Groundwater Sources, Well Design, and Permitting

March 6, 2018

All About Irrigation Workshop
Tidewater Agricultural Research
and Extension Center
Suffolk, VA

Presented by:
Curtis Consolvo, P.G.
GeoResources, Inc.
Permitting Requirements (VA & NC)

State-wide in Virginia and North Carolina:

- Health Department Permit for each well (well driller typically handles).

Virginia Groundwater Management Areas (Coastal Plain):

- Groundwater Withdrawal Permit for total withdrawal (via one or more wells) if > 300,000 gallons in any calendar month.

North Carolina:

- State Well Construction Permit for wells with design capacity > 100,000 gpd.

- If located in Central Coastal Plain Capacity Use Area (15-county area), registration and reporting requirements start at 10,000 gpd, and Water Use Permit required if > 100,000 gpd.
NC Central Coastal Plain Capacity Use Area

Source: NC DEQ Central Coastal Plain Capacity Use Area website (modified by adding title to right).
VA DEQ
Groundwater Management Areas
Figure 2. Generalized hydrogeologic section and directions of ground-water flow in the Virginia Coastal Plain (altitude relative to National Geodetic Vertical Datum of 1929).

Open-Hole Well (in Bedrock)

Screen and Gravel-Pack Well
(in unconsolidated, Coastal Plain sediments)

Modified from U.S.G.S. Professional Paper 1731, 2006, Plate 5.
Modified from U.S.G.S. Professional Paper 1731, 2006, Plate 5.
Hydrogeologic framework information available on-line:

And in North Carolina, the NC Division of Water Resources, Groundwater Management Branch is an excellent source of information.
Well depth: 42 feet
Water level depths: ~ 13 feet

Well depth: 96 feet
Water level depths: ~ 22 feet

Graphs from data querying/displaying via U.S.G.S. Water Data website for wells 54C 13 SOW 221D and 54C 12 SOW 221C (modified by adding text/numbers to left).
Well depth: 178 feet
Water level depths (recently): ~ 98 feet

Well depth: 537 feet
Water level depths (recently): ~ 110 feet

Graphs from data querying/displaying via U.S.G.S. Water Data website for wells 54C 11 SOW 221B and 54C 10 SOW 221A (modified by adding text/numbers to left).
Modified from U.S.G.S. Professional Paper 1731, 2006, Plate 5.
Unconfined versus Confined aquifers

In confined aquifers:

> water levels represent *potentiometric* levels;
> drawdown impacts are far-reaching and shared.

Potentiometric Surface Declines in Confined Aquifers of the Coastal Plain

Well with casing perforated at successively lower points in order to maintain a flow as artesian pressure declines; Isle of Wight County.
COMMONWEALTH of VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
APPLICATION FOR A GROUNDWATER WITHDRAWAL PERMIT

1. APPLICANT INFORMATION:
   Owner: ___________________________ Phone: ___________________________
   Owner Address: (Street, City, State, Zip Code) ___________________________
   Email: ___________________________

2. FACILITY INFORMATION:
   Facility/System Name: ___________________________
   Facility Address: (Street, Road, or Route location, City, State, Zip Code)
   Contact Name: ___________________________ Title: ___________________________
   Phone: ___________________________
   Email: ___________________________
   Location of Withdrawal Well or Well System: ___________________________
   (County/City)

3. PREAPPLICATION MEETING DATE: ___________________________

4. TYPE OF APPLICATION:
   [ ] Existing withdrawal, not previously permitted
   [ ] New or expanded withdrawal
   [ ] Modification of permit Number
   [ ] Reapplication for existing permit Number ________ with modification
   [ ] Reapplication for existing permit Number ________ without modification

   For Reapplications:
   Existing withdrawal permit amount ___________________ gallons per
   ___________________ (Day, Month, Year)
   Date of expiration of existing Groundwater Withdrawal Permit

5. REQUESTED WITHDRAWAL AMOUNT:
   ___________________ Maximum gallons per year,
   ___________________ Maximum gallons per month
   ___________________ Maximum gallons per 10 year permit term

   (*For seasonal or occasional withdrawal applications such as irrigation or drought relief)

6. TYPE OF USE:
   [ ] Public Water Supply – Municipal
   [ ] Public Water Supply – Non Municipal
   [ ] Non Public Water Supply Potable Use
   [ ] Industrial
   [ ] Commercial
   [ ] Agriculture (Irrigation, Livestock)
   [ ] Supplemental Drought Relief
   [ ] Surface Water and Groundwater Conjunctive Use

