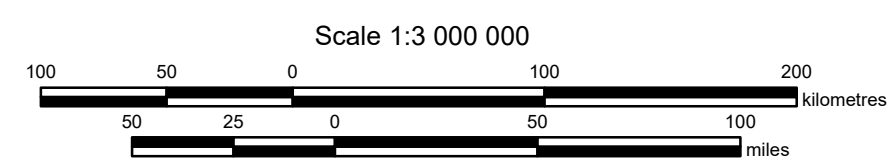
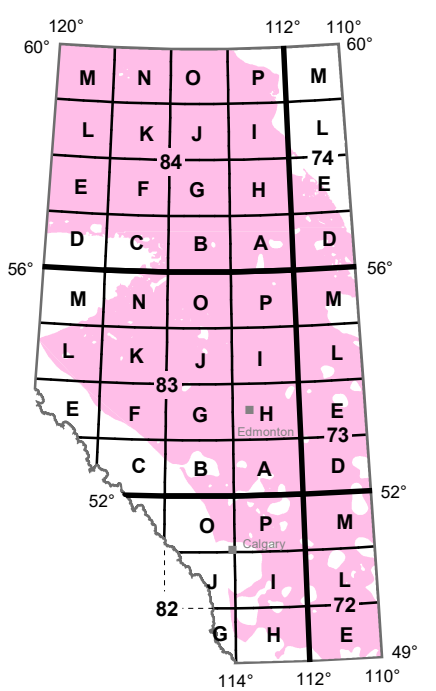


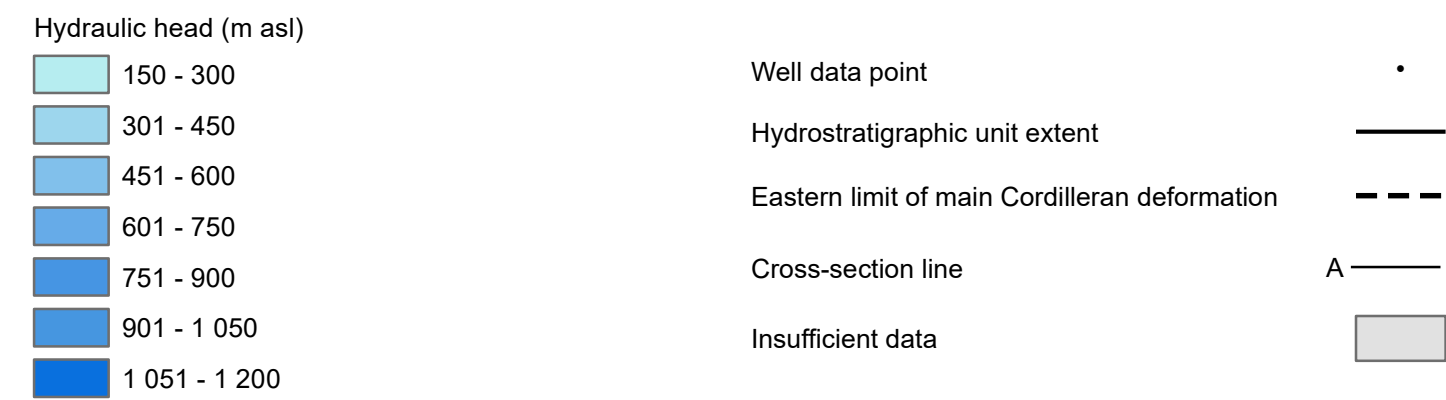
Map 639
Distribution of Hydraulic Head in the Swan Hills / Slave Point Hydrostratigraphic Unit
Hydrogeology by: J. Brinsky



