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Friends of the Russian River
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SHOULD BE 2005

3 December, 2003

Arthur G. Baggett, Jr., Chair and Members
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Subject: Comments Regarding Proposed 303(D) Listings For Santa Rosa-Area Waters

Dear Chairman Baggett and Members:

I have reviewed several comments forwarded to your committee regarding recommendations by the North Coast Regional Board Staff to include phosphate on the 303(D) list update for the Laguna de Santa Rosa. I have had the opportunity to exhaustively review extant data on phosphate pollution in the Laguna and am enclosing a report that I prepared for the City of Santa Rosa under contract. I am forwarding this report to you along with another study I conducted for the City on nutrient elimination from treated wastewater discharged to an innovative subsurface irrigation system at a redwood grove on the Sonoma State University Campus.

Both of these reports relate to lobbying efforts by the City to have your board rescind the well overdue listing of the Laguna for nutrients, especially phosphate. The Laguna Phosphate study I am forwarding is comprehensive and requires a thorough review by your agency, however the following points summarize the most important findings.

1. The Laguna de Santa Rosa has consistently exhibited phosphate concentrations that exceed all but a few fresh water bodies in the United States. Typical readings range from 1000-2000 ug/L where, as acknowledged by the City's consultant, the EPA criterion is 100 ug/L. The EPA criterion is based on widely accepted classifications of trophic states defining Oligotrophic (the likely original pre-civilization state of the Laguna) at <20 ug/L phosphate; mesotrophic at 20-80 ug/L; and eutrophic at >80 ug/L phosphate. Concentrations greater than

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100 ug/L are generally classified as hypertrophic, with the Laguna falling at almost 10-20 times the level that the EPA considers as heavily phosphate laden.

2. The EPA clearly and strongly states that of the nutrients nitrogen and phosphate only phosphate is "controllable". This is because nitrogen will be loaded to phosphate enriched waters from atmospheric sources when dissolved nitrate becomes unavailable. While atmospheric nitrogen oxides from local urbanized sources are significant, the most important nitrogen loading factor results from changes in the algal community from green algae and diatoms, the typical organisms in unpolluted water, to blue-green algae and cyanobacteria. This is because these organisms fix nitrogen from the atmosphere providing them with a competitive advantage where dissolved nitrate becomes depleted. Blue-green algae often are toxic and are used as indicators of pollution by virtually all regulatory agencies.

3. Compilations of nutrient readings in the extant data, both NCRWQCB and City of Santa Rosa, exhibit a very high correlation, significant at the 0.01 level of confidence, between phosphate and both chlorophyll or algal cell count. No correlation exists between either nitrate or ammonia with plant growth measured as above. This demonstrates that nitrate and ammonia are transient compounds taken up rapidly from the water by algae, but new sources of nitrogen from the atmosphere are readily available as long as phosphate is available.

The existence of a high correlation between total nitrogen incorporated in the plant tissue and both phosphate and algal cell count shows further that nitrogen from the atmosphere is directly taken up by the plants as long as phosphate exists to fuel cell growth.

4. In over 95% of upstream - downstream sampling at Santa Rosa Subregional System release points there is a significant and measurable increase in phosphate concentration. Total phosphorus load, based on flow and concentration in the releases is often within the range to suggest the City's releases are the predominant, even sole, source of the elevated levels.

5. Laboratory bench scale experiments cited by the City of Santa Rosa purport to show nitrogen limitation in these waters. However, these experiments were poorly designed and have no relevance to conditions in the field since they eliminated the sources of atmospheric nitrogen that would be available in field conditions. In these trials water samples were isolated from the Laguna and the algal population was allowed to grow in closed containers. Nitrogen was used up first, which was to be expected since levels of phosphate in these samples are far in excess of any normal N:P balance due to excessive phosphate loading. Because no extraneous sources of nitrogen were allowed in to these laboratory samples, no nitrogen fixation existed to act as a continuous supply. Consequently phosphate remained as unutilized. This condition does not occur in the Laguna since natural pathways allow a steady supply of atmospheric

nitrogen to the algal community through algal fixation and loading of nitrogen oxides. The excess phosphate therefore remains biologically available and algal blooms can reach phenomenal concentrations.

6. The City is proud to credit the nitrogen removed from the effluent in the treatment plant through denitrification to their account. This is misguided for the following reason. In natural systems the ratio of carbon to nitrogen to phosphorus is approximately 100:10:1. In the circumstance of Santa Rosa this means that even though a good deal of the nitrogen is removed during treatment, the release of every 1 lb. of phosphorus in the effluent stimulates fixation of 10 lbs. of nitrogen downstream due to growth of nitrogen fixing alga and bacteria. At the phosphate concentration cited for the City's effluent, approximately 2000 ug/L in 20 MGD of effluent, the city typically releases about 330 lbs of phosphate per day, as P, to the Laguna. This would stimulate a downstream load of approximately 3300 lb. of N into the Laguna. This is very close to the amount removed in the plant during denitrification. Assuming the plant receives 20 MGD of influent with approximately 30 mg/L of ammonia (as N) the plant receives 4950 lbs of N per day. Denitrification removes about 2/3 of that in the plant so approximately 3316 lbs. of N are removed by the plant each day. This is strikingly similar to the calculated amount of 3300 lbs. of N that the residual phosphate would cause to be recaptured from atmospheric sources. **In effect, the City has no nitrogen reduction program since they neglect to control phosphate. They should not receive any credit for nitrogen reduction in their TMDL until they also reduce phosphate.**

