

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

Final Technical Report

**Support of Data Service and Installation of New Monitoring Wells for National
Ground-Water Monitoring Network in Illinois**

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**FY2020 Award Term
September 1, 2020-August 31, 2021; extensions to August 31, 2023**

June 27, 2024

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 FY2020 request for proposals.

In collaboration with the ISWS, the Illinois State Geological Survey (ISGS) also installed 4 groundwater monitoring wells into Principal Aquifers in the northern half of 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 to fill data gaps in the glacial sand and gravel Principal Aquifer in east-central Illinois, northern Illinois and north-central Illinois. Furthermore, one well was installed in northeast Illinois in the Silurian-Devonian Principal Aquifer. The new NGWMN wells will contribute to a more robust monitoring coverage of Principal Aquifers and a better understanding of regional groundwater flow and local pumping effects within these aquifers. These activities were in congruence with Objective 5 of the FY2020 request for proposals.

The FY2020 contract award term was scheduled for September 1, 2020 through August 31, 2021. Two, 1-year extensions were requested for the award term until August 31, 2023. This extra period was critical for efficient workflow and project success, partially due to the COVID-19 pandemic and partially due to well-drilling delays and scheduling conflicts that were unavoidable. The award granted from the NGWMN for FY2020 was \$126,344. Final expenditures of the award totaled \$112,322.25.

Project objectives

Introduction

The FY2020 award was aimed at Objective 2 (Support Persistent 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 Persistent Data Service from Existing Data Providers

The four 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. Water levels have not been measured at these sites yet after they were drilled but will be measured during the remainder of 2024.

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 ISGS and ISWS collaborated to install 4 groundwater monitoring wells into Principal Aquifers in areas of northern Illinois (Figure 1). The Principal Aquifers of interest in this area are (a) aquifers of alluvial and glacial origin, (b) the Silurian-Devonian aquifer, and (c) the Cambrian-Ordovician aquifer. The prominent bedrock valley in the area of Site 1 is the Mahomet Bedrock Valley (Horberg, 1954), which is filled extensively with sand and gravel deposits of the Mahomet Aquifer (Roadcap et al., 2011). The prominent bedrock valley in the areas of Sites 3 and 4 is the Troy Bedrock Valley (Vaiden et al., 2004), which is also filled extensively with sand and gravel deposits. The bedrock valley incises into Galena-Platteville dolomites and the St. Peter sandstone of the Cambrian-Ordovician Principal Aquifer. The Principal Aquifer at Site 2 is the Silurian-Devonian aquifer, which is largely the uppermost bedrock unit in the area composed largely of fractured carbonate rocks.

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. Site 1 was selected to replace a non-functioning well in the Mahomet Aquifer. Site 2 was selected to monitor water levels in the shallow Silurian-Devonian carbonate-rock aquifer in a heavily-industrialized part of Will County, Illinois. Sites 3 and 4 were selected to monitor water levels in the sand and gravel aquifers and the underlying Cambrian-Ordovician rocks that are hydraulically connected with those sand and gravel aquifers within the Troy Bedrock Valley in northern Illinois.

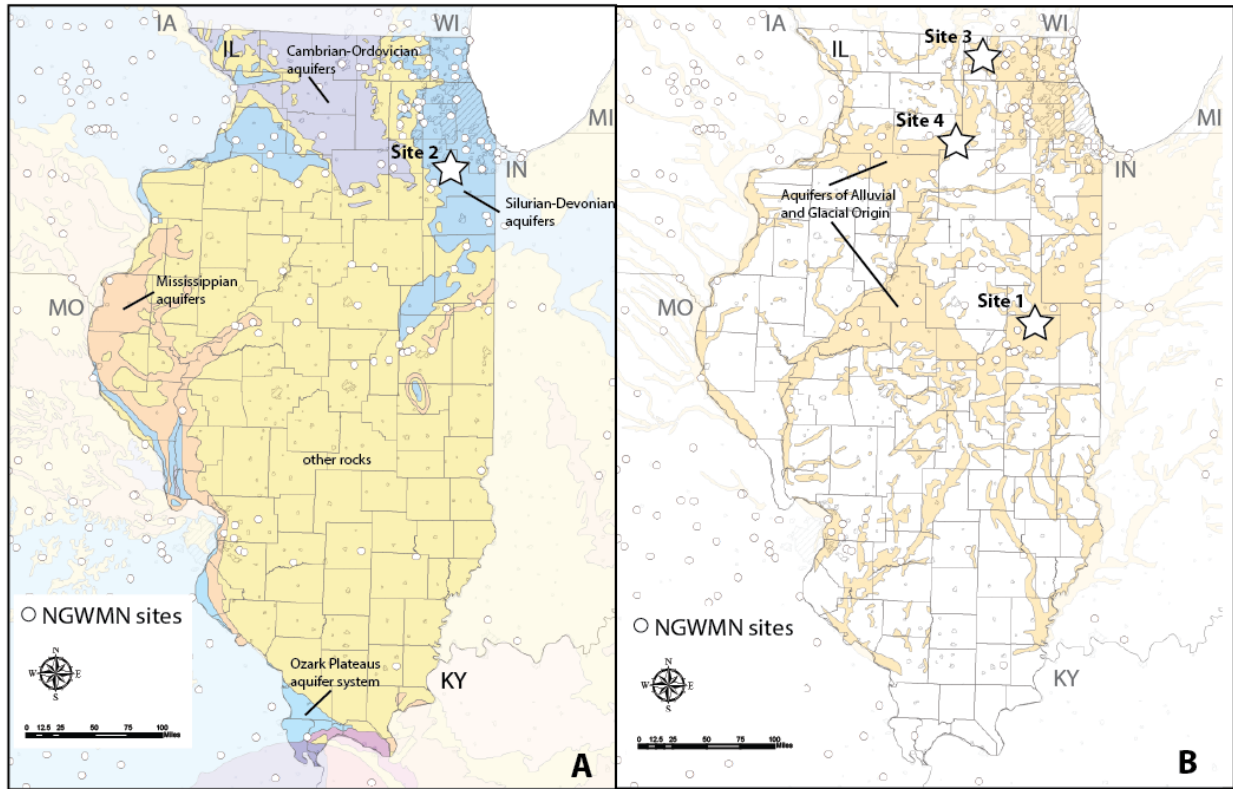


Figure 1. (a) Bedrock Principal aquifers and (b) Sand and Gravel Principal aquifers in Illinois and locations of NGWMN wells. White stars indicate general locations of new monitoring wells in Silurian-Devonian and Sand and Gravel Principal aquifers, respectively. More detailed maps of sites (1-4) are shown in Figures 2-6.

