



Cal/EPA

**North Coast
Regional Water
Quality Control
Board**

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December 19, 1997



Pete Wilson
Governor

Interested Person:

Subject: Resolution No. 97-108 Amending the *Water Quality Control Plan for the North Coast Region* to Include A Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed Into Section 4, Implementation Plans, Nonpoint Source Measures

On December 11, 1997 the California Regional Water Quality Control Board, North Coast Region (Regional Water Board) adopted Resolution No. 97-108. Development of the Stemple Creek Watershed Total Maximum Daily Load and Attainment Strategy (TMDL) is the product of efforts by landowners in the watershed, technical assistance, educational, and regulatory agencies, and the public to resolve water quality impairment and restore historical beneficial uses. The Stemple Creek Watershed has been listed as impaired pursuant to Section 303(d) of the Federal Clean Water Act. The contaminants of concern causing impairment are nutrients and sediment from nonpoint sources. The beneficial uses adversely impacted include non-contact water recreation (REC-2), cold freshwater habitat (COLD), commercial and sport fishing (COMM), preservation of areas of special biological significance (BIOL), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), spawning, reproduction, and/or early development (SPWN), and estuarine habitat (EST).

The TMDL establishes numeric targets for dissolved oxygen, temperature, hydrogen ion (pH), total and un-ionized ammonia, and sediment. Target attainment points are established at specific locations in the mainstem of Stemple Creek and in the Estero de San Antonio. With the exception of sediment, all numeric targets are to be met by year 2004. A phased approach for sediment is established with initial efforts focusing on active channel erosion areas and the implementation of management measures to reduce sheet and rill erosion from rangeland and cropland sources. By year 2004, a goal of 75 percent reduction of sediment is established.

The TMDL identifies confined animal facilities and the land spreading of manure as fertilizer as the main sources of nutrient impairments. Sediment sources are identified as channel and gully erosion, inadequate rangeland

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management, including animal access to riparian areas and overgrazing, and roads, landslides, and other land disturbance activities such as cultivated croplands.

Implementation of the TMDL calls for the voluntary preparation of ranch plans for all properties identified as contributing to nutrient and sediment water quality impairments. Technical assistance agencies and funding sources are identified in the TMDL to facilitate the development and implementation of ranch plans. In order for the Regional Water Board to track the success of the TMDL, water quality aspects of the ranch plans are to be submitted for all cases within the watershed where the numeric targets are not yet being attained. Should a significant number of landowners not voluntarily comply and fail to submit the water quality aspects of their ranch plan, or fail to implement their ranch plan, the Regional Water Board will implement its regulatory authority pursuant to the California Water Code to adopt waste discharge requirements or implement enforcement actions for significant discharges of sediments or nutrients. The status of attainment and review of the implementation measures is scheduled for the year 2000.

Water quality monitoring will be utilized to assess progress in complying with the TMDL. In addition to monitoring by Regional Water Board staff, citizen monitoring and landowner monitoring as a part of their ranch plan will be conducted. At least annually, Regional Water Board staff will evaluate and provide a report at a regularly scheduled meeting of the Regional Water Board on the progress of the TMDL. The progress report will include an annual inventory of projects completed, proposed projects, and projects in progress.

Public participation was a key element in the development of the Enhancement Plan for Stemple Creek and the Estero de San Antonio which is the foundation of this TMDL. Public participation will continue to be a key component as efforts to implement this TMDL progress. Opportunity for public comment is available at the Sonoma/Marin Farm Bureau's Animal Waste Committee meetings. In addition, the public is invited to participate in the Regional Water Board's annual meeting to assess progress in the watershed to meet the goals of the TMDL.

Enclosed is Resolution No. 97-108 Amending the *Water Quality Control Plan for the North Coast Region* to include a Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed into Section 4, Implementation Plans, Nonpoint Source Measures. A copy of the TMDL is also enclosed.

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Should you have any questions or comments, please contact Dennis L. Salisbury at (707) 576-2672.

Sincerely,

ORIGINAL SIGNED BY

Benjamin D. Kor
Executive Officer

Enclosures(2)

(sctran1.doc)

**Total Maximum Daily Load
and Attainment Strategy
for the
Stemple Creek Watershed**

Prepared for

California Regional Water Quality Control Board North Coast Region
5550 Skylane Boulevard, Suite A
Santa Rosa, California 95403

by

Dennis L. Salisbury
Associate Water Resources Control Engineer

December 11, 1997

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California Regional Water Quality Control Board
North Coast Region

Resolution No. 97-108

Amending the
Water Quality Control Plan for the North Coast Region
to Include A Total Maximum Daily Load
and Attainment Strategy for the Stemple Creek Watershed
Into Section 4, Implementation Plans,
Nonpoint Source Measures

- WHEREAS, The California Regional Water Quality Control Board, North Coast Region (Regional Water Board) last amended the Water Quality Control Plan for the North Coast Region (Basin Plan) on May 23, 1996. The Basin Plan includes water quality objectives, implementation plans for point source and nonpoint source discharges, and statewide plans and policies; and
- WHEREAS, Section 303(d) of the Clean Water Act requires states to identify and to prepare a list of waterbodies that do not meet water quality objectives and then to establish a waste load allocation, or a total maximum daily load, for each waterbody which will ensure attainment of water quality objectives, and then to incorporate that allocation or load into their water quality control plans; and
- WHEREAS, As part of its 1992 Water Quality Assessment, the Regional Water Board placed Stemple Creek on the Section 303(d) list, due to impairment and/or threat of impairment of water quality by nutrients and sediment from nonpoint sources of pollution. During its 1994 and 1996 Water Quality Assessments, the Regional Water Board retained Stemple Creek on its Section 303(d) list, and set forth nutrients from nonpoint sources as the pollutants of concern; and
- WHEREAS, In July 1994, a *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan* was prepared for the Marin County Resource Conservation District and the Southern Sonoma County Resource Conservation District. The report represents the efforts of the landowners in the Stemple Creek watershed to identify, and where possible, improve the natural resources of the watershed while maintaining a vigorous agricultural economy. The plan identified degraded water quality from nutrients and sediments, and recommends the implementation of both short and long-term goals; and
- WHEREAS, A Notice of Filing and Public Hearing, a Proposed Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed, and environmental documentation functionally equivalent to the California Environmental Quality Act requirements were transmitted to interested individuals and public agencies for review and comment; and
- WHEREAS, In a memorandum dated November 7, 1997, the California Department of Fish and Game described conditions under which the Proposed Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed are not likely to jeopardize any listed threatened or endangered species in the Stemple Creek watershed and which would minimize the likelihood of any taking of listed

species incidental to the proposed actions; and those conditions are set forth in the proposed Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed; and

WHEREAS, The Regional Water Board has determined that compliance with this Total Maximum Daily Load and Attainment Strategy will attain and maintain the applicable water quality objectives for nutrients and sediment and restore and protect beneficial uses. Beneficial uses adversely impacted include non-contact water recreation (REC-2), cold freshwater habitat (COLD), commercial and sport fishing (COMM), preservation of areas of special biological significance (BIOL), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), marine habitat (MAR), migration of aquatic organisms (MIGR), spawning, reproduction, and/or early development (SPWN), and estuarine habitat (EST); and

WHEREAS, The Regional Water Board held public hearings on October 23, 1997, and on December 11, 1997, and carefully considered all testimony and comments received on this matter; and has determined that the proposed Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed will not have a significant adverse effect on the environment.

THEREFORE, BE IT RESOLVED, that Section 4, Implementation Plans, Nonpoint Source Measures of the *Water Quality Control Plan for the North Coast Region* be amended to include at the end of the Section the following Total Maximum Daily Load and Attainment Strategy for the Stemple Creek Watershed.

BE IT FURTHER RESOLVED, that considering the record as a whole, this Basin Plan amendment will involve no potential for adverse effect, either individually or cumulatively on wildlife. Therefore, the Executive Officer is directed to sign an Certificate of Fee Exemption for a "De Minimis" Impact Finding.

PROBLEM STATEMENT: Stemple Creek, including the Estero de San Antonio, is a predominantly agricultural 50 square-mile coastal watershed located in southern Sonoma and northern Marin counties. Excessive amounts of nutrients and sediment from nonpoint sources are causing and/or threaten to cause impairment of beneficial uses and/or nonattainment of the water quality objectives which are set forth in the *Water Quality Control Plan for the North Coast Region* (Basin Plan). The deposition of sediment in the Estero de San Antonio reduces the tidal function of mixing fresh and salt water, and causes the mouth to be seasonally closed by the formation of a sand bar. Sediment has also filled many deep holes in Stemple Creek, reducing the stream's habitat value for fish and aquatic life. Livestock access to riparian areas has resulted in the destruction of riparian vegetation and the trampling of stream banks resulting in additional erosion. The loss of riparian vegetation also results in elevated water temperatures due to the lack of shade. Nutrients such as nitrates and phosphorus in the watershed adversely affect aquatic life by causing eutrophication. Ammonia, in its un-ionized form, is present at times in concentrations that are toxic to aquatic life. Currently, fish do not inhabit most reaches of Stemple Creek, yet historically, the stream was known to support the migration and spawning of anadromous fish. Beneficial uses adversely impacted include non-contact water recreation (REC-2), cold freshwater habitat (COLD), commercial and sport fishing (COMM), preservation

of areas of special biological significance (BIOL), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), marine habitat (MAR), migration of aquatic organisms (MIGR), spawning, reproduction, and/or early development (SPWN), and estuarine habitat (EST).

