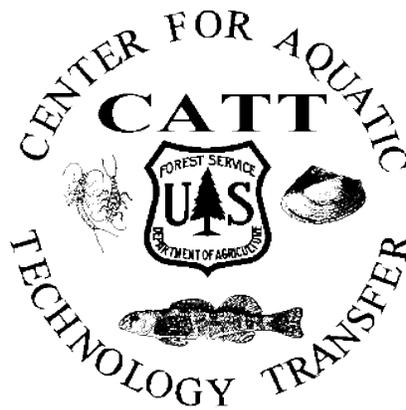


CADSS

Crossing Assessment Decision Support System

**USDA Forest Service, Southern Research Station
12/16/2011**



This manual includes instructions for the Watershed Prioritization Tool, the Crossing Replacement Tool, and several data editing tools contained within CADSS. For additional information contact Craig Roghair, croghair@fs.fed.us, 540 231-0078.

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CADSS Information

The crossing assessment decision support system (CADSS) is a suite of tools developed to assist managers with prioritization of road-stream crossing replacements. Currently there are two prioritization tools: the Watershed Prioritization Tool (WPT) and the Crossing Replacement Tool (CRT). The tools use geographic, physical, and biological data in combination with user-defined criteria to develop a list of high priority hydrologic units and a list of high priority crossing replacements. Several other tools are included to assist with data editing tasks.

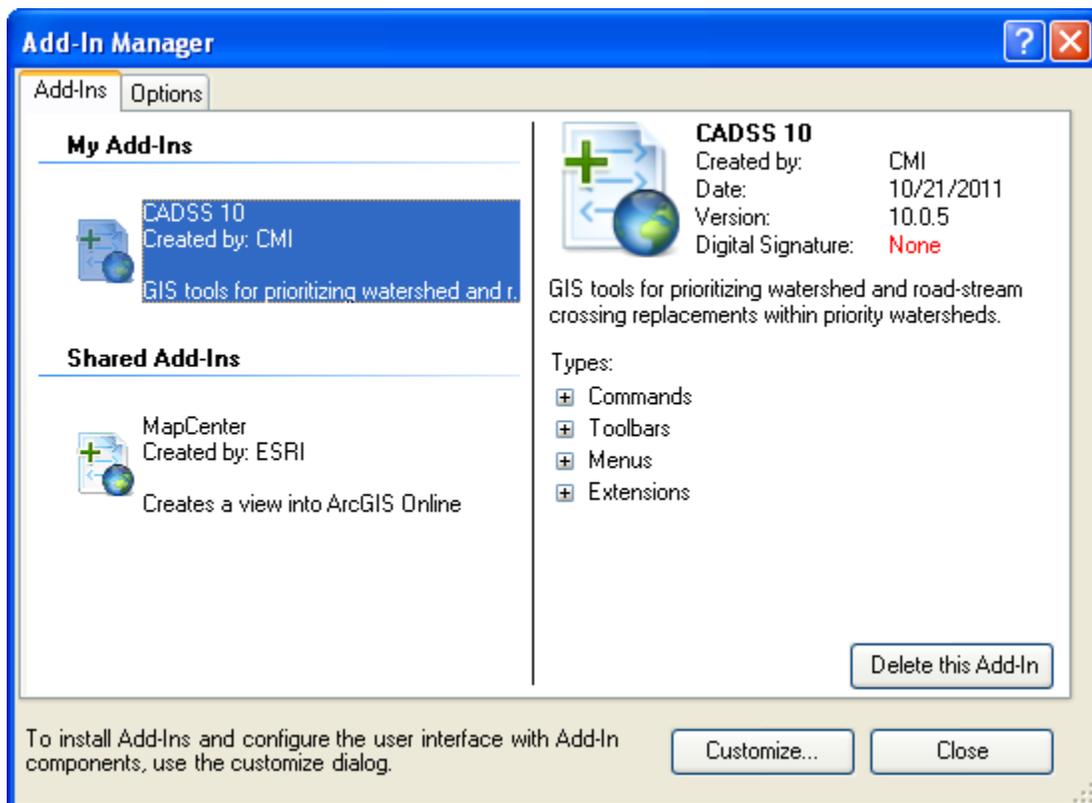
CADSS was developed through a partnership between the Forest Service Southern Research Station and the Virginia Tech Conservation Management Institute. The most recent release was developed as an add-in for ArcMap10, service pack 2. CADSS has been successfully used with service packs 1, 2, and 3.

The CADSS add-in installation file is available by contacting Craig Roghair croghair@fs.fed.us

Installing CADSS

Before installation

Before installing, check ArcMap to see if a previous version of CADSS is already installed. In ArcMap10 select **Customize > Add-In Manager**.



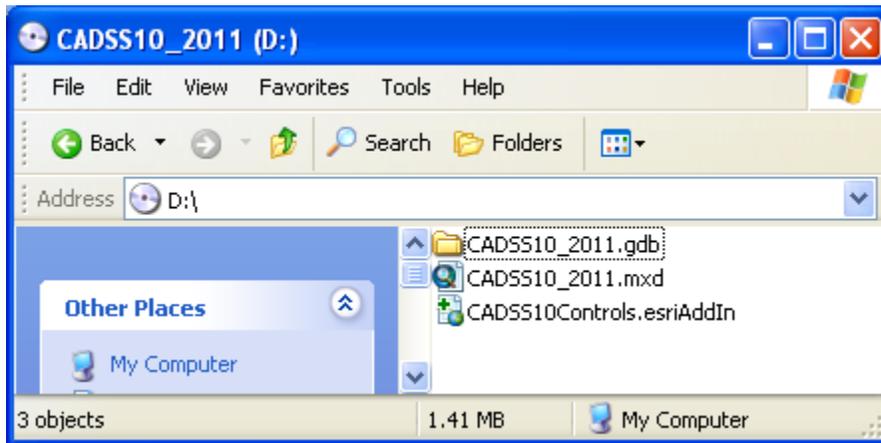
If CADSS appears in the Add-In Manager make sure it is the most current version; if not click **Delete this Add-In**.

If CADSS does not appear in the Add-In Manager then it is not installed.

Proceed with installation only after you confirm CADSS is not currently installed.

Installation

The CADSS installation disk contains 3 files:



CADSS10_2011.gdb is the geodatabase that contains data to run CADSS.

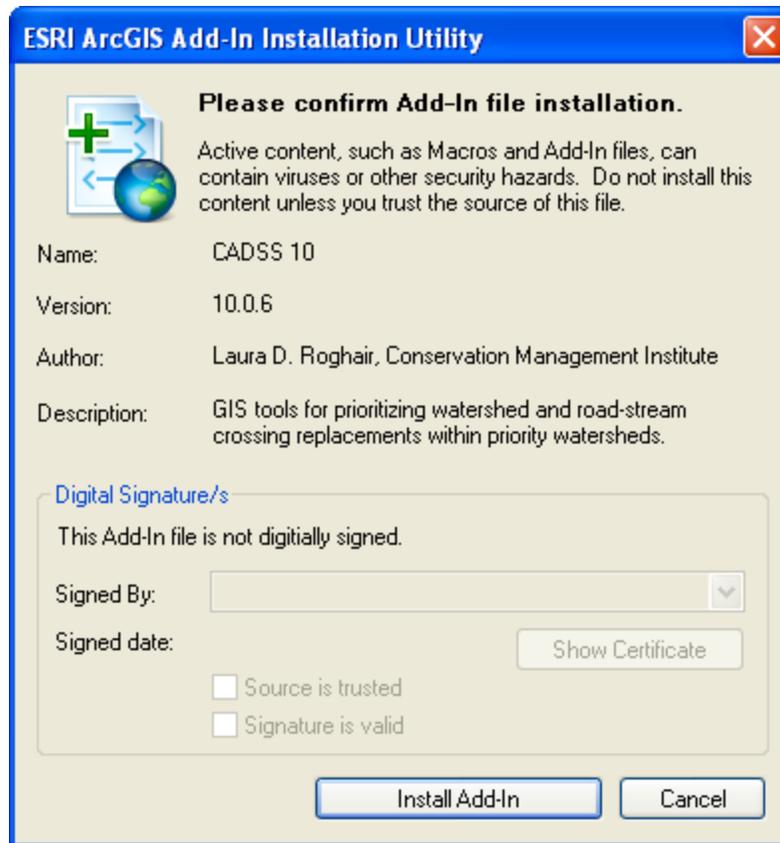
CADSS10_2011.mxd is the map document that displays CADSS data.

