Abandoned Water Wells in Canada

Water Technologies Symposium
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Banff

Presented by Jeff Printz
AAFC, Medicine Hat
Outline

- Introduction – Risks Posed by Abandoned Water Wells
- Objectives and Results of the Study
- Trends/Issues of Concern
- Technical Aspects
- Recommendations
Definition:

A water well is defined as “abandoned” when:

1) it is currently not in use, and

2) is not intended to be used in the future for water supply purposes.
Aquifer Contamination

Potential Points of Entry:
- Top of Casing
- Unsealed spaces along the outside of the casing
- Holes in the casing
Potential Cross-Contamination

Nearby Well in Use

Old Well
Groundwater Jurisdiction

- Provincial and Territorial governments exercise rights over natural resources within their boundaries and thus have primary responsibility for management and protection of both surface and groundwater.

- The Federal government has jurisdiction over fisheries, navigation, international treaties and water on federal lands.
Groundwater Jurisdiction

- The two levels of government share responsibilities for water management with implications for interprovincial concerns and also cooperate in water inventory, data collection, and research.

- The provinces and the federal government share responsibility for agriculture and health.
Why is Ag Canada Involved?

- One of the Agri-Environment Services Branch (AESB) goals is: improving the agriculture and agri-food sector’s environmental performance on agricultural landscapes.

- AESB has experience in the beneficial management practice of water well decommissioning and can provide a national perspective on this issue.
Abandoned Water Wells in Canada: Background Report

A Report Prepared for Agriculture and Agri-Food Canada

Robert J. Summers, Ph.D.
Objectives of the Study

- Review and summarize the status of provincial level reporting and collection of water well data across Canada
- Provide a summary of the estimated numbers of constructed and abandoned water wells in each Province/Territory
- Identify, summarize and compare the technical methods of water well decommissioning regulated and practiced across Canada and four States in the U.S. (Nebraska, CA, Texas, and New York)
Results of the Study

- The study found that a large proportion of water wells are not represented in Provincial databases.
- Numerous water wells were constructed prior to mandatory reporting and since mandatory reporting has been in place, compliance has been partial.
Results of the Study

- Reporting of water well decommissioning across the country was considered rather dismal.

- The limitations of the available data make it very difficult to estimate the number of water wells in use, inactive and decommissioned.
Results of the Study

- It was determined that the most effective method for estimating the total number of water wells constructed and the number of abandoned or inactive wells was to consider rural settlement patterns (using Canada Census data) along with assumptions based upon typical histories of wells on rural properties.
## Estimated Number of Abandoned Water Wells

<table>
<thead>
<tr>
<th>Province</th>
<th>Estimated Total Number of Active Wells</th>
<th>Estimated Number of Abandoned Wells</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>135,000</td>
<td>220,000</td>
</tr>
<tr>
<td>Alberta</td>
<td>162,000</td>
<td>292,000</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>71,000</td>
<td>309,000</td>
</tr>
<tr>
<td>Manitoba</td>
<td>91,000</td>
<td>187,000</td>
</tr>
<tr>
<td>Ontario</td>
<td>513,000</td>
<td>730,000</td>
</tr>
<tr>
<td>Quebec</td>
<td>350,000</td>
<td>617,000</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>148,000</td>
<td>136,000</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>166,000</td>
<td>140,000</td>
</tr>
<tr>
<td>PEI</td>
<td>28,700</td>
<td>37,000</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>20,300</td>
<td>72,000</td>
</tr>
<tr>
<td>Yukon</td>
<td>1,000</td>
<td>Unknown</td>
</tr>
<tr>
<td>NWT</td>
<td>Unknown</td>
<td>Unknown</td>
</tr>
<tr>
<td>Nunavut</td>
<td>Very Few</td>
<td>Very Few</td>
</tr>
<tr>
<td>Canada</td>
<td>1,686,000</td>
<td>2,740,000</td>
</tr>
</tbody>
</table>
Results of the Study

- More than 2.5 million abandoned water wells across Canada pose some level of risk of contamination to the quality of groundwater in aquifers.
B.C., Alberta, Ontario, N.S., N.B., Newfoundland and PEI all limit who can construct and work on water wells through the granting of certificates based upon apprenticeship, coursework, experience and competency testing.
Governance re: Construction

- Manitoba and Quebec require water well contractors to have licences, but obtaining a licence only requires completing a form and paying a fee; there are no competency requirements.

