TECHNICAL REPORT STANDARD PAGE

1. Title and Subtitle
   Geotechnical Database, Phase IV
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   Baton Rouge, LA 70804-9245
5. Report No.
   FHWA/LA.25/714
6. Report Date
   July 2025
7. Performing Organization Code
   LTRC Project Number: 21-2GT
   SIO Number: DOTLT1000393
8. Type of Report and Period Covered
   Final Report
   March 2021 - June 2025
9. No. of Pages
   84
10. Supplementary Notes
    Conducted in Cooperation with the U.S. Department of Transportation, Federal Highway Administration.
11. Distribution Statement
    Unrestricted. This document is available through the National Technical Information Service, Springfield, VA 21161.
12. Key Words
    Geotechnical database; OpenGround.
13. Abstract
    This research project expanded on the three previous LTRC geotechnical database efforts to improve and advance geotechnical data management within the Louisiana Department of Transportation and Development. This project facilitated the implementation of Bentley's OpenGround Cloud (OpenGround). The project uploaded historical boring log images and digital gINT project files to OpenGround, totaling over 2,500 projects, to establish the database. Custom templates facilitate data entry into KeyLAB, speed boring log requests, and ease analysis and quick log (i.e., soil and CPT) creation. The project embodied proper data management and followed the American Society of Civil Engineers' (ASCE) Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) standards. The efforts of this research will help preserve geotechnical data as an asset, fostering ease of access and use both today and into the future.

Project Review Committee

Each research project will have an advisory committee appointed by the LTRC Director. The Project Review Committee is responsible for assisting the LTRC Administrator or Manager in the development of acceptable research problem statements, requests for proposals, review of research proposals, oversight of approved research projects, and implementation of findings.

LTRC appreciates the dedication of the following Project Review Committee members in guiding this research study to fruition.

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Geotechnical Database, Phase IV

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LTRC Project No. 21-2GT
SIO No. DOTLT1000393

conducted for
Louisiana Department of Transportation and Development
Louisiana Transportation Research Center

The contents of this report reflect the views of the author/principal investigator, who is responsible for the facts and accuracy of the data presented herein.

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July 2025

Abstract

This research project expanded on the three previous LTRC geotechnical database efforts to improve and advance geotechnical data management within the Louisiana Department of Transportation and Development. This project facilitated the implementation of Bentley's OpenGround Cloud (OpenGround). The project uploaded historical boring log images and digital gINT project files to OpenGround, totaling over 2,500 projects, to establish the database. Custom templates facilitate data entry into KeyLAB, speed boring log requests, and ease analysis and quick log (i.e., soil and CPT) creation. The project embodied proper data management and followed the American Society of Civil Engineers' (ASCE) Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS). The efforts of this research will help preserve geotechnical data as an asset, fostering ease of access and use both today and into the future.

Acknowledgments

The authors would like to thank the Project Review Committee members for their insight and direction. Thanks to Jesse Rauser, DOTD Geotechnical Unit Supervisor, for his vision and implementation strategies, which were critical to the progress made on the geotechnical database efforts over the years. Scott Deaton of Dataforensics has also been instrumental in this phase, along with the previous two phases, of our database efforts. Scott's involvement as DOTD's Bentley Representative provided continuity along our database journey. His effort and insight are much appreciated. Christopher Mertz helped populate the database with multitudes of uploaded historical .pdf logs, and Adele Lee assisted with additional Web Mapping Services (WMS) layers. Kathy Ruegg assisted with File.NET data, and Todd Stevens of DOTD Section 26 was instrumental within the Bentley connections, enterprise support, and Office of Technology interactions. Thank you all.

Implementation Statement

Although prior LTRC research projects (03-1GT, 10-2GT, and 15-1GT) were conducted to create and upgrade the DOTD geotechnical database, there is still much to accomplish. The existing geotechnical data management software, gINT, is outdated. The Keynetix all-in-one enterprise database/data management solution, HoleBASE SI (HoleBASE) was implemented during 15-1GT for shallow boring applications and was slated for this project. Shortly after this project began, Bentley acquired Keynetix and rebranded HoleBASE into OpenGround Cloud (OpenGround).

The OpenGround software is well-suited for managing the DOTD deep soil boring database; migrating the existing database from gINT, pLog Enterprise, and HoleBASE creates an up-to-date, efficient, all-in-one (i.e., mapping, database, and data management) solution that is less reliant on IT support for routine operation.

The functionality of DIGGS will also allow for ready acquisition of geotechnical information from Consultants and adjacent states. The newer functionality and GIS apps of OpenGround will allow for the visualization of geotechnical data within DOTD and by its partners. The functionality and security of the data will be eased through the use of OpenGround and ultimately allow cloud access to both the public and Department partners through the secure portals of OpenGround and the Louisiana’s Office of Technology Services (OTS).

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Introduction

Over the past 20 years, the Louisiana Department of Transportation and Development (DOTD) has made great strides in the development of its Geotechnical Database. Three prior research projects have focused on standardizing and organizing the geotechnical data collected by DOTD. However, several challenges have also occurred over the years. For example, the GIS platform developed during Phase I was beneficial, but the custom ArcGIS code for the project did not age well with updated versions of the ArcGIS software. Additionally, the DOTD document management software (Content Manager) was phased out and moved to a newer platform (File.NET). Increased computing power has also changed the expectations for how geotechnical data should be stored and utilized.

The DOTD geotechnical database was historically managed through gINT software, a Bentley product. DOTD customized gINT with pLog enterprise solution via Phase II database upgrade efforts. The Department wanted to move away from gINT since it was outdated, was not integrated with an enterprise database, and was cumbersome in terms of data entry and retrieval. Another geotechnical software from Keynetix, HoleBASE, existed as a competitor to gINT. HoleBASE provided a newer, more robust interface with georeferencing features, and DOTD explored HoleBASE capabilities through Phase III of LTRC's geotechnical database research. This phase, however, was limited to shallow subgrade soil surveys and dynamic cone penetrometer (DCP) data.

Through this Phase IV research, DOTD investigated and implemented the switch from gINT to HoleBASE for deep boring applications. In 2019, shortly after starting this research and moving toward HoleBASE, Bentley purchased Keynetix and its HoleBASE software. Bentley subsequently rebranded HoleBASE into OpenGround Cloud (OpenGround), an all-in-one enterprise database/data management solution with georeferencing capability and cloud connectivity. Since DOTD is a Bentley state, this made OpenGround easily available to DOTD in a way that was timely for implementation, further accelerating the DOTD geotechnical database endeavor. This report documents these efforts to continue the development of the DOTD Geotechnical Database.

Literature Review

Over the past 20 years, DOTD and the Louisiana Transportation Research Center (LTRC) have made tremendous progress toward building a comprehensive Geotechnical Database. This current phase, Phase IV, both continues and builds on previous phases. A description of previous phases is included below for reference.

Phase I, LTRC Project 03-1GT [1]**.** Phase I began in 2003 and focused on existing boring logs within the Department. Soil borings were originally drafted by hand. Over time, the process shifted to Bentley's MicroStation Computer Aided Design (CAD) software to draw these digitally. DOTD Section 22, the Materials Laboratory (MatLab), was responsible for these DOTD internal efforts. These boring log documents were printed and included in the project plans. In the late 1990s, the signed and sealed logs were scanned as an image into a digital .pdf file and saved in a digital file folder as a record of the completed log. Eventually these logs began to accumulate as information.

Since global positioning systems (GPS) technology was historically limited, not all projects or boring logs included these location coordinates. As a way to locate projects, DOTD project numbers historically contained digits that referenced road control sections on a map. Researchers utilized this logic to locate old projects without GPS coordinates. These soil boring files were indexed, georeferenced, and added to the DOTD document management system (Content Manager). Custom code was developed to index and access these documents in two ways. First, a search page was developed to query soil borings by parish, route, project number, etc. Second, a geographic information system (GIS) utilizing ArcMAP was implemented; see Figures 1 and 2.

Figure 1. Phase I efforts

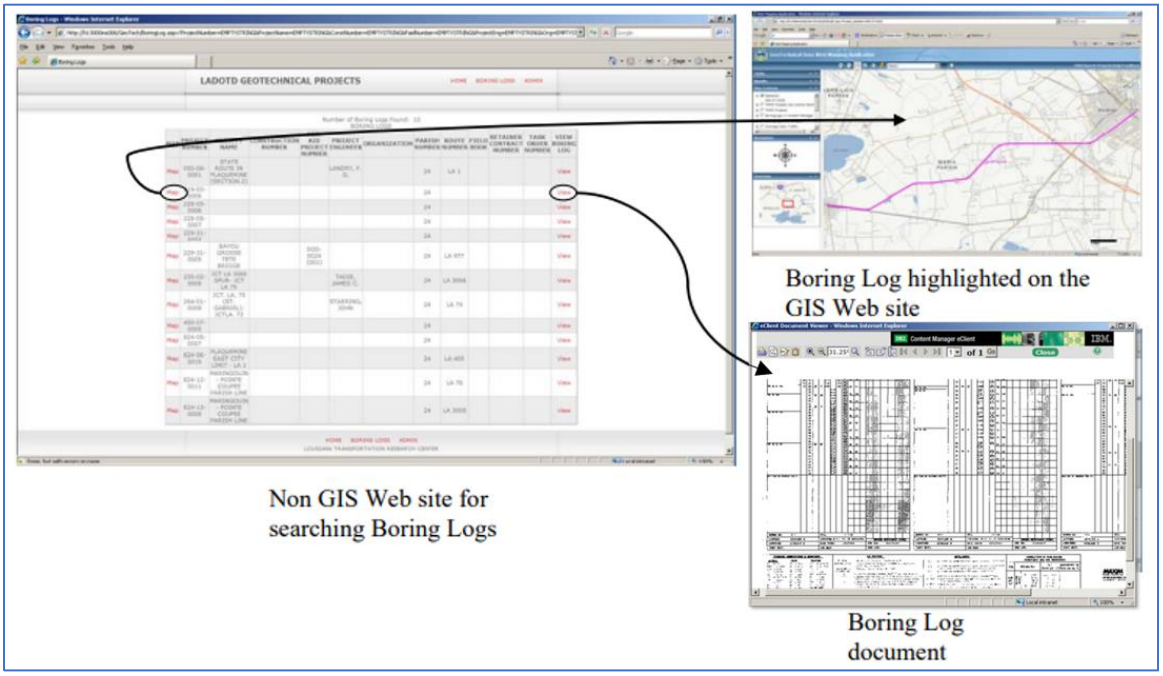
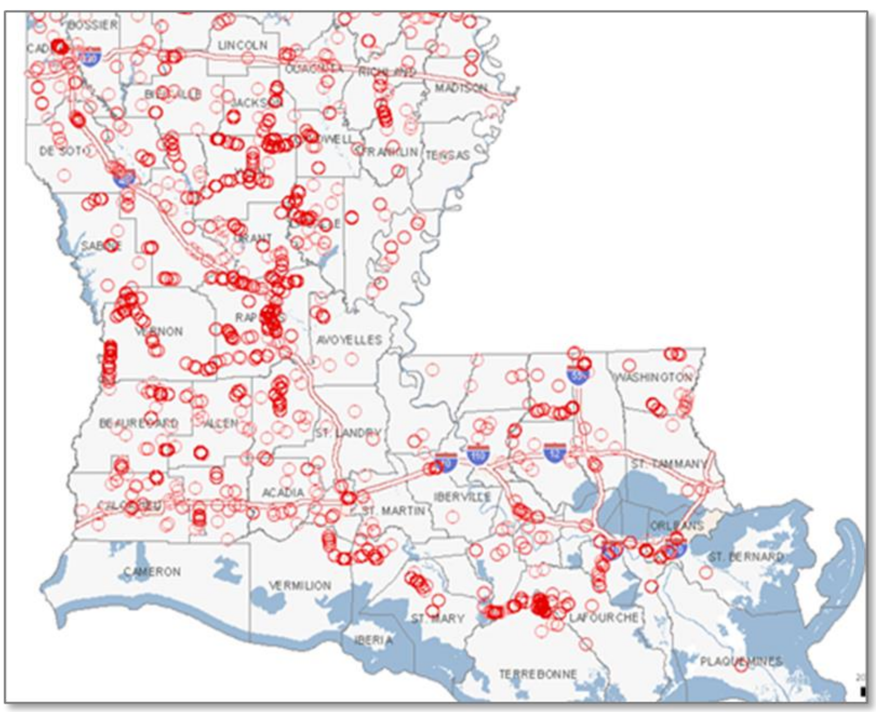


Figure 2. Phase I boring log map



This ArcGIS interface worked for several years, but unfortunately, it encountered several issues that caused its demise. The custom code developed in Phase I did not translate to future versions of the ArcMAP software, rendering the web-based option obsolete. Additionally, the DOTD Content Manager storage was changed to File.Net, rendering links in the non-GIS interface broken too. The files were not lost; they were just no longer accessible via the Phase I platform. Regardless, the information contained in this version was still only .pdf information (i.e., images), not digital data.

Phase II, LTRC Project 10-2GT [2]**.** Phase II began in 2010 and was initiated to begin collecting digital data, rather than only .pdf images. The project standardized the DOTD gINT project format to allow for consistent data interchange between DOTD and Consultants. This also allowed DOTD and Consultants to generate consistent boring logs from the data.

Phase II also collected and stored all relevant geotechnical data, rather than only the subset of values reported on the boring logs. The research project created a demarcation line beyond which DOTD would collect digital data. Screenshots of gINT tables prior to and after this upgrade/standardization are included in Figure 3a. In contrast, Figure 3b shows several of the additional columns collected along with the standardization of significant figures and allowable entry formats.

Phase II challenges also included the need for a better interchange format, independent of each consultant's software of choice, since some utilized their own database structure, rather than gINT. The Department required gINT for all geotechnical data at this time.

A DOTD gINT library was provided to Consultants. This allowed DOTD to make changes to the library and redistribute as needed when the boring log format changed. Figure 4 shows an example of the old MicroStation logs (i.e., fixed images) and the digital boring log created by gINT utilizing the project data.

Figure 3. Phase II gINT tables prior to and after standardization [3]

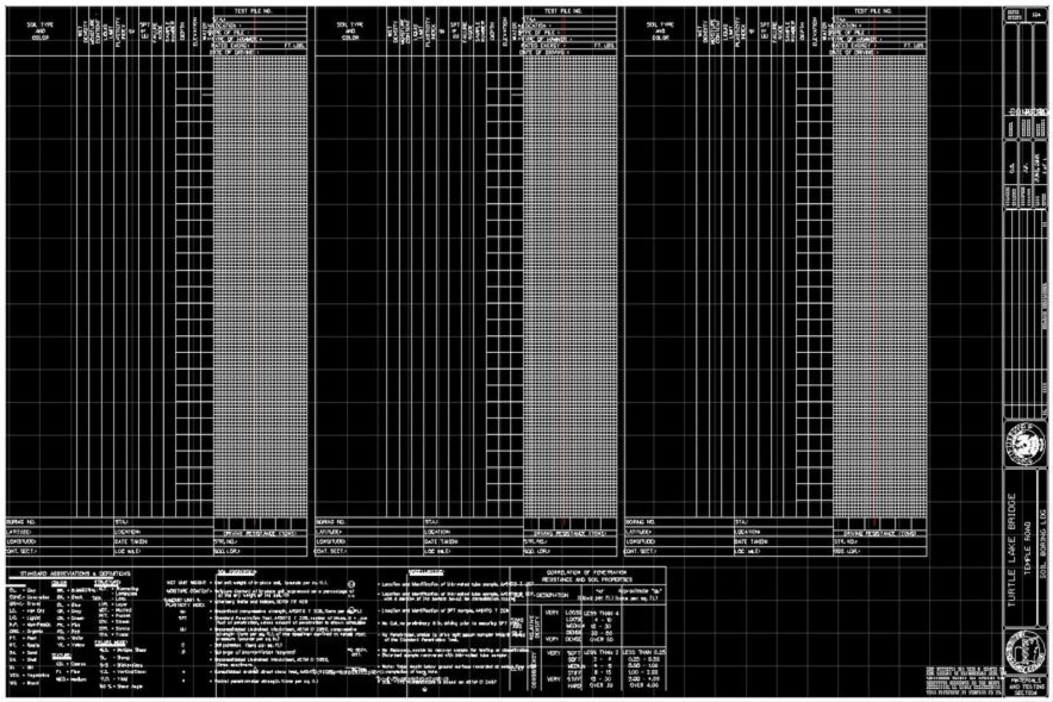
Depth	Interva	Sample Number	Wet Unit Wt	Moisture Content	Liquid Limit	Plasticity Index	Qu	SPT or UU	Failure Mode	Symbol	Upper Line Type	Bottom Line Type
0	5	C1	124	21	25	4	1.5		M.S.	Circle	Solid	Solid
5	5	C2	119	21	25	4	1.28		S/S	Circle	Solid	Solid
10	5	C3	126	23	41	21	0.87		M.S.	Circle	Solid	Solid
15	5	C4	116	37	73	46	1.28		S/S	Circle	Solid	Solid
20	5	C5	117	33	77	46	1.15		S/S	Circle	Solid	Solid
25	5	C6	118	31	70	42	1.5		M.S.	Circle	Solid	Solid
30	5	C7	129	19	26	10	1.6		M.S.	Circle	Solid	Solid
35	5	C8	125	18	38	16	3.79		M.S.	Circle	Solid	Solid
40	5	D9		17	43	23		N=31		Circle	Solid	Solid
45	5	C10	121	23	40	12	3.31		M.S.	Circle	Solid	Solid
50	5	C11	126	20	N	P	7.71		M.S.	Circle	Solid	Solid
55	5	C12	117	23	39	12	5.78		S/S	Circle	Solid	Solid
60	5	C13	129	16	37	17	6.39		S/S	Circle	Solid	Solid
65	5	C14	120	18	20	4	2.13		M.S.	Circle	Solid	Solid
70	5	D15		19	42	20		nc 10"=50		Circle	Solid	Solid
75	5	D16		10	41	19		nc 10"=50		Circle	Solid	Solid
80	5	C17								Circle	Solid	Solid
85	5	D18		18	40	16		nc 9"=50		Circle	Solid	Solid
90	5	D19		18	34	9		nc 7"=50		Circle	Solid	Solid
95	5	D20		21	43	14		nc 11"=50		Circle	Solid	Solid
100	5	D21		20	41	12		nc 7"=50		Circle	Solid	Solid
105	5	D22		26	50	18		nc 9"=50		Circle	Solid	Solid
110	5	D23		19	38	17		nc 11"=50		Circle	Solid	Solid
115	5	D24		21	33	12		N=40		Circle	Solid	Solid
120	5	D25		25	21	3		nc N=50		Circle	Solid	Solid
125	5	D26			N	P		nc N=50		Circle	Solid	Solid

