

# SNL Water Power Program

## Building an SNL-EFDC Model

Jesse Roberts<sup>1</sup>, Scott James<sup>2</sup>, and Craig Jones<sup>3</sup>

<sup>1</sup>Sandia National Laboratories

<sup>2</sup>E<sup>x</sup>ponent Inc.

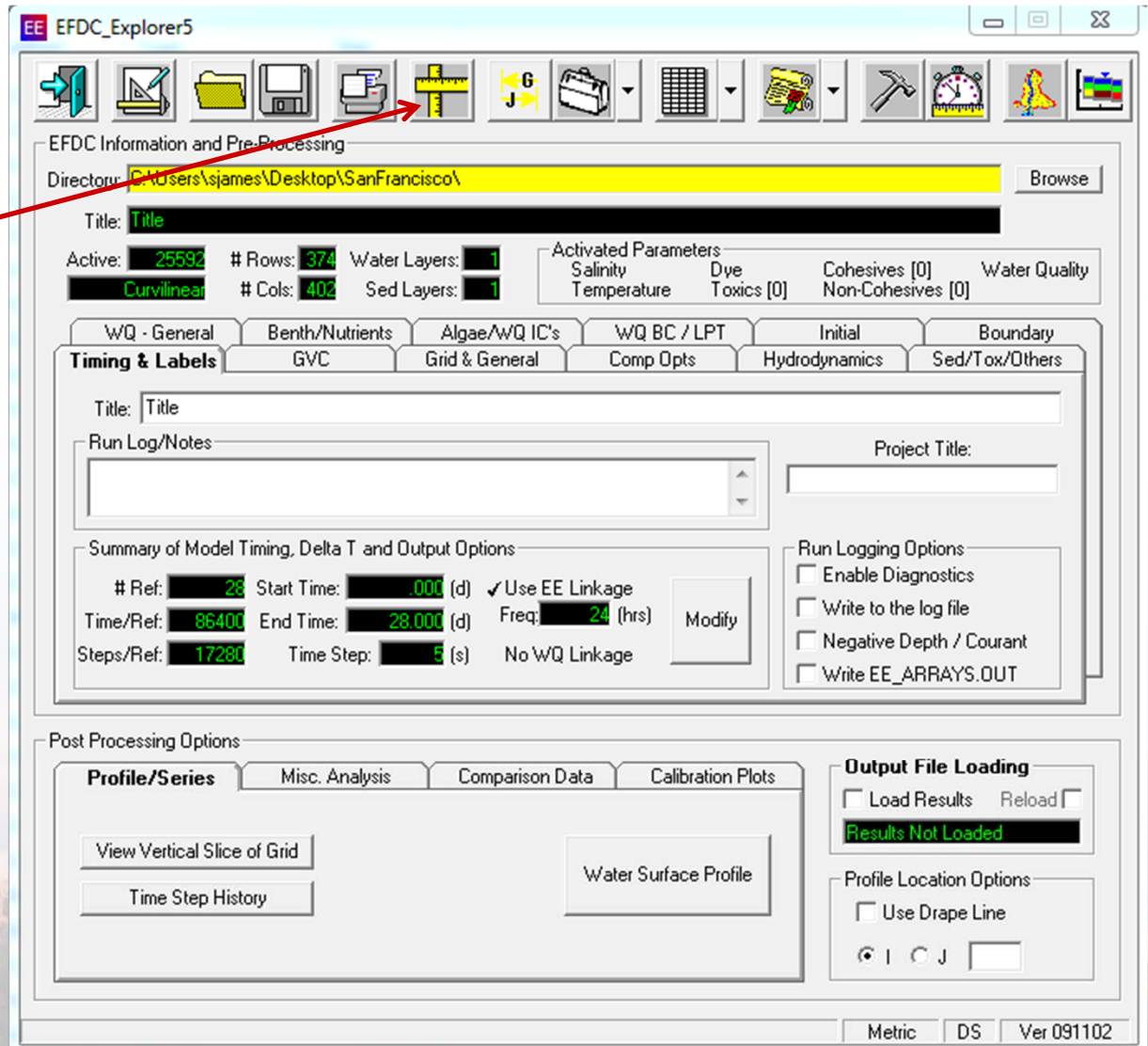
<sup>3</sup>Sea Engineering Inc.



Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

# Set Things Up

Click "Settings"



EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\sjames\Desktop\SanFrancisco\ Browse

Title: Title

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 1

Activated Parameters:  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others

Title: Title

Run Log/Notes

Project Title:

Summary of Model Timing, Delta T and Output Options

# Ref: 26 Start Time: .000 (d) Use EE Linkage  
Time/Ref: 86400 End Time: 28.000 (d) Freq: 24 (hrs) Modify  
Steps/Ref: 17280 Time Step: 5 (s) No WQ Linkage

Run Logging Options

☐ Enable Diagnostics  
☐ Write to the log file  
☐ Negative Depth / Courant  
☐ Write EE\_ARRAYS.OUT

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid

Time Step History

Water Surface Profile

Output File Loading

☐ Load Results Reload ☐  
Results Not Loaded

Profile Location Options

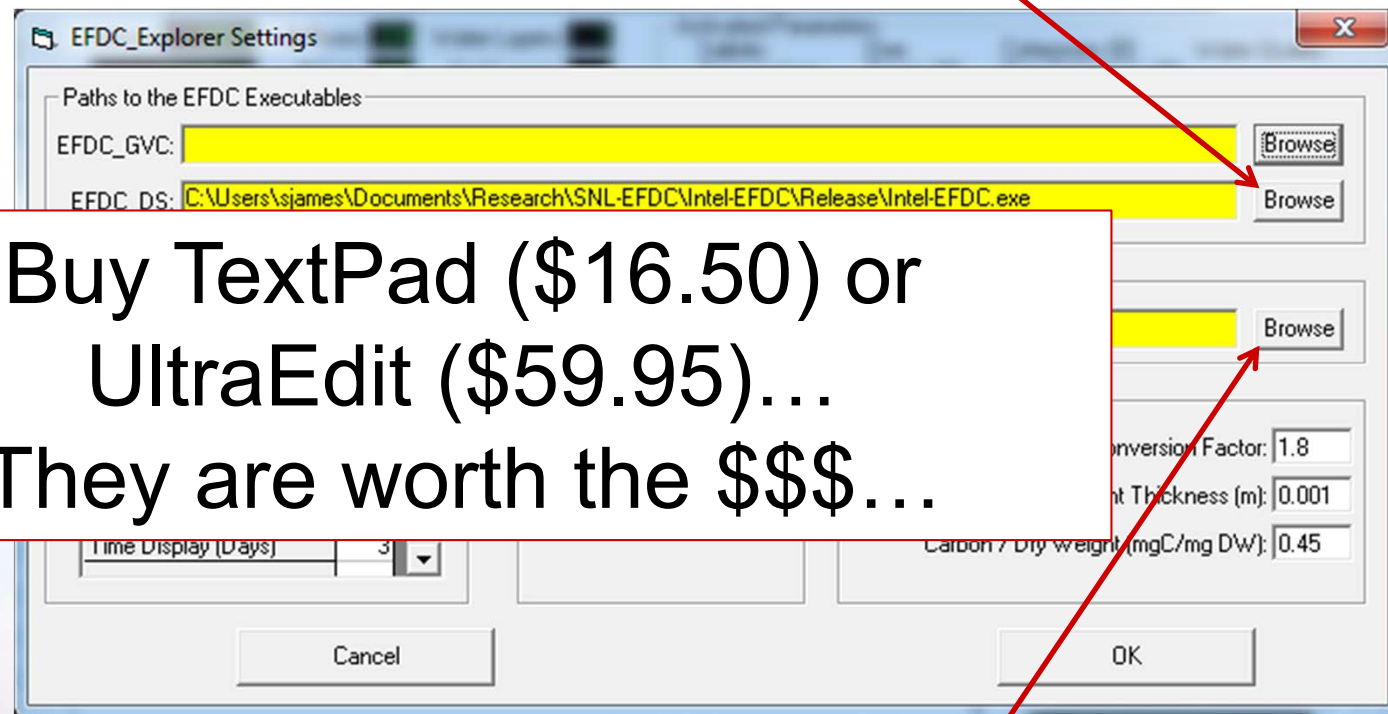
☐ Use Drape Line

Metric DS Ver 091102



# Select the Executable

Select the proper executable (e.g., Intel-EFDC.exe)



Buy TextPad (\$16.50) or  
UltraEdit (\$59.95)...  
They are worth the \$\$\$...

Select a "Text Editor" – like Notepad.exe



# Building a Grid (Using EE)

Click  
“Generate a New Model”

EFDC Explorer5

EFDC Information and Pre-Processing

Directory:  Browse

Title:

Active:  # Rows:  Water Layers:  # Cols:  Sed Layers:

Activated Parameters: Salinity, Dye, Cohesives (), Water Quality, Temperature, Toxics (), Non-Cohesives ()

WQ - General, Benth/Nutrients, Algae/WQ IC's, WQ BC / LPT, Initial, Boundary

**Timing & Labels** GVC, Grid & General, Comp Opts, Hydrodynamics, Sed/Tox/Others

Title: No Title

Run Log/Notes:

Project Title:

Summary of Model Timing, Delta T and Output Options

# Ref:  Start Time:  (d) Use EE Linkage  
Time/Ref:  End Time:  (d) Modify  
Steps/Ref:  Time Step:  (s) Wasp Linkage

Run Logging Options

☐ Enable Diagnostics  
☐ Write to the log file  
☐ Negative Depth / Courant  
☐ Write EE\_ARRAYS.OUT

Post Processing Options

**Profile/Series** Misc. Analysis, Comparison Data, Calibration Plots

View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

**Output File Loading**

☐ Load Results Reload ☐

Profile Location Options

☐ Use Drape Line

Metric DS Ver 091102





# Building a Grid (Using EE)

Select an appropriate  
efdc.inp template  
file

Look for the  
“SanFrancisco”  
folder in the  
“Models”  
directory

The screenshot shows the 'Generate EFDC Model' dialog box. A red arrow points from the text 'Select an appropriate efdc.inp template file' to the 'EFDC.INP Template File' field, which contains the path 'C:\Users\sjames\Desktop\SanFrancisco\efdc.inp'. This field and its 'Browse' button are circled in red. Another red arrow points from the text 'Look for the “SanFrancisco” folder in the “Models” directory' to the same path. The dialog box includes sections for 'Topographic Information File', 'Grid/Element Generation Options' (with 'Uniform Grid' selected), 'Grid Type' (with 'Curvilinear (EE)' selected), 'Roughness' (Channel: 0.02, FloodPlain: 0.04), 'Elevation Options' (with 'Average all Z's in Cell' selected), and 'Cell Test' (# Corners: 0). Buttons for 'Cancel', 'Keep Titles', and 'Generate' are at the bottom.

Generate EFDC Model

Upper Right  
Easting: [ ]  
Northing: [ ]

Lower Left  
Easting: [ ]  
Northing: [ ]

Grid Type  
☒ Cartesian  
☐ Curvilinear (EE)  
☐ Import Grid

Roughness  
Channel: 0.02  
FloodPlain: 0.04

Water Surface: 0  
# of Water Layers: 1

Topographic Information File  
[ ] Browse

EFDC.INP Template File  
C:\Users\sjames\Desktop\SanFrancisco\efdc.inp Browse

Grid/Element Generation Options  
☒ Uniform Grid  
☐ Expanding Grid  
Rotation Angle: 0

Uniform Grid  
Lower Left  
Easting: 0 Delta: 0 nX: 0  
Northing: 0 Delta: 0 nY: 0  
Upper Right  
Easting: 0  
Northing: 0

Active Cell Polygon: [ ] Browse

Channel Polygon: [ ] Browse

Elevation Options  
☒ Average all Z's in Cell  
☐ Use Minimum Z  
☐ Use Z at Cell Centroid  
☐ Flat Bottom  
☐ Bottom Slope - I Direction  
☐ Bottom Slope - J Direction

Cell Test  
# Corners  
0

Cancel Keep Titles ☐ Generate



# ***Building a Grid (Using EE)***

Select the  
shoreline data  
file

Generate EFDC Model

Upper Right  
Easting:   
Northing:

Lower Left  
Easting:   
Northing:

Grid Type  
☒ Cartesian  
☐ Curvilinear (EE)  
☐ Import Grid

Roughness  
Channel:   
FloodPlain:

Water Surface:   
# of Water Layers:

Topographic Information File  
  
Browse

EFDC.INP Template File  
  
Browse

Grid/Element Generation Options  
☒ Uniform Grid  
☐ Expanding Grid  
Rotation Angle:

Uniform Grid  
Lower Left  
Easting:   
Northing:   
Delta:   
nX:   
nY:   
Upper Right  
Easting:   
Northing:   
Set to Data  
Update

Active Cell Polygon:   
Channel Polygon:   
Browse

Elevation Options  
☒ Average all Z's in Cell  
☐ Use Minimum Z  
☐ Use Z at Cell Centroid  
☐ Flat Bottom  
☐ Bottom Slope - I Direction  
☐ Bottom Slope - J Direction

Cell Test  
# Corners

Cancel  
Keep Titles ☐  
Generate



## ***Building a Grid (Using EE)***

Click  
“Set to Data”

The screenshot shows the 'Generate EFDC Model' dialog box. A red box highlights the 'Set to Data' button in the 'Uniform Grid' section. A red arrow points from the text 'Click “Set to Data”' to this button. Another red box highlights the 'Active Cell Polygon' field, with a text box below it stating 'Then select the outline polygon data file (SFShoreLine.dx)'.

