City of
Santa Rosa

March 17, 2011

Catherine Kuhlman
Executive Officer
California RWQCB
5550 Skylane Blvd., Ste. A
Santa Rosa, CA 95403

LAGUNA LUDWIGIA NUTRIENT OFFSET PROJECT

Dear Ms. Kuhlman:

City of Santa Rosa and Regional Water Quality Control Board staff have held two meetings since October 2010 in which alternative nutrient offset projects were discussed and evaluated for feasibility and effectiveness. The outcome of this discussion was an understanding that a *Ludwigia* removal project would be proposed by the City for implementation in 2011. Through collaboration with the Laguna Foundation, the City has developed the attached proposal for your consideration pursuant to the terms of Board Resolution R1-2008-0061. The City has entered into a contract with the Laguna Foundation to plan and obtain the necessary approvals to implement the proposed Project. Thank you for your cooperation to make this Project possible in 2011.

Should you have any further questions or comments, please contact Mr. Lynn M. Small, Deputy Director Environmental Services, of my staff at telephone number (707) 543-3350

Sincerely,

Miles A. Ferris
Director of Utilities

c. David Bannister, Laguna Foundation
Jon Niehaus, Sonoma County Water Agency
Keenan Foster Sonoma County Water Agency
Dave Smith, Merritt Smith Consulting

Attachments

UTILITIES DEPARTMENT
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PROPOSAL

Laguna Ludwigia *Nutrient Offset Project*

INTRODUCTION

This document describes the Laguna *Ludwigia* Nutrient Offset Project (Project) and is intended for consideration by the North Coast Regional Water Quality Control Board (Board) as a basis for Project approval under the Santa Rosa Nutrient Offset Program adopted by the Board with Resolution R1-2008-0061. This proposal is organized according to the Nutrient Offset Program information requirements identified in Attachment 1 to Resolution R1-2008-0061.

PROJECT LOCATION

The Project area includes the Laguna de Santa Rosa (Laguna) main channel and its tributaries. Because the density of *Ludwigia*, and thus appropriate removal locations, changes from year to year, specific locations cannot be provided at this time. Details regarding the criteria for site selection are described in the Description of N and P Control Practices – Location Criteria section below.

DESCRIPTION OF N AND P CONTROL PRACTICES

BACKGROUND

The City of Santa Rosa (City) conducted a preliminary evaluation of the efficacy of *Ludwigia* removal as a nutrient offset option. This evaluation concluded that *Ludwigia* removal could potentially provide some or all of the City's wastewater discharge offset needs. *Ludwigia* removal as a nutrient offset option received tentative support from Board Staff in a January 31, 2011 meeting between City representatives and Board Staff. Therefore the City decided to proceed with developing and implementing a pilot *Ludwigia* removal project to offset potential 2011-2012 nutrient discharge. The Laguna de Santa Rosa Foundation (LF) conducted a *Ludwigia* removal project in the Laguna and Sonoma County Water Agency drainage channels from 2005–2007 (Meisler 2008). Because *Ludwigia* management is consistent with LF's restoration goals and because of LF's prior experience in *Ludwigia* removal, the City is partnering with the LF to conduct this project. As such, the LF will obtain the necessary approvals and permits to conduct the project (except for this nutrient offset proposal, which is submitted by the City). The LF will also manage all *Ludwigia* removal activity. The City is the source of funding for this proposed activity.

This proposal for nutrient offset credit applies to 2011 only. LF and the City expect to continue *Ludwigia* removal activity in future years for nutrient offset and will submit a proposal for future years as appropriate based on experience gained in 2011.

PROJECT DETAILS

Timing of Removal. *Ludwigia* removal will be conducted during the dry season subject to terms and conditions of the permits obtained.

Removal Location Criteria. An evaluation of the LF's 2005-2007 *Ludwigia* removal project indicated that that removal and hauling away *Ludwigia* is most efficient in channelized sites with access roads. Therefore, for the 2011 season, a site or sites will be selected that meet these criteria. Site selection criteria may change as experience is gained. Future site selection criteria may include factors relating to habitat improvement of the Laguna and tributaries (e.g. sites that have a high restoration value or potential, sites upstream of other restoration activities).

