Calculation Methodology for Case-by-Case WQBELs

1. Limitations

Numeric water quality-based effluent limitations (WQBELs) are calculated for:

- All parameters listed in Part 2 of the DRGP; and
- Any parameter with numeric criteria in the applicable States' water quality standards (WQSs) (Appendix E) that is known or believed present in the proposed source water type, soil/sediment that will be disturbed/dewatered during dewatering/remediation activities, and/or in materials applied on site or to discharges during dewatering/remediation activities.

No dilution is included in the calculations unless allowable under the terms of this general permit and approved by the appropriate State at the time of the submission of the NOI to EPA. EPA and/or the applicable State may request additional information, including monitoring, in order to calculate the limitations necessary to meet the terms of this general permit. The calculations are completed automatically in the electronic NOI unless a waiver is granted by EPA for e-reporting, in which case the calculation methodology described in this appendix must be completed and included in the NOI submitted to EPA. In the event of a calculation error, EPA will inform the operator of any corrections necessary to authorize the proposed discharge(s) under the DRGP.

2. Calculations

The calculation methodology used to calculate case-by-case WQBELs is completed automatically in the NOI submitted for a site based on the entries provided by the operator. No dilution factor or mixing zone applies to any discharge unless approved by the applicable State as follows:

For sites in Massachusetts, the regulations pertaining to dilution factors and mixing zones are located at 314 CMR 4.03 and in the *Massachusetts Water Quality Standards Implementation Policy for Mixing Zones*. For discharges to freshwater streams and rivers, 314 CMR 4.03(3)(a) requires that effluent dilution be calculated based on the receiving water lowest observed mean river flow for seven consecutive days, recorded over a 10-year recurrence interval, or 7-day 10-year low flow (7Q10). The receiving water 7Q10 can generally be determined using the United States Geological Survey (USGS) low-flow frequency statistics for sites with a USGS gauging station in proximity to a site, or by using the USGS StreamStats for Massachusetts watershed delineation tool.[1] For discharges to marine waters, unless the operator meets additional reporting requirements necessary for the State to approve a dilution factor,[2] the dilution factor for all saltwater receiving waters is zero. The critical hydrologic condition at which water quality must be met has been established on a case-by case basis. Existing uses are to be protected and the selected hydrologic condition is not to interfere with the attainment of designated uses (314 CMR 4.03(3)(c)). In all cases, use of a dilution factor in Massachusetts must meet the criteria at 314 CMR 4.03(2).

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[1] USGS StreamStats for Massachusetts Interactive Map: http://water.usgs.gov/osw/streamstats/massachusetts.html
[2] Generally, a dye study or dilution study, such as hydrodynamic modelling, must be completed and provided to MassDEP to support the request for a dilution factor in marine waters.

For sites in New Hampshire, the regulations pertaining to dilution factors are located at Env-Wq 1705. New Hampshire water quality standards establish the flows that shall be used to calculate permit limits in Part Env-Wq 1705.02. In order to satisfy New Hampshire regulations, EPA uses the 7Q10 statistic for non-tidal rivers and streams to calculate dilution factors for all aquatic life criteria and human health criteria for non-carcinogens, and uses the long-term harmonic mean flow for non-tidal rivers and streams to calculate dilution factors for all human health criteria for carcinogens. Because ten percent (10%) of the receiving water's assimilative capacity is held for future needs in New Hampshire, in accordance with Env-Wq 1705.01, the dilution factor is multiplied by 0.90 prior to use in permit limitation calculations. For discharges to tidal waters in New Hampshire, the low flow condition shall be equivalent to the conditions that result in a dilution that is exceeded 99 percent of the time (see Env-Wq 1705.02).

A. Critical Low Flow:

1. Using DFLOW: DFLOW 4.0 is an EPA-developed tool for calculating flow statistics. Version 4.0 is contained within the larger watershed planning tool BASINS 4.1. The BASINS program can be downloaded from EPA's website at: https://www.epa.gov/exposure-assessment-models/basins.

2. Using StreamStats: This online application is appropriate for determining drainage area ratios for nearby gages, and uses the 7Q10s for available gages from the U.S. Geological Gazetteer reports (1984 Wandle et al.). StreamStats is available at: http://water.usgs.gov/osw/streamstats/massachusetts.html.

3. For sites in New Hampshire, NHDES will calculate the critical low flow using
   a. the methodology in Dingman, S.L., and S.C Lawlor, 1995, 'Estimating Low-Flow Quantiles from Drainage-Basin Characteristics in New Hampshire and Vermont', *American Water Resources Association, Water Resources Bulletin*, pp 243-256, for discharges to non-tidal rivers and streams,
   b. the CORMIX hydrodynamic mixing zone model for discharges to tidal waters,
   c. or other method as determined appropriate by NHDES.

B. Dilution Factor:

Prior to submitting the NOI, the operator must contact the appropriate State to confirm the critical low flow of the receiving water, dilution factor (DF), other appropriate hydrologic conditions, or to authorize site-specific limiting factors. See Part 3.6 of the DRGP for contact information.

1. For dilution factors in Massachusetts, the equation below is typically used for discharges to freshwater. Dilutions factors for discharges to saltwater receiving waters in Massachusetts is 1:1, unless otherwise approved by the State.

$$\text{Dilution Factor} = \frac{Q_s + Q_d}{Q_d}$$

Where: Q_s = Critical low flow (e.g., 7Q10) in million gallons per day (MGD)
Q_d = Daily maximum discharge flow in MGD

2. All discharges in New Hampshire will not be allowed dilution for the purpose of calculating permit limits unless the applicant completes additional effluent and receiving water sampling as required by NHDES prior to submitting their NOI, per State Condition 6.2.4.7. If the required sampling is completed and there is available dilution in the receiving water for the proposed discharge flow rate, the dilution factor for discharges to tidal receiving waters will be calculated by NHDES using the CORMIX hydrodynamic mixing zone model or other method as determined by NHDES, and the dilution factors for discharges to non-tidal rivers and streams shall be calculated using the equation below.

