

CALCULATION OF TOTAL PHOSPHORUS LIMITS FOR NPDES PERMITS IN NEW HAMPSHIRE



APPLICABLE NH WATER QUALITY STANDARDS

- New Hampshire has narrative WQS relating to nutrients found at Env-WWq 1703.14
 - Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring
 - Existing discharges containing phosphorus or nitrogen, or both, which encourage cultural eutrophication shall be treated to remove the nutrient(s) to ensure attainment and maintenance of water quality standards.

TRANSLATOR FOR NARRATIVE CRITERIA AND APPLICABLE FLOW

- EPA currently uses EPA Quality Criteria for Water - 1986 (the Gold Book) values to interpret narrative criteria for total phosphorus in both NH and MA
 - To prevent the development of biological nuisances and to control accelerated or cultural eutrophication, total phosphates as phosphorus should not exceed 50 ug/l in any stream at the point where it enters any lake or reservoir, not 25 ug/l within the lake or reservoir. A desired goal for the prevention of plant nuisances in streams and or other flowing waters not discharging directly to lakes or impoundments is 100 ug/l total phosphorus.

TRANSLATOR FOR NARRATIVE CRITERIA AND APPLICABLE FLOW (CONTINUED)

- Gold Book values are “not to exceed” values
- NH WQS at Env-Wq 1705.01 requires that not less than 10 percent of the assimilative capacity of each surface water shall be held in reserve to provide for future needs (For example the Gold Book instream target of 0.1 mg/l is reduced to 0.09 mg/l to hold 10% assimilative capacity in reserve for future needs)
- 7Q10 flow is currently used in both NH and MA

REASONABLE POTENTIAL

- water quality based permitting regulations (40 CFR § 122.44(d))
 - discharges must be evaluated to determine the “reasonable potential” to cause, or contribute to an excursion of a numeric or narrative water quality criteria.
 - “reasonable potential” take into account existing controls on point and non-point sources of pollution.
 - Where there is “reasonable potential”, a water quality based limit must be developed.

REASONABLE POTENTIAL (CONTINUED)

- A water body does not need to be on the 303(d) list of impaired waters for a facility to receive a water quality based effluent limitation.
- The NPDES permitting program and implementing regulations are preventative programs so that impairments will not occur.

REASONABLE POTENTIAL CALCULATION

- RP calculations based upon a mass balance equations where: $Q_u C_u + Q_d C_d = Q_r C_r$
- Calculations for reasonable potential use the following information
 - Design flow of the POTW
 - Maximum (if less than 10 samples) or 95th percentile (for 10 samples or more) TP concentration in the effluent
 - Upstream 7Q10 flow
 - Median upstream TP concentration
 - Since TP limits are seasonal (April 1 – October 31) TP data from this timeframe are used
- If the resultant downstream concentration exceeds 0.09 mg/l then reasonable potential exists and a water quality based effluent limitation is established.

EXAMPLE: WINNIPESAUKEE RIVER BASIS PROGRAM (WRBP)

Reasonable Potential Calculation $\Rightarrow C_r = (Q_u C_u + Q_d C_d) / Q_r$

- Q_d = design flow of facility (11.5 mgd)
- C_d = 95th percentile April to October effluent phosphorus concentration (5.63 mg/l)
- Q_u = upstream 7Q10 flow (318.2 mgd)
- C_u = upstream median river phosphorus concentration (0.0127 mg/l)
- Q_r = downstream 7Q10 flow ($Q_u + Q_d = 329.7$ mgd)
- **C_r = downstream river phosphorus concentration = 0.208 mg/l \Rightarrow RP exists**

WRBP EXAMPLE (CONTINUED)

$$\text{Effluent Limit Calculation} \Rightarrow C_d = (Q_r C_r - Q_u C_u) / Q_d$$

- Q_u = upstream 7Q10 flow (318.2 mgd)
- C_u = upstream median river phosphorus concentration (0.0127 mg/l)
- Q_r = downstream 7Q10 flow ($Q_s + Q_d = 329.7$ mgd)
- C_r = 0.09 mg/l (Gold Book value times 0.9 to maintain 10% reserve capacity)
- Q_d = design flow of facility (11.5 mgd)
- **$C_d = 2.2$ mg/l \Rightarrow Effluent concentration limit to meet instream target of 0.09 mg/l**

WRBP EXAMPLE (CONTINUED)

- Permittees have been given the option to have mass TP limits as opposed to concentration based limits
- This allows greater flexibility and allows for higher effluent concentrations during periods of low effluent flow while still maintaining instream target of 0.09 mg/l
- To ensure that mass limits will be protective under the worst case scenario they are calculated using the upstream 7Q10 flow and the lowest monthly average plant flow

WRBP EXAMPLE (CONTINUED)

$$\text{Mass Limit Calculation} = M_d = Q_d C_d * 8.345 = (Q_r C_r (0.90) - Q_u C_u) * 8.345$$

- Q_d = effluent flow in mgd (lowest effluent monthly average flow (April 1 – Oct 31) = 3.99 mgd)
- C_d = effluent phosphorus concentration in mg/L
- Q_s = upstream 7Q10 flow (318.2 mgd)
- C_s = upstream median river phosphorus concentration (0.0127 mg/l)
- Q_r = downstream 7Q10 flow ($Q_s + Q_d = 322.2$ mgd)
- C_r = downstream river phosphorus concentration (Gold Book target = 0.100 mg/l)
- **M_d = mass-based phosphorus limit => 208 lb/day**

WRBP - COMPARISON OF CONCENTRATION VS. MASS LIMITS

Effluent Flow (mgd)	Concentration Limit (mg/l)	Mass limit (lb/d)	Concentration to Meet Mass Limit (mg/l)
4	2.2	208	6.23
5	2.2	208	4.99
6	2.2	208	4.15
7	2.2	208	3.56
8	2.2	208	3.12
9	2.2	208	2.77
10	2.2	208	2.49
11	2.2	208	2.27
11.5	2.2	208	2.17