

STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 94-46

APPROVAL OF \$15,000 FROM THE STATE WATER  
POLLUTION CLEANUP AND ABATEMENT ACCOUNT  
TO ASSIST IN FUNDING THE NITROGEN REMOVAL DEMONSTRATION  
PROJECT, COUNTY SERVICE AREA 114, COUNTY OF BUTTE

WHEREAS:

1. The Chico Urban Area is supplied exclusively by ground water that is seriously threatened by high nitrates;
2. Recent studies have attributed the high level of nitrates primarily to the extensive use of septic tanks in County Service Area 114 (CSA 114);
3. The Regional Water Quality Control Board, Central Valley Region, (RWQCB) adopted a Prohibition Order which prohibited installation of new septic tanks and waste discharge from septic tanks after July 1995;
4. The County of Butte (County), in cooperation with the City of Chico and the RWQCB, has initiated actions intended to prevent further degradation and minimize the existing nitrate problem;
5. The County has contracted with Dr. Stewart Oakley, Professor of Environmental Engineering at California State University, Chico, to conduct a study to demonstrate the feasibility of retrofitting septic tanks in CSA 114 with recirculating trickling filters for nitrogen removal as an alternative to abandoning existing septic systems;
6. The County has requested \$15,000 from the State Water Pollution Cleanup and Abatement Account to assist in funding the demonstration project; and
7. The results of the study may be useful in developing environmental technologies that will add to California's inventory of exportable environmental solutions.

THEREFORE BE IT RESOLVED THAT:

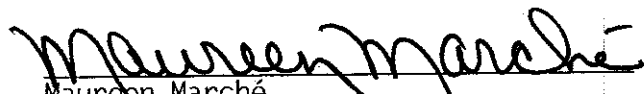
The State Water Resources Control Board:

1. Allocates \$15,000 from the Account to assist the County of Butte in funding a demonstration project to test the feasibility and effectiveness of retrofitting septic tanks with recirculating trickling filters for nitrogen removal;
2. Shall not be obligated to provide additional funds for similar demonstration projects, and/or for projects that may result from this study.

3. The County of Butte agrees to and does hereby grant to the State Water Board and its officers, agents, and employees acting within the scope of their official duties, a royalty free, non-exclusive and irrevocable license for:
  - A. the use of any patent(s), plans, drawings, specifications, reports, operating manuals and other written or graphic work developed under this project;
  - B. the copyright in any work developed under this project; and
  - C. The County of Butte shall be responsible for obtaining any licenses required from use of any proprietary processes.

#### CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 18, 1994.

  
Maureen Marché  
Administrative Assistant to the Board

NITROGEN  
7661 T 184

CHIEF ADMINISTRATIVE OFFICE  
COUNTY OF BUTTE



JOHN S. BLACKLOCK  
CHIEF ADMINISTRATIVE OFFICER

25 COUNTY CENTER DRIVE  
OROVILLE, CALIFORNIA 95965-3380  
Telephone: (916) 538-7631  
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MEMBERS OF THE BOARD:

BOB MEYER  
JANE DOLAN  
MARY ANNE HOUX  
ED McLAUGHLIN  
GORDON THOMAS

March 8, 1994

Mr. Harry Schueller  
Division Chief  
Division of Clean Water Programs  
State Water Resources Control Board  
P. O. Box 944212  
Sacramento, CA 94244-2120

Re: Request for Cleanup and Abatement Fund Participation in  
Nitrogen Removal Project County Service Area 114, County of  
Butte

Dear Mr. Schueller:

Please consider this letter a formal request for assistance in funding the study of a promising nitrate removal technology for use with existing individual leaching systems in the urban area of Chico in Butte County. If proven effective, we believe the recirculating trickling filter would be of enormous benefit to other areas throughout California struggling with elevated levels of groundwater nitrate. The amount requested is fifteen thousand dollars (\$15,000), which is one-half of the expected project cost.

