

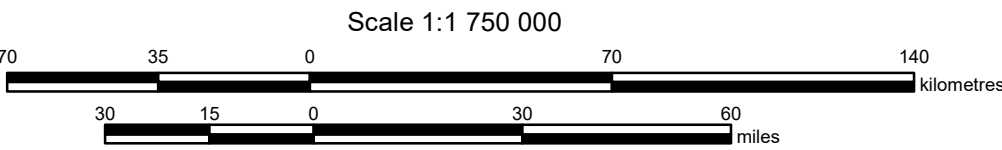
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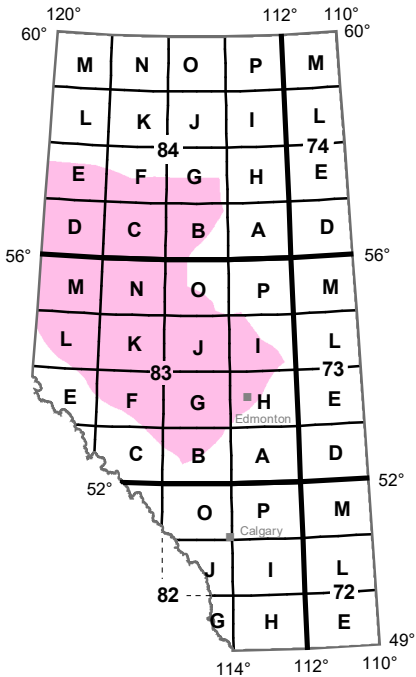
Map 637

Distribution of Hydraulic Head in the
Spirit River Hydrostratigraphic Unit

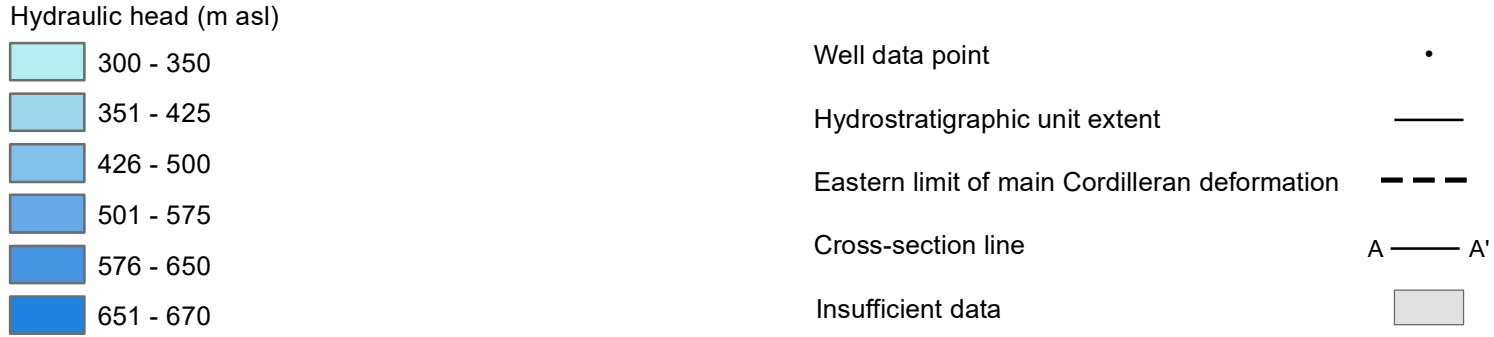
Hydrogeology by: C. Lucente and J. Brinsky



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



SYMBOL LEGEND



This map depicts the distribution of hydraulic head in groundwater in the Spirit River hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the Geological Framework of Alberta, Version 3 (Alberta Geological Survey, 2021). The relationship of the Spirit River 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 389 drillstem tests from oil and gas wells. A screening process modified from Jensen et al. (2013) was used to ensure that only representative formation 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 determined and used to identify and remove tests that have been influenced by production or injection (Figure 4).

Additional formation-scale hydrogeological maps for the Spirit River HSU are presented in Figures 5 and 6. Figure 5 shows the distribution of total dissolved solids in the Spirit River HSU. Figure 6 shows the water driving force (WDF) vector map for the Spirit River 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). Buoyancy does not not appear to have a significant effect on groundwater flow in the Spirit River HSU, except in the southern portion where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.

