Illinois State Geological Survey/Illinois State Water Survey
Prairie Research Institute
University of Illinois

Final Technical Report

Database Maintenance and Drilling New Monitoring Wells for the NGWMN

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Overview

The Illinois State Water Survey (ISWS) continued its maintenance of database and web services to the current sites in the National Ground Water Monitoring Network (NGWMN) registry. The ISWS performed routine maintenance to fix bugs, updated security protocols and connections to the NGWMN portal, and administered basic tasks of maintaining backups, performance and data storage. These activities were in congruence with Objective 2 of the FY2019 request for proposals.

In collaboration with the ISWS, the Illinois State Geological Survey (ISGS) also installed 5 groundwater monitoring wells into the Principal Aquifer in east-central Illinois. These wells were installed to fill in spatial data gaps within existing NGWMN subnetworks that are managed by the Illinois State Water Survey (ISWS). In collaboration with the ISWS, the ISGS focused the study in east-central Illinois within the glacial sand and gravel Principal Aquifer. More specifically, the project was aimed at expanding the well subnetwork through the area of DeWitt County, Illinois within the Mahomet Aquifer. In this area, the Mahomet Aquifer is the primary source of drinking water and irrigation supplies, which collectively totals approximately 200 million gallons per day. Prior to FY2019, no NGWMN wells existed within the Principal Aquifer in DeWitt County. The new NGWMN wells will contribute to a more robust monitoring coverage of the Principal Aquifer and a better understanding of regional groundwater flow and local pumping effects within the aquifer. These activities were in congruence with Objective 5 of the FY2019 request for proposals.

The FY2019 contract award term was scheduled for July 15, 2019 through June 30, 2020. A 6-month extension was requested for the award term until December 31, 2020. This extra period was critical for efficient workflow and project success, partially due to the COVID-19 pandemic. The award granted from the NGWMN for FY2019 was $136,949. Final expenditures of the award totaled $134,189.85.

Project objectives

Introduction

The FY2019 award was aimed at Objective 2 (Support Persistant Data Service from Existing Data Providers) and Objective 5 (Well Drilling) of the request for proposals. The contract award funded personnel to fulfill Objective 2, and it funded both personnel and drilling activities associated with Objective 5. Thus, this section describes site selection, scientific relevance, and outcomes associated with the project.

OBJECTIVE 2: Support Persistant Data Service from Existing Data Providers

The five wells drilled as part of this project were successfully added to the registry with the necessary data fields populated, pending measurement of well stickup and thus measurement elevation at each site. In part due to COVID-19 travel restrictions, water level measurement at the sites is also pending; many staff have received vaccinations and will resume field work in the coming weeks.

During the course of this work, telemetry station data was successfully migrated to a virtual machine environment and a centralized client-server arrangement, in part through a

LoggerNet upgrade purchased separate to this project. With the current arrangement and existing services, real-time data is managed on separate machines related to project-specific work, and this new arrangement exists as a redundancy that is not yet live. We are in the process of transitioning to this new arrangement pending final quality assurance and stability checks. Though all data currently receive regular backups and validations before being provided as services, centralizing management of real-time telemetry data has obvious advantages.

Work is ongoing to increase communication between the ISWS and ISGS well databases, which includes matching wells and adding missing data elements. When there is parity between the two databases we anticipate changing lithology services to be provided by the ISGS database directly instead of a secondary database maintained by the ISWS as is the current arrangement.

OBJECTIVE 5: Well Drilling

Regional location

The ISWS and ISWS collaborated to install 5 groundwater monitoring wells into the Principal Aquifer in the area of DeWitt County, IL (Figure 1). The Principal Aquifer of interest in this area is composed sand and gravel deposits that infill a network of regional buried bedrock valleys. The prominent bedrock valley in the area is the Mahomet Bedrock Valley (Horberg, 1954), which is filled extensively with sand and gravel deposits of the Mahomet Aquifer (Roadcap et al., 2011).

