Linda S. Adams
Secretary for
Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Arnold Schwarzenegger
Governor

COPY

April 20, 2007

Professor Chet A. Rock
Associate Dean, College of Engineering
210 Advanced Manufacturing Center
University of Maine
Orono, ME 04469

Dear Professor Rock,

INITIATION OF SCIENTIFIC PEER REVIEW ON TECHNICAL ISSUES CONTAINED THE DRAFT REGULATIONS FOR ONSITE WASTEWATER TREATMENT SYSTEMS

The State Water Board is proposing regulations for Onsite Wastewater Treatment Systems (OWTS). As required in the California Health and Safety Code Section 57004, we request a scientific peer review of the proposed regulations.

We are grateful that you have agreed to perform this review. We request that the review be completed with written analysis submitted within 30 days of receipt of the documentation from State Water Board staff. Please notify me at the earliest opportunity if it will be difficult for you to meet this review schedule.

The background and summary for the proposed regulations are provided in Enclosure 1. Enclosure 2 provides focus for the review (revised since peer review solicitation). Individuals involved in the development of the proposed amendment are identified in Enclosure 3. The proposed Regulations are attached as Enclosure 4. Also attached are references for each identified peer review topic listed in Enclosure 2. This reference material includes either the full article or excerpts of the referenced documents.

I am the staff contact for this review and can be reached at (916) 341-5518 or tthompson@waterboards.ca.gov. Please contact me for any questions or additional information needed to fulfill this scientific peer review request.

Thank you for your willingness to conduct this review in the most thorough yet prompt manner possible.

Sincerely,

Todd Thompson
Onsite Wastewater Treatment Systems Specialist
Division of Water Quality

Enclosures

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Linda S. Adams
Secretary for
onmental Protection

Arnold Schwarzenegger
Governor

COPY

April 20, 2007

Professor C. Herb Ward, Ph.D., M.P.H., P.E.
Foyt Family Chair of Engineering
Department of Civil and Environmental Engineering
Rice University
6100 Main Street, Mail Stop 316
Houston, TX 77005-1892

Dear Professor Ward,

INITIATION OF SCIENTIFIC PEER REVIEW ON TECHNICAL ISSUES CONTAINED THE DRAFT REGULATIONS FOR ONSITE WASTEWATER TREATMENT SYSTEMS

The State Water Board is proposing regulations for Onsite Wastewater Treatment Systems (OWTS). As required in the California Health and Safety Code Section 57004, we request a scientific peer review of the proposed regulations.

We are grateful that you have agreed to perform this review. We request that the review be completed with written analysis submitted within 30 days of receipt of the documentation from State Water Board staff. Please notify me at the earliest opportunity if it will be difficult for you to meet this review schedule.

The background and summary for the proposed regulations are provided in Enclosure 1. Enclosure 2 provides focus for the review (revised since peer review solicitation). Individuals involved in the development of the proposed amendment are identified in Enclosure 3. The proposed Regulations are attached as Enclosure 4. Also attached are references for each identified peer review topic listed in Enclosure 2. This reference material includes either the full article or excerpts of the referenced documents.

I am the staff contact for this review and can be reached at (916) 341-5518 or tthompson@waterboards.ca.gov. Please contact me for any questions or additional information needed to fulfill this scientific peer review request.

Thank you for your willingness to conduct this review in the most thorough yet prompt manner possible.

Sincerely,

Todd Thompson
Onsite Wastewater Treatment Systems Specialist
Division of Water Quality

Enclosures

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Linda S. Adams
Secretary for
onmental Protection

Arnold Schwarzenegger
Governor

COPY

April 20, 2007

William A. Yanko
Environmental Microbiology Consultant
19912 Echo Blue Drive
Penn Valley, CA 95946-8810

Dear Mr. Yanko,

INITIATION OF SCIENTIFIC PEER REVIEW ON TECHNICAL ISSUES CONTAINED THE DRAFT REGULATIONS FOR ONSITE WASTEWATER TREATMENT SYSTEMS

The State Water Board is proposing regulations for Onsite Wastewater Treatment Systems (OWTS). As required in the California Health and Safety Code Section 57004, we request a scientific peer review of the proposed regulations.

We are grateful that you have agreed to perform this review. We request that the review be completed with written analysis submitted within 30 days of receipt of the documentation from State Water Board staff. Please notify me at the earliest opportunity if it will be difficult for you to meet this review schedule.

The background and summary for the proposed regulations are provided in Enclosure 1. Enclosure 2 provides focus for the review (revised since peer review solicitation). Individuals involved in the development of the proposed amendment are identified in Enclosure 3. The proposed Regulations are attached as Enclosure 4. Also attached are references for each identified peer review topic listed in Enclosure 2. This reference material includes either the full article or excerpts of the referenced documents.

I am the staff contact for this review and can be reached at (916) 341-5518 or tthompson@waterboards.ca.gov. Please contact me for any questions or additional information needed to fulfill this scientific peer review request.

Thank you for your willingness to conduct this review in the most thorough yet prompt manner possible.

Sincerely,

Todd Thompson
Onsite Wastewater Treatment Systems Specialist
Division of Water Quality

Enclosures

Linda S. Adams
Secretary for
Environmental Protection

State Water Resources Control Board

Division of Water Quality
1001 I Street • Sacramento, California 95814 • (916) 341-5455
Mailing Address: P.O. Box 100 • Sacramento, California • 95812-0100
Fax (916) 341-5463 • http://www.waterboards.ca.gov

Arnold Schwarzenegger
Governor

COPY

April 20, 2007

Professor Jörg E. Drewes
Environmental Science and Engineering Division
Colorado School of Mines
Golden, CO 80401-1887

Dear Professor Drewes,

INITIATION OF SCIENTIFIC PEER REVIEW ON TECHNICAL ISSUES CONTAINED THE DRAFT REGULATIONS FOR ONSITE WASTEWATER TREATMENT SYSTEMS

The State Water Board is proposing regulations for Onsite Wastewater Treatment Systems (OWTS). As required in the California Health and Safety Code Section 57004, we request a scientific peer review of the proposed regulations.

We are grateful that you have agreed to perform this review. We request that the review be completed with written analysis submitted within 30 days of receipt of the documentation from State Water Board staff. Please notify me at the earliest opportunity if it will be difficult for you to meet this review schedule.

The background and summary for the proposed regulations are provided in Enclosure 1. Enclosure 2 provides focus for the review (revised since peer review solicitation). Individuals involved in the development of the proposed amendment are identified in Enclosure 3. The proposed Regulations are attached as Enclosure 4. Also attached are references for each identified peer review topic listed in Enclosure 2. This reference material includes either the full article or excerpts of the referenced documents.

I am the staff contact for this review and can be reached at (916) 341-5518 or tthompson@waterboards.ca.gov. Please contact me for any questions or additional information needed to fulfill this scientific peer review request.

Thank you for your willingness to conduct this review in the most thorough yet prompt manner possible.

Sincerely,

Todd Thompson
Onsite Wastewater Treatment Systems Specialist
Division of Water Quality

Enclosures

ENCLOSURE 1: SUMMARY OF THE PROPOSAL

On September 27, 2000, Assembly Bill 885 (**AB 885**) was chaptered into law, adding Chapter 4.5 (Section 13290 to 13291.5) to the Division 7 of the California Water Code (**CWC**). This law requires the State Water Resources Control Board to adopt regulations for the permitting or operation of onsite wastewater treatment systems (**OWTS**). In reference to the statute, the regulations or standards are to include, but are not be limited to:

1. Minimum operating requirements;
2. Requirements for OWTS adjacent to water bodies listed pursuant to Section 303(d) of the Clean Water Act;
3. Requirements for authorizing local agencies to implement the State regulations or standards;
4. Requirements for corrective action;
5. Minimum requirements for monitoring to determine performance, as applicable;
6. Exemption criteria to be established by the Regional Water Boards;
7. Requirements for determining when a system is subject to major repair.

California has approximately 1.2 million OWTS that serve as sewage treatment and disposal systems for approximately 10% (3.4 million people) of the State's population. In several counties, more than 40% of the housing units use OWTS. Statewide, approximately 50% of housing units with OWTS rely on a domestic well for drinking water. Given such facts, the proper treatment and disposal of this wastewater is important because the majority of it will pass through the soils underlying the OWTS to recharge groundwater.

OWTS is a permanent solution for solving existing and future sewage service needs. In the past, this view was not widely supported, as many believed that it was only a matter of time until most homes were served by a centralized collection system. However, history shows that many of the sewer lines were never built. Also, many OWTS were built to service vacation properties that have since become full-time residences.

Therefore, to assure protection of water quality at sites that rely upon OWTS, the State Water Board proposes a regulatory scheme with the mutually reinforcing focus areas:

1. For new and replaced OWTS, require that the design and installation to be done by a person technically qualified to recognize and respond appropriately to site-specific challenges including minimum soil depth requirements;
2. For all new OWTS, establish a process and minimum OWTS design requirements;
3. For new and replaced septic tanks, require an effluent screen to impede solids passing through from the septic tank to the dispersal field;

4. For all new OWTS, establish a process, design requirements and performance requirements for OWTS using supplemental treatment;
5. For new and replaced OWTS, require that the system designer and/or installer to provide the site owner with an Operating Manual;
6. For new and existing OWTS, require the system owner to monitor the septic tank solids levels every five years to ensure that pumping of the septic tank is done before solids begin to interfere with the operation of the OWTS;
7. For new and existing OWTS with onsite domestic wells, require the system owner to monitor the groundwater, every five years, and provide that information to the State Water Board. This requirement can be satisfied by monitoring the outside domestic well;
8. For new OWTS with supplemental treatment components, require the system owner to arrange for a service provider to conduct maintenance on the system, in accordance with the owner's manual;
9. For areas near an impaired surface water body, require existing OWTS to be replaced to meet the State Water Board's new performance requirements by a certain date and require new OWTS to be designed and built to meet those standards by a certain date that is earlier than the general application date for these regulations to new OWTS; and
10. Establish that the application of this regulatory scheme is the responsibility of the Regional Water Board, unless a qualified local agency enters into a formal written agreement or memorandum of understanding (MOU) to implement and enforce them.

REVISED

ENCLOSURE 2: DESCRIPTION OF THE SCIENTIFIC PORTION OF THE PROPOSED REGULATIONS TO BE ADDRESSED BY PEER REVIEWERS

The statute mandate for external scientific peer review (Health and Safety Code Section 57004) states that the reviewer's responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices.

We request that you make this determination for each of the following issues that constitute the scientific portion of the proposed regulatory action. An explanatory statement is provided for each scientific portion to focus the review.

An important caveat should be noted by the reviewers. The vast majority of existing OWTS are conventional systems (septic tank and dispersal system).

We anticipate that most new OWTS will be conventional systems due primarily to cost/affordability considerations. The proposed regulations include siting and design requirements for conventional OWTS that are intended to prevent surfacing effluent and achieve substantial reduction of pathogens (virus and bacteria) in the discharge from the OWTS dispersal system. With regard to other constituents in wastewater, soluble constituents that are not readily biodegradable, including nitrate in concentrations exceeding drinking water standard, will be found in the discharge from conventional system dispersal fields and will ultimately reach groundwater.

1. **The regulations (§24901(c)(1 and 2)) would require that no person operate a new OWTS or increase the average pollutant loading to an existing OWTS with a design capacity to treat over 5,000 gallons-per-day without first notifying the Regional Water Board.**

   Experience shows that larger OWTS (greater than 3,500 gallons-per-day) are more likely to fail than smaller ones and are best limited to design flows of less than 6,000 gallons-per-day (Plews et al. 1985). For this reason, we propose that the State retain the option for direct oversight to ensure that larger OWTS are in compliance with this Chapter and the applicable basin plan. The 5,000 gallons-per-day (gpd) limit is based on existing requirements from the water quality control plan at the Colorado River Basin Regional Water Board. After notification, Regional Water Board staff is required to determine whether or not specific waste discharge requirements (WDRs) should be issued for the OWTS. Such WDRs may be more stringent than required by the proposed regulations to ensure protection of human health and water quality.

REVISED

2. **These regulations (§24910(a)(2)) specify that the wastewater entering the OWTS dispersal system must be reduced to have a biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations not to exceed 150 mg/L in the septic tank effluent and prior to discharge to the dispersal system.**

   Wastewater hydraulic loadings (i.e. application rates) are traditionally established for domestic septic tank effluent. This is true for those included in Table 2 and Figure 1 of the proposed regulations. However, it is noted that this range can vary greatly (Laak 1986). For this reason, a multitude of numbers could have been chosen. The proposed regulations require a wastewater BOD and TSS concentrations of not greater that 150 mg/L based on USEPA's presentation in Table 6-1 in their 1980 design manual and Table 4-3 in their 2002 design manual (USEPA 1980, 2002). This is also consistent with effluent from septic tanks with effluent filters (Crites 1998).

3. **The proposed regulations (§24910(s)) require all new septic tanks to restrict solid particles in excess of 1/8 inch in diameter from passing through to the dispersal field.**

   Removal of larger particles in the septic tank effluent is likely to prolong the life of the dispersal system. Mechanisms that reduce the amount of solids passing through the septic tank ultimately results in better effluent (Crites 1998). Recognizing that better effluent reduces biomat clogging (Laak 1986), and possibly downstream problems in the dispersal system, this section requires that all new and replaced septic tanks be designed to minimize the passage of solids, especially neutrally buoyant solids, into the dispersal field (Byers 2001). Filter devices that omit solids with a diameter larger than 1/8" from passing to the dispersal field are widely available at a reasonable cost. The cost of these filters is inexpensive when compared to the commensurate benefit that they provide in protecting the dispersal field (Kahn 2000). Requiring such a device, as a standard feature, helps to ensure that the home/business owner's OWTS will provide good performance for as long as possible. These systems will require maintenance (USEPA 2002, Byers et. al. 2001).

4. **The proposed regulations (24910(t and u)) would require owners of existing OWTS with a domestic well on their property to sample groundwater from a monitoring well downgradient and within 100 feet of the OWTS dispersal system every five years, and within 30 days of a new OWTS installation. Alternatively, the OWTS owner can elect to sample the onsite domestic well. The water sample would be analyzed for total coliforms and other constituents as specified in the Section and the results of the analysis reported electronically to the State Water Board.**

   OWTS are identified as a possible contaminating activity (PCA) for groundwater (CA DHS 1999). OWTS contamination of water supplies is known to cause diseases such as infectious hepatitis, typhoid fever, dysentery, and various

REVISED

gastrointestinal illnesses (US EPA 1977). It is also known that dissolved contaminant plumes from conventional OWTS can travel hundreds of feet and exceed drinking water standards (USEPA 2002). Thus, discharges from OWTS are known to impair or threaten impairment of beneficial uses of groundwater in the immediate vicinity of the discharge.

The direction of groundwater flow, and thus the direction of the OWTS discharge plume, is generally not known, requires a costly study to determine, and can change substantially due to seasonal variations or due to groundwater pumping. In a fractured rock environment, it is rarely possible to predict the direction of OWTS discharge flow.

Most, if not all, local agency ordinances allow domestic wells be installed as close as 100 feet from an OWTS. Domestic wells are known to be more vulnerable to surface contaminants than public supply wells due to less stringent and thus less costly construction standards (GAMA 2007, DWR 1981). There are no requirements for owners of domestic wells to sample and analyze their well water. Whereas public supply wells are subject to routine and stringent water quality testing to ensure that the public is not served water that exceeds drinking water standards, no such requirements exist for domestic wells.

Analyzing for total coliforms would provide an indication of whether the well was vulnerable to pathogen contamination. Analyzing for minerals commonly found in water would provide information on existing water quality and provide a baseline for long-term trend analysis. This is not intended to be a definitive OWTS performance analysis, simply a starting point to better understand the resource below the discharge. Monitoring information would also provide the owner with the quality of water being consumed.

For these reasons, the proposed regulations require all OWTS owners with an onsite domestic well located on the property to monitor groundwater either at a monitoring well designed to measure the impacts of the OWTS discharge and downgradient of the OWTS (within 100 feet) every five years or, alternatively, monitor their onsite domestic well every five years. The distance of 100 feet is chosen because it provides flexibility for monitoring well placement within the existing landscape. Owners of new OWTS that have an onsite domestic well would be required to monitor the groundwater in the vicinity of the OWTS, or their domestic well, within 30 days after construction of the OWTS. This 30-day requirement is reasonable to establish a water quality baseline at the inception of the OWTS discharge.

The monitoring will not only provide the homeowner with an analysis of their own water quality, but will also establish the existing background water quality for broader assessment of the impacts of OWTS on water quality. Monitoring of groundwater is not uncommon in the OWTS industry, particularly where groundwater is close to the surface. Although not directly intended for this purpose, drinking water well monitoring is also recognized as a potential means

REVISED

of evaluating OWTS performance (USEPA 1980, USEPA 2002, Verstraeten 2004). It is expected that most well owners will monitor their domestic well rather than separately install a monitoring well, or wells, as the latter would be considerably more expensive. Domestic well monitoring will also provide the well owner with useful and public health-related information without the expense of installing additional wells. USEPA recommends that domestic wells be tested annually (USEPA 2002).

5. **A provision in proposed regulations (§24910(w)) "recommends" that water softener regeneration brine not be discharged to groundwater or OWTS**

   The discharge of water softener backwash water can result in increases of total dissolved solids (cationic and anionic salts) in groundwater. Pollution of groundwater by brine coming from septic tanks has occurred (Perkins1989). As a pollutant, the discharge of brine may not be in public interest because of the long-term adverse impacts on water quality. These proposed regulations recommend against this discharge to systems that may discharge to the groundwater.