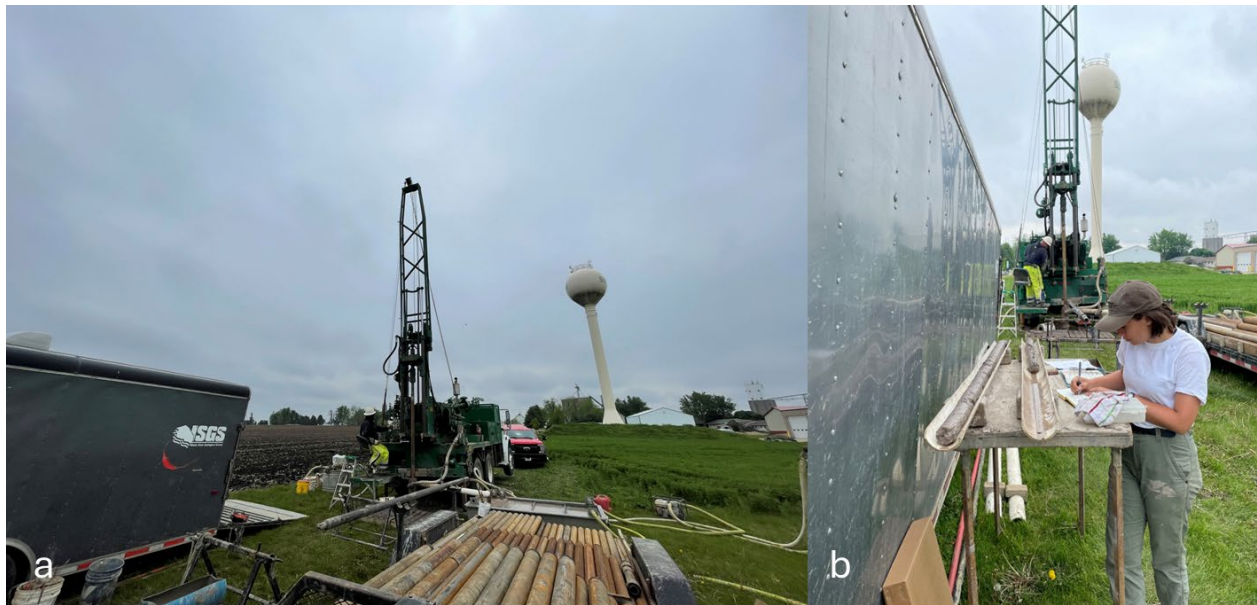


Figure 2. (a) Perspective view of CME drilling rig system operated by the ISGS and (b) description of continuous core from the wireline sampler. Photos are from the SUBL-21-01 well in Sublette, Illinois.

All four 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 FY2020, monitoring wells were installed at 1 township property, 1 municipality, and 2 county properties. All of these wells are intended to monitor long-term ambient water levels in their respective principal aquifers.

One monitoring well was installed in northern Champaign County, Illinois within the Mahomet aquifer near the village of Dewey (CHAM-20-01). This well was installed in a township property near a road intersection (Figure 3). This well was installed to replace a non-functioning monitoring well that was installed in 1996 that has been abandoned and sealed.

Another monitoring well was installed in Romeoville, Illinois within Veteran's Woods Forest Preserve (ROME-22-01). The city of Romeoville withdraws water partially from the Silurian-Devonian bedrock aquifer, which is stressed in some locations by increased chloride concentrations. This well is intended to monitor long-term water levels in the aquifer and potential long-term water quality in the future.

A third monitoring well was installed on Boone County Conservation District property in Boone County, Illinois along IL Rt 173 and Long Prairie Trail (BVNE-21-01). This well was installed along the trail with easy access for monitoring and measurements. The well fills a large data gap in north-central Boone County and north-central Illinois. There are no high-capacity wells nearby, so impacts from local pumping will be minimal. This well required two attempts at installation, because coarse gravel at depth was continually collapsing which resulted in a failed, first attempt. The result of this was increased costs, which prevented the installation of a 5th well for the contract period.

The fourth monitoring well (SUBL-21-01) was installed on property owned by the Village of Sublette, Illinois. The well was installed in a sand and gravel aquifer in contact with bedrock within the lower stretches of the Troy Bedrock Valley (Vaiden et al., 2004). However, the village of Sublette withdraws water from the much deeper Cambrian-Ordovician sandstone aquifer, so pumping effects on the monitoring well are not expected.

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 7). 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 FY2020 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 Dewey, Illinois (well CHAM-20-01).



Figure 4. Aerial view of well location at Romeoville, Illinois (well ROME-22-01).

