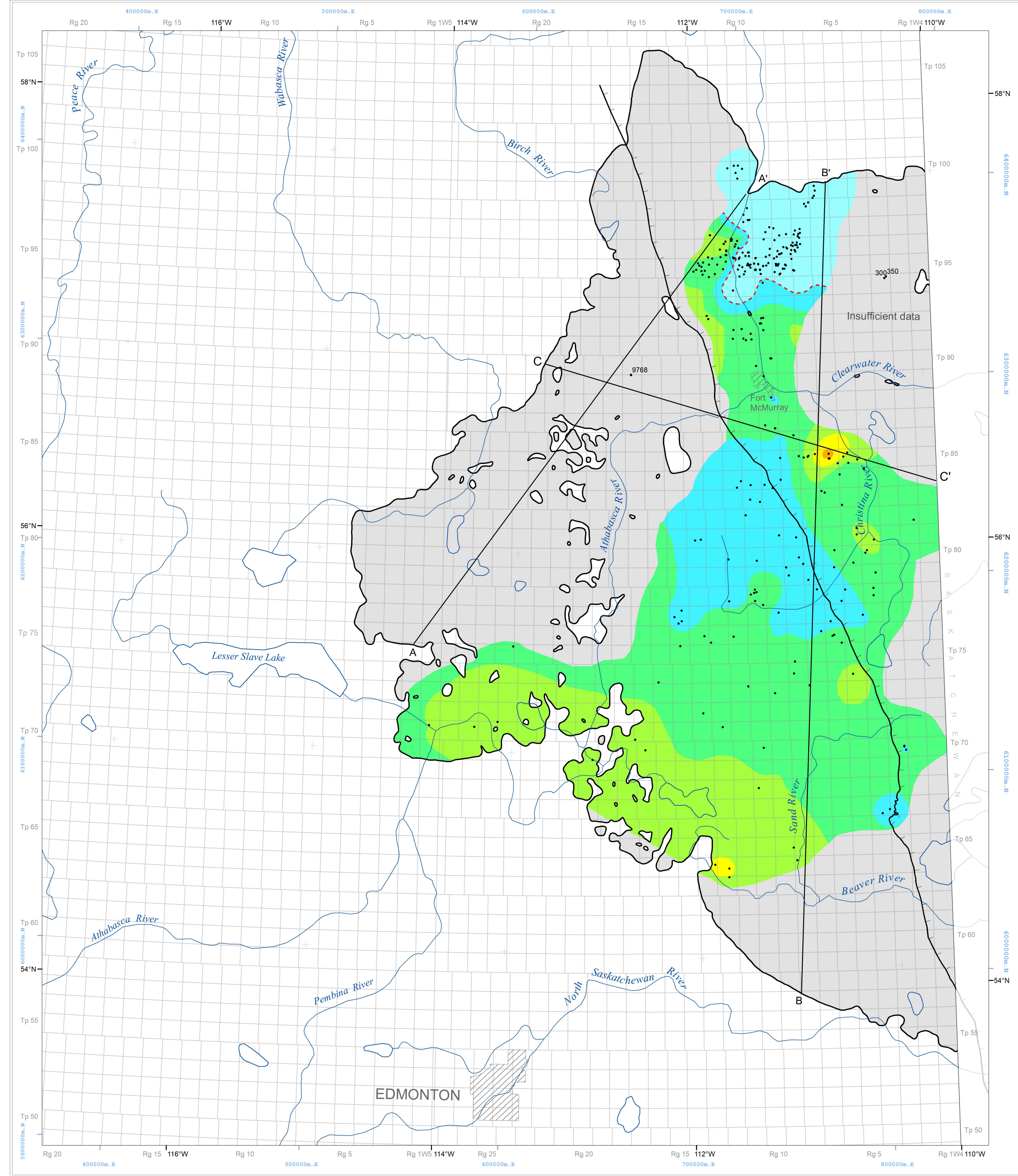
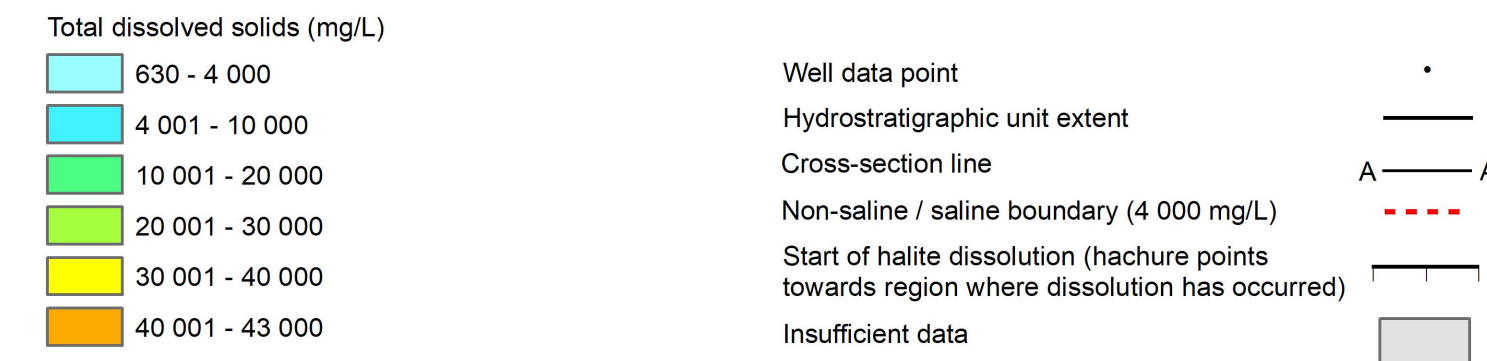