7. Sediment stores of phosphate in the Laguna are the primary point of relese to the water column during the summer growing period. Phosphate is bound to fine clay sediments. The City of Santa Rosa releases the largest portion of phosphate enriched wastewater in winter when fine sediments are prevalent in the water column where they act as foci for adsorption. This occurs when flows in the Russian River are high, backing up the Laguna so the phosphate enriched sediments can settle out. Summer release of phosphate is exacerbated when oxygen tension at the bottom approaches zero and phosphor becomes soluble. This sets in motion a positive feedback loop of ever worsening algal hypertrophy as increasing blooms lead to increased dark period O_2 depletion that then solubilizes more phosphorus. Nitrogen is never limiting because diminished dissolved nitrate favors nitrogen fixing algal species that readily capture it from the atmosphere.

Proposals to release the effluent directly into the main stem of the Russian River near Healdsburg would not address the issue. Every small bend or pool in the river would capture adsorbed phosphates in the sediments since it is virtually impossible to remove all of the suspended clays in the river during winter flows. At the same time, proposals to pump the effluents to a closed system like Lake Sonoma would have a disastrous effect on water quality, likely resulting in a water body similar to Clear Lake which has astronomical concentrations of algae.

8. The only biologically relevant DO readings in the Laguna are those taken between midnight and dawn. Algal blooms produce supersaturation with DO to as high as 20-30 mg/L during full sunshine because of excess photosynthesis. This is a transient reading with a rapid loss of this oxygen to the atmosphere as photosynthesis proceeds. Water can only hold about 7 mg/L at the temperatures typical of the Laguna. The supersaturation of oxygen reflects the excessive production of algal biomass. This same biomass respires at night, consuming very nearly the same amount of oxygen that the algae produced during the day. Unfortunately most of that oxygen escaped into the atmosphere because it is in excess of the 7 mg/L that the water can hold in dissolved form. As a consequence the algae remove virtually all of the oxygen during the night. My own readings in the Laguna have consistently shown that DO drops to near zero in most locations in the Laguna during the summer bloom period if measured just before dawn.

Presenting DO readings as averages over the course of a day has no biological validity. Ten minutes of zero oxygen in the predawn will kill aquatic animals that have lived for 23 hours and 50 minutes in saturated conditions. The only biologically valid reading for DO is the **minimum** tension experienced in a day since that reflects the bottleneck that animals must pass through to survive.

8, The City's sampling of subsurface water in their irrigation fields shows that virtually all of the phosphate applied to land through irrigation is sequestered by the soils and never reaches the Laguna .

The City should be recognized for the great strides it has made in managing their wastewater over the past 30 years. The single most important component of this is their implementation of an extensive land application system that reclaims virtually all of their wastewater during the summer months. The State Water Resources Board, as early as 1970 identified the summer releases of phosphate by the City as the single most important source of pollution to the Russian River. There can be no doubt that the cause of the improvements to the Russian River during the 70's, 80's, and 90's was due to the land application program and its dramatic uptake of the nutrients that otherwise would have reached the Laguna.

I have included in this letter a paper I presented to the Annual Symposium of the California Water Environment Association that documents the tremendous level of nutrient reduction the City achieved at the Redwood irrigation site at SSU. More important was the fact that this system showed that Santa Rosa could irrigate year around if they were to utilize subsurface forest irrigation in addition to their summer pasture irrigation program.

The State Water Quality Control Board should recognize that Santa Rosa has no justification for requesting relaxation of standards that your own regional staff has assiduously worked towards. The City has already implemented pilot scale

projects proving the viability of systems that could allow it to virtually eliminate loading of the critical nutrient phosphorus.

It is unconscionable for the City to continue to fly in the face of literally the entire scientific community in their denial of the essential need for phosphate control. The persistence of their supposedly scientifically literate consultants in supporting this absurd position suggests that the Santa Rosa ratepayers, City council and PUC, as well as the regulatory agencies receiving these consultant comments, are being defrauded by these same consultants. It is well past time for your board to support positions presented to you by staff members at the Regional Boards who have proven over and again a level of competence and responsibility sorely lacking in the City of Santa Rosa's counterparts. The recommendation to list phosphate as a non-compliant nutrient by your board is essential to finally restoring water quality in that body.

Respectfully,

Daniel E. Wickham, Ph.D.
President, Friends of the Russian River and Russian Riverkeeper Program