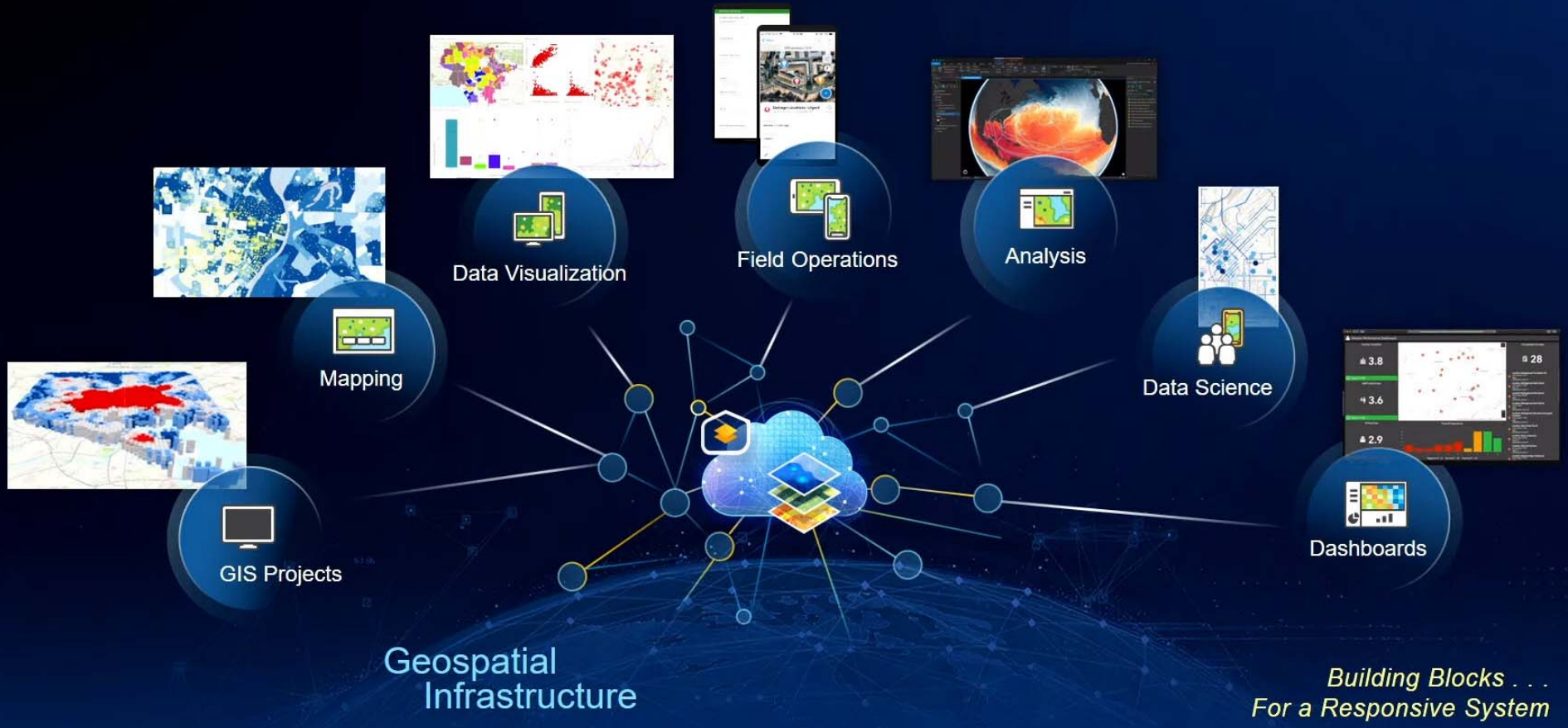
PLANIMETRIC DATA

DRONE ORTHOIMAGERY



Solution 1: Geographic Information Systems

Delivering Powerful Capabilities Across Organizations



Credits: Esri, 2019 User Conference Plenary

Key Highlights of ArcGIS Online

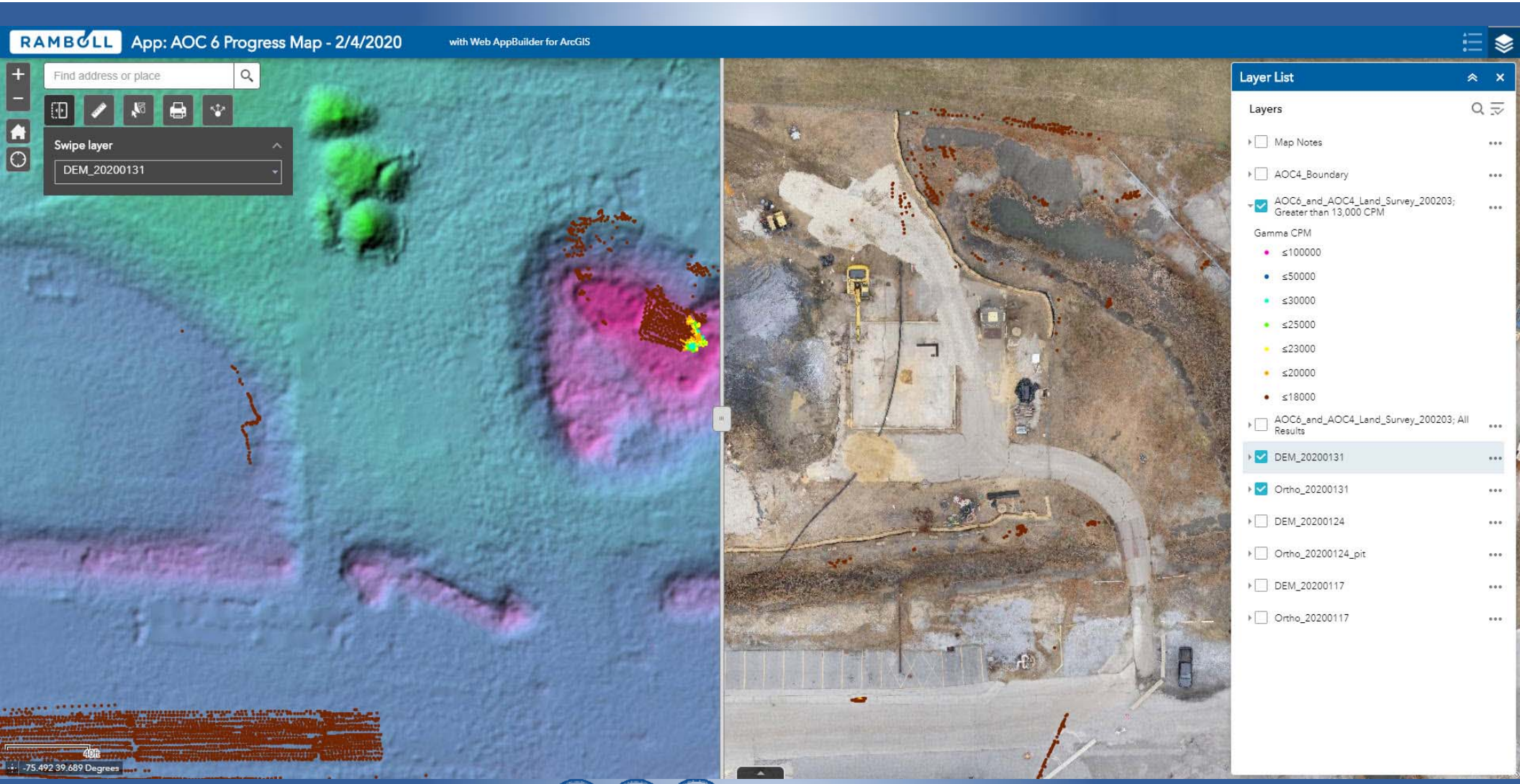
•Features **real-time data access,** querying, and visualization capabilities

•Incorporates **all available data sources** (orthoimagery, LiDAR, 3D field data, GIS, CAD, GPS, etc.)

•Provides a **common operating picture** to all team members in a secure, online platform

•Allows **mobile access** and enables adaptable **electronic field data collection**

•This is the hub for GIS data, maps, and apps for the Chambers Works project. This site is **dynamically updated** and can be **customed tailored** to meet ever-changing project needs.



