How the Oklahoma Corporation Commission Can Help Rural Water Districts and Town Water Systems

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Oklahoma Corporation Commission
Oil and Gas Conservation Division
Today Talk Is About Two H2O topics:

1. The Commission’s drinking water protection activities, and
2. How we can help Towns/Water Districts find new ground water supplies for wells

Please do not snore loudly.
Historic Oil & Gas Fields Affect >60% of OK Townships
Current Oil and Gas Activities Can Affect Surface Waters at Wellsites
Oilfield Produced H2O (Brine) Affected Streams, South OK

Salinity Impaired Streams (yellow) and Sampling Locations (green, sized by TDS)
O&G Activities Can Affect Groundwater
Corm Comm Has Taken > 2000 Groundwater/Well Samples STATEWIDE Over The Last 20 Years

• Unfortunately, there have been cases of water well pollution, especially in older oilfields, including:
  – Petroleum,
  – Salts (from brine co-produced with oil),
  – Barium (from drilling mud)
Petroleum, Water Wells, all Depths

Water Well Samples That Exceed EPA Drinking Water Standards
(Includes irrigation, public supply, livestock, domestic, and unspecified water wells)

PETROLEUM EXCEEDS
- TPH 0-12 > 25 mg/L
- TPH 12-28 > 25 mg/L
- TPH 28-38 > 25 mg/L
- TPH 38-50 > 25 mg/L
- Barren > 5 ug/L
- Toluene > 1,300 ug/L
- Ethylene > 200 ug/L
- Xylenes > 10,000 ug/L

Major aquifers are blue

OCC water sample locations are determined by public request and suspicion of contamination. As a result, SAMPLE POINTS DO NOT REPRESENT A COMPREHENSIVE SURVEY OF STATEWIDE WATER CONTAMINATION.

Current as of February 2013
Heavy Metals in Water Wells – just 10

Water Well Samples That Exceed EPA Drinking Water Standards
(Includes irrigation, public supply, livestock, domestic, and unspecified water wells)

Major aquifers are blue
Some Other Pollutants in Water Wells

Water Well Samples That Exceed EPA Drinking Water Standards
(Includes irrigation, public supply, livestock, domestic, and unspecified water wells)

OTHER EXCEEDS
- Barium > 2 ppm
- Boron > 1 ppm
- Nitrates > 10 ppm

- Historic dense oilfields
- Historic dense UIC fields outside oilfields
- Lake
- River
- OWRB Aquifers
- County

Map showing locations of water well samples that exceed EPA drinking water standards, including barium, boron, and nitrates.
Salinity in Water Wells – Ouch!

Water Well Samples That Exceed EPA Drinking Water Standards
(Includes irrigation, public supply, livestock, domestic, and unspecified water wells)

SALINITY EXCEEDS
- Sodium > 250 ppm
- Chlorides > 250 ppm
- Total Dissolved Solids > 500 ppm
- Total Soluble Salts > 500 ppm

Major aquifers are blue.
### One Set of Salinity Sampling Results – Water Wells ~300’ deep;

<table>
<thead>
<tr>
<th>Who</th>
<th>Na ppm</th>
<th>Cl ppm</th>
<th>SO4 ppm</th>
<th>TDS or TotlSolSalts</th>
<th>Na/Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>1314</td>
<td>3323</td>
<td>798</td>
<td>7597</td>
<td>0.395</td>
</tr>
<tr>
<td>L</td>
<td>665</td>
<td>2171</td>
<td>370</td>
<td>4996</td>
<td>0.306</td>
</tr>
<tr>
<td>C</td>
<td>438</td>
<td>1047</td>
<td>722</td>
<td>3247</td>
<td>0.418</td>
</tr>
<tr>
<td>D</td>
<td>210</td>
<td>460</td>
<td>357</td>
<td>1756</td>
<td>0.457</td>
</tr>
<tr>
<td>N</td>
<td>184</td>
<td>139</td>
<td>302</td>
<td>1095</td>
<td>0.662</td>
</tr>
<tr>
<td>B Front yard</td>
<td>92</td>
<td>417</td>
<td>79</td>
<td>1327</td>
<td>0.441</td>
</tr>
<tr>
<td>B Backyard</td>
<td></td>
<td></td>
<td></td>
<td>1600</td>
<td></td>
</tr>
</tbody>
</table>

