On-site Wastewater Treatment Technology and the Preservation of Agricultural Land in California's Central Valley

January 2003

California State University at Chico
California Wastewater Training and Research Center

On-site Wastewater Treatment Technology and the Preservation of Agricultural Land in California's Central Valley

Project Funding Provided By:

- **California State University, Agricultural Research Initiative**
- **National Decentralized Water Resources Capacity Development Project**

California Wastewater Training and Research Center
California State University, Chico
Chico, CA 95926-0930
(530) 898-6027   www.csuchico.edu/cwtrc

Cover Background Map: Modified from Ca. Dept. Conservation, 2002

ON-SITE WASTEWATER TREATMENT TECHNOLOGY AND THE PRESERVATION OF AGRICULTURAL LAND IN CALIFORNIA'S CENTRAL VALLEY

by

Schiffman, Irving
Department of Political Science, California State University, Chico, Ca.

Johns, Mitchell
College of Agriculture, California State University, Chico, Ca

Banathy, Tibor
California Wastewater Training and Research Center, Chico, Ca

Supported by:

- **California State University, Agricultural Research Initiative**
- **National Decentralized Water Resources Capacity Development Project with funding provided by the U.S. Environmental Protection agency through a Cooperative Agreement (EPA No. CR827881-01-0) with Washington University in St. Louis.**

Table of Contents

ABSTRACT

California's Central Valley is home to some 5.5 million residents and is one of the fastest growing areas of the state, its population is expected to double between now and the year 2040. The Valley is also the nation's most important agricultural resource producing 250 different commodities worth more than $16 billion a year while also providing a multitude of complementary economic and environmental benefits. The fertile soil and climate of the valley, ideally suited for irrigated agriculture, are characteristics also ideally suited for home development and septic tanks. The need to satisfy a growing housing demand poses a major threat to Valley farmland and there are serious limitations inherent in the regulatory and incentive means which are designed to save the resource. The adoption of on-site enhanced wastewater treatment systems, however, enables communities to both increase residential density through cluster development and place housing in marginal soils away from productive Valley farmland.

Over the past twenty years there have been significant advances in on-site wastewater technology enabling residential development to take place in areas where unsuitable soil, groundwater height, slope, size or other conditions had previously ruled out such locations as potential building sites. In addition, many of these new technologies provide more thorough treatment of wastewater than was true with earlier systems. However in California, creation of new parcels for development that would utilize these new technologies is generally not allowed. This report, prepared in conjunction with a proposed statewide model ordinance, seeks to familiarize planners, environmental health specialists and others with enhanced on-site wastewater systems and the role they can play in the preservation of agricultural land in California's Central Valley.

A survey of California county planners and environmental health officers indicated the influence septic system standards have on zoning decisions and the limited consideration given to enhanced wastewater technology in the planning process. The survey also revealed the perceived opposition and obstacles communities face in seeking to incorporate enhanced systems in their planning and land development process. Local officials, with the assistance of regional and state agencies, are encouraged to become familiar with enhanced wastewater treatment systems, the decision-making skills

necessary to implement them, and the management structure required for their administration. The ultimate adoption of such systems can lead to an expansion in the range of planning options available to local officials. More specific to the Central Valley, enhanced system technology can provide county governments additional tools with which to carry out policy objectives related to preserving agricultural lands threatened by a ballooning state population, particularly policy objectives that encourage home and similar development on marginal lands.

INTRODUCTION

The Central Valley is home to some 5.5 million residents and is one of the fastest growing areas of the state. The implementation of enhanced on-site technologies would appear to have great relevance to California's Central Valley where agriculture plays an exceedingly important role in the economic and social fabric. The Central Valley stretches from Shasta County to Kern County--some 450 miles long and typically 40 to 60 miles wide. It encompasses 18 counties with a total of over five million people and over 42,000 square miles--one-sixth of the population and more than two-fifths of the land area of the state. It is, in fact, larger in area than ten of the fifty states.

Over the past twenty years there have been significant advances in on-site wastewater technology enabling residential development to take place in areas where unsuitable soil, groundwater height, slope, size or other conditions had previously ruled out such locations as potential building sites. In addition, many of these new technologies provide more thorough treatment of wastewater than was true with earlier systems. However in California, creation of new parcels for development that would utilize these new technologies is generally not allowed.

In an effort to increase knowledge and use of enhanced as well as standard wastewater treatment technologies, the National Decentralized Water Resources Capacity Development Project, with funding provided by the U.S. Environmental Protection Agency, awarded a grant to the California Wastewater Training and Research Center, California State University, Chico, to develop a state-wide model ordinance for on-site wastewater treatment. The model ordinance (see Appendix D) seeks to foster the use of enhanced and standard onsite/decentralized wastewater treatment systems by, *inter alia*, establishing local management levels appropriate to the complexity of the adopted treatment system and by addressing issues of consistency and overlapping regulatory authority. The lack of consistency and overlapping authority are identified as barriers to the use of onsite systems in EPA's *Response to Congress on the Use of Decentralized Wastewater Treatment Systems* (U.S. EPA, 1997).

Furthermore, the model ordinance emphasizes performance-based standards that incorporate risk-based methodology, requiring treatment that is commensurate with required public or environmental treatment goals. Unlike prescriptive-based regulations, a performance code does not prescribe a specific solution but rather defines a desired outcome, e.g., a level of treatment needed to produce the desired outcome of protecting public health and the environment. This approach allows for multiple solutions for a given condition and a desired outcome. In contrast, a prescriptive code emphasizes a fixed set of specific solutions to a well-defined set of conditions. Prescriptive codes are therefore rigid and tend towards a "one size fits all" regulation that provides very little flexibility in siting and design. Performance-based standards offer enhanced treatment options that will reduce the need for requiring centralized sewage systems to address public health and water quality concerns and that will provide local governments with a wider range of choices with respect to lands suitable for development using on-site wastewater technology. Overviews of soil and site criteria for wastewater treatment systems and enhanced onsite wastewater treatment systems utilizing new technologies are provided in Appendices A and B.

Inherent to any performance-based code is that the treatment technology adopted must be operated, maintained and managed to assure continuing performance directed toward meeting the treatment goal. An effective management program is critical to the implementation of a performance-based code, and, as stated above, the model ordinance describes various proposed management levels. As Bounds noted "With operation and management programs, the onsite options available for treatment and discharge are as limitless as the site complexity." (Bounds, 2001). While the treatment technology provides a means to attain the treatment goal, it does not provide the means to assure ongoing performance to meet that goal. Rather site limitations can be overcome by both the use of appropriate technology <u>and</u> implementation of a management program to assure that the technology performs as needed. Appendix C includes case studies of six successful California management programs presently in operation.

The model ordinance, by facilitating the use of enhanced wastewater technology can also play a key role in the preservation of agricultural lands in California, particularly in the great farming basin of the Central Valley. This report will examine the threats to agriculture in the Central Valley and discuss the ways in which, by increasing housing density and enabling development in marginal areas through the use of enhanced wastewater technology, development can be directed away from productive farmland and toward land presently thought to be unsuitable for residential uses. While the focus is on the Central Valley, the discussion herein is applicable to almost any jurisdiction where farmland is threatened by urban development.

A GROWING INTEREST IN ENHANCED SYSTEMS

According to the U.S. Environmental Protection Agency, interest in enhanced on-site wastewater treatment technologies is increasing across the country. A major reason for this interest in on-site systems includes the cost of building and maintaining central treatment plans and of extending sewer lines or repairing leaking ones. This is particularly true in small and rural communities where the cost per household of installing, maintaining and operating a centralized sewer system may be higher because the population and/or density is smaller. In such cases the infrastructure/construction and operation and maintenance costs can exceed the ability of the community to pay.

The governmental funds that were available for sewer construction in the past do not flow as freely in the present. Beginning with the Clean Water Act (CWA) in 1972, the federal and state governments provided grants for 75-90 percent of the cost of construction of central treatment plants and sewer lines (under the Construction Grants Program). Since these grants were phased out in the mid-to-late 1980s and replaced by low interest subsidies or loans (the State Revolving Fund Program under the 1987 CWA amendments), the cost of treating local water pollution problems by constructing new sewage treatment plants in many rural areas has become prohibitive. Accordingly, throughout the nation state and local officials, along with concerned citizens, are seeking to determine if on-site approaches and management can provide a cheaper solution than sewers (EPRI, 2000).

The availability of innovative and alternative onsite technologies and accompanying management strategies now provides small communities with a practical, cost-effective alternative to centralized treatment plants. For example, analysis included in the EPA's *Response to Congress on Use of Decentralized Wastewater Treatment Systems* (U.S. EPA, 1997) shows that the costs of purchasing and managing an OWTS or a set of individual systems can be significantly (22 to 80 percent) less than the cost of purchasing and managing a centralized system (U.S. EPA, 2002) Moreover, the innovative technologies provide more effective treatment than conventional on-site systems and allow development in areas where soil, terrain and other considerations exclude the use of traditional approaches.

In California, the interest in enhanced decentralized wastewater treatment systems is also related to the preservation of quality agricultural land. Within the state, concern has mounted over the threat to agricultural and environmentally sensitive land as new residents move into the urban-rural fringe and further out into rural areas. In many cases such development is dependent on the use of conventional on-site wastewater technology. The physical conditions necessary to install a standard or conventional system under existing on-site treatment regulations, which generally require five feet of suitable soil depth below the infiltrative surface, are most often found in the deeper farmland soils. The result is that farmland is often targeted for development with conventional systems and conventional systems account for the vast majority of on-site systems installed in California

The use of enhanced wastewater treatment technology is also consistent with the state and national approach toward “smart growth” development as well as "smart water" resource management. While the concept of “smart growth” includes a number of planning objectives, an overriding concern is the preservation of open space, farmland and critical environmental areas. The “smart growth” approach recognizes that there are significant fiscal, environmental, economic and health benefits associated with the protection of open space, and resource lands. At a minimum, the preservation of such areas constrains discontinuous development, reduces the need for new infrastructure, prevents flood damage, helps to protect animal and plant habitats and areas of natural beauty, and removes nuisance-oriented development pressures on working farmland (Schiffman, 2001). Thus, the integration of enhanced wastewater treatment technology with “smart growth” planning enables communities to direct growth away from prime habitat and farmland to areas with less natural resource value that may not support conventional septic systems or would otherwise have high sewerage costs (e.g., areas with shallow soils, rocky areas).

“Smart water” resources management incorporates the concepts of keeping water in the watershed areas from which it was withdrawn and reusing/reclaiming water for beneficial purposes, a goal and process made more achievable through the adoption of enhanced on-site wastewater technology. The ability of such systems to provide additional treatment beyond that of conventional septic techniques results in a cleaner effluent which enhances groundwater quality and can be utilized for irrigation and other purposes. For example, subsurface drip dispersal systems (SDDS) are an engineered method of wastewater distribution. SDDS provide for an efficient, uniform distribution of effluent over a wide area and is being applied in areas with year round high groundwater conditions, shallow and slow permeable soils and in arid regions where water conservation is practiced. It is the most efficient of the distribution methods and is well suited for all types of SWIS applications (U.S. EPA, 2002). The effluent slowly disperses into a subsurface soil environment at relatively shallow depth enhancing the opportunity for nutrient and water uptake by plants, evaporation and soil treatment in the biologically active upper soil horizon.

REGULATION OF ON-SITE SYSTEMS

The Porter-Cologne Water Quality Control Act (CA Water Code Section 13000 et seq) establishes the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) as the principal State agencies having primary responsibility for coordinating and controlling the quality of surface and ground waters in California. The regional boards are guided in their activities by the preparation and adoption of water quality control plans, known as Basin Plans, which designate the beneficial water uses to be protected, establish the water quality objectives to protect those uses, and provide a program of implementation needed for achieving those objectives. The Basin Plan also fulfills the state's obligations under section 303 of the Federal Clean Water Act with regard to navigable waterways. The concern of the regional boards with on-site wastewater treatment systems, however, is primarily based on their role in protecting the quality of the state's underground water supply. Each Basin Plan must meet the approval of the State Water Resources Control Board. The nine RWQCBs regions are:

RWQCB Numerical Designations	
1	North Coast
2	San Francisco Bay
3	Central Coast
4	Los Angeles
5	Central Valley
6	Lahontan
7	Colorado River Basin
8	Santa Ana
9	San Diego

For California, the RWQCBs assigned regions are seen in Figure 1.

California has about 1.3 million septic systems and installs about 10,000 new systems annually, with about 20-30% described as “alternative”. There are no state-level laws or regulations governing onsite wastewater disposal in California. The job falls instead to the fifty-eight counties which rely on county ordinances and local implementing agencies such as environmental health departments and building departments to administer and enforce on-site wastewater treatment regulations. However, county regulations must accord with the policies of the appropriate RWQCB.

In the Central Valley, water quality is under the jurisdiction of the Central Valley Regional Water Quality Control Board (Region 5) which stretches from Modoc and Siskiyou counties in the north down to Kern County in the south and includes the eastern section of San Luis Obispo. The Regional Board’s jurisdiction in administered through offices in Fresno, Sacramento and Redding. The Region 5 Basin Plan was initially adopted in 1975. The standards for septic tanks were adopted in 1972 and subsequently incorporated into the Basin Plan. The Basin Plan is up-dated tri-annually, most recently in 1998, although the septic tank standards have not been reviewed since 1975 (Jim Pedri interview, 2002).

Regional Boards tend to differ in their approach to on-site septic systems. The Central Valley Board, for instance, generally outlines regional policy regarding on-site systems, while the North Coast Basin Plan and accompanying guidelines specify detailed percolation rates, set-back distances, use of alternative treatment technology and reporting procedures, etc. Nonetheless, the North Coast RWQCB, along with the Central Coast RWQCB, has taken a more proactive approach to the introduction and use of enhanced treatment technology than have other Regional Boards.

Figure 1.
California Counties
and Regional Water Quality Control Boards (Watersheds)

Source: State Water Resources Control Board

According to the Region 5 Basin Plan, "the control of individual wastewater treatment and disposal systems is best accomplished by local environmental health departments enforcing county ordinances designed to provide protection to ground and surface waters." Counties must act within guidelines adopted by the regional Board which contain criteria for proper installation of conventional systems. Although the Regional Water Board has also prohibited septic tank usage in certain areas, it has formal and informal agreements with counties to evaluate field performance of alternative and special design systems.

The conventional systems approved by the Region 5 consist of a septic tank with gravity flow to a trench or leach field, and may include pumping to the leach field. The Basin Plan emphasizes that the Board is guided by the anti-degradation directives of Section 13000 of the Water Code and State Water Board Resolution No. 68-16 which require that the high quality waters of the State shall be maintained "consistent with the maximum benefit to the people of the State." Accordingly, the Board (or at least the Redding office since policy interpretations differ among the three Region 5 offices) is rather strict in its guideline requirement of a minimum 5-feet soil separation of natural soil from ground water and the usage of conventional systems. However, Board standards only cover parcels that have come in existence since the septic tank standards were adopted in 1972, and counties have discretion to allow alternative systems on parcels that were in existence before that date. Within Region 5, the three offices also differ regarding their approach to the use of enhanced systems on new parcels.

CALIFORNIA'S CENTRAL VALLEY

Geographically, the Central Valley can be subdivided into northern and southern portions. The northern part, the Sacramento Valley, encompasses 10 counties, and the southern, or San Joaquin Valley, encompasses eight. Not all of the Central Valley is encompassed in these 18 counties, however. Omitted is Solano County (which is south of Yolo and west of Sacramento), although much of Solano's land area falls within the valley geographically. Because Solano touches on the San Francisco Bay, the county is included in the Bay Area, not the Central Valley, for planning and statistical purposes.

In terms of watersheds, the Central Valley is encompassed by the Sacramento River watershed, the San Joaquin River watershed, and the Tulare Lake watershed. The Sacramento River watershed stretches from roughly the northeast corner of California to Sacramento County. The San Joaquin Valley watershed encompasses the area from Sacramento County (including the southeast corner of the county itself) to Madera County (and portions of Fresno County). The Tulare Lake watershed includes most of Fresno County, all of Kings and Tulare counties, and all but the eastern fifth or so of Kern County.

Central Valley Agriculture

The Central Valley is the nation's most important agricultural resource, producing 250 different commodities worth more than $16 billion a year (Table 1). Eight of California's 10 top producing agricultural counties are in the Central Valley, and of the top seven, only one (Monterey) is not encompassed in the area from San Joaquin to Kern. This area is not only the most productive in California, it is widely considered the most productive in the world. Many of the 77 commodities that California leads the nation in are found in the Central Valley. More than 90 percent of the nation's processing tomatoes and grapes, and all of its commercial almonds, dates, figs, olives, cling peaches, prunes and raisins are grown in the valley.

Such productivity is, of course, only in part due to the natural conditions extant in the Valley. It has required the combined efforts of laborers, land-owners, agricultural researchers, hydraulic engineers, and many others over generations. As farmland disappears under driveways and rooftops, California loses a critical resource base as well as years of investment, experience and hard work.

Moreover, much of the economic activity of the Central Valley that is not *directly* agricultural is at least associated with agriculture: packing, shipping, processing, and the myriad specialties needed to support agricultural enterprises, from irrigation systems to pesticide research. Through multiplier effects, agricultural production and processing account for about 21% of the Valley's income, 19% of its value added, and 25% of its employment *(The Measure of California Agriculture, 2000*: Agricultural Issues Center, University of California, Davis*)*. When farms are bought up for development, business dries up for companies and individuals that support agriculture, farm workers, veterinarians, seed suppliers and equipment dealers. By protecting the integrity of farmland, local officials preserve the infrastructure that keeps the agricultural economy healthy.

Table 1. Gross Value of Agricultural Production 2000

	Value in $1,000	% of State Value	Rank in State
Fresno	$ 3,423,539	11.3%	1
Tulare	$ 3,068,063	10.1%	2
Kern	$ 2,209,928	7.3%	4
Merced	$ 1,538,545	5.1%	5
San Joaquin	$ 1,348,724	4.5%	6
Stanislaus	$ 1,197,302	4.0%	8
Kings	$ 885,062	2.9%	12
Madera	$ 748,972	2.5%	14
San Joaquin Valley	$14,420,135	47.7%	
Yolo	$ 302,736	1.0%	26
Sacramento	$ 285,589	.9%	28
Placer	$ 70,168	.2%	40
Sacramento Metro Area	$ 658,493	2.2%	
Colusa	$ 345,987	1.1%	21
Sutter	$ 343,496	1.1%	23
Butte	$ 324,829	1.1%	24
Glenn	$ 286,533	.9%	27
Yuba	$ 162,272	.5%	35
Tehama	$ 146,263	.5%	36
Shasta	$ 99,029	.3%	37
Northern Valley	$ 1,708,409	5.6%	

Source: Calif. Department of Food & Agriculture, County Agricultural Commissioners' Reports, 2001. K. Entin, Center for Public Policy Studies, CSU Stanislaus

Central Valley Soils

The soils of the Central Valley are the greatest natural resource of the region. The soils were formed from recent (epoch) and past sediments eroded from the Sierra Nevada mountains, and to a lesser extent from the Coast Ranges. These sediments were deposited on the floodplains and bottomlands as the mountain streams and rivers greatly decreased their velocity in the flat-bottom valley. At least four major pulses of deposition took place in the valley as sediment washed out from the Sierra Nevada during the glacial episodes of the past 2 million years (Harden, 1998). During these glacial episodes, mountain glaciation piled up huge quantities of sediment. Sierra Nevada rivers, made powerful by the abundant glacial meltwater and the considerably wetter climate during these periods, carried much of this sediment downstream to the mountain foothills and valley. In the last 10,000 years, the sediments were the parent material for the genesis of one of the most fertile and productive group of soils in the world.

For most agricultural crops of importance, the majority of the soils of the Central Valley possess their fertility and productivity due to a given set of desirable soil properties. These properties include soil texture, permeability, thickness, structure, and depth to water table, the exact same soil properties as those desired for conventional onsite, decentralized wastewater treatment (e.g., septic tank and leachfield). In addition, siting of homes on such soils is desired for all the personal benefits that can be derived from a fertile soil.

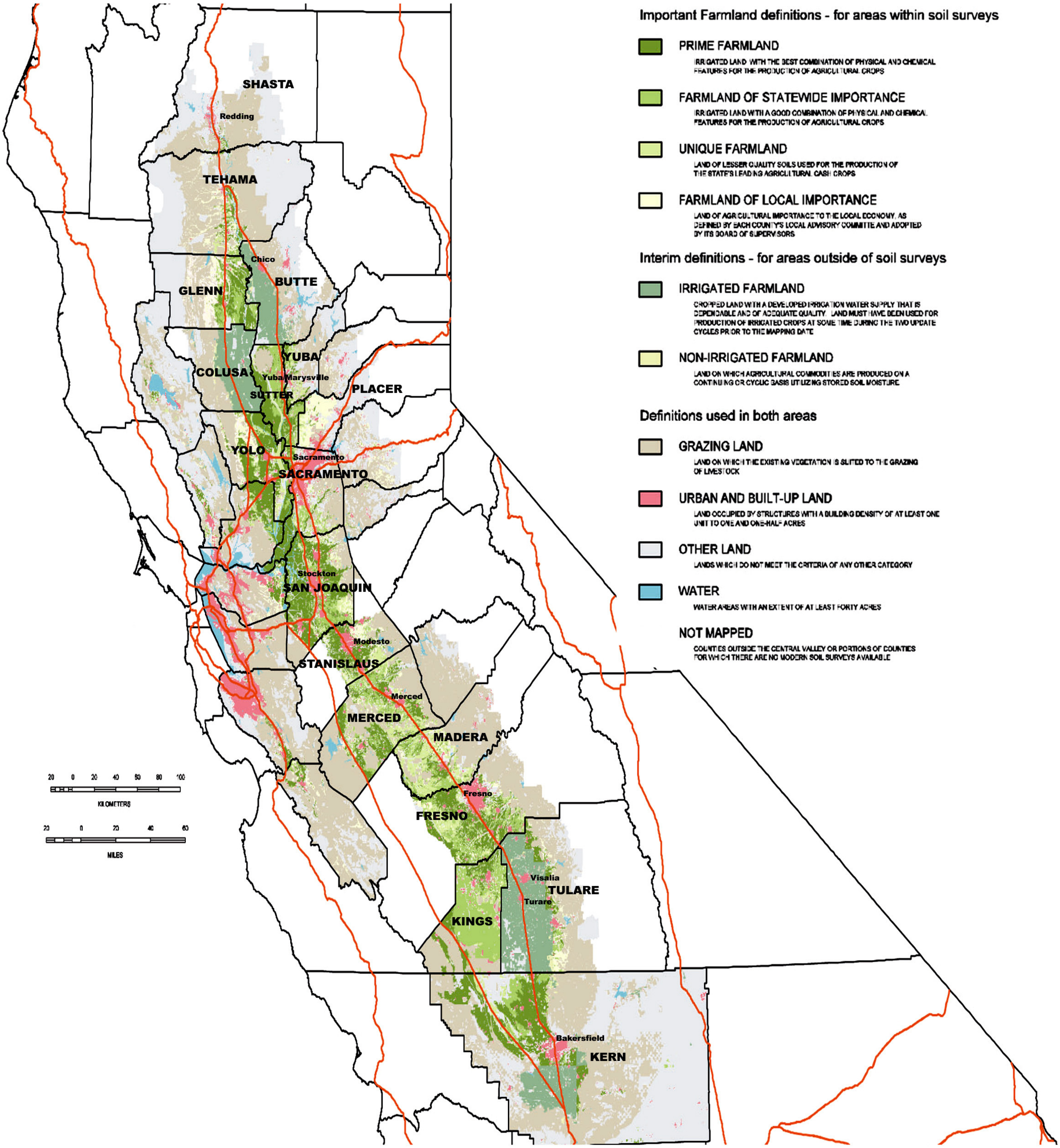
Presently, there is no complete modern soil survey of all 18 counties in the Central Valley which would enable the preparation of a comprehensive soil property database necessary for the mapping of Valley lands suitable for on-site, decentralized wastewater treatment. Figure 2, designating productive agricultural lands in the Central Valley (13,650,973 acres total), was modified from the latest farmland mapping effort of the California Department of Conservation (2000) and allows interpretation of those valley areas potentially threatened with non-agricultural expansion. The agency utilized available modern soil surveys and information gathered from other sources. Those lands most apparently valuable for agriculture are designated “Prime Farmland” (2,988,807 acres), “Farmland of Statewide Importance” (1,403,896 acres), “Unique Farmland”

(699,088 acres), “Farmland of Local Importance” (667,621 acres), and “Irrigated Farmland” (1,525,716 acres). The designations most closely akin to having excellent to good soil properties’ criteria for both agriculture and on-site wastewater treatment are “Prime Farmland” and “Farmland of Statewide Importance”. For instance, designated criteria for both soil depth (e.g., rooting depth) and depth to water table would likely be acceptable for placement of a septic tank and leachfield. “Unique Farmland” is defined as land used for production of specific high economic value crops. This designation includes rice land which is not suitable for on-site wastewater treatment due to mainly low soil permeability and high water table. “Irrigated Farmland” must be included in the above grouping since it includes current agricultural farmland not included in an available modern county soil survey. Many of the lands in the “Irrigated Farmland” designation can be expected to be reclassified as either “Prime Farmland” or “Farmland of Statewide Importance” once a modern soil survey is completed (i.e., Butte County).

Of the 13,650,973 acres of agricultural land in the Central Valley, the total amount of “Irrigated Farmland” declined by 35,996 acres to other uses from 1996 to 1998. The most common reasons for “Irrigated Farmland” loss were the cessation or idling of irrigated crop production, conversions to low density rural housing, urban residential and commercial development, and new golf courses (CA Dept. of Conservation, 2000). During 1996 to 1998, “Prime Farmland” , “Farmland of Statewide Importance”, and “Unique Farmland” lost 42,506 acres. Of this, 15,274 acres were lost due to suburban development. No information was available regarding losses due to low density rural housing.

A general review of available soil surveys indicates that most valuable agricultural soils in the Central Valley are classified in the taxonomic soil order as Mollisols, Alfisols, Inceptisols, and Entisols. These soils fall in the U.S. Department of Agriculture capability Classes I-IV. Consequently, these are the soils that are most threatened by non-agricultural development.

Figure 2. Land Use in California's Central Valley, 1998



Modified from Ca. Dept. of Conservation, 2000

An important value of enhanced on-site wastewater treatment systems is that they can be used on soils that do not meet the criteria for productive agricultural lands, that is, marginal soils. Much of this land in the Central Valley is generally designated as "Grazing" land. In addition, soils located in the foothill areas are generally of little agricultural use other than for vineyard development. Appendix B includes a discussion concerning the types of soils on which enhanced on-site systems can be utilized in place of conventional septic technology. A short discussion on using enhanced technology on marginal soils appears in Appendix A. A survey of enhanced onsite wastewater treatment systems that have been employed to replace failing conventional systems in the Central Valley counties are listed in Appendix E.

Valley Soils, Wells and Septic Systems

A comparison between Table 2 and Table 3 makes clear that the Central Valley is more dependent on on-site septic systems for residential development than is true for jurisdictions outside of the Valley. Most of these on-site systems are located on prime agricultural land where the soil is most amenable to conventional septic systems. Continuation of this trend will, of course, lead to increased development on farmland rather than on the marginal soils which are also located in each county.

On-site wells constitute decentralized water delivery systems which are very much dependent upon the quality of the ground water. Along with a greater percentage of on-site septic systems than the rest of California (Tables 2-3), the Central Valley also has a greater percentage of domestic wells (Table 4) than the remainder of the state (state average 2.7%). Because enhanced on-site treatment systems can reduce the extent of nutrient contribution to ground water more effectively than conventional systems, the introduction of enhanced systems provide an additional benefit to jurisdictions which adopt them. Besides adding flexibility to the planning process, they also contribute to the reduction of public health concerns involving drinking water from domestic wells.

Multifunctional Valley Agriculture

Agriculture has the potential to produce multiple benefits to Central Valley residents beyond the values that flow from farmland production and processing. First, there are the open space and landscape values that result from sweeping acres of farm and rangeland. A second benefit accruing from agricultural lands is its role as habitat for wildlife and threatened and endangered species. In addition to being California's agricultural heartland, the Sacramento and San Joaquin valleys continue to be a home to many endangered ecological communities, including numerous rare types of grasslands, marshes, scrublands, and forests. Third, the ability of organic matter in the soil to tie up carbon helps to reduce problems associated with global warming. Fourth, agricultural lands serve important functions in flood control and ground water recharge. Fifth, long established farmlands – particularly diverse family-sized farms - contribute to the cultural heritage of the community and provide opportunities for a new generation to experience the agricultural lifestyle.

Agricultural lands also provide buffers between natural areas and urban areas and serve as community separators, preserving and enhancing city form and identity when growth and annexations threaten to erase historic distinctions. For instance in 1995, the cities of Vacaville and Dixon purchased and leased back to farmers much of the agricultural land that separates them in order to preserve their cities' individual identities. Finally, the introduction of agricultural tourism in the Valley has increased opportunities for further contributions to the farm economy. Tourism farms presently operate in Fresno, Merced, Stanislaus and Madera counties (University of California, Davis, Small Farms Center, 2002). More recently, the cities of Woodland and Davis, in order to preserve their distinct identities, signed an agreement with the Yolo County Board of Supervisors to bar 11,600 acres of farmland between the two cities from being annexed into either city (Sacramento Bee, 2002).

Table 2. Onsite Wastewater Treatment Systems and Associated Demographics in California

	Housing units with individual sewage systems	Total housing units*	Percent housing units on individual systems	Population served	County population*	Percent population on individual systems	Systems installed per year (5 year average)	System repairs per year (5 year average)	Percent systems repaired versus new per year	Percent systems repaired per year - all systems	Persons* per household
Alameda	4,489	531,166	1%	12,388	1,433,309	1%	25	60	71%	1.3%	2.8
Alpine	551	1,461	38%	1,316	1,193	110%	10	5	33%	0.9%	2.4
Amador	9,600	14,905	64%	23,491	33,924	69%	175	35	17%	0.4%	2.4
Butte	44,314	86,563	51%	110,573	201,935	55%	335	245	42%	0.6%	2.5
Calaveras	15,378	22,937	67%	38,645	38,144	101%	300	50	14%	0.3%	2.5
Colusa	2,507	7,085	35%	7,215	18,537	39%	38	14	27%	0.6%	2.9
Contra Costa	11,222	349,912	3%	32,063	916,403	3%	250	100	29%	0.9%	2.9
Del Norte	5,230	10,688	49%	13,587	28,096	48%				0.0%	2.6
El Dorado	32,609	71,974	45%	89,917	150,824	60%	1,000	150	13%	0.5%	2.8
Fresno	42,861	270,782	16%	134,156	793,766	17%	600	200	25%	0.5%	3.1
Glenn	4,686	10,174	46%	13,196	26,943	49%	47	22	32%	0.5%	2.8
Humboldt	16,265	56,576	29%	41,277	128,086	32%	115	49	30%	0.3%	2.5
Imperial	6,651	43,067	15%	20,400	142,737	14%	90	15	14%	0.2%	3.1
Inyo	2,191	9,078	24%	5,126	18,204	28%	30	5	14%	0.2%	2.3
Kern	46,939	231,629	20%	136,442	648,398	21%				0.0%	2.9
Kings	5,533	36,176	15%	19,119	128,323	15%	54	12	18%	0.2%	3.5
Lake	13,452	31,910	42%	32,591	55,294	59%	100	55	35%	0.4%	2.4
Lassen	5,854	11,635	50%	15,814	34,059	46%	101	10	9%	0.2%	2.7
Los Angeles	80,135	3,261,750	2%	288,797	9,757,542	3%	287	265	48%	0.3%	3.6
Madera	17,526	39,018	45%	51,985	115,846	45%	273	185	40%	1.1%	3.0
Marin	9,276	104,420	9%	23,558	247,934	10%	200	100	33%	1.1%	2.5
Mariposa	6,347	9,146	69%	14,687	16,124	91%	98	15	13%	0.2%	2.3
Mendocino	20,520	37,112	55%	53,077	87,143	61%	446	140	24%	0.7%	2.6
Merced	15,000	68,542	22%	49,795	206,887	24%	125	40	24%	0.3%	3.3
Modoc	3,275	5,183	63%	7,717	9,934	78%	90	45	33%	1.4%	2.4
Mono	2,400	11,651	21%	5,704	10,812	53%	60	4	6%	0.2%	2.4
Monterey	21,154	130,924	16%	66,664	391,322	17%	225	380	63%	1.8%	3.2
Napa	9,450	48,373	20%	26,019	124,588	21%	110	50	31%	0.5%	2.8

Table 2. Continued

Nevada	22,988	44,605	52%	58,004	89,644	65%	300	90	23%	0.4%	2.5
Orange	6,708	954,882	1%	17,310	2,775,619	1%				0.0%	2.6
Placer	23,315	102,344	23%	61,259	225,873	27%	240	36	13%	0.2%	2.6
Plumas	9,286	13,812	67%	20,062	20,452	98%	425	50	11%	0.5%	2.2
Riverside	113,238	569,287	20%	336,986	1,473,307	23%	2,100	2,500	54%	2.2%	3.0
Sacramento	18,887	464,470	4%	50,393	1,177,835	4%	250	38	13%	0.2%	2.7
San Benito	4,993	15,954	31%	15,652	47,873	33%	100	100	50%	2.0%	3.1
San Bernardino	132,000	604,060	22%	415,189	1,654,007	25%	1,000		0%	0.0%	3.1
San Diego	71,930	1,026,142	7%	223,759	2,853,258	8%	1,250	205	14%	0.3%	3.1
San Francisco	0	337,983	0%	0	790,498	0%	0	0			2.5
San Joaquin	28,033	186,718	15%	81,758	554,438	15%	267	278	51%	1.0%	2.9
San Luis Obispo	26,700	99,905	27%	72,552	241,598	30%	462	90	16%	0.3%	2.7
San Mateo	6,360	261,434	2%	19,680	722,762	3%	35	100	74%	1.6%	3.1
Santa Barbara	11,434	145,135	8%	33,424	409,048	8%	140	145	51%	1.3%	2.9
Santa Clara	19,000	581,532	3%	56,547	1,715,374	3%	100	100	50%	0.5%	3.0
Santa Cruz	26,693	96,679	28%	73,699	252,806	29%	84	416	83%	1.6%	2.8
Shasta	28,516	71,042	40%	73,046	165,438	44%	215	200	48%	0.7%	2.6
Sierra	1,521	2,295	66%	3,388	3,216	105%	20	19	49%	1.2%	2.2
Siskiyou	9,760	21,989	44%	22,973	44,335	52%	131	84	39%	0.9%	2.4
Solano	5,938	134,294	4%	18,222	390,112	5%	40	30	43%	0.5%	3.1
Sonoma	43,360	180,415	24%	115,739	443,669	26%	300	300	50%	0.7%	2.7
Stanislaus	26,360	149,966	18%	82,987	432,990	19%	85	263	76%	1.0%	3.1
Sutter	11,671	29,080	40%	33,522	76,694	44%	100		0%	0.0%	2.9
Tehama	13,669	23,784	57%	34,630	55,671	62%	232	59	20%	0.4%	2.5
Trinity	5,790	8,074	72%	13,537	13,180	103%	75	25	25%	0.4%	2.3
Tulare	34,238	120,211	28%	114,743	363,305	32%	280	84	23%	0.2%	3.4
Tuolumne	16,013	28,252	57%	39,449	52,876	75%	163	111	41%	0.7%	2.5
Ventura	16,701	248,500	7%	50,513	742,008	7%	300	191	39%	1.1%	3.0
Yolo	5,164	59,911	9%	14,802	158,797	9%	75	75	50%	1.5%	2.9
Yuba	6,585	23,230	28%	18,685	60,409	31%	59	26	31%	0.4%	2.8
TOTAL	1,202,266	12,119,822	10%	3,507,829	33,773,399	10%	14,012	7,866	36%	0.7%	

***Information adapted from: Status Report: Onsite Wastewater Systems in California, Joint publication U.S. EPA and the California Wastewater Training and Research Center, June 2000.**

Table 3. Onsite Wastewater Treatment Systems in Central Valley*

	1999 Housing units with individual sewage systems	1999 Total housing units**	Percent housing units on individual systems	Persons** per household
Butte	44,314	86,563	51%	2.5
Colusa	2,507	7,085	35%	2.9
Fresno	42,861	270,782	16%	3.1
Glenn	4,686	10,174	46%	2.8
Kern	46,939	231,629	20%	2.9
Kings	5,533	36,176	15%	3.5
Madera	17,526	39,018	45%	3.0
Merced	15,000	68,542	22%	3.3
Sacramento	18,887	464,470	4%	2.7
San Joaquin	28,033	186,718	15%	2.9
Shasta	28,516	71,042	40%	2.6
Solano	5,938	134,294	4%	3.1
Stanislaus	26,360	149,966	18%	3.1
Sutter	11,671	29,080	40%	2.9
Tehama	13,669	23,784	57%	2.5
Tulare	34,238	120,211	28%	3.4
Yolo	5,164	59,911	9%	2.9
Yuba	6,585	23,230	28%	2.8
TOTAL	358,427	2,012,675	18%	

***Information adapted from: *Status Report: Onsite Wastewater Systems in California,* Joint publication U.S. EPA and the California Wastewater Training and Research Center, June 2000.**
****State of California, Department of Finance, City/County Population and Housing Estimates, 1991-1999, with 1990 census counts. Sacramento, California, May 1999.**

Table 4. Sewage Treatment Systems and Water Wells in the Central Valley.*

County	ONSITE SEWAGE TREATMENT SYSTEMS		WATER WELLS		
	1999 Housing units with individual sewage systems	Population served	Individual domestic water wells	Population served	Wells with nitrate last 5 yrs.
Butte	44,314	110,573	20,000	49,905	see note 1
Colusa	2,507	7,215	1,895	5,454	0
Fresno	42,861	134,156	11,084	34,693	6
Glenn	4,686	13,196	4,000	11,264	0
Kern	46,939	136,442	11,790	34,271	0
Kings	5,533	19,119	5,106	17,644	0
Madera	17,526	51,985	11,205	33,236	0
Merced	15,000	49,795	15,000	49,795	0
Sacramento	18,887	50,393	14,604	38,966	0
San Joaquin	28,033	81,758	23,239	67,776	0
Shasta	28,516	73,046	11,909	30,506	0
Solano	5,938	18,222	4,559	13,990	0
Stanislaus	26,360	82,987	16,895	53,189	0
Sutter	11,671	33,522	8,311	23,871	0
Tehama	13,669	34,630	7,477	18,943	0
Tulare	34,238	114,743	20,007	67,050	0
Yolo	5,164	14,802	4,566	13,088	0
Yuba	6,585	18,685	6,063	17,204	0
TOTAL	358,427	1,045,270	197,710	580,845	6

***State Of California, Department of Finance, City/County Population and Housing Estimates, 1991-1999, with 1990 census count. Sacramento, California, May 1999.**
[1.]Chico, Ca surrounding area aquifer separate from city wells and associated aquifer(s).

