River Discharge Notebook

- introduce river discharge and stage

- a couple of standard geometry definitions

Topical Learning Objectives: Quantitative Modeling of Sedimentary Systems

First Learning objectives with River Discharge Jupyter Notebook

- learn about data types, lists, numpy arrays and pandas, functions and basic statistics in Python

- Learn about reading/visualization of data or simulation output with matplotlib package

River Channel Geometry Definitions

A = channel cross-sectional area = wd

w = channel width

d = channel depth
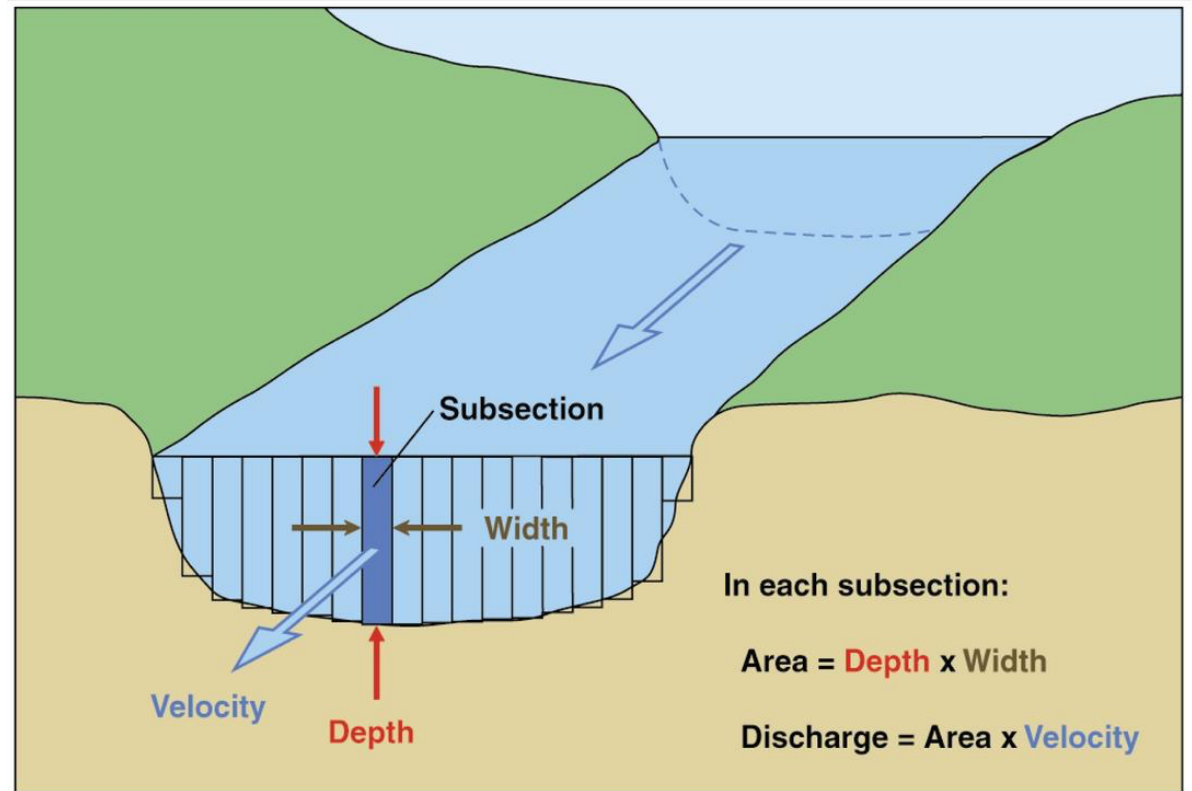
= wetted perimeter ~ w+2d
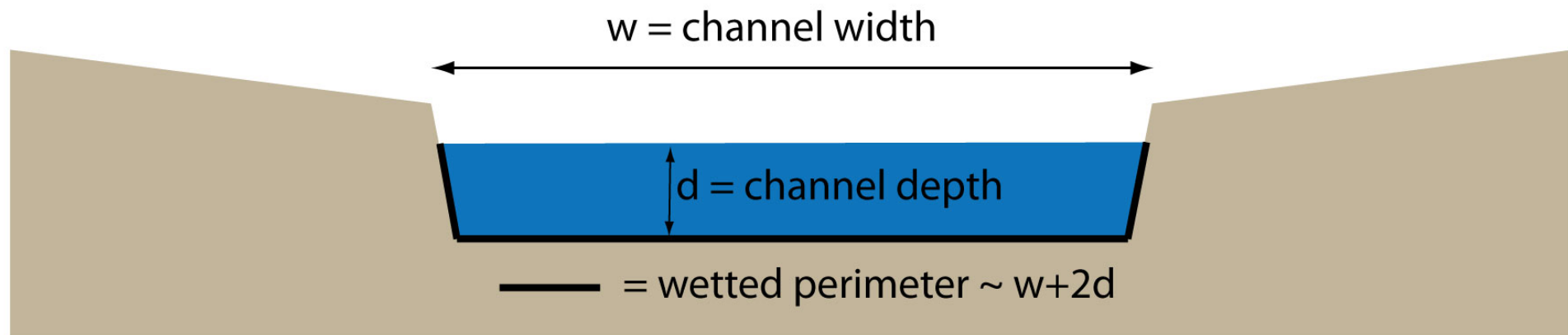
Hydraulic radius R = A/P

