EPA-APPROVED

TOTAL MAXIMUM DAILY LOAD (TMDL)
FOR THE
RIO RUIDOSO

DECEMBER 13, 2016

3.0 PLANT NUTRIENTS AND TOTAL PHOSPHORUS

Level I and Level II nutrient assessments were conducted on waterbodies in the Sacramento Mountains in 2012. Detailed assessment of various water quality parameters indicated plant nutrient impairment in two portions of the Rio Ruidoso: US Hwy 70 to Carrizo Creek and Eagle Creek to US Hwy 70. Assessment of water quality data indicated total phosphorus impairment for the Rio Ruidoso (Carrizo Creek to Mescalero Boundary) assessment unit. A TMDL for plant nutrients was developed in 2006 for the Rio Ruidoso (Rio Bonito to US Hwy 70) assessment unit; the plant nutrients TMDL for Rio Ruidoso (Eagle Creek to US Hwy 70) in this document serves as a revision to the 2006 TMDL.

SWQB is revising the 2006 TN and TP TMDLs for the Rio Ruidoso based on additional data collection, new nutrient and critical flow analyses, and to re-evaluate the wasteload allocation for the NPDES permit for the City of Ruidoso Downs and Village of Ruidoso Wastewater Treatment Plant (NM0029165). This revised TMDL is based on the same in-stream targets used in the previous 2006 TMDL (0.1 mg/L TP and 1.0 mg/L TN); however the critical flows in the revised TMDL are estimated using more recent streamflow data (2004-2015). Furthermore, the critical flow for nutrients was re-evaluated and determined to be the average annual median flow because of the long term growth cycle of algae in response to excess nutrients, in contrast to protecting for acute toxicity using the 4Q3 (see Section 3.2 for more information). Therefore, comparison of the 2006 TMDL with this revised TMDL should be done with caution as several parameters have changed the calculations and subsequent allocations. SWQB staff will conduct routine monitoring in the Rio Ruidoso watershed in 2021-2022, assess the new data in 2023, and revise the TMDL if necessary at that time.

To address concerns about reasonable assurance and questions that were raised during the first public review period in 2014 as well as USEPA reviews, SWQB is also taking a watershed approach to this revised TMDL to account for upstream contributing areas. This type of approach allows for calculation of a watershed-wide TMDL and better accounting of the incoming nutrient loads and allowable loading in the impaired sub-watersheds. By using this approach, point and nonpoint sources throughout the watershed are accounted for and can be appropriately targeted through the implementation process. Additional information about reasonable assurance is included in Section 5.0.

3.1 Target Loading Capacity

There are two potential causes of nutrient enrichment in a given stream: excessive phosphorus and/or nitrogen. Phosphorous is found in water primarily as orthophosphate. In contrast nitrogen may be found as several dissolved species, all of which must be considered in nutrient loading. Total nitrogen is defined as the sum of nitrate+nitrite (N+N), and Total Kjeldahl Nitrogen (TKN). At the present time, there is no USEPA-approved method to test for total nitrogen, however adding the results of USEPA methods 351.2 (TKN) and 353.2 (N+N) is appropriate for estimating total nitrogen (APHA 1989).

The intent of nutrient criteria, whether numeric or narrative, is to limit nutrient inputs in order to control the excessive growth of attached algae and higher aquatic plants. Controlling algae and plant growth preserves aesthetic and ecologic characteristics along the waterway. While conceptually there may be a number of possible combinations of total nitrogen (TN) and total

phosphorus (TP) concentrations that are protective of water quality, the application of simple chemical limitation concepts to a complex biologic system to determine these combinations is challenging. One of the primary reasons for this is that different species of algae and higher aquatic plants will have different nutritional needs. Some species will thrive in nitrogen limited environments while others will thrive in phosphorous limited environments. Because of the diversity of nutritional needs amongst organisms, numeric thresholds for both TN and TP are required to preserve the aesthetic and ecologic characteristics along a waterway. Focusing on one nutrient or trading a decrease in one for an increase in the other may simply favor a particular species without achieving water quality standards (USEPA 2012).

