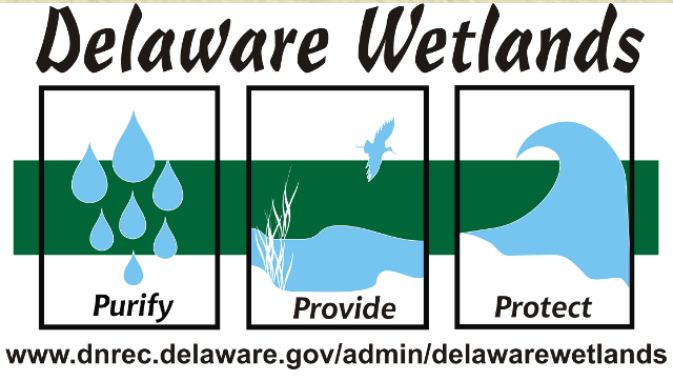
A Web-based Mapping System for the Delivery of Hydrogeologic Data



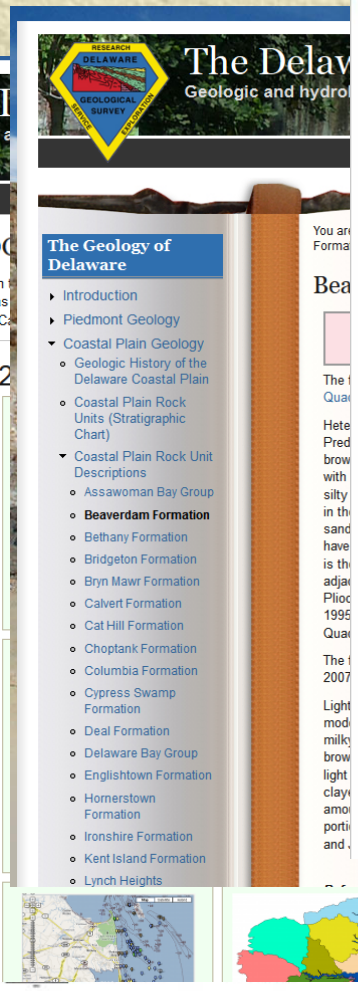
John Callahan, Scott Andres
Delaware Geological Survey
February 29, 2012

Currently at DGS…

Pubs

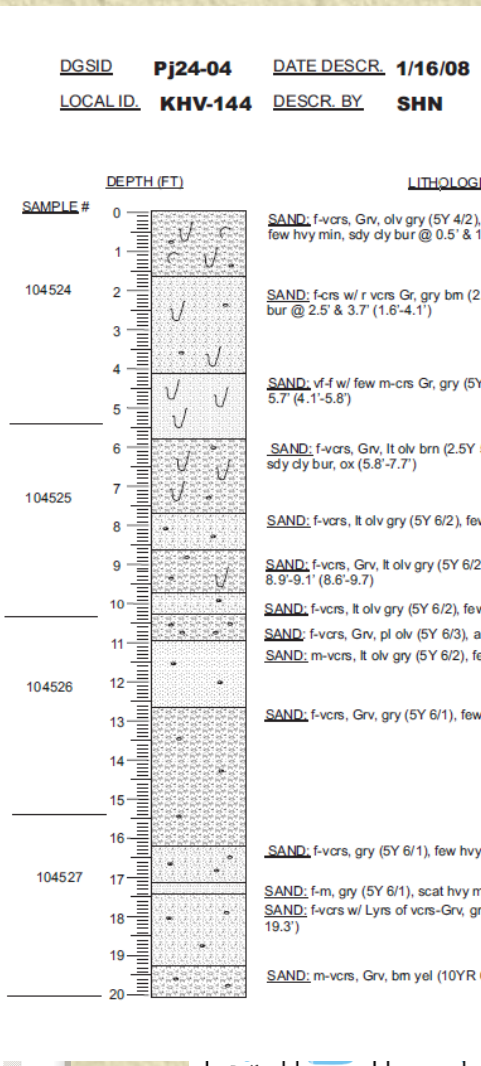
Datasets

Descriptions



Water Conditions

Logs



Project Summary

- Several existing and proposed regulations and ordinances cite DGS resources for preparation of development plans and permit applications

- Some agencies and consulting firms contact DGS and use our data; some don't.

- Consolidating access to DGS resources could facilitate the preparation and review (DNREC) of applications.

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Project Summary

- To deliver, via the web, the most commonly used geologic and hydrologic data released by DGS…

  ...and a few other non-DGS datasets relevant to groundwater and surface water (watersheds, wetlands, NHD, WHPA)

- Funded by DNREC Water Supply Section

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Example Applications

- How much groundwater is there – determine storage, flow and direction
- Where is the water – depths to confined aquifers and the water table
- What is the geology like – lithology and geophysical logs
- What is the permeability/hydraulic conductivity of the near surface layer – recharge

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So, What's the Plan?

1. Gather relevant datasets together
2. Ask people what they need
3. Digitize/Database hard-copy data (lithologic logs)
4. Develop map-based web portal
5. Ask users for feedback
6. Refine code and display/reporting methods
7. GOTO 5

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Needs Assessment Meetings

- Two initial meetings with State agency staff.
  - plus emails, phone calls with other groups
- Overall, very positive response.
- Data is more important than visualization!
- People are looking forward to a consistent and concise data reporting mechanism.

- Datasets prioritized

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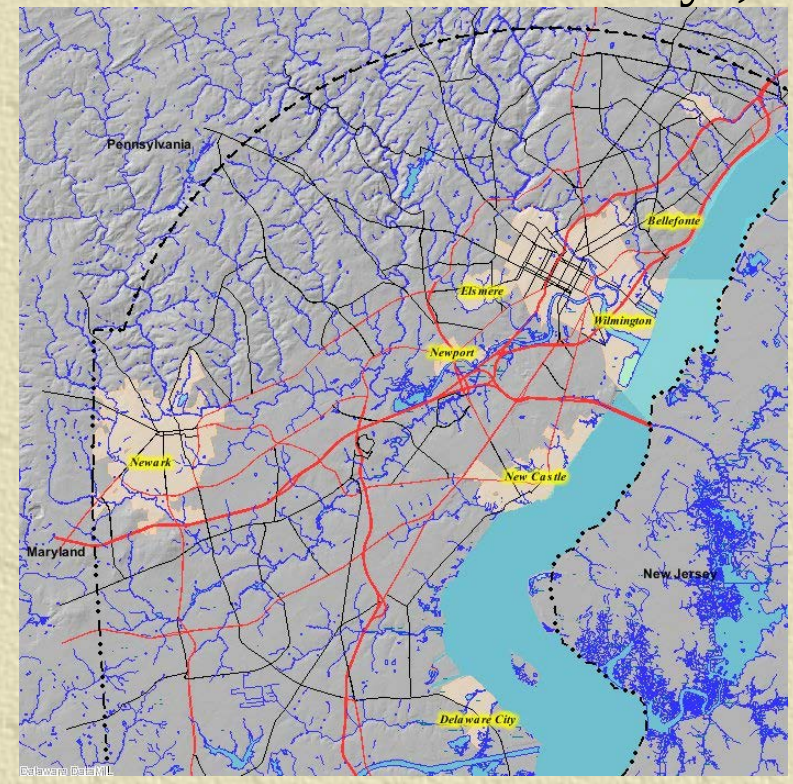
Datasets – Level 1

- Delaware Basemap
  - Google Maps (Terrain and Satellite)
  - DataMIL Waterways, Roads, DEM



