FINAL TECHNICAL REPORT

USGS NGWMN Grant G19AC00280

11/15/2019 - 11/14/2021

Wells and Transboundary Conditions at D. F. Walker Elementary School (Chowan County, NC)

Prepared by

N C Department of Environmental Quality
Division of Water Resources
Groundwater Management Branch
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Overview of Work Planned and Accomplished

On 9/24/2019, the North Carolina Division of Water Resources (DWR) was awarded a $57,666 grant (G19AC00280) in support of the USGS National Ground-Water Monitoring Network (NGWMN). During the two-year grant period from 11/15/2019 to 11/14/2021, funding was used to install a multi-well groundwater monitoring station at D. F. Walker Elementary School (DFWS) located at 125 Sandy Ridge Rd in Edenton, Chowan County, NC 27932. DWR completed the DFWS project during the period 6/14/2021 to 6/28/2021 at a cost of $57,666 or $104.85 per foot.

State matching funds expended by DWR during the grant period consisted of $57,666 for two replacement wells at DWR's Chinquapin Elementary School monitoring station in Duplin County, NC, at an average cost of $87.57 per foot.

Wells constructed with grant funds and state matching funds have been added to the state well network and NGWMN.

Description of Work Accomplished under Each Objective

During 2021, three monitoring wells were installed at DFWS by Toano Well and Pump Service, Inc. of Toano, VA, using a mud rotary drilling rig and water-based drilling fluid. Consisting of three wells 30, 195 and 325 feet (ft) deep, the station fills an important data gap within the Albemarle-Tidewater area of northeastern North Carolina. With well screens set in the Surficial, Yorktown, and Beaufort aquifers, the station will aid in resolving transboundary issues related to regional groundwater use and correlation of these hydrogeologic units throughout the region. Drilling cost increases at the time of contract renewal resulted in DWR having to submit at grant modification request to USGS. This modification reduced the number of wells drilled from four to three. As a result, a Castle Hayne aquifer well was not drilled.

The three wells were installed in line with one another at 20 ft spacing. In the deepest well (325 ft), drill cuttings were sampled and described at ten-foot intervals and geophysical logs consisting of gamma, spontaneous potential, single point resistivity, and 16" and 64" normal resistivity were made by the driller using Century logging equipment.

Each well was completed with 4" poly-vinyl chloride (PVC) well casing and 10 ft of stainless steel or PVC screen followed by a 5 ft section of blank casing and cap. In addition, the two deepest wells were installed with approximately 30 ft of 10" PVC surface casing. Each well was terminated approximately 2.5 ft above grade and protected by a 6" steel casing, locking cap, and 2 ft by 2 ft concrete pad. The wells were then developed by the driller using compressed air injected until water from each well ran clear.

Following well completion, DWR field staff purged each well, measured water levels and water quality field parameters, surveyed casing elevations, and installed water level data loggers. The wells were then added to the state well network and NGWMN at www.ncwater.org/gwmb and https://www.usgs.gov, respectively.

Figures and photographs for the project are provided in Appendix A. These include site maps, geophysical and lithologic logs, well hydrographs, and potentiometric surface maps. Details for each of the grant-funded and state match-funded wells are tabulated in Appendix B in Table 1. State-required GW-1 well construction records are provided in Appendix C for the grant-funded wells, and DWR's data management plan for data collection, quality control, and storage procedures is provided in Appendix D.

Description of Work Accomplished with DWR Matching Funds

During 2020, two replacement wells were installed at Chinquapin Elementary School at a cost of $73,030. Of this amount, $57,666 was applied as an in-kind services match to federal funding. The Chinquapin wells included a Surficial aquifer and Cretaceous Lower Cape Fear aquifer well installed to depths of 34 and 800 ft, respectively. Drilling services were provided by A. C. Schultes of the Carolinas. Well construction, sampling, logging, datalogger installation, and other tasks were performed in the same manner as at DFWS. Data for the Chinquapin wells is accessible through both the NGWMN Registry and DWR websites.

Work Done As Data Provider in Support of NGWMN

Work completed has consisted of well drilling under Objective 5.

Data Collection and Drilling Activities Completed

Data collection and drilling activities is discussed in previous sections describing work accomplished.

Table of New or Replacement Wells Added to the NGWMN

The three new and two replacement wells installed during this project are listed in Table 1 of Appendix B.

Well Construction Details

Well construction details are provided in the GW-1 Well Construction Records in Appendix C.

Methods Used for Data Collection

Methods used for data collection are provided in the Data Management Plan in Appendix D.

Procedures Used to Quality Assure Data Prior to Entry Into NGWMN

Data quality assurance procedures are provided in the Data Management Plan in Appendix D.

Updates to Web Services

In 2020, DWR advised USGS that it had shifted to a new server with separate domain for web services.

Problems Serving Data to the NGWMN Data Portal

There have been no problems serving data to the NGWMN portal.

Setting and Hydrogeology of DFWS Monitoring Station

The DFWS groundwater monitoring station is situated in the northeastern coastal plain physiographic province at latitude 36.165368 and longitude -76.650354. Site elevation is approximately 37.94 ft above mean sea level (MSL). Relative to nearby points of reference, the DFWS monitoring station is located approximately 50 miles west of the Atlantic Ocean and 27 miles south of the North Carolina - Virginia state line.

The general region where the DFWS station is located is referred to in this report as the Albemarle-Tidewater area and consists of northeastern North Carolina and southeastern Virginia. The general boundaries of the Albemarle-Tidewater area are the James River and Chesapeake Bay to the north, the Atlantic Ocean to the east, the Albemarle Sound to the south, and the Chowan and Blackwater Rivers to the west. Elevation of the Albemarle-Tidewater area generally increases from east to west ranging from sea level to nearly 100 ft above sea level. The terrain within the area is generally broad and flat to the east becoming dissected and gently rolling to the west.

The geology of the area consists of Recent to Cretaceous coastal plain sediments which dip and thicken eastward. The estimated depth to bedrock at the DFWS well station is 1,930 ft deep (-1892 ft MSL). Based on well records, basement bedrock consists of igneous and metamorphic bedrock, and in localized areas, Triassic basin sediments. The geology of the Albemarle-Tidewater area is complicated by multiple marine transgression and regression events, and structural and stratigraphic complexities related to the Chesapeake Bay impact crater of 35 million years ago.

Principal Aquifers within the Albemarle-Tidewater area consist of the Surficial, Castle Hayne, and Northern Atlantic coastal plain aquifer systems, the latter of which includes the Beaufort, Upper Cape Fear, and Lower Cape Fear North Carolina aquifers. The DFWS wells monitor the Surficial, Yorktown, and Beaufort aquifers and reach total depths of 30, 195, and 325 ft, respectively.

