

Animal Waste Management Strategies for Pacific Island Environments

# Protection of Island Water Resources from Livestock Waste Pollution

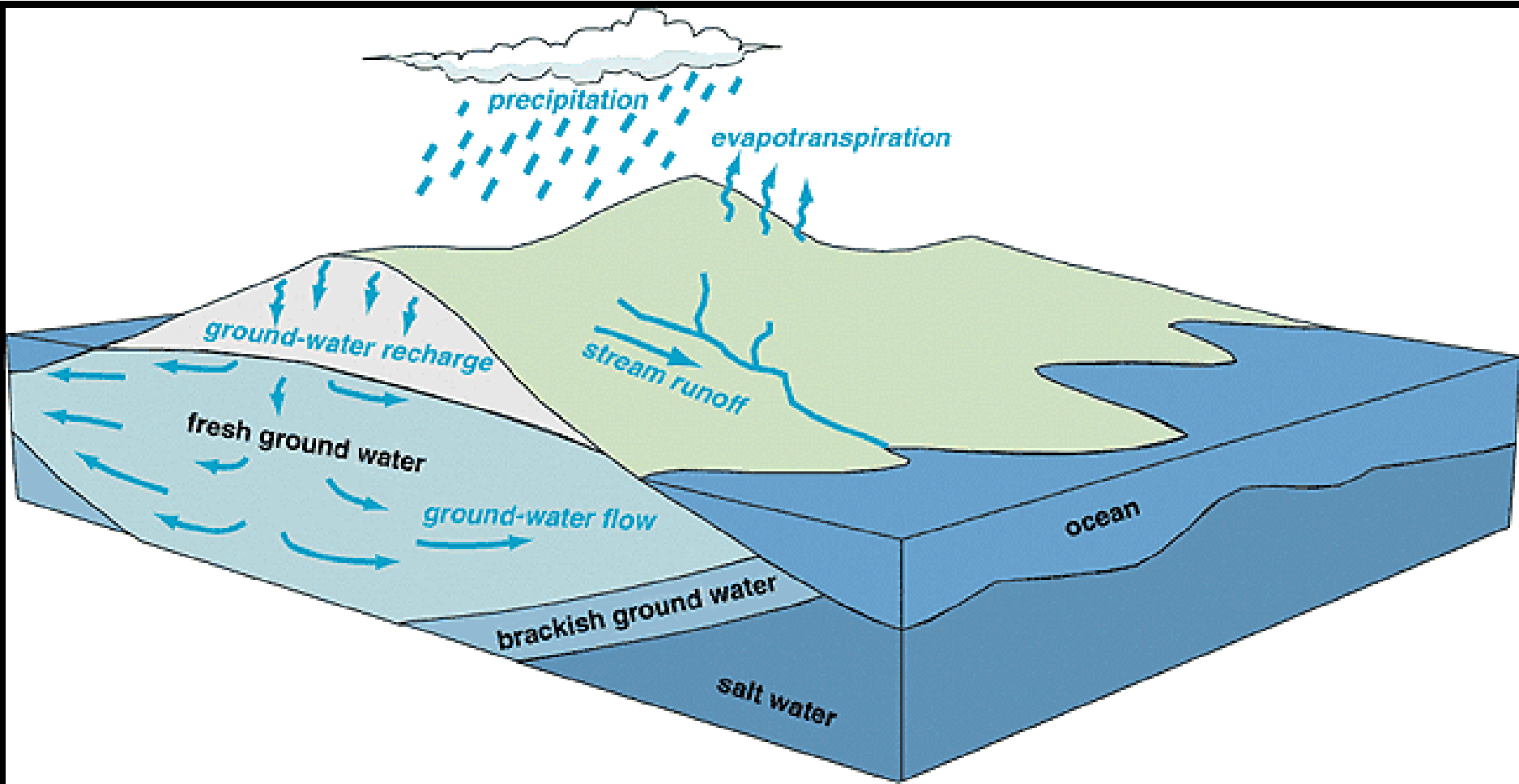


**Carl Evensen**



**University of Hawaii at Manoa**  
**College of Tropical Agriculture & Human Resources**

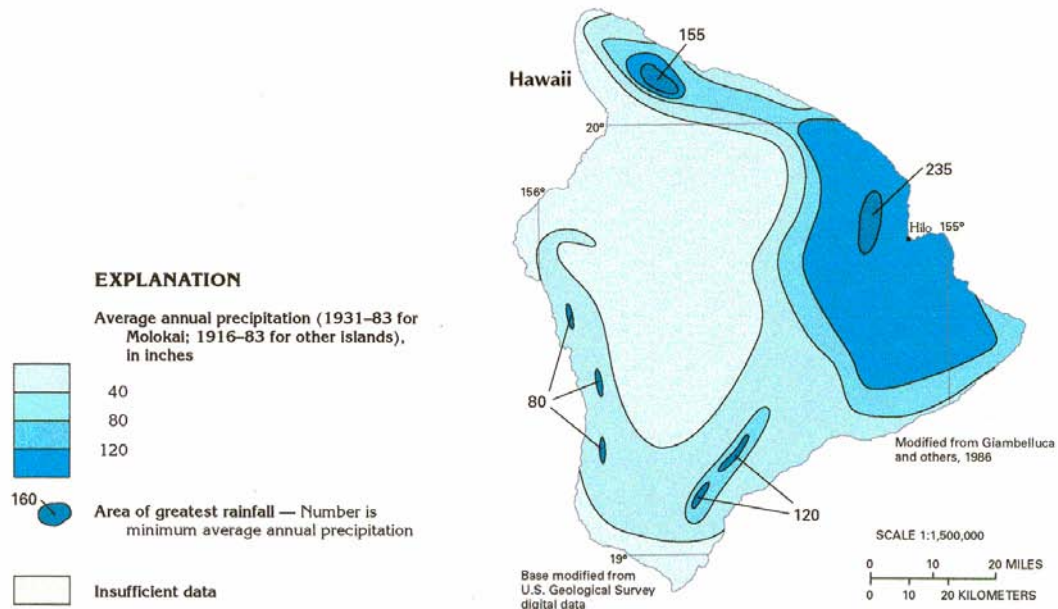
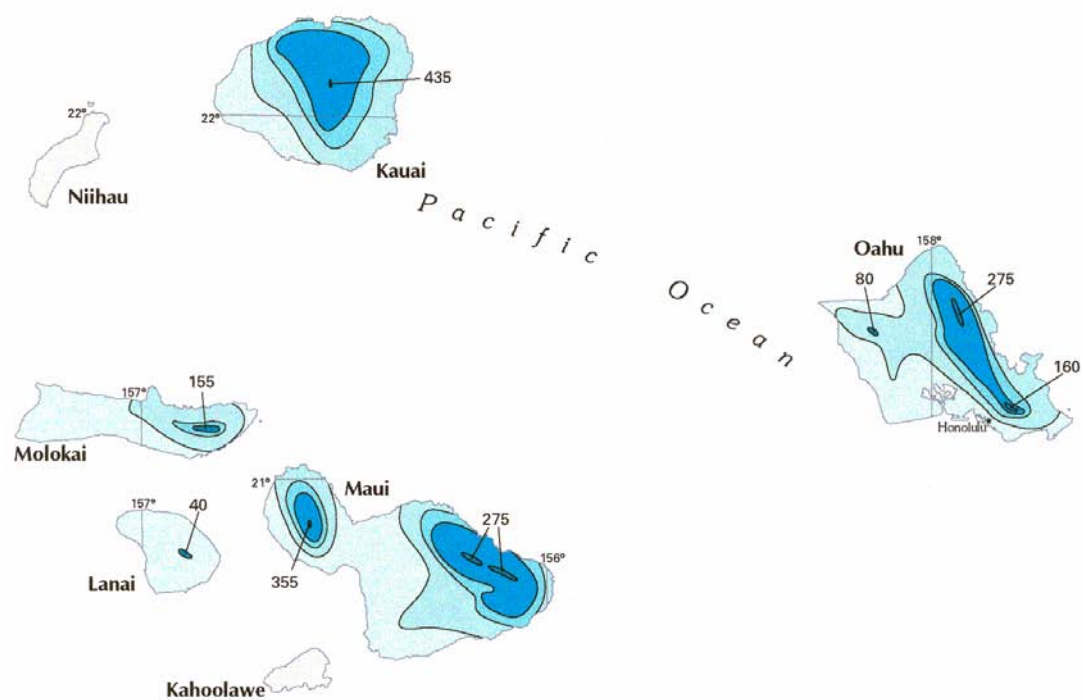
# Island Hydrology



