

ISLAND OF MOLOKAI SHOWING GEOHYDROLOGIC UNITS, SAMPLING SITES, AND GROUND-WATER SOURCES

ISLAND OF LANAI SHOWING GEOHYDROLOGIC UNITS, SAMPLING SITES, AND GROUND-WATER SOURCES

Table 1. Description of geohydrologic units, inventory of pollution sources, and location of monitoring sites on Molokai and Lanai

No.	Geohydrologic unit Name	Topography and rock units	Ground water		Sources of pollution and recipient water bodies	Wells monitored a, b, c, CI	Candidate monitor wells
			Occurrence	Movement			
1	West Molokai dome	Moderately dissected volcanic dome. It was built by basaltic lava flows erupted along southwest- and north-west-trending rift zones. Some alluvium and dunes in eastern and northern parts. Narrow coast.	Mostly underlain by brackish basal water. Possible dike-impounded ground water in rift zones, but there are no surface indications of it.	Movement is generally in direction of lava slopes except in rift zones where movement may be downgradient in direction of dikes. Basal water moves from volcanic rocks to sedimentary; thence to sea.	At least 220 cesspools in Mauna Loa and 1 soil-waste dump in southwestern part. Leachate from pineapple fields. Chief recipient is underlying brackish basal water.	None. Sampling point at Kolo wharf b 2/month	None. Need: None at present. Coastal waters or near-shore ground water need to be monitored if subsurface waste disposal is significantly increased by development.
2	Holehua-Kaunakakai area	Slopes of East Molokai dome and plateau connecting East and West Molokai. Surface rocks are mostly andesitic lava flows, basaltic lava flows underlie andesites and crop out in deeply eroded valleys. Moderately well developed sedimentary coastal plain in the southern part.	Mostly underlain by generally brackish near coast and in plateau. Water freshens toward the north. Dike-impounded water in rift zone in the north-eastern part. Small perched water bodies in andesitic lava flows in the north-eastern part. Most ground water developed for irrigation in plateau area. Perched water for small domestic supplies.	Perched water moves to surface as springs which is generally lost to evapotranspiration or moves to underlying dike-impounded or basal water. Dike-impounded water moves to underlying basal water. Basal water moves generally in direction of lava slopes where it discharges at or near the shore. Where coastal sediments are thick, basal water discharges into the sediments; thence to sea.	At least 840 cesspools, 3 sewage-disposal wells, 2 storm-runoff disposal wells, 4 soil-waste dumps, and 2 sludge beds. Sewage disposed in dry gulch south of Kaunakakai. Leachate from pineapple field and irrigated truck farms. Chief recipient is underlying basal water.	Well 16 b, CI monthly c annually Well 17 c annually CI monthly Molokai tunnel Kipua tunnels Well 11 Dug well 14 Kalua Koi Corp. well CI monthly Kaunakakai Harbor Moononi beach b 2/month c 4/year	See well map. Need: None at present. Monitoring of coastal waters or near-shore ground water near Kipua area is necessary if pollution significantly increases. Some wells in Kaunakakai area but generally are not suitable as monitor wells.
3	Windward East Molokai	Caldera and north slopes of East Molokai volcano. Pelona and Mauna valleys cut deep into the caldera region exposing dike-intruded basaltic lavas. Low permeable andesitic flows underlie gently sloping spur and farm swampy areas. Kalaupapa peninsula built by late volcanic activity.	Ground water in basaltic lavas is mostly dike impounded, and that in andesitic lavas mostly perched. Basal water near the shore, in Kalaupapa peninsula where it is brackish. Dike-impounded water in Maunaloa valley is developed by Molokai tunnel for irrigation use.	Overflow of perched water moves to stream channels or to underlying dike-impounded or basal water. Overflow of dike-impounded water to stream channels or to downgradient basal water. Most ground water discharges as streamflow.	Leachate from cesspools and other wastes in Kalaupapa. Population about 230. Chief recipient is underlying brackish ground water.	None. Halawa Bay b 2/month c 4/year	None. Need: None at present.
4	Leeward East Molokai	South and southeast slopes of East Molokai volcano. Surface rocks are mostly andesitic lava flows underlying the upper spur; basaltic lava flows in lower slopes and in valleys where andesitic flows have been eroded. Except near mouths of larger valleys, coastal plain is absent or narrow.	Principal occurrence is basal water in volcanic aquifer. Some water in dike-impounded water in interior mountainous areas. Basal water is important municipal supply.	Overflow of dike-impounded water to stream in interior which loses most of its flow into the ground and to underlying basal water. Basal water moves generally in direction of lava slopes where it discharges at or near the shore.	At least 185 cesspools scattered in towns along the south coast. Chief recipient is basal water in underlying volcanic or sedimentary aquifers.	Shafts 4 and 6 b, CI monthly c annually Shaft 8 CI monthly Sampling point in Kalaupapa Harbor b 2/month c 4/year	See well map. Need: None at present, but need to monitor contaminated large point source of pollution from future development.
5	Lanai Island	Eroded volcano built during one period of activity by eruptions at the summit and along three rift zones. Summit collapsed to form a caldera which was largely filled by lava flows. Palawai Basin is remnant of caldera. Lava massive in caldera and thin-bedded in flanks. Numerous dikes and faults. Sedimentary rocks consist of alluvium, dune sands, and marine deposits.	Most important occurrence is high-level impounded water in central part of island. Water is impounded by dikes or faults or both. Basal water occurs in all coastal areas in a zone 2 to 4 miles wide. Perched water supplies agricultural and domestic needs.	Overflow of high-level water to basal water; thence to sea at or near the shore.	At least 715 cesspools, nearly all of them in Lanai City. Chemical loading and washroom holding pond 1/4 mile west of Lanai City. Overflow from primary treated Lanai City sewage in storm ditch. Abandoned soil-waste dump 1/2 mile east of Lanai City. Recipient of leachate from soil-waste dump near airport is basal water. Leachate from pineapple fields to both high-level and basal water.	Wells 1 and 3 b 4/year c annually Well 4 b 4/year	See well map. All domestic supplies should be monitored.

