PGDP Seismic Characterization Project (SCP)
Technical Team Approach

University of Kentucky

Center for Applied Energy Research

Kentucky Research Consortium for Energy and Environment

Department of Earth and Environmental Sciences

Collier Geophysics

Explor, Geotomo, STRYDE

Lettis Consulting International

Chase-Cascade Drilling

December 2, 2024

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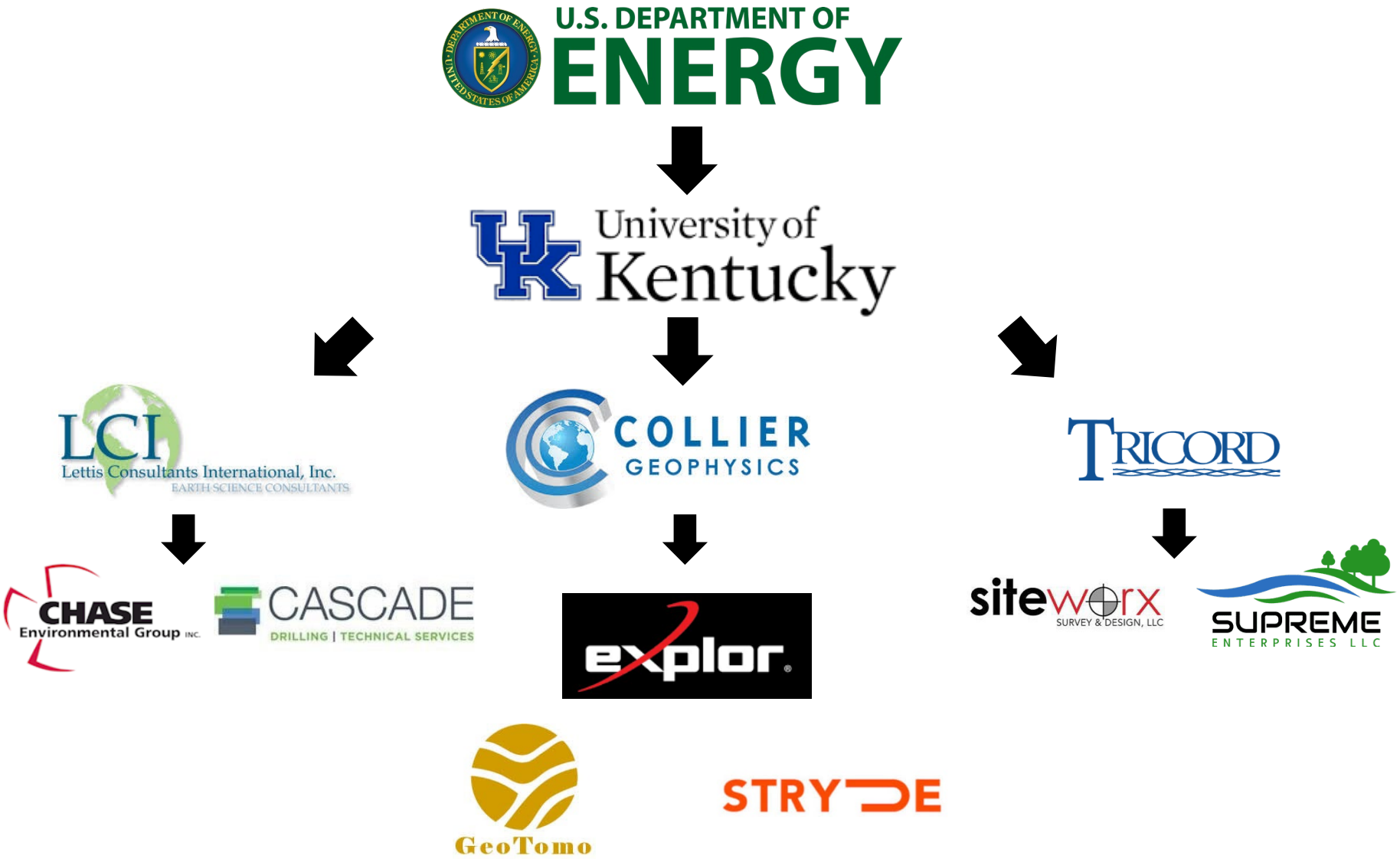
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PGDP Seismic Characterization Project (SCP) Technical Team Approach



PGDP Seismic Characterization Project (SCP)
Problem Description (DQO Background)

DQO Step 1. Problem Statement

Problem Description

- The U.S. Department of Energy's (DOE) Paducah Gaseous Diffusion Plant (PGDP) is located between two major intraplate seismic zones: the New Madrid Seismic Zone (NMSZ) and the Wabash Valley Seismic Zone (WVSZ).
- This places the PGDP within the seismic "halo" zone associated with each, and within the Fluorspar Area Fault Complex (FAC or FAFC), a northeast-oriented structural accommodation zone associated with the failed late Precambrian—early Cambrian rifting.
- Fault segments of the FAC are adjacent to and underlie the PGDP, and are in an area of modern, instrumentally recorded seismicity. However, no associated fault has been reported in the scientific literature (to date) having earthquakes large enough to produce displacement and/or deformation in geologic formations later than the Pleistocene.
- The seismically active WVSZ has shown evidence (e.g., liquefaction) of large earthquakes in the Holocene.
- In the NMSZ, historic reports from 1811–1812 indicate a sequence of at least three great earthquakes with estimated magnitudes > 7 occurring around the frontier community of New Madrid, Mo., approximately 55 miles southwest of PGDP.

PGDP Seismic Characterization Project (SCP)
Problem Description (DQO Background)

DQO Step 1. Problem Statement

Problem Description … cont'd

- DOE is evaluating PGDP waste disposal alternatives, including an On-Site Waste Disposal Facility (OSWDF), to support a future decision for Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) waste disposal.
- The Code of Federal Regulations (CFR), Subtitle D, Title 40, Part 258, subpart B (258.13) requires that disposal facilities be located more than 200 feet from a fault that has produced displacement or deformation within the Holocene (i.e., the past 11,700 years).
- Disposal facilities in seismically active areas must also be designed to withstand ground motion as specified by state-of-the-practice probabilistic hazard assessment techniques. Determining spatial and temporal characteristics of near-surface fault displacement and/or neotectonic deformation will also reduce uncertainty for the overall seismic hazard assessment.

PGDP Seismic Characterization Project (SCP)
Problem Description (DQO Background)

DQO Step 1. Problem Statement

Problem Description … cont'd

The University of Kentucky (UK) and others have deployed a range of standard geophysical field methods at PGDP between the early 1990s to the mid-2010s. These efforts were to satisfy applicable regulatory mandates relative to:

- Measuring the dynamic properties of the sediment overburden at various locations on the reservation to define and constrain the parameters for the site transfer functions and earthquake ground-motion response.

