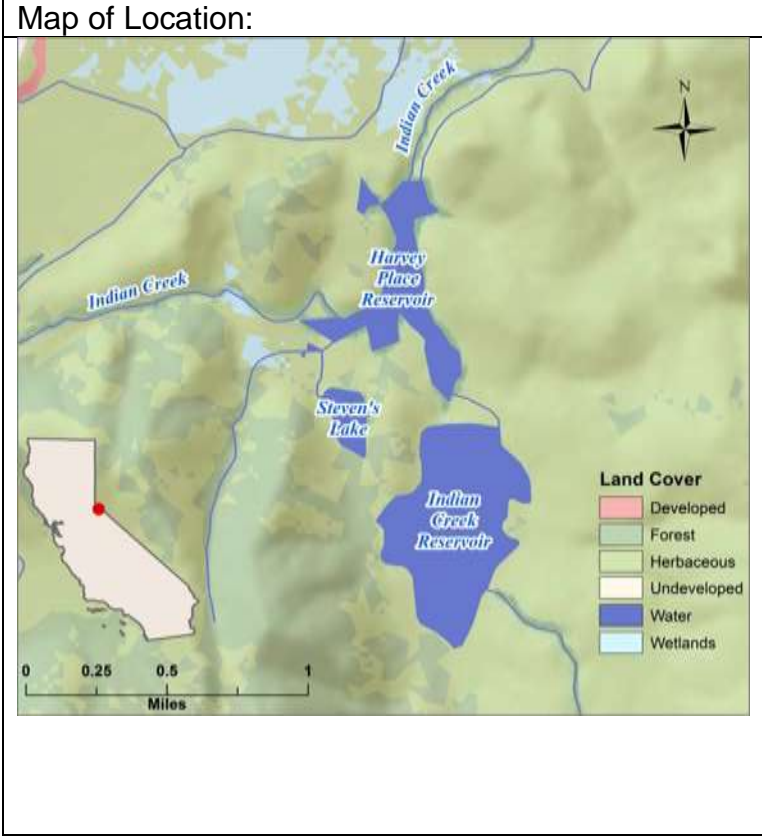


Waterbody: Indian Creek Reservoir	TMDL: Phosphorus	Updated: 4/28/15 Rich Booth
---------------------------------------------	-------------------------	-----------------------------------



TMDL Summary Information:

- *Date of approval:* July 2002 (Lahontan); July 1, 2003 (USEPA)
- *Basis for TMDL:* The South Tahoe Public Utility District (STPUD) disposed of South Lake Tahoe area wastewater to Indian Creek Reservoir from 1967-1989 with the residual effect of symptoms of eutrophication including blooms of blue-green algae, low transparency, and depletion of dissolved oxygen in the hypolimnion.
- *Project Implementers:* The responsibility of STPUD (for control of internal phosphorus loading) and the U.S. Bureau of Land Management, Alpine County, STPUD, and other land owners and land managers in the watershed (for control of external sources)
- *Target:* The primary numeric target is an annual mean concentration in the water column of 0.02 mg/L total phosphorus. Currently, the interim target of 0.04 mg/L is in effect.
- *Attainment of TMDL:* standards projected to occur within 21 years after final approval of TMDL (2024)

Phosphorus data from: *Indian Creek Reservoir TMDL Progress Report for 2014* by South Tahoe Public Utility District, 2/27/15



Permits that include TMDL implementation measures: no permit issued. Although the South Tahoe Public Utility District is not under permit, they voluntarily operate a hypolimnetic oxygenation system and provide a TMDL Status Report annually.

Grant/contract that includes TMDL implementation measures: CWA 319(h) non-point source grant [06-244-556-0]

Period of evaluation: 2007-2014

Indicator	Target Value	Evaluation Schedule	Source Reported	Compliance
Total Phosphorus (TP) concentration	(Interim ¹) No greater than 0.04 mg/L, annual mean	Annual mean of samples collected from all depths from all sites over the reporting period.	<i>Indian Creek Reservoir TMDL Progress Report for 2014 (2/27/15):</i> icr_stpud_2014.pdf	Yes , TP in compliance since 2010. TP was higher than the objective until the installation of the hypolimnetic system where levels have consistently met the objective since 2010.
	(Long term ²) No greater than 0.02 mg/L, annual mean			
Dissolved oxygen (DO) concentration	(Interim ¹) 30 day mean 6.5 mg/L; 7 day mean minimum 5.0 mg/L; 1 day minimum 4.0 mg/L	Mean of samples collected from all depths at each site measured monthly over the reporting period.	Ibid.	Yes , DO concentration ≤ 4.0 at ICR-1 during August 2007, 2008, and 2011. DO ≥ 4.0 at all sites during 2009 & 2010, 2012 through 2014.
	(Long term ²) Shall not be depressed by more than 10 percent, below 80 percent saturation, or below 7.0 mg/L at any time, whichever is more restrictive			
Secchi depth (SD)	Summer mean no less than 2 meters	Mean for all readings collected over the reporting period.	Ibid.	Yes , since 2009 summer means SD levels have been increasing and have been > 2 meters since 2010.
Chlorophyll a (chl-a)	Summer mean no greater than 10 $\mu\text{g/L}$	Mean for all samples collected over the reporting period.	Ibid.	Yes , since 2008, Chl-a levels have been decreasing and were less than 10 mg/cubic meter for the first time in 2012. Chl-a levels were consistently above 10 $\mu\text{g/L}$ until 2011 when levels showed a significant decrease and met the target value.
Trophic State Index ³ - Secchi Disk [TSI(SD)]	Composite index no greater than 45 units	Mean of all TSI (SD) derived from SD readings (in meters) collected from all sites over the reporting period.	Ibid.	Yes , since 2009 average reservoir TSI (SD) have been decreasing, less than 45 units for the first time in 2012.
Trophic State Index ⁴ - Chlorophyll-a [TSI(Chl-a)]	Composite index no greater than 45 units	Mean of all TSI (Chl-a) derived from Chl-a concentrations (in $\mu\text{g/l}$) collected from all sites over the reporting period.	Ibid.	Yes , TSI (Chl-a) was less than 45 units for first time in 2012.
Trophic State Index ⁵ - Total Phosphorus [TSI (TP)]	Composite index no greater than 45 units	Mean of all TSI (TP) derived from TP concentrations (in $\mu\text{g/l}$) collected from all sites over the reporting period.	Ibid.	Yes , since 2009, average reservoir TSI (TP) has been decreasing.

