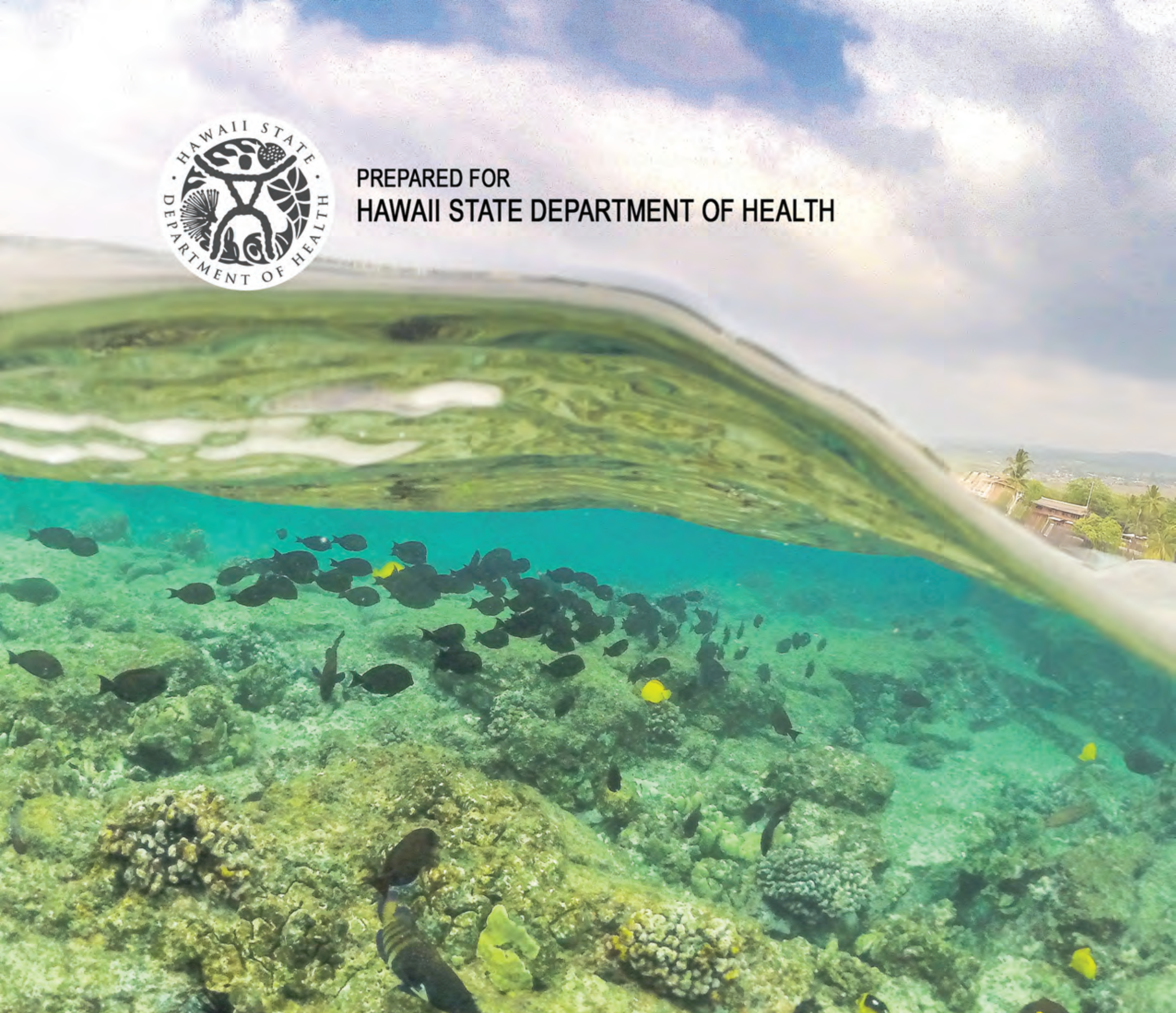

PREPARED FOR
HAWAII STATE DEPARTMENT OF HEALTH

CESSPOOL CONVERSION TECHNOLOGIES RESEARCH SUMMARY REPORT

FINAL | JANUARY 2021

Prepared by

carollo
Engineers...Working Wonders With Water ®

in association with

College of Engineering
UNIVERSITY OF HAWAI'I AT MĀNOA

Hawai'i State Department of Health

CESSPOOL CONVERSION TECHNOLOGIES RESEARCH

Summary Report

FINAL | JANUARY 2021

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Acknowledgements

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Table of Contents

Introduction

Act 125 requires the conversion of all cesspools in Hawai'i to approved systems by 2050. The purpose of this study is to assist the Department of Health (DOH) with the evaluation of onsite technologies for cesspool conversions.

LEGISLATIVE ACTIONS TO BAN CESSPOOLS IN HAWAI'I

Throughout the State of Hawai'i, there are approximately 88,000 cesspools, releasing an estimated 53 million gallons per day (mgd) of wastewater to the environment. Most of the existing cesspools provide wastewater disposal for single family residences, as opposed to large-capacity systems serving multiple residences or commercial areas. Given that over 90 percent of the State's drinking water supplies are from groundwater sources, cesspools pose a potential environmental and public health risk.

In 2017, the Hawai'i State Legislature passed Act 125, which states that by January 1, 2050 all cesspools in the State, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system (Act 125, 2017). The Legislature then passed Act 132 in 2018, which established a Cesspool Conversion Working Group (Working Group) to develop a long range, comprehensive plan and commission a statewide study of sewage contamination in nearshore marine areas (Act 132, 2018).

As a result of Act 125, homeowners will be required to upgrade their existing cesspools to a technology that complies with current health regulations. Historical costs of cesspool upgrades to approved systems range widely from approximately $9,000 to $60,000 or more depending on the wastewater system capacity (based on bedroom count), technology, and location or site constraints.[1] Assuming the average conversion cost of $23,000, the potential magnitude of the financial burden to convert all 88,000 cesspools is approximately two billion dollars.[2]

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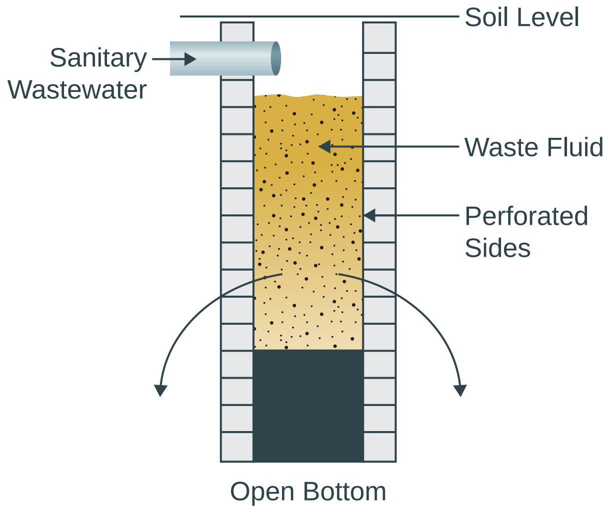

FIGURE 1. Cesspool Schematic.
Cesspools are underground excavations that receive sanitary wastewater from bathrooms, kitchens, and washers. The structure usually has an open bottom and perforated walls.

1. Based on cost data from DOH.
2. Costs shown in 2020 dollars.

Conversion Priorities

In the 2018 Legislature Report, DOH identified priority areas for cesspool conversions based on environmental and public health risks:

- **Priority 1:** Significant risk of human health impacts, drinking water impacts, or draining to sensitive waters.
- **Priority 2:** Potential to impact drinking water.
- **Priority 3:** Potential impacts on sensitive waters.
- **Priority 4:** Impacts not identified.

Table 1 summarizes the current priority areas by geographic region. DOH may revisit cesspool prioritization methods, and as a result, priority areas could be revised.

TABLE 1. Initial Priority Upgrade Areas Established by DOH Wastewater Branch (DOH, 2018)

GEOGRAPHIC AREA	PRIORITY LEVEL ASSIGNED	NUMBER OF CESSPOOLS	ESTIMATED EFFLUENT DISCHARGE (MGD)
Upcountry area of Maui	1	7,400	4.40
Kahalu'u area of O'ahu	1	740	0.44
Kea'au area of Hawai'i Island	2	9,300	4.90
Kapa'a/Wailua area of Kaua'i	2	2,900	2.20
Poipu/Koloa area of Kaua'i	2	3,600	2.60
Hilo Bay area of Hawai'i Island	3	8,700	5.60
Coastal Kailua/Kona area of Hawai'i Island	3	6,500	3.90
Puako area of Hawai'i Island	3	150	0.60
Kapoho area of Hawai'i Island	3	220	0.12
Hanalei Bay area of Kaua'i	3	270	0.13
Diamond Head area of O'ahu	3	240	0.17
'Ewa area of O'ahu	3	1,100	0.71
Waialua area of O'ahu	3	1,080	0.75
Waimanalo area of O'ahu	3	530	0.35
	TOTAL ASSIGNED	42,730	26.87
Hawai'i Island Un-Assigned	NA	24,430	12.18
Kaua'i Un-Assigned	NA	6,930	4.57
Maui Un-Assigned	NA	4,800	3.50
O'ahu Un-Assigned	NA	7,610	5.08
Moloka'i Un-Assigned	NA	1,400	0.80
	TOTAL UN-ASSIGNED	45,170	26.13
	OVERALL TOTALS	87,900	53.00

SCOPE OF TECHNOLOGIES EVALUATION OF CESSPOOLS CONVERSIONS

There are three options for cesspool conversions including:

1. **New onsite system.** New onsite wastewater treatment and disposal at an individual household level.
2. **Decentralized system.** New decentralized sewer systems that collect and treat sewage from multiple homes for treatment and disposal.
3. **Centralized sewers.** Connection to existing or new centralized sewer systems.

This report summarizes the technologies evaluation and challenges of cesspool conversions for Hawai'i, primarily focused on new onsite systems. A limited review of decentralized systems is also included. Evaluation of connection to an existing regional collection system and treatment plant was not included in the scope of this study.

Various approved and innovative onsite and decentralized wastewater treatment technologies were evaluated. The intent of this work is to provide guidance to the Working Group regarding the applicability, performance, and relative costs of different onsite and decentralized systems that may be considered for cesspool conversions required under Act 132.

The details of this effort were presented in a series of the following previously prepared technical memoranda (TMs):

- TM 1 – Assessment of Onsite Treatment Technology Testing and Approval Procedures Utilized by Other States
- TM 2 – Septic Tank Systems Review
- TM 3 – Onsite Treatment Technologies Evaluation
- TM 4 – Evaluation of Decentralized Cluster Wastewater Systems

Each of these TMs are presented in their entirety in Appendix A of this report.

LIMITATIONS

The content of this report was prepared specifically for the Working Group and was completed based on previous studies and publicly available information. Future public outreach and education are planned as a part of the overall cesspool conversion strategy development. Other considerations that may have impacts to this evaluation include exemptions to cesspool conversion, or changes to the priority areas. Granting exemptions to cesspool conversions are at the discretion of the DOH per Act 125. Ongoing efforts are underway to study available cesspool data validation and prioritization. If new information or guidance on cesspool priority areas is developed, the technologies evaluation should be revisited.

This report is not meant to provide specific design guidance for engineers or homeowners to convert their cesspools. Ultimately, homeowners should seek more specific guidance from a properly licensed and experienced civil engineer and/or general construction contractor. The engineer will need to prepare various studies and designs before a construction permit can be issued and constructed upgrades can begin. This will involve going through several steps to evaluate and select processes for the specific property that are both technically sound and cost effective.

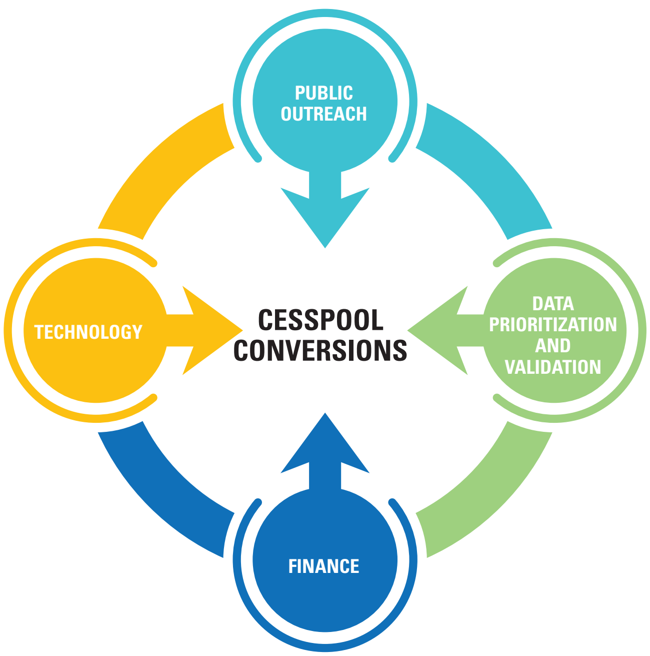

FIGURE 2. Four Aspects of Cesspool Conversion.
The Working Group is engaged in three aspects of cesspool conversions—conversion technologies, financing and funding needs, and data prioritization and validation. A separate but related effort is underway for public outreach and education.

Onsite Wastewater Treatment and Disposal Technologies

As cesspools are upgraded to new, approved onsite systems, homeowners will need technical guidance in selecting the appropriate and most cost-effect conversion technologies.

BACKGROUND

The following sections provide descriptions and characteristics of the onsite treatment and disposal technologies evaluated as part of this study. The technologies have four levels of approval noted relative to their potential application to cesspool conversions in Hawai'i:

- **Approved.** These technologies are already approved for use in current regulations[2] and the permitting and review process are more readily obtained than options that are not approved.
- **Approval Required.** These technologies are mentioned in current regulations; however, detailed design calculations must be submitted, and design review is required by DOH prior to site-specific approval. Thus, implementation of these technologies is possible, but will likely require a longer implementation timeline than approved options.
- **Innovative.** These technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH. Implementation of these technologies would have a longer timeline than approved options.
- **Emerging.** These technologies are at a research stage, and/or are undergoing pilot-testing or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH does not currently have a process for approving these technologies, thus implementation of these options would have a long timeline.

Table 2 summarizes the onsite technologies that were evaluated. Summary descriptions of each treatment, disposal, and alternative toilet technology are presented in Appendices B, C, and D, respectively.

KEY CONSIDERATIONS FOR ONSITE SYSTEM OPTIONS

There are several considerations when selecting the type of onsite system for cesspool conversions. These factors are site-specific and require planning and design on a case-by-case basis.

- **Site Restrictions.** Available land area and soil characteristics will dictate which technologies are feasible. The following constraints should be evaluated:
  - Separation from groundwater table.
  - Lot size.
  - Soil percolation rate.
  - Ground slope.
  - Location relative to flood zones.
  - Proximity to surface waters.
- **Treatment Performance.** Some systems provide better treatment than others. The following performance characteristics should be considered:
  - Applicability to each priority area. Is there sufficient treatment to protect the environment?
  - Recognized certifications. Technologies that have been rigorously tested and are certified make them easier for the DOH to approve. These technologies demonstrate treatment for typical wastewater pollutants (NSF40) and nutrients (NSF245).
  - Removal of fecal coliform. Fecal coliform are indicative of disease-causing pathogens in the wastewater. Consideration should be given to the need for disinfection.
- **Cost.** Consideration should be given to both initial and long-term costs.
  - Construction cost.
  - Operation and maintenance (O&M) costs.

2. Hawai'i Administrative Rules (HAR) 11-62.

TABLE 2. Onsite Treatment, Disposal, and Alternative Toilet Technologies[8]

TECHNOLOGY	APPROVAL STATUS
Treatment	
Septic Tank	Approved[1]
Aerobic Treatment Unit (with and without denitrification)	Approved[1]
Chlorine Disinfection	Approved[1]
Ultraviolet Disinfection	Approved[1]
Recirculating Filter	Approved[1]
Eliminite Wastewater Treatment Process	Innovative[3]
NITREX™ Nitrogen Removal Process	Innovative[3]
Recirculating Gravel Filter[5]	Emerging[4]
Disposal	
Absorption	Approved[1]
Seepage Pit	Approved[1]
Presby Enviro-Septic®	Approved[1]
Evapotranspiration	Approval Required[2]
Constructed Wetland	Approval Required[2]
Drip Dispersal	Approval Required[2]
Passive Treatment Unit[6]	Innovative[3]
Nitrification/denitrification biofilters, including various layered configurations[7]	Emerging[4]
Alternative Toilets	
Composting Toilet	Approval Required[2]
Incineration Toilet	Approval Required[2]

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH Wastewater Branch.
(4) "Emerging" technologies are at a research stage and/or are undergoing pilot-testing or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH Wastewater Branch does not currently have a process for approving these technologies.
(5) Studied by the Washington State Department of Health.
(6) Developed in Florida.
(7) Studied in Massachusetts and New York.
(8) See Appendices B, C, and D for summary descriptions of each technology.

TREATMENT TECHNOLOGIES

There are many onsite treatment technologies used throughout the United States and the world. The treatment technologies reviewed for this study were limited to those that would most likely be applicable to cesspool conversions in Hawai'i. While other treatment options may apply, all non-approved technologies would first need to obtain approval from the DOH before installation requiring a longer timeline for implementation and potentially more costly conversion.

Approved

The technologies that are already approved for use in Hawai'i are listed in current regulations (Hawai'i Administrative Rules (HAR) Title 11 Chapter 62). These technologies are discussed in the following sections.

Septic Tank

The most common conversion treatment technology that is approved for use in the State of Hawai'i is a septic tank system. Septic tanks are generally easy to install and maintain as they are typically a passive system that does not require power. Routine maintenance includes inspection and pumping approximately every two years. The downside of septic tanks is that without subsequent treatment processes, they do not remove nitrogen, so they may not be an appropriate conversion technology depending on the location within the priority areas. Further study is needed to determine recommended design criteria for septic tanks that are sufficiently protective of human health and the environment. More information on septic tanks is included in Appendix A - TM 2, and Appendix B.

Aerobic Treatment Unit

Aerobic treatment units (ATUs) provide biological treatment with the addition of air and mixing of the collected sewage. The storage tank retains the solids and the treated sewage flows into an approved disposal system. The ATU can be operated and designed differently to provide removal of ammonia and nitrate, both common pollutants in household wastewater. ATUs require power and more frequent inspections and pumping than septic tanks.

Chlorine Disinfection

Chlorine is a powerful oxidizing chemical often used for disinfection of water or wastewater after treatment. Solid hypochlorite in the form of powder or tablets (similar to tablets for swimming pools) can be used in onsite systems. All forms of chlorine are toxic, corrosive, and require careful handling and storage. Chlorine tablets are commonly used for systems. Chlorine tablets do not require electricity, are easy to operate and maintain, and are relatively inexpensive.

Ultraviolet Disinfection

Ultraviolet (UV) disinfection uses lamps emitting UV light that acts as a physical disinfection agent to prevent bacterial growth. A power source is required for the UV bulbs. UV disinfection is a polishing step that follows other treatment, such as septic tanks or ATUs; disinfected effluent then flows to the disposal system. Disinfection may be required for cesspool upgrades near sensitive waters or drinking water sources.

Recirculating Filter

Certain recirculating filters are approved for use in Hawai'i and are NSF40 and NSF245 certified. Wastewater must first flow through a septic tank prior to the recirculating filter, then to the disposal system. The advantage of this system is that secondary treated effluent can be produced without aeration.

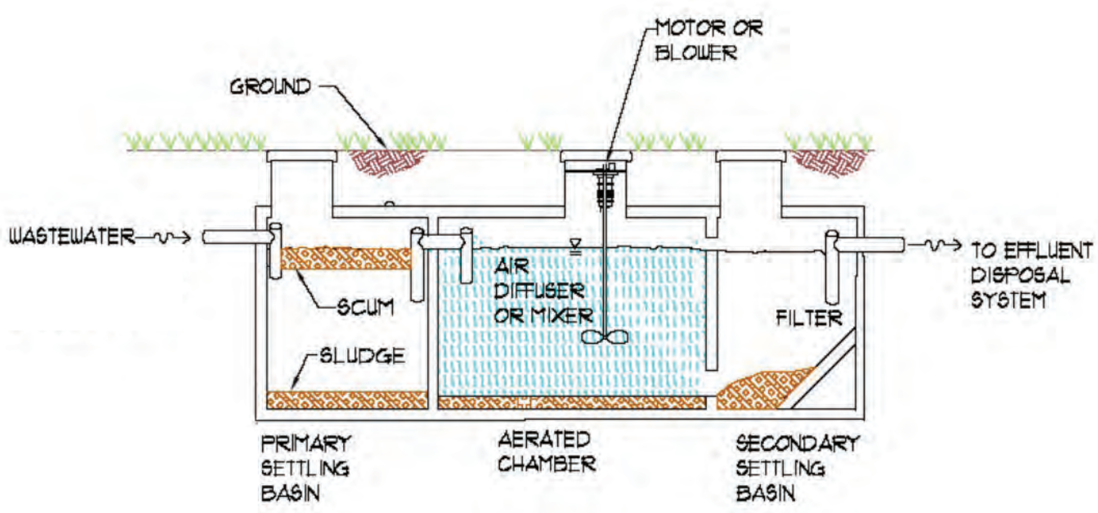

FIGURE 3. Schematic of Suspended-Growth Flow-Through ATU.
Aerobic treatment units can remove ammonia (nitrification) and nitrate (denitrification) providing better nitrogen treatment than a septic tank.

Innovative

The Eliminite and NITREX™ wastewater treatment systems are two innovative technologies that were reviewed as part of this study. Both offer potential for application in Hawai'i, but would require special approval by DOH. More information on each of these systems can be found in Appendix B.

Emerging

The recirculating gravel filter is an emerging technology which has been applied in the State of Washington for the treatment of septic tank effluent to remove nitrogen. DOH does not currently have a process for approving emerging technologies, thus a technology review and approval process would need to be developed prior to considering the use of this onsite treatment system in Hawai'i.

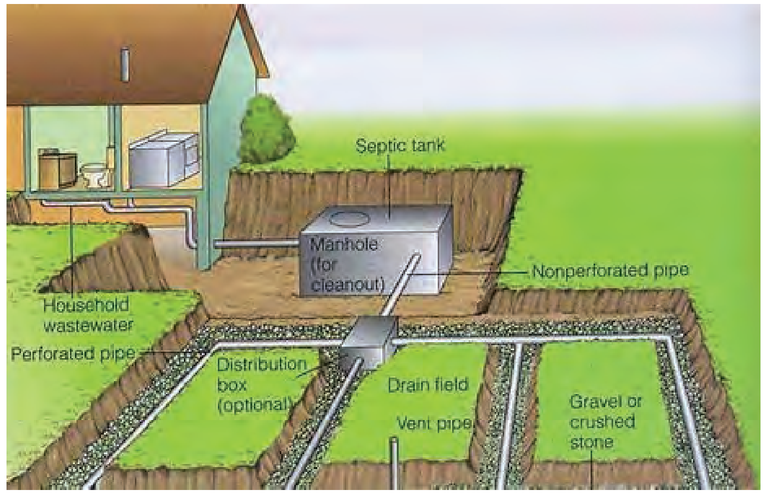

FIGURE 4. Trench Absorption System.
Absorptions systems are a common, cost-effective disposal option for onsite systems but do have a minimum space requirement.

DISPOSAL TECHNOLOGIES

Similar to onsite treatment, there are many different disposal technologies that could apply to cesspool conversions. However, the focus of this study was on disposal options that were the most likely options for Hawai'i and can be implemented relatively easily.

Approved

The disposal technologies that are already approved for use in Hawai'i are listed in current regulations (HAR 11-62) and are summarized below.

Absorption

Absorption systems are buried approximately 1.5 to 3 feet below grade and dispose of treated effluent by allowing the water to drain into the soil. The wastewater is typically first treated by a septic tank or ATU before it is distributed through perforated pipes laid in a trench or bed. Depending on soil conditions, new fill or bedding may be required. Absorption systems are relative easy to install and maintain, but do have minimum space requirements. Current regulations require a minimum area of of 350 square feet for a 4-bedroom home; larger areas may be required pending soil conditions. If sufficient space is not available, another disposal option should be considered.

Seepage Pit

Seepage pits are an approved disposal technology but are typically allowed only if there is not enough space for another disposal option and must be proceeded by the appropriate level of treatment. Pending DOH approval, an existing cesspool can be cleaned and repurposed for use as a seepage pit. These systems are typically constructed from reinforced concrete rings that are 8 to 10 feet in diameter and a height of 2 feet, that are stacked in order to achieve the depth required (usually 15 to 30 feet) to meet percolation requirements.

Presby Advanced Enviro-Septic® System

The Presby Advanced Enviro-Septic® System is an approved disposal technology that usually follows a septic tank and has NSF40 certification[3] because it provides additional treatment. It is a network of 10-foot long pipes for further treating and percolating septic tank effluent. It consists of special pipes embedded in a specific type of System Sand. Space requirements are similar to or slightlly less than what is required for an absorption sytem. This system does not require power or replacement media and can remove conventional pollutants (Presby Environmental, 2018).

FIGURE 5. Presby Advanced Enviro-Septic® Treatment System. (Presby Environmental, 2018) Presby systems can be used in higher priority areas where nitrogen removal is required.

Approval Required

Treatment technologies requiring DOH approval include:

- Evapotranspiration
- Constructed Wetland
- Drip Dispersal

Evapotranspiration and constructed wetlands do not require power, whereas drip dispersal requires power to pump treated effluent to the disposal system.

Innovative

Florida researched several types of passive disposal systems, such as biofilters that provide better nitrogen removal than standard absorption systems. These systems are not yet approved for use in Hawai'i, but may be a cost effective option for conversions requiring nitrogen removal.

Emerging

Emerging disposal technologies include:

- Nitrification/denitrification biofilters, including various layered configurations

These options require further study and demonstration prior to potential application to Hawai'i.

ALTERNATIVE TOILET TECHNOLOGIES

Alternative toilets provide treatment and disposal of toilet waste by converting it to compost or incinerating the waste to ash. Additional treatment and disposal of graywater (shower and laundry waste) and kitchen blackwater is still required. Design review and approval by DOH is required prior to installing alternative toilets. Alternative toilet technologies include:

- Composting toilets
- Incineration toilets

3. https://d2evkimvhatqav.cloudfront.net/documents/ww_nsf_40_and_245.pdf?mtime=20200417153207&focal=none

Technology Testing and Approval Procedures

The Hawai'i State DOH Wastewater Branch needs to develop review and approval processes for new technologies.

Onsite systems are regulated by the Hawai'i State DOH Wastewater Branch. Current Hawai'i regulations include procedures, design criteria, standards, and restrictions for design and installation of approved technologies. Detailed criteria are provided only for septic tanks, ATUs, and absorption trenches/beds. All other systems and technologies must be approved on a case by case basis, the procedures for which are not currently specified in detail.

To efficiently review and approve the designs for 88,000 cesspool upgrades, the DOH, in conjunction with the four counties, will need a process in place to review and approve innovative and emerging technologies. New technologies may have benefits, such as better treatment, reduced capital cost, or less maintenance than currently approved options. The current process for obtaining approval of new technologies in Hawai'i does not prescribe application procedures, fees, timelines, testing durations, sampling protocols, performance requirements, or renewal periods. In addition, DOH does not currently have procedures to certify new technologies or maintain a state-approved list of these technologies. DOH would need to establish procedures to review and approve of new, innovative, or emerging technologies for application to cesspool upgrades.

Several other states have established rules and processes for approving new technologies. The following section summarizes the lessons learned and suggested best practices from other states for reviewing and approving new technologies for cesspool conversions. The states investigated include: Delaware, Florida, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Texas. Figure 6 summarizes the major steps of the technology approval and system permitting process used by the State of Florida.

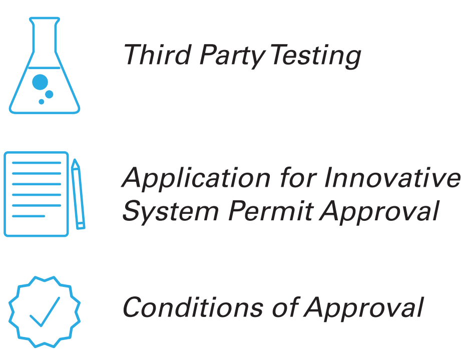

FIGURE 6. Florida Department of Health Innovative System Permit Approval Process.
Florida requires third party testing prior to vendors applying for approval. Approved technologies also must meet the Department of Health's conditions of approval.

APPROVAL PROCESSES UTILIZED BY OTHER STATES

Each of the states reviewed utilize different procedures and apply a range of requirements for the approval of new onsite technologies. Some states are very prescriptive on processes, requirements, durations, etc. with several types of progressive permitting phases to manage; and other agencies have less complicated procedures. The characteristics and components of these procedures were compared and evaluated for best practices.

The goal for DOH is to create a procedure that first and foremost protects public health and the environment. This goal must be balanced with data needs, review time, program complexity, program staffing and cost, testing, designer and installer needs, and homeowner costs. These are numerous and often competing factors to consider, and there is no perfect system. An effective system should strive to achieve the following:

- Provide a simple application process.
- Require only relevant information needed by DOH, and in a standard format/location to facilitate efficient review.
- Utilize a small number of types/phases of permits to manage.
- Limit the number of water quality tests required of the applicant.
- Provide and enforce a well-defined protocol for testing, including duration, sampling intervals, and types.

The suggested best practices and lessons learned from other states are summarized below (see Appendix A, TM 1 for notes from interviews with other states):

Additional agency staff. Most state agencies expressed concerns that they are understaffed to manage their programs. Staff members manage anywhere from 100 to 3,000 permit applications per staff member per year. Most agencies desire more staff so that they can do more inspections and follow up on converted systems.

Application fee and program funding. Most states expressed concern that they are underfunded. In general, they recommend adoption of an appropriate application fee that will cover the total cost of review and approval of new technologies.

- Some agencies also recommend that fees go to a dedicated (versus general) fund for cesspool conversion program management.
- Some states recommend requiring by law that homeowners convert their cesspool at point-of-sale of the home and implement meaningful fines for non-compliance.

Standardized application forms and templates. Utilizing standardized application forms and templates for required submittals helps to streamline the application review and approval process.

Water quality standards. Consider multiple sets of numerical water quality standards such as:

- Secondary treatment.
- Advanced wastewater treatment – where total nitrogen removal is required or desired.

Interviews with other state agencies showed that the common, recommended monitoring parameters are total Kjeldahl nitrogen, nitrite, and nitrate.

Certified laboratories. Requiring that testing is completed by a qualified third party according to standards established by the National Sanitation Foundation (NSF), American Society for Testing and Materials (ASTM), or Environmental Protection Agency (USEPA)-approved entities will help to bolster testing integrity.

Testing and data management. To sufficiently demonstrate satisfactory treatment performance, at a minimum, system testing should be conducted on a monthly basis, for one year, for at least 10 systems. Sampling and monitoring data can get unwieldy to manage and a good database program is required to facilitate data management and use.

Approvals. Other states recommend implementing a simplified approval process and suggest having two types of approvals –"Provisional" and "Approved", to allow a probationary period followed by conversion to be approved. The approval should be permanent, however, there should be a periodic reviews of process performance – conducted by a third party.

Consider not issuing official certifications for new technologies. Of the states reviewed, three have issued certifications of technologies when they approved the technology (Rhode Island, Massachusetts, and New Jersey). Rhode Island has since stopped issuing certifications because it gives the appearance of an endorsement.

Certifications and Training. Consider implementation of a certification program (and maintain lists on the DOH webpage) for:

- Designers
- Installers
- Inspectors/Maintainers

Decentralized Cluster Wastewater Systems

As an alternative to approved onsite systems, some neighborhoods may be able to collectively convert their cesspools using decentralized cluster wastewater systems.

BACKGROUND AND ASSUMPTIONS

In some cases where several cesspools are in close proximity, it may be feasible to construct small-scale, decentralized cluster wastewater systems for a number of homes on a neighborhood level. These systems will require wastewater collection, treatment, and disposal elements. A high-level evaluation of decentralized systems was performed for this study. The cluster systems evaluated were limited to those that can collect and treat domestic wastewater from 10 to 100 homes or capacities of approximately 5,000 to 50,000 gallons per day. However, many of these systems are modular and expandable to an extent. Decentralized systems could be owned and operated by public or private entities in Hawai'i.

CONSIDERATIONS FOR DECENTRALIZED WASTEWATER SYSTEMS

There may be instances and locations where decentralized systems are a better option for cesspool conversions in Hawai'i compared to individual, onsite solutions, or connections to centralized sewers. Factors to consider include:

- **The number of systems in the cluster and the separation distance between them.** There may be an ideal density of cesspools within a neighborhood that would allow for a cost-effective solution. This would need to be evaluated on a site-specific basis by a licensed engineer.
- **Terrain.** Depending upon the local soils, slopes, and other site-specific features, the terrain may limit the options and potential application of a decentralized system. Onsite systems need only consider the terrain of individual properties.
- **Availability of land.** Decentralized treatment systems will likely need to be constructed on newly acquired land and may require easements. These cluster systems would only be a viable option if the required land is available.
- **Public support for a decentralized system, including shared funding for a utility to provide O&M services.** For an onsite system, the homeowner is the only party involved and is responsible for the financing, O&M, any permits, and fines due to non-compliance or spills, etc. This is simple for the owner since they do not rely on other homeowners, a sewer district board, or potential future capital assessments for other people's problems. At the same time, the owner of an onsite system must be the responsible party and plan to have the O&M, and other related services, completed. While cost can be a powerful motivator, some homeowners may see value and convenience in having a separate service operate and maintain a decentralized system over an individual onsite approach. A decentralized utility has stable, regular monthly bills rather than less frequent larger bills for pumping/servicing/repair of an onsite system. Failures and surprise costs due to lack of care are much less likely for continuously operated cluster approach than onsite systems which are frequently neglected because they are "out-of-site, and out-of-mind".

SYSTEM TECHNOLOGIES

Decentralized cluster systems require wastewater collection, treatment, and disposal. The following sections summarize options available for each. More detailed information can be found in Appendix A, TM 4 – Evaluation of Decentralized Cluster Wastewater Systems.

Collection System

The collection system conveys wastewater from each home to a treatment and disposal facility and consists of a network of pipes and related equipment such as pumps, valves, manholes, etc. located on private and public property. The following options for wastewater collection may be appropriate for decentralized cluster systems. Summary descriptions of each of these collection system technologies can be found in Appendix E.

- Gravity Sewers
- Liquid-Only Pressure Sewers
- Low Pressure Sewers
- Vacuum Sewers

Wastewater Treatment

These systems treat the wastewater collected from the homes to a suitable degree to allow disposal and/or reuse. The process generally consists of tanks and other process equipment required for separation and storage of solids, oxidation of organic matter, and often disinfection of pathogenic microorganisms. Treatment facilities typically require land space and power, including back-up generators, and must have controlled access (fencing and alarms) and be maintained by certified operators who need 24/7 access. Pre-engineered, package plant type systems are generally more compact and economical for decentralized treatment facilities versus site-specific, ground-up complete designs. Such systems are also modular, facilitating easy expansion due to possible future growth. The different treatment technology options considered are listed below. Summary descriptions of each of these treatment options are presented in Appendix F.

- Activated Sludge
  - Conventional
  - Extended Aeration
  - Membrane Bioreactor
- Attached Growth Bioreactors
  - Textile Filter
- Moving Bed Bioreactor
- Constructed Wetlands

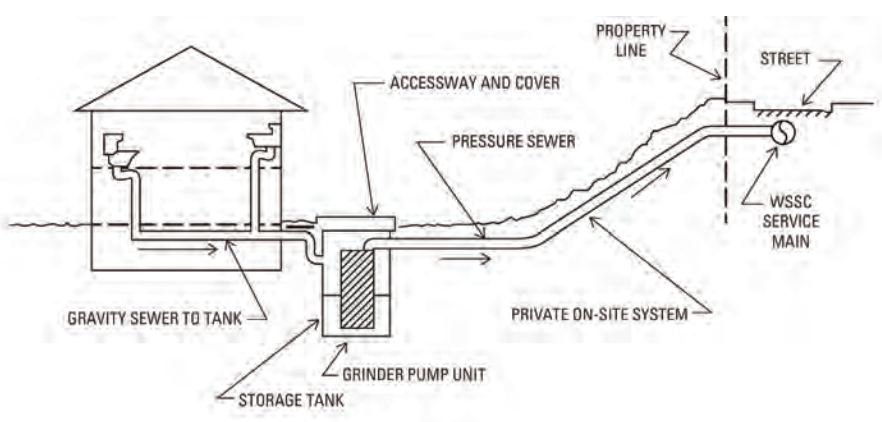

FIGURE 7. Low Pressure Sewer Systems
Low pressure sewers can be used to as a component of a decentralized system.

Effluent Disposal

The effluent disposal system must properly dispose or reuse the effluent from the treatment facility. Disposal can normally occur on the same site as the treatment facility (requiring additional land space), while reuse would usually require conveyance off-site to managed reuse areas. Residual solids must also be properly disposed of at an off-site facility. Effluent disposal options are listed below and summarized in Appendix G:

- Percolation
  - » Absorption Trench/Bed
  - » High Pressure Drip
  - » Low Pressure Pipe
  - » Seepage Pit
- Water Reuse
- Evapotranspiration
- Injection Well
- Surface Water Discharge

Seepage pits, injection well,s and surface water discharges are unlikely effluent disposal options and are included for completeness. Effluent disposal systems are regulated in HAR 11-62-25. Some of the basic provisions of these regulations are as follows:

- Disposal systems shall at least consist of a primary disposal component and a separate 100 percent back-up disposal component.
- Both primary and backup disposal units shall be designed to handle the peak flow, determined by the county or design engineer and approved by DOH.
- Stricter data monitoring and data submittals are required for subsurface disposal systems.
- Provisions to facilitate operation, maintenance, and inspection are required on a case-by-case basis.
- Disposal systems shall include provisions for purging and chemical shock treatment.

SUMMARY OF DECENTRALIZED CLUSTER WASTEWATER SYSTEMS

Benefits

Decentralized cluster wastewater systems may make sense to convert several cesspools that have a high density, are within high priority areas, and where there is community support for this kind of a solution. The benefits of implementing cluster systems, where feasible include:

- **Potential for rapid conversions.** The use of cluster systems may allow the conversion of a greater number of cesspools at a single point in time. This could help to mitigate the public health and environmental risks in high priority areas in the near term.
- **Reducing the administrative oversight and enforcement burden on state/county agencies.** For the county/state, having all systems converted on an individual basis is a much larger task than having decentralized cluster systems. Just in terms of sheer numbers of permitted units, it could reduce the number by orders of magnitude (e.g. instead of 88,000 individual units; 880 to 8,800 cluster systems).
- **Reduce the burden on individual homeowners to hire engineers and contractors independently to design and construct onsite systems.** A coordinated, organized effort to evaluate a cluster system for a neighborhood would relieve the burden on individual homeowners to understand and determine their cesspool upgrade needs.

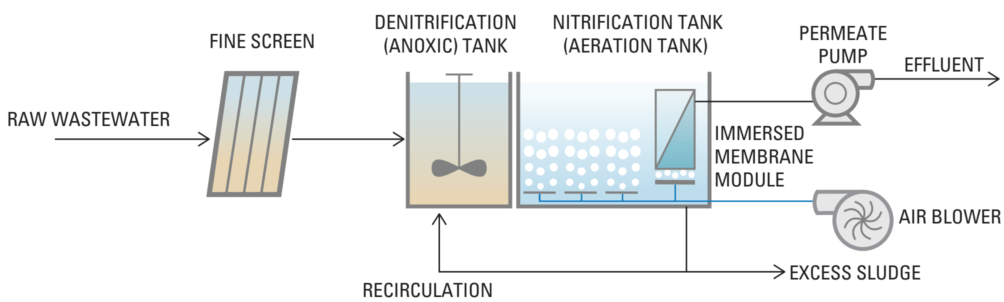

FIGURE 8. Membrane Bioreactor Treatment Process
Membrane bioreactors can be installed in a compact footprint and produce water suitable for reuse.

- **Ensure proper operations and ongoing maintenance of the systems by requiring a licensed wastewater operator.** Cluster systems are regulated and inspected by the State of Hawai'i DOH Wastewater Branch the same manner as existing WWTPs. The rules and procedures are already in place, including the requirement that state-licensed WWTP operators oversee the cluster systems. This is more likely to ensure that systems are inspected, operated, maintained, repaired, and function as required to meet regulations. A similar regulatory and enforcement program for individual onsite system management does not currently exist at the county/state level in Hawai'i and it will need to be developed, implemented, funded, and appropriately staffed .
- **Potentially broaden the range of funding opportunities.** One of the hurdles in funding cesspool conversions is that many existing funding options require a conduit agency or intermediate party to manage and administer available grant or low interest loan funds to individual homeowners for cesspool conversions. Given that decentralized systems will need to be managed and operated by a third party, this also opens the door for more funding options. In addition, if water reuse is a disposal option for the decentralized system, there are additional funding opportunities that may apply. Water reuse is not allowed for onsite systems; thus, those funding opportunities would not be available.

FIGURE 9. System Testing
Decentralized wastewater systems would be subject to the same operator licensing, rules, and requirements current in place for existing wastewater treatment plants.

Challenges

The challenges to implementing cluster systems for cesspool conversions in Hawai'i include:

- **Need for neighborhood-level coordination.** Implementation of decentralized solutions for cesspool conversions requires that a group of homeowners to take the initiative to form an association or district to collect fees and procure various professional and construction-related services. Legislative measures may be necessary to facilitate neighborhood-level coordination especially if participation will be required of homeowners. To truly evaluate the feasibility of decentralized systems for certain neighborhoods, a licensed engineer needs to perform a site-specific analysis and develop costs for a recommended system. This process could take time and involve attorneys to facilitate formation of a homeowner's association if needed.
- **Cost.** Decentralized cluster systems require higher up-front planning and design fees and have higher construction costs than onsite wastewater treatment systems. In addition, collection system construction costs can be significant. A site-specific analysis is necessary to evaluate the feasibility and best overall system options for a neighborhood. The engineering evaluation could be quite expensive – easily 5 to 10 times the cost of an onsite design for a single homeowner. In addition, the construction would be more extensive than onsite systems, and construction costs would accordingly be higher on a per lot basis.
- **Need for skilled operators.** Licensed wastewater operations professionals are required to operate and maintain the cluster system components in perpetuity.
- **Land/space requirement.** Decentralized systems would likely need to be constructed on newly acquired land and may require easements. These cluster systems would only be a viable option if the required land is available.

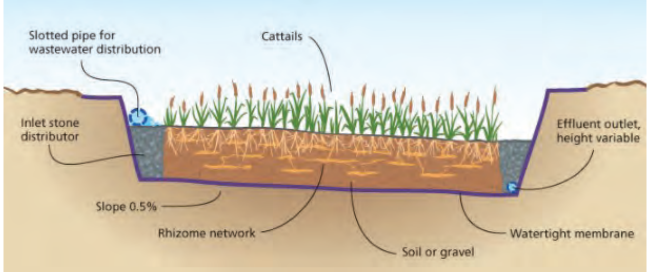

FIGURE 10. Treatment Wetlands Schematic.
Treatment wetlands require significant land area for implementation.

Findings and Recommendations

As the State continues to develop the cesspool conversion strategy, there are several issues that warrant further investigation. This section summarizes findings, recommendations, and the need for future studies and other early actions.

FURTHER EVALUATION OF SEPTIC TANK SYSTEMS

Hawai'i's existing wastewater regulations include a sufficient amount of guidance for septic tank system application and installation (HAR 11-62-31). Typical septic tank systems include a septic tank followed by a soil absorption system. However, the State may consider reviewing or evaluating the following design considerations in the future:

- **Allowable "density" of septic tank systems or numeric limits for total nitrogen.** Septic tank systems are known to provide water quality benefits over cesspools. However, septic tank systems do not provide significant treatment for total nitrogen. Upgrading cesspools to septic tanks in areas with a high density may not provide significant protection to groundwater or near surface water quality. Limiting the number of septic tank systems allowed within a certain area may help to provide groundwater and near surface water quality protection. Another way to protect water quality is to implement a numeric limit for total nitrogen discharged from onsite systems in certain areas.

DEVELOP A COORDINATED STRATEGY FOR METHODS OF CONVERSIONS

Because there are so many site-specific considerations for cesspool conversions, a clearer understanding of the best options to convert cesspools would be helpful to the State and cesspool owners. Some areas within the State do not have options to connect to local sewers, leaving decentralized treatment or continued onsite treatment as their only options. Decentralized treatment may not be feasible for other areas of the State due to low cesspool densities, nonfavorable site conditions, lack of community support, etc.

A countywide or statewide study focusing on developing recommended conversion options for different areas would be helpful in guiding homeowners with their conversion and may also help to develop strategic funding programs. Key objectives of such as study could include:

- Identification of cesspools that can be easily connected to existing sewers.
- Identification of cesspools that can be connected to extended or new sewer systems.
- Feasibility study of decentralized treatment for high-density, high-priority cesspool areas.
- Evaluation of the appropriate level of treatment required to protect public health and the environment for different areas of the State.

This study would require transparent feedback and input from various agencies, such as the counties and privately owned WWTPs on their future planning efforts and system capacities. Such a study would help to guide the conversion strategies for localized areas and a coordinated effort with public outreach, education, financing, and technical solutions.

BEST PRACTICES FOR APPLICATION AND APPROVAL OF ALTERNATIVE AND INNOVATIVE TECHNOLOGIES

The following recommendations are based on interviews and review of new, onsite technology testing and approval processes of other states:

- **Staffing Plan.** Develop a plan for the significant additional staff that will be required to administer and manage the cesspool conversion program. As part of this effort, define the necessary state-provided services and identify the associated staffing needs.
- **Fees and program funding.** Consider adopting appropriate fees to cover program costs. Consider dedicating those fees to a dedicated fund, and requiring by law, that homeowners convert their cesspools at the point-of-sale of the home.
- **Standardized application forms and templates.** Develop and use standardized application forms and templates for required submittals to streamline the application review and approval process. Suggested submittal materials include: technology description, design criteria, installation criteria, O&M requirements, warranty, and results of previous studies.
- **Water quality standards.** Consider multiple sets of numerical water quality standards such as:
    - » Secondary treatment.
    - » Advanced wastewater treatment – for where total nitrogen removal is required or desired.

Parameters may include: total suspended solids, 5-day biochemical oxygen demand pH, alkalinity, total nitrogen, total phosphorus, ammonia, nitrate, nitrite, and fecal coliform.

- **Certified laboratories.** Require that testing is completed according to NSF, ASTM, or USEPA-approved entities or by a qualified third party to bolster testing integrity. The State intends to develop a standardized program to obtain and maintain laboratory certifications.
- **Testing period, sampling intervals, and number of systems tested.** Establish appropriate testing period, sampling intervals, and number of systems to be tested to demonstrate satisfactory performance (e.g. one year of monthly sampling with a minimum of 10 installations).
- **Data collection and management.** Maintain a good database program to facilitate data management and utilization, and to track long-term performance of systems, inspection/maintenance compliance, and data/report submissions. This kind of a database program could also help Hawai'i to track long-term performance of systems, inspection/maintenance compliance, and data/report submissions. Data management must be coordinated with existing systems in place by the seperate counties.
- **Approvals.** Consider implementing a simplified approval process that has two types of approvals – "Provisional" and "Approved", to allow a probationary period followed by conversion to be approved. The approval for new technologies should be permanent; however, there should be periodic reviews by a third party of process performance. Consider maintenance of a list of approved technologies on the DOH webpage.
- **Technology certification.** Avoid issuing official certifications for new technologies.
- **Certifications and training.** Consider implementation of a certification program (and maintain lists on the DOH webpage) for:
    - » Designers
    - » Installers
    - » Inspectors/Maintainers

  Consider requiring manufacturers of approved new technologies to provide training for the certified individuals.

STAFFING/TRAINING/ WORKFORCE DEVELOPMENT

Once there is a better understanding of the feasible methods of conversions for different areas in the State, there needs to be sufficient, trained professional staff, contractors, and potentially wastewater system operators to implement and support the converted systems. Availability of well-trained staff and other human resources will impact the rate of cesspool conversions. This will require development of training programs and professional certifications so that the conversions are implemented successfully, and the upgraded systems are operated to deliver their designed performance.

PUBLIC OUTREACH, EDUCATION, AND HOMEOWNER TOOLS

Public outreach and education will be critical to progressing the cesspool conversion program for Hawai'i. Most importantly, cesspool owners will need clear guidance on what steps to take to successfully convert their cesspools and connection to technical and financial resources. Homeowner guidance should include:

- Educational resources on why cesspool conversions are needed.
- Feasible cesspool conversion options (i.e. connect to sewer, new decentralized system, or new onsite system).
- Access to professional engineers who can design the appropriate system.
- Access to contractors that are qualified and experienced in constructing the new system.
- Potentially licensed operators that can operate and maintain the new system.
- Guidance on financial support or funding options.

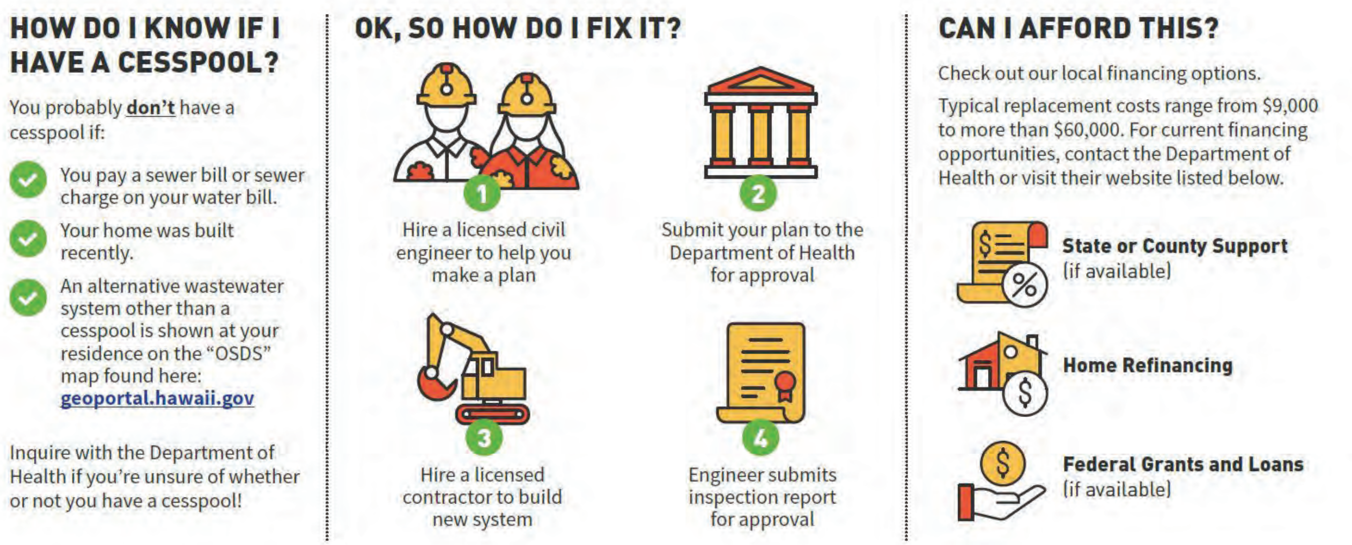

FIGURE 11. Example Public Outreach Handout
See Appendix H for the full page example handout.

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Appendix A

Technical Memoranda

Technical Memorandum 1:
ASSESSMENT OF ONSITE TREATMENT TECHNOLOGY TESTING AND APPROVAL PROCEDURES UTILIZED BY OTHER STATES
(July 2020)

Technical Memorandum 2:
SEPTIC TANK SYSTEMS REVIEW
(November 2020)

Technical Memorandum 3:
ONSITE TREATMENT TECHNOLOGIES EVALUATION
(October 2020)

Technical Memorandum 4:
EVALUATION OF DECENTRALIZED CLUSTER WASTEWATER SYSTEMS
(November 2020)

Hawai'i State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 1
ASSESSMENT OF ONSITE TREATMENT TECHNOLOGY TESTING AND APPROVAL PROCEDURES UTILIZED BY OTHER STATES

FINAL | July 2020

carollo
in association with
College of ENGINEERING
UNIVERSITY OF HAWAI'I AT MANOA

Hawai'i State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 1
ASSESSMENT OF ONSITE TREATMENT TECHNOLOGY TESTING AND APPROVAL PROCESSES UTILIZED BY OTHER STATES

FINAL | July 2020

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THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
SIGNATURE 04/30/2022 EXPIRATION DATE OF THE LICENSE

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THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
SIGNATURE 04/30/2022 EXPIRATION DATE OF THE LICENSE

Contents

Appendices

Tables

Figures

Abbreviations

Alk	Alkalinity
ASTM	American Society for Testing and Materials
ATT	alternative treatment technology
ATU	aerobic treatment unit
AIE	alternative, innovative, and emerging
ANSI	American National Standards Institute
BAT	best available technology
BCDHE	Barnstable County Department of Health and Environment
BOD_5	5-day biochemical oxygen demand
Carollo	Carollo Engineers, Inc.
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CCWG	Cesspool Conversion Working Group
COMAR	Code of Maryland Regulations
DE	Delaware
DNREC	Delaware Department of Natural Resources and Environmental Control
DOH	Hawaii State Department of Health
EPA	US Environmental Protection Agency
ETV	Environmental Technology Verification - USEPA
FAC	Florida Administrative Code
FDOH	Florida Department of Health
FL	Florida
FOG	fats, oil, and grease
gpd	gallons per day
gpd/ac	gallons per day per acre
HAR	Hawaii Administrative Rules
I/A	innovative and alternative
INBR	in-ground nitrogen-reducing biofilter
ISP	innovative system permit
LAA	local approving authority
LAMP	local agency management program
MassDEP	Massachusetts Department of Environmental Protection
MD	Maryland
MDE	Maryland Department of the Environment
mg/L	milligrams per liter
N/A	not applicable
NJ	New Jersey

NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollution Discharge Elimination System
NH_4	ammonium
NO_2	nitrogen dioxide
NO_3	nitrate
NSF	National Sanitation Foundation
NY	New York
O&M	operation and maintenance
OSDS	onsite treatment and disposal system
OSSF	onsite sewage facilities
OSS	onsite sewage system
OSTS	onsite sewage treatment system
OSWT	onsite wastewater treatment and disposal system
PDP	product development permit
PBTS	performance-based treatment system
RI	Rhode Island
RICR	Rhode Island Code of Regulations
RIDEM	Rhode Island Department of Environmental Management
SCDH	Suffolk County Department of Health Services
ST	septic tank
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
TKN	total Kjeldahl nitrogen
TM	technical memorandum
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
TWA	treatment works approval
TX	Texas

Technical Memorandum 1

ASSESSMENT OF ONSITE TREATMENT TECHNOLOGY TESTING AND APPROVAL PROCEDURES UTILIZED BY OTHER STATES

Executive Summary

Hawaiʻi's Act 125 requires the upgrade of all 88,000 existing residential cesspools by the year 2050. As a result, it is expected that these existing onsite sewage disposal systems will be replaced by a more appropriate technology, some of which may be emerging and innovative in nature.

Onsite wastewater treatment and disposal is regulated by the Hawaiʻi State Department of Health Wastewater Branch (DOH). Current Hawaiʻi regulations for onsite wastewater treatment (OSWT) and disposal systems include procedures, design criteria, standards, and restrictions for design and installation of approved standard OSWT technologies (Hawaiʻi Administrative Rules [HAR] 11-62). Detailed criteria are provided only for septic tanks (ST), aerobic treatment units (ATU), and absorption trenches/beds. All other systems and technologies must be approved on a case by case basis, the procedures for which are not currently specified in detail.

To efficiently review and approve the designs for 88,000 cesspool upgrades, the DOH will likely need a more prescriptive application and approval process for alternative, innovative, and emerging (AIE) technologies. AIE technologies are OSWT and disposal technologies not included in existing regulations but may have benefits over conventional options. The current process for obtaining approval of AIE technologies in Hawaiʻi does not prescribe application procedures, fees, timelines, testing durations, sampling protocols, performance requirements, or renewal periods. In addition, DOH does not currently certify AIE technologies or maintain a state-approved list of these technologies. Several other states have established rules and processes for approving AIE technologies. The procedures of other states were evaluated for best practices to assist DOH in developing a new, efficient application/approval methodology. States investigated include Delaware, Florida, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Texas.

Each of the states reviewed utilize different procedures and apply a range of requirements for the approval of AIE systems. The variation is wide, with some public entities being very prescriptive on processes, requirements, durations, etc. and having several types of progressive permitting phases to manage; while other agencies have less complicated procedures. The characteristics and components of these procedures were compared and evaluated for best practices.

The goal for DOH should be to create a procedure and set of requirements that first and foremost protects public health and the environment. This goal must be balanced with information and data needs, DOH review time, program complexity, program staff needs/costs, testing duration, testing costs, testing oversight, designer needs, installer needs, and homeowner needs/costs. These are numerous and often

competing factors to consider, and there is no perfect system. An effective system should strive to achieve the following:

- Applicants will not have extensive questions during application preparation.
- Most relevant information needed by DOH is included and in a standard format/location to facilitate efficient review.
- There is a small number of types/phases of permits to manage.
- Testing of a limited number of water quality parameters by the applicant.
- There is a defined protocol for testing, including duration, sampling intervals, and types.

These characteristics were integrated with the assessment of the approval processes of the 8 states and interviews with some state agencies to develop the following considerations for revision of Hawai'i's approval process components (see Appendix A for notes of interviews with other states) :

1. **Additional agency staff.** Most state agencies expressed concerns that they are under staffed to manage their conversion programs. Staff members manage anywhere from 100 to 3,000 permit applications per staff member per year. Most agencies desire more staff so that they can do more inspections and follow up on converted systems.
2. **Application fee and program funding.** Most states also expressed concerns that they are underfunded. They recommend adoption of an appropriate application fee that will cover the total cost of review and approval of new technologies is recommended. Other agencies also recommend that fees go to a dedicated (versus general) fund for cesspool conversion program management. In addition, other states recommend point-of-sale conversion and notification of DOH to be required by law with meaningful fines for non-compliance.
3. **Standardized application forms and templates.** Utilizing a standardized application form (form-fillable) could help to streamline the application review and approval process (Rhode Island form is a good example). Likewise, standardized templates for required submittals could help the review process (form-fillable, specific clear format). An example of a local guidance document is the the Honolulu's Storm Water Quality Report template. Suggested submittal materials include: technology description/info, design criteria, installation criteria, operations and maintenance (O&M) requirements, warranty info, and results of previous studies. Some states also require registered 3rd party reports, and/or draft manuals for owners, designers, installers, inspectors and maintainers.
4. **Water quality standards.** Consider multiple sets of water quality numerical standards such as:
    a. Secondary treatment.
    b. Advanced wastewater treatment – for where TN removal is required or desired.

    Parameters may include: total suspended solids (TSS), 5-day biochemical oxygen demand (BOD_5), pH, alkalinity (Alk), total nitrogen (TN), total phosphorus (TP), ammonia (NH_3), nitrate (NO_2), nitrite (NO_3), and fecal coliform. However, interviews with other state agencies showed that the common, recommended monitoring parameters are total Kjeldahl nitrogen (TKN), NO_2, and NO_3.

5. **Certified laboratories.** Requiring that testing is completed according to National Sanitation Foundation (NSF), American Society for Testing and Materials (ASTM), or Environmental Protection Agency (EPA)-approved entities or other by a qualified third party will help to bolster testing integrity.
6. **Testing period, sampling intervals, and number of systems tested.** The testing period for AIE technologies should be performed for an appropriate time frame to demonstrate satisfactory performance (e.g. 12 months minimum). The sampling interval should be at least monthly. Multiple systems should be tested (e.g. minimum of 10). Interviews with other state agencies showed

sampling and monitoring data can get unwieldy to manage. One common recommendation was for a good database program to facilitate data management and utilization. A good database program could help Hawaiʻi to track long-term performance of systems, inspection/maintenance compliance, and data/report submissions, which other states have been unable to implement.

7. **Approvals.** Consider limiting approvals to just one type of system – called AIE systems. Interviews with other state agencies showed the common recommendation for a simplified approval process. Consider having two types Provisional and Approved, to allow a probationary period followed by conversion to approved. The approval should be permanent, however, there should be a periodic review of process performance – conducted by a hired third party. Consider maintenance of list of approved AIE technologies on the DOH webpage.
8. **Consider <u>not</u> issuing official certifications for AIE technologies.** Of the states reviewed, three issued certifications of technologies (Rhode Island, Massachusetts, and New Jersey). When a technology is approved a certification document is issued. Rhode Island has stopped issuing certifications because it gives the appearance of an endorsement. This may not be a good approach for Hawaiʻi.
9. **Certifications and Training.** Consider implementation of a certification program (and maintain lists on the DOH webpage) for:
    a. Designers
    b. Installers
    c. Inspector/Maintainers

    Consider requiring manufacturers of approved AIE technologies to provide public trainings for the certified individuals. Other states often require O&M contracts of homeowners or homeowner training. In addition, other states recommend monitoring inspection services to avoid falsification of reports.

1.1 Introduction and Background

According to the US Environmental Protection Agency (EPA), cesspools are underground excavations that receive sanitary wastewater from bathrooms, kitchens, and washers. The structure usually has an open bottom and perforated sides (unlined). Domestic wastewater flows into the structure and the solid waste collects at the bottom of the cesspool and the liquid waste flows out of the perforations. Cesspools are not designed to treat wastewater but rather to retain solids and allow liquid wastes to percolate into the subsurface which may be hydraulically connected to groundwater and surface water.

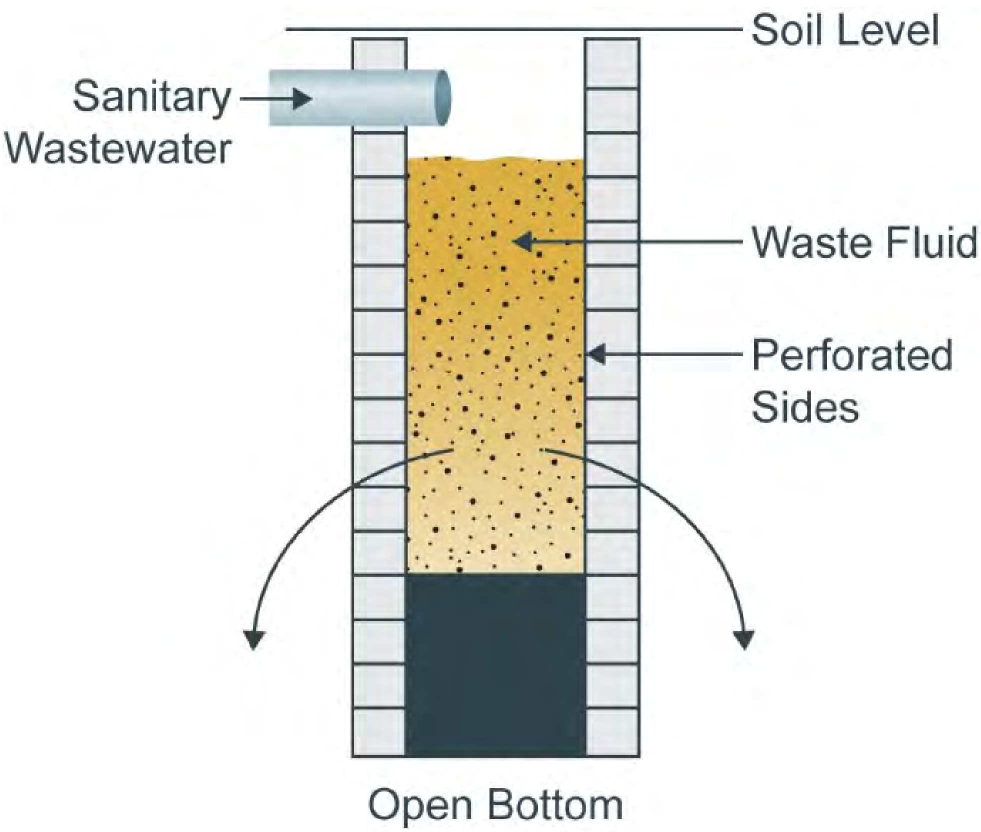

Figure 1.1 Cesspool

Throughout Hawai'i, there are approximately 88,000 cesspools; a majority of which are for single-family, residential wastewater disposal. In 2018, the Hawai'i State Legislature passed Act 125, which states that by January 1, 2050 all cesspools in the state of Hawai'i, unless granted exemption, shall upgrade or convert to a preferred waste treatment system or connect to a sewer system.

Act 132 allowed for the creation of the Cesspool Conversion Working Group (CCWG), with the DOH Director or designee as the chairperson. Other CCWG members include: the DOH wastewater branch chief or their designee; four members of the county wastewater agencies of the Counties of Hawai'i, Honolulu, Kaua'i, and Maui; a member representing the wastewater industry appointed by the president of the senate; a member of the financial and banking sectors appointed by the speaker of the house of representatives; members of the University of Hawai'i Institute of Marine Biology and Water Resources Research Center; a member of the

Hawaiʻi Associate of Realtors appointed by the Speaker of the house of representatives; a member of the Surfrider Foundation appointed by the President of the senate; one representative appointed by the Speaker of the house of representatives; and one Senator appointed by the President of the senate.

The CCWG subsequently retained the Carollo Engineers, Inc. (Carollo) team to support the cesspool conversion technologies and finance research as a part of the Cesspool Conversion strategy for the state of Hawaiʻi.

Existing Hawaiʻi regulations include an approval process for conventional OSWT technologies such as septic tanks, aerobic treatment units (ATUs), and disposal technologies, such as soil absorption systems, gravelless absorption systems, and seepage pits. However, approval of emerging and innovative technologies are on a case-by-case basis[1]. AIE technologies are OSWT and disposal technologies not included in existing regulations, but may have benefits over conventional OSWT and disposal technologies. Other states have established protocols for reviewing and approving AIE technologies. The Carollo team was tasked with reviewing and summarizing these protocols for evaluating and approving AIE technologies.

The purpose of this technical memorandum (TM) is to provide an assessment of what other states have done to date to evaluate and approve emerging and innovative OSWT and disposal technologies. It includes a summary of Hawaiʻi's current approval processes for OSWT, disposal, and AIE technologies, and a review of the approval processes for AIE technologies for Delaware, Florida, Maryland, Massachusetts, New Jersey, New York, Rhode Island, and Texas. The TM concludes with a summary of the approval processes for AIE technologies for the aforementioned states and a summary of best practices for approval processes for AIE technologies in Hawaiʻi for consideration.

1.2 Existing Hawaiʻi Approval Processes for Onsite Disposal Systems and Alternative Technologies

HAR include regulations for individual wastewater systems (HAR 11-62.31). The following sections summarize the current approval processes for OSDSs and emerging and innovative wastewater treatment technologies.

1.2.1 Hawaiʻi Approval Processes for Onsite Disposal Systems

The DOH is the agency that oversees on-site systems in the State. The Hawaiʻi regulations for OSWTs are contained in HAR 11-62 Wastewater Systems[2], subchapter 3 Individual Wastewater Systems. The general requirements specify:

- A minimum lot size of 10,000 square feet.
- A maximum of 5 bedrooms per system.
- A maximum flow of 1,000 gallons per day per system.
- No cesspools are allowed for new buildings and cesspool upgrades are required when buildings are modified.
- OSDSs must have an O&M manual.
- Written approval of an OSDS by the DOH Director is required prior to operation – this requires the engineer's certification and the "as-built" plans.

Regulations specify design criteria and procedures for the following approved processes:

- Septic tanks.

[1] HAR 11-62-34 refers to "new and proposed disposal systems."
[2] https://health.hawaii.gov/opppd/files/2015/06/11-62-Wastewater-Systems.pdf

- ATUs.
- Soil absorption systems.
- Gravelless absorption systems.
- Seepage pits.

Hawaiʻi regulations mention several other systems that must be evaluated on a case-by-case basis including:

- Evapotranspiration systems.
- Elevated mounds.
- Subsurface and recirculating sand filters.
- Drip irrigation.
- Disinfection

There are no design criteria for these other systems, but they are "approved" for use pending submission of engineering calculations/documentation.

For all OSWT systems, HAR 11-62 requires a site evaluation by a licensed engineer, including site slope, soil profile, thickness of soil layers, depth to groundwater, depth to bedrock, distance to water bodies and soil percolation tests (protocol is specified). The rule also specifies minimum separation distances to structures, property lines, surface waters, trees, other treatment units, and potable water wells.

1.2.2 Hawaiʻi Approval Process for Emerging and Innovative Technologies

The approval of innovative, alternative or experimental systems in Hawaiʻi is done on a case-by-case basis (HAR 11-62-35). The rules mention composting toilets, incinerator toilets, natural systems, and "other" systems, and that appropriate NSF or equivalent test procedures must be used and submitted to the DOH Director[3].

The rules specify that innovative systems can be approved if:

- Such systems could benefit the people of Hawaiʻi.
- The owner agrees to collect operational data for up to 12 months and submit it to DOH.
- The owner agrees to repair or replace the system if the Director finds the system performance to be unsatisfactory.

The processes for applying, approving, or testing of innovative systems in Hawaiʻi are not specified in detail. There is currently no list of approved AIE technologies.

1.3 Review of Approval Processes in Other States

A review was conducted of the practices utilized to approve AIE technologies and equipment in several states that have large numbers of onsite systems and active conversion programs. Information was gathered exclusively from publicly-available, on-line resources for each state. While each state evaluated maintains live websites containing the pertinent information, it is possible that some information is out-of-date, which is a limitation of this review. It could be that those states/agencies have approved changes that are scheduled to take effect in the near future or that "unofficial" practices are utilized or exceptions are allowed that are not reflected in the rules.

In addition to web research, agencies were contacted via phone and email to gather additional information on "lessons learned" on their respective AIE approval processes, and cesspool conversion programs in

[3] Refers to the Director of the Department of Health or the Director's duly authorized agenda, including a contractor of the director.

general. The following agencies responded to requests for additional information on their cesspool conversion programs:

- Barnstable County Department of Health and Environment (BCDHE), Massachusetts.
- Rhode Island Department of Environmental Management (RIDEM), Rhode Island.
- Delaware Department of Natural Resources and Environmental Control (DNREC), Delaware.
- Suffolk County Department of Health Services (SCDHS), New York.
- Florida Department of Health and Environment (FDOH), Florida.

A summary of the key lessons learned is incorporated to section 1.5. Notes gathered from phone calls and emails to the agency contacts are included in Appendix A.

1.3.1 Delaware

Delaware is a coastal state (381 miles coastline) which has an estimated 70,000 onsite systems, 18 percent of which are estimated to be failing. Beginning in 2015, cesspools were banned and required to be replaced within one year of discovery. The state has a goal to replace 6,074 septic and leachfield systems by 2025. Low interest loans of up to $35,000 are available to homeowners for replacements with AIE systems. Delaware has established statewide performance standards for AIE technologies and has developed licensing for designers, installers, inspectors and maintainers of OSWT systems. Delaware is included in the study because of the detailed AIE technology approval process they have developed. The drivers for cesspool conversions were groundwater contamination as well as impaired rivers and streams.

1.3.1.1 Approval of Alternative/Innovative/Experimental Technologies

The State of Delaware DNREC is the agency that oversees onsite wastewater treatment systems in the State. Delaware[4]. The Delaware regulations applicable to all OSWT systems are contained in 7 Del.C Ch. 60 Regulations Governing the Design, Installation and Operation of On-site Wastewater Treatment and Disposal Systems[5]. General requirements for the construction of small systems (<2,500 gallons per day [gpd]) include but are not limited to the following:

- Permitting from the DNREC.
- Wastewater characteristics.
- Designer/contractor/operator/evaluator licensing.
- Site drawings.
- Soil profile notes.
- Zoning verification.
- Separation distances.
- Disposal system sizing.
- Soil percolation rates.
- Wastewater design flow rates.
- Depth to limiting zones.

The rule also states that all work regarding OSWT systems must be authorized by professionals who have acquired specific licensure. The classification of licensure consists of:

- Class A – Percolation Tester.

[4] https://dnrec.alpha.delaware.gov
[5] http://www.dnrec.delaware.gov/wr/Information/GWDInfo/Documents/DelawareFinalOnSiteRegulations_01112014.pdf

- Class B – Designer (conventional systems).
- Class C – Designer (conventional & innovate/alternative).
- Class D – Soil Scientist/Site Evaluator.
- Class E – System Contractor.
- Class F – Liquid Waste Hauler.
- Class H – System Inspector.
- Class I – Construction Inspector.

Section 5.3.31 is titled "Innovative/Alternative Wastewater Treatment and Disposal Systems". The rules state the following reasons in which innovative/alternative systems may be permitted on sites:

- The seasonal high groundwater table or limiting condition is found to be deeper than 10 inches.
- Installation is necessary to provide sufficient sample data.
- The system will be used continuously throughout its life.
- Zoning, planning, and building requirements are met.
- In case of failure, an acceptable backup system is readily available.

Section 5.3.31.3 is titled "Product Approvals" and states that the approval of an innovative/alternative system depends on "applications that provide thorough documentation of proven technology". The approval of AIE systems that do not meet the requirements set for conventional treatment systems is granted by DNREC on a case-by-case basis and, as a result, a classification system of approved technologies does not exist. DNREC, however, maintains a list of approved technologies. The approval process for a potential AIE system is shown in Figure 1.2 and described as follows:

- **Application.** Applicants submit their request to the DNREC including:
  - Long-term use data from similar facilities that proves the proposed capabilities, or short-term documentation from reliable sources (Universities or National Sanitary Foundation International).
  - Executive summary describing the system (construction drawings, materials, etc.).
  - O&M manuals.
  - Design drawings must be completed by a Class C professional.

  If the application is accepted, a permit will be issued specifying installation guidelines, O&M requirements, and duration and frequency of system monitoring. The system must be constructed and used within two years of issuance.

- **Conditions of Approval**. The following conditions apply to newly approved, AIE systems:
  - Installed systems are inspected by a Class C, Class E.2 or Class E.3 wastewater professional, or both the DNREC and the manufacturer.
  - If the installation passes all inspections, the DNREC issues the applicant with a Certificate of Satisfactory Completion.
  - If the DNREC deems any system unsatisfactory, it is the owner's responsibility to repair, replace, or abandon the system.
  - Regular monitoring of the system will be carried out by the DNREC or its designee, as specified on the permit.
- **Testing and Monitoring.** Testing and monitoring periods vary from case to case and are documented in the construction permit found on the DNREC's website. Systems that treat flows less than 2,500 gpd must either reduce the total nitrogen concentrations by 50 percent or to a concentration of 20 mg/L.

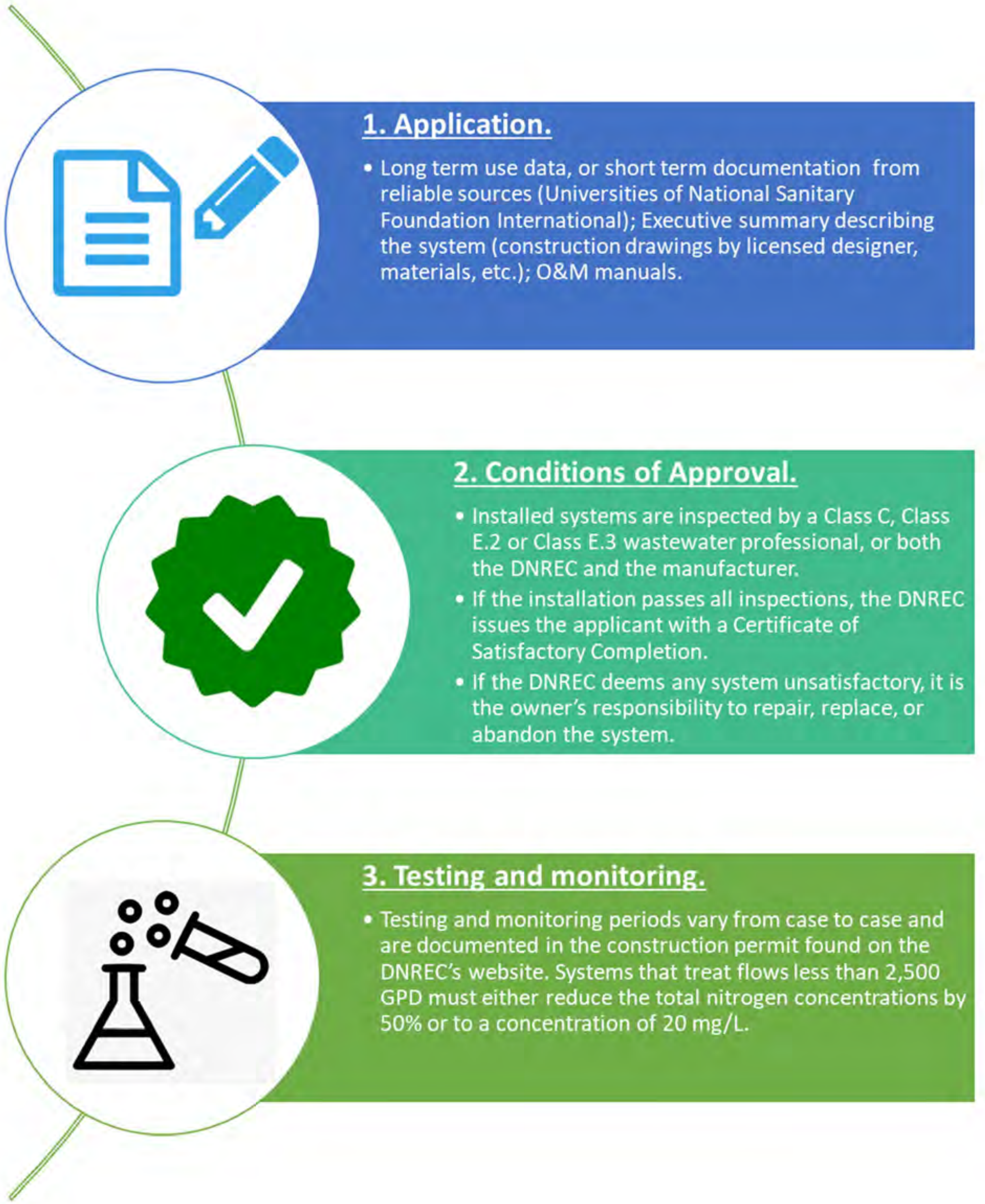

Figure 1.2 Delaware Department of Natural Resources & Environmental Control Alternative/Innovative/Experimental Technology Approval Process.

1.3.1.2 Summary of Approved Technologies in Delaware

Delaware has listings online for approved systems and components of the following categories. The complete list is shown in Appendix B and additional information is on the DNREC website[6]:

- Advanced Treatment Systems and Units (26 listings).
- Advanced Treatment Components (7 listings including biofilters and biological augmentation).
- Drip Dispersal Systems (4 listings).
- Aerobic Treatment Units (3 units).

1.3.2 Florida

Florida is a coastal state (8,436 miles coastline) which has an estimated 2,600,000 onsite systems serving one third of the population. The state has shallow groundwater and has had significant water quality issues. In 2008, legislation was passed that mandated the development of a comprehensive nitrogen reduction strategy for onsite systems. The resulting studies cost over $5 million. Florida has studied, piloted, and finally developed design criteria for passive denitrifying leachfields and also has detailed approval processes for AIE technologies. The emphasis in Florida is on replacement of cesspools and septic tanks with AIE technologies that remove nitrogen. Florida is included in the study because of the large number of onsite systems, the detailed AIE technologies approval process developed, and the work they have completed on passive nitrogen removal technology approval.

1.3.2.1 Approval of Alternative/Innovative/Experimental Technologies

The FDOH is the agency that oversees on-site systems in the state[7]. The Florida regulations for OSWT systems are contained in FAC 64E-6 (Standards for Onsite Sewage Treatment and Disposal Systems (FL-Rules)[8]. General requirements include but are not limited to the following:

- Wastewater flow capacity.
- Minimum setback distances.
- Separation distance to groundwater/impervious layers.
- Soil testing requirements.
- Effluent pipe sizing.
- Leachfield loading rates.
- Designer and installer licensing.
- Application requirements.

The rules also include standards for the following technologies that can be used "where standard subsurface systems are not suitable or where alternative systems are more feasible (FL-Rules, Section 6.009):

- Waterless, incinerating, or organic waste composting toilets.
- Sanitary pit privy.
- Mound systems.
- Filled systems.
- Drip irrigation systems.
- Tire chip aggregate systems.
- In-ground nitrogen-reducing biofilters (INBR).

[6] https://dnrec.alpha.delaware.gov/water/groundwater/alternative-systems/
[7] http://www.floridahealth.gov/environmental-health/onsite-sewage/
[8] http://www.floridahealth.gov/environmental-health/onsite-sewage/forms-publications/_documents/64e-6.pdf

The rules provide detailed requirements for most of these technologies, including design criteria. Part 9 of this section (FAC 64E-6-009 (9)) is "Other Alternative Systems" which identifies other technologies such as "low pressure distribution networks, small diameter gravity sewers, low pressure sewer systems, alternating absorption fields, and sand filters". These technologies can be approved where "evidence exists that use of such systems will not create sanitary nuisance conditions, health hazards, or pollute receiving waters". There are no formal design standards or submittals for these systems. The process for obtaining approval for any other system or component is as follows (FAC 64E-6-009 (8)):

- **OSWT System Testing.** Complete innovative system testing prior to making a request.
- **Application for approval.** Application for approval should include the following:
  - Detailed system design, construction plans, and certification of performance capabilities by a Florida licensed engineer.
  - Research supporting the proposed system/materials.
  - Empirical data showing results of innovative system testing in Florida.
  - A design, installation and maintenance manual showing how to design and install the system in accordance with Florida requirements for standard, filled, mounded, gravity-fed, dosed, bed and trench configurations.

After submission, the material is reviewed by the Onsite Sewage Program to determine whether or not there is a reasonable certainty of the effectiveness and reliability of the system. If not satisfied the FDOH will deny. If approved, the manufacturer shall list the FDOH approval date in the installation and design manual.

There are certain specific restrictions to this process (technologies that cannot be approved) and rules for conventional OSWT systems that also apply to AIE technologies:

- No alternative system can be approved that would reduce the required drainfield size using mineral aggregate as described in the rules.
- Items which are used to achieve a more advanced level of treatment than the baseline level.
- Aerobic treatment units.
- Septic tank designs, filters, seals, and sealants.
- Additives.
- Header and drainfield pipe, including layout.
- Water table separation and setback requirements.

Florida has a separate process for Innovative System Permits (ISP). Innovative systems are defined as: "an onsite sewage treatment and disposal system that, in whole or in part, employs materials, devices, or techniques that are novel or unique and that have not been successfully field-tested under sound scientific and engineering principals under climatic and soil conditions found in this state." The ISP permit application process is shown in Figure 1.3 and described below:

- **Third Party Testing.** Testing must be done by a third-party testing organization approved through the NSF environmental technology verification (ETV) program, or at an NSF test facility. If the data is found to be insufficient, a temporary permit can be issued for further testing and monitoring – with a fee of $2,500.
- **Application for ISP Approval.** Applicants must fill out an ISP application form DH 3143 and include the $2,500 application fee[9]; the form must be signed by a Florida licensed engineer. They must supply the following information:
  - Research and development studies.

[9] www.floridahealth.gov/environmental-health/onsite-sewage/forms-publications/index.html#innovative

  - Results of previous testing.
  - Design and installation criteria.
  - Performance and reliability data.
  - A disinterested third-party certifier report or a Florida Registered Engineer report.
  - Copy of system or product warranty.
  - Indicate the number of innovative systems and the testing time period requested.
  - Provide a sampling and analysis protocol with a mechanism for assessing performance.
  - Provide operation and maintenance manual.
- **Conditions of approval.** If approved, a one-time ISP is obtained from the Onsite Sewage Program. This permit is for a limited number of innovative systems to be installed and monitored during a given period of time. Construction permits must separately be obtained. In addition, the homeowner acknowledgement forms must be signed, and submitted. These AIE technologies are classified as engineer-designed performance-based treatment system (PBTS). After testing is complete and ISP expires, the product can apply for reclassification as an alternative system – PBTS.

The Florida process does not prescribe the exact testing period, or data requirements, but does have performance criteria for carbonaceous biochemical oxygen demand (CBOD), TSS, TN, TP, and fecal coliform. They also require testing by either NSF or an NSF-approved facility (ETV) which is highly prescriptive.

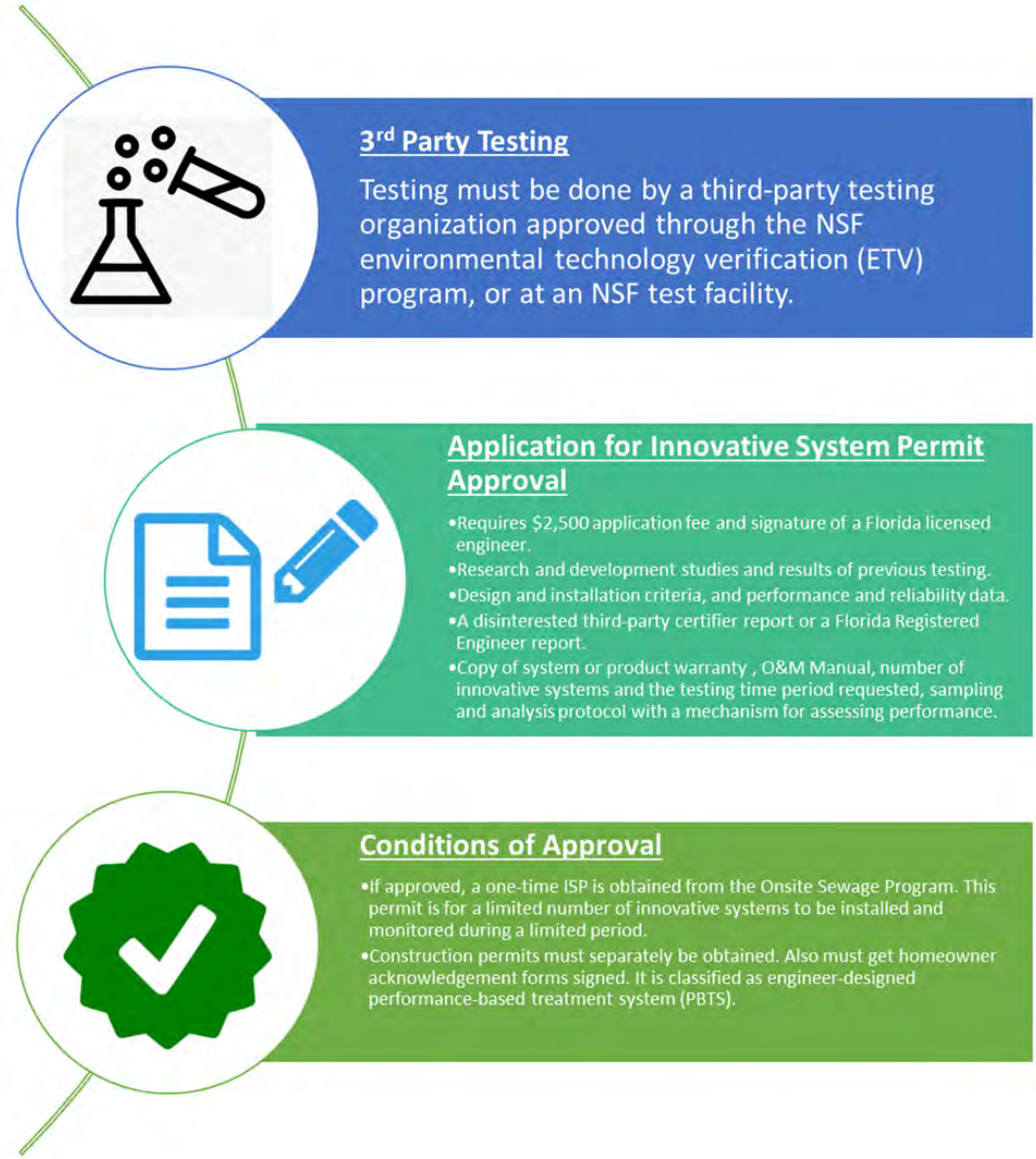

Figure 1.3 Florida Department of Health Innovative System Permit Approval Process

1.3.2.2 Summary of Approved Technologies in Florida

Florida has approved drainfield design standards for "nitrogen-reducing media layers" which includes a diagram of a layer-cake design that includes an upper drainfield area, a middle unsaturated nitrification sand layer at least 18 inches thick, and a bottom soil mix denitrification layer at least 12 inches thick (64E-6.009 (7)). The middle and bottom layers must be 12 inches wider and longer than the layers above them. The bottom layer must be at least 6 inches above the seasonal high-water table. The nitrification layer is sand and the denitrification layer is 40-60 percent wood chips/shavings/sawdust with the remainder fine aggregate.

Florida also has listings on-line for approved systems and components of the following categories[10]:

1. Approved Products and Components
    a. Alternative Drainfield Products (14 listings including chambers, tire chips and drip irrigation)
    b. Composting Toilets (5 listings)
    c. Incinerating Toilets – NSF Protocol P157 (one listing for a product in Norway)
    d. Fibers for Concrete Receptacles (12 listings)
    e. Pump Chamber Inserts/Filtered Pump Vaults (5 listings)
    f. Septic Tank Designs (dozens of listings)
    g. Septic Tanks Meeting HS20 Traffic Standards (18 listings)
    h. Septic Tanks Outlet Filters (18 listings)
    i. Septic Tank Seals and Sealants (8 listings)
2. Advanced Systems (ATUs, Performance-Based and Innovative Systems)
    a. Tanks Approved for use with Aerobic Treatment Units (ATUs) (dozens of listings)
    b. Advanced Systems and Permitted Maintenance Entities (21 listings of systems, dozens of service providers)
    c. Performance-Based Treatment Systems Including Innovative (not a listing, gives performance data)
    d. NSF 40 Certified ATUs (35 listings)
    e. NSF 245 Certified ATUs (9 listings)
3. Nitrogen-Reducing Systems for Springs Protection
    a. NSF 245 Certified ATUs (same 9 listings as above)
    b. Nitrogen-Reducing Performance-Based Treatment Systems (PBTS) (13 listings)
    c. Inground Nitrogen-Reducing Biofilters (INRBs) – not a listing, just refers to the rules

1.3.3 Maryland

Maryland is a coastal state (3,190 miles coastline) which had an estimated 420,000 onsite systems in 2004 when a bill was passed to upgrade OSWT systems to remove nitrogen. They found that OSWT systems contributed about 6 percent of nitrogen to Chesapeake Bay. The emphasis is on replacement of cesspools and septic tanks with AIE technologies that remove nitrogen. An average of 1,200 OSWT systems are converted to AIE systems annually. A total of 12,000 have either been connected to sewer or converted to AIE. Grants of up to $20,000 are available to homeowners for replacements with AIE systems. The money comes from a sewer fee ($5/yr) and an OSWT system fee ($60/yr). From 2016-2018, Maryland spent about $10.1 million per year to help install 1,000 AIE systems. Maryland is included in the study because of the large number of AIE technologies approved and installed.

1.3.3.1 Approval of Alternative/Innovative/Experimental Technologies

The Secretary or the Secretary's designee of the Maryland Department of the Environment (MDE) is the Approving Authority that oversees OSDS within the state[11]. Regulations on all onsite sewage disposal systems are contained in the Codes of Maryland (COMAR) 26.04 (Regulation of Water Supply, Sewage Disposal, and Solid Waste[12]. The general requirements specify:

- Minimum lot area.

[10] http://www.floridahealth.gov/environmental-health/onsite-sewage/products/
[11] https://mde.maryland.gov/Pages/index.aspx
[12] http://www.dsd.state.md.us/COMAR/SubtitleSearch.aspx?search=26.04.02.*

- Maximum density of 160 residents per square mile.
- One building per system.
- Approval of OSWT systems by the Approving Authority or a third party approved by the Approving Authority.
- OSWT systems may require an operating permit by the Approving Authority.
- Local jurisdictions may establish a management entity for OSWT systems.

Site evaluations are required by the approving authority, which include topography, geology, soil classification, hydrology, surface and subsurface drainage conditions, soil test results and boring logs, requirements for seasonal testing, performance of OSWT systems and wells in the area, and potential impacts of new OSWT systems on water wells in adjacent areas. Percolation test requirements, minimum drainage soil depths, minimum slopes, and horizontal separation distances from various features are also established in COMAR 26.04; however, it does not specify any qualifications for parties who may conduct a site evaluation.

MDE may approve new technology or experimental systems for situations in which a public sewer is not available and conventional OSWT systems are incapable of solving the issue. Approved systems are called best available technologies (BAT) and are summarized in Table 1.1. BATs are placed in one of four categories: Class I, Class II, Class III and Class IV.

Table 1.1 Classification of AEI On-Site Wastewater Treatment Systems in Maryland

Technology Type and Degree of Certification	Description	Probation Period	Renewal Period	Cost of Application/ Permit Process	Requirements
Class I	Fully approved treatment units; Field verified; Grant eligible	2 years	N/A	TBD	Total-N reduction to 30 mg/L or less, Successfully completed Maryland field verification
Class II	Currently undergoing field verification	2 years	N/A	TBD	Currently undergoing Maryland field verification
Class III	Field verified; Grant eligible	2 years	N/A	TBD	Total-N reduction to 48 mg/L or less, NSF 245, NSF 40 Class I, CAN/BNQ 3680-600, CEN Std. 12566-3 or equivalent certification, Must be paired with Class IV soil disposal system
Class IV	Approved Soil Distribution System (SDS); Sand Mound, At-Grade, or Low Pressure Dosing Dispersal	N/A	N/A	TBD	Nitrogen reduction of 20-30 percent without pretreatment; 75 percent with pretreatment
Class V	Waterless Toilets	N/A	N/A	TBD	N/A

Notes:
(1) N/A = not applicable
(2) TBD = to be determined

The steps in the overall approval process for BATs are shown in Figure 1.4 and summarized below:

- **Application.** Submit an application to the local Approving Authority for review. The Approving Authority may perform a site evaluation with the Water Management Administration's Regional Consultant, or request the applicant present a hydrology report, performed by a professional consultant.
- **Conditions for Approval.** A permit to design the system is granted to the applicant if both the Approving Authority and MDE determine that the site meets the general requirements:
  - The proposed system must be designed by a professional engineer, environmental health specialist, or other qualified consultant as determined by the Approving Authority.
  - One set of drawings will be submitted to the Approving Authority and MDE for concurrent review and approval to construct.
  - The applicant must submit a satisfactory agreement between the applicant, the Approving Authority and MDE if special operation or extensive maintenance is required.
  - A permit to construct the OSDS is issued by the Approving Authority once the applicant submits a copy of the land records notice that the area is served by a non-conventional OSDS.
- **Monitoring.** MDE monitors the newly installed OSDS for a minimum of 2 years.

