

DYNLET



A model for one-dimensional fluid flow from
the ocean through a tidal inlet,
into back bay regions,
and up tributaries

- Theory
- Interface
- Data requirements
- Grid generation
- Visualization



DYNLET MODEL EQUATIONS



$$\frac{\partial \mathbf{Q}}{\partial \mathbf{y}} + \frac{\partial \eta}{\partial t} - \mathbf{q} = \mathbf{0}$$

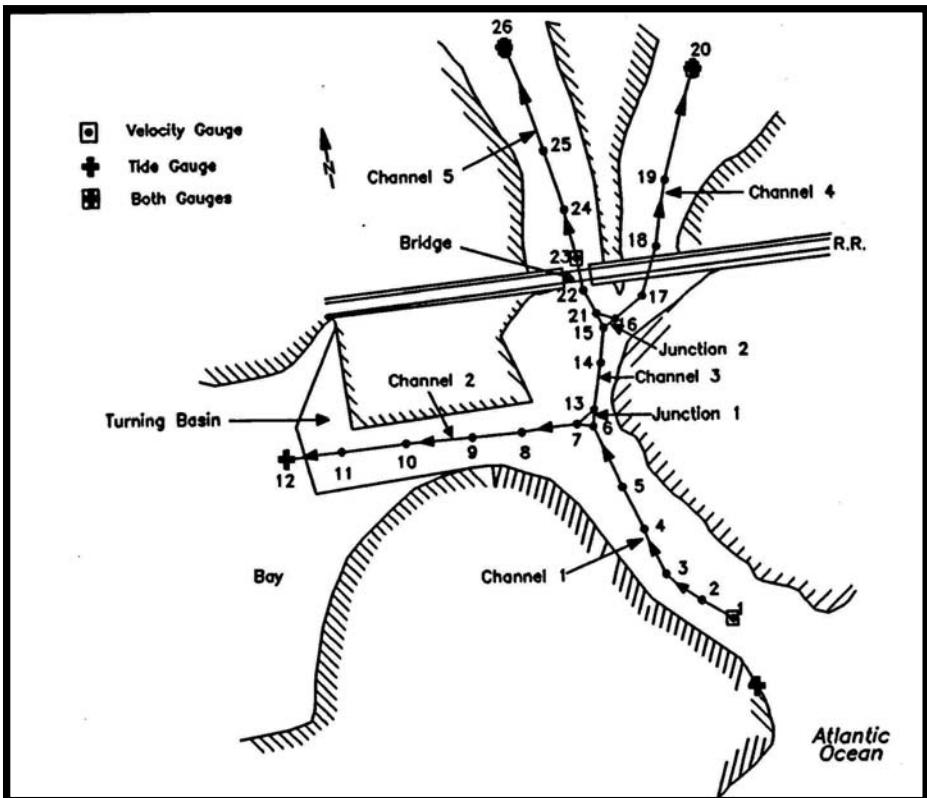
$$\frac{\partial \mathbf{Q}}{\partial t} + \frac{\partial}{\partial \mathbf{y}} \left[\frac{\mathbf{Q}^2}{\eta} \right] = -\mathbf{g}\eta S_f + \mathbf{gB}\tau_s - \mathbf{g}\eta S_e - \mathbf{g}\eta \frac{\partial \mathbf{z}}{\partial \mathbf{y}}$$

Solution

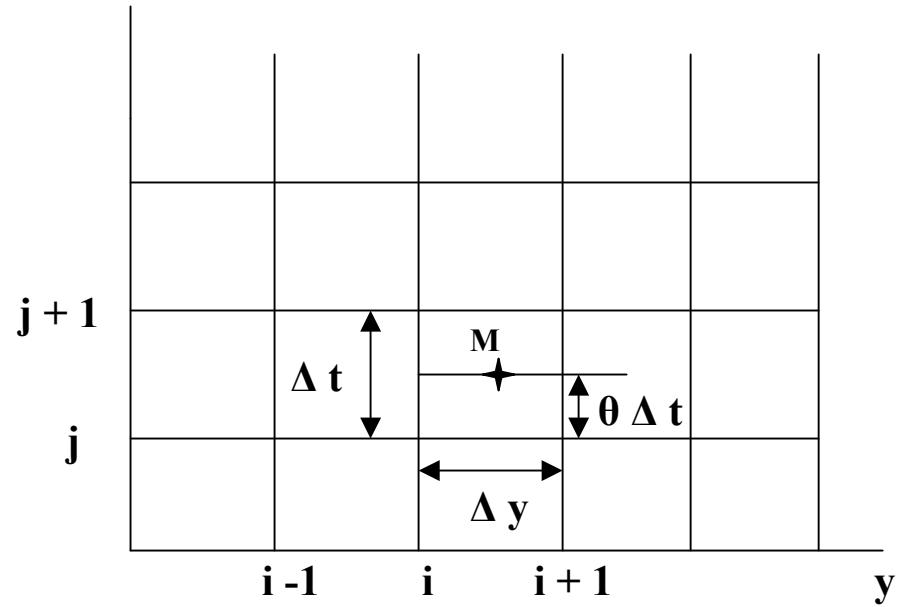
- Finite Difference - Implicit
- Conservation of mass satisfied at junctions