Background

The Chico Urban Area contains a population of approximately 85,000 persons, about half of whom rely upon individual septic tank/leaching systems. Groundwater studies conducted in 1983, 1985, 1992 and 1993 have documented levels of nitrate in excess of the Maximum Contaminant Level. These elevated levels have been attributed primarily to the extensive use of septic tanks.

In 1990 the State and Regional Boards adopted a Basin Plan Amendment (Prohibition Order 90-126) which prohibited the installation of new septic systems after July 1990 and further prohibited waste discharge from existing septic systems after July 1995. Individual systems discharging less than 334 gallons per acre per day (one dwelling unit per acre equivalent) were exempted.

The Prohibition Order further provided that exemptions would be considered by the Board "...if it can be demonstrated that costs to connect to a sewer system will be inordinately high, relative to beneficial uses protected and an adequate level of environmental protection can be achieved by alternative means." (emphasis added.)

As set forth in the Chico Urban Area Nitrate Action Plan, Butte County initiated a program of actions intended to prevent further degradation and minimize the existing nitrate problem. County Service Area 114 was formed, encompassing the affected area and providing an effective level of funding. The County hired a program manager and conducted the 1992 and 1993 groundwater sampling studies to further characterize the extent and severity of nitrate contamination.

In conjunction with the City of Chico, a Master Sanitary Sewer Plan and a Master Storm Drainage Plan have been developed. Additionally, a redevelopment project area was formed to enable the use of tax increment financing. This redevelopment project is a joint effort of the city and county, and further underscores the cooperative effort to address nitrate contamination among other infrastructure needs.

The ongoing work program has been closely scrutinized by Regional Water Quality Control Board (RWQCB) staff (Ronald Dykstra, Staff Engineer) who participates in all technical and strategic activities.

With the recent installation and sampling of existing and newly installed monitoring wells and sampling of existing domestic wells (at a cost of \$125,000) the "nitrate characterization phase" of the County's program is virtually complete. During 1994 the County intends to complete source evaluation and related studies, identify alternatives and perform cost/benefit analyses to determine the most feasible and cost-effective solutions.

Upon completion of this program of work, we anticipate submittal of a proposal for amendment of the prohibition order as appropriate, and implementation of a comprehensive program to resolve the groundwater nitrate problem.

#### Recirculating Trickling Filter Demonstration Project

The County of Butte has initiated a demonstration project to test the feasibility and effectiveness of retrofitting septic tanks with recirculating trickling filters (RTF) for nitrogen removal. If successful, the value in halting and/or preventing the degradation of ground water due to elevated levels of nitrate will be important throughout the state, particularly in areas where centralized collection, treatment and disposal is not feasible. In the Chico area specifically, the use of this technology may address the issue in a manner acceptable to the RWQCB at a fraction of the cost of conventional sewer systems.

A preliminary estimate of capital cost for retrofitting a typical domestic system (sketch attached) is approximately \$1,000. This would constitute a savings of tens of millions of dollars (and a protracted public debate regarding public acceptance of assessment districts or other public financing mechanisms) if applied throughout County Service Area 114.

March 7, 1994

The demonstration project consists of the installation of six RTF systems on five existing and one new septic tank in the Chico area, and monitoring performance over a one-year period. The details of the demonstration project were generated and agreed upon by a committee including RWQCB staff. The County has contracted with Dr. Stewart Oakley, Professor of Environmental Engineering at California State University, Chico (CSUC) and Director of the CSUC Environmental Laboratory to conduct the demonstration project, with results due in April of 1995. An estimated direct cost of approximately \$30,000 is expected, with the defined cost of \$27,432 for Dr. Oakley's work plus the remaining \$2,568 for related costs such as interaction with involved property owners, project coordination and incidental costs.

A full description of the demonstration project is attached.

#### Request

The County of Butte requests funding from the Cleanup and Abatement Fund for 50% of project costs, not to exceed \$15,000.

