Drainage Basins Field Lab:
San Gabriel Mountain Foothills

Dr. Jeff Marshall

GSC 323 – Geomorphology
Geological Sciences Department
Cal Poly Pomona University

Digital Elevation Model (DEM) of the central San Gabriel Mountains, Los Angeles County, California.
(Modified from NASA Shuttle Radar Topography Mission (SRTM) Image PIA 03332)

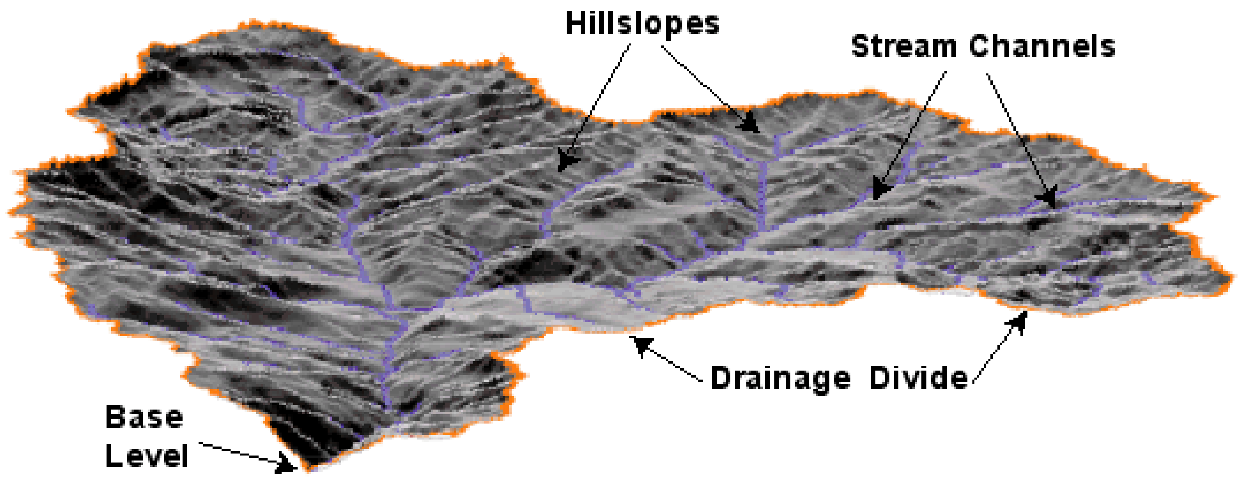
Introduction

One of the first tasks in a geomorphic investigation is to identify meaningful units of analysis within the landscape. On a first order, this involves dividing the landscape into areas of similar geomorphic and lithologic characteristics. This is often expressed by obvious variations in the local topographic relief and in the patterns of drainage networks developed on the landscape.

During our field trip to the San Gabriel Mountain foothills, we will identify three basic landscape units: 1) low relief alluvial fan surface, 2) moderate relief foothills, and 3) high relief mountain front.

Drainage Basin Analysis

Each of the three basic landscape units in our field area can be further subdivided into a system of *drainage basins* (also known as *watersheds* or *catchments*). Geomorphologists view drainage basins as a fundamental unit of landscape analysis. A drainage basin is defined as an area of land that contributes surface runoff to a common *trunk stream*. Every point on the Earth's land surface belongs to a drainage basin. The edges of a particular basin are referred to as *drainage divides*. These boundaries consist of a line that follows the highest elevation points along the basin's edge. A drainage divide separates one basin from another adjacent basin.



Drainage basins can be viewed as integrated landscape systems that are formed and modified by a suite of interrelated geomorphic processes, including tectonic uplift, rock weathering, runoff, erosion, stream flow, sediment transport, and deposition. The drainage basin system can be subdivided into two principal sub-systems which are affected by different sets of processes: 1) the *hill slopes* and 2) the *stream channel network*.

Analysis of drainage basin morphology can provide important data for understanding the processes operating in the landscape. This type of analysis focuses on a particular set of measurable basin characteristics referred to as *morphometric parameters*. These characteristics serve as indicators of *equilibrium* or *disequilibrium* in the landscape. Key morphometric parameters include: drainage basin area, width, and length; topographic relief and slope; the longitudinal profile; basin asymmetry; hypsometric integral; stream-length gradient index; and valley floor width to valley height ratio.

In this lab, you will identify the basic landscape units in the San Gabriel Mountain foothill region, delineate a set of drainage basins, and analyze some of the geomorphic characteristics of these basins. From this information, you will be asked to draw some basic conclusions about the processes affecting this landscape system, and its relative state of equilibrium.

Assignment

Turn in a professional field report following the format described in the *Lab Report Guidelines* that I provided at the beginning of the quarter.

1) Primary Landscape Units:

a) On Topographic Map #1, mark the boundaries between the three primary landscape units we identified in the field. Lightly shade each area with the indicated color: 1) alluvial fan surface (yellow), 2) moderate relief foothills (red), 3) high relief mountain front (green). The limits of your mapping area are defined by the edges of the map, San Antonio Creek, and the National Forest boundary.

b) Trace (in blue) all stream channels shown on the map (the solid lines)

c) Mark (in red) the regional drainage divide between the San Gabriel River and Santa Ana River drainage basins.

