DRAFT

SAN LORENZO RIVER WATERSHED MANAGEMENT PLAN UPDATE

December, 2001

County of Santa Cruz
Water Resources Program
Environmental Health Services
and
Planning Department

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TABLE OF CONTENTS

TABLES AND FIGURES

INTRODUCTION

On December 19, 1979, the Santa Cruz County Board of Supervisors adopted the San Lorenzo River Watershed Management Plan. That plan represented a joint effort by the County and the State Resources Agency, Department of Fish and Game, under the California Protected Waterways Program. The 1979 Plan was a comprehensive watershed management plan with detailed recommendations that addressed water supply, instream flows, groundwater recharge, erosion and sedimentation, flood hazard, water quality, fishery resources, aquatic habitat, biotic resources, recreation, scenic values, and historic resources. While the County was the primary agency for implementation, the 1979 Plan included recommendations for action by most of the 35 other federal, state, and local agencies whose actions affected the Watershed.

In 1995, the County of Santa Cruz Environmental Health Service obtained funding from the State Water Resources Control Board under Section 205(j) of the federal Clean Water Act to conduct a review and update of the 1979 Plan. The review focused on water quality, with detailed investigations of erosion and sedimentation and water quality degradation in the urban areas of the lower River. This document presents the results of that work and includes a broader evaluation of water quality, water resources, and fishery issues in the San Lorenzo Watershed. Ongoing programs are described and recommendations for maintaining and expanding efforts are presented. This document presents a summary of many related efforts, with references to the supporting documents for greater detail.

Background

The San Lorenzo River Watershed is a 138 square mile area located along the Central Coast of California. The River meets the Pacific Ocean at the north end of Monterey Bay in the City of Santa Cruz, some 70 miles south of San Francisco. The Watershed is the home to some 41,000 people, with 17,174 developed parcels (not including areas within the City of Santa Cruz). Approximately 3,150 of the developed parcels are located within the City of Scotts Valley. The large remainder of the Watershed is unincorporated under county jurisdiction and includes the communities of Felton, Mt. Hermon, Ben Lomond, Brookdale, Boulder Creek, Lompico, and Zayante. All residents of the Watershed derive their water supply from surface and groundwater in the Watershed. The River directly provides 60% of the water supply for 90,000 customers served by the City of Santa Cruz. The San Lorenzo River historically supported the largest salmon and steelhead fishery south of San Francisco Bay; the fourth largest steelhead fishery in the state. Coho salmon and steelhead are now listed as threatened or endangered species.

Historically the Watershed has been used for timber harvesting, and quarrying, both of which uses continue at a diminished level today. Agriculture is limited, consisting of scattered small Christmas tree farms, orchards, nurseries, and vineyards. The tourist industry has been and continues to be important, with three state parks, scattered summer homes, and motels. The San Lorenzo River discharges into the ocean at the Santa Cruz Beach Boardwalk, one of the busiest beaches in Santa Cruz County. Summer homes were the dominant residential use in the watershed until the 1950's. After that time, summer homes were converted to year round use and the Watershed experienced a high rate of residential development, peaking at some 3,300 new units

built in the 1970's. With the exception of the City of Scotts Valley, and some small sewered communities, some 13,000 properties are served by individual onsite sewage disposal systems.

The rapid rates of development, and conversion of second homes to year round use lead to extensive degradation of the River from failing septic systems, urban runoff, excessive erosion and sedimentation, and reduced streamflow from water extraction. Since the 1970's, considerable efforts have been undertaken to address these issues through the development and implementation of numerous planning documents: the San Lorenzo River Watershed Management Plan (1979), Santa Cruz County Growth Management Plan (1980), North County Water Supply Master Plan (1984), San Lorenzo Wastewater Management Plan (1995), San Lorenzo Nitrate Management Plan (1995), and the Evaluation of Water Resources Monitoring and Management (1998). While many of these efforts have made substantial steps toward addressing the problems, the San Lorenzo River continues to be listed by the federal and state government as impaired due to sediment, nutrients, and pathogens (Section 303d list). Steelhead levels continue to be depleted, Coho salmon runs are nonexistent, and the majority of water customers served by the Watershed do not have adequate, dependable long-term supplies.

THE 1979 WATERSHED MANAGEMENT PLAN

The impacts and threats to the River of the 1960's and 1970's created an impetus for action at both the state and local level. As stated in the first sentence of the 1979 Plan: “The San Lorenzo Watershed management planning process was set in motion because the people of the Watershed and their local government perceived the need to protect the natural, social and economic values of the San Lorenzo River. The River has also received statewide recognition, for both its values and its problems.”

In 1976, the San Lorenzo River was made a part of the State Protected Waterways Program, which provided substantial funding assistance for development of a waterway management plan. From the beginning this was expanded to address the whole watershed as it was recognized that protection of the waterway required watershed protection. Extensive field studies were conducted of water quality, fishery habitat, streamflow, sediment transport, erosion sources, biotic resources, fire hazard, and recreational, scenic, and historic values. Computer models of flooding, streamflow and fish habitat were developed, along with extensive databases of water quality, population growth, development trends and septic system history. The public and other agencies were extensively involved in the development of plan recommendations, through publication of a Preliminary Report on the San Lorenzo River Watershed Planning Process (1976), the draft San Lorenzo River Watershed Management Plan, and then the final plan, which was adopted in December of 1979.

Goals of the 1979 Plan

The 1979 contained goals, policies, and recommendations to address all aspects of watershed management:

- **S** water supply and instream flow protection,
- **S** erosion and sedimentation,
- **S** flood hazard,

- **S** water quality,
- **S** fishery resources,
- **S** vegetation and wildlife resources,
- **S** recreation, scenic and historic resources, and
- **S** balancing of costs and benefits.

The goals of the 1979 Plan were as follows

1. Provide for development and resource use consistent with the maintenance of watershed quality and productivity.
2. Provide for the restoration of watershed resources that have been degraded by past and present human activities.
3. Use nonstructural means to solve watershed problems.
4. Maintain and enhance streamflows for satisfaction of both human needs and the needs of the natural system.
5. Manage existing and future water supplies consistent with basin capacity, satisfaction of instream flow needs, and protection of environmental values.
6. Maximize water infiltration and minimize excessive runoff from development in the watershed.
7. Prevent excessive erosion and sedimentation.
8. Reduce flood hazard through watershed management, flood plain management, and other nonstructural measures.
9. Maintain or restore surface and groundwater quality consistent with desired human uses of the water.
10. Maintain water quality at levels suitable for maximum diversity of life forms and high fisheries productivity of stream ecosystems.
11. Preserve riparian vegetation as a protective buffer for stream quality.
12. Maintain and enhance fishery productivity.
13. Maintain and enhance vegetation cover, plant diversity, wildlife habitat and natural biotic communities.
14. Provide for recreational use consistent with capabilities of the watershed.
15. Preserve historical and archaeological sites and values.
16. Preserve and restore the scenic character of the watershed.
17. Educate the public regarding the need for watershed management and their role in watershed implementation.
18. Provide for the coordination of public and private efforts in the protection and management of the watershed.

The specific 1979 Plan recommendations are contained in Appendix A, along with annotations of the status of implementation of each recommendation. The large majority of the Plan recommendations have been implemented or are still relevant and in the process of being implemented, as summarized in the following section. In many ways the 1979 Plan still serves as a useful document to provide meaningful impetus for ongoing watershed management efforts.

Summary of 1979 Plan Implementation and Ongoing Recommendations

This Update Report is not intended to provide an extensive evaluation of the successes and failures of the 1979 Plan recommendations. This report is intended to evaluate current watershed issues, summarize efforts to address those issues, and make recommendations for maintenance and enhancement of effort, primarily in the area of water quality, erosion and sedimentation, water resources management and fishery protection. Following is a summary of outstanding issues and needed efforts that will be further addressed in the subsequent sections.

Water Quality

Status: Programs to implement the 1979 Plan recommendations regarding septic system management and nutrient reduction were eventually put in place by 1995, 16 years after Plan adoption. Resulting improvements in bacteria levels and nitrate levels have already been observed. Urban runoff control measures were partially implemented, but toxic contaminants from urban runoff have not been documented to be as much of a problem in the San Lorenzo Watershed as originally envisioned in the 1979 Plan. Measures to reduce bacteria levels in wet weather and dry weather urban runoff have been implemented, but further effort is needed. Contamination of groundwater by leaking underground storage tanks has emerged as a substantial issue subsequent to the 1979 Plan.

Needed Efforts:

1. Continue to implement the San Lorenzo Wastewater Management Plan and Nitrate Management plan to upgrade existing onsite sewage disposal systems, reduce pathogen levels and nitrate levels.
2. Implement urban runoff management measures to reduce dry weather and wet weather pathogen levels in urban and suburban areas:
    a. Promote good housekeeping practices through education, ordinance, and agency practices for proper management of pet waste, garbage, storm drain inlets, and food facilities
    b. Investigate and correct infiltration and illicit connections between sanitary sewers systems and storm drains.
3. Promote good livestock management practices to reduce discharge of sediment, nitrate and pathogens.
4. Strengthen efforts to remediate and prevent further groundwater contamination from leaking underground tanks and hazardous discharges.

Erosion Control and Sedimentation

Status: Stronger regulations were implemented to reduce erosion from new development, but many of the recommendations for funding and technical assistance to address existing chronic erosion sources were not fully implemented due to significant funding cutbacks in local and federal programs. Stream sedimentation has not improved substantially since adoption of the 1979 Plan. Chronic sediment contribution from public and private roads remains as a significant source of stream degradation, although significant steps are being initiated to start to address these problems.

Needed Efforts:

5. Develop and implement a comprehensive erosion control program which would involve all affected agencies/stakeholders to implement recommendations contained in this report.
6. Implement improved road maintenance practices for public and private roads to reduce erosion and sediment delivery.
7. Provide cost-sharing and technical assistance to promote improvement and erosion control on private roads and lands.
8. Seek funding for correction of chronic sediment sources and areas of degraded stream habitat.
9. Continue to implement erosion control ordinances and other practices for proper siting and design, and installation of erosion control practices for new development and land disturbing projects. Provide an adequate level of code enforcement, combined with technical assistance to facilitate compliance with regulations.
10. Provide adequate oversight and follow-up monitoring of timber harvests to provide for proper siting, restoration and maintenance of timber roads and skid trails.
11. Promote channel maintenance practices, bank erosion control efforts, and stream channel restoration to provide for structural improvement of fish habitat and long-term protection of streamside properties.

Water Resources

(This section will be refined and expanded upon completion of the San Lorenzo Water Supply Assessment, in late 2001, funded by the Santa Cruz County Flood Control and Water Conservation District.

Status: Additional diversion of dry season streamflow has been restricted and the amount of surface water use from the watershed has not increased substantially since 1979. Plan recommendations to increase use of groundwater resources have been implemented, but this has resulted in depletion of local groundwater levels and likely reduction of groundwater contribution to stream baseflow. Although some recharge protection measures have been put in place, they have not been fully implemented, and groundwater supplies have been further diminished by loss of recharge from new development. Groundwater supplies are also threatened or diminished by contamination from overlying land uses in parts of the watershed. There is currently not adequate flow or water supply infrastructure in place to meet human and natural system needs for water, particularly during dry years. Efforts for more efficient use of available resources are challenged by the difficulties of bringing together and coordinating the plans and efforts of multiple water supply agencies.

Needed Efforts:

12. Develop more efficient and coordinated use of water resources to provide increased supply, restore groundwater levels, and increase dry weather baseflows through conjunctive management, use of reclaimed wastewater, and increased storage or utilization of excess of winter streamflows.
13. Promote increased retention and recharge of rainfall to groundwater storage.

Fisheries

(This section will be revised or expanded upon completion of the San Lorenzo Salmonid Enhancement Strategy in 2002, funded by the California Coastal Conservancy.)

Status: Steelhead populations have not changed significantly from 1984 to 2000, and remain at a diminished level. No Coho salmon have been observed in recent years. The number of anglers using the River has greatly diminished since 1979, and fishing is mostly limited to catch and release. Fish production continues to be limited primarily by low baseflow and habitat degradation form sedimentation. Recent knowledge has indicated that log jams are not necessarily harmful to fish migration and the lack of in-channel large woody debris in the San Lorenzo has further diminished habitat quality, due to the lack of cover and large scour objects to create pools and sort bottom substrate. A number of projects have been made to restore channel conditions and remove barriers to migration (such as culverts and bedrock ledges).

Needed Efforts:

14. Implement Plan recommendations for erosion control, baseflow augmentation, and habitat restoration projects.
15. Reevaluate and update programs for management of woody debris and in-channel vegetation to improve fishery habitat without increasing flood threats.

CURRENT WATERSHED CONDITIONS AND TRENDS

The 1979 Watershed Plan was prepared at a time of great transition in the San Lorenzo Watershed, with high rates of new construction and conversion of old, substandard second homes to full time use. Since the time of Plan adoption, the rates of new development dropped sharply in most of the watershed (see Figure 2). This was due to several factors:

- the implementation of growth management in rural areas of the county greatly limited new subdivisions and limited the number of building permits which could be issued each year;
- the general decline of the economy reduced the demand for new building permits to less than the amount available under growth management;
- the adoption of a minimum parcel size of one acre for new septic systems made many existing lots of record unbuildable; and,
- with an estimate that the San Lorenzo Valley is over 90% built out, there is a general lack of new building sites and those that are available tend to be marginal and difficult to develop.

These diminished rates of growth, in conjunction with new environmental regulations implemented after Plan adoption, would tend to greatly reduce the impacts of new development. However, the development of the marginal lots has generally required more extensive private road and driveway construction, and potentially greater land disturbance on steeper lots. Much of the recent growth has also occurred in the northeastern part of the watershed, closer to the jobs available in Santa Clara Valley. Growth rates of over 30% occurred in Bear Creek, Upper Zayante, Bean Creek, and Branciforte (see Table 1). These areas tend to be more steep and erodible than most of the watershed. Growth also continued at a high rate in the City of Scotts Valley, with an 80% increase in developed parcels from the 1980 to 2000. The overall growth rate in the watershed outside Scotts Valley was 17%. In the 1990's growth in Scotts Valley was greater than in the entire remainder of the watershed that is unincorporated. High rates of development in the Scotts Valley area resulted in erosion of sandy areas, paving of groundwater recharge areas, and increased pumping of groundwater.

Table 3 shows the levels of permit activity and reported environmental violations in the unincorporated parts of the watershed during the past 15 years that a complete database of permits and code violations has been maintained. (Prior to 1998, grading permits were handled in a different fashion, and figures are not readily available.)The number of timber harvest permits has also been compiled by Regional Water Board staff from records maintained by the California Division of Forestry. Timber harvest activities were the greatest in the mid 1990's and have continued at a moderate level. In addition to the activities shown, there continue to be 4 active quarries in the watershed: one hard rock quarry and three sand quarries.

During the past 20 years, water extracted form the watershed for water supply has increased by about 28% from 13,100 acre-feet per year to 16,800 acre-feet per year. Most of this increased use has been in groundwater use, particularly in the Scotts Valley area. Although Citizens Utilities and San Lorenzo Valley Water District have upgraded their stream diversions, there have been no major surface water supply projects since the construction of the Felton Diversion Dam by the Santa Cruz City Water Department in 1976. Some of the smaller water companies have abandoned their surface diversions in favor of groundwater use, or connection to the larger water agencies. Limited amounts of California Water Project water are being imported to the water short Summit area via the Montevina pipeline from Santa Clara County. Changes and impacts of water use will be discussed more extensively under the water resources section.

Figure 1: San Lorenzo River Watershed and Subbasins

Subbasins listed in Table 1.

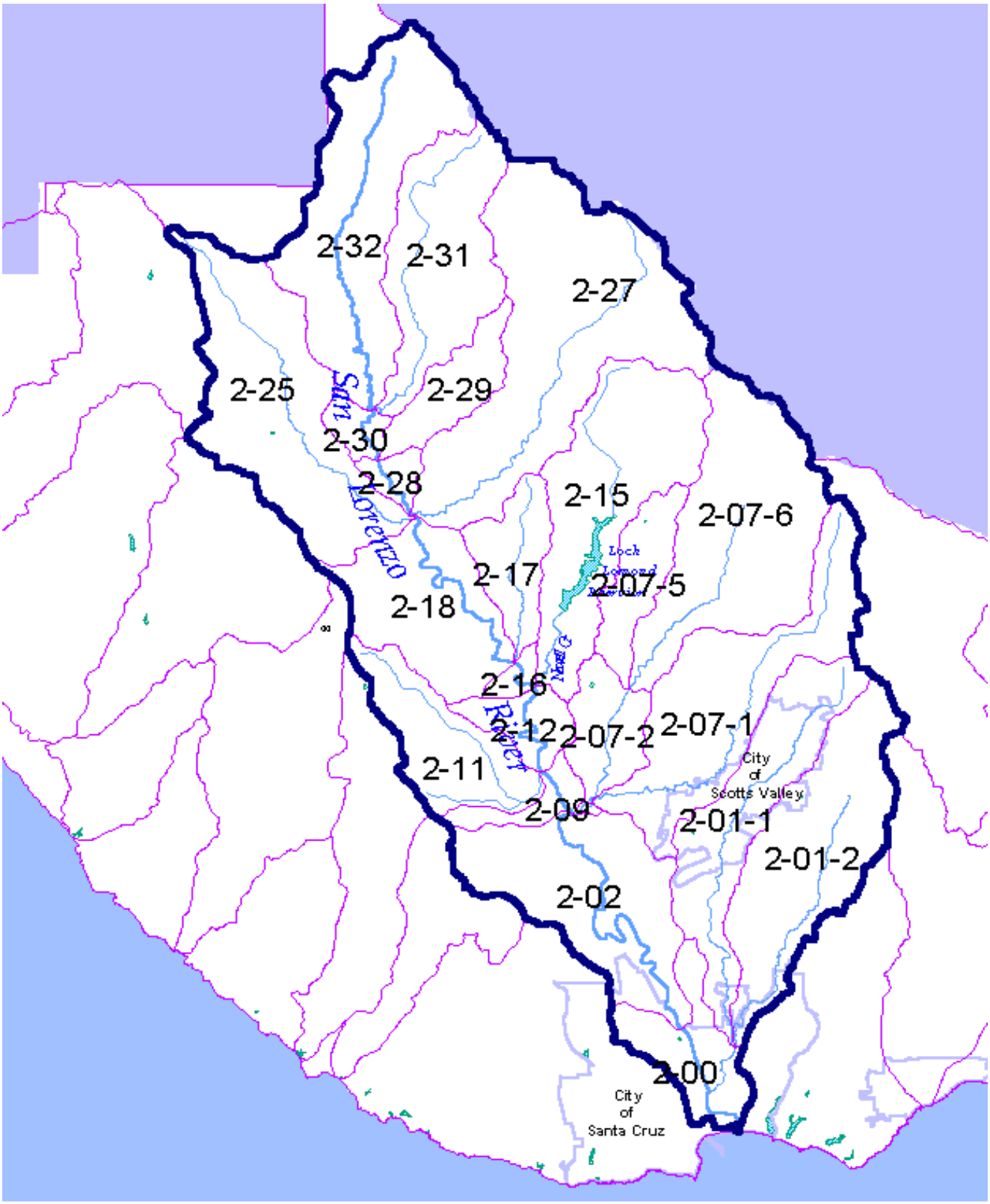


Figure 2: Periods of Growth in the San Lorenzo River Watershed

(Year of parcel development from Santa Cruz County Assessor records.)

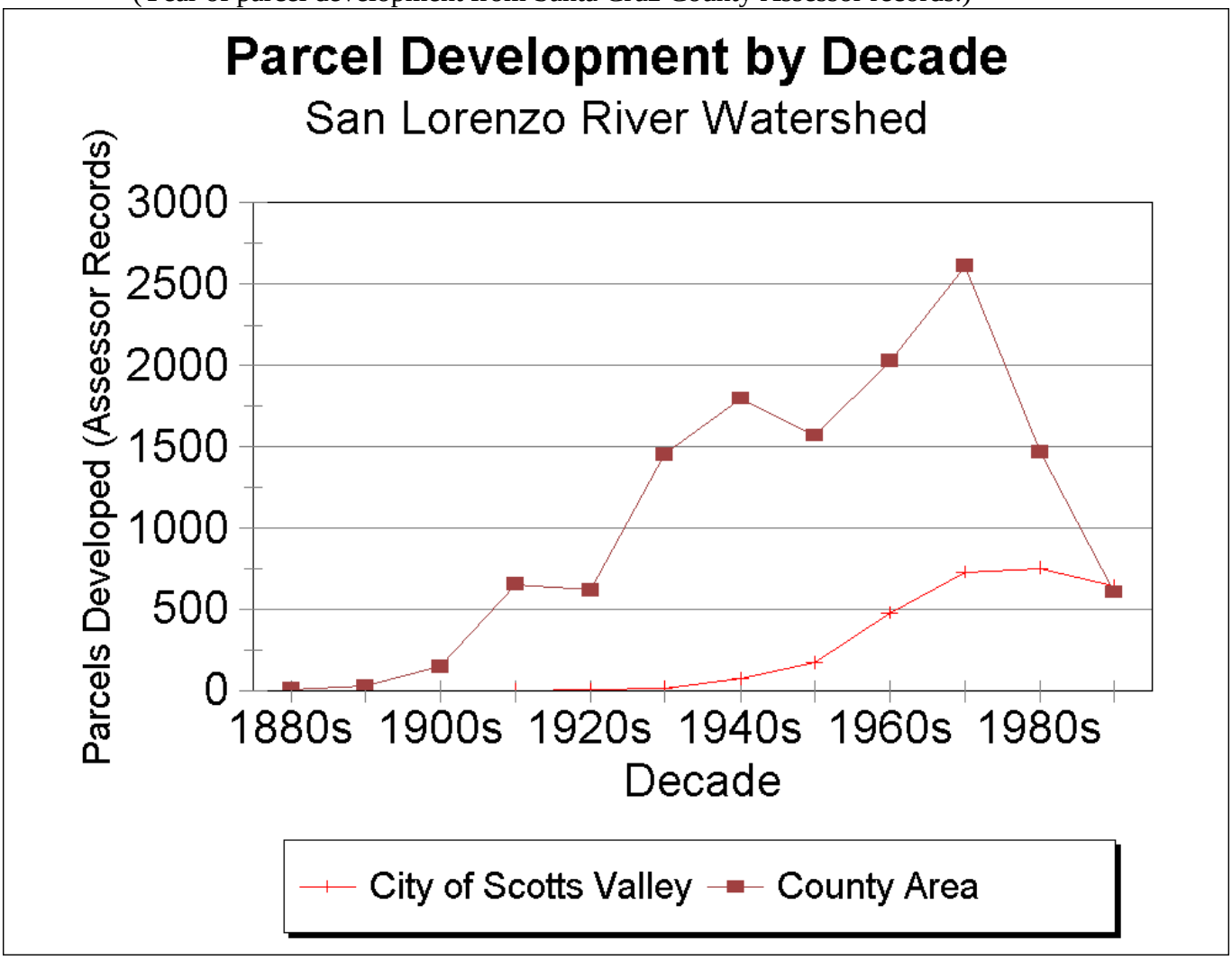


Table 1: Growth in San Lorenzo Watershed by Subbasin

Number of developed parcels, based on year developed, as shown in Santa Cruz County Assessor Records; allocated to subbasin and Scotts Valley City Limits by Santa Cruz County Electronic Mapped Information System (EMIS). Parcels in more than one subbasin are counted as ridgeline parcels. See Figure 1 for subbasin boundaries. Density calculations are shown in Table 2.

