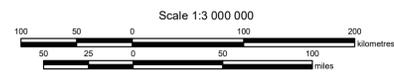


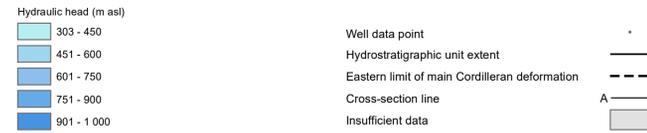
**Map 647**  
**Distribution of Hydraulic Head in the Exshaw-Banff Hydrostratigraphic Unit**  
Hydrogeology by: J. Brinsky



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



**SYMBOL LEGEND**



This map depicts the distribution of hydraulic head in the Exshaw-Banff hydrostratigraphic unit (HSU). The horizontal and vertical extent of the unit was adopted from the 3D Geological Framework of Alberta, Version 3 (Alberta Geological Survey, 2021). The relationship of the Exshaw-Banff 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 341 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. Where data density was insufficient to generate a hydraulic head grid, data points are plotted with hydraulic head labels only. 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 Exshaw-Banff HSU are shown in Figures 5 and 6. Figure 5 illustrates the distribution of total dissolved solids in the Exshaw-Banff HSU. Figure 6 shows the water driving force (WDF) vector map for the Exshaw-Banff 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). Buoyancy appears to have some influence in the north-central portion of the Exshaw-Banff HSU, where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.

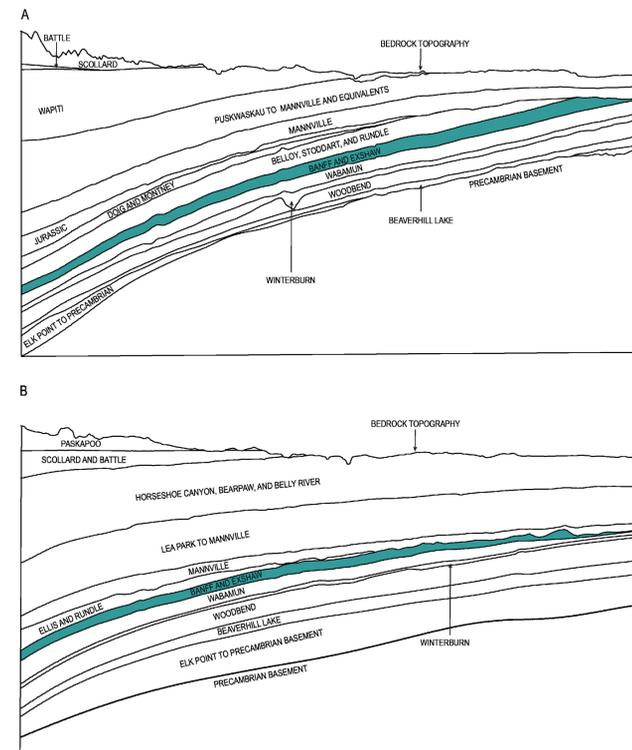


Figure 1. Schematic cross-sections (not to scale) identifying the geometry and variable thickness of the Exshaw-Banff HSU (shown in teal).

**Acknowledgements**

Data processing support by S. Stewart. Base data from the Atlas of Canada (Natural Resources Canada, 2012) and Spatial Data Warehouse, Ltd.

**References**

- Alberta Geological Survey (2019): Alberta Table of Formations; Alberta Energy Regulator, URL <https://ags.aer.ca/publications/table\_of\_formations\_2019.html> [October 2019].
- Alberta Geological Survey (2021): Geological Framework of Alberta, version 3 (interactive app and map, methodology, model, dataset, story maps, web maps); Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Interactive Application <https://gfa-v3-ags-aer.hub.arcgis.com> [December 2021].
- Brinsky, J. (2024): Distribution of total dissolved solids in the Exshaw-Banff hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 646 scale 1:3 000 000.
- Jensen, G.K.S., Rostrom, 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> [May 2021].
- Singh, A., Palombi, D., Nakevska, N., Jensen, G. and Rostrom, B. (2017): An efficient approach for characterizing basin-scale hydrodynamics; Marine and Petroleum Geology, p. 332-340, URL <https://dx.doi.org/10.1016/j.marpetgeo.2017.02.015>.

**Recommended Reference Format**

Brinsky, J. (2024): Distribution of hydraulic head in the Exshaw-Banff hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 647, scale 1:3 000 000.

**Disclaimer**

The Alberta Geological Survey and its employees and contractors make no warranty, guarantee or representation, express or implied, or assume any legal liability regarding the correctness, accuracy, completeness, or reliability of the publication. When using information from this publication in other publications or presentations, due acknowledgement should be given to the Alberta Energy Regulator / Alberta Geological Survey.