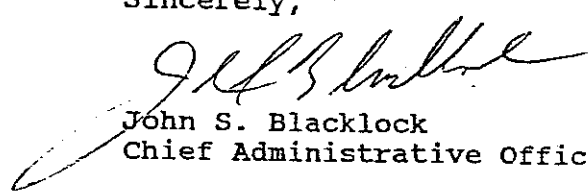
This request is respectfully made on the following basis:

- The citizens of County Service Area 114 have spent substantial sums toward the identification and solution of the nitrate problem, and will continue to spend additional money pursuing a solution;
- The results of the demonstration project would be applicable to other high-nitrate areas throughout the State of California.
- Participation by the RWQCB through the Cleanup and Abatement Fund would be a positive signal to local citizens which will assist in developing greater cooperation and willingness to comply with eventual mandates, financing mechanisms and the like.

In addition, as you know, Governor Wilson has implemented a strategic plan for promoting the environmental industry in California. The results of this RTF study may be useful in developing environmental technologies that will add to California's inventory of exportable environmental solutions.

The County of Butte and the citizens of CSA 114 extend our sincere appreciation, in advance, for your careful consideration of this request. Please address any questions or comments to Starlyn Brown, Assistant Chief Administrative Officer, at 916/538-7224.

Sincerely,



John S. Blacklock  
Chief Administrative Officer

Harry Schueller

-4-

March 7, 1994

SSB:db

enc.

cc: William H. Crooks  
Executive Officer  
Regional Water Quality Control Board  
Sacramento-Central Valley Region 5  
3443 Routier Road, Suite A  
Sacramento, CA 95827-3098

James C. Pedri  
Supervising Engineer  
Regional Water Quality Control Board  
Central Valley Region, Shasta Cascade Watershed Branch Office  
415 Knollcrest Drive  
Redding, CA 96002

Jim Bennett  
Office of Policy Development  
State Water Resources Control Board  
P. O. Box 944212  
Sacramento, CA 94244-2120

Recirculating Trickling Filters for Nitrogen Removal in Septic  
Systems: A Proposed Demonstration Project  
for  
County Service Area 114  
Butte County, California

by

Dr. Stewart M. Oakley  
Professor of Environmental Engineering  
Director, CSUC Environmental Laboratory  
California State University, Chico  
Chico, California 95929-0930

## **Objective**

The objective of this project is to demonstrate the feasibility of retrofitting septic tanks in CSA 114 with recirculating trickling filters (RTF) for nitrogen removal as an alternative to abandoning existing septic systems as mandated by Regional Water Quality Control Board Order No. 90-126. This will be accomplished by installing six recirculating trickling filters-- five on existing septic tanks and one on a new tank-- and monitoring them for a period of one year in order to obtain detailed data on RTF performance. At the end of the monitoring period, if RTF performance is satisfactory in the view of the Regional Water Quality Control Board (RWQCB), design and performance criteria could be established in collaboration with the RWQCB in order to exempt RTF systems from Board Order 90-126.

## **Significance**

It is believed this work, through the development, demonstration, and evaluation of a cost-effective emerging technology, has the potential to address the Chico Urban Area's nitrogen problem in a manner that would be acceptable to the RWQCB at a fraction of the cost of conventional sewers. Should the RTF prove feasible within certain areas of CSA 114, it is estimated that an individual household system could be retrofitted at a cost less than \$1000 (materials and labor), resulting in a savings of tens of millions of dollars for the residents of CSA 114 over the cost of conventional sewerage.

## **Problem Statement**

In April, 1990, the California Regional Water Quality Control Board adopted Board Order No. 90-126 for CSA 114, which prohibits the installation of new septic systems on parcels less than one acre and requires the abandonment of existing systems on parcels less than one acre by July, 1995. The Board Order was based on elevated nitrate concentrations in groundwater underlying the Chico Urban Area that had been documented by groundwater monitoring from 1983 to 1990.