		Number of Developed Parcels					
Subbasin (See Fig.1)	Subbasin	Total - 1980	Total - 2000	Increment 1980-2000	Growth Rate	Proportion of parcels in Subbasin	Subbasin Size Acres
	Ridgeline Parcels	827	1101	274	33%	8%	
2-00	Unincorp. Santa Cruz	289	319	30	10%	1%	2,351
2-01-1	Carbonera	1635	2738	1103	67%	32%	4,780
2-01-2	Branciforte	489	704	215	44%	6%	6,235
2-02	Lower San Lorenzo	2014	2159	145	7%	4%	5,830
2-07-0	Lower Zayante	43	43	0	0%	0%	56
2-07-1	Bean Creek	1302	1777	475	36%	14%	6,168
2-07-2	Mid Zayante	329	364	35	11%	1%	1,738
2-07-5	Lompico	431	476	45	10%	1%	1,791
2-07-6	Upper Zayante	466	650	184	39%	5%	7,197
2-09	Felton	336	355	19	6%	1%	805
2-11	Fall Creek	147	180	33	22%	1%	3,149
2-12	Glen Arbor	714	782	68	10%	2%	1,170
2-15	Newell	237	292	55	23%	2%	6,346
2-16	Ben Lomond	469	499	30	6%	1%	344
2-17	Love	165	200	35	21%	1%	1,913
2-18	Mid. San Lorenzo	1023	1158	135	13%	4%	4,259
2-25	Boulder	964	1155	191	20%	5%	7,293
2-27	Bear	557	741	184	33%	5%	10,399
2-28	Riverdale	190	207	17	9%	0%	525
2-29	Two Bar	128	150	22	17%	1%	1,676
2-30	Brimblecom	291	318	27	9%	1%	613
2-31	Kings	150	177	27	18%	1%	4,929
2-32	Upper San Lorenzo	504	629	125	25%	4%	7,439
	Total Watershed	13700	17174	3474	25%	100%	87,006
SV	City of Scotts Valley	1756	3155	1399	80%	40%	
Out of SV	County Area	11944	14019	2075	17%	60%	

Table 2: Density of Development in San Lorenzo Watershed by Subbasin

Numbers of developed parcels are taken from Santa Cruz County Assessor Records. Subbasin area and road mileage is from Santa Cruz County Geographic Information System. Road type is not distinguished. Many private and unpaved roads not used as access roads are not included.

Subbasin (See Fig.1)	Sub-basin	Total Develped Parcels	Acres in Subbasin	Units/ acre	Acres/ unit	Square Miles	Road Miles	Number of Roads	Road Density (mi/sq mi)	Road Miles/ Unit
	Ridgeline Parcels	1101								
2-00	Unincorp. Santa Cruz	319	2,351	0.14	7.37	3.7	49.9	724	13.59	--
2-01-1	Carbonera	2738	4,780	0.57	1.75	7.5	80.1	809	10.73	0.029
2-01-2	Branciforte	704	6,235	0.11	8.86	9.7	54.2	386	5.56	0.077
2-02	Lower San Lorenzo	2159	5,830	0.37	2.70	9.1	50.9	474	5.58	0.024
2-07-0	Lower Zayante	43	56	0.77	1.29	0.1	1.1	17	12.91	0.026
2-07-1	Bean Creek	1777	6,168	0.29	3.47	9.6	72.2	739	7.49	0.041
2-07-2	Mid Zayante	364	1,738	0.21	4.78	2.7	14.2	125	5.25	0.039
2-07-5	Lompico	476	1,791	0.27	3.76	2.8	35.2	539	12.58	0.074
2-07-6	Upper Zayante	650	7,197	0.09	11.07	11.2	53.0	242	4.71	0.082
2-09	Felton	355	805	0.44	2.27	1.3	6.3	82	5.00	0.018
2-11	Fall Creek	180	3,149	0.06	17.49	4.9	9.5	59	1.93	0.053
2-12	Glen Arbor	782	1,170	0.67	1.50	1.8	15.7	199	8.56	0.020
2-15	Newell	292	6,346	0.05	21.73	9.9	17.9	189	1.81	0.061
2-16	Ben Lomond	499	344	1.45	0.69	0.5	7.9	119	14.61	0.016
2-17	Love	200	1,913	0.10	9.57	3.0	20.6	297	6.89	0.103
2-18	Mid. San Lorenzo	1158	4,259	0.27	3.68	6.7	47.5	471	7.14	0.041
2-25	Boulder	1155	7,293	0.16	6.31	11.4	44.1	343	3.87	0.038
2-27	Bear	741	10,399	0.07	14.03	16.2	56.4	341	3.47	0.076
2-28	Riverdale	207	525	0.39	2.54	0.8	8.3	90	10.16	0.040
2-29	Two Bar	150	1,676	0.09	11.17	2.6	10.6	61	4.06	0.071
2-30	Brimblecom	318	613	0.52	1.93	1.0	11.3	160	11.85	0.036
2-31	Kings	177	4,929	0.04	27.85	7.7	9.1	51	1.18	0.051
2-32	Upper San Lorenzo	629	7,439	0.08	11.83	11.6	44.3	282	3.81	0.070
	Total Watershed	17174	87,006	0.20	5.07	135.9	720.3	6,799	5.30	0.040

Table 3: San Lorenzo Watershed Permits and Environmental Violations, 1986-2000.

Building application information is only from unincorporated areas served by septic systems.
Timber harvest dates are based on date of timber harvest plan submittal.

Activity	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Riparian Violations	2	0	2	7	8	11	15	14	9	15	14	19	21	15
Grading Violations	16	25	11	8	8	21	37	38	36	17	31	20	43	31
Erosion Violations	--	--	--	5	0	15	10	16	8	5	6	9	10	9
Timber Harvest Plans	8	17	17	18	10	15	13	22	18	22	15	18	15	7
Timber Harvest Parcels	16	24	24	26	14	31	22	58	39	64	35	36	--	--
Timber Harvest Acres	1,190	2,860	2,688	1,582	2,067	3,125	2,031	6,510	2,174	5,413	2,298	3,481	--	--
Building Applications	--	--	--	--	--									
New Residence	--	--	--	--	--	22	24	23	18	22	33	28	34	42
Accessory Structure	--	--	--	--	--	5	3	2	8	3	8	7	1	10
Reconst./Replacement	--	--	--	--	--	12	14	11	11	16	13	13	9	9
Major Addition (>500sf)	--	--	--	--	--	70	54	56	53	78	38	40	40	60
Minor Remodel	--	--	--	--	--	53	26	26	29	32	42	61	65	84

Figure 3: Water Resources Use in San Lorenzo Watershed

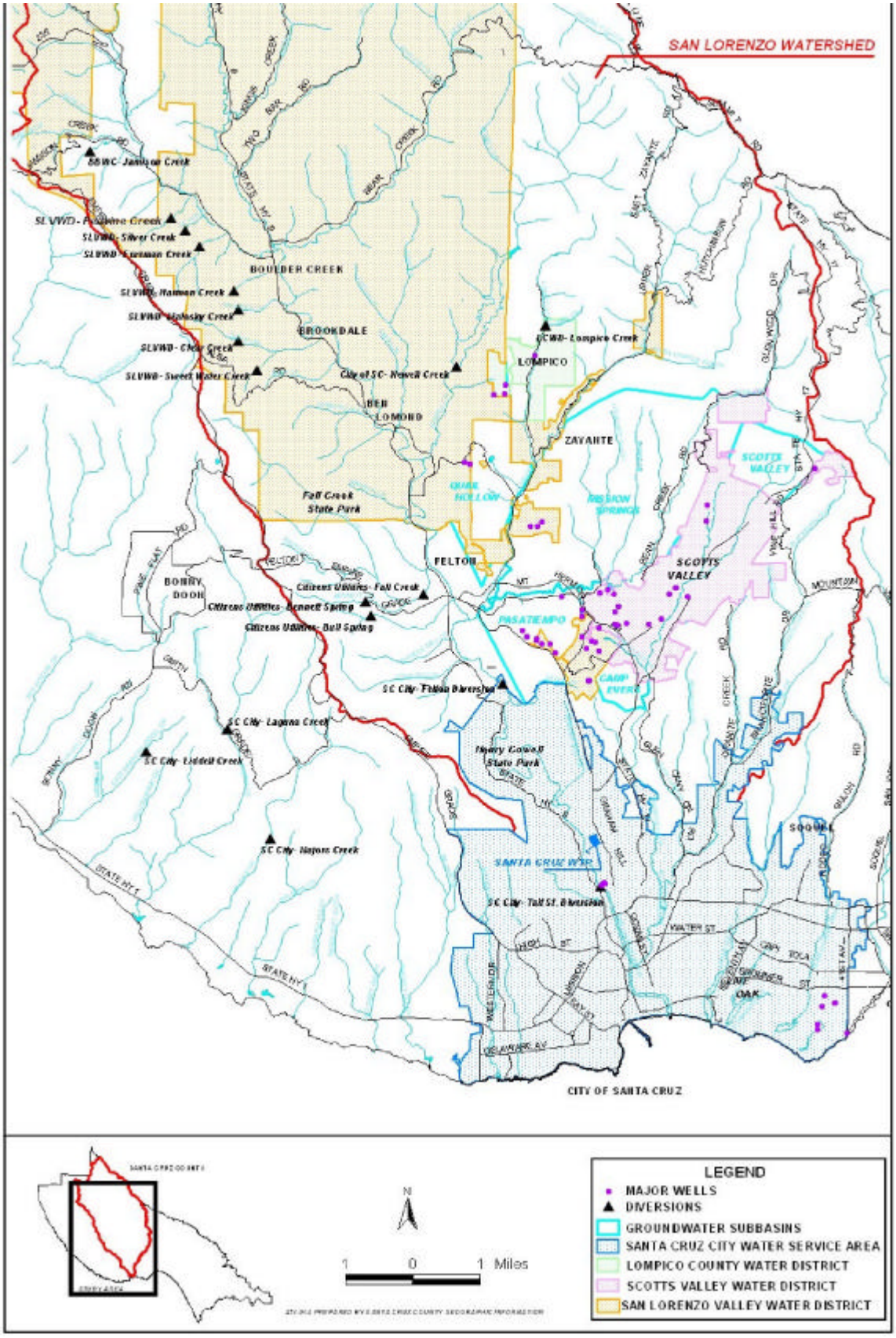


Table 4: Water Production from the San Lorenzo River Watershed, 1977-1998

	CONNECTIONS		WATER PRODUCTION FROM THE SAN LORENZO RIVER WATERSHED						
			1975-78 (dry)			1994-98 (wet)			
			% of total production (acre-feet)			production (acre-feet)			
WATER USER	1977	1998	surface	groundwater	total	surface	groundwater	total	% of water supplied by source
City of Santa Cruz[#] SLR only	18574	22694	(97%) 5,969		(100%) 5,969	(98%) 7,765		(100%) 7,765	
San Lorenzo River- Tait Street			2,984		(33%) 2984	4,705		(37%) 4705	
Felton Diversion			908		(10%) 908	0		0	
Loch Lomond			2,077		(23%) 2077	3,060		(24%) 3060	
North Coast Streams			*2,809*		*(31%) 2809*	*4,555*		*(36%) 4555*	
Beltz Wells				*288*	*(3%) 288*		*306*	*(2%) 306*	
San Lorenzo Valley WD	4816	5696	(60%) 745	(40%) 475	1220	(45%) 838	(55%) 1025	1863	wells 39%, Pasatiempo wells 16%
Scotts Valley WD	1420	3555		100%	600		(100%) 1949	1949	groundwater 100%
Lompico WD	470	497	(60%) 39	(40%) 26	65	(80%) 56	(20%) 14	70	streams 80%, groundwater 20%
Citizens Utilities	1260	1387	(39%) 136	(61%) 212	348	(96%) 439	(4%) 16	455	Fall Cr. 39%, springs 57%, wells 4%
Big Basin Water Co.	424	575	(100%) 325		325	(84%) 203	(16%) 39	242	Jamison Cr. 84%, groundwater 16%
Forest Lakes^	320	333	(100%) 90		90		143	143	groundwater 100%
Mt. Hermon^	460	528	(100%) 143		143		251	251	groundwater 100%
Mutual Water Companies (5-199 connections)*	1844	2239	(62%) 322	(38%) 198	520	(16%) 150	(84%) 790	940	streams 16%, groundwater 84%
Individuals (1-4 connections served)*	2000	2700	(30%) 318	(70%) 742	1060	(15%) 170	(85%) 964	1134	85% groundwater, 15% springs and stream diversions (Estimated)
Silicon Valley Group (formerly Watkins-Johnson)		n/a	n/a	n/a	n/a		144	144	groundwater 100%
Hanson Quarry		n/a	n/a	n/a	n/a		276	276	groundwater 100%
TOTAL	**31,588**	**40,204**	**(76%) 8,067**	**(24%) 2,541**	**10,608**	**(62%) 9,621**	**(38%) 5917**	**15,538**	

note[#]: City of Santa Cruz totals are for its SLR sources only. North Coast streams and Beltz wells are highlighted.

note^: No water production data for Forest Lakes and Mt. Hermon was available for 1975-78; the values of 70 and 143 are estimates.

note*: County records for individual water connections are incomplete. Estimated connections are between 2300 and 3000. Estimated water useage for "Mutual Water Companies" and "Individuals" was computed by multiplying the number of connections by an average water use per connection of .42 af./year.

WATER QUALITY

The San Lorenzo River, its tributaries, and its groundwater basins support a variety of uses that are dependent on good water quality. The quality of water is highly dependent on the nature of land use in the watershed, including the quality of any wastewater or runoff that originates from those uses. Over the years, particularly during the period of intense watershed development in the 1970's, water quality has been degraded by bacteria and pathogens, nutrients, and sediment. Some localized or sporadic contamination from toxic compounds has also occurred. Most of the water quality recommendations of the 1979 Plan have been implemented or are underway. Since 1979, water quality has stabilized and/or begun to improve, depending on the water quality constituent. A greater understanding of the significant sources of contamination and the means for addressing those sources has also been developed.

Following is a summary of the uses dependent on good water quality, the actual or potential threats to water quality, the efforts in place to protect and improve water quality, and recommendations to expand on those efforts. This information is also summarized in Table 5.

Water Quality Values and Threats

The primary beneficial uses of the San Lorenzo River are domestic/municipal water supply, body contact and non-body contact recreation, and fish habitat for salmon and steelhead and other aquatic organisms. The primary threats to these uses in the San Lorenzo Watershed are nitrate, pathogens, turbidity and sediment, and to a localized extent, toxic compounds.

Drinking Water Supply

The River is the largest single water source for the City of Santa Cruz, which serves 90,000 customers. Because water is diverted from the River at Felton and at Santa Cruz, the quality of this drinking water supply is dependent on upstream watershed land use and activities. Watershed tributaries and groundwater basins provide domestic/municipal water supply for another 17,000 homes and businesses. Drinking water supply in the San Lorenzo Watershed is threatened by constituents which may violate drinking water standards and/or substantially increase the cost of water treatment, including nitrate, pathogens, turbidity, and toxic compounds.

The City of Santa Cruz has reported an increase in levels of noxious taste and odor in the River since the 1970's. This increase is likely related to elevated levels of nitrate, which can simulate growth of algae and other organisms, which impart odor compounds the water (Nitrate Management Plan, 1995). Increased biological growth also releases organic compounds, which react with chlorine during the treatment process to form toxic disinfection byproducts. Although the treated water from the River meets standards for disinfection by-products, the River produces a higher concentration of disinfection byproducts than the City’s other sources. Elevated turbidity in the River and other streams has precluded use of the water during storms and for several days after storm periods. This requires the City to utilize their reserve supply in Loch Lomond, which is better saved for dry periods when streamflows are inadequate to meet demands.

During 1986, nitrate levels in the San Lorenzo Valley Water District wells in the Quail Hollow area rose dramatically, threatening the safety of that supply. However, the levels stabilized and declined before they approached the safe drinking water standard of 10 mg-N/L. Nitrate did reach levels exceeding drinking water standards in municipal wells in southern Scotts Valley in 1981. As a result, that area was sewered in 1986, and nitrate levels dropped to 5 mg-N/l by 1990. Presence of toxic compounds in groundwater in the Scotts Valley area has limited the use of some wells, required expensive treatment for others, and limits the potential for augmenting groundwater storage in the contaminated aquifers.

Recreation

The River and some of its tributaries are extensively utilized for swimming, wading, and non-body contact recreation throughout much of its length. The lower River lagoon divides Santa Cruz Main Beach and Seabright (Castle) Beach and influences the quality of the ocean swimming beaches in the immediate vicinity of the Rivermouth. These beaches both have substantially more than 50,000 visitors annually. Although limited occurrence of illness has been documented, indicator bacteria levels substantially exceed standards during storm periods, and the lower River lagoon is always posted as unsafe for swimming due to high bacteria levels. The River has numerous public swimming areas in Henry Cowell State Park, Ben Lomond, Boulder Creek, San Lorenzo Woods, and other areas. At times during the summer, swimming holes in the upper River have been posted as unsafe due to high fecal coliform bacteria levels. Excessive algae growth from elevated nitrate and presence of litter can also degrade the recreational experience.

Aquatic Habitat and Fisheries

Aquatic habitats can be degraded by elevated persistent turbidity, high temperatures, low dissolved oxygen, or toxic compounds. Extensive monitoring in the San Lorenzo River has consistently shown that elevated nitrate and toxic compounds do not appear to have any significant impact on fish or aquatic life in the San Lorenzo River Watershed, with the possible exception of Carbonera Creek, where assemblages of benthic invertebrates differ from those of other watershed streams suggesting possible impacts of nonspecific pollution. Dissolved oxygen levels and temperatures are generally within safe limits for cold water habitat, although temperatures can reach levels that may require higher levels of feeding in the middle portions of the River. In the lower lagoon area, dissolved oxygen and temperatures may reach levels unsuitable to salmonids, particularly when a salt-water layer forms at the bottom of the lagoon. Excessive sedimentation has a significant adverse impact on aquatic life throughout most of the Watershed.

Table 5: Interrelationship of Water Quality Parameters in the San Lorenzo River Watershed:

Impacts on Beneficial Uses, Sources of Impairment, and Management Efforts (Numbers indicate importance of relationship: 1-high, 2-moderate, 3-low, -- none)

Factor		Water Quality/ Resource Parameters				
		Pathogens/ Indicators	Nitrate	Sediment/ Turbidity	Flow/ Supply	Toxics
Beneficial Uses						
Water Supply		2	2	2	1	2
Recreation		1	3	3	2	3
Fish		--	3	1	1	3
Sources of Impairment						
Septic Systems/Sewers		1	1	--	3	3
Urban Development/ Runoff/Leakage		1	3	3	3	2
Erosion sources		--	3	1	3	--
Programs						
Wastewater Management Plan		1	1	--	2	3
Nitrate Management and Nitrate TMDL			1	--	--	--
Manure Management Assistance		2	2	2	--	--
Sewer System Upgrades		1	2	--	--	3
Urban Runoff Management		1	3	3	3	2
Drinking Water Source Protection		2	2	2	2	2
Hazardous Materials Facility Oversight		--	--	--	--	1
Hazardous Materials Site Remediation		--	--	--	--	1
Erosion Control Programs		--	--	1	3	--
Riparian Corridor Protection		2	2	2	2	2

Sources of Impairment

Nitrate

Nitrate levels in the River are estimated to be 5-7 times above natural background levels (SCCHSA, 1995). At about 0.35 mg-N/l, nitrate levels in the River are well below the safe drinking water standard of 10 mg-N/l. However, nitrate is the limiting nutrient in the River and increased nitrate levels can stimulate biological growth of algae, molds, fungi, and other organisms. This increased biological activity threatens drinking water supply by releasing organic compounds, which cause noxious tastes and odors and produce potentially carcinogenic disinfection byproducts when the water is treated. Localized concentrations of nitrate in groundwater have at times threatened to violate the drinking water standard in areas of Ben Lomond, Boulder Creek, and Scotts Valley.

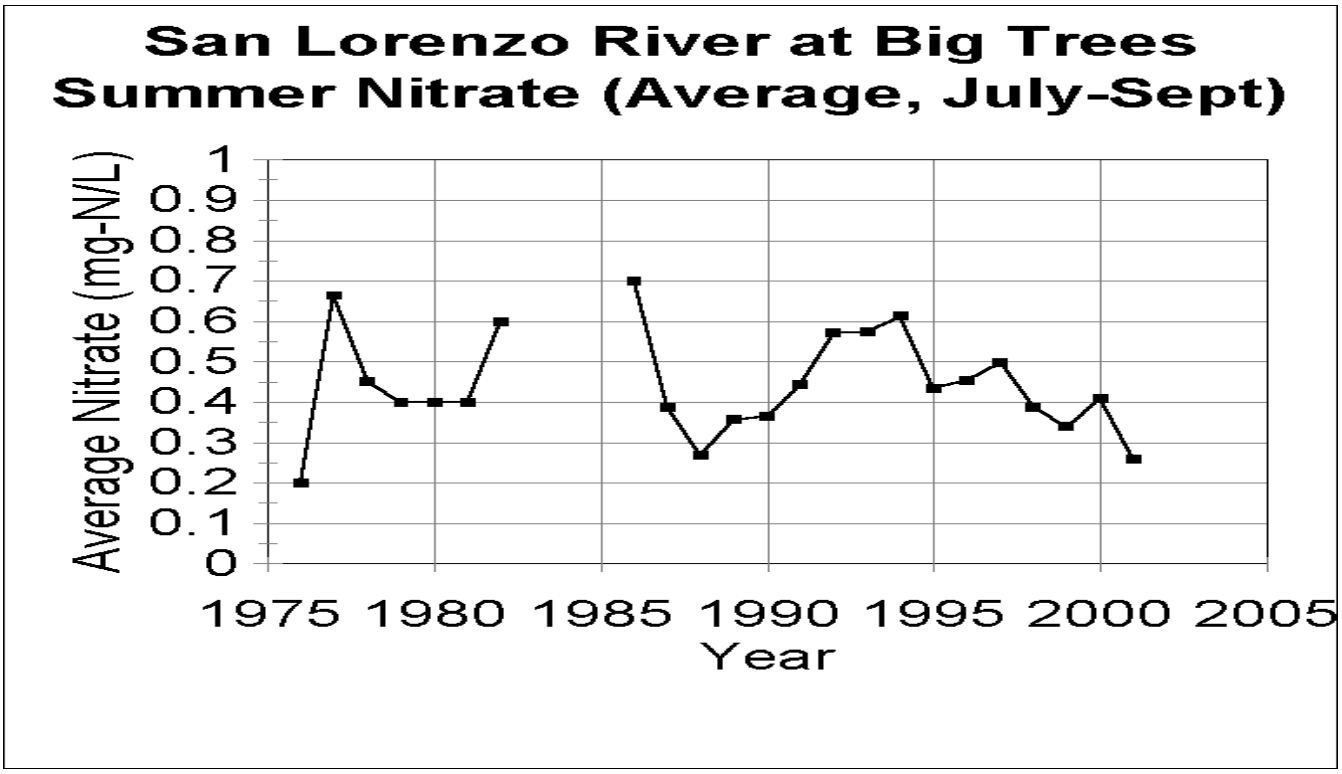
The San Lorenzo Nitrate Management Plan (SCCHSA, 1995) determined that an estimated 84% of the current nitrate load in the River results from human activities in the watershed. Calculations of relative contributions to present summer nitrate levels in the lower River (at Felton) are as follows:

- Septic Systems in sandy areas 38%
- Septic Systems in non-sandy areas 19%
- Natural sources in sandy areas 12%
- Sewer discharge from B.C. Country Club 10%
- Scotts Valley nitrate plume 9%
- Livestock and stables 6%
- Natural sources in non-sandy areas 4%
- Landscaping/fertilizer use 2%

Approximately 67% of the nitrate in the River during the summer comes from areas underlain by sandy soils of the Santa Margarita Sandstone. A septic system in sandy soils contributes 10-15 times as much nitrate to the River as a septic system in less permeable soils. Nitrogen reduction efforts are most needed and will be most effective in areas with sandy areas.

