Submergence Corrections for Thin-Plate Weirs

Thin-plate weirs are intended to operate under free-flow conditions with the nappe freely spilling over the weir's crest. However, there may be occasions when a weir becomes submerged – commonly this is either due to settling of the weir plate or to changes in the downstream channel. As with a flume, when a weir becomes submerged the discharge indicated at the point of measurement overstates the actual discharge over the weir.

This does not mean, however, that no flow calculation can be made. Research published by Villemonte (1947) provides a means to correct for submerged conditions:

$$Q_s = Q_f \left[1 - \left(\frac{h_2}{h_1}\right)^n\right]^{0.385}$$

Q_s = *submerged discharge*

Q_f = *free-flow discharge at the same upstream head,* h_1

h_1 = *head at point of measurement, relative to crest elevation*

h_1 = *head downstream, relative to crest elevation*

n = *exponent of the basic flow equation (1.5 for rectangular weirs, 2.5 for v-notch weirs)*

Villemonte recommended that h_2 should be measured just beyond the turbulence caused by the nappe entering the downstream water surface, generally 6 to 10-feet [1.83 – 3.05 m] downstream of the weir.

Submerged flow corrections for thin-plate weirs should only be viewed as only a temporary measure to provide an estimate of flow. In the long run, steps should be taken to correct the submergence condition.

These can include:

- Raising the weir crest
- Installing a wider crest weir
- Installing a different primary device
- Cleaning weeds, sediment, and debris from the downstream channel

Further Reading:
Villemonte, J., Submerged Weir Discharge Studies, Engineering News Record, December 25th, 1947.
Ackers, P., White, W., Perkins, A., Harrison, A., Weirs and Flumes for Flow Measurement, 1978.