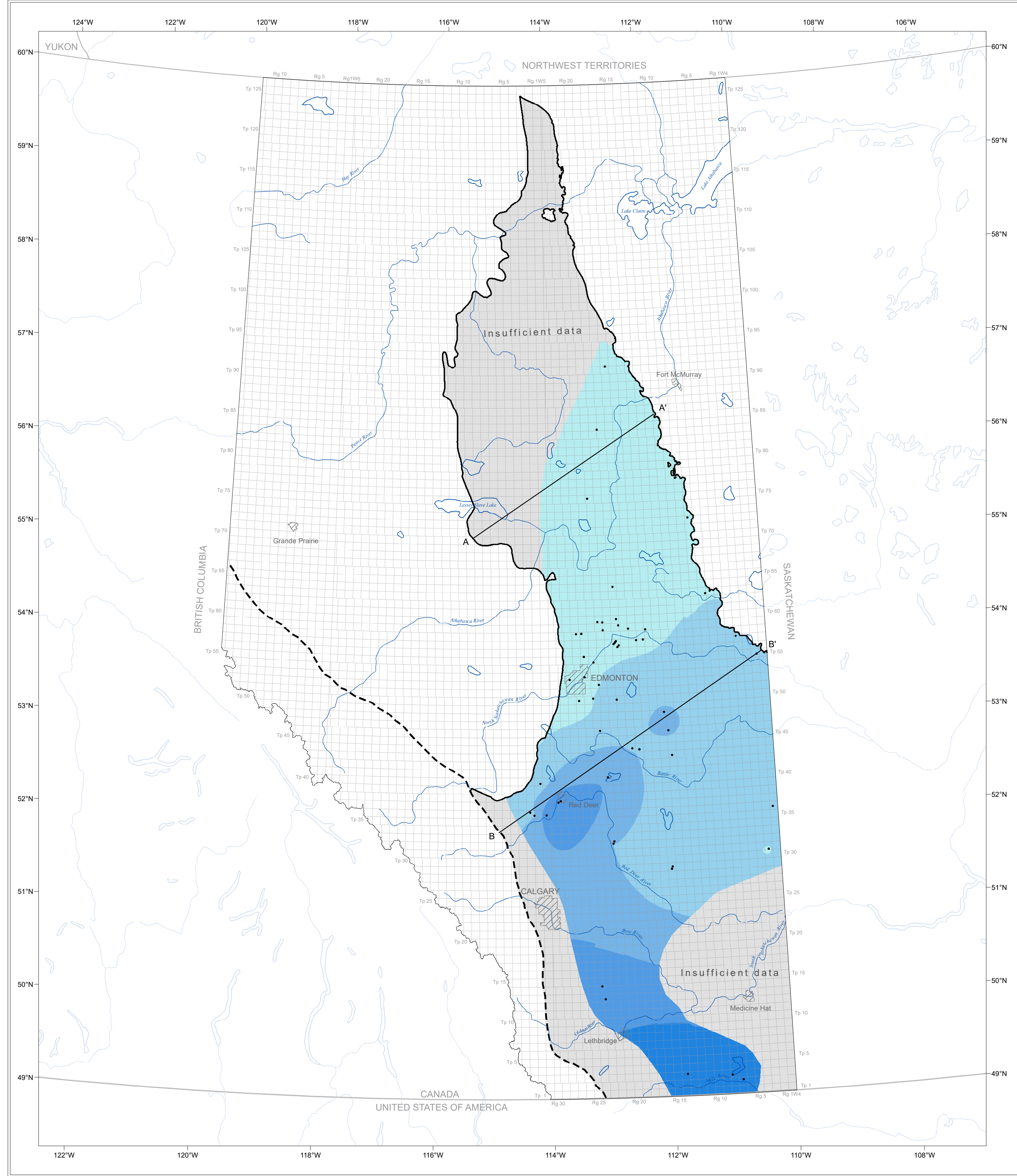


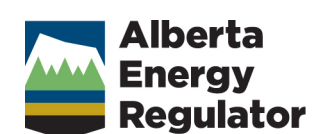
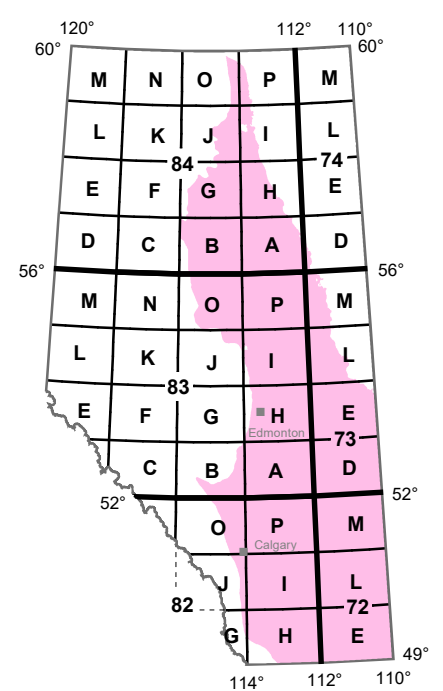
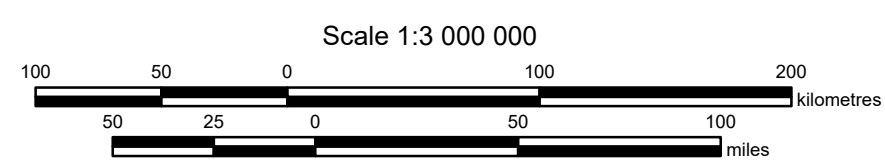
HYDRAULIC HEAD
COOKING LAKE HSU



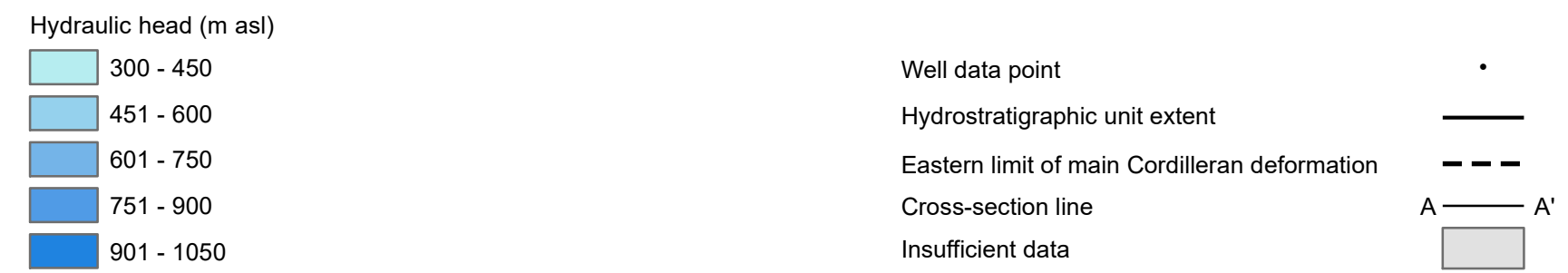
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Map 616
Distribution of Hydraulic Head in the
Cooking Lake Hydrostratigraphic Unit
Hydrogeology by: J. Brinsky



SYMBOL LEGEND



This map depicts the distribution of hydraulic head in the Cooking Lake 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 Cooking Lake HSU with the units above and below as well as its geometry can be seen in Figures 1 and 2.

Methodology

The hydraulic head distribution map is a result of an empirical Bayesian kriging technique using publicly available pressure data from 60 drillstem tests from oil and gas wells. A screening process modified from Jensen et al. (2013) was used to ensure that only representative pressures were used to calculate equivalent freshwater hydraulic heads. The final gridded map surface was clipped based on the spatial distribution of representative data. Residual values are plotted at each location (Figure 3) to indicate where underprediction or overprediction occurs compared to the measured hydraulic head values.

Using the methodology of Singh et al. (2017) the Cumulative Interference Index (CII) was applied to identify and remove tests that have been influenced by production or injection (Figure 4). Additional formation-scale hydrogeological maps for the Cooking Lake HSU are shown in Figures 5 and 6. Figure 5 illustrates the distribution of total dissolved solids in the Cooking Lake HSU. Figure 6 shows the water driving force (WDF) vector map for the Cooking Lake HSU. The WDF vector map allows identification of areas where the buoyancy effect of formation water density has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). For the majority of the Cooking Lake HSU, buoyancy does not appear to have a significant effect on groundwater flow. However, buoyancy may have some influence in the dark orange areas where larger angles between the WDF vector and hydraulic gradient vector are observed.