- Imaging the near subsurface for the presence of Quaternary-active faults, and if present, determining their potential spatial and temporal characteristics and effects in a Holocene sediment context. These parameters, elements of a larger seismic-hazard analysis, guided the footprint location and potential displacement setback criteria associated with the design, permitting, and construction of on-site waste-disposal cells.

PGDP Seismic Characterization Project (SCP)
Problem Description (DQO Background)

DQO Step 1. Problem Statement

Summary: (from KRCEE/DOE/USEPA R4/KDWM Meeting)

- Spatial and temporal seismotectonic characteristics at the PGDP site need to be defined to support the evaluation, approval, design, and construction of a proposed OSWDF used for environmental restoration and demolition of PGDP and the transfer of Paducah Site real property to the public for future use.

PGDP Seismic Characterization Project (SCP)
Project Approach (DQO Background)

DQO Step 1. Problem Statement

Problem Approach:

In coordination with DOE personnel and contractors, UK personnel and contractors will utilize state-of-the-art geophysical imaging, paleoseismology, and bedrock ground-motion design methods to:

- Derive characteristic earthquake time histories in terms of amplitude, spectra, and duration for the OSWDF engineering design using appropriate regulatory required probabilistic seismic hazard assessment techniques.

- Characterize the spatial and temporal seismotectonic sediment displacement and/or deformation at the two proposed OSWDF sites using recognized non-invasive geophysical imaging (e.g., P- and SH-wave seismic-reflection common-midpoint surveying), as well as invasive paleoseismic spatial mapping (e.g., borehole and trenching stratigraphic correlation) and ancillary temporal constraints (e.g., Optically Stimulated Luminescence, 14C, etc.), addressing the regulatory offset requirements for Holocene-active faults.

- Use derivative methods from the non-invasive surface seismic data to measure in-situ shear-wave velocity and dynamic site properties supporting engineering design, as well as identifying potential materials of design concern (e.g., loose sand bodies) underlying potential OSWDF locations.

PGDP Seismic Characterization Project (SCP)
Study Goals (DQO Background)

DQO Step 2. Identify the Goals of the Study

Project Goals:

- Technically address seismic siting and construction design components to support the construction of a CERCLA OSWDF at PGDP and support future use of the PGDP site.

- Identify a design bedrock ground motion for engineers to establish the OSWDF performance criteria. This process will include the appropriate level of probabilistic seismic hazard analysis (PSHA).

PGDP Seismic Characterization Project (SCP)
Information Inputs (DQO Background)

DQO Step 3. Identify Information Inputs

- Field data, both surface and/or borehole, will be collected for:
  - Imaging the near-surface geology for indications of potential earthquake fault displacement/deformation in existing Holocene units.
  - Attaining a shear-wave velocity of the sediment/soil overburden and dynamic site period at each candidate OSWDF site. Lateral variation, as well as vertical, will be addressed to the resolvable extent possible.
- At least one of the "deep" boreholes completed by the design contractor will be used by UK for subsequent instrumentation and long-term monitoring to improve the observational aperture of the local microseismicity to define any spatial clustering on discrete structure.

PGDP Seismic Characterization Project (SCP)
Study Boundaries (DQO Background)

DQO Step 4. Identify the Boundaries of the Study

Spatial Boundaries:

The approximate spatial boundaries of the study area encompass the DOE-PGDP Reservation, its immediate vicinity and nearby areas necessary to understand the relationship of faulting beneath the PGDP with faulting in the nearby Illinois part of the FAFC (subregional fault characterization).

Temporal Boundaries:

- Complete seismic field and technical work to support design, SME approval and regulatory approval of an OSWDF at PGDP in FY2025 – FY2026.
- Complete seismic reporting for a cell design start in FY2025, to be on schedule for record of decision (ROD) submission in FY2029.
- Complete subregional fault characterization in FY2027.
- Complete subregional fault characterization reporting in FY2028.
- Complete subregional paleoseismic feature characterization reporting in FY2028

PGDP Seismic Characterization Project (SCP)
Analytical Approach (DQO Background)

DQO Step 5. Develop the Analytical Approach

- Conduct appropriate field data collection for imaging near-surface neotectonic features, as well as characterizing bedrock velocity and soil properties at candidate OSWDF sites. Techniques to be used will include:
  - 6- or 9-component P- and SH-wave seismic-reflection common-midpoint surveying, pre-modeled and optimized for the specific PGDP candidate sites.
    - A minimum of 6,000 nodes will be statically deployed at any one time.
  - Lithologic description/characterization using standard observational descriptions, as well as core scanning that will provide density, magnetic susceptibility, and P-wave sonic velocity logs. Soil/sediment samples collected from focused borings will be used for 14C & OSL dating measurements.
  - Trenching and/or drilling on target faults.

PGDP Seismic Characterization Project (SCP)
Analytical Approach (DQO Background)

DQO Step 5. Develop the Analytical Approach (cont'd)

- Use new literature background to conduct a candidate site PSHA and update the most recent conventional PSHA (Risk Engineering 1999). This can utilize the local PSHA value identified in the 2023 U.S. Geological Survey National Seismic Hazard Map (Peterson et al. 2023) to provide design ground motion for the OSWDF.

- Short-term temporary 3-component seismic monitoring of an OSWDF candidate site to acquire in-situ fundamental (and higher-mode?) site response characteristics using the empirical horizontal-to-vertical ratio (HVSR) from ambient noise and/or any recorded earthquakes. This will assist cell design engineers identify potential double-resonance issues arising from large structures such as an OSWDF that often have spectral sensitivities at or around 1-second periods.

PGDP Seismic Characterization Project (SCP)
Analytical Approach (DQO Background)

DQO Step 5. Develop the Analytical Approach (cont'd)

- Continue microearthquake and strong-motion monitoring at and near PGDP using stations with the Kentucky Seismic and Strong-Motion Monitoring Network (KSSMN).

- Incorporate and instrument any observational stations established in this study for future microearthquake and strong-motion monitoring (Phase 2 future work).

- Conduct P-wave and SH-wave data acquisition and processing to identify and characterize FAFC southern Illinois fault trends that likely extend beneath the DOE reservation (Phase 2 future work).

- Conduct reconnaissance and characterization of subregional paleoseismic features to better determine the timing, location, and magnitude of their seismic sources (Phase 2 future work).