- **Na/Cl Ratio <0.6 indicates oilfield source**
- **Sulfate SO4** – from natural BaSO4, which makes Rose Rocks
- **Exceeds 250 ppm Chloride** secondary drinking water standards
We can’t prevent impacts that have occurred from Historic O&G activity but

We can help PROTECT water supplies from current oil and gas activity
Corp Comm has General Requirements To Protect Groundwater —

• Clay or textile membrane lined pits
• Surface Casing – steel cemented in place to protect fresh water aquifers from oil & other fluids in the well bore.
• Oil and Gas wells must be cased through the fresh to mildly saline from the surface to 50’ below the Base of Treatable Water.
• NO drilling in a Wellhead Protection Area
For added Protection – Cities, Towns and Rural Water Districts Can Request Special Oilfield Rules to Protect Surface and Groundwater Supplies
Corp Comm’s Special Oil Field Rules

165: 10-7-6 Protection of Municipal **Water Supplies** – surface OR ground water

“The Commission, upon application of any municipality **or other governmental subdivision**, may enter an order establishing special field rules within a defined area to protect and preserve fresh water and fresh water supplies”

**Town and Rural Water Districts are included**
Corp Comm Can Set Special Field Rules adopting a Rule or by an Administrative Law Order

Exactly what procedures are set depends on the needs & requests of the water district.

Lake (watershed) and Aquifer examples
Special Rule Areas – Some Protect H2O

Cushing Lake Area
2nd Example

Atoka Lake-McGee Creek
1st Example
Example #1 - Lake Atoka and streams in watershed are in steep-sided valleys; Hillside erosion, sediment infill, and O&G pits were concerns expressed.
IN RULES ADOPTED -

During the drilling/completion of an oil and gas within six (6) miles of the maximum water surface level contour line:

• Install erosion protection for drill site and roads;
• Maintain an earthen retaining wall downslope of the well ..... Minimum of 330 feet long and compacted height of two (2) feet, to contain spills and muddy stormwater]
• Maintain a (stormwater) diversion ditch upslope of the well to keep stormwater from picking up pollutants by flowing over a wellsite
• **Pit Liner** - higher than standard requirements, using linear low density polyethylene, 20 millimeters thick, conforming to GRI Test Method GM17;
Field Rules Example #2 - Cushing Lake Concerns - Drilling practices, salts, blowouts
Field Rules, Cushing Lake & Watershed

1. Within 1350’ of the lake high water mark, the well drilling derrick must be completely enclosed before drilling starts “as precaution against the spraying of oil due to blowouts or other causes”;

2. If ANY Produced salt water – shut the well down until “adequate means are had for the disposal of salt water”;

3. Pits must be “sufficiently large” to hold all oils, sands etc. removed from the well;

4. All of such material must be removed and deposited outside the water district (i.e. no land application of drilling mud or cuttings within the district);
Special Field Rules Example #3 - Recharge area on Rush Springs Aquifer
Rush Springs Aquifer – Simple Rule

• **165:10-29-3. Rush Springs Sandstone**

• (a) **Scope** - List of townships and sections in Aquifer outcrop area being protected

• (b) **Commercial pits prohibited.** The construction, enlargement, reconstruction or operation of any commercial pit (as defined in OAC 165:10-9-1) in any area listed in subsection (a) above, is prohibited.
To Start the Process Toward A Special Field Rule in Your Area

Contact:
Mr. Tim Baker
Manager of Pollution Abatement
T.baker@occemail.com
405-522-2763
Corp Comm’s Assistance to Water Districts to Find NEW Water Supplies