(a) before standardization

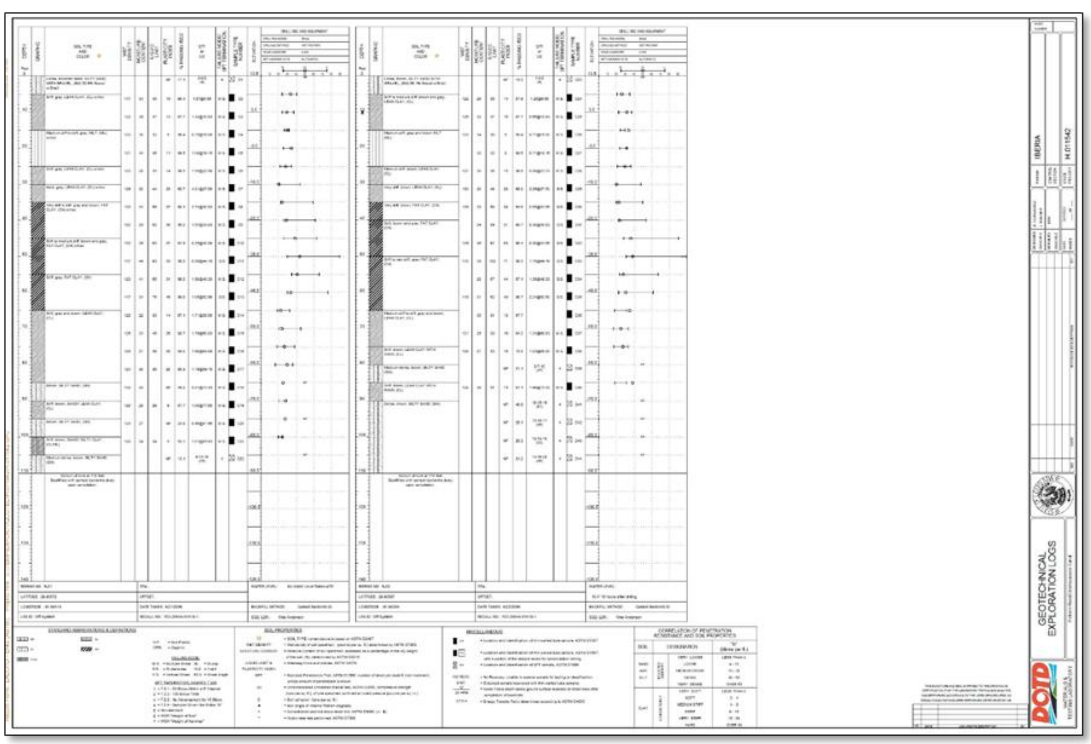
Depth (ft)	{Sample Number}	Water Content (%)	Water Content Wet Wt+Tare (g)	Water Content Dry Wt+Tare (g)	Water Content Wt Tare (g)	Wet Density	Dry Density	Wt Specimen + Tare (g)	Wt Tare (g)	Diameter 1 (in)
5	C2	33.5585	160.15	119.91	0	117.234	87.7772	1146.25	0	2.84
10	C3	28.98652	184.67	143.17	0	122.1764	94.7202	1169.47	0	2.81
15	C4	29.83327	261.64	201.52	0	121.9998	93.9665	1167.78	0	2.81
20	C5	34.10528	195.15	145.52	0	121.0798	90.2871	1175.53	0	2.83
25	C6	28.04925	301.62	235.55	0	122.6496	95.7831	1182.37	0	2.82
30	C7	19.92897	145.21	121.08	0	128.6916	107.306	1285	0	2.87
35	C8	24.28845	402.62	323.94	0	123.3941	99.2803	1206.48	0	2.84
40	C9	28.74809	294.64	228.85	0	120.3657	93.4892	1176.87	0	2.84
45	C10	38.77133	264.29	190.45	0	121.9679	87.8912	1118.15	0	2.75
50	C11	43.80081	226.4	157.44	0	116.5377	81.0410	1123.45	0	2.82
55	C12	41.04842	80.99	57.42	0	123.3097	87.4236	1197.18	0	2.83
60	C13	33.61896	226.11	169.22	0	116.8126	87.4221	1142.13	0	2.84
65	C14	22.29611	194.94	159.4	0	127.5696	104.312	1229.8	0	2.82
70	C15	23.52332	298.21	241.42	0	126.0338	102.032	1232.29	0	2.84
75	C16	26.5534	132.59	104.77	0	129.4589	102.295	1204.15	0	2.77
80	C17	29.7125	311.31	240	0	123.592	95.2814	1199.92	0	2.83
85	C18	25.01407	222.15	177.7	0	131.8375	105.458	1165.08	0	2.7
90	C19	27.89283	222.93	174.31	0	126.0595	98.5664	1164.08	0	2.76
95	C20	27.32883	243.44	191.19	0	124.3916	97.6932	1140.37	0	2.75
100	C21	24.38516	232.65	187.04	0	127.9791	102.889	1216.31	0	2.8

(b) after standardization

Figure 4. Phase II boring log examples (MicroStation and gINT) [3]



(a) MicroStation example



(b) gINT example

Phase III, LTRC Project 15-1GT [4]**.** Phase III began in 2015 as part of the LTRC Research Problem Identification Committee (RPIC). There was a need to standardize the soil subgrade survey investigations conducted by the DOTD districts. The objectives of this project were to simplify district workflows and provide a database for pavement boring and dynamic cone penetration (DCP) data. Subgrade soil investigations and DCP data are used for soil type and resilient modulus characterization for pavement design. The project was also designed to provide a central database for the DOTD Test Pile Database. The pile load test (PLT) database provides access to historical digital data.

The project utilized geotechnical software from Keynetix to collect soil information and manage the data. The Keynetix software KeyLAB was customized to allow the input of DOTD soil test parameters and the calculation of results. The Keynetix software HoleBASE allowed users to see test results in a georeferenced interface for these shallow borings. The project also allowed the export of data to other DOTD needs (e.g., Pavement Management—soil subgrade surveys, District Needs—borrow pits, and Site Manager Software—project pay needs).

Phase III allowed for the standardization of district data into one statewide system. Unfortunately, the districts were reluctant to implement the new software. However, the new software appealed to DOTD Section 67, HQ Geotechnical, for deep boring applications.

Phase IV, LTRC Project 21-1GT. Phase IV began in 2021 as an identified need from the LTRC Research Problem Identification Committee (RPIC) process. The project continued and built upon previous database efforts. This report outlines these project efforts.

Objective

The objectives of this project included:

- Upgrading the DOTD Geotechnical Database deep boring log templates and structure to the newer HoleBASE platform, which was already owned by the Department;
- Ensuring that the Department's data is compatible with the Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) to allow easy transfer from Consultants;
- Retrieving DOTD geotechnical data from Consultants via DIGGS platform (i.e., historical and newer retainer contracts); and
- Using the Geographic Information System (GIS) services of HoleBASE and the Department to share soil boring information graphically, both internally at DOTD HQ and externally to the general public.

Scope

This project focused on geotechnical data within the DOTD Section 67, HQ Geotechnical. The project was also able to include data from LSU and two DOTD Geotechnical Consultants, Ardaman & Associates and Terracon Consulting Engineers, related to their soil investigations on DOTD projects.

Methodology

The research team used software to expand DOTD efforts to link geotechnical data with a GIS-based platform. The Keynetix software, HoleBASE, was explored during previous LTRC research (Phase III). At that time, HoleBASE was evaluated as an alternative to gINT for DOTD deep boring data. This project (Phase IV) was initiated with the intent of implementing HoleBASE as the DOTD geotechnical software of choice, moving away from gINT for a more robust solution. Soon after the project started, Bentley, the owner of gINT, acquired Keynetix, the creator of HoleBASE and KeyLAB. Bentley subsequently upgraded and rebranded HoleBASE as OpenGround Cloud (OpenGround) to match their other products.

Software

- **Bentley Systems (Bentley)** is an infrastructure engineering software company. Their website outlines who they are and what they do: "Bentley's commitment extends beyond delivering the most comprehensive and integrated software paired with exceptional service, training, and 24/7 technical support. For over 39 years, Bentley has served the engineers and other professionals responsible for designing, constructing, and operating sustainable infrastructure, essential to the quality of life for everyone, everywhere." [5]
- **gINT** is a geotechnical software created in 1986, which was acquired by Bentley in 2009. gINT is a common software for managing geotechnical data. The software is being sunset by Bentley, with end of product support slated for December 31, 2028. This date has been pushed back by Bentley at least twice during the course of this project.
- **KeyLAB** is a laboratory software for data entry and calculation developed by Keynetix. The LTRC Geotechnical Database project, Phase III, utilized this software and made custom templates for the entry of laboratory testing data and calculation of results. This software communicates with HoleBASE/OpenGround to exchange and view data within a project. KeyLAB was acquired by Bentley in 2019.
- **HoleBASE** was developed by Keynetix as a robust geotechnical data management system. The software was developed more recently and has more features than gINT, including mapping. HoleBASE was acquired by Bentley in 2019.
- **OpenGround Cloud (OpenGround)** is Bentley's rebranded release of HoleBASE. This version allows for the smart cloud-based management of geotechnical data. The software

has mapping capabilities and the ability to generate boring logs from the digital data. Cloud storage allows for faster calculations and interconnectivity within DOTD HQ, and between DOTD and district offices and Consultants.

- **Everything** software, designed by Voidtools, is a powerful desktop file search utility that quickly locates files and folders on a computer.
- **Microsoft Excel** is a spreadsheet software that is commonly utilized to manage data. This software can read and write files in .csv format.
  - LTRC utilized a **DataConverterFeedbackTool** to analyze, correct, and prepare gINT files for upload to OpenGround. This can be found at the DIGGS GitHub website, https://github.com/DIGGSml/Data-Converter-Feedback-Tool.
  - LTRC utilized Excel to create working logs to monitor the status of uploading data. Each file in each data set (e.g., MatLab, Consultant, File.NET, etc.) could be logged to show progress of the upload to OpenGround and document any issues related to the upload of each file.
- **FALCON** is the DOTD Project Plan Room interface to digital documents. Digital documents can be posted on this platform for project letting and bidding purposes.
- **File.NET** is the newest version of document storage for DOTD. It is the repository for both old (i.e., Content Manager) and new documents. File.NET was fully implemented by DOTD in 2023.
- **Data Interchange for Geotechnical and Geo-Environmental Specialists (DIGGS)** is a transfer protocol. It allows each piece of data to be connected to key metadata such as test reference, geographic location, geologic references, etc. By using a common and robust transfer protocol, the end use (i.e., interpretation, storage, and presentation) is separated from data transfer [6]. The DIGGS project involves development of a GML (i.e., XML-based) geospatial standard schema for the transfer of geotechnical and geoenvironmental data within an organization or between multiple organizations. DIGGS can work with existing software, hardware, databases, and data storage facilities to easily transfer and share data [6]. Widespread adoption of DIGGS is a goal of the Federal Highway Administration (FHWA) and the American Society of Civil Engineers (ASCE) Geo-Institute. The implementation of DIGGS is also a DOTD geotechnical goal.
- **Microsoft Power BI (Power BI)** "is an interactive data visualization software product developed by Microsoft with a primary focus on business intelligence [1]. It is part of the Microsoft Power Platform. Power BI is a collection of software services, apps, and

connectors that work together to turn unrelated sources of data into coherent, visually immersive, and interactive insights. Data may be input by reading directly from a database, webpage, or structured files such as spreadsheets, CSV, XML, and JSON” [7].

- **Rapid CPT** is a gINT add-in that makes analyzing CPT Geotechnical data simple. RAPID CPT encapsulates the entire CPT analysis procedure into a single location: a gINT project. RAPID CPT allows the import raw text files from nearly any CPT manufacturer, whether in English or metric units [8].
- The Louisiana Division of Administration's **Office of Technology Services (OTS)** envisions an effective and efficient state government through information technology support, advancement, and innovation. OTS's mission is to establish competitive, cost-effective technology systems and services while acting as the sole centralized customer for the acquisition, billing, and recordkeeping of these services. OTS promotes integrity, quality, and efficiency in state government administration IT standards and policy implementation by providing exemplary technology systems and services to state agencies [9].

Discussion of Results

Software

Data management is an important practice in any organization. Geotechnical data is an asset for DOTD and should be managed appropriately. Over the years, software and technology have evolved and improved [10]. For many years, DOTD used gINT, a geotechnical software founded in 1986, to manage geotechnical data, including soil borings and cone penetrometer data. This software was functional, but it had no major upgrades to remain current with technological advances (e.g., Geographic Information Systems (GIS), computing power, user interfaces, etc.) over time. In 2009, Bentley acquired gINT, the software known for geotechnical integration [11]. More recently, Keynetix developed a competing software, HoleBASE, and its laboratory partner-software, KeyLAB [12]. This software was introduced to DOTD during LTRC's Phase III research [4].

The benefits of HoleBASE as an alternative to gINT were realized by DOTD during Phase III, which dealt with shallow soil subgrade surveys. Additional research to investigate and use HoleBASE for deep borings scored highly in the LTRC Research Problem Identification Committee (RPIC) process. At the time of the research, state funding did not allow LTRC to issue external contracts to Consultants, as was done in Phases II and III; therefore, LTRC conducted this research in house.

This project was approved and began with the intent of utilizing HoleBASE as part of the Geotechnical Database Phase IV implementation effort. As the LTRC research began, Bentley, the owner of gINT, acquired Keynetix (HoleBASE and KeyLAB) in 2019 [13]. Bentley soon upgraded HoleBASE and rebranded it as OpenGround Cloud (OpenGround) to match other Bentley *Open* products. The addition of cloud-based features also facilitates easier and faster data transfers.

Since DOTD has an account with Bentley for many other software (MicroStation, OpenBridge, OpenRoad, etc.), acquiring OpenGround for use by DOTD geotechnical groups was easier than anticipated for this research. Researchers met with the Louisiana Office of Technology Services (OTS) representatives housed within DOTD to discuss options and installation. OpenGround was subsequently approved for this project and for use within the Department.

LTRC discussed the transition to OpenGround with Dataforensics, who assisted with LTRC research in Phases II and III. Dataforensics was instrumental in making upgrades to gINT, Boring Log Templates, and the pile load test database. They were also familiar with DOTD geotechnical data, structure, and workflow. Researchers included Dataforensics along with other stakeholders in the Project Review Committee (PRC) for the project. Dataforensics agreed to assist on the PRC, and they also (unrelated to this research) established a business relationship with Bentley following the Keynetix acquisition, which allowed DOTD to choose Dataforensics as its OpenGround technical implementation representative. Meetings are held with Dataforensics each month to discuss, develop, and implement a strategy to move forward and address any issues that arose along the way.

Data and Information

Discussions throughout the DOTD geotechnical data management process included facilitating easier access to data, data management, long-term storage, and geotechnical asset management (GAM). This included the preservation, management, utilization, and cultivation of these assets. Geotechnical data is an asset. Each deep boring cost approximately $30,000 or more to complete and report, so preserving the data is critically important to the sustainability and effectiveness of geotechnical investigations and the design of deep foundations, both now and in the future. The 2025 value for Phase IV is up from the 2010 Phase II value of $15,000.

In addition to the monthly Dataforensics meetings, researchers created a recurring biweekly meeting with the DOTD Geotechnical Administrator that coincided with the Dataforensics meetings on a monthly basis. These meetings were primarily centered on strategy and troubleshooting and focused on navigating the implementation of OpenGround, which included the migration of historical data.

An early objective of the project from the DOTD Geotechnical Administrator was to identify and convert as much existing Geotech data as possible. Additionally, better data management leads to better reporting. DOTD is shifting toward Geotechnical Data Reports (GDR), which will include data not currently appearing on the logs (e.g., pocket pens, grainsize distributions, consolidation tests, etc).

The OpenGround platform is robust and can handle a variety of datasets and data formats. Researchers divided these DOTD datasets into metaphorical baskets. The logic grouped similarly formatted data which could be handled in roughly the same fashion to speed incorporation into the database. An outline of the data baskets is included below.

Table 1. DOTD data baskets for inclusion into OpenGround

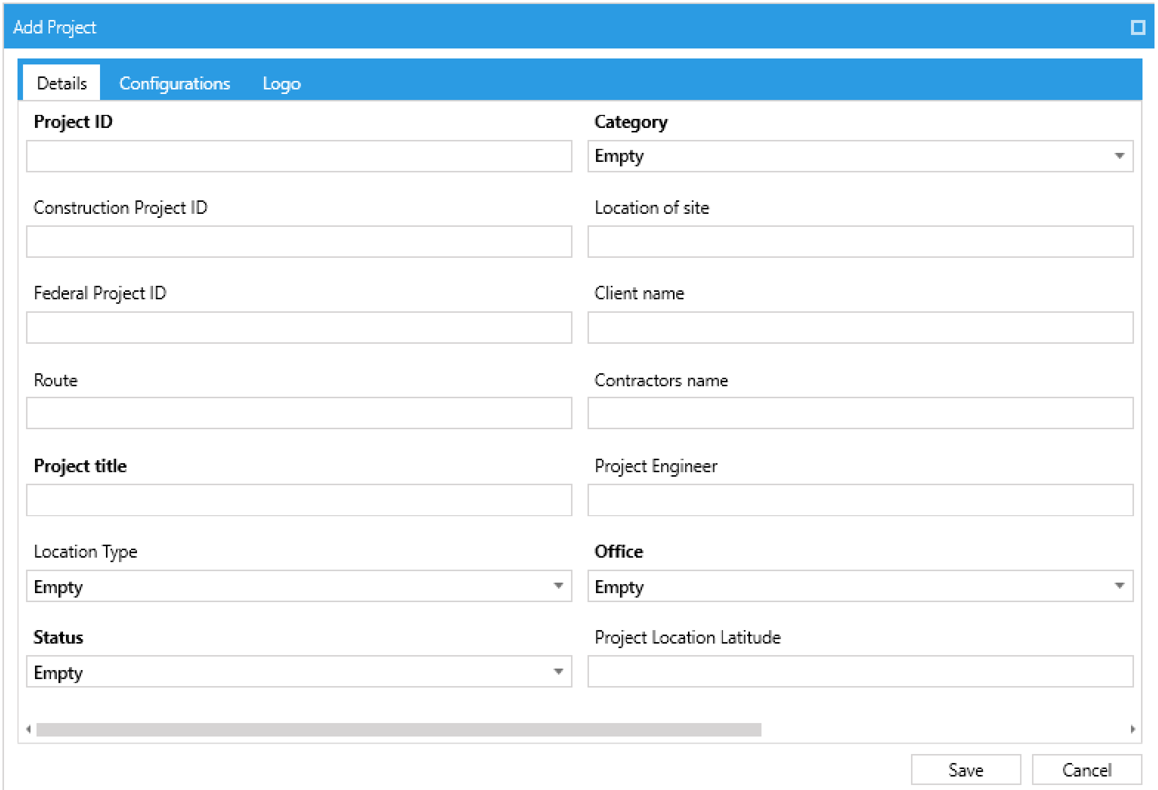
- DOTD Section 67 .pdf logs
- DOTD File.NET: Historical .pdfs in the DOTD document management system
- gINT digital files
  - DOTD Section 22, Materials Laboratory
  - DOTD Section 67, Geotechnical–converted files
  - Consultants
    - Ardaman & Associates
    - Terracon Consulting
- HoleBASE files: Section 67 production prior to OpenGround
- Other
  - As-builts (slope repair documents–GSI, etc.)
  - Coastal Protection Restoration Authority (CPRA)
  - Louisiana State University (LSU)
  - Louisiana Geological Survey (LGS)
  - Pile Load Test Data (LTRC Phase III)

Shared Excel spreadsheets were created to manage basket lists (e.g., projects, file names, file location, status, etc.) that needed to be uploaded to OpenGround. As files were uploaded, the spreadsheet was marked complete with dates and the uploader's name. If there were issues with uploads, these rows could be marked in the spreadsheet for future diagnosis with the Geotechnical Administrator and/or Dataforensics for data resolution. This process allowed for continuity and completeness in the uploads, ensuring that all data were addressed.

