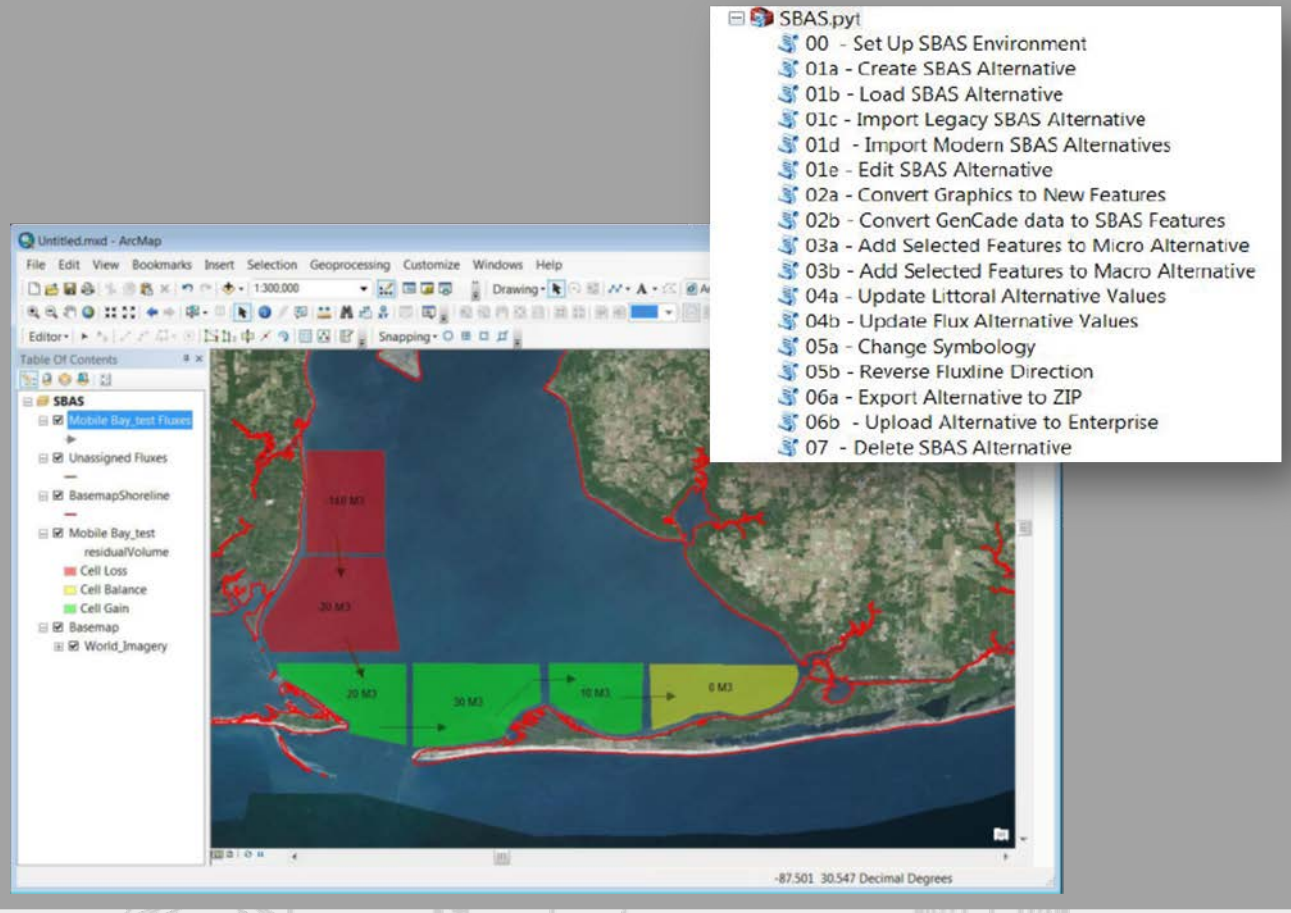
SEDIMENT BUDGET ANALYSIS SYSTEM: SBAS BASICS



Rose Dopsovic

Bowhead Professional Solutions &
Mobile District Spatial Data Branch

May 2017

"The views, opinions and findings contained in this report are those of the authors(s) and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other official documentation."

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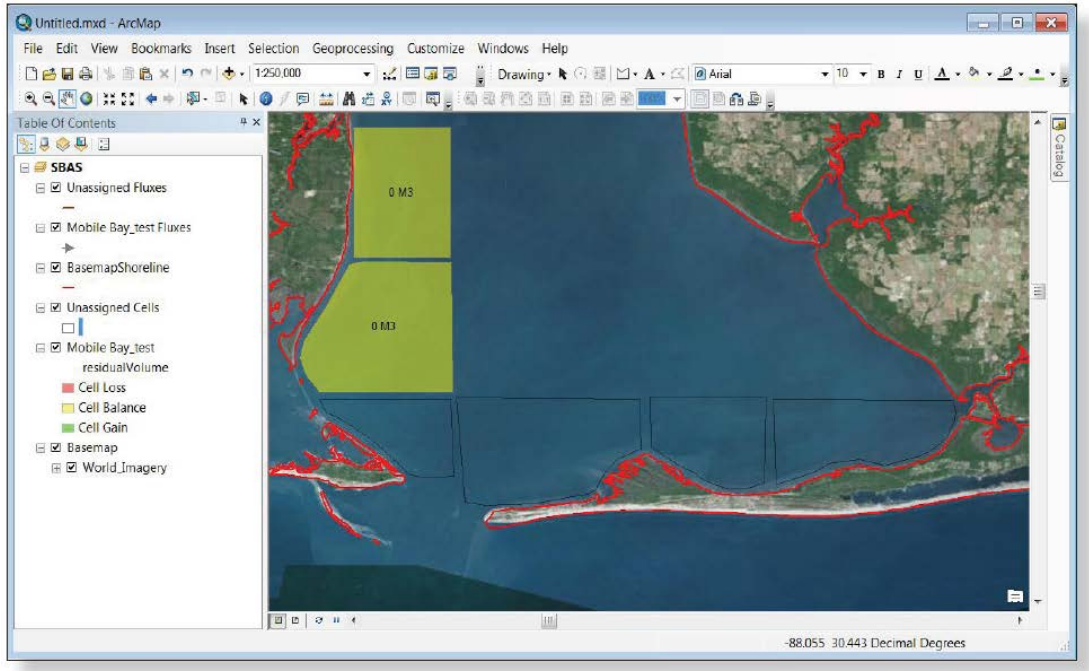
SEDIMENT BUDGET ANALYSIS SYSTEM (SBAS)

- SBAS (Sediment Budget Analysis System) for ArcGIS Desktop provides a framework for formulating, documenting, and calculating sediment budgets, including estimation of uncertainty.
- Once installed, this “toolbox” (available in ArcMap) allows users to define a conceptual budget visually by creating a series of cells and arrows that represent sources, sinks, and flux rates. It then calculates quantitative "micro" (local) and "macro" (regional) sediment budgets, using a pre-defined sediment-budget equation.



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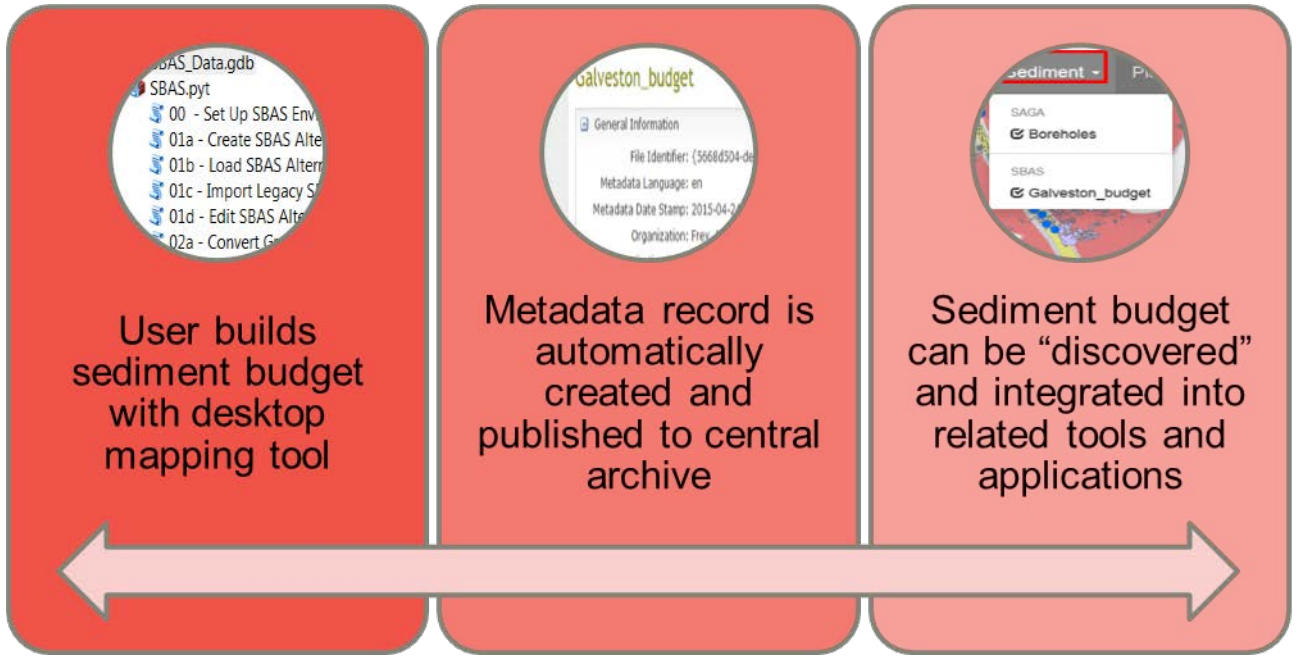
SBAS & DATA INTEGRATION FRAMEWORK

- User interfaces, built for a desktop mapping environment, assist engineers in graphically modeling sediment budgets. When complete, budgets are synchronized with a master online inventory.

- Master online inventory holds a spatial footprint of the budget; therefore mapping application can easily locate available sediment budgets.