Removal Method. LF's 2005-2007 *Ludwigia* removal project established that plant removal from channelized areas was most effective using a long-arm excavator with a perforated bucket, this method would be used in 2011. The excavator would load trucks parked immediately adjacent to the excavator and the trucks would haul to the disposal site (see below). Berms, silt fence or other method to retain high-turbidity water for settling will be constructed downstream as required in permits obtained from regulatory agencies. No herbicide use is proposed as part of this Project.

***Ludwigia* Disposal Criteria**. *Ludwigia* disposal will be to agricultural land sites selected on the basis of the proximity of the disposal site to the removal location, ease of access, landowner willingness and availability of disposal site, and agronomic nutrient needs of the site. The disposal process will involve hauling removed plant material and associated sediment to the disposal site(s), spreading plant material on the soil surface, removing associated trash, and incorporating the material into the soil. Care will be taken in the selection of disposal sites and plant material processing to insure that nutrients from decaying *Ludwigia* will not re-enter the Laguna, nearby waterways or groundwater.

QUANTITY OF N AND P REMOVED

The City is entitled to credit for bioavailable nutrients removed. Bioavailability is defined here as those nutrients that have the potential to be used by algae and rooted aquatic plants (macrophytes) for growth. This section provides a method by which the quantity of bioavailable nutrients removed will be determined. The quantity of nutrients removed or controlled by *Ludwigia* and removal activities will be determined using specific protocols described in this section.

LUDWIGIA *REMOVAL*

Ludwigia contains nutrients that are mineralized upon plant decay; therefore removing *Ludwigia* removes nutrients that would stimulate additional plant growth. Mineralization, or the conversion of organic nitrogen to nitrate via ammonium species, occurs in aquatic vegetation such as *Ludwigia* and therefore, nutrient offset credit for *Ludwigia* removal is

appropriate. This section describes the procedure that will be used to estimate nutrient offset credit for *Ludwigia* that is removed.

1. **Collect Vegetation Samples**. The nutrient content of *Ludwigia* may vary based on a number of factors including: season, location, age of plant, type of plant tissue (e.g., leaf or stem), species, and other factors unknown at this time. To capture this variability in nutrient value and accurately determine the quantity of nutrients removed in this project, samples will be collected on a weekly basis throughout the project period, at all removal locations, and from a variety of tissue types.

2. **Determine Quantity of Vegetation**. The volume, mass, and area of vegetation removed will be estimated at the time of removal using one of the following methods:

    a. **Volume**: Measuring the volume of dump trucks used to haul plant material and counting the number of dump truck loads, or direct measurement of the volume of vegetation removed.

    b. **Mass**: Weighing representative dump truck loads by measuring a fully loaded and empty truck.

    c. **Area**: Measuring the area of the removal site using GIS.

    Other methods in addition to those outlined above may be used as determined based on appropriate field conditions. In addition, the proportion of *Ludwigia* and sediment will be estimated. If water is present in loads hauled for disposal, the proportion of water will be estimated as well.

3. **Analyze Vegetation Samples**. *Ludwigia* samples will be analyzed for total nitrogen, total phosphorus, and moisture during 2011, and in 2012 if the project continues. If the mean nutrient content of the plants in each of the first two years of data collection is not different (95 percent confidence using T-test), the overall mean value from the first two years will be used in subsequent years instead of collecting additional plant samples. If the means from each of the first two years are different, additional data will be collected as needed to characterize nutrient content.

4. **Calculation of offset Credits from *Ludwigia* Removal**. Kadlec and Wallace (2009) provide a decay rate of 8.9 per year for floating species. *Ludwigia* is similar to floating species in that it lacks the more rigid structural (and slower decaying) components of emergent plants but has some structural components so it decays slower than submersed species (which have a decay coefficient of 10.2 per year). With a decay rate of 8.9 per year, 99.99 percent of the nutrients are leached from *Ludwigia* in the first year. Therefore, the nutrients in *Ludwigia* are considered 100 percent bioavailable. The nutrient offset will be calculated by multiplying the mass removed by the nutrient concentration.

SEDIMENT REMOVAL

The LF learned in its *Ludwigia* removal project that removing sediment with *Ludwigia* is not feasible to avoid under some conditions. Because the surface sediments that are removed will likely have a higher nutrient concentration than the deeper sediments that are exposed, removal of sediment will result in a net reduction of nutrients in the Laguna. For this reason, incidental sediment removal could also offset the City's nutrients loads. Details of determining sediment offsets are contained in Appendix A.

