A given salt solution contains a 1:1 salt \( j \) (e.g. NaCl) in which the salt, chemical substance \( j \), completely dissociates into ions. In other words, the total molality of solutes equals \( 2 \cdot m_j \). By definition the chemical potential of water in this aqueous solution, \( \mu_1^{\text{aq}} \), at fixed temperature and pressure, the latter being ambient and hence close to the standard pressure \( p^0 \), is given by equation (a).

\[
\mu_1^{\text{aq}} = \mu_1^*(\ell) - 2 \cdot \phi \cdot R \cdot T \cdot M_j \cdot m_j \quad (a)
\]

For the corresponding ideal solution, \( \phi = 1.0 \) at all \( T \) and \( p \), hence, \( \mu_1^{\text{aq}} = \mu_1^*(\ell) - 2 \cdot R \cdot T \cdot M_j \cdot m_j \quad (b) \)

Just as for solutions containing neutral solutes, the minus sign in equation (b) means that added salt stabilises the solvent in an ideal solution; \( \mu_1^{\text{aq}} < \mu_1^*(\ell) \).

For water in an aqueous salt solution containing salt \( j \), molality \( m_j \), where each mole of salt forms \( \nu \) moles of ions with complete dissociation, the chemical potential of the solvents is given by equation (c).

\[
\mu_1^{\text{aq}} = \mu_1^*(\ell; p^0) - \nu \cdot \phi \cdot R \cdot T \cdot M_j \cdot m_j + \int_{p^0}^p V_1^*(\ell) \cdot dp \quad (c)
\]

For the ideal dilute solution, \( \phi = 1.0 \). Here \( \mu_1^*(\ell; p^0) \) is the standard chemical potential of water at temperature \( T \). Alternatively we may switch the reference chemical potential for the solvent to the pure liquid at the same pressure [1,2].

\[
\mu_1^{\text{aq}}(T; p) = \mu_1^*(\ell; T; p) - \nu \cdot \phi \cdot R \cdot T \cdot M_j \cdot m_j \quad (d)
\]

Footnotes
[2] The impact of salts on osmotic coefficients is illustrated by the properties of aqueous solutions containing alkylammonium salts.
(a) S. Lindenbaum, J. Phys.Chem., 1971, 75, 3733; and references therein.