

## *White Paper*

# **A Plan for Improving Nevada's Temperature Water Quality Standards and Their Application**

Nevada Division of Environmental Protection

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## ***Introduction***

Nevada's current temperature criteria are not well documented and are in need of review. As part of our overall strategy, NDEP desires to improve existing water quality standards (including temperature) throughout the state. Over the years, more and more waters are being placed onto the 303(d) Impaired Waters List due to exceedances of the existing temperature standards. However, there may be cases where the standards are not appropriate. With 303(d) Listings comes pressure to create TMDLs (Total Maximum Daily Loads – water quality improvement plans) for listed waters. NDEP is concerned about basing such TMDLs on potentially inappropriate standards and desires to update these standards. Also, a number of stakeholders are voicing concerns about some existing temperature standards.

In addition to updating existing temperature in the regulations, NDEP desires to add waters to its regulations. As we add waters to the regulations, appropriate temperature criteria need to be assigned to these waters. Documented, scientifically defensible temperature criteria are needed for us to move forward.

## ***Background on Water Quality Standards***

Water quality standards define the water quality goals for a water body, or portion thereof, by designating the beneficial use or uses to be made of the water, and by setting numeric criteria necessary to protect the uses (Nevada Administrative Code (NAC) 445A.11704 – 445A.2234). Typical beneficial uses that are assigned to Nevada waters include: aquatic life, contact and noncontact recreation, irrigation, livestock watering, municipal or domestic supply, propagation of wildlife and industrial supply (see NAC 445A.122 for a brief description of these beneficial uses). Historic and existing uses along with desired potential or future uses are considered when establishing beneficial uses.

Once beneficial uses have been determined for a waterbody, numeric criteria for various pollutants are established as needed to protect these uses. The numeric criteria are based on either: (1) water quality criteria recommended by USEPA, (2) site-specific criteria derived from national criteria modified to reflect site-specific conditions or, (3) site-specific criteria developed solely for unique waters. ***In all cases, the established criteria must protect the most sensitive use.***

Water quality standards are generally established for waters based upon defined reaches. Factors considered in establishing the limits of waterbody reaches include:

- Changes in water quality conditions
- Changes in physical conditions
- Changes in land use
- Changes in beneficial uses

All water quality standards must be developed as part of a formal process before being incorporated into the NAC. Typically, NDEP will meet early on with stakeholders to solicit initial input regarding the proposed activity. Once a draft proposal has been developed, one or more public workshops will be held to present the proposal and provide an opportunity for public comment. The proposed regulation changes (including any changes in response to public comments) must then be approved by the Nevada State Environmental Commission and the Legislative Commission. Finally, U.S. EPA approval is needed before the standards can be applied under the federal Clean Water Act.

Once adopted into the NAC, Nevada's water quality standards are used in a variety of ways as part of the State's water quality management program. The key uses are described below:

- 1) Every 2 years, the Clean Water Act requires NDEP to assess the health of surface waters in Nevada. The assessment involves a compilation of readily available data, and a comparison of these data to the appropriate water quality standards. Waters not meeting water quality standards are then placed on the 303(d) List of impaired waters and are potentially targeted for the development of restoration/remediation plans (which could include TMDLs).
- 2) Nevada and federal law requires discharge permits for any point source discharge into a surface water. NDEP places permit effluent limitation on these discharges based upon the appropriate water quality standards of the receiving water.
- 3) Standards are used to guide voluntary nonpoint source improvement projects. NDEP funds a variety of best management practice projects aimed at addressing nonpoint sources of pollution, and ultimately meeting water quality standards.
- 4) In order to address water quality issues, watershed-based plans and TMDLs (Total Maximum Daily Loads – water quality improvement plan) are developed, if deemed appropriate. These plans use water quality standards as the target conditions desired in the waters.

### ***Existing Temperature Water Quality Standards and Their Shortcomings***

The existing temperature criteria have been in the regulations for about 20 to 40 years, depending upon the waterbody. Following is a discussion on their history and some shortcomings that NDEP is desirous to address.

#### **Existing Temperature Water Quality Standards**

As described above, NAC 445A contains numeric water quality criteria designed to protect the various beneficial uses that have been assigned to a waterbody. All waters in Nevada have been assigned "aquatic life" as a use:

**NAC 445A.122.1(c)** Aquatic life. The water must be suitable as a habitat for fish and other aquatic life existing in a body of water. This does not preclude the re-establishment of other fish or aquatic life.

