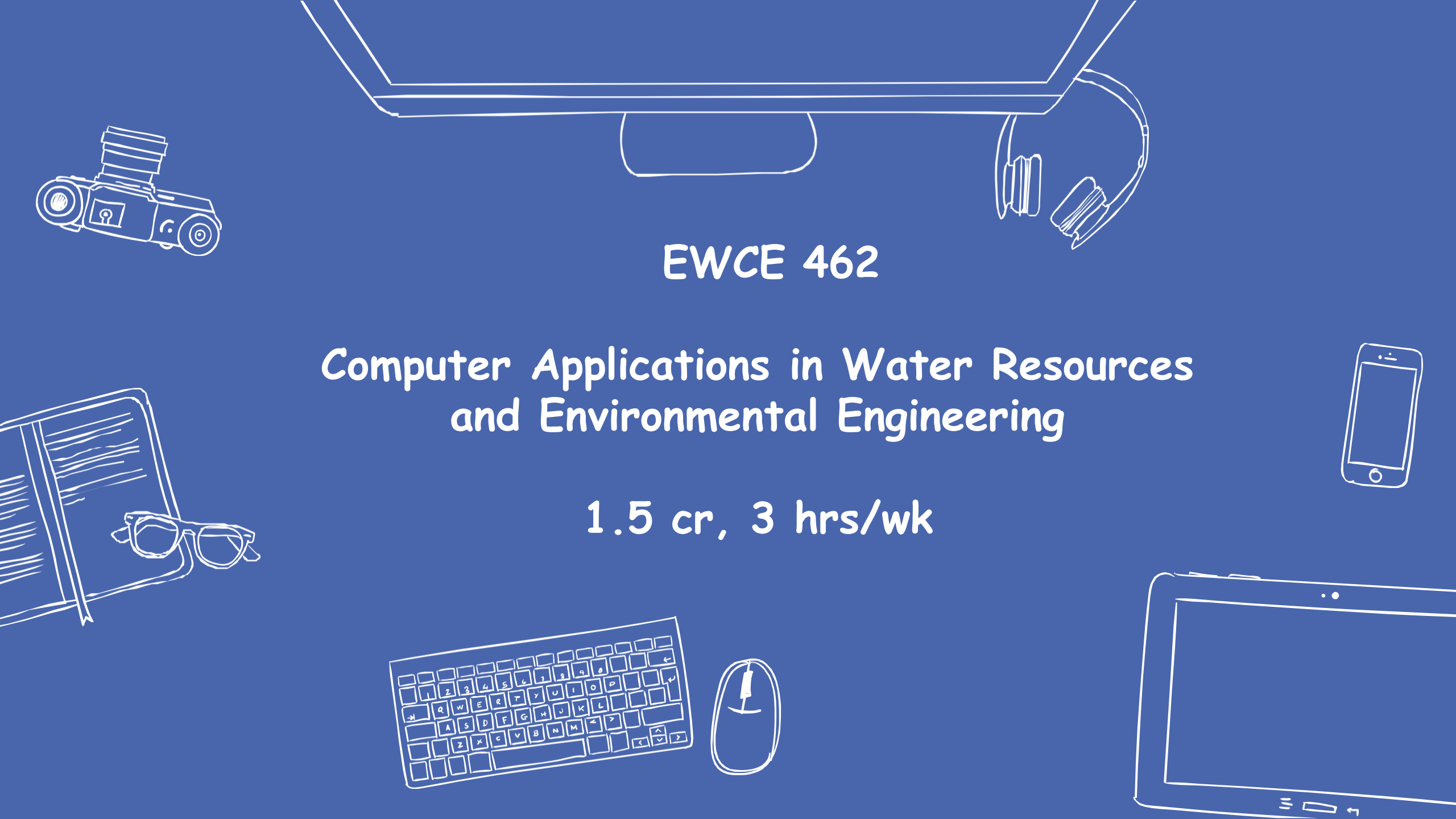


EWCE 462

Computer Applications in Water Resources and Environmental Engineering

1.5 cr, 3 hrs/wk

"Computer Applications" Why?

- Complexity and inter disciplinary nature
- Problems related to site and situation
- Combination of computerized spatial data management and mathematical modeling can be a solution

"Computer Applications" Which one?