Drilling operation

The ISGS operates and maintains a Central Mining Equipment (CME) mud-rotary drilling rig that is instrumented with a wireline coring system (Figure 2). The system allows the collection of 2.25-inch or 3.0-inch continuous core of geologic materials, up to 10 feet in length, to depths of up to 500 feet. Core recovery is more successful in clay-rich materials, but it generally ranges from 40-100%. The ISGS also operates a wireline downhole geophysical logging system. When feasible, at every borehole location, a downhole natural-gamma ray log is collected to the total drilling depth. The natural-gamma ray log adds information relative to the grain-size fraction of geologic materials and helps with stratigraphic interpretation of core samples. Natural gamma ray logs are included with lithologic logs and well-construction details in Appendix A.

Site selection

Drilling sites were selected to expand the local monitoring network and fill in spatial data gaps within it. The Mahomet Aquifer has been studied and monitored locally for decades, but the spatial coverage of NGWMN wells within it is incomplete. More specifically, in the central portion of the aquifer near DeWitt, Logan and McClean Counties, Illinois, there have been no NGWMN wells installed. Furthermore, it is interpreted that in this area the aquifer is bifurcated, so new wells and increased monitoring will help better understand the impacts of the aquifer geometry on long-term water supply and protection. Therefore, our investigation focused in this area for FY2019.

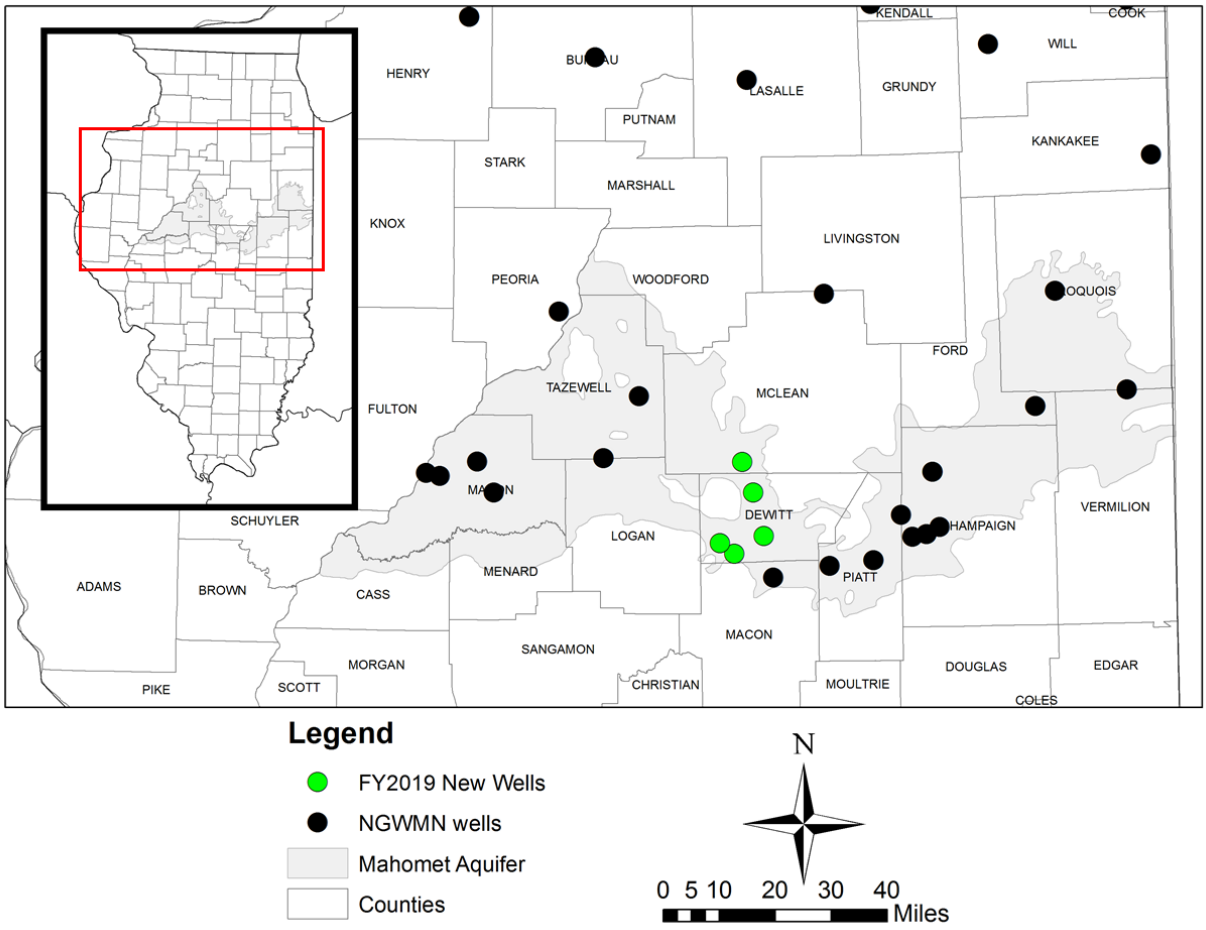

Figure 1. Locations of NGWMN wells to date in east-central Illinois. Mahomet Aquifer boundary is shown in gray.