TOTAL DISSOLVED SOLIDS  
MCMURRAY HSU



SYMBOL LEGEND



This map depicts the distribution of total dissolved solids (TDS) in groundwater in the McMurray hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the 3D Provincial Geological Framework Model of Alberta, Version 2 (Alberta Geological Survey, 2019a). The relationship of the McMurray HSU with the units above and below as well as its geometry can be seen in Figures 1 and 2.

Methodology

The TDS distribution map is a result of an empirical Bayesian kriging technique using publicly available data from 81 monitoring well locations compiled into an Alberta Environment and Parks database for the mineable and in-situ oil sands areas, 8 water wells in the Alberta Water Well Information Database, 202 locations compiled from a Ph.D. thesis (Cowie, 2013), and 18 formation water analyses from oil and gas wells. A screening process modified from Jensen et al. (2013) was used to ensure that only representative formation water chemistries were used.

Measured TDS values range from 300 mg/L to approximately 280 000 mg/L. The low values of TDS show the influence of recent recharge on McMurray HSU water chemistry, while the high TDS values reveal areas where the McMurray HSU is connected to deeper, highly saline groundwater from Devonian units. A number of anomalously high TDS regions fall within the area of halite dissolution from underlying Middle Devonian strata in the region (Hauck, 2020). The final gridded map surface was clipped based on the spatial distribution of representative chemistry data. Residual values are plotted at each location (Figure 3) to indicate where underprediction and overprediction occurs compared to the measured TDS values, and highlights where the highest TDS values are.

Additional formation-scale hydrogeological maps for the McMurray HSU are presented in Figures 4 and 5. Figure 4 shows the distribution of hydraulic head in the McMurray HSU, with hydraulic heads calculated using fresh water density. Figure 5 shows the water driving force (WDF) map for the McMurray HSU. The WDF vector map allows identification of areas where buoyancy has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). Buoyancy does not appear to have a significant effect on groundwater flow in the McMurray HSU.