(Source: USGS)

# Rainfall Distribution in Hawaii









- Orographic rainfall
- Extreme variation over short distances

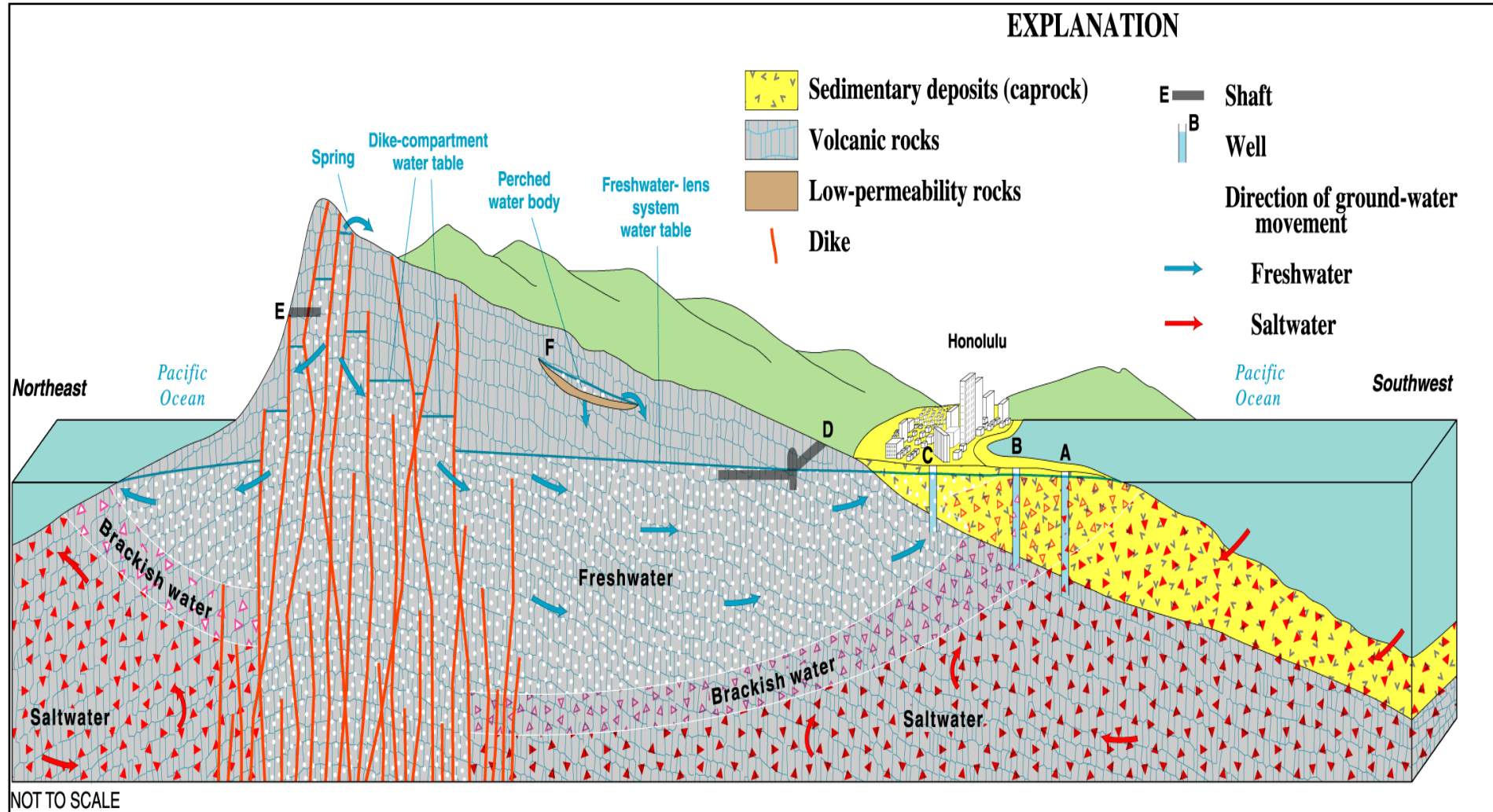


(Source: USGS)