**Generate EFDC Model**

Upper Right  
Easting: [ ]  
Northing: [ ]

Lower Left  
Easting: [ ]  
Northing: [ ]

Grid Type  
☒ Cartesian  
☐ Curvilinear (EE)  
☐ Import Grid

Roughness: [ ]

Topographic Information File  
[ ] Browse

EFDC.INP Template File  
[C:\Users\sjames\Documents\Research\WaterPower\SNLEFDC-TrainingFiles\Models\SanFranci: ] Browse

Grid/Element Generation Options  
☒ Uniform Grid  
☐ Expanding Grid  
Rotation Angle: [0]

Uniform Grid  
Lower Left  
Easting: 527469.313  
Northing: 4142646.250  
Delta: [0] nX: [0] nY: [0]  
Upper Right  
Easting: 627093.500  
Northing: 4235369.000  
[Set to Data] [Update]

Active Cell Polygon: [ ] Browse

Elevation Options  
☒ Average all Z's in Cell  
☐ Use Minimum Z  
☐ Use Z at Cell Centroid  
☐ Flat Bottom  
☐ Bottom Slope - I Direction  
☐ Bottom Slope - J Direction

Water Surface: [0]  
# of Water Layers: [1]

Cell Test  
# Corners: [0]

Cancel [Keep Titles] Generate

SFShoreLine.dx

# Building a Grid (Using EE)

Generate EFDC Model

Upper Right  
Easting: 607470.813  
Northing: 4229897.500

Lower Left  
Easting: 533370.813  
Northing: 4142897.500

EFDC.INP Template File  
C:\Users\sames\Desktop\SanFrancisco\efdc.inp

Grid/Element Generation Options  
☒ Uniform Grid  
☐ Expanding Grid  
Rotation Angle: 0

Grid Type  
☒ Cartesian  
☐ Curvilinear (EE)  
☐ Import Grid

Lower Left  
Easting: 527469.313  
Northing: 4142646.250  
Delta: 250  
nX: 400  
nY: 370

Upper Right  
Easting: 627093.500  
Northing: 4235369.000

Active Cell Polygon: C:\Users\sames\Desktop\SanFrancisco\SFSshoreLine.dxf

Channel Polygon:

Elevation Options  
☒ Flat Bottom  
☐ Average all Z's in Cell  
☐ Use Minimum Z  
☐ Use Z at Cell Centroid  
☐ Bottom Slope - I Direction  
☐ Bottom Slope - J Direction

Bottom Elev (m): -10

Cell Test  
# Corners: 0

Water Surface: 0  
# of Water Layers: 1

Channel: 0.02  
Flood Plain: 0.04

Set to Data Update

Cancel Keep Titles Generate

Finished Reading X, Y & Z Data Points (n=122611)

Select grid-cell  
sizes and  
"Update"

Select a flat  
bottom and enter  
a value (-10 m)

Keep titles and  
generate





# Viewing the Grid (Using EE)

Note the 12 available tabs

Click  
"View Grid"

EE EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory:

Title:

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 0

Activated Parameters  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others

Title:

Run Log/Notes:

Project Title:

Summary of Model Timing, Delta T and Output Options

# Ref: 28 Start Time: .000 (d) ☒ Use EE Linkage  
Time/Ref: 86400 End Time: 28.000 (d) Freq: 24 (hrs)   
Steps/Ref: 17280 Time Step: 5 (s) ☐ No WQ Linkage

Run Logging Options  
☐ Enable Diagnostics  
☐ Write to the log file  
☐ Negative Depth / Courant  
☐ Write EE\_ARRAYS.OUT

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

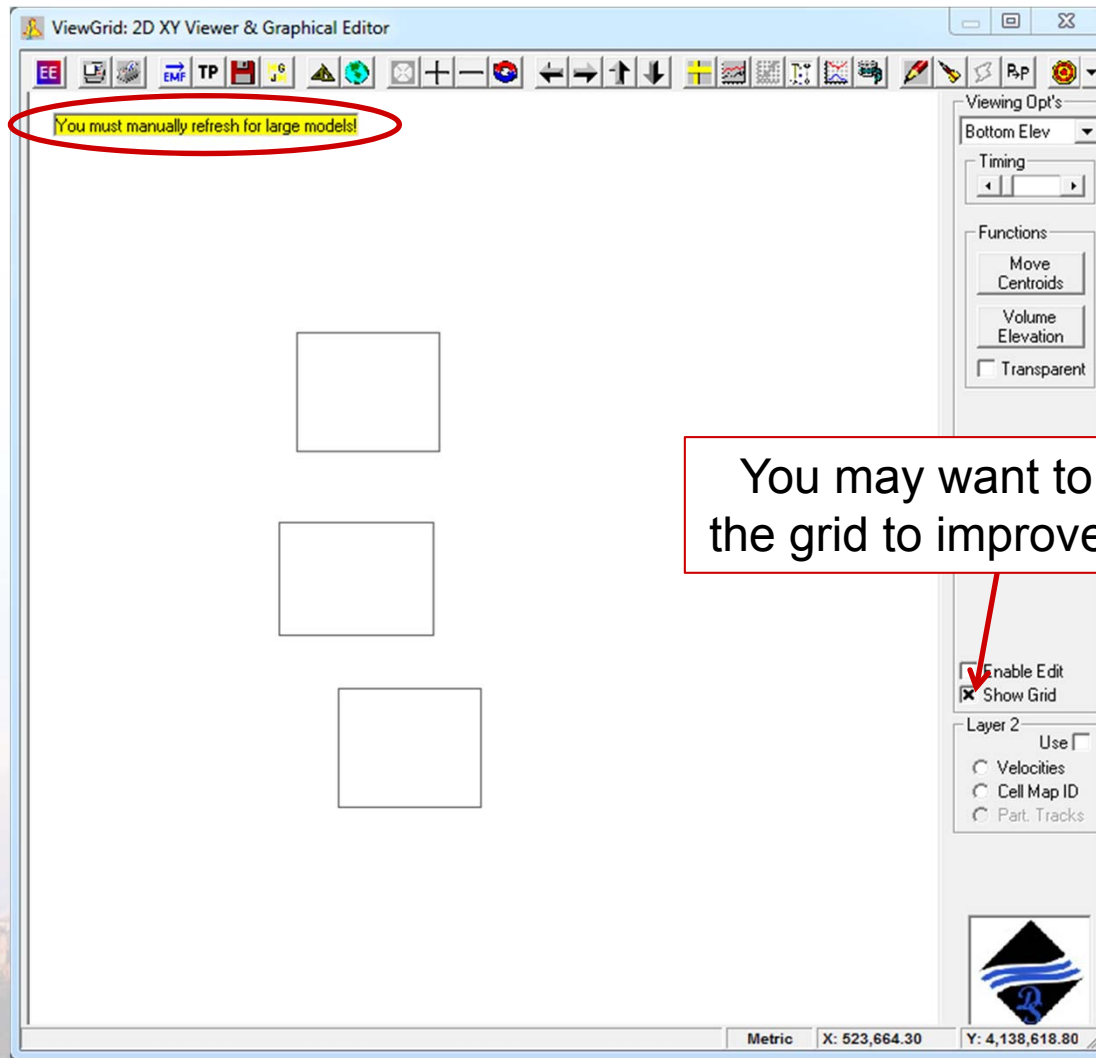
Output File Loading  
☐ Load Results   
Results Not Loaded

Profile Location Options  
☐ Use Drape Line  
☐ ☐ ☐

Metric DS Ver 091102



# Viewing the Grid (Using EE)

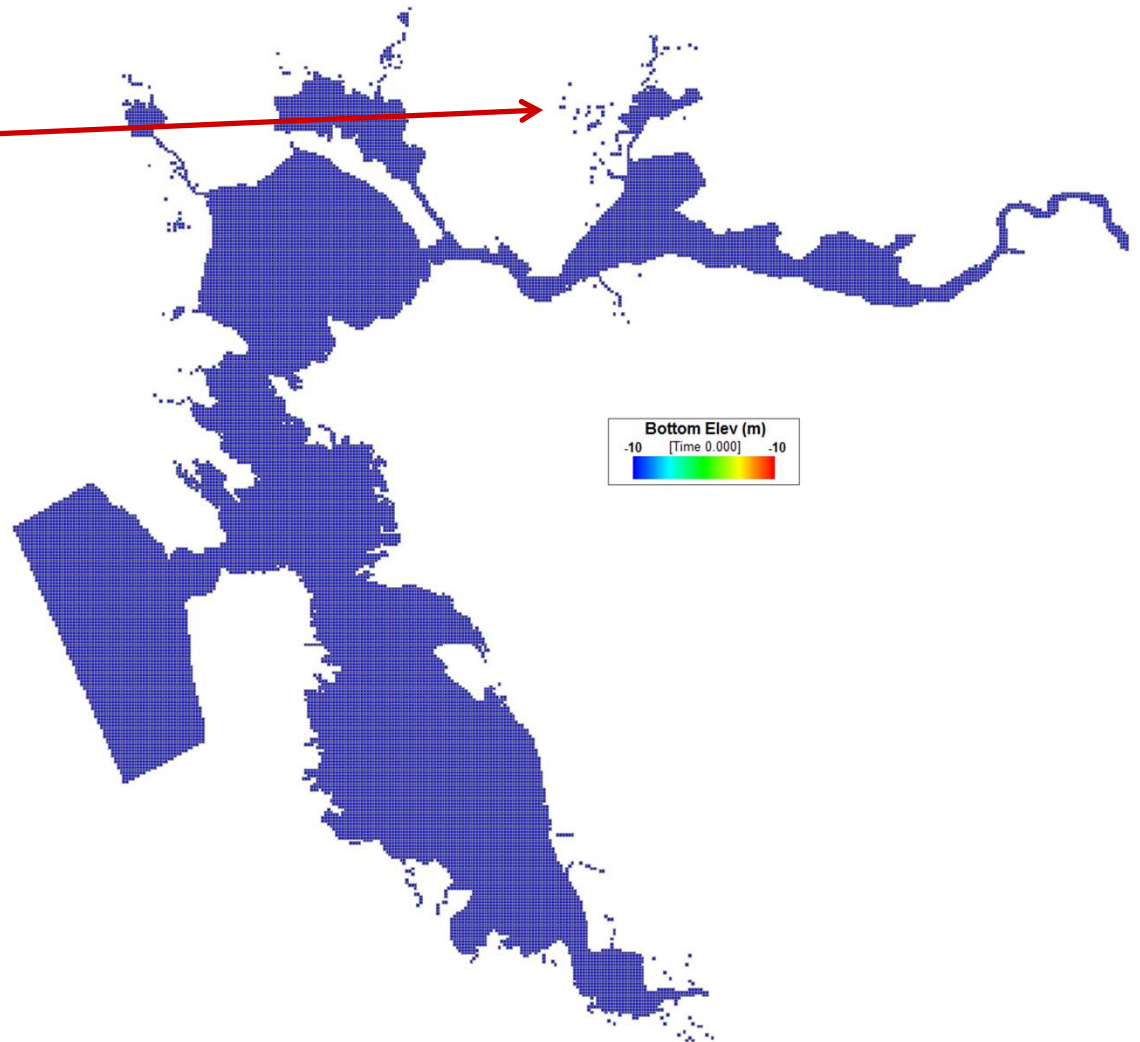


## *Viewing the Grid (Using EE)*

You can see some disconnected cells. These can be manually deleted by checking the “Enable Edit” button, right clicking each cell, and then clicking “Deactivate.”

We will not worry about this for now.

Instead, we will assign bathymetry data now.



# Adding Bathymetry (Using EE)

Switch to the  
“Initial” tab and  
then click on  
“Bottom  
Elevations”

The screenshot shows the EFDC\_Explorer5 software interface. The 'Initial' tab is selected, and the 'Bottom Elevations' button is highlighted with a red arrow. The interface includes a toolbar at the top, a directory field, and various parameter settings for water column and other parameters. The 'Bottom Elevations' button is located in the 'Set Initial Conditions - Other Parameters' section.

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: [Yellow Field] Browse

Title: Title

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 0

Activated Parameters  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others  
WQ - General Bath/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary

Set Initial Conditions - Water Column

Surface Elev [0] Toxics [ ] Use  
Salinity [NA] [ ] Use  
Temperature [20] [ ] Use  
Dye [NA] [ ] Use

Set Initial Conditions - Other Parameters

Bottom Elevations  
Sediment Bed: Solids  
Thermal Depth Bed Temp

EFDC Restart Option (Input)  
[ ] Use Option Set Files [ ] Dye Overwrite

Write Restart File  
[ ] Write File

EFDC IC Smoothing Options  
Smoothing Smoothing Not Used

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

Output File Loading  
[ ] Load Results Reload [ ]  
Results Not Loaded

Profile Location Options  
[ ] Use Drape Line  
[ ] [ ] [ ] [ ]

Metric DS Ver 091102





# Adding Bathymetry (Using EE)

Select the 100-m  
bathymetry data  
file

1. Interpolate Empty Cells
2. Nearest Neighbor Interpolation
3. Apply

Apply Cell Properties via Polygons for Bottom Elevation

Poly File:  Browse

Data File:  Browse

Modify Options

Adjustment Options

☐ Average all Z's in Cell ☐ Raise Only ☐ Lower Only ☒ Both

☐ Use Minimum Z ☒ Interpolate Empty Cells

☐ Clip Grid ☐ Flat Bottom

☐ Apply a Shift  ☐ Bottom Slope - I Direction

☒ Nearest Neighbor Interpolation ☐ Bottom Slope - J Direction

Inside Cell Test

☒ Centroid ☐ Corners #  ☐ Include Centroids





***Let's take a break...  
and let the computer work.***

Go back to "View Grid" when the  
bathymetry has been assigned.



