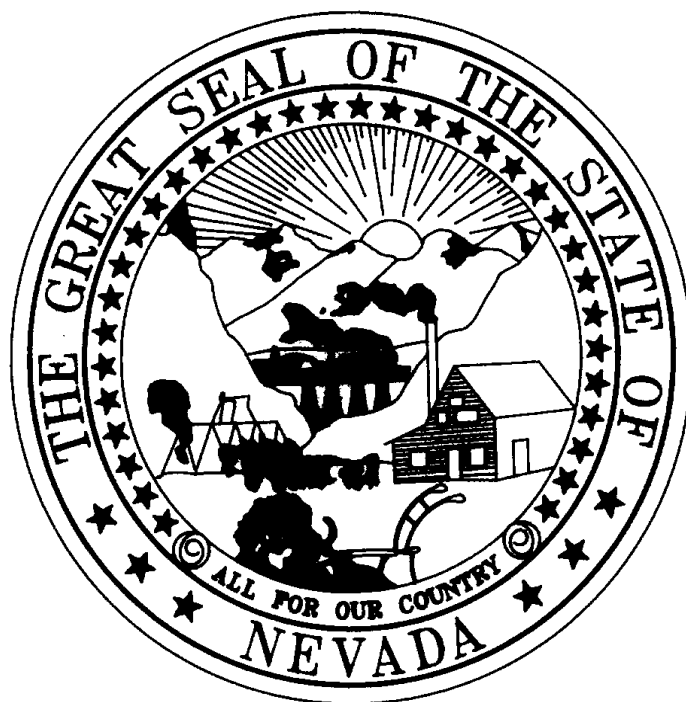


Rationale for Proposed Revisions to Ambient Water Quality Criteria for Colorado Basin Waters

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Prepared by:

**Nevada Division of Environmental Protection
Bureau of Water Quality Planning
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Rationale for Proposed Revisions to Ambient Water Quality Criteria for Select Colorado Basin Waters

Introduction

Water quality standards regulations promulgated by the U.S. Environmental Protection Agency (EPA) at 40 CFR 131.11(a) (1) require states to adopt protective criteria that are based on established scientific rationale. The Nevada Division of Environmental Protection (NDEP) is proposing to amend Nevada Administration Code (NAC) 445A.2142 – 445A.2160, *Standards for Water Quality*, by making changes to numeric criteria in the Colorado River Basin and formatting to provide clarity and consistency throughout the water quality standards tables.

Section 303 of the Clean Water Act requires that states periodically review and as appropriate modify water quality standards. The following includes proposed revisions and Rationale to the State of Nevada (State) Water Pollution Control Regulations water quality standards for Las Vegas Wash, Lake Mead, and the Colorado River below Hoover Dam.

The U.S. Environmental Protection Agency (EPA) is required by section 303 of the Clean Water Act and the implementing regulation located in 40 CFR part 131 to review and approve or disapprove state adopted water quality standards.

Background

Colorado River below Hoover Dam

The Nevada portion of the Colorado River extends 85 river miles from Hoover Dam to California Nevada border. Lake Mohave is a reservoir on the Colorado River created in 1951 following the completion of Davis Dam near present-day Laughlin, Nevada, and Bullhead City, Arizona. Named for the Mohave Indians who previously inhabited this region of the Colorado River valley, Lake Mohave extends approximately 67 miles along the valley from Willow Beach to Davis Dam straddling the southern Nevada and northwestern Arizona border, which follows the original river channel.

Lake Mead

Lake Mead is a manmade lake that lies on the Colorado River, southeast of the city of Las Vegas, Nevada, in the states of Nevada and Arizona. It is the largest reservoir in the United States, in terms of water capacity. Formed by the Hoover Dam on September 30, 1935, the reservoir serves water to the states of Arizona, California, and Nevada, as well as some of Mexico.

At maximum capacity, Lake Mead is 112 miles (180 km) long, 532 feet (162 m) at its greatest depth, has a surface elevation of 1,221.4 feet (372.3 m) above sea level and 247 square miles (640 km²) of surface area, and contains 26.12 million acre feet (32,220,000 ML) of water. Thermal stratification develops in May and June and a classical thermocline develops between a depth of 33 and 48 ft (10 and 15 meters) in July. Turnover begins in October and the lake is completely destratified by January.

Las Vegas Wash

Las Vegas Wash is the terminus of the approximately 1,600 mi² (4150 km⁺) Las Vegas Valley drainage system that discharges into Las Vegas Bay of Lake Mead. The drainage area includes the cities of Las Vegas, North Las Vegas and Henderson. Flow in the Wash has increased significantly since the early 1970s. The average flow at Northshore Road increased from about 60 cubic feet per second (cfs) (1.7 m³/sec) in 1973 to 320 cfs (9.06 m³/sec) in 2018. This trend reflects the continuing population increase in Las Vegas Valley. The City of Las Vegas and the Clark County Sanitation District discharge treated wastewater into the Wash about 11 mi (18 km) up stream of Las Vegas Bay and the City of Henderson's discharge enters the Wash approximately 7 mi (11 km) from the Bay.

Reaches

The Las Vegas Wash, Lake Mead and the Colorado River are divided into six reaches or segments that consider the physical characteristics, differing land uses, and beneficial uses of each. The reaches begin at the confluence of the City of Las Vegas and Clark County Sanitation District wastewater treatment plant discharges and extend down gradient into and including Lake Mead, and the Colorado River below Lake Mead. The six existing reach designations from upstream down to the state line are in the Nevada Administrative Code (NAC):

- **NAC 445A.2146 Colorado Region: Colorado River below Davis Dam. ([NRS 445A.425](#), [445A.520](#))** the Colorado River from the Lake Mohave Inlet to the California-Nevada state line below Davis Dam, except for the length of the river within the exterior borders of the Fort Mojave Indian Reservation.

- **NAC 445A.2148 Colorado Region: Colorado River below Hoover Dam.** (NRS 445A.425, 445A.520) the Colorado River from Hoover Dam to the Lake Mohave Inlet.
- **NAC 445A. 2152 Colorado Region: Lake Mead** -- Lake Mead, excluding the area covered by NAC 445A.2154 Inner Las Vegas Bay.
- **NAC 445A. 2154 Colorado Region: Inner Las Vegas Bay.** -- Lake Mead from the confluence of the Las Vegas Wash with Lake Mead to 1.2 miles into Las Vegas Bay;
- **NAC 445A.2156 Colorado Region: Las Vegas Wash at Telephone Line Road.** — Las Vegas Wash from the confluence of the discharges from the City of Las Vegas and Clark County wastewater treatment plants to Telephone Line Road;
- **NAC 445A.2158 Colorado Region: Las Vegas Wash at Lake Mead.** -- Las Vegas Wash from Telephone Line Road to its confluence with Lake Mead;

NDEP is proposing to add/adjust the following reaches as shown below: ~~Red bold and strikeout~~ are deletions, **Blue and bold** are insertions.

- **NAC 445A.2146 Colorado Region: Colorado River below Davis Dam.** (NRS 445A.425, 445A.520) The limits of this table apply to the body of water known as the Colorado River from ~~the Lake Mohave Inlet~~ **Davis Dam** to the California-Nevada state line ~~below Davis Dam~~, except for the length of the river within the exterior borders of the Fort Mojave Indian Reservation. This segment of the Colorado River below Davis Dam is located in Clark County.
- **NAC 445A.2147 Colorado Region: Lake Mohave.** (NRS 445A.425, 445A.520) **The limits of this table apply to the body of water known as Lake Mohave, which extends from Willow Beach to Davis Dam. Lake Mohave is located in Clark County.**
 - The Lake Mohave inlet was changed from “Lake Mohave inlet” to Willow Beach to separate the lake from the River Reach, The high water elevation of the lake (947 m) extends up to Willow Beach.
- **NAC 445A.2148 Colorado Region: Colorado River below Hoover Dam.** (NRS 445A.425, 445A.520) The limits of this table apply to the body of water known as the Colorado River from Hoover Dam to ~~the Lake Mohave Inlet~~ **Willow Beach**. This segment of the Colorado River is located in Clark County.

