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

Final Technical Report

Installation of New Monitoring Wells for the National Ground-Water Monitoring Network in Illinois to Fill in Spatial Data Gaps.

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FY2017 Award Term
July 1, 2017-June 30, 2018; extension to December 31, 2018

January 24, 2018

Overview

The Illinois State Geological Survey (ISGS) installed 5 groundwater monitoring wells into the Principal Aquifer in northeast 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). These activities were in congruence with Objective 5 (Well Drilling) of the FY2017 request for proposals.

In collaboration with the ISWS, the ISGS focused the study in northeast Illinois within the glacial sand and gravel Principal Aquifer. More specifically, the project was aimed at expanding the well subnetwork through the area of Kane County, Illinois. In this area, shallow sand and gravel aquifers fill major bedrock valleys and their tributaries, and they are the primary source of drinking water for many municipal and domestic supplies. Prior to this project, only 5 NGWMN wells existed within the Principal Aquifer in Kane County. The new NGWMN wells will contribute to a more robust understanding of regional groundwater flow and local pumping effects within the aquifer.

The FY2017 contract award term was scheduled for July 1, 2017 through June 30, 2018. A 6-month extension was requested for the award term until December 31, 2018. This extra period was critical for efficient workflow and project success. The award granted from the NGWMN for FY2017 was \$89,508. Final expenditures of the award totaled \$88,492.42.

Project objectives

Introduction

The FY2017 award was aimed exclusively at Objective 5 (Well Drilling) of the request for proposals. The contract award funded personnel and drilling activities associated with Objective 5. No other objectives were included in the proposal. Thus, this section describes site selection, scientific relevance, and well-drilling activities/outcomes associated with the project.

Regional location

The ISWS and ISWS collaborated to install 5 groundwater monitoring wells into the Principal Aquifer in the area of Kane 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 St. Charles bedrock valley constrains a large portion of the sand and gravel aquifer (locally named the St. Charles Aquifer), but numerous tributary bedrock valleys (i.e. Elburn Bedrock Valley/Aurora Bedrock Valley, and their associated sand-gravel deposits) also contribute to the regional Principal Aquifer (Figure 1).

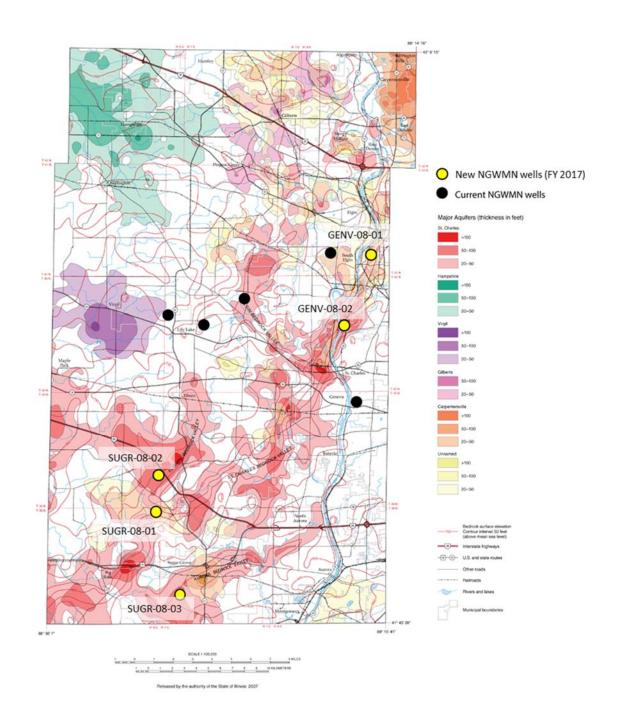


Figure 1. Locations of NGWMN wells to date in Kane County, Illinois. Map indicates location and thickness of six different sand/gravel aquifers in the region (St. Charles Bedrock Valley and tributaries shown in red).

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.