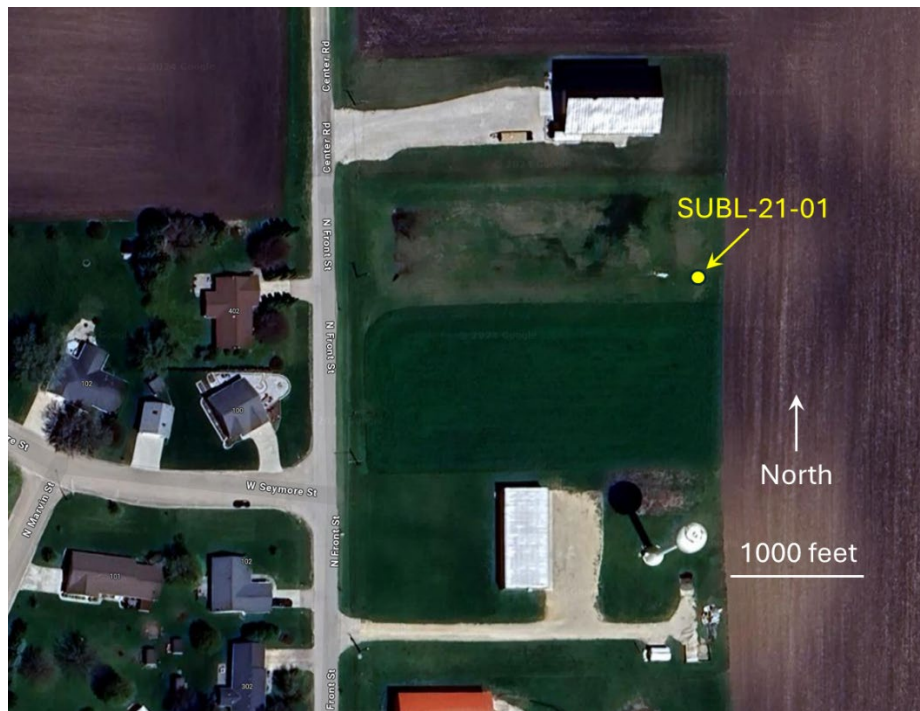


Figure 5. Aerial view of well location at Sublette, Illinois (well SUBL-21-01).



Figure 6. Aerial view of well location at Boone County, Illinois (well BVNE-21-01).



Figure 7. (a) 2-inch PVC casing and screen ready for installation, (b) well screen, (c) installing sand pack (d) completed wellhead protector during air-spurge well-development. All photos are from the SUBL-21-01 site at Sublette, Illinois.

Table 1. New wells installed for NGWMN (FY2020) in Illinois.

WELL NAME	PRINCIPAL AQUIFER	NGWMN SITE NO.	WELL DEPTH (FT)	LAT	LONG
CHAM-20-01	Sand and gravel	P505586	320	40.326040	-88.271916
ROME-22-01	Silurian-Devonian	P511702	87.3	41.673365	-88.057948
SUBL-21-01	Sand and gravel	P511701	340	41.646670	-89.227426
BVNE-21-01	Cambrian-Ordovician	P511699	363	42.379002	-88.774005

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

Vaiden, R.C., E.C. Smith and T.H.Larson, 2004, Groundwater geology of DeKalb County, Illinois with emphasis on the Troy Bedrock Valley, Illinois State Geological Survey Circular 563, 39 pp.

APPENDIX A.

Drilling logs and well-construction details



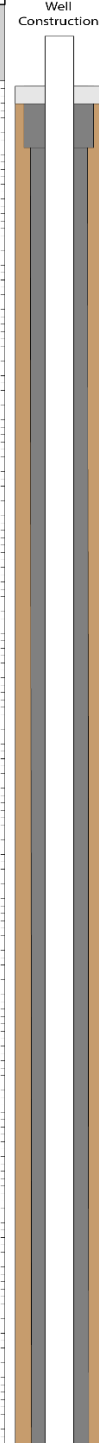
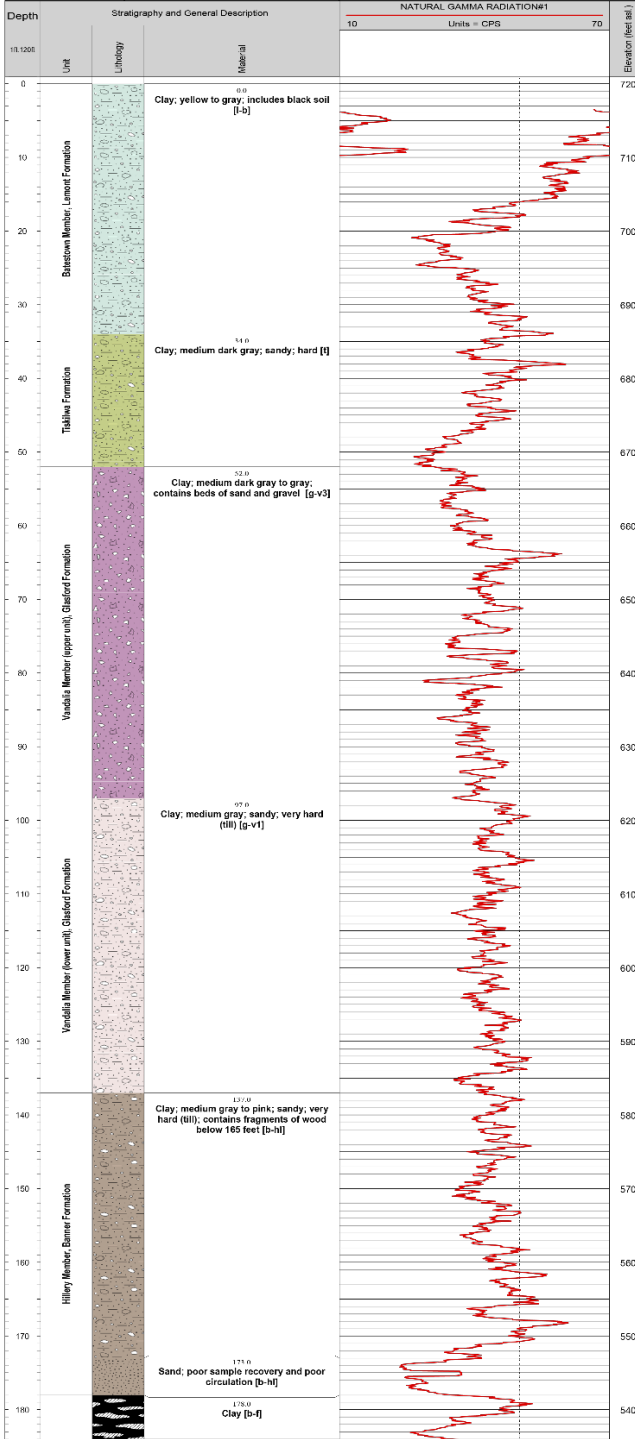
DOWNHOLE GEOPHYSICAL DATA

