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Map 631
Distribution of Hydraulic Head in the Leduc Hydrostratigraphic Unit
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Scale 1:3 000 000
 0 50 100 200 kilometers
 0 25 50 100 miles

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



SYMBOL LEGEND

- Hydraulic head (m asl)
 - 300 - 450
 - 451 - 600
 - 601 - 750
 - 751 - 900
 - 901 - 1 050
 - 1 051 - 1 200
- Well data point
- Hydrostratigraphic unit extent
- Eastern limit of main Cordilleran deformation
- Cross-section line
- Insufficient data

This map depicts the distribution of hydraulic head in the Leduc 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 Leduc 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 537 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 Leduc HSU are shown in Figures 5 and 6. Figure 5 illustrates the distribution of total dissolved solids in the Leduc HSU. Figure 6 shows the water driving force (WDF) vector map for the Leduc 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 northwestern and central portions of the Leduc HSU, where larger angles (dark orange areas) between the WDF vector and hydraulic gradient vector are observed.

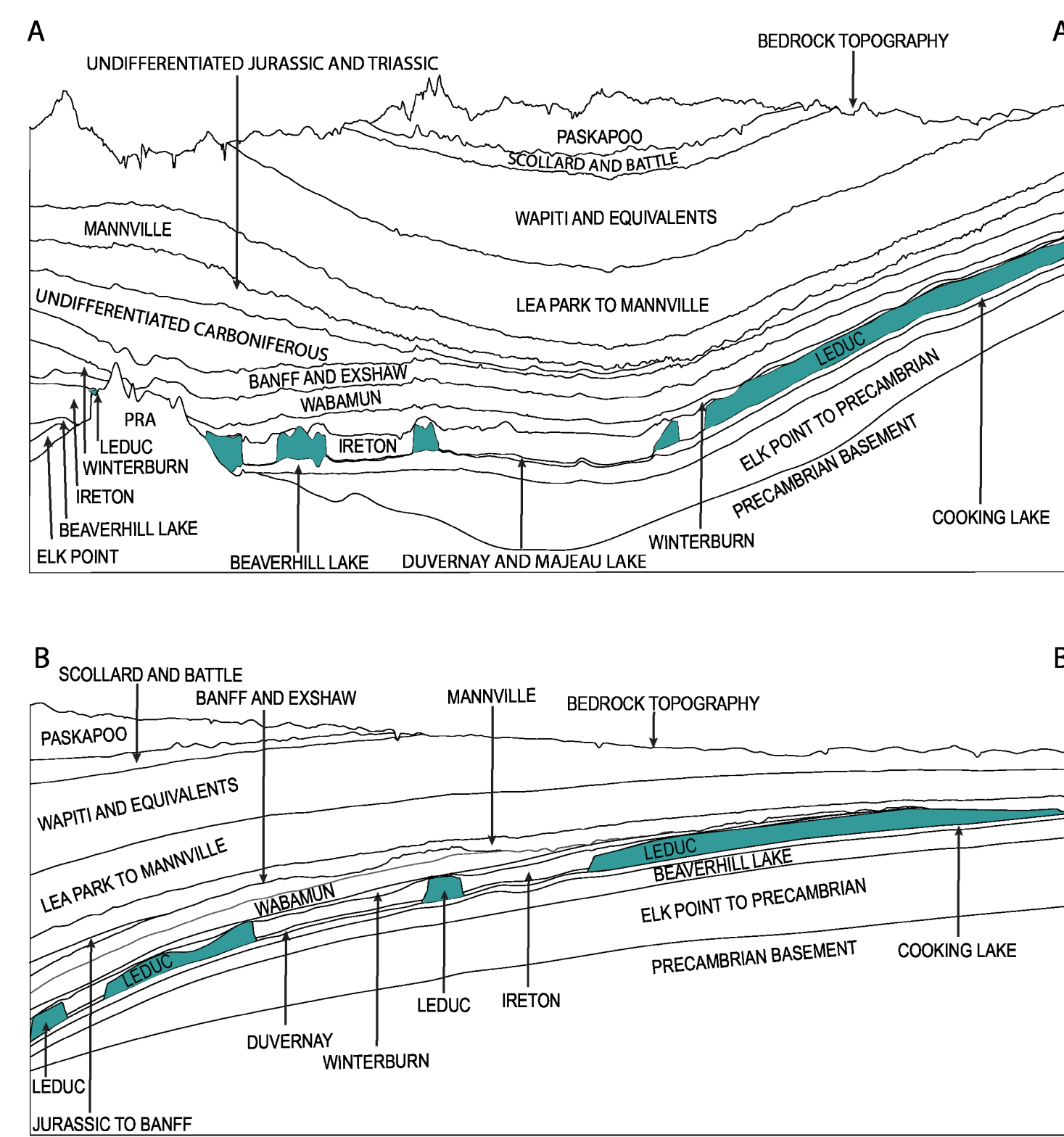


Figure 1. Schematic cross-sections (not to scale) identifying the geometry and variable thickness of the Leduc HSU. Triassic, Jurassic, and Carboniferous strata (excluding the Banff and Exshaw formations) have not been subdivided at the scale of these cross-sections. The location of the Peace River Arch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

Acknowledgements

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References

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Brinsky, J. (2023): Distribution of total dissolved solids in the Leduc hydrostratigraphic unit; Alberta Energy Regulator / Alberta Geological Survey, AER/AGS Map 630, scale 1:3 000 000.

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Recommended Reference Format

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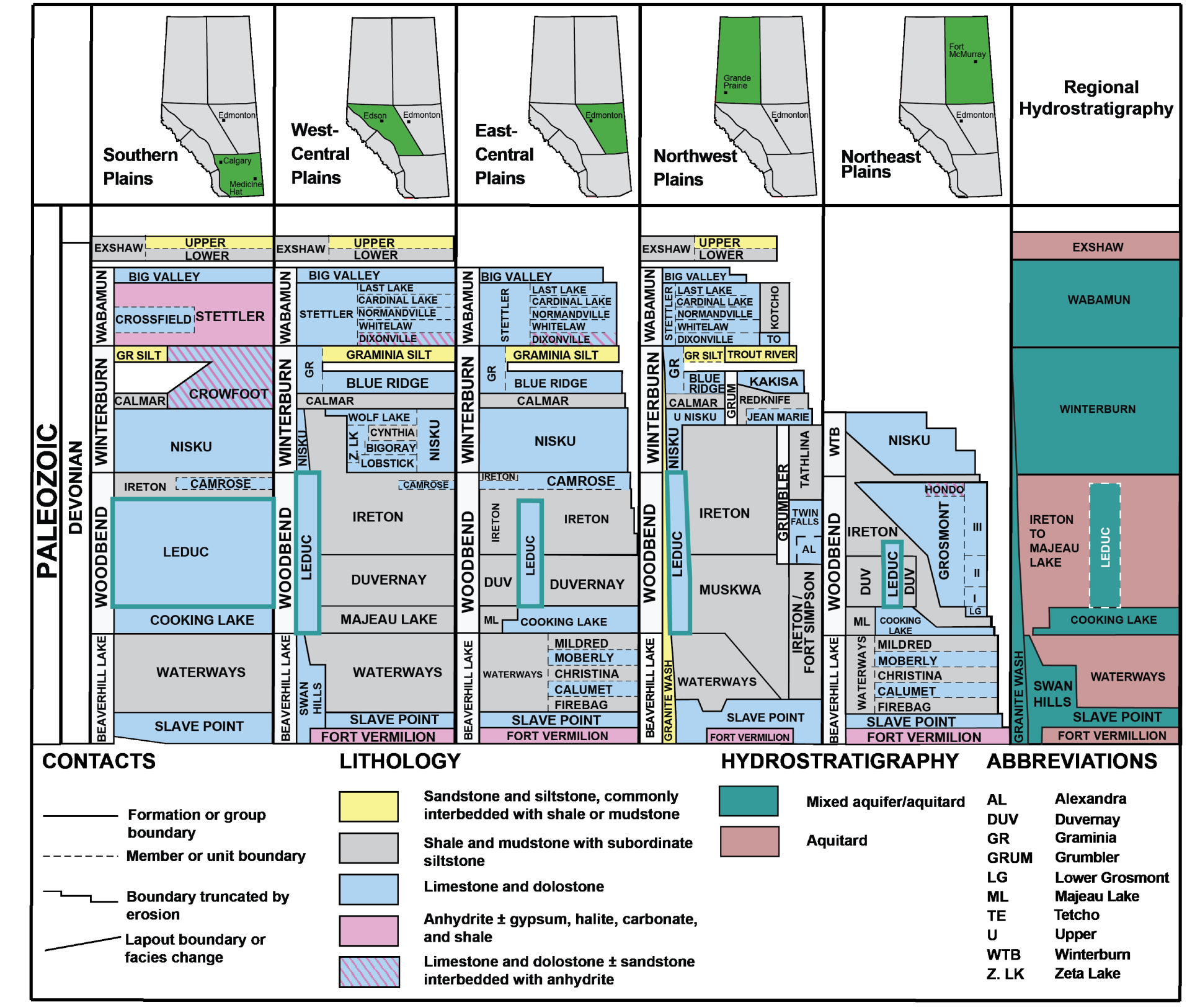