Figure 2. (a) Rear view of CME drilling rig operated by the ISGS and (b) extraction of continuous core from the wireline sampler.

Site selection

Drilling sites were selected to expand the local monitoring network and fill in spatial data gaps within it. Four of the monitoring wells are located on Kane County Forest Preserve District (KCFPD) properties, and one well is located on private property. Public properties, such as county or municipal properties, were prioritized as site locations due to the anticipated longevity (30+ years) of property ownership. For FY2017, the Kane County Forest Preserve District was extremely cooperative and generous with access to sites, logistical support to drilling, and a long-term commitment to collaboration with the ISGS and ISWS. One monitoring well is located on the private property of a local Kane County resident who is familiar with NGWMN objectives and strongly supportive of them.

Two monitoring well sites were located in northeast Kane County, near the cities of South Elgin and St. Charles, Illinois (GENV-08-01 and GENV-08-02, respectively). These wells were installed on KCFPD property (Figures 3 and 4, respectively), and they are intended to monitor water levels in heavily-populated regions that include high-capacity municipal pumping wells. These monitoring wells were screened within the main branch of the St. Charles bedrock valley, which provides large portions water resources to those respective cities and other local residents.

Three monitoring well sites are located in southeast Kane County within the southeast portion of the St. Charles bedrock valley and tributary valleys. One well (SUGR-08-01; Figure 5) is located within the main branch of the St. Charles bedrock valley on KCFPD property. A second well (SUGR-08-02; Figure 6) is installed on KCFPD property within the Elburn Bedrock Valley, which is a tributary valley to the St. Charles Bedrock Valley. Lastly, the third well (SUGR-08-03; Figure 7) in this region is located on private property near Sugar Grove, IL. The well is installed within the Aurora Bedrock Valley, which is also a mapped tributary valley to the St. Charles Bedrock Valley. Significant sand and gravel was not encountered in this borehole, so the well is screened within the shallow, fractured bedrock.

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, flush-mount 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 FY2017 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 near South Elgin, Illinois (well GENV-08-01).



Figure 4. Aerial view of well location near St. Charles, Illinois (well GENV-08-02).



Figure 5. Aerial view of well location in the St. Charles Bedrock Valley near Sugar Grove, Illinois (well SUGR-08-01).



Figure 6. Aerial view of well location in the Elburn Bedrock Valley north of Sugar Grove, Illinois (well SUGR-08-02).



Figure 7. Aerial view of well location in the Aurora Bedrock Valley southwest of Sugar Grove, Illinois (well SUGR-08-03).



Figure 8. (a) 2-inch PVC casing and screen ready for installation, (b) installing sandpack material, (c) well casing with lockable cap and (d) completed wellhead protector.

Table 1. New wells installed for NGWMN (FY2017) in northeast Illinois.

WELL NAME	PRINCIPAL AQUIFER	NGWMN SITE NO.	WELL DEPTH (FT)	LAT	LONG
GENV-18-01	Sand and gravel	120893719000	135	41.998174	-88.277802
GENV-18-02	Sand and gravel	120893719100	85	41.954638	-88.308611
SUGR-18-01	Sand and gravel	120893718900	58	41.808309	-88.493737
SUGR-18-02	Sand and gravel	120893719200	135	41.830320	-88.489510
SUGR-18-03	Sand and gravel	120893719300	122	41.743211	-88.463186

APPENDIX A.