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



SYMBOL LEGEND



This map depicts the distribution of hydraulic head in the Swan Hills / Slave Point 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 Swan Hills and Slave Point formations are partly equivalent, shallow-water, and open-marine carbonates (Hauck, 2014), and were mapped together as one HSU. The relationship of the Swan Hills / Slave Point 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 284 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 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 Swan Hills / Slave Point HSU are presented in Figures 5 and 6. Figure 5 shows the distribution of total dissolved solids in the Swan Hills / Slave Point HSU. Figure 6 shows the water driving force (WDF) vector map for the Swan Hills / Slave Point HSU. The WDF vector map allows identification of areas where the buoyancy effect of formation water density and the slope of the HSU has the potential to change the inferred magnitude and direction of groundwater flow (Singh et al., 2017). For the majority of the Swan Hills / Slave Point HSU, buoyancy does not appear to have a significant effect on groundwater flow. However, buoyancy appears to have some influence in the central and southern portions of the Swan Hills / Slave Point HSU, where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.

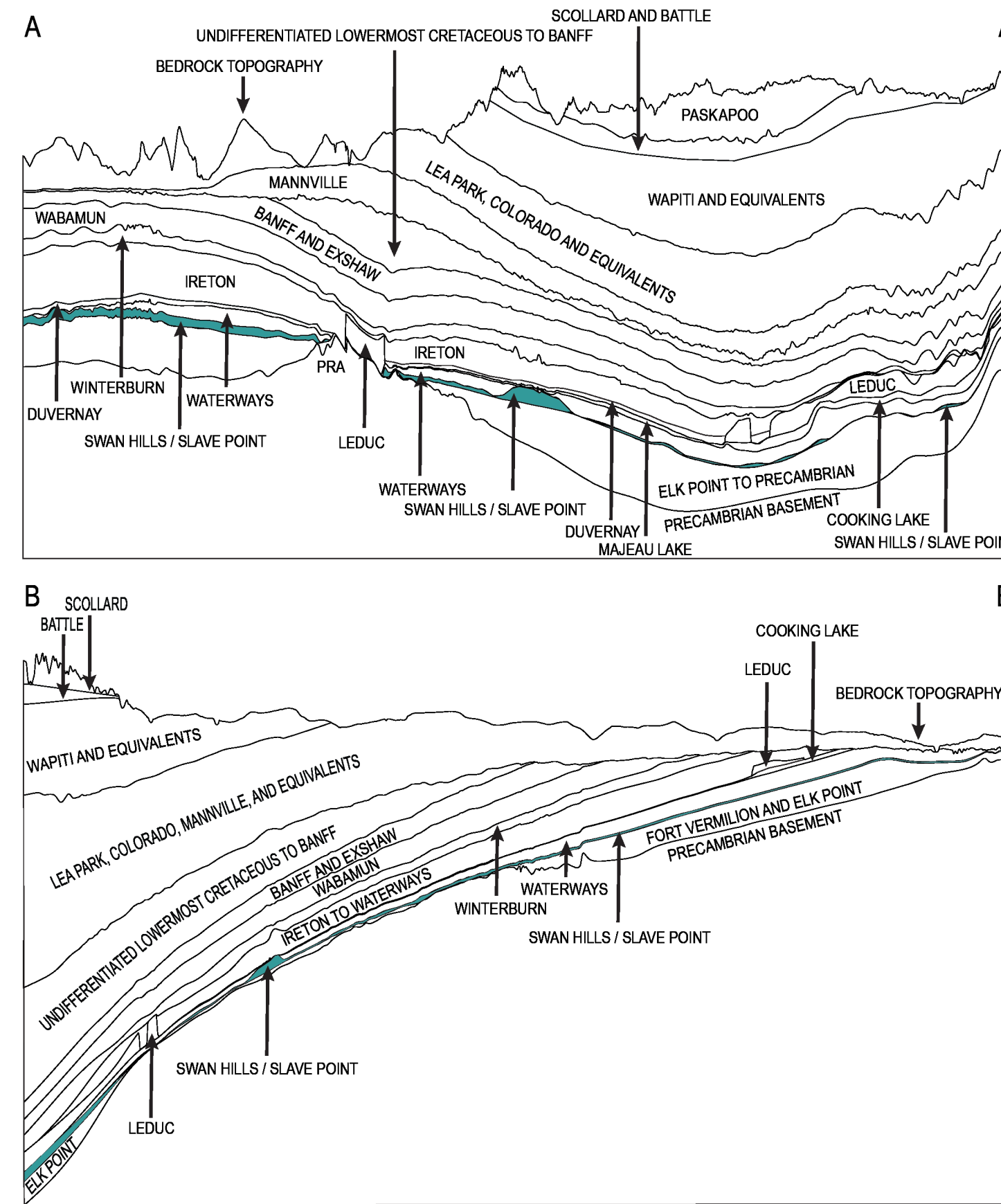


Figure 1. Schematic cross-sections (not to scale) identifying the geometry and variable thickness of the Swan Hills / Slave Point HSU. Lowermost Cretaceous, Jurassic, Triassic, and Carboniferous strata (excluding the Banff and Exshaw formations) have not been subdivided at the scale of these cross-sections. The location of the Peace River Arch (PRA) is shown on cross-section A-A'.

