Activity #3

Rain Forest on a Budget

● ● ● **In Advance** *Student Assignment*

- Assign the Student Page “Water in the Rain Forest—What Goes In and What Comes Out” (pp. 45-53) as homework.

● ● ● **Class Period One** *Rain Forest Water Budget & Demonstration*

Materials & Setup

- “Water Budget for Windward Haleakalā” acetate (master, p. 44)
- Overhead projector and screen

For each student

- Student Page “Water in the Rain Forest—What Goes In and What Comes Out” (pp. 45-53)

Four sets of the following materials for the demonstration

- Cardboard box, 17 inches long x 12.5 inches wide x 12.5 inches high (or similar)
- 33-gallon garbage bag
- Scissors
- Household sponges—enough to cover the bottom of the box
- Stapler
- Soil
- Board or dish drainer to put under box
- Leafy branches (leaves one to two inches long)
- Plastic 1/2-gallon jug with small holes drilled into the side (not the bottom, because you have to put water in it without letting it run out) or a garden watering can
- Timer
- Catchment container at open end of box
- Four measuring beakers of the same size

Instructions

1) Discuss student responses to the Student Page “Water in the Rain Forest—What Goes In and What Comes Out.” Use the “Water Budget for Windward Haleakalā” acetate as you are discussing question #3.

2) After the discussion, show the water budget acetate again, and ask students what they think would happen to each of the water budget elements if the understory and forest floor vegetation and/or canopy layers were disturbed or removed from the rain forest.

3) Do the “Rain Forest in a Box” demonstration following instructions in the teacher background (pp. 40-42). This demonstration helps students visualize what happens to the forest soil layer as rain falls in an intact rain forest, as well as one in which the understory and forest floor vegetation and/or the canopy layers have been removed.

4) After the demonstration, divide the class into four groups. Each group should select one water budget element and design an experiment to test their hypothesis about the effects of clearing the rain forest on that element. They will be conducting these experiments during the next class period. Encourage students to use the same materials as you used for the demonstration. If a group needs additional materials, students should bring them to the next class.

● ● ● Class Period Two *Testing the Effects of Rain Forest Clearing*

Materials & Setup

For each student

- Student Page "The Waters of Kāne" (pp. 54-55)

For the demonstration

- Same four sets of materials from Class Period One

Instructions

1) Provide each group with one set of "Rain Forest in a Box" materials. Have them conduct their experiments by:
   a) Writing the question they are trying to answer, as well as their hypothesis;
   b) Writing a description of the methods they will use to test their hypothesis;
   c) Setting up and conducting the experiment;
   d) Recording results; and
   e) Writing their conclusions.

2) Have groups share their methods and results with the rest of the class.

3) As homework, assign the Student Page "The Waters of Kāne" and/or one or more of the journal writing topics.

Journal Ideas

- What is the likely effect of rain forest degradation on human water supply from the Haleakalā rain forest?
- What do you think would happen to the rain forest if people started pumping large volumes of ground water from the East Maui Watershed? How could you test this hypothesis?
- What are some ways to reduce the growing demand for water from the Haleakalā rain forest? What can you do personally to contribute?
- Do you think surface water should be diverted from East Maui streams for agricultural and household use in Central, Upcountry, and East Maui? West and South Maui? Why or why not?

Assessment Tools

- Student Page "Water in the Rain Forest—What Goes In and What Comes Out" (teacher version, pp. 37-39)
- Participation in class discussion and demonstration
- Design, conduct, record-keeping, and reporting of experiment
- Student Page "The Waters of Kāne" (teacher version, p. 43)
- Journal entries

Teacher Version

Water in the Rain Forest—What Goes In and What Comes Out

1) Using the data in Table 1: Mean Monthly Water Budget for Windward Haleakalā for your calculations, identify the three months in which the ratio of fog drip to rainfall is the highest. Below, list these three months and the contribution of fog drip to the water budget as a percentage of total moisture input (fog drip + rainfall). Express percentages using two decimal places.

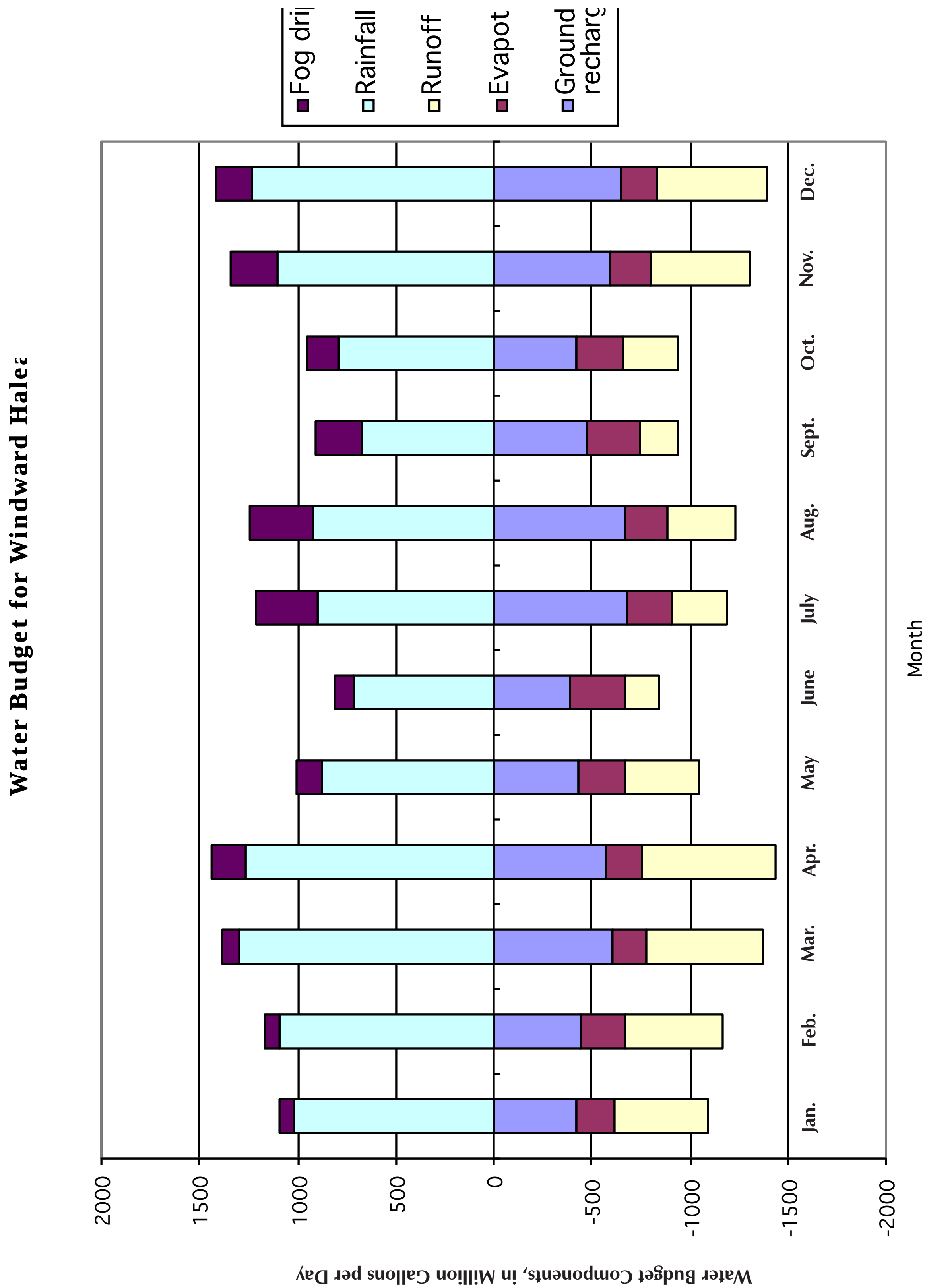
Top three months for fog-drip contribution	Percent of total moisture input
July	26.05%
August	25.99%
September	26.43%