NUMERIC TARGETS: Target attainment points are established at the Alexander Road crossing, which is located near the middle of the watershed (freshwater), and at the Valley Ford Franklin School Road crossing, which is located near the mid-point of the Estero de San Antonio (saline). Identified targets are as follows:

1. **Dissolved oxygen:** The targets for dissolved oxygen are final targets, with not less than the following minimum concentrations by the year 2004.
 - 5.0 mg/L in the Estero de San Antonio
 - 6.0 mg/L in Stemple Creek
 - 7.0 mg/L in Stemple Creek and the Estero de San Antonio wherever and whenever the aquatic habitat is suitable for salmonid migration rearing, and spawning, and
 - 9.0 mg/L during critical spawning and egg incubation periods, which is defined as applicable when and where anadromous fish redds are located.
2. **Temperature:** The targets for temperature are seasonal and apply to Stemple Creek and the Estero de San Antonio. The final targets, which apply in year 2004, are 20 degrees C. during May through November and 13.8 degrees C. during December through April.
3. **pH:** The target range for pH applies during late spring and early summer. The target range for pH is 7.0 to 8.5.
4. **Total and un-ionized Ammonia:** The targets for total ammonia and un-ionized ammonia apply whenever and wherever the aquatic habitat is suitable for salmonid migration, rearing, and spawning. The target for un-ionized ammonia is 0.025 mg/L. as NH_3 . The targets for temperature and pH must be achieved in order for the target for total ammonia to apply.

In order to achieve the target for un-ionized ammonia, the target ranges for total ammonia are set forth in the following table.

Concentration of Total Ammonia as Nitrogen in mg/L. in Freshwater
Which Contains 0.025 mg/L. Un-ionized Ammonia as NH_3

pH	10°C.	15°C.	20°C.
7.0	11.0	7.53	5.19
7.5	3.51	2.39	1.66
8.0	1.12	0.77	0.54
8.5	0.37	0.26	0.18

5. A phased approach for sediment reduction is proposed for the entire watershed, with initial work focusing on active channel erosion areas, and the implementation of management measures to reduce sheet and rill erosion from rangeland and cropland sources. A numeric target for sediment, with a yield of 12,760 tons per year, or a 75 percent reduction, by the year 2004 is established. The ultimate goal is prevention of erosion to the maximum extent possible so that winter flows naturally remove accumulated sediment from the estuary and re-establish the tidal prism. It may be necessary to consider at some point in the future, the physical removal of accumulated sediment in the estuary by dredging.

SOURCE ANALYSIS: Manure from concentrated animal feeding operations (dairies and poultry) has been identified as the primary source of the impaired water quality conditions in the Stemple Creek watershed. Land use activities such as the spreading of animal wastes on pasture and crop lands, and rangeland grazing (dairy, beef, and sheep) result in the discharge of nutrients in the watershed. Erosion from stream banks and upland gullies comprise the predominant sources of sediment, followed by inadequate rangeland management (animal access to riparian areas and overgrazing), roads, landslides, and land disturbance activities.

ALLOCATIONS OF RESPONSIBILITY: Animal agriculture land use activities and the nonpoint source pollutants associated with those land use activities are the responsibility of each landowner in the watershed. While the severity, extent, and source or type of water quality impairment varies from ranch to ranch, each landowner is responsible for a part of the restoration and enhancement of water quality in the watershed, and protecting the beneficial uses of the water. A phased approach and broad allocation is proposed, especially considering the community effort to restore the watershed.

IMPLEMENTATION PLAN: Each land owner of property identified as contributing to the nutrient and sediment impairments of water quality in the watershed will be encouraged to develop and implement a comprehensive ranch management plan which will provide an identification of problem areas that may exist and then set forth a basis for developing a schedule for correction. Technical assistance will be provided from numerous sources, such as the USDA's Natural Resource Conservation Service (formerly the Soil Conservation Service), University of California's Cooperative Extension, and the Southern Sonoma and Marin County Resource Conservation Districts. Funding resources for corrective actions will be available through a number of agencies including the USDA's Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Incentive Program (WHIP). The California Coastal Conservancy, Marin County Resource Conservation District, Southern Sonoma County Resource Conservation District, Marin Community Foundation, and Dean Witter Foundation, all contributors to the development of the watershed enhancement plan and its associated studies, will continue to provide assistance. It is hoped that CWA Section 319(h) funding will continue to provide education and outreach (including water quality monitoring training and acquisition of test kits), riparian area restoration demonstration projects, and support in the preparation of comprehensive ranch management plans.

It is anticipated that the implementation of Best Management Practices (BMPs) by landowners in the watershed and the utilization of available technical assistance will continue through the efforts of the resource conservation districts and the Sonoma/Marin County Farm Bureau. The Farm Bureau has an active Animal Waste Committee which meets quarterly. This committee has developed waste management guidelines to protect water quality. It has also established a protocol for landowner representatives to seek a solution for complaints, and is currently in the process of implementing a landowner monitoring program to assess water quality, and if water quality is impacted, to seek the source and correct the problem. Finally, Clover Dairy Products has implemented an incentives program that awards dairies that qualify as being environmentally friendly, and it is hoped that the creamery will continue to implement the program. Regional Water Board staff will continue to encourage landowners to voluntarily seek technical assistance for resource management including identifying problem areas and implementing BMPs.

The landowners in this watershed have already demonstrated a collective commitment to improve water quality. Under this TMDL, a landowner's development and implementation of a ranch plan is strictly voluntary. The Regional Water Board also understands that the timely implementation of some measure identified in a ranch plan may depend upon the availability of funding. For these reasons, the development of a ranch plan does not result in an enforceable commitment by the landowner to implement the ranch plan. In order for the Regional Water Board to track the success of this TMDL, land owners will submit the water quality aspects of their ranch plans for all cases within the watershed where the numeric targets are not yet being attained.

The Regional Water Board will review the water quality elements of the ranch plans in order to ensure that the measures and recommendations included in *The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan* are described for significant discharges or threatened discharges of nutrients or sediments. If a significant number of landowners fail to submit the water quality aspects of their ranch plans or fail to implement the ranch plans, the Regional Water Board may consider amending the TMDL so that it does not rely upon a strictly voluntary approach. If the water quality sections of the ranch plans are not submitted, or if they do not adequately address the measures and recommendations included in *The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan*, the Regional Water Board will utilize its existing authority in the California Water Code to adopt Waste Discharge Requirements or issue Cleanup and Abatement Orders for significant discharges of sediments or nutrients.

The status of attainment and review of the implementation measures is scheduled for the year 2000.

MONITORING PLAN: The Regional Water Board staff monitoring effort initiated in 1992 with eight mainstream stations will be continued. The Sonoma/Marin Farm Bureau Animal Waste Committee is planning on implementing a citizen monitoring program beginning in the fall of 1997, which will include these eight stations. These stations also include the two attainment points specified in the targets section of this plan. Landowners who have attended water quality monitoring training workshops and have been provided field test kits, will continue to conduct site specific assessments to identify problem areas. The site specific monitoring will also be used to assess the effectiveness of implemented corrective measures. Photographic monitoring of erosion control activities such as stream bank revegetation and gully repairs is

ongoing and will continue. Each landowner's ranch management plan includes sections for recording stream monitoring data and displaying before and after photographs. A monitoring protocol has also been developed to measure residual dry matter (RDM) as a rangeland management tool to prevent overgrazing.

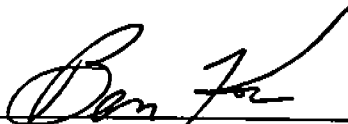
Regional Water Board staff will conduct periodic monitoring at two attainment points: the Alexander Road crossing in Stemple Creek, and the Valley Ford Franklin School Road crossing, which is located at the mid-point of the Estero de San Antonio. The Regional Water Board staff will conduct field measurements commensurate with the voluntary self-monitoring program and will utilize the information to evaluate progress towards reaching the numeric targets set forth in this TMDL and Attainment Strategy. At least annually after adoption, the Regional Water Board staff will evaluate the data and provide a report at a regularly scheduled meeting on the progress of this TMDL and Attainment Strategy. The progress report will include an annual inventory of projects completed, proposed projects, and projects in progress.

PUBLIC PARTICIPATION: Public participation was a key element in development of the Enhancement Plan for Stemple Creek and the Estero de San Antonio, and will continue as a key component in this TMDL process. Interested public and stakeholders will have the opportunity to comment on this TMDL at a properly noticed public hearing of the North Coast Regional Water Quality Control Board. Following adoption by the Regional Water Board, interested persons will continue to have the opportunity to provide comments at quarterly meetings of the Sonoma and Marin County Farm Bureau's Animal Waste Committee. The meeting dates for the committee are published in the monthly Farm Bureau newspaper.