OpenGround Project Creation

Each project in OpenGround has certain key fields that must be completed. The Project ID was a unique field. Other important information can be added to describe and locate the project, allowing for filtering within OpenGround. An example of the first input page is shown below in Figure 5. Each project contains Unique ID (Project Number), Title, Status, Category, Office, and Location info fields.

Figure 5. OpenGround project creation input



DOTD Project Numbers

DOTD project numbers are found on boring logs and are often unique. However, some projects have multiple unique numbers, which can cause confusion. Historically, DOTD projects in the early design stage have design numbers (e.g., 700-##-####). Drilling operations often included multiple bridge borings under one 700 number for mobilization purposes, and they sometimes included the different bridge borings on the same triple-panel log sheet. Later, those projects would be assigned individual, unique construction project numbers in the format of 713-##-####, or that of a project number where the initial five numbers of nine (###-##-####) represent the control section (i.e., stretch of road) of the project. The last four numbers of the project number represent the construction project on that particular control section. Older boring logs also have bridge structure numbers unique to the bridge on the log, representing individual bridges. Ultimately, some smaller projects were changed from bridges to culverts without a structure number.

LTRC Geotechnical Database Phase I utilized the DOTD Content Manager software as the repository for all DOTD documents. Phase I utilized ArcGIS custom code and DOTD project numbers (###-##-####). These project numbers and their referenced control sections helped locate projects without GPS coordinates, as GPS coordinates either did not exist or were not available for older projects. For example, project number 450-11-0001 represents a stretch of I-10 from Bayou Manchac to Dutchtown, Louisiana, just south of Baton Rouge (450-11), and was the first project on that section (0001).

More recently, DOTD project numbers changed to an H.####### format, which no longer references a control section. Fortunately, GPS now exists, and coordinates are collected and reported for each soil boring or CPT on their respective logs. Additionally, bridges now have a recall number that is unique to a bridge and links to Departmental data.

Unfortunately, the ArcGIS custom code of Phase I did not translate forward, and other changes also impacted Phase I longevity, including project number changes and the DOTD migration of Content Manager documents to a newer document management software, File.NET. However, the information was preserved and organized within DOTD Section 67, as well as in the File.NET software.

OpenGround Status

Within OpenGround, projects are identified and tagged with status identifiers. DOTD chose the status categories shown in Table 2. These different status indicators help to identify where the data originated and/or where the project stands in the design workflow.

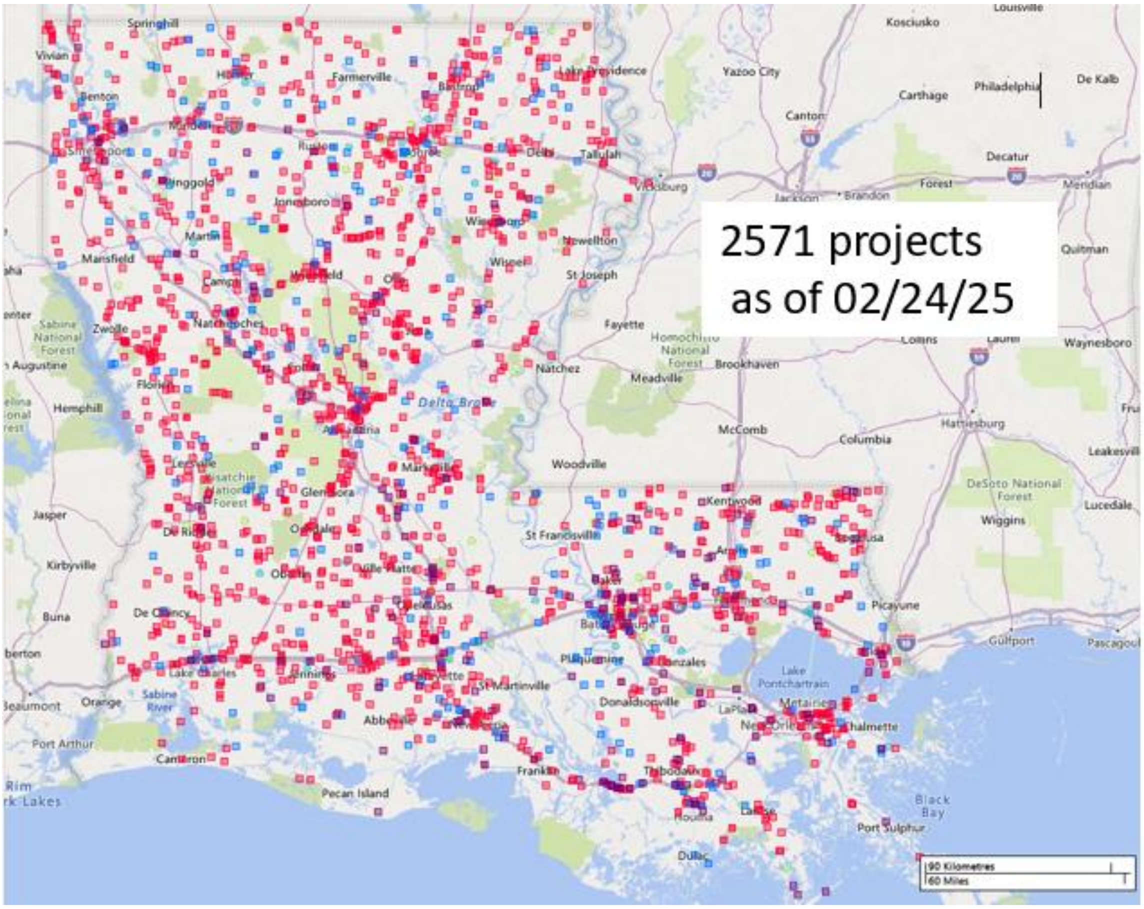
Table 2. DOTD OpenGround project status icons and descriptions

Icon	Status Name	Description
	Empty	Status not assigned
	Archive	Pile load test data, historical data (note: this was an initial category that was later subdivided into the two below; any items remaining in this status were via manual input or other means)
	Archive – Conversion	Projects converted from old gINT files (projects non-native to OGC that were converted from another system)
	Archive – Scan	Projects created based on old .pdf logs (projects non-native to OGC)
	Completed	Projects created and completed in OpenGround (note: these may be converted to another “archive” type status after the project is constructed)

Icon	Status Name	Description
	Desk Study	Projects created in OpenGround–not drilled (note: this was a default status within OGC that has temporarily been used to track drilling status)
	Open	Projects created in OpenGround–active
	Quoted	Projects created in HoleBASE ready for import to OpenGround. (note: this status may be disabled once HoleBASE is completely phased out)

The status and icons are visible in the main project page of OpenGround, allowing projects to be filtered according to project number, route, project name, status, category, and other project parameters. The status icons are also visible within the mapping page of OpenGround for easy determination of available data. Figure 6 shows the numerous historical .pdf projects (i.e., red icons) across the site. These icons represent hundreds of projects and borings that were paper files with limited access. Uploading these documents to OpenGround has made them more accessible for current and future projects. The blue icons represent projects that were converted from historical gINT files. As DOTD moves forward with more projects in digital format, the blue icons will grow. Purple projects represent pile load tests (PLT) across the state. A later chapter in this report will address DOTD pile load test projects and the Department’s plans to organize and coordinate PLT data within OpenGround.

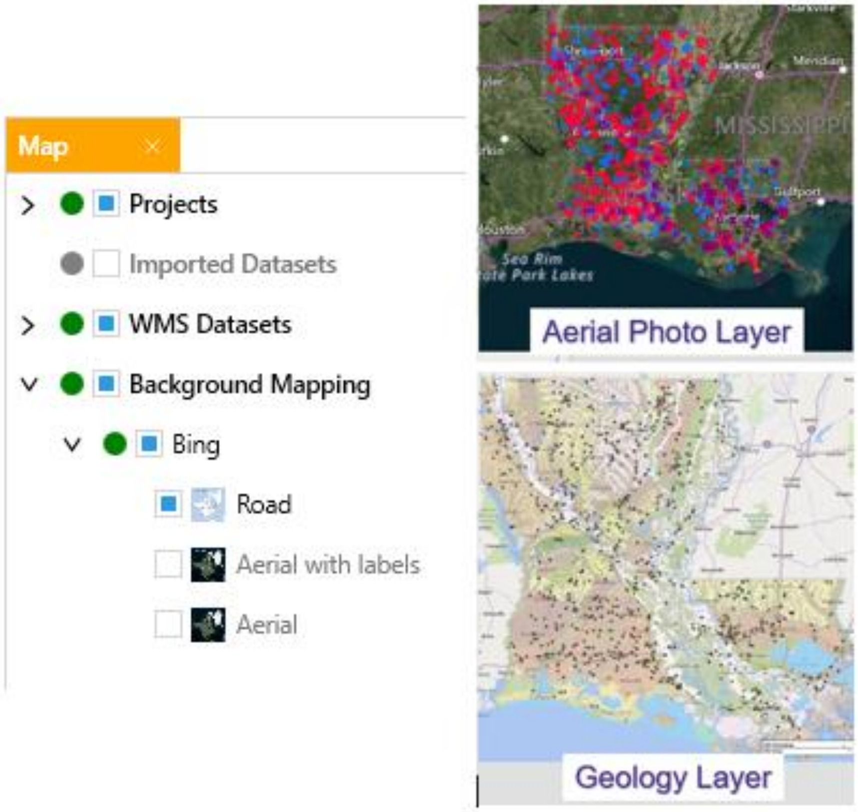
Figure 6. Uploaded projects (status icons) as of 02/24/25



Background Mapping

OpenGround includes default, pre-installed Bing road maps and aerial base maps. These maps provide regional and site details that help locate sites within OpenGround. Figure 7 shows an example of the background mapping included, and layers can easily be toggled on or off based on need.

Figure 7. OpenGround background mapping



OpenGround Categories

Within OpenGround, projects are tagged by category. Categories are used to differentiate project purpose and identify who generated the project data. One primary category subdivision is based on geotechnical investigation and who drilled and/or designed the project. DOTD maintains an in-house drill crew and has retainer contracts with Consultant partners for drilling and consulting. Other categories show borrow pits and shallow subgrade surveys for pavement applications. Pile load test (PLT) locations are shown across the state as a separate icon. The geotechnical asset category shows the location of emergency repairs and retaining walls, preserving the record for future reference. DOTD chose the different categories shown in Figure 8.

Figure 8 also shows an example map with different categories: archived .pdfs, pile load tests, and a blue icon showing the location (i.e., centroid) of a digital data project for a new bridge over Lake Charles. If that project is opened, the individual soil boring and CPT locations are revealed along with their associated data; see Figure 9.

Web Map Service (WMS)

In addition to background maps included in OpenGround (Bing road and aerial/satellite maps), LTRC also added layers for reference with the goal of providing a unified point of reference for Louisiana geotechnical site information and soil conditions. WMS layers and information are available via a variety of other sources. Researchers were able to link digital information layers to the OpenGround platform, making layers available within the mapping areas of OpenGround that can be toggled on or off with specific check boxes.

LTRC capitalized on the information from Phase I and added specific layers to provide additional information in one accessible location: the OpenGround map for designers. LTRC also included the locations of earth retaining walls inventoried through GAM research [14] as a WMS layer. Figure 8 shows the WMS layers included, and they are also briefly listed below:

- Louisiana Geological Survey [15]
- U.S. Geological Survey (USGS) [16]
- Surface Geology
- Hydrography Features
- Transportation Features
- National Resource Conservation Service (NRCS) Web Soil Survey (WSS) [17]
- U.S. Department of Agriculture (USDA) Soil Survey Geographic Database (SSURGO) [18]
- LTRC: Earth Retaining Structures (18-4GT), Retaining Walls [14]
- Salt Domes (Future) [19]
- Depth to Pleistocene Contours (Future) [19].
- Louisiana DOTD: Louisiana Imagery [20]

OpenGround Mapping

Figure 8 shows several icons in the category view mode. These icons show the centroid of projects. When the digital data project shown is opened, the individual soil boring and CPT locations can be seen in Figure 9. These investigations were conducted by multiple Consultant drilling crews due to an expedited schedule. These data are from different Consultants and were imported into the same OpenGround project. This digital data can be reviewed for data comparisons and quality checks.

Figure 8. OpenGround categories and WMS layers

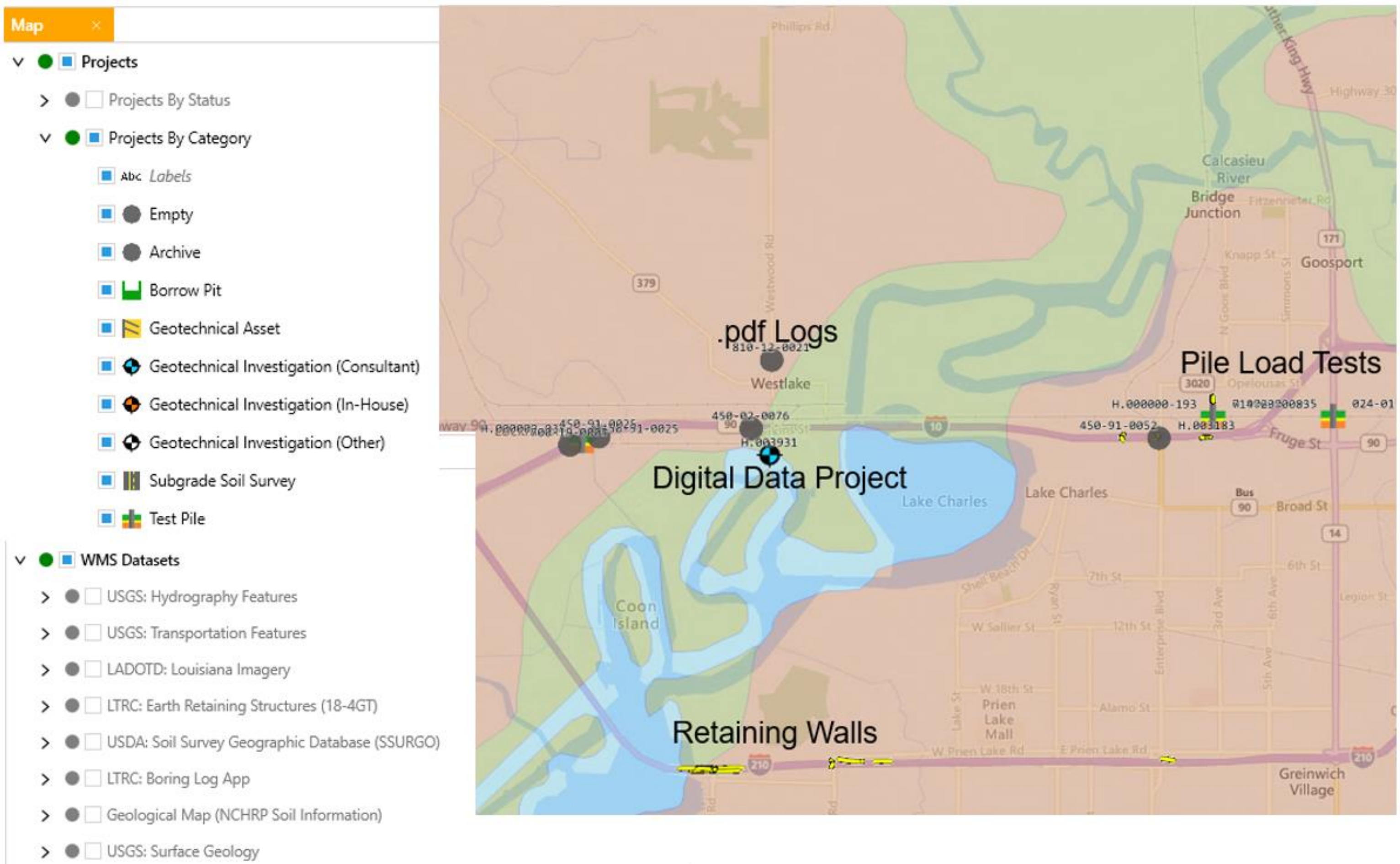
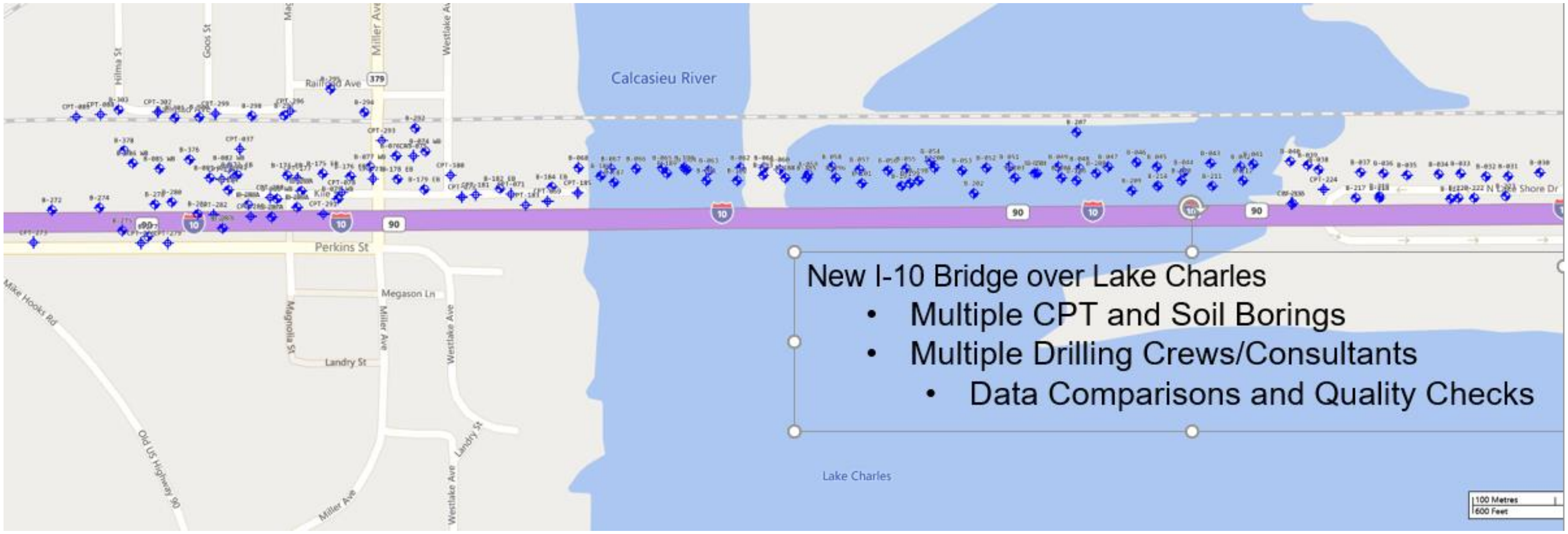


Figure 9. Example project showing soil boring and CPT layout



DOTD Section 67 .pdf Logs

Over the years, DOTD student workers found 2,500 borings in project files and scanned them into Section 67 files. Once a project is created in OpenGround, the simplest of project data is an uploaded document. OpenGround has a GIS interface which allows historical boring logs in image formats (e.g., .pdf, .tif, etc.) to be georeferenced to a point on the OpenGround map page. OpenGround users can search the map for projects with boring logs in a particular area without having to know any project numbers. DOTD chose a red icon on the OpenGround interface to indicate a scanned historical .pdf boring log that can be viewed in the software. Additionally, multiple project numbers can be attached to the unique ID in OpenGround in other fields to find projects. Like a Rosetta Stone, this allows users to connect the dots between multiple project numbers (e.g., design, construction, lead, federal, H#, etc).