CADSS10Controls.esriAddIn is the file used to install the CADSS tool in Arc10.

Keep a **backup** copy of the **CADSS10_2011.gdb** file and the **CADSS10_2011.mxd** file. The tools in CADSS can change values within the geodatabase, so if you want to be able to restore your original data after testing the tools, be sure to keep the original installation disk, or create a backup.

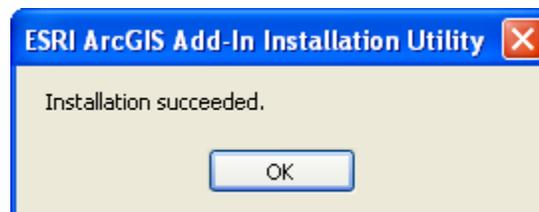
Copy all 3 files to a local directory.

Double-click the **CADSS10Controls.esriAddIn** to begin the installation utility.



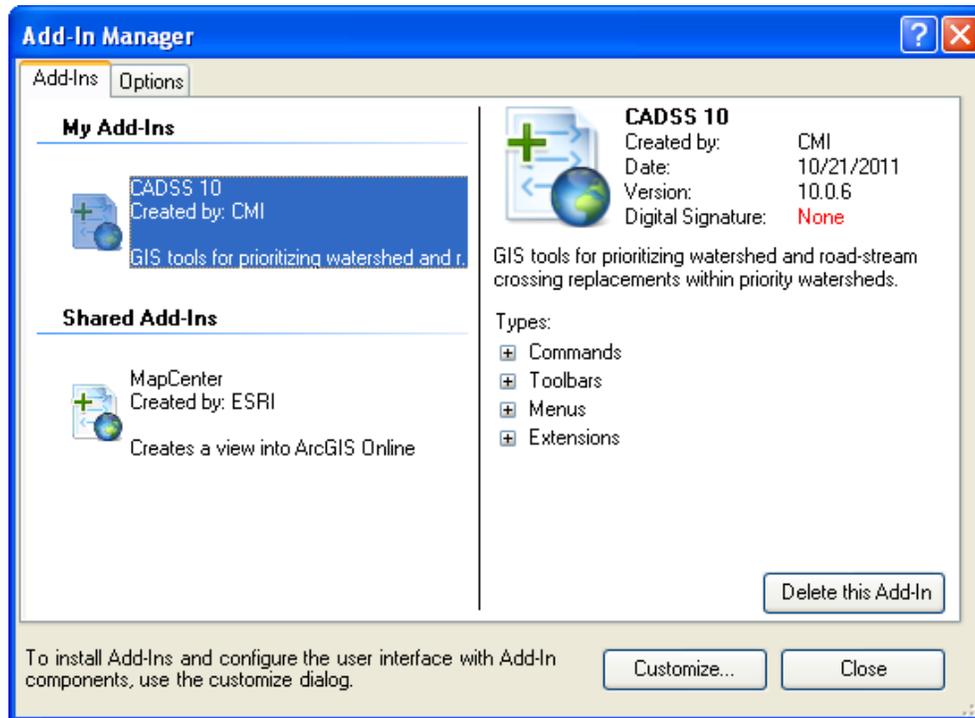
Click **Install Add-In** –

NOTE: you do **NOT** need to have admin rights (self-promote) to install

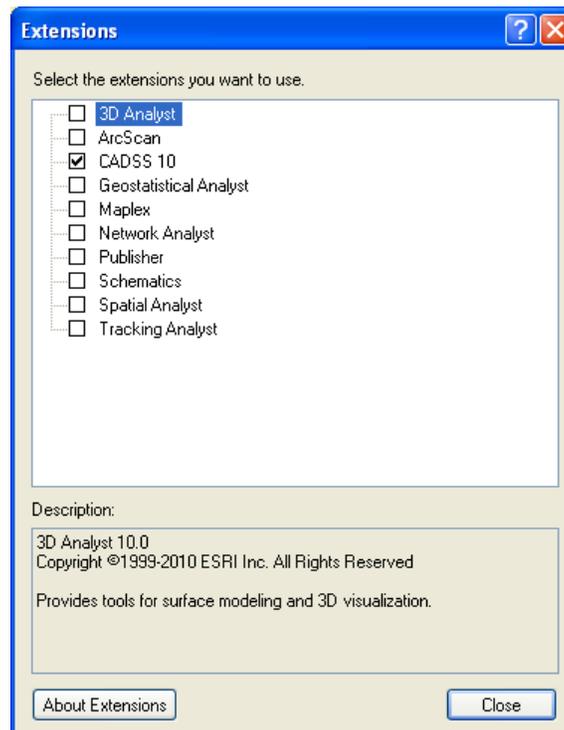


To confirm installation, **start ArcMap10**, then select **Customize > Add-In Manager**

If installation was successful CADSS will appear in the My Add-Ins section.



You must activate CADSS prior to use. Click **Customize > Extensions**, and check mark **CADSS 10**.

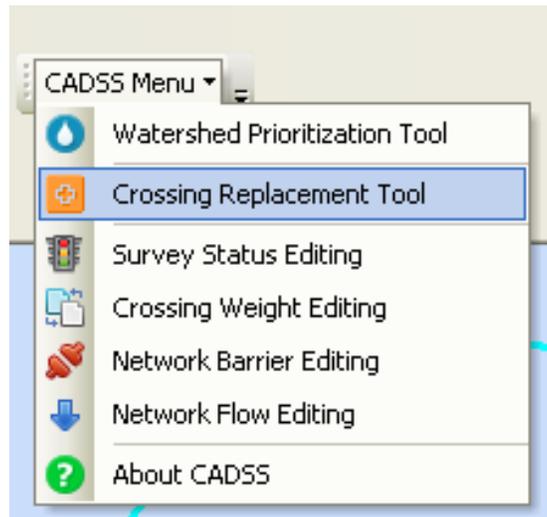


To view the CADSS toolbar, select **Customize > Toolbars > CADSS Main**

To view the CADSS tools available, click the dropdown arrow at the right of the menu bar

To run a tool, click on its name in the drop-down menu.

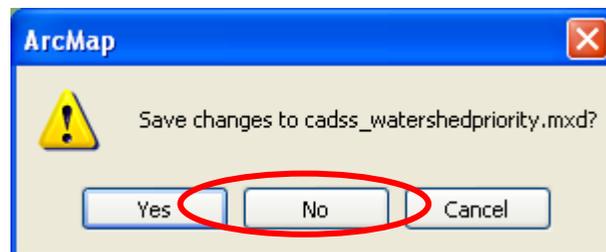
Refer to the appropriate sections in this manual for detailed use instructions.



Exiting CADSS

To close CADSS, simply close ArcMap as normal.

DO NOT save changes to the CADSS10_2011.mxd file

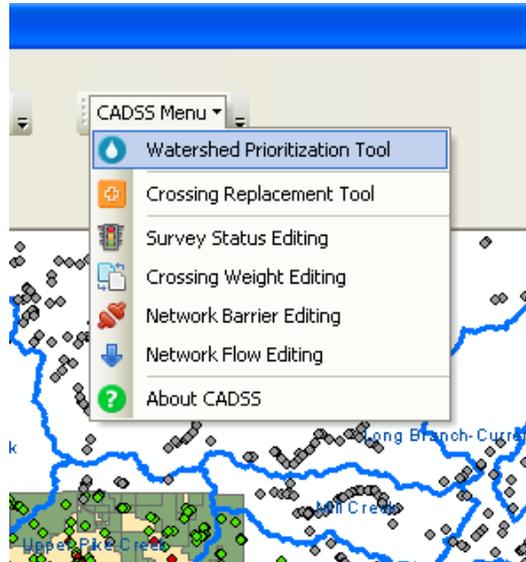


Watershed Prioritization Tool (WPT)

The WPT is used to prioritize among hydrologic units, typically HUCs, within a particular analysis area.