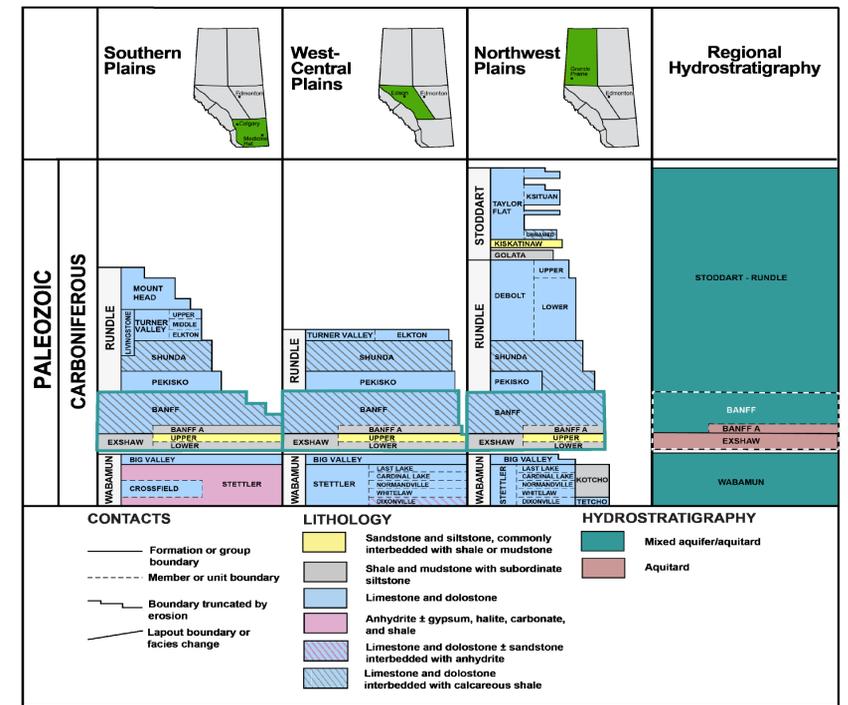


Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019). Solid teal lines depict the top and base of the stratigraphic units combined for mapping the Exshaw-Banff HSU. Dashed white lines depict the Exshaw-Banff HSU within the regional hydrostratigraphy. Strata above the Stoddard Group and below the Wabamun Group are not shown.

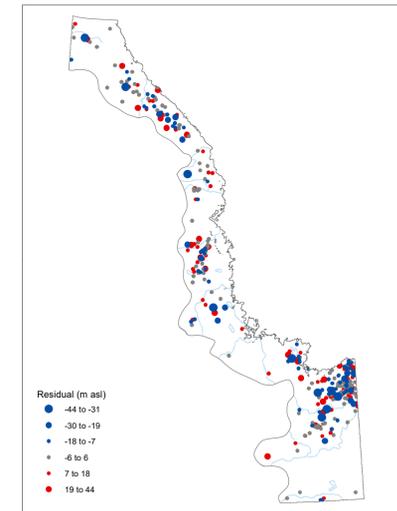


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the measured residuals.

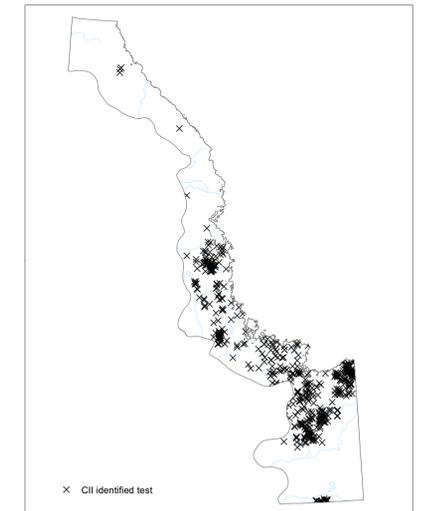


Figure 4. Location of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

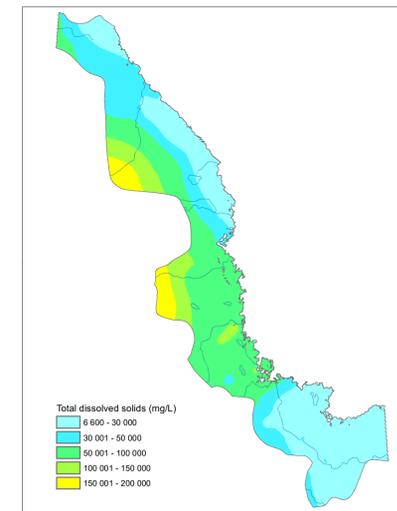


Figure 5. Distribution of total dissolved solids in the Exshaw-Banff HSU (Brinsky, 2024). The map extent is based on the spatial distribution of TDS data and differs from the extent on the main map.

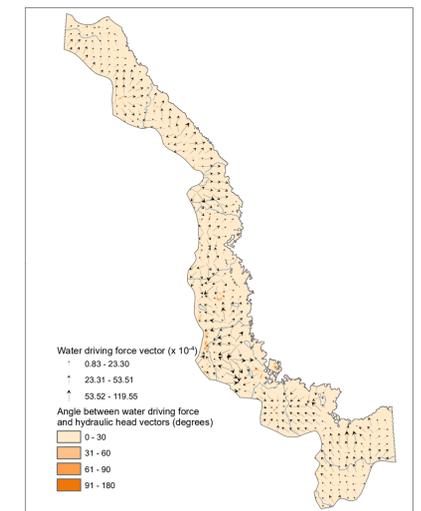


Figure 6. Water driving force vector map of the Exshaw-Banff HSU. The map covers only the area where the hydraulic head and TDS gridded surfaces overlap.