Windows 10 was required for OpenGround, and LTRC had it installed on their computers before DOTD Geotechnical Section 67. HoleBASE is a version of OpenGround, so the learning curve and eventual upgrade to OpenGround would be relatively easy. Section 67 began working in HoleBASE until they received their Windows 10 computers approximately one year later. In contrast, LTRC started using OpenGround immediately, working to build the OpenGround system prior to the time when Section 67 was able to join.

LTRC geotechnical technicians uploaded .pdf boring log documents as soon as OpenGround was installed within the Department. An instruction guide describing the upload process (i.e., Import Process) for the technicians is included as Appendix A**.**

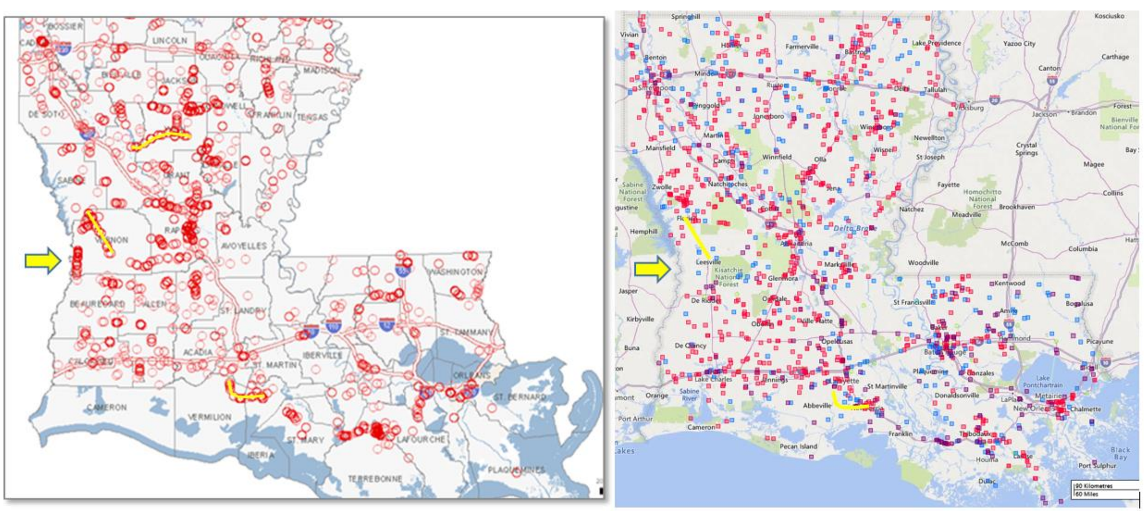
Within OpenGround mapping, an icon represents each project on the map. This icon represents the centroid of the project's boring and CPT locations; see Figure 6. For .pdf borings, the data was not digital; therefore, no detailed GPS coordinates existed. For this reason, the project centroid was set at the project bridge's center. By setting the centroid here, it simplified and sped the upload (80:20 logic) of these logs, while also preventing the improper placement of borings. The bridge and boring information (e.g., structure number, recall number, location, etc.) was crosschecked by engineers as part of a quality assurance procedure.

File.NET .pdf Logs

After researchers imported .pdf boring log files from the Section 67 basket, a comparison of the LTRC Geotechnical Database Phase I data to the OpenGround data showed several differences where researchers thought they would be identical. Figure 10 shows .pdf borings in red on each map, with differences highlighted in yellow.

To ensure all baskets were covered for complete datasets, researchers met with the DOTD File.NET coordinators to arrange getting these boring log data files into OpenGround. File.NET allows links to documents through its interface, and researchers attempted to incorporate these links with OpenGround, but rather than bringing users to the document, the links brought users to the File.NET interface. This process required too many steps to get to the actual boring log document. It was therefore decided to ask File.NET coordinators for a document search and data-dump into a Section 67 shared folder, so these historical documents could be uploaded directly and stored in OpenGround.

Figure 10. Map comparison: Phase I vs. initial OpenGround efforts



Researchers utilized the same Excel checklist logic for each basket of data to ensure files were imported and located appropriately. The checklist structure allowed for tagging problematic files to address later. This also matches the 80:20 logic of getting the data into OpenGround. Technicians would upload data files, and engineers would check the location and project information for accuracy. Researchers were able to locate these Phase I basket borings and add them to OpenGround, resolving the differences shown in Figure 10 for a more complete set of logs within OpenGround.

Triple Panel Soil Boring Logs

The historical boring log for DOTD was a large plan sheet comprised of three panels for boring log data, also called a triple panel. Each single panel within the triple panel sheet could contain a unique boring log. Historically, borings assigned to Section 22 drill crews were combined with other drilling projects for regional efficiency. Sometimes boring logs conducted by Section 22 were combined on to the same plan sheet based on the design project (700-##-####), even though these project numbers were unrelated to their construction project locations and construction numbers (713-##-####). As part of the upload of .pdf logs, LTRC researchers attempted to connect the disparate project numbers, plot the borings in their correct locations, upload the boring logs to the correct project, and split unrelated projects into their own unique projects. For example, a triple panel log with three unique projects will appear in each of the new split projects. This also allowed unique centroids on the map for the unique projects, rather than a random centroid of the three unrelated projects.

Additionally, because of the different project numbers used throughout design and construction process, a log could be stored under multiple project numbers (700#, 713#, ###, etc.). Part of this is due to DOTD silos. Rather than attempting to resolve subtle differences between the different project numbers, even though the logs were likely the same, the logic was to keep all logs, rather than deleting projects and potentially losing data. The 80/20 rule of not reviewing subtle differences would allow Department personnel to enter more data and separate the differences later. These multiple project numbers for one bridge may be resolved in a subsequent research effort.

Image Error Resolution

During the upload process, many old .pdf files had various issues, including:

- Illegibility
- No project number
- No reference
- No location information, coordinates, etc.
- Culverts vs bridges
- No structure number (or in an ancient format)

Most issues were based on the quality of the scanned data. While scanners have improved over time, the poor image quality could be based on:

- The machine quality (minimal dots per inch);
- The printed sheet's quality, based on the printer it came from; or
- The ability/capability of the operator scanning the image.

DOTD has improved their digital data collection and retention over the years; unfortunately, most of these problematic images are from long ago. These issues bring forth the question of when to discard this document. The poor quality of the image or missing information dictates that the fate of the boring log has little to no value. Therefore, it was time to cull this data. LTRC simplified these decisions for DOTD staff, and temporarily isolated these logs with separate special notes in the OpenGround Project Engineer data field. The note in this field also helped quickly isolate projects that needed more attention because this single field could be sorted and did not require project numbers and other information.

Digital gINT Data-Archive

Researchers with DOTD used the Everything software to search and create detailed lists of gINT files within Section 67. The search ensured that all files were located and placed into the Excel files for proper import. The search showed exactly where the files were located and in some cases found duplicates. The file locations were transformed into a hyperlink in the Excel spreadsheets to ease the location of files during the import process.

Old Unstructured Data Files

There were gINT files prior to Phase II. These unstructured files are another data basket of various gINT templates. This basket is like the Wild, Wild West, in that it is complex and will take a bit more effort to corral and convert the data, as they are not standardized in their old format. Based on newer technology such as Optical Character Recognition (OCR), Artificial Intelligence, and Machine Learning (ML), which are described later in this report, data scanning and import may actually be an easier process to import this basket of data into OpenGround. Even though the data is not structured correctly in the gINT files, the boring logs should appear correct and allow scanning of these gINT output files, as opposed to running the files through the data conversion process. This issue will be addressed in a future project to be discussed later in the report.

Digital Data-gINT Conversion

Phase II standardized the DOTD gINT Template, and DOTD shared this with the Materials Laboratory and its retainer contract Consultant laboratories. This helped create another basket of similar data.

DOTD Section 22. Section 22 drill crews provide samples to the Section 22 laboratory, which conducts testing and provides Section 67 with gINT files. There is an internally shared drive for transfer of data from the Materials Laboratory (Section 22) to the Geotechnical Design (Section 67). This process existed for many years, and there were many historical gINT projects (a large digital basket) within the drive.

Researchers, Section 67 personnel, and Dataforensics established a process to convert these gINT files to OpenGround. Like .pdfs, a similar step-by-step document was created for LTRC researchers to follow regarding the conversion of gINT files into an acceptable format for OpenGround digestion and incorporation; see Appendix B. These documents converted relatively easily due to the standardized format, but there were outliers that were logged via spreadsheets and addressed through biweekly meetings and monthly conference calls. This upload process was subsequently utilized within Section 67 to upload projects from gINT and HoleBASE to OpenGround.

Consultants. The research team worked with Section 67 and its retainer contract Consultants to update the standards for geotechnical deliverables. The gINT template updates shared during Phase II were utilized over several years by both DOTD and its Consultants.

As the LTRC research project began, Consultants were asked to share their gINT files from DOTD projects. Two Consultants, Ardaman and Terracon, each shared a basket of data files developed with the DOTD template. These baskets of files were migrated to OpenGround using the process outlined in Appendix B. These files were logged with spreadsheets as outlined earlier.

Both DOTD Section 22 and Consultants will be guided to provide standardized geotechnical data to the Department via gINT (.gpj files) exchanges until parallel LTRC research using a web-portal with a Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) exchange is implemented. This is discussed later in the report.

Digital Data Error Resolution

QA / QC

Throughout the upload process of the different digital baskets, various errors were encountered that needed resolution. The errors were associated with the conversion and upload of data from gINT to OpenGround. The errors were addressed with the help of the DOTD Geotechnical Administrator and Dataforensics. Most of the errors related to data formatting (e.g., significant figures, numbers vs. text, missing data, and/or data that was shoehorned into incompatible fields of gINT). A brief list of data error checks are compiled below:

- gINT
    - Pocket penetrometer error
    - WBS project information not in the data file
    - State Plane Coordinate system (incomplete or incorrect)
    - Sample names: B-1 to B-01, or B-001 if 100 or more borings
    - Sample depth checks
        - Sample beginning and end needed to match depths
        - Test versus sample needed to match
        - 4-4' versus 4-5.5'
        - Splitting samples into different depths via a & b designations
    - Shorten digits in the lithology table (i.e., too many significant figures)
        - Latitude
        - Longitude
        - Triaxial Chamber Pressure
    - Hole diameter size (4") in point table (text versus numeric)
    - Lab specimen
    - Consider deletion of these projects:
        - Projects with no GPS, or calculate via project number
        - Projects without boring logs
- Some data sets have multiple projects in one digital data file. These files were split into separate projects.

- Some boring logs have multiple sites/projects on one triple panel sheet. These were split into multiple sheets and individual projects as described earlier.

HoleBASE Data Migration

The project intended to move directly to OpenGround, but there was a delay of approximately one year in the arrival of Windows 10 computers for Section 67. As a result, they began using HoleBASE instead, which is a previous version of, as well as the basis for, OpenGround. Over the year waiting for Windows 10, Section 67 collected a basket of data in HoleBASE that needed to be migrated to OpenGround once they obtained Windows 10 computers.

As discussed earlier, LTRC prepared a digital step-by-step document for the conversion and import of old gINT files into OpenGround. The document outlined the steps to migrate to OpenGround. Similar to the old gINT file migration, the document was shared with Section 67 to assist with their migration from HoleBASE to OpenGround once their Windows 10 computers arrived. Each Section 67 engineer was tasked to migrate their own HoleBASE projects into OpenGround.

These files were easily converted and had few, if any, errors since they were created in HoleBASE and its DIGGS compatible data structure. As more projects are created and designed in OpenGround, some of the original icons mentioned in Table 2 may be retired.

Rapid CPT

Section 67 began using Rapid CPT with gINT during Phase II. After the switch to HoleBASE, Section 67 began using the Rapid CPT Plugin for HoleBASE. The Rapid CPT Plugin is located on a Louisiana OTS server. The software analyzes the CPT cone file format and prepares a cone file for gINT or HoleBASE. Like DIGGS, Rapid CPT helps ensure raw cone data is interpreted properly so it can be transferred regardless of cone manufacturer. Database software gINT and HoleBASE can digest the structured data from the newly formatted file. Next, within gINT or HoleBASE, the Rapid CPT Plugin automatically calculates numerous parameters (e.g., classification, OCR, etc.) based on the raw cone data. This includes the Fuzzy Soil Classification developed by LTRC [21] [22].

Section 67 currently uses the Rapid CPT Plugin within HoleBASE. Results are then exported from HoleBASE and imported into OpenGround via .csv files. At the time of publishing, Rapid CPT did not function with OpenGround. Bentley has disabled calculations within the OpenGround Cloud to ensure the speed and efficiency of the OpenGround Cloud server. DOTD and LTRC look forward to the ability to utilize Rapid CPT within OpenGround.

Transition to OpenGround and KeyLAB

KeyLAB as Part of a Replacement to gINT Data Entry

As discussed earlier, Bentley will sunset gINT in 2028. OpenGround will replace HoleBASE, but on the laboratory side, KeyLAB has not been updated to a Bentley "Open" Lab product as of the date of this report. This has created an opportunity for other competitive products to enter the market.

The sunset of gINT affects all users of the software globally. DOTD Section 22 and its Consultants were historically required to use gINT on DOTD projects for a number of reasons:

- It was ingrained into the geotechnical culture;
- It was the best product available for many years; and
- It allowed DOTD to standardize a data and log format by issuing a gINT library file.

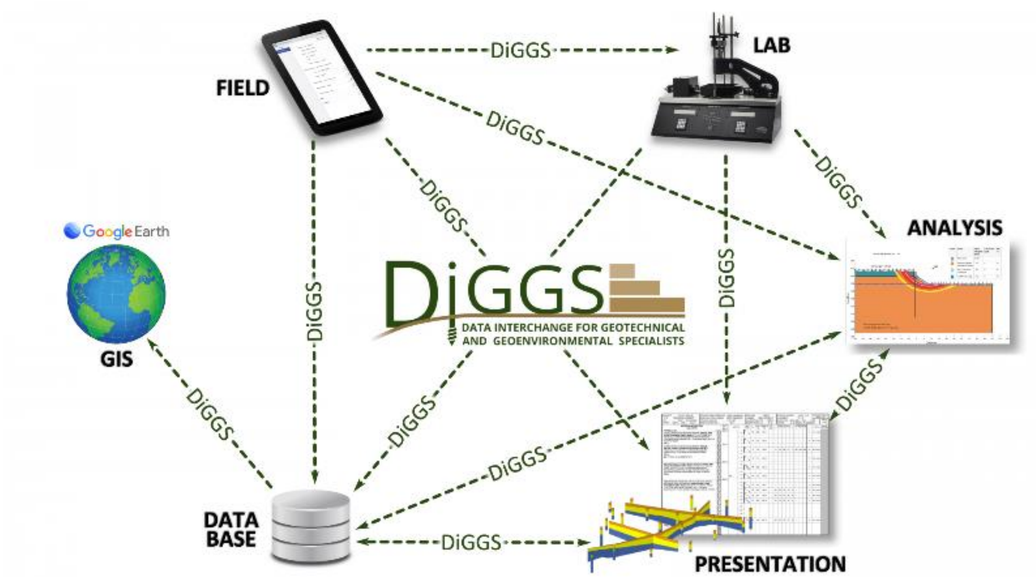
Moving away from gINT, DOTD does not plan to require Consultants to have a particular software. The market is in flux, and there are many potential solutions. For reference, the Army Corps of Engineers requires Consultants to use OpenGround. DOTD currently intends to remain software agnostic based on the improved connectivity allowed through structured data and the potential of DIGGS. LTRC plans to initiate a separate project to address data file transfer between Consultants and DOTD. This will allow a transfer through a DIGGS tool that converts data, even if the Consultant utilizes another geotechnical database management software.

Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS)

DIGGS is an effort supported and encouraged by the ASCE Geo-Institute and the Federal Highway Administration (FHWA). ASCE hosts a website that explains the DIGGS effort and provides links to the DIGGS efforts, including all code, DIGGS schema, and tools. The DIGGS effort to connect data, equipment, and other geotechnical processes has been furthered by advancements in computer capability and programming, more computer savvy students, and the combination of geotechnical skill with computer ingenuity. Figure 11 shows an example of how DIGGS can connect processes, reducing the chance of lost data and or transposition errors.

This and previous research efforts have worked to establish DIGGS compliant data. Having DIGGS compliant data will allow it to communicate through DIGGS with the other items shown in Figure 11.

Figure 11. Data Interchange for Geotechnical and Geoenvironmental Specialists (DIGGS) [6]



Several key stakeholders in the DIGGS effort have connections to DOTD. Dataforensics and Geosyntec (Xin Peng, formerly of Ardaman Baton Rouge) have worked to advance the DOTD data management effort and the DIGGS effort overall.

Dataforensics have proven a DIGGS round-trip, wherein data is exported from OpenGround into a DIGGS compatible file and imported into another instance of OpenGround with success and no errors. They have also developed a DIGGS Conversion Tool. Additionally, Xin Peng (Ardaman & Geosyntec), who worked closely with DOTD over the years, recently developed an open-sourced DIGGS file validation tool.

The efforts toward complete DIGGS implementation continue both at DOTD and across the nation. A DIGGS working group meets monthly to showcase, troubleshoot, and advance the standardization of geotechnical data through DIGGS.

Currently, laboratory testing procedures often require paper sheets to record raw data or pull raw data from a separated testing device to enter that data into gINT. These raw data sheets can introduce a variety of errors. DOTD is currently focusing on KeyLAB for data entry efforts, as outlined below. However, it would be ideal to have the testing devices (e.g., GeoComp, Humboldt, etc.) communicate directly with KeyLAB or OpenGround. GeoComp is currently making efforts to accomplish this goal, and DOTD is hopeful to implement this as a future geotechnical data management effort. Additionally, OpenGround representatives acknowledged during conversations with the author at the 2025 Southwest Geotechnical Engineering Conference (SWGEC) that OpenGround will make more efforts toward full DIGGS compatibility.

Consultant Drilling/Testing Contracts Transition

LTRC and DOTD staff have been questioned many times regarding our path forward. KeyLAB and OpenGround appear to be the reliable path forward for Louisiana DOTD. Department personnel have assisted its consultant partners and other state DOTs with conversations and demonstrations regarding our efforts. LTRC and DOTD have also met with other geotechnical data management software vendors to view and discuss their products so that we may be better informed as a Department and share these insights with partner Consultants and other state DOTs.

KeyLAB Customization

DOTD and KeyLAB

Based on DOTD's decision to choose HoleBASE, and Louisiana being a Bentley state, researchers progressed with their implementation of KeyLAB and HoleBASE, and ultimately OpenGround after the change. Researchers and DOTD personnel held many discussions with Dataforensics to discuss the HoleBASE and KeyLAB interaction, the gINT sunset plan, and a strategy (roadmap and workflow) to facilitate full implementation of KeyLAB in connection with OpenGround within DOTD. KeyLAB data can be uploaded to OpenGround, which cleared a path forward for Section 67 based on OpenGround implementation.

Internal Drilling

DOTD has a geotechnical drill crew with deep soil boring and cone penetration test (CPT) capability. The organizational structure of DOTD once had the Drill Crew under Geotechnical Design, Section 67. This was recently changed to move the crew into the Materials Laboratory, Section 22. Samples collected by the Drill Crew are delivered to and tested by Section 22. The workflow for interaction between the two sections regarding communication and action for assigning, collecting, testing, and reporting deep boring information is included in Figure 12.