   Does the requested volume include a portion for irrigation? Yes [ ] No [ ]

7. FEE SUBMITTED: $ ____________ DATE ____________ [ ] Agricultural Application – No Fee

OFFICE USE ONLY
Date Application Received ____________ Application No. __________________________
Date Fee Received ____________ Amount ____________ Date LGOF Received ____________
# Quarterly Ground Water Withdrawal Report

## Commonwealth of Virginia
### Department of Environmental Quality

**Quarterly Ground Water Withdrawal Report**

<table>
<thead>
<tr>
<th>Name of Facility</th>
<th>Name of Operator</th>
</tr>
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<tbody>
<tr>
<td>Owner</td>
<td>Position/Title</td>
</tr>
<tr>
<td>Address</td>
<td>Signature</td>
</tr>
<tr>
<td></td>
<td>Date</td>
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<td></td>
<td>Phone</td>
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<td></td>
<td>Permit #</td>
</tr>
</tbody>
</table>

*County/City*

Meter readings are in (gallons, 100's or 1000's of gallons, cubic feet, etc.)

<table>
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<tr>
<th>Month of</th>
<th>Year of</th>
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<tr>
<th>Owner Well Number</th>
<th>DEQ Well Number and MPID Number</th>
<th>Present Reading</th>
<th>Previous Reading</th>
<th>Total Gallons</th>
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Total Gallons (this month)

Total Gallons (year to date)

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2016 Reported Use Simulation - Potomac Aquifer
Simulated Water Levels Below the Critical Surface and Below the Aquifer Top

The 'Critical Surface' of an aquifer is the elevation of the potentiometric water level surface when 80% of the distance between the land surface and the top of the aquifer is removed.

Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply
October 2, 2017

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
Simulated Potentiometric Contours
Potomac Aquifer
2017 Total Permitted Simulation

Contour elevations are in feet
relative to mean sea level (msl)
and at 40 ft intervals.

Prepared by Aquaveo, LLC for the
Virginia DEQ, Office of Water Supply
October 2, 2017

Potentiometric Water Level Contours
Potomac Aquifer Model Boundary

VIRGINIA DEPARTMENT OF
ENVIRONMENTAL QUALITY
**2017 Total Permitted Simulation - Potomac Aquifer**

**Simulated Water Levels Below the Critical Surface and Below the Aquifer Top**

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Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply
October 2, 2017

Virginia Department of Environmental Quality
Simulated Potentiometric Contours
Aquia Aquifer
2017 Total Permitted Simulation

Contour elevations are in feet relative to mean sea level (msl) and at 30 ft intervals.

Potentiometric Water Level Contours
Aquia Aquifer Model Boundary

Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply
October 2, 2017
2016 Reported Use Simulation - Aquia Aquifer
Simulated Water Levels Below the Critical Surface and Below the Aquifer Top

The 'Critical Surface' of an aquifer is the elevation of the potentiometric water level surface when 80% of the distance between the land surface and the top of the aquifer is removed.

Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply
October 2, 2017

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY
2017 Total Permitted Simulation - Aquia Aquifer Simulated Water Levels Below the Critical Surface and Below the Aquifer Top

The 'Critical Surface' of an aquifer is the elevation of the potentiometric water level surface when 80% of the distance between the land surface and the top of the aquifer is removed.

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Proper Well Construction Requirements

*In addition to the Virginia Department of Health requirements.*

> **Conduct Geophysical logging** (Spontaneous Potential, Single Point Resistance, 16/64 Short and Long Normal, Natural Gamma) and complete geologist’s logs during well drilling (required for all permitted wells)

> **Install gravel packs and grout for observation wells and production wells in a manner that prevents leakance between aquifers.** Gravel pack should be terminated close to the top of well screens and should not extend above the top of the target aquifer as shown in Example 1. Bentonite plugs between screened intervals should be used. DEQ staff need to review the geophysical logs and driller’s logs to determine the gravel pack intervals prior to well construction (See contacts below.)

> **Ensure that Well Completion forms (GW2s) are completed** by the driller and retained by owner and driller.

> **Document Pump intake settings** and **do not set the pump intake** (1) below the top of the uppermost screened confined aquifer or (2) below the bottom of an unconfined aquifer. Evaluate the effect of the allowable pump intake level on needed production and pumping water levels in the well as part of the well performance evaluation. DEQ should be contacted to help evaluate the geophysical logs and determine the aquifer top and allowable pump intake limit. Two weeks notification of the drilling schedule is needed to schedule DEQ assistance.