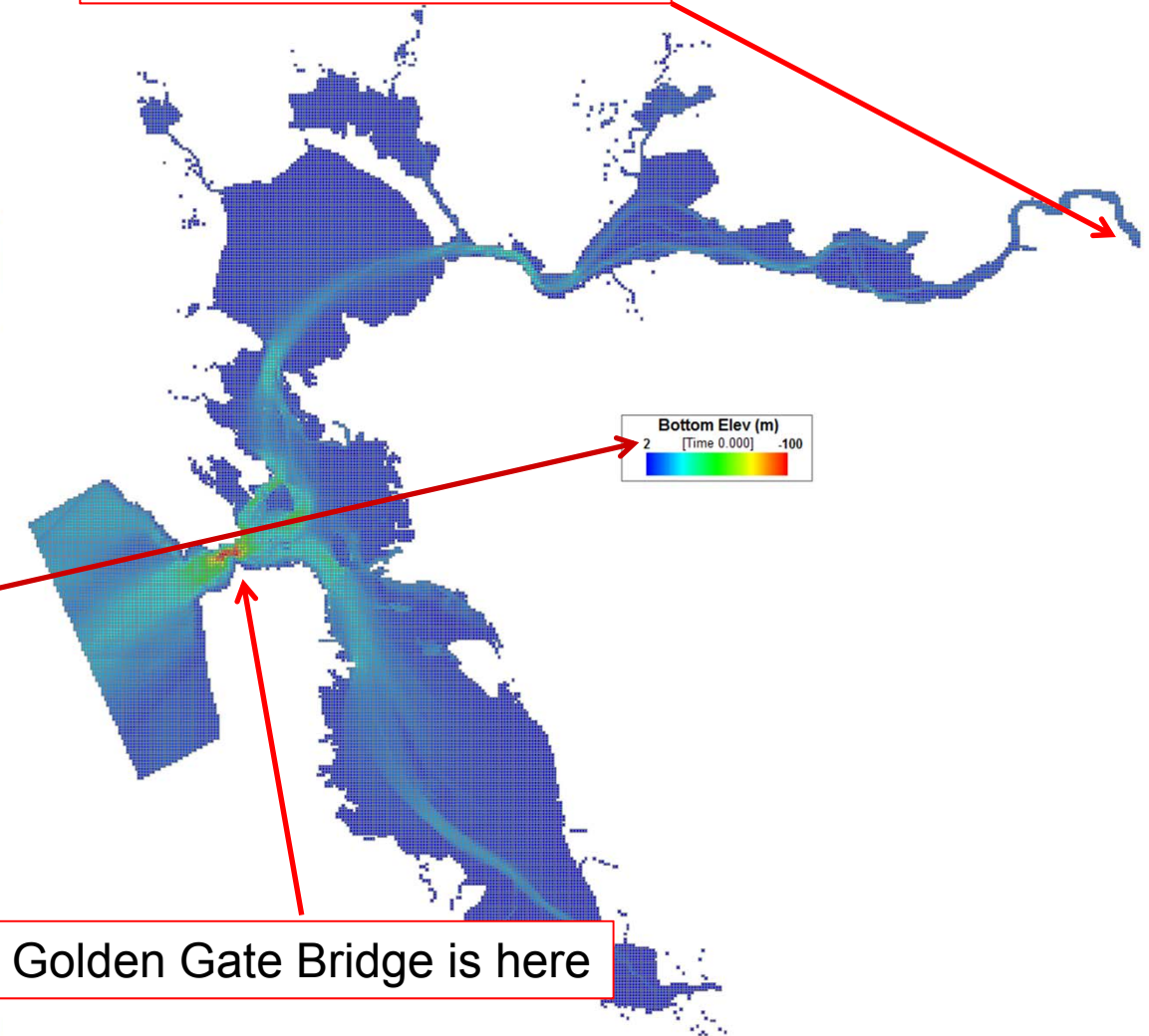
# ***What Did We Get?***

You will need to click the  
“Refresh View” button.

Select “Bottom Elev” from  
the “Viewing Opt’s” in the  
upper right corner.

I right-clicked on the  
legend and adjusted the  
“Color Ramp” in the lower  
right corner.

San Joaquin River is here



Golden Gate Bridge is here



# Assigning Initial Conditions

Click the "Initial" tab

Click "Surface Elev"

The screenshot displays the EFDC\_Explorer5 software interface. The 'Initial' tab is selected under the 'Hydrodynamics' category. The 'Set Initial Conditions - Water Column' section shows 'Surface Elev' set to 3.729, with 'Salinity', 'Temperature', and 'Dye' all set to 'NA'. The 'Set Initial Conditions - Other Parameters' section shows 'Bottom Elevations', 'Sediment Bed: Solids', 'Thermal Depth', and 'Bed Temp' all set to 'NA'. The 'EFDC Restart Option (Input)' section has 'Use Option' and 'Set Files' checked, and 'Dye Overwrite' unchecked. The 'Write Restart File' section has 'Write File' checked. The 'EFDC IC Smoothing Options' section has 'Smoothing' checked. The 'Post Processing Options' section has 'Profile/Series' selected, with 'View Vertical Slice of Grid' and 'Time Step History' buttons. The 'Output File Loading' section has 'Load Results' and 'Reload' buttons, and 'Results Not Loaded' is displayed. The 'Profile Location Options' section has 'Use Drape Line' checked. The status bar at the bottom shows 'Metric', 'DS', and 'Ver 091102'.

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: [Yellow Highlighted Field] Browse

Title: Title

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 6

Activated Parameters  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others  
WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary

Set Initial Conditions - Water Column

3.729 Surface Elev Toxics [NA] Use  
NA Salinity Use  
20 Temperature Use  
NA Dye Use  
NA Sediments Use

Set Initial Conditions - Other Parameters

Bottom Elevations  
Sediment Bed: Solids  
Thermal Depth Bed Temp

EFDC Restart Option (Input)

Use Option Set Files Dye Overwrite

Write Restart File

Write File

EFDC IC Smoothing Options

Smoothing Smoothing Not Used

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

Output File Loading

Load Results Reload  
Results Not Loaded

Profile Location Options

Use Drape Line

Metric DS Ver 091102





# Assigning Initial Conditions

Select “Use Constant.”  
Then enter the  
“Operator or Constant”  
(0 is fine).  
“Apply” this value.

Apply Cell Properties via Polygons: Water Surface Elevation

Poly File:  Browse

XYZ File:  Browse

Modify Options:

Set Initial Conditions:

☒ Use Constant

☐ Use Point Measurements/Gridded Data

Operator or Constant:

☐ Assign Depths Instead of Water Surface Elevations

Inside Cell Test:

☒ Centroid

☐ Corners #  ☐ Include Centroids

Apply

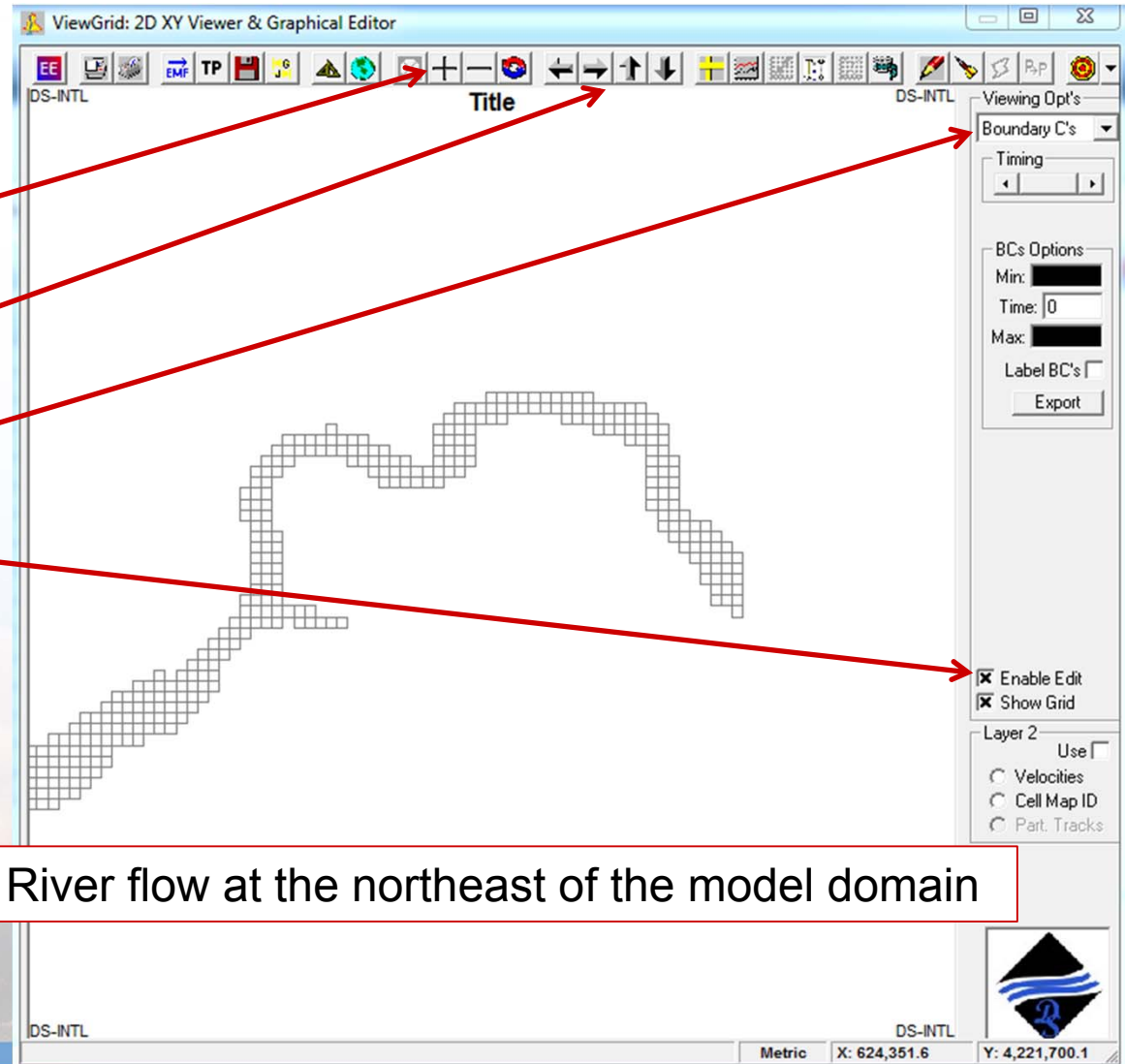
Done



# Assigning Boundary Conditions

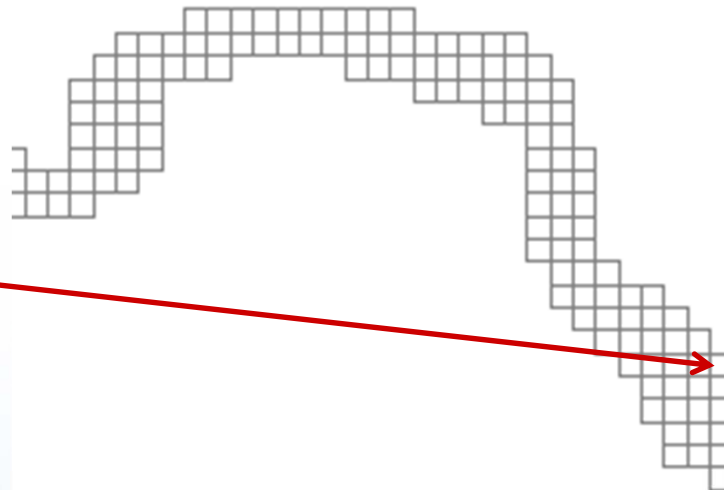
1. "Zoom in"
2. "Pan" appropriately
3. Select "Boundary C's" from "Viewing Opt's"
4. "Enable Edit"

San Joaquin River flow at the northeast of the model domain



# *Assigning Boundary Conditions*

1. Right-click this cell
2. Click "New"
3. Enter an appropriate name



## Boundary Conditions/Forcing Functions

Enter Boundary Group ID:

OK

Cancel

SanJoaquinRiver



# Assigning Boundary Conditions

1. Enter 1 for "Flow"
2. Then, just click "OK"  
(we will assign flows later)

Modify/Edit BC Properties

Boundary Condition Group Information

# BC Groups: 1      # of Time Series: 0      Current Group Type: Flow/Volume  
Cur Group: 1      Cur Group ID: SanJoaquinRiver

Boundary Condition Group

☒ Cell by Cell    ☐ Polygon

Cell by Cell

# Cells in Current Group: 1    Add    Remove  
I: 400    J: 290  
L: 21539    Bot Elev: 8.90156    Initial Depth: 10    Remove All

Flow Definition (Cell by Cell)

Flow Table: None    Edit    All  
Factor: 0    Dist Factors    All  
Constant Flow: 0    Distr Q

Flow Parameters for Entire Boundary Group

Apply Flow Files

Flow Multiplier Switch

Type: Normal Inflow/Outflow (L\*L\*L/T)

Constant Concentrations

Constituent	Conc
Salinity (ppt)	0
Temperature (°C)	0
Dye (mg/l)	0
	0

☒ Bottom    ☐ Surface

Concentration Tables (Time Variable)

Salinity: 0	E	Toxics: 0	E
Temperature: 0	E	Cohesives: 0	E
Dye: 0	E	Non-Cohesives: 0	E
Shell Fish: 0	E	Water Quality: 0	E

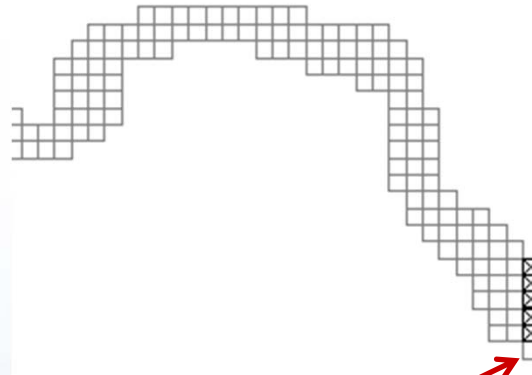
Cancel    OK





# *Assigning Boundary Conditions*

Right-click consecutive  
adjoining cells and  
“Add to Adjacent”



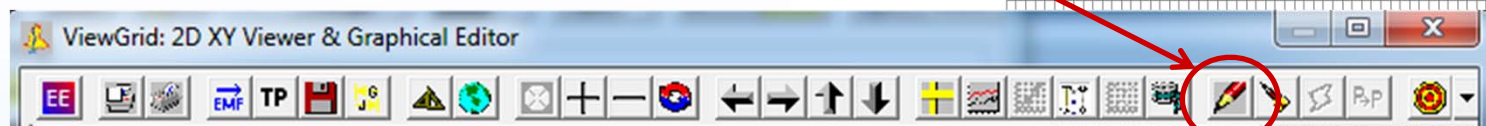
Why do we not assign this cell?