- **NAC 445A.2152 Colorado region: Lake Mead:**
 - No changes are proposed for the reach description for Lake Mead.
- **NAC 445A.2152 Colorado region: Inner Las Vegas Bay:**
 - No changes are proposed for the reach description for the Inner Las Vegas Bay.
- **NAC 445A.2156 Colorado Region: Las Vegas Wash at ~~Telephone Line Road~~ the Historic Lateral.** ([NRS 445A.425](#), [445A.520](#)) The limits of this table apply to the body of water known as the Las Vegas Wash from the confluence of the discharges from the City of Las Vegas and Clark County wastewater treatment plants to ~~Telephone Line Road~~. the Historic Lateral. This segment encompasses the discharge from the City of Henderson wastewater treatment plant. This segment of the Las Vegas Wash is located in Clark County.
 - This reach adjustment extends the reach approximately 2,500 feet downstream from Telephone Line Road. Sample Site LW5.5 was moved to just above the Historical Lateral and that sample site is used to determine water quality compliance for the Upper Las Vegas Wash reach (NAC445A.1256).
- **NAC 445A.2158 Colorado Region: Las Vegas Wash at Lake Mead.** ([NRS 445A.425](#), [445A.520](#)) The limits of this table apply to the body of water known as the Las Vegas Wash from ~~Telephone Line Road~~ the Historic Lateral to its confluence with Lake Mead. This segment of the Las Vegas Wash is located in Clark County.
- **NAC 445A.2160 Colorado Region: Lake Las Vegas. The limits of this table apply to the entire body of water known as Lake Las Vegas. Lake Las Vegas is located in Clark County.**

Other Actions

- NDEP is also proposing to add warm-water fish to both segments of Las Vegas Wash NAC 445A 2156 and NAC 445A.2158.
- NDEP is also proposing to revise temperature criteria to $\leq 24^{\circ}\text{C}$ to protect adult cold-water fish -- See Appendix 1
- NDEP is also proposing to revise dissolved oxygen criteria to ≥ 5.0 mg/l to protect adult cold-water fish -- See Appendix 2

Beneficial Uses

Beneficial uses designated for the Colorado River below Davis Dam (NAC 445A.2146), Lake Mohave (NAC 445A.2147) and the Colorado River below Hoover Dam (NAC 445A.2148) reaches include:

1. Irrigation;
2. Watering of livestock;
3. Recreation involving contact with the water;
4. Recreation not involving contact with the water;
5. Industrial supply;
6. Municipal or domestic supply, or both;
7. Propagation of wildlife; and ,
8. Propagation of aquatic life, *including an adult cold-water fishery*.

Beneficial uses designated for the Lake Mead reach (NAC 445A.2152) include:

1. Irrigation;
2. Watering of livestock;
3. Recreation involving contact with the water;
4. Recreation not involving contact with the water;
5. Industrial supply;
6. Municipal or domestic supply, or both;
7. Propagation of wildlife; and ,
8. Propagation of aquatic life, including a warm-water fishery.

Beneficial uses designated for the reach of Lake Mead from the western boundary of Las Vegas Marina Campground to the confluence of Las Vegas Wash (The Inner Bay, NAC 445A.2154), include:

1. Irrigation;
2. Watering of livestock;
3. **Recreation involving contact with the water**
4. Recreation not involving contact with the water;
5. Industrial supply;
6. Propagation of wildlife; and ,
7. Propagation of aquatic life, including a warm-water fishery.

Beneficial uses designated for the two Las Vegas Wash reaches (NAC 445A.2156 and NAC 445A.2158) include:

1. Irrigation;
2. Watering of livestock;
3. Recreation not involving contact with the water;
4. Maintenance of a freshwater marsh;
5. Propagation of wildlife; and ,
6. Propagation of aquatic life, ~~excluding fish. This does not preclude the establishment of a fishery~~ including warm-water fish.

Proposed beneficial uses designated for the Lake Las Vegas (NAC 445A.2157) include:

1. Irrigation;
2. Recreation involving contact with the water;
3. Recreation not involving contact with the water;
4. Propagation of wildlife; and,
5. Propagation of aquatic life, including warm-water fish.

Method of Determining Beneficial Use Standards

The beneficial use standards are established at a value to protect the most sensitive beneficial use designated, taking into account the beneficial uses downstream. For this water quality standards review, the existing beneficial uses were compared to current EPA criteria. In cases for which EPA criteria has changed since the standards were last reviewed, a revision to the standards is proposed to make standards consistent with the current criteria.

Summary of Changes to the Water Quality Standards of All Reaches

Temperature

In all cases, spawning and incubation thermal tolerances are more restrictive than the juvenile/adult needs for all the fish species in Table 2 (see Appendix B), with the most restrictive temperatures associated with rainbow trout. However before attempting to establish criteria to protect the early life stages of rainbow trout, two key factors need to be evaluated: 1) determine whether or not spawning and incubation are actually occurring; and 2) determine time and locations of spawning and incubation.

Based upon the available information, rainbow trout spawning and incubation has not been occurring in the Colorado River between Hoover Dam and stateline, and is not expected to occur with the stocking of triploid trout. Therefore, the temperature criteria need not be protective of rainbow trout spawning and incubation. However, the spawning and incubation of the warm-water species now needs to be considered. The warm-water fish species in the Colorado River reaches under review are believed to be self-propagating with the exception of the razorback sucker. However, the timing of spawning and incubation activities vary depending upon the species with spawning/incubation possibly not occurring during some months. Typically, little is known about the spawning/incubation locations and timing of fish spawning in most waters in Nevada. Such is the case for these Colorado River reaches under review, making it difficult to establish spawning/incubation temperature criteria.

Temperature for the Colorado River reaches will be adjusted to 24°C, with a change in temperature of ΔT of 2°C to protect for adult cold-water fish. Temperature for Lake Mead, the Inner Bay and Lake Las Vegas will remain at ΔT of 2°C. Temperature for both reaches of Las Vegas Wash will be adjusted to 34°C to be consistent with EPA guidance for the protection of warm-water fish.

pH

pH water quality standard for the Colorado River reaches will remain with a pH range of 6.5 – 9 and a change of ΔT of 0.5. The pH water quality standard for Lake Mead, the Inner Bay and Las Vegas Wash will remain at a pH range of 6.5 – 9. Lake Las Vegas pH range will be adjusted from 7.0 - 9.0 to 6.5 to 9.0 to be consistent with USEP pH criteria for Aquatic Life.

Dissolved Oxygen

The water quality standard for dissolved oxygen in the Colorado River/Lake Mohave reaches (NAC 445A 2146, 2147, and 2148) will be adjusted to S.V. \geq 5.0 mg/L to protect for adult cold-water fish. The water quality standard for dissolved oxygen in Lake Mead will remain at 5.0 mg/L, with the footnote expressing that the standard applies to the epilimnion when stratified, or the average in the water column during periods of nonstratification.

Total Inorganic Nitrogen

No changes are proposed to the requirements to maintain higher quality (RMHQs) for total inorganic nitrogen in Lake Mead or the Inner Bay.

Total Phosphorus

No changes are proposed to the water quality standard or RMHQs for total phosphorus in the Colorado River reaches.

Nitrate

No changes are proposed for nitrate in the Colorado River reaches or the Lake Mead and Inner Bay reaches. It is proposed to change the water quality standard for nitrate from 100 mg/l to 90 mg/l for the protection of warm-water fish in both Las Vegas Wash reaches, NAC 445A.2156 and 2158.

Nitrite

No changes are proposed for the Colorado River reaches or the Lake Mead and Inner Bay reaches. It is proposed to change the water quality standard for nitrite from 10 mg/l to 5 mg/l for the protection of warm-water fish in both Las Vegas Wash reaches, NAC 445A.2156 and 2158.

Ammonia

No changes are proposed to the water quality standard for ammonia.

Total Suspended Solids (TSS)

No changes are proposed to the water quality standard for total suspended solids (TSS).

Turbidity

No changes are proposed to the water quality standard for turbidity.

Color

No changes are proposed to the water quality standard for color in the Colorado River reaches.

Chloride

No changes to water quality standard for chloride are proposed for the Las Vegas Wash or the Inner Bay reaches. It is proposed to add a water quality standard of 400 mg/L chloride to the Colorado River reaches, NAC 445A.2146, 2147 and 2148, for the protection of municipal and domestic supply.

Sulfate

No changes to water quality standard for sulfate are proposed for the Las Vegas Wash or the Inner Bay reaches. It is proposed to add a water quality standard of 500 mg/L sulfate to the Colorado River reaches, NAC 445A.2146 2147 and 2148, for the protection of municipal and domestic supply.

Alkalinity

No changes are proposed to the water quality standard for alkalinity in the Colorado River reaches.

E. Coli

No changes are proposed to the water quality standard for E. coli in the Colorado River reaches or the Lake Mead and Inner Bay reaches. It is proposed to add a water quality standard for E. coli of an annual geometric mean (AGM) of ≤ 630 cfu/100 mL to the Las Vegas Wash, NAC445A.2156 and 2158, for the protection of noncontact recreation. Also proposed is the addition of E. coli at a geometric mean (GM) ≤ 126 cfu/mL and a single value (SV) of ≤ 410 cfu/mL to Lake Las Vegas to protect for the use of contact recreation on the Lake.

Fecal Coliform

No changes are proposed to the water quality standard for fecal coliform in the Lake Mead reaches, Colorado River reaches or the Las Vegas Wash reaches. It is proposed to change the water quality standard for fecal coliform from $\leq 200/400$ no./100 mL to $\leq 1,000$ no./100 mL for Lake Las Vegas to protect the beneficial use of Irrigation.