2) In the summer months, trade winds tend to be stronger and more reliable than at other times of the year. This pattern produces a well-developed trade wind inversion. How would this seasonally stronger atmospheric inversion help to explain the patterns in high fog-drip contribution you identified in question #1? Explain your reasoning.

   The fog zone on the windward (north) side of Haleakalā volcano extends from the mean cloud base level, at about 600 meters (1970 feet), to the lower limit of the most frequent temperature inversion base height at about 2000 meters (6560 feet). The high July to September ratio of fog drip to rainfall is the result of a well-developed atmospheric temperature inversion and strong trade winds. As the moist air is forced upslope, cloud height is restricted by the inversion, thus favoring fog rather than raindrop formation.

3) Using the data in Table 1: Mean Monthly Water Budget for Windward Haleakalā and the blank chart on the following page, create a stacked-column chart representing the relative proportion of water-budget components for windward Haleakalā. A sample stacked-column chart is shown below.
   Give this chart a title, labels for each axis, and a legend.

   See the completed chart on p. 38.


Water Budget for Windward Halea
Fog dri
Rainfall
Runoff
Evapot
Ground recharg
2000
1500
1000
500
0
-500
-1000
-1500
-2000
Water Budget Components, in Million Gallons per Day
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Month

4) Using the following data, calculate the mean monthly contribution of rainfall and fog drip (in millions of gallons per day) to the water budgets of leeward Haleakalā (zone C on the map) and windward Haleakalā (zone F on the map--see student version for map).

Water budget component	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Windward Haleakalā												
Rainfall	1018	1090	1300	1261	881	713	897	917	671	792	1104	1228
Fog drip	70	77	89	174	129	103	316	322	241	161	237	183
Leeward Haleakalā												
Rainfall	336	268	247	205	107	49	49	82	80	146	192	282
Fog drip	8	7	7	12	6	3	7	12	11	12	16	15

Data in Million Gallons per Day

Answers:

Windward rainfall	989
Windward fog drip	176
Leeward rainfall	170
Leeward fog drip	10

5) Explain the difference in relative contribution of fog drip to total moisture input between the leeward and windward zones using the information on the map and what you know about the climate of windward and leeward Haleakalā.

The basic answer is that there is, proportionately, a much smaller fog zone on leeward Haleakalā than there is on the windward side. The windward side is subject to the prevailing trade winds, which bring moisture-laden air from across the ocean. Haleakalā forces these winds upward (the orographic effect), forming clouds that hug the mountainside, capped by a temperature inversion layer.

The same temperature inversion layer caps the cloud/fog layer on leeward Haleakalā. But the winds coming around the mountain and onshore from the south tend not to be as strong, constant, or moist as the trade winds.

6) A water budget is a model based on past averages. Some people believe that a series of extremely dry years in the late 1990s may be a sign that East Maui is entering into a prolonged period of reduced average rainfall. If East Maui is indeed beginning a long drought, do you think this estimated water budget should be used as a tool for determining how much surface or ground water can be safely withdrawn from the watershed? Explain your response.

Well-reasoned responses are acceptable.

Teacher Background

Rain Forest in a Box

Overview

This demonstration illustrates the importance of the layer of mosses and other vegetation that covers the ground (and many trees) in the rain forest. This thick layer acts as a sponge in the capture and slow release of water in the rain forest. It also illustrates how trees and vegetation slow the speed of water onto the ground.

Materials

- Cardboard box, 17 inches long x 12.5 inches wide x 12.5 inches high (or similar)
- 33-gallon garbage bag
- Scissors
- Household sponges—enough to cover the bottom of the box
- Stapler
- Soil
- Board or dish drainer to put under box
- Leafy branches (leaves one to two inches long)
- Plastic 1/2-gallon jug with small holes drilled into the side (not the bottom, because you have to put water in it without letting it run out) or a garden watering can
- Timer
- Catchment container at open end of box
- Four measuring beakers of the same size

Preparation

In advance of the class period, assemble the four sets of materials in the following manner:

1) Cut away the narrow (12.5 inches) end of the box.

2) Cut open the plastic garbage bag, and line the inside of the box with it. Staple the edges to the box.

3) Support the underside of the box with a board or dish drainer.

4) Put soil into the box to a depth of approx. 1 1/2 inches; pack it down.

5) Completely cover the soil with sponges.

6) Prop the back of the box up two inches, so it is on a slight slope.

7) Place leafy branches in the box so that it looks like a forest inside.

8) Place one quart of water into the 1/2-gallon jug.

Procedure

Experiment 1 - How much water drains out with the forest vegetation intact?

1) Explain to students what you are about to do, and have them write down hypotheses about what will happen.

2) On one “rain forest in a box,” slowly sprinkle the quart of water onto the leafy branches. Note the length of time this takes.

3) Let the box drain into the catchment container for one minute.