Before starting the WPT, open **CADSS10_2011.mxd**; select File, Open, then browse to the file

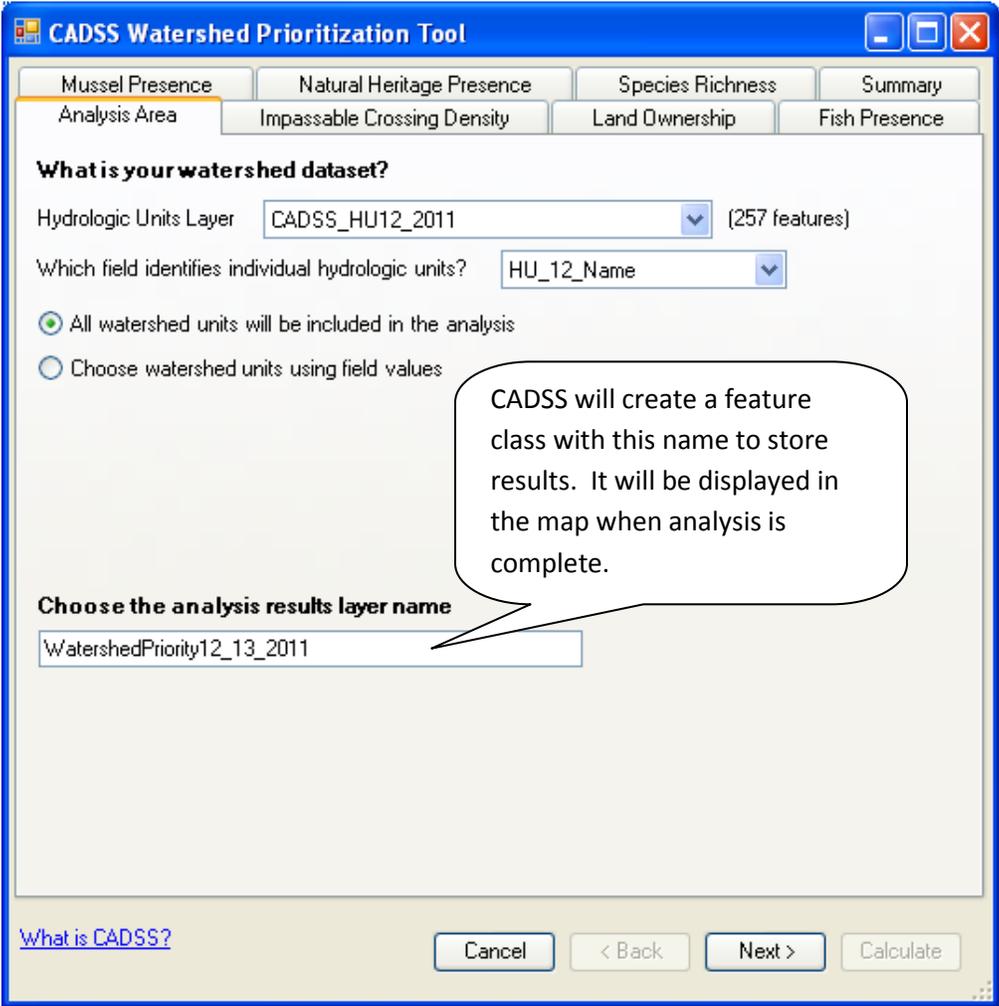
To run the WPT, select **Watershed Prioritization Tool** from the CADSS dropdown menu.



Analysis Area

The Analysis Area form shows the default hydrologic unit layer that is used by CADSS. You can analyze all hydrologic units (default), or customize the analysis area by selecting specific units for analysis.

Don't forget to **input a unique name** for your output feature class at the bottom of the form.



Choosing specific units is a good way to shorten the analysis run time. To select specific analysis units click either the **Choose watershed units using field values** radio button, or the **Advanced Selection** link. See next page for details.

Select individual analysis units by name or number using the dropdown menus

The screenshot shows a software interface with two radio buttons at the top: "All watershed units will be included in the analysis" (unselected) and "Choose watershed units using field values" (selected). Below this, there are two dropdown menus. The first is labeled "Which field identifies analysis units?" and has "HUC_12" selected. The second is labeled "Which value indicates an analysis unit?" and has a list of HUC numbers: 071401020201, 071401020202, 071401020203 (highlighted in blue), 071401020204, 071401020205, 071401020206, 071401020301, and 071401020302. A red "1" is next to the dropdown arrow. Below the dropdowns is a link "Advanced Selection" and a section titled "Choose the analysis results layer name" with a text box containing "WatershedPriority12_13_2011".

Select multiple analysis units by clicking the **Advanced Selection** link to open the SQL Query window

The screenshot shows a window titled "SQL Query" with a list of fields: "States", "LoadDate", "HUC_12", "HU_12_Name", "HU_12_Type", and "HU_12_Mod". Below the list are buttons for "<>", "Like", ">=", "And", "<=", "Or", "()", and "Not". A list of HUC values is shown: '102902010501', '102902010503', '102902010504', '102902010505', '102902010506', '102902010507', and '102902010602'. There are also buttons for "Is", "Get Unique Values", and "Go To:". The SQL query text at the bottom reads: "SELECT * FROM CADSS_HU12_2011 WHERE: 'HUC_12' LIKE '102902%'". At the bottom of the window are buttons for "Clear", "Verify", "Help", "Load...", "Save...", "OK", and "Cancel". A callout bubble on the left says: "Click **Advanced Selection** to select multiple units. This example code will select all HUCs starting with 102902."

Once you have made your selections, navigate to the next form using the **Next** button. To return to this form use the **Back** button.

Impassable Crossing Density

The Impassable Crossing Density form asks how important it is to consider crossing density when prioritizing analysis units.

Options range from ‘Extremely’ important to ‘No opinion’. Impassable crossing density must be included in the analysis, so ‘Not at all’ is not available as an option. The category weight (red numbers in upper right) will change as you select different values.

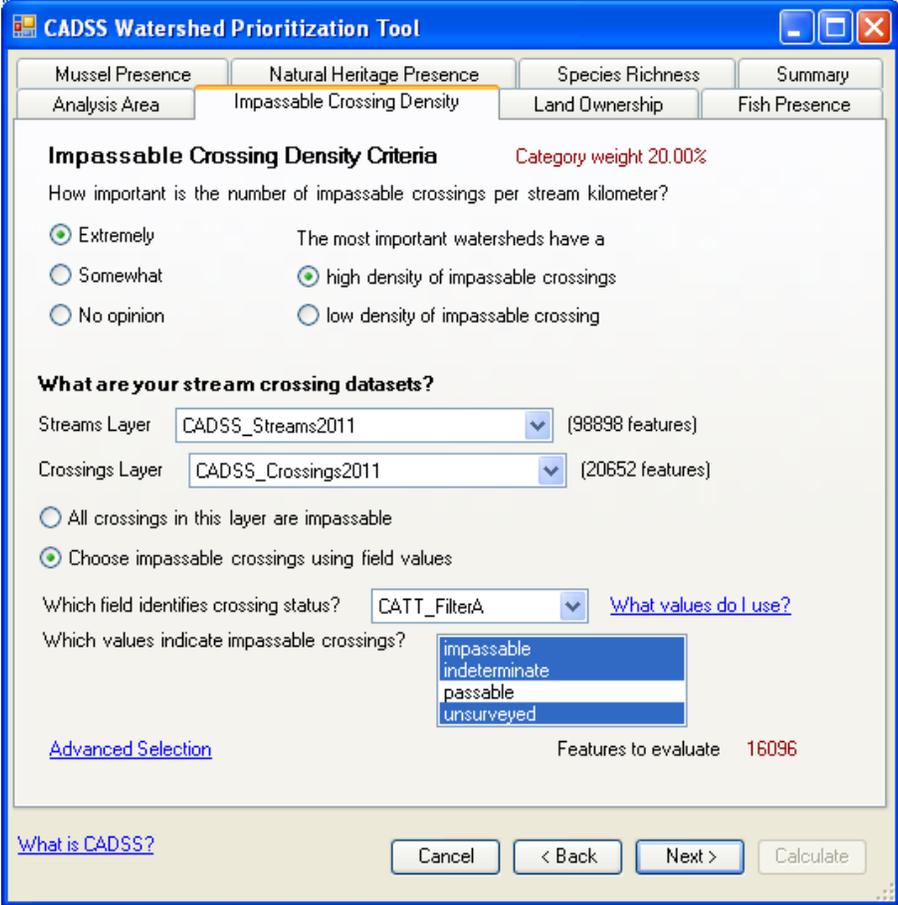
You may indicate whether you would like to prioritize for units with either high or low crossing density.

CADSS comes with default layers, but you may select other layers as needed.

You may choose to designate crossing status based on a field value (default), or to include all crossings as impassable.

If you wish to choose impassable crossings using a field value then you must indicate which field contains the values, and then what values should be considered as impassable. These fields are pre-populated if you use the default layers.

In the example below we are using Filter A results, and telling CADSS to consider impassable, indeterminate, and unsurveyed crossings as impassable when running the analysis.



Land Ownership

The Land Ownership form asks how important it is to consider Forest Service management when prioritizing analysis units.