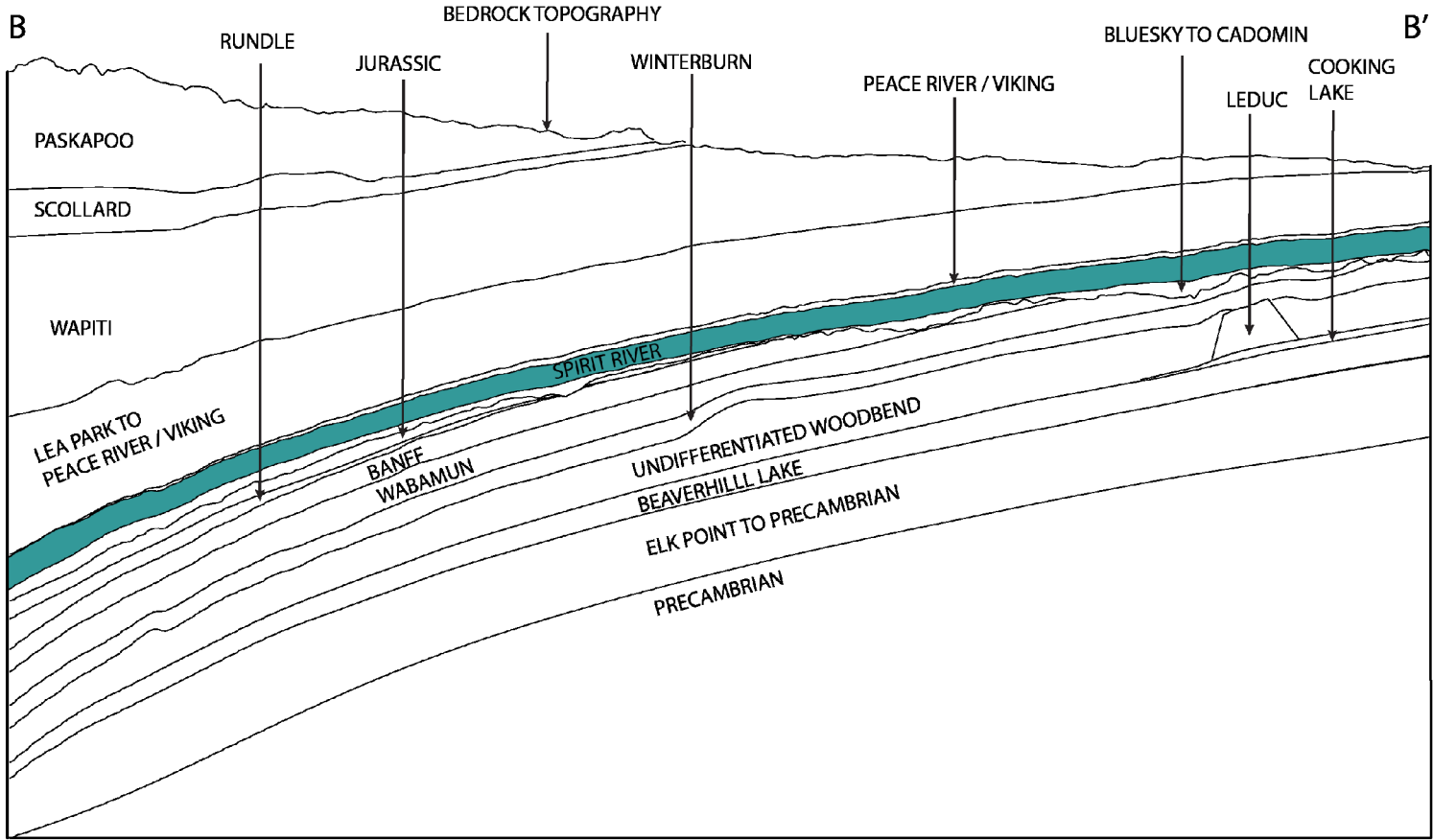