4) Pour the water and any soil into a measuring beaker or cup. If there is soil in it, let it stand awhile so the soil can settle out. Then measure the volume of soil and water, and record the results.

5) Squeeze out the sponges and measure the water they hold. Record the results.

6) Have students compare the results to their hypotheses.

Experiment 2 — Simulating understory destruction

Using a different “rain forest in a box,” do exactly the same as above, but without the sponges.

Experiment 3 — Simulating canopy opening

Using a new “rain forest in a box,” repeat the procedure, but without the leafy vegetation.

Experiment 4 — Simulating canopy opening and understory destruction

Carry this investigation one step further by taking both the leafy branches and the sponges out and sprinkling the water on the bare soil.

Interpretation

1) Measure the height of the soil layer in all beakers.

2) Measure the height of the water layer in all beakers.

3) Measure the height of the water taken from the sponges.

4) Make a bar graph for comparison.

Discussion

1) Did the sponge layer do anything to retard the flow of water and soil as runoff?

2) How does the sponge layer appear to be valuable in the forest?

   It slows the water getting to the ground, so the soil isn't washed away and releases the moisture slowly into the ground to recharge the aquifers.

3) What acts like a sponge in the rain forest?

   The forest floor is covered with a mat of mosses, lichens, and low-growing plants, along with a layer of soil and decaying plant matter that act as a sponge.

4) In nature, where does the runoff go?

   Into streams and then to the ocean

5) What destroys the sponge layer in the forest?

   Pigs root in the forest floor for fern roots and earthworms; the hooves of wild cattle break up the sponge; people walking over the same area break down the sponge.

6) Discuss the role that vegetation plays in slowing down the flow of water onto the ground.

   Leaves and branches provide surface area, which forces the rain water to slow as it falls.

7) Why is it important that the rain falls slowly onto the ground?

   Soil isn't washed away.

8) Why is the topsoil valuable?

   Most of the decomposition in the forest happens in the top soil layer, so all the nutrients are here.

Teacher Version

The Waters of Kāne

On the following page is a translation of a *mele* from Kaua'i that describes elements of the hydrologic cycle. It is entitled "*Ka Wai a Kāne,*" or "The Waters of Kāne." (Kāne is one of the four great Hawaiian gods.)

Read "*Ka Wai a Kāne.*" Then, on this page or a separate piece of paper, write your own *mele* that reflects the hydrologic cycle on windward Haleakalā. Be sure to include the water budget components you worked with in this unit.

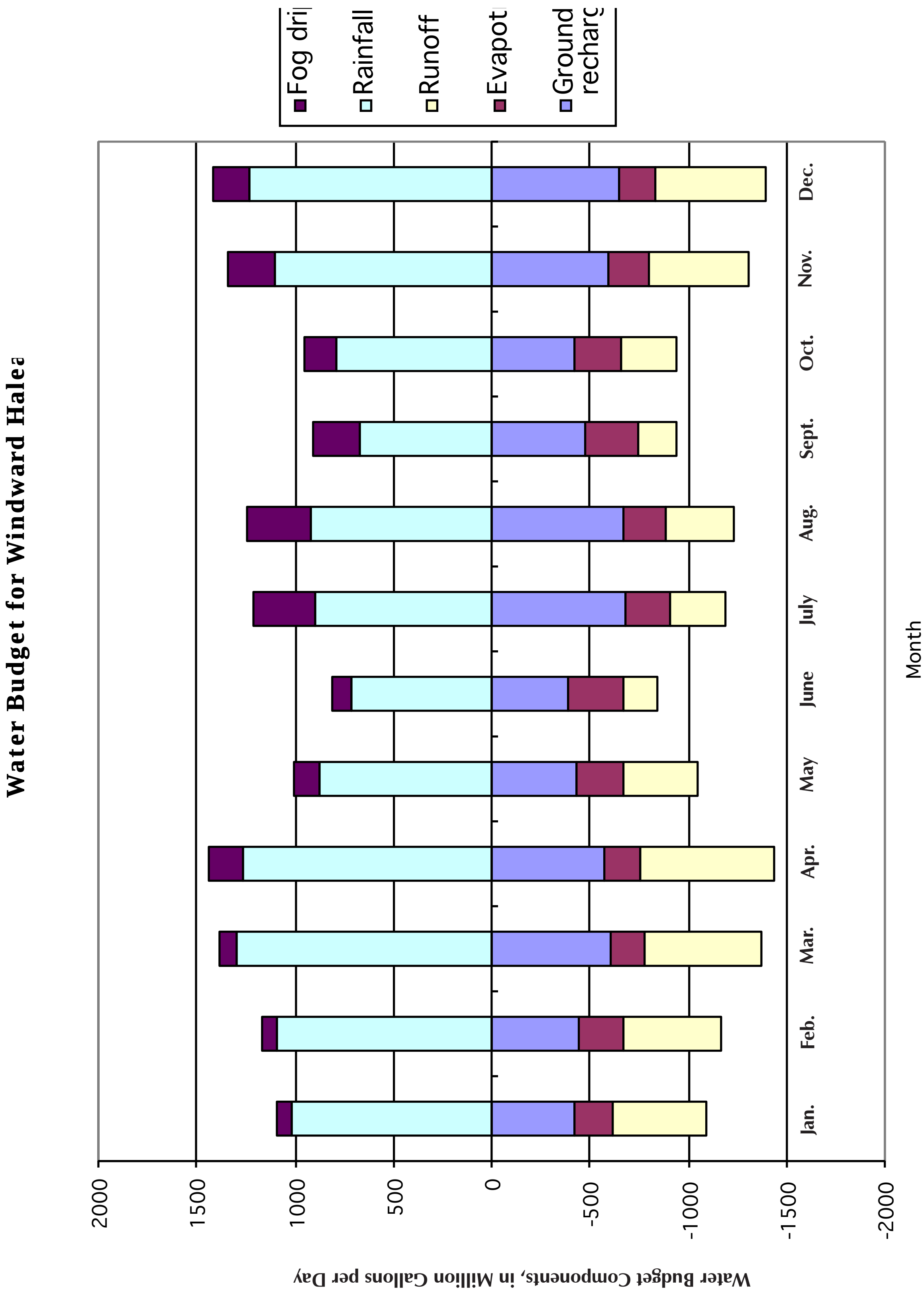
Other ideas for your *mele* include:

- Rain forest alterations that can or have changed the water budget,
- Specific places on East Maui,
- Inversion layer and lifting-condensation levels,
- Seasonal differences,
- Orographic lifting,
- Differences between the windward and leeward sides,
- Other climate characteristics you studied in this unit, and
- How people can help keep the "waters of Kāne" flowing on East Maui.