   Note that this is a recommendation, not a requirement, and is intended to highlight the increase in the salinity of the OWTS discharge associated with regeneration brine. Additionally, the adverse affect of sodium on OWTS dispersal systems, although not directly attributed to water softener regeneration brines, is described in Robert Patterson's Demonstration of effects on sodicity on soil hydraulic conductivity, Proceedings of conference on "Innovative Approaches to the On-site Management of Waste and Water." held at Southern Cross University Lismore, 26th of November, 1996.

6. **The proposed regulations (§24912) specify a protocol to determine the seasonal high groundwater level for purposes of OWTS siting (to establish the maximum depth of soil that remains continuously unsaturated in the proposed dispersal area).**

   This protocol is a technical interpretation and relies on similar protocols established in several county OWTS ordinances. Regional Water Boards would be allowed to establish an alternative protocol.

   Seasonal high groundwater, when in close proximity to the dispersal field, can result in inadequate treatment of wastewater (USEPA 2002). The draft regulations rely on soil mottling observations to determine seasonal groundwater levels because these soil conditions can provide a reliable indication, during the dry season, of what the maximum groundwater elevation is during the wet season, when the groundwater rises as a result of local recharging from infiltration of precipitation (USEPA 1980). The ten-foot requirement is based on professional judgment and is a reasonable depth, since it has been found that groundwater levels can fluctuate as much as 15 feet (Laak 1980). In fact, substantial groundwater elevation fluctuations due to recharge by rainfall has

REVISED

been observed in some areas of California (County of Santa Cruz 1989). In some cases, groundwater monitoring is required because not all soil exhibits mottling when saturated (USEPA 1980).

7. **Where a Regional Water Board requires OWTS to include disinfection to protect surface water or groundwater quality, the proposed regulations (§24913(c)) specify that OWTS supplemental treatment components must be designed to reduce total coliforms in the effluent.**

   Total coliforms are used as a measure of pathogen quality based on their use in drinking water as required in California regulations (Section 64426.1, Article 3, Chapter 15, Division 4, Title 22).

   The specific performance requirements contained in (§24913(c)) are intended to be equivalent to pathogen reduction obtained from a properly sited and designed conventional OWTS. The requirements are based on the State of Arizona's OWTS regulations (R18-9-A312, Article 2, Chapter 9, Title 18).

   Disinfection is required where there are pathogen pollution problems [§24940(a)(2)] and where the soil is thin and suspected of not being capable of full pathogen treatment [§24914(i)]. It is found that disinfection systems, if adequately maintained, can operate to achieve full disinfection (Arizona 2005). In cases where the OWTS must provide supplemental treatment to remove pathogens, the draft regulations contain the following two performance requirements:

   1. Highly permeable soils (coarse sand), areas with very thin soils, and soils with a high percentage of rock fragments may not provide the level of treatment necessary to effectively remove pathogens before entering groundwater (Canter et. al. 1985, p. 60-61). For these soil types, the proposed regulations contain a limit of 10 MPN/100 ml. This is very close to maximum disinfection achievable and leaves a very small population of viable microorganisms for the soil environment to remove in order to limit or exclude pathogens from entering groundwater. This level of disinfection may require additional contact time with the disinfection process (EPA 2002).

   2. The second disinfection performance requirement is for sites with soils that can be expected to provide reasonable treatment for pathogens (soils that consist with more fines mixed with sand). For these sites, the proposed performance requirement of 1000 MPN/100 ml is intended to remove pathogens by several logs and allow the environment to remove the remainder of the pathogens. According to literature, this second standard is readily achievable (USEPA 2002).

8. **Where a Regional Water Board requires OWTS to remove nitrogen in order to protect surface water or groundwater quality, the proposed regulations**

REVISED

(§24913(d)) specify that OWTS supplemental treatment components must be designed to reduce total nitrogen in the effluent to 10 mg/l.

The 10 mg/L effluent limit is based on the drinking water maximum contaminant level. Upon discharging to groundwater in a water table environment, contaminant plumes from OWTS tend to be long, narrow, definable, exhibiting little dispersion (U.S. EPA 2002). If the OWTS discharge is to a fractured rock environment, the discharge may travel considerable distances unpredictably with little or no dilution (Winneberger 1984). For this reason, nitrogen pollution from OWTS is a concern.

For OWTS sites where nitrogen is shown to be, or threatens to be a pollution problem, the SWRCB is proposing a performance standard as an effluent limit for total nitrogen. The performance standard for total nitrogen is based upon California drinking water standard (Section 64431(a), Article 4, Chapter 15, Title 22 of the California Code of Regulations) for nitrate. Unless removed, the majority of the nitrogen compounds will be transformed into nitrate in the soil and eventually enter the groundwater (Miller, et. al. 1975). Achieving the proposed performance standard for nitrogen has shown to be achievable by several technologies (SWRCB 2002).

9. **The regulations (§24913(e)) specify a protocol for certifying supplemental treatment technology by third parties.**

The proposed regulations require that all supplemental treatment components used in OWTS function as intended. To this end, all OWTS using supplemental treatment components are required to be designed by a qualified professional, as is required for a conventional OWTS. Even with such requirements, more skepticism confronts the use of proprietary technology. This is, in part, due to prior experiences with proprietary technology used as OWTS that either performed poorly or not at all (Pearson 1977). For that reason, required third party verification of proprietary technology is proposed in the draft regulations.

Third party certification is designed to screen out unreliable supplemental treatment technologies. The independent third party certification protocol required by the draft regulations is closely matched to the existing process used by the National Sanitation Foundation (NSF) International: Residential Wastewater Treatment Systems NSF/ANSI 40 (Standard 40). This was chosen because NSF International is widely recognized (Pearson 1977), has over 30 years of experience, and NSF has certified 315 different OWTS products from over 35 manufacturers (NSF International 2006). Although the protocol in the draft regulations is based on the NSF Program, any other independent third party that meets or exceeds the protocol standard will qualify for use under this draft rule.

REVISED

10. **The proposed regulations (§24913(h)) require weekly operational inspections of disinfection supplemental treatment units.**

Disinfection is required where pathogen contamination already exists [§24940(a)(2)] and where soils are thin [§24914(i)] and unlikely to be capable of adequate pathogen removal. Where such treatment is required, a malfunctioning supplemental treatment system can be a serious pollution source for surface water and groundwater if left unattended. This is an emergency situation where disinfection is required for the protection of public health. Unfortunately, disinfection processes have been shown to be subject to more frequent problems than other types of supplemental treatment (SWRCB 2006, Sexstone et. al. 2001). For this reason, the draft regulations require that all OWTS with supplemental treatment for disinfection have a monitoring system that ensures that the disinfection unit is operating properly either through continual monitoring, or, otherwise, frequent inspections. Telemetry is available for OWTS, affordable and is capable of assessing the operation processes (Jesperson 2000).

11. **The proposed regulations (§24914(b)) require that all dispersal systems except seepage pits be sized using bottom area as the infiltrative surface.**

Both the bottom and sidewall areas of the dispersal system excavation can be infiltration surfaces; however, if the sidewall is to be an infiltrative surface, the bottom surface must be overloaded and, therefore, pond. Continuous ponding of the infiltration surface results in a significant loss of hydraulic capacity of bottom. Loss of the bottom surface for infiltration will cause the ponding depth to increase over time as the sidewall also clogs. If allowed to continue, premature hydraulic failure of the system is plausible. Therefore, including sidewall area as an active infiltration surface is not recommended (USEPA 2002).

Also, the proposed rule requires effluent to be dispersed into subsurface soils in a manner that maximizes unsaturated zone treatment and aerobic decomposition of soluble and particulate organic compounds and other pollutants in the effluent [§24910(b)]. Designing the dispersal area using the sidewall as the primary dispersal area leads to deeper trenches, thus less evapotranspiration potential, reduced access to aeration through the soil column, and usually omits some of the best soils for OWTS treatment (USEPA 1980).

12. **The proposed regulations specify maximum design application rates for sizing the dispersal systems in Figure 1 and Table 2.**

Wastewater application rates are established for pathogen reduction and long-term unsaturated soil treatment of the wastewater and to prevent surfacing of OWTS effluent in the dispersal system. The wastewater application rates contained in Figure 1 and Table 2 are based on application rates specified in the North Coast Regional Water Board's Water Quality Control Plan (North Coast Regional Water Board 2006). These application rates are within the range of

REVISED

recommended/suggested values contained in both USEPA design manuals (USEPA 1980, USEPA 2002).

13. **The proposed regulations (Figure 2, §24914(c) and 24914(d)) would require additional unsaturated soil depth where excessive rock fragments exist in the dispersal system.**

Soils with a high fraction of coarse fragments (gravel, cobbles and rock) pose a problem for the treatment of the wastewater because the volume occupied by the coarse fragments is not available for providing the treatment of the wastewater (Woessner et. al. 1987, Ver Hey et. al. 1987). For that reason, at least one state in the nation requires that this rock fraction not be credited as part of the soil column, thus requiring compensation for the rock content (State of Wisconsin 2004). In considering this, the proposed regulations find that when the gravimetric fraction of coarse fragments in earthen material is greater than thirty percent, the effective depth of porous media is reduced by approximately one foot of treatment volume for conventional OWTS (30% of 3 feet). Accordingly, 30 percent seemed a reasonable level to require compensation. This decision is based on best professional judgment and the fact that on the 2002 U.S. EPA Onsite Wastewater Treatment Systems Manual (EPA/625/R-00/008) cites studies demonstrating that normal operation of OWTS "results in the retention and die-off of most, if not all, observed pathogenic bacterial indicators within 2 to 3 feet of the infiltrative surface" in the dispersal system.

If the soil contains 30% or greater coarse fragments, the proposed regulations require that the OWTS design either to compensate for the loss of available soil for effluent treatment using Figure 2 or to reduce the application rate. Figure 2 is a direct 1:1 soil volume replacement graph on a semi-log scale for easier use. Otherwise, the proposed regulations allow OWTS designers to compensate for the loss of available soil for effluent treatment by reducing the application rate proportionally to the percent rock in the earthen material. This is an important provision for sites that have limited soil depth but that have enough area to spread the effluent through an enlarged dispersal field. For either method, the compensation for the treatment volume lost is a straight percentage calculation (based on the gravimetric analysis).

14. **The proposed regulations contain a requirement (§24914(c)) for a minimum of 3 feet of unsaturated soil in the dispersal system to treat septic tank effluent in order to reduce pathogens.**

The requirement for conventional OWTS is based on the 2002 U.S. EPA Onsite Wastewater Treatment Systems Manual (EPA/625/R-00/008). The Manual cites studies demonstrating that normal operation of OWTS "results in the retention and die-off of most, if not all, observed pathogenic bacterial indicators within 2 to 3 feet of the infiltrative surface" in the dispersal system. This separation assumes that the hydraulic loading is done in a manner that promotes unsaturated conditions.

REVISED

15. **The proposed regulations contain a provision (§24914(d)) that allows using third-party certified wastewater treatment processes (supplemental treatment) as a surrogate for one foot of soil treatment (i.e. the regulations allow a minimum of 2 feet of unsaturated soil for OWTS with supplemental treatment rather than 3 feet of unsaturated soil required for conventional OWTS), provided that those processes meet performance requirements (§24913 (b), (c)) prior to discharge.**

    The requirement for conventional OWTS is based on the 2002 U.S. EPA Onsite Wastewater Treatment Systems Manual (EPA/625/R-00/008). The Manual cites studies demonstrating that normal operation of OWTS "results in the retention and die-off of most, if not all, observed pathogenic bacterial indicators within 2 to 3 feet of the infiltrative surface" in the dispersal system. This separation assumes that the hydraulic loading is done in a manner that promotes unsaturated conditions

    The proposed regulations would allow use of the lower end of the range cited above (i.e. 2 feet) provided that supplemental treatment components are used that achieve a biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations in the discharge to the OWTS dispersal field of 30 mg/L and 30 mg/L, respectively. This provision is intended for sites with limited unsaturated soil depth. This approach is taken because it is found that effluent treatment can be substituted for soil depth (Duncan et. al 1994). It is reported that supplemental treatment reduces some pathogens several logs (USEPA 2002)

16. **The proposed regulations (§24914(e)) would allow up to one equivalent foot (1.5 feet) of engineered sand fill (material specifications in Table 2) as a substitute for the lack of suitable native unsaturated soil below the OWTS.**

    The proposed rule allows the use of fill to make up for the lack of adequate soil depth, up to a maximum of one foot. The placement of fill material to serve as a treatment media and as a means to increase soil separation from sensitive receptors is not new and has been used in onsite wastewater treatment for several decades. These systems were usually constructed to overcome site constraints like shallow soils or high groundwater elevations (Goldstein et. al. 1973, Machmeier 1977, Salvato, 1975, USEPA 1980). The development of the mound system (a.k.a. Wisconsin Mound) is an example of the use of fill, although the mound is excluded from this provision so that nothing in this provision restricts the design of mound systems, which have had considerable design review and research. In fact, Table 2 is a specification for Wisconsin mound sand (Converse et. al. 2000). This is done because soils considered good for this application are coarse, non-cohesive, single-grained, materials (i.e. sand) so that compaction and the creation of impermeable lenses is minimized (Engle et. al. 1982, Converse 2000).

REVISED

Because of the nature of the fill and concern for rapid permeability of the material (uniform, single grain material), the draft regulations require a 1.5 to 1 replacement of fill to native soil based on best professional judgment. For example, a conventional OWTS and an OWTS using supplemental treatment with one foot of soil equivalent (fill) will have a minimum separation to seasonal high groundwater of three foot six inches (3'6") and two foot six inches (2'6"), respectively. The fifty percent increase in fill over native soil is required as a factor of safety and is based to ensure that these systems have sufficient soil to provide unsaturated retention time. This factor of safety is reasonable since sand is a granular soil texture that usually contains no structure and therefore primarily relies on space between the soil particles, usually resulting in rapid permeability (USEPA 1980, 2002).

17. The proposed regulations (§24914(g)) would allow design of gravel-less dispersal systems with a reduction (adjustment multiplier of 0.7) of the minimum required dispersal system area for effluent application.

It has been shown in the laboratory and in the field that gravel-less chambers function as well as conventional dispersal systems even when the system size is reduced by as much as fifty percent (King, et. al. 2002). When gravel-less chambers are sized equivalently to conventional OWTS, it has been shown that the long-term acceptance rate can be 1.5 to 2 times higher than that of conventional OWTS dispersal systems (Seigrist et. al. 2004). For this reason, SWRCB staff has included a multiplier allowing the reduction of the dispersal system when chambers are used.

18. The proposed regulations (§24914(h)) would require a minimum of six inches of soil over shallow subsurface dispersal systems.

Drip dispersal and pressure dispersal systems distribute wastewater across the dispersal field in a manner that is more uniform than conventional gravity dispersal systems (USEPA 2002). With relatively uniform distribution of the wastewater, there is a tendency to raise these systems closer to the land surface (Beggs, et. al. 2004). Drip dispersal systems are the best method to distribute the wastewater uniformly and pose less of a threat to the environment than a conventional dispersal field, due to the fact that to do so optimizes the retention of pollutants and allows the dispersal of the wastewater into the root dispersal field (Watson 2004). Accordingly, the proposed regulations allow these systems to be placed less than six (6) inches from the ground surface. This is supported in literature (Crites 1998).

19. The proposed regulations contain conditions for the use and placement of seepage pits specified in §24914(i)(1 through 3).

§24914(i)(1) — Historically, seepage pits are used where land area is too limited for a leachfield or bed or where the upper 3 to 4 feet of soil is poor for OWTS and underlain by a more permeable soil (USEPA 1980). Seepage pits primarily rely on, and are accordingly designed for using, the sidewall as the infiltrative surface (USEPA 2002, Kaplan 1987). This portion of the draft regulations is consistent with those existing standards. Since seepage pits, due to their depth, are believed to be a greater threat as a pollution source than other types of dispersal systems, the draft regulations require that other dispersal system types be considered before the use of seepage pits (USEPA 2002).

§24914(i)(2) — The proposed regulations require a separation from groundwater of at least 10 feet at all times for seepage pits. This is consistent with Appendix K of the California Plumbing Code (CPC 2000). Unfortunately, Appendix K does not apply to one- and two-family dwellings or where or local government has approved alternate installations or facilities. This creates no statewide minimum standard for OWTS. Since this requirement is in the California Plumbing Code, this separation requirement may already be deemed to be previously peer-reviewed.

§24914(i)(3)— Soil is a determining factor for all OWTS, including those using seepage pits. The unsaturated flow through the soil is expected to provide treatment of the wastewater. Where soil thickness between the bottom of the seepage pit and rock is less than ten feet but greater than two feet, the lack of soil available for providing treatment requires that the OWTS must provide additional treatment as mitigation. For this reason, the proposed regulations require that the OWTS meet performance standards contained in §24913(a) for conventional pollutants and must meet the pathogen requirements contained in §24913(b) before discharging into the seepage pit. Similarly, in a case where soil thickness between the bottom of the seepage pit and rock is less than two feet, the OWTS must meet performance standards contained in §24913(a) for conventional pollutants and must meet the pathogen requirements contained in §24913(b) (1) before discharging into the seepage pit as mitigation. The intent of these requirements is to provide active treatment and reduce pathogen indicators to very low levels before discharging to compensate for the lack of soil treatment. This is acceptable because, by providing a higher level of treatment, supplemental systems do not require as much soil as standard septic systems to perform an equivalent or greater level of treatment (Duncan et. al. 1994).

