



Review of the Thyne Report's Analysis and Conclusions of Mamm Creek Phase II Hydrogeologic Study

Prepared for:

Colorado Oil & Gas Conservation Commission

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Thyne Report Assertions

- Chloride (Cl^-) and Methane (CH_4) concentrations in groundwater are increasing over time with number of gas wells installed.
- **The data do not support Dr. Thyne's assertions - The data show that**
 - **Chloride (Cl^-) is NOT increasing through time**
 - **Methane (CH_4) is NOT increasing through time**

Thyne Report Assertions (cont.)

All CH₄ (and most Cl⁻) is from Williams Fork Formation

1. Background (pre-drilling) methane concentrations in groundwater are less than 1 mg/L
2. “Only source of Na-Cl in the study area is produced water from the Williams Fork” Formation
3. CO₂ from Williams Fork Formation is migrating and then being reduced to CH₄ biogenically

The data do not support Dr. Thyne’s assertions – The data show:

1. There is no technical basis presented for the background concentration of 1 mg/L. The background concentration ranges from non-detect to approximately 3.5 mg/L
2. The Wasatch Formation contains elevated chloride and/or sodium-chloride water types (especially in Molina-like sandstone) prior to the start of major oil and gas drilling operations
3. The Wasatch Formation contains thermogenic methane (CH₄) prior to 1990
4. Carbon dioxide (CO₂) from the Williams Fork Formation, if reduced to methane, is not the same type of methane detected in domestic wells

Summary on Chloride Concentrations in Groundwater

- The data show that the average monthly chloride (Cl^-) concentrations do not increase with time
- High variability in average monthly chloride (Cl^-) concentrations is related to number of samples collected
- The bars on the following graph show the variations in chloride concentrations within \pm one standard deviation of the average
- The data set includes duplicate samples and multiple samplings of the same well. These inclusions bias the analysis to the “worst case”.

Conclusion: The data clearly show that there is no increase in chloride concentrations with time

Summary on Methane Concentrations in Groundwater

- There is no technical basis that background methane (CH_4) concentrations in groundwater are less than 1 mg/L. The range is from non-detect to approximately 3.5 mg/L.
- High variability in average monthly methane (CH_4) concentrations is related to number of samples collected
- The bars on the following graph show the variations in methane (CH_4) concentrations within \pm one standard deviation of the mean (average)
- The data set includes seep monitoring wells, duplicate samples, and multiple samplings of the same well. These inclusions bias the analysis to the “worst case”.

Conclusion: The data clearly show that there is no increase in methane concentrations with time

Summary and Conclusions

- **The water-quality data do not support Dr. Thyne's assertions that chloride and methane concentrations are increasing with time or with the number of gas wells.**
- **The methane detected in domestic wells is not from the flow of methane or CO₂ through fractures or the annulus of gas wells.**

Potential sources:

Naturally occurring (biogenic) methane from naturally occurring carbon in soil gas and groundwater.

Diffusive fractionation that occurs over millions of years (this diffusion does not result in increasing concentrations with time).