The 54th STGEC, Williamsburg, VA

# A Software-Agnostic Approach to Geotechnical Data Management Supporting Design and Construction

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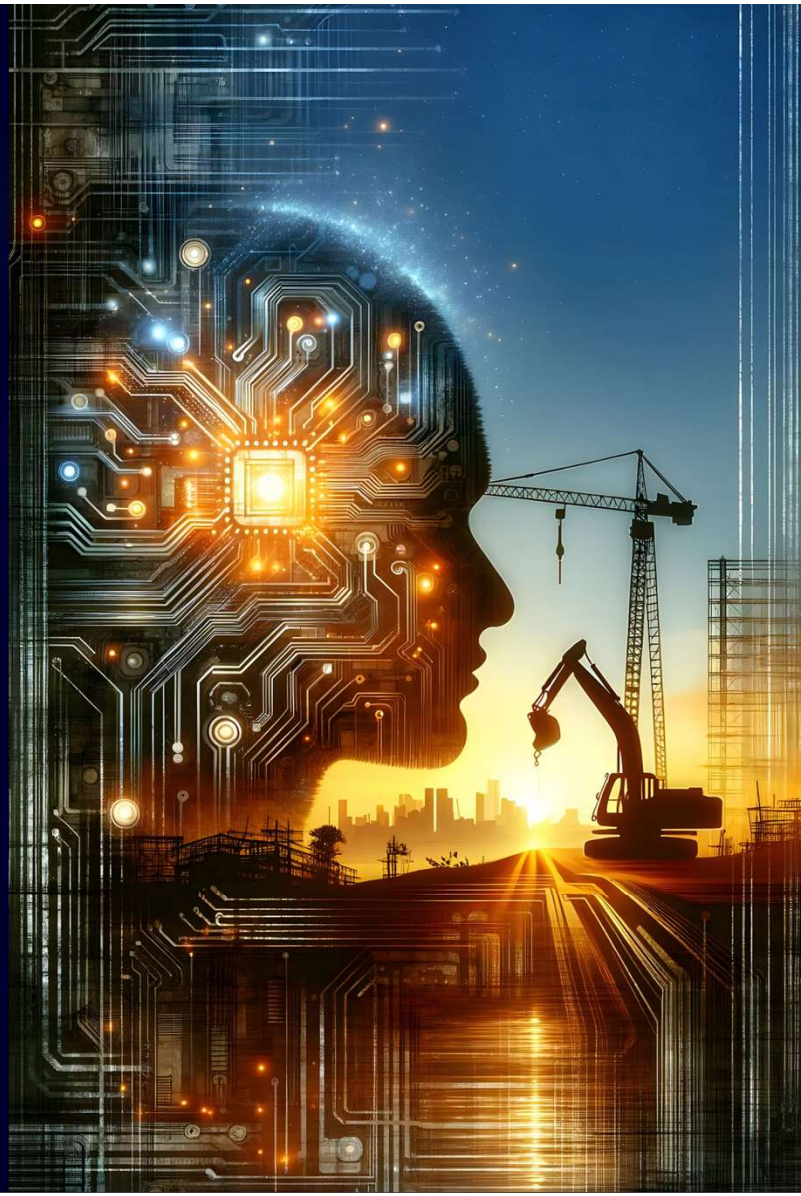


# Setting the Stage: The Geotechnical Data Challenge

The geotechnical industry is experiencing an unprecedented **explosion of data types** that traditional methods and software weren't designed to handle:

- Soil borings and laboratory testing
- Cone Penetration Tests (CPTs)
- Geophysical investigations
- Measurement While Drilling (MWD)
- Real-time instrumentation monitoring and pile driving analyzer
- LiDAR and remote sensing data

From a DOT perspective, we need **reliable, reusable data across long project lifecycles** that can span decades.

### Data Silos

Each dataset isolated in separate systems

### Format Incompatibility

Different software, different standards

### Limited Integration

Difficult to combine multiple data sources

# The Shift in Software Landscape

1. **gINT Era**
   Dominant industry standard for geotechnical data management and reporting

2. **Transition Period**
   gINT retirement announcement creates uncertainty and forces industry adaptation

3. **Multi-Vendor Ecosystem**
   Multiple strong alternatives emerge, each with unique strengths and approaches

## The Challenge

Adopting new tools requires significant investment in:

- Staff retraining and skill development
- Workflow redesign and optimization
- Risk management during transition
- Data migration and validation

# Why Software-Exclusive Thinking Is Risky

## Vendor Lock-in

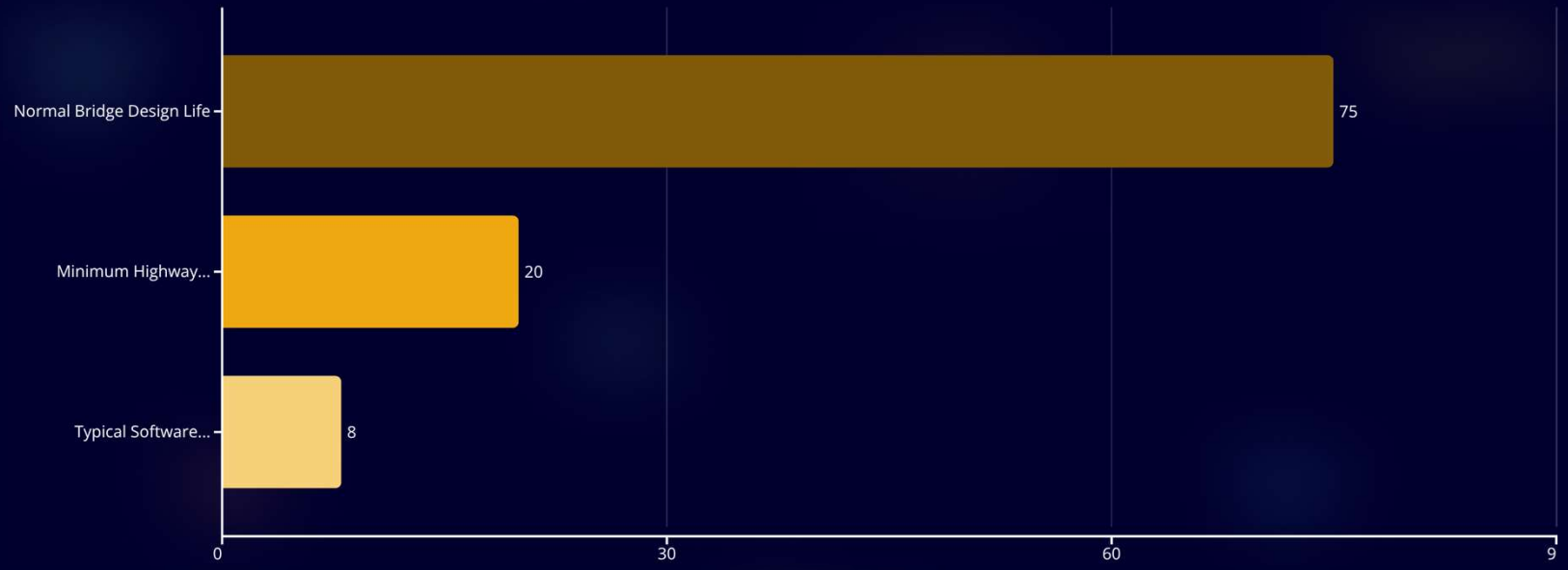
Reduces flexibility and limits future options for technology adoption

## Lifecycle Mismatch

Software lifecycles (5-10 years) are much shorter than DOT project/infraustructure lifecycles (30+ years)

## High Migration Costs

Expensive retraining, data conversion, and workflow disruption with each software change




**Priority: Data must outlast software.** Our geotechnical data represents decades of investment and must remain accessible regardless of changing technology landscapes.