> Collect the GPS location for the well and include the Lat/Long and reference datum (i.e. WGS 84, NAD 27) on the Well Completion Form.

**Who to Contact for Additional Information:**

- **Ground Water Characterization:** Erinn Tisdale
  - (804) 698-4066
- **Groundwater Withdrawal Permitting:**
  - Scott Bruce
  - (804) 698-4041

*Note: This construction is recommended even if your facility or public system, etc. does not currently need a withdrawal permit since it can prevent future permitting problems.*
DEQ Factsheet: Groundwater Well Installation in Groundwater Management Areas

Well Construction to Avoid - Example 2

- Extending the Gravel pack beyond the top of the screened interval and/or extending the gravel pack into other aquifers as shown in Example 2
- Including multiple aquifers in the well screen or extending the well screen through multiple aquifers or as shown in Example 2 and 2a

*Wells with this type of construction often do not meet regulatory requirements due to the unintended impact on overlying aquifers and the pump intake limit may be impacted limiting capacity. This means the well may have to be abandoned and a new well constructed.* Even if the wells may be usable, this construction can cause the need for expensive and complex aquifer testing in order to obtain a permit, and for the pump intake limit to be shallow (above Aquifer A in Example 2)

Other Common Well Construction Problems

- No geophysical log: Geophysical logging data is necessary for permit issuance in almost every case. *Collection of geophysical and geologist's logs must be performed during well drilling and cannot be collected once the well is completed.* Drilling an additional bore hole and conducting geophysical logging may be necessary if geophysical data is not available for the location.

- No well completion form: *This information is necessary to issue a permit. If the depth of the well, the screened intervals, the grout depth, and the gravel pack extent are not documented, a camera survey may be necessary to determine the basic well construction.*

- No documentation of the Pump Intake depth *It is illegal for a pump intake to be set (1) below the top of the uppermost confined aquifer in use or (2) below the bottom of an unconfined aquifer. If the pump depth is not documented, the pump may have to be pulled to determine the depth or to raise the pump. Raising the pump can reduce the well yield, sometimes significantly.*
If you’re in a VA DEQ Groundwater Management Area and will be using wells (or already are) for > 300,000 gallons in any calendar month,

Start the permitting process as soon as possible:

• It can take years for permits to be issued.

• Forecast is for enforcement.

• 300,000 gallons/month isn’t much: equivalent to 11 acre inches.
Get the DEQ involved BEFORE drilling wells:

- The DEQ wants to be notified and to make site-specific calls on aquifer depths, grouting and pump setting depth requirements.
- Avoid costs of meeting requirements after-the-fact.
- Gain key information for making best well-design decisions:
  - Which aquifer(s) more/less likely to be permitted for withdrawal rates needed;
  - Proximity to permitted withdrawals/permits in progress;
  - Depth limit for pump (rough idea – actual determination made from drilling/logging results).
Consider the surficial (Columbia) aquifer:

- Depending on location, can have high yields and good water quality.

- For example, at a site where coarse sands extend to nearly 80 feet, we’re getting 150 gpm from each of two wells, with excellent water quality.

- Withdrawal impacts minimal (unconfined aquifer).

- The VA DEQ is considering a fast-track permitting process for groundwater withdrawals from the surficial aquifer.
If you need a Groundwater Withdrawal Permit and your wells are already constructed......

**In the past** (from my experiences), requirements have included/ranged from:

- Pulling pumps to confirm depths (and raising if necessary), running down-hole camera, and geophysical logging (inside well via EM-induction);
- Drilling borehole next to well(s) for drill logging, obtaining samples (of drilling returns), and geophysical logging;
- Permit issued with condition requiring replacement of well(s) within the term of the permit.

**Going forward**, requirements will include........?
Summary Recommendations:

- In the Coastal Plain, you’ve got choices when it comes to the source of your groundwater supply.

- Make that choice with the DEQ on-board and in light of their input to streamline requirements and help ensure a viable (and sustainable) supply.

And if already using groundwater above limits without a permit, contacting DEQ sooner probably better than later.
Review of Groundwater Resources

The Virginia Coastal Plain Hydrogeologic Framework

Professional Paper 1731

U.S. Department of the Interior
U.S. Geological Survey

2006

Prepared in cooperation with the Virginia Department of Environmental Quality and the Hampton Roads Planning District Commission

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- Matthew Link - (804) 698-4078

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The Office of Water Supply Water Withdrawal Permitting
Groundwater Management Area Permitting Contacts