Well Address: Located in right-of-way, 0.7 miles northeast of Dewey, at intersection of County Roads 1000E and 3100N (Test hole #13) Date: 10/06/2020

ISGS ID	120192855200
BORE ID	CHAM-20-01
Owner Name	East Bend Township
File Name	
Depth Logger	347.6 feet
Casing	2.0-inch PVC
Operator	Aaron Blacker
Notes	

OVERVIEW MAP

Coordinates: N40.326043° W98.271908° Elevation: 720.08 foot



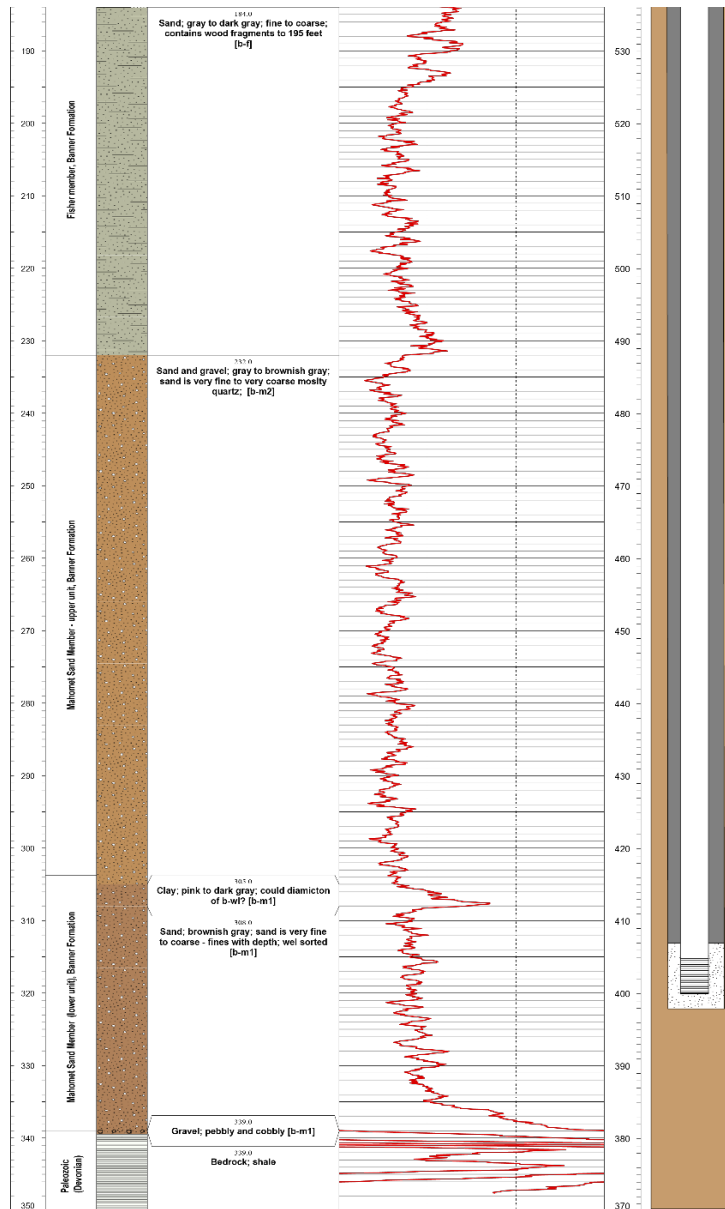


Figure A1. Lithologic log, gamma log, and well construction details of NGWMN Site No. 121132527100 (CHAM-20-01).



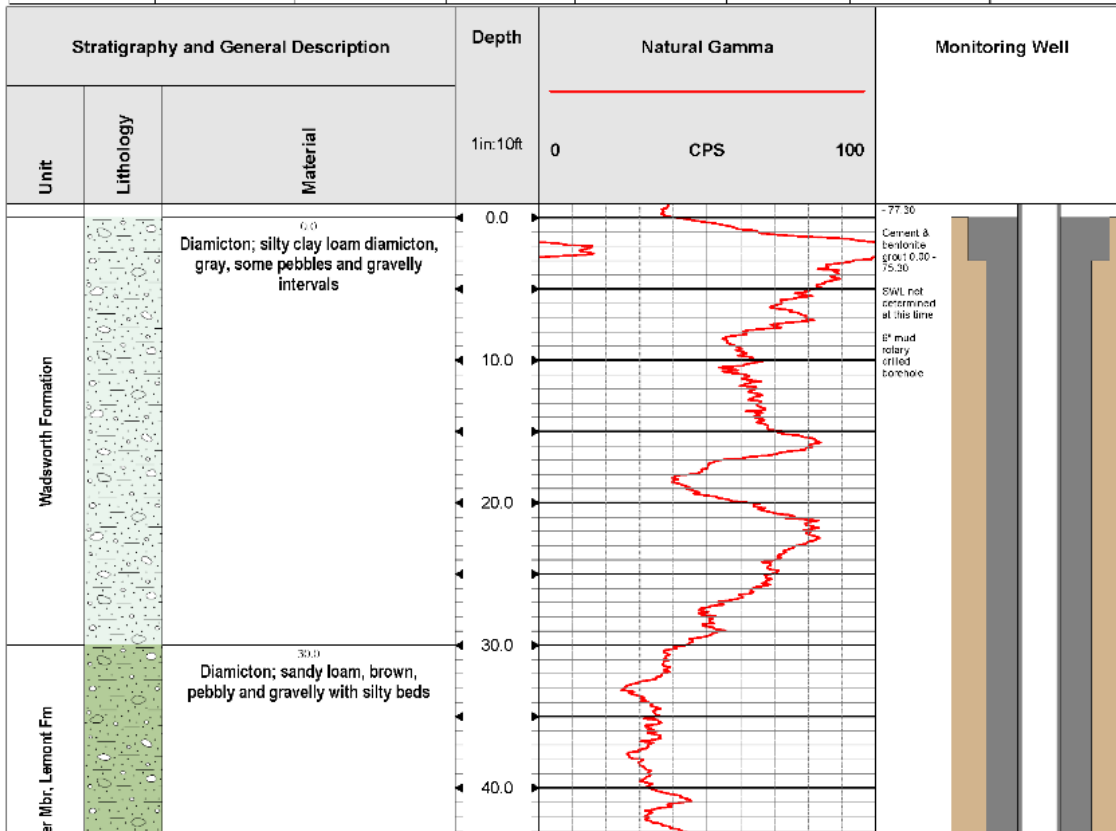
Owner: Illinois State Geological Survey	Project: National Ground Water Monitoring Program
Well Name: ROME-22-01	Company: United States Geological Survey
API number: 121974725000	Hole Type: Exploratory & MW Installation
County: Will State: IL	Drilling Co.: ISGS
Location: NE, SE, SW, S. 23, T.37N, R.10E.	Hole Fluid: Fresh drilling mud
East / Long: -88.057948 North / Lat: 41.673365	Fluid Level: Ground surface
Datum: WGS84 Elevation: 694 amsl	

