Eq. (3.1.4) serves as the cornerstone of the unified channel charge expression at the source for small V_{ds}. To account for the influence of V_{ds}, the V_{gsteff} function must keep track of the change in channel potential from the source to the drain. In other words, Eq. (3.1.4) will have to include a *y* dependence. To initiate this formulation, consider first the re-formulation of channel charge density for the case of **strong inversion**

$$Q_{chs(y)} = C_{ox}(V_{gs} - V_{th} - A_{bulk}V_{F(y)}) \tag{3.1.5}$$

The parameter $V_F(y)$ stands for the quasi-Fermi potential at any given point *y*, along the channel with respect to the source. This equation can also be written as

$$Q_{chs(y)} = Q_{chs0} + \Delta Q_{chs(y)} \tag{3.1.6}$$

The term $\Delta Q_{chs}(y)$ is the incremental channel charge density induced by the drain voltage at point *y*. It can be expressed as

$$\Delta Q_{chs(y)} = -CoxA_{bulk}V_{F(y)} \tag{3.1.7}$$

For the **subthreshold region** (V_{gs}<<V_{th}), the channel charge density along the channel from source to drain can be written as

$$\begin{aligned} Q_{chsubs(y)} &= Q_0 \exp(\frac{V_{gs} - V_{th} - A_{bulk}V_{F(y)}}{nv_t}) \\ &= Q_{chsubs0} \exp(-\frac{A_{bulk}V_{F(y)}}{nv_t}) \end{aligned} \tag{3.1.8}$$