Basic parameters for evaluating the students' *mele* include:

- Accurate inclusion of the main water budget components (rainfall, fog drip, runoff, evapotranspiration, soil-moisture storage, and groundwater recharge),
- Accuracy in describing/including other concepts related to the hydrologic cycle, and
- Accurately locating places on Maui with respect to the hydrologic cycle.

You may also want to account for creativity, evidence of additional research, the range of additional information included beyond the six components of the water budget.


Water Budget for Windward Halea
Fog dri
Rainfall
Runoff
Evapot
Ground recharg
2000
1500
1000
500
0
-500
-1000
-1500
-2000
Water Budget Components, in Million Gallons per Day
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
Month

Water in the Rain Forest--What Goes In and What Comes Out

Growing numbers of residents, tourists, and commercial developments mean an increasing demand for fresh water on Maui. Currently, the main source for water to supply most of the island's municipal uses is on West Maui, where wells pump water from the ʻĪao "aquifer" (an underground source of water). The ʻĪao aquifer is near its limit and cannot support much greater water withdrawals, so people are looking around for other sources of water for drinking, cooking, bathing, watering lawns and golf courses, filling pools, washing clothes and dishes, and all of our other daily activities that require fresh water.

One place people are looking is the windward side of East Maui, where large sources of ground water are still untapped. Sixty billion gallons of surface water per year from this part of East Maui already provide much of Upcountry and East Maui drinking water and most of the irrigation water that goes to the Hawaiian Commercial & Sugar Company in Central Maui. Some people, including the Board of Water Supply, want to tap the "ground water," too. (Ground water is the water that flows and is held in aquifers below the surface.) They look at that underground water as a key to providing fresh water for the entire island's future needs.

But the water that flows above the surface ("surface water") and the water that flows below it (ground water) are linked. Some people are concerned that pumping a lot of ground water and piping it off for use elsewhere on Maui would reduce the flow in the springs and streams that course down the flank of Haleakalā. They want more information about how the ground water and surface water interact on windward Haleakalā.

One effort to provide that information was a project completed in 1999 by the U.S. Geological Survey in partnership with the County of Maui Department of Water Supply and the State of Hawaiʻi Commission on Water Resource Management (Patricia J. Shade, *Water Budget of East Maui, Hawaii,* U.S. Geological Survey, Honolulu, 1999). Project investigators used existing data and models to calculate an average monthly "water budget" for East Maui. Part of that calculation focused specifically on the wet, windward side of East Maui between Māliko Gulch on the west and Makapipi Stream on the east, and from the shore to the north rim of the Haleakalā summit basin. (Figure 1, p. 46 shows the study area.)

A "water budget" is simply a model that estimates how much water enters and leaves a particular area, and through what mechanism. It is a first step in understanding a ground water system so that water resources can be managed well. Calculating a water budget is a complicated undertaking that involves many measurements, estimates, and calculations. The basic idea, however, is simple: What goes in must come out—or be stored somewhere within the system. Here is the basic equation:

$$G = P + F - R - ET - DSS$$

Where:

G = "ground water recharge"
P = rainfall
F = "fog drip"
R = "runoff"
ET = "evapotranspiration"
DSS = change in "soil-moisture storage"

(Figure 2, p. 47 illustrates the basic elements of the hydrologic cycle.)

Water Budget Equation Elements

Ground Water Recharge

This refers to the amount of water that filters into the soil, percolating through until it reaches

