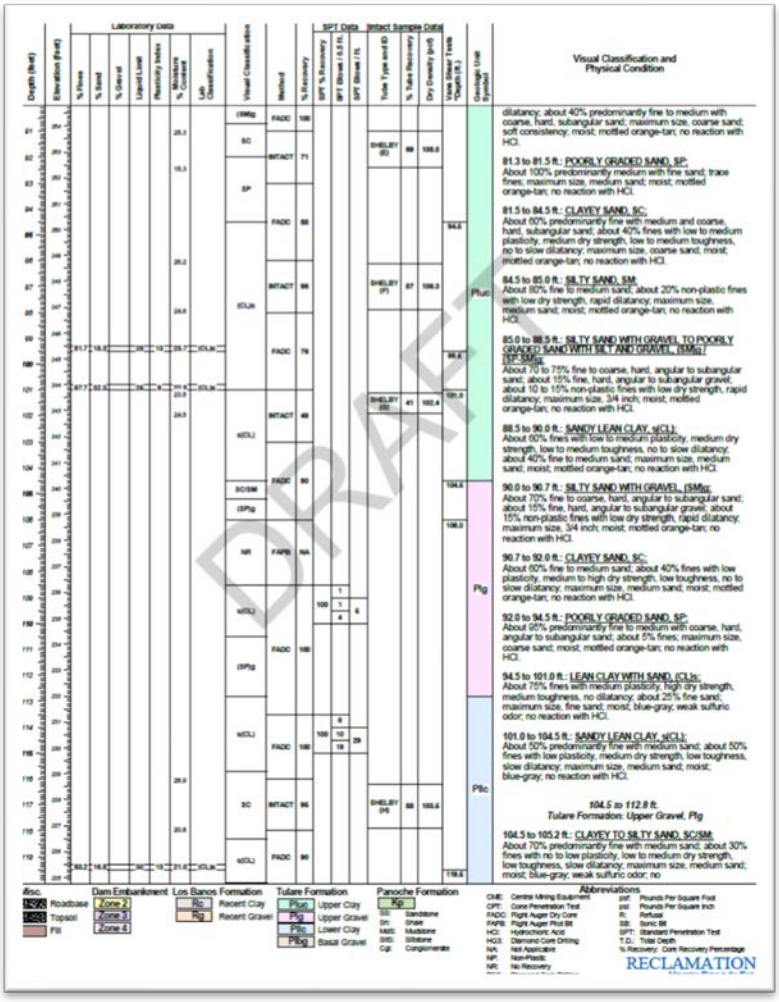
RECLAMATION

Managing Water in the West

Scoping Study: Alternatives for Electronic Geologic Logging

Research and Development Office
Science and Technology Program
(Final Report) ST-2019-19117-01



U.S. Department of the Interior
Bureau of Reclamation
Research and Development Office

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Mission Statements

Protecting America's Great Outdoors and Powering Our Future

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

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14. ABSTRACT It is becoming more and more common to utilize tablet computers in field work applications. Reclamation's geologic investigations stand to benefit from this technology in terms of shorter turnaround time for final drill logs, increased quality of data, and fewer overall staff hours spent producing logs. This scoping study, which has very broad TSC and Regional office support, evaluates a variety of commercial e-logging products and recommends steps for future research.

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Executive Summary

It is becoming more and more common to utilize tablet computers in field work applications. Reclamation's geologic investigations stand to benefit from this technology in terms of shorter turnaround time for both draft and final drill logs, increased quality of data, and fewer overall staff hours spent producing logs. This scoping study, which has very broad TSC and Regional office support, evaluates seven commercial e-logging products. Three alternatives – pLog produced by Rockware, Quick Log produced by M-Tech Software, and WinLOG RT produced by GAEA Software have the best combination of built-in features and customizability and are recommended for further evaluation. The recommended next step in this project is to identify upcoming projects with diverse data collection needs and implement the three software on a trial basis. The Research Office could consider brokering proposals to that end, and the research team plans to submit proposals to this end for FY21 funding.

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Introduction

Current Reclamation practice for geologic drill hole and concrete core logging involves taking hand written notes during field activities, transferring these notes to hand drawn draft or “stick” logs, entering data into MS Word and Excel formats, and finally turning the draft logs over to a CAD technician to produce final, digital logs (often in the gINT software). This process can be inefficient and slow, and can be error prone due to the number of people involved, interpreting another person’s notes, and the amount of data transfer that occurs.

Technology exists, and is commonly used in the Private Sector, that utilizes tablet computers (Apple iPad, Microsoft Surface, etc.) with specialized software to produce digital logs in real time while in the field. These logs still require review for accuracy and completeness but eliminate unnecessary data transfer and remove extra personnel from the log production workflow.

