KEY

SEE ATTACHED SHEET FOR UNIT ALGEBRA/SHOW MATH

ES476 Hydrology In-Class Exercise

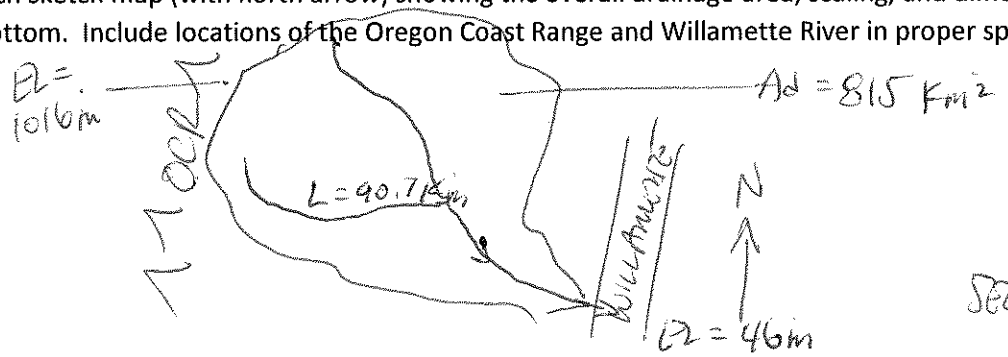
Luckiamute River Basin Water Budget Problems

Introduction

The Luckiamute River basin is located west and south of WOU campus, between Monmouth and Lewisburg. The main channel crosses under Hwy99 south, where a USGS gaging station is located about 1 mile up river at Helmick State Park. The Luckiamute flows eastward from the crest of the Oregon Coast Range and forms a confluence with the Willamette River. Land surface elevations range from 46 m at the confluence with the Willamette River to 1016 m at Fanno Peak. The Luckiamute has a total channel length of 90.7 km. The total drainage area is 815 km^2 (Rhea, 1993; Slack and others, 1993). Total average annual precipitation is 1894 mm across the entirety of the drainage basin. Total average annual evapotranspiration and infiltration is 739 mm. The average annual unit discharge of the river system is 1.16 x 10^6 m^3/yr/km^2 [volume discharge per year per sq. km of drainage basin averaged over the total area)

Objective: complete the following water budget problems related to the Luckiamute River basin.

Task 1. Draw a sketch sketch map (with north arrow) showing the overall drainage area, scaling, and dimensions of the basin from top to bottom. Include locations of the Oregon Coast Range and Willamette River in proper spatial orientation.



SEE MATH WORK ON PAGE 2

Task 2. Based on the introductory paragraph, complete the data table below. Show all of your math work and unit algebra

1	Drainage Area	815 km^2	8.15x10^8 m^2	8.15x10^4 ha
2	Maximum Elevation	1016 m	3332.5 ft	
3	Minimum Elevation	46 m	150.9 ft	
4	Total Channel Length	90.7 Km (1000m/Km) = 90,700 m	297,496 ft	= 90,700m (3.28ft/m)
5	Average Channel Gradient (Elevation / Length)	10.7 m/km	56.6 ft / mi	
6	Average Annual Unit Discharge	1.16x10^6 m^3/yr/km^2		
7	Average Annual Precipitation Input	(1in/25.4mm) 1894 mm/yr =	74.6 in	
8	Average Annual ET-Infiltration	(1in/25.4mm) 739 mm =	29.1 in	
9	Total Annual Basin Input Volume from Precipitation	1.54x10^9 m^3/yr	5.4x10^{10} ft^3/yr	
10	Total Annual Basin Loss Volume from ET-Infiltration	-6.02x10^8 m^3	-2.12x10^{10} ft^3	
11	Total Annual Channel Discharge Runoff	9.45x10^8 m^3/yr	3.33x10^{10} ft^3	
12	Percent Total Annual Runoff	61 %		
13	Percent Total Annual ET-Infiltration	39 %		

(1) DRAINAGE AREA

$$815\ km^2 \left(\frac{1000\ m}{km}\right)\left(\frac{1000\ m}{km}\right) = 8.15\times10^8\ m^2$$

$$8.15\times10^8\ m^2 \left(\frac{1\ ha}{10^4\ m^2}\right) = 8.15\times10^4\ ha$$

(2) (3) ELEVATIONS

$$1016\ m \left(\frac{3.28\ ft}{m}\right) = 3332.5\ ft$$

$$46\ m \left(\frac{3.28\ ft}{m}\right) = 150.9\ ft$$

(5) AVG. CHANNEL GRADIENT $= \frac{MAX\ E2 - MIN\ E2}{\text{CHANNEL LENGTH}} = \frac{1016m - 46m}{90.7\ km} = 10.7\ \frac{m}{km}$

$$10.7\ \frac{m}{km}\left(\frac{1\ km}{0.62\ mi}\right)\left(\frac{3.28\ ft}{m}\right) = 56.6\ \frac{ft}{mi}$$

(9) TOTAL ANNUAL PRECIP INPUT

$$\left(\frac{1000\ m}{km}\right)\left(\frac{1000\ m}{km}\right)(815\ km^2)\left(1894\ \frac{mm}{yr}\right)\left(\frac{1\ m}{1000\ mm}\right) = 1.54\times10^9\ \frac{m^3}{yr}$$

$$1.54\times10^9\ \frac{m^3}{yr}\left(\frac{3.28\ ft}{m}\right)^3 = 5.4\times10^{10}\ \frac{ft^3}{yr}$$

(10)

$$\left(\frac{1000\ m}{km}\right)\left(\frac{1000\ m}{km}\right)(815\ km^2)\left(-739\ \frac{mm}{yr}\right)\left(\frac{1\ m}{1000\ mm}\right) = -6.02\times10^8\ \frac{m^3}{yr}$$

$$-6.02\times10^8\ \frac{m^3}{yr}\left(\frac{3.28\ ft}{m}\right)^3 = -2.12\times10^{10}\ \frac{ft^3}{yr}$$

(11)

$$\left(1.16\times10^6\ \frac{m^3/yr}{km^2}\right)(815\ km^2) = 9.45\times10^8\ m^3$$

$$9.45\times10^8\ \frac{m^3}{yr}\left(\frac{3.28\ ft}{m}\right)^3 = 3.33\times10^{10}\ \frac{ft^3}{yr}$$

(12)

$$\left(\frac{9.45\times10^8\ m^3/yr}{1.54\times10^9\ m^3/yr}\right)\times 100\% = 61\%$$

(13)

$$\left(\frac{6.02\times10^8\ m^3/yr}{1.54\times10^9\ m^3/yr}\right)\times 100\% = 39\%$$

} 100%