

Onsite Wastewater Treatment System Repair of Failure/Malfunction Survey

Prepared for: the California State Water Resources Control Board

Prepared by: the California Wastewater Training & Research
Center, California State University, Chico

January 2003

Onsite Wastewater Treatment System Repair of Failure/Malfunction Survey

A)	Introduction	3
	Table A-1 Common Onsite System Failures	5
B)	Purpose.....	7
C)	Methods.....	8
D)	Results	8
	Number of Repairs and Permit fees	9
	How is failure/malfunction identified?	9
	How are failures/malfunctions requiring repair discovered?.....	9
	What steps does your agency follow and/or take into consideration when issuing a repair permit/approval?	10
	Variance/waiver for system repairs	10
	Technologies Allowed for System Repairs.....	10
	Compliance Procedures.....	11
	Table D-2 Repair Rates Compared to the Number of Systems	15
E)	Discussion.....	12
	How Failures are Discovered.....	12
	Failure Diagnosis	13
	Variance/Waiver for Repairs	13
	Types of Systems/Technology Jurisdictions Allow for Repairs	14
	Compliance Procedure	16
F)	Methods Used for Renovation and Repair of Failed or Malfunctioning Systems	16
	Primary treatment	17
	Hydraulic overload	17
	Organic overload.....	18
	Secondary treatment.....	18
	Aerobic Treatment Unit (ATU).....	18
	Media Filters - Packed-Bed Filters	19
	Absorption Mound Systems	20
	Final Effluent Dispersal Methods.....	21
	Standard Trenches	21
	Shallow Trenches.....	21
	Deep Trenches.....	21
	Absorption Mound Systems	22
	At-grade.....	22
	Imported Fill	22
	Sand-lined Trenches	22
	Chambers.....	22
	Gravel Alternatives	22
	Seepage Pits	23
	Evapotranspiration Systems	23
	Constructed Wetlands	23
	Subsurface Drip Dispersal Systems	23
G)	Costs of Replacement Systems	23
	Table G-1 Typical Repair Costs.....	24
H)	Conclusion	25
I)	Recommendations.....	27
	References.....	30
	Appendices.....	32
	Tables.....	33
	System Statistics for Failure/Malfunction - Local Jurisdictions.....	34
	Evaluation Procedures and Variance/Waiver Practices - Local Jurisdictions.....	35
	Compliance Procedures - Local Jurisdictions.....	36
	Wastewater Treatment Technology Allowed/Permitted - Local Jurisdictions.....	37
	Sample Survey	38

This study was funded by a contract with the State Water Resources Control Board. The California Wastewater Training and Research Center conducted the study and is solely responsible for its content. The contents do not necessarily reflect the views or opinions of the State Water Resources Control Board, California State University at Chico or the California State University at Chico Research Foundation.

We would like to acknowledge and thank all of the agencies that responded to this survey. Their contribution helps to further our understanding of the status of the onsite wastewater treatment system programs in California.

Onsite Wastewater Treatment System Repair of Failure/Malfunction Survey

A) Introduction

There are approximately 1.2 million onsite wastewater treatment systems in California. This type of sewage management is frequently used in rural and suburban residential development and can adequately provide water quality and environmental protection when properly designed, sited, constructed, maintained, and operated. It is now recognized and generally accepted that these types of systems will continue to serve as the appropriate sewage treatment method in many areas both now and in the future. The functioning of these systems is an important consideration in protecting the public health and water quality in the state.

One of the issues concerning the use of onsite systems is how to effectively address the repair of failing or malfunctioning systems. The State Water Resources Control Board convened a technical advisory committee in 1994 to identify the issues and propose a plan of action. The committee report Management Measures and Implementation for New and Existing Onsite Sewage Disposal Systems identified the ... "Need of effective upgrade and repair of existing OSDS" as one of the issues of concern. No specific action has been taken since this report.

The pending statewide regulations mandated by AB 885 will focus more attention on onsite systems and their use in all parts of the state. AB 885 was enacted in large part due to concerns over the role that onsite systems may have on public health and water quality issues. Initially these concerns were focused on the relationship between onsite systems and water quality in coastal areas but were broadened to include consideration of onsite systems throughout the state. Part of the legislation requires adopting regulations that deal specifically with the following:

1. Any system that is subject to a major repair.
2. Any system that pools or discharges to the surface.
3. Any system that, in the judgment of a regional board or authorized local agency, discharges waste that has the reasonable potential to cause a violation of water quality objectives, or to impair present or future beneficial uses of water, to cause pollution, nuisance, or contamination of the waters of the state.

These three conditions can all describe onsite systems that are failing. Condition #1 is a little vague in that the reason for the major repair nor what constitutes a major repair is defined, but certainly repairs occur frequently when a system is no longer functioning. Condition #2 fits the traditional view of failure, which is "... failures are declared when wastewater is observed on the ground surface or is backing up in the household plumbing." (USEPA, 2002). The third condition fits the most inclusive definition ... "Failure occurs when performance requirements are not met" (USEPA, 2002). A variety of conditions can be considered 'failures' and this depends on the performance expected of a system. Performance should be dictated by the treatment goals a system must meet to address specific public health or environmental needs. In

other words, a system should do what it was designed to do. Table A-1 describes failure scenarios as suggested in the EPA 2002 Design Manual.

This broader perspective of performance as the measure to determine system function and system failure causes a shift in the traditional view of onsite wastewater treatment systems. The traditional view was that the primary function of onsite systems was to dispose of sewage. The new perspective is that onsite systems are treatment systems that treat sewage and disperse the treated water back into the environment. This shift places much more importance on the proper installation of new systems and the repair and/or upgrade of existing systems. Further, onsite systems are a permanent part of the community infrastructure and must therefore continue to perform effectively in order to protect the community.

The following is offered to further examine the relationship between system function, performance and system failure...“Understanding and defining system malfunction or failure is important to our understanding of how systems should function. In some respects this definition determines performance expectations. Failure can be defined in at least two ways, 1) failure to dispose and, 2) failure to treat. Failure to dispose is relatively easy to determine. The system is backing up into the house or sewage is surfacing on the ground or entering surface water. Failure to dispose also represents a failure to treat. These situations are generally recognizable and lead to system repair or replacement. Failure to treat is a much more difficult situation to identify. Adequate disposal may be taking place, no surfacing or backup, but poor location, design, installation or maintenance may allow inadequately treated wastewater to contaminate ground or surface water. In order to define what constitutes failure to treat, treatment goals must be set in order to measure performance. First, these goals must be clearly defined and based on public health and environmental concerns. This is complicated because there is no clear consensus or total understanding of what happens to all of the wastewater constituents of concern, how to measure them, and where to measure for them. Second, treatment goals must be realistic and achievable. This means that there need to be reliable and affordable systems available that can reach these goals. Third, the goals should incorporate risk-based assessment tools that provide for flexibility in order to take into account important factors such as density of development and specific site conditions such as depth to ground water, and depth and type of soil. And finally, the goals must be measurable in some practical way. This said, failure to treat to some agreed to level, while considering the site variables, should be the criteria for defining system malfunction.” (CWTRC, 2000).

Table A-1 Common Onsite System Failures

Common onsite wastewater treatment system failures – USEPA 2002

Type of Failure	Evidence of failure
Hydraulic failure	Untreated or partially treated sewage pooling on ground surface, sewage backup in plumbing fixtures, sewage breakouts on hill slopes
Pollutant contamination of ground water	High nitrate levels in drinking water wells; tastes or odor problems (e.g., sulfur, household cleaners) in well water caused by untreated, poorly treated, or partially treated wastewater; presence of toxics (e.g., solvents, cleaners) in well water.
Microbial contamination of ground and surface water	Shellfish bed bacterial contamination, recreational beach closures due to high bacterial levels, contamination of drinking water wells with fecal bacteria or other fecal indicators.
Nutrient contamination of surface water	Algae blooms, high aquatic plant productivity, low dissolved oxygen concentrations.

Systems fail for a variety of reasons. System failure/malfunction can result from three factors that are controllable, and a fourth, system age that is not. The three controllable factors are; 1) improper installation - this includes siting, design, inappropriate application of technology, and construction, 2) improper operation, 3) inadequate maintenance. A brief discussion of installation, operation, and maintenance follows to demonstrate the elements involved. Improper or inadequate application of best management practices to any of these elements can result in system failure. The fourth reason, system age is also discussed.

Installation

In this discussion installation includes all of the aspects that go into placing a system into operation. Siting is the first step in this process and involves assessing the proposed location of the system. Assessment takes into account such factors as soil conditions (type, depth, structure, etc.), depth to ground water or other limiting horizons, topography, landscape position, and proximity to features that require setbacks. Once this assessment is completed a system is designed that is compatible with these findings. Factors considered in the design include the intended use of the system (i.e., residential, commercial, single family, etc), the needs of the owner, and future development. The design should accommodate the expected hydraulic and organic load that the facility served is expected to produce. The last step in this process is construction of the system. Important considerations are using the material(s) specified in the design, proper installation of the system components, and using construction practices that do not compromise site/soil conditions or the integrity of system components.

Operation

Onsite systems are generally designed to operate within a range of loading factors that include waste volume (the hydraulic load), waste type (domestic, commercial, etc) and waste strength (the organic load). The anticipated waste volume and strength determines the sizing and operation of system components from primary treatment (septic tank),

through any secondary treatment units (media filter, aerobic treatment unit, etc.) and to the final dispersal component (leach lines, leach bed, absorption mound, etc.). Each component is sized to process this anticipated load. The waste type may dictate additional operational requirements based on the constituents anticipated in the waste stream.

Maintenance

The maintenance required for an onsite system is dependent on the complexity of the system. Generally, the more parts and mechanical components used, the more critical adhering to maintenance schedules becomes. For example, the standard onsite system is a passive system without mechanical parts and consists of the septic tank and soil dispersal system. Maintenance typically consists of pumping the septic tank when the solids and scum level reaches a point where the effective tank volume is reduced enough so that retention time through the tank is inadequate. On the other hand, advanced treatment units may have pumps, floats, control panels and other components that need to be maintained at some prescribed frequency. These systems must be maintained for them to continue to function properly and to attain performance expectations.