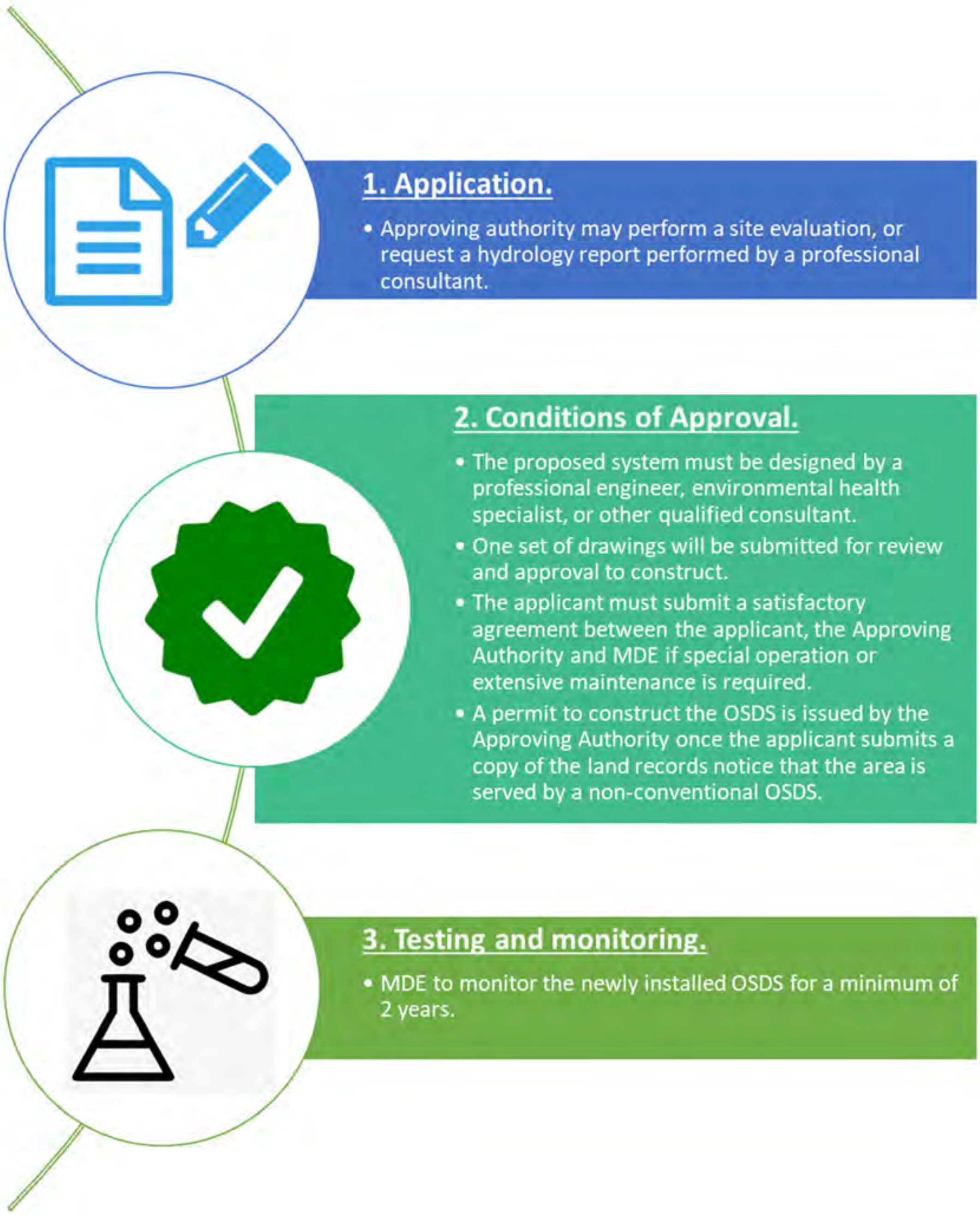

Figure 1.4 Maryland Department of Environment Best Available Technologies Approval Process

1.3.3.2 Summary of Approved Technologies in Maryland

Maryland has listings on-line for approved systems and components of the following categories[13]:

1. BAT Class I - Alternative Treatment Units (9 listings)
2. BAT Class II - Alternative Treatment Units (5 listings)
3. BAT Class III - Alternative Treatment Units (2 listings)
4. BAT Class IV (no product listings; design criteria is given)
   a. Sand Mound SDS
   b. At-Grade SDS
   c. Shallow Placed Low Pressure Dosed Dispersal SDS
5. BAT Class V - Compost Toilet (1 listing – Clivus Multrum)

1.3.4 Massachusetts

Massachusetts is a coastal state (1,519 miles coastline). The number of OSWT systems in Massachusetts is not readily available, but Massachusetts has a well-developed approval process for AIE technologies, including pilot stage, provisional use, and general use categories. Grants of up to $25,000 plus tax credits up to $1500 per year for 4 years for a maximum total of $6,000 are available to homeowners for replacements. Massachusetts is included in the study because of their detailed AIE approval process.

1.3.4.1 Approval of Alternative/Innovative/Experimental Technologies

The Massachusetts Department of Environmental Protection (MassDEP) provides oversight of all OSWT systems in the state[14]. The Massachusetts regulations on OSWT systems are contained in 310 CMR 15.000: Title 5 of the Environmental Code[15]. The general requirements specify:

- Maximum design flow of 10,000 gpd.
- Septic systems shall treat no more than one facility.
- Connection to sewer is mandatory if feasible.
- All septic tanks, distribution boxes, pump chambers, dosing chambers and grease traps are watertight and constructed of non-corrosive materials.
- More stringent requirements may be established by Local Approving Authorities (LAA).

Massachusetts developed an approval program for innovative, alternative, or experimental OSWT systems. These alternative systems may be considered for use in areas where connection to a municipal sewer system is not feasible, or to serve a facility in a nitrogen sensitive area which exceeds the minimum design flow of 440 gpd. To have an OSWT systems approved in Massachusetts, the system must go through a series of approval stages which is summarized in Figure 1.5 and as follows:

- **Application.** Submit a formal application to MassDEP or an agent authorized by MassDEP. Seek approval from LAA first if applying for site specific piloting approval. MassDEP may request additional information on the proposed system, such as performance evaluations of systems in other jurisdictions.
- **Conditions of Approval.** Pilot testing approval is issued under the following conditions:
  - Technical data of field performance shows environmental protection equal to or better than conventional OSWT systems.

[13] https://mde.maryland.gov/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/index.aspx
[14] https://www.mass.gov/orgs/massachusetts-department-of-environmental-protection
[15] https://www.mass.gov/doc/310-cmr-15000-title-5-of-the-state-environmental-code/download

  - The applicant presents an environmental monitoring and reporting plan for at least 18 months of operation.
  - The applicant provides a contract to the LAA and MassDEP ensuring that operation and maintenance will be performed appropriately by the vendor or other acceptable means.
- Provisional use approval is issued under the following conditions:
  - At least 75 percent of the systems in the piloting phase meet the general requirements for at least 12 months.
  - The applicant publishes notice of the application in the Massachusetts Environmental Policy Act (MEPA Environmental Monitor).
  - The applicant presents an environmental monitoring and reporting plan for at least 3 years of operation of the first 50 systems.
- Upon receiving the performance report of the provisional stage, MassDEP takes action:
  - Certify the system for general use if 90 percent of systems meet the general requirements.
  - Request additional evaluation at the discretion of MassDEP.
  - Disapprove use of the system if failed, failing or non-compliant with 150 CMR 15.000.

When certified for general use, MassDEP publishes a notice of the application in the MEPA Environmental Monitor and may establish special conditions to ensure environmental protection, and LAAs can impose additional conditions. The use of a system that has been denied for general use may still be permitted for use under 314 CMR 5.00: Ground Water Discharge Permit Program. Remedial use may be granted to systems that are likely to improve existing conditions of a particular site, under the conditions that the system is used for upgrading a failed, failing, or noncompliant system; the design flow is less than 10,000 gpd and will not increase; and the applicant provides proof that the system is successfully used for at least one year in other jurisdictions with similar climate conditions to Massachusetts. Approval for remedial use, however, does not provide a basis for provisional and general use approvals.

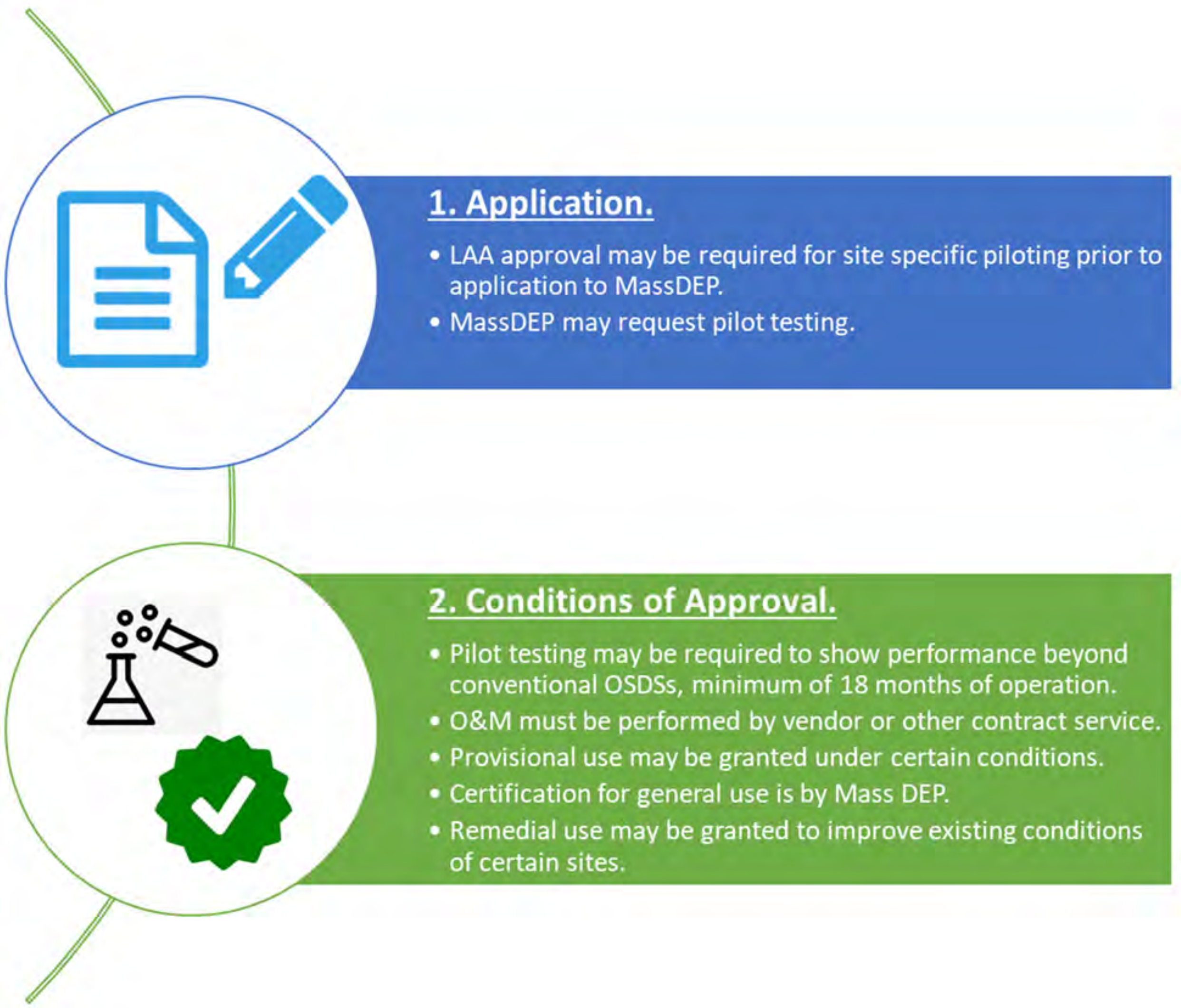

Figure 1.5 Massachusetts Department of Environmental Protection OSWT System Approval Process

1.3.4.2 Summary of Approved Technologies in Massachusetts

Massachusetts has listings on-line for approved systems and components of the following categories[16]:

- General Use
  - Alternative Treatment Systems and Components (15 listings, including pump vaults and recirculating sand filters)
  - Alternative Aggregate (1 listing – polystyrene aggregate)
  - Alternative Soil Absorption Systems, Patented Sand Filters and Chambers (13 listings)
  - Secondary Treatment Units (12 listings, including Aerobic Treatment Units)
- Piloting Use
  - Alternative Treatment Systems (6 listings)

[16] https://www.mass.gov/guides/approved-title-5-innovativealternative-technologies#-remedial-use-

  - Alternative Treatment Components (4 listings, including bubblers, filters, and phosphorous reducing devices)
- Provisional Use
  - Alternative Treatment Systems (9 listings)
  - Alternative Treatment Components (2 listings – biofilters)
- Remedial Use
  - Bottomless Sand Filters (Generic)
  - Recirculating Sand Filters (Generic)
  - Composting Toilets (Generic)
  - Alternative System Components (5 listings, including aeration devices, biofilters, and biological augmentation)
  - Drip Dispersal Systems (2 listings)
  - Alternative Soil Absorption Systems, Patented Sand Filters and Chambers (7 listings)
  - Secondary Treatment Units (15 listings)
- Effluent Tee Filters
  - 15 listings

1.3.5 New Jersey

New Jersey is a coastal state (1,792 miles coastline). The number of OSDSs in New Jersey is not readily available, but since 2012 cesspools must be upgraded upon property sale or transfer. New Jersey was included in this study because it has a very simple approval process for AIE technologies.

1.3.5.1 Approval of Alternative/Innovative/Experimental Technologies

The New Jersey Department of Environmental Protection (NJDEP) is the agency that oversees onsite systems in the state. The New Jersey regulations of OSWT systems are contained in N.J.A.C. 7:9A Standards for Individual Subsurface Sewage Disposal Systems[17]. The general requirements specify:

1. Maximum total daily volume of sewage per dwelling unit = 2,000 gpd.
2. OSWT systems are limited to treat no more than one property for sewage wastes only, and no more than the maximum total daily volume unless a treatment works approval (TWA) or New Jersey Pollution Discharge Elimination System (NJPDES) permit is issued by NJDEP.
3. OSWT systems shall not be installed, constructed, altered or repaired without first obtaining necessary permits.
4. Effluent discharge into any well, onto the ground surface or into any water course is prohibited.
5. Installation of an OSWT systems will be denied if a sanitary sewer line is within 100 feet of the property to be served and connection to the sewer line is feasible.
6. Cesspools, privies, outhouses, latrines, and pit toilets are prohibited.
7. Seepage pits may be allowed with compliance to N.J.A.C 7:9A-7.6.

For all OSWT systems, N.J.A.C. 7:9A requires a site evaluation to be performed, including slope, surface drainage and flood potential (protocol is specified). The rule also specifies minimum separation distances for

[17] https://www.state.nj.us/dep/dwq/pdf/njac79a.pdf

reservoirs, water service lines under pressure, water courses, occupied buildings, property lines, disposal fields, existing seepage pits and cesspools, and in-ground swimming pools.

In New Jersey, the approval of AIE systems is documented in a certificate of compliance. This is explained in N.J.A.C. 7:9A-3 Administration. The overall steps in the approval process for OSWT systems in New Jersey are summarized in Figure 1.6 and below:

- **Application.** Submit an application (standard form) for a construction permit to the administrative authority along with soil logs, soil test data, design data and calculations, and plans and specifications, all of which must be stamped and sealed by a septic system designer.

  If the administrative authority determines that the system does not meet one or more of the general requirements of N.J.A.C. 7:9A, the applicant will be directed to apply for a treatment works approval (TWA) and an NJPDES permit. The application should include endorsements by the administrative authority, and supporting documentation with proof of surface and groundwater quality protection.

- **Approval.** NJDEP and/or the administrative authority reviews the application and issues the TWA if the criteria are satisfied. Upon issuance of the TWA, the administrative authority may issue final design approvals, and any deviations from the general requirements will be stated in the TWA. A certificate of compliance is issued by NJDEP under one of the following conditions:
  - The administrative authority makes sufficient inspections of the construction and installation process, or
  - A licensed professional engineer submits a signed and sealed statement in writing that the system was located, constructed, installed or altered in compliance with the general requirements.

NJDEP does not specify probation periods, or effluent water quality limitations. They also do not provide a classification system of alternative and innovative technologies. However, NJDEP describes experimental systems as "new technologies which may improve the treatment of sanitary sewage prior to discharge or allow environmentally safe disposal of sanitary sewage in areas where standard sewage disposal systems might not function adequately". Advanced wastewater pretreatment components are used for altering an existing system to meet the increasing sanitary sewage volume of a site.

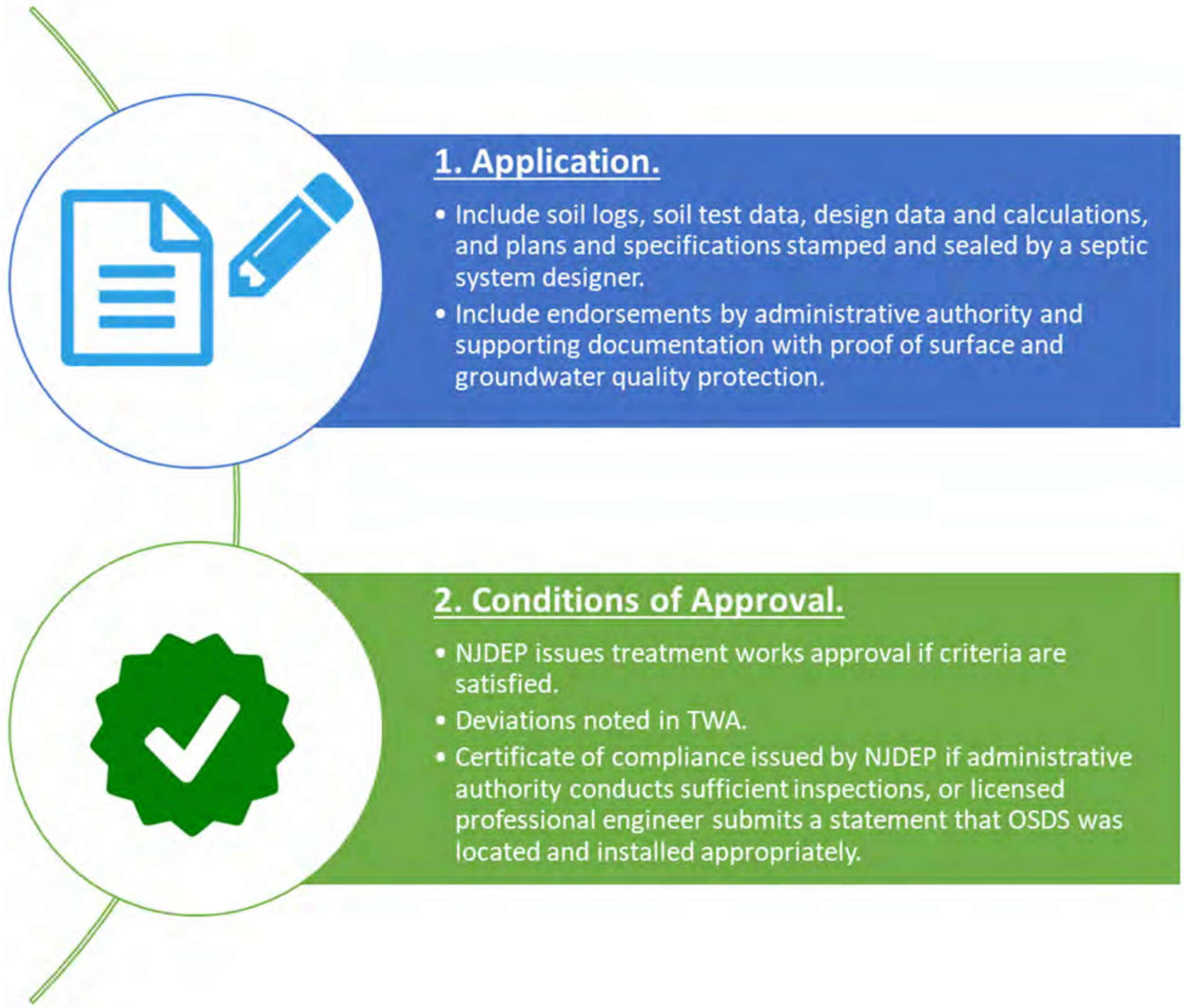

Figure 1.6 New Jersey Department of Environmental Protection OSDS Approval Process

1.3.5.2 Summary of Approved Technologies in New Jersey

New Jersey has listings on-line for approved systems and components of the following categories[18]:

1. Aerobic Treatment Units (dozens of listings)
2. Alternatives to Laterals and Filter Material (21 listings)
3. Dripper line/ Drip Tubing (2 listings)
4. Tire Chips (Generic)

1.3.6 New York

Suffolk County is the best example of an approval process for OSWT systems in New York State. It is a coastal county (980 miles coastline) which has an estimated 252,000 cesspools and 108,000 other OSDSs placing 75 percent of the population on OSWT systems. Their replacement efforts are driven by protection

[18] https://www.nj.gov/dep/dwq/owm_ia.htm

of drinking water aquifers from nitrogen contamination. They have identified 209,000 priority systems and estimate a need to replace almost 2,600 per year based on home sales. Suffolk County awards grants up to $30,000 per system for replacements that utilize AIE technologies and can award about 200 per year currently. Future funding will ramp up grants to 1,000 per year. At least 550 AIE system installations have been approved. Suffolk County is included in the study because of the large scale of the cesspool issue and the detailed and well-defined approval program they have developed.

1.3.6.1 Approval of Alternative/Innovative/Experimental Technologies

Suffolk County Department of Health Services (SCDH) is the agency that oversees on-site wastewater treatment systems[19,20]. The regulations for modified subsurface treatment in Suffolk County are found in The Suffolk County Code Chapter 760-610[21]. General requirements include the following standards: project location, sewer availability, subsoil and groundwater conditions, wastewater flow capacity and water quality. The approval process of innovative and alternative onsite wastewater treatment systems is detailed in the Suffolk County Code 760-19-104[22]. In order for a permit to be issued for the construction of an AIE system, it must be on the SCDH's list of approved technologies. The approval process is summarized in Figure 1.7 and below:

- **Application.** Submit documents to the SCDH including an engineering report describing the technology with process design calculations and drawings prepared by a licensed professional engineer. The application should also include performance data of previously installed and tested systems at a testing facility acceptable to the SCDH. The system must have been tested at full-scale with a minimum design capacity of 440 gpd. Influent and effluent sampling results collected over a minimum of one year at a maximum of 30 day intervals for total nitrogen (TN), total Kjeldahl nitrogen (TKN), ammonia (NH_3), nitrite (NO_2), nitrate (NO_3), pH, BOD_5, TSS, and alkalinity analyzed by a certified lab are required. The Department reviews the submitted items and issues a written determination to either approve or deny the technology within 60 days.
- **Conditions of approval.** The OSDS must be installed so that it can function by gravity flows. Effluent samples must be tested by state certified laboratory at least every 30 days after the system reaches equilibrium for TN, TKN, NH_3, NO_2, NO_3, pH, BOD_5, TSS, and alkalinity. When approved, the technology will be added to the SCDH's approved list and is subject to a series of approval phases before becoming fully available. A final guidance document must be submitted (design, installation, O&M). The applicant must provide training to the SCDH and Industry. The technology must be installed, operated and maintained according to guidance document.
- **Testing and Monitoring.** Duration and frequency of sampling of the effluent varies by approval phase (see Table 1.2) and must be analyzed by a state-certified laboratory. The four approval phases are experimental, piloting, provisional, and general use. To advance from one phase to the next, the technology must meet the requirements stated in the Suffolk County Code 760-19-104. A summary of the approval phases for Suffolk County New York is displayed in Table 1.2.

[19] https://www.suffolkcountyny.gov/health
[20] https://www.suffolkcountyny.gov/health
[21] Sewage Facilities Requirements for Other Construction Projects (Other Than Single-Family Residences and Conventional Single-Family Residential Subdivisions or Developments): Suffolk County Sanitary Code - Article 6
[2222] Approval Process for I/A OSWT: Suffolk County Sanitary Code - Article 19

Table 1.2 Classification of AIE On-Site Wastewater Treatment Systems in Suffolk County, New York (NY)

Approval Phase	Sample Frequency	Number of Installations	Probation Period	Cost of Application /Permit Process	Additional Requirements
General Use	Every 36 Months (residential), or Every 12 months (commercial)	At least 20	N/A	NA	• Full technical report of sampling results, • Show that total-N effluent is less than 19 mg/L in 100 percent of Provisional 1 data set
Provisional 2	Every 12 Months (residential), or Every 12 months, unless seasonal then every month of operation (commercial)	At least 20	2 to 5 years	NA	• Show that total-N effluent is less than 19 mg/L in 75 percent of total piloting data set
Provisional 1	Bi-Monthly for 12 months (residential), and Monthly for 12 months; Bi-monthly for an additional 12 months (commercial)	20	2 to 5 years	NA	• Same requirements as Provisional 2
Piloting	Monthly; 12 months rolling average	At least 8; no more than 12	1 to 2 years	NA	• Have NSF 245 certification, or • EPA Environmental Technology Verification Program Certification, and • Show that total-N effluent is less than 19 mg/L in 75 percent of total experimental data set
Experimental	Monthly; 12 months rolling average	At least 3; no more than 5	1 to 2 years	NA	• Engineering report by a licensed P.E., • Lab test data

Notes
(1) N/A = not applicable
(2) NA = not available

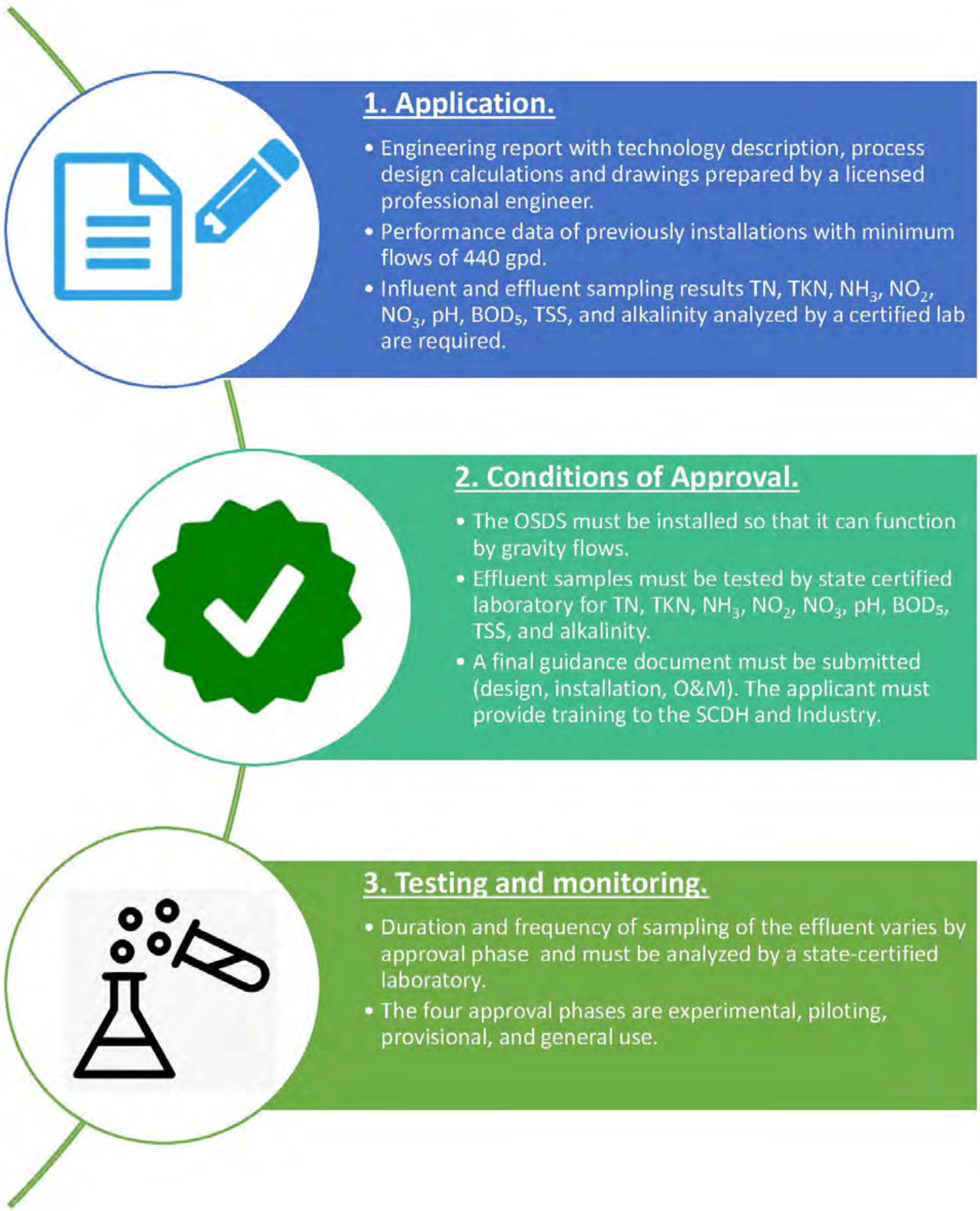

Figure 1.7 Suffolk County Department of Health Approval Process for Innovative and Alternative Onsite Wastewater Treatment Systems

1.3.6.2 Summary of Approved Technologies in Suffolk County NY

As of this date, the Suffolk County Department of Health Services List of Approved Innovative and Alternative Onsite Wastewater Treatment Systems (I/A OSWT) consists of:

- Six experimental technologies.
- Two piloting technologies.
- Eight provisional technologies.

Of the six experimental technologies, only two are currently installed—Lined Nitrogen Reducing Biofilters and Unlined Nitrogen Reducing Biofilters. There are currently no piloting technologies in use. SCDHS Division of Environmental Quality reports that there were 545 I/A OSWT system permit approvals and 169 installations as of 12/31/2018 (2018 Report on the Performance of Innovative and Alternative Onsite Wastewater Treatment Systems[23]).

1.3.7 Rhode Island

Rhode Island is a coastal state (400 miles coastline) which had an estimated 25,000 cesspools in 2007 when they passed a cesspool act to replace the 1,400 high priority cesspools (near coast, aquifers, and drinking water wells). It appears that the priority systems have been upgraded and since then a point-of-sale required upgrade approach has been adopted for cesspools in other areas. It is unclear how many cesspools remain in Rhode Island, however, as of 2015, almost 21,000 AIE technologies have been installed (these are not all for cesspool replacements, many are new homes). The cost of the program is unknown, however, the state received an EPA grant of $3 million dollars to create a plan/strategy and Rhode Island has created a low-interest loan program which has distributed at least $12.4 million dollars in 783 loans to homeowners to assist with upgrades. Rhode Island is included in the study because of the large number of AIE technologies approved and installed.

1.3.7.1 Approval of Alternative/Innovative/Experimental Technologies

The Rhode Island Department of Environmental Management (RIDEM) is the agency that oversees on-site systems[24]. The Rhode Island regulations for OSDSs is contained in 250-RICR-150-10-6 (Rules Establishing Minimum Standards Relating to Location, Design, Construction and Maintenance of Onsite Wastewater Treatment Systems (RI-Rules[25]). General requirements include but are not limited to the following: wastewater flow capacity, minimum setback distances, separation distance to groundwater/impervious layers, soil testing requirements, effluent pipe sizing, leachfield loading rates, designer and installer licensing, application requirements, etc.

Section 6.41 addresses "Alternative or Experimental Technology Approval". In order for a permit to be issued for construction of a non-standard technology in Rhode Island, it must have been approved and certified and appear on the RIDEM's approved list. The overall steps in the approval/certification process are summarized in Figure 1.8 and below:

- **Application.** The application to RIDEM must include several submittals for the proposed technology, such as technology information, approval/denial history, performance data, design criteria, installation criteria, operation and maintenance/cost/monitoring requirements, failure history, and draft guidance document for owners, designers, installers, and inspectors/maintainers.

[23] https://reclaimourwater.info/Portals/60/docs/2018_Performance_Evaluation_of_IAOWTS_Appendices_11-18-2019.pdf
[24] http://www.dem.ri.gov/programs/water/owts/
[25] https://rules.sos.ri.gov/regulations/part/250-150-10-6#meta-details

The application is reviewed by the OSDS Technical Review Committee which provides a recommendation within 90 days. The Director may approve or deny as submitted, and/or recommend resubmission with suggested modifications; with reclassification; or both.

- **Conditions of approval.** Once approved, a final guidance document must be submitted (design, installation, O&M). The applicant must provide training for licensed designers, installers and inspectors/maintainers. The technology is certified for use in Rhode Island and is added to the approved list. The certification contains: general design requirements, general certification requirements, operation and maintenance requirements, and reporting requirements.
- **Monitoring and Testing.** The Director may require monitoring/sampling, performance reports, annual summary reports.

Several degrees of approval certifications exist. An AIE technology's classification depends mainly on the timeframe of available data that shows the DEM's general requirements have been met. Table 1.3 summarizes the various AIE approval classifications in Rhode Island.

Table 1.3 Classification of AIE On-Site Wastewater Treatment Systems in Rhode Island

Technology Type and Degree of Certification	Renewal Period	Number of Installations	Probation Period	Cost of Application/ Permit Process	Additional Requirements
Alternative System Class One	Permanent	At least 10 in RI, or At least 10 in each of 3 other states	4 years	NA	
Alternative System Class Two	Every 5 years	At least 10 in RI, or At least 10 in each of 1 other state	2 years	NA	• Demonstrate theory or applied research
Alternative System Class Two with nitrogen-reduction	Every 5 years	At least 10 in RI, or At least 10 in each of 1 other state	2 years	NA	• Have NSF 245 certification Show that total-N effluent is less than 19 mg/L
Alternative Component Class One	Permanent	At least 10 in RI, or At least 10 in each of 3 other states	2 years	NA	• Manufacturer's and material standards are met
Alternative Component Class Two	Every 5 years	At least 10 in RI, or At least 10 in each of 1 other state	1 year	NA	• Manufacturer's and material standards are met
Experimental	N/A	At least 3 and no more than 10 in RI	2 years	NA	• Demonstrate that it works in practice and theory • Subject to third-party monitoring • Abandon and replace with approved technology upon failure

Notes
(1) N/A = not applicable
(2) NA = not available

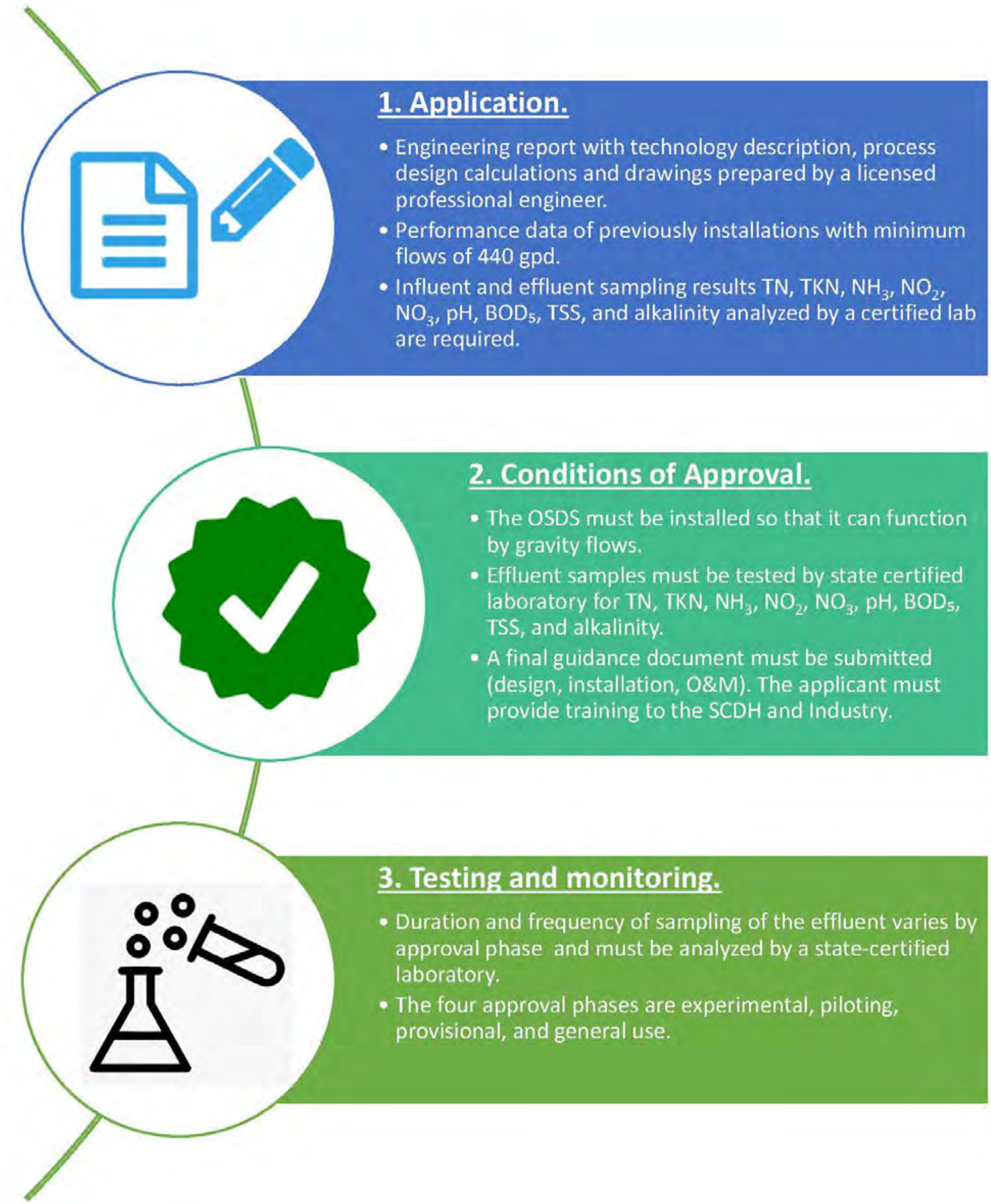

Figure 1.8 Rhode Island Department of Environmental Management Alternative and Experimental Technologies Approval Process

1.3.7.2 Summary of Approved Technologies in Rhode Island

The RIDEM website contains a list of the approved and certified Alternative/Experimental Technologies according to RIDEM's standards[26]. There are:

- Three Class I-Alternative Systems
- Nine Class II-Alternative Systems
- 14 Class I-Alternative Components
- Seven Class II-Alternative Components
- Zero Experimental Technologies

Most technologies approved as Alternative Systems were described by the system's capability to significantly reduce the effluent concentrations of BOD; TSS; fats, oil, and grease (FOG); and TN. The most common approved components are chambered leachfields and effluent filters. The list does not currently contain any "Experimental" technologies.

1.3.8 Texas

Texas is a coastal state (3,359 miles coastline) where about 45,000 new onsite systems are installed every year and 25-35 percent of the population is served by such systems (possibly 2 to 3 million systems total). The state has developed a rigorous approval process for proprietary and non-standard treatment systems. Texas is included in the study because of the large number of onsite systems they have, the rigorous AIE technologies approval process developed, and the large number of AIE technologies they have approved.

1.3.8.1 Approval of Alternative/Innovative/Experimental Technologies

The Texas Commission on Environmental Quality (TCEQ) is the agency that oversees the installation of OSWT systems. The Texas regulation of onsite sewage facilities (OSSFs) is contained in 30 Texas Administrative Code (TAC) Chapter 285 On Site Sewage Facilities[27]. Subchapter D (Planning, Construction and Installation Standards) contains the rules on approval of systems[28]. The Standards include the following elements:

1. Site Evaluation
    a. Soil analysis
    b. Groundwater evaluation
    c. Surface drainage analysis
    d. Separation requirements
2. Selection criteria for treatment and disposal systems
3. Criteria for sewage treatment systems
    a. Pipe from building to treatment system
    b. Standard treatment systems: 1) Septic tanks, 2) Intermittent sand filters
    c. Proprietary Treatment Systems
    d. Non-Standard Treatment Systems
    e. Effluent quality
4. Criteria for effluent disposal systems
5. Other Requirements
6. Emergency repairs

[26] http://www.dem.ri.gov/programs/benviron/water/permits/isds/pdfs/ialist.pdf
[27] https://www.tceq.texas.gov/rules/indxpdf.html#285
[28] https://www.tceq.texas.gov/assets/public/legal/rules/rules/pdflib/285d.pdf

7. Abandoned tanks, boreholes, cesspools and seepage pits
8. Water treatment equipment and appliances
9. Prevention of unauthorized access to OSSFs
10. OSSF maintenance and management practices

The regulations that are most relevant to AIE systems are 3c Proprietary Treatment Systems and 3d Non-Standard Treatment Systems. The difference is that 3c applies to vendor-supplied units and 3d applies to emerging or experimental designs not yet commercially available. The approval process for 3c is summarized in Figure 1.9 and below:

- **Testing.** Two testing options for proprietary treatment systems are provided.
  - **Method A.** Systems tested by NSF and listed as NSF 40 – Class I systems, or by an American National Standards Institute (ANSI) accredited testing institution, or by other standards approved by the executive director.
  - **Method B.** Systems not approved by Method A may only be approved through independent, third party testing for 2 years; and all supporting data submitted for approval by the executive director. The third party must obtain a temporary authorization from the executive director before testing; containing the number of systems to be tested (between 20 and 50), location of test sites (must be similar to where the technology will be used if approved), how the system will be installed and maintained, testing protocol for collecting/analyzing samples, equipment monitoring procedures, and provisions for data recording and data retention to evaluate performance and the effect on public health, groundwater and surface waters. The third party must obtain construction authorization from permitting authorities, and must notify homeowner that it is approved only for testing, if it fails, it will be replaced with an approved system at manufacturer's expense. It remains the manufacturer's responsibility until final authorization is received.
- **Application.** After completion of 2-years of testing, submit a detailed report on the performance. The director can issue conditional approval or deny use.
- **Monitoring and Ongoing Review.** Conditional approval only applies to use in similar areas, and is for a specified monitoring period not to exceed five years. The AIE system must be monitored according to a plan approved by the director. Approval or disapproval will be based on performance during the monitoring period. Upon successful completion of the monitoring period, the monitoring requirements can be lifted, the notice of approval made permanent for the test systems, and system is deemed suitable for use in similar areas. Approved systems must be reviewed every seven years – to be completed prior to the end of the seven-year period. System reviews must be performed by a third party such as NSF, ANSI- accredited, or other independent third party approved by the director. The review shall include evaluation of short-term and long-term effectiveness, structural integrity, maintenance of the system, owner access to maintenance support, any impacts the system had on the environment, and effectiveness of the manufacturer's installer training program. Any system not approved due to the review shall be removed from the approved list.

The approval process for Non-Standard Treatment Systems (3d) is the same as for Proprietary Treatment Systems. The Non-Standard systems section is applicable to any system not covered in 3b (standard treatment systems) or 3c. (proprietary treatment systems)

The Texas process does not prescribe data requirements (number of samples), but does prescribe the testing period, and does have performance criteria for CBOD, TSS, TN, TP, and fecal coliform. They do not require testing by NSF or a NSF-approved facility, but if not by NSF, there must be at least 20 systems tested by an approved, independent third party.

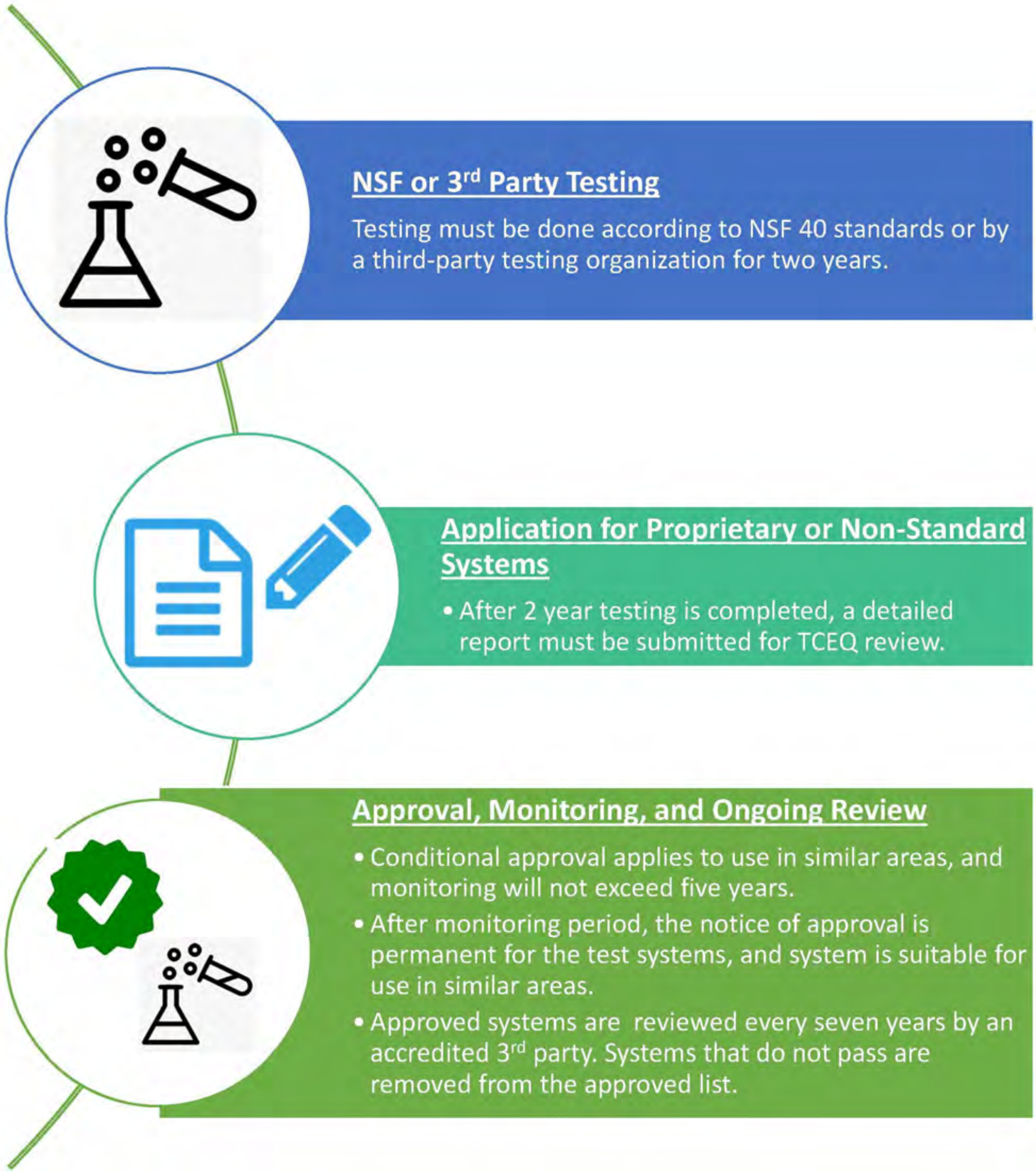

Figure 1.9 Texas Commission on Environmental Quality Proprietary and Non-Standard Treatment Systems Approval Process

1.3.8.1 Summary of Approved Technologies in Texas

Texas maintains online lists of approved systems[29] as follows:

- Composting toilets: 13 models of one brand and 16 models of another brand
- Disinfection devices: none listed
- Disposal systems: 6 brands with 6, 9, 1, 11, 1, and 3 models
- Effluent filters: 6 brands with 6, 2, 1, 50, 1, and 4 models
- Treatment systems: numerous systems by size:
  - 400-550 gpd: 26 brands
  - 600 gpd: 19 brands
  - 700-890 gpd: 24 brands
  - 900-1100 gpd: 22 brands
  - 1200-1500 gpd: 20 brands

1.4 Comparison of Approved Technologies, System Requirements, and Advanced/Innovated/Emerging Technologies Approval Processes

Table 1.4 compares the AIE onsite system approval processes for eight states studied. The table lists a variety of approval components such as types of systems, renewal/probationary periods, application submittal requirements, testing requirements, and training/certification requirements.

Each of the eight states reviewed utilize different procedures and have varying, specific requirements for approval. The variation is wide, with some states being very prescriptive on processes, requirements, durations, etc. and having several types of progressive permitting phases to manage; while others have less complicated procedures. Some observations and comparisons of the approval processes are as follows:

1. **Types:** There are as few as one type/phases of systems, Delaware and as many as five or six (Rhode Island and New York). Most states have just 2 or 3 categories. Fewer types of alternative systems and phases of approval are likely easier to manage.
2. **Probationary Periods:** The range for probation is from one to five years followed by permanent approval. Only three of the eight states studied have required probationary periods. Probationary periods seem like a good idea to ensure that AIE technologies perform as expected for extended periods and some studies (Suffolk County, NY) have shown that 20 percent of systems do not perform as well over time. However, it results in additional burdens on regulators with the responsibilities of tracking and monitoring.
3. **Renewal Periods:** The range is from non-renewal for experimental systems, to one to five years for probationary systems, to seven year system reviews of approved systems, to permanent approval (no renewals required). It seems prudent to have a renewal or review period even for "permanently" approved technologies. This renewal/review period could be as long as 10 years.
4. **Review Periods and Fees:** Review periods range from 15 to 90 days. Some states do not specify a review period. Application fees ranged from $115 to $3,675.
5. **Required Application Submittals:** There is quite a bit of common ground in this component with most states requiring extensive submittals. These include technology description/info, design criteria, installation criteria, O&M requirements, warranty info, and results of previous studies. Some states also require registered third party reports, and/or draft manuals for owners, designers, installers, inspectors and maintainers.

[29] https://www.tceq.texas.gov/permitting/ossf/ossf-products

6. **System Testing:** Most states provide alternatives including NSF, NSF-approved sites, EPA-approved sites, or university labs. Some states only allow NSF or other certified testing sites/organizations. Current practice in Hawaiʻi allows testing by NSF or other approved such as universities.
7. **Number of systems that must be tested:** Several states do not specify any number and leave it to the proposer to suggest – thus, the minimum could be one. For those states that specify a number, the range is from three to five for experimental systems, to 10 for probationary systems, to a minimum of 20 (and max of 50). It would seem that at least 10 to 20 systems should be tested in state at locally typical sitesprior to "permanent" approval.
8. **Water Quality Parameters to be Monitored:** All require TSS, BOD_5 (or $CBOD_5$), pH, and alkalinity. Many also require TN, TP. Some also require NO_2, NO_3, NH_3, TKN, FOG, and/or fecal coliform. At least one state requires all data to be produced by a state certified laboratory. In general, more data is better, however, data is expensive and especially from certified laboratories.
9. **Testing Period:** Some states do not specify a period. Most specify at least one year, and some states specify two or four years. Some specify the NSF testing period which is approximately nine months.
10. **Sampling Interval Requirements:** Some states require monthly or quarterly sampling, but most do not specify the sampling interval – leaving it up to the applicant to propose. It seems important to specify the sampling interval. Monthly sampling intervals or a minimum number of samples collected would be prudent to provide meaningful data.
11. **Special Denitrification Requirements:** The NSF 245 protocol specifies at least 50 percent removal of TN. Several of the New England states eschew the percent removal for a maximum concentration of 19 mg/L TN. Delaware specifies 50 percent and less than 20 mg/L. Florida specifies 65 percent removal. The NSF 245 standard specifies at least 50 percent TN removal which seems insufficient. It seems important to specify a maximum effluent TN concentration. However, it is not clear that 20 mg/L is low enough. Data posted from New York indicates that many of the ATUs are not able to consistently achieve the less than 19 mg/L standard, so careful consideration is required. Prior testing of N/DN systems in Hawaiʻi found that less than 19 mg/L TN and 50-80 percent removal can be achieved.
12. **Certifications Issued and Required:** Rhode Island is the only state that issues a certification for AIE technologies. Rhode Island also certifies designers, installers, inspectors, and maintainers. A few other states also certify these people, which seems like an important feature of these programs. All of the states maintain online lists of approved AIE technologies.
13. **Required Trainings:** Rhode Island requires approved system manufacturers to provide public training sessions for designers, installers, and inspectors/maintainers. This seems like an important program feature.

Table 1.4 Comparison of AEI On-Site Technology Approval Processes for Other States

Approval Process Component	Delaware	Florida	Maryland	Massachusetts	New Jersey	New York - Suffolk County	Rhode Island	Texas
	DNREC	FDOH	MDE	MassDEP	NJDEP	SCDH	RIDEM	TCEQ
Types or Phases	Innovative/Alternative	1. Alternative Systems 2. Innovative Systems Numerical WQ Standards: 1. Adv Secondary 2. Adv Wastewater 3. Florida Keys	1. BAT CLASS I 2. BAT Class II 3.BAT Class III 4. BAT Class IV 5. BAT Class V	1. Piloting 2. Provisional 3. General Use 4. Remedial	Experimental	1. Experimental 2. Piloting 3. Provisional 1 4. Provisional 2 5. General Use	1. Alt Systems Class 1 2. Alt Systems Class 2 3. Alt Sys Class 2 w/DN 4. Alt Components Class 1 5. Alt Components Class 2 6. Experimental Systems	1. Standard Systems 2. Proprietary Systems 3. Non-Standard Systems
Renewal Period	Not available	Not available	Permanent, but if samples show poor performance, can be revoked or suspended	1 & 2. 5 years 3 & 4. Permanent, but if annual samples show poor performance, may be revoked or suspended	Not available	General Use is permanent, but if annual samples show poor performance, can be revoked or suspended	1 & 4. Permanent 2, 3 & 5. Five Years 6. Not Renewable	System Review every 7 years
No. of Installations Required	Not available	Not available	Not available	1. No more than 15 2. At least 50 3 & 4. NA	Not available	1. 3 to 5 2. 8 to 12 3. 20 4 & 5. At least 20	1 & 4. 10 in RI or 10 ea in 3 other states 2, 3, & 5. 10 in RI or 10 in another state 6. 3 to 10 in RI	20 to 50
Probation Period	Not available	Not available	First 12 months	1. 18 months 2. 12 months as piloting 3. 3 years as provisional 4. 1 year in other jurisdictions	Not available	1 & 2. 1 - 2 years 3 & 4. 2 - 5 years 5. Permanent	1. Four years 2, 3, 4, & 6 Two years 5. One year	After 2 years testing, get conditional approval for a Monitoring Period ≤ 5 yearrs, after this period it is approved

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Approval Process Component		Delaware	Florida	Maryland	Massachusetts	New Jersey	New York - Suffolk County	Rhode Island	Texas
		DNREC	FDOH	MDE	MassDEP	NJDEP	SCDH	RIDEM	TCEQ
Required submittals	Applicant Info	X	X	X	X	X	X	X	X
	Technology Info	X	X	X	X	X	X	X	X
	Design Criteria	X	X	X	X	X	X	X	x
	Installation Criteria		X	X			X	X	x
	O&M Requirements	X	X	X	X		X	X	X
	O&M Costs			X	X	X	X	X	
	Failure History							X	
	Draft Guidance: Owners				X			X	
	Draft Guidance: Designers						X	X	
	Draft Guidance: Installers							X	
	Draft Guidance: Inspectors and Maintainers			X	X			X	
	Fee	AEI Application fee - $0 Site Evaluation Application Fee - $65 Engineering Permit Application Fee - $115 Gravity System Application Fee - $50	Innovative System Permit Application Fee - $2,500	Not available	Innovative/Alternative (I/A) System Application Fee - $3,675 IA System Permit Fee - $50/yr/home $200 per site visit by operator $100 per sampling visit	Not available	Not available	A/E technology renewal fees: Class One or Two - $1,000 Experimental - $2,000 Class One or Two renewal - $500 Experimental renewal - $1,000	Not available
	Warranty		X				X		
	Research and Development studies	X	X		X	X			
	Results of previous testing	X	X		X	X			
	Registered 3rd party report	X	X	X					
	# of systems to test		X						X (20 to 50)
	Requested test period		X						2 yrs
	Sampling and analysis protocol proposed	X	X		X				X

Approval Process Component	Delaware	Florida	Maryland	Massachusetts	New Jersey	New York - Suffolk County	Rhode Island	Texas
	DNREC	FDOH	MDE	MassDEP	NJDEP	SCDH	RIDEM	TCEQ
Who Can Test	NSF or a University	NSF or NSF-approved	Third party testing facility chosen and trained by the manufacturer	System proponent	NJDEP/NJPDES	NSF or EPA-ETV or a NY-licensed PE	Not specified	NSF or other independent approved by Director

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Approval Process Component	Delaware	Florida	Maryland	Massachusetts	New Jersey	New York - Suffolk County	Rhode Island	Texas
	DNREC	FDOH	MDE	MassDEP	NJDEP	SCDH	RIDEM	TCEQ
WQ Parameters to be Tested	BOD_5, TSS, Fecal coliform, TN	$CBOD_5$, TSS, TN, TP, Fecal coliform	TN, TKN, Nitrate, Nitrite, DO, Temp, BOD, TSS, pH	TN, pH, BOD_5, TSS	Turbidity,Odor, pH	TN, TKN, NH_3, NO_2, NO_3, pH, BOD_5, TSS, Alk, by a Certified Lab	Flow, DO, Temp, BOD_5, TSS, pH, TN, NO_2, NO_3, NH_4, Alk, TKN, O&G	$CBOD_5$, TSS, pH
Test Period Specified	No, proposed by designer	No, proposed by designer	First 12 months	No, proposed by designer	No, proposed by designer	Minimum 1 year	Alt Sys Class I - 4 yrs, Alt Sys Class II - 2 yrs, Alt Comp Class I - 2 yrs, Alt Comp Class II - 1 yr	2 years
Number of Samples Specified	No	No	4 Samples Quarterly	Quarterly	No, proposed by designer	Monthly	Quarterly	No
Special DN requirement	TN: 50 percent removal and less than 20 mg/L	TN: at least 65% removal	TN effluent values less than (1) 19 mg/L and (2) 48 mg/L	TN effluent values less than 19 mg/L	N/A	TN effluent values less than 19 mg/L	preponderance of TN effluent values less than 19 mg/L	N/A
Review by:	Onsite System Advisory Board	FDOH Bureau of Onsite Sewage Programs	by BAT Technical Review Comt	MassDEP and Local Approving Authority	NJDEP/Local Administrative Authority		by OSDS Technical Review Comt	TCEQ
Review Period:	N/A	15 days	Not Specified	Not Specified	N/A	60 days	90 days	N/A
Approved List online?	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Certification Issued?	Not available	Not available	Not available	Contains: general design requirements, general certification requirements, operation and maintenance requirements, and reporting requirements	Contains: general design requirements, general certification requirements, construction requirements, operation and maintenance requirements, and site requirements	Not available	Contains: general design requirements, general certification requirements, operation and maintenance requirements, and reporting requirements	Not available
Training Required?	Homeowners required to have O&M contract and homeowners may get trained.	Not available	Not available	Some counties require O&M contracts	Not available	Not available	Yes: for licensed designers, installers and inspectors / maintainers	Not available
Certification of Designers	Yes	PE	Not available	PE	PE	Not available	Yes	Not available
Certification of Installers	Yes	Yes	Not available	Yes	Yes	Not available	Yes	Not available
Certification of Inspectors	Yes	Yes	Not available	Yes	Yes	Not available	Yes	Not available
Certification of Maintainers	Homeowners required to have O&M contract.	Yes	Not available	Yes	Yes	Not available	Yes	Not available
Onsite System Registration or Permit?	Not specified	Not specified	Not available	Not specified	Not available	Yes, required, renewed every 3 years	None	Not available

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1.5 Summary of Best Practices for Application and Approval of AIE Technologies in Hawai'i

The goal for DOH should be to create a procedure and set of requirements that first and foremost protects public health and the environment, and then balances information/data needs, department review time, program complexity, program staff needs/costs, testing duration, testing costs, testing oversight, designer needs, installer needs, and homeowner needs/costs. These are a lot of issues to consider and there is no perfect system. A good AEI approval system will ensure the following:

- Applicants will not have questions during application preparation.
- All information needed by DOH to decide on approval is included in the application and in a standard format/order to facilitate efficient review.
- There are a small number of different types/phases of permits to manage.
- There is not an overwhelming amount of water quality data to analyze, but there is enough to assess system performance and reliability.
- The approval process will allow accurate assessment of O&M requirements and costs.

These characteristics were integrated with the assessment of the approval processes of the 8 states and interviews with some state agencies to develop the following considerations for revision of Hawai'i's approval process components (see Appendix A for notes of interviews with other states) :

1. **Additional agency staff.** Most state agencies expressed concerns that they are understaffed to manage their conversion programs. Staff members manage anywhere from 100 to 3,000 permit applications per staff member per year. Most agencies desire more staff so that they can do more inspections and follow up on converted systems.
2. **Application fee and program funding.** Most states also expressed concerns that they are underfunded. Adoption of an appropriate application fee that will cover the total cost of review and approval of new technologies is recommended. Other agencies also recommend that fees go to a dedicated (versus general) fund for cesspool conversion program management. In addition, other states recommend point-of-sale conversion and notification of DOH to be required by law with meaningful fines for non-compliance.
3. **Standardized application forms and templates.** Utilizing a standardized application form (form-fillable) could help to streamline the application review and approval process (Rhode Island form is a good example).Likewise, standardized templates for required submittals could help the review process (form-fillable, specific clear format). An example of a local guidance document is the the Honolulu's Storm Water Quality Report template. Suggested submittal materials include; technology description/info, design criteria, installation criteria, O&M requirements, warranty info, and results of previous studies. Some states also require registered third party reports, and/or draft manuals for owners, designers, installers, inspectors and maintainers.
4. **Water quality standards.** Consider multiple sets of water quality numerical standards such as:
   a. Secondary treatment.
   b. Advanced wastewater treatment – for where TN removal is required or desired.

   Parameters may include: TSS, BOD_5, pH, Alk, TN, TP, NH_3, NO_2, NO_3, and fecal coliform. However, interviews with other state agencies showed that the common, recommended monitoring parameters are TKN, NO_2, and NO_3.

5. **Certified laboratories.** Requiring that testing is completed according to NSF, ASTM, or EPA-approved entities or other by a qualified third party will help to bolster testing integrity.

6. **Testing period, sampling intervals, and number of systems tested.** The testing period for AIE technologies should be performed for an appropriate time frame to demonstrate satisfactory performance (e.g. 12 months minimum). The sampling interval should be at least monthly. Multiple systems should be tested (e.g. minimum of 10). Interviews with other state agencies showed sampling and monitoring data can get unwieldy to manage. One common recommendation was for a good database program to facilitate data management and utilization. A good database program could help Hawaiʻi to track long-term performance of systems, which other states have been unable to implement.
7. **Approvals.** Consider limiting approvals to just one type of system – called AIE systems. Interviews with other state agencies showed the common recommendation for a simplified approval process. Consider having two types Provisional and Approved, to allow a probationary period followed by conversion to approved. The approval should be permanent, however, there should be a periodic review of process performance – conducted by a hired third party. Consider maintenance of list of approved AIE technologies on the DOH webpage.
8. **Consider not issuing official certifications for AIE technologies.** Of the states reviewed, only Rhode Island issues certifications. When the RIDEM approves an AIE technology, they issue a certification document. These certifications have the appearance of RIDEM endorsing particular technologies, which may not be a good approach for Hawaiʻi.
9. **Certifications and Training.** Consider implementation of a certification program (and maintain lists on the DOH webpage) for:
    a. Designers
    b. Installers
    c. Inspector/Maintainers

    Consider requiring manufacturers of approved AIE technologies to provide public trainings for the certified individuals. Other states often require O&M contracts of homeowners or homeowner training. In addition, other states recommend monitoring inspection services to avoid falsification of reports.

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Appendix A

NOTES FROM INTERVIEWS WITH OTHER STATES

1. Contact: Emily-Michele Olmsted
Barnstable County Dept of Health & Environment (BCDHE), Massachusetts

Phone: (508) 375-6901 (talked on 9 June 2020)

Email: Emilymichele.Olmsted@barnstablecounty.org

Question	Response/Notes
How many people are needed?	One full-time person can handle 3,000 permits. Emily has been there 4.5 yrs and the number has increased from 500 to 3000 permits. This involves 27,000 samples and 43,000 inspections. There are about 25 private operators/firms.
Are more people needed?	Yes, then would be able to do more follow-up
Costs of program?	N/A
How does the management program work?	Either a town or county board of health or the State runs the program – depends on location. If the homesite is near the shore or nitrogen is otherwise a concern, then an I/A system is required and TN must be 19 mg/L or less. Otherwise a concrete septic tank and absorption system is OK. Barnstable Co has a database system that tracks required O&M contracts, reported inspection data and sample collection/data. The operators enter data on-line into the database. Database informs Emily when contracts expire. 1st letter sent by regular mail, 2nd by certified mail. 90% comply with these two steps. After that goes to collection/fines.
New approvals	Approvals of new I/A are done at State level: Pilot 12 systems w/monthly sampling; Provisional w/quarterly sampling; General Use. Measure lots of things (not sure how determined initially): CBOD/BOD, TSS, TN, NH_3, NO_2, NO_3, TP, pH, temp, DO, conductivity
Fees?	I/A application fee: $3675. I/A systems Permit fee: $50 per year per home – collected by operators (they transfer to BCDHE). Site visit by operator $200 plus $100 for sampling. This adds up to $1200/yr if require quarterly maintenance/sampling.
Online information?	Lists of certified operators, but not engineers or vendors. Rules, procedures, etc.
Public outreach efforts?	Website mainly. Only do a hodge-podge of occasional community events.
Recommendations	Set-up for success – put system type on the house deed. When transfer of deed – a septic survey is required. Partner with environmental groups. Provide education of homeowners – if no info, they don't want to pay – if don't understand, they think it is not working Have random Q/A checks on operators and their data (split samples).
Issues/problems?	More staff needed. Eliminate incentive to lie by operators. Homeowners know that there are 15 towns on the Cape and that you cannot watch 100% of them.

Question	Response/Notes
What to measure?	Recommend: only measure $CBOD_5$/TSS/TN quarterly for 1-2 years, then can request reduction to annual measurements. Labs need to be available locally (on same island).
Interesting data	There are 11 types of I/A systems with lots of data. They track what percentage meet the 19 mg/L TN median requirement. Most systems = FAST (709) which has 59% meeting; Singulair (170) 65% meeting; Advantex (67) 67% meeting; Bioclere (66) 74% meeting; SeptiTech (57) 60% meeting, etc.
Enforcement?	From the data above, it seems that there are at least 1000+ systems not in compliance: Previously: If an annual sample reading exceeded 19 mg/L N – had to test again w/in 45 days. If less than 19, then can resume annual sampling. If second sample is greater than 19, then start quarterly sampling and keep going until 4 consecutive quarterly samples are all less than 19 – then go to annual. Current: If an annual sample reading exceeds 19 mg/L N – the owner gets a notice that they "shall repair, replace, modify, or take other action as required by the approving authority..."

2. Contact: Stephen Tyrrell
Rhode Island Dept of Environmental Management (RIDEM), Rhode Island

Phone: (401) 222-4700 (talked on 11 June 2020)

Email: Stephen.Tyrrell@dem.ri.gov

Question	Response/Notes
How many people are needed?	They have one full-time person plus a half-time inspector to run the cesspool phase-out program. There are a total of 9,000 A/E systems approved and about 7,000 in service. There is inspection at end of construction, however, after installed, there is no tracking except for overflows. No permits or data collection programs. Stephen has been there three years. They handle a few hundred per year – this is all point-of sale upgrades. The permitting Department (separate) approves 500-600 systems per year and they have 6 engineers and 2 supervisors.
Are more people needed?	Yes, 3-5 people needed, so then could find cesspools, issue NOVs, follow-up, etc.
Costs of program?	N/A
How does the management program work?	Started in 2007 – went after 1400 cesspools within 200 ft of coast (all homes older than 1968 when septic law went into effect). Sent 3 letters over one year. Had good response. Enforcement was 4th letter with $200 fine. Fine should have been $2500 (Stephen). 2010 Point-of-sale amendment – was watered down at end – disclosure to RIDEM not required by law – but probably most do fix it. Enforcement is during spring when snow melts and there are overflows. In winter catch-up, look for old homes in a town-by-town basis. After construction, owner must show service contract – vendor must provide. After that there is no follow-up, no reporting, no data.
Recommendations	Record notice of cesspool on Land Evidence Record (deed). Have a good website – Stephen feels like theirs is TERRIBLE.
Issues/problems?	More staff needed. No follow-up No source of revenue – fees needed No data on whether systems are performing
Interesting data	They have a loan program with 1% interest. Use Rhode Island Infrastucture Bank (RIIB). There is $300 origination fee and 1% annual servicing fee, and that is it. Can get up to $25,000 and term up to 10 years. Can use for engineering and construction fees.

3. Contact: Brian Lafaille
Rhode Island Dept of Environmental Management (RIDEM), Rhode Island

Phone: (401) 255-6987 (talked on 24 June 2020)

Email: Brian.Lafaille@dem.ri.gov

Question	Response/Notes
How many people are needed?	Brian is the principal Engineer in the program, 14 yrs there. He has 11 people at the state level for all on-site enforcement, including 4 inspectors. There are 4 people for plan review, permitting. Per year: 2300 site reviews, 5000 permit reviews, 11,000 inspections. Once built, there is little oversight.
Are more people needed?	Yes, then would be able to do more follow-up
Costs of program?	N/A
How does the approval process work?	A lot of N-removal systems were approved with a limit of 50 units in the ground for a given technology – then data required to put more in. But no one followed up, now some vendors have 250 in the ground and no data. Now require data for 10 systems, quarterly for one year, before can install more. RI issued certificates to technologies, required annual reporting, # of homes, etc. – no follow-up was done – cancelled this (still shows on website). New: all technologies have a 5-year renewal – require data to be submitted.
Fees?	Only fees are for new/renew A/E technologies, none for homeowners. \$1,000 for Class One or Class Two, \$2,000 for Experimental, \$500 for renewal of Class One or Two, \$1,000 for renewal of Experimental. No annual fees for homeowners.
Public outreach efforts?	N/A
Recommendations	State mandates need to be funded by the state. Put in place a utility management fee to ensure a funding stream. Septic loan program is good. If you want to only get experienced vendors – just have one classification. If want to help develop new technologies – have two classifications. If want to allow experimental systems – have three classifications. General: keep it simple, don't need elaborate/fancy/complicated program. Set application submittal standards. Set the time for approval – 90d. Consider sea level rise.
Issues/problems?	More staff needed. Technical Review Committee exists to approve A/E systems. Includes builders, engineers, presentations by vendors, discussion, votes, members did not study the materials, cumbersome process for staff which had to do the back-and-forth with the vendors, staff did all the work. Have such a panel just make recommendations.
What to measure?	Currently: Flow, DO, Temp, BOD_5, TSS, pH, TN, NO_2, NO_3, NH_4, Alk, TKN, O&G – these are all good.

4. Contact: Jason Baumgartner
Delaware Dept of Natural Resources and Environmental Control (DNREC), Delaware)

Phone: (302) 233-5434 (talked on 26 June 2020)

Email: Jason.Baumgartner@delaware.gov

Question	Response/Notes
How many people are needed?	Delaware has 70,000 on-site systems. Cesspools were banned in 2015, with all systems to be replaced within one year of discovery.
Are more people needed?	Yes, then would be able to do more follow-up
Costs of program?	N/A
How does the management program work?	Homeowners are required to have an O&M contract. Homeowners can take training and get certified to maintain and inspect their own systems. About 1500 systems in DE require O&M contract. Inspections every 6 months are required and an annual report. Before 2007, the state provided inspectors to visit every system once per 3 years (no fee for this service). There is too much data to look at. No time. Used to track inspections – this has been in limbo for 2 years. Inspections are very basic – based on vendor input – really just whether it is operating – no sampling data is required.
New approvals	Application is on the web. There were a lot in 2005 at start, then very few after that. Third party testing is ok. NSF testing is not required. This works fine. Require 50% removal AND less than 20 mg/L TN. Vendors did group trainings initially, but then never again. Vendors certified the people to do O&M initially. They should have annual updates/recertification.
Fees?	I/A application fee: $0. $65 site evaluation application. $115 Engineering permit application. $50 gravity system application. No annual fees for homeowners.
Recommendations	Make fee for new I/A systems; should be $2500. Allow homeowners to get trained to inspect and maintain their system – it works. Tracking is critically important – they have little/none. Need to know which are being inspected or not and how well/if performing.

5. Contact: Justin Jobin
Suffolk County Dept of Health Services (SCDHS), New York)

Phone: (631) 599-3321 (talked on 10 July 2020)

Email: Justin.Jobin@suffolkcountyny.gov

Question	Response/Notes
How many people are needed?	Suffolk County is 1.5 million population, they have 250,000 cesspools. I/A program has 16 people, including 12 that work on grant/loan program (can get up to $30,000 in grants for a system). There is a 500-person waiting list for funding. Permitting needs 1 engineer per thousand apps. They have 20 sanitarians who can do 200 inspections per year each. There are 300 I/A systems installed per year.
Are more people needed?	Yes, then would be able to do more follow-up
Costs of program?	N/A
How does the management program work?	Three-legged stool (sewering, clustering, individual I/A's)
New approvals	How much data is really needed? A study was conducted and determined that for 90% confidence, need 12 data points from 20 operating systems. This is to know whether a system meets the less than 19 mg/L TN standard for I/A's.
Fees?	N/A
Public outreach efforts?	WQ issues are very visible in NY, fish kills, red/brown tides, reduced clam harvests. They go to 100's of events – that lots of people attend – very visible. There was a very visible technology demonstration program at the start – they gave lots of tours of systems that were half buried. They have partnered with various environmental groups – they helped a lot, lobbying for funding, keeping grants non-taxable, also boots-on-the-ground to get word out about the program.
Recommendations	They are currently updating their rules. New systems need monthly data for one year from 20 systems. For all others, annual sampling – are changing to once every 3 years. Experimental systems classification is still needed. General use Class need the 20 x 12 samples – vendor should pay for all of this. Suggest if lot is < 10,000 sf, require N-removal. Need a revenue fund. Suffolk Co is trying to get a monthly fee of $5. Need a grant to get started – NY State gave $3M grant to start this program and it only got started because of this grant.
Issues/problems?	Trying to get a revenue fund - $5 monthly fee (or $1/1000 gal water use). Need $70-100 Million/yr to run the program long-term.
What to measure?	Recommend for long-term monitoring: Sample parameters - Just need TKN and NO_3/NO_2. Also need pH, temperature in the field. Do not need BOD, TSS, ammonia. With just TKN and NO_3/NO_2 should be only $25/sample.
Interesting data	Pressure drain fields that are very shallow (18 inches deep) are OK since 2018/2019. These have shallow/narrow drainfields. These are

Question	Response/Notes
	very popular and good, they facilitate uptake of NO_3 by the plants/grass. There are 13 proprietary technologies approved and 8 with provisional approval. The smallest size ones are most popular. Only 8 passed the <19 mg/L TN requirement even though they had passed the NSF 245 approval (50% TN removal). They currently get 40% FujiClean, 30% HydroAction, then three that are smaller and similar (SeptiTech, Norweco, Orenco). Grants funding is very large in NY; since 2017, get $2M/yr. Upgrades can get $10,000 from NY state, plus $10,000 from Suffolk County, plus $5000 for pressure drain field, plus $5000 for low income (<80% MFI) – thus the total is $30,000. The average replacement cost is $27,000. In one city (Southampton) there is an additional $20,000 rebate possible – thus total is $50,000 possible. They do this via a fund from a 2% property transfer tax. Mostly local assembly/manufacturing is occurring – lots of jobs. A good database system is critical. Got a $2M grant from NY State to build a new in-house one. Currently using a private vendor system (Ocello from CA – start at $1/system to set up). Other vendors include Carmody and Orenco. Need to be able to track compliance, reports, data, due dates, enforcement actions, letters, etc.

6. Contact: Marcelo Blanco
Florida Dept of Health & Environment (FDOH), Florida)

Phone: (850) 491-0850 (talked on 24 July 2020)

Email: Marcelo.Blanco@flhealth.gov

Question	Response/Notes
How many people are needed?	N/A
Are more people needed?	N/A
Costs of program?	N/A
Fees?	Innovative systems permit (ISP) application fee is $2500.
How does the management program work?	Blanco recommended that I talk to Dr. Eberard Roeder for more info. Blanco is the Environmental Administrator and handles rules/policy for statewide program. There are 67 county health department offices – permits are issued at that level. They have an in-house database for everything and are currently building a new one. There is an annual fee for inspection. There is a requirement to have a maintenance contract in place. New rules are currently being drafted/issued.
Recommendations	Allow homeowners to get trained to inspect and maintain their system – it works. Twice per year inspection on own, submit reports, then have annual county inspection. In first few years, vendors should supply parts for systems, after that let engineers specify replacement parts – less costly. Technical Review Committee to approve I/A systems is good – gets everyone at the table, there have been no rules challenges faced yet – perhaps due to this committee.
Issues/problems?	N/A
Interesting data	One location in Florida Keys has a sewer utility that replaced a few hundred cesspools with N-removing IWS's. They paid for the replacements, they own, operate, and maintain all the systems. They have an easement to own/operate the systems located on private property. The homeowner pays the regular sewer fee (as if connected).

Appendix B

APPROVED INNOVATIVE/ALTERNATIVE SYSTEMS FOR DELAWARE

Table 1B Approved Innovative / Alternative Systems for Delaware

Proprietary Name	Meets PSN3	Approval Issued To	Approval Document
AdvanTex Treatment System AX-20 *	Yes	Orenco Systems, Inc	AdvanTex Treatment AX-20
AdvanTex AX-RT Treatment System	Yes	Orenco Systems, Inc	AdvanTex AX-RT Treatment System
Advanced Enviro-Septic® Treatment System		Presby Environmental	Advanced Enviro-Septic
AeroCell® SCAT Treatment Unit	Yes	Quanics, Inc.	AeroCell SCAT Treatment
American Manufacturing Perc-Rite(r) Drip Dispersal System - ASD	Yes	American Manufacturing Company	American ASD
American Manufacturing Perc-Rite(r) Drip Dispersal System - WD	Yes	American Manufacturing Company	American WD
Amphidrome Wastewater Treatment Systems		F.R. Mahony & Associates	Amphidrome Approval
Aqua Aire Aerobic Treatment Unit	Yes	Ecological Tanks, Inc.	Aqua Aire Approval.pdf
Aqua Safe Aerobic Treatment Unit	Yes	Ecological Tanks, Inc.	Aqua Safe Approval.pdf
Aquaworx Remediator		Aquaworx Remediator (A division of Infiltrator Systems, Inc.)	Aquaworx Remediator
BioBarrier Membrane Bioreactor System 0.5, 1.0, and 1.5		Bio-Microbics Incorporated	BioBarrier Approval.doc
Bioclere Advanced Treatment Unit	Yes	AquaPoint	Bioclere Advanced Treatment Unit
Bio-Coir® SCAT Treatment Unit	Yes	Quanics, Inc.	Bio-Coir SCAT Treatment Unit
Bio-Microbics FAST Advanced Treatment Unit	Yes	Bio-Microbics Incorporated	Bio-Microbics FAST Advanced Treatment Unit
Bio-Microbics RetroFAST Advanced Treatment Unit	Yes	Bio-Microbics Incorporated	Bio-Microbics RetroFAST Advanced Treatment Unit
Clearstream Advanced Treatment Unit		Clearstream Wastewater Systems, Inc.	Clearstream Advanced Treatment Unit
Cromaglass Advanced Treatment Systems	Yes	Cromaglass Corporation	Cromaglass Advanced Treatment Systems
Delta Pre-Engineered Drip*		Delta Environmental Products	Delta Pre-Engineered Drip
Delta Ultra Clear Aerobic Treatment Unit		Delta Environmental Products	Delta Ultra Clear Aerobic Treatment Unit

Proprietary Name	Meets PSN3	Approval Issued To	Approval Document
Delta Whitewater Aerobic Treatment Unit		Delta Environmental Products	Delta Whitewater Aerobic Treatment Unit
Ecoflo Coco ECDn	Yes	Premier Tech Aqua	Ecoflo Coco ECDn
Ecoflo Peat Biofilter		Premier Tech Aqua	Ecoflo Peat Biofilter
Ecopod Advanced Treatment Unit	Yes	Delta Environmental Products	Ecopod Advanced Treatment Unit
ECO-PURE 300 Series Peat Moss Biofilter		ECO-PURE Waste Water Systems	ECO-PURE 300 Series Peat Moss Biofilter
Enviro-Flo Advanced Treatment Unit		Enviro-Flo Inc.	Enviro-Flo Advanced Treatment Unit
E-Z Treat Advanced Treatment		E-Z Set Tank Company	E-Z Treat Advanced Treatment
Fuji Clean CEN-Series Advanced Treatment Unit	Yes	Fuji Clean USA, LLC	Fuji Clean CEN-Series Advanced Treatment Unit
Geoflow "drip" Dispersal System		Geoflow	Geoflow Dispersal System
H-Series Hoot System	Yes	Hoot Aerobic Systems Inc.	H-Series Hoot System
Hydo-Kinetic Model 600 FEU Advanced Treatment Unit	Yes	Norweco Equipment Company	Hydro Kinetic
Jet 500-CF Advanced Treatment Unit		Jet Inc.	Jet Aerobic Treatment Unit
Jet Aerobic Treatment Unit		Jet Inc.	Jet Aerobic Treatment Unit
Nitrex Filter Advanced Treatment Unit	Yes	Lombardo Associates, Inc.	Nitrex FilterAdvanced Treatment Unit
SludgeHammer Group, Ltd		SludgeHammer	SludgeHammer Group
Platinum Submerged Aerated Filter	Yes	ANUA	Platinum Submerged Aerated Filter
Puraflo Peat Biofilter		ANUA	Puraflo Peat Biofilter
Puraflo Peat Biofilter Denitrification System	Yes	ANUA	Puraflo Peat Biofilter DenitrificationSystem
PuraSys SBR Advanced Treatment Unit	Yes	ANUA	PuraSys SBR Advanced Treatment Unit
Singulair Green Model TNT Advanced Treatment Unit	Yes	Norweco Equipment Company	Singulair Green TNT Advanced Treatment Unit
Singulair Model 960 Advanced Treatment Unit		Norweco Equipment Company	Singulair 960 Advanced Treatment Unit
Singulair Model TNT Advanced Treatment Unit	Yes	Norweco Equipment Company	Singulair TNT Advanced Treatment Unit
White Knight Enhanced Biological Augmentation System		Knight Treatment Systems	White Knight Enhanced Biological Augmentation System

Hawaiʻi State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 2
SEPTIC TANK SYSTEMS REVIEW

FINAL | November 2020

carollo

in association with

College of ENGINEERING
UNIVERSITY OF HAWAIʻI AT MĀNOA

Hawaiʻi State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 2
SEPTIC TANK SYSTEMS REVIEW

FINAL | November 2020

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THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.

SIGNATURE

04/30/2022
EXPIRATION DATE OF THE LICENSE

Contents

Technical Memorandum 2: Septic Tank Systems Review

Appendices

Tables

Figures

Abbreviations

ANSI	American National Standards Institute
BOD	biochemical oxygen demand
BWS	Honolulu Board of Water Supply
Carollo	Carollo Engineers, Inc.
CCWG	Cesspool Conversion Working Group
DOH	Hawaiʻi State Department of Health Wastewater Branch
EPA	United States Environmental Protection Agency
FRP	fiberglass reinforced polyethylene
ft	foot or feet
gpcd	gallons per capita per day
HAR	Hawaiʻi Administrative Rules
IAPMO	International Association of Plumbing and Mechanical Officials
in.	inch(es)
mg/L	milligrams per liter
min/in.	minutes per inch
MPN/100 mL	Most probable number per 100 milliliters
mgd	million gallons per day
N	Nitrogen
OSWT	onsite wastewater treatment
sf	square foot or feet
TM	Technical Memorandum
TSS	Total suspended solids

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Technical Memorandum 2

SEPTIC TANK SYSTEMS REVIEW

2.1 Executive Summary

Throughout Hawaiʻi, there are approximately 88,000 cesspools that release an estimated 53 million gallons per day (mgd) of wastewater to the environment. Most of these existing cesspools provide wastewater disposal for single-family residences, versus large-capacity systems serving multiple residences or commercial areas. Given that over 90 percent of the state's drinking water supplies are from groundwater sources, it was recognized that cesspools pose an environmental and public health risk.

One of the most common and well-known onsite wastewater treatment (OSWT) technologies accepted as a means for upgrading cesspools are septic tanks followed by a soil absorption system, collectively referred to as septic tank systems. Given appropriate site conditions, these systems can provide water quality benefits and may be one of the most cost effective OSWT options for current cesspool owners. The purpose of this technical memorandum (TM) is to present a general description of septic tank systems, discuss appropriate site conditions for their use, identify advantages/disadvantages, and summarize overall performance relative to cesspools. This document is not intended to be a comprehensive guide for cesspool conversion to septic tanks, and those interested in such a conversion should seek the advice of a registered professional engineer and/or licensed general contractor.

Septic tank systems are a common means of wastewater treatment and disposal for small populations, such as individual residences, small institutions, schools, etc., where a centralized sewer system may not be available, or a connection may not be feasible. The septic tank itself is typically constructed from concrete, fiberglass, plastic or other similar material. The size of the tank required is dependent upon the volume of wastewater to be handled which is usually expressed in terms of the number of bathrooms, bedrooms, and/or occupants of a residence. Unlike cesspools, septic tanks have unique inlet and outlet designs, baffles, and compartmentation to facilitate and breakdown its organics, resulting in an increased level of wastewater treatment.

Wastewater flowing out of the septic tank, flows to a soil absorption system for further treatment and ultimate disposal. Figure ES.1 shows a soil absorption system (or drain field) that includes pipes with small holes laid inside a covered trench filled with gravel where septic tank effluent is slowly released to percolate through the soil profile. Both the septic tank and soil absorption system collectively make up the septic tank system for OSWT and disposal.

Current Hawaiʻi wastewater regulations issued by the Hawaiʻi State Department of Health Wastewater Branch (DOH) provide design and installation guidance for septic tank systems. Specific guidance is provided for septic tank volumes, compartmentalization, and materials (Hawaiʻi Administrative Rules [HAR] 11-62-33.1 and International Association of Plumbing and Mechanical Officials [IAPMO] American National Standards Institute [ANSI] Z1000), and for inlet/outlet/internal septic tank requirements. Current regulations also provide guidance for soil absorption systems, which are a key component of effluent treatment and disposal following the septic tank. Space requirements for soil absorption systems can be significant in comparison to the footprint of cesspools. Existing regulations provide guidance on setback requirements, soil percolation tests, slope, and minimum depth to the seasonal high groundwater table.

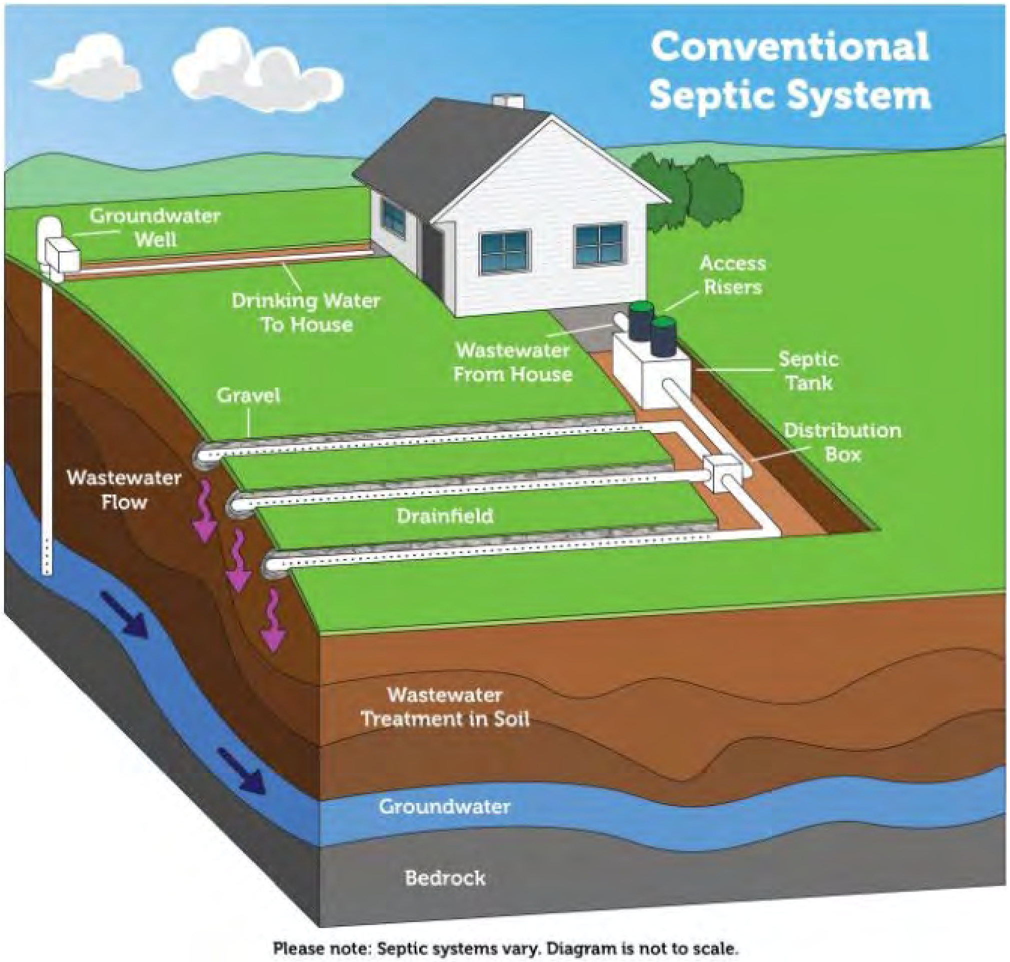


Figure ES.1 Septic Tank with Soil Absorption System or Drain Field (United States Environmental Protection Agency [EPA], 2017)

When designed and sited appropriately, and properly maintained, septic tank systems can provide water quality benefits beyond that which can be achieved by cesspools. Table ES.1 presents the relative water quality of raw residential, septic tank effluent, and following a typical soil absorption system. Cesspools are not designed to provide wastewater treatment; thus, cesspool effluent quality is expected to be similar to raw residential wastewater quality. Septic tank systems can provide improved treatment efficacy for total suspended solids (TSS) and biochemical oxygen demand (BOD), over cesspools.

Septic tank systems can be installed and maintained for relatively lower cost than many other OSWT systems. Maintenance includes periodic inspection, pumping of solids/scum, and cleaning the effluent screen. EPA guidance recommends that septic systems be inspected at least every three years by a professional. The inspector should look for leaks, check for signs of backup, inspect mechanical components (if any), inspect/clean the effluent filter/screen, and empty the tank by pumping out the septage, if necessary.

Table ES.1 Typical Water Quality Data for Raw Residential, Septic Tank Effluent, and Following Soil Absorption System

Contaminant	Typical Raw Residential Wastewater(1)	Typical Septic Tank Effluent Quality(2)	Typical Effluent Quality Following Soil Absorption System(2)
Total Nitrogen, mg N/L(4)	14-40	39-82	~1
TSS (mg/L)	100-400	49-161	~4
BOD (mg/L)	100-400	132-217	<30
Fecal Coliform, MPN/100 mL(3)	~10^6	1-10^6	~13

Notes:
(1) From Table 2-1 (Water Resources Research Center (WRRC) University of Hawaiʻi-Manoa, 2008).
(2) From Table 4-1 in the Onsite Wastewater Treatment Survey and Assessment Study (WRRC, 2008).
(3) MPN/100 mL = most probable number per 100 milliliters.

Homeowners should be cautious of what they put down their drains to avoid overwhelming their septic tank systems with trash, non-degradable materials, or chemicals that could create non-settling suspensions that could clog soil absorption systems.

Hawaiʻi's existing wastewater regulations include a sufficient amount of guidance for septic tank system application and installation (HAR 11-62-31). However, there are two design considerations that DOH may consider reviewing or evaluating in the future:

- **Depth to groundwater table.** One aspect of septic tank system guidance that is recommended for reevaluation is the requirement for the depth to the groundwater table for the soil adsorption system. The evaluation of the depth to the groundwater should be based on the amount of separation required to assure adequate treatment to protect drinking water supplies.
- **Allowable "density" of septic tank systems or numeric limits for total N.** Septic tank systems are known to provide water quality benefits over cesspools. However, septic tank systems do not provide significant treatment for total nitrogen. Upgrading cesspools to septic tank systems in areas with a high density within a small area may not provide significant protection to groundwater or near surface water quality. Limiting the number of septic tank systems allowed within a certain area may help to provide groundwater and near surface water quality protection. Another way to protect water quality is to implement a numeric limit for total N discharged from OSWT.

Figure ES.2 is an example decision tree to help homeowners determine if a septic tank system is a potential option for them to convert their cesspool. The first question asks about the cesspool location relative to coastal waters, surface waters, and potable water supplies based on current regulations. The second question asks if the property is listed in the Priority 1 or Priority 2 areas shown in the 2018 Department of Health (DOH) Act 125 Report[1]. If the first two sets of criteria are met, the minimum lot size question is posed, followed by slope of the property, and depth to the groundwater table. A minimum of 10 feet (ft) depth to the groundwater table was selected as an example. As described above, further evaluation of the requirement of depth to the groundwater table is warranted. This decision tree can be modified as needed but may be a helpful tool for homeowners to determine if upgrading their cesspool to a septic tank system is feasible.

[1] Cesspools located in the Priority 1 areas pose significant risk of human health impacts, drinking water impacts, or draining to sensitive waters. Priority 2 areas have potential impact on drinking water quality.

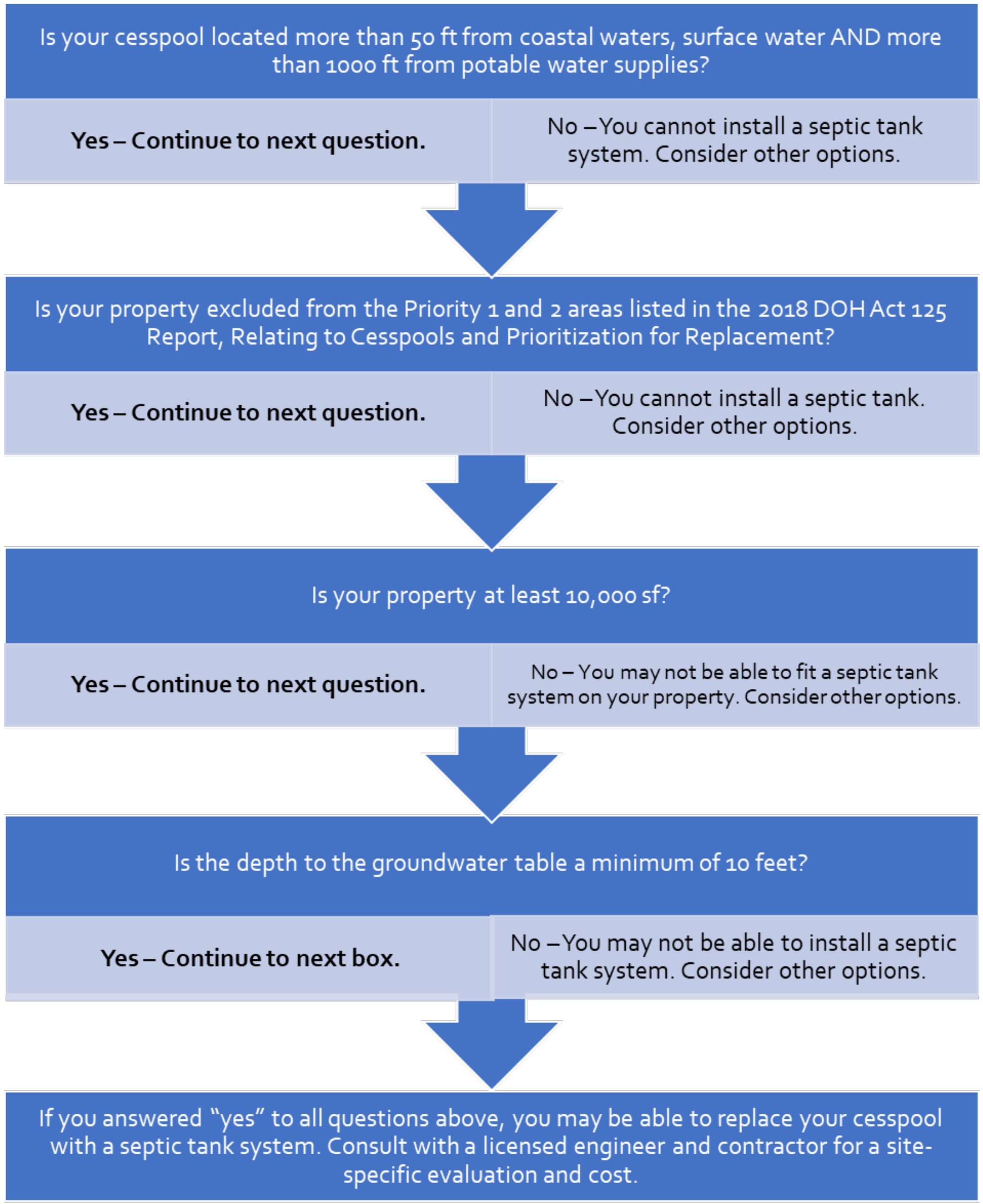


Figure ES.2 Decision Tree to Determine if a Septic Tank System is Feasible for Cesspool Conversion

2.2 Introduction

According to the EPA, cesspools are underground excavations that receive sanitary wastewater from bathrooms, kitchens, and washers. Figure 2.1 is a schematic diagram of a typical cesspool. The structure usually has an open bottom and perforated walls (unlined, except for geotextile on the outside). Domestic wastewater flows into the structure and the solid waste collects at the bottom of the cesspool and the liquid waste flows out of the perforations. Cesspools are not designed to treat wastewater but rather separate sanitary waste and allow liquid wastes to percolate into the soil strata and underlying groundwater table.