Within the Albemarle-Tidewater area, chlorides and other dissolved solids generally increase in all aquifers with increasing depth and proximity to the Atlantic Ocean. Groundwater quality in the three aquifers at DFWS was tested in August 2021 for chlorides, specific conductance, salinity, and pH. Chloride levels were detected in the Beaufort well at 53 mg/l but were below detection limits of 32 ppm in the shallower Surficial and Yorktown wells. Test results are provided in Table 1.

Regional Hydrogeology and Transboundary Conditions

The Albemarle-Tidewater area lies in the Northern Atlantic Coastal Plain. Within this area, aquifer names used in North Carolina, Virginia, and by the USGS often vary, as shown in Table 1. The absence of consistent, uniform naming conventions frequently makes correlating geologic and hydrologic units across state boundaries difficult. It is anticipated that the geologic and water level data from the new DFWS wells will aid in resolving such transboundary conditions within the Albemarle-Tidewater area.

Acknowledgements

Special thanks are extended to the Edenton-Chowan Schools Board of Education, especially Gene Jordan, Chair, and Dr. Michael Sasscer, Superintendent, for their support and access to the D. F. Walker Elementary School well drilling site. Additional thanks are extended to David Tawes, Director, Chowan County Water Department for overall support and assistance with the project.

Disclaimer

The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Geological Survey. Mention of trade names or commercial products does not constitute their endorsement by the U.G. Geological Survey.

Copies for USGS

PDF copies of this report are being submitted to:

Daryll Pope dpope@usgs.gov
Bill Cunningham wcunning@usgs.gov

References

1) Subcommittee on Ground Water of the Advisory Committee on Water Information, 2009 (revised 2013), A national framework for ground water monitoring in the United States: Advisory Committee on Water Information, accessed January 2017, at https://acwi.gov/sogw/ngwmn_framework_report_july2013.pdf.

2) G19AC00280 Cooperative Agreement Grant Proposal, NCDWR, 2019, and Grant Modification, 2021.

3) Cunningham, William L., Thomas E. Reilly, Daryll Pope, April 25, 2016, Use of the National Ground-Water Monitoring Network to Evaluate Selected Transboundary Aquifer Systems, presentation at NGWA Groundwater Summit, Denver, CO.

4) https://cida.usgs.gov/ngwmn/

5) http://www.ncwater.org/gwmb

6) Lautier, Jeff C., 1998, Hydrogeologic Framework and Ground Water Resources of the North Albemarle Region, North Carolina: NC Department of Environment and Natural Resources, Division of Water Resources, 61 p.

7) Status of Virginia's Water Resources, October 2018, A Report on Virginia's Water Resources Management Activities, Virginia Department of Environmental Quality, Commonwealth of Virginia, 49 p.

8) McFarland, E. Randolph and T. Scott Bruce, 2006, The Virginia Coastal Plain Hydrogeologic Framework, U. S. Geological Survey Professional Paper 1731, 119 p.

9) Trapp, Henry, Jr., and Marilee A. Horn, 1997, Ground Water Atlas of the United States, Hydrologic Investigations Atlas 730-L, Segment 11 Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia: U.S. Geological Survey, --p. (https://pubs.usgs.gov/ha/730l/report.pdf).

Appendix A

Figures and Photographs

Figure 1. During 2020-2021, three wells were installed at DF Walker Elementary School with USGS funds (G19AC00280) and two wells were installed at Chinquapin Elementary School with NC DWR matching funds. These wells are now included in the National Ground-Water Monitoring Network (NGWMN).

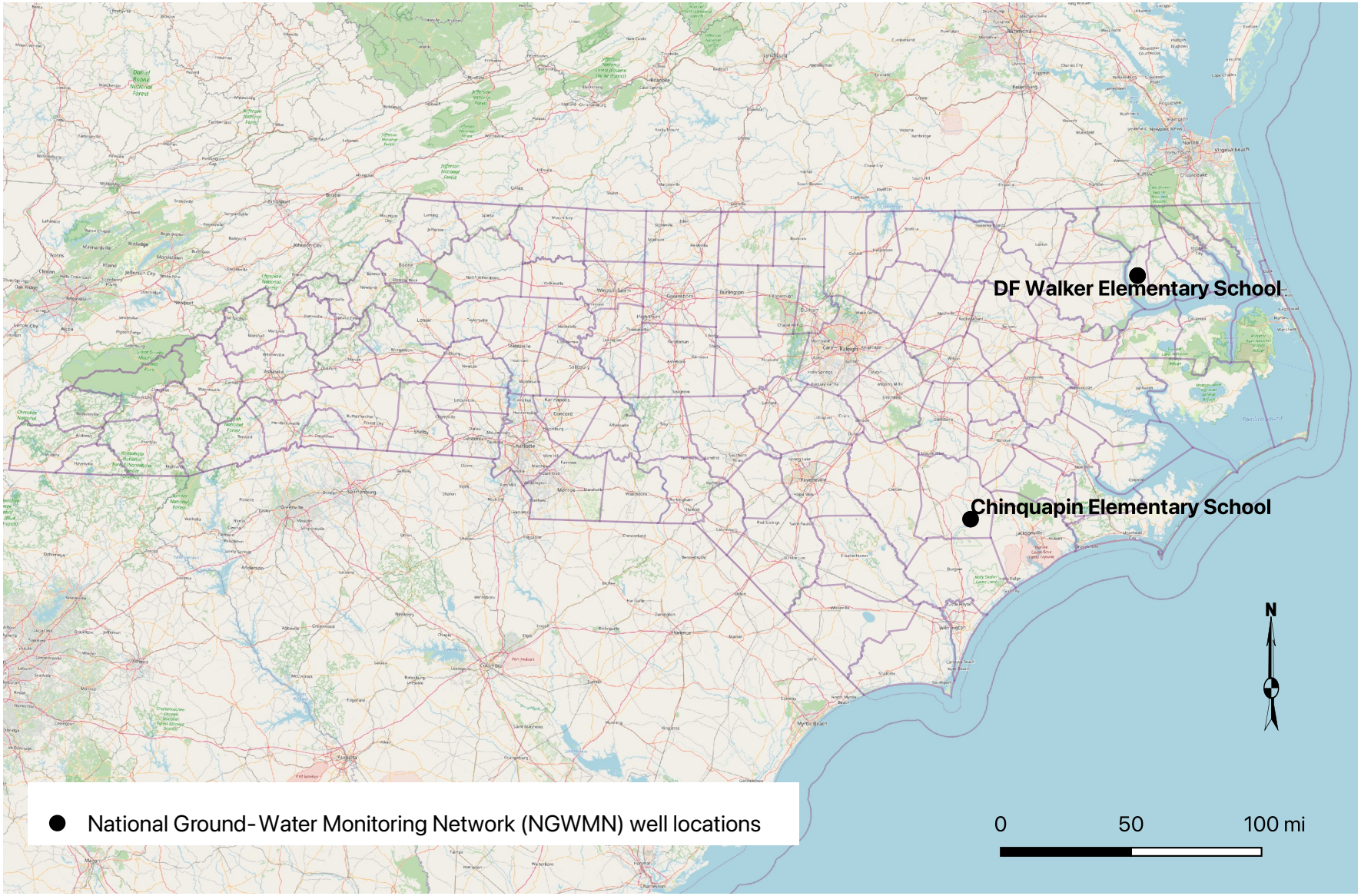


Figure 2. Inset map showing NC DWR well stations in the Albemarle-Tidewater area of northeastern North Carolina. Well stations installed with NGWMN funds include Merchants Millpond State Park,Shingle Landing, and DF Walker School.