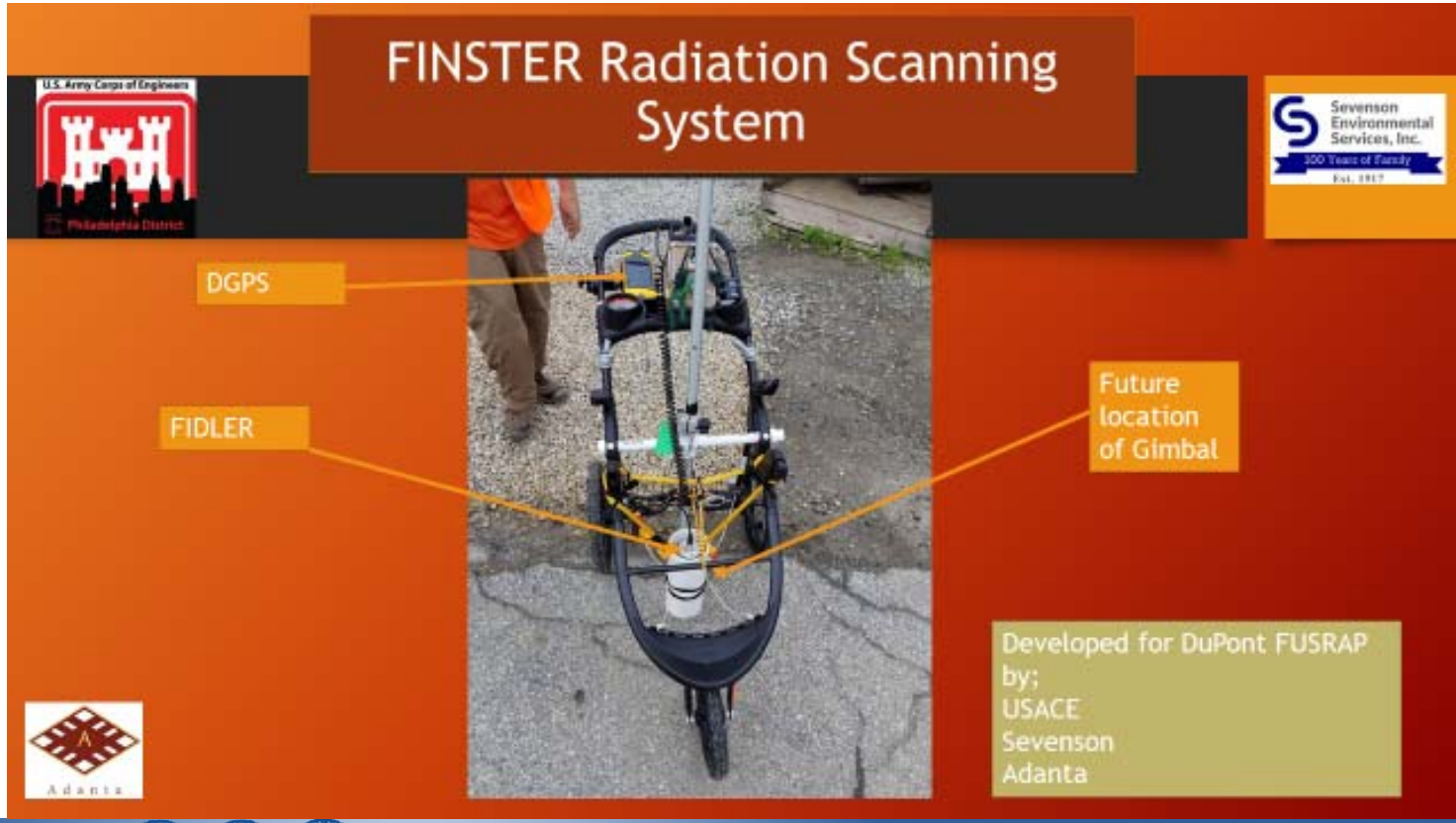
SAME DCHWS Design and Construction Issues at Hazardous Waste Sites

OCTOBER 26-28, 2020

Solution 2: Electronic Field Data Collection

Recent improvements include:

- Wireless communications with radiation detection equipment
- Real Time Kinematic GNSS GPS equipment for cm-grade accuracy
- Mobile data logger
- Improved field software for data processing



In the Field

Live Data Streams

Solution 2: Electronic Field Data Collection

Collector for ArcGIS

Accurate data collection made easy

Survey123 for ArcGIS

Smarter forms, smarter data collection

Tracker for ArcGIS

Know what happens in the field

Workforce for ArcGIS

Smarter field workforce coordination at your fingertips.

