CRITICAL PRESSURE CALCULATION
CTV IV

Critical Pressure Calculation

The Critical pressure was calculated using the methods of Thornhill et al. (1982), which is referenced in the US EPA AoR and Corrective Action Guidance.

Based on pressure data available in [redacted] (Upper Injection Zone) and [redacted] (Lower Injection Zone) in the region (**Figure 2**), it appears that both formations are under-pressured. Graph and data table showing this are shown in **Figure 1** below, and [redacted] This is likely due to historic withdrawal from [redacted] and limited recharge.

[redacted]

For the purpose of calculating the critical pressure and delineating the AoR for the project area, the aquifers are considered to be under-pressured by 128 psi for the upper injection zone and 37 psi for the lower injection zone. Also the following equations were used to calculate critical pressure across the model domain:

$$P_{i,f} = P_u + \rho_i g(Z_u - Z_i) \quad \text{- Eq (1)}$$

$$\Delta P_{i,f} = P_u + \rho_i g(Z_u - Z_i) - P_i \quad \text{- Eq (2)}$$

Where,

- $\Delta P_{i,f}$ - the admissible overpressure in an under-pressured aquifer before fluid in the injection zone would flow into the USDW through a hypothetical open conduit
- P_u - the initial pressure in the USDW. Assumed to be hydrostatic.
- P_i - the initial pressure in the injection zone. The upper injection zone is assumed to be 128psi below hydrostatic pressure across the model domain, and the lower injection zone is assumed to be 37psi below hydrostatic.

g - acceleration due to gravity, 9.81m/s^2
Z_u - Elevation of the base of the USDW
Z_i - Elevation of the injection zone
ρ_i - Density of the brine in injection zone

An average TDS of 13,889 ppm was used for the upper injection zone and 14,415 ppm was used for the lower injection zone based on test data. An average TDS of 6,930ppm was assumed for the USDW based on Salinity calculations in the project area. Injection zone and USDW depths were based on the model grid and USDW mapping in the project area. Density and density gradients were calculated as a function of temperature and salinity using standard methods (McCutcheon et. al. 1993). Using these, the critical pressure was calculated at each grid point in the Petrel model using **Equations 1 & 2** and combined with the pressure outputs from the plume simulation to delineate an AoR boundary at different timesteps. The final AoR boundary was based on combined the outermost threshold overpressure [redacted] years (upper injection zone) and [redacted] years (lower injection zone) into injection which are when the maximum extent were seen. **Figure 3** shows Lower Injection Zone critical pressure front and Upper Injection Zone critical pressure front, so project AoR is combined upper injection zone critical pressure front and lower injection zone critical pressure front. **Figure 4** shows the AoR extent, CO2 plume extent, injector locations and proposed monitoring well locations.