PGDP Seismic Characterization Project (SCP) Performance Criteria (DQO Background)

DQO Step 6. Specify Performance or Acceptance Criteria

Location/Issue	Requirement/Comment Summary	Regulation/Notification/ Comment
PSHA return period *(applicable)	Requirement that any landfill in a seismic impact zone be designed to resist its site-specific PGA having a 2500-year return period	KDWM (Kentucky Division of Waste Management) 2002. Letter from Robert H. Daniell, Director, February.
Siting (applicable)	Portions of new facilities where treatment, storage, or disposal of hazardous waste will be conducted shall not be located within 61 meters (approximately 200 ft) of a fault that had displacement in Holocene time.	401 KAR 34:020 § 9(1) 40 CFR § 264.18(a)
Design requirements for a TSCA chemical waste landfill (applicable)	Shall be located in thick, relatively impermeable formations such as large area clay pans. Where this is not possible, the soil shall have a high clay and silt content with the following parameters:	40 CFR § 761.75(b)(i)
	In-place soil thickness of 4 ft or compacted soil liner thickness of 3 ft	40 CFR § 761.75(b)(i)(i)
	Permeability equal to or less than 1×10^{-7} cm/sec	40 CFR § 761.75(b)(i)(ii)
	Percent soil passing No. 200 sieve > 30	40 CFR § 761.75(b)(i)(iii)
	Liquid limit > 30	40 CFR § 761.75(b)(i)(iv)
	Plasticity index > 15	40 CFR § 761.75(b)(i)(v)
Siting of LLW disposal facility (relevant and appropriate)	Areas shall be avoided if tectonic processes, such as faulting, folding, seismic activity, or vulcanism may occur with a frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives of 902 KAR 100:022 or may preclude defensible modeling and prediction of long-term impacts	902 KAR 100:022 § 22(9)
Siting LLW disposal facility (TBC)	Proposed locations for low-level waste facilities shall be evaluated considering environmental characteristics, geotechnical characteristics, and human activities including whether it is located in a floodplain, a tectonically active area, or in the zone of water table fluctuation.	DOE M 435.1 1 (IV)(M)(3)(a)(2)

Source: (DOE 2018)

PGDP Seismic Characterization Project (SCP)
Performance Criteria (DQO Background)

DQO Step 6. Specify Performance or Acceptance Criteria (con't)

* **Applicable Requirements.** Are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting law that are legally applicable and specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site (40 CFR § 300.5).

* **Relevant and Appropriate Requirements.** Are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental, state environmental, or facility siting law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (40 CFR § 300.5).

* **To Be Considered (TBC) Guidance.** In addition to federal or state-promulgated regulations, there are other advisories, criteria, or guidance to be considered for a particular release that were developed by the U.S. Environmental Protection Agency, other federal agencies, or states that may be useful in developing CERCLA remedies. Published unpromulgated information that does not necessarily meet the definition of an ARAR may be necessary, under certain circumstances, to determine what is protective of human health and the environment. These are not potential ARARs but are TBC guidance [40 CFR § 300.400(g)(3)].

PGDP Seismic Characterization Project (SCP)
Plan for Data Acquisition (DQO Background)

DQO Step 7. Develop the Detailed Plan for Obtaining Data

The process of obtaining data has been laid out in Step 5.

References

Petersen, M.D., and 52 others. 2024. The 2023 US 50-State National Seismic Hazard Model: Overview and implications. *Earthquake Spectra* 40(1): 5–88. https://doi.org/10.1177/87552930231215428

Risk Engineering Inc. 1999. Updated Probabilistic Seismic Hazard Analysis for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Final Report (Revision 3), April 26, 1999.

DOE Headquarters Independent Review Team Report on Paducah Gaseous Diffusion Plant Seismic Characterization, Department of Energy Independent Review Team, June 2009.

DOE. 2018. Remedial Investigation/Feasibility Study Report for CERCLA Waste Disposal Alternatives Evaluation at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-0244&D2/R1.

PGDP Seismic Characterization Project (SCP)

PGDP Seismic Characterization Project (SCP)

SCP Overview

The SCP Project Consists of 2 Major Objectives

Technically address seismic siting and construction design components to support the construction of a CERCLA OSWDF at PGDP and support future use of the PGDP site.

1. Conduct non-invasive (geophysical) imaging and invasive (paleoseismic) sampling field surveys to identify potential Holocene (<12,000 years BP) seismogenic faults or deformation within the footprint or a 200-ft perimeter around the site.
2. Identify a design bedrock ground motion for engineers to establish the OSWDF performance criteria. This process will include the appropriate level of probabilistic seismic hazard analysis (PSHA)

PGDP Seismic Characterization Project (SCP)
SCP – Objectives/Tasks

1. Identify and design a bedrock ground motion that engineers can apply to the site-specific transfer function and establish the OSWDF performance criteria. The design bedrock ground motion process will include the level of appropriate probabilistic (PSHA)

   Task 1. Develop PSHA derived design-level bedrock ground motions conforming to applicable seismic hazard regulations and criteria for candidate sites

2. Technically address seismic siting and construction design components to support the construction of a CERCLA OSWDF at PGDP and support future use of the PGDP site.

   Task 2. Field Data Acquisition and Data Processing, Assessment, & Interpretation
   - Geophysical P- and SH-wave seismic-reflection CMP acquisition, processing, and interpretation
   - Paleoseismic Investigation of Geophysically-Derived Targets
     - Drilling 1 – Preliminary Materials/Lithologic Calibration Data (CPT/DPT)
     - Test Pits (TP's) – Direct Lithologic Calibration Observations
     - Drilling 2 – 'Paleoseismic' DPT's on Geophysical Targets
     - Trenching – Direct observation of targets from Drilling 2 & Geophysics

