Water Quality Modeling
Using HEC-RAS

Objectives

This course is intended to provide participants with the knowledge to utilize the HEC-RAS software to analysis water quality problems under steady or unsteady flow conditions.

Topics include: model stability; model trouble shooting; simulation of conservative and non-conservative tracers; model input requirements; energy budget and water temperature modeling; riparian shading; and nutrient modeling.

Prerequisites

Participants must have familiarity with HEC-RAS and be experienced in both steady and unsteady flow modeling. It is assumed that you already use HEC-RAS for performing steady or unsteady flow analysis. Familiarity with water quality modeling, the advection-dispersion equation and numerical solution techniques is desirable.

Day 1

8:00 – 9:00 am	**INTRODUCTIONS, COURSE OVERVIEW, AND PRE-TEST**	
9:00 – 9:15 am	BREAK	
9:15 – 10:30 am	1.1 Lecture	**WATER QUALITY MODELING: THEORY AND FUNDAMENTALS**

Review of the advection-diffusion equation, numerical methods, and relevant stability issues. Introduction to source and sink terms.

10:30– 11:45 am	1.2 Lecture	**SETTING UP A HEC-RAS WATER QUALITY MODEL: INPUT AND BOUNDARY DATA**

Discussion of necessary input and boundary data, and required parameters including dispersion coefficients.

11:45 – 1:00 pm	ICE BREAKER LUNCH

1:00 – 2:00 pm	1.3 Lecture	**MODEL CAPABILITY AND COMPUTATION OPTIONS**

Discussions of time step and water quality cell size selection, steady and unsteady flow considerations, when and why to apply the ULTIMATE limiter, and output options.

2:00 – 2:15 pm	BREAK

2:15 – 3:15 pm	1.4 Lecture	**MODELING SIMPLE TRACERS**

Description and comparison of various types of simple tracers that are easily to implement and their use as tools for model troubleshooting and refinement.

3:15 – 4:30 pm	1.5 Workshop	**IMPLEMENTING A STEEP FRONT MODEL**

This workshop will be used to learn about how to set up and run a simple water quality model; input and adjust dispersion coefficients; and enter and view observed data points.

4:30 – 5:00 pm	Review	Workshop 1.5

Day 2

8:00 – 9:00 am	2.1 Lecture	**TROUBLESHOOTING**

Overview of common water quality modeling problems including time step selection and water quality cell size selection.

9:00 – 9:15 am	BREAK	
9:15 – 10:30 am	2.2 Workshop	**TROUBLESHOOTING**
10:30 – 11:00 am	Review	Workshop 2.2
11:00 – 12:00 pm	2.3 Lecture	**OVERVIEW OF WATER TEMPERATURE MODELING**

Description of energy budget terms and adjustment of wind function parameters for model calibration. Discussion of parameters for flux partitioning and atmospheric stability. Generation of synthetic cloud cover time series using measured and computed solar radiation.

12:00 – 1:00 pm	LUNCH	
1:00 –2:30 pm	2.4 Lecture	**DATA INPUT FOR WATER TEMPERATURE MODELING**

Overview of meteorological data input requirements and sources for this data. Designing a water temperature monitoring program to obtain adequate data for water temperature model calibration

2:30 – 2:45 pm	BREAK	
2:45 – 4:30 pm	2.5 Workshop	**WATER TEMPERATURE MODELING**

This workshop will be used to introduce the steps required to construct a functioning water temperature model including boundary data input; observed data input; and model calibration.

4:30 – 5:00 pm	Review	Workshop 2.5

Day 3

8:00 – 9:00 am	3.1 Lecture	**USING THE NUTRIENT SUB-MODEL**

Discussion of the nutrient submodel (NSM) including algae, nitrogen and phosphorus pathways, and configuration of the model for a simplified Streeter-Phelps (BOD-DO) type application. Discussion of boundary data, calibration parameter, and computation options.

9:00 – 9:15 am	BREAK	
9:15 – 10:45 am	3.2 Workshop	**STREETER-PHELPS MODEL**

Construction of a simplified (BOD and DO only) model and comparison of model results with classic Streeter-Phelps solution.

10:45– 12:00 pm	3.3 Workshop	**NUTRIENT MODELING**

Construction of a full water quality model including dissolved oxygen, nitrogen and phosphorus

12:00 – 1:00 pm	LUNCH	
1:00 – 1:30 pm	Review	Workshop 3.2 and Workshop 3.3
1:30 – 2:30 pm	3.4 Lecture	**RIPARIAN SHADING**

Discussion of riparian shading function in HEC-RAS. Input of tree heights and locations and other shading parameters.

2:30– 2:45 pm	BREAK	
2:45 –3:45 pm	3.5 Workshop	**RIPARIAN SHADING**

Constructing a water temperature model using the riparian shading option. Exploration of model sensitivity to riparian transmissivity, stream width and other hydraulic parameters.

3:45 – 4:00 pm	Review	Workshop 3.5
4:00 – 5:00 pm	**POST TEST, COURSE CRITIQUE, AND CLOSING REMARKS**	