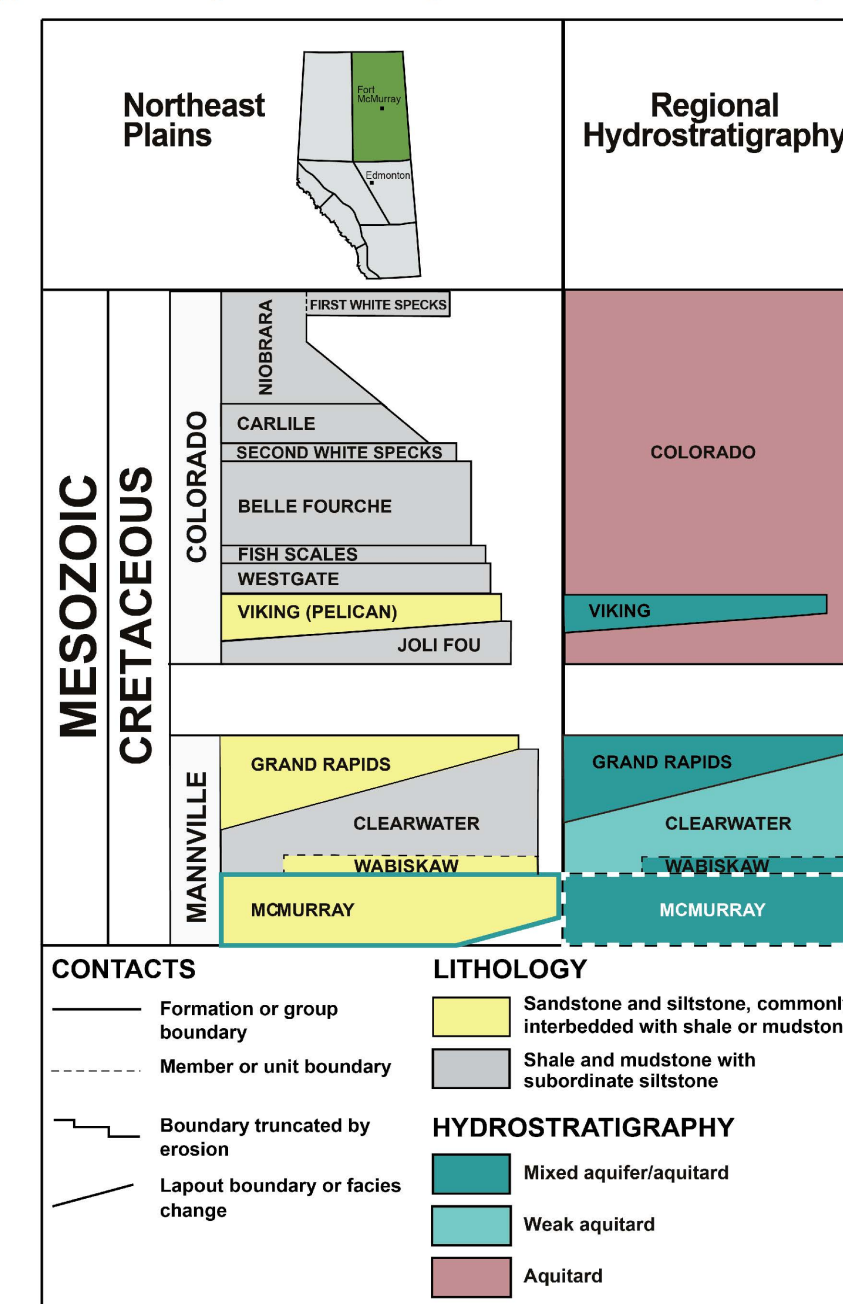


Figure 1. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlight the McMurray stratigraphic unit. Dashed white lines depict the McMurray HSU within the regional hydrostratigraphy. Strata above the Colorado Group are not shown.