In the case of temperature standards, the protection of fish is the primary beneficial use of interest. Each waterbody segment in the NAC has a placeholder for "Aquatic Life Species of Concern" defining which fish are generally being protected with the temperature criteria. Entries into this category have been

inconsistent over time and NDEP is looking for an improved system. For a majority of the waters in the regulations, maximum daily temperature criteria have been established. In addition to the daily maximum temperature criteria, most waters have criteria to limit temperature changes due to surface water discharges.

### **Daily Maximum Temperature Criteria**

Until recently, waters in Nevada’s water quality regulations were divided into 2 general categories – Class Waters and Designated Waters. Class Waters were generally the smaller streams and reservoirs and Designated Waters were the larger streams, with many being interstate waters (Carson River, Truckee River, Walker River, Jarbidge River, Bruneau River, etc.). While the 2 category system is no longer in existence, it is helpful to discuss the temperature criteria for these waters based upon this historic system. In addition, temperature criteria can be grouped into a third category – Lake Tahoe tributaries. Following is a discussion of the existing temperature criteria for these 3 groups of waters. In addition to the daily maximum temperature criteria, most waters have criteria to limit temperature changes due to surface water discharges.

**Class Waters:** Within the Class Water system, four classes, A to D, were recognized. Class A waters, the least impacted by human activities, were of the highest quality; Class D waters, being the most impacted by human activities, were of the lowest quality. The current maximum daily temperature standards for Class Waters were added to Nevada’s regulations in 1978 (Table 1). No documentation has been found which explains the source of these values.

As seen in Table 1, temperature criteria varied by class and whether or not the water is considered a “Trout” or “Non Trout” water. While Class A does not have this designation, the use of the 20° C standard would indicate that these waters should be considered “Trout Waters.” With the dismantling of the Class Water system, a separate standards table was created for each waterbody segment. For these waters in the NAC, entries in the “Aquatic Life Species of Concern” are either: 1) no entry; 2) Trout; or 3) Non Trout.

**Table 1. Class Water Temperature Standards**

Class	Maximum Daily Temperature		
	All Waters	Trout Waters	Non Trout Waters
Class A	20° C	n/a	n/a
Class B	n/a	20° C	24° C
Class C	n/a	20° C	34° C
Class D	n/a	n/a	n/a

**Designated Waters:** For those waters previously known as designated waters, the identified “Aquatic Life Species of Concern” vary much more than with the Class Water system. For many of these waters, specific fish species are identified (e.g. rainbow trout, brown trout, mountain whitefish, catfish, walleye) while for some others, NAC merely identifies a waterbody as a “coldwater fishery” (Lake Tahoe and tributaries) or a “warmwater fishery” (Lake Mead, Humboldt River) with no listing of particular species.

In some cases, particular life stages are also called out, such as “all life stages of mountain whitefish, rainbow trout and brown trout” or “juvenile and adult rainbow trout and brown trout”. However for most waters, the NAC does not specify any particular life stage. One could assume that the intent is to protect

all life stages of the fish of interest. In fact, a goal of the Clean Water Act is to provide for the protection and propagation of fish (all life stages).

A majority of the temperature standards currently in place for the designated waters were based upon recommendations from the Nevada Department of Wildlife (NDOW) and the U.S. Fish and Wildlife Service during the 1980s (see Attachment A). Unfortunately, the sources relied upon for these recommendations were never documented. However according to Mark Warren, retired NDOW biologist, available literature values and field observations were used in developing NDOW recommendations.

Drawing from Attachment A, different temperature criteria were set for various time periods reflecting the needs of different life stages (spawning, incubation, nursery, juvenile, adult) of the identified fish species. The most restrictive needs of the various fish species/life stages were generally used to define the criteria. Table 2 shows an example of the type of temperature criteria assigned for designated waters.

**Table 2. Temperature Standards for the East Fork Carson River at the Stateline (NAC 445A.1796)**

<b>Time Period</b>	<b>Maximum Daily Temperature</b>	<b>Most Restrictive Aquatic Use (see Attachment A)</b>
November - May	13° C	RBT spawning; BT spawning and incubation
June	17° C	RBT incubation
July	21° C	RBT nursery
August – October	22° C	RBT juvenile

Note: RBT = rainbow trout; BT = brown trout

**Lake Tahoe Tributaries:** In 1995, temperature water quality criteria were established for Lake Tahoe tributaries based upon NDOW recommendations for the protection of coldwater fish (Table 3). It was assumed that temperatures protective of selected coldwater fish would also be protective of other aquatic life. Again, sources relied upon for these recommendations were never documented.