- There is currently no requirement for licensing water well contractors in Saskatchewan.
Governance re: Construction

- Both Manitoba and Saskatchewan require that the drilling rigs themselves be licenced for water well construction.
Construction Standards

- B.C., Alberta, Ontario, N.S., N.B., PEI and NF provide very detailed construction standards.
- Ontario’s standards are particularly meticulous.
- Other provinces rely on older and less comprehensive regulations, many of which would be considered to be lacking relative to the standards promoted by the industry.
Construction Standards

- All provinces regulate the sealing of the annulus (the open space along the outside of the casing) to some degree and make clear mention of the sealing of the annular space, except Manitoba where the regulations only stipulate that surface water must not be able to enter the well.
General Trends

- Regulations and recommendations regarding abandoned water wells range from being very lax to being very stringent across Canada.
- Most homeowners do not see the need for proper decommissioning.
Trends/Issues of Concern

- Interview respondents across the country indicated mixed experiences with the professional water well industry.

- Where there have been a significant number of water well decommissioning subsidy programs, interview respondents indicated that capabilities were expanding.
Current systems of mapping aquifer vulnerability are based largely upon the attenuation effectiveness of the strata above aquifers, but abandoned water wells create a bypass through these layers.

Such mapping of aquifer vulnerability is of limited assistance in prioritizing regions and sites for decommissioning.
Trends/Issues of Concern

- The provinces all provide different levels of detail regarding sealing materials.
- Bentonite grouts are broadly accepted as fill material but research in Nebraska indicates some weaknesses of this material in dry conditions.
Trends/Issues of Concern

- The use of sand as fill material is allowed in some provinces and not in others.
- There is little research done on the impact of layering plugs and permeable fill materials.
Figure 4: Sealing a small diameter screened or open hole well. Alternating layers of sand and bentonite are used. It is important to have a bentonite seal at the base of the casing.
Trends/Issues of Concern

- Exploring bentonite/sand mixtures (for example 20% bentonite, 80% sand) could be valuable in improving effectiveness and lowering costs.
Technical Aspects

- Decommissioning is made much more difficult by the presence of open space along the outside of the casing (the annulus of the well)

- In practice, the annular space of older wells (and too often newer wells) is not sealed properly with impermeable material
Technical Aspects

- To allow the void to be effectively filled in a decommissioning procedure, some regulations recommend that the casing of a water well be removed from the hole if possible.

- Alternatively, the well casing can be punctured (and left in place) to allow the cement or bentonite grout to push out into the annular space.
Technical Aspects

- The cost of decommissioning ranges greatly depending upon the methods employed.
- The approach currently advocated in Ontario involves the use of professional contractors and equipment and other practices that increase cost.
Downhole Camera
Least Expensive Method

Diagram showing a coarse mesh screen and a minimum 4" diameter well. The water table is shown at 350' max. well depth, with a max. well depth of 500'.
Grouting Procedure
Wooden Sucker Rod Removed from Well
Recommendations

- Continue to promote and inform landowners with regards to the benefits and practices of proper water well decommissioning.

- Water well contractors are on the front line of the problem of abandoned wells and having their informed and active involvement in addressing the issue is critical.
Recommendations

- On-the-ground well owner surveys can be very valuable to develop accurate information regarding the numbers of wells in use, abandoned, inactive, and decommissioned.
Recommendations

- Given limited funding to subsidize decommissioning, there is value in knowing which areas should be prioritised.

- Vulnerability mapping for abandoned wells should emphasize surface risks, well densities, multiple aquifer conditions, agricultural intensity, industrial intensity, and aquifer characteristics.
Recommendations

Further investigation needs to be done on the relative effectiveness and cost of alternative approaches:

- The use of professional contractors and equipment
- Pouring in coated bentonite pellets