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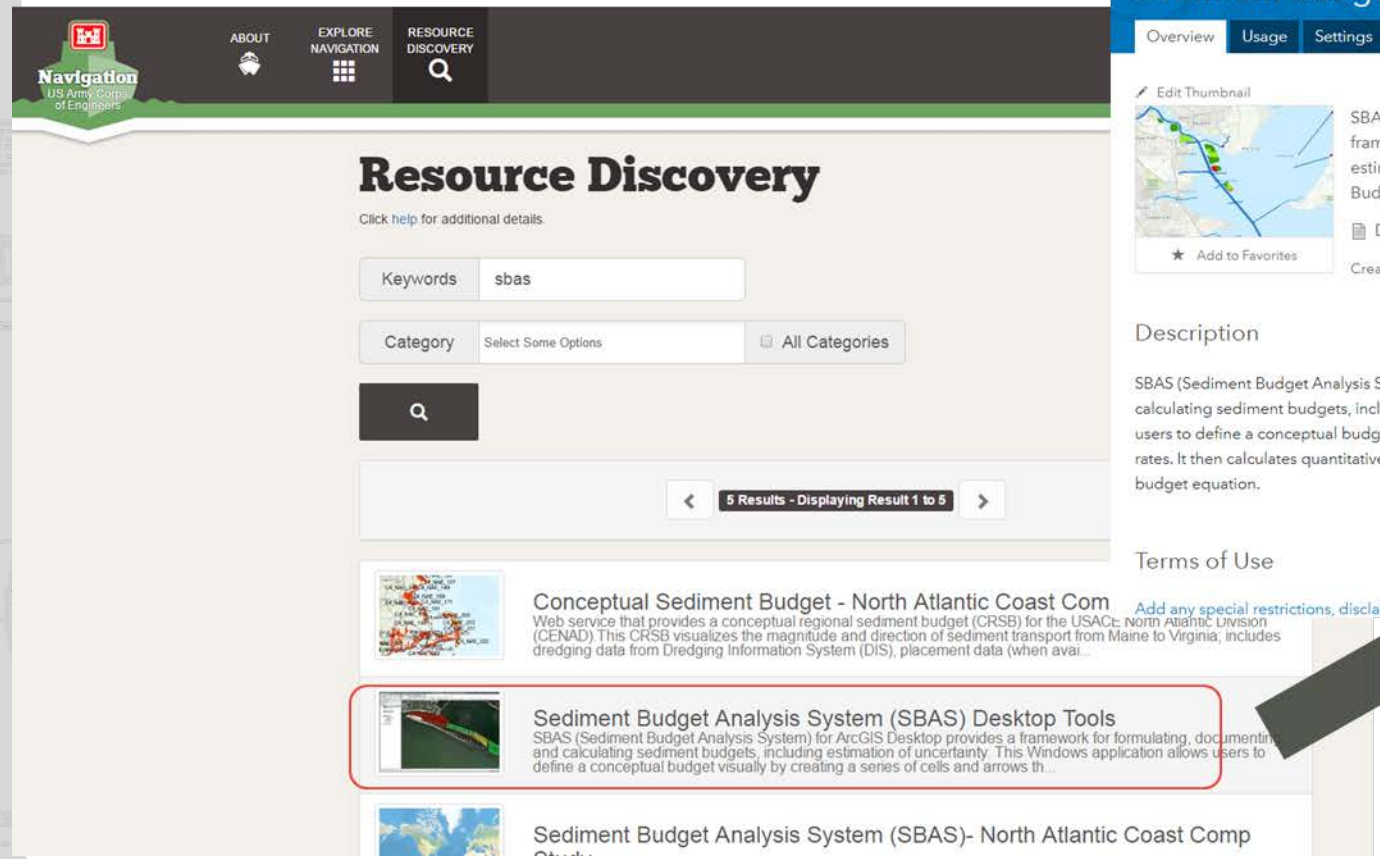
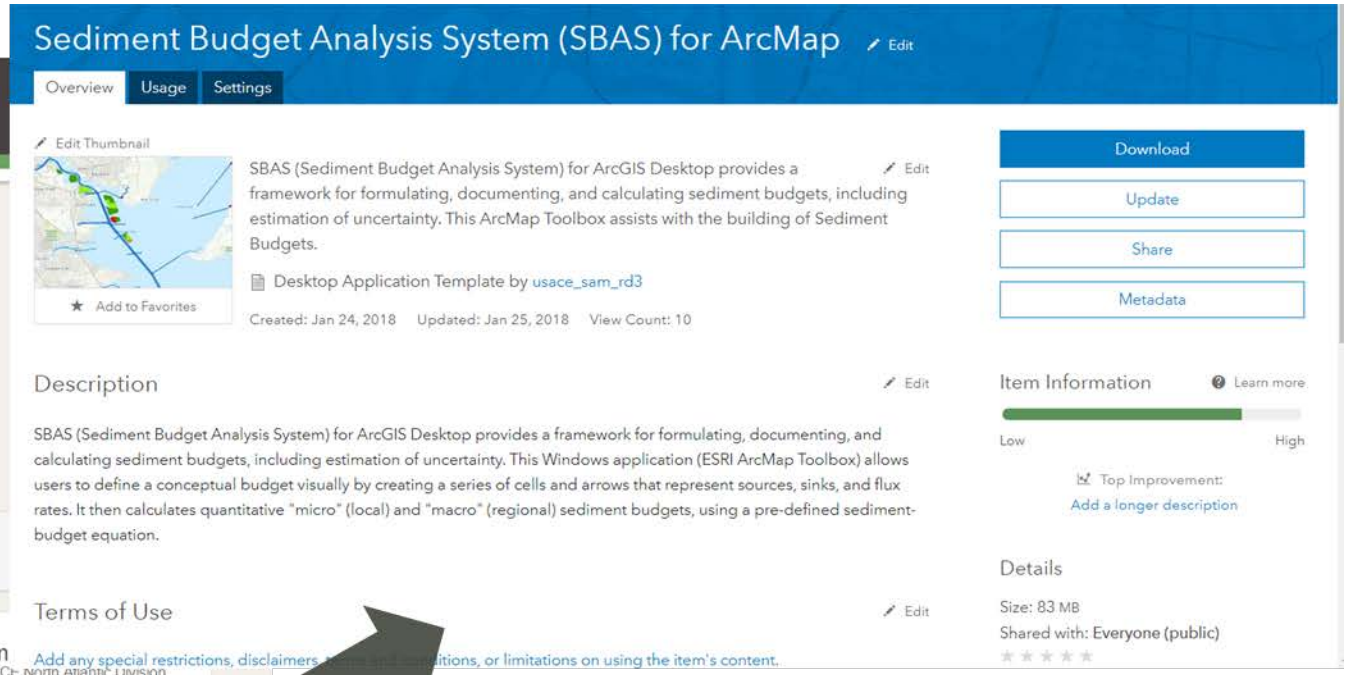
SBAS TOOL DOWNLOAD

- SBAS Tools are designed as tools for use within ArcMap 10.x, ArcToolbox.
- To download, go to http://navigation.usace.army.mil > Resource Discovery > and search for SBAS





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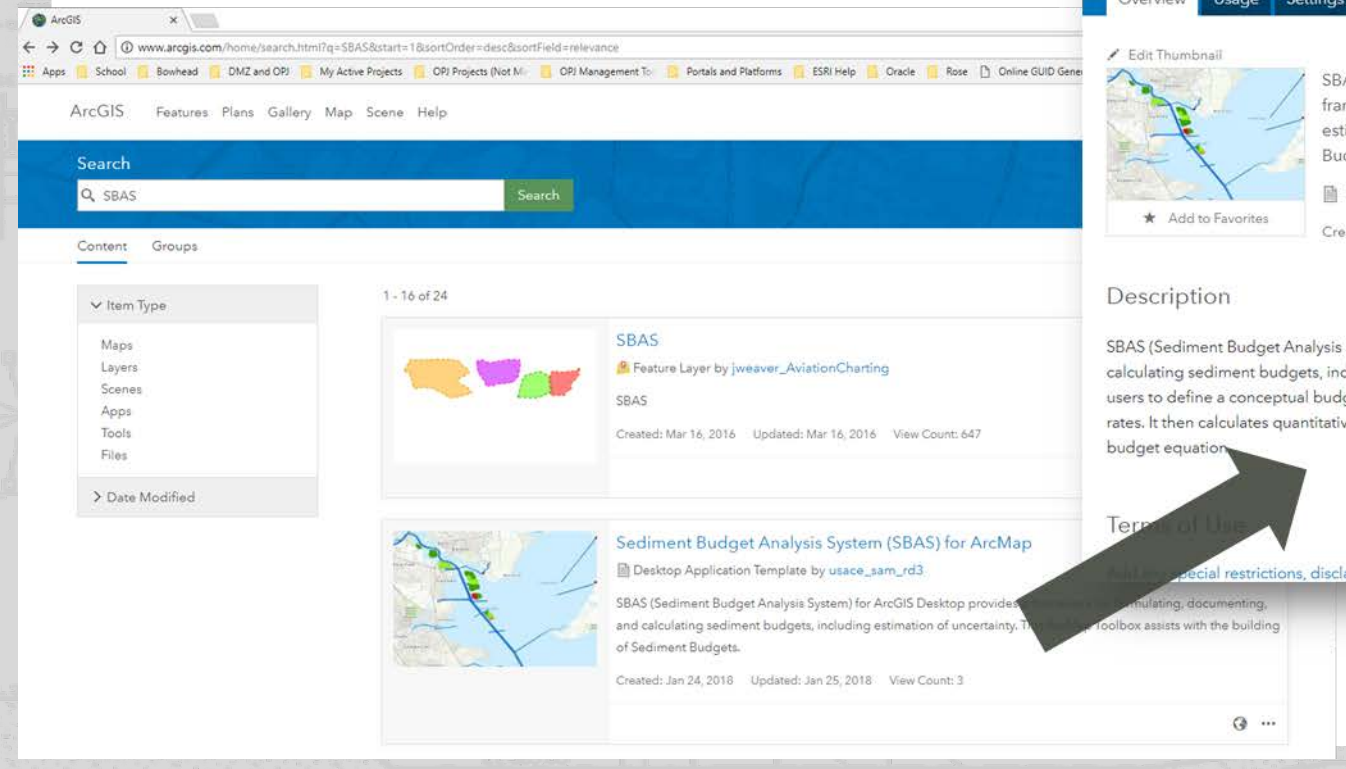
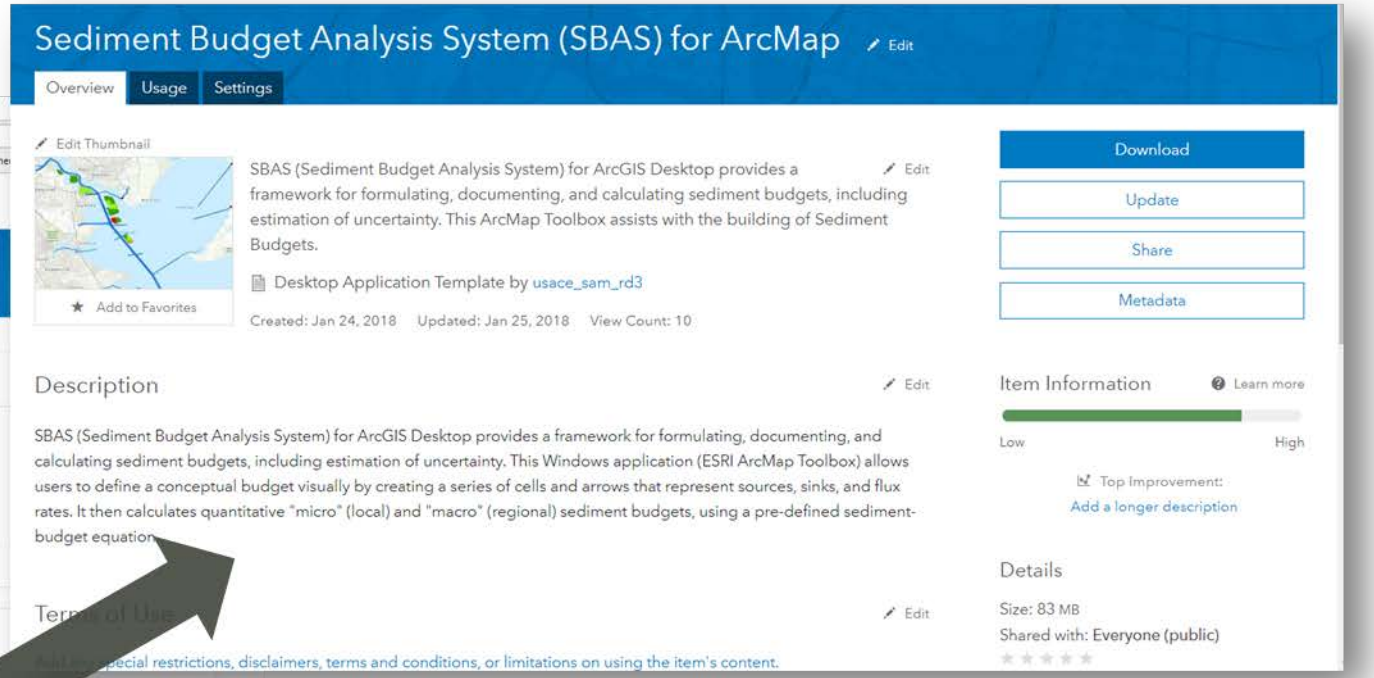
OTHER WAYS TO DOWNLOAD