**Table 3. Temperature Standards for Lake Tahoe Tributaries (NAC 445A.1628-445A.1666)**

<b>Time Period</b>	<b>Maximum Daily Temperature</b>
October - May	10° C
June - September	20° C

**Change in Temperature Criteria**

In addition to the daily maximum temperature criteria, most waters have criteria to limit temperature changes due to surface water discharges. Though not stated in the regulations, it is assumed that one purpose of these criteria is to maintain a natural temperature regime throughout the year. The delta temperature ( $\Delta T$ ) criteria range from 0° C to 3° C depending upon the waterbody as measured at the boundary of an approved mixing zone. In general, the 0° C criteria have been assigned to the higher

elevations waters while the 3° C criteria have been assigned to the lower elevation waters. Unfortunately, the basis for these criteria is unknown.

### **Key Shortcomings of Existing Temperature Water Quality Standards**

There are a number of shortcomings with the existing temperature water quality standards as follows:

- In all cases, there is little to no scientifically defensible documentation to support these criteria. This makes it extremely difficult to ascertain their appropriateness as we review existing standards and look to incorporate new waters into the regulations.
- The regulations do not define which temperature measurement is applicable. Criteria are assumed to be daily maximum limitations, however this is not stated in the regulations.
- EPA guidance recommends that both acute and chronic temperature effects be considered when establishing temperature criteria. The current temperature criteria only address acute impacts.
- Maintenance of a “natural-like” temperature regime throughout the years is an important consideration when establishing water quality standards. The “Designated Waters” criteria provide this protection with multiple seasons, however this complexity in the standard may not be supported in the literature. The “Class Water” criteria only protect for a year round maximum temperature, yet the “Change in Temperature” criteria provides protection from significant changes in temperature due to a heated discharge. Unfortunately, the regulations do not define what condition the  $\Delta T$  criteria are intended to protect. It is uncertain if the criteria are to be applied to any instantaneous temperature reading, daily maximum temperature, daily average temperature, etc.

### ***Existing Approach for Evaluating Compliance with Temperature Water Quality Standards***

Every 2 years NDEP is required to develop a 303(d) List of waters not meeting water quality standards. In general, we attempt to evaluate 5 years of data (if available) when creating our 303(d) List. In recent years, we have been obtaining more and more continuous temperature data for use in our 303(d) List evaluations, etc. In many cases, each monitored stream has had only one thermograph for temperature data collection so we rarely have a sense of spatial variability in the system. Additionally challenging is the fact that much of the data may only be for 1 to 2 summers, so there is uncertainty about temporal variability.

Though not explicitly stated in any of the documentation, the existing temperature criteria are treated as Daily Maximum (DM) criteria in our assessments. A waterbody is considered impaired for temperature if approximately more than 10% of the days sampled exceed the DM standard. In our assessments for the 303(d) List, there is considered to be 1 violation if the DM criteria are exceeded anytime during a day, even if only for 5 minutes. The number of days with a violation are then compared to the number of days in the assessment period to determine the frequency of violation. As a result, the assessment is largely effected by the amount of data rather than by the needs of the fish.

The regulations provide for special considerations for temperature measurements collected during extreme low or high flow conditions. Temperature criteria exceedance occurring during these flow conditions are not considered to be violated, and will not be used in calculated the percent exceedance

statistic. While not defined in the regulations, the low and high flow thresholds are typically defined using 7Q10 statistics. The 7Q10 statistic is the average streamflow for 7 consecutive days that can be expected to occur once every 10 years. Unfortunately, applicability of the 7Q10 statistic is limited to those stream reaches with long-term USGS streamflow gages. Most of the available temperature data in Nevada are for those streams without extensive flow measurements.

There are 2 main problems with the approach used by NDEP in determining compliance with the temperature criteria:

1. Use of the 10% threshold is common throughout the country, however there is no scientific basis that a 10% threshold accurately defines some biological needs of the fish.
2. The results of data analysis are greatly affected by the amount of data collected. For example if temperature data were collected every day for an entire year, the temperature criteria would have to be exceeded approximately 37 times (days) or more for a water would to be considered impaired. If that same water was monitored for only the summer (90 days), the criteria would only need to be exceeded about 10 times (days) or more for the water to be impaired.