In some parts of the country, harvesting of timber can cause significant release of nitrate to streams. Several monitoring efforts in the San Lorenzo Watershed have indicated that timber harvests are not a significant source of nitrate in this area. This is likely due to several factors: the relatively small extent of individual harvests, harvests are not clear-cuts, forest soils in the San Lorenzo Watershed tend to be more clay-rich and hold onto nitrate, and the other sources of nitrate in San Lorenzo tend to be much more significant than any contribution from timber harvests.

Figure 4: Nitrate Trends in the San Lorenzo River at Big Trees



Pathogens

Presence of bacteria, virus, giardia, cryptosporidium, and other pathogens can make the water unsafe for swimming and require more expensive treatment efforts for drinking water supply. Practically all of the testing for pathogens involves testing for indicator bacteria (total coliform, fecal coliform, E. coli, and enterococcus) that would suggest the possible presence of pathogens from sewage, fecal contamination, or other contamination. Limited testing for pathogens by the City of Santa Cruz has confirmed the presence of cryptosporidium and giardia in the San Lorenzo River. The presence of indicator bacteria, while not necessarily causing illness, causes beaches to be posted with warning signs and significantly impacts recreational opportunity. The frequency of posting of swimming areas in the watershed has declined significantly since the 1970's and the 1980's, as septic systems have been upgraded and better maintained. However, the Rivermouth continues to have consistently high bacteria levels and is permanently posted as unsafe for swimming. Sources of pathogens and indicator bacteria are non-point source urban runoff, failing septic systems, sewer system leaks, pet waste, livestock, encampments, and waterfowl.

There are over 13,000 septic systems in the San Lorenzo Watershed upstream from Santa Cruz. Under current wastewater management programs, the occurrence of septic system failures is relatively low. Since 1986, the wintertime septic failure rate has declined from 5-14% to 1-3%, depending on the area (SCCHSA, 2000). However, during rainfall periods, partially treated sewage

which comes to the ground surface from septic failures can be readily washed into ditches, roadways, creeks and then the River. For brief periods after storms and in the early spring when water tables are high, ditches may continue to run, conveying diluted sewage to creeks. During dry periods, sewage from failing septic systems would not reach a waterway unless the failure was right on the banks of the creek. Programs implemented since 1986 have required system upgrades, improved setbacks from creeks and early identification of failures. Summer bacteria levels have shown substantial improvement, and the River generally meets standards for safe swimming at all areas upstream from Santa Cruz. Subsurface contribution of bacteria from apparently functioning septic systems has not been found to occur in the San Lorenzo Watershed (SCCHSA, 1989). Dry season bacteria in the upstream areas are most likely from nonspecific urban sources. The highest levels of indicator bacteria are consistently observed in the more dense urban areas of Santa Cruz and Scotts Valley, which are sewered, indicating most of the bacterial contamination is more related to urban runoff than septic systems. Bacteria levels drop substantially as the River flows out of the suburban areas and through the State Parks or other low-density areas.

Livestock operations are also a potential source of bacterial contribution during storm periods. It is estimated there may be some 400-600 head of livestock kept in the watershed, primarily horses in commercial stables and small homeowner operations. Runoff from paddock areas, trails and manure stockpiles during storms can contribute elevated levels of fecal coliform, Cryptosporidium, and other organisms. Except where animals are allowed into creeks, stables are not a significant source of microbiologic contamination during nonstorm periods. County Environmental Health has had success with improvement of runoff and manure management at many of the larger operations. However, additional effort is needed.

As a part of this project, the County conducted extensive testing in the lower River area from 1995 through 1997 to better assess the sources of high bacteria in the urban reach of the River. The work found consistently high levels of bacteria downstream from the confluence with Branciforte Creek, which originate from storm drain discharge to the River and Branciforte Creek, as well as the concentrations of waterfowl that congregate in that area. Although the storm drains typically have very high bacteria levels, their dry weather flow is generally light and intermittent. High levels of bacteria in storm drains originate from decaying organic material (including garbage, leaves, and pet waste), occasional sewage spills, and possible subsurface leakage of sanitary sewer systems. Sewage leaks have been confirmed in several storm drains and subsequently corrected, resulting in a decline in bacteria levels in those drains. Leakage may persist in some drains. Since the 1997 sampling, the sewer lines in the vicinity of Branciforte Creek were upgraded and bacteria levels from the Creek have declined significantly. However, the general nonspecific urban contamination keeps the bacteria levels elevated well above standards for safe swimming. Storm sampling of ditches and gutters with no likely sewage influence frequently yielded high levels of indicator bacteria. It has not been confirmed whether pathogens are also present.

Water quality sampling using the four standard bacteria indicators was coupled with a health risk survey of persons in the water to determine the health risk of swimming in areas adjacent to the San Lorenzo River mouth as well as other areas designated as swimming/surfing areas. The health risk survey showed that there are generally low levels of indicator bacteria producing a good quality swimming water in the beaches adjacent to the mouth of the San Lorenzo River as well as upstream of the City of Santa Cruz in the San Lorenzo River. While the safe swimming standard was almost always exceeded at the mouth of the river only one person out of the 165 persons interviewed that had been swimming or wading in that area became ill. During the study, a total of 1325 people were interviewed at all areas. Eleven cases of illness from swimming were reported.

Figure 5: Fecal Coliform at Lower River Stations, 1996-97

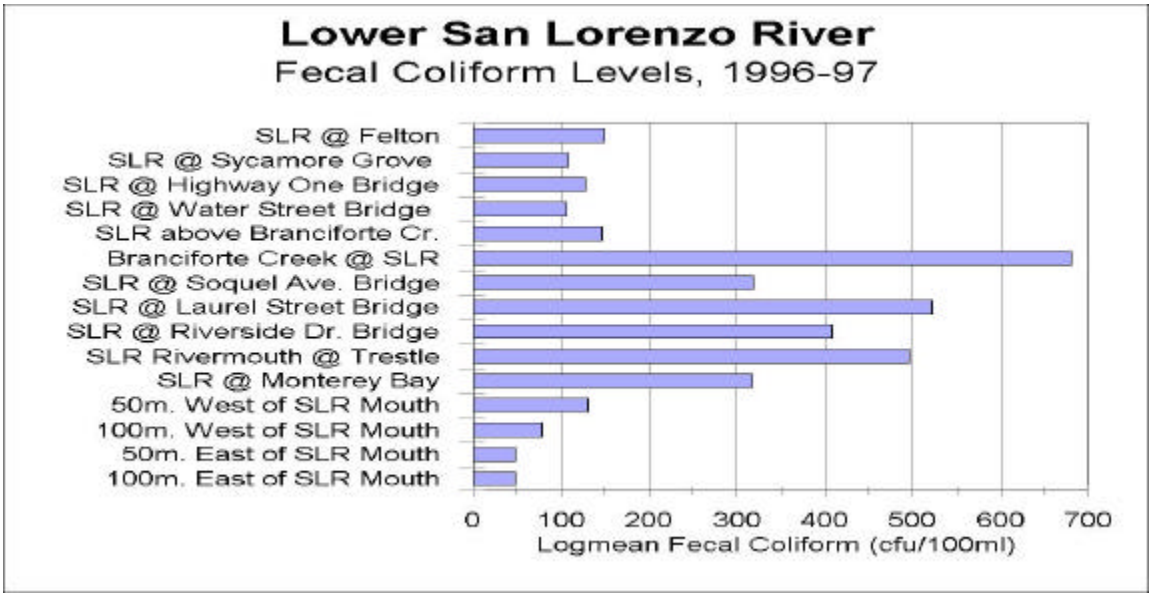


Figure 6: Lower San Lorenzo River Fecal Coliform Trends

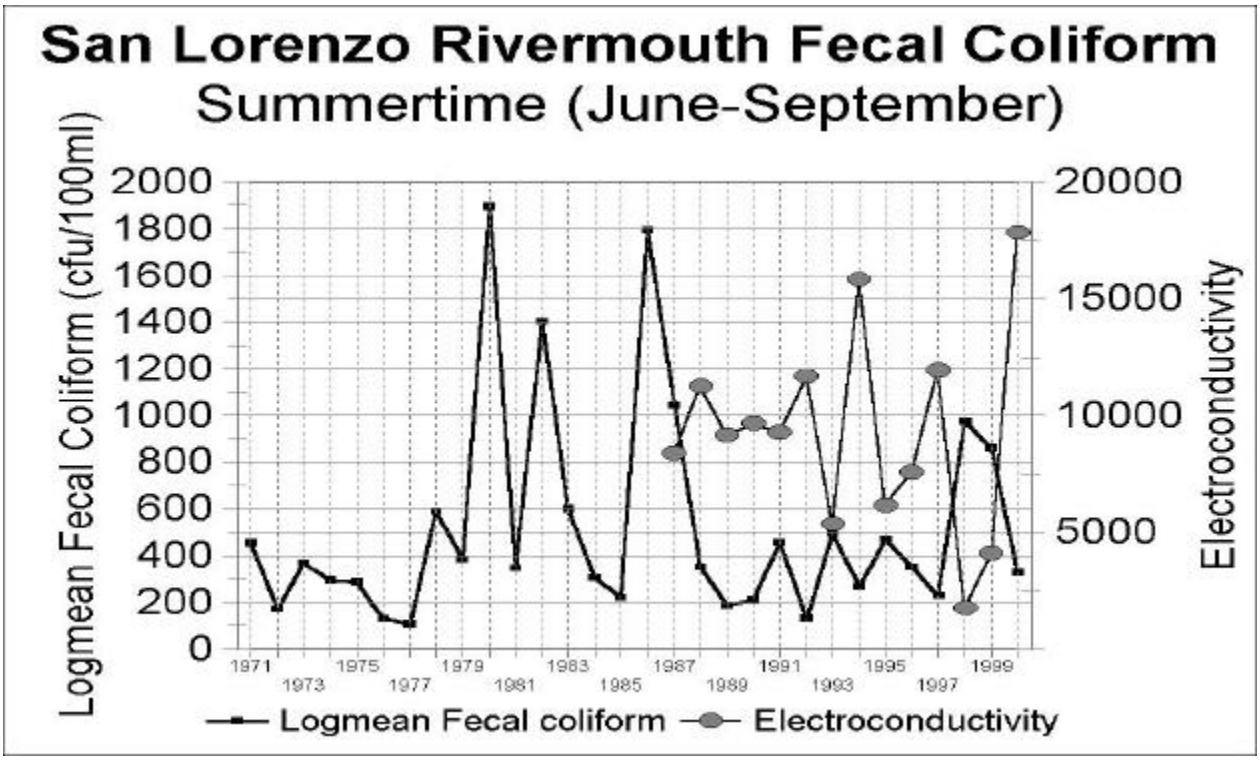
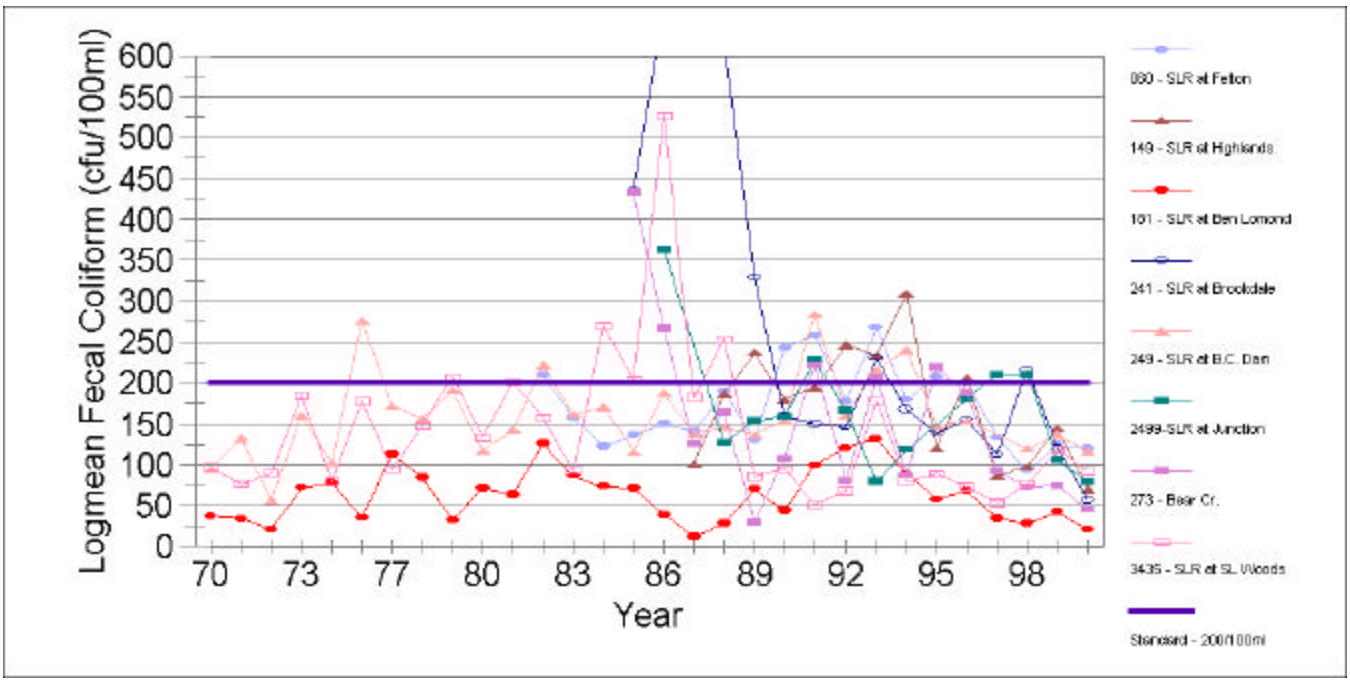


Figure 7: Summer Fecal Coliform Levels in the Upper San Lorenzo River

(Logmean of results for June through September)



Turbidity and Sediment

Excessive sediment and turbidity degrade aquatic habitat and render water unsafe to drink and/or require extensive treatment. Persistent high turbidity can diminish the usability of surface water during the winter months when there is otherwise substantial excess water available for use. Measurements of turbidity during the winter of 2000 showed that turbidity levels in the watershed appeared to be lower than the 1970's, and that the River had generally lower turbidity than most other major Santa Cruz county streams. Turbidity levels dropped to acceptable levels for water supply usually within 1-2 days after a storm event. Although turbidity appears to be only a moderate problem at this time, it remains an ongoing concern. Sources of excessive turbidity and sediment are bare soils, diminished riparian corridors, landslides, and other upland erosion sources. These are discussed at length in the section on erosion and sedimentation.

Toxic Compounds

The presence of toxic compounds in the San Lorenzo Watershed results from discharge of toxic materials from: 1) leaking underground storage tanks and spills, and 2) wash-off of heavy metals, pesticides, and other contaminants in urban runoff. The first impact has had significant impact on groundwater supplies. The second source results in generally low levels of contaminants with little or no observed impact.

Drinking water aquifers in Scotts Valley and some other localized parts of the watershed have been

contaminated by gasoline and other toxic chemicals from leaking underground storage tanks or toxic waste discharges to septic systems. This has required discontinuance of wells and/or expensive treatment. A very extensive groundwater remediation project has been underway since 1990 at the old Watkins-Johnson Facility in Scotts Valley near Bean Creek, where groundwater contaminated with a solvent has been pumped out, treated and then discharged to Bean Creek. This has been a USEPA designated Superfund site. Other areas of significant groundwater contamination occur in the Camp Evers and El Pueblo areas of Scotts Valley. A contaminated site from an old dry cleaner in Felton continues to seep small amounts of dry cleaning compounds to the River, which dissipate within a short distance downstream. There are several other areas contaminated by gasoline in Scotts Valley, Felton and Boulder Creek. These are still under investigation , with remediation pending . The presence of contaminants in the aquifer underlying Scotts Valley threatens current water supply and limits the potential to use that area for enhanced groundwater storage.

Past studies in the San Lorenzo River Watershed have indicated low to nondetectable levels of heavy metals, pesticides, PCB's, oil and grease in the San Lorenzo River and it's biota. There have been no documented impacts on organisms or beneficial uses of the River resulting from toxic constituents in urban runoff. Follow-up studies were conducted as a part of Watershed Plan Update to investigate possible accumulation of toxic compounds in freshwater clams located in reaches of the River subject to urban runoff. Tests for heavy metals and trace organic compounds showed results similar to previous studies. Very low levels of only a small number of trace organic compounds (pesticides and PCB's) were found. The two compounds found were 2-7% of the level considered hazardous. Elevated levels of lead, zinc, and cadmium were found, but none of the compounds were found at levels that are known to cause a threat to human or biotic health. Zinc and cadmium are of geologic origin, while lead is a likely result of historic accumulations from vehicle emissions.

One die-off of adult steelhead occurred in the Lower San Lorenzo River, following a small early storm which consisted mostly of urban runoff, with little dilution from the upstream watershed. Although the cause was never confirmed, it is believed that this resulted from either depressed dissolved oxygen from accumulated organic material or problems with the fish acclimating to the fresh water.

Status of Water Quality Protection Efforts

Many of the recommendations for water quality protection that were contained in the 1979 San Lorenzo Watershed Plan have been implemented, albeit almost 20 years after plan adoption. Following is a summary of the programs in place.

San Lorenzo Wastewater Management Program

The San Lorenzo Wastewater Management Program has been implemented by the Santa Cruz County Environmental Health Services since late 1985 and was formalized through the adoption of the San Lorenzo Wastewater Management Plan by the County Board of Supervisors and the California Central Coast Regional Water Quality Control Board in the spring of 1995.

The program provides for management and improvement of approximately 13,500 individual onsite sewage disposal systems in the San Lorenzo River Watershed, which have historically contributed to elevated nitrate and pathogen levels in the River. Proper septic system functioning has been challenged by age of systems, small lot size, high winter groundwater levels, steep slopes, close proximity to waterways, and common occurrence of clay soils or excessively drained soils. The Wastewater Management Program has sought to overcome these constraints through water quality monitoring, system inspection, upgrade of systems to effective standards, public education, and tracking of system performance.

Table 6: Summary of Wastewater Management Activities in the San Lorenzo Watershed, 1986-2000

Details are presented in Table 7.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	**Total**
Inspections - Surveys and Rechecks	687	496	96	158	284	1842	1723	1658	1343	1169	1532	1795	1562	1745	792	**16,882**
Repair Permit Applications	207	151	160	177	235	268	361	336	310	303	317	333	277	320	358	**4,113**
Tank Pumping (Private Pumpers)	- -	- -	1210	1721	1789	1796	1893	1752	1954	1984	1936	2039	2072	2099	2074	**24,319**
Water Samples	1391	1191	1119	1009	1056	1087	1293	1227	1164	1623	1243	827	1198	790	810	**17,028**

Activities within the main elements of the Wastewater Plan can be summarized as follows:

Evaluation of Existing Onsite Sewage Disposal Systems - Over 11,700 parcels have been inspected, and over 80 boreholes or shallow monitoring wells have been installed to evaluate soil and groundwater conditions. Data on inspection results, pumping history, septic system characteristics, and site characteristics has been entered into a computerized database for 12,500 of the 13,500 septic systems in the Watershed. This information has been combined with data from water quality monitoring to evaluate the current performance and the potential for continued use of individual onsite disposal systems in various communities of the Watershed. Despite the constraints present, the large majority (at least 85%) of the systems evaluated were found to be functioning well, and it expected that all but about 10% can ultimately be upgraded to meet current standards using conventional technology. The remainder will likely require use of alternative systems or nonconforming systems with a higher level of oversight.

Disposal System Improvements Completed - Minimum standards for septic system repairs were established by ordinance in 1993, and were strengthened further in 1995, pursuant to the adopted Wastewater Management Plan. At least 2500 systems have been upgraded under permit between 1986 and 1998. The number of system repair applications is currently about 300 per year, an increase of 50% since the beginning of the program. The impetus for system upgrade has been: independent property owner initiative (66%), building remodel (9%), loan inspection (11%), complaint investigation (5%), and inspections done under the Management Plan (9%). In 1996-98, 90% of the system repairs were able to meet the requirements for a standard conventional system. At the end of 1998, 40 alternative systems had been installed in the Watershed: 24 mounded bed systems, 3 at-grade systems, 9 sand filters, and 4 other enhanced treatment units. IN the two years

since 1998, another 75 systems have been or are in the process of being upgraded using alternative technologies.

Inspection and Maintenance - Inspection and maintenance activities consist of County inspections, public education, private pumping activities, and management activities by homeowners. Frequently septic problems have been corrected through improved system management by the property owners. System upgrades and improved management have resulted in a significant decline in failure rates from 5-14% during the initial inspections of Class I areas to 1-3% during reinspections in 1995, and 1-5% during reinspections in the wet year of 1997. Failure rates have continued to decline (Figure 8).

Figure 8: Observed Septic Failures During Parcel Surveys in the San Lorenzo Watershed

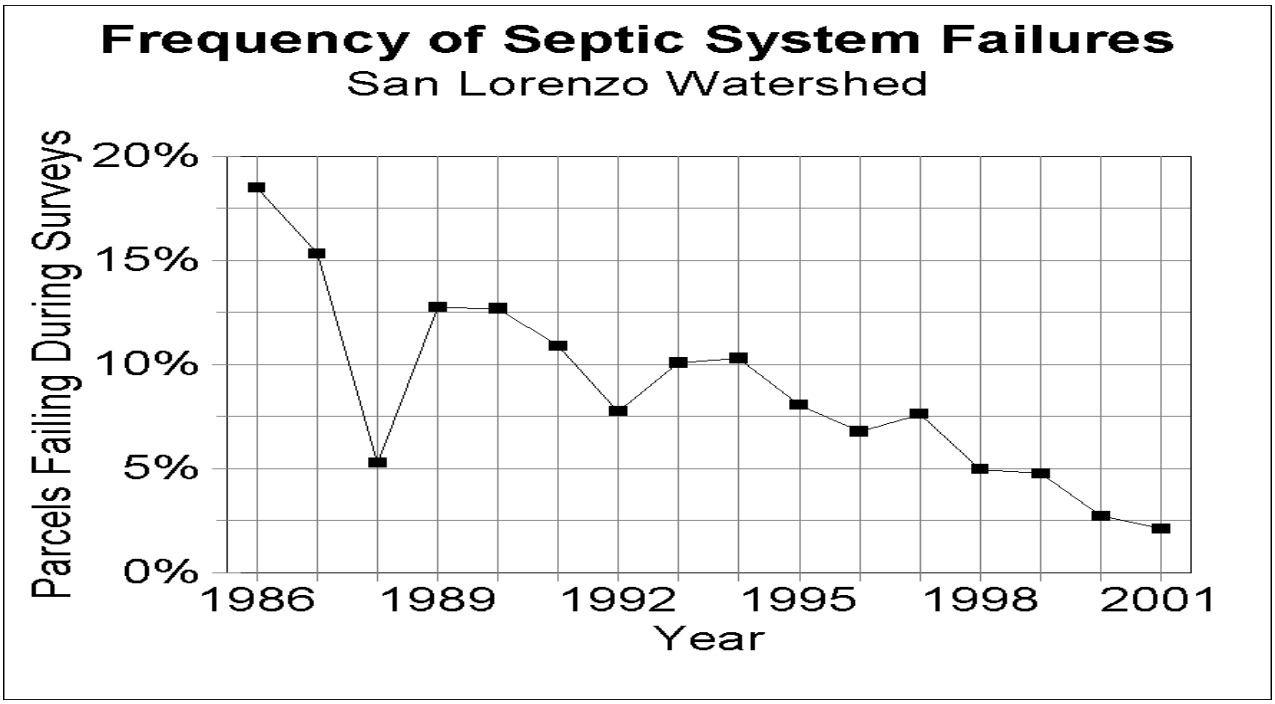


Table 7: San Lorenzo Wastewater Management Program Activities, 1986-2000

(Notes on following page.)