# Groundwater in Hawaii

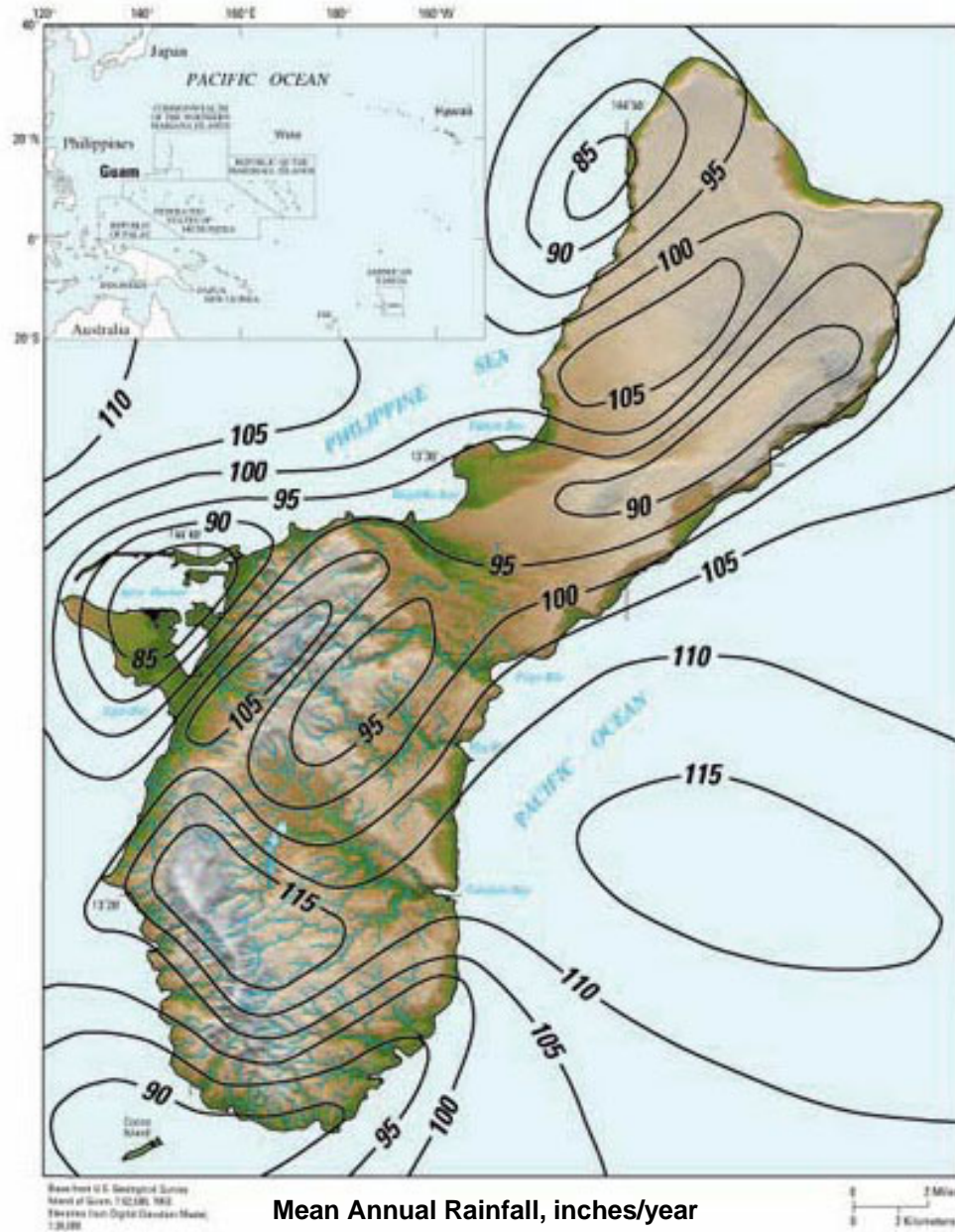
## EXPLANATION

-  Sedimentary deposits (caprock)
-  Volcanic rocks
-  Low-permeability rocks
-  Dike
-  Shaft
-  Well
- Direction of ground-water movement**
-  Freshwater
-  Saltwater

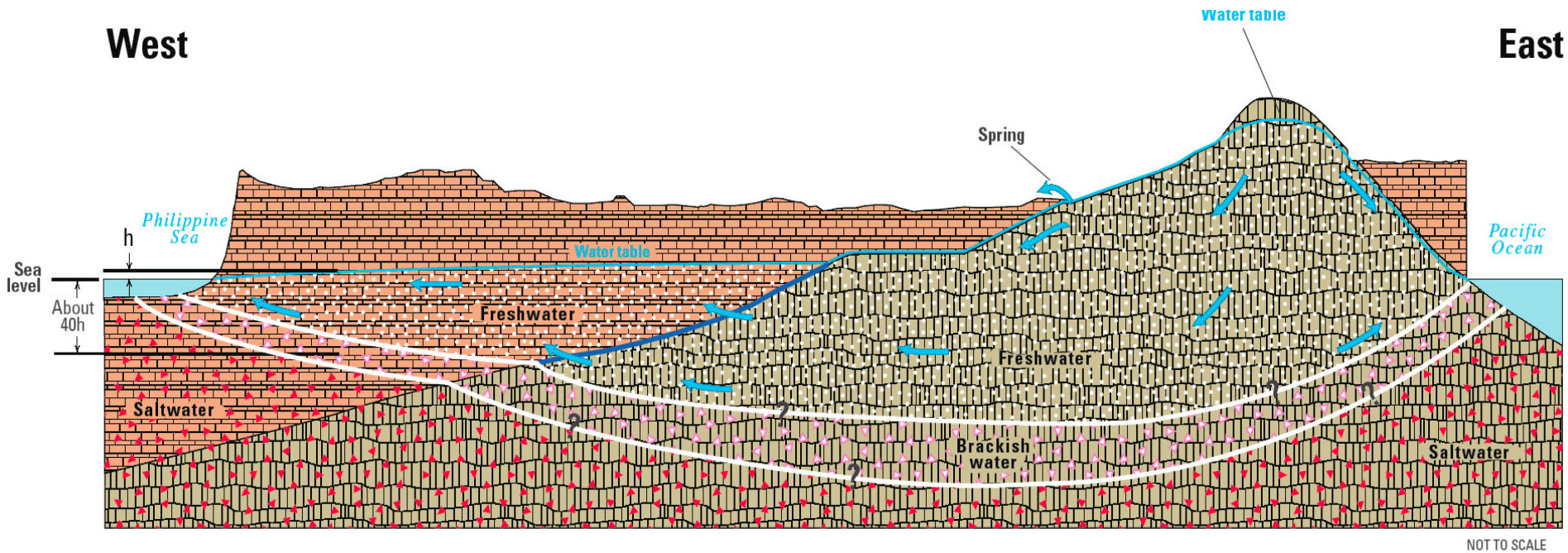


NOT TO SCALE





# Geohydrology of Guam



(Source: USGS)



### EXPLANATION

-  LIMESTONE
-  VOLCANIC ROCKS
-  GENERAL DIRECTION OF FRESH GROUND-WATER FLOW
-  ZONE WHERE FRESHWATER IN LIMESTONE IS IN DIRECT CONTACT WITH FRESHWATER IN UNDERLYING VOLCANICS (PARA-BASAL)