Drilling logs and well-construction details

4	7	SEOLO	S STATE SICAL S	URVEY				LOGGED BY J. Thomason DRILLING METHOD		DATE L	OGGED	API NO. 120893719 BOREHOLE	
	P	RAIRIE RE	SEARCH IN	NSTITUTE				CME 75 - Wirelin			pt-2018	GENV-08-	
6	7 T 1	I. I. I	IN (S.I.C				TOWNSHIP/RANGE	/SECTION	+		CORE NUME	ER
=	UNIVER	ISITY OF ILLIN	IOIS AT URBAN	NA-CHAMPAIGN				T41N, R8E, SE	NWNW, S	Sec 36			
								NEAREST CITY / TO	WN / LANDI	MARK		COUNTY	
								South Elgin, IL				Kane	
PROJECT		Cround	water Me	onitoring N	lotwork			WATER LEVEL				QUADRANG Geneva	LE
OWNER	National	Ground	water we	onitoring i	letwork			TIME				DRILLED BY	
	ounty F	orest Pr	eserve					I IIII				Rich Padil	
DATUM	- 1	ATION L		OF BORING				DATE				START TIME	END TIME
NAD 83	755		N: 41.99			3.277802		O A OIN O DEPTH				START DATE	END DATE
.UCATIO	N Kenyo grass a	n Farm Fo at northwe	orest Prese est corner	erve, flush-n of parking a	nount wel rea	ll in prairie		CASING DEPTH				START DATE	END DATE
Depth (ft.)	Rec/Drive	Sample	Well	Graphic		mma 50 :ps)	Facies Code	Geolo	gic Material	Description	1	Interpr	etation
0_													
-				<u> </u>				(0.0) silt loam; black				Glaciofluvial	
10 —				0-0-	3			(1.0) clay loam; b-hor (2.5) sand and gravel			/		
					Ī			(2.0) Sand and graver	, coarse				
20 —								(22.0) diamicton; silty	clay loam, 10	/R4/1 (gray), d	ense,	Diamicton	
30 —			22		-			gravelly, poor recover	y, decreasing	gravel with dep	th		
=					=								
40 —											A		
-								1					
50 — -											I		
60 —				\triangle									
-			2 2					ļ					
70 —			12 12	\vee \vee									
-			2 2					lì			İl		
-			12 12					H			- 11		
80 —								(27.0) sand and grave	el; coarse			Glaciofluvial	
90 —								(34.0) diamicton; silty gravelly, poor recover				Diamicton	
=								(80.0) sand; medium				Diamicton	
100 —								(86.0) diamicton; silty	clay loam				
-							F	(88.0) sand; medium					
110 —								(89.0) diamicton; silty	clay loam				
120 —													
130 —			./		1			(123.0) gravel; very o	oarse, poor red	covery		Glaciofluvial	
Sheet 1	of 1 /	API No.:	1208937	19000		BH Num	ber:	GENV-08-01		ore Numbe	er:		

Figure A1. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120893719000 (GENV-08-01).

OWNER Kane C DATUM NAD 83 LOCATION	NAME National County F ELEVA 723	Ground Ground Orest Pr ATION L yer Bluff E grass on	water Moreover COCATION N: 41.95	O I S NA-CHAMPAIGN Onitoring N	E:-88 flush-mou area 0 Gar	.308611 nt well in	Facies	LOGGED BY J. Thomason DRILLING METHOD CME 75 - Wireli TOWNSHIP/RANGI T40, R8E,SEN NEAREST CITY / T St. Charles, IL WATER LEVEL TIME DATE CASING DEPTH	ine E/SECTION IWNE, Sec	03-Oct	OGGED tober-201	CORE NUMB COUNTY Kane QUADRANGI Geneva DRILLED BY Aaron Blace	NUMBER D2 ER LE Eker (ISGS) END TIME END DATE
0_					ı								
10 —					And the second s			(0.0) loam; clay loan (4.5) clay; gravelly (5.0) sand and grave coarse gravel, poor:	al; very coarse, recovery			Glaciofluvial	
100 —			^/					(95.0) diamicton; silt				Subglacial Glaciofluvial	
=					-			(103.0) gravel; coars	se w/ clay lenses	s		Subglacial	
110 —								(105.3) diamicton; g (110.0) diamicton; g (111.1) bedrock; lim	ravelly, 2.5YR5/	3		Deep Marine	
Sheet 1 o	of 2 4	API No :	1208937	19100		BH Num	her	GENV-08-02		Core Numbe	r:		

Figure A2. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120893719100 (GENV-08-02).