We will use modeling softwares

- ❑ Computer Application in Water Resources Engineering

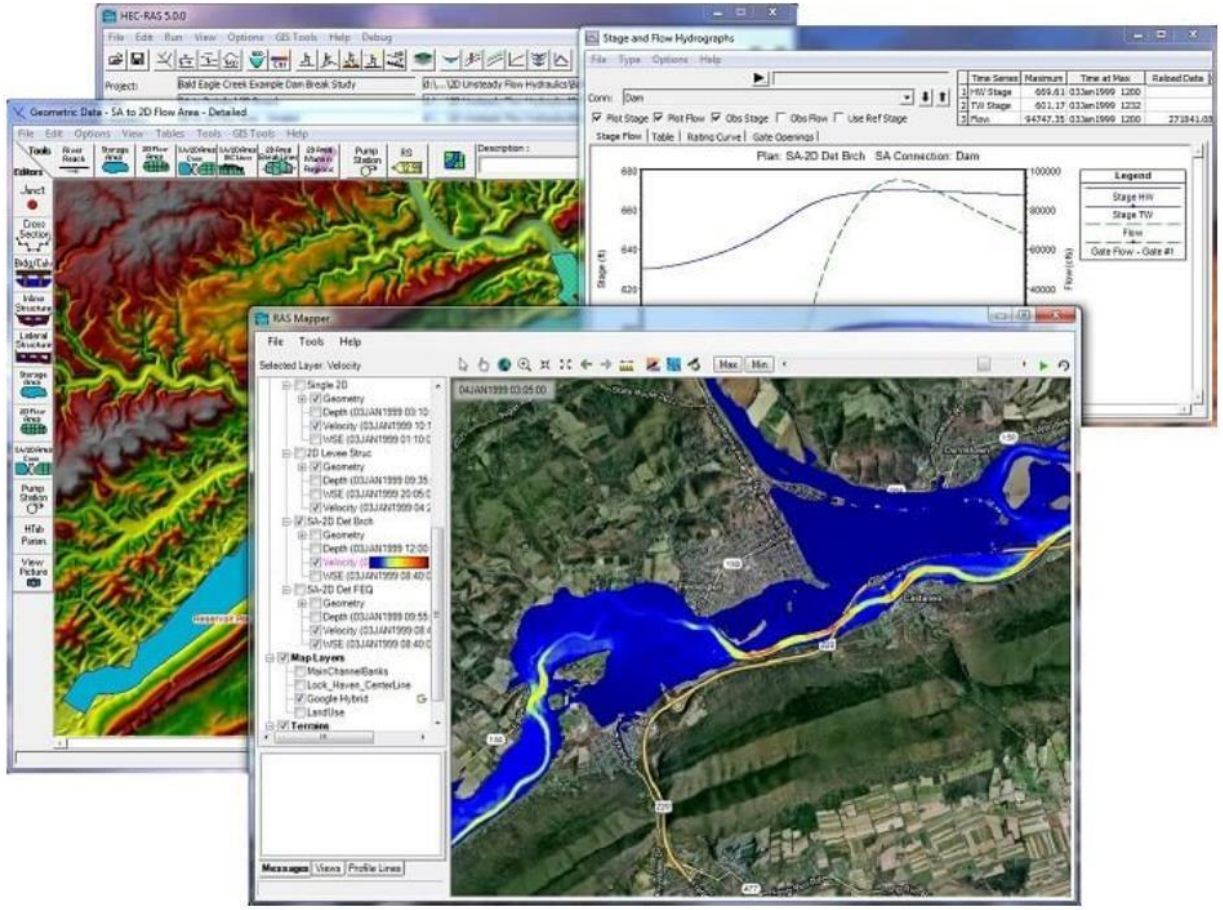
HEC RAS (latest version)

https://www.hec.usace.army.mil/software/hec-ras/download.aspx

- ❑ Computer Application in Environmental Engineering

EPANET (Version 2.0/latest)
https://www.epa.gov/water-research/epanet

Introduction to HEC RAS



Introduction to HEC RAS

- Hydrologic Engineering Center's (CEIWR-HEC) River Analysis System (HEC-RAS)

- This software allows the user to perform

1. one-dimensional steady flow,
2. one and two-dimensional unsteady flow calculations,
3. sediment transport/mobile bed computations, and
4. water temperature/water quality modeling

Learn more from
https://www.hec.usace.army.mil/about/

Introduction to HEC RAS

HEC-RAS is designed to perform one and two-dimensional hydraulic calculations for a full network of natural and constructed channels.

Major capabilities of HEC-RAS are as follow:

- User Interface
- Hydraulic Analysis Components
- Data Storage and Management
- Graphics and Reporting
- RAS Mapper

Introduction to HEC RAS

User Interface

The interface provides for the following functions:

- File Management
- Data Entry and Editing
- Hydraulic Analyses
- Tabulation and Graphical Displays of Input and Output Data
- Inundation mapping and animations of water propagation
- Reporting Facilities
- Context Sensitive Help

Introduction to HEC RAS

Hydraulic Analysis Components

- Steady Flow Water Surface Profiles
- One- and Two-Dimensional Unsteady Flow Simulation
- Sediment Transport/Movable Boundary Computations
- Water Quality Analysis