The Board Order impacts approximately 35,000 citizens within CSA 114, and the cost of full implementation of the Sewer Master Plan could be over \$80 million. Given the magnitude of the problem and the proposed costs of conventional sewerage, which may be beyond the reach of local government resources, it is important to consider emerging technologies for nitrogen removal in onsite wastewater treatment systems, several of which may be very cost-effective. One of these technologies in particular, the RTF, offers much promise as a cost-effective alternative because it could be retrofitted to existing septic systems at minimal cost. The RTF



system, however, currently is in the development stage, and more data are needed to ensure that high nitrogen removal rates can be maintained over the long-term and that site constraints within the Chico Urban Area can be overcome in a cost-effective manner.

### **Preliminary Work**

Orengo Systems, Inc., has developed the RTF as shown in Figure 1. In this system a septic tank is retrofitted with a small trickling filter and a recirculating pump; nitrification occurs in the trickling filter and, with recirculation ratios of 15 to 1, the trickling filter effluent is denitrified after return to the septic tank. Table 1 shows the preliminary results of nitrogen removal in this system. Over a period of approximately two months, the time it takes for the system to biologically equilibrate, total nitrogen levels in the septic tank effluent are reduced by 84% (from 68 mg/l to 11 mg/l).

An average concentration of 10 to 15 mg/l total nitrogen in septic tank effluent, if it can be maintained consistently over time, would probably, in the view of the RWQCB, be sufficient nitrogen removal to permit certain existing systems to be exempted from Board Order No. 90-126; any exemption would be based on quantitative nitrogen loading rates for a given location within CSA 114.

### **The Necessity of a Demonstration Project in CSA 114**

The septic tank retrofitted with a RTF is in the developmental stage and more detailed data are needed in order to ensure the RWQCB the system is capable of high removal efficiencies for long time periods under varying flow rates and wastewater strengths. Therefore, a demonstration project is proposed as a method of systematically testing and evaluating nitrogen removal rates, developing design and performance criteria under varying conditions, selection of appropriate local materials, material and construction costs, operation and maintenance requirements, and monitoring requirements. This approach will make it possible to fully evaluate whether this emerging technology offers a viable, cost-effective method of addressing the nitrogen issue in the Chico Urban Area.

### **Demonstration Project Implementation**

It is the overall purpose of this study to 1) select and retrofit six septic tanks with a recirculating trickling filter; 2) to systematically monitor the systems over a period of one year to have a sufficient data base to definitively determine whether the RTF offers a viable solution to Board Order 90-126; and 3) to develop design, monitoring, and operation and maintenance criteria in collaboration with the RWQCB for RTF retrofit

systems within CSA 114, and to accurately determine material and installation costs of RTF retrofits. This will be accomplished by the following specific work objectives:

**1) Septic Tank Survey and Preliminary Selection (1 month)**

Approximately 50 existing septic tanks will be surveyed within key areas of CSA 114 in order to select 12 tanks for possible RTF retrofit. These tanks will be selected based on the following criteria:

**a) Wastewater flow and strength.**

It will be important to select systems with different flow and wastewater strength characteristics to ensure the feasibility of the RTF retrofit for all septic systems likely to be encountered within the Chico Urban Area.

**b) Ease of sample collection**

Because sampling will be performed on a routine basis, it will be important to select existing systems where effluent samples can be collected with a minimum of physical modification of the existing septic tank.

**c) Condition of tank**

Leak tests will be performed on all tanks inspected in the survey to ensure the selection of watertight tanks. These preliminary leak test data will also be used to assess whether leaking tanks pose a problem within CSA 114.

**d) Research and Development Potential**

Because of the probable need to alter select parameters to improve treatment efficiencies (such as alternating the recirculation ratios and accurately monitoring flows), it is proposed that one RTF retrofit be installed on the septic tank of the CSUC Farm; this would enable greater flexibility in research and development of the RTF design than would be possible with a system installed at a private residence. In addition, the university is the most appropriate location to display the RTF technology to the public for demonstration and educational purposes.

