

**ATTACHMENT A - NCCW General Permit**  
**Example Receiving Water Temperature**  
**Engineering Calculation for Massachusetts Facilities**

Example calculation for a facility that uses a river as the receiving water:

The basic equations used for the calculation of river temperature rise are as follows:

$$Q_{\text{plant}} = C_p m_p \Delta T_p$$

$$Q_{\text{river}} = C_p m_r \Delta T_r$$

$$C_p m_p \Delta T_p = C_p m_r \Delta T_r$$

$$\Delta T_r = m_p / m_r \times \Delta T_p$$

Where

$Q_{\text{plant}}$  = heat load discharged from plant (btu)

$C_p$  = heat capacity of water = 1.0 °F x btu/lb

$m_p$  = mass of effluent, lbs (gal. or cubic feet per second if volume is used)

$\Delta T_p$  = change in temperature, effluent – influent, °F

$m_r$  = mass of river, lbs (gal. or cubic feet per second if volume is used)

$\Delta T_r$  = change in river temperature, °F

Notes:

(1) Since both the effluent mass ( $m_p$ ) and river mass ( $m_r$ ) convert to volume by using the same factor of 1 gal/8.34 lbs, a volumetric unit may be substituted for mass in the above equation, as long as same units are consistently used for both the river and plant terms.

(2) The 7Q10 should be used as the mass of the river. Typically, 7Q10 information is given in units of cubic feet per second (cfs).

The state permitting authority must be contacted, via email at

a. Massachusetts facilities: [Kathleen.Keohane@state.ma.us](mailto:Kathleen.Keohane@state.ma.us)

b. New Hampshire facilities: [jandrews@des.state.nh.us](mailto:jandrews@des.state.nh.us), [ddudley@des.state.nh.us](mailto:ddudley@des.state.nh.us)  
or [swilloughby@des.state.nh.us](mailto:swilloughby@des.state.nh.us)

to confirm the annual 7Q10 low flow for the facility prior to completing the NOI requirements for the permit. Prior to contacting the state permitting authority, new applicants may wish to view the 7Q10 data posted at the USGS StreamStats website at <http://water.usgs.gov/osw/streamstats/>

For the convenience of Massachusetts facilities that were granted coverage under the expired NCCW general permit, the 7Q10 estimates for those permits are posted at <http://www.epa.gov/region1/npdes/nccwgp.html> and can be used by those applicants if re-applying for coverage under this general permit.

## ATTACHMENT A of General Permit Continued

(3) Often, the facility discharge is given in units of gallons per day, or million gallons per day (mgd). Use the conversion factor of 0.645 mgd/cfs or 0.645 mgd per 1 cfs to convert from cfs to mgd.

Therefore, for this equation, we are assuming all of the waste heat from the facility is transferred to the river. The waste heat from the facility can either be calculated using the maximum change in temperature and the maximum effluent flow or it can be determined by plant engineering personnel.

### EXAMPLE 1:

A facility has a maximum permitted flow rate of 1 mgd. The maximum amount of heat that needs to be rejected from the plant is 10,000 btu/hr. The 7Q10 of the river has been determined to be 325 cfs. What is the maximum calculated change in river temperature? The plant is located in a Massachusetts Warm Water fishery.

### SOLUTION 1:

Since all of the heat rejected by the plant is assumed to be absorbed by the river,  $Q_p = Q_r$  and  $Q_r = C_p M_r \Delta T_r$  or  $\Delta T_r = Q_r / C_p M_r$

$$Q_r = 10,000 \text{ btu/hr}$$

$$\text{Convert 325 cfs to mgd, } 325 \text{ cfs} \times 0.645 \frac{\text{mgd}}{\text{cfs}} = 209.6 \text{ mgd}$$

$$\begin{aligned} \Delta T_r &= (10,000 \text{ btu/hr}) / (1 \text{ btu/lbs}^\circ\text{F}) \times (24 \text{ hrs/day}) \times (\text{gal}/8.34 \text{ lbs}) / 209.6 \times 10^6 \text{ gal/day} \\ &= 1.37 \times 10^{-4} \text{ }^\circ\text{F} \end{aligned}$$

In this example, the facility has demonstrated that the receiving water will be protected. Therefore, no in-stream monitoring would be required.

### EXAMPLE 2:

A facility has a maximum reported  $\Delta T$  of 35°F. The maximum plant design is 1 mgd. The 7Q10 is determined to be 125 cfs. The plant is located in a Massachusetts Cold Water fishery.

### SOLUTION 2:

$$\text{Convert 125 cfs to mgd, } 125 \text{ cfs} \times 0.645 \frac{\text{mgd}}{\text{cfs}} = 80.62 \text{ mgd.}$$

$$\Delta T_r = m_p / m_r \times \Delta T_p$$

$$= (1 \text{ mgd} / 80.62 \text{ mgd}) \times 35 \text{ }^\circ\text{F}$$

$$= 0.43 \text{ }^\circ\text{F}$$