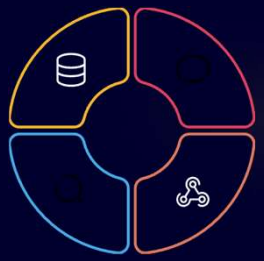
# LADOTD's Approach: Data First, Workflow Focused, Software Friendly

### Data Standards

Establish consistent formats and quality requirements

### Future-Ready

Create resilient backbone for evolving software landscape



### Standardized Workflows

Define processes that work across multiple platforms

### Application Programming Interfaces (APIs)

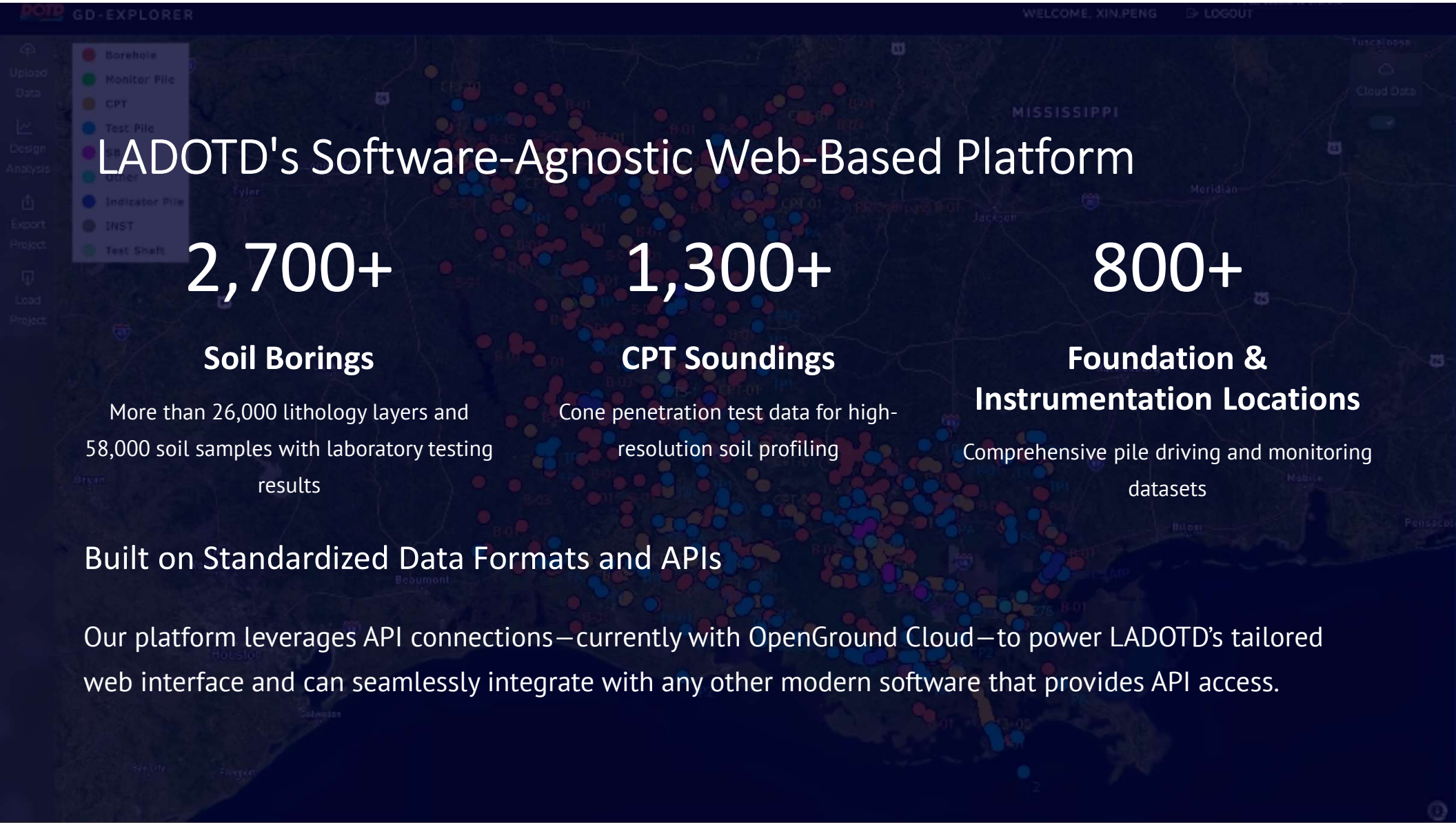
Enable seamless integration with various software tools

## Core Strategy

**Software-inclusive, not software-dependent**

This approach allows tools to:

- Connect seamlessly to the data
- Add specialized value and functionality
- Evolve independently without disrupting workflows




# LADOTD's Software-Agnostic Web-Based Platform

**2,700+**

### Soil Borings

More than 26,000 lithology layers and 58,000 soil samples with laboratory testing results