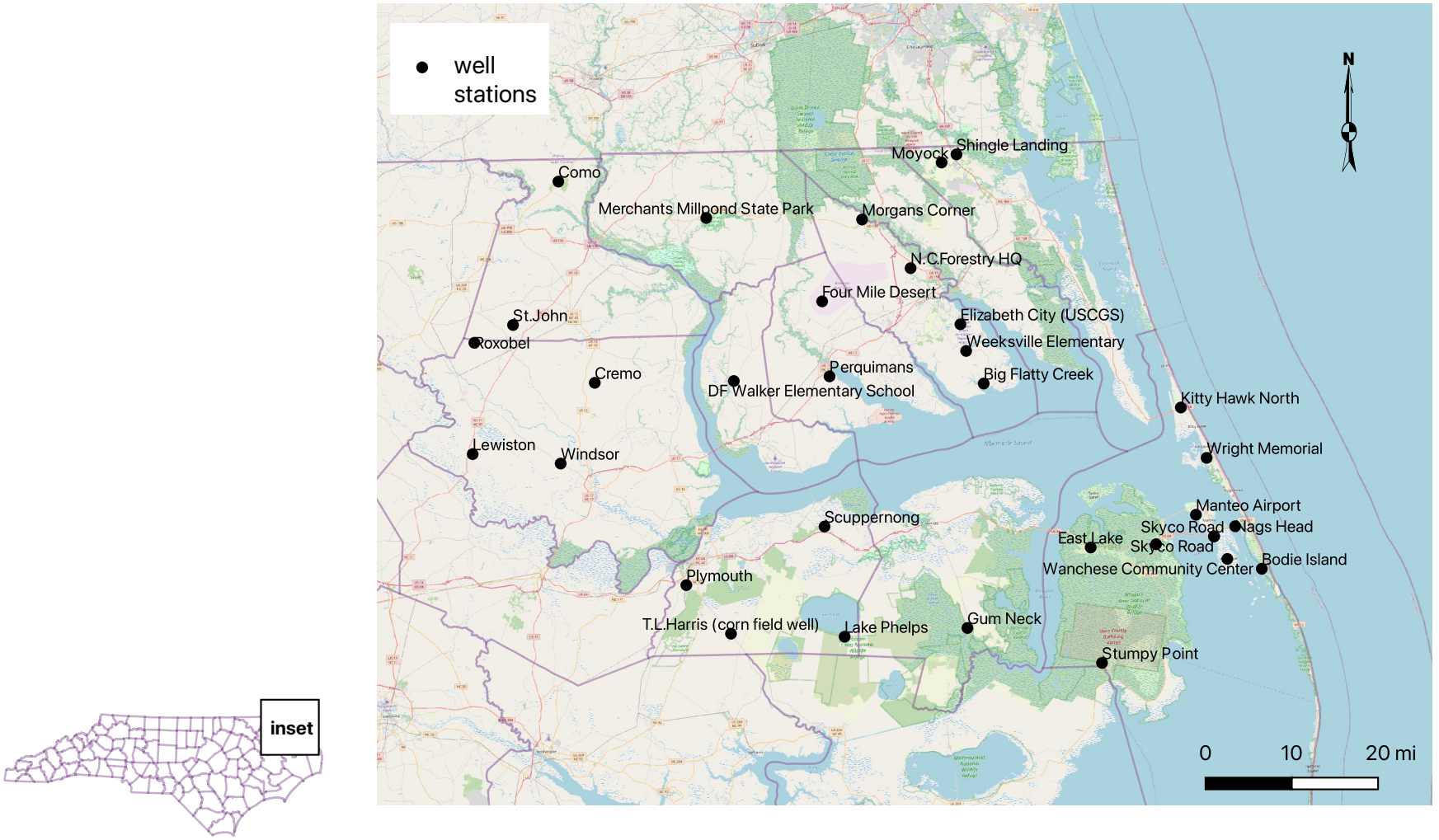


Figure 3.

DWR Geophysical Log Database Detail for G 15E, DF Walker Elementary School

Field	Data
County	Chowan
Latitude	36.165368
Longitude	-76.650354
Location Accuracy Show Map	GPS
Quad link to framework & wells	G 15E
Land Surface	37.94
Dates	06/16/2021
Source	DWR