The Threat to Valley Agriculture

The Central Valley is the agricultural center of California. And because agriculture is the state's leading industry, the disappearance of Valley farmland is, or should be, of great concern to Valley and state policymakers. Nearly half of the state's farmland, two-thirds of its cropland and nearly 75 percent of the irrigated land is found in the fertile Sacramento and San Joaquin Valleys. Unfortunately, the agronomic characteristics of land that are key for crop production (warm temperature, especially in the winter, an adequate supply of water, and level, well drained soils) are also characteristics that are highly valued for urban development.

According to the state Department of Finance, the population of the Central Valley is expected to double between now and the year 2040, putting tremendous pressure on agricultural land and public services (Table 5).

Table 5. Projected Population Increases in the Central Valley

Year	Sacramento Valley	San Joaquin Valley	Central Valley Total
1990	1,897,000	2,740,000	4,637,000
2000	2,470,000	3,301,000	5,771,000
2020	3,190,000	5,082,000	8,272,000
2040	4,173,000	7,303,000	11,476,000

U.S. Bureau of the Census, Census 2000; CA Dept. of Finance; CA County Profiles, March 20, 2001

The impact of this growth on agriculture will vary depending on the pattern the new development assumes. According to a recent survey, the major housing preference in California continues to be the detached single-family home: 87 percent of people who own their residence live in single-family homes, and slightly more (91%) would prefer a single family home. In contrast, two in three renters currently live in apartments (50%) or attached dwellings (13%). However, 74 percent of them would prefer to live in a single-family house. In the Central Valley, 73 percent of residence owners live in a single-family detached house while 88 percent would prefer to live in such a home (Baldassare, 2001).

According to a study of the Valley by the American Farmland Trust, low-density urban sprawl, the kind facilitated by single-family home development, would consume more than 1 million acres of farmland by 2040. Approximately 60 percent of this is likely to be prime farmland and farmland of statewide importance. In addition, agriculture would experience increased risks and costs, and lower productivity, within a one-third mile wide "zone of conflict" around urban areas, totaling 2.5 million acres. By contrast, according to the study, more compact, efficient growth would reduce farmland conversion to 474,000 acres, including 265,000 acre of prime and important farmland, and would shrink the zone of conflict to 1.6 million acres.

PRESENT POLICIES DESIGNED TO PRESERVE AGRICULTURAL LAND

Traditionally, communities have sought to protect their farmland on their urban fringe – the most threatened – through large lot zoning, that is, the establishment of five to ten acre or more minimum size lots in rural zoning districts with one residence allowed per lot. This is one of the "solutions" that many conventional zoning ordinances use for presumably maintaining open space and preserving agricultural land. Although large lot zoning does reduce the number of homes that can be built, it also spreads out the homes in such a way that it is difficult to use the remaining land for economically viable farming. Moreover, large lot zoning is highly subject to political influence because of the great diversity in value between land for farming and land for residences. The absence of mandatory state or regional guidelines deprives local officials of the ability to deny politically sensitive land use applications while placing the blame on a higher level of government.

A resource-saving technique of growing use in California is that of urban growth boundaries, but this has its limitations as well. Here, the long-term growth areas of incorporated cities are defined and the city and county cooperate in implementing land use policies that discourage urban-type growth from occurring outside of the urban growth boundaries onto agricultural and other resource lands. While stopping farmland-threatening subdivisions, however, this approach, does not prevent individual homes from being established on agricultural land and incrementally diminishing productive farmland. Moreover, the urban growth boundary technique has received little support in the Central Valley.

Apart from land use controls, for many years the Williamson Act has been used to preserve California farmland. This is a voluntary program which uses the tax system to prevent premature conversion of agricultural land. The Act authorizes local governments and property owners to enter into contracts to commit land to specified open space uses for ten or more years. Contracts entered into value contracted land according to the income it is capable of generating from agriculture and other compatible uses rather than its fair market value. Most cities and counties require that land subject to a contract be zoned with an agricultural designation consistent with General Plan policy. Recently, the Williamson Act has been strengthened with the addition of farm security zone contracts (Cal. Govt. Code section 51296). These differ from traditional 10-year contracts in that landowners receive an additional 35 percent reduction in their property tax. In return, the landowners are subject to stricter provisions, such as a 20-year contract period, state approval of cancellations and a penalty set at 25 percent of the land's fair market value.

During the past twenty years agricultural conservation easements have emerged as a potentially effective way both to permanently protect farmland and channel urban growth. They are established by legal agreements between landowners and governmental or conservation organizations in which the landowner voluntarily sells the development rights to the land but retains title to the land for farming or ranching. A permanent deed restriction is placed on the property to ensure that the land remains in agriculture. In return, the landowner receives direct cash payments, tax advantages, or simply the satisfaction of having made a valuable contribution to the community. A number of Central Valley jurisdictions arrange for conservation easements through land trusts, a locally based, nonprofit, tax-exempt corporation legally empowered to accept land and easements for the purpose of preserving its open space and natural character. Examples include the Yolo Land Conservation Trust and the Foothills Farmland Trust of Placer County.

The purchase of farmland development rights through conservation easements is growing as an effective tool to protect working farms both in California and across the nation.

The California Farmland Conservancy Program was established in 1996. It is administered through the Department of Conservation's Division of Land Resource Protection and funded with annual appropriations. The program provides grants to local governments, resource conservation districts, nonprofit organizations, and regional open space districts for projects that use conservation easements to protect agricultural land. Voters approved Proposition 12 in March 2000, providing another $25 million for agricultural easements, an amount that was increased by $75 million with the passage of Proposition 40 in 2002.

In 1990 Sonoma County voters approved a quarter-cent increase in the county's sales tax to fund its purchase of farmland and open space as part of the county's "community separators' program (Sonoma County 1989). In Davis, California developers pay for conservation easements through a farmland mitigation program which allows them to develop properties in appropriate locations if they pay to purchase development rights on agricultural properties in preservation areas. Marin, San Joaquin, and Solano Counties have also used special taxation districts, in which landowners and homebuyers pay extra tax to fund farmland preservation. The tax pays off revenue bonds that have been sold to raise money for PDR (Trust for Public Land 2002). In 1999, the David and Lucille Packard Foundation launched a five-year, $175 million California initiative to conserve open space, farmland, and critical natural areas.

At the national level, the federal government has begun to play an active role in farm land conservation through the purchase of development rights (PDR). The major Federal program that funds PDR is the Farmland Protection Program (FPP). Originally created under the 1996 Farm Bill and administered by the Natural Resources Conservation Service (NRCS) of the US Department of Agriculture, FPP exists to assist ranchers and farmers monetarily to retain the ownership of their land and to enhance the economic viability of their agricultural enterprises. The FPP achieves this by providing, in the form of Federal funds, 50 percent of the cost of a permanent conservation easement on a working ranch or farm. The remaining half of the purchase price comes from the county, land trust, or other non-federal sources. The 2002 Farm Bill (Farm Security and Rural Investment Act of 2002) authorized $600 million for the FPP over a six year period.

The Williamson Act, fee purchases, conservation easements, "community separators" (such as Vacaville/Dixon and Woodland/Davis, *infra*) and other governmental and private incentive programs all have the positive effect of maintaining agricultural land for farming purposes. However, they also have the not-so-positive effect of *reducing land traditionally available for housing while housing demand continues to grow*. This is particularly true in the Central Valley. This, then, creates the dilemma that unless additional sites for market and affordable housing can be provided in urban communities and on other non-agricultural land, there will be strong pressure to rezone remaining farmland for residences and/or reduce the use of voluntary and incentive techniques that take agricultural land out of the housing market. The ability to place residential uses on less arable lands through the use of enhanced wastewater technology can assist communities seeking ways to satisfy a growing housing market without threatening the viability of their agricultural economy.

ENHANCED ON-SITE TECHNOLOGY AND LAND USE PLANNING

Under California planning law, each city or county must adopt a comprehensive, long-term general plan for the physical development of the city or county and any land outside its jurisdiction which bears relation to its planning. Pursuant to Government Code section 65302, general plans must contain seven elements: (1) land use, (2) circulation, (3) housing, (4) conservation, (5) open space, (6) noise, and (7) safety. Among the most important of these is the land use element which designates categories such as housing, industry, commercial and natural resources and sets forth density and locations for each particular category.

While the General Plan is a long-range look at the future of a community, the zoning ordinance spells out the immediate allowable uses for each property in the community. Each property in the community is assigned a "zone" listing the kinds of uses that will be allowed on that land (e.g., single family residential, multi-family residential, neighborhood commercial, light industrial, agricultural, etc.) and setting development standards (e.g., minimum lot size, maximum building height, minimum front-yard depth). The distribution of residential, commercial, industrial, and other zones is based on the pattern of land uses established in the community's General Plan. Zoning is adopted by ordinance and carries the weight of local law. All local governments use some form of a permitting process whereby a permit is issued for a specific project and can be conditioned based on conformance with the zoning ordinance (Fulton, 1999).

The treatment of wastewater is, obviously, a critical factor in planning and zoning decision-making, yet planners, historically have had little to do with determining how and where a community's wastewater treatment will happen. Planners are often left to react to municipal decisions on sewer line extensions, connection policies, or allocation of new capacity. In unsewered areas, planners have often relied, for better or for worse, on the ability of land to support septic systems as a *de facto* method of development regulation. Indeed, the phrase "zoning by septic" has been commonly used to describe land use policies based on the prescriptive septic system regulations imposed by state and/or local authorities (Hoover, 2001).

By providing a community with more location options, enhanced on-site wastewater treatment systems have the potential to encourage better planning and land use decision-making. Smart growth planning can only be as imaginative and effective as the tools available for implementation. The many varieties of innovative wastewater systems open up opportunities for planners to undertake comprehensive land use planning unburdened by the artificial constraints imposed by conventional septic systems. The requirement that each house be built on a site suitable for a conventional septic system has not only caused subdivisions to be placed on working farmland, but has caused them to range over a larger area than would be the case if the code allowed technology suited to the site. Lots that meet all developable requirements except for wastewater treatment may be able to be built upon with enhanced systems and with designs unsuitable for conventional systems, such as cluster development.

Greater Use of Cluster Development

Cluster development is a development pattern in which uses are grouped or "clustered" through a density transfer within the parcel rather than spread evenly throughout a parcel as in conventional lot-by-lot development. The same number of homes is clustered on a smaller portion of the total available land The area equal to the total reduction in the normally required lot remains in open space. This form of development is particularly appropriate in sensitive environmental areas—steep slopes, woodlands, wetlands -permitting substantial portions of development sites to be left in undisturbed natural open space. Beyond protecting the natural features of a site, the open space itself can benefit the environment by providing habitat for wildlife, naturally filtering storm water, and reducing storm water runoff from impervious surfaces. Moreover, linking the open space of several cluster design subdivisions can help develop larger and more effective “environmental corridors” within and between communities.

The cluster approach is also noted for the savings it can generate because of reduced infrastructure costs and other economies of development. Diminished road lengths and sidewalks, the reduced cost of installing gas and electric utilities, and reduced clearing and grading costs are some of the project savings attributable to cluster design. The cluster design can also be used as part of a buffer scheme for housing on the rural/urban fringe where non-farm residences situated close to agricultural lands frequently result in nuisance problems for both homeowner and farmer. By clustering the non-farm residences at the urban end of the parcel, the permanent open space remaining between the residences and the farmland acts as a buffer between the two disparate uses, thus alleviating some of the pressures of neighboring development and allowing farming to continue in nearby areas longer into the future (Arendt, 1999; U. of Ilinois, 2000).

Cluster developments are possible in unsewered areas because of the availability of innovative cluster or communal septic systems. These systems serve two or more dwellings (but not usually an entire community) and are located near the buildings they serve. The wastewater from each dwelling or business flows into its own interceptor (septic) tank to settle out and allow solids to break down. From the tank, the effluent is able to travel through smaller diameter, therefore less expensive, collection pipes. The pipes are buried at a shallower depth than full sewers and run relatively short distances to smaller, less maintenance-intensive treatment and dispersal units. These units often use soil absorption fields or effluent recycling rather than discharging the treated wastewater into surface waters.

Cluster Housing on Farmland

While cluster development provides a number of advantages consistent with smart growth planning, as shown above, it can also be used as a means of providing some economic relief to farmers by allowing limited development on farmland in a manner that preserves the vast majority of the land for agriculture. Moreover, with enhanced on-site technology, the houses need not be sited on the best (deep, well-drained, most productive) land. However, care must be taken in the use of this technique in agricultural areas because it does bring more residences into close proximity with working farmland and, thus, creates the potential for conflicts between farmers and non-farmers. Nevertheless, it is an option made feasible by the availability of septic systems, particularly so when there is strong political pressure to rezone agricultural areas for housing (Daniels and Bower, 1997).

Two Traditions Undergoing Change

There is an interesting comparison between traditional zoning and traditional wastewater treatment practices and how both traditional approaches are now in the process of change. Traditional zoning was based on the concept of separation of uses, that is, the notion that different uses had to be kept separate from one another in order to protect the health, safety and welfare of the public. The result placed development in a kind of legal straightjacket and resulted in the segregation of home, workplace and shopping area that has contributed to the massive construction of roads and an increase in auto congestion and pollution in many of our urban and suburban areas. A contemporary and smart growth response to these problems has been the implementation of mixed-use zoning, neo-traditional development, and performance zoning, all designed to regulate land use on the basis of performance or impact, rather than on a specific list of permitted uses and prescribed design standards.

Similarly, traditional on-site wastewater treatment programs have been based on prescriptive siting, design and setback standards to dictate where and when septic tank systems are appropriate. The assumption underlying this approach was that such rigid regulations were necessary to protect the public health, safety and welfare. The result mandated the use of conventional wastewater treatment systems and placed development in a kind of risk management straightjacket contributing to the placement of housing on the best agricultural land and causing homes to range all over the countryside. A contemporary and smart growth response has been the use of performance requirements related to the site and proposed density rather than one-size-fits-all prescriptive regulations, and the introduction of new treatment technologies that can achieve high performance levels on sites with size, soil, ground water and landscape limitations that might preclude installing conventional systems.

THE CHALLENGE FOR ADMINISTRATORS

At the same time that the availability of enhanced technology makes planning more flexible and consistent with smart growth principles, it also makes it more complex. For one thing, enhanced septic systems can make many previously unbuildable sites buildable and the question is whether or not existing environmental and land use laws are able to deal with this consequence. It is important that communities have a clear idea of what land use patterns and objectives they wish to support now that they have a wider range of wastewater treatment possibilities to choose from and which systems can support creative design approaches, including cluster design. A review of present plan policies will be in order, indicating potential new development sites as well as areas they should be off limits due to various environmental, aesthetic, resource or safety considerations.

The adoption of enhanced systems as an appropriate technology for residential development will necessitate the integration of comprehensive planning and zoning programs with the on-site wastewater program. This is particularly true given the use of performance requirements in conjunction with the enhanced systems. While traditional programs use prescriptive siting, design and setback requirements to dictate where and when conventional septic systems can be used, enhanced systems are frequently employed in a performance context in which system design is based on the characterization of wastewater flow and pollutant loads, the evaluation of site conditions, and the defining of performance and design boundaries.

Performance requirements contribute a flexibility to the planning process which enables the most efficient use of the enhanced system. Therefore, using a performance-based code can allow the use of onsite/decentralized systems in soil/site conditions that fall outside of the desirable soil/site conditions used for agriculture. As Hoover notes, “It is clear from many studies of advanced on-site technologies that there is no scientific basis for extreme development limitations imposed due to ‘the lands inability to handle septic systems’. With proper management, advanced on-site technologies can be used within an extremely broad range of soil conditions in most watersheds without substantial environmental impact” (Hoover, 1997). To streamline a performance-based process, overlay zones can be designated in which specific technologies or management strategies are required to protect sensitive environmental resources (U.S. EPA, 2002).

Central to any performance-based code is that systems must be operated, maintained and managed to assure continuing and effective system performance. This can only be achieved by having in place a management program that assigns responsibility and provides the accountability sought by regulators. While the treatment technology provides a means to attain the treatment goal, it does not provide the means to assure ongoing performance to meet that goal. A disciplined and effective management program that assures that the on-site technology performs as needed is as essential to overcoming site limitations as is the technology itself. (Bounds, 2001). Further discussion on on-site technology management can be found in Appendix C which includes case studies of successful California management programs now in operation. Appendix D includes the model ordinance with the description of the proposed management programs.

As a final thought, administrators and officials should be ready for possible opposition on the part of local residents. In states such as Wisconsin, Connecticut, and Minnesota, efforts to amend state regulations to promote the use of enhanced on-site treatment technologies have been opposed by environmental groups concerned that enhanced systems will facilitate growth *per se* or will facilitate sprawl-type growth on lands otherwise not suitable for development. Advocates of change in these states have found it necessary to undertake education programs to familiarize opponents with the advantages of enhanced system technologies both in terms of planning objectives and enhanced ground water quality. Equally important, in some communities an education effort may be necessary to help local residents understand the goals and advantages of cluster development

ON-SITE WASTEWATER POLICY SURVEY

In February 2002, questionnaires were sent to the planning directors and environmental health directors of all 58 California counties. We received responses from slightly more than half including 16 of the 18 Central Valley county planners, and 15 of the 18 Central Valley county environmental health directors. In general, the survey sought to determine whether or not conventional septic standards influenced land use policy-making , official familiarity with and usage of enhanced septic systems, the amount of consideration such systems are given in the planning process, and the opposition and obstacles communities might face in seeking to incorporate advance systems in their planning and land development process. Initial plans to report separately responses from the Central Valley was put aside when such responses indicated no significant differences between Central Valley responses and responses from the rest of the state. The results are given in percentages.

Findings

"Zoning by Septic?"

We asked both county planners and county environmental health directors whether or not the density or lot size requirement in their county's General Plan is based, in whole or in part, on the capabilities of conventional septic systems. While a majority of county environmental health officials agreed this was true, the overwhelming answer on the part of the planners was "yes," indicating their belief concerning the fundamental influence that on-site wastewater standards have on local land use decisions:

Is the density or lot size requirement of the Land Use element of your General Plan based, in whole or in part, on the capabilities of conventional septic systems?

Response	County Planners	Environmental Health Directors
YES	86%	62%
NO	14%	38%

Providing for Enhanced Systems

We asked county environmental health directors whether or not enhanced on-site wastewater treatment systems are in use in their jurisdiction and the overwhelming response was "yes." The most common systems used are mound, intermittent and recirculating sand filters, and low pressure systems. Others systems in present use are at-grade systems, subsurface drip dispersal, multi-flow aerobic treatment systems, and, as stated by several respondents, any reasonable design by a qualified consultant. These systems are primarily used where soil conditions are unsuitable for conventional septic or in cases of high ground water. Based on the comments, however, it does not appear that enhanced systems are used as a matter of course, but rather, most often as replacement systems when conventional systems fail, and on existing parcels rather than in newly zoned areas (Appendix E). Creation of new parcels that rely on enhanced treatment systems to overcome site constraints or environmental/public health concerns are generally not allowed. There are a few exceptions to this, notably mound systems are an accepted technology for new parcel development within the North Coast Regional Water Quality Control Board.

Does your ordinance allow enhanced on-site wastewater treatment system under certain conditions?

Response	Environmental Health Directors
YES	**80%**
NO	**20%**

If yes, what kind of systems do you allow?

Mound systems	**96%**
Sand filter systems	**96%**
Low pressure pipe system	**63%**
Other	**56%**

If yes, under what conditions?

Lot size	**50%**
Soil conditions unsuitable for conventional septic	**100%**
High groundwater	**96%**
Proximity to water bodies or other Critical resource areas	**39%**

Steep slopes	**32%**
Other	**7%**

Performance Standards

We sought to determine to what extent performance standards were utilized in the approval of septic systems. In most counties prescriptive regulations are in use and less than a third of the responding jurisdictions decide on septic system utilization based on performance standards

Does your ordinance set performance standards (or discharge standards) for on-site wastewater treatment systems which allow the designer to choose the appropriate system?

Response	Environmental Health Directors
YES	28%
NO	72%

Cluster Septic Systems

We sought to determine to what extent on-site cluster systems were utilized.

Does your Community allow development using on-site cluster systems and communal drainfields?

Response	Environmental Health Directors
YES	57%
NO	43%

Consideration by Planning Authorities

We sought to determine whether or not the use of enhanced treatment systems had been considered in the making of plan policy, either through discussion within the planning department or by the county planning commission. Virtually none of the respondent counties had brought up the topic for consideration. It appears that in those communities where enhanced treatment systems are in use, such systems are not seen as opportunities to change development patterns in order to preserve farmland or open space.

Has your Department or the Planning Commission discussed the possibility of preserving agricultural land by allowing the use of advanced on-site septic systems in non-farm areas where development cannot now take place with conventional septic systems?

Response	County Planners
YES	7%
NO	93%

Has your Department or the Planning Commission discussed the possibility of increasing density or reducing lot size through the use of enhanced on-site septic system technology?

Response	County Planners
YES	28%
NO	72%

Familiarity with Enhanced Systems

It appears that most county planners are either very familiar or familiar with enhanced on-site wastewater treatment systems, and slightly less familiar with septic systems that can be used for clustered residential development.

How familiar are you with advances in wastewater treatment technology such as mound systems and sand filters, that can enable development to take place in areas where it would be unsuitable with conventional septic systems?

Response	County Planners
VERY FAMILIAR	11%
FAMILIAR	64%
NOT FAMILIAR	25%

How familiar are you with on-site wastewater treatment systems for clustered residential development?

Response	County Planners
VERY FAMILIAR	**7%**
FAMILIAR	**61%**
NOT FAMILIAR	**32%**

Cluster Developments

We sought to determine whether or not cluster development was allowed using on-site wastewater treatment systems rather than central sewers. About half of the counties do allow such development, and about two-thirds of them allow them on communal septic systems. Cluster systems typically can utilize a variety of 'treatment plant' designs such as small package treatment plants as well as septic systems. A communal septic system is, in reality, a conventional system serving a number of residences, with either individual septic tanks and one large soil treatment area or one large septic tank serving all the residences followed by a soil treatment area. Package treatment plants are more in line with a small sewage treatment plant and utilize enhanced treatment technology.

Are cluster developments allowed in areas in which central sewer service is not available?

Response	County Planners
YES	**54%**
NO	**46%**

If yes, are communal septic systems allowed?

Response	County Planners
YES	**65%**
NO	**35%**

Expected Environmental Opposition

We asked both county planners and environmental health directors whether or not they could foresee opposition from environmental or other groups should enhanced systems come into general use and allow development in areas not now buildable with conventional septic systems. Both the planners and health officials agreed there would be opposition, with the planners more certain of the fact. They thought that much of the opposition would be based on the fear of greater dispersion of development in rural areas, compromising existing open space, and that there is general opposition to the notion of increasing density.

Do you foresee any opposition from environmental or other groups should a decision be made to permit enhanced on-site systems which would allow development in areas not now suitable for development with conventional septic systems?

Response	County Planners	Environmental Health Directors
YES	64%	57%
NO	36%	43%

Obstacles to Use of Enhanced Systems

We asked both county planners and county environmental health directors to state what they believed to be the major obstacles to introducing or expanding the use of enhanced on-site treatment systems (EOTS). The health directors chose implementation of effective maintenance and operation of the enhanced systems as the leading obstacle, followed by the cost of purchase and operation of the system. They recognize that enhanced systems require more oversight than conventional systems. In contrast, county planners saw the State and Regional Water Boards as the most significant obstacle followed by opposition by citizen groups concerned with issues of growth.

The major obstacle to introducing or expanding the use of enhanced on-site wastewater treatment systems ranked by preference:

Environmental Health Directors	**County Planners**
1. Implementation of effective maintenance and operation system	**1. State Water Board or RWQCB**
2. Purchase and/or operation cost	**2. Issues related to growth**
3. Finding systems that are proven or have state seal of approval	**3. Purchase and/or operation cost**
4. State Water Board or RWQCB	**4. Lack of knowledge concerning system capabilities**

ADOPTING ENANCED WATER TREATMENT SYSTEMS

For many communities the utilization of enhanced on-site technology as a regular part of the development process - rather than approval for specific purposes, e.g., as replacement for failed septic systems or for use on pre-existing parcels - will constitute a significant innovation in the decision-making process. Research into the adoption of innovations by local governments has attempted to pinpoint the reasons why utilization of enhanced on-site technology is successful in some communities and not in others. The studies have found the most serious obstacles to be (not necessarily in order of importance):

- lack of perception of need (apparent adequacy of the present system or technique)
- lack of knowledge or understanding of the innovation
- lack of interest or motivation on the part of local officials
- unknown aspects of the innovation which makes trial or adoption risky
- lack of technical evaluation capability,
- distrust of private sector experts
- lack of a "climate of acceptance" among officials and local residents (Bingham, 1976; Abramson and Littman, 2002).

Underlying some of these concerns is the unwillingness, and in some cases, the perceived inability to obtain the necessary funding to support the fiscal needs for new or expanded programs.

In addition, the more information available concerning an innovation—especially its successful implementation elsewhere—the more ready a community will be to try it. Local officials do not like to deal with uncertainty or risk the possibility of making mistakes. This may be even more so in the case of new treatment techniques, the advantages of which are not as easily demonstrated as are productivity-type innovations which lend themselves to more direct measurement, such as computerizing traffic records or consolidating service functions.

The impediments to innovation adoption are no doubt more formidable in non-metropolitan environments due to a number of characteristics associated with those areas: the relative isolation of the population and distance from professional assistance, fiscal constraints, small staff, and limited expertise. The same studies that have provided us with the various obstacles to innovation adoption, also discuss the conditions under which innovations tend to be both successfully adopted and implemented:

- there is a perceived need for the innovation, whether or not such perception is pre-existing or the result of an educational campaign
- local officials fully supported the innovation and allocate (or are allocated) sufficient resources to see it through its initial stages
- those responsible for implementation collaborate and communicate effectively with individuals and groups affected by the change
- the innovation can be injected into the on-going stream of activity with minimal disruption of existing programs, institutional arrangements, and behavior patterns,
- administrators have the capacity to carry out the innovation in a competent and flexible manner.

Frequently economic, political and public health/environmental factors combine to force innovative adoptions, e.g., a finding of elevated nitrate levels in drinking water. Such an eventually results in a prohibition/moratorium on further development imposed by a state oversight regulatory agency (typically the Regional Water Quality Control Board and in some cases the State Department of Health). This action triggers a local response that requires “a new way of doing business.” Santa Cruz County and Sonoma County are evidence of how communities can effectively respond to crisis situations affecting the environment or public health (Appendix C).

Factors that can contribute to the perceived need for innovative adoptions of enhanced on-site technology include:

- Growth/development pressures result in development in areas that are not suitable for standard onsite treatment systems – this may be realized after the fact, that is, after a number of standard systems begin to fail.
- Conversion of existing rural homes and ‘summer’ homes into full-time residences (expansion of bedroom communities). These homes may not have adequate onsite treatment capability for the upgrade.
- Findings of contaminated ground water.
- Findings of contamination in surface water.
- Turf wars among local agencies or a lack of effective coordination between local agencies resulting in incomplete assessment/planning.
- Lack of understanding of cumulative effects results in public health or environmental concerns.

The need to involve residents in the various stages of the innovation adoption process is essential. A technique perceived by the community to be imposed on them by local, state or federal officials will not obtain the degree of acceptance of policy or programs as one adopted through a collaborative arrangement. From a broader perspective, citizen involvement in the utilization of enhanced on-site technology helps to create legitimacy and credibility for the newly adopted techniques, no unimportant matter where suspicions may arise as to the environmental and growth-inducing impact of the change.

The adoption of an innovative technique does not ensure its survival. To survive, the innovation must be absorbed, that is, it must become a part of the regular process of government and a functioning policy tool. For this to happen local officials need the resources and capacity to perform at a level sufficient to intelligently and efficiently carry out the new policy. The availability or acquisition of such resources and capacity should receive important consideration in the development of the implementation strategy.

CONCLUSION

The on-site wastewater treatment industry has developed many new treatment technologies that can achieve high performance levels on sites with size, soil, groundwater and landscape limitations that might preclude installing conventional systems. Although planners generally claim a knowledge of these enhanced systems, they have yet to integrate them into their plan implementation strategies in such a way as to facilitate cluster design or to preserve agricultural land. While it is time to rethink old models of wastewater treatment, it is equally important for local officials to rethink the wastewater-land use planning connection as well. Cooperation is needed between state, county and local governments, and between agencies, such as environmental health and county planning that typically have limited communication on wastewater treatment planning.

The State Water Resources Control Board and its nine regional boards have critical roles to play in preparing local agencies for change in the area of on-site sewage treatment systems. However, these bodies have multiple mandates and the supervision of on-site systems is not necessarily a priority among them. Indeed, local officials view the regional boards as an obstacle to innovation. Additional staff and budget resources are required in order for these state bodies to become proactive in the development of regional and local policies and the providing of technical information to local agencies. At a minimum, the State and regional boards should undertake to review, update and distribute technical information regarding enhanced systems and their implementation, including information on the development of on-site management and education programs. The state-wide model ordinance provides a framework for enabling local agencies to adopt innovative on-site technology.

The use of enhanced on-site treatment systems has expanded the range of planning options available to local decision makers. It has given county governments additional tools with which to carry out policy objectives related to farmland and open space preservation as well as expanded the feasibility of utilizing clustered development projects. The loss of prime agricultural lands constitutes a serious challenge to Central Valley communities and the adoption of enhanced on-site treatment systems can play a critical role in their preservation. The implementation of these systems will require the informed consensus of elected officials, county administrators and the public, a consensus which can be achieved if information is widely shared, issues are openly discussed, and all sides join in a good faith search for common ground. In the final analysis, success in combining enhanced on-site technology with essential planning objectives will depend on the presence of imaginative leaders at the state, regional and local levels who are able to see beyond the practices of today in order to prepare for the responsibilities of tomorrow.

REFERENCES

Abramson, M.A. and I.D. Littman, editors. 2002 *Innovation* (New York: Rowman & Littlefield).

Arendt, R. 1999. *Conservation Design for Subdivisions: A Practical Guide to Creating pen Space Networks*. (Covelo, CA: Island Press).

Baldassare, M. November 2001. PPIC Statewide Survey: Special Survey on Land Use (Pubic Policy Institute of California).

Bingham, R.D. 1976. *The Adoption of Innovation by Local Government* (Lexington, MA: D.C. Heath).

Bounds, T.R., 2001. Management of Decentralized and Onsite Wastewater Systems. In: Proceeding of the Ninth National Symposium on Individual and Small Community Sewage Systems, ASAE.

California Department of Conservation. 2000. California Farmland Conversion Report 1996-1998.

Daniels, T and D. Bowers. 1997 *Holding Our Ground: Protecting America's Farms and Farmland* (Covelo, CA: Island Press).

EPRI. 2000. *Enhanced On-Site Wastewater Treatment and Management Market Study: Volume 1: Assessment of Short-Term Opportunities and Long-Run Potential* (Palo Alto, CA).

Fulton, W. 1999. *Guide to California Planning* (Point Arena, CA, Solano Press).

Harden, D.R. 1998. *California Geology* (Saddle River, NJ, Prentice Hall).

Hoover, J.B. 2001. "Decentralized Wastewater Management: Linking Land Use, Planning & Environmental Protection." A paper presented at the American Planning Association National Planning Conference, March, 2001.

Hoover, M.T. 1997. A framework for site evaluation, design, and engineering of on-site technologies within a management context. Marine Studies Consortium, Waquoit Bay National Estuarine Research Reserve, and a*d hoc* Task Force for Decentralized Wastewater Management. Marine Studies Consortium, 400 Heath St., Chestnut Hill, MA 02167 (Page 44).

Pedri, J. (Interview). Assistant Executive Officer, California Regional Water Quality Control Board, Region 5, March 2002.

Sacramento Bee (newspaper). 2002. "Yolo cities draw green line in dirt". Sacramento, CA. September 5, 2002.

Schiffman, I. 2001. *Alternative Techniques for Managing Smart Growth* (Berkeley, Institute of Governmental Studies).

Sonoma County General Plan, 1989, Part 4, Section 2.1: *Open Space Element, Scenic Resources, Policy For Community Separators.*

The Trust for Public land and the National Cattlemen's Beef Association. June 2002. *Purchase of Development Rights: Conserving Lands. Preserving Western Livelihoods*. Denver, Western Governors Association).

University of California, Davis Agricultural Issues Center, *The Measure of California Agriculture, 2000.*

University of California, Davis Small Farms Center: www.sfc.ucdavis.edu.

University of Illinois Extension Service, *Local Government Topics: Cluster/Conservation* LGIEN Fact Sheet 2000-010.

U.S. Environmental Protection Agency. 1997. *Response to Congress on the Use of Decentralized Wastewater Treatment Systems.* EPA 832-R-97-001b. U.S. EPA. Washington D.C.

US Environmental Protection Agency. 2002. *Onsite Wastewater Treatment System Manual.* EPA 625/R-00/008. U.S. EPA. Washington D.C.

APPENDIX A

What soil and site criteria help determine suitability for on-site wastewater treatment system?

Both soil and site properties are considered to determine the suitability of conventional on-site wastewater systems. Current regulatory emphasis in established guidelines is mostly on conventional wastewater systems (e.g., septic and leachfield) and some enhanced wastewater treatment systems (U.S. EPA, 1980). However, over the last decade there has been a change to an emphasis on performance-based water quality (discharge) standards and other similar approaches that can include other enhanced onsite wastewater treatment systems (U.S. EPA, 2002). These performance-based approaches have been proposed as a substitute for prescriptive requirements for system design, siting, and operation.

Performance-based water quality standards stipulate the acceptable discharge (maximum) concentrations for wastewater constituents that are of concern to a sensitive receiving environment. Thus, the constituents of concern vary from one area to the next so that the contaminants of concern are specific to that receiving environment. For example, performance-based standards would stipulate nutrient reduction in areas with high nitrate levels in the ground water. Generally, performance-based standards can stipulate discharge concentrations where one or several wastewater constituents such as BODs (or CODs), nitrogen, phosphorus, organic compounds, bacteria, viruses, and other environmental and public health contaminants would be of concern to an environment. Performance-based water quality standards are better suited in defining the long-term suitability of an on-site wastewater treatment system since this approach is irresistibly simple and inherently logical. However, it is often difficult to certify the performance of various treatment technologies under the wide range of climates, site conditions, hydraulic loads, and pollutant outputs they are subjected to and to predict the transport and fate of those pollutants in the environment. Performance-based water quality standard goals are being advocated by the California Wastewater Training and Research Center (Chico, Ca) and many members of the expert community for inclusion in the proposed California statewide on-site wastewater treatment regulations. The use of performance-based water quality standards utilizes treatment technology and soil property guidelines in conjunction with all other environmental criteria specific to a given site to achieve these goals in water quality.

The primary system for onsite and decentralized wastewater treatment in the U.S. includes septic tank pretreatment followed by subsurface infiltration and percolation (see *Conventional Septic System*, Appendix A) through the soil vadose zone prior to recharge of the underlying ground water (Figures 1 and 2). When soil conditions are suitable for use, the wastewater soil absorption system (e.g., leachfield) can achieve a high treatment efficiency over a long service life at low cost, and be protective of public health (Siegrist et al., 2002). Treatment is the process of purification by which the disease microorganisms, the organic nutrients, and the inorganic materials are removed from the wastewater before being returned to the hydrological cycle.

The success of a subsurface wastewater infiltration system (SWIS) is not solely dependent upon the soil, but is also dependent upon the engineering design of the septic tank system and it's compatibility with the environmental conditions established by a site evaluation. The conditions imposed by a SWIS design (e.g., applied effluent quality and hydraulic loading rate) in a given environmental setting (e.g., soil type, geology, topography and climate) must be such that key treatment processes occur at a rate and to an extent that effective water quality treatment goals are reliably achieved before ground water recharge occurs.