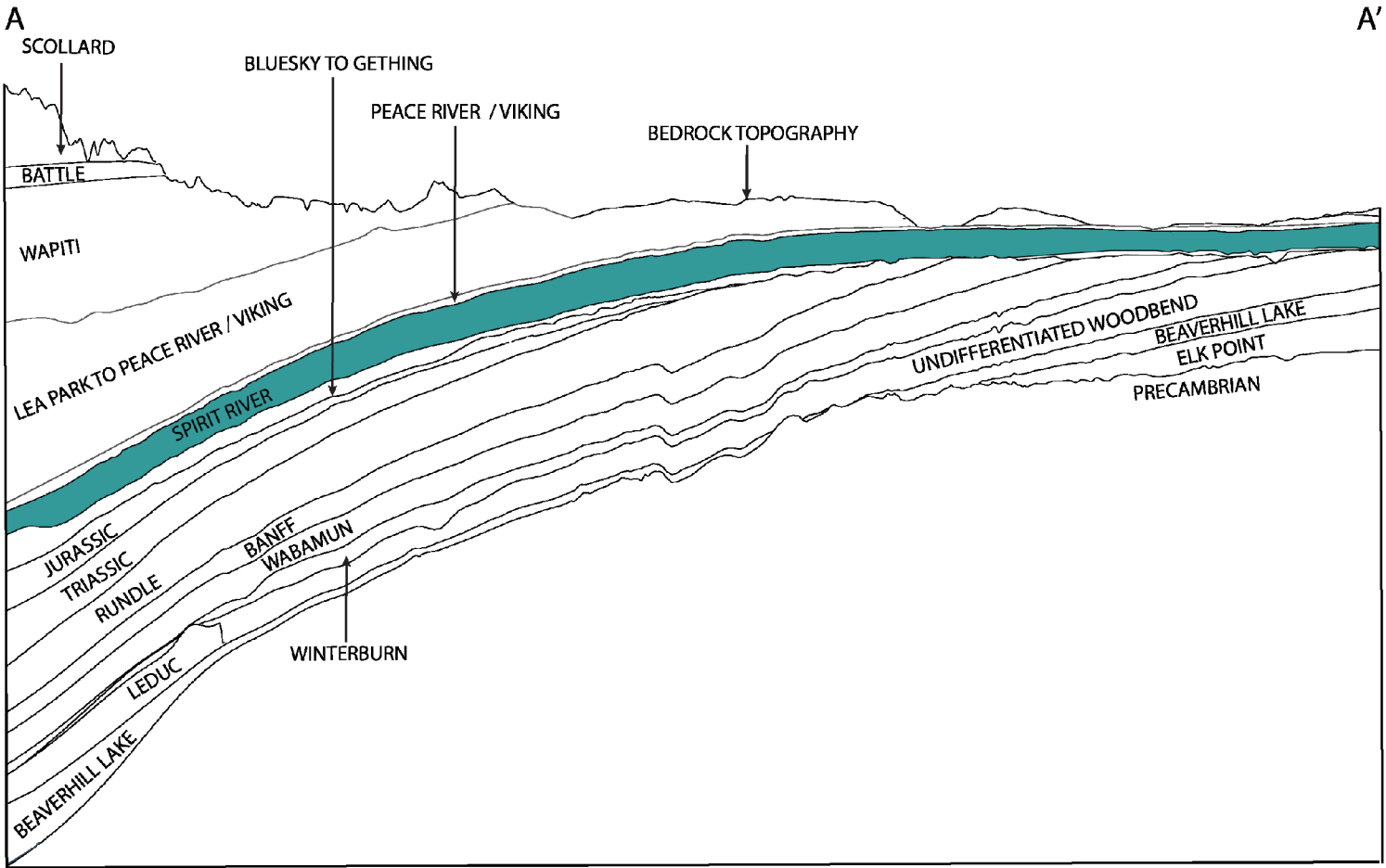