At least annually, the public will have the opportunity to comment on the progress of this TMDL and Attainment Strategy at a regularly scheduled meeting of the Regional Water Board in the Santa Rosa area.

Certification

I, Benjamin D. Kor, Executive Officer,
do hereby certify that the foregoing is
a full, true, and correct copy of a
Resolution adopted by the California
Regional Water Quality Control Board,
North Coast Region, on December 11, 1997.



Benjamin D. Kor
Executive Officer

EXECUTIVE SUMMARY

PROBLEM STATEMENT: Stemple Creek, including the Estero de San Antonio, is a predominantly agricultural 50 square-mile coastal watershed located in southern Sonoma and northern Marin counties. Excessive amounts of nutrients and sediment from nonpoint sources are causing and/or threaten to cause impairment of beneficial uses and/or nonattainment of the water quality objectives which are set forth in the *Water Quality Control Plan for the North Coast Region* (Basin Plan). The deposition of sediment in the Estero de San Antonio reduces the tidal function of mixing fresh and salt water, and causes the mouth to be seasonally closed by the formation of a sand bar. Sediment has also filled many deep holes in Stemple Creek, reducing the stream's habitat value for fish and aquatic life. Livestock access to riparian areas has resulted in the destruction of riparian vegetation and the trampling of stream banks resulting in additional erosion. The loss of riparian vegetation also results in elevated water temperatures due to the lack of shade. Nutrients such as nitrates and phosphorus in the watershed adversely affect aquatic life by causing eutrophication. Ammonia, in its un-ionized form, is present at times in concentrations that are toxic to aquatic life. Currently, fish do not inhabit most reaches of Stemple Creek, yet historically, the stream was known to support the migration and spawning of anadromous fish. Beneficial uses adversely impacted include non-contact water recreation (REC-2), cold freshwater habitat (COLD), commercial and sport fishing (COMM), preservation of areas of special biological significance (BIOL), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), marine habitat (MAR), migration of aquatic organisms (MIGR), spawning, reproduction, and/or early development (SPWN), and estuarine habitat (EST).

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adequately address the measures and recommendations included in *The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan*, the Regional Water Board will utilize its existing authority in the California Water Code to adopt Waste Discharge Requirements or issue Cleanup and Abatement Orders for significant discharges of sediments or nutrients.

The status of attainment and review of the implementation measures is scheduled for the year 2000.

MONITORING PLAN: The Regional Water Board staff monitoring effort initiated in 1992 with eight mainstream stations will be continued. The Sonoma/Marin Farm Bureau Animal Waste Committee is planning on implementing a citizen monitoring program beginning in the fall of 1997, which will include these eight stations. These stations also include the two attainment points specified in the targets section of this plan. Landowners who have attended water quality monitoring training workshops and have been provided field test kits, will continue to conduct site specific assessments to identify problem areas. The site specific monitoring will also be used to assess the effectiveness of implemented corrective measures. Photographic monitoring of erosion control activities such as stream bank revegetation and gully repairs is ongoing and will continue. Each landowner's ranch management plan includes sections for recording stream monitoring data and displaying before and after photographs. A monitoring protocol has also been developed to measure residual dry matter (RDM) as a rangeland management tool to prevent overgrazing.

Regional Water Board staff will conduct periodic monitoring at two attainment points: the Alexander Road crossing in Stemple Creek, and the Valley Ford Franklin School Road crossing, which is located at the mid-point of the Estero de San Antonio. The Regional Water Board staff will conduct field measurements commensurate with the voluntary self-monitoring program, and will utilize the information to evaluate progress towards reaching the numeric targets set forth in this TMDL and Attainment Strategy. At least annually after adoption, the Regional Water Board staff will evaluate the data and provide a report at a regularly scheduled meeting, on the progress of this TMDL and Attainment Strategy. The progress report will include an annual inventory of projects completed, proposed projects, and projects in progress.

PUBLIC PARTICIPATION: Public participation was a key element in development of the Enhancement Plan for Stemple Creek and the Estero de San Antonio, and will continue as a key component in this TMDL process. Interested public and stakeholders will have the opportunity to comment on this TMDL at a properly noticed public hearing of the North Coast Regional Water Quality Control Board. Following adoption by the Regional Water Board, interested persons will continue to have the opportunity to provide comments at quarterly meetings of the Sonoma and Marin County Farm Bureau's Animal Waste Committee. The meeting dates for the committee are published in the monthly Farm Bureau newspaper.

At least annually, the public will have the opportunity to comment on the progress of this TMDL and Attainment Strategy, at a regularly scheduled meeting of the Regional Water Board in the Santa Rosa area.

BACKGROUND

Clean Water Act (CWA) Section 303(d) requires states to identify waterbodies that do not meet water quality objectives and then to establish a waste load allocation, or a TMDL, for each waterbody which will ensure attainment of the water quality objectives. The USEPA has established a process for the development and implementation of TMDLs, which is based on the development of an attainment strategy. The USEPA must review and approve the TMDL and the attainment strategy developed for each 303(d) listed waterbody.

A TMDL is the sum of individual wasteload allocations for point sources, load allocations for nonpoint sources and natural background pollutants, and an appropriate margin of safety. TMDLs may be determined from available information, or they may be developed over the long-term using a phased approach. Phased approach TMDLs are particularly appropriate when addressing nonpoint source issues. Through the phased approach, available information is used to establish interim targets, begin implementation of needed controls and restoration actions, monitor waterbody response to these actions, and plan for TMDL review and revision in the future.

A TMDL represents the total load of a pollutant which can be discharged to a water body on a daily basis and still meet the applicable water quality standard. Whereas chemical water quality constituents are usually expressed in parts per million or milligrams per liter, the TMDL may be expressed in pounds per day. In most cases, the TMDL sets forth an allowable pounds per day of a constituent and divides it among the various contributors in the watershed as waste load and load allocations. The TMDL also accounts for natural background sources and provides a margin of safety. For nonpoint sources such as accelerated erosion it may not be feasible or useful to derive a pounds per day figure. In such cases, a percent reduction in pollutant discharge may be proposed.

The process of developing this TMDL utilizes the following seven components.

- (1) Problem Statement
- (2) Numeric Target
- (3) Source Analysis
- (4) Allocations of Responsibility
- (5) Implementation Plan
- (6) Monitoring Plan
- (7) Public Participation

Stemple Creek was placed on the Section 303(d) list in 1990. The pollutants causing impairment and/or threat of impairment in the Stemple Creek watershed are nutrients and sediment from nonpoint sources. Therefore, a phased TMDL is proposed.

The following references provide a basis for the proposed TMDL for the Stemple Creek Watershed.

A. *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan*, July 1994, prepared by Prunuske Chatham, Inc., P.O. Box 828, Occidental, CA 95465 for Marin County Resource Conservation District and Southern Sonoma County Resource Conservation District. This report represents the efforts of numerous stakeholders to identify and, where possible, improve the natural resources of the watershed while maintaining a vigorous agricultural economy. The plan identifies degraded water quality from nutrients and sediment, and recommends the implementation of both short and long-term goals. A total of ten enhancement recommendations are identified. Several technical studies were conducted in conjunction with the effort and are appended to the report. They are as follows:

Appendix A: *Biological Assessment for Estero de San Antonio* - John Maron, 1994

Appendix B: *Vegetation and Habitat Restoration* - Marco Waaland, and Golden Bear Biostudies, 1993

Appendix C: *Erosion and Sediment Study* - U.S.D.A. Soil Conservation Service, 1992

Appendix D: *Water Resources Technical Report* - M. Kim Cordell, Prunuske Chatham, Inc., 1993

Appendix E: *Geomorphic and Hydrodynamic Analysis* - Philip B. Williams and C. Kelly Cuffe, Philip Williams & Associates, Ltd., 1993

Appendix F: *Summary of Watershed Residents Interviews* - Liza Prunuske, Prunuske Chatham, Inc., 1994

B. *Stemple Creek Water Quality Characteristics and a Maximum Daily Load Process*, August 1995, prepared by staff of the California Regional Water Quality Control Board, North Coast Region. This report contains sampling results from 1990 to 1994 which was conducted to assess conditions and trends over time. Also presented is the investigation of two water quality models for Stemple Creek, using the obtained monitoring information, to develop waste load reduction strategies.

C. *Calculation of Un-Ionized Ammonia for Fresh Water*, by Norman L. Morgan and J.L. Turner, California Department of Fish and Game, Environmental Services Branch, Administrative Report No. 77-1, January 1977.

D. *1992 Revised Tables for Determining Average Freshwater Ammonia Concentrations*, memorandum from Margaret Heber and K. Ballentine, United States Environmental Protection Agency, dated July 30, 1992.