Sandia National Laboratories

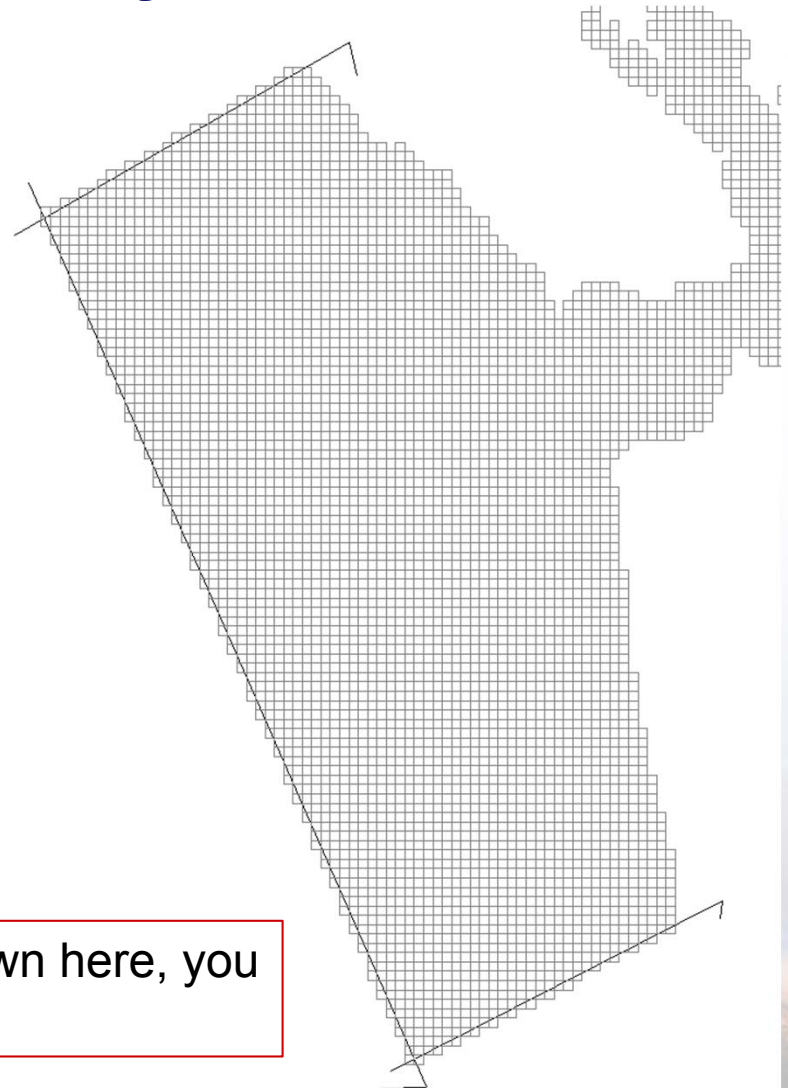
# *Assigning Boundary Conditions*

We will assign the numerous open-ocean boundary cells using the “Active Polyline Tools.” Click it (after zooming in on the open-ocean region).



# Assigning Boundary Conditions

1. First click “Cancel” as we will be creating three polylines (and not opening one).
2. Carefully follow the directions in the yellow box to create a polyline that intersect one of the three boundary edges (north, west, or south).
3. Enter “StringID” (name).
4. Unclick “Active Polyline Tools”
5. Enter a file name to save the file.
6. Do this three times (once for each boundary).
7. Exit the Grid Viewer.



All three of my polylines are shown here, you will do one at a time.



# Assigning Boundary Conditions

Switch to the  
“Boundary” tab

Click “Edit/Review”

The screenshot displays the EFDC\_Explorer5 software interface. The 'Boundary' tab is selected under the 'Sed/Tox/Others' category. The interface includes a toolbar at the top, a directory field, and various configuration options for parameters like Flow, Temperature, and Salinity. The 'Edit/Review' button is highlighted with a red arrow. The 'Post Processing Options' section at the bottom includes buttons for 'View Vertical Slice of Grid' and 'Time Step History'. The 'Output File Loading' section shows 'Results Not Loaded'.

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: [Yellow Highlighted Field] Browse

Title: [Black Field]

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 0

Activated Parameters:  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others  
WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial **Boundary**

Edit/Review View Loadings Wind Data Atmospheric Data Groundwater  
Import HSPF Check Sheltering Shade Factors  
Series Weighting Series Weighting

Number of Input Tables and Series

Flow: 0 E	Temperature: 0 E	Cohesives: 0 E	WD/Return: 0 E
Struct: 0 E	Salinity: 0 E	Non-Cohesives: 0 E	Jet: 0 E
Dye: 0 E	Pressure: 0 E	Toxics: 0 E	
Winds: 0 E	Harmonics: 0 E	Water Quality: 0 E	Atmospheric: 0 E

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid Water Surface Profile  
Time Step History

Output File Loading

☐ Load Results Reload ☐  
Results Not Loaded

Profile Location Options

☐ Use Drape Line

Metric DS Ver 091102





# San Joaquin River Steady Flow

Click "Edit"

Boundary Condition Definitions/Groups

Number of Boundary Groups:

Flow:  Structure:   
With/Ret:  Jet:

North:   
West:  East:   
South:

Batch Define

San Joaquin River

Current BC Information:

Boundary Type: **Flow**  
# Cells:   
1st Cell's Flow Table:   
Begin:   
End:   
Edit

Salinity:   
Temperature:   
Dye:   
Cohesives:   
Non-Cohes:   
Toxics:   
Water Quality:

☒ Sort Boundary Condition by ID

OK



Sandia National Laboratories

# San Joaquin River Steady Flow

Click "Distr Q" and enter a flow rate.  
I used 180 m<sup>3</sup>/s (cms).

You can click here to  
see the flow applied to  
each of the five  
boundary cells.  
Why are they different?

Click OK

Modify/Edit BC Properties

Boundary Condition Group Information

# BC Groups: 1 # of Time Series: 0 Current Group Type: Flow/Volume  
Cur Group: 1 Cur Group ID: SanJoaquinRiver

Boundary Condition Group

☒ Cell by Cell ☐ Polygon

Cell by Cell

# Cells in Current Group: 5 Add Remove Remove All

I: 400 J: 290

L: 21539 Bot Elev: 8.90156 Initial Depth: 8.901568

Flow Definition (Cell by Cell)

Flow Table: None Edit All

Factor: 0 Dist Factors All

Constant Flow: 47.7793 Distr Q

Flow Parameters for Entire Boundary Group

Apply Flow Files

Constant Concentrations

Constituent	Conc
Salinity (ppt)	0
Temperature (°C)	0
Dye (mg/l)	0
	0

☒ Bottom ☐ Surface

Flow Multiplier Switch

Type: Normal Inflow/Outflow (L\*L\*L/T)

Concentration Tables (Time Variable)

Salinity: 0 E	Toxics: 0 E
Temperature: 0 E	Cohesives: 0 E
Dye: 0 E	Non-Cohesives: 0 E
Shell Fish: 0 E	Water Quality: 0 E

Cancel OK



# Open Ocean Heads

Click the Insert button on your keyboard  
(after mouse clicking in the white space).  
Enter a name for the Open Ocean Boundary.  
Click "OK"

Boundary Condition Definitions/Groups

Number of Boundary Groups

Flow: 1 Structure: 0 North: 0  
With/Ret: 0 Jet: 0 West: 0 East: 0 South: 0 Batch Define

SanJoaquinRiver

Current BC Information

Boundary Type: Flow  
# Cells: 5  
1st Cell's Flow Table  
None  
Begin: N/A  
End: N/A Edit

Salinity: Not Used  
Temperature: Not Used  
Dye: Not Used  
Cohesives: Not Used  
Non-Cohes: Not Used  
Toxics: Not Used  
Water Quality: Not Used

OK

☒ Sort Boundary Condition by ID

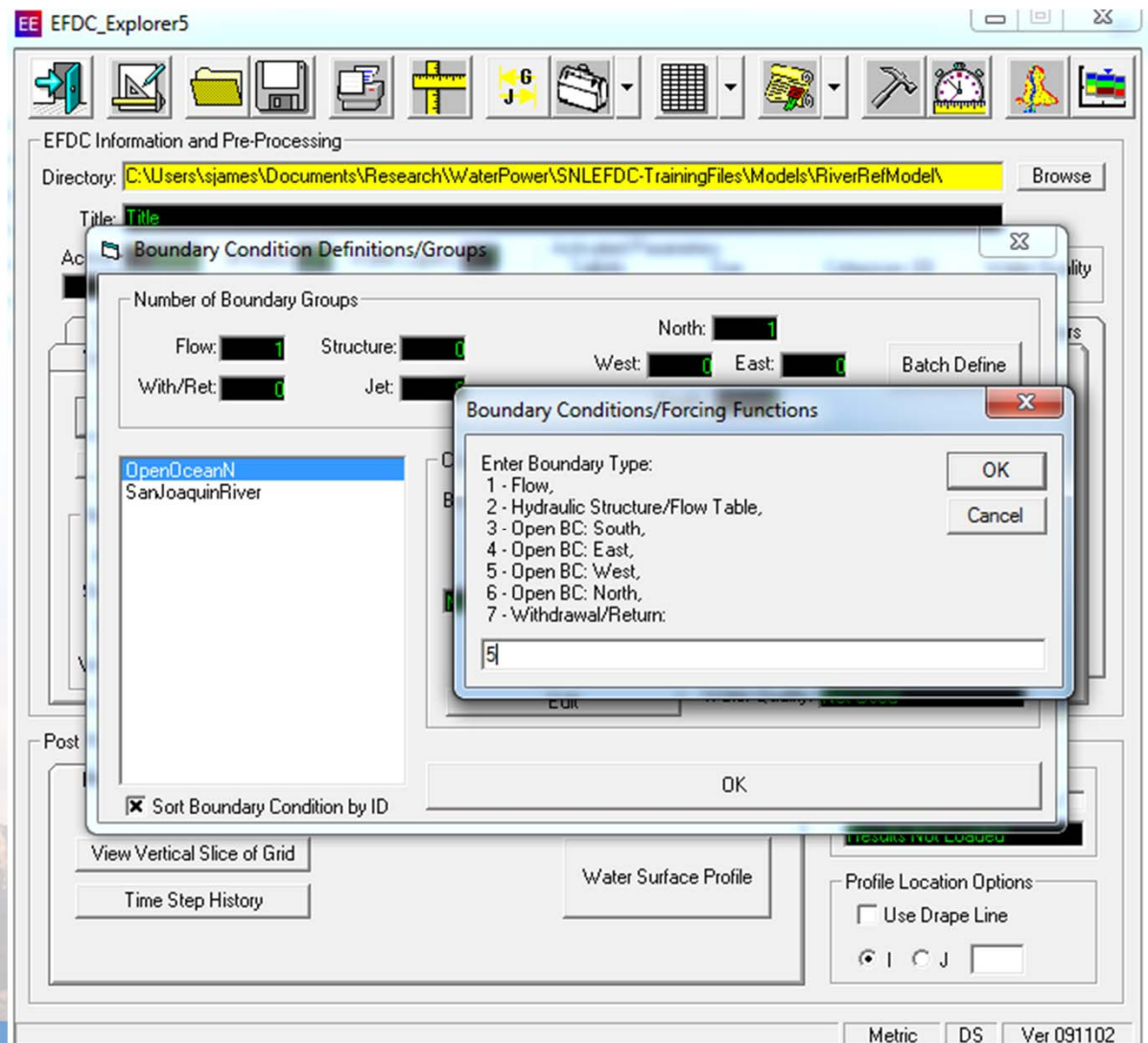


# Open Ocean Heads

Enter (the appropriate)  
Boundary Type:

“Open BC:” on the

- “South” - 3
- “West” - 5
- “North” - 6





# Open Ocean Heads

Assign the  
“Boundary Condition Group”  
by “Polygon”

Select the appropriate  
“Polygon/Polyline Definition File”  
and “Apply”

Make sure this agrees...

Assign a “Harmonic” series

**Boundary Condition Group Information**

# BC Groups: 3    # of Time Series: 0    Current Group Type: Open Boundary/Pressure  
Cur Group: 3    # of Harmonic Series: 1    Cur Group ID: OpenOceanE

**Boundary Condition Group**

☐ Cell by Cell    ☒ Polygon

Polygon/Polyline Based

i:    j:    L: 13339    # Cells: 93

Polygon/Polyline Definition File:    Apply    Browse

[C:\Users\s\james\Desktop\SanFrancisco\OpenOceanW...]

**Head Table or Periodic Function**

Pressure: None    E    Set All  
Harmonic: None    E  
Series 2: None    E  
Tangential Factor: 0    Set

**Head Parameters for Entire Boundary Group**

☒ West    ☐ North    ☐ East  
☐ South

**Constant Concentrations**

Constituent	Conc
Salinity (ppt)	0
Temperature (°C)	0
Dye (mg/l)	0
	0

☒ Bottom    ☐ Surface

**Open Boundary Forcing Type**

Type: Elevation Specified

**Interpolated Series**

Build    Reset

**Change To Inflow From Outflow**

# Time Steps for Smooth Transition: 0

**Concentration Tables (Time Variable)**

Salinity: 0    E	Toxics: 0    E
Temperature: 0    E	Cohesives: 0    E
Dye: 0    E	Non-Cohesives: 0    E
Shell Fish: 0    E	Water Quality: 0    E

Cancel    OK



# Open Ocean Heads

- First, enter the "Number of Series" (1 - Enter)
- Second, click the "Current Series" to 1
- Third, enter "Symbol" and "Title" (M2)
- Fourth, enter the "Period" (44712, which is 12.42 hr)
- Fifth, enter the "Amplitude" (1)
- Sixth, "View" the results
- Seventh, click "OK"

The screenshot shows the 'Harmonic Tidal Boundary Series' dialog box. Red arrows from the instructions point to the following elements:

- 'Number of Series' (set to 1)
- 'Current Series' (set to 1)
- 'Symbol' (set to M2)
- 'Title' (set to M2)
- 'Period (s)' (set to 44712)
- 'Amplitude (m)' (set to 1)
- 'View' button (circled in red)

The dialog box contains the following sections:

- Forcing Type:** ☒ Constant, ☐ Linear Variation, ☐ Quadratic Variation
- Tides:** A table with columns 'Symbol' and 'Period (s)'. Row 1 contains 'M2' and '44712'.
- Composite Forcing Series:** A section with 'Current Series' (1), 'Number of Series' (1), and 'Title' (M2).
- Results Table:** A table with columns 'Symbol', 'Amplitude (m)', and 'Phase (sec)'. Row 1 contains 'M2', '1', and '0'.

Buttons at the bottom: Cancel, OK.



# Open Ocean Heads

Select the “M2” Harmonic data

“Set All” of the cells in this group to this boundary condition.

Click “OK”

Modify/Edit BC Properties

Boundary Condition Group Information

# BC Groups: 4 # of Time Series: 0 Current Group Type: Open Boundary/Pressure  
Cur Group: 3 # of Harmonic Series: 1 Cur Group ID: OpenOceanW

Boundary Condition Group

☐ Cell by Cell ☒ Polygon

Polygon/Polyline Based

i: 3 j: 186 L: 13339 # Cells: 93

Polygon/Polyline Definition File: Apply Browse  
C:\Users\sames\Desktop\SanFrancisco\OpenOceanW

Head Table or Periodic Function

Pressure: None E  
Harmonic: M2 E Set All  
Series 2: None E  
Tangential Factor: 0 Set

Head Parameters for Entire Boundary Group

☒ West ☐ North ☐ East  
☐ South

Constant Concentrations

Constituent	Conc
Salinity (ppt)	0
Temperature (°C)	0
Dye (mg/l)	0
	0

☒ Bottom ☐ Surface

Open Boundary Forcing Type

Type: Elevation Specified

Interpolated Series

Build Reset

Change To Inflow From Outflow

# Time Steps for Smooth Transition: 0

Concentration Tables (Time Variable)

Salinity: 0 E	Toxics: 0 E
Temperature: 0 E	Cohesives: 0 E
Dye: 0 E	Non-Cohesives: 0 E
Shell Fish: 0 E	Water Quality: 0 E

Cancel OK





# *Open Ocean Heads*

1. Repeat the same steps twice more to assign the remaining of the north, west, or south boundaries.
2. Then, lets look at the boundary conditions in the “Grid Viewer.”
3. We will need to clean up our boundaries, make sure you “Enable Edit.”
4. Make sure your “Viewing Opt’s” are set to “Boundary Cs.”