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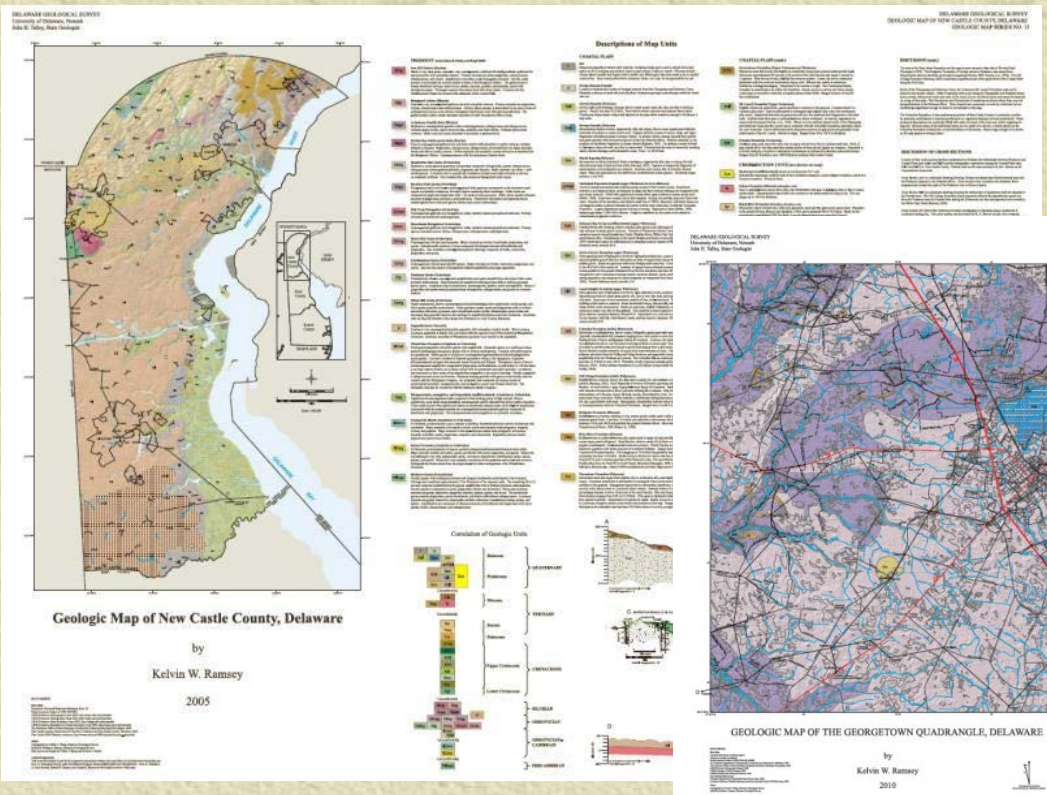
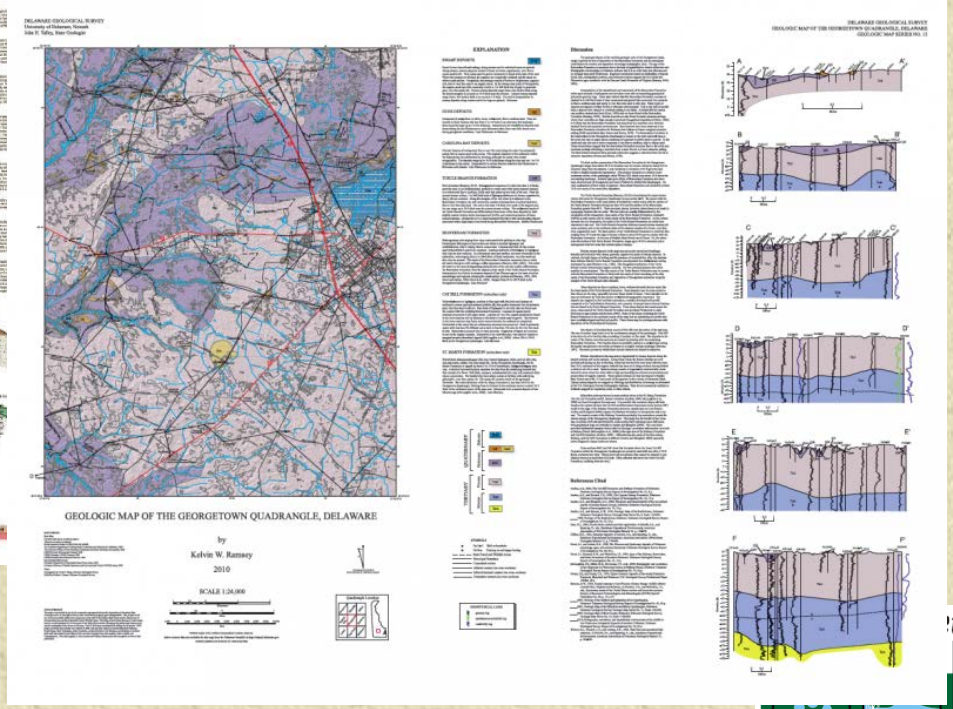
Datasets – Level 1

- DGS Surficial Geologic Map Series





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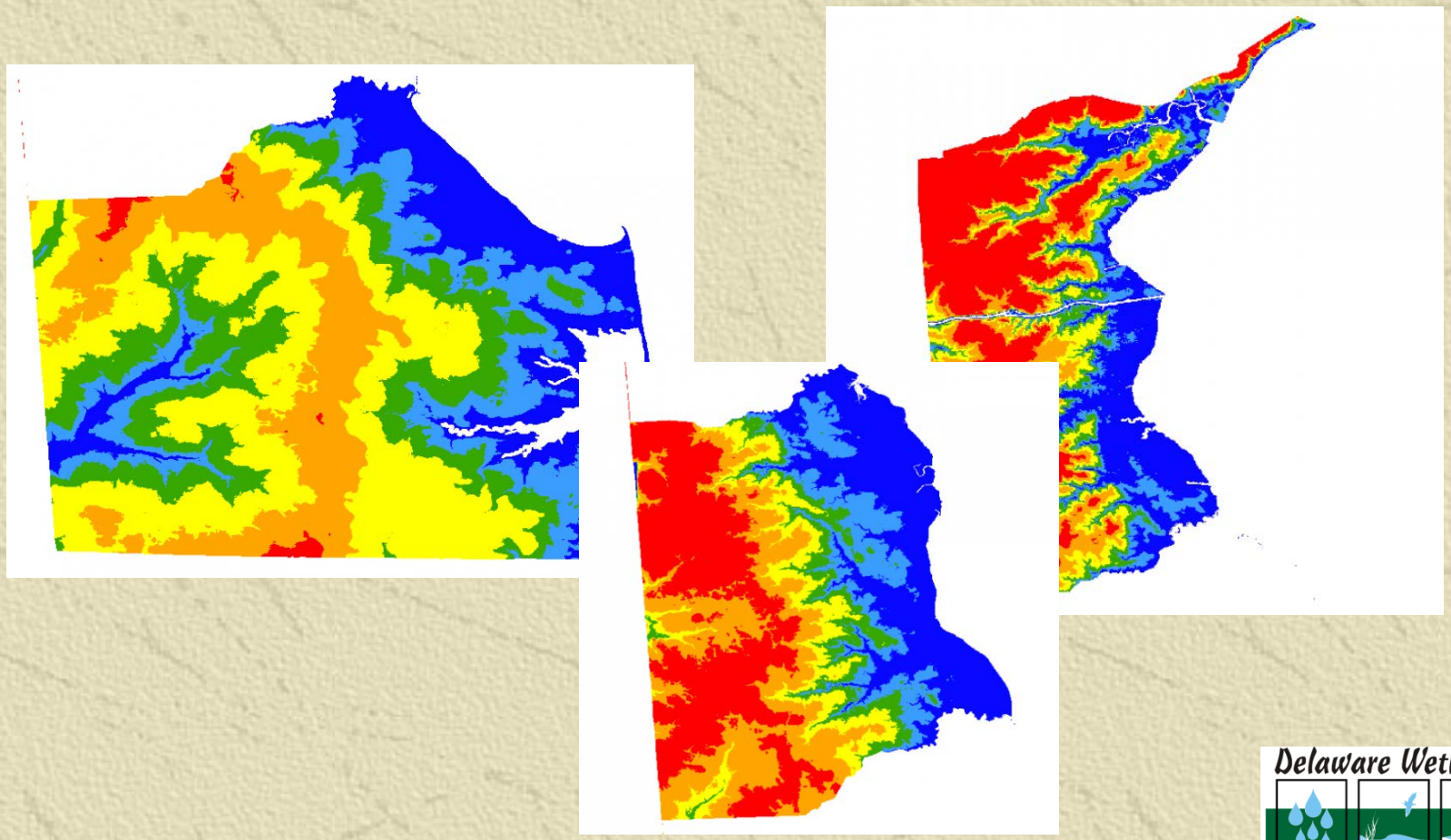
Datasets – Level 1

- County Water Table Grids (Depth to Water)



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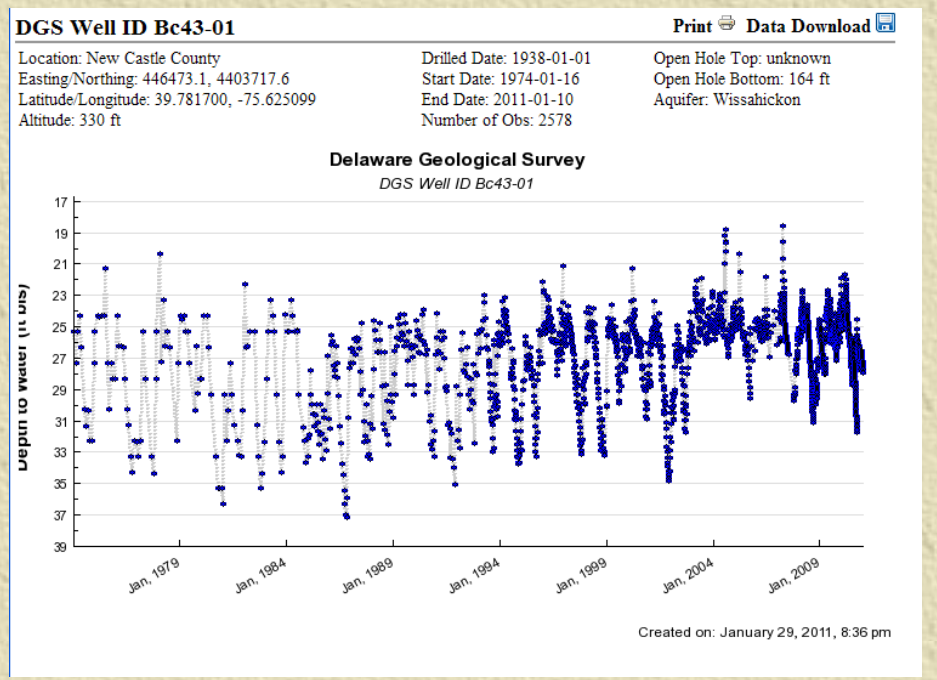
Datasets – Level 1