¹ Interim targets were expected to be attained by 2013.

² Long term targets are expected to be attained by 2024.

EPA calculations for [Carlson Trophic Status Index](#)

³ Secchi depth calculation = $60 - 14.41 * (\text{natural logarithm (Secchi depth in meters)})$

⁴ Chlorophyll *a* = $9.81 * (\text{natural logarithm Chlorophyll } a \text{ (ug/L)}) + 30.6$

⁵ Total Phosphorus = $14.42 * (\text{natural logarithm TP (ug/L)}) + 4.15$

ICR = Indian Creek reservoir

mg/L = milligrams per liter

ug/L = micrograms per liter (equivalent to milligrams per cubic meter)

Implementation Measures			
Internal Loading	Responsible Party	Schedule	Status
After approval of TMDL, Regional Board staff will request a report from STPUD on the method(s) it intends to use to reduce internal loading of phosphorus to ICR to meet TMDL target.	STPUD	Due 2003	Met requirements: Grant from 319 (federal grant) to implement the Hypolimnetic Oxygenation System. Implemented in 2007.
By 15 months after final approval of TMDL, STPUD will submit a plan for approval by the Regional Board for management measures to meet TMDL target.	STPUD	Due October 1, 2004	Met requirements: Regional board accepted 319 grant plan and monitoring plan. The plan has been implemented and is being utilized and monitored.
STPUD will fully implement controls for internal phosphorus loading	STPUD	Due 2013	Met requirements: Hypolimnetic Oxygenation System.

External Loading	Responsible Party	Schedule	Status
By one year after approval of the TMDL, Regional Board staff and stakeholders will identify sites in the watershed <i>contributing direct surface runoff</i> to ICR that need Best Management Practices (BMPs) for phosphorus control.	Lahontan and stakeholders	Due July 1, 2004	Did not meet requirements: Stakeholders Group Kickoff Meeting October 22, 2003 to discuss ICR TMDL implementation. This led to the ICR external phosphorus loading field tour with Hal Byrd (STPUD) to get a preliminary idea of sites to visit for the planned Stakeholder Group field tour/meeting March 23, 2004. On March 3, 2004, ICR TMDL implementation letter – Invitation to March 23, 2004 Stakeholders field tour, to identify sites needing external phosphorus loading reduction BMPs – Alpine County. Scheduled for March 23, 2004 from 1:30-4:30PM. There is no other information regarding the Stakeholder Group.
By one year after approval of the TMDL, Regional Board staff and stakeholders will identify sites on public and private lands within the watershed <i>tributary to the irrigation ditch that provides inflow to ICR from Indian Creek and the West Fork Carson River</i> needing BMPs.	Lahontan and stakeholders	Due July 1, 2004	Did not meet requirements: Refer to letters and meetings regarding Stakeholders Group stated above. There is no other information in the file regarding current efforts if any.
By three years after final approval of the TMDL, staff will consider the need for regulatory action to ensure implementation of BMPs to control external sources of phosphorus loading to ICR.	Lahontan	Due July 1, 2006	Did not meet requirements: No information stating this has been completed
BMPs will be fully implemented for nonpoint sources of phosphorus loading to ICR within the subwatershed affected by the TMDL.	stakeholders	Due 2013	Have not met requirements: Not completed

A list of possible changes that might be expected in a north temperate lake as the amount of algae changes along the trophic state gradient.

TSI	Chl (ug/L)	SD (m)	TP (ug/L)	Attributes	Water Supply	Fisheries & Recreation
<30	<0.95	>8	<6	Oligotrophy: Clear water, oxygen throughout the year in the hypolimnion	Water may be suitable for an unfiltered water supply.	Salmonid fisheries dominate
30-40	0.95-2.6	8-4	6-12	Hypolimnia of shallower lakes may become anoxic		Salmonid fisheries in deep lakes only
40-50	2.6-7.3	4-2	12-24	Mesotrophy: Water moderately clear; increasing probability of hypolimnetic anoxia during summer	Iron, manganese, taste, and odor problems worsen. Raw water turbidity requires filtration.	Hypolimnetic anoxia results in loss of salmonids. Walleye may predominate
50-60	7.3-20	2-1	24-48	Eutrophy: Anoxic hypolimnia, macrophyte problems possible		Warm-water fisheries only. Bass may dominate.
60-70	20-56	0.5-1	48-96	Blue-green algae dominate, algal scums and macrophyte problems	Episodes of severe taste and odor possible.	Nuisance macrophytes, algal scums, and low transparency may discourage swimming and boating.
70-80	56-155	0.25-0.5	96-192	Hypereutrophy: (light limited productivity). Dense algae and macrophytes		
>80	>155	<0.25	192-384	Algal scums, few macrophytes		Rough fish dominate; summer fish kills possible

Chlorophyll (Chl), Secchi depth (SD), and Total phosphorus (TP) with the values of the Trophic Status Index (TSI) as evaluated by EPA (<https://www.nrc.gov/docs/ML0427/ML042790430.pdf>).