NDEP is interested in improving its assessment approach, however there is little guidance on more appropriate methodologies. States have been using a range of methodologies that may or may not be appropriate for Nevada. While some states use a 10% threshold for evaluating temperature compliance, others are far more restrictive. For example, Colorado considers a waterbody impaired for temperature if the criteria are exceeded only 2 or more times during a 3 year block. Some states will consider a waterbody impaired if the temperature criteria are exceeded only 1 time during the evaluation period.

### ***A Plan to Improve Nevada's Temperature Criteria***

NDEP, Bureau of Water Quality Planning, is embarking on an effort to review and update the Nevada temperature water quality standards for the protection of aquatic life. As discussed above, Nevada's current temperature criteria are not well documented and scientifically supported guidance is needed as NDEP reviews temperature standards throughout the state. As part of this work, NDEP is creating a Work Group consisting of biologists with fisheries expertise to help in the development of technical guidance to support future temperature standards review activities.

The Work Group effort can be generally divided into 4 categories:

- Establish a methodology for defining thermal tolerances for various fish species and life stages
- Establish matrices of thermal tolerances for various fish species and life stages
- Establish a methodology for using thermal tolerance values to construct temperature criteria recommendations for a given waterbody
- Establish a methodology for determining compliance with the proposed temperature criteria

These efforts will not include any formal regulation adoption activities. However, it is hoped that the resulting products will serve as technical guidance as NDEP works to update temperature regulations across the state.

## **Methodology for Defining Thermal Tolerances**

The methodology(ies) to be used in developing the thermal tolerance recommendations need to be discussed by the Work Group and generally agreed upon. Three basic approaches are available for consideration: 1) quantitative methods based upon thermal threshold equations and laboratory-based thermal tolerance studies; 2) multiple lines of evidence based upon literature reviews, etc., or 3) combination of both. EPA approval of the desired methodologies early in the process is desirable.

Following is a brief discussion of available approaches as presented in available EPA guidance and used recently by other western states. More detailed discussions are provided in White Papers prepared by NDEP.

### **EPA Guidance (1977/1986)**

EPA guidance (1977/1986) recommends a very quantitative approach for determining appropriate temperature criteria. The guidance generally relies on two equations for calculating chronic and acute temperature criteria utilizing laboratory-derived thermal response values.

### **EPA Region 10 Guidance (2003)**

Based upon an extensive review of more recent scientific studies, EPA, the National Marine Fisheries Service and the U.S. Fish and Wildlife Service concluded that the EPA guidance (1977/1986) criteria would not adequately account for a variety of chronic and sub-lethal effects on the Pacific Northwest salmonids. Therefore, Region 10 guidance was developed based upon multiple lines of evidence gathered from the available literature.

### **State of Colorado WQS (2007)**

The State of Colorado developed updated temperature criteria using quantitative methods similar to the EPA guidance (1977/1986) approaches with some modifications. As part of the effort, Colorado developed a database of thermal response metrics reported in the literature for a variety of coldwater and warmwater fish species. This effort greatly updated the thermal response data presented in the EPA guidance (1977/1986).

### **State of Oregon WQS (1999/2004/2011)**

Beginning in 1992, the State of Oregon embarked on a long, drawn out process to update their temperature water quality standards. A technical advisory committee chose not to follow the EPA guidance (1977/1986) and instead relied on multiple lines of evidence in over 500 scientific publications to develop their criteria recommendations. After a couple of EPA partial-disapprovals and revisions, Oregon ultimately ended with temperature criteria consistent with the EPA Region 10 Guidance (2003).

### **State of Washington WQS**

Like Oregon, the State of Washington initiated a review of their temperature standards during the 1990s. Washington chose not to follow the EPA guidance (1977/1986) and, in a similar fashion to Oregon, implemented a multiple lines of evidence approach. In 2003, the resulting criteria were adopted by the State of Washington, but were partially disapproved by EPA. Washington made additional revisions, that were approved by EPA, and concluded with temperature criteria similar to the EPA Region 10 Guidance (2003) recommendations.

## **Matrices of Thermal Tolerances**

Using the desired methodologies as discussed above, matrices of thermal tolerances need to be developed. Some key considerations that need to be addressed include:

- Identification of fish species of concern and associated early life stages
- Seasonal detail of the thermal tolerance matrices
- Selection of temperature metrics (daily maximum, weekly average, etc.)

Following is a discussion of these key considerations.