System Age

System components do deteriorate over time, even with proper operation and maintenance. The EPA Design Manual points out that "... Tanks and pipes buried in the ground begin to deteriorate after 20 or more years of use and may require repair or replacement. In addition, the treatment capabilities of soils below infiltration fields that have been in use for several decades might not be adequate for continued use. Years of treatment use can cause the interstitial spaces between soil particles to become filled with contaminants (e.g., TSS, precipitates, biomass). Soil structure can also be affected after many years of use. Finally, changes in design and construction practices in the past 25 years have led to marked improvements in system performance and treatment capacity."

Common Causes of Failure

System failure or malfunction, with the exception of the problems associated with age, can almost always be attributed to deviations from following best practices for installation, operation and maintenance. Some common causes of system failure are:

1. Hydraulic overload – more water is entering the system than the soil absorption system or other system component was designed to process (leaking plumbing fixture, surface water run on, septic tank and other components not watertight, etc.).
2. Organic overload – organic material in the waste is too high for a system component or process causing clogging of the infiltrative surface of that component (i.e., media filter) or a downstream component (subsurface soil absorption system) resulting in a hydraulic failure (effluent surfacing or backing up).
3. Mechanical failure of pumps, floats, blowers or other components resulting in either hydraulic or organic overload, or both.

4. Physical/structural component failure such as pipes breaking, uneven settling of tanks and distribution boxes, collapse of system components. This type of failure often results in hydraulic overload.
5. Change of use at the facility that the system serves. For example, converting a summer/weekend residence to full time occupancy.
6. Introducing incompatible materials that disrupt the biological, chemical or physical processes within a treatment unit or in the subsurface soil-receiving environment.

There are some situations where failure/malfunction can be caused by less obvious events. For example, converting from an individual water supply to a public water supply can result in increased water use due to the availability of more water than previously provided by the individual water system. This change can put an increased hydraulic load on the onsite wastewater treatment system and can result in a failure if the system was already operating at its maximum hydraulic load (NSW-OSRAS, 2001).

Failure Diagnosis

Diagnosing the cause of system failure/malfunction and then applying the proper correction to overcome the cause has become more complex as systems have become more sophisticated. The importance of accurate failure diagnosis is essential if the system is expected to continue functioning properly. Correcting the symptom of the failure may not insure continued performance. For example, a situation of surfacing effluent may be corrected in the short term by adding more soil absorption area, but the cause may have been hydraulic abuse of the system, in which case the failure will recur. The point here is that effective corrective action should involve a failure diagnosis strategy that can identify the reason for the failure. An example of such a strategy was developed by Adams, et al., (1998).

Effective correction of failed systems can be used to remedy past mistakes and also to upgrade systems to meet new treatment goals. Sites that were inappropriately developed using traditional systems can be renovated by using treatment technology that overcomes the site limitations and is protective. Systems can now be designed to overcome many of the siting constraints that prohibited the use of traditional systems (Hoover 1999, Bounds 2001). Systems can also be designed to achieve specific treatment goals where the failure is in performance. In either case using the broadest definition of system failure should pertain. The traditional definition is no longer adequate in that it only pertains to visible failure scenarios and does not deal with the performance issues.

Addressing the issues of failed/malfunctioning systems is an important element in any onsite program. It is therefore important to gain an understanding of how local jurisdictions currently diagnose and take corrective action for failing or malfunctioning onsite systems.

B) Purpose

The purpose of this study is to identify and document methodologies used to resolve failing onsite wastewater treatment systems as practiced by local authorities responsible

for the onsite wastewater program. The study also identifies and examines the common technologies used to remediate failed systems.

C) Methods

This study was conducted using a survey developed to obtain information from the local agencies with jurisdiction for the onsite wastewater program.

The local agencies were all mailed survey forms and a cover letter explaining the purpose of the survey. The recipients were requested to return the forms by mail and were also given the option to use electronic versions with return by email.

The survey was designed to provide basic information needed to help assess the methods used to address failing/malfunctioning systems in California. Information requested included; 1) the method(s) used to identify failure, 2) number of failures requiring repairs, 3) factors taken into consideration in diagnosing the cause, 3) variance/waiver considerations, 4) technologies allowed for repairs, and 5) compliance procedures and authority utilized. Sample survey forms are in the appendix.

Extensive phone and email follow-up was conducted to clarify responses and to obtain the requested information.

A second, less comprehensive survey was conducted to obtain cost estimates for system repairs. This survey sampled a selected group of jurisdictions and persons engaged in designing onsite systems.

D) Results

Survey responses were received from 45 local agencies out of the 64 surveyed. The majority, 34, of agencies with jurisdiction are either county environmental health departments or environmental health programs within the county public health department. These forty-five jurisdictions collectively contain more than 75% of all of the onsite systems in California. Five counties (Calaveras, Fresno, Kern, Riverside, and San Bernardino) have split responsibilities between environmental health and planning/building, with environmental health investigating failures and the other agency typically issuing the permit for the repair and subsequent construction inspections. Three counties (Sonoma, San Luis Obispo, and Orange) have the entire program outside of the environmental health function. Several counties (Sonoma, El Dorado, Butte and Marin) also have separate onsite management zone entities with onsite jurisdiction within their county).

The following discussion provides summary tables of the survey results. Complete tables of the results can be found in the appendix. The question or topic is listed first followed by the results.

Number of Repairs and Permit fees

The responding agencies reported 4,831 system repairs for 2001. This represents a failure rate of less than one percent of the onsite systems within these jurisdictions (See Table D-2 for a breakdown by jurisdiction). All of the agencies require a repair permit. The fee for a repair permit ranges from no cost to \$975. Several jurisdictions have a sliding fee scale that reflects the complexity of the repair with a higher rate for advanced treatment technologies and/or engineered designs.

How is failure/malfunction identified?

The survey asked which of the following methods the agency uses to identify a failure/malfunction. The table below summarizes the responses (out of a total of 45 responses).

Failure/malfunction identified by:		
Effluent surfacing	43	96%
Sewage backup	38	84%
Monitoring/monitoring report	11	24%
Other	4	9%

How are failures/malfunctions requiring repair discovered?

The survey asked respondents to indicate what was the cause of the agency response or what notified the agency of a failure/malfunction. The table below summarizes the responses.

Approximately 25% of the jurisdictions do not track or differentiate the reason for discovering the failure/malfunction. Of the 4,831 reported repairs, a reason for the agency response was given for 2,103 cases.

Failure/malfunctions discovered as a result of (2103 responses):		
Self-initiated by agency personnel	565	27%
Upgrade for remodel	480	23%
Complaint	444	21%
Service request by owner or occupant	394	19%
Point of sale inspection	195	9%
Survey	12	.6%
System monitoring inspection	13	.6%

What steps does your agency follow and/or take into consideration when issuing a repair permit/approval?

The purpose of this question was to determine what process agencies follow to assess the cause of the failure and the appropriate correction.

What steps does you agency follow in diagnosing cause:		
Determining the type of system	41	91%
Evaluating site and soil conditions	38	84%
Identifying the location of the malfunction	37	82%
Developing and implementing appropriate repair options to solve the problem	31	69%
Evaluating the water use in the home (hydraulic and organic)	25	56%
Evaluating functioning of the soil treatment and distribution system	24	53%
Determining the frequency and duration of the malfunction	21	47%
Summarizing the factors contributing to the failure	15	33%
Evaluating the likelihood of a biomat induced malfunction	12	27%

Variance/waiver for system repairs

The purpose of these questions is to help determine how many systems are given a variance from standards and the nature of the standard in order for the system to be repaired. Respondents were asked if the variance was for local or regional board standards. Variances were classified into three broad categories; 1) horizontal setbacks from potentially sensitive receptors (streams, lakes, wells, etc.), 2) horizontal setbacks from artificial boundaries (property line, building, easement, etc.), and 3) vertical setbacks from restricting layers (ground water, impervious soil horizon, etc.)

How many of the repairs required a variance from local ordinance requirement? = 160
This represents 3.3% of the repairs reported.

How many of the repairs required a variance of RWQCB Basin Plan Guidelines? = 73
This represents 1.5% of the repairs reported.

The survey asked for a yes or no response to the three situations listed. The number shown is the number of agencies responding ‘yes’ and indicates the types of variance that would be allowed.

Would you/do you allow variances for:		
Horizontal setback distance (property line, road, easement, etc.)	32	71%
Vertical setback (depth to groundwater/restricting layer)	25	56%
Horizontal setback distance (well, spring, surface water, etc.)	23	51%

Technologies Allowed for System Repairs

To the question “Do you allow the use of enhanced/alternative systems for repairs?” the response was 38 yes and 7 no.

The technologies were broken into two major categories: 1) Allowable treatment system technology and 2) Allowable final effluent dispersal technology. The number in the table is the number of agencies that allow the technology to be used for repairs (out of 45 total responses).

Treatment Technology Allowed for Repairs		
Mound system	32	71%
Intermittent sand filter	26	58%
Recirculating sand filter	20	44%
Aerobic treatment unit	18	40%
Textile filter	15	33%
Evapo-transpiration system	13	29%
Other media filter	10	22%
Holding tank	10	22%
Peat filter	9	20%
Constructed wetland	5	11%
Compost/waterless toilet	4	9%

Final Effluent Dispersal Systems Allowed for Repairs		
Pressure distribution	34	76%
Chamber	28	62%
Seepage pit	22	49%
At-grade	21	47%
Deep trench > 6'	21	47%
Subsurface drip dispersal	20	44%
Cap and fill	18	40%
Bed	16	36%
Sand-lined trench	13	29%
Gravel alternatives (foam, etc.)	4	9%

Compliance Procedures

This section deals with the types of compliance procedures in place, the authority used and the administrative and legal enforcement procedures used by local jurisdictions.