Figure 2. (a) Perspective view of CME drilling rig system operated by the ISGS and (b) extraction of continuous core from the wireline sampler. Photos are from the KENN-20-02 site at Rowell, Illinois.

All five of the monitoring wells are located on either municipal, county or state properties. Public properties were prioritized as site locations due to the anticipated longevity (30+ years) of property ownership. For FY2019, monitoring wells were installed at 2 municipalities, 2 county properties, and 1 state-owned property. All of these wells are intended to monitor long-term ambient water levels in the central portion of the Mahomet Aquifer. Site locations were chosen specifically to minimize the impacts of high-capacity municipal wells or irrigation wells.

One monitoring well was installed in southern McClean County, Illinois in the village of Heyworth (HWTH-19-01). This well was installed at a Heyworth Village municipal park on the outer boundaries of the village property (Figure 3). The Village of Heyworth withdraws drinking water from shallow wells in an unconfined aquifer that is not hydraulically connected to the Mahomet Aquifer, so local pumping should not impact the NGWMN well performance significantly.

Another monitoring well was installed in DeWitt County, Illinois within the village of Wapella (CLIN-20-01). This well was installed at a municipal maintenance facility at the northern edge of the village (Figure 4). The Village of Wapella withdraws drinking water from a confined aquifer that is shallower than the Mahomet Aquifer and not generally hydraulically connected, so impacts to water levels by local withdrawals by the village should be minimal. A long-term agreement was developed by the village and the University of Illinois to establish property-access and liability expectations.

A third monitoring well was installed at Weldon Springs State Park in south-central DeWitt County, Illinois (MARO-20-01). The well was installed in a remote and inconspicuous portion of the park, yet with easy access to the well for monitoring and maintenance (Figure 5). There are no high-capacity wells at the park or nearby, so impacts from local pumping will be

minimal. A long-term agreement was also developed by the State of Illinois and the University of Illinois to establish property-access and liability expectations.

The fourth and fifth monitoring wells (KENN-20-01 and KENN-20-02, respectively) were installed in southwest DeWitt County on county properties managed by the DeWitt County Highway Department. These wells were installed in the rural towns of Kenny (Figure 6) and Rowell (Figure 7), respectively, on properties managed as aggregate stockpiles for the county highway department. The Village of Kenny has a single municipal well that withdrawals water from the Mahomet Aquifer, but the population and water demand is so small that minimal impacts from pumping are expected in the KENN-20-01 well. The Village of Rowell has no municipal water supply well, so there should be no local pumping impacts to KENN-20-02 water-level measurements.

Well construction

Monitoring wells were constructed to the standards of the Illinois State Water Well Construction Code 920. Wells were constructed with 2-inch diameter PVC riser and slotted screen components. Sand pack materials encased the screened interval, bentonite plug bounded the sandpack materials, and bentonite grout filled the rest of the borehole column. Each well was finished at land surface with a locked, 3-foot tall, steel wellhead protector encased in concrete (Figure 8). The wells were developed using compressed-air surging methods. A summary of the new wells that were drilled/installed and added to the NGWMN during FY2019 is included in Table 1. Details of well construction and geologic materials at each monitoring-well location are available in Appendix A.

Figure 3. Aerial view of well location at Heyworth, Illinois (well HWTH-19-01).

Figure 4. Aerial view of well location at Wapella, Illinois (well CLIN-20-01).

Figure 5. Aerial view of well location at Weldon Springs State Park (well MARO-20-01).

Figure 6. Aerial view of well location at Kenney, Illinois (well KENN-20-01).

Figure 7. Aerial view of well location at Rowell, Illinois (well KENN-20-02).