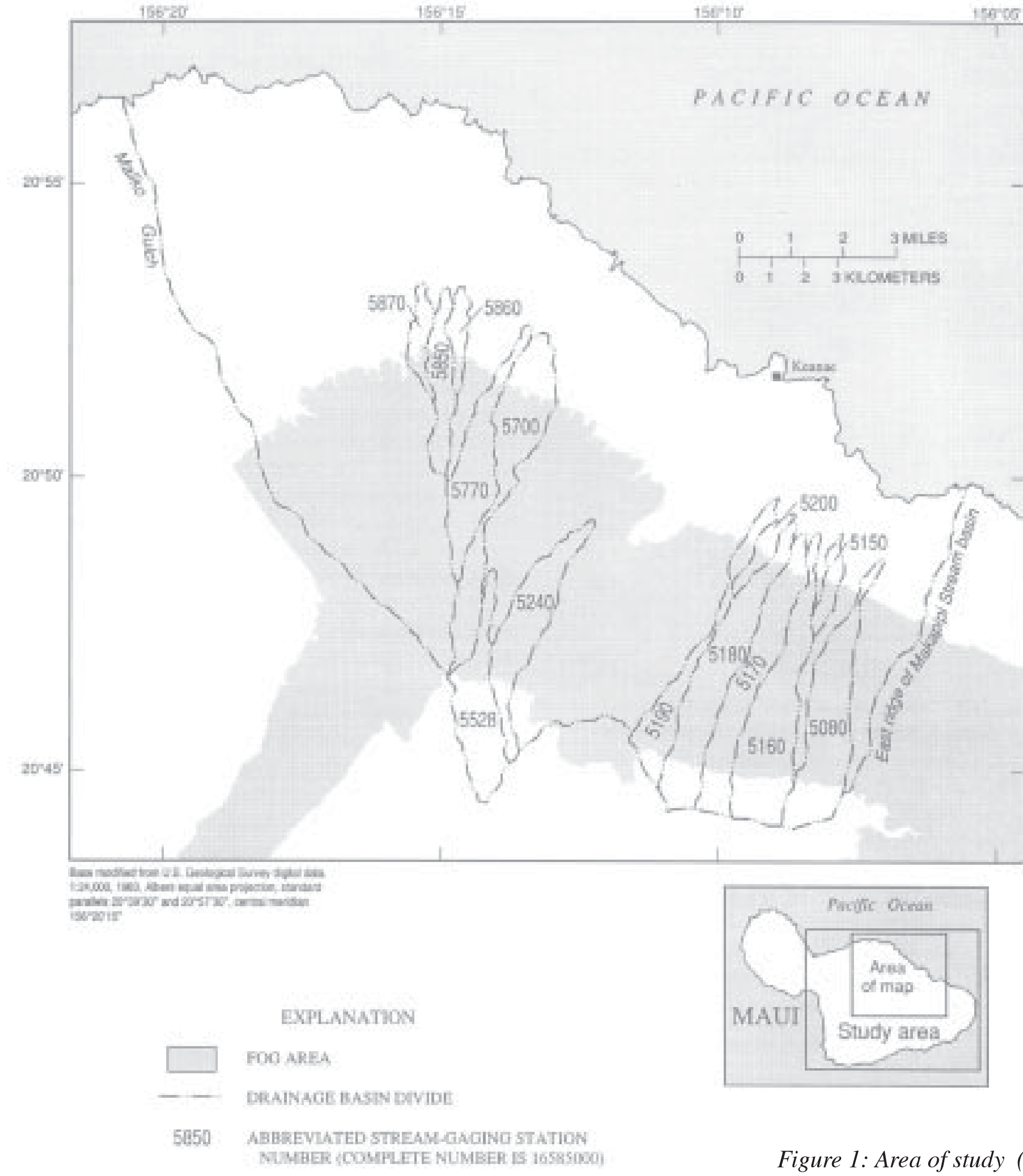


Figure 1: Area of study (Patricia J. Shade, Water Budget of East Maui, Hawaii, *U.S. Geological Survey, Honolulu, 1999, p. 13.)*

the underground reservoirs and flow-ways called aquifers. To calculate this amount, the other variables need to be known or estimated.

Rainfall

As you have learned in this unit, the rainfall distribution on windward Haleakalā is influenced by the orographic effect. Rainfall is abundant at most elevations as the prevailing trade winds are forced to rise and cool, condensing into clouds and rain. Monthly mean rainfall levels were calculated based on interpreting collected data to create maps denoting different rainfall levels across the study area.

Fog Drip

Also known as cloud-water interception, fog drip contributes water to the water budget

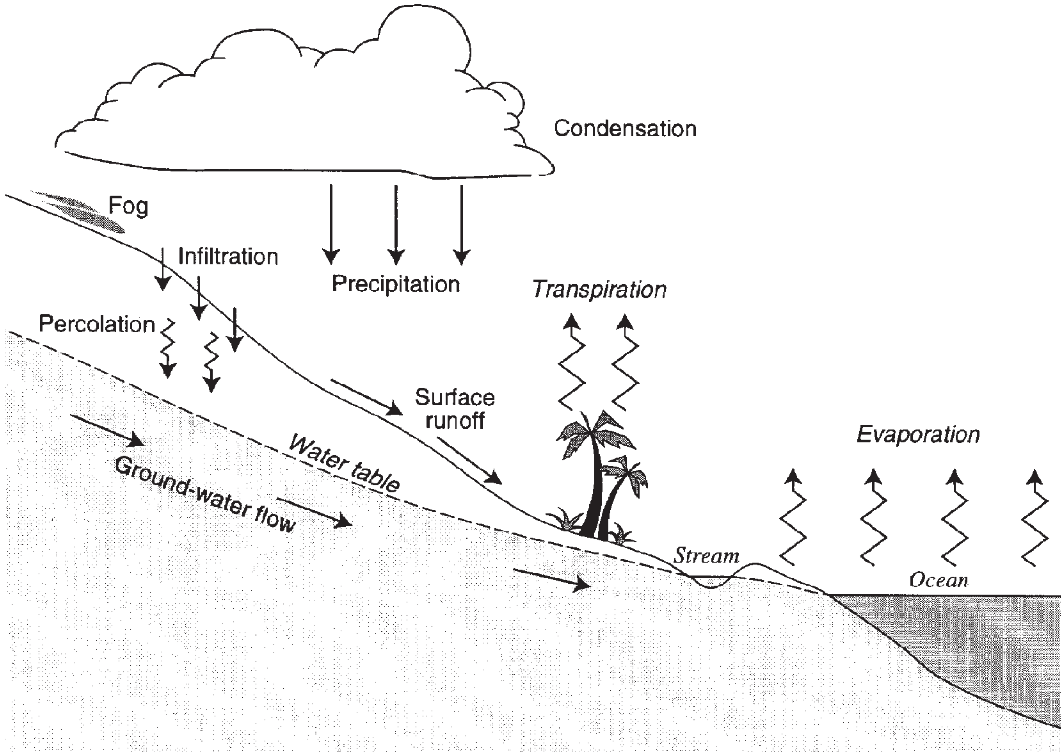


Figure 2: The hydrologic cycle (Patricia J. Shade, Water Budget of East Maui, Hawaii, *U.S. Geological Survey, Honolulu, 1999, p. 6.)*

through condensation that accumulates on the surfaces of plants and the ground. Limited data are available for calculating this part of the equation on East Maui. So its contribution was estimated based on research done on the windward slopes of Mauna Loa on the island of Hawai‘i. As you have also learned in this unit, the cloud (or fog) zone on windward Haleakalā is influenced by the interaction of the orographic lifting effect and the trade wind inversion. In this area, fog drip makes a significant contribution to the water budget.

Runoff

Runoff is the water that flows across the land surface and into stream channels promptly after rainfall. It is calculated using data gathered about streamflow in fourteen different drainage basins on windward Haleakalā. Stream flow has two components: runoff and "base flow." Base flow is the part of stream flow that is sustained through dry weather by the discharge of ground water into the stream. So runoff can be estimated by subtracting the base flow from the total stream flow.

Evapotranspiration

This is the quantity of water evaporated from soil and water surfaces added to the amount of water evaporated as plants "transpire" (vaporize water through their leaf surfaces). For this study, evapotranspiration rates were estimated using two sets of data.

Soil characteristics

Soils of East Maui have been analyzed and mapped according to several characteristics that affect their ability to store moisture that would then be available to plants. These characteristics include "permeability rate" (how quickly water filters through the soil), how many inches of water each inch of soil can store, and the average depth of plant roots in that soil type. A maximum soil-moisture storage value was calculated for each soil type using these values, and the results were plotted on a soils distribution map. The maximum soil-moisture storage affects evapotranspiration because it can limit the amount of water available for plants to take up from the soil and transpire through their leaves.

Potential evapotranspiration

This is an estimate of the maximum evapotranspiration from an extensive area of well-watered, actively growing vegetation. It is estimated using data from standardized evaporating pans, which are easier to collect and have been shown to closely correspond with actual potential evapotranspiration. Where these data were not available, potential evapotranspiration was estimated based on research done on the windward slopes of Mauna Kea on the island of Hawai'i.