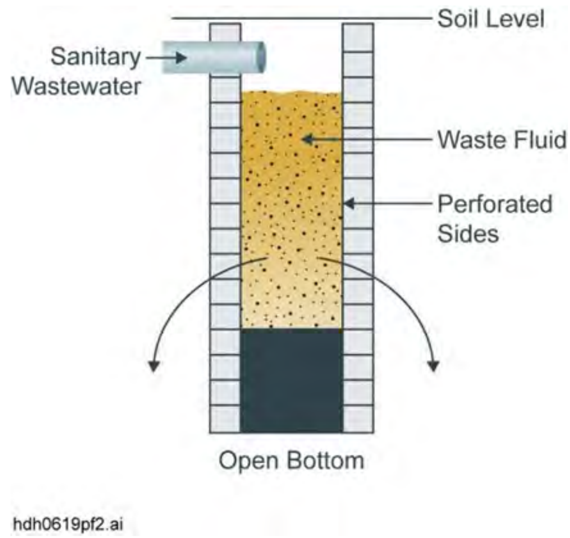


Figure 2.1 Schematic Diagram of a Typical Cesspool

Throughout Hawaiʻi there are approximately 88,000 cesspools that release an estimated 53 mgd of wastewater to the environment. Most of these existing cesspools provide wastewater disposal for single-family residences, versus large-capacity systems service multiple residences or commercial areas. Given that over 90 percent of the state's drinking water supplies are from groundwater sources, it was recognized that cesspools pose an environmental and public health risk.

In 2017, the Hawaiʻi State Legislature passed Act 125, which states that by January 1, 2050 all cesspools in the state of Hawaiʻi, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system (ACT125, 2017). Act 132 was passed in 2018 to establish a Cesspool Conversion Working Group (CCWG) to develop a long range, comprehensive plan and commission a statewide study of sewage contamination in nearshore marine areas (ACT132, 2018). The CCWG retained Carollo Engineers, Inc., (Carollo) to provide expertise on OSWT technologies and cesspool conversion funding and finance options.

Given appropriate site conditions, an engineered system consisting of a septic tank followed by a soil absorption system, collectively referred to as a "septic tank system" may be an appropriate technology to replace existing cesspools. The purpose of this TM is to:

- Provide an overview and identify advantages and disadvantages of septic tank systems.
- Summarize design considerations and best practices for ideal septic tank system performance.
- Summarize maintenance needs for septic tank systems.
- Summarize overall performance of septic tank systems relative to cesspools.

This TM is not intended to be a comprehensive guide for cesspool conversion to septic tanks, and those interested in such a conversion should seek the advice of a registered professional engineer and/or licensed general contractor.

2.3 Overview of Septic Tank Systems

Septic tank systems are a common means of wastewater treatment and disposal for small populations, such as individual residences, small institutions, schools, etc., where a centralized sewer system may not be available, or a connection may not be feasible.

Figure 2.2 shows a cross section of a typical septic tank installation. Domestic wastewater flows from the household sewer pipes into the tank and undergoes settling and anaerobic processes to reduce solids and organics. Septic tanks are designed to hold water under anaerobic conditions for a minimum detention time of 6 to 24 hours during which the removal of settleable solids takes place (EPA, 2002). These solids collect and decompose at the bottom of the tank. Gas entrained with the solids rises through the wastewater to the surface and forms a layer of scum, until the gas escapes at which point the solids settle again. The flow through current from inlet to outlet can carry some of the solids towards the outlet causing them to be discharged with the effluent into the disposal system or soil absorption system[2] (Muralikrishna and Manickam, 2017). An effluent screen or filter can be added to the septic tank outlet to prevent excess solids from flowing out of the septic tank and potentially clogging the soil absorption system piping.

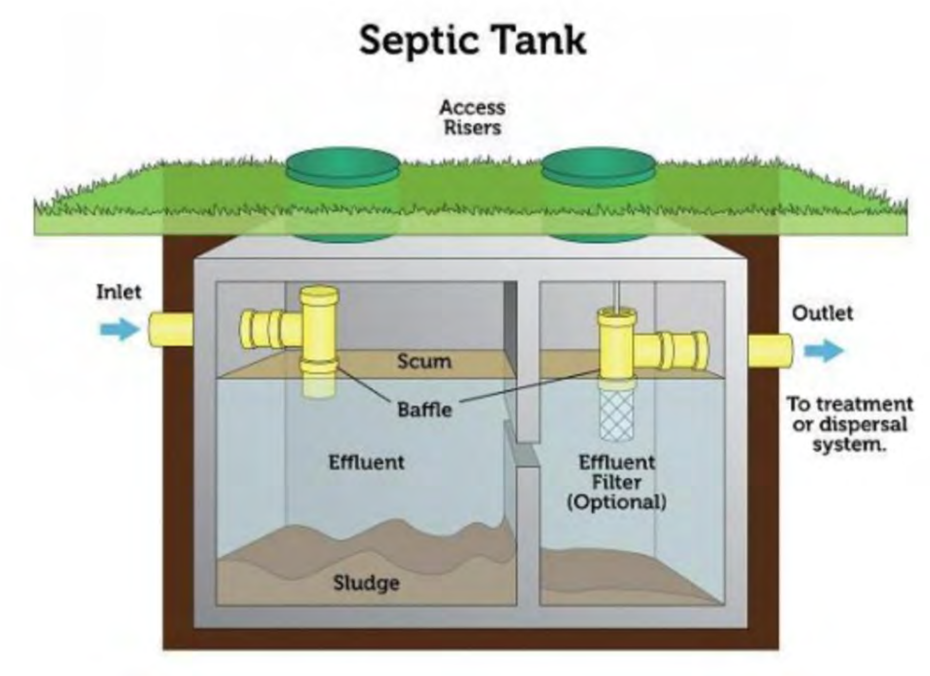


Figure 2.2 Septic Tank with Two Chambers (EPA, 2017)

After leaving the septic tank, wastewater flows to a soil absorption system for further treatment and ultimate disposal. Figure 2.3 shows a soil absorption system (or drain field) that includes pipes with small holes laid inside a covered trench filled with gravel where septic tank effluent is slowly released to percolate through the soil profile. The wastewater treatment efficacy of septic tank systems is dependent on the leaching ability (permeability) of the soil and it requires annual inspection and periodic removal of sludge and scum from the septic tank (Muralikrishna and Manickam, 2017).

Alternative soil absorption system media, such as sand, peat and sawdust, can help to improve removal of nutrients and other contaminants. These options for alternative soil absorption system media will be reviewed and discussed in TM 3 related to this project. This TM will focus on a conventional septic tank and soil absorption system as depicted in Figure 2.3.

[2] In this context, "disposal system" means a soil absorption system (also leach field, drain field, or dispersal system), seepage pit, or disposal trench (HAR 62-01).

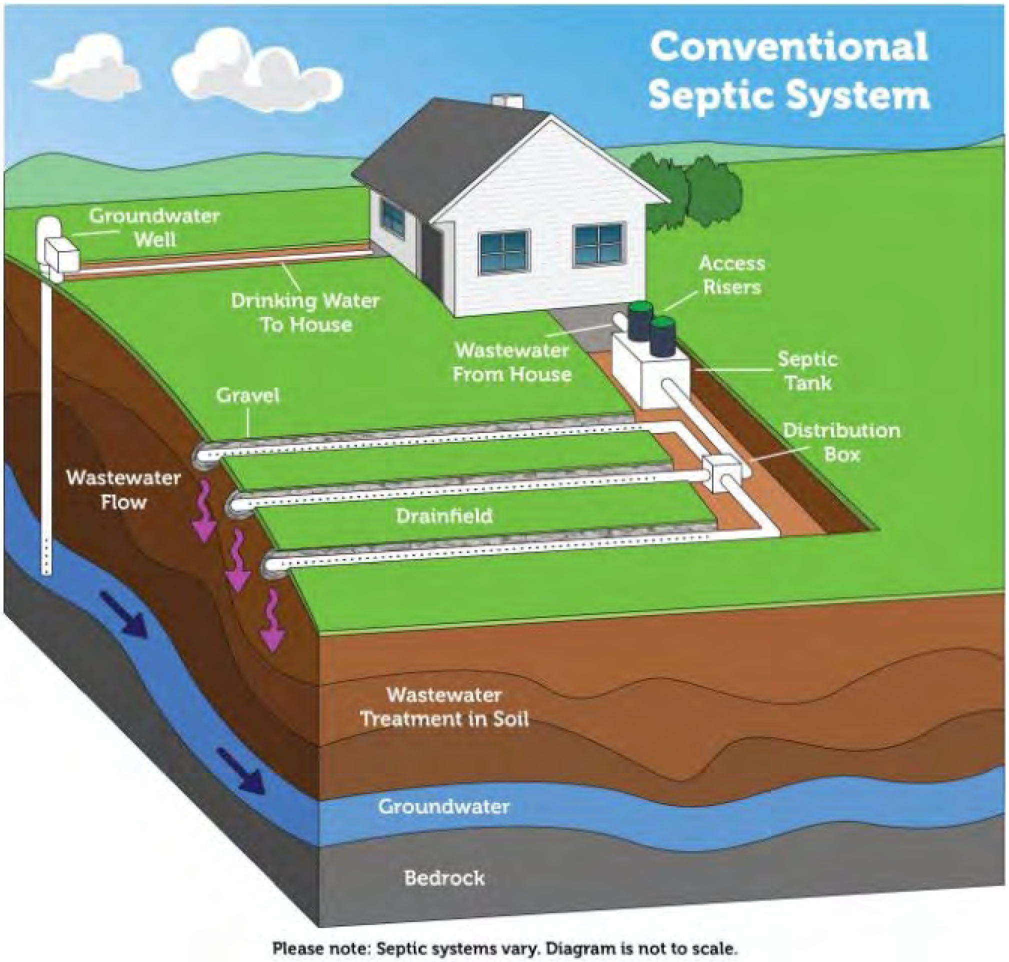


Figure 2.3 Septic Tank with Soil Absorption System or Drain Field (EPA, 2017)

2.3.1 History of Septic Tank Systems

Septic tanks were invented by Jean-Louis Mouras around 1860 in France. Mouras had been trying to design a method of waste disposal without going outside to use the restroom (such as an outhouse). He ran clay pipes from his house to a concrete tank in his backyard and used it successfully for ten years. When he decided to open the tank, both he and his neighbors were surprised to discover that it mostly contained liquid with a layer of scum on top. Subsequently, the system was introduced into the United States in 1883 (Amador and Loomis, 2020).

Following Mouras's design, early American septic tanks were made of concrete or steel and emptied into a soil absorption system. By the 1940s, septic tank systems were relatively inexpensive to build and were popular nationwide in areas that did not have centralized wastewater systems[3] (Amador and Loomis, 2020).

In the 1960s, older septic systems began failing due to cracks and rust found in septic tanks. There were also concerns that the sewage from the soil absorption system was seeping into the groundwater causing local governments to start regulating the placement of absorption systems. The design of the septic tank chambers and soil absorption systems for modern septic tank systems have improved, but septic tanks still

[3] Centralized wastewater systems include sewer collection pipes, wastewater pump stations, and wastewater treatment plants.

need to be regulated and only implemented in areas that fulfill ideal conditions that do not pose risks to contaminating groundwater or surface water (Amador and Loomis, 2020).

Some communities have converted areas of clustered septic tank systems to centralized wastewater collection and treatment to protect water resources and accommodate growth and development. However, septic tank systems are still common throughout the U.S. and provide environmental, public health, and economic benefits to certain communities. More than 60 million people across the United States are currently served by septic tank systems. Septic tank systems are common in New Hampshire, Maine, North Carolina, South Carolina, and Kentucky (EPA, 2017).

2.3.2 Advantages and Disadvantages of Septic Tank Systems

Septic tanks are a simple, passive OSWT system that can reliably manage and dispose of domestic wastewater at a low cost to homeowners with proper siting and maintenance. As with any technology, there are both advantages and disadvantages. Septic tank systems and other OSWT systems can provide upgraded wastewater treatment in comparison to existing cesspools and without implementing costly, centralized or decentralized wastewater infrastructure projects.

The biggest advantages of septic tank systems as an option for occurrence of cesspool upgrades in Hawaiʻi are their simplicity, reliability, and relative low cost. Once they are installed there is no power required and only periodic monitoring and maintenance are necessary. Another big benefit is that a properly designed, well-maintained system can last for decades.

A disadvantage is that there are several site-specific factors that must be considered, including natural soil type and permeability bedrock, groundwater, and site topography for septic tank systems to work effectively. Septic tank systems also have space requirements that can be significant and may not be appropriate for small lots. Most states have adopted regulations pertaining to setbacks from water supply and lot lines, as well as appropriate distance from groundwater, surface water, and coastal areas. During project planning, the characteristics of the influent wastewater should also be considered.

Improperly functioning systems can introduce nitrogen, phosphorus, organic matter, and bacterial and viral pathogens into surrounding areas, groundwater, and/or coastal water. Accumulated sludge and scum must be removed on a regular basis of every three years to prevent carryover of these materials into downstream processes, especially soil absorption systems which can become clogged and generally cannot be cleaned/serviced. Septic tank systems may not be an option for all cesspool conversions in Hawaiʻi.

Homeowners should be cautious of what they put down their drains to avoid overwhelming their septic tank systems with trash, non-degradable materials, or chemicals that could create non-settling suspensions that could clog soil absorption systems. If installed and maintained appropriately, septic tank systems may be a good option for some homeowners in Hawaiʻi that need to convert their existing cesspools.

2.4 Design Considerations and Best Practices for Ideal Septic Tank System Performance

Since its invention, septic tank systems have improved as an OSWT technology. When properly planned/sited, designed, constructed, and maintained, septic tanks can provide sufficient treatment of domestic wastewater prior to release to the subsurface environment. Septic tank systems are prevalent across the United States mainland, and the world. Some systems also exist in Hawaiʻi and are monitored and regulated by DOH. The following section discusses design, siting, performance, and maintenance considerations for septic tank systems.

2.4.1 Design and Siting Considerations

Design considerations for septic tank systems include septic tank volume, geometry, material, compartmentalization, and inlet/outlet design. Siting considerations include depth to groundwater table or location relative to surface waters, lot size, soil characteristics, and slope. The following sections discuss design and siting considerations for septic tank systems as they apply to Hawai‘i for cesspool conversions.

2.4.1.1 Tank Volume

Selection of the septic tank volume is typically based on the number of bedrooms or number of residents in the home. Typically, 250 gallons of septic tank capacity must be added for each bedroom. If the house has a garbage grinder or a hundred gallon or greater tub will require an extra 250 gallons of septic tank capacity. Given that there are many multi-generational and extended family households in Hawai‘i, a per capita wastewater generation rate could also be considered for household designs. Based on water use demand estimates noted in the Honolulu Board of Water Supply's (BWS) Water Master Plan, water conservation has decreased per capita water demands over the last three decades. The estimated per capita water demands for 2020 is 150 gallons per capita per day (gpcd) (BWS, 2016). Assuming a minimum hydraulic retention time[4] of 24 hours, the required septic tank volume can be calculated based on number of residents. Many states have established 1,000 gallons as the minimum volume for a septic tank (EPA, 2002).

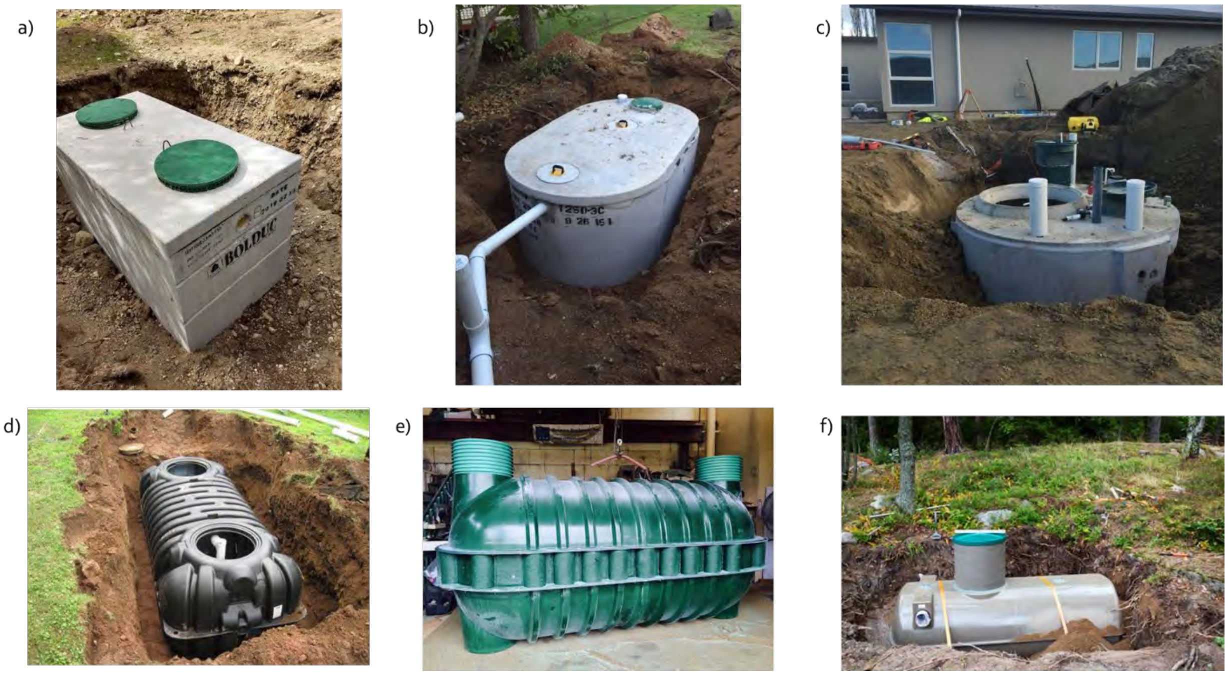
Current OSWT system regulations state that the total wastewater flow per individual system shall not exceed 1,000 gallons per day with a maximum bedroom count of five (HAR 11-62-31.1). The minimum septic tank size is 1,000 gallons for four or less bedrooms and 1,250 gallons for five bedrooms (HAR 11-62-33.1).

2.4.1.2 Tank Geometry, Compartmentalization, and Material

The shape of the septic tank or its geometry impacts the treatment efficacy of the system. The septic tank geometry is important since the treatment mechanism is a physical process where solids settle out of wastewater and primarily liquid waste exits the tank. If the tank geometry does not allow for proper settling of solids, the waste could flow out of the septic tank and potentially clog the soil absorption system and/or contaminate the soils.

Septic tanks can have rectangular, oval, or cylindrical shapes, and be made of concrete, plastic (polyethylene), fiberglass reinforced polyethylene (FRP), or steel. Figure 2.4 shows septic tanks of different shapes and materials. Elongated tanks with a length-to-width ratio of 3:1 or more have been shown to have improved solids removal. However, with improved solids removal, more frequent pumping and maintenance of the septic tank is required (septic tank system maintenance is discussed further in Section 2.3.3). Cylindrical or vertical tanks tend to be less effective in solids removal but have the benefit of a smaller, more compact footprint. A common, specified minimum liquid depth below the outlet invert is 36 inches as shallower depths can result in solids washing out of the septic tank to the soil absorption system and require more frequent pumping maintenance (EPA, 2002).

[4] Hydraulic retention time is the average time that domestic wastewater is stored in the septic tank prior to flowing out of the septic tank and into the leach field.



Notes:

(a) Rectangular, Concrete Tank
(b) Oval, Concrete Tank
(c) Cylindrical, Concrete Tank
(d) Rectangular, Plastic Tank
(e) Fiberglass, Oval Tank
(f) Steel, Horizontal, Cylindrical Tank

Figure 2.4 Examples of Different Septic Tank Shapes and Materials

Septic tanks are required to have at least two compartments (see Figure 2.2). The access risers act as necessary air vents for each compartment to allow for gases generated by biological activity within the compartments to escape.

Septic tank materials can vary and considerations to the homeowners include cost (material, installation, shipping), and structural strength and durability. Table 2.1 is a summary of the advantages and disadvantages of the different septic tank materials. Coated steel tanks are not typically installed since they can corrode easily; thus, steel tanks were excluded from the comparison table.

Septic tanks less than 6,000 gallons are typically prefabricated; however, concrete tanks can be pre-casted or cast-in-place. Concrete tanks are the most durable in comparison to plastic and FRP tanks and are less likely to fail due to structural collapse and/or floatation during flooding. Concrete tanks can be cast-in-place for a custom-shaped tank. However, concrete tanks are typically more expensive than plastic or FRP tanks due to greater shipping and installation costs. Concrete tanks typically require a crane for installation, so contractors will need to be able to get a crane on site. Also, concrete can be subject to corrosion over time with exposure to sewage gases. A coating can be applied to the interior of the tank to help prevent or slow corrosion.

Table 2.1 Comparison of Septic Tank Materials

Septic Tank Material	Advantages	Disadvantages
Concrete	• Durable • Less susceptible to collapse and floatation • May be cast-in-place for custom shape	• Precast tanks can be more expensive than plastic or FRP due to shipping and installation costs • Typically requires use of a crane for installation • Concrete may corrode over time due to acidic sewer gases
Plastic (polyethylene)	• Less expensive than precast concrete tanks (lower shipping and installation costs) • Variety of manufacturers and sizes for desired footprint • Plastics are typically resistant to corrosion • May not require a crane for installation	• Plastic tanks may deform depending upon quality of the plastic and potential structural weaknesses of the material • If not installed properly, plastic tanks can float if flooded
Fiberglass-reinforced polyester (FRP)	• Less expensive than precast concrete tanks (lower shipping and installation costs) • Variety of manufacturers and sizes for desired footprint • Fiberglass is typically resistant to corrosion • May not require a crane for installation • More rigid and sturdy than plastic tanks	• Less structurally strong than concrete tanks • If not installed properly, fiberglass tanks can float if flooded

Plastic tanks are typically made of polyethylene and typically less expensive than concrete tanks due to lower material and shipping costs. There are many different plastic septic tank manufacturers that provide a wide variety of tank sizes and shapes. Plastic tanks may not require the use of a crane since they are lighter in weight than precast concrete tanks. Plastics are also more resistant to corrosion than concrete. The disadvantage of plastic tanks is that they can deform due to structural weaknesses in the material and if they are not installed properly. Plastic tanks can float or shift due to flooding or wet soil conditions.

Similar to plastic, FRP tanks are typically less expensive than concrete tanks due to lower shipping and installation costs. There are many manufacturers that can provide a wide variety of FRP tank volumes and shapes. FRP is resistant to corrosion and may not require a crane for installation. FRP tanks are typically more rigid and sturdy than plastic tanks, but not as structurally strong as concrete tanks. Another disadvantage of FRP tanks is that they can shift under flooding or wet soil conditions.

Current OSWT regulations require that septic tanks meet IAPMO material and property standards for prefabricated septic tanks (IAPMO ANSI Z1000-2013) and shall be approved and listed by IAPMO (HAR 11-62-33.1).

2.4.1.3 Inlet/Outlet/Internal Design

Inlet and outlet baffles can be added to septic tanks to improve hydraulic performance and enhance solids entrapment. A minimum of 2 to 3 inches of drop across the tank from inlet to outlet is recommended to avoid backing up the sewer to the home should the outlet become obstructed. Also, a minimum of 9 inches of headspace is recommended to provide room for scum/floatable waste storage and ventilation. It is recommended that septic tank effluent screens[5] be installed on the tank outlet to prevent larger solids from passing through the tank. Mesh or slotted screens of 1/32 to 1/8 inch are typically used. An access port directly above the outlet is required to remove, inspect, and clean the effluent screens (EPA, 2002).

2.4.1.4 Soil Absorption System Considerations

Determining the soil absorption system size entails striking a balance amongst allowing the septic tank effluent to percolate through the soil without creating subsurface flooding of the soils or ponding and allowing for adequate travel time for the effluent to reach the groundwater table. As the septic tank effluent percolates through the soil, additional treatment of pollutants occurs in the soil column via physical and biological processes.

The required size of the soil absorption system depends upon the design flow rate of the septic tank system, and the percolation or infiltration rates of the soil. The soil percolation rate is a measure of how long it takes for water to drain through soil. Current regulations for OSWT systems require a percolation test at a minimum depth of 3 ft (HAR 11-62-31.2). Typically, clay soils have low percolation rates as it can take a long time for water to drain (60 minutes per inch) (min/in.); whereas sandy, well-drained soil have high percolation rates (5 min/in.). Soil absorption system sizing guidance provided in current wastewater regulations are shown in Appendix A.

EPA provided guidance on soil absorption system sizing with recommended maximum hydraulic and organic loading rates. Appendix B shows maximum loading rates recommended for varying soil conditions for septic tank systems (EPA, 2002).

Once the required area for the soil absorption system is determined, the footprint needs to be accounted for along with the septic tank installation footprint. Note that it is not recommended that structures (homes, sheds, garages, etc.) are constructed over the soil absorption system area as the soil/structural integrity is compromised when saturated with septic tank effluent. However, it is common for soil absorption systems to be constructed with adequate protection under driveways.

2.4.1.5 Siting Considerations

There are several site conditions to consider before installing a septic tank system for cesspool conversions. The site conditions account for the requirements of the complete septic tank system, including the septic tank and the soil absorption system. Some of the key site considerations include lot size, depth to the groundwater table, soil type, distance to the nearest water body, and slope of the property. Table 2.2 summarizes the ideal, acceptable, and unfavorable site conditions for septic tank system installation. Each site condition is discussed in the following sections.

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[5] Effluent screens may also be referred to as effluent filters.

Table 2.2 Conditions for Septic Tank and Soil Absorption System Installation

Site Condition or Design Parameter	Ideal condition	Acceptable	Unfavorable conditions
Lot size	Large lot size(> 10,000 square foot, [sf])	10,000 sf (minimum)	Inadequate space for soil absorption system (Less than 10,000 sf)
Depth to Groundwater Table	Deep water table level	Absorption trench must be a minimum of 3 ft from the seasonal high groundwater table (HAR 11-62-34(a)(1)).	Shallow groundwater table (within 3 ft of the seasonal high groundwater table)
Soil Type	Medium soil percolation rate Sand or Silt	Slow soil percolation rate feasible Silty clay	Low or high percolate rate Gravel or clay
Distance from water	>> 50 ft from coastal waters and/or drinking water supplied		In flood zone or < 50 ft from coastal waters or drinking water supplies
Slope	Sloped down between 1/8 in. per foot and 1/4 in. per foot	No slope is feasible Sloped down greater than 3 in. per foot feasible Maximum slope of 8 percent	Sloping upward

Lot size can prove to be a limiting factor in the feasibility of installing a septic tank system. The space requirements of the septic tank and soil absorption system may prove to be several thousands of square feet. Many states have different standards regarding the minimum acceptable lot size. The current minimum lot size for OSWT systems in Hawaiʻi is 10,000 sf (HAR 11-62-31). Lots that do not have sufficient area for septic tank systems may need to utilize alternative OSWT technologies. Current regulations have minimum horizontal spacing requirements for OSWT systems, including septic tanks and soil absorption systems or soil absorption systems. Appendix C includes a summary of current spacing requirements (HAR 11-62, Appendix D, Table II).

Water table depth plays a key role for septic tanks with soil absorption systems. If the water table is too shallow, the septic tank effluent will not have enough seepage time to strip nutrients and bacteria before it enters the groundwater. This can lead to pollution in rivers, streams, and near-shore waters and potentially harm drinking water sources downstream. Also, if the groundwater table is too shallow, it is possible that during heavy usage or storms, the groundwater table may rise and flood the septic tank site. Figure 2.5 shows how major flooding in Hanalei, Kauaʻi caused an installed septic tank to rise out of the ground. Besides dislodging installed septic tanks, rising groundwater levels or surface flooding could lead to significant pollution to the groundwater and surface water as the raw wastewater is released. Another consideration is that groundwater levels are anticipated to rise both along the coastlines and inland areas of Hawaiʻi with rising sea levels due to climate change (Rotzoll and Fletcher, 2012).

Current regulations state that the seasonal high groundwater level must be no less than 3 ft from the bottom of the soil adsorption system. With a minimum adsorption trench depth of 18 inches, the minimum depth to seasonal high groundwater level is 4.5 ft for septic tank systems (HAR 11-62-34).

To protect surface waters and potable water supplies, current OSWT system regulations require minimum horizontal separations. The minimum horizontal distance between soil absorption systems and coastal waters, streams, ponds, lakes or other surface waters is 50 ft. The minimum horizontal distance from potable drinking water supplies, such as groundwater wells or surface water sources is 1,000 ft (HAR 11-62, Appendix D, Table II).

Figure 2.5 Significant Rainfall in April 2018 Caused a Septic Tank to Float in Hanalei, Kauaʻi[6]

Another consideration in siting septic tank systems is the slope of the site. Ideally, the septic tank system is sited and designed such that the wastewater flows by gravity from the house, to the septic tank, to the soil absorption system at the appropriate, evenly distributed rates. If the slope of the site is too steep, it may be difficult to design the septic tank system and wastewater may flow too quickly through the soil absorption system pipes and back up at the end of the pipes, even if installation is feasible.

Current regulations state that soil absorption systems cannot be installed on land with a slope gradient greater than 8 percent. The maximum length of the trench distribution line is 100 ft, with a minimum number of two trenches. The minimum trench width is 18 inches, and the maximum trench width is 36 inches. The bottom of the trench must be a minimum of 18 inches below the finished grade (HAR 11-62-34).

2.4.2 Septic Tank System Performance

When designed and sited appropriately, and properly maintained, septic tank systems can provide water quality benefits beyond that which can be achieved by cesspools. Table 2.3 presents the typical characteristics of raw domestic wastewater, septic tank effluent, and following soil absorption systems. Available cesspool effluent water quality data is extremely limited. However, it is widely accepted that cesspools are not designed to provide wastewater treatment; cesspool effluent quality can be expected to be similar to that of raw domestic wastewater quality.

[6] Photo by Dolan Eversole. Featured in Ka Pili Kai, Kaʻū 2019, www.hawaiiseagrant.org

Properly designed septic tanks effectively provide similar treatment as primary treatment in conventional wastewater treatment plants. Studies have shown that septic tanks are able to remove TSS and some BOD (Metcalf and Eddy, 1991). The amount of nitrogen removal is only 10-20 percent through septic tanks. Soil absorption systems provide further reductions in TSS, BOD, fecal coliform, and some total nitrogen removal (up to 40 percent). In comparison, cesspools provide some TSS and BOD removal, and no nitrogen removal.

Common requirements for OSWT systems located in areas where surface water or groundwater could be contaminated are for a minimum of 50% nitrogen removal. Some states set numeric limitations of 19 or 20 mg/L of total N. These types of removals cannot be achieved with conventional septic tank systems. Other treatment options exist for such locations. TM 3 will discuss other OSWT technologies that can provide improved total N removal.

Table 2.3 Typical Water Quality Data for Raw Residential, Septic Tank Effluent, and Following Soil Absorption System

Contaminant	Typical Raw Residential Wastewater(1)	Typical Septic Tank Effluent Quality(2)	Typical Effluent Quality Following Soil Absorption System(2)
Total Nitrogen, mg N/L(4)	14-40	39-82	~1
TSS (mg/L)	100-400	49-161	~4
BOD (mg/L)	100-400	132-217	<30
Fecal Coliform, MPN/100 mL(3)	~10^6	1-10^6	~13

Notes:
(1) From Table 2-1 (Water Resources Research Center (WRRC) University of Hawaiʻi-Manoa, 2008).
(2) From Table 4-1 in the Onsite Wastewater Treatment Survey and Assessment Study (WRRC, 2008).
(3) MPN/100 mL = most probable number per 100 milliliters.

2.4.3 Maintenance

Septic tank systems do not require significant maintenance since it is a passive system. Maintenance activities include regular inspections, septage pumping, and periodic cleaning of the effluent filter/screen. These maintenance activities are discussed further in the following section.

EPA guidance recommends that septic systems be inspected at least every 3 years by a professional. The inspector should look for leaks, check for signs of backup, inspect mechanical components, inspect/clean the effluent filter/screen, and empty the tank by pumping out the septage, if necessary.

The inspector should also observe the level of the scum (upper) and sludge (lower) layers within the tank. If the scum later is within 6 inches of the outlet, or if the sludge layer is within 12 inches of the outlet tee, the septic tank should be pumped. Maintaining a log of the scum and sludge layers will help the homeowner to determine how frequent septage pumping may be required. EPA guidance recommends that septic tanks are pumped every three years (EPA, 2005).

Homeowners can also take the following steps to maintain their soil absorption system (EPA, 2005):

- **Plant grasses.** Only grasses should be planted near the septic tank and soil absorption system as roots from larger shrubs or trees could damage the drain field.
- **Do not drive on the soil absorption system unless it is designed for that action.** Avoid driving vehicles over the soil absorption system as the additional load will compact the soil and potentially damage the septic tank or underlying pipes.

- **Manage stormwater.** Keep roof drains and other stormwater drains away from the drain field to avoid flooding and potentially backing up the septic tank system.
- **Avoid toxic and clogging chemicals.** Avoid the use of toxic chemicals/cleaners and disposing of excess paint or cleaning of painting brushes. Latex paints, in particular, can cause clogs within the septic tank system.
- **Reduce food waste and solids.** Reduce use of garbage disposals and food waste disposed in kitchen sinks, which contribute to sludge production and more frequent septage pumping. Minimize washing solids and grit (such as sand) down the drain.

2.5 Relative Cost of Installing and Maintaining Septic Tank Systems

Septic tank systems can be installed and maintained for relatively lower cost than other OSWT systems. Septic tanks generally have no power costs. Maintenance costs include periodic inspection, pumping of solids/scum, and cleaning the effluent filter. Maintenance is generally needed every 2-3 years. For a well-maintained septic tank the replacement interval can be as long as 60 years.

Septic tank installation costs depend on the type of tank material. Plastic and FRP tanks are typically less expensive than concrete tanks. Other installation cost considerations include the cost for cleaning out, filling and closing the old cesspool and preparing the land for the new septic tank and soil absorption system as well as restoring the landscape after installation is complete.

Installation costs of septic tank systems can vary based upon site specific, non-standard conditions, such as poor soils, unknown underground utilities, undocumented structures, large tree removal, placement in traffic bearing areas, and contractor availability (Babcock et al. 2019). Compared to other, more mechanical OSWT systems, septic tank systems are relatively cheaper to install and operate. Actual costs can only be determined following engineering analysis of the specific property and receipt of bids from a licensed contractor.

2.6 Recommendations for Further Evaluation of Septic Tank Systems for Converting Cesspools in Hawaiʻi

Septic tanks are a viable solution to convert cesspools due to their low cost and ease of maintenance. However, there are many factors that must be considered before deciding to use septic tanks. The conditions in Table 2.2 outline the ideal, acceptable, and unfavorable conditions for septic tank system installation.

Hawaiʻi's existing wastewater regulations include a sufficient amount of guidance for septic tank system application and installation (HAR 11-62-31). As discussed previously, existing regulations provide guidance on design requirements for the septic tank volume, compartmentalization, inlet and outlet design, as well as the soil absorption system design. However, there are two design considerations that DOH may consider reviewing or evaluating in the future:

- **Depth to groundwater table.** One aspect of septic tank system guidance that is recommended for reevaluation is the requirement for the depth to the groundwater table for the soil adsorption system. The evaluation of the depth to the groundwater should be based on the amount of separation required to assure adequate treatment to protect drinking water supplies.

- **Allowable "density" of septic tank systems or numeric limits for total N.** Septic tank systems are known to provide water quality benefits over cesspools. However, septic tank systems do not provide significant treatment for total nitrogen. Upgrading cesspools to septic tank systems in areas with a high density within a small area may not provide significant protection to groundwater or near surface water quality. Limiting the number of septic tank systems allowed within a certain area may help to provide groundwater and near surface water quality protection. Another way to protect water quality is to implement a numeric limit for total N discharged from OSWT.

Figure 2.6 is an example decision tree to help homeowners determine if a septic tank system is a potential option for them to convert their cesspool. The first question asks about the cesspool location relative to coastal waters, surface waters, and potable water supplies based on current regulations. The second question asks if the property is listed in the Priority 1 or Priority 2 areas shown in the 2018 DOH Act 125 Report[7].

If the first two sets of criteria are met, the minimum lot size question is posed, followed by slope of the property, and depth to the groundwater table. A minimum of 10 ft depth to the groundwater table was selected as an example. As described above, further evaluation of the requirement of depth to the groundwater table is warranted. This decision tree can be modified as needed but may be a helpful tool for homeowners to determine if upgrading their cesspool to a septic tank system is feasible.

[7] Cesspools located in the Priority 1 areas pose significant risk of human health impacts, drinking water impacts, or draining to sensitive waters. Priority 2 areas have potential impact on drinking water quality.

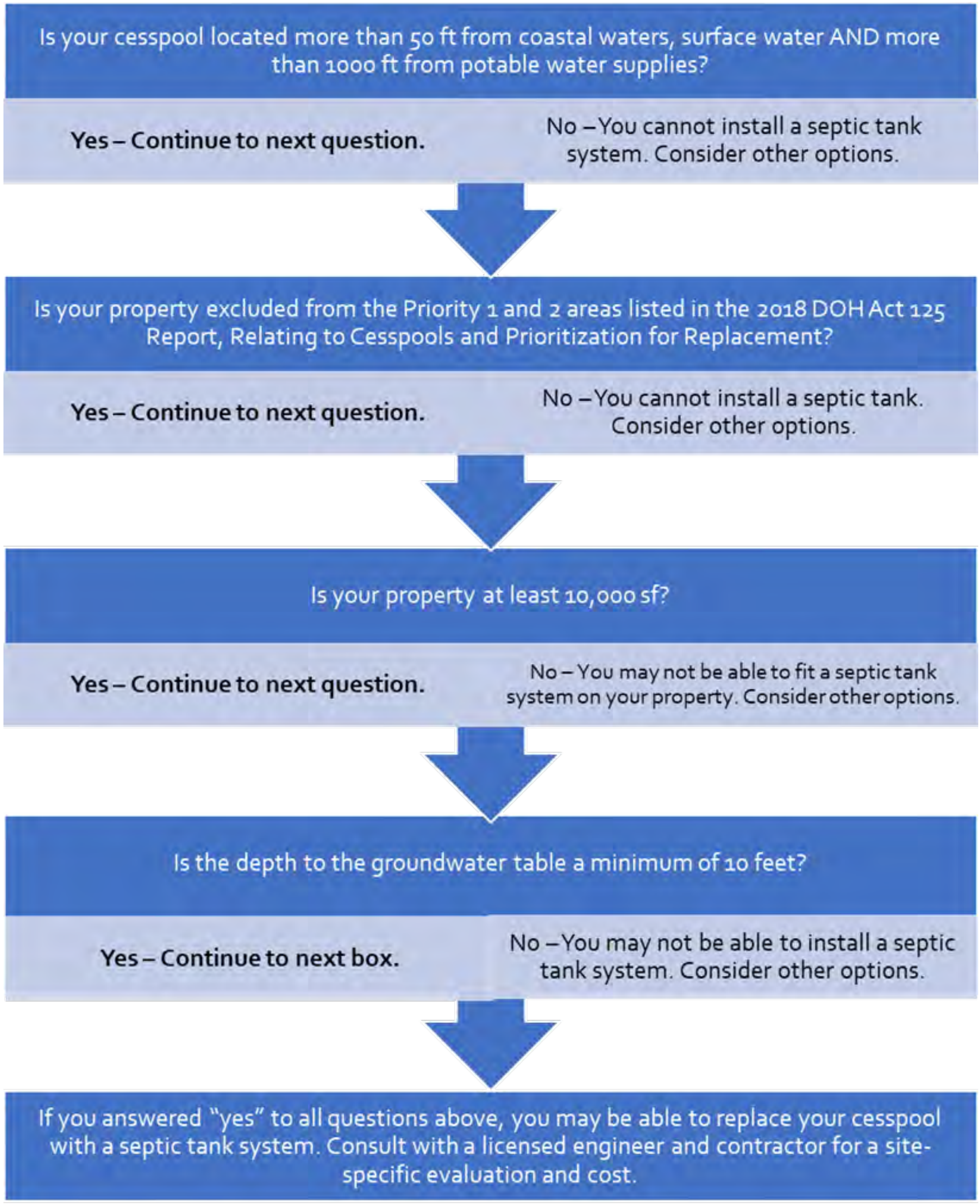

Figure 2.6 Decision Tree to Determine if a Septic Tank System is Feasible for Cesspool Conversion

2.7 References

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Appendix A
SOIL ABSORPTION SYSTEM SIZING GUIDANCE BY VARYING PERCOLATION RATE

Table A.1 Soil absorption System Sizing Guidance by Varying Percolation Rate (HAR 11-62, Appendix D, Table III)

Percolation rate (min/in.) less than or equal to	Required absorption area (sf/bedroom or 200 gallons)	Percolation rate (min/in.) less than or equal to	Required absorption area (sf/bedroom or 200 gallons)
1	70	31	253
2	85	32	257
3	100	33	260
4	115	34	263
5	125	35	267
6	133	36	270
7	141	37	273
8	149	38	277
9	157	39	280
10	165	40	283
11	170	41	287
12	175	42	290
13	180	43	293
14	185	44	297
15	190	45	300
16	194	46	302
17	198	47	304
18	202	48	306
19	206	49	308
20	210	50	310
21	214	51	312
22	218	52	314
23	222	53	316
24	226	54	318
25	230	55	320
26	243	56	322
27	238	57	324
28	242	58	326
29	246	59	328
30	250	60	330

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Appendix B

SUGGESTED HYDRAULIC AND ORGANIC LOADING RATES FOR SIZING INFILTRATION SURFACES

Table B.1 Suggested Hydraulic and Organic Loading Rates for Sizing Infiltration Surfaces (from EPA, 2002)

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

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Appendix C

SPACING REQUIREMENTS FOR OSWT SYSTEMS

Table C.1 Spacing Requirements for OSWT Systems (HAR 11-62, Appendix D, Table II, July 1, 2014)

Minimum Horizontal Distance From	Cesspool (ft)	Treatment Unit (ft)	Seepage Pit (ft)	Soil Adsorption System (ft)
Wall line of any structure or building	5	5	5	5
Property Line	9	5	9	5
Stream, the ocean at the shoreline certification, pond, lake, or other surface water body	50	50	50	50
Large trees	10	5	10	10
Treatment unit	5	5	5	5
Seepage pit	18	5	12	5
Cesspool	18	5	18	5
Soil absorption system	5	5	5	5
Potable water sources serving public water systems	1,000	500	1,000	1,000

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Hawai'i State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 3
ONSITE TREATMENT TECHNOLOGIES EVALUATION

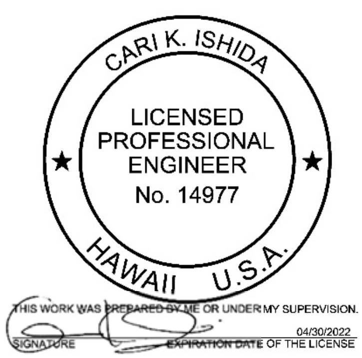
FINAL | June 2020

carollo
in association with College of Engineering University of Hawai'i at Mānoa

Hawaiʻi State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 3
ONSITE TREATMENT TECHNOLOGIES EVALUATION

FINAL | June 2020



Contents

Appendices

Tables

Figures

Abbreviations

ALTT	alternative zero-discharge toilets
ATU	aerobic treatment unit – with nitrification
ATU-DN	ATU with denitrification for N removal
BOD_5	5-day biochemical oxygen demand
BR	bedroom
BW	black water sewage
Carollo	Carollo Engineers, Inc.,
$CBOD_5$	5-day carbonaceous biochemical oxygen demand
CCWG	Cesspool Conversion Working Group
CFU	colony forming unit (on petri dishes)
DIS	disinfection system
DOH	Hawai'i State Department of Health
DRIP	drip irrigation/dispersal system
ELM	Eliminate nitrogen removal system
Engineer	Licensed Civil Engineer in the state of Hawai'i
EPA	US Environmental Protection Agency
ET	evapotranspiration
ETI	evapotranspiration-infiltration
FC	fecal coliform bacteria
FOG	fats, oil, and grease
gpd	gallons per day
GRAY	graywater recycling system
GW	graywater
HAR	Hawai'i Administrative Rules
ITUFL	Innovative treatment units for N removal developed in FL
LCA	Life-cycle-cost analysis
LSTMA	layered soil treatment systems developed in MA
mgd	million gallons per day
mg/L	milligrams per liter
N	nitrogen
N/A	not applicable
NJDEP	New Jersey Department of Environmental Protection
NSF	National Sanitation Foundation
NSF40	NSF Standard 40 for secondary level treatment
NSF245	NSF Standard 245 for enhanced nitrogen removal
NTX	NITREX nitrogen removal system

O&M	operation and maintenance
OSDS	onsite treatment and disposal system
OSWT	onsite wastewater treatment and disposal system
OWTS	onsite wastewater treatment system
PBY	Presby disposal system – standard
PBY-DN	Presby disposal system with N removal
RAW	raw sewage
RGSWA	recirculating gravel system WA
RSF	recirculating sand filter
SABS	soil absorption system
SBR	sequencing batch reactor
SDWB	Safe Drinking Water Branch
SEEP	seepage pit
ST	septic tank
TM	technical memorandum
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
UIC	underground injection control
UV	ultraviolet light
WET	constructed wetland system
WQ	water quality
WWB	Wastewater Branch

Technical Memorandum 3

ONSITE TREATMENT TECHNOLOGIES EVALUATION

3.1 Executive Summary

Hawai'i's Act 132 requires the upgrade of all 88,000 existing residential cesspools by the year 2050. As a result, it is expected that these existing onsite sewage disposal systems will be replaced by a variety of engineered treatment and disposal units, some of which are already approved for use in Hawai'i, and others that may be emerging and innovative in nature.

Onsite wastewater treatment and effluent disposal system(OSWT) is regulated by the Hawai'i Department of Health Wastewater Branch (DOH WWB). Regulations are contained in Hawai'i Administrative Rules (HAR) 11-62 (effective March 21, 2016), and include procedures, design criteria, standards and restrictions for design and installation of approved standard OSWT technologies (see Appendix A). Complete systems require both a treatment technology and a disposal technology and there are multiple alternatives for both types. In addition, there are many site characteristics, property restrictions, treatment requirements, and other factors that must be considered.

This Technical Memorandum 3 (TM03) includes an evaluation of potential OSWT and disposal technologies which may be considered for the upgrade of existing cesspools. Technologies evaluated are shown in Table ES.1. This study does not attempt or purport to contain evaluations of every technology in existence today. Instead, it focuses on the most common technologies available in Hawai'i that are either approved for use or are promising innovative and emerging technologies that are documented well enough to be considered feasible and likely available during the timeframe of the Act 132 (i.e. 2050).

The technologies were evaluated by several criteria that can be grouped into the following categories:

- Type of technology
- Approval status
- Siting restrictions
- Treatment performance
- Replacement interval and types of costs likely to be incurred
- Benefits and challenges involved with implementation

The intent of this TM is to provide guidance to the Cesspool Conversion Working Groupon as to the applicability, performance, and relative costs of different OSWT technologies that may be considered for cesspool conversions required under Act 132. Ultimately, homeowners should seek more specific guidance from a properly licensed civil engineer (engineer) and general construction contractor. The engineer will need to prepare various studies and designs before a construction permit can be issued and constructed upgrades can begin. This will involve going through several steps to evaluate and select processes for the specific property that are both technically feasible and cost effective. These steps are outlined in Figure ES.1.

Table ES.1 Onsite Wastewater Treatment and Disposal Technologies Evaluated

Technology	Approval Status
Treatment	
Septic Tank	Approved(1)
Aerobic Treatment Unit with nitrification (ATU-N)	Approved(1)
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)
Chlorine Disinfection	Approved(1)
UV Disinfection	Approved(1)
Recirculating Sand Filter	Approval Required(2)
Eliminite	Innovative(3)
NITREX	Innovative(3)
Recirculating Gravel Filter System (WA)	Emerging(4)
Disposal	
Absorption Systems (Bed/Trench)	Approved(1)
Seepage Pit	Approved(1)
Presby Advanced Enviro-Septic	Approved(1)
Evapotranspiration	Approval Required(2)
Constructed Wetland	Approval Required(2)
Drip Irrigation	Approval Required(2)
Passive Treatment Units (medium and high treatment) (FL)	Innovative(3)
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging(4)
Disposal by Nitrification/Denitrification Biofilter (NY)	Emerging(4)

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

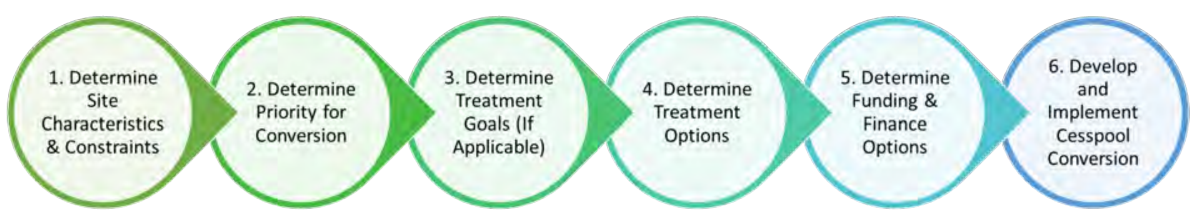


Figure ES.1 Stepwise Approach to Cesspool Conversions for Individual Homeowners

OSWT and disposal technologies can be utilized in many combinations, and in some cases, two or even three different treatment technologies may be needed in sequence ("treatment train"). A set of 35 treatment trains were created, each of which is a set of treatment and disposal technologies that work together to meet requirements and optimize other considerations. Potential treatment trains are summarized in Table ES.2.

There are many other possible treatment trains beyond the listed, those options perceived to be impractical, ineffective, or overly expensive were not included. The ones shown are considered the most feasible and practical.

Of the 34 treatment trains presented:

- 16 treatment trains utilize technologies that are currently approved in Hawai'i
  - Using these technologies should result in faster DOH WWB approval
  - Some technologies are for small properties (less than 10,000 square feet [sf])
  - Some technologies can be used for Priority 1 systems
  - Some technologies meet National Sanitation Foundation (NSF)40[1] water quality criteria
  - Some technologies meet both NSF40 and NSF245[2] criteria
  - Some technologies provide robust disinfection of bacteria
- 19 treatment trains incorporate septic tanks into the treatment system
- 10 treatment trains involve alternative toilets and graywater recycling systems
  - Black and grey water are source-separated
  - Some use septic tanks
  - Some use aerobic treatment units (ATUs) or aerobic treatment units with denitrification (ATU DN)

[1] NSF40 Residential Onsite Systems is a standard for residential wastewater systems with rated capacities between 400 and 1500 gallons per day.
[2] NSF245 Nitrogen Reduction is a standard that defines total nitrogen reduction requirements for wastewater treatment systems with rated capacities between 400 and 1500 gallons per day.

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Table ES.2 Feasible Treatment Trains That Combine Treatment and Disposal Technologies to Meet Different Goals

No.	Treatment Train Name	Source	Treatment 1	Treatment 2	Treatment 3	Disposal	Notes	NSF40	NSF245 (N removal)	Coliform (pathogen removal)
1	1a	RAW	ST			SABS	Standard conventional/traditional system			
2	1b	RAW	ST			PBY	Presby disposal system	Y		
3	2	RAW	ST			SEEP	By DOH approval, only for lots too small for absorption systems			
4	3a	RAW	ST			WET	DOH design review required			
5	3b	RAW	ST			ET	DOH design review required, zero discharge			Y
6	3c	RAW	ST	RSF		SABS	DOH design review required			Y
7	3d	RAW	ST	RSF		DRIP	DOH design review required			
8	4	RAW	ST	RSF	DIS	SEEP	By DOH approval, only for lots too small for absorption systems and/or near surface water			Y
9	5a	RAW	ATU			SABS	Standard conventional/traditional system	Y		
10	5b	RAW	ATU			WET	DOH design review required	Y		
11	5c	RAW	ATU			DRIP	DOH design review required	Y		
12	6	RAW	ATU			SEEP	By DOH approval, only for lots too small for absorption systems	Y		
13	7a	RAW	ATU-DN			SABS	For properties near surface water	Y	Y	
14	7b	RAW	ATU-DN			WET or DRIP	By DOH approval, for properties near surface water	Y	Y	
15	7c	RAW	ATU-DN			ET	By DOH approval, for properties near surface water, zero discharge	Y	Y	Y
16	8	RAW	ATU-DN	DIS		SEEP	For properties near surface water	Y	Y	Y
17	9a	RAW	ST	ELM		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
18	9b	RAW	ST	NTX		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
19	9c	RAW	ST	ITUFL		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
20	10	RAW	ST	ELM or NTX or ITUFL	DIS	SEEP	Innovative treatment system, only for lots too small for absorption systems and/or near surface water, not currently DOH approved			F
21	11a	RAW	ST	RGSWA		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
22	11b	RAW	ST	LSTMA		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
23	11c	RAW	ST	NDBFNY		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
24	12	RAW	ST	RGSWA or LSTMA or NDBFNY	DIS	SEEP	Emerging treatment system, only for lots too small for absorption systems and/or near surface water, not currently DOH approved			F
25	13a	BW GW	ALTT GRAY	ST		SABS SEEP	Meets current graywater guidelines			
26	13b	BW GW	ALTT GRAY	ST		DRIP SEEP	Meets current graywater guidelines, DOH design review required			

No.	Treatment Train Name	Source	Treatment 1	Treatment 2	Treatment 3	Disposal	Notes	NSF40	NSF245 (N removal)	Coliform (pathogen removal)
27	13c	BW GW	ALTT GRAY	ST		ET SEEP	Meets current graywater guidelines, DOH design review required			Y
28	13d	BW GW	ALTT GRAY	ATU		SABS SEEP	Meets current graywater guidelines	Y		
29	13e	BW GW	ALTT GRAY	ATU		DRIP SEEP	Meets current graywater guidelines, DOH design review required	Y		
30	13f	BW GW	ALTT GRAY	ATU		ET SEEP	Meets current graywater guidelines, DOH design review required	Y		Y
31	13g	BW GW	ALTT GRAY	ATU-DN		SABS SEEP	Meets current graywater guidelines	Y	Y	
32	13h	BW GW	ALTT GRAY	ATU-DN		DRIP SEEP	Meets current graywater guidelines, DOH design review required	Y	Y	
33	13i	BW GW	ALTT GRAY	ATU-DN		ET SEEP	Meets current graywater guidelines, DOH design review required	Y	Y	Y
34	13j	BW GW	ALTT GRAY	w/Kitchen Sink limits		None SEEP	Requires changes to graywater Guidelines	F	F	F

Notes/Acronymns:

Y Yes
N No
F Future

ALTT Alternative Zero-discharge Toilets (composting, incinerating, nano-membrane)
ATU Aerobic Treatment Unit with nitrification
ATU-DN ATU with denitrification
BW Black Water Sewage
DIS Disinfection system (chlorine or UV)
DRIP Drip irrigation system
ELM Eliminite nitrogen removal system (innovative)
ET Evapotranspiration (zero-discharge) system
GRAY Graywater recycling system
GW Graywater
GWT Graywater Recycle Tank
ITUEL Innovative Treatment Units Developed in Florida
LSTMA Layer Soil Treatment Systems developed in Massachusetts
NDBFNY Emerging Nitrifying/Denitrifying Biofilters Developed in New York
NSF245 National Sanitation Foundation Standard 245 for enhanced nitrogen removal
NSF40 National Sanitation Foundation Standard 40 for secondary level treatment
NTX NITREX nitrogen removal system (innovative)
PBY Presby disposal system - standard
PBY-DN Presby system with De-Nyte nitrogen removal
RAW Raw Sewage
SABS Absorption System - trenches or beds, traditional or gravelless
SEEP Seepage Pit
ST Septic Tank
RGSWA Recirculating Gravel System (WA) (emerging)
WET Constructed Wetland System

Table ES.3 Costs of Retrofits Completed Since 2016 under State Tax Credit Program

Type	Size	No.	Cost ($)			
			Mean	Median	Low	High
Septic Tank + Absorption System	1 BR	2	19,803	19,803	10,813	28,792
	2 BR	3	16,435	12,400	10,500	26,406
	3 BR	13	18,817	14,790	9,399	45,797
	4 BR	13	21,989	19,800	9,787	45,550
	5 BR	42	23,688	22,850	8,925	52,356
	Total	73	22,114	21,945	8,925	52,356
Aerobic Treatment Unit	2 BR	1	18,706	ND	ND	ND
	3 BR	2	22,500	22,500	20,000	25,000
	5 BR	5	33,298	26,339	21,760	59,585
	Total	8	28,774	23,380	18,706	59,585
Septic Tank + Presby System	3 BR	1	24,160	ND	ND	ND
	4 BR	1	32,500	ND	ND	ND
Total		**2**	**28,330**	**ND**	**ND**	**ND**

Notes/Acronyms:
BR bedroom
ND Insufficient data available to provide additional statistics.

3.2 Introduction and Background

According to the US Environmental Protection Agency (EPA), cesspools are underground excavations that receive sanitary wastewater from bathrooms, kitchens, and washers. The structure usually has an open bottom and perforated sides (unlined). Domestic wastewater flows into the structure and the solid waste collects at the bottom of the cesspool and the liquid waste flows out through the perforations. Cesspools are not designed to treat wastewater but rather to retain solids and allow liquid wastes to percolate into the subsurface which may be hydraulically connected to groundwater and surface water.

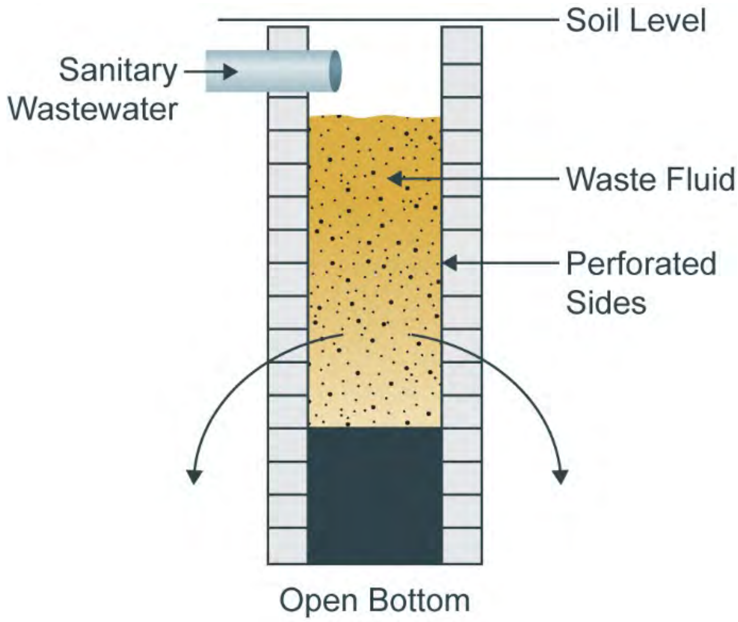

Figure 3.1 Cesspool Schematic

Throughout Hawai'i, there are approximately 88,000 cesspools for single-family, residential wastewater disposal. In 2018, the Hawai'i State Legislature passed Act 132, which states that by January 1, 2050 all cesspools in the state of Hawai'i, unless granted exemption, shall upgrade or convert to a preferred waste treatment system or connect to a sewer system. There are generally three options for cesspool conversions including:

- **Connection to existing or new centralized sewer systems.** In the large municipal areas of Hawai'i, homes and businesses are connected to county or privately owned, sewer collection and treatment systems, where the wastewater flows to a large centralized treatment facility for treatment and disposal. Centralized sewer collection and treatment systems are cost effective because of economies of scale, treating the water either for discharge to the Pacific Ocean or for water reuse applications (e.g., golf course irrigation). However, there are significant capital investments required by counties or private developers, and connections to centralized systems may not be feasible for many cesspool conversions.
- **Connection to decentralized sewer systems.** Decentralized sewer systems (also "cluster" wastewater systems) are similar to centralized sewer systems, but typically have a smaller collection system service area and wastewater treatment facility. Decentralized treatment can range from passive treatment with soil dispersal to more sophisticated, mechanical treatment, such as membrane

bioreactors. Within the rural portions of Hawai'i, which are extensive, the costs to dig and construct long sewer systems from remote locations to a centralized treatment facility are substantial.

- **Conversion of cesspools to new OSWT and disposal systems.** A 1999 survey conducted by DOH showed that approximately 19 percent of the households in Hawai'i had OSWT and disposal systems, including cesspools. Since many of the cesspools are in rural areas without centralized wastewater systems, conversion to OSWT and disposal may be the most cost-effective option for some homeowners.

The scope of this TM03 is limited to evaluating OSWT and disposal systems as cesspool conversion options. Evaluations of centralized and decentralized sewer options will be investigated separately.

Act 132 also allowed for the creation of the Cesspool Conversion Working Group (CCWG), with the DOH Director or designee as the chairperson. Other CCWG members include: the DOH wastewater branch chief or their designee; four members of the county wastewater agencies for Hawai'i, Honolulu, Kaua'i, and Maui; a member representing the wastewater industry appointed by the president of the senate; a member of the financial and banking sectors appointed by the speaker of the house of representatives; members of the University of Hawai'i Institute of Marine Biology and Water Resources Research Center; a member of the Hawai'i Associate of Realtors appointed by the Speaker of the house of representatives; a member of the Surfrider Foundation appointed by the President of the senate; one representative appointed by the Speaker of the house of representatives; and one Senator appointed by the President of the senate.

The CCWG subsequently retained the Carollo Engineers, Inc. (Carollo) team to support the cesspool conversion technologies and finance research as a part of the Cesspool Conversion strategy for the state of Hawai'i.

There are several parts of the cesspool conversion technologies portion of this project. Besides the cesspool conversion technologies and finance research, the CCWG is also developing strategies for public outreach and education, and data prioritization and validation as it relates to cesspool conversions. Figure 3.2 shows a stepwise process to facilitate homeowners with cesspools in determining how to upgrade their existing cesspools. The CCWG is working to develop strategies and tools to aid cesspool conversions and the overall strategy is anticipated to be complete by 2022.

The first two products of the Cesspool Conversions Technologies Research were Technical Memorandum 1 (TM01) – Assessment of Onsite Treatment Technology Testing and Approval Procedures Utilized by Other States, and Technical Memorandum 2 (TM02) – Septic Tank Systems Review. The purpose of this TM03 is to evaluate existing OSWT technologies and disposal systems to upgrade cesspools at individual residences. This TM helps to support Step No. 4 Determine Treatment Options shown in Figure 3.2.

Figure 3.2 Stepwise Approach to Cesspool Conversions for Homeowners

3.2.1 Methodology

The data and information for this TM03 was gathered from prior products of the team members, including the DOH/Safe Drinking Water Branch (SDWB)-funded study *Investigation of Cesspool Upgrade Alternatives in Upcountry Maui* completed in October 2019, internet research of technology matrices employed in other states, and information available in textbooks, the technical literature, and from vendor websites. The data was gathered from publicly available resources that are considered current and up to date. However, this report does not attempt or purport to contain evaluations of every technology and variety of technology available for this type of application. Instead, it focuses on the most common technologies available in Hawaiʻi that are either approved for use or are promising innovative and emerging technologies that are not yet approved for sale in Hawaiʻi but are well documented enough to be considered likely available during the 30-year timeframe of the Act 132 cesspool ban.

3.2.2 Risk to Environment and Human Health

The legislation passed to ban cesspools (Act 132) was based upon an understanding by the DOH WWB of the existing and potential risks of the 88,000 cesspools to the environment and public health. The DOH WWB created a set of four priority categories for the upgrade of cesspools (Table 3.1). The categories were then used to assign priority categories to geographic areas around the State (Table 3.2). The following risk factors were considered in formulating the priority categories:

- Density of cesspools in an area
- Soil characteristics
- Proximity to drinking water sources, streams, and shorelines
- Other groundwater inputs including agriculture and injected wastewater
- Physical characteristics of coastal waters that may compound the impacts of wastewater in bays and inlets

Table 3.1 shows that the highest risk areas (Priority 1) should be addressed as soon as possible, rather than waiting until closer to 2050 due to high risk. Table 3.2 shows that Priority 1 areas include 8,140 cesspools which comprise a little less than 10 percent of the 88,000 cesspools in Hawaiʻi. These priority categories and assignments were presented by the DOH WWB and the US EPA to the 2018 Hawaiʻi Legislature and they are subject to evaluation and possible revision through the activities of the CCWG. Cesspool upgrades located in Priority 1 areas may require technologies that remove nitrogen and may also require disinfection (if near surface water). The specific requirements are site specific and will be determined the DOH WWB Director. These restrictions will limit the number of appropriate technologies available for properties in these areas.

Table 3.1 Cesspool Priority Area Definitions and Actions to Take

Category	Definition	Characteristics	Action to Take
Priority 1	Significant risk of human health impacts, drinking water impacts, or draining to sensitive waters	Cesspools appear to contribute to documented impacts to drinking water or human health and appear to impact sensitive streams or coastal waters.	Address these cesspools as soon as possible using any means possible. Such action represents a significant reduction in risk to public health.
Priority 2	Potential to impact drinking water	Cesspools are within the area of influence of drinking water sources and have a high potential to impact the sources.	Homeowners can use Act 120 tax credits[3] to upgrade cesspools located within 500 ft of waters. Actions should be taken simultaneous to or following actions under Priority 1.
Priority 3	Potential impacts on sensitive waters	Cesspools in these areas cumulatively represent an impact to an area that includes sensitive State water or coastal ecosystems (coral reefs, impaired waterways, water with endangered species, or other vulnerabilities).	Homeowners can use Act 120 tax credits(3) to upgrade cesspools located within 500 feet of waters. Actions should be taken simultaneous to or following actions under Priority 2.
Priority 4	Impacts not identified	Comprehensive health and environmental risks have not yet been assessed, or the risk of affecting public or environmental health currently appears low.	Action should be taken as possible: if homeowners independently initiate action or if a supporting agency has available funds.

[3] Current Act 120 tax credits expire on December 31, 2020 (https://health.hawaii.gov/wastewater/home/taxcredit/)

Table 3.2 Initial Priority Upgrade Areas Established by DOH WWB

Geographic Area	Priority Level Assigned	Number of Cesspools	Estimated Effluent Discharge (mgd)
Upcountry area of Maui	1	7,400	4.4
Kahaluu area of Oahu	1	740	0.44
Keaau area of Hawai'i Island	2	9,300	4.9
Kapaa/Wailua area of Kauai	2	2,900	2.2
Poipu/Koloa area of Kauai	2	3,600	2.6
Hilo Bay area of Hawai'i Island	3	8,700	5.6
Coastal Kailua/Kona area of Hawai'i Island	3	6,500	3.9
Puako area of Hawai'i Island	3	150	0.60
Kapoho area of Hawai'i Island	3	220	0.12
Hanalei Bay area of Kauai	3	270	0.13
Diamond Head area of Oahu	3	240	0.17
Ewa area of Oahu	3	1,100	0.71
Waialua area of Oahu	3	1,080	0.75
Waimanalo area of Oahu	3	530	0.35
	Total Assigned:	**42,730**	**26.87**
Hawai'i Island Un-Assigned	NA	24,430	12.18
Kauai Un-Assigned	NA	6,930	4.57
Maui Un-Assigned	NA	4,800	3.5
Oahu Un-Assigned	NA	7,610	5.08
Molokai Un-Assigned	NA	1,400	0.80
	Total Un-Assigned:	**45,170**	**26.13**

3.2.3 Approved Technologies in Hawai'i

There are somewhat limited statistics for on-site systems currently in operation in Hawai'i. All the systems in the ground and operating are by definition approved. Table 3.3 has a breakdown of these different OSWT systems by island, the estimated discharge flows, the discharge of nitrogen, and the discharge of phosphorus. Table 3.3 only includes information for the following types of systems:

- Cesspools
- Septic tanks + absorption systems
- Septic tanks + seepage pits
- Aerobic treatment units

There are no data available on other approved technologies including (of which there are thought to be very few):

- Disinfection systems
- Recirculating sand filters
- Constructed wetland systems
- Drip irrigation systems
- Seepage pits

Table 3.3 The Number of OSWT and Disposal Systems in Hawai'i from 2018 DOH/EPA Report to Hawai'i Legislature

Island	Housing Units	Number of Cesspools	Septic + Absorption	Septic + Seepage Pit	ATU	Total OSDS units	Estimated Cesspool Effluent Discharge (mgd)	Estimated Total OSDS Effluent Discharge (mgd)	Estimated Total N Flux (kg/d)	Estimated Total P Flux (kg/d)
Hawai'i	82,000	49,344	8,951	694	68	58,982	27.4	34.6	6,607	1,848
Kauai	29,800	13,688	3,107	190	304	18,011	9.5	12.5	2,115	607
Maui	65,200	12,242	4,105	559	75	16,883	7.9	11.6	1,869	554
Oahu	336,900	11,253	2,620	534	199	14,606	7.5	9.7	1,732	500
Molokai	3,700	1,442	477	33	4	1,956	0.8	1.2	206	59
Total	**517,600**	**87,969**	**19,170**	**2,730**	**650**	**110,438**	**53.0**	**69.9**	**12,529**	**3,568**

3.3 Description of Onsite Wastewater Treatment Technologies

The following sections provide descriptions and characteristics of the various treatment technologies evaluated. The various treatment technologies have four levels of approval noted:

- **Approved.** These technologies are already approved for use in HAR 11-62 and are rapidly approved by DOH WWB upon receipt of required submittals for review.
- **Approval Required.** These technologies are mentioned in HAR 11-62; however, detailed design calculations must be submitted and design review is required by DOH WWB prior to site-specific approval.
- **Innovative.** These technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
- **Emerging.** These technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.3.1 Septic Tanks

A septic tank serves as both a settling and skimming tank and partial anaerobic treatment. It is an approved technology by DOH WWB. The baffles in the tank cause solids settle to the bottom and create a layer of sludge, while fats, oils, grease (FOG), and other floatables rise to the top and create a layer of scum (Figure 3.3). Based on Hawai'i's design requirements, a screen should also be installed on the effluent end to enhance solids removal and prevent clogging of the downstream disposal system. If high quality effluent is desired, a septic tank could be used to pretreat wastewater prior to a secondary treatment step, such as an ATU.

Figure 3.3 Septic Tank with Two Chambers (United States Environmental Protection Agency, 2018)

The benefits, challenges, and operations and maintenance (O&M) requirements are summarized as follows:

- Benefits
  - Power is not required to operate a septic tank.
- Challenges
  - Accumulated sludge and scum must be removed on a regular basis to prevent carryover of these materials into downstream processes.
  - The effluent filter must be cleaned periodically to prevent clogging.
  - Odor – objectionable odors can be emitted.
- Operation and Maintenance
  - The solids that accumulate in the septic tank need to be removed periodically, depending on the loading rate (e.g., how many people use the system) and wastewater characteristics. Solids removal is conducted with a septic pumping and hauling truck and consists of removal of the settled sludge, liquid contents, and scum layer. The liquid and solid contents from the septic tank must be hauled to an approved wastewater treatment facility for where a fee is collected for treatment.
  - Septic tanks that are regularly serviced and maintained can have the solids removed on an as needed basis (estimated 5 to 10 years), whereas septic tanks that are not regularly serviced may require more frequent solids removal (estimated 1 to 2 years). Technologies that are being developed for measuring water level and solids depth will make remote monitoring more feasible.

3.3.2 Aerobic Treatment Units (ATUs)

There are many varieties of ATUs which are manufactured all over the world. ATUs are an approved technology by DOH WWB. There are a small number of Hawai'i-produced units, many mainland-produced and numerous from all over the world, including Japan/Asia, and Europe. The most popular here are locally produced, mainland-produced, and Japan-produced brands. Depending on the application, ATUs can provide or not provide total nitrogen (N) removal. Both ATU types are discussed in the following sections.

3.3.2.1 Without Nitrogen Removal

An ATU is a self-contained OSWT system that is designed to provide full secondary biological treatment by retaining solids, aerobically decomposing organic matter over time, and allowing effluent to discharge into an approved disposal system. There are many types of ATUs, and the following will describe the most commonly used: suspended-growth flow-through ATUs and combined attached and suspended growth ATUs. ATUs typically include primary treatment and biological secondary treatment (oxidation of 5-day biochemical oxygen demand [BOD_5] to carbon dioxide) in different compartments. These units typically include nitrification in the aerobic zone (conversion of ammonia to nitrate).

A suspended-growth flow-through ATU is a biological treatment system where microorganisms are kept in suspension by mixing air with wastewater influent and concentrated underflow or sludge (from a clarifier) in an aeration tank (Figure 3.4). If there is no integral primary settling basin, a separate septic tank or pre-loader should be installed upstream of the ATU. The purpose of this additional tank is to remove readily settleable solids and floating matter that will reduce suspended solids loading.

From the aeration tank, the mixture is passed into a secondary clarifier, where microorganisms settle to the bottom, forming a layer of sludge. The clarified liquid effluent is passed to a disposal system. Some of the sludge solids in the settling basin will decompose, while the remainder accumulates and must periodically be removed (pumped out) and properly/legally disposed of offsite.

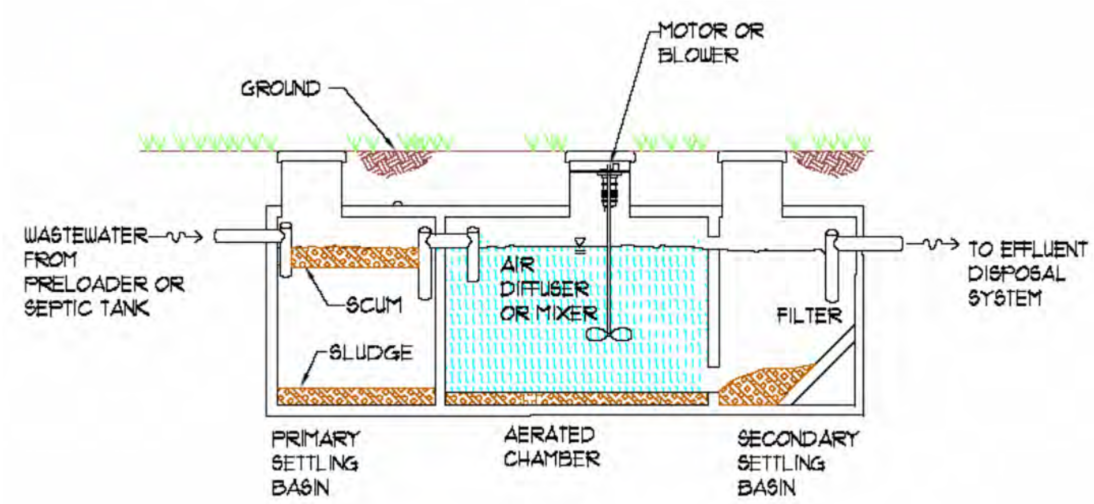

Figure 3.4 Schematic of Suspended-Growth Flow-Through ATU

A combined attached and suspended-growth flow-through ATU is a biological treatment system where the aerated part of the unit contains plastic media where microorganisms can attach and grow and other microorganisms are kept in suspension by mixing air with wastewater influent and concentrated underflow or sludge (from a clarifier) in an aeration tank (Figure 3.5). This setup allows microorganisms to form a slime layer on the surface of submerged plastic media which essentially allows incorporation of more biomass in the same volume. Wastewater is treated as it passes through the media. The system is similar to the suspended-growth flow-through ATU, except that the aerated chamber contains submerged plastic media.

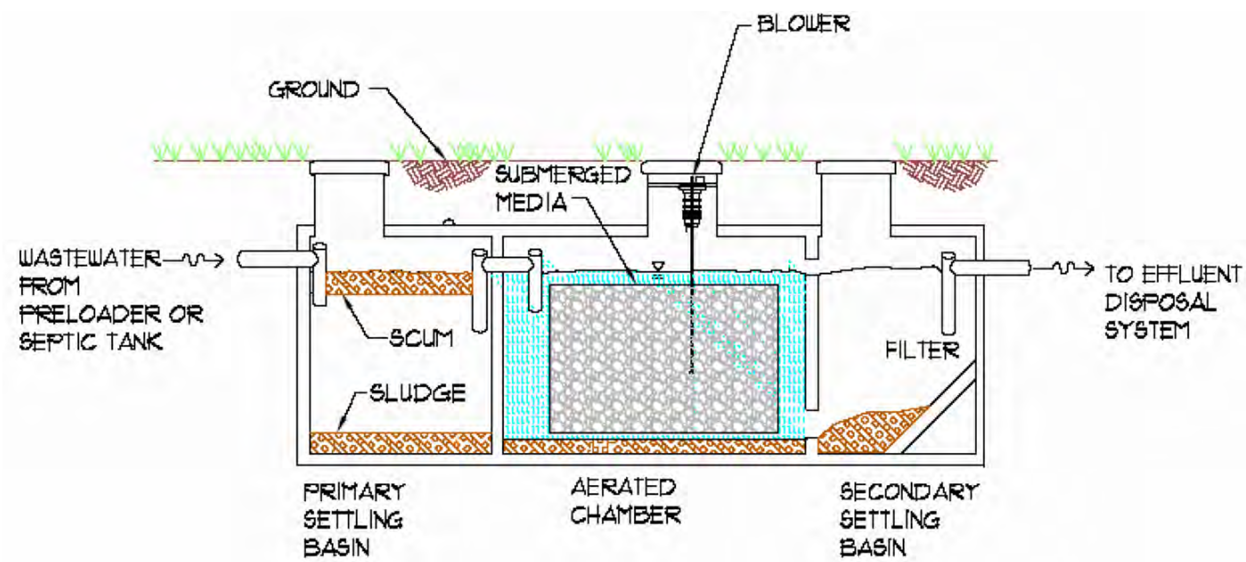

Figure 3.5 Schematic of Combined Attached and Suspended Growth ATU

- Benefits
  - These types of ATUs can achieve effluent quantity of BOD_5 concentrations of 5-25 milligrams per liter (mg/L) and total suspended solids (TSS) concentrations of 5-25 mg/L.
  - Since the biological process takes place in an aerobic environment where free oxygen is available, complete nitrification of ammonia will occur in the ATU.

- Challenges
  - Consideration should be given to determine how best to use available site slopes to allow gravity flow from the preloader (if present) to the ATU to the disposal system.
  - Power is needed to operate the blowers, controls, and monitoring and alarm systems in the ATU.
  - Denitrification does not occur due to absence of an anaerobic environment. Therefore, effluent quantities of nitrate-N range from 10 to 60 mg/L. Because this type of ATU alone cannot remove nitrogen, the pairing with a denitrifying disposal method may be necessary.
  - ATUs are sensitive to high and low temperatures, heavy loading of solids, toxic chemicals (including chemical cleansers), power failures, and large influent flow variability.
  - Odor – objectionable odors can be emitted – this can be mitigated with separated venting
- Operation and Maintenance
  - Trained professionals should inspect the system every four to six months, along with sludge/scum pumping, as needed.

3.3.2.2 With N removal

Some ATUs include both nitrification and denitrification capabilities. Flow-through type systems look just like the previous ATUs but add a recirculation pump to return nitrified water to the front of the system where it mixes with raw wastewater under anaerobic conditions and it is held there to allow denitrification. Another type of system is the sequencing batch reactor (SBR) described below.

In an SBR-type ATU, all the aerobic, anaerobic, and clarifying processes occur within a single tank. The operating sequence includes at least the four following steps (Figure 3.6), which can be cycled several times per day (e.g. one cycle every 4 hours):

1. Fill: tank is filled with raw wastewater to a predetermined volume.
2. Aeration: air is added for mixing and suspension of the microorganisms and the wastewater and for microbial oxidation of the waste including conversion of N into nitrate via nitrification
3. Settle: aeration is turned off and the microorganisms/sludge settles to the tank bottom; concurrently, the contents become anaerobic which allows denitrification of the nitrate into nitrogen gas.
4. Decant: clarified portion is decanted as effluent. Cycle repeats.

These ATUs are designed to operate continuously using a control system of times, level sensors, and microprocessors.

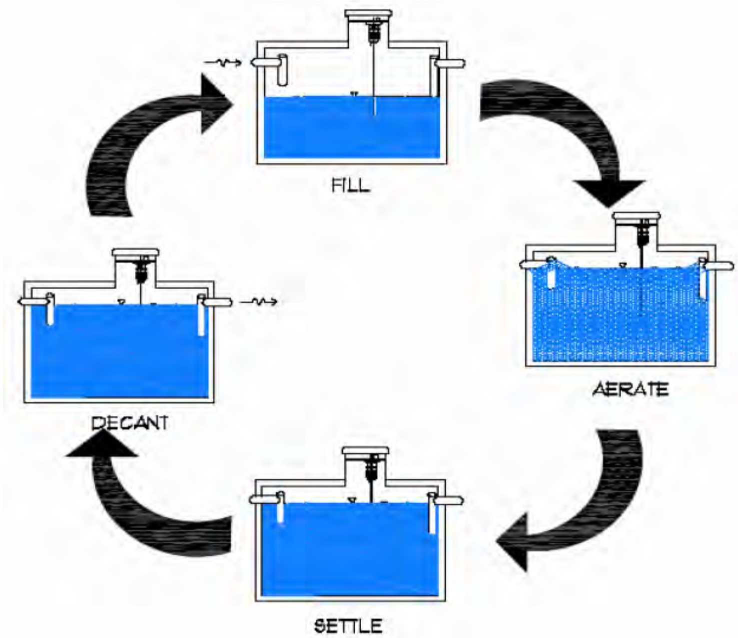

Figure 3.6 Cycles of an SBR-Type ATU

- Benefits
  - This type of ATU that can achieve effluent quantity of BOD_5 concentrations of 5-25 mg/L and TSS concentrations of 5-25 mg/L.
  - An SBR can provide both nitrification and denitrification through cycles of an aeration step and settling and decanting steps.
  - At least 50 percent of influent nitrogen can normally be removed (up to 80 percent under ideal conditions).
- Challenges
  - Consideration should be given to determine how best to use available site slope to allow gravity flow from the preloader (if present) to the ATU to the disposal system.
  - Power is needed to operate the blowers, controls, and monitoring and alarm systems in the ATU.
  - Accumulated sludge and scum must be removed on a regular basis to prevent carryover of these materials into the downstream disposal system.
  - ATUs are sensitive to high and low temperatures, heavy loading of solids, toxic chemicals (including chemical cleansers), power failures, and large influent flow variability.
  - Odor – objectionable odors can be emitted – this can be mitigated with separated venting
- Operation and Maintenance
  - Trained professionals should inspect the system every four to six months, along with sludge/scum pumping, as needed.

3.3.3 Alternative Toilets

Alternative toilets with zero discharge of were developed for use in remote locations lacking water and/or electricity and generally not for heavy daily use. Approval by DOH WWB is required for use of these systems. Alternative toilet options include composting, incinerating, chemical, and nano-membrane (Gates-type) toilets. The most commonly seen are composting toilets and incinerating toilets, which are discussed below. The amount of hands-on homeowner maintenance required, the high potential for odors, and the level of sophistication involved should be evaluated carefully when considering such systems.

3.3.3.1 Composting Toilets

A typical composting toilet (Figure 3.7), is comprised of a composting reactor tank or bin connected to one or more waterless toilets in the house. For very small families, there are self-contained units with the compositing bin immediately under the toilet seat. Daily residential use may overload these smaller systems, so extra capacity will be necessary. Alternatively, a centralized tank reactor with a rotating drum could be located in a basement or underground structure adjacent to the house. The reactor tank or bin contains and controls the decomposition of excrement, toilet paper, and carbon-based bulking agents such as wood chips, straw, hay, or grain hulls. Bulking agent materials break down quickly to prevent buildup of aerobic bacteria and fungi. Composting reactor tanks or bins may be single-chambered, continuous process, or multi-chamber batch units (National Small Flows Clearinghouse, 2000). The owner must remove and dispose of aged compost frequently, turn the composting waste with every use, and replenish bulking agents and odor control fluid.

No other liquid besides urine is present in the bin, allowing for aerobic decomposition of waste. Temperature should be properly maintained between 78 and 113 degrees Fahrenheit for optimal decomposition rates. An exhaust system driven by a fan vents odor, carbon dioxide, and moisture from the reactor bin to the outdoors (the fan could be electricity-driven or a swamp cooler type). The decomposing material needs to be turned frequently to break up the mass and to keep the pile porous and aerated. The final material is about 10 to 30 percent of its original volume and must be properly disposed as municipal solid waste (recycling/reuse on the property is not allowed in Hawai'i).

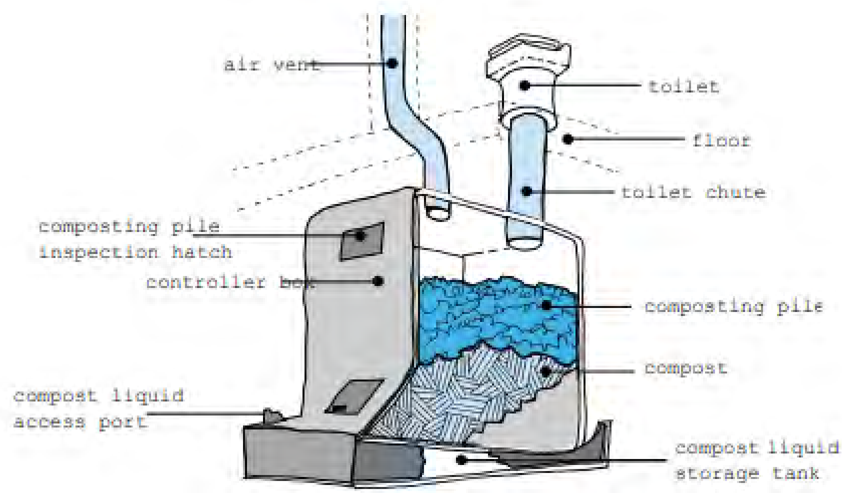

Figure 3.7 Composting Toilet (National Small Flows Clearinghouse, 2000)

- Benefits
  - As a zero-discharge system, nitrogen will not be released into the groundwater.
  - Since water is not needed for flushing, household water consumption is reduced.
  - System consumes very little power (only the small fan).
  - Residents may be able to install a reduced-size wastewater treatment and disposal system, minimizing costs and disruption to the landscape.

- Challenges
  - A high level of maintenance is required by the owner, such as periodic turning of the compost, daily addition of bulking agents, handling and disposal of compost, and preventing too much liquid in the composter.
  - A power source is generally needed.
  - Composting excrement may be visible in some systems.
  - There can be objectionable odors emitted from these systems.
  - If more than one toilet is desired within the household or property, costs are multiplied accordingly with the number of toilets installed.
- Operation and Maintenance
  - The decomposing material needs to be turned frequently to break up the mass and to keep the pile porous and aerated.

3.3.3.2 Incinerating Toilets

These types of toilets use electricity, oil, natural gas, or propane to burn waste to a sterile ash. A typical setup is depicted in Figure 3.8. A paper-lined upper bowl holds newly deposited waste. The paper liner is replaced after each use. Flushing using a foot pedal causes an insulated chamber cover to lift and swing to the side while the bowl halves separate. The paper liner and its contents deposit into the incinerating chamber. When the foot pedal is released, the chamber cover reseals and the bowl halves close (National Small Flows Clearinghouse, 2000).

A "start" button on the toilet begins the burning process, which occurs after each individual deposit. An electric heating unit cycles on and off for about an hour while a blower motor draws air from the incinerating chamber over a heat-activated catalyst to remove odors. A fan then distributes the air through a vent pipe to the outdoors. The fan is also used to cool the incinerating unit. The entire cycle takes from about 1.5 to 1.75 hours per "flush" or use (National Small Flows Clearinghouse, 2000).

If the incinerating toilet runs on gas, then a toilet bowl is not present, and the waste drops directly into a holding chamber. Prior to the burning process, an anti-foam agent is added to reduce the risk of liquid wastes boiling over. The toilet seat is lifted, and a cover plug is inserted to act as a fire wall (National Small Flows Clearinghouse, 2000).

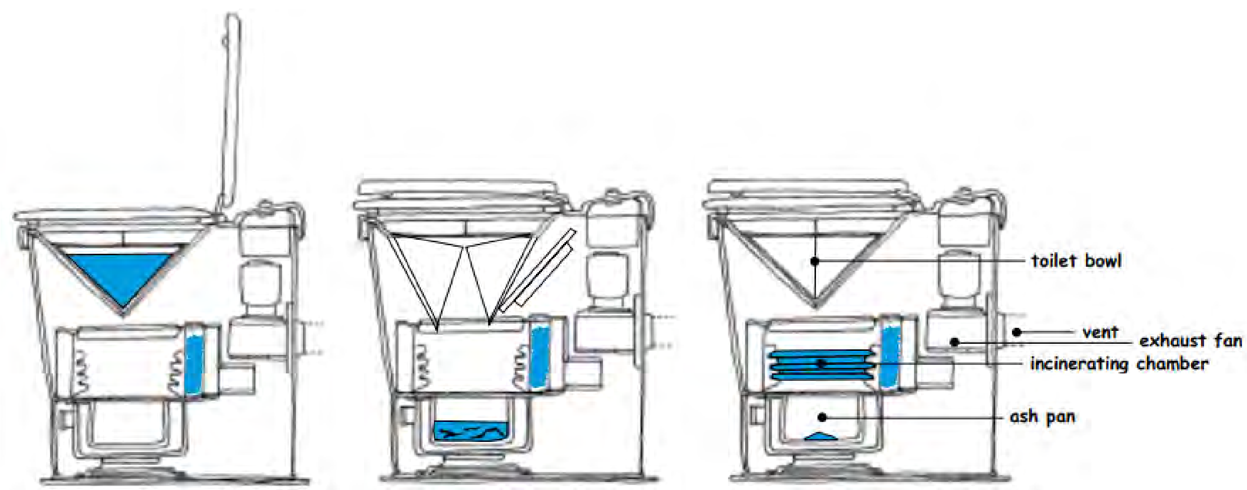

Figure 3.8 Incinerating Toilet Shown with Seat Cover Up, Seat Cover Down and Incinerating Chamber Opened, and Seat Cover Down and Incinerating Chamber Closed (Left to Right) (National Small Flows Clearinghouse, 2000)

Figure 3.9 shows a nano-membrane incinerating toilet. These toilets are currently under development with sponsorship by the Gates Foundation. Commercially units are not yet available at time of completion of this TM. There are several prototypes in laboratories. These systems are designed to be self-contained in terms of no need to add flush water; instead they use membranes to filter the urine and recycle it for flushing. These units do require electricity, and have an incineration function such that the only byproduct is ash.

Figure 3.9 Mock-up Conceptual Nano-membrane-incinerating Toilets

- Benefits
  - As a zero-discharge system, nitrogen will not be released into the groundwater.
  - Since water is not needed for flushing, household water consumption is reduced.
  - Residents may be able to install a reduced-size wastewater treatment and disposal system, minimizing costs and disruption to the landscape.
- Challenges
  - Care must be taken to minimize electrical hazards.
  - A power source is needed.
  - The toilet cannot be used during the incinerating cycle.
  - If more than one toilet is desired within the household or property, costs are multiplied accordingly with the number of toilets installed.
- Operation and Maintenance
  - Regular cleaning of the toilet seat and bowl as needed.
  - Disposal of generated ash in a sealed bag with regular municipal solid waste.
  - Mechanical/electrical inspection, maintenance, and repair requirement are unknown at this time.

3.3.4 Disinfection Units

Wastewater disinfection is a treatment technology that can be used to reduce the possibility of pathogenic organisms entering the environment. This technology is approved by DOH WWB. The most common types of onsite disinfection units use chlorine tablets or ultraviolet radiation. Depending on the pretreatment process, disinfection may be required for some disposal systems, such as drip irrigation.

3.3.4.1 Chlorination

Chlorine is a powerful oxidizing chemical frequently used for disinfection of water or wastewater. Powder or tablets of solid hypochlorite (calcium hypochlorite and sodium hypochlorite) are the forms that can be used in OSWT systems. All forms of chlorine are toxic, corrosive, and require careful handling and storage. For small onsite wastewater treatment systems, the most common type of disinfection equipment is the tablet chlorinator. A typical setup is depicted in Figure 3.10. The tablet chlorinator is the most common disinfection system because it does not require electricity, is easy to operate and maintain, and is relatively inexpensive.

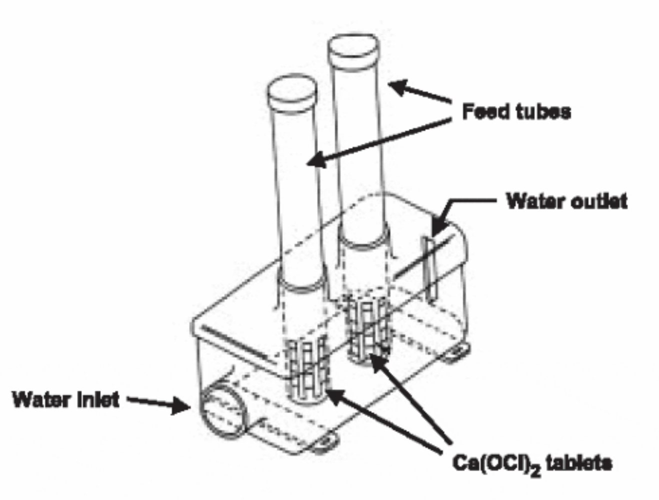

Figure 3.10 Stack-Feed Tablet Chlorinator

- Benefits
  - The main advantages of chlorine are it is ready availability, low cost, and is effective against a wide range of pathogenic organisms. Chlorine can reduce fecal coliforms by 99 to 99.99 percent and can continue to exist as a residual in wastewater effluent.
  - Units are inexpensive and do not require energy to operate.
  - Easy to operate and maintain.
- Challenges
  - Chlorine chemicals need to be stored and handled carefully.
  - Require periodic chemical addition. Chlorine tablet feeder may jam and cause system to not work properly.
  - Residual chlorine released in treated wastewater may have adverse effects on other organisms in the environment.
  - Obtaining the correct type of chlorine tablets can be difficult, Wastewater-type tablets are different than pool-type chlorine tablets which expand when wetted.
- Operation and Maintenance
  - For this system, the operational parameters include the rate at which the chlorine tablets dissolve, the amount of chlorine transferred into solution, the capacity of the chorine tablet reservoir, and the time required between servicing. Systems should be inspected monthly to ensure operation. For a typical system, tablets may need to be added every 4 to 6 months.