click on each log chart to access complete log

log legend

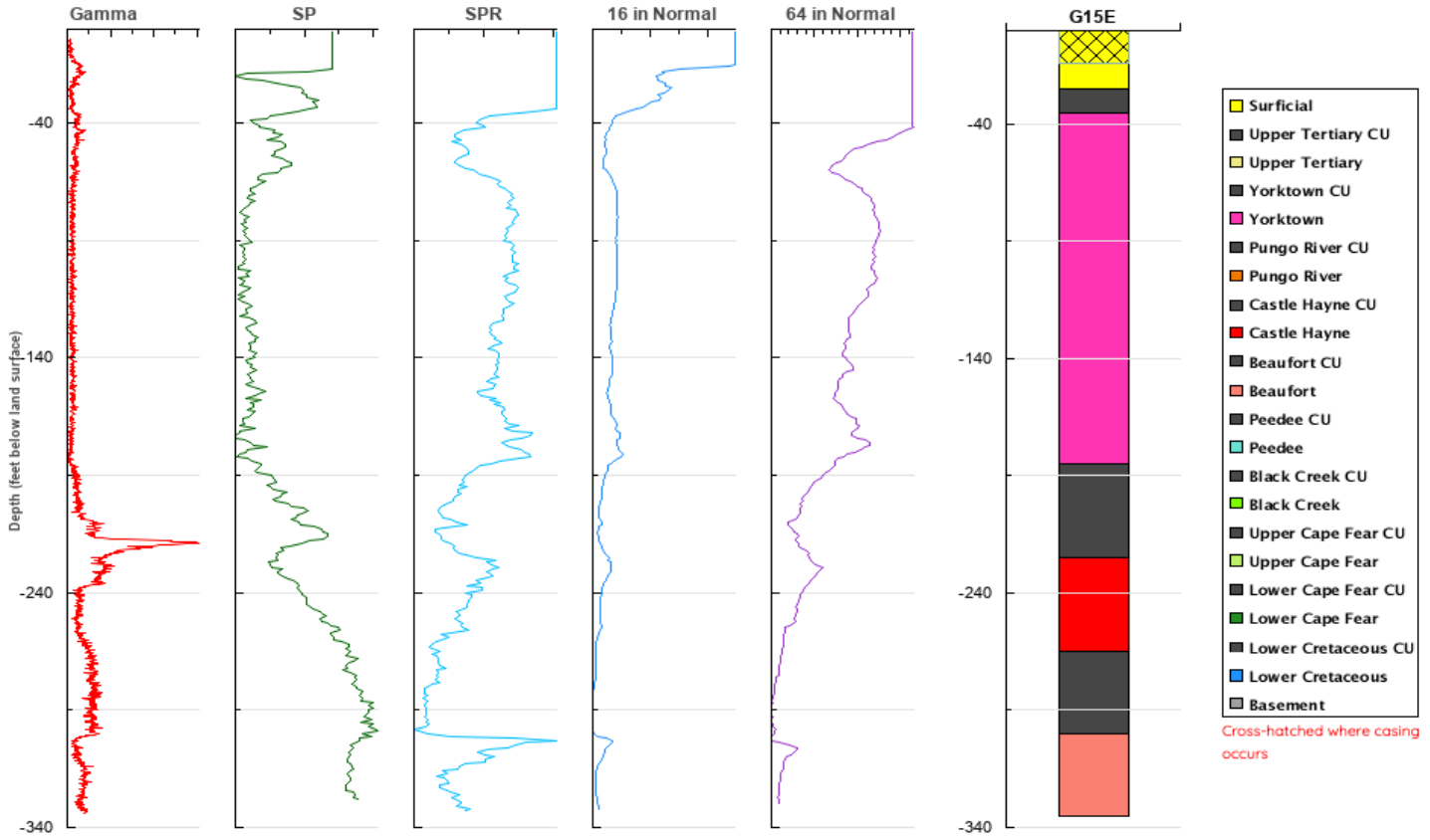


Figure 4. Lithologic Log

Quad	**G 15E**
Well Name	**DF Walker School**
County	**Chowan**
Lat	**36.165500**
Lon	**76.650500**
Driller	**Toano Well and Pump Service Inc.**
Log	**Toano Well and Pump Service Inc.**
TD (ft)	**335**
Elevation (ft)	**37 +- (37.94)**

Depth (ft)			Lithology	Lithologic Description	Color	Munsell Color	Formation Top	Well, TD, aquif, csg, scr
0	-	15	SAND	loose	dk yel brn	10 YR 4/2	S @ land surf	surficial well (TD 30)
15	-	25	SILT and CLAY		ol gy	5Y 4/1		4" pvc scr (17-27)
25	-	35	SAND	vc sd with silt, loose	med gy	N4		
35	-	170	SAND with silt	vc sd with silt, friable to loose, calc cmt, abun shell frags, occ pyr and lig, i/b slt and cly	ol gy	5GY 4/1	Ty at 35'	
170	-	185	SANDY LIMESTONE	sdy ls or limey sst with cly, slt, and abun shell frags (basal Yorktown)	"	"		Ty/Tch well (TD 195)
185	-	237	CLAY	calc cly; abun i/b shell frags beginning at 219; fish vertabrae and shark teeth at 220-230	"	"		4" ss scr (175-185)
				with drill chatter and high gamma spike at 227.	"	"	Tch @ 225' +- per geophysical log	
237	-	270	SILT	calc silt with abun loose vf and coarser i/b qtz sd and vf black specks	"	"	Tch/Tb boundary unclear based on cuttings;	
270	-	300	CLAY	calc cly with first occurrence of abun globular glauc (assumed glauc and not phosphate	"	"		Tch not screened due to
				because of low gamma response)	"	"		drill cost increase
300	-	335	LIMESTONE	sdy ls or limey sst, hd, with abun globular, black, vitreous-subvitreous glauc and abun	yel gy to lt ol brn	5Y 7/2, 5Y 5/6	Tb @ 265'	Tb well (TD 335)
				shell frags; hd band at 305; wh to yel gy from 300-310;				14 ft outer csg (10")
				becoming lt ol brn as depth increases; note significant color change at top of interval				4" ss scr (300-310)

Comments:

log describes bulk lithology and color when wet

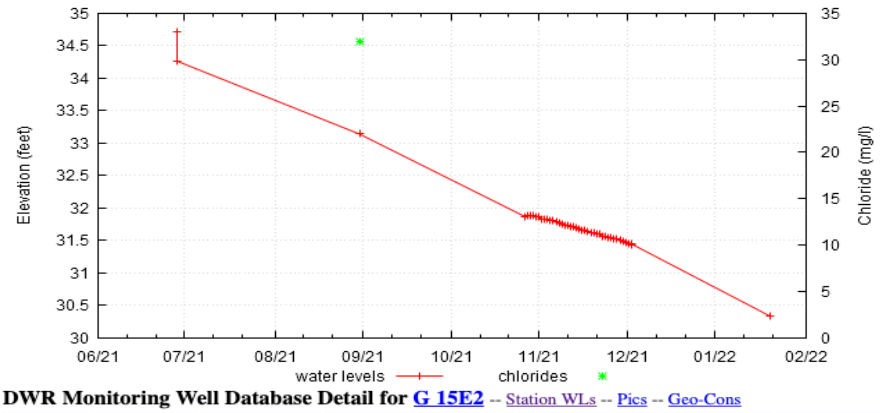
csg grouted with
bentonite (not cmt)

Ty=Yorktown
Tch=Castle Hayne
Tb=Beaufort

Figure 5. Well Hydrograps for DF Walker School

DWR Monitoring Well Database Detail for G 15E3 -- Station WLs -- Pics -- Geo-Cons

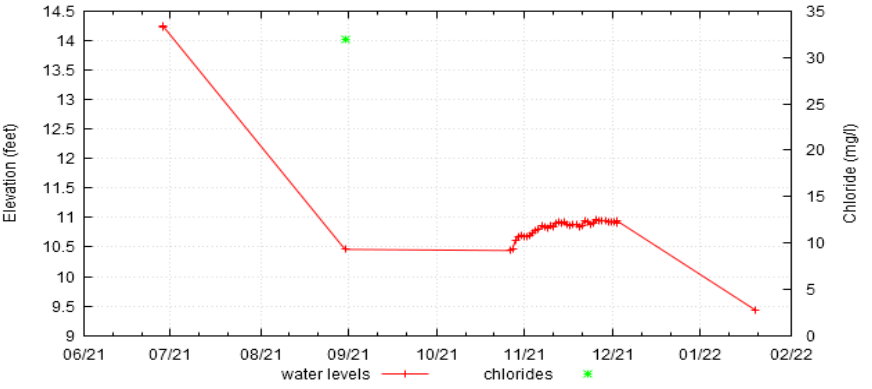
HEADER	REDUCERS	CHLORIDES	WATER LEVELS	STS	RECORDERS	LAND OWNER	MONITORING
	0 reducers	1 samples download chlorides	43 water levels download water levels		Hobo30	susceptibility 2	installed 2021-06-29