The first question asked was “Do you have a formal compliance/enforcement procedure in place”. Forty (40) jurisdictions responded ‘yes’.

The second question asked what legal authority was used.

Legal Authority		
Local ordinance	38	90%
Health and Safety Code	27	67%
Uniform Housing Code	18	40%
Uniform Plumbing Code	1	2%

The third question asked, “What type of administrative/enforcement procedures do you use?”

Administrative/Enforcement Procedures		
Violation notice	39	98%
Letter from director of environmental health	25	63%
Letter from district attorney	23	58%
Administrative hearing	22	55%
Criminal proceedings	18	45%
Civil proceedings	15	38%
Property lien	12	30%
Letter from health officer	10	25%
Administrative fine	10	25%
Other	6	15%

The final two questions asked about formal legal action.

“How many cases had to go to court for resolution?” Ten (10) cases went to court

“How many inspection warrants issued?” Eleven (11) inspection warrants were issued.

E) Discussion

The survey indicates less than 5,000 repair permits in 2001, which represents a failure rate of less than one percent annually for the onsite systems in California. This is considerably lower than national estimates of 10% (USEPA), but is consistent with the rate reported in the Status Report: Onsite Wastewater Treatment Systems in California (CWTRC and USEPA 2000). Part of the explanation for this discrepancy may be that onsite systems in California may be newer on the whole than those nationwide and system age related failures might not yet be occurring at the same rate as elsewhere.

How Failures are Discovered

The survey demonstrates that most failures are identified by the traditional symptoms of surfacing effluent or sewage backup. Almost 25% of the jurisdictions are now using monitoring reports to also identify failures, an indication that system performance is becoming a tool to identify failure/malfunction. This is an important trend as it indicates that jurisdictions are looking at treatment and treatment goals as a measure of system performance.

The question of how the jurisdiction is made aware of failures is revealing in that the most common method (27% of the time) is self-initiated by agency personnel. This means that in the course of their duties personnel come across a failure without benefit of a complaint or request for service. Typically this is by noticing surfacing effluent. Complaints and service requests combined account for another 40% of the discoveries and typically are triggered by effluent surfacing or sewage backup. The upgrade for remodel/building addition is interesting in that it implies that the requestor (owner) has been dealing with but not repairing a failed/malfunctioning system. This may be because the owner was planning on the remodel and waited to incorporate the system repair.

Percentage of failures discovered by	
Self-initiated by agency personnel	27%
Upgrade for remodel	23%
Complaint	21%
Service request by owner or occupant	19%
Point of sale inspection	9%
Survey	.6%
System monitoring inspection	.6%

Failure Diagnosis

The question concerning the steps jurisdictions follow to diagnose the cause of the failure reveals how extensive and thorough a process is followed. The nine items listed in the survey follow the failure diagnosis format proposed by Adams, et.al. (1998).

Percentage of jurisdictions using the following steps:	
Determining the type of system	91%
Evaluating site and soil conditions	84%
Identifying the location of the malfunction	82%
Developing and implementing appropriate repair options to solve the problem	69%
Evaluating the water use in the home (hydraulic and organic)	56%
Evaluating functioning of the soil treatment and distribution system	53%
Determining the frequency and duration of the malfunction	47%
Summarizing the factors contributing to the failure	33%
Evaluating the likelihood of a biomat induced malfunction	27%

The finding of note is that jurisdictions do not necessarily assess the water use or determine the duration and frequency. These are important considerations when the primary symptom initiating investigation is surfacing effluent. A diagnosis following all of the steps in formal failure diagnosis may result in a different solution than one derived without considering all of them.

Variance/Waiver for Repairs

Approximately three percent of the repair permits issued required a variance from local ordinance (160 out of the 4,831 reported). Jurisdictions were asked to indicate what conditions would qualify for a variance.

Percent of jurisdictions that would consider granting a variance for:	
Horizontal setback distance (property line, road, easement, etc.)	82%
Vertical setback (depth to groundwater/restricting layer)	64%
Horizontal setback distance (well, spring, surface water, etc.)	59%

Variances are a complicated issue and jurisdictions take granting variances very seriously and only after making a determination or finding that the variance will not threaten public health. The summary table above demonstrates that jurisdictions are much more inclined to grant a variance for reducing a set back distance to some artificial marker/boundary.

Types of Systems/Technology Jurisdictions Allow for Repairs

Eighty-four percent of the jurisdictions responding stated that advanced treatment units/systems are allowed to repair failed/malfunctioning systems. Two jurisdictions responded that they would consider any proposed technology or engineered design to remedy a failure situation.

Types of Systems/Technology Jurisdictions Allow for Repairs			
Treatment Unit/System Technology		Final Effluent Dispersal Systems	
Mound system	71%	Pressure distribution	76%
Intermittent sand filter	58%	Chamber	62%
Recirculating sand filter	44%	Seepage pit	49%
Aerobic treatment unit	40%	At-grade	47%
Textile filter	33%	Deep trench > 6'	47%
Evapo-transpiration system	29%	Subsurface drip dispersal	44%
Other media filter	22%	Cap and fill	40%
Holding tank	22%	Bed	36%
Peat filter	20%	Sand-lined trench	29%
Constructed wetland	11%	Gravel alternatives (foam, etc.)	9%
Compost/waterless toilet	9%		

The table above includes all of the major treatment and effluent dispersal technology generally available. Disinfection technology was not included in the survey. The table illustrates that California jurisdictions are willing to use all of the major treatment technologies. The table does not represent what technologies are actually in use but what technologies would be allowed. For example, there are no constructed wetland systems in use even though 11% of the jurisdictions would allow their use.

The above also demonstrates that certain technologies are more acceptable than others. For example, only 9% allow the use of compost/waterless toilets or gravel alternatives (foam, shredded tires, etc). In the case of gravel alternatives this is probably due to their being relatively new on the market. The low acceptance of compost/waterless toilets is due primarily to concerns over maintaining the units once they are installed as well as reservations over subsequent property transactions and the possible need to retrofit with conventional toilets. Also, the use of compost/waterless toilets does not eliminate the need for dealing with the other generated wastewater (graywater). California law (Appendix G Graywater Systems, Title 24, Part 5, California Administrative Code) does allow graywater systems but the requirements for these are very similar to that of a standard onsite sewage treatment system.

Jurisdiction	Housing units with individual sewage systems*	Systems requiring repair (2001)	Repair rate in percent	Notes
Alameda	4,489	20	0.4%	
Amador	9,600	50	0.5%	
Butte	44,314	273	0.6%	
Calaveras	15,378	20	0.1%	
City of Vernon	?	1	?	
Contra Costa	11,222	75	0.7%	
El Dorado	32,609	150	0.5%	
Fresno	42,861	?	0.5%	**
Georgetown Divide	893	50	5.6%	***
Glenn	4,686	38	0.8%	
Inyo	2,191	4	0.2%	
Kern	46,939	275	0.6%	
Lake	13,452	97	0.7%	
Lassen	5,854	15	0.3%	
Los Angeles	80,135	219	0.3%	
Marin	9,276	38	0.4%	
Mariposa	6,347	3	0.0%	
Mendocino	20,520	87	0.4%	
Modoc	3,275	19	0.6%	
Mono	2,400	6	0.3%	
Orange	6,708	6	0.1%	
Placer	23,315	40	0.2%	
Plumas	9,286	192	2.1%	
Riverside	113,238	?	0.4%	**
San Benito	4,993	55	1.1%	
San Bernardino****	132,000	?	?	
San Diego	71,930	500	0.7%	
San Francisco	0	0		
San Joaquin	28,033	286	1.0%	
San Luis Obispo	26,700	200	0.7%	
San Mateo	6,360	76	1.2%	
Santa Barbara	11,434	245	2.1%	
Santa Clara	19,000	63	0.3%	
Santa Cruz	26,693	409	1.5%	
Shasta	28,516	125	0.4%	
Sierra	1,521	10	0.7%	
Solano	5,938	20	0.3%	
Sonoma	43,360	346	0.8%	
Stanislaus	26,360	372	1.4%	
Stinson Beach	700	5	0.7%	
Sutter	11,671	30	0.3%	
Tehama	13,669	51	0.4%	
Trinity	5,790	15	0.3%	
Tulare	34,238	58	0.2%	
Ventura	16,701	258	1.5%	
Yuba	6,585	29	0.4%	
Totals	912,949	4,831	0.6%	

Notes:

* System figures from Status Report: Onsite Wastewater Systems in California (2000)

** Repair figures from Status Report: Onsite Wastewater Systems in California (2000)

*** Figures from On-site Treatment Technology for Preservation of Agricultural Land in California's Central Valley (2002)

**** San Bernardino was not included in the repair rate calculation

Compliance Procedure

Forty of the forty-three jurisdictions responding to the question have a formal compliance procedure. Thirty-seven of these rely on local ordinance as the authority. Also used, but less frequently cited, are the California Health and Safety Code – Sections 5410-5416 and 17920 (27 jurisdictions) and the Uniform Housing Code – Substandard Buildings (18 jurisdictions). Only one jurisdiction listed the Uniform Plumbing Code.

Authority Cited	
Local Ordinance	86%
California Health & Safety Code	61%
Uniform Housing Code	41%
Uniform Plumbing Code	2%

The legal or administrative procedure used most frequently is a violation notice with thirty-nine jurisdictions. This is followed by abatement letters from the Director of Environmental Health with twenty-five.

Administrative/Legal Procedures That Can Be Used	
Violation notice	98%
Letter from director of environmental health	63%
Letter from district attorney	58%
Administrative hearing	55%
Criminal proceedings	45%
Civil proceedings	38%
Property lien	30%
Letter from health officer	25%
Administrative fine	25%
Other	15%

Formal legal action to abate a failing system is infrequent with only ten (10) instances cited that had to go to court for resolution. Likewise, only eleven (11) inspection warrants were sought in situations where access was denied to investigate a suspected failing system.

