Total Maximum Daily Loads – Humboldt And Walker Rivers

Excerpted (with format modifications) from "Water Quality Management (208) Plan for the Non-designated Area of Nevada", Nevada Division of Environmental Protection, Bureau of Water Quality Planning, January 1993.

1. Introduction

A total maximum daily load (TMDL) is that amount or mass of pollutants which could be carried in a stream segment without violating water quality standards. Once a TMDL is established, the State is required to allocate this loa among various pollutants sources – both point (wasteload allocation or WLAs) and nonpoint (load allocation or Las). A margin of safety (MOS) is also a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbodies.

The Clean Water Act (CWA) requires States to establish TMDLs for Section 303(d) listed waters which are impaired by point source discharges, nonpoint source discharges, or by a combination of sources. Specifically, Section 303(d)(1)(C) of the CWA requires each State to develop TMDLs for all water bodies for which the effluent limitations required by Section 301(b)(1)(A) and Section 301(b)(1)(B) are not stringent enough to achieve applicable water quality standards. These previously cited sections of the CWA refer to the establishment of TMDLs for waters which have point source discharges. Section 303(d)(3) states that for the specific purpose of developing information, each State shall identify all water not identified in Sections 303(b)(1)(A) and (B) (or waters impaired by nonpoint source discharges) and estimate for such waters the total maximum daily load with seasonal variations and margins of safety.

As detailed in the Water Quality Planning and Management; Final Rule (Federal Register Vol. 50, No. 8), a strict interpretation of this legislation would mean that States would have to establish TMDLs for all waters. However, EPA acknowledges that this would draw resources from areas where there are water quality problems.

Therefore, EPA has stated that the CWA is best served if TMDLs are established only where such TMDLs are needed to "bridge the gap" between existing effluent limitation required by Section 301(b)(1(A) and (B) (or technology based effluent limits), other pollution controls and water quality standards. Thus for water quality limited segments, the TMDL process assigns margins of safety, distributes treatment burdens and considers nonpoint source controls.

The methodology to calculate TMDLs varies with the type of pollutant, with on method of calculation for pollutants which are generally classified as conservative and another method for pollutants generally classified as nonconservative (Federal Register, Vol. 43, No. 250).

Conservative pollutants (such as certain dissolved solids) are those pollutants which persist in the water column of the aquatic environment and remain essentially constant in a given segment over time. The Conservative Pollutant TMDL (C-TMDL) of a body of water is that pollutant loading which by simple dilution with the receiving body of water, results in an ambient concentration equal to the specified numerical concentration limit for that pollutant, i.e., the concentration limit based upon the applicable water quality standard. The G-TMDL varies directly with the volumes or flows of dischargers and the receiving water body of water.

Nonconservative Pollutants (such as organic compounds) decay or are otherwise removed over time. This decrease in concentration may be due to a number of factors including chemical breakdown and biodegradation. Therefore, Nonconservative Pollutant TMDLs (N-TMDL) are not an instrinsic property of a body of water, since the N-TMDL varies with a number of factors, such as, flow or volume of the receiving body of water, flow from dischargers, and the configuration of discharge locations on the body of water. N-TMDLs are also affected by a number of factors including chemical and biological processes in the aquatic environment. Therefore, N-TMDLs can only be calculated with fairly sophisticated techniques such as mathematical modeling which takes these factors into account.

EPA has acknowledged that the dividing line between conservative and nonconservative pollutants in not sharp and the classification of a given pollutant may vary according to the situation. Furthermore, as TMDL calculations are made on a case-by-case basis, the States are free to use their judgment in classifying a pollutant as either conservative or nonconservative based on its characteristics of the segment in question.

Once a TMDL load has been completed, a wasteload allocation or load allocation (WLA/LA) for that TMDL forms the basis to allocate the permissible load among the various pollutant sources, both point and nonpoint.

Since TMDL's must be established at levels necessary to implement the applicable water quality standards, any change in numerical criteria for pollutants contained in water quality standards will impact the TMDLs caculated for such a pollutant. Therefore, TMDLs should be reviewed each time the corresponding water quality standards are revised.

The TMDL process has significance to both point and nonpoint sources of pollution. The TMDL process has traditionally been applied to point sources, as is the case of the TMDLs established for the Humboldt River the 1979 208 Plan. However, TMDLs are also important on water where nonpoint source (NPS) pollution makes up a jamor part of the pollution loadings. The establishment of TMDLs, where there are no point sources, provides the guidelines to determine the actual amount of NPS pollution reduction needed and the actions necessary to achieve those reductions. As the TMDLs become part of the State's 208 management plan, whenever a potential pollution generating activity, (construction permits, mining activity, etc.) is proposed on a waterbody which has an established TMDL, the State has the legal authority to mandate the necessary pollution controls. The State also has authority to mandate nonpoint source pollution controls for sources such as agriculture runoff and urban runoff through the Diffuse Source regulations.