Figure 8. (a) 2-inch PVC casing and screen ready for installation, (b) installing well screen, (c) installing sand pack (d) completed wellhead protector during air-spurge well-development. All photos are from the KENN-20-02 site at Rowell, Illinois.

Table 1. New wells installed for NGWMN (FY2019) in central Illinois.

WELL NAME	PRINCIPAL AQUIFER	NGWMN SITE NO.	WELL DEPTH (FT)	LAT	LONG
HWTH-19-01	Sand and gravel	P502610	335	40.312259	-89.001585
CLIN-20-01	Sand and gravel	P502611	320	40.23155	-88.96528
MARO-20-01	Sand and gravel	P502612	315	40.11876	-88.93013
KENN-20-01	Sand and gravel	P502613	250	40.10051	-89.07915
KENN-20-02	Sand and gravel	P502614	340	40.072638	-89.029502

References

Horberg, L., 1950, Bedrock Topography of Illinois. Illinois State Geological Survey Bulletin 73, Urbana, IL

Roadcap, G.S., H.V. Knapp, A. Wehrmann, and D.R. Larson, 2011, Meeting East-Central Illinois Water Needs to 2050: Potential Impacts on the Mahomet Aquifer and Surface Reservoirs, Illinois State Water Survey Contract Report 3011-08

APPENDIX A.

