River Technologies

Hyraulic Testing Laboratory

River Structure Services

2D/3D Hydrodynamic model

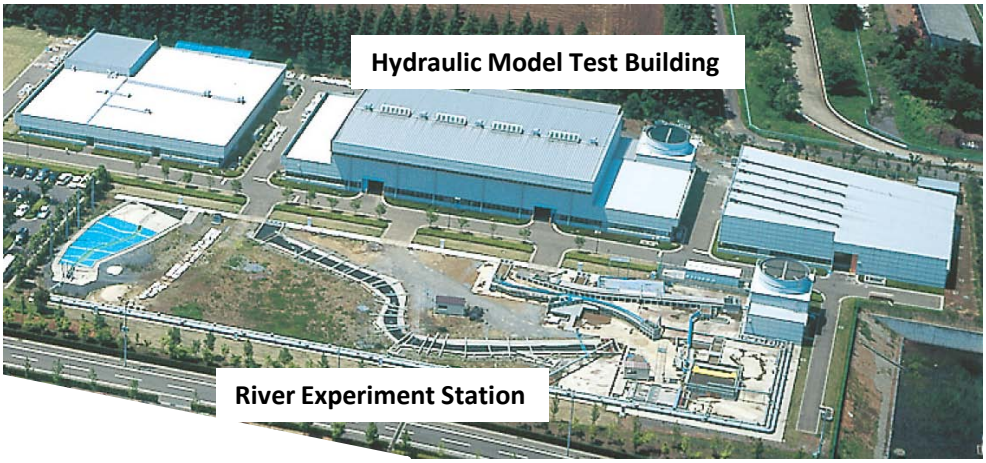
Prediction of Riverbed Deformation

Prediction of River Vegetation with NKhydro2D

R&D Center
for Innovation, New Technologies & Engineering Solutions
2304 Inarihara, Tsukuba City, Ibaraki 300-1259, JAPAN
Email: tkb-info@cx.n-koei.co.jp
Web: www.n-koei.co.jp/english/rd-center/index.html

Hydraulic Testing Laboratory

Our Hydraulic Laboratory offers a wide range of testing facilities in the Hydraulic Model Test Building and the River Experimental Yard to meet all needs related to hydraulic design.



Hydraulic Model Test Building

- Dimensions: 35 m by 80 m with water supply and drainage system (8 lines, maximum capacity of 1.2 m^3/s)

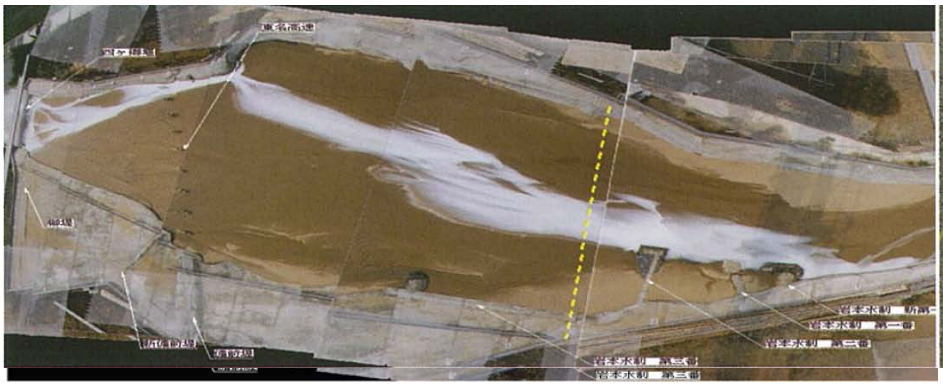
River Experiment Station

- Dimensions: 50 m by 140 m withwater supply and drainage system (6 lines, maximum capacity of 1.2 m^3/s)

River Structure Services

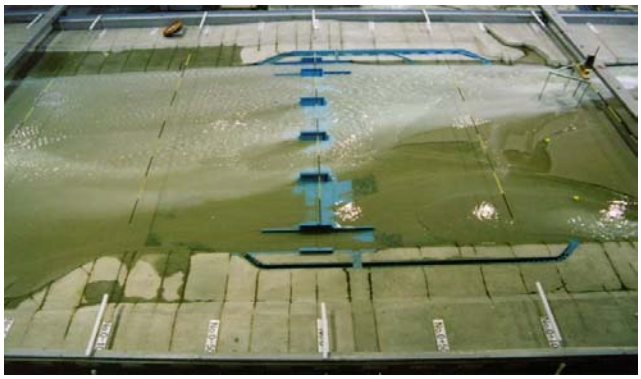
Bridge pier

■ To perform comprehensive study on appropriate positions of bridge piers and their form, protecting structure around the piers includes investigating local souring and adverse effects on the surroundings due to the pier construction.