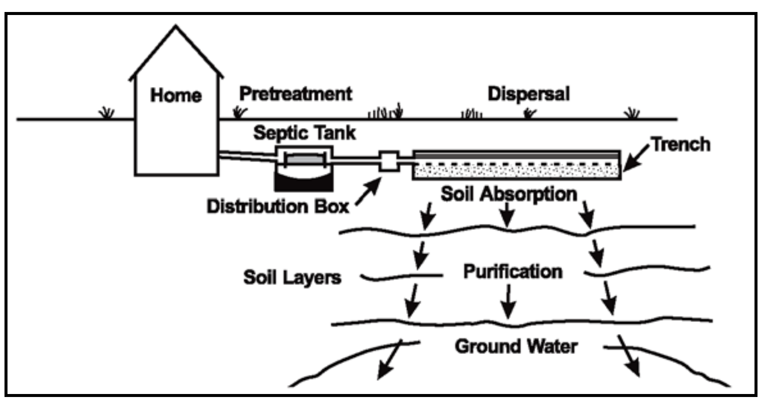


Figure 1. Lateral view of a conventional septic tank system showing septic tank and soil absorption field (leachfield). (U.S. EPA, 2002)

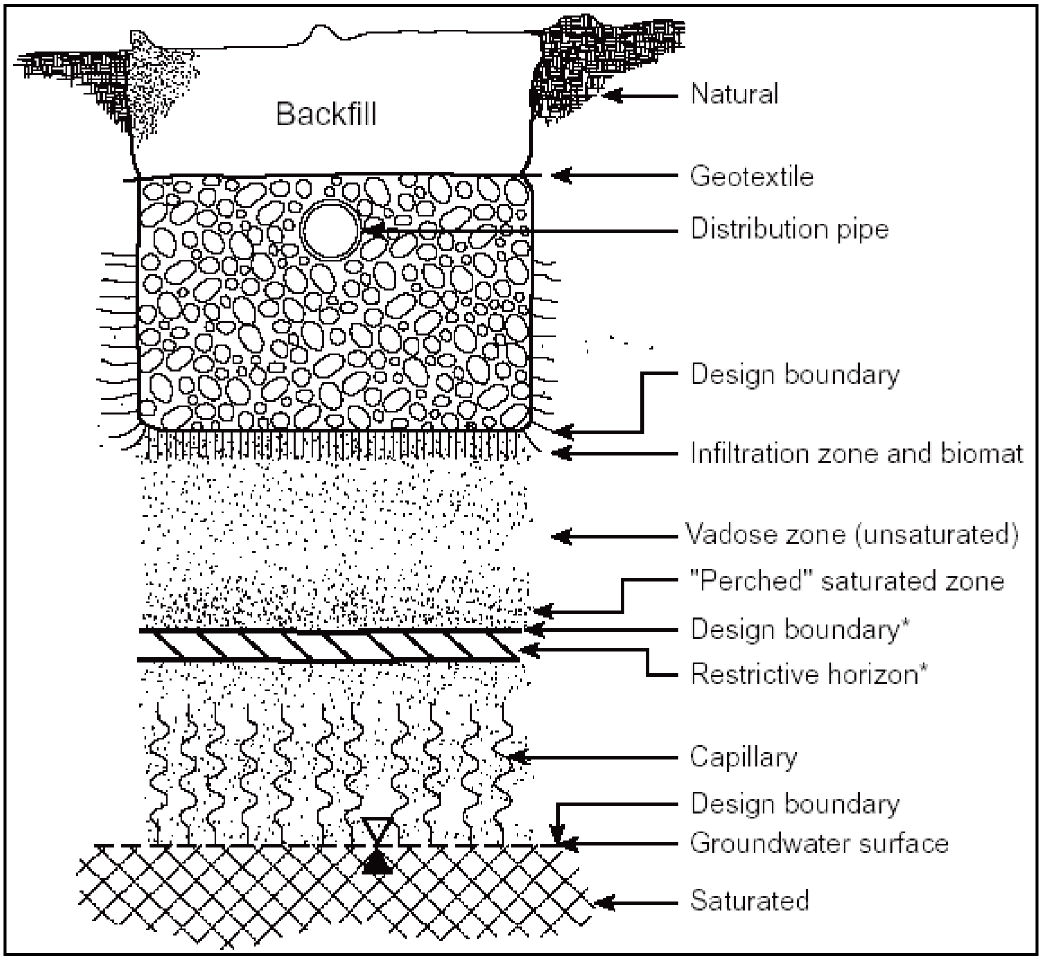


Figure 2. **Possible soil treatment zones that are relevant to a successful SWIS leachfield. (U.S. EPA, 2002)**

The soil properties listed in Table 1 are relevant to the soil's ability to effectively percolate and treat effluent from a leachfield. The properties were identified from regulatory guidelines established by the U.S.-EPA and for many states in the United States. The reader is referred to the *Onsite Wastewater Treatment and Disposal Systems – Design Manual Number 35* (U.S. EPA, 1980) for additional detail on these soil properties. These fundamental soil properties are used to interpret the feasibility of SWIS treatment by way of gauging soil permeability or vertical separation or both. Soil permeability is the rate of water (e.g., saturated and unsaturated hydraulic conductivity) and air movement through soil (i.e., aerobic and/or anaerobic conditions). Soil permeability can directly affect the degree of soil purification (defined as the change in contaminant concentration per unit depth) or treatment of the effluent. Vertical separation is the depth of permeable, unsaturated soil that exists between the bottom of a SWIS and some restrictive or limiting layer or feature such as a water table, bedrock, hardpan, unacceptable fine textured soils, or excessively permeable material (Hall, 1990).

Table 1. Soil properties important for successful leachfield soil treatment of septic tank effluent.

Soil Property	Apparent Leachfield Parameter
Soil texture	**Soil Permeability**
Soil structure type and grade.	
Soil consistence.	
Coarse fragments	
Depth to seasonally saturated soil	**Vertical Separation**
Depth to hardpan or restrictive layer	
Soil depth below trench	
Soil color	**Soil Permeability and/or Vertical Separation**
Redoximorphic feature(s) presence indicative of wetness and/or poor aeration.	
Other considerations, organic matter, clay mineralogy, presence of carbonates, etc.	

Subsurface soil treatment via use of a leachfield relies upon gradual seepage of wastewater into the surrounding soils. By the gradual seepage of wastewater over a relatively large soil surface area, major treatment processes can effectively occur in the soil. These processes include chemical and biological transformations, including natural die-off of pathogens, and filtration, that includes adsorption, absorption, precipitation and sedimentation. Successful SWIS treatment can only be achieved where favorable soil characteristics and geology exist for treatment and subsequent dispersal of the treated wastewater into the environment. For effective wastewater treatment, prospective soils should be relatively permeable and should remain unsaturated to several feet below the system depth (e.g., vertical separation). Moreover, the soil absorption system should be set well above water tables and bedrock. It cannot be easily located in steeply sloped areas, nor should a leachfield be installed closed to a lake, stream, or drinking water well (U.S. EPA, 1999).

Soil and site guidelines vary from one jurisdiction to the next, however they are similar. In Nebraska, the groundwater table should be at least 4 ft below the absorption field during the wettest season (Harlan and Dicky, 1980). In areas that have a seasonal high water table, sewage effluent can easily contaminate the groundwater, especially if the soil above the groundwater is sand or gravel. In other areas there may be a seasonal high water table due to a clay layer which inhibits downward flow. In this case, adding septic effluent to the soil will bring the water table even closer to the surface during the wet season. Effluent in this perched water can cause odor when exposed at the surface and result in the spread of disease. In addition, effluent under high water table conditions may not achieve the level of soil treatment needed to remove harmful contaminants and pathogens. With other site conditions, the depth of soil should be greater than 4 ft from the bottom of the absorption trench for coarse sands and gravels or to bedrock. This thickness is needed for adequate filtration and purification.

Soil slopes of less than 15 percent usually do not create a serious problem in laying out or maintaining an absorption field. The standard practice is always to place the adsorption trenches on the contour. Where slope exceeds 5 to 6 percent, extra caution should be taken to ensure that absorption trenches are placed on the contour. On steeper slopes, laying out and maintaining absorption fields is more difficult, especially where the downward flow of effluent is intercepted by a horizontal layer of clay or rock. Interception of these flows will cause effluent to move horizontally and potentially seep to the soil surface.

Soil Permeability

The amount of sand, silt and clay (soil texture) in the soil influences soil permeability by its relationship to pore size, pore size distribution, and pore continuity. Water moves faster through sandy soils than through clay soils. Water will move faster through a soil having coarse fragments than through a soil of similar texture without coarse fragments. Locating an absorption field in a sandy or gravelly soil is not recommended since the septic tank effluent will not be filtered properly, especially if soil is thin and overlies a shallow water table. Similarly, locating an absorption field in a soil having a high clay content (e.g., a clay textured soil) is not recommended due to the slow permeability. In addition, some clays generally swell when wet, reducing permeability, which limits the effectiveness of the absorption field.

Traditionally, soil permeability is evaluated using a percolation rate. The percolation rate is a measure of the water movement rate through a soil. Acceptable limits of percolation for leachfield suitability range between 1 and 60 minutes per inch (U.S. EPA, 1980). Percolation rates of 3 and 60 minutes per inch would correspond to leachfield absorption areas of about 753 and 3658 square feet respectively per bedroom of the house to be serviced (Harlan and Dicky, 1980). There remains current debate about what is the effective leachfield absorption area and if this include the sidewalls, along with the bottom of the absorption trench. Though the number of bedrooms has typically been used as a rule-of-thumb measure for tank sizing and leachfield absorption area, it should be noted that this is only an approximation; by itself, it is an unreliable way to gauge anticipated waste volume (U.S. EPA, 1980). While some states continue to use the percolation rate as a criterion for soil permeability and site suitability, many use a more comprehensive measure, the long-term acceptance rate, as part of a thorough site evaluation (U.S. EPA, 1999). The long-term acceptance rate accounts for the texture, structure, color, and consistency of all soil layers beneath the leachfield, as well as the local topography, to make a determination of the wastewater loads the area is able to accept on a long-term basis once a microbial biomass or biomat has formed beneath the distribution pipe. The infiltration rate through the biomat is typically slower than through the soil. The effluent must pass through the biomat before it enters into the vadose zone (Figure 1).

The hydraulic and organic loading rates of applying septic tank effluent into soil are dictated by soil texture and structure, and their influence on soil permeability. Table 2 shows examples of the long-term, sustainable hydraulic and organic rates for septic effluent (Tyler, 2002). Long-term hydraulic rates are considered in determining the long-term acceptance (percolation) rate. Soil permeability accurately reflects both water dispersal and aeration. The degree of purification of effluent is generally inversely related to permeability as long as there remains in soil, some water movement and adequate aeration. We can expect that longer residence times for effluent in the soil vadose zone to be associated with unsaturated water flow. This will result in greater purification of the effluent for a soil depth. Coarser textured soils have higher hydraulic loading rates due to greater soil permeability. However, prescribed hydraulic loading rates are dependent upon effluent quality (e.g., BOD) (Table 2). Certain soil structural types and grades such as weak, moderate, or strong platy structures are not acceptable with any soil texture because these structure will result in an extremely low or no permeability. Moderately textured soils (e.g., loam and silt loam) have lower permeabilities, but with certain structural types and grades can have similar hydraulic and organic loading rates compared to a coarser textured sandy loam.

Table 2. Suggested hydraulic and organic loading rates (long-term acceptance rates) based on soil texture and structure. Shaded areas indicate unsuitability for SWIS treatment. (Tyler, 2002)

Texture	Structure		Hydraulic loading (gal/ft^2-day)		Organic loading (lb BOD/1000ft^2-day)	
	Shape	Grade	BOD=150	BOD=30	BOD=150	BOD=30
Coarse sand, sand, loamy coarse sand, loamy sand	Single grain	Structureless	0.8	1.6	1.00	0.40
Fine sand, very fine sand, loamy fine sand, loamy very fine sand	Single grain	Structureless	0.4	1.0	0.50	0.25
Coarse sandy loam, sandy loam	Massive	Structureless	0.2	0.6	0.25	0.15
	Platy	Weak	0.2	0.5	0.25	0.13
		Moderate, strong				
	Prismatic, blocky, granular	Weak	0.4	0.7	0.50	0.18
		Moderate, strong	0.6	1.0	0.75	0.25
Fine sandy loam, very fine sandy loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.6	0.25	0.15
		Moderate, strong	0.4	0.8	0.50	0.20
Loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Silt loam	Massive	Structureless		0.2	0.00	0.05
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Sandy clay loam, clay loam, silty clay loam	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.3	0.25	0.08
		Moderate, strong	0.4	0.6	0.50	0.15
Sandy clay, clay, silty clay	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak				
		Moderate, strong	0.2	0.3	0.25	0.08

Vertical Separation

The vertical separation or depth of permeable, unsaturated soil (e.g., vadose zone) primarily affects degradation of organic nutrients (i.e., BOD) and removal of bacteria and viruses (Hall, 1990). It is essential for removal of pathogenic and biochemical sewage contaminants to an acceptable level. It also plays a role in converting nitrogen to soluble nitrate (NO_3^-) ions which can then readily migrate into the groundwater unless denitrifying conditions are present.

In order to achieve vertical separation as defined, the hydraulic loading must be low enough so that movement of the wastewater occurs under unsaturated conditions. The determination of the hydraulic load must consider the soil's permeability which is controlled by several soil properties such as soil texture and structure (Table 2). During unsaturated flow, water moves through the soil by matric forces, with slower average pore water velocities. The wastewater remains in close proximity to the soil surfaces and soil microorganisms, where treatment readily occurs. Unsaturated flow is much slower than saturated flow and therefore increases the residence time of the effluent per net distance traveled.[8] In addition unsaturated flow permits aerobic conditions, which promote faster and more complete treatment of the wastewater.

Saturated flow conditions more often results in inefficient and incomplete effluent contaminant treatment (Reneau et al., 1989). The following types of soil conditions would prevent safe soil treatment and dispersal. They each resulted in saturated flow conditions before adequate treatment can occur: (1) shallow soils over creviced bedrock (or excessively permeable soils), (2) shallow soil over high groundwater tables, and (3) impermeable soils (e.g., clay textured or massive structured soils) (Hansel and Machmeier, 1980).

There is a certain necessary distance that wastewater must travel under unsaturated conditions in order to provide adequate treatment. The amount of vertical separation required in various states is highly variable (Table 3). Where the separation is less than two feet, there seems to be no technical justification within the state's regulatory guidelines for doing so (Hall, 1990).

The amount of soil separation between the bottom of the SWIS and the wet season water table required by agencies varies widely from state to state around the United States. The USEPA Design Manual (U.S. EPA, 1980) recommends a minimum water-unsaturated soil thickness of 24 to 48 inches.

Crucial for successful SWIS treatment is the deactivation of viruses and bacteria. In column studies, viral deactivation occurs within 16 inches with unsaturated flow (Lance et al, 1976; Lance and Gerba, 1984). Under unsaturated flow conditions, bacteria can be adequately removed within 3 to 4 feet of effluent travel through soils (U.S. EPA, 1980; Hansel and Machmeier, 1980). In a Wisconsin study that examined 19 subsurface soil disposal systems (Bouma et al., 1972). Fecal coliforms were reduced to background levels within 2 feet of the trench bottom (Hagedorn et al., 1981). In a sandy soil, it was found that there was a 3000-fold reduction in bacteria levels 15 inches below the trench bottom and 1 foot laterally (Ziebell et al., 1974).

In addition to pathogens, vertical separation is also critical for the degradation or removal of organic and inorganic septic effluent contaminants. Table 4 summarizes a case study (Anderson et al., 1994) that characterized the septic tank effluent and soil water quality in the first 4 feet of a soil treatment system consisting of fine sands. Given the increased physiochemical-biological reactivity of other soil textures, that include clay and silt, and structures, we can expect that many other soil types to be more effective in treatment compared to fine sand. Note in Table 4 that BODs are removed within the first two feet (0.6 meter), while breakthroughs of nitrogen, phosphorus, chlorine, and other dissolved solids still occur after 4 feet (1.2 meters) of leaching.

Table 3. Minimum vertical separation in soil required for various states derived from each state's regulatory on-site wastewater treatment guidelines. (Hall, 1990; CA Wastewater Training & Research Center, 2002)

State	Vertical Separation Required	Comments
Alabama	1.5 feet	Minimum
Colorado	4 feet	May be reduced if designed by a registered engineer and approved by the local board of health (where local regulations permit such variances for exclusively domestic wastes).
Florida	3.5 feet 2 feet	To impervious layer. To highest level of the water table.
Idaho	3-6 feet 4 feet	To water table or fractured bedrock, depending on soil type. To an impervious layer.
Louisiana	2 feet 4 feet	To the maximum level of water table. To impervious layer.
Maine	1-2 feet	Depending on soil and subsoil.
Massachusetts	4 feet	
Montana	4 feet	
Nebraska	4 feet	
Nevada	4 feet	
New Jersey	4 feet	
North Carolina	4 feet	
Oregon	4 feet 0.5 feet 0 feet	To permanent water table. To impervious layer when bottom of trenches are in rapidly or very rapidly permeable soils. To temporary water table (dries up for period of time each year) or permanent water table where it is determined by groundwater study that degradation of the groundwater and public health hazard will not occur and where water table is 2 feet below the ground surface.
Pennsylvania	4 feet	
South Carolina	1 foot	
South Dakota	4 feet	
Texas	2 feet	
Utah	2 feet	
Virginia	1.5 feet	
Washington	2 feet	
West Virginia	3 feet	
Wisconsin	3 feet	
Wyoming	4 feet	

Table 4. Case study: septic tank effluent and soil water quality[a]. (Anderson et al., 1994)

Parameter (units)	Statistics	Septic tank effluent quality	Soil water quality [b] at 0.6 meter	Soil water Quality[b] at 1.2 meters
BOD	Mean	93.5	<1	<1
(mg/L)	Range	46–156	<1	<1
	# samples	11	6	6
TOC	Mean	47.4	7.8	8.0
(mg/L)	Range	31–68	3.7–17.0	3.1–25.0
	# samples	11	34	33
TKN	Mean	44.2	0.77	0.77
(mg/L)	Range	19–53	0.40–1.40	0.25–2.10
	# samples	11	35	33
NO_3-N	Mean	0.04	21.6	13.0
(mg/L)	Range	0.01–0.16	1.7–39.0	2.0–29.0
	# samples	11	35	32
TP	Mean	8.6	0.40	0.18
(mg/L)	Range	7.2–17.0	0.01–3.8	0.02–1.80
	# samples	11	35	33
TDS	Mean	497	448	355
(mg/L)	Range	354–610	184–620	200–592
	# samples	11	34	32
Cl	Mean	70	41	29
(mg/L)	Range	37–110	9–65	9–49
	# samples	11	34	31
F. Coli	Mean	4.57	nd [c]	nd
(log # per	Range	3.6–5.4	<1	<1
100 mL)	# samples	11	24	21
F. strep.	Mean	3.60	nd	nd
(log # per	Range	1.9–5.3	<1	<1
100 mL)	# samples	11	23	20

[a] The soil matrix consisted of a fine sand; the wastewater loading rate was 3.1 cm per day over 9 months. TOC = total organic carbon; TKN = total Kjeldahl nitrogen; TDS = total dissolved solids; Cl = chlorides;
F. coli = fecal coliforms; F. strep = fecal streptococci.
[b] Soil water quality measured in pan lysimeters at unsaturated soil depths of 2 feet (0.6 meter) and 4 feet (1.2 meters).
[c] nd = none detected.

Source: Adapted from Anderson et al., 1994.

Enhanced On-Site Treatment Systems for Marginal Soil and Site Conditions

Marginal soils and sites exist that may not be suitable for a conventional septic tank and soil absorption system (SWIS) design. This includes sites or regions with high water tables, shallow soils to bedrock, steep slopes, and excessively permeable or impermeable soils. Horizontal separation distances from property lines, bodies of water, and buildings may also limit the use of a conventional system. In all these cases, other wastewater treatment systems using more advanced or alternative technology may be better options for wastewater treatment.

Since the soil and site characteristics limit the treatment method more than other components, the dispersal, soil absorption component (e.g., SWIS design) should be selected first, followed by pretreatment and advanced wastewater treatment unit(s) selection (See section on *Enhanced On-Site Wastewater Treatment Systems*). A list of dispersal methods applicable to marginal soil and site conditions are given in Table 5.

The systematic approach in choosing the SWIS design and treatment units should also take into consideration the pollutants of concern, such as pathogens and nutrients. This is in keeping with the current emphasis on the establishment of performance based water quality discharge standards in regulatory guidelines. A comparison of the discharge or effluent water quality from conventional and advanced treatment units (Table 6) can be useful in selecting appropriate treatment hardware especially on marginal soils.

Table 5. Selection of dispersal methods under various soil and site constraints. (Noah, 2001)

	Soil Permeability			Depth to Bedrock			Depth to Water Table		Slope			Small Lot Size
	Very Rapid	Rapid-Moderate	Slow-Very slow	Shallow and Porous	Shallow and non-porous	Deep	Shallow	Deep	0-5%	5-15%	>15%	
Trenches		X	X			X		X	X	X	X	X
Beds		X				X		X	X			X
Pressure/Low-Pressure Pipe System		X	X		X	X	X	X	X	X	X	X
Contour Trench		X	X	X	X	X	X	X	X	X	X	
Drip Irrigation	**X**	X	X	X	X	X	X	X	X	X	X	
Spray Irrigation		X		X	X	X	X	X	X	X		
Gravelless/Chamber System		X				X		X	X	X	X	X
Mound System	X	X	X	X	X	X	X	X	X	X		
At-Grade System	X	X	X	X	X	X	X	X	X	X	X	
Evapotranspiration Trench	X	X	X	X	X	X	X	X	X	X	X	
Evapotranspiration-Infiltration Trench		X	X			X		X	X	X	X	X

Table 6. Wastewater constituents of concern and representative concentrations in the effluent of various treatment units. (Siegrist et al., 2000; Siegrist and Van Cuyk, 2001)

Constituents of concern	Example direct or indirect measures (Units)	Tank-based treatment unit effluent concentrations					SWIS percolate into ground water at 3 to 5 ft depth (% removal)
		Domestic STE[1]	Domestic STE with N-removal recycle[2]	Aerobic unit effluent	Sand filter effluent	Foam or textile filter effluent	
Oxygen demand	BOD_5 (mg/L)	140-200	80-120	5-50	2-15	5-15	>90%
Particulate solids	TSS (mg/L)	50-100	50-80	5-100	5-20	5-10	>90%
Nitrogen	Total N (mg N/L)	40-100	10-30	25-60	10-50	30-60	10-20%
Phosphorus	Total P (mg P/L)	5-15	5-15	4-10	<1-10[4]	5-15[4]	0-100%
Bacteria (e.g., *Clostridium perfringens, Salmonella, Shigella*)	Fecal coliform (organisms per 100 mL)	10^6-10^8	10^6-10^8	10^3-10^4	10^1-10^3	10^1-10^3	>99.99%
Virus (e.g., hepatitis, polio, echo, coxsackie, coliphage)	Specific virus (pfu/mL)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	0-10^4 (episodically present at high levels)	0-10^5 (episodically present at high levels)	0-10^5 (episodically present at high levels)	>99.9%
Organic chemicals (e.g., solvents, petro-chemicals, pesticides)	Specific organics or totals (µg/L)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	0 to trace levels (?)	>99%
Heavy metals (e.g., Pb, Cu, Ag, Hg)	Individual metals (µg/L)	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	0 to trace levels	>99%

[1] Septic tank effluent (STE) concentrations given are for domestic wastewater. However, restaurant STE is markedly higher particularly in BOD_5, COD, and suspended solids while concentrations in graywater STE are noticeably lower in total nitrogen.
[2] N-removal accomplished by recycling STE through a packed bed for nitrification with discharge into the influent end of the septic tank for denitrification.
[3] P-removal by adsorption/precipitation is highly dependent on media capacity, P loading, and system operation.
Source: Siegrist, 2001 (after Siegrist et al., 2000)

References

Anderson, D.L., R.J. Otis, J.I McNeillie, and R.A. Apfel. 1994. In-situ Lysimeter Investigation of Pollutant Attenuation in the Vadose Zone of a Fine Sand. In *On-Site Wastewater Treatment: Proceedings of the Seventh International Symposium on Individual and Small community Sewage Systems.* American society of Agricultural Engineers, St. Joseph, Mi.

Bouma, J.W.A., W.G. Walker, P.G. Olcutt, E. McCoy, and F.D. Hole. 1972. Soil Absorption of Septic Tank Effluent. Extension Circular No. 20. University of Wisconsin, Madison.

Hagedorn, C., E.L. McCoy, and T.M. Rahe. 1981. The Potential for Ground Water Contamination from Septic Effluents. J. Environ. Qual. 10:1-8.

Hall, S. 1990. Vertical Separation: A Review of Available Scientific Literature and a Listing from Fifteen Other States. Office of Environmental Health and Safety, Wa. State Dept. of Health, Olympia, Wa.

Hansel, M.J. and R.E. Machmeier. 1980. Onsite Wastewater Treatment on Problem Soils. J. Water Pollution Control Federation. 52(3):548-558.

Harlan, P.W. and E.C Dicky. 1980. Soils, Absorption Fields, and Percolation Tests for Home Sewage Treatment. Nebraska Cooperate Extension G80-514A. University of Nebraska, Lincoln.

Lance, J.C., C.P. Gerba, and J.L. Melnick. 1976. Virus Movement in Soil Columns Flooded with Secondary Sewage Effluent. Applied Environ. Micro. 32:520-526.

Lance, J.C. and C.P. Gerba. 1984. Virus Movement in Soil During Saturated and Unsaturated Flow. Applied Environ. Micro. 47:335-337.

Noah, M. 2001. Onsite Treatment Options: Matching the System to the Site. Small Flows Quarterly. 2(1)14-19.

Reneau, R.B., C. Hagadorn, and M.J. Degen. 1989. Fate and Transport of Biological Contaminants from On-Site Disposal of Domestic Wastewater. J. Environ. Qual. 18(2):135-144.

Siegrist, R.L., E.J. Tyler, and P.D. Jenssen. 2000. Design and Performance of Onsite Wastewater Soil Absorption Systems. In *Risk-Based Decision Making for Onsite Wastewater Treatment: Proceedings of the Research Needs Conference.* National Decentralized Resources Capacity Development Project. U.S. Environmental Protection Agency, Cincinnati, Oh. (In press).

Siegrist, R.L., and S. Van Cuyk. 2001. Wastewater Soil Absorption Systems: The Performance Effects of Process and Environmental Conditions. In *On-site Wastewater Treatment: Proceedings of the Ninth National symposium on Individual and Small Community Sewage Systems.* American Society of Agricultural Engineers, St. Joseph, Mi.

Siegrist, R.L., E. J. Tyler, and P.D. Jenssen. 2002. Design and Performance of Onsite Wastewater Soil Absorption Systems. National Research Needs Conference: Risk-Based Decision Making for Onsite Wastewater Treatment. Washington University, St. Louis, Mo. May 19-20, 2000.

Tyler, E.J. 2000. Unpublished paper. University of Wisconsin-Madison, Department of Soil Science, Madison, WI.

U.S. EPA. 1980. Design manual no. 35. Onsite Wastewater Treatment and Disposal Systems. EPA 625/1-80/012. U.S. EPA. Washington D.C.

U.S. EPA. 1999. Decentralized Systems Technology Fact Sheet: Septic Tank – Soil Absorption Systems. EPA 932-F-99-075. U.S. EPA. Washington D.C.

U.S. EPA. 2002. Onsite Wastewater Treatment and Disposal Systems Manual. EPA 625/R-00/008. U.S. EPA. Washington D.C.

Ziebell, W.A., D.H. Nero, J.F. Deininger, and E. McCoy. 1974. Use of bacteria in Assessing Waste Treatment and Soil Disposal systems. In *Home Sewage Treatment*, American Society of Agricultural Engineers Publication Proc- 175. St. Joseph, Mi. pg 58.

APPENDIX B

ENHANCED ON-SITE SEWAGE TREATMENT SYSTEMS

Introduction

Enhanced on-site sewage treatment systems (OSTS) are systems that replace, add to, or modify existing components or add additional components to a conventional septic tank and leach field. These systems are capable of providing improved treatment and a higher quality wastewater effluent. They are use primarily in situations where a conventional system can not provide acceptable treatment due to site or soil constraints and/or conditions where conventional systems may not be capable of meeting established performance requirements to protect public health and water resources. Enhanced onsite sewage treatment systems, in many applications, are variations of the conventional treatment system because they use one or more naturally occurring biological, chemical, or physical principles and processes found in the conventional system. A major objective of using enhanced OSTS technology is to utilize a treatment method that maximizes performance of one or more of the conventional treatment processes by providing an enhanced environment for the process.

Sites that can be considered for enhanced OSTS include high ground water, low-permeability soils, shallow soils, other soil conditions that limit the infiltration and dispersal of wastewater, lot size, slope of the land, and sites where additional treatment is needed to protect groundwater or surface water quality. In many situations, enhanced OSTS treat wastewater to a very high degree, resulting in an extremely clean effluent being discharged to a leach field or used for some other purpose (e.g., irrigation). Enhanced OSTS use more complicated ways to achieve treatment and therefore, involve more intensive operation and maintenance than does the conventional system. Experience has found that proper operation and maintenance are the key to keeping these systems functioning properly.

In the next section, a conventional septic system is described prior to describing enhanced OSTS.

On-Site Wastewater Treatment System Technology

Conventional Septic System

A conventional septic system consists of a septic tank and a subsurface absorption field or leachfield (Figure 1). Sometimes a distribution box is used to provide for homogenous flow of the effluent to the subsurface wastewater infiltration system. The entire system is connected by pipes, and a sewer pipe connects the home or business to the septic system. The buried septic tank receives wastewater from the home or business and separates and digests settleable solids. The capacity of a septic tank typically ranges from 1,000 to 2,000 gallons. A sludge layer forms on the bottom of the tank. Solids heavier than water settle at the bottom of the tank forming this layer of sludge. Collected solids undergo some decay by anaerobic digestion in the tank bottom. Grease and other light materials, or "scum", float to the top, while gases are vented. This leaves a middle layer of partially clarified wastewater. An outlet baffle in the septic tank is positioned to allow only the partially treated liquid waste in the middle layer to flow out of the tank to the leachfield. The septic tank must be pumped periodically, with the frequency dependent on flows and wastewater characteristics.

The partially clarified liquid effluent below the scum layer in the septic tank is distributed in the absorption fields, which consist of perforated piping and gravel in a trench or bed (see Figure 1). The soil absorption system (also called a "leachfield" or "drainfield") forms a biological "clogging mat" or "biomat" at the gravel-soil interface below the perforated piping. This can contribute to an even distribution of the waste into the drainfield (U.S. EPA, 1980; U.S. EPA, 1999). State regulations usually require between two and four feet (or sometimes less) of unsaturated soil beneath the drainfield to treat the wastewater before it reaches a "limiting layer"—the point at which conditions for waste purification become unsuitable. The limiting layer may be bedrock, an impervious soil layer or the seasonal high water table.

Absorption trenches and beds are the most common design options for soil absorption systems. Trenches are shallow, level excavations, usually from one to five feet deep and one to three feet wide (U.S. EPA, 1980). The bottom is filled with at least six inches of washed gravel or crushed rock over which a single line of four-inch perforated pipe is placed. Additional rock is placed over and around the pipe. A synthetic building fabric is laid on top of the gravel to prevent backfill from migrating into the gravel trench. Beds are constructed analogously to trenches, but are more than three feet wide and may contain multiple lines of distribution piping. While beds are sometimes preferred for space savings in more permeable soils, trench designs provide more surface area for soil absorption and better aeration in tight soils (U.S. EPA, 1980). The size of a soil absorption system is based on the anticipated waste flow from the house or other facility, and the soil characteristics.

Under ideal soil and site conditions, advantages of a conventional septic system, in comparison to a centralized sewer system, include that it is 1) a simple and effective wastewater treatment system, 2) less disruptive to the environment to install and maintain, 3) less expensive to operate than a centralized treatment facility, 4) a feasible wastewater treatment in areas where it would not be available otherwise, and 5) a system that can help to replenish groundwater when functioning properly (National Small Flows Clearinghouse, 1995).

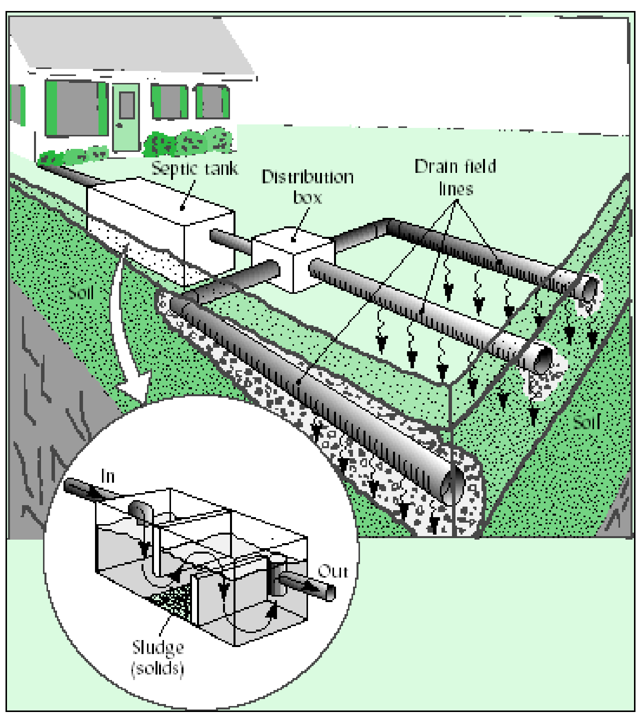


Figure 1. **Conventional septic treatment system having a septic tank, distribution box, and drain field lines. (Brady and Weil, 2002)**

Enhanced On-site Sewage Treatment Systems

Elevated Mound Systems

This treatment system was first used in the late 1940s in North Dakota. Currently many states and counties have accepted the mound system when conventional treatment systems are not suitable. Because of this, many agencies consider a mound system as a conventional system. Although there are many mound designs in use, one of the most popular was developed by the University of Wisconsin-Madison and is called the Wisconsin mound (National Small Flows Clearinghouse, 1998a).

An elevated mound system has sand fill placed over an exposed soil surface. The soil surface should be plowed to increase infiltration. Above the sand fill is placed a suitable soil cover, typically a sand loam, that allows aeration and used to support vegetation. Below the soil cover, a fabric-covered coarse gravel aggregate is used to place the network of small diameter perforated pipes. A pressure dosing system distributes the septic tank effluent to the distribution network where the effluent filters through the sand before it reaches the natural soil. The three principal components of a mound system are a septic tank, dosing (pumping) chamber, and the elevated mound (Figure 2). A mound can be a relatively inexpensive means to compensate for shallow soils if sources of quality sand are nearby. Besides shallow soils, other site restrictions where a mound system can be used include slow or fast permeable soils, shallow soils underlain by creviced or porous bedrock, and a high water table. Two factors that determine the size and configuration of a mound are the wetting pattern and rate of the effluent movement away from the system. The prediction of the movement and rate of movement is done from the soil and site information. A suitable depth of original soil is required (usually 1 to 4 feet) to treat the effluent before it reaches the limiting condition, such as bedrock, a high water table, or a slowly permeable soil layer.

Treatment occurs through physical, chemical, and biological means as the effluent filters down through the sand and the natural soil that is present. Mounds can consistently and effectively treat effluent. Some nitrogen removal can occur in mound systems.

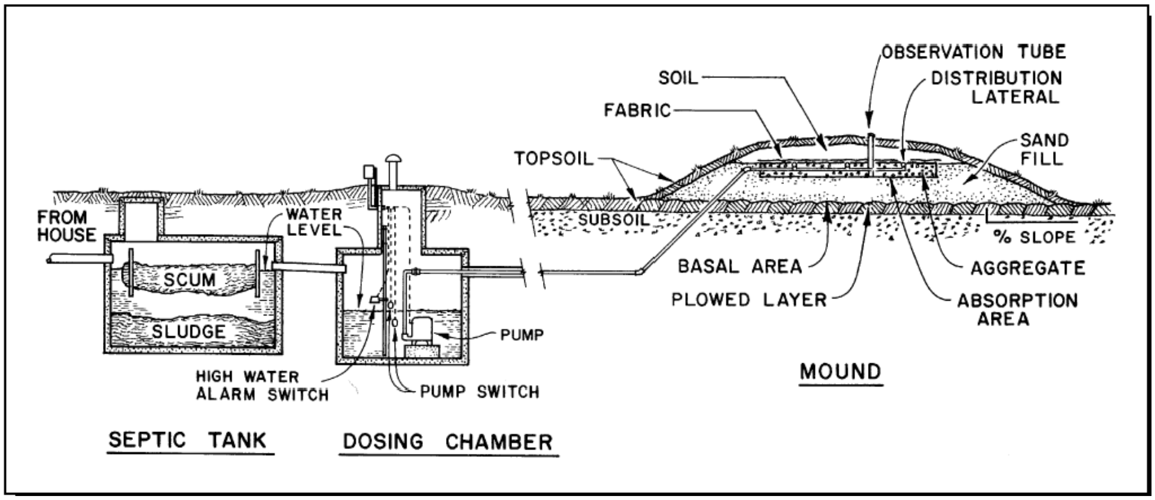


Figure 2. Schematic of a Wisconsin mound system. (National Small Flows Clearinghouse, 1998a)

Mound systems enable use of land that would otherwise be unsuitable for in-ground or at-grade onsite systems. Mounds can be used in most climates and can be constructed using locally available materials of good quality. The system needs minimal but knowledgeable maintenance. Disadvantages of mound systems include higher costs than conventional systems, siting may affect drainage patterns and limit land use options, and mounds may not be aesthetically pleasing. Mound reconstruction is required when failure or malfunction such as leakage or seepage occurs.