1. Go to http://www.arcgis.com.
2. Search for “SBAS”. Searching this site will retrieve USACE and non-USACE resources.
3. Click “Sediment Budget Analysis System (SBAS) for ArcMap”
4. Download Zip





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OTHER WAYS TO DOWNLOAD

1. Go to the RSM Website: http://rsm.usace.army.mil/
2. Browse to Tools & Databases > SBAS Arc10 > SBAS Arc 10 Toolbox (zip)

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INCLUDED THE SBAS DOWNLOAD (ZIP FILE)

Local File Geodatabase

- Holds country polygons and NOAA shorelines for use as basemaps
- Holds any local SBAS datasets you create during SBAS sessions

SBAS Toolbox (written in Python)

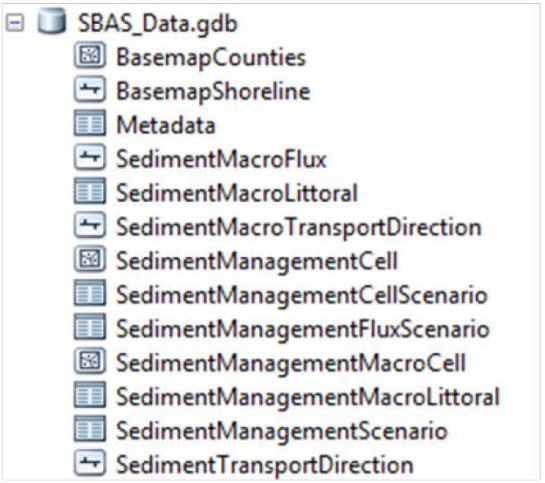
- Scripts are to be run sequentially
- If red 'X's appear, be sure to run the tools above

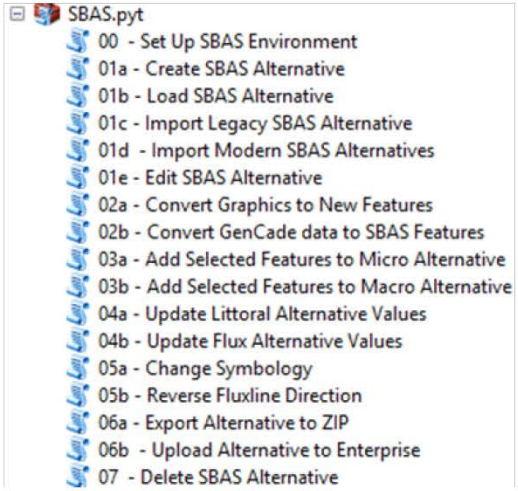
Connection to the Master Dataset & Source Code

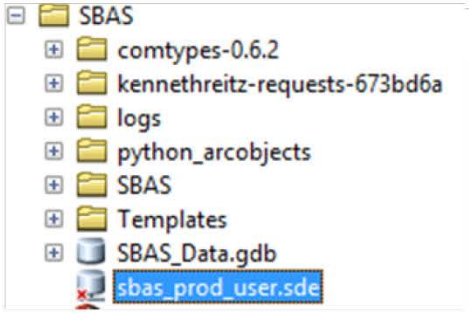
- SDE connection to master database
- Python source code

User's Guide

- User Guide support ArcGIS 10.1 through 10.5
- Contains steps for installations and usage of the tools







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INSTALLATION STEPS (README.TXT)

Installation:

1. Extract ZIP distribution
2. Move SBAS directory to one's desired location
3. Run SBAS\comtypes-0.6.2\install_comtypes.bat
4. Run SBAS\install_dependencies.bat
5. Within the Catalog, add a Folder Connection to the SBAS directory
6. Within the Folder Connection to the SBAS toolbox, expand the toolbox and execute the "00 - Set Up SBAS Environment" tool.

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INSTALL TROUBLESHOOTING

If a red X appears next to the ArcMap SBAS toolbox, verify 3 files included in the SBAS installation:

- ..\SBAS\comtypes-0.6.2\install_comtypes.bat
- ..\SBAS\install_dependencies.bat
- ..\SBAS\python_arcobjects\Snippets.py
- Open each .bat file in a text editor and verify the active version of ArcGIS is listed in the logic

```bat
if exist c:\Python27\ArcGIS10.2 (
    set python=c:\Python27\ArcGIS10.2\python.exe
) else if exist c:\Python27\ArcGIS10.1 (
    set python=c:\Python27\ArcGIS10.1\python.exe
) else if exist c:\Python27\ArcGIS10.3 (
    set python=c:\Python27\ArcGIS10.3\python.exe
) else if exist c:\Python27\ArcGIS10.4 (
    set python=c:\Python27\ArcGIS10.4\python.exe
) else if exist c:\Python27\ArcGIS10.5 (
    set python=c:\Python27\ArcGIS10.5\python.exe
) else (
    echo Unknown Python install path.
    pause
    exit 1
```

Install_comptypes.bat & install_dependencies.bat

```python
def GetLibPath():
    """Return location of ArcGIS type libraries as string"""
    # return "C:/Program Files/ArcGIS/com/"
    import _winreg, os
    keyESRI = _winreg.OpenKey(_winreg.HKEY_LOCAL_MACHINE, \
                              "SOFTWARE\\ESRI\\ArcGIS")
    p = _winreg.QueryValueEx(keyESRI, "InstallDir")[0] + "com\\"
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.1\\com\\'
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.2\\com\\'
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.2.2\\Desktop10.2\\com\\'
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.3\\com\\'
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.4\\com\\'
    if not os.path.isdir(p): p = 'C:\\Program Files (x86)\\ArcGIS\\Desktop10.5\\com\\'
    return p
```

Snippets.py

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GENERAL SBAS TROUBLESHOOTING

- Ensure only ONE instance of ArcMap is open
- Verify that the SBAS setup tool created a Data Frame named, “SBAS”. This Data Frame needs to keep the name “SBAS” and sit in the first position in the Table of Content
- Tools in the SBAS toolbox are to be run sequentially. If you see a red X next to the tool you wish to run, check that your run all prerequisite steps.
- If you believe your sequence is correct but a red X still appears or your Alternative is not listed for selection, refresh the toolbox by right-clicking on the SBAS.pyt file and choose Refresh.

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ORACLE CLIENT INSTALLATION

Create Environmental Variables for your User Account

1) Download Oracle instantclient (or contact ACE-IT for assistance)

2) Unzip the ZIP file (C:\Oracle\instantclient_12_1).

3) Start > Search Windows > Environment. Choose ‘Edit Environment Variables for your Account’.

4) Create 2 new Variables:

- **Path** (set variable path to C:\Oracle\instantclient_12_1)
  - If a Path variable is already listed in the User Variables section of the Environment Variables dialog, select it, and then click Edit. Keep the existing value, add a semi-colon (;) then the path to the instanclient.
- **TNS_ADMIN** (set to C:\Oracle\TNSNAMES)

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SBAS: TOOL INPUT

- Littoral Cell footprint with detailed attributes of:
  - Volume Change
  - Placement & Removal Volumes
  - Sediment Transport Volumes
- Sediment Transport Direction
  - Sediment Transport Rates
- Data is grouped into Alternatives
  - **Alternative**—A representation of one set of assumed conditions for a sediment budget. Each alternative has its own set of littoral cells (with delta, placement [input], and removal [output] volumes) and fluxes.
  - Alternatives may be created to reflect different assumptions about sediment-transport paths/rates and engineering activities, or they may reflect different time periods.
  - **At least one alternative must be created in an SBAS session.** Alternatives hold all **values** applied to littoral cells and fluxes.