	4 1	LLINOI	S STATE	:				LOGGED BY J. Thomason				API NO. 1208937189	900
/			SEARCH IN					DRILLING METHOD CME 75 - Wireli			OGGED pt-2018	BOREHOLE SUGR-08-0	
	II	L	INC	O I S				TOWNSHIP/RANGE		ec 1		CORE NUMB	ER
	ONIVER	IOTT OF ILLIN	IOIS AT UNBAN	M-CHARINION				NEAREST CITY / TO				COUNTY	
								Sugar Grove, II	•			Kane	
PROJECT USGS		Ground	water Mo	onitoring I	Vetw	ork		WATER LEVEL				QUADRANGI Sugar Gro	
OWNER								TIME				DRILLED BY	
Mane C	ounty F			OF BORING	2			DATE				Rich Padil	Ia (ISGS)
NAD 83	740		N: 41.80	8309		E:-88.49373		DATE				START TIME	END TIME
LOCATIO	N Sauer I well loo	Family Fo	rest Prese roximately	erve, Kane (2800 feet (Coun east o	ty, flush-mou of Lasher/Ha	nt ter	CASING DEPTH				START DATE	END DATE
Depth (ft.)	Rec/Drive	Sample	Well	Graphic	0	Gamma 50 (cps)	Facies Code	Geole	ogic Materia	l Description	1	Interpr	etation
0	I	Į.	I				ı						
- -	-							(0.0) silt loam; (0-1 fi	t) 10YR2/1, (1-	3 ft) 10YR4/4-1	0YR4/2,	Glaciofluvial (Her Formation)	nry
-							-	(3.0) sandy loam; 10	YR4/6, some la	arge ∞bbles			
10 — -			7 7				-	(7.5) silty sand; few above 10 feet	pebbles, well so	orted, v.f. sand,	oxidized		
20 —	-							(15.0) diamicton; silt	y clay loam, 7.5	5YR4/3, pebbly		Diamicton (Tiskil Formation)	wa
-								(26.9) silt; 7.5YR2/1	(black), organi	c, paleosol		Paleosol (Robein	/Sangamon)
30 —	-							(27.2) diamicton; silt brown, paleosol	y clay loam, 7.5	5YR3/1-7.5YR3	/2, dark		
- -	-							(32.0) diamicton; pod	or recovery			Diamicton? (Glas Formation)	aford
40 — - -								(40.0) sand; med-co possible diamicton a	arse sand, trac t 45-50', 55-60'	e gravel, interva ', and 65-70'	als of	Glaciofluvial (Pea	arl Formation)
- 50 —			11	\vee				(47.0) diamicton; poo	or recovery, ma	aybe cobbly san	d		
- - -	-							(50.0) sand; med-co possible diamicton a			als of		
60 —	1		· .	\triangle				(58.0) diamicton; pod	or recovery, ma	aybe cobbly san	d		
_					-			(61.0) sand; med-co possible diamicton a			als of		
70 —				\rightarrow \right				(65.0) diamicton; pod	or recovery, ma	aybe cobbly san	d	Diamicton (Glasf Formation)	ord
/0— - -			\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\		-			(70.0) bedrock; limes	stone, fractured	but in place		Bedrock (Limest	one)
80	-51	ADI NE	4000007	10000		BULL		CHOP 22 24		Oana Nissasi			
Sheet 1	or 1 /	API No.:	1208937	18900		BH Nu	mber:	SUGR-08-01	(Core Numbe	er:		

Figure A3. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120893718900 (SUGR-08-01).