**2) Septic Tank Monitoring and Final Selection (1 month)**

The 12 septic tanks will be intensively monitored for all nitrogen species for one month in order to obtain detailed data on effluent quality and total nitrogen loadings; flowrates will also be estimated based on dwelling occupancy rates. The results will be used to select four septic tanks for retrofit; one RTF will also be installed at the CSUC Farm and one will be installed on a new septic tank.

### 3) Recirculating Trickling Filter Installation (1 month)

Once the septic tank locations have been selected with the owners approval, RTFs will be installed by local contractors. Personnel from Orenco Systems, Inc., who have developed the equipment for the RTF, will advise the contractors in the installation process to ensure they meet all code specifications and requirements.

### 4) Septic Tank Monitoring (1 year)

At the start of the study, it is proposed to monitor septic tank effluent bimonthly for total kjeldahl nitrogen (TKN), ammonia nitrogen ( $\text{NH}_3\text{-N}$ ), and nitrate nitrogen ( $\text{NO}_3\text{-N}$ ); monitoring frequency may later be changed to a monthly basis if the data show relative consistency. Because nitrite nitrogen ( $\text{NO}_2\text{-N}$ ) is actually the etiologic agent for methemoglobinemia, and because it is remotely possible that nitrite levels may be significant in the total nitrogen balance for RTFs, it is proposed to monitor nitrite concentrations periodically throughout the study; if nitrite concentrations are found to be significant, more frequent analyses will be performed.

Samples will be collected and analyzed by the CSUC Environmental Laboratory, which is state-certified, to ensure consistency of results and that all data will be acceptable for regulatory decision-making. All samples will be collected and analyzed in accordance with procedures outlined in Standard Methods for the Analysis of Water and Wastewater, 18th Ed, 1992. Procedures for Data Quality Objectives, Quality Assurance and Quality Control will be followed according to standard protocols for certified laboratories as outlined in the CSUC Environmental Laboratory's Quality Assurance Manual.

### 5) Data Analysis and Final Report (2 months)

The results of this project will be disseminated as a technical report published by the CSUC Environmental Laboratory.

## Timetable

<u>Task</u>	<u>Time Frame</u>
1) Septic Tank Survey	January, 1994
2) Septic Tank Monitoring and Final Selection	February-March, 1994
3) RTF Installation	February-March, 1994
4) RTF Monitoring	March, 1994-February, 1995
5) Final Report	March-April, 1995