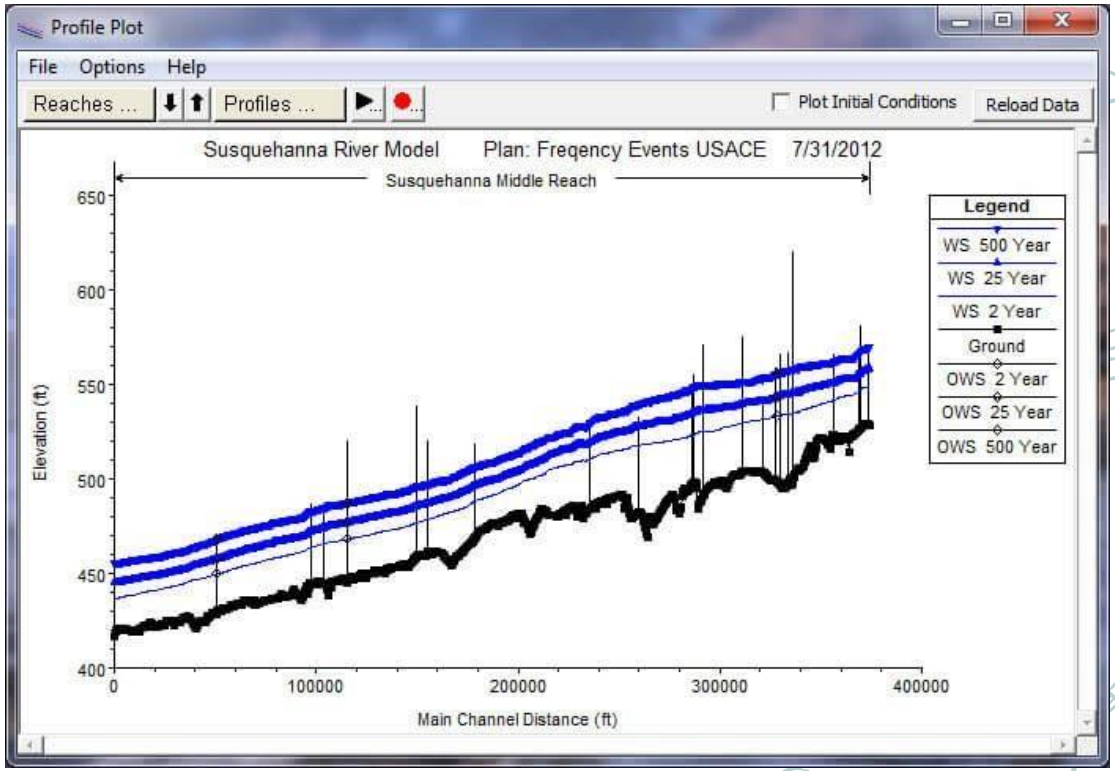
all four components use a common geometric data representation and common geometric and hydraulic computation routines.

the system contains several hydraulic design features that can be invoked once the basic water surface profiles are computed.

Introduction to HEC RAS

Steady Flow Surface Water Profile

- water surface profiles for steady gradually varied flow.
- capable of modeling subcritical, supercritical, and mixed flow regimes water surface profiles.
- Energy losses are evaluated by friction (Manning's equation) and contraction/expansion (coefficient multiplied by the change in velocity head).
- The momentum equation may be used in situations where the water surface profile is rapidly varied. These situations include mixed flow regime calculations (i.e., hydraulic jumps), hydraulics of bridges, and evaluating profiles at river confluences (stream junctions).
- For 1D Unsteady flow: saint venant equation