Grid Notation



Time



Distance along channel

$\Theta(\theta) = 0$ Explicit
 $0.5 < \theta \leq 1.0$ Implicit





Parameterization

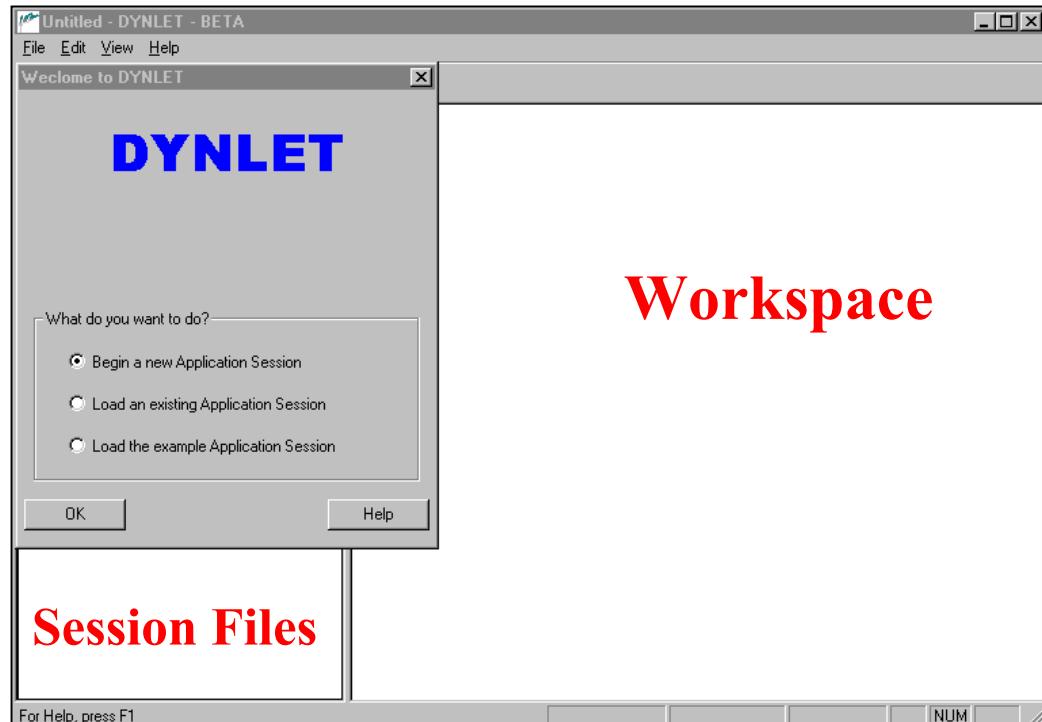
- Friction - Mannings formulation
- Surface Stress - $\tau_s = \frac{C_D}{2} \rho_a V_w^2$
- Transition Losses - K_e
- Boundary Conditions :
 - Elevation and / or Discharge
 - Weir , rating curve , uniform flux
 - Sine curve , Keulegan K



Welcome Screen

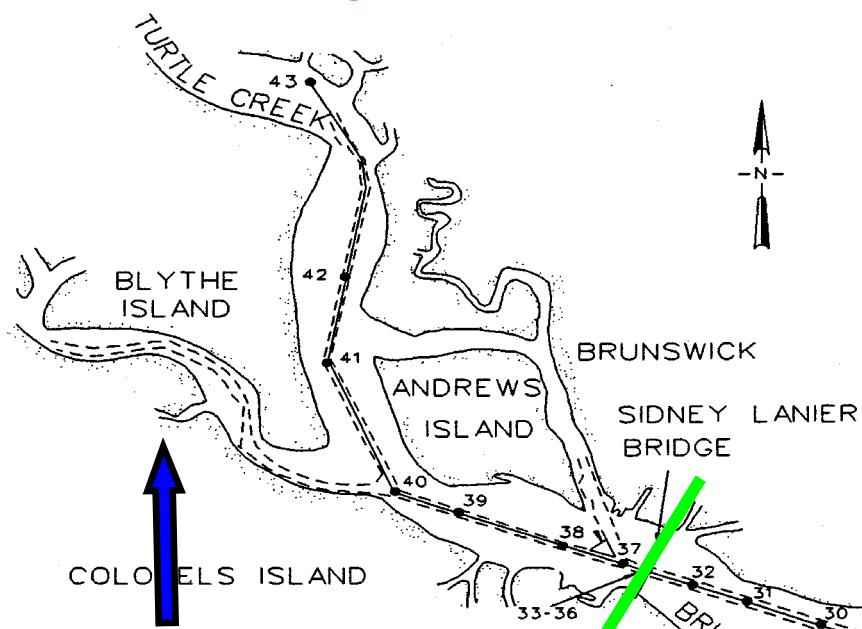


- Dual window environment
- Begin new or load existing application sessions
- Help - “Getting Started”



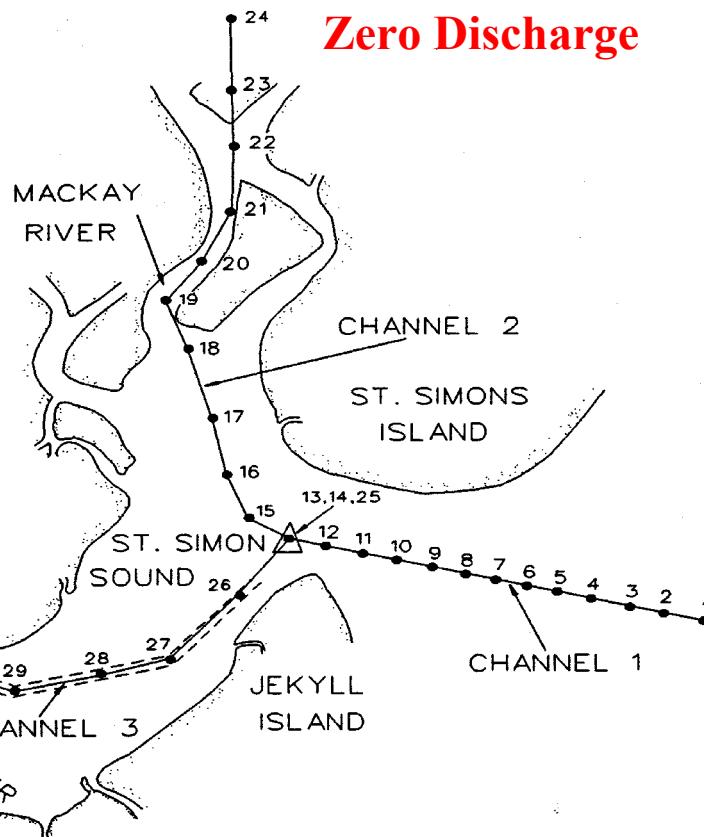
Example Grid

Zero Discharge



Potential for lateral inflow

Zero Discharge



Ocean Tide





Data Edit Menu

Model Parameters

nodes

start/end time

time step

tolerances

wind effects

Simulation
meta data



Data Edit

General Parameters | Channels | Junctions | Boundaries | Output Parameters | Cross-section Parameters | Nodal Parameters | Time-Dependent Data

Title: BrunswickTIDE

Units: English SI Units of distance: Feet Miles Wind effect: None

Number of nodes: 43

Start time (T0): 6 hr End time (Tfin): 24 hr

Delta T: 1800 sec Initial surface elevation: 5 ft

Tolerance value for stage: 0.05 ft Tolerance value for discharge: 50 ft³/sec

Defaults

Maximum iterations for numerical scheme: 20 Weighting coefficient (theta): 1

Notes

Brunswick Harbor is located in Georgia, USA. This application was made to investigate storm and tidal hydraulics of the inlet and back bay/river systems. The first case is an astronomical tidal simulation to check model performance and verify that measured data can be reproduced by DYNLET. Interest is focused on Node 35, located at the Sidney Lanier Bridge spanning the Brunswick River. The stations at cross section 35 are selected to accurately