Figure 1. Schematic cross-sections identifying the geometry and variable thickness of the Spirit River HSU (not to scale). Jurassic and Triassic strata have not been subdivided at the scale of these cross-sections.

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Alberta Geological Survey (2019): Alberta Table of Formations; Alberta Energy Regulator, URL <<https://ags.aer.ca/publication/alberta-table-formations>> [May 2021].

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Singh, A., Palombi, D., Nakevska, N., Jensen, G. and Rostron, B. (2017): An efficient approach for characterizing basin-scale hydrodynamics; Marine and Petroleum Geology, v. 84, p. 332-340, URL <<https://dx.doi.org/10.1016/j.marpetgeo.2017.02.015>>.

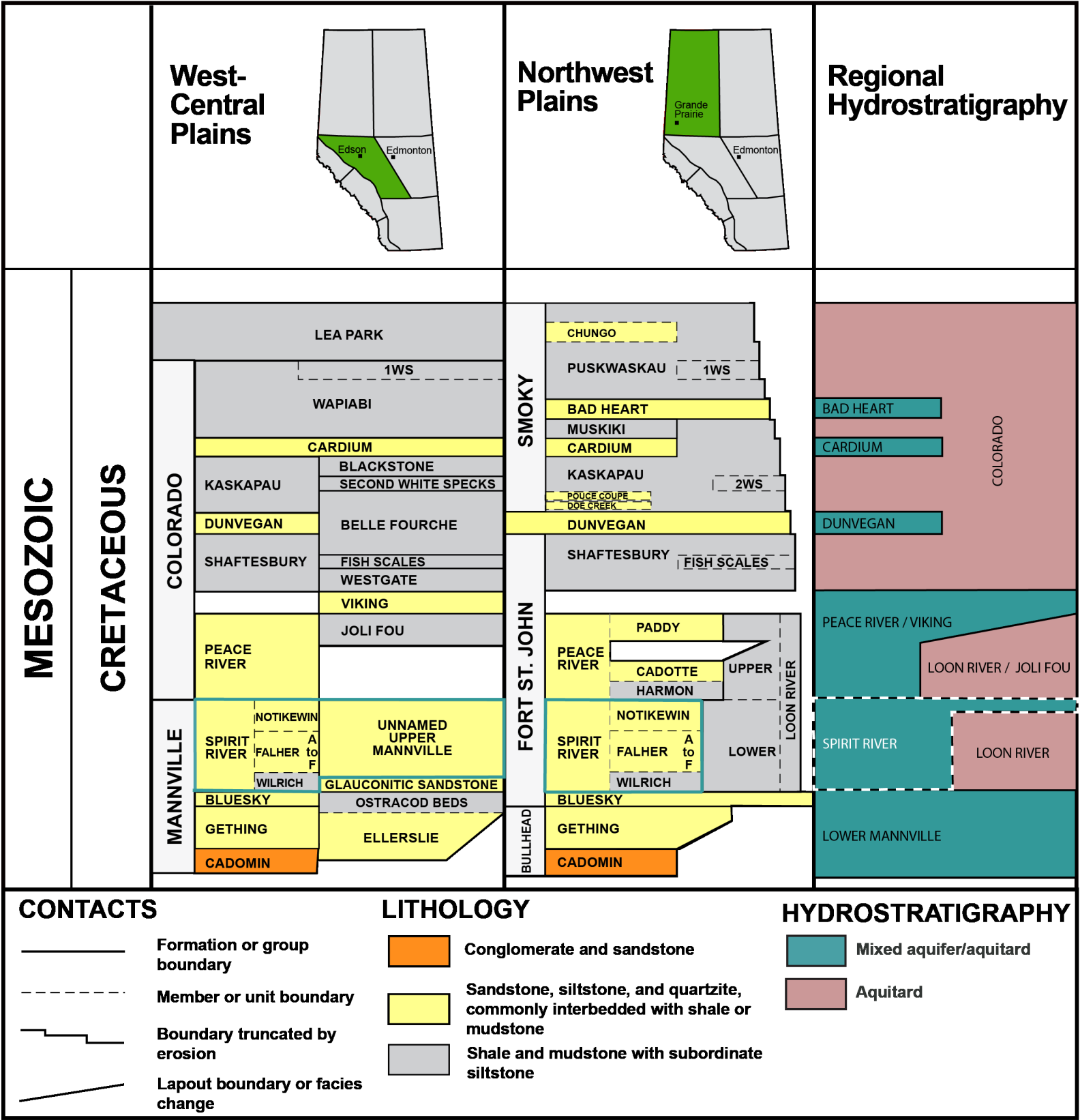


Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019). Solid teal lines highlight the Spirit River Formation. Dashed white lines depict the Spirit River HSU within the regional hydrostratigraphy. Strata above the Lea Park Formation and below the Cadomin Formation are not shown.