PROBLEM STATEMENT

The Watershed: Stemple Creek and the Estero de San Antonio comprise 17 miles of water course and 50 square miles of drainage area tributary to Bodega Bay and the Pacific Ocean. The Estero de San Antonio is part of the Gulf of the Farallones National Marine Sanctuary and is included in the Central California Coast Biosphere Reserve (UNESCO Man and Biosphere Program). The watershed is divided by the Sonoma and Marin county line with the upper watershed in Sonoma County immediately north and west of Petaluma and including the United States Coast Guard Training Center at Two Rock and the Sonoma County Central Landfill. The upland areas of the watershed are mainly rolling hills covered with pasture. West of Highway 1, the slopes increase in steepness and the marine influence is reflected by coastal vegetation. The watershed enters Bodega Bay north of Dillon Beach and the mouth of Tomales Bay.

Only 20 percent of the stream channels in the watershed now have willows or other woody plants growing along them. The lack of riparian vegetation results in inadequate shading and higher water temperatures and a significant decline in wildlife species which depend on riparian vegetation for habitat.

Sediment yield from the watershed is estimated at about 51,000 tons per year, with 6,000 tons per year deposited in the Estero de San Antonio and the remaining 45,000 tons going on to the ocean. Channel erosion, defined as stream bank erosion and erosion in gullies, is estimated to produce 68 percent of the total sediment yield. Sheet and rill erosion is responsible for the remaining 32 percent. Accelerated erosion, defined as erosion caused by man that is in addition to the background or geologic rate of erosion, contributes an estimated 70 percent of the sediment yield, or 35,700 tons per year.

The Stemple Creek watershed has about 26,000 acres of rangeland, which comprises approximately 80 percent of the watershed. About 10 percent of the rangeland, or 2,600 acres, has low (less than 1000 pounds per acre) residual dry matter [RDM]. Low RDM results in reduced soil fertility and water infiltration, and exposes the soil to direct rainfall. The increase in runoff causes sheet and rill erosion and higher stream flow. A moderate RDM (1,000 to 1,500 pounds per acre) is the desired level.

Land Use: Land use in the watershed is predominantly animal agriculture, including dairy, livestock, and poultry ranches. About 80 percent of the watershed land area is rangeland. There are 27 dairies in the watershed, with two-thirds of the dairies located in the eastern half or the Sonoma County area of the watershed. Dairy operations represent nearly 30 percent (9,500 acres) of the watershed land area. The dairies have large concentrations of livestock, with the average ranch having an animal population of 500 head, including dry stock. A major cause of concern, from a water quality perspective, is the volume of manure production and waste water generation at these confined animal facilities. These animals generate large amounts of manure and nutrients. For example, a 1400-pound dairy cow produces about 21 gallons (three cubic feet) of waste per day, with 86 pounds per day of feces, and 26 pounds per day (3.5 gallons) of urine. By comparison, it takes 42 adult humans to generate the same volume of waste. The daily nutrient value of the waste from one dairy cow is 0.63 pounds of nitrogen, 0.098 pounds of phosphorus, and 0.364 pounds of potassium. The annual nutrient production of the 6800 milk

cows in the watershed (a human adult population equivalent of 285,600 people) is 780 tons of nitrogen, 120 tons of phosphorus, and 450 tons of potassium. The dairies utilize the nutrient value of the animal wastes for fertilizing their forage lands, with growth prompted by seasonal winter precipitation. Land spreading in the fall just prior to wet weather is the application method. The dairies in the watershed have an average of 350 acres of forage land that is fertilized, which yields annual per acre application rates of 160 pounds of nitrogen, 25 pounds of phosphorus, and 95 pounds of potassium. Forage production is mainly pasture and hay. The major mode of nutrient transport to Stemple Creek and the Estero de San Antonio is storm water runoff from lands that have been fertilized with manure. Annual rainfall amounts vary from 40 to 60 inches. Because of the large number of animals in the watershed and the subsequent nutrient production that results from these operations, this TMDL and Attainment Strategy focuses on animal agricultural operations, with particular emphasis on dairy operations.

Adverse water quality impacts in the watershed result from:

- Inadequately managed and/or undersized animal waste containment and storage facilities (manure pits and liquid waste storage ponds). Overflow or spillage from these facilities and/or runoff from manured areas (pens and corrals) can result in extremely adverse water quality impacts, since they contain concentrated wastes.
- Inadequately managed rangeland, including grazing and fertilization practices that result in sediment and nutrient discharges. Examples are as follows:
 - ▶ Overgrazing, which can result in low residual dry matter (RDM), and ultimately sedimentation in the waterways.
 - ▶ Application of manure in close proximity to water courses and/or drainages and in flood plain areas, which can result in rainfall runoff or flood induced discharges of nutrients.
 - ▶ Fertilization at rates in excess of rangeland or crop demand, which can result in discharges of nutrients.
 - ▶ Fertilization during the wet weather season (typically December through March), which can result in rainfall induced runoff and discharges of nutrients.
 - ▶ Allowing uncontrolled animal access to riparian areas or drainages and flood plain areas, which can result in rainfall runoff or flood induced discharges of nutrients and sediment.

While animal agriculture is the major land use in the watershed, there are other additional land use activities. Two important and diverse land use activities, both located in the upper watershed, are the U.S. Coast Guard's Two Rock Training Center on Tomales Road and the County of Sonoma's Central Solid Waste Disposal Site on Mecham Road. Both of these facilities are regulated by the Regional Water Board. Waste discharge requirements adopted by the Regional Water Board prohibit any discharge of pollutants from these facilities to Stemple Creek.

U.S. Coast Guard's Two Rock Training Center: This facility has a domestic wastewater treatment plant which utilizes irrigation for disposal of treated effluent. Irrigation runoff to Stemple Creek has occurred, and efforts are in progress to correct the problem, which is a violation of waste discharge requirements. A portion of the property is also leased to a local rancher for fodder crop production. This crop is fertilized with manure from this dairy ranch. There have been no identified water quality problems associated with the fodder crop operation.

County of Sonoma's Central Solid Waste Disposal Site: This facility has experienced operational problems in violation of waste discharge requirements, resulting in Regional Water Board enforcement measures. The discharger is implementing corrective actions. The problems have been associated with runoff from the site during rainfall events. The discharger and Regional Water Board staff will monitor and evaluate the success of the implemented corrective actions.

Beneficial Uses: The beneficial uses of the waters of Stemple Creek, a minor coastal stream not specifically listed in the Basin Plan, and the Estero de San Antonio, an estuary, are listed below. The adversely impacted beneficial uses are marked by a bullet.

- Municipal and Domestic Supply (MUN)
- Agricultural Supply (AGR)
- Industrial Service Supply (IND)
- Industrial Process Supply (PROC)
- Groundwater Recharge (GWR)
- Navigation (NAV)
- Water Contact Recreation (REC-1)
- Non-Contact Water Recreation (REC-2)
- Commercial and Sport Fishing (COMM)
- Cold Freshwater Habitat (COLD)
- Preservation of Areas of Special Biological Significance (BIOL)
- Wildlife Habitat (WILD)
- Rare, Threatened, or Endangered Species (RARE)
- Marine Habitat (MAR)
- Migration of Aquatic Organisms (MIGR)
- Spawning, Reproduction, and/or Early Development (SPWN)
- Shellfish Harvesting (SHELL)
- Estuarine Habitat (EST)

Surface Water Objectives: To protect beneficial uses, compliance with water quality objectives, as set forth in the Basin Plan is required. A general objective, which applies to all waters of the North Coast Region, states that whenever the existing quality of water is better than the water quality objectives established by the Basin Plan, such existing quality shall be maintained unless otherwise provided by the provisions of the State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California", including any revisions thereto.

In addition to the general objective, the following specific objectives are applicable to the Stemple Creek watershed:

Toxicity - The Basin Plan states: "All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Water Board." Un-ionized ammonia can be very toxic to many aquatic life forms, especially salmonid fish and a variety of aquatic insects. The un-ionized fraction of ammonia is very sensitive to pH (decreasing with increasing hydrogen ion concentration) and temperature (increasing with water temperature). The USEPA has and the California Department of Fish and Game have established water quality criteria for un-ionized ammonia that can be used as a measure of compliance with the toxicity objective, which call for concentrations of un-ionized ammonia to be equal to or less than approximately 0.025 mg/L as NH₃ within the temperature and pH ranges acceptable and expected to occur in the watershed.

Biostimulatory Substances - The Basin Plan states: "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths, cause nuisance, or adversely affect beneficial uses."

Color - The Basin Plan states: "Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses."

Tastes and Odors - The Basin Plan states: "Waters shall not contain taste or odor-producing substances in concentrations that impart undesirable tastes or odors to fish flesh or other edible products of aquatic origin that cause nuisance or adversely affect beneficial uses."

Floating Material -The Basin Plan states: "Waters shall not contain floating material, including solids, liquids, foams, and scum, in concentrations that cause nuisance or adversely affect beneficial uses."

Suspended Material - The Basin Plan states: "Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses."

Settleable Material - The Basin Plan states: "Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses."

Sediment - The Basin Plan states: "The suspended sediment load and suspended sediment discharge rate of surface waters shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses."

pH - The Basin Plan sets a numeric range for pH of 6.5 to 8.5, and requires that any change in normal ambient pH levels not exceed 0.2 units in waters designated marine MAR beneficial use and 0.5 units within fresh waters designated as COLD beneficial use.