EXPECTED LIFE OF PROJECT

The first year of the Project is scheduled to occur in the summer of 2011 prior to the 2011-2012 discharge season, during which the zero nutrient discharge limit is scheduled to take effect. Therefore, any credit for nutrients removed by the Project would be banked and then applied to offset the discharge of nutrients for the three discharge seasons beginning with the 2011-2012 discharge season as described in Resolution R1-2008-0061. Ludwigia removal in future years will be proposed and undertaken based on the results of this proposed 2011 project.

MONITORING AND REPORTING PLAN

The nutrient offset credit derived from *Ludwigia* and sediment removal will be calculated using an estimate of the bioavailable nutrients as described in the Quantity of N and P Removed section above. This information will generally be available in fall 2011 and prior to the 2011-2012 discharge season. By spring 2012 and after the 2011-12 discharge season, the quantity of nutrients discharged and the quantity of nutrients removed (as calculated the fall 2011), will be tabulated and reported on or before July 1st, 2012 consistent with the Nutrient Offset Policy (see Section 5 of Attachment 1 to Resolution R1-2008-0061).

The City has been a long-term supporter of efforts to improve and restore the physical and ecological condition of the Laguna de Santa Rosa. In addition to receiving nutrient offset credit from *Ludwigia* removal, the City intends for the Project to contribute to Laguna restoration. One of the ways the Project can contribute to Laguna restoration is to use the Project as an opportunity to contribute to LF's understanding of *Ludwigia* biology and population dynamics. The City therefore proposes follow-up monitoring of *Ludwigia* plant density at the site(s) from which *Ludwigia* is removed and control sites for three years after harvesting using standard plant density estimating methods to be determined by City/LF agreement.

CEQA COMPLIANCE

Because Sonoma County Water Agency will need to issue an approval of the work conducted in their right of way, they will be the lead CEQA agency for the Project. Based on the LF *Ludwigia* removal project in 2005-2007, for which the Water Agency

was also the lead CEQA agency, the Project is expected to qualify for a categorical exemption. The 2005-2007 LF *Ludwigia* removal project was considered categorically exempt for the following reasons:

- It involved the maintenance and restoration of existing flood control channels where there was no expansion of an existing use.
- The removal of *Ludwigia* was required to preserve hydraulic capacity and to maintain service through the channels to meet current standards of public health and safety.
- Removal of *Ludwigia* would also protect fish and wildlife resources by improving water quality and fish passage conditions.

The City of Santa Rosa certified the IRWP Discharge Compliance Project EIR in 2008, and this EIR included evaluated implementation of the Nutrient Offset Program at a programmatic level.

REFERENCES

Kadlec, Robert, and Scott Wallace. 2009. Treatment Wetlands. Second Edition. CRC Press.

Meisler, Julian. 2008. Ludwigia Control Project Final Report.

APPENDIX A

NUTRIENT OFFSET FROM INCIDENTAL SEDIMENT REMOVAL

The bioavailable fraction of sediment nutrients has two components: compositionally bioavailable and spatially bioavailable.

Compositionally bioavailable refers to the fraction of nutrients in sediment that can be utilized by plants (algae and/or macrophytes). This is distinct from nutrients that are bound to the sediment or incorporated into organic compounds that are highly resistant to mineralization in a way that makes them unusable for plant growth (called herein refractory nutrients).

Spatially bioavailable refers to the fraction of compositionally bioavailable sediment that can actually reach plants. This is distinct from compositionally bioavailable sediment that, although potentially suitable for plant utilization, is too far below the surface to be utilized by plants. Because only incidental surface sediments are anticipated to be removed in the 2011 program, spatial bioavailability is not addressed here.

Compositionally Bioavailable Nutrients in Sediment

This section describes the composition of sediment relative to the bioavailability of the two primary plant nutrients – phosphorus and nitrogen.