KeyLAB Sheets

Because KeyLAB data entry sheets were created in Phase III, minimal effort was needed to add additional sheets for deep boring operations and testing. Custom test sheets, which can be printed from raw number input, will calculate other relevant values and parameters. For example, raw wet and dry weights can be input into KeyLAB to calculate moisture content. Similarly, sheets existed for grainsize, Proctor, and soil classification. Modifications to the grainsize analysis sheet to include wet wash and the option of additional sieves, as well as Triaxial UU testing, were added. Consolidation test sheets were not created due to the complexity of the test and the movement by geotechnical equipment and testing companies like GeoComp to utilize and transfer DIGGS compatible test data and results to OpenGround and other geotechnical databases.

Phase IV did require a small contract with Dataforensics to add and modify some KeyLAB testing sheets to meet Section 67 deep boring requirements and provide KeyLAB training to populate test data into sheets before uploading it back into OpenGround via the workflow shown in Figure 12.

KeyLAB Training

LTRC hosted two training events with Dataforensics to assist with the implementation of KeyLAB within DOTD. The first was held on September 4, 2024, and the second on March 24, 2025. The sessions outlined the workflow designed by Section 67, including the necessary steps and interactions of Sections 22 and 67. The training also conducted a a complete input of data through various KeyLAB test sheets, as well as the creation of boring logs, transfer of data, and parts of a Geotechnical Data Report (GDR) submittal to Section 67. Training documents are available via the DOTD intranet under the Pavement and Geotechnical links. Additionally, training videos are available on the Section 67 Geotechnical DB folder.

Figure 12. DOTD deep boring work flow

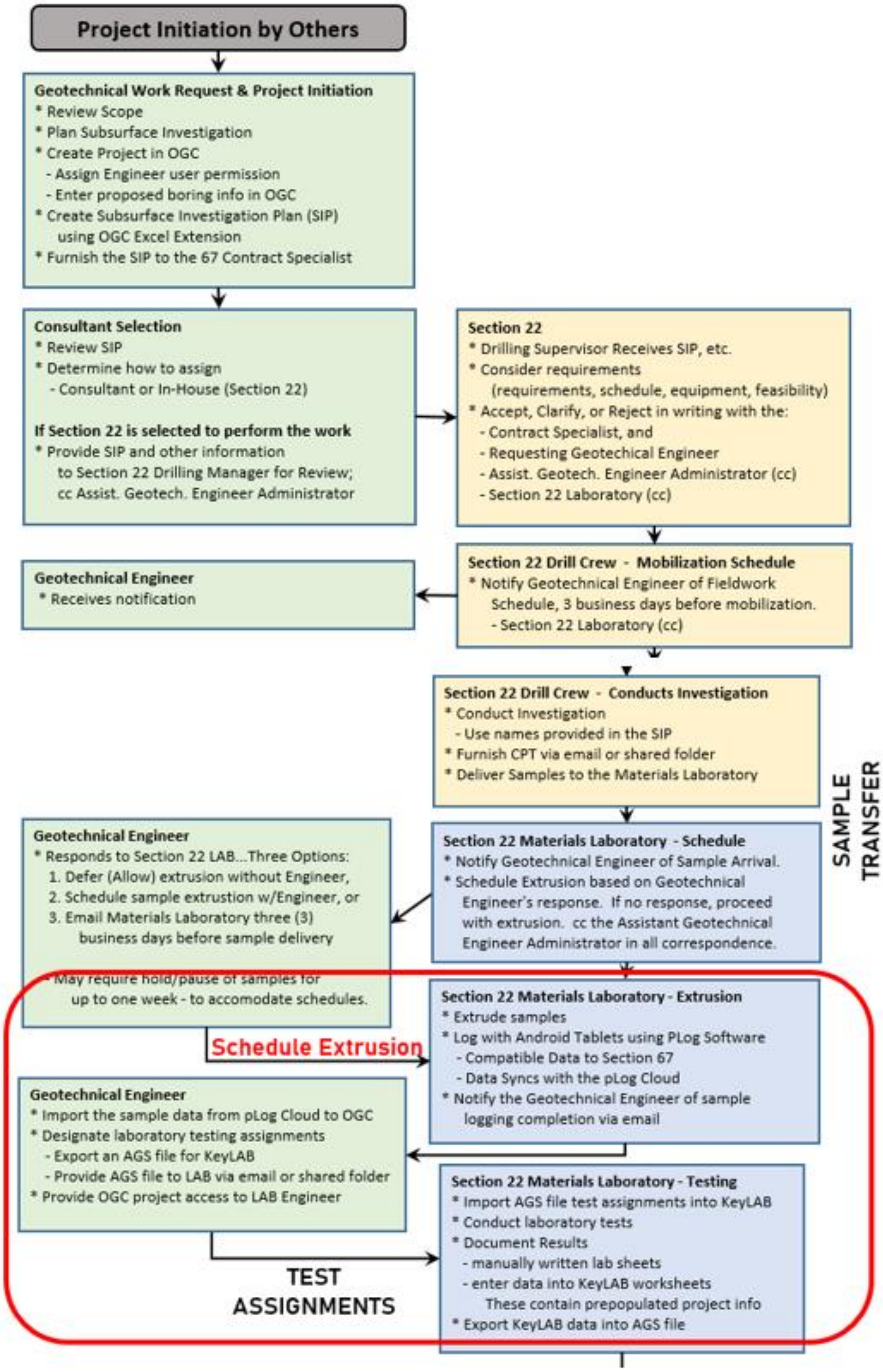
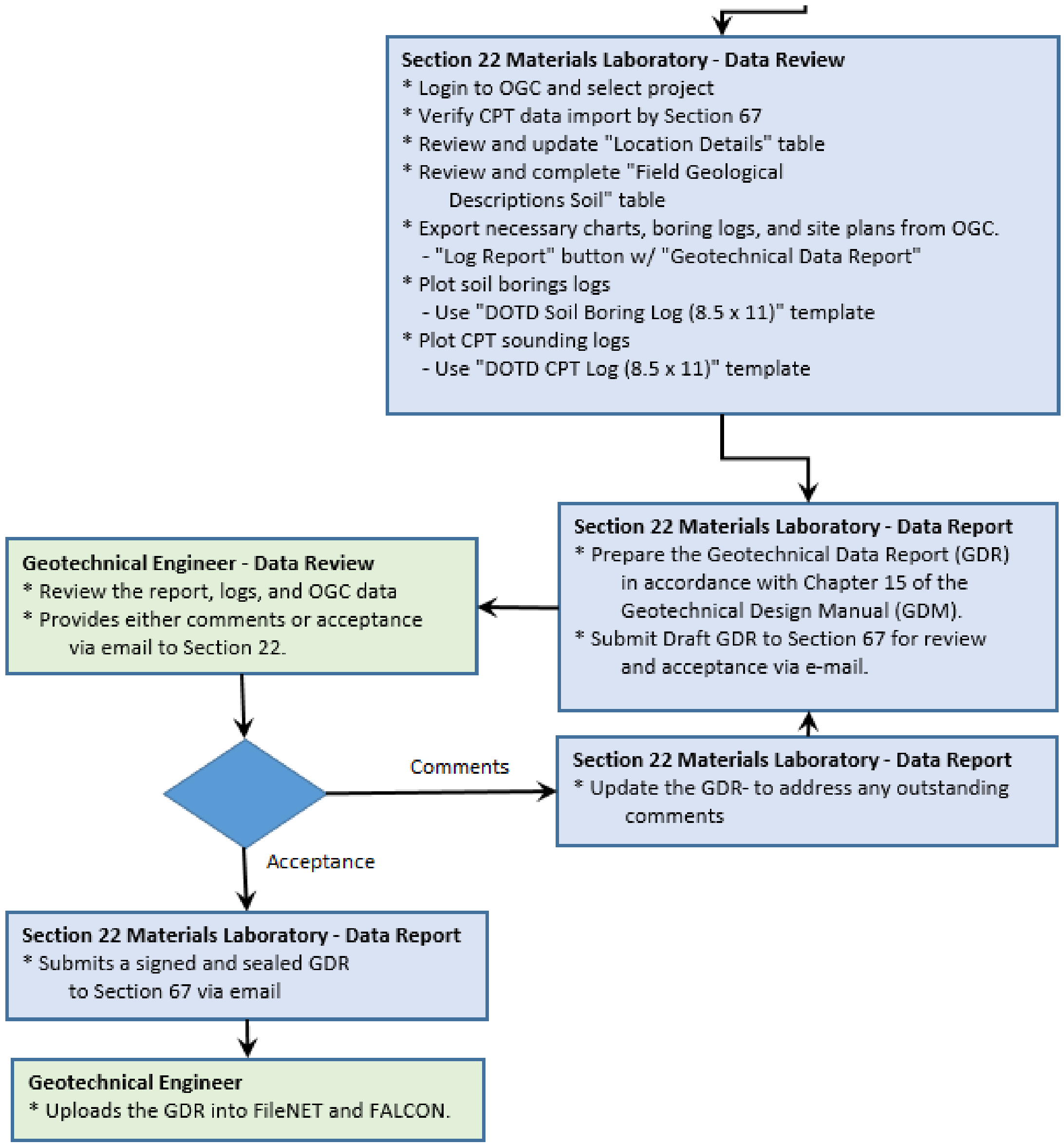


Figure 12. DOTD deep boring workflow (continued)

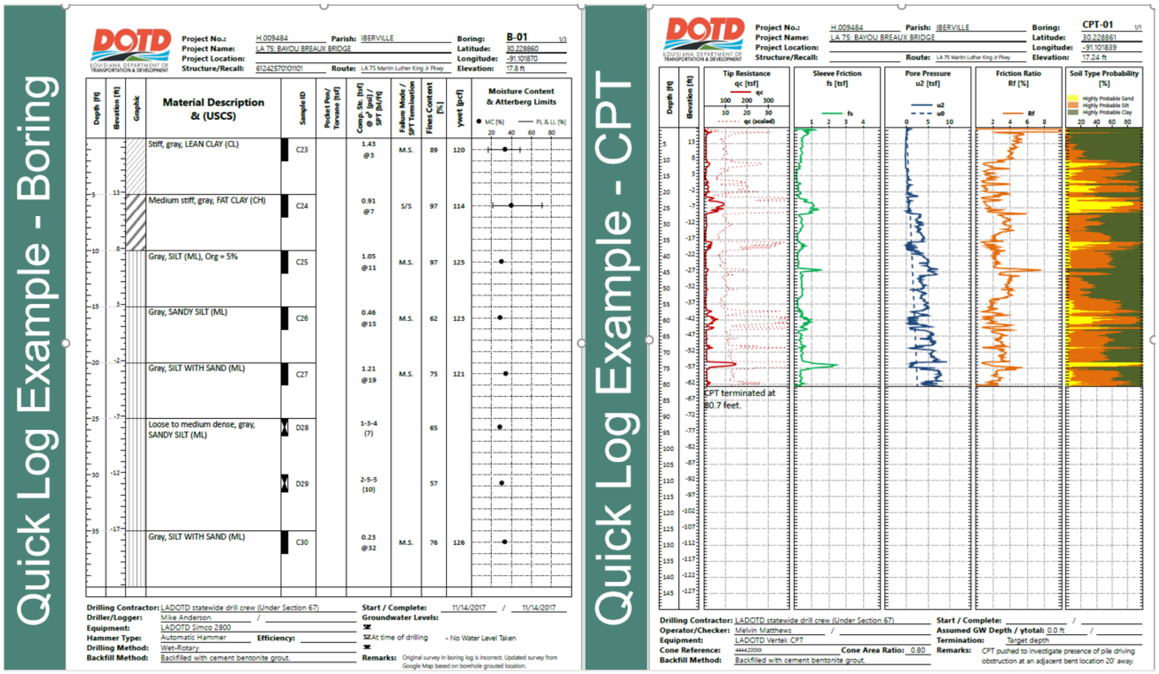


OpenGround Customization

Quick Logs

OpenGround produces quick logs to view the soil boring and CPT data in a standardized form. These templates were developed by the Section 67 Geotechnical Administrator through the OpenGround Template Studio. Figure 13 shows an example of the soil boring and CPT templates created by DOTD. These quick logs can be created for individual boring logs or as a quick log report that contains all boring logs for the chosen project. These boring logs will become part of the each project's GDR.

Figure 13. Quick log examples



Geotechnical Data Reports (GDR)

DOTD plans to implement Geotechnical Data Reports (GDR) with each project. GDRs provide a full picture of site conditions and includes the quick log data sheets for the project. GDRs, in contrast to only plan sheet boring logs, provide all geotechnical data, supporting information, and other testing (e.g., consolidation tests, etc). GDRs will be required from both DOTD Section 22 and external Consultants.

Paper Boring Logs (Plan Sheets)

The push to add full GDRs and remove full size sheets from the plans received some resistance throughout the process. Here is an excerpt from an email discussing the proposed path forward from Jesse Rauser, P.E., DOTD Geotechnical Unit Supervisor, to the DOTD Materials Laboratory regarding paper plan sheets on September 9, 2024:

> *The current state of practice in geotechnical engineering has changed since the triple-panel log was first used in the plans decades ago. Those old logs often only*

included visual classifications and blow counts, whereas today we are going to a much more data-driven practice with more testing.

The old full-size borings no longer meet the Geotechnical Unit's design needs as a final deliverable (deficiencies are discussed below). Furthermore, the software used to generate these logs (gINT) will be phased out by Bentley in a couple of years, requiring a change. The Geotech Unit and LTRC have therefore worked to develop a practical solution to preempt this phasing-out. We have worked on the details for several years and we believe the solution meets the future needs of the Department and its Contractors. Ultimately, we are just asking that subsurface investigations be documented in a Geotechnical Data Report (GDR) containing all testing results and documentation. These reports will be placed into File.NET and FALCON for long-term storage and contractor access. All test data will also be provided digitally via an approved format.

The old-style logs are deficient for the following reasons:

- *The only practical means for developing the triple-panel, full size log is a custom gINT template developed for DOTD 14 years ago. This template will be obsolete once gINT is phased out in a couple years;*
- *There are incompatibilities between the triple-panel template and current versions of gINT that require changing/falsifying of digital data to make things appear properly on the log. This is unacceptable from a data management standpoint and requires manual editing of each data file to fix the changes;*
- *After the planned gINT sun-setting, there will not be a practical means for creating or maintaining a template for the three-panel, full-size boring log format. We have had complaints in the past that the nature of the DOTD log makes it difficult Consultants to do business with us. This would continue;*
- *Contractors are not receiving all of the test data when we offer only the full-size plan sheet. Important data such as grain size curves, consolidation curves, and load vs. deflection curves are not included because there is no room on the boring log. How much value do we really want to attribute to an incomplete log?;*

- *Because of this, a Geotechnical Design Report (GDR) is the industry standard for conveying hardcopy geotechnical investigation results; and*
- *8.5” x 11” soil boring logs are also industry standard. Modern geotechnical borehole software reflects this. Individual paper log sheets (three or more) from the GDR could be placed adjacent to each other by engineers or contractors to view soil conditions. GDR Digital data allows this without paper.*

We recognize that contractors also use the boring data and we believe that going the GDR route provides them more geotechnical data than they have ever received in the past from DOTD. We should want to provide as much of this to the contractor as possible to avoid unknowns. Knowing that the current log format omits some of the lab results, and that our consultants have been doing GDRs for years, is it really too big an ask to expect the contractor to receive the GDR as a part of the Bid Documents? The triple-panel log was originally hand-drawn, then moved to MicroStation, then on to a gINT custom template. The GDR and digital data are the next evolution of Geotechnical Data/databases, ultimately leading to digital data transfers, Digital Twins, and Building Information Modeling BIM.

The new process does not prevent placing logs into the plans, but it does make it redundant. If Section 22 chooses to produce full-sized logs for inclusion in the plans, that is their prerogative. However, note that in the past Section 67 has provided extensive editing, maintenance, troubleshooting, etc. for the template and log generation. As these full-sized logs are no longer relevant to the Geotech Unit’s workflow, I can’t continue to invest time into providing this support. These full-sized logs will also need to match the GDR in content, exactly – OGC as a newer geotechnical data management system is more easily modified, a single solution, and a logical path forward. More importantly, Section 22 will need to consider how it will continue to generate the old-style logs after gINT is obsolete.

Ultimately, to meet the requested push for a paper plan sheet, a temporary solution was found by Section 22. Their process was to print quick logs in OpenGround, then digitally snip and paste these images into the old boring log MicroStation plan sheet. This method will be examined and tested by Section 22. As the value of the digital data and GDR is further realized, it is unlikely these paper logs will be continued forward.

Building Information Modeling (BIM)

BIM and digital documents are growing in use across the U.S. Designers use these 3-D BIM models to document their designs, show and address potential conflicts in the three-dimensional space, convey to the contractor the scope and details of the project, and preserve the project for future generations and the next project in the area. This research effort helps set a path forward toward BIM within DOTD. As an example of how the construction industry is also shifting towards digital delivery and electronic construction, Louisiana State University (LSU) plans to construct a $107 million Construction & Advancement Manufacturing Building to "include state-of-the-art facilities for innovative materials production, as well as design of transformative three-dimensional printing and construction methods that incorporate the latest capabilities in artificial intelligence and integrated sensing" [23].

Leapfrog Works

Leapfrog Works (Leapfrog) is a Bentley software product for visualization, analysis, and dynamic 3D geological modeling. Leapfrog is a product under Seequent, the Bentley Subsurface Company. Leapfrog links to OpenGround and is designed for civil engineering and environmental projects. LTRC and DOTD personnel met with Seequent and Leapfrog staff on April 16, 2025, to discuss the potential use and implementation by DOTD. A virtual demonstration is planned to share the potential with DOTD. Other Seequent/Bentley products besides OpenGround and Leapfrog are GeoStudio, Central, and Plaxis. These products and their connected features could offer DOTD a more connected and efficient workflow for design.

Excel Extension

OpenGround allows for the creation of different templates and analysis spread sheets. Figure 14 shows an example of the Excel extension tabs within OpenGround. The Section 67 Geotechnical Administrator developed different templates and spreadsheets via the OpenGround Template Studio to ease the laborious hand calculations that are often utilized to characterize the soil based on the available soil data. Figure 14 also shows a list of the available templates within the DOTD OpenGround interface. Figure 15 shows several examples of the templates created within OpenGround for DOTD. These templates access data directly from the OpenGround Database and remove the laborious steps of retyping values from soil boring logs and/or plotting data points by hand.

Historically, the analysis of geotechnical data required hand plots from boring log images. In contrast, with the availability of digital data, tables, graphs, and forms can be utilized to speed and ease these calculations. Additionally, these templates allow Section 67 personnel to standardize their design process and workflow. This allows employees to be trained easily, worksheets to be created and checked easily, and work to be transferred from one engineer to another with continuity, if necessary.

The standardization of data and the use of OpenGround, as discussed previously, eases the workload of the designer, reduces the potential for transposition errors, and has many other benefits. Short-term benefits help convince a designer on why they might want to utilize digital data and a database. The use of the database also creates long-term benefits. The data preserves the digital data and the analysis for the future record moving forward, as well as providing an ever-growing source of data for researchers to study. Researchers intend to use the data to improve Louisiana specific Load Resistance Factored Design (LRFD) correlations, among other applications.