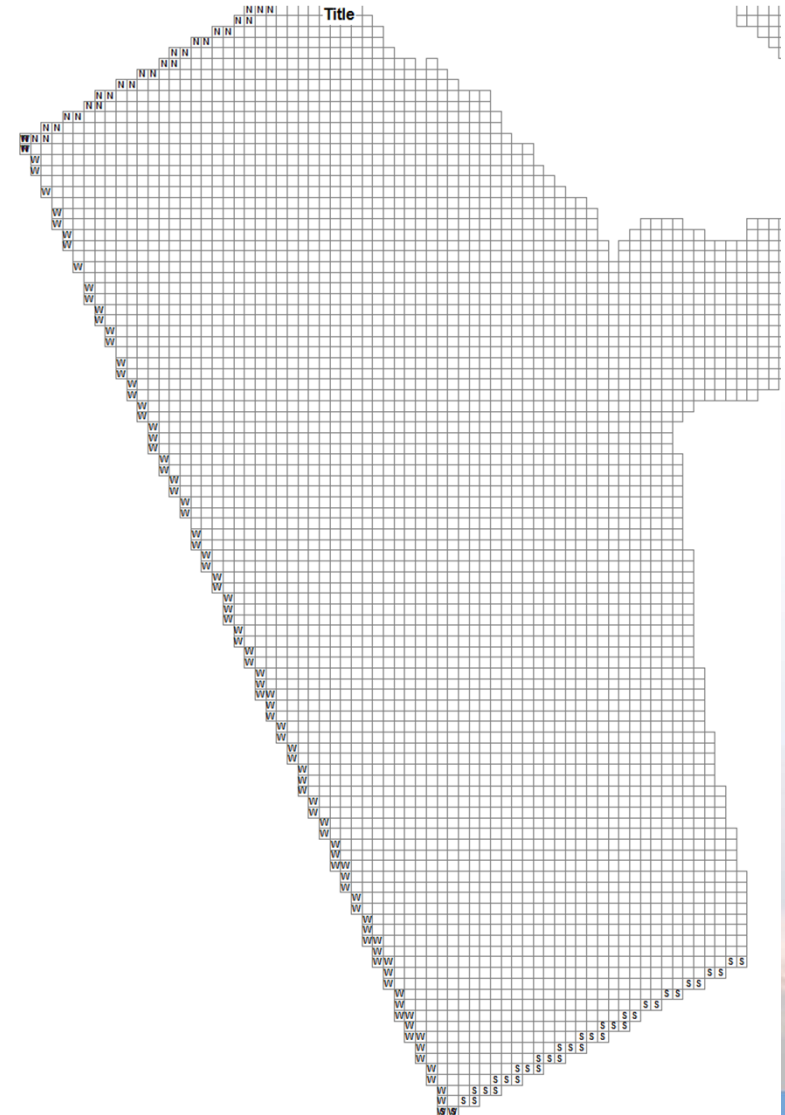
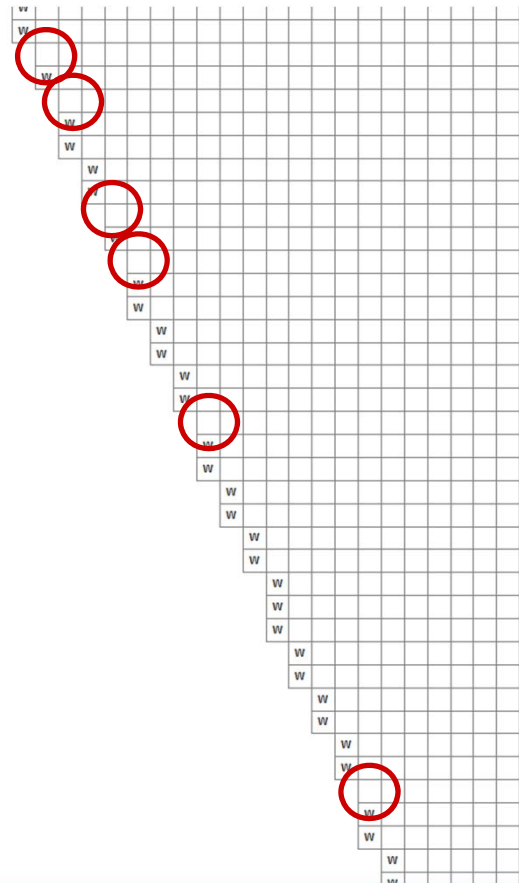


# Open Ocean Heads

I see several cells that need to be assigned boundary conditions

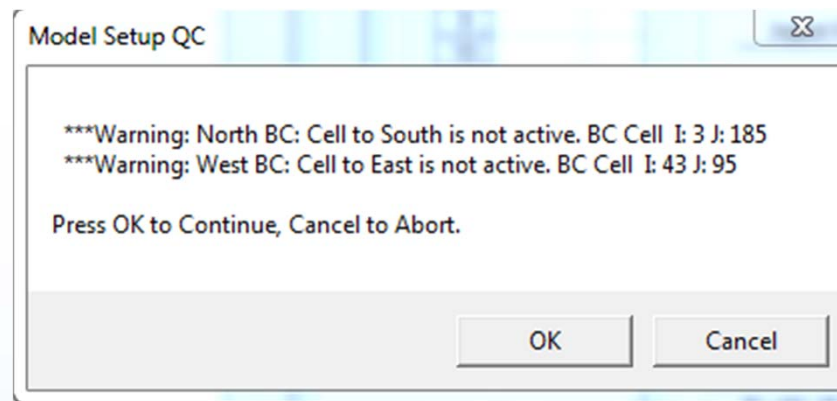
Right click and  
“Add to  
Adjacent”

Exit and Save



# *Open Ocean Heads*

Are there any problems?



There may be more than just this, let's clean up the boundary cells.



# Open Ocean Heads

Don't need N boundary conditions to the south of N BC's

Extraneous  
(and double assigned)

Left click on the problem cells  
and write down their I,J  
locations.

Then, right click on a boundary cell and  
click "Edit"



Sandia National Laboratories

# Open Ocean Heads

Click "Cell by Cell"

Cycle through and find the bad cells.

Remove them

Click OK when done

Modify/Edit BC Properties

Boundary Condition Group Information

# BC Groups: 4 # of Time Series: 0 Current Group Type: Open Boundary/Pressure  
Cur Group: 4 # of Harmonic Series: 1 Cur Group ID: OpenOceanN

Boundary Condition Group

☒ Cell by Cell ☐ Polygon

Cell by Cell

# Cells in Current Group: 36 Add Remove Remove All

I: 31 J: 201

L: 14657 Bot Elev: -4.45

Head Table or Periodic Function

Pressure: None E  
Harmonic: M2 E Set All  
Series 2: None E

Head Parameters for Entire

☐ West ☒ North ☐ South

Constant Concentrations

Constituent
Salinity (ppt)
Temperature (°C)
Dye (mg/l)

☒ Bottom ☐ Surface

Dye: 0 E Non-Cohesives: 0 E  
Shell Fish: 0 E Water Quality: 0 E

Cancel OK

This may take some time...





# The Time Step

Click the  
“Timing & Labels”  
tab

Let's run through

Before we  
“Modify” the  
time step, we  
should know  
what value to  
use.

ues...

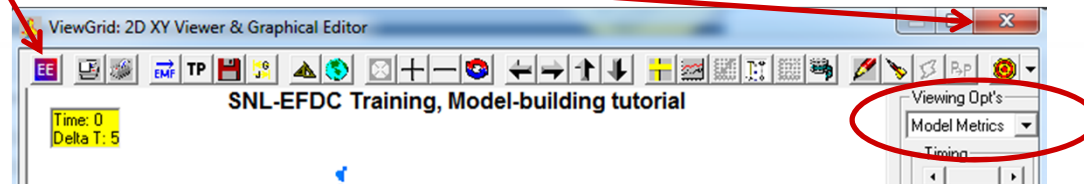
The screenshot shows the EFDC\_Explorer5 software window. The 'Timing & Labels' tab is selected. The interface includes a toolbar at the top with various icons. Below the toolbar, the 'EFDC Information and Pre-Processing' section shows the directory 'C:\Users\sjames\Desktop\SanFrancisco\' and the title 'Model-building tutorial'. The 'Active' section displays '25592' and 'Curvilinear'. The 'Activated Parameters' section lists 'Salinity', 'Dye', 'Temperature', 'Toxics [0]', 'Cohesives [0]', 'Non-Cohesives [0]', and 'Water Quality'. The 'Timing & Labels' section shows the title 'Model-building tutorial', a 'Run Log/Notes' area with the text 'This is an example problem that will teach you how to build an SNL-EFDC model.', and a 'Summary of Model Timing, Delta T and Output Options' section. This summary includes fields for '# Ref: 28', 'Start Time: 000 (d)', 'Time/Ref: 86400', 'End Time: 28.000 (d)', 'Steps/Ref: 17280', 'Time Step: 5 (s)', and 'Freq: 24 (hrs)'. There are checkboxes for 'Use EE Linkage' (checked), 'No WQ Linkage', 'Enable Diagnostics', 'Write to the log file', 'Negative Depth / Courant', and 'Write EE\_ARRAYS.OUT'. The 'Post Processing Options' section includes tabs for 'Profile/Series', 'Misc. Analysis', 'Comparison Data', and 'Calibration Plots'. The 'Output File Loading' section has checkboxes for 'Load Results' and 'Reload', with a status bar indicating 'Results Not Loaded'. The 'Profile Location Options' section has a checkbox for 'Use Drape Line'. The bottom status bar shows 'Metric', 'DS', and 'Ver 091102'.



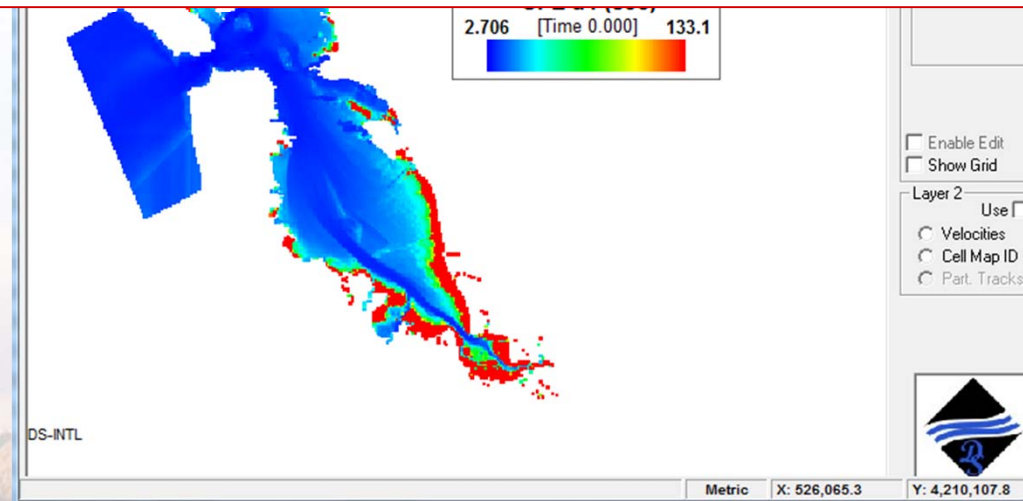
Sandia National Laboratories

Exit out of the Grid Viewer

## *The Time Step*



This is a map of the stable time step to be used for hydrodynamic modeling. For flow simulations only, the time step can often be slightly increased beyond the minimum. For dye and temperature transport, sediment dynamics, and water-quality simulations, you may need to use a smaller time step than indicated.



# Timing & Labels

Click "Modify"

EE EFDC\_Explorer5 Shared

EFDC Information and Pre-Processing

Directory:  Browse

Title:

Active:  # Rows:  Water Layers:   
 # Cols:  Sed Layers:

Activated Parameters  
Salinity ☒ Dye ☒  
Temperature ☒ Toxics [0] Cohesives [0] Water Quality  
Non-Cohesives [0]

**Timing & Labels** | WQ General | Benth/Nutrients | Algae/WQ IC's | WQ BC / LPT | Initial | Boundary  
GVC | Grid & General | Comp Opts | Hydrodynamics | Sed/Tox/Others

Title:

Run Log/Notes:

Project Title:

Summary of Model Timing, Delta T and Output Options

# Ref:  Start Time:  (d) ☒ Use EE Linkage  
Time/Ref:  End Time:  (d) Freq:  (hrs) Modify  
Steps/Ref:  Time Step:  (s) No WQ Linkage

Run Logging Options  
☐ Enable Diagnostics  
☐ Write to the log file  
☐ Negative Depth / Courant  
☐ Write EE\_ARRAYS.OUT

Post Processing Options

**Profile/Series** | Misc. Analysis | Comparison Data | Calibration Plots

**Output File Loading**  
☒ Load Results Reload  
☐ Results Not Loaded

Profile Location Options  
☐ Use Drape Line

Metric DS Ver 091102





# Timing & Labels

Click “Modify” on the “Timing & Labels” tab

Let's simulate a week of 1-day reference periods using a 5-sec time step

Select the number of writes per reference period. Careful! This could generate large output files.

EFDC Run Time Parameters & EE Output Options Shared

Time Options  
J <-> G Time of Start: 0 (days)  
# Reference Periods: 7  
Duration of Reference Period: 24 (hrs)  
Time Step: 5 (sec)

Dynamic Timestep Options  
Safety Factor: 0  
# Ramp-Up Loops: 1000

Linkage to Water Quality Models  
☒ None  
☐ WASP EPA DOS Ver 4  
☐ CE-QUAL\_ICM  
☐ RCA Model (w/CA2A Production Version)

EFDC\_Explorer Output Options (REQUIRED for Post-Processing)  
☒ Use Reset All Other Output Options ☐  
Writes per Ref. Period: 12  
☒ Water Surface ☒ Water Column  
☒ Velocities ☐ Bed Layers  
☐ Sediment Diagenesis Data Output Interval: 0  
☐ Use High Frequency Dates # Dates: 0 Set Dates

Model Simulation Start Time (For Synchronization to Other Data)  
Beginning Date/Time: 1/1/2013

EFDC Generated Time Series  
☐ Use Currently Defined Cells: 0 Modify

Cancel OK





# Grid & General

Allow "Wetting & Drying"

Screen display

Select the number of layers.  
Note: Computation time scales linearly with this number.