Toxic Materials

There are no changes to the water quality standard for toxic materials, NAC 445A.1236; toxic materials already apply to all reaches.

The water quality standard tables with all the changes are shown below in **Appendix A, NAC Water Quality Standards Tables with Changes.**

Appendix A

NAC Water Quality Standards Tables with Changes

Matter in ***Bold and italics*** is new; matter in brackets ~~[omitted material]~~ is material to be omitted.

NAC 445A.122 Standards applicable to beneficial uses. (NRS 445A.425, 445A.520)

1. The following standards are intended to protect both existing and designated beneficial uses and must not be used to prohibit the use of the water as authorized under title 48 of NRS:

(a) Watering of livestock. The water must be suitable for the watering of livestock without treatment.

(b) Irrigation. The water must be suitable for irrigation without treatment.

(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 reestablishment of other fish or aquatic life.

(d) Recreation involving contact with the water. There must be no evidence of man-made pollution, floating debris, sludge accumulation or similar pollutants.

(e) Recreation not involving contact with the water. The water must be free from:

(1) Visible floating, suspended or settled solids arising from human activities;

(2) Sludge banks;

(3) Slime infestation;

(4) Heavy growth of attached plants, blooms or high concentrations of plankton, discoloration or excessive acidity or alkalinity that leads to corrosion of boats and docks;

(5) Surfactants that foam when the water is agitated or aerated; and

(6) Excessive water temperatures.

(f) Municipal or domestic supply. The water must be capable of being treated by conventional methods of water treatment in order to comply with Nevada's drinking water standards.

(g) Industrial supply. The water must be treatable to provide a quality of water which is suitable for the intended use.

(h) Propagation of wildlife. The water must be suitable for the propagation of wildlife and waterfowl without treatment.

(i) Waters of extraordinary ecological or aesthetic value. The unique ecological or aesthetic value of the water must be maintained.

(j) Enhancement of water quality. The water must support natural enhancement or improvement of water quality in any water which is downstream.

(k) Maintenance of a freshwater marsh. The water must be suitable to maintain a freshwater marsh.

2. This section does not entitle an appropriator to require that the source meet his or her particular requirements for water quality.

[Environmental Comm'n, Water Pollution Control Reg. § 4.1.1, eff. 5-2-78] — (NAC A 11-22-82; 12-3-84; 11-9-95)

NAC 445A.2142 Colorado Region: Designated beneficial uses. (NRS 445A.425, 445A.520) The designated beneficial uses for select bodies of water within the Colorado Region are prescribed in this section:

Water Body Name	Segment Description	Beneficial Uses											Aquatic Life Species of Concern	Water Quality Standard NAC Reference			
		Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh					
<i>Colorado River below Davis Dam</i>	[From the Lake Mohave Inlet to the California-Nevada state line below Davis Dam, except for the length of the river within the exterior borders of the Fort Mojave Indian Reservation.] <i>Colorado River, from Davis Dam to the California-Nevada state line, except for the length of the river within the exterior borders of the Fort Mojave Indian Reservation.</i>	X	X	X	X	X	X	X	X								NAC 445A.2146
<i>Lake Mohave</i>	<i>The entire lake</i>	X	X	X	X	X	X	X	X						<i>Adult Coldwater Fishery</i>	NAC 445A.2147	
<i>Colorado River below Hoover Dam</i>	[From Hoover Dam to the Lake Mohave Inlet.] <i>From Hoover Dam to Willow Beach</i>	X	X	X	X	X	X	X	X						<i>Adult Coldwater Fishery</i>	NAC 445A.2148	
Lake Mead	Lake Mead, excluding the area covered by NAC 445A.2154 , Inner Las Vegas Bay.	X	X	X	X	X	X	X	X						Warm-water fishery	NAC 445A.2152	
Inner Las Vegas Bay	Lake Mead from the confluence of the Las Vegas Wash with Lake Mead to 1.2 miles into Las Vegas Bay.	X	X	X		X		X	X						Warm-water fishery	NAC 445A.2154	
Las Vegas Wash at [Telephone Line Road] the Historical Lateral	From the confluence of the discharges from the City of Las Vegas and Clark County wastewater treatment plants to [Telephone Line Road] <i>the Historical Lateral</i> . This segment encompasses the discharge from the City of Henderson wastewater treatment plant.	X	X	X		X			X					X	[Excluding fish, this does not preclude the establishment of a fishery.] <i>Warm-water fish</i>	NAC 445A.2156	
Las Vegas Wash at Lake Mead	From [Telephone Line Road] <i>the Historical Lateral</i> to its confluence with Lake Mead.	X	X	X		X			X					X	[Excluding fish, this does not preclude the establishment of a fishery.] <i>Warm-water fish</i>	NAC 445A.2158	

Water Body Name	Segment Description	Beneficial Uses											Aquatic Life Species of Concern	Water Quality Standard NAC Reference	
		Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh			
<i>Lake Las Vegas</i>	<i>The entire lake</i>		X	X	X	X			X					<i>Warm-water fish</i>	NAC 445A.2157
Virgin River at the state line	At the Arizona-Nevada state line, near Littlefield, Arizona.	X	X	X		X		X	X						NAC 445A.2162
Virgin River at Mesquite	From the Arizona-Nevada state line to Mesquite.	X	X	X		X		X	X						NAC 445A.2164
Virgin River at Lake Mead	From Mesquite to the river mouth at Lake Mead.	X	X	X		X		X	X						NAC 445A.2166
Muddy River at the Glendale Bridge	From the river source to the Glendale Bridge, except for the length of the river within the exterior borders of the Moapa Indian Reservation.	X	X	X	X	X	X	X	X						NAC 445A.2168
Muddy River at the Wells Siding Diversion	From the Glendale Bridge to the Wells Siding Diversion.	X	X	X	X	X		X	X						NAC 445A.2172
Muddy River at Lake Mead	From the Wells Siding Diversion to the river mouth at Lake Mead.	X	X	X	X	X		X	X						NAC 445A.2174
Meadow Valley Wash	From the bridge above Rox to its confluence with the Muddy River.	X	X	X		X		X	X						NAC 445A.2176
Beaver Dam Wash	Above Schroeder Reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2178
Schroeder Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2182	
White River at the national forest boundary	From its origin to the national forest boundary.	X	X	X	X	X	X		X						NAC 445A.2184
White River at Ellison Creek	From the national forest boundary to its confluence with Ellison Creek.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2186	
Dacey Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2188
Sunnyside Creek	From its origin to Adams McGill Reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2192
Adams McGill Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2194
Hay Meadow Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2196	
Nesbitt Lake	The entire lake.	X	X	X	X	X	X	X	X						NAC 445A.2198
Pahrnagat Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2202
Bowman Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X						NAC 445A.2204
Eagle Valley Creek	From its headwaters to Eagle Valley Reservoir.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2206	
Eagle Valley Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2208	
Echo Canyon Reservoir	The entire reservoir.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2212	
Clover Creek	From its origin to the point where it crosses the east range line of T. 4 S., R. 67 E., M.D.B. & M.	X	X	X	X	X	X	X	X				Trout	NAC 445A.2214	

Water Body Name	Segment Description	Beneficial Uses											Aquatic Life Species of Concern	Water Quality Standard NAC Reference
		Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh		
Irrigation	Irrigation													
Livestock	Watering of livestock													
Contact	Recreation involving contact with the water													
Noncontact	Recreation not involving contact with the water													
Industrial	Industrial supply													
Municipal	Municipal or domestic supply, or both													
Wildlife	Propagation of wildlife													
Aquatic	Propagation of aquatic life													
Aesthetic	Waters of extraordinary ecological or aesthetic value													
Enhance	Enhancement of water quality													
Marsh	Maintenance of a freshwater marsh													

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008)

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a													
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh			
Fecal Coliform - No./100 mL	A.G.M. ≤ 50 S.V. ≤ 100	S.V. ≤ 1,000		*												
Toxic Materials		^f														

* = The most restrictive beneficial use.

X = Beneficial use.

^a Refer to [NAC 445A.122](#) and [445A.2142](#) for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone, but the increase must not cause a violation of the single value standard.

^c The water quality criteria for ammonia are specified in [NAC 445A.118](#).

^d The salinity standards for the Colorado River system are specified in [NAC 445A.1233](#).

^e The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.

^f The water quality criteria for toxic materials are specified in [NAC 445A.1236](#).

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008; A by R131-12, 12-20-2012; R093-13, 12-23-2013; R102-16 & R109-16, 12-19-2017)

NAC 445A.2147 Colorado Region: Lake Mohave. (NRS 445A.425, 445A.520) The limits of this table apply to the body of water known as Lake Mohave, which extends from Willow Beach to Davis Dam. Lake Mohave is located in Clark County.