# Geohydrology of Tinian

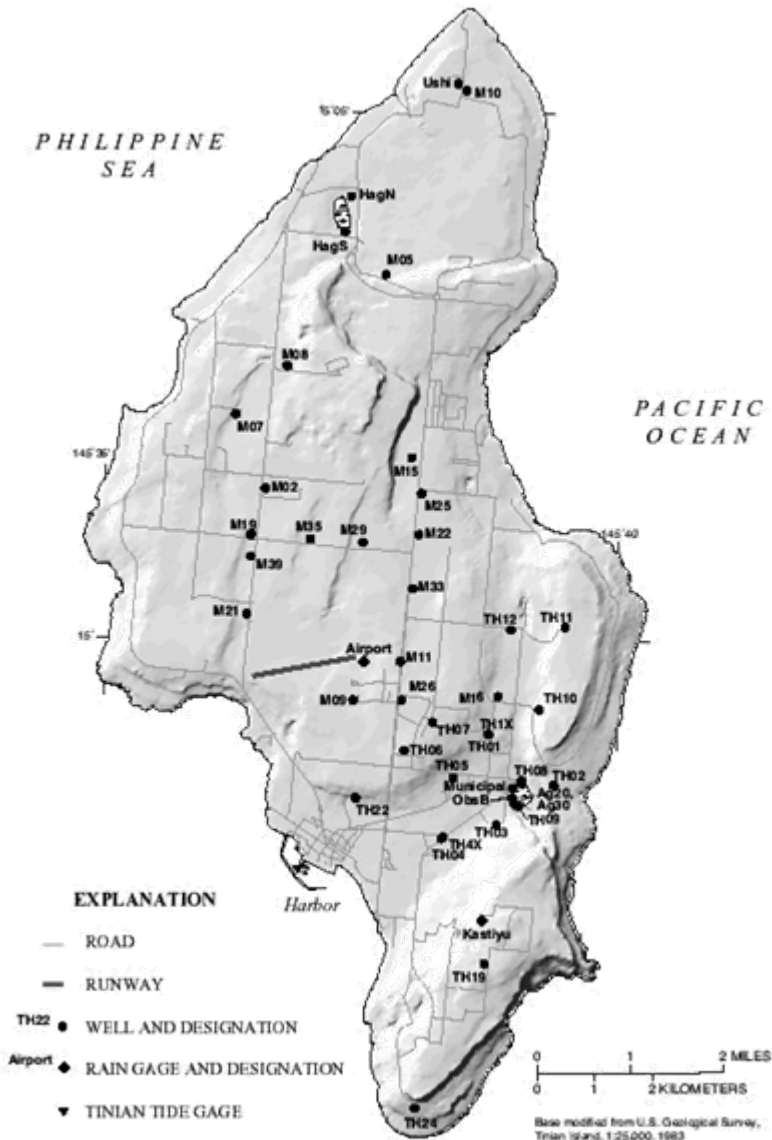


Figure 7. Location of selected wells and rain gages, Tinian.

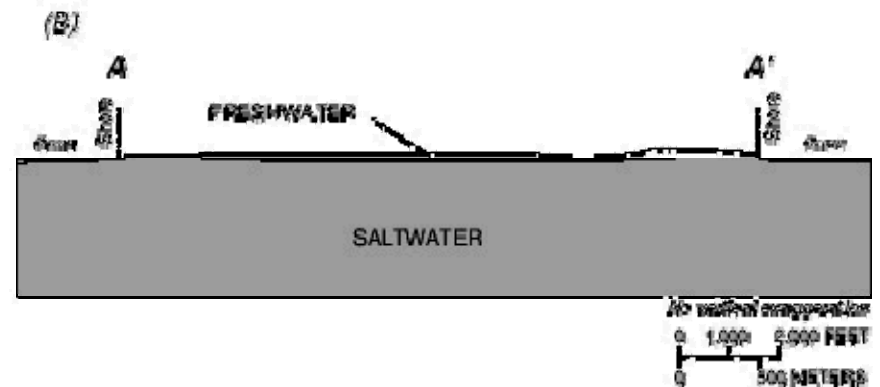
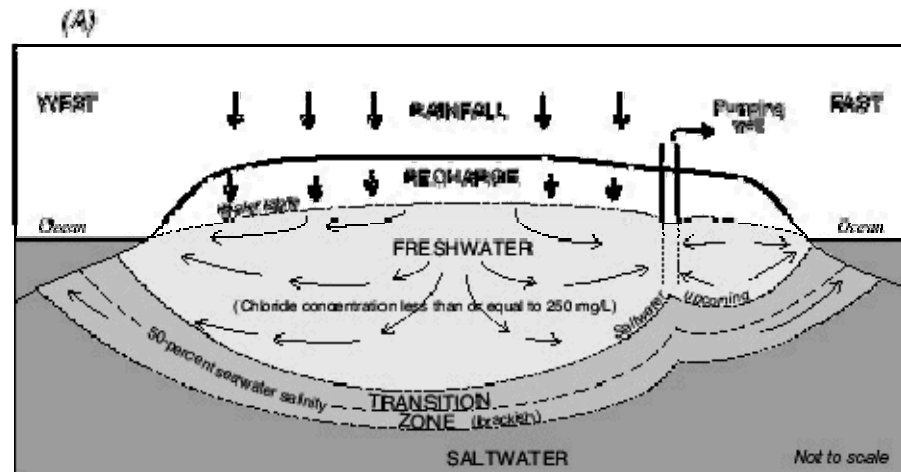


Figure 8. Cross-section of freshwater lens. (A) Schematic diagram of salinity structure and ground-water flow pattern. *Vertical dimensions greatly exaggerated.* (B) Tinian freshwater lens, *no vertical exaggeration.* Line of section shown in figure 1.

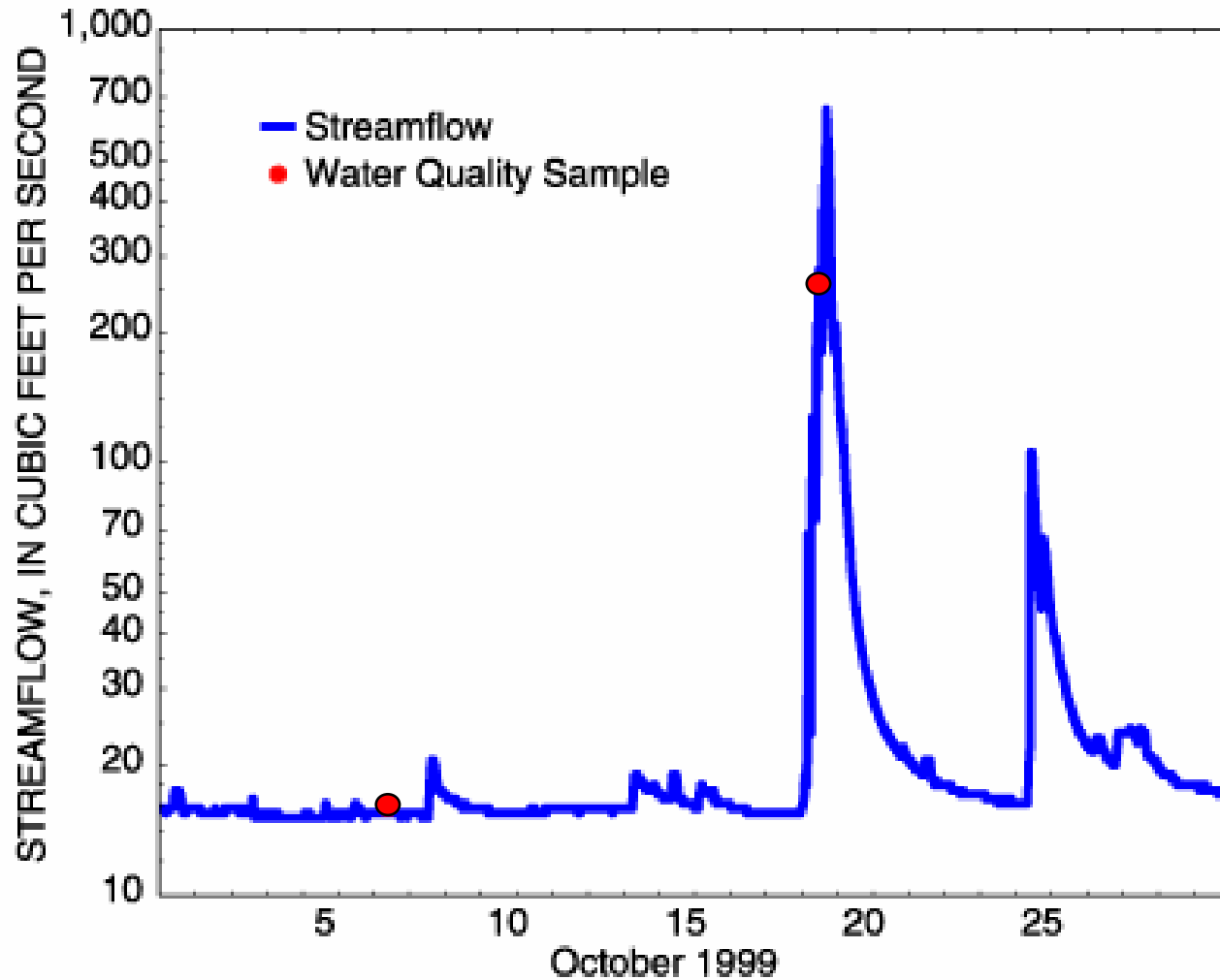
(Source: USGS)