Drilling logs and well-construction details

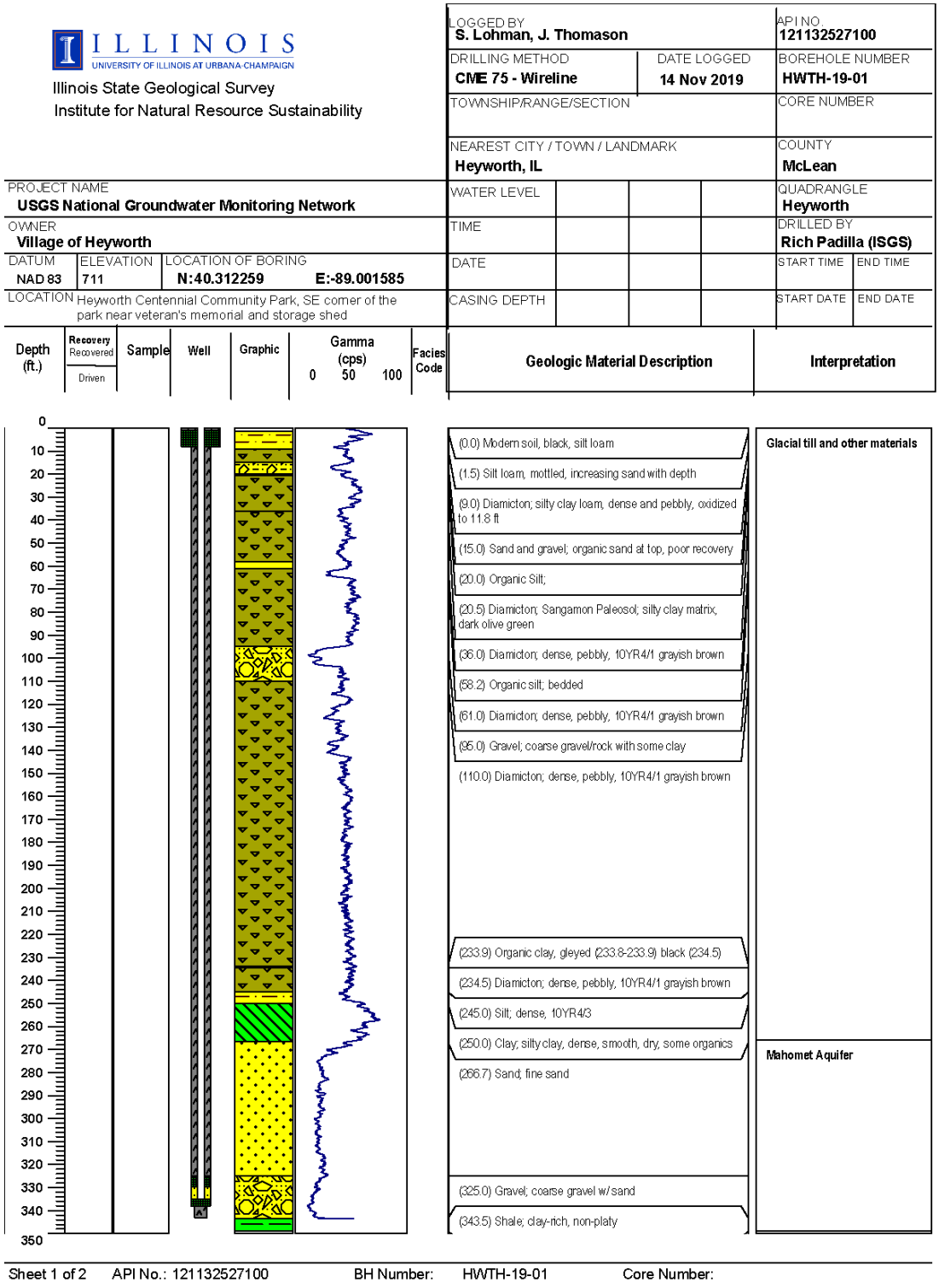

Figure A1. Lithologic log, gamma log, and well construction details of NGWMN Site No. 121132527100 (HWTH-19-01).