3.3.4.2 Ultraviolet Radiation

Ultraviolet (UV) disinfection employs mercury-type lamps separated from the water by a quartz sleeve contained in a flow through stainless-steel reaction vessel (pipe). UV light acts as a physical disinfection agent due to the germicidal properties of UV in the range of 240 to 270 nanometers. The radiation penetrates the cell wall of microorganisms and causes cellular mutations that prevent reproduction. Effectiveness of UV disinfection depends on the clarity of the treated wastewater, UV intensity, time of exposure, and reactor configuration. A typical setup is depicted in Figure 3.11.

Figure 3.11 An ultraviolet disinfection system (steel cylinder to the right of the control box) used to treat sand filter effluent before landscape irrigation

- Benefits
  - UV successfully inactivates most bacteria, viruses, spores, and cysts.
  - In contrast to chlorine chemicals, this method does not involve handling or storing of hazardous or toxic chemicals.
  - Does not leave residual chemical or toxicity in the water.
  - Not space intensive.
- Challenges
  - A continuous power supply is required to operate the UV bulbs.
  - Periodic cleaning of the quartz sleeves is required to ensure transmission of the UV radiation into the wastewater (monthly minimally).
  - Bulbs must be replaced (typically annually)
  - UV treatment is rendered ineffective in wastewater with low clarity due to bacteria being shielded by high turbidity and total suspended solids.
- Operation and Maintenance
  - UV disinfection systems require that the lamps be cleaned and/or changed periodically to maintain a high level of treatment. Because the system uses electrical power it will need regular inspection to ensure correct operation

3.3.5 Recirculating Sand Filter

A Recirculating Sand Filter (RSF) is a treatment technology, in which septic tank effluent is pressure distributed (such as by spray nozzles) to the top of a bed of sand, which is biologically treated as it percolates through (Figures 3.12 and 3.13). Approval by DOH WWB is required to use this technology. Carbon oxidation, nitrification, and denitrification can all occur. A portion of the water is pumped back to the pump chamber or the treatment process, and another portion passes on to a dispersal system such as drip irrigation or a seepage pit. The nitrate in the recirculated water undergoes denitrification under anaerobic conditions (Barnstable County Department of Health and Environment, 2018).

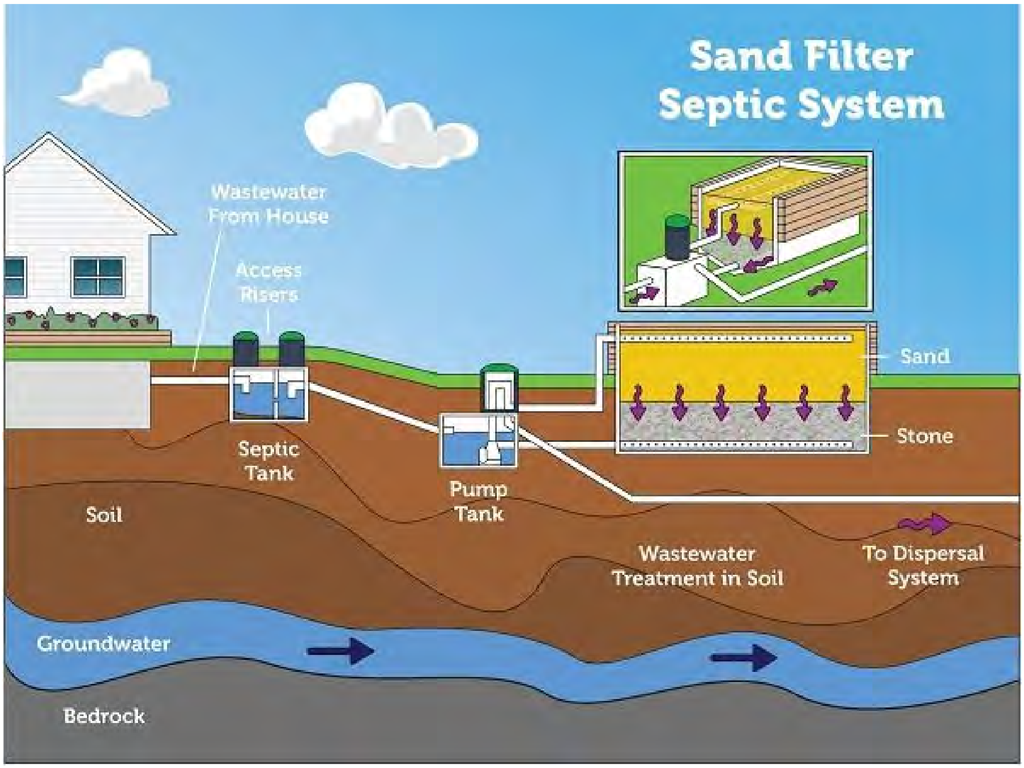

Figure 3.12 RSF with Primary Treatment by Septic Tank (United States Environmental Protection Agency, 2018)

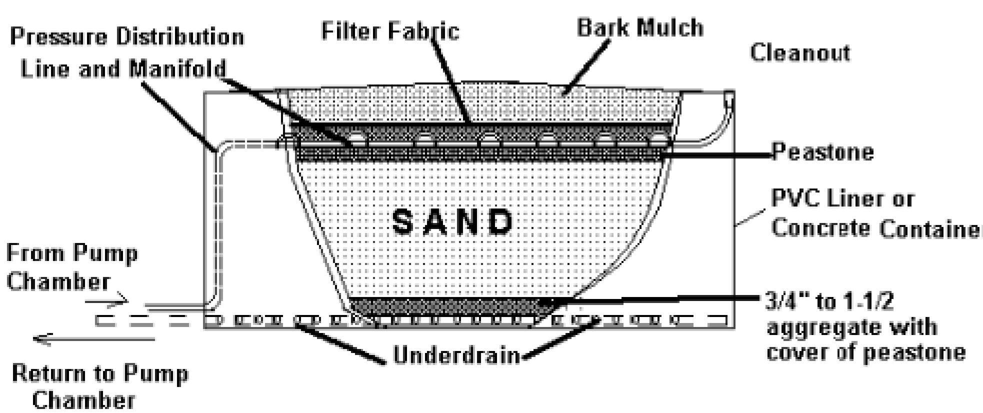

Figure 3.13 Profile Schematic of a RSF

- Benefits
  - RSFs can remove up to 50 percent total nitrogen.
- Challenges
  - Large land area may be required.
  - Filters need to be covered to protect against odor, debris, algae fouling, and precipitation.
  - A pump is needed for recirculating the wastewater.

- Operation and Maintenance
  - Operational costs include electricity for the pump and labor. The filter should be inspected every 3 to 4 months, and the top layer of the filter media should be removed and replaced periodically.

3.3.6 Eliminite Innovative Technology

Eliminite is a denitrifying septic system with two 1,500-gallon concrete tanks. This is an innovative technology and approval by DOH WWB is required for use. As depicted in Figure 3.14, the Eliminite system uses patented, proprietary treatment media called MetaRocks® to remove nitrogen. MetaRocks® provide a surface for nitrifying and denitrifying bacteria to thrive. The first 1,500-gallon tank is used as a septic tank, and the second tank has two chambers to house the MetaRocks® and provide BOD_5, TSS, and total N removal. The Eliminite system is followed by a disposal system such as absorption or seepage pit (Eliminite, Inc., 2018).

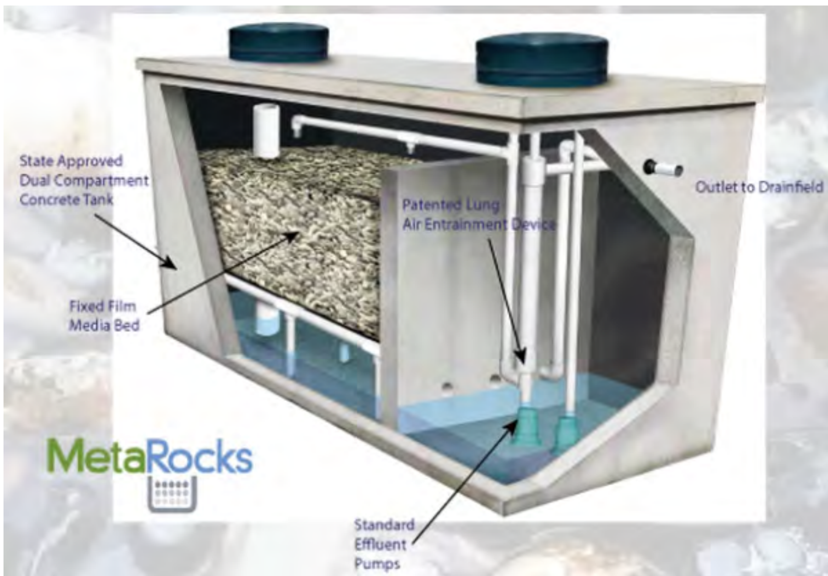

Figure 3.14 Nitrogen Reduction by Eliminite's MetaRocks® (Eliminite, Inc., 2018)

- Benefits
  - Average total nitrogen removal is expected to be 62 percent.
- Challenges
  - Pump operation and electrical power are needed.
  - This innovative technology is new to Hawai'i, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.
- Operation and Maintenance
  - Make sure recirculation pump is functional and repair/replace as needed
  - Annual inspection of rock media chamber, with cleaning and addition of lost media as needed

3.3.7 NITREX Innovative Technology

NITREX™ reactive media is contained in a tank that receives nitrified wastewater effluent from an ATU or RSF. This is an innovative technology and approval by DOH WWB is required for use. As depicted in Figure 3.15, a typical setup includes wastewater sequentially passing through a septic tank, a nitrifying sand filter, the NITREX™ denitrifying filter tank, and then an absorption bed or trench for disposal. The NITREX™ media can also be placed in a lined excavation instead of a tank. The sand filter serves as a necessary nitrification step so that the NITREX™ can perform denitrification on nitrate-rich effluent (Lombardo Associates, Inc., 2018).

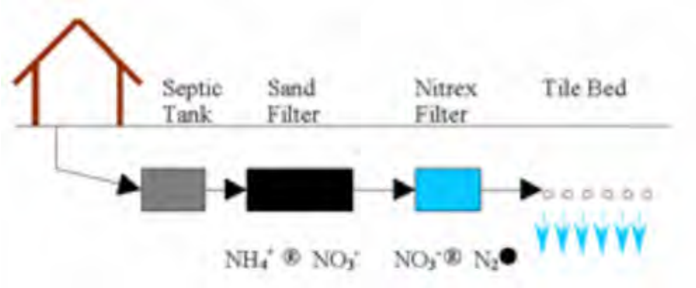

Figure 3.15 Nitrogen Reduction by NITREX™ Filter (Lombardo Associates, Inc., 2018)

- Benefits
  - Average total nitrogen removal is expected to be up to 97 percent.
  - There is no pumping or chemical addition requirement.
  - The NITREX™ media has an expected performance period of 50 years.
  - Virtually no maintenance of the system is needed, but routine inspections and pumping of the upstream septic tank will be necessary.
- Challenges
  - This innovative technology is new to Hawai'i, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.
- Operation and Maintenance
  - Annual inspection of rock media chamber, with cleaning and addition of lost media as needed.

3.3.8 Recirculating Gravel Filter System (WA)

This is an emerging technology required DOH WWB approval for use. The treatment system is based on a two-step process:

1. Under aerobic conditions, the effluent undergoes nitrification.
2. Under anaerobic conditions, denitrification occurs (Washington State Department of Health and University of Washington Civil and Environmental Engineering Department, 2012).

This system would be placed following a septic tank. Effluent could be transferred to an absorption bed or trench. There are three zones in this system, with effluent continually circulated through the first two zones. With each circulation cycle, a portion of the nitrified effluent is released to the third zone for denitrification. The different zones are denoted by numbers in circles in Figure 3.16:

- Zone 1: The septic tank effluent flows into the recirculating tank. As the effluent level rises in the tank, a float activates a timer to control a pump. The pump sends timed doses of effluent to the recirculating gravel filter in Zone 2.

- Zone 2: The wastewater flows down through the gravel, and ammonia is converted to nitrate. The nitrified effluent exits through a slotted pipe at the bottom and about 80 percent flows back to the recirculating tank in Zone 1 with 20 percent flowing to Zone 3.
- Zone 1: (repeated cycle): The nitrified effluent from Zone 2 mixes with additional septic tank effluent. Serving as a carbon source for bacteria, the septic tank effluent allows for some denitrification to occur here. The effluent is then pumped to Zone 2 to repeat the process.
- Zone 3: This is a vegetated woodchip bed with constant submergence of the woodchips to create an anoxic zone. The bed can also be described as an anoxic subsurface constructed wetland. Denitrification occurs as the effluent flows horizontally through the bed. Plants such as cattails can also provide increased nitrate removal, as well as provide another carbon source. Finally, effluent from this zone would be transferred to a water level control basin and then an absorption system (Washington State Department of Health and University of Washington Civil and Environmental Engineering Department, 2012).

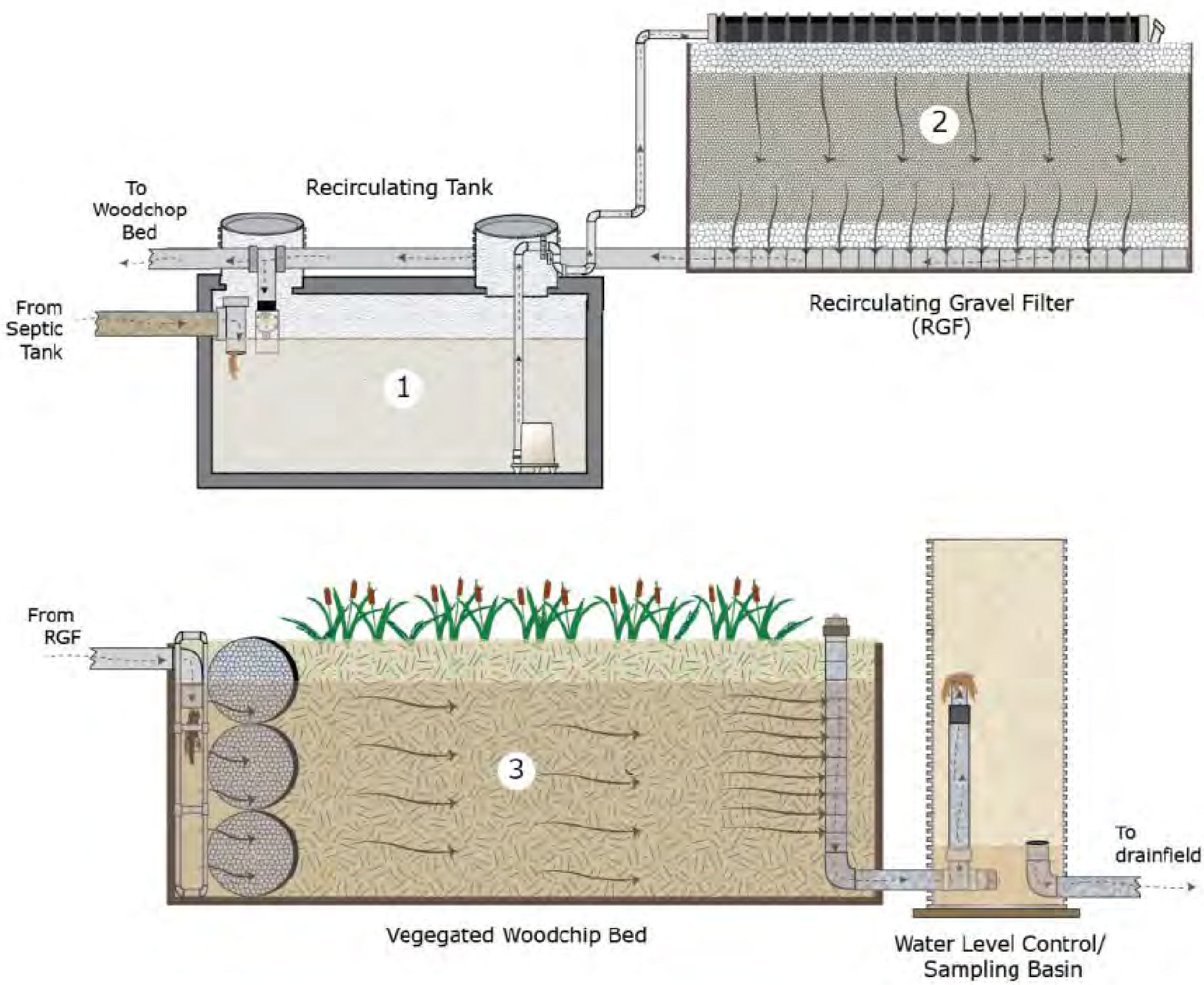

Figure 3.16 Recirculating Gravel Filter with Vegetated Woodbed System (Washington State Department of Health and University of Washington Civil and Environmental Engineering Department, 2012)

- Benefits
  - Average total nitrogen removal is 92 percent.
  - Local materials may be used for the woodbed media.
- Challenges
  - Pump operation and electricity are needed for the recirculation system.
  - This emerging technology is new to Hawaiʻi, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.
- Operation and Maintenance
  - Routine inspections should include the pump and control panel, adequacy of pumped dosage frequency, and effluent filter on the septic tank outlet. The septic tank should also be maintained to ensure proper functioning of the subsequent treatment and disposal steps (Washington State Department of Health and University of Washington Civil and Environmental Engineering Department, 2013).

3.4 Description of Onsite Wastewater Disposal Technologies

The following sections of this TM provide descriptions and characteristics of the various disposal technologies that were evaluated. The various disposal technologies have four levels of approval:

- **Approved.** These technologies are already approved for use in HAR 11-62 and are rapidly approved by DOH WWB.
- **Approval Required.** These technologies are mentioned in HAR 11-62, however, design review is required by DOH WWB prior to site-specific approval.
- **Innovative.** These technologies are commercially available outside of Hawaiʻi, but do not have established regulatory design criteria and would require design review by DOH WWB.
- **Emerging.** These technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.4.1 Absorption Systems

Absorption systems are an approved subsurface disposal technology that allows treated effluent to percolate into the soil (Figures 3.17, 3.18, and 3.19). Treated effluent comes from a treatment system (usually a septic tank or ATU) and is distributed through perforated pipes laid in either a trench or bed, the bottom surface area of which depends on the hydraulic properties of the native soil. Due to the aerobic conditions in the shallow soil layer, further treatment including filtration of suspended solids and microorganisms, oxidation of organic wastes, and nitrification can occur. The extent of such treatment is dependent upon the characteristics of the native soil, the loading rate, and other factors which can cause treatment to vary from 0 percent to as high as 90 percent.

Absorption systems generally range in depth from 1.5 to 3 feet below grade. Trench widths range from 18 to 36 inches (Figure 3.17), while bed widths are at least 3 feet (Figure 3.18). The major distinction between the two is that in an absorption bed, the entire disposal area is excavated and backfilled with gravel, whereas absorption trenches have distinct areas of undisturbed soil.

Gravelless trench and bed absorption systems utilize plastic dome-shaped segmented chambers buried in the trench/bed in with large open spaces instead of perforated pipes surrounded by gravel (Figure 3.19).

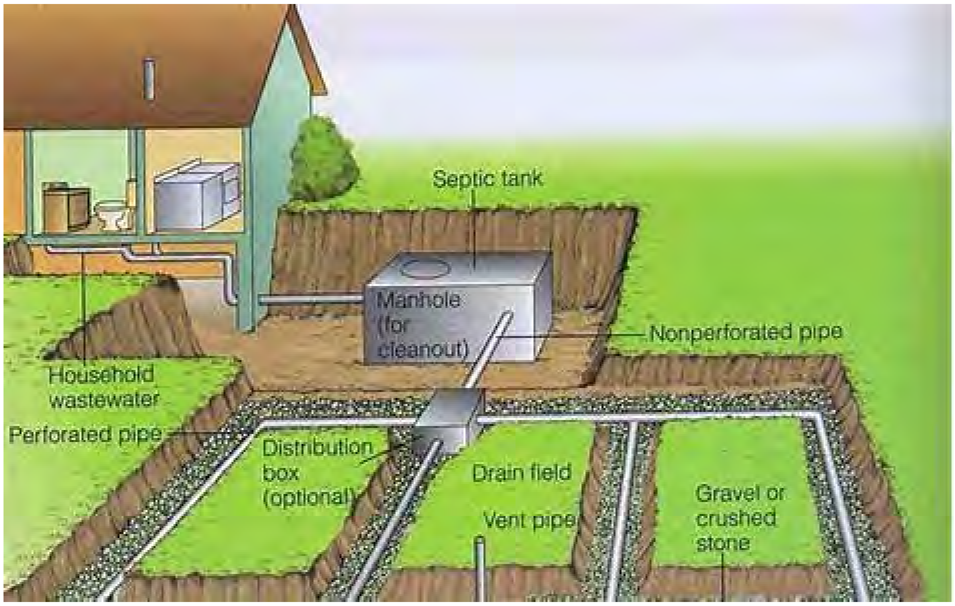

Figure 3.17 Trench Absorption System

Figure 3.18 Absorption Bed Disposal System

Figure 3.19 InfiltaratorTM Gravelless Drainfield System (Infiltratorwater.com, 2020)

- Benefits
  - Absorption systems are the most common type of disposal system and thus there are many products available and experience with installation.
  - When used downstream of a septic tank in good soil, under ideal conditions, absorption trenches can discharge less than 30 mg/L of BOD_5, 30 mg/L of TSS, and 13 coliform forming units per 100 milliliters (CFU/100 mL) of fecal coliform.
  - When deployed downstream of an ATU, absorption trenches can ideally achieve levels of 4 mg/L of BOD_5, 1 mg/L of TSS, and 13 CFU/100 mL of fecal coliform.
  - No power is required, and maintenance is generally not necessary.
- Challenges
  - Trenches cannot be used in terrain where the natural slope is too steep (>12 percent per HAR 11-62).
  - These systems cannot be used if groundwater is too close to the surface (minimum vertical separation of three feet per HAR 11-62).
  - Large amounts of land may be needed, since the effective absorption area is at the bottom of each trench.
  - Root intrusion can adversely impact performance.
  - Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surrounding soil, or surface water.
- Operation and Maintenance
  - There are no O&M requirements for absorption systems. The potential to clog the systems is highly dependent on the performance of the upstream treatment operations; therefore, a well-maintained treatment system (e.g. septic tank effluent filter) will keep the absorption system working properly. Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected.

3.4.2 Seepage Pit

A seepage pit is an approved disposal technology by DOH WWB and is constructed the same as a cesspool (often it is a former cesspool that has been cleaned and repurposed), but it receives treated wastewater, whereas a cesspool receives untreated wastewater. These systems are generally constructed from reinforced concrete rings, with a diameter of 8 or 10 feet and a height of 2 feet, that are stacked in order to achieve the depth required (usually 15-30 feet) to meet percolation requirements. Each ring has large openings in the sides and looks like Swiss cheese. A concrete lid with a 12-inch inspection port is placed on top. Water percolates out from the sides and the bottom of the unit into the surrounding soil. The effective percolation area is measured as the pit sidewall area.

- Benefits
  - Seepage pits are the simplest and most compact method to percolate water into the ground.
  - They are viable options when the available land area is insufficient for absorption beds or trenches, the terrain is steep, or when an impermeable layer overlies more suitable soil.
  - These units can be maintained (accumulated solids from poorly functioning upstream treatment units can be accessed and pumped out) unlike absorption trenches/beds.
- Challenges
  - Seepage pits generally cannot provide the same level of treatment as absorption bed and trench systems, but there have been few studies.
  - There can be a danger of structural stability including potential cave-ins when converting an old cesspool with un-lined walls or lined walls in poor condition into a seepage pit.
- Operation and Maintenance
  - Proper functioning of a seepage pit relies heavily on maintenance of the upstream treatment process. This prevents clogging of the seepage pit. Otherwise, periodic pumping of any accumulated sludge will be required.

3.4.3 Presby System

The Presby Advanced Enviro-Septic® System is an approved disposal technology that follows a septic tank and has NSF40 certification because it provides additional treatment. It is a network of 10-foot long pipes for further treating and percolating septic tank effluent. It consists of special pipes embedded in a specific type of System Sand. The pipes contain ridges, perforations with skimmers, geotextile fabric, green plastic fiber mat, and Bio-Accelerator® fabric. These work together to treat wastewater as depicted in Figure 3.20 (Presby Environmental, 2018). Without using any electricity or replacement media, the Advanced Enviro-Septic® system can remove BOD_5, TSS, and provide full nitrification. (Presby Environmental, 2018).

Figure 3.20 Presby Advanced Enviro-Septic® Treatment System (Presby Environmental, 2018)

- Benefits
  - Passive system that does not need electricity. There are no moveable parts and no replaceable media.
  - Enhanced treatment and disposal of wastewater are combined in this system.
  - No maintenance of the system is needed, but routine inspections and pumping of the upstream septic tank will be necessary.
- Challenges
  - This technology is still relatively new to Hawai'i, so the practical lifespan is unknown.
- Operation and Maintenance.
  - This is a buried, passive system which does not require operation or maintenance (same as an absorption bed).

3.4.4 Evapotranspiration Systems

Evapotranspiration (ET) is a disposal technology (approved with DOH WWB design review) that combines direct evaporation and plant transpiration for wastewater disposal. Pretreated effluent (usually an ATU) is conveyed to a porous bed containing water-tolerant plants (Figure 3.21). Wicking, or capillary action, draws water to the surface, where it is either taken up by the plants and transpired, or evaporated from the surface.

Effluent that is not transpired or evaporated will percolate from the bottom of the bed. This type of system is known as evapotranspiration-infiltration (ETI).

These systems can also be designed with an underlying impermeable liner for a "zero-discharge" system. In this case, disposal is strictly dependent on evaporation and plant transpiration. Additionally, the liner allows the system to be placed above an Underground Injection Control (UIC) line or where there is shallow groundwater or proximate surface water such as a stream, lake or the ocean.

Other components that are typically included are drip or distribution lines, flushing or filtering mechanism, controller to automate dosing cycles, distribution pump, and alternating ET beds.

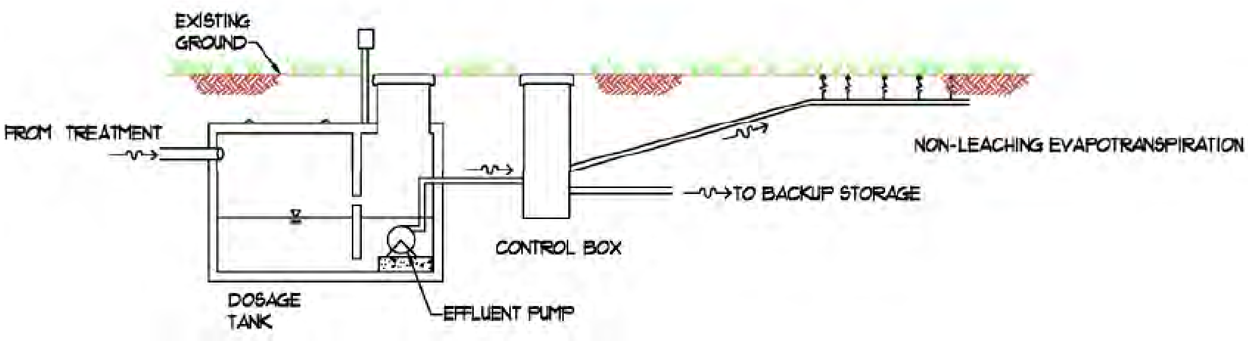

Figure 3.21 Profile of Typical ET System

- Benefits
  - If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved.
- Challenges
  - Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates.
  - ET systems are more effective in arid climates where evaporation rates are much higher than precipitation rates.
  - Recordkeeping of lysimeter (soil pore water sampler) data is required to ensure proper functioning.
- Operation and Maintenance
  - O&M tasks will include simple inspection of observation wells, electrical costs for pumping, as needed, minor landscaping, and maintaining upstream processes to avoid overflow of solids into the ET bed.

3.4.5 Constructed Wetland Systems

Constructed wetlands are a disposal technology (approved with DOH WWB design review) that is designed and constructed to recreate the processes that naturally treat wastewater by the environment. Septic tank effluent flows (typically by gravity) to an earthen basin or cell containing microorganisms, porous media and plants. A perforated pipe runs along the length of the cell just below the plants to evenly distribute the effluent. A second pipe runs along the length of the cell to collect the effluent as it travels through the porous media, where it then flows through a distribution box and into a drainfield (Figure 3.22). The wastewater flows through the constructed wetland and undergoes filtration, nitrification, denitrification, and absorption. In residential applications, wastewater flows are kept beneath the ground surface to limit potential contact with wastewater.

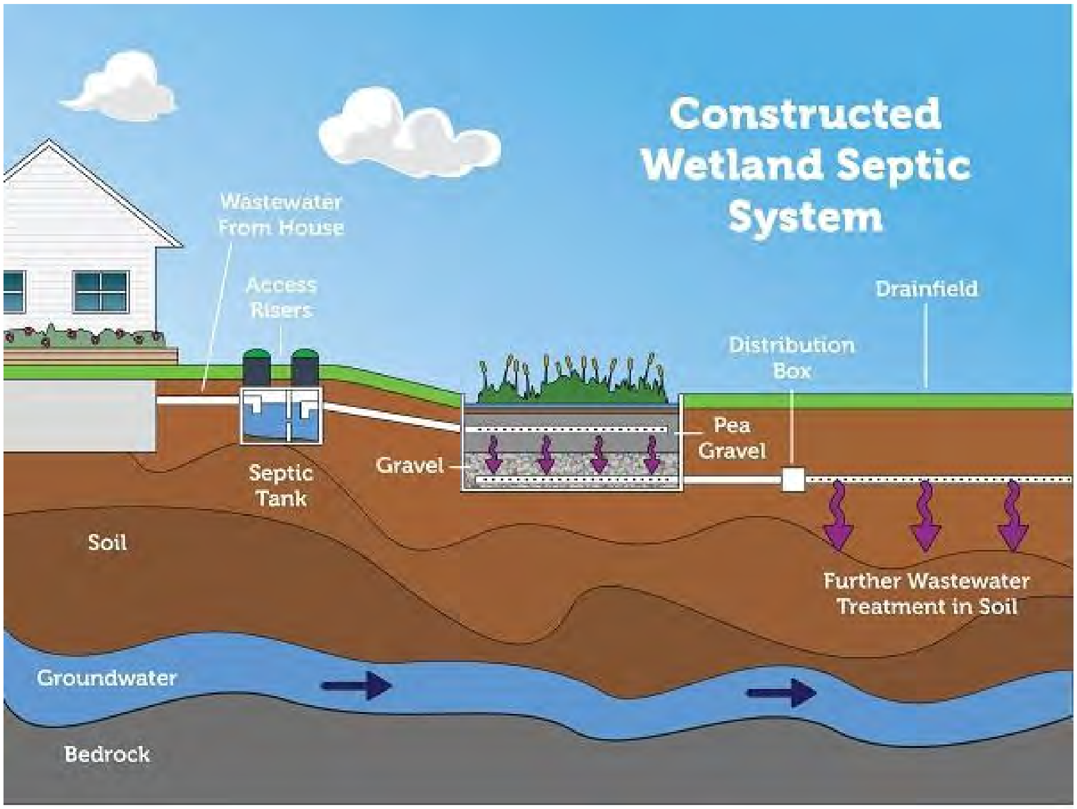

Figure 3.22 Constructed Wetland with Primary Treatment by Septic Tank (United States Environmental Protection Agency, 2018)

- Benefits
  - A constructed wetland provides suitable conditions for denitrification to occur.
  - Power is not required to operate a wetland.
- Challenges
  - Large land area may be required.
  - It is important to maintain an even cross-sectional flow throughout the constructed wetland.
  - The water level should be maintained in the cell during low- or no-flow periods so that the plants do not die.
- Operation and Maintenance
  - Routine maintenance of the vegetation should be done to prevent problems caused by root systems, such as surface ponding. Frequent inspection of the vegetation, inlet distributor, liner, berms or retaining walls, pumps, if present, and drainfield is required. To facilitate this, a maintenance plan should be completed and should detail what is to be done, how it is to be done, and how often it should be done (Beharrell, 2004).

3.4.6 Drip Dispersal Systems

Drip disposal systems (also called drip irrigation systems) are a disposal technology (approved with DOH WWB design review) that use a network of pipes containing emitters commonly spaced 12 inches apart and installed in excavations similar to but shallower than absorption beds. Rather than working by gravity, these systems receive treated effluent in pumped doses from a dosing tank, which allows for controlled loading rates to the shallow root zone of the surrounding soil (Figures 3.23 and 3.24). While some of the treated wastewater percolates into the ground, drip disposal systems act partially as an evapotranspiration system since some of the effluent is taken up by the plants at the ground surface.

Figure 3.23 Drip Irrigation System

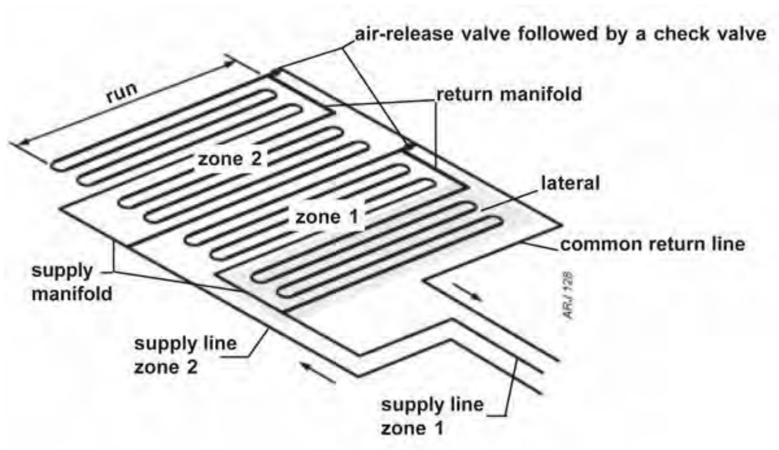

Figure 3.24 Drip Irrigation Zones (Jarrett, 2008)

- Benefits
  - Reliable alternative for areas with low permeability, seasonal high water tables, or severe slopes.
  - Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally.
- Challenges
  - In some cases, a large dose tank is needed to accommodate timed dose delivery to the drip absorption area.
  - The septic tank and its effluent filter must be monitored and maintained in order to prevent clogging and possible failure of the drip emitters.
  - Drip disposal systems are active systems, meaning power is required to run pumps, sensors and controls. Regular monitoring and maintenance shall be performed by an authorized service provider as described in an O&M manual provided by the manufacturer. Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters (New Jersey Department of Environmental Protection [NJDEP], 2008).
- Operation and Maintenance
  - Regular monitoring and maintenance of pump, filter and piping shall be performed by an authorized service provider as described in an O&M manual provided by the manufacturer. Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters (NJDEP, 2008).

3.4.7 Passive Systems (FL)

Several variations of passive-type systems have been developed during a large research project in the State of Florida. These systems are a disposal technology (innovative – not currently approved in Hawaiʻi) that follow a septic tank. One type (Figure 3.25) is an in-ground (non-tank confined) variation that treats septic tank effluent which is dosed at low pressure to an in-ground Stage 1 unsaturated biofilter in native soil. The Stage 1 biofilter is underlain by a Stage 2 lignocellulosic biofilter in a lined bed. The effluent is allowed to overflow the liner into surrounding soil. As shown in Figure 3.25, nitrification occurs in Stage 1. Afterwards, the nitrate-rich water travels to the Stage 2 biofilter, which is saturated and therefore an anoxic environment suitable for denitrification. Studies have identified fine sand and lignocellulosic materials from woody plants as candidate media for Stage 2. This configuration had total nitrogen removal of 50 to 70 percent.

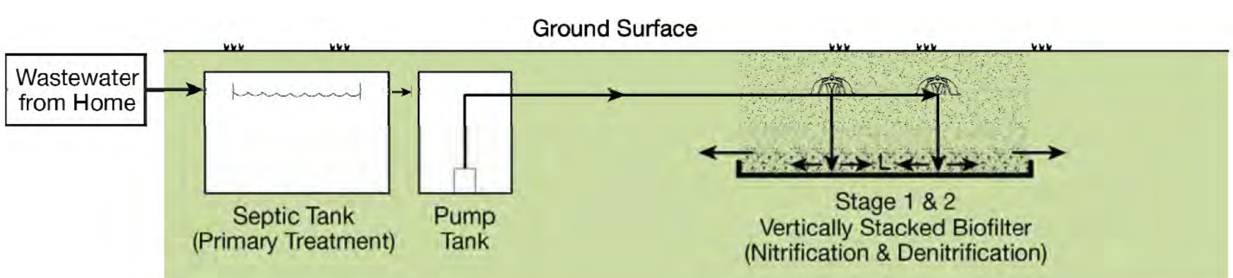

Figure 3.25 Treatment by In-Ground Unsaturated Biofilter in Native Soil Underlain by Saturated Biofilter in Liner and Disposal by Overflow into Surrounding Soil (Hazen and Sawyer, 2015)

A second type evaluated in Florida is shown in Figure 3.26. This system also treats septic tank effluent via secondary treatment in a Stage 1 unsaturated biofilter and Stage 2 saturated biofilter. The denitrified effluent is then disposed of in an absorption bed or trench. The Stage 1 biofilter hydraulics can be either single pass or recirculation. In Figure 3.26, the pump tank can be run either with single pass or with a recycle stream for internal recirculation to spray nozzles located above the surface of the Stage 1 media. The Stage 2 biofilters can contain single or dual media, such as lignocellulosic/sand mixture. This configuration had total nitrogen removal of 85 to 95 percent.

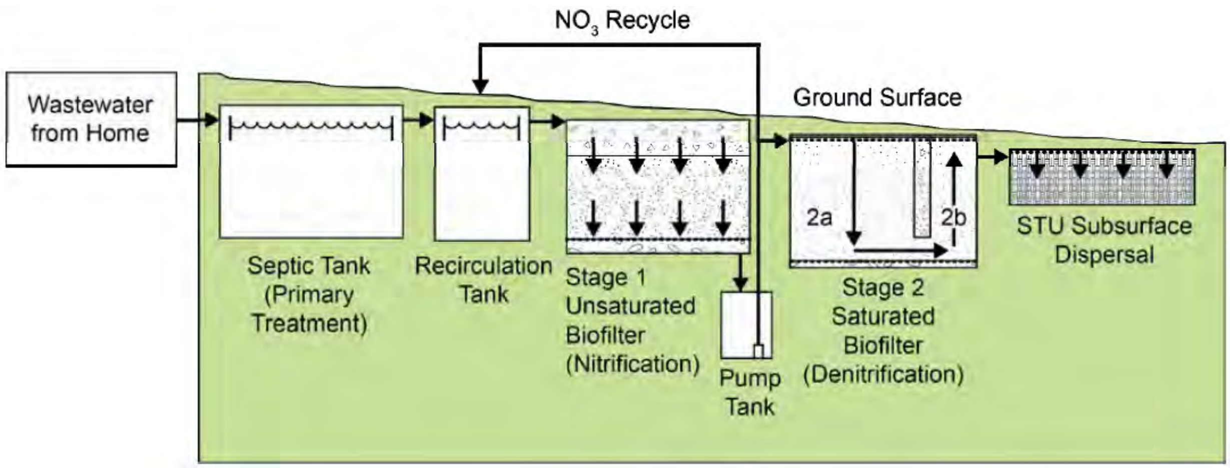

Figure 3.26 Treatment by Recirculating Unsaturated Biofilter and Saturated Biofilter and Disposal by Soil Treatment Unit (Hazen and Sawyer, 2015)

Figure 3.27 shows an in-ground variation of the previously described in-tank based system. Here, septic tank effluent is treated in a Stage 1 unsaturated biofilter stacked on a Stage 2 saturated biofilter. The effluent can continue to another Stage 2 saturated biofilter for further denitrification, or to a soil absorption system. Figure 3.27 shows the additional Stage 2 filter and a drip irrigation soil treatment unit (Hazen and Sawyer, 2015). This configuration has total nitrogen removal of 85 to 95 percent.

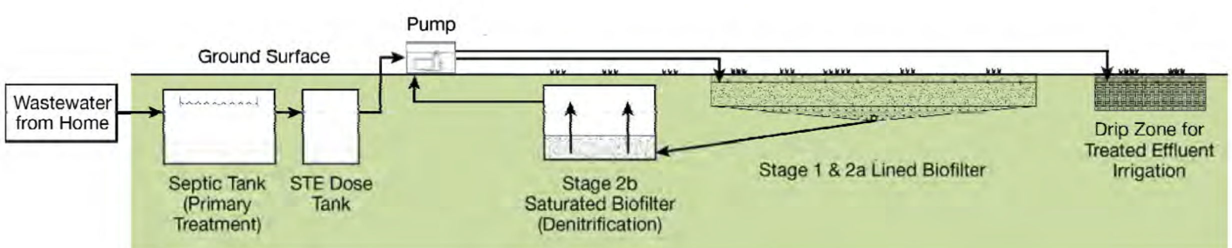

Figure 3.27 Treatment by Unsaturated and Saturated Biofilter in Liner and Second Saturated Biofilter and Disposal by Drip Irrigation (Hazen and Sawyer, 2015)

- Benefits
  - Total N removal depends on the configuration and is expected to be either 50 to 95 percent prior to discharge to the soil absorption system.
  - Local materials may be used for biofilter media.
- Challenges
  - Pump operation and electricity will be needed if a recirculation system is included.
- Operation and Maintenance
  - Routine inspections (twice a year is required by Florida code) include pump operation and electrical connections, hydraulic inspection, flushing and cleaning of distribution lines, biofilter

media life, and the recirculation system. The septic tank must also be maintained to prevent clogging and failure of the subsequent treatment and disposal steps.

3.4.8 Layered Soil Treatment systems (MA)

The layer cake soil treatment system is a disposal technology (emerging – not currently approved in Hawai'i) that treats septic tank effluent in a modified absorption bed or trench (Figure 3.28). The modified absorption bed is a "layer cake" filtration system of 18 inches of sand and 18 inches of a sand and sawdust (or woodchips) mixture. The sand supplies oxygen for nitrification to occur, and the sand and sawdust mixture create an anaerobic environment for denitrification (Hilsman, 2016).

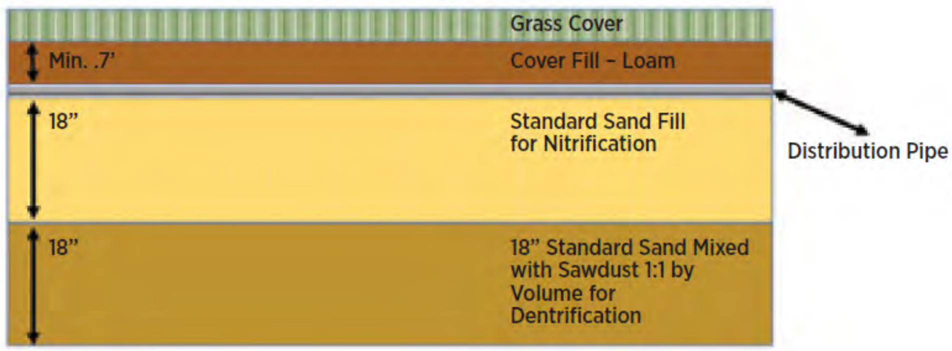

Figure 3.28 Disposal by "Layer Cake" System (Buzzards Bay Coalition, West Falmouth Village Association, Barnstable County Department of Health and the Environment, 2017)

- Benefits
  - Total nitrogen removal is expected to be 50 percent to 90 percent.
  - Local materials may be used for filter media.
  - Low operating and maintenance requirements.
- Challenges
  - Pump operation and electricity may be required for conveying wastewater to the modified leach field if gravity cannot be utilized.
  - The replacement interval of the sawdust/woodchips is unknown but estimated at 50-70 years.
- Operation and Maintenance
  - The septic tank, its effluent filter, and dosing pump must be routinely inspected for proper functioning and to prevent clogging and failure of the layer-cake treatment/disposal system.

3.4.9 Nitrification/Denitrification Biofilters (NY)

Several configurations of biofilter disposal technologies have been researched in New York (emerging – not currently approved in Hawai'i). Septic tank effluent is transferred through a low-pressure distribution system comprised of a low energy pump and parallel, low pressure dosing pipes with drilled orifices (similar to an absorption bed). As the wastewater percolates down, it infiltrates the lined nitrification/ denitrification biofilter underlying the pipes. Nitrification and denitrification occur in the sand and sand/lignocellulose layers, respectively.

One configuration of the biofilter is a 6- to 8-inch soil cover, followed by a 12- to 18-inch nitrifying sand layer, and then a 12- to 18-inch denitrifying sand/sawdust layer, as shown in Figure 3.29. The system is lined to maintain saturation conditions and to allow effluent discharge to a dispersal system. An alternative configuration is presented in Figure 3.30, where the denitrification step is designed in an upflow mode. This removes the need for an underdrain for effluent collection, and the effluent is simply discharges through overflow of the system (The New York State Center for Clean Water Technology, Stony Brook University, 2016).

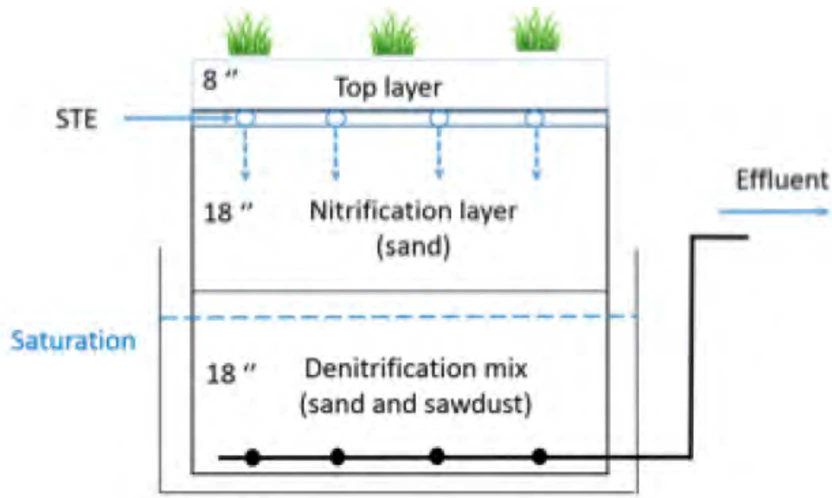

Figure 3.29 Disposal by Lined Nitrification/Denitrification Downflow Biofilter

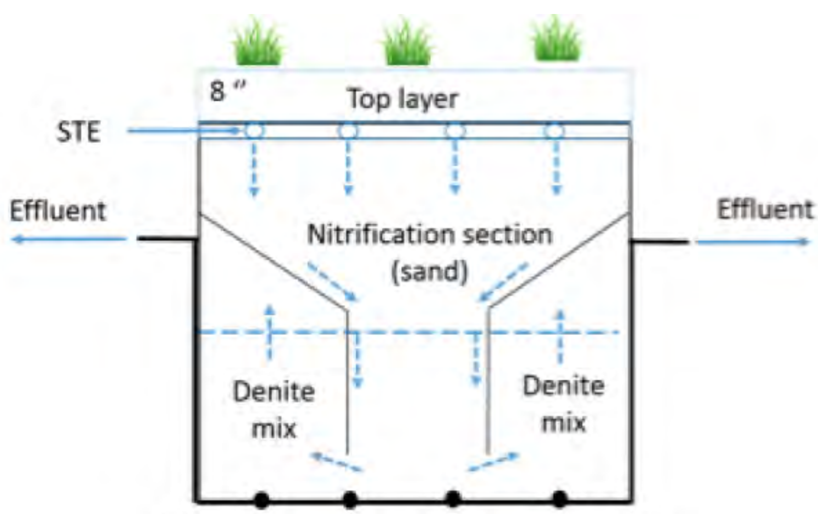

Figure 3.30 Disposal by Lined Nitrification/Denitrification Biofilter with Upflow Denitrification

This setup was designed to address the uncertainty of the wood material lifespan in biofilters. Literature reviews and calculations have indicated that the wood sources should persist for many decades; however, passive nitrogen reduction biofilters have not been in existence for more than a decade. Therefore, the lifespan of these wood sources remains an open question.

- Benefits
  - Total nitrogen removal is expected to be up to 90 percent.
  - Processes are primarily driven by gravity and capillary forces.
  - Saturated nature of sand and sawdust layer should minimize oxidation and degradation of the wood source over time.

  - Local materials can be used for the biofilter media.
  - Woodchip biofilter tank allows for convenient replacement of woodchips.
- Challenges
  - Pump operation and electricity needed for sending wastewater to the woodchip biofilter tank.
- Operation and Maintenance
  - The septic tank, its effluent filter, and pump, if included, must be routinely inspected and maintained for proper functioning and to prevent clogging and failure of downstream biofilters.

3.4.10 Graywater Reuse

A graywater reuse system (Figure 3.31) is a way to divert a large portion of a home's wastewater away from unnecessary treatment to beneficial reuse for yard irrigation. Graywater is all household drainage other than toilets and the kitchen sink (as currently defined in the Hawai'i Guidelines). Toilet and kitchen sink drainage are considered black water that must be treated in an OSWT system. The untreated graywater is stored in a holding tank and used for yard irrigation and the tank must have an overflow pipe connected to a disposal system. The DOH will likely approve a repurposed cesspool (cleaned and converted into seepage pit) for the graywater overflow. If a home also installed alternative toilets with zero discharge (composting, incinerating, and/or nano-membrane in the future), then all black water except for kitchen sink water would be eliminated and an OSWT system would almost be unnecessary. In the future, kitchen sink drainage could possibly be reclassified as graywater provided certain restrictions are met (e.g. no in-sink grinders are allowed, restrictions on disposal of chemicals and other materials that would foul/compromise a graywater storage tank) which would make an OSWT system unnecessary. Currently, a household with an alternative toilet and a graywater reuse system for other sources of water must still have a wastewater treatment and disposal system.

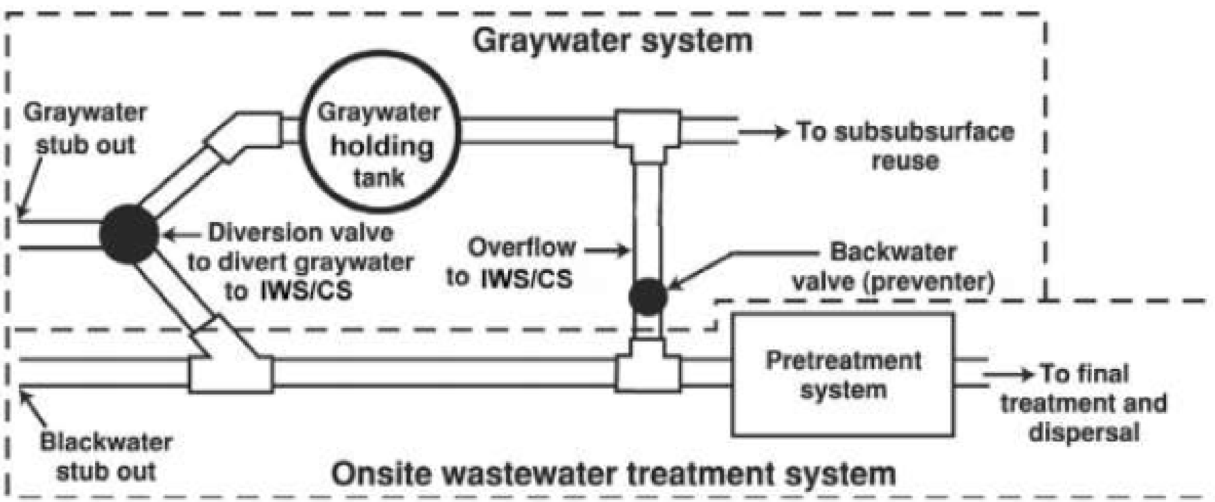

Figure 3.31 Onsite Wastewater Treatment and Disposal Requirement for Graywater System (Hawaii State Department of Health, 2009)

3.5 Technology Evaluation Criteria and Technology Evaluations

For the evaluation of technologies that can meet the goals of this project, several criteria were considered, as listed below:

- **The type of technology**, recognizing that both treatment and disposal systems are needed, the technologies were divided accordingly:

  - Treatment. The OSWT technology provides a level of pollutant reduction.
  - Disposal. The technology is a means for releasing the treated water back to the environment.
- **The approval status of the technology**, recognizing that lack of approval is not a disqualification for consideration of the OSWT or disposal technology, but DOH approval is required prior to installation:
  - Approved in HAR 11-62 (see Appendix A).
  - Design review by DOH is required per HAR 11-62 (see Appendix A).
  - Innovative[4] or Emerging[5].
- **The various residential site restrictions,** as the available land area for treatment and the soil characteristics will dictate which OSWT and disposal technologies are feasible. The following site constraints were considered:
  - Minimum separation from water table.
  - Minimum lot size[6].
  - Minimum soil percolation rate.
  - Maximum ground slope.
  - Location relative to flood zones.
  - Proximity to surface waters.
- **The treatment performance of the technologies**, as some systems provide for better treatment than others. The following performance characteristics were considered:
  - Applicability to areas with high cesspool density. If many cesspools were converted utilizing a single technology, would there be adverse effects to public health or the environment?
  - Potential treatment targets
  - NSF40 or similar systems. Particulate material, which may or may not be organic and thus may or may not biodegrade, also represents a pollutant to water systems. OSWT technologies with NSF40 certification can reliably treat for removal/reduction of organics (measured by BOD_5) and particulates (measured by TSS).
  - NSF245 or similar systems. Nutrients in wastewater, which may impact ground water or surface water quality (primary concern is nitrogen, but phosphorus was also evaluated). If released into aquatic systems in excess, nutrients can cause an imbalance in those systems by stimulating algae growth which has subsequent oxygen impacts and degrade water quality. OSWT technologies with NSF245 certification can reliably reduce nitrogen levels by 50 percent.
  - Removal of fecal coliform. Bacteria, often represented by fecal coliform, are indicative of potential pathogens in the wastewater. Consideration was given to the potential for fecal coliform reduction by OSWT technologies.
- **The costs and maintenance of the different systems,** noting that some systems are more robust and will last longer with less maintenance than others:
  - Construction cost.
  - Operation and maintenance (O&M) costs.

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[4] "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
[5] "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.
[6] Lot size is assumed to be the area for an individual property versus multiple properties.

The technology evaluation criteria were separated into the following categories:

1. Site Conditions
2. Separation Distances
3. Performance
4. Operations and Maintenance
5. Cost
6. Benefits and Challenges

The following sections provide more detail on each technology evaluation criteria category.

3.5.1 Site Conditions

Table 3.4 shows the site conditions that affect selection of the OSWT and disposal technologies and the symbology used in the technologies evaluations. These include:

1. **Proximity of the groundwater table.** There should be at least three feet separation from the bottom of the unit to the seasonal high water table (HAR 11-62).
2. **Minimum lot size.** It should be at least 10,000 square feet (sf) of usable land area, not including land area under buildings. For properties smaller than 10,000 square feet created before 1991, only one system is allowed per property. Because the design must assume 200 gpd per bedroom, and the maximum flow per disposal system is 1,000 gpd, the maximum number of bedrooms for a 10,000 sf property is 5. Larger properties (e.g. 20,000 sf) can have 10 bedrooms served by two OSDSs, etc. (HAR 11-62).
3. **Soil percolation rate.** The soil percolation rate must be no slower than 60 minutes per inch (min/in).
4. **Maximum ground slope.** The maximum site slope is 8 percent for an absorption bed and 12 percent for an absorption trench (HAR 11-62).
5. **Location in a regulated flood zone.** The zones where impacts will occur in a 100-year flood (and thus require flood insurance) include the following designations: A, AE, AH, AO, V, VE, and AEF. Zones of less or unstudied risk include: XS, X, and D.
6. **Proximity to inland or coastal waters.** There should be at least 50 feet separation between the unit and any surface water, including a stream, the ocean shoreline, pond, lake or other surface water body. Other minimum separation distances are shown in Table 3.4.

Table 3.4 Site Condition Considerations

Site Consideration	Symbology Shown in Technology Evaluation	Symbology Description
Proximity to the Groundwater Table	Y	Technology may be installed under conditions with high groundwater table.
	Y if >3 ft	Technology may be installed under conditions where the groundwater table depth is greater than 3 ft.
Minimum Lot Size	Y	Technology may be installed in lots with areas less than 10,000 sf.
	Y if >minimum absorption area required by HAR	Technology may be installed in lots with areas less than 10,000 sf if the minimum absorption area as required by HAR 11-62 is provided.
Soil Percolation Rate	Y	Technology may be installed where soil percolation rate is greater than 60 min/in.
	Y if < 60 min/in	Technology may be installed where soil percolation rate is less than 60 min/in.
Maximum Ground Slope	Y	Technology may be installed where maximum ground slope is 8 percent for absorption beds, and 12 percent for absorption trenches (HAR 11-62).
	Y if <12 percent (Trench used if 8 percent <slope <12 percent)	Technology may be installed where maximum ground slope is 8 percent for absorption beds, and 12 percent for absorption trenches (HAR 11-62).
	Y if ≥ 12 percent and absorption system not feasible	Technology may be installed where maximum ground slope is 12 percent and an absorption system is not feasible.
	Y if <12 percent	Technology may be installed where maximum ground slope is 12 percent.
Location in a Regulated Flood Zone	Y	Technology may be installed at a property that is within the 100-year flood zone as defined by federal insurance rate maps (FIRM).
	N	Technology may not be installed within the 100-year flood zone as defined by FIRM.
Proximity to Inland or Coastal Waters	Y	Technology may be installed regardless of proximity of the installation location to inland or coastal waters.
	Y if >50 feet away	Technology may be installed if the installation location is greater than 50 feet from inland or coastal waters.

With these site conditions in mind, it is possible to sort through the broad range of treatment and disposal options, as done in Tables 3.5 and 3.6, for OSWT and disposal options, respectively. Each of the technologies were described previously.

Table 3.5 Site Conditions for Different Treatment Technologies

Option	Technology Status	Proximity to Groundwater	Lot Size	Soil Permeability	Maximum Ground Slope	Location in a Regulated Flood Zone	Proximity to Coastal Waters
Septic Tank	Approved(1)	Y (with anchoring)	Y	Y	Y	N	Y if >50 feet away
ATU with nitrification (ATU-N)	Approved(1)	Y	Y	Y	Y	N	Y if >50 feet away
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)	Y	Y	Y	Y	N	Y if >50 feet away
Chlorine Disinfection	Approved(1)	Y	Y	Y	Y	N	Y if >50 feet away
UV Disinfection	Approved(1)	Y	Y	Y	Y	N	Y
Recirculating Sand Filter	Approval required(2)	Y	Y	Y	Y	N	Y if >50 feet away
Eliminite	Innovative(3)	Y	Y	Y	Y	N	Y if >50 feet away
NITREX	Innovative(3)	Y	Y	Y	Y	N	Y if >50 feet away
Recirculating Gravel Filter System (WA)	Emerging(4)	Y	Y	Y	Y	N	Y if >50 feet away

Notes:

(1) Technology approved by DOH in HAR 11-62.

(2) Technology mentioned in HAR 11-62, but design review is required.

(3) "Innovative" technologies are commercially available outside of Hawaiʻi, but do not have established regulatory design criteria and would require design review by DOH WWB.

(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

Table 3.6 Site Conditions for Different Disposal Technologies

Technology	Technology Status	Proximity to Groundwater	Lot Size	Soil Permeability	Maximum Ground Slope	Location in a Regulated Flood Zone	Proximity to Coastal Waters
Absorption Systems (Bed/Trench)	Approved(1)	Y if >3 feet	Y if >minimum absorption area required by HAR	Y if < 60 min/in	Y if <12 percent (Trench used if 8 percent <slope <12 percent)	N	Y if >50 feet away
Seepage Pit	Approved(1)	Y if >3 feet	Y	Y if < 60 min/in	Y if ≥ 12 percent and absorption system not feasible	N	Y if >50 feet away
Presby Advanced Enviro-Septic	Approved(1)	Y if > 3 ft	Y if >minimum absorption area required by HAR	Y if < 60 min/in	Y	N	Y if >50 feet away
Evapotranspiration	Approval Required(2)	Y	Y	Y	Y if <12 percent	N	Y if >50 feet away
Constructed Wetland	Approval Required(2)	Y if >3 ft	Y	Y	Y if <12 percent	N	Y if >50 feet away
Drip Irrigation	Approval Required(2)	Y if > 3ft	Y if >minimum absorption area required by HAR	Y	Y	N	Y if >50 feet away
Passive Treatment Units (medium and high treatment) (FL)	Innovative Technology	Y if > 3 ft	Y	Y	Y	N	Y if >50 feet away
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging Technology	Y if >3 ft	Y	Y	Y if <12 percent	N	Y if >50 feet away
Disposal by Nitrification/Denitrification Biofilter (NY)	Emerging Technology	Y if > 3 ft	Y	Y	Y	N	Y if >50 feet away

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.5.2 Separation Distances

Table 3.7 shows the minimum separation distances between cesspools, seepage pits, septic tanks, treatment units, soil absorption systems, and features including: structures, large trees, property lines, surface water bodies and potable water wells. These required separation distances are used when determining appropriate locations for OSWT and disposal technologies on a specific property. These minimum separation distances should be considered when determining feasibility of OSWT and disposal technologies.

Table 3.7 Minimum Separation Distances between OSDSs and Several Features from HAR 11-62

Minimum Horizontal Distance from:	Cesspool (feet)	Treatment Unit (feet)	Seepage Pit (feet)	Soil Absorption System (feet)
Wall line of any structure or building	5	5	5	5
Property line	9	5	9	5
Stream, the ocean at the shoreline certification, pond, lake, or other surface water body	50	50	50	50
Large trees	10	5	10	10
Treatment unit	5	5	5	5
Seepage pit	18	5	12	5
Cesspool	18	5	18	5
Soil absorption system	5	5	5	5
Potable water sources serving public water systems	1,000	500	1,000	1,000

3.5.3 Treatment Performance

Table 3.8 shows the treatment performance considerations that affect selection of the OSWT, and disposal technologies and the symbology used in the technologies' evaluations.

Tables 3.9 and 3.10 show summaries of the treatment performance of OSWT and disposal technologies, respectively. A review of the different technologies is presented subsequent to this section.

It is noted that a combination of a treatment technology followed by a disposal technology are required to meet DOH rules in Hawaiʻi. Sometimes more than one treatment technology may be required (e.g. ATU plus disinfection). Performance of treatment technologies is based upon recognized standards for removal of conventional water quality parameters including BOD_5, TSS, and pH; as well as other constituents such as total N, phosphorus (P), and fecal coliform bacteria (FC).

The National Sanitation Foundation Standard 40 (NSF40) includes detailed testing protocols and performance criteria for BOD_5, TSS, and pH. This standard requires secondary-level wastewater treatment that cannot be achieved in a septic tank alone. NSF certifies treatment units for a fee and maintains an online list of approved technologies (for an annual fee)[7]. NSF40 can be achieved in an ATU or with a septic tank combined with a Presby system and possibly also with a septic tank combined with several of the innovative and emerging technologies evaluated. The NSF245 standard encompasses NSF40 and adds to it a requirement of at least 50 percent removal of total N. This can be accomplished by an ATU designed as such (generally at greater cost) and/or by an advanced Presby system and possibly several of the innovative and emerging technologies.

[7] www.NSF.org

Table 3.8 Treatment Performance Considerations for Different OSWT and Disposal Technologies

Performance Metric	Symbology Shown in Technology Evaluation	Symbology Description
Application to Areas with High Cesspool Density	N	Technology should not be installed in areas with more than approximately 1 unit per acre because a higher level of treatment is necessary to avoid negative cumulative impacts
	Y	Technology may be installed in locations with 1 or more units per acre
Water Quality meets NSF40 criteria for CBOD5, TSS, and pH	Y	Technology is certified by the National Sanitation Foundation (NSF) as passing a 6-months performance test and meeting effluent water quality standards that include average $CBOD_5$ concentrations of less than 25 mg/L, TSS less than 30 mg/L, and pH between 6 and 9.
	N	Technology does not have NSF40 certification.
	N/A	Technology is not designed or intended to meet this metric
	Goal	Technologies for which meeting this standard is a goal, but certification has not yet been granted
Water Quality meets NSF245 criteria for total Nitrogen Removal	Y	Technology is certified by NSF as passing a 6-months performance test and meeting effluent water quality standards for NSF40 plus an average of at least 50 percent total nitrogen removal.
	N	Technology does not have NSF245 certification.
	N/A	Technology is not designed or intended to meet this metric
	Goal	Technologies for which meeting this standard is a goal, but certification has not yet been granted
Phosphorus Removal	Low	Technology may remove 10-20 percent of P due to bacteria uptake during metabolism of wastewater organic material
	Medium	Technology utilizes sand or sandy soil which facilitates some limited P removal by adsorption (20-30 percent)
	High	Technology utilizes clayey/silty/alluvial soils which facilitates significant P removal by adsorption (>50 percent)
	Medium/High	Technology utilizes a range of media types between Medium and High to remove P in a wide range
	Complete	Technology discharges zero quantity of P to the environment
	N/A	Technology is not designed or intended to remove P
Fecal Coliform Removal	Low	Technology may remove a portion of the fecal coliform ranging from 0 percent to less than 90 percent
	Medium	Technology may remove approximately 90 percent of fecal coliform.
	High	Technology may remove up to 99.99999 percent of fecal coliform
	Medium/High	Technology may remove between 99 and 99.99 percent of fecal coliform
	Complete	Technology discharges zero quantity of fecal coliforms to the environment
	N/A	Technology is not designed or intended to remove fecal coliforms

Table 3.9 Treatment Performance of OSWT Technologies

Technology	Technology Status	Application to Areas w/ High Cesspool Density	Water Quality meets NSF40 criteria for CBOD5, TSS, and pH(5)	Water Quality meets NSF245 for Total Nitrogen Removal(6)	Phosphorus Removal(7)	Fecal Coliform Removal
Septic Tank	Approved(1)	N	N	N	Low	Low
ATU with nitrification (ATU-N)	Approved(1)	Y	Y	N	Low	Medium
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)	Y	Y	Y	Low	Medium
Chlorine Disinfection	Approved(1)	Y	N	N	N/A	High
UV Disinfection	Approved(1)	Y	N	N	N/A	High
Recirculating Sand Filter	Approval Required(2)	Y	N	N	Low	Low
Eliminite	Innovative Technology(3)	Y	Goal	Goal	Low	Medium
NITREX	Innovative Technology(3)	Y	Goal	Goal	Low	Medium
Recirculating Gravel Filter System (WA)	Emerging Technology(4)	Y	Goal	N	Low	Low

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.
(5) National Sanitation Foundation (www.NSF.org), NSF Standard 40 testing protocol Class A effluent requirements.
(6) NSF Standard 245 testing protocol specifies at least 50 percent removal of total nitrogen (TN)
(7) Phosphorus removal is low during biological treatment (less than 20 percent), phosphorus removal is primarily due to absorption in soil.

Table 3.10 Treatment Performance of Disposal Technologies

Technology	Technology Status	Application to Areas w/ High Cesspool Density	Water Quality meets NSF40 criteria for CBOD5, TSS, and pH (5)	Water Quality meets NSF245 for Total Nitrogen Removal(6)	Phosphorus Removal(7)	Fecal Coliform Removal
Absorption Systems (Bed/Trench)	Approved(1)	Y	N/A	N/A	Medium/High(8)	Medium/High(8)
Seepage Pit	Approved(1)	N	N/A	N/A	Medium/High(8)	Medium/High(8)
Presby Advanced Enviro-Septic	Approved(1)	Y	Y	Y	Medium/High(8)	Medium/High(8)
Evapotranspiration	Approval Required(2)	Y	Y	Y	Complete	Complete
Constructed Wetland	Approval Required(2)	N	N/A	N/A	Medium	Medium
Drip Irrigation	Approval Required(2)	Y	N/A	N/A	Medium/High(8)	Medium/High(8)
Passive Treatment Units (medium and high treatment) (FL)	Innovative Technology(3)	Y	Goal	Goal	Medium/High(8)	Medium/High(8)
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging Technology(4)	Y	Goal	Goal	Medium/High(8)	Medium/High(8)
Disposal by Nitrification/Denitrification Biofilter (NY)	Emerging Technology(4)	Y	Goal	Goal	Medium/High(8)	Medium/High(8)

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.
(5) National Sanitation Foundation (www.NSF.org), NSF Standard 40 testing protocol Class A effluent requirements.
(6) NSF Standard 245 testing protocol specifies at least 50 percent removal of total nitrogen (TN)
(7) Phosphorus removal is low during biological treatment (less than 20 percent), phosphorus removal is primarily due to absorption in soil.
(8) Depends on soil type: for sandy soil = medium removal for all others = high

3.5.4 Operations and Maintenance

Table 3.11 shows the O&M considerations that affect selection of the OSWT, and disposal technologies and the symbology used in the technologies' evaluations.

Tables 3.12 and 3.13 show the summaries of the O&M considerations of OSWT and disposal technologies, respectively. A review of the different technologies is presented subsequent to this section.

Tables 3.12 and 3.13 show the approximate replacement intervals of 20, 30 or 60 years for each technology and a relative O&M quantity assessment for each treatment and disposal technology which ranges from None to Low to Medium to High. Tables 3.12 and 3.13 also include descriptions of the specific required O&M activities along with suggested intervals. Almost all cesspool replacement treatment and disposal technologies have O&M requirements, but the amount and frequencies are different. O&M requirements also have associated costs which add to the annual cost of the system and must be considered in a life-cycle-cost analysis (LCA).

Table 3.11 O&M Considerations for Different OSWT and Disposal Technologies

Performance Metric	Symbology Shown in Technology Evaluation	Symbology Description
Replacement Interval	20	Technology lifespan is estimated as 20 years prior to replacement with a new unit.
	30	Technology lifespan is estimated as 30 years prior to replacement with a new unit.
	60	Technology lifespan is estimated as 60 years or longer.
Operation and Maintenance Quantity	None	Technology does not require inspections, measurements, adjustments, repairs, cleaning, pumping, or inputs such as power or chemicals.
	Low	Technology requires inspection and pumping only every 2 to 4 years and may require minor landscape maintenance.
	Medium	Technology has a small pump, and requires annual cleaning and repair as needed
	High	Technology has one or more pumps, require more than annual inspections and adjustments, possibly require measurements, require annual cleaning, pumping and repair as needed.

Table 3.12 Operation and Maintenance Requirements for OSWT Technologies

Technology	Technology Status	Replacement Interval	O&M Level of Effort	Operations Requirements	Maintenance Requirements
Septic Tank	Approved(1)	60	Low	None	Inspection and pumping every 2 to 4 years
ATU with nitrification (ATU-N)	Approved(1)	30	High	Provide continuous electricity; Semi-annual inspection, measurements, and adjustments	Annual cleaning, repair (if needed) and pumping
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)	30	High	Provide continuous electricity; Semi-annual inspection, measurements, and adjustments	Annual cleaning, repair (if needed) and pumping
Chlorine Disinfection	Approved(1)	20	Medium	Check and add chlorine tablets every 2 to 4 weeks	Annual cleaning, repair (if needed)
UV Disinfection	Approved(1)	20	High	Provide continuous electricity to UV unit	Monthly cleaning of UV quartz sleeve, replace bulb as needed
Recirculating Sand Filter	Approval Required(2)	30	Medium	Provide continuous electricity to recirculation pump	Annual cleaning, repair (if needed)
Eliminite	Innovative Technology(3)	30	Medium	Provide continuous electricity to recirculation pump	Annual inspection, cleaning and rake-up of media as needed
NITREX	Innovative Technology(3)	30	Medium	Provide continuous electricity to recirculation pump	Annual inspection, cleaning and make-up of media as needed
Recirculating Gravel Filter System (WA)	Emerging Technology(4)	30	Medium	Provide continuous electricity to recirculation pump	Annual cleaning, repair (if needed)

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

Table 3.13 Operation and Maintenance Requirements for Disposal Technologies

Technology	Technology Status	Replacement Interval	O&M Level of Effort	Operations Requirements	Maintenance Requirements
Absorption Systems (Bed/Trench)	Approved(1)	60	None	None	None
Seepage Pit	Approved(1)	60	Low	Low	Inspection and pumping every 2 to 4 years
Presby Advanced Enviro-Septic	Approved(1)	60	None	None	None
Evapotranspiration	Approval Required(2)	60	Low	Provide continuous electricity to small dosing pump	Trim vegetated area of ET system, replace plants as needed
Constructed Wetland	Approval Required(2)	30	Medium	Provide continuous electricity to small dosing pump	Trim vegetation in wetland, replace plants as needed, control insects and mosquitos
Drip Irrigation	Approval Required(2)	30	Medium	Provide continuous electricity to small dosing pump	Annual cleaning, repair (if needed) of pump
Passive Treatment Units (medium and high treatment) (FL)	Innovative Technology(3)	60	None	None	None
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging Technology(4)	60	None	None	None
Disposal by Nitrification/Denitrification Biofilter (NY)	Emerging Technology(4)	60	None	None	None

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawaiʻi, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.5.5 Estimated Cesspool Retrofit Costs

In an attempt to estimate the cost of actual cesspool retrofits, data was analyzed from 83 total conversions throughout the State since 2016. Cost information was based on original receipts that were submitted to DOH WWB in order for the homeowner to qualify for the State Tax Credit Program. The resulting information is presented on Table 3.14. As indicated, the cost of conversion ranged from approximately $9,000 to as much as $60,000, depending on the type and size of system installed.

These large cost ranges illustrate that there are many factors involved in the cost of a cesspool retrofit which can include different site conditions (soil type, access, slope, etc.), different material costs, and different market conditions (e.g. number of available contractors). Such data show that it is challenging to come up with a "typical" cost, because there are so many variables – basically each project is different and generalizing costs is very difficult. We can observe that larger systems cost more, that ATU systems cost more than septic systems, and that the septic + Presby systems cost as much as the ATUs (however, there are only two data points).

Relative costs of the various treatment and disposal technologies are presented in Tables 3.15 and 3.16, respectively. It includes the relative capital costs (engineering, permitting, equipment and installation), operation costs (electricity), and maintenance costs (monitoring, upkeep, pumping).

Table 3.14 Costs of Retrofits Completed Since 2016 under State Tax Credit Program

Type	Size	No.	Cost ($)			
			Mean	Median	Low	High
Septic Tank + Absorption System	1 BR	2	19,803	19,803	10,813	28,792
	2 BR	3	16,435	12,400	10,500	26,406
	3 BR	13	18,817	14,790	9,399	45,797
	4 BR	13	21,989	19,800	9,787	45,550
	5 BR	42	23,688	22,850	8,925	52,356
	All	73	22,114	21,945	8,925	52,356
Aerobic Treatment Unit	2 BR	1	18,706	ND	ND	ND
	3 BR	2	22,500	22,500	20,000	25,000
	5 BR	5	33,298	26,339	21,760	59,585
	All	8	28,774	23,380	18,706	59,585
Septic Tank + Presby System	3 BR	1	24,160	ND	ND	ND
	4 BR	1	32,500	ND	ND	ND
Total		**2**	**28,330**	**ND**	**ND**	**ND**

Notes/Acronyms:
BR bedroom
ND Insufficient data available to provide additional statistics.

Table 3.15 Relative Costs of Various OSWT Technologies

Technology	Technology Status	Cost ($)		
		Construction	Operation	Maintenance
Septic Tank	Approved(1)	$$	0	$$$
ATU with nitrification (ATU-N)	Approved(1)	$$$	$$$	$$$
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)	$$$$	$$$	$$$
Chlorine Disinfection	Approved(1)	$	$$	$
UV Disinfection	Approved(1)	$	$$	$$$
Recirculating Sand Filter	Approval Required(2)	$$	$$$	$$$
Eliminite	Innovative Technology(3)	$$$	$$$	$$
NITREX	Innovative Technology(3)	$$/$$$	0	$$$
Recirculating Gravel Filter System (WA)	Emerging Technology(4)	$$	$$$	$$$

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

Table 3.16 Relative Costs of Various Disposal Technologies

Technology	Technology Status	Cost ($)		
		Construction	Operation	Maintenance
Absorption Systems (Bed/Trench)	Approved(1)	$	0	0
Seepage Pit	Approved(1)	$ convert, $$$ new	0	$$$
Presby Advanced Enviro-Septic	Approved(1)	$$$	0	$
Evapotranspiration	Approval Required(2)	$$	$$	$$
Constructed Wetland	Approval Required(2)	$$	$$$	$$$
Drip Irrigation	Approval Required(2)	$$	$$$	$$
Passive Treatment Units (medium and high treatment) (FL)	Innovative Technology(3)	$$	0	0
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging Technology(4)	$$	0	0
Disposal by Nitrification / Denitrification Biofilter (NY)	Emerging Technology(4)	$$	0	0

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.5.6 Benefits and Challenges

Tables 3.17 and 3.18 show a compilation of benefits and challenges of implementing the OSWT and disposal technologies, respectively. All the benefits and challenges of the OSWT and disposal systems need to be considered on a case by case basis.

Table 3.17 Benefits and Challenges of OSWT Technologies

Technology	Technology Status	Implementation Benefits	Implementation Challenges
Septic Tank	Approved(1)	Relatively simple, familiar, lower-cost installation; no electricity requirement and no operation requirements; long-interval pumping requirements; minimal site restrictions; long life	Minimal treatment performance
ATU with nitrification (ATU-N)	Approved(1)	Relatively simple, familiar installation; minimal site restrictions; high treatment performance	Higher cost installation; electricity required, periodic inspection and maintenance required; annual pumping likely required; shorter life
ATU with nitrification and denitrification (ATU-N-DN)	Approved(1)	Same as ATU w/N	Same as ATU w/N
Chlorine Disinfection	Approved(1)	Complete disinfection of pathogens achieved if maintained	Requires regular inspection for chemical use and replenishment (weekly); hazardous chemical storage required in cool dry location; chemical cost/availability
UV Disinfection	Approved(1)	Complete disinfection of pathogens achieved if maintained	Requires electricity; requires regular maintenance cleaning of bulbs (monthly) and regular replacement of bulbs (1-2 years)
Recirculating Sand Filter	Approval Required(2)	Enhanced biological treatment following a septic tank prior to disposal in seepage pit; medium cost; green option	Unfamiliar installation; design approval required; electricity required for dosing and recirculation pumps; maintenance of plantings required
Eliminite	Innovative Technology(3)	May achieve NSF 40 and NSF 245	High cost; approval process unclear; electricity may be required for dosing pump; maintenance unknown; lifespan unknown/untested
NITREX	Innovative Technology(3)	May achieve NSF 40 and NSF 245	High cost; approval process unclear; electricity may be required for dosing pump; maintenance unknown; lifespan unknown/untested
Recirculating Gravel Filter System (WA)	Emerging Technology(4)	May achieve NSF 40 and NSF 245	High cost; approval process unlearns; electricity required for circulation pump; maintenance unknown; lifespan unknown/untested

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

Table 3.18 Benefits and Challenges of Disposal Technologies

Technology	Technology Status	Implementation Benefits	Implementation Challenges
Absorption Systems (Bed/Trench)	Approved(1)	Relatively simple, familiar, lower-cost installation; no operation requirements; no maintenance requirements; long life	Cannot be used on small lots or large slopes or shallow groundwater or near water bodies; size related to local soil type; performance varies widely due to loading rate and soil type
Seepage Pit	Approved(1)	Can be a converted (cleaned and rehabilitated) cesspool at very low cost; no operation requirements; long-interval pumping requirements; minimal site restrictions; long life	Minimal treatment performance
Presby Advanced Enviro-Septic	Approved(1)	Installed in absorption bed following a septic tank; achieves NSF40; achieves NSF245 at additional cost; no operation requirements; no maintenance requirements; long life	Higher cost
Evapotranspiration	Approval Required(2)	Zero discharge (non-polluting) option; can be used where there is shallow groundwater or poor soils, and near water bodies; medium cost; long life	Design approval required; electricity required for dosing pump; maintenance of plantings required
Constructed Wetland	Approval Required(2)	Enhanced biological treatment following a septic tank prior to disposal in seepage pit; medium cost; green option	Unfamiliar installation; design approval required; electricity required for dosing pump; maintenance of plantings required
Drip Irrigation	Approval Required(2)	Can be used on small lots and steep slopes	High cost; design approval required; electricity required; maintenance required; specialized installation required
Passive Treatment Units (medium and high treatment) (FL)	Innovative Technology(3)	May achieve NSF 40 and NSF 245; no maintenance	High cost; approval process unclear; lifespan unknown/untested
Disposal by Layered Soil Treatment ("Layer Cake") Systems (MA)	Emerging Technology(4)	May achieve NSF 40 and NSF 245; no maintenance	High cost; approval process unlearn; lifespan unknown/untested
Disposal by Nitrification/Denitrification Biofilter (NY)	Emerging Technology(4)	May achieve NSF 40 and NSF 245	High cost; approval process unclear; electricity may be required for dosing pump; maintenance unknown; lifespan unknown/untested

Notes:
(1) Technology approved by DOH in HAR 11-62.
(2) Technology mentioned in HAR 11-62, but design review is required.
(3) "Innovative" technologies are commercially available outside of Hawai'i, but do not have established regulatory design criteria and would require design review by DOH WWB.
(4) "Emerging" technologies are at a research stage and/or pilot-testing and/or full-scale probationary approval in other states. They are not commercially available and do not have established regulatory design criteria. DOH WWB does not currently have a process for approving these technologies.

3.6 Recommendations

The CCWG and their advisors will be developing a broader strategy to facilitate homeowners with the cesspool upgrades. The following sections provide initial recommendations to facilitate the development of the broader strategy relative to developing guidance on OSWT and disposal technology selection.

3.6.1 Approach to selecting OSWT and disposal technologies

Several different types of OSWT and disposal technologies were described and evaluated in this TM. In this section, an evaluation/ selection process of treatment and disposal technologies is suggested. In order to implement an OSWT and disposal system to replace a cesspool on a piece of property, the homeowner will have to hire a contractor and an engineer. These could be hired together or separately. If separately, the homeowner would hire the engineer first to complete the detailed site investigation and soil testing, complete the design and submit plans and reports to the DOH WWB for approval. Once approved, the homeowner would find a contractor holding the correct licenses and having experience installing OSWT and disposal systems. The contractor would submit the paperwork to obtain a building permit and would not begin work until the permit it granted from the County building department (in Honolulu: Department of Planning and Permitting). The engineer will have to do his/her work before a construction permit can be issued and construction of cesspool upgrades can begin. The engineer will go through the steps in the selection process.

This document can be used to inform and guide the homeowner through the process to see what the possibilities are, the different levels of performance and costs, and the benefits/challenges of what is likely possible for upgrade of a cesspool on their property. The suggested steps are as follows:

1. Gather site characteristics including conducting soil tests.
2. Check site restrictions to rule out un-feasible treatment and disposal options.
3. Check priority category – if Priority 1 – check with DOH WWB whether nitrogen removal is required.
4. Check performance levels for feasible treatment and disposal options.
5. Look at relative costs for combinations of feasible treatment and disposal options.
6. Consider benefits and challenges of feasible combinations of treatment and disposal and create a ranked list of feasible systems.
7. Homeowner: discuss ranked list with an experienced engineer. Engineer: prepare preliminary sketches/plans and submittals and meet with DOH WWB to discuss any issues.

3.6.2 Treatment trains

Several different OSWT and disposal technologies have been described in this report and could be paired in many combinations. In addition, in some cases, two or even three different treatment technologies may be needed in sequence. Overall, what is required is to determine a treatment train of processes to meet required objectives and desired outcomes and costs. A treatment train is a set of treatment and disposal technologies that work together to meet requirements and optimize other considerations. We have prepared a set of typical/feasible/practical/logical treatment trains (and possible future treatment trains) to meet the various treatment requirements (See Table 3.19). The following can be noted about the 35 treatment trains shown in Table 3.19:

- Treatment trains 1 through 16 all utilize technologies that are currently approved in Hawaiʻi
  - 1a, 1b, , 5a, 7a and 8 do not require DOH design review
  - 3a, 3b, 3c, 3d, 5b, 5c, 7b and 7c require DOH design review
  - 2, 4, 6 only apply to properties that are too small for absorption systems

  - 1c, 3b, 3c, 3d, 4, 5b, 7a, 7b, 7c and 8 could possibly be used in a Priority 1 designated cesspool upgrade area depending on site conditions
  - 9 of the treatment trains would meet NSF40 water quality criteria
  - 4 of the treatment train would meet both NSF40 and NSF 245
  - 5 of the treatment trains would completely remove coliform bacteria
- Treatment trains 17 through 24 all utilize septic tanks plus an additional innovative/emerging treatment technology that are not currently approved in Hawai'i and are designated as F (future)
- Treatment trains 25 through 34 all involve alternative toilets and graywater recycling systems
  - In each case black water and graywater are source-separated
  - 13a, 13b and 13c utilize septic tanks
  - 13d, 13e, 13f, 13g, 13h and 13i utilize ATUs or ATU-DNs
  - 13j requires no treatment unit, but requires changes to the graywater guidelines and is designated as F (future)

There are many other "possible" treatment trains, however, most/all would be illogical or overly expensive, and the ones shown are considered the most feasible and practical.

3.6.3 Develop Tools for Homeowners

The characteristics of several different type of treatment and disposal technologies have been described in this TM and the building blocks for a technology evaluation database is included. A helpful tool that could be developed for homeowners is a web or mobile device application ("app") to help them determine what OSWT and disposal options are most applicable for their cesspool conversion. The app could also integrate cesspool conversion funding and finance options and coordinated with mapping and other databases/tools through the other CCWG subgroups (e.g. data prioritization and validation, and public outreach).

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Table 3.19 Feasible Treatment Trains that Combine Treatment and Disposal Technologies to Meet Different Goals

No.	Treatment Train Name	Source	Treatment 1	Treatment 2	Treatment 3	Disposal	Notes	NSF40	NSF245 (N removal)	Coliform (pathogen removal)
1	1a	RAW	ST			SABS	Standard conventional/traditional system			
2	1b	RAW	ST			PBY	Presby disposal system	Y		
3	2	RAW	ST			SEEP	By DOH approval, only for lots too small for absorption systems			
4	3a	RAW	ST			WET	DOH design review required			
5	3b	RAW	ST			ET	DOH design review required, zero discharge			Y
6	3c	RAW	ST	RSF		SABS	DOH design review required			Y
7	3d	RAW	ST	RSF		DRIP	DOH design review required			
8	4	RAW	ST	RSF	DIS	SEEP	By DOH approval, only for lots too small for absorption systems and/or near surface water			Y
9	5a	RAW	ATU			SABS	Standard conventional/traditional system	Y		
10	5b	RAW	ATU			WET	DOH design review required	Y		
11	5c	RAW	ATU			DRIP	DOH design review required	Y		
12	6	RAW	ATU			SEEP	By DOH approval, only for lots too small for absorption systems	Y		
13	7a	RAW	ATU-DN			SABS	For properties near surface water	Y	Y	
14	7b	RAW	ATU-DN			WET or DRIP	By DOH approval, for properties near surface water	Y	Y	
15	7c	RAW	ATU-DN			ET	By DOH approval, for properties near surface water, zero discharge	Y	Y	Y
16	8	RAW	ATU-DN	DIS		SEEP	For properties near surface water	Y	Y	Y
17	9a	RAW	ST	ELM		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
18	9b	RAW	ST	NTX		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
19	9c	RAW	ST	ITUFL		SABS or WET or ET	Innovative treatment system, not currently DOH approved			
20	10	RAW	ST	ELM or NTX or ITUFL	DIS	SEEP	Innovative treatment system, only for lots too small for absorption systems and/or near surface water, not currently DOH approved			F
21	11a	RAW	ST	RGSWA		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
22	11b	RAW	ST	LSTMA		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
23	11c	RAW	ST	NDBFNY		SABS or WET or ET	Emerging filtration system, not currently DOH approved			
24	12	RAW	ST	RGSWA or LTSMA or NDBFNY	DIS	SEEP	Emerging treatment system, only for lots too small for absorption systems and/or near surface water, not currently DOH approved			F
25	13a	BW GW	ALTT GRAY	ST		SABS SEEP	Meets current graywater guidelines			
26	13b	BW GW	ALTT GRAY	ST		DRIP SEEP	Meets current graywater guidelines, DOH design review required			

No.	Treatment Train Name	Source	Treatment 1	Treatment 2	Treatment 3	Disposal	Notes	NSF40	NSF245 (N removal)	Coliform (pathogen removal)
27	13c	BW GW	ALTT GRAY	ST		ET SEEP	Meets current graywater guidelines, DOH design review required			Y
28	13d	BW GW	ALTT GRAY	ATU		SABS SEEP	Meets current graywater guidelines	Y		
29	13e	BW GW	ALTT GRAY	ATU		DRIP SEEP	Meets current graywater guidelines, DOH design review required	Y		
30	13f	BW GW	ALTT GRAY	ATU		ET SEEP	Meets current graywater guidelines, DOH design review required	Y		Y
31	13g	BW GW	ALTT GRAY	ATU-DN		SABS SEEP	Meets current graywater guidelines	Y	Y	
32	13h	BW GW	ALTT GRAY	ATU-DN		DRIP SEEP	Meets current graywater guidelines, DOH design review required	Y	Y	
33	13i	BW GW	ALTT GRAY	ATU-DN		ET SEEP	Meets current graywater guidelines, DOH design review required	Y	Y	Y
34	13j	BW GW	ALTT GRAY	w/Kitchen Sink limits		None SEEP	Requires changes to graywater Guidelines	F	F	F

Notes/Acronymns:
Y Yes
N No
F Future

ALTT Alternative Zero-discharge Toilets (composting, incinerating, nano-membrane)
ATU Aerobic Treatment Unit with nitrification
ATU-DN ATU with denitrification
BW Black Water Sewage
DIS Disinfection system (chlorine or UV)
DRIP Drip irrigation system
ELM Eliminite nitrogen removal system (innovative)
ET Evapotranspiration (zero-discharge) system
GRAY Graywater recycling system
GW Graywater

GWT Graywater Recycle Tank
ITUEL Innovative Treatment Units Developed in Florida
LSTMA Layer Soil Treatment Systems developed in Massachusetts
NDBFNY Emerging Nitrifying/Denitrifying Biofilters Developed in New York
NSF245 National Sanitation Foundation Standard 245 for enhanced nitrogen removal
NSF40 National Sanitation Foundation Standard 40 for secondary level treatment
NTX NITREX nitrogen removal system (innovative)
PBY Presby disposal system - standard
PBY-DN Presby system with De-Nyte nitrogen removal
RAW Raw Sewage
SABS Absorption System - trenches or beds, traditional or gravelless
SEEPSeepage Pit
ST Septic Tank
RGSWA Recirculating Gravel System (WA) (emerging)
WET Constructed Wetland System

3.7 References

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Appendix A

HAWAI'I ADMINISTRATIVE RULE, TITLE 11 DEPARTMENT OF HEALTH, CHAPTER 62 WASTEWATER SYSTEMS

Rules Amending Title 11
Hawaii Administrative Rules

(MAR 21 2016)

1. Chapter 62 of Title 11, Hawaii Administrative Rules, entitled "Wastewater Systems" is amended and compiled to read as follows:

"HAWAII ADMINISTRATIVE RULES

TITLE 11

DEPARTMENT OF HEALTH

CHAPTER 62

WASTEWATER SYSTEMS

3176

Subchapter 5 Wastewater Management Permits and Registration

Subchapter 6 Wastewater and Wastewater Sludge Pumpers and Haulers

Subchapter 7 Variances, Penalties and Severability

Subchapter 8 Field Citations

SUBCHAPTER 1

PROHIBITIONS AND GENERAL REQUIREMENTS

§11-62-01 Preamble. The department of health seeks to ensure that the use and disposal of wastewater and wastewater sludge does not contaminate or pollute any valuable water resource, does not give rise to public nuisance, and does not become a hazard or potential hazard to the public health, safety, and welfare.

The department of health seeks to migrate towards an ultimate goal of regional sewage collection, treatment and disposal systems that are consistent with state and county wastewater planning policies. Off-site treatment and disposal systems, followed in priority by on-site systems, meeting health and environmental standards will be allowed whenever they are consistent with state and county wastewater planning policies and on the premise that these systems will eventually connect to regional sewage systems. Individual wastewater systems may be utilized in remote areas and in areas of low population density. Hawai`i is long overdue in eliminating construction of wastewater disposal systems depositing untreated sewage into the environment, such as cesspools. Indeed, the department stated in its prior rules back in the 1990's, with the agreement of all counties' wastewater advisory committees, that installation of new cesspools should end after the year 2000.

The department of health seeks to work in close partnership with the counties to manage wastewater to prevent pollution and harm to public health, safety and welfare. Each county may participate in the implementation of these rules through the recommendations of a county wastewater advisory committee to the director.

The department of health seeks to advance the use of recycled water and wastewater sludge consistent with public health and safety and environmental quality. The state department of health acknowledges that when properly treated and used, all recycled water and wastewater sludge are valuable resources with environmental and economic benefits and can be used to conserve the State's precious resources. The director acknowledges that the most highly treated recycled water and exceptional quality wastewater sludge can be used for a wide variety of applications with the appropriate restrictions and when best management practices and other requirements of this chapter are met. [Eff 12/10/88; am and comp 12/09/2004; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-4, 342D-5, 342E-3)(Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50, 342E-3)

§11-62-02 Purpose and applicability. (a) This chapter seeks to ensure that the use and disposal of wastewater and wastewater sludge from wastewater systems:

(1) Do not contaminate or pollute any drinking water or potential drinking water supply, or the waters of any beaches, shores, ponds, lakes, streams, groundwater, or shellfish growing waters;
(2) Do not encourage the harborage of insects, rodents, or other possible vectors;
(3) Do not give rise to nuisances;
(4) Do not become a hazard or a potential hazard to public health, safety and welfare;
(5) Contribute to the achievement of wastewater management goals contained in approved county water quality management plans;
(6) Reinforce state and county planning policies; and
(7) Are consistent with the State's administration of the National Pollutant Discharge Elimination System.

(b) This chapter seeks to advance the appropriate uses of recycled water and wastewater sludge.

(c) This chapter allows and does not preempt provisions in county codes, rules or ordinances that are not inconsistent with these rules, including, without limitation:

(1) Plumbing requirements in county plumbing codes or rules, including county adoptions of all or parts of the Uniform Plumbing Code;

(2) Sanitary sewer system and wastewater treatment works use permission and pretreatment requirements in county ordinances or rules regarding the introduction of fats, oils, grease, septage, sludge, or wastewater into sanitary sewers or wastewater treatment works, requirements on the use of grease traps, and requirements on wastewater and wastewater sludge pumping and hauling;

(3) Storm sewer system use permission requirements in county ordinances or rules; or

(4) Water recycling requirements in county ordinances or rules, including requirements for connection to or use of available recycled water. [Eff 12/10/88; am and comp 12/09/2004; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-4, 342D-5, 342E-3) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50, 342E-3; HRS ch. 340E; 33 U.S.C. §§1311, 1342, 1345; 40 CFR Parts 122, 123, 501, 503)

§11-62-03 Definitions. As used in this chapter:

"Activated sludge process" means a biological wastewater treatment process in which a mixture of wastewater and microorganisms is agitated with induced aeration. Aeration supplies dissolved oxygen and wastewater supplies the organic substrate necessary for microorganism growth. This process includes sedimentation units which follow the aeration and where settled solids are withdrawn for disposal or returned to the aeration unit.