# Island Streamflow Characteristics

- **Streams are short with steep gradients and small drainage areas**
- **Few streams are perennial over their entire reaches**
- **Flow is highly variable**
  - **Low flows maintained by ground-water discharge**
  - **High flows in response to short-term rainfall events**



# Rapid runoff with high peak flows



(Source: USGS)



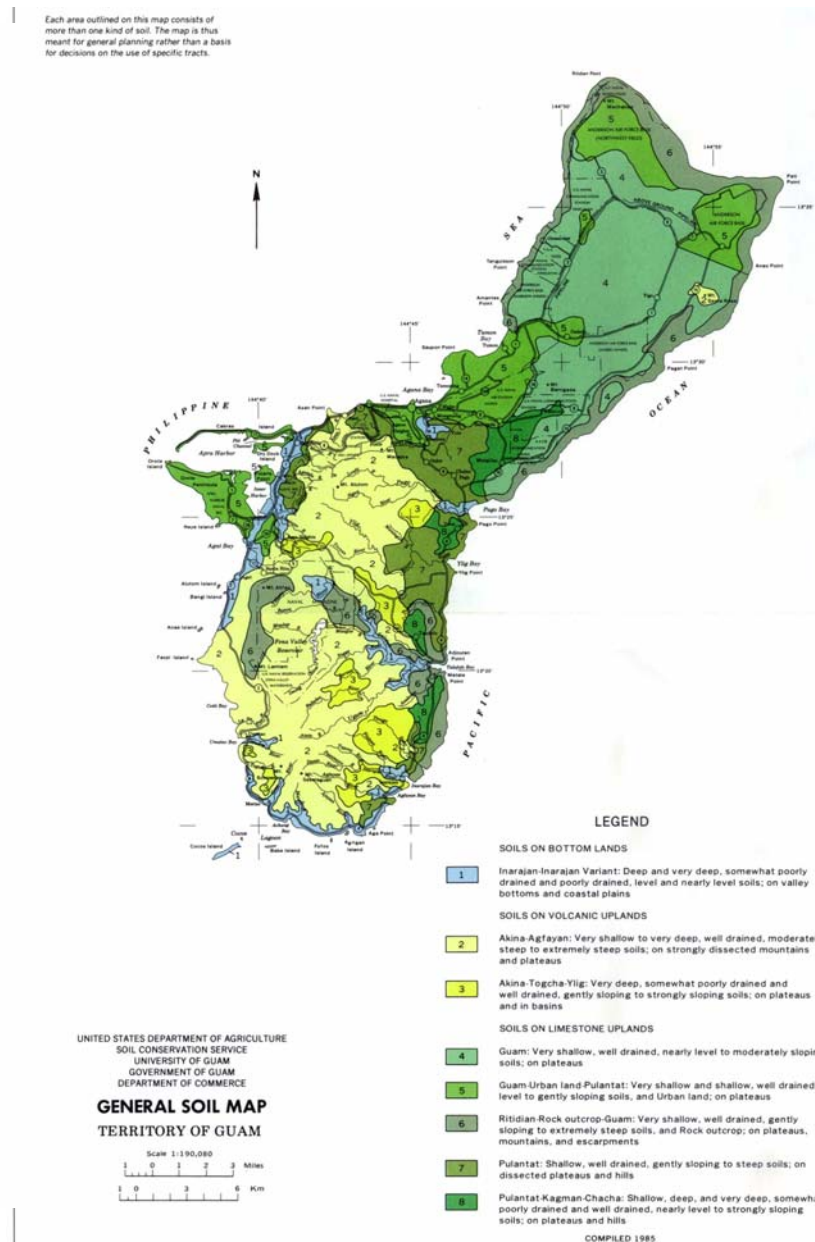
**Flooded pasture at Waipa, Hawaii**

# Geology & Soils of Guam



(Source: USGS)

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



(Source: NRCS)