Field	Data
County	Chowan
Quad Show Map	G 15E3
Name	DF Walker Elementary School DF Walker Elementary School.pdf
USGS Netname	
USGS ID	
Region	5
Latitude	36.165368
Longitude	-76.650354
Location Accuracy	G
Aquifer	S
Land Surface NED elevation = 37.94 feet	37.94
Measuring Point	0.00
Date Constructed	06/24/2021
Diameter	4
Outer Protective Casing Diameter	6
Depth	30
Casing Material	PVC
Top of Screen	17
Bottom of Screen	27

DWR Monitoring Well Database Detail for G 15E2 -- Station WLs -- Pics -- Geo-Cons

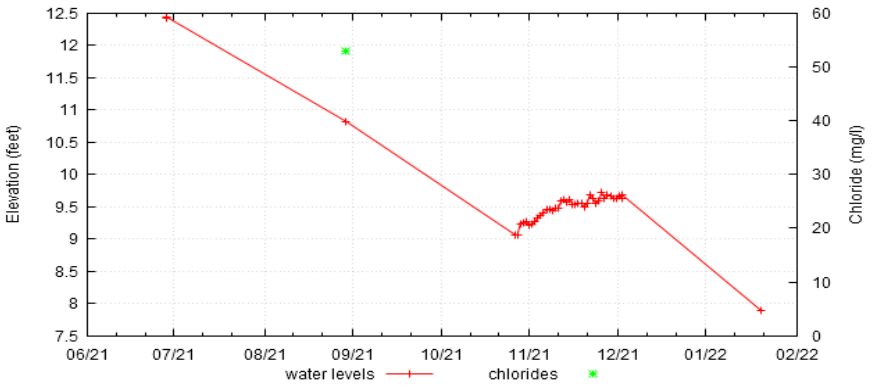
HEADER	REDUCERS	CHLORIDES	WATER LEVELS	STS	RECORDERS	LAND OWNER	MONITORING
	0 reducers	1 samples download chlorides	43 water levels download water levels		Hobo30	susceptibility 2	installed 2021-06-29



Field	Data
County	Chowan
Quad Show Map	G 15E2
Name	DF Walker Elementary School DF Walker Elementary School.pdf
USGS Netname	
USGS ID	
Region	5
Latitude	36.165368
Longitude	-76.650354
Location Accuracy	G
Aquifer	Ty
Land Surface NED elevation = 37.94 feet	37.94
Measuring Point	0.00
Date Constructed	06/23/2021
Diameter	4
Outer Protective Casing Diameter	6
Depth	195
Casing Material	PVC
Top of Screen	175
Bottom of Screen	185

DWR Monitoring Well Database Detail for G 15E1 -- Station WLs -- Pics -- Geo-Cons

HEADER	REDUCERS	CHLORIDES	WATER LEVELS	STS	RECORDERS	LAND OWNER	MONITORING
	0 reducers	1 samples download chlorides	43 water levels download water levels		Hobo30, Hobo13	susceptibility 2	installed 2021-06-29



Field	Data
County	Chowan
Quad Show Map	G 15E1
Name	DF Walker Elementary School DF Walker Elementary School.pdf
USGS Netname	
USGS ID	
Region	5
Latitude	36.165368
Longitude	-76.650354
Location Accuracy	G
Aquifer	Tb
Land Surface NED elevation = 37.94 feet	37.94
Measuring Point	0.00
Date Constructed	06/17/2021
Diameter	4
Outer Protective Casing Diameter	6
Depth	325
Casing Material	PVC
Top of Screen	300
Bottom of Screen	310

Figure 6. Potentiometric Surface and Extent of the Yorktown Aquifer

Figure 7. Potentiometric Surface and Extent of the Castle Hayne Aquifer

Figure 8. Potentiometric Surface and Extent of the Beaufort Aquifer

Photo 1. Aerial view of D. F. Walker Elementary School. The three monitoring wells are located on the east side of the property in the area marked by the yellow pin.

Photo 2. The three monitoring wells at D. F. Walker Elementary School.

Appendix B

Tables

Table 1. List of Wells

NGWMN ID	Name	County	Funding Source	Elevation (ft)	Depth (ft)	Screen Top (ft)	Screen Bottom (ft)	NC Aquifer Code	NC Aquifer Name	VA Aquifer Name	Principal Aquifer Code	National Aquifer Code	Principal Aquifer System	Well Replaced and Gap Filled	NGWMN Well Replaced	Well Cost per Foot	Average Well Cost	Latest Water Level (ft)	Water Level Date	Chloride (ppm)	Chloride Date	Latitude	Longitude
NCDWR:G15E3	DF Walker Elementary School	Chowan	USGS G19AC00280	37.94	30	17	27	S	Surficial	Surficial	S	S100SURFCL	Surficial	Filled S gap in county	None	$104.85	$3,145.42	7.61	1/20/22	53	8/30/21	36.165368	-76.650354
NCDWR:G15E2	DF Walker Elementary School	Chowan	USGS G19AC00280	37.94	195	175	185	Ty	Yorktown	Yorktown-Eastover	NACP	S100NATLCP	Northern Atlantic Coastal Plain	Filled Ty gap in county	None	$104.85	$20,445.22	28.51	1/20/22	<32	8/31/21	36.165368	-76.650354
NCDWR:G15E1	DF Walker Elementary School	Chowan	USGS G19AC00280	37.94	325	300	310	Tb	Beaufort	Aquia	NACP	S100NATLCP	Northern Atlantic Coastal Plain	Filled Tb gap in county	None	$104.85	$34,075.36	30.05	1/20/22	<32	8/31/21	36.165368	-76.650354
Total					550												$57,666.00						
NCDWR:W29D11	Chinquapin Elementary School	Duplin	NC DWR match	42.44	34	19	29	S	Surficial	Surficial	S	S100SURFCL	Surficial	Replaced failed well	W29D9	$87.57	$2,977.24	7.60	10/26/21	<32	6/10/20	34.82593	-77.816446
NCDWR:W29D12	Chinquapin Elementary School	Duplin	NC DWR match	pending	800	624	644	Klcf	Lower Cape Fear	Potomac	NACP	S100NATLCP	Northern Atlantic Coastal Plain	Filled Klcf gap in county	None	$87.57	$70,052.76	-13.56	10/26/21	211	6/10/20	34.82593	-77.816446
Total					834												$73,030.00						