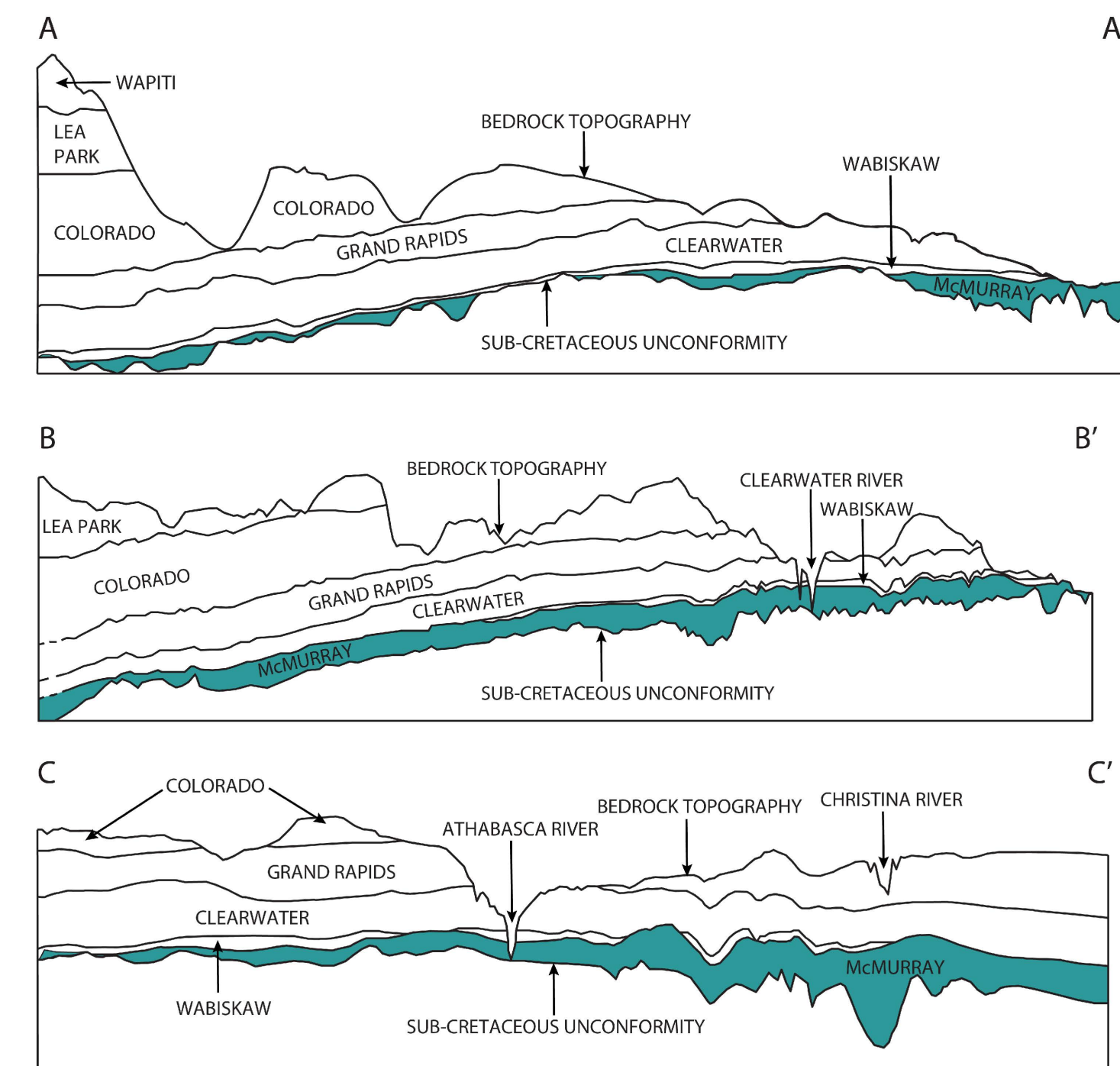


Figure 2. Schematic cross-sections identifying the geometry and variable thickness of the McMurray HSU (not to scale). Dashed lines in the southern extent of cross-section B-B' indicate that the Grand Rapids, Clearwater, and McMurray formations transition into equivalent strata to the south.