2) Drainage Basins and Longitudinal Profiles:

a) On Topographic Maps #2 and #3, outline the drainage divides (in red), and channel network (in blue) of the following local drainage basins:

Map #2:

1) Burbank Canyon
2) "Cobalito" Canyon
   (small unnamed basin we visited - between Burbank and Cobal Canyons)
3) Cobal Canyon
4) Palmer-Williams Canyons
5) Chicken Canyon
6) Evy Canyon

Map #3:

7) Spruce Canyon
8) Cat Canyon
9) Dry Lake Canyon

b) Make a *longitudinal profile* graph for the trunk stream of each of these 9 basins

c) Calculate the *drainage area* for each basin.

3) Morphometric Indices:

In the following three steps (a-c), you will calculate *morphometric indices* for our drainage basins. See detailed instructions for these calculations in Chapter 4 of:

Keller, E.A. and Pinter N., 2002, *Active Tectonics: Earthquakes, Uplift, and Landscape, Second Edition,* Prentice Hall, Upper Saddle River, New Jersey, USA, 362 p.

a) Calculate the *Drainage Basin Asymmetry Factor (AF)* for each the nine drainage basins.

b) Calculate the *Hypsometric Integral (Hi)* for each basin.

c) Calculate the *Stream Length-Gradient Index (SL)* for the upper, middle, and lower reaches of each trunk stream. To define these reaches, divide each stream into thirds.

4) Results & Discussion:

a) Present your results neatly in a set of maps, figures, and tables.

b) Provide a general discussion of the drainage basin morphologies in this area. How do the basins differ between landscape units (maps #2 and #3)?

c) Examine the longitudinal profiles and discuss any irregularities. What might be the cause of any departures from a "graded profile"?

d) How do the long profiles compare between Maps #2 and #3? What similarities or differences are there between long profiles within each major landscape unit? Explain.

e) Do any of the basins show significant asymmetry (*AF*)? If so, what does this indicate?

f) Are there variations in hypsometric integral among the basins? What do your computed *Hi* values indicate about this area?

g) How do *SL* values compare among basins? Are there similarities or differences between each major landscape unit? Explain the significance.

h) Discuss any other significant observations

4) Conclusions

Based on your observations, describe the overall set of geomorphic processes that have influenced the development of this landscape. Explain any significant variations in the geomorphology between the three primary landscape units.

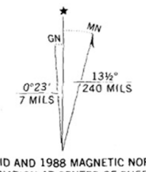
SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



UTM GRID AND 1988 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Areas covered by dashed light-blue pattern are subject to controlled inundation

There may be private inholdings within the boundaries of the National or State reservations shown on this map

Purple tint indicates areas of urban extensions

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY
DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

QUADRANGLE LOCATION

Revisions shown in purple and woodland compiled from aerial photographs taken 1985 and other source data. Partial field check by U.S. Forest Service. Map edited 1988

nd 5

Mo

Canyon
Water Tank
Evey Canyon
Lower San Antonio Station
Stoddard
Gravel Pit
4743
4413
FOREST ROAD
BDY
WT
3551
West Fork Canyon
Spring
Potato Mtn
Palmer Canyon
Chicken Canyon
Williams Canyon
SPILLWAY ELEV 2238
Intake
SAN ANTONIO DAM
MOUNTAIN AVE
Padua Hills Theater
Cobal Canyon
Burbank Canyon
Fire Sta
BALDY MT ROAD
24TH ST
CHANNEL
GRANT BDY
Radio Tower
Thompson Creek Dam
Gail Canyon
Well
Wells
Res
CLAREMONT
Canal Creek
PADUA AVE
MILLS AVE
MIRAMAR AVE
BONNIE BRAE AVE
Scudder Oaks Sch
SAN ANTONIO CREEK
LOS ANGELES CO
SAN BERNARDINO CO
Gravel Pits
ORANGE GROVE AVE
WILSON AVE
Girls Collegiate Sch
Gravel Pit
Water Tank
370 000 FEET (7)
434
42'30"
435
436
(ONTARIO)
2452 II SW
437
2.6 MI. TO INTERSTATE 10
SCALE 1:24 000
1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
GN
MN

ANGELES
ONAL FOREST
GLENDORA RIDGE ROAD
SUNSET RIDGE FIRE ROAD
Saddle
Fallen Leaf Spring
Lookout Tower
Sunset Peak
5796
Powerplant
Grave
Hog Back
San
ROAD
Barrett
Gaging Sta
Kerkh
North Fork
Canyon
Cascade Canyon
BARRETT
Spring Hill
4056
Powerplant
MT. BALDY
Dry Lake Canyon
Cat Canyon
Water Tank
WT
Stoddard Flat
STODDARD TRUCK TRAIL
Stoddard Peak
4624
Canyon
San Antonio Canyon
Spruce Canyon
Sunset
5399
5078
5432
5595
4413
4324
Water Tank
Lower San Antonio Station
Stoddard
Gravel Pit
Frankish Peak
4198
Evey
3261
3869
Pole