Name: _____ Date:_____

SimWater: Simulating Water Supply, Demand, and Management

Background

Water managers balance water needs with water availability. They need to understand how humans and the environment can both fit into a region's water cycle. The following exercises demonstrate some of the issues that water managers solve as they regulate complex systems of water storage, delivery, and consumption.

Exercise 1 – Warm up

Goal

As water manager, your goal is to achieve a ***river discharge*, or flow out of the water system, equal to 100,000 m^3**. This discharge goal represents a minimum discharge for the river to avoid major environmental impacts of water use. To do this, balance the volume of water coming into the system with the volume of water leaving the system through agricultural and residential consumption.

Instructions

Use Map 1 for this exercise. On the map, all water runoff flows toward the river (blue line) flowing down the middle. Precipitation, or water coming into the system, is uniform across the map.

Each small square on the map represents 10,000 m^2 (100 m x 100 m) of land, or one *hectare (ha).* The volume of water that falls on land from precipitation is equal to the amount of precipitation times the area of land. If 1 m of precipitation falls on 1 map square, or 1 ha of land, it results in a volume of 10,000 m^3.

To model water consumption, *allocate,* or assign, agricultural and residential land use areas by using colored pencils or the different colored squares on the Water Demands page.

Use the following table of water supply for calculating water balance:

Table 1 – Water Supply and Consumption Rates (per ha per year)

Precipitation	*(light blue)*	1 m	
Agricultural Use	*(light green)*	1 m	
Residential Use	*(brown)*	1 m	1 hectare provides homes for 80 people

Question

1. *If **960 people live in the map area** and you need to **maintain a river flow of 100,000 m^3**, what is the **maximum number of hectares of agricultural land** that can exist in this region?*

Updated 2016 by Michelle Gilmore & Erin Stacy. Originally created by Ryan Lucas.
Southern Sierra Critical Zone Observatory, University of California, Merced.

Exercise 2 – A Little More Complicated

Goal

Supply and demand of resources can be complex to calculate. Different land uses require more or less water use than one another. And precipitation amounts can vary over a large area. Communities also need *provisions* such as food, housing, and jobs. Working with city and agricultural planners, you need to keep the region sustainable and maintain your **river discharge goal of 100,000 m^3**.

Instructions

Use Map 2 for this exercise. This map area includes two different precipitation zones, where one part receives more precipitation than the other (Table 2). Water consumption rates also vary now (Table 3) with two different agricultural crops (Ag1, Ag2) and both residential and commercial areas. Table 4 lists provision rates, or the food, housing, and job resources provided per hectare.

Table 2 – Water Supply Rates (per ha per year)

Precipitation 1	*(light blue)*	1 m
Precipitation 2	*(dark blue)*	2 m

Table 3 – Water Consumption Rates (per ha per year)

Ag1	*(light green)*	0.5 m
Ag 2	*(dark green)*	2 m
Residential Use	*(brown)*	0.5 m
Commercial Use	*(gray)*	1 m

Table 4 – Food, Housing, and Job Provision Rates (per ha)

Ag 1	produces food for 6 people
Ag 2	produces food for 18 people
Residential Use	provides homes for 80 people
Commercial Use	provides jobs for 100 people

Questions

2. **Sustainable Community:** *What is the **greatest amount of discharge** possible, if you need to provide **local food and jobs** for a city of **1200 people**?*

3. **Open Space:** *For the above question, reallocate your land to maximize space. What is the **greatest amount of open space (ha)** you can maintain? And what is the **water discharge** with that open space?*

4. **Eating Locally:** *What is the **largest community** you can develop to ensure that **all residents can eat local food** grown in the area of the map? Report land allocations in hectares for Ag1, Ag2, and Residential use, and report the total population.*

Exercise 3 – A Model California

Goal

California is a complex region with many different precipitation patterns and water demands. Regulations on agriculture, urban development, and water usage affect how you manage water. As water manager, you need to keep California sustainable and meet your **river discharge goal of 100,000 m^3**.

Instructions

Use Map 3 for this exercise. This map is broken into four precipitation zones: the Coastal areas (light blue), Central Valley (orange), Sierra foothills (dark blue), and mountains of the Sierra Nevada (purple).

Use Tables 3 and 4 for water consumption and provision rates. Table 5 below lists water supply for Map 3.

Table 5 – Water Supply Rates (per hectare per year)

Precipitation 1	(light blue)	1 m
Precipitation 2	(dark blue)	2 m
Precipitation 3	(orange)	0.25 m
Precipitation 4	(purple)	3 m

These development restrictions also apply:

a) In order to prevent coastal erosion and fertilizer runoff into the ocean, no residential, commercial, or agricultural land use is allowed within 100 m of the ocean.
b) Environmental regulations also prohibit residential and commercial land use within 200 m of the river.
c) Poor soils and snowy winters make agriculture too difficult to develop in the Sierra Nevada.

Questions

5. **Sustainable Community:** *What is the **greatest amount of discharge** possible, if you need to **provide local food and jobs** for a city of **1200 people**?*

6. **Open Space:** *For the above question, reallocate your land to maximize space. What is the **greatest amount of open space (ha)** you can maintain? And what is the **water discharge** with that open space?*

7. **Eating Locally:** *What is the **largest community** you can develop to ensure that **all residents can eat local food** grown in the area of the map? Report land allocations in hectares for Ag1, Ag2, and Residential use, and report the total population.*

Explore more. What if water could only be used in its precipitation zone? Would building reservoirs and/or irrigation canals help your population grow more food or build larger cities?