Dissolved Oxygen - The Basin Plan sets numeric limits for dissolved oxygen concentrations of not less than 9.0 mg/L for waters designated SPWN during critical spawning and egg incubation periods, not less than 7.0 mg/L for waters designated SPWN, not less than 6.0 mg/L for waters designated COLD, and not less than 5.0 mg/L for waters designated MAR.

Bacteria - The Basin Plan states: "The bacteriological quality of waters of the North Coast Region shall not be degraded beyond natural background levels. In no case shall coliform concentrations in waters of the North Coast Region exceed the following:

In waters designated contact recreation (REC-1) the median fecal coliform concentration shall not exceed 50/100 ml, based on a minimum of not less than five samples for any 30-day period, nor shall more than ten percent of total samples during any 30-day period exceed 400/100 ml.

At all areas where shellfish may be harvested for human consumption (SHELL), the fecal coliform concentration throughout the water column shall not exceed 43/100 ml for a 5-tube decimal dilution test or 49/100 ml when a three-tube decimal dilution test is used."

Temperature - The Basin Plan states: "Temperature objectives for COLD interstate waters, WARM interstate waters, and enclosed Bays and Estuaries are as specified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays of California" including any revisions thereto.

In addition, the following temperature objectives apply to surface waters:

The natural receiving water temperature of intrastate waters shall not be altered unless it can be demonstrated to the satisfaction of the Regional Water Board that such alteration in temperature does not adversely affect beneficial uses.

At no time or place shall the temperature of any COLD water be increased by more than 5 degrees Fahrenheit above the natural receiving water temperature."

Chemical Constituents - The Basin Plan states: "Waters designated for use as domestic or municipal supply (MUN) shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Chapter 15, Division 4, Article 4, Section 64435 (Tables 2 and 3), and Section 64444.5 (Table 5)..."

Pollutants or Stressors Causing Impairment: The California Water Code defines pollution as "an alteration of the quality of the state waters by waste to a degree which unreasonably affects either of the following: (1) The waters for beneficial uses; and/or (2) Facilities which serve these beneficial uses."

The CWA identifies categories of pollution as either point source or nonpoint source (NPS). Point source pollution is an observable, specific, and confined discharge of pollutants into a water body. Examples of point source pollution include discharges or overflows from dairy waste ponds, domestic waste sewage treatment plants and collection systems, and industrial waste treatment plants. Such discharges must have permits and are required by their permit to meet specific discharge criteria to avoid adverse water quality impacts.

In contrast, NPS pollution consists of diffuse discharges of pollutants, usually as a result of rainfall runoff, throughout the natural environment. Nonpoint sources of pollution, including erosion, and to a lesser degree nutrients, occur naturally at levels which normally do not adversely affect water quality. However, adverse water quality impacts can result from unstable

and highly erodible soils and even common farming practices, such as the application of nutrients by dry spreading of manure on grazing land. NPS pollution from rangelands can be exacerbated by over-grazing, road building, mining, and recreational activities. The over-grazing can produce excessive sediment (from sheet and rill erosion), nutrients, and pathogens. Animal access to riparian areas allows the direct deposition of nutrients and pathogens (from manure) into waterways, and can cause sedimentation from bank erosion and sedimentation by the browsing and trampling of riparian vegetation. The NPS pollutant discharges of animal wastes which adversely affect the beneficial uses are nutrients, including ammonia, nitrate, nitrite, and phosphorus, and sediment.

The pollutants and stressors in the Stemple Creek watershed are summarized as follows:

Toxicity: The toxic effects of un-ionized ammonia follow a seasonal trend, with the most critical periods occurring in March and April. The average concentration of un-ionized ammonia in Stemple Creek is between 0.003 and 0.23, mg/L as NH_3 depending on the season and the location (Reference B). Highest concentrations of un-ionized ammonia in Stemple Creek were calculated to be 1.97 mg/L as NH_3 , based on a pH of 7.8 and a temperature of 14.7 degrees C. It should be noted that this sample was taken in late spring, at a location which was adversely affected by livestock access to the stream immediately upstream of the sampling site, and that the installation of exclusionary fencing has corrected this problem. The pH in Stemple Creek has been measured as high as 8.4, and temperatures have been measured to be as high as 24.2 degrees C. At these levels, total ammonia should not exceed 0.18 mg-N/L in order for the un-ionized ammonia to be less than toxic.

Nutrients: The identified nutrients include ammonia, nitrate, and nitrite and total inorganic phosphorus. In Stemple Creek, nitrate has been measured as high as 11.0 mg-N/L. Total Inorganic Phosphorous has been measured as high as 4.0 mg-P/L. Nutrient-induced algae blooms and subsequent algae die off result in organic depositions and eutrophic conditions that adversely affect dissolved oxygen. In spring, dissolved oxygen levels decline to near 0 mg/L in the upper reaches of Stemple Creek when flow is low and there is no shade. At the target attainment point at Alexander Road, dissolved oxygen levels have ranged between 6.5 and 9.2 mg/L. At the target attainment point in the Estero de San Antonio at Valley Ford Franklin School Road, dissolved oxygen levels have ranged between 3.8 and 10.1 mg/L. In addition, the nutrient-induced aquatic growths result in objectional color, taste and odor, and floating and settleable materials.

The concentration of chlorophyll-*a*, a parameter which is used to estimate phytoplankton biomass, has exceeded 600 $\mu\text{g/L}$ in the lower reaches of Stemple Creek and the upper reaches of the Estero de San Antonio. This relatively high level of chlorophyll-*a* is characteristic of an algal bloom caused by excessive nutrients and indicative of eutrophic conditions. Reference A, Appendix A indicates that chlorophyll-*a* can be quite variable, and reports that mean concentrations at three stations were at more normal or acceptable levels of 16, 44, and 69 $\mu\text{g/L}$ during the 1988 through 1990 sampling period. Typical monitoring results indicate nitrate levels between 1.5 and 5.5 mg/L, total inorganic phosphorus between 0.85 and 1.5 mg/L and chlorophyll-*a* between 0.8 and 240 $\mu\text{g/L}$.

Manure nutrients from concentrated animal feeding operations are identified as the primary cause of the impaired water quality conditions in the Stemple Creek watershed (Reference A,

Appendices A, B, C, and D). The land application of manure as fertilizer is the predominant manure nutrient management method, and is considered an acceptable management practice provided the application is at rates which are reasonable for the crop, soil, climate, special local situations, management system, and type of manure. However, when manure is spread on land in close proximity to surface drainages and/or on steep slopes and where inadequate or dormant vegetation is present, rainfall-induced runoff results in the transport of manure nutrients to surface waters.

Sedimentation: Rangeland management is the highest priority in the watershed to reduce sediment as well as nutrient effects on water quality. Critical components of rangeland management which contribute to the maintenance of a moderate RDM, are deferred grazing and planned grazing systems used in conjunction with other recommended practices, such as cross fencing, range seeding, fertilization, mechanical treatment of the soil, and stream channel revegetation. Deferred grazing is the postponing of grazing or resting of grazing land for a prescribed period of time. Planned grazing is the alternate resting and grazing of two or more grazing units in a planned sequence for a period of years. The rest period may be throughout the year or during the growing season of key plants. Stream channel fencing and off-stream or upland water and shade facilities for livestock should be incorporated into the planned grazing systems to maximize the benefits of the fencing systems. The restoration of riparian vegetation with exclusionary fencing will prevent further bank erosion, provide wildlife habitat, and also shade the stream. The highest priority within rangeland management is the exclusion of animals from riparian areas. The second highest priority is the application of manure (fertilization) at a nutrient uptake rate that is appropriate for the rangeland vegetation.

Excessive erosion of rangeland and stream channels is occurring in the Stemple Creek watershed. Turbidity has been measured between 4.7 and 47.7 Formazine turbidity units (FTU). While turbidity is not a measure of sedimentation and may or may not relate directly to the deposition of sediment, it is a valuable tool for identification of sites and stream segments where erosion is occurring. Monitoring for turbidity also provides a means of evaluating measures implemented to correct identified erosion problems.

NUMERIC TARGETS

The Regional Water Board concurs with the waste reduction goal for nutrient and sediment discharges to Stemple Creek recommended by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) in its *Stemple Creek Preauthorization Report*, (1995), (Reference A, Appendix C). This Report sets forth a goal to reduce the amount of nutrients reaching Stemple Creek and the Estero de San Antonio by 75 percent. It is expected that this goal will achieve compliance with Basin Plan objectives and would also help implement the recommendations set forth in the *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan* (Reference A).

Regional Water Board staff used the STREAMDO IV computer model, provided by the USEPA for use in the Stemple Creek watershed, to verify the NRCS goal. STREAMDO IV is a steady-state mathematical model which can be used in wasteload allocation/total maximum daily load analyses related to dissolved oxygen and ammonia. Use of this model is further discussed in the Regional Water Board staff report *Stemple Creek Water Quality Characteristics And A Maximum Daily Load Process*, (1995) (Reference B). While additional water quality and flow data is needed for more precise calibration and verification of the model, the information developed supports the overall reduction goal of 75 percent. Using the model, the 75 percent reductions of NH₃-N and BOD (representing nutrient and organic loads) would result in a predicted concentration of 0.023 mg/L as NH₃ for un-ionized ammonia at the target Alexander Road attainment point during the late spring/early summer critical period which meet the California Department of Fish and Game and the USEPA criteria for un-ionized ammonia, as well as the Basin Plan objectives for pH and temperature. (References C and D).