Options range from ‘Extremely’ important to ‘Not at all’. Selecting ‘Not at all’ will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

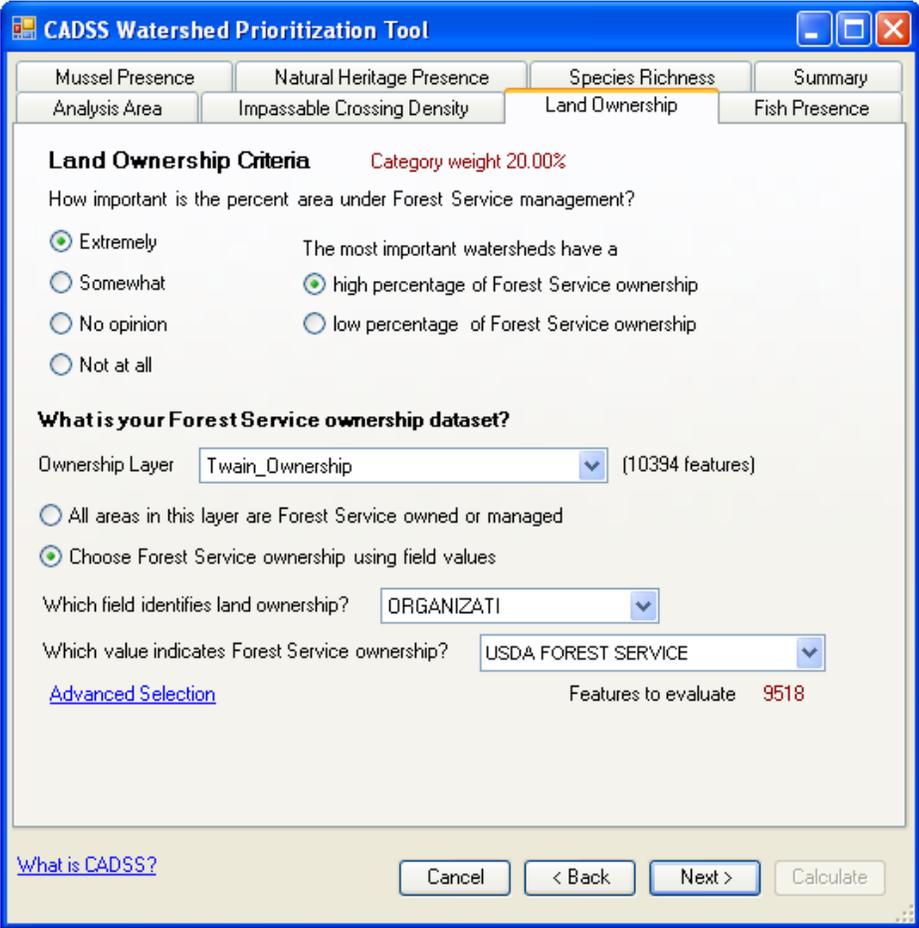
You may indicate whether you would like to prioritize for units with either high or low FS management.

CADSS comes with a default layer, but you may select other layers as needed.

You may choose to designate ownership based on a field value (default), or to include all areas as FS owned.

If you wish to choose ownership using a field value then you must indicate which field contains the values, and then what values should be considered as impassable. These fields are pre-populated if you use the default layer.

In the example below we are using a field labeled ORGANIZATI, with a value of USDA FOREST SERVICE to select FS managed lands from the Twain_Ownership layer.



Fish Presence

The Fish Presence form asks how important it is to consider the presence of a particular fish species when prioritizing analysis units.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

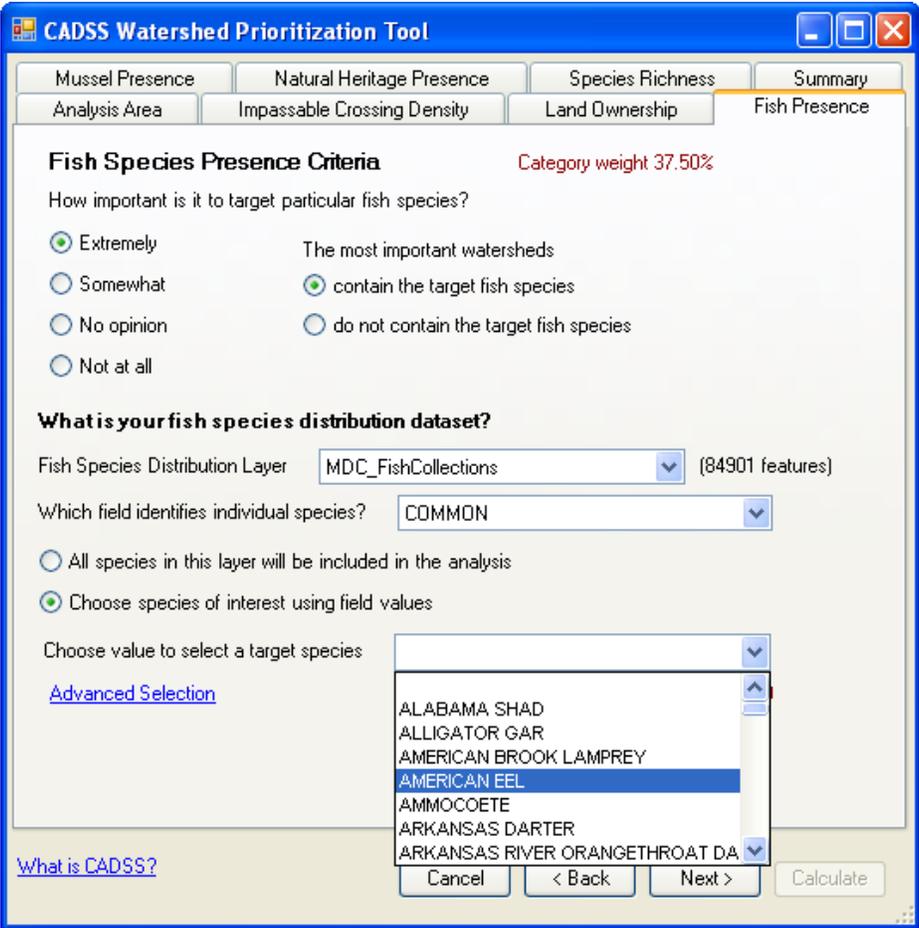
You may prioritize for units that either do or do not contain the species.

CADSS comes with a default layer, but you may select other layers as needed.

You may choose to target a particular species (default), or to include all records from the species layer.

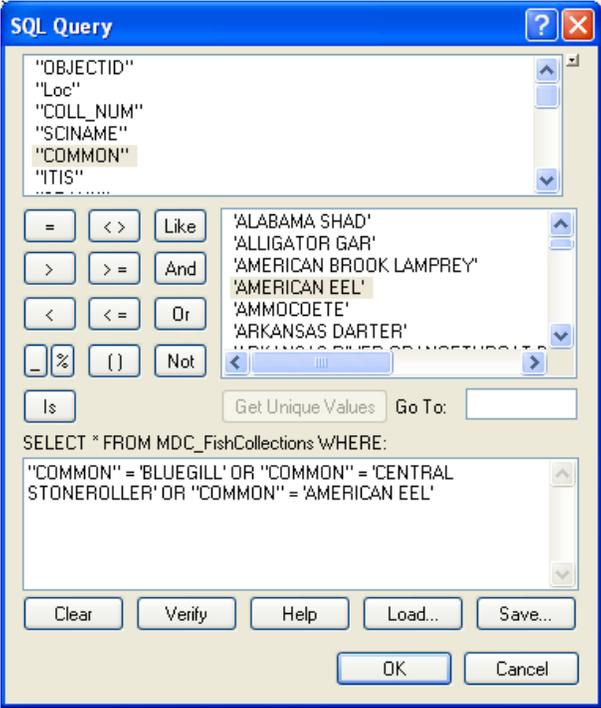
If you wish to select a target species you must indicate which field contains the species list, and select a species from the list.

In the example below we are selecting AMERICAN EEL from a field labeled COMMON in the MDC_FishCollections layer. American eel will be set as the target species. To set **multiple target species** you must use the **Advanced Selection** link (see next page).