ACTION	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total Inspections	688	497	97	160	284	1869	1882	1863	1535	1408	1798	2172	1838	1989	898
Surveys	687	496	95	157	276	1627	1485	1507	1204	472	989	1076	1249	1051	663
Problems	127	76	5	20	35	177	115	152	124	38	67	82	62	50	18
	18.5%	15.3%	5.3%	12.7%	12.7%	10.9%	7.7%	10.1%	10.3%	8.1%	6.8%	7.6%	5.0%	4.8%	2.7%
Rechecks			1	1	8	215	238	151	139	697	543	719	313	694	129
Problems							20	19	23	34	35	33	9	16	14
							8.4%	12.6%	16.5%	4.9%	6.4%	4.6%	2.9%	2.3%	10.9%
Annual Checks			1				8	34	38	74	76	98	91	99	0
Problems							0	0	1	3	1	1	0	1	
							0.0%	0.0%	2.6%	4.1%	1.3%	1.0%	0.0%	1.0%	
Complaints				2		27	122	124	116	136	164	135	165	142	104
Problems							78	81	73	91	104	65	69	75	66
							63.9%	65.3%	62.9%	66.9%	63.4%	48.1%	41.8%	52.8%	63.5%
Loan Insps.		1					28	36	28	22	26	14	12	3	2
Problems							1	2	1	2	0	0	0	1	1
							3.6%	5.6%	3.6%	9.1%	0.0%	0.0%	0.0%	33.3%	50.0%
Total Results															
Failures	51	25	2	10	4	31	65	111	93	64	83	72	76	90	67
Greywater	76	51	3	10	31	146	122	118	108	58	73	86	55	52	14
Failure Rate	18.5%	15.3%	5.2%	12.5%	12.3	9.5%	9.9%	12.3%	13.1%	8.7%	8.7%	7.3%	7.1%	7.1%	9.0%
Annual Rain (in.)	62.6	25.9	25.4	29.9	28.3	28.6	50.4	70.6	28.5	67.6	54.9	54.1	72.2	43.4	44.2
Tank Pumping	-	180	1210	1721	1789	1796	1893	1752	1954	1984	1936	2039	2072	2099	2074
Cited Cause															
Maintenance	-	54	468	705	816	835	980	955	967	1089	923	1024	1107		
Loan Inspec.	-	65	485	479	408	404	445	392	435	345	432	487	488		
Failure	-	45	129	239	223	199	141	144	275	203	238	202	85		
Haulaway	-	7	24	138	149	140	119	40	86	137	143	146	129		
Other	-	9	104	160	193	218	208	221	191	210	200	180	263		
Reported Failure		12	95	130	105	125	105	149	152	208	189	92	151	141	125
Failure Rate		7%	8%	8%	6%	7%	6%	9%	8%	10%	10%	5%	7%	7%	6%
Area Fail. Rate		0.1%	0.7%	1.0%	0.8%	1.0%	0.8%	1.1%	1.2%	1.6%	1.5%	0.7%	1.2%	1.1%	1.0%
Reported High Level		54	232	411	387	341	410	434	486	441	418	452	476	469	458
Pre-Failure rate		30%	19%	24%	22%	19%	22%	25%	25%	22%	22%	22%	23%	22%	22%
Area Pre-Failure Rate		0.4%	1.8%	3.2%	3.0%	2.6%	3.2%	3.3%	3.7%	3.4%	3.2%	3.5%	3.7%	3.6%	3.5%
Repairs															
Applications	207	151	160	177	235	268	361	336	310	303	317	333	290	320	358
Finalled Permits							318	266	230	243	245	286	208	257	236
Info. Available	143	152	122	131	163	202	254	241	217	222	243	268	189	230	206
Cause															
Maintenance	57	78	89	97	113	101	139	147	150	181	169	222	146	173	181
Build. Permit	2	4	4	3	9	21	43	32	9	16	38	18	25	29	9
Loan	3	12	15	25	39	67	38	29	22	3	15	6	7	1	1
Complaint	1	9	7	5	1	2	12	10	24	13	12	17	8	13	12
Survey/Invest	80	49	7	1	1	11	22	23	12	9	9	5	3	14	3

Notes for Table 7:

1. For 1986 - 1991, complete inspection records are available only for surveys. After 1991, inspections include: surveys, rechecks, complaint investigations, and loan inspections. Total summaries for inspections only are for the period 1992-95. For repair actions, records may be inconsistent prior to July, 1991, when systematic data entry began. Pumping records are good after Sept., 1988, when submittal of pumping reports became mandatory.

2. Numbers of problems under inspections, and total failure rates (unless otherwise indicated) are the total number of leachfield failures and greywater discharges for that year divided by the total number of inspections for that year. Under each type of inspection, the percentage of problems found during that type of inspection is also indicated for each year.

3. Under tank pumping, the area failure rate is the number of failures, divided by the total number of parcels in the study area.

4. Number of repairs is the number of repair permits applied for in that year. Repair figures for 1986 and 1987 also include other repair activities that do not require a permit.

Evaluation of Potential for Community Disposal Systems - The Management Plan calls for an evaluation of the potential for use of community disposal systems for areas where there are severe constraints for meeting current standards using conventional septic systems. Under this program, community disposal alternatives have been explored for parts of Boulder Creek, Brook Lomond, Ben Lomond, Glen Arbor, and Felton. For all areas, community disposal systems were found to be less cost-effective than use of individual systems (including alternative systems) and were found to be unaffordable without some kind of grant funding. A community disposal system could be considered for downtown Boulder Creek, which might be eligible for economic development grants since constraints to standard sewage disposal is limiting expansion of the business district. A community disposal feasibility study has been completed for 900 parcels in the Greater Pasatiempo area, in the lower part of the Watershed, and a sewer project is currently being pursued for that area.

New Development - Any new development served by septic systems, which is the majority of the Watershed, must fully meet current standards, including a one acre minimum parcel size, regardless of the date of parcel creation. This requirement was implemented in 1983 in response to State direction to prevent an increase in cumulative impacts from septic systems. Expansion or remodel of existing development does not need to meet the minimum parcel size, but other standards must be met. Expansion of existing development provides a good trigger to bring older systems up to current standards. During the period of 1992-98, 244 permit applications for septic systems to serve new homes were received, and about 390 applications for major residential additions have been received. Over 224 septic system repairs were related to building remodels (almost 10% of the total repairs).

Water Quality Monitoring - An average of about 1000 water samples per year are currently being collected to measure trends in water quality and identify problem areas. Both nitrate and bacteria levels are significantly elevated above natural background levels in the River and many of its tributaries. Although there have been episodes of bacterial contamination from individual septic system failures, much of the bacteria contamination seems to be related to nonspecific nonpoint contamination in the relatively dense urban areas. Most of the nitrate increase is attributable to septic systems, particularly in sandy soils. There have been significant localized improvements in bacteria

levels, and there appears to be an improving trend in bacterial levels at most stations since 1996. Nitrate levels and loading in Boulder Creek and the River north of Ben Lomond declined significantly as a result of upgrades of the Boulder Creek Country Club (CSA 7)Treatment Plant.

Program Administration and Financing - The annual budget for countywide wastewater management activities is about $102,500, with an additional $237,5000 for activities specific to the San Lorenzo. (Roughly 60% of the parcels in the county with septic systems are located within the San Lorenzo Watershed.) These budget figures do not include permit processing activities. The program is funded primarily by annual service charges collected from property owners with septic systems. Since 1996-97, the countywide service charges have been $6.90 per parcel, with an additional $18.56 per parcel paid by property owners in the San Lorenzo Watershed. In late 1995, the State Water Resources Control Board approved the County's request for $2.2 million from the State revolving Fund to set up a loan program to facilitate septic system repairs. This program has been available since summer of 1998, and is currently being updated to be more usable.

San Lorenzo Nitrate Management Plan and Nitrate TMDL

The San Lorenzo Nitrate Management Plan was developed to address all major sources of elevated nitrate in the River. A grant was obtained under Section 205j of the Clean Water Act to investigate the impacts of nitrate on algae growth and water supply, to determine the primary sources of nitrate in the watershed, and to evaluate various alternatives for nitrate reduction. The Plan includes a watershed nitrate budget, which was used to calculate resulting nitrate levels in the River under different scenarios. The adopted Plan represented a balance between cost and available technology and the need to reduce nitrate levels by a moderate amount in order to reduce potential threats to drinking water quality and recreation. The San Lorenzo Nitrate Management Plan was adopted by the County and State in 1995. The Plan findings and recommendations also formed the basis for the Nitrate TMDL (Total Maximum Daily Load Plan) that was adopted by the Central Coast Regional Water Quality Control Board in 2000.

The recommended nitrate management plan provides for implementing the most cost-effective measures to achieve the desired level of nitrate reduction. The plan provides for limiting increased nitrate release from new or expanded development in sandy soils, and gradually reducing nitrate discharge from existing sources as public and private funds become available and reduction technology improves. Implementation of the recommended policies will provide for a 15-20% reduction in current nitrate levels over the next 10 years, with a further reduction of 10% in the following 10 years. The following measures were recommended (the status of implementation is shown in parentheses):

Manage Wastewater Disposal for Nitrogen Reduction

1. Maintain the existing requirement of a one acre minimum parcel size for new development served by septic systems in the San Lorenzo Watershed (Ongoing)

2. Implement improved wastewater disposal management through the San Lorenzo Wastewater Management Plan (Ongoing).

3. Complete ongoing efforts to improve treatment procedures at Boulder Creek Country Club Treatment Plant to reduce nitrate discharge by using wastewater reclamation on the golf course. (Construction was mostly completed by 1997. The treatment process was then refined and fully operational by May 1998. The improvements provide for wastewater reclamation on the golf course much of the year, with treatment for nitrogen removal at other times. These improvements should ultimately reduce the amount of nitrate in Boulder Creek and in the River between Boulder Creek and Ben Lomond by about 75%. Reductions beginning in 1998 appear to be substantial.)

4. Maintain the new requirement for shallow leachfields for new and repaired septic systems (less than 4 feet in sandy areas, and 4-6.5 feet in other areas). (Ongoing)

5. Implement enhanced technology for at least 50% nitrogen removal for septic system in sandy soils:
    a. Require septic systems serving new or expanded uses in sandy soils to install enhanced treatment measures which will reduce nitrogen discharge by at least 50%. (Implemented August, 1995; existing systems to be upgraded at the time of major remodels (projected rate of 1.2% (20 systems) per year).)
    b. Encourage the use of nitrogen removal methods for any onsite disposal system which will use a nonstandard system. (Estimated 20 upgrades per year.)
    c. Continue to evaluate new onsite wastewater disposal technology for nitrogen reduction to identify more cost-effective measures. Require higher levels of nitrogen removal if measures become available that are more cost-effective than sand filters.
    d. Apply for State revolving funds and other funds to develop a funding source to assist property owners in repairing their systems to provide enhanced treatment. (Revised program to be implemented January 2002, with an estimated 40-100 upgrades per year thereafter.)
    e. When more cost-effective technology and/or funding assistance becomes available, require all onsite system repairs in sandy areas to utilize enhanced treatment for nitrogen removal. (Implementation deferred, pending more inexpensive technology.)

6. Require all large onsite disposal systems which serve more than 5 residential units or dispose more than an average of 2000 gallons per day to utilize enhanced treatment to reduce nitrate discharge by at least 50%. Installation of such measures for existing systems shall be required at the time of system repair or upgrade. (Estimated 1-2 upgrades involving approximately 5000 gallons per day per year.)

7. Require all new or revised waste discharge permits and all new development projects in the San Lorenzo Watershed to include nitrogen control measures consistent with this Nitrate Management Plan. (County staff has worked with staff at the Regional Board to include nitrogen reduction requirements in new or amended waste discharge permits. This was included in the permits for expansion of the Mount Hermon Association system, the Boulder Creek Country Club system, and the San Lorenzo Valley High School system.)

<u>Livestock Management for Nitrogen Reduction</u>

8. Continue to work with stable owners and develop a new ordinance requiring practices to reduce nitrate discharge: cover manure piles, maintain manure piles and paddock areas at least 50-100 ft from streams or drainageways, direct drainage away from paddock areas, and

provide other measures as necessary to reduce discharge of nitrate, sediment, and contaminants. (Ongoing, after meetings with stable and horse owners, it was decided to pursue an approach of education, technical assistance, and voluntary compliance. A grant funded effort by the Resource Conservation District got underway in 2001)

Land Use Regulations for Nitrogen Reduction

9. Maintain current density restrictions requiring 10 acres per parcel for new land divisions and other protective measures for groundwater recharge areas.

10. Maintain current regulations on erosion control, land clearing, and riparian corridor protection.

11. Do not approve new land use projects within the San Lorenzo Watershed which will increase the discharge of nitrate to groundwater or surface water by more than 15 pounds of nitrogen per acre per year from the project area.

Ongoing Monitoring of Nitrogen Sources

12. Monitor the Scotts Valley nitrate plume, and identify potential ongoing sources of nitrate. Work with the City of Scotts Valley and property owners for reduction of nitrate discharge from Scotts Valley, if feasible. (Ongoing monitoring, implementation of potential control measures in 2005, if necessary and feasible).

13. Continue to monitor nitrate levels in surface and groundwater. Reevaluate implementation of more stringent control measures if summer nitrate levels in the River have not declined by at least 15% by 2010. (Ongoing monitoring, reevaluation in 2010).

Livestock Management for Water Quality Protection

In addition to reducing nitrogen discharge, efforts are underway to improve other aspects of livestock management to provide reduced runoff of pathogens and sediment from livestock operations. Initial oversight and assistance by County Environmental Health staff in the mid 1990's was provided as a part of the nitrate management program. This resulted in improvements at some of the larger commercial stables in the Watershed. Policies and brochures were subsequently developed through a manure management committee with representatives from the County, water users, and livestock owners. The Santa Cruz County Resource Conservation District has received a Clean Water Act Section 319h grant to work with the Santa Cruz County Horsemen's Association to provide education, technical assistance and demonstration projects for improved management. For new and expanded operations that require County permits, a manure management plan must be prepared and implemented. The County has established guidelines which cover runoff management, manure pickup, storage and disposal, and stream corridor protection.

Sewer System Operation and Maintenance

Although most Watershed residents are served by individual onsite sewage disposal systems, community sewage systems with treatment and in-basin disposal are used for some 300 homes at the Boulder Creek Country Club area, 35 homes at Bear Creek Estates, and 30 homes in Rolling Woods. The Boulder Creek and Rolling Woods systems are under the jurisdiction of the County Public Works Department, while the Bear Creek System is operated by the San Lorenzo Valley Water District. The Cities of Scotts Valley and Santa Cruz each operate their sewage collection and treatment systems, with disposal to a common ocean outfall. Scotts Valley has recently constructed a tertiary treatment plant and expects to begin use of recycled water for landscape irrigation on selected parcels in summer of 2001. Boulder Creek Country Club previously used reclaimed wastewater, but that has been discontinued due to problems with the storage and distribution system. All of these sewage facilities operate under permits issued by the Central Coast Regional Water Quality Control Board.

Occasional sewage discharge to the River or its tributaries may occur from overflows that are caused by line blockages, line breaks, pump failures, power outages, or excessive wet weather flow from infiltration. Such overflows are very infrequent in Scotts Valley, which has a relatively new system and fairly infrequent at Rolling Woods and Bear Creek Estates, which are small systems with excess capacity. The Boulder Creek system reports several spills per year, while the City of Santa Cruz reports about 25 spills per year in the area that drains into the River (a total of about 2500 gallons per year). The City of Santa Cruz has a much older sewer system and is also very thorough about reporting all spills within its jurisdiction. About 75-80% of the overflows were from blockage and overflow of private sewer laterals, which run from the house or business to the sewer main in the street. Most of these spills go into the street areas, into the storm drain system, and eventually into the lower River. Due to age and high groundwater, the City of Santa Cruz system also has a high potential for subsurface leaks from the sewers to the storm drain system. Although many past problems have been corrected, it is likely that spills and leaks from the sewer system contribute along with other sources to the high bacteria levels that occur in the lower River.

In order to maximize public health protection it is important to reduce the amount of sewage discharge to the storm drain system and the River to the greatest extent possible by reducing the likelihood and duration of sewer overflows and preventing subsurface leaks from the sanitary sewer system to the storm drain system. This includes the following measures:

1. Upgrade public sewer lines to provide adequate capacity, reduce wet weather infiltration and overload, and reduce leakage to groundwater and storm drains. The City of Santa Cruz implemented a program in 1986, to identify deficient sewer lines and to plan the upgrade or replacement of the worst lines. Much of the work has been completed, but it would be advisable to consider increasing the priority for additional projects in areas with continuing water quality problems. It is also important to maintain adequate back-up power and/or emergency storage at pump stations in the sewer systems.

2. Maintain a high level of oversight and maintenance for sewer lines which have a higher probability of overflow or leakage. The City of Santa Cruz has an excellent sewer line maintenance program, with prompt response to spills, documentation of chronic problem areas, and scheduling of preventative cleaning and maintenance for problem areas. Other agencies also have good programs.

2. Maintain programs to reduce discharge of grease or other materials that can cause blockages and overflow of sewer lines. The Cities and County have a comprehensive program of regulations, inspections, enforcement, and education to reduce grease discharge to the sewer system.

3. Maintain programs for prompt cleanup of sewage spills and correction of problems with private sewer laterals that cause chronic spills. Santa Cruz City crews rapidly cleanup spills and correct problems with sewer mains under City jurisdiction. City crews also cleanup spills from private lines and attempt to open blockages in those private sewer laterals. Frequently chronic spills result from private sewer laterals in poor condition that should be replaced. Replacement is the responsibility of the property owner and is frequently delayed. Spills could be further reduced if the City and other agencies had the authority to correct problems with private laterals and bill the property owner.

5. Consider providing for testing of private laterals and correction at time of sale and/or in areas subject to contamination by subsurface sewage leakage. Although the City has upgraded most of its sewer mains, the potential remains for leakage from private laterals in poor condition. Some jurisdictions have implemented programs for inspection or testing and upgrade at time of property transfer. This would reduce dry weather leakage and wet weather infiltration.

Urban Runoff Management

Urban runoff management is needed to address water quality degradation form urban areas during both storm periods and low flow conditions. Over the years, the Cities and the County have implemented various efforts. In the next few years, these efforts will need to be organized under a comprehensive urban runoff program. Such a program is required to be in place for all urban areas by March, 2003, under the federal Phase II Storm Water Rule. The City of Santa Cruz has already begun implementing a program with the assistance of the State Coastal Commission and the Monterey Bay National Marine Sanctuary Water Quality Protection Program. The Water Quality Protection Program has developed an Urban Runoff Management Plan for areas draining into the Sanctuary. This Plan will eventually be implemented by the Cities, the County, and other jurisdictions The City of Santa Cruz has already established a stormwater utility charge to finance flood control and urban runoff management.

The USEPA Storm Water Phase II Final Rule requires that the following elements be included in a storm water program:

- Public education and outreach on the impacts of urban runoff and methods for improving water quality.
- Public participation and involvement in program development.
- Detection and elimination of illicit discharges of anything other than stormwater to the storm drain system, including unintentional discharges or leaks.
- Construction site runoff control to contain sediment and other contaminants.
- Post-construction runoff control to implement measures to help keep runoff quality and quantity at predevelopment levels.
- Pollution prevention and good housekeeping for municipal operations.

Urban stormwater and runoff programs will also need to be implemented in the upper San Lorenzo

Watershed. While a program will be mandatory for the City of Scotts Valley, it has not yet been determined whether it will be required for the unincorporated communities of the San Lorenzo Valley, which do not have storm drain networks. However, implementation of urban runoff management programs is advisable, particularly the implementation of measures to reduce bacterial contamination during both dry weather and wet weather.

Reducing water pollution from urban runoff ultimately requires source control, storm drain maintenance, and sanitary sewer system maintenance and upgrade, as discussed in the previous section. In addition to sewage, microbiologic contaminants can enter the storm drain system and the River from other sources, including pet waste, garbage, fertilizer, decaying vegetation, or other nonspecific urban sources. Because treatment of stormwater is generally unsuccessful at reducing bacteria, it is important to remove the sources of elevated bacteria before they get into street gutters or the storm drain system:

1. Encourage pet owners to collect and properly dispose of pet waste. In urban areas, pet waste should be collected and flushed down the toilet or bagged for disposal at the landfill. Plastic bags are provided at many public park areas, but further encouragement is likely needed through education and possible regulation.
2. Maintain trash receptacles, and dumpsters in a sanitary condition that prevents garbage and leachate from entering the storm drain system. Dumpsters and trash can should be kept covered. If dumpsters for restaurants or other facilities are found to discharge leachate, they should be kept in a covered area with a drain that discharges to the sanitary sewer system.
3. Residents and businesses should be encouraged (and required as necessary) to prevent discharge of anything but storm water to the storm drain system. Even discharge of relatively clean water to gutters can pick up accumulated contaminants and carry them to the storm drain system and the River.
    a. Prevent over watering and runoff of irrigation water into the street.
    b. Take cars to a carwash or wash them in areas that won't run into the street.
    c. All washwater from carpet cleaning, mop buckets, floor mat washing, etc, should be discharged to the sanitary sewer system.
    d. Clean up spills with mops or absorbent material, without washing the spill into a gutter or storm drain inlet. The City of Santa Cruz has an educational program to promote these measures for restaurants and auto service shops. A storm drain ordinance is in preparation. The County and City of Scotts Valley need to begin to pursue such measures.
4. Maintain stenciled warnings on storm drain inlets as a reminder not to discharge to the inlet.
5. Maintain street sweeping programs in urban areas to remove accumulated lifter, garbage, leaves and other material, particularly before the first rains of the season.

Storm drain catch basins, pipes, and pump station wet wells all have the potential to accumulate debris, garbage, and organic material, particularly during dry periods. These accumulations provide an environment for indicator bacteria and potentially pathogens, which can lead to very high bacterial concentrations when discharge to the River occurs. Heavy metals and other urban contaminants can also accumulate in these conditions.

6. Provide for regular cleaning of storm drains and removal of accumulations of silt and organic material, particularly before the first storm of the season. The City of Santa Cruz has implemented a program of wet well and catch basin cleaning in the last three years using their sewer vacuum trucks. Tremendous volumes of material have been removed and transported to the sewage treatment plant and landfill for disposal. Significant improvement in water quality in

discharge water has been reported.