For development of numeric targets, two attainment sites, Alexander Road on the main stem of Stemple Creek, and the Valley Ford Franklin School Road crossing near the mid-point of the Estero De San Antonio, are proposed. The critical target attainment season is during late spring and early summer season. During the winter wet-weather season water temperature is cooler, stream flows are higher, pH is slightly more acidic, and upland storm water runoff results in elevated nutrient levels in the stream. Typical winter water temperature is 15 degrees C. or less at both target attainment sites. Typical winter pH is 7.8 units or less in Stemple Creek and 8.0 units in the Estero de Americano. In late spring and early summer, water temperatures increase, stream flows decrease, pH levels are more basic, and nutrient inputs from runoff are less. The late spring and early summer water temperature typically reaches 20 degrees C. in Stemple Creek and up to 25 degrees C. in the Estero de San Antonio. The late spring and early summer pH values are typically 0.5 pH units higher than winter.

As salinities increase, the fraction of un-ionized ammonia decrease, so that the fraction of un-ionized ammonia in sea water is approximately one half of the amount for fresh water. This factor will be a consideration for the Estero de San Antonio attainment site.

The identified water quality constituent numeric targets, seasons, target dates, and locations are as follows:

1. Dissolved oxygen: The targets for dissolved oxygen are final targets, with not less than the following minimum concentrations by the year 2004.
 - 5.0 mg/L in the Estero de San Antonio
 - 6.0 mg/L in Stemple Creek

7.0 mg/L in Stemple Creek and the Estero de San Antonio wherever and whenever the aquatic habitat is suitable for salmonid migration rearing, and spawning, and
 9.0 mg/L during critical spawning and egg incubation periods, which is defined as applicable when and where anadromous fish redds are located.

2. Temperature: The targets for temperature are seasonal and apply to Stemple Creek and the Estero de San Antonio. The final targets, which apply in year 2004, are 20 degrees C. during May through November and 13.8 degrees C. during December through April.
3. pH: The target range for pH applies during late spring and early summer. The target range for pH is 7.0 to 8.5. Limited sampling at the two attainment points indicates that the pH target range is currently being met.
4. Total and un-ionized Ammonia: The targets for total ammonia and un-ionized ammonia apply whenever and wherever the aquatic habitat is suitable for salmonid migration, rearing, and spawning. The target for un-ionized ammonia is 0.025 mg/L. as NH₃. The targets for temperature and pH must be achieved in order for the target for total ammonia to apply. The numeric targets for total and un-ionized ammonia are derived from "Calculation of Un-Ionized Ammonia for Fresh Water," by Norman L. Morgan and J.L. Turner, California Department of Fish and Game, Administrative Report No. 77-1, January 1977.

In order to achieve the target for un-ionized ammonia, the target ranges for total ammonia are set forth in the following table.

Concentration of Total Ammonia as Nitrogen in mg/L. in Freshwater
 Which Contains 0.025 mg/L. Un-ionized Ammonia as NH₃

pH	10° C.	15° C.	20° C.
7.0	11.0	7.53	5.19
7.5	3.51	2.39	1.66
8.0	1.12	0.77	0.54
8.5	0.37	0.26	0.18

5. Sediment: A phased approach for sediment reduction is proposed for the entire watershed, with initial work focusing on active channel erosion areas, and the implementation of management measures to reduce sheet and rill erosion from rangeland and cropland sources. A numeric target for sediment, with a yield of 12,760 tons per year, or a 75 percent reduction, by the year 2004 is established. The ultimate goal is prevention of erosion to the maximum extent possible so that winter flows naturally remove accumulated sediment from the estuary and re-establish the tidal prism. It may be necessary to consider at some point in the future, the physical removal of accumulated sediment in the estuary by dredging.

SOURCE ANALYSIS¹

Nutrients: Animal agriculture has been identified as the source of nutrient pollution affecting the waters of Stemple Creek and the Estero de San Antonio. The effects in the watershed are the result of cumulative increases from non-point sources. No one particular source or small group of sources has been identified as a major contributor of these pollutants. However, the 27 dairies in the watershed are acknowledged as having large concentrations of animals with large amounts of animal wastes to manage.

Concentrated animal feeding operations (dairies), animal rangeland grazing operations (dairy, beef, and sheep), and poultry operations (chickens and turkeys) produce manure which is spread on pastures and croplands (hay and silage). Animal access to watercourses, the spreading of manure on overgrazed pasture land, and application of manure in excess of crop demand all contribute to nutrients entering the stream. Other nutrient sources include rainfall runoff through and from corrals, pens, and other areas where animals are concentrated and animal wastes accumulate, rainfall-induced overflow of liquid manure from waste storage ponds where pond size is not adequate and/or storm water runoff is not diverted or excluded, and flooding of crop or pasture land that has been fertilized with manure.

The 27 dairies in the watershed have an average of 250 milk cows each. Most dairies have an equal number of dry stock (non-lactating cows, heifers, calves, etc.), for an average of 500 head on each ranch. Average ranch size is 350 acres, for a total of nearly 10,000 acres. Typically, the milk cows are housed during the wet weather winter months of December, January, February, and March. For the remainder of the year the animals are pastured. Most operations do not commonly house their dry stock, except for newly born calves.

Sediment: Predominant sediment sources include stream banks, gullies, cultivated lands, and poorly managed rangelands which are associated with animal agriculture operations. Other sediment sources include unstable natural landforms, which result in landslides and soil creep, unsurfaced roads, and land disturbance activities (Sonoma County's Central Landfill). Sediment movement occurs predominantly during intense rainfall events, and is exacerbated by stream banks devoid of vegetation and rangelands where gully head-cuts are active. Mass wasting of soil during storm events results in deposition of sediment in Stemple Creek and the Estero de San Antonio.

The USDA Soil Conservation Service (SCS) (now Natural Resources Conservation Service [NRCS]), Davis, California, under authority of California Special Studies Basin and Area Planning, conducted the *Erosion and Sediment Study Stemple Creek Watershed* (1992), Reference A, Appendix C. The study was for, and in cooperation with, Marin County Resource Conservation District, Southern Sonoma County Resource Conservation District, and the California Coastal Conservancy. The study evaluates the erosion and sediment sources in the watershed, and investigates the conceptual designs for erosion control and sediment reduction to

¹Staff and laboratory resources were not sufficient to sustain an in-depth modeling effort and specific source identification. The resultant high level of uncertainty made identification of specific allocations of source difficult.

Stemple Creek, the Estero de San Antonio, and Bodega Bay. The study indicates that the total sediment yield from the watershed is about 51,000 tons per year, with 6,000 tons per year being deposited in the Estero de San Antonio and the remaining 45,000 tons going on to the Pacific Ocean.

The study identifies channel erosion as the major source of sediment deposits in the Estero de San Antonio. Channel erosion, defined as stream bank erosion and erosion in gullies along Stemple Creek and its tributaries, is estimated to produce about 68 percent of the total sediment yield, or about 34,680 tons per year. Of the 34,700 tons per year, the study estimates that 1.9 percent (660 tons) originates in the upper subwatershed, 15.6 percent (5,420 tons) originates in the middle subwatershed, and 82.5 percent (28,620 tons) originates in the lower subwatershed. The lower subwatershed is the most critical area for channel erosion control. About 46 percent of the sediment produced by channel erosion in the lower subwatershed is from gullies, 30 percent is from tributary stream banks, and 9 percent is from the banks of Stemple Creek. The remaining 15 percent in the lower subwatershed is from crop and rangeland sheet and rill erosion.

The study indicates that sheet and rill erosion is responsible for the remaining 32 percent (16,320 tons per year) of the total sediment yield in the watershed. Sheet and rill erosion is defined as sediment from upland (cropland and rangeland) sources that is transported by rainfall runoff. The middle subwatershed is the source of 40 percent of the sheet and rill erosion and sediment yield with the upper and lower subwatersheds each responsible for 30 percent. Although cropland comprises only about 6 percent (2,000 acres) of the total acreage (33,000), it contributes about 22 percent (3,300 tons per year) of the total sheet and rill sediment yield in the watershed. The remaining 78 percent of sheet and rill erosion (11,400 tons per year) is from rangeland sources.

The study defines accelerated erosion as the erosion caused by man that is in addition to the background or geologic rate of erosion. The study estimates that about 70 percent of the sediment yield (35,700 tons per year) in the Stemple Creek/Estero de San Antonio watershed is due to accelerated erosion. This accelerated erosion began over 100 years ago when much of the land in the watershed was cleared of native vegetation to make way for cultivated crops (potatoes). Since the watershed is characterized by a combination of highly erodible soil, steep slopes, and unstable geologic material, the accelerated erosion caused the formation of large gullies and degraded stream channels in the watershed. Although lands in the watershed today have been converted back to rangeland and only 2,000 out of 33,000 acres is now cultivated, large gullies and degraded stream banks remain and continue to erode with visible effects after large storm events.