New Mexico has a narrative criterion for plant nutrients set forth in Subsection E of 20.6.4.13 NMAC:

> ***Plant Nutrients:*** *Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in the dominance of nuisance species in surface waters of the state.*

This narrative criterion can be challenging to assess because the relationships between nutrient levels and impairment of designated uses are not defined, and distinguishing nutrients from "other than natural causes" is difficult. Numeric thresholds are necessary to establish targets for TMDLs, to develop water quality-based permit limits and source control plans, and to support designated uses within the watershed. Therefore, SWQB, with the assistance from EPA and the USGS, developed nutrient-related thresholds, or *narrative translators*, to address both cause (TN and TP) and response variables (dissolved oxygen [DO], pH, and periphyton chlorophyll *a*). Water quality assessments for nutrients are based on quantitative measurements of these causal and response indicators. If these measurements exceed the numeric nutrient threshold values, indicate excessive primary production, and/or demonstrate an unhealthy biological community, the reach is considered impaired (NMED/SWQB 2015a). The applicable threshold values for cause and response variables in the Rio Ruidoso watershed are shown in **Table 3.1**. These threshold values were used for water quality assessments and as a starting point for TMDL development.

Table 3.1 Applicable nutrient-related thresholds for the Rio Ruidoso watershed

Ecoregion	23-Arizona/New Mexico Mountains
WQS segment	20.6.4.208, 20.6.4.209
Aquatic Life Use	Coldwater, High Quality Coldwater
Total Phosphorus	< 0.1 mg/L[(a)]
Total Nitrogen	≤ 0.25 mg/L[(b)]
Dissolved Oxygen	≥ 6.0 mg/L[(c)]
pH	6.6 – 8.8[(c)]
Chlorophyll *a*	5.8 – 11.0 µg/cm^2 [(b)]

Notes: *(a)* Segment-specific TP criterion in 20.6.4.208 and 20.6.4.209 NMAC.
(b) Threshold value for Ecoregion 23.
(c) Criteria for coldwater and high quality coldwater aquatic life uses.

For this TMDL the target value for TP is the segment-specific TP criterion of 0.1 mg/L (20.6.4.208 and 20.6.4.209 NMAC); however, in recommending a TN target for this TMDL, a 10:1 ratio of TN:TP was determined to be appropriate. With a segment-specific TP standard of 0.1 mg/L, the corresponding TN TMDL target is 1.0 mg/L. Documentation in support of the 10:1 ratio include regional studies from the Rocky Mountain West (see discussion below) as well as site-specific data from the Rio Ruidoso.

A nutrient ratio of 10:1 is consistent with other recently adopted nutrient limits in the Rocky Mountain West and NMED's ecoregion-based nutrient thresholds for the state of New Mexico**.** Colorado and Montana are two Mountain West states that have recently adopted numeric TN and TP standards. Colorado adopted interim nutrient limits which have a TN:TP ratio of 11.4 and 11.8 for warm and cold water streams and rivers, respectively (Colorado Department of Public Health and Environment 2013). Montana's nutrient standards have TN:TP ratios that range from 2.4 to 13.3, with an average ratio of 7.6 (Montana Department of Environmental Quality 2014). Finally, New Mexico specific TN:TP ratios calculated from the nutrient thresholds developed using regional data range from 5.5 to 13 with an average of 10.2 (NMED/SWQB 2015a). Of particular note, the Rio Ruidoso is located within the Arizona/New Mexico Mountain Ecoregion. The ratios of nutrient thresholds for this ecoregion are 12.5 for coldwater systems and 5.8 for warmwater systems. The Rio Ruidoso is located in a transitional zone between these systems, with segment 20.6.4.209 designated high-quality cold water and segment 20.6.4.208 designated coldwater with a segment specific criterion of 30°C. The ratios of TN and TP thresholds in the *Refinement of Stream Nutrient Impairment Thresholds in New Mexico* report (NMED/SWQB 2016b) are 10 for steep sites and 8.4 for flat-moderate sites.

A nutrient ratio of 10:1 is also supported by site specific data collected on the Rio Ruidoso. The water quality data collected by SWQB during the 2012 survey indicate that the stream is impaired, but marginally. A review of 26 stream samples (**Table 3.2**) collected above and below the Highway 70 bridge during the summer period (July through September) when biological productivity is greatest, found that concentrations averaged above the TMDL targets of 1.0 and 0.1 mg/L for TN and TP, respectively, whereas the median values are just below these targets. Both average and median values produce ratios near 10:1. This is a strong indication that these targets based on the 10:1 ratio are protective of water quality in the Rio Ruidoso.