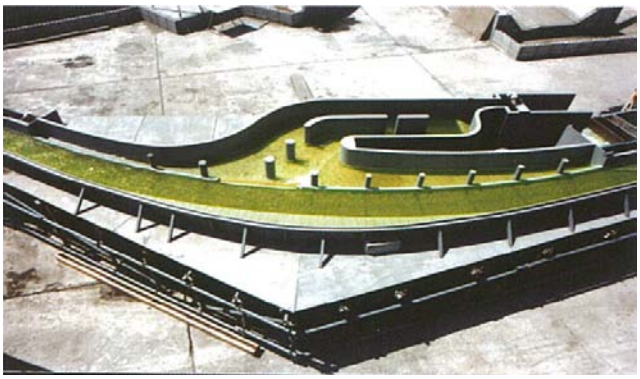
Diversion weir

■ To evaluate the effects on the river channel due to the diversion weir construction and comprehensive countermeasures such as protection works.



Side overflow weir of flood control reservoir

■ To propose optimal structure dimensions by investigating diversion ability of various types of diversion weirs.



2D/3D Hydrodynamic Model

NKhydro2D/3D is a hydrodynamic modeling system for two dimensional (2D) and three dimensional (3D) flow study and analysis of various problems in waters.

- The model is based on a boundary-fitted orthogonal curvilinear coordinate system.
- In addition to the hydrodynamics of free surface water flow, density stratification, sediment and water quality transport can be simulated with the model.

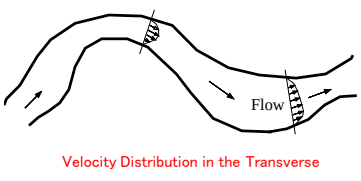
Typical application of NKhydro2D

Country	Project
Japan	Prediction of river vegetation
Indonesia	Reservoir sedimentation management

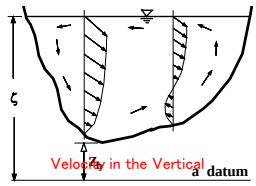
Typical application of NKhydro3D

Country	Project
Japan	Water quality management in land-locked waters
Bangladesh	Sedimentation Mitigation for Irrigation Intake Canal

Prediction of Riverbed Deformation

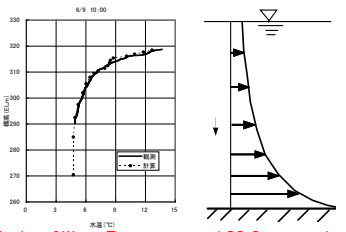


Velocity Distribution in the Transverse



Velocity in the Vertical

River Confluence



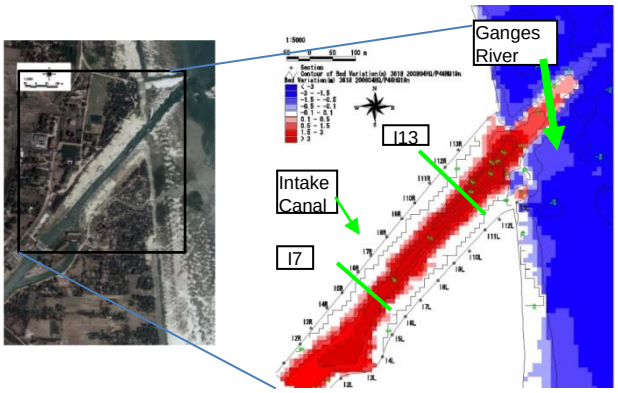
Distribution of Water Temperature and SS Concentration

General Distribution of Velocity, Water Temperature and Suspended Sediment Concentration

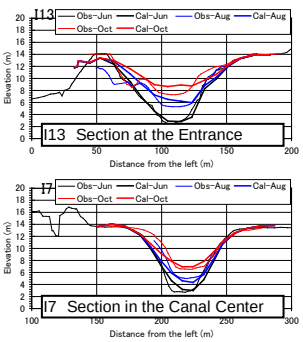
Water flow and transport of sediment and water quality are generally three dimensional unsteady phenomena. Especially, hydraulic phenomena around bridge piers, river confluence and divergence, bend and so it is better to be evaluated with a three dimensional hydrodynamic model.