The study indicates that the following factors are contributing to continued unstable conditions:

- Soils which have a relatively impermeable subsurface layer promote lateral movement of surface and subsurface water leading to piping and erosion.

As the water seeps along the impermeable layer to a bank, the bank becomes undercut by piping, creating an overhang which falls as a block of soil. This causes continued headcut movement. Grazing causes compaction, which contributes to the development of an impermeable soil layer, and is aggravated when the soil is wet.

- Access by livestock to riparian zones where vegetation is browsed and trampled.

The beneficial effects of slowing runoff, trapping sediment, and stabilizing stream channels are seriously compromised when livestock enter riparian zones, browse vegetation, and trample and denude the stream banks.

- Inadequate rangeland and cropland management.

Increased surface runoff results in increased erosion and the creation of new gullies and/or the reactivation of old ones. Rapid and high volume runoff also causes degradation of the stream channels by increasing the amount of water that the channels must carry. Under normal conditions, the Stemple Creek channel has the hydraulic capacity to hold runoff flow from storms that occur at a frequency of about every two years. However, during flood events, as much as 90 percent of the flow is out of the channel, resulting in deposits of up to 0.24 inches of sediment per year on the floodplain in the lower subwatershed. At the present rate of erosion, as much as two feet of sediment could be deposited in the flood plain in the next 100 years.

ALLOCATIONS OF RESPONSIBILITY

The nutrient and sediment problems in the watershed have demonstrated cumulative increases, and mismanagement of animal waste on a single property can adversely impact water quality in a large portion of Stemple Creek. Due to the level of source analysis and this cumulative effect, each landowner in the watershed is responsible for reducing the impact of pollutants on water quality from his or her property.

- **Nutrients, Dissolved Oxygen, pH, and Ammonia:** The only significant nutrient source of concern in the watershed is animal agriculture operations, including dairies, ranches, and poultry operations. Therefore, the TMDL allocates 100% of the needed nutrient load reductions (the 75% reduction target) to this source category. This allocation will be adequate to implement the dissolved oxygen, pH, and ammonia targets, as these stressors are controlled, for the most part, by nutrient loading. Measures to reduce stream temperature will also assist in reducing ammonia toxicity problems.
- **Sediment:** *The Erosion and Sediment Study* (Reference A, Appendix C) estimates average annual sediment loading by upper, middle, and lower watershed subareas, and by sediment source type. This TMDL established load allocations by watershed subareas in proportion to the loadings set forth in *The Erosion and Sediment Study*. The overall load reduction target is therefor allocated as follows:

<u>Watershed Subarea</u>	<u>Total Estimated Load</u>	<u>Allocation to Attain 75% Reduction</u>
	Tons/Year	Tons/Year
Upper	5550	1390
Middle	11940	2990
Lower	33510	8380
Total	51000	12760

The allocations are not intended to provide a focus on individual landowners actions. Rather, these allocations are intended as a general guide for further development of ranch plans and planned restoration projects and evaluation of followup monitoring data. Each individual ranch plan and restoration project does not necessarily have to be designed to meet a 75% reduction goal. Different approaches may be needed to address sediment sources in each subarea since the relative importance of different sources varies by subarea.

- **Temperature:** Temperature problems in the watershed are believed to be caused primarily by the absence of healthy riparian vegetation communities in the watershed. Only 20 percent of the stream channels currently support willows or other woody plants. Therefore, riparian vegetation restoration is the appropriate method of addressing the primary cause of temperature-related stress on beneficial uses. The TMDL allocation to address temperature is to carry out riparian restoration activities to be identified in ranch plans, with particular attention to be focused in the 80 percent of the channel areas which do not currently support riparian communities.

The *Stemple Creek/Estero de San Antonio Watershed Enhancement Plan* (Reference A) identifies who is responsible for completion of the plan's recommendations. Goals, both short-term and long-term, are identified, along with who is responsible, what potential funding sources are available, what resources and technical assistance are available, and what permits are needed.

Specific efforts identified by the plan are summarized as follows:

- ▶ The formation of an advisory committee of watershed residents to lead the effort.
- ▶ The obtaining of watershed-wide permits from all responsible agencies for projects identified by the plan. These would include activities that frequently require permits and/or environmental review, such as erosion control, cattle crossings in conjunction with riparian fencing, and removal of exotic plants.
- ▶ The development of a watershed newsletter to keep residents updated on enhancement activities and to share information on technical, economic, and regulatory issues that affect them.
- ▶ Assist the watershed's major producers with the development of comprehensive conservation plans (ranch plans) to coordinate range management, animal waste management, erosion control, wildlife habitat, economics, and other factors.
- ▶ Encourage cooperative planning and projects between neighboring producers.
- ▶ Provide water quality monitoring field test kits and training in monitoring techniques.
- ▶ Repair all major, active gullies and bank erosion areas and incorporate native vegetation, especially woody plants, to control erosion and increase wildlife habitat.
- ▶ Implement conservation tillage, filter strips, and other methods to reduce cropland erosion and provide follow-up monitoring to measure effectiveness.
- ▶ Restore instream pools if sediment reduction alone is not effective.
- ▶ Establish a long-term monitoring program to determine the impacts of enhancement measures on water quality, ecology, and bathymetry (to see if net scour or deposition is occurring in the Estero de San Antonio, and the dynamics related to the closure of the mouth of the Estero de San Antonio).

IMPLEMENTATION PLAN

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan (Reference A) will be used as the framework for implementation. The plan contains ten enhancement recommendations and each recommendation is followed by a list of goals. Short-term goals are intended to be completed by the year 2000. The long-term goals are projected to take five to ten years. Fulfillment of each goal is subject to receiving continued support from the community, the availability of technical assistance, and the securing of funding through grants, cost-share programs, and other sources. The recommendations and proposed methods of implementation are summarized as follows:

1. Encourage the local community to take the lead in developing and implementing enhancement projects. This is being implemented by the formation of an advisory group of watershed residents who, with the assistance of all agencies and organizations, encourage the development of landowner stewardship projects. Actions include the development of a watershed newsletter to keep residents updated on enhancement activities and to share information on technical, economic, and regulatory issues that affect them.
2. Assist agricultural producers with practices that promote the conservation and enhancement of natural resources. This is being implemented by securing watershed-wide environmental review and/or permits from all regulatory agencies for projects requiring permits such as erosion control and stream crossing projects. The development by each landowner of a comprehensive conservation plan to coordinate range management, animal waste management, erosion control, wildlife habitat, economics, and other factors is recommended. Plans were completed on two dairies with CWA Section 319(h) grant funding, and have served as prototypes for ranch management planning workshops. These workshops have been well attended by landowners. Additional ranch planning workshops are anticipated.
3. Reduce pollutants entering Stemple Creek and the Estero de San Antonio. This is being accomplished by implementation of specific projects by landowners on each ranch. Project need and priority is occurring through the development of the ranch management plans and self-monitoring of water quality by landowners. Continue to conduct water quality monitoring training workshops and provide field monitoring test kits. Monitoring is essential in identifying site specific problem areas and also provides a means to evaluate the success of measures implemented to correct the identified problem. Many landowners have implemented a monitoring program on their ranches. Since 1992, when activities in the watershed began to focus on water quality related problems, a significant reduction in pollutants has occurred in the watershed.
4. Reduce soil erosion. This is being accomplished by incorporation of erosion control measures in each landowners ranch management plan. Rangeland management measures are being implemented, including riparian fencing to exclude animal access and the planting of riparian vegetation along stream channels where erosion is occurring. Riparian fencing demonstration projects were implemented on four ranches utilizing CWA Section 319(h) grant funding. Additional projects have been scheduled on ten ranches, with funding provided by a grant from the California Coastal Conservancy. Educational and outreach materials, including a creek care guide, have been developed

and provided to landowners in the watershed. Finally, a comprehensive erosion control plan has been prepared (Reference A, Appendix C) by the United States Department of Agriculture Natural Resource Conservation Service. The Stemple Creek watershed has received a high priority for implementation funding.

