



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
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BOSTON, MASSACHUSETTS 02109-3912

May 11, 2018

Emily Boedecker, Commissioner
Vermont Department of Environmental Conservation
1 National Life Drive, Main 2
Montpelier VT 05620-3522

SUBJECT: Approval of Moon and Mussey Brook Temperature TMDLs

Dear Commissioner Boedecker:

Thank you for your submittal of the Total Maximum Daily Load (TMDL) documents for Moon and Mussey Brooks. These brooks are included on Vermont's 2016 303(d) list and were prioritized for TMDL development. The purpose of the TMDLs is to address temperature impairments.

The U.S. Environmental Protection Agency (EPA) hereby approves Vermont's October 2017 TMDLs for Moon and Mussey Brooks, submitted with a cover letter dated October 13, 2017. EPA has determined that these TMDLs meet the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

Thank you again for your submittal. We were pleased with the quality of these TMDLs. My staff and I look forward to continued cooperation with VTDEC in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

Sincerely,

/s/

Ken Moraff, Director
Office of Ecosystem Protection

Enclosure

cc: Tim Clear, VTDEC

EPA NEW ENGLAND'S TMDL REVIEW

TMDLs: Moon Brook and Mussey Brook Temperature TMDLs, Rutland, Vermont
Waterbodies VT03-06-01, VT03-06-02

STATUS: Final

DATE: May 11, 2018

IMPAIRMENT/POLLUTANT: Temperature

BACKGROUND: The Vermont Agency of Natural Resources (VANR) submitted to EPA New England the final Moon and Mussey Brook TMDLs for temperature with a transmittal letter dated October 13, 2017.

REVIEWER: Eric Perkins (617-918-1602) E-mail: perkins.eric@epa.gov

REVIEW ELEMENTS OF TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. § 130 describe the statutory and regulatory requirements for approvable TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

1. Description of Waterbody, Pollutant of Concern, Pollutant Sources and Priority Ranking

The TMDL analytical document must identify the waterbody as it appears on the State/Tribe's 303(d) list, the pollutant of concern and the priority ranking of the waterbody. The TMDL submittal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. Where it is possible to separate natural background from nonpoint sources, a description of the natural background must be provided, including the magnitude and location of the source(s). Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (3) present and future growth trends, if taken into consideration in preparing the TMDL; and, (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments, or chlorophyll a and phosphorus loadings for excess algae.

The TMDL documents describe the waterbodies and the cause of impairment as identified in the 2016 303(d) list. Portions of the two brooks are impaired by temperature (heat) and ranked high for TMDL development. Moon Brook drains a watershed of approximately 5,545 acres and Mussey Brook (a tributary to Moon) drains a watershed of 1,856 acres located in the City of Rutland and the Towns of Rutland and Mendon in Rutland County, Vermont. The headwaters of these streams drain the undeveloped forested area of East Mountain and the streams flow through increasingly dense residential and developed areas as they enter the City of Rutland. Two on-

stream impoundments, Combination Pond and Piedmont Pond, are situated about a half mile apart along Moon Brook. Based on land cover mapping estimates, the watersheds are nearly evenly divided between developed and forested land, with only very small portions categorized as either agricultural or open space.

The main source (or cause) of the elevated temperatures is identified as heat from solar radiation due to insufficient riparian vegetation along portions of both streams and, for Moon Brook, the two in-stream ponds referenced above. The reduced riparian vegetation both along the streams and around the ponds allows for increased solar radiation to reach the water. The in-stream ponds also slow the flow of water, allowing more time for the water to heat up, and widen the channel, providing greater surface area, both of which allow for more interception of solar radiation.

The TMDLs include a direct accounting of solar flux (solar radiation heat load) in the development of the loading capacity and load allocations. The TMDL documents also present “effective shade”, or the fraction of potential solar radiation that is blocked by vegetation and topography before it reaches the water’s surface, as a surrogate measure of heat flux to help guide management actions needed to meet the TMDL targets, given the identified cause of the impairment. The effective shade measure captures the heat-related effects of riparian vegetation, water surface area, and velocity.

Assessment: The TMDL documents identify the pollutant of concern as heat, primarily added to the waterbodies via solar radiation. The TMDL documents also helpfully identify “effective shade” – the fraction of potential solar radiation that is blocked by vegetation and topography before it reaches the water’s surface – as an alternative metric that may help guide management actions to attain TMDL temperature targets. EPA Region 1 concludes that Vermont DEC adequately describes the waterbody, pollutant of concern, and pollutant sources.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribe water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. Such information is necessary for EPA’s review of the load and wasteload allocations which are required by regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must be identified. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, usually site specific, must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal.