"Aerobic treatment unit system" shall have the same meaning as defined in Chapter 235, HRS.

"Aerosol" means a solid suspended in air with or without preceding evaporation.

"Bedrock" means a continuous horizontal layer of hardened mineral deposits that does not support the growth of common plant life.

"Bedroom" means any room within a dwelling that is or might reasonably be used as a sleeping room. A room is presumed to be a bedroom if it has a superficial floor area not less than seventy square feet and is provided with windows or skylights with an area of not less than one-tenth of the floor area or ten square feet, whichever is greater.

"Best management practices" or "BMPs" means the most effective, practical schedules of activities, prohibitions of conduct, maintenance procedures, and other specifications of conduct to prevent or reduce the pollution. BMPs also include treatment requirements, operating procedures, and practices to site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage.

"BOD_5" means five days biochemical oxygen demand as measured by a standard test indicating the quantity of oxygen utilized by wastewater under controlled conditions of temperature and time.

"Building" means a structure, permanent or temporary, built, erected, and framed of component structural parts used or designed for the housing, shelter, workplace, enclosure or support of persons, animals or property of any kind.

"Building modification" means any change to an existing building's configuration that may result in the increase in wastewater flows or change in the wastewater characteristics.

"Cesspool" means an individual wastewater system consisting of an excavation in the ground whose depth is greater than its widest surface dimension, which receives untreated wastewater, and retains or is designed to retain the organic matter and solids discharging therein, but permits the liquid to seep through its bottom or sides to gain access to the underground formation.

"Collection system" means the conveyance system, which includes the building and street sewer laterals, Interceptor sewer, sewage pump station, and force main, used to transport the sewage to the treatment unit.

"Composite sample" means sample(s) collected on regular intervals in proportion to the existing flow or volume and then combined to form a sample that represents the flow or volume over a period of time or space.

"Compost toilet" means a non-flush, waterless toilet that employs an aerobic composting process to treat toilet wastes.

"Confined work areas" means any area having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined work areas include, but are not limited to, storage tanks, process vessels, bins, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than four feet in depth such as pits, tubs, vaults and vessels.

"Construction" in the context of a wastewater system means the building of the system in the ground; construction is not completed until the system has been fully installed so that it is ready for hookup.

"Contractor" means the installer of a wastewater system or any part of a wastewater system.

"County" means any county of the state.

"Critical Wastewater Disposal Area (CWDA)" means an area where the disposal of wastewater has or may cause adverse effects on human health or the environment due to existing hydrogeological conditions.

"Department" means the department of health.

"Director" means the director of health or the director's duly authorized agent, including a contractor of the director.

"Disinfection" means a process to destroy, neutralize, or inhibit the growth of pathogenic microbes.

"Disposal system" means any sewer, sewer outfall, sewer lateral, seepage pit, cesspool, injection well, soil absorption system, disposal trench, or other facility used in the disposal of wastewater or wastewater sludge, including any wastewater

3176

transmission lines, pumps, power, or other equipment associated with the ultimate disposal of wastewater or wastewater sludge.

"Distribution box" means a watertight chamber from which effluent from a treatment unit is distributed evenly to various portions of a disposal system.

"Drip irrigation" means application of water and wastewater, including recycled water, from emitters, either on the surface or subsurface, that are part of a piping system alongside the plants being irrigated and that discharges at a rate not to exceed two gallons per hour per emitter.

"Domestic sewage" is waste and wastewater from humans or household operations that is:

(1) Discharged to or otherwise enters a treatment works; or

(2) Of a type that is usually discharged to or otherwise enters a treatment works or an individual wastewater system.

"Domestic wastewater" has the same meaning as "domestic sewage".

"Dwelling" means any building which is wholly or partly used or intended to be used for living or sleeping by human occupants and includes, but is not limited to, apartment houses, single family houses, duplex houses, cluster houses, townhouses, and planned developments, but excludes hotels and lodging houses.

"Dwelling unit" means any habitable room or group of habitable rooms located within a dwelling and forming a single habitable unit with facilities which are used or intended to be used for living, sleeping, cooking, and eating.

"Engineer" means a professional engineer registered in the State of Hawaii.

"EPA" means the United States Environmental Protection Agency.

"EPA's methods for chemical analysis of water and wastes" means the 1979 edition of "Methods for Chemical Analysis of Water and Wastes" as published by the EPA.

"Evapotranspiration system" means a subsurface disposal system which relies on soil capillarity and

3176

plant uptake to dispose of treated effluent through surface evaporation and plant transpiration.

"Exceptional quality sludge" means wastewater sludge that has been treated to a level specified in this chapter in which it may be used with little or no restrictions for land application.

"Existing" means constructed under a valid county permit or with written approval from the director before the effective date of this rule.

"Filter fabric" means a woven or spun-bonded sheet material used to impede or prevent the movement of sand, silt and clay through the filter material. This material shall be non-biodegradable, resistant to acids and alkalies within a pH range of 4 to 10, and resistant to common solvents.

"Grab sample" means a single discrete sample of wastewater collected at a particular time and place which represents the composition of the source at that time and place.

"Graywater" shall have the same meaning as defined in HRS section 342D-1.

"Haul" means the transport of an item by vehicle or boat.

"Holding tank" means a nonportable, watertight closed vault used or designed to temporarily hold domestic wastewater.

"Household aerobic unit" means an individual wastewater system which receives domestic wastewater from dwellings or from other sources generating wastewater of a similar volume and strength, and retains solids, aerobically digests organic matter over a period of time, and allows the clarified effluent to discharge outside the tank into a disposal system.

"Individual permit" means a document issued under this rule to a specific person for a specific facility, or practice to generate, treat, use, dispose, or discharge of wastewater and wastewater sludge at a specific location.

"Individual wastewater systems" means facilities, such as septic systems, aerobic treatment units, and cesspools, that are not connected to a sewer and are used and designed to receive and dispose of:

(1) No more than one thousand gallons per day of domestic wastewater; or

(2) Greater than one thousand gallons per day of domestic wastewater from buildings with highly variable flows.

"Injection well" has the same meaning as defined in chapter 11-23.

"Land application" means the spraying or spreading of wastewater sludge onto the land surface, the injection of wastewater sludge below the land surface, or the incorporation of wastewater sludge into the soil such that the wastewater sludge can either condition the soil or fertilize crops or vegetation grown in the soil.

"Large capacity cesspool" means a cesspool that serves more than one residential dwelling or, for a non-residential cesspool, has the capacity to serve twenty or more persons per day.

"Living area" means the portion(s) of a dwelling unit including, but not limited to, the bedroom, kitchen, bathroom, living room, family room, covered lanai, den, and library, but excluding the garage, carport, open lanai, fence, and utility shed.

"Makai" means toward the sea or the area outside the Underground Injection Control (UIC) Line encircling the protected aquifer.

"Manual of Septic Tank Practice" means the United States Department of Health, Education and Welfare Publication No. (HSM) 72-10020, formerly known as "PHS Publication No. 526", revised in 1967.

"Modal time" means the amount of time elapsed between the time that a tracer, such as salt or dye, is injected into the influent at the entrance to a chamber and the time that the highest concentration of the tracer is observed in water where it is discharged from the chamber.

"Mound system" means a soil absorption system which is installed in or below an artificially created mound or earth.

"MPN" means most probable number.

"New" means constructed on or after the effective date of this chapter.

"Non-domestic wastewater" means all wastewater excluding domestic wastewater.

"Non-exceptional quality wastewater sludge" means wastewater sludge that is not exceptional quality wastewater sludge.

"Owner" means a person(s) who has legal title to a treatment works or individual wastewater system, or duly authorized representative of the owner.

"Pathogenic organisms" means disease-causing organisms. These include, but are not limited to, certain bacteria, protozoa, viruses, and viable helminth ova.

"Person" has the same meaning as defined in section 342D-1, HRS.

"Person who prepares wastewater sludge" means anyone who generates wastewater sludge during the treatment of wastewater in a wastewater treatment works, a person who derives a material from wastewater sludge, a person who provides treatment of wastewater sludge, or a person who changes the quality of wastewater sludge.

"pH" means the logarithm of the reciprocal of the hydrogen ion concentration measured at 25 degrees Celsius or measured at another temperature and then converted to an equivalent value at 25 degrees Celsius.

"Private" means not owned or operated by a federal, state, or county authority.

"Proposed" means put forward for consideration or suggested to the director. For the purposes of this chapter, "proposed" shall refer to the plans for a wastewater system or activity.

"Public" means, for issues of ownership, owned or operated by a federal, state, or county authority.

"Public water system" has the same meaning as defined in chapter 11-20.

"Qualified cesspool" shall have the same meaning as defined in Chapter 235, HRS.

"Qualified expenses" shall have the same meaning as defined in Chapter 235, HRS.

"R-1 water" means recycled water that has been oxidized, filtered, and disinfected to meet the corresponding standards set in this chapter.

"R-2 water" means recycled water that has been oxidized and disinfected to meet the corresponding standards set in this chapter.

"R-3 water" means recycled water that has been oxidized to meet secondary treatment standards as set forth by EPA.

"Recycled water" means treated wastewater that by design is intended or used for a beneficial purpose.

"Recycled water system" means a facility which conveys to users or uses recycled water. Recycled water systems are subdivided into distribution and use systems. Recycled water systems include all piping, storage, and repressurization facilities to deliver recycled water to users, but exclude treatment units.

"Residential large capacity cesspool" shall have the same meaning as defined in HRS section 342D-1.

"Reuse guidelines" means the "Guidelines for the treatment and use of reclaimed water", Hawaii State Department of Health, Wastewater Branch, November 23, 1993, revised January 2016.

"Seepage pit" means an excavation in the ground whose depth is greater than its widest surface dimension and which receives the discharge from treatment units and permits the effluent to exit through its bottom or sides for gradual seepage into the ground which does not result in contamination of water-bearing formations or surface water.

"Septage" means either a liquid or solid material removed from a septic tank, cesspool, portable toilet, Type III marine sanitation device, or similar treatment works that receives wastewater.

"Septic system" shall have the same meaning as defined in Chapter 235, HRS.

"Septic tank" means a watertight receptacle that receives the raw wastewater, retains after settling solid matter or sewage for treatment by bacteria, and discharges a partially treated effluent.

"Sewage sludge" means any solid, semi-solid, or liquid residue removed during the treatment of municipal wastewater or domestic sewage. Sewage sludge includes, but is not limited to, solids removed during primary, secondary, or advanced wastewater treatment, scum, septage, portable toilet pumping, Type III Marine Sanitation device pumpings (33 Code of

Federal Regulations Part 159), and sewage sludge products. Sewage sludge does not include grit, screenings, or ash generated during the incineration of sewage sludge.

"Sewer" means a pipe or conduit or any other appurtenances that carry wastewater from a building or buildings to a specific point for treatment and disposal.

"Sewer system" shall have the same meaning as defined in Chapter 235, HRS.

"Soil absorption" means a process which uses the soil to treat and dispose of effluent from a treatment unit.

"Spray irrigation" means application of water and wastewater, including recycled water, to the land to maintain vegetation or support the growth of vegetation by spraying the water and wastewater above ground from sprinklers, micro-sprinklers, or orifices in piping.

"SS" means suspended solids and indicates the characteristic state of solids in wastewater.

"Standard methods" means the 22nd edition, 2014, of "Standard Methods for the Examination of Water and Wastewater" as published by the American Water Works Association, American Public Health Association and the Water Pollution Control Federation, unless another edition is specified by the director.

"State waters" shall have the same meaning as defined in section 342D-1, HRS.

"Subsurface disposal system" means a disposal system that allows the gradual seepage of effluent into the ground which does not result in contamination of water-bearing formations or surface water, such as a seepage pit, cesspool, soil absorption system, or other facility used in the disposal of wastewater, including any wastewater transmission lines, pumps, power, or other equipment associated with the disposal of wastewater.

"Subsurface drip irrigation" means the application of water and wastewater, including recycled water, to the land to maintain vegetation or to support the growth of vegetation by discharging or emitting the water and wastewater from orifices in piping below the surface or finished grade.

"Suitable soil" means a soil which acts as an effective filter in the removal of organisms and suspended solids before the effluent reaches any highly permeable earth formations, bedrock, or groundwater.

"Surface disposal" means the placing of wastewater sludge on the land for final disposal and includes storage on land for two or more years.

"Surface irrigation" means the application of water and wastewater, including recycled water, by means other than spraying.

"Ten States Standards" means the 1980 edition of the Recommended Standards for Individual Sewage Systems, a report by the committee of the Great Lakes-Upper Mississippi River Board of State Sanitary Engineers on the policies for review and approval of plans and specifications for individual wastewater systems.

"Theoretical detention time" means the value obtained by dividing the volume of a chamber, through which fluid flows, by the flow rate expressed in amount of fluid volume per unit of time.

"Treatment unit" means any plant, facility, or equipment used in the treatment of wastewater, including the necessary pumps, power equipment, blowers, motors, holding tanks, flow splitter, and other process equipment.

"Treatment works" means any treatment unit and its associated collection system and disposal system, excluding individual wastewater systems.

"Vector attraction" means the characteristic of wastewater sludge that attracts rodents, flies, mosquitoes, or other organisms capable of transporting infectious agents.

"Wastewater" means any liquid waste, whether treated or not, and whether animal, mineral, or vegetable, including agricultural, industrial, and thermal wastes.

"Wastewater sludge" has the same meaning as "sewage sludge".

"Wastewater sludge facility" means a facility which collects, handles, stores, treats, or disposes of wastewater sludge. Wastewater sludge facilities shall exclude individual wastewater systems.

"Wastewater system" means the category of all wastewater and wastewater sludge treatment, use, and disposal systems, including all wastewater treatment works, collection systems, wastewater sludge facilities, recycled water systems, and individual wastewater systems.

"Water pollution" has the same meaning as defined in section 342D-1, HRS.

"Watertight" means constructed so that no water can enter and discharge except through the inlet and outlet pipe respectively. [Eff 12/10/88; am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 328(a), 342D-1, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-1, 342D-2, 342D-4, 342D-5, 342D-50, 342E-3; 40 CFR Parts 501, 503, 40 CFR §501.2)

§11-62-04 <u>County wastewater advisory committee.</u> (a) The mayor of each county may request that the director form a county wastewater advisory committee ("committee"), and the mayor may nominate its members, who may include representatives of the county water supply, public works, planning, and land utilization departments, labor, industry, environmental groups, and other interested people. The chief of the environmental management division on Oahu and the district environmental health program chiefs on the neighbor islands shall serve as ex officio members of their respective county committees. The department shall provide technical and support services for the committee.

(b) The primary role of the committee is to review and make recommendations to the director on the application of this chapter on matters which are unique to each county, on the establishment of critical wastewater disposal areas, on proposals which are not specifically addressed in these rules, and upon the director's request, for applications for variances. The committee's recommendations shall seek to advance the purposes of this chapter.

[Eff 12/10/88; am 8/30/91; am and comp 12/09/2004; am and comp MAR 21 2016] (Auth: HRS §§321-11,342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50)

§11-62-05 <u>Critical wastewater disposal areas (CWDA).</u> (a) All areas of the State are critical wastewater disposal areas.

(b) The director may impose more stringent requirements than those specified in this chapter for wastewater systems located or proposed to be located within areas that require additional protection. Requirements that the director may impose include, but are not limited to, meeting higher effluent standards for wastewater systems, limiting the method of effluent disposal, and requiring flow restriction devices on water fixtures. [Eff 12/10/88; am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11,342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50)

§11-62-06 <u>General requirements.</u> Owners shall comply with these requirements: (a) All buildings used or occupied as a dwelling, all public buildings, and all buildings and places of assembly generating wastewater or with toilets, sinks, drains, or other plumbing fixtures capable of conveying wastewater, shall be connected to a wastewater system. In addition, any new building capable of generating wastewater shall be connected to a wastewater system which meets the requirements of this rule.

(b) All buildings and places of assembly generating wastewater or with toilets, sinks, drains, or other plumbing fixtures capable of conveying wastewater and located within or near an available public sewer system as determined by the director, shall connect to the public sewer.

(c) All wastewater systems shall be designed, constructed, operated, and maintained in accordance with this chapter.

3176

(d) Operation and maintenance. All wastewater systems and parts thereof that are installed or used by persons to achieve compliance with this chapter and the conditions of any department approval for use issued under this rule shall at all times be properly operated and maintained. Proper operation and maintenance includes adequate laboratory controls and appropriate quality assurance procedures as specified by the director. Effluent testing for private wastewater systems shall be performed by an independent laboratory. Proper operation and maintenance also includes operation of any required back-up or auxiliary facilities or similar systems as specified by the director to be installed to achieve compliance with this chapter and the conditions of any department approval for use issued under this chapter.

(e) No holding tank, except for public facilities, and no privy shall be used. No portable toilets shall be used for any permanent structure unless approved by the director.

(f) No person or the owner shall cause or allow any wastewater system to create or contribute to any of the following:

(1) Human illness;
(2) Public health hazard;
(3) Nuisance;
(4) Unsanitary condition;
(5) Wastewater spill, overflow, or discharge into surface waters or the contamination or pollution of state waters, except in compliance with a permit or variance issued under chapter 11-55, or a water quality certification or waiver obtained under chapter 11-54;
(6) A wastewater spill, overflow, or discharge (spill) onto the ground, except for R-1 water from a recycled water system that is implementing BMPs approved by the director. The burden of proof is on the recycled water system's owner or operator to demonstrate that the spill qualifies for this exception;

(7) Harborage of vectors, including insects and rodents;
(8) Foul or noxious odors;
(9) Public safety hazard; or
(10) Contamination, pollution, or endangerment of drinking waters, except in compliance with a permit issued under chapter 11-23.

(g) Notice. If any of the conditions in subsection (f) exist, the owner or the person responsible for the wastewater system shall notify the director immediately, unless for subsection (f)(5) and (f)(6), the owner or person responsible demonstrates compliance with the protocol attached to this chapter as Appendix B, entitled Responses for Wastewater Spills, Overflows, and Discharges ("Spills") dated July 1, 2014.

(h) In case of a violation of this chapter, the director, at the director's discretion, shall initiate enforcement action against the owner(s) of the wastewater system and initiate enforcement action against other persons to have the offending condition abated, corrected, or removed. In addition, once a violation of this chapter occurs, the director shall order the owner to take immediate actions to protect public health and safety.

(i) Duty to mitigate. The owners of wastewater systems shall take steps to minimize or prevent the use and disposal of wastewater or wastewater sludge in violation of this chapter which has a reasonable likelihood of adversely affecting human health or the environment.

(j) Upon request by the director, proposed wastewater systems in critical wastewater disposal areas shall be approved in writing or by rule by the respective county board of water supply or department of water supply.

(k) If applicable, a wastewater system involving the subsurface disposal of wastewater shall be in compliance with chapter 11-23.

(l) Approvals to-construct the wastewater system shall be considered invalid if:

(1) A county does not issue a building permit for a private building within one year after

the director approves the wastewater system, or the construction of the wastewater system has not begun within one year of the approval; and

(2) A county revokes or rescinds a building permit and the building is to be served by a wastewater system that was approved in conjunction with the building permit application. Reapproval of any wastewater system for which the director's approval has been rescinded or determined invalid pursuant to this paragraph shall be based on the applicable rules in effect at the time the request for reapproval is made.

(m) The director, at the director's discretion, may require that a wastewater system be upgraded to meet the applicable requirements of this chapter whenever a building modification is proposed that may change the nature or quantity of the wastewater flowing to the wastewater system. The modifications may include but not be limited to adding additional bedrooms to a dwelling or adding a restaurant to a shopping complex. The director, at the director's discretion, may also require that a wastewater system be upgraded if any of the following conditions exists:

(1) The existing wastewater system has created or contributed to any of the conditions noted in subsection (f);

(2) The existing wastewater disposal system has within the last twelve months been pumped more than twice or has spilled wastewater more than once;

(3) The existing wastewater system disposes untreated wastewater directly into the groundwater table; or

(4) The owner of the existing wastewater system has not satisfactorily addressed all of the deficiencies noted by the director.

(n) Modifications to wastewater systems that may affect the quality or quantity of the wastewater and wastewater sludge shall meet the applicable provisions of this chapter.

(o) Actions taken by the director to evaluate and determine possible measures to achieve compliance with this chapter do not guarantee that an approved wastewater system will function satisfactorily for any period of time, or mean that department employees are liable for any damages, consequential or direct, that are or may be caused by a malfunction of the wastewater systems.

(p) Duty to comply. The owners of any wastewater system shall comply with all applicable provisions of this chapter. In addition, all owners shall comply with all conditions of any department approval for use issued under this chapter. Any noncompliance constitutes a violation and is grounds for: enforcement action; department approval for use termination, revocation and reissuance, or modification; or denial of a department approval for use renewal application.

(q) In cases where the director is required to conduct an inspection at a location outside the State, the owner of the wastewater system shall be required to cover all costs related to the inspection. [Eff 12/10/88; am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-4, 342D-5, 342D-15, 342E-3) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50, 342E-3; HRS chs. 340E; 33 U.S.C. §§1311, 1342, 1345; 40 CFR Parts 122, 123, 40 CFR §501.15(b)(6))

§11-62-07 REPEALED [R 8/30/91]

§11-62-07.1 <u>Requirements for non-domestic wastewater.</u> (a) The director will review the use and disposal of non-domestic wastewater on a case-by-case basis.

(b) Non-domestic wastewater includes, but is not limited to:

(1) Wastewater from agricultural, commercial, or industrial activities or operations;

(2) Solids, semi-solids, or liquids removed from the non-domestic wastewater;

(3) Wastewater that contains a mix of both domestic and non-domestic wastewater; or

(4) Solids, semi-solids, or liquids removed from wastewater that contains a mix of both domestic and non-domestic wastewater.

(c) Buildings and operations generating non-domestic wastewater, including farms, shall meet the specific requirements of this chapter as determined to be applicable by the director.

(1) Wherever applicable, the director shall use the requirements for non-domestic wastewater as set forth by the EPA, Chapter 11-23, the Department's Guidelines for the Treatment and Reuse of Recycled Water, and wherever applicable, Department's Guidelines for Livestock Waste Management. The Guidelines are available on-line at the Wastewater Branch section of the department's website. Construction plans and engineering reports for proposed non-domestic wastewater systems shall be sufficient in scope and depth for determining compliance with the provisions of this chapter.

(2) Any building or facility which is located within the state agricultural land use district, county agricultural zoned districts, or conservation districts may be exempt from the provisions of subchapters 2 and 3 for its non-domestic wastewater provided that the buildings or facilities are essential to the operation of an agricultural enterprise or consistent with the conservation district use intent. The owner shall submit for the director's approval plans or engineering reports, or both, for the wastewater systems proposed to accommodate the wastewater generated from any building or facility in this category. Information submitted shall be sufficient in scope and depth for determining the adequacy

of performance of the wastewater system in meeting the provisions of this chapter.

(d) In determining treatment requirements for the non-domestic wastewater, the director shall use requirements for non-domestic wastewater as set forth by EPA, Chapter 11-23, the Department's Guidelines for the Treatment and Reuse of Recycled Water and the Department's Guidelines for Livestock Waste Management. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342E-3) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342E-3)

§11-62-08 Other requirements for wastewater systems. (a) Purpose.

(1) It is the purpose of this section and subchapters 2, 3, and 4 to set forth minimum requirements for the following purposes:
   (A) To clarify responsibilities of owners, engineers, and the department;
   (B) To set minimum distance requirements so that nuisances are avoided;
   (C) To set minimum requirements to protect public health, safety, and welfare, and to protect the wastewater systems from malicious damage or unauthorized entry; and
   (D) To emphasize the need for proper design, installation, operation, and maintenance.

(2) This section and subchapters 2, 3, and 4 give the engineer designing the wastewater system flexibility and design responsibility. The design engineer is responsible for the choice of equipment, types of treatment processes used, structural integrity, electrical components, disposal system designs, adequate work space, accessibility for operation, maintenance and repair, redundancy of major equipment and processes, corrosion control,

3176

and all other major aspects of wastewater system design.

(3) Nothing in this chapter shall be construed to prevent the engineer from exceeding the minimum requirements if the engineer determines that specific conditions warrant such additional measures.

(b) No person shall construct, modify the construction of, or modify the use of a wastewater system without the approval of the director. The following documents shall be submitted to the director prior to such approval:

(1) Construction plans prepared by or under the supervision of an engineer indicating the following:

(A) Acreage, address, and tax map key number(s) of the project site;

(B) Plot plan drawn to scale showing the location of the proposed and any existing wastewater system and its distances from existing and proposed buildings, structures, legal boundaries, property lines, adjacent surface bodies of water, drinking water sources, and existing public sewers within 2,000 feet of the nearest property line; and

(C) Sufficient details to show compliance with all applicable requirements of this chapter.

(2) Construction plans for an individual wastewater system prepared by the engineer showing sufficient details to enable the contractor to construct the individual wastewater system.

(3) Wastewater sludge use and disposal plan indicating how the wastewater sludge facility will comply with subchapter 4.

(c) Whenever applicable, the design flow of any development to be served by a wastewater system shall be based on Appendix D, Table I, dated July 1, 2014, except as provided by section 11-62-24(b).

(d) Measures to control public accessibility to all treatment units shall be provided to prevent accidents, drownings, vandalism, and interference with the treatment process. At a minimum, the provisions shall include:

(1) Fencing or other secured enclosures at least six feet in height with no more than three and a half inch clear openings or spaces for treatment units with exposed water surfaces or equipment; or

(2) Completely enclosed treatment units with unexposed water surfaces and equipment. Access openings to completely enclosed treatment unit(s) and equipment shall be secured and properly identified, and be large enough to allow removal of equipment from the facility.

(e) No person shall use the area adjacent to or directly above any wastewater system for purposes or activities which may hinder or interfere with the operation and maintenance, modification, or replacement of the wastewater system.

(f) No person shall operate a wastewater system unless that person or the owner of the wastewater system is authorized by the director in accordance with the applicable provisions of sections 11-62-23.1(e) and 11-62-31.1(f) and the applicable provisions of chapter 11-61. The director may inspect the wastewater system or its site at any time before authorizing the use of the system and may require advance notice of the engineer's inspection.

(g) All wastewater systems shall be constructed or modified by a person meeting the requirements of chapter 444, HRS, and any pertinent rules adopted by the department of commerce and consumer affairs, State of Hawaii. [Eff 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5, 342E-3) (Imp: §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50, 342E-3)

§11-62-09 Public access to information. (a) The following information is available for public inspection:

(1) The name and address of any person seeking or obtaining registration, an individual permit, or department approval for use of an individual wastewater system; and

(2) Registration information and forms, registrations, individual permit applications and permits, department approval for use of an individual wastewater system, sludge and effluent data, and reports required to be submitted under this chapter. This includes information submitted on the forms themselves and any attachments used to supply information required by the forms.

(b) This section is not intended to limit chapter 92F, HRS, or any other law requiring the disclosure of information.

(c) Applications for request for public information regarding wastewater system shall be made in writing on forms furnished by the director. At a minimum, the application shall identify where the wastewater system is, including when possible the applicable street address to and tax map key of the lot, and a mailing address which the information is to be sent. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§91-2, 92-21, 342D-4, 342D-5, 342D-14) (Imp: HRS §§91-2, 92-21, 342D-2, 342D-4, 342D-5, 342D-6, 342D-14, 342D-55)

§11-62-10 Public hearings and informational meetings. (a) The director may hold a public hearing in the director's discretion, when such a hearing may help the director's decision on a matter regulated by this chapter or for another reason which the director considers to be in the public interest.

(b) The director may hold a public informational meeting when the director considers it to be in the public interest. [Eff and comp 12/09/04; comp

13176

MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-57; 40 CFR Part 501, §501.15(d)(7))

§11-62-11 Incorporation by reference. Appendices A through E, dated July 1, 2014, located at the end of this chapter, are made a part of this chapter. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: 342D-4, 342D-5) (Imp: 342D-4, 342D-5, 342D-6)

§11-62-12 Timely processing. (a) This section applies to applications for a permit, license, certificate, or any form of approval required under this chapter.

(b) The director shall approve, approve with conditions, or deny a complete application and notify the applicant accordingly within one hundred eighty days of the receipt of the complete application. Otherwise, the application is deemed automatically approved on the one hundred eighty-first day.

(c) The director shall determine and notify an applicant of the completeness or deficiency of an application covered by this section, including payment of required fees, within forty-five days of receipt of the application. Failure by the applicant to provide additional information, pay the fees, or correct a deficiency for completeness of the application is sufficient ground to suspend or terminate a review of the application. The director shall determine and notify an applicant of the completeness of a revised application covered by this section, including payment of required fees, within thirty days of receipt of the revised completed application.

(d) Notice to the applicant shall be complete upon mailing, facsimile transmission, or electronic mail transmission.

(e) The period for the director's action includes all calendar days, but if the period ends on a Saturday, Sunday, or state holiday, the period extends to the next working day.

(f) The one hundred eighty day period for the director's action under subsection (b) applies to the director's initial decision and notice. The initial decision and notice do not become untimely if later there is a request for hearing, an actual hearing, a lawsuit, or other challenges to the initial decision which prevents it from becoming final.

(g) The time for the director's action and notice to the applicant shall be extended when allowed by section 91-13.5, HRS.

(h) Any action taken and any wastewater system or sludge facility built, modified, or operated under an automatic approval shall comply with all applicable requirements of this chapter, and the automatic approval is effective for a period of one year. [Eff 10/21/00; comp 12/09/04; am and com MAR 21 2016] (Auth: HRS §§91-13.5, 322-11, 322-8(a), 342D-4, 342D-5) (Imp: HRS §91-13.5)

SUBCHAPTER 2

WASTEWATER TREATMENT WORKS

§11-62-21 REPEALED [R 8/30/91]

§11-62-22 REPEALED [R 8/30/91]

§11-62-23 REPEALED [R 8/30/91]

§11-62-23.1 Specific requirements for wastewater treatment works. (a) In addition to the requirements of section 11-62-08(b), the following documents shall be submitted to the director prior to approval to construct the treatment works:

(1) A written declaration signed and dated by the engineer that the proposed treatment works was designed to meet all applicable

3176

effluent requirements of sections 11-62-26 and 11-62-27; and

(2) Certification by the owner of a proposed treatment works that the treatment works shall be operated and maintained in accordance with all of the provisions of the operation and maintenance manual developed pursuant to subsection (d)(2). The owner shall certify that the operation and maintenance manual shall be available to the operator of the treatment works and shall further certify that, upon sale or transfer of ownership of the treatment works, the sale or transfer will include construction drawings, equipment manuals, operational data collected, and the appropriate transfer documents and provisions binding the new owner to the operation and maintenance manual.

(b) All treatment works shall be provided with a continuous effluent flow measuring device such that daily wastewater flow can be determined. For treatment works with design flows equal to or greater than 100,000 gallons per day, the continuous effluent flow measuring device shall include recording equipment to totalize or chart daily flows.

(c) Unless otherwise specified by the director, the following distance requirements apply to all treatment works:

(1) Treatment units, except as provided in paragraph (3), shall not be less than twenty-five feet from any property lines nor less than ten feet from any building and swimming pools;

(2) Disposal systems, excluding effluent irrigation systems, shall not be less than five feet from a property line nor less than five feet from any building; and

(3) Completely enclosed, locked, and ventilated equipment rooms used to house items such as blowers, motors, pumps, electrical controls, and chemical feeders shall not be less than

3176

five feet from property lines or less than ten feet from dwelling unit(s).

(d) No person shall operate a treatment works unless the following documents are provided:

(1) A written declaration signed and dated by the engineer responsible for the preparation of the operation and maintenance manual for the treatment works, that the operation and maintenance manual meets paragraph (2) and that if the treatment works is operated in accordance with the manual, all applicable effluent requirements will be met; and

(2) An operation and maintenance manual prepared by the engineer. The manual as a minimum, shall provide the details on the following:

(A) Operation and maintenance instructions for each pump station and treatment unit or process under normal and emergency conditions such as power outage and equipment malfunction;

(B) Operation and maintenance instructions for the disposal system including procedures for purging or chemical "shock loading" to prevent or eliminate biological growth in the subsurface disposal system;

(C) List of required sampling frequencies and analyses to be conducted by the operator;

(D) Troubleshooting, corrective, and preventive measures to be taken to maintain process control and treatment performance;

(E) Start-up procedures;

(F) Applicable state effluent requirements;

(G) Instructions on wasting and disposal of wastewater sludge;

(H) Manpower requirements needed to operate and maintain the treatment works;

(I) List of critical parts of the treatment works;

(J) "As-built" drawings of the treatment works;

3176

(K) List of required daily activities, checks, and observations;
(L) Logs or report forms for all operation and maintenance activities performed;
(M) Flow schematic diagrams with details of piping and valving;
(N) Plot plan of the treatment works and Project site including all collection lines and equipment;
(O) Details on all safety equipment at the treatment works site, any applicable spare parts, maintenance, and operation instructions; and
(P) Details on all monitoring equipment including spare parts, maintenance, and operating instructions.

(e) No person shall operate a treatment works until it has been inspected to the director's satisfaction and the director has authorized in writing the use of the treatment works.

(1) The owner's engineer shall inspect the treatment works and submit to the director a final inspection report stating whether the wastewater treatment works has been constructed according to the submitted plans approved by the director and identifying any discrepancies and their resolutions. Any discrepancy between the constructed treatment works and the approved plans is sufficient reason to withhold approval to operate the treatment works.
(2) Before operation of the treatment works, the owner shall resolve all discrepancies.
(3) Any changes to the approved plan shall be resubmitted to the director for approval before the final inspection.
(4) The inspection shall not be considered final until the constructed treatment works conforms to the approved plans.

(f) After the first year of operation, the owner's engineer shall submit to the director a written statement based on results of actual sampling and professional judgment of whether or not the

3176

treatment works is meeting and at the design flow will meet the applicable effluent requirements of sections 11-62-26 and 11-62-27. If the treatment works is not meeting the applicable effluent requirements, the owner's engineer shall submit to the director a corrective action report containing:

(1) An analysis of the cause of the treatment works' failure to meet the effluent requirements and an estimate of the scope of the corrective action necessary to enable the treatment works to be in compliance;

(2) A schedule for undertaking the corrective actions; and

(3) A date by which the treatment works shall be in compliance with the applicable effluent requirements.

(g) Treatment works shall be designed with safety in mind and comply with appropriate provisions of the Occupational Safety and Health Standards of the State of Hawaii, Department of Labor and Industrial Relations.

(h) Upon abandoning, retiring, or permanently discontinuing use of a treatment works, the owner shall render it safe by removing it or filling it completely with earth, sand, gravel, or similar non-organic matter. All above ground portions of the treatment works shall be rendered safe and vector free. Electrical components shall be disconnected at the circuit breaker or source and all access openings sealed. Injection wells shall be abandoned in accordance with chapter 11-23.

(i) For public wastewater treatment works, a facility plan shall be initiated when the actual wastewater flow reaches 75 per cent of the design capacity of the wastewater treatment works. Implementation of the recommendation of the facility plan shall be initiated when the actual wastewater flow reaches 90 per cent of the design capacity of the wastewater treatment works.

(j) The owner or operator shall provide standby power for all lift stations to prevent unauthorized discharges of wastewater during a primary power outage.

(k) For all treatment works which produce recycled water, the director shall be guided by the requirements of subchapter 1, other applicable sections of this subchapter, and the Reuse Guidelines for all decisions on production of recycled water. [Eff 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-24 Treatment unit requirements. (a) For private wastewater treatment works of required design capacities of less than 100,000 gallons per day:

(1) For sludge digesters or aerated sludge holding tanks constructed after December 10, 1988, the sludge digesters or aerated sludge holding tanks shall treat and store at least the amount of sludge generated over a twenty day period;
(2) Except for subsurface disposal systems, continuous disinfection of the treated effluent shall be provided for treatment works unless otherwise approved or ordered by the director;
(3) For aeration tanks constructed after December 10, 1988, the aeration tank loading shall not exceed 12.5 pounds of BOD_5 per 1,000 cubic feet. For the sequencing batch reactor process, food to microorganism (F/M) ratios shall be between 0.05 and 0.10;
(4) For final settling tanks constructed after December 10, 1988, the detention time for final settling tanks shall not be less than four hours and the surface overflow rate shall not exceed 300 gallons per day per square foot based on the average daily flow;
(5) For treatment works constructed after December 10, 1988, flow equalization shall be provided unless the engineer submits written justification that changes in normal daily flow rate or seasonal occupancy rates

3176

shall not affect the treatment unit's ability to meet continuous compliance with the effluent requirements of sections 11-62-25, 11-62-26, and 11-62-27;

(6) For treatment works constructed after December 10, 1988, easy access shall be provided for operators to allow necessary operation, maintenance, and repair. Completely enclosed treatment units with unexposed water surfaces and equipment shall not be allowed unless the design engineer can satisfy the director that provisions have been included to eliminate confined space work areas and to allow accessibility for necessary operation, maintenance, and repair, and replacement; and

(7) For all treatment units utilizing gas chlorination for disinfection, the following equipment shall be provided: chlorine gas leak detector and alarm, self contained breathing apparatus, chlorine gas mask, warning signs, and an emergency eyewash and shower.

(b) New and proposed private wastewater treatment works of required design capacity greater than or equal to 100,000 gallons per day and new and proposed county wastewater treatment works shall comply with the design standards of their respective counties. If a county does not have wastewater treatment works design standards, then the design standards of the City and County of Honolulu shall be used.

(c) Private wastewater treatment works with design flows greater than or equal to 100,000 gallons shall have solids dewatering equipment included in the facility design. [Eff 12/10/88, am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-25 Wastewater effluent disposal systems.
(a) New and proposed effluent disposal systems.
(1) Effluent disposal systems shall at least consist of a primary disposal component and a separate 100 per cent back-up disposal component.
(2) The primary disposal component and the back-up disposal component shall each be designed to handle the peak flow. The peak flow shall be determined in accordance with the design standards of their respective county. If a county does not have design standards, the design standards of the City and County of Honolulu shall be used. Other means of determining the peak flow, as recommended by the design engineer, may be approved by the director.
(3) Each disposal component shall be tested to accommodate the wastewater flow as required in paragraph (2).

(b) For treatment works utilizing subsurface disposal systems, design data and other pertinent data shall be submitted to and approved by the director on a case-by-case basis. Decisions by the director shall be guided by subchapter 1 and other applicable sections of this subchapter.

(c) All wastewater effluent disposal systems shall include provisions to facilitate operation, maintenance, and inspection.

(d) All wastewater subsurface effluent disposal systems and injection wells shall include provisions for purging and chemical "shock loading". [Eff 12/10/88, am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-26 Wastewater effluent requirements, recycled water quality, monitoring, and reporting requirements applicable to treatment works treating domestic wastewater. (a) All treatment works shall meet the applicable requirements of this section.

Nothing in this section shall be construed to prevent the engineer from applying more stringent requirements if the engineer determines that the particular design and circumstances for which the engineer is responsible warrants the more stringent requirements.

(b) Treatment works' effluent and other parameters shall be monitored as follows and shall not exceed the following limits:

(1) Biochemical oxygen demand (BOD_5).

(A) For wastewater treatment works excluding wastewater pond systems with average daily flows greater than or equal to 100,000 gallons per day, the owner or operator shall perform composite sampling at least weekly.

(B) For wastewater treatment works with average daily flows less than 100,000 gallons per day, the owner or operator shall perform grab sampling at least monthly.

(C) For wastewater pond systems with average daily flows greater than or equal to 100,000 gallons per day, the owner or operator shall perform grab sampling at least weekly.

(D) The BOD_5 in the effluent from a treatment works shall not exceed 30 milligrams per liter based on the monthly average of the results of the analyses of composite samples.

(E) The BOD_5 in the effluent from a treatment works shall not exceed 60 milligrams per liter based on a grab sample.

(2) Suspended solids.

(A) For wastewater treatment works, except for wastewater pond systems, with average daily flows greater than or equal to 100,000 gallons per day, the owner or operator shall perform composite sampling at least weekly.

(B) For wastewater treatment works with average daily flows less than 100,000 gallons per day, the owner or operator shall perform grab sampling at least monthly.

(C) For wastewater pond systems with average daily flows greater than or equal to 100,000 gallons per day, the owner or operator shall perform grab sampling at least weekly.

(D) The suspended solids in the effluent from a treatment works shall not exceed 30 milligrams per liter based on the monthly average of the results of the analyses of composite samples.

(E) The suspended solids in the effluent from a treatment works shall not exceed 60 milligrams per liter based on a grab sample.

(3) Owners or authorized agents shall submit suspended solids and BOD_5 lab data to the director no later than thirty days after the last day of June and December, unless the data is already being submitted to the Department under an NPDES permit by a public agency.

(4) The dissolved oxygen, pH, and 30 minutes settleability of the contents of the aeration tank shall be sampled and analyzed at least weekly.

(5) Effluent chlorine residual, if any, shall be sampled and analyzed at least weekly.

(6) Total daily flow shall be monitored at least weekly.

(7) The volume of wastewater sludge wasted, the solids concentration of wastewater sludge wasted, the name of the wastewater sludge pumping and hauling firm, and the dates of pumping and hauling, if applicable, shall be recorded.

(8) The operator shall maintain a log book or records which shall include but not be limited to: the date and time of operator

3176

entry, operating conditions, process control testing performed, and any servicing or preventative maintenance done while at the wastewater treatment works.

(9) Alternative effluent limitations as permitted by EPA regulations, (40 CFR 125 and 40 CFR 133), relating to the definition of secondary treatment or other industrial categories, may be utilized by the director.

(10) For the purposes of this section, the arithmetic average of the results of the analyses of composite samples shall be based upon one or more analyses made within a 30 consecutive calendar day period. The arithmetic average shall be the sum of the results of all analyses divided by the number of analyses made during the 30 consecutive calendar day period.

(11) For the purposes of this section, composite samples shall consist of at least eight sample aliquots, collected at periodic intervals during the operating hours of the facility over a 24-hour period. The composite sample must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically.

(c) In addition to subsection (b), treatment works producing R-1 water or R-2 water for recycled water systems shall provide continuous disinfection of the effluent as specified below unless otherwise specified by the director.

(1) R-1 water disinfection requirements.

(A) For chlorine disinfection process. The disinfection process shall provide a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligrams-minutes per liter at all times with a modal contact time of at least ninety minutes based on peak dry weather design flow; or

(B) For non-chlorine disinfection processes. The disinfection process shall demonstrate to the director's satisfaction the inactivation and removal of 99.999 per cent of the plaque forming units of F-specific bacteriophage MS2 or polio virus in the wastewater.

(2) R-2 water disinfection requirements.

(A) For chlorine disinfection processes.

(i) A theoretical contact time of fifteen minutes or more and an actual modal time of ten minutes or more throughout which the chlorine residual is 0.5 milligrams per liter or greater; and

(ii) Automatic continuous measuring and recording of chlorine residual shall be provided. The chlorine facilities shall have adequate capacity to maintain a residual of 2 milligrams per liter.

(B) For non-chlorine disinfection processes.

(i) The disinfection process shall demonstrate to the director's satisfaction the ability to meet the requirements of subsection (d)(2); and

(ii) Automatic controls shall be provided to continuously measure and record disinfection dosage and residuals, if any.

(3) Monitoring shall be by grab samples that shall be taken at a point following disinfection.

(d) In addition to subsections (b) and (c), treatment works producing R-1 water or R-2 water for recycled water systems shall meet the following daily fecal coliform requirements unless other sampling frequencies are approved by the director. Monitoring shall be by grab samples that shall be taken at a point following disinfection.

(1) R-1 water.

(A) The median density measured in the disinfected effluent shall not exceed 2.2/100 milliliters using the bacteriological results of the last seven days for which analyses have been completed;

(B) The density shall not exceed 23/100 milliliters in more than one sample in any thirty day period; and

(C) The density in any one sample shall not exceed 200/100 milliliters.

(2) R-2 water.

(A) The median density as measured in the disinfected effluent shall not exceed 23/100 milliliters using the bacteriological results of the last seven days for which analyses have been completed; and

(B) The density of shall not exceed 200/100 milliliters in more than one sample in any thirty day period.

(e) In addition to subsections (b) through (d), treatment works producing R-1 water for recycled water systems shall provide continuous turbidity monitoring and recording prior to the filtration process and at a point after the filters and before application of the disinfectant. The R-1 water shall meet the following turbidity limits:

(1) For filtration systems utilizing sand or granular media, cloth, or other synthetic media, the turbidity shall not exceed any of the following:

(A) An average of two nephelometric turbidity units (NTU) within a twenty-four hour period;

(B) 5 NTU more than five percent of the time within a twenty-four hour period; and

(C) 10 NTU at any time.

(2) For filtration systems utilizing membrane filtration, the turbidity shall not exceed any of the following:

(A) 0.2 NTU more than five percent of the time within a twenty-four hour period; and

(B) 0.5 NTU at any time.

(f) When using media filtration for existing R-1 facilities the following performance criteria shall apply:

(1) The design UV dose shall be at least 100 mJ/cm^2 under maximum daily flow; and

(2) The filtered UV transmittance shall be 55 percent or greater at 254 nanometers (nm).

(g) When using membrane filtration for existing R-1 facilities, the following performance criteria shall apply:

(1) The design UV dose shall be at least 80 mJ/cm^2 under maximum daily flow; and

(2) The filtered effluent UV transmittance shall be 65 percent or greater at 254 nm.

(h) The minimum acceptable design requirements and commissioning of new UV disinfection systems shall comply with the Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, Third Edition, 2003, published by the National Water Research Institute.

(g) The analysis, including the handling and preservation of samples, to determine compliance with effluent requirements shall be performed in accordance with Standard Methods or EPA's Methods for Chemical Analysis of Water and Wastes. The director may approve alternative methods for analyzing the effluent limits of this section. The alternative test methods, when approved, may be used by the director to determine compliance with effluent limits as stated in this rule. [Eff 12/10/88, am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-27 Recycled water systems. (a) No recycled water system shall be constructed, used, or modified without written approval by the director.

(b) In reviewing recycled water systems and in addition to this chapter, the director shall be guided by the Reuse Guidelines.

(c) Before using recycled water, the owner of the recycled water system shall submit to the director the following information:

(1) Name, address, and phone number of the owner and party responsible for the application of recycled water at the site (if different from the owner);

(2) Clear identification of the people who will actually operate and maintain the system, if different from paragraph (1);

(3) Detailed site information on the water recycling application site and its surroundings, including site name, address, and tax map key number(s), a map indicating specific areas of use, areas of public access, surrounding land use, location of all wells within a one-fourth mile radius, description of nearest housing or public area, setbacks, general location of existing and proposed water and sewer lines, the direction of drainage with a description of how the drainage will flow, and the depth to groundwater underlying the irrigated area with a description of the ground water quality; and

(4) Information sufficient to show compliance with the requirements of subsection (h), and identification of best management practices.

(d) Before using recycled water, the owner of the recycled water system shall also submit to the director for approval an engineering report or recycled water application. The report or application form shall include the following information and shall clearly identify all best management practices to be implemented:

(1) An irrigation use plan that includes information on application rates, intended

13176

uses, and schedules for recycled water use. The irrigation use plan shall also include information on types of vegetation, types and methods of irrigation, proposed irrigation schedules, vegetative consumption rates, water balance calculations, nutrient balance calculations, and the corresponding acreage to be used for irrigation;

(2) An overflow control plan that includes detailed best management practices to control or minimize runoff or ponding or recycled water;

(3) A management plan that includes establishment and delineation of the responsibilities of operation and maintenance of the recycled water system;

(4) A public information and access plan, to minimize public contact with the recycled water, that includes methods to adequately inform the public that recycled water is being used and that the recycled water is unfit for human consumption; and methods to control public access to the recycled water system and areas of recycled water use;

(5) A labeling plan to distinguish piping and appurtenances which carry or contain recycled water from those for potable water;

(6) An employee training plan that describes the training that the employees will receive to ensure compliance with this chapter and any other features specified by the director;

(7) A vector control plan (if applicable); and

(8) A groundwater monitoring plan (if applicable), including formulation of a strategy for the observation and surveillance of groundwater for possible sources of pollution.

(e) For existing users of recycled water, the owner of the recycled water system shall submit the information and plans required in subsections (c) and (d), except for the information contained in subsection (d)(1) regarding the vegetative consumption rates and water balance, and subsection (d)(8) regarding groundwater monitoring. For users of non R-1 recycled water spray irrigation systems, the owner shall also describe the methods and controls used to ensure that public contact with aerosols are minimized.

(f) For new users of recycled water obtaining access to an existing recycle water system, the user shall submit the information and plans required in subsections (c) and (d), except for the information contained in (d)(1) regarding vegetative consumption rates and water balance, and subsection (d)(8) regarding groundwater monitoring. For users of non R-1 recycled water spray irrigations systems, the owner shall also describe the methods and controls used to ensure that public contact with aerosols are minimized.

(g) For recycled distribution water systems, the owner of the recycled water distribution system shall submit an engineering report or recycled water application containing the following information:

(1) Name, address, and phone number of the owner and party responsible for the recycled water distribution system (if different from the owner);

(2) Information about the treatment works supplying the recycled water, including the name, address, tax map key number, and owner's name;

(3) Maps showing the location of the distribution system layout. The maps shall also include the location of all water and sewer lines;

(4) A labeling plan to distinguish piping and appurtenances which carry or contain recycled water from those for potable water; and

(5) A description of how the distribution system complies with this chapter and the Reuse Guidelines.

(h) The engineering report or application required in subsection (d), (e), (f), or (g) plus any other submittals shall contain sufficient information to assure the director that the degree of treatment and reliability is commensurate with the proposed use, that the distribution and use of the recycled water will not create a health hazard or nuisance, and that the director is able to make decisions in accordance with subsection (b).

(i) For recycled water systems that use recycled water, the owner of the recycled water system shall operate the system in accordance with the requirements of this chapter and to the maximum extent practicable shall:

(1) Irrigate at a rate not greater than the plants use it;
(2) Minimize recycled water runoff and ponding on the ground;
(3) Post signs or other devices warning the public not to drink, swim, or otherwise come into contact with the recycled water;
(4) Keep the public away from the areas being irrigated with recycled water;
(5) Clearly mark pipes, tanks, valves, and equipment used in recycled water use systems such that they are easily differentiated from potable water systems;
(6) Provide training to employees such that they are aware of this chapter and any conditions the director imposed on the recycled water use system;
(7) Provide control measures to minimize vector nuisances; and
(8) Monitor groundwater as required by the director.

(j) The owners of new, proposed, or modified recycled water systems, where applicable, shall provide adequate storage basin(s) or a backup disposal system to prevent any overflows or discharges from the system when the irrigation system is not in operation or when recycled water quantities exceed the irrigation requirements.

(k) Spills, overflows, and discharges ("spills") of recycled water shall be responded to as required by section 11-62-06(f) and (g) and Appendix B, entitled

3176

Responses for Wastewater Spills, Overflows, and Discharges ("Spills"), dated July 1, 2014.

(l) For recycled water systems, the owner or the owner's duly authorized agent, unless otherwise directed, shall report the following information to the director:

(1) The volume of recycled water used, the volume of recycled water stored, the volume and location of any recycled water spills, and details on the irrigated areas, including water budgets, precipitation, evaporation, application rates, and monitoring of best management practices; and

(2) Reported information shall be submitted by February 19 of each year and shall be in a monthly summary format for the preceding calendar year unless otherwise specified or agreed to by the director. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 33 U.S.C. §§1311, 1342; 40 CFR Parts 122, 123)

Historical note: §11-62-27 is based substantially upon §11-62-25(b)(1), (b)(2), and (c). [Eff 12/10/88; am and comp 8/30/91]

§11-62-28 Additional monitoring, recordkeeping, and reporting. (a) The owners of treatment works or the owners' duly authorized agents shall maintain complete records of operation and maintenance, repairs, replacements, and improvements performed or installed at the treatment works.

(b) The monitoring results, reports, and all records required in sections 11-62-26 and 11-26-27, this section, and Appendix B, entitled Responses for Wastewater Spills, Overflows, and Discharges ("Spills"), dated July 1, 2014, located at the end of this chapter shall be kept on site and available for the director's inspection for at least two years and a copy made available to the director without charge upon the director's request. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-6, 342D-50)

§§11-62-29 (Reserved)

SUBCHAPTER 3

INDIVIDUAL WASTEWATER SYSTEMS

§11-62-31 REPEALED [R 8/30/91]

§11-62-31.1 General requirements for individual wastewater systems. (a) Individual wastewater systems may be used as a temporary on-site means of wastewater disposal in lieu of wastewater treatment works under the following conditions:

(1) Developments involving dwellings.
 (A) There shall be 10,000 square feet of land area for each individual wastewater system;
 (B) Total development of an area shall not exceed fifty single family residential lots or exceed fifty dwelling units except for developments consisting of one dwelling unit per acre or greater;
 (C) Area of the lot shall not be less than 10,000 square feet, except for lots created and recorded before August 30, 1991. For lots less than 10,000 square feet which were created and recorded before August 30, 1991, only one individual wastewater system shall be allowed.
 (D) The total wastewater flow into one individual wastewater system shall not exceed one thousand gallons, and one

3176

individual wastewater system shall not serve more than five bedrooms, whether they are in one dwelling unit or two.

(2) Developments involving buildings other than dwellings.

(A) There shall be 10,000 square feet of usable land area for each individual wastewater system. Usable land area shall not include the area under buildings;

(B) The total wastewater flow of the development shall not exceed 15,000 gallons per day;

(C) Area of the lot shall not be less than 10,000 square feet except for lots created and recorded before August 30, 1991. For lots less than 10,000 square feet which were created and recorded before August 30, 1991, only one individual wastewater system shall be allowed; and

(D) The total wastewater flow into each individual wastewater system shall not exceed one thousand gallons per day.

(b) Whenever an individual wastewater system is allowed under subsection (a), the following shall apply:

(1) The director may allow an individual wastewater system other than a cesspool to be used for two dwelling units which may or may not be located within the same building, provided that:

(A) Both of the dwelling units are located on the same single family residential lot; and

(B) The individual wastewater system used shall meet the current requirements of this chapter.

(2) A building may use more than one individual wastewater system where each individual wastewater system shall connect to a single dwelling unit.

(3) For buildings without any dwelling units:
   (A) More than one individual wastewater system may be used provided that the building is owned by one person; or
   (B) Upon the director's discretion, buildings may connect to one individual wastewater system other than a cesspool provided the buildings are located on the same lot and the buildings generate wastewater of similar strength and character.

(4) For buildings, other than dwellings with highly variable wastewater flow rates, such as but not limited to schools, parks, and churches, the individual wastewater system excluding cesspools may exceed a design flow rate of 1000 gallons per day; provided that the density does not exceed 1000 gallons per day per 10,000 square feet of useable land area and the development is owned by one person.

(c) The director may require the installation of dry sewers as a condition of approval of proposed individual wastewater systems where:

(1) Public sewers exist but are at capacity such that connection is prohibited but remedial actions have been initiated to increase the public sewer capacity;

(2) Public sewers exist, but the treatment and disposal system is not complete or operational;

(3) Design of the public sewers has been completed and construction of the public sewers is imminent; or

(4) Conditions warrant such requirements.

(d) No cesspool shall be used as the wastewater system by any new building. No new cesspools shall be constructed after the effective date of this rule unless they have been approved for construction before the effective date of this rule.

3176

(e) Before the approval of the operation of an individual wastewater system excluding cesspools, the following requirements shall be satisfied:

(1) An operation and maintenance manual developed pursuant to section 11-62-23.1(d)(2) as applicable shall be submitted and approved by the director; and

(2) The owner of the individual wastewater system shall certify that the individual wastewater system shall be operated and maintained in accordance with all of the provisions of the operation and maintenance manual developed pursuant to paragraph (1). The certification shall include a statement that upon sale or transfer of ownership of the individual wastewater system, the sale or transfer will include the appropriate transfer documents and provisions binding the new owner to the operation and maintenance manual.

(f) No person shall use an individual wastewater system until authorized in writing by the director.

(1) Written approval to use an individual wastewater system shall be issued if:

(A) The owner resolves all discrepancies recorded as a result of any inspections conducted.

(B) The engineer furnishes a final inspection report to the director within thirty days after the completion of the construction which provides the following information:

(i) A certification that the individual wastewater system was constructed and installed in accordance with the approved plans and specifications or that changes made to the approved plans and specifications are accepted by the engineer; and

(ii) An "as-built" plan of the individual wastewater system; and

3176

(2) The director may inspect the individual wastewater system or its site at any time before approving the system and may require advance notice of the engineer's inspection.

(g) A graywater system shall be designed in accordance with Chapter 3-183.

(h) Each individual wastewater system shall be an independent system and shall have all of its plumbing, treatment (if any), and disposal components separate from any other wastewater system.

(i) Wastewater into an individual wastewater system from buildings other than dwellings shall meet the pretreatment standards and local pollutant limits as set by the respective county. If the county does not have any local pollutant limits, the local limits as set forth by the City and County of Honolulu shall be used.

(j) Certification of a qualified cesspool. A taxpayer seeking a cesspool upgrade, conversion, or connection income tax credit must obtain a certification by the director indicating: that the cesspool location makes it eligible to be a qualified cesspool; that the cesspool upgrade has been completed consistent with this rule and plans prepared by a licensed engineer; and the total dollar amount the taxpayer paid for the cesspool upgrade. The director may issue such certification only where the director has received:

(1) A certification from a licensed contractor or licensed engineer that the cesspool is located within 200 feet of a shoreline, perennial stream, or wetland. Certifications are not required for properties that are located in their entirety within 200 feet of a shoreline, perennial stream, or wetland. The director shall certify as qualified all cesspools that are located within a source water assessment area (two year time of travel from a cesspool to a public drinking water source);

(2) Design plans prepared by a licensed engineer for a sewer connection or individual wastewater system that complies with this chapter;

(3) Certification by a licensed contractor of closure and filling of the cesspool and completion of

an upgrade, either sewer connection or installation of an individual wastewater system that complies with this chapter; and

(4) A licensed engineer's final construction inspection report with photos and as built plans and certifying that the system was constructed in accordance with design plans and this chapter. The director will review submitted documentation and provide certification to the taxpayer and the Department of Taxation of any qualified cesspool.

(k) Certification of qualified expenses. The director will determine all qualified expenses for the tax credit. The taxpayer seeking a tax credit shall submit to the director all receipts of payments made to engineers and installers for the design, completed installation and final construction inspection for the cesspool upgrade along with the appropriate form as directed by the Department of Taxation. The director will notify the taxpayer and the Department of Taxation of the amount of the tax credit allowed for the tax year by noting the same on the form and affixing the signature of the director or the director's designee thereto.

(l) If the annual amount of the certified credits reaches $5,000,000 in the aggregate, the director shall immediately discontinue certifying credits for that year and notify the Department of Taxation. Any taxpayer who is not eligible to claim the credit in a taxable year due to the $5,000,000 cap having been exceeded for that taxable year shall be eligible to claim the credit in the subsequent taxable year, except if the $5,000,000 cap was exceeded in 2020 and no additional credits are available. [Eff 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-31.2 <u>Site evaluation.</u> (a) The site evaluation shall be performed by the engineer.

(b) The site shall be evaluated for depth of permeable soil over seasonal high groundwater, bedrock, or other limiting layer, soil factors, land slope, flooding hazard, and amount of suitable area available.

(c) The minimum depth of the soil profile observation shall be at least five feet. If the engineer performs a preliminary observation at three feet, the engineer shall confirm the soil profile to five feet at the time of construction.

(d) The following factors shall be evaluated and reported for a depth of at least three feet below the proposed absorption system:

(1) Thickness of layers or horizons;
(2) Texture of soil layers;
(3) General color, and color variation (mottling);
(4) Depth to water, if observed;
(5) Depth to estimated seasonal high groundwater table;
(6) Depth to and type of bedrock, if observed; and
(7) Other prominent features such as structure, stoniness, and roots.

(e) Percolation tests.

(1) Soil percolation tests shall be conducted at a minimum depth of three feet. If at the time of construction, the soil profile at five feet is different than at three feet, another percolation test shall be performed at the depth of the bottom of the absorption system;
(2) Percolation tests shall follow the falling head test procedure in Appendix C, entitled Falling Head Test Procedure, dated July 1, 2014, located at the end of this chapter; and
(3) Additional percolation tests may be required to identify the existence of a limiting layer.

(f) The site evaluation information shall be reported on forms developed by the director.

(g) If, during construction the actual site conditions differ from the site conditions upon which the wastewater system was approved, the design engineer shall revise the wastewater plans to reflect the actual site conditions. The plans of the revised wastewater system shall be submitted to the director for approval pursuant to section 11-62-31.1(f). [Eff 8/30/91, am and comp 12/09/04; am and comp MAR 21 2016](Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50)

§11-62-32 Spacing of individual wastewater systems. No individual wastewater system shall be located at any point having less than the minimum distances indicated in Table II attached to this chapter in Appendix D, entitled Tables, dated July 1, 2014, and located at the end of this chapter unless otherwise approved by the director. The minimum distances indicated in Table II shall be measured from the outer edge of each item. [Eff 12/10/88, am 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016](Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-33.1 Specific requirements for new and proposed treatment units. (a) Septic tank.

(1) All wastewater shall discharge into the septic tank. Roof, footing, garage, surface water drainage, cooling water, and graywater disposed of in accordance with section 11-62-31.1(g)(4) shall be excluded.
(2) Septic tanks shall meet the International Association of Plumbing and Mechanical Officials (IAPMO) material and property standards for prefabricated septic tanks, IAPMO ANSI Z1000-2013. Septic tanks shall be approved and listed by IAPMO.
(3) Plans for cast-in-place septic tanks shall be submitted with the application for the individual wastewater system. The plans for the septic tank shall be designed and stamped by a licensed structural engineer

13176

and shall meet the IAPMO design specifications.

(4) The following schedule shall apply to septic tank sizing:

No. of Bedrooms	Minimum Capacity (Gallons)
4 or less	1000
5	1250

(5) For wastewater flows greater than 1,000 gallons per day or five bedrooms, the formula: Minimum capacity gallons = 1,000 + (Q-800)x 1.25, where Q=design flow, shall be used.

(6) Concrete septic tanks shall be coated to protect the tank from leakage and corrosion by acceptable means. The coating shall cover the entire tank interior.

(7) Manholes or removable covers to septic tanks shall be brought to grade. The cover shall be secured to prevent unauthorized entry or opening of the tank.

(8) When septic tanks are installed in ground water or in clay soils with an expansive nature, the engineer shall design or provide adequate protection to prevent the tank from floating, moving, or crushing.

(9) The excavation to receive the tank shall be large enough to permit the proper placement of the tank and backfill. Tanks shall be installed on a solid base that will not settle and shall be level. Where rock or other undesirable protruding obstructions are encountered, the bottom of the hole shall be excavated an additional six inches and backfilled with sand, crushed stone, or gravel to the proper grade. Backfill around and over the septic tank shall be placed in such a manner as to prevent undue strain or damage to the tank or connected pipes.

(10) When a septic tank is installed under a driveway, parking lot, in a heavy saturated

3176

soil, or other areas subject to heavy loads, the tank shall be capable of withstanding an H-20 wheel load as defined by the American Association of State Highway Officials.

(11) Effluent from a septic tank shall be discharged into a soil absorption system, sand filter, subsurface irrigation system as approved by the director, or other treatment unit approved for use by the director.

(b) Household aerobic units.

(1) All wastewater shall discharge into the household aerobic unit. Roof, footing, garage, surface water drainage, and cooling water shall be excluded.

(2) Household aerobic units shall be approved by the director based upon the "Standard No. 40" for Class I units as set forth by the National Sanitation Foundation. The performance data shall have been obtained by an agency such as a university or an independent research laboratory acceptable to the director or from the National Sanitation Foundation (NSF) Testing Laboratory, Ann Arbor, Michigan.

(3) Owners of proposed and existing household aerobic units shall have an active service contract for the proper maintenance of the aerobic unit and its disposal system with a certified operator or factory certified representative, and a copy of an active service contract shall be submitted annually to the department. The contract shall also include pumping service to maintain the household aerobic unit. For proposed household aerobic units, a copy of an executed service contract shall be submitted prior to the final approval of the individual wastewater system.

(4) As a minimum, the aerobic treatment unit service contract shall include the term of contract period (start and end dates) and the following requirements:

(A) Inspect all aerobic treatment unit equipment to ensure its proper operation at least every six (6) months;

(B) Provide regular maintenance of equipment as required by the manufacturer;

(C) Verify the aerobic treatment unit is providing adequate mixing and aeration of the microbes;

(D) Measure the depth or volume of sludge in the aerobic treatment unit every six months, and assess whether sludge removal by pumping is necessary. Provide sludge pumping, as needed. If pumping is necessary, record the depth of sludge or percentage of sludge volume in the ATU prior to pumping; and

(E) Maintain a log of all service provided.

(5) Effluent from an aerobic unit shall be discharged into a soil absorption system, sand filter, subsurface irrigation system as approved by the director, or other treatment unit or disposal system approved for use by the director.

(6) In areas below (makai of) the Underground Injection Control Line established pursuant to chapter 11-23, where the vertical separation distance from the discharge to the seasonal high groundwater table is less than three feet, a new household aerobic unit may discharge its effluent into an elevated mound to achieve the vertical separation or drip irrigation system or, with a variance approved by the director and if the effluent is disinfected, to a seepage pit. Where water bearing formations are in danger of contamination, the director may require greater vertical separation.

(c) Subsurface and recirculating sand filters shall be reviewed on a case-by-case basis by the director. [Eff 8/30/91; am and comp

3176

12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50)

§11-62-34 Specific requirements for new and proposed disposal systems. (a) Absorption trenches.

(1) Location.
   (A) Absorption trenches shall be located in accordance with section 11-62-32.
   (B) Absorption trenches shall not be constructed in soils with a percolation rate slower than sixty minutes per inch or where rapid percolation may result in contamination of water-bearing formations or surface waters.
   (C) Absorption trenches shall be located on the property to maximize the vertical separation distance from the bottom of the absorption trench to the seasonal high groundwater level, bedrock, or other limiting layer, but under no circumstance shall the vertical separation be less than three feet. The director may require a greater vertical separation where water-bearing formations are in danger of contamination.
   (D) Absorption trenches shall not be constructed in unstabilized fill.

(2) Design.
   (A) The minimum absorption area for any absorption trench system shall be based upon a flow of 200 gallons per bedroom per day and in accordance with Table III located in Appendix D, entitled Tables, dated July 1, 2014, and located at the end of this chapter.
   (B) The absorption area shall be computed using the bottom area of the absorption trench.

3176

(C) Each absorption trench system shall have a minimum of two trenches.
(D) Each distribution line shall be equal in length.
(E) The maximum length of any one trench shall be one hundred feet.
(F) Absorption trenches shall be at least eighteen inches wide but no more than thirty-six inches wide.
(G) The bottom of absorption trenches shall be at least eighteen inches below the finished grade.
(H) Gravity fed absorption lines and trenches shall have a slope at the rate of two to four inches per hundred feet.
(I) Absorption trenches shall not be installed on land with a slope gradient greater than twelve per cent.
(J) On rolling or sloping land, each absorption trench shall approximate the land surface contour.
(K) A distribution box or header shall be installed between the treatment unit and the absorption trenches.
(L) Each distribution line shall connect individually to the distribution box.
(M) If a header is used, there shall be an equal number of distribution lines on each side of the influent junction. An inspection port shall be provided on the header and shall be brought to grade and fitted with a screw type cap or cover.
(N) If a distribution box is used, a permanent inspection port with a minimum interior diameter of six inches shall be secured to the box cover, brought to the finished grade, and fitted with a screw type cap or cover.

(3) Materials.
(A) The engineer shall be responsible for the choice of materials used in the soil absorption system.

3176

(B) Pipe used for distribution lines shall meet the appropriate ASTM standard or those of an equivalent testing laboratory. Fittings used in the absorption system shall be compatible with the materials used in the distribution lines.

(C) Gravel or crushed stone shall be washed and shall range in size from three-fourths to two and one-half inches.

(D) The material used to cover the top of the stone shall be a filter fabric material or equal.

(4) Construction.

(A) A distribution box or header shall be set level and arranged so that effluent is evenly distributed to each distribution line. Adequate provisions shall be taken to assure stability and provide access for inspection of the distribution lines.

(B) The pipe connecting the distribution box to the distribution line shall be of a tight joint construction laid on undisturbed earth or properly bedded throughout its length.

(C) If a header is used, it should be made of water-tight construction.

(D) When the trenches have been excavated, the sides and bottom shall be raked to scarify any smeared soil surfaces. Construction equipment and other materials not needed to construct the system should be kept off the area to be used for the absorption system to prevent undesirable compaction of the soils. Construction shall not be initiated when the soil moisture is high.

(E) At least six inches of gravel or crushed stone shall be placed in the bottom of the trench.

(F) The distribution line shall be carefully placed on the bedding at a uniform slope and covered with at least two inches of gravel or stone.

(G) The ends of the distribution lines shall be capped or plugged.

(b) Deep absorption trenches. Deep absorption trenches may be considered where the depth of suitable soil is insufficient to permit the installation of a conventional trench system due to the presence of a limiting layer more than two feet in depth which overlies suitable soils of sufficient thickness. Requirements for location, design, slope, material, construction, and dosing system design contained in subsection (a) shall apply to deep absorption trenches except for depth of construction. In addition, the following design considerations shall apply:

(1) The site evaluation procedure shall include soil profile observations of at least three soil observation pits constructed to a minimum depth of three feet below the proposed trench bottom. Monitoring to establish depth to seasonal soil saturation or high groundwater may be considered;

(2) Deep absorption trenches shall be constructed at least one foot into the suitable soil; and

(3) The distribution piping in deep absorption trenches shall be installed with the invert of the piping at a depth of not more than thirty inches. Gravel or crushed stone shall be placed from the bottom of the trench excavation to a point two inches above the top of the distribution piping.

(c) Absorption beds.

(1) Location.

(A) Absorption beds shall be located in accordance with section 11-62-32.

(B) Absorption beds shall not be constructed in soils with a percolation rate slower than sixty minutes per inch or where rapid percolation may result

13176

in contamination of water-bearing formations or surface waters.

(C) Absorption beds shall be located on the property to maximize the vertical separation distance from the bottom of the absorption bed to the seasonal high groundwater level, bedrock, or other Limiting layer, but under no circumstance shall the vertical separation be less than three feet. The director may require a greater vertical separation where water-bearing formations are in danger of contamination.

(D) Absorption beds shall not be constructed in unstabilized fill.

(2) Design.

(A) The minimum area for any absorption bed system shall be based upon a flow of 200 gallons per bedroom per day and in accordance with Appendix D, Table III dated July 1, 2014 and located at the end of this chapter.

(B) The absorption area shall be computed using the bottom area of the absorption bed.

(C) Each soil absorption bed system shall have a minimum of two distribution lines.

(D) If more than one absorption bed is designed, each absorption bed shall be equal in area.

(E) The maximum length of any distribution line shall be one hundred feet.

(F) Distribution lines within an absorption bed shall be uniformly spaced no more than six nor less than four feet apart.

(G) Distribution lines within an absorption bed shall be placed no more than three feet nor less than eighteen inches from the sidewall of the bed.

(H) The bottom of absorption beds shall be at least eighteen inches below the finished grade.

(I) Absorption beds shall not be installed on land with a slope gradient greater than eight per cent.

(J) A distribution box or header shall be installed between the treatment unit and the absorption bed.

(K) Each distribution line shall connect individually to the distribution box.

(L) If a header is used, there shall be an equal number of distribution lines on each side of the influent junction. An inspection port shall be provided on the header and shall be brought to grade and fitted with a screw type cap.

(M) If a distribution box is used, a permanent inspection port with a minimum interior diameter of six inches shall be secured to the box cover, brought to the finished grade, and fitted with a screw type cap or cover.

(3) Materials.

(A) The engineer shall be responsible for the choice of materials used in the soil absorption system.

(B) Pipe used for distribution lines shall meet the appropriate ASTM standard or those of an equivalent testing laboratory. Fittings used in the absorption system shall be compatible with the materials used in the distribution lines.

(C) Gravel or crushed stone shall be washed and shall range in size from three-fourths to two and one-half inches.

(D) The material used to cover the top of the stone shall be a filter fabric material or equal.

(4) Construction.

(A) The floor of the absorption bed shall be level.

(B) A distribution box or header shall be set level and arranged so that effluent is evenly distributed to each distribution line. Adequate provisions shall be taken to ensure stability and provide access for inspection of the distribution lines.

(C) The pipe connecting the distribution box to the distribution line shall be of a tight joint construction laid on undisturbed earth or properly bedded throughout its length.

(D) If a header is used, it should be made of watertight construction.

(E) When the beds have been excavated, the sides and bottom shall be raked to scarify any smeared soil surfaces. Construction equipment and other materials not needed to construct the system should be kept off the area to be used for the absorption system to prevent undesirable compaction of the soils. Construction shall not be initiated when the soil moisture is high.

(F) At least six inches of gravel or crushed stone shall be placed in the bottom of the bed.

(G) The distribution line shall be carefully placed on the bedding with no slope and covered with at least two inches of gravel or stone.

(H) The ends of the distribution lines shall be capped or plugged.

(d) Seepage pits.

(1) Location.

(A) Seepage pits shall be located in accordance with section 11-62-32.

(B) Seepage pits shall not be constructed in soils having a percolation rate slower than ten minutes per inch (weighted average) or where rapid percolation through such soils may result in contamination of water-bearing formations or surface water.

(C) The seepage pit shall be located on the lot to maximize the vertical separation distance from the bottom of the seepage pit to the seasonal high groundwater table, bedrock, or other limiting layer. The vertical separation shall not be less than three feet unless otherwise approved by the director and the requirements of section 11-62-33.1(b)(5) are met. Where water-bearing formations are in danger of contamination, greater vertical separation may be required.

(2) Design.

(A) Seepage pits shall be used only when one of the following are met:

(i) Slope of the finished elevation of the lot is greater than twelve per cent and the use of absorption beds or trenches is not feasible.

(ii) The presence of a limiting layer more than seven feet in depth which overlies suitable soils of sufficient thickness.

(iii) Insufficient land area exists to install absorption trenches or beds.

(B) The minimum area in any seepage pit shall be based upon a flow of 200 gallons per bedroom per day and in accordance with Appendix D, Table III dated July 1, 2014 and located at the end of this chapter.

(C) The surface dimension is measured as the mean distance of the clear opening below the inlet pipe.

(D) The minimum surface dimension is six feet.

(E) The effective depth of the seepage pit shall be measured from the bottom of the inlet pipe to the bottom of the pit, with the thickness of strata of soils having percolation rates slower than thirty minutes per inch deducted.

(F) The minimum effective depth is ten feet and shall be greater than its widest surface dimension.

(G) The effective area of the seepage pit shall be the vertical wall area of the areas corresponding to the effective depth of the pit excavation. No allowance shall be made for the bottom area.

(H) When more than one seepage pit is used, a distribution box shall be installed between the treatment unit and all seepage pits. Each seepage pit shall individually connect to the distribution box.

(I) When more than one seepage pit is used, each pit shall have an equal effective area.

(J) If a distribution box is used, a permanent inspection port with a minimum interior diameter of six inches shall be secured to the box cover, brought to the finished grade, and fitted with a screw type cap or cover.

(3) Construction.

(A) Seepage pits shall include a sidewall lining constructed of durable material that will permit free passage of wastewater without excessive plugging while still excluding the entry of surrounding soil.

(B) Seepage pits shall include a cover which extends at least twelve inches beyond the seepage pit excavation, unless a concrete ring is used.

(C) The lining and cover of any seepage pit shall be capable of supporting the normal loads imposed. The engineer shall submit written justification for the deletion of any sidewall lining.

(D) The distance between the outer diameter of the lining and the excavation diameter shall be at least six inches, but not more than twelve inches. The space between lining and the excavation diameter shall be filled with washed gravel or crushed stone ranging in size from three-fourths to two and one-half inches. The placement of the gravel or stone shall fill the annular space between the pit lining and excavation diameter. Gravel and stone shall not be placed within the seepage pit itself.

(E) The watertight cover shall be provided and at least one watertight manhole either round or square, tapered to a minimum of twelve inches in dimension shall be provided in the cover for inspection or for emptying the contents when required.

(F) The top of the seepage pit shall be within twelve inches of the final grade.

(G) If the cover of the seepage pit does not extend to the finished grade, a permanent inspection port with a minimum diameter of twelve inches expanding through and secured to the cover shall be brought to the finished grade and fitted with a screw type cap or cover.

(H) The distribution box shall be set level so that the effluent is evenly distributed to each seepage pit.

(I) The distribution box shall connect to each seepage pit with pipe of watertight construction at least six inches in diameter, and sloped at least one-eighth inch per foot.

(J) The material used to cover the top of the stone or gravel surrounding the lining shall be a filter fabric material or equal.

(e) Elevated mound system. Elevated mound systems shall be reviewed on a case-by-case basis.

(f) Other disposal systems.

(1) Soil replacement system.

(A) Soil replacement systems shall be used for sites with the following soils layers in the upper soil horizons:

(i) Soils with percolation rates less than one minute per inch;

(ii) Soils with percolation rates greater than sixty minutes per inch that occur within the upper five feet of the soil and underlain by more permeable soils. Installation guidelines shall comply with the requirements of very high permeability soils of subparagraph (B); or

(iii) Fractured lava.

(B) Trenches may be excavated up to thirty-six inches in width to depths not to exceed five feet below grade nor closer than three feet to seasonal high groundwater level, provided any groundwater mounding induced by wastewater does not rise closer than one foot from the bottom of the excavation and bedrock is at least three feet below the bottom of the excavation.

(C) Soil replacement absorption trenches and beds shall follow the applicable provisions of subsections (a), (b), and (c).

(2) Evapotranspiration systems shall be reviewed on a case-by-case basis by the director. The director shall use the provisions of section 7.3.2 of the October 1980 edition of

the EPA Design Manual on Onsite Wastewater Treatment and Disposal Systems as a guide for the review of evapotranspiration systems.

(3) Gravelless systems.

(A) Gravelless soil absorption systems may be used as an alternative to soil absorption systems as specified in subsections (a) and (b), except for sections 11-62-34(a)(3)(C), 11-62-34(a)(3)(D), 11-62-34(a)(4)(E), and 11-62-34(a)(4)(F), 11-62-34(c)(2)(F), 11-62-34(c)(2)(G), 11-62-34(c)(3)(C), 11-62-34(c)(3)(D), and 11-62-34(c)(4)(F).

(B) Design criteria, material specifications, and other pertinent data shall be submitted to the director.

(C) The total area of the soil absorption system for the gravelless system shall be the same as specified in subsections (a), (b), and (c), except for chambered system where the director may approve of a reduction factor as deemed appropriate.

(D) If chambered systems are used, the chamber units shall be placed up against the sidewall of the excavation. In absorption beds, the adjacent chambers shall abut one another.

(E) The use of filter fabric, unless specified by the director, shall follow the manufacturer's recommendation. [Eff 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-50)

§11-62-35 Other individual wastewater systems. (a) The specific design requirements for composting toilets, incinerator toilets, natural systems, and

3176

other individual wastewater systems not specifically covered in this chapter shall be reviewed and approved by the director on a case-by-case basis. Solids generated from such products that are land applied must meet the requirements of subchapter 4. Such products, if sold in Hawaii, shall be approved by the director based on appropriate testing procedures and standards as set forth by the National Sanitation Foundation (NSF) Testing Laboratory, Ann Arbor, Michigan. The performance data shall be obtained by an agency such as a university or an independent research laboratory acceptable to the director or from the NSF.

(b) The director may approve an innovative wastewater system based on the following conditions:

(1) The innovative system provides or may provide a benefit to the people of the State;

(2) The owner of the innovative system shall agree that for a period of up to twelve months after the initiation of the operation of the innovative system, operational data shall be gathered and submitted to the director; and

(3) The owner shall submit a written agreement stating that should the director at any time find the operation of the innovative system unsatisfactory, the owner shall promptly repair or modify the system, or replace it with another acceptable system. [Eff 8/30/91; am and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50)

§11-62-36 <u>Cesspools.</u> (a) No new cesspools shall be constructed after the effective date of this rule unless they have been approved for construction before the effective date of this rule.

(b) The director may require a cesspool card from an owner whose cesspool has no cesspool card on file with the department. An existing cesspool card shall be completed and signed by a licensed engineer, contractor, plumber, or architect. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5, 342E-3)(Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-50, 342E-3)

§11-62-37 Application for and review of building permits and individual wastewater systems. (a) The director shall review all individual wastewater systems before the director signs any related county building permit application.

(b) The application to construct a new individual wastewater system or to modify an existing individual wastewater system shall be made by the applicant on forms furnished by the director. The application at a minimum shall contain the following information:

(1) Name of the owner of the individual wastewater system;
(2) The location of the individual wastewater system, including a location map, plot plan, street address, and tax map key number;
(3) The type and size of treatment unit and disposal system;
(4) Certification by the engineer that the individual wastewater system has been designed in accordance with sections 11-62-31.1 through 11-62-41; and
(5) Certification by the engineer that a final inspection report will be submitted to the director in accordance with section 11-62-31.1(f)(1)(B).

(c) Every applicant for an individual wastewater system shall pay a filing fee in accordance with the schedule of this subsection. The filing fee shall be submitted with the individual wastewater system application and shall not be refunded nor applied to any subsequent individual wastewater system

3176

application. Fees shall be made payable to the State of Hawaii.

(1) New individual wastewater system, new treatment unit or new disposal system - $100; and

(2) Addition or modification to an approved or existing individual wastewater system or part thereof - $25. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5, 342D-6, 342D-13, 342D-50)

§§11-62-38 to 11-62-39 (Reserved)

SUBCHAPTER 4

WASTEWATER SLUDGE USE AND DISPOSAL

§11-62-41 General requirements and prohibition. (a) No person shall generate, treat, prepare, store, haul, apply, place, use, or dispose of wastewater sludge except:

(1) In compliance with:
   (A) A permit or department approval for use of an individual wastewater system obtained under this chapter;
   (B) A registration under this chapter; or
   (C) An exemption from permitting or registration provided by section 11-62-50.

(2) In a municipal solid waste landfill unit which is in compliance with the sludge related conditions in a permit issued under chapter 11-58.1:
   (A) Where that permit was issued following public participation procedures at least as open to the public as those specified in subchapter 5; and

(B) Incorporates the requirements of 40 CFR Part 258.

(3) By incineration in a facility in compliance with the requirements of 40 CFR Part 503, Subpart E, Incineration, and 40 CFR §503.8, Sampling and analysis, and §503.9, General definitions;

(4) In a facility in compliance with the sludge related conditions in a National Pollutant Discharge Elimination System (NPDES) permit issued under chapter 11-55 or issued by the U.S. EPA, where that permit includes or incorporates the requirements of 40 CFR Part 503, Subpart B, Land Application, Subpart D, Pathogens and Vector Attraction Reduction, and 40 CFR §503.8, Sampling and analysis, and §503.9, General definitions and any applicable requirements of this chapter;

(5) For hauling, by a county, state, or federal agency, or by a person or an operation registered under section 11-62-50(b)(4); or

(6) As otherwise authorized in writing by the director.

(b) Direct enforceability. No person shall generate, treat, prepare, store, haul, apply, place, use, or dispose of wastewater sludge except in compliance with the requirements of this chapter and all applicable federal rules, whether or not a permit has been issued or registration has been made.

(c) Exclusion. This chapter does not apply to operations and facilities involved with the collection, handling, storage, treatment, use, disposal, or transportation of the following:

(1) Wastewater sludge co-fired in an incinerator with other wastes or incinerators in which the wastewater sludge and other wastes are co-fired;

(2) Wastewater sludge generated at an industrial facility during the treatment of industrial wastewater, including wastewater sludge generated during the treatment of industrial

wastewater combined with domestic wastewater;

(3) Wastewater sludge determined to be hazardous under state rule or federal regulation;

(4) Wastewater sludge containing polychlorinated biphenyls (PCBs) equal to or greater than 50 milligrams per kilogram of total solids (dry weight basis);

(5) Incinerator ash generated during the firing of wastewater sludge in a wastewater sludge incinerator;

(6) Grit and screenings;

(7) Drinking water treatment sludge; and

(8) Commercial and industrial septage that contains no domestic wastewater. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Parts 258, 501, 503, 40 CFR 503 Subparts B, C, D, E, 40 CFR §§501.15, 503.1(b), 503.3, 503.4, 503.6, 503.7, 503.8, 503.9)

§11-62-41.1 Relation to federal law. (a) This chapter shall be interpreted and applied so that it is at least as stringent as 40 CFR Part 503 and so that the department's sludge management program complies with 40 CFR Part 501.

(b) No wastewater sludge generation, treatment, preparation, storage, hauling, application, placement, use, or disposal shall be conducted unless allowed by this chapter, even if allowed under 40 CFR Part 503.

(c) References to the Code of Federal Regulations (CFR) are to the July 1, 1999 version, and references to specific sections or subparts of the CFR incorporate those regulations and make them part of this chapter, whether or not the word incorporate is specifically used, unless otherwise specifically stated.

(d) Special definitions. For the purposes of this chapter, when used in 40 CFR Part 503:

"Municipal solid waste landfill unit" has the same meaning as defined in 40 CFR Part 258.

"Permitting authority" means the director.
"Sewage" means wastewater.
(e) No permit shall be issued when the United States Environmental Protection Agency Administrator for Region IX has objected in writing under 40 CFR §123.44. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Parts 258, 501, 503, 40 CFR §§123.41, 123.42, 123.44, 501.2, 501.18, 501.19, 501.20, 503.1(b), 503.5, 503.21, 503.32)

§11-62-42 Land application of exceptional quality wastewater sludge. (a) Exceptional quality wastewater sludge shall meet the following criteria at a minimum:

(1) Pollutant limits. No pollutant concentration shall exceed the ceiling limits in Appendix D, Table IV.
(2) Pathogens. The Class A pathogen requirements in section 11-62-46(a) shall be met.
(3) Vectors. One of the vector attraction reduction requirements in 40 CFR §503.33(b)(1) through (8) shall be met.

(b) Monitoring. Exceptional quality wastewater sludge shall be monitored by the preparer at least as often as required by 40 CFR § 503.16(a). References in §503.16(a) to federal pollutant limit tables are replaced with Appendix D, Table IV dated July 1, 2014 and located at the end of this chapter. To determine compliance with section 11-62-42(a)(2), wastewater sludge shall be monitored not more than sixty days before land application or being bagged for distribution unless otherwise specified by the director. The director may also specify more monitoring, to better protect human health or the environment.

(c) Recordkeeping.

(1) The preparer of exceptional quality wastewater sludge that is applied to the land shall meet the requirements of 40 CFR

3176

§503.17(a)(1), except the certification requirement there;

(2) The preparer shall sign complete certification form, form A, entitled Certification Form - Land Application, dated July 1, 2014, and located at the end of this chapter, in Appendix E, items 1, 2.a, and 3.a, and retain the form for five years; and

(3) The preparer shall develop and retain information for five years on the volume of wastewater sludge bagged, distributed, or land applied.

(d) Reporting. The test results and records required in subsections (b) and (c) shall be kept on site and unless otherwise specified, copies shall be submitted to the director on February 19 of each year.

(e) The exceptional quality sludge shall be applied to the land at a rate that is less than ten dry tons per acre and equal to or less than the agronomic rate.

(1) The preparer shall provide to each land applier a fact sheet which contains the nitrogen, phosphorus, and potassium concentrations of the wastewater sludge; and

(2) When the wastewater sludge is applied in bulk to agricultural land, forest, a public contact site, or a reclamation site, the director may require a nutrient balance to be submitted prior to the application to the land. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR §§503.1, 503.5, 503.10, 503.13, 503.15(a), 503.16(a), 503.17(a), 503.18, 503.32, 503.33(b))

§11-62-43 <u>Land application of other than exceptional quality wastewater sludge, to agricultural land, forest, public contact site, or reclamation site.</u> (a) No person shall apply non-exceptional quality wastewater sludge to land unless the land is agricultural land, forest, a public contact site, or a reclamation site, and all the requirements of this section are met.

(b) Pollutant limits. Non-exceptional quality wastewater sludge shall not be land applied if the concentration of any pollutant in the wastewater sludge exceeds the ceiling limits in Appendix D, Table IV dated July 1, 2014, and located at the end of this chapter.

(c) Pathogens. The Class A pathogen requirements in section 11-62-46(a) or the Class B pathogen requirements in 40 CFR §503.32(b) shall be met for non-exceptional quality wastewater sludge.

(d) Vectors. One of the vector attraction reduction requirements in 40 CFR §503.33(b)(1) through (10) shall be met for non-exceptional quality wastewater sludge.

(1) The preparer shall meet one of the requirements of 40 CFR §503.33(b)(1) through (8); or

(2) The applier shall meet one of the requirements of 40 CFR §503.33(b)(9) or (10).

(e) Notice. The preparer of the non-exceptional quality wastewater sludge shall inform in writing to the land applier and the owner of the land application site of:

(1) The vector attraction reduction requirements of 40 CFR §503.33(b)(9) and (10), if the preparer did not use or meet any of the requirements of 40 CFR §503.33(b)(1) through (8);

(2) The spacing and site restrictions in subsection (g);

(3) The management requirements of subsection (h); and

(4) The concentration of total nitrogen (as N on a dry weight basis).

(f) Monitoring. Non-exceptional quality wastewater sludge shall be monitored at least as often as required by 40 CFR § 503.16(a). References in §503.16(a) to federal pollutant limit tables are replaced with Appendix D, Table IV dated July 1, 2014, and located at the end of this chapter. To determine compliance with section 11-62-43(c), wastewater sludge shall be monitored not more than sixty days before land application unless otherwise specified by the director. The director may also specify more monitoring, to better protect human health or the environment.

(g) Spacing and site restrictions for non-exceptional quality sludge.

(1) Horizontal distances. The land application of wastewater sludge shall meet the minimum horizontal limits in Appendix D, Table VI.

(2) Vertical separation. The land application of wastewater sludge shall be at least five feet above the seasonal high groundwater table.

(3) If the class B pathogen requirements are met, the site restrictions in 40 CFR §503.32(b)(5) shall be met.

(h) Management practices. The management practices required by 40 CFR §503.14(a), (b), (d), (e)(1), and (e)(2) shall be met, and wastewater sludge shall not be applied to the land so that either the sludge or any pollutant from the sludge enters state waters.

(i) Recordkeeping, preparers of non-exceptional quality wastewater sludge.

(1) The preparer of the wastewater sludge which meets the Class A pathogen requirements in section 11-62-48(a) shall develop and retain for five years information on:

(A) The concentration of pollutants listed in Appendix D, Table IV dated July 1, 2014, and located at the end of this chapter; and

(B) A description of how the pathogen requirements in section 11-62-48(a) are met.

(2) The preparer of wastewater sludge which meets the class B pathogen requirements in 40 CFR §503.32(b) shall develop and retain for five years information on:

(A) The concentration of pollutants listed in Appendix D, Table IV dated July 1, 2014, and located at the end of this chapter;

(B) A description of how the pathogen requirements in 40 CFR §503.32(b) are met; and

(C) A description of how one of the vector attraction reduction requirements of 40 CFR §503.33(b)(1) through (8) is met, when one is met.

(3) The preparer shall sign and complete certification form, form A entitled Certification Form - Land Application dated July 1, 2014, and located at the end of this chapter, in Appendix E, items 1, 2, and 3, and retain the form for five years; and

(4) The preparer shall develop and retain for five years information on the volume of wastewater sludge prepared for land application, names of persons taking wastewater sludge from the facility, the date and time the wastewater sludge was taken, and the amount taken.

(j) Recordkeeping, appliers of non-exceptional quality wastewater sludge to the land.

(1) The applier shall meet the information requirements of 40 CFR §503.17(a)(3)(ii)(B) and (C); or §503.17(a)(4)(ii)(B), (C), (D), and (E);

(2) The applier shall sign and complete the certification form, form A entitled Certification Form - Land Application, July 1, 2014, and located at the end of this chapter, in Appendix E, items 4, 5, and 6, and retain the form for five years; and

(3) The applier shall develop and retain for five years the following information:

(A) The location, including street address and tax map key number, of the site on which wastewater sludge is applied;

(B) The number of acres in each site on which wastewater sludge is applied;

3176

(C) The date and time the wastewater sludge is applied to each site;
(D) The amount of wastewater sludge applied to each site; and
(E) A nutrient balance.

(k) Reporting. The test results and records required in subsections (f), (i), and (j) shall be kept on site and unless otherwise specified copies shall be submitted to the director on February 19 of each year.

(l) Notification to other states. Any person who prepares wastewater sludge that is land applied in another state shall provide written notice, prior to the initial land application, to the permitting authority for the state in which the bulk in which the wastewater sludge is to be applied to the land in accordance with 40 CFR §503.12(i). [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR §§503.12, 503.13(b), 503.14, 503.15(a), (c), 503.16(a), 503.17, 503.18, 503.32, 503.33(b))

§11-62-44 Land application of domestic septage to agricultural land, forest, or reclamation site. (a) No person shall apply domestic septage to land unless the land is agricultural land, forest, or a reclamation site if the annual application rate (AAR) exceeds 1/0.0026 the amount of nitrogen (N) in pounds per acre per 365 day period needed by the crop or vegetation growth on the land.

$$AAR = \frac{N}{0.0026} \qquad \text{Equation (1)}$$

(b) Pathogens. The pathogen requirements of
(1) 40 CFR §503.32(c)(1); or

(2) 40 CFR §503.32(c)(2), including the site restrictions of 40 CFR §503.32(b)(5)(i) through (iv), shall be met for domestic septage.

(c) Vectors. One of the vector attraction reduction requirements in 40 CFR §503.33(b)(9), (10), or (12) shall be met for domestic septage.

(d) Monitoring. If either the pathogen requirement in subsection (b)(2) or vector attraction reduction requirement in 40 CFR §503.33(b)(12) applies, each container of domestic septage shall be monitored for compliance with those requirements. The director may specify more monitoring, to better protect human health or the environment.

(e) Recordkeeping.

(1) The applier shall meet the information requirements of 40 CFR §503.17(b)(2),(3),(4),(5),(7), and (8);

(2) The applier shall develop and retain for five years the location, including street address and tax map key number, of the site on which septage is applied; and

(3) The applier shall sign and complete the certification form, form A entitled Certification Form - Land Application dated July 1, 2014, and located at the end of this chapter, in Appendix E, items 7, 8, 9, and 10, and retain the form for five years.

(f) Reporting. The test results and records required in subsection (e) shall be kept on site and unless otherwise specified copies shall be submitted to the director on February 19 of each year.

(g) Spacing and site restrictions.

(1) Horizontal distances. The land application of domestic septage shall meet the minimum horizontal limits in Appendix D, Table VI dated July 1, 2014, and located at the end of this chapter.

(2) Vertical separation. The land application of domestic septage shall be at least five feet above the seasonal high groundwater table.

3176 ''

(3) The site restrictions in:
(A) 40 CFR §503.32(b)(5); or
(B) The pathogen requirement of 40 CFR §503.32(c)(2) and the site restrictions of 40 CFR §503.32(b)(5)(i) through (iv) shall be met for domestic septage.