20. **The proposed regulations (§24914(j)) require that evapotranspiration beds be designed to remove, without spilling over, all the expected wastewater generated at the site plus rainfall that is expected to have a return frequency of once every 25 years on annual, monthly and seasonal basis.**

The purpose of these requirements is to ensure that the designer of the evapotranspiration and infiltration system considers the hydrologic cycle in full so as to minimize insufficient designs leading to overflow. Precipitation falling on and being captured in OWTS using ET systems must be capable of disposing of this extra wastewater. SWRCB guidance (SWRCB 1980) recommends that the design assume that 100 percent of all the rainfall on the bed enters the OWTS.

REVISED

To clarify whether this is the 100-year probability event, average rainfall or some other level of rainfall event, the 25-year return frequency was selected because it is considered the probable design life for the OWTS, although this translates to a four percent chance of exceeding rainfall in any one year.

21. **The proposed regulations in Article 4 (§24940) would require the owners of all OWTS within 600 lateral feet of a water body listed as impaired pursuant to §303(d) of the Federal Clean Water Act, to take specified actions where OWTS (in general) were identified as contributing to the impairment of the water body by the Regional Water Board. For purposes of this Section, impairment is limited to nitrate or bacterial contamination.**

The proposed regulations establish a capture distance (600 feet) in lieu of requiring a case-by-case determination regarding each OWTS contribution. This approach is preferred because of cost concerns regarding actual groundwater transport studies. However, the OWTS owner(s) would have the option of conducting a groundwater study to determine whether their OWTS impacts the impaired water body. The 600 feet distance is based on: California Department of Health Services (DHS), ***Drinking Water Source Assessment and Protection Program***. As detailed in the document (page 54), a radial distance established a microbial/direct chemical contamination zone to protect public drinking water supply wells from possible contaminating activities associated with viral, microbial and direct chemical contamination. OWTS are identified as possible contaminating activities posing "very high potential risks" (CA DHS 1999, pg 54, 92).

As detailed in the document (page 54), a radial distance established a microbial/direct chemical contamination zone to protect water supply from viral, microbial and direct chemical contamination. For porous media aquifers, 600 feet was the recommended minimum distance considered to be sufficiently conservative for protection from microbial contaminants (as well as chemical contaminants such as nitrate). As a general requirement, this is similar to the DHS approach due to the contaminants and source involved. As stated in subsequent subsections [i.e. §24940(b) and §24940(c)], site-specific studies are allowed that may exempt OWTS within the default setback.

The regulations require the removal of conventional pollutants (BOD and TSS) as well as the pollutant of concern OWTS that remove nitrogen and pathogens also remove conventional pollutants to the performance standards when properly operating.

REVISED

The Big Picture

Reviewers are not limited to addressing only the specific issues presented above, and are asked to contemplate the following "big picture" questions:

(a) Are there any additional issues that are part of the scientific basis of the proposed regulations that are not described above?

(b) Taken as a whole, is the scientific portion of the proposed regulations based upon sound scientific knowledge, methods, and practices?

Reviewers should also note that some portions of the proposed regulations may rely significantly on professional judgment where available scientific data are not as extensive as desired to support the statue requirement for absolute scientific rigor. In these situations, the proposed course of action is favored over no action.

The preceding guidance will ensure that reviewer have an opportunity to comment on all aspects of the scientific basis of the proposed State Water Board action. At the same time, reviewers also should recognize that the State Water Board has a legal obligation to consider and respond to all feedback on the scientific portions of the proposed regulations. Because of this obligation, reviewers are encouraged to focus feedback on the scientific issues that are relevant to the central regulatory elements being proposed.

ENCLOSURE 3: INDIVIDUALS INVOLVED IN PROPOSED REGULATIONS

The overall establishment of these regulations was a long (5years), controversial, and involved process. Many drafts were generated and many drafts were scrapped. Consultation occurring over that same period during the process was also very involved. For the sake of being complete, State Water Board staff has taken special effort to identify everyone involved in the process of the time span, even though their contribution may have been limited with respect to the current draft rule. They are as follows:

State Water Board Staff:

James Giannopoulos, P.E.
Lisa Babcock, P.G.
Todd Thompson, P. E.
Cecil Martin, R.S.
Walt Shannon, P.E.
Ed Wosika
Darren Polhemus, P.E.
Marleigh Wood, J.D.
Ted Cobb, J.D.
Phillip Wyels, J.D.

Regional Water Board Staff (Advisory):

Charles Reed, P.E.
Theresa Wistrom
Blair Allen, P.E.
Howard Kolb, P.E.
Kwangil Lee, Ph.D.
Wendy Phillips, P.G.
Wendy Wyels
Ronald Dykstra, P.E.
Jim Pedri, P.E.
Alan Miller, P.E.
Logan Raub
Jon Rokke, P.E.
Jun Martirez, P.E.
Susan Beeson
Dat Quach, P.E.
Charles Springer
Joan Stormo, P.G.

Consultants:
Susan Dupre (facilitator)
Leslie DePol (facilitator)
Greg Gallagher (facilitator)
Steven Ekstrom (facilitator)

Academic Scholars (Advisory):
George Tchobanoglous, Ph.D.
Harold Leverenz, Ph.D.
Kenneth Kerri, Ph.D.
Robert Rubin, Ph.D.

Advisory Committee(s):
Norman Hantsche, P.E. (Questa Engineering)
Barbara Bradley, P.E. (Advanced Onsite Systems, Inc)
Terry Schmidbauer, REHS (Solano County)
Doug Ames, REHS (Lassen County)
Ted Walker, REHS (Sonoma County)
Don Holm, REHS (Glen County)
Richard Holmer, REHS (Sonoma County)
Ken Stuart, REHS (Contra Costa County)
Richard Wilson, REHS (Santa Cruz County)
Tibor Banathy, REHS (California Wastewater Training and Research Center)
Mark Gold, D.Env. (Heal the Bay)
Leslie Mintz (Heal the Bay)
Mark Capron, P.E. (Ventura Regional Sanitation District)
Bill Carpenter (Envirocycle)
Walt Kruse, REHS (Tuolumne County)
Christina Edvardssson, P.E. (Microseptec)
Armando Alegria, REHS (County of Marin)
David Dauwalder, P.E. (Dauwalder Engineering)
Peggy Langle, REHS (Santa Barbara County)
Mark Jeude, (CA Department of Health)
Richard Blood, REHS (CA Department of Health)
Jean Choi, P.E. (Ocean Conservancy)
Beth Owen (Ocean Conservancy)
Andrea Shepard, Ph.D. (NDWRCDP)
Brian White (Building Industry Association)
Eileen Reynolds (California Association of Realtors)
Jim Hemminger, P.E. (Regional Council for Rural Counties)
Vic Peterson, P.E. (City of Malibu)
Joe Soulia (Orenco)
John Ricker, REHS (Santa Cruz)
Larry Young, J.D., REHS (city of Malibu)
Ron Torres, REHS (Alameda County)
Darrell Siegrist, REHS (Ventura County)

Advisory Committee(s) - continued:
Dale Dunnells, (Infiltrator)
Robert Gallagher, REHS (Ventura county)
Robert Greenhaughl, REHS (CA Department of Health Services)
Derek Lee (CA Coastal Commission)
Steven Dix (Infiltrator)

ENCLOSURE 4: DRAFT REGULATIONS – PEER REVIEW

Division 4. Onsite Wastewater Treatment Systems

Subdivision 1. General Requirements

CHAPTER 7. ONSITE WASTEWATER TREATMENT SYSTEMS (OWTS)

ARTICLE 1. GENERAL PROVISIONS

§24900. SWRCB – General Definitions.

Except as otherwise indicated in this Article, definitions of terms used in the SWRCB-promulgated portions of this Chapter shall be those set forth in Division 7 (commencing with Section 13000) of the Water Code and Chapter 6.5 of Division 20 of the Health and Safety Code (commencing with Section 25100).

"At-grade system" means an OWTS dispersal system with a discharge point located at the preconstruction grade (ground surface elevation). The discharge from an at-grade system is always subsurface.

"Basin plan" means the same as "water quality control plan" as defined in Division 7 (commencing with Section 13000) of the Water Code. Basin plans are adopted by each Regional Water Board, approved by the SWRCB and the Office of Administrative Law, and identify surface water and groundwater bodies within each Region's boundaries and establish, for each, its respective beneficial uses and water quality objectives. Copies are available from the Regional Water Boards.

"Bedrock" means the rock, usually solid, that underlies soil or other unconsolidated, surficial material.

"Certification" means an expression of professional opinion in the form of a certificate, stamp, or signature that the OWTS, or its components, meets industry standards that are the subject of the certification, but does not constitute a warranty or guarantee, either express or implied. For proprietary supplemental treatment systems, certification is a statement that indicates the subject system has demonstrated performance through an independent, third-party evaluation of performance data as required in §24913(e), but does not constitute a warranty or guarantee, either express or implied.

"Cesspool" means an excavation in the ground receiving wastewater, designed to retain the organic matter and solids, while allowing the liquids to seep into the soil. Cesspools differ from seepage pits because cesspool systems do not have septic tanks.

"Clay" means a soil particle; the term also refers to a type of soil texture. As a soil particle, clay consists of individual rock or mineral particles in soils having diameters <0.002 mm in diameter. As a soil texture, clay is the soil material that is comprised as 40 percent or more clay particles and not more than 45 percent sand and not more than 40 percent silt particles.

"Community water supply" means a public water system regulated by the California Department of Health Services or a local health department.

"Conventional system" means an OWTS consisting of a septic tank and a subsurface system for dispersal of septic tank effluent. A gravity subsurface dispersal system may be a leachfield or seepage pit. A conventional system may include septic tank effluent pumping where the dispersal area is located at a higher elevation than the associated septic tank or to accomplish uniform distribution. Properly sited, designed, installed and operated conventional systems are capable of nearly complete removal of suspended solids, biodegradable organic compounds and fecal coliform bacteria. However, other pollutants may not be removed to acceptable levels. Conventional systems can be expected to remove no more than 10 to 40% of the total nitrogen compounds (TN) in domestic wastewater after final soil treatment.

"Dispersal system" means a leachfield, seepage pit, mound, at-grade, subsurface drip field, evapotranspiration and infiltration bed, or other type of system for final wastewater treatment and subsurface discharge.

"Domestic wastewater" means the type of wastewater normally discharged from or similar to that discharged from plumbing fixtures, appliances and other household devices including, but not limited to toilets, bathtubs, showers, laundry facilities, dishwashing facilities, and garbage disposals. Domestic wastewater does not include wastewater from industrial processes other than inputs considered *de minimis* (less than 5 percent).

"Domestic well" means a groundwater well that provides water for human consumption and is not regulated by the California Department of Health Services.

"**Dosing tank**" means a watertight receptacle located between an OWTS treatment unit (i.e. septic tank or supplemental treatment unit) and a dispersal area equipped with an automatic siphon device or pump designed to discharge wastewater intermittently in the distribution lines in amounts proportioned to the capacity of such lines and to provide adequate rest periods between such discharges.

"**Earthen material**" means a substance composed of the earth's crust (i.e. soil and rock).

"**EDF**" see "electronic deliverable format."

"**Effluent**" means the wastewater discharged from an OWTS treatment component or any portion thereof.

"**Electronic deliverable format**" or "**EDF**" means the data standard adopted by the SWRCB for submittal of groundwater quality monitoring data to the SWRCB's internet-accessible database system."**Engineered Fill**" means soil that meets the criteria in Table 3 in §24914 and that is designed and constructed to assist in treatment and drainage of OWTS effluent. Engineered fill systems are not the same as "mound systems."

"**ETI**" see "Evapotranspiration and infiltration bed."

"**Evapotranspiration and infiltration (ETI) bed**" means a subsurface dispersal bed in which soil capillarity and root uptake help to disperse the effluent from a septic tank or supplemental treatment system through surface evaporation, soil absorption, and plant transpiration.

"**Existing OWTS**" means an OWTS that was either permitted by the applicable local agency or legally installed before the effective date of this Chapter.

"**Fecal coliform bacteria**" are indicator bacteria common to the digestive systems of warm-blooded animals that are cultured in standard tests to indicate either contamination from wastewater or the level of disinfection.

"**Fines**" are soil particles with a diameter less than 0.05 millimeters. Fines consist of silt- or clay-sized particles.

"**Gravel-less chamber**" system means a buried structure used to create an aggregate-free absorption area for infiltration and treatment of wastewater.

"**Grease interceptor**" means a passive interceptor that has a rate of flow exceeding 50 gallons-per-minute and that is located outside a building. Grease interceptors are used for separating and collecting grease from wastewater.

"**Groundwater**" means water below the land surface that is at or above atmospheric pressure.

"**High-strength waste**" means wastewater from an establishment (e.g. restaurant, other food service), home, or business (e.g. brewery) having a 24-hour average concentration of biochemical oxygen demand (BOD) greater than 300 milligrams-per-liter (mg/L) or of total suspended solids (TSS) greater than 300 mg/L.

"**Major repair**" means any repair required for an OWTS constructed after the effective date of this Chapter due to surfacing wastewater effluent or, for OWTS with supplemental treatment where the effluent concentration exceeds the requirements contained in §24913(b), §24913(c), or §24913(d).

"**Memorandum of understanding**" (MOU) means a formal agreement between the Regional Water Board and a local agency. The agreement authorizes the local agency to administer the OWTS discharge program in lieu of direct State regulation of discharges from OWTS.

"**Mottling**" means a soil condition that results from oxidizing or reducing conditions due to soil moisture changes from saturated conditions to unsaturated conditions over time. Mottling is characterized by spots or blotches of different colors or shades of color (grays and reds) interspersed within the dominant color as described by the United States Department of Agriculture soil classification system. This soil condition can be indicative of historic seasonal high groundwater level.

"**MOU**" please see "Memorandum of understanding."

"**Mound system**" means an aboveground dispersal system (covered sand bed with effluent leachfield elevated above original ground surface inside) used to enhance soil treatment, dispersal, and absorption of effluent discharged from an OWTS treatment unit such as a septic tank. Mound systems have a subsurface discharge and specific design parameters.

"**New Lot**" means a lot recorded after the effective date of this Chapter.

"**New OWTS**" means an OWTS permitted after the effective date of this Chapter.

"**Onsite wastewater treatment system(s)**" (**OWTS**) has the same meaning as found in §13290 of the California Water Code. The short form of the term may be singular or plural.

"**Percolation test**" means a method of testing water absorption of the soil. The test is conducted with clean water and test results can be used to establish the dispersal system design.

"**Performance requirements**" means the maximum allowable concentrations of BOD, TSS, total nitrogen (TN), and total coliform resulting from the active treatment of domestic wastewater from an OWTS.

"**Permit**" means a document that allows the installation and use of an OWTS. The term refers to any one of the following:

1. A conditional waiver of waste discharge requirements issued by a Regional Water Board;
2. Waste discharge requirements issued by a Regional Water Board or the SWRCB; or
3. A document, so named, issued by a local agency that is operating under an MOU or other agreement with a regional water board or SWRCB pursuant to these regulations.

"**Person**" means any individual, firm, association, organization, partnership, business trust, corporation, company, State agency or department, or unit of local government who is, or that is, subject to this Chapter.

"**Pollutant**" means any substance that pollutes water and may potentially affect the beneficial uses of water, as listed in a basin plan.

"**Pressure distribution**" means a type of dispersal system employing a pump or automatic siphon and distribution piping with small diameter perforations (1/4 of an inch of less) or drip emitters to introduce effluent into the soil with uniform distribution.

"**Qualified professional**" means an individual who possesses a registered environmental health specialist certificate or is currently licensed as a professional engineer or professional geologist.

"**Record Plan**" means the document prepared by either a qualified professional or person authorized to install OWTS pursuant to §24910(h). Record plans detail the "as-built" installation of the OWTS, including but not limited to final placement of an OWTS its components, sizes and the specifications of components.

"**Replaced OWTS**" means an OWTS that has its treatment capacity expanded, or its dispersal system replaced, after the effective date of this Chapter .

"**Rock**" means any naturally formed aggregate of one or more minerals (e.g., granite, shale, marble); or a body of undifferentiated mineral matter (e.g. obsidian), or of solid organic matter (e.g., coal) that is greater than 0.08 inches (2mm) in size.

"**Sand**" means a soil particle; this term also refers to a type of soil texture. As a soil particle, sand consists of individual rock or mineral particles in soils having diameters ranging from 0.05 to 2.0 millimeters in diameter. As a soil texture, sand is the soil material that is comprised as 85 percent or more sand particles and the percentage of silt plus 1.5 times the percentage of clay particles is less than 15 percent.

"**Seepage pit**" means a drilled or dug excavation, three to six feet in diameter, either lined or gravel filled, that receives the effluent discharge from a septic tank or other OWTS treatment unit for dispersal.

"**Septic tank**" means a watertight, covered receptacle designed for primary treatment of wastewater and constructed to:

1. Receive wastewater discharged from a building;
2. Separate settleable and floating solids from the liquid;
3. Digest organic matter by anaerobic bacterial action;
4. Store digested solids; and
5. Clarify wastewater for further treatment with final subsurface discharge.

"**Septic tank effluent**" means wastewater discharged from a septic tank.

"**Service provider**" means a person capable of operating, monitoring, and maintaining an OWTS consistent with the requirements and responsibilities in §24910(k), §24913(g), §24913(h), §24914(f), and the O&M manual or capable of inspecting a septic tank in accordance with §24910(v) of this Chapter.

"**Shallow dispersal system**" means a dispersal system designed to apply wastewater at the upper layer of the soil column using pressure distribution.

"**Silt**" means a soil particle; this term also refers to a type of soil texture. As a soil particle, silt consists of individual rock or mineral particles in soils having diameters ranging from between 0.05 and 0.002 mm in diameter. As a soil texture, silt is the soil material that is comprised as approximately 80 percent or more silt particles and not more than 12 percent clay particles.

