DRAFT REVIEW OF POULTRY HOUSE GROUNDWATER WITHDRAWAL PERMIT APPLICATIONS

August 2018
Locations of Poultry Houses that have submitted Groundwater Withdrawal Applications

- 57 Poultry Houses
- All located in Accomack County
- Distributed relatively uniformly N-S across the County
- Majority are close to the “Spine Recharge Area”
- Several are close to the coast, Bay-side or Sea-side

At the time the Applications were submitted earlier this year a number of facilities were still under construction. Others were reporting groundwater use.
Number of Requested and Permitted Groundwater Withdrawals

Poultry Houses are the single largest category of withdrawals requiring a permit
Relative to other Permitted Withdrawals, Individual poultry houses use less water on average
Total permitted withdrawals by category

Annual Total

<table>
<thead>
<tr>
<th>Category</th>
<th>Requested Poultry</th>
<th>Permitted Agricultural</th>
<th>Permitted Industrial</th>
<th>Permitted Municipal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Total</td>
<td>57 (count)</td>
<td>37</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Monthly Maximum

<table>
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<tr>
<th>Category</th>
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Notes:
- Ag: Actual agricultural use is predominantly for drought use, and normal year use is typically less than 20% of permitted use.
- Ind: Actual industrial use almost equal permitted use (>90% for most users).
- Municipal: Actual Municipal use is close to permitted use (close to 80% for most users).

Poultry use expected to more closely follow municipal demand with seasonal (winter-summer) cycle.
Comparison of Annual Average Permitted Withdrawal to Requested Poultry Withdrawals

- Industrial withdrawal amounts are concentrated on two users.
- Larger Agricultural withdrawals tend to be clustered.
- Poultry houses are individually much smaller and distributed more evenly across Accomack County.

Legend

<table>
<thead>
<tr>
<th>Permitted Municipal</th>
<th>Permitted Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 0.1 mgd</td>
<td>&lt; 1 mgd</td>
</tr>
<tr>
<td>0.1 to 0.5 mgd</td>
<td>0.1 to 0.5 mgd</td>
</tr>
<tr>
<td>0.5 to 1 mgd</td>
<td>0.5 to 1 mgd</td>
</tr>
<tr>
<td>1 to 2 mgd</td>
<td>1 to 2 mgd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Permitted Commercial/Industrial</th>
<th>Requested Poultry House</th>
</tr>
</thead>
<tbody>
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</table>

Number of withdrawals, amounts per facility, and varying locations complicate direct comparisons.

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Portion of Withdrawal Used for Cooling

Majority of the water will be used for cooling. Less than ½ is used by the birds for consumption.
Source Aquifers

• None of the 42 applications reviewed have wells screened in the Columbia (surficial) aquifer

• Some wells were installed earlier (greater than 10-years ago). Other wells were installed as recently as July 2018.

• There is no documentation of test wells for the Columbia aquifer at any of the facilities from these applications.

• Most of the applications give one of the following reasons for not screening the Columbia aquifer:
  • “it is believed that a shallow groundwater supply system would lack the reliability, volume, and/or quality”
  • “the surficial aquifer does not yield water of sufficient quantity or suitable quality for meat production at this location”

The Groundwater Committee has made preferred use of the Columbia aquifer to reduce stress on the Yorktown-Eastover aquifer a major goal to maintain a sustainable resource for over 20-years.
From available data, the Columbia aquifer can yield in excess of 40 gpm over most of Accomack County. 40 gpm meets the requirements for most of the poultry houses.
Poultry House Location Relative to Columbia Aquifer Test Sites

- Many poultry houses are near other permitted users where the Columbia aquifer yield has been demonstrated.

- Average requested cooling water demand is 46,000 gpd average under maximum month use.

- Lowest aquifer test for the Columbia aquifer was 50,000 gpd.

There is no reason to believe the yield will be substantially different at the poultry house site.
Based on available boring and geophysical logs provided in the Poultry House Applications, there is no reason to believe the Columba aquifer is not available.
Columbia aquifer Water quality is “different” but in some ways may be better for certain uses

- Based on water quality samples there is no reason to believe the Columbia has substantially worse water quality:
  - Iron is about the same
  - Yorktown-Eastover chlorides (salt) is higher
  - Columbia nitrate (nutrients) is higher
  - Susceptibility to contamination
    - Columbia aquifer is more susceptible to contamination from land-use practices (mostly nutrients)
    - Yorktown-Eastover is more susceptible to contamination from over pumping

<table>
<thead>
<tr>
<th>Aquifer</th>
<th>Average (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Iron</td>
</tr>
<tr>
<td>Columbia aquifer</td>
<td>1.7</td>
</tr>
<tr>
<td>Yorktown-Eastover aquifer</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: DEQ Database and Virginia Household Water Quality