- Well Locations
  and Hydrographs



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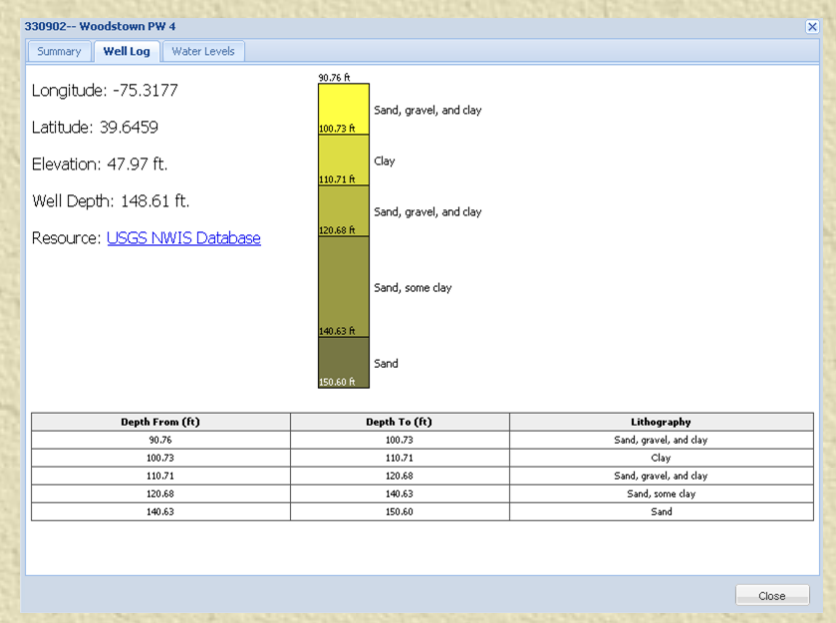
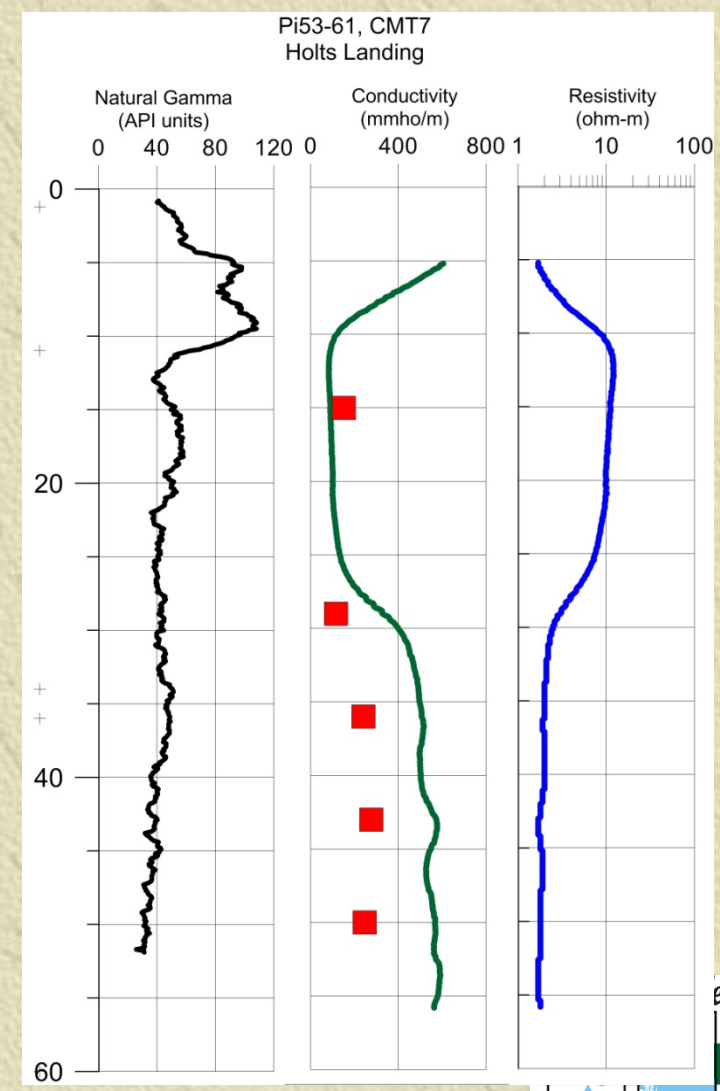
Datasets – Level 1

- Geophysical logs
- Lithologic Descriptive logs



Depth From (ft)	Depth To (ft)	Lithography
90.76	100.73	Sand, gravel, and clay
100.73	110.71	Clay
110.71	120.68	Sand, gravel, and clay
120.68	140.63	Sand, some clay
140.63	150.60	Sand



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Datasets – Level 1

- Kent and Sussex County Recharge Potential

(DGS Publication RI66)

- New Castle County Recharge RPAs

(UD Water Resource Agency)

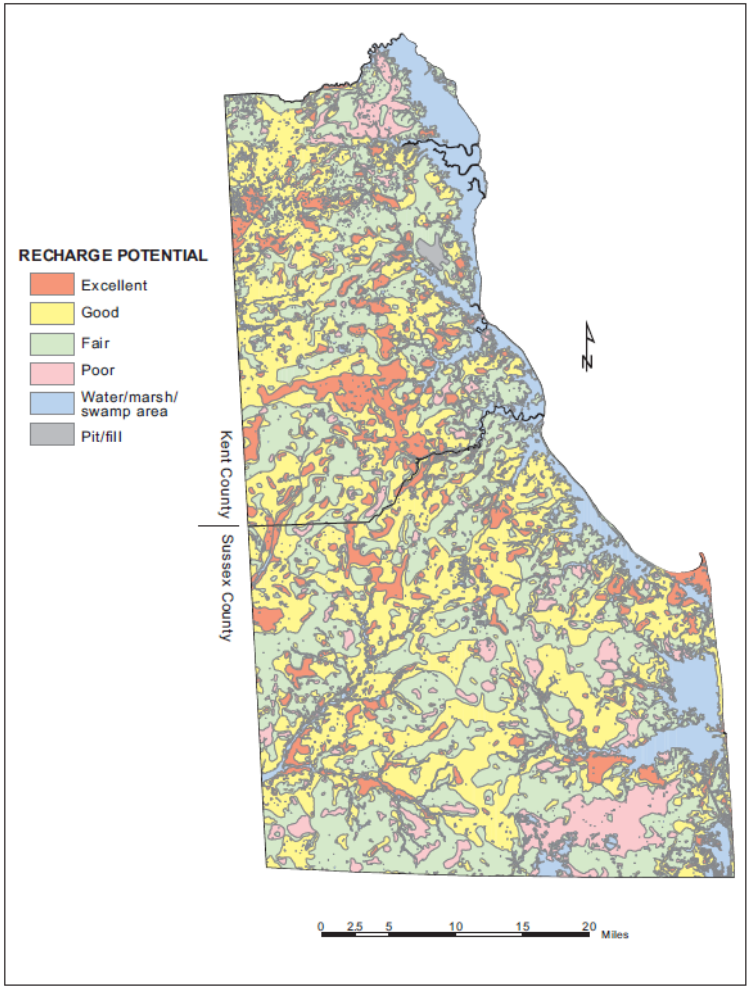

Figure 4. Recharge potential map of Kent and Sussex counties. Map compiled from data of Andres et al. (2002).