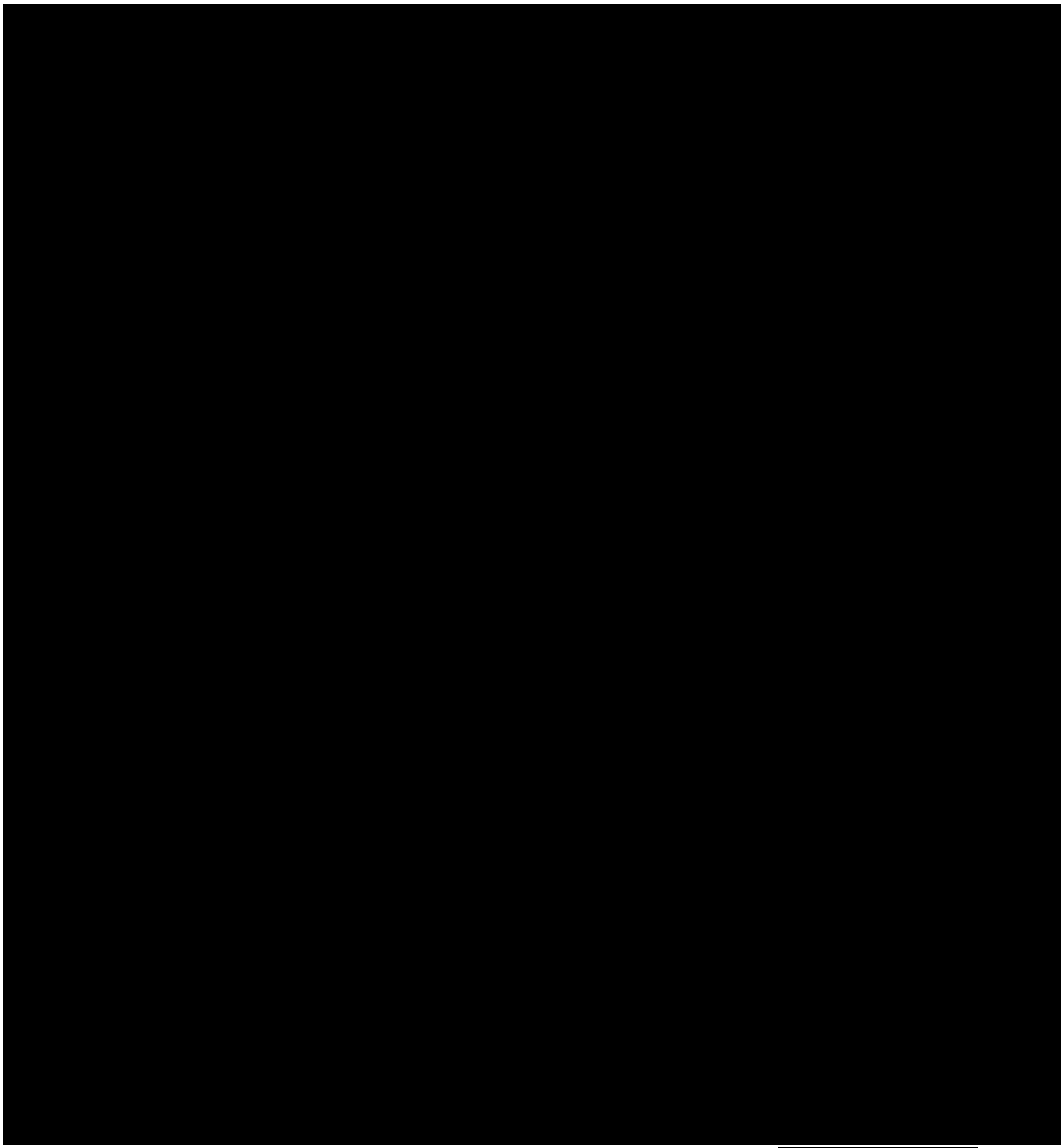

Figure 2. Map showing location of wells with pressure data for the [redacted] and [redacted]

Figure 3. Upper Injection Zone Critical Pressure Front (Pink), Lower Injection Zone Critical Pressure Front (Light Blue), and Project AoR (Dark Blue). Larger Red outline is the model boundary.

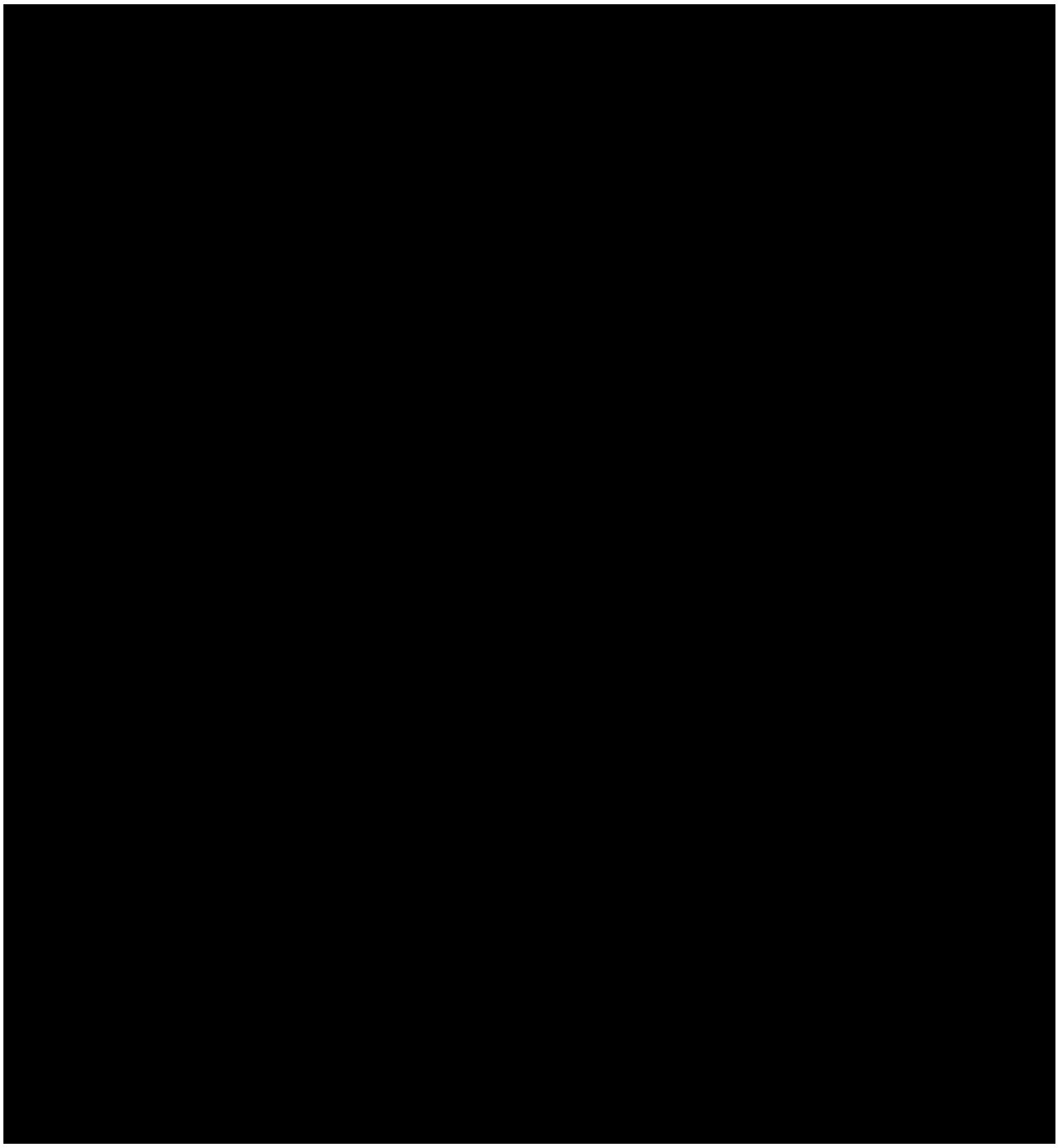

Figure 4: Map showing the location of injection wells and plume monitoring wells.