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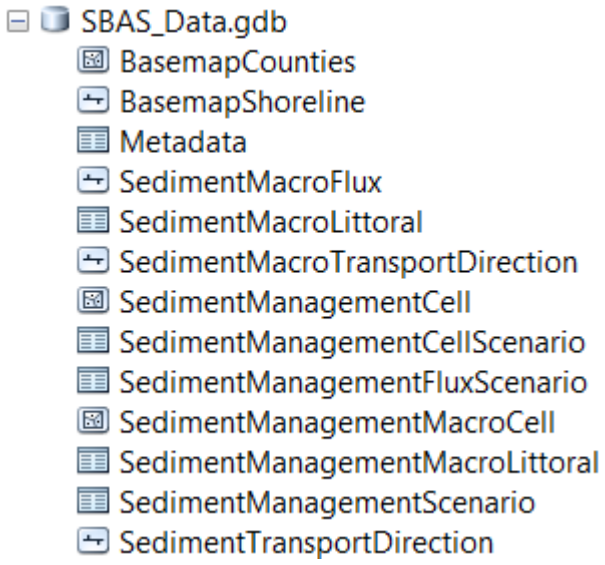
SBAS DATABASE SCHEMA

- All SBAS generated data is houses in the SBAS_Data file geodatabase
- All **geometries** are housed in:
  - Micro Budgets: SedimentManagementCell (Littoral Cell), SedimentTransportDirection (Flux)
  - Macro Budgets: SedimentManagementMacroCell (Littoral Cell), SedimentMacroFlux (Flux)
- Cells can we used in multiple Alternatives. These **non-spatial tables** contain a foreign key to a flux or cell geometry:
  - SedimentManagementScenarios (All Alternatives)
  - SedimentManagementCellScenrio (All Cell Values)
  - SedimentManagemetnFluxScenario (All Flux Values)



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SBAS: TOOL OUTPUT

- Calculated Residual:
  - *Identifies, per cell, if sediment in primary moving in or out.*
- Sediment Budget:
  - *Assists the District in identifying the erosion and accretion areas along a swath of shoreline.*
- Published Metadata Record:
  - *Metadata allows the budget to be discoverable to others and provides an official archive of the budget.*

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SBAS DEMO

Using ArcGIS 10.4

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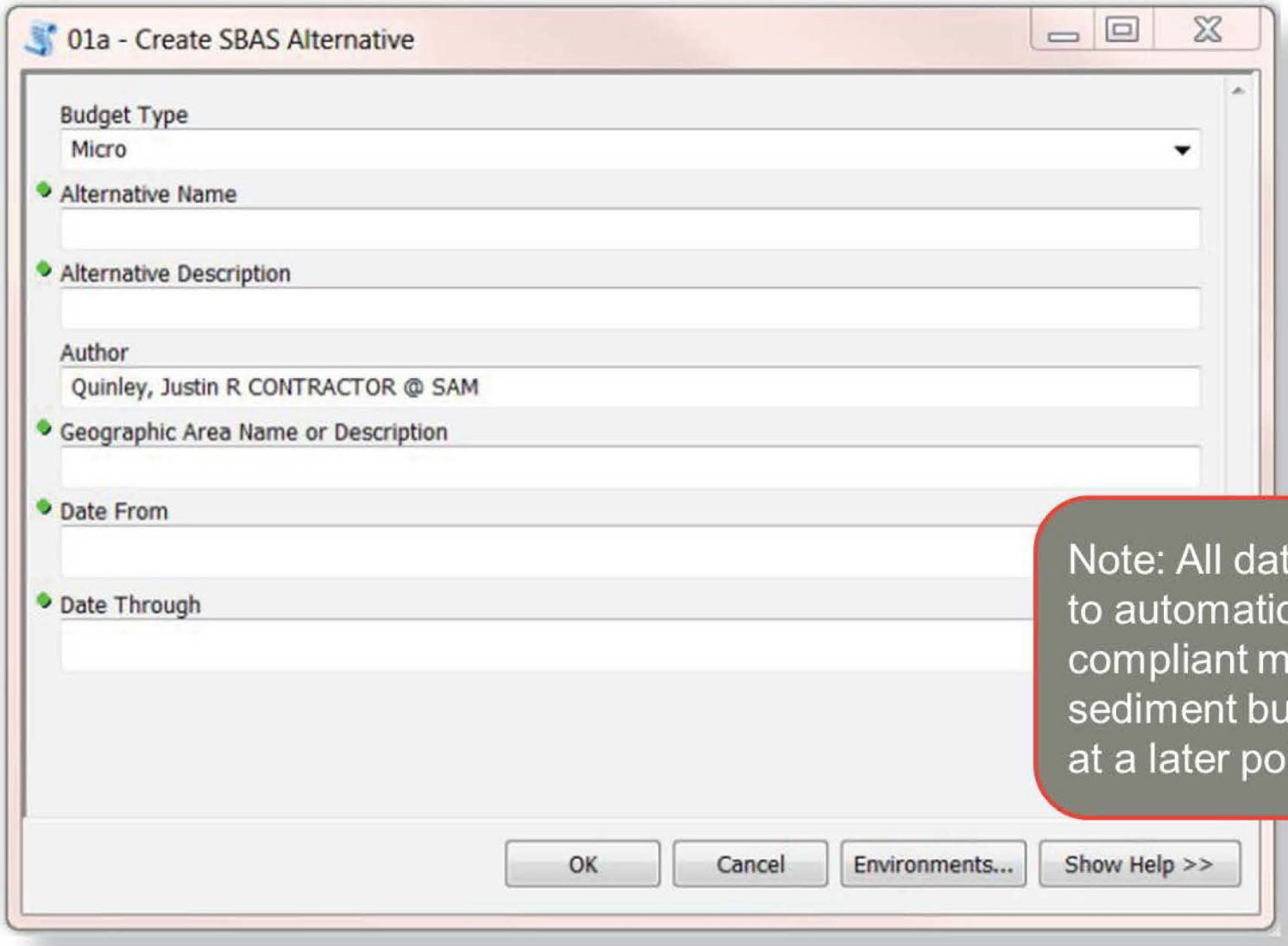
CREATING SEDIMENT BUDGETS



Note: All data collected here is used to automatically create an ISO-compliant metadata record so the sediment budget cab be discovered at a later point.

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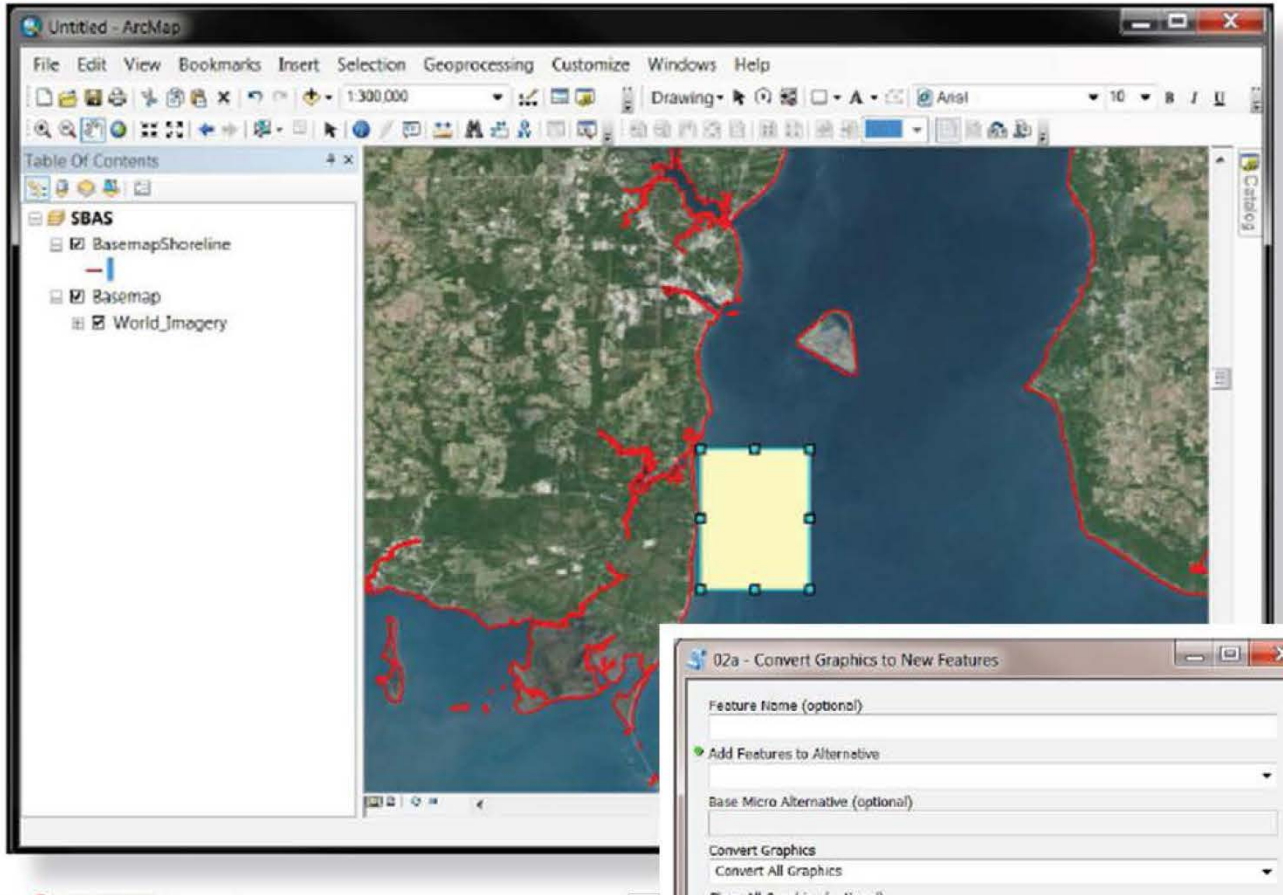
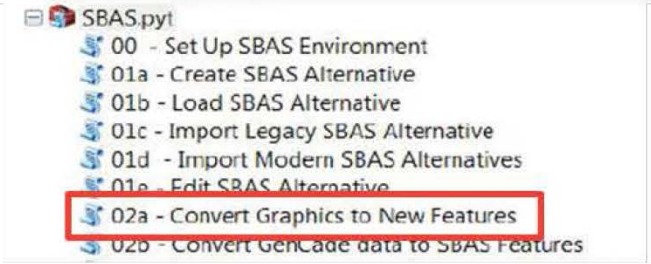
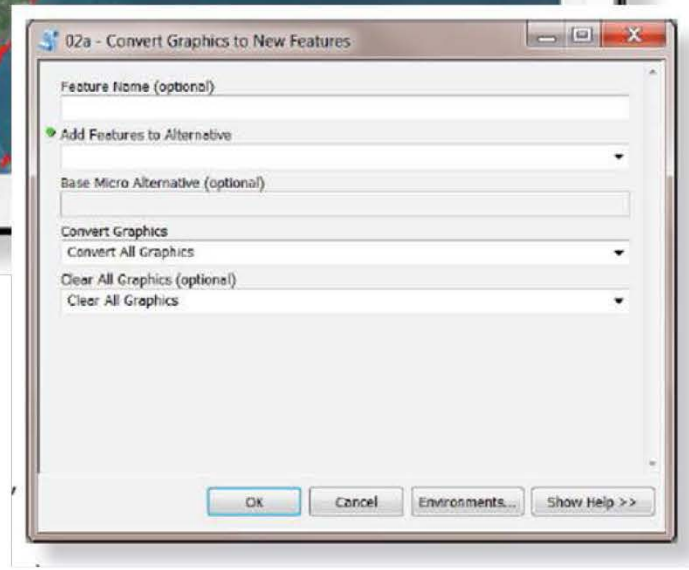
CREATING SEDIMENT BUDGET CELLS