"**Site**" means the location of the OWTS and, where applicable, a reserve dispersal area capable of disposing 100 percent of the design flow from all sources the OWTS is intended to serve.

"**Site Evaluation**" means an assessment of the characteristics of the site sufficient to determine its suitability for an OWTS to meet the requirements of this Chapter.

"**Soil**" means the naturally occurring body of porous mineral and organic materials on the land surface, and is composed of unconsolidated materials, including sand-sized, silt-sized, and clay-sized particles mixed with varying amounts of larger fragments and organic material. The various combinations of particles differentiate specific soil textures identified in the soil textural triangle developed by the United States Department of Agriculture (USDA) as found in Soil Survey Staff, USDA; **Soil Survey Manual, Handbook 18,** U.S. Government Printing Office, Washington, DC, 1993, p. 138.. For the purposes of this chapter, soil shall contain earthen material of particles smaller than 0.08 inches (2 mm) in size.

"**Soil permeability**" means a measure of the ability of a soil to transmit liquids.

"**Soil texture**" means the soil class that describes the relative amount of sand, clay, silt and combinations thereof as defined by the classes of the soil textural triangle developed by the USDA (referenced above).

"**Supplemental treatment** " means any OWTS or component of an OWTS, except a septic tank or dosing tank that performs additional wastewater treatment so that the effluent meets the performance requirements of §24913 prior to discharge of effluent into the dispersal field. .

"**Telemetric**" means the ability to automatically measure and transmit OWTS data by wire, radio, or other means..

"**Total coliform**" means a group of bacteria consisting of several *genera* belonging to the family *Enterobacteriaceae*, which includes fecal coliform bacteria.

"**Waste discharge requirement**" means an operation and discharge permit issued for the discharge of waste pursuant to Section 13260 of the California Water Code.

Authority Cited: CA Water Code § 13291, § 1058

Reference: CA Water Code § 13291(b)

§24901. SWRCB -- Applicability and General Requirements.

(a) Minimum requirements for the permitting, monitoring, and operation of OWTS for preventing conditions of pollution and nuisance are established in this Chapter. Regional Water Boards and local agencies implementing the OWTS regulations retain the option of establishing requirements for OWTS that are more protective of water quality than the requirements contained in this Chapter.

(b) This Chapter applies to all new OWTS and to all existing OWTS, although this Chapter addresses these two groups of OWTS in different ways.

(c) No person shall do any of the following without first notifying the Regional Water Board:

(1) operate either a new OWTS or an OWTS that has been relocated, expanded, repaired or replaced with the capacity to treat over 5,000 gallons-per-day.

(2) increase the average pollutant loading of the waste stream going into an OWTS with the capacity to treat over 5,000 gallons-per-day.

(3) change the type (e.g., from domestic to commercial) of the waste stream entering an OWTS.

(4) discharge wastewater above the design flow into an OWTS.

(d) New OWTS and replaced OWTS shall be operated and maintained to perform as designed.

(e) This Chapter shall be implemented through conditional waivers of WDRs by the SWRCB or Regional Water Boards.

(f) OWTS regulated by WDRs may be exempted from the requirements of this Chapter by Regional Water Boards.

(g) A local agency may implement this Chapter, or a portion thereof, as authorized by the SWRCB or by a Regional Water Board through agreement, adopted resolution, or Memorandum of Understanding (MOU). Any MOU, adopted resolution, or similar agreement must require adherence to these regulations and the applicable Regional Water Board basin plan.

Authority Cited: CA Water Code §1058, 13291

Reference: CA Water Code §13291(d), 13291(e)

§24910. SWRCB – General Requirements.

(a) New OWTS and replaced OWTS shall be operated to accept and treat flows of domestic wastewater, excluding any material not generally associated with household activities (e.g., toilet flushing, food preparation, laundry, household cleaning including drain cleaning, and personal hygiene). Additionally, OWTS may be designed and operated to accept other wastewater from facilities that:

(1) exclude hazardous waste, as defined in Title 22 of the California Code of Regulations;

(2) reduce high strength wastewater to below 150 mg/L BOD and 150 mg/L TSS in the septic tank effluent and prior to discharge to the dispersal system; or

(3) use waste segregation practices and systems to reduce pollutant concentrations entering the OWTS to domestic wastewater levels.

(b) New OWTS and replaced OWTS shall be designed to disperse effluent to subsurface soils in a manner that maximizes unsaturated zone treatment and aerobic decomposition of soluble and particulate organic compounds and other pollutants in the effluent.

(c) New OWTS shall be designed, operated and maintained to prevent a condition of pollution or nuisance, as defined in the California Water Code.

(d) The design of new OWTS and replaced OWTS shall be based on the expected influent wastewater quality, the wastewater quantity, the characteristics of the site, and the required level of treatment to not adversely affect water quality or endanger public health.

(e) A qualified professional shall perform all necessary soil and site evaluations for all new OWTS and for all existing OWTS where the treatment or dispersal system will be replaced or expanded.

(f) A qualified professional shall design all new OWTS and existing OWTS where the treatment or dispersal system will be replaced or expanded, unless the new or existing OWTS meet the requirements of ¶g.

(g) A qualified professional employed by a local agency, while acting in that capacity, can review, design, and approve a design for a proposed conventional OWTS in lieu of the requirement of ¶f.

(h) A Licensed General Engineering Contractor (Class A), General Building Contractor (Class B), Sanitation System Contractor (Specialty Class C-42), or Plumbing Contractor (Specialty Class C-36) shall install all new OWTS and replaced OWTS in accordance with California Business and Professions Code Section and Article 3, Division 8, Title 16 of the California Code of Regulations. A property owner may also install his/her own OWTS if the as-built diagram and the installation are inspected at a time when the OWTS is in an open condition (not covered by soil and exposed for inspection) and approved by the Regional Water Board or authorized local agency.

(i) Materials in concentrations that are deleterious and inhibiting to OWTS operations shall not be discharged to an OWTS. Deleterious and inhibition materials include the following:

(1) any biocide, or

(2) all products and matters defined in Chapter 41, Division 4.5, Title 22 in the California Code of Regulations.

(j) The owner of any site on which is located a new OWTS or replaced OWTS shall have an operation and maintenance (O&M) manual prepared by a qualified professional. O&M manuals shall include, at a minimum:

(1) the name, address, telephone number, business and professional license of the OWTS designer;

(2) the name, address, telephone number, business and professional license, where applicable, of the OWTS installer;

(3) the name, address, and telephone number of the service provider that maintains any supplemental treatment system;

(4) the instructions for the proper operation and maintenance and a protocol for an assessment of performance of the OWTS;

(5) the Record Plan with a certification that the dispersal system meets all applicable requirements contained in §24914(a);

(6) the design flow and performance requirements for the OWTS;

(7) a list of types of substances that could inhibit performance if discharged to the OWTS, including those applicable to ¶i; and

(8) a list of substances that could cause a condition of pollution or nuisance if discharged to the OWTS, including but not limited to pharmaceutical drugs and water softener regeneration brines; and

(9) a copy of the SWRCB or Regional Water Board waiver or waste discharge requirements.

(k) Each owner of a new OWTS with supplemental treatment components (see §24913) shall maintain, in addition to maintaining the O&M manual and record plan, a contract with a service provider to ensure that the OWTS is operated, maintained and monitored as designed.

(l) The owner shall retain a Record Plan and an O&M manual for any new or replaced OWTS upon completion of an OWTS installation. Upon the sale of a site, it is the obligation of the owner of the site to provide the buyer, through escrow or otherwise, a complete copy of the O&M manual and record plan for the OWTS at the site.

(m) The owner shall retain all inspection records pertaining to their OWTS for a minimum of five years.

(n) Cesspools shall not be used for new or replaced OWTS.

(o) All new septic tanks, replaced septic tanks, and grease interceptor tanks shall meet the standards contained in Sections K5(b), K5(c), K5(d), K5(e), K5(k), K5(m)(1), and K5(m)(3)(ii) of Appendix K, of Part 5, Title 24 in the California Code of Regulations..

(p) All new OWTS septic tanks shall meet the following requirements:

(1) Access openings shall have watertight risers and shall be set within 6 inches of finished grade; and

(2) Access openings shall be secured to prevent unauthorized access.

(q) The installation of new prefabricated septic tanks shall be limited to those approved by the International Association of Plumbing and Mechanical Officials (IAPMO) and their installation shall be installed according to the manufacturer's instructions. If IAPMO certified tanks are not available locally, other prefabricated tanks may be allowed only if they comply with subsection (r) below.

(r) New non- prefabricated tanks or prefabricated tanks not certified by IAPMO shall be installed only after the design is stamped and certified by a California registered civil engineer as meeting the general industry standards necessary to comply with these requirements;

(s) New and replaced OWTS septic tanks shall be designed to prevent solids in excess of one-eighth (1/8) inch in diameter from passing to the dispersal system. Septic tanks that use a National Sanitation Foundation/American National Standard Institute (NSF/ANSI) Standard 46 certified septic tank filter at the final point of effluent discharge from the OWTS and prior to the dispersal system shall be deemed to meet this requirement.

(t) OWTS owners with onsite domestic wells on their property must monitor groundwater by sampling and analyzing water from:

(1) a monitoring well designed to measure the impact of the OWTS discharge and down-gradient and within 100 feet of the OWTS dispersal system within 30 days upon the installation of a new OWTS and no less than once every five years thereafter; or

(2) an existing onsite domestic well on the property within 30 days upon the installation of a new OWTS and no less than once every five years thereafter

Groundwater analyses shall be conducted in accordance with ¶u. Existing OWTS and new OWTS installations shall be exempt from this requirement if the facility that the OWTS serves is provided water from a community water supply system.

(u) The owner or owner's authorized representative shall collect groundwater samples pursuant to ¶(t) and shall have them analyzed by a laboratory certified by the California Department of Health Services. The laboratory shall be capable of producing laboratory results in EDF format. The groundwater samples shall be analyzed for the following: calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), iron (Fe), manganese (Mn), zinc (Zn), sulfate (SO_4), chloride (Cl), Nitrate (NO_3), nitrite (NO_2), fluoride (F), TDS, total alkalinity (as $CaCO_3$), carbonate (CO_3), bicarbonate (HCO_3), MBAS, pH and total coliforms. If a sample tests positive for total coliforms, the sample shall be analyzed for fecal coliform bacteria. The name of the site owner, the site address and the laboratory results shall be transmitted to the SWRCB in EDF format. The names and addresses of owners of tested domestic wells shall not be released.

(v) Any person owning a septic tank shall have a service provider inspect the septic tank a minimum of once every five years to ensure that the level of settleable solids and/or floatable solids do not impair the performance of the septic tank. It is recommended that septic tanks be pumped if the sum of the scum depth and sludge depth exceeds 25% of the septic tank depth as measured from the water line to the bottom of the tank.

(w) The SWRCB recommends that the regenerating saline backwash from water softeners not be discharged either to the OWTS or to the ground in any manner.

(x) All owners of any OWTS requiring a major repair shall correct the malfunctioning OWTS within 90-days of the date that the malfunction was discovered. The Regional Board may exempt a property from the 90-days requirement and extend the time frame, but such exemptions shall not be greater than 180 days.

Authority Cited: CA Water Code §1058, 13291

Reference: CA Water Code §13291(d), 13291(e)

ARTICLE 2. GROUNDWATER LEVEL DETERMINATIONS FOR NEW OWTS

§24912 SWRCB -- Groundwater Level Monitoring

(a) Unless the seasonal high groundwater level at the site is known to be greater than 10 feet below the ground surface, based on local knowledge of groundwater conditions with the relevant source cited (e.g. previous evaluations and studies, well driller information), a site evaluation conducted by a qualified professional to establish the depth to the seasonal high groundwater shall be performed. Soil mottling observed during the site evaluation by a qualified professional may be used to determine the seasonal high groundwater level. Where soil mottling observations cannot be made or lead to unreliable conclusions, a qualified professional shall use the following protocols to determine seasonal high groundwater prior to design and installation of an OWTS:

(1) To measure depth to seasonal high groundwater, a groundwater level monitoring well shall be installed to a minimum depth of ten feet in the vicinity of a proposed wastewater dispersal system. If an impermeable layer is present at a depth of less than ten feet below the ground surface, the depth of the groundwater level-monitoring well shall be decreased to the depth of the impermeable layer.

(2) For OWTS serving facilities other than single family homes, the Regional Water Board shall determine the number and depth of groundwater level monitoring wells. Such determinations by the Regional Water Board shall supercede the depth requirements in §24912(a)(1).

(3) Measurements of depth to seasonal high groundwater shall be conducted from November 1, to April 1 unless otherwise specified by the Regional Water Board. Groundwater levels shall be measured continuously using a piezometer to record the seasonal high groundwater level. The piezometer may be a float device that mechanically or electrically records the highest water level.

(4) For areas that are subject to special circumstances such as seasonal high groundwater caused by snowmelt or irrigation, measurements to determine the annual high groundwater level shall be conducted during a period specified by the Regional Water Board. Groundwater levels shall be measured continuously using a piezometer to record the seasonal high groundwater level. The piezometer may be a float device that mechanically or electrically records the highest water level.

(5) The Regional Water Board may exempt sites or areas from this Section where an alternative protocol for determining seasonal high ground water is established in the basin plan.

Authority Cited: CA Water Code §1058, 13291

Reference: CA Water Code §13260, 13264, 13267, 13269, and 13291

ARTICLE 3 PERFORMANCE REQUIREMENTS AND SPECIFICATIONS

§24913. SWRCB -- Performance Requirements for Supplemental Treatment Components

(a) Local agencies or the Regional Water Board may require supplemental treatment systems where treatment is needed to mitigate for insufficient soil depths, as required in §24914(c) for a conventional system or 24914(d), or to provide for protection of the water quality and public health, as deemed necessary.

(b) Supplemental treatment components, other than for disinfection or nitrogen reduction, shall be designed to reduce biochemical oxygen demand (BOD) and total suspended solids (TSS) concentrations. Supplemental treatment components, other than for disinfection or nitrogen reduction, shall produce an effluent that meets the following requirements:

(1) The 30-day average carbonaceous BOD (CBOD) concentration shall not exceed 25 milligrams per liter (mg/L), or alternately, the 30-day average BOD shall not exceed 30 mg/L; and

(2) The 30-day average TSS concentration shall not exceed 30 mg/L;

(c) Supplemental treatment components designed to perform disinfection shall have sufficient pretreatment of the wastewater so that effluent does not exceed a 30-day average TSS of 10 mg/L and shall further achieve an effluent total coliform bacteria concentration, at the 95 percentile, of not greater-than either of the following;

(1) 10 MPN per 100 milliliters prior to discharge into a dispersal field where the soils exhibit percolation rates between 1 and 10 minutes per inch (MPI) or where the soil texture is sand; or

(2) 1000 MPN per 100 milliliters prior to discharge into a dispersal field where the soils exhibit percolation rates greater than 10 MPI or consist of a soil texture other than sand.

(d) Effluent from supplemental treatment components designed to reduce nitrogen shall not exceed a 30-day average TN concentration of 10 mg/L as nitrogen.

(e) Before the installation of any proprietary supplemental treatment OWTS, all such treatment components shall be tested by an independent third party testing laboratory. The independent third party laboratory shall certify that the type of system being installed and its components are capable of reliably meeting the performance requirements when installed according to manufacturer specifications, as applicable, based upon the results from the testing protocol. The testing protocol shall include but not be limited to ¶1 thru ¶5 below:

(1) a testing duration of not less than six continuous months.

(2) the wastewater used for testing shall consist primarily of municipal or domestic wastewater and shall have concentrations in the following ranges:

(A) BOD: 125 to 300 milligrams per liter;

(B) TSS: 125 to 300 milligrams per liter;

(C) TN (as N): 50 to 75 milligrams per liter,

(D) total coliform bacteria: $1X10^6$ to $1X10^8$ MPN/100 ml, and

(E) alkalinity (as $CaCO_3$): 50 to 200 milligrams per liter.

(3) hydraulic and organic design loading shall be varied during the test to simulate OWTS operational stress at different levels of use, including all of the following:

(A) regular daily use, where the following daily wastewater flow regime entering the supplemental treatment system is as follows:

i. approximately 35% of the daily wastewater design flow enters the OWTS from 6:00 a.m. to 9:00 a.m.

ii. approximately 25% of the daily wastewater design flow enters the OWTS from 11:00 a.m. to 2:00 p.m.

iii. approximately 40% of the daily wastewater design flow enters the OWTS from 5:00 p.m. to 8:00 p.m.

(B) working parent use, where the following 5-day wastewater flow regime entering the supplemental treatment system is as follows:

i. approximately 40% of the daily wastewater design flow enters the OWTS from 6:00 a.m. to 9:00 a.m.

ii. approximately 60% of the daily wastewater design flow enters the OWTS from 5:00 p.m. to 8:00 p.m.

(C) wash-day use, where following a 5-day regular daily use flow regime provides additional wastewater from a clothes washing machine during the first, third and fifth days. Additional clothes washing water shall have a minimum of 3 wash cycles (including 6 rinse cycles) interspersed between 6:00 a.m. to 2:00 p.m. per 500 gallons of design flow..

(D) vacation (e.g., one week rest).

(4) testing of supplemental treatment components to comply with the performance requirements of ¶b, ¶c or ¶d shall be conducted with the following detection limits listed in Table 1:

Table 1: Detection Limits for Wastewater Constituents	
Parameter	Detection Limit
BOD	2 mg/L
TSS	5 mg/L
Total Coliform	2.2 MPN
Total Nitrogen	1 mg/L

(f) The ongoing monitoring of supplemental treatment components designed to meet the performance requirements of ¶b ¶c or ¶d shall be monitored in accordance with the operation and maintenance manual for the OWTS or more frequently as required by the Regional Water Board.