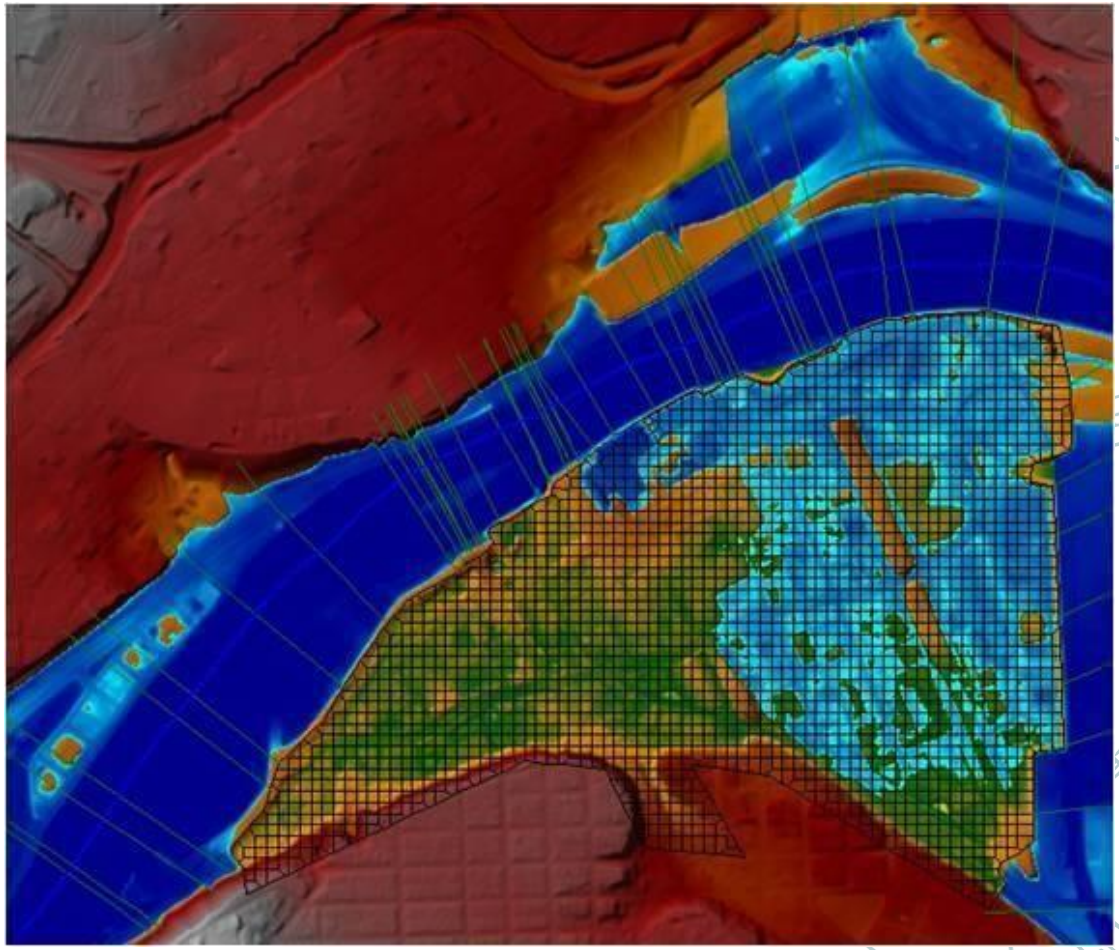


Introduction to HEC RAS

One- and Two-Dimensional Unsteady Flow Simulation

- capable of simulating one-dimensional; two-dimensional; and combined one/two-dimensional unsteady flow

- Special features of the unsteady flow component include:
  - extensive hydraulic structure capabilities Dam break analysis;
  - levee breaching and overtopping;
  - Pumping stations;
  - navigation dam operations;
  - pressurized pipe systems;
  - automated calibration features;
  - User defined rules;
  - and combined one and two-dimensional unsteady flow modeling.



Introduction to HEC RAS

Steady Transport/Movable Boundary Computations

- simulation of one-dimensional sediment transport/movable boundary calculations resulting from scour and deposition over moderate time periods (typically years, although applications to single flood events are possible).

- simulate long-term trends of scour and deposition in a stream channel that might result from modifying the frequency and duration of the water discharge and stage, or modifying the channel geometry.

- deposition in reservoirs, design channel contractions required to maintain navigation depths, predict the influence of dredging on the rate of deposition, estimate maximum possible scour during large flood events, and evaluate sedimentation in fixed channels.

Introduction to HEC RAS

Water Quality Analysis

- riverine water quality analyses.
- capability to model water temperature.
- Transport and Fate of a limited set of water quality constituents
- The currently available water quality constituents are: Dissolved Nitrogen (NO3-N, NO2-N, NH4-N, and Org-N); Dissolved Phosphorus (PO4-P and Org-P); Algae; Dissolved Oxygen (DO); and Carbonaceous Biological Oxygen Demand (CBOD).