F) Methods Used for Renovation and Repair of Failed or Malfunctioning Systems

Effectively resolving failed or malfunctioning systems means to match the causes of the failure or malfunction with the appropriate treatment technology that will remedy the cause of the failure. The method used to renovate or repair a system should be dictated by a thorough failure diagnosis. As previously discussed this should be a method that looks beyond the symptom(s) and tries to determine the cause.

Ranges of repair options are available and are being used throughout the state. As previously indicated 82% of jurisdictions allow the use of some type of advanced treatment unit or alternative dispersal method to remedy failures.

The most common repair options and the appropriate technology are discussed below. The discussion is organized to categorize the options into the three major components commonly used in onsite systems: 1) primary treatment component (septic tank), 2) secondary treatment component (media filter, aerobic treatment unit, etc.), and 3) the final dispersal component (leach lines, pressure distribution, subsurface drip dispersal, etc.).

Primary treatment

This discussion on primary treatment units does not follow the options scenario as described above but goes into more detail on function. The primary treatment unit is typically a septic tank. Tank replacement is not often deemed unnecessary in large part due to the lack of critical examination of the tank. Examination often emphasizes gross structural integrity and the presence of required fittings. This is a result of not recognizing the importance of such features as water tightness for proper tank function. Replacement options relate primarily to tank size and construction material, and to some extent design. Replacement tanks should always be watertight with watertight fittings and watertight access risers. Watertight concrete, fiberglass and poly tanks are available. Replacement tanks should be fitted with effluent filters as these provide some benefit to the downstream components (USEPA 2002)

The primary treatment component (septic tank) can be the cause of a system failure for a number of reasons. The tank is a passive part of the system with the function of providing retention time for the separation of solids and floatable materials from the wastewater as it passes through the tank, storage space for these separated materials, and some anaerobic digestion/degradation of the retained materials. Because of the passive nature, the results of tank failure often affect the down stream components and are not directly observable in the tank itself. Factors that can disrupt this process are hydraulic overload, organic overload, introduction of incompatible materials, and structural failure.

Hydraulic overload

In the case of hydraulic overload the tank is receiving more water than it is designed to process. This may be due to:

- excessive water use
- undersized tank or change in use
- ground water intrusion
- surface water intrusion

Correcting these causes may involve simply educating the user regarding water use practices, repairing leaking plumbing fixtures, and retrofitting with low-flow plumbing, fixtures. In some situations the tank itself needs to be replaced with a properly sized and watertight tank.

Organic overload

Wastewater entering a tank with high concentration of organic material, referred to as high strength waste, does not fail the tank but results in the effluent leaving the tank to also have high organic content (typically measured as Total Suspended Solids – TSS, Fats, Oil and Grease – FOG, and Biological Oxygen Demand – BOD). This high BOD effluent can have significant impact on downstream components including overwhelming the processing ability of secondary treatment units and clogging of the interface between the final effluent distribution system and the soil infiltrative area.

Correcting high strength waste related problems may involve educating the user regarding the proper use of the system and the types of materials that can be disposed. Additional treatment devices can also be added to reduce the impact on the downstream components. Aerobic treatment units (ATUs) have successfully been used to reduce the BOD in the waste stream so that downstream components can function properly (Stuth, 2000; Converse et.al 2001).

Secondary treatment

Secondary treatment is adding another treatment component between the tank and the final effluent dispersal system. Secondary treatment methods involve using biological, chemical and physical processes to provide additional treatment of septic tank effluent. This additional treatment can compensate for inadequate site and soil conditions and therefore can be used to replace failed or malfunctioning systems. These treatment methods achieve additional treatment of the wastewater constituents and can provide nitrogen reduction, pathogen reduction, and reduce waste strength.

For example, bottomless intermittent sand filters are used in many parts of the state to replace failed conventional systems in situations where there is limited replacement area. This system essentially replaces the standard subsurface soil absorption system with an engineered filter media (sand and gravel). Septic tank effluent is dosed onto the filter area and is treated as it passes through the filter bed. The treated effluent is allowed to pass through the bottom of the constructed sand filter unit into the soil interface directly below it.

Secondary treatment methods fall into two broad categories: media filters/packed bed filters and aerobic treatment units.

Aerobic Treatment Unit (ATU)

Aerobic treatment units come in a variety of configurations that create an aerobic environment inside of a containment vessel/tank to treat wastewater. These units use mechanisms to inject and circulate air inside the treatment tank. This allows certain bacteria that need an oxygen rich environment to thrive and work to break down and digest wastewater constituents. ATUs designs use suspended growth, fixed film, and a combination of the two for their process.

ATUs have been successfully used in repairs to handle and treat high strength waste conditions in commercial applications. They have also been used to renovate failed mound and sandfilter systems.

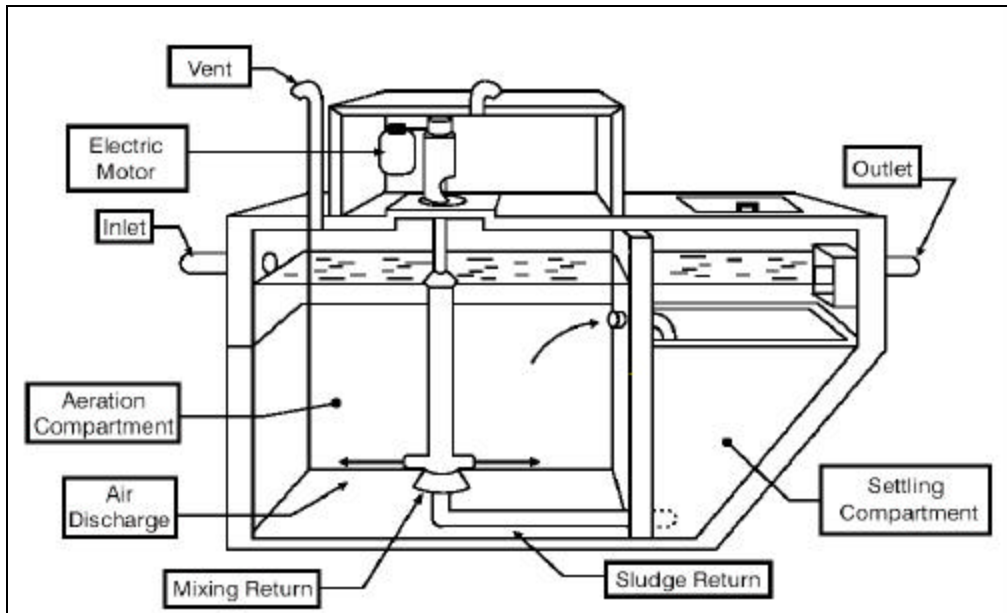


Figure **Suspended growth aerobic unit and design components.** U.S. EPA. 2002. Onsite Wastewater Treatment Systems Technology Fact Sheet 1: Continuous-Flow, suspended-Growth Aerobic Systems (CFSGAS).

Media Filters - Packed-Bed Filters

Recirculating sand filters, intermittent sand filters, peat filters, textile media filters, and recirculating gravel filters are secondary treatment methods that use media to enhance naturally occurring biological, chemical, and physical processes to treat wastewater. The media function to provide a very large surface area for these processes to occur. They usually consist of a container to hold the filter media and a wastewater distribution system that doses the wastewater onto the media in a controlled manner. This controlled dosing is designed to maintain an aerobic treatment environment for the breakdown of wastewater constituents.

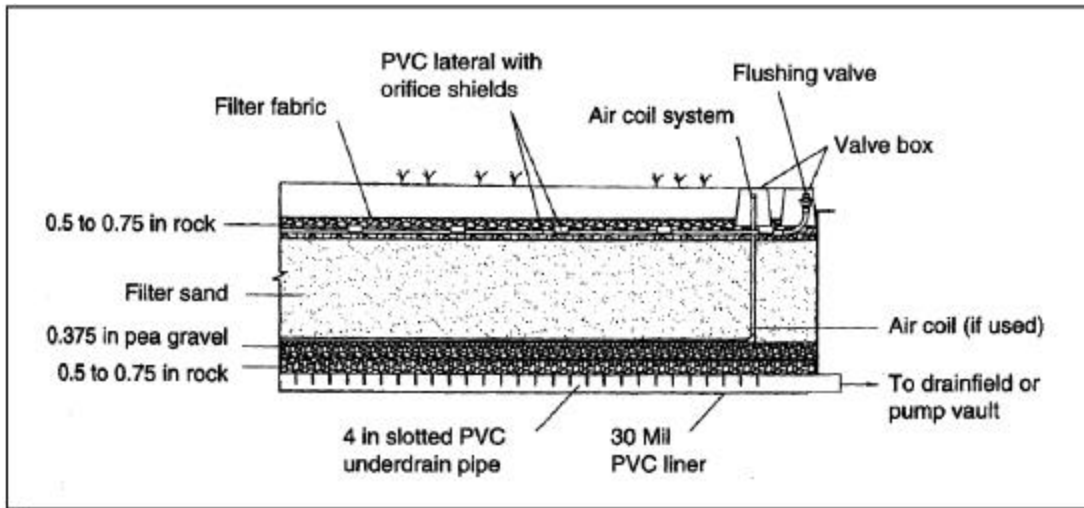


Figure Typical cross section of an intermittent sand filter. National Small Flows Clearinghouse. 1998. Intermittent Sand Filters. Fact Sheet WWFSOM26

Absorption Mound Systems

These systems are designed to provide treatment and dispersal in situations where there is not adequate soil depth or separation to groundwater that would allow installation of standard gravity or pressure distribution systems. These function as both the secondary treatment unit and the dispersal component. A “mound” of specific sand is placed above properly prepared original soil. A pressure distribution network is placed at the top of the sand. Wastewater from the primary treatment unit is distributed into the mound where it receives a high-level of treatment as it flows downward through the sand and into the underlying soil.