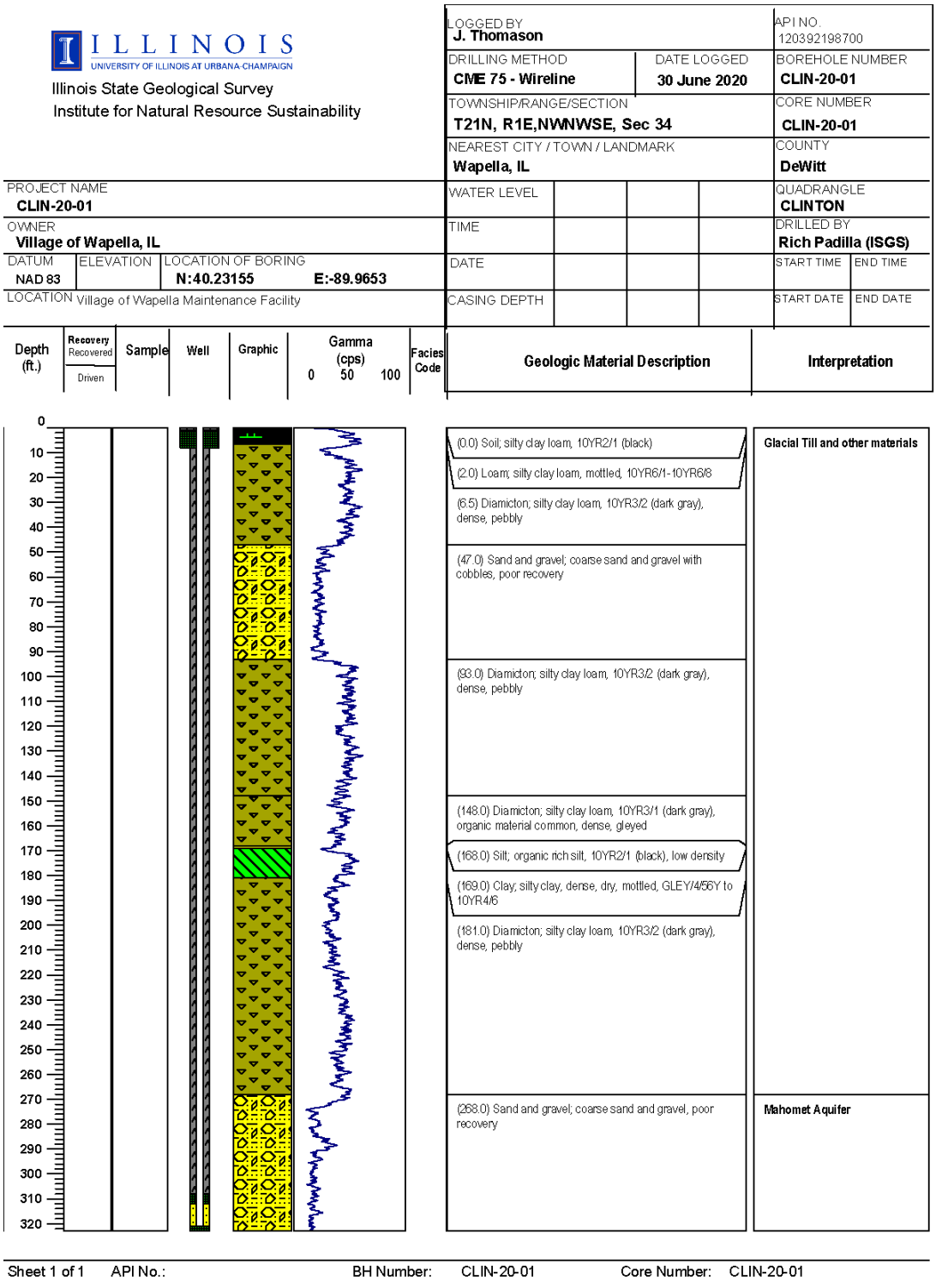

Figure A2. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392198700 (CLIN-20-01).

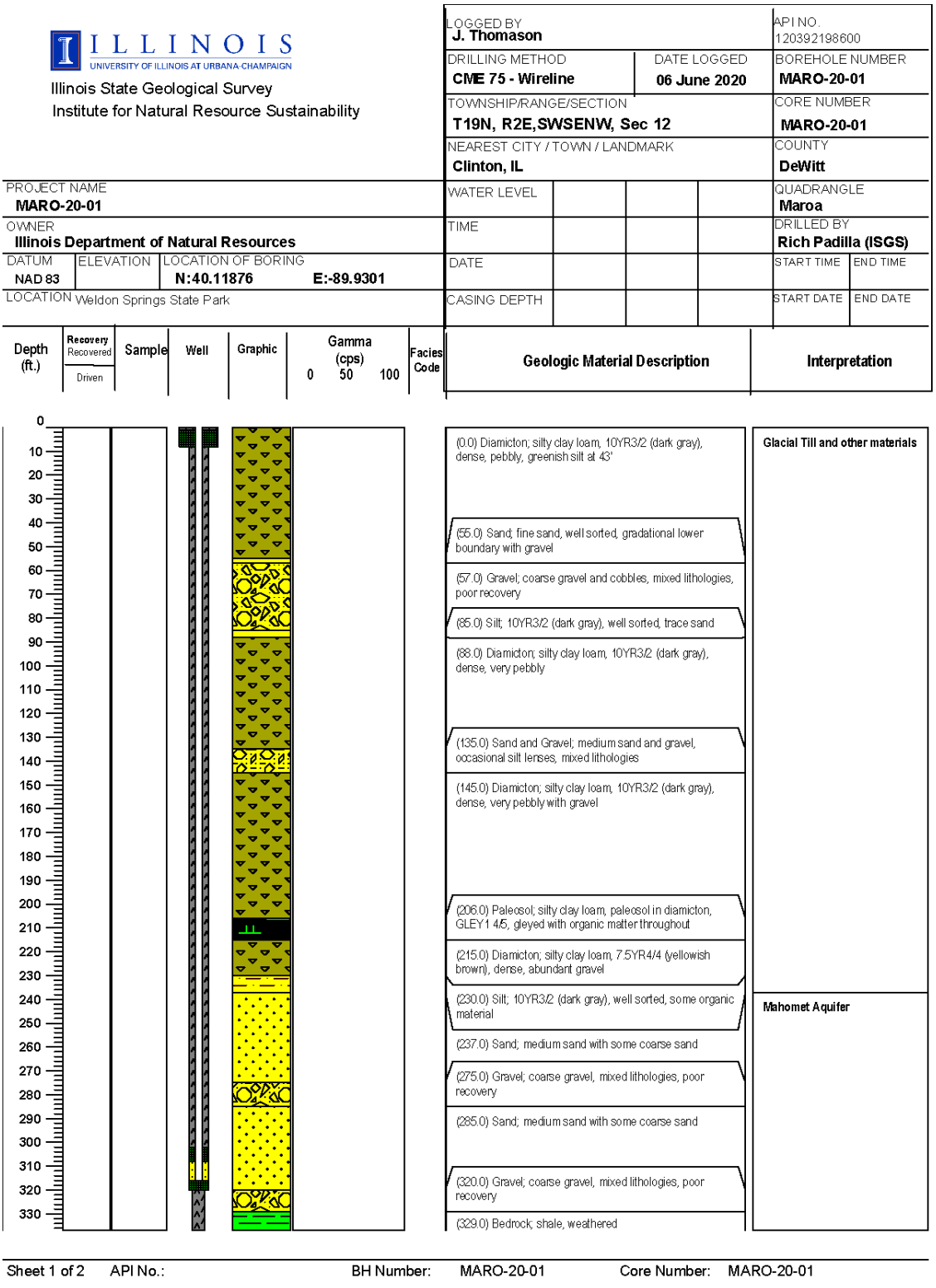

Figure A3. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392198600 (MARO-20-01).