Navigator for ArcGIS

Advanced navigation and routing for your workforce

Explorer for ArcGIS

Maps at your fingertips

Operations Dashboard for ArcGIS

Make decisions at a glance

https://www.esri.com/en-us/arcgis/products/collector-for-arcgis/overview
https://www.esri.com/en-us/arcgis/products/explorer-for-arcgis/overview
https://www.esri.com/en-us/arcgis/products/navigator-for-arcgis/overview
https://www.esri.com/en-us/arcgis/products/operations-dashboard/overview
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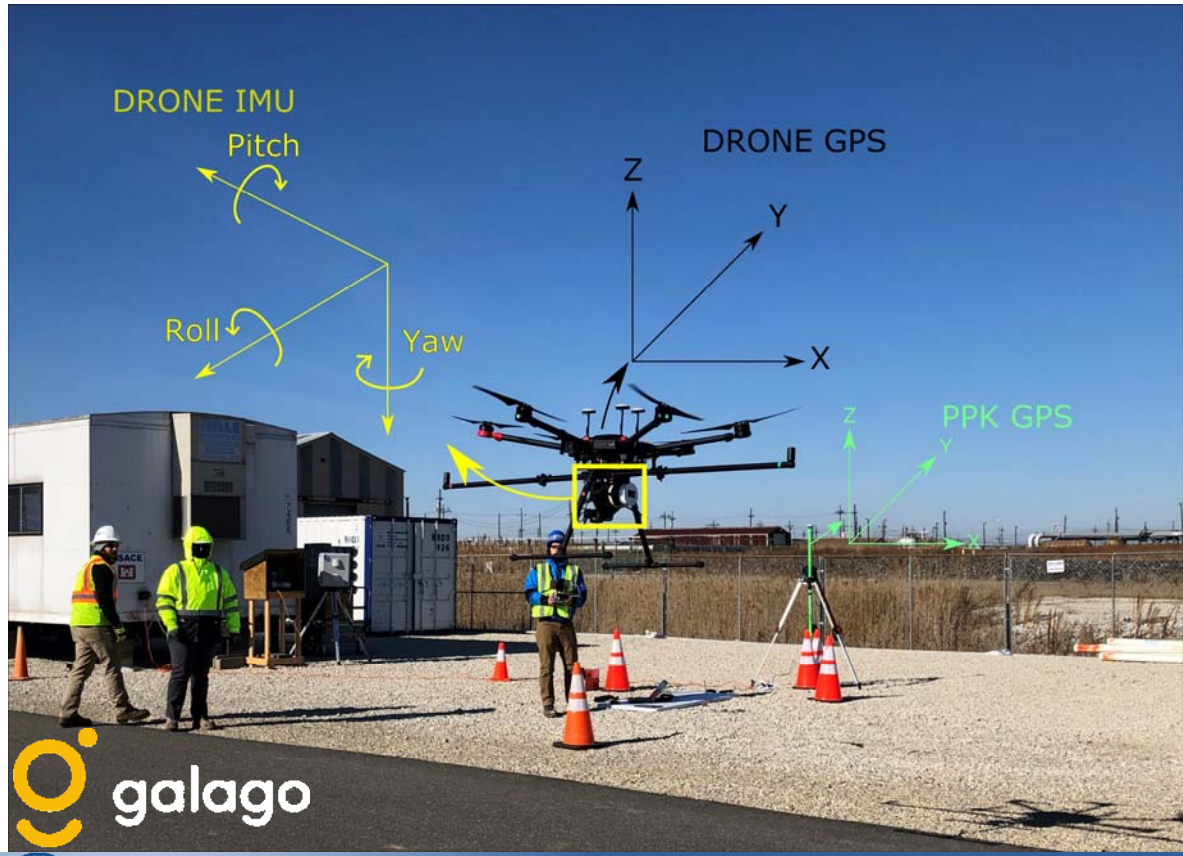
https://www.esri.com/en-us/arcgis/products/field-operations/overview?rmedium=esri_com_redirects01&rsource=/en-us/arcgis/field-mobility/overview

Solution 3: Drones for LiDAR and Imagery

New Technology Platform includes:

- 8-rotor UAV (octocopter) with gimbal and sensor array mount
- Velodyne-32MR LiDAR sensor
  - Light Detection and Ranging (LiDAR)
  - 1.2 million points per second; 100 meters +/-10 cm accuracy
- Sony A6000 24MP Digital camera
  - RGB image collection for orthophotos
  - Tied to IMU/GPS for precise image location and seamless image matching