# Geology & Soils of Saipan

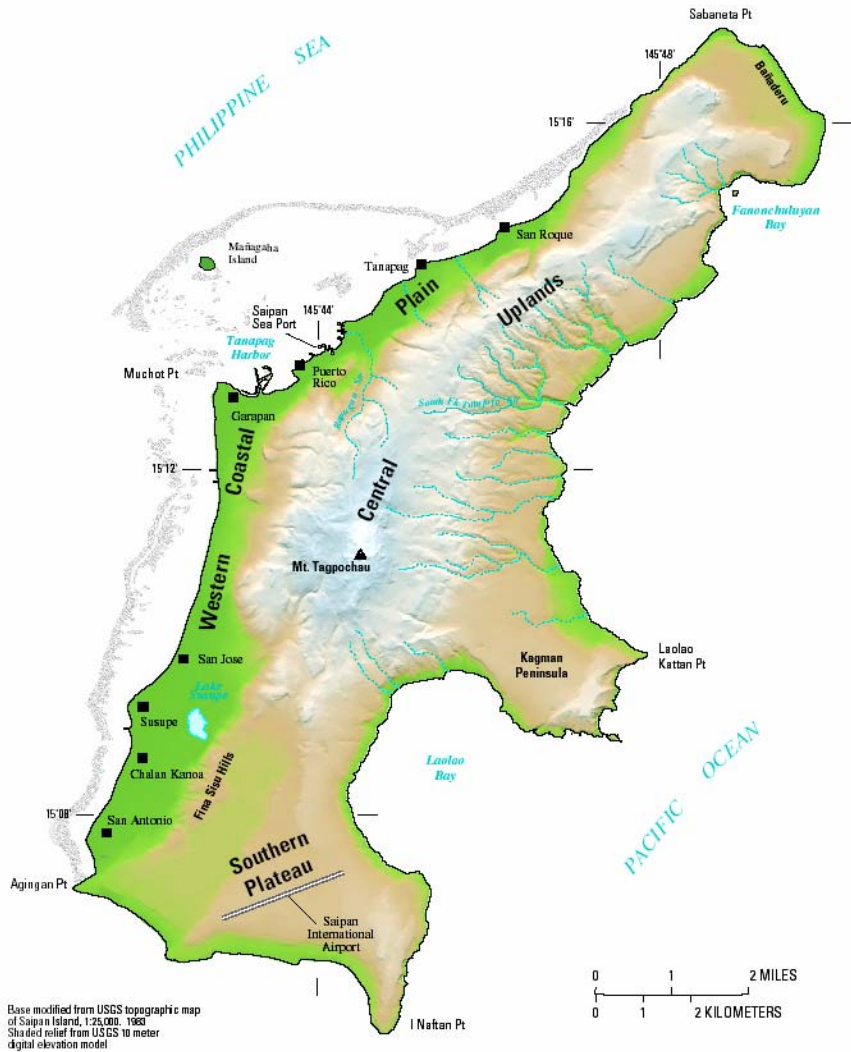
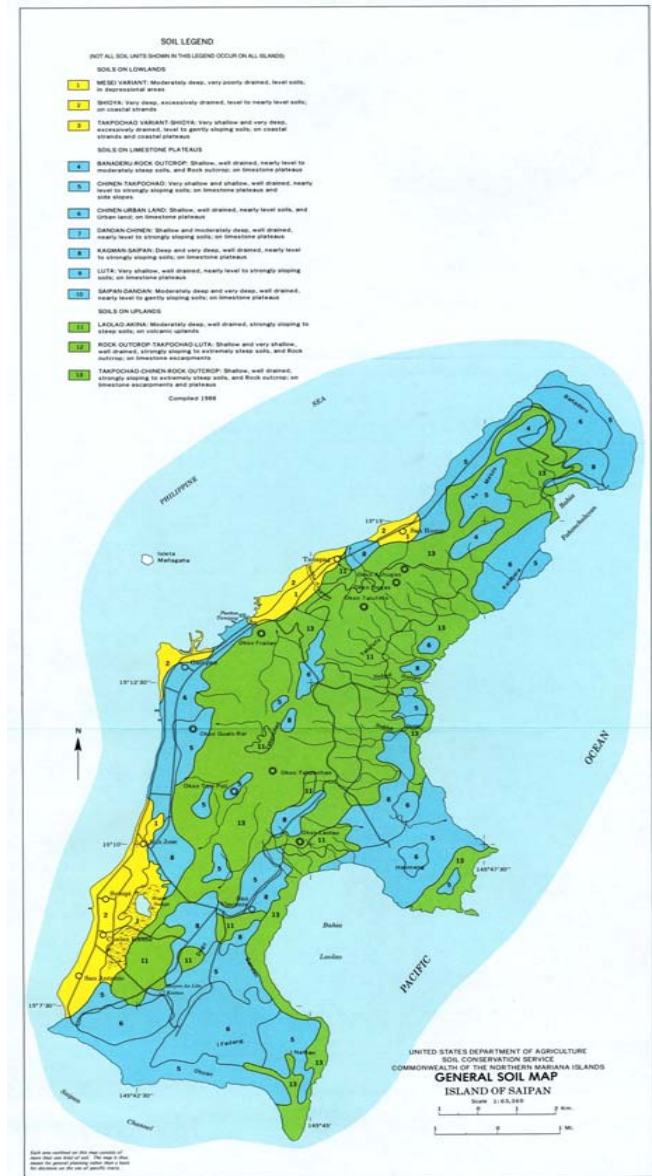


Figure 1. Location map and shaded relief of Saipan.

(Source: USGS)



(Source: NRCS)