This Science and Technology Program scoping level study explored various options available for electronic geologic logging. Seven software programs were investigated based on software specifications desired in borehole logs. Recommendations for future research and software compatibility are included.

Background

Geologic investigations are the cornerstone of infrastructure investigation programs, and the quality and detail of the geologic investigation underpins the reliability of Reclamation’s infrastructure. Ensuring that data is collected in real-time and at the state-of-the-art is critical for Reclamation’s mission of water and power delivery.

Reclamation’s field investigation practices are antiquated in that they rely solely on paper notes and multiple levels of data transfer. It is common for drill hole or core logs to take months to be completed, causing slips to project schedules or design activities to move ahead using assumed values. In addition, the multiple levels of data transfer and personnel involved can lead to errors. These delays, assumptions, and errors can be costly. Significant improvements could potentially be made to Reclamation’s practices by adopting the use of tablet computers and specialized software for logging geotechnical investigation drill holes and concrete coring activities. With Reclamation’s Geology personnel – responsible for creating drill hole and coring logs – experiencing extremely high workload across the agency, improving the logging process would directly benefit dozens of projects annually, across all Regions. Further, standardizing log across the agency would be more efficient in general as project personnel change frequency and most staff work on multiple projects across different Regions simultaneously.

Utilizing tablet computers with logging software/apps allows Reclamation’s field investigation activities to be performed better, faster, and cheaper. Rather than a multistep process involving multiple personnel, a single field Geologist could produce draft logs in near real-time which could then be sent back to the office for review and finalization. A process that takes up to a year

could be completed in less than a month with the potential for more data-rich logs with fewer errors. In addition, the field tablet can be very useful when communicating problems with the investigation or design team – a preliminary log can be sent in real-time to provide a visual in order to help the team field-fit a solution.

Such practice is becoming more and more common in the Private Sector and may soon be standard practice. By entering data directly into software, being able to pair log data with photographs within the same software, utilizing drop down menus and a consistent and complete logging format, and being able to transmit draft logs electronically in near real-time, higher quality logs can be produced much more efficiently.

Solutions Investigated

Various electronic logging software were evaluated based on software specifications and desirable data included in a log. Software specifications considerations include:

- Price
- License options (single, group, floating, etc.)
- 2D/3D data visualization integration
- Operating system
- Offline utilization and cloud storage
- Customization
- Photos
- Notes

Customization is useful for both input data and log format. Customization of input data allows all the needed information to be recorded. Customization of log format allows projects with specific objectives (rock, soil, testing, etc.) to display relevant data.

Desirable data in logs includes drilling and borehole information and geologic (soil and rock) characteristics.

Drilling and borehole considerations include:

- Drilling and sampling methods
- Driller
- Field team
- Drill rig
- Drilling fluid, return and color
- Reason for hole termination
- Hole completion
- Purpose of hole
- Angle from horizontal
- Total depth
- Groundwater levels
- Reservoir water levels
- Companion investigations
- Drilling conditions
- Location
- Advance rate
- Core diameter

Geologic data considerations include:

- USCS Classification
- SPT data
- Laboratory data
- Depth
- Elevation
- Water content
- Datum
- Coordinates
- Start and end date
- Visual classification and physical condition
- Sample data
- Testing data
- Color
- Density
- RQD
- % Recovery
- Weathering
- Geologic unit symbol

Where the desirable geologic data is not available within a specific software, it is necessary to customize the input data.

Seven software packages were investigated based on the above needs. The software packages available at the time of this report included:

1. The Drilling Log
2. pLog Tablet
3. GeoLite
4. Quick Log
5. WinLog
6. Deposits
7. GeoSpark Core.

The software packages were researched based on data available online and speaking with sales representatives by e-mail or phone. Table 1 and 2 provide software specifications and drilling, borehole, and geologic considerations respectively for the software.

Table 1: Software Considerations

Program	Contact Phone Number	Price	Floating License	Integrated with 2D	Integrated with 3D	IOS	Windows	Cloud Storage?	Customizable	Photos	Notes	Free Trial/ Demo
The Drilling Log - Go Canvas	703-436-8069	$45-60/user/ month	X			X	X	X	X	X	X	X
pLog Tablet - RockWare	678-367-0870	$1,500-2,000 initial, $906/year	X	X	X		X	X	X	X	X	
Geolite - Geologix	719-917-6755	$3,600-$60,000/year	X				X	Optional	X		X	X
Quick Log - M-Tech Software	310-822-3624	Various options starting at $3,600/year	X	X	X		X		X	X	X	X
WinLog - GAEA	613-900-1950	$895 /computer +20%/year		X	X		X	Optional	X	X	X	X
Deposit - GEOSOFT (Seequent)	437-220-4634	$95-375/month (yearly price)			X		X	X		X	X	X
GeoSpark Core - GeoSpark Consulting	250-619-1874	$39/month per computer		X	X		X	Optional	X	X	X	
LogitEasy		$10-20/log $99/month/ user		X		X	X	X			X	X