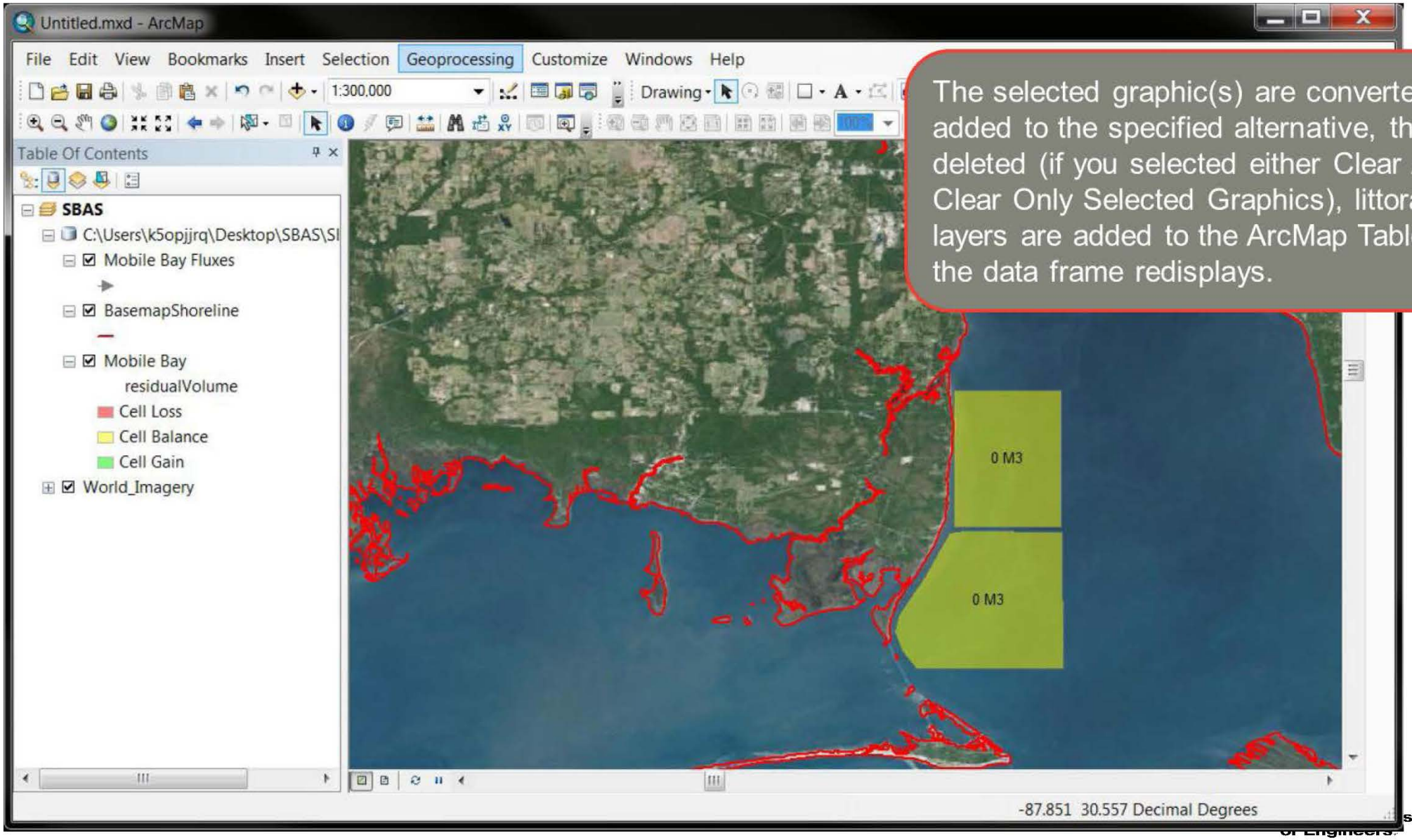
Using the ArcMap Drawing tool, sketch the littoral cells in the mapping display, using basemap data for reference.

When satisfied, convert to features.

Littoral Cell—A collection of information describing similar physical, biological, and cultural characteristics within a particular area along a river, lake, sea, or ocean. Littoral cell data can be in the form of a map, database, or text. The boundaries of the littoral cells can be defined either by morphological features (such as ebb and flood shoals, an inlet throat, and adjacent beaches) or by political features (such as nautical charts and municipal boundaries).

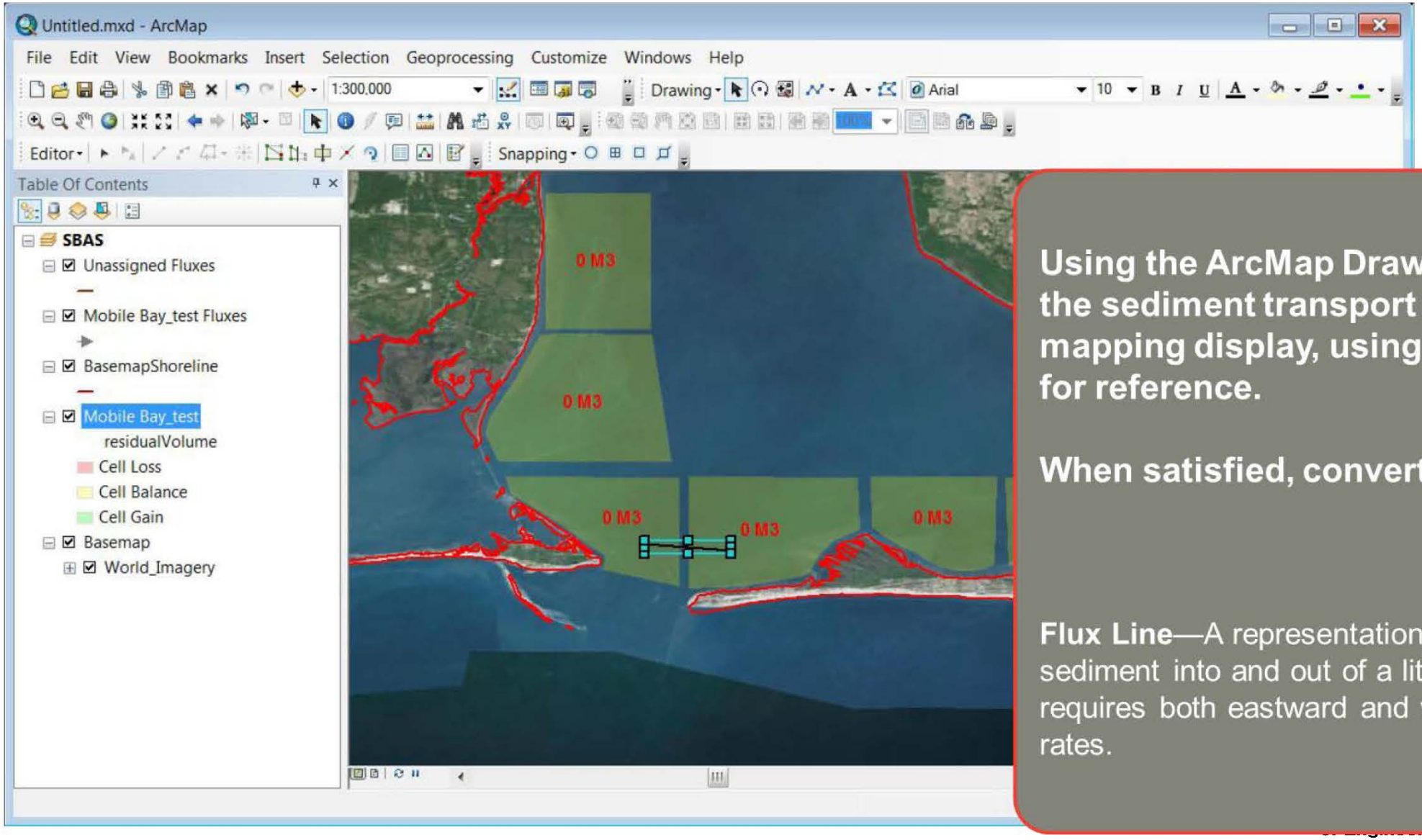
Feature—A point, line, or polygon that represents an object on a map.

CREATING SEDIMENT BUDGETS - GEOMETRY



The selected graphic(s) are converted to features and added to the specified alternative, the graphics are deleted (if you selected either Clear All Graphics or Clear Only Selected Graphics), littoral cell and flux layers are added to the ArcMap Table of Contents, and the data frame redisplays.

CREATING SEDIMENT BUDGET FLUXES



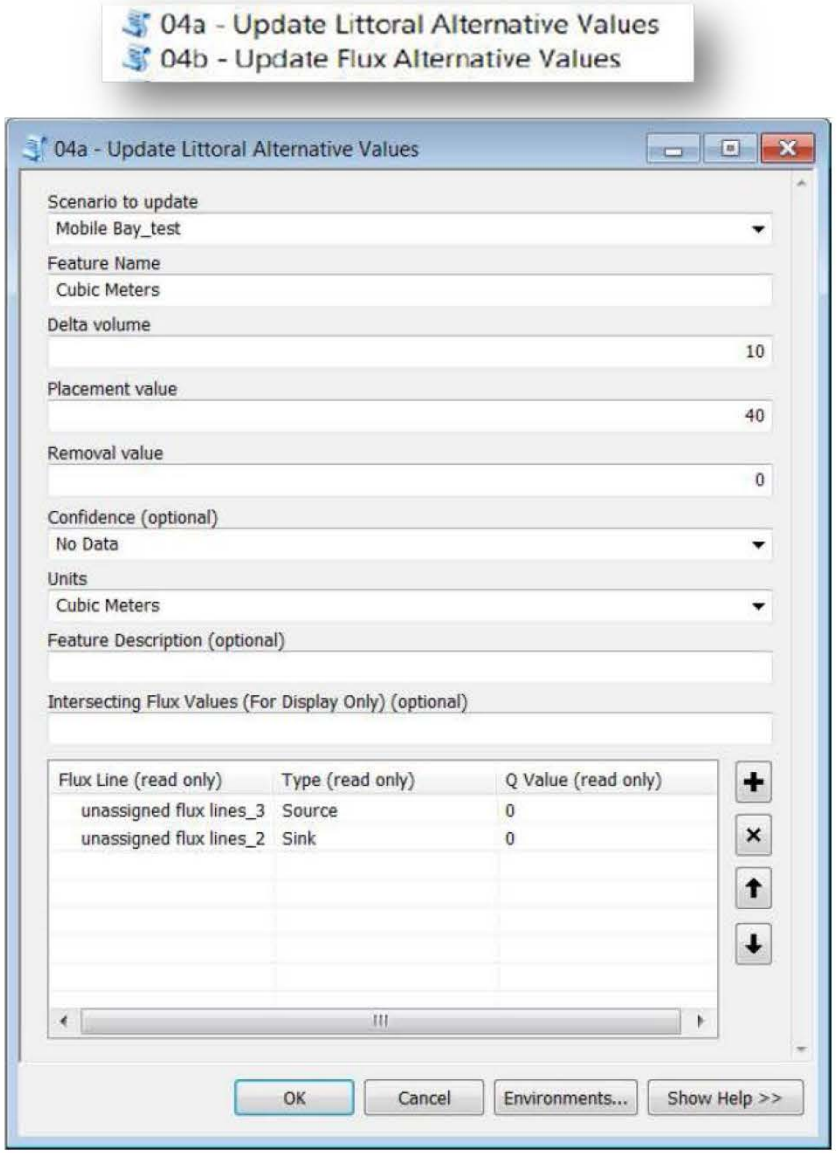
Using the ArcMap Drawing tool, sketch the sediment transport direction in the mapping display, using basemap data for reference.