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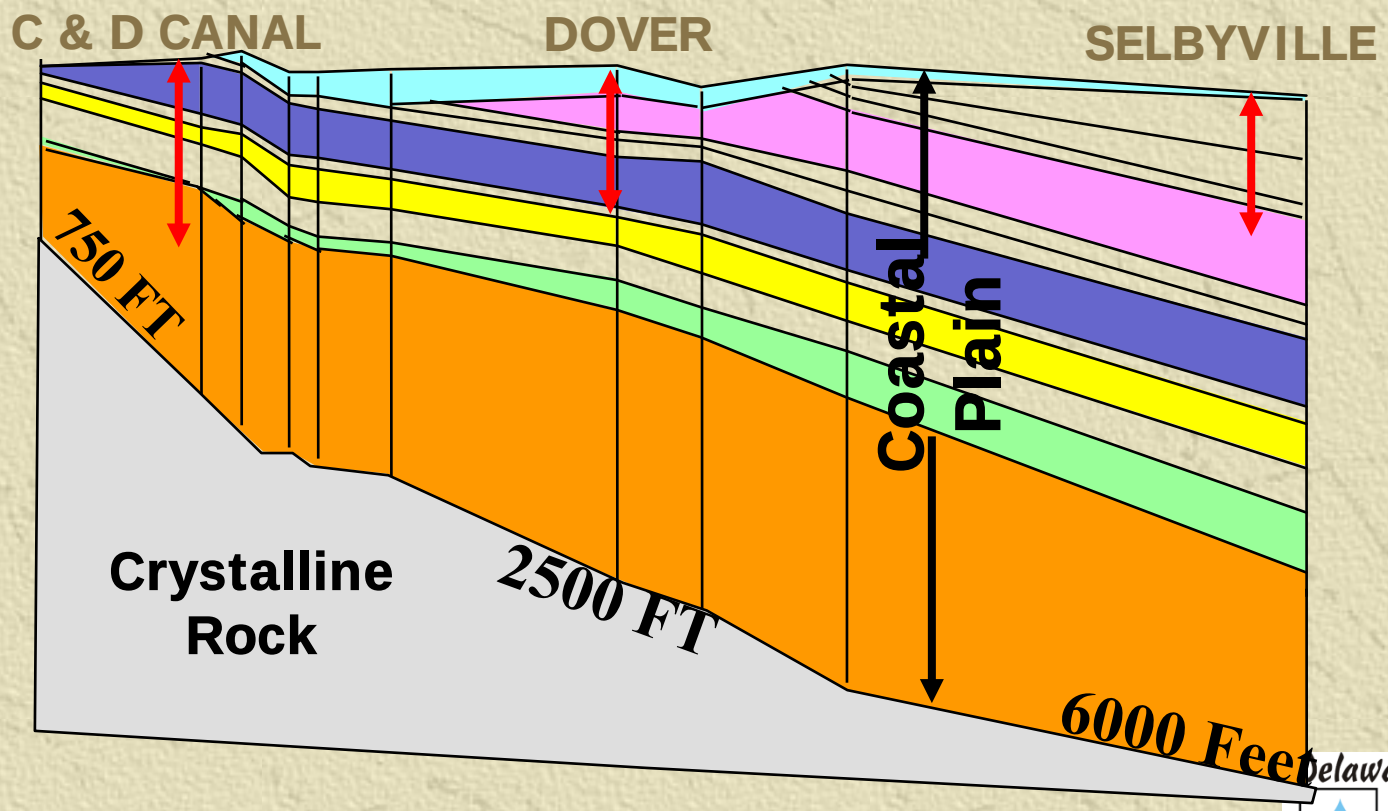
Datasets – Level 1

- Depths to aquifer surfaces (top and bottom)



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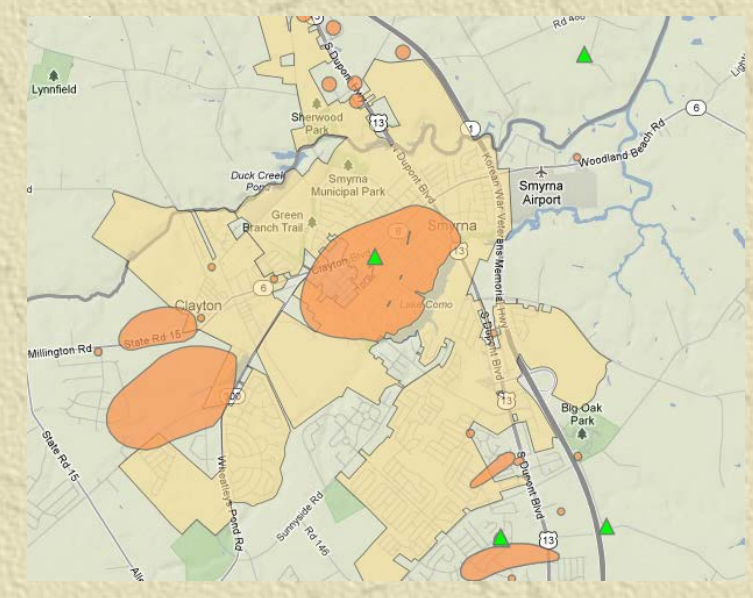
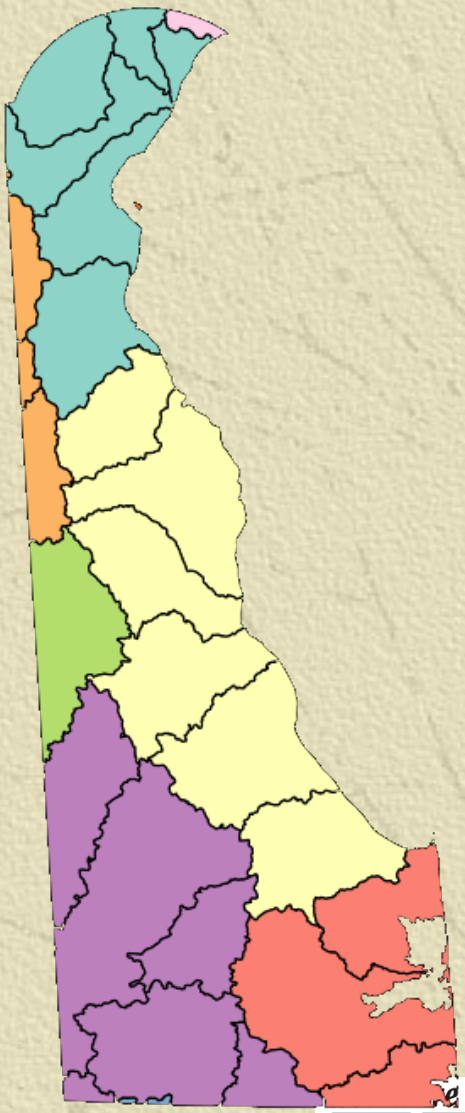
Datasets – Level 1

- Wetlands
- Watersheds
- Wellhead Protection Areas





Wetlands
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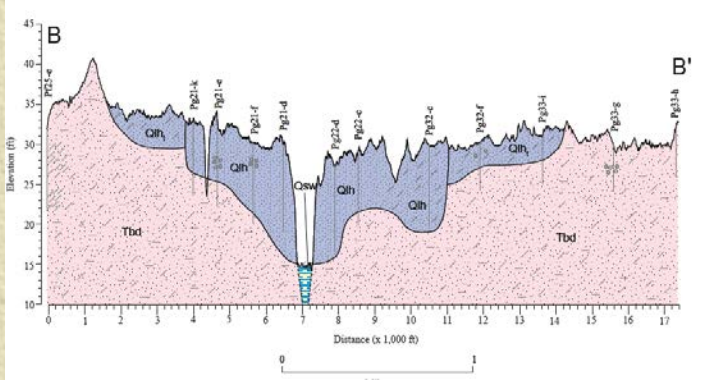
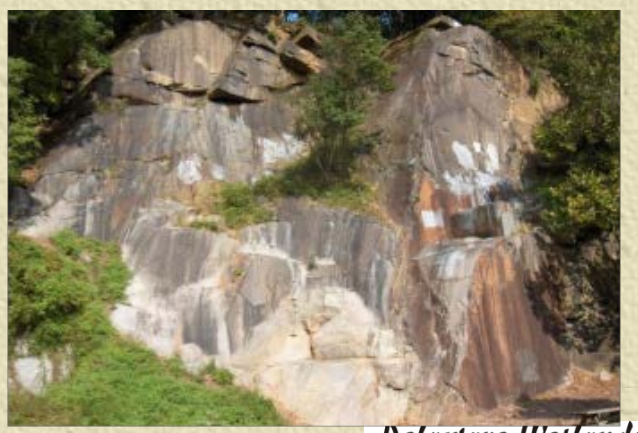
Proposed Datasets – Level 2

- Wells included in DGS published cross-sections
- Digital photos
- Water quality data
- Aquifer hydraulics
- Water and rock chemistry
- Domestic well data
- Railroads

- DNREC WMS map services





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Development of a Lithologic Database

- Primary R&D portion of this project
- Using MS Access to data entry

- Concept is to digitize each section of the well log separately, enabling us to:
  - Interact with data programmatically, AND
  - Replicate log info as a table or graphic, AND
  - Ask complicated questions!

- More than digitized PDFs!