7. Consider dry weather diversion of storm drain water to the sanitary sewer system on a temporary or permanent basis. Control of sewer leaks and other sources of bacterial contamination requires considerable effort and expense. Even with the best control efforts, storm drains may continue to have elevated bacteria levels. In many cases a simple solution is to divert the dry weather and first flush discharge to the sanitary sewer system. The sewer system and treatment plant will always have substantial excess capacity during the summer and early winter before the wet weather infiltration increases. In some cases flow can be diverted with a weir that allows peak storm flows to continue to discharge to the River. In other cases, the storm drain may need to be physically blocked, with a pump system installed to periodically pump the contents of the backed up storm drain to the sanitary system. The City of Santa Cruz already does this with the discharge from Neary Lagoon, and has done it several times on a temporary basis in the lower River area. This should again be considered for dealing with storm drains with very high bacteria levels, particularly if efforts are pursued to maintain the freshwater in the lagoon at an elevated level.

Toxic Spills and Leaks

Facilities which handle, store, or generate hazardous materials are under the jurisdiction of the Hazardous Materials program of the County Environmental Health Services (SCCEHS). Each facility must have a hazardous material management plan in place to prevent any release of materials into the environment. Facilities are inspected on at least an annual basis for compliance. Any facility with underground storage tanks for petroleum products or other hazardous materials must have proper containment designs and demonstrate that leaks have not occurred. During tank replacement or other operations surrounding soils are assessed for presence of contamination. If contaminated soils are discovered, the site must be cleaned up, under the oversight of SCCEHS. If contamination of groundwater is found, the site cleanup is overseen by the State's Regional Water Quality Control Board. Site cleanup can be very expensive and take many years, particularly where the source of the contamination must be determined. Site remediation could progress faster if there were more agency resources dedicated to overseeing and pushing efforts by the responsible parties. Additional public funding might also help to expedite efforts.

Toxic contamination of surface and groundwater can also occur from illicit discharges or accidental spills. The County, the fire agencies, and the City of Scotts Valley, respond to such spills to contain and clean up the spill. If the spill enters a waterway, the State Department of Fish and Game is notified, and downstream water users are contacted.

Drinking Water Protection: Sanitary Surveys and Source Assessment

Most of the San Lorenzo Watershed drains directly into the City of Santa Cruz municipal water supply. Other large and small public water systems have smaller surface diversions and wells throughout the watershed (see Figure 3). The federal Safe Drinking water Act requires water agencies to take several efforts to assess the effect of the watershed and overlying land uses on the quality of their water sources:

- entities using surface water must prepare a Watershed Sanitary Survey every five years.
- all entities must prepare a Drinking Water Source Assessment for each of their diversions and wells by the end of the year 2002.

Compliance with the federal act and accompanying regulations promulgated by USEPA is enforced by the California Department of Health Services (DHS). Public water suppliers serving more than 200 connections are under the direct authority of DHS, while smaller entities that serve the general public, or have 5-199 connections are under the jurisdiction of the County Environmental Health Service (with oversight and reporting to DHS).

At this stage, preparation of these documents plays primarily an informative role. There is no mandate for watershed protection or land use restriction within the areas that may influence the quality of water supplies. However, the findings of these efforts may influence treatment requirements imposed by the State, and local water agencies may seek to voluntarily initiate protective measures. The City of Santa Cruz added a watershed specialist and has been working with other agencies to address issues raised in the 1996 Sanitary Survey. The 1996 Sanitary Survey addressed all of the City's surface water sources, as well as the sources of other entities within the San Lorenzo Watershed. San Lorenzo Valley Water District also has a watershed specialist and a watershed management plan for the watersheds that it utilizes for surface water supply.

Santa Cruz County Environmental Health Service has also received a grant form USEPA to incorporate water supply concerns with water quality planning efforts in the San Lorenzo Watershed. This effort is ongoing and will be incorporated into the Watershed Plan update review process.

Erosion Control and Riparian Corridor Protection Efforts

Turbidity and degradation of water quality from contaminants attached to sediment is reduced through erosion control and grading ordinances in both the county and the cities. These and other erosion control efforts are discussed under the section on erosion and sedimentation. General water quality protection is also effected through implementation of riparian corridor (streamside) protection ordinances, which require setback of land disturbing activities from creeks in the county and both cities. However, these policies are subject to variances, particularly on properties where there is already existing disturbance of the riparian corridor.

Recommendations for Water Quality Protection

1. Continue implementation of the San Lorenzo Wastewater Management Plan**,** Nitrate Management Plan, and Nitrate TMDL. *(Responsibility: SCCEHS, RWQCB*)
   a. Complete efforts to provide low interest loans and potential grant funds to assist property owners with expensive system upgrades.
   b. Continue to pursue new technologies for nitrogen reduction, including passive approaches. If reasonable approaches are developed, require more extensive use in septic system repairs.
   c. Increase efforts for property owner education and encouragement regarding septic system pumping and maintenance.

2. Complete the pathogen TMDL to identify continuing sources of pathogens and determine additional measures to reduce pathogen loads. (*Responsibility: SCCEHS, RWQCB)*

3. Implement urban runoff management measures to reduce dry weather and wet weather pathogen levels in urban and suburban areas:
   a. Promote good housekeeping practices through education, ordinance, and agency practices for proper management of pet waste, garbage, storm drain inlets, food facilities, and other operations that contribute to elevated pathogen levels.
   b. Investigate and correct leaks and possible illicit connections between sanitary sewers systems and storm drains.
   c. Maintain and enhance efforts to regularly clean storm drains and catch basins, particularly before first flush events.
   d. Implement Phase II Storm Water Programs in urban areas. Consider expanding programs to suburban areas where benefit can be demonstrated.
   e. Develop and implement a strategy to eliminate potential water quality impacts from camping and loitering in flood plain areas.

4. Promote good livestock management practices to reduce discharge of sediment, nitrate and pathogens. *Responsibility: SCCRCD, Santa Cruz Horsemen's Association, SCCEHS.*

5. Maintain and strengthen efforts to remediate and prevent further groundwater contamination from leaking underground storage tanks and toxic discharges. Establish strong source water protection programs to limit and phase out land uses that impact or have the potential to render drinking water sources unusable through the release of toxic compounds.

   a. Complete mapping of existing information on wells, water sources and hazardous material facilities as part of the County s Geographic Information System (GIS). Review the mapped information to assist the Regional Board in prioritizing cleanup sites with the greatest potential to impact water supply wells. Provide for updating maps as additional information becomes available.
      Responsibility: SCCEHS (Environmental Health), DHS (State Department of Health Services), Water Agencies
      Timing: March, 2002, with ongoing enhancements
      Cost: Ongoing work effort, plus $10,000/year for 5 years for additional field assessment of wells.

   b. Work with the State Department of Health Services, Environmental Health Services, and the larger water purveyors to complete the Drinking Water Source Assessment and Protection Program and incorporate the designated water source protection zones into the County s GIS.
      Responsibility: SCCEHS, DHS, Water Agencies
      Timing: December, 2002
      Cost: Ongoing work effort

   c. Review and update mapping and protection policies for groundwater recharge areas and wellhead protection areas as part of the General Plan update.
      Responsibility: SCCPD (Santa Cruz County Planning Department), SCCEHS
      Timing: December, 2001
      Cost: Planned work effort

d. Develop overlay zoning or other measures to restrict within critical groundwater protection areas the location of new gas stations and other hazardous material facilities that have the potential to contaminate groundwater. Evaluate options to encourage phasing out of existing facilities in critical areas.
   Responsibility: SCCPD, SCCEHS, County Counsel, Cities
   Timing: June, 2002
   Cost: Recommended work effort.

e. Work with water agencies that have groundwater management authority under AB 3030 to implement protective measures as needed for their groundwater basins.
   Responsibility: SCCPD, Water Agencies
   Timing: December, 2002
   Cost: Recommended work effort.

f. Actively pursue the identification and proper destruction of abandoned wells in order to eliminate pathways for contamination of deeper aquifers. A priority should be given to areas near wellhead protection zones, known cleanup sites and other hazardous material facilities. Seek grant funds to conduct this effort and provide funding assistance to property owners for proper well destruction.
   Responsibility: SCCEHS, Water Agencies, Cities, USEPA, State Water Board or DWR
   Timing: June, 2002
   Cost: Recommended work effort at $20,000-100,000/year for 5 years if grants available.

g. Provide more property owner education to prevent the discharge of hazardous chemicals into home septic systems.
   Responsibility: SCCEHS, Water Agencies
   Timing: June, 2002
   Cost: Recommended work effort.

h. Shift soil site mitigation oversight from an adjunct function of existing SCCEHS staff to a more focused program under a registered professional in the field. Change the focus of the program from demand services to combination demand and regulatory driven program. Consider application to RWQCB to change status from Local Implementing Agency (LIA) to Local Oversight Program (LOP) thus expanding authority and responsibility to include oversight of groundwater contaminated sites.
   Responsibility: SCCEHS, RWQCB
   Timing: July 2002
   Cost: At Board direction, initiate feasibility study and cost estimates with a report back prior to FY 2002/2003 Budget Hearings.

EROSION AND SEDIMENTATION

Introduction

Accelerated erosion and sedimentation impairs water quality, fish and wildlife habitat, and recreational, aesthetic and property values. Sedimentation increases flood hazards, and causes or aggravates bank stability problems, leading to more downstream sedimentation. Excessive sediment in the San Lorenzo Watershed has been identified as a significant negative impact on water supply and salmonid habitat quality since the 1940's (DWR, 1958, as cited in Swanson Hydrology 2001). Earlier studies have suggested that disturbance related erosion in the San Lorenzo River has increased sediment production by 2-3 fold over the past 150 years (Brown, 1973; HEA, 1980). On the eastern side of the watershed in the upper Zayante Area, erosion rates observed in the 1970's suggest sediment production 4-6 times historic background rates (Brown, 1973; HEA, 1980). This impairment is often attributed to extensive road building and development in the entire San Lorenzo River basin over a terrain where natural conditions combine structurally weak geologic materials with a high level of seismic activity, steep hillslopes and high seasonal rainfall. Fine sediments, especially sand, are the principal impairment of water quality and fish habitat. These fine sediments should be the primary focus of erosion control efforts.

Sediments are delivered to streams both episodically and chronically. Under natural conditions, local ecosystems are adapted to episodic inputs, and can recover over time. However, human land use can exacerbate the impact of episodic events. For example, concentrated drainage and road cuts can contribute to landsliding, such as during the 1982 storms. In turn, these landslides and other disturbances create chronic erosion. It is the chronic, year after year, erosion that is the primary concern for stream habitats. While erosion control efforts cannot control episodic events, they can address chronic sources of erosion.

The severity of bed sedimentation indicates the extent of stream habitat impairment and the severity of accelerated erosion in the watershed. Bed sedimentation in the San Lorenzo River Watershed has not improved since 1979, despite successful implementation of many erosion control efforts by the County, State and other agencies (Balance Hydrologics, 1998). It is likely that significant improvements in erosion control for new development has not outweighed the cumulative impacts from existing roads, intensified land uses, and mass wasting.

Within the watershed, erosion and sedimentation have been more intensely studied in the highly erosive Zayante Area, the lower part of which is underlain predominantly by Santa Margarita Sandstone (Balance Hydrologics, 1998; Swanson Hydrology, 2000). While sandy soils are found throughout the watershed, they are concentrated in the Zayante, Bean, Newell and Love Creek basins. Erosion control efforts should focus on these sandy-soil areas and other highly erosive areas of the watershed, especially the inner gorge or canyon areas adjacent to streams.

Roads are the primary sediment source in the watershed, including public, private and timber harvest roads. Unpaved and poorly maintained roads that are used for year-round access continue to be the most persistent sources of bed sedimentation. Increasing use and disturbance of the roadway surfaces as well as inadequate roadway drainage appear to be the primary immediate sediment sources.

Inner gorge roads in sandy-soils areas are a priority for erosion control efforts. Funding, along with a focused program to improve private roads, including timber harvest roads, is a challenge that needs to be undertaken to significantly reduce erosion and sedimentation in the watershed. Public outreach, and financial and technical assistance should be a primary focus of erosion control efforts in the near future.

Other sediment sources include bank erosion, mass wasting, and other disturbance on urban and rural lands, including riparian disturbance. Road improvements and better drainage should reduce human-induced mass wasting. Addressing several point sources, including the Mount Hermon Slide and the Bean Creek Road corridor will be contribute significantly to erosion control efforts. Sandy soils are very susceptible to erosion from the increased runoff that results from development. It is important to retrofit existing development to reduce runoff and put more rainfall back into the ground as recharge. These measures will also benefit groundwater storage and stream baseflow.

Residential land clearing, grading without effective erosion control, and ad-hoc drainage management, active timber harvests and disruption of riparian zones continue to contribute sediment, most noticeably from newer or recurring areas of disturbance. A higher percentage of older sites seem to be effectively managed; nonetheless, with more residents, there is more activity and continuing contributions from such areas.

Watershed planning and erosion control efforts have intensified greatly in the past few years. Several agencies, including the County, City of Santa Cruz, California Department of Fish and Game, Regional Water Quality Control Board, and Coastal Conservancy have hired new staff to better address impacts to stream habitats, including impacts from erosion and sedimentation. These staff will facilitate the implementation of recommendations to reduce erosion and sedimentation. Several grants have been obtained to assist with implementation, and additional funding is available from several sources.

Background

Impacts of Erosion and Sedimentation

Accelerated erosion and sedimentation impairs water quality, fish and wildlife habitat, water supply, recreational opportunities, aesthetic values, and property values. Sedimentation increases flood hazards, and causes or aggravates bank stability problems, leading to more sediment delivery.

Declines of anadromous steelhead and Coho salmon runs in the San Lorenzo River are related to sedimentation, the loss of lagoon rearing habitat, the removal of in-channel large woody material, and the diversion of streamflow for residential, industrial, and municipal water supply. Sedimentation of fish habitat has been noted as a primary cause of the decline in local fisheries stocks since at least as early as 1958 (DWR, 1958). Bed sedimentation is a focus of concern in Department of Fish and Game Stream Surveys conducted in 1966 and again in 1972. During that period, habitat degradation by sediment deposition was noted in the changes in bed composition in the mainstem from 8 percent silt in 1966 to 65 percent silt in 1972. During this same period, the percentage of the bed consisting of gravel, which is utilized by Coho and steelhead for spawning, dropped from 20 percent to 2 percent (Santa Cruz County Planning Department, 1979).

The San Lorenzo watershed is an important source of public water supply in Santa Cruz County, supplying all its residents as well as those served by the City of Santa Cruz. Persistent turbidity caused by fine sediments limits when water can be diverted for use, and increases the water treatment costs. Bed sedimentation also limits water supply development. Since bed sedimentation reduces aquatic habitat by filling pools, undercut banks and lagoons, more water should remain in the stream for fish and wildlife.

Erosion and sedimentation have additional costs beyond water supply and wildlife impacts. Bank erosion can impact private landowners through property loss, cost of stabilization efforts and decreased property values. While bank erosion occurs naturally, often during large storm events, humans increase bank erosion in a number of ways. Humans contribute to bank erosion by removing riparian vegetation, improper drainage, and by contributing to bed sedimentation. Excess bed sedimentation, such as mid-channel sandbars, often results in bank erosion due to changes in the stream dynamics. For example, sedimentation is affecting bank stability and landowner costs in the middle river, especially near Henry Cowell Park and in Paradise Park. The Army Corps of Engineers and the City of Santa Cruz are raising flood control levees to offset chronic sediment loads and provide needed flood capacity in the channelized reach through downtown Santa Cruz. Upland property owners can also be impacted by erosion, through gullies, landslides, and private road maintenance and repairs.

Processes Of Erosion And Sedimentation

Erosion occurs when soil particles becomes detached and are carried away by water, wind or gravity. Soil erosion by water and gravity (usually with the addition of water) are the primary causes of erosion in the San Lorenzo Watershed. Soil erosion by water can occur in numerous forms, such as surface, gully, streambank, and slope failures (mass wasting or landslides). Erosion potential varies throughout the watershed depending on rainfall, geology, soils, vegetation, the length and steepness of slopes, and disturbance of land or drainage patterns. Erosion and mass wasting tend to peak during saturated conditions and during intense rainfall. It is under these conditions that surface runoff is highest resulting in surface and channel erosion, and slope strength is most likely to be exceeded, resulting in slope failures.

Sedimentation refers to the accumulated deposits of eroded material in streams. With accelerated erosion, excess materials cannot be carried by the stream system and accumulate in pools, gravel areas and sandbars. Fine particles such as fine sand, silt and clay are carried more easily by the stream within the water column as *suspended sediment*. Coarse material such as gravel, cobble and boulders move by bouncing or rolling along the stream bottom as *bedload*. Of the total sediment load in local streams, approximately 90% is carried as suspended load (Swanson 2001). Much of this suspended sediment is carried out of the river system into Monterey Bay during storm events. These flood-borne suspended sediments, especially silt, affect water quality treatment and timing of water diversions more than in-stream habitat quality. Sand, which disproportionately degrades in-stream habitat quality, will be carried both as suspended load and as bedload. Since sand is heavier than silt, even sand carried as suspended sediment will drop out more quickly than silt as stream power decreases at the end of storm events. Consequently, sand remains in the stream system impairing habitat by filling pools and embedding larger particles in riffles.

Under natural conditions, the San Lorenzo Watershed has a high background erosion rate. Rapid uplift of the Santa Cruz Mountains, combined with area geology and soils, make this one of the most erosive areas in the

world. Erosion is a natural process that delivers sediments to streams to create habitat for aquatic organisms, and brings sediments into the ocean and beach environments. However, under natural conditions, dense vegetation minimized erosion by increasing infiltration and protecting steep slopes from surface erosion. Human land uses - especially roads – increase erosion by changing drainage patterns, disrupting sensitive slopes prone to landsliding, and by concentrating runoff. This results in gullies, streambank erosion and slope failures. On average, erosion rates in the San Lorenzo Watershed are estimated at 2-4 times the natural rate (Balance Hydrologics, 1998, Swanson Hydrology 2001).

Sediment is delivered to streams during episodic events and through chronic erosion. Local ecosystems are adapted to episodic inputs, and can recover over time. However, episodic events, such as 1982, create also chronic erosion through landslides and gullies. Both episodic and chronic sediment delivery are a concern for stream habitats and water quality. Episodic sedimentation events will occur in the watershed, regardless of erosion control efforts. However, addressing problems that lead to mass wasting will reduce significantly the severity of episodic sediment delivery and elevated erosion rates in the following years.

Geology

Geology and soils influence erosion hazards within the San Lorenzo Watershed. Three separate geological terrains are recognized within the watershed. These three geologic terrains differ not only in geology and erodibility, but also in the persistence of dry-season streamflows, the nature of low-flow aquatic habitat, and water quality.

North of the Zayante Fault. Principal watersheds are the upper San Lorenzo River (above Boulder Creek), Kings, Two Bar, and Bear creeks, plus the northern portions of the Boulder and Zayante creeks basin. In these areas, interbedded sandstones, shales, and mudstone predominate, with steeply inclined and folded strata. Slopes tend to be steep and prone to moderate to severe erosion. Steep slopes associated with the Butano Fault are especially prone to erosion from roadcuts and land disturbance. Dry-season flows are generally lowest in this geologic terrain, with streams often drying to isolated pools during mid-summer of dry years; hence, sedimentation (which fills pools) is especially harmful to aquatic habitat, recreation and water quality. Many of these streams drain steep gradient areas and deliver high sediment yields to downstream reaches.

Ben Lomond Mountain. Principal watersheds are Fall, Alba, Clear, Sweetwater, Malosky, Peavine and Jamison creeks, and the southern portion of Boulder Creek basin. Crystalline bedrock types – principally granitics, schists, and marble (locally known as limestone) – have developed residual soils which support steep, small forested watersheds with low to moderate background erosion rates. Streams clear up quickly after storms. The lower portions of these watersheds have developed in downslope-dipping sandstones and mudstones, locally prone to landsliding, especially where disturbed. Summer flows are generally sufficient to support perennial stream threads and diverse aquatic habitat. In addition, dry season discharge from these streams contributes beneficially to water quality and quantity in the mainstem San Lorenzo River. The lower reaches of a few streams emanating from the eastern slope of Ben Lomond Mountain are used by steelhead and once supported Coho, with the middle and upper reaches being too steep for access by anadromous fish.

South of the Zayante Fault. The third terrain is found south of the Zayante fault, and east of the Ben Lomond fault and the San Lorenzo River. It includes the Love Creek, Quail Hollow, Graham Hill Road, Olympia, Mount Hermon and Scotts Valley areas, as well most of the Bean, Carbonera, and Branciforte creek basins, and the southern portions of the Zayante and Newell creek watersheds.

Here, unconsolidated sandstones and shales form erodible soils which tend to be either very sandy or clay rich. Much of the sandy area was once vegetated with unusual associations of trees and shrubs, which exploited niches, made available by these atypical soils. By far the largest continuous units of sandy soils are found in this area, and these tend to be sandier than other sandstone-derived soils elsewhere in the watershed. Erosion rates are often high to extreme in this terrain, especially where sandy soils occur in headwater areas or near channels. In contrast, shales and mudstone units produce clay-rich soils that are less erodible, but may be susceptible to landsliding.

The sandy soils, which were capable of absorbing nearly all rainfall under natural conditions, often form steep-walled gullies and gulches where runoff from paved or covered surfaces is now concentrated. Residential, commercial, and industrial uses (including quarries) are among the densest in the San Lorenzo watershed. Roads and homes are the predominant sources of sediment although much of the sediment they "generate" is from inclusion of downstream gullies and from bank erosion along gulches and creeks. In places, landslides impinge upon the channels, feeding a seemingly endless supply of sandy material directly into the channels. Eroded sediment entering local streams commonly contains mostly medium and coarse sands, which fills pools and mantles riffles with soft, habitat-impairing sandy beds. The Santa Margarita and Lompico aquifers are recharged through the sandy soils; erosion-inducing runoff represents recharge being lost from these important water-bearing units. The two aquifers not only sustain summer flows in the San Lorenzo River and lower Zayante Creek, but also provide the municipal and industrial water supply for much of the watershed's population.

In each of the three segments of the valley, sources and processes of erosion differ somewhat. Challenges posed in restoring fish habitats, summer flows, summer recreational and aesthetic values, and water quality also differ somewhat amongst the three geologic terrains. Nonetheless, important similarities also cut across these geologic boundaries. Each segment contains areas of sandy soils. Each includes dispersed areas of unstable slopes, and significant areas of sediment sources along the road network. In each area, riffles and pools which once provided crucial over-summering habitat for anadromous steelhead and coho salmon are chronically filled with sand and fine gravels.

Soils

As noted above, the San Lorenzo watershed is underlain by a complex mosaic of alluvial and terrace deposits, mudstones, shales and sandstones, and fractured granitic rocks, schists and metamorphosed limestones. Soils vary, sometimes markedly, from location to location, depending on the underlying parent materials, and other factors such as climate, aspect, vegetation cover, and local relief. (Lindsey and Beutler, 1968) Soils of mixed parent material and texture have developed on the alluvial and terrace deposits along nearly all of the major streams and on the colluvial and slope deposits, which fill many of the swales and hollows near their headwaters.

In the most general terms, it can be stated that soils underlain by permeable sandstones, as well as igneous and metamorphic rocks, are classified as deep and well drained to excessively well drained. These sandy and sandy loam soils are dispersed throughout much of the San Lorenzo Valley, most notable in areas underlain by the Santa Margarita formation. Soils formed from mudstones and shales tend also to be deep, yet somewhat less well drained. Overall steep slopes and the gradual loss of topsoil to erosional forces often limit depth. In alluvial areas of San Lorenzo, soils are also

considered to be deep and well drained, although soil depth may be limited by less permeable layers of fines.