OK Cancel Apply Help





Channels & Junctions

Data Edit

General Parameters | Channels | Junctions | Boundaries | Output Parameters

# Channels	<input type="text" value="3"/>
Start Node	End Node
1	13
14	24
25	43

Channels

Data Edit

General Parameters | Channels | Junctions | Boundaries | Output Parameters | Cro

# Junctions	<input type="text" value="1"/>		
# Nodes	Node 1	Node 2	Node 3
3	13	14	25

Junctions





Boundary Conditions

Options
Water Elevation Table
Discharge Table
Bay Parameters
Sinusoidal - a , T
Weir Flow
Rating Curve
Uniform Flux

Data Edit

Variable descriptions				
Type	Var 1	Var 2	Var 3	Var 4
Elevation from table	N/A	N/A	N/A	N/A
Discharge from table	N/A	N/A	N/A	N/A
Given bay data	Bay area	Bank slope	Repletion	N/A
Sinusoidal elevation	Amplitude	Period (hr)	N/A	N/A
Weir flow	Weir coefficient	N/A	N/A	N/A
Rating curve	C1	C2	C3	zbottom
Uniform flux (dq/dy)	N/A	N/A	N/A	N/A

Note: N/A means not applicable

# Boundaries	3	Type	Var 1	Var 2	Var 3	Var 4
Node #						
1	Elevation from table					
24	Discharge from table					
43	Discharge from table					

WARNING: A channel cannot end without assigning a boundary condition to the END NODE unless it ends at a junction.