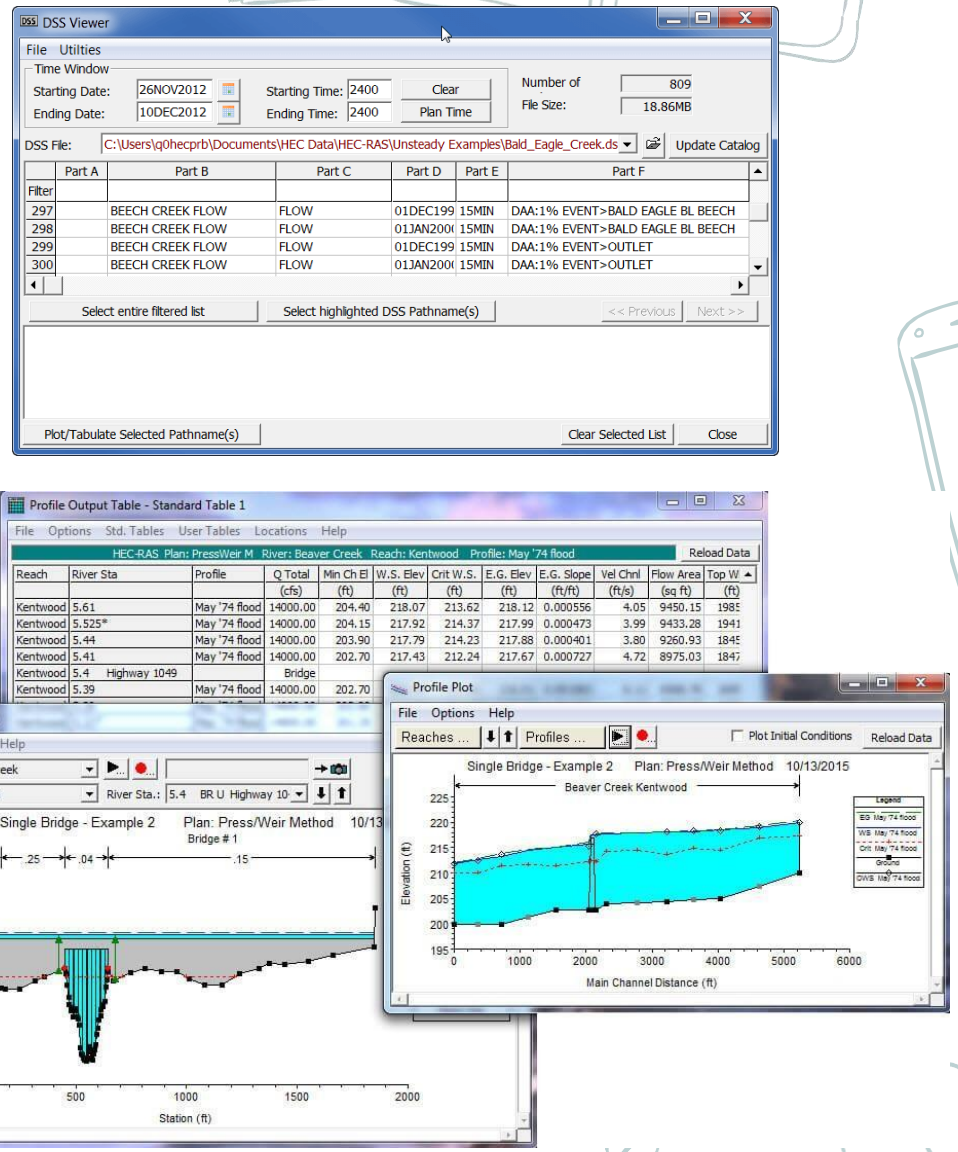
Introduction to HEC RAS

Data Storage and Management

"flat" files (ASCII and binary),
the HEC-DSS (Data Storage System), and
HDF5 (Hierarchical Data Format, Version 5).

Graphics and Reporting

- Graphics include X-Y plots of the river system schematic, cross-sections, profiles, rating curves, hydrographs, and inundation mapping.
- A three-dimensional plot of multiple cross-sections is also provided.
- Inundation mapping is accomplished in the HEC-RAS Mapper portion of the software.