The equation used to calculate a dilution factor for a non-tidal river or stream in New Hampshire is:

$$\text{Dilution Factor} = \frac{(Q_R + Q_P)}{Q_P} \times 0.9$$

Where: Q_R = Critical low flow (e.g., 7Q10) in million gallons per day (MGD)
Q_P = Daily maximum discharge flow in MGD
0.9 = Factor to reserve 10 percent of the receiving water's assimilative capacity

3. For dilution factors in Vermont, the calculation is typically the same as for Massachusetts, above.

C. Water Quality Criterion:

These calculations are completed to: 1) Adjust water quality criteria for metals that are hardness-dependent; and 2) Convert WQBELs expressed as dissolved metal to total recoverable metal.

These calculations are completed automatically in the NOI. The equations and appropriate factors for each parameter are specified in applicable State WQSs and are generally summarized below.

1. When the receiving water is a freshwater waterbody, use the upstream hardness in mg/L,[3] calculate the total recoverable water quality criteria for hardness-dependent metals (e.g., copper, lead, nickel, zinc) as:

Chronic WQC in µg/L = $\exp\{m_c [\ln(h)] + b_c\}$
Acute WQC in µg/L = $\exp\{m_a [\ln(h)] + b_a\}$

Where: m_c = Pollutant-specific coefficient, chronic[4]
b_c = Pollutant-specific coefficient, chronic[4]
m_a = Pollutant-specific coefficient, acute[4]
b_a = Pollutant-specific coefficient, acute[4]
ln = Natural logarithm
h = Hardness calculated in Step 1

[3] If the sample size is greater than 1, the median value may be used.
[4] Per 314 CMR 4.05(5)(e) (or as revised). Per Env-Wq 1703.24(c) (or as revised). For silver, use the acute coefficient, b_a, for b_c.

3. When the receiving water is a saltwater waterbody and the WQC for a metal must be converted to total recoverable, or when the receiving water is a freshwater waterbody but a given metal is not hardness-dependent (e.g., arsenic, chromium VI), calculate the total recoverable water quality criteria as:

$$\text{WQC in } \mu g/L = \frac{\text{dissolved WQC in } \mu g/L^{5}}{\text{dissolved to total recoverable factor}^{6}}$$

D. WQBEL:

1. The WQBEL for which the applicable State has not approved a dilution factor is generally:

$$C_d = C_r$$

Where: C_r = Downstream parameter concentration (WQC) in µg/L[7]
C_d = Discharge parameter concentration (WQBEL) in µg/L[8]

2. The WQBEL for a parameter for which Massachusetts has approved a dilution factor is generally:

$$C_d = \frac{Q_r C_r - Q_s C_s}{Q_d}$$

Where: C_r = Downstream parameter concentration (WQC) in µg/L[7]
Q_d = Discharge flow in MGD[9]
C_d = Discharge parameter concentration (WQBEL) in µg/L[8]
Q_s = Receiving water flow (e.g., 7Q10) in MGD
C_s = Receiving water parameter concentration in µg/L[10]
Q_r = Downstream receiving water flow ($Q_s + Q_d$) in MGD[11]

Note that unless otherwise instructed to enter receiving water parameter concentrations by the State, the assumed receiving water concentration of a parameter is zero, which results in:

$$C_d = \frac{Q_r C_r}{Q_d} = \frac{(Q_s + Q_d)}{Q_d} \times C_r = DF \times WQC$$

Note that if a WQBEL is calculated to be lower than the criterion, then the WQBEL is set at the criterion.

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[5] Use the WQC listed in Part 2.1.1 of the RGP, Part 6, and/or Appendix E, per 314 CMR 4.05(5)(e) or Env-Wq 1703.23 and 1703.24 (or as revised).
[6] Dissolved to total recoverable conversion factors per 314 CMR 4.05(5)(e) or Per Env-Wq 1703.23(e) (or as revised).
[7] The WQC is as calculated in this appendix, when required for a parameter; for all other parameters, use the WQC for the given parameter as specified in Appendix E of the DRGP, per the applicable State WQSs.
[8] If the sample size is greater than one, the maximum value is generally used.
[9] Equal to the discharge flow limitation, which is either the design flow or 1.0 MGD, whichever is less.
[10] If the sample size is greater than one, the median concentration is generally used.
[11] Equal to the sum of the receiving water flow (e.g., 7Q10) and the discharge flow.

3. The WQBEL for a parameter for which NHDES has approved a dilution factor is as in 2.D.2. above, except:

$$C_d = \frac{[Q_r (C_r \times 0.9) - Q_s C_s]}{Q_d}$$

Where: 0.9 = Factor to reserve 10 percent of the receiving water's assimilative capacity

4. The WQBEL for a parameter for which VTDEC has approved a dilution factor is as in 2.D.2.

3. Applicability

The WQBEL for a given parameter as calculated in 2, above, applies if:

- The WQBEL is less than the wastewater limit in Part 2 of the DRGP for that parameter;
- The WQBEL is less than the State-specific limit for that parameter in Part 6 of the DRGP;
- The WQBEL is less than the maximum allowable technology-based effluent limitation (TBEL) for that parameter as specified in Appendix E of the DRGP; and
- An impaired waters limit as specified in Appendix G of the DRGP does not apply for that parameter. If an impaired waters limit is specified, the impaired waters limit applies.