**Supporting Information B**

This section lists the derivation process of the Boltzmann transformation of governing equation, i.e. Equation (15), and boundary conditions, i.e. Equations (7), (8) and (16), to obtain the dimensionless drawdown equation.

(7)

(8)

(15)

(16)

The Boltzmann transform is a common and convenient technique in solving problems of partial differential equations. Hence, parameters of and are introduce to transform the partial differential equations into ordinary differential equation as follows.

(A1)

(A2)

where is the similar substitutions of and ; is the similar substitutions of and ; are constant

Applying Equations (A1) and (A2), the three different partial differential terms can be replaced by the equations of as follows

(B1)

(B2)

(B3)

Assuming that and, Equations (B1) to (B3) can be expressed as

(C1)

(C2)

(C3)

Substituting Equations (C1) to (C3) into Equation (15) gives

(D1)

Equation (D2) can be gained from Equation (D1) as

(D2)

Then Equations (7), (8) and (16) can be re-written as

(D3)

(D4)

(D5)

Then Equation (E1) can be gained from Equation (E5) as

(E1)

Substituting Equation (E1) into Equation (D2) gives

(E2)

Combining Equations (E2) and (D2) gives

(E3)

After the integral and simplification of Equation (E3), Equations (E4) and (E5) are given as

(E4)

(E5)

Combining Equation (E4) and (E5) gives

(E6)

Then let , the solution for the drawdown induced by non-Darican flow with wellbore storage can be gained from the combination of Equations (A1) and (C1) as

(17)

After the simplification, Equation (17) also can be expressed as

(18)

where .