<u>Low-Pressure Pipe Systems</u>

Low-pressure pipe (LPP) systems were developed to eliminate or overcome problems such as excessive clogging of the soil from localized overloading, anaerobic conditions due to continuous saturation, and a high water table. The main components of an LPP system are a septic tank, pumping (dosing) chamber, and small diameter distribution laterals with small perforations (Figure 3). The LPP system has the following characteristics: 1) shallow placement, 2) narrow trenches, 3) continuous trenching, 4) pressure-dosed with uniform distribution of the effluent, 5) design based on real loading, and 6) resting and re-aeration between doses. The laterals are placed in the narrow gravel-filled trenches 10 to 18 inches deep and spaced 5 or more feet apart. The narrow trenches must allow enough storage volume so that the depth of the effluent does not exceed 2 or 3 inches of the total trench depth during each dosing cycle.

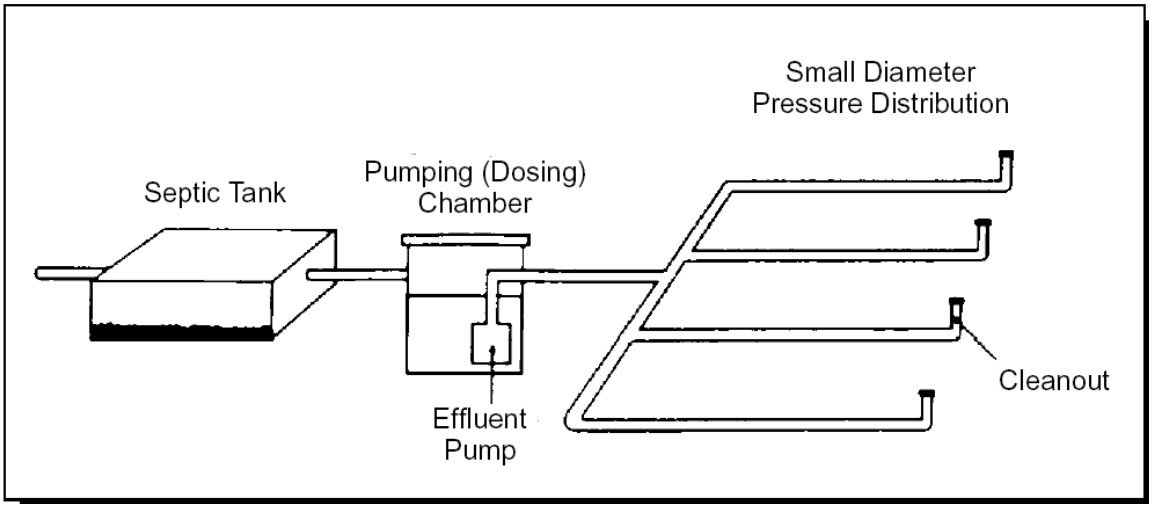


Figure 3. Low-pressure pipe system. (National Small Flows Clearinghouse, 1998b)

A LPP system is usually applied in soils not suitable for conventional septic system. Soils that have slow or extremely fast permeability, or inadequate soil depth to a restricting layer can be considered for a LLP system. A minimum of 12 inches of usable soil is required between the bottom of the absorption field trenches and any underlying restrictive horizons, such as consolidated bedrock or hardpan, or to the seasonally high water table. A minimum of 20 to 30 inches of soil depth is need for the entire trench.

Shallow placement of trenches in LPP installations promotes evapotranspiration and enhances growth of aerobic bacteria. Adsorption fields can be located on sloping ground or on uneven terrain that would otherwise be unsuitable for gravity flow systems. Other advantages include 1) uniform application of effluent due to pressurized dosing, 2) periodic dosing encourages aerobic conditions in the soil, 3) less area is required and soil disturbance is much less than a conventional system, and 4) LPP systems allow placement of the leachfield upslope of the home. Disadvantages of LPP include a potential of clogging of drain pipes, limited storage capacity around LPP laterals, and a requirement of regular monitoring and maintenance.

Two critical factors that affect the performance of an LPP system are dosing and distribution of the effluent. An LPP system cycles back and forth between aerobic and anaerobic conditions, which can lead to favorable conditions for nitrification and denitrification.

A properly designed LPP system requires very little ongoing maintenance. However, periodic inspection and maintenance by professional operators is required for continued performance. Studies have documented a 40-50% failure rate when maintenance was left to the homeowners rather than professionals (National Small Flows Clearinghouse, 1998b).

Based on an evaluation of sixteen LPP systems in Texas (Jensen, 2001), a following set of recommendations were made to help LPP systems succeed on marginal and unsuitable soils. First, make sure the site is large enough. Second, install swales, mounds, or crowns to help drainage. Third, sod the field with a high water-use grass and then overseed it with winter rye. Fourth, lower the rate at which effluents will be applied to 0.05 to 0.07 gallons per square foot per day, and practice water conservation to reduce the volume of effluent that needs to be applied. Using a smaller diameter pipe and orifice size allows dosing to be controlled by a timer, making it less likely that hydraulic failure will occur. Finally, to enhance drainage, make sure the system is designed and installed so that there is separation between the bottom of the trench and the seasonal groundwater table.

Intermittent Sand Filters

An intermittent sand filter (ISF) is a pre-treatment unit that follows the septic tank where settling of solids and removal of scum occurs and precedes the final dispersal of liquid effluent in a leachfield (Figure 4). ISFs, along with all types of sand filters, are considered passive aerobic systems while aerobic units (discussed later) are considered active systems. An ISF, generally 24 inches thick, is a covered or uncovered bed of uniformly-sized, clean sand in either a watertight container or a porous trench where the effluent leaches directly in the soil below. At the bottom of the sand is a gravel collection underdrain. In a watertight container design, beneath the gravel can have an underdrain pipe that can collect the leached effluent for pumping or gravity distribution to a leachfield. Sand is the commonly used filter media, but anthracite, mineral tailings, bottom ash, etc., have also been used. Effluent from the septic tank is "intermittently" dosed onto the sand filter, anywhere from 4-24 times a day.

ISFs can be used on sites that have shallow soil cover, inadequate permeability, high groundwater, and limited land area. The sand filters remove contaminants in wastewater through physical, chemical, and biological treatment processes. The biological processes play the most important role in sand filters. Most of the organic matter from septic effluent is converted to carbon dioxide, water, and new organic matter in the form of biomass cells. Demonstration studies in Placer County, California have found that ISFs resulted in a marked improvement in effluent quality over conventional septic treatment systems (National Small Flows Clearinghouse, 1998c). Biological oxygen demand (BOD), total suspended solids (TSS), and total Kjeldahl nitrogen were reduced 80-90% compared to the effluent coming from the septic tank. Although ISFs can perform well, nitrogen and bacteria are not totally removed. Because ISFs can significantly convert organic N and ammonium to nitrate-nitrogen, the treatment can be considered where denitrification is used to remove nitrogen from the treated effluent before it enters into the soil.

ISFs can produce a high quality effluent that can be used for subsurface drip dispersal or in some states, the effluent can be surface discharged after disinfection. Other advantages of ISFs include that small and shallow drainfields can be used, ISFs have low energy requirements, skilled personnel are not needed, and ISF construction costs are generally low. One major disadvantage with ISFs is odor, but this can be eliminated with adequate soil cover and proper operation.

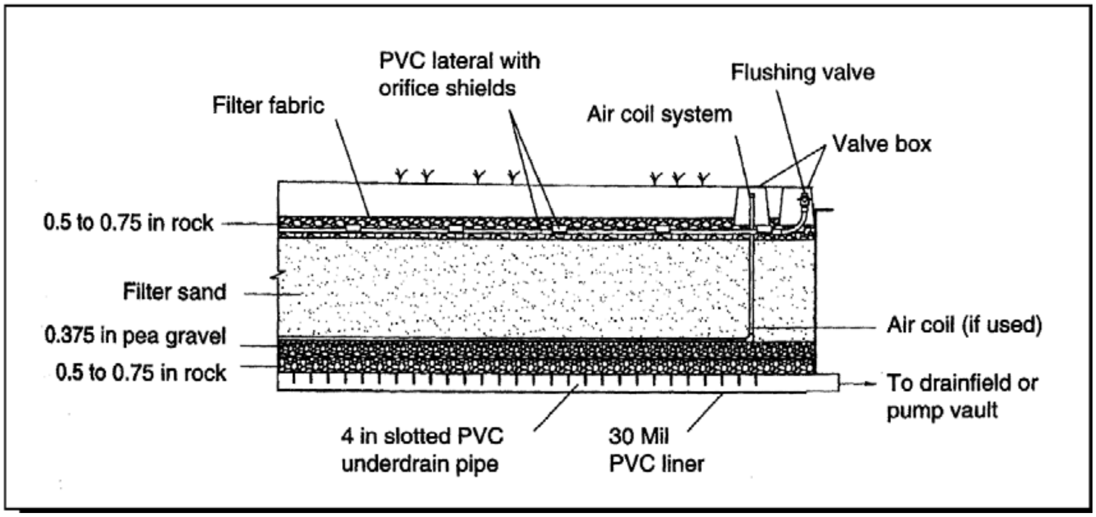


Figure 4. **Typical cross section of an intermittent sand filter. (National Small Flows Clearinghouse, 1998c)**

<u>Recirculating Sand Filters</u>

A recirculating sand filter (RSF) has an additional recirculating tank, which mixes filtrate that has already passed through the ISF treatment system with fresh septic tank effluent (Figure 5). The mixture is sent back to the ISF again, with a portion diverted into the soil absorption field. The recirculating sand filter removes significantly more nitrogen than either the conventional septic system or intermittent sand filter.

Recirculating sand filter systems were originally designed to alleviate the odors associated with open sand filters by increasing the oxygen content of the effluent prior to distribution to a filter bed. RSFs are applicable to sites where limitations require the use of ISFs or a similar type filtering media/system. RSFs are used in subdivisions, mobile home parks, rural schools, small municipalities, and other generators of small wastewater flows. RSF systems are appropriate for cluster developments.

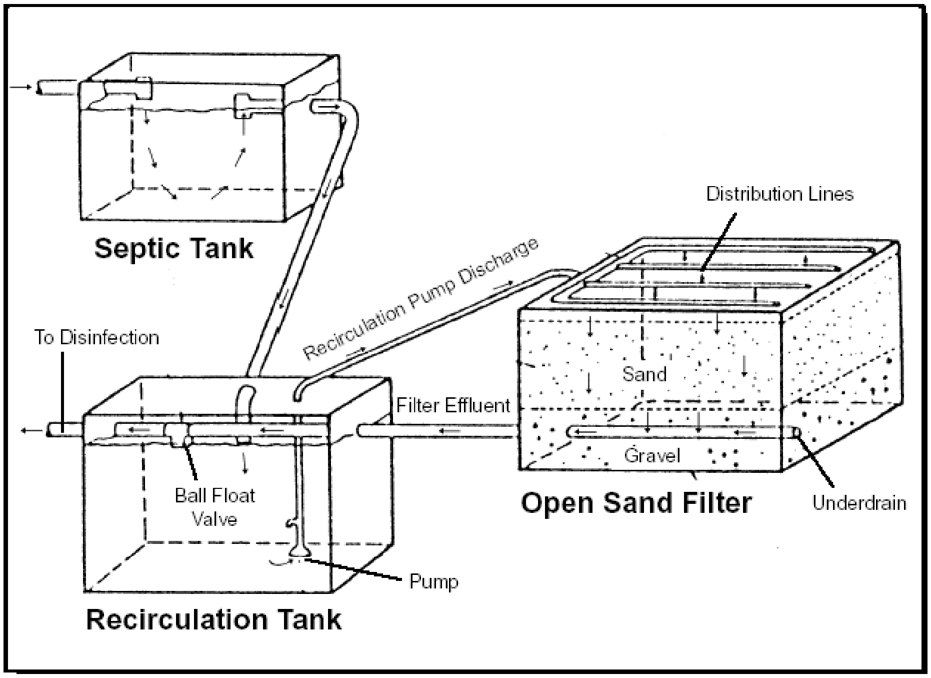


Figure 5. Typical recirculating sand filtering system. (National Small Flows Clearinghouse, 1998d)

By increasing the oxygen content of the effluent, RSFs provide a very good effluent quality with over 95% removal of BOD and TSS. RSFs are suitable for high strength (e.g., very high BOD) waste waters. A significant reduction in nitrogen level is achieved with the RSF system (National Small Flows Clearinghouse, 1998d). The use of a RSF system with enhanced anoxic modification has been shown to be very effective in reducing total nitrogen in effluent by favoring the sequential nitrification-denitrification pathway (U.S. EPA, 2002a). Other advantages include RSF systems are suitable where treatment capacity may be increased, accessible for monitoring and do not require a lot of skill, and suitable where land area is limited since RSF systems do not require much area. Disadvantages include 1) higher construction costs, 2) weekly or monthly maintenance required for media, pumps, and controls, and 3) RSF design must address extremely cold temperatures.

Other Media Filters

There has been a great deal of experience is using other filter media, in place of sand, where filtration is employed in septic treatment (e.g., ISF and RSF systems). These include natural materials such as peat, bottom ash, pea gravel, anthracite, and mineral tailings, and synthetic materials such as textiles, foam, and others. A manufactured, synthetic filter media has great advantages for use since it has consistency in specification, increased effective surface area for filtering, and very easy to install. These synthetic media systems can be set to a recirculating mode for enhanced nitrogen reduction similar to the recirculating sand filter. A major trend is the use of the fabric filters that can be used in relatively small units that come essentially assembled from the factory for easy installation prior to use.

Several different media types have been proposed for advanced treatment systems for the enhanced removal of nitrogen and phosphorus (U.S. EPA, 2002a; U.S. EPA, 2002b). Both cationic and anionic exchange resins have been proposed for removal of nitrogen in septic effluent. Clinoptiloplite, a naturally occurring zeolite that has excellent selectivity for ammonium over most other cations in wastewater, can be used as an alternative cationic exchange medium over resins. However, zeolite filters can be expensive and difficult to maintain. Anionic exchange resins could be used to remove nitrate and phosphorus (e.g., orthophosphates). Other special filter materials have been studied for phosphorus removal. Studies using high-iron sands, high-aluminum muds, and calcareous sands indicate that 50 to 95% of the phosphorus can be removed. However, the life of these systems has yet to be determined, after which the filter media will have to be removed and replaced or a much lower rate of phosphorus removal will occur.

Aerobic Treatment Units

Aerobic treatment units (ATUs) refer to a broad category of pre-engineered wastewater treatment devices for residential and commercial use. Aerobic treatment units biodegrade or decompose wastewater by bringing it into contact with aerobic bacteria in a biological reactor. ATUs are designed to oxidize both organic material (BODs) and ammonium-nitrogen (to nitrate nitrogen), decrease suspended solids concentrations and reduce pathogen concentrations. The biological reactor can be either a suspended growth system where the microorganisms are suspended in a liquid (Figure

6) or an attached growth where microorganisms are attached to a media. A trickling filter is one of the oldest of all attached growth aerobic systems (Figure 7). A trickling filter is an aerobic reactor that employs the fixed-filmed principle where a medium such as rock, plastic, wood, or other natural or synthetic solid material will support microbial biomass on its surface and within its porous structure (U.S. EPA, 2002c). Although most ATUs are suspended growth devices some units are designed to include both suspended growth mechanisms combined with fixed-growth elements. Proprietary aerobic treatment units come in a variety of types, with differences in pumps, air injectors, and biological contact surfaces. Aerobic units follow a septic tank and discharge into a soil absorption field or in some states, with disinfection into surface waters. Effluent also can be sprayed onto the land where regulatory bodies allow this.

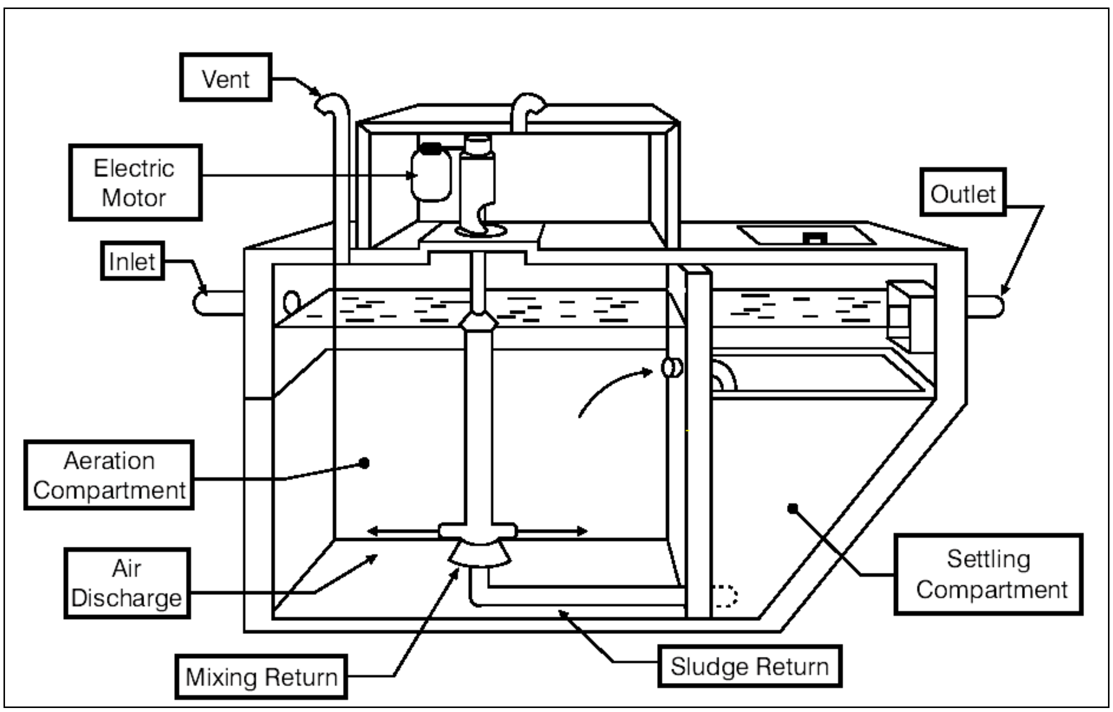


Figure 6. Suspended growth aerobic unit and design components. (U.S. EPA, 2002d)

The way and the rate in which effluent is received by and flows through the aerobic unit differ from design to design. However, there are two major design flows in aerobic treatment systems. Continuous flow designs simply allow the wastewater to flow through the unit at the same rate that it leaves the home. Figure 8 illustrates the use of a continuous flow design with a suspended growth aerobic reactor. Continuous flow designs include attached growth ATUs (e.g., trickling filters). Continuous flow designs employ a clarifier to separate the biomass from the liquid and to return the sludge to the aerobic unit. Other designs employ devices, such as pretreatment tanks, surge chambers, and baffles, to control the amount of the incoming flow. In contrast, the batch process designs use pumps or siphons to control the amount of wastewater in the aeration tank (intermittent flow design) and/or discharge the treated wastewater in controlled amounts after a certain period of time. Normally, all major steps occur in the aerobic tank (Figure 6). The batch process commonly applies the sequencing batch reactor design principle (Figure 9). Controlling the flow of wastewater helps to protect the treatment process.

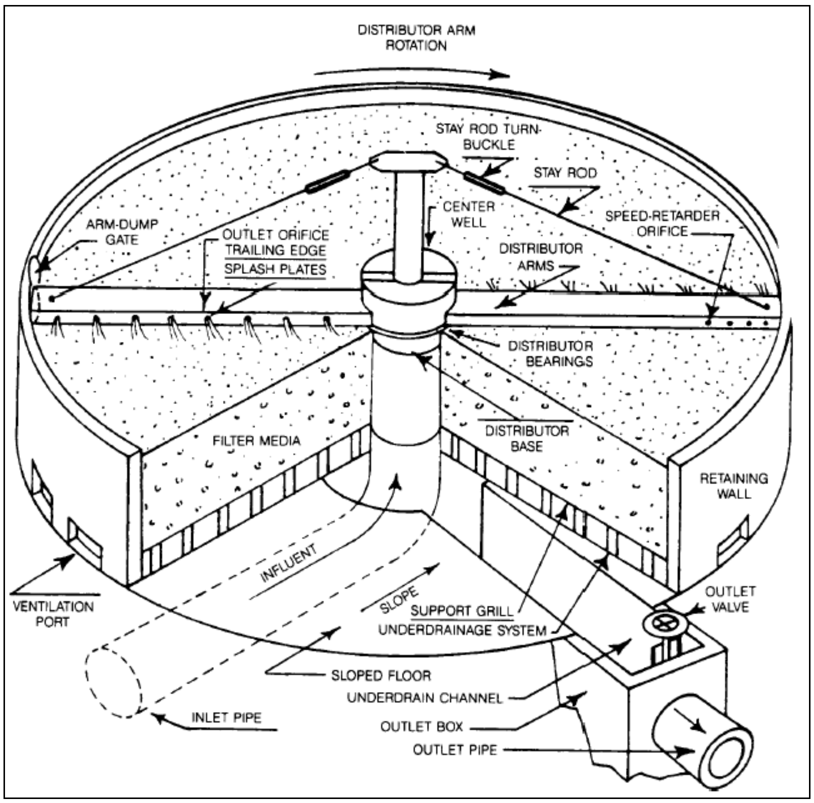


Figure 7. Schematic of a trinkling filter. (National Small Flows Clearinghouse, 1998e)

Aerobic treatment systems can provide a higher level of treatment than a conventional septic tank system and help to protect valuable water resources where conventional septic systems are failing. ATUs provide an alternative for sites not suited for septic systems, extend the life of a leachfield, and may allow for a reduction in the leachfield size. Some disadvantages of ATU systems are that they are more expensive to operate than a conventional septic system, require electricity, and include mechanical parts that can break down. Routine maintenance is more frequent than a conventional system. ATUs can malfunction under sudden heavy loads and when not properly maintained. ATU design must consider temperature drops in colder climates. ATUs may release more nitrates immediately to soil than a septic system. Thus, this could result in greater groundwater contamination if the water table is near the soil surface.

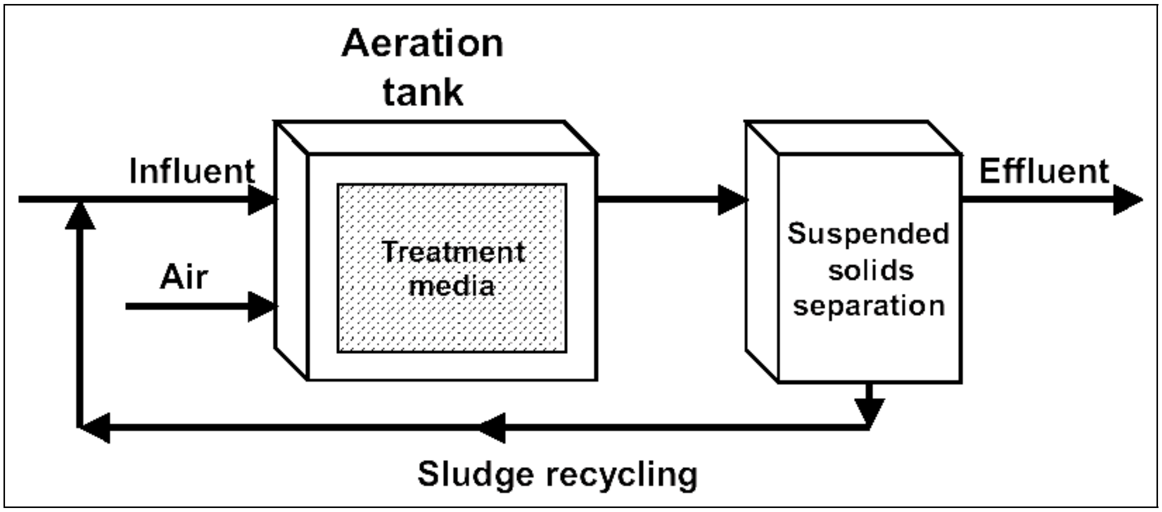


Figure 8. An enhanced continuous-flow, suspended growth aerobic system. (U.S. EPA, 2002d)

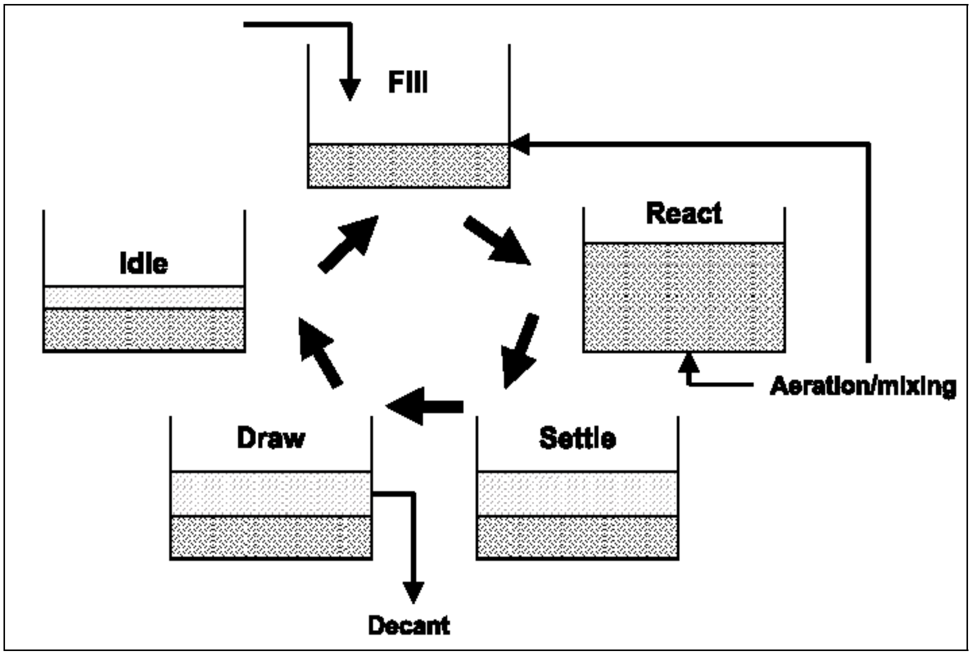


Figure 9. Sequencing batch reactor design principle. (U.S. EPA, 2002e)

Anaerobic Treatment Systems

Anaerobic treatment systems can be used solely or used in conjunction with other treatment systems such as aerobic treatment units. An anaerobic reactor is any tank or cavity filled with solid media through which effluent flows with a high hydraulic retention time. Reactor designs and/or hydraulic flows result in anaerobic (no oxygen) environments. The two primary types are vegetated submerged beds and anaerobic upflow reactors.

Anaerobic upflow reactors can take on several designs such as an anaerobic filter process, anaerobic sludge blanket process, and an anaerobic fluidized bed process (U.S. EPA, 2002f). Anaerobic upflow reactors (Figure 10) consist of a liquid-tight tank normally filled with rock or other aggregate materials. Upflow reactors containing rock are the most typical U.S. application. Influent is introduced through a distribution system at the bottom of the tank with the liquid moving upward and exiting the tank near the top. Somewhat uniform distribution of influent is required to minimize short circulating of liquid through the aggregate.

The primary removal mechanisms in all of these systems are physical such as flocculation, sedimentation, and adsorption. Anaerobic reactors can follow a septic tank or be a pre-treatment prior to a septic tank. Anaerobic systems typically are used with high strength wastewaters, where they can reduce BODs and TSS to levels that can be readily treated by typical aerobic processes. BOD and TSS reductions of 40-60% and 25-50%, respectively, with half day retention times are reported (Coverse, 1992). Vegetated submerged beds have been reported to remove measurable levels of wastewater constituents such as heavy metals, organic nitrogen, organic phosphorus, pesticides, and other toxic organics. Anaerobic treatment units require minimal maintenance. Further interest and use of anaerobic treatment systems would be significantly increased if further design research results in an effective denitrification potential for treating sewage effluent. Anaerobic units can then follow aerobic treatment units where nitrification of organic- and ammonium-nitrogen is maximized.

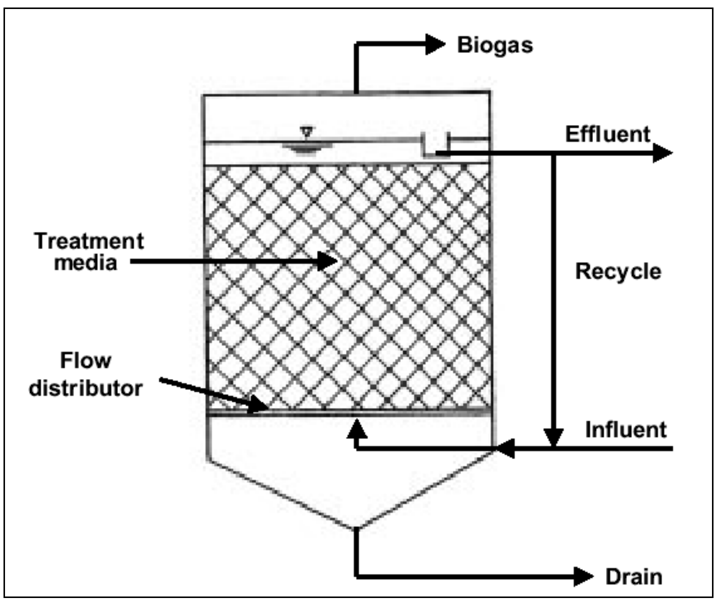


Figure 10. Schematic of the unflow anaerobic filter process. (U.S. EPA, 2002f)

Constructed Wetlands

Wetlands can be an alternative to the use of a conventional leachfield for the disposal of septic effluent (Noah, 2001). Closely resembling natural marshes or bogs, constructed wetlands are artificially created ponds (called lagoons if at the surface) with a coarse media, such as gravel, to support aquatic vegetation over an impermeable liner.

The vegetation aids in the reduction of nutrient pollutants, such as nitrogen and phosphorus, and helps to remove solid particles by trapping them in the plant root structures or gravel. With wetlands, wastewater will undergo some combination of physical, chemical, and/or biological processes that treat and render the wastewater more acceptable for discharge to the environment.

There are two main types of constructed wetlands, surface flow and subsurface flow. With surface flow wetlands (Figure 11), the water and wastewater remain at a level above the soil and are therefore exposed to the atmosphere. There are two general types of lagoons, facultative and aerated. Aerated lagoons are often preferred because of their smaller size requirement. Anaerobic lagoons and maturation ponds are not used in the United States. In some areas, lagoons must be lined. Facultative lagoons are large in size, perform best when segmented into a least three cells or sections, obtain necessary oxygen for treatment by surface re-aeration, combine sedimentation of particulates with biological degradation, and produce large quantities of algae, which limits the utility of their effluent without further treatment (U.S. EPA, 2002g). The surface of the effluent remains below the substrate in subsurface flow systems (Figure 12) , reducing odor levels and breeding sites for pests. Overall, subsurface flow systems are the most appropriate for household wastewater treatment. All wetlands require some plant harvesting (which should be performed just before the onset of summer) and periodic removal of solids from the gravel.

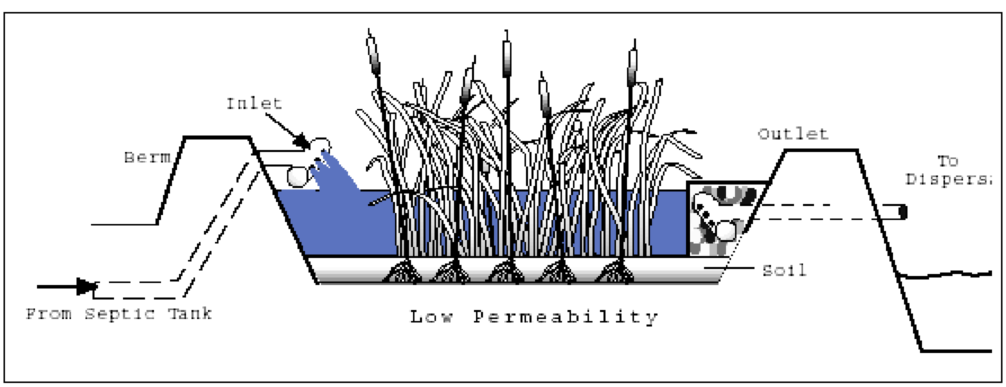


Figure 11. Surface flow constructed wetland treatment system. (U.S. EPA, 2002g)

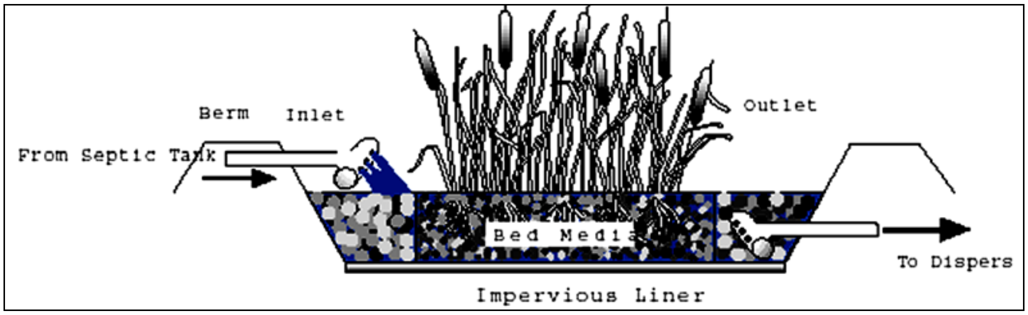


Figure 12. Subsurface flow constructed wetland treatment system. (U.S. EPA, 2002g)

Used as a secondary treatment process, constructed wetlands are especially valuable in areas where soils are too dense or saturated to work well with a conventional onsite system. They are also good at handling intermittent periods of both light and heavy wastewater flows. Of the two common designs, the subsurface system requires less land area than surface flow wetlands, and they usually can be designed to blend into the surrounding landscaping.

Evapotranspiration and Evapotranspiration/Infiltration Systems

Onsite evapotranspiration (ET) wastewater treatment systems are designed to disperse effluent exclusively by evapotranspiration. The evapotranspiration/infiltration (ETI) process is a subsurface system designed to disperse effluent by both evapotranspiration and infiltration into the soil. Both of these systems are preceded by primary treatment units (e.g., septic tanks) to remove settleable and floatable solids. The influent to the ET and ETI units enters through a series of distribution pipes to a porous bed (Figure 13). The porous bed is a coarse textured soil to facilitate increased soil evaporation. In an ET system a liner is placed below the bed unless the soil is impermeable. Both systems can be used in arid and semi-arid regions, with ETI systems possessing greater adaptability. Both systems can be used when site characteristics are not appropriate for conventional systems (U.S. EPA, 2002h). Site characteristics that can be overcome using these systems include shallow soils, high groundwater or unprotected sole source aquifer, impermeable soils, or fractured bedrock. For ET systems evapotranspiration must exceed annual precipitation. These systems are especially suitable for the SW United States. Vegetation has to be planted on the surface of the bed to enhance the transpiration process.

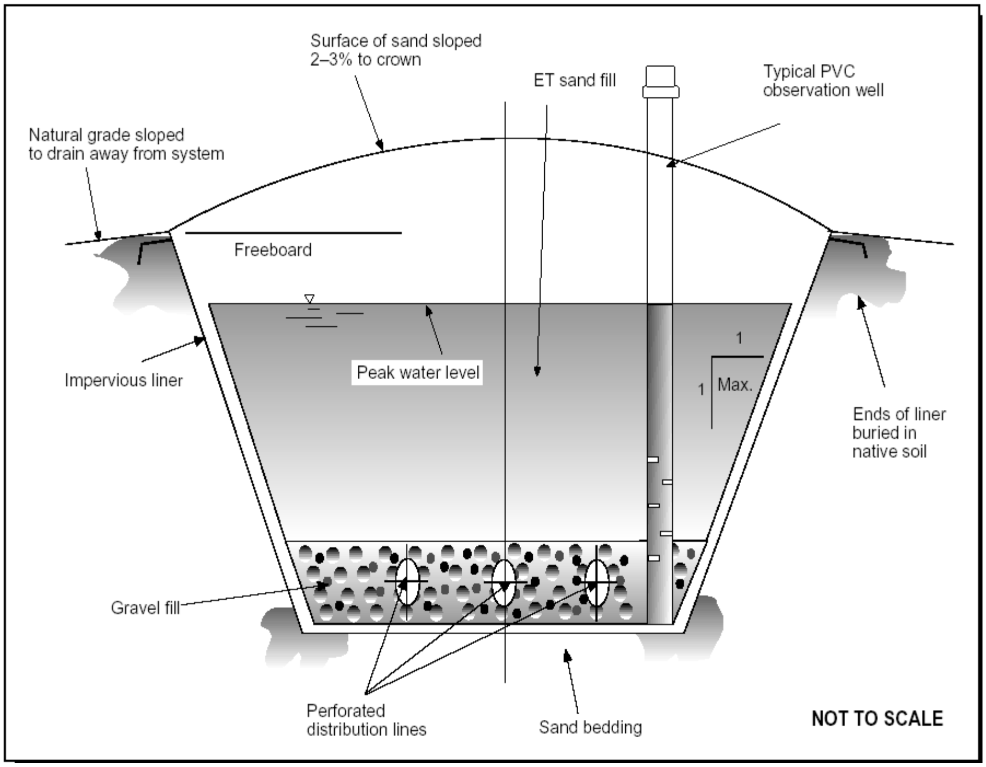


Figure 13. Cross section of a typical evapotranspiration bed. (National Small Flows Clearinghouse, 1998f)

The risk of groundwater contamination is reduced with ET systems that have impermeable liners. In ET and ETI systems, annual regular operation and maintenance is usually minimal. Only a few studies have been done on ET and ETI systems. Where systems have failed, the fault has been related to poor design assumptions. ET bed requirements have varied from 3,000 to 10,000 ft^2. ET systems are generally expensive, reinforcing their use as a "last resort" alternative. However, the costs are competitive with other alternative treatment systems. These systems are not suitable in areas where the land is limited or where the surface is irregular. ET and ETI systems have limited storage capacity and can be overloaded due to infiltration from precipitation. It is anticipated that better designs will allow these systems to have improved performance.