Acknowledgements

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

References

Alberta Geological Survey (2019a). 3D Provincial Geological Framework Model of Alberta, version 2; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Model 2018-2. URL <https://ags.aer.ca/publication/3d-pgf-model-v2.html> [November 2020].

Alberta Geological Survey (2019b). Alberta Table of Formations; Alberta Energy Regulator. URL <https://ags.aer.ca/publications/Table_of_Formations_2019.html> [November 2020].

Brinsky, J. and Rabbani, A. (2023). Distribution of total dissolved solids in the Swan Hills / Slave Point hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 639, scale 1:3 000 000.

Hauck, T.E. (2014). Regional correlation of the Beaverhill Lake Group in the subsurface of Alberta, townships 29 to 113 and ranges 1W4 to 13W6; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Open File Report 2014-05, 29 p. URL <https://static.ags.aer.ca/files/document/OFR/OFR_2014_05.pdf> [November 2020].

Jensen, G.K.S., Rostron, B., Palombi, D. and Melnik, A. (2013). Saskatchewan Phanerozoic Fluids and Petroleum Systems project: hydrogeological mapping framework. In Summary of investigations 2013, v.1, Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy, Miscellaneous Report 2013-4.1, Paper A-5, 10 p.

Natural Resources Canada (2012). CanVec digital topographic data; Natural Resources Canada, Earth Sciences Sector. URL <https://open.canada.ca/data/en/dataset/8ba2aa2a-7bb9-4448-b4d7-f164409fe056> [September 2020].

Singh, A., Palombi, D., Naveks, 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://doi.org/10.1016/j.marpetgeo.2017.02.015> [November 2020].