5. Encourage environmentally-sound management of rangeland. This is being accomplished by the aforementioned development and implementation of comprehensive ranch management plans, the preparation and distribution of educational and outreach materials, and the implementation of monitoring to identify problem areas and assess the success of corrective action measures. The ranch plans are intended to be dynamic documents that detail the history of actions completed, actions that are in progress, and the schedule for future activities.
6. Conserve and enhance existing natural habitats. This is being accomplished by identification of important habitat areas, such as healthy riparian corridors, wetlands, areas of native grassland, oak and madrone forests, and areas inhabited by endangered species. Identification and management of these areas is included with the development and implementation of the conservation element of ranch management plans.
7. Restore the riparian corridor. Specific measures to protect and restore the riparian corridor have been developed by landowners and technical assistance agencies. Options include exclusionary fencing, riparian pastures, grazing management, and development of alternative livestock water and shade sources. Selected options and implementation measures are included in the ranch management plans developed by each landowner. In those cases where the riparian corridor is also the property boundary between ranches, cooperative planning and implementation is encouraged.
8. Develop a long-term monitoring program. This is being accomplished by implementation of the monitoring element in ranch management plans. Also, the Sonoma and Marin County Farm Bureau's Animal Waste Committee plans to initiate watershed monitoring at public right-of-way crossings (road bridges) in the watershed. These "pulse point" monitoring locations are intended to identify any stream segments where, based on monitoring results, additional efforts are in order, and also assess the success of efforts implemented. A ten year monitoring program is also recommended by Reference A, Appendix E for the Estero de San Antonio to assess the effectiveness of erosion control measures in maintaining the tidal prism.
9. Support agriculture as the major land use in the watershed. Although current zoning is designed to protect agricultural lands, development pressure and rising land prices are a cause for concern. Current efforts to protect farmland through open space districts and land trusts need public support to maintain their effectiveness.
10. Request additional investigation by the Santa Rosa Subregional Water Reclamation System on the potential impacts of the proposed West County Alternative on agriculture and natural resources. The City of Santa Rosa's long range plan for reclaimed wastewater disposal further studies this option.

Each land owner of property identified as contributing to the nutrient and sediment impairments of water quality in the watershed will be encouraged to develop and implement a

comprehensive ranch management plan, which will provide an identification of problem areas that may exist and then set forth a basis for developing a schedule for correction. Technical assistance will be provided from numerous sources, such as the USDA's Natural Resource Conservation Service (formerly the Soil Conservation Service), University of California's Cooperative Extension, and the Southern Sonoma and Marin County Resource Conservation Districts. Funding resources for corrective actions will be available through a number of agencies including the USDA's Environmental Quality Incentive Program (EQIP) and Wildlife Habitat Incentive Program (WHIP). The California Coastal Conservancy, Marin County Resource Conservation District, Southern Sonoma County Resource Conservation District, Marin Community Foundation, and Dean Witter Foundation, all contributors to the development of the watershed enhancement plan and its associated studies, will continue to provide assistance. It is hoped that CWA Section 319(h) funding will continue to provide education and outreach (including water quality monitoring training and acquisition of test kits), riparian area restoration demonstration projects, and support in the preparation of comprehensive ranch management plans.

It is anticipated that the implementation of Best Management Practices (BMPs) by landowners in the watershed and the utilization of available technical assistance will continue through the efforts of the resource conservation districts and the Sonoma/Marin County Farm Bureau. The Farm Bureau has an active Animal Waste Committee which meets quarterly. This committee has developed waste management guidelines to protect water quality. It has also established a protocol for landowner representatives to seek a solution for complaints, and is currently in the process of implementing a landowner monitoring program to assess water quality, and if water quality is impacted, to seek the source and correct the problem. Finally, the Clover Dairy Products has implemented an incentives program that awards dairies that qualify as being environmentally friendly, and it is hoped that the creamery will continue to implement the program. Regional Water Board staff will continue to encourage landowners to voluntarily seek technical assistance for resource management including identifying problem areas and implementing BMPs.

The landowners in this watershed have already demonstrated a collective commitment to improve water quality. Under this TMDL, a landowner's development and implementation of a ranch plan is strictly voluntary. The Regional Water Board also understands that the timely implementation of some measures identified in a ranch plan may depend upon the availability of funding. For these reasons, the development of a ranch plan does not result in an enforceable commitment by the landowner to implement the ranch plan. In order for the Regional Water Board to track the success of this TMDL, land owners will submit the water quality aspects of their ranch plans for all cases within the watershed where the numeric targets are not yet being attained.

All of the efforts by the landowners in the watershed, including the development of the watershed enhancement plan, have been accomplished through a voluntary program made possible through educational outreach activities and technical assistance. The commitment of the landowners and the projects that they have implemented have already shown an improvement in water quality in the watershed. Due to these efforts and projects, implementation is reasonably assured through voluntary means.

The Regional Water Board will review the water quality elements of the ranch plans in order to ensure that the measures and recommendations included in *The Stemple Creek/Estero de San*

Antonio Watershed Enhancement Plan are described for significant discharges or threatened discharges of nutrients or sediments. If a significant number of landowners fail to submit the water quality aspects of their ranch plans or fail to implement the ranch plans, the Regional Water Board may consider amending the TMDL so that it does not rely upon a strictly voluntary approach. If the water quality sections of the ranch plans are not submitted, or if they do not adequately address the measures and recommendations included in *The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan* the Regional Water Board will utilize its existing authority in the California Water Code to adopt Waste Discharge Requirements or issue Cleanup and Abatement Orders for significant discharges of sediments or nutrients.

Implementation of the above recommendations is occurring, with many individual projects already completed, others in progress, and many more planned. A partial inventory of enhancement projects funded in the period 1993 through 1996 indicates that \$564,899 has been expended in the watershed. Additional funding in excess of \$2,000,000 is either approved or pending approval.

An inventory of implementation funding is being maintained. The inventory describes completed projects, costs, and proposed projects with anticipated costs.

MONITORING PLAN

A voluntary water quality self-monitoring program has been implemented on individual ranches in Stemple Creek. Landowners will continue to monitor the sample points identified in Reference B, and the agricultural community will continue to evaluate and follow-up on results. Test kits have been provided and are available to landowners. Water quality monitoring classes have been conducted, with good attendance. Landowners have used their monitoring information to identify problems, to implement corrective measures, and evaluate the effectiveness of implemented corrective measures. Many landowners are maintaining monitoring information as an element of their comprehensive ranch management plans. Expansion of the water quality monitoring program is scheduled for implementation by the Sonoma and Marin County Farm Bureau's Animal Waste Committee in the fall of 1997. The evaluation of the monitoring results for each stream segment will enable the identification of problem areas, the establishment of priorities, and the implementation of corrective measures.²

In addition to water quality monitoring, landowners have implemented photographic monitoring of stream restoration efforts, with before, during, and after pictures. Several projects have involved fencing to exclude animals from the riparian corridor and the planting of native vegetation. The photographs show improved changes over time, as the vegetation matures and the stream banks become stabilized. Each landowner is encouraged to include the photographs in their ranch plan.

Landowners will continue to be encouraged to monitor upland areas by measuring the amount of residual dry matter (RDM) left after grazing. Measuring RDM provides the landowner with a tool to avoid over grazing and prevent erosion. By leaving residual dry matter in the upland pastures, the landowner is able to decrease erosion during rainfall events.

Regional Water Board staff will conduct periodic monitoring at two attainment points: the Alexander Road crossing in Stemple Creek, and the Valley Ford Franklin School Road crossing, which is located at the mid-point of the Estero de San Antonio. The Regional Water Board staff will conduct field measurements commensurate with the voluntary self-monitoring program, and will utilize the information to evaluate progress towards reaching the numeric targets set forth in this TMDL and Attainment Strategy. At least annually after adoption, the Regional Water Board staff will evaluate the data and provide a report at a regularly scheduled meeting, on the progress of this TMDL and Attainment Strategy. The report will include an annual inventory of projects completed, proposed projects, and projects in progress. As an example, a partial inventory for 1993-1996 is attached.

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan identifies three specific monitoring categories: 1) sediment deposition and ecological health of the Estero de San Antonio; 2) water quality for both surface and groundwater, and; 3) the population of the freshwater shrimp, *Syncaris pacifica*. The proposed monitoring plan will provide information regarding each of these categories.

The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan has proposed the implementation of a ten-year monitoring program for the Estero de San Antonio to measure the impacts of erosion control measures on the current tidal prism, to better define closure conditions at the mouth, to assess the physical evolution of the lagoon, and to monitor water quality and ecological changes.

²Funding to sustain the self-monitoring effort is not considered a problem. The cost of an ammonia test kit is about \$50.00. Refills for 30 samples cost about \$25.00. The cost of litmus paper and a thermometer is about \$10.00. Pet stores (aquariums), drug stores, hardware stores, and swimming pool supply stores all have relatively inexpensive water quality monitoring kits.

PUBLIC PARTICIPATION

Public participation was a key element in the development of *The Stemple Creek/Estero de San Antonio Watershed Enhancement Plan*. A watershed advisory committee, comprised of landowners, various agency representatives, local political representatives, and technical assistance agencies conducted three public meetings as the plan was developed. Individual landowners were contacted in person and a watershed newsletter was distributed periodically to keep everyone involved informed. Workshops, meetings, and tours were provided, as well as training and education.

Similarly, the watershed advisory committee and the Regional Water Board have continued an active level of public participation during the development of this TMDL and Attainment Strategy. Input from the watershed advisory committee has been sought and their comments and recommendations have been considered. Prior to adopting this TMDL and Attainment Strategy, the Regional Water Board will conduct a properly noticed public hearing, and will consider all comments from interested persons and agencies. At least annually after adoption, the Regional Water Board will provide the opportunity, at a regularly scheduled meeting, for interested persons and agencies to comment and provide suggestions on the progress of this TMDL and Attainment Strategy. In addition, opportunity for comment will be provided at quarterly Animal Waste Committee meetings of the Sonoma and Marin County Farm Bureau.

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