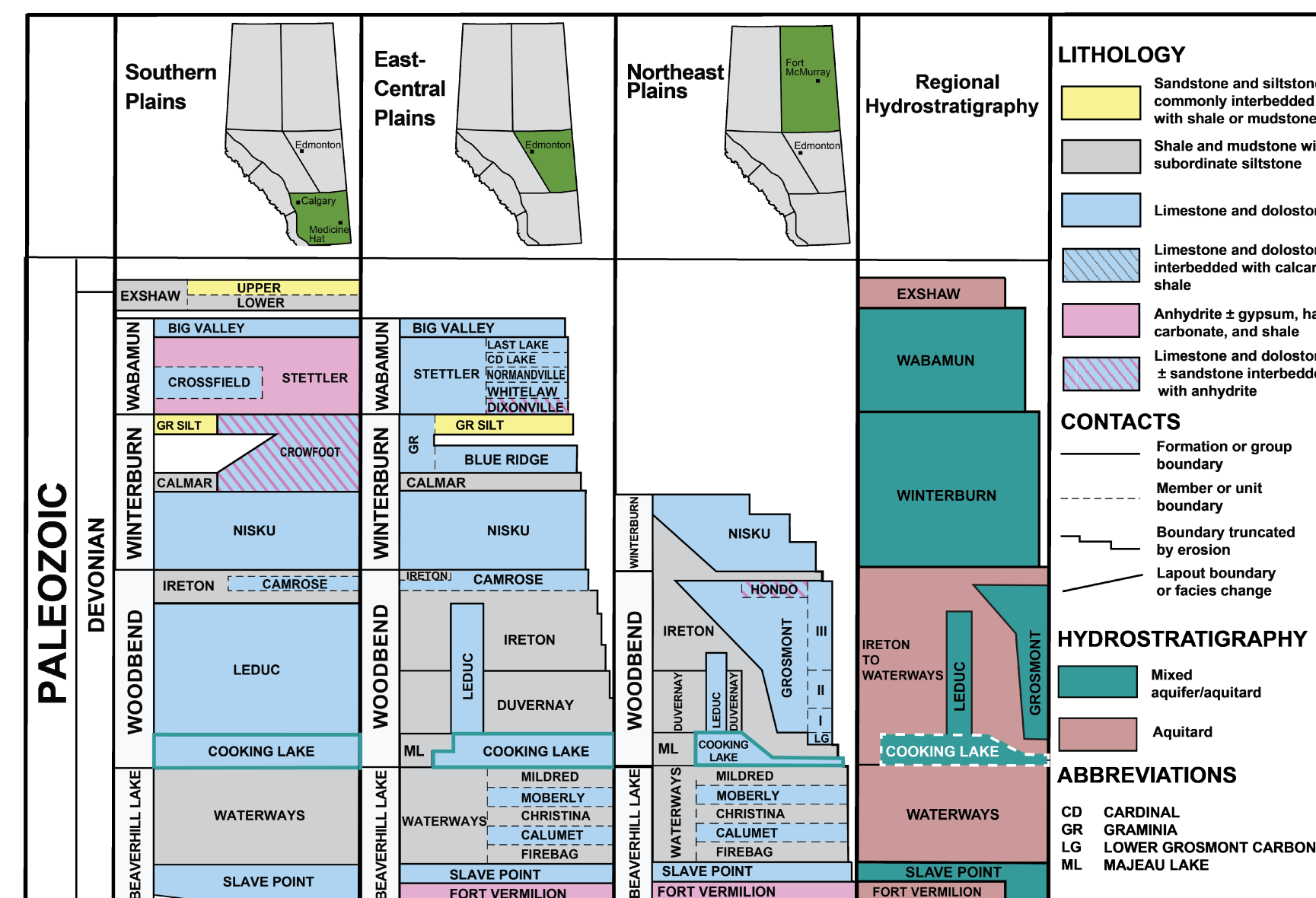


Figure 1. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlight the Cooking Lake Formation. Dashed white lines depict the Cooking Lake HSU within the regional hydrostratigraphy. Strata above the Exshaw Formation and below the Beaverhill Lake Group are not shown.