Lower chlorides in the Columbia aquifer make it less corrosive for cooling water use than some Yorktown-Eastover groundwater. Increasing withdrawals from the Columbia for uses tolerant to nutrient levels helps to maintain a sustainable Yorktown-Eastover aquifer.
DEQ Permit Requirements for Water Sources

The following is part of the regulatory requirements when evaluating sources of water:

C. The applicant shall provide an alternatives analysis that evaluates sources of water supply other than groundwater and the availability and use of lower qualities of groundwater that can still be put to beneficial use. For all proposed withdrawals, the applicant shall demonstrate to the satisfaction of the board:

2. The project utilizes the lowest quality water for the proposed activity;

4. Practicable alternatives, including design alternatives, have been evaluated for the proposed activity. Measures that would avoid or result in less adverse impact to high quality groundwater shall be considered to the maximum extent practicable.

Maximizing use of the Columbia aquifer meets the regulatory requirement of: “would avoid or result in less adverse impact to high water groundwater”
Grout for many recently constructed wells extend no more than 50-ft, this does not appear to meet DEQ construction requirements and other permit holders have been required to construct replacement wells. Most wells are classified as “IV (private for use other than drinking water)”
Most of the proposed withdrawals are from the deeper portions of the Yorktown-Eastover Aquifers.

Most wells are currently screened in the deeper middle or lower Yorktown-Eastover aquifers. It is likely most if not all of the proposed withdrawals screened in the middle or lower Yorktown-Eastover aquifers will meet the 80% criteria.
80% Drawdown Criteria Summary

- It is likely most if not all of the requested Poultry House withdrawals will meet the DEQ 80% drawdown criteria based on the following observations:
  - Withdrawal per facility is relatively low, reducing drawdown impacts at each individual location;
  - Distribution of facilities is relatively uniform across Accomack County reducing the impact of “clustered” withdrawals; and
  - Most of the wells are screened in the deeper middle and lower Yorktown-Eastover aquifer, where there is more head above the “critical surface” as defined by the 80% criteria.

It is unlikely the 80% drawdown criteria will result in a substantial number of wells relocated to the Columbia aquifer
Potential Adverse Impacts from the Deeper Withdrawals

- Recharge to the deeper aquifers is progressively less (as the intervening clays restrict flow).
- Reduced recharge results in increased loss of storage and increased potential for salt water intrusion.
- Deeper screen intervals greatly increase potential for upconing.
- Some wells are screened as deep as 300 feet bgs.
  - Water quality results were not provided in any of the 41 applications.
  - Even if current water quality is sufficiently fresh, it could very easily become brackish with use.

Some of the deeper wells may be, or may become brackish with use which may affect both cooling water use and consumption.
Summary

• 42 applications of 57 Poultry House applications have been reviewed.
  • This represents the majority (almost ¾) of the applications.
  • Requested withdrawal amounts and targeted aquifers are sufficiently similar to support the following observations.
  • As a class, the poultry house withdrawals:
    – Are the largest number of facilities
    – Individual withdrawal amounts are lower
    – Net effect is the total withdrawal amounts are smaller, and more widely distributed than the other permitted withdrawals.
  • Most of the demand is for cooling. Use of the Columbia aquifer for irrigation and cooling has been a primary use goal to reduce stress on the confined Yorktown-Eastover aquifer for the Groundwater Committee for over 20-years.
  • All of the wells reviewed are screened in the Yorktown-Eastover aquifer.
    – Most are in the deeper middle and lower Yorktown-Eastover aquifer.
    – These wells are more likely to meet the 80% drawdown criteria used by DEQ.
    – They have a substantially higher risk for saltwater intrusion (no water quality information was provided).
    – Many do not meet the DEQ construction requirements (for ground / gravel pack. DEQ has required some other permit holders to replace wells that do not meet the construction requirements.)
Based on all available data the Columbia aquifer is capable of providing yield and quality that meets the need for cooling water. Maximizing use of the Columbia aquifer meets a primary goal of the Groundwater Committee for maintaining a sustainable groundwater supply.

Summary (continued)

- Based on aquifer tests and actual use, the Columbia aquifer is capable of providing 50 gpm or more over many / most areas of Accomack County. This yield should be sufficient to meet the cooling water demand.
- Water quality for the Columbia is not quantitively “worse” than the Yorktown-Eastover.
  - Iron levels are similar
  - Nitrates are higher
  - Chlorides (salt) are lower
- High chlorides can be very detrimental to a cooling water system.
- The primary regulatory requirement for Columbia aquifer use is under the alternative source analysis requiring use of groundwater “would avoid or result in less adverse impact to high water groundwater”