Figure 2. Regional lithostratigraphy and hydrostratigraphy (based on Alberta Geological Survey, 2019b). Solid teal lines highlight the Leduc Formation. Dashed white lines depict the Leduc HSU within the regional hydrostratigraphy. Strata above the Exshaw Formation and below the Slave Point, Swan Hills, or Fort Vermilion formations are not shown.

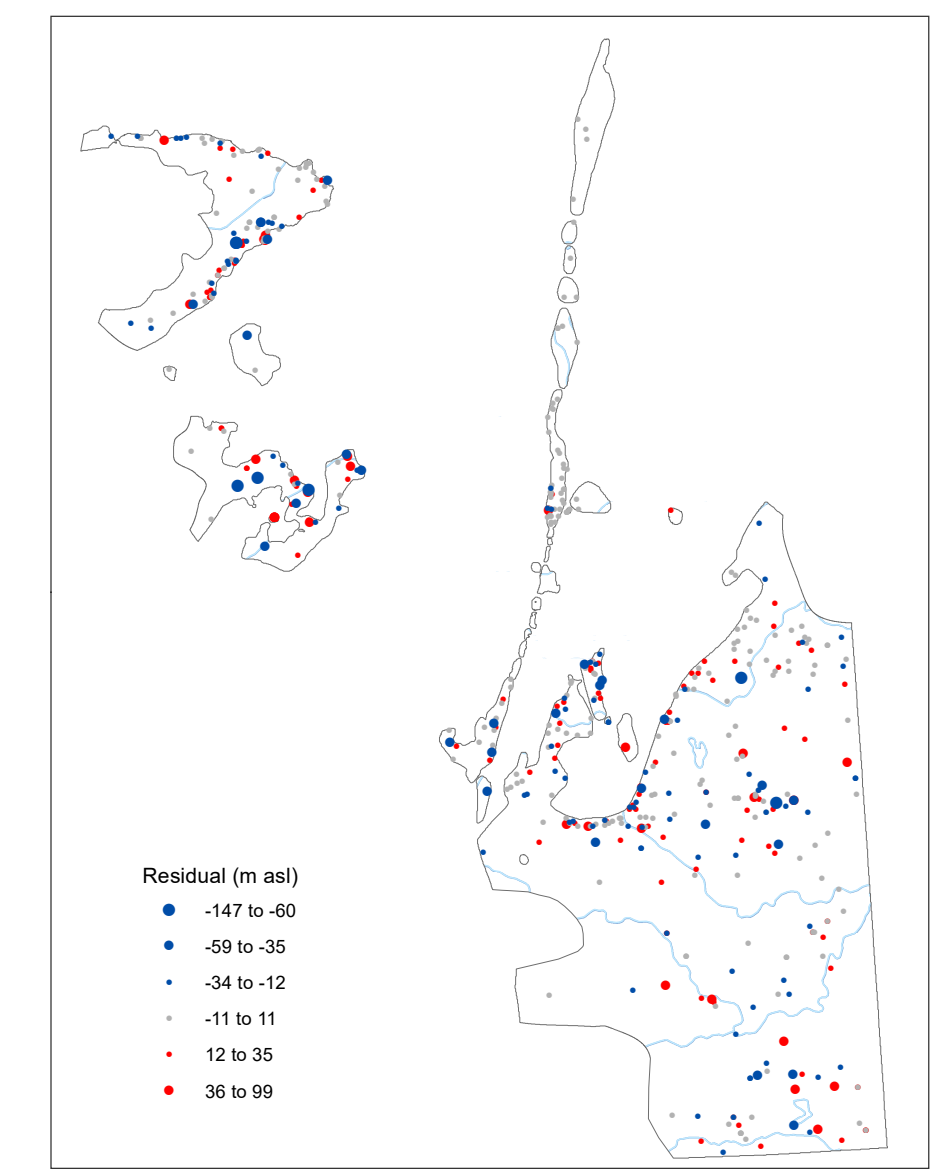


Figure 3. Calculated residuals between the modelled distribution of hydraulic head and measured values. Symbol classes are based on the standard deviation of the calculated residuals.