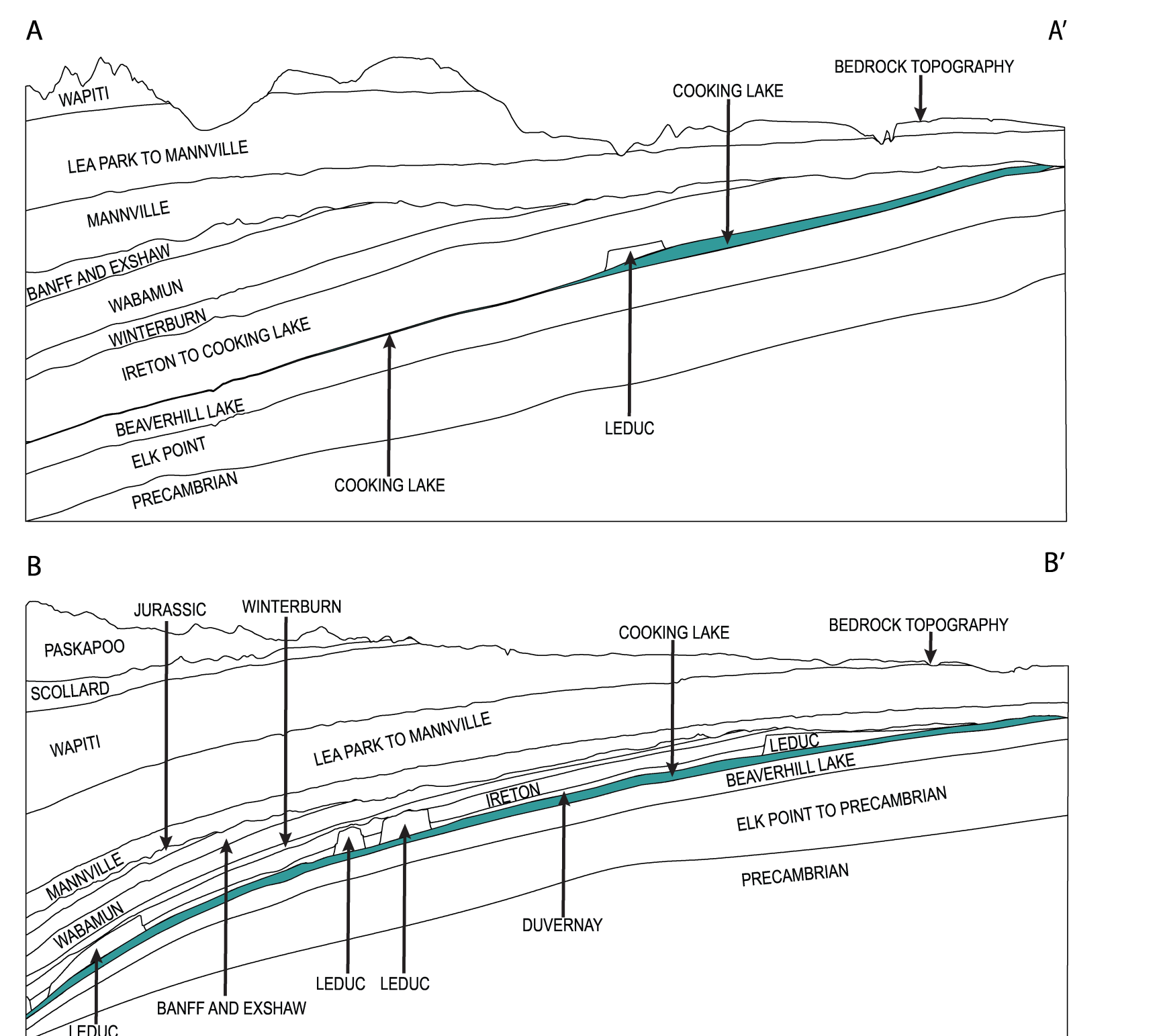


Figure 2. Schematic cross-sections identifying the geometry and variable thickness of the Cooking Lake HSU (not to scale). Jurassic strata have not been subdivided in this cross-section.