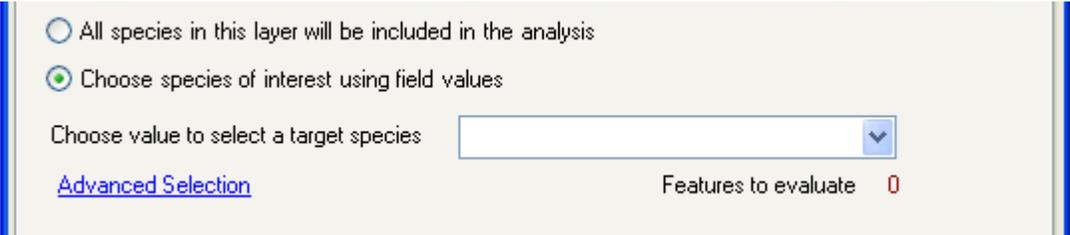


Advanced Selection

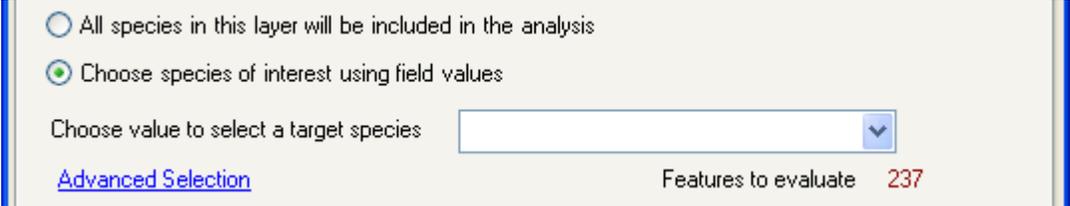
Clicking the Advanced Selection link will open the SQL Query window. You may select multiple species using custom SQL statements. In the example below we are selecting analysis units that contain bluegill, stoneroller, or American eels. Analysis units that contain all 3 species will be ranked higher than those with 0, 1, or 2 of the species.



The use of 'OR' is required because of the structure of the MDC datasets. Do not use 'AND' when selecting multiple species. Use of 'AND' will result in Features to evaluate = 0, as in example below.



Features to evaluate is greater than 0 when your query is structured properly, as in example below.



Mussel Presence

The Mussel Presence form asks how important it is to consider the presence of a particular mussel species when prioritizing analysis units.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

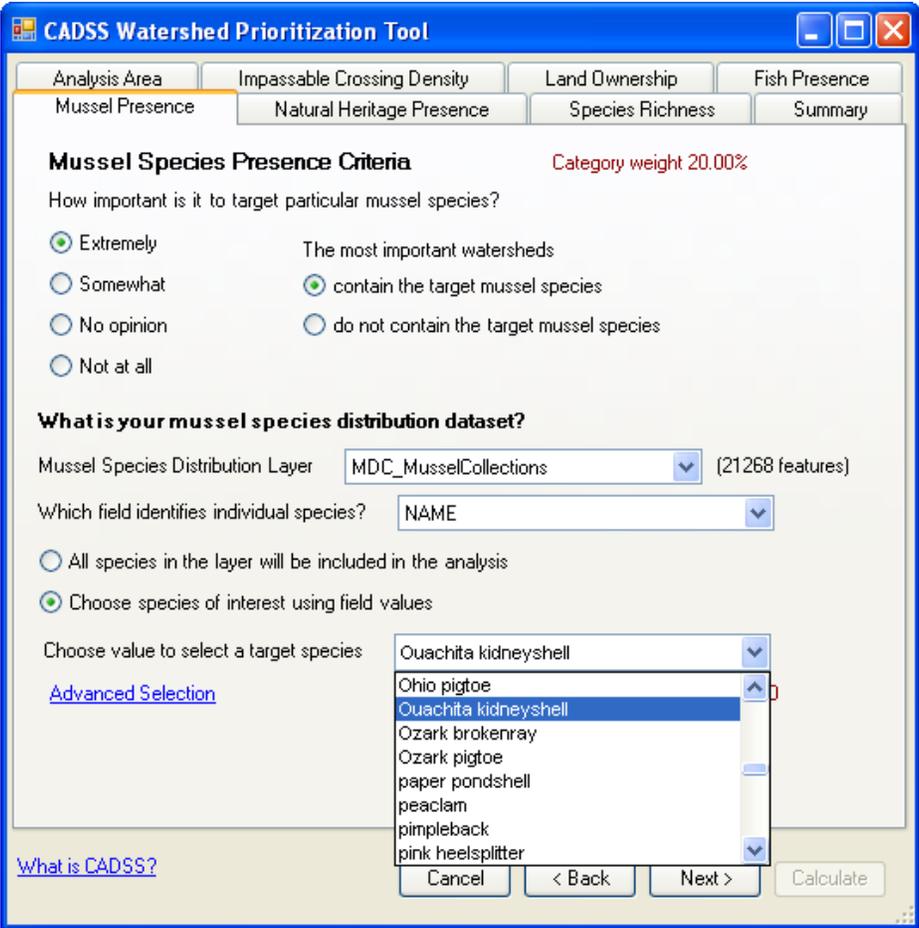
You may prioritize for units that either do or do not contain the species.

CADSS comes with a default layer, but you may select other layers as needed.

You may choose to target a particular species (default), or to include all records from the species layer.

If you wish to select a target species you must indicate which field contains the species list, and select a species from the list.

In the example below we are selecting Ouachita kidneyshell from a field labeled NAME in the MDC_MusselCollections layer. Ouachita kidneyshell will be set as the target species. To set **multiple target species** you must use the **Advanced Selection** link (see page 13).



Natural Heritage Presence

The Natural Heritage Presence form asks how important it is to consider the presence of a particular species from the Natural Heritage database when prioritizing analysis units.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

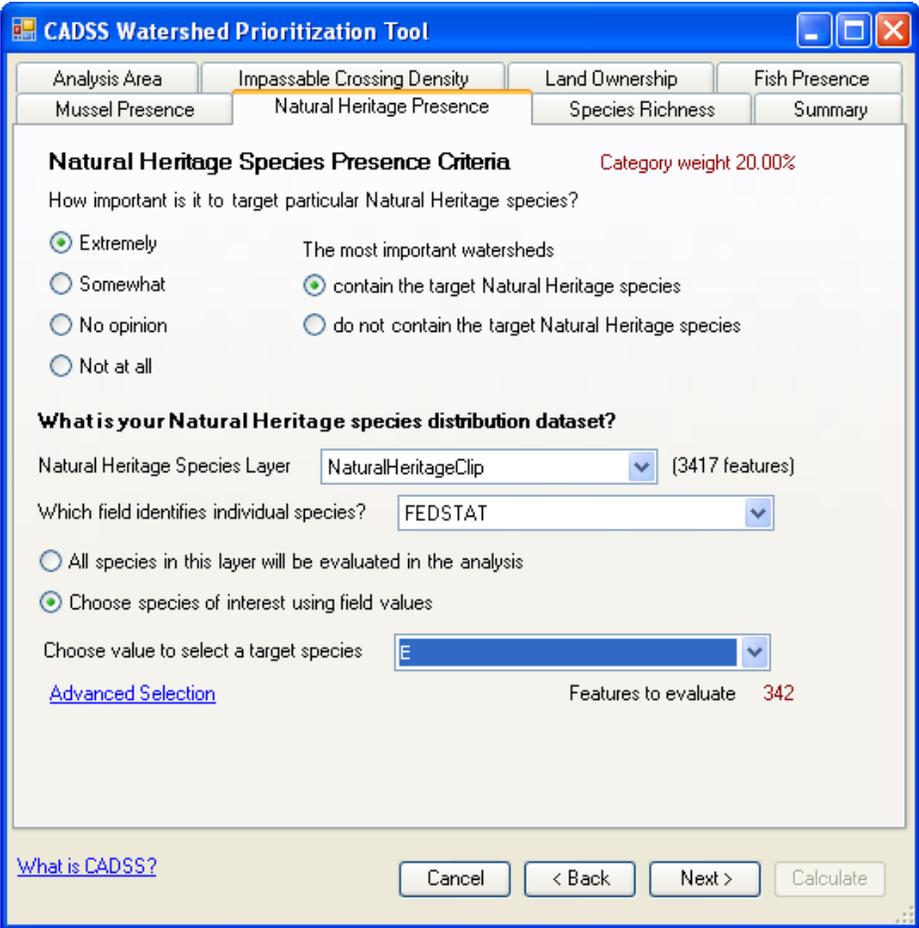
You may prioritize for units that either do or do not contain the species.

CADSS comes with a default layer, but you may select other layers as needed.

You may choose to target a particular species (default), or to include all records from the species layer.

If you wish to select a target species you must indicate which field contains the species list, and select a species from the list.

In the example below we are selecting E from a field labeled FEDSTAT in the NaturalHeritageClip layer. Species with FEDSTAT = E will be set as the target. To set **multiple target species** you must use the **Advanced Selection** link (see page 13).