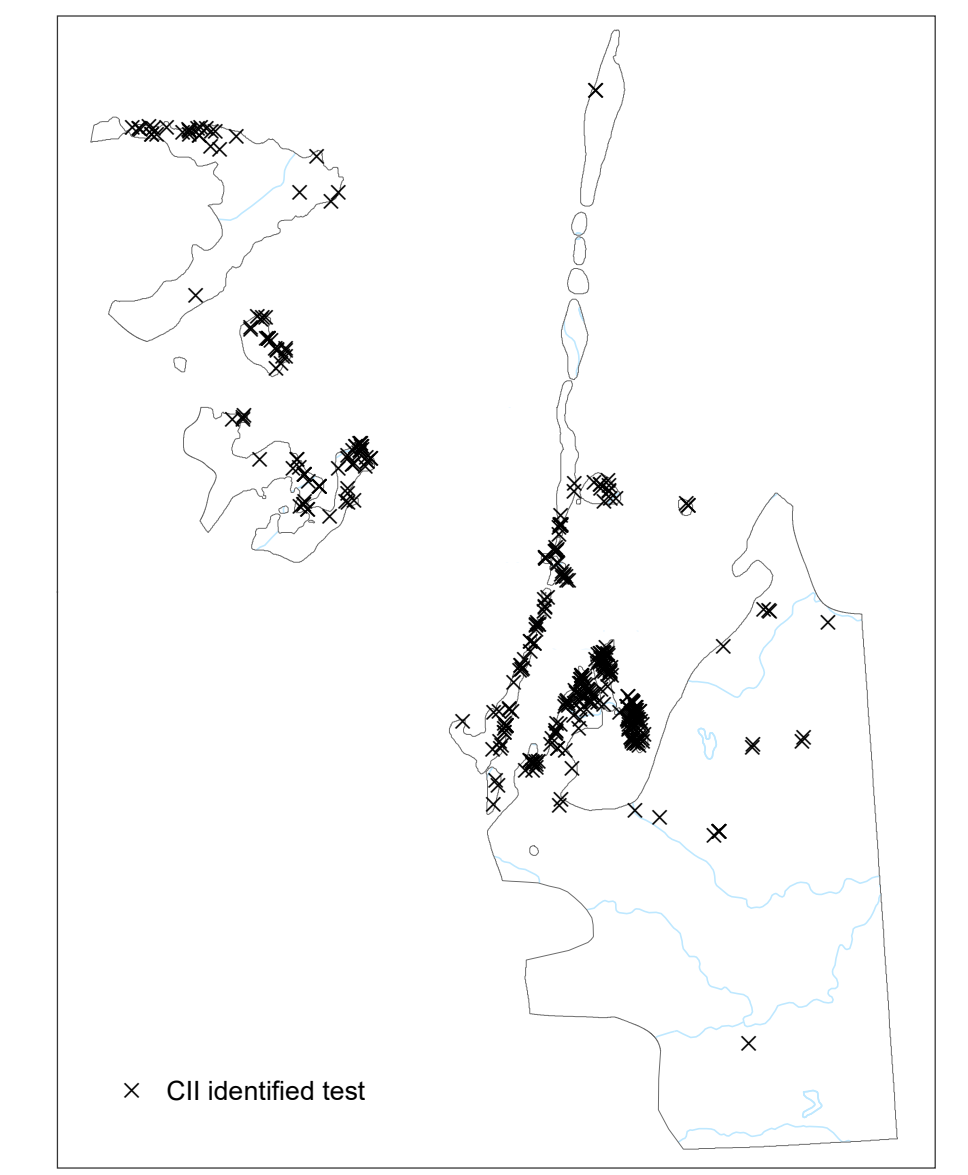


Figure 4. Locations of tests that may have been influenced by production or injection and were removed during the Cumulative Interference Index (CII) process.