Notes and abbreviations

ft	water level in feet above or below marked measuring point (typically top of well casing); negative value indicates water level is above marked measuring point
<32	chloride detection limit (part per million, ppm)

Unit drilling costs based on payment invoices as follows:
DF Walker School total cost =$57,666
Chinquapin total cost =$73,030

Appendix C

GW-1 Well Construction Records

WELL CONSTRUCTION RECORD (GW-1)

For Internal Use Only:

1. Well Contractor Information:

Charles N Dozier
Well Contractor Name

4088-A
NC Well Contractor Certification Number

Toano Well and Pump Service Inc
Company Name

2. Well Construction Permit #: _____
List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐ Agricultural
- ☐ Geothermal (Heating/Cooling Supply)
- ☐ Industrial/Commercial
- ☐ Irrigation
- ☐ Municipal/Public
- ☐ Residential Water Supply (single)
- ☐ Residential Water Supply (shared)

Non-Water Supply Well:
- ☒ Monitoring
- ☐ Recovery

Injection Well:
- ☐ Aquifer Recharge
- ☐ Aquifer Storage and Recovery
- ☐ Aquifer Test
- ☐ Experimental Technology
- ☐ Geothermal (Closed Loop)
- ☐ Geothermal (Heating/Cooling Return)
- ☐ Groundwater Remediation
- ☐ Salinity Barrier
- ☐ Stormwater Drainage
- ☐ Subsidence Control
- ☐ Tracer
- ☐ Other (explain under #21 Remarks)

4. Date Well(s) Completed: 06/25/2021 **Well ID#** G15E3

5a. Well Location:

NCDENR
Facility/Owner Name

Facility ID# (if applicable)

125 SANDY RIDGE ROAD, EDENTON, NC 27932
Physical Address, City, and Zip

Chowan
County

Parcel Identification No. (PIN)

5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

36.1653162 N -76.6502900 W

6. Is(are) the well(s): ☒ **Permanent** or ☐ **Temporary**

7. Is this a repair to an existing well: ☐ **Yes** or ☒ **No**
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. For Geoprobe/DPT or Closed-Loop Geothermal Wells having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled: _____

9. Total well depth below land surface: 30 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: 3 (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

12. Well construction method: Mud Rotary
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) _____ **Method of test:** _____

13b. Disinfection type: _____ **Amount:** _____

14. WATER ZONES

FROM	TO	DESCRIPTION
20 ft.	30 ft.	Sand
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2.5 ft.	20 ft.	4 in.	SDR17	PVC
ft.	ft.	in.		

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
20 ft.	30 ft.	4 in.	0.020		PVC
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
15 ft.	0 ft.	Hole Plug	Pour from top shaking pipe and probing with tremmi
ft.	ft.		
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
30 ft.	15 ft.	#3 Silica sand	Tremmie
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
0 ft.	10 ft.	Orange Sand
10 ft.	30 ft.	Blue Clay with sand and shell
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor

07/14/2021
Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTRUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

WELL CONSTRUCTION RECORD (GW-1)

For Internal Use Only:

1. Well Contractor Information:

Charles N Dozier
Well Contractor Name

4088-A
NC Well Contractor Certification Number

Toano Well and Pump Service Inc
Company Name

2. Well Construction Permit #: _____
List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐ Agricultural
- ☐ Geothermal (Heating/Cooling Supply)
- ☐ Industrial/Commercial
- ☐ Irrigation
- ☐ Municipal/Public
- ☐ Residential Water Supply (single)
- ☐ Residential Water Supply (shared)

Non-Water Supply Well:
- ☒ Monitoring
- ☐ Recovery

Injection Well:
- ☐ Aquifer Recharge
- ☐ Aquifer Storage and Recovery
- ☐ Aquifer Test
- ☐ Experimental Technology
- ☐ Geothermal (Closed Loop)
- ☐ Geothermal (Heating/Cooling Return)
- ☐ Groundwater Remediation
- ☐ Salinity Barrier
- ☐ Stormwater Drainage
- ☐ Subsidence Control
- ☐ Tracer
- ☐ Other (explain under #21 Remarks)

4. Date Well(s) Completed: 06/25/2021 **Well ID#** G15E2

5a. Well Location:

NCDENR
Facility/Owner Name

Facility ID# (if applicable)

125 SANDY RIDGE ROAD, EDENTON, NC 27932
Physical Address, City, and Zip

Chowan
County

Parcel Identification No. (PIN)

5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

36.1653706 N -76.6503383 W

6. Is(are) the well(s): ☒ **Permanent** or ☐ **Temporary**

7. Is this a repair to an existing well: ☐ **Yes** or ☒ **No**
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. **For Geoprobe/DPT or Closed-Loop Geothermal Wells** having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled: _____

9. Total well depth below land surface: 195 **(ft.)**
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: _____ **(ft.)**
If water level is above casing, use "+"

11. Borehole diameter: 10 **(in.)**

12. Well construction method: Mud Rotary
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) _____ **Method of test:** _____

13b. Disinfection type: _____ **Amount:** _____

14. WATER ZONES

FROM	TO	DESCRIPTION
180 ft.	192 ft.	Sand
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
ft.	ft.	in.		

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2.5 ft.	180 ft.	4 in.	SDR17	PVC
190 ft.	195 ft.	4 in.	SCH 40	Stainless Steel

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
180 ft.	190 ft.	4 in.	0.020		Stainless Steel
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
175 ft.	0 ft.	Well Grout DF	Tremmie
ft.	ft.		
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
195 ft.	175 ft.	#3 Silica sand	Tremmie
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
ft.	ft.	SEE ATTACHED DRILL LOG
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	

21. REMARKS

22. Certification:

Signature of Certified Well Contractor

07/14/2021
Date

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTRUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

ADDITIONAL DRILL LOG:
Well Construction Permit #: G15E2
D.F. WALKER ELEMENTARY SCHOOL
125 Sandy Ridge Road
Edenton, NC 27932

FROM:		TO:		DESCRIPTION
0	FEET	10	FEET	ORANGE SAND
10	FEET	30	FEET	BLUE CLAY, SHELLS AND SAND MIX
30	FEET	40	FEET	BLUE AND BROWN CLAY
40	FEET	50	FEET	GREEN CLAY WITH SAND AND SHELL
50	FEET	60	FEET	BLUE CLAY WITH SAND AND SHELL
60	FEET	80	FEET	SHELL AND SAND
80	FEET	90	FEET	CEMENTED FORMATION
90	FEET	100	FEET	SHELL MATERIAL
100	FEET	110	FEET	HRD ROCK AND SHELL FORMATION
110	FEET	120	FEET	SHELLS AND SAND
120	FEET	130	FEET	GREEN CLAY, SHELLS AND SAND
130	FEET	140	FEET	GREEN CLAY, SHELLS AND SAND
140	FEET	150	FEET	SHELL AND BLACK SAND
150	FEET	160	FEET	BLUE CALY, SHELLS AND SAND
160	FEET	170	FEET	BLUE CLAY, SHELLS AND SAND MIX
170	FEET	180	FEET	SAND AND SHELL

WELL CONSTRUCTION RECORD (GW-1)

For Internal Use Only:

1. Well Contractor Information:

Charles N Dozier
Well Contractor Name

4088-A
NC Well Contractor Certification Number

Toano Well and Pump Service Inc
Company Name

2. Well Construction Permit #: G15E1
List all applicable well construction permits (i.e. UIC, County, State, Variance, etc.)