**1,300+**

### CPT Soundings

Cone penetration test data for high-resolution soil profiling

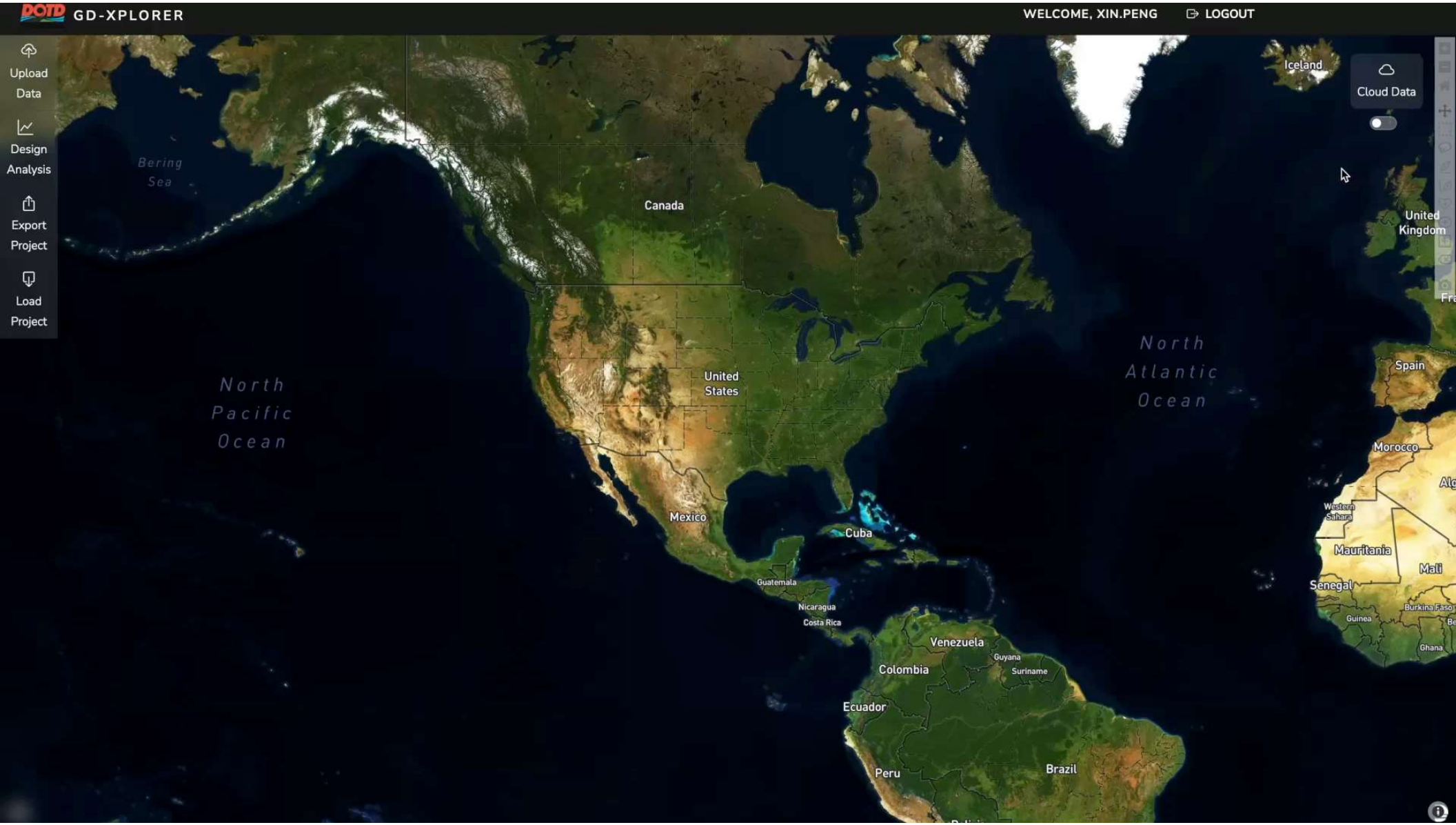
**800+**

### Foundation & Instrumentation Locations

Comprehensive pile driving and monitoring datasets

## Built on Standardized Data Formats and APIs

Our platform leverages API connections—currently with OpenGround Cloud—to power LADOTD's tailored web interface and can seamlessly integrate with any other modern software that provides API access.


GD-XPLORER
WELCOME, XIN.PENG
LOGOUT
Upload Data
Design Analysis
Export Project
Load Project
Cloud Data
Bering Sea
Canada
United States
North Pacific Ocean
North Atlantic Ocean
Iceland
United Kingdom
Spain
Morocco
Western Sahara
Mauritania
Mali
Senegal
Burkina Faso
Guinea
Ghana
Mexico
Cuba
Guatemala
Nicaragua
Costa Rica
Venezuela
Guyana
Suriname
Colombia
Ecuador
Peru
Brazil

# Key Features of the Platform

## Searchable Database

Comprehensive statewide repository of geotechnical investigations with advanced filtering and query capabilities

## Advanced Visualization

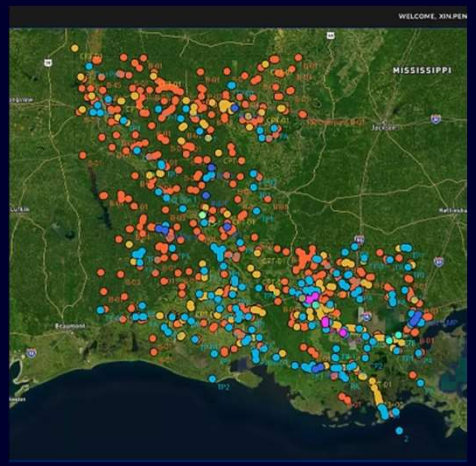
Interactive cross-sections, soil profiles, and mapping tools for comprehensive data analysis

## Design Analytics

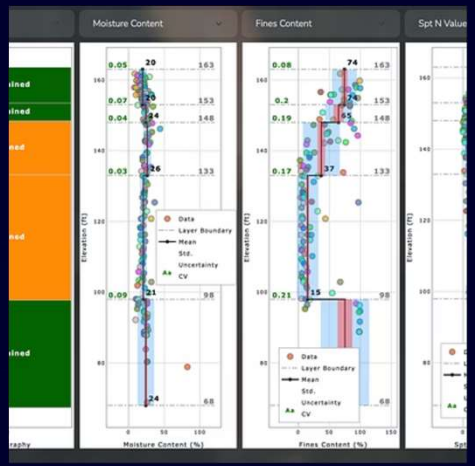
Sophisticated analysis tools supporting critical design decision-making processes

## Standards Compliance

Built-in adherence to both state and national geotechnical standards and specifications







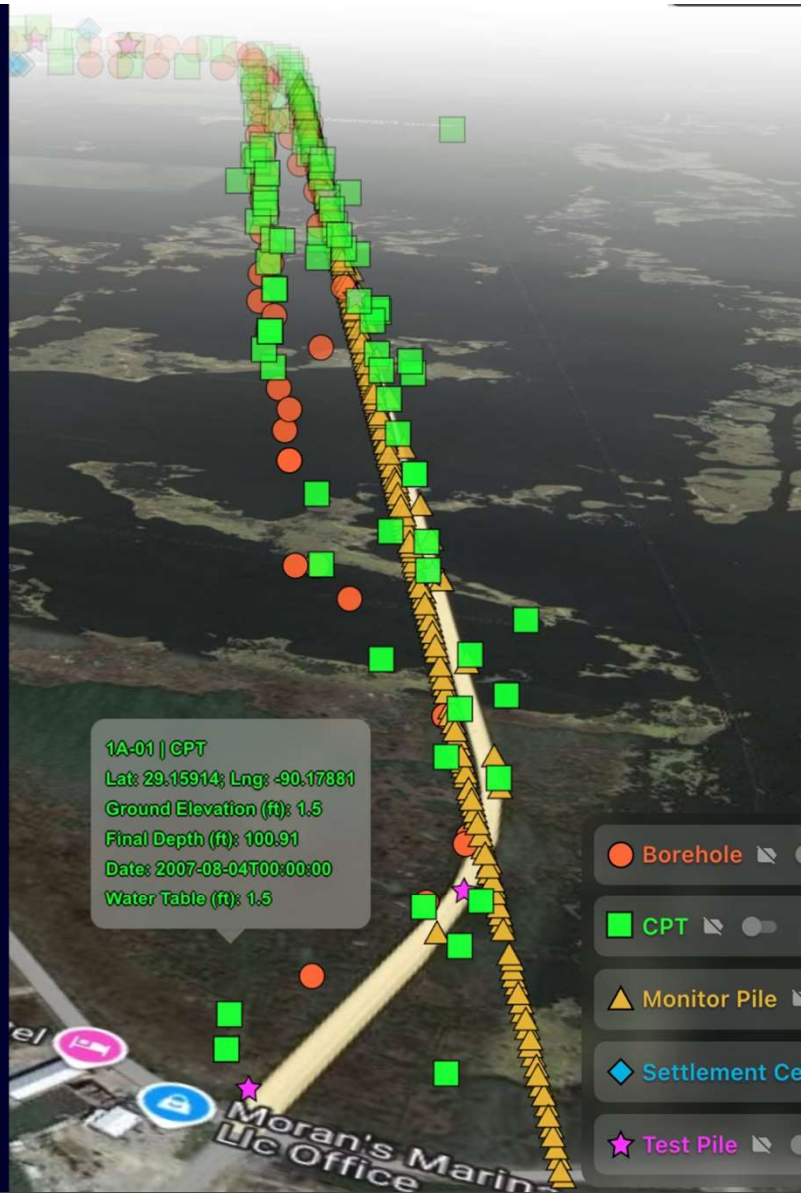

These integrated features transform raw geotechnical data into actionable engineering insights, supporting better project outcomes across Louisiana's diverse geological conditions.