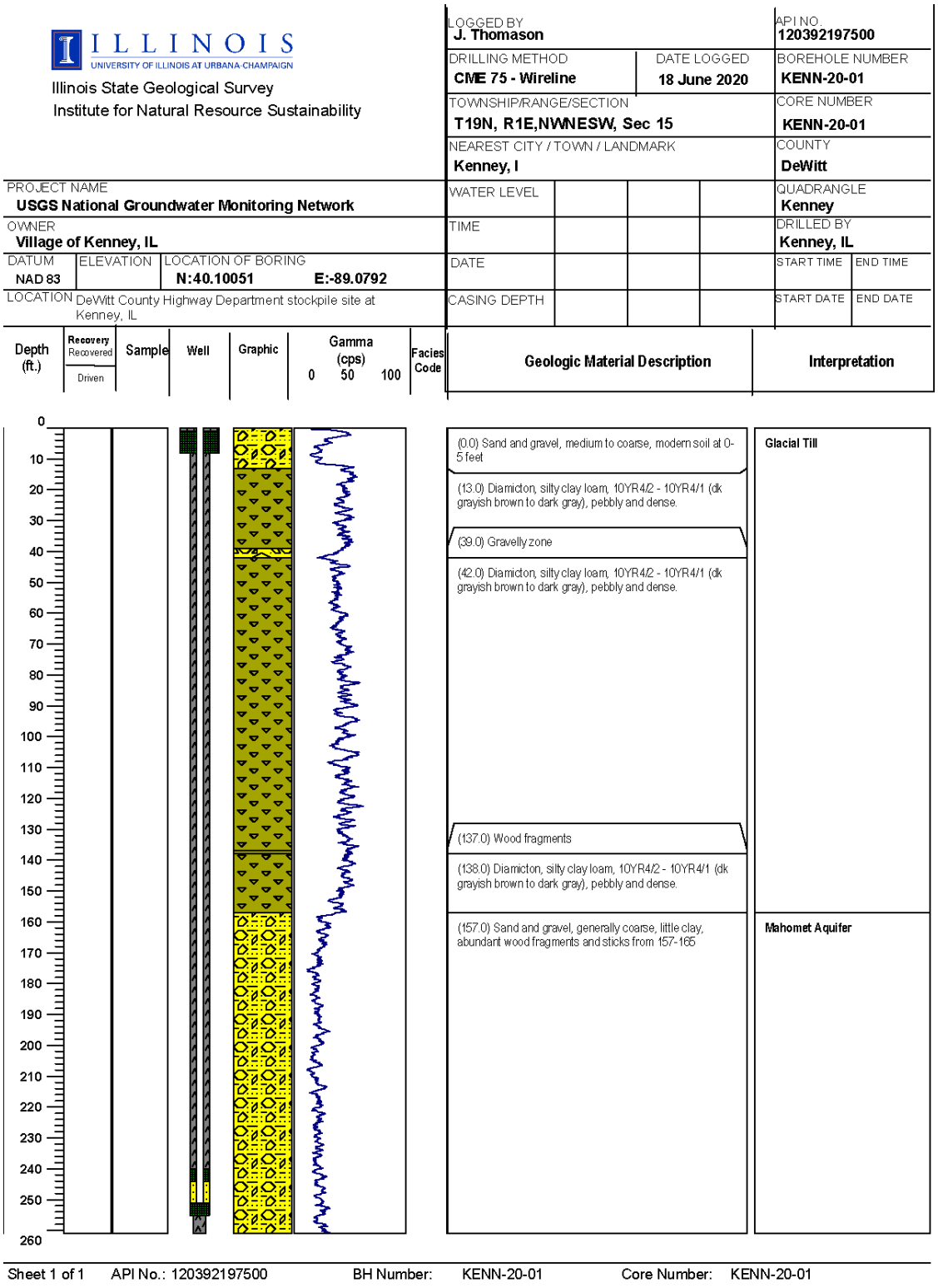

Figure A4. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392197500 (KENN-20-01).