**STANDARDS OF WATER QUALITY
Colorado River: Lake Mohave**

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a													
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh			
Beneficial Uses			X	X	X	X	X	X	X	X	X					
Aquatic Life Species of Concern			Adult Coldwater Fishery													
Temperature - °C		S.V. ≤24														
ΔT ^b - °C	ΔT = 0	ΔT ≤ 2			*											
pH - SU		S.V. 6.5 - 9.0 ΔpH ± 0.5			*											
Dissolved Oxygen - mg/L		S.V. ≥ 5.0 ^c			*											
Total Phosphorus (as P) - mg/L		A-Avg. ≤ 0.05			*	*										
Nitrate (as N) - mg/L		S.V. ≤ 10							*							
Nitrite (as N) - mg/L		S.V. ≤ 0.06			*											
Total Ammonia (as N) - mg/L		^d			*											
Total Suspended Solids - mg/L		S.V. ≤ 25			*											
Turbidity - NTU		S.V. ≤ 10			*											
Color - PCU		S.V. ≤ 75							*							
Total Dissolved Solids - mg/L		^e							*							
Chloride - mg/L		S.V. ≤ 400 ^e							*							
Sulfate - mg/L		S.V. ≤ 500 ^e							*							
Alkalinity (as CaCO ₃) - mg/L		S.V. ≥ 20			*											
E. coli - cfu/100 mL ^f		G.M. ≤ 126 S.V. ≤ 410				*										
Fecal Coliform - No./100 mL		S.V. ≤ 1,000		*												
Toxic Materials		^g														

* = The most restrictive beneficial use.

X = Beneficial use.

^a Refer to NAC 445A.122 and 445A.2142 for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone, but the increase must not cause a violation of the single value standard.

^c When reservoir is stratified, the dissolved oxygen criterion applies only to the epilimnion.

^d The water quality criteria for ammonia are specified in NAC 445A.118.

^e The salinity standards for the Colorado River system are specified in NAC 445A.1233.

- ^f *The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.*
- ^g *The water quality criteria for toxic materials are specified in [NAC 445A.1236](#).*

NAC 445A.2148 Colorado Region: Colorado River below Hoover Dam. ([NRS 445A.425](#), [445A.520](#)) The limits of this table apply to the body of water known as the Colorado River from Hoover Dam to ~~[the Lake Mohave Inlet]~~ *Willow Beach*. This segment of the Colorado River is located in Clark County.

**STANDARDS OF WATER QUALITY
Colorado River below Hoover Dam**

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a														
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh				
Beneficial Uses			X	X	X	X	X	X	X	X	X						
Aquatic Life Species of Concern			Adult Coldwater fishery														
Temperature - °C ΔT ^b - °C	ΔT = 0	[S.V. Nov-Apr ≤ 13 S.V. May-Jun ≤ 17 S.V. Jul-Oct ≤ 23] S.V. ≤ 24 ΔT ≤ 2			*												
pH - SU		S.V. 6.5 - 9.0 ΔpH ± 0.5			*												
Dissolved Oxygen - mg/L		[S.V. Nov-May ≥ 6.0] S.V. [Jun-Oct] ≥ 5.0			*												
Total Phosphorus (as P) - mg/L	A-Avg. ≤ 0.02 S.V. ≤ 0.033	A-Avg. ≤ 0.05			*	*											
Total Nitrogen (as N) - mg/L	A-Avg. ≤ 1.0 S.V. ≤ 1.5				*	*											
Nitrate (as N) - mg/L		S.V. ≤ 10							*								
Nitrite (as N) - mg/L		S.V. ≤ 0.06			*												
Total Ammonia (as N) - mg/L		c			*												
Total Suspended Solids - mg/L		S.V. ≤ 25			*												
Turbidity - NTU		S.V. ≤ 10			*												
Color - PCU		S.V. ≤ 75							*								
Total Dissolved Solids - mg/L		d							*								
<i>Chloride - mg/L</i>		<i>S.V. ≤ 400^d</i>							*								
<i>Sulfate - mg/L</i>		<i>S.V. ≤ 500^d</i>							*								
Alkalinity (as CaCO ₃) - mg/L		S.V. ≥ 20			*												
E. coli - cfu/100 mL ^e		G.M. ≤ 126 S.V. ≤ 410				*											
Fecal Coliform - No./100 mL	A.G.M. ≤ 50 S.V. ≤ 100	S.V. ≤ 1,000		*													
Toxic Materials		f															

* = The most restrictive beneficial use.

X = Beneficial use.

^a Refer to [NAC 445A.122](#) and [445A.2142](#) for beneficial use terminology.

- b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone, but the increase must not cause a violation of the single value standard.
- c The water quality criteria for ammonia are specified in [NAC 445A.118](#).
- d The salinity standards for the Colorado River system are specified in [NAC 445A.1233](#).
- e The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.
- f The water quality criteria for toxic materials are specified in [NAC 445A.1236](#).

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008; A by R131-12, 12-20-2012; R102-16 & R109-16, 12-19-2017)

NAC 445A.2152 Colorado Region: Lake Mead. (NRS 445A.425, 445A.520) The limits of this table apply to the body of water known as Lake Mead, excluding the area covered by NAC 445A.2154, Inner Las Vegas Bay. Lake Mead is located in Clark County.

**STANDARDS OF WATER QUALITY
Lake Mead**

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a													
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh			
Beneficial Uses			X	X	X	X	X	X	X	X	X					
Aquatic Life Species of Concern			Warm-water fishery.													
Temperature ΔT^b - °C	$\Delta T = 0$	$\Delta T \leq 2$			*											
pH - SU	95% of S.V. samples ≤ 8.8	S.V. 6.5 - 9.0			*											
Dissolved Oxygen - mg/L		S.V. $\geq 5.0^c$ [Applies to the epilimnion when stratified, or average in water column during periods of nonstratification]			*											
Total Inorganic Nitrogen (as N) - mg/L	95% of S.V. samples ≤ 4.5				*	*										
Nitrate (as N) - mg/L		S.V. ≤ 10								*						
Nitrite (as N) - mg/L		S.V. ≤ 1								*						
Total Ammonia (as N) - mg/L		^{e-d}			*											
Chlorophyll a - $\mu\text{g/L}$	[^d] ^e				*	*										
Total Suspended Solids - mg/L		S.V. ≤ 25			*											
Turbidity - NTU	[^e] ^f	S.V. ≤ 25			*											
Color - PCU	[^f] ^g									*						
Total Dissolved Solids - mg/L	Flow Weighted A-Avg. Concentration ≤ 723 measured below Hoover Dam [^g] ^h	S.V. ≤ 1000								*						
Chloride - mg/L		S.V. ≤ 400 [^h] ⁱ								*						
Sulfate - mg/L		S.V. ≤ 500 [^h] ⁱ								*						
E. coli - cfu/100 mL [^j] ^j		G.M. ≤ 126 S.V. ≤ 410				*										
Fecal Coliform – [MF or MPN] No./100 mL		$\leq 200/400$ [^j] ^k				*										
Toxic Materials		[^k] ^l														

* = The most restrictive beneficial use.

X = Beneficial use.

^a Refer to NAC 445A.122 and 445A.2142 for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone.

^c **Applies to the epilimnion when stratified, or average in water column during periods of nonstratification**

[e]^d The water quality criteria for ammonia are specified in [NAC 445A.118](#)

[e]^e The requirements for chlorophyll *a* are:

- 1 Not more than 1 monthly mean in a calendar year at Station LWLVB 1.85 may exceed 45µg/L. Station LWLVB 1.85 is located at the center of the channel at a distance of 1.85 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead.
- 2 The mean for chlorophyll *a* in summer (July 1-September 30) must not exceed 40 µg/L at Station LWLVB 1.85, and the mean for 4 consecutive summer years must not exceed 30 µg/L. The sample must be collected from the center of the channel and must be representative of the top 5 meters of the channel. Station LWLVB 1.85 is located at the center of the channel at a distance of 1.85 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead.
- 3 The mean for chlorophyll *a* in the growing season (April 1-September 30) must not exceed 16 µg/L at Station LWLVB 2.7 and 9 µg/L at Station LWLVB 3.5. Station LWLVB 2.7 is located at a distance of 2.7 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead. Station LWLVB 3.5 is located at a distance of 3.5 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead.
- 4 The mean for chlorophyll *a* in the growing season (April 1-September 30) must not exceed 5 µg/L in the open water of Boulder Basin, Virgin Basin, Gregg Basin and Pierce Basin. The single value must not exceed 10 µg/L for more than 5 percent of the samples.
- 5 Not less than two samples per month must be collected between the months of March and October. During the months when only one sample is available, that value must be used in place of the monthly mean.

[e]^f Turbidity must not exceed that characteristic of natural conditions by more than 10 NTU.

