

Dilution is not a Salt Solution

Case Studies: Assessment, Containment and Recovery of Two Produced Water Spills into Domestic Use Aquifers in Central Alberta

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There have been literally billions of cubic metres of saline water produced from oil and gas formations in central Alberta over the past 60 years. Produced water in Alberta is often highly saline and may contain up to 150,000 mg/L chloride. Historical practices did not always manage this water in a responsible way relative to current environmental standards. Today, there is a lot of old surface and subsurface infrastructure that is still used to transport, store and dispose of produced water. Corrosion, metal fatigue and physical damage continue to result in large one time or cumulative releases of hundreds to thousands of cubic metres of salt water.

Highly saline produced water is dense and when released into a fresh water aquifer it will quickly sink to the base of the most permeable zone. Long lasting salinity stratification in the aquifer will occur where the release is large and there is sufficient difference in density. Once at the base of the aquifer, dense salt plumes will flow by gravity downslope on the top of the underlying aquitard or aquiclude. This movement is often in a different direction than groundwater flow. These characteristics must be considered when designing assessment and remediation plans.

Alberta's fresh water aquifers are increasingly being recognized as a valuable resource. Regulations under the Environmental Protection and Enhancement Act and the Water Act require both protection of this resource and remediation should an aquifer become salinized. Current remediation criteria for chloride in groundwater vary dependent on land use and receptor and are as low as 100 mg/L for irrigation purposes. Using this stringent criterion, a 100 m³ release of produced water with a chloride concentration of 100,000 mg/L has the potential to unacceptably salinize up to 100 million litres of water. It is obvious that past spill response practices that relied mainly on dilution are no longer acceptable.

This paper will explore the assessment and remediation of two sites where produced water spills affected domestic use aquifers. For each site the following topics will be discussed:

- applicability and limitations of assessment tools and methods;
- rationale used to select the containment and remediation methods;
- recovered water management, maintenance and monitoring programs;
- performance assessments based on the produced water equivalents recovered and the extent and concentration of groundwater salinity; and
- future system enhancements and long term operational requirements.

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