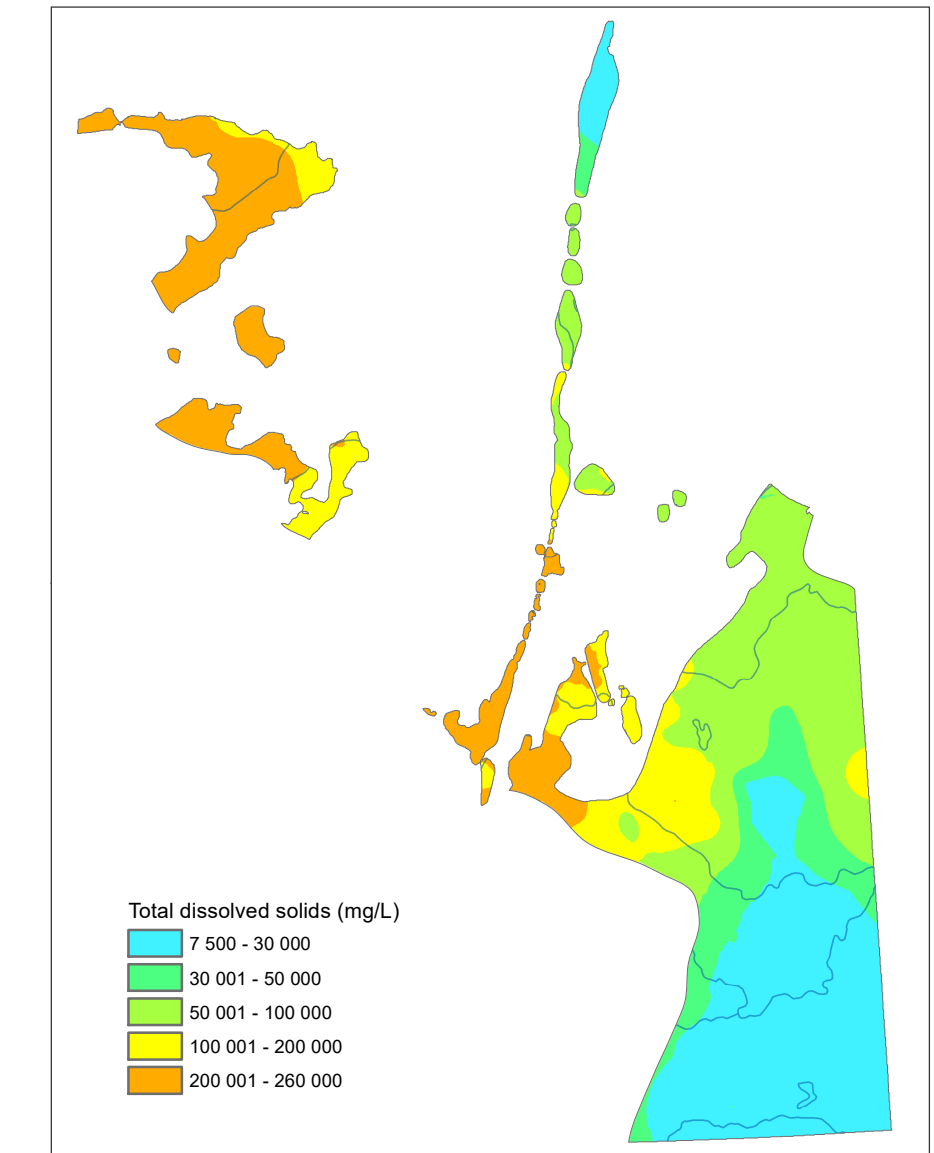


Figure 5. Distribution of total dissolved solids in the Leduc HSU (Brinsky, 2023). The map extent is based on the spatial distribution of TDS data and differs from the extent on the main map.