(g) OWTS with supplemental treatment components shall be equipped with visual or audible alarm as well as a telemetric alarm that alerts the owner and service provider in the event of system malfunction. OWTS using supplemental treatment shall, at a minimum, provide for 24-hour wastewater storage based on design flow as a means to minimize pollution from overflow discharge after a system malfunction or power outage.

(h) OWTS designed to meet the disinfection performance requirements outlined in §24913(c) shall be inspected for proper operation weekly by a service provider unless a telemetric monitoring system is capable of continuously assessing the operation of the disinfection system. Testing of effluent from supplemental treatment components that perform disinfection shall be conducted quarterly based on analysis of total coliform with a minimum detection limit of 2.2 MPN. Effluent samples shall be taken by a service provider and analyzed by a California Department of Health Services certified laboratory.

Authority Cited: CA Water Code 1058, 13291

Reference: CA Water Code §13260, 13264, 13267, 13269, and 13291

§24914. SWRCB -- Dispersal Systems

Any dispersal system that is part of a new OWTS shall meet the following requirements;

(a) Dispersal systems shall be designed and installed at the shallowest practicable depth to maximize elements critical to effective treatment of effluent in the soil. Elements critical to effective treatment include oxygen transfer, biological treatment, evapotranspiration and vegetative uptake of nutrients.

(b) Dispersal systems, except those addressed in §24914(g) and §24914(i), shall be designed using only the bottom area of the dispersal system as the infiltrative surface. The infiltrative surface shall be sized using the design application rates contained in either Table 2 or Figure 1.

(c) Dispersal systems of all conventional OWTS shall have at all times during operation at least three feet of continuous unsaturated, undisturbed, earthen material with less than 30 percent of that material by weight containing mineral particles in excess of 0.08 inches (2 mm) in size (i.e. rock) between the bottom of the dispersal system and top of the seasonal high groundwater level, impermeable strata, or bedrock, whichever of these three, if present, has the highest elevation. Where greater than 30 percent of the undisturbed earthen material exceeds 0.08 inches (2 mm) in size, pressure distribution shall be used to disperse the OWTS effluent and either of the following shall apply:

(1) the minimum depth of undisturbed earthen material required shall be determined using Figure 2; or

(2) the application rate as shown in Table 2 or Figure 1 shall be reduced by the same percentage as that of the earthen materials in excess of 0.08 inches (2 mm) at the dispersal area.

(d) Dispersal systems of all OWTS with supplemental treatment components shall have at all times during operation at least two feet of continuous unsaturated, undisturbed, earthen material with less than 30 percent of that material consisting of mineral particles in excess of 0.08 inches (2 mm) in size (i.e. rock) between the bottom of the dispersal system and top of the seasonal high groundwater level, impermeable strata, or bedrock whichever of these three, if present, has the highest elevation. Where greater than 30 percent of the undisturbed earthen material exceeds 0.08 inches (2 mm) in size, pressure distribution shall be used to disperse the OWTS effluent and either of the following shall apply:

(1) the minimum depth of undisturbed earthen material required shall be determined using Figure 2; or

(2) the application rate as shown in Table 2 or Figure 1 shall be reduced by the same percentage as that of the earthen materials in excess of 0.08 inches (2 mm) at the dispersal area.

(e) Where undisturbed earthen material has insufficient depth to satisfy the minimum depth requirements in ¶c or ¶d, engineered fill as defined herein may be added to existing site soils so that the site exceeds the specified soil depth requirements in ¶c and ¶d. Engineered fill (i.e. sand or crushed glass) shall meet the specifications contained in Table 3. Engineered fill shall compensate for the lack of in-place earthen material at a 1.5 to 1 basis so that a one foot deficiency in the soil column depth would require one and one half feet of engineered fill material. A pressure distribution system is required where engineered fill is used to comply with the minimum earthen material depth requirements. In no case shall engineered fill compensate for more than one foot of the minimum native soil depth requirements in ¶c or ¶d.

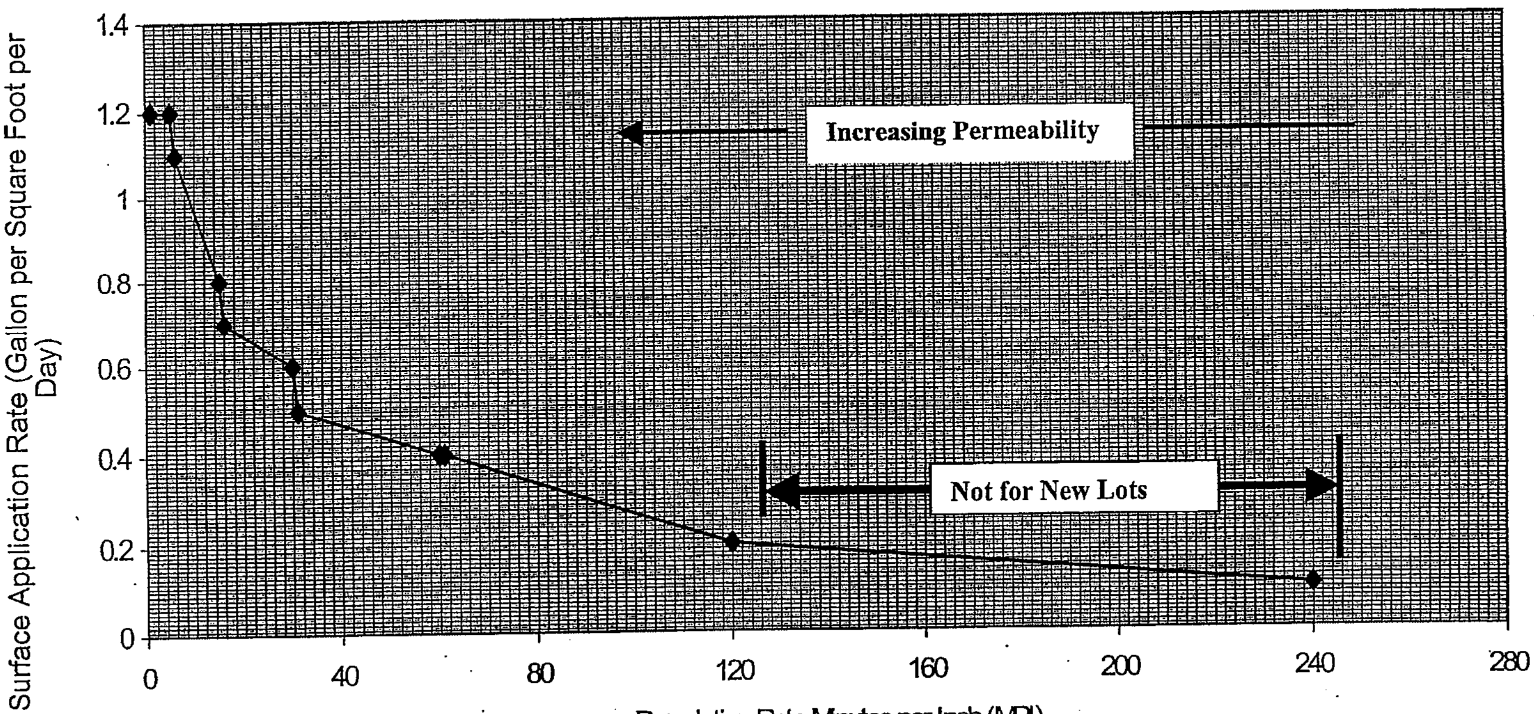
(f) Conventional OWTS dispersal systems in which pumps are used to move effluent from the septic tank to the dispersal system shall be equipped with one of the following: a visual, audible, or telemetric alarm that alerts the owner or service provider in the event of pump failure. All pump systems shall, at a minimum, provide for storage in the pump chamber during a 24-hour power outage or pump failure and shall not allow an emergency overflow discharge.

(g) Gravel-less chambers shall meet the requirement for conventional dispersal systems contained in ¶c and ¶d. The infiltrative surface shall be sized using the design application rates contained in either Table 2 or Figure 1. The design infiltrative surface area of such a system can be reduced to no less than seventy percent (70%) of the area that would be for a conventional dispersal system.

Table 2: Design Infiltrative Surface Application Rates	
USDA Soil Texture Classification	Maximum Wastewater Application Rate (gallons per day per square foot)
Coarse Sand with percolation rate less than 1 MPI	Prohibited
Coarse sand, medium sand	1.2
Fine sand, loamy sand	1.1 to 0.8
Sandy loam, loam, sandy clay loam	0.7 to 0.6
Silt loam	0.5 to 0.4
clay loam, silty clay loam, sandy clay	0.3 to 0.2

Table 3: Engineered Fill Specifications	
1. Maximum percentage of particles smaller than 0.053 mm in diameter (sieve #270).	Dry Weight % Passing 5%
2. Maximum percentage of particles over 2.0 mm in diameter.	Dry Weight % Passing 20%
3. Sieve Size	Dry Weight % Passing
3/8	100
4	95-100
10	75-100
16	50-85
30	25-60
50	10-30
100	2-16
200	0-3

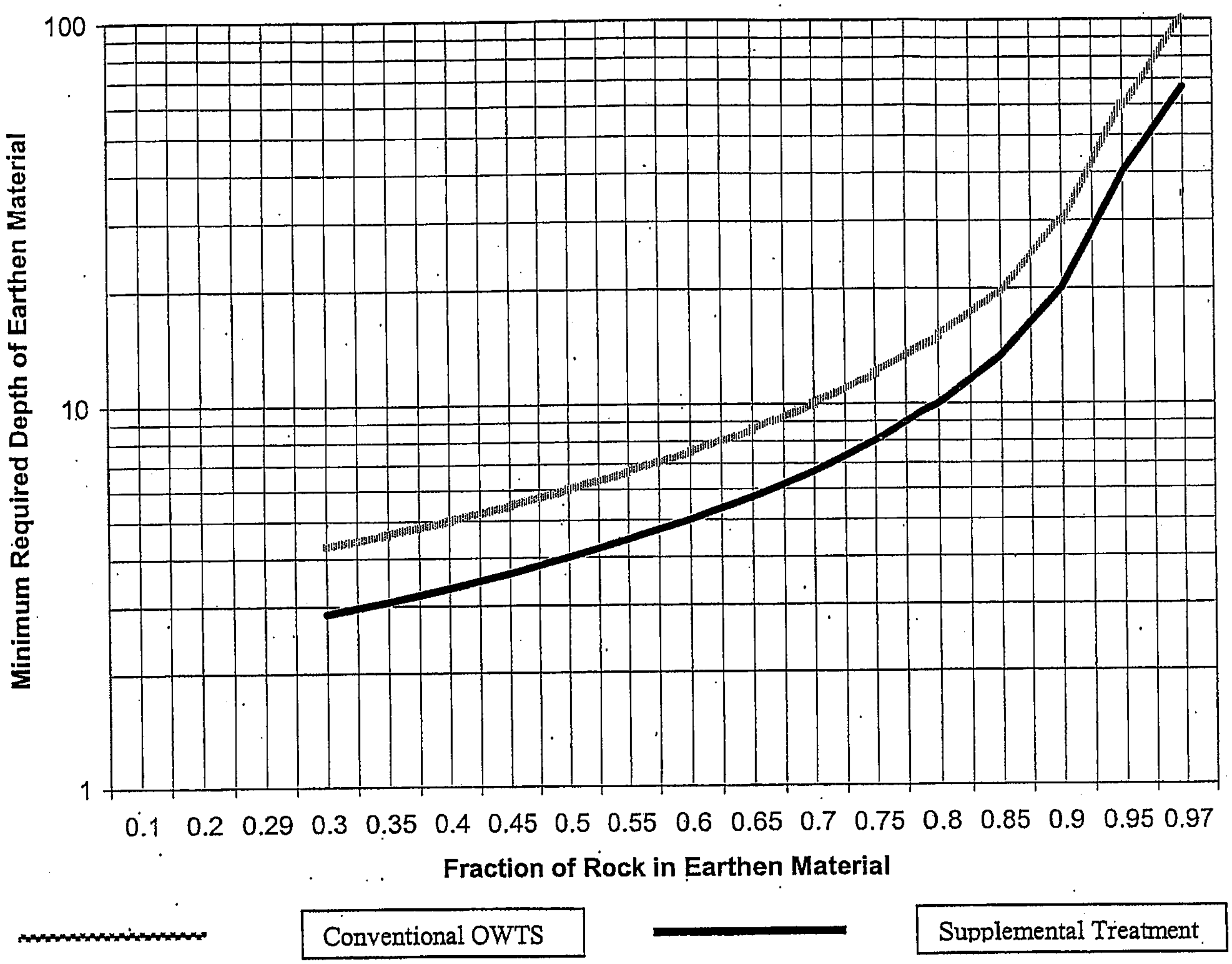
Figure 1 : Design Infiltrative Surface Application Rates



Percolation Rates < 1 MPI have a Zero Surface Application Rate

Note: Application rates with a percolation rates higher than 120 are restricted to existing parcels.

Figure 2: Minimum Depth of Earthen Material



(h) Dispersal systems using shallow pressurized drip or orifice dispersal shall meet the following requirements:

(1) The allowed application area shall not exceed four square foot per emitter/orifice. In no case are application areas allowed to be overlapping or less than one square foot per lineal foot; and

(2) all systems shall be designed and maintained to reduce orifice clogging and root intrusion.

(i) Seepage Pits shall be designed on sidewall area as the infiltrative surface and are allowed where the following conditions apply:

(1) the site has been determined by a qualified professional to be unsuitable for other types of dispersal systems due to soil properties or amount of area available at the site;

(2) the bottom of the seepage pit shall be a minimum of ten feet above seasonal high groundwater level; and

(3) the site shall meet one of the conditions:

(A) There must be a minimum of ten feet of soil below the bottom of the seepage pit and above the seasonal high groundwater level, impervious layer, or bedrock. All strata to a depth of 10 feet below the pit bottom must be free of groundwater in accordance with §24912, or

(B) When an OWTS has supplemental treatment components designed to meet the performance requirements specified in §24913(b), and §24913(c) are met, a seepage pit may have less than 10 feet of soil below the bottom of the seepage pit, but no less than two feet of soil, or

(C) When an OWTS has supplemental treatment components designed to meet the performance requirements specified in §24913(b) and §24913(c)(1), a seepage pit may have less than two feet of soil beneath the bottom of the seepage pit.

(j) Evapotranspiration and infiltration (ETI) systems shall be designed such that evapotranspiration and infiltration exceed the design waste flow combined with a 25-yr return rate precipitation event on an annual, monthly and seasonal basis. ETI systems shall be operated in a manner that prevents human exposure to wastewater.

Authority Cited: CA Water Code §1058, 13291

Reference: CA Water Code §13260, 13264, 13267, 13269, and 13291

ARTICLE 4: PROTECTING IMPAIRED SURFACE WATER

§24940. SWRCB -- Applicability and Requirements.

This section shall apply to any water body that has been designated as impaired due to nitrogen or pathogens pursuant to Section 303(d) of the Clean Water Act but only where a TMDL has been approved that includes a determination that OWTS contribute to the impairment of the water body.

(a) No new OWTS dispersal area shall be constructed or operated within 600 linear feet [in the horizontal (map) direction] of the edge of the river bank, lake or the mean high tide unless one of the following applies:

(1) where the waterbody is listed as impaired due to nitrogen, OWTS meets the performance requirements for supplemental treatment contained in §24913(b) and §24913(d).

(2) where the water body is listed as impaired due to pathogens, OWTS meets the performance requirements for supplemental treatment contained in §24913(b)(1) and §24913(c).

(b) Unless modified or exempted pursuant to ¶c, ¶d, or ¶e, an owner of any existing OWTS dispersal area within 600 linear feet [in the horizontal (map) direction] of the edge of the river bank, lake or the mean high tide shall have the OWTS inspected by a qualified professional within one year of the effective date of these regulations or within one year after the effective date of a TMDL that includes a determination that OWTS contribute to impairment of the water body, whichever is later.

(1) The inspection shall include but not be limited to:

(A) a determination of whether the OWTS is discharging to the surface;

(B) a determination of whether the OWTS complies with the depth to seasonal high groundwater requirements of this Chapter, unless the OWTS owner chooses to assume that the OWTS is contributing to the impairment;

(C) for a water body impaired for pathogens, a determination of whether fecal coliform in the OWTS discharge is reaching groundwater, unless the OWTS owner chooses to assume that the OWTS is contributing to the impairment; and

(D) for a water body impaired for nitrogen, a determination of whether nitrogen exceeding 10 mg/l is reaching groundwater, unless the OWTS owner chooses to assume that the OWTS is contributing to the impairment.

(2) The OWTS owner shall send a report of the inspection to the Regional Water Board within 30 calendar days of the completion of the inspection.

(3) Where a determination is made by a qualified professional that an OWTS discharge of fecal coliform or nitrogen exceeding 10 mg/l is reaching groundwater, the owner of the OWTS shall have four years following the date of the determination to meet the applicable requirements of ¶a.

(c) Adoption or amendment of a TMDL may alter the 600-foot distance requirement or compliance dates in ¶a and ¶b.

(d) This Section does not apply to impaired waters where, prior to the effective date of this Chapter, the Regional Water Board has adopted a TMDL requiring implementation of a wastewater management plan. The wastewater management plan must include methods to reduce the OWTS pollutant contribution to the impaired water body, a plan for water quality monitoring, and a program for the repair or replacement of existing OWTS. The wastewater management plan must be designed to result in either elimination of the impairment or the reduction of the contribution of OWTS to the impairment.