2. TMDLs And Load Allocations As Specified In The 1979 208 Plan

In the 1979 208 Plan, TMDLs were calculated for the Humboldt and Walker Rivers by use of a mathematical model known as RIVQUAL (a modification of the QUAL III model), which was developed exclusively for these rivers. Each river was divided into study reaches. For modeling purposes, these reaches were further divided into segments which had the same physical, chemical and biological characteristics, and therefore, would have a unique set of model parameters.

TMDLs by reach were calculated for dissolved oxygen (DO), biochemical oxygen demand (BOD), orthophosphate phosphorus (PO_4-P), nitrate nitrogen (NO_3-N) and total dissolved solids. Based on the calculated TMDLs, various model scenarios were run to calculate the WLAs and Las for the Humboldt and Walker River segments. Sensitivity tests were also performed on both rivers. The results indicated that point sources had no appreciable impacts on the water quality of the Humboldt River. However, the effects of nonpoint sources both natural and man-induced were identified as critical in the control of water quality of the river system. This conclusion was also reached in the analysis of the Walker River which, as of today, has not direct discharges from point sources.

In 1979, the Wells, Elko and Carlin Wastewater Treatment Facilities discharged into the Humboldt River. However as of 1989, all three facilities had eliminated their discharge to the Humboldt River. It should be noted that the Lovelock WWTP was not considered as a discharge to the Humboldt River as effluent from this source is discharged to the Lovelock Drain a tributary to Toulon Sink (which is a desert sink) where the effluent evaporates. However, it should be noted that water from the Toulon Sink ultimately end up in the Humboldt Sink, an important wetland currently having nutrient and TDS problems.

3. Amended TMDLs And Load Allocations

To assure that WQM plans continue to provide effective frameworks for management, the 208 Plan is being amended to reflect changing water quality conditions, results of implementation activities, new requirements, and to remove conditions in prior plans.

Table 1 summarizes the non-supporting water quality limited segments and provides a synopsis of the segments for which new TMDLs were calculated in the 208 Plan.

In order to institute effective program planning and to insure a margin of safety, the worst case scenarios were utilized. This, the following assumptions and methods were employed in the calculation of the TMDLs.

1. TMDLs were established using pollutant by pollutant approach based on dilution and mass balance equations that can be performed on desk top calculators. More sophisticated models such as steady state or dynamic computer models may be more representative of the true situation; however, at this time, Nevada does not have adequate data and information on the Walker and the Humboldt about the sources, fate and transport of the pollutants available to utilize more sophisticated models.

2. No margin of safety was assumed. All pollutants for which TMDLs were calculated are conservative. Therefore, the relationship between the pollutant and the quality of the receiving water can be determined based on dilution and mass balance equations.

Table 1. Water quality limited segments and identification of the segments for which TMDLs will be calculated

REACH	PARAMETER	COMMENTS
Humboldt River		
Palisade	Phosphorus	No violation of the standard since 1987. However, TMDL will be calculated for the Las
	TSS	TMDL will be calculated
Battle Mountain	Phosphorus	TMDL will be calculated
	TSS	TMDL will be calculated
Comus	Phosphorus	TMDL will be calculated
	TSS	TMDL will be calculated
	TDS	TMDL will be calculated
	Iron	No longer meets the definition of a non-supporting water body. TMDL will not be calculated
Imlay	Phosphorus	TMDL will be calculated
	TSS	TMDL will be calculated
	TDS	TMDL will be calculated
Near Sink	Iron	No longer meets the definition of a non-supporting water body. TMDL will not be calculated
	Selenium	No violation of standard since 1981. No TMDL will be calculated.
Walker River		
W. Fork near Wellington (Hoye Station)	pH	May not meet the criteria of water quality limited. In 33 samples, no value exceeded pH 9. TMDL will not be calculated at this time.
	Mercury	TMDL will not be calculated at this time.
W. Fork at Nordyke Road (Nordyke W. Station)	pH	May not meet the criteria of water quality limited. In 33 samples, no value exceeded pH 9. TMDL will not be calculated at this time.
	Phosphorus	May not meet the criteria of water quality limited. TMDL will not be calculated at this time.
Schurz Bridge	pH	Only 2 of 33 samples exceeded a pH of 9. Therefore, this may not meet the criteria of water quality limited. TMDL will not be calculated at this time.
E. Fork above Yerington (Nordyke E. Station)	TSS	TMDL will be calculated
	Iron	TMDL will not be calculated at this time.
Inlet to Weber Reservoir (Mason Station)	TSS	TMDL will be calculated.
	Iron	TMDL will not be calculated at this time.

3. The average flow for each river segment was taken from the USGS flow records from October 1, 1983 to September 30, 1989. This time period reflects the actual data from seven water years and thus represents actual on-site conditions at each water quality limited segment.

