

metric is oriented to daily maximum temperatures, it can be used to protect against acute effects, such as lethality and migration blockage conditions.

This metric can also be used to protect against sub-lethal or chronic effects (e.g., temperature effects on growth, disease, smoltification, and competition), but the resultant cumulative thermal exposure fish experience over the course of a week or more needs to be considered when selecting a 7DADM value to protect against these effects. EPA's general conclusion from studies on fluctuating temperature regimes (which is what fish generally experience in rivers) is that fluctuating temperatures increase juvenile growth rates when mean temperatures are colder than the optimal growth temperature derived from constant temperature studies, but will reduce growth when the mean temperature exceeds the optimal growth temperature. See "Issue Paper 5: Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids," prepared as part of the EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-005, May 2001, pp. 51-56. When the mean temperature is above the optimal growth temperature, the "mid-point" temperature between the mean and the maximum is the "equivalent" constant temperature. This "equivalent" constant temperature then can be directly compared to laboratory studies done at constant temperatures. For example, a river with a 7DADM value of 18°C/64°F and a 15°C/58°F weekly mean temperature will be roughly equivalent to a constant laboratory study temperature of 16.5°C/61.7°F (mid-point between 15°C/58°F and 18°C/65°F). Thus, both maximum and mean temperatures are important when determining a 7DADM value that is protective against sub-lethal/chronic temperature effects. See the Temperature Guidance, pp.19-20.

As discussed in the Temperature Guidance, many rivers and streams occupied by salmon and steelhead in the Pacific Northwest have a 3°C/5°F difference between the 7DADM and the weekly mean temperature. So, for many streams occupied by salmon and steelhead, a protective 7DADM temperature is approximately 1.5°C/2.7°F higher than a protective constant temperature derived from laboratory studies. *Id.* For bull trout streams, where the difference between the 7DADM and the weekly mean is smaller because there is less diurnal variation, a protective 7DADM temperature is approximately 0.5°C/0.9°F higher than a

protective constant temperature derived from laboratory studies. *Id.*

### 3. Numeric Temperature Water Quality Criteria for EPA's Salmonid Use Designations

*i. Temperature Criteria for Waters Designated for Bull Trout Juvenile Rearing and Spawning.* EPA proposes a 12°C/54°F maximum 7DADM numeric criterion (which roughly translates to an equivalent constant temperature of 11.5°C/52.7°F) for waters designated for a bull trout juvenile rearing and spawning use to: (1) Protect juvenile bull trout from lethal temperatures (22–23°C/72–73°F constant); (2) provide conditions during the period of summer maximum temperature at the upper end of the optimal temperature range when food is limited for juvenile growth (8–12°C/46–54°F constant), thus providing optimal temperatures for other times of the year; (3) provide temperatures where juvenile bull trout are not at a competitive disadvantage with other salmonids (greater than 12°C/54°F constant); and (4) provide temperatures that are consistent with the temperatures observed in field studies identifying where juvenile bull trout have the highest probability to occur (12–13°C/54–55°F daily maximum). See Table III-2.

When determining the overall optimal range for bull trout juvenile rearing, EPA reviewed both laboratory and field data and considered both physiological and ecological aspects. Optimal growth under limited food rations in laboratory experiments, preference temperatures in laboratory experiments where fish select between a gradient of temperatures, and field studies on where rearing predominately occurs are three independent lines of evidence that form the basis for identifying the optimal temperature range for bull trout rearing in the natural environment. These three lines of evidence show very consistent results, with the optimal range between 8-12°C/46–54°F for bull trout juvenile rearing. See the Temperature Guidance.

EPA is proposing that this numeric criterion apply to the warmest times of the summer, the warmest years (except for the warmest year out of ten), and throughout the water body or segment, including the lowest downstream extent of that waterbody or segment designated for that use. Because of the conservative nature of how this criterion is applied to the water body, EPA believes that it is appropriate to propose this numeric criterion near the warmer end of the optimal temperature range for bull trout rearing. EPA expects that a numeric criterion near the warmer end of the optimal range that is applied during the

period of summer maximum temperatures is likely to result in temperatures near the middle of the optimal range for most of the spring through fall in the segments where most of the rearing use occurs. EPA has identified three reasons for this. First, if the criterion is met during the summer maximum period, then temperatures will be colder than that value during the rest of the year. Second, because the criterion would apply throughout the water body or segment including the furthest point downstream where the use is designated, temperatures will generally be colder as you move upstream in the waterbody or segment. Finally, the criterion must be met in the warmest years (except for the warmest year in ten), so that in most years, the waters will be colder.

As mentioned previously, the scientific literature indicates that water with a temperature of 9°C/48°F is necessary for the protection of bull trout spawning. See Table III-2. For a more detailed explanation of why EPA believes the proposed 12°C/54°F summer maximum criterion would protect bull trout spawning, see section III.B.2.vi.

For four water bodies where EPA is proposing a 12°C/54°F 7DADM criterion to protect bull trout spawning, FWS believes that criterion may not be protective. In these waters, dams delay the natural seasonal cooling of waters in the fall to an extent that may prevent waters from cooling to 9°C/48°F downstream at times of the year when bull trout spawning occurs. The four locations identified by FWS are segments immediately downstream of: Laurence Lake Reservoir (Hood River Basin on the Middle Fork of the Hood River); Melhorne Reservoir and Clear Creek Reservoirs (Pine Creek Sub-Basin of Powder Basin); and Carmen Reservoir (behind Carmen dam in the Willamette Basin, on the McKenzie River above Blue River).

EPA requests comment on two approaches to address the four identified water body segments where this situation occurs. First, EPA requests comment on whether a numeric criterion of 9°C/48°F is necessary in these waters at the time of spawning (in addition to the 12°C/54°F 7DADM criterion) to protect the designated use of bull trout spawning. Such a criterion would apply immediately downstream of each reservoir, starting at the beginning of the spawning period. The proposed bull trout spawning and rearing use designation continues downstream of each reservoir for some distance, and some warming could occur as the water moves downstream