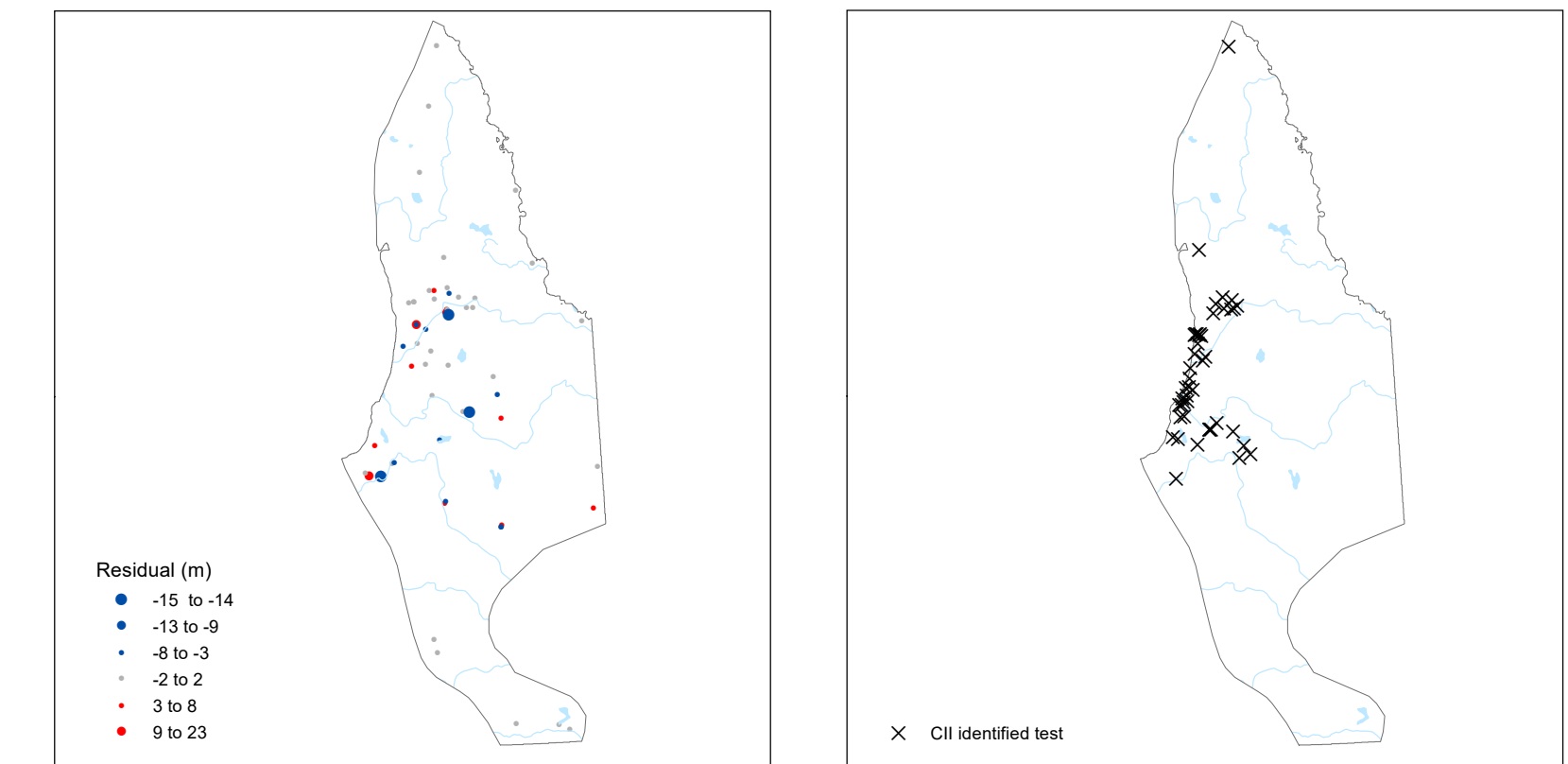


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

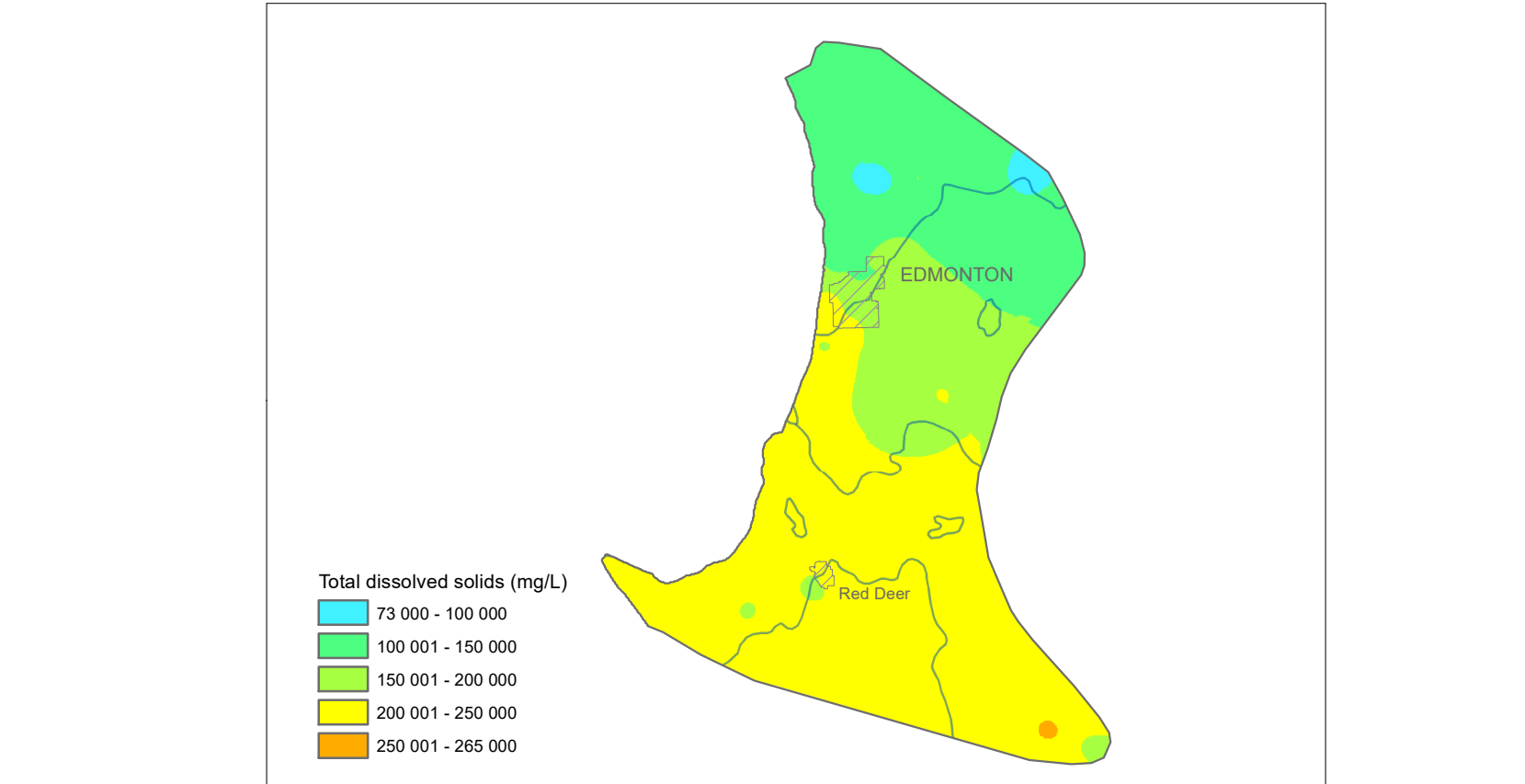


Figure 5. Distribution of total dissolved solids in the Cooking Lake HSU (Brinsky, 2022). The map extent is based on the spatial distribution of TDS data and differs from the extent of the main map.