OK Cancel Apply Help



Options for Model Output

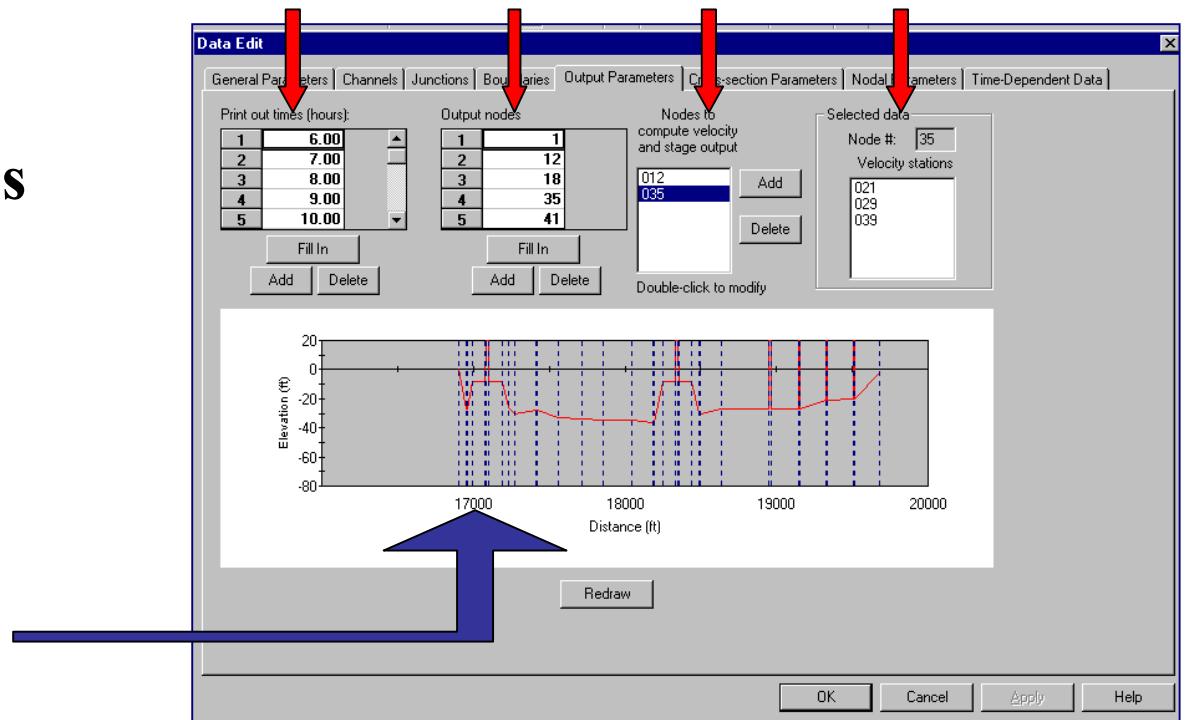


Printout - all results
save at specified times

Output Nodes - Stations
for saving η , Q , and
X-sectional data

Velocity - nodes and
X-sectional stations

Hi-Lighted station
appears on plot

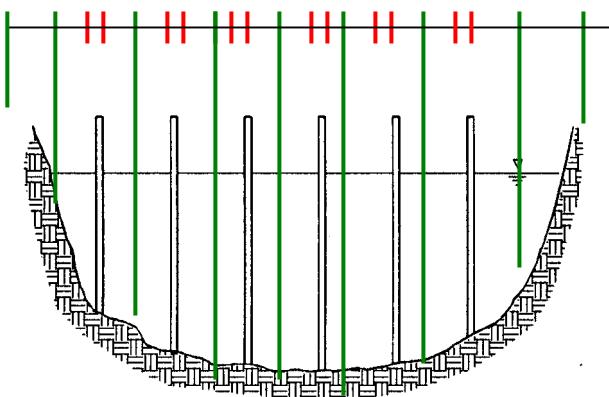


Cross-section Discretization



Representation of structures

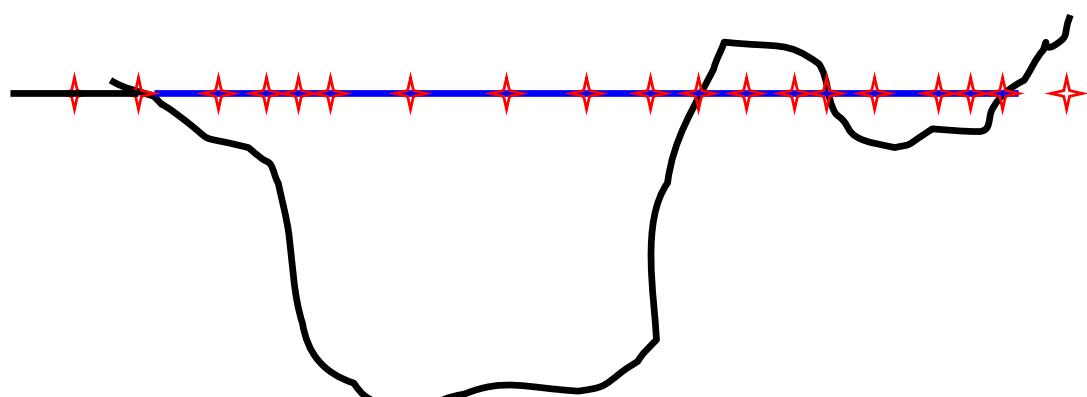
21 station points



|| Defines bridge piers

| Defines bottom bathymetry

Model permits flooding and drying



Typical discretization - 19 stations points



Cross-section Data

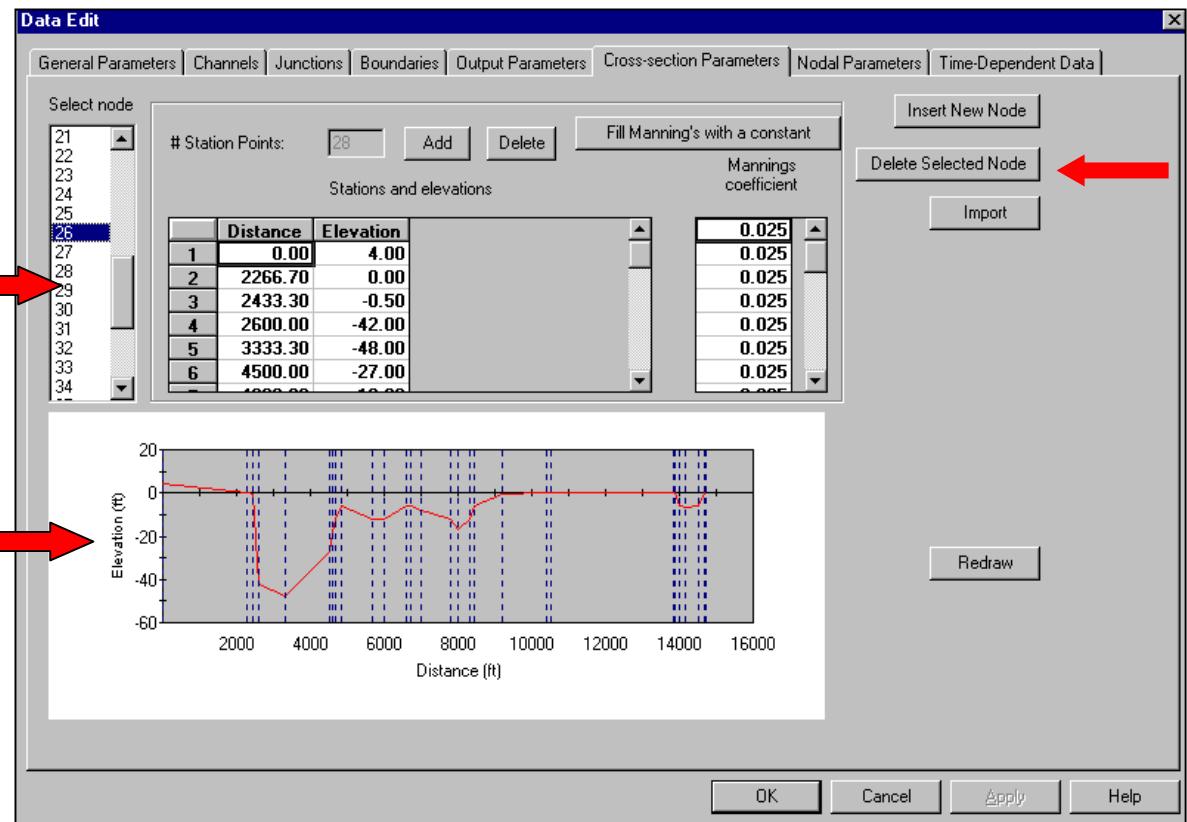


Prepare data on spread-sheet and import

Enter data directly

Plot below helps decision
on discretization for best
channel representation

Ability to insert / delete
nodes



Nodal Parameters



- Distance between nodes