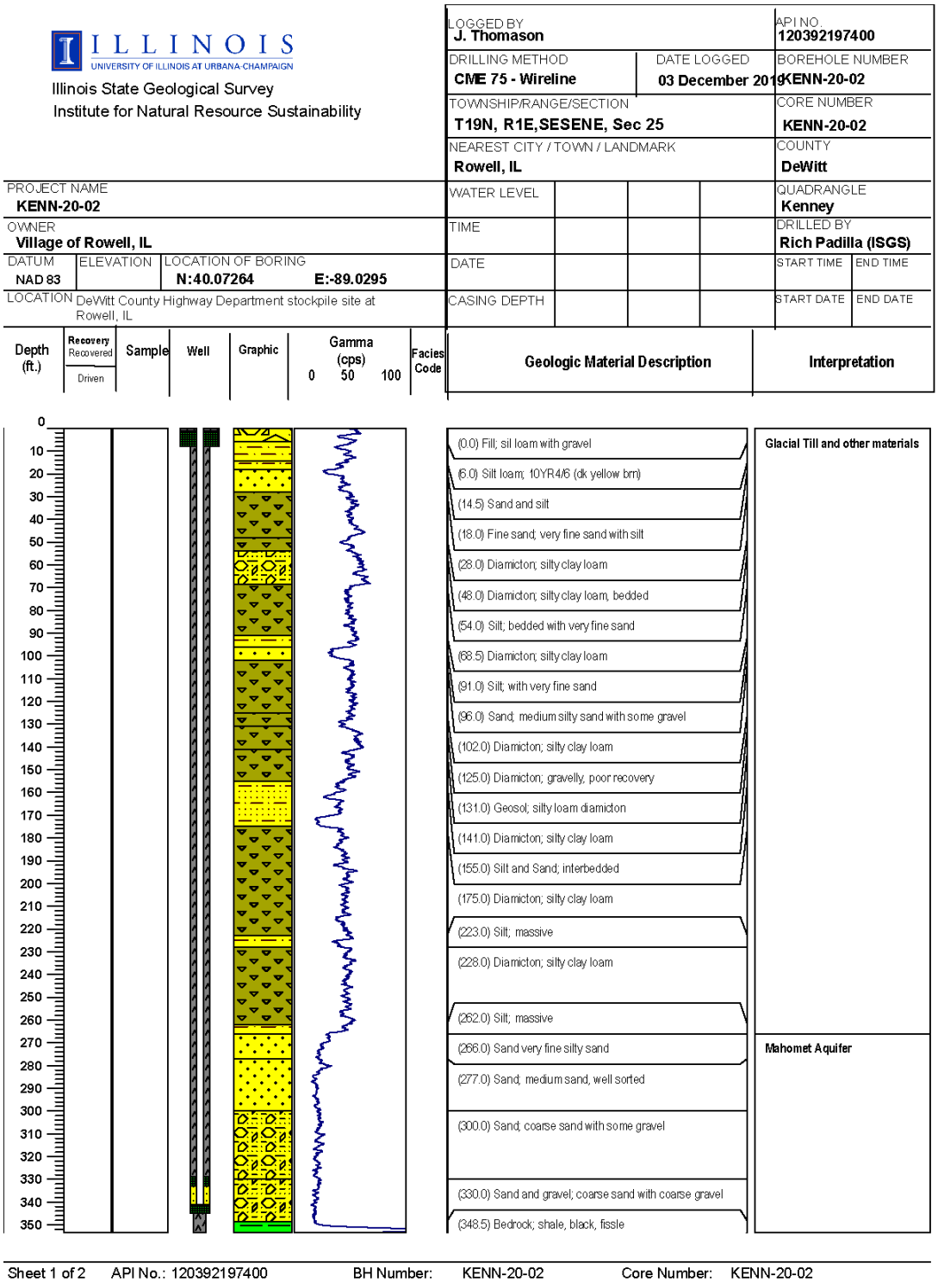

Figure A5. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392197400 (KENN-20-02).