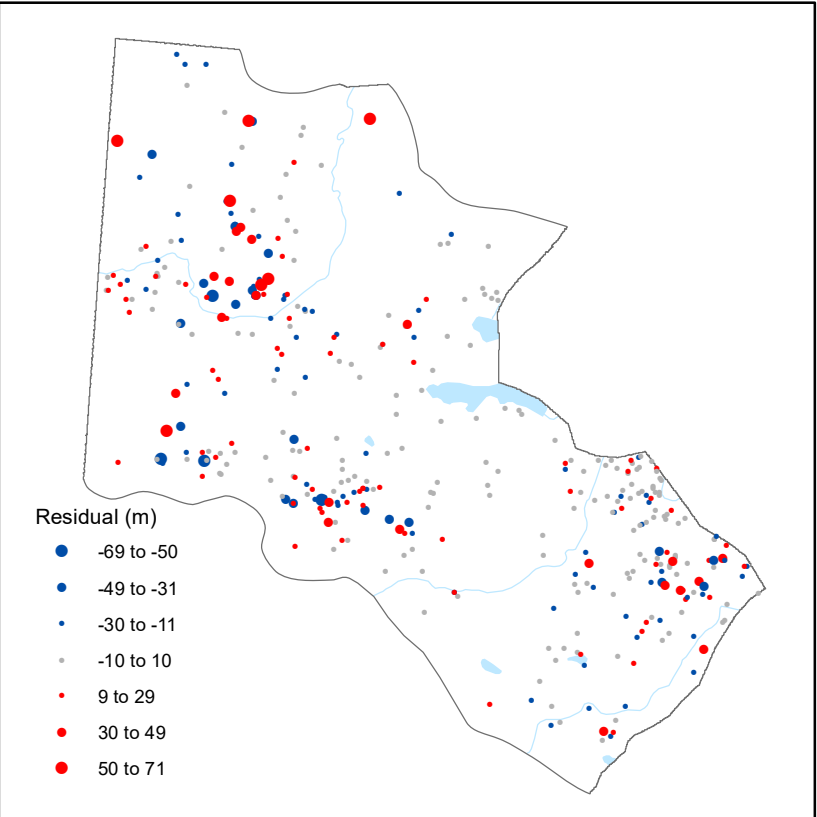


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

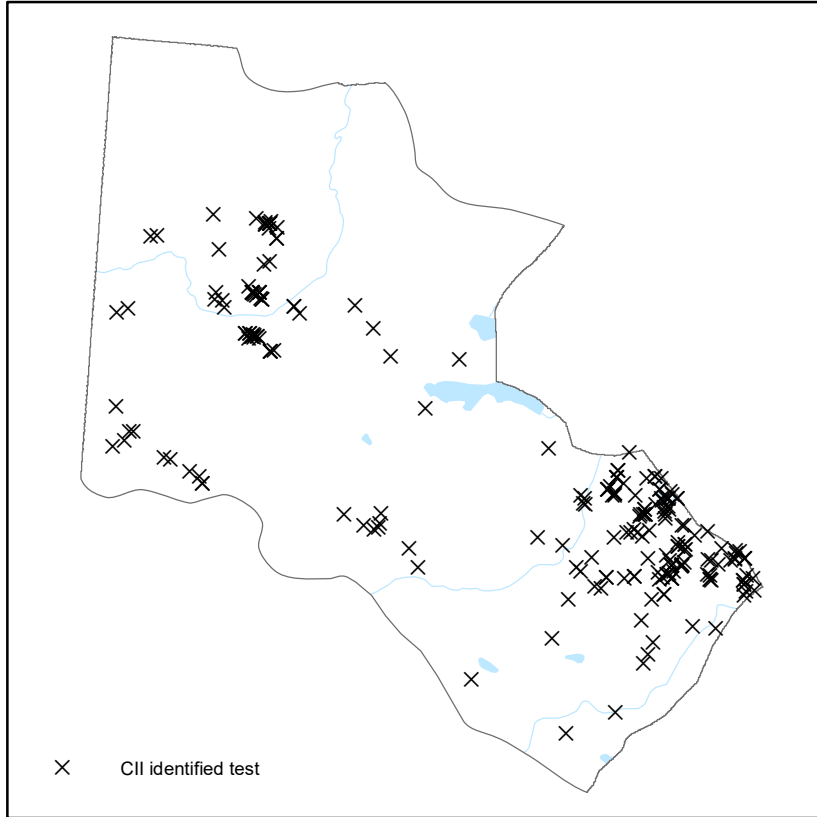


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

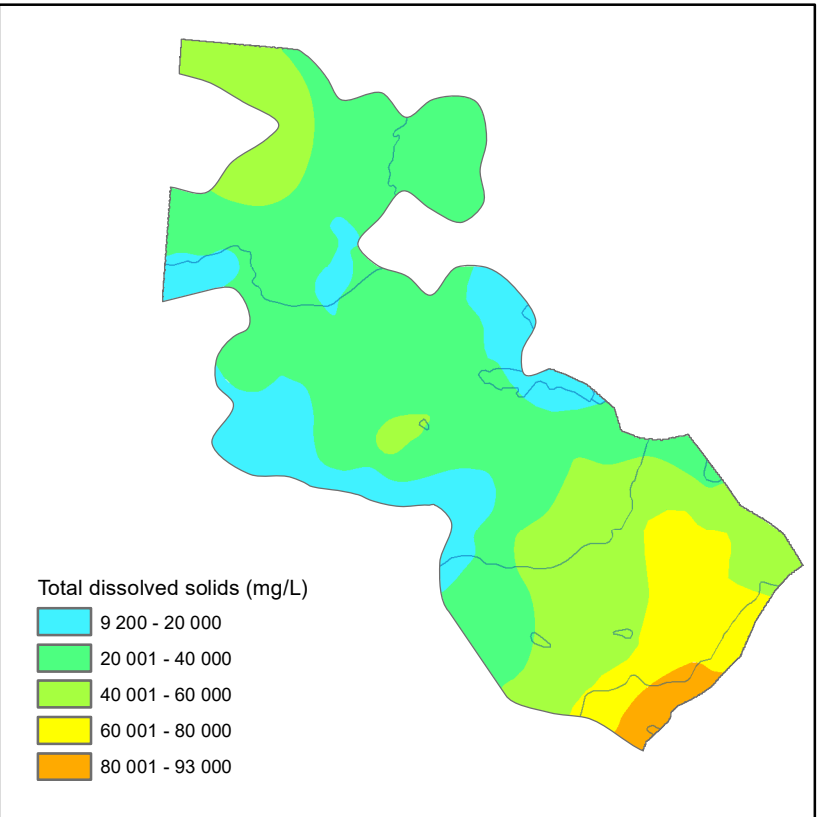


Figure 5. Distribution of total dissolved solids in the Spirit River HSU (Lucente and Brinsky, 2023). The map extent is based on the spatial distribution of TDS data and differs from the extent of the main map.

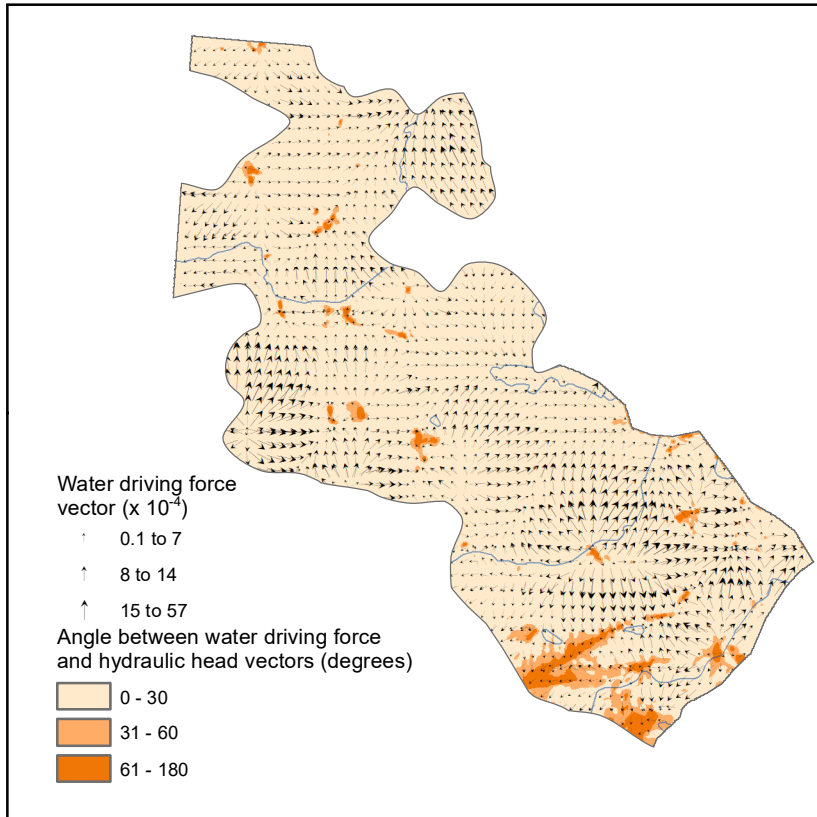


Figure 6. Water driving force vector map of the Spirit River HSU. The map only covers the area where hydraulic head and TDS gridded surfaces overlap.

Acknowledgements

Base data from the Atlas of Canada (Natural Resources Canada, 2012) and Spatial Data Warehouse Ltd.

Recommended Reference Format

Lucente, C. and Brinsky, J. (2023): Distribution of hydraulic head in the Spirit River hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 637, scale 1: 1 750 000.

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