Corp Comm has a lot of data regarding soil and rock below the ground surface:

- Depth to the base of fresh/treatable water – which can be 50’ - 2500’+; location dependant
- Well Logs from some of the 500,000 wells drilled to date in OK – both O&G and non-productive wells
- Other geologic and water data we can access, from USGS, OGS, OWRB, etc.
Statewide Mapping of Former Oilfield Areas With Possible Pollution

Example:
East Edmond

Oklahoma County 14N 2W Oilfield Wells

Legend:
- UIC Wells
- OG Well Type
- CLASS
- OIL
- GAS
- DRY
- SWD
- INJ
- P&A
- TA
- WSW
- 
- No type listed
- OG wells 750 ft
- OG wells 1400 ft
- Township-Range Grid
- Thunderhead Hills Area

Lake Arcadia
Spring Creek
Maps of Base of Treatable Water (BTW)

• BTW is the base of the fresher water = the top of very saline water underlying fresh water
• We map this so we can tell drillers how deep to set Surface casing in oil & gas wells, to prevent polluting fresh water aquifers.
• It also tells us the thickness of the fresh water zone that could be available for water wells.
• Corp Comm mapped the BTW across most of the state >15 years ago, and we are now re-mapping it with more data using GIS.
BTW - Seminole & Carter Co. Example Well Logs
Base Treatable Water is picked from electric logs run in oil & gas wells

Fresh Water Zones

Saline Water Sands

Brackish Water and Oil Sand
Saline water within 300' of the surface

Saline water 1300' below the surface – more possible fresh H2O zones

Gentle BTW Contours

Steep BTW Contours
Two Example Wells (4 miles apart)
Counties with new GIS-BTW maps

County Status - Base of Treatable Water (BTW)
One Rural Water District Example

• This Lincoln County water district needed more water
• There were a dozen square miles where they had potential locations – where was their best shot?
Types of Information Provided, To help pre-plan drilling

Table I - Locations of former E&P wells with logs

NOTE – there are more old wells that DID NOT produce than producers

<table>
<thead>
<tr>
<th>Sec-T-R</th>
<th>Quarters</th>
<th>Likely Max depth, feet, of Freshest H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-16N-4E</td>
<td>NESESW</td>
<td>250</td>
</tr>
<tr>
<td>2-16N-4E</td>
<td>SESESE</td>
<td>430</td>
</tr>
<tr>
<td>3-16N-4E</td>
<td>SWNESE</td>
<td>214</td>
</tr>
<tr>
<td>4-16N-4E</td>
<td>NWNWSE</td>
<td>200</td>
</tr>
<tr>
<td>5-16N-4E</td>
<td>SESESE</td>
<td>360</td>
</tr>
<tr>
<td>8-16N-4E</td>
<td>SWSWSE</td>
<td>330</td>
</tr>
</tbody>
</table>
BTW Map, Water Wells, Oilfields, Logs

Red area is old oilfield, skip or drill with special precautions.

More than 300' down to salt water, and old E&P well (RED DOT) shows sands.

More than 800’ down to salt water @ Arrow; possible new well location.

Existing Water wells where BTW > 300’

Less than 100’ to saline water; no water wells.
BTW Map, Water Wells, Oilfields, Logs

Lincoln County

Depth to Base of Fresh Water
Sections: 15, 16, and 17 in T16N-R4E

Red area is old oilfield, skip or drill with special precautions

More than 300’ down to salt water, and old E&P wells (RED DOTs) show sands – possible water well locations

Less than 50’ to saline water; no water wells

Legend
- Available Electric Log Data for Fresh Water
- Historic_dense_oilfields
- Water Wells (data below)