# Case Study: LA-1 Project

The LA-1 Project represents a **data-intensive project** with complex geotechnical challenges that require innovative data management solutions.

| | |
|---|---|
| **Soil Borings**<br>Comprehensive subsurface characterization | **CPT Data**<br>High-resolution soil profiling |
| **Deep Foundations**<br>Pile installation and capacity data | **Instrumentation**<br>Over 3 years' settlement monitoring for embankments |

This project serves as a **test bed for LADOTD's software-inclusive, data-centric approach**, demonstrating how integrated data management can support complex infrastructure projects from design through construction and long-term monitoring.



# Soil Borings & CPT Data in 3D

Moving beyond traditional 2D representations, 3D visualization empowers engineers to gain deeper insights from complex geotechnical data.

1

## Spatial Context

Visualize lithology and CPT profiles within their true spatial context, providing a comprehensive understanding of subsurface conditions.

2

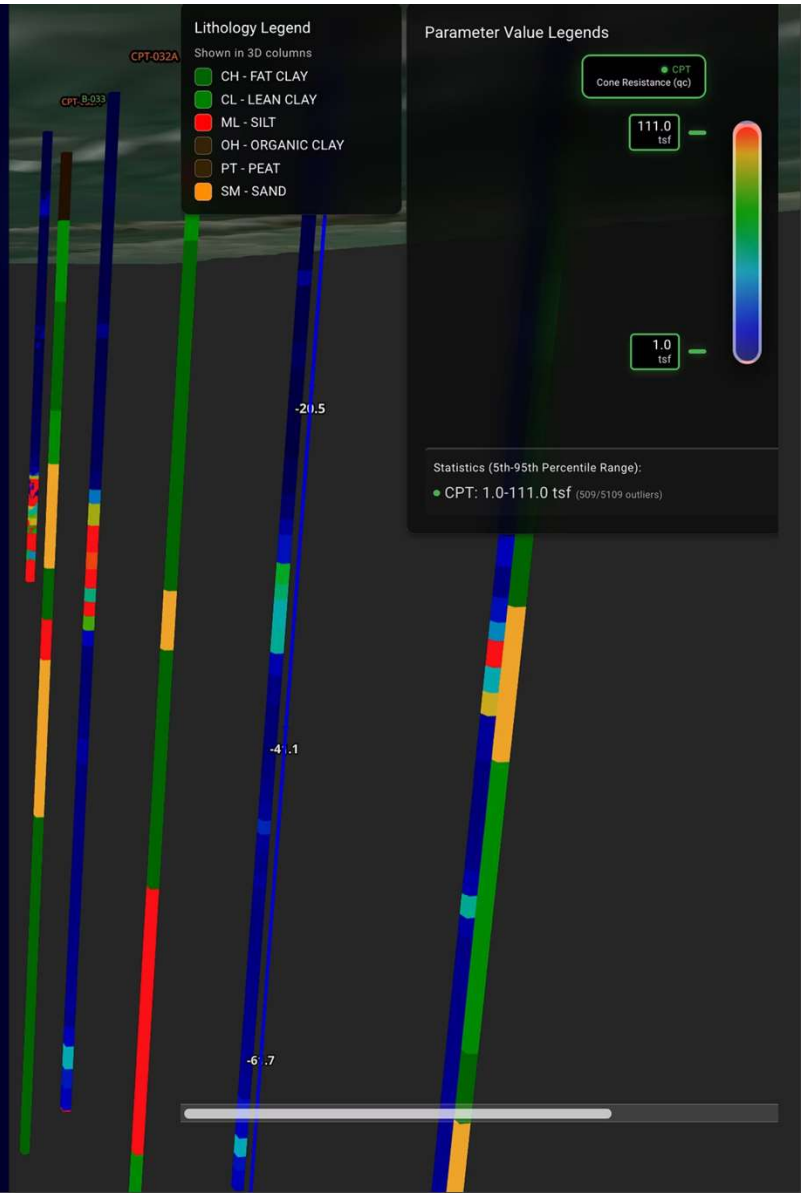
## Variability Across Alignments

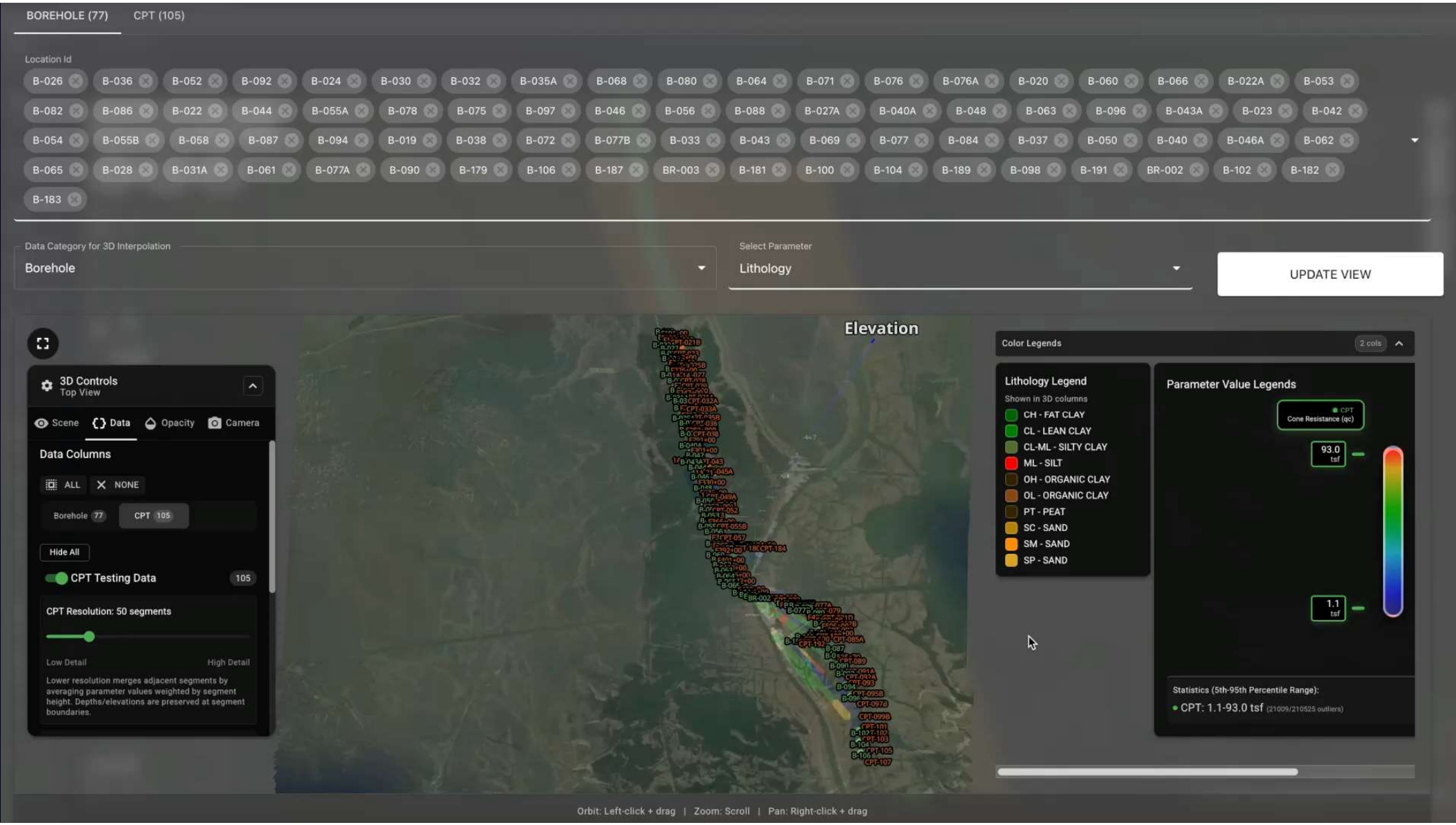
Easily identify and interpret soil variability and continuity across project alignments, crucial for design optimization.