Species Richness

The Species Richness form asks how important it is to consider the number of species present when prioritizing analysis units.

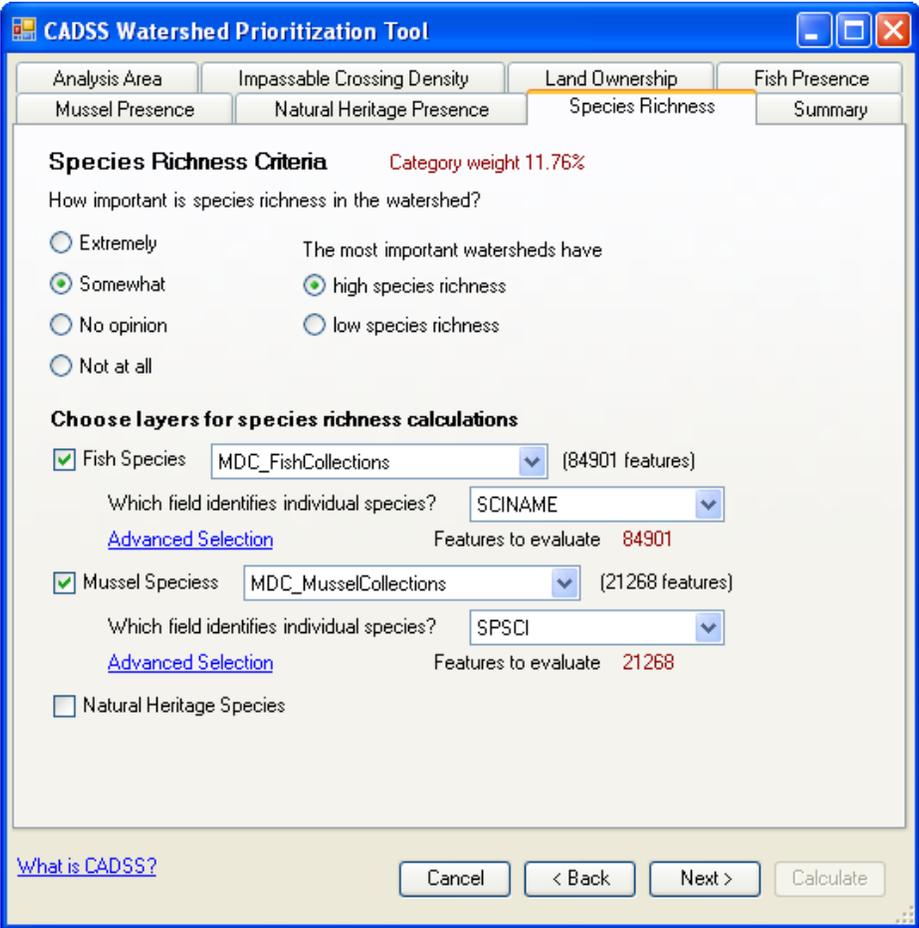
Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

You may prioritize for units that have either high or low species richness.

Richness is calculated as the sum of unique species present from selected datasets. Options include MDC Fish, MDC Mussels, and the Natural Heritage Database. You may select any combination of the 3 datasets. CADSS comes with a default layers, but you may select other layers as needed.

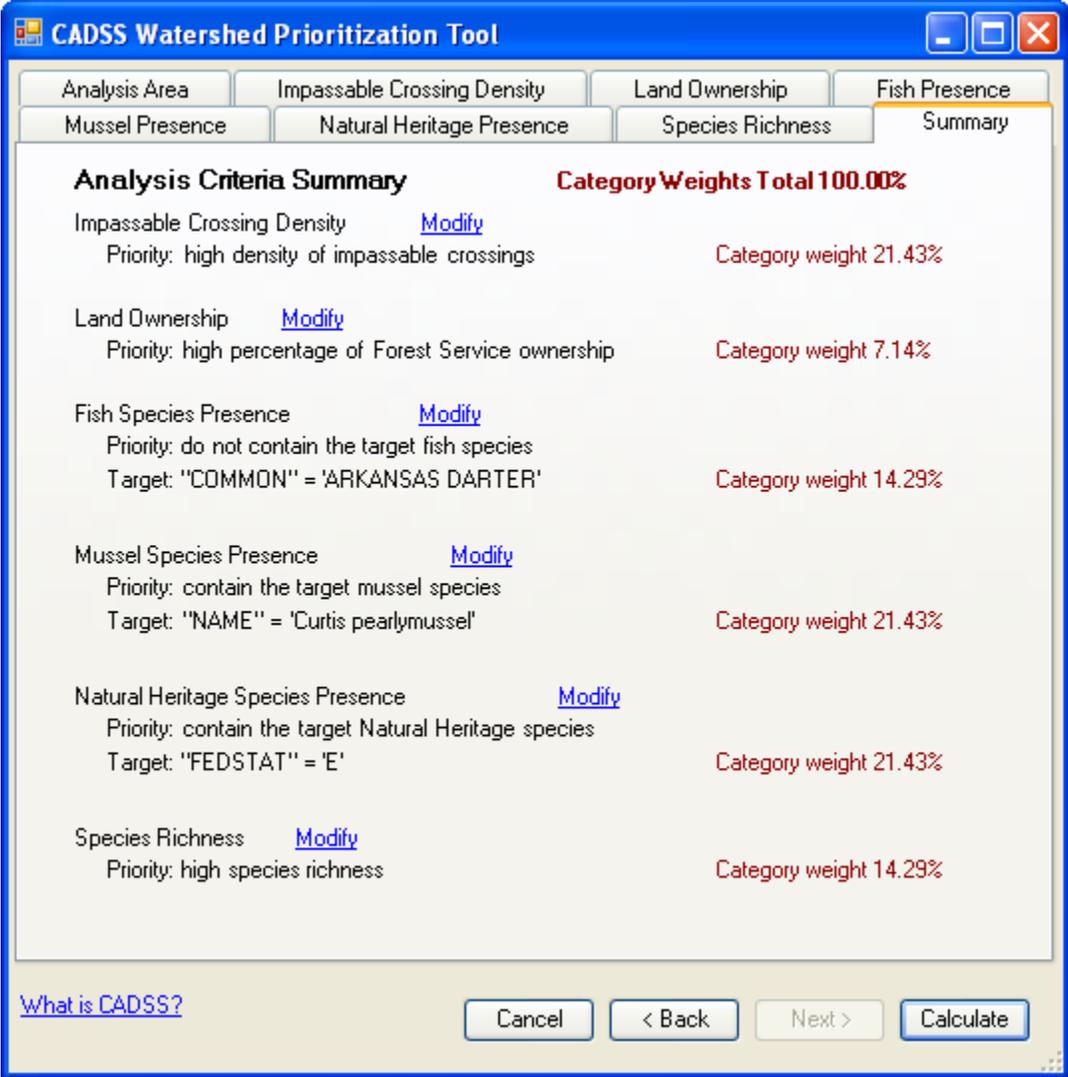
For each dataset selected you must indicate the field that contains the species list. These fields are pre-populated if you use the default layers.

In the example below we are using the SCINAME field from MDC_FishCollections and the SPSCI field from MDC_MusselCollections to calculate species richness. To **target specific species** within a particular dataset you must use the **Advanced Selection** link (see page 13).

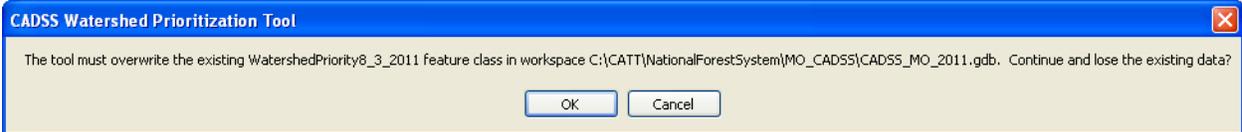


Summary

The Summary form allows you to review and modify your selections. To accept your settings and run the analysis, click the **Calculate** button.



If you get this warning message then you must change your output layer name or CADSS will overwrite existing output files. Click **Cancel** to change your output file name.