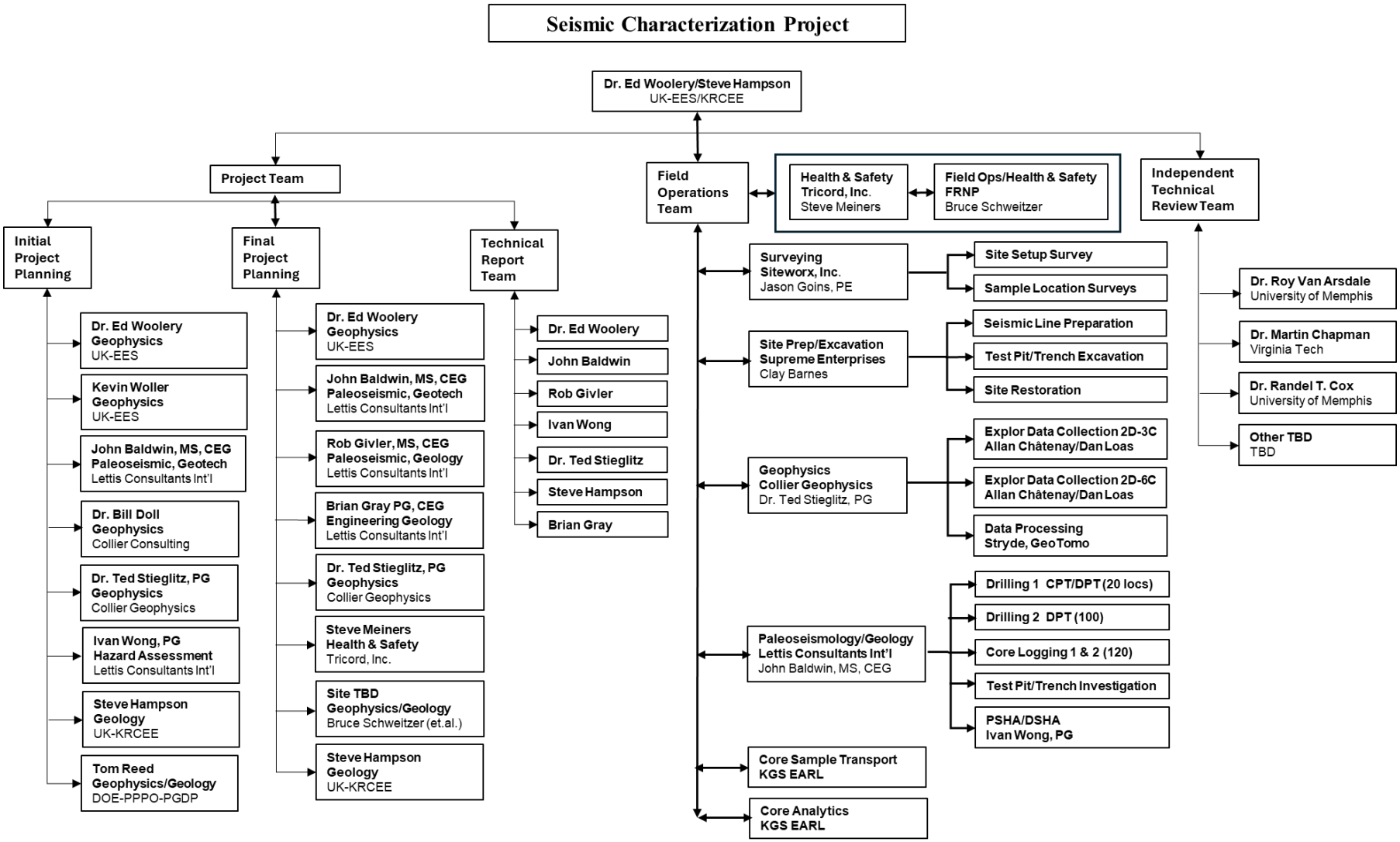
   Task 3. Conduct Independent Technical Review (ITR)

   Task 4. Data Dissemination & Reporting

PGDP Seismic Characterization Project (SCP)
SCP Project Team

Organization	Role	Contact
KRCEE	Project Planning (Co-PI)	Steve Hampson
	Project Management (Co-PI)	Dr. Ed Woolery
	Financial Management	Don Challman
Collier Geophysics (CGP)	Project Planning	Dr. Ted Stieglitz
	Geophysical Data Collection	Dr. Bill Doll
	Data Processing	Field Staff (tbd)
Explor (CGP Sub)	Field Equipment Preparation/Testing	Allan Châtenay
	Field Geophysical Deployment	Daniel Loas
	Field Source/Receiver Equipment	Field Staff (tbd)
	Field Data Collection	
Stryde (CGP Sub)	Geophysical Data Processing	Contacts (na)
GeoTomo (CGP Sub)	Geophysical Data Processing	Contacts (na)
Lettis Consultants International (LCI)	Project Planning	John Baldwin
	Seismic Hazard Assessments	Rob Givler
	Drilling (CPT & DPT) (Subs tbd)	Ivan Wong
	Chain of Custody (Core & Samples)	
	Lithologic Characterizations	Field Staff (tbd)
	Test-Pit/Trench Assessments	
Tricord, Inc.	Health and Safety (H&S) Plan	Steve Meiners
	Field Task & Personnel H&S	Andrea Hays
	Field Sample Screening	
	Equipment Screening	
Siteworx	Site Preparation Survey	Jason Goins
	Post Sampling Surveys	Herbert F. Simmons
Supreme Enterprises	Site Prep, Chipping, Mulching	Clay Barnes
	TP/Trench Excavation	
	Site Restoration	
Kentucky Geological Survey (KGS)	Core Transportation	Contacts (tbd)
	Core Materials Properties Testing	
UK Earth and Environmental Sciences	Supplemental Geophysical Data Collection	Dr. Ed Woolery
	Supplemental Geophysical Data Processing	

PGDP Seismic Characterization Project (SCP)
Project Organization

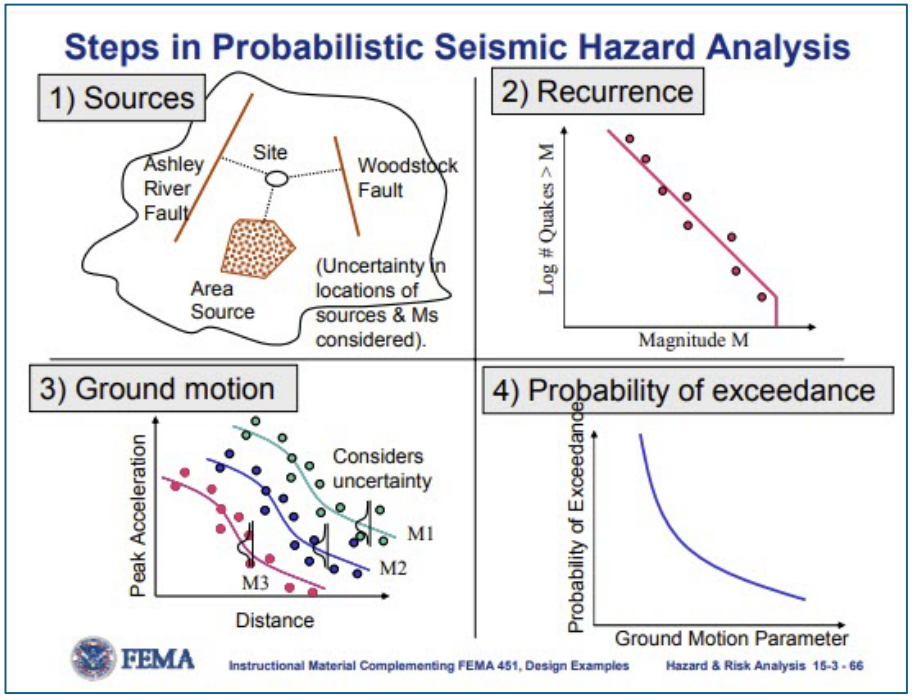


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PGDP Seismic Characterization Project (SCP)
Task 1. Seismic Hazard Assessments

Probabilistic seismic hazard analysis (PSHA) estimates the likelihood that various levels of earthquake-caused ground motions will be exceeded at a given location in a given future time period. The results of such an analysis are expressed as estimated probabilities per year or estimated annual frequencies**."**



Probabilistic Outcome (example, not PGDP)

"The earthquake hazard for the site is a peak ground acceleration of 0.28g with a 2 percent probability of being exceeded in a 50-year period."