- Lateral inflow rates
- Channel alignment angles
- Transition loss coefficients
- Initial discharge rates

Data Edit

General Parameters | Channels | Junctions | Boundaries | Output Parameters | Cross-section Parameters | Nodal Parameters | Time-Dependent Data

Node distances (ft)		Lateral inflow rates (ft^3/sec)		Channel alignment angles (deg)	
1	0.00	1	0.00	1	0.00
2	7333.00	2	0.00	2	0.00
3	16166.00	3	0.00	3	0.00
4	20433.00	4	0.00	4	0.00
5	25433.00	5	0.00	5	0.00
6	29933.00	6	0.00	6	0.00
7	34600.00	7	0.00	7	0.00

Transition loss coefficients Initial discharge (ft^3/sec)

Transition loss coefficients		Initial discharge (ft^3/sec)	
1	0.00	1	0.00
2	0.00	2	0.00
3	0.00	3	0.00
4	0.00	4	0.00
5	0.00	5	0.00
6	0.00	6	0.00
7	0.00	7	0.00

OK Cancel Apply Help



Time Dependent Data

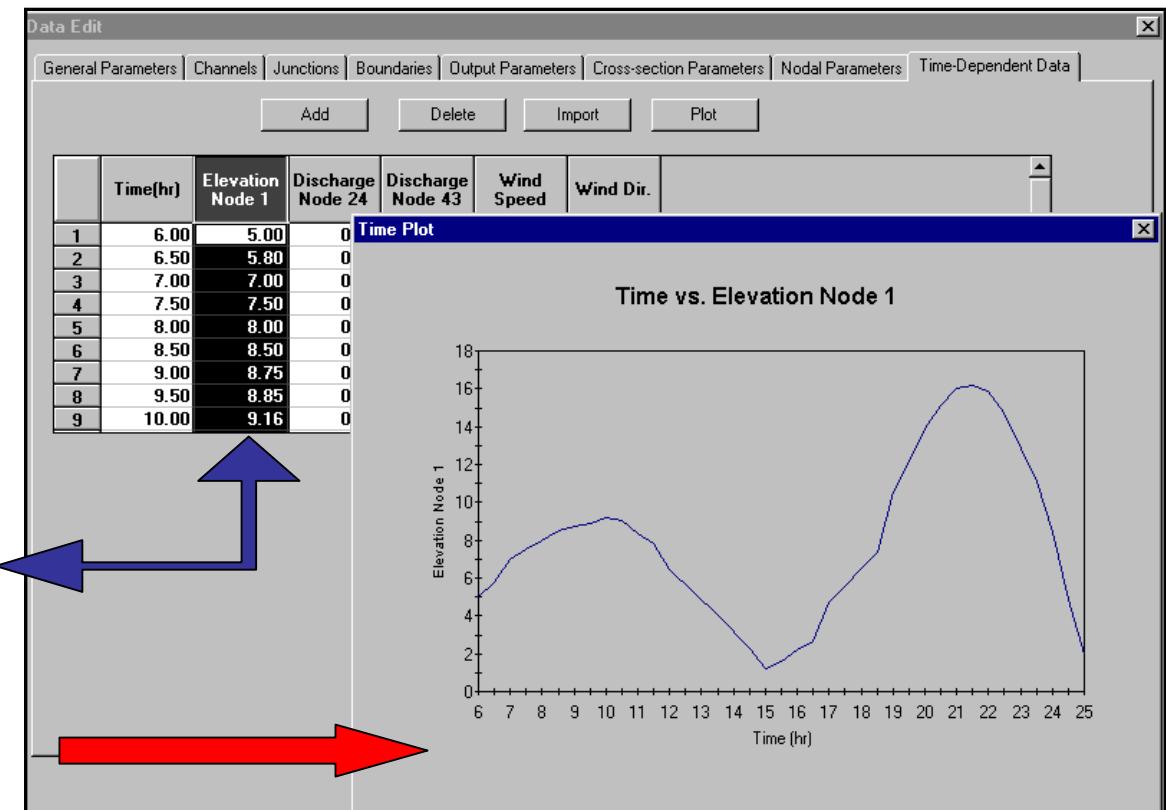
Depending on BC
selection:

Specify time series

for

- Elevation
- Discharge
- Wind Speed
- Wind Direction

Plot time series curve



Display Results

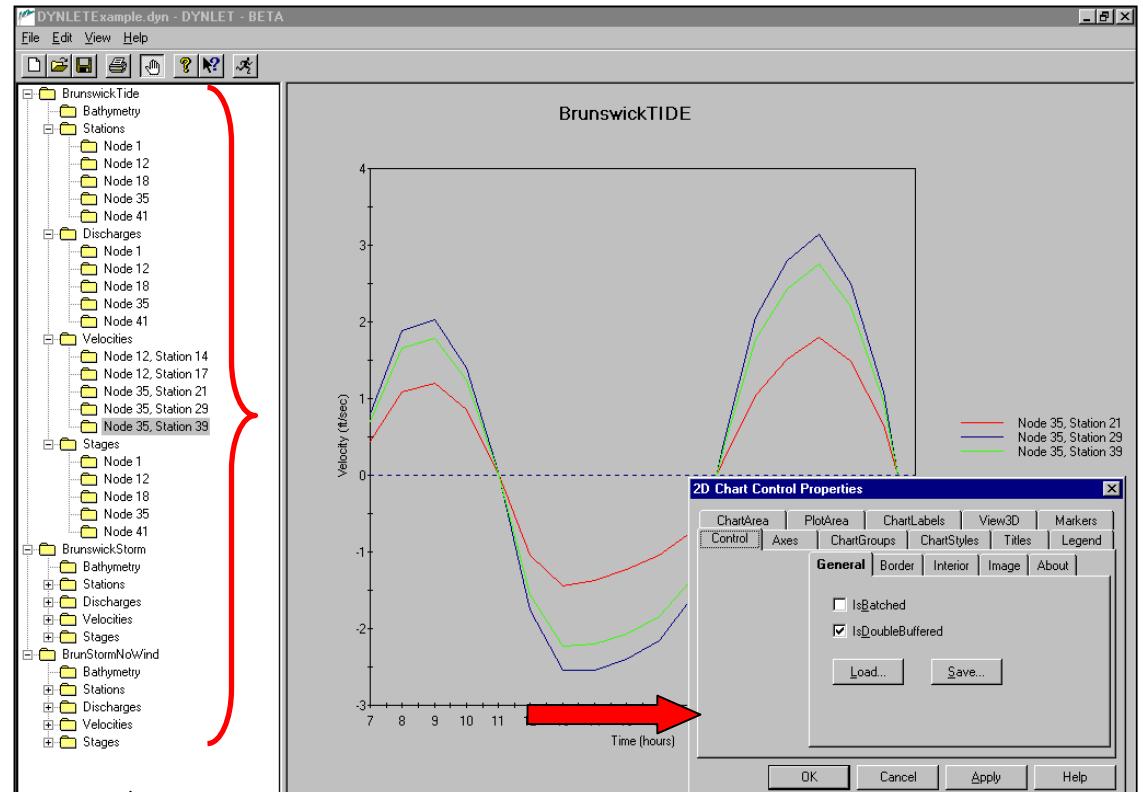
Expanding folders permits access

- Station
- Discharge
- Velocity
- Stage

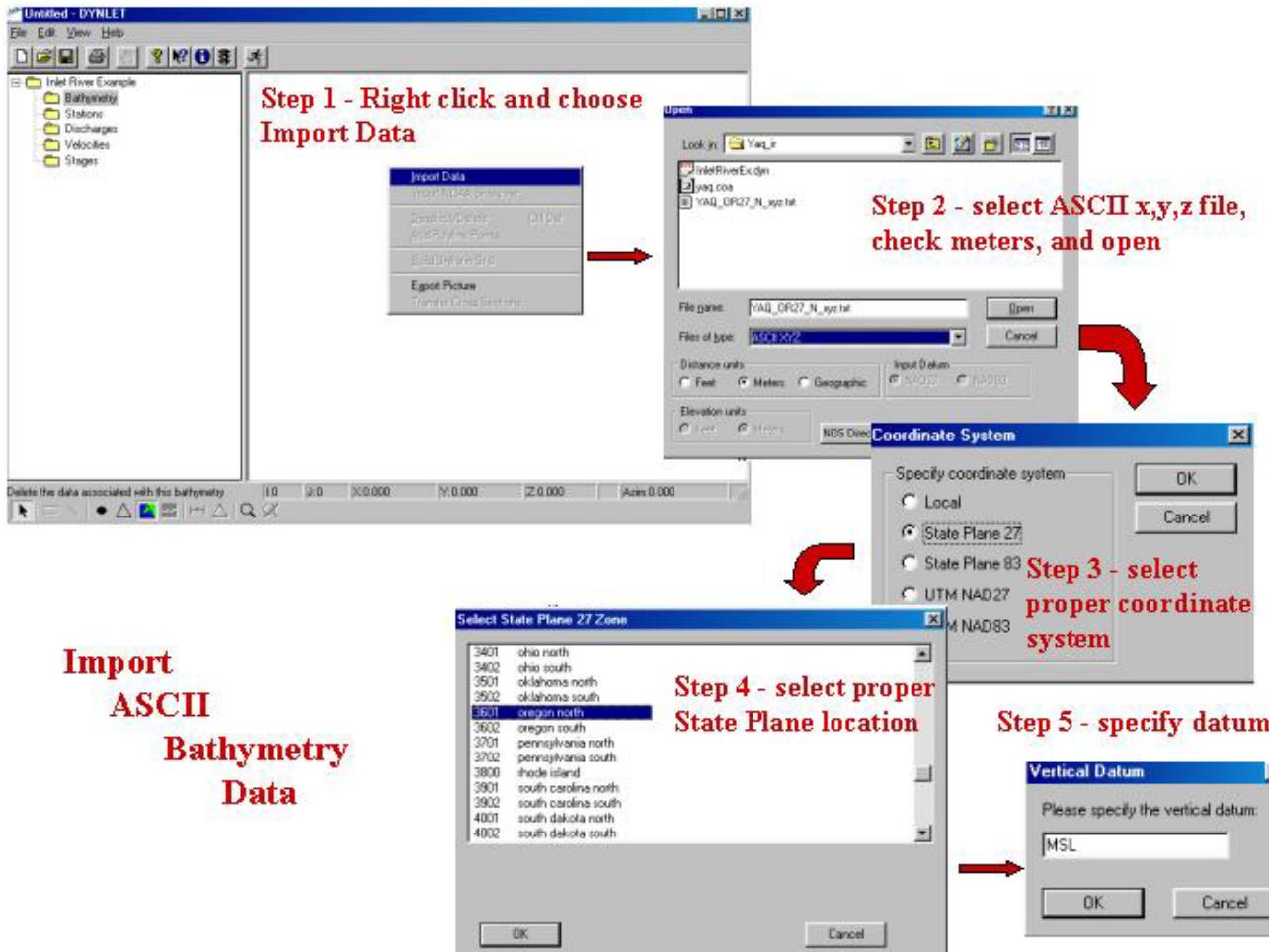
R
E
S
U
L
T
S

Hand Icon - holds plot for overlay

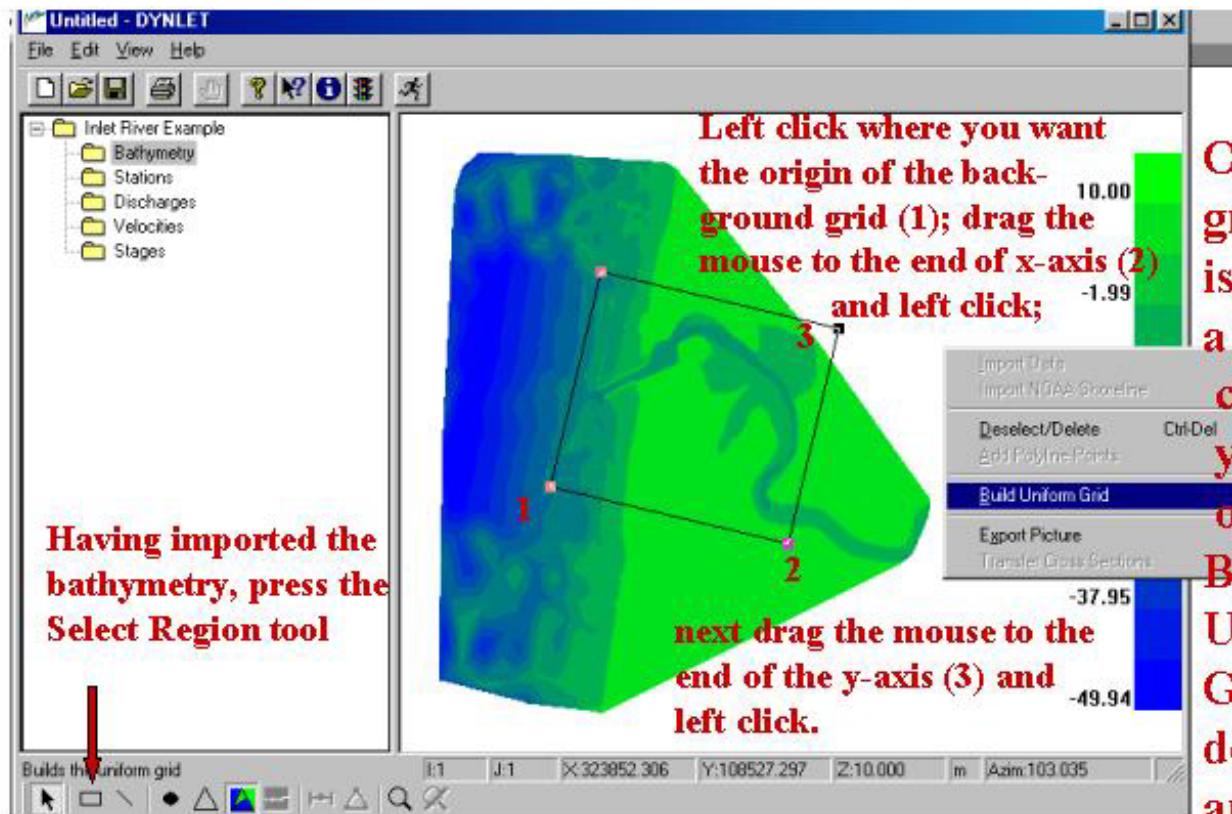
Control graphic properties



Automated Grid Generation



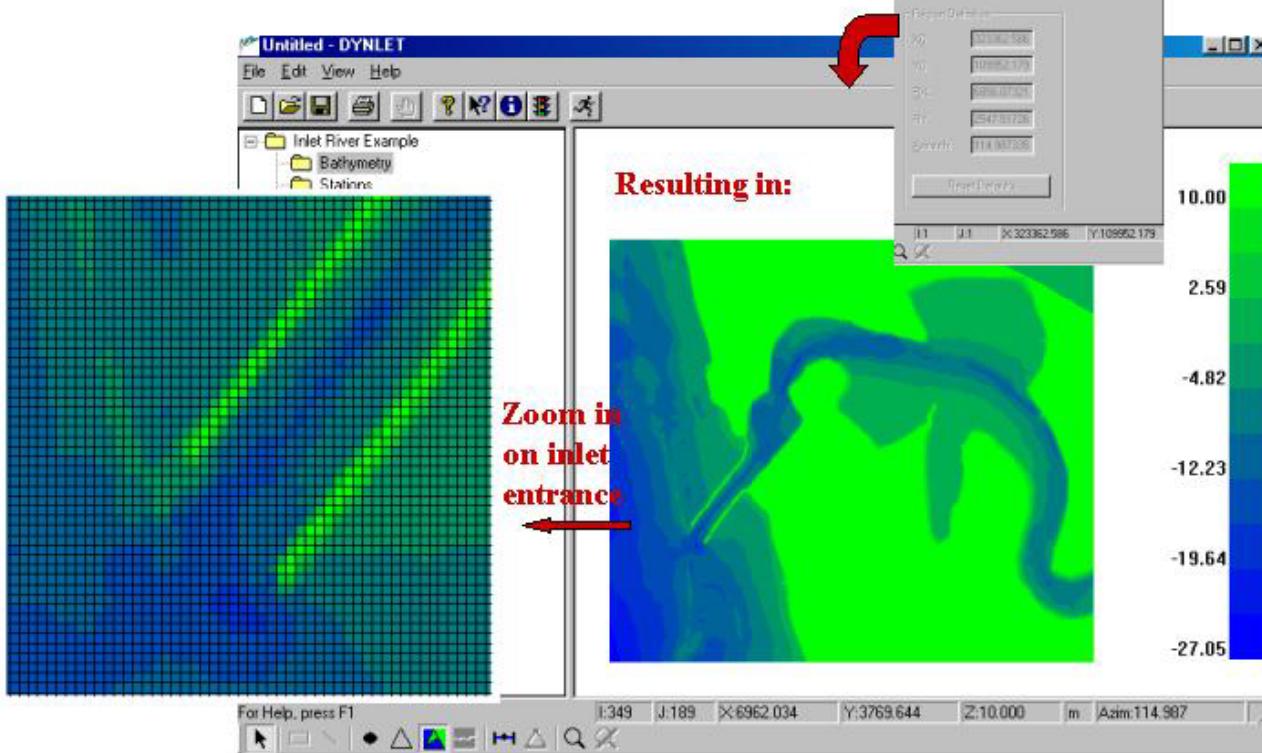
Background Grid



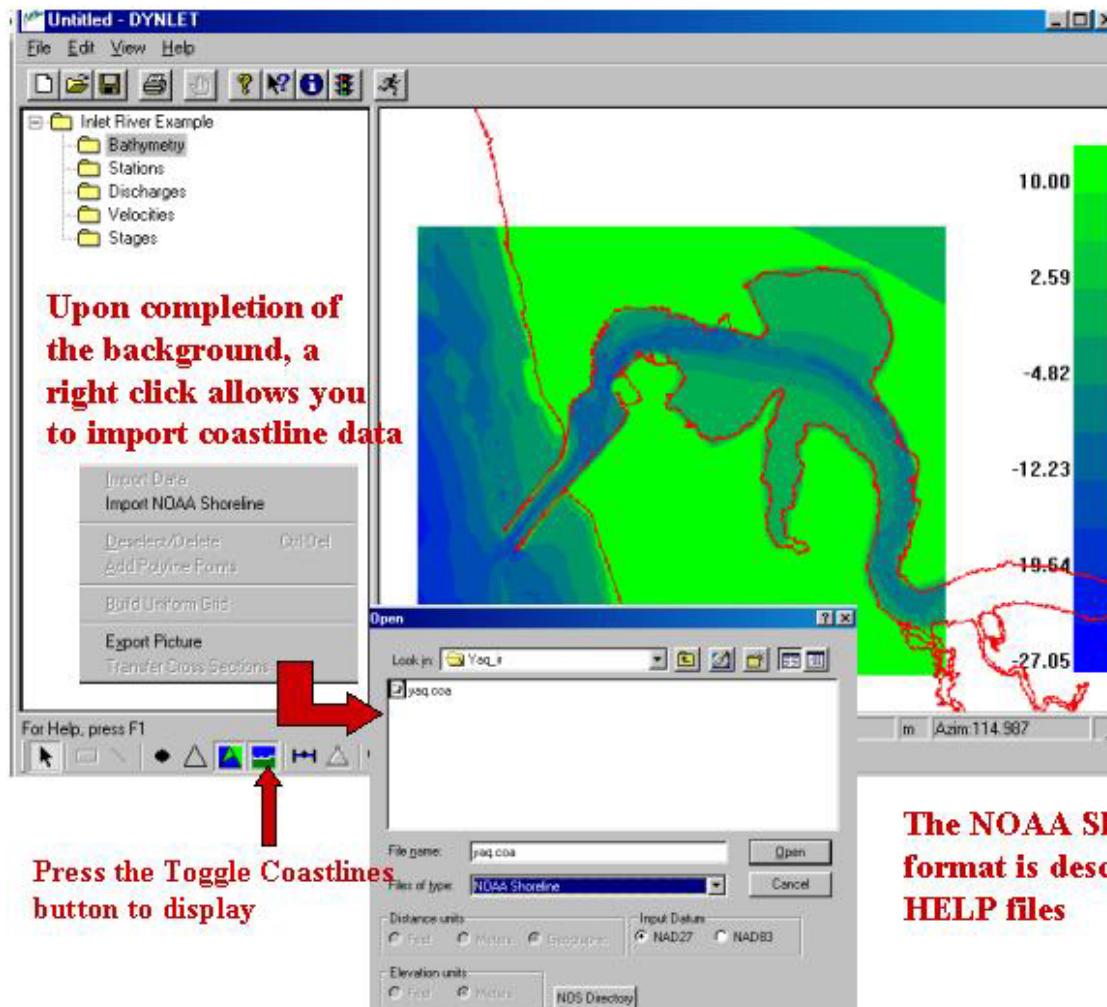
Background Grid

Background Grid

Build Uniform Grid dialog box permits specification of grid size



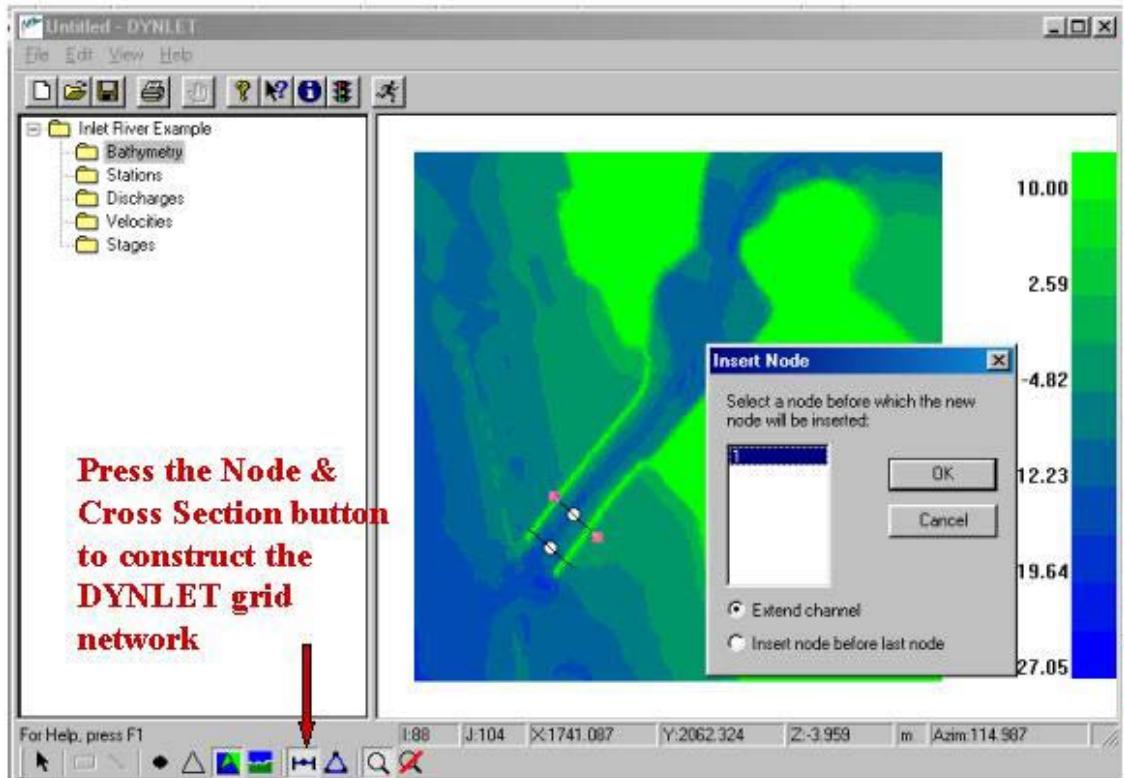
Shoreline Data