### **Fish Species of Concern and Life Stages**

Using the appropriate methodology, temperature thresholds for the main fish species of concern will need to be developed. The effort could potentially address a broad range of fish including coldwater/coolwater/warmwater, game/nongame, native/nonnative, and threatened/endangered species. NDEP will look to the Work Group to assist in developing a list of fish species that need to be considered in the evaluation. It must be noted that thermal tolerance values may not be available for each identified species. For example, the State of Washington concluded that insufficient information exists to develop individual temperature recommendations for each warmwater species. Therefore they recommended that warmwater species be considered broadly as a community. However, their focus was on indigenous warmwater species not game species. Colorado also found limited warmwater thermal threshold information in the literature but nonetheless was able to compile a number of species-specific criteria.

At a minimum, the Work Group will need to consider developing thermal tolerance values to protect two life stage groups: 1) adult/juvenile; and 2) spawning/incubation. It is recognized that there are other life stages of fish species, but it may be difficult to identify thermal thresholds specifically for protection of these stages.

### **Seasonal Detail of the Thermal Tolerance Matrices**

The temporal detail of the thermal tolerance matrices (and subsequently the resulting water quality regulations) will need to be decided as part of this project. As shown in Table 2, some waters have criteria for 4 (or more) seasonal time periods. This type of criteria can be cumbersome to evaluate and may not be necessary to protect the fisheries. Also, it may be that the science does not exist to support this level of detail in the standards. At the other end of the spectrum, some Nevada waters only have Daily Maximum standards for the entire year. However, these criteria may not provide enough seasonal detail to be protective.

At a minimum, NDEP and the Work Group likely need to consider establishing criteria for 2 seasons in order to be protective of the more restrictive spawning needs, and to maintain a somewhat natural year round temperature regime as called for in the EPA Guidance. This will require determining spawning/incubation time periods for the fish species of concern along with the thermal tolerances associated with the spawning/incubation times. Montana, Colorado and Idaho have developed a matrix of species life stages and time periods which may be helpful in our efforts.

As noted in Idaho's *Water Body Assessment Guidance* (Idaho DEQ, 2002), selecting time periods to apply temperature criteria for salmonid spawning is somewhat circular. Salmonids are cued to spawn during time when certain temperature conditions occur. Thus the time periods for applying temperature criteria suitable for spawning are determined by the temperature conditions not necessarily the date.

Colorado found it challenging to establish a generic coldwater spawning/incubation season for use in the regulations since dates for spawning can vary significantly from waterbody to waterbody and from year to year.

### **Temperature Metrics**

A variety of temperature metrics have been used in EPA guidance and by other states, such as Daily Maximum, Maximum Weekly Average Temperature, etc. Currently, Nevada only uses the daily maximum. However, EPA guidance recommends that states adopt acute and chronic numbers. The actual metrics used may be somewhat driven by which methodology is used in deriving the thermal response value.

### **Methodology for Constructing Temperature Criteria for a Given Waterbody**

Using the thermal response matrices values, NDEP intends to develop temperature water quality standards for incorporation in the NAC. However, it is anticipated that this process could be involved and guidance is needed to lay out a methodology to ensure consistency in the standards development process. The methodology should address the following challenges:

- Defining which fish species and life stages occur in the waterbody, along with locations
- Establishing applicable time limits for the criteria
- Dealing with coldwater/warmwater transition areas
- Maintaining a natural thermal regime
- Attainability of the recommended criteria

A discussion of these challenges follows.

### **Identification of Fish Species and Life Stages**

When setting temperature criteria for a given waterbody, these criteria are typically set to protect the most sensitive fish species that occurs in that waterbody. Therefore, it will be important to understand which main species are expected to occur for each of the waterbodies targeted for updated/new temperature criteria. It is standard practice for NDEP to consult with NDOW, USFWS, and others when identifying species of concern for a waterbody. Another source of information often used by NDEP is the NDOW Fishable Waters Maps. NDOW fish survey results have also been compiled and could be a helpful resource. NDEP will need to consult with USFWS and NDOW when evaluating waters for Lahontan cutthroat trout and bull trout. If nongame fish criteria are to be determined, input is needed on the best sources for NDEP to use.

Within the NAC, the limits of waterbody reaches/segments have been defined as needed to account for changes in conditions (e.g. coldwater to warmwater fishery) based upon available information at the time. However, there may be instances where the limits of waterbodies need to be revised to better account for changes in fish species and spawning areas throughout the length of a stream. Given that spawning temperature criteria may be the most restrictive (depending upon the species and the waterbody), there may be a need to identify spawning areas if spawning is not thought to exist throughout an entire waterbody reach. Idaho, Oregon and Washington have identified stream spawning areas throughout the state. This has been a huge undertaking, and it is not anticipated that Nevada would develop similar statewide information. Spawning in streams versus lakes and reservoirs may also require special considerations.