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Fieldwork Data Collection and Assessment conducted in ten (10) phases.

- **Phase 1. Development of Project Workplans, Health and Safety Plans**
  Workplans identify guidelines for execution of work and identify Health and Safety practices for execution of work
- **Phase 2. Site GPS and Civil Surveys**
  Set up the site for fieldwork and continues to document field data locations throughout all phases
- **Phase 3. Site Preparation for Site Geophysical Data Lines**
  Prepares the geophysical lines for node placement, source deployment, data collection and site vehicle/equipment traffic
- **Phase 4. Collection & Processing of Field Geophysical Data**
  Node deployments, source testing & deployment, data acquisition, data processing (Brute Stack thru Final)
- **Phase 5. Collection of CPT Soil Property Measurements**
  Collection and evaluation of in-situ core materials properties
- **Phase 6. Collection of DPT Cores 1, Core Material Testing and Lithologic Characterization 1**
  Collection of 20 DPT Cores at Sites 5b & 11, core transport to KGS-EARL, Lithologic Logging, Properties Testing
- **Phase 7. Excavation of Observation Test Pits & Test Pit Restoration**
  Excavation of Test Pits at Sites 5b and 11, Paleoseismic/Lithologic/Stratigraphic Observations, Sampling, Restoration
- **Phase 8. Collection of DPT Cores 2, Core Material Testing and Lithologic Characterization 2**
  Collection of 100 DPT Cores at Sites 5b & 11 based on P & SH wave targets, core transport to KGS-EARL, Paleoseismic/ Lithologic/Stratigraphic logging, Properties Testing
- **Phase 9. Trench Excavation & Direct Trench Lithostratigraphic Characterization**
  Excavation of trenches based on targets from Phases 4 – 8, Paleoseismic/Lithologic/Stratigraphic logging, Sampling
- **Phase 10. Line and Trench Restoration**
  Restoration of trenches and lines

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

- **Phase 1. Development of Project Workplans, Health and Safety Plans, Training**
  a. Workplans identify guidelines for execution of work and identify Health and Safety practices for execution of work
  b. Draft Workplan for Geophysical Data Collection submitted November 2024
  c. Final Workplan and HASP for On-Site PGDP Geophysical Data Collection
  d. Draft Paleoseismic Work Plan and HASP submitted February 2025

- **Phase 2. Site GPS and Civil Surveys**
  a. Set up the site for fieldwork and document field data locations throughout all project phases
  b. Survey seismic lines, hinge points on seismic lines
  c. Survey DPT, CPT and Test Pit locations
  d. Survey trench features and sample locations
  e. Survey restoration - Trenches

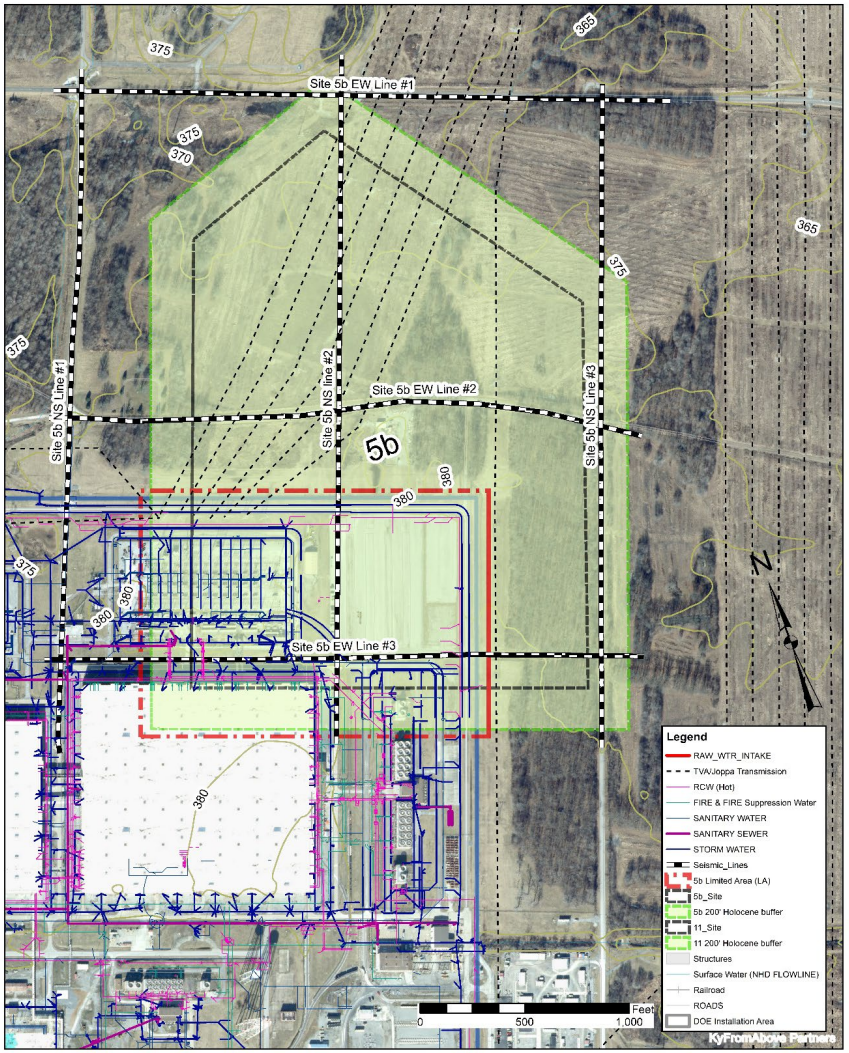
- **Phase 3. Site Preparation for Site Geophysical Data Lines**
  a. Prepare geophysical lines for node placement, source deployment, data collection and site vehicle/equipment traffic
  b. Original seismic lines required clearing and grubbing 1000+ feet of densely wooded lines
     - Modified survey lines to locations along roads as well as through grass and brush instead of dense woods
  c. Allowed modification of site preparation to chipping and mulching
  d. Chipped, mulched material left in place will protect soil surface from vehicle, equipment and pedestrian traffic
  e. Preparation of drill pads if necessary

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phase 4. Collection and Processing of Field Geophysical Data

- 4 seismic lines encompass Site 5b
- 2 seismic lines cross interior of Site 5b
- Seismic lines total length @ 3.7 mi.