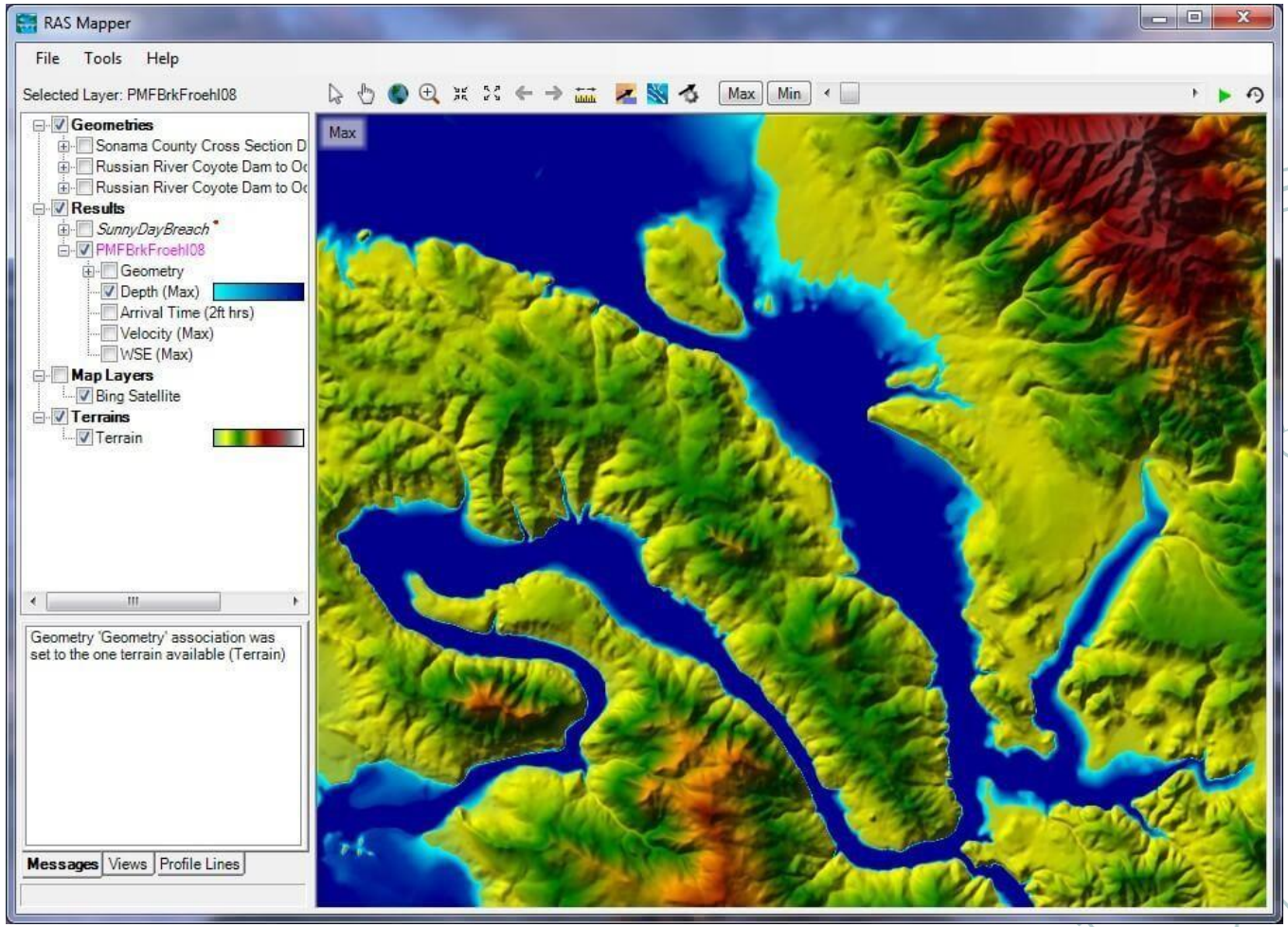


Introduction to HEC RAS

RAS Mapper

HEC-RAS has the capability to perform inundation mapping of water surface profile results directly from HEC-RAS.

Using the HEC-RAS geometry and computed water surface profiles, inundation depth and floodplain boundary datasets are created through the RAS Mapper.



Course Details



Computer Application in Water and Environmental Engineering

1.5 Cr Hr , 3 Hrs/Week

Course Teachers

- Lec Simlia
- Lec Rafid
- Lec Atik
- Lec Nishat







Marks Distribution

Attendance: 5%

Assignments and Daily performance: 20%

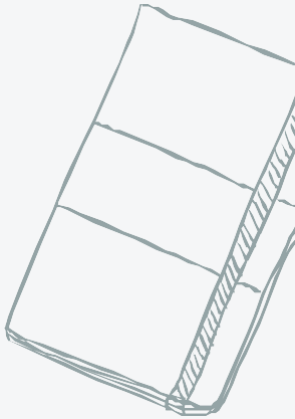
Midterm quiz: 30%

Final quiz: 25%

Term Project: 20%










Lets Start
Working with
HEC RAS

Working with HEC RAS

Useful Links

Manuals
https://www.hec.usace.army.mil/software/hec-ras/documentation.aspx

Working with HEC RAS
https://www.hec.usace.army.mil/confluence/rasdocs/rasum/latest/installing-hec- ras

https://www.youtube.com/watch?v=d416442IC4c&list=PL26VoPqZfrgC-9qYKOHVr7ITbHh1akkU7

https://www.youtube.com/@anajuarezgomez690

https://www.youtube.com/watch?v=HBFQsd7ZLfg&list=PLTIyb8CQ97tQGi05_jd38-JVcFGvmymh3

https://www.youtube.com/watch?v=r-BY0lSI_lU&list=PLFpH0pcIK_vX0CIYso2OwUDWdEzRAoy-J

https://www.youtube.com/watch?v=BUjF_MGcxYQ&list=PLk_n8Ox5nf3G3SXucyn8XQNtwnByMXrvP

https://www.youtube.com/watch?v=C1Z3r3C5Hwg

Working with HEC RAS

General steps to build a hydraulic model in HEC-RAS

- ❑ Creating a schematic of a river
- ❑ Assigning all the geometric variables and parameters
- ❑ Assigning all the initial conditions and boundary conditions
- ❑ Performing an analysis
- ❑ Viewing the results