(h) Management practices. The management practices required by 40 CFR §503.14(a), (b), (d), (e)(1), and (e)(2)for wastewater sludge shall be met for domestic septage, and domestic septage shall not be applied to the land so that the septage or any pollutant from septage enters state waters. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR §§503.12(c), 503.13(c), 503.14, 503.15(b), (d), 503.16(b), 503.17, 503.18, 503.32, 503.33)

§11-62-45 REPEALED [R MAR 21 2016]

§11-62-46 Pathogens. (a) Wastewater sludge - class A. (1) The requirements of this subsection shall be met for a wastewater sludge to be classified exceptional quality sludge or class A with respect to pathogens.

(2) One of the class A requirements in paragraphs (3), (4), (6) or (7) shall be met, or with the prior approval of the director paragraph (5) shall met. The requirements in paragraphs (3) through (7) shall be met before or at the same time that the vector attraction reduction requirements in 40 CFR §503.33 are met, unless one of the vector attraction reduction requirements in 40 CFR §503.33(b)(6) through (8) is met.

(3) Class A - alternative 1. The requirements of 40 CFR §503.32(a)(3) apply, except that the requirements of §503.32(a)(3)(i) are replaced with those of paragraph (8).

(4) Class A - alternative 2. The requirements

of 40 CFR §503.32(a)(4) apply, except that the requirements of §503.32(a)(4)(i) are replaced with those of paragraph (8).

(5) Class A - alternative 3. The requirements of 40 CFR §503.32(a)(6) apply, except that the requirements of §503.32(a)(6)(i) are replaced with those of paragraph (8).

(6) Class A - alternative 4. The requirements of paragraph (8), and subsection (d), Process to Further Reduce Pathogens (PFRP), apply.

(7) Class A - alternative 5. The requirements of paragraph (8) apply and, as determined by the director, a process equivalent to one in subsection (d), Process to Further Reduce Pathogens (PFRP), shall be used.

(8) Pathogen density at the time the wastewater sludge is used, disposed, or prepared for sale or give away in a bag or other container for land application, shall meet the following:

(i) Unless otherwise specified by the director, seven samples shall be analyzed; and

(ii) For each sample the fecal coliform shall be less than 1000 MPN per gram of total solids (dry weight basis) or for each sample the Salmonella sp. bacteria shall be less than three MPN per four grams of total solids (dry weight basis).

(b) Wastewater sludge - class B. The requirements of 40 CFR §503.32(b) shall be met for a wastewater sludge to be classified class B with respect to pathogens.

(c) Domestic septage. The requirements of 40 CFR §503.32(c) apply.

(d) Processes to further reduce pathogens (PFRP). The requirements of 40 CFR Part 503, appendix B, Pathogen Treatment Processes, section B, Processes to Further Reduce Pathogens, apply, except for section B.1 which is replaced by paragraph (1).

(1) Composting.

(A) Windrow. The temperature of the wastewater sludge is maintained at 55 degrees Celsius or higher for at least fifteen consecutive days during the composting period. In addition, during the high temperature period, the windrow must be turned at least five times and turned at least once every three days.

(B) Static aerated pile. The wastewater sludge must be maintained at operating temperatures of 55 degrees Celsius or greater for three consecutive days.

(C) Within vessel method. The wastewater sludge must be maintained at operating temperatures of 55 degrees Celsius or greater for three consecutive days.

(2) Heat Drying. See Part 503, appendix B, section B.2.

(3) Heat Treatment. See Part 503, appendix B, section B.3.

(4) Thermophilic Aerobic Digestion. See Part 503, appendix B, section B.4.

(5) Beta ray irradiation. See Part 503, appendix B, section B.5.

(6) Gamma ray irradiation. See Part 503, appendix B, section B.6.

(7) Pasteurization. See Part 503, appendix B, section B.7.

(e) Processes to significantly reduce pathogens (PSRP). The requirements of 40 CFR Part 503, appendix B, Pathogen Treatment Processes, section A, Processes to Significantly Reduce Pathogens, apply.

(1) Aerobic Digestion. See Part 503, appendix B, section A.1.

(2) Air Drying. See Part 503, appendix B, section A.2.

(3) Anaerobic Digestion. See Part 503, appendix B, section A.3.

(4) Composting. See Part 503, appendix B, section A.4.

(5) Lime Stabilization. See Part 503, appendix

B, section A.5. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 503, Subpart D, Appendix B, 40 CFR §503.32)

§11-62-47 Vector attraction reduction. (a) Requirements for land application.

(1) One of the vector attraction reduction requirements in 40 CFR §503.33(b)(1) through (8) shall be met before exceptional quality wastewater sludge is land applied.

(2) The requirements of 40 CFR §503.33(a)(1), (4), and (5) apply.

(b) Vector attraction reduction requirements. The requirements of 40 CFR §503.33(b) apply. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5,342D-6, 342D-50; 40 CFR Part 503, Subpart D, 40 CFR §503.33)

§11-62-48 Sampling method. Samples of wastewater sludge that is applied to the land, [placed on a surface disposal site,] fired in a wastewater sludge incinerator, or disposed into a solid waste landfill or any other wastewater system shall be collected and analyzed using the methods specified in 40 CFR §503.8. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR §503.8)

SUBCHAPTER 5

WASTEWATER MANAGEMENT PERMITS AND REGISTRATION

§11-62-50 Registration and permits. (a) Owners and operators are not required under this subchapter to register or obtain any permit coverage for their:

3176

(1) Individual wastewater systems (e.g., cesspools, septic tanks, and household aerobic units);
(2) Land on which exceptional quality wastewater sludge is applied;
(3) Land application or land placement operations involving only exceptional quality wastewater sludge;
(4) Operations, such as businesses, that haul only exceptional quality wastewater sludge; or
(5) Non-domestic wastewater treatment works, unless deemed necessary by the director.

(b) Owners or operators or both of the following shall register with the department:
(1) Land on which non-exceptional quality sludge is applied or placed, with or without the landowner's permission;
(2) Land on which non-exceptional quality sludge is stored for less than two years, if the land is different from the treatment works which generated the sludge;
(3) Land application or land placement operations for non-exceptional quality wastewater sludge, whether or not the wastewater sludge is applied or placed on land with the landowner's permission;
(4) Operations, such as businesses, that haul wastewater or wastewater sludge, or both, including grease haulers and cesspool pumpers, except those operations that only haul exceptional quality sludge; and
(5) Other facilities, operations, or land, if directed by the director.

(c) Owners or operators or both shall obtain an individual permit for their:
(1) Treatment works that generate wastewater sludge that is directly land applied;
(2) If different from the generator, facilities or operations that treat or prepare wastewater sludge that is land applied or surface disposed;
(3) Treatment works not located in the State but

generate wastewater sludge that is directly land applied in the State;

(4) Facilities or operations not located in the State that treat or prepare wastewater sludge that is land applied or surface disposed in the State; and

(5) Other facilities, operations, or land, if directed by the director.

(d) The department may accept and issue consolidated registrations and individual permits (collectively "authorizations"), and for the consolidated authorizations the department may charge the fee for only the most expensive authorization. The department may also charge the fees for all or some of the authorizations. [Eff and comp 12/09/04; am and comp MAR 2 1 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-13, 342D-50; 40 CFR §§501.15, 503.3(a))

§11-62-51 Fees. (a) Registration. Every registrant shall pay a filing fee according to this subsection. The filing fee shall be submitted with the registration and shall not be refunded nor applied to any later registration after filing or denial of a registration. Fees shall be made payable to the State of Hawaii.

(1) For a new operation, facility, or land, the fee is $30;

(2) For major changes in the registration of an operation, facility, or land, the fee is $30;

(3) For renewal, the fee is $10;

(4) To change only ownership shown in a registration, the fee is $5; and

(5) To make other changes in a registration, the fee is $10;

(b) Individual permits. Every person applying for an individual permit, its modification, or renewal shall pay a filing fee according to this subsection. This filing fee shall be submitted with the application for the permit or permit modification and shall not be refunded nor applied to any subsequent

3176

individual after final issuance or denial. Fees shall be made payable to the State of Hawaii.

(1) To apply for an individual permit for a new or existing operation or facility, the fee is $1000;
(2) To apply to modify an individual permit to cover a substantial alteration or addition to an operation, facility, or land, the fee is $1000;
(3) To renew an individual permit for an existing operation or facility, the fee is $1000;
(4) To transfer ownership or to modify an individual permit to show only a change in ownership, the fee is $25; and
(5) To apply to modify an individual permit to cover a change other than those covered above, the fee is $100.

(c) Late fees. Every person who fails to submit complete forms for a new or renewed registration or a complete application for a new or renewed individual permit when required by this chapter, shall pay a late fee. Fees shall be payable to the State of Hawaii. Late submission of required fees and registration forms, notice of intent, or individual permit application does not excuse a person from liabilities for any violations due to the lack of a required registration or individual permit.

(1) The fee for submitting a registration form late is $5;
(2) The fee for submitting an application for an individual permit late is $250.

(d) Relation to other fees. The foregoing fees are subject to section 11-62-50(e) and do not include any public participation costs (for notices, hearings, etc.) that the would-be registrant or permittee may be required to pay under other sections. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-13, 342D-50)

§11-62-52 Signatories and certification requirements. (a) Unless otherwise specified, each registration, notice of intent, permit application, and any information required to be submitted to the director shall be signed and certified as required by 40 CFR §122.22.

(b) Each person who knowingly makes any false statement, representation, or certification in any application, record, report, plan, or other documentation submitted or required to be maintained under this chapter or who knowingly falsifies, tampers with, or renders inaccurate any monitoring device or method required to be maintained under this chapter is subject to the penalties and remedies in section 11-62-72. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Parts 122, 501, 40 CFR §§122.22, §501.15(a)(4), (b)(11))

§11-62-53 Wastewater management registration. (a) Timing. Completed registrations forms required under section 11-62-50 shall be submitted as follows.

(1) For existing lands, facilities, and operations, not later than ninety days after the effective date of this rule; and

(2) For new lands, facilities, and operations, no later than one hundred eighty days before such lands, facilities, or operations are used or begin activity.

(b) Registration information and forms. Registrants shall complete and submit one original and one copy of the form(s) furnished by the director. Registrants shall provide at least the following information:

(1) Activities conducted by the applicant which require registration;

(2) Name, mailing address, and location of the wastewater or wastewater sludge collection, handling, storage, treatment, use, disposal, or transportation facility, operation, or land;

(3) Owner's name, mailing address, telephone

3176 11

number, ownership status, and status as federal, state, private, public, or other entity; and

(4) Operator's name and certification number under chapter 11-61, if applicable.

(c) The director may require the submission of additional information after registration forms have been submitted.

(d) Records. Registrants shall keep records of all data used to complete registrations and any supplemental information submitted under this section for at least five years from the date the registrant submits the registration form, unless otherwise specified by the director.

(e) Fees. Each registrant shall pay the filing fee specified in section 11-62-51 for each facility, operation, or land registered, except as the director may provide under section 11-62-50(e).

(f) Term. Registrations expire on November 15 of each even-numbered year.

(g) Renewals. Renewal registration forms shall be submitted by November 15. If a renewal registration form is not submitted on time, it may be submitted after payment of the current annual fee and a late payment fee. If a renewal registration form is submitted more than ninety days after it is due, then the registrant shall supply all the information required for a new registration regardless of whether there have been any changes to report.

(h) Automatic filing. Registrations shall be deemed filed automatically sixty days after submission, or on the next working day after sixty days expire, unless the director suspends registration.

(i) Filing suspension. If the director considers a registration form incomplete, lacking payment of all or part of the fee, otherwise deficient, or considers more information necessary, the director shall order that the land, operation, or facility shall not be registered until the registrant has supplied the missing information or otherwise corrected the deficiency. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-6, 342D-13)

§11-62-54.01 Wastewater management individual permits. (a) Timing. Applications for individual permits required under section 11-62-50 shall be submitted as follows:

(1) For existing lands, facilities, operations, and lands, not later than one year after the effective date of this section; and
(2) New facilities, operations, and lands, not later than one hundred eighty days before the facilities, operations, or lands are used or begin activity. The director may waive this one hundred eighty day requirement by issuing the permit before the one hundred eighty days expire.

(b) Information and forms. Applicants for individual permits shall complete and submit one original and one copy of the form(s)furnished by the director. Applicants shall provide at least the type of information required by 40 CFR Part 501 and the following information:

(1) The type of activities conducted by the applicant which requires a permit to be obtained;
(2) The name, mailing address, and location of the wastewater or wastewater sludge collection, handling, storage, treatment, use, disposal, or transportation facility, operation, or land;
(3) The owner's name, address, telephone number, ownership status, and status as federal, state, private, public, or other entity;
(4) The operator's name, address, telephone number, ownership status, status as federal, state, private, public or other entity, and operator's certification number under chapter 11-61, if applicable;
(5) A listing of all environmental permits received or applied, including all federal, state, or local permits;
(6) A topographical map or other map if a

topographical map is unavailable extending one mile beyond the property boundaries of the sludge management facility, depicting the treatment and disposal sites, the location of all water bodies, and the locations of potable water wells within one-quarter mile of the property boundaries;

(7) Any sludge monitoring data and for land application, any available groundwater monitoring data, with a description of the well locations and approximate depth to the groundwater;

(8) A description of the applicant's sludge use and disposal practices, including where applicable, the location of any sites where the applicant transfers wastewater sludge for treatment, disposal, or both, as well as the name of the applier who applies the wastewater sludge to the land if different from the applicant, and the name of any distributors when the sludge will be distributed, if different from the applicant;

(9) For each land application site the applicant will use during the life of the permit, the applicant will supply information necessary to determine if the site is appropriate for land application and a description of how the site is, or will be managed. Applicants intending to apply wastewater sludge to land application sites not identified at the time of application must submit a land application plan which at a minimum:

   (A) Describes the geographical area covered by the plan;
   (B) Identifies the site selection criteria;
   (C) Describes how the site will be managed;
   (D) Provides for advanced notice to the director of specific land application sites; and
   (E) Provides for advance public notice and notice to landowners and occupants adjacent to or abutting the proposed

land application site;

(10) Annual sludge production volumes; and

(11) Any information required to determine the appropriate standards for permitting under 40 CFR Part 503.

(c) The director may require the submission of additional information after an individual permit application has been submitted.

(d) Records. Applicants shall keep records of all data used to complete permit applications and any supplemental information submitted under this section for a period of at least five years from the date the application is submitted, unless otherwise specified by the director.

(e) Fees. Every applicant for an individual permit shall pay the filing fee specified in section 11-62-51 for each facility, operation, or land to be permitted, except as the director may provide under section 11-62-50(e).

(f) Processing suspension. If the director considers permit application incomplete, lacking payment of the fee, otherwise deficient, or considers more information necessary, the director shall order that the permit application shall not be processed or a permit issued until the applicant supplies the missing information or otherwise corrects the deficiency. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-6, 342D-13, 342D-50; 40 CFR Part 501, 40 CFR §501.15(a),(d))

§11-62-54.02 Draft individual permits. After an application for a new, modified, or renewed permit is complete, the director shall tentatively decide to prepare a draft individual permit or deny the application. If the director tentatively proposes to revoke and reissue a permit, the director shall prepare a draft individual permit. A draft permit shall contain the necessary conditions to implement the requirements of this chapter, 33 U.S.C. §1345, and the incorporated sections of 40 CFR Parts 501 and 503.

[Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, 40 CFR §501.15(d)(3))

§11-62-54.03 Fact sheets. (a) The director shall prepare a fact sheet for every draft individual permit for a major facility, operation, or activity, and when required by 40 CFR §501.15(d)(4).

(b) The director shall send the fact sheet to the applicant and, upon request, to any other person.

(c) Fact sheets shall include at least the information required by 40 CFR §501.15(d)(4)(i). [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, 40 CFR §501.15(d)(4))

§11-62-54.04 Public notices of draft individual permits; public comments and hearing requests. (a) The director shall notify the public that a draft individual permit has been prepared and that the public has thirty days to comment on it. The comment period may be extended at the discretion of the director. The director may require the permit applicant to have the notice published.

(b) Methods. The director shall notify the public by at least the methods specified in 40 CFR §501.15(d)(5)(ii).

(c) Content. The public notice shall include at least the information required by 40 CFR 501.15(d)(5)(iii)(A).

(d) Costs. All publication and mailing costs associated with notifying the public of a draft permit shall be paid by the permit applicant(s) to the appropriate publishing agency or agencies determined by the director. Failure to provide and pay for public notice as required by the director is a basis to deny issuance of a permit.

(e) Public comments and hearing requests. During the public comment period, any person may submit comments in writing and may ask in writing for a public hearing. A request for hearing shall state the nature of the issues that the hearing should cover. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6, 342D-13) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, 40 CFR §501.15(d)(5),(6))

§11-62-54.05 Public meetings or hearings on individual permits. (a) The director shall hold a public meeting or hearing if the director determines that there is a significant degree of public interest in a draft individual permit, based on hearing requests.

(b) The director may hold a meeting or hearing at the director's discretion, when such a meeting or hearing may help the director's decision on an individual permit application or for another reason which the director considers to be in the public interest. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: 342D-4, 342D-5, 342D-6) (Imp: 342D-2, 342D-4, 342D-5, 342D-6, 342D-57; 40 CFR Part 501, 40 CFR §501.15(d)(7))

§11-62-54.06 Public notice of public meetings or hearings on individual permits. (a) The director shall notify the public that a meeting or hearing on an individual permit matter has been scheduled. The notice shall be given at least thirty days before the hearing. The director may require the permit applicant to have the notice published.

(b) Methods. The director shall notify [to] the public by at least the methods specified in 40 CFR §501.15(d)(5)(ii).

(c) Content. The public notice shall include at least the information required by 40 CFR §501.15(d)(5)(iii).

(d) Costs. All publication and mailing costs associated with notifying the public of a public meeting or hearing shall be paid by the permit applicant(s) to the appropriate publishing agency or agencies determined by the director. Failure to provide and pay for public notice as required by the director is a basis to deny issuance of a permit. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6, 342D-13) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, 40 CFR §501.15(d)(5))

§11-62-54.07 Response to comments. When a final individual permit is issued, the director shall issue a written response to written comments as required by 40 CFR §501.15(d)(8). [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, 40 CFR §501.15(d)(8))

§11-62-54.08 Issuance of individual permits; duration, conditions. (a) Duration. The director may issue an individual permit for any period not exceeding five years, may renew such permit for any additional periods not exceeding five years each, and shall not modify an individual permit to extend its maximum period.

(b) Each individual permit shall contain conditions and requirements at least as stringent as:

(1) Those conditions contained in 40 CFR §501.15(b);
(2) The wastewater sludge standards in subchapter 4;
(3) The treatment requirements in subchapter 2;
(4) The application rates in sections 11-62-27;
(5) The standard permit conditions stated in Appendix A entitled Wastewater Management Individual Permit Standard Conditions dated July 1, 2014, and located at the end of this chapter; and
(6) Other requirements deemed necessary by the director. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Parts 501, 503, 40 CFR §§501.15(a)(5),(b),

503.3(a), 503.10(b),(c), 503.13, 503.32, 503.33)

§11-62-54.09 <u>Schedules of compliance.</u> Individual permits may contain schedules of compliance that are at least as stringent as those allowed by 40 CFR §501.15(a). [Eff and comp 12/09/04; comp MAR 2 1 2016](Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 501, 40 CFR §501.15(a)(6))

§11-62-55.01 REPEALED [R MAR 2 1 2016]

§11-62-55.02 REPEALED [R MAR 2 1 2016]

§11-62-55.03 <u>Requiring an individual permit.</u> Cases where an individual permit may be required include, but are not limited to the following:

(1) The wastewater system generates wastewater sludge that is land applied; and

(2) Other relevant factors. [Eff and comp 12/09/04; am and comp] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 122, 40 CFR §122.28(b)(3)(i))

§11-62-55.04 REPEALED [R MAR 2 1 2016]

§11-62-55.05 REPEALED [R MAR 2 1 2016]

§11-62-55.06 REPEALED [R MAR 2 1 2016]

§11-62-55.07 REPEALED [R MAR 2 1 2016]

§11-62-55.08 REPEALED [R MAR 21 2016]

§11-62-56 Standard permit conditions. Standard permit conditions for individual permits are contained in Appendix A entitled Wastewater Management Individual Permit Standard Conditions dated July 1, 2014, and located at the end of this chapter. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 501, 40 CFR §501.15(b))

§11-62-57.01 Transfer of permits. An individual permit coverage may be transferred for the reasons and under the procedures specified in 40 CFR §501.15(c)(1), which allows for transfers by modification or automatically. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6; 40 CFR Part 501, §501.15(c)(1))

§11-62-57.02 Modification or revocation and reissuance of permits. (a) Each permit coverage shall be subject to modification or revocation and reissuance by the director after notice and opportunity for a contested case hearing, except for minor modifications.

(b) Individual permits may be modified, or revoked and reissued, for the reasons specified in 40 CFR §501.15(c)(2) and section 342D-6(e), HRS, and the director shall follow the procedures in 40 CFR §501.15(c)(2) and (d)(2) and section 342D-6(e), HRS, except for minor modifications, which shall follow the procedures specified in Appendix A.

(c) All applications under section 342D-7, HRS, for a variance from the requirements of subchapter 4 shall be treated as an application for a modification under this section. Any variances, if granted, shall be for a period not to exceed five years and may be renewed upon application. [Eff and comp 12/09/04; am

3176

and comp MAR 2 1 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6, 342D-7) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-7, 342D-50; 40 CFR Part 501, §501.15(c)(2),(d)(2))

§11-62-57.03 Termination of permits. (a) On the expiration date specified in the individual permit, the permit shall automatically terminate and the permittee shall be divested of all rights therein.

(b) Each individual permit coverage shall be subject to termination by the director after notice and opportunity for a contested case hearing.

(c) Individual permits may be terminated or denied for any of the reasons specified in 40 CFR §501.15(c)(3) and section 342D-6(e), HRS, and under the procedures specified in 40 CFR §501.15(d)(2) and section 342D-6(e), HRS. [Eff and comp 12/09/04; am and am and comp MAR 2 1 2016] (Auth: HRS §§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 501, 40 CFR §§501.15(c)(3), (d)(2))

§11-62-57.04 Renewal of permits. (a) Permittees seeking individual permit renewal shall submit a renewal application at least one hundred eighty days before the individual permit expires.

(b) An application for individual permit renewal is subject to all of the requirements for an application for a new permit, including a draft permit and fact sheet, public notice, and a possible public hearing, but excepting deadlines and fees specific to new permits.

(c) The director may administratively extend the existing permit pending the renewal of a wastewater management permit.

(d) Individual permits may be renewed for the reasons and under the procedures specified in section 342D-6(c), HRS, and renewal may be denied for noncompliance with the permit. [Eff and comp 12/09/04; am and comp MAR 2 1 2016] (Auth: HRS

3176

§§342D-4, 342D-5, 342D-6) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50; 40 CFR Part 501, 40 CFR §501.15(b)(14))

§11-62-58 Conflict of interest. (a) Any board or body who reviews or approves applications for new, modified, or renewed individual permits shall not include as a member any person who receives, or has during the previous two years received, a significant portion of that person's income directly or indirectly from permit holders or applicants for a permit.

(b) For this section the definitions of 40 CFR §501.15(f)(1) shall apply. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-3, 342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-3, 342D-4, 342D-5; 40 CFR Part 501, 40 CFR §501.15(f))

SUBCHAPTER 6

WASTEWATER AND WASTEWATER SLUDGE PUMPERS AND HAULERS

§11-62-60 Applicability. This subchapter applies to all persons who own or conduct operations that haul or pump wastewater or wastewater sludge, including septage and grease, and including cesspool pumping firms (collectively "pumpers"). [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-50)

§11-62-61 Registration requirements. In addition to meeting the registration requirements of sections 11-62-50(b)(4) and 11-62-53, each pumper shall submit with its registration:

(1) A statement signed by the owner of the wastewater and wastewater sludge pumping and hauling firm attesting that:
    (A) The owner has read, understands, and

shall follow all applicable rules regarding the collection, disposal, monitoring, recordkeeping, and reporting of pumping and hauling wastewater and wastewater sludge, including septage from individual wastewater systems and other wastewater systems; and

(B) The owner has and will continue to provide employees of the pumping and hauling firm with adequate training in the proper pumping, collection, hauling, and disposal of wastewater and wastewater sludge;

(2) Copies of authorization to dispose of wastewater and wastewater sludge into any state, county, federal, or private facility or site; and

(3) A statement signed by the owner of the wastewater and wastewater sludge pumping and hauling firm describing the firm's prior and current involvement in the activity of cesspool pumping. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-50)

§11-62-62 <u>Recordkeeping and reporting.</u> In addition to meeting the requirements of section 11-62-53(c) and (d), each pumper shall maintain the following types of records and information. Such information shall be made available upon request to any state, county, or federal wastewater agency regulating or managing wastewater:

(1) Number of wastewater systems, including individual wastewater systems and grease traps pumped;

(2) Names of the owner of each wastewater system and grease trap pumped;

(3) Location (street address or tax map key or both) of each wastewater system and grease trap pumped;

(4) Date of pumping;
(5) Type of wastewater or wastewater sludge pumped;
(6) Volume of wastewater or wastewater sludge pumped;
(7) Results of any test analyses performed on the wastewater or wastewater sludge;
(8) Disposal site of the pumped wastewater or wastewater sludge; and
(9) Date of such disposal. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-6, 342D-50, 342D-55)

SUBCHAPTER 7

VARIANCES, PENALTIES, AND SEVERABILITY

§11-62-71 Variances. (a) Variances and variance applications shall comply with section 342D-7, HRS.

(b) Variance application forms shall be provided by the department. All applications for variances shall be submitted with a filing fee of $300 for each application. Additionally, the applicant shall pay all fees assessed for publishing the legal notice(s) for each variance application. If a public hearing is required, the applicant shall pay all fees assessed for publishing the public hearing notice(s).

(c) Applications for renewal of variances shall be submitted one hundred eighty days before the expiration of the variance on forms provided by the department. A filing fee of $150 shall be submitted with each application for renewal. Additionally, the applicant shall pay all fees assessed for publishing the legal notice(s) and public hearing notice(s). Failure to renew a variance within the specified time will result in the termination of the variance and require the applicant to apply for a new variance. [Eff 12/10/88, am 8/30/91; §11-62-41; ren, am and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5, 342D-7, 342D-13) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-5,342D-7, 342D-50)

§11-62-72 Penalties and remedies. Any person who violates any provision of this chapter shall be subject to the penalties and remedies for violations provided for in chapters 321, 322-part I, 342D, and 342H, HRS. [Eff 12/10/88; §11-62-42; ren, am and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-1, 342D-4, 342D-5, 342D-9, 342D-11, 342D-30, 342D-31, 342D-50) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 322-9, 342D-2, 342D-4, 342D-5, 342D-9, 342D-11, 342D-18, 342D-30, 342D-31, 342D-50, 603-23)

§11-62-73 Severability. If any provision of this chapter or its application to any person or circumstance is held invalid, the application of such provision to other persons or circumstances, and the remainder of this chapter, shall not be affected thereby. [Eff 12/10/88; §11-62-43; ren and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§321-11, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 322-4, 322-8, 342D-2, 342D-4, 342D-19, 342D-50)

§11-62-74 Public participation in enforcement. The department shall provide for public participation in enforcement relating to violations of subchapters 4 and 5 at least to the extent specified in 40 CFR §501.17(d)(2). [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§342D-4, 342D-5) (Imp: HRS §§342D-2, 342D-4, 342D-5, 342D-50; 40 CFR Part 501, 40 CFR §501.17(d)(2))

3176

SUBCHAPTER 8

FIELD CITATIONS

§11-62-81 Purpose. This subchapter authorizes field citations to effectively and quickly settle easily verifiable violations of chapters 322 and 342D, HRS, and this chapter. Settlements under this section are an additional remedy and do not supplant the director's authority to issue orders under section 342D-9, HRS. [Eff and comp 12/09/04; comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-1, 342D-4, 342D-5, and 342D-31) (Imp: HRS §§321-11, 322-1 to 4, 322-8, 342D-2, 342D-4, 342D-5, 342D-9, 342D-18, 342D-31, 342D-50)

§11-62-82 Offer to settle; settlement amounts. (a) A field citation is an offer to settle an administrative case against a specific violation on a specific day. Instead of issuing a formal notice and finding of violation and order, the director, in the director's sole discretion, through any authorized employee, may issue a field citation by personal service or certified mail to:

(1) Any person or owner who causes or allows a wastewater system to create or contribute to a wastewater spill, overflow, or discharge onto the ground or into surface waters, in violation of section 11-62-06(f)(5) or (6);

(2) Any person or owner who uses or occupies a building not connected to a wastewater system in violation of section 11-62-06(a);

(3) Any person or owner who constructs, modifies, or uses any individual wastewater system without approval by the director or a county authorized by the director to approve and regulate individual wastewater systems, in violation of section 11-62-08(b) or 11-62-31.1(f); or

(4) Any person or owner who does not respond within thirty days to an operation and maintenance inspection report issued by the Department.

(b) A field citation shall indicate the following settlement amounts:

(1) $200 for a first violation, and $500 for a subsequent violation for:
   (A) Violating sections 11-62-06(a),(f)(1)-(4) and (f)(6)-(9), 11-62-08(b) or 11-62-31.1(f);
   (B) Failing properly to operate or maintain an aerobic treatment unit;
   (C) Failing to provide an effective contract for an aerobic treatment unit;
   (D) Failing to respond to department inspection reports, if the report states a response is required;
   (E) Having a cesspool without a concrete cover;
   (F) Not having a secured manhole cover for the cesspool; or
   (G) A collapsed cesspool.

(2) $500 for a first violation, and $2,000 for a subsequent violation for violating section 11-62-06(f)(5) or (10); and

(3) $1,000 for a first violation, and $2,500 for a subsequent violation for constructing an individual wastewater system without department approval to construct. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-1, 342D-4, 342D-5, 342D-9, 342D-11, 342D-30, 342D-31, 342D-50) (Imp: HRS §§321-11, 322-1 to 4, 322-8, 342D-2, 342D-4, 342D-5, 342D-9, 342D-11, 342D-18, 342D-30, 342D-31, 342D-50)

3176

§11-62-83 <u>Resolution of field citation.</u> (a) A person issued a field citation may accept the citation by:

(1) Signing the field citation;
(2) Paying the full amount indicated by the field citation. Payment shall be made payable to the "State of Hawaii" by check, cashier's check, money order or as otherwise specified by the director;
(3) Mailing or delivering the signed citation and full payment to the wastewater branch in Honolulu, or the district health office for the county where the violation occurred. The department must receive the signed filed citation and full payment within twenty days after the person receives the field citation; and
(4) Correction within seven days or unless otherwise specified on the field citation any violation of section 11-62-06(f)(6).

(b) By signing the field citation, the person to whom it was issued agrees to:

(1) Give up the person's right to a contested case hearing under chapter 91 or 342D, HRS, or otherwise challenge the field citation;
(2) Pay the amount indicated; and
(3) Correct the violation.

(c) If the field citation is not accepted in compliance with subsection (a), the director may seek for that cited violation any remedies available under this chapter, chapters 321, 322, 342D, HRS, or any other applicable law. For all other violations the director retains authority to seek any available remedies. [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-1, 342D-4, 342D-5, 342D-9, 342D-11, 342D-30, 342D-31, 342D-50) (Imp: HRS §§321-11, 322-1 to 4, 322-8, 322-9, 342D-2, 342D-4, 342D-5, 342D-9, 342D-11, 342D-18, 342D-30, 342D-31, 342D-50, 603-23)

§11-62-84 Form of citation. The department shall prescribe a field citation form." [Eff and comp 12/09/04; am and comp MAR 21 2016] (Auth: HRS §§321-11, 322-8(a), 342D-1, 342D-4, 342D-5) (Imp: HRS §§321-11, 322-1 to 4, 322-8, 342D-2, 342D-4, 342D-5, 342D-9, 342D-18, 342D-31, 342D-50)

3176

Amendments and compilation of chapter 62, title 11, Hawaii Administrative Rules, on the Summary Page dated MAR 21 2016 were adopted on MAR 21 2016 following public hearings held on December 11, 14, 15, 17, 18 and 21, 2015, after public notice was given in the Honolulu Star-Advertiser, Hawaii Tribune-Herald, West Hawaii Today, The Maui News, and The Garden Isle on November 23, 2015.

The adoption of chapter 11-62 shall take effect ten days after filing with the Office of the Lieutenant Governor.

Virginia Pressler
VIRGINA PRESSLER, M.D.
Director of Health

David Y Ige
DAVID Y. IGE
Governor
State of Hawaii

Dated: 2-1-2016

LIEUTENANT GOVERNOR'S OFFICE
'16 MAR 11 A11 :01

Filed

APPROVED AS TO FORM:

Edward G. Bohlen
EDWARD G. BOHLEN
Deputy Attorney General

3176

CHAPTER 11-62 APPENDIX A

INDIVIDUAL PERMIT
STANDARD CONDITIONS

July 1, 2014

Appendix A, Individual standard conditions

1. Duty to comply
2. Compliance with sludge standards
3. Compliance with wastewater effluent standards
4. Compliance with water quality standards
5. Clean Water Act (CWA) penalties
6. Signatory and certification requirement
7. Duty to reapply
8. Need to halt or reduce activity not a defense
9. Duty to mitigate
10. Proper operation and maintenance
11. Permit actions
12. Property rights
13. Duty to provide information
14. Inspection and entry
15. Sampling requirements and definitions
16. Monitoring and recordkeeping
17. Notice requirements
18. Reopener clause
19. Transfers by modification
20. Automatic transfers
21. Minor modification of permits
22. Modification or revocation and reissuance of permits
23. Termination of permits
24. Availability of reports
25. Civil and criminal liability
26. State law
27. Severability

The following conditions apply to individual permits unless otherwise specified. "Permittee" refers to a person to whom an individual permit has been issued.

1. **Duty to comply.** Permittees shall comply with and are subject to §11-62-06(q).

2. **Compliance with sludge standards.** Permittees shall comply with HAR chapter 11-62, subchapter 4.

3. **Compliance with wastewater effluent standards.** Permittees treating wastewater shall comply with §11-62-26 and, if applicable, §11-26-27.

4. **Compliance with water quality standards.** Permittees shall not cause or contribute to any violation of applicable sections of HAR chapter 11-54.

5. **Clean Water Act (CWA) penalties.** The monetary fines and imprisonment terms referred to in 40 CFR §§501.15(b)(3), on CWA §309; 501.15(b)(11)(ii), on false statement, representation, or certification; and §501.15(b)(10), on falsification, tampering with, or rendering inaccurate any monitoring device or method; all apply, in addition to any state penalties.

6. **Signatory and certification requirements.** Each permit application, report, notice, and any information submitted to the director shall be signed and certified as required by §11-62-52.

7. **Duty to reapply.** Permittees shall comply with §11-62-57.04.

8. **Need to halt or reduce activity not a defense.** It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

9. **Duty to mitigate.** Permittees shall comply with §11-62-06(j).

10. **Proper operation and maintenance.** Permittees shall comply with §11-62-06(e).

11. **Permit actions.** This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

12. **Property rights.** This permit does not convey any property rights of any sort, or any exclusive privilege.

13. **Duty to provide information.** The permittee shall furnish to the director, within a reasonable time, any information which the director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The permittee shall also furnish to the director, upon request, copies of records required to be kept by this permit.

14. **Inspection and entry.** The permittee shall allow the director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

    a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

    b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances, parameters, or practices at any location.

15. Sampling requirements.

a. Sampling points. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before final use, disposal, or discharge. Monitoring points shall not be changed without notification to and the approval of the director. No use, disposal, or discharge is authorized which does not totally pass through the final monitoring point.

b. Calibration. The permittee shall periodically calibrate and perform maintenance on all monitoring and analytical equipment used to monitor the pollutants, sludge, and other items specified by the director under this permit, at intervals which will ensure the accuracy of measurements, but no less than the manufacturer's recommended intervals or one year intervals (whichever comes first). [Records of calibration shall be kept pursuant to section 13(b) of this general permit.]

16. Monitoring and recordkeeping.

a. Monitoring results shall be reported at a frequency specified here or elsewhere in the permit, whichever is greater. The frequency of sampling shall be dependent on the size of the wastewater system, nature and effect of the wastewater, reclaimed water, and wastewater sludge use and disposal practices. At a minimum, the frequency shall be as required by §§11-62-26(a), 11-62-26(c), 11-62-28(a), and subchapter 4.

b. Representative sampling. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activities listed in §§11-62-26(a), 11-62-26(c), 11-62-28(a), and subchapter 4.

As used in this section, a representative sample means that the content of the sample shall (1) be identical to the content of the substance sampled at the time of the sampling; (2) accurately represent the monitored item (for example, sampling to monitor final effluent quality shall accurately represent that quality, even though the sampling is done upstream of the discharge point); and (3) accurately represent the monitored item for the monitored time period (for example, sampling to represent monthly average effluent flows shall be taken at times and on days that cover significant variations). Representative sampling may mean including weekends and storms and may mean taking more samples than the minimum number specified elsewhere in the permit. The burden of proving that sampling or monitoring is representative shall be on the permittee.

c. Record retention. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least five (5) years from the date of the sample, measurement, report or application. This period may be extended by request of the director of health at any time.

d. Records' content. Records of monitoring information shall include:
   (1) The date, exact place, and time of sampling or measurements;
   (2) The name of individual(s) who performed the sampling or measurements;
   (3) The date(s) analyses were performed;
   (4) The name of individual(s) who performed the analyses;
   (5) The analytical techniques or methods used and if available, references and written procedures for these techniques or methods; and
   (6) The results of such analyses, including bench sheets, instrument readouts, etc., used to determine these results.

e. Monitoring procedures. Unless other procedures have been specified in this permit, monitoring shall be conducted according to test procedures approved under 40 CFR Part 136 or, in the case of sludge use or disposal, approved under 40 CFR Part 503.

17. Notice requirements.

a. Planned changes. The permittee shall give notice to the director as soon as possible of any planned physical alterations or additions to the permitted facility, or significant changes planned in the permittee's sludge use or disposal practice, where such alterations, additions, or changes may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Anticipated noncompliance. The permittee shall give advance notice to the director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

c. Transfers. This permit is not transferable to any person except after notice to the director. The director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the CWA.

d. Other noncompliance reporting. The permittee shall report all instances of noncompliance. Reports of noncompliance shall if applicable follow the spill protocol of appendix C otherwise shall be submitted with the permittee's next self monitoring report or earlier if requested by the director or if required by an applicable standard for wastewater sludge use or disposal or condition of this permit.

e. Other information. Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the director, it shall promptly submit such facts or information.

18. **Reopener clause.**

a. If the standards for wastewater and wastewater sludge applicable to the permittee's use, disposal, or discharge method are promulgated under the Clean Water Act, the Hawaii Revised Statutes, or the Hawaii Administrative Rules before the expiration date of this permit, and those standards are more stringent than the wastewater or wastewater sludge pollutant limits or acceptable management practices authorized in this permit, or controls a pollutant or practice not limited in this permit, this permit may be promptly modified or revoked and reissued to conform to the standards for wastewater or wastewater sludge use, disposal, or discharge by no later than the compliance deadline specified in the regulations establishing those standards, whether or not this permit has been modified or revoked and reissued.

b. This permit shall be modified or revoked and reissued at any time if, on the basis of any new data, the director determines that continued wastewater or wastewater sludge use, disposal, or discharge may cause unreasonable degradation of the environment.

c. The permittee shall comply with new standards for wastewater sludge use or disposal adopted in 40 CFR 503 during the term of the permit, if they are more stringent than the terms of the permit and chapter 11-62, even if this permit has not yet been modified to incorporate the standards.

19. **Transfers by modification.** Except as provided in condition 20 of these standard conditions, a permit may be transferred by the permittee to a new owner or operator only if the permit has been modified or revoked and reissued to identify the new permittee and incorporate such other requirements as may be necessary to assure compliance with the CWA.

20. **Automatic transfers.** As an alternative to transfers under condition 19 of these standard conditions, the director may authorize automatic transfer of any permit issued under this rule to a new permittee if:

    a. The current permittee notifies the director at least 30 days in advance of the proposed transfer date in condition 20.c. of these standard conditions;

    b. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and

    c. The director does not notify the existing permittee and the proposed new permittee of the director's intent to modify or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement of condition 20.b of these standard conditions.

21. **Minor modification of permits.** Upon the consent of the permittee, the director may modify a permit to make the corrections or allowances for changes in the permitted activity listed in this section without following the procedures of §11-62-57.02. Any permit modification not processed as a minor modification under this section must be made for cause and with draft permit and

public notice as required. Minor modifications may only:

a. Correct typographical errors;

b. Require more frequent monitoring or reporting by the permittee;

c. Change an interim compliance date in a schedule of compliance, provided the new date is not more than 120 days after the date specified in the existing permit and does not interfere with attainment of the final compliance date requirement; and

d. Allow for a change in ownership or operational control of a facility where the director determines that no other change in the permit is necessary, provided that a written agreement containing a specific date for transfer of permit responsibility, coverage, and liability between the current and new permittee has been submitted to the director.

22. **Modification or revocation and reissuance of permits.** Permittees shall comply with and are subject to §11-62-57.02, except for minor modifications.

23. **Termination of permits.** Permittees are subject to §11-62-57.03 and general permittees are also subject to §11-62-55.03.

24. **Availability of reports.** Except for data determined to be confidential under HRS §342D-14, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the director. As required by this rule, permit applications, permits, and effluent and wastewater sludge data shall not be considered confidential.

25. **Civil and criminal liability.** Nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

26. **State law.** Nothing in this permit shall be constructed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation.

27. **Severability.** The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, if held invalid, the application of such provision to other circumstances, and remainder of this permit, shall not be affected thereby.

CHAPTER 11-62 APPENDIX B

**RESPONSES FOR WASTEWATER
SPILLS, OVERFLOWS, AND DISCHARGES
("SPILLS")**

July 1, 2014

Table of contents

CHAPTER 11-62 APPENDIX B

1. Points of contact

Agency	Phone	Fax
Clean Water Branch (CWB)	586-4309	586-4352
Wastewater Branch (WWB)	586-4294	586-4352
Environmental Health Programs (EHP)		
Hawaii District Health Office	933-4371	933-4669
Kauai District Health Office	241-3323	241-3480
Maui District Health Office	984-8234	984-8237
State Hospital Operator (SHO)	247-2191	
Communications Office		586-4444

2. Spills from any facility into state waters, excluding R-1 water from recycled water systems

a. Applicability. Any wastewater spill which enters into state waters from a public or private wastewater system.
   (1) "State waters" has the meaning defined in HRS section 341-D, and includes drainage ditches, whether or not water is always flowing in them.
   (2) Exclusion. Spill of R-1 water covered by Appendix J to HAR chapter 11-5, "NPDES General Permit Authorizing Discharges of R-1 Water from Recycled Water Systems". That general permit does not cover spills from treatment works.

b. Immediate notice to DOH. If a spill occurs during working hours:
   (1) The wastewater system owner or its agent (owner/agent) shall immediately notify the CWB of any spill into state waters; and
   (2) If a spill occurs on the neighbor islands, the owner/agent shall also immediately notify their respective

district environmental health program chief.

If a spill occurs during non-working hours:
(1) Contact the state hospital operator; and
(2) The next working day notify the CWB and the respective district EHP chief with a follow-up call.

c. Press Release. The owner/agent shall immediately send out a press release for spills of a thousand gallons or more and for lesser spills if they present a substantial threat to public health. A press release shall comply with section 7. A press release is not required if the owner/agent demonstrates that the spill was of R-1 water and that BMPs as approved by the director were implemented.

d. Disinfection. The owner/agent shall disinfect wastewater which is continuously being spilled into nearshore waters if sufficient disinfection contact time is available. Best judgment should be used in determining the amount of chlorine added to the discharge if chlorine is used as a disinfectant. Disinfection is not required if the owner/agent demonstrates that the spill was either R-1 or R-2 water and that BMPs as approved by the director were implemented.

e. Warning signs. The owner/agent shall immediately post warning signs in the area(s) likely to be affected by the spill and where public access is possible. Posting of warning signs is not required if the owner/agent demonstrates that the spill was of R-1 water and that BMPs as approved by the director were implemented.

The director shall also assure that a sufficient number of warning signs have been posted and the locations are adequate. Authorization to remove the signs shall also come from the director.

f. Monitoring. The owner/agent shall conduct bacterial monitoring for any spill greater than 100 gallons or when public health may be threatened in accordance with section 8. Monitoring is not required if the owner/agent demonstrates that the spill was R-1 water and that BMPs as approved by the director were implemented.

g. Reporting. The owner/agent shall report to the CWB under section 9.a.

3. Spills into state waters of R-1 water from recycled water systems

a. Applicability. Any spills of R-1 water covered by Appendix J to HAR chapter 11-55, "NPDES General Permit Authorizing Discharges of R-1 Water from Recycled Water Systems."
   (1) "State waters" has the same meaning defined in HRS section 342D-1, and includes drainage ditches, whether or not water is always flowing in them.
   (2) Exclusion. The general permit does not cover spills from treatment works.

b. Requirements. Among other things, the general permit requires filing a Notice of Intent before any discharge, compliance with standard conditions in appendix A of chapter 11-55, implementation of best management practices (BMPs), monitoring of discharges, avoiding violations of water quality criteria, and specified reporting. The full statement of requirements appears in the general permit.

4. Spills to ground only - with public access

a. Applicability. Any wastewater spill from a wastewater system onto the ground and that does not enter state waters but is in an area which is or may be accessible to the public.

(1) In this appendix, the public includes hotel, apartment, and condominium residents and guests, or condominium apartment owners at their own condominium, and management personnel and building or facility staff, unless the person is specifically an operator of the wastewater system or a manager of the property.

(2) In this appendix, areas inaccessible to the public include areas:

(a) Confined within a fenced or walled (six foot high with locked gate or door) area; and

(b) Contact with the spill is limited to wastewater system operating personnel and management personnel for the property owner or lessee.

(3) Exclusion. Spills of R-1 water provided the owner/agent demonstrates that the spill was of R-1 water and that BMPs as approved by the director were implemented.

b. Immediate notice to DOH. If a spill of a thousand gallons or more occurs during working hours:

(1) On Oahu, the wastewater system owner/agent shall immediately notify the WWB; or
(2) On the neighbor islands, the owner/agent shall immediately notify their respective district EHP chief.

If a spill of a thousand gallons or more occurs during non-working hours:
(1) Contact the state hospital operator; and
(2) The next working day notify the WWB or on the neighbor islands, the respective district EHP chief with a follow-up call.

c. Press release. The owner/agent shall immediately send out a press release for spills of a thousand gallons or more, and for lesser spills if they present a substantial threat to public health. A press release shall comply with section 7.

d. Disinfection. The owner/agent shall disinfect the wastewater that is spilled onto the ground if the wastewater remains ponded on the ground for any sufficient length of time or if the discharge continues for any significant duration. Disinfection is not required if the owner/agent demonstrates that the spill was R-2 water and that BMPs as approved by the director were implemented.

e. Warning signs. The owner/agent shall immediately post warning signs in the vicinity of the spill area.

f. Clean up. All spill sites shall be cleared of all debris and standing wastewater, and disinfected pursuant to section 4.d.

In areas containing standing wastewater which cannot be removed, the owner/agent shall limit public access by having barricades or other means.

g. Reporting. The owner/agent of a public or private wastewater system shall report to the WWB as follows:
   (1) For spills of a thousand gallons or more, the owner/agent shall report to the WWB under section 9.a.
   (2) For spills less than a thousand gallons, immediate notice and reporting are not required. A tabulated summary of all spills less than a thousand gallons each shall be submitted to the WWB on a quarterly basis in accordance with section 9.b.
   (3) Exfiltration. Reporting of leaks or breaks in pipelines discovered during inflow/infiltration repair work is not required. These situations are considered exfiltration.

5. Spills to ground only - with no public access

a. Applicability. All wastewater spills from any public or private wastewater system that does not enter state waters and are in areas inaccessible to the public.
   (1) The public and inaccessibility are described in section 4.a.
   (2) Exclusion. Spills of R-1 water provided the owner/agent demonstrates the spill was of R-1 water and that BMPs as approved by the director were implemented.

b. Immediate notice to DOH. If a spill of a thousand gallons or more, and for spills over 50 gallons occurring more than twice within a 12 month, from the same cause and/or location, period within the confines or fence line of a wastewater system, the owner/agent shall notify the WWB within 24 hours.

c. Reporting. For spills of a thousand gallons or more, and for spills over 50 gallons occurring more than twice within a 12 month period, from the same cause and/or location, within the confines or fence line of a wastewater system, the owner/agent shall report to the WWB under section 9.a.

d. Recording. The owner/agent shall record and tabulate the date and time of the spill, the amount released, the cause(s) for the spill, clean up efforts, and remedial actions taken to prevent future spills for all spills greater than 50 gallons as they happen. The owner/agent shall keep the records and tabulations on site and make the records and tabulation available to the director for inspection and copying.

6. Spills to ground only - R-1 and RO water only

a. Applicability. Spills of R-1 or RO water provided the owner/agent demonstrates the spill was of R-1 or RO water and that BMPs as approved by the director were implemented.

b. Notice to DOH.
   (1) For spills of a thousand gallons or more occurs, the wastewater system owner/agent shall notify the WWB at least by phone by the end of the next working day. The notice shall provide the information required by section 6.d(1), below.
   (2) For spills of less than a thousand gallons, but more than fifty gallons, next day notice is not required, but the wastewater system owner/agent shall record the information and report as required by section 6.d.

c. Warning signs. For spills greater than fifty gallons, the owner/agent shall immediately post warning signs in the vicinity of the spill area.

d. Reporting. The owner/agent of a wastewater system shall report in writing to the WWB as follows:
   (1) Information of each spill shall include at least the spill's date, time, location, quantity, the reason for the spill, and any corrective action.
   (2) For spills more than fifty gallons, a tabulated summary shall be submitted to the WWB each year with the summary report required by section 11-62-28.

7. Press release

The press release shall describe the location of the spill, the amount of wastewater released, what caused the spill, and what is being done to correct the situation. Also, include a contact person and telephone number (including an after hours/weekend contact). At a minimum, the press release shall be faxed, emailed or telephoned to the following:

a. Associated Press (for radio dissemination);
b. Major statewide and island newspapers;
c. Major television news stations;
d. Department of Health, Communications Office, Oahu
e. CWB if into state waters, otherwise WWB; and
f. For neighbor island spills, also include faxing the press release to the respective island DHOs.

8. Monitoring of state waters

Monitoring shall begin as soon as possible and be conducted in the receiving water area affected by the spill. Bacterial monitoring is not required if the owner/agent demonstrates that the spill was of R-1 water and that BMPs as approved by the director were implemented.

For spills entering fresh or brackish waters, the bacterial monitoring shall consist of sampling for the following indicator organisms:

a. Enterococci; and
b. Clostridium perfringens.

For spills entering marine waters, the bacterial monitoring shall consist of sampling for the following indicator organisms:

a. Enterococci; and
b. Clostridium perfringens.

Results of the bacterial monitoring shall be submitted to the director in care of the CWB immediately. Monitoring shall continue until notification to stop is received from the director. With the approval of the director, on a case by case situation, some protocol requirements such as sampling or sign posting may be waived.

The director shall also be informed of the sampling stations and may modify the number of stations and site selection.

The director may require additional bacterial monitoring by the owner/agent to supplement their existing monitoring program, as may be necessary or appropriate.

9. Reporting

a. When required above, the owner/agent shall submit a written report of the details of the spill within five (5) working days of the incident to the director in care of the CWB or WWB as applicable. The director may waive the five day written reporting requirement on a case by case basis provided that the director receives a request for waiver prior to the due date of the report.

The report shall include the date and time of the spill, the amount released, the cause(s) of the spill, location where the spill entered state waters (storm drains, ditches, streams, etc.), clean up efforts, remedial actions to prevent future spills, a summary of the monitoring data, a map of the sampling locations and public notification procedures if applicable.

b. For spills not reported under section 9.a. and when required above, the owner/agent shall tabulate the following information: the date and time of the spill, the amount released, the cause(s) for the spill, clean up efforts, and remedial actions taken to prevent future spills. The owner/agent shall submit each quarter's tabulation to the WWB within 30 days after the quarter.

10. Modifications by the director

With the approval or under the direction of the director, response requirements may be increased, changed, reduced, or eliminated. For example, the director may require the owner/agent to post additional Warning Signs as needed or may assist in the removal of warning signs.

CHAPTER 11-62 APPENDIX C

FALLING HEAD TEST PROCEDURE

July 1, 2014

A. Preparing Percolation Test Hole(s)
   1. Dig or bore a hole, four to twelve inches in diameter with vertical walls to the approximate depth of the soil absorption system (bottom of trench or bed).
   2. Scratch the side wall and bottom to remove any smeared soil and remove loose material.
   3. Place one inch of coarse sand or gravel on bottom to protect bottom from scouring action when the water is added.

B. Determine Percolation Rate
   1. If soil is mostly clay, go to step D.
   2. Place twelve inches of water in hole and determine time to seep away. Record this time on the site evaluation form.
   3. Repeat step B.2. above. Also record this time on the site evaluation form.
   4. If the time of the second test is less than ten minutes go to step C, if not skip to step D.

C. Sandy (granular) Soils
   1. Establish a fixed reference point, add water to six inches above gravel and measure water level drops every ten minutes for 1 hour.
   2. Use a shorter time interval if first six inches seeps away in ten minutes or less.
   3. After each measurement, the water level is readjusted to the six inch level. At no time during the test is the water level allowed to rise more than the six inches above the gravel.
   4. Record time intervals and water drops on site evaluation form.
   5. Use final water level drop interval to calculate percolation rate. (step F)

D. Other soils (non-granular, e.g. silt, loams and clays)
   1. Maintain at least twelve inches of water in the hole for at least four hours to presoak soil.
   2. Do not remove water remaining after four hours.
   3. Permit soil to swell at least twelve hours. (Dry clayey soils should be soaked and permitted to swell for longer periods to obtain stabilized percolation rates).
   4. After swelling, remove loose material on top of gravel.
   5. Use fixed reference point, adjust water level to six inches above gravel and measure water level drop.
   6. If the first six inches of water seeps away in less than thirty minutes, measure water level drops every ten-minutes and run for one hour.
   7. If the first six inches of water takes longer than thirty minutes to seeps away, use thirty minute time intervals for four hours or until two successive drops do not vary by more than one-sixteenth inch (stabilized rate).
   8. After each measurement, the water level is readjusted to the six inch level. At no time during the test is the water level allowed to rise more than the six inches above the gravel.
   9. Record time intervals and water drops on site evaluation form.
   10. Use final water level drop interval to calculate percolation rate. (step F)

F. Use final drop interval to calculate percolation rate and record on site evaluation form:

$$\frac{\text{Time Interval}}{\text{Water Level Drop}} = \text{Perc rate}$$

13176

CHAPTER 11-62 APPENDIX D - TABLES

TABLE I
July 1, 2014

Type of Establishment	Gallons Per Person Per Day (Unless Otherwise Noted)
Airports (per passenger)	5
Camps:	
Campground with central comfort stations	32
With flush toilets, no showers	25
Construction camps (semi-permanent)	50
Day camps (no meals served)	15
Resort camps (night and day) with limited plumbing	50
Luxury camps	100
Church	
With kitchen	10
Without kitchen	5
Cottages and small dwellings with seasonal occupancy (2 persons per bedroom minimum)	100
Country clubs (per resident member)	100
Country clubs (per non-resident member present)	25
Dentist per chair	200
Doctor per patient	5
Dwelling (2 persons per bedroom minimum)	100
Factories (gallons per person, per shift, exclusive of industrial waste)	35
Hair salons and barber shops,	
Barber shops (per chair)	50
Beauty salons (per chair)	125
Hospitals (per bed space)	250
Hotels with private baths (2 person per bedroom minimum)	100
Institutions other than hospitals (per bed space)	125
Laundries, self-service (per machine)	300
Mobile home parks (per space)	250
Motels with bath, toilet, and kitchen waste (per bed space)	60
Picnic parks (toilets wastes only) (per picnicker)	5
Picnic parks with bathhouses, showers, and flush toilets	50
Restaurants	
Per day per seat	50
Per meal without public restrooms	5
Per meal served with toilets	10
Additional kitchen wastes per take out meals	3
Additional for bars and cocktail lounges, per seat	15
Schools:	
Boarding	100
Day, without gyms, cafeteria, or showers	15
Day, with gyms, cafeteria, and showers	25
Day, with cafeteria, but without gyms or showers	20
Service station (per vehicle served)	10
Swimming pools and bathhouses	10
Theaters:	
Movie (per auditorium seat)	5
Drive-in (per car space)	5
Workers (in addition to above):	
Construction (at semi-permanent camps)	50
Day, at schools and offices (per shift)	20
Employee (per shift)	20

TABLE II
July 1, 2014

Minimum Horizontal Distance From	Cesspool (ft)	Treatment Unit (ft)	Seepage Pit (ft)	Soil Absorption System (ft)
Wall line of any structure or building	5	5	5	5
Property line	9	5	9	5
Stream, the ocean at the shoreline certification, pond, lake, or other surface water body	50	50	50	50
Large trees	10	5	10	10
Treatment unit	5	5	5	5
Seepage pit	18	5	12	5
Cesspool	18	5	18	5
Soil absorption system	5	5	5	5
Potable water sources serving public water systems	1000	500	1000	1000

TABLE III
July 1, 2014

Percolation Rate (min/inch) Less than or equal to	Required Absorption Area (ft2/bedroom or 200 gallons)	Percolation Rate (min/inch) Less than or equal to	Required Absorption Area (ft2/bedroom or 200 gallons)
1	70	31	253
2	85	32	257
3	100	33	260
4	115	34	263
5	125	35	267
6	133	36	270
7	141	37	273
8	149	38	277
9	157	39	280
10	165	40	283
11	170	41	287
12	175	42	290
13	180	43	293
14	185	44	297
15	190	45	300
16	194	46	302
17	198	47	304
18	202	48	306
19	206	49	308
20	210	50	310
21	214	51	312
22	218	52	314
23	222	53	316
24	226	54	318
25	230	55	320
26	234	56	322
27	238	57	324
28	242	58	326
29	246	59	328
30	250	60	330

TABLE IV
July 1, 2014

Pollutant	Pollutant Ceiling Concentration Limit (dry weight basis, mg/kg)
Arsenic	20
Cadmium	15
Chromium	200
Copper	1500
Lead	300
Mercury	10
Molybdenum	25
Nickel	420
Selenium	25
Zinc	2000

TABLE V
July 1, 2014

Amount of Wastewater Sludge (Metric Ton per 365 day period, dry weight basis)	Frequency
Greater than zero but less than 290	Once per year
Equal to or greater than 290 but less than 1500	Once per quarter
Equal to or greater than 1500 but less than 15,000	Once per 60 days
Equal to or greater than 15,000	Once per month
Amount of Wastewater Sludge (English Ton per 365 day period, dry weight basis)	Frequency
Greater than zero but less than 320	Once per year
Equal to or greater than 320 but less than 1650	Once per quarter
Equal to or greater than 1650 but less than 16,500	Once per 60 days
Equal to or greater than 16,500	Once per month

TABLE VI
July 1, 2014

Horizontal Distance From	Feet
Waters of the United States, state waters, the ocean at the vegetation line, or any other surface water body	50
Property line	50
Occupied building or dwelling	500
Potable water source serving public water systems	1000

TABLE VII
July 1, 2014

Pollutant	Pollutant Ceiling Concentration Limit (dry weight basis, mg/kg)
Arsenic	20
Chromium	200
Nickel	420

13176

CHAPTER 11-62 APPENDIX E

CHAPTER 11-62 FORM A
CERTIFICATION FORM - LAND APPLICATION
July 1, 2014

Instructions:

1. Each form must be signed and dated to be valid.
2. The certifier shall print or type his name below the signature line and print or type the certifier's title, if any, where indicated.
3. When the certifier checks a box or fills in a line other than the signature or date lines, the certifier shall initial below the check or the line, unless the certifier uses preprinted versions of the form which delete the boxes and lines which must be initialed.

[ ] For preparers only, I certify, under penalty of law, that:

[ ] 1. The pollutant concentration ceiling limits in Table IV of chapter 11-62, HAR have been met.

[ ] 2. The following pathogen requirements have been met:

[ ] a. The Class A pathogen requirements of §11-62-46(a), HAR, specifically §11-62-46(a) (_____); or

[ ] b. The Class B pathogen requirements of 40 CFR §503.32 (b),specifically §503.32(b) (_______) and notification each land owner and land applier of wastewater sludge which I have prepared, of the spacing and site restrictions in §11-62-43(g), HAR; and the

13176

management requirements in §11-62-43(h), HAR.

[ ] 3. Vector attraction reduction:

[ ] a. One of the vector attraction reduction requirements in 40 CFR §503.33(b) (1) through (8), has been met, specifically §503.33(b) (____); or

[ ] b. I have not met the one of the requirements of 40 CFR §503.33(b) (1) through (b) (8), and I informed the land applier and the owner of the land application site that one of the vector attraction reduction requirements in 40 CFR §503.33(b) (9) or (b) (10) must be met;

[ ] For appliers of wastewater sludge only, I certify, under penalty of law, that:

[ ] 4. One of the vector attraction reduction requirements in 40 CFR §503.33(b) (9) or (b) (10) has been met, specifically §503.33(b) (____);

[ ] 5. The spacing and site restrictions in §11-62-43(g) have been met; and

[ ] 6. The management requirements in §11-62-43(h), HAR have been met.

[ ] For appliers of septage only, I certify, under penalty of law, that:

[ ] 7. One of the pathogen requirements in 40 CFR §503.32(c) (1) or (c) (2) has been met, specifically §503.32(c) (____);

3176

[ ] 8. One of the vector attraction reduction requirements in 40 CFR §503.33(b) (9), (b) (10), or (b) (12) has been met, specifically §503.33(b) (____);

[ ] 9. The spacing and site restrictions in §11-62-44(g), HAR have been met; and

[ ] 10. The management requirements in §11-62-44(h), HAR have been met.

I certify, under penalty of law, that the information that will be used to determine compliance with the foregoing requirements was prepared under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate this information. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment.

____________________ ____________________________

Date Name

Title:______________________

Hawai'i State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 4
EVALUATION OF DECENTRALIZED CLUSTER WASTEWATER SYSTEMS

FINAL | November 2020

carollo
in association with
College of ENGINEERING
UNIVERSITY OF HAWAI'I AT MĀNOA

Hawaiʻi State Department of Health
Cesspool Conversion Technology Research

Technical Memorandum 4
EVALUATION OF DECENTRALIZED CLUSTER WASTEWATER SYSTEMS

FINAL | November 2020

CARI K. ISHIDA
LICENSED PROFESSIONAL ENGINEER
No. 14977
HAWAII U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION.
SIGNATURE 04/30/2022 EXPIRATION DATE OF THE LICENSE

ROGER W. BABCOCK, JR.
LICENSED PROFESSIONAL ENGINEER
No. 12133-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
SIGNATURE 04/30/2022 EXPIRATION DATE OF THE LICENSE

Contents

Appendices

Tables

Figures

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Abbreviations

ABS	absorption trench/bed
BOD	biochemical oxygen demand
Carollo	Carollo Engineers, Inc.
CAS	conventional activated sludge
CCTV	closed circuit television
CCWG	Cesspool Conversion Working Group
CW	constructed wetland
DO	dissolved oxygen
DOH	Department of Health
DRIP	high-pressure drip irrigation
EAAS	extended aeration activated sludge
EPA or US EPA	US Environmental Protection Agency
ET	evapotranspiration
ETI	evapotranspiration-infiltration
FOG	fats, oils, and grease
fps	feet per second
ft	feet
GP	grinder pumps
gpd	gallons per day
GS	gravity sewers
H	high maintenance
HAR	Hawaiʻi Administrative Rules
HRT	hydraulic retention time
L	low maintenance
LPP	low-pressure pipe
LPS	low-pressure sewers
M	moderate maintenance
MBBR	moving bed biofilm reactor
MBR	membrane bioreactor
MG	million gallons
mgd	million gallons per day
mg/L	milligrams per liter
mL	milliliter
MLSS	mixed liquor suspended solids
N	no maintenance
NTU	Nephelometric Turbidity Units

O&M	Operations and Maintenance
OSWT	onsite wastewater treatment and disposal system
RAS	return activated sludge
SAT	soil aquifer treatment
sf	square foot (feet)
STEP	septic tank effluent pumping
TDS	total dissolved solids
TM04	Technical Memorandum 4
TSS	total suspended solids
TXF	textile filter
UIC	underground injection control
UV	ultraviolet light
WERF	Water Environment Research Foundation
WSSC	Washington Suburban Sanitary Commission
WWB	Wastewater Branch
WWTP	wastewater treatment plant

Technical Memorandum 4

EVALUATION OF DECENTRALIZED CLUSTER WASTEWATER SYSTEMS

4.1 Executive Summary

Hawaiʻi's Act 125 requires the upgrade of all 88,000 existing residential cesspools by the year 2050. As a result, it is expected that cesspools will be replaced either by onsite wastewater treatment (OSWT) and disposal systems located on individual properties or connection to sewers and offsite wastewater treatment facilities. Connections to centralized sewers are feasible for some, but not all cesspools. Most cesspools are not located within a reasonable distance of an existing sewer system and expanding the centralized sewer system can be infeasible and cost prohibitive.

In some cases where several cesspools are in proximity, it may be feasible to construct small-scale, decentralized cluster wastewater systems for a number of homes on a neighborhood level. These systems will require wastewater collection, treatment, and disposal. The purpose of this technical memorandum (TM04) is to summarize the evaluation and comparison of the technologies available for decentralized or cluster systems in Hawaiʻi. The cluster systems evaluated were limited to those that can collect and treat domestic wastewater from 10 to 100 homes or capacities of approximately 5,000 to 50,000 gallons per day (gpd).

This evaluation of decentralized cluster system components includes collection, treatment, and disposal technologies. Table ES.1 summarizes the technologies evaluated. Data and information for were gathered from previous studies, technical literature, vendor websites, and other publicly available resources. This study was limited to common and accepted technologies available in the wastewater industry, with a focus on those treatment technologies that are available in "package plant" configurations. Package wastewater treatment plants typically use proven technologies, are easily transported and installed, and generally have a small footprint. Collection and disposal systems are not configured as pre-engineered package units and must be customized to each site.

The cluster system technologies were evaluated by several criteria that can be grouped into the following categories:

- Benefits and challenges involved with implementation.
- Operation and maintenance (O&M) requirements.
- Land requirements for treatment and disposal systems.
- Construction, O&M, and 60-year life-cycle costs.

Costs were adapted from a 2010 study conducted by Water Environment Research Foundation (WERF) (see Appendix C). These costs should only be used for relative comparison purposes. Similar to OSWT and disposal systems, a more detailed, site-specific engineering evaluation is necessary to gain a better grasp of potential conversion costs for decentralized cluster systems. A comparison of conversions to individual OSWT versus decentralized cluster system conversions can facilitate homeowner's decision processes.

Decentralized cluster wastewater systems may make sense to convert several cesspools that have a high density, are within high priority areas, and where there is community support for this kind of a solution. The benefits of implementing cluster systems, where feasible include:

- **Potential for rapid conversions.** The use of cluster systems may allow the conversion of a greater number of cesspools at a single point in time. This could help to mitigate the public health and environmental risks in high priority areas in the near term.
- **Reducing the administrative oversight and enforcement burden on state/county agencies.** For the county/state, having all systems converted on an individual basis is a much larger task than having decentralized cluster systems. Just in terms of sheer numbers of permitted units, it could reduce the number by orders of magnitude (e.g. instead of 88,000 individual units; 880 to 8,800 cluster systems).
- **Reduce the burden on individual homeowners to hire engineers and contractors independently to design and construct onsite systems.** A coordinated, organized effort to evaluate a cluster system for a neighborhood would relieve the burden on individual homeowners to understand and determine their cesspool upgrade needs.
- **Ensure proper operations and ongoing maintenance of the systems by requiring a licensed wastewater operator.** Cluster systems are regulated and inspected by the State of Hawaiʻi Department of Health (DOH) Wastewater Branch (WWB) the same manner as existing wastewater treatment plants (WWTPs). The rules and procedures are already in place, including the requirement that state-licensed WWTP operators oversee the cluster systems. This is more likely to ensure that systems are inspected, operated, maintained, repaired, and function as required to meet the treatment and disposal regulations.
- **Potentially broaden the range of funding opportunities.** One of the hurdles in funding cesspool conversions is that many existing funding options require a conduit agency or intermediate party to manage and administer available grant or low interest loan funds to individual homeowners for cesspool conversions. Given that decentralized systems will need to be managed and operated by a third party, this also opens the door for more funding options. In addition, if water reuse is a disposal option for the decentralized system, there are additional funding opportunities that may apply. Water reuse is not allowed for onsite systems; thus, those funding opportunities would not be available.

The challenges to implementing cluster systems for cesspool conversions in Hawaiʻi include:

- **Need for neighborhood-level coordination.** One of the greatest hurdles to implementing decentralized solutions for cesspool conversions is that a group of homeowners would need to take the initiative to form an association or district to collect fees and procure various professional and construction-related services. To truly evaluate the feasibility of decentralized systems for certain neighborhoods, a licensed engineer needs to perform a site-specific analysis and develop costs for a recommended system. Legislative measures may be necessary to facilitate neighborhood-level coordination especially if participation will be required of homeowners.
- **Cost.** Decentralized cluster systems require higher up-front planning and design fees and have higher construction costs than OSWT and disposal systems. A site-specific analysis is necessary to evaluate the feasibility and best overall system options for a neighborhood. The engineering evaluation could be quite expensive – easily 5 to 10 times the cost of an onsite design for a single homeowner. In addition, the construction would be more extensive than onsite systems, and construction costs would accordingly be higher on a per lot basis.

- **Need for skilled operators.** Licensed wastewater operations professionals would be required to operate and maintain the cluster system components in perpetuity.
- **Land/space requirement.** Decentralized systems would likely need to be constructed on newly acquired land and may require easements. These cluster systems would only be a viable option if the required land is available.

A countywide or statewide study of potential neighborhoods/sites for cluster systems with an initial focus on priority areas, including planning level cost estimates could facilitate this process. Such a study could help the state to evaluate and upgrade those cesspools deemed to pose the greatest risks to public health and the environment more rapidly. The information provided within this TM can help to facilitate future studies and evaluations of decentralized cluster wastewater systems by licensed engineers.

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Table ES.1 Summary of Benefits, Challenges, and Operation and Maintenance Requirements for Decentralized Cluster Systems

Technology[(1)]	Benefits	Challenges	Technology Status	Replace Interval (year)	O&M Effort[(2)]	O&M Requirements[(3)]
Collection System Options						
Gravity Sewers (GSs)	• Can handle grit and other solids, as well as large volumes of flow. • Does not require onsite treatment or storage of the household wastewater before it is discharged. • Little impact to homeowners and their properties. • Presents a viable option if there is an appropriate difference in elevation. • No electricity for pumping and no pump maintenance.	• Flat or large variations in terrain can increase costs • Larger pipes compared to other collection system options. • Prone to clogging. • Manholes associated with gravity sewers are a potential source of inflow and infiltration. • Higher capital costs.	Most common, highly developed	60	L	• Inspect on a regular schedule, this can be accomplished via surface inspections of manholes, lowering hand-held camera or robotic CCTV. • Proactively flush accumulated debris and fats, oils, and grease (FOG). • Remove blockages and tree roots as required.
Liquid-Only Pressure Sewers	• Independent from land topography restrictions. • The septic tank retains most of the FOG and solids reducing clogging problems. • Septic tanks have storage capacity to operate during power outages. • Smaller pipes compared to conventional gravity sewers. • Can be installed at a shallow depth and do not require a minimum flow velocity or slope to function.	• Requires an onsite septic tank and pump on each property. • Grease and sludge must be pumped from each individual septic tank. • Anaerobic septic tanks can generate odors and methane gas. • Leaks pose a risk of wastewater exfiltration. • Pumps and filters must be maintained.	Highly developed	Pump - 20 Septic tank - 60 Piping - 60	M	• Provide/maintain electricity to each unit. • Inspect and clean filter on pump monthly. • Periodically remove accumulated sludge and scum from septic tank. • Remove any blockages in the pressure pipe network.
Low-Pressure Sewers	• Small diameter piping, shallow, easily installed. • Independent from land topography restrictions. • No manholes required and no storm water infiltration. • Less clogging and subsequent O&M cleaning or flushing.	• Requires pump/vault installation on each property. • Requires an energy source for the grinder pumps. • Pumps must be maintained on each property.	Highly developed	Pump - 20 Piping - 60	M	• Provide/maintain electricity to each unit. • Inspect pump and chamber on a regular basis, remove any accumulated materials. • Inspect and maintain backflow preventers. • Remove any blockages in the pressure pipe network.
Vacuum Sewers	• Small diameter piping, shallow, easily installed. • No manholes required and no storm water infiltration. • Closed system with no exfiltration or odors. • Flexible installations regardless of topography and water availability.	• Requires construction of vacuum equipment at each home. Requires land for central vacuum stations • Economic feasibility depends on the number of homes served by the system (the more the better). • Requires energy to create the permanent vacuum. • Vacuum stations require regular O&M checks, typically higher O&M than gravity collection systems.	Uncommon, Highly developed	Pumps - 20 Equipment - 20 Piping - 60	H	• Provide/maintain electricity to each unit and vacuum station. • Regular pressure/vacuum testing. • Vacuum stations require regular O&M checks • Remove any blockages in the pressure pipe network.

Technology(1)	Benefits	Challenges	Technology Status	Replace Interval (year)	O&M Effort(2)	O&M Requirements(3)
Treatment System Options						
Conventional Activated Sludge	• High BOD and nitrogen removal, high effluent quality, self-sustaining system. • Small land area requirement. • Free from fly and odor nuisance. • Can be modified to meet specific discharge limits.	• High electricity consumption and costly mechanical parts. • Requires skilled operation and maintenance. • Requires expert design and construction. • Bulking and biological surface foaming.	Most common, highly developed	30	M	• Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Extended Aeration Activated Sludge	• Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels. • Long HRT and complete mixing, minimal impact of a shock load or hydraulic surge. • Produces less sludge due to extended retention of biological solids in the aeration tank.	• Higher energy uses due to longer aeration time. • Larger footprint than CAS. • Less flexibility than CAS should regulations for effluent requirements change.	Most common, highly developed	30	M	• Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Membrane Bioreactor Activated Sludge	• Secondary clarifiers and tertiary filtration processes are eliminated, thereby reducing plant footprint. • High quality effluent.	• Membrane complexity and fouling. • Higher capital, operation, and energy costs. • Hydraulic flow peak capacity is limited to 1.8 times average flows and only for short periods.	Highly developed	30	M	• Maintenance includes chemical cleaning of membranes. • Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Textile Filter (Attached Growth Systems)	• Can operate at a range of organic and hydraulic loads. • Lower energy input than CAS. • Low sludge production.	• Requires expert design, construction, operation and maintenance. • Some variations have larger footprints. • Risk of clogging, depending on pre and primary treatment.	Highly developed	30	L	• Monitoring of influent and effluent. • Maintenance of all equipment following manufacturer's recommendations. • Optimum dosing rates and flushing frequency are determined from the field operation. • The packing should also be kept moist which can be problematic at night or during power failures. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • The sludge that accumulates on the filter must be periodically washed away to prevent clogging and to keep the biofilm thin and aerobic.

Technology[1]	Benefits	Challenges	Technology Status	Replace Interval (year)	O&M Effort[2]	O&M Requirements[3]
Moving Bed Biofilm Reactor	• Efficient treatment, low HRT, flexibility to adapt to fluctuating hydraulic and organic loads. • Low Maintenance. • Very compact, due to the maximized surface area the media provide for biofilm growth.	• High-tech system. • Higher capital and operating costs. • Carriers can wash out of the system, necessitating supplemental additions.	Uncommon, Highly developed	30	H	• Monitoring of influent and effluent. • Maintenance of all equipment following manufacturer's recommendations. • Observation of media color and adjustment of air. • Monitoring and adjustment of dissolved air flotation units. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Operators must take samples periodically and analyze them to ensure the bacteria on the carriers are still thriving.
Constructed Wetland	• Simple, easily operated natural system. • Inexpensive compared to other treatment options. • Requires little energy when the system operates with gravity flow.	• Large land requirement. • Not available as a package facility. • Vector and odor nuisances.	Uncommon, Highly developed	30	L	• Vector control to prevent population growth of insects and odor control. • Occasional maintenance of the vegetation promotes growth of desired vegetation and maintains hydraulic capacity. • Monitoring of influent and effluent.
Effluent Disposal Options						
Absorption Trench/Bed	• Common type of disposal system so there are many products available and experience with installation. • When deployed downstream from an aerobic treatment system, it provides some treatment for BOD, TSS, and fecal coliform. • No power is required, and maintenance is generally not necessary. • Graveless dome systems require less gravel backfill and provide significant additional water storage volume.	• Cannot be used in terrain where natural slope is > 12 percent. • Cannot be used if groundwater is too close to the surface, minimum vertical separation of three feet from the bottom of the trench/bed. • Large land requirement. • Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surroundings.	Most common, highly developed	60	N	• Normally none. • Some systems use a dosing pump - if present, it must be checked and cleaned. • Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected.
High-Pressure Drip	• Reliable alternative for areas with low permeability, seasonal high-water tables, or severe slopes. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally. • Significant evapotranspiration is expected.	• Large dose tank is needed to accommodate timed dose delivery to the drip absorption area. • Power is required to run pumps, sensors, and controls. Some minimal regular maintenance is required. • Clogging of emitters can occur.	Highly developed	30	L	• Provide continuous electricity to small dosing pumps. • Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters. • Regular monitoring and maintenance of pump, filter and piping shall be performed.
Low Pressure Pipe	• Reliable alternative for areas with low permeability, seasonal high-water tables, and/or severe slopes. • Shallow and narrow trenches reduce site disturbance and land area requirement. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally.	• Limited storage capacity around laterals. • Possibility of wastewater accumulation in the trenches. • Potential for clogging and infiltration problems.	Highly developed	60	L	• Monitoring ponding at the bottom of trenches, readjusting operating pressure, and reducing flow to overloaded trenches. • Flushing manifold and lateral lines periodically.

Technology(1)	Benefits	Challenges	Technology Status	Replace Interval (year)	O&M Effort(2)	O&M Requirements(3)
Seepage Pit	• Simplest and most compact method to percolate water into the ground. • Viable options when land is insufficient for absorption beds or trenches, or the terrain is steep.	• Cannot provide additional treatment or evapotranspiration. • Must have adequate separation from groundwater (at least 3 ft).	Uncommon, unlikely to be approved	60	N	• Inspection and pumping every 2 to 4 years.
Water Reuse	• Helps reduce overall demand on potable water supply. • Utilized in landscaping, agricultural irrigation, and even toilet flushing.	• Often more expensive treatment is required to reach water quality requirements. • Strict rules and regulations to prevent potential environmental or health consequences.	Highly developed	60	H	• Extensive monitoring at the treatment facility is required; for R-1 water: continuous for NTU and fecal coliforms. • A water reuse plan is required for the reuse site, with monitoring and reporting. Signage is required at the site.
Evapotranspiration	• If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved. • Low cost, simple disposal system.	• Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates. • More effective in arid climates where evaporation rates are much higher than precipitation.	Uncommon, highly developed	60	L	• Provide continuous electricity to small dosing pumps. • Inspection of observation wells. • Trim vegetated area of ET system, replace plants as needed.
Injection Well	• Very simple system. • Little to no maintenance required.	• Limited applicable locations/siting. • Very difficult to obtain a permit.	Uncommon, unlikely to be approved	60	M	• Sampling and reporting.
Surface Water Discharge	• Simple system. • Effectively recycles water back into the environment. • Can augment stream flow.	• Potential negative impacts on natural bodies of water or drinking water. • NPDES permit required. Expensive monitoring and reporting required. • Very limited applicable locations/siting.	Uncommon, unlikely to be approved	60	M	• Sampling and reporting.

Notes:
(1) CAS = conventional activated sludge, LPP = low pressure pipe, ET = evapotranspiration.
(2) O&M = operations and maintenance, N = no maintenance, L = low maintenance, M = moderate maintenance, H = high maintenance.
(3) CCTV = closed circuit television, DO = dissolved oxygen, MLSS = mixed liquor suspended solids, BOD = biochemical oxygen demand, TSS = total suspended solids, HRT = hydraulic retention time, mg/L = milligrams per liter, mL = milliliter, NTU = Nephelometric Turbidity Units.

4.2 Introduction and Background

According to the United States Environmental Protection Agency (US EPA), cesspools are underground excavations that receive sanitary wastewater from bathrooms, kitchens, and washers. Figure 4.1 is a schematic diagram of a typical cesspool. The structure usually has an open bottom and perforated walls (unlined, except for geotextile fabric on the outside). Domestic wastewater flows into the structure and the solid waste collects at the bottom of the cesspool and the liquid waste flows out of the perforations. Cesspools are not designed to treat wastewater, but rather to separate solids from sanitary waste and allow liquid wastes to percolate into the soil strata and underlying groundwater aquifer as well as any hydraulically connected surface waters.

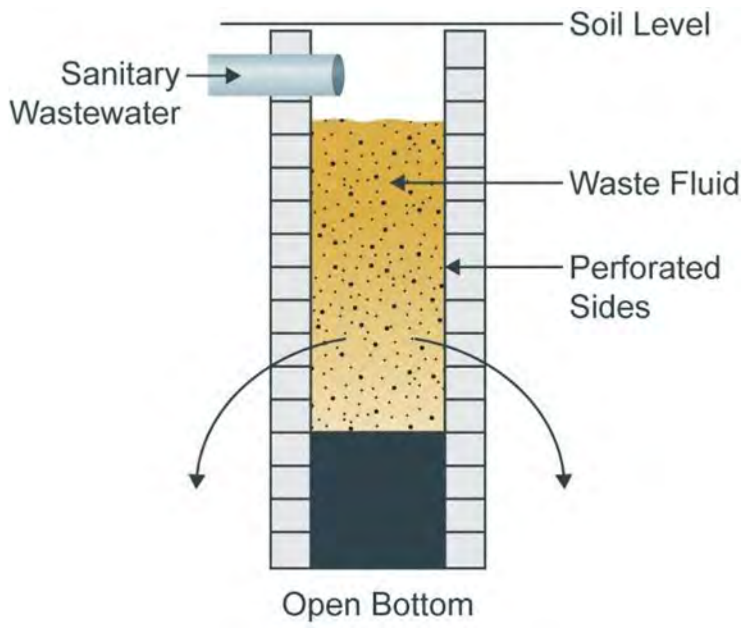

Figure 4.1 Cesspool Schematic

Throughout Hawaiʻi there are approximately 88,000 cesspools that release an estimated 53 million gallons per day (mgd) of wastewater into the environment. Most of these existing cesspools provide wastewater disposal for single-family residences, versus large-capacity systems that service multiple residences or commercial areas. Given that over 90 percent of the state's drinking water supplies are from groundwater sources, it was recognized that cesspools pose an environmental and public health risk.

In 2017, the Hawaiʻi State Legislature passed Act 125, which states that by January 1, 2050 all cesspools in the state of Hawaiʻi, unless granted exemption, shall upgrade or convert to a septic or aerobic treatment unit, or connect to a sewer system (ACT 125, 2017). Act 132 was then passed in 2018 to establish the Cesspool Conversion Working Group (CCWG) to develop a long-range, comprehensive plan and commission a statewide study of sewage contamination in nearshore marine areas (ACT 132, 2018). The CCWG retained Carollo Engineers, Inc., (Carollo) to provide expertise related to OSWT technologies, decentralized sewer systems, and cesspool conversion funding and finance options. There are generally three options for cesspool conversions including:

- New OSWT and disposal systems.
- New decentralized cluster sewer systems.
- Connection to existing or new centralized sewer systems.

The purpose of TM04 is limited to the evaluation of decentralized cluster sewer systems as a cesspool conversion option. Evaluations of OSWT and disposal systems are covered in TM03. Evaluation of centralized sewer systems is not included in the scope of this project.

4.2.1 Decentralized Cluster Wastewater Systems and Key Assumptions

For the purposes of this evaluation, decentralized cluster systems are defined as small systems treating wastewater flows from as few as 10 homes up to approximately 100 homes, or roughly 5,000 to 50,000 gpd. These systems consist of three major components: wastewater collection, treatment, and disposal. A decentralized system must be jointly owned by the homeowners it serves, a homeowner's association, private entity, or a public agency.

State rules require the use of a licensed wastewater treatment plant operator for any system with a flow of 1,000 gpd or more and for all multi-owner systems. The operator is required to visit the facility at least weekly to manage ongoing O&M including monitoring, cleaning, maintaining back-up power, reporting to DOH, hauling away and properly disposing of residual sludges, etc. The homeowners would generally have to form some sort of sewer district or other legal entity and have the decentralized system recorded on their property deeds to ensure timely payments to fund the system. Monthly fees would also need to be collected; this could be accomplished by a private wastewater operation firm or by a homeowner's association, district board, etc.

These systems will generally require infrastructure located off-site from the homeowner member properties. This could include sewer systems below ground in public or private rights-of-way requiring easements, as well as treatment and disposal facilities located on land that would have to be procured, leased, or possibly on common area property belonging to a homeowner's association.

This TM04 investigates the different options for:

- Small collection systems applicable to decentralized cluster systems.
- Treatment systems (in particular, package plants).
- Disposal systems.

All systems described herein must be designed to meet all applicable state and county regulations and rules including design criteria and regulated contaminants such as total suspended solids (TSS), biochemical oxygen demand (BOD), nitrogen, phosphorus, and fecal coliform. For each technology, a description is provided followed by analysis of constraints, benefits/challenges, and estimated costs.

Estimated costs for most of the systems evaluated were adapted from a previous report entitled *Performance and Cost of Decentralized Unit Processes* (WERF, 2010). Several of the systems evaluated were not included in the WERF study and thus new cost estimates were developed. The WERF report provided costs in 2009 dollars for mainland USA. Those costs were adapted and estimated for Hawaiʻi in 2020 dollars. Costs exclude engineering, permitting, land acquisition, and contingencies related to challenging site conditions (i.e. occurrence of rock, high groundwater, steep slopes, etc.). It should also be noted that collection system costs are highly dependent on the proximity of the parcels served and the distance to the treatment and disposal site.

4.2.2 Factors Related to the Comparison of Decentralized Versus Onsite Systems for Cesspool Replacements

There are approximately 150 privately owned wastewater treatment facilities in the state of Hawaii (versus approximately 49 publicly owned treatment works). Figure 4.2 shows the locations of the public and privately-owned wastewater treatment plants in the state[1].

Most of the privately-owned facilities serve resorts, condominiums/apartments, industries, and/or commercial buildings, and are generally constructed when new development or significant redevelopment occurs. There have not been many decentralized systems constructed to service existing residential areas of single-family homes, and it is not known if this option has been considered or evaluated for specific areas.

There may be instances and locations where decentralized systems are a better option for cesspool conversions in Hawaiʻi compared to individual, onsite solutions, or connections to centralized sewers. Factors to consider include:

- **The number of systems in the cluster and the separation distance between them.** There may be an ideal density of cesspools within a neighborhood that would allow for a cost-effective solution. This would need to be evaluated on a site-specific basis by a licensed engineer.
- **Terrain.** Depending upon the local soils, slopes, and other site-specific features, the terrain may limit the options and potential application of a decentralized system. Onsite systems need only consider the terrain of individual properties.
- **Availability of land.** Decentralized systems will likely need to be constructed on newly acquired land and may require easements. These cluster systems would only be a viable option if the required land is available.
- **Public support for a decentralized system, including shared funding for a utility service providing O&M.** For an onsite system, the homeowner is the only party involved and is responsible for the financing of the system, its O&M, any permits, and fines due to non-compliance or spills, etc. This is very simple for the owner in the sense that they do not rely on any other homeowners, a sewer district board, or potential future capital assessments for other people's problems. At the same time, the owner of an onsite system must be the responsible party and plan to have the O&M completed. While cost can be a powerful motivator, some homeowners may see value and convenience in having a separate service operate and maintain a decentralized system over an onsite system. Utility systems have stable, regular monthly bills rather than less frequent larger bills for pumping/servicing/repair of an onsite system. Failures and surprise costs due to lack of care are much less likely for continuously operated cluster systems than onsite systems which are frequently neglected because they are "out-of-site, and out-of-mind".

[1] https://geoportal.hawaii.gov/datasets/wastewater-treatment-plants/data?geometry=-178.050%2C16.796%2C-136.236%2C23.998

Figure 4.2 Publicly and Privately-Owned Wastewater Treatment Plants in Hawaii

- **Number of wastewater systems to oversee and manage.** For the county/state, having all systems converted on an individual is a much larger task than having decentralized cluster systems. Just in terms of sheer numbers of permitted units, it could reduce the number by orders of magnitude (e.g. instead of 88,000 individual units; 880 to 8,800 cluster systems). In addition, cluster systems are regulated and inspected by the Hawaii DOH WWB the same manner as existing WWTPs. The rules and procedures are already in place, including the requirement that state-licensed WWTP operators oversee the cluster systems. This is more likely to ensure that systems are inspected, operated, maintained, repaired, and function as required to meet the treatment and disposal regulations. A similar regulatory and enforcement system for individual onsite system management does not currently exist at the county/state level in Hawaiʻi and it will need to be developed, implemented, funded, and appropriately staffed[2].
- **Potential for funding opportunities.** Decentralized systems may have a broader range of funding opportunities than onsite systems. One of the hurdles in funding cesspool conversions is that many existing funding options require a conduit agency or intermediate party to manage and administer available grant or low interest loans to individual homeowners for cesspool conversions. Given that decentralized systems will need to be managed and operated by a third party, this also opens the door for more funding options. In addition, if water reuse is a disposal option for the decentralized system, there are additional funding opportunities that may apply. Water reuse is not allowed for onsite systems; thus, those funding opportunities would not be available.

4.2.3 Potential Application of Decentralized Cluster Systems for Cesspool Conversions in High Priority Areas

The 2018 DOH Report to the Hawaii State Legislature prioritized existing cesspools into four categories:

- **Priority 1:** Significant risk of human health impacts, drinking water impacts, or draining to sensitive waters.
- **Priority 2:** Potential to Impact Drinking Water.
- **Priority 3:** Potential Impacts on Sensitive Waters.
- **Priority 4:** Impacts Not Identified.

The highest risk areas (Priority 1) should be addressed as soon as possible due to high public health and environmental risks.

The following risk factors were considered in formulating the priority categories:

- Density of cesspools in an area.
- Soil characteristics.
- Proximity to drinking water sources, streams, and shorelines.
- Other groundwater inputs including agriculture and injected wastewater.
- Physical characteristics of coastal waters that may compound the impacts of wastewater in bays and inlets.

Table 4.1 shows that Priority 1 areas include 8,140 cesspools which comprise approximately 9 percent of the 88,000 cesspools in Hawaiʻi. These priority categories and assignments were presented by the DOH WWB and the US EPA to the 2018 Hawaiʻi Legislature and they are subject to evaluation and possible revision through the activities of the CCWG. It is recommended that cesspools located in Priority 1 areas are upgraded with technologies that remove nitrogen and may also require disinfection (if near surface water).

[2] TM01 included a discussion of staffing requirements by other agencies.

The costs for each OSWT and disposal system in the Priority 1 areas will likely be higher than other areas since a higher level of treatment is required.

Decentralized cluster systems may be a good option for Priority 1 areas to provide:

- Rapid, near-term conversions within areas deemed to have the greatest environmental risks.
- Reliable and appropriate level of treatment of wastewater prior to disposal.

Table 4.1 Initial Priority Upgrade Areas Established by DOH WWB (DOH, 2018)

Geographic Area	Priority Level Assigned	Number of Cesspools	Estimated Effluent Discharge (mgd)
Upcountry area of Maui	1	7,400	4.4
Kahaluʻu area of Oʻahu	1	740	0.44
Keaʻau area of Hawaiʻi Island	2	9,300	4.9
Kapaʻa/Wailua area of Kauaʻi	2	2,900	2.2
Poipu/Kōloa area of Kauaʻi	2	3,600	2.6
Hilo Bay area of Hawaiʻi Island	3	8,700	5.6
Coastal Kailua/Kona area of Hawaiʻi Island	3	6,500	3.9
Puako area of Hawaiʻi Island	3	150	0.60
Kapoho area of Hawaiʻi Island	3	220	0.12
Hanalei Bay area of Kauaʻi	3	270	0.13
Diamond Head area of Oʻahu	3	240	0.17
ʻEwa area of Oʻahu	3	1,100	0.71
Waialua area of Oʻahu	3	1,080	0.75
Waimanalo area of Oʻahu	3	530	0.35
	Total Assigned	**42,730**	**26.87**
Hawaiʻi Island Un-Assigned	NA	24,430	12.18
Kauaʻi Un-Assigned	NA	6,930	4.57
Maui Un-Assigned	NA	4,800	3.5
Oahu Un-Assigned	NA	7,610	5.08
Molokaʻi Un-Assigned	NA	1,400	0.80
	Total Un-Assigned	**45,170**	**26.13**
	Overall Totals	**87,900**	**53.0**

4.2.4 Regulation of Decentralized Cluster Wastewater Systems in Hawaiʻi

Collection, treatment, and disposal systems are all regulated separately in Hawaiʻi. Decentralized collection systems are regulated at the county level similar to centralized systems. These regulations include design standards, such as minimum slopes and diameters, materials, and depths[3].

Decentralized treatment systems are considered "treatment works" and thus, are regulated the same as centralized systems, such as those owned and operated by each of the counties, military facilities, and

[3] Honolulu County's rules are contained here: http://www.honolulu.gov/rep/site/env/wwm_docs/DESIGN_STANDARDS_-_CHAPT_1_FINAL.pdf, http://www.honolulu.gov/rep/site/env/wwm_docs/DESIGN_STANDARDS_-_CHAPT_2_FINAL.pdf

private sewer systems or districts. These regulations can be found in Hawaiʻi Administrative Rules (HAR) HAR 11-62 [4]. In addition, the City and County of Honolulu also has their own rules for treatment plant design[5].

HAR 11-62 also covers disposal via absorption and discharge to state waters. DOH has additional rules for water reuse[7] and for underground injection[8].

4.3 Description of Collection System Technologies

The collection system conveys wastewater from each home to a treatment and disposal facility and consists of a network of pipes and related equipment such as pumps, valves, manholes, etc. located on private and public property. The following options for collection systems are described in the following sections:

- Gravity Sewers (GS).
- Liquid-Only Pressure Sewers.
- Low-Pressure Sewers.
- Vacuum Sewers.

4.3.1 Gravity Sewers

Gravity sewers are a network of underground pipes that convey wastewater (greywater plus blackwater[5]) from individual households to a treatment facility (Figure 4.3). Gravity sewers are the standard, conventional type of system for centralized wastewater systems that connect numerous homes, businesses, and industries to a regional treatment plant. The sewers utilize gravitational energy resulting from a difference in elevation to cause flow.

Table 4.2 summarizes the benefits and challenges of this type of wastewater collection system. Where appropriate differences in elevation exist, gravity sewers are a feasible collection system option that has little unwanted effects on homeowners and their properties. Conventional gravity sewers do not require storage of household wastewater before it is discharged into the collection system pipes, and they can handle grit and other solids, as well as large volumes of flow. However, these sewers must be designed to maintain a self-cleansing velocity, generally 2 feet per second (fps), at a minimum, during most flow conditions.