Soils formed from the Santa Margarita and (locally) several other sandstone formations, and decomposed granite are also sandy, deep to very deep, excessively well drained, and extremely erodible. Focused efforts to limit mechanical disturbance of sandy soils and reduce runoff, combined with added efforts and appropriate erosion control strategies, are necessary to reduce excessive sedimentation from these highly erodible areas.

Watershed History Since 1979

Several significant hydrologic and erosional events occurred in the past twenty-two years in the San Lorenzo Watershed. The largest events, the storms of 1982, resulted in intense disturbance throughout the watershed. A number of large existing landslides, including ones along Bean Creek and Love Creek roads, and at Mt. Hermon, were activated in the 1982 storms. Throughout the whole watershed, evidence of 1982 can be found in numerous landslides, road failures and streambank erosion sites. Intense winter storms occurred in 1983, 1995-6 and 1997-8 associated with El Nino conditions. In 1999-2000, storm events created bankfull discharge for many weeks, which resulted in many streambank and road failures, but the storms lacked the duration to cause major landslides.

Large-scale watershed disturbances can result in significant erosion. Local agencies should plan for these events by anticipating locations to stockpile landslide material or implementation of emergency erosion control projects. In 1989, the Loma Prieta Earthquake, measured 7.1 on the Richter scale, brought some disturbance through landslides, slope failures and reconstruction efforts. A future earthquake during wet conditions could have a much greater erosion impact through greater number and severity of landsliding. Significant wildfires, and the resulting slope and channel disturbances, have not occurred in recent decades in the watershed. Inevitably, wildland fires will occur and impacts will depend on the scale and intensity of the burns.

Status of Erosion and Sedimentation in the Watershed

Technical Studies

Two technical studies were completed recently that address erosion and sedimentation in the San Lorenzo River Watershed. The findings from these two studies form the foundation for this chapter; the following briefly describes the study and principal conclusions. Both studies identify roads and sandy-soil areas as priorities for erosion control efforts, and make solid recommendations for addressing erosion and sedimentation in the San Lorenzo watershed.

An Assessment of Streambed Conditions and Erosion Control Efforts in the San Lorenzo River Watershed, Santa Cruz County, California was completed in 1998 by Balance Hydrologics. This study investigated whether bed conditions have improved or worsened since the 1979 Watershed Plan. In addition, this study evaluated the effectiveness of erosion- and sedimentation-control measures recommended in the 1979 San Lorenzo Watershed Plan. As part of this investigation, bed conditions were monitored in 1996 and compared to the base monitoring period of 1978-81. In

addition, other information was examined, such as gage data and sediment transport and stream gage data. This report concluded that bed conditions have not substantially changed, but habitat impairing fine sediments may be coming more from the lower watershed (Zayante Area), than the upper watershed. Not surprisingly, the study found also that the 15-20 year interval between monitoring was too long, both to locate sampling sites and to effectively evaluate sedimentation changes.

In 2001, Swanson Hydrology and Geomorphology completed the *Zayante Area Sediment Source Study*. This study analyzed sediment contribution from different sources in the Zayante Area and sets priorities for treatment. The Zayante Area includes watersheds of Newell, Bean, Zayante, Love and Lompico creeks. This area was chosen because the Zayante Creek watershed has been a consistent source of habitat-impairing fine sediment to streams and the Lower San Lorenzo River. Moreover, the geologic, physiographic and land use conditions in the Zayante Area appear to be a reflective sample of most of the San Lorenzo Watershed. However, the most apparent erosive geologic formation within the watershed, the Santa Margarita Sandstone, occurs almost exclusively within the Zayante study area.

The Zayante Area Sediment Study will used by the Regional Water Quality Control Board (RWQCB) to develop a Total Daily Maximum Load (TMDL) for the entire watershed. The TMDL will be completed in 2001. The San Lorenzo River is identified as an impaired waterway under the Federal Clean Water Act for sediment, pathogens, and nutrients affecting drinking water, fisheries and recreational beneficial uses (California Regional Water Quality Control Board Basin Plan Region 3 and CWA). In order to gain compliance, the Regional Waters Quality Control Board (RWQCB) and local agencies are required to prepare and implement water quality improvement programs to set targets for Total Maximum Daily Load (TMDL) of specific pollutants ranging from nitrates and sediment to trash.

For habitat impairing sediment, the TMDL process begins with identification of impacts from excessive sediment, followed by quantification of sediment sources, then design and implementation of an erosion control program to reduce sediment input and achieve “target” aquatic habitat conditions to eliminate impacts.

In the face of limited data and immense variability, quantifying sediment loading and relating it to specific land use factors must be viewed as an *index of severity* rather than an absolute statement of sediment volume. This stems largely from the variable nature of sediment transport and circumstances of available data. Sediment detachment and loading to streams is subject to a high level of variability in time and space, particularly since detachment and transport is dependent upon rainfall and stream flow.

Zayante Area Sediment Source Study estimates the sediment yield (tons/year) of eight land use categories: inner gorge public and private roads, inner gorge THP roads and skid trails, hillslope THP roads and skid trails, hillslope public and private roads, active and recent THP parcels, other urban and rural lands, mass wasting, and channel erosion. For each land use category, the controllable yield is estimated as a percentage (10-50%) to calculate the controllable load, and remaining load. Erosion control measures that reduce erosion from 10-50%, depending on the land use category, could reduce sediment yield by at least 50%. This study found that some of the greatest benefits will come from addressing erosion from inner gorge roads and point sources where delivery to the stream is estimated to be 100%.

Status of Bed Sedimentation

The measurement of erosion, sedimentation, and sediment transport is extremely difficult, even for experts in the field, and costly. However, information is sufficient to indicate trends and point to principal sources and priorities for remediation.

Bed sedimentation in the San Lorenzo River Watershed has not improved since 1979, despite successful implementation of erosion control efforts by the County, State and other agencies (Balance Hydrologics, 1998). The strongest comparative data are available for the Zayante and Bean Creek watersheds. In this portion of the watershed, the bed material is now composed of slightly finer bed material, with fewer clean spawning gravels or cobbles and boulders for summer rearing of young fish. The composition of the bed sediment indicates that *proportionately* less bed sediment is originating from the upper portions of these watersheds, and more from the lower sandy portions. This suggests that existing measures may be helping slightly or at least inhibiting further sedimentation.

While bed sedimentation has not improved, it has also not gotten substantially worse. This may indicate that erosion control efforts have been effective at mitigating the impact of increasing development and population.

Status of Sediment Discharge

Sediment discharge can be quantified by measuring suspended sediment and bedload transport. Minimal monitoring of suspended sediment over time makes it difficult to identify trends over the past twenty-two years. In their 1998 report, Balance Hydrologics observed the possibility that suspended sediment discharge decreased somewhat during 1996 compared to the base monitoring period of 1976-1981. However, this observation occurred prior to the El Niño storm years of 1995-96 and 98-99.

The *Zayante Area Sediment Study* estimated sediment yield for the Zayante Study Area at 2930 tons/square mile/year, or a total of 115,100 tons/year. This value can be compared to the synthetic sediment yield developed from the Zayante Creek gage at Zayante. This gage shows a sediment yield of 5,400 tons/square mile/year based on field measurements taken in the early 1970's. Though the estimated sediment yield calculated for this study is substantially lower than past gage estimates from Zayante Creek, this lower value makes sense when considering factors such as the trapping efficiency of the Loch Lomond reservoir (Newell Creek watershed) and reduced sediment production from the upper Zayante Creek watershed.

Table 8: Comparison of pebble count sediment size distributions for repeated monitoring sites

(Source: Swanson, 2001)

Stream	Station	Date	Grain Size Distribution (in mm)			
			D_{50}	D_{16}	D_{84}	% < 4 mm
Zayante	Riffle above Graham Hill Road	4/5/79	69	23	180	8
		3/21/80	111	37	200	31
		10/24/96	40	12	128	7
		6/26/99	53	16	120	16
Zayante	Riffle above Woodwardia Weir	2/9/79	78	27	220	6
		4/5/79	86	38	304	2
		3/22/80	86	31	227	2
		10/24/96	66	26	125	4
		5/22/99	21	8	71	36
		5/22/99	46	8	148	41
Zayante	Above Mountain Charlie Gulch	12/12/78	87	20	236	4
		6/22/99	38	11	222	11
M.C. Gulch	At Confluence w/ Zayante Creek	12/12/78	100	27	228	12
		6/22/78	12	4	182	38
Bean	Riffle at 1958 DWR Site	8/8/96	40	19	81	4
		7/30/99	25	10	57	23
Bean	First Riffle below Lockhart Gulch	2/9/79	44	27	72	0
		8/8/96	29	12	50	0
		6/5/99	24	7	55	42

Table 9: 1999 Streambed Conditions

Source: Swanson, 2001

1999 Conditions Location Description	< 4mm	Pebble Count Embeddedness (particles > 16 mm)
Bean Creek below Lockhart Gulch	42%	52%
Bean Creek at 1958 DWR site	23%	50%
Bean Creek downstream of Mt. Hermon slide	55%	60%
Bean Creek upstream of Mt. Hermon slide	15%	49%
Love Creek below slide	12%	44%
Newell Creek at Steel bridge	1%	23%
Newell Creek above Glen Arbor Bridge	4%	22%
Woodwardia, Zayante Creek	38%	54%
Woodwardia, Zayante Creek	34%	47%
Mountain Charlie Gulch	38%	24%
Zayante Creek above Mtn Charlie Gulch	11%	39%
Zayante Creek store	27%	42%
Zayante Creek at Graham Hill Road	16%	46%
Zayante Creek scour logs	28%	25%
Lompico Creek	6%	48%
Target	**30%**	**25%**

Sources of Accelerated Erosion and Sedimentation

Sources of accelerated erosion and sedimentation are identified in numerous watershed and water supply evaluations, the 1979 Watershed Plan, and the most recent two technical studies: (1) Balance Hydrologics' 1998 Report: An Assessment of Streambed Conditions and Erosion Control Efforts in the San Lorenzo River Watershed, Santa Cruz County, and (2) Swanson Hydrology and Geomorphology (2001), Zayante Area Sediment Source Study. The following are primary causes of accelerated erosion and sedimentation as described in the Balance Hydrologics report and are supported in the *Zayante Area Sediment Study.*

Roads. Overall, the most persistent, chronic source of sediment to area streams appears to be (1) roadcuts on public and private roads, (2) year-round use of dirt roads, primarily for residential access, and (3) timber harvest road networks. Periodic roadcut failures, grading, and leveling of road surfaces continuously exposes erodible material both on the road surface and along the road shoulder. This loose, unconsolidated material may be extremely mobile in relatively insignificant rainfall events. Roadcuts along most steep roads are chronic sediment sources. Examples include Jamison Road, China Grade, Kings Creek Road, Araki Road, Logan Creek Road, Deer Creek Road, Two Bar Road, and Bean Creek Road. Small cut/fills for residential driveways exacerbate sedimentation problems.

Where public and private roads are located along tributaries in the riparian zone, they are frequently subject to failure by slippage and/or undercutting as streams migrate into the fill prism below the roadbed. Kings Creek Road, Logan Creek Road, Deer Creek Road, Bean Creek Road and Jarvis Road have visible examples of this condition. Numerous county-maintained and private roads cross old landslides and debris flows or cones. Love Creek Road, Kings Creek Road, and Deer Creek Road are notable examples. These are particularly unstable where steep bedding in the geologic formations facilitates deep-seated slides. Roads in steep side drainages, particularly access roads to homes, retreats, and camps appear to contribute significant sediment to larger tributaries just downstream, particularly when sediment yield is viewed on a road mileage per capita perspective. This is due to the persistent use of dirt roads in all seasons. Use of drain rock on the road surface reduces rutting, and may decrease fine sediment loads.

Road Maintenance. The stockpiling of winter landslide debris contributes sediment to streams on roads that are subject to slides. Sidecasting of material appears to be less common than stockpiling. Where stockpiles are left through subsequent winters, erosion of piles can be a major source of sediment. Where stabilization, or removal, of stockpiles occurs, streambank vegetation and downstream bed conditions show less disturbance. Stockpiles and side-casting of debris on non-county maintained roads appear to contribute sediment in proportions that appear greater than contributions from county roads.

Ditch clearing and vegetation removal in roadside swales also contribute sediment exposing soils to rainfall and road runoff. The level of impact resulting from these maintenance activities on county roads and private lands appears to be less significant than unsurfaced roads, failed roadcuts, and landslides.

Landslides and geologic instabilities. Background geologic instabilities, landslides, mudflows, and debris slides are significant factors in overall sediment budget, and often affect the severity of human-induced erosion and sedimentation problems, and greatly increase costs of stabilization

efforts. These instabilities include the Mt. Hermon slide, Love Creek slide, and Bean Creek road corridor.

Geologic Formations. Several geologic formations are consistent contributors of sediment loads to local streams, despite stabilization efforts. Santa Margarita Sandstone along Bean, Zayante and Newell creek, and neighboring drainages. Disturbance of the soils and weathered mantle results in severe gullying and long term instability. The high permeability and low available water capacity in exposed Santa Margarita sandstone severely limits revegetation efforts, particularly on south-facing slopes. Mudstones in Kings Creek, Logan Creek, and upper San Lorenzo are another problematic geologic formation. Where exposed, vegetation is often naturally sparse, soils are thin or non-existent, and weathering continuously exposes erosive surfaces. Steep slopes, unsurfaced roads, and roadcuts in these areas are notable sources of persistent turbidity, particularly where year-round road use is necessary for residential access. Sandier members of the Purisima formation in Branciforte and Carbonera creeks are highly erodible, particularly where residential development, roads, and livestock (primarily horses) concentrate flows or reduce the soil capacity to hold moisture and attenuate runoff. In these area, old logging roads and residual instabilities are also sources of landslides and winter debris flows. Vaqueros Sandstone where disturbed by road development in upper Bear, Kings, and Deer creeks also serves as a primary sediment source in the upper San Lorenzo Watershed.

Where exposed to weathering or erosive forces, the interface between geologic formations may be a significant chronic source of sediment. Steeply bedded contacts between mudstones, shales, and less coherent sandstone units in the upper watershed are often points of continuous sediment supply.

Poor site drainage. Many erosion sites, mudslides, and landslides result from ad hoc and uncoordinated control for drainage onto, across, and off of private lands and public rights of way. Landowner responsibilities and obligations for management of storm runoff are not well understood and chosen strategies are often emergency “fixes” that neglect to consider downslope conditions. Runoff from roofs, impervious driveways and private roads can greatly increase the volume, velocity and erosive force of offsite runoff. In addition, undersized, plugged, poorly installed, or inadequately maintained culverts and drainage structures can lead to changes in drainage patterns that exacerbate gullying, sheet erosion, or sliding of saturated slopes.

Riparian disturbance. Repeated riparian disturbance is self perpetuating. Where there is a discontinuous riparian canopy, there is often bank instability. Where bank stabilization has been attempted without re-establishing riparian vegetation, few stable streambanks are observed. Restored riparian zones result in improved bank stability whether actively planted or simply left to naturally regenerate.

Timber Harvest Areas. Within timber harvest areas, roads and skid trails, not harvest areas, contribute the majority of the site’s sediment yield. In the harvested area, the regeneration of redwoods and herbaceous understory plants serve to stabilize slopes, especially when minimally disturbed. However, even well-managed timber harvests contribute sediment, particularly in the first winter season following harvest activities.

At-grade crossings in residential/timber harvest areas are chronic sediment sources.
Harvest landings may eventually be converted to home sites without measures which will anticipate and reduce erosion both at the home site and along the access roads. Timber harvests can result in road networks which may result in ongoing erosion as neighboring or subsequent homeowners modify the road net to provide privacy and as they perform ad hoc repairs of post-logging

instabilities. Timber harvest roads are not necessarily constructed to standards required for residential access roads. In particular they may cross steeper slopes than allowed in the county grading standards. The construction of multi-purpose road networks (for timber harvest and post-harvest uses) may result in road systems that are longer or denser than would be built for each use alone. There may be opportunities to reduce erosion through improved design or re-bedding of roads at the time when post-harvest uses commerce.

Horse and livestock facilities on slopes and encroaching the riparian zones may locally be notable contributors of sediment. Where riparian vegetation has been lost and use is constant, livestock facilities, trails, and stream crossing are chronic sources of fine sediment.

Quarry Operations in the Bean Creek and Zayante Creek subwatershed and in Gold Gulch have substantially improved sediment management since the first watershed plan.

Status of Implementation

Many of the 1979 plan recommendations addressing sediment control have been implemented. For example, both the County and the City of Scotts Valley now have erosion control and grading ordinances that limit the period of legal earthwork to the dry season, generally April 15 through October 15. The success of these ordinances in reducing erosion and stream sedimentation is clearly seen in cases where landowners conscientiously prepare erosion control plans and proceed through the established planning process. In general, due to the existence of erosion control ordinances, new development in the San Lorenzo watershed is now subject to far more oversight and restrictions than existing developments and unpermitted watershed activities.

Nonetheless, it is evident that something is lacking – incentive, funding, information, and technical expertise – to more effectively minimize erosion and sedimentation from existing sources in the San Lorenzo Watershed. There needs to be a more concerted effort to address chronic problems

The Status of Implementation section is divided into Federal and State Regulation, Local Policy and Practices, Enforcement, Projects, and Outreach-Education-Technical Assistance.

Federal and State Regulation.

Anadromous steelhead trout (*Oncorhynchus mykiss*) have been listed as threatened under the Federal Endangered Species Act (ESA). The National Marine Fisheries Service has published 4-d rules that define "take" for this listed species. The California Department of Fish and Game will prepare Steelhead Recovery Plans for each watershed that will identify actions that should be undertaken to secure of the viability of this population. Since sedimentation is a known limiting factor, both federal and state agencies will be involved with erosion control efforts in the San Lorenzo Watershed. Coho salmon (Oncorhynchus kisutch) has been listed as threatened under the Federal ESA and listed as endangered under the State ESA. Sediment has been identified as a limiting factor in the *Draft Strategic Plan for Restoration of the Endangered Coho Salmon South of San Francisco Bay* (CDFG, 1998).

Table 10: Sources of Sediment – Zayante Study Area

Source: Swanson, 2001

Sediment Source	Area or Length Represented by Source (inner gorge length)	Erosion Rate	Delivery Efficiency	Sediment Delivery Rate to Streams	Sediment Yield (tons/yr)	Percent Controllable	Controllable Load (tons/yr)	Percent of Total Controllable Load	Remaining Load/Allocation (tons/yr)
Hillslope THP Roads and Skid Trails [1]	42.9 miles	413 tons/mi/yr	42%	173 tons/mi/yr	7422	50%	3711	13.9%	3711
Inner Gorge THP Roads and Skid Trails [2]	8.2 miles	413 tons/mi/yr	100%	413 tons/mi/yr	3387	50%	1694	6.3%	1694
Hillslope Public and Private Roads [3]	148.5 miles	120 tons/mi/yr	42%	50 tons/mi/yr	7425	50%	3713	13.9%	3713
Inner Gorge Public and Private Roads [4]	54.1 miles	120 tons/mi/yr	100%	120 tons/mi/yr	6492	50%	3246	12.1%	3246
Active and Recent THP Parcels [5]	4.5 square miles	206 tons/mi^2/yr	42%	87 tons/mi^2/yr	393	30%	118	0.4%	275
Other Urban and Rural Lands [6]	35.7 square miles	1310 tons/mi^2/yr (50% classified as mass wasting)	42%	550 tons/mi^2/yr (50% classified as mass wasting)	21615	30%	6485	24.2%	15131
Mass Wasting (Natural and Human Caused) [7]	39.3 square miles	3570 tons/mi^2/yr	42%	1500 tons/mi^2/yr	58950	10%	5895	22.0%	53055
Channel Erosion [8]	23.5 miles	400 tons/mi/yr	100%	400 tons/mi/yr	9432	20%	1886	7.1%	7546
Estimated Total					**115116**	**23%**	**26747**	**100%**	**88369**
Measured Sediment Yield @ Zayante Gage (tons/mi^2/yr)					**5400** [9]				
Estimated Sediment Yield for Study Area (in tons/mi^2/yr)					**2930**				
Expected Sediment Yield after Erosion Control Treatments (in tons/mi^2/yr)					**2249**				

Sediment Yield and Source Load Allocation for the Zayante Study Area. Sediment yields were generated from values averaged over each subwatershed and adjustments based on known sediment sources and best professional estimates. Percent controllable was based on BMP's and current sediment source control methods. Since length or area measurements are rounded, calculations may not produce exact values.

Footnotes on Following Page

Footnotes for Table 10 (Source: Swanson, 2001)

1) Erosion rates from Hillslope and Ridge THP Roads and Skid Trails is taken from CDF (1993) estimates for Forestry Roads Currently in Use with a delivery efficiency assumed to be 42%. Soil bulk density was assumed to be 85 lbs/ft^3.

2) Erosion rates from Inner Gorge THP Roads and Skid Trails is taken from CDF (1993) estimates for Forestry Roads Currently in Use with a delivery efficiency assumed to be 100%. Soil bulk density was assumed to be 85 lbs/ft^3.

3) Erosion rate from Hillslope and Ridge Public and Private Roads was estimated using a combination of road surveys conducted by SH&G and CDF(1993) estimates for Non-Forestry Roads with a delivery efficiency assumed to be 42%. SH&G estimated erosion rates from road cuts using a USDA-NRCS method. This rate was then tripled to account for erosion from road surfaces, inside ditches and road shoulders producing an erosion rate of 120 tons/mi/yr, which was comparable to the CDF rate.

4) Erosion rate from Inner Gorge Public and Private Roads was estimated using a combination of road surveys conducted by SH&G (see Footnote #3) and CDF(1993) estimates for Non-Forestry Roads with a delivery efficiency assumed to be 100%.

5) Erosion from THP lands taken from CDF (1993) estimates of 0.28 yd3/ac/yr, which converts to a sedimentation rate of 87 tons/mi2/yr (assuming 42% delivery efficiency). This estimate was assumed to only include surface erosion features such as rilling, gullying and sheetwash. Soil bulk density was assumed to be 85 lbs/ft^3.

6) Erosion rates from Other Urban and Rural Lands were estimated from sedimentation rates in Loch Lomond Reservoir (Brown, 1973). This estimate was assumed to include surface erosion features as well as erosion from mass wasting from an assortment of land uses including urban and rural residential and timber harvests. Therefore, 50% of the estimated value was subtracted from this category and added to the mass-wasting category.

7) Sediment Yield from Mass Wasting was estimated by taking 50% of the value from Other Urban and Rural Lands and adding estimated erosion rates from known active landslides in the project area. An additional amount was also added to account for unknown mass wasting sources. This category also accounts for mass wasting from timber lands and roads that was not accounted for in Categories 1-5.

8) Sediment Yield from Channel Erosion is assumed to come from two sources, bank erosion (assumed to be 60% of the process) and channel downcutting (assumed to be 40% of the process). Bank erosion was estimated based on field surveys conducted by Don Alley. The total cut area for the survey was calculated and multiplied by an assumed retreat rate of 0.5 feet per year. The volume was then divided by the total stream mileage surveyed to produce a sediment yield per mile of stream. Since no data are available for rates of channel downcutting in the Santa Cruz Mountains, channel downcutting was assumed to amount to 40% of the Channel Erosion sediment yield. The combined value of bank erosion and channel downcutting was converted to tons/mi^2/yr by multiplying by the stream mileage in the studied watersheds and dividing by the total drainage area. Soil bulk density was assumed to be 100 lbs/ft^3.