Careful with this value. While it will cause numbers to stream on the screen faster, it will also make a HUGE output file called "tecplot2d.dat"

The screenshot shows the EFDC\_Explorer5 software interface. The 'Grid & General' tab is selected. The 'Wetting & Drying' section has 'Flag: -99' selected. The 'Run Time Status' section has 'I: 75' and 'J: 176' selected. The 'Print Interval' is set to '1000'. The 'Water Layers' table is circled, showing 3 layers. The 'Layer Sum' is 0.99999. The 'Output File Loading' section shows 'Results Not Loaded'.

Lay	Frac	#
3	0.33333	3
2	0.33333	
1	0.33333	

Layer Sum: 0.99999

Wetting & Drying Flag: -99

Run Time Status I: 75 J: 176

Print Interval: 1000

Output File Loading: Results Not Loaded



# Comp Opts

Activate Dye

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\sames\Desktop\SanFrancisco\ Browse

Title: Model-building tutorial

Active: 25592 # Rows: 374 Water Layers: 3  
Curvilinear # Cols: 402 Sed Layers: 1

Activated Parameters:  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General **Comp Opts** Hydrodynamics Sed/Tox/Others

Computational Options

☐ Activate Salinity Details  
☐ Activate Temperature No Atmospheric Linkage  
☐ Activate Dye  
☐ Activate Toxics  
☐ Activate Cohesive Sediments  
☐ Activate Non-Cohesive Sediments  
☐ Activate Water Quality

Global Transport Options  
Upwind Difference  
Anti-Diffusion Correction  
Flux Limitation

Numerical Solution Options

Array Solver: 9 Residual 1E-09  
Buoy. Forc: Internal Pressure Gradient  
3 Time Level 2 Time Level  
Momentum Equation Solution  
Explicit Implicit

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

Output File Loading  
☐ Load Results Reload  
Results Not Loaded

Profile Location Options  
☐ Use Drape Line  
I J

Metric DS Ver 091102



Sandia National Laboratories

# Hydrodynamics

Assign bottom roughnesses here (calibration parameter)

We will turn on MHKs here (later)

Important parameters!!!  
Click here!

Buoyant forces are off (T and S). Set to 1 to turn on.

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\sames\Desktop\SanFrancisco\ Browse

Title: Model-building tutorial

Active: 25592 # Rows: 374 Water Layers: 3  
Curvilinear # Cols: 400 Sed Layers: 1

Activated Parameters: Salinity, Dye, Cohesives [0], Water Quality, Temperature, Toxics [0], Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General Comp Opts **Hydrodynamics** Sed/Tox/Other

Turbulence Options:  
☒ Computed Horiz Viscosity  
Constant Vert Viscosity  
Wave Induced Turbulence  
Modify

Ramp Up Options:  
Bouyancy Factor: 0  
Timing: Not Used Modify

Roughness Options:  
Additive Factor: 0  
Multiplicative Factor: 1  
Floodplain z0's  
Channel z0's  
Polygon Set

Vegetation:  
Vegetation Flag: 0  
Laminar Flag: 0  
Number of Classes: NA  
Modify Classes  
Apply Overlays

Coriolis Effect:  
Latitude (Deg): 0  
Coriolis Factor: 0  
Channel Modifiers:  
Flag: 0

Post Processing Options:  
Profile/Series Misc. Analysis Comparison Data Calibration Plots  
View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

Output File Loading:  
☐ Load Results Reload ☐  
Results Not Loaded  
Profile Location Options:  
☐ Use Drape Line  
Metric DS Ver 091102

Coriolis forces are off



Sandia National Laboratories



# Modify the Turbulence Options

AHO should be between 0 and 0.25

AHD (calibration parameter)

Activate  
Horizontal  
Momentum  
Diffusion

In General  
AHD > 0.1  
AHD =  $\Delta x \Delta y / 1000$   
AHD < 5

I never touch the rest of these...

EFDC Hydrodynamic Options & Parameters

**Turbulent Diffusion** | Turbulent Intensity | Wave Turbulence | Miscellaneous

Horizontal Kinematic Eddy Viscosity & Diffusivities Options

☐ Disable HMD      Background/Constant Horizontal Eddy Viscosity: 0 (m<sup>2</sup>/s)

☒ Activate HMD with Smagorinsky      Dimensionless Hor. Momentum Diff: 1

☐ Activate HMD with Smagorinsky and Wall Drag Effects      Wall Roughness: 0

Vertical Eddy Viscosities & Diffusivities

Time Advance Filter: ☐ No Filter      Background or Constant Eddy Viscosity & Diffusivity: ☐ Constant

☐ Average, ☒ SQRT, T

Minimum Magnitudes for Diffusivity Terms

Minimum Kinematic Eddy Viscosity: 0.000001 (m<sup>2</sup>/s)      Use Minimums: ☐

Minimum Eddy Diffusivity: 1E-08 (m<sup>2</sup>/s)

Cancel      OK



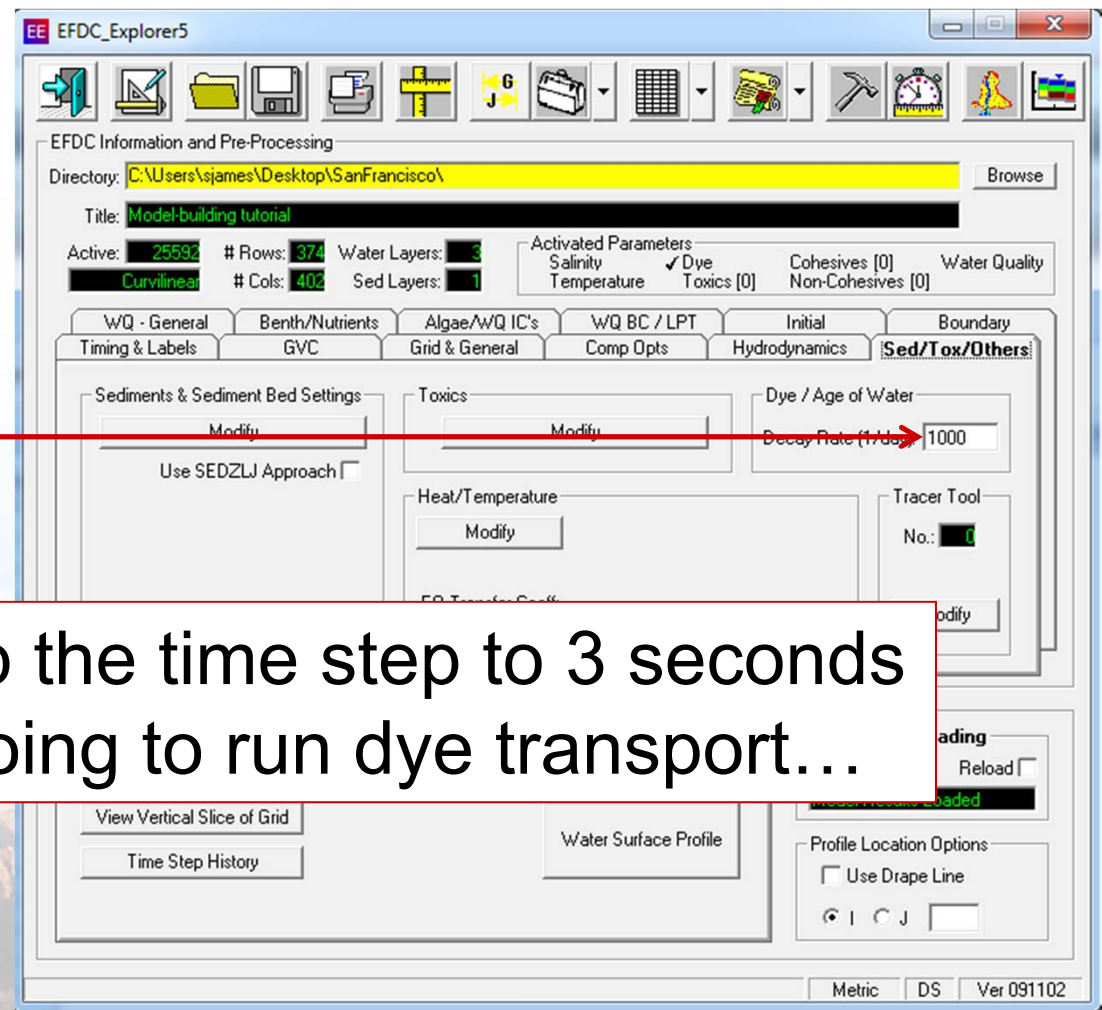


# Should We Add Dye?

“Activate Dye” in the “Comp Opts” tab.

Activate “Age of Water” by  
setting the  
“Decay Rate (1/day)” = 1000

Careful! Drop the time step to 3 seconds  
if you are going to run dye transport...



# Run the Model

EE EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\sjames\Desktop\SanFrancisco\ Browse

Title: Model-building tutorial

Active: 25592 # Rows: 374 Water Layers: 1  
Curvilinear # Cols: 402 Sed Layers: 1

Activated Parameters  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC **Grid & General** Comp Opts Hydrodynamics Sed/Tox/Others

Water Layers

Lay	Frac	#
3	0.33333	3
2	0.33333	
1	0.33333	

Layer Sum:  
0.99999

Wetting & Drying  
Flag: -99  
Dry Depth: 0.05  
Wet Depth: 0.1  
Dry Step: -1

Masks  
No.: 1  
Use: ☐  
Modify

Run Time Status  
Type: 3  
I: 75  
J: 176  
Print Interval: 1000

Water Depth Settings  
Additive Factor: 0  
Multiplicative Factor: 1  
Minimum Height: 0.05

Bottom Elev. Adjustments  
Additive Factor: 0  
Multiplicative Factor: 1

Mass Balance Reporting Options  
Compute ☐ # Steps: 21600 V

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid

Time Step History

Water Surface Profile

Output File Loading  
☐ Load Results Reload ☐  
Results Not Loaded

Profile Location Options  
☐ Use Drape Line  
☒ I ☐ J ☐

Metric DS Ver 091102



Sandia National Laboratories



***Run the Model***

**Let's take lunch...**



Sandia National Laboratories

# View the Results

“Load Results”  
from  
“Output File  
Loading”

Then “View Grid”

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\sjames\Desktop\SanFrancisco\ Browse

Title: Model-building tutorial

Active: 25592 # Rows: 374 Water Layers: 3  
Curvilinear # Cols: 402 Sed Layers: 1

Activated Parameters  
Salinity Dye Cohesives [0] Water Quality  
Temperature Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General Comp Opts Hydrodynamics Sed/Tox/Others

Title: Model-building tutorial

Run Log/Notes:  
This is an example problem that will teach you how to build an SNL-EFDC model.

Project Title: SNL-EFDC Training

Summary of Model Timing, Delta T and Output Options

# Ref: 14 Start Time: 0.000 (d) ✓ Use EE Linkage  
Time/Ref: 86400 End Time: 14.000 (d) Freq: 2 (hrs) Modify  
Steps/Ref: 17280 Time Step: 5 (s) No WQ Linkage

Run Logging Options  
☐ Enable Diagnostics  
☐ Write to the log file  
☐ Negative Depth / Courant  
☐ Write EE\_ARRAYS.OUT

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid

Time Step History

Water Surface Profile

Output File Loading  
☒ Load Results Reload  
Results Not Loaded

Profile Location Options  
☐ Use Drape Line

Metric DS Ver 091102

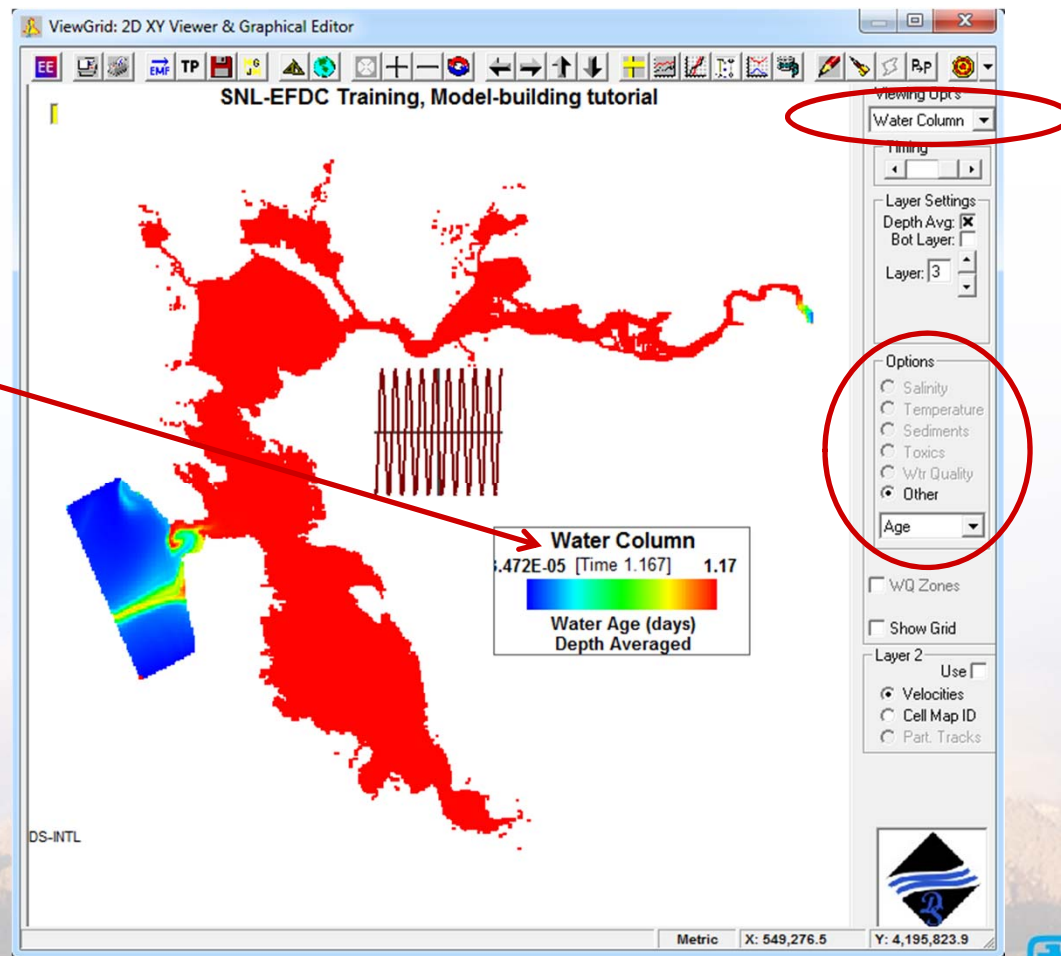




# View a Water-Age Animation

Select "Water Column" from "Viewing Opt's"  
Select "Other" and "Age" from "Options"