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[4] https://health.hawaii.gov/opppd/files/2015/06/11-62-Wastewater-Systems.pdf

[5] Wastewater can be separated into graywater and blackwater. Blackwater includes wastewater from toilets and kitchen sinks (includes foodwaste). Graywater excludes blackwater sources and is generally limited to bathroom sinks, showers/tubs, and laundry.

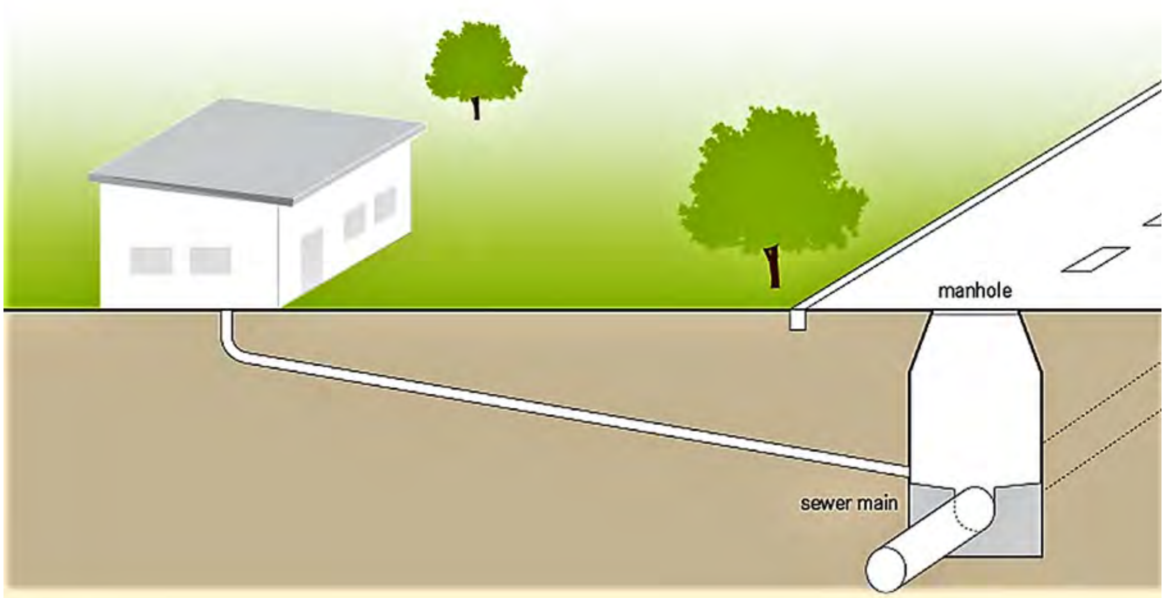

Figure 4.3 Typical Gravity Sewer System (Tilley et al, 2014)

Table 4.2 Benefits and Challenges for Decentralized Conventional Gravity Sewers

Benefits	Challenges
• Can handle grit and other solids, as well as large volumes of flow. • Does not require onsite treatment or storage of the household wastewater before it is discharged. • Little impact to homeowners and their properties. • Presents a viable option if there is an appropriate difference in elevation. • No electricity for pumping and no pump maintenance.	• Flat or large variations in terrain can increase costs • Larger pipes compared to other collection system options. • Prone to clogging. • Manholes associated with gravity sewers are a potential source of inflow and infiltration. • Higher capital costs.

4.3.2 Liquid-Only Pressure Sewers

A liquid-only sewer system is a network of pipes that convey pre-treated wastewater pumped under pressure to the treatment facility. A precondition for these sewers is that efficient preliminary treatment is available at the household level, typically achieved using a septic tank (see Figure 4.4). This system is also known as a septic tank effluent pumping (STEP) sewer system and is practical in areas with a limited number of homes and relatively short distances to the neighborhood treatment facility.

Some of the benefits and challenges of liquid-only pressure sewers are summarized in Table 4.3. Liquid-only sewer systems are most feasible in communities that have existing septic tanks at individual homes. Thus, for Hawaiʻi's cesspool conversions, septic tanks would be required in addition to a STEP collection system, followed by treatment and disposal systems. The septic tanks retain most of the fats, oils, and grease (FOG), thereby greatly reducing or eliminating clogging problems, and have storage capacity to hold its contents during power outages.

Compared to conventional gravity sewers, liquid-only pressure sewers can have lower capital costs depending upon terrain, local site conditions, and if there is an existing septic tank at each homesite. They also do not have to be installed on a uniform gradient with a straight alignment between inspection points; the alignment may curve vertically (go under or over) and horizontally (go around) to avoid obstacles, allowing for greater construction flexibility.

Figure 4.4 Typical Liquid-Only Pressure Sewer System (Orenco Systems, Inc.)

Table 4.3 Benefits and Challenges for Decentralized Liquid Only Pressure (STEP) Sewers

Benefits	Challenges
• Independent from land topography restrictions. • The septic tank retains most of the FOG and solids reducing clogging problems. • Septic tanks have storage capacity to operate during power outages. • Smaller pipes compared to conventional gravity sewers. • Can be installed at a shallow depth and do not require a minimum flow velocity or slope to function.	• Requires an onsite septic tank and pump on each property. • Grease and sludge must be pumped from each individual septic tank. • Anaerobic septic tanks can generate odors and methane gas. • Leaks pose a risk of wastewater exfiltration. • Pumps and filters must be maintained.

4.3.3 Low Pressure Sewers

Low pressure sewers (LPS) utilize grinder pumps (GPs) located in a small receiving station/vault on each property to transport finely ground raw wastewater from the home through a network of pressurized sewer pipes to the treatment facility (see Figure 4.5). Table 4.4 summarizes the benefits and challenges of low-pressure systems. Raw wastewater from the home enters an onsite tank that is much smaller than a septic tank which houses the GP where the sewage is shredded by cutting blades in the pump intake. Pumps at each home contribute flow to the pressurized network which conveys the chopped raw sewage to the treatment facility. Compared to conventional gravity sewers, low-pressure sewers can have lower capital costs depending upon terrain and local site conditions.

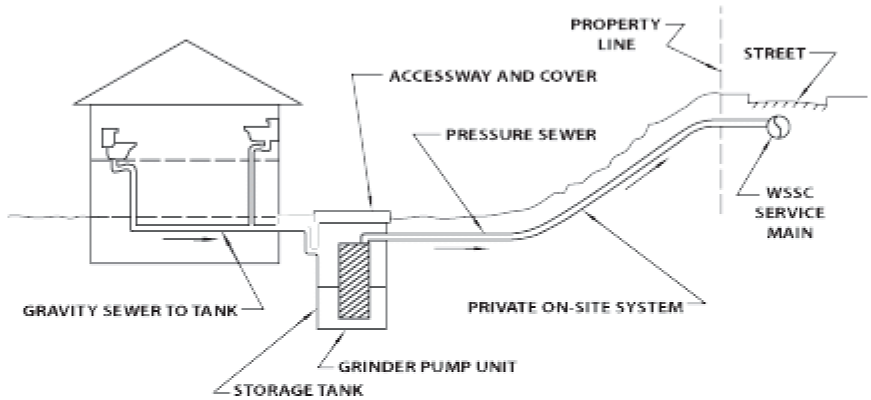

Figure 4.5 Typical Low-Pressure Sewer System (Washington Suburban Sanitary Commission [WSSC] Water, 2019

Table 4.4 Benefits and Challenges for Decentralized Low-Pressure Sewers

Benefits	Challenges
• Small diameter piping, shallow, easily installed. • Independent from land topography restrictions. • No manholes required and no storm water infiltration. • Less clogging and subsequent O&M cleaning or flushing.	• Requires pump/vault installation on each property. • Requires an energy source for the grinder pumps. • Pumps must be maintained on each property.

4.3.4 Vacuum Sewers

Vacuum sewers use differential air pressure (i.e., negative pressure) to transport raw sewage from its source to a treatment facility. It maintains a partial vacuum with an air pressure below the atmospheric pressure inside the pipe network and vacuum station's collection vessel. A vacuum sewer system consists of valve vaults (i.e., collection chambers) at each home, vacuum interface valves that regulate the entry of wastewater and air from the valve vault into the collection system, collection system piping, and one or more vacuum stations. The system requires a normally closed interface valve at each entry point to seal the lines, so that the vacuum is maintained. The valves open when a specific amount of sewage accumulates in the collection chamber, upon which the resulting pressure difference drives the sewage towards the vacuum station and then to the treatment facility (see Figure 4.6). Such a system works best in flat or gently rolling terrain because it has limited capabilities to transport wastewater uphill (a maximum of about 20 feet). The pipes of vacuum sewers have relatively small diameters and can be laid at shallow depths.

Table 4.5 summarizes the benefits and challenges of vacuum sewers. These sewers require vacuum equipment and central vacuum stations to be constructed on an available parcel of land, and they also have relatively high operating costs because of the technology involved and the constant energy requirement for permanent vacuum generation. However, the capital cost can be similar to conventional gravity sewers, depending on the number of homes served by the system.

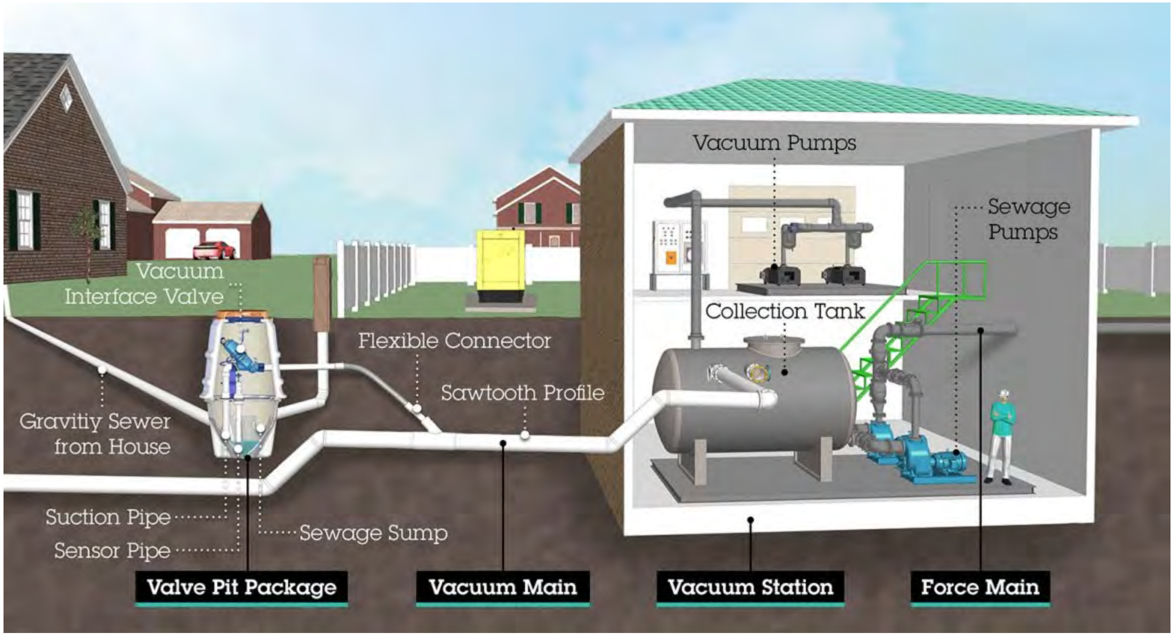

Figure 4.6 Typical Vacuum Sewer System (Airvac ® Vacuum Sewer Systems, QSM, 2020)

Table 4.5 Benefits and Challenges for Decentralized Vacuum Sewers

Benefits	Challenges
• Small diameter piping, shallow, easily installed. • No manholes required and no storm water infiltration. • Closed system with no exfiltration or odors. • Flexible installations regardless of topography and water availability.	• Requires construction of vacuum equipment at each home. Requires land for central vacuum stations • Economic feasibility depends on the number of homes served by the system (the more the better). • Requires energy to create the permanent vacuum. • Vacuum stations require regular O&M checks, typically higher O&M than gravity collection systems.

4.4 Description of Small/Cluster Wastewater Treatment Systems

The second of the three components of a decentralized cluster system is the treatment system which must treat the wastewater collected from the homes to a suitable degree to allow disposal and/or reuse. The process generally consists of the tanks and other process equipment required for separation and storage of solids, oxidation of organic matter, and often disinfection of pathogenic microorganisms. These facilities typically require land space and power, including back-up generators. Treatment facilities must have controlled access (fencing and alarms) and be maintained by certified operators who need 24/7 access. Pre-engineered, package plant type systems are generally more economical for decentralized treatment facilities versus site-specific, ground-up complete designs. Such systems are also modular, facilitating easy expansion due to possible future growth. The different treatment technology options described in this section include:

- Activated Sludge:
  - Conventional.

  - Extended Aeration.
  - Membrane Bioreactor.
- Attached Growth Bioreactors:
  - Textile Filter.
- Moving Bed Bioreactor.
- Constructed Wetlands.

4.4.1 Activated Sludge

The term activated sludge refers to biological treatment via suspended-growth, aerobic mixed liquor consisting of flocs of active bacteria, which consume and remove aerobically biodegradable organic substances from screened or screened and pre-settled raw wastewater.

Activated sludge processes can be used for treating wastewater flows from clusters of homes. They provide a high-quality effluent, with reduction of BOD, TSS, nitrogen, and phosphorus. Activated sludge processes are also flexible because they can be modified to meet specific discharge limits, operate at a range of organic and hydraulic loading rates, and are resistant to organic and hydraulic shock loads.

Specific variations of activated sludge include conventional activated sludge (CAS), extended aeration activated sludge (EAAS), and membrane bioreactors (MBRs). Each is described in the following sections.

4.4.1.1 Conventional Activated Sludge

CAS consists of an aeration tank, which is used for biological degradation, and a secondary clarifier, where the sludge is separated from the treated wastewater (see Figure 4.7). Prior to CAS, screens and degritters are used to remove large and heavy solids, respectively. Primary sedimentation is also commonly used to remove rapidly settling solids in larger facilities but is typically not used for package plants. The pretreated wastewater enters the activated sludge treatment system. In the aeration tank air is transferred to the wastewater to facilitate biological treatment and biodegradation of organics and nutrients. Additional settling and pollutant removal occur in the secondary clarifier prior to disinfection (if needed) and disposal. Waste sludge typically requires additional stabilization and disposal.

Some of the benefits and challenges of CAS are summarized in Table 4.6. CAS technology is suitable for any flow rate in the range considered here (5,000 to 50,000 gpd).

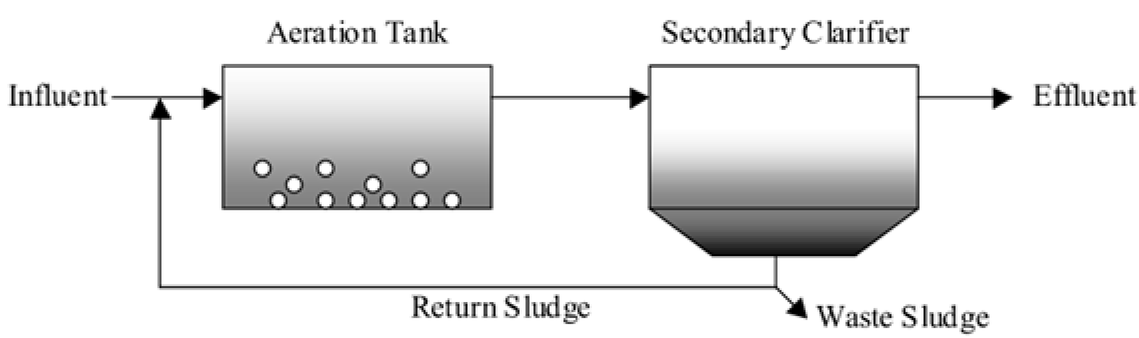

Figure 4.7 Typical Conventional Activated Sludge System (Water Research Foundation and Carollo, Engineers, Inc., 2008)

Table 4.6 Benefits and Challenges of Conventional Activated Sludge Systems

Benefits	Challenges
• High BOD and nitrogen removal, high effluent quality, self-sustaining system. • Small land area requirement. • Free from fly and odor nuisance. • Can be modified to meet specific discharge limits.	• High electricity consumption and costly mechanical parts. • Requires skilled operation and maintenance. • Requires expert design and construction. • Bulking and biological surface foaming.

4.4.1.2 Extended Aeration Activated Sludge

EAAS is a variation of the activated process which provides removal of biodegradable organic wastes under aerobic conditions without primary settling and with a longer aeration time, and a longer sludge age (Figure 4.8). The long aeration time means a larger aeration tank than CAS. The process has a high BOD removal efficiency and generates less sludge than conventional activated sludge.

In a typical EAAS package plant, raw wastewater is screened or goes through a grinder to reduce large suspended, settleable, or floating solids. Then, it is conveyed to the aeration tank where it is mixed with return activated sludge (RAS) and oxygen is provided to microorganisms. The resulting mixed liquor is settled in the clarifier resulting in RAS and clarified effluent. In EAAS, solids are generally allowed to accumulate in the aeration tank for long periods allowing digestion in the same tank and periodic wasting for disposal. If needed, the clarified effluent is then disinfected by chlorine or ultraviolet light (UV) in a disinfection tank.

Some of the benefits and challenges of EAAS are summarized in Table 4.7.

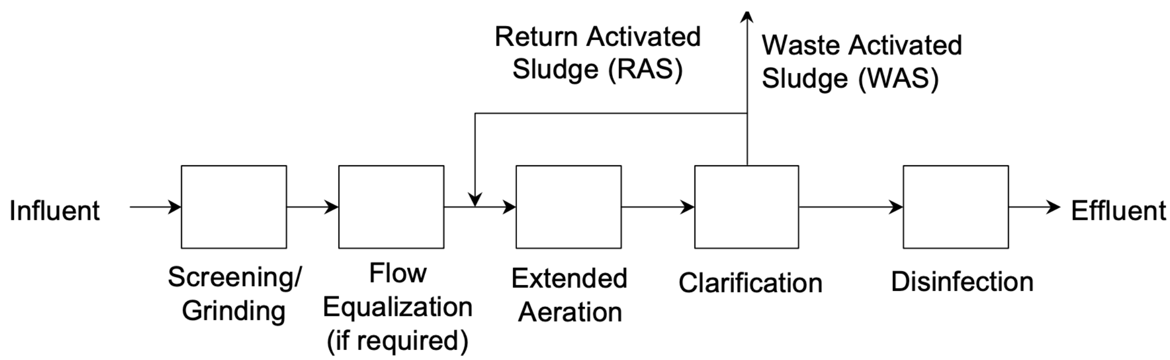

Figure 4.8 Typical Extended Aeration Activated Sludge System (Water Research Foundation and Carollo, Engineers, Inc., 2008)

Table 4.7 Benefits and Challenges of Extended Aeration Activated Sludges Treatment Systems

Benefits	Challenges
• Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels. • Long HRT and complete mixing, minimal impact of a shock load or hydraulic surge. • Produces less sludge due to extended retention of biological solids in the aeration tank.	• Higher energy uses due to longer aeration time. • Larger footprint than CAS. • Less flexibility than CAS should regulations for effluent requirements change.

4.4.1.3 Membrane Bioreactor Activated Sludge

MBR is an activated sludge process which uses membrane filtration instead of a secondary clarifier to separate mixed liquor from treated effluent (Figure 4.9). Fine screening is an essential pre-treatment step to protect the membranes from damaging debris and particles, extending the membrane life, reducing operating costs, and guaranteeing a higher sludge quality. MBR systems nearly always have an anoxic tank and internal pumping of mixed liquor to facilitate nitrogen removal via denitrification. MBR is an ideal process for water reuse applications since the membranes provide a barrier to many pathogens. Better effluent quality comes with a higher capital, operation, and energy costs which present a hurdle to implementing MBR systems for cluster systems.

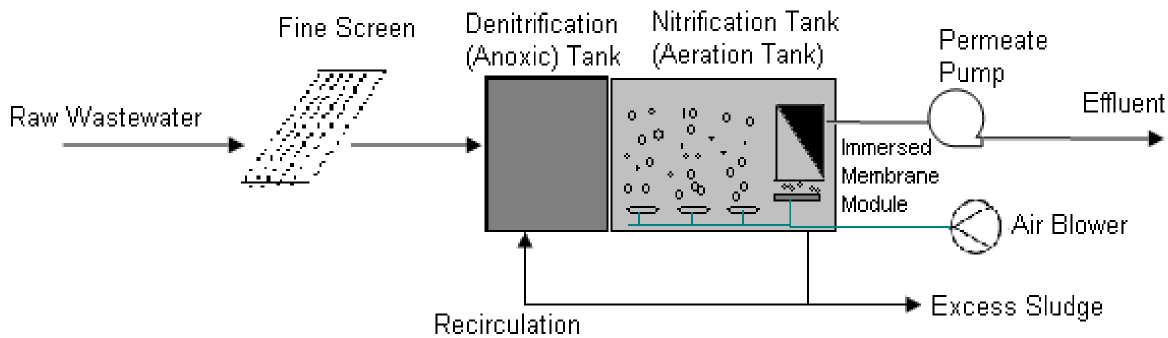

Figure 4.9 Typical Membrane Bioreactor Activated Sludge System (Wastewater Engineering Group 2007)

A typical MBR package plant will consist of a preliminary coarse screen, followed by a fine screen, an anoxic tank/zone, an aeration tank with an integral membrane module, a permeate pump to create effluent, and a blower to provide coarse aeration of the membrane cassette and fine bubble aeration for the remainder of the aeration tank. It will usually include an aerobic digester to treat, thicken, and store WAS prior to periodic pump-out and disposal. The package plant may also contain a disinfection system which most commonly would utilize UV[6].

Some of the benefits and challenges of MBR are summarized in Table 4.8.

Table 4.8 Benefits and Challenges of Membrane Bioreactor Treatment Systems

Benefits	Challenges
• Secondary clarifiers and tertiary filtration processes are eliminated, thereby reducing plant footprint. • High quality effluent.	• Membrane complexity and fouling. • Higher capital, operation, and energy costs. • Hydraulic flow peak capacity is limited to 1.8 times average flows and only for short periods.

4.4.2 Attached Growth Bioreactors – Textile Filter

Like the suspended growth activated sludge processes, attached growth bioreactors take advantage of biological treatment. The biological mass in this case grows as a biofilm on the surface of a media or disk as opposed to suspended flocculated biomass in CAS, EAAS, and MBR processes. The media should have a large surface area to volume ratio to support the microbial growth and form biofilms. Some versions of the process eliminate secondary clarifiers and associated cost and space requirements.

[6] Current recycled water regulations require disinfection following MBR for R-1 water.

A textile filter (TXF) is a variation of an attached growth bioreactor. TXF is a fixed-bed, biological reactor that operates under (mostly) aerobic conditions. TXF systems are available in modular package plant configurations specifically for cluster treatment applications. The system uses fixed spray nozzles and hanging textile media sheets (see Figure 4.10). The sheets are suspended on racks at the top of a tank that is mostly open, and water can accumulate below for recirculation. These systems are designed to treat pre-settled wastewater, most often from a large septic tank.

Some of the benefits and challenges of TXF systems are summarized in Table 4.9. TXF systems are generally low maintenance. Like other systems, the mechanical components (pumps, motor-driven chains, fans, blowers, rotating influent applicators, clarifier mechanisms, etc.) still require regular inspection and maintenance.

Table 4.9 Benefits and Challenges of Textile Filter Systems

Benefits	Challenges
• Can operate at a range of organic and hydraulic loads. • Lower energy input than CAS. • Low sludge production.	• Requires expert design, construction, operation and maintenance. • Some variations have larger footprints. • Risk of clogging, depending on pre and primary treatment.

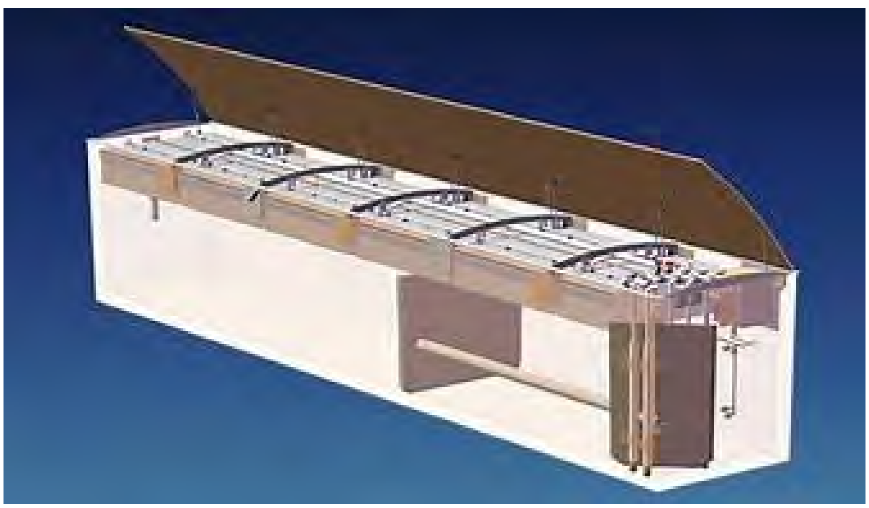

Figure 4.10 Typical Textile Trickling Filter System (Orenco Systems, Inc.)

4.4.3 Moving Bed Biofilm Reactor

The moving bed bioreactor (MBBR) process is a combination of activated sludge (suspended growth) and attached growth processes. It uses plastic floating media within an aeration basin which are carriers of attached growth of biofilm. Pre-treated (settled) influent enters the aeration basin for treatment and may enter a second basin for further treatment (full nitrification). Fine-bubble aeration with high oxygen transfer efficiency is commonly used for mixing/suspension (Figure 4.11). Thousands of small plastic chips, called media or carriers, occupy as much as 50 to 70 percent of the tank volume. In order to keep the carrier media in the tank, there is a strainer attached to the aeration basin effluent pipe. The aeration effluent which contains sloughed biofilm and suspended solids is conveyed either to a secondary settling tank or, more commonly, to a dissolved air flotation separator.

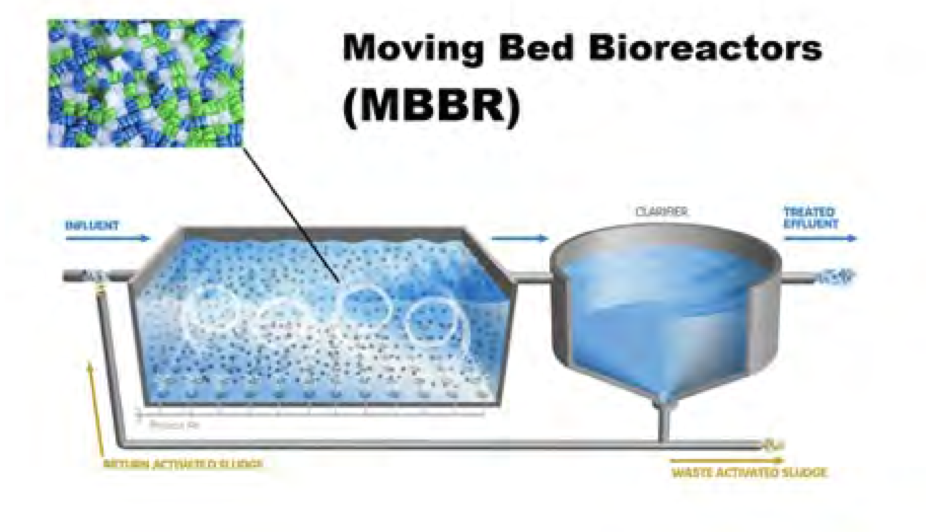

Figure 4.11 Typical Moving Bed Bioreactor System (Lanyu Gustawater Treatment, 2020)

A typical MBBR package plant has a screen, a primary sedimentation tank, one or two MBBR aeration tanks, a blower, a dissolved flotation separator unit, and an aerobic digestion tank to stabilize, thicken, and store the sloughed solids for eventual offsite disposal. If needed, the clarified effluent is then disinfected by chlorine or UV in a disinfection tank. As with all the previous treatment options described, waste sludge requires stabilization and disposal.

Some of the benefits and challenges of MBBR are summarized in Table 4.10. MBBR is known for being a low maintenance process. Construction cost of the MBBR is moderate compared to other highly mechanical wastewater treatment systems but more expensive when compared to simple or natural treatment systems. It does require electricity input and comes with increased associated costs for operation. A disadvantage is that carriers can wash out of the system over time, despite the strainers in place, and must be supplemented with additional new media.

Table 4.10 Benefits and Challenges of Moving Bed Bioreactors Treatment Systems

Benefits	Challenges
• Efficient treatment, low HRT, flexibility to adapt to fluctuating hydraulic and organic loads. • Low Maintenance. • Very compact, due to the maximized surface area the media provide for biofilm growth.	• High-tech system. • Higher capital and operating costs. • Carriers can wash out of the system, necessitating supplemental additions.

4.4.4 Constructed Wetlands

Constructed wetlands (CW) are a "green" technology designed to re-create the processes that naturally treat wastewater in the environment. Wastewater flows to a lined earthen basin or cell containing microorganisms, porous media and plants. A perforated pipe runs along the length of the cell just below the plants to evenly distribute the influent. A second pipe runs along the length of the cell to collect the effluent after it travels through the porous media, where it then flows through a distribution box and into a drain field (see Figure 4.12).

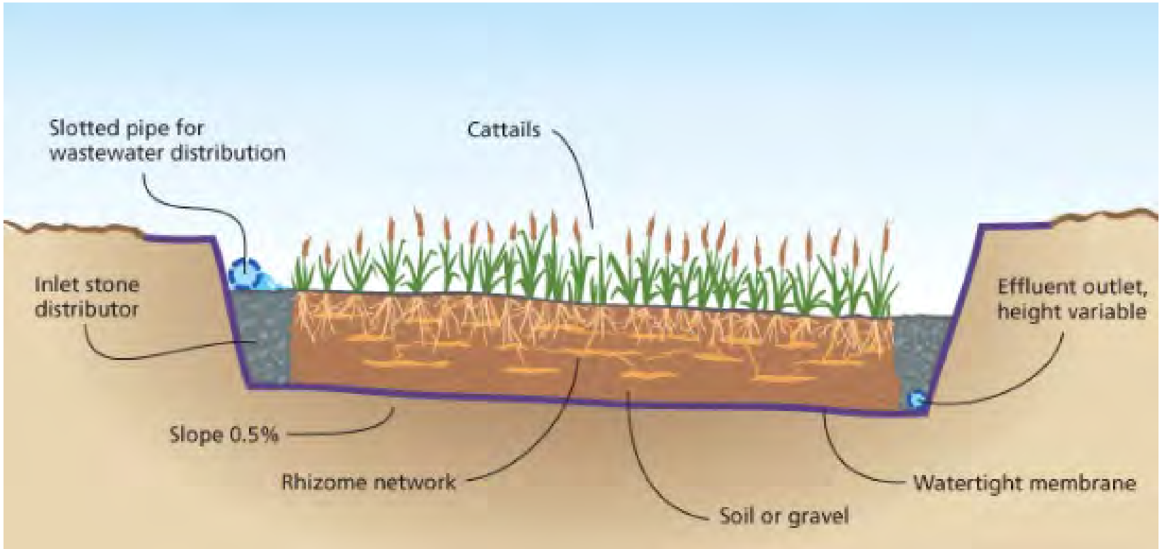

Figure 4.12 Typical Constructed Wetland Treatment System (Grismer and Shepherd, 2011)

Some of the benefits and challenges of CW treatment systems are summarized in Table 4.11. CWs are simple, low-tech, low-energy, natural systems that are easily operated compared to other systems and come with lower costs. However, the main challenges with implementing a CW as a cluster wastewater treatment system are availability of land and vector and odor nuisances. CWs are not available as package plant facilities.

Table 4.11 Benefits and Challenges of Constructed Wetlands Treatment Systems

Benefits	Challenges
• Simple, easily operated natural system. • Inexpensive compared to other treatment options. • Requires little energy when the system operates with gravity flow.	• Large land requirement. • Not available as a package facility. • Vector and odor nuisances.

4.4.5 Package Treatment Plants

Except for CWs, all the above-described treatment technologies are available in pre-engineered, self-contained treatment units of various specific treatment capacities. Installation generally would involve pouring of a concrete pad for the system, bringing-in power supply, influent piping, and possibly seeding with a source of bacteria. The system would then be ready to start operations. Other package systems are less containerized and more like a "kit" or a prefabricated building in which all the necessary components are delivered for assembly, such as tank(s), pumps, pipes, valves, blowers, controls and all the other required components to assemble and start-up the system.

4.5 Description of Treated Effluent and Residual Solids Disposal Strategies

The effluent disposal system must properly dispose or reuse the effluent from the treatment facility. Disposal could normally occur on the same site as the treatment facility (requiring additional land space), while reuse would require conveyance off-site to managed reuse areas. Residual solids must also be properly disposed of at an off-site facility. There are several options for effluent disposal which are described in the following sections, including:

- Percolation:
  - Absorption Trench/Bed.
  - High Pressure Drip.
  - Low Pressure Pipe.
  - Seepage Pit.
- Water Reuse.
- Evapotranspiration.
- Injection Well.
- Surface Discharge.

Effluent disposal systems are regulated in HAR 11-62-25. Some of the basic provisions of these regulations are as follows:

- Disposal systems shall at least consist of a primary disposal component and a separate 100 percent back-up disposal component.
- Both primary and backup disposal units shall be designed to handle the peak flow, determined by county or design engineer and approved by DOH.
- Stricter data monitoring and data submittals are required for subsurface disposal systems.
- Provisions to facilitate operation, maintenance, and inspection are required on a case-by-case basis.
- Disposal systems shall include provisions for purging and chemical shock loading.

4.5.1 Percolation

Percolation disposal strategies include absorption trenches/beds, seepage pits, high-pressure drip dispersal, low-pressure pipe dispersal, seepage pits, and soil aquifer treatment (SAT). These strategies are summarized in the following sections.

4.5.1.1 Absorption Trench/Bed Systems

Absorption systems are an approved subsurface disposal technology that allows partially- or fully treated effluent to percolate into the soil. These systems are installed with a very mild slope to allow effluent to flow by gravity. Effluent comes from a treatment system and is distributed by gravity through perforated pipes laid in either a trench or bed, the surface area of which depends on the hydraulic properties of the native soil.

Absorption systems generally range in depth from 1.5 to 3 feet below grade. Trench widths range from 18 to 36 inches, while bed widths are at least 3 feet. The major distinction between the two is that in an absorption bed, the entire disposal area is excavated and backfilled with gravel, whereas absorption trenches have distinct areas of undisturbed soil. Gravelless trench and bed absorption systems utilize plastic dome-shaped segmented chambers buried in the trench/bed with large open spaces instead of perforated pipes surrounded by gravel (see Figure 4.13).

A summary of benefits and challenges are shown in Table 4.12. The potential to clog the systems is highly dependent on the performance of the upstream treatment operations; therefore, a well-maintained treatment system will keep the absorption system working properly. Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected. Absorption disposal systems are common and can achieve high levels of effluent quality when employed downstream from effective treatment. No power is required, and maintenance is generally not necessary. However, they cannot be used in terrain with severe slopes or if groundwater is too close to the surface. Also, overloading, heavy rainfall, or unsuitable soils can cause surfacing (overflows).

Figure 4.13 Typical Gravelless Absorption Bed Disposal System (Infiltratior.com, 2020)

Table 4.12 Benefits and Challenges of Absorption Disposal Systems

Benefits	Challenges
• Common type of disposal system so there are many products available and experience with installation. • When deployed downstream from an aerobic treatment system, it provides some treatment for BOD, TSS, and fecal coliform. • No power is required, and maintenance is generally not necessary. • Gravelless dome systems require less gravel backfill and provide significant additional water storage volume.	• Cannot be used in terrain where natural slope is greater than 12 percent. • Cannot be used if groundwater is too close to the surface, minimum vertical separation of three feet from the bottom of the trench/bed. • Large land requirement. • Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surroundings.

4.5.1.2 High Pressure Drip Systems

Drip disposal systems (also called drip irrigation systems) are a disposal technology that uses a network of pipes containing emitters commonly spaced 12 inches apart and installed in excavations similar to but shallower than absorption beds (see Figure 4.14). Rather than working by gravity, these systems receive treated effluent in pumped doses from a dosing tank, which allows for controlled loading rates to the shallow root zone of the surrounding soil.

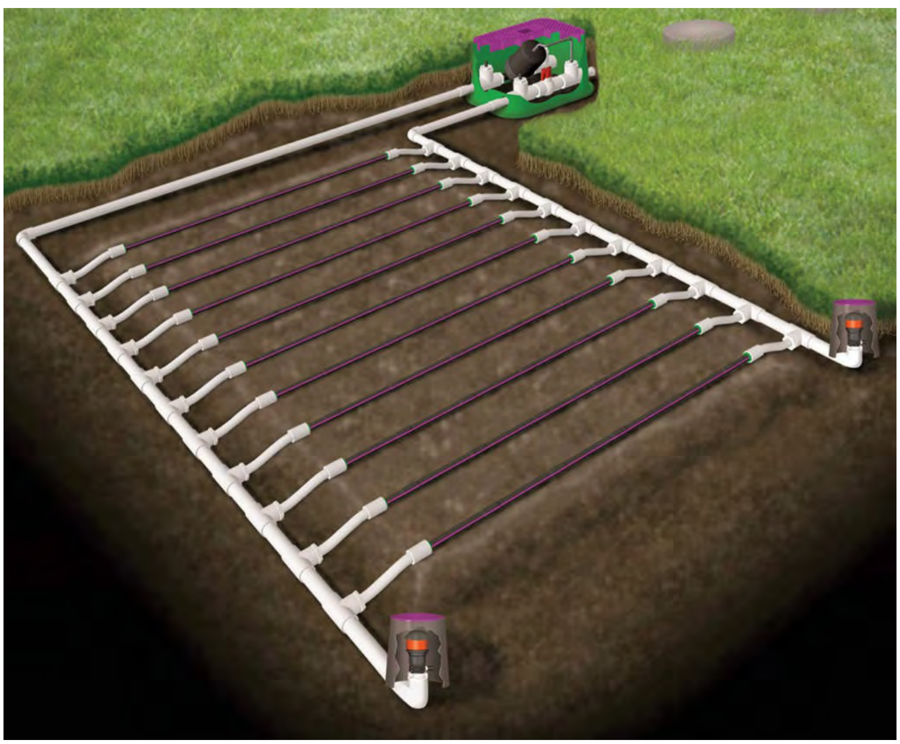

Figure 4.14 Typical High-Pressure Drip Disposal System (Norweco)

A summary of benefits and challenges are shown in Table 4.13. These systems are cost comparable to alternate disposal systems (low pressure pipe disposal systems) and the operating costs include power, pipe and equipment repair, and monitoring costs. Drip disposal systems are reliable alternatives for areas with low permeability, seasonal high-water tables, or severe slopes. Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally. However, they require a large dosing tank and power to run pumps, sensors, and controls.

Table 4.13 Benefits and Challenges of High Pressure Drip Disposal Systems

Benefits	Challenges
• Reliable alternative for areas with low permeability, seasonal high-water tables, or severe slopes. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally. • Significant evapotranspiration is expected.	• Large dose tank is needed to accommodate timed dose delivery to the drip absorption area. • Power is required to run pumps, sensors, and controls. Some minimal regular maintenance is required. • Clogging of emitters can occur.

4.5.1.3 Low Pressure Pipe Systems

A low-pressure pipe disposal system is a shallow, pressure-dosed soil absorption system that includes a network of small diameter perforated pipes placed in narrow trenches or beds (see Figure 4.15). Pressure distribution is used to uniformly feed the pipes. Lower pressure is used because the pipes have orifices rather than emitters associated with high pressure systems. Alternating the dosing and resting cycles helps improve treatment and promote aeration. Low pressure systems can be either time-dosed or demand-dosed.

The main components of a low-pressure pipe disposal system include:

- Submersible effluent pump in a pumping (dosing) chamber with a high-water alarm, level controls and a supply manifold.
- Small diameter perforated distribution laterals.
- Drain field media (gravel or sand).

A summary of benefits and challenges are shown in Table 4.14. These systems are reliable alternatives for areas with low permeability, seasonal high-water tables, or severe slopes. Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally. They require less space and power than high-pressure drip disposal systems but have less storage capacity and higher possibilities of ponding, infiltration, and clogging. Typical O&M is very minimal but includes monitoring ponding at the bottom of trenches, flushing manifold and lateral lines periodically, re-adjusting operating pressure, and reducing flow to overloaded trenches. Costs vary depending on the site and volume and characteristics of the wastewater being treated. These systems are comparable to drip disposal systems and the operating costs include power, pipe and equipment repair, and monitoring.

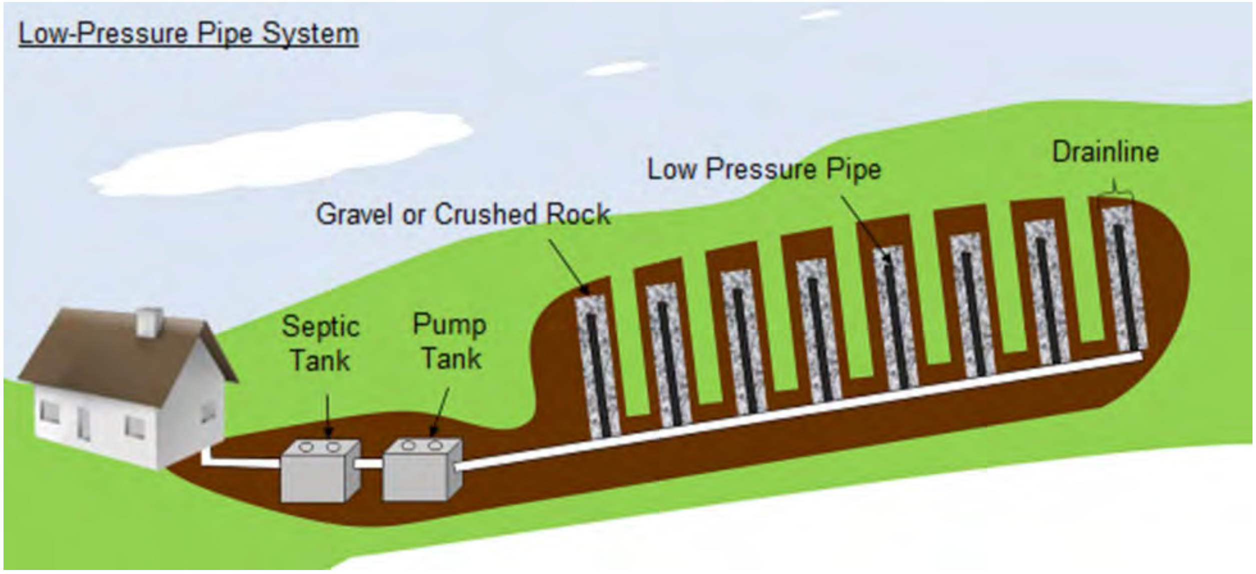

Figure 4.15 Typical Low-Pressure Pipe Disposal System (Three Oaks Engineering)

Table 4.14 Benefits and Challenges of Low-Pressure Pipe Disposal Systems

Benefits	Challenges
• Reliable alternative for areas with low permeability, seasonal high-water tables, and/or severe slopes. • Shallow and narrow trenches reduce site disturbance and land area requirement. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally.	• Limited storage capacity around laterals. • Possibility of wastewater accumulation in the trenches. • Potential for clogging and infiltration problems.

4.5.1.4 Seepage Pit

A seepage pit is a disposal system constructed in a similar manner as a cesspool, but it receives treated wastewater. These systems are generally constructed from reinforced concrete rings, with a diameter of 8- to 10-feet and a height of 2 feet, that are stacked in order to achieve the depth required (usually 15 to 30 feet) to meet percolation requirements (see Figure 4.16). Each ring has large openings in the sides. A concrete lid with a 4-inch inspection port is placed on top. Water percolates out from the sides and the bottom of the unit into the surrounding soil. The effective percolation area is measured as the pit sidewall area. For a cluster system, multiple seepage pits would be required.

A summary of benefits and challenges of seepage pits are shown in Table 4.15. Seepage pits are the simplest and most compact method to percolate water into the ground. They are viable options when the available land is insufficient for absorption beds, the terrain is steep, or when an impermeable layer overlies more suitable soil. However, seepage pits do not provide additional treatment like most other disposal systems. In general, seepage pit disposal from a decentralized cluster treatment system would be functionally identical to an injection well and thus would not be allowed by the DOH unless other options such as percolation or reuse were not feasible.

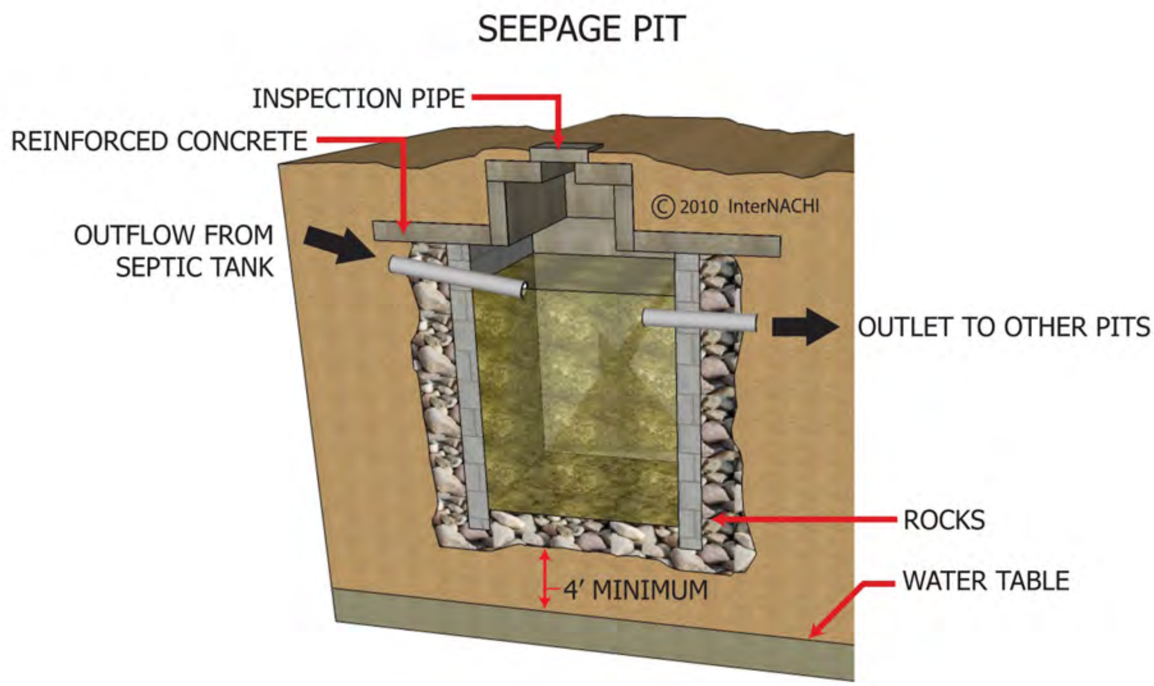

Figure 4.16 Typical Seepage Pit Disposal System (InterNACHI, 2020)

Table 4.15 Benefits and Challenges of Seepage Pit Disposal Systems

Benefits	Challenges
• Simplest and most compact method to percolate water into the ground. • Viable options when land is insufficient for absorption beds or trenches, or the terrain is steep.	• Cannot provide additional treatment or evapotranspiration. • Must have adequate separation from groundwater (at least 3 ft).

4.5.2 Water Reuse

If an effluent from a treatment system meets criteria set by the DOH, then the recycled water can be utilized in landscaping, agricultural irrigation, and even toilet flushing.

The highest quality of recycled water defined by DOH is R-1 and is the only level of recycled water that can be used above the underground injection control (UIC) line. The requirements for R-1 water include tertiary filtration, daily monitoring for fecal bacteria, continuous turbidity monitoring, automatic diversion of off-spec water, 100 percent back-up disposal, and a reuse site with an approved management plan, signage, and a named responsible manager. The requirements for R-1 water are likely too numerous and costly for all but the upper end of cluster system sizes considered here (50,000 gpd). The requirements for R-2 recycled water are less stringent, making recycling of effluent less difficult. However, the acceptable uses of R-2 water are also more limited (generally subsurface use only to prevent human contact). Also, a reuse site is still required as well as an approved management plan/manager.

Systems should be designed such that there are no crossings of recycled water lines and potable water lines. Clear markings should be used to identify recycled water pipelines. Strict and specific monitoring and record keeping are required, depending on the level of effluent quality and the method of application of the recycled water. The DOH has published Guidelines for the Treatment and Reuse of Recycled Water, available at the DOH website.[7]

Although water reuse is feasible for small cluster systems, the up-front capital and on-going O&M costs of a complete water reuse system including off-site reuse area management will almost certainly be greater than any other disposal alternative. A summary of benefits and challenges are shown in Table 4.16.

Table 4.16 Benefits and Challenges of Water Reuse Disposal Systems

Benefits	Challenges
• Helps reduce overall demand on potable water supply. • Utilized in landscaping, agricultural irrigation, and even toilet flushing.	• Often more expensive treatment is required to reach water quality requirements. • Strict rules and regulations to prevent potential environmental or health consequences.

4.5.3 Evapotranspiration

Evapotranspiration is a disposal technology that combines direct evaporation and plant transpiration . Treated effluent is conveyed to a porous bed containing water-tolerant plants. Wicking, or capillary action, draws water to the surface, where it is either taken up by the plants and transpired, or evaporated from the surface (see Figure 4.17). Effluent that is not transpired or evaporated will percolate from the bottom of the bed. This type of system is also known as evapotranspiration-infiltration (ETI).

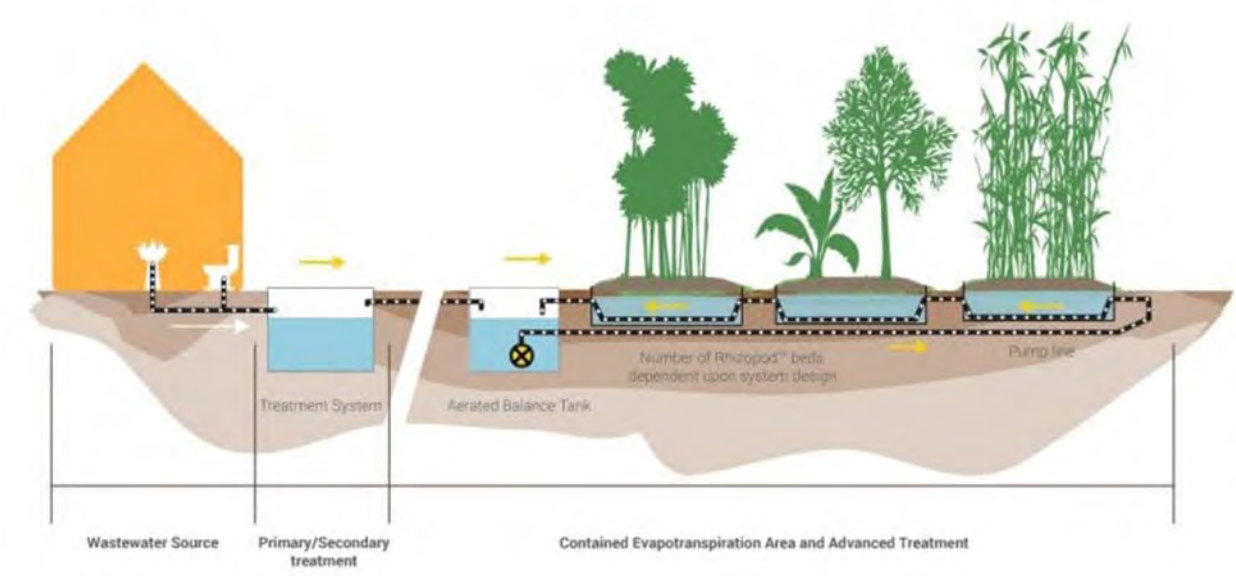

Figure 4.17 Typical Evapotranspiration Disposal System (Rhizopod System Technology)

These systems can also be designed with an underlying impermeable liner for a “zero-discharge” system. In this case, disposal is strictly dependent on evaporation and plant transpiration. Additionally, the liner allows

[7] http://www.hawaii.gov/health/environmental/water/wastewater/forms.html

the system to be placed above a UIC line or where there is shallow groundwater or proximate surface water such as a stream, lake or the ocean. Other components that are typically included are high-or low-pressure distribution lines, flushing or filtering mechanism, controller to automate dosing cycles, distribution pump, and alternating evapotranspiration beds.

A summary of benefits and challenges are shown in Table 4.17. These systems are a simple and low-cost way of achieving effective treated effluent disposal. However, they can require large surface areas and are best applied in locations where evaporation rates are much higher than precipitation rates.

Table 4.17 Benefits and Challenges of Evapotranspiration Disposal Systems

Benefits	Challenges
• If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved. • Low cost, simple disposal system.	• Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates. • More effective in arid climates where evaporation rates are much higher than precipitation.

4.5.4 Injection Wells

In this system, subsurface disposal of wastewater occurs by injection via a well (HAR 11-23). The current rules in Hawaiʻi are designed to prohibit the contamination of US drinking waters. Wastewater cannot be injected into current sources or potential future sources of drinking water. Injection can only occur into "exempted" aquifers which are already highly contaminated or have total dissolved solids (TDS) greater than 5,000 mg/L, making them brackish. In Hawaiʻi, there is a UIC line, which is a line on the map of each island which designates brackish groundwater near the coast. Makai of the UIC line, wastewater injection could potentially be granted a UIC permit. These types of permits are difficult to obtain and contain restrictions on flow, numerical contaminant limitations, and monitoring and reporting requirements.

A summary of benefits and challenges of injection wells are shown in Table 4.18. For some cesspool replacement areas close to the coast, where decentralized cluster systems could be viable, an injection well is potentially feasible as a disposal alternative. However, the DOH would generally consider it to be a "last resort" type option only applicable if other options are not viable. Currently, due to the 2019 Supreme Court ruling on the Maui County injection wells at the Lahaina WWTP, it is unlikely that any new UIC permits for wastewater will be issued in the foreseeable future.

Table 4.18 Benefits and Challenges of Injection Well Disposal Systems

Benefits	Challenges
• Very simple system. • Little to no maintenance required.	• Limited applicable locations/siting. • Very difficult to obtain a permit.

4.5.5 Surface Water Discharge

Discharge of treated wastewater to surface water requires a National Pollution Discharge Elimination System (NPDES) permit. Permit requirements are found in HAR 11-62 Wastewater Systems and in the EPA's Clean Water Act. Obtaining a new NPDES permit for wastewater discharges in Hawaiʻi is generally avoided due to cost, complexity, monitoring requirements, 5-year duration/renewal requirements, etc.

A summary of benefits and challenges of surface water discharges are shown in Table 4.19. For decentralized cluster systems near a stream or inland lake, a surface discharge permit is technically an option, and these permits are handled by the Hawaiʻi DOH. However, similar to an injection well, the DOH would generally consider it to be a "last resort" type option only applicable if other options are not viable. In addition, there are very few permitted discharges to inland lakes and streams and high levels of treatment are generally required.

Table 4.19 Benefits and Challenges of Surface Water Discharge Disposal Systems

Benefits	Challenges
• Simple system. • Effectively recycles water back into the environment. • Can augment stream flow.	• Potential negative impacts on natural bodies of water or drinking water. • NPDES permit required. Expensive monitoring and reporting required. • Very limited applicable locations/siting.

4.5.6 Residual Solids Management and Disposal

Decentralized cluster treatment systems generate residual sludges that require proper treatment and disposal just like any other WWTP. Regulations regarding sludge treatment/disposal/reuse are contained in HAR 11-62 subchapter 4. For cluster systems, the most feasible method for handling residual sludges is periodic pumping and transport of the liquid material to an offsite facility willing to accept the sludge for a fee. Typically, this is a county-owned facility, such as the regional WWTP. In some cases, it could be a privately owned and operated facility.

It is possible to process residual sludges via stabilization and dewatering within the decentralized treatment system, followed by transport of these materials to a proper disposal site such as a landfill for a fee. However, this would be very unusual for a small cluster system because the additional treatment processes and equipment and O&M required would not be cost effective compared to hauling/disposal of residual sludges to a WWTP in Hawaiʻi.

4.6 Summary of Decentralized Cluster Systems

The data and information included in this evaluation were gathered from previous studies, technical literature, vendor websites, and other publicly available resources. The evaluation is limited to common and accepted technologies available in the wastewater industry, with a focus on those treatment technologies that are available in "package plant" configurations. Package plants typically use proven technologies, are easily transported and installed, and have a small footprint. Collection systems and disposal systems are generally not configured as pre-engineered package units and must be customized to each site.

The services of a licensed engineer are required for the planning and design of a complete decentralized system consisting of a wastewater collection network, treatment facility, and a method of effluent disposal and/or reuse. There are several approaches and numerous combinations of technologies that can be applied for a complete and operable system. Some of the considerations that are involved in selecting the best overall cluster system discussed in the following sections, including:

- Benefits and challenges inherent in each technology/system.
- O&M requirements.
- Land area requirements
- Life cycle costs.

Although the performance of treatment options varies, it is not an evaluation criterion, because all the systems evaluated are assumed to meet all applicable rules and regulations for siting, sizing, and treatment performance with proper design.

4.6.1 Benefits and Challenges

The benefits and challenges of each of the decentralized collection systems, treatment systems, and disposal systems are described in Sections 4.4, 4.5, and 4.6, respectively and summarized in Table 4.20. These are some of the considerations that an engineer will make when deciding which collection, treatment, or disposal systems to include in the overall decentralized system design.

4.6.2 Operation and Maintenance Requirements

Table 4.20 also summarizes the general O&M requirements for the collection, treatment, and disposal options. All three types of systems (collection, treatment, and disposal) must be operated, serviced, maintained and ultimately replaced after expiration of their useful life. This requires appropriate labor, electricity, expendable supplies, and outside services such as water quality analyses, etc. Appendix A, Table A.1 includes a list of representative O&M providers.

4.6.3 Land Area Requirements

Land values and property acquisition is a very challenging issue for most projects in Hawaiʻi. Often, the inability to obtain necessary lands for projects becomes an insurmountable hurdle and ultimately cancelling project implementation. Likewise, for decentralized cluster systems to be successfully implemented, available land is a necessity.

A significant difference in planning for onsite wastewater treatment versus decentralized treatment is the land area required. Similar to centralized wastewater systems, decentralized cluster collection systems are located partly on private property and partly in public rights-of-way.

Decentralized treatment and disposal systems are assumed to be sited on available land or common area in/near the neighborhood/community it serves. Most, but not all, of the treatment technologies described are available as compact package plants which require only a small space. Typically, the disposal system will be co-located on the same site as the treatment plant. The area required for disposal is dependent upon the type of disposal. For percolation methods (most common disposal method), the area required is based on the soil type.

The total land area requirements for package plant-based systems can range from 0.25 to 0.75 acres for a 10 home cluster system, and from one to several acres for a 100 home cluster system, depending on the type of soil (percolation rate) at the treatment plus disposal site. The land areas required for constructed wetland-based treatment facilities are larger than package plant systems and could require twice as much land area.

Additional information on estimated land requirements is provided in Appendix B.

4.6.4 Construction, O&M, and Life-Cycle Costs

The cost of a technology/facility/system is always a very important consideration. There are up-front capital costs for system planning, design, and construction, followed by on-going, permanent, annual costs for O&M. These are normally combined in a net present worth analysis by the design engineer to determine life-cycle costs when making system comparisons.

Costs were adapted from a 2010 study conducted by WERF (see Appendix C). However, these costs should only be used for relative comparison purposes. Similar to OSWT systems, a more detailed, site-specific engineering evaluation is necessary to gain a better grasp of potential conversion costs for decentralized cluster systems. A comparison of individual OSWT conversions and decentralized cluster system conversions can facilitate homeowner's decision processes.

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Table 4.20 Summary of Benefits, Challenges, and Operation and Maintenance Requirements for Decentralized Cluster Systems

Technology[1]	Benefits	Challenges	Technology Status	Replace Interval (yr)	O&M Effort[2]	O&M Requirements[3]
Collection System Options						
Gravity Sewers	• Can handle grit and other solids, as well as large volumes of flow. • Does not require onsite treatment or storage of the household wastewater before it is discharged. • Little impact to homeowners and their properties. • Presents a viable option if there is an appropriate difference in elevation. • No electricity for pumping and no pump maintenance.	• Flat or large variations in terrain can increase costs • Larger pipes compared to other collection system options. • Prone to clogging. • Manholes associated with gravity sewers are a potential source of inflow and infiltration. • Higher capital costs.	Most common, highly developed	60	L	• Inspect on a regular schedule, this can be accomplished via surface inspections of manholes, lowering hand-held camera or robotic CCTV. • Proactively flush accumulated debris and FOG. • Remove blockages and tree roots as required.
Liquid-Only Pressure Sewers	• Independent from land topography restrictions. • The septic tank retains most of the FOG and solids reducing clogging problems. • Septic tanks have storage capacity to operate during power outages. • Smaller pipes compared to conventional gravity sewers. • Can be installed at a shallow depth and do not require a minimum flow velocity or slope to function.	• Requires an onsite septic tank and pump on each property. • Grease and sludge must be pumped from each individual septic tank. • Anaerobic septic tanks can generate odors and methane gas. • Leaks pose a risk of wastewater exfiltration. • Pumps and filters must be maintained.	Highly developed	Pump - 20 Septic tank - 60 Piping - 60	M	• Provide/maintain electricity to each unit. • Inspect and clean filter on pump monthly. • Periodically remove accumulated sludge and scum from the septic tank. • Remove any blockages in the pressure pipe network.
Low-Pressure Sewers	• Small diameter piping, shallow, easily installed. • Independent from land topography restrictions. • No manholes required and no storm water infiltration. • Less clogging and subsequent O&M cleaning or flushing.	• Requires pump/vault installation on each property. • Requires an energy source for the grinder pumps. • Pumps must be maintained on each property.	Highly developed	Pump - 20 Piping - 60	M	• Provide/maintain electricity to each unit. • Inspect pump and chamber on a regular basis, remove any accumulated materials. • Inspect and maintain backflow preventers. • Remove any blockages in the pressure pipe network.
Vacuum Sewers	• Small diameter piping, shallow, easily installed. • No manholes required and no storm water infiltration. • Closed system with no exfiltration or odors. • Flexible installations regardless of topography and water availability.	• Requires construction of vacuum equipment at each home. Requires land for central vacuum stations • Economic feasibility depends on the number of homes served by the system (the more the better). • Requires energy to create the permanent vacuum. • Vacuum stations require regular O&M checks, typically higher O&M than gravity collection systems.	Uncommon, Highly developed	Pumps - 20 Equipment - 20 Piping - 60	H	• Provide/maintain electricity to each unit and vacuum station. • Regular pressure/vacuum testing. • Vacuum stations require regular O&M checks • Remove any blockages in the pressure pipe network.

Technology[1]	Benefits	Challenges	Technology Status	Replace Interval (yr)	O&M Effort[2]	O&M Requirements[3]
Treatment System Options						
Conventional Activated Sludge	• High BOD and nitrogen removal, high effluent quality, self-sustaining system. • Small land area requirement. • Free from fly and odor nuisance. • Can be modified to meet specific discharge limits.	• High electricity consumption and costly mechanical parts. • Requires skilled operation and maintenance. • Requires expert design and construction. • Bulking and biological surface foaming.	Most common, highly developed	30	M	• Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Extended Aeration Activated Sludge	• Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels. • Long HRT and complete mixing, minimal impact of a shock load or hydraulic surge. • Produces less sludge due to extended retention of biological solids in the aeration tank.	• Higher energy uses due to longer aeration time. • Larger footprint than CAS. • Less flexibility than CAS should regulations for effluent requirements change.	Most common, highly developed	30	M	• Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Membrane Bioreactor Activated Sludge	• Secondary clarifiers and tertiary filtration processes are eliminated, thereby reducing plant footprint. • High quality effluent.	• Membrane complexity and fouling. • Higher capital, operation, and energy costs. • Hydraulic flow peak capacity is limited to 1.8 times average flows and only for short periods.	Highly developed	30	M	• Maintenance includes chemical cleaning of membranes. • Monitoring of DO, pH, and MLSS. • Influent and effluent must be monitored, changing the parameters accordingly. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Control of concentrations of sludge and oxygen levels in the aeration tanks. • Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.
Textile Filter (Attached Growth Systems)	• Can operate at a range of organic and hydraulic loads. • Lower energy input than CAS. • Low sludge production.	• Requires expert design, construction, operation and maintenance. • Some variations have larger footprints. • Risk of clogging, depending on pre and primary treatment.	Highly developed	30	L	• Monitoring of influent and effluent. • Maintenance of all equipment following manufacturer's recommendations. • Optimum dosing rates and flushing frequency are determined from the field operation. • The packing should also be kept moist which can be problematic at night or during power failures. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • The sludge that accumulates on the filter must be periodically washed away to prevent clogging and to keep the biofilm thin and aerobic.

Technology[1]	Benefits	Challenges	Technology Status	Replace Interval (yr)	O&M Effort[2]	O&M Requirements[3]
Moving Bed Biofilm Reactor	• Efficient treatment, low HRT, flexibility to adapt to fluctuating hydraulic and organic loads. • Low Maintenance. • Very compact, due to the maximized surface area the media provide for biofilm growth.	• High-tech system. • Higher capital and operating costs. • Carriers can wash out of the system, necessitating supplemental additions.	Uncommon, Highly developed	30	H	• Monitoring of influent and effluent. • Maintenance of all equipment following manufacturer's recommendations. • Observation of media color and adjustment of air. • Monitoring and adjustment of dissolved air flotation units. • Regular cleaning of influent screens. • Regular sludge wasting and disposal. • Operators must take samples periodically and analyze them to ensure the bacteria on the carriers are still thriving.
Constructed Wetland	• Simple, easily operated natural system. • Inexpensive compared to other treatment options. • Requires little energy when the system operates with gravity flow.	• Large land requirement. • Not available as a package facility. • Vector and odor nuisances.	Uncommon, Highly developed	30	L	• Vector control to prevent population growth of insects and odor control. • Occasional maintenance of the vegetation promotes growth of desired vegetation and maintains hydraulic capacity. • Monitoring of influent and effluent.
Effluent Disposal Options						
Absorption Trench/Bed	• Common type of disposal system so there are many products available and experience with installation. • When deployed downstream from an aerobic treatment system, it provides some treatment for BOD, TSS, and fecal coliform. • No power is required, and maintenance is generally not necessary. • Graveless dome systems require less gravel backfill and provide significant additional water storage volume.	• Cannot be used in terrain where natural slope is > 12 percent. • Cannot be used if groundwater is too close to the surface, minimum vertical separation of three feet from the bottom of the trench/bed. • Large land requirement. • Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surroundings.	Most common, highly developed	60	N	• Normally none. • Some systems use a dosing pump - if present, it must be checked and cleaned. • Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected.
High-Pressure Drip	• Reliable alternative for areas with low permeability, seasonal high-water tables, or severe slopes. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally. • Significant evapotranspiration is expected.	• Large dose tank is needed to accommodate timed dose delivery to the drip absorption area. • Power is required to run pumps, sensors, and controls. Some minimal regular maintenance is required. • Clogging of emitters can occur.	Highly developed	30	L	• Provide continuous electricity to small dosing pumps. • Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters. • Regular monitoring and maintenance of pump, filter and piping shall be performed.
Low Pressure Pipe	• Reliable alternative for areas with low permeability, seasonal high-water tables, and/or severe slopes. • Shallow and narrow trenches reduce site disturbance and land area requirement. • Ability to control dose/rest cycles allows for even spacing or dosing of effluent and facilitates wastewater infiltration by spreading it spatially and temporally.	• Limited storage capacity around laterals. • Possibility of wastewater accumulation in the trenches. • Potential for clogging and infiltration problems.	Highly developed	60	L	• Monitoring ponding at the bottom of trenches, readjusting operating pressure, and reducing flow to overloaded trenches. • Flushing manifold and lateral lines periodically.

Technology(1)	Benefits	Challenges	Technology Status	Replace Interval (yr)	O&M Effort(2)	O&M Requirements(3)
Seepage Pit	• Simplest and most compact method to percolate water into the ground. • Viable options when land is insufficient for absorption beds or trenches, or the terrain is steep.	• Cannot provide additional treatment or evapotranspiration. • Must have adequate separation from groundwater (at least 3 ft).	Uncommon, unlikely to be approved	60	N	• Inspection and pumping every 2 to 4 years.
Water Reuse	• Helps reduce overall demand on potable water supply. • Utilized in landscaping, agricultural irrigation, and even toilet flushing.	• Often more expensive treatment is required to reach water quality requirements. • Strict rules and regulations to prevent potential environmental or health consequences.	Highly developed	60	H	• Extensive monitoring at the treatment facility is required; for R-1 water: continuous for NTU and fecal coliforms. • A water reuse plan is required for the reuse site, with monitoring and reporting. Signage is required at the site.
Evapotranspiration	• If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved. • Low cost, simple disposal system.	• Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates. • More effective in arid climates where evaporation rates are much higher than precipitation.	Uncommon, highly developed	60	L	• Provide continuous electricity to small dosing pumps. • Inspection of observation wells. • Trim vegetated area of ET system, replace plants as needed.
Injection Well	• Very simple system. • Little to no maintenance required.	• Limited applicable locations/siting. • Very difficult to obtain a permit.	Uncommon, unlikely to be approved	60	M	• Sampling and reporting.
Surface Water Discharge	• Simple system. • Effectively recycles water back into the environment. • Can augment stream flow.	• Potential negative impacts on natural bodies of water or drinking water. • NPDES permit required. Expensive monitoring and reporting required. • Very limited applicable locations/siting.	Uncommon, unlikely to be approved	60	M	• Sampling and reporting.

Notes:
(1) CAS = conventional activated sludge, LPP = low pressure pipe, ET = evapotranspiration.
(2) O&M = operations and maintenance, N = no maintenance, L = low maintenance, M = moderate maintenance, H = high maintenance.
(3) CCTV = closed circuit television, DO = dissolved oxygen, MLSS = mixed liquor suspended solids, BOD = biochemical oxygen demand, TSS = total suspended solids, HRT = hydraulic retention time, mg/L = milligrams per liter, mL = milliliter, NTU = nephelometric turbidity units.

4.7 Recommendations

Decentralized systems may make sense to convert several cesspools that have a high density, are within high priority areas, and where there is community support for this kind of a solution. The benefits of implementing cluster systems, where feasible include:

- **Potential for rapid conversions.** If cluster systems are implemented, this would help the state to convert more cesspools at a time. This could help to mitigate the public health and environmental risks of cesspools in high priority areas in the near term.
- **Reducing the administrative oversight and enforcement burden on state/county agencies.** For the county/state, having all systems converted on an individual is a much larger task than having decentralized cluster systems. Just in terms of sheer numbers of permitted units, it could reduce the number by orders of magnitude (e.g. instead of 88,000 individual units; 880 to 8,800 cluster systems).
- **Reduce the burden on individual homeowners to hire engineers and contractors independently to design and construct onsite systems.** A coordinated, organized effort to evaluate a cluster system for a neighborhood would relieve the burden on individual homeowners to understand and determine their cesspool upgrade needs.
- **Ensure proper operations and ongoing maintenance of the systems by requiring a licensed wastewater operator.** Cluster systems are regulated and inspected by the Hawaii DOH WWB the same manner as existing WWTPs. The rules and procedures are already in place, including the requirement that state-licensed WWTP operators oversee the cluster systems. This is more likely to ensure that systems are inspected, operated, maintained, repaired, and function as required to meet the treatment and disposal regulations.
- **Potentially broaden the range of funding opportunities.** One of the hurdles in funding cesspool conversions is that many existing funding options require a conduit agency or intermediate party to manage and administer available grant or low interest loans to individual homeowners for cesspool conversions. Given that decentralized systems will need to be managed and operated by a third party, this also opens the door for more funding options. In addition, if water reuse is a disposal option for the decentralized system, there are additional funding opportunities that may apply. Water reuse is not allowed for onsite systems; thus, those funding opportunities would not be available.

The challenges to implementing cluster systems for cesspool conversions in Hawaiʻi are:

- **Need for neighborhood-level coordination.** One of the greatest hurdles to implementing decentralized solutions for cesspool conversions is that a group of homeowners would need to take the initiative to form an association or district to collect fees and procure various professional services. To truly evaluate the feasibility of decentralized systems for certain neighborhoods, a licensed engineer needs to perform a site-specific analysis and develop costs for a recommended system. Legislative measures may be necessary to facilitate neighborhood-level coordination especially if participation will be required of homeowners.
- **Cost.** Decentralized cluster systems require higher up-front planning and design fees and have higher construction costs than OSWT and disposal systems. A site-specific analysis is necessary to evaluate the feasibility and best overall system options for a neighborhood. The engineering evaluation could be quite expensive – easily 5 to 10 times the cost of an onsite design for a single homeowner. In addition, the construction would be more extensive than onsite systems, and construction costs would accordingly be higher on a per lot basis.

- **Need for skilled operators.** Licensed wastewater operations professionals would be required to operate and maintain the cluster system components in perpetuity.
- **Land/space requirement.** Decentralized systems would likely need to be constructed on newly acquired land and may require easements. These cluster systems would only be a viable option if the required land is available.

A countywide or statewide study of potential neighborhoods/sites for cluster systems with an initial focus on priority areas, including planning level cost estimates could facilitate this process. Such a study could help the state to evaluate and upgrade those cesspools deemed to pose the greatest risks to public health and the environment more rapidly. The information provided within this TM can help to facilitate future studies and evaluations of decentralized cluster wastewater systems by licensed engineers.

4.8 References

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http://www.honolulu.gov/rep/site/env/wwm_docs/DESIGN_STANDARDS_-_CHAPT_1_FINAL.pdf
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Appendix A
REPRESENTATIVE OPERATOR AND PACKAGE TREATMENT PLANT VENDOR INFORMATION

Table A.1 Representative Operation and Maintenance Providers

Service Provider	County	Facilities Operated	Web Page
Aqua Engineers	Kauaʻi, Oʻahu, Hawaiʻi	30 facilities, including Schofield Barracks WWTP and Poipu WWTP	www.aquaengineers.com
Hawaiʻi American Water	Oʻahu, Hawaiʻi	East Honolulu WWTP	www.amwater.com
Hawaiʻi Water Service, part of California Water Service Group	Hawaiʻi	Waikoloa WWTPs	www.calwatergroup.com
Aqua Certified Operations	Oʻahu	Various	NA Aiea
O&M Enterprises	Oʻahu	Various	NA Kapolei

Table A.2 Representative Collection System Vendors

Vendor	Product	Type	Capacities	Web Page
Environment One Inc. Niskayuna, NY Local Rep: Engineered Systems, Paul Scott	All-Terrain Sewer ™	Low pressure sewer with grinder pumps	unlimited number of individual homes	https://eone.com/
Orenco Systems Inc. Sutherlin, OR	Prelos ™	Pressure liquid-only sewer system	unlimited number of individual homes	www.orenco.com/
Flovac Inc, Palm Coast, FL	Flovac ™	Vacuum sewer system	unlimited number of individual homes	https://flovac.com/
Aqseptance Group Inc, Rochester, IN	Airvac ™ Roediger	Vacuum sewer system	unlimited number of individual homes	www.aqseptence.com/app/en/keybrands/airvac/
Redivac, Northamptonshire, UK. RDC Sale, Richmond, VA	Redivac ™	Vacuum sewer system	unlimited number of individual homes	www.iseki-vacuum.com/

Table A.3 Representative Package Plant Vendors

Vendor	Product	Type	Capacities	Web Page
Smith and Loveless Inc. Lenexa, KS Local Rep: Fluid Technologies Mike Choy	FAST™	Submerged media activated sludge	Modular: Non-modular: up to 1,000,000 gpd	www.smithandloveless.com
	Titan™	MBR	Titan MBR QUBE™ 0-20,000 gpd (containerized) Titan MBR MEM-BOX™ and Titan MBR MEM-FRAME™ 0-190,000 gpd (retrofit)	
	Oxigest™	CAS	ADDIGEST™ 0-56,000 gpd (modular) Model R Oxigest ™ 100,000-1,000,000 gpd	
Delta Treatment Systems. Infiltrator Water Technologies LLC. Old Saybrook, CT	ECOPOD-D™	Submerged media activated sludge	1,500-250,000 gpd	www.infiltratorwater.com/delta-treatment-systems
	Delta Extended Aeration Package Plant	Extended aeration activated sludge	500-250,000 gpd	
WesTech Engineering, Inc. Salt Lake City, UT Local Rep: Hawai'i Eng. Services, Mike Elhoff	STM-Aerotor™	Submerged media activated sludge	5,000-5,000,000 gpd	www.westech-inc.com/
	ClearLogic™	MBR	5,000-5,000,000 gpd	
Alfa Laval Inc. Richmond, VA	AS-H	Activated sludge: Complete Mix, MBR and SBR configurations	5,000-200,000 gpd	www.alfalaval.us/products/process-solutions/wastewater-treatment-plants/
International Wastewater Technologies, Honolulu, HI Rep: Glen Lindbo	CBT™	Sequencing batch activated sludge	1,000-50,000 pgd	https://internationalwastewater.com/
Lakeside Equipment Inc. Bartlett, IL. Local Rep: Promark Corp Freddy Lenore	E. A. Aerotor™	Extended Aeration complete-mix activated sludge	10,000-500,000 gpd	www.lakeside-equipment.com/product/package-treatment-plants/

Vendor	Product	Type	Capacities	Web Page
Pollution Control Systems Inc. Milford, OH	Package Plants	Activated Sludge	500-100,000 gpd	www.pollutioncontrolsystem.com/packaged-plants
WSI International, Annapolis, MD	Package Plants	MBBR	1,000-100,000 gpd Several in Hawaiʻi	www.wsi-llc.com/
EDI, Inc. Columbia, MO Local Rep: H2O Process Milton Choi	IDEAL™	Activated Sludge Lagoon: Intermittently Decanted Extended Aeration Lagoon	>10,000 gpd	www.wastewater.com/valueaddedsolutions/lagoonsolutions
Orenco Systems Inc. Sutherlin, OR	Advantex™	Recirculating textile filter for septic effluent or raw sewage. Modular.	AX100: 0-2,500 gpd/unit for septic effluent. AX-Max: 0-15,000 gpd/unit for septic effluent, or 0-5,000 gpd for raw sewage.	www.orenco.com/

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Appendix B

ESTIMATED LAND AREA REQUIREMENTS

Table B.1 Estimated Land Area Requirements for Decentralized Cluster Treatment and Disposal System

System Size (gpd)	Treatment System Technology (area range, sf)(1)(2)	Disposal System Technology (area range, sf)(1)(3)	Total Treatment and Disposal (area range)(4)	
			square feet (sf)	acres
	CAS, EAAS, MBR, TXF, MBBR	ABS, LPP		
5,000	8,000-10,000	3,500-16,000	11,500-26,000	0.25-0.6
10,000	10,000-15,000	7,000-32,000	17,000-48,000	0.4-1.1
50,000	20,000-25,000	35,000-160,000	55,000-185,000	1.3-4.2
	CAS, EAAS, MBR, TXF, MBBR	DRIP, ET, Water Reuse		
5,000	8,000-10,000	7,000-32,000	15,000-32,000	0.35-0.75
10,000	10,000-15,000	14,000-64,000	24,000-79,000	0.6-1.8
50,000	20,000-25,000	70,000-320,000	90,000-345,000	2.1-7.9
	CW	ABS, LPP		
5,000	20,000	3,500-16,000	23,500-36,000	0.5-0.8
10,000	30,000	7,000-32,000	37,000-62,000	0.8-1.4
50,000	85,000	35,000-160,000	120,000-245,000	2.8-5.6
	CW	DRIP, ET, Water Reuse		
5,000	20,000	7,000-32,000	27,000-52,000	0.6-1.2
10,000	30,000	14,000-64,000	44,000-94,000	1.0-2.1
50,000	85,000	70,000-320,000	155,000-405,000	3.6-9.3

Notes:

(1) CAS = conventional activated sludge, EAAS = extended aeration activated sludge, MBR = membrane bioreactor, TXF = textile filter (attached growth system), MBBR = moving bed biofilm reactor, CW = constructed wetland, ABS = absorption trench/bed, DRIP = high-pressure drip, LPP = low pressure pipe, ET = evapotranspiration.

(2) For typical package plant treatment systems, the following assumptions were made: Package unit dimensions: 5000 gallons per day (gpd): 8 feet (ft) x 24 ft; 10,000 gpd: 10 ft x 50 ft; 50,000 gpd: 12 ft x 120 ft; Buffer to adjacent properties: 25 ft; Small building with lab and generator: 10 ft x 20 ft; Access driveway/parking/turnaround for truck: 30 ft x 30 ft. For a constructed wetland system, it was assumed that the area required is 1 sf per gpd of flow (Purdue Wetland Manual). The facility would also require a small building, access/turnaround and 25 ft buffer all around. The resulting lot size for a CW system are as follows: 5000 gpd: 20,000 square feet (sf) or 1/2 acre; 10,000 gpd: 30,000 sf or 3/4 acre; 50,000 gpd: 85,000 sf or 2 acres.

(3) The area required for disposal is dependent upon the type of system. For percolation methods, the area required is based on the soil type. The area required for infiltration is determined and then normally 100 percent backup is required which doubles the area. In HAR 11-62 (Appendix D, Table III), the maximum application rates are specified 0.61 and 2.86 gallons per day per square feet (gpdsf) which correspond to percolation rates between 1 and 60 minutes per inch (determined from average results of field percolation tests). The range of areas required for percolation systems including absorption, and low-pressure pipe are as follows (drip irrigation and evapotranspiration systems will require double these areas): 5000 gpd: 3,500-16,000 sf or 0.1 to 0.4 acre; 10,000 gpd: 7,000-32,000 sf or 0.2 to 0.8 acre; 50,000 gpd: 35,000-160,000 sf or 1 to 4 acres.

(4) The required areas for treatment and disposal technologies must be summed to obtain the size of a decentralized cluster treatment and disposal facility. The total land area requirements for package plant-based systems range from 0.25 to 0.75 acres for a 10-home cluster system, and from 1.3 to 7.9 acres for a 100 home cluster system, depending on the type of soil (percolation rate) at the treatment plus disposal site. The land areas required for constructed wetland-based treatment facilities are larger, ranging from 0.5-1.2 acres for a 10 home cluster to 2.8-9.3 acres for a 100-home cluster. The CW land areas are roughly twice as large for the smaller clusters; however, the required areas are not so large as to rule out the CW-based systems.

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Appendix C

ESTIMATED CONSTRUCTION, O&M, AND LIFE CYCLE COSTS

Estimated Construction, O&M, and Life-Cycle Costs

Costs were adapted from developed by the Water Environment Research Foundation (WERF) (2010). The WERF report provided costs in 2009 dollars for mainland USA for construction, O&M, and 60-year life cycle costs (5.5 percent discount rate) for three different sizes of systems. Their construction costs include the on-property and off-property equipment and installation costs and 20 percent for contractor overhead and profit. It does not include engineering design costs. They estimated costs for 20, 40, and 200 homes with corresponding flows of 5,000, 10,000 and 50,000 gpd. The WERF flow per home assumption is 250 gpd/home which is one half of the value assumed in this TM04. (500 gpd). For those systems which were included in the WERF report, the 2009 costs for construction and O&M were adjusted to 2020 dollars in Hawaiʻi using a ratio of the RS Means Construction Cost Index - 239.1/180.1 = 1.328. The 60-year net-present-worth life-cycle costs were recalculated using the adjusted costs, the replacement schedules in Tables C.1 through C.3, and a discount rate of 3.0 percent.

The WERF report included cost estimates for all of the collection and disposal options described in TM04. For evapotranspiration disposal, the WERF report stated that ET should cost slightly more than percolation - absorption systems, and thus the costs for ET were estimated as 5 percent greater than ABS disposal.

The WERF report did not include cost estimates for CW, MBR, MBBR, and TXF. For CW treatment, it was assumed that the costs should be similar to the cost of percolation-absorption disposal system with the addition of a synthetic liner system. The liner is assumed to add 5 percent to the construction cost of an absorption system to derive the CW cost. For MBRs costs, it is assumed that MBRs are 50 percent greater construction cost due to additional equipment required for the membrane separation system. TXF are recirculating media filters that use textile instead of traditional sand media. The basic components are the same and thus the WERF cost estimates for recirculating media filters were used in Table C.2.

Table C.1 Estimated Costs for Decentralized Cluster Collection System Technologies

Collection System Technology	Size (gpd)	Costs ($)		
		Construction(1)	Annual O&M	60-year Life-Cycle
Conventional Gravity Sewers	5,000	311,000-467,000	24,000-36,000	976,000-1,467,000
	10,000	623,000-934,000	33,000-49,000	1,523,000-2,286,000
	50,000	3,226,000-4,839,000	102,000-153,000	6,056,000-9,066,000
Liquid-Only Pressure Sewers(2)	5,000	117,000-177,000	8,000-12,000	337,000-507,000
	10,000	235,000-352,000	16,000-24,000	676,000-1,013,000
	50,000	1,197,000-1,795,000	80,000-120,000	3,402,000-5,103,000
Low-Pressure Sewers	5,000	175,000-264,000	15,000-21,000	580,000-852,000
	10,000	352,000-527,000	28,000-42,000	1,124,000-1,703,000
	50,000	1,781,000-2,672,000	141,000-211,000	5,677,000-8,516,000
Vacuum Sewers	5,000	248,000-372,000	12,000-18,000	584,000-876,000
	10,000	496,000-745,000	24,000-36,000	1,169,000-1,752,000
	50,000	2,482,000-3,724,000	122,000-182,000	5,845,000-8,759,000

Notes:
(1) Excludes engineering, easements, permits, and contingencies for difficult site conditions.
(2) Excludes the cost of an onsite septic tank.

Table C.2 Estimated Relative Costs for Decentralized Cluster Treatment System Technologies

Treatment System Technology	Size (gpd)	Costs ($)		
		Construction(1)	Annual O&M	60-year Life-Cycl
Conventional and Extended Aeration Activated Sludge, and Moving Bed Biofilm Reactor	5,000	133,000-199,000	8,000-12,000	415,000-627,000
	10,000	197,000-296,000	14,000-21,000	674,000-995,000
	50,000	544,000-818,000	57,000-86,000	2,349,000-3,544,000
Membrane Bioreactor	5,000	199,000-299,000	16,000-25,000	737,000-1,113,000
	10,000	295,000-444,000	29,000-42,000	1,210,000-1,781,000
	50,000	817,000-1,227,000	114,000-173,000	4,314,000-6,511,000
Textile Filter	5,000	40,000-61,000	6,000-9,000	220,000-325,000
	10,000	139,000-195,000	11,000-16,000	485,000-731,000
	50,000	381,000-572,000	46,000-68,000	1,810,000-2,679,000
Constructed Wetlands	5,000	75,000-113,000	3,000-5,000	163,000-242,000
	10,000	146,000-220,000	6,000-9,000	314,000-471,000
	50,000	721,000-1,082,000	29,000-43,000	1,520,000-2,280,000

Notes:
(1) Excludes engineering, easements, permits, and contingencies for difficult site conditions.

Table C.3 Estimated Relative Costs for Decentralized Cluster Disposal Systems

Disposal System Technology	Size	Costs ($)		
		Construction(1)	Annual O&M	60-year Life-Cycle
Absorption Systems	5,000 gpd	72,000-108,000	3,000-5000	159,000-237,000
	10,000 gpd	139,000-210,000	6,000-9000	307,000-461,000
	50,000 gpd	687,000-1,031,000	29,000-43,000	1,486,000-2,229,000
Drip Systems	5,000 gpd	49,000-74,000	5,000-7,000	199,000-302,000
	10,000 gpd	113,000-169,000	10,000-14,000	431,000-632,000
	50,000 gpd	437,000-656,000	44,000-67,000	1,844,000-2,786,000
Low Pressure Pipe	5,000 gpd	112,000-169,000	7,000-10,000	297,000-449,000
	10,000 gpd	244,000-365,000	14,000-20,000	622,000-932,000
	50,000 gpd	1,813,000-2,718,000	89,000-133,000	4,289,000-6,396,000
Seepage Pit	Any	NA	NA	NA
Water Reuse via Spray Irrigation	5,000 gpd	183,000-274,000	3,000-5,000	273,000-412,000
	10,000 gpd	352,000-527,000	6,000-10,000	527,000-791,000
	50,000 gpd	1,673,000-2,510,000	31,000-46,000	2,530,000-3,778,000
Evapotranspiration Systems	5,000 gpd	75,000-113,000	3,000-5,000	163,000-242,000
	10,000 gpd	146,000-220,000	6,000-9,000	314,000-471,000
	50,000 gpd	721,000-1,082,000	29,000-43,000	1,520,000-2,280,000
Injection Well	Any	NA	NA	NA
Surface Water Discharge	Any	NA	NA	NA

Notes:
(1) Excludes engineering, easements, permits, and contingencies for difficult site conditions.
(2) NA = not applicable

Appendix B

Onsite Treatment Technologies

Septic Tank

APPROVED ONSITE TREATMENT TECHNOLOGY

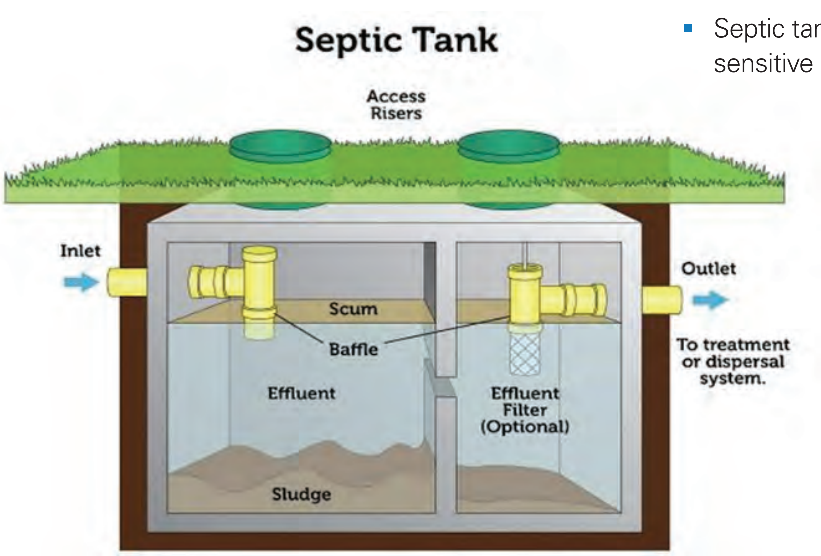
A septic tank serves as both a settling and skimming tank and partial anaerobic treatment. The baffles in the tank cause solids to settle to the bottom and create a layer of sludge, while fats, oils, grease, and other floatables rise to the top and create a layer of scum. Based on Hawaiʻi's design requirements, a screen should also be installed on the effluent end to enhance solids removal and prevent clogging of downstream disposal system. If high quality effluent is desired, a septic tank could be used to pretreat wastewater prior to a more advanced treatment process.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Where a basic level of treatment is required.

BENEFITS

- Power is not required to operate a septic tank.
- Simple, passive system that does not require significant maintenance.



Septic Tank with Two Chambers (US EPA, 2018).

CHALLENGES / RESTRICTIONS

- Accumulated sludge and scum must be removed on a regular basis to prevent carryover of these materials into downstream processes.
- The effluent filter must be cleaned periodically to prevent clogging.
- Odor – objectionable odors can be emitted.

OPERATIONS AND MAINTENANCE

- Septic tanks need to be pumped out and inspected approximately once every 2 years.

EFFLUENT QUALITY

- Water quality does not meet NSF245 criteria for total nitrogen removal, or NSF40 criteria for CBOD5, TSS, and pH without further treatment.
- Septic tanks may not apply to environmentally sensitive areas.

Aerobic Treatment Unit (with and without Denitrification)

APPROVED ONSITE TREATMENT TECHNOLOGY

An aerobic treatment unit, or ATU, is a self-contained onsite system that is designed to provide secondary biological treatment, allowing effluent to discharge into an approved disposal system. These units typically include nitrification in the aerobic zone (conversion of ammonia to nitrate) and may include denitrification in an anoxic zone (conversion of nitrate to nitrogen gas).

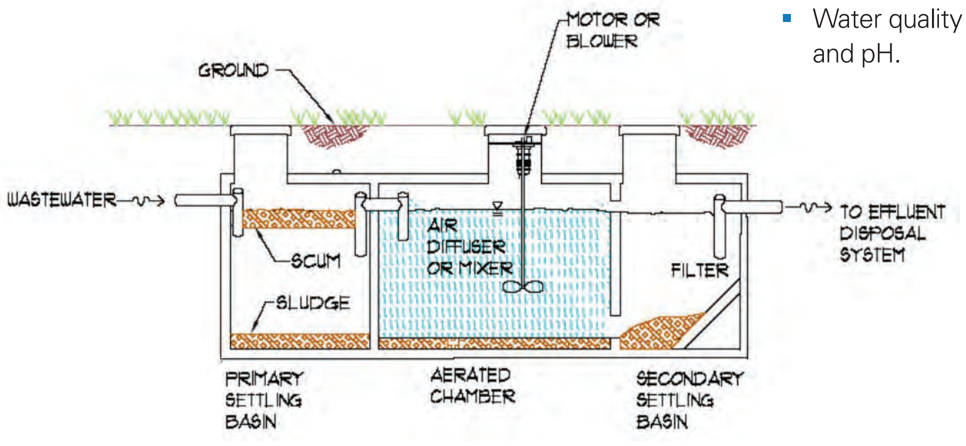
A combined attached and suspended-growth flow-through biological treatment system is a type of ATU where the aerated part of the unit contains plastic media. This allows microorganisms to attach and grow and other microorganisms are kept in suspension by mixing air with wastewater influent and concentrated underflow or sludge (from a clarifier) in an aeration tank. This configuration allows microorganisms to form a slime layer on the surface of submerged plastic media which essentially allows incorporation of more biomass in the same volume. Wastewater is treated as it passes through the media.

IDEAL APPLICATION

- Areas where a higher level of treatment is required (i.e. compliance with NSF245).
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- Since the biological process takes place in an aerobic environment where free oxygen is available, complete nitrification of ammonia can occur.
- ATUs can also be designed to include denitrification.



Combined Attached and Suspended Growth ATU.

CHALLENGES / RESTRICTIONS

- Power is needed to operate the blowers, controls, and monitoring and alarm systems in the ATU.
- ATUs are sensitive to high and low temperatures, heavy loading of solids, toxic chemicals, power failures, and large influent flow variability.

OPERATIONS AND MAINTENANCE

- Trained professionals should inspect the system every four to six months, along with sludge/scum pumping, as needed.

EFFLUENT QUALITY

- Water quality does not meet NSF245 criteria for total nitrogen removal (for nitrifying ATU).
- Water quality does meet NSF245 criteria for total nitrogen removal (for denitrifying ATU).
- Water quality meets NSF40 criteria for CBOD5, TSS, and pH.