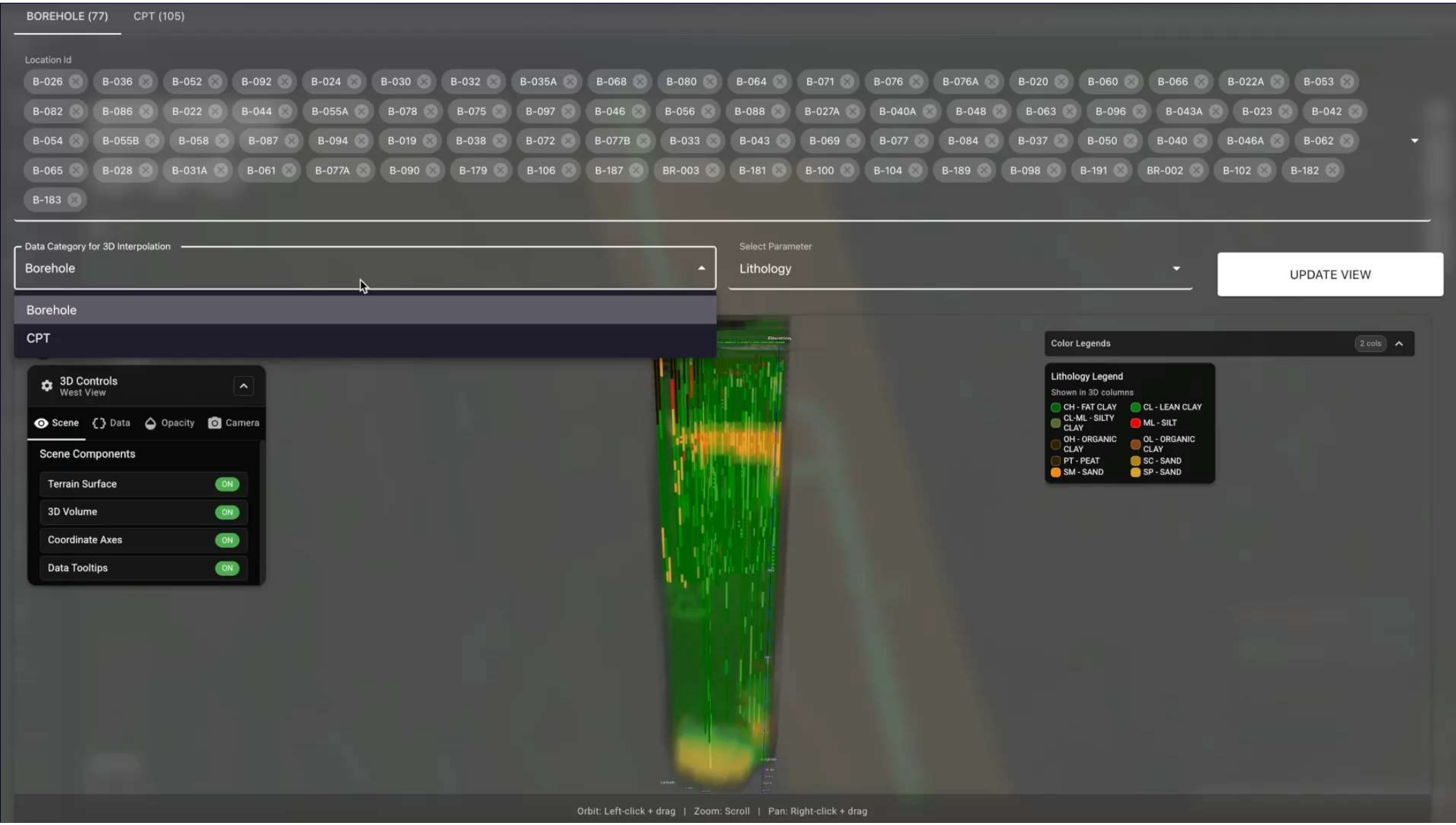
3

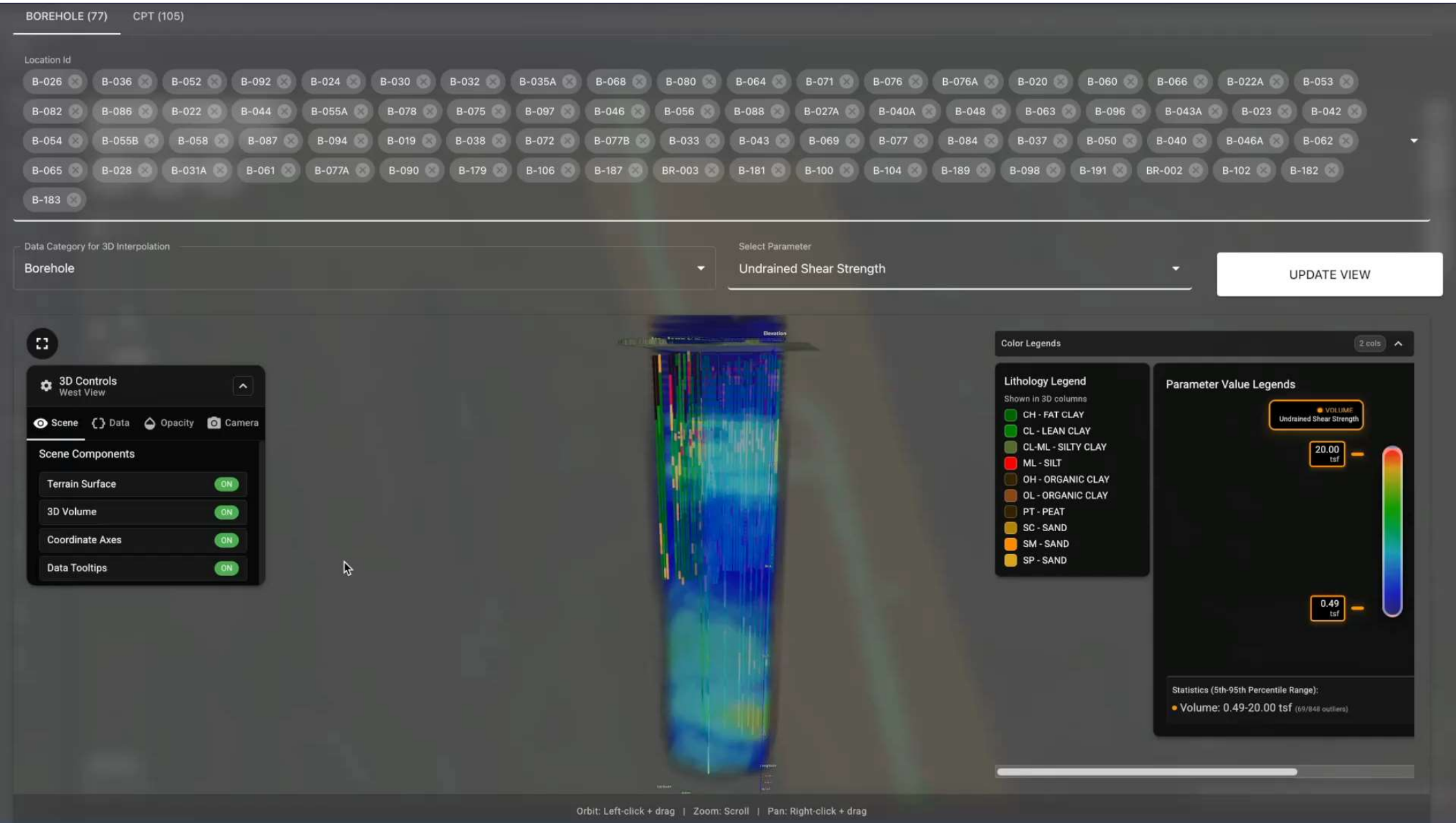
## Immediate Insights

Derive immediate engineering insights into critical parameters such as layer continuity and the presence of anomalies.




BOREHOLE (77)
CPT (105)
Location Id
B-026 B-036 B-052 B-092 B-024 B-030 B-032 B-035A B-068 B-080 B-064 B-071 B-076 B-076A B-020 B-060 B-066 B-022A B-053
B-082 B-086 B-022 B-044 B-055A B-078 B-075 B-097 B-046 B-056 B-088 B-027A B-040A B-048 B-063 B-096 B-043A B-023 B-042
B-054 B-055B B-058 B-087 B-094 B-019 B-038 B-072 B-077B B-033 B-043 B-069 B-077 B-084 B-037 B-050 B-040 B-046A B-062
B-065 B-028 B-031A B-061 B-077A B-090 B-179 B-106 B-187 BR-003 B-181 B-100 B-104 B-189 B-098 B-191 BR-002 B-102 B-182
B-183
Data Category for 3D Interpolation
Borehole
Select Parameter
Lithology
UPDATE VIEW
Elevation
3D Controls
Top View
Scene
Data
Opacity
Camera
Data Columns
ALL
NONE
Borehole 77
CPT 105
Hide All
CPT Testing Data
105
CPT Resolution: 50 segments
Low Detail
High Detail
Lower resolution merges adjacent segments by averaging parameter values weighted by segment height. Depths/elevations are preserved at segment boundaries.
Color Legends
2 cols
Lithology Legend
Shown in 3D columns
CH - FAT CLAY
CL - LEAN CLAY
CL-ML - SILTY CLAY
ML - SILT
OH - ORGANIC CLAY
OL - ORGANIC CLAY
PT - PEAT
SC - SAND
SM - SAND
SP - SAND
Parameter Value Legends
CPT
Cone Resistance (qc)
93.0
tsf
1.1
tsf
Statistics (5th-95th Percentile Range):
CPT: 1.1-93.0 tsf (21009/210525 outliers)
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag


BOREHOLE (77)
CPT (105)
Location Id
B-026 B-036 B-052 B-092 B-024 B-030 B-032 B-035A B-068 B-080 B-064 B-071 B-076 B-076A B-020 B-060 B-066 B-022A B-053
B-082 B-086 B-022 B-044 B-055A B-078 B-075 B-097 B-046 B-056 B-088 B-027A B-040A B-048 B-063 B-096 B-043A B-023 B-042
B-054 B-055B B-058 B-087 B-094 B-019 B-038 B-072 B-077B B-033 B-043 B-069 B-077 B-084 B-037 B-050 B-040 B-046A B-062