Right click the  
legend



Sandia National Laboratories

# View a Water-Age Animation

Show the “Timing Frame” and “View” an ocean BC

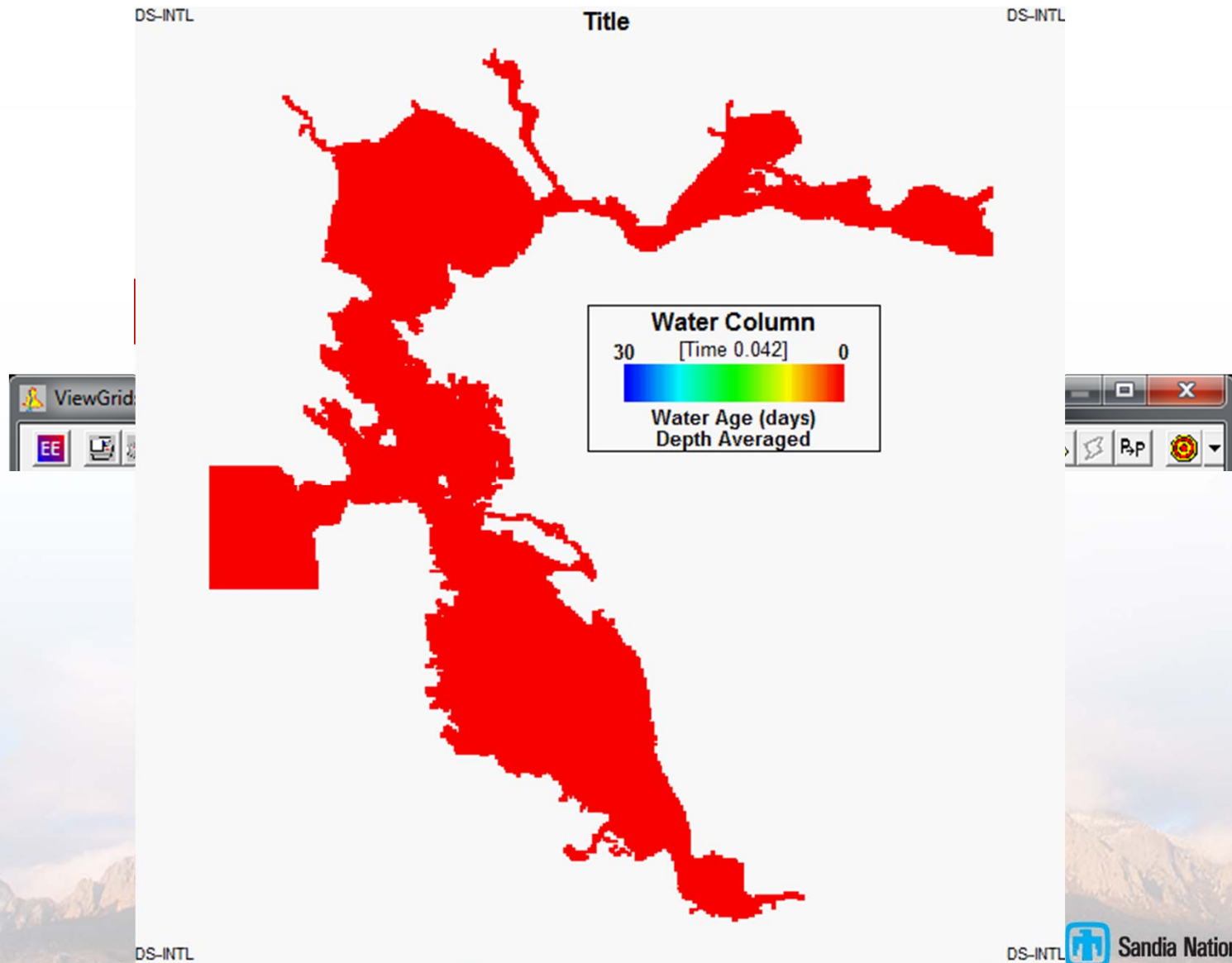
Change the “Color Ramp” (if you like)

Display Options

General Options	Velocity / Boundary Conditions	Annotations	Particle Tracks
<p>Plot Title Model-building tutorial <span>Font</span></p>			
<p>Model Grid Characteristics <input type="text"/> Use "Corners" <input checked="" type="checkbox"/></p>		<p>Background Color <input type="text"/></p>	
<p>E/N Scales Modifiers Easting: <input type="text"/> Northing: <input type="text"/></p>		<p>Time Display <input checked="" type="radio"/> Julian Time <input type="radio"/> Gregorian Date Precision: <input type="text"/></p>	
<p>Coordinate Grid Easting: <input type="text"/> Northing: <input type="text"/> <span>Use</span> <span>Modify</span></p>		<p>Horizontal Units Scale <input type="checkbox"/> Show Units: <input type="text"/></p>	
		<p>Timing Frame <input checked="" type="checkbox"/> Show Scale: <input type="text"/> View: <input type="text"/></p>	
		<p>Color Ramp Autoscale with View <input type="checkbox"/> Blue: <input type="text"/> Red: <input type="text"/> Auto Precision: <input type="text"/></p>	
<p>Cancel</p>		<p>OK</p>	



# *View a Water-Age Animation*



# The MHK Module

Let's add some devices

By changing the  
“Vegetation Flag” to 1 you  
can introduce vegetation  
AND MHK devices.

EFDC\_Explorer5

EFDC Information and Pre-Processing

Directory: C:\Users\james\Desktop\SanFrancisco\ Browse

Title: Model-building tutorial

Active: 25592 # Rows: 374 Water Layers: 3  
Curvilinear # Cols: 402 Sed Layers: 1

Activated Parameters:  
Salinity ☒ Dye Cohesives [0] Water Quality  
Temperature ☒ Toxics [0] Non-Cohesives [0]

WQ - General Benth/Nutrients Algae/WQ IC's WQ BC / LPT Initial Boundary  
Timing & Labels GVC Grid & General Comp Opts **Hydrodynamics** Sed/Tox/Other

Turbulence Options  
☒ Computed Horiz Viscosity  
Constant Vert Viscosity  
Wave Induced Turbulence  
Modify

Roughness Options  
Additive Factor: 0  
Multiplicative Factor: 1  
Floodplain z0's  
Channel z0's  
Polygon Set

Vegetation  
Vegetation Flag: 1  
Laminar Flag: 0  
Number of Classes: NA  
Modify Classes  
Apply Overlays

Ramp Up Options  
Buoyancy Factor: 0  
Timing Not Used Modify

Coriolis Effect  
Latitude (Deg): 0 Coriolis Factor: 1  
Channel Modifiers  
Flag: 0

Post Processing Options

Profile/Series Misc. Analysis Comparison Data Calibration Plots

View Vertical Slice of Grid  
Time Step History  
Water Surface Profile

Output File Loading  
☒ Load Results Reload ☐  
Results Not Loaded

Profile Location Options  
☐ Use Drape Line  
G I C J

Metric DS Ver 091102

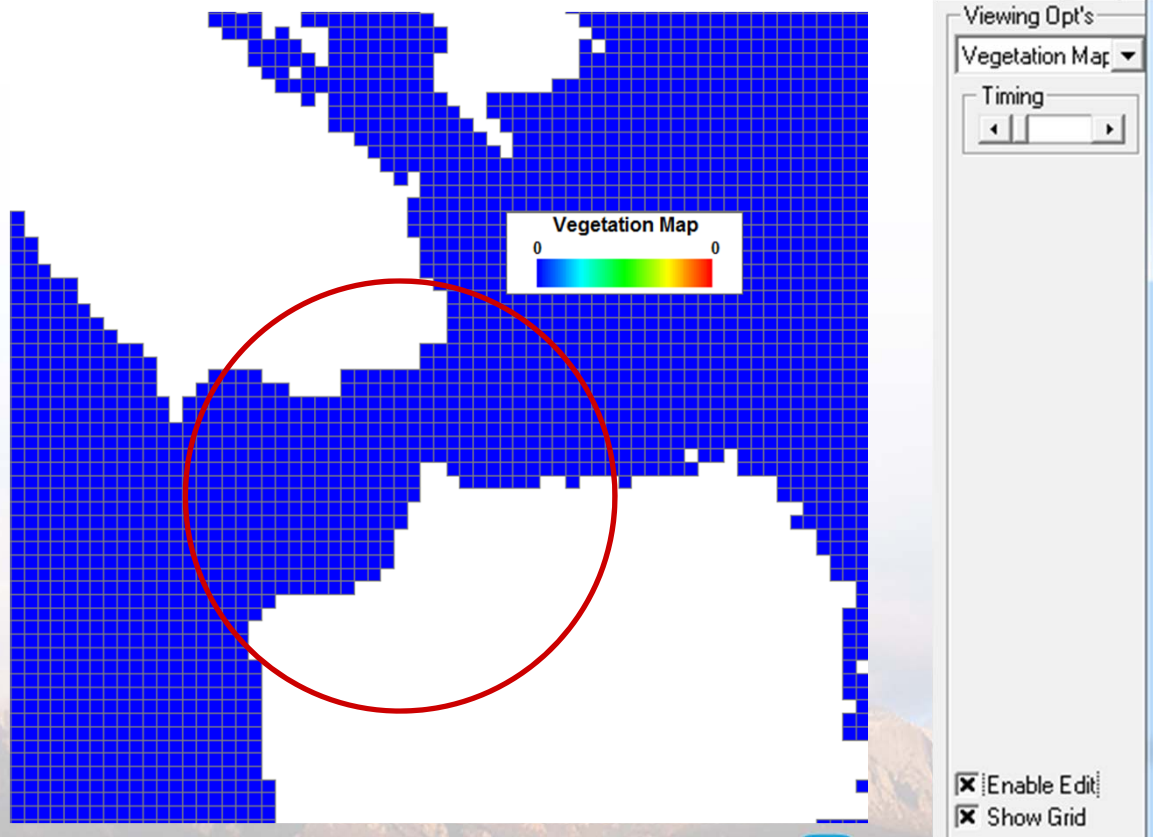




# The MHK Module

Turn on the “Vegetation Flag” in the “Hydrodynamics” tab...  
...and re-enter the “Grid Viewer.”  
Then, select the “Vegetation Map” under “Viewing Opt’s”...  
...and “Enable Edit.”

Right click some  
(non-boundary) cells  
and add some  
turbines under the  
Golden Gate Bridge.



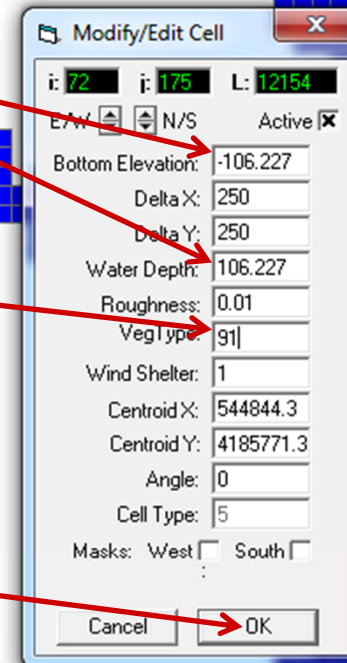
Sandia National Laboratories

# Add MHK Devices

Ensure that the water is sufficiently deep.

Enter a "Veg Type" of 91 (or greater)

Click "OK" and add as many as you like...



Modify/Edit Cell

i: 72 j: 175 L: 12154

EW N/S Active ☒

Bottom Elevation: -106.227

Delta X: 250

Delta Y: 250

Water Depth: 106.227

Roughness: 0.01

Veg Type: 91

Wind Shelter: 1

Centroid X: 544844.3

Centroid Y: 4185771.3

Angle: 0

Cell Type: 5

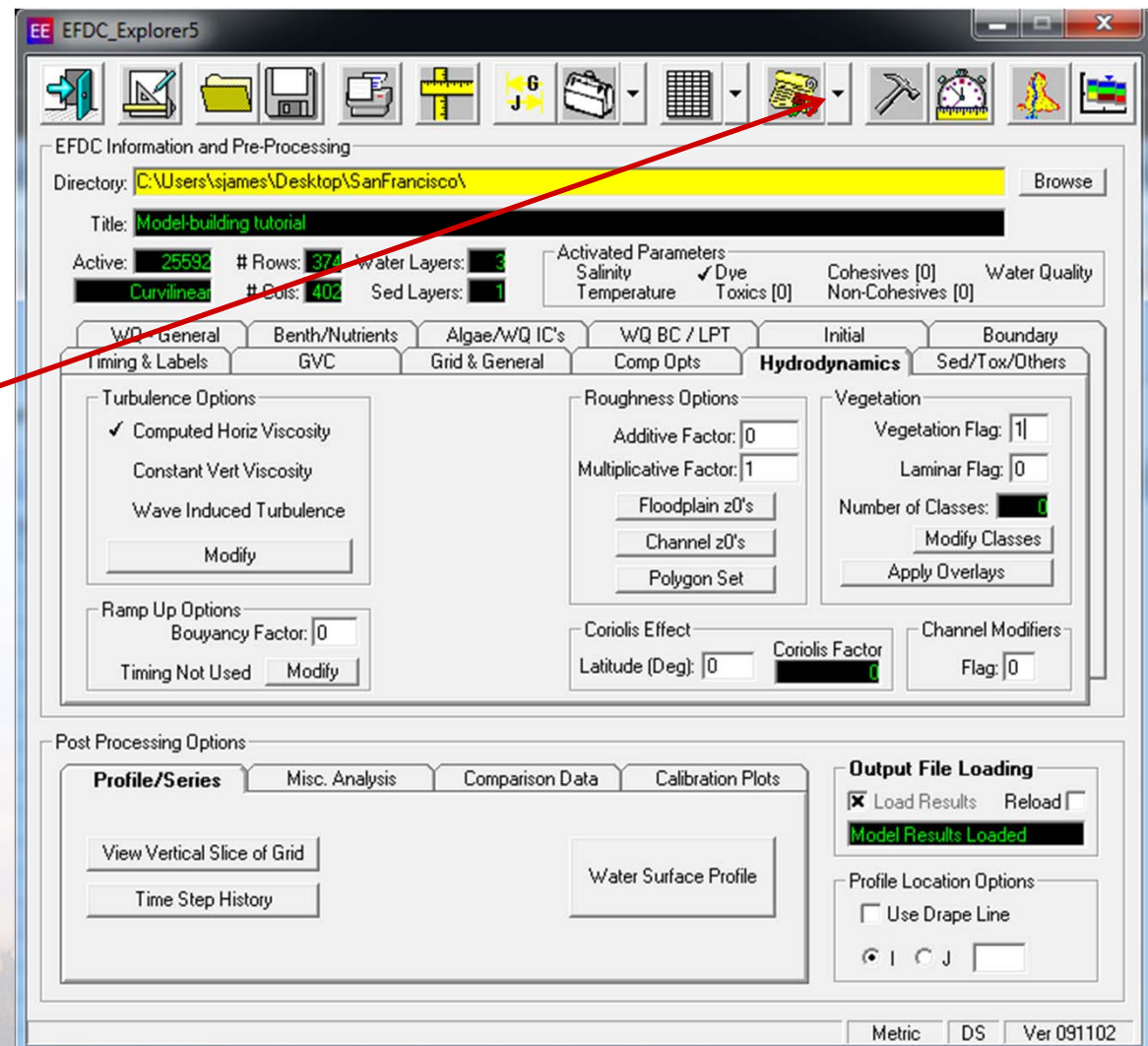
Masks: West ☐ South ☐

Cancel OK



# *We Must Hand Edit MHK.INP*

In the “Text Editor,” select “Other.INP” and open the MHK.INP file. No need to change anything unless you want to change the size/characteristics of the MHK devices.