- 27 acres of 5b is within Limited Area
- Active and Abandoned Infrastructure
- Electric, Water, Cooling system, Process



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PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phase 4. Collection and Processing of Field Geophysical Data

- Seismic data collection will utilize high-density wireless nodes
- Utilize STRYDE™ equipment (Explor-custom spikes, nodes, hardware, software, geo-positioning). https://strydefurther.com/what-we-do/the-nimble-system
- Collect S-Wave (transverse in 2 source passes), S-Wave (radial/longitudinal in 1 source pass), and P-Wave data (vertical w/ 1 source pass); 9-component data.
- Node station/group spacing along lines is 1 meter ~ Up to 1100 locations/line.
- 3 nodes mounted on spike at each location ~ Up to 3300 nodes/line. https://www.linkedin.com/pulse/explor-successfully-completes-first-three-component-seismic-chatenay



STRYDE nodes in their 9-capacity magazine.


3-component nodal deployment in experimental wave-box for assessing various source radiation patterns.


Test line deployment on Anderson Road north of Site 11 in the WKWMA

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PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phase 4. Collection and Processing of Field Geophysical Data

- Primary Energy Sources: 1) EXPLOR Lightspeed vertical and transverse impact and 2) I-beam & hammer
- Source testing/maintenance/upgrades November – December 2024
- P- and SH-wave field testing November 2024 – January 2025
- P- and SH-wave production data acquisition underway January 2025
- Data processing: Brute Stack thru Final began January 2025 – December 2026
- Signal Processing Vendors: Stryde and GeoTomo
- UK In-House Signal Processing: S-wave Splitting/Birefringence, Wave Box, MASW, HVSR, SPAC

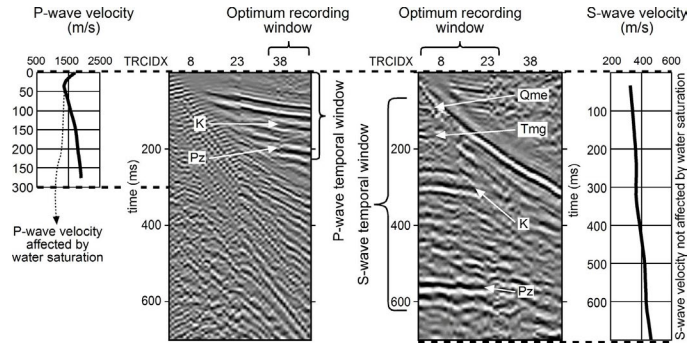
Explor Lightspeed



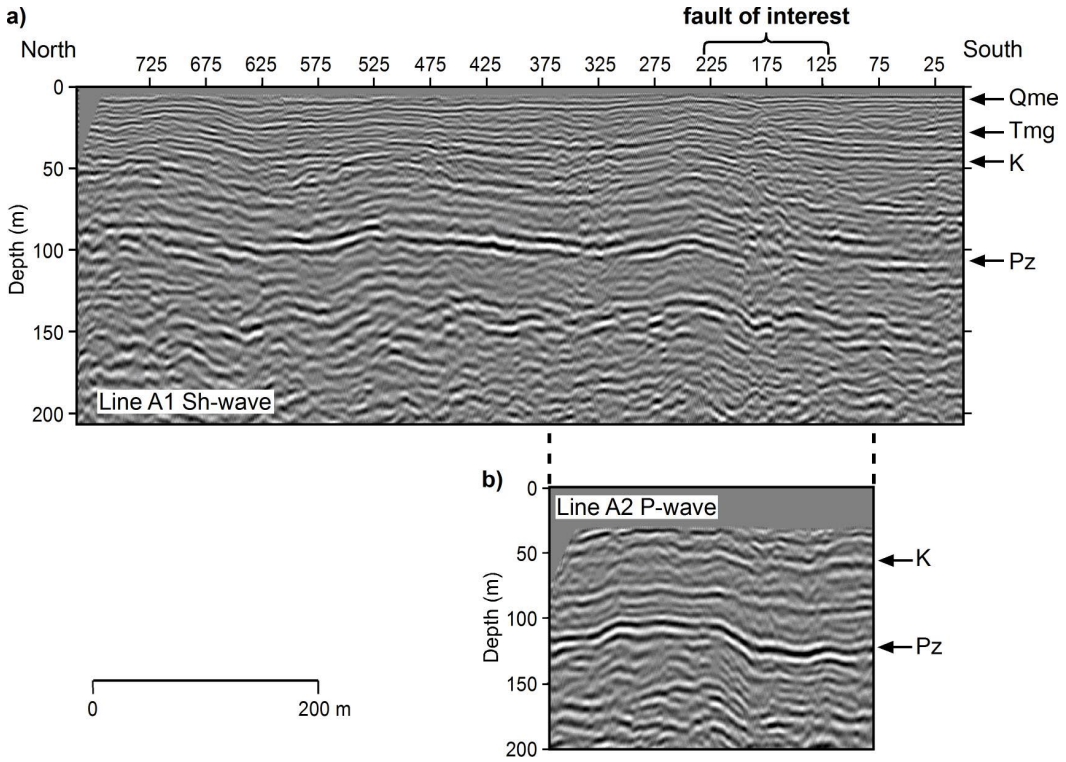
PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phase 4. Collection and Processing of Field Geophysical Data

- P- and SH-wave Energy Modes:



P-wave and SH-wave walkaway sounding tests are shown on the left and right sides of the figure, respectively. These initial tests were used to define the optimum spatial and temporal recording windows for both energy modes. The P-wave has a more limited recording window relative to the SH-wave data. Also, the P-wave stacking velocity curve indicates sensitivity to the groundwater that can often mask the lithologic matrix, whereas the water does not affect the S-wave velocity curve (Woolery and Almayahi, 2014).



(a) Line A1-SH and (b) Line A2-P are stacked depth-converted CMP reflection images coincidentally acquired along Bethel Church Rd, just west of the PGDP reservation boundary. The lines are very low fold, but high quality and provide an excellent comparison of the benefits for using P- and SH-mode energy, particularly in the context of the latter's better recording window (Woolery and Almayahi, 2014).