**Limestone Quarry**



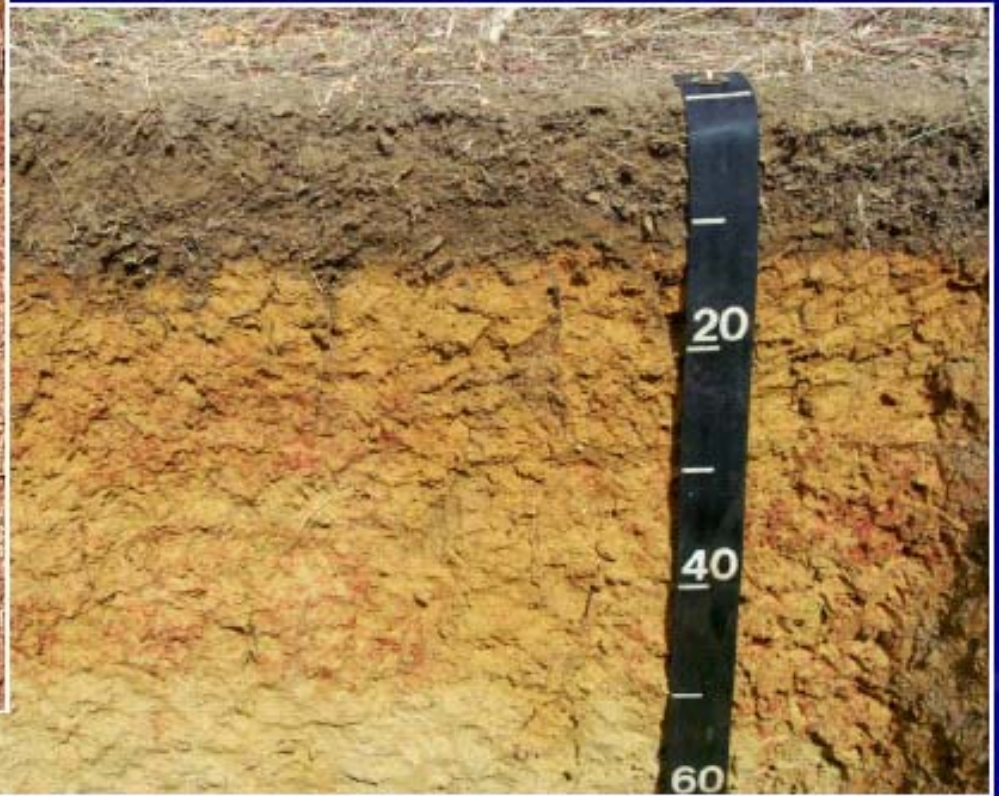
**Surface Soil**



**Limestone Cliffs of Western Tinian, CNMI**



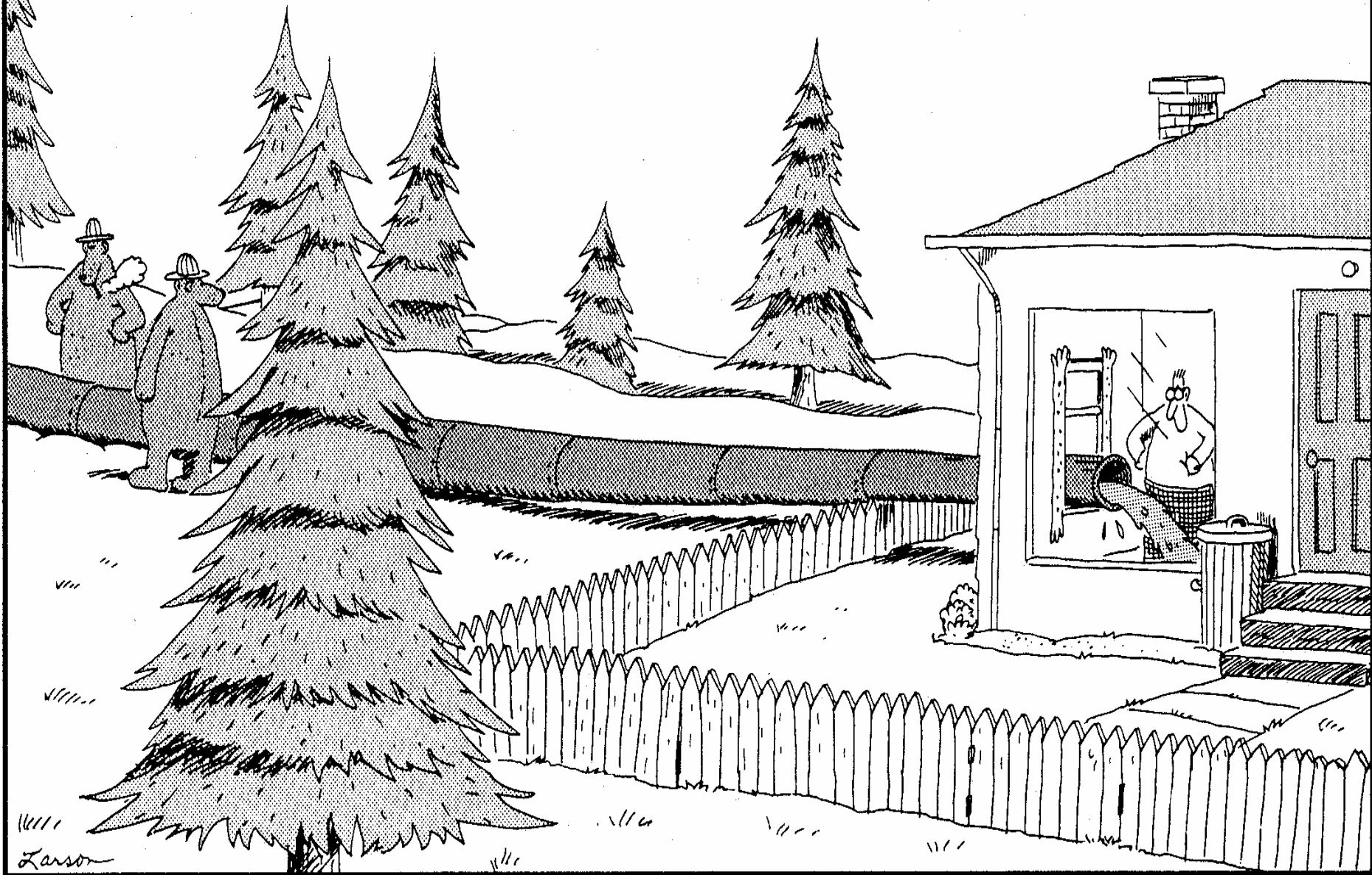
*Soils differ in their properties, behavior and management*



*Soil = f(pm, cl, o, r, t, . . . h)*

(Source: NRCS)

# Animal Waste Management







**PROBLEMS**

# Pathways by which Manure Contaminates Water

## Pollutant

## Pathway

1) Nitrate – N

Leaching & Runoff

2) Ammonium – N

Surface water run off &  
Aerial deposition

3) Phosphorus

Surface water runoff

4) Pathogens

Surface water runoff

5) Organic Matter

Surface water runoff

# Water Quality Contaminants in Manure

## Possible Pollutants

## Environmental / Health Risk

1) *Nitrate-N*

*Human Health*

2) *Ammonia-N*

*Fish Kills*

3) *Phosphorus*

*Eutrophication*

4) Pathogens

Human Health

5) Organic Matter

Oxygen Depletion



**Island Piggery**



**Effluent Drainage to Field**



**Overflowing “septic tank”**

# **Alternative Manure Management Practices are needed ...**

- **to avoid environmental degradation of our water resources**
- **to avoid possible human health & environmental problems**
- **to take advantage of the nutrients or “fertilizer” value for growing crops**

A Guide to a  
**COMPREHENSIVE  
NUTRIENT  
MANAGEMENT PLAN**  
for Livestock Production  
in Hawaii



September 2003

The manure manager should select a manure application rate that:

- **Supplies the crop's nutrient needs without buildup of soil nutrients.**
- **Prevents runoff to surface water.**
- **Minimizes percolation to groundwater.**
- **Reduces / eliminates pathogen transmission**



# LEPTOSPIROSIS IN AMERICAN SAMOA

Knowledge is the Key to  
Prevention and Good Health



Information in the brochure was provided by the Center for Disease Control website at :

[http://www.cdc.gov/ncidod/dbmd/diseaseinfo/leptospirosis\\_g.htm](http://www.cdc.gov/ncidod/dbmd/diseaseinfo/leptospirosis_g.htm)

Information provided in this brochure is not intended as a substitute for consultation with a health-care provider. If you have questions about leptospirosis, please contact the LBJ Tropical Medical Center at 633-2662, or the American Samoa Department of Health at 633-4606. This brochure was created by the Interagency Piggery Management Council, and published by the American Samoa Community College, with funding from the USDA-CSREES Farm Safety Program.



## Swine Husbandry in American Samoa



In American Samoa, pigs are raised in small pens commonly located along stream banks or wetlands. Pig waste is discharged directly to these bodies of water.

Not only can this degrade water quality, but it also poses serious public health risks. One of the most dangerous infectious diseases that can be contracted from contaminated water, and from the piggery itself, is leptospirosis.

### What is leptospirosis?

Leptospirosis is a bacterial disease transmitted to humans from animals (pigs, cattle, horses, dogs, and rodents).

People become infected through contact with contaminated urine, water, or soil. The bacteria enter the body through skin or mucous membranes (eyes, nose, or mouth), especially if the skin is broken from a cut or scratch. Drinking contaminated water can also cause infection.