Disinfection Systems

Disinfection systems inactivated pathogens (bacteria, viruses, parasites) from pre-treated wastewater effluent through chemical or physical processes. There are three applied or proven disinfection methods. The methods are chlorination, ultraviolet, and ozonation. All three disinfection methods can effectively meet the discharge permit requirements for treated wastewater. Effective disinfection involves specified mixing and/or contact time (Figure 14).

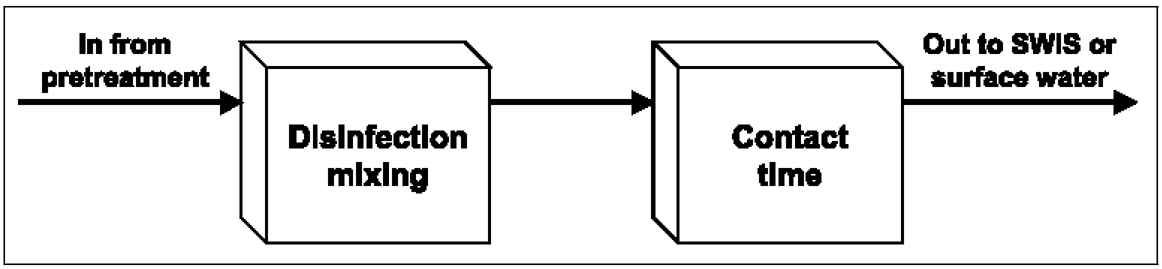


Figure 14. Generic disinfection diagram. (U.S. EPA, 2002i)

Chlorination involves the mixing of liquid or solid forms of chlorine into the wastewater. A stack-chlorinator is illustrated in Figure 15 where calcium hypochlorite ($Ca(OCl)_2$) tablets are used. Chlorine is a powerful oxidizing agent. Chlorination is more cost-effective than either ultraviolet or ozone disinfection, but chlorine remains corrosive and toxic when concentrated. Chlorine disinfection is reliable and effective against a wide spectrum of pathogenic organisms. The chlorine residual that remains in wastewater effluent can prolong disinfection, although the residual may be toxic to aquatic life. Chlorine is effective in oxidizing some organic and inorganic compounds, and can eliminate certain noxious odors. However, it can oxidize certain types of organic compounds to more hazardous compounds such as trihalomethanes. Some parasitic species have shown resistance to low doses of chlorine, including oocysts of *Cryptosporidium parvum*, cysts of *Endamoebi histolytica* and *Giardia Lamblia*, and eggs of parasitic worms (National Small Flows Clearinghouse, 1998g).

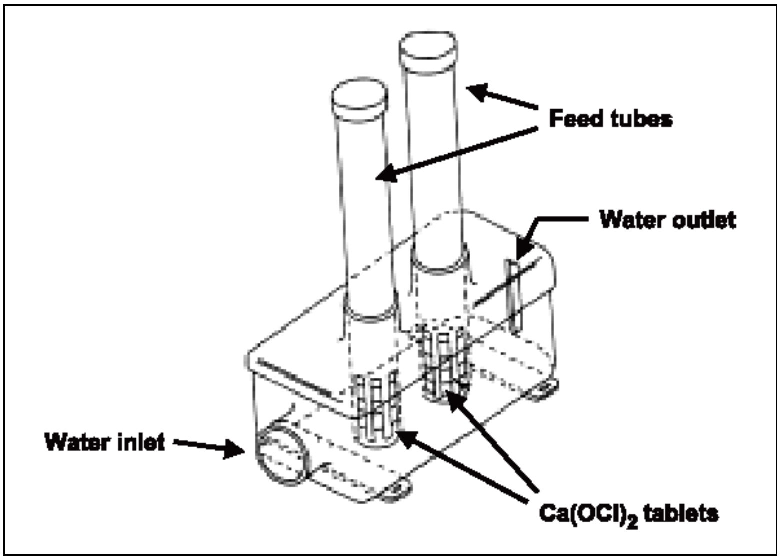


Figure 15. A stack-feed chlorinator that can be used to treat sewage effluent. (U.S. EPA, 2002i)

Ultraviolet (UV) disinfection utilizes high-intensity lamps submerged in wastewater to damage bacterial or viral cell walls. UV disinfection is effective at inactivating most viruses, spores, and cysts. The disinfection process is a physical process requiring exposure of wastewater to a UV lamp, rather than a chemical disinfection (Figure 16). The method requires a shorter time exposure (approximately 20 to 30 seconds) than for chlorination and easy to operate. However, a preventive maintenance program is necessary to control fouling of tubes (lamp glass). UV dosage is critical, and low dosages may not effectively inactivate some viruses, spores, and cysts. The effectiveness of UV disinfection is affected by turbidity and total suspended solids in the wastewater. There are three major considerations in UV disinfection (National Small Flows Clearinghouse, 1998h). First, the hydraulic properties of the reactor should ensure that there is uniform flow with enough axial motion to maximize UV exposure. Second, the intensity of the UV radiation is critical. The age of the lamps, lamp fouling, and the configuration and placement of lamps in the reactor are significant in affecting intensity of the UV radiation exposure. Third, the wastewater characteristics including bacterial density are important in ensuring effective disinfection.

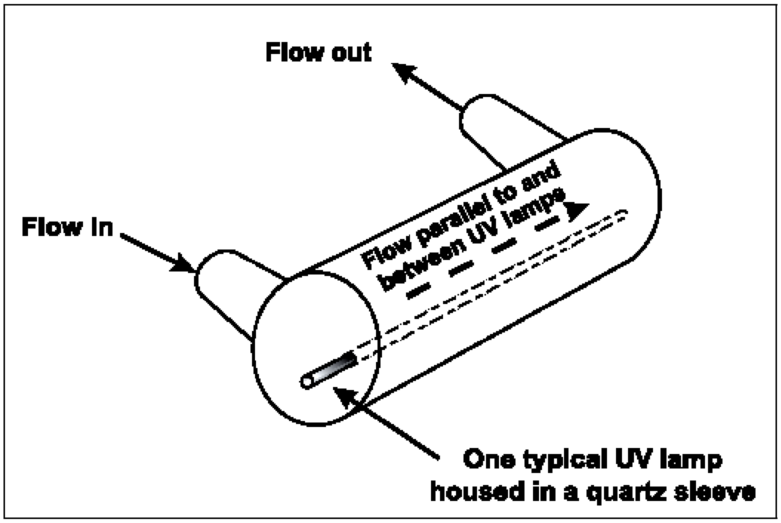


Figure 16. Wastewater flow in a quartz UV unit. (U.S. EPA, 2002i)

Ozonation is more effective than chlorination in destroying viruses and bacteria, and produces no residual in the wastewater. Ozone, like chlorine, is a strong oxidizer. Ozone is an unstable gas that when exposed to microorganisms penetrate the organisms and retards their ability to reproduce. Ozonation requires a contact time from 10 to 30 minutes (National Small Flows Clearinghouse, 1998i). After ozonation, there is no regrowth of microorganisms, except for those protected by the particulates in the wastewater. Ozone is generated onsite and when used to treat wastewater, ozone elevates the dissolved oxygen concentration of the effluent, a positive attribute. Dosage of ozone is critical and low dosages may not effectively inactivate some viruses, spores, and cysts. The technology and equipment is much more complex than chlorination or UV disinfection. Production of ozone gas consumes significant amounts of electricity. Regular and knowledgeable maintenance are required. Ozone is a toxic and corrosive gas and must be handled with care. The cost of treatment can be relatively high, being both capital- and power-intensive. Ozonation may not be cost competitive to the other disinfection systems.

Surface and Subsurface Drip Dispersal Systems

Drip dispersal systems apply treated wastewater to soil slowly and uniformly through a network of thin, flexible tubing placed at shallow depths in the soil. Drip dispersal may be a feasible alternative to site conditions that do not allow placement of a conventional leachfield. Effluent is pumped through the tubes and drips slowly from a series of engineered orifices (emitters) directly to plant roots (Figure 17). Both evapotranspiration and soil infiltration/percolation can occur to utilize and disperse the effluent. To protect public health and to prevent the system from clogging, the wastewater must be pretreated to remove a portion of the solids contained in the system and filtered. The system must be designed to backflush the filters, and the soil dispersal area must be designed to facilitate field flushing.

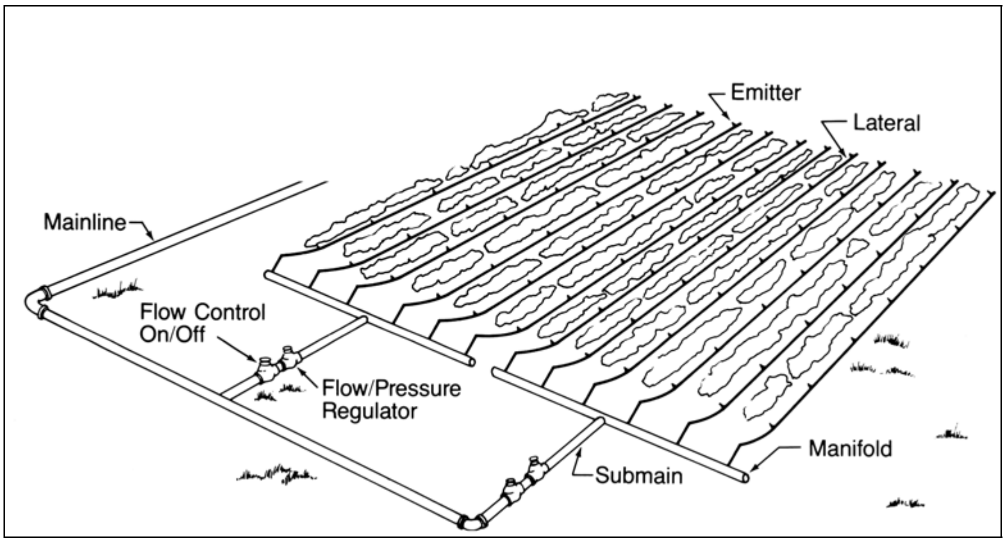


Figure 17. A typical drip system layout that can be applied for effluent dispersal.

Because drip dispersal systems are designed to apply wastewater at very shallow depths, irrigation may be permitted on certain sites with high bedrock, high groundwater, or slowly permeable soils. Drip systems can be designed to accommodate sites with complex terrain (e.g., sloping land, varying soil depths) due to the flexible tubing used.

While subsurface drip systems distribute water evenly and create fewer problems with odors and ponding, emitters have been found to clog, affecting the uniformity of application. The subsurface positioning can make it difficult to monitor and correct clogging. For this reason, flow monitoring is recommended. The flow monitoring can be used to troubleshoot system operation and indicate when field flushing is necessary.

Cluster Systems

Although not an enhanced onsite wastewater treatment system in itself, cluster systems transport wastewater or septic tank effluent from two or more structures to an offsite leachfield, sand filter, constructed wetlands, or other treatment unit. Many of the previously described treatment systems could possibly be used singly or in combination to create an effective treatment system for a cluster development. A cluster treatment system must be properly designed and generally requires timely maintenance by trained personnel.

References

Brady, N.C. and R.R. Weil. 2002. The Nature and Properties of Soils. (13th ed.). Pearson Education Inc. New Jersey.

Coverse, J.C. 1992. Principles of Pretreatment Systems for On-Site Waste Disposal. Document No. 2.29. Small Scale Waste Management Project, University of Wisconsin-Madison.

Jensen, Ric. 2001. Harris County, Texas – Engineer's Office Evaluates Field Performance of Low-Pressure Dosing Systems. Small Flows Quarterly. 2(1)6.

National Small Flows Clearinghouse. 1995. Septic Systems – a practical alternative for small communities. Pipeline 6(3):1-5.

National Small Flows Clearinghouse. 1998a. Mound Systems. Fact Sheet WWFSOM27.

National Small Flows Clearinghouse. 1998b. Low-Pressure Pipe Systems. Fact Sheet WWFSOM29.

National Small Flows Clearinghouse. 1998c. Intermittent Sand Filters. Fact Sheet WWFSOM26.

National Small Flows Clearinghouse. 1998d. Recirculating Sand Filters. Fact Sheet WWFSOM25.

National Small Flows Clearinghouse. 1998e. Trickling Filters: Achieving Nitrification. Fact Sheet WWFSOM24.

National Small Flows Clearinghouse. 1998f. Evapotranspiration Systems. Fact Sheet WWFSOM32.

National Small Flows Clearinghouse. 1998g. Chlorine Disinfection. Fact Sheet WWFSOM21.

National Small Flows Clearinghouse. 1998h. Ultraviolet Disinfection. Fact Sheet WWFSOM20.

National Small Flows Clearinghouse. 1998i. Ozone Disinfection. Fact Sheet WWFSOM22.

Noah, M. 2001. Onsite Treatment Options: Matching the System to the Site. Small Flows Quarterly. 2(1)14-19.

U.S. EPA. 1980. Design manual no. 35. Onsite Wastewater Treatment and Disposal Systems. EPA 625/1-80/012. U.S. EPA. Washington D.C.

U.S. EPA. 1999. Decentralized Systems Technology Fact Sheet: Septic Tank – Soil Absorption Systems. EPA 932-F-99-075. Washington D.C.

U.S. EPA. 2002a. Onsite Wastewater Treatment Systems Technology Fact Sheet 9: Enhanced Nutrient Removal – Nitrogen.

U.S. EPA. 2002b. Onsite Wastewater Treatment Systems Technology Fact Sheet 8: Enhanced Nutrient Removal – Phosphorus.

U.S. EPA. 2002c. Onsite Wastewater Treatment Systems Technology Fact Sheet 2: Fixed-Film Processes.

U.S. EPA. 2002d. Onsite Wastewater Treatment Systems Technology Fact Sheet 1: Continuous-Flow, suspended-Growth Aerobic Systems (CFSGAS).

U.S. EPA. 2002e. Onsite Wastewater Treatment systems Technology Fact Sheet 2: Sequencing Batch Reactor Systems.

U.S. EPA. 2002f. Onsite Wastewater Treatment Systems Technology Fact Sheet 5: Vegetated Submerged Beds and Other High-Specific Surface Anaerobic Reactors.

U.S. EPA. 2002g. Onsite Wastewater Treatment Systems Technology Fact Sheet 7: Stabilization Ponds, FWS Constructed Wetlands, and Other Aquatic Systems.

U.S. EPA. 2002h. Onsite Wastewater Treatment Systems Technology Fact Sheet 6: Evapotranspiration and Evapotranspiration/Infiltration.

U.S. EPA. 2002i. Onsite Wastewater Treatment Systems Technology Fact Sheet 4: Effluent Disinfection Processes.

APPENDIX C

EXEMPLARY MANAGEMENT PROGRAMS FOR ONSITE SEWAGE TREATMENT SYSTEMS IN CALIFORNIA

Introduction

It is now generally recognized and accepted that onsite sewage treatment systems must be properly managed to ensure that they perform the treatment function intended. This function is to treat, reduce, or eliminate constituents/contaminants of concern to levels at which they no longer pose a threat to public health or the environment. Appropriate infrastructure needs to be in place to manage the systems and technologies that are available or can be developed that provide the necessary treatment. The three elements of treatment, management, and application of appropriate technology are the keys to ensuring onsite/decentralized systems perform as needed. Onsite/decentralized systems are an integral part of the infrastructure used to support continued growth and development in the state and are the fiscal, public health, and environmentally responsible method for sewage treatment.

One obstacle to acceptance of onsite treatment system technology is the perception that effective management programs do not exist. The purpose here is to briefly describe six successful management programs to demonstrate this is not the case.

The four of six programs have been functioning for more than fifteen years. The other two have been fully in place for almost ten.

I. Santa Cruz County

Santa Cruz County has over 22,000 septic systems, 13,000 of which are in the San Lorenzo River Watershed. The San Lorenzo Watershed has the highest density of septic systems of any comparable area in the State. The majority of septic systems in the county are over 25 years old and are located on parcels that do not fully meet today's standards for installation of a new septic system due to: small lot size, close proximity to a stream, high groundwater, steep slope, or clay soil. Many of these systems have already been repaired or replaced at least once. However, many of the repairs were done prior to 1980 when there were little or no standards for septic system repairs. There were no minimum size requirements and systems were allowed to go in very deep, with little regard to soil conditions or winter groundwater levels.

During the 1970's and early 1980's the San Lorenzo Valley area experienced a number of onsite system failures, high bacteria levels in the San Lorenzo River and elevated nitrate levels that threatened the City of Santa Cruz water supply. As a result, in 1982, the Central Coast Regional Water Quality Board (CCRWQCB) issued Resolution 82-10, an order prohibiting any new development and prohibiting the continued use of existing septic systems in the San Lorenzo Valley. The CCRWQCB determined that the solution to the water quality problems was to sewer the area. The proposed sewer project failed in 1985 due to high cost, lack of grant funds, and substantial disagreement in the community about whether sewers were really needed.

Santa Cruz County Environmental Health proposed and implemented a compromise solution in 1986 that would allow the continued use of septic systems provided they were upgraded over time to meet a minimum set of standards necessary to improve the water quality in the River. The program included ongoing inspection of systems and water quality monitoring to ensure that immediate problems were found and corrected. In spite of this, the State still felt sewers were needed and the prohibition on septic systems remained in effect.

County Service Area No. 12 (CSA 12) was formed in 1989 to provide services promoting proper septic system function and maintenance. In order to finance these services, property owners with septic systems are paying annual service charges on their tax bills.

As a result of these efforts the CCRWQCB lifted the septic system prohibitions and adopted the San Lorenzo Wastewater Management Plan in May 1995. The Regional Board has conditionally delegated authority to oversee and regulate the installation of septic systems to the County Environmental Health Service through a memorandum of understanding. The County must comply with the minimum standards contained in the Basin Plan in order to keep the authority to permit septic systems.

Since the County began the program in 1986, septic system failure rates have dropped from 15% to 5%. Some 2300 systems have been repaired and 85% of these have been able to fully meet the repair standards for a standard system. However, some 5-10% of the system upgrades present major challenges for the owner, the designer, the contractor, and County staff to design and install a workable system that meets minimum requirements for protection of water quality.

The county program includes a loan program to assist property owners in upgrading/repairing their systems. The County of Santa Cruz Environmental Health Service, working with the Bank of America and the California State Water Resources Control Board is accepting loan applications from property owners in the San Lorenzo River Watershed for septic system repairs and upgrades. This program provides loans at an interest rate 3% less than the prevailing interest rate and is designed to particularly assist property owners needed to make repairs using more expensive alternative systems.

Alternative System Use:

Type	San Lorenzo Only	Santa Cruz County
Sand Filters	14	21
At-Grade	5	5
Mound	24	51
Advantex	4	4
FAST	66	83
Multiflo	23	29
Clearwater	1	2
Total	137	195

The county program is funded through a set of fees as follows:

Annual service charges on tax bill:

$ 100,000 - County Service Area 12 (CSA 12) -Countywide Septic Maintenance ($6.90/parcel)
240,000 - CSA 12, Zone A, San Lorenzo Septic Management (+$18.54/parcel)
30,000 - CSA 12N, Nonstandard System Charges - Inspection and Monitoring (+$196/parcel for alternative system, or +$98/parcel for nonconforming)

$ 500,000 - Permit Fees for installation permits (countywide)

The program provides the following services:

- Planning, Management Oversight and Reporting to meet Regional Board Requirements
- Parcel Specific Data Management
- Septage Receiving Facility
- Water Quality Monitoring
- Parcel Inspections for Signs of Failure (average every 6 years)
- Public Education
- Annual Inspection and Effluent Monitoring of Nonstandard Systems
- Community Sewer Feasibility Studies
- Evaluation and Approval of Proposed Designs
- Inspection of Installations
- Low interest loans for system upgrades

There are 17 staff working in the program (11 FTE positions) under the direction of the Environmental Health Director and supervised by the Land Use and Water Quality Program Coordinator. The program consists of two teams:

- The Land Use Permitting Team processes all septic permits and conducts annual inspections of alternative systems. This team consists of 3 Environmental Health Specialists, 3 Senior Environmental Health Specialists, 1 Supervising Environmental Health Specialist and one clerk

- The Water Quality and Wastewater Management Team conducts water quality monitoring, system inspections and investigations, data management and program oversight. This team consists of 1 Senior Environmental Health Specialist, 2 Wastewater Disposal Technicians, 1 Water Quality Specialist, 2 Environmental Health Aides, 1 Resources Planner, and 1 clerk

II. Sonoma County

Sonoma County is located north of San Francisco Bay and has a population of over 450,000. The county experienced significant growth pressures with a resultant increase in the demand for housing over the past thirty years. Much of this demand was in the urban/rural interface that lacked access to or the prospect of centralized sewage treatment facilities. As a result significant housing has and continues to be developed in areas that rely on onsite/decentralized sewage treatment.

The Sonoma County Permit and Resource Management Department (PRMD) administers the onsite sewage treatment program for Sonoma County. County staff performs the inspection, approval and monitoring functions. There are approximately 45,000 onsite systems in the County.

It became apparent about thirty years ago that many areas could not be developed using the standard/conventional onsite system and in response the county developed a program to use what is termed 'nonstandard' systems to mitigate for the various site constraints encountered. This process involved working with two Regional Water Quality Control Boards and receiving oversight authority for the program from these boards.

Oversight is granted via Joint Innovative Individual Waste Treatment and Disposal System Evaluation Agreements (the Agreement) between the County of Sonoma and the North Coast Regional Water Quality Control Board (NCRWQCB) and the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). The above Agreements as well as Sonoma County Code Sections 24-32 to 36 have established the legal authority for the program. The program has evolved over time into one that resembles in many respects program level 3 described in the EPA Voluntary Management Guidelines for Onsite/Decentralized Wastewater Treatment.

The Permit and Resource Management Department (PRMD) is required by the Regional Water Quality Control Boards (RWQCB) to monitor the function and maintenance of all nonstandard septic systems in operation in the county and to evaluate newly proposed and/or experimental methods for on-site sewage disposal. A three-phase program of testing and evaluation is used to determine the suitability of the various proposals and techniques for wastewater treatment. The Agreement with each RWQCB requires the PRMD to submit the results of the monitoring program in the form of an annual report on the performance of the various system types.

Nonstandard system monitoring is now routinely performed by one full time Environmental Health Specialist and one retired Environmental Health Specialist working a limited work schedule (approximately one day a week). A full-time Clerk Typist III handles invoicing, permit issuance, mail outs to property owners and file record maintenance.

The monitoring program in Sonoma County has grown from 22 systems in 1983 to 2,204 potential sites through 2000. There were 146 new nonstandard systems added in 2000. The total number of systems requiring annual inspection continues to grow steadily due to the number of new sewage disposal system permits issued each year as well as the ongoing inspection of existing systems. This means that the number of systems requiring annual inspection services will likely exceed 1,250-1,500 in the coming year.

There are two categories with ten (10) types of nonstandard sewage disposal systems available for use in Sonoma County. These types include:

1. Mound-2
2. At-Grade
3. Shallow In-grade
4. Sand Filters; Intermittent and/or Recirculating
5. Bottomless Sand Filter
6. Evapotranspiration Bed
7. Aerobic pretreatment
8. Peat moss filter
9. Mound
10. Shallow Trench Pressure Distribution

In 1993, regulation changes to the GUIDELINES AND REGULATIONS FOR NONSTANDARD SEWAGE DISPOSAL SYSTEMS allowed expanding the use of the Program to monitor the performance of "standard" septic systems. Specific circumstances have involved difficult situations where placing certain standard systems under annual operating permit appeared to provide viable solutions. There were 12 sites with standard septic systems being operated under operating permits in 2000.

The defined performance standards as referenced in Section 209 I of Sonoma County's GUIDELINES AND REGULATIONS FOR NONSTANDARD SEWAGE DISPOSAL SYSTEMS remain the measure for functional evaluation of all system types. 98% of all systems inspected are performing in an acceptable manner. Nineteen of the systems monitored have had their operating permits suspended or revoked or, have had repair permits issued. Several of these cases have been referred to County Counsel for abatement when efforts by this office failed to obtain compliance with our earlier notices to repair or renew their Operational Permit. The overall results of the monitoring program continue to reflect favorably on the entire nonstandard inventory regardless of the age, size, location and/or type of system as a way to accurately measure their true performance.

PRMD conducts a number of educational activities including an annual Homeowner Education Class and mailing information packages to "new" nonstandard system operators.

PMRD also oversees a contract with for the 1570 properties designated for on site systems on the Sea Ranch. The Sea Ranch Association operates and maintains the On-Site Wastewater Zone under contract subject to the supervision of and control of the Sonoma County Permit & Resource Department.

Staffing and Budget:

Staffing is 1 Environmental Health Specialist III, 1.4 Environmental Health Specialist II, 1 Clerk Typist III and portions of supervisory and management that is allocated as overhead.

The revenue collected in Fiscal Year 01-02 (July through June) was $210,729. The annual fee was $246, $123 or $82 depending upon whether the system is inspected annually, every two years or every three years. The base fee this Fiscal Year is $260 with similar reductions for reduced inspection frequency.

III. Stinson Beach

Stinson Beach is a small coastal community located in Marin County north of San Francisco Bay. The issue of a sewer was first raised by a June 1961 directive of the Marin County Board of Supervisors recognizing the potential health hazard of failing septic systems in both Stinson Beach and Bolinas that were contributing to the pollution of Bolinas Lagoon. With the expected build out projected by the 1961 Bolinas/Stinson Beach Master Plan of 22,000 residents around Bolinas Lagoon, it was felt by the County Health Department, that the best solution to the problem would be a centrally located and publicly owned sewage collection and treatment system. Shortly thereafter, the San

Francisco Regional Water Quality Control Board (SFRWQCB) urged investigation of plans and costs for sewerage facilities for the area.

As a result, the Stinson Beach County Water District (SBCWD) was formed in November 1962 to deal with these septic issues. Between the 1965 and 1974, 10 separate sewer studies were undertaken. All were rejected for many different reasons including excessive cost, potential for inducing population growth and density, failure to recognize environmental concerns, location and reliability of the projects. A sewer plan bond election was defeated the voters of Stinson Beach in 1974. Studies were also completed during this time documenting the pollution of the lagoon as well as the degrading of other beneficial water uses, and the SFRWQCB in 1973 adopted a resolution prohibiting any further construction of septic systems and prohibiting use of existing systems after 1977.

During that period of time, a number of changes occurred that made a plan for individual on-site wastewater disposal systems more likely to meet the approval of governmental agencies: The 1961 Master Plan was repealed and replaced with the existing Countywide Plan calling for a much reduced population density around the lagoon; Marin County adopted the 18.06 code requiring more stringent ground water and percolation rate requirements for on site systems; and the technology of septic systems had advanced.

In 1975 the SBCWD embarked upon an exhaustive two-year study by Eutek Engineering. The study analyzed all sewage treatment alternatives then available and conducted a parcel-by-parcel survey of groundwater depth, failed systems, and potential costs. The study determined that the most cost effective alternative was individual onsite systems and developed a feasible basis for their continued use. It also developed a mitigation process for failing systems and a timetable for continuing inspection. After much discussion, revision of procedures, and numerous conditions, which have resulted in the program now in existence, SFRWQCB agreed to allow Stinson Beach to upgrade and maintain onsite systems, and allowed the resumption of building new septic systems.

Senate Bill 1902 was passed by the legislature on September 13, 1976, which made it possible to form a management District for the operation and maintenance of onsite wastewater disposal systems. This authority is codified in the California Water Code Sections 31145-31149. After the District adopted an acceptable set of rules and regulations, on January 17, 1978, the SFRWQCB passed Resolution 78-01 to allow for the continued use of onsite systems for the treatment and disposal of wastewater in the community of Stinson Beach under the management of the SBCWD.

In 1988, the SBCWD assumed authority from the County of Marin for the permitting of new onsite systems and in 1994 the District Board of Directors under took the task of completely revamping the sixteen-year-old rules and regulations. The new Wastewater Code (SBCWD Ordinance 1994-01 and revised in 1996 as SBCWD Ordinance 1996-01) eliminates the relaxed repair code, formalizes design standards for sand filters, requires the installation of a system that meets current code if "new construction" is proposed for the property.

Implementation of the OWMD by SBCWD involved;

1. Adoption of the Program Rules and Regulations,
2. Employment of staff,
3. Development of office procedures,
4. Issuance of Permits and Citations,
5. Initiation of the inspection & monitoring program,
6. Continuation of the water quality monitoring program,
7. Submission of monthly reports to RWQCB,
8. Cooperative programs.

The objectives of the SBCWD onsite program:

1. Educate the "local" general public regarding septic systems.
2. Select types of wastewater systems to be used throughout the District.
3. Monitor pollutants entering the groundwater including lagoons, bays and streams.
4. Select the best type of wastewater system to be used in specific areas & increase groundwater testing & inspection as numbers increase.
5. Establish a uniform wastewater enforcement code.

Each homeowner is requested to provide permanent access to the septic tank on their property for the purposes of inspection and routine maintenance. Systems found to be operating marginally as part of the District's routine inspection program are placed in a special monitoring category. Special monitoring is also conducted for:

1. High groundwater demonstration system
2. Alternative waste disposal system
3. Gray water systems
4. Other non-conventional onsite systems

The District established a Water Quality Monitoring Program in 1978. The current program has six surface water and ten ground water stations that are sampled quarterly for total coliform and fecal coliform, ammonia, nitrite, nitrate, and nitrogen. The purpose of the program is to:

1. Inspect and Document Ambient environmental conditions of surface and ground water.
2. Facilitate self-policing by the waste discharger in the prevention and abatement of pollution arising from waste discharge.
3. Prepare water and wastewater quality inventories.

Staffing, Budget and Homeowner costs:

The program employs one full time staff, one clerical support position, one part-time engineering technician, and one engineering consultant (part-time).

The OSWMD budget portion of the SBCWD
Expenses 2001-02
–Employee Services………….$ 201,556
–Supplies…..……………………..9,281
–Outside services………… ……..28,042
–Contractual Service……………..37,536
–Debt Service……………………...5,351
Total……………………………$ 281,766

Revenues 2001-02
•Wastewater fees……………..$ 250,320
•Property Taxes………………$ 0
•Miscellaneous……………….$ 31,750
•Total Revenues………………$ 282,070

Homeowner Costs:

•The yearly homeowners cost in the fiscal year 2001-02 was $355.00 per residence ($59.17 bi-monthly).
•Each special inspection is an additional $30.00.

Future Plans:

- The District is planning to utilize telemetry on each onsite system to collect data and monitor operation. Presently the District has eight alternative systems ready to use this technology.

- Onsite monitoring wells have been installed on 150 systems which will monitor the ground water quality in close proximity to the septic systems.
- The design procedures for alternative onsite systems will be continued to be reviewed as technological advancements are developed.

Since the inception of the Onsite Wastewater Management Program (OSWMP), the SBCWD has introduced special systems to the Bay Area that help solve depth to groundwater and poor percolation rate problems. These systems, first used in Stinson Beach are being used throughout the county. Stinson Beach is considered to be a model for other communities throughout the United States for onsite system management.

IV. Sea Ranch

In 1978, the State Legislature adopted SB 430, which authorized public agencies such as special districts, which have powers to manage sewer systems, to form on-site wastewater zones. The zones were to provide for the collections, treatment, reclamation or disposal of wastewater without the use of community-wide sanitary sewers or sewage systems. The purpose, the State Water Resources Control Board asserted, was "to provide the means and effective controls to allow small rural communities, where centralized treatment systems are very expensive to build, to maintain and employ less costly on-site wastewater treatment systems where technically appropriate." They considered zone formation an alternative to establishment of septic prohibition areas, which would leave lots unbuildable.

The Sea Ranch Association is a planned community consisting of 5200 acres containing 2297 lots together with extensive common area within the County of Sonoma. The On-Site Wastewater Zone is a department of The Sea Ranch Association doing business under contract with the County of Sonoma.

In 1981, after an extended moratorium on construction at The Sea Ranch and protracted litigation with the Coastal Commission, The Sea Ranch Association agreed to abide by special legislation, AB 2076, the Bane Bill. The Bane Bill directed that something should be done about septic system construction, operation, and monitoring within The Sea Ranch to ensure protection of coastal zone resources. It did not specify *what*, but whatever we adopted the North Coast Regional Water quality Control Board had to approve.

An attempt to comply with the Bane Bill by establishing a Community Services District to handle all utilities failed. A Wastewater Disposal Task Force was formed to determine what could be done to set up a zone/entity that would include all lots on The Sea Ranch that were designated for septic systems. The “zone” concept was allowed by SB 430, which authorized public agencies such as special districts to form on-site wastewater zones. The zones were to provide for the collections, treatment, reclamation or disposal of wastewater without the use of community-wide sanitary sewers or sewage systems.

In 1987, the Sonoma County Board of Supervisors approved the zone. On August 9, 1988, the County Supervisors approved the implementing ordinance setting up a fee schedule and general provisions relating to the use of on-site systems, operating permits, inspections, enforcement, and penalties for violations.

Early in 1989, after extensive negotiations between The Sea Ranch Association and Sonoma County, an operating agreement was finalized. In it, Sonoma County contracted with The Sea Ranch Association to operate and maintain the Zone subject to the supervision and control of Sonoma County’s health officer (this control was moved to the Sonoma County Permit & Resource Dept in 1995).

There are 2297 lots at The Sea Ranch; and as of September 2001, 712 or 31 percent were undeveloped. The Sea Ranch also includes common areas shared by all.

<u>County Service Area 41 consists of two separate sewage collection zones.</u>

Zone 1 – Two sewage treatment plants that serve the northern most end of The Sea Ranch. The Sea Ranch Water Company operates both under an agreement with the County of Sonoma.

Zone 2 – The monitoring program established for the1570 properties designated for on-site systems on The Sea Ranch. Currently, 1,000 of those systems are in place and monitored.

Zone ordinances require the issuance and maintenance of Operating Permits for all septic systems in the Zone. For new systems, the Operating Permit is issued following final construction inspection. For existing developed properties, the Operating Permit was issued following the initial septic system inspection; and then renewed at the time of each subsequent inspection. The Operating Permit is the means by which the Zone maintains accounting of the functioning status of septic systems, and enforces timely attention to corrective work, where needed.

The startup costs for The Sea Ranch On-Site management and inspection program were funded through a loan granted by the County of Sonoma and repaid through assessments.

The Sea Ranch Association contracts with the County of Sonoma to administer The Sea Ranch On-Site Wastewater Zone. Each homeowner within the Zone is currently assessed $105.00 per year on their property tax bill.

2000/2001Budget: $193,449.00

Zone Operating Budget - $173,173.00
Sonoma County administration costs, rents/leases equipment, public/legal notices, legal services, audit/accounting, vehicle, small tools, depreciation - $20,276.00

<u>Staffing</u>

Staff working in On-Site program: 3

Number of staff in FTE's 2.2

V. Town of Paradise

The management program for the Town of Paradise is unique in that the while responsibility for the management of onsite systems is with the Town the actual implementation of the program has been privatized. The ongoing operations such as inspection, approval and system oversight are performed by a private consulting firm.

In 1992 the Town of Paradise created the Onsite Wastewater Management Zone (OWMZ) by adoption of Ordinance No. 219. This ordinance established the regulatory provisions for the installation, operation and maintenance of onsite wastewater treatment systems. The Butte County Public Health Department (Environmental Health) administered the program for the first two years. In 1994 the Town of Paradise adopted Municipal Code Title 13, Chapter 13.04, “Sewage Disposal” and the “Manual for the Onsite Treatment of Wastewater” and assumed the administration of the zone. The code provides for the regulatory and enforcement aspects of the zone and the manual delineates the detailed technical specifications for design, construction, inspection and operation of all onsite systems.

The OWMZ functions as a Division within the Town of Paradise Public Works Department with the Onsite Sanitary Official reporting to the Director of Public Works/Town Engineer. The onsite division was privatized five years ago and is funded through an enterprise fund. Approximately 8,100 person hours/year are expended to carryout the responsibilities and duties within the zone. The annual operating budget for Fiscal 2001/2002 was $281,333.

The Central Valley Regional Water Quality Control Board (CVRWQCB) provides oversight to the OWMZ. They participate in the review process of all proposed rule ad manual changes. The OWMZ provides the CVRWQCB with an annual “Report of Operations”.

There are approximately 13,100 parcels within the Town of Paradise with 11,118 of these having operating permits for onsite sewage treatment systems. Of these 11,118 systems 61 utilize enhanced treatment systems as follows: 22 bottomless sand filters; 13 intermittent sand filters; 18 recirculating gravel filters, and; 7 activated sludge wastewater treatment. OWMZ estimates that three (3) million gallons of wastewater are treated daily by the towns onsite systems.