Table 3.2 2012-2014 Rio Ruidoso water quality data statistical summary

	TN (mg/L)	TP (mg/L)	TN:TP Ratio
Average	2.09	0.54	14.2
Median	0.69	0.09	10.4
Maximum	10.12	3.11	60
Minimum	0.30	0.005	3.25
Sample size (n)	26	26	22

These results are consistent with an algal growth assay study conducted in 2002 by UNM (under contract from NMED). This study examined the effect of phosphorus and nitrogen additions on algal mass for river waters from three sites (**Table 3.3**) on the Rio Ruidoso (**Appendix D**).

Table 3.3 2002 Algal Bioassay sites

Site number	Site Name
I	Rio Ruidoso @ Mescalero Boundary west of Ruidoso – Upper Canyon Road
II	Rio Ruidoso @ NM mile marker 267.5 (HWY 70), below WWTP
III	Rio Ruidoso abv. site on Susan Lattimer's property

In all three water samples, algal growth was increased by the addition of nitrogen indicating that nitrogen is the primary limiting nutrient in the Rio Ruidoso and is driving the productivity of algae and macrophytes in the stream. Two examples of the responses are shown in **Figures 3.1 and 3.2**. Phosphorus addition alone did not increase algal growth but did increase growth when added along with nitrogen. Therefore, the algal growth assay suggests that to ensure that the narrative WQS are met, land use and/or point source management activities should avoid any increased inputs of nitrogen as well as nitrogen and phosphorus combinations.

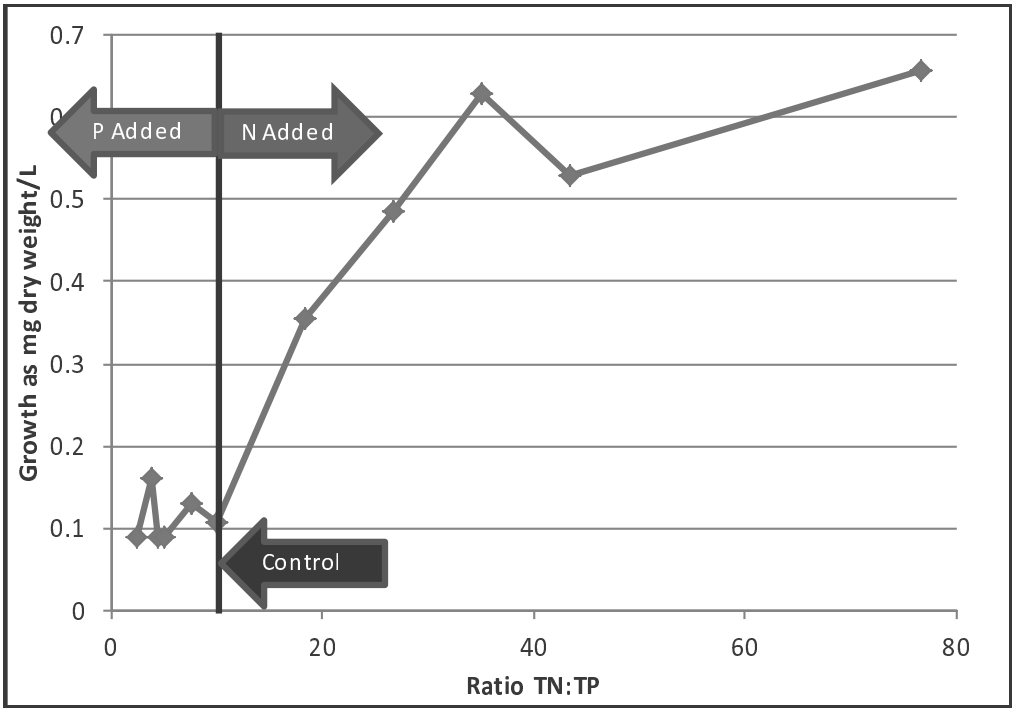

Figure 3.1 2002 Algal Growth Assay at Site I