(e) The requirements contained in this Section do not apply to OWTS owners who commit by way of a legally binding document to connect to a centralized wastewater collection and treatment system regulated through WDRs within nine years. To become effective, the owner must sign the document within forty-eight months of the effective date of this Chapter or the effective date of a TMDL, whichever is later. The specified date for the connection to the centralized community wastewater collection and treatment system shall not extend beyond nine years following a Regional Water Board determination made pursuant to this Section.

§24940 to §25500 [Reserved for SWRCB]

COLORADO SCHOOL OF MINES
Dr. Jörg E. Drewes, Associate Professor

Environmental Science and Engineering Division
1500 Illinois Street
Golden, Colorado 80401-1887
Telephone: 303-273.3401
Telefax: 303.273.3413
E-mail: jdrewes@mines.edu
ESE URL: http://www.mines.edu/academic/envsci/
Water Tech http://www.mines.edu/~jdrewes/

Todd Thompson, P.E.
Onsite Treatment Systems Specialist
Division of Water Quality
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

June 1, 2007

RE: Peer Review of California's Proposed Rule for OWTS

Dear Sirs:

Please find enclosed my review of the proposed rule for OWTS in the State of California. I summarized my review below. Comments are divided into two parts: a.) issues regarding the rule draft language and b.) issues regarding the scientific basis of the proposed rule.

<u>a.) Comments regarding rule draft language (as provided as Enclosure 4: Draft Regulations – Peer Review):</u>

- p. 2. Separate definitions of "Electronic deliverable format" from "Engineered Fill". Present as two paragraphs rather than one.

- p. 4. "Waste discharge requirement". Provide acronym, should read "Waste discharge requirements" or "WDRs"
Note: This acronym has not been introduced anywhere before it is mentioned in §24901(e) for the first time.

- p. 4, §24901(c)(1) operate either a new OWTS or an OWTS that has been relocated, expanded, repaired or replaced with a capacity...".
Comment: While it is clear what is meant with "relocated and replaced", what constitutes an expansion or repair? Is this defined somewhere?

- p. 6, §24910(j)(8) a list of substances that could cause a condition of pollution or nuisance if discharged to the OWTS, including but not limited to pharmaceutical drugs and water softener regeneration brines; and".
Comment: While there is ample evidence that brines from water softeners can adversely affect the performance of OWTS, it remains unclear why also "pharmaceutical drugs" are mentioned but other organic chemicals that might have a more severe impact, such as personal care products,

household chemicals, etc., are not? What is the basis for this selection? While implied, the language chosen also is not clear that what is meant here refers to "unused or/and expired pharmaceutical drugs" that are disposed via the OWTS rather than pharmaceutical drugs that are excreted via urine and faeces after they were administered to humans. Considering the occurrence level of common household chemicals or the mass loading that is generated after expired or leftover household chemicals are disposed via OWTS, these chemicals (including cleaning agents, detergents, nail polishing solutions, pesticides, etc.) will likely cause a significant upset in an OWTS.
I suggest the following language: "a list of substances that could cause a condition of pollution or nuisance if discharged to the OWTS, including but not limited to household chemicals, pesticides, pharmaceutical drugs and water softener regeneration brines; and"

- p. 7, §24910(u). "MBAS" is not defined anywhere. "Nitrate" is capitalized but shouldn't.

b.) Comments regarding the scientific basis of the proposed rule:

After carefully reviewing the draft regulation; I conclude that the proposed rule is based upon sound scientific knowledge, methods, and practices and provides a comprehensive framework for operation and monitoring of OWTS in California.

The only comment I have refers to monitoring requirements as outlined in §24910(t and u) and the intention to protect public health:
The proposed rule is considering monitoring of groundwater to measure the impacts of the OWTS discharge on the underlying groundwater. With the overarching concept to protect public health and the intention of the SWRCB to establish baseline-monitoring information, the underlying approach of this monitoring requirement is good and the proposed parameters (i.e, total coliforms and minerals as outlined in (u)) are appropriate. What is not clear are the frequency and conditions under which monitoring is conducted.
The monitoring requirement calls for an initial sampling after 30 days of construction of the OWTS, followed by samples collected every five years. Since most OWTS owners will likely choose to monitor the domestic well rather than a newly installed monitoring well downstream of the OWTS, there is a good likelihood that a 30 day time period is not sufficient to determine whether the domestic well is hydraulically connected to the plum of the OWTS. This determination could also be affected by how and when the sample is collected (e.g., pumping to steady-state conditions prior to sampling vs. grab sampling at the tap; sampling during dry-weather vs. wet-weather period; sampling during the same season (winter vs. summer), etc.). Since the next sample will be collected after 5 years, there is a chance that the owner utilizing the domestic well can be at risk for a significant time period. I assume the reasoning for monitoring after 5 years was the outcome of balancing the financial burden of monitoring costs to the owner and the likelihood of putting the public at risk. However, a potential impact of the OWTS operation on the domestic well will likely establish after a couple of months and this impact might not be discovered for several years to come. The Wisconsin Administrative Code (Comm 83.52 Responsibilities (1)(c) a.) is requiring monitoring at an interval of 12 months or less. This seems to be a more appropriate time period to assess a potential impact of the OWTS on drinking water derived from a domestic well and to establish long-term monitoring data for the SWRCB for OWTS operation.
The SWRCB might want to consider revising the monitoring frequency to for example 30 days, 1 year, 3 years and every 5 years thereafter. Clear guidance should be given to how and when a representative sample is collected.
***

If you have any questions, please do not hesitate to contact me at 303-273-3401 or via E-mail at jdrewes@mines.edu. I would like to thank you for the opportunity to review the proposed rule.

Sincerely,

Dr. Jörg E. Drewes
Associate Professor of Environmental Science & Engineering
Director, Advanced Water Technology Center (AQWATEC)

Scientific Peer Review of Technical Issues Contained in the Draft Regulations for Onsite Wastewater Treatment Systems

By

C. Herb Ward, Ph. D., MPH., PE

General Observations/ Comments

1. The proposed regulations for OWTS appear to be comprehensive and should be generally protective of groundwater and onsite drinking water wells. However, OWTS are widely known to be major sources of groundwater pollution. Hence, in areas, and especially on properties, that have unregulated onsite domestic wells, OWTS regulations to protect human health should error on the conservative side. The draft OWTS regulations missed or perhaps avoided a strategic chance to regulate domestic water wells on properties with OWTS. The state-of-the-art and guidance on siting of OWTS has improved dramatically since the early work on transport and fate of chemicals from septic tank effluents in 1960's by the USEPA Robert S. Kerr Environmental Research Laboratories in Ada, Oklahoma. However, it is questionable if the proposed regulations require sufficient monitoring of domestic wells to protect human health in rural communities.

2. The proposed regulations do not specifically address communities sewered by OWTS, e.g. rural trailer parks, retirement communities, etc. Should community OWTS be addressed?

3. Water quality monitoring/analysis is regulated and must be done by certified laboratories. Similar certification is not required for facilities used for testing, evaluation, and certification of supplemental treatment technology/units This issue is addressed specifically under response to scientific issue # 9 and deserves further consideration.

4. References cited to support scientific judgments/decisions in the regulations are heavily weighted to articles in conference proceeding that frequently/generally are not peer reviewed. Where possible, original peer reviewed articles published in well-known scientific/engineering journals should be cited as the basis for scientific judgments. Official USEPA publications are peer reviewed but many reports submitted to federal and state government by contractors are not. These should be avoided as authoritative publications where possible: Also, state and local government publications that do not reference original literature should be avoided as the authoritative basis for new regulations.

5. Many of the references given in Enclosure 2 are incorrectly cited (see responses to scientific issues #'s 1 – 4). It would have been helpful in "References for Enclosure 2" if

a list of full references had been provided. Placing author(s) name on and marking specific sections referenced would save reviewer time.

Responses to Scientific Issues

1. The regulations (§24901(c)(1 and 2)) would require that no person operate a new OWTS or increase the average pollutant loading to an existing OWTS with a design capacity to treat over 5,000 gallons-per-day without first notifying the Regional Water Board.

Requirement seems reasonable. Literature reference is adequate for factual basis. However, reference should be (Plews and DeWalle 1985) not (Plews et al. 1985). The paper was written by Plews and De Walle. The study was done by five individuals, including Plews and DeWalle.

2. These regulations (§24901(c)(3)) specify that, if the waste type of the wastewater entering the OWTS is changed or if biochemical oxygen demand (BOD) or total suspended solids (TSS) concentrations exceed 150 mg/L in the septic tank effluent and prior to discharge to the dispersal system, the OWTS owner must notify the Regional Water Board.

Requirement seems reasonable based on references cited. Is the correct reference Crites and Tchobanoglous 1998?

3. The proposed regulations (§24910(t)) require all new septic tanks to restrict solid particles in excess of 1/8 inch in diameter from passing through to the dispersal field.

Requirement seems reasonable based on references cited. Not clear from reference about the benefit-cost relationship between size of particles omitted eg. 1/8, 1/4. However, size criteria could have large impacts on frequency/cost of filter maintenance.

The references should be Byers et al. 2001 and Kahn et al. 2000.

4. The proposed regulations (24910(u and v)) would require owners of existing OWTS with a domestic well on their property to sample groundwater from a monitoring well downgradient and within 100 feet of the OWTS dispersal system every five years, and within 30 days of a new OWTS installation. Alternatively, the OWTS owner can elect to sample the onsite domestic well. The water sample would be analyzed for total coliforms and other constituents as specified in the Section and the results of the analysis reported electronically to the State Water Board.

Requirement does not seem reasonable or adequate based on supporting literature. Use of a monitoring well to determine if an onsite domestic well is contaminated with OWTS effluent does not seem advisable or reasonable. Your rationale for this requirement explains the reason – "The direction of groundwater flow, and thus the direction of the OWTS discharge plume, is generally not known". Since 50% of housing units with OWTS rely on a domestic well for drinking water and the direction of ground water flow is known to shift, at times dramatically with season and rainfall, it does not seem adequately protective of human health to rely on monitoring wells as surrogates for drinking water wells. I recommend that monitoring of onsite domestic wells be required at intervals less than 5 years. "The USEPA recommends that domestic wells be tested annually (USEPA 2002)."

5. A provision in proposed regulations (§24910 (x)) "recommends" that water softener regeneration brine not be discharged to groundwater or OWTS.

Recommendation is questionable. Other parts of this proposed OWTS regulation correctly stress the importance of practices that enhance the useful life of OWTS. The known effects of sodicity on hydraulic conductivity are counter to this philosophy.

6. The proposed regulations (§24912) specify a protocol to determine the seasonal high groundwater level for purposes of OWTS siting (to establish the maximum depth of soil that remains continuously unsaturated in the proposed dispersal area).

Requirement/methodology seems reasonable based on references cited.

7. Where a Regional Water Board requires OWTS to include disinfection to protect surface water or groundwater quality, the proposed regulations (§24913(c)) specify that OWTS supplemental treatment components must be designed to reduce total coliforms in the effluent.

Requirement seems appropriate based on existing technology, current understanding of pathogen reduction in unsaturated subsurface dispersal systems, and references cited.

8. Where a Regional Water Board requires OWTS to remove nitrogen in order to protect surface water or groundwater quality, the proposed regulations (§24913(d)) specify that OWTS supplemental treatment components must be designed to reduce total nitrogen in the effluent to 10 mg/l.

Requirement is appropriate and supported by cited references and a large body of other literature. This requirement is especially important when onsite drinking water wells are present.

QA/QC for certification of supplemental treatment technologies is equally important.

9. The regulations (§24913(e)) specify a protocol for certifying supplemental treatment technology by third parties.

Requirement is subject to the vagaries of the test and certification process and to abuse. State and Regional Water Boards require the use of certified laboratories for water analysis - for good reason and based on long experience. QA/QC for certification of supplemental treatment technologies is equally important.

The important/operative wording in this discussion of the requirement includes the phrases "qualified professional" and "independent third party certification." The protocol for testing and evaluation of supplemental treatment technologies appears appropriate in all respects but independent third party laboratories are not all equal and some are incompetent.

This requirement and its implementation should receive more thought.

10. The proposed regulations (§24913(h)) require weekly operation inspections of disinfection supplemental treatment units.

Requirement is appropriate and strongly supported by references cited.

11. The proposed regulations (§24914(b)) require that all dispersal systems except seepage pits be sized using bottom area as the infiltrative surface.

Requirement strongly supported by subsurface science and references cited.

12. The proposed regulations specify maximum design application rates for sizing the dispersal systems in Figure 1 and Table 2.

Proposed wastewater application rates are within EPA guidelines and appropriate for OWTS in California.

13. The proposed regulations (Figure 2, §24914(c) and 24914(d)) would require additional unsaturated soil depth where excessive rock fragments exist in the dispersal system.

Requirement and analysis of tradeoffs are appropriate, straight forward, and supported by literature cited.

14. The proposed regulations contain a requirement (§24914(c)) for a minimum of 3 feet of unsaturated soil in the dispersal system to treat septic tank effluent in order to reduce pathogens.

Requirement/guidelines probably appropriate for most bacterial pathogens but are questionable for viruses. See Azadpour-Keeley, A and C. H. Ward. 2005. Transport and

Survival of Viruses in the subsurface-Processes, Experiments, and Simulations Models Remediation 15(3): 23 – 49.

15. The proposed regulations contain a provision (§24914(d)) that allows using third-party certified wastewater treatment processes (supplemental treatment) as a surrogate for one foot of soil treatment (i.e. the regulations allow a minimum of 2 feet of unsaturated soil for OWTS with supplemental treatment rather than 3 feet of unsaturated soil required for conventional OWTS), provided that those processes meet performance requirements (§24913 (b), (c)) prior to discharge.

Requirement/guidelines are probably appropriate but may not be sufficiently conservative. See responses to discussion of requirement #'s 9 and 14.

16. The proposed regulations (§24914(e)) would allow up to one equivalent foot (1.5 feet) of engineered sand fill (material specifications in Table 2) as a substitute for the lack of suitable native unsaturated soil below the OWTS.

Requirement/guidelines are based on acceptable literature cited. Why is engineered fill (sand or crushed glass) specified instead of onsite or earthen materials (native soil) from the area that would generally have higher sorptive capacity? Use of local native soil could assure that the regulation would be both achievable and conservative.

17. The proposed regulations (§24914(g)) would allow design of gravel-less dispersal systems with a reduction (adjustment multiplier of 0.7) of the minimum required dispersal system area for effluent application.

Requirement/guidance supported by literature cited. Excellent reference.

18. The proposed regulations (§24914(h)) would require a minimum of six inches of soil over shallow subsurface dispersal systems.

Requirement/guideline probably satisfactory but may not be sufficiently conservative. What about protection of shallow drip dispersal systems from compaction from weight of heavy vehicles, including farm equipment? During wet weather the butane delivery truck has sunk more that 6 inches in the yard of my farm in Arkansas.

19. The proposed regulations contain conditions for the use and placement of seepage pits specified in §24914(i)(1 through 3).

Requirement/guidelines appear to be consistent with supporting references. What fraction of total OWTS consist of seepage pits? Seepage pits should be the last option and the least used. Wording in proposed regulation could be stronger.

20. The proposed regulations (§24914(j)) require that evapotranspiration beds be designed to remove, without spilling over, all the expected wastewater generated at the site plus rainfall that is expected to have a return frequency of once every 25 years on annual, monthly, and seasonal basis.

Requirement/guidance appropriate based on State Water Resources Control Board guidelines. See response to discussion of requirement # 18, which is also applicable to protection of evapotranspiration beds from compaction and loss of mechanical integrity.

21. The proposed regulations in Article 4 (§24940) would require owners of OWTS within 600 lateral feet of an impaired water body, listed as impaired pursuant to §303(d) of the Federal Clean Water Act, to take specified actions where OWTS (in general) were identified as contributing to the impairment of the water body by the Regional Water Board. For purposes of this Section, impairment is limited to nitrate or bacterial contamination.

Requirement/guidelines supported by reference to California Department of Health Services document that contains no references to original literature. This should be corrected. The draft regulation states that Article 4 (2940) applies to any water body that has been designated impaired under the CWA "but only where a TMDL has been approved that includes determination that OWTS contribute to the impairment of the water body." What about areas/water bodies not covered by TMDL determinations?

E-Herb Ward
June 18, 2007

Review of California Draft Regulations
Onsite Wastewater Treatment Systems (OWTS)

Prepared By
Chet A. Rock, Ph.D., P.E.

It is obvious that close attention has been paid to the scientific literature in the development of the OWTS regulations. The regulations are well-crafted and are built on a solid scientific foundation.

The only area that might be given extra attention is the management of cluster systems. While the regulations do cover cluster systems (systems of several septic tanks discharging to a common drainfield), specific reference to cluster systems would add clarity.

The following comments address the specific issues raised by the Board.

Issue 1: Notification requirement for flows greater than 5,000 gpd...

This standard is based on the Colorado River Board (CRB) Guidelines for Sewage Disposal from Land Developments, hence the 5,000 gpd 'trigger' for notification of the Regional Water Board. The CRB Guidelines note that commercial and/or industrial dischargers are required to file regardless of flow to be treated. Does Para.24901 also need to include this statement?

Why 5,000 gpd has been selected is not clear to this reviewer. It represents the flow from 20 average households (250 gpd/household). This represents a significant development. Since this is basically a reporting requirement, it seems a 2,500 gpd 'checkpoint' would be more conservative. As noted in Plews el al. (1985) larger OWTS are more likely to fail. They note a level of concern at 3,500 gpd.

Issue 2: Requirement for OWTS effluent limit...

Regardless of whether 150 mg/L is the right number, is this an instantaneous, daily, or monthly (30 day) average?