[e]^g Color must not exceed that characteristic of natural conditions by more than 10 PCU.

[e]^h The salinity standards for the Colorado River system are specified in [NAC 445A.1233](#).

[e]ⁱ The combination of this constituent with other constituents comprising TDS must not result in the violation of the TDS standards for Lake Mead and the Colorado River.

[e]^j The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.

[e]^k Based on a minimum of not less than five samples taken over a 30-day period, the fecal coliform bacterial level must not exceed a log mean of 200 per 100 milliliters, nor must more than 10 percent of the total samples taken during any 30-day period exceed 400 per 100 milliliters.

[e]^l The water quality criteria for toxic materials are specified in [NAC 445A.1236](#).

↪ The Commission recognizes that at entrances of tributaries to Lake Mead, localized violations of standards may occur.

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008; A by R102-16 & R109-16, 12-19-2017)

NAC 445A.2154 Colorado Region: Inner Las Vegas Bay. (NRS 445A.425, 445A.520)

The limits of this table apply to the body of water known as Inner Las Vegas Bay, consisting of Lake Mead from the confluence of the Las Vegas Wash with Lake Mead to 1.2 miles into Las Vegas Bay. Inner Las Vegas Bay is located in Clark County.

**STANDARDS OF WATER QUALITY
Inner Las Vegas Bay**

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a												
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh		
Beneficial Uses			X	X	X	X	X		X	X					
Aquatic Life Species of Concern			Warm-water fishery.												
Temperature ΔT^b - °C	$\Delta T = 0$	$\Delta T \leq 2$			*										
pH - SU	95% of S.V. samples ≤ 8.9	S.V. 6.5 - 9.0			*										
Dissolved Oxygen - mg/L		S.V. ≥ 5.0			*										
Total Inorganic Nitrogen (as N) - mg/L	95% of S.V. samples ≤ 5.3				*										
Nitrate (as N) - mg/L		S.V. ≤ 90			*										
Nitrite (as N) - mg/L		S.V. ≤ 5			*										
Total Ammonia (as N) - mg/L		c			*										
Total Suspended Solids - mg/L		S.V. ≤ 25			*										
Turbidity - NTU	d	S.V. ≤ 25			*										
Total Dissolved Solids - mg/L	e	S.V. ≤ 3000	*												
<i>E. coli</i> - cfu/100 mL ^f		<i>A.G.M. ≤ 126 S.V. ≤ 410</i>				*									
Fecal Coliform [MF or MPN] No./100 mL		$\leq 200/400$ [f] g					*								
Toxic Materials		[*] h													

* = The most restrictive beneficial use.

X = Beneficial use.

^a Refer to [NAC 445A.122](#) and [445A.2142](#) for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone.

^c The requirement for water quality with regard to the concentration of total ammonia is provided pursuant to the provisions of [NAC 445A.118](#). Data must be collected at Station LWLVB 1.2. Station LWLVB 1.2 is located at the center of the channel at a distance of 1.2 miles into Las Vegas Bay from the confluence of the Las Vegas Wash with Lake Mead.

^d Turbidity must not exceed that characteristic of natural conditions by more than 10 NTU.

^e The salinity standards for the Colorado River system are specified in [NAC 445A.1233](#).

^f The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.

[f] ^g Any discharge from a point source into Las Vegas Wash must not exceed a log mean of 200 per 100 milliliters based on a minimum of not less than five samples taken over a 30-day period, nor may more than 10 percent of the total samples taken during any 30-day period exceed 400 per 100 milliliters.

[f] ^h The water quality criteria for toxic materials are specified in [NAC 445A.1236](#).

↪ The Commission recognizes that, because of discharges of tributaries, localized violations of standards may occur in the Inner Las Vegas Bay.

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008; A by R109-16, 12-19-2017)

NAC 445A.2156 Colorado Region: Las Vegas Wash at ~~Telephone Line Road~~ the Historic Lateral, (NRS 445A.425, 445A.520) The limits of this table apply to the body of water known as the Las Vegas Wash from the confluence of the discharges from the City of Las Vegas and Clark County wastewater treatment plants to ~~Telephone Line Road.~~ the Historic Lateral. This segment encompasses the discharge from the City of Henderson wastewater treatment plant. This segment of the Las Vegas Wash is located in Clark County.

STANDARDS OF WATER QUALITY ~~{X}~~
Las Vegas Wash at ~~Telephone Line Road~~ the Historic Lateral

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a												
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh		
Beneficial Uses			X	X	X		X			X					X
Aquatic Life Species of Concern			[Excluding fish, this does not preclude the establishment of a fishery.] Warm-water fish												
Temperature ΔT ^b - °C	ΔT = 0	S.V. ≤ 34°			*										
pH - SU		S.V. 6.5 - 9.0			*										
Dissolved Oxygen - mg/L		^e S.V. ≥ 5.0			*										
Total Inorganic Nitrogen (as N) - mg/L	95% of S.V. samples ≤ 20				*										
Nitrate (as N) - mg/L		S.V. ≤ 100 90	*		*										
Nitrite (as N) - mg/L		S.V. ≤ 10 5	*		*										
Total Suspended Solids - mg/L		S.V. ≤ 135 ^d c			*										
Total Dissolved Solids - mg/L	95% of S.V. samples ≤ 1900	S.V. ≤ 3000	*												
Fecal Coliform MF or MPN No./100 mL		^e d		[*]											*
E. coli - cfu/100 mL		A.G.M ≤ 630						*							
Toxic Materials		^e f													

* = The most restrictive beneficial use.
X = Beneficial use.

~~{X} The goal of the standards set forth in this table is to ensure that the beneficial uses for the body of water described in this section will include, without limitation, the propagation of aquatic life, including, without limitation, fish by the next triennial review required by the Clean Water Act, 33 U.S.C. §§ 1251 et seq.~~

^a Refer to NAC 445A.122 and 445A.2142 for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone except during storm flow conditions.

~~^e Aerobic conditions are desirable for the beneficial uses of propagation of aquatic life, excluding fish, watering of livestock, recreation not involving contact with water and propagation of wildlife. So as not to prevent the development and restoration of marshes and wetlands in the Las Vegas Wash, aerobic conditions are established as a goal rather than a standard and the goal is not intended to preclude development of a limited fishery in selected areas. Aerobic conditions is intended to mean the absence of objectionable odors that may be caused by wastewater discharges in excess of existing odors.~~

^d ^c Total suspended solids standard does not apply when flows are greater than 110 percent of average flow as measured at the nearest gage. "Average flow" is defined as the 12-month rolling average of the average monthly flow.

~~FF~~^d Any discharge from a point source into the Las Vegas Wash must not exceed a log mean of 200 per 100 milliliters based on a minimum of not less than five samples taken over a 30-day period, nor may more than 10 percent of the total samples taken during any 30-day period exceed 400 per 100 milliliters.

~~FF~~^e The water quality criteria for Toxic Materials are specified in NAC 445A.1236.

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008)

NAC 445A.2158 Colorado Region: Las Vegas Wash at Lake Mead. ([NRS 445A.425](#), [445A.520](#))

The limits of this table apply to the body of water known as the Las Vegas Wash from ~~[Telephone Line Road]~~ *the Historical Lateral* to its confluence with Lake Mead. This segment of the Las Vegas Wash is located in Clark County.

STANDARDS OF WATER QUALITY ~~[X]~~
Las Vegas Wash at Lake Mead

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a											
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh	
Beneficial Uses			X	X	X		X				X			X
Aquatic Life Species of Concern			[Excluding fish, this does not preclude the establishment of a fishery.] <i>Warm-water fish</i>											
Temperature ΔT ^b - °C	ΔT = 0	<i>S.V. ≤ 34°</i>			*									
pH - SU		S.V. 6.5 - 9.0			*									
Dissolved Oxygen - mg/L		^e <i>S.V. ≥ 5.0</i>			*									
Total Inorganic Nitrogen (as N) - mg/L	95% of S.V. samples ≤ 17				*									
Nitrate (as N) - mg/L		S.V. ≤ [100] <i>90</i>	[*]		*									
Nitrite (as N) - mg/L		S.V. ≤ [10] <i>5</i>	[*]		*									
Total Suspended Solids - mg/L		S.V. ≤ 135 ^[d] <i>c</i>			*									
Total Dissolved Solids - mg/L	95% of S.V. samples ≤ 2400	S.V. ≤ 3000	*											
Fecal Coliform - MF or MPN No./100 mL		[e] <i>d</i>						[*]						*
<i>E. coli</i> - cfu/100 mL		<i>A.G.M ≤ 630</i>						*						
Toxic Materials		^{f e}												

* = The most restrictive beneficial use.

X = Beneficial use.