OWNER	NAME lational ELEVA 723	Ground Ground Ground Jiderwoo	water Mo eserve OCATION N: 41.83	DIS A-CHAMPAIGN OF BORING 0320 Forest Press	E:-88.489510 erve, flush-mount		LOGGED BY J. Thomason DRILLING METHOD CME 75 - Wirelin TOWNSHIP/RANGE T39N, R6E, SE NEAREST CITY / TC Sugar Grove, IL WATER LEVEL TIME DATE CASING DEPTH	ne /SECTION SENE, Se DWN / LANDM	c 25	OGGED ober-201	API NO 120893719: BOREHOLE SUGR-08-I CORE NUME COUNTY Kane QUADRANG Sugar Gro DRILLED BY RICH Padil START TIME	NUMBER 12 ER LE Ve
Depth (ft.)		Sample	Well	Graphic	0 Gamma 50 (cps)	Facies Code	Geolo	gic Material	Description		Interpr	etation
0	,		I	ı l		1						
Ę	I			ON CO		1	(0.0) loam; silt loam,	10YR3/1 (black))	7	Glaciofluvial	
10 20 30 40 50							(1.0) gravel, very coa	rse, poor recovi	ery	nma loc	Diamicton	
70 — 80 —						-	(78.0) gravel; very co				Glaciofluvial	
90												
100							(92.0) silty clay; with				Glacio lacustrine	
110				0-0-			(98.0) sand and grave pebbles	el; t-med sand v	v some silt and	small	Glaciofluvial	
120							(115.0) diamicton; bro	own w/ limeston	e-shale pebble	s	Subglacial/Glaci	ofluvial
130							(124.0) gravel; very c	oarse, poor rec	overy			
140							(138.0) diamicton; ve organics at bottom, 1	ry fine with few 0YR4/1 to 10YF	pebbles, some R2/1 (black)			
150							(146.0) gravel; very o	oarse, poor rec	overy			
160 —			XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			5-	(152.0) diamicton and boulders w/ some dia		ecovery, coarse	, 1		
180			\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\				(175.0) shale; fracture	ed shale with till	l infillings		Shallow Marine	
Sheet 1 o	f1 A	API No.:	12089371	19200	BH Num	ber:	SUGR-08-02	С	ore Numbe	r:		

Figure A4. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120893719200 (SUGR-08-02).

OWNER Dan Nag DATUM NAD 83 LOCATION	NAME lational gel ELEVA 714 Nagel F Sugar	RAIRIE RE L J SITY OF ILLIN Ground	water Mo	D I S DATE OF BORING 3211	E:-88 Prairie S O Ga	8.463186	Facies Code	LOGGED BY J. Thomason DRILLING METHOD CME 75 - Wireli TOWNSHIP/RANGE T38N, R7E,NE NEAREST CITY/TC Sugar Grove, IL WATER LEVEL TIME DATE CASING DEPTH	ne E/SECTION NENESW, DWN / LANDM	25-Oct Sec 29 MARK	ogged tober-201	API NO. 120893719 BOREHOLE SUGR-08-I CORE NUME COUNTY Kane QUADRANG Yorkville DRILLED BY Rich Padil START TIME Interpr	NUMBER 03 BER LE Ia (ISGS) END TIME END DATE
0													
10 —								(0.0) silt loam; 10YR: (1.6) silt loam; 10YR: (4.5) sand and grave (10.0) gravel; very oc (25.0) silt; v.f. sandy	4/4 i; coarse parse, poor reco			Glaciofluvial Glaciolacustrine	
40 —								(37.4) diamicton; silty intervals, soft at 42'	/ clay loam, 7.5	YR4/2, pebbly,	gravelly	Subglacial	
50 — 60 — 70 — 80 — 90 — 1100 — 1110 — 1110 — 1								(46.5) diamicton; sith gravelly at 70-72' (107.5) clay, some si sand lense at 114'				Glaciolacustrine	
120 —								(117.0) limestone; fra	actured limestor	ie .		Deep Marine	
Sheet 1 of	f 1 A	PI No.:	1208937	19300		BH Num	ber:	SUGR-08-03	C	ore Numbe	r:		

Figure A5. Lithologic log, gamma log, and well construction details of NGWMN Site No. 120893719300 (SUGR-08-03).