Figure 14. OpenGround Cloud (OGC) Excel extension

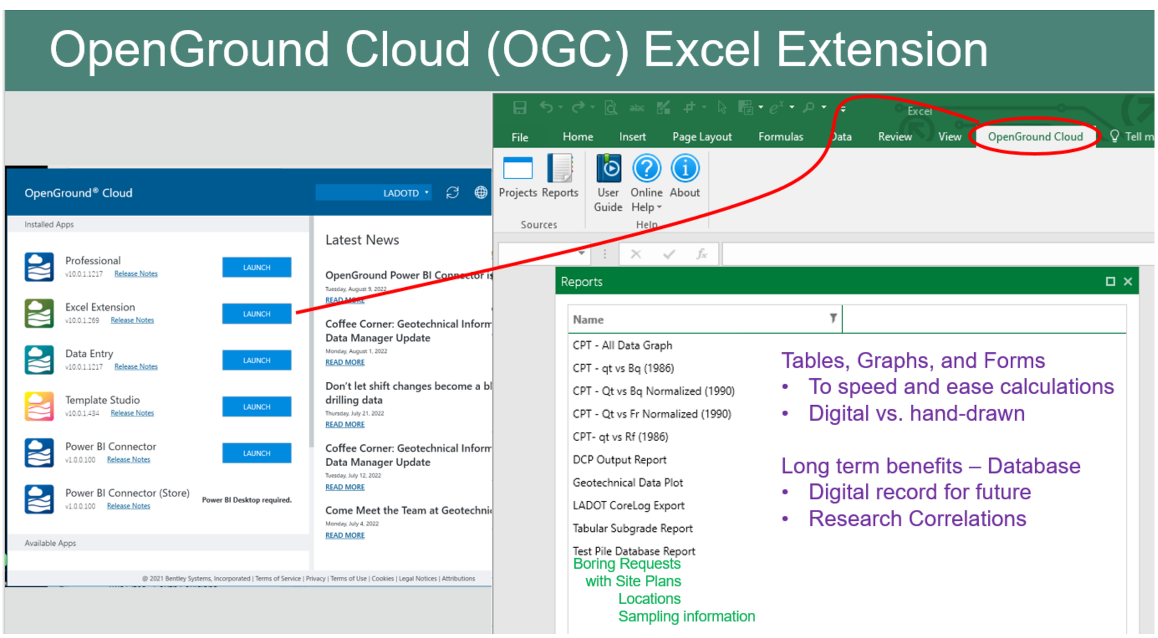
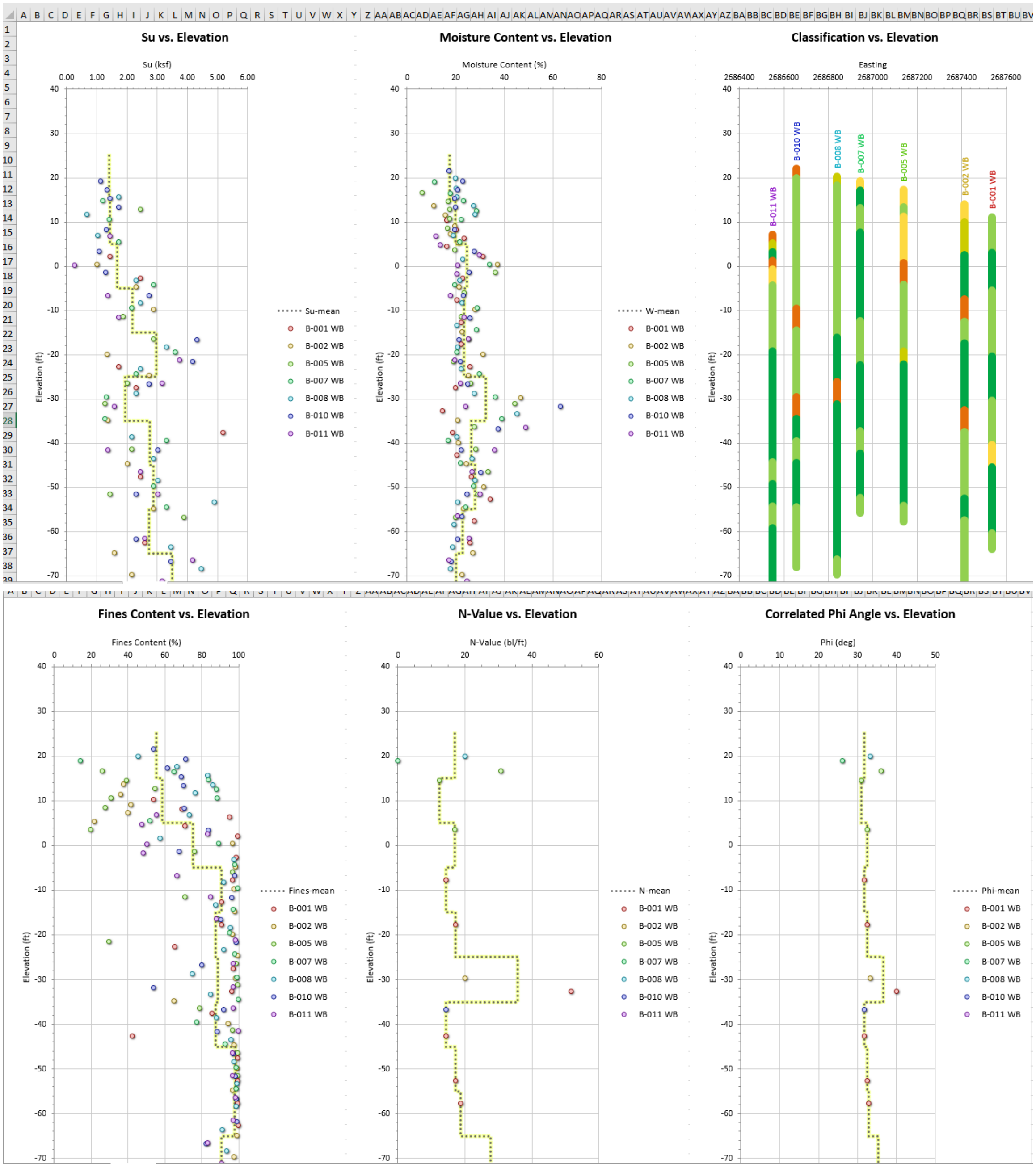


Figure 15. DOTD OpenGround Excel analysis templates



Boring Log Request

DOTD has capitalized on background maps included within OpenGround to add to a Boring Log Request form. The form was created using the OpenGround Excel extension and pulls the data from the OpenGround project data. This ensures continuity of data and reduces the potential for error. The form also speeds the process of creating the form. The engineer can create a fieldwork request entirely within the OpenGround system, which ensures that the project is in the database prior to any sampling or testing.

PowerBI

OpenGround allows users to review project data and create visualizations via the Excel extension for design decisions. This was discussed earlier in the report. In contrast, through the OpenGround PowerBI connector shown in Figure 16, Section 67 can review data across the entire database via queries, regardless of project number or location. For example, in Figure 17 the plot shows soil boring samples collected across Louisiana plotted by their saturation on the x-axis and sample elevation on the y–axis. The variables can be altered, and the plots can vary similarly to the various Excel graph and plot options. The comparisons can:

- Speed and improve OpenGround database quality control and quality assurance (QA/QC);
    - Outliers
    - Nomenclature: Company A, vs Company A, Inc., DOTD vs. LADOTD
- Analyze different parameters for technical differences and quality; and
    - By Driller/Engineer
    - By Date/Time/Temporally
- Improve correlations for research.

Figure 16. PowerBI Connector

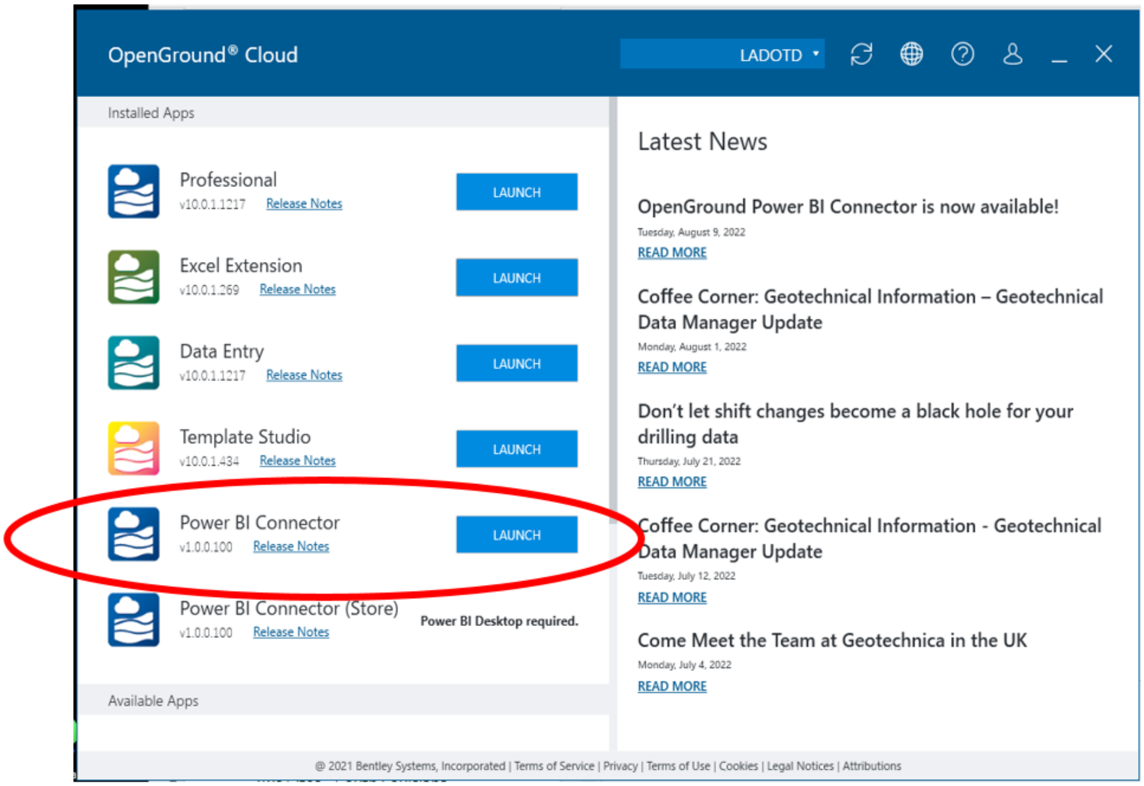


Figure 17. PowerBI example data plot

As this project is completed, LTRC is deploying and developing research projects to continue the DOTD Geotechnical Data Management process. LTRC Project 24-2GT was initiated to assist with several related problems that developed recently.

Data and Site Variability

The American Association of State Highway Transportation Officials (AASHTO) T-15 Committee plans upcoming changes to Section 10 of the AASHTO (LRFD) Bridge Design Manual. Section 67, through its geotechnical data management, began working on database improvements and statistical comparisons. The upcoming changes will blend well with the digital data within the DOTD OpenGround. Scott Hidden (NCDOT) and Jesse Rauser (DOTD) introduced the upcoming changes, which require serious statistical calculations, at the 2023 and 2024 STGEC, respectively. To address these upcoming changes, LTRC initiated a separate research project. LTRC Project 24-2GT will formalize visualizations used in other specific projects, address and simplify the upcoming AASHTO changes regarding site variability, and address the exchange of data regarding consultant contracts and the sun-setting of gINT. The LTRC website provides more information on this parallel project.

Access and Digitization

One of the original objectives of Phase I was to help speed access to historical soil boring data. The objective still remains, but there is hope that the data can reach a wider audience. One concern is the security of the DOTD networks. DOTD falls under the Louisiana Office of Technology Services (OTS) and is governed by their internet and security protocols. Firewalls and connectivity do not always blend together, but with the advent of cloud software and application programming interfaces (API), DOTD personnel hopes to provide access across the firewall, linking the public (read-only access) to soil borings (.pdf and digital quick logs) via a mapping interface. This will likely be part of an upcoming research project.

Section 22 recently discovered sixteen old boxes of boring log documents that should be scanned and uploaded to OpenGround. Additionally, LTRC intends to work toward digitizing all historical .pdf boring log images in OpenGround. These thousands of logs could provide a plethora of digital data for DOTD. Some key members of the DIGGS effort are working on ways to interpret and digitize discrete data from .pdf images and full scanned reports. This will likely require machine learning (ML), artificial intelligence (AI), and human involvement in the form of QA/QC tests and checks to verify accurate data. The digitization of historical data will likely be part of a parallel effort to provide data to the public, as mentioned previously.

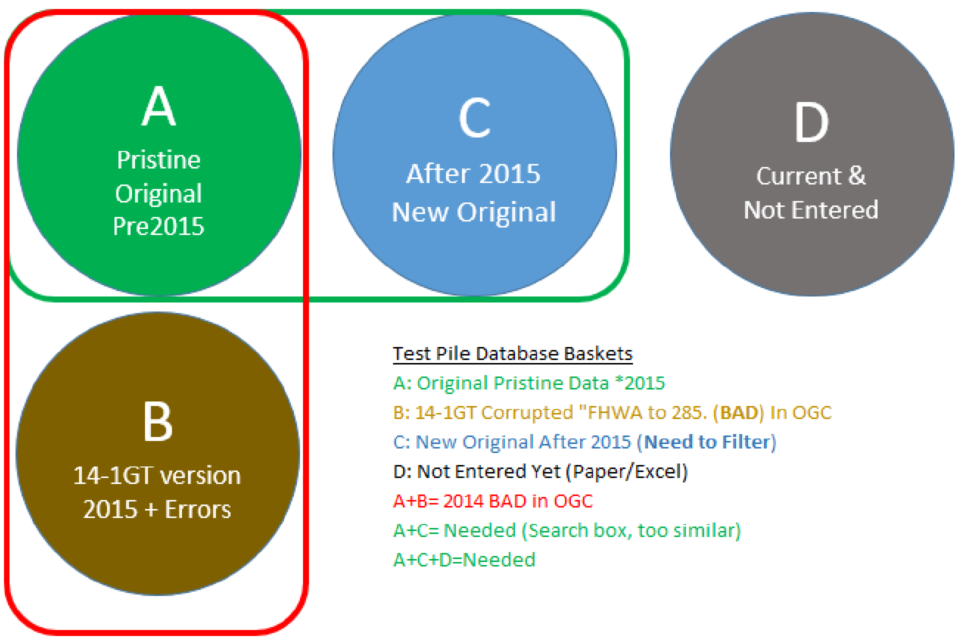
Pile Load Test Data

DOTD conducts pile load tests to further validate design calculations. These test data are valuable records for the Department. Like soil borings, they are costly endeavors and take time to conduct. For this reason, these assets should be preserved for future reference, Load Resistance Factored Design (LRFD) correlations, etc., in the mindset of Geotechnical Asset Management (GAM).

Section 67 has conducted and collected pile load test data for many years. The database has gone through several upgrades over the years, migrating to digital records in the past. Phase III dedicated time to upgrade the database.

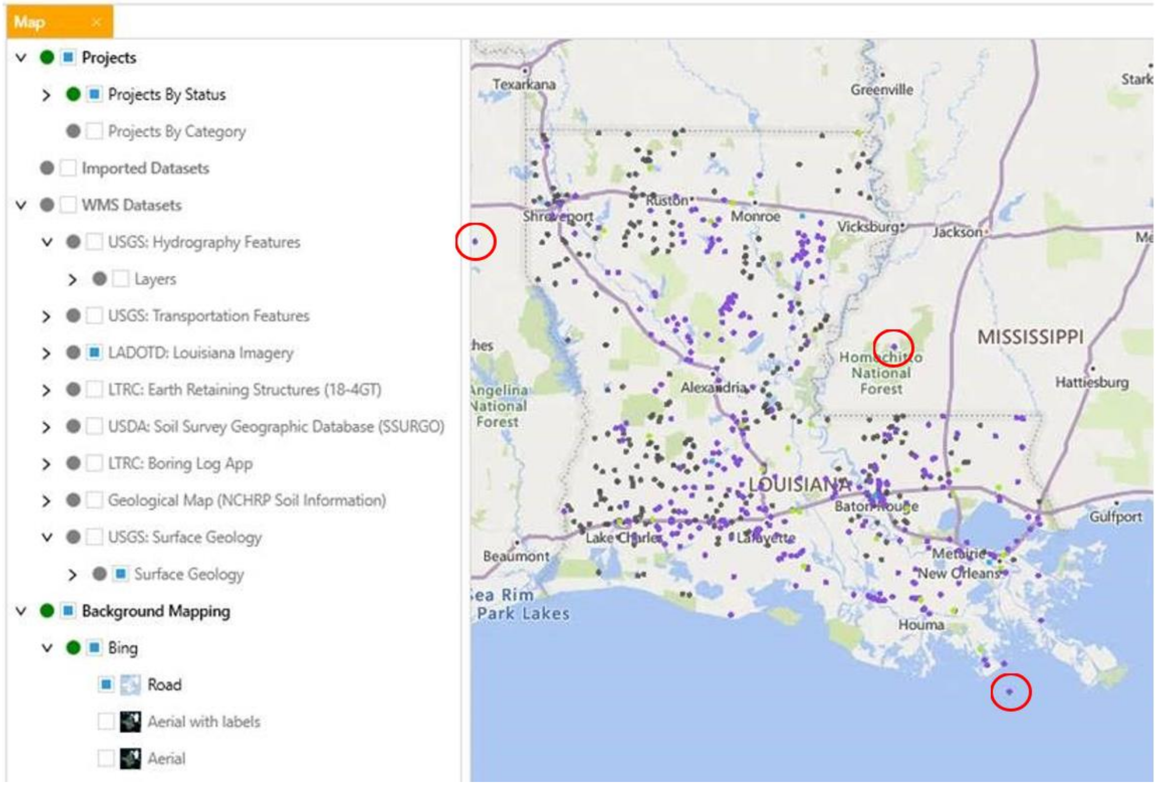
Phase III migrated pile load test data compiled in LTRC Project 14-1GT into HoleBASE/OpenGround to provide more reliable and accessible data storage for the pile load test data. Through the import of the pile load test data into OpenGround, researchers were able to discover several issues with the pile load test data. Erroneous data, for example, included pile load tests showing up in the Gulf of America, Texas, and Mississippi. Researchers were able to detect and adjust blatant errors and will also review the data again to ensure data accuracy and quality. Figure 19 shows the pile load tests across Louisiana, including some that need to be corrected. Figure 18 shows a Venn diagram of the PLT DB iterations as they are believed to exist currently. Another separate research effort will be needed to repair and clean the data. Positively, DOTD's pile data management efforts and database structure have been noticed by others, specifically the U.S. Army Corps of Engineers, which asked to utilize the DOTD structure, model, and OpenGround Excel templates for their own pile database efforts.

Figure 18. Venn diagram of pile load test database iterations



Ultimately, combining the pile load test data with deep borehole data provides tremendous data mining opportunities, wherein performance of specific pile foundations can be assessed and compared to expected performance based on actual soil properties in the database. LTRC is using OpenGround to help improve correlations between soil borings, CPT data, and pile load test data. LTRC Project 24-3GT, "Statewide Calibration of CPT Direct Design Methods Using Static Load Test Data," will help DOTD improve their understanding of pile behavior by providing the basis for combining this valuable data with existing site investigation data.