The TMDL reports describe the applicable water quality standards including designated uses and applicable numeric criteria (Section 4 of each TMDL report). The streams are impaired for aquatic use support, and the ultimate determination of an impaired water’s compliance with the aquatic use support provisions in Vermont’s water quality standards is attainment of the relevant biological criteria (as measured through fish and/or macroinvertebrate monitoring).

For these TMDLs, given that the cause of the biological impairment is (at least in part) elevated water temperature, the State also needed to consider any relevant temperature criteria. The

Vermont water quality standards do not include applicable numeric temperature criteria; the standards only contain a general narrative provision specifying that the temperature change needs to be controlled to ensure full support of aquatic biota.

For purposes of these TMDLs, the State established a numeric temperature target of “not to exceed 70 degrees F for more than 10% of the time from June through September” based on a literature review and an analysis of local fish and temperature data. The State indicates that attainment of this target will support the presence of brook trout, the species most sensitive to elevated temperatures. Available data indicate that fish are more sensitive to elevated temperatures than other forms of aquatic life such as macroinvertebrates¹. Accordingly, the TMDL documents explain that attainment of this temperature target will remove the temperature-caused stress to the aquatic biota. While there may be other stresses to the aquatic biota, such as those caused by stormwater (and which are addressed through a separate stormwater TMDL) the State indicates that the contributions to the impairment caused by temperature will be removed once the specified temperature target is met.

Assessment: EPA Region 1 concludes that VTDEC has properly presented its water quality standards and the applicable numeric water quality target. EPA agrees that the selection of the temperature target based on the tolerances of brook trout is appropriate given that this is the most sensitive Vermont fish species to elevated temperatures and that fish are more sensitive to elevated temperatures than other forms of aquatic life.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The loadings are required to be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. § 130.2(i)). The TMDL submittal must identify the waterbody’s loading capacity for the applicable pollutant and describe the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In most instances, this method will be a water quality model. Supporting documentation for the TMDL analysis must also be contained in the submittal, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc. Such information is necessary for EPA’s review of the load and wasteload allocations which are required by regulation.

In many circumstances, a critical condition must be described and related to physical conditions in the waterbody as part of the analysis of loading capacity (40 C.F.R. § 130.7(c)(1)). The critical condition can be thought of as the “worst case” scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards.

VTDEC used the combination of a stream water quality model (QUAL2KW), a spreadsheet tool (SHADE), and a GIS ArcMap application (Ttools) to calculate the loading capacities for each stream, making use of site-specific data sets for stream flow, temperature, weather, riparian vegetation, stream geomorphology and stream hydrography among other data layers. Loading

¹ See Hester, E.T and M.W. Doyle, Human impacts to river temperature and their effects on biological processes: A quantitative synthesis, Journal of the American Water Resources Association, Vol 47, No 3, 2011.

capacities and allocations were expressed both in solar flux (or heat load) units (141 W/m²/day for Moon Brook and 170 W/m²/day) and percent effective shade (73% for Moon Brook and 72% for Mussey Brook). The loading capacities for the streams were set at levels modeled to meet the in-stream temperature targets, as described in Section 5 of the TMDL documents. The QUAL2KW model and supporting analytical methods used for these TMDLs represent commonly used modeling approaches for streams and rivers with temperature impairments.

Assessment: EPA Region 1 concludes that the loading capacities have been appropriately set at levels necessary to attain and maintain applicable water quality standards for each stream. The TMDLs are based on a reasonable and widely accepted approach for establishing the relationship between solar radiation inputs, effective shade, and water temperatures in streams. The selected model, QUAL2KW, has been successfully used to model stream systems and reservoir modification scenarios for EPA-approved temperature TMDLs in the Pacific Northwest, where most temperature TMDLs have been completed. The loading capacity is expressed in terms of daily loads (W/m²/day solar flux). The good fit between measured and predicted temperatures and the ability of the model to also reproduce observed hydrologic and geomorphic variables such as flow, velocity and depth provide strong evidence that the simulations are scientifically sound. In addition, the extreme low flow conditions used in the modeling analysis ensure that the TMDL is protective of critical conditions.

4. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)). EPA guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

VTDEC identified an implicit margin of safety based on conservative assumptions in the TMDL analyses for both streams. The modeling made use of flow data collected in August 2016 that turned out to represent worst case flow conditions. Comparisons with USGS flow data and a synthetic flow duration curve for Moon Brook indicated that the observed August flows in the Moon Brook watershed (which includes both Moon and Mussey Brooks) have significantly less than a 1% chance of occurring in this system. The establishment of allocations to meet the temperature target even during these extreme low flow conditions provides an implicit margin of safety.