Change in Soil-Moisture Storage

This variable is an estimate of the amount of water actually being stored in the soil across the study area. The volume of water stored in the soil changes from month to month and is approximated based on an estimated initial value, monthly changes in the other variables, and the maximum soil-moisture storage values.

Arriving At the Water Budget

Using this basic equation, a lot of complex modeling, and some well-calculated estimates, researchers produced a mean monthly water budget for East Maui. Table 1: "Mean Monthly Water Budget for Windward Haleakalā" shows the main results for windward Haleakalā. Use it to answer the questions that follow.

Table 1: Mean Monthly Water Budget for Windward Haleakalā

Water budget component	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fog drip	70	77	89	174	129	103	316	322	241	161	237	183
Rainfall	1018	1090	1300	1261	881	713	897	917	671	792	1104	1228
Runoff	-475	-493	-598	-684	-378	-175	-286	-346	-193	-285	-509	-569
Evapotranspiration	-203	-230	-169	-185	-239	-272	-230	-222	-276	-238	-204	-177
Ground water recharge	-417	-445	-608	-571	-428	-394	-678	-667	-471	-417	-596	-651

Data in million gallons per day

Questions

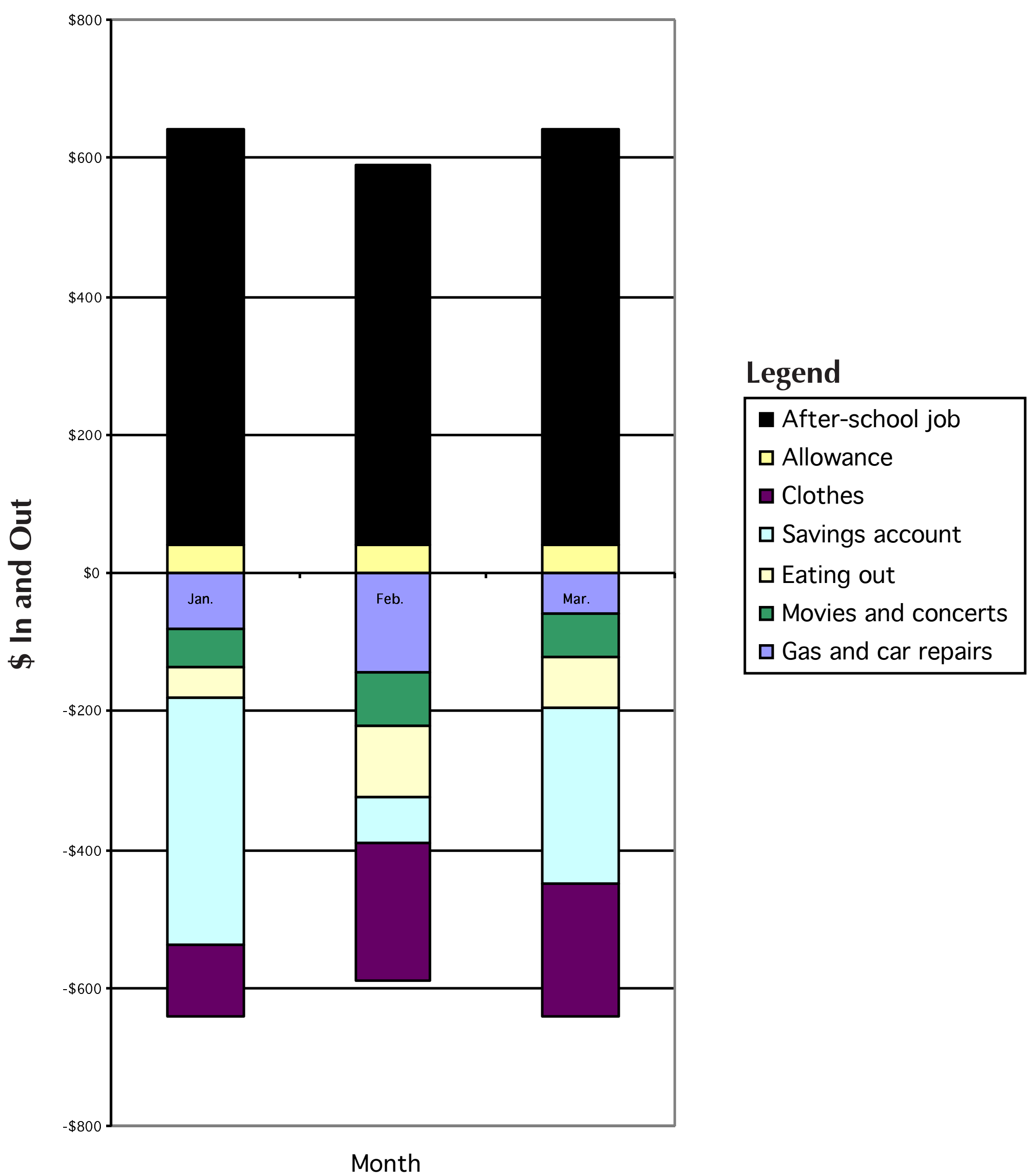
1) Using the data in Table 1: Mean Monthly Water Budget for Windward Haleakalā for your calculations, identify the three months in which the ratio of fog drip to rainfall is the highest. Below, list these three months and the contribution of fog drip to the water budget as a percentage of total moisture input (fog drip + rainfall). Express percentages using two decimal places.