3. Well Use (check well use):

Water Supply Well:
- ☐ Agricultural
- ☐ Geothermal (Heating/Cooling Supply)
- ☐ Industrial/Commercial
- ☐ Irrigation
- ☐ Municipal/Public
- ☐ Residential Water Supply (single)
- ☐ Residential Water Supply (shared)

Non-Water Supply Well:
- ☒ Monitoring
- ☐ Recovery

Injection Well:
- ☐ Aquifer Recharge
- ☐ Aquifer Storage and Recovery
- ☐ Aquifer Test
- ☐ Experimental Technology
- ☐ Geothermal (Closed Loop)
- ☐ Geothermal (Heating/Cooling Return)
- ☐ Groundwater Remediation
- ☐ Salinity Barrier
- ☐ Stormwater Drainage
- ☐ Subsidence Control
- ☐ Tracer
- ☐ Other (explain under #21 Remarks)

4. Date Well(s) Completed: 06/25/2021 **Well ID#** G15E1

5a. Well Location:

NC DENR
Facility/Owner Name

Facility ID# (if applicable)

125 SANDY RIDGE ROAD, EDENTON, NC 27932
Physical Address, City, and Zip

Chowan
County

Parcel Identification No. (PIN)

5b. Latitude and longitude in degrees/minutes/seconds or decimal degrees:
(if well field, one lat/long is sufficient)

36.1655018 N -76.6504171 W

6. Is(are) the well(s): ☒ **Permanent** or ☐ **Temporary**

7. Is this a repair to an existing well: ☐ **Yes** or ☒ **No**
If this is a repair, fill out known well construction information and explain the nature of the repair under #21 remarks section or on the back of this form.

8. **For Geoprobe/DPT or Closed-Loop Geothermal Wells** having the same construction, only 1 GW-1 is needed. Indicate TOTAL NUMBER of wells drilled:

9. Total well depth below land surface: 325 (ft.)
For multiple wells list all depths if different (example- 3@200' and 2@100')

10. Static water level below top of casing: (ft.)
If water level is above casing, use "+"

11. Borehole diameter: 10 (in.)

12. Well construction method: Mud Rortary
(i.e. auger, rotary, cable, direct push, etc.)

FOR WATER SUPPLY WELLS ONLY:

13a. Yield (gpm) **Method of test:**

13b. Disinfection type: **Amount:**

14. WATER ZONES

FROM	TO	DESCRIPTION
ft.	ft.	
ft.	ft.	

15. OUTER CASING (for multi-cased wells) OR LINER (if applicable)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
0 ft.	12 ft.	10 in.	SCH40	PVC

16. INNER CASING OR TUBING (geothermal closed-loop)

FROM	TO	DIAMETER	THICKNESS	MATERIAL
+2.5 ft.	310 ft.	4.5 in.	SDR 17	PVC
320 ft.	325 ft.	4 in.	SCH 40	Stainless Steel

17. SCREEN

FROM	TO	DIAMETER	SLOT SIZE	THICKNESS	MATERIAL
310 ft.	320 ft.	4 in.	0.020		Stainless Steel
ft.	ft.	in.			

18. GROUT

FROM	TO	MATERIAL	EMPLACEMENT METHOD & AMOUNT
305 ft.	0 ft.	WEll Grout DF	Tremme
ft.	ft.		
ft.	ft.		

19. SAND/GRAVEL PACK (if applicable)

FROM	TO	MATERIAL	EMPLACEMENT METHOD
330 ft.	305 ft.	#3 Silica sand	Tremmie
ft.	ft.		

20. DRILLING LOG (attach additional sheets if necessary)

FROM	TO	DESCRIPTION (color, hardness, soil/rock type, grain size, etc.)
ft.	ft.	SEE ATTACHED DRILL LOG
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	
ft.	ft.	

21. REMARKS

Surface Observation Well for NCDENR

22. Certification:

Signature of Certified Well Contractor — Date: 07/14/2021

By signing this form, I hereby certify that the well(s) was (were) constructed in accordance with 15A NCAC 02C .0100 or 15A NCAC 02C .0200 Well Construction Standards and that a copy of this record has been provided to the well owner.

23. Site diagram or additional well details:
You may use the back of this page to provide additional well site details or well construction details. You may also attach additional pages if necessary.

SUBMITTAL INSTRUCTIONS

24a. For All Wells: Submit this form within 30 days of completion of well construction to the following:

Division of Water Resources, Information Processing Unit,
1617 Mail Service Center, Raleigh, NC 27699-1617

24b. For Injection Wells: In addition to sending the form to the address in 24a above, also submit one copy of this form within 30 days of completion of well construction to the following:

Division of Water Resources, Underground Injection Control Program,
1636 Mail Service Center, Raleigh, NC 27699-1636

24c. For Water Supply & Injection Wells: In addition to sending the form to the address(es) above, also submit one copy of this form within 30 days of completion of well construction to the county health department of the county where constructed.