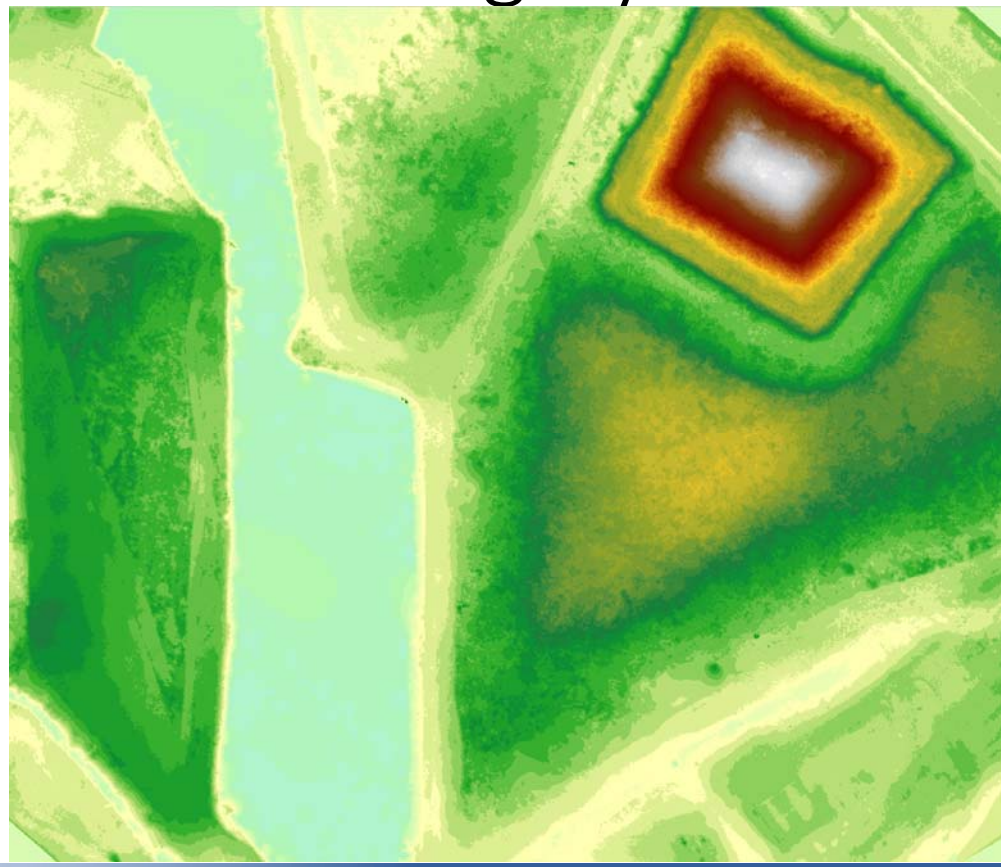
Solution 3: Drones for LiDAR and Imagery

<u>High-resolution aerial imagery (Orthomosaic)</u>

- Low altitude imagery collection from a highly adaptable platform. Very quick turn-around-time.
- < 0.5-in per pixel, best available imagery today!
- No comparison to modern satellite imagery or other commonly available basemaps.