### Qualifications of Key Personnel

#### Dr. Stewart Oakley:

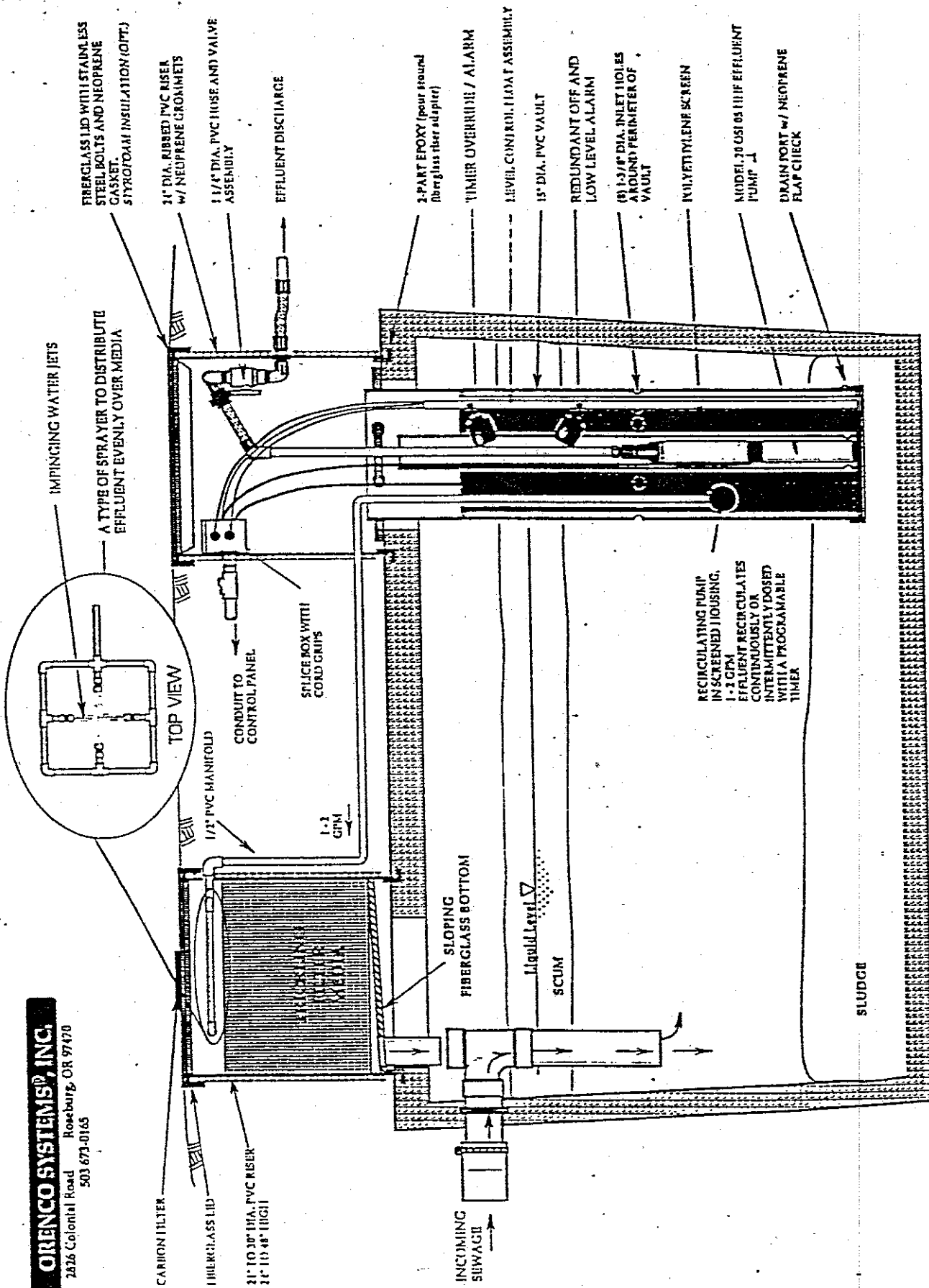
Dr. Oakley is Professor of Environmental Engineering at California State University, Chico (CSUC) and Director of the CSUC Environmental Laboratory. He has worked extensively in research and development of onsite wastewater treatment systems for the last 15 years, has published numerous articles and technical reports, and teaches one of the few onsite wastewater treatment engineering classes offered at a major university. Dr. Oakley has helped organize two onsite wastewater treatment conferences in the past two years at CSUC as part of the university's long-term plan of developing a training center for onsite wastewater treatment. Dr. Oakley has also worked extensively in Latin America and the People's Republic of China in the areas of wastewater treatment and sanitation.

## Project Budget

<u>Item</u>	<u>Requested Funds</u>
<u>Personnel</u>	
Student Technicians for Septic Tank Survey (2 x 20 hrs/wk x 8 wks x \$8.00/hr)	\$2560
Contractor for Retrofit Installation (6 retrofits x \$500/retrofit)	\$3000
<u>Supplies and Equipment</u>	
Recirculating Trickling Filter Retrofit (6 @ \$1000 each; includes appurtences)	\$6000
Chemicals and Miscellaneous Supplies	\$1000
<u>Chemical Analyses</u>	
<u>Preliminary Septic Tank Effluent Analyses</u>	
Total Kjeldahl Nitrogen (24 analyses x \$20/analysis)	\$480
Ammonia Nitrogen (24 analyses x \$15/analysis)	\$360
Nitrate Nitrogen (24 analyses x \$15/analysis)	\$360
<u>Retrofit Monitoring</u>	
Total Kjeldahl Nitrogen (12 analyses/mo. x 12 mo. x \$20/analysis)	\$2880
Nitrate Nitrogen (12 analyses/mo. x 12 mo. x \$15/analysis)	\$2160
Ammonia Nitrogen (12 analyses/mo. x 12 mo. x \$15/analysis)	\$2160
Nitrite Nitrogen (6 analyses/mo. x 12 mo. x \$20/analysis)	\$1440
<u>Travel</u>	
Sample collection (\$0.25/mile x 10 miles/trip x 12 trips/mo x 14)	\$460
<u>Total Direct Costs</u>	<u>\$22,860</u>
Indirect Costs @ 20% of Direct Costs	\$4572
<u>Total Requested Funds</u>	<u>\$27,432</u>