<table>
<thead>
<tr>
<th>FID</th>
<th>Shape *</th>
<th>Well_ID</th>
<th>Qtrs</th>
<th>SEC_TWP_R</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
<th>Date_Const</th>
<th>Use</th>
<th>TD_ft</th>
<th>Static_WL</th>
<th>Est_Yd</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Point</td>
<td>94201</td>
<td>SENE</td>
<td>15-16N-04E</td>
<td>35.857471</td>
<td>-96.8603</td>
<td>4/4/2005</td>
<td>Domestic</td>
<td>80</td>
<td>n/a</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>Point</td>
<td>112520</td>
<td>SWSE</td>
<td>15-16N-04E</td>
<td>35.856433</td>
<td>-96.870083</td>
<td>8/30/2007</td>
<td>Domestic</td>
<td>192</td>
<td>79</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>Point</td>
<td>31840</td>
<td>NEW</td>
<td>15-16N-04E</td>
<td>35.868432</td>
<td>-96.808787</td>
<td>2/8/1995</td>
<td>Domestic</td>
<td>200</td>
<td>64</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>Point</td>
<td>23160</td>
<td>NESW</td>
<td>17-16N-04E</td>
<td>35.857589</td>
<td>-96.808787</td>
<td>8/3/1989</td>
<td>Domestic</td>
<td>110</td>
<td>n/a</td>
<td>15</td>
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<tr>
<td>4</td>
<td>Point</td>
<td>26160</td>
<td>NENW</td>
<td>17-16N-04E</td>
<td>35.857589</td>
<td>-96.808787</td>
<td>8/3/1989</td>
<td>Domestic</td>
<td>180</td>
<td>n/a</td>
<td>12</td>
</tr>
</tbody>
</table>
### Detailed Recommendations (with usual iffy qualifiers in text)

<table>
<thead>
<tr>
<th>Sec-T-R</th>
<th>Recommend?</th>
<th>Max depth to drill</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-16N-4E</td>
<td>Yes</td>
<td>250, possibly 450’ where depth to BTW is thickest</td>
</tr>
<tr>
<td>3-16N-4E</td>
<td>Yes E/2, No W/2</td>
<td>214</td>
</tr>
<tr>
<td>4-16N-4E</td>
<td>Yes, except East of the 200’ contour line</td>
<td>200</td>
</tr>
<tr>
<td>5-16N-4E</td>
<td>Yes</td>
<td>360</td>
</tr>
<tr>
<td>8-16N-4E</td>
<td>Yes</td>
<td>260 or 330</td>
</tr>
<tr>
<td>9-16N-4E</td>
<td>Yes</td>
<td>220</td>
</tr>
<tr>
<td>10-16N-4E</td>
<td>Perhaps for NE corner; No for the rest</td>
<td>220</td>
</tr>
</tbody>
</table>
How to Request

• **Rural Water Districts** – contact Jeannie Anthony, Oklahoma Rural Water Association; she will assemble your information and send what we need. ACOG will do this in Central OK.

• **Towns** – ACOG does this for Central OK; otherwise call Corp Comm
Other Possibly Useful Information

Corp Comm has been collecting historically aerial photos from the 1930s to the 1980s.

If you want to know what was on a particular site ‘back in the day’, perhaps to make sure that you are not proposing to install a well or build district facilities where there was once a well or old gas station or other problem site, ask us to see!
One Site, Back In Time

We were trying to figure out why EM data showed a possible groundwater salinity problem at this site.

2006 and 1978 air photos
Until we looked back in time

1963

1956

2 Large Salt Water Pits

3 Large Pits
Maps, Current Air Photo coverage (we are processing more weekly) 1930s
OCC Historical Aerial Photo Inventory
1950-1959
Any Questions?
Maps of Old Oilfields

If you want to know what old oilfields are in YOUR rural Water District:

• INCOG (NE OK), ACOG (Central OK), and ASCOG (SW OK) will make maps for you – We have contact information handouts at our booth

• For other areas, ask Corp Comm (Jeannie Anthony, ORWA, can arrange)
Maps of Old Oilfields
Dense OG Fields and All UIC Wells

This is NE OK, INCOG area
Slaughterville
Pre-1980 Oil Wells and Dense Wellfields