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MEMORANDUM

This memorandum is in response to the State Water Resources Control Board's (SWRCB) request for information and data regarding water quality conditions in surface waters of California. Specifically it addresses data and information pertaining to the decision by the U.S. EPA (EPA) to include the Laguna de Santa Rosa on the 2002 303(d) list as impaired for phosphorus despite the SWRCB's decision to place the Laguna on the monitoring list for further study. We recommend that the City of Santa Rosa (City) request reassessment of the listing of the Laguna as impaired for phosphorus for the reasons listed below.

- The decision to list the Laguna as impaired for both phosphorus and nitrogen came about because the Regional Water Quality Control Board (Regional Board) is concerned about dissolved oxygen levels in the Laguna. Nutrients can affect oxygen through stimulation of algae, which deplete oxygen at night when not photosynthesizing, and upon their death and decomposition. However, the link between algae and dissolved oxygen depletion in the Laguna has never been substantiated. Chlorophyll *a* data in the Laguna are limited in number and spatial extent. In fact, according to the Regional Board, "the cause of the low dissolved oxygen levels is not certain." (North Coast Regional Water Quality Control Board November 16, 2001 303(d) List Update Recommendations (Staff Recommendations)). Other factors may be causing the low dissolved oxygen. For example organic loading contributes to the oxygen deficit, but organic loading, like algal biomass, has not been adequately studied.
- Even if algae were controlling oxygen in the Laguna, phosphorus is not the algal-growth limiting nutrient in the Laguna. The Staff Recommendations point out that data show that *nitrogen* - - and not phosphorus - - is the limiting nutrient in the Laguna. The ratio of bioavailable N to P is an indication of which nutrient is limiting in an aquatic system. Figure 1 shows the ratio of N to P in the Laguna for data collected by the Regional Board as part of its nitrogen TMDL monitoring that is the basis for the Regional Board staff's conclusion that nitrogen is the likely limiting nutrient in the Laguna. These data were collected in the Laguna at Stony Point, Occidental, Guerneville, and Trenton Healdsburg roads and are presented in Appendix A. Since the TMDL monitoring program is no longer active, no samples have been collected since November 2000. However, the City collects nitrogen and phosphorus data as part of its NPDES discharge permit compliance monitoring. Nutrient data collected during the discharge season between December 1995 and March 2004 are available and are also shown in Figure 1. These data are monthly averages of samples collected weekly during the discharge season and are presented in Appendix B. The NPDES data are summarized for all Laguna stations where measurements were made and were collected between the Laguna at Llano Road and the confluence of the Laguna and Santa Rosa Creek. Lee et al. (1980) found that for a wide variety of aquatic habitats, a good estimate of the bioavailable phosphorus is given by the sum of the dissolved orthophosphate and 0.2 x the particulate phosphorus in a water

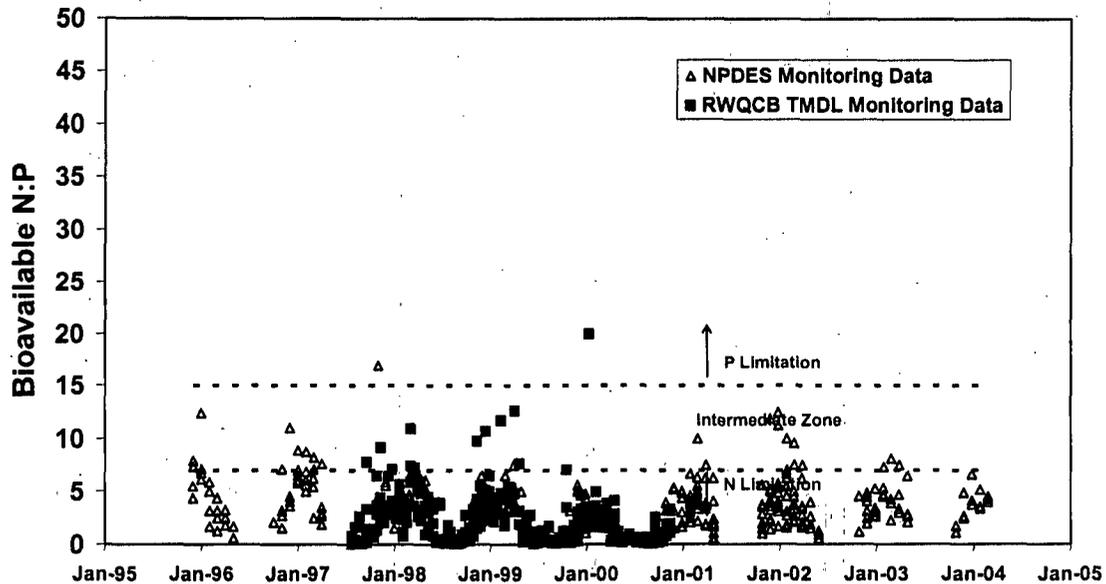
Limiting agent - agent that
is completely consumed