~~[X The goal of the standards set forth in this table is to ensure that the beneficial uses for the body of water described in this section will include, without limitation, the propagation of aquatic life, including, without limitation, fish by the next triennial review required by the Clean Water Act, 33 U.S.C. §§ 1251 et seq.]~~

^a Refer to [NAC 445A.122](#) and [445A.2142](#) for beneficial use terminology.

^b Maximum allowable increase in temperature above water temperature at the boundary of an approved mixing zone.

~~[^c Aerobic conditions are desirable for the beneficial uses of propagation of aquatic life, excluding fish, watering of livestock, recreation not involving contact with water and propagation of wildlife. So as not to prevent the development and restoration of marshes and wetlands in the Las Vegas Wash, aerobic conditions are established as a goal rather than a standard and the goal is not intended to preclude development of a limited fishery in selected areas. Aerobic conditions is intended to mean the absence of objectionable odors that may be caused by wastewater discharges in excess of existing odors.]~~

^{d e} Total suspended standard does not apply when flows are greater than 110 percent of average flow as measured at the nearest gage. "Average flow" is defined as the 12-month rolling average of the average monthly flow.

^{e d} Any discharge from a point source into the Las Vegas Wash must not exceed a log mean of 200 per 100 milliliters based on a minimum of not less than five samples taken over a 30-day period, nor may more than 10 percent of the total samples taken during any 30-day period exceed 400 per 100 milliliters.

^{f e} The water quality criteria for Toxic Materials are specified in [NAC 445A.1236](#).

(Added to NAC by Environmental Comm'n by R160-06, eff. 8-26-2008)

NAC 445A.2160 Colorado Region: Lake Las Vegas. The limits of this table apply to the entire body of water known as Lake Las Vegas. Lake Las Vegas is located in Clark County.

STANDARDS OF WATER QUALITY

Lake Las Vegas

PARAMETER	REQUIREMENTS TO MAINTAIN EXISTING HIGHER QUALITY	WATER QUALITY CRITERIA TO PROTECT BENEFICIAL USES	Beneficial Uses ^a											
			Livestock	Irrigation	Aquatic	Contact	Noncontact	Municipal	Industrial	Wildlife	Aesthetic	Enhance	Marsh	
Beneficial Uses				X	X	X	X				X			
Aquatic Life Species of Concern.			Warm-water fish											
Temperature <i>AT^b - °C</i>		<i>AT ≤ 2</i>			*									
pH - <i>SU</i>		[S.V. 7.0 - 9.0] <i>S.V. 6.5 - 0 9.0</i>			*									
Dissolved Oxygen - <i>mg/L</i>		<i>S.V. ≥ 5.0^c</i>			*									
Chlorophyll <i>a</i>		[Avg. 0.005 mg/l^d] <i>Avg. 5 µg/l^d</i>			*	*								
Turbidity <i>NTU</i>		<i>S.V ≤ 10^e</i>			*									
Total Dissolved Solids - <i>mg/L</i>		<i>S.V. ≤ 2000^f</i>		*										
Fecal Coliform <i>No./100ml</i>		[≤ 200/400^g] <i>S.V. ≤ 1,000^g</i>		*										
<i>E. Coli - cfu/100 mL^h</i>		<i>G.M. ≤ 126</i> <i>S.V. ≤ 410</i>		*		*								
Toxic Materials		<i>i</i>												

* = The most restrictive beneficial use.

^a Refer to NAC 445A.122 and 445A.2142 for beneficial use terminology.

^b Average temperature in the epilimnion should not exceed 2 C above ambient temperature (i.e., temperature in epilimnion of Lake Mead).

^c When lake is stratified, the dissolved oxygen criterion applies only to the epilimnion, during non stratification 5.0 mg/l applies to the watercolumn .

^d April – September, The average must include at least 2 samples per month. A single value must not exceed 10 µg/l in 10% of the samples.

^e Turbidity must not exceed that characteristic of natural conditions by more than 10 Nephelometric Turbidity Units (NTU).

^f The salinity standards for the Colorado River system are specified in NAC 445A.1233.

^g In all Lake areas, the log mean of not less than five fecal coliform samples taken over a 30-day period during ~~the recreational season~~ (April- September) should not exceed 1000 most probable number (MPN)/100 milliliter (mL).

^h The geometric mean must not be exceeded in any 30-day period. The single value must not be exceeded in more than 10 percent of the samples collected within any 30-day period.

ⁱ The water quality criteria for Toxic Materials are specified in NAC 445A.1236.

↪ It is recognized that occasional storm waters from Las Vegas Wash may enter the Lake and localized exceedances of the standards may occur

APPENDIX B

Proposed Water Quality Standards for Temperature in Colorado River Reaches

Background on Current Temperature Criteria for the Colorado River

The current criteria for temperatures in the Colorado River were established in 1984 for two reaches of the Colorado River:

- Colorado River from Hoover Dam to the Lake Mohave inlet
- Colorado River from Davis Dam to the stateline

The following temperature criteria were assigned to both reaches of the Colorado River:

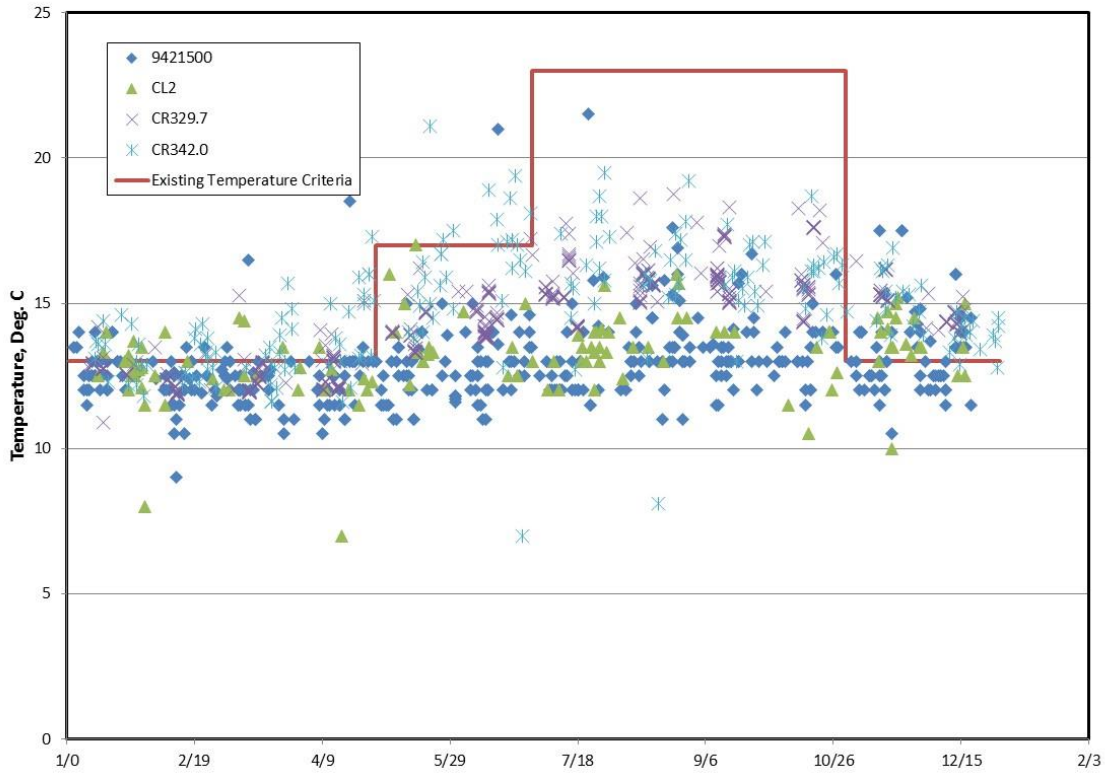
- S.V. Nov-Apr ≤ 13 °C
- S.V. May-Jun ≤ 17 °C
- S.V. Jul-Oct ≤ 23 °C
- $\Delta T \leq 2$ °C

According to the 1984 Rationale (NDEP, 1984), both reaches of the Colorado River were deemed coldwater fisheries based upon a 1973 State of Nevada Water Planning Report prepared in cooperation with the Nevada Department of Wildlife (NDOW) (NDOW, 1973). Channel catfish, largemouth bass, striped bass, and rainbow trout were reported as game fish found in these reaches of the Colorado River. The temperature criteria were set to protect the most sensitive of these species (rainbow trout) and were based upon recommendations from NDOW for different life stages (spawning, incubation, nursery-fry, juvenile-fingerlings, adult). Although the criteria were set to protect all life stages of the rainbow trout, the Rationale made no mention as to whether or not rainbow trout were actually self-propagating in these reaches.