9) Based on average annual synthetic suspended sediment load estimate from Zayante Creek, based on data collected in the early 1970's, plus an additional 10% to account for bedload (see Appendix C in Technical Addendum, Swanson, 2001).

Subsequent to the 1979 Watershed Plan, the San Lorenzo River was identified as an impaired waterway under the Federal Clean Water Act (section 303.d) for sediment, pathogens, and nutrients affecting drinking water, fisheries and recreational beneficial uses (California Regional Water Quality Control Board Basin Plan Region 3 and CWA). In order to gain compliance with the Clean Water Act, the Regional Waters Quality Control Board (RWQCB) and local agencies are required to prepared and implement water quality improvement programs to set targets for Total Maximum Daily Load (TMDL) of the specific pollutants including nitrates, sediment, and pathogens.

For habitat impairing sediment, the TMDL process begins with identification of impacts from excessive sediment, pollution, followed by quantification of sediment sources, then design and implementation of an erosion control program to reduce sediment input and achieve "target" aquatic habitat conditions to eliminate impacts. The TMDL for the San Lorenzo Watershed is in progress and scheduled for completion in 2001.

Local Policy and Practices

County of Santa Cruz. The most significant erosion control efforts by the County of Santa Cruz have been the development and implementation of ordinances that reduce erosion through development: the Erosion Control Ordinance (County Code Section 16.22), the Grading Ordinance (Section 16.20), the Geological Hazards Ordinance (Section 16.10) and the Riparian Corridor Protection Ordinance (Section 16.30). These ordinances work in concert to minimize both short-term and long-term site disturbance by development. The Geological Hazards ordinance restricts development, including both roads and homes, on slopes greater than 30%. The Grading Ordinance restricts excessive grading for road construction or home sites, establishes a grading season of April 15 – Oct. 15, and requires a special permit for winter grading. The Erosion Control Ordinance minimizes site disturbance and requires controlling erosion at all stages of development and prohibits maintaining any condition which results in excessive erosion. Both the Grading and Erosion Control Ordinance have provisions for enforcement.

Staffing and organizational support play an important role in erosion control efforts in the San Lorenzo Watershed. In general, there is more staff available since 1979, with more specific responsibilities. In the early 1980's, erosion control projects, review and enforcement were under the responsibility of the Watershed Section which focused on erosion, timber harvests and watershed issues. This section implemented the Rancho Rio Sediment Control Projects and improvements to Love Creek Road. Since then, erosion control and resource protection has become integrated into the overall development review process, which increases consistency and effectiveness of implementation of county planning standards. At the same time, there was less staff available specifically for erosion control projects and planning.

In the past three years, there has been increased focus and staffing for watershed management and erosion control efforts. In 1995, Environmental Health staff began working on the update of the San Lorenzo Watershed Plan. In 1999, a Water Resources Section of the Planning Department was created that included a new Resource Planner position, with a primary responsibility to advocate and coordinate erosion control efforts within the County. In addition, new Resource Planners work in Environmental Health and Public Works.

The Environmental Planning Section has made several improvements for erosion control. Streambank stabilization project applicants must include a hydrologist's evaluation that the project will not induce off-site bank erosion. For the past four years, Environmental Planning has coordinated with Public Works to improve erosion control for subdivision grading projects. Winter grading approvals have been consolidated into a computer database to facilitate tracking of projects. The past year, environmental planning staff began to implement more consistently retention/detention requirements for groundwater recharge zones in sandy-soil areas.

In past few years, the City of Santa Cruz has become more active in watershed issues and is currently involved in several planning processes that relate to erosion and sediment control. Erosion and sedimentation impacts the city's drinking water supply and affects flooding and habitat function in the lower river within the city limits. The City of Santa Cruz also owns properties associated with Loch Lomond (Newell Creek) and Zayante Creek. The City of Santa Cruz created a new position for watershed issues that has coordinated with the County on erosion control enforcement.

City of Scotts Valley. The City of Scotts Valley has revised their grading ordinance and reformed their approach to erosion control since 1996. In 1996, a large development resulted in a large amount of sediment entering Carbonera Creek. The City solicited enforcement from the County, CDFG and Regional Water Quality Control Board that resulted in a large fine against the developer. Following this incident, the City revised their grading ordinance in 1997. The revised grading ordinance limits cuts to 40', with extra review required for cuts over 20'. Development is prohibited on slopes greater than 40%. More importantly, the City began to review grading as an integral component of a development proposal, instead of reviewing grading once approval had been granted. The City began to more vigorously enforce the erosion control components of the grading ordinance, including the requirement for erosion control plans, winter inspections to insure compliance, and the ability to address urgent erosion control problems and charge the developer for the cost. In cooperation with police, calls about erosion control problems can be received 24 hours a day. Areas of Scotts Valley have been declared critical habitat for listed species in special sandy area habitats; this has reduced development pressure in the Bean Creek area, and upper Carbonera, two areas of high erosion potential.

Timber Harvest Rules. In 1985, agency review of timber harvesting transferred from the County to the California Department of Forestry (CDF). Timber harvesting is governed by the State Timber Harvest Rules. The County of Santa Cruz pursued changes to the State Forest Practice Rules twice in 1999 and 2000. Proposed rule changes were intended to increase protection of streams from erosion and sedimentation, protect adjacent properties from timber impacts, and improve notification. A few rule changes were adopted by the State Board of Forestry, mostly to do with notification, along with improved road maintenance, but these changes are not expected to reduce erosion substantially from timber lands. In 2000, the County of Santa Cruz Board of Supervisors adopted a Zoning Ordinance limiting the parcels on which timber could be harvested and applying the riparian corridor ordinance to timber lands. However, much of these restrictions were overturned through a suit against the County. With the listing of steelhead and coho salmon, Forest

Practice Rules may be further changed in the next several years to better protect streams from sedimentation.

County of Santa Cruz Public Works. Since 1979, Public Works has made some significant improvements in maintenance and project practices to reduce erosion. Improved maintenance practices include: a policy against side-casting material over the edge of the road; end-hauling slide material to local stockpile sites, and reducing the time that material is stockpiled at road turnouts. In 1995, Public Works began including erosion control specifications as part of a contractor bid. In addition, the County has been more assertive about funding improvements for FEMA projects, which only pay to replace in-kind services.

While Public Works responds to other agency improved regulations (for example, Planning Department and CDFG), it has implemented also a number of in-house policies for improved erosion control. Erosion control is bid as a separate item, which encourages contractors to accommodate the cost of time and materials for erosion control. Public Works, who is responsible for reviewing grading projects on subdivisions, communicates with Environmental Planning prior to the winter season to insure installation of erosion control measures.

Public Works has received two grants from the California Department of Fish and Game SB271 grant program. One will fund a partial roads assessment for the San Lorenzo watershed to document culverts and identify areas of high erosion potential. The other grant will fund training for about half of the maintenance crews in erosion control and the creation of an erosion control manual for Public Works.

For the near future, Public Works needs to build on their improvements. They need to implement recommendations from a grant-funded erosion control manual, complete the road surveys, and continue to improve maintenance policies. In addition, it will be implementing drainage and road-cut improvements along highly erosive inner gorge roads. An important task is the purchase of a County spoils site in or near the San Lorenzo Watershed.

Enforcement.

Several state and local agencies have enforcement authority for issues related to erosion, sedimentation and water quality. The principal enforcement agencies are the Regional Water Quality Control Board, California Department of Fish and Game, County of Santa Cruz. While the City of Santa Cruz has no direct authority, they have a strong interest in facilitating enforcement since erosion impacts their water supplies.

The County of Santa Cruz is the primary agency that enforces erosion control standards in most of the San Lorenzo Watershed. Public Works, Environmental Planning, and Code Compliance have different responsibilities to enforce the Erosion Control Ordinance. Environmental Planning staff is responsible for enforcing erosion control measures for grading and other development permits. Public Works is responsible for enforcing erosion control measures on subdivisions.

County code compliance responds initially to complaints for violations of the Erosion Control Ordinance. Enforcement has evolved substantially in the past twenty-two years. Following passage of the erosion control ordinance in 1978, enforcement was performed informally under the Watershed Section. Then, enforcement of the environmental ordinances evolved from a part-time position to a full-time position within Environmental Planning. In 1995, environmental code compliance was consolidated with code compliance for building and zoning regulations. This consolidation has several positive benefits. Erosion enforcement is now more standardized, especially for tracking cases, and has benefited from the code compliance senior staff and management attention. Code enforcement staff has received some training in erosion control issues. One staff person is responsible for the San Lorenzo Watershed and is located at the Felton office. Code compliance has also received also increased attention and support from County Counsel and the District Attorney's office. Currently, code compliance is better positioned to abate erosion problems with the recent creation of an Environmental Mitigation Fund and hiring of two contractors who will correct erosion control violations when property owners fail to achieve compliance and the cost will be billed to the owner.

Despite these improvements, other agency staff and the public perceive that County code enforcement for erosion control could be improved. Low staffing, long response times and the perceived low priority for erosion control violations are the primary criticisms. However, erosion control violations, especially larger ones, can be difficult and expensive to resolve. In recent years, staff turnover and an existing code compliance backlog may have delayed timely enforcement and perhaps have increased the proportion of minor grading activities conducted outside of existing regulations. Erosion control enforcement could be improved with regular training, especially for new staff, better communication between environmental planning and code compliance staff, and regular evaluations to track effectiveness and make improvements. Recently, the City of Santa Cruz Watershed Specialist has begun coordination with the County on enforcement issues, and tries to resolve small violations through outreach to private property owners.

The California Department of Fish and Game enforces erosion control standards in four ways: (1) by issuing Streambed Alteration Agreement Permit (SSA permit) for work in the bed or bank of streams, (2) by enforcement action against work done in streams without an SSA permits, (3) by participating in reviews of timber harvest plans; and (4) by enforcement action against the discharge of materials deleterious to fish life, including sediment discharge. In the past, the California Department of Fish and Game (CDFG) issued streambed alteration agreements on a local, less formal basis. Due to a lawsuit, the California Department of Fish and Game is now required to comply with CEQA for all projects under their jurisdiction. CEQA review results in a more careful project review, more coordination with County review, a more lengthy review time, and hopefully better original projects with adequate mitigation.

The Regional Water Quality Control Board (RQWCB) enforces water quality standards through several programs. Land clearing and other construction projects require a Section 401 permit. This permit evaluates erosion control and runoff from the site to reduce water quality impacts. In addition, the Regional Water Quality Control Board (RQWCB) has become more active in recent years in enforcing water quality standards for timber harvests and other projects. Within the watershed, RWQCB requires an NPDES Permit from both the City of Santa Cruz (currently) and

the County (in 2003). While these permits regulate non-point source pollution from primarily urban areas, they will contribute to sediment delivery in local streams. While RWQCB has the authority to enforce several programs, their effectiveness is limited by staff time and their distant location in San Luis Obispo. New staff and implementation of the TMDL will likely increase enforcement by the RWQCB.

Enforcement can successfully be combined from several cooperating agencies. In 1996, a developer within the City of Scotts Valley had grievous erosion from the construction site into Carbonera Creek. When the City of Scotts Valley were unable of effectively control the situation, the City received assistance from CDFG, RWQCB and the County, who acted together and obtained $500,000 fine from the developer that has been spent on stream restoration projects.

Projects

Since 1979, agencies and individual property owners have implemented numerous erosion control projects throughout the watershed. Projects have addressed a wide range of sources, including …. (I wanted to describe projects somehow). Over the years, many property owners have worked with the Natural Resources Conservation Service (formerly the Soil Conservation Service) for technical assistance and funding.

County Planning Department has implemented many erosion control projects in the San Lorenzo Watershed. In the 1980's, a sediment basin and slough walls were constructed in the Rancho Rio development, and a sediment basin constructed on Mill Creek. In addition, some improvements were made to Love Creek Road (1981) and the Bean Creek Road Slide (1980's). More recently, significant improvements were made on King's Creek Road (1999).

Diverse agencies have implemented erosion control projects in the watershed. The Natural Resources Conservation Service, through their Watershed Emergency Program, sponsored bank stabilization efforts at Felton Covered Bridge, Glen Arbor and Spring Street. State Parks stabilized successfully an eroding streambank in Henry Cowell that threatened a group of old-growth redwood trees. Since 2000, Caltrans has repaired three large landslides along Highway 9: south of Felton, at Glen Arbor Road, and north of Boulder Creek. In 2000, the Natural Resources Employment Program installed biotechnical slide stabilization measures on Araki Road. The San Lorenzo Valley Watershed District repaired a large gully on Box Gulch, in the Zayante watershed.

The Santa Cruz County Resource Conservation District has implemented recently a number of erosion control projects in San Lorenzo Valley. Three projects were installed recently (2000) as part of a Section 319 (h) grant. One project assisted a private landowner with a bank stabilization project including retention of a large log on Bean Creek. Another project involves improving drainage and reducing erosion from a site along Bean Creek Road. The last project involved drainage and paving a small private road to reduce erosion.

In the lower 2 miles of the San Lorenzo, the Army Corps of Engineers and the City of Santa Cruz are raising the levees through downtown Santa Cruz to provide better flood protection. At the

same time, the City of Santa Cruz is looking at opportunities to enhance steelhead habitat in the lower river and lagoon. Increased or decreased sedimentation from the upper watershed will impact the success of this project.

Outreach, Education and Technical Assistance

There are ongoing and consistent efforts for erosion and sedimentation education and outreach in the San Lorenzo Watershed. Overall, there is consensus that the public is better informed about erosion and sedimentation issues than in 1979. However, while public awareness has increased, a constant influx of new residents and growing watershed population will keep public education and outreach a challenge.

Outreach and education efforts include the San Lorenzo Watershed Caretakers, a Coordinated Resource Management and Planning (CRMP) group supported by the Santa Cruz County Resource Conservation District (RCD) that has been active since 1995. As part of their recent 319(h) grant, the Santa Cruz County Resource Conservation District sponsored a number of outreach efforts, including newsletters, tours and rural roads maintenance workshops.

The County has implemented numerous public outreach and educational programs over the past twenty-two years. A Rural Road Maintenance Workbook was developed by the Planning Department in the early 1980's and was distributed for many years. In 1986, the County distributed a Stream Care Guide to all stream-side residents that included information on impacts of sedimentation and techniques for bank stabilization. Brochures on the Erosion Control and related ordinances have been updated. County staff present information at a Soil Conservation Class taught each year at Cabrillo College. The City of Santa Cruz, through its watershed specialist, has been active in the last year with informal outreach to erosion control violators in the watershed.

The 1979 Watershed plan envisioned greater technical assistance for erosion control efforts than is currently available. Staffing and organizational changes have limited technical assistance provided by the Natural Resources Conservation Service. Local specialists in erosion control and road construction are few, costly, and not readily available.

However, technical assistance has increased in the past few years as funding for technical studies and design. For example, the Zayante Sediment Study was funded as a grant from the State Water Resources Control Board. The County has a grant currently from the Coastal Conservancy that will fund design of fish-enhancement projects. These projects will most likely include preliminary designs to mitigate landslides along Bean Creek. Watershed planning efforts and the listing of steelhead will help provide more technical assistance over the next several years. While more technical assistance may be available to agencies and organizations, it may not be widely available to individual landowners.

Recommendations to Reduce Erosion and Sedimentation

These recommendations integrate recommendations from (1) *An Assessment of Streambed Conditions and Erosion Control Efforts in the San Lorenzo River Watershed, Santa Cruz County, California* (Balance Hydrologics, 1998), (2) *Zayante Area Sediment Source Study* (Swanson Hydrology and Geomorphology, 2001), and (3) Planning, Public Works and Environmental Health staff. For a more detailed description of the recommendations, see the referenced technical studies.

1. Develop Comprehensive Erosion Control Program.
   (County of Santa Cruz – lead, City of Scotts Valley, City of Santa Cruz, State Parks, Resource Conservation District (RCD), Natural Resources Conservation Service(NRCS), Regional Water Quality Control Board(RWQCB), Caltrans, California Department of Fish and Game(CDFG))
   a. Complete efforts to establish an ongoing program within the County government to inventory problems, coordinate implementation with other agencies and track effectiveness of erosion control efforts. *(County, ongoing)*
   b. Coordinate erosion control efforts among agencies, including County of Santa Cruz, City of Santa Cruz, City of Scotts Valley, State Parks, Caltrans, San Lorenzo Valley Water District, and Resource Conservation District. *(Coordination has begun through preparation of this Watershed Plan update).*
   c. Develop a program for permit coordination among agencies to facilitate permitting for erosion control and habitat restoration projects. *(RCD, SCCPD, CDFG, NMFS).*

2. Reduce Erosion from Public Roads
   (County of Santa Cruz, California Dept of Transportation, State Parks, City of Scotts Valley, Department of Fish and Game)

   a. Create county road database to identify culverts, and to prioritize maintenance and improvement projects. Complete road assessments on inner gorge roads and in sandy-soils areas first, then complete rest of rest of watershed, especially areas of high erosion hazard. *(County of Santa Cruz, Summer 2001, CDFG grant)*

   b. Develop a Road Maintenance Best Management Practices (BMP) Program
      1) Develop BMP manual *(County of Santa Cruz Public Works, ongoing, CDFG grant)*
      2) Train County of Santa Cruz Public Works staff in erosion control practices *(County of Santa Cruz Public Works, ongoing, CDFG grants)*
      3) Develop regular training for staff *(County of Santa Cruz Public Works)*

c. Improve maintenance and preventative actions to reduce erosion
   1) Increase staffing during storms to address culvert maintenance and drainage problems before damage occurs *(County of Santa Cruz Public Works, no funding for staff increase)*
   2) Evaluate policy regarding placement of driveways and associated drainage fees. Consider increase in drainage fees to mitigate impacts of new private driveways on public roads. *(County of Santa Cruz Planning and Public Works)*
   3) Develop a policy to remove leaning trees near roads to reduce slipouts and road repairs. *(County of Santa Cruz Planning and Public Works).*
   4) Continue practice of no side-casting and berm construction along County roads. *(County of Santa Cruz Public Works)*
   5) Improve road drainage to minimize landslides *(County of Santa Cruz Public Works)*
   6) Plan for major erosional events, such as fires, major storms, and landslides. *(County of Santa Cruz Planning and Public Works)*

d. Improve spoils management and disposal
   1) Develop spoils disposal site(s) in or near the San Lorenzo Watershed. *(County of Santa Cruz Public Works – lead, Caltrans).* This site should be open to the public for a fee. Site could be purchased property or contracts to dispose of spoils on private property.
   2) Continue improvements in handling winter slide material, including identification of winter stockpiling sites, and end-hauling. Develop erosion control practice BMPs for stockpiling sites. *(County of Santa Cruz Public Works – lead; Caltrans)*
   3) Eliminate illegal dumping of slide material from private property at road pull-outs. *(County of Santa Cruz Public Works; Caltrans)*

e. Assess State Park roads and trails for erosion into streams and rivers. Develop a program for funding and addressing any identified problems

f. Assess and address erosion at prior repair sites.

g. Augment emergency road repair funds to install betterments during damage repairs in order to prevent future failure and sediment production. Work to modify FEMA policy regarding betterments and/or ensure local funding for adequate improvements. *(County, NMFS, Legislators, FEMA, OES)*

3. <u>Develop and Implement a Private Roads Sediment Reduction Program</u>
(*Resource Conservation District-lead, Natural Resources Conservation Service, County, Regional Water Quality Control Board, California Department of Fish and Game. Grant submitted by RCD in 2001 for Prop 13 funding*).

   a. Develop and implement private road education program
      1) Revise and distribute Booklet, *Maintaining Your Private Road (RCD)*
      2) Continue/support Rural Roads workshops, sponsored by RCD

b. Develop private road database, treatment priorities and strategies

c. Provide cost-sharing for private road improvement, including emergency repairs *(County, RCD, funding agencies)*

d. Increase enforcement of erosion control regulations for private roads where property owners do not address problems under the programs listed above *(County, RWQCB, CDFG)*

e. Encourage formation of road associations or county service areas to fund upgrades and effective maintenance.*(County, RCD)*

4. Improve Timber Harvest and Appurtenant Roads
(*California Department of Forestry and Fire Protection-lead, Resource Conservation District (through private roads program), County of Santa Cruz, California Department of Fish and Game, Regional Water Quality Control Board, National Marine Fisheries Service. No current funding. Timber Harvest Rules may be modified due to listing of steelhead and coho salmon.).*
   a. Document and improve THP access roads
   b. Upgrade timber roads with special attention to drainage and potential for mass wasting
   c. Surface year-round access roads and maintain unsurfaced roads and skid trails
   d. Increase road abandonment (fills, culverts and stream crossings pulled) between harvests
   e. Upgrade stream crossings to reduce failures and provide for fish passage *(CDFFP, NMFS*)
   f. Identify and address problems associated with legacy (pre-1970) roads, including relocation and closure
   g. Require review by an Engineering Geologist for grading on inner gorge slopes
   h. Require mitigation for timber roads along stream corridors; limit new roads and trails in stream corridors.
   i. Create more stringent guidelines for "existing roads" for post-harvest development. *(County of Santa Cruz)*
   j. Provide for ongoing maintenance and/or enforce county erosion control ordinance following the current 3-year THP maintenance period. *(CDFFP, County of Santa Cruz)*

5. Reduce erosion from private and public lands

   a. Reduce erosion from point sources, including Mount Hermon slide, Bean Creek Road slides, McEnery Road, Skypark, Rancho Rio and Monte Fiore. *(County of Santa Cruz, City of Scotts Valley, and other agencies)*

   b. Promote retrofits for retention and detention to reduce excessive drainage and mass wasting .

c. Improve technical support and community education provided by federal, state and local agencies. *(Natural Resources Conservation Service, Resource Conservation District, California Dept of Fish and Game, County of Santa Cruz, City of Scotts Valley)*

d. Develop awards program to showcase successful efforts in minimizing erosion and bed sedimentation. *(County of Santa Cruz and City of Scotts Valley)*

e. Provide additional field staff to strengthen programs to identify and promote correction of erosion problems through assessment, education, outreach, and incentives. *(SCCRCD, SCCPD, Water Agencies)*

e. Continue to provide training to code compliance staff on erosion control issues and increase staffing level. *(County of Santa Cruz Planning Dept)*

6. Implement programs to address erosion problems unique to sandy soils.
(County of Santa Cruz-lead City of Scotts Valley, Resource Conservation District, Natural Resources Conservation Service.)

a. Seek funding for a 3-year program to develop, demonstrate, and disseminate information about sandy-soil erosion control to permitting staff and the public.
b. Revise the County's Erosion Control Ordinance to include more specific regulations and guidelines for sandy-soils areas. These revisions will benefit other sandy-soil areas throughout the County, including portions of Bonny Doon, Soquel watershed, and Aptos/La Selva Beach/Corralitos areas.
c. Evaluate need to revise erosion control provisions in City of Scotts Valley Grading Regulations to better protect sandy-soil areas

6. Protect and Improve Stream Channel Function
Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain large woody material in streams. Encourage natural recruitment and retention of large woody material that supports pool development and sediment transport.
(County of Santa Cruz – lead, California Dept of Fish and Game, Resource Conservation District, Natural Resources Conservation Service. CDFG has funded SB271 grant to County of Santa Cruz to sponsor workshop for public and private engineers for Fall 2001)

8. Evaluate Erosion Control Efforts
Monitor bed sedimentation, channel conditions, and stream geomorphology every 1-3 years to evaluate if erosion control efforts are resulting in improved stream habitat conditions.
(County of Santa Cruz, baseline monitoring will be completed in 2001)

IMPLEMENTATION

The San Lorenzo River Watershed Management Plan Update reflects many interrelated efforts by various entities to improve the protection and management of land and water resources and to protect and enhance the organisms, values, and human uses that are dependent on those resources. The Plan Update is one more step in a continuum of efforts to live sustainably within the Watershed and the natural and human systems which comprise it. However, the Plan Update also demonstrates the need to focus an adequate level of financial resources and effort for successful implementation. Although most of the recommendations of the 1979 Watershed Plan were sound and comprehensive, implementation was delayed and incomplete. Recommendations for improved wastewater management were only fully implemented in 1995. Issues of excessive sedimentation and depleted water supplies continue to be significant unresolved problems, partly because recommendations in the 1979 were never fully implemented..