When satisfied, convert to features.

Flux Line—A representation of the flow of sediment into and out of a littoral cell. Each cell requires both eastward and westward transport rates.

ADDING VALUES TO SEDIMENT BUDGETS

- **Scenario to Update**—The name of the alternative; the current alternative is selected by default
- **Feature Name**—The name of the cell as assigned by the user or SBAS
- **Delta Volume**—Volume change of sediment within the cell (in the units specified in the Units drop-down)
- **Placement Value**—Amount of sediment placed in the cell (in the units specified in the Units drop-down)
- **Removal Value**—Amount of sediment removed from the cell (in the units specified in the Units drop-down), typically through dredging
- **Confidence**—Your certainty level that the values assigned to the littoral cell in this dialog are accurate—No Data (default), High, Medium, or Low
- **Units**—Units in which the delta, placement, and removal volumes are recorded— Cubic Yards (default) or Cubic Meters
- **(Optional) Intersecting Flux Values (For Display Only)**—Visual



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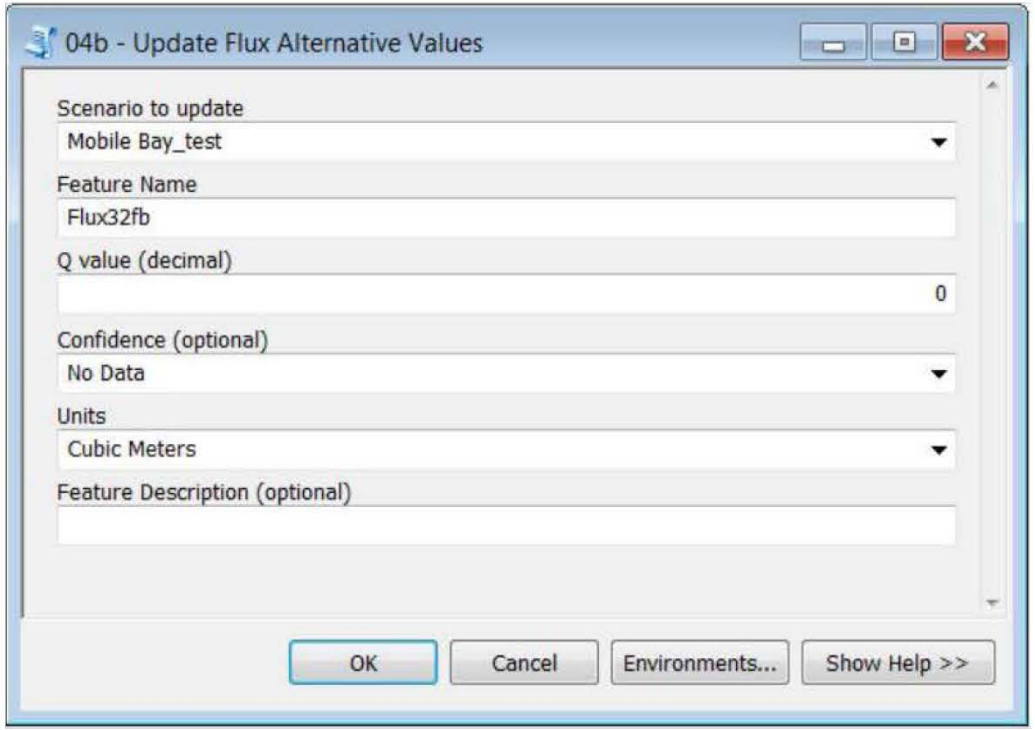
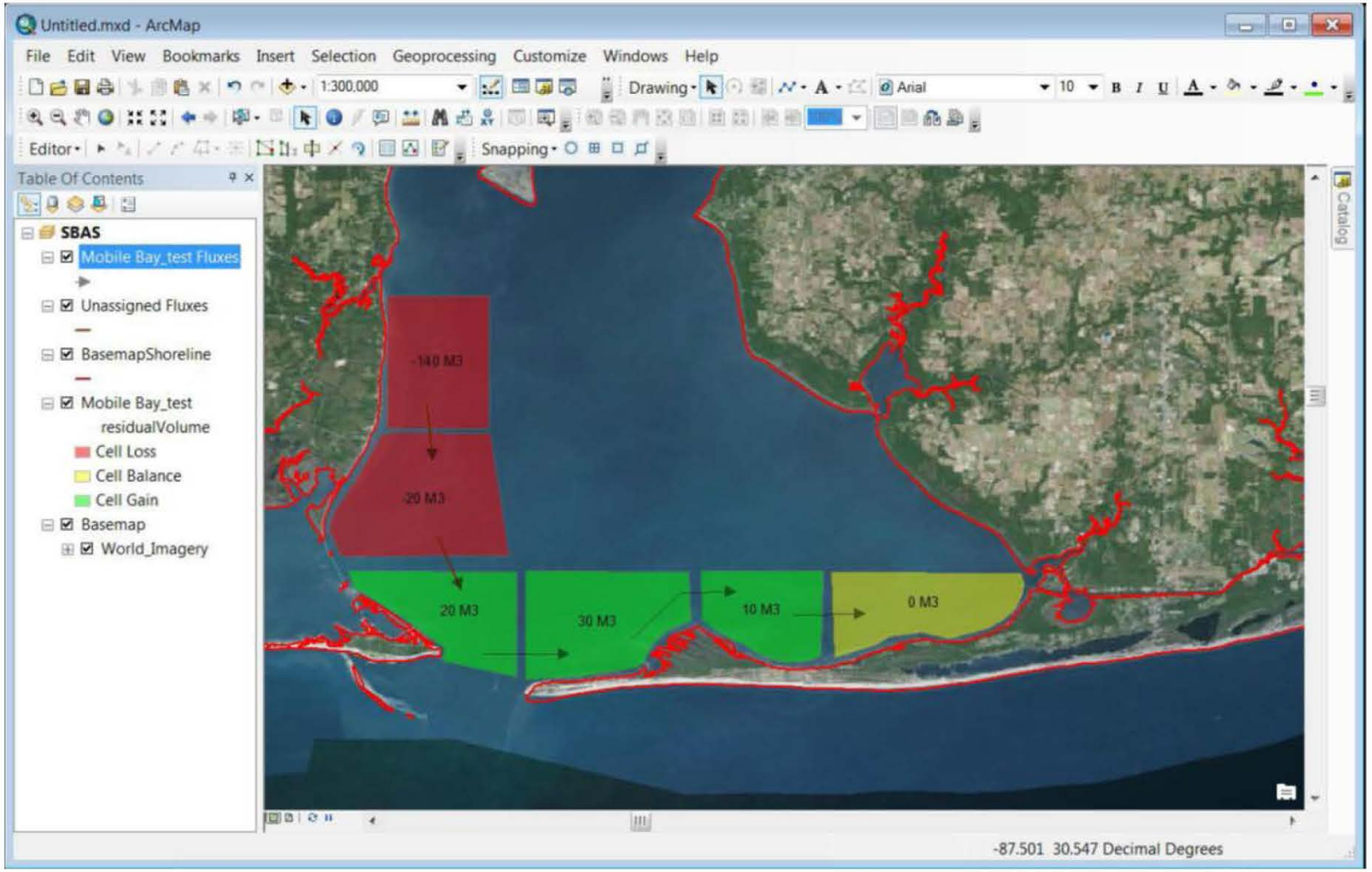
ADDING VALUES TO SEDIMENT BUDGETS

- **Scenario to Update**—The name of the alternative; the current alternative is selected by default
- **Feature Name**—The name of the flux as assigned by the user or SBAS
- **Q Value**—The volume of sediment moved into or out of a littoral cell
- **Confidence**—Your certainty level that the values assigned to the flux line in this dialog are accurate—No Data (default), High, Medium, or Low
- **Units**—Units in which the delta, placement, and removal volumes of the littoral cell are recorded—Cubic Yards, Cubic Yards/Year, Cubic Meters, or Cubic Meters/Year



LITTORAL CELLS & SEDIMENT FLUX VISUALIZATION



$$\Sigma Q_{source} - \Sigma Q_{sink} - \Delta V + P - R = Residual$$

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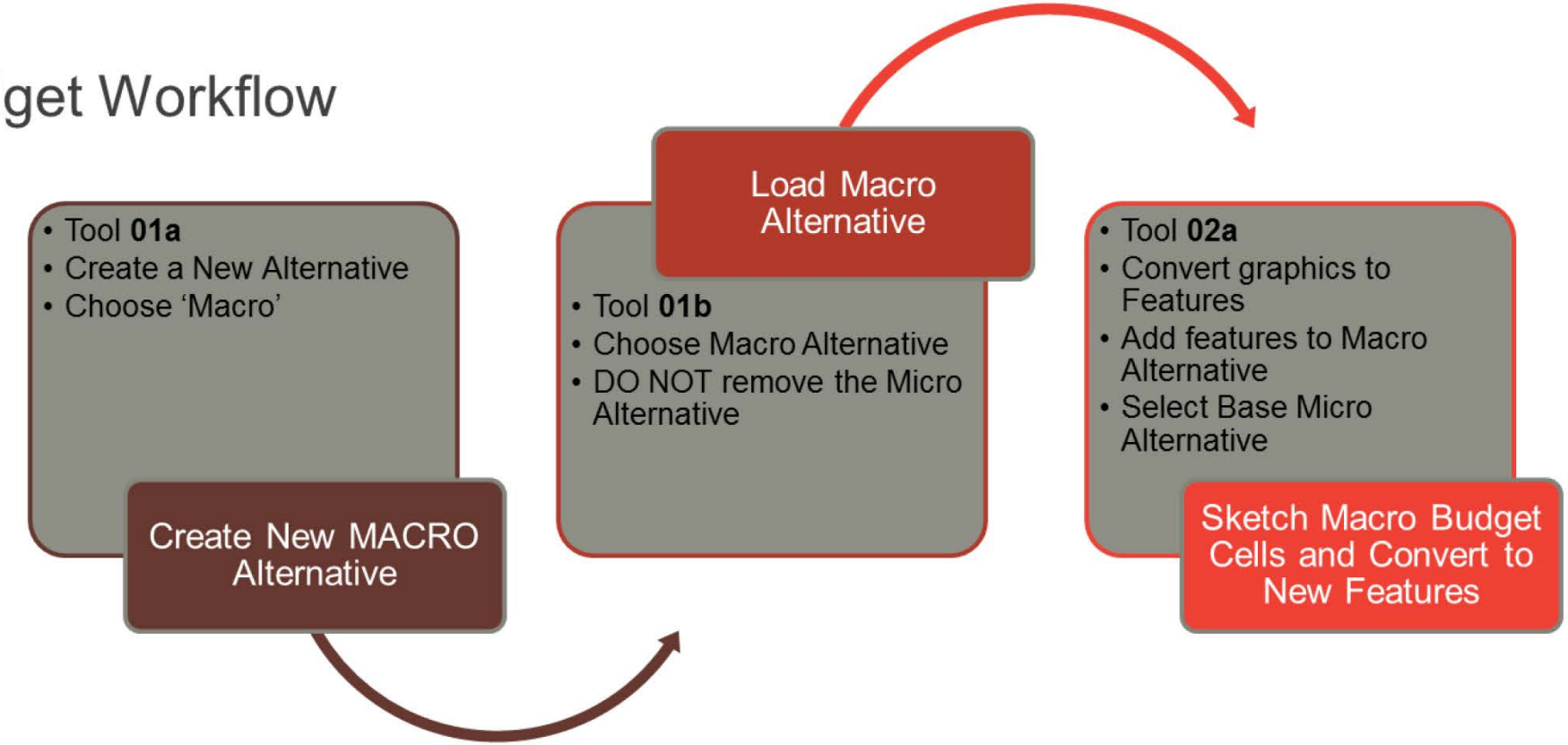
MACRO BUDGETS