Working with Projects

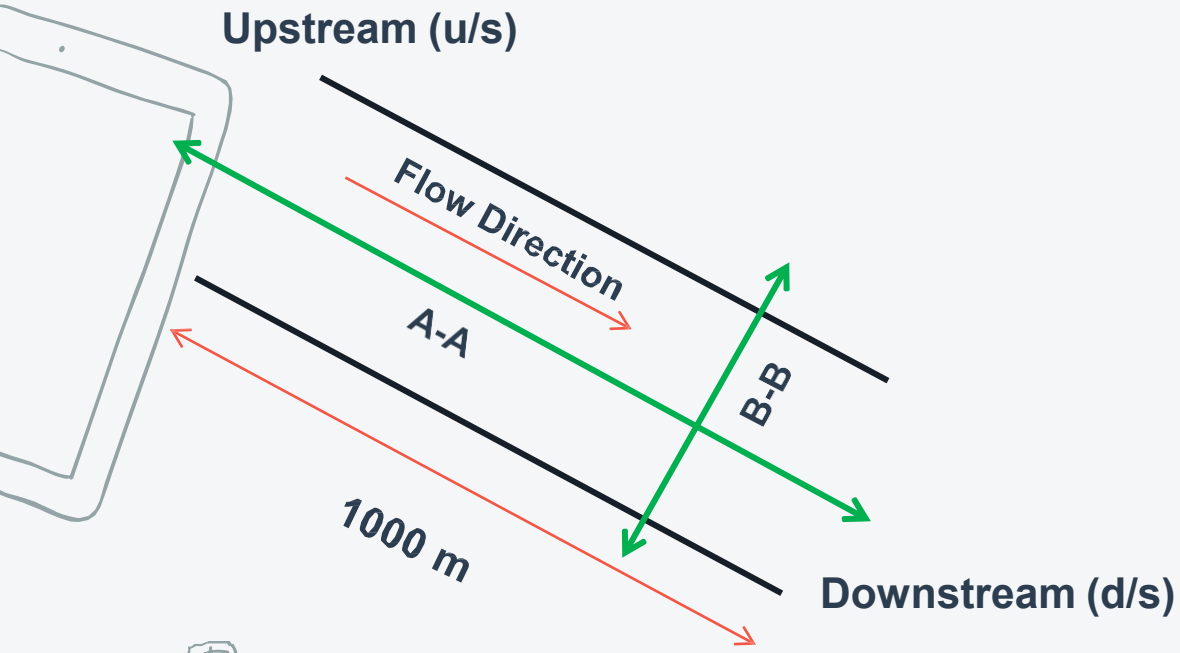
Project 1: 1D (One dimensional) steady flow water surface profile computations

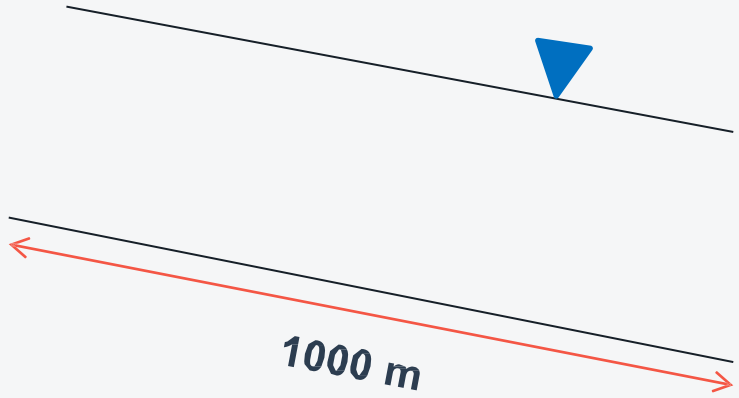
Following information are given for this project:

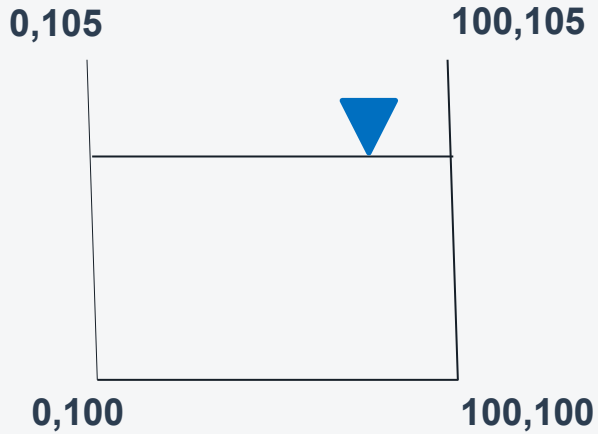
- The channel is rectangular
- The channel length is 1000 m.
- The channel width is 100 m.
- Manning's n can be assumed as 0.025 *s/m1/3.*
- The discharge in the channel is 200 m3/s.
- The channel slope is (Last two digits of your student number + 50)/100,000.
- Downstream depth is = normal depth=channel slope.

Working with Projects

Project 1: 1D (One dimensional) steady flow water surface profile computations







Project 1 Assignment

Submissions

- ❑ Calculate uniform depth for your case using Manning's equation and compare it with your model result.
- ❑ Derive 1D Saint-Venant equations and write down its assumptions.
- ❑ Discussions.