# MHK.INP

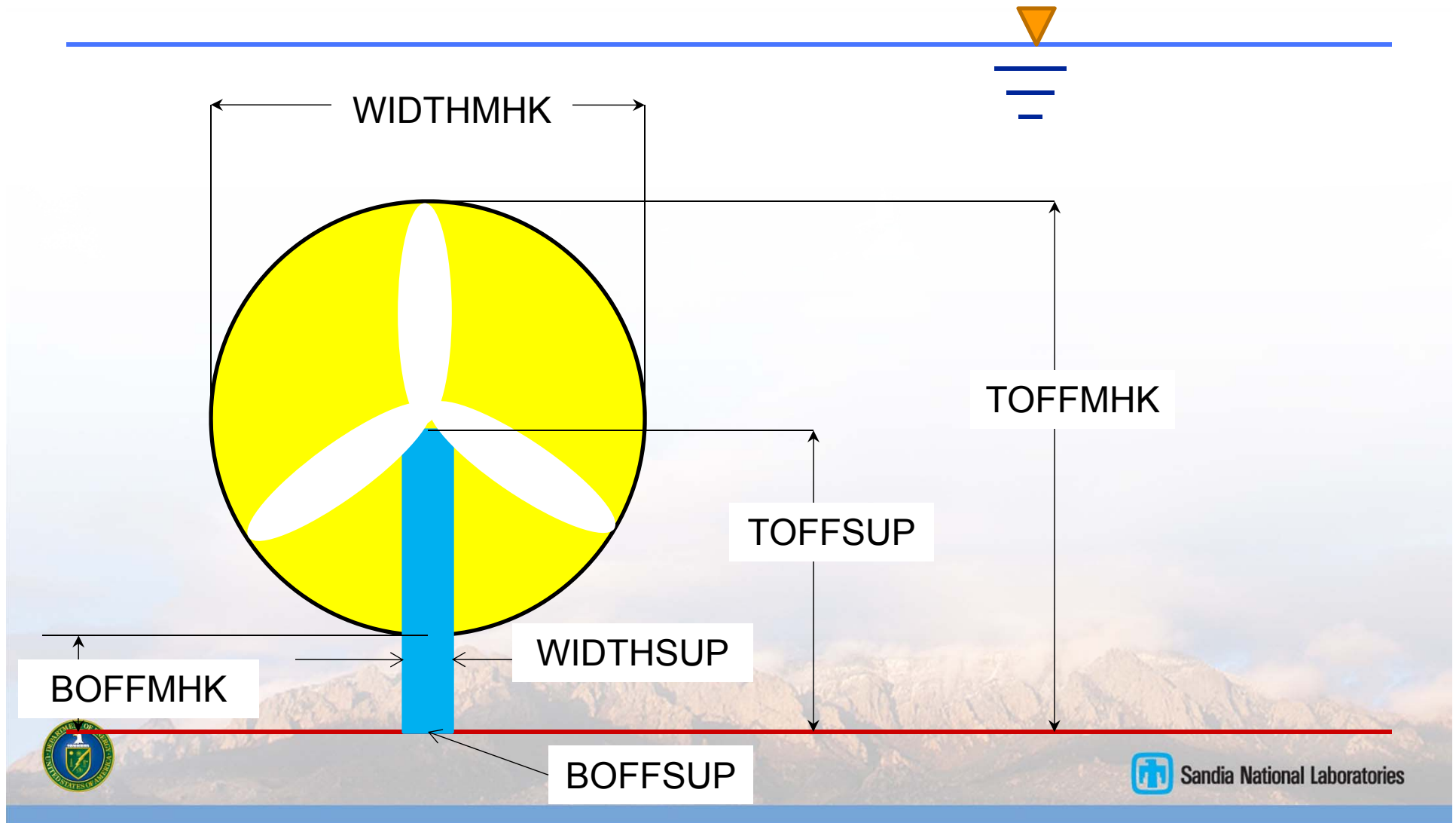
- C WIDTHMHK is the width of MHK device type
- C WIDTHSUP is the width of MHK support structure type
- C BOFFMHK is the bottom offset of the MHK device type (how far from the bottom)
- C BOFFSUP is the bottom offset of the MHK support structure type
- C TOFFMHK is the top offset of the MHK device type
- C TOFFSUP is the top offset of the MHK support structure type
- C CTMHK is the thrust coefficient of MHK device type
- C CDSUP is the coefficient of power dissipation of MHK support structure type
- C VMINCUT is the minimum velocity cut-in for MHK device type power curve
- C VMAXCUT is the maximum velocity cut-out for MHK device type power curve
- C DENMHK is the number of MHK devices in a cell

Look at the values I entered for you.  
Change them if you like.  $C_T < 1$ ;  $C_D = 1.2$  (for cylinders)  
Don't put too many devices in a cell  $DENMHK \leq 5$ .



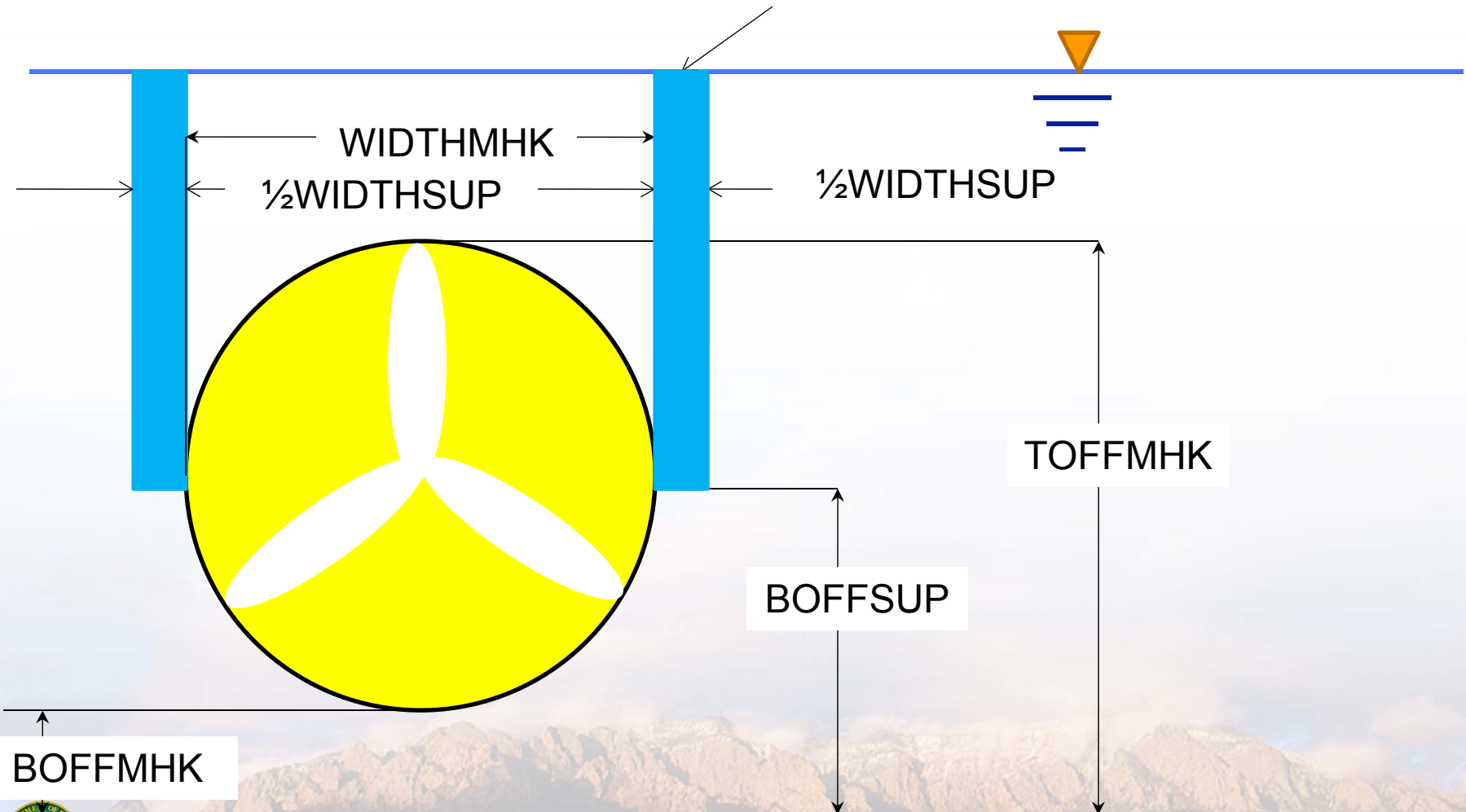


# ***Bottom-Mounted MHK***



# Top-Mounted MHK

TOFFSUP ( $\approx$  water depth)



Sandia National Laboratories

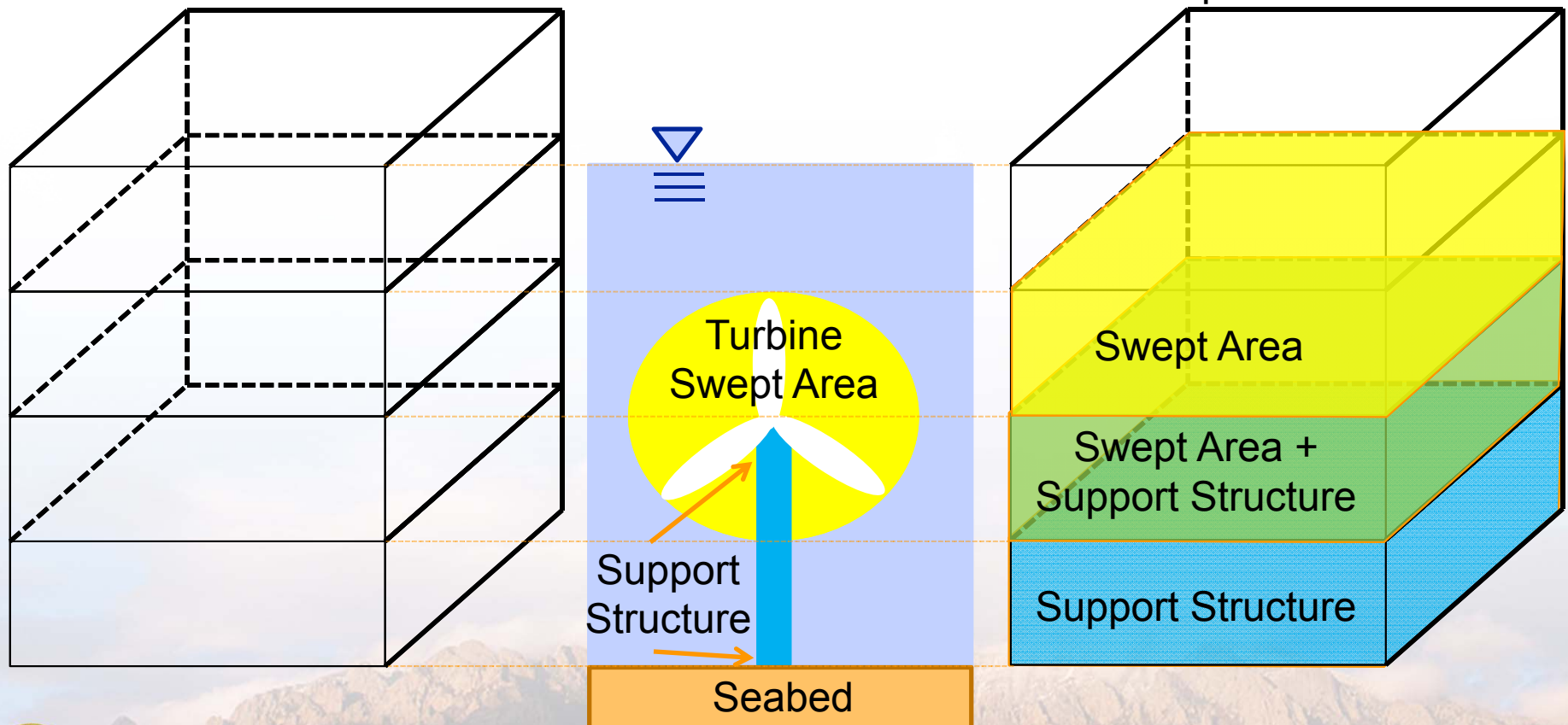
# Porous Approximation

- MHK can be represented with multiple cells or contained within a single cell
- MHK can occupy an entire cell or a fraction of a cell

Hydrodynamic Model Grid

+

SNL-EFDC Turbine Representation



Sandia National Laboratories



***Save the Model Run it Later...***