In some locations, some fish species may exist solely due to stocking efforts and spawning criteria for those species are likely not appropriate. In self-propagating settings, temperature criteria are generally set to support the growth and health of the juveniles and adults over the summer and beyond. This level of temperature criteria may not be necessary to protect the adult fish that are stocked and only expected to survive the summer or until caught.

### **Establish Applicable Time Limits for the Criteria**

A preliminary review of temperature data suggest that a strict application of spawning temperature criteria for a set period of time will represent some challenges. For example, Montana's spawning times matrix shows rainbow trout spawning/incubation period extending from March through July. Colorado concluded that the rainbow trout spawning temperature criteria from the literature were not attainable throughout the entire March through July period. Ultimately, Colorado set the seasons for the spawning temperature criteria based upon which months the criteria could be expected to be attainable. Nevada may need to take a similar approach.

Warmwater spawning criteria may have similar challenges. Again, Montana's spawning times matrix shows many warmwater fish with spawning/incubation periods extending through July and later. According to EPA guidance (1977/1986), warmwater spawning criteria are typically more restrictive than the warmwater juvenile/adult criteria. Therefore, the spawning criteria could drive the temperature standard set for some warmwater streams. Interestingly, Colorado did not consider EPA guidance (1977/1986) in addressing warmwater spawning protection. Instead, winter criteria were set to prevent anthropogenic warming which could induce spawning.

### **Coldwater/warmwater Transition Areas**

When developing criteria recommendations, NDEP may wish to consider gradients in the use due to natural and anthropogenic causes (irrigation flow diversions, naturally higher temperatures for lower elevation sites, etc.). Criteria for waters ranging from coldwater, seasonal coldwater to warmwater fisheries may be helpful. However, it may be challenging to develop criteria for those coldwater-to-warmwater transition areas due to the lack of guidance.

### **Maintain Natural Thermal Regime**

Another consideration when building criteria is the desire to maintain a somewhat natural thermal regime with colder temperatures in the winter and warmer in the summer. For those waters with fall/winter spawning fish (brook trout, brown trout, mountain whitefish, etc.), use of the spawning temperature criteria will protect temperature conditions during the winter. However for those waters without these species, another approach is likely needed to ensure colder winter temperatures are not significantly changed by anthropogenic causes. Potential approaches for a water without fall/winter spawning fish could include: 1) application of the salmonid spawning criteria throughout the winter even though no salmonids are spawning during this time; and/or 2) application of  $\Delta T$  criteria to control temperature changes from discharges.

### **Attainability of Criteria**

One of the issues often encountered when establishing water quality standards is the question of whether or not the proposed standards are reasonably achievable. As discussed above, attaining coldwater spawning criteria may be challenging (for those species with late spring, early summer spawning) and special considerations will need to be made in setting the time period for the spawning criteria.

Attainability of criteria to support juvenile and adult fish could be equally challenging in some streams. Given irrigation diversions, natural variations in flow, natural gradients in temperatures from the headwaters down, etc., the achievability of the proposed criteria may not be realistic especially for the lower gradient streams. Many of these various streams have been identified as supporting trout species, but it is likely that the same temperature criteria are not achievable throughout. Some of these streams may contain both warmwater and coldwater fish however it may not be realistic to expect that the more restrictive coldwater temperature be met in these reaches.

### **Methodology for Determining Compliance with Temperature Standards**

As discussed above, NDEP considers a water impaired for temperature if approximately more than 10% of the days sampled exceed the daily maximum standard. There are 2 main problems with this approach:

1. Use of the 10% threshold is common throughout the country, however there is no scientific basis that a 10% threshold accurately defines some biological needs of the fish.
2. The results of data analysis are greatly affected by the amount of data collected. For example if temperature data were collected for an entire year, the temperature criteria would have to be exceeded approximately 37 times or more for a water would to be considered impaired. If that same water was monitored for only the summer (90 days), the criteria would only need to be exceeded about 10 times or more for the water to be impaired.