Log measured from:

Height Above G.S.:

Date Logged	09-Nov-2022	Recording Direction	Up
Date Drilled	09-Nov-2022	Start Down Depth	n/a
Run Number	1	Start Up Depth	82.9
Depth - Driller	87.3	Recorded By	R. Padilla
Depth - Logger	82.9	Witness	J. Thomason

RUN		BOREHOLE RECORD				CASING RECORD		
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO	
1	NQ Wireline Carbide	0.0	87.3	2.0" ID PVC Pipe	Schedule 40	0.0	77.3	
2	8" Tri-cone	0.0	87.3	2.0" ID Slotted Screen	Schedule 40	77.3	87.3	



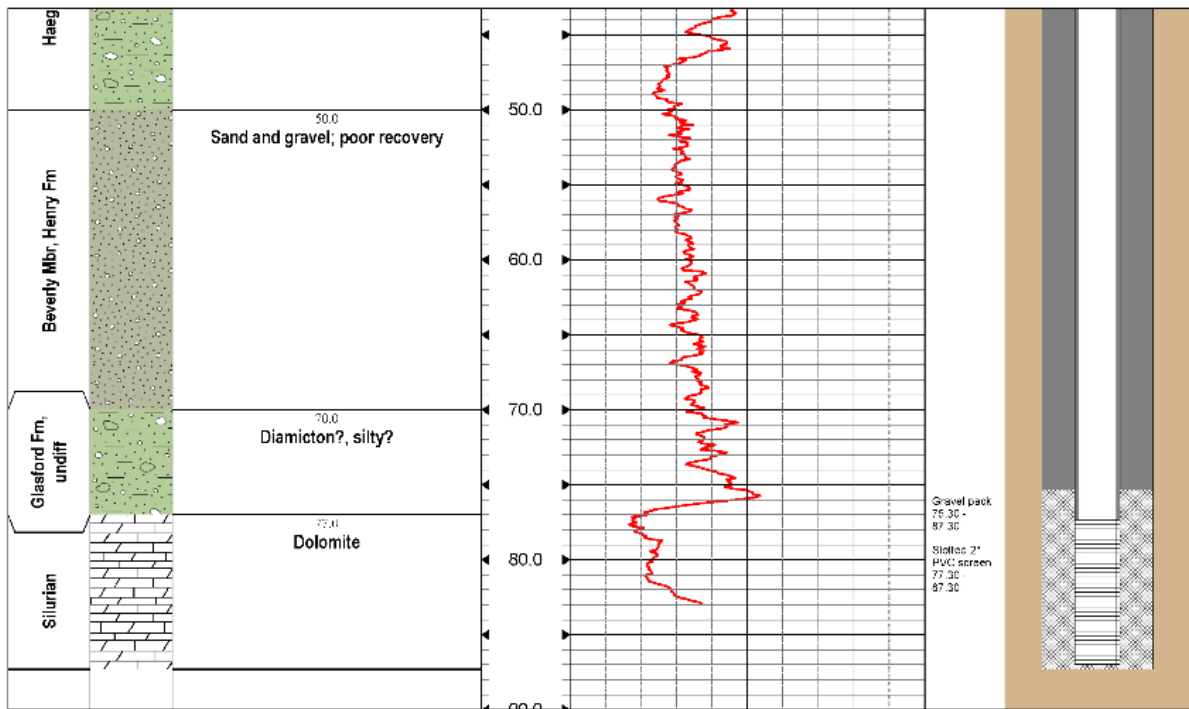
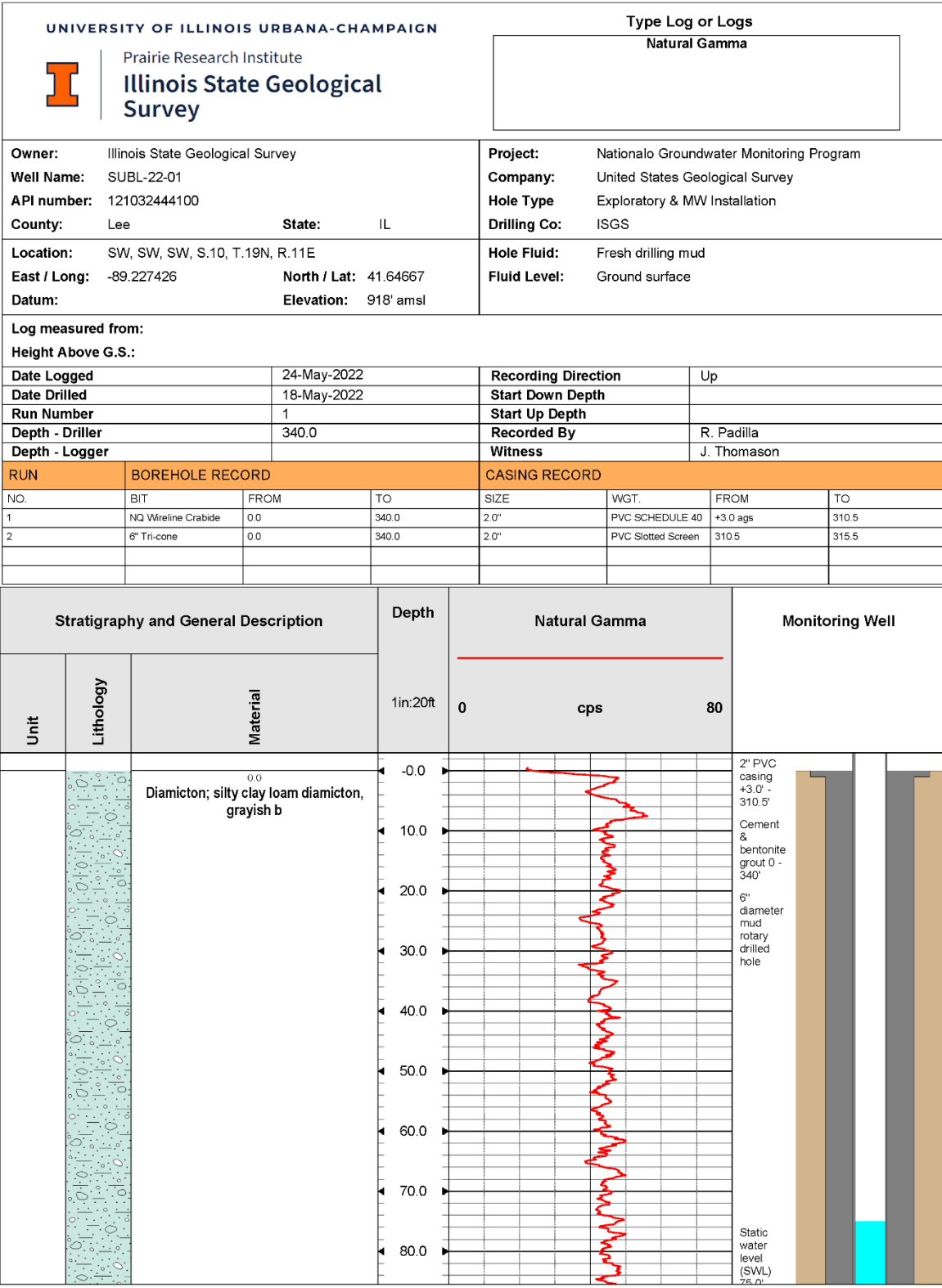
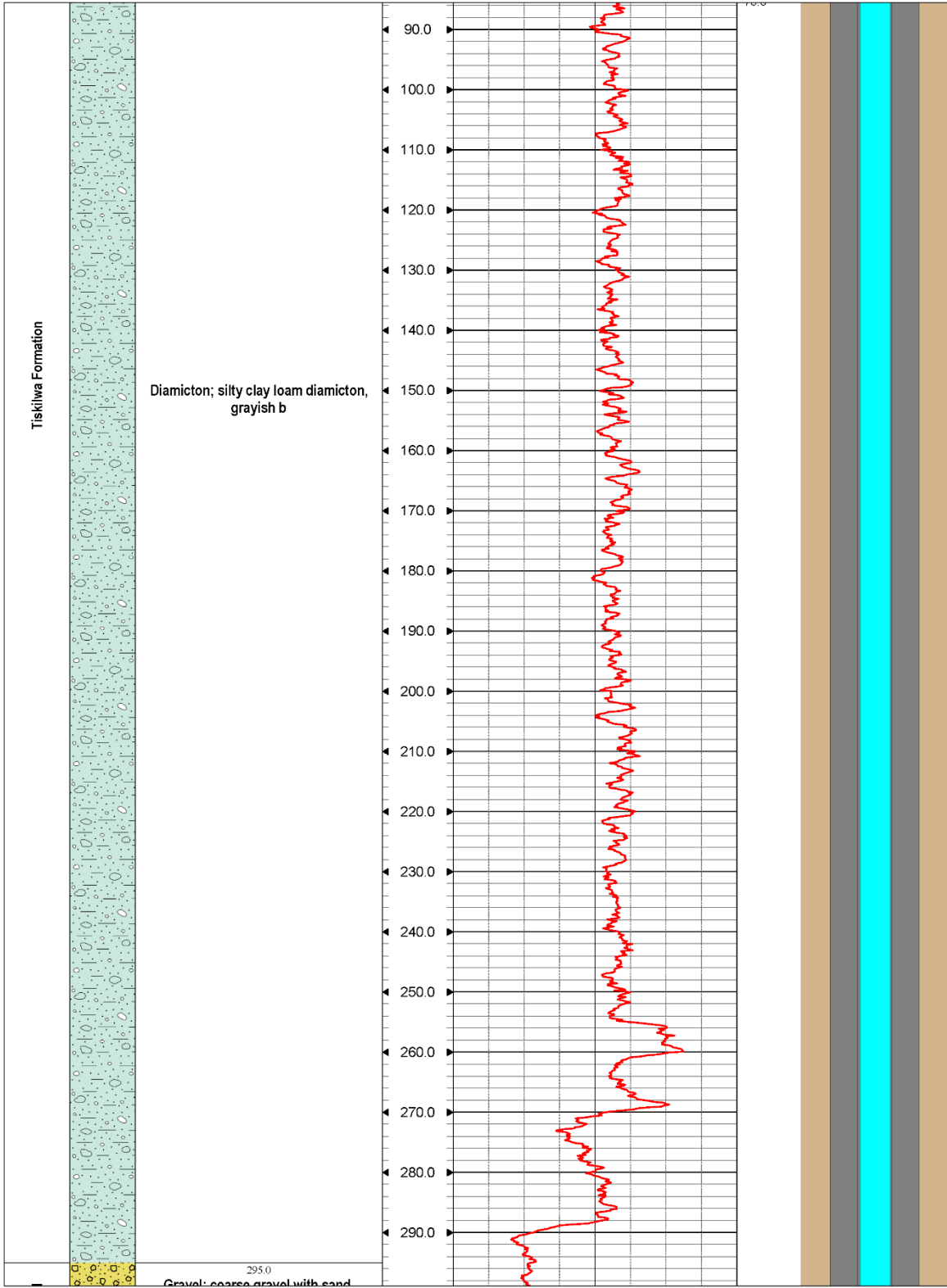


Figure A2. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392198700 (ROME-22-01).