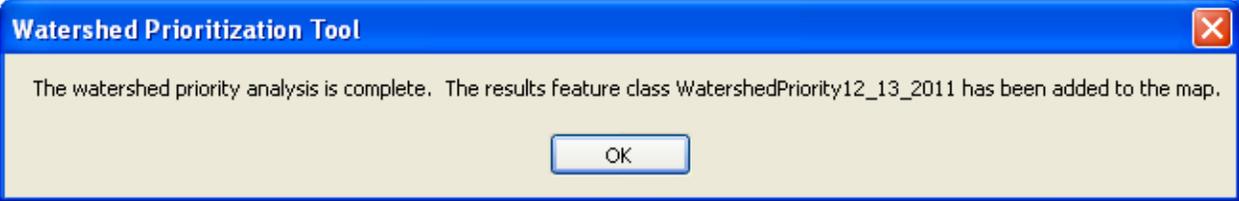


WPT Output

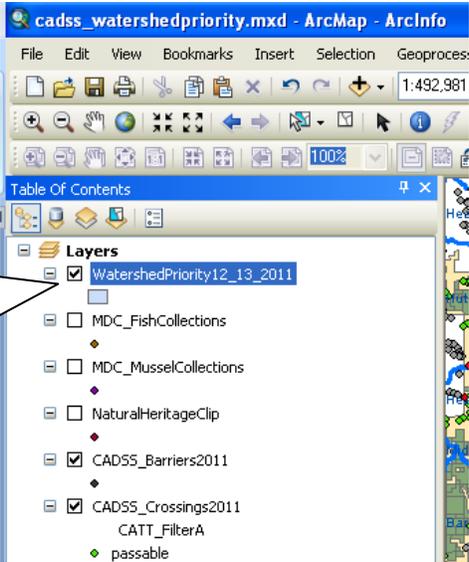
Be patient while CADSS calculates... it may take several minutes depending on analysis area size.



CADSS will alert you when the analysis is complete, click 'OK' to view a table of top results. Note the **addition of your feature class to the map.**



A feature class containing the analysis results is added to the table of contents. This is available even after the top 10 priority table is closed (see next page).



The table in the pop-up window shows the top 10 priority HUCs based on your input. The 'Sum of Weighted Scores' column is what CADSS uses to rank the HUCs. Hover your mouse-pointer over a field in the 'Sum of Weighted Scores' column to see how the score is calculated (shown in red at top of table). Raw, scaled, and weighted scores are also available in the table, just scroll to the right.

Click on a record in the table to select it on the map. Use the **Zoom** button to zoom to the map feature.

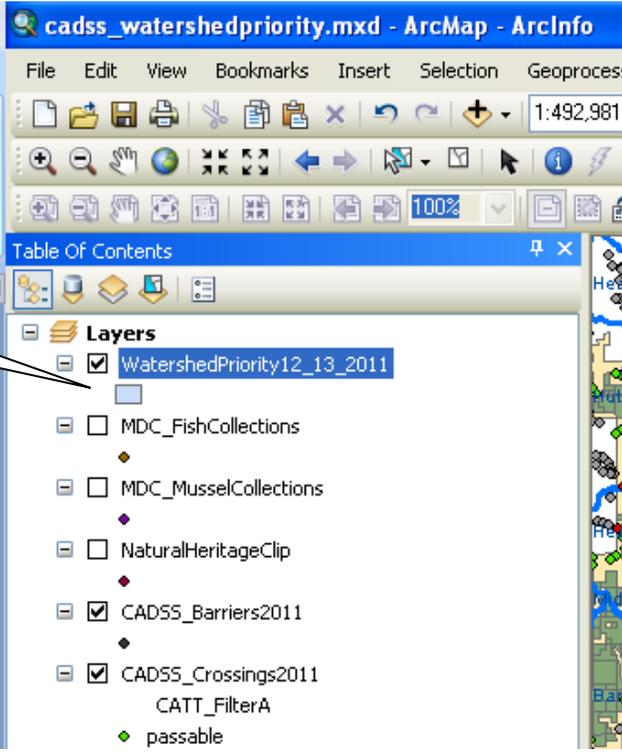
This table is no longer available for viewing once closed, but ranks and scores are all saved for future reference in the geodatabase associated with CADSS (see next page).

The screenshot shows a software window titled "CADSS Watershed Prioritization Tool". Inside the window, there is a section titled "Top 10 Priority Watersheds". Below this title, there is a legend for "Sum of Weighted Scores: sum of weighted scores for all criteria". A red text line shows a calculation: "Weighted score 94.223 = crossing density 50.000 + land ownership 10.890 + fish presence 33.333 + mussel presence 0 + Natural Heritage presence 0 + species richness 0". Below this is a table with 6 columns: HU_12_Name, Priority Rank, Sum of Weighted Scores, Impassable Crossings, and Stream Length. The first row is highlighted in blue and shows "Caldwell Creek-St Francis River" with a rank of 1, a score of 94.223, 2 impassable crossings, and a stream length of 154666.539. Other rows include Otter Creek, Big Lake Creek-St Francis River, Wappapelo Dam-St Francis River, Captain Creek-St Francis River, Turkey Creek-St Francis River, Mud Creek-St Francis River, Marble Creek, and Upper Big Creek. At the bottom of the window, there are "Zoom" and "Close" buttons.

| HU_12_Name | Priority Rank | Sum of Weighted Scores | Impassable Crossings | Stream Length |
|---------------------------------|---------------|------------------------|----------------------|---------------|
| Caldwell Creek-St Francis River | 1 | 94.223 | 2 | 154666.539 |
| Otter Creek | 2 | 87.924 | 24 | 148272.102 |
| Big Lake Creek-St Francis River | 3 | 85.139 | 32 | 248182.608 |
| Wappapelo Dam-St Francis River | 4 | 83.764 | 7 | 164289.224 |
| Captain Creek-St Francis River | 5 | 75.219 | 34 | 94318.592 |
| Turkey Creek-St Francis River | 6 | 72.665 | 30 | 126206.637 |
| Mud Creek-St Francis River | 7 | 71.654 | 7 | 142828.738 |
| Marble Creek | 8 | 70.992 | 68 | 195840.194 |
| Upper Big Creek | 9 | 70.288 | 55 | 237553.479 |

To view results after the top 10 table is closed, right click on your output feature class in the table of contents window, then open the attribute table.

Right-click, then open attribute table.



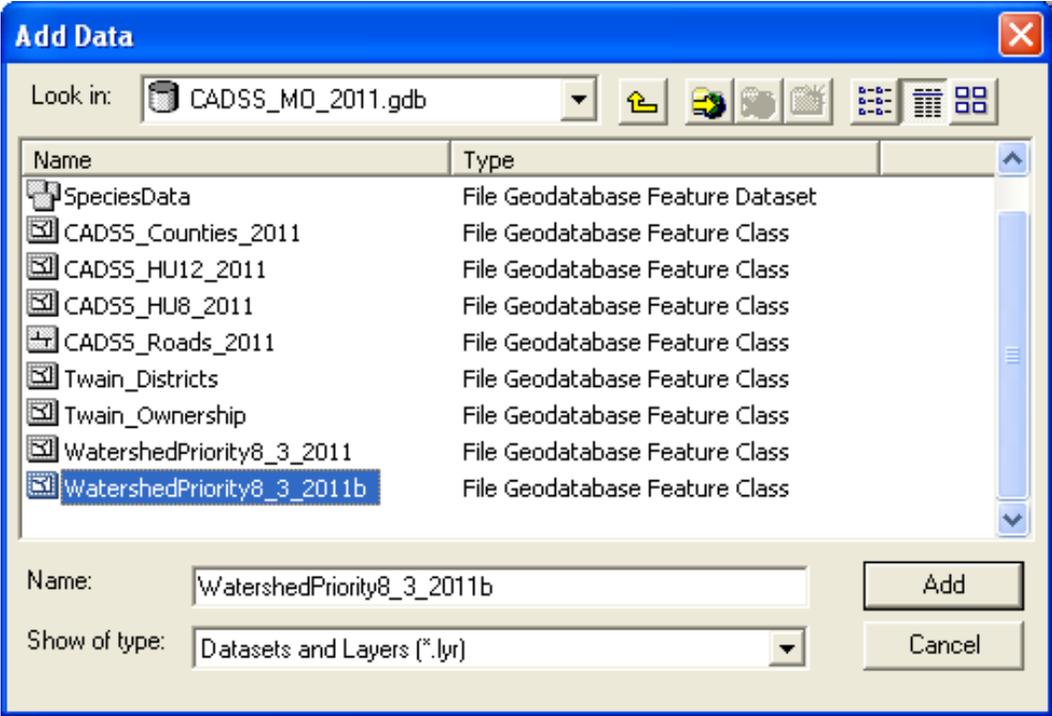
The attribute table contains all data used to generate the final rankings. The sum of weighted scores and priority rank fields are near the end of the table – scroll to the right to view them.