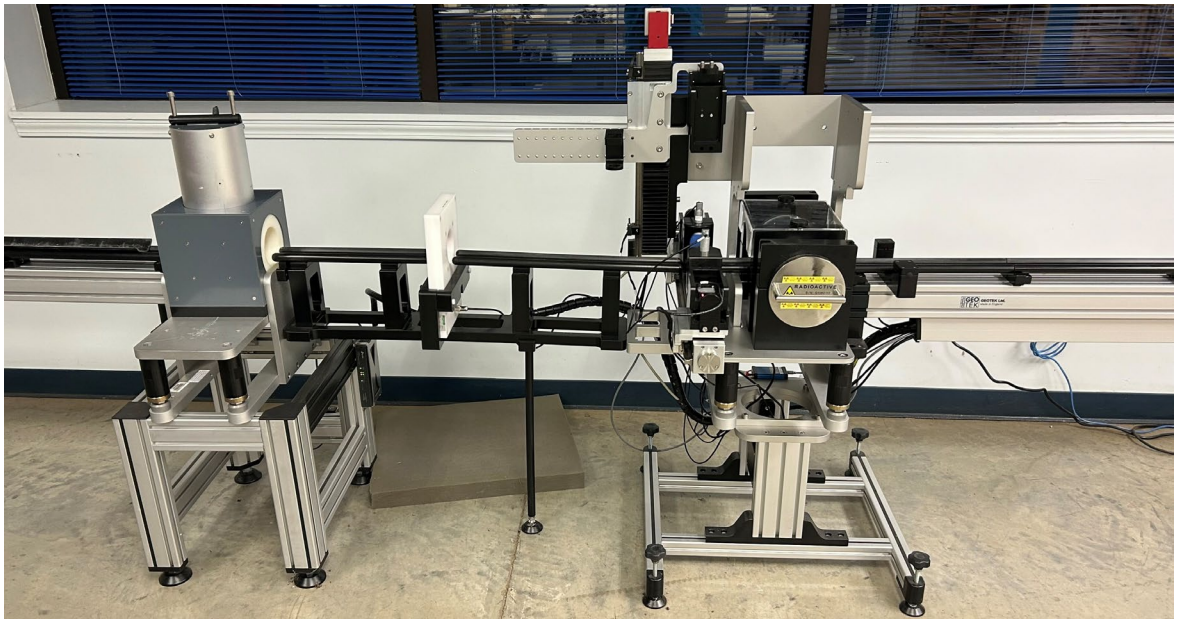
PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phases 5-10. Paleoseismology

- DPT and Core Scanning Technology:



Geoprobe "Direct Push Tube" (DPT) samples in the plastic liners/sleeves. Prior to splitting the samples, the core will be returned to UK and scanned for physical index properties. After the core is split, LCI will perform observational logging and correlate stratigraphic boundaries. From https://www.legiondrilling.com.au/direct-push-sampling-environmental-drilling

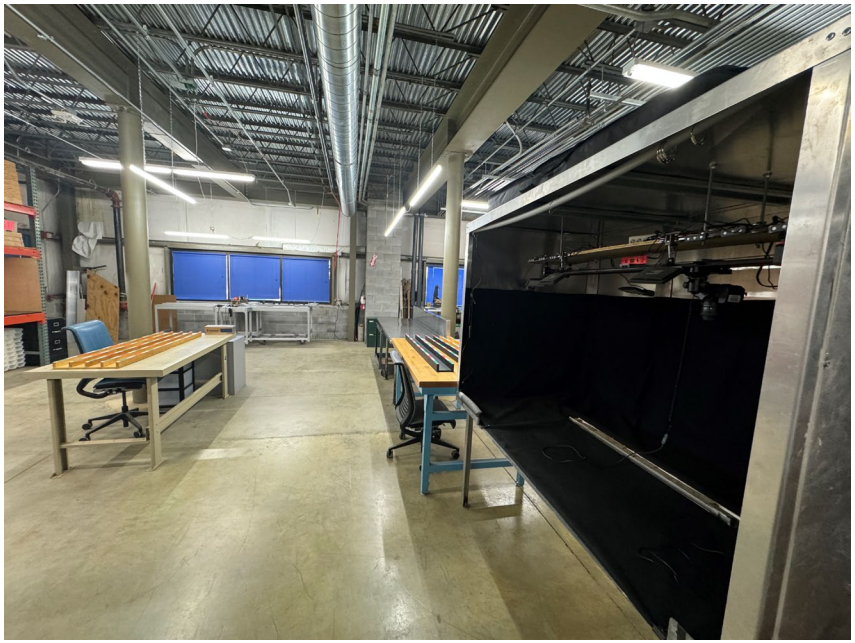


The UK-KGS Earth Analysis and Research Lab's new GeoTek Core Scanner can analyze physical index properties (e.g., P-wave velocity, magnetic susceptibility, density, etc.) on DPT samples inside their plastic liners/sleeves prior to splitting the core. The cores can be analyzed at the sub-centimeter to 10's of centimeter scale.

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phases 5-10. Paleoseismology

- Paleoseismic Core Photography and Observational Logging:



UK-KGS Earth Analysis Research Laboratory (EARL) high-resolution photography chamber (stainless steel chamber on right side of photo), and its ancillary core staging area in the background.