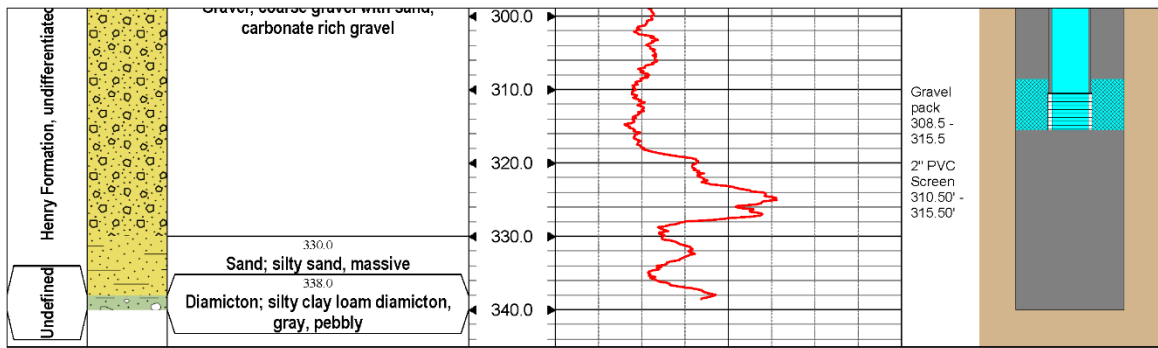
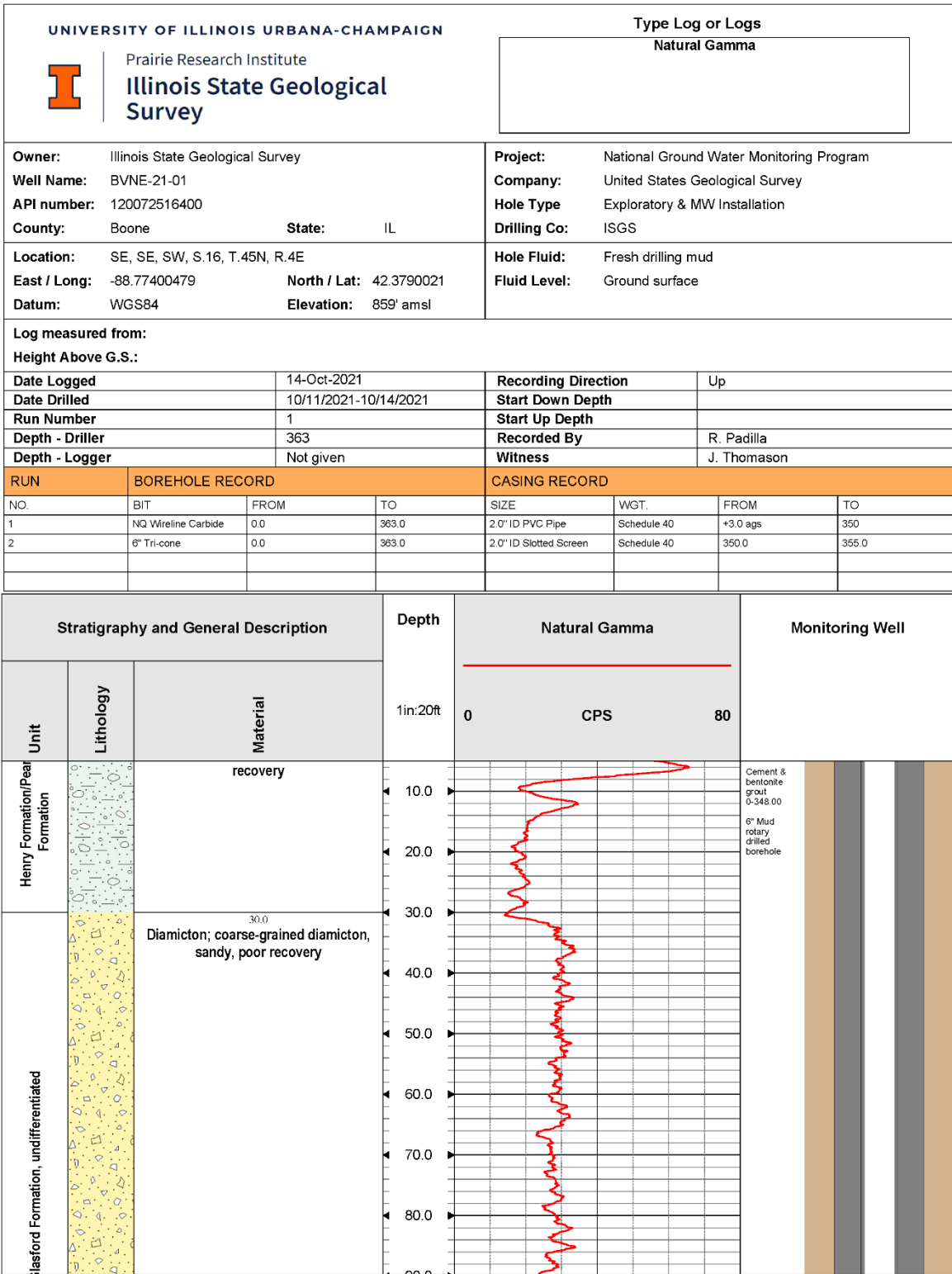
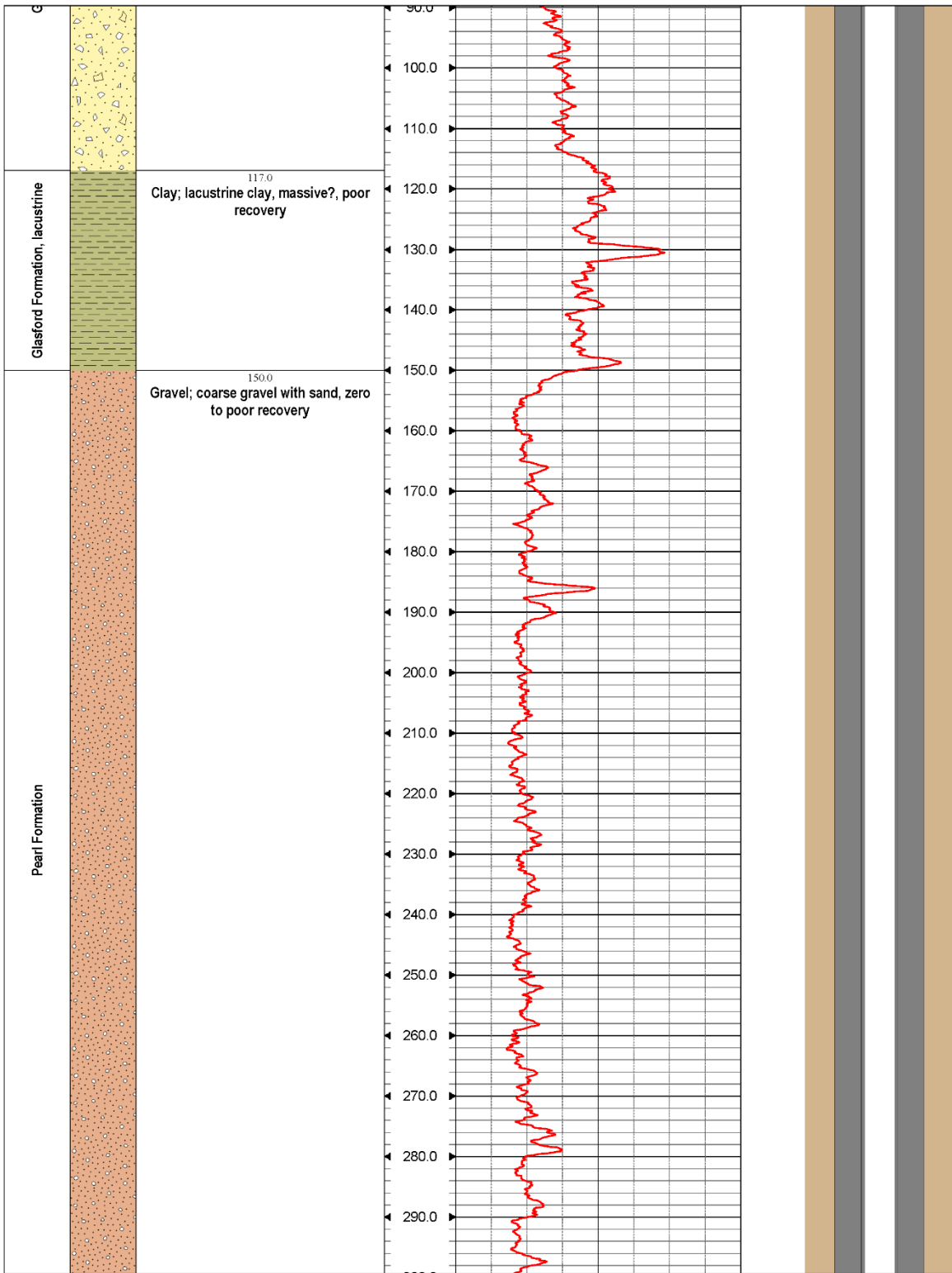