MAIL TO:

WATER SUPPLY SECTION
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY
DOVER, DELAWARE 19901
PHONE: 302-739-3665
FAX: 302-739-2296

STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL

WELL COMPLETION REPORT MUST BE RETURNED WITHIN 30 DAYS OF CONSTRUCTION DATE 6

FORMATION LOG

Od 41-15
Od 41-15

PAGE _____ OF _____ PAGES

PLEASE PRINT OR TYPE - ILLEGIBLE OR INCOMPLETE FORMS WILL BE RETURNED

PERMIT# 160195 LOCAL ID#

PROPERTY OWNER Dennis Bry Fogle

WELL CONTRACTOR White LIC# 1

DESCRIPTION	TOP OF STRATA	BOTTOM OF STRATA
top soil	0	1
white clay	1	11
Coarse orange sand	11	24
Coarse tan sand	24	52
Coarse orange sand	52	64
med orange sand	64	75

DESCRIPTION	TOP OF STRATA	B
top soil	0	1
white clay	1	1
Coarse orange sand	11	2
Coarse tan sand	24	5
Coarse orange sand	52	6
med orange sand	64	7

OTHER COMMENTS:

I HEREBY AFFIRM THE INFORMATION I HAVE SUBMITTED IS ACCURATE AND CORRECT

Roy E White II — Signature of Well Driller In Charge
5 — License#
9/25/98 — Date

White - DNREC • Canary - Contractor • Pink - Owner

Doc. No. 40-08-82-12-11

Slaughter Beach Water Co.

DESCRIPTIVE LOG

DGS No. Lg 41-8 Drilling Method _____ Date Drilled 3/22/82

Local No. _____ Project _____ Logged by White Drill Corp

DNREC # 49476

Ditch Samples		Cores	
Depth	Lithology	Depth	Lithology
0-2	fill		
2-7	gray sand		
7-15	white sand		
15-71	fine to coarse white yellow and orange sand and gravel with thin layers of silty, sandy white, yellow and orange clay		
71-82	silty, sandy, gray clay		
82-101	fine and coarse yellow sand and gravel with some layers of clay		
101-109	silty gray clay		
109-158	clayey, silty, gray sand		
158-166	very fine to coarse slightly clayey gray sand with shells		
166-198	silty gray clay		
198-225	very fine and fine clayey gray sand		
225-251	very fine to some very coarse gray sand (mostly fine) with shells, clayey		
251-	silty gray clay		
	Drilled to 263		

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Evaluation Process / Rank system:

- The Rank system has a scale 1-5
- 1 – Being the most accurate and precise
- 5 – Being of very poor quality or unusable record

- Ranking Criteria include materials, number and depths of intervals, color, grain size(s), proportions with standard terminology, and accessory materials

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Access Data Entry Form

DGSDB_LITH_PRIM

DGSID	Dc11-09	S_MAT1	Cly	HUE/CHROMA		SORTING	
START_DEPTI	0	S_TEXTURE1		Ligtht/Sat		SORT MOD	
STOP_DEPTH	1.5	S_MAT2		INTENSITY1		HARD/SOFT	
MAT_TYPE	S	S_TEXTURE2		VERBOSE COL1	brn	BIO_STRUCT1	
P_MAT1	SD	S_MAT3		INTENSITY2		BIO_STRUCT2	
TEXTURE1	fc	S_TEXTURE3		VERBOSE COL2		ROC_STRUCT	
PMAT2	SLT	Tr_MAT1		COLOR MOD		ROC_STRUCT	
TEXTURE2		T_TEXTURE1		INTENSITY3		ROC_STRUCT	
PMAT3	TS	Tr_MAT2		VERBOSE COL		RQX	
TEXTURE3		T_TEXTURE2		COLOR MOD		UC	
		Tr_MAT3		BED THICKNESS		U_CONTACT	
		T_TEXTURE3		BED TYPE		L_CONTACT	

template - reuse for allfield

Record: 1 of 5575 No Filter Search

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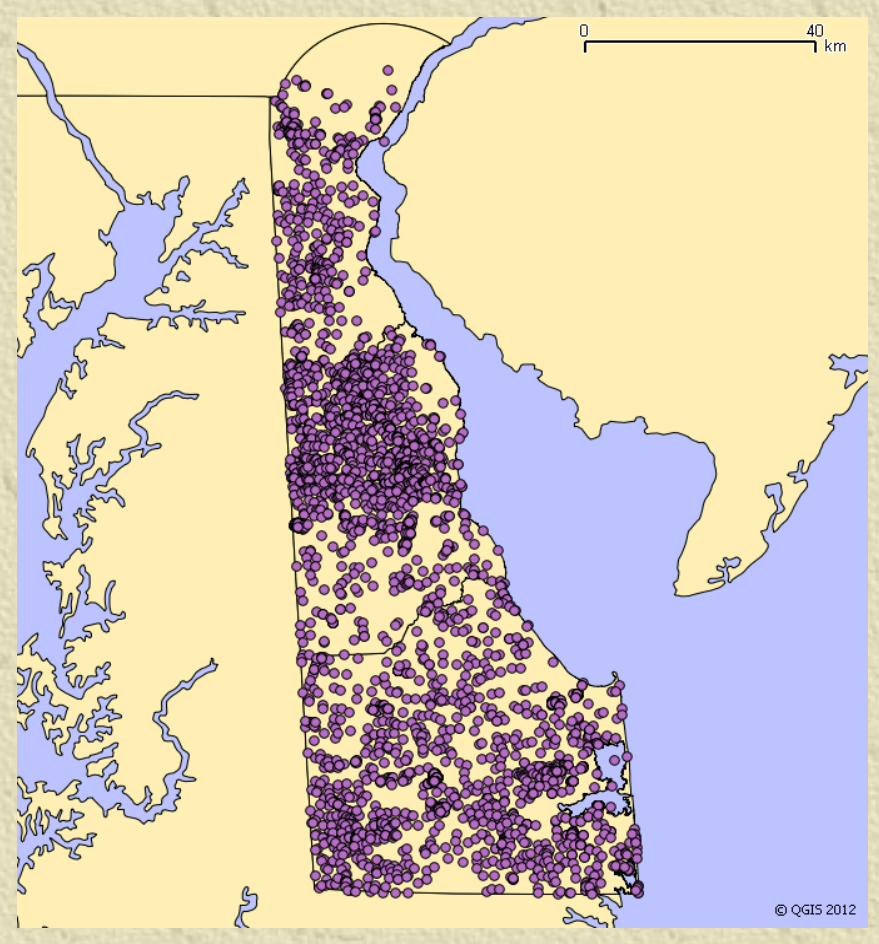
Completed Lithologic Logs

- 3710 wells
  (as of Jan 2012)

- Geologist and Engineer logs



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Status… By the Numbers

- 3700+ lithologic logs
- 2000+ geophysical logs
- 300+ photos
- 900+ water observation sites
- ~130 wells with hydrographs

- ~35 - 40 datasets
- 85 cross-sections
- 1 user guide

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A Bit About Technology

- Web-based
  - Apache/PHP/JpGraph
  - OpenLayers web interface with Google base maps
- Data storage
  - Postgres/PostGIS for vectors, rasters, tables
  - TIFFs/IMG for some raster display
- MapServer
  - OGC WMS/WFS web services
- **It’s all Open Source!**