$\frac{\text{Total Inorganic N}}{\text{Total Phos}}$

sample. For both the Regional Board data set and the NPDES data set, total phosphorus was measured, but dissolved P was not. However, based on 82 pairs of total and dissolved P in water samples collected at Laguna stations in 1993-1999, the dissolved orthophosphate averaged 76% of total P. Assuming 76% of P is dissolved, bioavailable P is estimated as $0.8 \times \text{total P}$ (see Roth 2001). The ratio of bioavailable N:P from the two data sets are calculated as $\text{TIN} \div 0.8 \text{ TP}$. These results are shown in Figure 1, which shows that the ratio of bioavailable N:P is usually less than 7, which indicates that nitrogen, not phosphorus, is the nutrient limiting algal growth in the Laguna de Santa Rosa.

Since the NPDES N:P ratios shown in Figure 1 are derived from monthly averages, an evaluation was conducted to determine N:P ratios determined from monthly averaged nitrogen and phosphorus data are representative of N:P ratios from individual measurements. The individual sample data for 2003 (N= 101 samples) were used to calculate individual N:P ratios for comparison to the monthly average values. These data are provided in Appendix C. The average of these individual N:P ratios was 4.4 with a 99 percent confidence interval of ± 0.8 compared to the average of the monthly average N:P ratios for the same period of 3.9. No statistically significant difference exists between the monthly and the daily data (Mann Whitney Rank Sum test $p = 0.683$). In addition, the NPDES average data track quite well the TMDL data which are not averages. Therefore, the N:P ratios based on monthly average values are representative of nutrient conditions in the Laguna.

Figure 1. Ratio of Bioavailable N:P
Laguna de Santa Rosa Stations 1995-2004



- In recent years, *Ludwigia* has increased in abundance in the Laguna. This is problematic due to the difficulty of controlling mosquito larvae in areas where *Ludwigia* is particularly abundant. Nutrients also potentially limit growth of plants such as *Ludwigia* that obtain nutrients from the water column and the sediment. According to Lars Anderson (USDA ARS Exotic and Invasive Weed Research, Weed Science Program), nitrogen is the most important factor to control *Ludwigia* "He [Lars Anderson] also said eliminating as many of the nitrogen pollution sources as possible was crucial. ... "the \$10 answer would be, nitrogen, nitrogen, nitrogen," said Anderson." " (Sonoma West January 20, 2003). Other factors such as low flow in the Laguna in recent years due to drought conditions also may be controlling or contributing to the control of *Ludwigia* abundance.
- More study is needed to determine whether elevated phosphorus in the Laguna is the cause of the low dissolved oxygen and increased *Ludwigia* abundance and whether reducing phosphorus will result in improving dissolved oxygen and controlling *Ludwigia* in the Laguna. Without these additional studies, placing the Laguna on the 2002 303(d) List for phosphorus could result in significant

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economic impacts to the ratepayers of Santa Rosa with no known or reasonably expected environmental benefits. The SWRCB recognized the merit of these arguments, and decided to place the Laguna on the 2002 Monitoring List for phosphorus. These studies are a necessary first step to determine whether phosphorus reduction is necessary.

- Despite the State's well-founded decision to place the Laguna on the 2002 303(d) monitoring list for phosphorus, the EPA overruled the State's decision and placed the Laguna on the 2002 303(d) list as impaired for phosphorus. The EPA's review of California's 2002 Section 303(d) List presented the EPA's rationale for listing the Laguna for nutrients. We have reviewed the analysis, and disagree with the U.S. EPA's analysis for the following reasons:

1. The EPA review concludes that "the nitrogen and phosphorus levels found in the Laguna far exceed the levels associated with excessive aquatic growths that can adversely affect beneficial uses, and that the Basin Plan narrative water quality standard for biostimulatory substances is violated." While this statement may be true in the abstract, to our knowledge, little or no information about the levels of aquatic growths in the Laguna is available. There is no information presented in the EPA review to substantiate this statement.
2. EPA's decision to overrule the State Board was based on EPA's erroneous application of nitrogen and phosphorus criteria (1 mg/L and 0.1 mg/L, respectively) that EPA claimed is required to protect the Laguna. These criteria are inappropriate for the following reasons:
 - EPA justifies the use of the 1 mg/L criterion for nitrogen by reference to the nitrogen objective (1 mg/L) included in the San Diego Regional Basin Plan. However, this objective was developed by taking a 1970's recommendation for phosphorus of 0.1 mg/L and applying a 10:1 N:P ratio, resulting in the N objective of 1 mg/L. The P recommendation is presumably the EPA's "Red Book" recommendation and is outdated and not based on region-specific, let alone waterbody-specific, information. Similarly, EPA's application of a 10:1 N:P ratio to derive a standard does not take into account region-specific information. We have taken site-specific information into account when application of the N:P ratio, and site-specific information indicates that phosphorus is not limiting algal growth (see above).
 - EPA's decision to overrule the State Board also relies upon the nitrogen and phosphorus targets in the Malibu Creek TMDL document (U.S.EPA 2003).
 - The Malibu Creek TMDL document states that various nutrient standards, including the San Diego Regional Board standard, "have