OWMZ regulations require that permits be obtained to construct, operate, and repair onsite systems. The town does not issue and operating permit until as-built plans have been received, and for enhanced systems, the system designer has submitted operating and maintenance manuals. All systems must be periodically evaluated for compliance. Inspections are required whenever a system is pumped, the property is sold, or a complaint filed. Inspections are required at least every seven years except in identified “areas of concern”, where schedules are more frequent.

VI. Auburn Lake Trails Subdivision - Georgetown Divide Public Utilities District

The Georgetown Divide Public Utilities District (GDPUD) provides management for the onsite/decentralized sewage treatment systems at the Auburn Lake Trails Subdivision. The subdivision is situated on the western slope of the Sierra Nevada mountain range, in El Dorado County. GDPUD was formed initially to be the water utility for the subdivision. The proposed sewage treatment plant designed to handle the 2,500 lot subdivision could not be brought on line to service the lots being developed due to the slow build out rate. As a result onsite systems were proposed but state and local agencies had concerns due to restrictive site and soil conditions and the associated water quality concerns. In 1971 the GDPUD agreed, with concurrence from the County and The Central Valley Regional Water Quality Control Board (CVRWQCB), to initiate a comprehensive onsite management program that included site testing, system design, construction management, operation, maintenance, and environmental monitoring. GDPUD established an assessment district that provided the mechanism to build a plant when it was required. This approach allayed the concerns and development commenced using onsite/decentralized sewage treatment.

However, by the mid 1970s, several problems arose including septic systems (many of them innovative) failing despite the management program. The CVRWQCB imposed a moratorium on more development until the problems were solved. In 1985 the District, the homeowners, and the developer agreed to reorganize the district and establish a permanent wastewater management zone. This agreement reduced the number of lots in the subdivision to 1100 and abandoned plans for a central sewer plant.

<u>Program staffing and Responsibilities</u>:

Present staffing consists of two-and-a-half people: the program coordinator and professional designer (1/2 time), and two field inspectors. The district has established a data system that includes system design aids, inspection results, water quality data, soil data, report generating, schedules and other "tickler" functions. The district has completely mapped the hydrology and soil geology of the subdivision, identifying 10 geological and soil types. Staff is responsible for:

- Site evaluation and testing;

- System design, including post-backfill landscape design and erosion control;
- Construction management and oversight;
- System maintenance and monitoring;
- Environmental monitoring of ground- and surface waters;
- Performance monitoring of alternative systems; and
- Alternative systems research.

The district is in the process of retrofitting all tanks with new inspection risers that provide better maintenance access. Depending on their type, systems are inspected at intervals ranging from 4 to 18 months. Homeowners must grant an access easement to the district, retain ownership of their systems and are responsible for operation, maintenance and pumping costs of their system. The cost of repairs is also borne by the homeowner. The ultimate enforcement device of the district is its easement. If necessary, the district will pump or repair, putting a lien on the property until the costs are recovered.

<u>Size and Cost of Program</u>

The program was responsible for the management of 893 individual systems (approximately 200 conventional, the rest specially designed), and one communal system that presently services about 120 houses. User charges are apportioned according to the "level of benefit received," and are as follows:

> *$540 for ISDS design and construction oversight, or $1825 for design, construction oversight, and connection fees for the communal system; in addition to $150 per year management charge for ISDSs, or $275 per year for the communal system.*

There are also smaller annual charges on vacant lots. (The cost of pumping a system, which homeowners bear, is about $250; and the cost of installing a system, which also falls to the homeowner, ranges from about $4000 to $15,000 depending on requirements. Generally, lot prices reflect the anticipated cost of system installation.)

<u>Monitoring and Reporting Program</u>

Monitoring and reporting requirements are stipulated by the County and the Central Valley Regional Water Quality Control Board.[4] Reports were submitted quarterly; at present the zone submits an annual report. The district is currently reinstalling monitoring and sampling wells. A number of the early wells were improperly installed resulting in unreliable sampling results. At present, personal contact with the CVRWQCB is not frequent, as the Board has been satisfied with the program's progress and reports.

Alternative system designs are monitored for leachfield discharges, groundwater beneath them, and surface water at seven streams are regularly sampled and tested for fecal and total coliform, chloride, nitrate, electrical conductivity, temperature, and pH. Groundwater hydrology (depth to water table, flow rate, etc.) is also routinely monitored.

Sources:

1. California Wastewater Training and Research Center, 2002. *Management Methods and Programs for Onsite/Decentralized Sewage Treatment Workshop, April 26, 2002 - Proceedings.* California State University, Chico.
2. Sonoma County: Richard Holmer, Program Manager , Sonoma County Permit and Resource Management Department
3. Santa Cruz County: John Ricker, Land Use and Water Quality Program Coordinator and Land Use Program Manager, Environmental Health Division, Santa Cruz County
4. Stinson Beach: Richard Dinges, General Manager, Stinson Beach County Water District
5. The Sea Ranch: Sandra Moersch-Hughes, Assistant Utilities Director, The Sea Ranch Association
6. Town of Paradise: Lloyd Hedenland, Sr., Onsite Official, Town of Paradise
7. Georgetown Divide Public Utilities District: Dave Honeycutt, Program Manager, Georgetown Divide PUD

References:

1. Prince, R.N., and M.E. Davis, 1988. On-site system management in the Georgetown Divide PUD. Presented at the National Environmental Health Association's Third Annual Midyear Conference, *Onsite Wastewater Management and Groundwater Protecti*on, Mobile, AL. (The document is available from the National Small Flows Clearinghouse, P.O. Box 6064, Morgantown, WV 26506.)

2. California State Water Resources Control Board, 1978. *Public Management of On-site Wastewater Systems: An Explanation of Senate Bill 430.* (Available from National Small Flows Clearinghouse, Box 6064, Morgantown, WV 26506.)

3. Georgetown Divide PUD, 1996. *[Notice to Auburn Lake Trails Property Owners.]*

APPENDIX D

CALIFORNIA MODEL ORDINANCE FOR ONSITE SEWAGE TREATMENT & MANAGEMENT

INTRODUCTION

The California Model Ordinance for Onsite Sewage Treatment & Management project is supported in part by the National Decentralized Water Resources Capacity Development Project with funding provided by the U.S. Environmental Protection Agency through a Cooperative Agreement (EPA No. CR827881-01-0) with Washington University in St. Louis.

The intent of the model ordinance is to help eliminate existing regulatory barriers for the use of onsite/decentralized wastewater treatment systems. The ordinance promotes consistency and addresses issues of overlapping regulatory authority. The lack of consistency and overlapping authority are identified as barriers to the use of onsite systems in EPA's *Response to Congress on the Use of Decentralized Wastewater Treatment Systems* (EPA 832-R-97-0001b).

The California Model Ordinance for Onsite Sewage Treatment & Management project is supported in part by the National Decentralized Water Resources Capacity Development Project with funding provided by the U.S. Environmental Protection Agency through a Cooperative Agreement (EPA No. CR827881-01-0) with Washington University in St. Louis.

The intent of the model ordinance is to help eliminate existing regulatory barriers for the use of onsite/decentralized wastewater treatment systems. The ordinance promotes consistency and addresses issues of overlapping regulatory authority. The lack of consistency and overlapping authority are identified as barriers to the use of onsite systems in EPA's *Response to Congress on the Use of Decentralized Wastewater Treatment Systems* (EPA 832-R-97-0001b).

Draft California Onsite Wastewater Treatment System Ordinance 12/2002 Revision

The ordinance emphasizes performance-based standards that incorporate risk-based methodology, requiring treatment that is commensurate with required public or environmental treatment goals. Required performance can then target certain goals such as nutrient reduction, thereby helping to mitigate water quality concerns.

Performance-based standards offer enhanced treatment options that will reduce the need for requiring centralized sewage systems to address public health and water quality concerns. Using enhanced treatment systems can maintain the character of rural areas as sustainable development can proceed without the high infrastructure cost associated with centralized sewers. Onsite systems can help maintain low housing densities in contrast to the higher densities required to support a central sewer system. Federal Clean Water Act money is no longer readily available to fund sewer plants and onsite (decentralized) systems offer a cost effective alternative that still allows development, but does not encourage high densities.

The ordinance uses a performance by management approach that incorporates the *USEPA Voluntary Management Guidelines for Onsite/Decentralized Wastewater Treatment Systems,* (EPA, 2001). System management is the critical element in developing effective regulations that best serve the community and further the advantages of onsite/decentralized wastewater treatment systems. These measures will enable electric utilities, water and wastewater utilities, municipalities, engineers, contractors, regulators and other public and private entities to effectively respond to the increasing needs and complexities of decentralized wastewater treatment.

Draft California Onsite Wastewater Treatment System Regulations - 12/02A Revision

GENERAL STANDARDS

GENERAL STANDARDS

1.0 Purpose and Objective

The purpose of these Regulations is to provide for safe, dependable and economical use of Onsite Wastewater Treatment Systems (OWTS) in California and provide consistency statewide in system management, design and installation practices. The objective is to provide statewide general guidance for use at the local level. It is the intent that this regulation be continually reviewed and updated as the industry and technology evolves.

1.1 Scope

The California Onsite Wastewater Treatment System Regulations:

1. Establish minimum management programs that must be implemented by the authorized local agencies.
2. Provide performance and prescriptive requirements for the use of standard and enhanced Onsite Wastewater Treatment Systems.
3. Establish site evaluation, design, installation and equipment standards.
4. Provide education, training and certification requirements for professionals who design, install, monitor, repair, maintain and regulate OWTS.
5. Establish provisions for adopting maintenance and monitoring programs at the county level and enforcement procedures to ensure that monitoring programs are successful.
6. Develop public education programs for property owners to promote water conservation and periodic monitoring and maintaining of their septic system.
7. Encourage research and demonstration projects for innovative technology.
8. Establish protocol for mainstreaming experimental and innovative systems for use in California.

2.0 Ordinances

The Authorized Local Agency[1] (ALA) overseeing Onsite Wastewater Treatment Systems shall prepare an Onsite Wastewater Treatment System (OWTS) Ordinance after holding a public hearing on reasonable notice thereof, to control and enhance the quality of the ground and surface waters in order to eliminate the pollution, waste, and contamination of water flowing into, through, or originating within watercourses, both natural and artificial, to prevent contamination, nuisance, pollution, or otherwise rendering unfit for beneficial use the surface or ground water used or useful, and to expend such amounts as are necessary to exercise such powers from the funds of local authorized agency. Such regulations shall not be in conflict with state law or county ordinances.

[1] The permitting agency shall mean any agency that has authority to regulate the use of Onsite Wastewater Treatment Systems.

GENERAL STANDARDS

The local ordinance shall be reviewed by the RWQCB for compliance with applicable State Standards and Regulations and the RWQCB Basin Plan. The local ordinance shall be reviewed and updated at least every 5 years.

3.0 Memorandum of Understanding

The ALA shall enter into a memorandum of understanding with the appropriate Regional Water Quality Control Board(s) that establishes the authority to implement the ALA program. The memorandum shall include the following:

4.0 Authority

The authorized local agencies shall have jurisdiction of OWTS up to a maximum daily average discharge of 20,000 gallons per day (gpd)[2] or as otherwise established by the memorandum of understanding between the ALA and the RWQCB. All other Onsite Wastewater Treatment Systems with discharges greater than 20,000 gpd shall be regulated by the RWQCB.

5.0 Authorized Local Agency Function and Duties

5.1 Function

The Authorized Local Agency (ALA) or its representative officers shall provide oversight of OWTS to protect health and safety and preserve water quality standards as prescribed in the RWQCB basin plan and the Federal and State water quality requirements. The ALA shall provide relevant operation and maintenance information and promote and distribute educational materials to assist the Owner in preserving the performance and life of their system.

5.2 Representative Officers

Representative Officers may include; qualified septic tank contractors, registered environmental health specialists or a qualified designer employed or contracted by the ALA.

5.3 Duties

In addition to the other powers provided by law, the ALA, shall have all of the following powers and shall promptly and effectively exercise such powers as may be appropriate to ensure that onsite wastewater treatment systems, as defined in Section 6952 of the Health and Safety Code (Section 6952. reads "On-site wastewater disposal system" means any of several works, facilities, devices, or

[2] Local authority must be established by Memorandum of Understanding with the RWQCB

GENERAL STANDARDS

other mechanisms used to collect, treat, recycle, or dispose of wastewater without the use of communitywide sanitary sewers or sewage systems), do not pollute surface water and ground water.

The ALA shall develop administrative procedures to:

1. Establish the appropriate management levels necessary to comply with the management standards of these regulations.
2. Establish a record keeping and reporting program to ensure that up-to-date records are kept of location, ownership, site evaluation, design, and compliance reports are maintained and performance of systems is monitored.
3. To carry on technical and other investigations, examinations, or tests, of all kinds, make measurements, collect data, and make analyses, studies, and inspections pertaining water quality, nuisance, pollution, waste, and contamination of water as such activities relate to the use of onsite wastewater treatment systems.
4. Enter into agreements with qualified management entities to fulfill the maintenance, operation and monitoring functions described for the management program levels.
5. Issue appropriate permits for the installation and operation of Onsite Wastewater Treatment Systems.
6. Inspect or cause to have inspected Onsite Wastewater Treatment Systems as prescribed by this ordinance.
7. Coordinate with the Regional Water Quality Control Board Watershed Management Initiative Program and other agencies to identify areas of special concern.
8. Develop/adopt and provide an educational program that ensures that system owners and service providers understand their roles, responsibilities, requirements, and procedures for managing onsite systems.
9. Monitor all OWTS performance throughout their jurisdiction or in concentrated areas of special concern, whichever is considered appropriate to protect public health and safety and evaluate the effects on ground and surface water quality.
10. Enter any parcel where an OWTS is located for the purpose of inspecting or evaluating the performance of the system. The ALA shall provide appropriate notice as to the date and approximate time of the inspection in writing to the owners and occupants before entering the property.
11. May enter property without written <u>or</u> verbal notification when there is reasonable cause to suspect that the OWTS is failing[3] and endangering public health, safety and water quality.

[3] A failing system shall be defined as any system where wastewater effluent and solids are no longer safely treated and/or discharged and pose a direct health and safety risk to humans, animals and water quality.

GENERAL STANDARDS

12. When an owner or occupant denies entry to the ALA or its representative officers during routine or emergency inspections, the ALA shall obtain a Court Order (Inspection Warrant) pursuant to Title 13 (commencing with Section 1822.50) of Part 3 of the Code of Civil Procedure for right of entry to inspect and/or evaluate the system.[4]
13. When applicable, the ALA shall issue to the owner a correction notice to pump the tank or correct any system deficiencies. The owner shall comply with the directives of the ALA within the required time stated in the notice. Failure of the owner to comply with the directive shall be in violation; their operating permit will be suspended; and the system must be abandoned until the requirements of the correction notice have been met. Continued use of the OWTS without an operating permit is a violation of law and subject to criminal action as may be set forth by the ALA.

5.4 Violation

Any violation of a regulation is a misdemeanor punishable by a fine not to exceed five hundred dollars ($500), or imprisonment not to exceed 60 days, or by both such fine and imprisonment. Each day of such a violation shall constitute a separate offense. Any violation or threatened violation of a regulation may also be enjoined by civil suit.

5.5 Eligible Management Entities

Cities & towns, public utility districts, water & sewer districts, special-use districts, and corporations and homeowner associations with demonstrated capacity to assure long-term management.

5.6 Areas of Special Concern

The local ALA may investigate and take appropriate action to minimize public health and/or environmental risk in formally designated areas such as:

1. Shellfish protection districts or shellfish growing areas;
2. Sole Source Aquifers designated by the U.S. Environmental Protection Agency;
3. Areas with a critical recharging effect on aquifers used for potable water;
4. Designated public water supply wellhead protection areas as identified in the County Source Water Protection Program.
5. Up-gradient areas directly influencing water recreation facilities designated for swimming in natural waters with artificial boundaries within the waters;

---

[4] See California Water Code Section 31143-31143.5 for possible abatement/enforcement language (Appendix III).

GENERAL STANDARDS

6. Areas designated by the State Water Resources Control Board as special protection areas;
7. Areas designated by the Regional Water Quality Control Board(s) as special protection areas identified in the Watershed Management Initiative program;
8. Wetland areas under production of crops for human consumption;
9. Frequently flooded areas delineated by the Federal Emergency Management Agency; and
10. Areas identified and delineated by the local ALA in consultation with the Regional Water Quality Control Board to address public health threat from on-site systems.

The ALA may impose more stringent requirements on new development and corrective measures to protect public health upon existing developments in areas of special concern, including:

1. Additional location, design, and/or performance standards for OWTS;
2. Larger land areas for new development;
3. Prohibition of development;
4. Additional operation, maintenance, and monitoring of OWTS performance;
5. Requirements to upgrade existing OWTS;
6. Requirements to abandon existing OWTS; and
7. Monitoring of ground water or surface water quality.

Within areas of special concern, to reduce risk of system failures, a person approved or designated by the local ALA shall:

1. Inspect every OWTS at least once every three years;
2. Submit the following written information to both the local ALA and the property owner within 30 days following the inspection:
3. Location of the tank;
4. Structural condition of the tank, including baffles;
5. Depth of solids in tank;
6. Problems detected with any part of the system;
7. Maintenance needed;
8. Maintenance provided at time of inspection; and
9. Other information as required by the local ALA.
10. Immediately report failures to the local ALA.

5.7 Fees

Agencies shall establish fees for permits, plan checking, inspection and monitoring and maintaining files and all other costs necessary to administer the program.

5.8 Appeals

ALAs shall establish an independent panel for hearing appeals. The panel shall be comprised of at least one each of the following members: one agency staff, one professional OWTS consultant, one OWTS Installer or Pumper, **one industry representative**, one person from the public at large with alternates for each position. Decisions of the panel shall be reviewed by the Administrative Officer for compliance with the OWTS ordinance in force and the State Health and Safety code.

5.9 Abatement[5]

In the event that the local ALA determines that a violation of the provisions of this code exists, the local ALA shall **require the owner of the property to** abate any **system failure** or nuisance that imposes a risk to public health and safety.[6] Violation of any of the provisions of a regulation adopted pursuant to Section xxxx may be abated as a public nuisance, and the governing body may by regulation establish a procedure for the abatement of such a nuisance and to assess the cost of such abatement to the violator. If the violator maintains the nuisance upon real property in which he has a fee title interest, the assessment shall constitute a lien upon such real property.

6.0 Management Program[7]

Authorized Local Agencies shall establish a management program that consists of one or more of the five management levels (Table 1). Authorized Local Agencies shall establish the appropriate management level(s) after:

1. consultation with and concurrence from the Regional Water Quality Control Board(s) concerning the management level necessary to implement the provisions of this ordinance. The management level shall be determined by an assessment of the level of oversight and system management necessary to protect public health and water quality.
2. public hearing

6.1 Management Program Level 1 System Inventory and Awareness of Maintenance Needs

Management Program 1 is the required basic management program. It is suitable where:

1. Standard Onsite Wastewater Treatment Systems are/can be installed
2. There is no recognized water quality threat from OWTS use.
3. Onsite Wastewater Treatment Systems are owned and operated by individual property owners in areas of low environmental sensitivity. Areas of low environmental sensitivity are areas where there is no demonstrated impairment of ground or surface water resulting from the continued use of standard Onsite Wastewater Treatment Systems.

---

[5] This section was taken in part with additional changes from the Santa Cruz County Code.

[6] See Appendix III for Water Code language

[7] See Appendix IV for additional guidance for the management levels

GENERAL STANDARDS

An Onsite Wastewater Treatment System managed at this level shall be issued a standard operating permit. System operation and maintenance responsibilities lie solely with the system owner.

6.1.1 Program Objectives/Agency Responsibilities

a. to ensure that all systems are sited, designed and constructed in compliance with the prevailing rules for a Standard Onsite Wastewater Treatment System,
b. ensure that all systems are recorded and inventoried,
c. ensure property owners are informed of maintenance needs of the systems, and
d. to provide communities with basic data for determining whether higher management levels are necessary.

6.2 Management Program Level 2 - Renewable Operating Permits and Maintenance Contracts

Minimum management program necessary where enhanced Onsite Wastewater Treatment System designs are employed to provide treatment to overcome restrictive site conditions in areas of low environmental sensitivity. This program is suitable where:

1. Sites have limiting soil/site conditions that do not allow for a standard Onsite Wastewater Treatment System.
2. System owners retain responsibility for system operation and maintenance.
3. Maintenance is provided for by means of a maintenance contract with a public or private entity or by the system owner.

6.2.1 Program Objectives/Agency Responsibilities

a to ensure that all systems are sited, designed and constructed in compliance with the prevailing rules for a Enhanced Onsite Wastewater Treatment System,
b ensure that all systems are recorded and inventoried,
c ensure property owners are informed of maintenance needs of the systems, and
d to provide communities with basic data for determining whether higher management levels are necessary.
e Utilize Renewable Operating Permits (ROP) that are of limited term and are issued to the property owner. The owner must demonstrate that the system is in compliance with the terms and conditions of the permit on a predetermined frequency.
f The ROP provides the local permitting agency a mechanism for continuous oversight of system performance and negotiating corrective actions or levying penalties if compliance with the permit is not maintained.

- g The ROP shall be renewed only upon certification of proper system function.
- h The property owner shall provide the necessary maintenance as stipulated in the operating permit.

6.3 Management Program Level 3 - Renewable Operating Permits, Maintenance Contracts, and Performance Monitoring

Minimum management program necessary where:

1. Onsite Wastewater Treatment Systems are located in areas with sensitive receiving environments.

It is necessary to achieve specific water quality objectives.

6.3.1 Program Objectives/Agency Responsibilities

- a to ensure that all systems are sited, designed and constructed in compliance with the prevailing rules for a Onsite Wastewater Treatment System,
- b ensure that all systems are recorded and inventoried,
- c ensure property owners are informed of maintenance needs of the systems, and to provide communities with basic data for determining whether higher management levels are necessary.
- d Establish a monitoring and reporting program that ensures onsite systems continuously meet their performance requirements.
- e Conduct sanitary surveys to provide assessment of existing onsite system performance.
- f Utilize renewable operating permits that are of limited term and are issued to the property owner. The owner must demonstrate that the system is in compliance with the terms and conditions of the permit on a predetermined frequency
- g The ROP provides the local permitting agency a mechanism for continuous oversight of system performance and negotiating corrective actions or levying penalties if compliance with the permit is not maintained.
- h The property owner shall contract with a maintenance provider to provide the necessary maintenance as stipulated in the operating permit.
- i Ensure that trained operators are under contract to perform timely maintenance.

6.4 Management Program Level 4 - Utility Operation and Maintenance

This management level is for Onsite Wastewater Treatment Systems where:

1. the sensitivity of the environment is high
2. the need for properly functioning systems is essential to maintain public health and environmental protection.
3. Operation and maintenance functions are delegated to a public or private utility.

GENERAL STANDARDS

Applicable where: monitoring of a public drinking water supply has detected pathogens or elevated levels of nutrients and a source water assessment has identified onsite/decentralized systems as sources of concern, or a determination has been made that ground water or surface water is impaired as a result of onsite treatment systems (CWA , 303(d) & 305(b) reports).

6.4.1 Program Objectives/Agency Responsibilities

a. to achieve greater control over compliance by issuing the operating permit to a utility instead of the property owner,
b. monitor and make assessments of watershed impacts from onsite systems and replace existing systems with higher performance units where necessary
c. to enable utilization of enhanced systems that provide the performance required to mitigate public health or environmental concerns,
d. ensure higher level of maintenance by having a public or private utility take responsibility for the operation and maintenance of systems,
e. ownership of the system remains with the property owner, and
f. the renewable operating permit is issued to a public or private utility that meets the specified criteria as determined by the local ALA.

6.5 Management Program Level 5 - Utility Ownership and Management,

The designated management entity both owns and operates the onsite systems. The utility maintains total control of all aspects of management, not just operation and maintenance. This management level is for Onsite Wastewater Treatment Systems where:

1. the sensitivity of the environment is high
2. the need for properly functioning systems is essential to maintain public health and environmental protection.

6.5.1 Program Objectives/Agency Responsibilities

a. provide professional management of all aspects including siting, design, construction, operation and maintenance,
b. monitor and make assessments of watershed impacts from onsite systems and replace existing systems with higher performance units where necessary
c. provide comprehensive monitoring, maintenance and operation in new, high-density development proposed in the vicinity of sensitive receiving waters.
d. provides the highest level of management and allows for integration of Onsite Wastewater Treatment Systems into the wastewater treatment infrastructure of a community.

GENERAL STANDARDS

Management Level	Risk Level	Risk Level Characteristic (Can be assigned to an area or to a site.)	Site response	**Minimum** Permitting Authority Responsibility direct or delegated to service provider	Available technologies that can provide necessary level of treatment
I	RO	No water quality problem, no site limiting conditions.	Any type of system allowed by local code is acceptable.	Permit to Construct and Standard Operating Permit & System inventory	Standard septic tank and leachfield or seepage pit
II	R1	Site limiting conditions (such as unsuitable soils and/or inadequate depth to limiting factor.)	Any type of system that physically replaces what site is lacking, to ensure that there is no human exposure to untreated sewage.	Renewable Operating Permit that ensures non-standard components are maintained.	Advanced treatment systems (media filter, ATU (?), etc., and/or advanced soil treatment & dispersal (mound, subsurface drip, LPP, etc.).
III	R2	Areal dependence on shallow ground water for drinking water, shellfish or recreational use	Risk level should be assigned to individual sites proposed for development. New systems should include advanced treatment. Repairs should include advanced treatment where feasible.	Renewable Operating Permit that ensures non-standard components are maintained. Physical monitoring by system owner.	Standard Systems and Advanced treatment systems (media filter, ATU, etc., and/or advanced soil treatment & dispersal (mound, subsurface drip, LPP, etc.).
	R3	Documented nitrate or human bacterial water quality problem in ground water or nearby surface waters, or onsite system density exceeds area's assimilative capacity for contaminant	Repairs and new systems should include advanced treatment that treats the contaminant of concern.	Renewable Operating Permit that ensures non-standard components are maintained. Physical monitoring by regulator or contracted service provider required. Effluent sampling and/or ground water monitoring required at permitting agency discretion.	Advanced treatment systems (media filter, ATU, etc., and/or advanced soil treatment & dispersal (mound, subsurface drip, LPP, etc.) to address the contaminant(s) of concern; such as disinfection for bacteria, or treatment for nitrate removal/reduction
IV	R4	Documented water quality problem, nitrates and/or human pathogens, identified by the Regional Water Quality Control Board (RWQCB) through various water quality assessment processes (such as WMI, 303(d), or TMDL) or the Department of Health Services (Source Water Assessment)	Corrective action needed to mitigate, may require system upgrades and/or conversion to cluster or centralized sewer treatment.	Renewable Operating Permit that ensures all components are maintained. Physical monitoring by regulator or contracted service provider required. Effluent sampling and/or ground water monitoring required at state's discretion, in consultation with permitting agency.	Same as above, and: Utility managed onsite, clustered or centralized sewage treatment should be considered as an option if homeowners are unwilling or unable to upgrade systems and assume burden of demonstrating compliance
V	R5	Need for direct reuse (systems that irrigate, directly recharge a drinking water aquifer, or discharge fluids at surface or at depths less than minimum soil depth to restrictive horizon)	Denitrification and disinfection required. Chlorination is not an acceptable disinfection technology if disinfection by-products are of concern.	Renewable Operating Permit, that ensures all components are maintained. Physical monitoring by regulator or contracted service provider required. Effluent sampling and/or ground water monitoring required.	Utility owned onsite, clustered or centralized sewage treatment should be considered as an option if homeowners are unwilling or unable to upgrade systems and assume burden of demonstrating compliance

303

GENERAL STANDARDS

7.0 PERMITS

Permits are required prior to the construction, **replacement**, operation and repair of any OWTS.

7.1 Onsite Wastewater Treatment System Installation Permits

The ALA shall require that Contractors installing or repairing OWTS have the proper license to conduct business within their jurisdiction. The ALA will either issue or deny the onsite wastewater treatment system installation permit within a reasonable amount of time after the receipt of a completed application for all standard or enhanced designs. The Permit shall be issued to the homeowner, the contractor hired by the owner, the easement holder on which the system is to be installed, or the utility that will own and manage the system. The approved onsite sewage treatment installation permit will remain effective for **a period of one year**, or as otherwise determined by the ALA, from the date of issuance for construction of the system. The onsite wastewater treatment system installation permit should not be transferable. If necessary, a renewal of an Onsite Wastewater Treatment System installation permit may be granted to the original applicant if the original permit has expired. The applicant should apply for a renewal prior to the expiration date of the onsite wastewater treatment system installation permit.

7.1.1 Application Requirements – New Installations

The application for an Onsite Wastewater Treatment System permit should include an approved Site Evaluation Report (SER) specified in Section 12.1 prepared by a qualified designer as specified in Section 10.2.

7.1.2 Application Requirements – Existing Systems, Replacements and Repairs

The application for a repair Onsite Wastewater Treatment System permit should include the information deemed necessary by the ALA. Application requirements shall be identified in the local ordinance.

7.2 Operating Permits

A valid Operating Permit shall be required for all OWTS. Operating permits are not transferable. An operating permit shall not be issued until such time that the system is in compliance with the terms and conditions of the onsite wastewater treatment system installation permit.

7.2.1 Standard Operating Permit (SOP)

A Standard Operating Permit (SOP) shall be issued by the ALA upon final approval of the completed Standard Onsite Wastewater Treatment System in Management Program Levels 1 and 2. The issuing agency shall issue an SOP when the system is in compliance with the requirements specified in the onsite wastewater treatment system installation permit. The issuing agency **shall** issue an operating permit **at such time that** the as-built plans and the operations and maintenance instructions are submitted and the final inspection and testing of the system has been performed.

7.2.2 Renewable Operating Permit (ROP)

A Renewable Operating Permit (ROP) shall be issued by the ALA upon final approval of the completed Enhanced Onsite Wastewater Treatment System in Management Program Level 2-5. ROPs are also required for Standard Onsite Wastewater Treatment Systems in Management Program Level 3-5. The applicant shall also provide evidence, when required, that a maintenance agreement has been established with a qualified public or private entity. The issuing agency shall issue an ROP when the system is in compliance with the requirements specified in the onsite wastewater treatment system installation permit. The issuing agency shall issue a renewable operating permit **at such time that** the as-built plans and the operations and maintenance instructions are submitted, the final inspection and testing of the system has been performed, and when required a satisfactory maintenance agreement has been obtained.

7.2.2.1 Renewal Frequency

The maximum length of time a Renewable Operating Permit shall remain in effect is three years. The local implementing agency **may** determine **a shorter** length of time that the Renewable Operating Permit shall remain in effect **based on** one or more of the following considerations:

a. System complexity
b. Public health concerns
c. Environmental concerns

7.2.2.2 Renewal Procedure

The ALA personnel or representative officers shall renew the ROP after a satisfactory compliance inspection. Representative Officers may include; qualified septic tank contractors, registered environmental health specialists or a qualified designer employed or contracted by the ALA. The ALA shall require any corrections necessary to bring the OWTS into compliance with all applicable regulations. Failure to make the corrections within thirty days after written notification or posting of a Correction Notice at the site shall result in a violation of the permit process and the issuance of a Violation Notice by the issuing agency.

7.2.3 Change of Ownership

The ALA personnel or representative officers at all changes in ownership shall conduct an inspection of the OWTS in accordance with 11.4.3. Representative Officers may include; qualified septic tank contractors, registered environmental health specialists or a qualified designer employed or contracted by the ALA. The ALA shall require any corrections necessary to bring the OWTS into compliance with all applicable regulations. Permits shall only be renewed upon receipt of satisfactory evidence that the corrections have been made. Failure to make the corrections within thirty days after written notification or posting of a

Correction Notice at the site shall result in a violation of the permit process and the issuance of a Violation Notice by the issuing agency.

8.0 Maintenance, Operation and Monitoring

Onsite wastewater treatment systems require Maintenance, Operation and Monitoring (MO&M) consistent with the applicable Management Program Level and the type of system.

8.1 ALA Responsibilities

The ALA shall ensure that onsite wastewater treatment systems are maintained, operated and monitored in accordance with the Management Program Level in effect.

8.1.1 Maintenance, operation and monitoring assurance

The ALA may either establish it's own protocol to be administered by the agency personnel or representative officers or may require the owner of the OWTS to use <u>one or more</u> of the following methods to take effect within 12 months of implementation of the state regulations by the ALA:

a. owners may manage their own system and provide to the ALA routine monitoring and evaluation reports per requirements set forth by the ALA;
b. recording the presence and type of onsite system on the property deed;
c. recording the requirement for an on-going service contract on the property deed;
d. obtaining a Renewable Operating Permit (in addition to the initial onsite wastewater treatment system installation permit), with the maintenance requirements stipulated by the management level in effect for the OWTS;
e. obtaining the services of a management entity[8] to provide MO&M assurance.

8.1.2 Registration of Service Providers

a. Permitting agencies shall establish a method to register service providers that includes at a minimum the following:
b. Verification that the service provider has the demonstrated knowledge and ability to perform services on the system(s) or device(s) by possessing certification from the manufacturer or by some other method satisfactory to the ALA.
c. Reciprocity: Service providers with a valid registration with a local ALA shall be deemed eligible for registration in all jurisdictions. The local ALA may impose a local registration fee to cover administrative costs of the registration program.

[8] Examples of management entities include: cities & towns, public utility districts, water & sewer districts, special-use districts, and corporations and home-owner associations with demonstrated capacity to assure long-term management.

GENERAL STANDARDS

d. Maintain a listing of registered service providers that shall be made available upon request.

8.1.3 Record Keeping

a. The ALA shall establish a record keeping and tracking system to verify compliance with maintenance, operation and monitoring to include the following:
b. System location including assessors' parcel number or some other unique identification number established by the ALA.
c. Date of installation
d. Type of system
e. Owner of record
f. Maintenance, operation and monitoring requirements
g. Identification of service provider
h. Results of maintenance and monitoring reports

8.2 Owners Responsibility

Owners are responsible for proper operation and maintenance of their onsite wastewater treatment system. Owners shall be responsible for the following:

a. Maintain their system to prevent surfacing of effluent. In the event of surfacing effluent, the owner shall minimize use or cease operation of the system until it is repaired. Until the system is repaired, the owner shall prevent effluent from surfacing by having the system continuously pumped and the waste disposed at an approved septage handling facility until the system is repaired[9].
b. Have their septic tank inspected and the scum and solid levels measured at the prescribed frequency indicated on the operating permit. Owners shall have their tanks pumped when the clear liquid zone separation in the tank is less than 2/3 of the total depth in the tank.
c. Owners shall preserve and protect their onsite wastewater treatment system. Owners shall not place buildings, livestock, impervious materials, equipment, parking areas, or driveways over the treatment areas[10]. Surface and subsurface soils in the treatment areas shall not be removed, ripped, contoured or compacted. The treatment areas may be tilled with a light duty, hand operated garden tiller (no tractor operated implements), hand graded and covered with lawn or non-invasive plants. The treatment areas may be irrigated with portable sprinklers or landscape irrigation. Flood irrigation and surface drainage shall not encroach on or impact the septic tank, treatment areas or other components of the

---

[9] The system shall be pumped by a certified liquid waste hauler as defined in this ordinance. The system shall be repaired under permit issued by the local agency. All repairs and improvements shall be performed by a qualified licensed contractor as defined in this ordinance.

[10] Treatment areas include the primary and reserve areas

system. Building foundation and roof drains shall be located a safe distance and directed away from the treatment areas.

d. The owner shall control the wastewater discharge to the system within the design quantity and strength parameters. The owner shall not introduce strong bases, acids, chlorine, formaldehyde, thinners, solvents or other atypical wastewater components to their systems other than in minute concentrations contained in mild cleansers and chemicals used in normal household cleaning. The owner should refrain from using septic tank additives and soil amenders without first consulting with the system designer or ALA as to any possible adverse affects to the system and ground water quality.

e. The owner shall operate and maintain their system in conformance with the conditions prescribed in the operating permit and the Designer's and Installer's recommendations.

8.3 System Designer Responsibilities:

The onsite wastewater system designer must instruct, or assure that instruction is provided to, the owner of the residence or facility regarding proper operation of the entire onsite wastewater treatment system. This instruction should emphasize operating and maintaining the entire onsite wastewater system within the parameter ranges for which it is designed.

8.4 User's Manual - All Systems

a. A user's manual for the treatment system must be developed and / or provided by the system designer and/or manufacturer. These materials must contain the following, at a minimum:

   i. Diagrams of the system components including schematic flow diagrams.

   ii. Maintenance frequency of system components.

   iii. Explanation of general system function, operational expectations, owner responsibility, etc.

   iv. Names and telephone numbers of the system designer, local health authority, component manufacturer, supplier/installer, and/or the management entity to be contacted in the event of a failure.

   v. Information on "Trouble-shooting" common operational problems that might occur. This information should be as detailed and complete as needed to assist the system owner to make accurate decisions about when and how to attempt corrections of operational problems, and when to call for professional assistance.

8.4.1 Enhanced Treatment System Operations and Maintenance Manual

For enhanced treatment systems/devices, a complete maintenance and operation document must be developed and provided by the designer. This document must be made available to the system owner and the service provider. This document must include all the appropriate items mentioned below, plus any additional general and site-specific information. A copy of this document must also be provided to the ALA, prior to the issuance of the onsite wastewater treatment system operating permit. The operation and maintenance manual(s) must be written so as to be easily understood by the owner and O&M service provider and include as a minimum:

a. a maintenance schedule for all critical components;
b. requirements and recommended procedures for periodic removal, **treatment and disposal** of residuals from the system;
c. a detailed procedure for visually evaluating function of system components;
d. a description of olfactory and visual techniques for confirming correct process parameters (i.e. mixed liquor concentration and biomass health) and system performance;
e. a recommended method for collecting and transporting effluent samples;
f. the effluent quality parameters expected to be produced by a properly operating system as established through analytical methods, and
g. safety concerns that may need to be addressed.