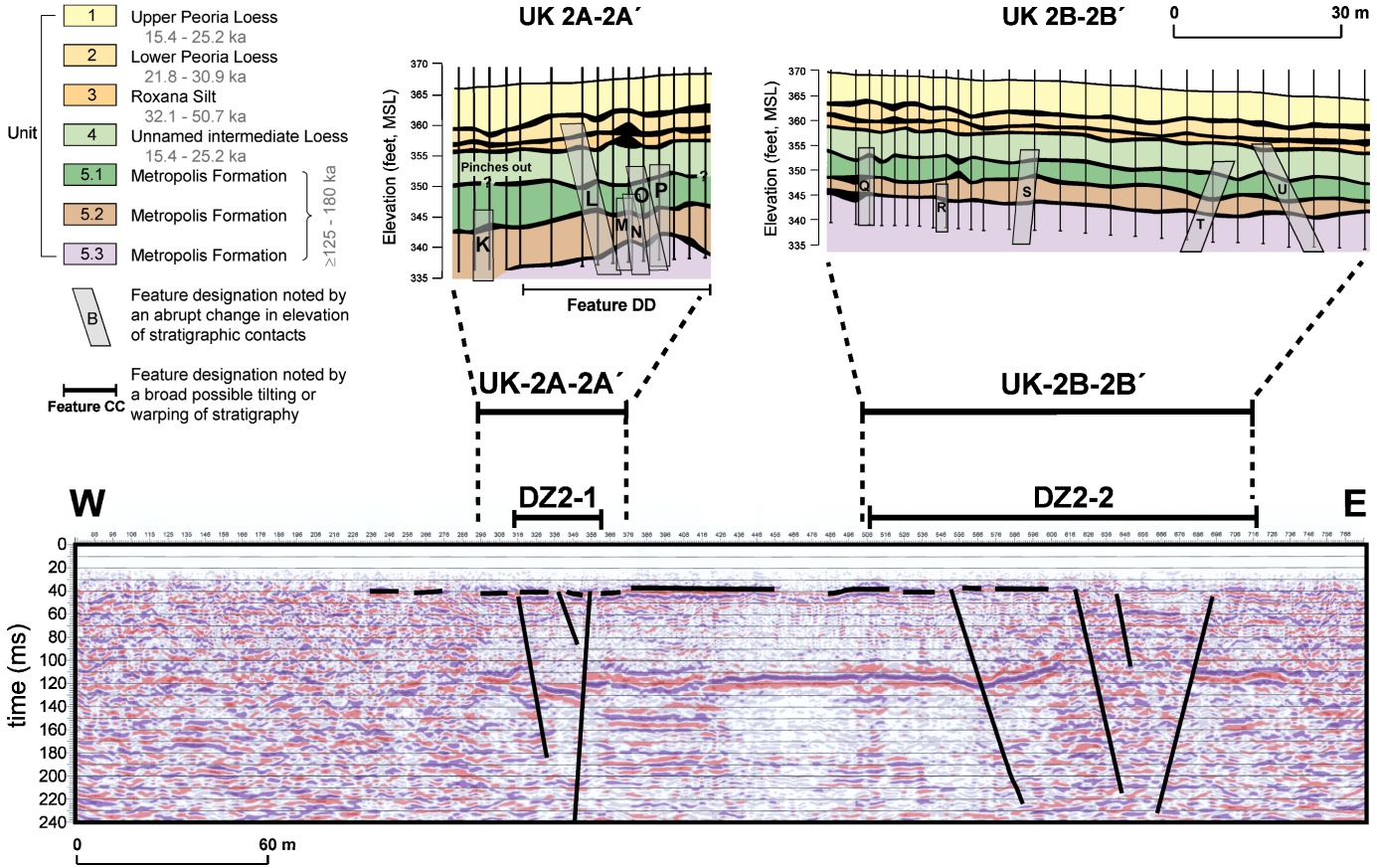


UK-KGS Earth Analysis Research Laboratory (EARL) core observational logging stations with organized scaled trays for displaying 50-ft of split core in liners. The logging station in background is being retrofitted as a “dark room” for extracting datable OSL samples.

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phases 5-10. Paleoseismology (example)

- DPT Sampling and Correlative Cross-Section over a Seismic-Reflection Imaged Target:

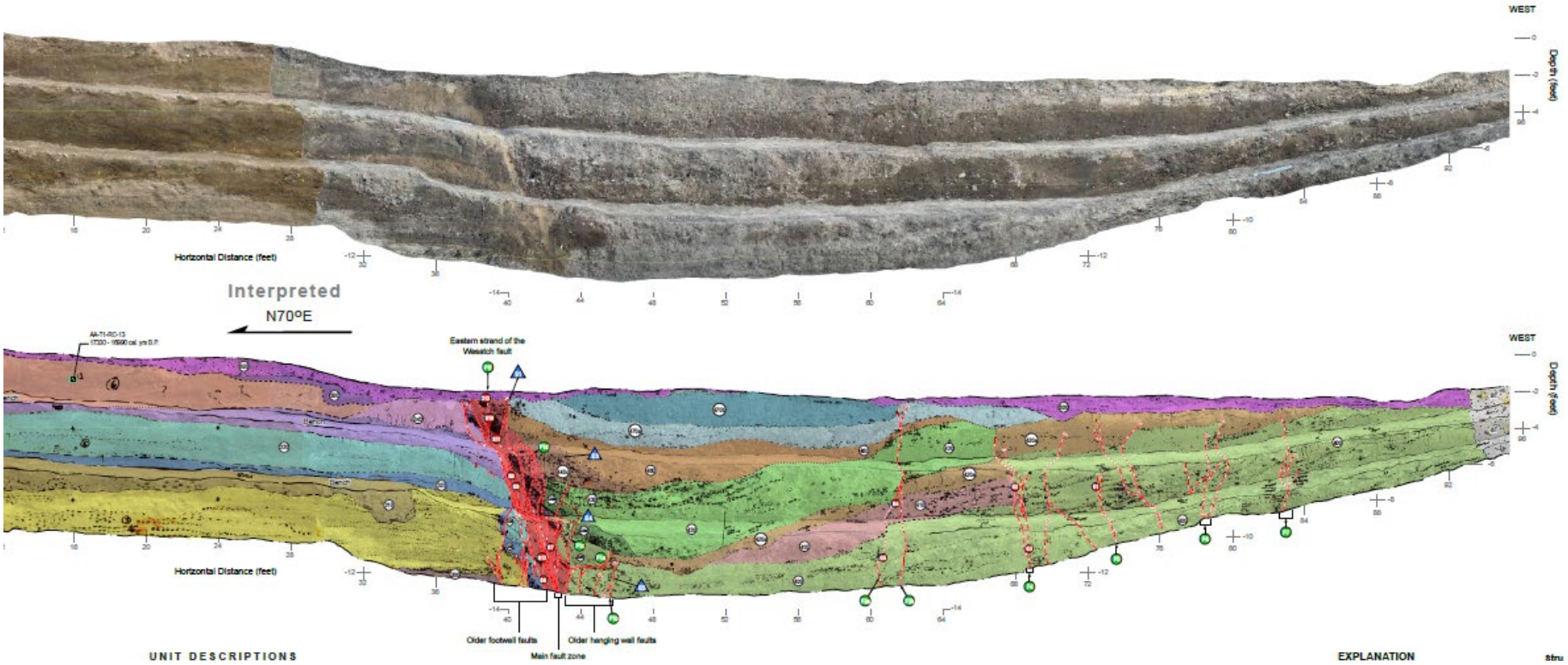


Previous DPT high-density borings and interpretive correlations over SH-wave seismic reflection targets at the PGDP C-746-U landfill (Woolery et al., 2009).

PGDP Seismic Characterization Project (SCP)
Task 2. Fieldwork Data Collection and Assessment

Phases 5-10. Paleoseismology (example)

- Paleoseismic Trench and Interpretive Overlay placed over a Geophysically Imaged Target:



Example terraced or stepped trench with a high-resolution photo-mosaic wall image (top) and a detailed geologic/neotectonic interpretative overlay (bottom) that was part of a previous DOE study in the western United States (LCI, 2019).