Figure 19. OpenGround screenshot with pile load test data including errors for correction

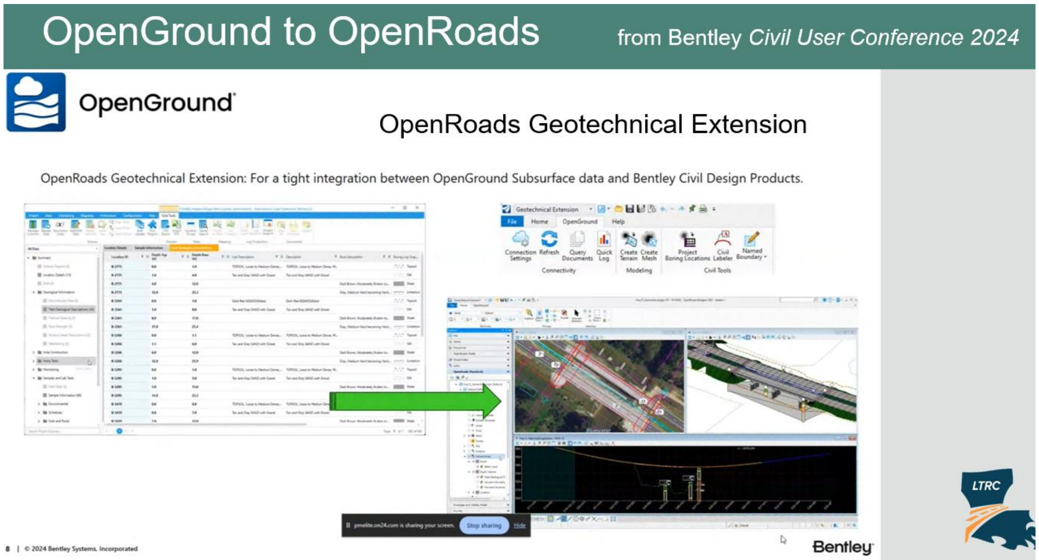


Future Research Goals

OpenGround Geotechnical Extension to OpenRoads

In early 2025, Bentley released the OpenRoads Geotechnical Extension. This extension will allow for the sharing and use of OpenGround data within OpenRoads. The DOTD Road Design section attended training on OpenRoads in early 2025, and the DOTD Geotechnical Section looks forward to connecting data across sections for continuity and ease of workflow. LTRC intends to follow up on these interactions and connections to help bridge these sections moving forward.

Figure 20. OpenRoads Geotechnical Extension



Future Research in Development

LTRC completed several research projects over the years; see Table 3. Not shown in the table are two proposed projects mentioned in this report and bulleted below the table. These projects scored highly in the LTRC Geotechnical Research Problem Identification Committee (RPIC), and LTRC intends to initiate these projects in FY 25-26 to continue the improvements and advancements in Louisiana.

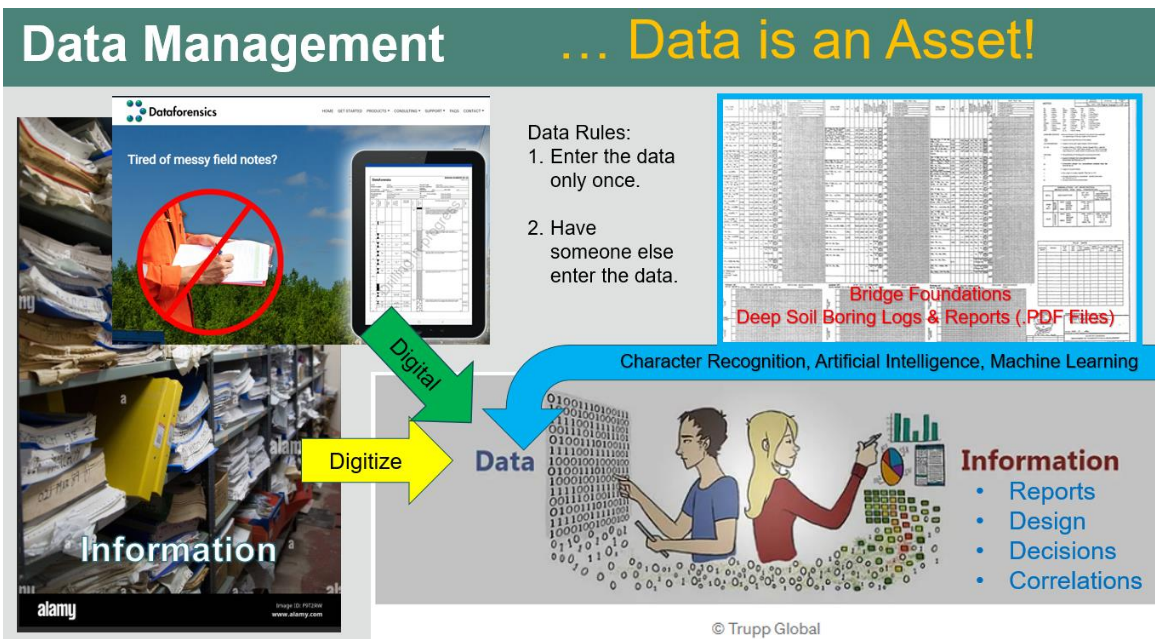
Table 3. Summary of LTRC Geotechnical Database research

LTRC Project Number	Project Name	Final Report	Technical Summary	Capsule - Ongoing Research
03-1GT	Development of a Geotechnical Information Database	View PDF	View PDF	
10-2GT	Geotechnical Information Database – Phase II	Final Report	Technical Summary	
15-1GT	Geotechnical Database, Phase III - pLog Enterprise GIS-Based Geotechnical Data Management System Enhancements	Final Report	Technical Summary	
21-2GT	Geotechnical Database - Phase IV	In Progress	In Progress	21-2GT: Geotechnical Database, Phase IV
24-2GT	GEC - 5	In Progress	In Progress	24-2GT: Web-based Tool to Advance Geotechnical Data Interchange and Reliability-based Site Characterization

- Public Access Interface to & Digitization of Historical Data
- Pile Load Test Database Improvements

Data is an asset, and the authors believe that data has value and should be managed appropriately. This data can serve a variety of purposes, but it needs to be collected and managed before it can be analyzed and used appropriately. Figure 21 is a slide the author used to simplify the objectives of the research. Uploading data is key, and this research has populated a total of over 2,500 projects, including both information (.pdf) and digital projects into OpenGround for DOTD. Creating a single source of truth for DOTD geotechnical data is the goal. Building the database provides immediate and long-term benefits for DOTD, and the planned enhancements including the visualization and AASHTO tools from 24-2GT and the proposed efforts (e.g., public access portal and digitization of historical .pdfs) will continue to bring Louisiana DOTD to the forefront of geotechnical data management.

Figure 21. Data management slide



Conclusions

DOTD began its geotechnical data management journey over 20 years ago. The previous projects helped set the stage for this project, which focused on updating the current geotechnical database to modern platforms that will stand the test of time and allow user-friendly GIS display of the data. The project researched and assisted with DOTD's implementation of OpenGround, the cloud-based version of HoleBASE.

The timing of the Bentley acquisition of Keynetix (HoleBASE and KeyLAB) and their release of OpenGround was fortuitous in that DOTD, already intending to adopt HoleBASE, sped the implementation of OpenGround Cloud. Additionally, DOTD already uses Bentley products, and this eased the implementation of OpenGround.

The sunset of gINT began a series of changes for many in the geotechnical realm and allowed other database options into the market to fill the gINT void. DOTD plans to remain software agnostic, as DIGGS is a way to exchange data moving forward.

The LTRC technicians' effort to upload historical boring logs in .pdf form provides relevant data that will benefit designers with preliminary and supplementary data. Newer technologies using Artificial Intelligence (AI) and Machine Learning (ML) can digitize data from .pdf soil boring logs and hard copy reports to expand the value of the database further.

LTRC used Excel spreadsheets to manage different data types, or baskets, to ensure all data were uploaded properly to OpenGround. KeyLAB is Excel based and allows digital entry of laboratory data. KeyLAB then can export .AGS files digestible by OpenGround. The research included customization and training on KeyLAB to facilitate implementation within DOTD.

DOTD Geotechnical Section 67 provided tools via the OpenGround Excel extension to connect OpenGround to analysis spreadsheets. These tools create plots, which were previously hand drawn, to speed engineering design decisions. The immediate value of these digital tools benefits the designer, but the digital data also adds to the long-term value of the database for future correlations and design efforts (e.g., quick access to data, possibly fewer borings, etc.), fostering functional effectiveness and efficiencies.

Soil parameter comparisons within OpenGround projects help designers make appropriate decisions. The addition of the OpenGround PowerBI Connector adds even more value. PowerBI allows engineers to conduct QA/QC and powerful comparisons across regions, parameters, drillers, etc. for expanded insight and correlations.

Pile load data, retaining wall locations, slope repair sites, geological data, soil subgrade survey maps, satellite maps, and other layer information through web mapping services (WMS) will provide designers with one-stop references and resources to help with succession planning and knowledge retention.

Data is an asset, and DOTD continues to advance in its geotechnical data management journey. This research helped implement OpenGround, a GIS database, and facilitate access to geotechnical data in over 2,500 projects across Louisiana within DOTD.

The leadership and vision of the DOTD Geotechnical Unit Supervisor was fundamental and critical to the advancement of the research. LTRC and DOTD efforts have been lauded in the geotechnical community. The author hopes to continue this trend and advance geotechnical data management further into the future.

Recommendations

DOTD's geotechnical data management journey should continue. There are more efficiencies that can be developed as the digital age progresses. Artificial Intelligence and Machine Learning will not only aid with the import and digitization of data (e.g., .pdf boring logs and reports to digital data), but also aid quick access and allow for correlations that will improve calculations, analyses, design decisions, and research correlations.

Deep borings and CPTs represent the majority of geotechnical data used by DOTD. The move to an all-in-one database/mapping/management solution should continue. Expanded OpenGround use in these target areas is recommended:

- Increase efficiency by continuing to add geotechnical data (e.g., deep boring, CPT, shallow boring, DCP, pile load test) to OpenGround, a single unified database designed specifically for geotechnical data.
- Review OpenGround prior to new borings on projects. Soil boring information may already exist.
- Use the Excel extension tables to save time generating soil boring logs, figures, and profiles for geotechnical design.
- Reduce the possibility for data input errors by streamlining the laboratory test reporting process through the increased use of tablets and DIGGS compatible equipment.
- Save design and repair information regarding slope repairs or other emergency repairs (e.g., plan sheets, notes, photos, etc.) into OpenGround to preserve this information for future generations. Work may be required in that area later, so having the information accessible and georeferenced is valuable.
- Improve pile load test (PLT) data management by adding additional PLT locations and by standardizing the method by which PLT data are entered into OpenGround.
- Require Geotechnical Data Reports (GDRs) and digital data (compatible DIGGS files) from Consultants that are directly digestible by OpenGround.

- Capitalize on other LTRC research moving forward. LTRC Project 24-2GT will further incorporate DIGGS and the upcoming AASHTO changes regarding site variability and statistical calculations.
- Begin projects based on the results of the recent RPIC process, specifically research directed toward a public interface to access borings and the digitization of soil boring logs through AI and ML. This will increase the usefulness of .pdfs from static images to digital data. These and other steps will continue to advance the DOTD geotechnical efforts forward, allowing more available and interactive data for design and research.

Acronyms, Abbreviations, and Symbols

Term	Description
AASHTO	American Association of State Highway and Transportation Officials
ArcGIS	ESRI Software for GIS
ArcMAP	Former main component of ESRI's ArcGIS Software
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing Materials
Bing	Bing Internet Browser
Bentley	Bentley Systems, Software Company
cm	Centimeter(s)
Central	Bentley Geological Model Management Software
Content Manager	DOTD's old Document Management System
CPT	Cone Penetration Test
.csv	Comma-Separated Values
Dataforensics	Dataforensics, Geotechnical Software Consulting Group
DCP	Dynamic Cone Penetration
DIGGS	Data Interchange for Geotechnical and Geoenvironmental Specialists
DOTD	Louisiana Department of Transportation and Development
ESRI	Environmental Systems Research Institute, Inc., GIS Software Company
FALCON	DOTD Project Plan Room (Digital Interface)
File.NET	DOTD's Document Management System
FHWA	Federal Highway Administration
.gpj	gINT geotechnical database file
GAM	Geotechnical Asset Management
gINT	Bentley Geotechnical Software Integrator
GeoStudio	Bentley Stability, Groundwater, and Environmental Analysis Software

Term	Description
GDR	Geotechnical Data Report
GDS	Geotechnical Design Section
GEOR	Geotechnical Engineer of Record
GIS	Geographic Information System
GPS	Global Positioning System
HoleBASE	Keynetix Geotechnical Management Software
JSON	JavaScript Object Notation
KeyLAB	Keynetix (and Bentley) Laboratory Software
LeapFROG	Leapfrog Works, Bentley Geotechnical 3D Modeling Software
LRFD	Load Resistance Factored Design
LTRC	Louisiana Transportation Research Center
MatLab	DOTD's Material Laboratory, Section 22
XML	eXtensible Markup Language
OGC	OpenGround Cloud Software
OpenBridge	Bentley OpenBridge Software
OpenGround	Bentley OpenGround Cloud Geotechnical Data Management Software
OpenRoad	Bentley OpenRoad Software
OTS	Louisiana Office of Technology Services
.pdf	Portable Document Format (File Format)
Plaxis	Bentley Geotechnical Analysis Software
PLT	Pile load test
PowerBI	Microsoft PowerBI (Data Visualization) Software
QA/QC	Quality Assurance/Quality Control
RapidCPT	Dataforensics Software Tool for CPT
Recall Number	DOTD unique identifying bridge number
RPIC	Research Problem Identification Committee
PRC	Project Review Committee
Section 22	DOTD Materials Laboratory Section
Section 67	DOTD Pavement and Geotechnical Section

Term	Description
Seequent	Bentley Subsurface Company
.tif	Tagged Image File Format
WMS	Web Mapping Service

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Appendix A

DOTD Process to Import Old .pdfs to OpenGround

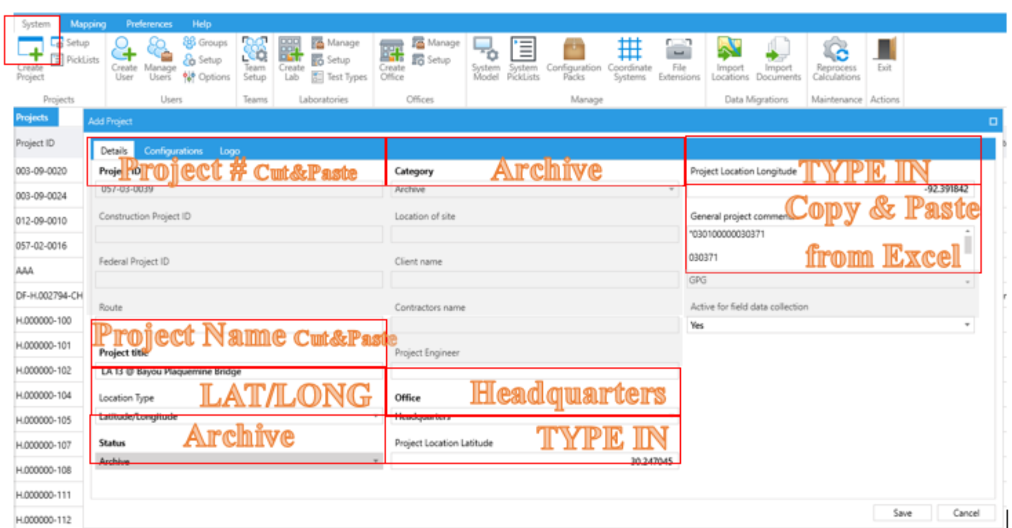
There are two scenarios regarding boring logs. Boring logs may or may not have GPS coordinates. For .pdf files, the current process is to locate the project centroid at the bridge center. To upload .pdf files, three things are needed: OpenGround, the boring log files to map, and the Excel project list spreadsheet to manage and document the upload process.

The project documents are located here.

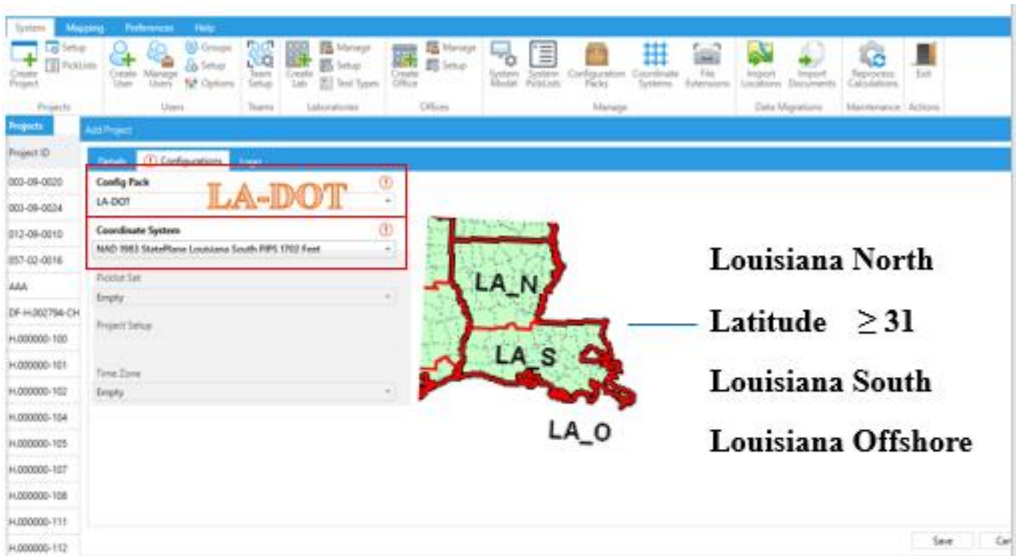
- DOTD Map Files Location: "Z:\Geotechnical DB\Borings\Boring Logs\a_Completed Parishes" by parish folder
- DOTD Excel Project List: "Z:\Geotechnical DB\Borings\Boring Logs\Completed Boring Logs - Updated.xlsx"

Open the OpenGround Cloud (OpenGround) software and create the project.

- Complete the relevant boxes



--------------Save-----------



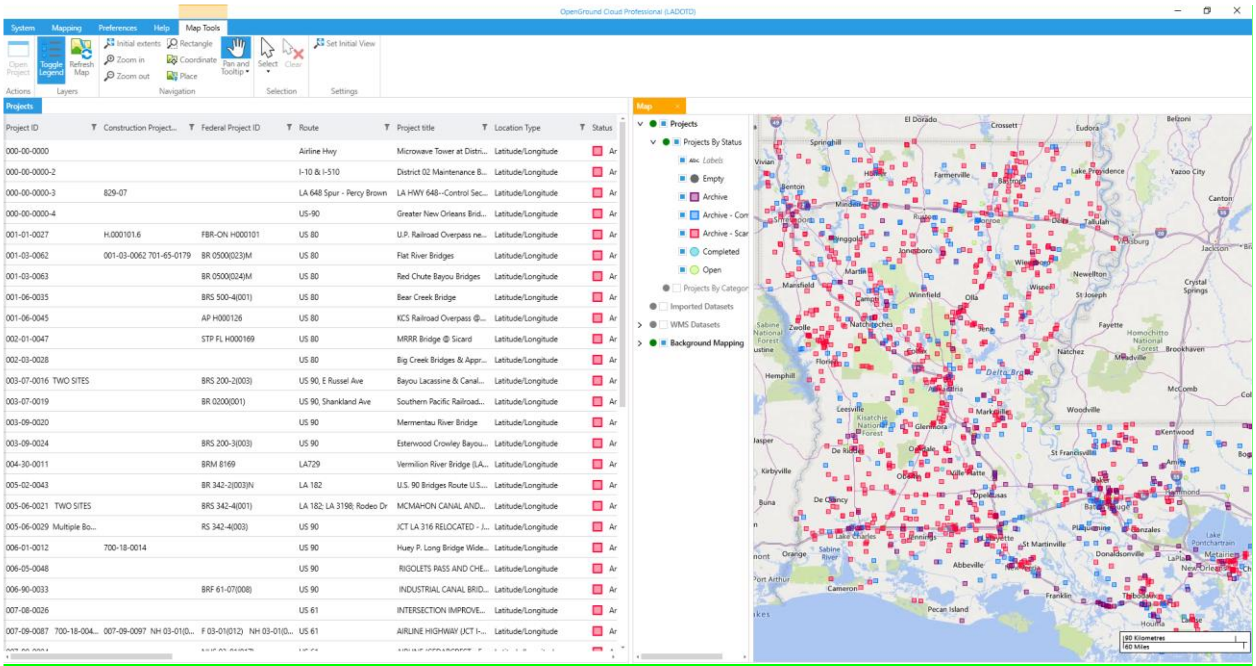
- For these .pdfs: skip the logo tab.