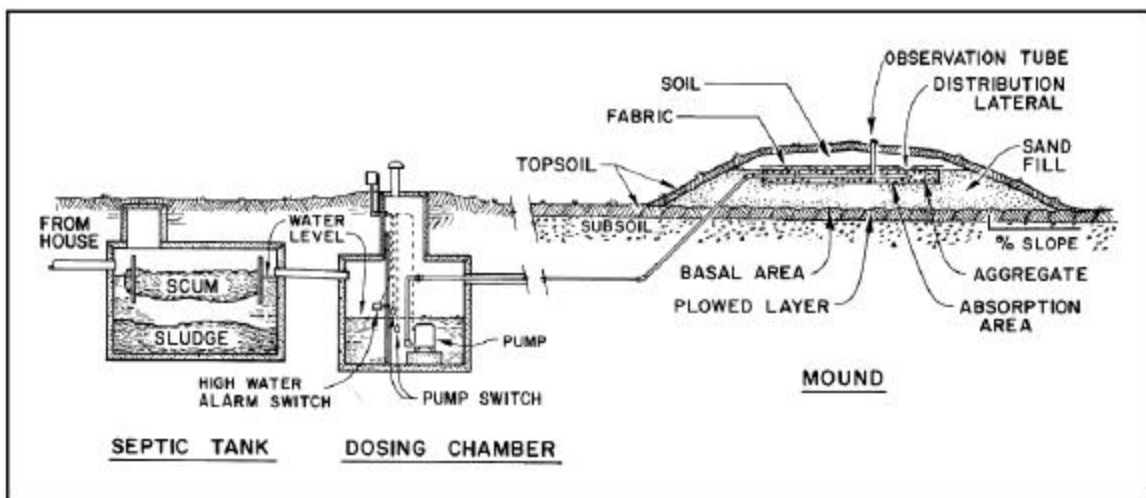


Figure Schematic of a Wisconsin mound system. National Small Flows Clearinghouse. 1998. Mound Systems. Fact Sheet WWFSOM27.

Final Effluent Dispersal Methods

Surfacing effluent from the subsurface soil treatment area is the most common evidence of a failed system. As previously discussed, while this is the most common symptom it may not be the cause of the failure. However, once effluent is surfacing the subsurface soil absorption area often needs to be replaced. The replacement options are listed below and should be chosen to overcome or compensate for any limiting site and/or soil conditions. Frequently the 'failed' soil absorption system can be set aside for reuse at a later date. The replacement system design should incorporate an alternating/diverter valve to allow directing flows back to the 'failed' system once it has recovered. Flows can then be alternated between the old system and the replacement system at some determined frequency.

Final effluent dispersal technology has evolved steadily over the past thirty years in large part to a better understanding of the biological, chemical and physical treatment processes that can occur in the soil. The preferred methods now encourage shallow dispersal into the aerobic and most biologically active regions of the soil. This not only enhances treatment, it maximizes evapotranspiration, nutrient uptake and separation to groundwater. The second major trend has been to disperse the effluent uniformly through pressure distribution allowing for better utilization of the entire infiltrative surface.

Standard Trenches

Standard trenches (leachlines) are constructed with the trench bottom level. Their depth is 2-6 feet, with a width of between 2 and 3 feet. The trenches typically contain 18 inches of gravel with a distribution pipe placed 12 inches from the trench bottom and surrounded by gravel. Wastewater is generally gravity fed into the perforated distribution pipe where it leaches out into the soil. The wastewater is treated as it moves through the soil.

Shallow Trenches

These trenches are a variation on the standard drainfield. They are designed to use the upper soil to receive the effluent from the treatment unit. These shallow systems enhance wastewater treatment since there is more biological activity at these shallow depths. These systems are also used to provide for greater separation from underlying groundwater.

Deep Trenches

Deep trenches are typically used to get below poor soil conditions or below an impervious layer that restricts the downward movement of the wastewater. They can, therefore, provide effective wastewater disposal but not necessarily effective treatment, as there is limited biological activity at this depth. Deep trenches also provide wastewater storage in slowly permeable soils.

Absorption Mound Systems

Absorption mound systems serve the dual role of providing a treatment unit and a dispersal component and are discussed previously under secondary treatment. They are often used to artificially provide adequate soil depth or separation to groundwater.

At-grade

These are designed to use the upper soil to receive the effluent from the treatment unit. Their function is similar to the shallow trenches. These systems also provide for greater separation from groundwater or restrictive soil layers.

Imported Fill

Imported fill systems are used to either replace excavated soil or place additional soil at a site in which to place the soil dispersal area. The fill material is carefully selected and placed and is used as the soil absorption/dispersal component. Fill systems must be carefully engineered in order to function properly. This methodology is rarely used in California.

Sand-lined Trenches

These systems use carefully selected sand to line the trench excavation. The sand acts as a media filter for the applied wastewater. These systems are often used to improve treatment in areas of shallow soils over fractured rock or soils that are too permeable, that is, leach too quickly. They can be either gravity or pressure dosed, though pressure distribution should be design of choice.

Chambers

Chambers are preformed structures used to replace the gravel in a leach trench. The structures provide a void space for passage and storage of wastewater from the treatment component and hold open the soil interface for wastewater distribution. This method has the same function performed by the layer of gravel that has traditionally been used in drainfields. Chamber technology is accepted in over 50% of jurisdictions in California. Plastic chambers are the most commonly used although concrete chambers are used in other parts of the country. Chambers are often used in situations where site access is difficult and/or where clean drain rock is not readily available.

Gravel Alternatives

As the name implies these systems replace the gravel in the trench system. Replacement materials include foam, shredded tires, and synthetic chips. These materials act in a similar fashion as gravel, holding the excavation open and providing a void space for passage and storage of wastewater from the effluent distribution system to the soil interface. This option has a similar function performed by the layer of gravel and can be used in all types of leachfield configurations.

Seepage Pits

Seepage pits or dry wells are deep excavations used for subsurface disposal of wastewater from a primary treatment unit. These pits are designed to provide storage and dispersal of the wastewater into formations that are permeable. No appreciable wastewater treatment occurs in the pits with their primary function being disposal of the wastewater. Seepage pits are used in situations where there is limited area and this precludes the use of standard leachlines.

Evapotranspiration Systems

These systems discharge wastewater to large sand beds with an impervious liner. Wastewater from a primary treatment unit is distributed into the bed and is removed by evaporation. Specific plants can also be used in the beds to enhance transpiration of wastewater. These systems are used in areas where conditions prohibit wastewater discharge into the ground and where climatic conditions provide enough evaporation potential.

Constructed Wetlands

Constructed wetland systems are artificially constructed systems that copy features of naturally occurring wetlands. They rely on plants and naturally occurring biological, chemical, and physical processes to treat wastewater constituents and reduce the volume of wastewater by evapotranspiration. Wastewater is applied to 'cells' that are carefully designed to support and enhance the processes.

Subsurface Drip Dispersal Systems

These systems use small diameter pipes and drip emitters for subsurface dispersal of the wastewater into the soil. They are designed to discharge very small doses of effluent over a large surface area and at shallow depths and utilize the biological, physical and chemical processes in the shallow soil for wastewater treatment. These systems typically require effective pretreatment and filtering to keep the emitters from clogging. These systems are being designed to provide subsurface irrigation for landscaping.

G) Costs of Replacement Systems

Selected jurisdictions and persons involved in the onsite industry were contacted to get a sampling of the costs of the various replacement options. As expected the costs are variable and depend on a number of factors:

1. how much of the system needs to be replaced,
2. complexity of the treatment methodology/technology
 - waste strength
 - hydraulic load
3. the costs of engineering the system,
 - prepackaged, proprietary design versus unique design
 - additional site evaluation and testing

4. site constraints and access,
5. treatment needs, i.e., nitrogen reduction, pathogen reduction, etc.,
6. availability and cost of raw material (e.g., specification sand for intermittent sand filters, clean drain rock, etc.),
7. hauling costs for raw materials
8. value and location of the property
9. monitoring requirements
10. installation difficulties
11. permit fees
12. prevailing labor costs

Replacement costs are also dictated by what a particular treatment method can handle in terms of the characteristics of the influent it receives and is expected to process from the upstream component. If a treatment method can handle a certain quantity and quality of influent then the upstream component must be capable of producing a compatible effluent. The components of a treatment system are interdependent and this makes failure diagnosis very important so that the cause is determined and the repair is not based on the symptom. Two examples illustrate this: 1) secondary treatment units typically require watertight septic tanks, pump chambers and the like and therefore the existing tank often needs to be replaced, and 2) subsurface drip dispersal systems require effluent that is low in suspended solids so that the emitters can function properly and this requires secondary treatment and filtering that can produce effluent that meets this criteria.

The following table gives some broad estimates of repair costs. These estimates are very general and the cost can vary significantly. They are provided for illustrative purposes and to demonstrate the differences in costs from one area to another. The information was provided through email and phone interviews.

Table G-1 Typical Repair Costs

Typical Repair Costs – Selected Jurisdictions and Areas			
Area	Intermittent Sand Filter	Bottomless Sand Filter	Leach Line Replacement
Butte County		\$12,000 - \$15,000	
Sutter County	\$12,000 - \$15,000		\$1,500+
Shasta County			\$1,200+
El Dorado County			\$1,500+
Modoc Co.			\$2,500+
Solano County	\$18,000+		
Sierra Foothills (Motherlode)	\$18,000 - \$25,000		\$3,000+
Santa Cruz County	\$18,000 - \$25,000+		\$5,000
Napa/Sonoma Valley	\$20,000 - \$30,000		\$5,000
North Coast			
San Diego Co	\$15,000 - \$25,000		\$2,500+
Malibu	>\$30,000	>\$30,000	
Georgetown Divide	>\$15,000	>\$15,000	

H) Conclusion

This survey helped to identify both quantitatively and to some degree qualitatively how the jurisdictions in California approach the question of onsite system failure/malfunction. It is clear that jurisdictions currently rely heavily on the traditional definitions of failure (i.e. surfacing and backup) to find and identify these problems. However, nearly 25% of the jurisdictions are now using system monitoring and monitoring reports as a tool for evaluating system performance and determining failure/malfunction based on this evaluation. This aspect will become increasingly important as more sophisticated technology is utilized and as treatment goals are required.