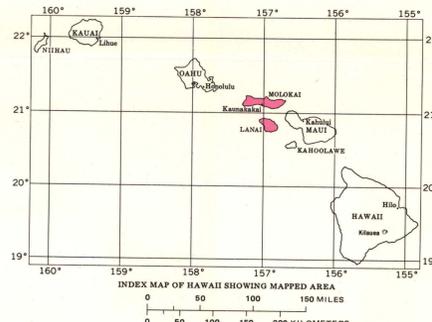


Table 2. Rock units on the islands of Molokai and Lanai

Rock unit	Assemblage	General character	Water-bearing properties	Location in geohydrologic unit
Sedimentary material	Beach sands, dunes	Loose sand, mixed basaltic and calcareous	Highly permeable; carry brackish water near coast but no water inland	All units
	Alluvium	Unconsolidated and consolidated	Poor to moderate permeability; carry small quantities of fresh and brackish water	All units
Rocks of Molokai Island	Marine deposits	Reef limestone, consolidated	Permeable but carry only brackish water	All units
	Kalaupapa Volcanic Series	Basaltic lava flows	Highly permeable but carry only brackish water	Unit 3
Rocks of Lanai Island	East Molokai Volcanic Series	Upper member: Chiefly andesitic and trachytic flows Lower member: Chiefly thin-bedded basaltic flows	Massive lava flows have low permeability; carry small quantity of perched water	Units 2, 3, 4
	West Molokai Volcanic Series	Chiefly thin-bedded basaltic flows which are weathered deeply. Lavas are dike intruded in the rift zones.	Highly permeable and freely yield water to wells except in caldera complex where permeability is low	Units 2, 3, 4
Rocks of Lanai Island	Lanai Volcanic Series	Basaltic lava flows, dikes, and breccia	Fresh lavas are highly permeable, but owing to low rainfall and salt spray, ground water is generally brackish	Unit 1
Rocks of Lanai Island	Lanai Volcanic Series	Basaltic lava flows, dikes, and breccia	Lavas are highly permeable, dikes and fault zones impound water. Breccia deposits are poorly permeable	Unit 5

Table 4. Pollution potential of seawater, irrigation water, and common wastes, Islands of Molokai and Lanai

Geohydrologic unit	POLLUTANT									
	NONPOINT				POINT					
	Seawater intrusion	Irrigation return	Pasture	Septic cesspool	Sewage effluent	Livestock farm	Industrial waste Toxic	Industrial waste Nontoxic	Solid waste	Urban and flood runoff
Molokai										
1	H	L	M	M	H	H	H	H	H	M
2	H	L	M	M	H	H	H	H	H	M
3	L	L	L	L	L	L	L	L	L	L
4	M	L	L	L	M	H	H	H	H	M
Lanai										
5	H	L	M	M	L	H	H	H	H	M

Note: Explanation of tables found in text under "Presentation of Information by Islands"

Table 3. Aquifers tapped by wells, shafts, test borings, and tunnels on islands of Molokai and Lanai

No.	Name	Sedimentary material	Molokai Island		Lanai Island
			West Molokai Volcanic Series	East Molokai Volcanic Series	
1	None	None	Lower member	Upper member	Lanai Volcanic Series
2	Dug wells 14, Yoshida, Buchanan	None	Wells 1, 0915-01, 1014-02, 1114-03, -04	None	Absent
3	None	Absent	Wells 11, 15, 16, 17, 19, 0700-01 Molokai irrigation tunnel, west portal Wells 22, 23, 24 (Well 22 is located inside tunnel)	Tunnels 4, 5 Many small perched springs	Absent
4	Dug well 31	Absent	Wells 31, 0352-07, 0354-02, 0344-01 Shafts 4, 6, 8	None	Absent
5	Gay wells A, B	Absent	Absent	Absent	High-level water Wells 1, 3, 4, 5 Shafts 2, 3 Tunnels 1, 2 Test hole 3 Basal water