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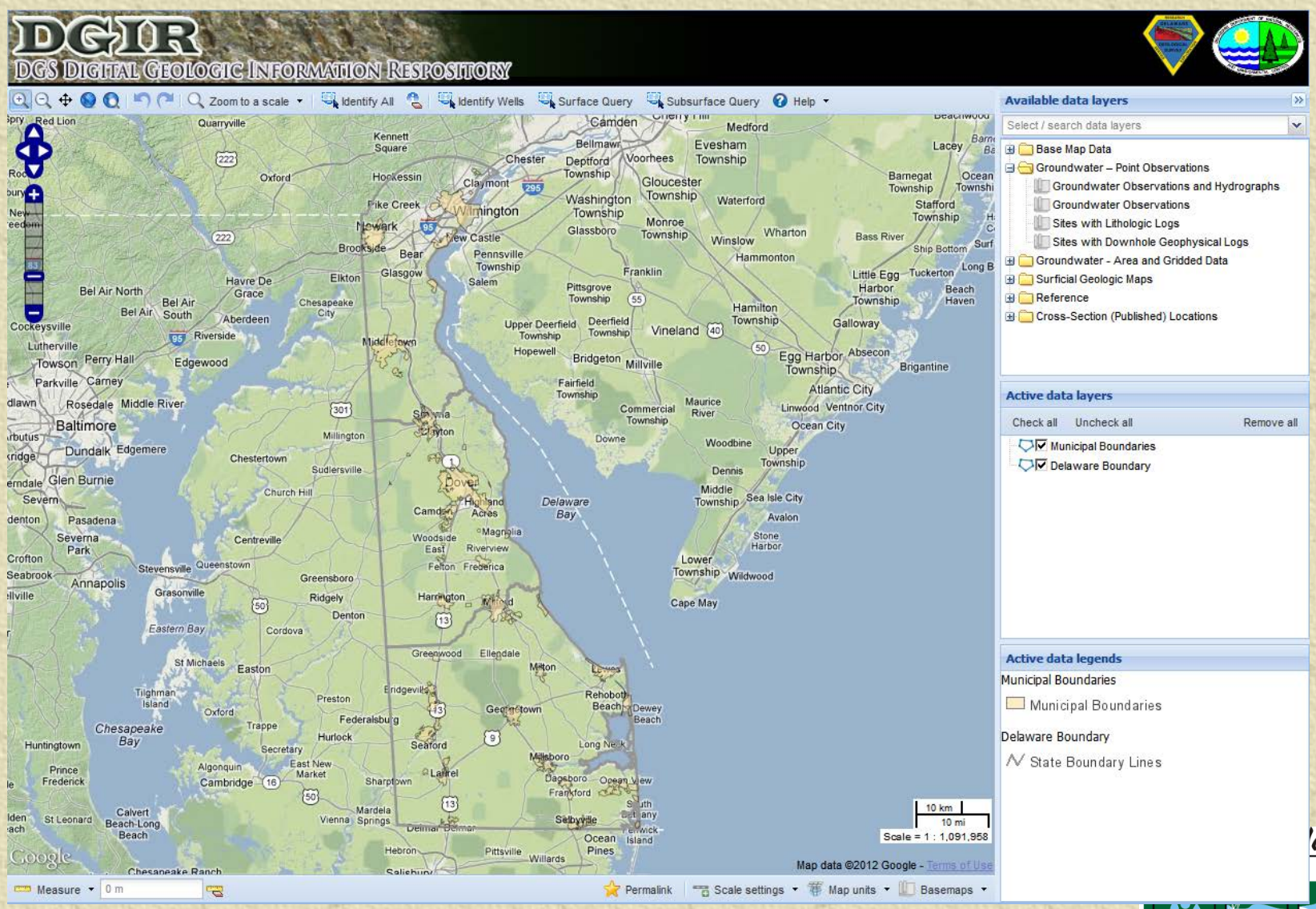
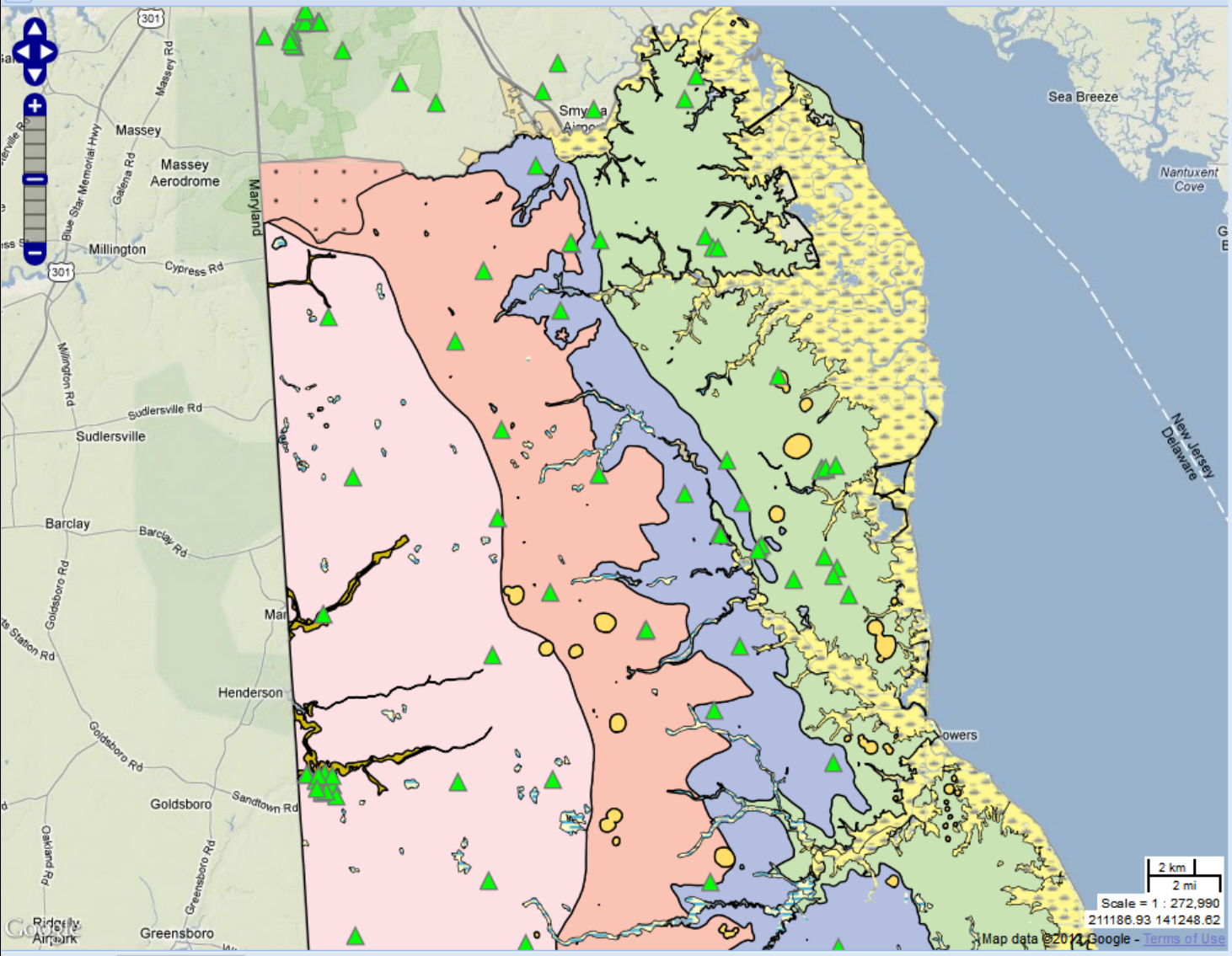
Website Screenshots



DGIR

DGS Digital Geologic Information Respository

Zoom to a scale | Identify All | Identify Wells | Surface Query | Subsurface Query | Help



Measure | 0 m | Permalink | Scale settings | Map units | Basemaps

Available data layers

Select / search data layers

- Groundwater Observations
- Sites with Lithologic Logs
- Sites with Downhole Geophysical Logs
- Groundwater - Area and Gridded Data
  - Wellhead Protection Areas
  - Kent/Sussex Groundwater Recharge Potential
  - New Castle County Recharge RPAs
  - Depth to Water - Dry Conditions
  - Depth to Water - Normal Conditions
  - Depth to Water - Wet Conditions
  - Water Table Elevation - Dry Conditions
  - Water Table Elevation - Normal Conditions

Active data layers

Check all | Uncheck all | Remove all

- New Castle County Recharge RPAs
- GeoMap 12 Cape Henlopen
- Groundwater Observations
- GeoMap 14 Ke
- GeoMap 10 Ap
- Municipal Boun
- Delaware Bou

Zoom to layer
More information
Remove layer
0% Opacity 100%

Active data legends

Groundwater Observations

- Groundwater Observation Sites

GeoMap 10 App Piedmont

- Ardentown Granitic Suite
- Baltimore Gneiss
- Barley Mill Gneiss
- Brandywine Blue Gneiss
- Bringhurst Gabbro
- Christianstead Gneiss
- Cockeysville Marble
- Faulkland Gneiss
- Iron Hill Gabbro
- Iron Hill Gabbro Subsurface

DGIR
DGS Digital Geologic Information Respository

Zoom to a scale | Identify All | Identify Wells | Surface Query | Subsurface Query | Help

Subsurface Query Results

Subsurface Aquifer and Water Depth Results

Location coordinates: 190256, 131149

Elevation at ground surface: 25.39 ft (7.74 m)

Subsurface Elevations:

Aquifers		Water Table
-46 / -82	Federalsburg	**Wet Conditions: 21.39 ft (4 bls)**
-96 / -162	Cheswold	**Normal Conditions: 21.39 ft (4 bls)**
-265 / -433	Piney Point	**Dry Conditions: 21.39 ft (4 bls)**
-647 / -750	Rancocas	
-789	Mount Laurel	

1 km
1 mi
Scale = 1 : 136,495
196519.50 141153.01
Map data ©2012 Google - Terms of Use