Table 2: Software Drilling, Borehole, and Geologic Considerations

Program	Drilling and Borehole Data						Geologic Data											
	Driller	Field Team	Location	Drilling Method	Hole Inclination	Core Diameter	Soil Based?	Rock Based?	USCS	SPT	Advance Rate	Water Content	Constituent Percentages	Sample	Color	Density	RQD	Recovery
*The Drilling Log - Go Canvas**			X			X		X							X			
*pLog Tablet – RockWare**	X	X	X			X	X	X	X	X	X	X	X	X	X			
*Geolite – Geologix**		X	X		X			X						X	X			X
*Quick Log - M-Tech Software**	X	X	X			X	X	X	X	X		X	X	X	X			
*WinLog – GAEA**	X	X	X					X	X	X		X	X	X		X		X
Deposit - GEOSOFT (Seequent)	X		X					X						X	X		X	
*GeoSpark Core - GeoSpark Consulting**		X	X		X	X	X	X					X	X	X		X	X
LogitEasy	X	X	X	X		X	X	X	X	X			X	X	X		X	X

**Data is customizable in software*

The Drilling Log - Go Canvas

Go Canvas strives to digitize forms for easily data organization for a variety of applications (mostly non-engineering), and The Drilling Log is one of many forms they have created. Data that can be entered onto the standard form includes most of the desired drilling information but little of the geologic data. It is possible to customize the form. Photos can be uploaded to the application. This software compiles all the data needed for a drilling log, but does not create a log, therefore, additional software would still be required making this solution less desirable. The tablet app for this form is compatible with Windows, Android and Apple systems. It is unclear if the data can be integrated with other 2D and 3D interpretation/visualization software.

The system's price is $45 to $60 per user per month with an option for a floating license. For more information on The Drilling Log software, contact GoCanvas sales support at 703-436-8069.

pLog Tablet – RockWare

pLog Tablet is a field data collection software created by RockWare, a geoscientific software and consulting company staffed by geoscientists. The pLog Tablet software was specifically developed for geotechnical and geo-environmental data collection. The software enables collection of most of the desired borehole and geologic data and can be customized. Photos can be uploaded to the software. Data is entered in a form, which automatically creates a log. The software is compatible with Android operating systems, and the data can be exported and integrated with a variety of 2D and 3D interpretation/visualization software including RockWare's own RockWorks program.

The price of the software ranges from $1,500-2,000 per license with a $900 annual subscription fee per license. Floating licenses are available for $1450 per year. For more information on pLog Tablet, contact Kevin Leung at 678-367-0870.

Geologix – GeoLite

The GeoLite Wellsite Geology application is created by Geologix. Geologix develops technology and engineering applications specifically for drilling, subsurface, production and pipelines. Since the software is designed for mineral/petroleum exploration applications, the standard templates include little of the desired drilling and geologic data. The software can be customized for a fee. Photos cannot be uploaded to the software. The software is compatible with Windows operating systems. It is unclear if the data can be integrated with 2D and 3D interpretation/visualization software.

The price of the general software ranges from $3,600 to $60,000 per year. Daily and monthly licenses are also available. Floating licenses and dongle-based licenses are available. For more information on GeoLite, contact Jeremy Porter at 713-917-6755.

Quick Log - M-Tech Software

The Quick Log software is created by M-Tech Software which strives to create fast, intuitive software for creating and utilizing logs. The software was developed for environmental, geotechnical, petroleum, and mining applications. The standard application enables collection of most of the desired borehole data and to a lesser extent, the geologic data. The software is customizable, and photos can be uploaded to software. Data is entered into a spreadsheet and converted into a log. The software is compatible with Windows operating systems, and the data can be integrated with the M-Tech 2D and 3D interpretation/visualization software, QuickCross/Fence. It is unclear if the data can be easily exported for use with other software.

The price per license is $850/person with an annual fee of $450. Network licenses are available for multiple users. This software was previously used at the TSC and is currently used at the Lower Colorado region's Yuma Office. For more information on Quick Log, call Marc Gleason at 310-822-3624.