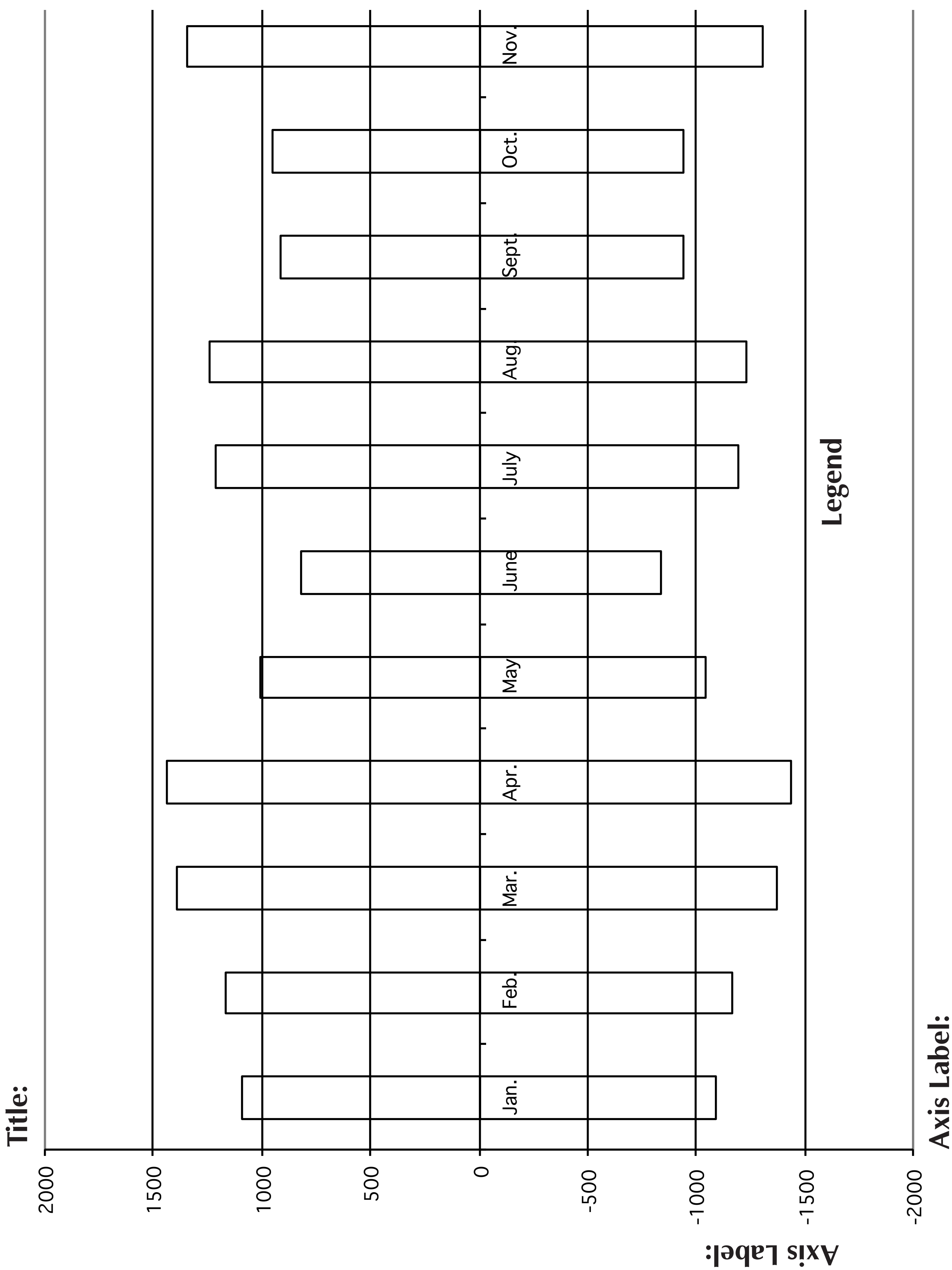
Top three months for fog-drip contribution	Percent of total moisture input
______________________	____________
______________________	____________
______________________	____________

2) In the summer months, trade winds tend to be stronger and more reliable than at other times of the year. This pattern produces a well-developed trade wind inversion. How would this seasonally stronger atmospheric inversion help to explain the patterns in high fog-drip contribution you identified in question #1? Explain your reasoning.

3) Using the data in Table 1: Mean Monthly Water Budget for Windward Haleakalā and the blank chart on the following page, create a stacked-column chart representing the water-budget components for windward Haleakalā. A sample stacked-column chart is shown below.
   Give your chart a title, labels for each axis, and a legend.

SAMPLE STACKED COLUMN CHART: Monthly Cash Flow




Title:
Axis Label:
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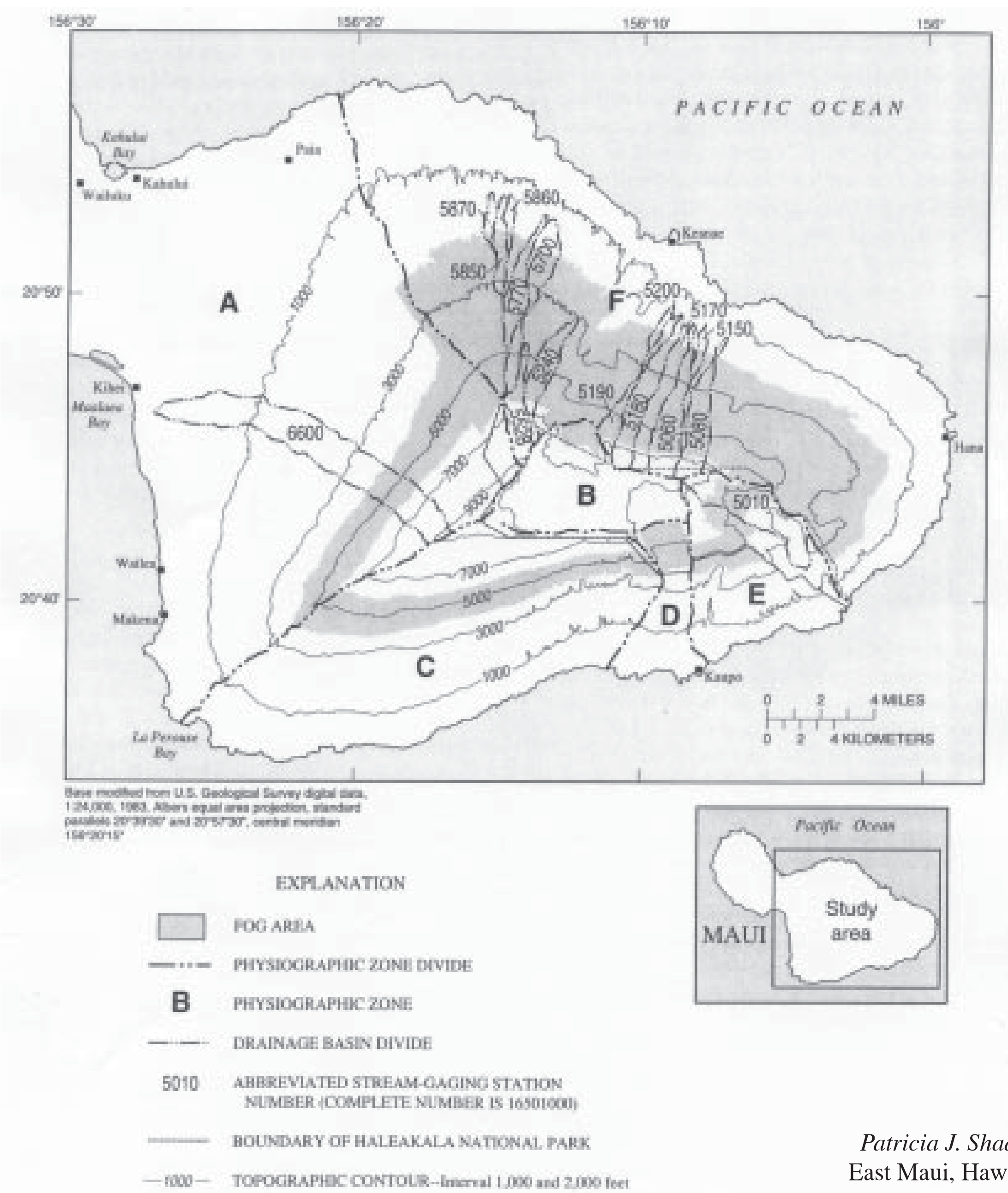
-1000
-1500
-2000
Axis Label:

4) Using the following data, calculate the average contribution of rainfall and fog drip (in million gallons per day) to the water budgets of leeward Haleakalā (zone C on the map below) and windward Haleakalā (zone F on the map below). Show your calculations on the next page.

Water budget component	**Jan.**	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
<u>Windward Haleakalā</u>												
Rainfall	1018	1090	1300	1261	881	713	897	917	671	792	1104	1228
Fog drip	70	77	89	174	129	103	316	322	241	161	237	183
<u>Leeward Haleakalā</u>												
Rainfall	336	268	247	205	107	49	49	82	80	146	192	282
Fog drip	8	7	7	12	6	3	7	12	11	12	16	15

Data in Million Gallons per Day



This map shows where the windward and leeward fog zones are so you can picture the areas for which you are performing calculations. It is not used in your calculations.

Patricia J. Shade, Water Budget of East Maui, Hawaii, *U.S. Geological Survey, Honolulu, 1999, p. 13.*

4) (continued) Show calculations here.

5) Explain the difference in relative contribution of fog drip to total moisture input between the leeward and windward zones using the information on the map and what you know about the climate of windward and leeward Haleakalā.

6) A water budget is a model based on past averages. Some people believe that a series of extremely dry years in the late 1990s may be a sign that East Maui is entering into a prolonged period of reduced average rainfall. If East Maui is indeed beginning a long drought, do you think this estimated water budget should be used as a tool for determining how much surface or ground water can be safely withdrawn from the watershed? Explain your response.

The Waters of Kāne

On the following page is a translation of a *mele* from Kaua‘i that describes elements of the hydrologic cycle. It is entitled "*Ka Wai a Kāne*" or "The Waters of Kāne." (Kāne is one of the four major Hawaiian gods.)

Read "*Ka Wai a Kāne*." Then, on this page or a separate piece of paper, write your own *mele* that reflects the hydrologic cycle on windward Haleakalā. Be sure to include the water budget components you worked with in this unit.

Other ideas for your *mele* include:

- Rain forest alterations that can or have changed the water budget,
- Specific places on East Maui,
- Inversion layer and lifting-condensation levels,
- Seasonal differences,
- Orographic lifting,
- Differences between the windward and leeward sides,
- Other climate characteristics you studied in this unit, and
- How people can help keep the "waters of Kāne" flowing on East Maui.

Ka Wai a Kāne (The Waters of Kāne)

He ui, he ni nau,
E ui aku ana au iā ʻoe:
Aia i hea ka wai a Kāne?
Aia i ka hikina a ka lā,
Puka i Haʻehaʻe
Aia i laila ka wai a Kāne.
E ui aku ana au iā ʻoe,
Aia i hea ka wai a Kāne?
Aia i Kaulanakalā
I ka pae ʻōpua i ke kai,
Ea mai ana ma Nihoa
Ma ka mole mai o Lehua,
Aia i laila ka wai a Kāne.
E ui aku ana au iā ʻoe:
Aia i hea ka wai a Kāne?
Aia i ke kuahiwi, i ke kualono,
I ke awāwa, i ke kahawai,
Aia i laila ka wai a Kāne.
E ui aku ana au iā ʻoe:
Aia i hea ka wai a Kāne?
Aia i kai, i ka moana,
I ke Kaulau, i ke anuenue,
I ka pūnohu, i ka uakoko
I ka ʻālewalewa
Aia i laila ka wai a Kāne.
E ui aku ana au iā ʻoe:
Aia i hea ka wai a Kāne?
Aia i luna ka wai a Kāne,
I ke ʻōuli, i ke ao ʻeleʻele,
I ke ao panopano,
I ke ao popolohua mea a Kāne la e!
Aia i laila ka wai a Kāne.
E ui aku ana au iā ʻoe:
Aia i hea ka wai a Kāne?
Aia i lala, i ka honua, i ka wai hu,
I ka wai kau a Kāne me Kanaloa
He waipuna, he wai e inu,
He wai e mana, he wai e ola,
E ola nō, ʻeā!

A question, a query
I put to you:
Where is the water of Kāne?
At the eastern gate
Where the sun comes in at Haʻehaʻe
There is the water of Kāne.
A question, a query I put to you:
Where is the water of Kāne?
Out there with the floating sun
Where cloud-forms rest of the ocean
Uplifting their forms at Nihoa
This side the base of Lehua
There is the water of Kāne.
A question, a query I put to you:
Where is the water of Kāne?
There on the mountain peak, on the ridges steep,
In the valleys deep, where the rivers sweep,
There is the water of Kāne.
A question, a query I put to you:
Where is the water of Kāne?
There at sea, on the ocean
In the driving rain, in the rainbow arch,
In the misty spray, in the blood-red rainbow
In the ghost-pale cloud form,
There is the water of Kāne.
A question, a query I put to you:
Where is the water of Kāne?
High up is the water of Kāne,
In the heavenly blue, in the black-piled cloud,
In the thick dark cloud,
In the dark sacred cloud of the gods, indeed!
There is the water of Kāne.
A question, a query I put to you:
Where is the water of Kāne?
Deep in the ground, in the gushing spring
In the place of Kāne and Kanaloa,
A wellspring of water, water to drink
A water of power, the water of life!
Life indeed!