4. To calculate the TMDLs in pounds per day using the flow data, which is in cubic feet per second, and the concentration of each pollutant, which is in micrograms per liter, the following constant was calculated:

   (1 mg/l) x (1 g / 1000 mg) x (1 oz / 28.35 g) x (1 lb / 16 oz) x (28.316 l / ft^3) x (60 sec/min) x 60 (min/hr) x (24 hr/day) = 5.394 lb·l·sec/mg· ft^3 day

5. To determine each TMDL, the following calculation was utilized:

   (average flow in ft^3/sec) x (water quality standard in mg/l) x (5.394 lb·l·sec/mg· ft^3 day) = TMDL in lbs/day

6. To determine the required reduction of a given pollutant in order to achieve compliance with established water quality standards, the following calculation was utilized:

   Reduction (lbs/day) = TMDL (lbs/day) – Existing load (lbs/day)

7. Section 303(d)(1)(C) requires that TMDLs shall be established at a level necessary to implement the applicable water quality standards. Any discharge which improves the existing water quality, and has permitted discharge limits as strict or stricter than the water quality standards will be considered in compliance with the TMDLs.

The model selected for calculating TMDLs should be based on its adequacy for the intended use, for the specific waterbody, and for the critical conditions occurring at that waterbody. Annual average flow data is adequate for dilution and mass balance calculations when the water quality standard goal is in terms of an annual average. The total phosphorus standard is based on an annual average. The total suspended solids and total dissolved solids standards, on the other hand, are based on single values.

Currently, NDEP does not have the capability to run a computer model to evaluate the dynamics of flow and water quality changes in the Humboldt and Walker rivers. TMDLs will be more thoroughly examined when the water quality standards are reviewed. The CPP will clearly describe the process used for the development of TMDLs pursuant to 40 CFR 130.7(a).

Thus, the TMDL process is extremely important to nonpoint source pollution control programs. The calculated LAs will define the amount of pollution reduction needed and this data will be utilized to determine the actions necessary to achieve that reduction.

Tables 2 through 5 provide a summary of the existing loads, TMDLs and reductions needed to comply with the water quality standards.

Table 2. Humboldt River - Summary of pollutants of concern, water quality standards, calculated flow rates, and the calculated TMDL

REACH	POLLUTANT	STANDARD (mg/l)	AVERAGE FLOW RATE (cfs)	TMDL (lbs/day)
Palisade	Phosphorus	A.A. ≤ 0.10	790	426
	TSS	S.V. ≤ 80		340,901
Battle Mtn	Phosphorus	A.A. ≤ 0.10	758	409
	TSS	S.V. ≤ 80		327,092
Comus	Phosphorus	A.A. ≤ 0.10	727	392
	TSS	S.V. ≤ 80		313,715
	TDS	A.A. ≤ 500		1,960,719
Imlay	Phosphorus	A.A. ≤ 0.10	657	354
	TSS	S.V. ≤ 80		283,509
	TDS	A.A. ≤ 500		1,771,929

Notes
A.A. = annual average
S.V. = single value

Table 3. Humboldt River - Load allocations, existing loads and required reduction to meet water quality standards

REACH	POLLUTANT	EXISTING CONCENTRATION (mg/l)	EXISTING LOAD (lbs/day)	TMDL or LOAD ALLOCATION (lbs/day)	REDUCTION REQUIRED (lb/day)
Palisade	Phosphorus	0.12	511	426	85
	TSS	315.17	1,343,021	340,901	1,002,120
Battle Mtn	Phosphorus	0.16	654	409	245
	TSS	321.73	1,315,442	327,092	988,350
Comus	Phosphorus	0.18	706	392	314
	TSS	381.83	1,497,323	313,715	1,183,608
	TDS	550	2,156,791	1,960,719	196,072
Imlay	Phosphorus	0.15	461	354	107
	TSS	315	850,703	283,509	567,194
	TDS	467	1,654,982	1,771,929	No reduction in load required at this time

Table 4. Walker River - Summary of pollutants of concern, water quality standards, calculated flow rates, and the calculated TMDL

REACH	POLLUTANT	STANDARD (mg/l)	AVERAGE FLOW RATE (cfs)	TMDL (lbs/day)
E. Fork above Yerington (Nordyke E. Station)	TSS	S.V. ≤ 80	300	129,456
Inlet to Weber Reservoir (Mason Station)	TSS	S.V. ≤ 80	279	120,394

Notes
S.V. = single value

Table 5. Walker River - Load allocations, existing loads and required reduction to meet water quality standards

REACH	POLLUTANT	EXISTING CONCENTRATION (mg/l)	EXISTING LOAD (lbs/day)	TMDL or LOAD ALLOCATION (lbs/day)	REDUCTION REQUIRED (lb/day)
E. Fork above Yerington (Nordyke E. Station)	TSS	107.51	173,973	129,456	44,517
Inlet to Weber Reservoir (Mason Station)	TSS	62.97	94,765	120,394	Although 9 of 33 samples (27%) exceeded the standard, the average of all the samples was less than the standard