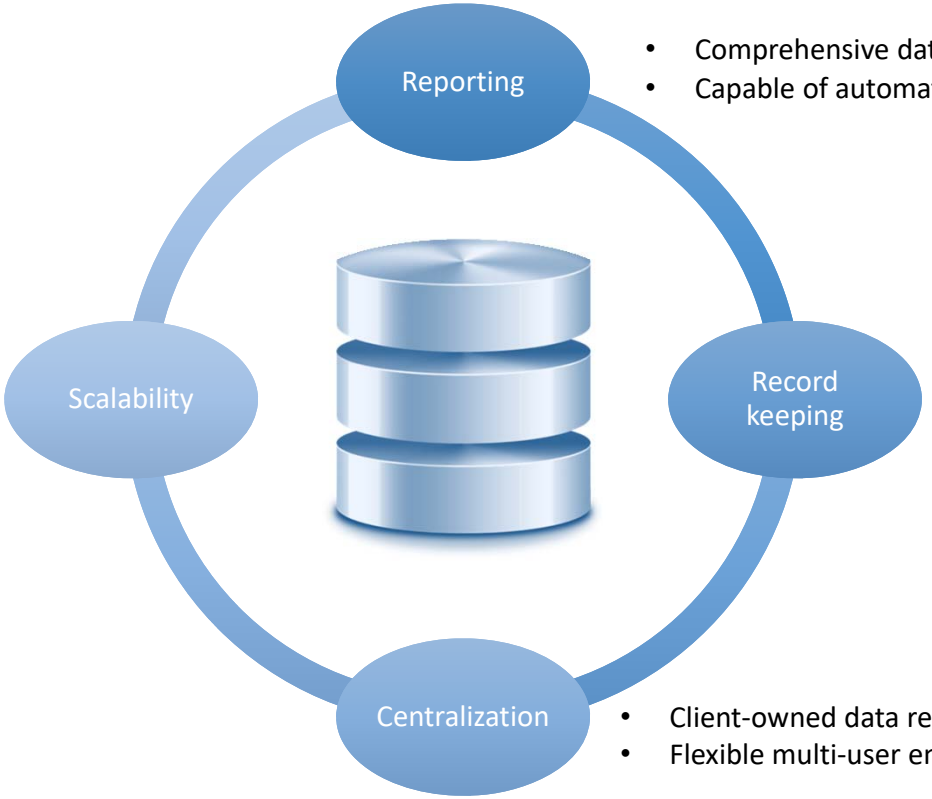
<u>LiDAR point-cloud and Digital Elevation Models (DEMs)</u>

- High sample density for increased accuracy and precision
- Point-cloud classification and enhanced post-processing
- Near-real-time volumetric analysis and interpretation
- Allows easy access and full coverage in inaccessible places



Solution 4: Centralized Database Management

- Adaptable for other needs, such as GIS mapping & 3D modeling
- Scalable for exponential expansion
- Can accommodate new data-types and new data-collection methods



- Comprehensive data reporting of project information
- Capable of automated spatial analyses

- Perpetual documentation
- Multi-discipline data repository
- Secure, cloud environment

- Client-owned data resource
- Flexible multi-user environment

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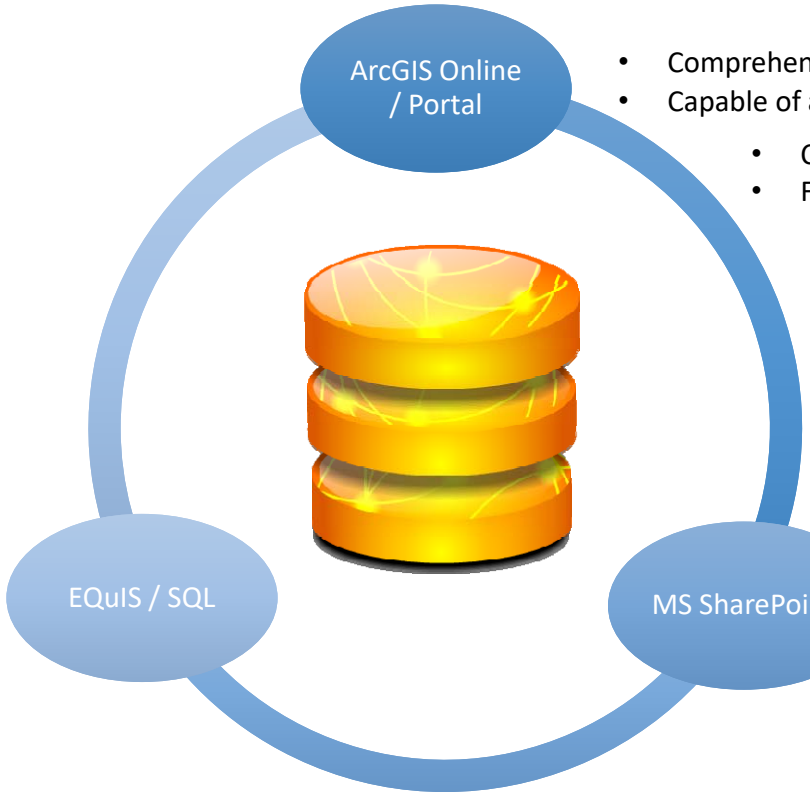