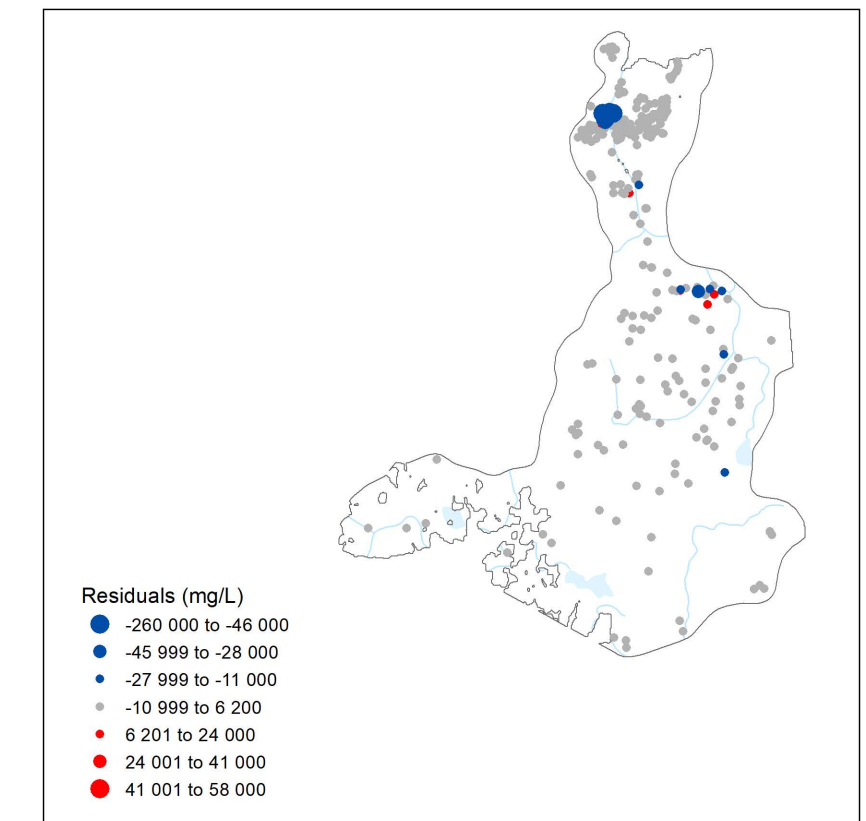


Figure 3. Calculated residuals between the modelled distribution of TDS and measured TDS values. Symbol classes are based on the standard deviation of the calculated residuals.

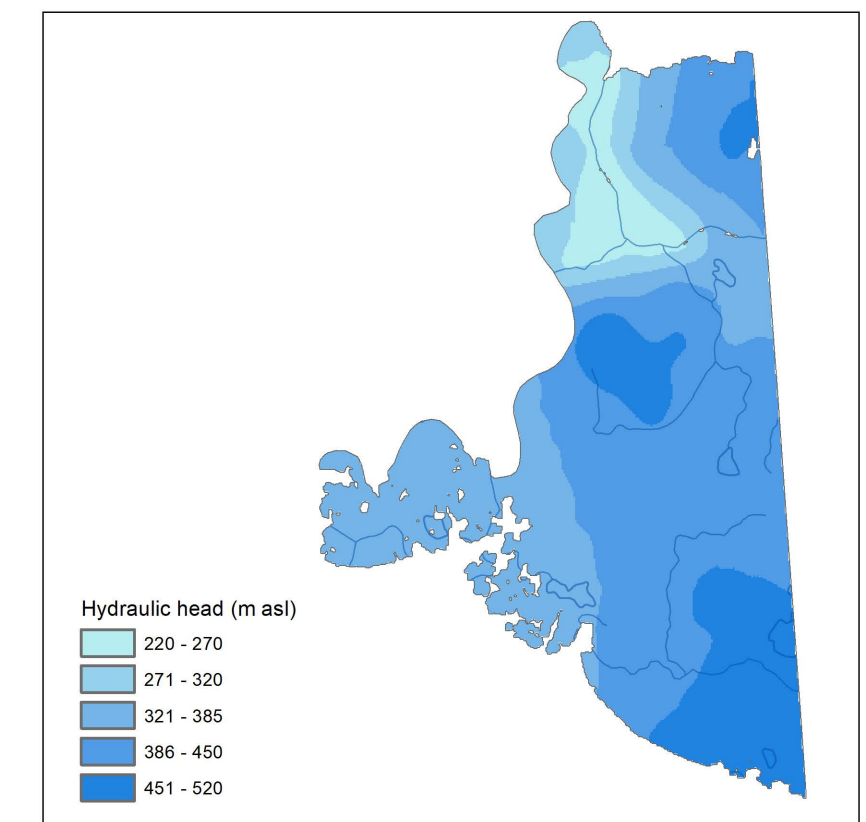


Figure 4. Distribution of hydraulic head in the McMurray HSU (Nakevska and Lemay, 2020). The map extent is based on the spatial distribution of hydraulic head data and differs from the extent of the main map.