System monitoring is a relatively new development in California and is used most often in areas developed with alternative technologies to overcome site conditions or water quality concerns. The number of systems currently monitored is small and predictably the number of failures/malfunctions found through this process is very few (about 0.6% of all repairs reported). The main purpose of system monitoring is to prevent failure/malfunction by ensuring proper operation and maintenance through periodically checking performance and is part of an overall onsite management program.

The survey did help to confirm that the previously reported rate of failure in California is less than 1% of the total number of systems. The reasons for this low rate cannot be determined from the survey response, however the following are offered as possible contributing factors:

1. California has had an established regulatory program in environmental and public health for more than 50 years. As a result, most locales have had some level of regulatory oversight for onsite sewage treatment and this probably resulted in the application of some level of minimum standards.
2. A large number of systems in California are relatively new and were typically installed in site and soil conditions suitable for a standard system. These systems are passive and the operation and maintenance requirements minimal, so even with minimum care they can function. The age related deterioration described as a cause of failure might not yet be occurring at any appreciable rate.
3. The historical emphasis for many installations was to dispose of the effluent, that is keep it underground, and with this in mind systems were sized to accomplish this. Local practices may evolve to compensate for limitations. For example, leachlines may be installed with extra depth and rock under the drainline to provide for additional storage of the effluent.
4. Designs for standard systems are very conservative. Design flow rates typically assign much larger flows than actually encountered, offering a considerable 'reserve' capacity for a system.
5. A number of repairs are probably conducted without benefit of a permit so the local jurisdiction has no record of a 'failure'. This is exacerbated by the lack of a certification/licensure program. Without such a program the qualifications and accountability of persons engaged in the onsite industry is not officially tracked.

6. In a number of jurisdictions the responsibility for the onsite program is split among several agencies complicating the record keeping and reporting. For example one agency may investigate the problem via a complaint and a second agency may issue a repair permit for that complaint without necessarily coordinating records with the first agency.

The specific reasons for California's low failure rate cannot be determined. It should be noted that most jurisdictions do not have the resources or programs in place to proactively inspect existing systems for proper function. This is primarily due to the funding mechanisms for local programs. The funding typically relies on permit fees that cover approval and construction inspections but not ongoing oversight. Jurisdictions that have monitoring programs also have instituted operating permits that provide an ongoing source of revenue. This revenue generally allows for oversight of systems that are required to monitor (the alternative systems used to overcome site limitations or attain treatment goals) but not for previously existing systems.

The majority of local jurisdictions, 84%, will generally accept some type of alternative treatment technology or dispersal technology to repair a failed system. That said, only two treatment technologies (mound and intermittent sand filter) and two dispersal technologies (pressure distribution and chamber systems) are accepted in greater than 50% of the jurisdictions responding to the survey. It is suggested that institutional factors have a significant bearing on accepting new technology. The reasons for reluctance to accept alternative technologies are probably based on several factors (adapted from Agricultural Lands Preservation Utilizing a Performance-Based Onsite Sewage Treatment Ordinance, 2003):

1. lack of perception of need (apparent adequacy of the present system or technique),
2. lack of knowledge or understanding of the innovation,
3. lack of interest or motivation on the part of local officials,
4. unknown aspects of the innovation which makes trial or adoption risky,
5. unknown aspects of reliability – what are the expectations of long-term performance,
6. lack of technical evaluation capability,
7. distrust of private sector experts, and
8. lack of a "climate of acceptance" among officials and local residents (Bingham 1976).

Additionally, as Otis (2001) points out regulatory programs have to be adequately prepared and have sufficient resources to provide the management oversight necessary for assuring system performance. Therefore, the regulatory infrastructure should be in place to accomplish this end and this is not the case in many jurisdictions.

Approximately 70% of the jurisdictions allow variances off of their local ordinance/standards to accomplish repairs, although this only occurred in 3% (160 instances) of the repairs reported. The most often used variance is for a variance off of horizontal set back requirements from artificial boundaries such as property lines. Typically this happens on small parcels where the replacement area for the soil treatment

component is limited and a reduction in a setback distance is needed to install the system. Approximately 50% of the jurisdictions indicated that they would consider setback reductions in depth to groundwater or distance to a water body to accommodate repairs.

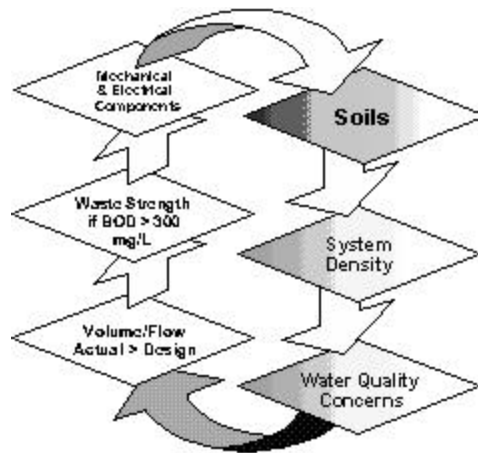
Nearly 90% of the jurisdictions reported a formal compliance procedure for remedying failed/malfunctioning systems. Most cite local ordinance as their legal authority but will also use other legal authority options such as the California Health and Safety Code. The most frequently used compliance tool is a violation notice followed by abatement letters from the administrative authority. More than half (55%) has an administrative hearing process in place and a quarter have the ability to issue administrative fines. Of note is that 30% of the jurisdictions can use property liens to effect repairs.

These findings indicate a range of compliance procedures and abatement options are in use. These have been developed over time and are reflective of the local administrative structure and political climate.

D) Recommendations

The use of onsite wastewater treatment systems is and will continue to be an important part of the infrastructure that serves many areas in California. This type of waste management can be reliable, economic, protective, and appropriate in many situations. In April 1997, EPA published its *Response to Congress on Use of Decentralized Wastewater Treatment Systems* which concluded that, overall, “adequately managed decentralized (onsite) wastewater treatment systems can be a cost effective and long-term option for meeting public health and water quality goals, particularly for small, suburban, and rural areas.” These waste management systems, as with any aspect of infrastructure, must be properly operated and maintained to continue to serve the purpose intended. Our concept of this purpose is evolving from one of disposal to one of treatment. This evolution requires that we reexamine our understanding of what constitutes a properly functioning system. Traditionally, onsite systems were considered to be failing when sewage effluent surfaced above ground or there was a backup of sewage into the facility being served by the system. This perception is changing with recognition that the appropriate function of these systems is treatment. Along with this change in perception comes a change in defining what constitutes a failing system. Now, we must consider if the system is performing, that is meeting a treatment goal, in order to determine if it is functioning properly.

This is the context within which onsite systems should be evaluated. Essentially it is risk analysis measuring the variables and risks and the desired outcome. The following diagram depicts these considerations:



Risk Factors for OWTS – USEPA 2002

Sophisticated technology and treatment goals also require a disciplined failure analysis protocol. It will become much more important to correctly diagnose the cause of a system failure/malfunction. Correcting the symptom may provide a short-term fix or may accomplish the goal of keeping effluent subsurface but it may not ensure that the treatment unit is performing in the treatment goal context. Local jurisdictions should be encouraged to adopt a disciplined failure analysis so that repairs can be effective both in the short term and the long term. This should incorporate risk analysis so that environmental and public health concerns may also be identified and addressed.

Local agencies should be encouraged to establish a more comprehensive record keeping system to track failures/malfunctions. The database should include information on the failure diagnosis. This will not only develop a database on repair numbers but can also be used to develop a record of system performance and can provide necessary information for planning and policy decisions.

Funding for more comprehensive and proactive onsite programs is an issue facing many local jurisdictions. In general, they do not have the resources necessary to proactively survey existing onsite systems for proper function. In part this may help explain the low onsite system failure rate reported for the State. In any event, a reliable source of funding should be established to develop and maintain a comprehensive oversight program both at the state and local level. A comprehensive program can help ensure public health and water quality protection.

The State Water Resources Control Board, the Regional Water Quality Control Boards, local agencies and communities, the private sector and the public should work together to:

1. Secure a reliable and sustainable source of funding for the onsite wastewater management program.
2. Develop comprehensive local programs so that expectations for system performance can be verified.

3. Develop a technology evaluation/certification program so that alternative technologies can be utilized to help address public health or water quality concerns. Local agencies do not have the resources to perform this function by themselves. The most efficient utilization of resources is a state level clearinghouse and this must be designed to encourage innovation and the introduction of new technology while assuring reliability.
4. Develop a common or compatible data system for tracking onsite systems. The data elements should include information on system performance and failure diagnosis.
5. Develop a certification/licensure program so that onsite practitioners can be held accountable to the consumer and the regulatory agencies.

Failure or malfunction of onsite treatment systems will continue to occur, as will failures or malfunctions of other parts of our infrastructure. Some of these may be inevitable and many are probably avoidable. The common feature is that all types of infrastructure must be maintained with the expectation that components will eventually need to be replaced or repaired. Managing the onsite infrastructure requires local and state programs provide the oversight necessary to ensure systems function as needed to protect the consumer, and meet public health and water quality objectives.

References

- Adams, A. et.al., 1998 FACTSS: Failure Analysis Chart for Troubleshooting Septic Systems. In: Proceeding of the Eight National Symposium on Individual and Small Community Sewage Systems, ASAE.
- Bingham, Richard D. The Adoption of Innovation by Local Government (Lexington, MA: D.C. Heath, 1976)
- 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 Administrative Code, Title 24, Part 5, Appendix G Graywater Systems.
- California Water Resources Control Board, (1994), Report of the Technical Advisory Committee for Onsite Sewage Disposal Systems, Sacramento, CA November 1994.
- California Wastewater Training and Research Center and USEPA (2000). Status Report: Onsite Wastewater Systems in California, Final Draft, June 2000, California State University, Chico.
- Converse, J.C., Converse, M., and E.J. Tyler. 2001. Aerobically Treated Effluent for Renovating Failing Soil Absorption Units. In: Proceeding of the Ninth National Symposium on Individual and Small Community Sewage Systems, ASAE.
- 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 *ad hoc* Task Force for Decentralized Wastewater Management. Marine Studies Consortium, 400 Heath St., Chestnut Hill, MA 02167 (Page 44)
- National Small Flows Clearinghouse. 1998. Mound Systems. Fact Sheet WWFSOM27.
- National Small Flows Clearinghouse. 1998. Intermittent Sand Filters. Fact Sheet WWFSOM26
- National Small Flows Clearinghouse. 1998. Mound Systems. Fact Sheet WWFSOM27.
- New South Wales Department of Local Government, 2001, On-site Sewage Risk Assessment System, April 2001 Draft (OSRAS).
- Otis, R.J., McCarthy, B.J., and J. Crosby, 2001. Performance Code Framework for Management of Onsite Wastewater Treatment in Northeast Minnesota. In: Proceeding of the Ninth National Symposium on Individual and Small Community Sewage Systems, ASAE.