Figure A3. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392198600 (SUBL-21-01).





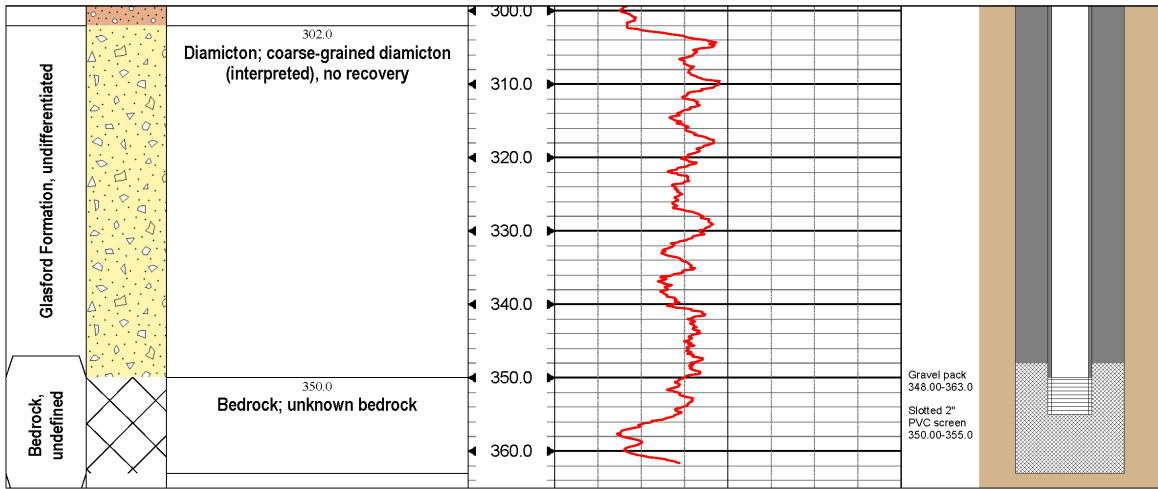


Figure A4. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120392197500 (BVNE-21-01).