WinLog– GAEA

The WinLog software is created by GAEA. The goal of GAEA is to integrate software solutions with geoscientists and engineers. The software has a version specifically designed for geotechnical applications, and the logged data includes most of the desired borehole and geologic data. The software can be customized if needed, and photos can be uploaded to the software. The software is compatible with Windows operating systems, and data can be integrated with WinLog's 2D and 3D systems for interpretation/visualization. It is unclear if the data can be easily exported for use with other software.

The price per license for the geotechnical version is $895/person with an annual fee of 20% of the license fee. For more information on WinLog RT, call 613-900-1950 or contact Michael J. Fraser at mfraser@gaeatech.com.

Deposit – GEOSOFT (Seequent)

The Deposit software is created by GEOSOFT, a Seequent company. GEOSOFT strives to make data management easier for geoscientists. The software is designed specifically for geologic exploration applications, but unfortunately only collects some of the designed borehole and geologic data. Data is not customizable within this software. Photos can be uploaded to the software. The software is compatible with Windows operating systems. The data can be integrated with GEOSOFT's 3D interpretation software, but it is unclear if the data can be easily exported for use with other software.

The price per license varies from $275 to 375 per month for yearly subscriptions. Monthly licenses can also be purchased but are more expensive. For more information on Deposits and GEOSOFT, call Vladimir Belsch at 437-220-4634.

GeoSpark Core

The GeoSpark Core software is created by GeoSpark, which aims to provide affordable, intuitive geology database software. GeoSpark primarily serves mineral exploration and mining industries, and the logged data includes some of the desired borehole and geologic data. The software can be customized by the company for a fee. Photos can be uploaded to the software. The data created by the software can be exported through open database connectivity (ODBC) to various 2D and 3D interpretation software packages.

The software costs $4,800 for a license that can be used on any computer. The annual fee for the software is $468. Floating licenses are unavailable. For more information on GeoSpark Core, call Caroline Vallat at 250-619-1874.

LogitEasy eForm

The LogitEasy eForms allows for the easy creation of field logs. There is a template specifically for geotechnical applications, but it is not customizable. The logged data on the standard template does include most of the desired borehole and geologic data. However, photos cannot be uploaded. The data can be viewed in 2D cross sections when coordinates are input. The program is an internet based boring log software and can be used offline. It is compatible with Windows, Apple, and Android systems. It is unclear if the data can be integrated with other 2D and 3D interpretation/visualization software.

The premium software costs $10-20 per log, or $99 per month per user for unlimited logs. Floating licenses are unavailable. For more information on LogitEasy eForm, call 312-239-0505.

Other Software Packages

Other software packages were researched briefly, but little information was available for a comprehensive understanding of the software. These include Geotonic Log, WellCAD, and GEO-LOG 4.

Cloud Storage

Cloud storage is a service allowing data to be stored remotely and accessed through a network. Many cloud storage options utilize the internet as the network. Cloud storage is convenient because data can be accessed easily from anywhere. Unfortunately, cloud storage is generally not acceptable within the government. The data is stored on an external server owned by the company offering the service and this is problematic for security reasons. Therefore, some software will not be usable for the Bureau of Reclamation due to federal government Cloud requirements. Software run off a cloud system include: The Drilling Log, pLog tablet, Geolite, WinLog RT, Deposits, GeoSpark Core, and LogitEasy. There is few software that have optional cloud use such as GeoLite, WinLog, and GeoSpark Core. In these cases, cloud storage are nonstandard additional items. The only software that does not have the option to use cloud storage is the WinLog RT program.

Software providers that utilize cloud products and services must be FedRAMP Certified. FedRAMP certified software must pass standards for security assessment, authorization and continuous monitoring. None of the researched software have the FedRAMP certification.

Recommendations for Future Research

The software with the most promise of those researched include pLog Tablet (RockWare), QuickLog (M-Tech Software), and WinLog (GAEA). These three software allow for customizable logs, are able to integrate with 2D and 3D interpretation/visualization software packages, have templates with the majority of the necessary logging data, and were designed specifically for geotechnical applications. Of these programs, pLog Tablet might be particularly desirable as the TSC geology group is moving forward with plans to start using RockWare software for select geologic modelling activities.

Unfortunately, pLog Tablet uses cloud storage for saving and transferring logs by default. However, the Army Corp of Engineers – who has similar or even more strict IT security regulations than Reclamation – has used this software in the past so it is possible it could be used by Reclamation. The other two software, QuickLog and WinLog, do not use cloud storage or have optional cloud storage.

Trial evaluations with the three preferred software will be needed to fully assess the functionality, ease of field use, and benefit of each system. Windows operating system tablets would be needed since all the programs run on that operating system. The software and tablets should be acquired, and field tested by Reclamation geologists on future investigation projects as part of a Science & Technology Program conducting level study.

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