Schiffman, I., Johns, M. and T. Banathy, 2003. Agricultural Lands Preservation Utilizing a Performance-Based Onsite Sewage Treatment Ordinance. California Wastewater Training and Research Center., California State University, Chico.

Stuth, William L. 2000. Operation, Limitations, and Recovery of Sand Filters. In: Workshop on advanced Onsite Wastewater Systems: Design, Waste Strength Considerations and Operations and Maintenance. California Wastewater Training and Research Center, California State University, Chico.

U.S. Department of Commerce, U.S. Census Bureau, American Housing Survey for the United States - 1995, issued September 1997.

U.S. Environmental Protection Agency (2002) Onsite Wastewater Treatment Systems Manual, Environmental Protection Agency, Office of Water, Washington, DC. (EPA/625/R-00/008), February 2002.

U.S. Environmental Protection Agency (1997), Response to Congress on Use of Decentralized Wastewater Treatment Systems. EPA 832-R-001b. Environmental Protection Agency Office of Wastewater Management, Washington, D.C., April 1997.

APPENDICES

TABLES

System Statistics for Failure/Malfunction - Local Jurisdictions

Jurisdiction	Systems requiring repair (2001)	Permit required		Permit fee	Failure/malfunction identified by				Number of failure/malfunction discovered by						Notes	
		Yes	No		Effluent surfacing	Sewage backup	Monitoring report	Other	Complaint	Self-initiated	Survey	Service request owner or occupant	Point of sale inspection	Upgrade for remodel		System monitoring inspection
Alameda	20	X		\$250	X	X			10	1		4	3	2		
Amador	50	X		95-500	X	X	X	X	*	*	*	*	*	*	*	
Butte	273	X		\$233	X	X			*	*	*	*	*	*	*	
Calaveras	20	X		262-297	X				19	1						
City of Vernon	1	X		**	X	X										
Contra Costa	75	X		\$492	X	X	X	X	15	30			30			
El Dorado	150	X		\$216	X	X			75	73			2	70		
Fresno	?	X		\$76	X	X			X			X	X	X		
Georgetown Divide	50	X			X	X	X									
Glenn	38	X		\$38	X	X			*	*	*	*	*	*	*	
Inyo	4	X		\$160						4						
Kern	275	X		\$53	X				*	*	*	*	*	*	*	2
Lake	97	X		\$174	X	X			10			10	70	7		
Lassen	15	X		\$86	X	X			2			10	3			
Los Angeles	219	X		\$554	X	X			*	*	*	*	*	*	*	
Marin	38	X		\$812	X	X	X		4	1		15		19		
Mariposa	3	X		\$120	X	X			3							
Mendocino	87	X		\$137	X	X		X	*	*	*	*	*	*	*	
Modoc	19	X		\$13	X							17	2			
Mono	6	X		\$80	X	X	X	X	2	4						
Orange	6	X		\$100	X	X			6							
Placer	40	X		357-950	X	X	X		16	8		4	8	4		
Plumas	192	X		\$219	X	X			X	X		X	X			
Riverside	?	X		\$90	X	X			*	*	*	*	*	*	*	
San Benito	55	X		218-438	X	X						50	2	3		
San Bernardino	?	X		?	X	X			X							X
San Diego	500	X		\$190	X	X			25%	9%	1%	30%	15%	20%		
San Francisco	0															
San Joaquin	286	X		\$180	X	X	X		*	*	*	*	*	*	*	
San Luis Obispo	200	X		35-60	X	X			*	*	*	*	*	*	*	
San Mateo	76	X		\$500	X	X			4			59	5	5	3	
Santa Barbara	245	X		\$138	X	X			*	*	*	*	*	72	*	
Santa Clara	63	X		\$400	X	X			2			26		35		
Santa Cruz	409	X		148-816	X	X	X		10	320	10	32	3	54		
Shasta	125	X		\$0	X	X			62	6		32	6	13	6	
Sierra	10	X			X	X			2			8				
Solano	20	X		\$267	X	X			3			5	9	3		
Sonoma	346	X		304-747	X		X		96			178				1
Stanislaus	372	X		\$112	X	X	X		56	93			37	182	4	
Stinson Beach	5	X		\$100	X	X	X				2	3				
Sutter	30	X		\$80	X	X			7			12	4	7		
Tehama	51	X		\$140	X	X			35	10		6				
Trinity	15	X		\$0	X	X			2			5	3	5		
Tulare	58	X		\$59	X	X								X		
Ventura	258	X			X											
Yuba	29	X		\$280	X	X			3	14			10	2		
	4831	45	0		44	39	11	4	444	565	12	444	197	483	13	

* Not tracked

** Fee based on cost of repair

Notes: 1. 72 remodels in addition to repairs
2. Most are request for service

Evaluation Procedures and Variance/Waiver Practices - Local Jurisdictions

Jurisdiction	Which of the following steps taken into consideration for repair permit									Repairs requiring variance		Variances allowed for			Notes:
	Determine type of system	Identify location of malfunction	Determine frequency and duration	Evaluate hydraulic and organic load	Evaluate site and soil conditions	Function soil treatment and distribution system	Evaluate if Biomats induced	Summarize contributing factors	Develop/ Determine repair options	Local ordinance	Regional Board guidelines	Horizontal setback from well, surface water	Horizontal setback from property line, etc.	Vertical setback	
Alameda	X	X	X		X				X	10	?	YES	YES	YES	
Amador	X	X	X	X	X	X	X	X	X	3	3	NO	YES	YES	
Butte	X	X	X	X	X	X	X	X	X	0	N/A	NO	NO	YES	
Calaveras												NO	YES	NO	
City of Vernon	X	X	X	X	X	X				0	0				
Contra Costa	X	X	X	X	X	X	X	X	X	0	1	YES	YES	NO	
El Dorado	X	X		X	X	X				3	3	NO	YES	YES	1
Fresno	X	X			X	X						YES	YES	NO	
Georgetown Divide	X	X	X	X	X	X		X	X						
Glenn	X	X	X	X	X	X					N/A	YES	YES	YES	
Inyo	X	X			X			X	X	0	0	NO	YES	YES	
Kern										2	0				
Lake	X	X		X	X	X	X	X	X	NR	NR	NR	NR	NR	
Lassen	X	X			X				X	0	0	YES	YES	YES	
Los Angeles	X	X			X					0	0	NO	NO	YES	
Marin	X	X	X	X	X	X	X	X	X	>30	0	YES	YES	YES	
Mariposa	X	X	X	X	X				X	0	0	YES	YES	NO	
Mendocino	X	X		X	X	X	X		X	**	**	YES	YES	YES	
Modoc	X				X					0	0	YES	NO	NO	
Mono	X	X	X	X	X	X		X	X	0	0				
Orange	X	X										NO	NO	NO	
Placer	X	X	X	X	X	X	X	X	X	8	0	YES	YES	YES	
Plumas	X	X	X	X	X	X	X		X	0	N/A	*	*	*	
Riverside	X				X				X	0	0	NO	YES	NO	
San Benito	X	X			X				X	0	0	NO	YES	NO	
San Bernardino	X	X			X	X			X	0	0				
San Diego	X	X	X	X	X	X		X	X	5%	1%	NO	YES	YES	
San Francisco															
San Joaquin	X	X	X	X	X	X	X		X	13		YES	YES	NO	
San Luis Obispo	X	X						X	X	<5	<5	YES	YES	YES	2
San Mateo	X	X	X	X	X	X	X	X	X	0	0	YES	YES	NO	
Santa Barbara	X	X							X	25	25	YES	YES	YES	
Santa Clara	X	X		X	X	X				10	0	YES	YES	YES	
Santa Cruz	X	X	X	X	X	X			X	54	24	YES	YES	YES	
Shasta	X	X	X	X	X	X	X	X	X	12	12	YES	YES	YES	
Sierra	X	X			X				X	4		YES	YES	YES	
Solano												YES	YES	YES	
Sonoma	X	X	X	X	X	X			X			YES	YES	YES	
Stanislaus	X			X	X					7	0	NO	YES	NO	
Stinson Beach	X	X	X	X	X	X		X	X			NO	YES	YES	
Sutter	X	X			X				X	5	5	YES	YES	YES	
Tehama	X	X			X				X	0	0	NO	YES	YES	
Trinity	X	X	X		X				X	0		YES	NO	NO	
Tulare	X	X	X	X	X	X	X	X	X	0	0	YES	YES	YES	
Ventura	X				X					?	?	NO	YES	YES	
Yuba	X	X		X	X					4	0	NO	YES	NO	
Totals	42	38	21	25	39	24	12	15	32	160	73	23	33	25	