Assessment: EPA Region 1 concludes that VTDEC has provided an adequate implicit MOS for these TMDLs. The allocations were established to achieve the temperature target even during extreme low flow conditions. Given that these extreme conditions almost never occur (i.e., significantly less than 1% of the time) the TMDL includes allocations modeled to reduce elevated temperatures more than needed for virtually all conditions (more than 99% of the time).

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources (40 C.F.R. § 130.2(h)). If no point sources are present or if the TMDL recommends

a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to nonpoint sources and background will result in attainment of the applicable water quality standard, and all point sources will be removed.

In preparing the wasteload allocations, it is not necessary that each individual point source be assigned a portion of the allocation of pollutant loading capacity. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, an aggregated WLA can be assigned to the group of facilities. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the water quality standard.

The TMDL submittal should also discuss whether a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. In such cases, the State/Tribe will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

The TMDL documents indicate that there are no point source discharges contributing to the elevated temperatures in these streams. The heat inputs are attributed to channel surface area characteristics and insufficient riparian vegetative cover (shade). Stormwater discharges in this watershed are not typically routed through stormwater ponds or other devices that could cause a warming of the water, but even if they were, the TMDL documents note that stormwater discharges occur during precipitation events when critical conditions (very low flow conditions) do not exist. For these reasons, the TMDLs do not include WLAs – the WLAs are effectively set at zero.

Assessment: Given that the State has attributed the heat inputs entirely to nonpoint sources associated with channel characteristics and insufficient shade, EPA Region 1 concludes that VTDEC has appropriately set the WLAs for these TMDLs at zero.

6. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background (40 C.F.R. § 130.2(g)). Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g)). Where it is possible to separate natural background from nonpoint sources, load allocations should be described separately for background and for nonpoint sources.

If the TMDL concludes that there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, the LA must be expressed as zero. If the TMDL recommends a zero LA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero LA implies an allocation only to point sources will result in attainment of the applicable water quality standard, and all nonpoint and background sources will be removed.

The TMDL documents explain that the primary pathway for heat flux to the water is through energy transfer from shortwave solar radiation reaching the stream surface causing excessive heating. This solar radiation flux (or heat load) associated with insufficient riparian vegetation represents a nonpoint source loading category. As noted above, VTDEC determined that there are no point source discharges contributing to the temperature impairments, so the TMDLs assign the full loading capacities to the load allocation side of the TMDL equation. The load allocations are broken out by stream reach (with the aid of the QUAL2KW model) and specified in Table 10 in the TMDL documents for both streams. The allocations are expressed as mean estimated solar flux in $W/m^2/day$ and also as percent mean effective daylight shading to aid in guiding implementation efforts.

Assessment: EPA Region 1 concludes that the load allocations were derived using a scientifically sound model and are adequately specified in the TMDLs at levels necessary to attain and maintain water quality standards.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The method chosen for including seasonal variations in the TMDL must be described (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)).

The Moon and Mussey Brook TMDLs considered seasonal variations because the allowable load was developed to be protective of the most sensitive time of year – during critical conditions in the late summer, when flows are lowest and temperatures highest. Thus, the TMDLs are protective during all seasons.

Assessment: EPA Region 1 concludes that seasonal variation has been adequately accounted for in these TMDLs because the TMDL was developed to be protective during the most environmentally sensitive period, the late summer season, when solar flux impacts are highest and flows are lowest.

8. Monitoring Plan

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), and EPA's 2006 guidance, Clarification Regarding "Phased" Total Maximum Daily Loads, recommend a monitoring plan when a TMDL is developed using the phased approach. The guidance indicates that a State may use the phased approach for situations where TMDLs need to be developed despite significant data uncertainty and where the State expects that the loading capacity and allocation scheme will be revised in the near future. EPA's guidance provides that a TMDL developed under the phased approach should include, in addition to the other TMDL elements, a monitoring plan that describes the additional data to be collected, and a scheduled timeframe for revision of the TMDL.

The TMDL documents propose a monitoring approach featuring periodic measurements of stream temperature and riparian shade to evaluate progress towards the TMDL temperature targets.

Assessment: EPA Region 1 concludes that the monitoring plan components referenced above, and described more fully in the TMDL reports, are sufficient to evaluate success of the TMDLs and their implementation.