When localized Micro Sediment Budgets are complete*, littoral cells can be grouped into “Macro Budget Cells”

Macro Budget Workflow



**If a Macro budget is created for a Micro budget, the Micro Budget can no longer be edited. To resume editing of the Micro budget, delete the Macro Alternative with tool 07.*

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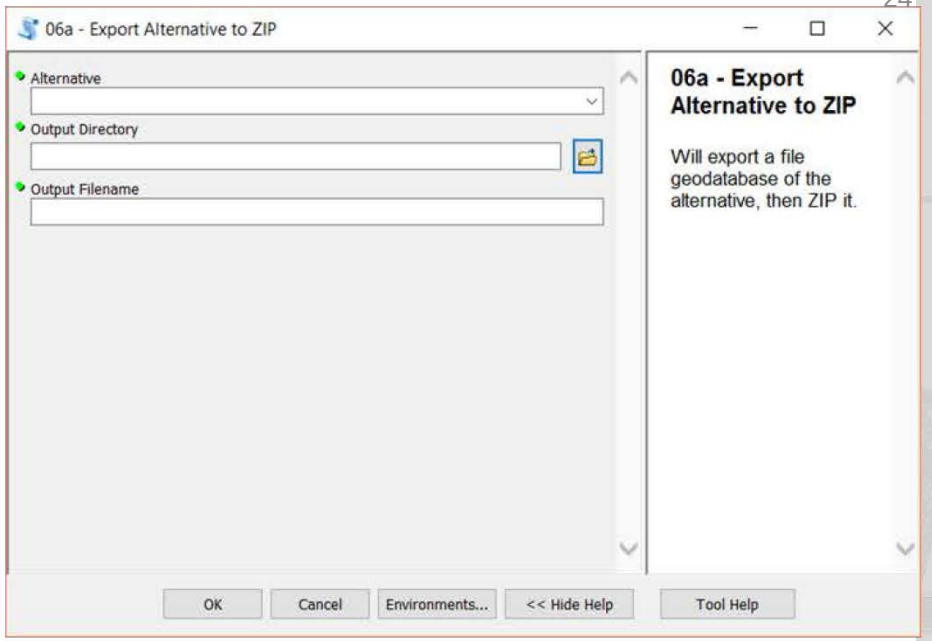
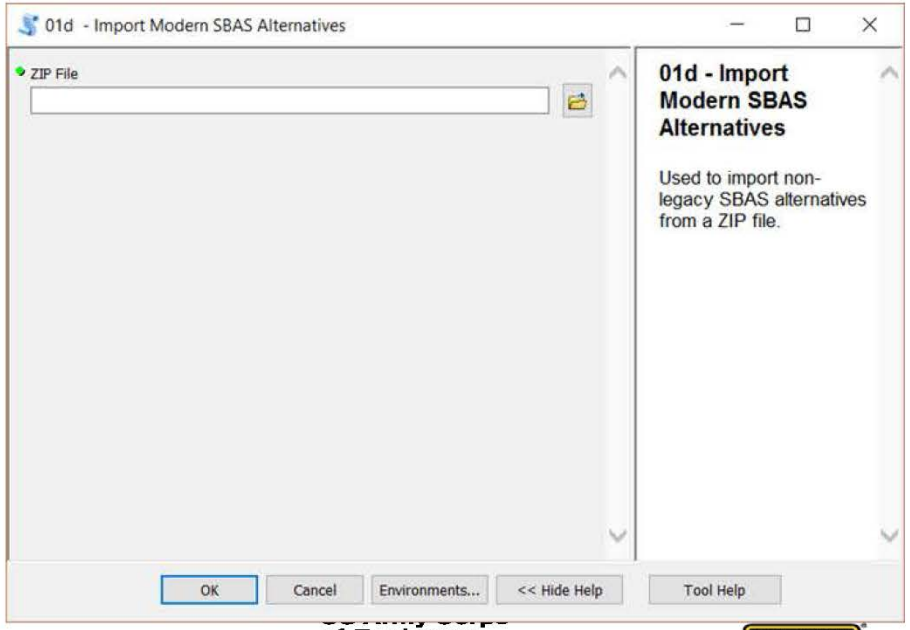
SAVING AND RETRIEVING SEDIMENT BUDGETS

- All data is automatically saved to the SBAS_Data.gdb as new features and values are created or updated.
  - To share budget with another SBAS users extract just the active alternative, use Tool 6a – Export Alternative to ZIP to create a composite file.
  - A new file geodatabase will be created that ONLY includes data for the selected Alternative.
- An MXD (ArcMap Project) file can be saved if you add non-SBAS feature classes or additional basemaps into the display.
- Retrieving Alternative
  - To load the littoral cells and fluxes into any ArcMap session from a ZIP file, use Tool **1d – Import Modern SBAS Alternative**
  - If data was not exported into a ZIP, alternatives can also be loaded with the **Tool 1b – Load Alternative**. This directly connects to the SBAS_Data.gdb.





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SBAS IN THE ENTERPRISE

How others can access your final datasets

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SBAS WORKSPACES

- All SBAS data remains on your local machine until they are “uploaded to the enterprise”. (Tool 6b – Upload Alternative to the Enterprise)
- “Into the Enterprise” = central USACE database that is available through Web Services
  - The SBAS installation include a SDE connection to the central USACE database holding all finalized SBAS data.
  - In order to publish, an Oracle Client must be available on your machine.
- Web Services are public (read-only) data connectors that allow SBAS alternatives to be accessed by desktop or online mapping applications.
- The Web Services are hosted from CESAM and read the CPC data.
- Multiple web maps call these web services.

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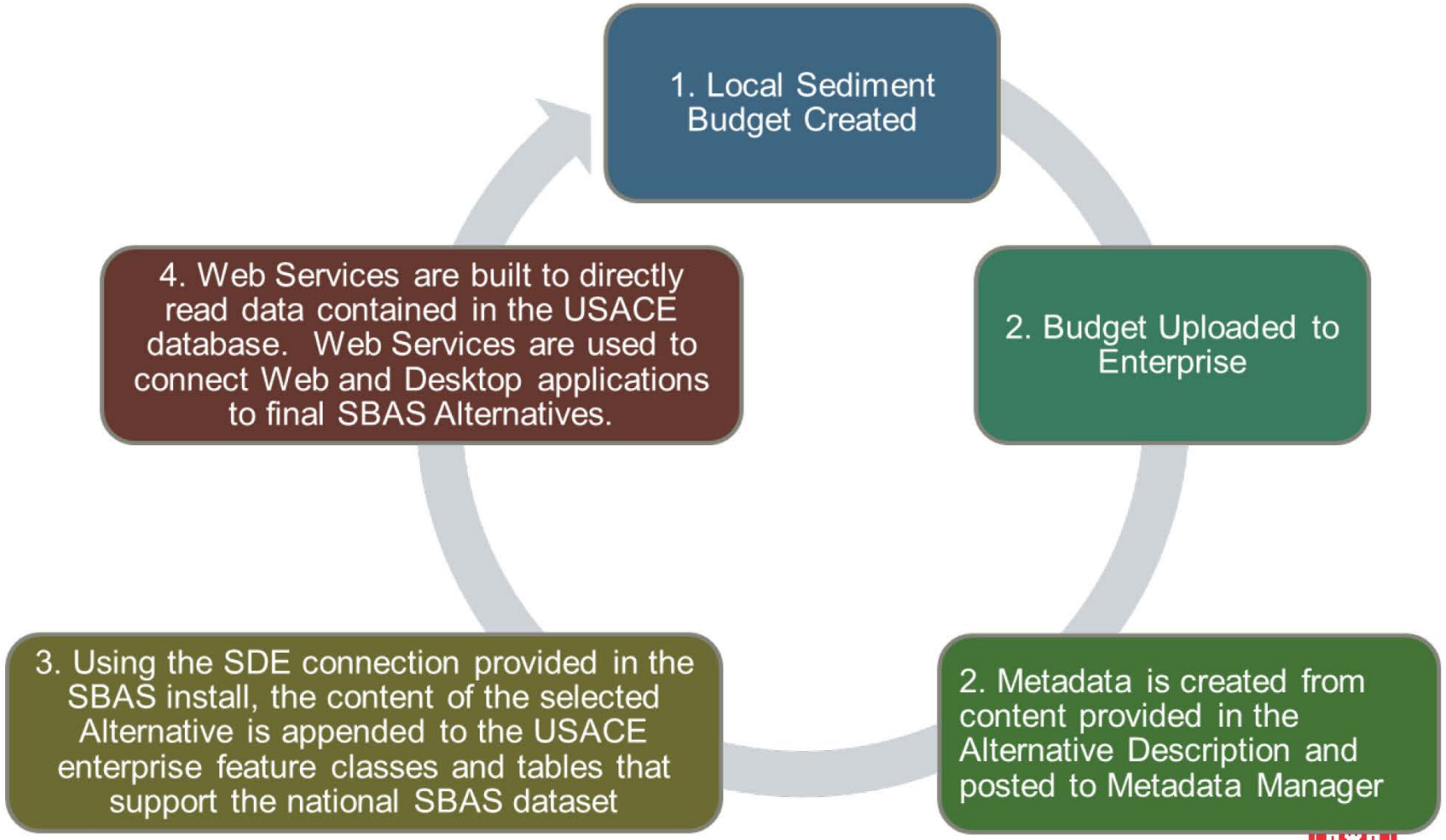
PRODUCTION DATA WORKFLOW