8.5 Proprietary System/Device Manufacturer Responsibilities:

The authorized representative for the Proprietary System/Device must instruct, or assure that instruction regarding proper operation of the Proprietary System/Device is provided to the owner of the residence or facility, the designer, and the ALA.

8.5.1 Operations and Maintenance Manual

The authorized Proprietary System/Device representative must provide a manufacturer-prepared manual to the wastewater system designer, the system owner and, if requested, to the local ALA at the time of system installation. The information in this manual(s) must be presented in a manner which can be easily understood by the owner and include, at a minimum:

a. a parts list which includes all primary functional components, equipment manufacturer(s) and model designations;
b. a statement of product performance demonstrated during testing;
c. a statement regarding the use of pre-treatment with the Proprietary System/Device, including whether or not a pre-treatment tank was used during product testing and any application-specific recommendations for using pre-treatment tanks.
d. a functional description of how the process functions, including diagrams which illustrate basic system design and flow-path;
e. a clear statement which provides examples of the types **and strength** of waste that can be effectively treated by the system;

f. a list of household substances that, if discharged into to the system could adversely affect system performance or groundwater quality;
g. comprehensive operating instructions that clearly delineate proper function of the system, operating and maintenance responsibilities of the owner and authorized service personnel, and service-related obligations of the manufacturer(s);
h. requirements for periodic removal of residuals from the system;
i. a course of action to be taken if the system is subjected to electrical power interruption **that could effect system performance**
j. a course of action to be applied if the system will be used intermittently or if extended periods of non-use are anticipated;
k. detailed methods and criteria for identifying system malfunction or problems;
l. a statement instructing the owner to reference the Proprietary System/Device data plate in the event that a problem is identified or service obligations related to the Proprietary System/Device needs to be met by the manufacturer;
m. the name and telephone number of a service representative to be contacted in the event that the system experiences a problem;
n. a description of the initial and extended service policies;
o. electrical schematics for the system if not appearing as a permanent attachment on the system; and,
p. emergency contact numbers for service providers, pumpers and local health.

8.6 Service Provider Responsibilities

a. Register with the local ALA in a manner prescribed by the agency.
b. Provide maintenance and monitoring reports for systems they are servicing to the ALA consistent with the terms of the renewable operating permit. Reports shall be provided to the ALA no later than 90 days following the required service.
c. Report system malfunctions that result in ______________ within ____ hours/days to the ALA.
d. Maintain certification and training for operation and maintenance of systems as determined by the manufacturer, proprietary device manufacturer and the local agency.

8.7 Service Contract

A Service Contract for on-going service and maintenance of the entire wastewater system is required for all OWTS in Management Program Level 3. The service and maintenance requirements may be modified by the local ALA, but as a minimum continued service and maintenance must be addressed for the life of the system by an operation plan. OWTSs in Management Program Level 4 and 5 shall be deemed to comply with this section by nature of the management oversight provided by the utility.

8.8 Monitoring Easements

The ALA may require the owner to dedicate easements for inspections, maintenance and future expansion and replacement area for OWTS.

8.9 Groundwater Quality Monitoring

When there is reasonable cause to suspect that an owner's OWTS is contributing to groundwater quality degradation or contamination, the ALA may require either:

a. the owner provide an easement to the agency to install and monitor groundwater sampling wells on their parcel,
b. the owner install and sample monitoring wells at their own expense. Water samples collected by the owner shall be given to the ALA or to a certified water testing lab for analysis with the results sent to the ALA. The owner shall follow the water sampling procedures as directed by the ALA or water testing lab.

9.0 Enhanced Treatment System Warranty Requirements

All enhanced wastewater treatment systems and enhanced treatment system components shall have a warranty provided. It shall be the responsibility of the system designer to ensure that warranties are obtained. The system designer may warranty the entire system or may secure part or all of the warranty from the system component manufacturer and system installer. In all cases, the entire treatment system shall be warrantied through the designer, manufacturer, installer or some combination acceptable to the ALA. The warranty shall be for a period not less than five years in duration.

9.1 Adoption and use.

Warrantied individual wastewater treatment systems meeting the requirements under this section may be employed unless specifically prohibited in local ordinance.

9.2 Submittal requirements

The designer or manufacturer must submit satisfactory information to the ALA as follows:

a. how the system must be used and installed, how it is expected to perform under those conditions, the anticipated design life, and the period to be warrantied;
b. pertinent existing data, including in-field testing data, that the system will perform as expected;
c. a commonly accepted financial assurance document or documentation of the designer's or manufacturer's financial ability

to cover potential replacement and upgrades necessitated by failure of the system to meet the performance expectations for the duration of the warranty period;

d. a full warranty effective for the designated warranty period, which must be at least **five** ~~three~~ years from the time of installation, covering design, labor, and material cOWTS to remedy failure to meet performance expectations for systems used and installed in accordance with the designer's or manufacturer's instructions; and

e. additional information requested by the ALA to ensure compliance with this part.

9.3 Allowable designer, manufacturer, installer conditions for warranty.[11]

9.3.1 Enhanced Onsite Wastewater Treatment Systems

Designer, manufacturer and installers of treatment systems and system components may set exclusions, limitations and conditions on warranties. These shall be made available in writing prior to entering into a contract for installation to the system owner and the ALA. Exclusions, limitations and conditions voiding the warranty must be specified by the designer or manufacturer for the following reasons:

a. Failure of the System Owner to maintain an active service contract with a service provider who is trained and certified as required by the designer and/or manufacturer and registered with the ALA.

b. System or component failure is determined to have occurred as a result of improper operation or maintenance of any component of the System.

c. Failure is a result of introduction of toxic contaminants not normally present in the area water supply or derived from normal human wastes or gray water.

d. Discharge of any garbage grinders, grinder pumps, or vacuum pumps into the system.

e. Construction, installation, and/or start up of the system are not done by a licensed and/or certified installer.

f. Any materials, parts, or equipment used in the construction or maintenance of the system do not conform to the plans and specifications or have not been approved by the system designer or manufacturer.

g. Flows exceed the design capacity of the system.

h. The system is not operated and maintained according to the Operation and Maintenance Manual provided by designer and/or the manufacturer.

i. Unauthorized changes in system settings or operation of pumps, metering devices, effluent distribution

[11] Designer, manufacturer, and installer include duly authorized persons acting on behalf of the designer, manufacturer or installer.

j. The System Owner changes components or other parts that can affect the integrity and proper functioning of the system without consultation with, and the concurrence of, a System service provider trained and certified by the designer and/or manufacturer.
k. Failure of the System Owner to allow the designer and/or manufacturer, or any agent or service provider designated by the designer and/or manufacturer to enter the System Owner's property where the System is located at any reasonable time, to inspect, sample, test and monitor System for the purpose of assuring proper operation and warranty compliance.

9.3.2 Enhanced Treatment Systems with Performance Requirements

Designer, manufacturer and installers of treatment systems and system components that must meet performance requirements may set ‘influent constituent standards’ to limit their liability as it relates to system performance by specifying influent quality and quantity limits for constituents of concern. The influent quality and quantity standards specified may include limits for the following:

a. Hydraulic load
b. BOD
c. TSS
d. TN
e. pH
f. Total Coliform
g. Alkalinity
h. Fats, Oil and Grease (FOGs)
i. Temperature
j. Toxic/Chemical Contaminants

9.4 Administrative requirements

1. Individual wastewater treatment systems meeting the requirements of section 9.3 shall be listed as an approved enhanced treatment system by the ALA.
2. Changes made to a warrantied individual wastewater treatment system that are not included in the original warranty submittal require resubmittal to the ALA.
3. The ALA may remove a warrantied individual wastewater treatment system from consideration as an approved enhanced treatment system upon a finding of fraud, system failure, failure to meet warranty conditions, or failure to meet the requirements of this part or other matters that fail to meet with the intent and purpose of this chapter. Removal of a technology or design does not alter or end warranty obligations for systems installed under the previously approved warranty.
4. A copy of the warranty must be provided to the owner and included with the design records.

GENERAL STANDARDS

10.0 License, Certification, Training and Education

Any person who is responsible for the investigation, design, installation, inspection and regulation of onsite wastewater systems is subject to the requirements contained in this section.

10.1.1 Qualifications

The following professions are authorized to perform the functions listed under Table 10-1.

Table10-1

Occupation	Soil investigation	Design	Installation	Inspection	Regulation
Civil Engineer	X	X		X	X
Geologist	X	X		X	
REHS	X	X		X	X
Soil Scientist	X				
A1, B1 & C42 & C36 Contr.			X		

10.1.2 Experience

Licensed or registered persons shall work within their field of expertise and demonstrate reasonable knowledge and experience in onsite wastewater systems.

10.1.3 Responsibility for Design

All soils evaluations and designs shall by stamped and signed by the licensed or registered person responsible for the work. Unregistered individuals may perform the above work under the supervision[12] of the registered individual in control of the work.

10.1.4 Responsibility for Installation

A Contractor, the Contractor's responsible managing employee or subcontractor working directly for the Contractor of Record, shall perform all installations and repairs requiring the work of a licensed Contractor. The installation shall be the sole responsibility of the Contractor of Record.

10.2 Education and Training

Persons involved in the design and installation of OWTS shall have received sufficient training and education to be competent in performance of their work. Civil Engineers, Environmental Health Specialists, and Engineering Geologist, shall be registered in the State of California. Soil Scientists are required to show proof of registration from any State in the U.S. Any person qualified under section 10.1 that is responsible for soils evaluations, design, plan review and inspection of OWTS shall have completed a total of 9 college semester units, with 3 units each from the following group of courses:

a. 3 semester units of soil science, soil morphology or soil mechanics,
b. 3 semester units of fluid mechanics or hydraulics,

[12] Supervision shall mean the direction and responsibility for a subordinate's work by a registered professional. A subordinate can perform office and field work <u>outside the physical presence</u> of the registered supervisor in control of the work.

GENERAL STANDARDS

c. 3 semester units of biology, microbiology or chemistry.

All persons actively engaged in and responsible for work related to the design, installation, inspection and regulation of OWTS shall have completed a minimum of 6 months in-service training under the direct supervision of qualified professional working in the OWTS profession. It is recommended that professionals earn at least 3 units of continuing education every 2 years in related subjects, workshops and seminars in OWTS technology.

10.3 Certification

Persons who are actively engaged in the design, installation, repair, inspection, maintenance, and regulation of OWTS shall have completed a State-recognized training and/or testing program and obtained a certificate in onsite wastewater systems. Such persons shall submit a copy of certification to be kept on record with the State Department of Consumer Affairs. Permitting agencies responsible for the regulation of OWTS systems shall require that OWTS professionals working in their jurisdiction provide proof of certification. Individuals or entities who are currently engaged in work in the OWTS profession in California will be required to obtain a Certificate of training from a State recognized training and/ or testing program within two years of establishment of a statewide OWTS certification program.

10.4 Violation

It shall be a misdemeanor for persons who misrepresent, ignore or willfully violate any portion of section 10.0; those who do may be subject to fines or legal action as set forth by the ALA.

11.0 Parcel Development and Requirements

This section addresses existing undeveloped parcels, developed parcels with OWTS systems, developed parcels requiring modifications to the existing OWTS and creation of new parcels for commercial and residential use.

11.1 Variance/waiver

Developed and undeveloped parcels shall comply with the requirements of this Regulation whenever feasible. Portions of this Regulation may be waived by the ALA to provide for reduced setbacks or incorporate adjacent lands through recorded easements or allow for use of enhanced treatment systems to mitigate any of the following conditions:

a. Insufficient parcel size or
b. Insufficient effective soil depth or
c. Insufficient ground or surface water clearance

The waiver shall be granted only if ALA makes a finding that the proposed system does not degrade water quality, impact beneficial uses or create a health hazard or nuisance condition

GENERAL STANDARDS

11.1.1 Repairs to Failing Systems

When a failed system is repaired, no increased usage or expansion to the system will be permitted unless the system can be upgraded and sized in accordance with the applicable sections in this Ordinance.

11.1.2 Modifications to existing systems

Expansion or modifications to the existing system to allow for increased usage shall conform to the Technical Standards of this document. Waiver of these standards to expand or modify an existing system for increased usage is not permitted.

11.1.3 Off-Parcel Systems

When additional land is required outside the boundaries of the parcel where sewage is to be generated, an easement binding to the land shall be executed and recorded describing the location, dimension and components of the system that cross property lines and which lies in part or wholly on land different from the parcel from which the wastewater generates.

The ALA on case-by-case basis may waive portions of these regulations to accommodate repairs.

11.2 New land division

11.2.1 Residential and Subdivisions

Any residential land division including single and multi-family parcels that will use OWTS for wastewater treatment shall be subject to the following criteria for approval:

a. Documented site and soils evaluation by a qualified consultant or the ALA.
b. Any additional evaluation or testing deemed necessary to satisfy the standards set forth in these regulations.
c. A plot or site plan prepared by the consultant performing the site and soils evaluation noting the dimension and location of the proposed waste treatment area. The soil treatment area shall note the size and dimension of the primary treatment and expansion fields. The site plans shall be recorded with the parcel or subdivision map. A copy of the site plan and recommended type of OWTS shall be placed on file with the ALA.
d. Each parcel within the proposed land division shall have a designated sewage treatment area. The location of the treatment area shall be determined from evaluation of the site and soil characteristics, and absorption capacity of the soil in gallons per day, per square foot. The treatment areas <u>for all parcels</u> shall be sufficient to accommodate a minimum daily flow of 300 gallons and the recommended type of treatment system.

GENERAL STANDARDS

11.2.2 Commercial Land Divisions

The creation of parcels for commercial use shall conform to Section 11.3.1 except that the reserved treatment area shall be sized according to the estimated strength and volume of waste flow generated by the commercial facility and shall be sized to accommodate a minimum of 200% expansion. The use of OWTS for any waste discharge other than sewage and gray water shall not be allowed without Waste Discharge Requirements issued by the RWQCB or an Underground Injection Control (UIC) permit from the U.S. Environmental Protection Agency.

TECHNICAL STANDARDS

12.0 Evaluation Procedures

The purpose of the site and soils evaluation is to assess the suitability of a given site and location to be used for wastewater treatment

12.1 Site evaluation report (SER)

A Site Evaluation Report (SER) is required for every individual parcel proposing use of an OWTS. The ALA shall establish the specific information required for a complete SER.

12.2 SER Minimum Requirements

The SER shall include information regarding soil conditions, characteristics and estimated permeability, depth of zones of saturation, depth to bedrock, surrounding geographic and topographic features, direction of ground contour and % slope, distance to drainages, water bodies and potential for flooding, location of existing or proposed roads, structures, utilities, domestic water supplies, wells and ponds, existing wastewater treatment systems and facilities, relevant geographic and topographic information and drainage features. Site limitations and special conditions shall be listed in the SER.

12.2.1 Site Limitiations

During the preparation of the SER, the consultant shall address the direction treated water will travel once it enters the soil treatment area. Additional work may include a geotechnical report and a site capacity study (SCC). Special designs and site conditions are required for systems on slopes over 30 percent.

12.2.1.1 Table 12-1

MINIMUM REQUIRED HORIZONTAL SETBACKS – STANDARD SYSTEMS

		Septic Tank & Other Effluent	Soil Treatment System Primary Treatment Unit	Soil Treatment System Secondary Effluent
Public Water Supply Well		100’	150’	
Water Well		100'	100'	100'
Springs or Seeps				
Upgradient		50'	50'	50'
Downgradient		50'	100'	50'
Flood Plain (10 year event)		50’	100’	100’
Lava Outcropping		50'	100'	50'
Surface Waters				
Perennial Streams		50'	100'	100'
Intermittent Streams		50'	100'	50'
Ephemeral Streams		50'	25'	25'
Lakes & Reservoirs		50'	200'	100'
Wetlands		50’	100’	100’
Ocean – mean high water mark		50’	100’	100’
Groundwater Interceptors				
Upgradient		20'	20'	20'
Downgradient		25'	75'	25'
Irrigation Canal				
Lined		25'	50'	25'
Unlined				
	Upgradient	50'	100'	50'
	Downgradient	50'	100'	50'
Storm Drainage Pipe[2]		5'	25'	5'
Cutbanks				
Intersect effective soil depth within 48" of ground surface		25'	4X Height	4X Height
Effective soil depth not intercepted		10'	4X Height	4X Height
Fill		10'	4X Height	4X Height
Escarpment				
Intersect effective soil depth within 48” ground surface		25'	75'	50'
Effective soil depth not intercepted		10'	50'	25'
Roadway Setback		20'	20'	20'
Property Line		5'	5'	5'
Swimming Pool		5'	5'	5'
Water Pipe				
Main Line		10'	10'	10'
Service Line		5'	10'	5'
Driveway or Parking Area				
Perc Rate < 30 MPI		0'	0'	0'
Perc Rate > 30 MPI		0'	Not Allowed	0'
Foundation				
Footing		5'	5'	5'
Basement		5'	25'	25'
Absorption Trench		1'	10'	6'

Footnotes:
1 If domestic water supply, setback shall be 100'
2 Watertight

12.3 Soil evaluation

12.3.1 Procedure

The number of soil observations shall be determined by the ALA and the professional judgment of the individual conducting the site evaluation. Soil observations shall be performed in an exposed pit. Underground utilities must be located before soil observations are undertaken. Required safety precautions[13] must be taken before entering soil pits. Soil observations shall be conducted prior to any required hydraulic tests to determine whether the soils are suitable and to determine if and at what depth hydraulic tests are warranted. The depth of the soil profile test pits shall be to the seasonally saturated layer, the bedrock, or three feet below the proposed depth of the system, whichever is less.

a. Soil observations. The soil profile pit shall be observed and described measuring the thickness of each major horizon and depth relative to the ground surface. The soil description shall be based on the USDA soils definition of textural classes, structure, color, chroma, size and percentages of roots, pores, rocks, clay skins and redoximorphic features and the USDA soils chart[14] for estimating soil permeability. The soil profil*e* description shall identify soil characteristics that may enhance or limit treatment of wastewater.

b. Soil description. Each soil observed at the proposed soil treatment area shall be evaluated under adequate light conditions with the soil in a moist state.

(1) The depth of each soil horizon measured from the ground surface. Soil horizons are differentiated by changes in soil texture, soil color, redoximorphic features, bedrock, consistence, and any other characteristic that may affect water percolation or treatment of effluent.

(2) The soil matrix and mottled color described per horizon by the Munsell Soil Color Charts, 1992 Revised Edition or equivalent, which is incorporated by reference. This document is available from Macbeth Division, Kollmorgen Instruments Corporation, 405 Little Britain Road, New Windsor, New York 12553.

(3) A description of the soil texture and consistence using the United States Department of Agriculture (USDA) soil classification system as specified in the Soil Survey Manual, Agricultural Handbook No. 18 (October 1993), which is incorporated by reference. The manual is issued by the United States Department of Agriculture and is available through the Superintendent of Documents, United States Government Printing Office, Washington, D.C.

(4) Depth to the bedrock.

(5) Depth to the seasonally saturated soil for new construction or replacement as determined by redoximorphic features.

(6) Any other soil characteristic that may need to be described to properly design a system such as hardpans or restrictive layers must be classified in

[13] See CALOSHA requirements for entering open excavations
[14] Soil texture based on USDA soil triangle

accordance with chapter 3 of the Soil Survey Manual, Agricultural Handbook No. 18, which is incorporated by reference in sub item (3).

12.3.2 Classification

Soils shall be classified using the U.S. Department of Agriculture soils classification system for soil name, type and particle size limits. The soil type shall be classified in the field by the consultant and/or representative officers of the ALA having jurisdiction for OWTS. Soil classification may include supplemental laboratory procedures along with the field work. Where the soil permeability or infiltration rate cannot be reasonably estimated, additional testing procedures may be required by the ALA. These tests may include traditional percolation testing and other methods approved by the ALA.

12.3.3 Evaluation of Groundwater

A static water table that lasts longer than three weeks in any given season shall be considered groundwater. The water table shall be evaluated using peizometers constructed in accordance with _______.

12.3.3.2 Data and Information

The groundwater evaluation shall include an assessment of the hydraulic gradient and direction of flow of the groundwater. The collected data shall be reviewed by the consultant and ALA to determine if wastewater can be applied without contamination of the groundwater or creating significant groundwater mounding.

12.3.3.3 Monitoring

Groundwater monitoring shall be performed at the time of year when the maximum groundwater elevation is expected to occur. The monitoring shall be performed during the normal wet season after 80% of the expected average rainfall has occurred. Monitoring shall be performed 48 to 72 hours after a rainfall. In areas that experience high groundwater due to flood irrigation, monitoring shall be done when flooding is at its maximum.

12.3.4 Estimating Soil Permeability

The estimated soil permeability shall be based on the USDA soil classification chart for soil structure and texture. Hydraulic testing maybe required to provide meaningful data that can be used to design absorption fields.

12.3.5 Hydraulic Tests

Hydraulic tests shall be required for the following:

a. Soils with an estimated clay fraction greater than 30% as determined from the USDA soil chart.
b. For any proposed system that will serve more than one single-family residence.
c. Any site where in the opinion of the consultant or the ALA, the soil permeability is questionable.
d. The hydraulic tests shall either be a percolation test, infiltration test, or absorption test, as determined by the ALA. **The type of**

test depends on the type and size of soil absorption system needed.

13.0 Design and Performance Parameters

13.1 Minimum discharge standards

Onsite Wastewater Treatment Systems shall be designed to meet the minimum treatment standards in table 13-1:

Table 13-1

Predominant soil below soil treatment system bottom	Min. Soil (ft) below soil treatment system	BOD5	TSS	NH3-N	N	TKN	PO4-P	Coliform CFU's
Sand / Loamy Sand	4	?	?	?	?	?	?	?
Sandy Loam	3							
Loam	3							
Silt / Silt Loam	3							
Sandy Clay Loam	2							
Clay Loam	2							
Silty Clay Loam	2							
Sandy Clay	2							
Silty Clay	2							
Clay	2							

* Values for BOD5, TSS, NH3-N, N, TKN, and PO4-P are discretionary and all are to be determined by the ALA with **concurrence from the Regional Water Quality Control Board.**

13.2 Determining design flows

Design flows shall be estimated by one of two methods:

1. by number of bedrooms for the proposed dwelling or by estimating the treatment capacity of the soil treatment area/leachfield in gpd/sf. In sizing by number of bedrooms the designer shall use a minimum of 120 gpd /bedroom with low flow fixtures, otherwise 150 gpd/bedroom. The minimum design flow for single-family residences shall be 300 gal/day.
2. The dwelling shall be designed not to exceed the maximum number of fixture units or number of bedrooms that can be supported by the estimated maximum daily flow in relation to the capacity of the soil treatment area to treat and accept effluent.

13.3 Replacement area

There shall be a minimum of 100% reserve area set aside for replacement of the Onsite Wastewater Treatment System.

13.4 Determining design application rates (gpd/sf)

Soil application rates may be determined from either table 13-2 Table 13-3, or the USDA soil chart. Empirical methods may be used in conjunction with the USDA soil chart.

13.4.1 Table 13-2[15]

To determine the design application rate, read the table below in sequence beginning at the top row and continue downward. Find the soil description that best matches the predominant soil type found below the soil treatment system (bottom of trench, bed, etc.). Use the corresponding application rate in the right hand columns.

Table 13-2

Soil Texture	Structure	Application rate Gallons per Day / SQ. Ft.
Gravelly coarse sand & coarser	loose or cemented	0.0
Clay, sandy or silty clay silt loam	weak or massive massive	0.0 0.0
Sandy clay loam, clay loam or silty clay loam	massive	0.0
Sandy clay, clay or silty clay	moderate to strong	0.2
Sandy clay loam, clay loam or silty clay loam	weak	0.2
Sandy clay loam, clay loam or silty clay loam	moderate to strong	0.4
Sandy loam, loam or silt loam	weak	0.4
Sandy loam, loam or silt loam	moderate to strong	0.6
Fine, very fine, loamy fine and very loamy fine sand	na	0.8
coarse, single grain sand	na	1.2

13.4.1.1 Empirical Methods Used to Determine Application Rates

Empirical Methods may include use of hydraulic tests. Enhanced treatment systems shall be used for soils with rates faster than 5 minutes per inch and slower

[15] Compiled from Wisconsin Small Scale Waste Management Project and North Coast Regional Water Quality Control Board Guidelines.

than 60 minutes per inch. Soils with percolation rates greater than 240 minutes per inch are generally considered to be unsuitable.

13.4.2 Table 13.3 Suggested hydraulic and organic loading rates for sizing infiltration surfaces – USEPA Manual

Texture	Structure		Hydraulic loading ($gal/ft^2/day$)		Organic loading (lb BOD/ $1000ft^2/day$)	
	Shape	Grade	BOD=150	BOD=30	BOD=150	BOD=30
Coarse sand, sand, loamy coarse sand, loamy sand	Single grain	Structureless	0.8	1.6	1.00	0.40
Fine sand, very fine sand, loamy fine sand, loamy very fine sand	Single grain	Structureless	0.4	1.0	0.50	0.25
Coarse, sandy loam, sandy loam	Massive	Structureless	0.2	0.6	0.25	0.15
	Platy	Weak	0.2	0.5	0.25	0.13
		Moderate, strong				
	Prismatic, blocky, granular	Weak	0.4	0.7	0.50	0.18
		Moderate, strong	0.6	1.0	0.75	0.25
Fine sandy loam, very fine sandy loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.6	0.25	0.15
		Moderate, strong	0.4	0.8	0.50	0.20
Loam	Massive	Structureless	0.2	0.5	0.25	0.13
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Silt loam	Massive	Structureless		0.2	0.00	0.05
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.4	0.6	0.50	0.15
		Moderate, strong	0.6	0.8	0.75	0.20
Sandy clay loam, clay loam, silty clay loam	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak	0.2	0.3	0.25	0.08
		Moderate, strong	0.4	0.6	0.50	0.15
Sandy clay, clay, silty clay	Massive	Structureless				
	Platy	Weak, mod., strong				
	Prismatic, blocky, granular	Weak				
		Moderate, strong	0.2	0.3	0.25	0.08

TECHNICAL STANDARDS

Source: USEPA Onsite Wastewater Treatment Systems Manual – Adapted from Tyler, 2000.

13.5 Adequate separation from groundwater

13.5.1 Determining Depth to Groundwater or Seasonal Water Table

The level of groundwater or seasonal water table shall be determined in accordance with Section 11.3.2.

13.5.2 Minimum Groundwater Separation

Table 13.4 shall be used to determine the minimum required separation from groundwater. Groundwater shall be defined as the highest seasonal level of the permanent water table in the soil. Perched water or seepage observed in the profile hole shall be monitored to determine if the water is a localized phenomenon or if the water reaches a standing level in the soil mantle.

13.5.3 Table 13.4 Groundwater Separation

Table 13-4		
Soil Texture	Structure	Separation/ft
Gravelly coarse sand & coarser	loose or cemented	Enhanced treatment required
Clay, sandy or silty clay silt loam	weak or massive massive	3 3
Sandy clay loam, clay loam or silty clay loam	massive	3
Sandy clay, clay or silty clay	moderate to strong	3
Sandy clay loam, clay loam or silty clay loam	weak	3
Sandy clay loam, clay loam or silty clay loam	moderate to strong	5
Sandy loam, loam or silt loam	weak	5
Sandy loam, loam or silt loam	moderate to strong	5
Fine, very fine, loamy fine and very loamy fine sand	na	5
coarse, single grain sand	na	40 or enhanced treatment

13.5.4 Groundwater Mounding

Groundwater mounding analysis shall be used to predict the highest rise of the water table during the wet weather season taking into account background groundwater conditions. The maximum acceptable short term rise of the water table under treatment systems are as follows:

Systems with design flows of <1,500 gpd...........50% reduction in separation

Systems with design flows > 1,500 gpd................Minimum of 24" separation

13.5.5 Assessing Cumulative Impacts[16]

The local regulatory agency and Regional Board shall determine the need for a cumulative impact assessment of OWTS for subdivisions, commercial development and for single systems with a design capacity greater than 1,500 gpd. The assessment shall include, but not be limited to, effects of groundwater mounding, nitrate loading and fecal (**pathogen?**) contamination. Analysis of cumulative impact effects shall be conducted using principles of groundwater hydraulics and shall reference the methodology and literature used in the analysis. The wastewater flow used for the analysis shall be as follows:

Individual Residential Homes.................................120 gpd per bedroom (150 gpd per bedroom without low flow fixtures) or number of fixtures units

Multi-family and Non-Residential Systems...............System design flows

13.5.6 Nitrate Loading

Analysis of nitrate loading effects shall be based, at a minimum, on an estimate of an annual chemical - water mass balance. The minimum values used for the total nitrogen concentration of septic tank effluent shall be 40 mg/l as N (for average flow conditions) for residential wastewater, or as determined from the sampling of comparable system(s) or literature values. Onsite Wastewater Treatment Systems shall not cause the groundwater nitrate concentration to exceed 10.0 mg/l N at any source of drinking water on the property nor on any off-site potential drinking water source.

14.0 Onsite Wastewater Treatment Systems

14.1 Classification and description

14.1.1 Standard Onsite Wastewater Treatment System

Standard onsite wastewater treatment systems consist of a septic tank and gravity distribution of effluent to a soil treatment system consisting of leaching trenches, fields, or beds. Effluent is discharged from the septic tank to the leachfield by gravity.

[16] Portions of this section are reprinted from the North Coast Regional Water Quality Control Board Basin Plan for On-Site Wastewater Systems.

14.1.1.1 Design

Standard system designs may be prepared by a certified design consultant or by the ALA. The septic tank shall be sized in accordance with section 13.3. Soil treatment system sizing shall be determined using the estimated application rate as defined in Section 13.5.

14.1.2 Enhanced Onsite Wastewater Treatment Systems

Enhanced treatment systems are defined as any system other than a standard system. Enhanced treatment systems shall be used on parcels where site and soil conditions will not support a standard system or where increased treatment is needed. These systems are designed by professional consultants deemed eligible under Section 10. Enhanced treatment systems are characterized as having increased design and performance criteria. Unlike standard systems, enhanced treatment systems vary in design and concept depending on the site and soil conditions and are usually required in specific applications.

14.1.3 Experimental Systems

Experimental systems are individual or proprietary designs that are considered to be new or recent innovations in the industry, or in use in other states and countries but uncommon to California.

14.1.3.2 Approval of Experimental Systems

Experimental systems shall be reviewed on a case-by-case basis at the local level. The use of experimental systems may be considered combined with a reasonable testing and monitoring protocol subject to approval by the Regional Water Quality Control Board having jurisdiction.

14.1.3.3 Testing and Monitoring

Experimental systems shall be tested and evaluated for a minimum of three years and shall be limited in number of installations per year by agreement between the RWQCB and the local permitting agencies. The RWQCB shall issue a wastewater discharge permit during the testing period. The owner and the design consultant of the system shall be responsible for the performance, operation and evaluation of the system for the first five years. Thereafter, the owner shall assume responsibility to operate and monitor the system. The owner shall also have a contingency system approved for replacement should the experimental system fail to perform in accordance with the local ordinance and the wastewater discharge permit requirements.

14.1.4 Proprietary Systems

Proprietary systems are components or units used for treatment of wastewater. Proprietary systems may include filters, aeration units, treatment processes and distribution equipment. Proprietary systems are distinguished as being manufactured equipment that is patented and sold commercially through the manufacturer and their distributors. The proposed application or use of the proprietary system shall determine what classification requirements govern its use.

14.2 Final effluent handling

14.2.1 Surface Treatment

Treated effluent can either be applied to land or discharged to surface water.

14.2.1.4 Surface Water Discharge

Onsite Wastewater Treatment Systems designed for surface water discharge of effluent requires that ~~a~~ National Pollutant Discharge Elimination System (NPDES) Permit is obtained from the RWQCB with jurisdiction. **(Comment: An NPDES permit for a small system is extremely difficult to obtain and is strongly discouraged due to CEQA constraints and cost.)**

14.2.1.5 Land Application

a. Use of treated effluent for irrigation is allowed when it can be applied safely and effectively and when it can meet state wastewater discharge requirements contained in Title 22 reclamation regulations.
b. Land application subject to storm water runoff requires disinfection to a median [illegible] MPN/100 ML total coliform (240 max) (California Department of Health Services).
c. For applications requiring disinfection, Title 22 requires an engineering report, redundancy features, and daily coliform monitoring.
d. Wastewater used for crop irrigation for non-milking animals (with no stormwater runoff) requires secondary undisinfected effluent.

14.2.2 Subsurface Treatment

Approved methods of subsurface treatment of effluent include leaching trenches, beds, **sub-surface drip dispersal (SDD), and** seepage pits.

14.2.3 Evapo-transpiration and Wetland Systems

Evapo-transpiration systems are shallow lined holding ponds with large exposed surface areas. The performance of evapo-transpiration systems is dependent upon optimum climate conditions and therefore has limited applications. Most evapo-transpiration systems are site specific and vary in design and concept. Artificial wetlands use aquatic plants to filter nutrients and pathogens from the wastewater. The wastewater is dispersed to the atmosphere through evapo-transpiration.

14.2.3.6 Evapo-transpiration requirements

14.2.3.7 Wetland systems requirements

(1) The bottom slope is a maximum of 1 percent. For larger flows, the bottom slope should be based on hydraulic loading rates.
(2) To assist in providing adequate retention time, the length-to-slope ratio shsll br between 2-to-1 and 3-to-1.

(3) Sufficient cross-sectional areas must exist in the bed/channel for water to move through it without surfacing.
(4) Hydraulic retention time in the bed/channel (amount of time the effluent remains in the bed/channel), is a minimum of 2 – 3 days.
(5)Discharges other than into the soil require disinfection (maximum two log reduction in fecal coliform) and aeration (they are anaerobic).

14.2.4 Holding Tanks

Use of holding tanks is generally limited to recreational areas, parks and commercial facilities where sewer facilities are not available and where installation of OWTS is not feasible. Operating permits for installing holding tanks shall include a routine pumping schedule. Holding tanks shall be equipped with high water alarms and have sufficient reserve storage capacity. Holding tanks shall be watertight and have sampling wells installed to monitor contamination. Use of holding tanks for individual and multi-family residences is not permitted for new development. Holding tanks may be used as a temporary facility in emergencies or during repairs to an existing septic system. Sampling wells are not required on temporary installations.

14.2.5 Graywater Systems

Graywater systems are to be designed in accordance with the provisions of the Uniform Plumbing Code (UPC) except as otherwise provided for in Appendix G Graywater Systems, Title 24, Part 5, California Administrative Code, and any additional requirements set forth by the ALA. The use of graywater systems shall conform to the requirements of the General and Technical Standards in this Ordinance.

15.0 Material and Component Requirements

All pipes, fittings and appurtenances used in onsite wastewater systems shall be made of non- degradable, corrosion resistant PVC, ABS or polyethylene plastic materials. Use of ferrous metal, aluminum, copper, brass or bronze coated materials is not allowed. Fittings with solid stainless steel parts are acceptable. Stainless steel coated parts and fittings should not be used.

15.1 Septic and dosing tanks

Septic and Dosing tanks shall be water tight and tested when installed in accordance with section 15.1.8.

15.1.1 Septic Tank Sizing

15.1.2 Tank Construction

Tanks shall be constructed as described in Appendix II of this ordinance. Tanks shall maintain their rigidity and structural integrity when filled with water. Any tank that deforms sufficiently to distort, bend or separate the baffle, tees, fittings, connections and risers from the tank shall be rejected and removed from the site. The inlet and outlet ports of tanks shall be fitted with a molded or cast in place IAPMO approved flexible neoprene waterproof boot gasket. Tank openings requiring that fittings be mortared or connected with screw or bolt on adapters are not allowed except for repairs or necessary modifications as approved by the ALA. A registered civil engineer shall design all septic and dosing tanks. Septic tanks shall be capable of supporting a vertical load of a least 500 lbs./sf when the maximum coverage does not exceed three feet. Tanks installed with more than three feet of cover shall be reinforced to support the load. All Tanks shall be designed for lateral loads of at least 62.4 lbs. / cf. All tanks shall be marked on the uppermost exterior tank surface with the liquid capacity of the tank and the manufacturer's identification.

15.1.3 Tank Configuration

a. Concrete tanks shall be "one-piece" whenever practical. Joints between tank sections and between the cover and access riser shall be tongue and groove, sealed watertight using a bituminous compound or epoxy. All tanks shall be fitted with access risers.
b. Septic Tanks shall have multiple compartments. The primary (inlet) compartment shall have a minimum liquid capacity of at least two-thirds of the required liquid capacity, as measured from the invert of the outlet tee fitting.

15.1.3.1 Pump Systems

Pump systems shall require a separate septic tank and dosing tank. The septic tank may be single or multi chambered. The dosing tank (where the pump is located) may be a single chamber tank. In certain applications where expected waste flows will be low and intermittent (e.g. office with few employees with restroom and no other facilities) a two chamber baffled septic tank may be used as a combination septic and dosing tank with the pump located in the secondary chamber. Any tank equipped with a pump shall conform to the requirements of section 14.1.6.