The NOAA Shoreline data format is described in the HELP files



Node / Cross sections



Press the Node & Cross Section button to construct the DYNLET grid network

You can always edit a grid to insert or delete nodes or adjust depth or friction values.

You can zoom on a region to make the node selection.

Zoom is a toggle switch - remember to deactivate zoom while you construct the node network.

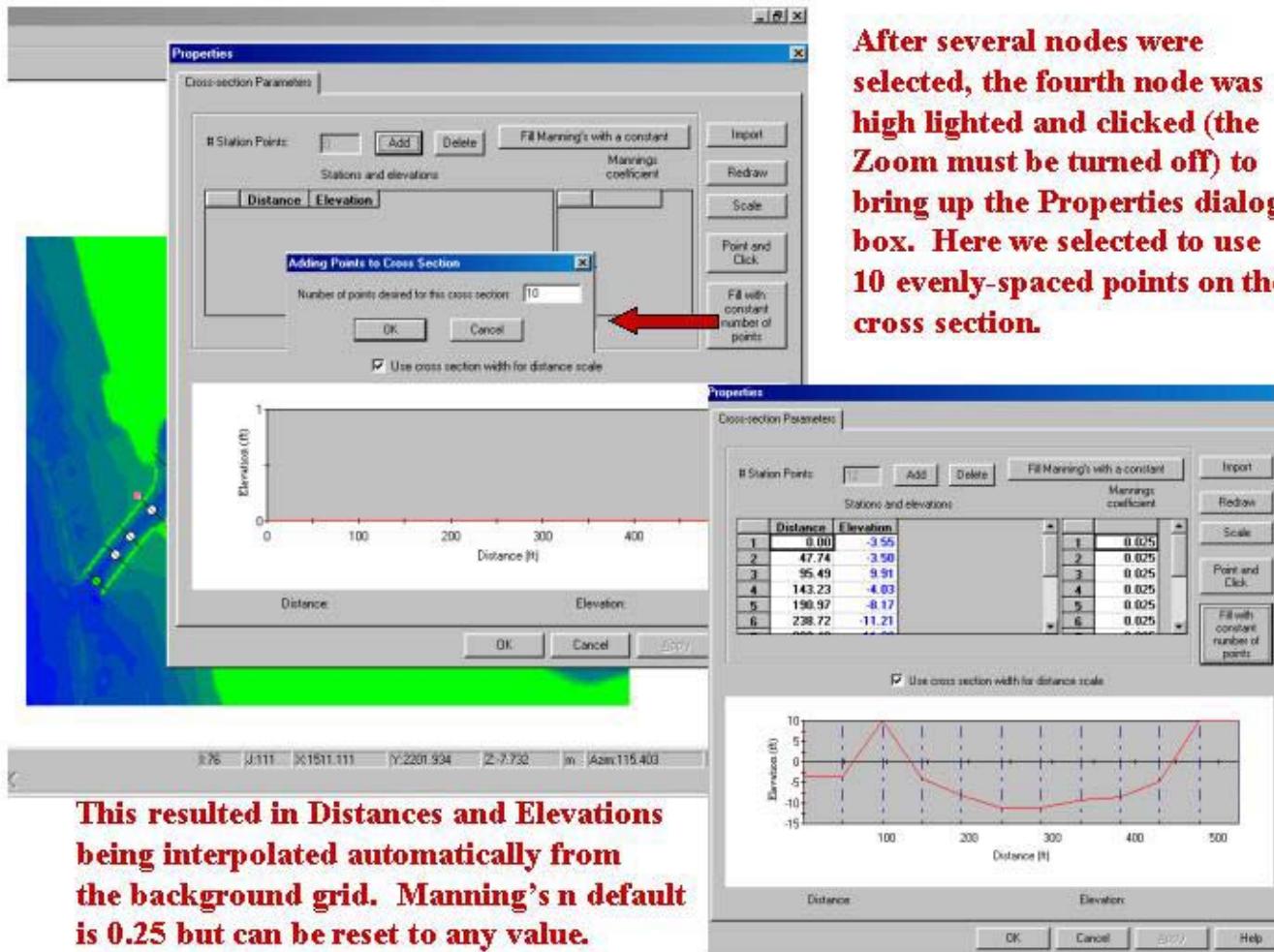
Nodes are left clicked, followed by dragging the mouse up and to the left to select one cross section endpoint and left click; then drag the mouse lower and to the right to left click the other endpoint. Proceed to the next node - you will be asked where you want to place the node.



Visualizing / Editing Grid

After several nodes were selected, the fourth node was highlighted and clicked (the Zoom must be turned off) to bring up the Properties dialog box. Here we selected to use 10 evenly-spaced points on the cross section.

This resulted in Distances and Elevations being interpolated automatically from the background grid. Manning's n default is 0.25 but can be reset to any value.



Distance [ft]	Elevation [ft]	Manning's coefficient
0.00	-3.55	0.025
47.74	3.50	0.025
95.49	9.91	0.025
143.23	-4.03	0.025
190.97	-8.17	0.025
238.72	-11.21	0.025
286.46	-14.25	0.025
334.20	-11.21	0.025
381.94	-4.03	0.025
429.69	9.91	0.025
477.43	3.50	0.025
525.17	-3.55	0.025