If I understand this regulation correctly, this limit would only apply to systems that accept high strength wastewater, that is, atypical of domestic wastewater. Data we collected in the early nineties suggest that meeting the BOD limit would be difficult for domestic wastewater (see Table 1); whereas TSS is easily met even without an effluent filter (Table 2).

Effective monitoring is questionable. Without special sampling ports, an instantaneous grab sample seems the only plausible alternative. Given the highly variable effluent concentrations, it would have limited meaning. Perhaps requiring pretreatment of high concentration wastes before sending them to septic tanks is more plausible. Another consideration is to require these systems to have special sampling boxes downstream of the septic tank for monitoring.

Table 1. Mean Biochemical Oxygen Demand (BOD_5) Results.
Note: Phase II is not continuous data (*).

SEPTIC TANK DESIGN	# of DATA PTS	BOD_5 INFLNT (mg/L)	# of DATA PTS	BOD_5 EFFLNT (mg/L)
PHASE I - Rectangular 1,000 gallons				
1. CONVENTIONAL TANK	76	254	75	175
2. BAFFLED TANK	75	253	76	160
3. COMPARTMENT + BAFFLES	76	249	76	147
PHASE II - Two Compartments*				
4. 2,000 GALLON TANK*	61	242	65	165
5. 1,000 GALLON ROUND TANK*	68	237	73	193
6. COMPARTMENT + BAFFLES 2*	79	248	85	173

Table 2. Mean Total Suspended Solids (TSS) Results.
Note: Phase II is not continuous data (*).

SEPTIC TANK DESIGN	# of DATA PTS	TSS INFLNT (mg/L)	# of DATA PTS	TSS EFFLNT (mg/L)
PHASE I - Rectangular 1,000 gallons				
1. CONVENTIONAL TANK	122	269	127	64.6
2. BAFFLED TANK	124	254	127	63.8
3. COMPARTMENT + BAFFLES	124	252	127	50.7
PHASE II - Two Compartments*				
4. 2,000 GALLON TANK*	63	212	63	54.5
5. 1,000 GALLON ROUND TANK*	73	221	76	79.0
6. COMPARTMENT + BAFFLES 2*	83	217	87	74.3

Issue 3: Requirement for effluent filter...

Effluent filters are proven; required in other states, and require monitoring. This latter fact will lead to fewer drainfield failures due to solids overloading as system back up will prompt owners to take action.

Issue 4: Requirement for groundwater monitoring...

While the need for data is valid, it is questionable whether this requirement will yield any systematically useful data. It seems to be a compromise to minimize the cost of data collection for the property owner. The results will be a 'hodge-podge' of data collected from domestic wells. Basically, wells will be randomly located on the property and not scientifically located to monitor groundwater. In other words, only the occasional domestic well will be located downgradient and within 100 feet of the OWTS on a property.

It is recognized that "it is rarely possible to predict the direction of OWTS discharge flow" even with an expensive study. Collecting data to determine contamination by an OWTS without knowing site groundwater conditions is a waste of time and money and could even lead to erroneous conclusions.

It is true, however, that sampling a domestic well will give the owner valid information about well water quality. If this is a good thing, then it should be a drinking water regulation and sampling should be more often than once every five years (annually is recommended by US EPA). It does not belong in an OWTS regulation.

Rather than "simply a starting point', it is likely this requirement will be a false start.

Issue 5: Recommendation against discharge of water softener brines...

This may "highlight the increase in salinity", but it will not have any impact. The disposal of backwash brines is problematic and, to be effective, an alternative disposal solution must be forthcoming. If not, it is entirely possible that a more serious problem may be created from improper disposal of brines.

The citation of Perkins (1989) is misleading as Perkins states, "The brine solution...can be drained into the septic tank without harm. Although it has been theorized that salt could have a bad effect on the drain field...no such effect has been shown." Patterson's reference (1996) to his Ph.D. thesis is not a refereed publication; further only refers to finely textured soils.

The literature contains many references of salt contamination from irrigation practices, so we know an increase in salinity can cause a serious problem. It is logical to conclude that brines have a similar effect, but until California has some documented cases, even a recommendation does not belong in the regulations.

Issue 6: Protocol to determine seasonal high groundwater level...

The determination of seasonal high groundwater level using soil molting is well documented and is codified in other state regulations (see Attachment 1: Maine Onsite Regulations). The use of monitoring wells is similarly documented and the ten-foot requirement is scientifically sound.

Issue 7: Requirement for disinfection...

I am assuming that the requirement for supplemental treatment is to allow OWTS in locations where OWTS would not normally be allowed. Obviously, not allowing installation on poor sites is best, but sufficient technology does exist so that safe disposal can be designed for an otherwise marginal site.

Highly permeable soils do not provide adequate treatment. It is also well known that the presence of too many particles can render disinfection ineffective, so that the pretreatment requirement is needed.

I do not understand the need for Para. 24913(c)(2). If the site "can be expected to provide reasonable treatment for pathogens...," why is additional treatment required? Are these not "a properly sited and designed conventional OWTS?"

Issue 8: Reduction of total nitrogen...

It is a given that nitrate is highly mobile and a conservative anion (little denitrification has been shown to occur within the soil (Sikora and Keeney, 1975)). Using the drinking water standard of 10 mg N/L ensures compliance in areas where very little or no effective dilution takes place.

Issue 9: Certification of supplemental treatment technology...

This requirement is essential to ensure the integrity of supplemental treatment units. Over the years, I have seen devices purported to remove wastes that did not work as claimed. NSF has had a long history of testing and certifying, while ATSM[1] has been equally as successful in establishing standards.

The detailed prescription for wastewater and hydraulic design loading seem unnecessarily detailed (Para.24913(e)(2) and (3) given 'real world' variability. For example, the wastewater should only specify a minimum concentration, e.g., BOD: 125 mg/L or higher, or meet ASTM Standard D5905-98(2003).

The hydraulic loading should only address Para.24913(e)(3)(A) and should be conducted for a continuous six months. The other scenarios are

[1] C913-02 Standard Specification for Precast Concrete Water and Wastewater Structures; D5905-98(2003) Standard Practice for the Preparation of Substitute Wastewater

superfluous, if not down right silly. Either the system will operate or it will fail under scenario A.

First, the wastewater prescription is only an average estimate so that many other concentrations can and will occur (addition of garbage grinders, for example). Second, the testing period is only six months and there needs to be time to reach equilibrium and stable operation. Third, actual operation of systems may or may not follow any logical pattern and guessing at what might occur will not provide any assurance of a better testing regime.

If (B), (C), and (D) remain, should the systems be required to meet the standard 100% of the time or, say, 95% of the time?

Perhaps more importantly, a minimum sampling frequency and number of samples should be given.

Issue 10: Inspection of disinfection units...

If systems are required to have disinfection systems in order to be approved, then monitoring is essential. Further, California has an excellent study prepared by Leverenz et al (2006). My own experience has been limited to chlorine tablet systems and indeed they were a problem with tablets jamming and going undetected for months. Thus, weekly inspections are a reasonable requirement to ensure the protection of public health. These systems are going to be installed in areas of 'subpar' conditions, so it is even more important that performance be monitored.

Issue 11: Use of bottom area for design...

The pros and cons of sidewall and bottom area have been debated over the years, and, as the regulation calls for, the correct approach is to use just the bottom area.

Issue 12: Maximum design application rates...

Hydraulic loading rate is a critical factor in the design of OWTS; fortunately substantial history is available to have reliable application rates. Table 2 is within the appropriate ranges.

Issue 13: Requirement for additional soil...

The 'Y-axis' in Figure 2 does not have units.

It is reasonable to require additional action where soil is very porous for conventional OWTS; however, the option given (c) is to use pressure distribution AND either (1) more suitable soil or (2) reduced application rate is required. Is not an acceptable alternative to add disinfection instead (Para.24913(c))?

Para.24914(d) states that supplemental systems, which have disinfection, must also use pressure distribution. At the very least, I find this section is very confusing and potentially contradictory. If a supplementary system has adequate disinfection, why is there a further requirement?

Issue 14: Minimum of 3 feet of unsaturated soil...

This is reasonable. I do not understand the reason that "during operation" is used in the first line of Para.24914(c). It is either superfluous or its significance escapes me.

Issue 15: Supplemental treatment equivalent to one-foot of soil...

The concept that treating septic tank effluent (STE) prior to discharge to the drainfield will take less soil to treat is sound. Whether such 'pre-treatment' will substitute for one foot of soil is unknown.

The study by Duncan, et al. (1994) used laboratory columns rather than field data. Their results varied from 30% to 70% greater infiltration rates with significant reductions in pollutants monitored.

Since the minimum depth of unsaturated soils needed for treatment may be less than 3 feet, adding supplemental treatment provides sufficient confidence that treatment can be achieved within two feet or less. As a regulatory limit, the reduction should certainly be no more than one foot.

Why isn't disinfection an acceptable alternative as in the case of porous soils?

Issue 16: Use of engineered fill...

This is a conservative standard based on a solid history of performance.

Issue 17: Reduction allowance for gravel-less dispersal systems...

The practice of giving credit for gravel-less dispersal systems is relatively common and has been successful.

Issue 18: Minimum coverage for dispersal systems...

Locating dispersal systems in the root zone offers several treatment advantages; however, there is a need for minimum cover to prevent systems from being too close to the surface.

Issue 19: Use of seepage pits...

The use of seepage pits is a bad practice and should be discouraged. Seepage pits should only be use in conjunction with supplemental treatment. The requirement of 10 feet of soil beneath the infiltrative layer should always be required and no reductions be permitted. The 10 feet above seasonal high level of groundwater should stand.

There may be considerable infiltration through the pit bottom before clogging forces discharge through the sidewalls. Thus, significant flow can enter and in the likely case of little dispersion could produce a contaminant plume.

Issue 20: Performance of ET beds...

The proper operation of ET beds is highly dependent upon meteorological conditions. Periods of unusually heavy precipitation can overwhelm an ET system. Thus the 25-year return frequency is necessary if the system is expected to handle variations in precipitation.

Issue 21: Impacts of OWTS on impaired water bodies...

Preventing further degradation of an impaired water body is good science.

Appendix 1

MAINE SUBSURFACE WASTE WATER DISPOSAL RULES

10-144 CMR 241

SECTION 404.0 ON-SITE MONITORING OF SEASONAL HIGH GROUNDWATER TABLE CONDITIONS

404.1 When used: When the "A" or "Ap" (plow layer) horizons are greater than 7 inches thick or the site evaluator is unable to determine the seasonal groundwater table depth at the proposed disposal field site by direct soil profile observation or by soil drainage class/moisture regime using Table 400.1. Groundwater monitoring documentation may be provided which shows that soil mottling, or other color patterns, at a particular site are not an indication of seasonally saturated soil conditions. Documentation shall be made by directly measuring seasonal groundwater levels and temperatures in accordance with the procedures cited in this Section.

404.1.1 Groundwater table modifications: Seasonal groundwater table monitoring documentation shall be provided for sites where an attempt has or is being made to lower the seasonal water table level, to verify that soil mottling or other color patterns at a specific site are not a true indication of seasonally saturated soil conditions or high groundwater levels or that site modification has successfully drained a particular site to make it suitable for subsurface wastewater disposal in compliance with these Rules.

404.1.2 Monitoring responsibility: A Maine Licensed Site Evaluator shall be responsible for establishing and conducting the monitoring program. The Licensed Site Evaluator shall be responsible to adequately determine site conditions, properly locate and install monitoring wells on site, and accurately collect monitoring data.

404.1.3 Monitoring program proposal: A Maine Licensed Site Evaluator shall submit a completed proposal to the Department and the LPI prior to initiating any monitoring program. A preliminary scaled plan shall be submitted by the site evaluator which illustrates the location of proposed monitoring well, property lines, dwelling(s), disposal system(s), terrain slopes, existing well(s), artificial drainage, and natural surface drainage. Logs of soil profiles observed, proposed monitoring well depths, a description of procedures and equipment to be employed to collect accurate monitoring data, and other pertinent information shall also be provided.

404.1.4 Departmental approval: The Division of Environmental Health shall approve the monitoring program prior to its initiation. Failure to request prior approval from an applicant is considered cause not to accept any results of a monitoring program.

404.1.5 Monitoring well construction: Monitoring wells shall consist of 2 inches minimum diameter solid PVC pipe which extends above the soil surface a minimum of 24 inches for ease of location. This pipe shall be placed a minimum of 3 inches into a 6 inch minimum thick layer of clean stone or gravel that is placed at the base of the excavation. Compacted native soil shall be installed in the area between the pipe and the excavation. Monitoring wells shall have a vented cover and the pipe shall be surrounded by a mounded seal extending 6 inches down from the ground surface consisting of a layer of puddled clay, bentonite, or a bentonite/grout mixture or native soil material, to prevent direct entry of precipitation or other contaminants. Site conditions may require modifications of monitoring well design, in which case the Division of Environmental Health shall be consulted.

404.2 Monitoring well observation period: Groundwater level and temperature monitoring shall be done during the time of year when seasonal high groundwater table conditions are expected to occur. The first observation shall be made on or before April 1st. Subsequent groundwater level readings shall be made at least every seven days until June 15th or until the site is determined to be unacceptable, whichever comes first. Seasonal groundwater table depths below the mineral soil surface and the soil water temperatures shall be recorded.

404.3 Site conditions: Sites to be monitored shall be carefully checked for groundwater drainage tile and open ditches that may have altered the natural seasonal groundwater table.

404.4 Witnessing the location and installation of monitoring wells: The property owner shall give the plumbing inspector permission to witness the excavation and installation of the monitoring wells. The plumbing inspector may require a maximum of 15 days written notice prior to witnessing the location and installation of the monitoring wells.

404.5 Minimum number and location of monitoring wells: There shall be at least two monitoring wells plus an additional well for every 300 gpd design flow above 300 gpd. The site evaluator shall locate the monitoring wells so that the wells will reveal representative groundwater table conditions in the soils beneath the footprint of the proposed disposal field and fill material extensions.

404.6 Monitoring well depth: In general, monitoring wells shall extend to a depth of at least 3 feet below the ground surface, except that special soil conditions may require different monitoring well depths, such as the following: In permeable soils that overlie a hydraulically restrictive soil horizon, monitoring wells shall terminate within the mottled soil horizon above the hydraulically restrictive soil horizon; in cases where a mottled soil horizon lies above a permeable unmottled soil, wells shall terminate in the lower part of the mottled horizon. The site evaluator shall determine the depth of the monitoring wells for each site. However, for complex situations, the Division of Environmental Health shall be consulted prior to installation of the monitoring wells.

404.7 Monitoring well data calibration: Climatic conditions may cause significant year to year fluctuations in the highest seasonal groundwater table. Monitoring well data shall be compared with water resources conditions information obtained from the United States Geological Survey (USGS) to determine whether the observed seasonal high groundwater table is at or near its normal level. The Division of Environmental Health shall be consulted if USGS data indicate above or below normal groundwater levels. In addition, specific unusual climatological events occurring during the monitoring period shall be recorded, such as heavy rainfall. Comparison results shall be included with a monitoring report as prescribed in Subsection 404.9.

404.8 Determination of seasonal high groundwater table conditions: Acceptable or unacceptable seasonal high groundwater table conditions, based on depth and temperature measurements, as modified by water resources information described in Subsection 404.7, shall be determined in accordance with the following Subsections:

404.8.1 Water table is found at depths greater than allowed in Table 600.2 or 600.4: If the water table is found at depths greater than the minimum allowed in Table 600.2 or 600.4, monitoring shall continue until June 15th or until the site has been determined to be unacceptable as prescribed in Subsection 404.8.2.

404.8.2 Water table is found at depths shallower than allowed in Table 600.2 or 600.4: If the water table is found at a depth shallower than allowed in Table 600.2 or 600.4, and, if the corresponding soil water temperature is at or above 41°F, the site shall be considered unacceptable, and the site evaluator shall notify the Department in writing. If the corresponding soil water temperature is below 41°F, monitoring shall continue until June 15th or until the site has been determined to be unacceptable.

404.9 Reporting findings: If monitoring discloses that a site is acceptable, the applicant may submit an application for a disposal system permit that includes a written monitoring report prepared by the investigating site evaluator. The monitoring report shall provide monitoring well locations, ground elevations at the monitoring wells, soil profile descriptions, measurement data and dates of measurement depths to observed water tables, and soil water temperatures, as well as supporting data indicating that monthly precipitation amounts are within the normal range.

404.10 Monitoring well abandonment: At the completion of the monitoring program, all monitoring wells located within the footprint of the proposed disposal field and fill extensions shall be abandoned and sealed to prevent the migration of surface water or potential contaminants to the subsurface. Monitoring well pipe shall be completely removed and the excavation filled with compacted native soil.

Peer Review of Draft Onsite Wastewater Treatment Systems

William A. Yanko
Environmental Microbiology Consultant

This review was conducted for the California State Water Resources Control Board. All documentation and data provided with the draft regulations were considered in preparing the following comments. The primary focus of the review follows the outline of numbered issues provided to reviewers and identified as "Enclosure 2: Description of the scientific portion of the proposed regulations to be addressed by peer reviewers". Although aware these draft regulations were being promulgated, this reviewer had not previously reviewed earlier drafts or versions of this document. The opinions and conclusions presented here are solely those of the writer.

Issue 1: It is intrinsically logical that Onsite Wastewater Treatment Systems (OWTS) will become increasingly challenged as the volume disposed increases. While a multitude of local factors will affect performance, it makes sense to establish a volume level that will trigger increased oversight. The specified 5,000 gallons-per-day limit appears reasonable based on available data.

