COOPERATIVE ECOSYSTEM STUDIES UNITS
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CESU Final Report Summary for
LAHAINA GROUNDWATER TRACER STUDY – LAHAINA, MAUI, HAWAII
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Purpose: This report was prepared by the University of Hawaii for the U. S. Army Engineer Research and Development Center at Vicksburg, Mississippi, the State of Hawaii Department of Health and the U.S. Environmental Protection Agency to provide critical data about the possible existence of a hydrological connection between the injected effluent from the Maui County, Hawaii, Lahaina Wastewater Reclamation Facility (LWRF) and the nearby coastal waters, confirm the locations of emerging injected effluent discharge in these coastal waters, and determine a travel time from the LWRF injection wells to the coastal waters.

Location: Maui County, Hawaii

Methods: The studies presented in this report provide the positive establishment of hydrologic connections between the municipal wastewater injection from the LWRF and the nearshore region of the Kaanapali coast on the Island of Maui, Hawaii, and provide the results from the study's principal objectives, which have been to: (1) implement a tracer dye study from the LWRF (Section 3), (2) conduct continuous monitoring for the emergence of the injected tracer dyes at the most probable points of emergence at nearshore sites within the coastal reaches of the LWRF (Section 2), (3) conduct an airborne infrared sea surface temperature mapping survey of coastal zone fronting the LWRF in an effort to detect cool and/or warm temperature anomalies that may be indicative of cool submarine groundwater discharge and warm wastewater effluent (Section 4), (4) complete radon and radium radiochemical surveys to detect the emergence points and flow rates of the naturally occurring submarine groundwater along the coastal zone (Section 5), (5) complete geochemical and stable isotopic analyses of LWRF effluent, upland well waters, terrestrial surface waters, marine waters, and submarine groundwater discharge in an effort to help partition the relative contribution of effluent waters to the ocean (Section 6), and (6) combine complete dye emergence breakthrough curves with which to develop groundwater models to determine the LWRFs effluent flow paths and rates of emergence to the coastal zone (Section 7).

Results: Our principal findings include the following key results:
(1) Fluorescein tracer dye added to LWRF injection Wells 3 and 4 arrived at coastal submarine spring sites with a minimal travel time of 84 days; a second dye, Sulpho-Rhodamine-B added to LWRF injection Well 2, has yet to be confirmed.

(2) Submarine springs releasing the fluorescein dye to the coastal ocean are located at North Kaanapali Beach, approximately 0.85 km (0.5 miles) to the southwest of the LWRF, and within 3 to 25 meters of shore.

(3) Waters discharging the fluorescein dye from the submarine springs are warm and brackish, and have an average salinity of 4.5 and a pH of 7.5.

(4) Geochemical mixing analyses indicate that the submarine spring waters are predominately LWRF treated wastewater which while in transit to the submarine springs undergo oxic, suboxic and likely anoxic microbial degradation reactions that consume dissolved oxygen, dissolved nitrate, and organic matter.

(5) The N concentration of the submarine springs is reduced compared to LWRF treated wastewater, while the P concentration is enriched. Averaged N and P concentrations collected from the submarine springs were ca. 1,100 □g/L and 425 □g/L, respectively.

(6) As based on radon mass balance measurements, average total (fresh + marine) discharge from the submarine springs and the surrounding diffuse flow was about 2.76 million gallons per day (mgd) (10,450 m3/d). The freshwater component of that flow was about 2.25 mgd (8,500 m3/d), or about 75% of the LWRF total average daily injection rate (~3.0 mgd; 11,350 m3/d).

(7) High-resolution airborne thermographic infrared mapping identified a large sea surface thermal anomaly associated with the warm water submarine springs. The nearshore surface area of this thermal anomaly is ~ 674,000 m2, or about 167 acres in size.

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