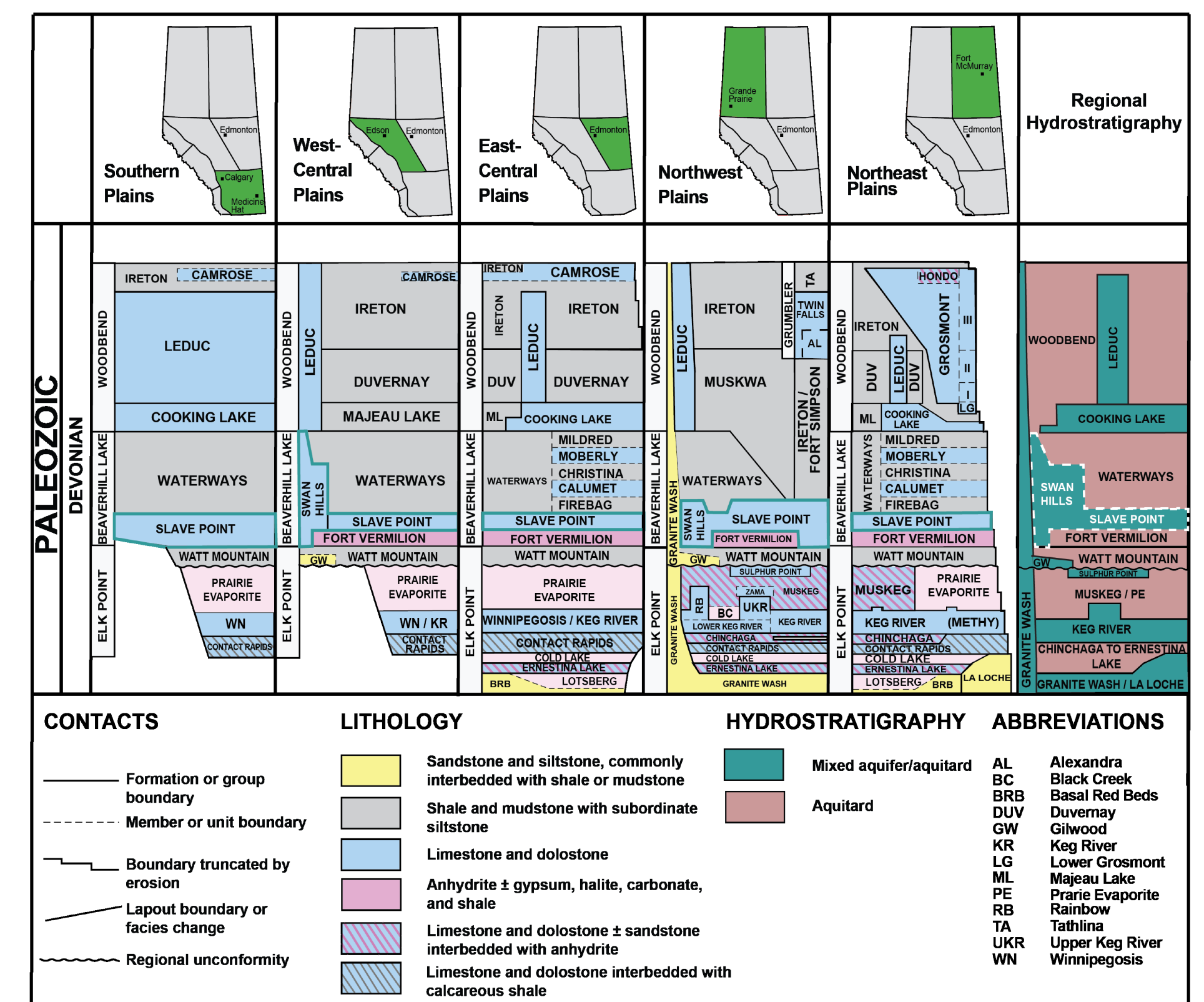


Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines depict the top and base of the stratigraphic units combined for mapping the Swan Hills / Slave Point HSU. Dashed white lines depict the Swan Hills / Slave Point HSU within the regional hydrostratigraphy. Strata above the Ireton Formation and below the Elk Point group are not shown.