little predictive power in explaining the patterns in algal abundance or biomass within the Malibu Creek watershed". The Malibu Creek TMDL document also indicates "uncertainty as to what factors control algal abundances in the Malibu Creek watershed. ... Therefore, when establishing a numeric target to control algal biomass and chlorophyll *a* concentrations, it is important to consider the factors limiting algal growth. No single study element was identified as the factor most likely limiting algal growth. ... However, it is anticipated that the limiting condition will be determined prior to full implementation of these TMDLs. ... After these determinations, the Regional Board may need to revise these TMDLs." Therefore, EPA (in the Malibu Creek TMDL document) acknowledged the criteria (which were also applied by the EPA to list the Laguna) were applied despite a lack of information to assess whether they were correct, and that the TMDL targets may need to be revised based upon site-specific information.

- The EPA review also cites as support for the reasonableness of both the nitrogen and phosphorus criteria Dodds and Welch (2000).
 - Dodds and Welch (2000) state " ...so many factors are related to DO depletion rates, existing data for most streams are insufficient to develop nutrient criteria for avoiding DO deficits. . . . As more data become available, it will be possible to directly link frequency and severity of low DO events with nutrient loading."
 - The various standards Dodds and Welch (2000) provides for controlling benthic chlorophyll *a* were derived from data collected from temperate streams throughout the world and thus may not be applicable to streams in semiarid regions such as the Laguna. In temperate climates, rain falls for much of the year and is rarely torrential, resulting in more continuous vegetative ground cover and in little natural soil erosion. Regions with semiarid climates have fewer, often larger storms and less continuous ground cover. The main natural source of nitrogen in all watersheds is rainfall, and the main natural source of phosphorus is soil erosion. Thus rivers in semiarid climates tend to have excess phosphate and to be nitrogen-limited, while those in temperate climates have excess nitrate and tend to be phosphorus-limited. (Horne and Goldman, 1994. *Limnology*)
 - Additionally, Dodds and Welch (2000) state "[m]oreover, a large amount of the variance in benthic chlorophyll levels in streams is not related to nutrient levels." They also conclude that "a significant

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amount of monitoring data are necessary to refine recommendations for nutrient criteria," including seasonal means and maxima for benthic and planktonic chlorophyll *a*, associated water column nutrients and diurnal DO concentrations. These are the sorts of data would likely be collected in the study on the Laguna that the City of Santa Rosa has proposed to conduct.

The draft Water Quality Control Policy For Developing California's Clean Water Act Section 303(d) List (303(d) Policy) provides the following factors for placement or removal of water segments on the list:

1. Numeric Water Quality Objectives and Criteria for Toxicants in Water
2. Numeric Water Quality Objectives for Conventional or Other Pollutants in Water
3. Numerical Water Quality Objectives or Standards for Bacteria Where Recreational Uses Apply
4. Health Advisories
5. Bioaccumulation of Pollutants in Aquatic Life Tissue
6. Water/Sediment Toxicity
7. Nuisance
8. Adverse Biological Response
9. Degradation of Biological Populations and Communities

EPA invoked factors 2 (Numeric Water Quality Objectives for Conventional or Other Pollutants in Water) and factor 7 (Nuisance from excessive plant growth) in its decision to place the Laguna on the 303(d) list. The draft 303(d) policy states that, for excessive algae growth, a water segment should be placed on the list if acceptable nutrient-related numeric criteria are exceeded. As discussed above, no numeric criterion yet exists for phosphorus in the Laguna. Therefore, under the proposed policy, the Laguna could not be listed as impaired for phosphorus. Since no evidence exists to indicate lowering phosphorus concentrations will improve water quality conditions in the Laguna, the Laguna should be de-listed for phosphorus.

SUPPLEMENTAL DATA NECESSARY TO ENABLE THE SWRCB TO CONDUCT A COMPLETE REASSESSMENT

The supplemental information provided here are for the NPDES data collected by the City since the State presumably has information for the RWQCB data.