Simulation of Riverbed Deformation (an example)

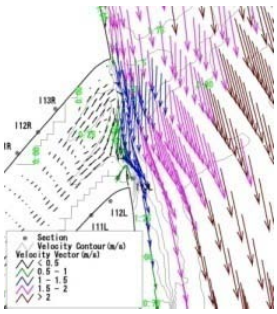
- The model has been applied to predict the sedimentation phenomena in the intake canal of the irrigation project, Bangladesh.
- Sedimentation in the intake canal and comparison with the measurement in the representative sections are shown in the Figures. The computational results are consistent with the survey.



Sedimentation in the Intake Canal in 2007 Flood Season (Red=deposition, Blue=Erosion)



Comparison at Sections I7 and I13

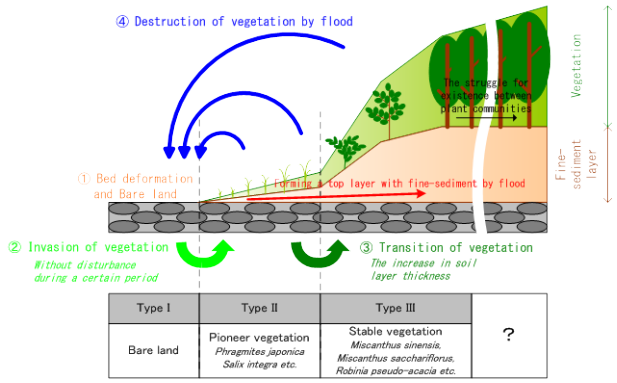


Depth-averaged Velocity around the Entrance of the Intake Canal

Prediction of River Vegetation with NKhydro2D

In 1978 In 2000

Changes in river vegetation



Conceptual diagram of the vegetation model

Computational conditions

- Discharge hydrograph over 2,000 m^3/s
- Vegetation flush U_*: 21 cm/s (D90 move limit)
- Invasion of vegetation (without disturbance) : 1 year
- Transition of vegetation (soil layer thickness) : 3 cm

Vegetation in a river causes the following problems:

- **Reduction of flood capacity, increasing the risk of driftwood**
- **Destruction of the ecosystem with invasion of an alien species**
- **Reduction of gravel river beds**
- **Loss of river landscapes and hydrophily**

A rational river channel plan can be formulated with the river vegetation model incorporated with bed deformation prediction

Outline of the Vegetation Model

■ The model predicts vegetation transition indirectly by simulating river bed deformation, formation of a fine sediment layer and its duration, etc., as follows:

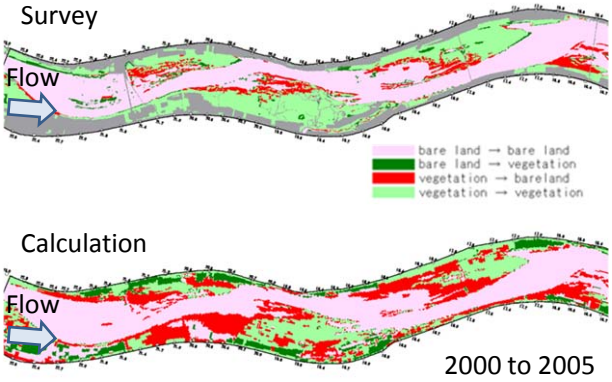
- Pioneer vegetation invades if the riverbed is not disturbed due to sediment transport in a certain period.
- The pioneer vegetation will transit to stable vegetation if a fine-sediment layer is formed.
- Shear stresses velocity is employed to estimate flush of vegetation.

Simulation of river vegetation (an example)

■ The model has been applied to the Yoshino river.

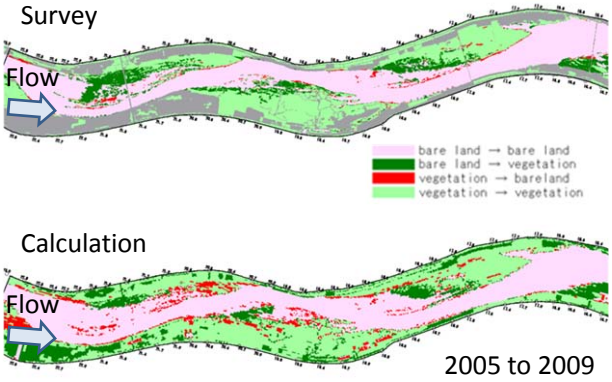
■ Deduction of vegetation is reproduced in the calculation for five years, in which the largest flood in recent years occurred (left figure).

■ Recovery of vegetation is also reproduced in the calculation for four years thereafter (right figure).



Destruction and invasion of vegetation (2000 to 2005)

The vegetation in the water front was flushed out



Destruction and invasion of vegetation (2005 to 2009)

The vegetation in the water front was recovered