

## GENERAL BACKFILLING SCENARIOS FOR AN INJECTION-WELL CESSPOOL

(August 2004)

**Basis:** Backfilling and permanently abandoning an injection-well cesspool constitutes an injection well closure. When backfilling work is satisfactorily done under the guidelines, review, and reporting criteria of the Underground Injection Control (UIC) program, the injection well closure is deemed official and documented. An official injection well closure indicates that the injection well has been cleaned out and permanently filled and sealed with an inert material having stability and physical strength. Furthermore, an official closure indicates that the injection well's remaining profile will not ever serve as a preferential route for the infiltration/migration of fluids into, out of, or between soil, sedimentary, or volcanic formations. In this regard, an official injection well closure should minimally reestablish the subsurface and ground back to its original condition. Indeed, an official injection well closure is more than just filling a hole in the ground so that the hole is unnoticeable.

**Approach:** For the purpose of this document, step-by-step backfilling procedures are not described. Instead, for a variety of typical on-site ground conditions, mixed with a variety of size-and-depth injection-well cesspool dimension considerations, here listed are general backfilling scenarios:

1. Ground condition: Not considered: either no information available or, by intent, only one generalized backfilling method/specification is desired.

Backfilling: Use a cement mixture. Cement mixtures may range from cement/water (neat cement), to sand/cement (1/1, 2/1, or 3/1), to concrete (1500, 2500 psi). Determining the appropriate mixture depends primarily on the diameter of the injection well. Any diameter smaller than 12 inches requires neat cement. Emplacement of the cement mixture into the injection well is via the Tremie method. Cement mixtures have a water-to-cement ratio of approximately 5 gallons, but not exceeding 6 gallons, per 94 pounds of cement (one sack).

2. Ground condition: Lava formations: either a`a or pahoehoe lava flows, dikes, welded tuff, or welded cinders, regardless of fractures, clinkers, or voids.

Backfilling: Use a cement mixture as described in item # 1. If the injection-well cesspool is not deeper than 25 feet and does not encounter groundwater, a controlled low-strength material (flowable fill) may be alternatively used. The flowable fill should have a minimum strength of 500 psi. Emplacement of the flowable fill is the same as of a cement mixture.

Cesspool diameters vary, but diameters may typically range from 5 to 8 feet. The use of additional appropriate inert aggregate materials, to help reduce the volume of the cement mixture, or the flowable fill, is possible. However, this method of backfilling must be first approved by the UIC program. Appropriate inert aggregate materials may include clean boulders and cobbles, certain types of smaller-sized aggregates, and clean concrete blocks from demolition. When aggregate materials are deemed appropriate and appropriately sized, emplacement of the aggregate with the cement mixture must not create voids due to bridging or incomplete cement mixture filling. Emplacement of the inert aggregate should never rise above the cement mixture level. In other words, the cement mixture must be emplaced first in the well to a certain level, and aggregates should then be dropped into the cement mixture. The cement mixture is continually added in order to keep the cement mixture level above the inert aggregate.

3. Ground condition: Consolidated material: either hard coral, cemented sand, in situ decomposed rock, tuff, or conglomerate.

Backfilling: Use a controlled low-strength material (flowable fill). The flowable fill should have a minimum strength of 300 psi. Emplacement of the flowable fill is the same as of a cement mixture. The use of appropriate inert aggregate materials, to help reduce the volume of the flowable fill, is possible. Refer to item #2 for details.

(600 psi  
below water)

4. Ground condition: Unconsolidated material: either soil, sand, gravel, loose coral, loose cinders, or alluvium.

(300 psi  
below water)

Backfilling: A material similar to the site's natural material may be used for backfilling. The condition of the injection-well cesspool, e.g., the dimensions, open-hole integrity, accessibility, standing water, etc., may affect the determination to use a site-similar material. A more stringent backfilling material (cement mixture) may be required. When using a site-similar material, the material should be emplaced in one-foot layers and compacted sequentially to match or exceed the site's natural formation density. As an alternative to a site-similar material, a controlled low-strength material (flowable fill) may be used. The flowable fill should have a minimum strength of 150 psi. Emplacement of the flowable fill is the same as of a cement mixture.

If a site-similar material is used to backfill a casing, and if the casing's top is less than 5 feet below the ground surface, then the inside top 24 inches of the casing must be completely filled with concrete (1500 psi).

5. Ground condition: The injection-well cesspool is fully eliminated by excavation, i.e, the entire cesspool profile is excavated away.

Backfilling: A material similar to the site's natural material may be used for backfilling the excavation. The material should be emplaced in layers and sequentially compacted to match or exceed the site's natural formation density. Local soil engineering principles and practices should be used for backfilling, in full consideration of stability, strength, and safety objectives.

**General Remarks:**

- a. Prior to any method of backfilling, each injection-well cesspool should be cleared to its original constructed depth, and all sediments, sludge, and organic materials in the cesspool should be removed and disposed of properly.
- b. Backfilling with a cement mixture or flowable fill may stop short of reaching the ground surface in order to accommodate

top soil, landscaping, grading, underground utilities, or foundation considerations. Stop-short depths should generally not exceed 4 feet. The remaining unfilled hole may be filled with soil. Stop-short depths do not apply in casings; casings must always be filled completely.

- c. All backfilling methods should not leave behind a depression in the ground. The final ground surface should be shaped or graded to prevent tripping or falling, as well as water ponding.
- d. An application to the UIC program is first required in order to abandon an injection-well cesspool. When applicable, the application fee is \$100, payable to the State of Hawai`i. Project specific, written backfilling instructions are then issued to the applicant. The instructions contain details about the backfilling material, work methods, and reporting requirements.
- e. Hawai`i injection well regulations are under Hawai`i Administrative Rules, Title 11, Chapter 23, titled Underground Injection Control.