**ORENCO SYSTEMS<sup>®</sup>, INC.**

2826 Colonial Road Roseburg, OR 97470  
503-673-0165



drawing

FIGURE 1  
SEPTIC TANK EFFLUENT PUMP SYSTEM WITH RECIRCULATING FILTER OPTION

FIGURE 1

# Orenco Systems, Inc.

2826 Colonial Road, Roseburg, Oregon 97470

503-673-0165

FAX 503-673-1126

October 28, 1992

From: Harold Ball

To: Ron Crites  
Ron Dykstra  
George Tchobanoglous  
Richard Piluk  
Stewart Oakley

## Summary to Date Home Septic Tank Effluent

A 1000-gallon single-compartment fiberglass septic tank was installed for a new two-bedroom home in November of 1990. Effluent from the septic tank is dosed to a 32 sqft sand filter. The septic tank was retrofitted with a recirculating trickling filter unit on August 15, 1993. Daily wastewater flow to the septic tank has averaged 115 gpd.

### Average Septic Tank Effluent Quality—Nov 1990 to Jun 1993

BOD	TSS	TKN	NH <sub>3</sub>	NO <sub>3</sub>
175	28	66	54	2

### Average Septic Tank Effluent Quality following retrofit with trickling filter unit (see drawing) on Aug 15, 1993

DATE	BOD	TSS	TKN	NH <sub>3</sub>	NO <sub>3</sub>
Aug 25, 1993	61	25	57	37	3
Sept 9, 1993			35	24	3
Sept 16, 1993		9	11	7	7
Sept 22, 1993	36	16	16	10	3
Sept 30, 1993			14	11	2
Oct 4, 1993	48	27	14	9	2
Oct 7, 1993			20	8	7
Oct 13, 1993	20	5	10	2	6
Oct 20, 1993	15	8	5	4	6

TABLE 1

# MEMORANDUM

## CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD • CENTRAL VALLEY REGION

3443 Routier Road, Suite A  
Sacramento, CA 95827-3098

Phone: (916) 255-3000  
CALNET: 8-494-3000

TO: Harry Schueller, Chief  
CWP, SWRCB

FROM: William H. Crooks  
Executive Officer

DATE: 15 March 1994

SIGNATURE: 

SUBJECT: ***BUTTE COUNTY REQUEST FOR PARTIAL FUNDING OF NITROGEN  
REMOVAL PROJECT***

I have received and reviewed a copy of the 8 March 1994 letter to you from Butte County.

The letter accurately describes the situation leading to adoption of the Regional Board's Prohibition Order. The Chico Urban Area is supplied exclusively by ground water that is seriously threatened by high nitrates. The County is cooperating with us in defining the extent and severity of this problem. The solution clearly will not be cheap. This proposed demonstration project will allow the County to evaluate, in cooperation with California State University, Chico, a potentially cost-effective solution.

I respectfully ask your favorable consideration of this "hands on" demonstration project. It could, as Mr. Blacklock points out, become a valuable technology to add to California's inventory of exportable environmental solutions.

Please call me at 255-3039 if you wish to discuss this matter. If your staff needs additional details, please call Jim Pedri at CALNET 441-4845, or at (916) 224-4845.

WHC:icc

cc: John S. Blacklock, Butte County Chief Administrative Office, Oroville  
James Pedri, Central Valley Regional Board, Redding