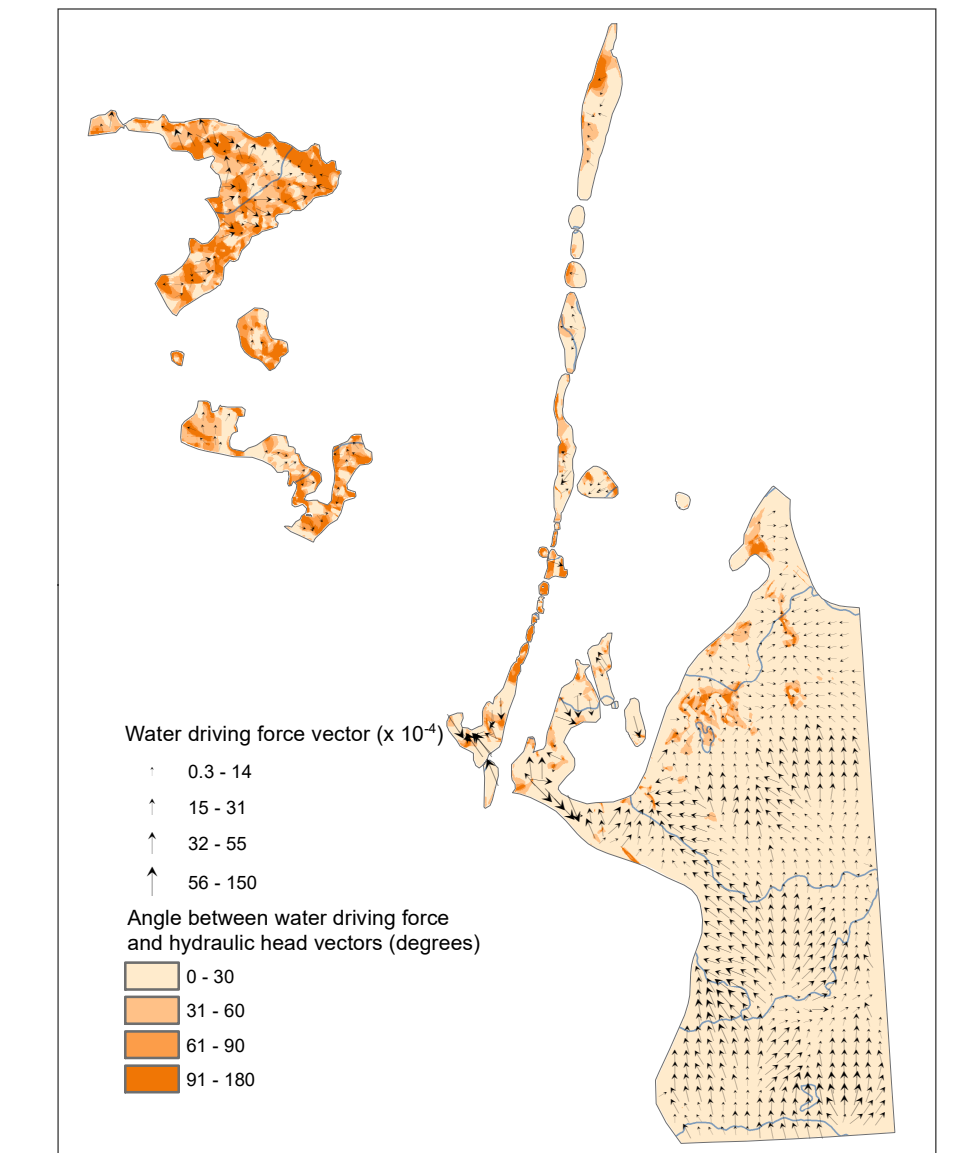


Figure 6. Water driving force vector map of the Leduc HSU. The map covers only the area where the hydraulic head and TDS gridded surfaces overlap.