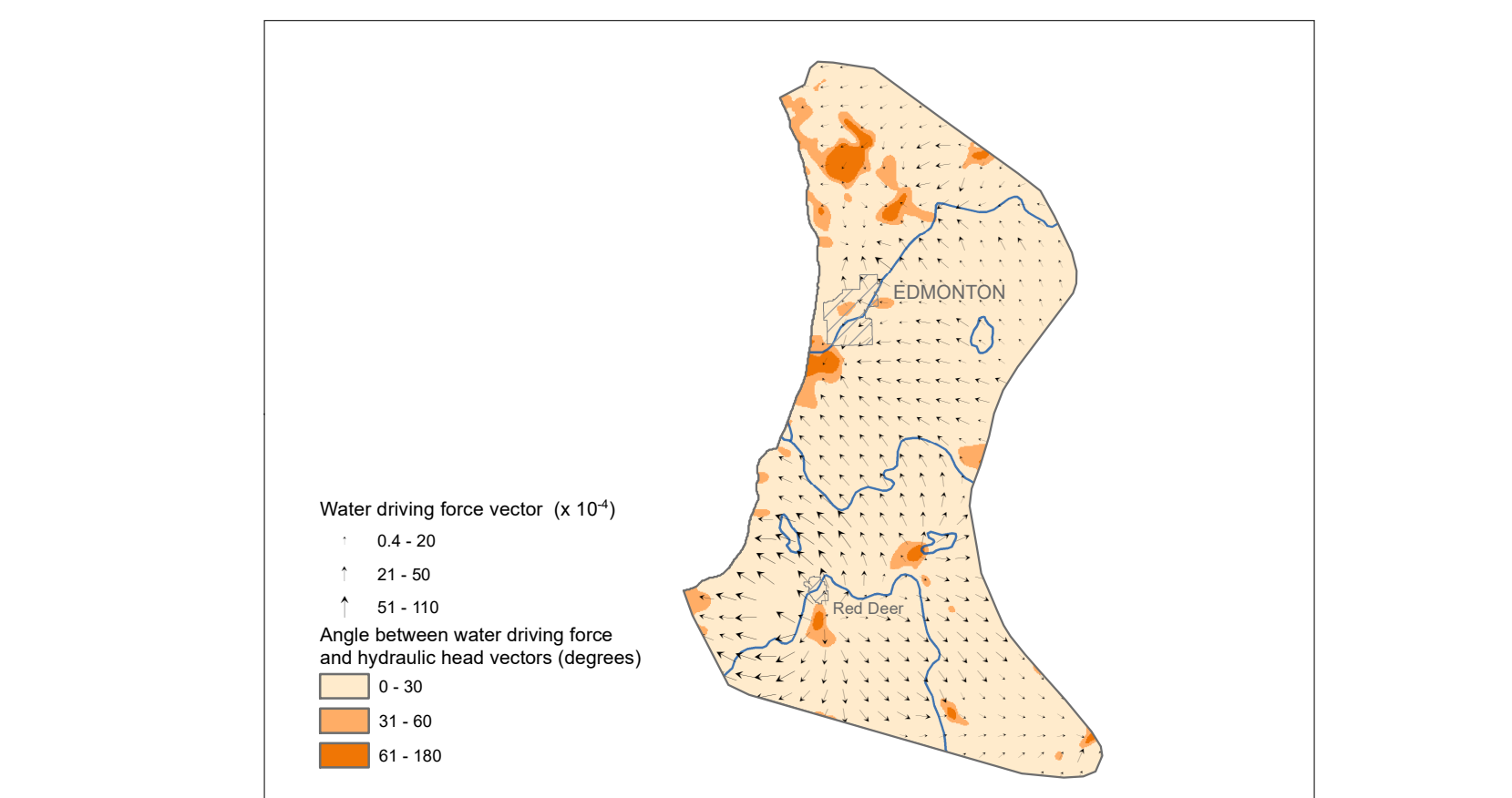


Figure 6. Water driving force vector map of the Cooking Lake HSU. The map covers only the area where hydraulic head and TDS gridded surfaces overlap.

Acknowledgements

Data processing support by S. Stewart. Base data from the Atlas of Canada (Natural Resources Canada, 2012) and Spatial Data Warehouse, Ltd. Water driving force vector map created by A. Singh.

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