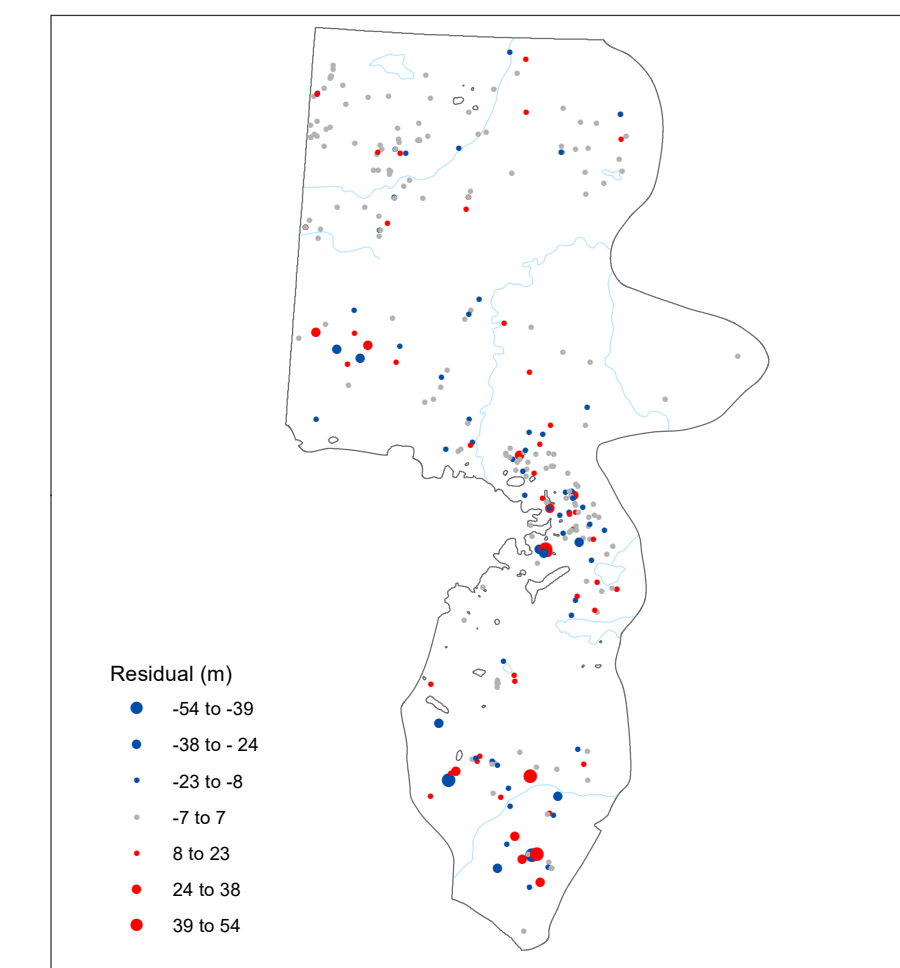


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

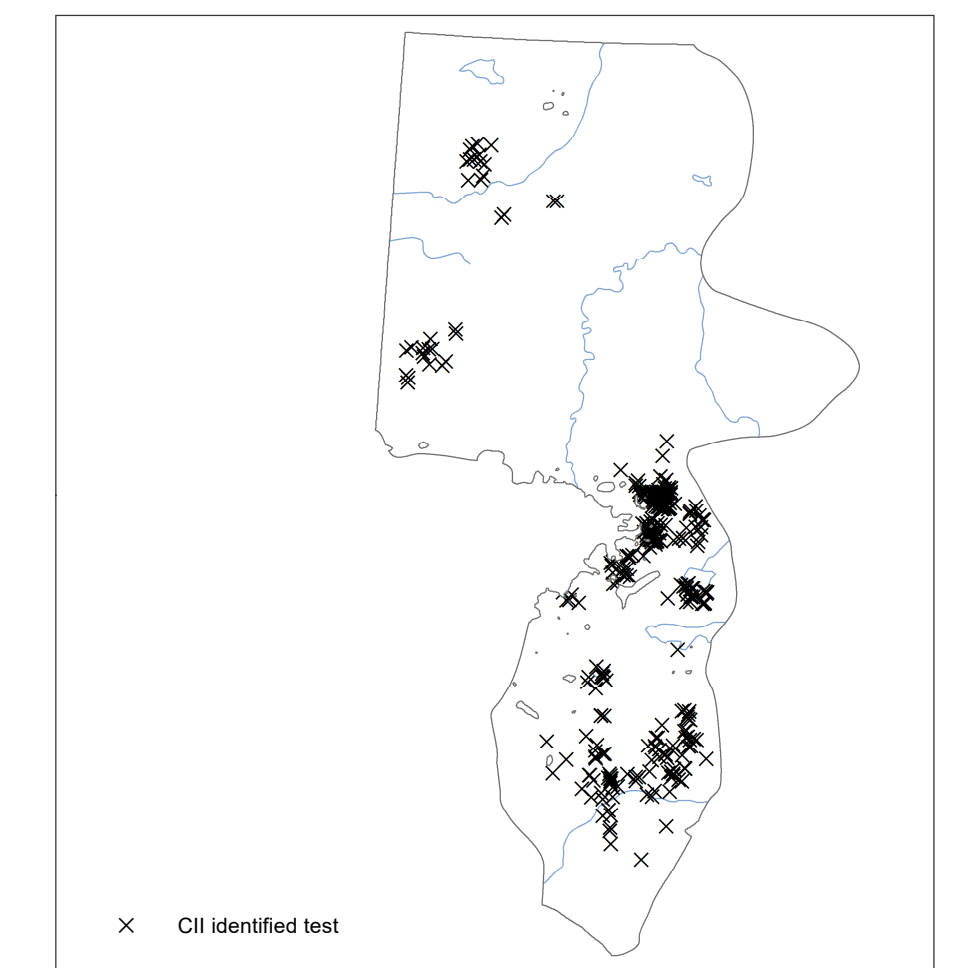


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

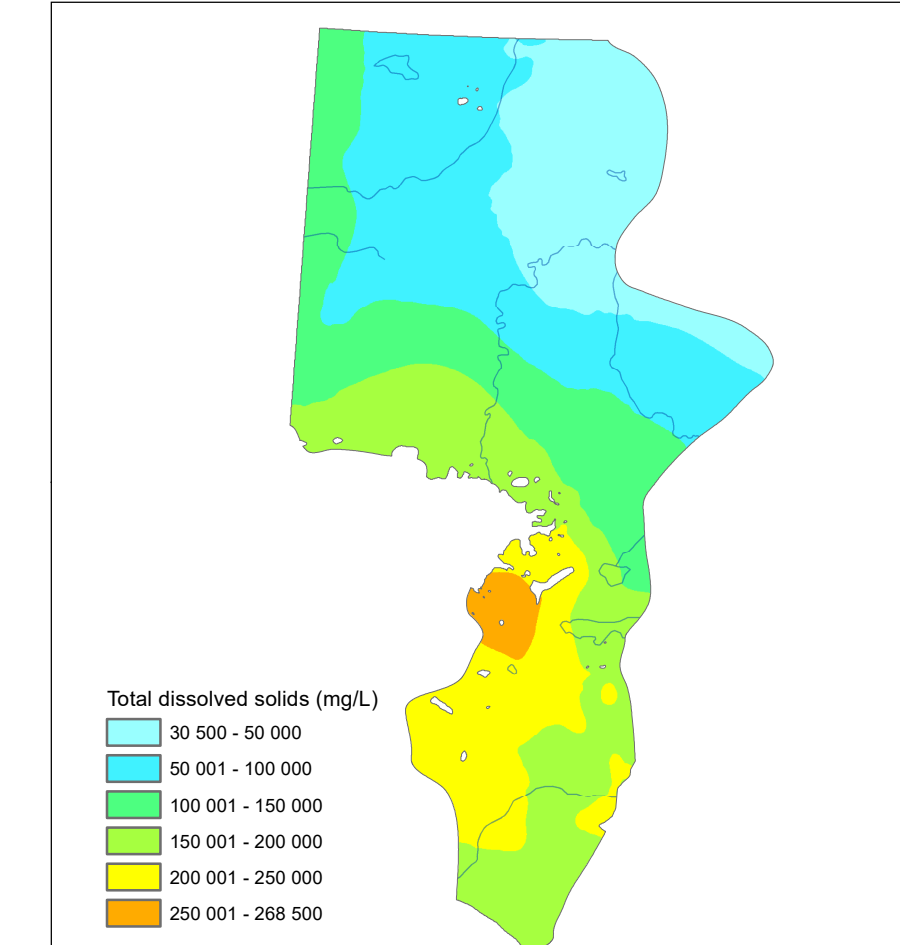


Figure 5. Distribution of total dissolved solids in the Swan Hills / Slave Point HSU (Brinsky, 2023). The map extent is based on the spatial distribution of TDS data and differs from the extent of the main map.