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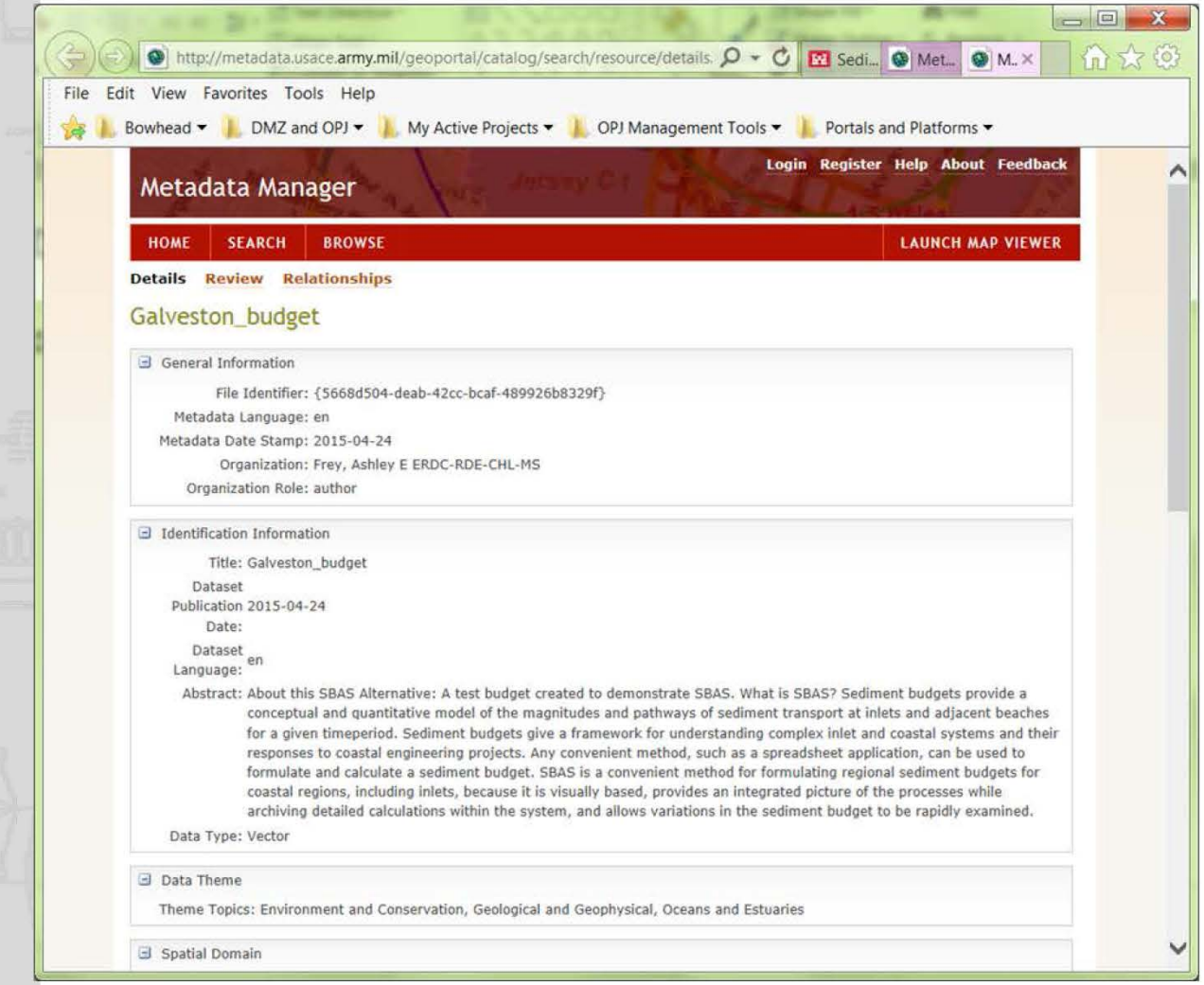
METADATA MANAGER



- Published metadata allows sediment budgets to be discovered.
- Content can be designed to be consumed into other applications where web services are supported.
- The architecture of USACE's Metadata Manager is being modified to be registered with data.gov

http://metadata.usace.army.mil/geoportal/catalog/main/home.page

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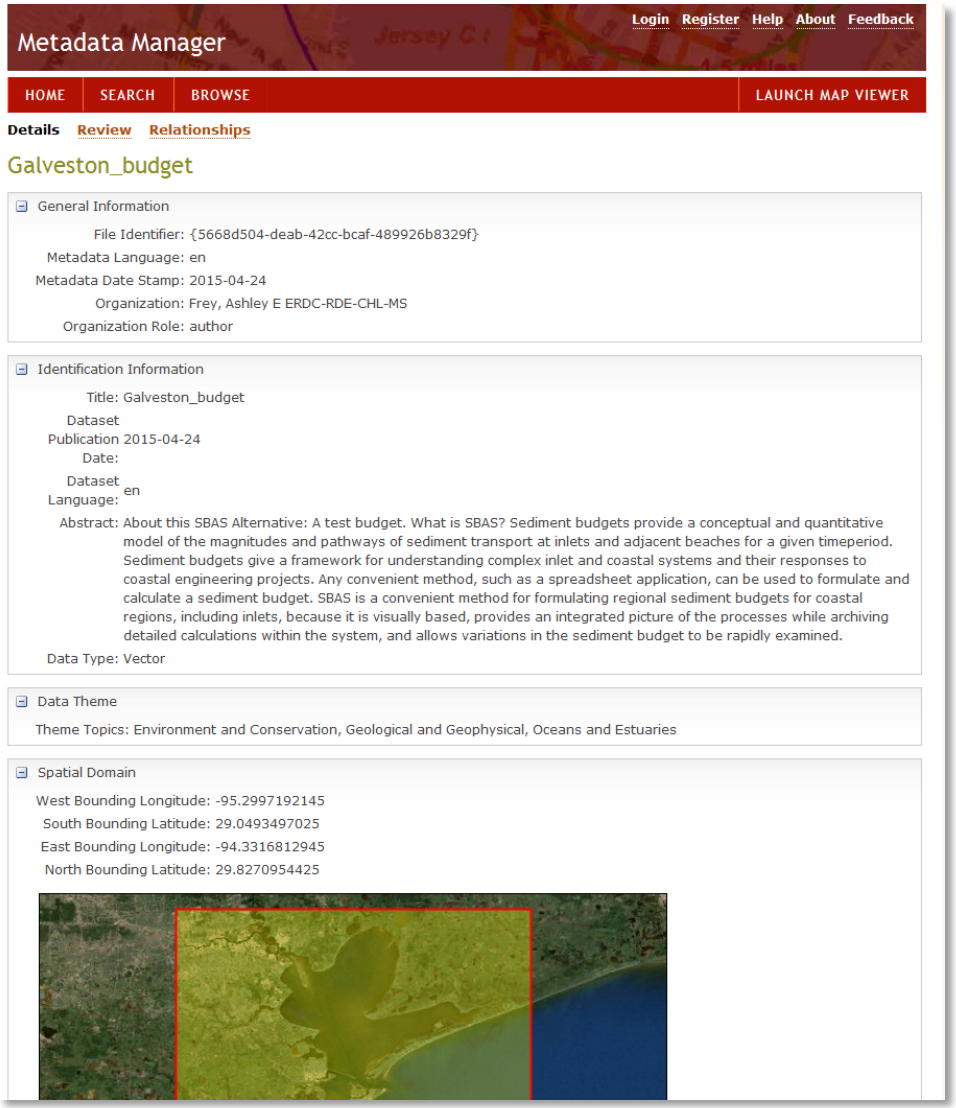
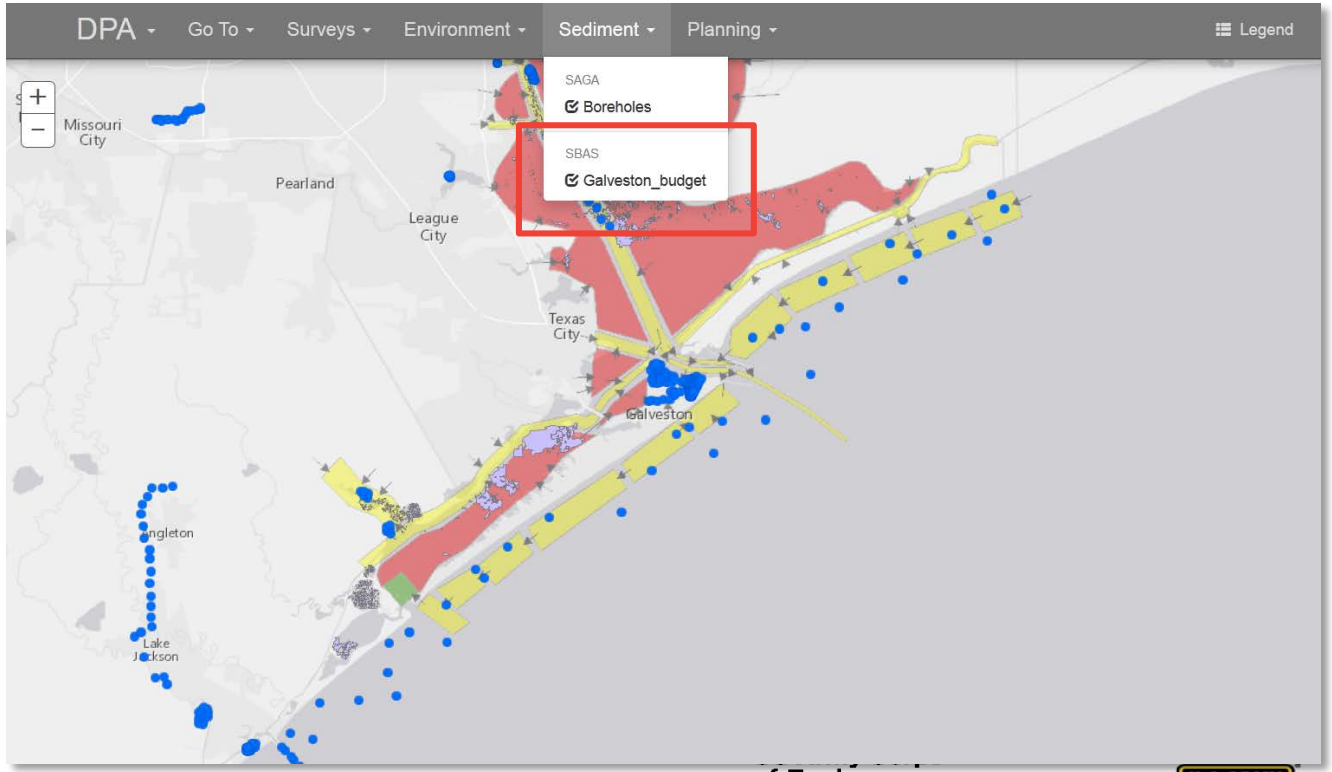
- Online mapping applications are designed to read published SBAS metadata records.
- Using the accessible web service URL, applications can quickly query (text and spatial), load, and draw sediment budgets directly pulled from the masterly SBAS database.