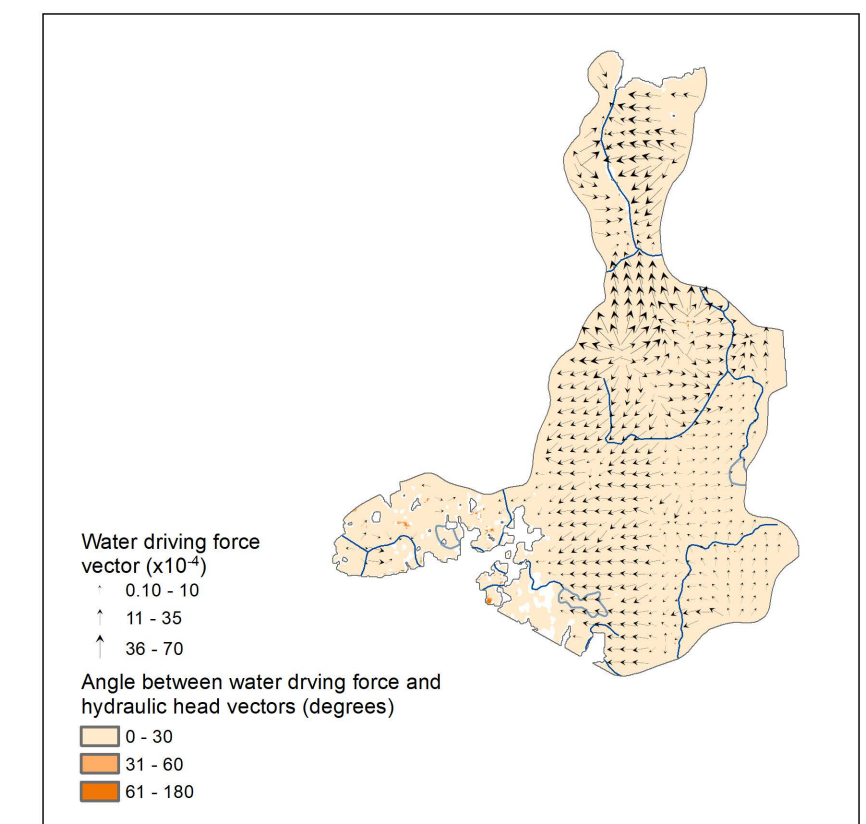


Figure 5. Water driving force map of the McMurray HSU. The map only covers the area where hydraulic head and TDS gridded surfaces overlap.

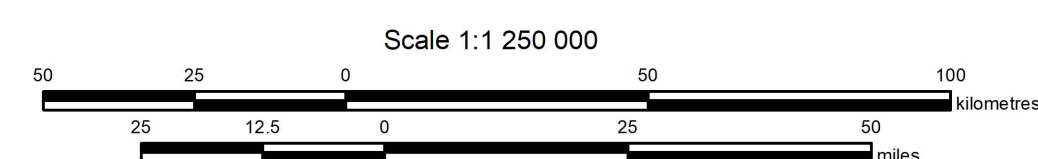
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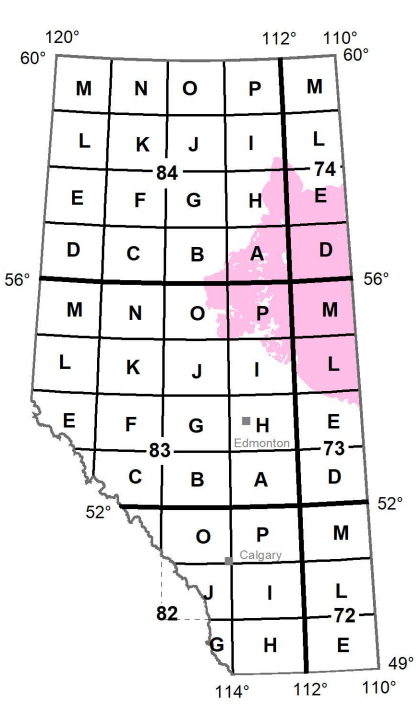
Map 612

Distribution of Total Dissolved Solids in the  
McMurray Hydrostratigraphic Unit

Hydrogeology by: T.G. Lemay and N. Nakevska



Projection: 10 Degree Transverse Mercator  
Datum: North American Datum, 1983



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