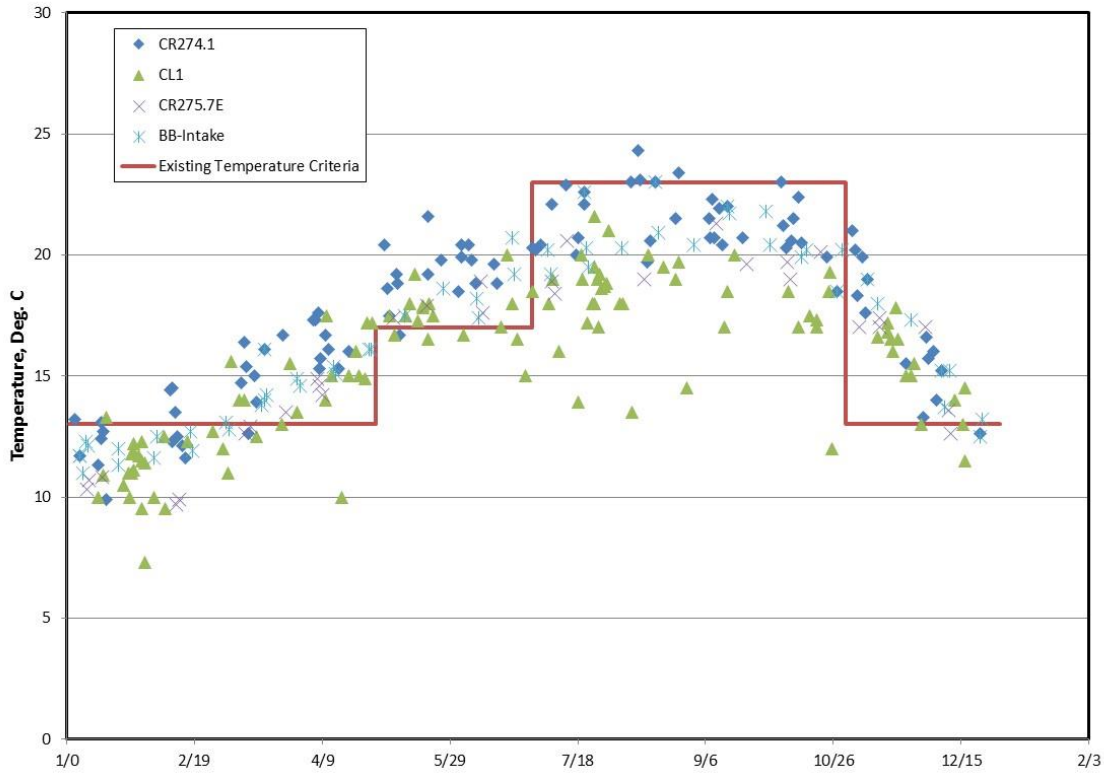
The Colorado River is currently listed as impaired for temperature on Nevada's 2014 303(d) List of Impaired Waters. Most of the exceedances of the water quality criteria have occurred during the non-summer months. The temperature criteria for these months were set to protect rainbow trout spawning and incubation (Figures 1 and 2).

Some samples taken from shore – may not be representative of river conditions

Colorado River - Hoover Dam to Lake Mohave - Water Temperature



Colorado River - Davis Dam to Stateline - Water Temperature



Current Status of Fisheries

The fisheries in the Colorado River below Hoover Dam include several warmwater species and one coldwater species (rainbow trout) (Table 1). Most of the fish species are non-native, with the exception of the razorback sucker and the bonytail chub, both of which are classified as endangered by the U.S. Fish and Wildlife Service (USFWS).

Table 1. Summary of Fish Species in Colorado River below Hoover Dam

Species	Native/Non-Native	Hoover Dam to Davis Dam	Below Davis Dam
GAME			
Striped Bass	Non-native	1,2	1
Rainbow Trout	Non-native	1,2 (stocked)	1 (stocked)
Largemouth Bass	Non-native	1,2	1
Smallmouth Bass	Non-native	1,2	1
Redear Sunfish	Non-native	---	1
Bluegill Sunfish	Non-native	1,2	1
Green Sunfish	Non-native	1,2	1
Channel Catfish	Non-native	1,2	1
Yellow Bullhead Catfish	Non-native	1	1
NONGAME			
Threadfin Shad	Non-native	1	1
Gizzard Shad	Non-native	1	1
Common Carp	Non-native	1,2	1
Razorback Sucker	Native, endangered	1,2	1
Flannelmouth Sucker	Native	---	1
Bonytail Chub	Native, endangered	1,2	---

1: Per NDOW (2014a, 2014b)

2: Per Rosen et al. (2012)

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In response to concerns regarding the potential impact of trout stocking upon endangered species (razorback sucker, bonytail chub), the USFWS issued a Biological Opinion in 1994. This Opinion concluded that the continuing stocking program for rainbow trout was not likely to jeopardize the continued existence of razorback sucker and bonytail chub. At that time, the USFWS was proposing to annually stock rainbow trout (from Willow Beach National Fish Hatchery) in seven different areas of the Hoover Dam to Davis Dam reach, and in the Colorado River below Davis Dam (USFWS, 1994).

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With the discovery of razorback sucker spawning in some rainbow trout stocking areas, the USFWS decided to revisit the 1994 Biological Opinion. Again, the USFWS concluded that the trout stocking program, as proposed, was not likely to jeopardize the continued existence of razorback suckers. The proposed program included stocking in the upper Lake Mohave (Willow Beach), and below Davis Dam (Davis Camp, Rotary Park, Bullhead City Park). To minimize adverse affects on the razorback sucker, the current stocking activities use triploid (non-reproductive) rainbow trout (USFWS, 2016). Prior to that time, diploid (reproductive) rainbow trout were stocked (Olson, 2017).

Although rainbow trout are likely to prey on larval razorback suckers, the USFWS concluded that the predation was not likely to result in quantifiable effects on the razorback sucker population. The USFWS also concluded that survival of rainbow trout in the Colorado River system between Hoover Dam and stateline was expected to be low due to stocking stress, poor foraging behavior of hatchery-raised fish, high angling pressure, and high water temperature (USFWS, 2016). Predation by striped bass has also affected the survival of stocked rainbow trout (Stewart and Burrell, 2013).

All indications are that the rainbow trout population in the Colorado River between Hoover Dam and the stateline is maintained solely by the stocking activities. Stocked rainbow trout may only be living 3 to 4 months (USFWS, 1994). Prior to the cessation of rainbow trout stocking in 2013, angler harvest at Willow Beach was dominated by rainbow trout. However in 2014, rainbow trout harvest was zero during a year of no stocking activities (NDOW, 2014b). This would further suggest that the stocked trout were living short lives.

No evidence of historical rainbow trout spawning in this reach has been found in the literature. In the 1994 Biological Opinion, the USFWS concluded that the stocked rainbow trout do not reproduce in Lake Mohave (including the river reach between Hoover Dam and Lake Mohave). According to Walters et al. (1996), no natural recruitment of rainbow trout occurs in the Hoover Dam tailwater, due to the lack of appropriate spawning substrates. In addition, the USFWS is not aware of any evidence that rainbow trout are spawning in the Colorado River below Hoover Dam or below Davis Dam (Olson, 2017). With stocking now limited to triploid trout, the stocked rainbow trout will not be able to reproduce.

Proposed Temperature Criteria

Temperature criteria are typically set to protect the most sensitive fish species that occur in a given waterbody, while also considering the most sensitive life stages. EPA guidance recommends establishing both acute and chronic temperature for the protection of fish for two main life stages: 1) adult and juvenile; and 2) spawning and incubation (Brungs and Jones, 1977; NDEP, 2017). In addition, seasonally variable temperatures must be maintained. According to Todd et al. (2008), temperature criteria that meet all life stages throughout the year (i.e., seasonally variable criteria) are necessary to maintain viable fish populations.

To assist in the design of the proposed criteria, Table 2 provides acute and chronic thermal-tolerance values for the various game and non-game species that are found in the Colorado River between Hoover Dam and stateline (NDEP, 2017). In all cases, the thermal tolerance values for spawning and incubation of these fish are more restrictive than the tolerance values for adult and juvenile life stages.

Temperature Criteria for Juvenile and Adult Life Stages

The juvenile and adult fish species listed in Table 2 are assumed to exist in the Colorado River between Hoover Dam and stateline throughout the year. Therefore, the temperature criteria should be protective of these fish year-round. Of the thermal tolerance values in Table 1, the acute (24°C) and chronic (19°C) criteria for rainbow trout represent the most restrictive criteria for the protection of juvenile and adult fish. Although the acute criteria for juveniles and adults are intended to protect fish from short-term exposures of elevated temperature, the chronic criteria for juveniles and adults are designed to provide conditions for the growth of the fish. For put-and-take fisheries, fish growth and long-term survival are not anticipated. The rainbow trout fishery in the Colorado River between Hoover Dam and stateline is considered to be a put-and-take fishery (Olson, 2017) and, therefore, chronic temperature criteria are not needed to protect the rainbow trout. An acute temperature criterion of 24°C is recommended for the protection of the juvenile and adult rainbow trout. This criterion will be protective of the thermal needs of the other juvenile and adult fish in the Colorado River between Hoover Dam and stateline.