ADDITIONAL DRILL LOG:
Well Construction Permit #: G15E1
D.F. WALKER ELEMENTARY SCHOOL
125 Sandy Ridge Road
Edenton, NC 27932

FROM:		TO:		DESCRIPTION
0	FEET	10	FEET	ORANGE SAND
10	FEET	30	FEET	BLUE CLAY, SHELLS AND SAND MIX
30	FEET	40	FEET	BLUE AND BROWN CLAY
40	FEET	50	FEET	GREEN CLAY WITH SAND AND SHELL
50	FEET	60	FEET	BLUE CLAY WITH SAND AND SHELL
60	FEET	80	FEET	SHELL AND SAND
80	FEET	90	FEET	CEMENTED FORMATION
90	FEET	100	FEET	SHELL MATERIAL
100	FEET	110	FEET	HRD ROCK AND SHELL FORMATION
110	FEET	120	FEET	SHELLS AND SAND
120	FEET	130	FEET	GREEN CLAY, SHELLS AND SAND
130	FEET	140	FEET	GREEN CLAY, SHELLS AND SAND
140	FEET	150	FEET	SHELL AND BLACK SAND
150	FEET	160	FEET	BLUE CALY, SHELLS AND SAND
160	FEET	170	FEET	BLUE CLAY, SHELLS AND SAND MIX
170	FEET	180	FEET	SAND AND SHELL
180	FEET	190	FEET	LIMESTONE ROCK
190	FEET	200	FEET	GREEN CLAY
200	FEET	210	FEET	GREEN CLAY
210	FEET	220	FEET	GREEN SILTY CLAY
220	FEET	230	FEET	GREEN SILTY CLAY
230	FEET	240	FEET	SILTY CLAY AND SHELL MIX
240	FEET	260	FEET	GREEN SILT AND SHELL
260	FEET	270	FEET	BLUE AND GREEN CLAY
270	FEET	300	FEET	BLACK SAND
300	FEET	310	FEET	SAND AND SHELL
310	FEET	330	FEET	BROWN SHELL

Appendix D

Data Management Plan

NC DWR Data Management Plan

Effective: January 1, 2022

Project: All DWR Operations and DWR-USGS Cooperative Agreements for the National Ground-Water Monitoring Network (NGWMN)

Contacts: USGS
Daryll Pope, Tel (804) 261-2630/(609) 462-7119, dpope@usgs.gov
Candice Hopkins, Tel (208) 387-1331, chopkins@usgs.gov

NC DWR
Mark Durway, (919) 707-9018, mark.durway@ncdenr.gov
Susan Laughinghouse, (252) 229-3349, susan.laughinghouse@ncdenr.gov

Budget: State and USGS Funding Sources

Types of Data Collected

Four data types are routinely collected by the NC DWR Groundwater Management Branch (GWMB). These data types consist of groundwater levels, groundwater quality analyses, well drilling data, and locational data. Currently, NC DWR provides persistent data to the NGWMN from over 600 wells. Nine USGS Principal Aquifers located in the North Carolina coastal plain, piedmont, and mountains are monitored by these wells.

Groundwater levels will be acquired hourly or at other regular intervals, validated, and downloaded to the appropriate NC DWR database. Water quality data will be collected at less frequent intervals and will consist primarily of chloride concentrations from discrete depth intervals within the aquifer.

Drilling data consisting of lithology, geophysical logs, and well construction specifications will be acquired during the drilling and well completion process. Lithology will be determined from rock cuttings collected at 10 ft intervals during well drilling. Lithologic data and well specifications including total depth, casing and screen dimensions, and other information will be used to produce a drilling log once the well has been completed. The geology of the well will be further evaluated after the well has been drilled to total depth using open-hole geophysical logging techniques. The geophysical data will be used to produce the following geophysical logs: gamma, spontaneous potential (SP), single-point resistivity (SPR), 16" normal resistivity, 64" normal resistivity. Lithologic descriptions, geophysical logging, drilling, and well completion will be overseen by a geologist and drilling will be performed by a certified well contractor in accordance with state requirements.

Accuracy of locational data will be accomplished using survey grade GPS equipment to determine latitude, longitude, and altitude. Accuracy and geodetic reference systems used by NC DWR are state plane coordinates and latitude/longitude (<0.05 ft), altitude (<0.1 ft), horizontal datum (NAD83), and altitude datum (NAVD88).

Data and Metadata Standards

NC DWR stores data in the following databases:

Data Type	Database Tables
Groundwater Levels	gwb.dwr, gwb.dwrwatlev, gwb.dwrwatlevhourly
Groundwater Quality	gwb.dwrchloride
Well Logs	gwb.logs, gwb.logdata, gwb.resstafr
Location, Latitude/Longitude, Altitude	gwb.dwr

The NC DWR groundwater monitoring network uses the MariaDB database management platform. This platform is supported by branch and division level IT staff. The NC DWR Groundwater Monitoring Branch website is hosted by Apache web server. Internal database tables are used to maintain database quality control and allow for editing. Water level data meeting standards are unloaded to public tables listed above.

Policies for Access and Sharing

Project data collected will be available through the NGWMN Data Portal without restriction.

Policies and Provisions for Re-Use and Re-Distribution

There will be restriction on the use of the data through the portal. Any data obtained through the portal and redistributed is expected to cite the original source of the data as NC DWR through this USGS/NGWMN Cooperative.

Plans for Archiving and Preservation of Access

Paper copies of field data will be scanned and stored by NC DWR and will be included in regular system backups. This data and all databases will be backed up at least weekly.

Project Personnel and Qualifications

GWMB staff oversee project management, supervision and administration, procurement, data collection and analysis, and reporting. Project staff and their qualifications are:

Mark Durway, PG, NC DWR GWMB Hydrogeologist
Susan Laughinghouse, PG, NC DWR GWMB Monitoring Unit Head
Kevin McVerry, NC DWR GWMB Environmental Specialist
Nathaniel C. Wilson, PG (Retired/Consultant), Former Head, NC DWR GWMB

Mark Durway is a licensed geologist in NC and Louisiana and has BS and MS degrees in geology from Guilford College and NCSU. He has oil and gas experience with Core Laboratories and Halliburton, regulatory and resource management experience with the NC Superfund Program, Petroleum UST Program and Division of Water Resources, and private sector experience as an environmental consultant. His current position as GWMB hydrogeologist includes all aspects of data review and interpretation, groundwater use and availability studies, drilling oversight, grant and contract procurement, and reporting.

Susan Laughinghouse is a licensed geologist in NC and has BS degree in geology from East Carolina University. She has regulatory and resource management experience with the NC Division of Water Resources, and private sector experience as an environmental consultant. Her current position as GWMB Monitoring Unit Head includes all aspects of operation and maintenance of the state well network, data collection and entry, well procurement and drilling contracts, access agreements and reporting, and staff supervision.

Kevin McVerry is an Environmental Specialist with a BA in geology from NCSU. He has regulatory and resource management experience with the NC Division of Water Resources and the NC Division of Coastal Management, and private sector experience as an environmental consultant. His current position as GWMB geologist/hydrogeologic field technician involves all aspects of well network maintenance and data collection and serving as team leader on special projects.

Nat Wilson, PG, is a licensed geologist and has BS and MS degrees in geology from Middlebury College and University of Oregon. His qualifications include a combination of education, licensing, and experience in the fields of geology, hydrology, computer programming, and data analysis. He served as GWMB Branch Head for 20 years during which time he created the existing map interface, website, and numerous applications and tables which define the state Groundwater Management Branch. He has over 20 years of experience developing complex groundwater database programs and websites. He retired from DWR in December 2020 after a total of 34 years with the state and currently works as an independent consultant.