* Case-by-case evaluation

** Repairs exempt from waivers

Notes:
 1. Vertical setback for soil depth
 2. Only with concurrence RWQCB

Compliance Procedures - Local Jurisdictions

Jurisdiction	Have formal compliance procedure		Authority				Administrative Procedures										Formal Legal Action	
	Yes	No	Local ordinance	Uniform Housing Code	Uniform Plumbing Code	Health & Safety Code	Admin. Fine	Admin. Hearing	Property Lien	DA letter	EH letter	Health Officer letter	Criminal	Civil	Violation notice	Other	Court cases	Inspection warrants
Alameda	X		X			X			X	X				X			0	0
Amador	X		X	X		X		X		X	X			X	X		0	0
Butte	X		X			X						X		X			2	0
Calaveras	X		X				X	X	X			X		X			1	10
City of Vernon	X		X	X				X	X	X		X		X			0	0
Contra Costa	X		X	X		X	X	X	X	X	X			X			0	0
El Dorado	X		X	X		X	X	X	X	X			X	X			2	0
Fresno	X		X	X		X	X	X	X	X				X			1	0
Georgetown Divide	X		X															
Glenn		X	X	X		X								X	X		0	0
Inyo	X		X				X			X							0	0
Kern	X		X	X										X			0	0
Lake	X		X					X		X		X		X			0	0
Lassen	X					X			X	X	X	X		X			0	0
Los Angeles	X		X					X	X			X		X			0	0
Marin	X		X					X		X			X	X			0	0
Mariposa	X		X					X		X			X				0	0
Mendocino	X		X						X				X	X			1	1
Modoc	X		X											X			1	0
Mono		X							X	X	X	X		X			0	0
Orange	X			X		X				X		X		X			0	0
Placer	X		X	X		X		X	X	X	X	X	X	X			0	0
Plumas		X																
Riverside	X		X			X				X				X			0	0
San Benito	X		X	X		X			X	X	X	X	X	X			0	0
San Bernardino																		
San Diego	X		X			X		X						X			<1%	0
San Francisco	X		X			X	X	X	X			X		X				
San Joaquin	X		X	X		X		X	X			X		X			0	0
San Luis Obispo	X		X	X		X	X	X				X		X	X		<2	<2
San Mateo	X		X	X		X			X		X	X	X	X			0	0
Santa Barbara	X		X			X	X	X	X	X		X	X	X			0	0
Santa Clara	X		X							X		X					0	0
Santa Cruz	X		X			X	X	X	X	X			X	X	X		0	0
Shasta	X		X	X		X		X	X	X		X	X	X			0	0
Sierra	X			X		X			X		X			X			0	0
Solano	X		X				X							X			0	0
Sonoma	X		X	X		X	X	X					X	X	X		1	0
Stanislaus	X		X	X		X		X	X				X	X			0	0
Stinson Beach	X		X					X	X					X	X		0	0
Sutter	X		X			X			X	X			X	X			0	0
Tehama	X		X			X		X	X	X	X		X	X			0	0
Trinity		X			X	X			X		X						0	0
Tulare	X		X	X		X		X	X	X	X	X	X	X			0	0
Ventura	X		X	X		X		X		X		X		X			0	0
Yuba	X		X						X	X				X			1	0
Totals	41	4	39	19	1	28	10	22	12	24	26	11	19	16	40	6	10	11

Wastewater Treatment Technology Allowed/Permitted - Local Jurisdictions

Jurisdiction	Do you allow use of alternative technology		Treatment Systems											Final Effluent Dispersal Systems									Notes	
			Mound	ISF	RSF	Peat Filter	Textile Filter	Other media filter	ATU	Const. wetland	ET	Holding tank	Compost or waterless	Pressure distrib.	Chamber	Sub-surface drip	Cap and fill	At-grade	Sand lined trench	Deep trench >6'	Gravel alternatives (foam, etc.)	Bed		Seepage pit
	Yes	No																						
Alameda	X		X	X	X	X	X	X					X	X	X	X	X	X	X	X	X			
Amador	X		X	X									X				X	X	X					
Butte	X		X	X										X	X	X	X					X		
Calaveras	X		X	X	X						X	X					X	X						
City of Vernon		X																						
Contra Costa	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X						
El Dorado	X		X											X	X	X	X	X						
Fresno	X		X											X	X	X		X					X	
Georgetown Divide	X		X	X	X				X					X	X	X		X				X		
Glenn	X		X											X	X	X	X	X						
Inyo	X		X	X	X						X			X	X	X		X						
Kern	X		X																				X	
Lake	X			X	X	X			X				X	X	X	X			X			X		
Lassen	X		X	X	X								X	X	X	X		X					X	
Los Angeles	X								X				X	X	X				X			X	X	
Marin	X		X	X	X				X				X	X	X			X				X	X	
Mariposa	X		X	X	X				X				X	X	X		X	X		X				
Mendocino	X		X	X	X	X	X	X				X	X	X	X	X	X			X		X		
Modoc		X																						
Mono	X		X										X	X			X	X				X		
Orange		X																						
Placer	X		X	X										X	X		X						X	
Plumas	X		X											X				X						
Riverside	X		X										X						X					
San Benito	X		X										X										X	
San Bernardino	X		X	X							X	X	X	X				X				X	X	
San Diego	X		X						X				X	X	X		X					X	X	
San Francisco	N/A																							
San Joaquin	X		X	X	X	X			X				X				X	X					X	
San Luis Obispo	X		X	X	X				X				X	X								X	X	
San Mateo	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X				X	X	
Santa Barbara		X												X	X			X				X	X	
Santa Clara		X																		X				
Santa Cruz	X		X	X	X				X	X	X		X	X	X	X	X		X			X	X	
Shasta	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	1	
Sierra	X		X	X										X					X					
Solano	X		X	X	X	X	X	X	X	X			X	X	X	X	X					X		
Sonoma	X		X	X	X	X	X	X					X	X	X	X	X		X			X	X	
Stanislaus	X		X											X					X				X	
Stinson Beach	X			X	X				X	X	X					X		X						
Sutter	X		X	X										X	X	X		X						
Tehama	X		X	X	X								X	X		X	X	X				X	X	
Trinity	X		X											X	X									
Tulare		X																					X	
Ventura		X	X																				X	
Yuba	X		X	X					X					X				X				X	X	
Totals	38	7	33	26	20	9	15	10	18	5	14	10	4	35	28	20	18	21	13	21	4	16	23	

Notes:
 1. Would allow any technology that would solve problem
 2. Seepage pit max. depth 6'

SAMPLE SURVEY

Failure/Malfunction Report Survey - Local Onsite Sewage Treatment Programs

Jurisdiction _____

County _____

Program manager _____

Person completing survey _____

Address _____

Phone # _____ Fax# _____

Email Contact _____

Please answer the following questions (both sides) - for calendar year 2001:

How does your agency identify system failure/malfunction?

- | | |
|--------------------------|--|
| <input type="checkbox"/> | surfacing sewage |
| <input type="checkbox"/> | system backing up into home/system no longer accepting sewage |
| <input type="checkbox"/> | failed monitoring report (system performance inadequate as per operating permit) |
| <input type="checkbox"/> | Other (list) |

Number of system failures/malfunctions requiring repairs:

Of these how many were the result of:

- | | |
|--------------------------|--|
| <input type="checkbox"/> | Complaint |
| <input type="checkbox"/> | Self-initiated (happened on it) |
| <input type="checkbox"/> | Sanitary Survey |
| <input type="checkbox"/> | Request for service by owner/occupant |
| <input type="checkbox"/> | Point of sale inspection |
| <input type="checkbox"/> | System upgrade request for remodel/addition |
| <input type="checkbox"/> | Routine/scheduled system monitoring inspection |

Is a permit required for system repairs?

Yes	No
-----	----

If so, what is the cost of the permit? _____

System failure/malfunction can be caused by a variety of factors. Which of the following steps does your agency follow and/or take into consideration when issuing the repair permit/approval? Check all that apply.

- | | |
|--------------------------|---|
| <input type="checkbox"/> | determining the type of system |
| <input type="checkbox"/> | identifying the location of the malfunction |
| <input type="checkbox"/> | determining the frequency and duration of the malfunction |
| <input type="checkbox"/> | evaluating water use in home (hydraulic load and organic load) |
| <input type="checkbox"/> | evaluating site and soil conditions |
| <input type="checkbox"/> | evaluating functioning of the soil treatment and distribution system |
| <input type="checkbox"/> | evaluating likelihood of biomat induced malfunction |
| <input type="checkbox"/> | summarizing the factors contributing to the failure |
| <input type="checkbox"/> | developing and implementing appropriate repair options to solve the problem |

Variance/Waiver for System Repairs

How many of the repairs required a variance from local ordinance requirements? _____

How many of these required variance from RWQCB Basin Plan Guidelines? _____

Would you/do you allow variance for:

- Horizontal setback distance (well, spring, surface water, etc.)
- Horizontal setback distance (property line, road, easement, etc.)
- Vertical setback (depth to groundwater/restricting layer)

Technologies Allowed for System Repairs

Do you allow the use of enhanced/alternative systems for repairs?

Yes	No
-----	----

Allowable treatment systems:

- Mound
- Intermittent Sand Filter
- Recirculating sand filter
- Peat Filter
- Textile Filter
- Other packed-bed filter
- Aerobic Treatment Unit (ATU)
- Constructed Wetland
- Evapotranspiration
- Holding Tank
- Compost/waterless toilet
- Other (list)

Allowable soil treatment area modifications:

- Pressure distribution Chamber
- Subsurface drip
- Cap and fill
- At-grade
- Sand-lined trench
- Deep trench >6'
- Gravel alternatives (foam, shredded tires, etc.)
- Treatment bed
- Seepage Pit
- Other (list)

Compliance Procedures

Do you have a formal compliance/enforcement procedure in place?

Yes	No
-----	----

Authority:

<input type="checkbox"/>	Local ordinance
<input type="checkbox"/>	State code - Uniform Housing Code
<input type="checkbox"/>	Health & Safety Code

<input type="checkbox"/>	Other - please list
--------------------------	---------------------

What administrative/enforcement procedures do you/can you use:

- Administrative fines
- Administrative hearing
- Lien on property
- Letter from District Attorney
- Letter from Director of Environmental Health
- Letter from Health Officer
- Criminal proceeding
- Civil proceeding
- Violation notice
- other (list)

How many cases had to go to court for resolution? _____

How many inspection warrants issued? _____