B-065 B-028 B-031A B-061 B-077A B-090 B-179 B-106 B-187 BR-003 B-181 B-100 B-104 B-189 B-098 B-191 BR-002 B-102 B-182
B-183
Data Category for 3D Interpolation
Borehole
Borehole
CPT
Select Parameter
Lithology
UPDATE VIEW
3D Controls
West View
Scene
Data
Opacity
Camera
Scene Components
Terrain Surface ON
3D Volume ON
Coordinate Axes ON
Data Tooltips ON
Color Legends
2 cols
Lithology Legend
Shown in 3D columns
CH - FAT CLAY
CL - LEAN CLAY
CL-ML - SILTY CLAY
ML - SILT
OH - ORGANIC CLAY
OL - ORGANIC CLAY
PT - PEAT
SC - SAND
SM - SAND
SP - SAND
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag


BOREHOLE (77)
CPT (105)
Location Id
B-026 B-036 B-052 B-092 B-024 B-030 B-032 B-035A B-068 B-080 B-064 B-071 B-076 B-076A B-020 B-060 B-066 B-022A B-053
B-082 B-086 B-022 B-044 B-055A B-078 B-075 B-097 B-046 B-056 B-088 B-027A B-040A B-048 B-063 B-096 B-043A B-023 B-042
B-054 B-055B B-058 B-087 B-094 B-019 B-038 B-072 B-077B B-033 B-043 B-069 B-077 B-084 B-037 B-050 B-040 B-046A B-062
B-065 B-028 B-031A B-061 B-077A B-090 B-179 B-106 B-187 BR-003 B-181 B-100 B-104 B-189 B-098 B-191 BR-002 B-102 B-182
B-183
Data Category for 3D Interpolation
Borehole
Select Parameter
Undrained Shear Strength
UPDATE VIEW
3D Controls
West View
Scene
Data
Opacity
Camera
Scene Components
Terrain Surface ON
3D Volume ON
Coordinate Axes ON
Data Tooltips ON
Elevation
Color Legends
2 cols
Lithology Legend
Shown in 3D columns
CH - FAT CLAY
CL - LEAN CLAY
CL-ML - SILTY CLAY
ML - SILT
OH - ORGANIC CLAY
OL - ORGANIC CLAY
PT - PEAT
SC - SAND
SM - SAND
SP - SAND
Parameter Value Legends
VOLUME
Undrained Shear Strength
20.00
tsf
0.49
tsf
Statistics (5th-95th Percentile Range):
Volume: 0.49-20.00 tsf (69/848 outliers)
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag


# Deep Foundations & Instrumentation Data

Extending our data-centric approach, LADOTD integrates comprehensive deep foundation and instrumentation data directly within the subsurface model environment, providing a holistic view of project performance.