Temperature Criteria for Spawning and Incubation Life Stages

In all cases, the thermal tolerances for spawning and incubation life-stages are more restrictive than the requirements for juvenile and adult life-stages for all the fish species listed in Table 2. The most restrictive thermal tolerances are associated with the early life-stages of rainbow trout. However before attempting to establish criteria to protect the early life-stages of rainbow trout, two key questions need to be answered: 1) are spawning and incubation of rainbow trout actually occurring?; and, if so, 2) what are the times and locations of spawning and incubation for rainbow trout?

Based upon the available information, spawning and incubation of rainbow trout have not been occurring in the Colorado River between Hoover Dam and stateline. Additionally, spawning and incubation are not expected to occur with the stocking of triploid trout. Therefore, the temperature criteria need not be protective of rainbow trout spawning and incubation. Instead, the spawning and incubation of the warmwater species need to be considered. The warmwater fish species in the Colorado River reaches under review are believed to be self-propagating (reference), with the exception of the razorback sucker. The timing of spawning and incubation depend upon the species, with spawning and incubation possibly not occurring for any species during some months. Typically, little is known about the locations and timing of fish spawning and incubation in most waters in Nevada. Such is the case for these Colorado River reaches under review, making it difficult to establish temperature criteria to protect these life stages.

Table 2. Thermal Tolerance Values for Fish in Colorado River, °C

Species	Native/Non-Native	NDEP Recommended: Juvenile/Adult		EPA Recommended: Spawning/Incubation	
		DMT (Acute)	WAT (Chronic)	DMT (Acute)	WAT (Chronic)
GAME					
Striped Bass	non-native	32	30	24	18
Rainbow Trout	non-native	24	19	13	9
Largemouth Bass	non-native	34	32	27	21
Smallmouth Bass	non-native	31	29	23	17
Redear Sunfish	non-native	31	29	---	---
Bluegill Sunfish	non-native	35	32	34	25
Green Sunfish	non-native	34	31	---	---
Channel Catfish	non-native	35	32	29	27
Yellow Bullhead Catfish	non-native	---	---	---	---
NONGAME					
Threadfin Shad	non-native	---	---	34	19
Gizzard Shad	non-native	---	---	---	---
Common Carp	non-native	37	32	33	21
Razorback Sucker	native	33	29	---	---
Flannelmouth Sucker	native	32	29	---	---
Bonytail Chub	native	33	29	---	---

Note: DMT = Daily maximum temperature

WAT = Weekly average temperature; 7-day average of daily average temperature

One option for constructing appropriate temperature criteria could be to estimate spawning and incubation timing based upon a literature review; however, there are some significant problems with this strategy. Fish spawning is typically cued by certain environmental conditions, such as temperature, streamflow, and length of daylight (Whitehead et al. 1978; Bjornn and Reiser, 1991; Idaho Department of Environmental Quality, 2002). Response to these different cues results in spawning for a particular species occurring at a different times in different streams located at different latitudes and elevations. As a result, spawning times cited in the literature vary widely, with great uncertainty regarding applicability for the Colorado River reaches under review here.

The recommended option is as follows: For waters with limited knowledge of the location and timing of spawning and incubation, NDEP guidance (NDEP, 2017) recommends setting criteria to protect the juvenile and adult fish, along with a “change in temperature” (i.e., “delta T” or “ ΔT ”) criterion to maintain a seasonally variable temperature regime similar to current conditions. By maintaining the existing seasonal variations in temperature, historical spawning and incubation uses will be protected.

APPENDIX C

Proposed Water Quality Standards for Dissolved Oxygen in Colorado River Reaches

Background on Current Criteria for Dissolved Oxygen in the Colorado River

The current criteria for dissolved oxygen (DO) were established in 1984 for two reaches of the Colorado River:

- Colorado River from Hoover Dam to the Lake Mohave inlet
- Colorado River from Davis Dam to the stateline

The following DO criteria were assigned to both reaches of the Colorado River:

- S.V. Nov-May ≥ 6.0 mg/L
- S.V. May-Oct ≥ 5.0 mg/L

At the time these criteria were proposed, both reaches of the Colorado River were deemed coldwater fisheries, based upon a 1973 State of Nevada Water Planning Report prepared in cooperation with the Nevada Department of Wildlife (NDOW) (NDEP, 1984; Nevada Division of Water Resources, 1973). Channel catfish, largemouth bass, striped bass, and rainbow trout were reported as game fish found in these reaches of the Colorado River .

The current DO criteria were based upon the EPA's Quality Criteria for Water (Red Book) (1976) and were set to protect the most sensitive of these species (rainbow trout) for both spawning and incubation and juvenile and adult life-stages. According to the 1984 Rationale:

The proposed single values BUS [beneficial use standard] of 6.0 mg/l D.O. or greater from November to April...is intended to assure sufficient intragravel D.O. for protection of incubating salmonid eggs and fry.

Although the criteria were set to protect all life stages of the rainbow trout, the Rationale made no mention as to whether or not rainbow trout were actually self-propagating in these reaches.

Current Status of Fisheries

The fisheries in the Colorado River below Hoover Dam includes several warmwater species and one coldwater species (rainbow trout) (Table 1). Most of the fish species are non-native, with the exception of the razorback sucker and the bonytail chub, both of which are classified as endangered by the U.S. Fish and Wildlife Service (USFWS).

Table 1. Summary of Fish Species in Colorado River below Hoover Dam

Species	Native/Non-Native	Hoover Dam to Davis Dam	Below Davis Dam
GAME			
Striped Bass	Non-native	1,2	1
Rainbow Trout	Non-native	1,2 (stocked)	1 (stocked)
Largemouth Bass	Non-native	1,2	1
Smallmouth Bass	Non-native	1,2	1
Redear Sunfish	Non-native	---	1
Bluegill Sunfish	Non-native	1,2	1
Green Sunfish	Non-native	1,2	1
Channel Catfish	Non-native	1,2	1
Yellow Bullhead Catfish	Non-native	1	1
NONGAME			
Threadfin Shad	Non-native	1	1
Gizzard Shad	Non-native	1	1
Common Carp	Non-native	1,2	1
Razorback Sucker	Native, endangered	1,2	1
Flannelmouth Sucker	Native	---	1
Bonytail Chub	Native, endangered	1,2	---

1: Per NDOW (2014a, 2014b)

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stock rainbow trout (from Willow Beach National Fish Hatchery) in seven different areas of the Hoover Dam to Davis Dam reach and in the Colorado River below Davis Dam (USFWS, 1994). Operations under the 1994 Biological Opinion continued until 2013, when the hatchery lost its coldwater intake and the ability to raise rainbow trout (Las Vegas Review-Journal, January 11, 2017; USFWS, 2016). In October 2016, the hatchery restarted its production of rainbow trout. Stocking activities began again on January 2017 (Las Vegas Review-Journal, January 11, 2017).

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Proposed Dissolved Oxygen Criteria

DO criteria are typically set to protect the most sensitive fish species that occur in a given waterbody while also considering the most sensitive life stages. EPA guidance recommends DO criteria for coldwater and warmwater fish for the protection of 2 main life stages: 1) early life stages; and 2) other life stages (USEPA 1986) (Table 1).

Table 1. EPA Recommended DO Criteria (mg/L)

Description	Coldwater Fish Criteria		Warmwater Fish Criteria	
	Early Life Stages ^{1,2}	Other Life Stages	Early Life Stages ²	Other Life Stages
30-Day Mean	---	6.5	---	5.5
7-Day Mean	9.5 (6.5)	---	6.0	---
7-Day Mean Minimum	---	5.0	---	4.0
1-Day Minimum ^{3,4}	8.0 (5.0)	4.0	5.0	3.0

¹These are water column concentrations recommended to achieve the required intergravel dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.

²Includes all embryonic and larval stages and all juvenile forms to 30-days following hatching.

³For highly manipulated discharges, further restrictions apply.

⁴All minima should be considered as instantaneous concentrations to be achieved at all time.

Although the warmwater fisheries are largely self-propagating, the rainbow trout fishery is supported solely by stocking, with no documented early life stages found in the river. Therefore, the DO criteria need to be protective of all life stages of warmwater fish, and protective of only the non-early life stages for the rainbow trout. The following single value criterion is proposed:

$$S.V. \geq 5.0 \text{ mg/L}$$

EPA guidance recommends criteria in terms of averages 7-day and 30-day periods, however, it is not deemed appropriate to establish these criteria for the Colorado River at this time. Detailed continuous data are needed to evaluate these two types of criteria. Currently, DO readings exist only for grab sampled collected from the two Colorado River reaches under review.

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