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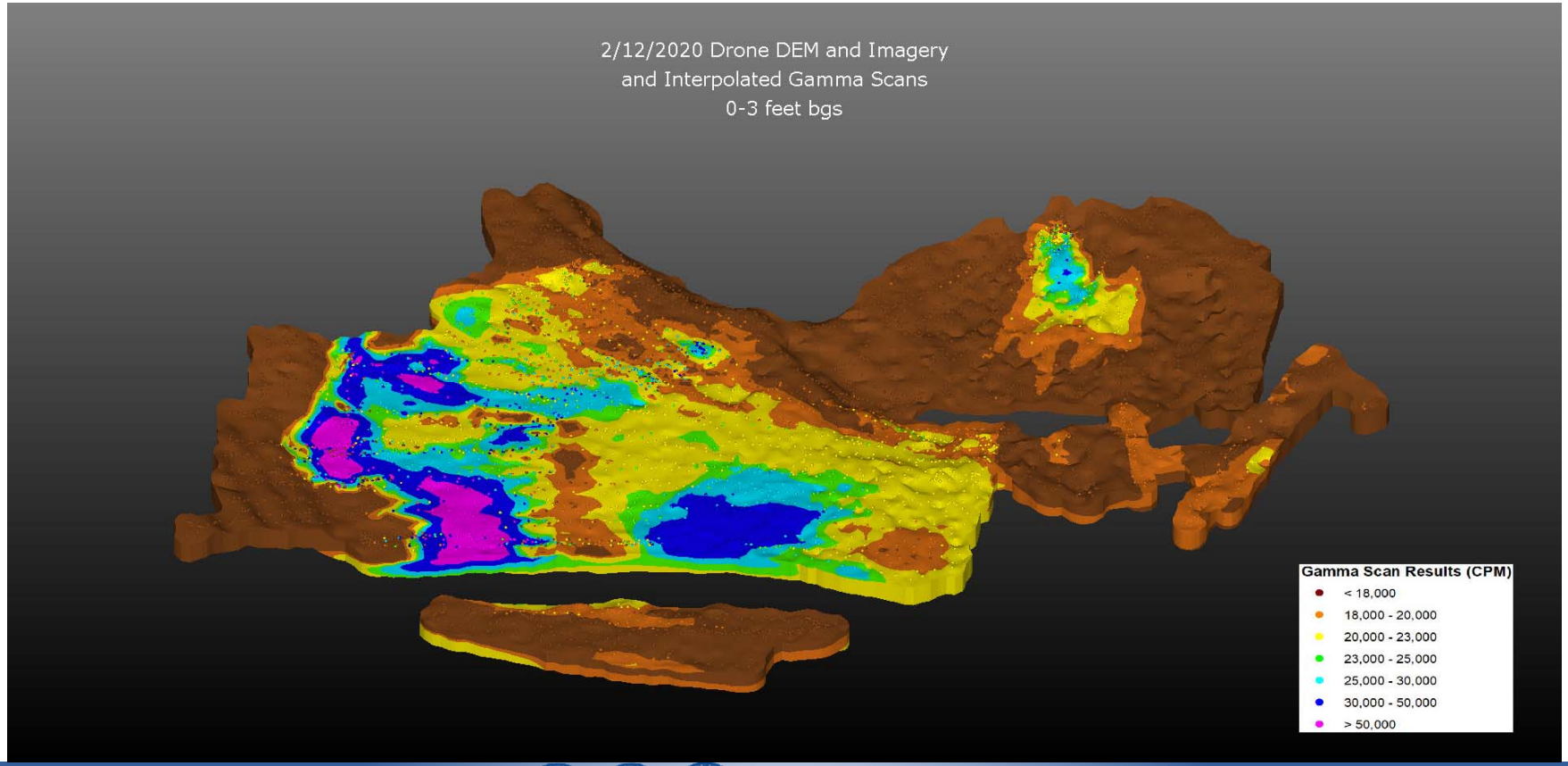
Solution 5: 3D Visualization and Modeling



2/12/2020 Drone DEM and Imagery and Interpolated Gamma Scans

Former Chambers Works FUSRAP Site Team

- USACE
  - Daniel M. Sirkis, PG - US Army Corps of Engineers Philadelphia
  - George Bock - US Army Corps of Engineers Philadelphia
  - Dave Watters, CHP - US Army Corps of Engineers Baltimore
- Ramboll
  - Thomas Cornuet, PG
  - Tim Cushman, GISP
  - Christopher Bowles (Founder and Director of Galago)
  - Kyle Kohler (FAA certified UAV pilot)
- Sevenson
  - Don Wadsworth, MSHP
  - Daniel Caputo, CHP