## Integrated Performance

Seamlessly integrates pile test data, and instrumentation monitoring for embankment settlement with subsurface conditions.

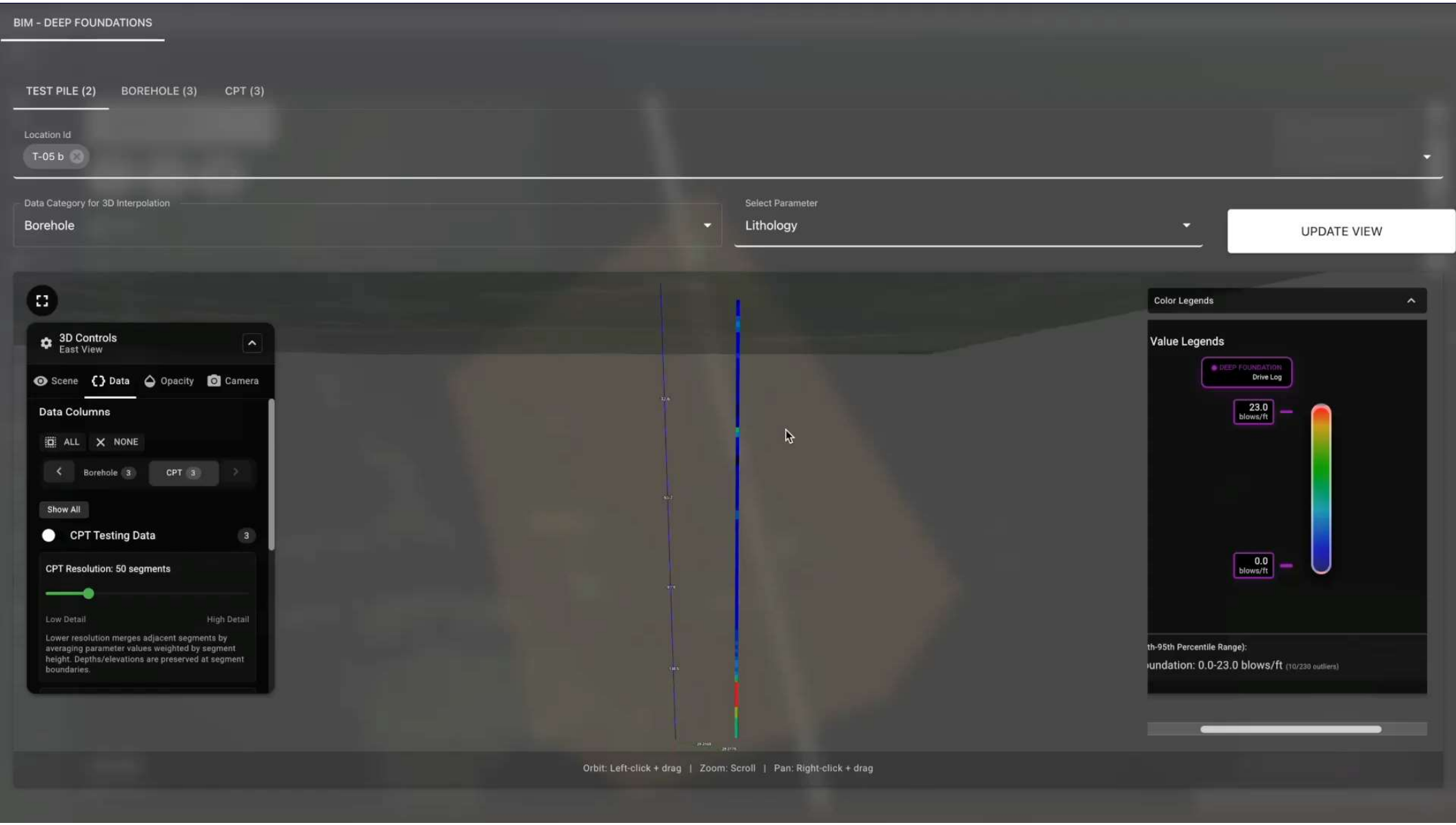
## Unified Environment

Monitors foundation performance directly within the same 3D environment as the surrounding geotechnical data.

## Validation & Optimization

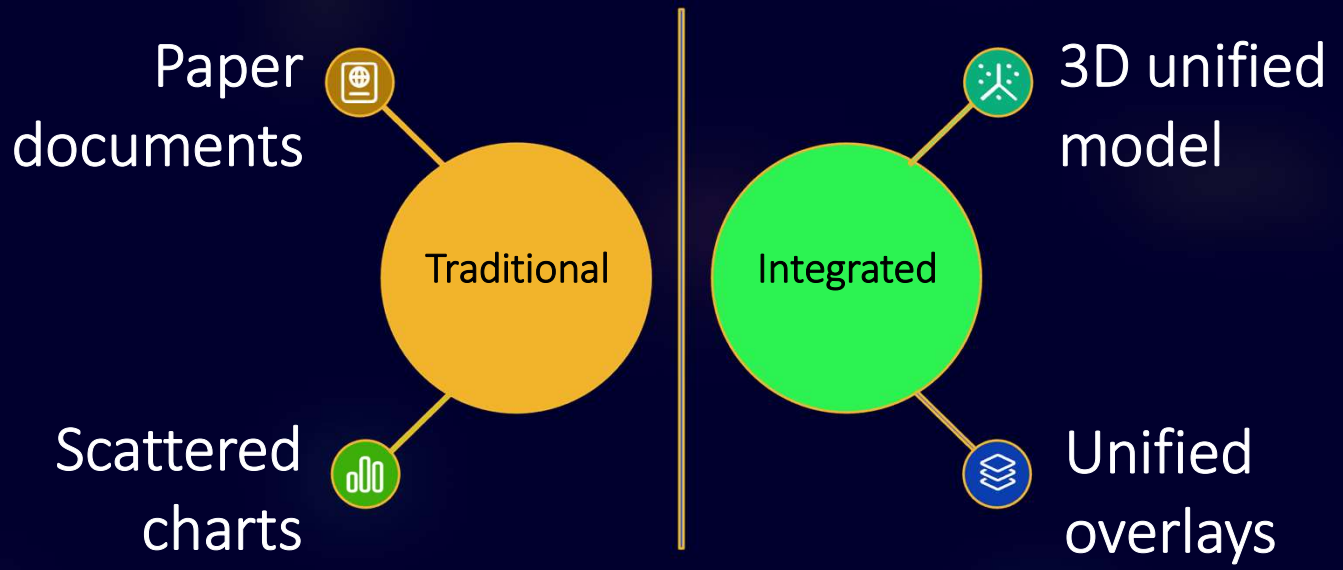
Aligns critical field measurements with design expectations, enabling data-driven validation and optimization of foundation systems.