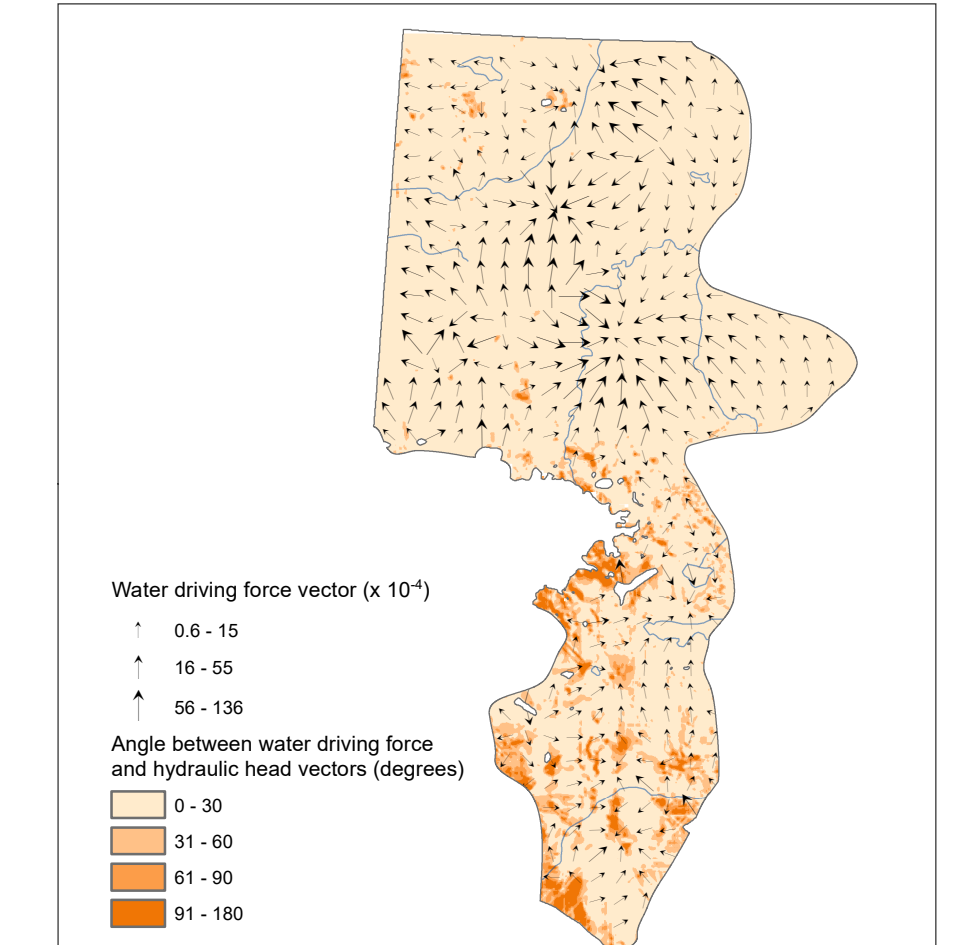


Figure 6. Water driving force vector map of the Swan Hills / Slave Point HSU. The map covers only the area where the hydraulic head and TDS gridded surfaces overlap.

Recommended Reference Format

Brinsky, J. (2023). Distribution of hydraulic head in the Swan Hills / Slave Point hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 639, scale 1:3 000 000.

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