15.1.3.2 Dosing tanks

The pump intake port shall be located in the clear liquid zone of the minimum liquid level or a minimum of 8 inches above the bottom of the tank; whichever is the greater distance from the bottom.

15.1.4 Tank Fittings and Appurtenances

Pipes, valves and appurtenances located in septic and dosing tanks shall be installed for easy access, repair and replacement through the tank access hole and risers. Electrical splice boxes may be installed internally in the tank risers or externally mounted on a weatherproof, non-degradable pedestal, securely anchored to prevent settlement or tilting. Splice boxes shall be gas and water tight and corrosion resistant and installed in conformance with the manufacturer's specifications and local electrical codes where applicable. All electrical conduits exiting the tank shall be sealed against gas vapor and moisture with silicone or other National Electrical Manufacturers Association (NEMA) approved materials.

15.1.5 Effluent Filter

All effluent discharged from the septic tank shall be screened with a 1/8th inch mesh screen filter. If a dosing tank is used following a septic tank, the effluent filter shall be located at the dosing tank outlet.

15.1.6 Access Riser Assembly

The septic and dosing tanks shall have at least one 24"∅ access riser with removable lid set to grade for access and inspection. The diameter of the riser shall be increased depending on the depth of the tank to facilitate access to the tank. Septic tanks with pump chambers and dosing tanks shall have the access riser installed where the pump assembly is located. Risers and lids shall be concrete, fiberglass or PVC. The lids shall have a gas and watertight seal. Risers shall be permanently attached to the tank by epoxy or a bituminous mastic compound. Risers shall not be attached to the tank lid with cement or mortar products. No-shrink cement grout may be applied as an additional coating sealant at the joints <u>after</u> the riser is installed with epoxy or bituminous mastic. Risers shall be subject to the testing requirements of section 15.1.8.

15.1.6.3 Access Riser Cover Security

Access risers shall be equipped with tamper proof covers that require the use of entry tools or procedures or strength not normally possessed by children under 11. Access risers at or above the ground surface in areas accessible to the public shall be locked to prevent unauthorized access and entry.

15.1.7 Pump and Suspended Pump Assemblies

Pumps shall be rated for wastewater use. Pumps shall be appropriately sized so that the pump does not operate near its shut-off head. When appropriate, pumps shall be fitted with anti-siphon and back-flow check valves. Mechanical floats or timers shall control each pump. Pumps may be seated on a level and stable platform of poured concrete or cement block or placed in suspended pump assemblies with the pump intake port placed in the clear liquid zone whenever feasible. In all cases the pump inlet port shall be located a minimum of 8 inches above the tank bottom or per the pump manufacturers requirements, whichever is greater. The pump or suspended pump assemblies shall be installed in accordance with the manufacturers requirements and recommendations. Suspended pump packages shall be held in place with PVC or other non-corrosive brackets inside the tank riser. Package Assemblies need not rest on the tank bottom or platform unless specified by the manufacturer. The Pump discharge should not exceed a rate that causes the pump to stir the liquid or solids in the tank.

15.1.8 Emergency Storage Reserve

Tanks with pumps shall maintain emergency reserve storage area measured below the invert of the inlet tee. The minimum reserve storage shall be 200 gallons or one-day <u>average daily flow (gpd)</u>, whichever is greater. The average daily flow shall be determined by the number of bedrooms of the home multiplied by 120 gallons per day per bedroom (150 gpd/bedroom without low flow fixtures). Local jurisdictions regulating onsite wastewater systems may consider enhanced treatment system proposals for providing emergency storage they feel are reasonable and appropriate. The tank shall be equipped with a high water alarm float. The minimum liquid level shall be set no lower than what is necessary to provide the minimum required emergency storage + dosing volume. Setting the "off" floats arbitrarily low to maximize emergency storage capacity is discouraged. The off float shall not be set as to expose any portion of the pump. Tanks and pump configurations should be selected which will optimize the use of the tank volume during operation and not compress the clear liquid zone. The minimum liquid level should be kept as high as practical to minimize the exposed interior surface of the tank to corrosive gases and stress from exterior hydrostatic and earth pressures.

15.1.9 Testing Tanks for Leakage

Tanks are to be tested in place prior to backfill using a 24 hr. hydrostatic water test. The tank shall have the inlet and outlet sanitary tees and riser installed. The inlet and outlet tees shall be temporarily sealed to hold water. The tank shall be filled with water to 2 inches above the tank lid and riser interface to check for leakage. Tanks shall not have a drop in water greater than 1 inch in a 24-hour period.

15.1.10 Control and Alarm Assembly

Pumps used in an OWTS shall be connected to and operated from an approved control panel assembly. Pump controls and alarms shall be located in an exterior rated, water proof, non-corrosive service panel, mounted outside dwellings and buildings in a location that is visible and easily accessible for service. Each pump shall be controlled either by a mechanical float or timer assembly. Each pump shall have an event counter and hour meter included in the control panel. The conduits enter pump control and service panels shall be sealed against gas vapor and moisture with silicone or other approved NEMA sealant.

15.1.11 Control Panel Access and Security

Control panels shall be equipped with covers that require the use of entry tools or procedures or strength not normally possessed by children under 11. Control panels in areas accessible to the public shall be locked to prevent unauthorized access and entry.

15.2 Effluent distribution and soil treatment system

15.2.1 Gravity Distribution

Gravity distribution of effluent through the soil treatment system can be either serial or uniform distribution. In a serial distribution system the trenches are constructed in such a way that effluent is discharged continuously into one trench with the excess effluent flowing to the next trench in serial fashion. A system using uniform distribution applies the effluent equally to all of the trenches.

15.2.2 Distribution Boxes, Flow Splitter and Divider Assemblies

Distribution boxes and flow divider assemblies shall be made of concrete, ABS, PVC, PE plastic or fiberglass. Concrete assemblies shall have a corrosion resistant coating applied to interior surfaces. D-boxes and flow divider assemblies shall be installed outside of traffic and pedestrian areas with the lids and inspection ports set at or above grade for easy access and inspection.

15.2.3 Pipe and Filter Media and Plastic Leaching Chambers

Distribution pipe in the treatment field shall conform to Section 15.0. Filter media used in the treatment field shall be approved by the ALA. Plastic Leaching Chambers may be used for private <u>and</u> commercial applications in lieu of pipe and filter media. Installation of plastic leaching chambers shall conform to the manufactures specifications and recommendations.

15.2.4 Pressure Distribution Systems

Pressure distribution systems shall be engineered to distribute the effluent uniformly under low pressure throughout the soil treatment system. The pipe laterals in a pressure distribution treatment field shall be CL 200 or greater PVC plastic pipe with 1/8 to 1/4 inch ∅ orifices of uniform size drilled at even spacing along the length of the pipe.

15.2.4.4 Pressure Distribution Hydraulics

Pressurized distribution systems shall be designed for the appropriate head and capacity and shall be demonstrated to produce a minimum residual head or squirt height of five feet. All pressure distribution lines shall be squirt tested to verify adequate squirt height. The designer shall determine the maximum length of pressure laterals used in each design in conformance to section 14.2.4.2.

15.2.4.5 Pressurized Laterals

Pressure laterals in treatment fields shall be a minimum 1 1/4” ∅ diameter pipe. Lateral orifices may be pointed up or down. Orifices pointed up shall have orifice shields or other protection to prohibit media particles from blocking or clogging the orifice. Lateral distribution lines shall not exceed a maximum allowable 15% loss in head between the first and last orifice in each lateral and a maximum 15% loss across the entire field between the first and last lateral. Pressure laterals can be designed with variable lengths and configurations limited to the following design parameters:

a. Maximum allowable head loss in each line as defined above,
b. Orifice diameter and maximum allowable spacing determined by the designer and ALA,

c. Adequate placement of cleanouts (maximum of one cleanout every 70 feet for lines 1" to 11/4" ID and every 100ft for laterals 11/2" ID and up).[17]

d. A maximum of 35-gpm design pump discharged from the dosing tank, other hydraulic and mechanical limitations which may impair performance and operation.[18]

15.2.5 Infiltrative surface sizing requirements

15.2.6 Subsurface Drip Dispersal Soil Treatment Systems

Subsurface drip dispersal distribution systems are enhanced treatment systems that are engineered.

15.2.6.6 Requirements

a. self-cleaning filters shall be designed to remove particles larger than 100 to 115 microns

b. backflush water generated from a self-cleaning filter and dripline flushing shall be returned to the headworks

c. time dosing shall be used to dose effluent to the distribution system

d. uniform pressure distribution at 15-45 psi

e. turbulent flow emitters require that filtered wastewater must first pass through a pressure regulator to control the maximum pressure in the dripline.

f. the difference in discharge rates between emitters shall be no more than 10 percent

g. vacuum relief valves are required at the high points of both the supply and return manifolds

h. manufacturer recommended hydraulic loading rates shall be used in design to establish the square foot of drip distribution footprint area necessary

i. operations and maintenance manual

15.3 Inspection Wells

A sufficient number of inspection wells, as determined by the ALA, shall be strategically placed directly in the subsurface treatment beds and trenches to observe the standing liquid level. Inspection wells shall extend to the bottom of the trench or leaching bed and anchored sufficiently to prevent disturbance or removal. The inspection wells shall have removable caps and may either extend above grade or be enclosed in service boxes set to grade with removal lids. The

[17] Pressure laterals 3/4" to 11/4" ID may be greater than 70 if with proper location of cleanouts. Cleanouts can be located in line with laterals and are not limited to terminal
ends. Most plumbing outfits and rooter services carry on hand a standard plumber's snake 75 ft. in length and can rod pipe 1" ID and greater. Most rooter services have plumber snakes 100 ft. in length. Plumbers and rooter services can clean 3/4" ID pipe and up.

[18] Pump discharge from the dosing tank should not exceed 35 gpm to prevent stirring the tank.

boxes shall be made of non-degradable material such as PVC, fiberglass or concrete. Additional inspection and sampling wells may be installed outside the leaching area to monitor groundwater and movement of effluent through the soil.

15.4 Cleanouts

Cleanouts are recommended on all gravity and pressure laterals in leaching beds and trenches. The cleanouts should be installed above grade or at grade enclosed in a service box with removable lid. Gravity leach lines may benefit from having cleanouts installed to provide periodic flushing of sludge and grease that settles in the pipe. Pressure pipes require cleanouts and should be flushed annually to prevent clogging of distribution orifices. Cleanouts are required at mid section or both ends of pressure laterals over seventy-five feet in length.

15.5 Diversion Ditches and Curtain Drains

Use of diversion ditches or curtain drains shall conform to the set back requirements in table 12-1. Diversion ditches and curtain drains may be used to intercept seasonal surface and subsurface lateral seepage on the uphill slope above the treatment field. Curtain drains should not be used to attempt to de-water sites or lower the water table to install a treatment field.

16.0 Design Review & Plan Checking

All design submittals for new OWTS and for repairs shall be reviewed by the ALA or its representative officers.

16.1 Design submittals

Designs submittals shall conform to these regulations and any additional requirements of the ALA. Designs shall be signed and stamped by the person responsible for the design.

16.1.1 Design Review

Competent staff or representative officers of the ALA who possess the appropriate training, certificates and experience in OWTS as prescribed in section 10.0 of the General Standards of these regulations shall review designs. Jurisdictions that do not have qualified personnel to review designs shall contract with outside agencies or consultants to perform design review and plan checking. Any person who provides OWTS designs, plan review and checking and who is not trained and certified in accordance with section 10.0 may be subject to misdemeanor violation and penalties under sub-section 10.4.0.

16.1.2 Design Approval

Designs that are judged to be in substantial compliance with the regulations of the ALA shall be approved for construction. Designs shall be valid for a minimum of one year from date of approval. Permitting agencies may extend the approval date beyond one year at their discretion.

16.2 General Installation Requirements for OWTS

TECHNICAL STANDARDS

All materials, fixtures or equipment used in the installation, repair or alteration of any sewage treatment system shall conform to the standards referenced in this code. All materials installed in sewage treatment systems shall be handled and installed so as to avoid damage. The quality of the material shall not be impaired. Defective or damaged materials, equipment or apparatus shall not be installed or maintained.

16.3 Workmanship

All construction shall be completed in a professional manner in conformance with the accepted industry standards and shall be of such character as to secure the results necessary to comply with this code.

16.4 Inspection

All sewage treatment systems shall be inspected after construction is completed and prior to backfill. Any system that has been backfilled before being inspected shall be uncovered to allow for inspection. The Installer shall make arrangements with the ALA to perform an inspection and the operation of the system. The Installer is required to provide all the necessary apparatus, equipment, power, and water for testing the system. The design consultant shall certify in writing that the system installation has been completed in substantial conformance with the approved plans and specifications and that all necessary construction inspections have been completed. Where inspection discloses defective material, design, siting or un-workmanlike construction not conforming to the requirements of this ordinance, the owner and Installer shall be issued a correction notice to bring the system into compliance and to schedule for re-inspection of the system by the ALA.

16.4.1 Precover Inspection

The system installer shall request a precover inspection after completion of construction, alteration or repair of the system and before the system is backfilled and covered. The ALA shall inspect the system to determine if the system conforms to the design and regulatory requirements. The precover inspection may be waived at the discretion of ALA. Once the system is installed, it shall be backfilled (covered), only after the permitee is notified by the ALA that the precover inspection has been completed or was waived. The designer shall provide the ALA with a detailed, as-built plan (drawn to scale) of the system at the completion of work and before the initial operating permit is issued. Unless otherwise required by the ALA, the installer should backfill the system within a reasonable amount of time after issuance of the Initial Operating Permit.

16.4.2 Recommended Minimum Inspection Intervals

Standard Systems	Every 5 years
Enhanced Treatment Systems	Twice during the first year and every three years thereafter. *

Experimental Systems	Twice during the first year and once a year for 5 years, every three years thereafter. *

*Or as defined in the maintenance and operation plan submitted by the system designer or manufacturer, but no less than indicated in this table.

- Whenever the septic tank is pumped.
- Whenever the property is sold.
- Whenever a complaint is filed with the ALA.
- Every 5 years for residences identified by the issuing agency as having a high rate of water use or being located in an area of water quality concern.
-

16.4.3 Exceptions

Systems treating high strength or atypical wastewater shall be inspected annually by representatives or officers of the ALA or by entities eligible under Section 4.2.

16.4.4 Inspection During Sale Or Transfer Of Property

The owner's OWTS shall be inspected at the time of property sale prior to close of escrow. Certified staff or representative officer of the ALA, at the expense of the property owner, shall prepare an inspection report. The report shall be presented to the buyer, lender and ALA. The report shall contain the following information:

a. The type, configuration and condition of the septic tank, the primary soil treatment system (and reserve treatment area if known) and any enhanced treatment components and treating devices.[19]
b. The operational status of the system as observed in the field or taken from recent monitoring reports on file with the ALA.
c. If the tank requires pumping based on a measurement of accumulated scum and solids greater than 25% of the total tank depth.
d. Any observable problems or needed repairs requiring immediate attention.
e. An estimate of remaining usable area on the parcel to support repair or expansion of the existing leachfield if no known expansion site has been designated for the system.

[19] Enhanced as opposed to a standard gravity septic tank and leachfield system.

Appendix I – Septic Tank Construction Requirements

General Design Criteria

a. Top = 500 psf *(The tank shall be capable of supporting long-term unsaturated soil loading in addition to the lateral hydrostatic load.)*

b. Lateral Load = 62.4 pcf *(The tank shall be capable of withstanding long-term hydrostatic loading with the water table maintained at ground surface.)*

c. Concentrated Wheel Load = 2500 lb. *(The tank and accesses shall be capable of supporting short-term wheel load in addition to the unsaturated soil loading.)*

d. Soil Bearing = 1000 psf *(Soil bearing is site specific and must reflect the worst case conditions.)*

e. Cold weather installations requiring deep burial need special consideration.

f. All tanks shall successfully withstand an above ground static hydraulic test.

g. The inlet plumbing shall penetrate at least 30.5 cm (*12 in.*) into the liquid from the inlet flow line. If the submerged scum depth is expected to be greater than 30.5 cm (*12 in.*), the inlet fixture should be extended into the liquid two inches below the expected lowest scum depth.

General Specifications

a. Manufacturer's Guarantee shall be for a period of two years.

b. All tanks shall be installed in strict accordance with the manufacturer's instructions.

Concrete tanks

The walls, bottom and top of reinforced-concrete tanks are usually designed spanning the shortest dimension using one-way slab analysis. Stresses in each face of monolithically-constructed tanks are determined by analyzing the tank's cross-section as a continuous fixed frame.

The walls and bottom slab should be required to be poured monolithically. When a tank is expected to be submerged, subjected to heavy traffic loads, or buried deeply, the top slab must be cast onto the walls with wall reinforcement extending into the top slab.

The bottom thickness of the wall should be equal to the thickness of the floor, which is usually thicker. At the wall-floor joint the stress is equally shared; therefore, steel spacing is more efficient and cost effective if the wall thickness is equal to the thickness of the floor. The wall can taper to *three* inches at the top. Tapering the interior mold at the bottom improves the flowability of the concrete around the walls and into the floor. Chamfering the wall-floor junction on the inside reduces the effect of suction between the tank-mold and concrete surfaces; thus the integrity of the concrete at the joint is better maintained and less effort is needed to remove the interior mold.

TECHNICAL STANDARDS

Casting the top in place will produce a much stronger tank than will setting the top in place. A cast on lid, with wall reinforcement adequately tied to the top reinforcement, improves the structural capacity of the top and bottom by more than 40 percent and the walls by about 25 percent. The required rebar spacing will be wider, which reduces materials cost and labor in fabrication. With the wall and top joint cast together there is greater assurance that if differential settlement occurs the top will not separate from the wall causing loss of lateral support at the top. Separation of the top lid from the wall would significantly reduce the tank's strength and its watertightness would be lost. Set in place lids must be mechanically attached to the walls to assure the joint does not separate when the tank shifts or settles.

Concrete Specifications

Concrete must achieve a minimum compressive strength of 4,000 psi in 28 days. The design of the concrete mix depends on the gradation of the aggregate and should be determined by a professional engineer. A common 4000 psi ready-mix design has a cement content of six and one half ($6^1/_2$) sacks per cubic yard and maximum aggregate size of 19 mm (*$^3/_4$ in*.) *(Ready-mix cement conforming to ASTM C-150, Type II.)*

Water/Cement Ratio. To ensure proper curing and ultimate strength, it's important to keep the water/cement ratio low, 0.35 ±.

Air-entraining agents may be required depending on the mix design, although they are not usually necessary for small concrete tanks. Air-entrainment without additives is usually 1 to 2 %.

Fiber Additives may be used to enhance watertightness by controlling concrete shrinkage.

Protective Coatings. Heavy *cement-based* sealants may be used inside and out. The manufacturer's directions must be followed exactly. *Bituminous coatings are not necessary*.

Reinforcing Steel shall be Grade 60, fy = 60,000 psi (*ASTM A-615 Grade 60*). Size and placement must be determined by a structural engineer. Wire fabric is not acceptable. Weldable steel may be specified if the reinforcing cage is to be tack welded during assembly. Misalignment of reinforcement in a three-inch thick section can significantly reduce the strength of the tank; for instance, a quarter inch of misalignment will reduce the capacity of that section by about thirty percent, one-half inch of misalignment will reduce the capacity by fifty percent.

Form Release must be Nox-Crete or equal. Diesel or other petroleum products are not acceptable.

Vibration. Tank molds must have attached vibrators to ensure adequate flow of concrete down the walls and across the bottom. Excess vibration can cause the aggregate to segregate.

Curing. Proper curing techniques are necessary to ensure watertight tanks. Tanks must not be moved until they have cured for seven (7) days or have reached two-thirds of the design strength.

Test Cylinders must be taken from each batch of concrete and tested until the minimum compression strength has been obtained.

Fiberglass Tanks

Glass fiber and resin content must comply with IAPMO IGC 3-74, and there should be no exposed glass fibers.

Metal parts must be 300 series stainless steel.

Wall thickness must average at least 6.3 mm ($^{1}/_{4}$ *in.*) with no wall thickness less than 4.8 mm ($^{3}/_{16}$ *in.*) No delamination is allowable.

Holes specified in the tank must be protected with an application of resin on all cut or ground edges sufficient so that no glass fibers are exposed and all voids are filled.

Neoprene gaskets, or an approved equal, must be used at the inlet to join the tank wall and the ABS inlet piping. ABS Schedule 40 pipe and fittings must be used at the inlets.

Testing

Follow these test procedures to ensure watertightness. Test every tank at the factory and again after installation:

1) Fill the tank to its brim with water and let it stand for 24 hours. To help expedite larger orders a vacuum test may be substituted at the factory, and after the tanks are delivered to the job site. A vacuum test may not, however, take the place of the final installed static water test.

2) Measure the water loss; if there is no water loss during the first 24 hours the tank is acceptable for installation. Some water absorption, however, may occur during this first time period. If so, refill the tank and determine any exfiltration by measuring the water loss over the next two (2) hours. Any water loss is cause for rejection.

3) Install the tank and repeat steps 1 and 2. These procedures should be followed after setting and after backfilling. Test the seal between the riser and the tank top for watertightness by filling the riser with water to a level 2" above the top brim of the tank. *Caution: To prevent hydrostatic uplift damage to the top joint of the tank, do not allow the level of water in the riser to exceed the level of the backfill.*

TECHNICAL STANDARDS

Buoyancy

Improper septage pumping of a buried tank may result in the tank suddenly "floating" to the surface, causing damage to piping, landscaping or worse, injuring maintenance personnel. The following precautions help to ensure tank submergence in areas with high groundwater:

- Require a minimum cover where high groundwater conditions are suspected (evaluation must be provided after identifying site specific soil conditions).
- After setting the tank, pour an additional 15.25 cm (*6 in.*) of concrete over the top; extend a minimum of 30.5 cm (*12 in.*) beyond the sides of the tank. Lightweight plastic tanks (≈ 400 lbs) require concrete or other counter measures sufficient to exceed the buoyant force.
- The weight of concrete tanks can be increased by adding thickness to the walls, top and/or bottom.
- Operation and maintenance instructions should clearly state that tanks must never have more than half (50%) of their contents pumped out during periods when the groundwater is high; especially if they are located in sandy soil. This recommendation is for cautionary purposes only, and is not a substitute for physical buoyancy restraints.

TECHNICAL STANDARDS

Appendix II – California Codes

CALIFORNIA CODES
WATER CODE
SECTION 31143-31143.5

31143. In addition to the other powers provided by law, the San Lorenzo Valley Water District, Santa Cruz County, shall have all of the following powers and shall promptly and effectively exercise such powers as may be appropriate to ensure that onsite waste water disposal systems, as defined in Section 6952 of the Health and Safety Code, along the San Lorenzo River do not pollute the river, its tributaries, and ground water:

(a) To carry on technical and other investigations, examinations, or tests, of all kinds, make measurements, collect data, and make analyses, studies, and inspections pertaining to the water supply, use of water, water quality, nuisance, pollution, waste, and contamination of water within the district as such activities relate to the use of public, combined, or private onsite waste water disposal systems.

(b) To require all persons discharging from onsite waste water disposal systems within the district to register the system with the district, and to charge annual registration fees in such amount as will defray all or a portion of the cOWTS of exercising the powers provided in this article. Applications for permits for onsite waste water disposal systems within the district to the County of Santa Cruz shall be referred to the district for the district's review and comment.

(c) To adopt and enforce regulations for onsite waste water disposal systems within the district, after holding a public hearing on reasonable notice thereof, to control and enhance the quality of the ground and surface waters of the district, in order to eliminate the pollution, waste, and contamination of water flowing into, through, or originating within watercourses, both natural and artificial, within the district, to prevent contamination, nuisance, pollution, or otherwise rendering unfit for beneficial use the surface or ground water used or useful in the district, and to expend such amounts as are necessary to exercise such powers from the funds of the district. Such regulations shall not be in conflict with state law or county ordinances.

31143.1. The district shall immediately do all such acts as are reasonably necessary to secure compliance with any federal, state, regional, or local law, order, regulation, or rule relating to water pollution or discharges from onsite waste water disposal systems within the area of the district. For such purpose, any authorized representative of the district, upon presentation of his credentials, or, if necessary under the circumstances, after obtaining an inspection warrant pursuant to Title 13 (commencing with Section 1822.50) of Part 3 of the Code of Civil Procedure, or with the permission of the owner, shall have the right of entry to any premises on which an onsite waste water disposal system is located for the purpose of inspecting such system, including securing samples of discharges therefrom, or any records required to be maintained in connection therewith by federal, state, or local law, order, regulation, or rule.

TECHNICAL STANDARDS

31143.2. (a) Violation of any of the provisions of a district regulation adopted pursuant to Section 31143 may be abated as a public nuisance by the district, and the board of directors may by regulation establish a procedure for the abatement of such a nuisance and to assess the cost of such abatement to the violator. If the violator maintains the nuisance upon real property in which he has a fee title interest, the assessment shall constitute a lien upon such real property.

(b) The amount of any cOWTS incurred by the district in abating such a nuisance upon real property shall be added to the annual taxes next levied upon the real property subject to abatement and shall constitute a lien upon that real property as of the same time and in the same manner as does the tax lien securing such annual taxes. All laws applicable to the levy, collection, and enforcement of district taxes shall be applicable to such assessment, except that if any real property to which such lien would attach has been transferred or conveyed to a bona fide purchaser for value, or if a lien of a bona fide encumbrancer for value has been created and attached thereon, prior to the date on which the first installment of such taxes would become delinquent, then a lien which would otherwise be imposed by this section shall not attach to such real property and the delinquent and unpaid charges relating to such property shall be transferred to the unsecured roll for collection. Any amounts of such assessments collected are to be credited to the funds of the district from which the cOWTS of abatement were expended.

31143.3. (a) The owner of any real property upon which is located an onsite waste water disposal system, which system is subject to abatement as a public nuisance by the district, may request the district to replace or repair, as necessary, such system. If replacement or repair is feasible, the board of directors, in its sole discretion, may provide for the necessary replacement or repair work.

(b) The person or persons employed by the board of directors to do the work shall have a lien, subject to the provisions of subdivision (b) of Section 31143.2, for work done and materials furnished, and the work done and materials furnished shall be deemed to have been done and furnished at the request of the owner. The district, in the discretion of the board of directors, may pay all, or any part, of the cost or price of the work done and materials furnished; and, to the extent that the district pays the cost or price of the work done and materials furnished, the district shall succeed to and have all the rights, including, but not limited to, the lien, of such person or persons employed to do the work against the real property and the owner.

(c) As an alternative power to the enforcement of the lien provided in subdivision (b), the board of directors may, by ordinance adopted by two-thirds vote of the members, fix the cOWTS of replacement or repair; fix the times at which such cOWTS shall become due; provide prior to the replacement or repair for the payment of the cOWTS in installments over a period not to exceed 15 years; establish a rate of interest not to exceed 8 percent per annum, to be charged on the unpaid balance of the cOWTS; and provide that the amount of the cOWTS and the interest shall constitute a lien, subject to the provisions of subdivision (b) of Section 31143.2, against the respective lots or parcels upon which the work is done.

(d) With the written consent of the owner and the lien holder, if other than the district, the board of directors may issue an improvement bond pursuant to the improvement bond provisions of the Improvement Act of 1911 (Part 5 (commencing with Section 6400) of Division 7 of the Streets and Highways Code), to represent and be secured by the lien established pursuant to subdivision (b). The bond may be delivered to the lien holder if other than the district or may be sold by the board of directors at public or private sale. The amount of the bond shall be the amount of the lien, including incidental expenses allowable under the Improvement Act of 1911. The bond term and interest rate shall be determined by the board of directors within the limits established by the Improvement Act of 1911 and other applicable provisions of law.

31143.4. In order to avoid duplication, either the district or the County of Santa Cruz may contract with the other party for any services or activities authorized to be performed pursuant to this article.

31143.5. Any violation of a regulation of the district adopted pursuant to Section 31143 is a misdemeanor punishable by a fine not to exceed five hundred dollars ($500), or imprisonment not to exceed 60 days, or by both such fine and imprisonment. Each day of such a violation shall constitute a separate offense. Any violation or threatened violation of a regulation of the district may also be enjoined by civil suit.

CALIFORNIA CODES
HEALTH AND SAFETY CODE
SECTION 6950-6954

6950. "Board" or "board of directors" means the governing authority of a public agency.

6951. "Public agency" means a city, a county, a special district, or any other political subdivision of the state which is otherwise authorized to acquire, construct, maintain, or operate sanitary sewers or sewage systems.

"Public agency" does not mean an improvement district organized pursuant to the Improvement Act of 1911 (Division 7 (commencing with Section 5000), Streets and Highways Code), or the Municipal Improvement Act of 1913 (Division 12 (commencing with Section 10000), Streets and Highways Code) or the Improvement Bond Act of 1915 (Division 10 (commencing with Section 8500), Streets and Highways Code), or a county maintenance district.

6952. "On-site wastewater disposal system" means any of several works, facilities, devices, or other mechanisms used to collect, treat, recycle, or dispose of wastewater without the use of communitywide sanitary sewers or sewage systems.

TECHNICAL STANDARDS

6952.5. "Owner of real property" means any public agency owning land and any person shown as the owner of land on the last equalized assessment roll; provided that where such person is no longer the owner, the term means any person entitled to be shown as owner on the next assessment roll and where land is subject to a recorded written agreement of sale, the term means any person shown therein as purchaser.

6953. "Zone" means an on-site wastewater disposal zone formed pursuant to this chapter.

6954. "Real property" means both land and improvements to land which benefit, directly or indirectly from, or on behalf of, the activities of the zone.

CALIFORNIA CODES
HEALTH AND SAFETY CODE
SECTION 6975-6982

6975. An on-site wastewater disposal zone may be formed to achieve water quality objectives set by regional water quality control boards, to protect existing and future beneficial water uses, protect public health, and to prevent and abate nuisances. Whenever an on-site wastewater disposal zone has been formed pursuant to this chapter, the public agency shall have the powers set forth in this article, which powers shall be in addition to any other powers provided by law. A public agency shall exercise its powers on behalf of a zone.

6976. An on-site waste water disposal zone shall have the following powers:

(a) To collect, treat, reclaim, or dispose of waste water without the use of communitywide sanitary sewers or sewage systems and without degrading water quality within or outside the zone.

(b) To acquire, design, own, construct, install, operate, monitor, inspect, and maintain on-site wastewater disposal systems, not to exceed the number of systems specified pursuant to either Section 6960 or Section 6960.1, within the zone in a manner which will promote water quality, prevent the pollution, waste, and contamination of water, and abate nuisances.

(c) To conduct investigations, make analyses, and monitor conditions with regard to water quality within the zone.

(d) To adopt and enforce reasonable rules and regulations necessary to implement the purposes of the zone. Such rules and regulations may be adopted only after the board conducts a public hearing after giving public notice pursuant to Section 6066 of the Government Code.

6977. The public agency shall do all such acts as are reasonably necessary to secure compliance with any federal, state, regional, or local law, order, regulation, or rule relating to water pollution or the discharge of pollutants, waste, or any other material within the zone. For such purpose, any authorized representative of the public agency, upon presentation of his credentials, or, if necessary under the circumstances, after obtaining an inspection warrant pursuant to Title 13 (commencing with Section 1822.50) of Part 3 of the Code of Civil Procedure, shall have the right of entry to any premises on which a water pollution, waste, or contamination source, including, but not limited to, septic tanks, is located for the purpose of inspecting such source, including securing samples of discharges therefrom, or any records required to be maintained in connection therewith by federal, state, or local law, order, regulation, or rule.

6978. (a) Violation of any of the provisions of a rule or regulation adopted pursuant to subdivision (d) of Section 6976 may be abated as a public nuisance by the board. The board may by regulation establish a procedure for the abatement of such a nuisance and to assess the cost of such abatement to the violator. If the violator maintains the nuisance upon real property in which he has a fee title interest, the assessment shall constitute a lien upon such real property in the manner provided in subdivision (b).

(b) The amount of any cOWTS, which are incurred by the zone in abating such a nuisance upon real property, shall be assessed to such real property and shall be added to, and become part of, the annual taxes next levied upon the real property subject to abatement and shall constitute a lien upon that real property as of the same time and in the same manner as does the tax lien securing such annual taxes. All laws applicable to the collection and enforcement of county ad valorem taxes shall be applicable to such assessment, except that if any real property to which such lien would attach has been transferred or conveyed to a bona fide purchaser for value, or if a lien of a bona fide encumbrancer for value has been created and attached thereon, prior to the date on which such delinquent charges appear on the assessment roll, then a lien which would otherwise be imposed by this section shall not attach to such real property and the delinquent and unpaid charges relating to such property shall be transferred to the unsecured roll for collection. Any amounts of such assessments collected are to be credited to the funds of the zone from which the cOWTS of abatement were expended.

6979. (a) The owner of any real property upon which is located an on-site wastewater disposal system, which system is subject to abatement as a public nuisance by the public agency, may request the public agency to replace or repair, as necessary, such system. If replacement or repair is feasible, the board may provide for the necessary replacement or repair work.

(b) The person or persons employed by the board to do the work shall have a lien, subject to the provisions of subdivision (b) of Section 6978, for work done and materials furnished, and the work done and materials furnished shall be deemed to have been done and furnished at the request of the owner. The zone, in the discretion of the board, may pay all, or any part, of the cost or price of the work done and materials furnished; and, to the extent that the zone pays the cost or price of the work done and materials furnished, the zone shall succeed to and have all the rights, including, but not limited to, the lien, of such person or persons employed to do the work against the real property and the owner.

TECHNICAL STANDARDS

6980. A board may exercise all of the public agency's existing financial powers on behalf of a zone, excepting that any assessment or tax levied upon the real property of a zone shall be subject to the provisions of Sections 6978 and 6981.

6981. Notwithstanding any other provision of law, a public agency may levy an assessment reasonably proportional to the benefits derived from the zone, as determined by the board, and subject to the approval of the voters pursuant to the provisions of Article 6 (commencing with Section 2285) of Chapter 3 of Part 4 of Division 1 of the Revenue and Taxation Code. Such benefit assessment shall be in addition to any other charges, assessments, or taxes otherwise levied by the public agency upon the property in the zone.

6982. (a) Notwithstanding Section 6952, the West Bay Sanitary District may use the procedures in this chapter to provide alternative or innovative waste water technologies in the district's jurisdiction.

(b) The determination of a public health officer pursuant to Section 6955.1 shall include written findings, adopted by the district board of directors, regarding the existing or potential public health hazard.

(c) If the district uses the procedures in this chapter to provide alternative or innovative waste water technologies pursuant to this section, the district shall submit to the Legislature, by January 1, 1991, a report on the effectiveness of alternative waste water technologies and the procedures in this chapter, recommend changes, if any in the requirements, and make recommendations as to the desirability of continuing the requirements after January 1, 1992.

(d) "Alternative or innovative waste water technologies" means either (1) an onsite waste water disposal system, as defined in Section 6952, or (2) such a system in conjunction with communitywide sewer or sewage systems, if one or more of the components of the system is located on or in close proximity to the real property and employs innovative or alternative waste water technologies, including, but not limited to, grinder pump pressure sewer systems, septic tank effluent pump pressure sewer systems, vacuum sewer systems, or small-diameter gravity septic tank systems.

APPENDIX E

Onsite Treatment System Usage In The Central Valley For Repairs and Replacements*

	Aerobic treatment unit	Recirculating sand filter	Intermittent sand filter	Peat filter	Recirculating gravel filter	Composting toilet	Shallow trenches <2'	Deep trenches >6'	At-grade	Imported fill	Sand-lined trenches	Gravelless (chambers)	Seepage pits	Constructed wetland	Evapotranspiration system	Subsurface drip dispersal	Absorption mound
Butte	Y	Y	Y	N	Y	N	Y	N	Y	Y	N	N	Y	N	N	N	N
Colusa	NR	Y	Y	NR	NR	NR	Y	Y	Y	Y		Y	Y		Y	Y	Y
Fresno	N	N	N	N	N	Y	Y	Y	Y	Y	N	Y	Y	N	N	N	Y
Glenn	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	N			Y
Kern	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Kings	N	N	N	N	N	N	N	N	N	Y	N	Y	Y	N	N	N	N
Madera	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	N	N	N	Y
Merced	Y	Y	Y	NR	NR	NR	Y	Y	NR	Y	Y	Y	Y	NR	Y	NR	NR
Sacramento	N	N	Y	N	N	N	N	Y	N	N	N	N	Y	N	Y	N	Y
San Joaquin	Y	Y	N	N	N	N	Y	N	Y	Y	N	Y	Y	N	Y	Y	Y
Shasta	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y
Solano	N	Y	Y	N	Y	N	Y	Y	Y	N	N	Y	N	N	N	Y	Y
Stanislaus	Y	Y	Y	Y	Y	N	Y	Y	Y	N	N	Y	Y	N	Y	Y	Y
Sutter	N	N	N	N	N	N	Y	N	N	N	N	Y	N	N	N	N	Y
Tehama	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	N	N	N	N
Tulare	N	N	N	N	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	N	Y
Yolo	N	N	N	N	N	N	N	N	Y	Y	N	Y	N	N	Y	N	N
Yuba	N	Y	Y	N	Y	N	Y	Y	N	N	N	Y	Y	N	Y	N	N
Yes Responses	8	12	12	5	8	4	14	11	12	13	6	16	13	1	10	6	12

***Information adapted from: Status Report: Onsite Wastewater Systems in California, Joint publication U.S. EPA and the California Wastewater Training and Research Center, June 2000. (Y = Yes, N = NO, and NR = Not Reported)**