Chlorine Disinfection

APPROVED ONSITE TREATMENT TECHNOLOGY

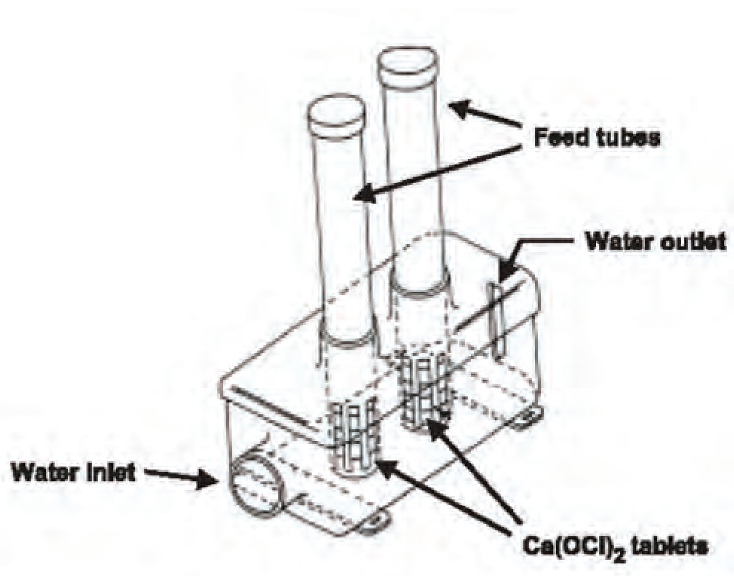
Wastewater disinfection reduces the possibility of pathogenic organisms entering the environment. Chlorine is a powerful oxidizing chemical often used as a disinfectant following wastewater treatment. Powder or tablets of solid hypochlorite (calcium hypochlorite and sodium hypochlorite) are the forms that can be used for onsite systems. All forms of chlorine are toxic, corrosive, and require careful handling and storage. For small onsite systems, the most common disinfection method is a tablet chlorinator—it does not require electricity, is easy to operate and maintain, and is relatively inexpensive.

IDEAL APPLICATION

- Following a wastewater treatment system such as an ATU where disinfection is required (e.g. near coastal or sensitive waters).

BENEFITS

- Chlorine is readily available, low cost, and is effective against a wide range of pathogenic organisms.
- Units are inexpensive and do not require energy to operate.
- Easy to operate and maintain.



Stack-Feed Tablet Chlorinator.

CHALLENGES / RESTRICTIONS

- Requires substantial treatment prior to disinfection.
- Chlorine chemicals need to be stored and handled carefully.
- Require periodic chemical addition. Chlorine tablet feeder may jam and cause system to not work properly.
- Residual chlorine released in treated wastewater may have adverse effects on other organisms in the environment.
- Obtaining the correct type of chlorine tablets can be difficult; wastewater-type tablets are different than pool-type chlorine tablets which expand when wetted.

OPERATIONS AND MAINTENANCE

- Systems should be inspected monthly to ensure operation. For a typical system, tablets may need to be added every 4 to 6 months.

EFFLUENT QUALITY

- Can remove a high percentage of fecal coliform.

Ultraviolet Disinfection

APPROVED ONSITE TREATMENT TECHNOLOGY

Ultraviolet (UV) disinfection employs mercury-type lamps separated from the water by a quartz sleeve contained in a flow through stainless-steel reaction vessel (pipe). UV light acts as a physical disinfection agent due to the germicidal properties of UV in the range of 240 to 270 nanometers. The radiation penetrates the cell wall of microorganisms and causes cellular mutations that prevent reproduction. Effectiveness of UV disinfection depends on the clarity of the treated wastewater, UV intensity, time of exposure, and reactor configuration.

IDEAL APPLICATION

- Following a wastewater treatment system such as an ATU where disinfection is required (e.g. near coastal or sensitive waters).

BENEFITS

- UV successfully inactivates most bacteria, viruses, spores, and cysts.
- In contrast to chlorine, this method does not involve handling or storing of hazardous or toxic chemicals.
- Does not leave residual chemical or toxicity in the water.
- Very compact system.

An ultraviolet disinfection system (steel cylinder to the right of the control box) used to treat sand filter effluent before landscape irrigation.

CHALLENGES / RESTRICTIONS

- Requires a high level of treatment prior to disinfection.
- A continuous power supply is required to operate the UV bulbs.
- Periodic cleaning of the quartz sleeves is required to ensure transmission of the UV radiation into the wastewater (monthly minimally).
- Bulbs must be replaced (typically annually)
- UV treatment is rendered ineffective in wastewater with low clarity due to bacteria being shielded by high turbidity and total suspended solids.

OPERATIONS AND MAINTENANCE

- Requires that the lamps be cleaned and/or changed periodically to maintain a high level of treatment. Because the system uses electrical power it will need regular inspection to ensure correct operation.

EFFLUENT QUALITY

- Can remove a high percentage of fecal coliform.

Recirculating Filter

APPROVED ONSITE TREATMENT TECHNOLOGY

A recirculating filter is a treatment technology in which septic tank effluent is percolated through a bed of sand or textile material where it undergoes further biological treatment. Carbon oxidation, nitrification, and denitrification can all occur. A portion of the percolated water is pumped back to the pump chamber or the treatment process, and another portion passes on to a dispersal system such as drip irrigation or a seepage pit. The nitrate in the recirculated water undergoes denitrification under anaerobic conditions (Barnstable County Department of Health and Environment, 2018).

IDEAL APPLICATION

- Where additional treatment of septic tank effluent is needed prior to disposal.
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- Can remove up to 50 percent total nitrogen.
- Secondary effluent quality can be obtained without aeration.

CHALLENGES / RESTRICTIONS

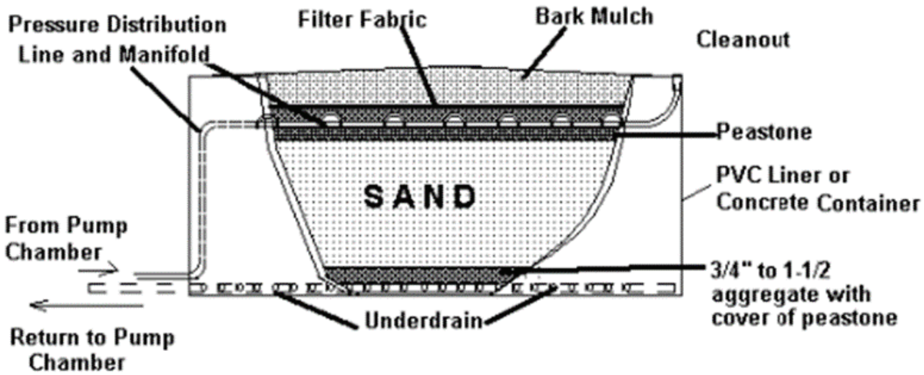
- A septic tank is needed for preliminary treatment of the wastewater.
- Large land area may be required for effluent disposal.
- Filters need to be covered to protect against odor, debris, algae fouling, and precipitation.
- A pump is needed for recirculating the wastewater.

OPERATIONS AND MAINTENANCE

- Operational costs include electricity for the pump and labor. The filter should be inspected every 3 to 4 months, and the filter media must be removed and replaced periodically.

EFFLUENT QUALITY

- Water quality can meet NSF245 criteria for total nitrogen removal or NSF40 criteria for CBOD5, TSS, and pH depending upon the selected unit.



Typical Recirculating Sand Filter.

Eliminite Wastewater Treatment Process

INNOVATIVE ONSITE TREATMENT TECHNOLOGY – APPROVAL REQUIRED

The Eliminite wastewater treatment process is a denitrifying septic system utilizing multiple tanks and a patented, proprietary treatment media called MetaRocks® to remove nitrogen. MetaRocks® provide a surface for nitrifying and denitrifying bacteria to thrive. The first tank is used as a septic tank, and the second tank has two chambers to house the MetaRocks® and provide BOD5, TSS, and total N removal. The Eliminite system is followed by a disposal system such as absorption or seepage pit (Eliminite, Inc., 2018).

IDEAL APPLICATION

- Where nitrogen removal is required in addition to BOD and TSS.
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps

BENEFITS

- Average total nitrogen removal is expected to be approximately 60 percent.

CHALLENGES / RESTRICTIONS

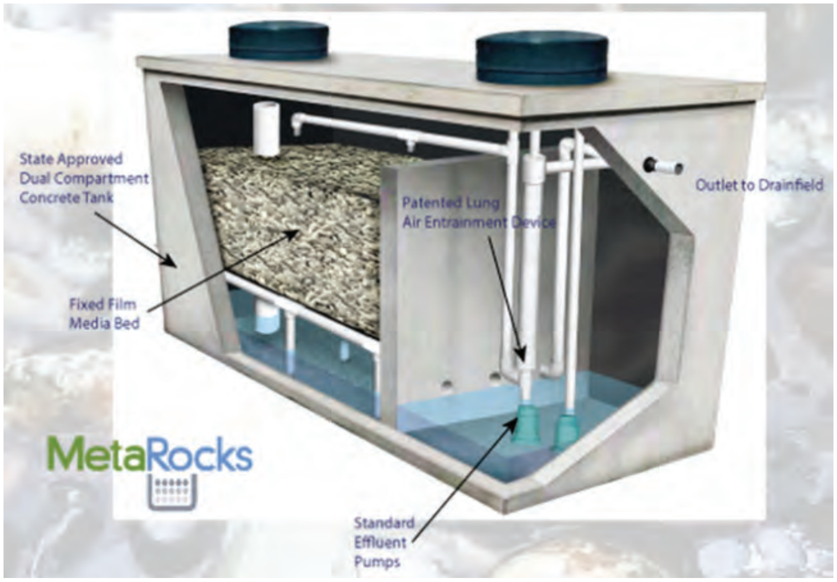
- Pump operation and electrical power are needed.
- This innovative technology is new to Hawai'i, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.

OPERATIONS AND MAINTENANCE

- Inspections to verify the recirculation pump is functional and repair/replace as needed.
- Annual inspection of rock media chamber, with cleaning and addition of lost media as needed.

EFFLUENT QUALITY

- Meeting NSF245 criteria for total nitrogen removal is a goal, but certification has not yet been granted.
- Meeting NSF40 criteria for CBOD5, TSS, and pH is a goal, but certification has not yet been granted.



Nitrogen Reduction by Eliminite's MetaRocks® (Eliminite, Inc., 2018).

NITREX™ Nitrogen Removal Process

INNOVATIVE ONSITE TREATMENT TECHNOLOGY – APPROVAL REQUIRED

The NITREX™ system utilizes a proprietary reactive media to achieve denitrification of nitrate-rich wastewaters. As such, the process requires an aerobic treatment unit or the combination of a septic tank/ recirculating sand filter as a pretreatment step to treat BOD and TSS and provide nitrification (conversion of ammonia to nitrate). The nitrate contaminated wastewater is fed through NITREX™ media, which is contained in a prefabricated tank, or for larger installations, in an engineered excavation. NITREX™ is a relatively passive system that requires no pumping or chemical addition.

IDEAL APPLICATION

- Where a high degree of nitrogen removal is required.
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- Average total nitrogen removal is expected to be over 90 percent.
- There is no pumping or chemical addition requirement.
- The NITREX™ media has an expected performance period of 50 years.
- Virtually no maintenance of the system is needed, but routine operation and maintenance of the upstream treatment system will be necessary.

CHALLENGES / RESTRICTIONS

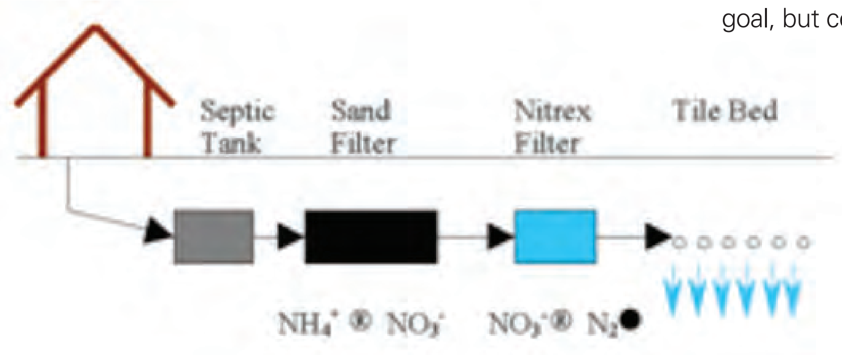
- This innovative technology is new to Hawai'i, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.
- Requires pretreatment step such as the combination of a septic tank/recirculating sand filter or ATU to remove BOD and TSS and provide nitrification.

OPERATIONS AND MAINTENANCE

- Annual inspection of media chamber, with cleaning and addition of lost media as needed.
- Routine operation and maintenance of the upstream treatment system.

EFFLUENT QUALITY

- Water quality does not meet NSF245 criteria for total nitrogen removal.
- Routine operation and maintenance of the upstream treatment system.
- Meeting NSF40 criteria for CBOD5, TSS, and pH is a goal, but certification has not yet been granted.



Nitrogen Reduction by NITREX™ Filter in a Septic Tank System (Lombardo Associates, Inc., 2018).

Recirculating Gravel Filter

EMERGING ONSITE TREATMENT TECHNOLOGY – APPROVAL REQUIRED

The recirculating gravel filter system is a multi-step process that provides both aerobic and anaerobic conditions for nitrification and denitrification, respectively. The process is based on the use of a septic tank as a pretreatment step.

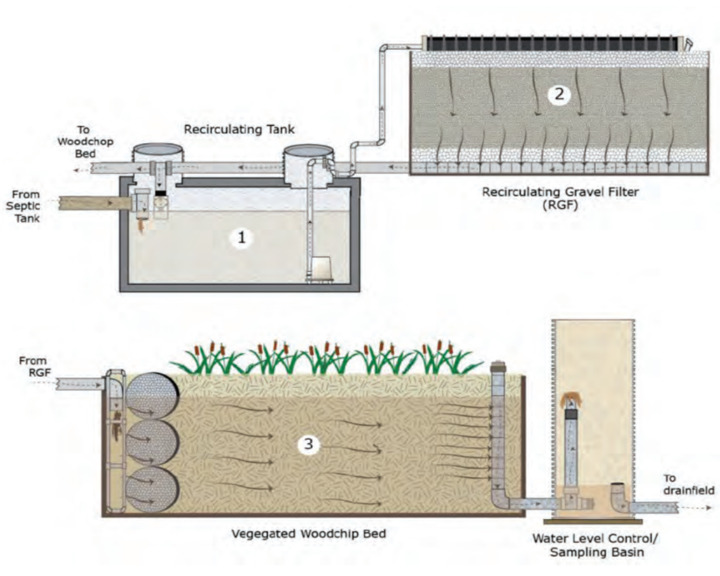
There are three zones in this system, with effluent continually circulated through the first two zones. With each circulation cycle, a portion of the nitrified effluent is released to the third zone for denitrification. The different zones are denoted by numbers in circles in the figure below. Effluent could be transferred to an absorption bed or trench.

IDEAL APPLICATION

- Where a high degree of nitrogen removal is required.
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- Average total nitrogen removal is over 90 percent.
- Local materials may be used for the woodbed media.



Recirculating Gravel Filter with Vegetated Woodbed System (Washington State Department of Health and University of Washington Civil and Environmental Engineering Department, 2012).

CHALLENGES / RESTRICTIONS

- Pump operation and electricity are needed for the recirculation system.
- This emerging technology is new to Hawai'i, so a pilot program with a robust inspection and sampling program would be necessary. Design would need to be reviewed and approved by DOH WWB.
- Requires a septic tank as a pretreatment step.

OPERATIONS AND MAINTENANCE

- Routine inspections should include the pump and control panel, adequacy of pumped dosage frequency, and effluent filter on the septic tank outlet.
- The septic tank should be maintained to ensure proper functioning of the subsequent treatment and disposal steps.

EFFLUENT QUALITY

- Water quality does not meet NSF245 criteria for total nitrogen removal.
- Meeting NSF40 criteria for CBOD5, TSS, and pH is a goal, but certification has not yet been granted.

Appendix C

Onsite Disposal Technologies

Absorption

APPROVED EFFLUENT DISPOSAL TECHNOLOGY

Absorption systems are an approved subsurface disposal technology that allows partially, or fully treated effluent to percolate into the soil. These systems are installed with a very mild slope to allow effluent to flow by gravity. Effluent comes from a treatment system and is distributed by gravity through perforated pipes laid in either a trench or bed, the surface area of which depends on the hydraulic properties of the native soil. Due to the aerobic conditions in the shallow soil layer, further treatment including filtration of suspended solids and microorganisms, oxidation of organic wastes, and nitrification can occur. The extent of such treatment is dependent upon the characteristics of the native soil, the loading rate, and other factors which can cause treatment as high as 90 percent.

Absorption systems generally range in depth from 1.5 to 3 feet below grade. Trench widths range from 18 to 36 inches, while bed widths are at least 3 feet.

Gravelless trench and bed absorption systems utilize plastic dome-shaped segmented chambers buried in the trench/bed in with large open spaces instead of perforated pipes surrounded by gravel.

IDEAL APPLICATION

- Soil percolation rate is less than 60min/in.
- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 8 percent for absorption beds, and 12 percent for absorption trenches.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Cannot be used if groundwater is too close to the surface, minimum vertical separation of three feet from the bottom of the trench/bed.

Gravelless Absorption Bed Disposal System.

BENEFITS

- Common type of disposal system, so there are many products available and experience with installation.
- When deployed downstream from an aerobic treatment system, it provides some treatment for BOD, TSS, and fecal coliform.
- No power is required, and maintenance is generally not necessary.
- Gravelless dome systems require less gravel backfill and provide significant additional water storage volume.

CHALLENGES / RESTRICTIONS

- Large land requirement.
- Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surroundings.
- Root intrusion can adversely impact performance.

OPERATIONS AND MAINTENANCE

- Normally none. Some systems use a dosing pump - if present, it must be checked and cleaned.
- Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected.

EFFLUENT QUALITY

- Can effectively remove a high percentage of fecal coliform, depending on soil type.

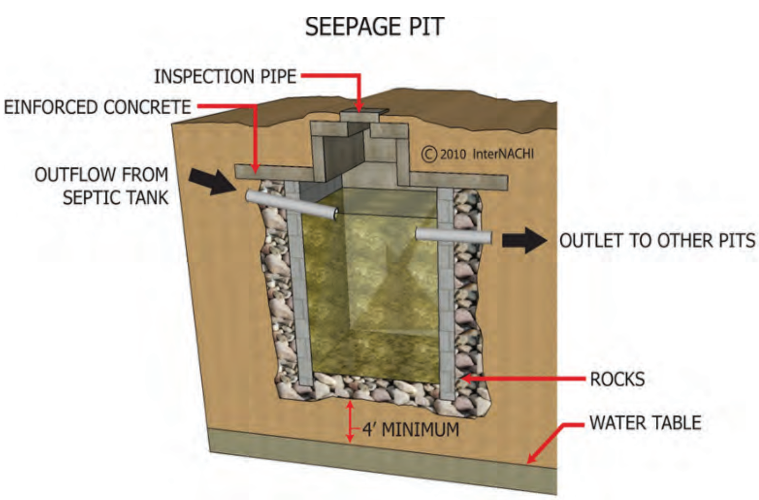
Seepage Pit

APPROVED EFFLUENT DISPOSAL TECHNOLOGY

A seepage pit is constructed the same as a cesspool (often it is a former cesspool that has been cleaned and repurposed), but it receives treated wastewater, whereas a cesspool receives untreated wastewater. These systems are generally constructed from reinforced concrete rings, with a diameter of 8 or 10 feet and a height of 2 feet, that are stacked in order to achieve the depth required (usually 15-30 feet) to meet percolation requirements. Each ring has large openings in the sides and looks like Swiss cheese. A concrete lid with a 12-inch inspection port is placed on top. Water percolates out from the sides and the bottom of the unit into the surrounding soil. The effective percolation area is measured as the pit sidewall area

IDEAL APPLICATION

- Soil percolation rate is less than 60min/in.
- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 12 percent and an absorption system is not feasible.
- Groundwater table depth is greater than 3 feet from the bottom of the seepage pit.
- Should not be installed in areas with more than approximately 1 unit per acre because a higher level of treatment is necessary to avoid negative cumulative impacts.



Seepage Pit Disposal System (InterNACHI, 2020).

BENEFITS

- Seepage pits are the simplest and most compact method to percolate water into the ground.
- They are viable options when the available land area is insufficient for absorption beds or trenches, the terrain is steep, or when an impermeable layer overlies more suitable soil.
- These units can be maintained (accumulated solids from poorly functioning upstream treatment units can be accessed and pumped out) unlike absorption trenches/beds.

CHALLENGES / RESTRICTIONS

- Seepage pits generally cannot provide the same level of treatment as absorption bed and trench systems.
- There can be a danger of structural stability including potential cave-ins when converting an old cesspool with un-lined walls or lined walls in poor condition into a seepage pit.

OPERATIONS AND MAINTENANCE

- Proper functioning of a seepage pit relies heavily on maintenance of the upstream treatment process. This prevents clogging of the seepage pit. Otherwise, periodic pumping of any accumulated sludge will be required.

EFFLUENT QUALITY

- No additional treatment of BOD, TSS, nutrients, or fecal coliform.

Presby Advanced Enviro-Septic® System

APPROVED EFFLUENT DISPOSAL TECHNOLOGY

The Presby Advanced Enviro-Septic® System is a network of 10-foot long pipes used for further treating and percolating septic tank effluent. It consists of special pipes embedded in a specific type of System Sand. The pipes contain ridges, perforations with skimmers, geotextile fabric, green plastic fiber mat, and Bio-Accelerator® fabric. These work together to treat wastewater as depicted in figure below (Presby Environmental, 2018). Without using any electricity or replacement media, the Advanced Enviro-Septic® system can remove BOD5, TSS, and provide full nitrification. (Presby Environmental, 2018).

IDEAL APPLICATION

- Soil percolation rate is less than 60min/in.
- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet below the Presby system.
- Where a higher level of treatment is required.

Presby Advanced Enviro-Septic® Treatment System (Presby Environmental, 2018).

BENEFITS

- Passive system that does not need electricity. There are no moveable parts and no replaceable media.
- Enhanced treatment and disposal of wastewater are combined in this system.
- No maintenance of the system is needed, but routine inspections and pumping of the upstream septic tank will be necessary.

CHALLENGES / RESTRICTIONS

- This technology is still relatively new to Hawaiʻi, so the practical lifespan is unknown.

OPERATIONS AND MAINTENANCE

- This is a buried, passive system which does not require operation or maintenance.

EFFLUENT QUALITY

- Water quality does not meet NSF245 criteria for total nitrogen removal.
- Water quality does meet NSF40 criteria for CBOD5, TSS, and pH.
- Can effectively remove a high percentage of fecal coliform, depending on soil type.

Evapotranspiration

EFFLUENT DISPOSAL TECHNOLOGY – APPROVAL REQUIRED

Evapotranspiration combines direct evaporation and plant transpiration for wastewater disposal. Pretreated effluent (usually an aerobic treatment unit) is conveyed to a porous bed containing water-tolerant plants. Wicking, or capillary action, draws water to the surface, where it is either taken up by the plants and transpired, or evaporated from the surface. Effluent that is not transpired or evaporated will percolate from the bottom of the bed. This type of system is known as evapotranspiration-infiltration.

These systems can also be designed with an underlying impermeable liner for a "zero-discharge" system. In this case, disposal is strictly dependent on evaporation and plant transpiration. Additionally, the liner allows the system to be placed above an Underground Injection Control (UIC) line or where there is shallow groundwater or proximate surface water such as a stream, lake or the ocean.

Other components that are typically included are drip or distribution lines, flushing or filtering mechanism, controller to automate dosing cycles, distribution pump, and alternating evapotranspiration beds.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 12 percent.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved.

CHALLENGES / RESTRICTIONS

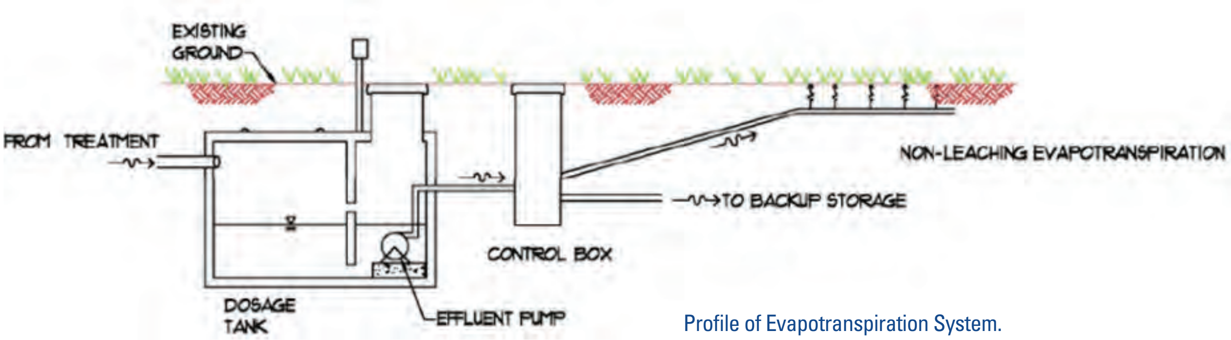
- Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates.
- These systems are more effective in arid climates where evaporation rates are much higher than precipitation rates.
- Recordkeeping of lysimeter (soil pore water sampler) data is required to ensure proper functioning.

OPERATIONS AND MAINTENANCE

- O&M tasks will include simple inspection of observation wells, electrical costs for pumping, as needed, minor landscaping, and maintaining upstream processes to avoid overflow of solids into the evapotranspiration bed.

EFFLUENT QUALITY

- Water quality does meet NSF245 criteria for total nitrogen removal.
- Water quality does meet NSF40 criteria for CBOD5, TSS, and pH.
- Discharges zero quantity of fecal coliforms to the environment when lined.



Profile of Evapotranspiration System.

Constructed Wetland

EFFLUENT DISPOSAL TECHNOLOGY – APPROVAL REQUIRED

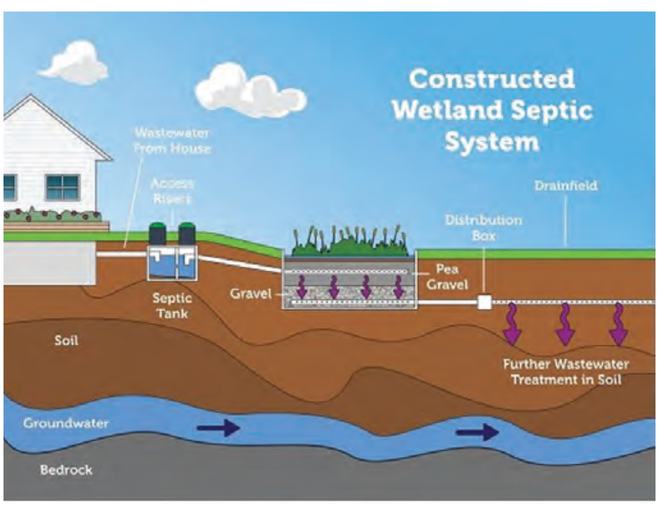
A constructed wetland is a disposal technology that is designed and constructed to recreate the processes that naturally treat wastewater by the environment. Septic tank effluent flows (typically by gravity) to an earthen basin or cell containing microorganisms, porous media and plants. A perforated pipe runs along the length of the cell just below the plants to evenly distribute the effluent. A second pipe runs along the length of the cell to collect the effluent as it travels through the porous media, where it then flows through a distribution box and into a drain field. As the wastewater flows through the constructed wetland it undergoes filtration, nitrification, denitrification, and absorption. In residential applications, wastewater flows are kept beneath the ground surface to limit potential human contact with wastewater.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 12 percent.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet.

BENEFITS

- A constructed wetland provides suitable conditions for denitrification to occur.
- Power is not required to operate a wetland.



Constructed Wetland with Primary Treatment by Septic Tank (United States Environmental Protection Agency, 2018).

CHALLENGES / RESTRICTIONS

- Large land area may be required.
- It is important to maintain an even cross-sectional flow throughout the constructed wetland.
- The water level should be maintained in the cell during low- or no-flow periods to maintain survival of the plants.

OPERATIONS AND MAINTENANCE

- Routine maintenance of the vegetation should be conducted to prevent problems caused by root systems, such as surface ponding.
- Frequent inspection of the vegetation, inlet distributor, liner, berms or retaining walls, pumps, if present, and drain field is required. A maintenance plan should be completed to detail O&M requirements (Beharrell, 2004).

EFFLUENT QUALITY

- Can effectively remove a high percentage of fecal coliform, depending on soil type.

Drip Dispersal

EFFLUENT DISPOSAL TECHNOLOGY – APPROVAL REQUIRED

Drip dispersal systems use a network of pipes containing emitters commonly spaced 12 inches apart and installed in excavations similar to but shallower than absorption beds. Rather than working by gravity, these systems receive treated effluent in pumped doses from a dosing tank, which allows for controlled loading rates to the shallow root zone of the surrounding soil. While some of the treated wastewater percolates into the ground, drip disposal systems act partially as an evapotranspiration system since some of the effluent is taken up by the plants at the ground surface.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet below the drip system.

BENEFITS

- Reliable alternative for areas with low permeability, seasonal high-water tables, or severe slopes.
- Ability to control dose/rest cycles allows for even spacing or dosing of effluent. This facilitates wastewater infiltration by spreading it spatially and over time.

Drip Irrigation System.

CHALLENGES / RESTRICTIONS

- In some cases, a large dose tank is needed to accommodate timed dose delivery to the drip absorption area.
- The septic tank and its effluent filter must be monitored and maintained in order to prevent clogging and possible failure of the drip emitters.
- Drip disposal systems are active systems, meaning power is required to run pumps, sensors and controls.

OPERATIONS AND MAINTENANCE

- Regular monitoring and maintenance of pump, filter and piping shall be performed by an authorized service provider as described in an O&M manual provided by the manufacturer. Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters (NJDEP, 2008).

EFFLUENT QUALITY

- Can effectively remove a high percentage of fecal coliform, depending on soil type.

Passive Treatment Unit

INNOVATIVE EFFLUENT DISPOSAL TECHNOLOGY – APPROVAL REQUIRED

Several variations of passive-type systems have been developed during a large research project in the State of Florida. These systems are a disposal technology that follow a septic tank and typically include multiple saturated and unsaturated stages, with or without recirculation to facilitate nitrification and denitrification.

The unit shown here provides treatment of septic tank effluent in a Stage 1 unsaturated biofilter and Stage 2 saturated biofilter. The denitrified effluent is then disposed of in an absorption bed or trench. The Stage 1 biofilter hydraulics can be either single pass or recirculation. The pump tank can be run either with single pass or with a recycle stream for internal recirculation to spray nozzles located above the surface of the Stage 1 media. The Stage 2 biofilters can contain single or dual media, such as lignocellulosic/sand mixture. This configuration demonstrated a total nitrogen removal of 85 to 95 percent.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet below the disposal system.
- Where nitrogen removal is required.

BENEFITS

- Total nitrogen removal depends on the configuration and is expected to be either 50 to 95 percent prior to discharge to the soil absorption system.
- Local materials may be used for biofilter media.

CHALLENGES / RESTRICTIONS

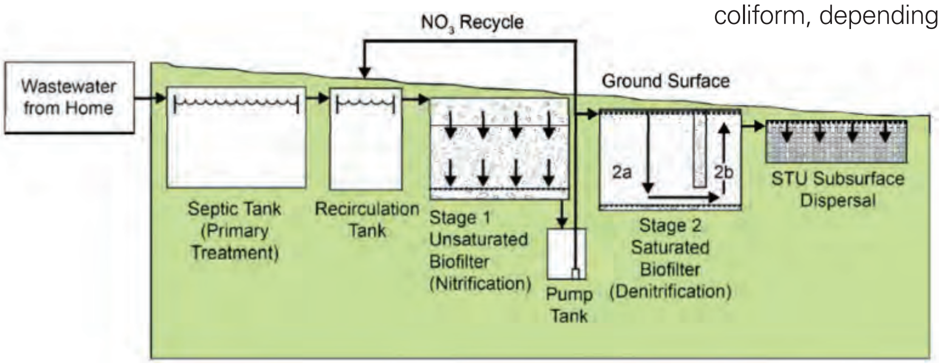
- Pump operation and electricity will be needed if a recirculation system is included.

OPERATIONS AND MAINTENANCE

- Routine inspections (twice a year is required by Florida code) include pump operation and electrical connections, hydraulic inspection, flushing and cleaning of distribution lines, biofilter media life, and the recirculation system.
- The septic tank must be maintained to prevent clogging and failure of the subsequent treatment and disposal steps.

EFFLUENT QUALITY

- Meeting NSF245 criteria for total nitrogen removal is a goal, but certification has not yet been granted.
- Meeting NSF40 criteria for CBOD5, TSS, and pH is a goal, but certification has not yet been granted.
- Can effectively remove a high percentage of fecal coliform, depending on soil type.



Treatment by Recirculating Unsaturated Biofilter and Saturated Biofilter and Disposal by Soil Treatment Unit (Hazen and Sawyer, 2015).

Nitrification / Denitrification Biofilter

EMERGING EFFLUENT DISPOSAL TECHNOLOGY – APPROVAL REQUIRED

Several configurations of biofilter disposal technologies have been researched in New York. Septic tank effluent is transferred through a low pressure distribution system comprised of a pump and parallel, low pressure dosing pipes with drilled orifices. As the wastewater percolates down, it infiltrates the lined nitrification/denitrification biofilter underlying the pipes. Nitrification and denitrification occur in the sand and sand/lignocellulose layers, respectively.

One configuration of the biofilter consists of 6 to 8 inches of soil cover, followed by a 12- to 18-inch nitrifying sand layer, and then a 12- to 18-inch denitrifying sand/sawdust layer. The system is lined to maintain saturation conditions and to allow effluent discharge to a dispersal system.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet, below the effluent disposal system.
- Where nitrogen removal is required.

BENEFITS

- Total nitrogen removal is expected to be up to 90 percent.
- Processes are primarily driven by gravity and capillary forces.
- Saturated nature of sand and sawdust layer should minimize oxidation and degradation of the wood source over time.
- Local materials can be used for the biofilter media.
- Woodchip biofilter tank allows for convenient replacement of woodchips.

CHALLENGES / RESTRICTIONS

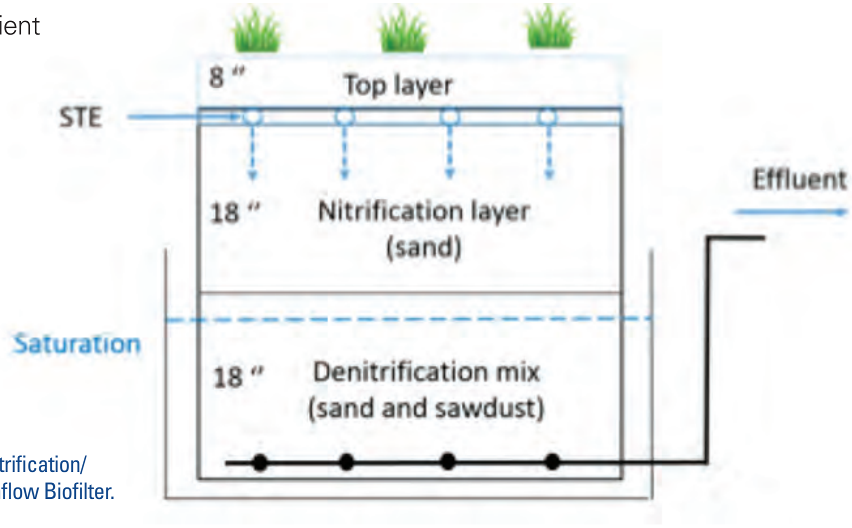
- Pump operation and electricity needed for sending wastewater to the woodchip biofilter tank.

OPERATIONS AND MAINTENANCE

- The septic tank, its effluent filter, and pump, if included, must be routinely inspected and maintained for proper functioning and to prevent clogging and failure of downstream biofilters.

EFFLUENT QUALITY

- Meeting NSF245 criteria for total nitrogen removal is a goal, but certification has not yet been granted.
- Meeting NSF40 criteria for CBOD5, TSS, and pH is a goal, but certification has not yet been granted.
- Can effectively remove a high percentage of fecal coliform, depending on soil type.



Disposal by Lined Nitrification/
Denitrification Downflow Biofilter.

Appendix D

Alternative Toilet Technologies

Composting Toilet

ALTERNATIVE TOILET TECHNOLOGY – APPROVAL REQUIRED

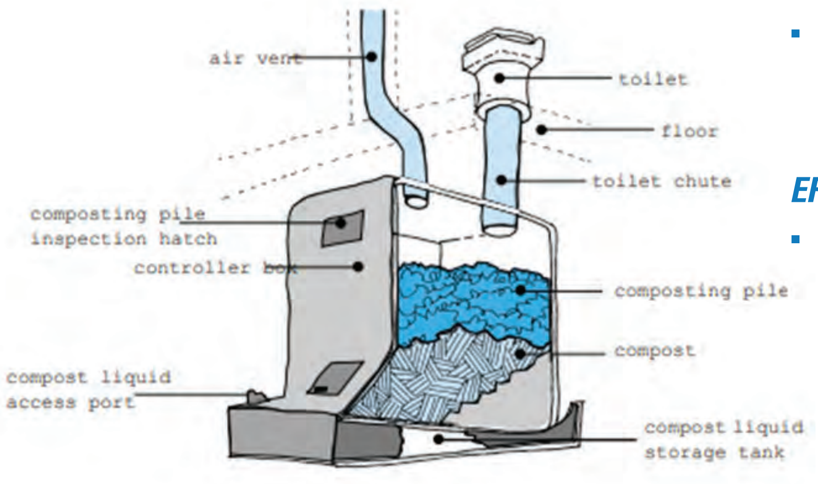
A typical composting toilet includes a composting reactor tank connected to one or more waterless toilets in the house. There are self-contained units with the compositing bin under the toilet seat. The reactor tank controls the decomposition of excrement, toilet paper, and carbon-based bulking agents such as wood chips, straw, hay, or grain hulls. Bulking agent materials break down quickly to prevent buildup of aerobic bacteria and fungi. The owner must remove and dispose of aged compost frequently, turn the composting waste with every use, and replenish bulking agents and odor control fluid. An exhaust system driven by a fan vents odor, carbon dioxide, and moisture from the reactor bin to the outdoors. The decomposing material needs to be turned frequently to break up the mass and to keep the pile porous and aerated. The final material is about 10 to 30 percent of its original volume and must be properly disposed as municipal solid waste (recycling/reuse on the property is not allowed in Hawai'i).

IDEAL APPLICATION

- This may be an option for homeowners who are willing to perform the maintenance required.

BENEFITS

- As a zero-discharge system, nitrogen will not be released into the groundwater.
- Since water is not needed for flushing, household water consumption is reduced.
- System consumes very little power (only the small fan).
- Residents may be able to install a reduced-size wastewater treatment and disposal system, minimizing costs and disruption to the parcel.



Composting Toilet (National Small Flows Clearinghouse, 2000).

CHALLENGES / RESTRICTIONS

- A high level of maintenance is required by the owner, such as periodic turning of the compost, daily addition of bulking agents, handling and disposal of compost, and preventing too much liquid in the composter.
- A power source is generally needed.
- Composting excrement may be visible in some systems.
- There can be objectionable odors emitted from these systems.
- If more than one toilet is desired within the household or property, costs are multiplied accordingly with the number of toilets installed.
- Additional approved treatment/disposal system required for household grey water and kitchen blackwater.

OPERATIONS AND MAINTENANCE

- The decomposing material needs to be turned frequently to break up the mass and to keep the pile porous and aerated.

EFFLUENT QUALITY

- There is no discharge from composting toilets, thus this would help to mitigate nitrogen release.

Incinerating Toilet

ALTERNATIVE TOILET TECHNOLOGY – APPROVAL REQUIRED

These types of toilets use electricity, oil, natural gas, or propane to burn waste to a sterile ash. A paper-lined upper bowl holds newly deposited waste. The paper liner is replaced after each use. Flushing using a foot pedal causes an insulated chamber cover to lift and swing to the side while the bowl halves separate. The paper liner and its contents deposit into the incinerating chamber. When the foot pedal is released, the chamber cover reseals and the bowl halves close (National Small Flows Clearinghouse, 2000).

A "start" button on the toilet begins the burning process, which occurs after each individual deposit. An electric heating unit cycles on and off for about an hour while a blower motor draws air from the incinerating chamber over a heat-activated catalyst to remove odors. A fan then distributes the air through a vent pipe to the outdoors. The fan is also used to cool the incinerating unit. The entire cycle takes from about 1.5 to 1.75 hours per "flush" or use (National Small Flows Clearinghouse, 2000).

IDEAL APPLICATION

- This may be an option for homeowners who are willing to complete the maintenance required.

BENEFITS

- As a zero-discharge system, nitrogen will not be released into the groundwater.
- Since water is not needed for flushing, household water consumption is reduced.
- Residents may be able to install a reduced-size wastewater treatment and disposal system, minimizing costs and disruption to the parcel.

CHALLENGES / RESTRICTIONS

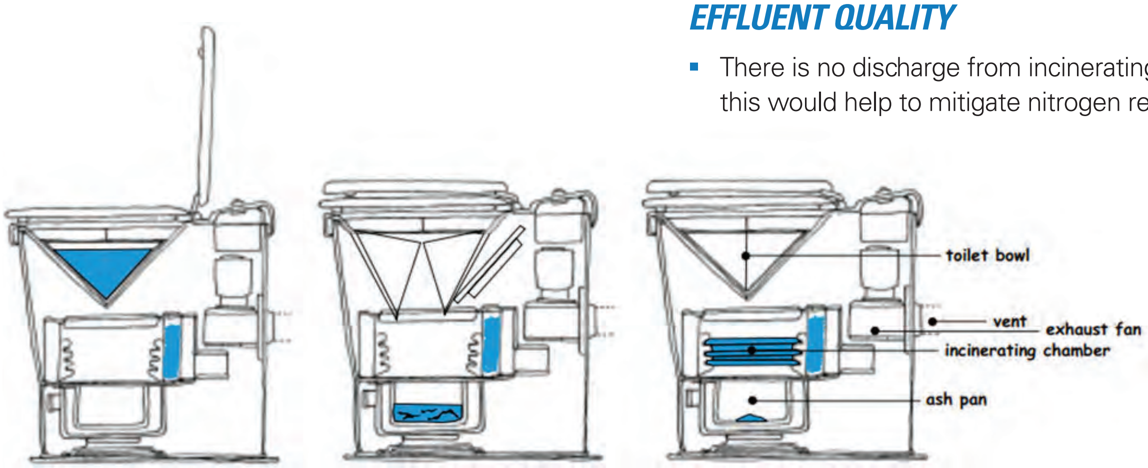
- Care must be taken to minimize electrical hazards.
- A power source is needed.
- The toilet cannot be used during the incinerating cycle.
- If more than one toilet is desired within the household or property, costs are multiplied accordingly with the number of toilets installed.
- Additional approved treatment/disposal system required for household grey water and kitchen blackwater.

OPERATIONS AND MAINTENANCE

- Regular cleaning of the toilet seat and bowl as needed.
- Disposal of generated ash in a sealed bag with regular municipal solid waste.
- Mechanical/electrical inspection, maintenance, and repair requirement are unknown currently.

EFFLUENT QUALITY

- There is no discharge from incinerating toilets, thus this would help to mitigate nitrogen release.



Incinerating Toilet Shown with Seat Cover Up, Seat Cover Down and Incinerating Chamber Opened, and Seat Cover Down and Incinerating Chamber Closed (Left to Right) (National Small Flows Clearinghouse, 2000).

Appendix E

Decentralized Cluster Wastewater Collection Technologies

Gravity Sewers

COLLECTION SYSTEM TECHNOLOGY

Gravity sewers are a network of underground pipes that convey wastewater from individual households to a treatment facility. Gravity sewers are the standard, conventional type of system for centralized wastewater systems that connect numerous homes, businesses, and industries to a regional treatment plant. The sewers utilize gravitational energy resulting from a difference in elevation to cause flow.

IDEAL APPLICATION

- Where ground conditions allow for gravity flow and relatively easy excavation.

BENEFITS

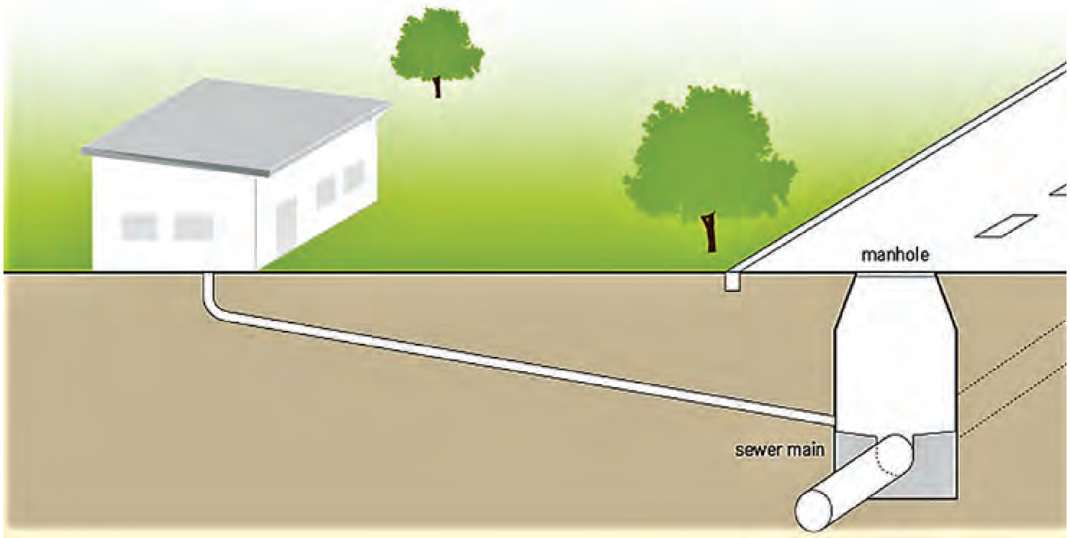
- Can handle grit and other solids, as well as large volumes of flow.
- Does not require onsite treatment or storage of the household wastewater before it is discharged.
- Little impact to homeowners and their properties.
- Presents a viable option if there is an appropriate difference in elevation.
- No electricity for pumping and no pump maintenance.

CHALLENGES / RESTRICTIONS

- Flat or large variations in terrain or difficult excavation conditions can increase costs.
- Larger pipes compared to other collection system options.
- Prone to clogging.
- Manholes associated with gravity sewers are a potential source of inflow and infiltration.
- Must be designed to maintain a self-cleansing velocity, generally 2 feet per second, at a minimum, during most flow conditions.

OPERATIONS AND MAINTENANCE

- Inspect on a regular schedule, this can be accomplished via surface inspections of manholes, lowering hand-held camera or robotic closed-circuit TV.
- Proactively flush accumulated debris, fats, oil, and grease.
- Remove blockages and tree roots as required.



Typical Gravity Sewer System (Tiley et al., 2014).

Liquid-Only Pressure Sewers

COLLECTION SYSTEM TECHNOLOGY

A liquid-only sewer system is a network of pipes that convey pre-treated wastewater pumped under pressure to the treatment facility. A precondition for these sewers is that efficient preliminary treatment is available at the household level, typically achieved using a septic tank. This system is also known as a septic tank effluent pumping (STEP) sewer system and is practical in areas with a limited number of homes and relatively short distances to the neighborhood treatment facility.

IDEAL APPLICATION

- Where a septic tank already exists at each property.
- Where appropriate differences in elevation do not exist for gravity flow, or where shallow construction is preferred.

BENEFITS

- Independent from land topography restrictions.
- The septic tank retains most of the fats, oils, grease, and solids reducing clogging problems.
- Septic tanks have storage capacity to operate during power outages.
- Smaller pipes compared to conventional gravity sewers.
- Can be installed at a shallow depth.

CHALLENGES / RESTRICTIONS

- Requires power for the pumps located at each property.
- Requires a septic tank at each property.
- Grease and sludge must be periodically pumped from each individual septic tank.
- Pumps and filters must be maintained on each property.

OPERATIONS AND MAINTENANCE

- Provide/maintain power to the pump at each property.
- Inspect and clean filter on pump monthly.
- Periodically remove accumulated sludge and scum from septic tank.
- Remove any blockages in pressure pipe network.

Liquid-Only Pressure Sewer System (Orenco Systems, Inc.).

Low Pressure Sewers

COLLECTION SYSTEM TECHNOLOGY

Low pressure sewers utilize grinder pumps located in a small receiving station/vault on each property to transport finely ground raw wastewater from the home through a network of pressurized sewer pipes to the treatment facility.

Raw wastewater from the home enters an onsite tank that is much smaller than a septic tank which houses the grinder pump where the sewage is shredded by cutting blades in the pump intake. The pumps contribute flow to the pressurized network of pipes which convey the chopped raw sewage to the treatment facility.

IDEAL APPLICATION

- Where appropriate differences in elevation do not exist for gravity flow, or where shallow construction is preferred.

BENEFITS

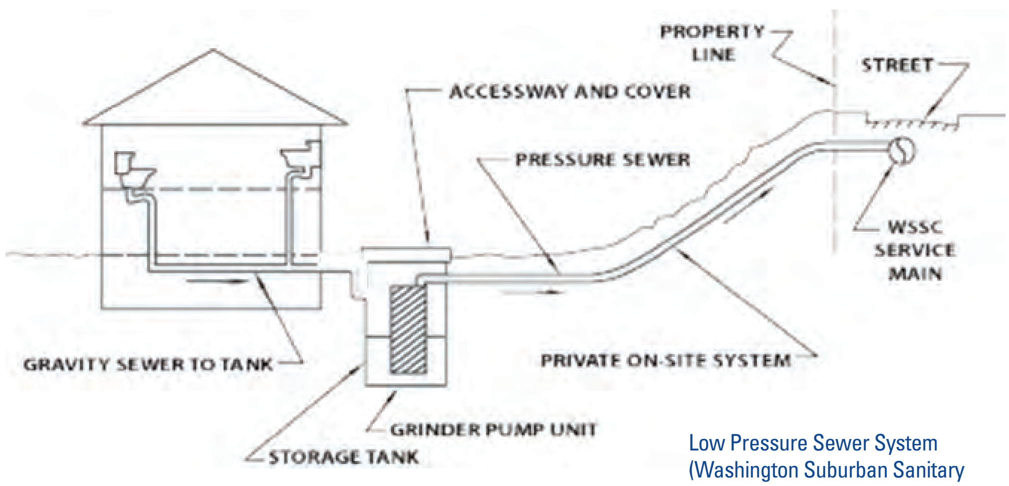
- Independent from land topography restrictions.
- Smaller pipes compared to conventional gravity sewers.
- Can be installed at a shallow depth.

CHALLENGES / RESTRICTIONS

- Requires power for the grinder pumps at each property.
- Pumps must be maintained on each property.

OPERATIONS AND MAINTENANCE

- Provide/maintain power to each pump.
- Inspect pump and chamber on a regular basis, remove any accumulated materials.
- Inspect and maintain backflow preventers.
- Remove any blockages in pressure pipe network.



Low Pressure Sewer System (Washington Suburban Sanitary Commission [WSSC] Water, 2019)

Vacuum Sewers

COLLECTION SYSTEM TECHNOLOGY

Vacuum sewers use negative pressure to transport raw sewage from homes to the treatment facility. This system maintains a partial vacuum with an air pressure below atmospheric inside the pipe network and vacuum station's collection vessel. A vacuum sewer system consists of valve vaults at each home, valves that regulate the entry of wastewater and air, collection system piping, and one or more vacuum stations. The system requires a normally closed valve at each entry point to seal the lines, so that the vacuum is maintained. The valves open when a specific amount of sewage accumulates in the collection chamber, upon which the resulting pressure difference drives the sewage towards the vacuum station and then to the treatment facility. Such a system works best in flat or gently rolling terrain because it has limited capabilities to transport wastewater uphill (a maximum of about 20 feet). The pipes of vacuum sewers have relatively small diameters and can be installed at shallow depths.

IDEAL APPLICATION

- Where there is flat or low slope terrain.
- Where shallow construction is preferred.

BENEFITS

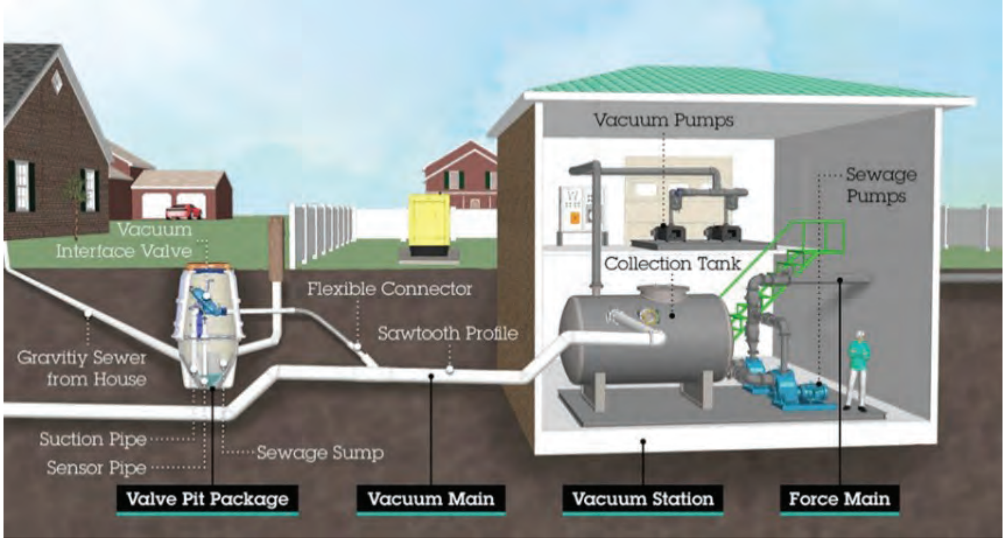
- Smaller diameter pipes compared to conventional gravity sewers.
- Can be installed at a shallow depth.
- Closed system with no exfiltration or odors.

CHALLENGES / RESTRICTIONS

- Economic feasibility depends on the number of homes served by the system (the more the better).
- Requires energy to create the permanent vacuum.
- Vacuum stations require regular maintenance checks, typically higher maintenance than gravity systems.
- Limited application where there are significant changes in elevation.

OPERATIONS AND MAINTENANCE

- Provide/maintain power to each unit and vacuum station.
- Regular pressure/vacuum testing.
- Vacuum stations require regular checks.
- Remove any blockages in pressure pipe network.



Vacuum Sewer System (Airvac® Vacuum Sewer Systems, QSM, 2020).

Appendix F

Decentralized Cluster Wastewater Treatment Technologies

Conventional Activated Sludge

TREATMENT TECHNOLOGY

The term activated sludge refers to biological treatment via suspended-growth, aerobic mixed liquor consisting of flocs of active bacteria. These bacteria consume and remove aerobically biodegradable organic substances from screened or screened and pre-settled raw wastewater.

A conventional activated sludge system consists of an aeration tank, which is used for biological degradation, and a secondary clarifier, where the sludge is separated from the treated wastewater. Screens, de-gritters, and primary settling tanks are often used prior to the aeration tanks to remove large and heavy solids. In the aeration tank, air is transferred to the wastewater to facilitate biological treatment and biodegradation of organics and nutrients. Additional settling and pollutant removal occur in the secondary clarifier prior to disinfection (if needed) and disposal.

IDEAL APPLICATION

- Where a high level of treatment is required.

BENEFITS

- High BOD and nitrogen removal, high effluent quality, self-sustaining system.
- Small land area requirement.
- Free from fly and odor nuisance.
- Can be modified to meet specific discharge limits.
- Available in a modular package plant configuration.

CHALLENGES / RESTRICTIONS

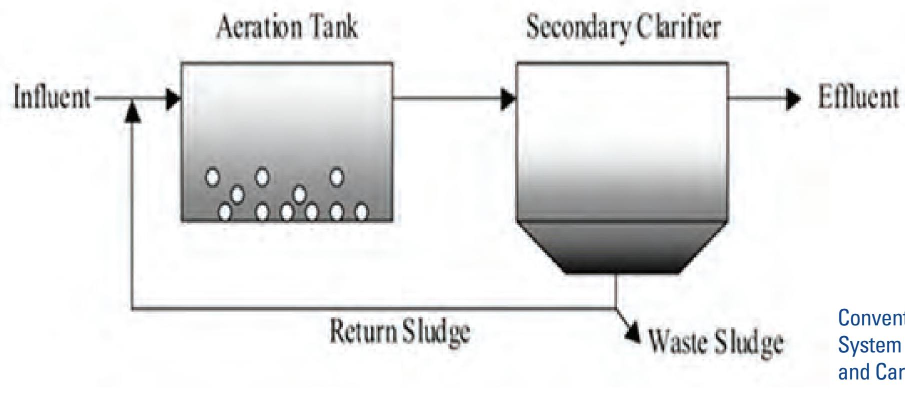
- High electricity consumption.
- Requires skilled operation and maintenance.
- Requires expert design and construction.
- Bulking and biological surface foaming.

OPERATIONS AND MAINTENANCE

- Monitoring of dissolved oxygen, pH, and mixed liquor suspended solids.
- Influent and effluent must be monitored, changing the parameters accordingly.
- Regular cleaning of influent screens.
- Regular sludge wasting and disposal.
- Control of concentrations of sludge and oxygen levels in the aeration tanks.
- Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.

EFFLUENT QUALITY

- Produces high quality effluent with low concentrations of BOD and TSS.
- Capability to provide nitrification and denitrification.



Conventional Activated Sludge System (Water Research Foundation and Carollo Engineers, Inc., 2008).

Extended Aeration Activated Sludge

TREATMENT TECHNOLOGY

The term activated sludge refers to biological treatment via suspended-growth, aerobic mixed liquor consisting of flocs of active bacteria. These bacteria consume and remove aerobically biodegradable organic substances from screened or screened and pre-settled raw wastewater.

Extended aeration activated sludge is a variation of the activated process which provides removal of biodegradable organic wastes under aerobic conditions without primary settling and with a longer aeration time, and a longer sludge age. The long aeration time means a larger aeration tank than the conventional activated sludge process. The process has a high BOD removal efficiency and generates less sludge than conventional activated sludge.

In a typical extended aeration package plant, raw wastewater is screened or goes through a grinder to reduce large suspended, settleable, or floating solids. It is then conveyed to the aeration tank where it is mixed with return activated sludge and oxygen is provided to microorganisms. The resulting mixed liquor is settled in the clarifier. Solids are generally allowed to accumulate in the aeration tank for long periods allowing digestion in the same tank and periodic wasting for disposal. If needed, the clarified effluent is then disinfected via chlorine or ultraviolet light.

IDEAL APPLICATION

- Where a high level of treatment is required.

BENEFITS

- Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels.
- Long HRT and complete mixing, minimal impact of a shock load or hydraulic surge.
- Produces less sludge due to extended retention of biological solids in the aeration tank.
- Available in a modular package plant configuration.

CHALLENGES / RESTRICTIONS

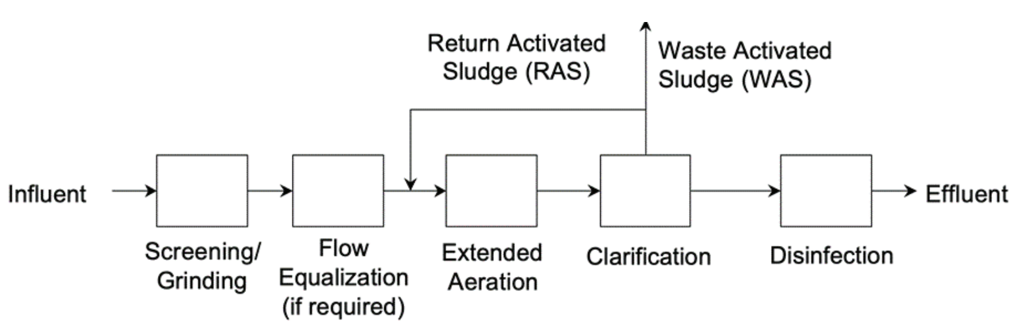
- Higher energy use due to longer aeration time.
- Larger footprint than conventional activated sludge.

OPERATIONS AND MAINTENANCE

- Monitoring of dissolved oxygen, pH, and mixed liquor suspended solids.
- Influent and effluent must be monitored, changing the parameters accordingly.
- Regular cleaning of influent screens.
- Regular sludge wasting and disposal.
- Control of concentrations of sludge and oxygen levels in the aeration tanks.
- Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.

EFFLUENT QUALITY

- Produces high quality effluent with low concentrations of BOD, TSS, and ammonia.
- Capability to provide denitrification.



Extended Aeration Activated Sludge System (Water Research Foundation and Carollo, Engineers, Inc., 2008).

Membrane Bioreactor Activated Sludge

TREATMENT TECHNOLOGY

A membrane bioreactor (MBR) is an activated sludge process which uses membrane filtration instead of a secondary clarifier to separate mixed liquor from treated effluent. Fine screening is an essential pre-treatment step to protect the membranes from damaging debris and particles, extend the membrane life, reduce operating costs, and guarantee a higher sludge quality. MBR systems nearly always have an anoxic tank and internal pumping of mixed liquor to facilitate nitrogen removal via denitrification. An MBR is an ideal process for water reuse applications since the membranes provide a barrier to many pathogens. Better effluent quality comes with a higher capital, operation, and energy costs which present a hurdle to implementing MBR systems for cluster systems.

A typical MBR package plant will consist of a preliminary coarse screen, followed by a fine screen, an anoxic tank/zone, an aeration tank with an integral membrane module, a permeate pump to create effluent, and a blower to provide coarse aeration of the membrane cassette and fine bubble aeration for the remainder of the aeration tank. It will usually include an aerobic digester to treat, thicken, and store WAS prior to periodic pump-out and disposal. The package plant may also contain a disinfection system which most commonly would utilize ultraviolet light.

IDEAL APPLICATION

- Where a very high level of treatment is required in a small footprint.

BENEFITS

- Systems consistently provide high quality effluent in terms of TSS, BOD, and ammonia levels.
- Long HRT and complete mixing, minimal impact of a shock load or hydraulic surge.
- Produces less sludge due to extended retention of biological solids in the aeration tank.
- Available in a modular package plant configuration.

CHALLENGES / RESTRICTIONS

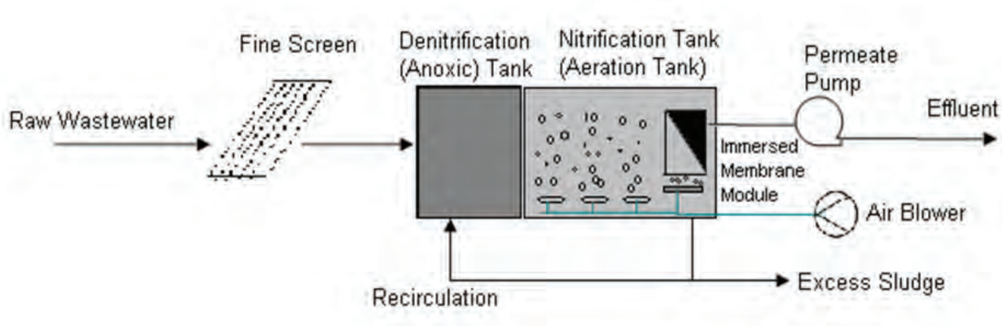
- Higher energy use due to longer aeration time.
- Larger footprint than conventional activated sludge.

OPERATIONS AND MAINTENANCE

- Monitoring of dissolved oxygen, pH, and mixed liquor suspended solids.
- Influent and effluent must be monitored, changing the parameters accordingly.
- Regular cleaning of influent screens.
- Regular sludge wasting and disposal.
- Control of concentrations of sludge and oxygen levels in the aeration tanks.
- Maintenance includes inspecting the aeration system and following manufacturer recommendations for maintenance of all equipment.

EFFLUENT QUALITY

- Produces very high quality effluent with low concentrations of BOD, TSS, and ammonia.
- Capability to provide denitrification.



Membrane Bioreactor Activated Sludge System (Wastewater Engineering Group, 2007).

Attached Growth Bioreactors - Textile Filter

TREATMENT TECHNOLOGY

Like the suspended growth activated sludge processes, attached growth bioreactors take advantage of biological treatment. The biological mass in this case grows as a biofilm on the surface of a media or disk as opposed to suspended flocculated biomass in activated sludge processes. The media should have a large surface area to volume ratio to support the microbial growth and form biofilms. Some versions of the process eliminate secondary clarifiers and associated cost and space requirements.

A textile filter is a variation of an attached growth bioreactor. It is a fixed-bed, biological reactor that operates under (mostly) aerobic conditions. Textile filter systems are available in modular package plant configurations specifically for cluster treatment applications. The system uses fixed spray nozzles and hanging textile media sheets. The sheets are suspended on racks at the top of a tank that is mostly open, and water can accumulate below for recirculation. These systems are designed to treat pre-settled wastewater, most often from a large septic tank.

IDEAL APPLICATION

- Modular package plant that can be used for treating wastewater flows from clusters of homes.

BENEFITS

- Can operate at a range of organic and hydraulic loads.
- Lower energy input than conventional activated sludge.
- Low sludge production.

CHALLENGES / RESTRICTIONS

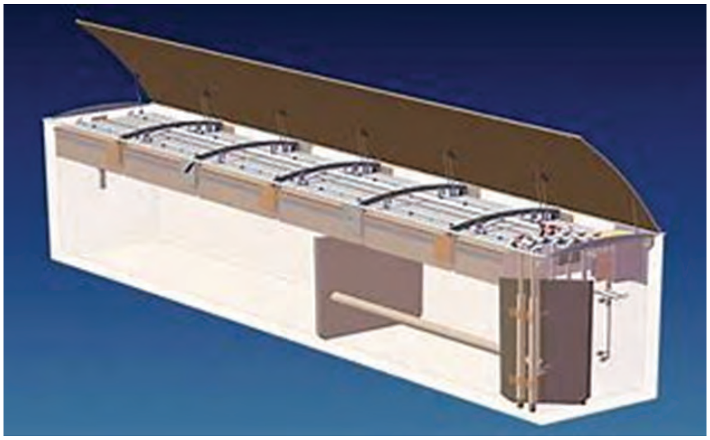
- Requires expert design, construction, operation and maintenance.
- Some variations have larger footprints.
- Risk of clogging, depending on pre and primary treatment.

OPERATIONS AND MAINTENANCE

- Monitoring of influent and effluent.
- Maintenance of all equipment following manufacturer's recommendations.
- Optimum dosing rates and flushing frequency are determined from the field operation.
- The packing should also be kept moist which can be problematic at night or during power failures.
- Regular cleaning of influent screens.
- Regular sludge wasting and disposal.
- The sludge that accumulates on the filter must be periodically washed away to prevent clogging and to keep the biofilm thin and aerobic.

EFFLUENT QUALITY

- Produces high quality effluent with low concentration of BOD and TSS
- Capability to provide nitrification, and nitrogen reduction.



Textile Trickling Filter System (Orenco Systems, Inc.).

Moving Bed Biofilm Reactor

TREATMENT TECHNOLOGY

The moving bed bioreactor (MBBR) process is a combination of activated sludge (suspended growth) and attached growth processes. It uses plastic floating media within an aeration basin which are carriers of attached growth of biofilm. Pre-treated (settled) influent enters the aeration basin for treatment and may enter a second basin for further treatment (full nitrification). Fine-bubble aeration with high oxygen transfer efficiency is commonly used for mixing/suspension. Thousands of small plastic chips, called media or carriers, occupy as much as 50 to 70 percent of the tank volume. In order to keep the carrier media in the tank, there is a strainer attached to the aeration basin effluent pipe. The aeration effluent which contains sloughed biofilm and suspended solids is conveyed either to a secondary settling tank or, more commonly, to a dissolved air flotation separator.

A typical MBBR package plant has a screen, a primary sedimentation tank, one or two MBBR aeration tanks, a blower, a dissolved flotation separator unit, and an aerobic digestion tank to stabilize, thicken, and store the sloughed solids for eventual offsite disposal. If needed, the clarified effluent is then disinfected via chlorine or ultraviolet in a disinfection tank. As with other treatment options, waste sludge requires stabilization and disposal.

IDEAL APPLICATION

- Where a high level of treatment is required in a relatively small footprint.

BENEFITS

- Efficient treatment, low HRT, flexibility to adapt to fluctuating hydraulic and organic loads.
- Low Maintenance.
- Very compact, due to the maximized surface area the media provide for biofilm growth.
- Available in a modular package plant configuration.

CHALLENGES / RESTRICTIONS

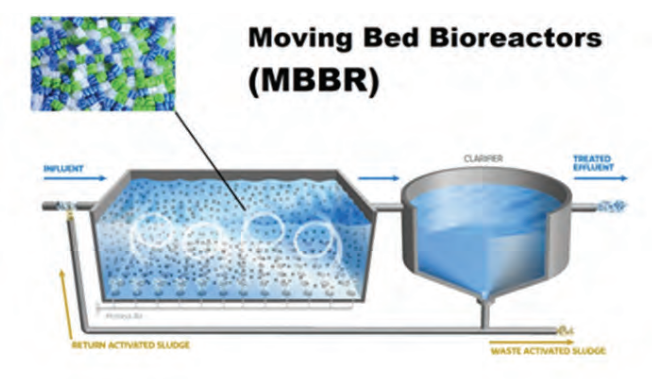
- High-tech system.
- Higher capital and operating costs.
- Carriers can wash out of the system, necessitating supplemental additions.

OPERATIONS AND MAINTENANCE

- Monitoring of influent and effluent.
- Maintenance of all equipment following manufacturer's recommendations.
- Observation of media color and adjustment of air.
- Monitoring and adjustment of dissolved air flotation units.
- Regular cleaning of influent screens.
- Regular sludge wasting and disposal.
- Operators must take samples periodically and analyze them to ensure the bacteria on the carriers are still thriving.

EFFLUENT QUALITY

- Produces high quality effluent with low concentrations of BOD and TSS.
- Capability to provide nitrification and denitrification.



Moving Bed Bioreactor System (Lanyu Gustawater Treatment, 2020).

Constructed Wetland

TREATMENT TECHNOLOGY

Constructed wetlands are a "green" technology designed to re-create the processes that naturally treat wastewater in the environment. Influent wastewater to the wetlands is usually pre-treated using a septic tank or similar process. After pre-treatment, the wastewater flows to a lined earthen basin or cell containing microorganisms, porous media and plants. A perforated pipe runs along the length of the cell just below the plants to evenly distribute the influent. A second pipe runs along the length of the cell to collect the effluent after it travels through the porous media, where it then flows through a distribution box and into a drain field.

IDEAL APPLICATION

- Where a natural treatment system is desired.
- Where there are no significant land area constraints.

BENEFITS

- Simple, easily operated natural system.
- Inexpensive compared to other treatment options.
- Requires little energy when the system operates with gravity flow.

CHALLENGES / RESTRICTIONS

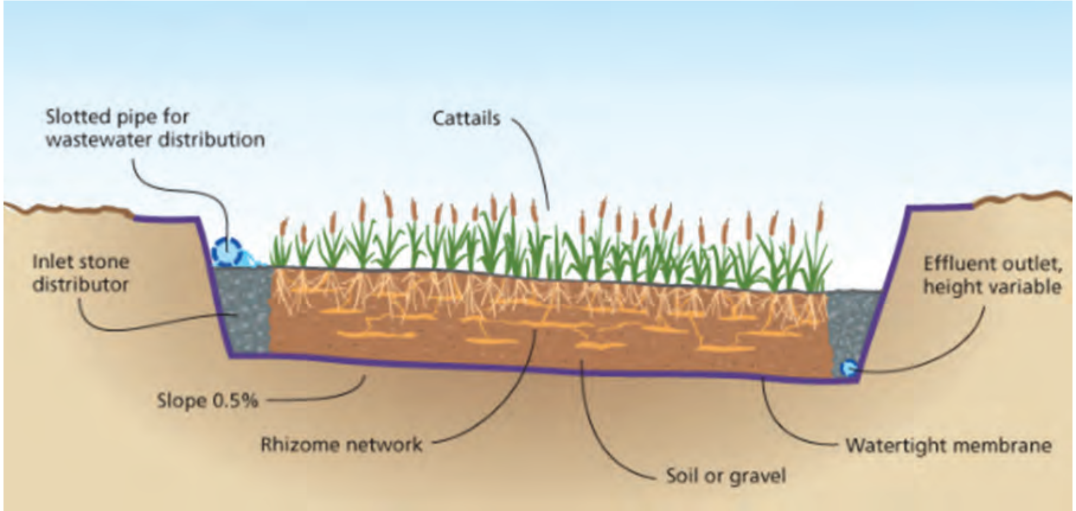
- Large land requirement.
- Not available as a package facility.
- Vector and odor nuisances.
- Requires some level or pre-treatment, usually by use of a septic tank.

OPERATIONS AND MAINTENANCE

- Vector control to prevent population growth of insects and odor control.
- Occasional maintenance of the vegetation promotes growth of desired vegetation and maintains hydraulic capacity.
- Monitoring of influent and effluent.

EFFLUENT QUALITY

- Produces high quality effluent with low concentrations of BOD and TSS.
- Nitrification and denitrification are possible.



Constructed Wetland Treatment System (Grismer and Shepherd, 2011).

Appendix G

Decentralized Cluster Wastewater Disposal Technologies

Absorption Trench / Bed

EFFLUENT DISPOSAL TECHNOLOGY

Absorption systems are a subsurface disposal technology that allows treated effluent to percolate into the soil. These systems are installed with a mild slope to allow effluent to flow by gravity through perforated pipes laid in either a trench or bed. The disposal surface area which on the hydraulic properties of the native soil.

Absorption systems generally range in depth from 1.5 to 3 feet below grade. Trench widths range from 18 to 36 inches, while bed widths are at least 3 feet. The major distinction between the two is that in an absorption bed, the entire disposal area is excavated and backfilled with gravel, whereas absorption trenches have distinct areas of undisturbed soil. Gravelless trench and bed absorption systems utilize plastic dome-shaped segmented chambers buried in the trench/bed with large open spaces instead of perforated pipes surrounded by gravel. Current DOH regulations include detailed guidance for the design of these systems.

IDEAL APPLICATION

- Soil percolation rate is less than 60 min/in.
- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 8 percent for absorption beds, and 12 percent for absorption trenches.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Cannot be used if groundwater is too close to the surface, minimum vertical separation of three feet from the bottom of the trench/bed.

Gravelless Absorption Bed Disposal System.

BENEFITS

- Common type of disposal system so there are many products available and experience with installation.
- No power is required, and maintenance is generally not necessary.
- Gravelless dome systems require less gravel backfill and provide significant additional water storage volume.

CHALLENGES / RESTRICTIONS

- Large land requirement.
- Overloading, rainfall, or unsuitable soils may cause contaminants to spill out into the surroundings.
- Root intrusion can adversely impact performance.

OPERATIONS AND MAINTENANCE

- Normally none. Some systems use a dosing pump - if present, it must be checked and cleaned.
- Observation ports can be installed within the disposal area to check whether the water is percolating into the ground as expected.

EFFLUENT QUALITY

- Provides some additional treatment for BOD, TSS, nutrients, and fecal coliform.

High Pressure Drip

EFFLUENT DISPOSAL TECHNOLOGY

Drip disposal systems (also called drip irrigation systems) are a disposal technology that uses a network of pipes containing emitters commonly spaced 12 inches apart and installed in excavations like but shallower than absorption beds. Rather than working by gravity, these systems receive treated effluent in pumped doses from a dosing tank, which allows for controlled loading rates to the shallow root zone of the surrounding soil. While some of the treated wastewater percolates into the soil, drip disposal systems act partially as an evapotranspiration system since some of the effluent is taken up by the plants at the ground surface.

IDEAL APPLICATION

- Installation location is greater than 50 feet from inland or coastal waters.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet below the drip system.

BENEFITS

- Reliable alternative for areas with low permeability, seasonal high-water tables, or severe slopes.
- Ability to control dose/rest cycles allows for even spacing or dosing of effluent. This facilitates wastewater infiltration by spreading it spatially and over time.
- Significant evapotranspiration is possible.

CHALLENGES / RESTRICTIONS

- Large dose tank may be needed to accommodate timed dose delivery to the drip absorption area.
- Power is required to run pumps, sensors, and controls. Some minimal regular maintenance is required.
- Clogging of emitters can occur.

OPERATIONS AND MAINTENANCE

- Provide continuous electricity to small dosing pumps.
- Typical inspections may include observing and reporting of the general condition of the system, water level in tanks, ponding around the system, clogging at pumps and filters, pump cycles, and readings of any meters.
- Regular monitoring and maintenance of pump, filter and piping shall be performed.

EFFLUENT QUALITY

- Provides some additional treatment of BOD, TSS, nutrients, and fecal coliform.

High-Pressure Drip Disposal System.

Low Pressure Pipe

EFFLUENT DISPOSAL TECHNOLOGY

A low pressure pipe disposal system is a shallow, pressure-dosed soil absorption system that includes a network of small diameter perforated pipes placed in narrow trenches or beds. Pressure distribution is used to uniformly feed the pipes. Lower pressure is used because the pipes have orifices rather than emitters associated with high pressure systems. Alternating the dosing and resting cycles helps improve disposal efficiency and promote aeration. Low pressure systems can be either time-dosed or demand-dosed.

The main components of a low pressure pipe disposal system include:

- Submersible effluent pump in a pumping (dosing) chamber with a high-water alarm, level controls and a supply manifold.
- Small diameter perforated distribution laterals.
- Drain field media (gravel or sand).

IDEAL APPLICATION

- Areas with low permeability, seasonal high-water tables, or severe slopes.
- Groundwater table is greater than 3 feet below the disposal system.

BENEFITS

- Reliable alternative for areas with low permeability, seasonal high-water tables, and/or severe slopes.
- Shallow and narrow trenches reduce site disturbance and land area requirement.
- Ability to control dose/rest cycles allows for even spacing or dosing of effluent. This facilitates wastewater infiltration by spreading it spatially and over time.

CHALLENGES / RESTRICTIONS

- Limited storage capacity around laterals.
- Possibility of wastewater accumulation in the trenches.
- Potential for clogging and infiltration problems.

OPERATIONS AND MAINTENANCE

- Monitoring ponding at the bottom of trenches, readjusting operating pressure, and reducing flow to overloaded trenches.
- Flushing manifold and lateral lines periodically.

EFFLUENT QUALITY

- Provides some additional treatment of BOD, TSS, nutrients, and fecal coliform.

Low Pressure Pipe Disposal System Demonstration (North Carolina State University).

Seepage Pit

EFFLUENT DISPOSAL TECHNOLOGY

A seepage pit is constructed the same as a cesspool, but it receives treated wastewater. These systems are generally constructed from reinforced concrete rings, with a diameter of 8 or 10 feet and a height of 2 feet, that are stacked in order to achieve the depth required (usually 15-30 feet) to meet percolation requirements. Each ring has large openings in the sides. A concrete lid with a 12-inch inspection port is placed on top. Water percolates out from the sides and the bottom of the unit into the surrounding soil. The effective percolation area is measured as the pit sidewall area. These systems are unlikely to be approved by DOH.

IDEAL APPLICATION

- Soil percolation rate is less than 60min/in.
- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 12 percent and an absorption system is not feasible.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.
- Groundwater table depth is greater than 3 feet from the bottom of the seepage pit.

BENEFITS

- Seepage pits are the simplest and most compact method to percolate water into the ground.
- They are possible options when the available land area is insufficient for absorption beds or trenches, the terrain is steep, or when an impermeable layer overlies more suitable soil.
- These units can be maintained (accumulated solids from poorly functioning upstream treatment units can be accessed and pumped out) unlike absorption trenches/beds.

CHALLENGES / RESTRICTIONS

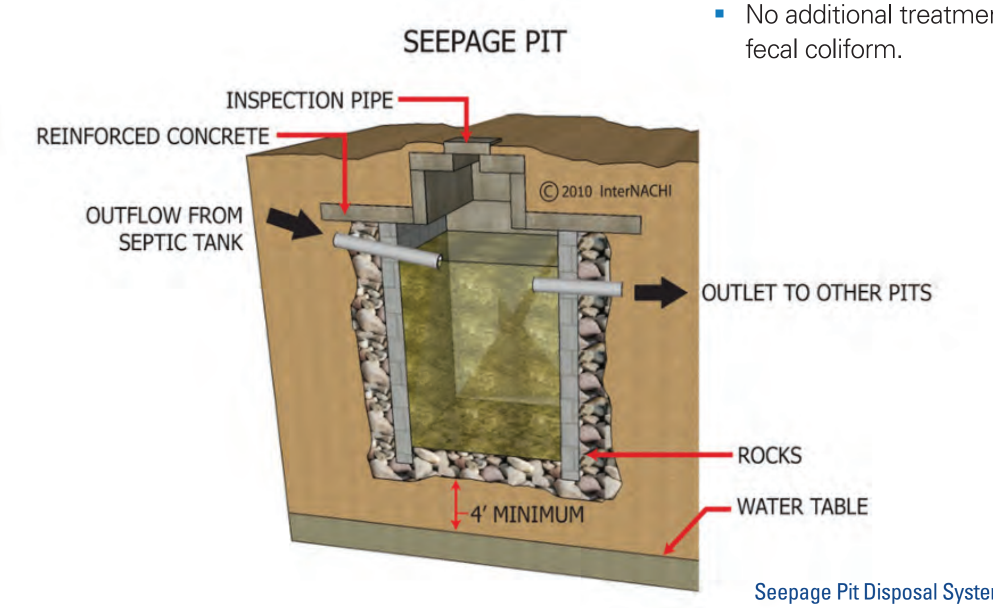
- Unlikely to be approved by DOH.

OPERATIONS AND MAINTENANCE

- Proper functioning of a seepage pit relies heavily on maintenance of the upstream treatment process. This prevents clogging of the seepage pit. Otherwise, periodic pumping of any accumulated sludge will be required.

EFFLUENT QUALITY

- No additional treatment of BOD, TSS, nutrients, or fecal coliform.



Seepage Pit Disposal System (InterNACHI, 2020).

Water Reuse

EFFLUENT DISPOSAL TECHNOLOGY

If an effluent from a treatment system meets criteria set by the DOH, then the recycled water can be utilized in landscaping, agricultural irrigation, and even toilet flushing.

The highest quality of recycled water defined by DOH is R-1 and is the only level of recycled water that can be used above the underground injection control (UIC) line. The requirements for R-1 water include tertiary filtration, daily monitoring for fecal bacteria, continuous turbidity monitoring, automatic diversion of off-spec water, 100 percent back-up disposal, and a reuse site with an approved management plan, signage, and a named responsible manager. The requirements for R-2 recycled water are less stringent, making recycling of effluent less difficult. However, the acceptable uses of R-2 water are also more limited (generally subsurface use only to prevent human contact). Also, a reuse site is still required as well as an approved management plan/manager.

Systems should be designed such that there are no crossings of recycled water lines and potable water lines. Clear markings should be used to identify recycled water pipelines. Strict and specific monitoring and record keeping are required, depending on the level of effluent quality and the method of application of the recycled water.

IDEAL APPLICATION

- Where appropriate, reliable reuse sites are near the wastewater treatment facility.
- Where the appropriate level of treatment is provided.

BENEFITS

- Helps reduce overall demand on potable water supply.

CHALLENGES / RESTRICTIONS

- Often more expensive treatment is required to reach water quality requirements.
- Strict rules and regulations to prevent potential environmental or health consequences.

OPERATIONS AND MAINTENANCE

- Extensive monitoring at the treatment facility is required.
- A water reuse plan is required for the reuse site, with monitoring and reporting. Signage is required at the site.

EFFLUENT QUALITY

- Effluent limits and monitoring requirements are regulated by DOH.

Water Reuse as an Emerging Solution.

Evapotranspiration

EFFLUENT DISPOSAL TECHNOLOGY

Evapotranspiration is a disposal technology that combines direct evaporation and plant transpiration. Treated effluent is conveyed to a porous bed containing water-tolerant plants. Wicking, or capillary action, draws water to the surface, where it is either taken up by the plants and transpired, or evaporated from the surface. Effluent that is not transpired or evaporated will percolate from the bottom of the bed. This type of system is known as evapotranspiration-infiltration.

These systems can also be designed with an underlying impermeable liner for a "zero-discharge" system. In this case, disposal is strictly dependent on evaporation and plant transpiration. Additionally, the liner allows the system to be placed above an Underground Injection Control (UIC) line or where there is shallow groundwater or proximate surface water such as a stream, lake or the ocean. Other components that are typically included are drip or distribution lines, flushing or filtering mechanism, controller to automate dosing cycles, distribution pump, and alternating evapotranspiration beds.

IDEAL APPLICATION

- Where zero discharge is desirable and there is adequate land area.
- Installation location is greater than 50 feet from inland or coastal waters.
- Maximum ground slope is 12 percent.
- Cannot be installed within the 100-year flood zones as defined by flood insurance rate maps.

BENEFITS

- If an impermeable liner is included for a "zero-discharge" system, then 100 percent nitrogen removal is achieved.

CHALLENGES / RESTRICTIONS

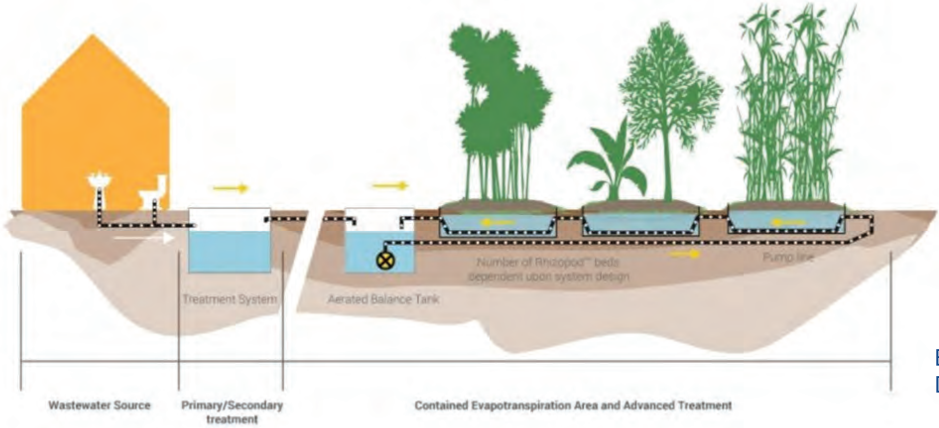
- Large surface areas are needed for year-round disposal. The size is controlled by a water balance based on rainfall and pan evaporation rates.
- These systems are more effective in arid climates where evaporation rates are much higher than precipitation rates.
- Recordkeeping of lysimeter (soil pore water sampler) data is required to ensure proper functioning.

OPERATIONS AND MAINTENANCE

- O&M tasks will include simple inspection of observation wells, electrical costs for pumping, as needed, minor landscaping, and maintaining upstream processes to avoid overflow of solids into the evapotranspiration bed.

EFFLUENT QUALITY

- Provides some additional treatment of BOD, TSS, nutrients, and fecal coliform.



Evapotranspiration Disposal System.

Injection Well

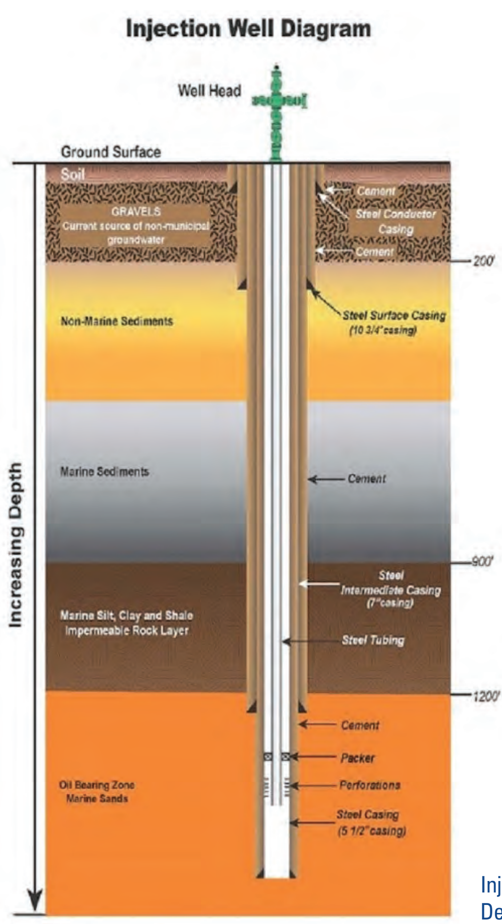
EFFLUENT DISPOSAL TECHNOLOGY

In this system, subsurface disposal of wastewater occurs by injection via a well (Hawai'i Administrative Rules 11-23). The current regulations are designed to prohibit the contamination of US drinking waters. Wastewater cannot be injected into current sources or potential future sources of drinking water. Injection can only occur into "exempted" aquifers which are already highly contaminated or have total dissolved solids (TDS) greater than 5,000 mg/L, making them brackish. In Hawai'i, there is an underground injection control (UIC) line, which is a boundary for each island which designates brackish groundwater near the coast. Makai of the UIC line, wastewater injection could potentially be granted a UIC permit. These types of permits are difficult to obtain and contain restrictions on flow, numerical contaminant limitations, and monitoring and reporting requirements.

For some cesspool replacement areas close to the coast, where decentralized cluster systems could be viable, an injection well could be considered as a possible disposal alternative. However, the DOH would generally consider it to be a "last resort" type option only applicable if other options are not viable. Currently, due to the 2019 Supreme Court ruling on the Maui County injection wells at the Lahaina WWTP, it is unlikely that any new UIC permits for wastewater will be issued in the foreseeable future.

IDEAL APPLICATION

- In areas of brackish groundwater and a permit is feasible.



Injection Well Diagram (California Department of Conservation).

BENEFITS

- Very simple system.
- Little to no maintenance required.

CHALLENGES / RESTRICTIONS

- Limited applicable locations/siting.
- Very difficult, if not impossible, to obtain a permit.

OPERATIONS AND MAINTENANCE

- Sampling and reporting requirements are extensive.

EFFLUENT QUALITY

- Discharge limits would be regulated by DOH.

Surface Water Discharge

EFFLUENT DISPOSAL TECHNOLOGY

Discharge of treated wastewater to surface water requires a National Pollution Discharge Elimination System (NPDES) permit. Permit requirements are found in Hawai'i Administrative Rules 11-62 Wastewater Systems and in the EPA's Clean Water Act. Obtaining a new NPDES permit for wastewater discharges in Hawai'i is generally avoided due to cost, complexity, monitoring requirements, 5-year duration/renewal requirements, etc.

For decentralized cluster systems near a stream or inland lake, a surface discharge permit is technically an option, and these permits are handled by the Hawai'i Department of Health (DOH). However, similar to an injection well, the DOH would generally consider it to be a "last resort" type option only applicable if other options are not viable. In addition, there are very few permitted discharges to inland lakes and streams and high levels of treatment are generally required.

IDEAL APPLICATION

- Following a high level of treatment where the treatment facility is near a stream or inland lake.
- Where an NPDES permit can be secured.

BENEFITS

- Simple system.
- Effectively recycles water back into the environment.
- Can augment stream flow.

CHALLENGES / RESTRICTIONS

- Potential negative impacts on natural bodies of water or drinking water.
- NPDES permit required. Expensive monitoring and reporting required.
- Very difficult to obtain a permit.
- Very limited applicable locations/siting.

OPERATIONS AND MAINTENANCE

- Sampling and reporting requirements are extensive.

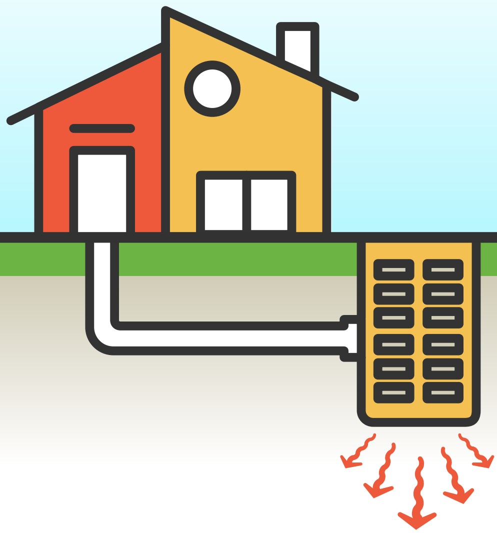
EFFLUENT QUALITY

- Effluent limits are included in NPDES permits and regulated by DOH.

Surface Water Discharge (IECE).

Appendix H

Example Homeowner's Information Packet



RULES ARE CHANGING FOR YOUR
HOME CESSPOOL

CESSPOOLS NEED TO GO!

Cesspools are underground wells used to dispose of household wastewater into the groundwater table. In 2017, the Hawaii State Legislature passed Act 125 requiring the replacement of all cesspools by 2050 to prevent environmental contamination. Cesspools pose a high risk to drinking water sources and coastal ecosystems. Even if you don't plan on being in your house in 2050, having a cesspool will negatively effect the resale value of your home.

HOW DO I KNOW IF I HAVE A CESSPOOL?

You probably **<u>don't</u>** have a cesspool if:

- You pay a sewer bill or sewer charge on your water bill.
- Your home was built recently.
- An alternative wastewater system other than a cesspool is shown at your residence on the "OSDS" map found here: **geoportal.hawaii.gov**

Inquire with the Department of Health if you're unsure of whether or not you have a cesspool!

OK, SO HOW DO I FIX IT?

1. Hire a licensed civil engineer to help you make a plan

2. Submit your plan to the Department of Health for approval

3. Hire a licensed contractor to build new system

4. Engineer submits inspection report for approval

CAN I AFFORD THIS?

Check out our local financing options.

Typical replacement costs range from $9,000 to more than $60,000. For current financing opportunities, contact the Department of Health or visit their website listed below.

State or County Support
(if available)

Home Refinancing

Federal Grants and Loans
(if available)

For additional information contact the Department of Health at 808-586-4294 or visit their website at **health.hawaii.gov/wastewater**

CESSPOOL ALTERNATIVES

Different locations will require different levels of treatment! Follow this guide for an idea of what system you may need and then get in touch with a local engineer for a personalized estimate as prices may vary.

Is your property near an existing sewer system?

Recommendation: A

Is your property small[1], sloped[2], upcountry[3], in a floodzone, or near a body of water[4]?

Recommendation: B + C + D

None of the above?

Recommendation: B + D

1 *Less than 10,000 sf*

2 *Slope greater than 8%*

3 *Mauka of the UIC line (a boundary protecting drinking water aquifers)*

4 *Within 1,000 ft of a drinking water source, 50 ft of a waterbody, or 3 ft of water table*

SEWER CONNECTION OR BASIC TREATMENT

Every property will need to either connect to an existing sewer system or install a septic tank to treat wastewater onsite! Septic tanks need annual maintenance while a sewer connection means you'll get a monthly sewer bill!

A Existing Sewer System

This is the lowest maintenance option but there is a connection fee and a monthly sewer bill!

OR

B Septic Tank

This tank settles out and breaks down solids, which then need to be pumped out every few years by a licensed contractor.

C ADDITIONAL TREATMENT

Homes using onsite treatment near a vulnerable water resource need additional treatment with their septic tank to reduce the amount of nutrients discharged into the environment.

Alternative Toilets
These waterless toilets don't produce wastewater! The septic tank handles the rest of the water from your house.

OR

Aerobic Treatment
In this case, the septic tank is smaller and an aerated zone is added for additional treatment.

OR

Biofilter
A media like sand or gravel is used to polish the water leaving your septic tank.

D DISPOSAL

Treated water needs to be fed back into the ground.

Seepage Pit
Converting your cesspool into a seepage pit is the cheapest option but it's not always allowed.

OR

Absorption Field
Tubes with tiny holes spread wastewater out underground so it can filter through the soil.

OR

Evapotranspiration
This option is the same as the absorption field except it's shallow so the water feeds your plants then evaporates.

For additional information contact the Department of Health at 808-586-4294 or visit their website at **health.hawaii.gov/wastewater**