Symptoms can occur as early as 2 days or up to 4 weeks after exposure. They include:

- |                 |              |
|-----------------|--------------|
| Severe headache | Fever        |
| Vomiting        | Red Eyes     |
| Chills          | Muscle aches |
| Abdominal pain  | Diarrhea     |
| Rash            |              |

More severe symptoms include:

- Kidney damage
- Liver failure
- Jaundice (yellow skin and eyes)
- Respiratory distress

**In rare cases death can occur.**

## Protect Your Family Prevent Leptospirosis

If you own a piggery, make sure you properly dispose of the pig waste. Contact NRCS at 633-1031 or Land Grant at 699-1394 for more information.

Wear protective clothing (gloves and boots), and thoroughly clean yourself after working with pigs or in your piggery.

Do not swim or bathe in water that might be contaminated with animal waste.


Vaccinate your pets against leptospirosis. For more information, contact the Veterinary Clinic at the Department of Agriculture at 699-9445.

Seek medical attention should you feel any of these symptoms. Leptospirosis can be treated with antibiotics.



# The National Water Quality Program

## A Regionally-Based National Network



CSREES  
National  
Water Quality Program


— Research, Education & Extension —

[Directory](#) • [Event Calendar](#) • [Feedback](#) • [Reporting](#) • [Site Map](#)



<p>About this Program</p> <hr/> <p><b>Regional Programs</b></p> <p><b>National Themes</b></p> <hr/> <p>National Facilitation</p> <p>Extension Education</p> <p>Integrated Research, Education, and Extension</p> <hr/> <p>Funded Projects</p> <p>Success Stories</p> <hr/> <p>Online Resources</p> <p>Home</p> <p>Previous Page</p> <hr/> <p>search this website:</p> <input type="text"/> <input data-bbox="409 1258 453 1282" type="button" value="Go!"/>	<p><b>FY 2005 REQUEST FOR APPLICATIONS</b></p> <p><b>National Research Initiative Competitive Grants Program</b> Watershed Processes and Water Resources Deadline for applications: March 1, 2005</p> <p><a href="#">Download the RFA &gt;&gt;</a></p>	<p><b>FY 2005 REQUEST FOR APPLICATIONS</b></p> <p><b>Integrated Research, Education, and Extension Competitive Grants Program</b> National Integrated Water Quality Program Deadline for applications: March 15, 2005</p> <p><a href="#">Download the RFA &gt;&gt;</a></p>	<p><b>Upcoming Events</b></p> <p><a href="#">Feb 7-9 &gt;&gt;</a> 2005 CSREES National Water Quality Conference Venue: La Jolla, CA</p> <p><a href="#">Feb 14-15 &gt;&gt;</a> AWRA's 2nd National Water Resources Policy Dialogue Venue: Tucson, AZ</p> <p><a href="#">March 5-10 &gt;&gt;</a> ASAE Conference on Watershed Management to Meet Water Quality Standards and Emerging TMDLs Venue: Atlanta, GA</p> <p><a href="#">more events are listed in the event calendar.</a></p> <hr/> <p><a href="#">USDA-CSREES National Water Quality Conference Proceedings</a></p>
---	--	--	--

the CSREES Regional Water Quality Programs  
(select a region to learn more)



Pacific Islands

# Building Bridges Across a Vast Region





**CSREES**  
Southwest States  
& Pacific Islands  
Regional Water Quality Program  
*Applying knowledge to improve water quality*



**Western Pacific Water Quality Programs**  
— Research, Education & Extension —

---

**Home**

**Home**

[CSREES website](#)

[About Us](#)

[Western Pacific](#)

[Contact Us](#)

[About Us](#)

[Regional Info](#)

[National Info](#)

**Contact Information for State and Island Coordinators**



**American Samoa Community College**

Kristel van Houten-Hovess  
ASCC Land Grant Program  
Department of Community and Natural Resources  
PO Box 5219  
Pago Pago, American Samoa 96799  
Ph: (808) 699-1175  
Fax: (808) 699-5011  
email: [khovess@ascc.ac](mailto:khovess@ascc.ac)

---



**Commonwealth of the Northern Mariana Islands**

Lawrence J. Dupont-Pheil  
Northern Marianas College  
Cooperative Research, Extension, and Education Service (CREES)  
P.O. Box 134  
Tapan, MP 96962  
Phone: (870) 433-0639  
Fax: (870) 433-2161  
Email: [lawrence.dupont@nmaria.edu](mailto:lawrence.dupont@nmaria.edu)

---



**Federated States of Micronesia**

Jackson Philip  
College of Micronesia  
P.O. Box 1906  
Kororua, Pohnpei, FM 96941  
Voice: 691-323-0221  
Fax: 691-320-2123  
Email: [jphillip@uonfm.edu](mailto:jphillip@uonfm.edu)

---



**Guam**

Tadi Iyechial  
University of Guam Cooperative Extension Service  
UOG Station  
Mangilao, Guam 96923  
Phone: (871) 735-2046  
Fax: (871) 734-1244  
Email: [tyadi@guam.edu](mailto:tyadi@guam.edu)

---



**Hawaii**

Carl Everson  
University of Hawaii  
Dept. of Natural Resources and Environmental Mgt.  
College of Tropical Agriculture & Human Resources  
1910 East-West Rd.  
Honolulu, HI 96822  
808-956-8825  
fax: (808)956-6539  
email: [carleverson@hawaii.edu](mailto:carleverson@hawaii.edu)

---



**Republic of the Marshall Islands**

Aniel Kaimen  
College of the Marshall Islands  
P.O. Box 1258  
Majuro, MH 96960  
Ph: (882) 626-2394, 3391  
Ph: (882) 626-5033, 5034  
Fax: (882) 626-4088  
Email: [anienk@ccmri.edu](mailto:anienk@ccmri.edu)

---



**Republic of Palau**

Fortia K. Franz  
Palau Community College  
Cooperative Research & Extension  
P.O. Box 8  
Koror, Republic of Palau 96945  
Ph: (500) 486-4363  
Fax: (500) 486-2746  
Email: [gf.kfranz@palau.edu](mailto:gf.kfranz@palau.edu)

[American Samoa](#) • [Arizona](#) • [California](#)  
[Commonwealth of the Northern Mariana Islands](#) • [Federated States of Micronesia](#)  
[Guam](#) • [Hawaii](#) • [Marshall Islands](#) • [Northern Mariana Islands](#) • [Palau](#) • [Texas](#)

# Livestock Manure Management

**Several regional projects have been initiated to promote:**

- (1)** safe application rates of livestock waste,
- (2)** understanding interactions of nutrients with arid and tropical soils,
- (3)** adoption of nutrient management plans.





# Pacific Dairy Lagoon



EFFLUENT RESEARCH  
- GRASS PRODUCTION  
- TREATMENT & REUSE  
PACIFIC DAIRY  
UH COLLEGE OF TROPICAL AGRICULTURE  
USDA



An example of a practice being promoted is a portable dry-litter system which eliminates discharges into waterways and integrates composting.

A series of workshops were conducted in July-August 2004 in Guam and CNMI to extend this information to farmers and agencies in the Western Pacific.



**Kalangan**

**Fa'afetai**

**MAHALO**

**Ke kmal mesulang**

**Komoltata**

**Dunkalu Na Si Yuus Maase**