River Discharge

$Q = uwd$

Discharge is measured in m³/s or cuft/s

Discharge

Discharge is defined as the volume of water flowing through a stream cross-section (Q)
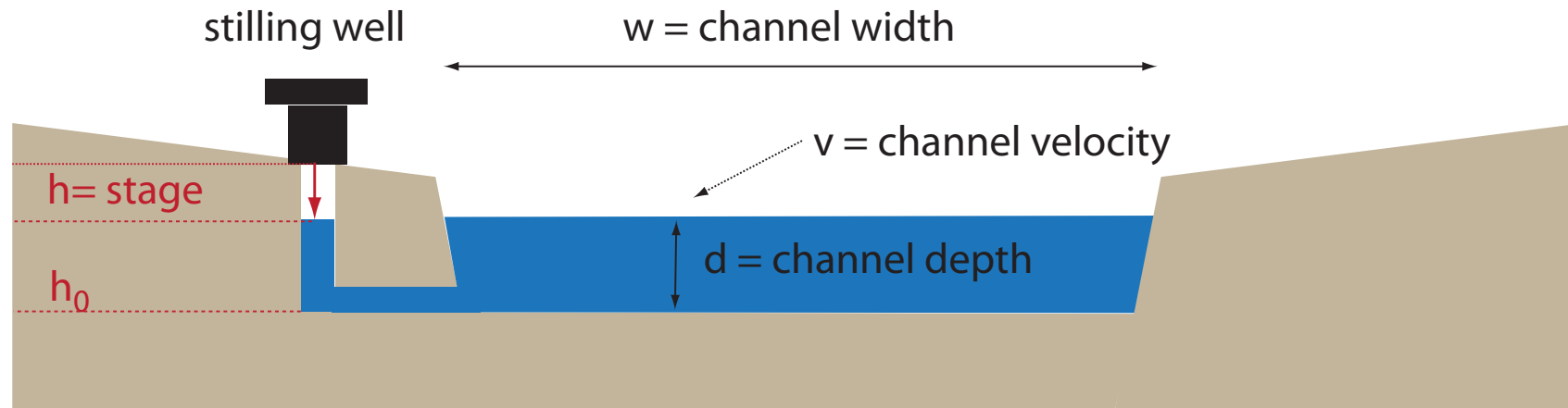
Q= v w d = v A

Q = discharge (in m³/s)

v = velocity (in m²/s)

A = channel X-section (in m²)

Stage-discharge relationship

$$d = h_0 - h$$

$$d = cQ^f$$

stilling well

w = channel width

v = channel velocity

h= stage

d = channel depth

h_0

This method is still operational around the world, was first used in the 1800's.

EXAMPLE 1
Work with USGS River Discharge Data

Information on this stretch of the Colorado River:

https://www.americanwhitewater.org/content/River/detail/id/379/

Gauging Station at Kremmling

https://waterdata.usgs.gov/usa/nwis/uv?09058000

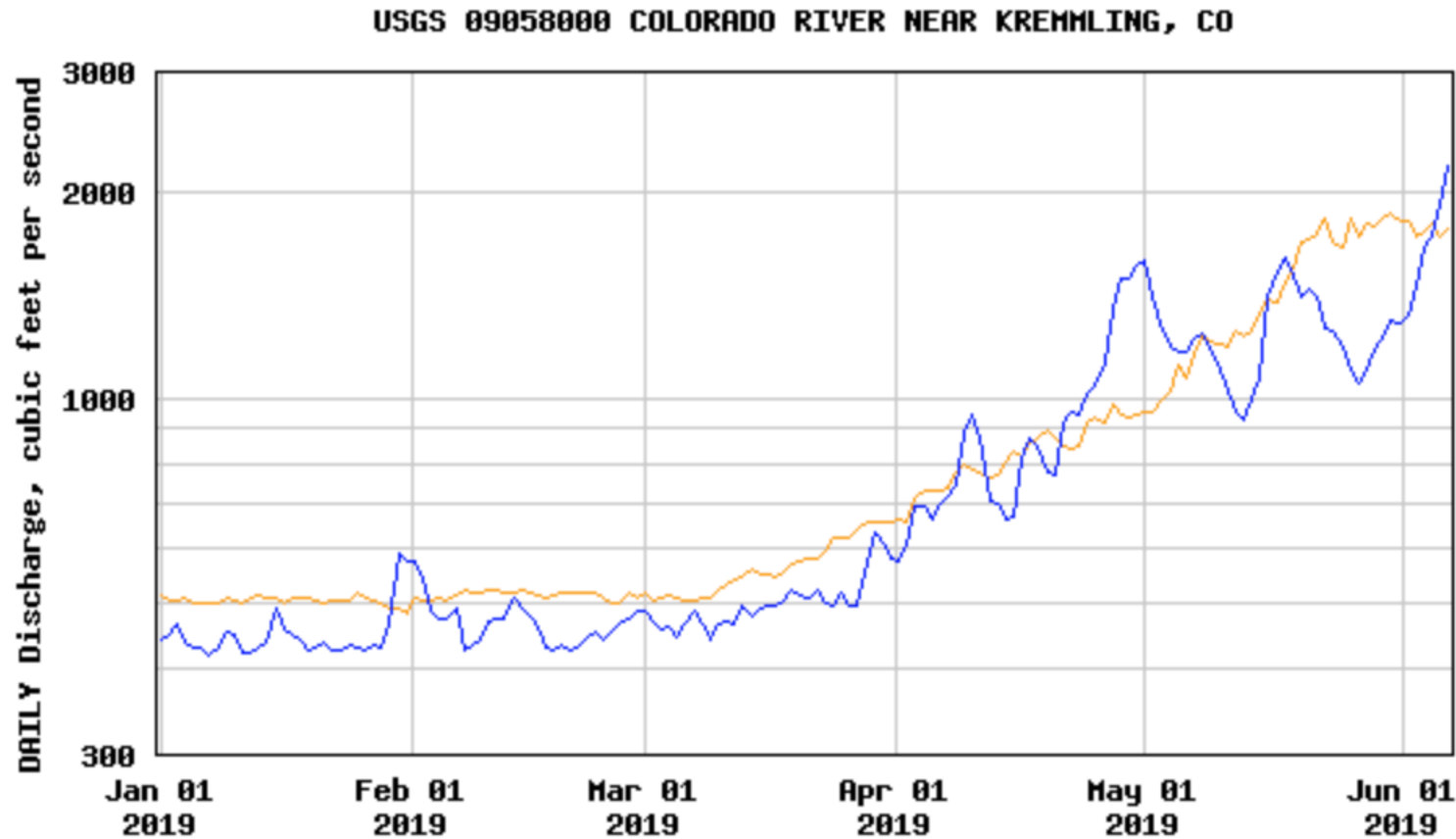# Pumphouse – Mid Channel Bars, Upper Colorado

Downstream Pumphouse, Bar during lower flow, Upper Colorado River

Legend
Pumphouse Campground

Google Earth

USGS 09058000 Gauging Station near Kremmling, CO

Discharge, cubic feet per second

USGS 09058000 COLORADO RIVER NEAR KREMMLING, CO

June 8th 2019
Discharge near Kremmling, Co

2260 cfs = 64 m³/s

Hint: Replace 0 values with NaN entries

https://stackoverflow.com/questions/45416684/python-pandas-replace-multiple-columns-zero-to-nan?rq=1

Hint: from the date-time calculate DOY

'Day of Year' – the number of the day in a year is a useful concept for plotting data of multiple years on one common axis.

See pandas documentation on datatime options here:

https://pandas.pydata.org/pandas-docs/stable/reference/arrays.html#datetime-data

Papers with week 3

Kean, J., Smith,D., 2010. Calculation of stage-discharge relations for gravelbedded channels. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, F03020, doi:10.1029/2009JF001398, 2010.

Kean, J., Smith, D., 2005. Generation and verification of theoretical rating curves in the Whitewater River basin, Kansas. JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 110, F04012, doi:10.1029/2004JF000250, 2005.