Measure | 0 m | Permalink | Scale settings | Map units | Basemaps

Available data layers

Select / search data layers

- Base Map Data
- Groundwater – Point Observations
  - Groundwater Observations and Hydrographs
  - Groundwater Observations
  - Sites with Lithologic Logs
  - Sites with Downhole Geophysical Logs
- Groundwater - Area and Gridded Data
  - Wellhead Protection Areas
  - Kent/Sussex Groundwater Recharge Potential
  - New Castle County Recharge RPAs
  - Depth to Water - Dry Conditions
  - Depth to Water - Normal Conditions

Active data layers

Check all | Uncheck all | Remove all

- [x] Groundwater Observations and Hydrographs
- [ ] New Castle County Recharge RPAs
- [ ] GeoMap 12 Cape Henlopen
- [x] Groundwater Observations
- [x] GeoMap 14 Kent County
- [x] GeoMap 10 App Piedmont
- [x] Municipal Boundaries
- [x] Delaware Boundary

Active data legends

Groundwater Observations and Hydrographs
- Groundwater Hydrograph Sites

Groundwater Observations
- Groundwater Observation Sites

GeoMap 10 App Piedmont
- Ardentown Granitic Suite
- Baltimore Gneiss
- Barley Mill Gneiss
- Brandywine Blue Gneiss
- Bringhurst Gabbro
- Christianstead Gneiss
- Cockeysville Marble

DGIR
DGS Digital Geologic Information Respository

Zoom to a scale | Identify All | Identify Wells | Surface Query | Subsurface Query | Help

Available data layers

Select / search data layers

- Base Map Data
- Groundwater – Point Observations
  - Groundwater Observations and Hydrographs
  - undwater Observations
  - s with Lithologic Logs
  - s with Downhole Geophysical Logs
  - water - Area and Gridded Data
  - head Protection Areas
  - t/Sussex Groundwater Recharge Potential
  - Castle County Recharge RPAs
  - th to Water - Dry Conditions
  - th to Water - Normal Conditions

layers

Uncheck all | Remove all

- undwater Observations and Hydrographs
- Castle County Recharge RPAs
- Map 12 Cape Henlopen
- undwater Observations
- Map 14 Kent County
- Map 10 App Piedmont
- icipal Boundaries
- ware Boundary

legends

- r Observations and Hydrographs
- dwater Hydrograph Sites
- r Observations
- Groundwater Observation Sites

GeoMap 10 App Piedmont

- Ardentown Granitic Suite
- Baltimore Gneiss
- Barley Mill Gneiss
- Brandywine Blue Gneiss
- Bringhurst Gabbro
- Christianstead Gneiss
- Cockeysville Marble

Well/Borehole Summary Information

Well Details | Water levels | Lithology Log | Geophysical Log | Digital photos

Well information for DGSID Db24-10

DNREC ID: Db2410
County: New Castle County
Easting/Northing: 440068.0, 4389034.0
Longitude/Latitude: W754156, N393856
Altitude: 78.00 ft

Drilled Date: 2057-10-14
Hole Depth: 28.0 ft
Geologic Unit: n/a
Hydrologic Unit: cl

Water Observation Well?: Yes
Primary Well with Hydrograph?: Yes (Download)
Screen Top: 21.0 ft
Screen Bottom: 24.0 ft
No. of records: 282

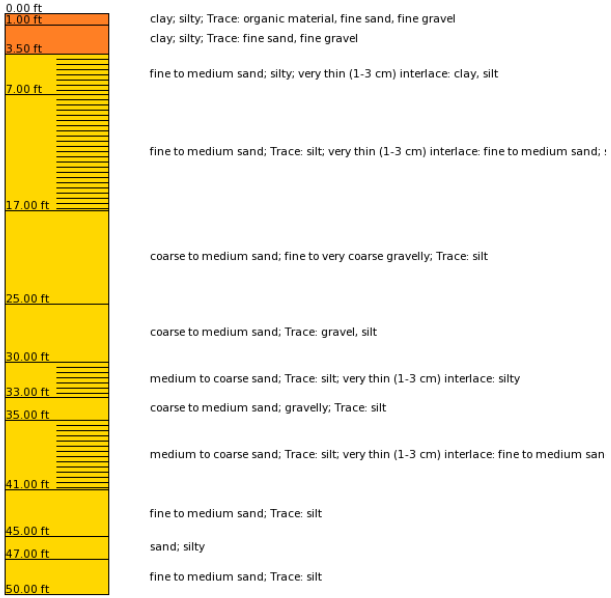
Lithologic Log?: No
Geophysical Log?: No

Photo Available?: unk

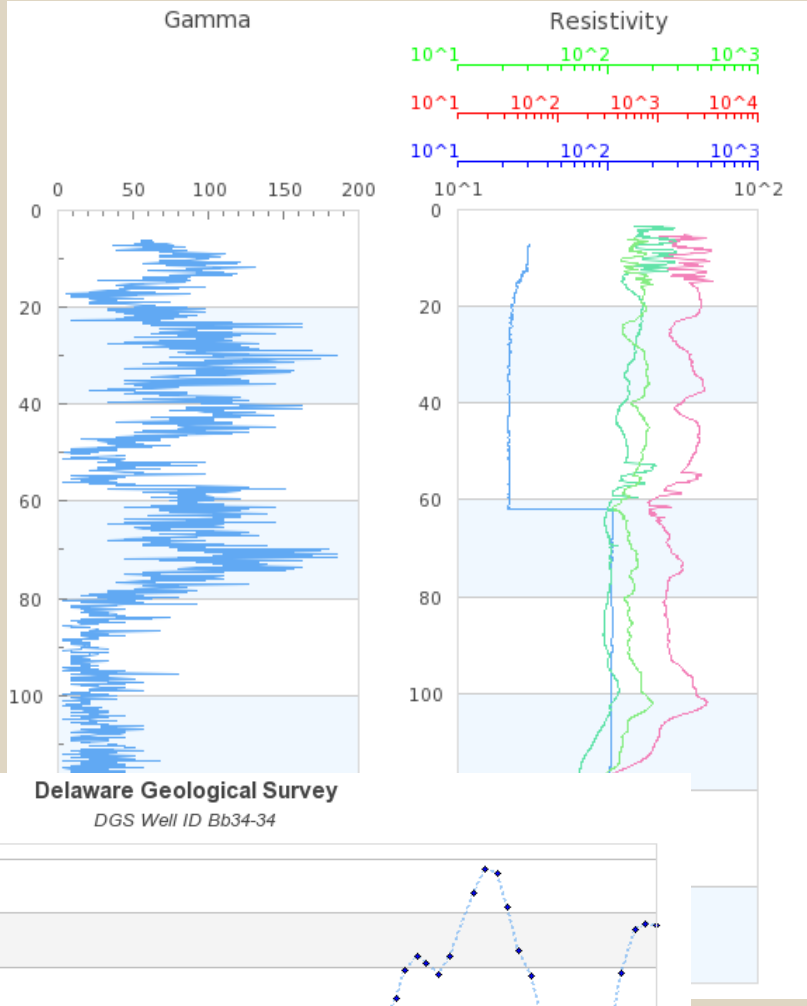
Scale = 1 : 136,495
176794.77 182917.49
Map data ©2012 Google - Terms of Use

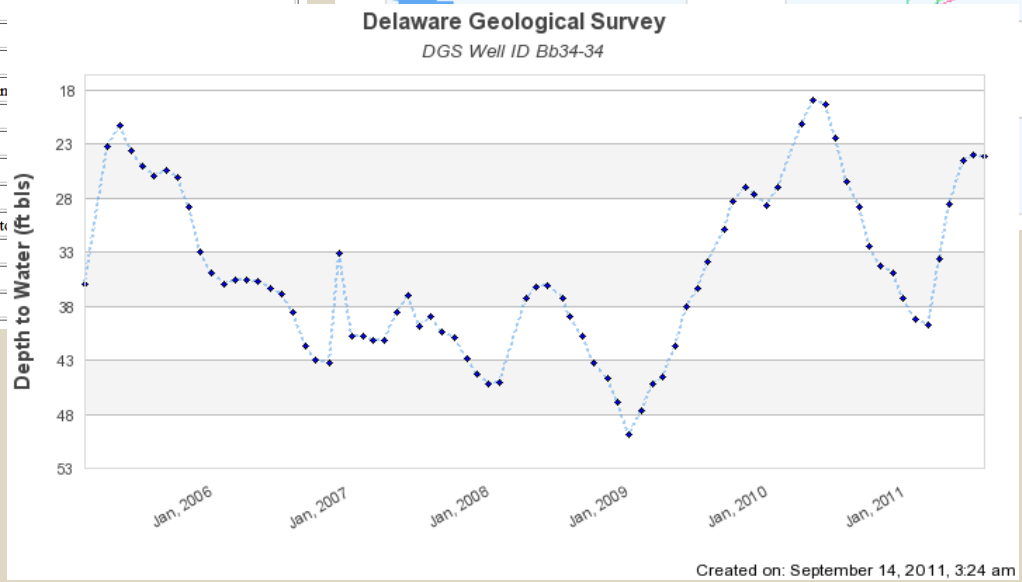
Measure | 0 m | Permalink | Scale settings | Map units | Basemaps