NDEP is interested in improving its assessment approach, however there is little guidance on more appropriate methodologies. States have been using a range of methodologies that may or may not be appropriate for Nevada. While some states use a 10% threshold for evaluating temperature compliance, others are far more restrictive. For example, Colorado considers a waterbody impaired for temperature if the criteria are exceeded only 2 or more times during a 3 year block. Some states will consider a waterbody impaired if the temperature criteria are exceeded only 1 time during the evaluation period.

**Attachment A**

**Temperature Criteria for Various Fish Species as  
Recommended to NDEP during the 1980s**



# Temperature Criteria for Various Fish Species as Recommended to NDEP during the 1980s

## Introduction

A majority of the numeric temperature criteria currently contained in Nevada's water quality regulations were based upon recommendations from the Nevada Department of Wildlife (NDOW) and the U.S. Fish and Wildlife Service (USFWS). This fact sheet provides a brief summary of these recommendations dating back to the 1980s.

## Background on Water Quality Standards

Nevada's water quality standards, contained in the Nevada Administrative Code (NAC) 445A.119 – 445A.225, define the water quality goals for a waterbody by: 1) designating beneficial uses of the water; and 2) setting criteria necessary to protect the beneficial uses. Beneficial uses consist of such things as irrigation, recreation, aquatic life, fisheries, irrigation and drinking water. Once beneficial uses are determined for a waterbody, numeric water quality criteria are set to protect these uses. Typically, these criteria are based upon either: 1) U.S. Environmental Protection Agency guidance; 2) site-specific criteria derived from national criteria; and 3) recommendations from other agencies.

## Recommendations for Temperature Criteria

Prior to the mid-1980s, Nevada's regulations defined aquatic life as a beneficial use for most waters in the state. However the regulations did not provide any further explanation of which species were to be protected. During the 1980s, Nevada Division of Environmental Protection (NDEP) undertook an effort to expand the aquatic life uses for main western Nevada waters to include lists of fish species of concern, such as rainbow trout, brown trout, Lahontan cutthroat trout, catfish and walleye. At the same time, NDEP solicited NDOW and USFWS for temperature criteria recommendations needed to support the various species. In addition, NDEP reviewed EPA guidance ("Quality Criteria for Water" (Red Book), EPA, 1976)



for temperature recommendations for the warmwater fishes. The results of these efforts have been taken from available NDEP files and documents, and are summarized in Table 1. The sources relied upon by

NDOW and USFWS were not identified in the available NDEP documents. However according to Mark Warren, NDOW biologist, available literature values and field observations were used in developing NDOW recommendations.



In general, temperature criteria recommendations were given for the five main stages: spawning, incubation, nursery-fry, juvenile, and adult.; and the associate time frame for these stages. As shown in Table 1, much more detail was provided for the coldwater species than for the warmwater species. While not explicitly described as such in the NDEP support documents, it is assumed that these recommendations are intended to represent maximum daily temperature limits.

It is interesting to note that NDOW's recommendation for rainbow trout (spawning) was significantly higher during the Truckee River standards review when compared to their recommendations found in the standards reviews for the Carson, Walker and other waters. However, it appears that the Carson basin recommendations were used in setting temperature criteria for some of the Truckee River reaches. Documentation explaining this difference could not be found in NDEP files.

## From Recommendations to Regulations

The recommendations in Table 1 served as guidance to NDEP for the development of the temperature standards. However, these values were not directly used in all cases. According to the Truckee River Water Quality Standards Revisions Rationale Supplement (NDEP, 8/15/1984), modifications (less restrictive) to the agency recommendations were agreed upon due to attainability problems.

## For More Information

To find out more, contact:

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Or visit NDEP's website at <http://ndep.nv.gov/>

*"to preserve and enhance the environment of the state in order to protect public health, sustain healthy ecosystems and contribute to a vibrant economy" - NDEP's mission statement*

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Summary of Recommended Temperature Criteria for Various Fish Species