BIM - DEEP FOUNDATIONS
TEST PILE (17)
BOREHOLE (78)
Location Id
T-04 b
T-11
T-02 b
T-01
T-05 b
T-09
T-08
T-10
T-06
T-07
T-03 a
Data Category for 3D Interpolation
Borehole
Select Parameter
Lithology
UPDATE VIEW
3D Controls
Top View
Scene
Data
Opacity
Camera
ALL
NONE
Test Pile 11
Borehole 78
Hide All
Test Pile Columns
11
Test Pile Column Parameter
Select Parameter
Drive Log
Parameter Selection: For each pile location, the selected parameter value is taken from the pile event with the highest elapsed time (most recent data). If no data is available for a parameter, the column will appear semi-transparent.
Elevation
Color Legends
arameter Value Legends
DEEP FOUNDATION
Drive Log
40.0
blows/ft
0.0
blows/ft
tatistics (5th-95th Percentile Range):
Deep Foundation: 0.0-40.0 blows/ft (60/1291 outliers)
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag


BIM - DEEP FOUNDATIONS
TEST PILE (2)
BOREHOLE (3)
CPT (3)
Location Id
T-05 b
Data Category for 3D Interpolation
Borehole
Select Parameter
Lithology
UPDATE VIEW
3D Controls
East View
Scene
Data
Opacity
Camera
Data Columns
ALL
NONE
Borehole 3
CPT 3
Show All
CPT Testing Data
3
CPT Resolution: 50 segments
Low Detail
High Detail
Lower resolution merges adjacent segments by averaging parameter values weighted by segment height. Depths/elevations are preserved at segment boundaries.
Color Legends
Value Legends
DEEP FOUNDATION
Drive Log
23.0
blows/ft
0.0
blows/ft
th-95th Percentile Range):
undation: 0.0-23.0 blows/ft (10/230 outliers)
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag


BIM – DEEP FOUNDATIONS
BOREHOLE (4)
CPT (3)
SETTLEMENT CELL (5)
Location Id
B-179
B-181
B-182
B-183
Data Category for 3D Interpolation
Borehole
Select Parameter
Lithology
UPDATE VIEW
3D Controls
Top View
Scene
Data
Opacity
Camera
Settlement Cell 5
Hide All
Settlement Cell Columns 5
Time: 6/7/2006
Animation Duration: 5s total
Fast (5s)
Slow (30s)
Time Position
6/7/2006
10/29/2008
Use the play button to animate settlement
B-179
CPT-180
B-181
F5124+50
B-182
B-183
SC-2
SC-3
SC-4
SC-5
SC-1
CPT-184
Color Legends
2 cols
CLAY
Parameter Value Legends
CPT
Cone Resistance (qc)
SETTLEMENT CELL
Column Height
44.8
tsf
4.9
ft
1.1
tsf
0.5
ft
Statistics (5th-95th Percentile Range):
CPT: 1.1-44.8 tsf (577/5809 outliers)
Settlement Cell: 0.5-4.9 ft (10/213 outliers)
Orbit: Left-click + drag | Zoom: Scroll | Pan: Right-click + drag

# Benefits Demonstrated in LA-1




The LA-1 Project clearly illustrates the transformative impact of a software-inclusive, data-centric approach, delivering significant advantages across the project lifecycle:

- **Faster Insights:** Data interpretation was quicker and more confident.
- **Clearer communication:** 3D visuals made it easier to explain conditions to both engineers and stakeholders.
- **Smarter decisions :** Linking soil data with foundation performance led to more informed design and construction adjustments.

# Key Takeaways

## Standards

Prioritize data standards, interoperability, and APIs.

## Resilience

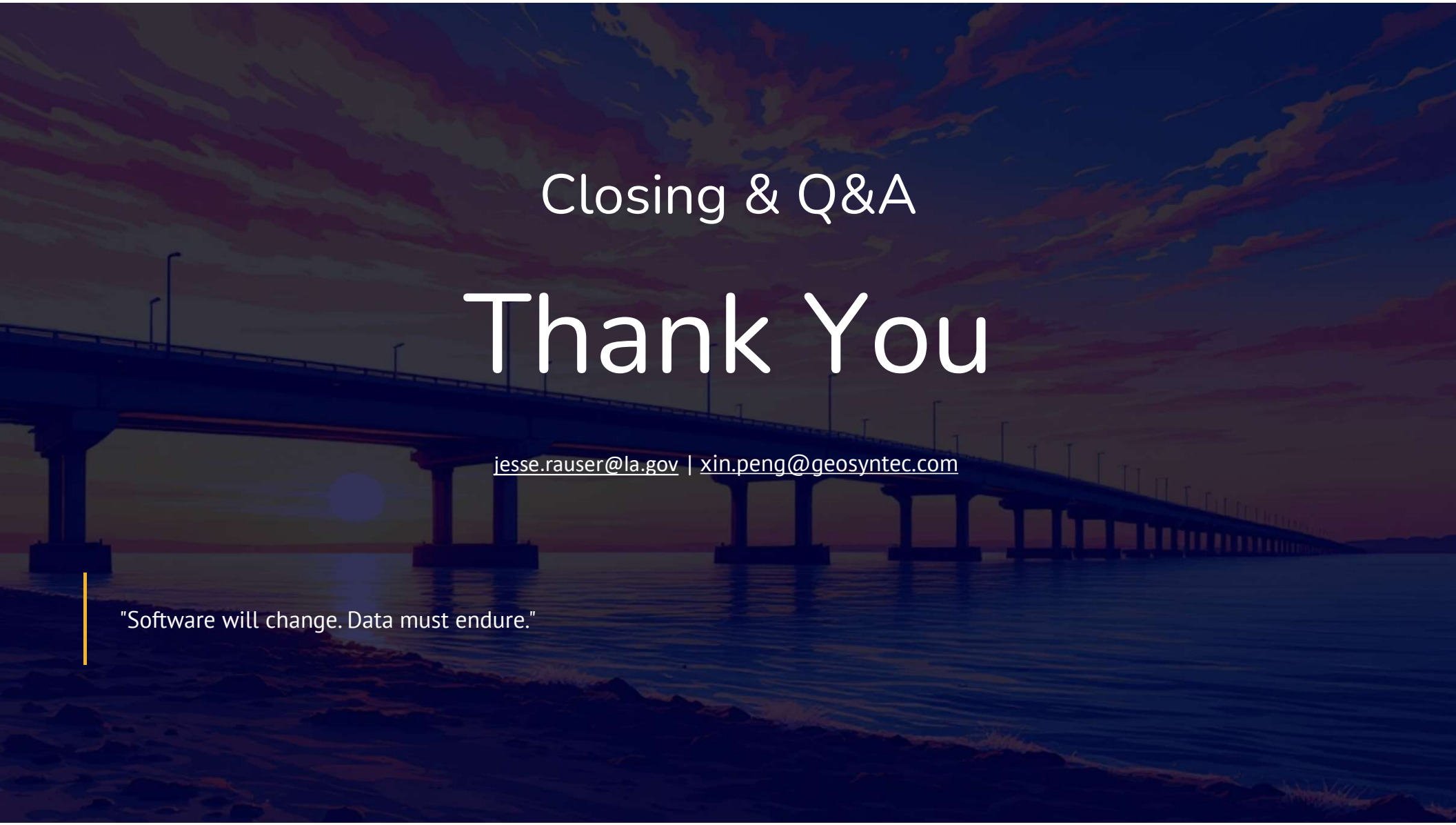
Invest in ecosystems, not just tools.

## Interoperability

Build data strategies that are vendor-inclusive and future-proof.

## Future-Ready

Software will evolve — resilient data practices will ensure continuity.



## Closing & Q&A

# Thank You

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"Software will change. Data must endure."