In sediment, phosphorus may exist in many different forms. These can be subdivided into three groups which are defined by their availability for plant uptake: the solution pool, the active pool, and the fixed pool. The following descriptions (adapted from the Busman, et al. 2002) summarize the properties of these three groups or "pools". The **solution pool** P is the dissolved fraction and will usually be in the orthophosphate form, but small amounts of organic P may exist as well. Plants will only take up P in the orthophosphate form. The solution P pool is important because it is the pool from which plants take up P and is the only pool that has any measurable mobility. The **active P pool** is P in the solid phase which is relatively easily released to the sediment solution, the water surrounding sediment particles. As plants take up phosphate, the concentration of phosphate in solution is decreased and some phosphate from the active P pool is released. Because the solution P pool is very small, the active P pool is the main source of available P for plants. The active P pool contains inorganic phosphate that is attached (or adsorbed) to small particles in the sediment, phosphate that reacted with elements such as calcium or aluminum to form somewhat soluble solids, and organic P that is easily mineralized. Adsorbed phosphate ions are held on active sites on the surfaces of soil particles. The **fixed P pool** of phosphate contains inorganic phosphate compounds that are very insoluble and organic compounds that are resistant to mineralization by microorganisms in the sediment. Phosphate in this pool may remain in sediment for years without being made available to plants and may have very little impact on plant growth. The inorganic phosphate compounds in this fixed P pool are more crystalline in their structure and less soluble than those compounds considered to be in the active P pool.

Some slow conversion between the fixed P pool and the active P pool does occur in soils. The mass of inorganic phosphates in the fixed pool is a function of the geology of the watershed. Thus, the mass of P that is not compositionally bioavailable P (refractory P) is similar in surface and subsurface sediments.

Compositionally Bioavailable Nitrogen

Unlike phosphorus, which can be bound to compounds in sediments and unavailable for plant uptake, nitrogen tends to be readily soluble and thus bioavailable. Of the non-soluble nitrogen component, the majority is readily mineralizable and thus easily converted to a soluble form. A small fraction of N (typically contained in humic compounds) is not compositionally bioavailable and is a function of the geology of the watershed and climate. Thus, the mass of refractory N is similar in surface and subsurface sediments.

DETERMINATION OFFSET CREDIT

Offset Credits from Sediment

To determine the nutrient offsets from sediment, the following steps will be followed:

1. **Collect Stratified Sediment Samples**. If a significant amount of sediment is removed as part of the *Ludwigia* removal project (which is not expected), a minimum of three samples will be collected from the removed sediment. In addition, a minimum of three samples will be collected from the sediment exposed where the *Ludwigia* and sediment were removed. This is necessary because nutrients in the exposed layer will become available after exposure. Therefore, the concentration of nutrients in the exposed layer will be subtracted from the concentration of nutrients in the dredged layer as part of the determination of offset credit.

   After two years of sediment quality data collection, data will be reviewed to determine variability of nutrient content. If the mean nutrient content of the sediment in each of the first two years is not different (95 percent confidence using T-test), the overall mean value from the first two years will be used in subsequent years instead of collecting additional sediment samples. If the means from each of the first two years are different, additional data will be collected as needed to characterize nutrient content.

2. **Analyze Sediment Samples**. Each sediment sample will be analyzed for total N and total P concentration. The bulk density of each sample will also be determined so that sediment volume (which is typically the parameter for measuring sediment removal) can be converted to sediment mass (which is the basis of measuring nutrient content). Additionally, the moisture fraction in the sediment will be measured.

3. **Determine Quantity of Sediment**. The quantity of sediment removed will be estimated using the following approach:

   Truck contents (Kg) x [(soil fraction x Kg N/Kg soil) + (plant fraction x Kg N/Kg plant)]

4. **Calculate Nutrient Offset Credit From Sediment Removal**. The volume of sediment (m^3) removed will be converted to a dry weight sediment mass (Kg) using results of the bulk density analysis (kg/m^3) and the percent moisture in the sediment. The sediment mass will be multiplied by the nutrient content (mg nutrient/Kg sediment) minus the nutrient content in the exposed layer to determine the sediment nutrient mass (kg). Because the refractory masses of N and P are similar in both dredged and exposed sediment and the exposed mass of N and P will be subtracted from the dredged concentration, the numbers cancel each other out and only the compositionally bioavailable fraction is calculated.

APPENDIX A REFERENCE

Busman, Lowell, et al. 2002. The Nature of Phosphorus in Soils. Available at: http://www.extension.umn.edu/distribution/cropsystems/DC6795.html