Species	Source of Recommendation	Life stage	Value (Degrees C)	Date Range	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref.		
<b>Coldwater Species</b>																			
Rainbow Trout	NDOW - for Truckee River	Spawning	17.8	3/1-5/15			17.8										1		
		Incubate	16.7	3/1-6/30			16.6												
		Nursery	21.1	4/1-7/31				21.1											
		Juvenile	22.2	5/1-9/15					22.2										
		Adult	23.3	1/1-12/31						23.3									
	NDOW	Spawning	13.3	3/1-5/15			13.3											2, 3, 4	
		Incubate	16.7	3/1-6/30			16.7												
		Nursery	21.1	4/1-7/31				21.1											
		Juvenile	22.2	5/1-9/15					22.2										
		Adult	23.3	1/1-12/31						23.3									
Brown Trout	NDOW	Spawning	13.3	10/15-12/15											13.3		1, 2, 3, 4		
		Incubate	13.3	10/15-3/15		13.3													
		Nursery	21.1	11/15-4/15			21.1										21.1		
		Juvenile	22.2	2/15-6/30				22.2											
		Adult	23.3	1/1-12/31							23.3								
Mountain Whitefish	NDOW	Spawning	7.2	10/15-12/15											7.2		1		
		Incubate	7.2	10/15-3/15		7.2										7.2			
		Nursery	16.7	1/15-4/15			16.7												
		Juvenile	20	2/15-6/30				20											
		Adult	20	1/1-12/31							20								
Lanternjaw Cutthroat Trout	NDOW	Spawning	13.3	4/1-5/31				13.3									1		
		Incubate	16.7	4/1-8/1					16.7										
		Nursery	20	5/1-9/1						20									
		Juvenile	21.1	6/1-10/15							21.1								
		Adult	22.2	1/1-12/31								22.2							
	USFWS - 1/9/1984	Not Specified	Spawning	13.3	10/1-3/31			13.3									13.3		
			Juvenile	13.9	4/1-6/30					13.9									
			Juvenile	21.1	7/1-9/30									21.1					
			Juvenile	13.3	11/1-3/31			13.3											13.3
			Juvenile	18.3	4/1-6/30					18.3									
USFWS - 7/3/1984	Not Specified	Spawning	13.3	11/1-3/31			13.3										13.3		
		Juvenile	18.3	4/1-6/30					18.3										
		Juvenile	21.1	7/1-10/31									21.1						
		Juvenile	13.3	10/1-3/31		13.3												13.3	
		Juvenile	13.9	4/1-6/30					13.9										
Cui-ui	USFWS - 1/9/1984	Not Specified	Spawning	13.3	10/1-3/31		13.3									13.3	1		
			Juvenile	13.9	4/1-6/30				13.9										
			Juvenile	21.1	7/1-9/30									21.1					
			Juvenile	13.8	4/1-6/15					13.8									
			Juvenile	17.2	6/16-6/30							17							
USFWS - 7/3/1984	Not Specified	Juvenile	20	7/1-7/31							20								
		Juvenile	20	7/1-7/31															
<b>Warmwater Species</b>																			
Catfish	NDOW, EPA Guidance (Red Book)	Spawning	24	6/15-7/15							24						2, 3, 4		
		Incubate	29	none given															
		Nursery	none given	none given															
		Juvenile	32	none given															
		Adult	32	none given															
Smallmouth Bass	NDOW, EPA Guidance (Red Book)	Spawning	18	4/15-7/15				18									2		
		Incubate	23	none given															
		Nursery	none given	none given															
		Juvenile	29	none given															
		Adult	29	none given															
Largemouth Bass	NDOW, EPA Guidance (Red Book)	Spawning	21	4/15-7/15				21									3, 4		
		Incubate	23	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	32	none given															
Bluegill	NDOW, EPA Guidance (Red Book)	Spawning	25	none given													4		
		Incubate	34	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	32	none given															
Black Crappie	NDOW, EPA Guidance (Red Book)	Spawning	17	none given													4		
		Incubate	20	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	27	none given															
Striped Bass	NDOW, EPA Guidance (Red Book)	Spawning	18	none given													4		
		Incubate	24	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	none given	none given															
White Bass	NDOW, EPA Guidance (Red Book)	Spawning	17	none given													2		
		Incubate	26	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	none given	none given															
Walleye	NDOW, EPA Guidance (Red Book)	Spawning	11	10/15-4/15		11									11		2		
		Incubate	none given	none given															
		Nursery	none given	none given															
		Juvenile	none given	none given															
		Adult	28	4/15-10/15							28								

- References**
1. Truckee River Water Quality Standards Revisions Rationale Supplement - 8/15/84
  2. Carson River Water Quality Standards Revisions Rationale - 11/8/84
  3. Walker River Water Quality Standards Revisions Rationale - 6/20/1985
  4. Colorado River Basin and Miscellaneous Southern Nevada Streams Water Quality Standards Revisions Rationale- 1/15/1984

**Abbreviations**  
 NDOW - Nevada Department of Wildlife  
 USFWS - United States Fish and Wildlife Service  
 EPA - United States Environmental Protection Agency