9. Implementation Plans

On August 8, 1997, Bob Perciasepe (EPA Assistant Administrator for the Office of Water) issued a memorandum, "New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," that directs Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired solely or primarily by nonpoint sources. To this end, the memorandum asks that Regions assist States/Tribes in developing implementation plans that include reasonable assurances that the nonpoint source load allocations established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. The memorandum also includes a discussion of renewed focus on the public participation process and recognition of other

relevant watershed management processes used in the TMDL process. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs.

The TMDL documents indicate that a settlement agreement between the State and the City of Rutland stipulates that the City shall provide a tree planting plan for publicly-owned lands to the VT ANR for review and approval. The agreement also specifies that the City shall submit a plan for promoting the preservation and planting of shade trees on private lands. These plans will help guide implementation needed to meet the effective shade targets in the TMDLs. In addition, the City committed to seek modifications to Combination and Piedmont Ponds to address thermal impacts. The TMDL documents indicate that the City and neighborhood property owners are currently engaged in this effort. The Moon Brook TMDL document also indicates that the State has committed to taking action under state law to address the impoundments in the event the City efforts are unsuccessful.

Assessment: Addressed, though not required. EPA is taking no action on the implementation plan.

10. Reasonable Assurances

EPA guidance calls for reasonable assurances when TMDLs are developed for waters impaired by both point and nonpoint sources. In a water impaired by both point and nonpoint sources, where a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur, reasonable assurance that the nonpoint source reductions will happen must be explained in order for the TMDL to be approvable. This information is necessary for EPA to determine that the load and wasteload allocations will achieve water quality standards.

In a water impaired solely by nonpoint sources, reasonable assurances that load reductions will be achieved are not required in order for a TMDL to be approvable. However, for such nonpoint source-only waters, States/Tribes are strongly encouraged to provide reasonable assurances regarding achievement of load allocations in the implementation plans described in section 9, above. As described in the August 8, 1997 Perciasepe memorandum, such reasonable assurances should be included in State/Tribe implementation plans and "may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs."

As discussed above in Section 10, the TMDL documents indicate that as part of a settlement agreement between the City of Rutland and the State, the City has committed to taking several key implementation actions to address causes of the temperature impairment. These commitments cover both the restoration of riparian shade and modifications to the in-stream ponds. Given that both the identified causes of the elevated temperatures are addressed by these actions, the settlement agreement provides assurance that needed implementation will occur. In addition, as noted in Section 9 above, the State has committed to taking action under state law in the event that the City's efforts to modify the impoundments are unsuccessful.

Assessment: Based on the components described above, EPA concludes that the TMDLs include reasonable assurance that the needed nonpoint source reductions will be achieved.

11. Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each State/Tribe must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements (40 C.F.R. § 130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval must describe the State/Tribe's public participation process, including a

summary of significant comments and the State/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. § 130.7(d)(2)). Inadequate public participation could be a basis for disapproving a TMDL; however, where EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

The public participation for the Moon and Mussey Brook TMDLs is described in Section 10 of each TMDL report and in the separate Responsiveness Summary to Public Comments submitted with the TMDL report. A public comment period ran from August 25, 2017, through September 29, 2017. The comment period was noticed on the VTDEC website and via direct email contact to interested parties. VTDEC also hosted a public meeting on September 21, 2017, to present the TMDL and to answer questions. VTDEC described the comments and VTDEC responses in the Responsiveness Summary document referred to above. The State made several clarifications to the final TMDL reports in response to comments received.

Assessment: EPA Region 1 concludes that VTDEC provided adequate opportunities for the public to comment on the TMDLs, and provided appropriate responses to the comments received.

Data for entry in EPA's National TMDL Tracking System								
TMDL Name		Moon Brook Temperature TMDL						
Number of TMDLs*		1						
Type of TMDLs*		Temperature						
Number of listed causes (from 303(d) list)		1						
Lead State		VT						
TMDL Status		Final						
TMDL Segment name	TMDL Segment ID #	TMDL Pollutant ID# & name	TMDL Impairment Cause(s) ⁺	Pollutant endpoint	Unlisted?	TMDL ID#	NPDES Point Source & ID#	Listed for anything else?
Moon Brook	VT03-06-01	960 (Temperature)	960 (riparian shade)	70 degrees F		R1-VT-2018-01		
TMDL Type		Nonpoint Sources						
Establishment Date (approval)*		May 11, 2018						
EPA Developed		No						
Towns affected*		City of Rutland, Town of Rutland, Town of Mendon, VT.						