Home Assignment 1

Modeling Three slopes





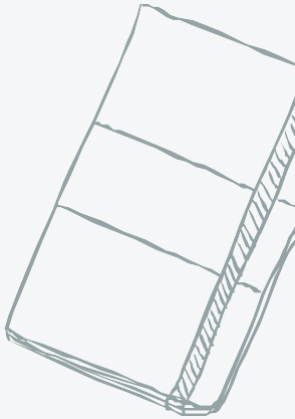









Copying Assignments from someone else will be considered as a copying in an exam and will be handled as per university ordinance

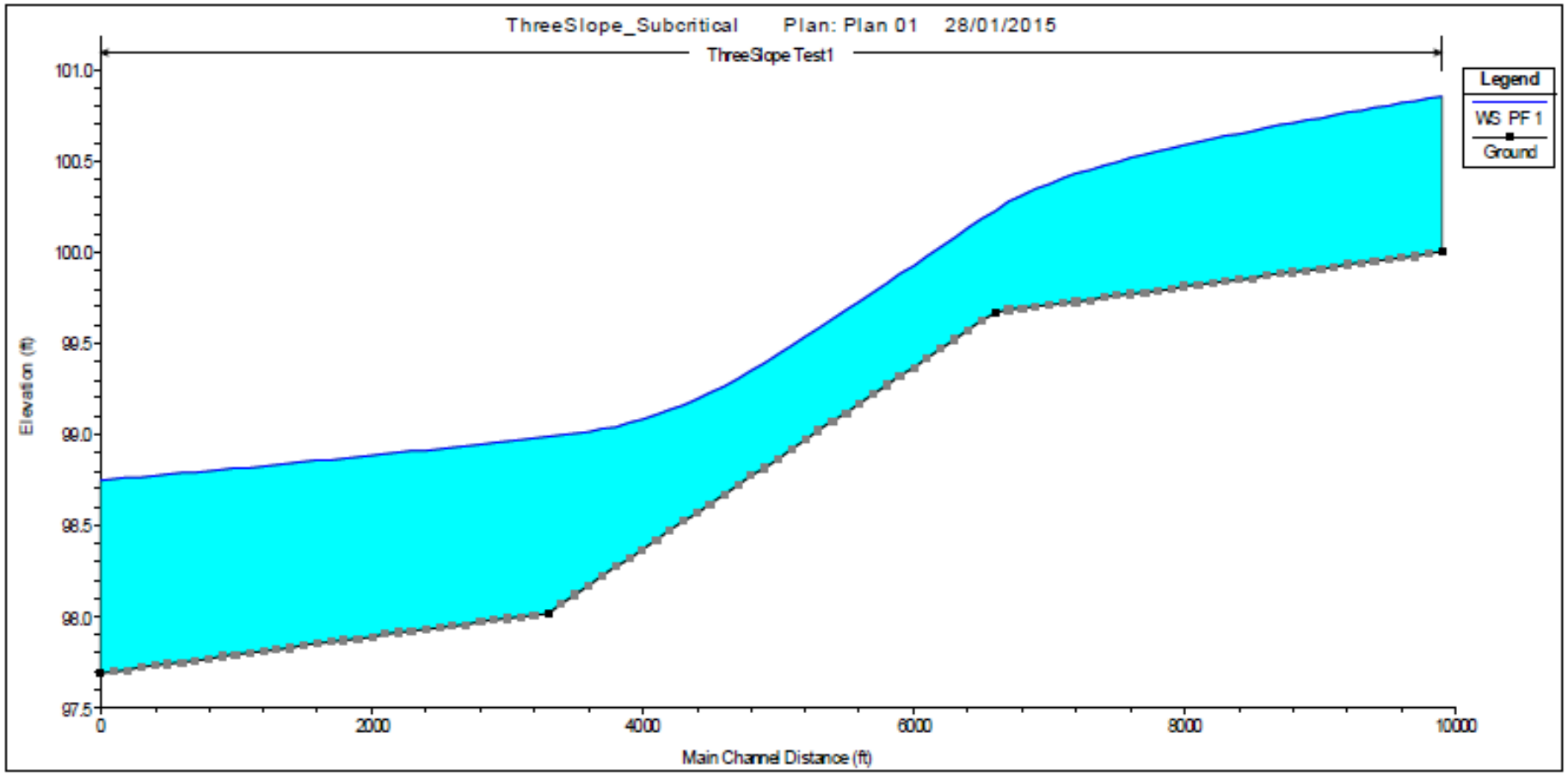

Home work

Specific Objectives:

1. Create a new project.
2. Draw a schematic of a straight river.
3. Assign cross section data.
4. Assign boundary condition data.
5. Perform the analysis
6. View and present the results.

Following information are needed for this assignment:

- The channel is rectangular.
- The channel width is 100 m.
- The channel length is 9900 m.
- Manning's n can be assumed as 0.025 $s/m^{1/3}$.
- The discharge in the channel is 200 m^3/s.
- The channel slope for the first and last third parts of the channel is = (Last two digits of your student number + 50)/100,000.
- The channel slope for the middle part is = twice the slope of the first or last part of the channel.
- Downstream boundary condition is =normal depth


ThreeSlope_Subcritical Plan: Plan 01 28/01/2015
ThreeSlope Test1
Legend
WS PF 1
Ground
Elevation (ft)
101.0
100.5
100.0
99.5
99.0
98.5
98.0
97.5
0
2000
4000
6000
8000
10000
Main Channel Distance (ft)

Submissions:

1. Printing of longitudinal profile of water surface elevation.
2. Printing of longitudinal velocity profile.
3. Show the result output table.
4. Discussions.