--------------Save-----------

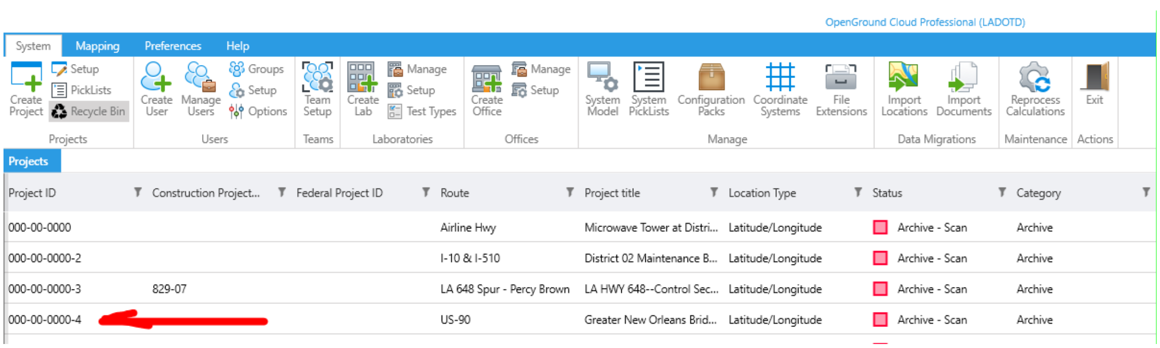
Open the newly created project ➔ Upload Documents from Section 67 folder or other source.

Appendix A - Continued Uploading Procedure - .pdf

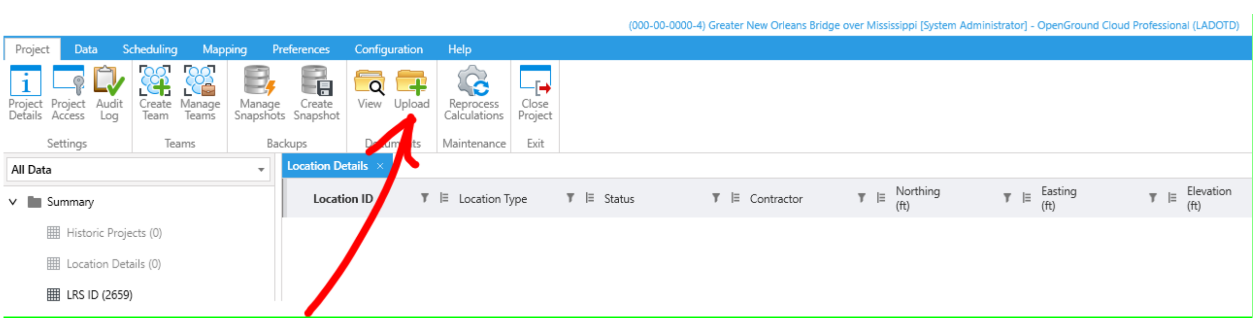
Create or Find Project 000-00-0000-4



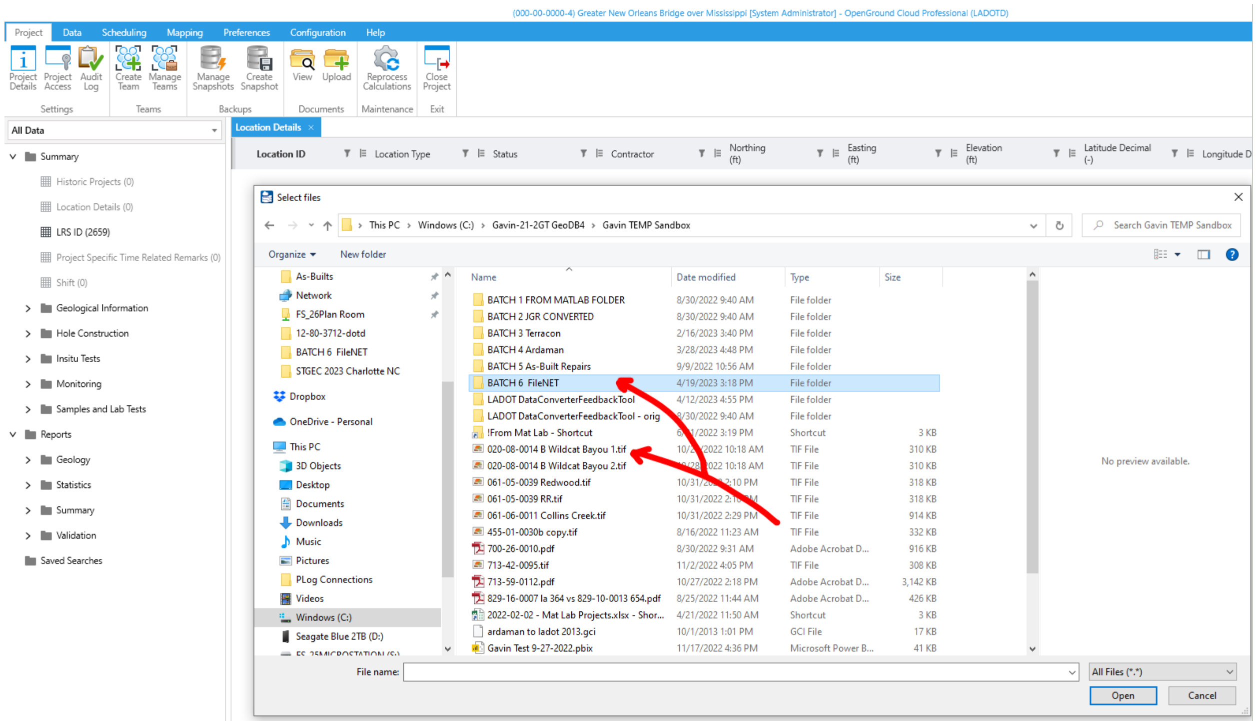
Open Project 000-00-0000-4



Upload PDF and other documents to tag as Geo-Referenced to projects.

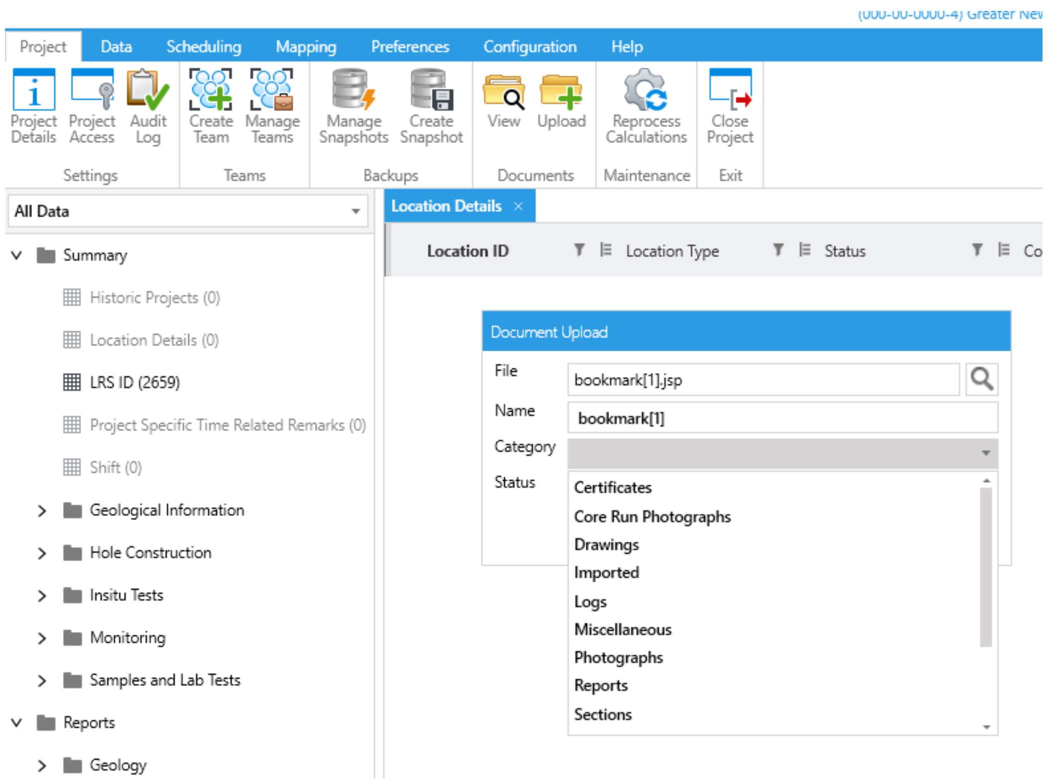


Normally select a .pdf, .jpg, or tif within the file window that pops up.



The project centroid for these documents (.pdf, images, etc.) can be located in two ways, either by entering the latitude and longitude in the project details tab or by setting the location on the map via clicks. As stated earlier, this location for .pdfs is the center of the bridge.

Choose the appropriate Category and Status of the uploaded documents. For historical boring logs this is normally: Category: Logs and Status: Final.



Multiple logs can be uploaded at one time.

- Select the multiple logs
- Set Category: logs
- Set Status: Final
  - Upload Docs (multiple) Close project
- Mapping
  - Zoom to project Check location
- Open Project
  - View Uploads to check that documents are attached
- Close project.
- EXIT button to leave OpenGround

Save changes to Excel file.

Appendix B

DOTD Process to Migrate Old gINT Projects into OpenGround

The process to migrate old gINT projects into OpenGround is similar to the .pdf process, but more complicated. Using the DOTD Excel spreadsheet list, start with the oldest to newest (these will likely be inactive projects).

- Geotechnical DB – gINT Projects –MatLab Projects
  - gINT Projects -21-2GT-OGC LTRC (PUT COMPLETED PROJECTS HERE)
- Open Link & Copy gINT file to TEMP (***Sandbox***) folder location

Open gINT

- File, Change Library
  - Load Library: OGC migration not "Master"
    - T:\Geotechnical DB\Software\HoleBASE\gINT Conversion Tools\Current Data Migration files
  - Click Open (If Error: *Cannot open because it is read only. Open as read-only?*) Your License level does not permit you to execute this feature. Please upgrade to the Dataforensics Security Tool. See DOTD IT (Intergraph). You will need to install latest and open ports.
- gINT Tabs: Utilities, Convert Projects (Yellow Boxes Appear)
  - Data Template from above location: *LADOT 1.39 to OGC.gdt*
  - Correspondence Folder: *Migrate LADOT descriptions.gci*
  - Select file from Temp Folder/ **Sandbox**: *H.00XXXXX.gpj*
    - Click Open
    - Leave box **un**checked: Remove key…
  - Click Execute ➔ Exports when finished to ***Sandbox*** TEMP folder
    - …conversion complete =>Click OK
    - Creates DF Dataforensics files and extra fields for Scott's data conversion software (~$15k)
    - Cleans up remarks
    - Lists errors to fix, prior to rerun
      - If all Zeros- fail

        - Test results confirm that boring info was converted. If all Zero: no borings
        - Close gINT

    - Rename Borings to B-01 format

<u>Data Converter Tool   (Trust Desktop and Sub folders)</u>

- All files into TEMP folder

- Open & Pin "Data Converter Tool" file to Excel (May need to copy the file to Sandbox)

- Select & Import gINT file ➔ Locate File in ***Sandbox*** TEMP folder
    - Click on and USE LADOT20210429.xlsm Template
    - Pulls in gINT file into Excel
    - Adds TABs in excel
    - Import Complete – Click OK
        - Reduce Triaxial Cell Pressure to 5 decimal places.

- Back to Data Converter Tool
    - Export .csv   Runs….. Click OK
        - Like DIGGS, but with .csv
        - …will always return with error …check OK
            - Errors in project #.txt
        - Ignore Point Sheet Errors

<u>Open OpenGround</u>

- Check with filter to see if project already exists. If not, create project. See Appendix A.

- Details
    - Project ID (UNIQUE ID)…. H.XXXXXXX
    - Pull Project Info from DOTD INTRANET "More Info" so details match DOTD
    - "Title"
    - Route: LA.XXX
    - Location Lat/Long
    - Status: Archive – Conversion (vs. Manually or Scanned PDF)
    - Category: Geotechnical Investigation, In-house, etc.
    - Location: Similar w/ Near/west of …

- Client: "LADOTD" vs. Contractor
- Project Engineer Blank (Section 67)
- Office: Headquarters
- General Project Comments: By Gavin (GPG)
- Project Lat & Long …Blank individual borings create a centroid.
- General Project Comments: "Conversion By INITIALS/ DATE, Imported as part of 21-2GT"
  - Active: Yes
  - Restrict: No

- Config Pack: LA-DOT
  - Coordinate: LA NAD 1983 (North, South, Coastal) dependent upon location
  - Picklist: Empty
    - NA b/c picklist is empty
    - Time Zone: Central
  - Pick Logo: Print Color 4in 300DPI (Download from internet & Store copy in ***Sandbox***)
  - Save Click OK

Import Data into OpenGround

- Open Project that was just created.

- Data - Import Data
  - File format: .CSV vs. AGS…leave other Defaults

- ADD => select folder
  - In File Explorer for Project: Select all .csv files, Right Click at top File => Send to Zip File
  - Select file (OPEN newly created Zip file from ***Sandbox*** -name from first file)

- Upload: Importing
  - Checks Format, New Project all new additions

- Status: Click Next – ignore warnings

- Locations: Click Next (good to see borings)
  - Ignore .import project data (leave unchecked)
  - Change Easting/Northing to LAT/LONG (this appears to set how /which data is used to plot)
  - Groups New Files (leave all checked) Click Next
  - Preparation: (approx. 30seconds to process) Finalizing

            - If Error: Cell pressure too large, too many decimals, ….cancel
            - Edit XLSM Via DATA Conversion Tool …change to 5 decimals
                - Export .CSV   Rinse & REPEAT Import Data Steps.
                - When good, Click Next, processing submissions
                - Import Completed Click Finish

- Plan: IF No Errors, Click Next
- Import: When complete, Click Finish   …clean up location details and other items (PET-PEEVES: Change B1 to B-01, etc.).
- Check on MAP
- Bulk update to change multiple rows
    - "Final" status on all
    - Change "Undefined" on issues to help make logs make sense.
        - Contractor: LADOTD Section 67
        - Description/Log Text
        - LADOTD to Section 67 Drillers
        - Mud Rotary – or DRY Auger then Wet???
        - Backfill:
        - Equipment: DOTD DRILL RIG SIMCOE 2800
        - Hammer:
    - Check location on Map
        - Alignment ID = Street name, ex. LA 507
        - No Dashes on Structure number
        - Location Description if 2 sites share same log
            - Merge into one OGC project
    - Input (into HoleBASE/OGC) by GPG
    - Copy gINT PDF log into TEMP Folder
    - Add "Viewers to that Specific Project (67 and LTRC)
- Attach Pocket Penetrometer Data to file:
    - Add P.P. info in gINT…flip between borings via drop box.
    - Create PDF Log via gINT (~1mb) to compare with stamped log (~15mb too big)
        - Eventually stamped log may not be needed.
- Discuss with Jesse any special items.

- Export the Folder, and put completed projects HERE: Geotechnical DB - gINT Projects -21-2GT-OGC LTRC

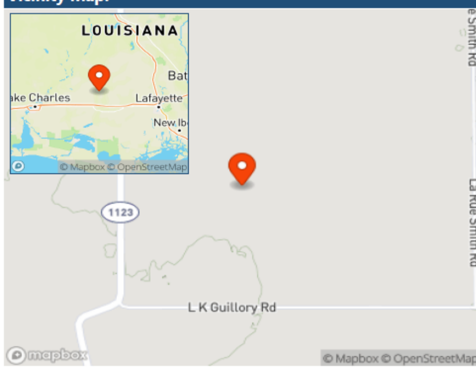
Appendix C

Examples: DOTD Soil Boring Requests Using OpenGround

LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

Soil Boring Request

Vicinity Map:



Project Information:

Project No:	H.016311
Project Name:	LA 1123 Creek Bridges
Engineer:	KCM
Route:	LA 1123
Location:	Acadia
Near Address:	6992 Riverside Road, Basile, LA 70515
Borings:	3
CPT's:	0
Sampling:	10' continuous > 5' centers (in clay) / 3' centers (in sand)
Water Table:	Water level in all borings w/at least one 24-hr reading

Other Instructions:

Boring	Type	Depth	Lat	Long	Location	Struct/Recall	Purpose	Remarks
B-01	BH	120	30.37578	-92.60063	Boring Box Culvert	005300		Survey coordinates and elevation
B-02	BH	120	30.34867	-92.60267	Boring Box Culvert	005290		Survey coordinates and elevation
B-03	BH	120	30.33420	-92.59003	Boring Box Culvert	005286		Survey coordinates and elevation
3		360						

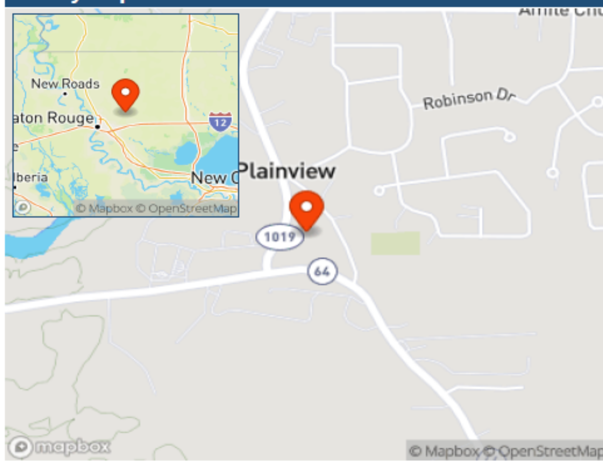
BH = Soil Boring
SCP = Cone Penetrometer

1/1

1/16/2025

Soil Boring Request

Vicinity Map:



Project Information:

Project No:	H.009837
Project Name:	LA 64: Roundabout @ LA 1019
Engineer:	Blaine Perret
Route:	LA 64
Location:	Denham Springs near Amite River
Near Address:	7060 Magnolia Beach Road, Denham Springs, LA 70706
Borings:	1
CPT's:	2
Sampling:	20' continuous > 5' centers (in clay) / 3' centers (in sand)
Water Table:	Short-term in all borings

Other Instructions:

Boring	Type	Depth	Lat	Long	Location	Struct/Recall	Purpose	Remarks
B-01	BH	40	30.53769	-90.96996				Shallow Borehole for settlement analysis
CPT-01	SCP	40	30.53944	-90.96986				Push till Refusal
CPT-02	SCP	40	30.53746	-90.96857				Push till Refusal
3		120						

BH = Soil Boring
SCP = Cone Penetrometer

4/16/2025