Issue 2: It is unclear to me how the 150 mg/L BOD and 150 mg/L TSS will be applied or used. If I am reading this correctly (24910.a), it is assumed that "normal" household septic tank effluent will generally meet these levels and therefore these values represent reasonable design criteria for the dispersal system. Some assumption for design is necessary, and as noted, the BOD value is consistent with the 2002 EPA design criteria (Table 4-3), but the EPA loading designs say nothing about TSS. In paragraph 24910.s it appears that all new or replaced OWTS tanks will be required to have effluent filters. The data in the Crites and Tchobanoglous reference (Table 4-16) show a range of 20-55 mg/L TSS for septic tank effluent with a filter. So I'm not sure where or how the 150 mg/L TSS criteria gets used for design purposes.

Further, the actual values appear in Section 24910.a.3 and refer to "other wastewater", *i.e.* other than household. Who makes the determination of whether the septic tank effluent would be expected to exceed the 150 mg/L BOD and/or 150 mg/L TSS, and as noted, since it appears effluent filters are being required, the TSS seems moot? How does one determine what the "strength" of the waste entering the dispersal system will be for situations other than household waste? Is some kind of documentation required? I can envision certain circumstances, but it appears this requirement needs additional clarification.

Issue 3: The benefits of effluent filters are well documented. For clarification, as I understand the draft regulation, an effluent filter is not considered a Supplemental Treatment Component and does not trigger the mandatory requirement for a service contract. Therefore the servicing and maintenance requirements for effluent filters will be an important item to be documented in the homeowner O&M Manual.

Issue 4: This section presented the greatest technical challenge to me. I recognize the need to find a balance between sound science and practicality, and the following comments are offered in that spirit. My concerns are with multiple aspects of the monitoring requirement, including (1) the purpose or goal, (2) the sampling point, and (3) choice of constituents. While these are related to some extent, I'll address them separately.

(1) The goal of the monitoring seems to be ill defined. Regulatory monitoring is typically conducted for compliance purposes, but in this case there are no stated limits to meet or actions that result from the monitoring requirement. How will these data be used? Who has responsibility? Looking at the bacterial requirement as an example, it specifies testing for total coliform, and if positive, retesting for fecal coliform (I will discuss indicator choice later). If total coliform is positive, and fecal negative, is that end of story? What if both are positive? There does not appear to be any follow through of any kind connected with the testing requirement, other than the data is reported to SWRCB. What value is that unless there is some associated response? I find this a difficult

concept to justify on a scientific or public health basis as currently articulated in the draft regulation.

2. The testing requirement is being applied to those with a septic system and a potable well on the property. The requirement further indicates that a monitoring well located down gradient within 100 feet of the OWTS may be used for sampling, or alternatively, the potable well may be sampled. The discussion information provided correctly concludes that most homeowners would simply sample their well. But if the well is sampled, there is no consideration for the location of the well relative to the OWTS, or time in service of the well and OWTS. Since background data are likely not available, it is unclear how these data will be used to assess the impacts of OWTS. This raises a question of what the value will be of reporting these data to SWRCB.

3. If a testing requirement is going to be included in this regulation, I recommend additional thought be given to the specified constituents. I will start with the microbial testing, since that is my specific area of expertise. USEPA recently promulgated the Groundwater Rule (GWR), which was designed to address groundwater microbial contamination, but applies only to public water supplies. Much research went into developing that regulation. Many technical workshops were held to get the most current scientific input. It too was controversial, and the end result was a compromise that not all in the science community agreed with. Nevertheless, I think it would be of value to incorporate the basic concepts of the groundwater rule into any required monitoring that may result from the draft OWTS regulation.

It is pretty much the consensus of the environmental public heath microbiology community that viruses represent the most significant public health risk associated with groundwater, and a viral indicator would be the preferred predictor of safety. That said, there have been many documented disease outbreaks resulting from bacterial and/or protozoan parasites in well water with serious illness and deaths associated with *E. coli* 0157:H7 infections. Although viruses have been demonstrated to have a much greater potential to migrate through soil, the factors governing virus transport and survival are complex. Somewhat surprisingly, more of the documented groundwater associated disease outbreaks have been caused by bacterial pathogens compared to viruses. There are a number of possible explanations for this. In reality, most groundwater disease outbreaks I have looked at occurred in settings where filtration was compromised, such as karst or fractured rock formations, or well integrity was compromised in some way. Another concern with testing for viral indicators (coliphage) was that the analyses are more expensive than conventional bacterial indicators. The final approach utilized for the GWR was to model it somewhat after the Total Coliform Rule, however, the GWR did maintain the option to be able to use any of three more specific fecal indicators, *E. coli*, enterococci, or coliphage for follow-up determination of fecal contamination if the total coliform test is positive.

I would suggest any required microbial monitoring for the OWTS regulation follow this basic model, and eliminate the use of fecal coliform. Fecal coliform is truly a misnomer and should more correctly be called thermotolerant coliforms. The fecal coliform test is a surrogate for testing for *E. coli*. When the fecal coliform test was originally developed, there were not simple, inexpensive tests available to test specifically for *E. coli*. Now there are, and *E. coli* is a more specific fecal indicator than "fecal coliform". Another advantage of using *E. coli* is that currently available tests are able to test for both total coliform and *E. coli* simultaneously in a single test (e.g. Colilert and m-Coli Blue membrane filter).

Total coliform is a conservative test, but may not be indicative of fecal contamination. Fecal coliform is a better indicator, but one of the common organisms that gives a positive result in the fecal coliform test is *Klebsiella pneumonia*, which is a common soil organism and more importantly, also frequently associated with biofilms. In a research project I'm currently involved with in Southern Cal., we are seeing some wells with biofilm problems where we get positive results for total and fecal coliforms, but none of the more specific fecal indicators, *i.e. E. coli*, enterococci or coliphage, have been detected.

As currently drafted, the OWTS specifies testing for total coliform, and if positive retesting for fecal coliform. If fecal coliform was replaced by *E. coli* in the OWTS Draft, a single test would provide both total coliform and *E. coli* data with the initial test for no additional cost. This represents a lot more value for your dollar, and has the added advantage of being conceptually consistent with the GWR. I personally believe it is also of value from a public perception standpoint if our regulatory structures have some "internal consistency". In this same vein, it would be of value to designate enterococci and coliphage (especially male-specific coliphage) as alternative "fecal" indicators in addition to *E. coli*. I would expect most well owners would not test for these due to additional cost, just as most complying with the GWR will elect to use *E. coli*, but naming them as recognized fecal indictors again maintains consistency with the GWR and provides for more options in those cases where one might want more testing information about the well water quality and potential fecal contamination. In addition, giving these alternative fecal indicators "regulatory" recognition could be of value in situations where surface water contamination has been identified as an issue and septic systems may be part of the problem. I'll outline an approach below of how a microbial monitoring requirement might better be used with the change to *E. coli*.

Regarding the specified chemical constituents, some of the listed chemicals have associated drinking water limits, but others do not. How will the results from these other constituents be used? MBAS is obviously a potential sewage indicator. But it is unclear how the calcium, magnesium, sodium, potassium, carbonate and bicarbonate data will be used. What will be the value of reporting these data to the SWRCB when there is no indicated response associated with the testing?

If a testing requirement is going to be justified, there needs to be provision for some associated response or consequence. That may be as simple as a mandated advisory notice will be issued to the well owner explaining the significance of the results and possible actions. For those chemical constituents with current drinking water limits, the well owner can be advised if any exceed State and Federal safe drinking water limits. In the case of MBAS a well owner can be notified that sewage related chemicals are present in the well water, and the significance of that determination. Again, I'm not clear on how the other unregulated constituents will be used.

For microbial testing, as noted above, I recommend fecal coliform be replaced by *E. coli*. Then if the well owner has a coliform test run, there are three possible results that can come back from that initial test: (1) negative, (2) total coliform positive, but *E. coli* negative, or (3) positive for both total coliform and *E. coli*. If negative, no further action required. When positive for total coliform, but negative for *E. coli*, an advisory notice can be issued to the well owner explaining that the well may have fecal contamination, or may have a biofilm problem. The well owner could be advised to have the well disinfected by a well service company, and/or be provided instructions for how to disinfect the well with chlorine. There's tons of information available on the internet instructing home owners how to disinfect private wells. It would be a simple task to put together and advisory notice. Then following disinfection, the well owner would have a second bacterial test run. Even though the original test was negative for the more specific fecal indicator, biofilms can harbor opportunistic pathogens that may be a problem for immunocompromised individuals.

In those cases where the first test was positive for both total coliform & *E. coli* (#3 above), the well owner should be advised that the well is fecally contaminated and that disinfection of the well may not solve the problem. Further investigation may be required to assess the safety of the well for potable use.

Issue 5: Addressing the issue of brines is logical and warranted. I am a little unclear with the concept of a "regulated" recommendation, and how this will be accomplished. I wonder if it would be more logical to include that item with the required information that needs to be included in an operating manual (24910.j). Unfortunately that does not address existing OWTS. Perhaps a one-time generic guidance document should be prepared and distributed to existing OWTS owners; it could include much of the information specified in the requirement for new systems owner manuals, such as the list of substances that could inhibit operation and substances that could cause pollution. It also might be worthwhile to mention the potential benefits of using water-use reduction devices, i.e. low flow toilets, water saving showerheads, etc.

Issue 6: Determining high groundwater level is important. In those cases where historical records for the area, or other methods are deemed inadequate, there is a provision for determining high groundwater using a piezometer and measuring between November and April. We historically go through wet and dry weather cycles, and water tables can drop dramatically during a prolonged drought period. I'm not sure what the solution is, but it seems drought periods need to be considered, or this method may significantly underestimate the groundwater level.

Issue 7: This section deals with performance requirements for supplemental treatment components, specifically disinfection units that would be required to protect groundwater or surface water when the geological setting is determined to not be capable of providing adequate treatment. As noted previously, there is adequate scientific evidence suggesting that viruses represent the greatest potential health risk related to inadequate filtration due to their potential to migrate further in soil, and their relatively low infectious doses. For testing the safety of wells, the use of coliform monitoring represents a "pragmatic" compromise and is consistent with the final approach used in the Ground Water Rule for public water supplies. However, qualifying or determining the adequacy of a supplemental treatment unit is a different issue. We can use California's wastewater treatment criteria as an example. A disinfection/filtration system must demonstrate the ability to remove 5 logs of virus. This removal demonstration can be based on the use of poliovirus, or male-specific coliphage. The coliphage test, while more expensive than the coliform test, is relatively inexpensive compared to human virus testing and would not represent an unreasonable financial burden for "qualifying" acceptable disinfection equipment. Once the process has been adequately shown to accomplish the requisite virus removal and is an accepted process, coliform can be used for periodic monitoring to demonstrate ongoing performance, as designated in 24913.h.

Given the scientific consensus that viruses represent the greatest potential microbial health risk with groundwater, it is only logical that viruses are included as a target organism to demonstrate the adequacy of a supplemental disinfection process that will be used when it is determined that natural filtration is inadequate. This approach is consistent with California's wastewater treatment requirements.

Issue 8: Using the drinking water limit is logical.

Issue 9: This is a reasonable requirement.

Issue 10: No specific comment. I concur with the premise. The details represent professional judgment.

Issue 11: This specific subject is not one that I have personal expertise with, however, it is apparent that this drives design and will have some site specific consequences. That said, there appears to be some conflict between the EPA references provided. The February 2002 Manual clearly recommends that sidewalls not be included as infiltrative surfaces. The earlier 1980 EPA design manual appears to argue that there are situations where deeper trenches are preferable. I am assuming that there is adequate documentation and experience that the earlier recommendations are no longer considered valid, and the current Manual supercedes the earlier recommendations.

Issue 12: Appears to be standard design criteria; no comment.

Issue 13: I am not a hydrogeologist, but I have been involved in much groundwater recharge research and have worked with research teams that included hydrogeologists. This subject has come up. Obviously water cannot filter through large rocks. What then becomes critical is the nature and make-up of the material between the rocks. The rocks actually create a much more circuitous travel path, and depending on the nature of the material between the rocks, the filtration path may actually be increased relative to vertical travel. Was any thought given to the possibility of some more complete kind of soil assessment that could potentially mitigate the presence of course fragments?

Issue 14: Assuming there are no preferential flow paths, I agree with the premise that most bacterial pathogens (and protozoans) will be removed within 3 feet of effective soil filtration. Effective and reliable removal of viruses is much less certain with this minimum distance of unsaturated soil. There is extensive literature documenting virus transport over greater distances, however, these studies are generally conducted with high doses of virus, so it is difficult to translate the data to risk. It is reasonable to assume that one would normally see at least an order of magnitude reduction in most cases with 3 feet of unsaturated flow, and most likely much greater reduction depending on numerous factors. The two primary factors governing the distance a virus may migrate are inactivation (die-off) and attenuation (adsorption). Many different variables affect the relative contribution of each for removing viruses. Adsorbed viruses also may desorb and migrate under certain conditions, such as heavy rainfall or flooding.

I guess the emphasis is on the word "minimum" here regarding depth of the unsaturated zone, and what level of virus removal one wanted to be assured of. If a multi-log reduction of viruses is to be guaranteed, 3 feet of unsaturated flow may not provide that consistently. Virus inactivation does not cease once in the saturated zone, but it is less effective and the virus removal rate decreases with distance. On the other hand, if one hits fractured rock, little additional virus reduction may occur. The pathogen load in private family septic tanks is quite variable because most individuals are normally not infected. However, when ill, it has been reported that virus concentrations as high as 10^{10} may be present in the waste from a single household, for short periods. Some of that virus load will be removed in the septic tank itself since a large portion of the viruses are associated with solids and will settle out. One study reported that 75% of the virus load will be removed in the septic tank, but with high concentrations entering, there can be short periods when the concentration of viruses reaching the dispersal system will be quite high. With minimal unsaturated flow, the setback and location for potable wells and distance to surface water becomes a greater concern.

There have been numerous efforts to model virus transport in soil. One of interest is Virtus, a model of virus transport in unsaturated soil (Appl. & Environ. Microbiol. 58:5, p. 1609-1616. 1992). While these models are not robust enough for regulatory purposes, they can help give one a sense of virus reduction that may be expected under different conditions, and might be used to develop some general guidelines for relating setbacks to unsaturated soil depths.

To summarize briefly, I am not comfortable that the 3 foot minimum unsaturated depth provides adequate protection for virus contamination, however, that could be mitigated by considering other factors, such as setbacks to surface water and distance and location of potable wells. The documentation presented with the review package does not suggest that the potential for virus migration was fully considered.

Issue 15: I think this is entirely reasonable if the performance criteria for the supplemental treatment include some level of documented virus reduction in addition to bacterial reduction.

Issue 16: I have no experience with the use of engineered fill. I have no conceptual objection to the use of engineered fill; comments for Issue 14 would apply.

Issue 17: Documentation appears to support this approach.

Issue 18: There appears to be an error in this section. The Issue 18 subject line indicates "the proposed regulations would require a minimum of 6 inches of soil over shallow subsurface dispersal systems." In the text below the item 18 subject line, it says the "proposed regulations allow these systems to be placed less than 6 inches below the surface".. When I look at the text of the draft regulation, 24914(h) says nothing about depth below the surface. Clearly there should be some minimum depth, but the emitters need to remain in the root zone. As noted in the Beggs *et al.* reference, recommendations range from 4 to 12 inches. The evaluation reported by Beggs *et al.* was conducted with emitters at 6-inch depth. This is a judgment call. Six inches seems very reasonable as a minimum. But it is unclear if some other depth is being proposed, or if a minimum depth requirement was eliminated.

As a personal note, I think this option should be promoted. Philosophically this shifts the OWTS from a disposal method to a reuse option, which is important given the increasing demand on water supplies.

Issue 19: No Comment

Issue 20: Probably represents a reasonable risk of failure, i.e. overflow. Location would be important factor relative to the impact of failure. Were any additional siting requirements considered for the use of seepage pits?

Issue 21: This section focuses on impaired surface water where OWTS may contribute to the impairment, specifically on pathogens and nitrogen. Excess nitrogen can represent a health problem in drinking water, but also contributes to water body impairment as a nutrient at a lower concentration than that which triggers health concerns. There are two main nutrients that contribute to eutrophication: nitrogen and phosphorus. Algal growth, especially blue-green algae (cyanobacteria) is becoming an increasing problem, especially in connection with the toxic blue-greens. Phosphorus, not nitrogen, is generally the primary nutrient driving algal blooms. Numerous TMDLs have been generated for controlling phosphorus, so it would be logical to include phosphorus here along with nitrogen from the perspective of protecting impaired surface water.

Per my discussion for Issue 4, I would suggest fecal coliform be changed to *E. coli* in this section, and that enterococci and coliphage be added as indicators that are also considered indicative of fecal contamination. As noted in much of the above discussion, viruses present the greatest theoretical risk and it is important to include a viral indicator as being a valid indication of fecal contamination from OWTS. This is fully consistent with the

Groundwater Rule. Including these organisms simply indicates that "impairment" could be established by indicators other than coliform.

I realize that fecal coliform is specified as the "pathogen" indicator in Basin Plans. USEPA has established recreational water standards based on enterococci for marine water and *E. coli* or enterococci for fresh water. In September 2002 the CVRWQCB Staff recommended amending that Basin Plan to change the fecal coliform limits to federal *E. coli* limits. To my knowledge, that change was never enacted. Given that we now have two federal regulations (Recreational limits and GWR) based on some combination of *E. coli*, enterococci and coliphage, and both of these are directly related to this issue of impaired surface waters, I think the OWTS regulation should be consistent with current scientific thinking and regulatory requirements. Hopefully the Basin Plans will catch up some day.