Well ID: Jc23-02
Easting: 446042.5
Northing: 4332757.5
Altitute: 58.00
Hyd Unit: Not Available



Start Depth	Stop Depth	Description
0.00	1.00	clay; silty; Trace: organic material, fine sand, fine gravel
1.00	3.50	clay; silty; Trace: fine sand, fine gravel
3.50	7.00	fine to medium sand; silty; very thin (1-3 cm) interlace: clay, silt
7.00	17.00	fine to medium sand; Trace: silt; very thin (1-3 cm) interlace: fine to n
17.00	25.00	coarse to medium sand; fine to very coarse gravelly; Trace: silt
25.00	29.00	coarse to medium sand; Trace: gravel, silt
30.00	33.00	medium to coarse sand; Trace: silt; very thin (1-3 cm) interlace: silty
33.00	35.00	coarse to medium sand; gravelly; Trace: silt
35.00	41.00	medium to coarse sand; Trace: silt; very thin (1-3 cm) interlace: fine t
41.00	45.00	fine to medium sand; Trace: silt
45.00	47.00	sand; silty
47.00	50.00	fine to medium sand; Trace: silt





Next Steps

- Start using in operational sense
  - Fix bugs as needed
- Develop an update procedure
  - New DGS published data
  - Digitizing historical logs
- Prioritize remaining data and functionality

Delaware Wetlands

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www.dnrec.delaware.gov/admin/delawarewetlands

Questions?

John Callahan
Delaware Geological Survey
john.callahan@udel.edu

United States Groundwater Data Portal - Mozilla Firefox

File Edit View History Delicious Bookmarks Tools Help GBookmarks

http://cida.usgs.gov/gw_data_portal/

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize Tools View Source Options

ACWI
Advisory Committee on Water Information

United States Groundwater Data Portal

Filter Map Data

Agency

ctrl + click to select more than one

- MT Bureau of Mines and Geology
- MN Dept. of Natural Resources
- MN Pollution Control Agency
- TX Water Development Board
- US Geo Survey NJ / NJ Geo Survey

National Aquifer Name

ctrl + click to select more than one

- All National Aquifers
- Alluvial aquifers
- Cambrian-Ordovician aquifer system
- Coastal lowlands aquifer system
- Early Mesozoic basin aquifers

Water Level Network

ctrl + click to select more than one

- All Water Level Sub Networks
- Surveillance - Targeted
- Surveillance - Unstressed
- Trend - Targeted
- Trend - Unstressed

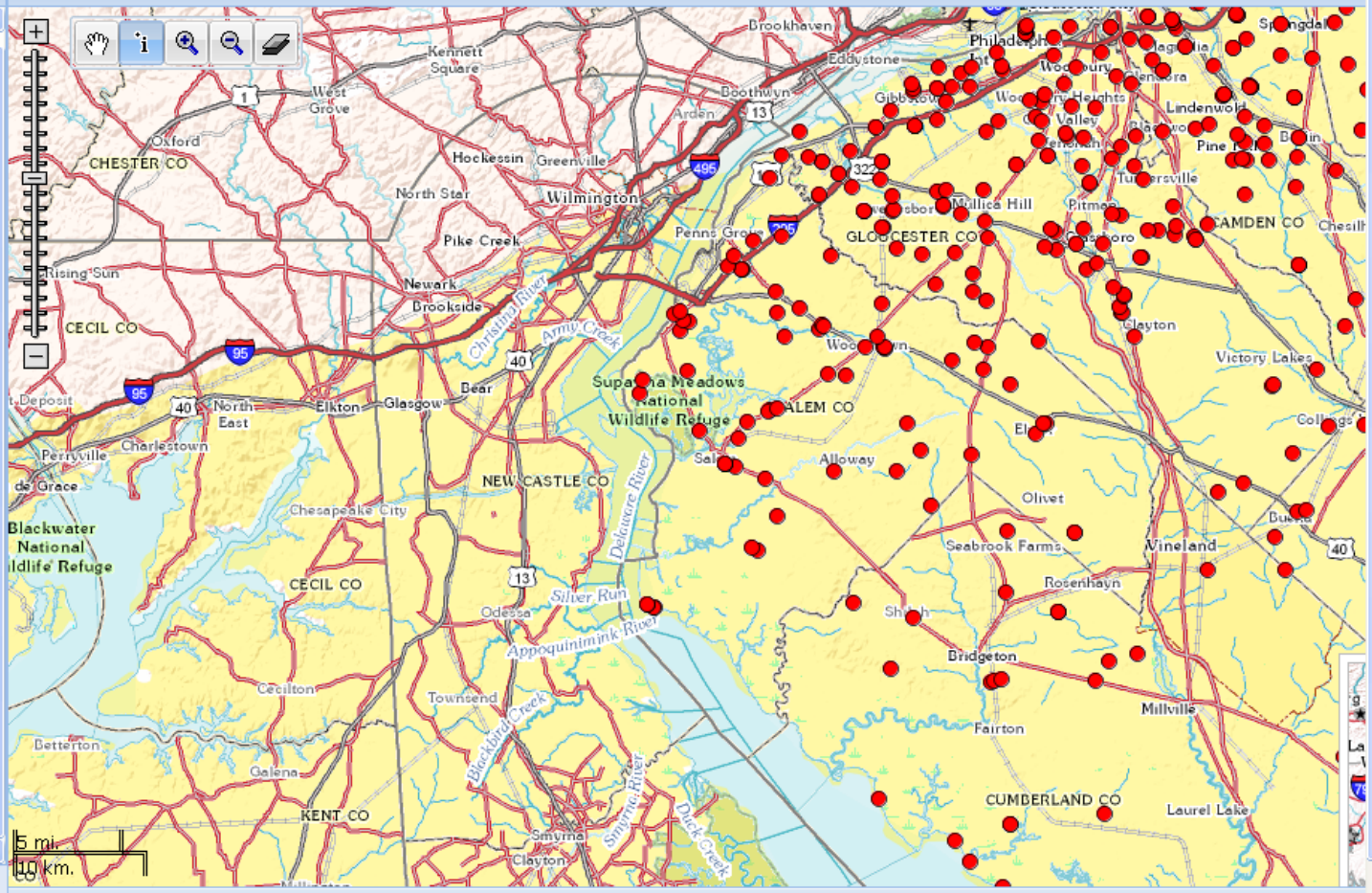
Water Quality Network

ctrl + click to select more than one

- All Water Quality Sub Networks
- Surveillance - Targeted
- Surveillance - Unknown
- Surveillance - Unstressed
- Trend - Targeted

Map

Click on map to identify a point of interest



Number of points meeting criteria: 1835

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United States Groundwater Data Portal - Mozilla Firefox

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http://cida.usgs.gov/gw_data_portal/

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ACWI Advisory Committee on Water Information

United States Groundwater Data Portal

Filter Map Data

Agency

ctrl + click to select more tha

MT Bureau of Mines and Ge
MN Dept. of Natural Resour
MN Pollution Control Agency
TX Water Development Boa
US Geo Survey NJ / NJ Geo

National Aquifer Name

ctrl + click to select more tha

All National Aquifers
Alluvial aquifers
Cambrian-Ordovician aquife
Coastal lowlands aquifer sy
Early Mesozoic basin aquife

Water Level Network

ctrl + click to select more tha

All Water Level Sub Networ
Surveillance - Targeted
Surveillance - Unstressed
Trend - Targeted
Trend - Unstressed

Water Quality Network

ctrl + click to select more tha

All Water Quality Sub Netwo
Surveillance - Targeted
Surveillance - Unknown
Surveillance - Unstressed
Trend - Targeted

Map

Click on map to identify a point of interest

330902-- Woodstown PW 4

Summary | **Well Log** | Water Levels

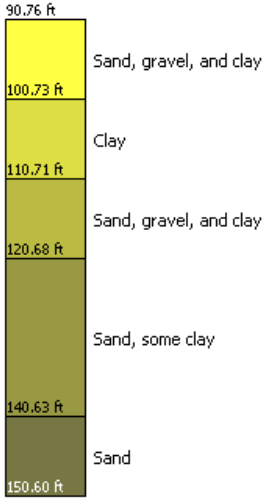
Longitude: -75.3177

Latitude: 39.6459

Elevation: 47.97 ft.

Well Depth: 148.61 ft.

Resource: USGS NWIS Database



Depth From (ft)	Depth To (ft)	Lithography
90.76	100.73	Sand, gravel, and clay
100.73	110.71	Clay
110.71	120.68	Sand, gravel, and clay
120.68	140.63	Sand, some clay
140.63	150.60	Sand

Close

Number of points meeting criteria: 1835

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