The Watershed Plan Update seeks to pull together and coordinate the management efforts of numerous agencies, which often tend to be more focused on single purposes. Many agencies have interests or legal mandates for management of watershed resources (Table 11). Additionally, improved watershed management is highly dependent on actions of the more than 125,000 residents and users of the Watershed. Much more can be accomplished where common purposes are identified and efforts can be coordinated. This section of the Plan Update identifies the opportunities for coordinated effort, identifies possible funding sources, and lays out a plan for implementation.

Many of the Plan recommendations are interrelated, particularly within the context of natural watershed systems. Implementation actions can serve multiple purposes and satisfy numerous agencies and interests. This increases opportunities for coordination of effort, funding and sharing of management resources.

Following are some examples of how efforts can achieve multiple purposes:

1. Drainage and erosion control along roads can protect roadways and property values, reduce erosion and sedimentation, improve fish habitat, and reduce turbidity, thereby increasing availability of winter flow for diversion and storage for water supply.
2. Reducing impermeable surfaces and providing for onsite runoff retention or detention increases groundwater storage, increasing water supply, increasing summer baseflow, reducing runoff, reducing downstream flooding and channel erosion, and reducing downstream sedimentation.
3. Use of effective onsite sewage disposal devices increases groundwater recharge, summer baseflows, fish habitat, and water supply.

There is also substantial opportunity for coordination and combining efforts to achieve common goals. For example, significant erosion problems can be identified by county code compliance inspectors or water agency staff. Technical assistance and design for control measures can be provided by the Natural Resource Conservation Service (NRCS) or the Resource Conservation District (RCD). Cost-share funds for implementation can be provided through grants from Department of Fish and Game, State Water Board, or the Coastal Conservancy.

Table 11: Primary Stakeholders, Interests, Management roles, and Recommended Effort

Agency/ Stakeholder	Interests or Mandates	Existing or Potential Management Actions	Recommend. Effort
Property Owners, Residents, and Users	S Adequate water supply of good quality S Protect property and value S Maintain access to property S Live and play in a healthy watershed	S Water Conservation S Erosion control, drainage S Septic system management S Good housekeeping S Fund property improvements and maintenance S Fund agencies by water bills or property taxes/charges	Increase current efforts
County Environ. Health Services (SCCEHS)	S Ensure adequate sewage disposal S Ensure safe natural swimming areas S Ensure adequacy of wells, individual and small water supplies S Ensure safe-handling of hazardous materials	S Water Quality Monitoring S Watershed management and water quality planning (Part of County Water Resources Mgt Program (see below)). S Septic system permitting and oversight S San Lorenzo Wastewater Management - inspections, monitoring, special studies S San Lorenzo Nitrate Management: wastewater disposal, livestock mgt. S Regulates small water systems (1-200 connections), Well permits	Ongoing
		S Wellhead and aquifer protection programs	New effort
		% Site remediation and response to spills	Ongoing, increase effort
County Planning Dept. (SCCPD)	Ensure that land use planning and development is done safely while protecting other properties and natural resources, including water.	S Grading, erosion control, riparian corridor permits S Timber harvest review and comment S General Plan Update, 2002 S Water Resources Mgt Program (see below) S Zoning	Ongoing
		S Environmental Code Compliance	Enhance functions
County Public Works Dept. (SCCDPW)	Upgrade and maintain county roads, bridges, culverts, drainage facilities, sewers, treatment plants	% Road and culvert maintenance % Manual of Erosion Control standards % Drainage review for new development % Log Jam Removal program	Continue to enhance efforts (Modify log jam programs)
		% Stormwater Management program (Phase II)	New program being developed
Co. Water Resources Managmnt Program (SCCWMP)	Promote coordinated water resources management and watershed management among county departments and other agencies in Santa Cruz County	S Water Resources Monitoring and Mgt Plan S Watershed Mgt Efforts S Fisheries Protection (FishNet 4C) S Develops water resource data S Promotes regional water planning	Continue efforts in progress

Agency/ Stakeholder	Interests or Mandates	Existing or Potential Management Actions	Recommend. Effort
Santa Cruz City Water Dept. (SCWD)	**S** Supply adequate, good quality water on a sustainable basis in wet and dry years **S** Manage City watershed lands	**S** Watershed education, outreach and mgt. programs **S** Water conservation	Ongoing
		% City Watershed Plan % Manages existing facilities to reduce impacts on fish % Participates in pending City Habitat Conservation Plan % Watershed Sanitary Survey % Drinking Water Source Assessment Plan % Develops new water supplies in conjunction with other agencies and instream flow needs.	In progress Enhance efforts in progress
Santa Cruz City Public Works Dept. (SCCPW)	Operate and maintain City sewage, drainage, and flood control facilities, including the Lower San Lorenzo River channel.	**S** Utilizes existing Stormwater Utility to implement Phase II Stormwater programs and other urban runoff programs **S** Lower San Lorenzo Enhancement Plan **S** Upgrades sewers and storm drains to reduce contamination	Ongoing and in progress
City of Scotts Valley (Planning and Public Works) (SV)	**S** Ensure that land use planning and development is done safely while protecting other properties and l resources, including water. **S** Operate and maintain City roads, sewage, and drainage facilities	**S** Grading, subdivision ordinances **S** Regulates limited number of septic systems and new wells **S** Develops and implements Phase II Stormwater Management program **S** Operates reclaimed water facility	Ongoing and in progress
Scotts Valley Water Dist. (SVWD)	Supply adequate, good quality water on a sustainable basis.	% Groundwater monitoring and Management under AB 3030 % Distributes reclaimed water **S** Drinking Water Source Assessment Program % Develops new supplies in conjunction with other agencies and basin needs	Ongoing Enhance efforts in progress
San Lorenzo Valley Water Dist. (SLVWD)	**S** Supply adequate, good quality water on a sustainable basis in wet and dry years **S** Manage District watershed lands	**S** Participates in regional watershed and water quality protection efforts **S** District Watershed Mgt. Plan **S** Manages existing facilities to reduce impacts on fish % Manages supplies in conjunction with other agencies and resource needs.	Ongoing, in progress Enhance efforts in progress
S.C. County Resource Conservatin District. (SCCRCD)	Provide services to promote protection and management of soil and water resources	**S** Helps coordinate local efforts of NRCS **S** Obtains and administers grants for property owner and agency assistance for erosion control, road maintenance, manure management **S** Education, outreach and technical assistance on erosion control and resource management **S** Coordinated Resource Management Planning (CRMP) groups	Maintain and enhance efforts, secure stable funding, consider providing direct technical services.

Agency/ Stakeholder	Interests or Mandates	Existing or Potential Management Actions	Recommend. Effort
State Water Resources Control Board (SWRCB)	Establishes and maintains statewide programs for protection of water quality and efficient use of water resources.	S Grants for water quality planning and implementation S Establish broad policies for water quality protection and oversee the Regional Boards S Permits for surface water use.	Maintain efforts, establish more stable funding in state budget for local water programs
Regional Water Quality Control Board, Central Coast Region (RWQCB)	Establishes and maintains statewide programs for protection of water quality and efficient use of water resources.	S Water quality control regulations, management programs and monitoring programs for the Central Coast Region. S Permit requirements for waste discharges. S TMDL's and implementation plans for control of nonpoint pollution for impaired waterways S Delegates some authority to counties. S Awards and administers some State Board grants. S Oversees remediation of groundwater contamination	Maintain current efforts, Enhance remediation efforts
State. Dept. of Health Services (DHS)	Administers federal Safe Drinking Water Act and Ensures safe drinking water for citizens of the State.	S Permits and oversees operations of large water agencies (>200 connections) S Delegates authority and oversees efforts of counties to regulate small public systems S Regulates wastewater reclamation. S Administers source water protection, and water shed sanitary survey programs. S Grants for water system upgrades.	Maintain efforts, provide funding for implementation of source water protection
State Dept. Fish and Game (CDFG)	Protect and restore populations and habitats for fish and wildlife and threatened species.	S Regulates streambed alterations. S Enforces limits on actions deleterious to fish life and other provisions of Fish and Game Code. S Enters into agreements for safe operation of water diversion facilities. S Develops and implements salmon and steelhead restoration plans S Provides grants for fish habitat improvement under SB 271.	Maintain efforts, continue to provide funding for projects
State Coastal Conservcy. (CCC)	Provide funding for coastal access and protection of coastal resources, including salmonids.	S Currently providing funding to develop a fishery enhancement plan for SLR. S May provide funding for implementation of habitat restoration projects.,	Maintain current efforts, Fund projects
State Div. Forestry & Fire Protec. (CDFFP)	S Protect and encourage reasonable use of forest resources of the state. S Prevent damage from wildfires.	S Regulates all commercial logging under the State Forest Practice Rules S Provides technical assistance and grants for mgt. and improvement of timber properties. S Conducts wildland fire suppression and management efforts S Implements fire hazard reduction programs	Maintain and enhance current efforts
State Parks	Manage State Park lands for the benefit of visitors and protection of resources.	S Maintains roads, trails, and sewage disposal systems in State Parks S Prepares and implements resource mgt. plans.	Enhance maintenance efforts.

Agency/ Stakeholder	Interests or Mandates	Existing or Potential Management Actions	Recommend. Effort
U.S. Environ. Protection Agency (USEPA)	Promote improved water quality, reduced nonpoint pollution, safe drinking water by implementing provisions of Clean Water Act, Safe Drinking Water Act and Coastal Zone Act	S Approval of effective TMDL's S Drinking Water Protection S Grant funds for drinking water protection, water quality planning and implementation S Substantial delegation of permitting and management responsibility to State Water Resources Control Board and State Dept. of Health Services (drinking water)	Maintain efforts, provide more funding for implementation
Natl Marine Fisheries Service (NMFS)	Protects and manages ocean fish populations and their habitat, including anadromous fish such as salmon and steelhead	Develops and implements programs and regulations to protect habitat and regulate activities that could impact salmon or steelhead.	Efforts in progress.
Monterey Bay National Marine Sanctuary (MBNMS)	Coordinates programs to protect Sanctuary water quality , including watersheds that drain into the Sanctuary.	S Development and implementation of Water Quality Protection Plan to guide efforts to reduce erosion and urban runoff. S Promotes grants for Plan implementation.	Maintain efforts Encourage ongoing federal funding for local efforts.
Natural Resources Conserv. Service (NRCS)	Provide technical services and funding to promote protection and management of soil and water resources	S Technical assistance for erosion and drainage control S Funding for storm damage repair	Increase non-agriculture assistance
Federal Emergency Management Admin. (FEMA)	Minimize impacts of disasters and assist in disaster recovery.	Provides funding for storm damage repair and disaster aid.	More funding for damage prevention.

Constraints to Implementation

Constraints to implementation include:

- % Funding limitations and inadequate staff resources at all levels of government.
- % Reluctance or inability of property owners to provide funds to upgrade their roads and property to reduce erosion or septic system pollution.
- % A potential reluctance among a majority of the populace to approve generating additional funding through property taxes or property-based charges for broad resource restoration enhancement and property owner assistance programs.
- % A reluctance among water agencies to combine and coordinate efforts for management of existing water supplies as well as new supply development.
- % Reluctance among agencies and property owners to consider changes to their operations which may subject them to review and substantial cost or impact on operations to come into compliance with current environmental regulations such as endangered species regulations.
- % Reluctance of property owners to seek permits, technical assistance, or otherwise interact with government programs due to perception of excessive red tape, onerous requirements, delays, and general distrust.

These constraints can be reduced by including in the implementation programs elements of public education, technical assistance, and cost-sharing, along with an emphasis on voluntary compliance. Adequate funding will be needed, which hopefully can be partially provided from state and federal grants, given that there are resources at stake which have been recognized at both the state and federal level. The availability of cost-sharing funds typically stimulates investment at the local and private level. Additional fact finding and demonstration of feasibility and benefits of cooperative approaches should help to convince agencies of the value of higher levels of cooperation and joint management of resources for multiple objectives.

Funding Opportunities

Many watershed management efforts are already funded by a variety of sources. Following is a description of sources of funds that are currently utilized and that could be considered for funding new or enhanced management and restoration efforts:

1. Private Expenditures - Most of the work of watershed protection and restoration is done by property owners developing, upgrading, and maintaining their property, including septic systems, roads, drainage facilities, landscaping, etc. This funding can be directed and encouraged through regulation, education, technical assistance, cost-sharing, and measures to encourage voluntary compliance with watershed objectives.

2. Permit Fees - Permit fees are charged by agencies to fund the cost of agency oversight to ensure that development is done in accordance with standards for resource protection. Although there is a perception that many fees in Santa Cruz County are already high, higher fees could help finance efforts where higher levels of oversight are needed, such as remediation of contaminated soil and groundwater. On the other hand, permit coordination

and simplification could help reduce the amount of agency time and private cost needed for project oversight.

3. Fees for Service - A fee for service may be charged by an agency where a direct service is provided unrelated to permitting, such as technical assistance for erosion control. These are not utilized extensively at this time.

4. Cost-sharing - Cost-sharing can be utilized to spread the cost of correcting an existing problem between a private property owner and the larger public, which may also benefit from the improvement. This can also provide an incentive for expenditure of private funds. Public funding for cost-sharing can come from local taxes or service charges or from grants from state or federal funds or private organizations, such as corporations or charitable foundations.

5. Grants: A variety of grants are potentially available to fund direct agency actions or cost-sharing to support private actions for water supply protection, groundwater protection, water quality planning, restoration of fish habitat , restoration of storm-damaged structures, or improvement of timberland. Grants are potentially available from state or federal agencies, or private sources such as foundations and corporations. Grants are better for short term projects and are limited for long term programs.

6. State and Federal Funding - State and federal funding supports the actions of state and local agencies and may also provide partial funding to local agencies on a short or long term basis. Funds come from state and federal taxes, and are often dependent on the state of the economy. Bond measures can also support targeted efforts.

7. Local General Funds - County and city general funds are those undesignated funds derived from property taxes, sales taxes, and other revenue streams that can be allocated by the governing bodies. However, general funds are frequently dedicated to maintenance of existing efforts, including mandate programs, with minimal opportunity to fund new programs.

8. Special Districts - A variety of special districts have been established within the county and the cities which have dedicated funding sources (typically service charges or property assessments) to provide specific services such as water supply, fire protection, drainage, flood control and water conservation, sewage disposal, septic system maintenance, or refuse disposal. These funds can be utilized for specific watershed management efforts where such efforts are consistent with the purpose of the district. However, new charges cannot be levied and existing charges may not be increased without a majority vote of the property owners subject to the charge.

9. Redevelopment Agency - A Redevelopment Agency can generate and shift additional property tax revenue to funding local infrastructure improvements in “blighted areas”. The County is considering formation of such an agency within the developed areas of the San Lorenzo Valley.

10. Water Bills - Water bills are charged to customers to pay the cost of providing the water, including infrastructure, treatment, administration. A number of water agencies also fund watershed protection efforts. Funding for such efforts could be increased through higher water bills where there is a benefit in water quality or quantity for the agency customers.

11. Pooled resources among agencies - When dealing with limited resources, it is important for agencies to utilize those resources as efficiently as possible, through sharing of equipment or staff and ensuring that the agency most suited to carry out a task is doing it.

12. Shift of Existing funding - One other method of working with limited resources is to evaluate the priority of existing work and expenditures relative to proposed efforts and consider shifting resources away from existing efforts if they are deemed to have a lower priority.

Implementation of Plan recommendations will require utilizing a variety of funding sources. Many recommendations can be wholly or partially implemented with existing staff and resources. Others can be funded by grants for targeted, one time efforts or projects. However, improved management will require the establishment of additional sources of long term funding, most likely from a variety of sources. A number of possible funding sources are identified for specific efforts in Tables 11 and 12. Following are the likely sources of new funding:

1. Increase general fund contributions
2. Increase funding by water agencies, paid by water bills
3. Establish permanent line item funding for local agencies in state or federal budgets
4. Secure voter approval of a special district to fund watershed management and environmental protection activities

Approximately $100,000 to $300,000 of new annual funding is needed, depending on the level of effort desired. Securing funding will be dependent on working with the public, and decision makers to demonstrate the needs and the opportunities for funding.

Recommended Implementation Plan

An implementation plan has been developed within the context of existing and potential agency roles, constraints to implementation, and funding opportunities. Table XZ presents that plan with a summary of recommendations, including responsible agencies, proposed schedule and funding sources. The details of the recommendations are presented in the specific sections of this document.

Moving toward implementation will require further discussions among the affected agencies and the public to convince the public and decision makers of the need and appropriate mechanisms for implementation, It is expected that the recommendations will be further refined during those discussions.

Table 12: Implementation – San Lorenzo River Watershed Management Plan Update

Details of recommendations are contained in body of report. See Table 11 for explanation of agency abbreviations.

Recommendation	Lead Agency	Other Agencies	Timing	Funding
Water Quality Protection				
1.Continue implementation of the San Lorenzo Wastewater Management Plan, Nitrate Management Plan, and Nitrate TMDL	SCCEHS	RWQCB	Ongoing	Existing funding: CSA 12 Charges ($200,000/y) Permit fees ($300,000/y) Private funds ($3 mill/y.)
2. Complete pathogen TMDL and implementation.	RWQCB	SCCEHS USEPA	2003+	Existing - State staff
3.Develop and implement Phase II Storm Water Programs and other urban runoff measures.	SCCDPW Cities	SCCEHS SCCPD RWQCB	2003+	Existing staff, Additional funding to be developed for implementation ($100,000/y?)
4. Promote improved livestock management practices to reduce discharge of sediment, nitrate and pathogens.	SCCRCD SC Horsemen	SCCEHS SCCPD	2002	Current funding: Grant funds ($70,000) Private funds ($100,000/y?)
5. Strengthen efforts to remediate and prevent further groundwater contamination from leaking underground tanks and toxic discharges. a. Mapping wells and critical areas b. Zoning to limit uses. c. Identify and destroy abandoned wells d. Expedite remediation efforts	SCCEHS	RWQCB Water Agencies	2002-2003	Existing staff augmented by grants, increased permit fees and private funds. (Total: $10,000-250,000/yr + remediation costs)
Establish New Ongoing Funding				
Establish additional dedicated funds for ongoing implementation of watershed management measures, using a combination of contributions from water agencies, general fund, state budget line item, and new special district funds.	SCCBS Legislature Cities	RWQCB	2003	$300,000/yr

Recommendation	Lead Agency	Other Agencies	Timing	Funding
Erosion and Sediment Control				
1. Complete establishment of a comprehensive erosion control program, including inventory of problems, coordinated implementation, coordinated permitting, and monitoring of effectiveness.	SCCPD	SCCDPW SCCRCD NRCS Cities State Parks	2002	Existing staff ($30,000) and seek new funding for implementation ($50,000/yr?)
2. Complete efforts to establish updated policies and maintenance procedures for drainage, erosion control and emergency repairs of public roads. a. Create a public road database: inventory and prioritize problems for correction. b. Establish a spoil site c. Modify policies and secure funds for betterments during emergency repairs and disaster recovery	SCCDPW Caltrans Cities	SCCRCD Cities State Parks SWRCB Funds FEMA NMFS	2002 2002 2003 2003	Existing staff Current grant funds ($70,000) In progress with current grant In progress ($500,000?) Policy change, federal funds or local funds
3. Establish a private road improvement program including outreach, assessment, technical assistance, and funding assistance.	SCCRCD	County, SWRCB funds	2003	Proposed for grant funding ($200,000/yr)
4. Reduce erosion on timber properties by improving road standards, establishing responsibility for long term oversight, and improving protective streamside buffers.	CDFFP	RWQCB SCCPD	2002	Regulation change: increased private cost, some loss of private revenue
5. Implement programs to reduce erosion from private lands. a. Secure funding to reduce sediment from large point sources b. Provide additional field staff to strengthen programs to identify and promote correction of erosion problems through assessment, education, outreach, and incentives. c. Strengthen programs for enforcement action where other efforts for voluntary compliance are inadequate.	SCCPD RWQCB DFG SCCRCD	CCConservcy SWRCB DFG Water Agencies SCCPD	 2003 2002 2003	 $500,000, grant funds $150,000/yr Grant funding and/or new funding source. $75,000/yr - new funding source
6. Establish targeted policies, requirements and assistance for sandy soils areas	SCCPD Scotts Vally	RWQCB	2003	Existing staff? Or grant funds for consultant assistance ($30,000)
7. Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain woody material.	SCCPD DFG Cities	RWQCB SCCRCD SCCDPW NRCS	2003	Existing staff, with expanded effort ($25,000/yr from grants or new funding source.
8. Monitor channel conditions and bed sedimentation every 3 years	SCCEHS	RWQCB	2002+	Existing staff

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Implementation Checklist

Recommendation	Timing
Water Quality Protection	
1.Continue implementation of the San Lorenzo Wastewater Management Plan**,** Nitrate Management Plan, and Nitrate TMDL	Ongoing
2. Complete pathogen TMDL and implementation.	2003+
3.Develop and implement Phase II Storm Water Programs and other urban runoff measures.	2003+
4. Promote improved livestock management practices	2002
5. Strengthen efforts to remediate and prevent further groundwater contamination from leaking underground tanks and toxic discharges.	2002-2003
Establish New Ongoing Funding	
Establish a dedicated fund for ongoing implementation of watershed management measures, using a combination of contributions from water agencies, general fund, state budget line item, and new special district funds.	2003
Erosion and Sediment Control	
1. Complete establishment of a comprehensive erosion control program, including inventory of problems, coordinated implementation, coordinated permitting, and monitoring of effectiveness.	2002
2. Complete efforts to establish updated policies and maintenance procedures for drainage, erosion control and emergency repairs of public roads. a. Create a public road database: inventory and prioritize problems for correction. b. Establish a spoil site c. Modify policies and secure funds for betterments during emergency repairs and disaster recovery	 2002 2003 2003
3. Establish a private road improvement program including outreach, assessment, technical assistance, and funding assistance.	2003
4. Reduce erosion on timber properties by improving road standards, establishing responsibility for long term oversight, and improving protective streamside buffers.	2002
5. Implement programs to reduce erosion from private lands. a. Secure funding to reduce sediment from large point sources b. Provide additional field staff to strengthen programs to identify and promote correction of erosion problems through assessment, education, outreach, and incentives. c. Strengthen programs for enforcement action where other efforts for voluntary compliance are inadequate.	 2003 2002 2003
6. Establish targeted policies, requirements and assistance for sandy soils areas	2003
7. Implement education programs and modify policies and procedures to improve riparian corridor protection, maintain channel integrity, implement alternatives to hard bank protection, and retain woody material.	2003
8. Monitor channel conditions and bed sedimentation every 3 years	2002+

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APPENDIX A: ANNOTATED COPY OF 1979 SAN LORENZO RIVER WATERSHED MANAGEMENT PLAN RECOMMENDATIONS