Name of the person or organization providing the information:

City of Santa Rosa

PO Box 1678

Santa Rosa, CA 95402

Mailing address, phone number, and email address of a contact responsible for answering questions about the information submitted:

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industrial service supply, contact water recreation, non-contact water recreation, commercial and sport fishing, cold freshwater habitat, wildlife habitat,

Complete background information (metadata) for field data (i.e., when and where measurements were taken, number of samples, detection limits, etc.):

See Appendices A, B and C.

Full identification of any citizen volunteer water quality monitoring efforts:

N/A

Data quality assurance assessment(s):

The Laguna Environmental Laboratory is an ELAPHE certified laboratory. No reason exists to think the data would not be of high quality.

Spatial representation:

Data come from a variety of locations in the Laguna from the Laguna at Stony Point Road to the Laguna at Trenton Healdsburg Road.

Temporal representation:

TMDL data were collected throughout the year. NPDES data were collected during the discharge season (October 1 through May 14)

Age(s) of the data:

Data were collected December 1995 through March 2004.

Effects of seasonality:

The data in Figure 1 indicate that the N:P ratio tends to be lower in the summer.

Effects of any events that might influence data evaluation (e.g., storm events, flow conditions, laboratory data qualifiers, etc.):

No laboratory qualifiers are known that might influence the data evaluation. Although environmental events such as storms can influence data, a large data set such as that provided with the NPDES data will cover most environmental conditions and not be skewed by a single type of environmental condition. The exception to this is that, as noted above, the NPDES data were collected only during the discharge season.

The total number of samples:

The TMDL data consist of 318 N:P ratios, the NPDES data consist of 217 N:P ratios.

The number of samples exceeding standards:

No standards exist for N:P ratios. However, only two of the ratios (out of 535) fall within the phosphorus limitation range.

The source or reference for samples:

The TMDL samples were collected by the North Coast RWQCB. The NPDES samples were collected and analyzed by the City of Santa Rosa's Laguna Environmental Laboratory.

The potential sources of pollutants

Internal nutrient cycling, point and nonpoint sources such as wastewater discharge, agricultural and urban runoff.

Any program that might address the water quality problem in lieu of a TMDL.

More study is needed to determine whether elevated phosphorus in the Laguna is the cause of the low dissolved oxygen and *Ludwigia* growth and whether reducing

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Bibliographic citations for all published information provided

Dodds and Welch. 2000. *Establishing Nutrient Criteria in Streams*. J. North. Am. Benthol. Soc. 19(1): 186-196.

Horne and Goldman, 1994. *Limnology*. McGraw Hill, Inc.

Lee, G.F., R.A. Jones, and W. Rast. 1980. Availability of phosphorus to phytoplankton and its implications for phosphorus management strategies. P. 259-308, *In*: "Phosphorus Management Strategies for Lakes," Ann Arbor Science Publishers, Inc.

Roth, J.C. 2001. Comments on Proposed 303(d) listing for Laguna de Santa Rosa. Letter dated 10/5/2001 submitted to the NCRWQCB (reference #118 in North Coast Region Water Quality Control Board 303(d) List Update Recommendations November 16, 2001).

EPA. 2003. Total Maximum Daily Loads for Nutrients: Malibu Creek. EPA Region 9.

To the extent possible, all information should be submitted in electronic format:

Data provided in the Appendices will also be provided electronically.

Detailed quality assurance and quality control information about sampling and analysis of all numeric data:

The quality assurance manual for the Laguna Environmental Laboratory who collected and analyzed the samples is found in Appendix D.

Water body name and California water body identification number.

Laguna de Santa Rosa, California Watershed number 11421020

Geographic extent of the potential water quality limited segment:

The entire Laguna from the headwaters to the confluence with the Russian River is on the 303(d) list.

Pollutant(s) of concern:

phosphorus

Applicable water quality objective or criterion:

Biostimulatory substances – waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause a nuisance or adversely affect beneficial uses.

Comparison of results against applicable water quality objective or criterion:

N/A

Designated beneficial use(s) that may be impacted by pollutant(s):

Phosphate does not directly impact any beneficial uses. However, if the phosphate results in a substantial increase in aquatic plant biomass, the resulting low dissolved oxygen and filter clogging can impact the following beneficial uses: agricultural supply,

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phosphorus will result in improving dissolved oxygen in the Laguna and reducing *Ludwigia*. Without these additional studies, having the Laguna on the 303(d) List for phosphorous could result in massive economic impacts to the ratepayers of Santa Rosa with no known or reasonably expected environmental benefits. Santa Rose has a long history of taking responsibility when necessary to address actual or suspected water quality problems. Should the Board remove phosphorus from the 303(d) list and place it on the monitoring list, the City is prepared to fund and perform a study necessary to help evaluate if phosphorus is adversely affecting water quality and thus should be moved from the monitoring list to the 303(d) list.