The screenshot shows the 'Table' window for 'WatershedPriority12_13_2011'. The table contains 19 rows of data. The columns are: OBJECTID, Shape, HU_12_Name, Impassable Crossings, Stream Length, Crossing Density (Raw Score), and Crossing Density (Scaled). The data is as follows:

| OBJECTID | Shape | HU_12_Name | Impassable Crossings | Stream Length | Crossing Density (Raw Score) | Crossing Density (Scaled) |
|----------|---------|--------------------------------------|----------------------|---------------|------------------------------|---------------------------|
| 1 | Polygon | Musco Creek-Little St Francis River | 112 | 259873.08617 | 0.43098 | |
| 2 | Polygon | Saline Creek-Little St Francis River | 144 | 205533.804856 | 0.700615 | |
| 3 | Polygon | Headwaters Twelvemile Creek | 79 | 97840.307525 | 0.807438 | |
| 4 | Polygon | Twelvemile Creek | 86 | 170524.406004 | 0.504327 | |
| 5 | Polygon | Big Lake Creek-St Francis River | 32 | 248182.608126 | 0.128937 | |
| 6 | Polygon | Lost Creek | 32 | 188156.721625 | 0.170071 | |
| 7 | Polygon | O'Bannon Creek-St Francis River | 50 | 82773.201058 | 0.60406 | |
| 8 | Polygon | Wachita Creek-St Francis River | 45 | 177237.358053 | 0.253897 | |
| 9 | Polygon | Headwaters Stouts Creek | 80 | 121208.866288 | 0.660019 | |
| 10 | Polygon | Stouts Creek | 62 | 169549.459329 | 0.365675 | |
| 11 | Polygon | Turkey Creek-St Francis River | 30 | 126206.637007 | 0.237705 | |
| 12 | Polygon | Little St Francis River | 44 | 119771.251455 | 0.367367 | |
| 13 | Polygon | Upper Big Creek | 55 | 237553.479209 | 0.231527 | |
| 14 | Polygon | Marble Creek | 68 | 195840.193807 | 0.347222 | |
| 15 | Polygon | Cedar Bottom Creek-St Francis River | 61 | 133943.797296 | 0.455415 | |
| 16 | Polygon | Crane Pond Creek | 72 | 215293.397819 | 0.334427 | |
| 17 | Polygon | Captain Creek-St Francis River | 34 | 94318.5924 | 0.36048 | |
| 18 | Polygon | Leatherwood Creek-St Francis River | 37 | 110755.577371 | 0.334069 | |
| 19 | Polygon | Marler Branch-Otter Creek | 10 | 142243.25497 | 0.070302 | |

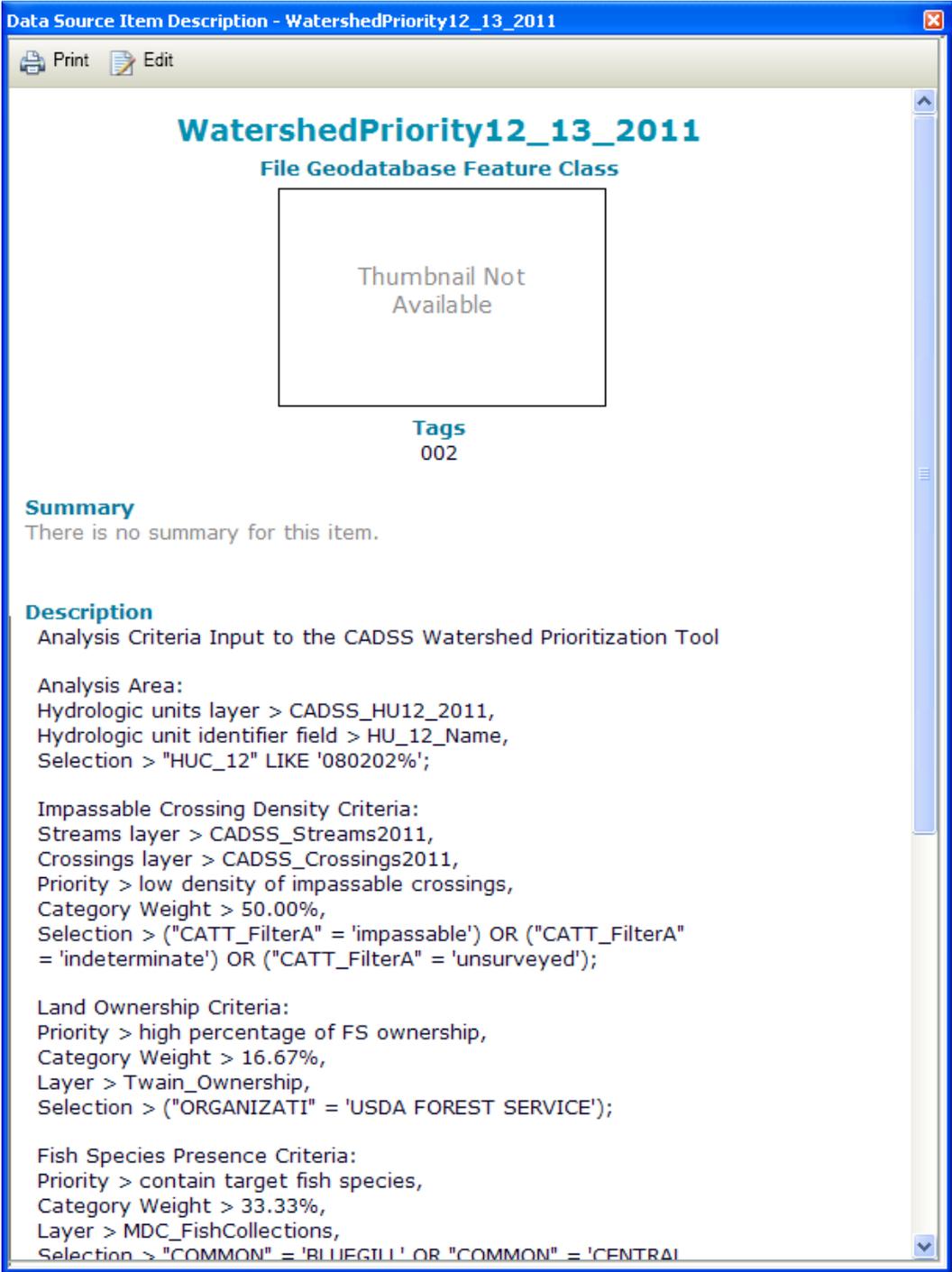
If the feature class is not available in the table of contents, click the Add Data button and browse to the geodatabase associated with CADSS, then select your feature class (see next page).

Your output feature class is saved in the **CADSS_MO_2011.gdb** geodatabase, and is available for future use, unless you overwrite or delete it. To add a feature class from a previous CADSS run, simply click the add data button and browse to the feature class within the geodatabase.



It is easy to forget what settings you selected within CADSS. The selections you made to generate a particular output file can be viewed within the metadata:

Right-click on your output file in the table of contents, then select **Data > View Item Description**. All CADSS settings are listed in the Description section.

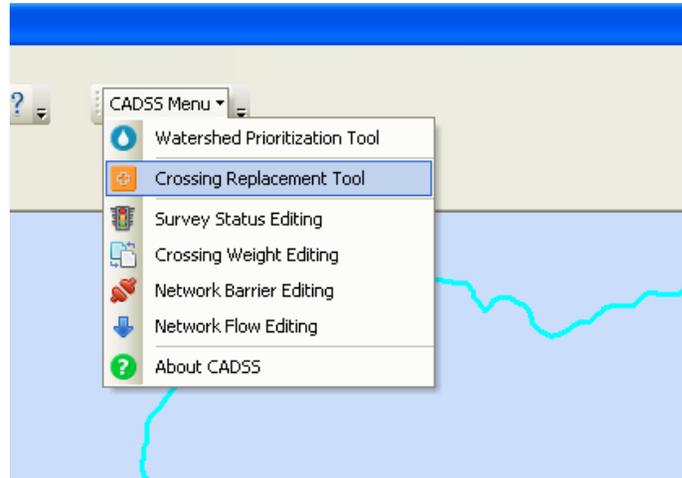


Crossing Replacement Tool (CRT)

The CRT is used to prioritize replacements within a designated analysis area, typically a single HUC.

Before starting the CRT, open **CADSS10_2011.mxd**; select File >Open, then browse to the file.

To run the CRT, select **Crossing Replacement Tool** from the CADSS dropdown menu.

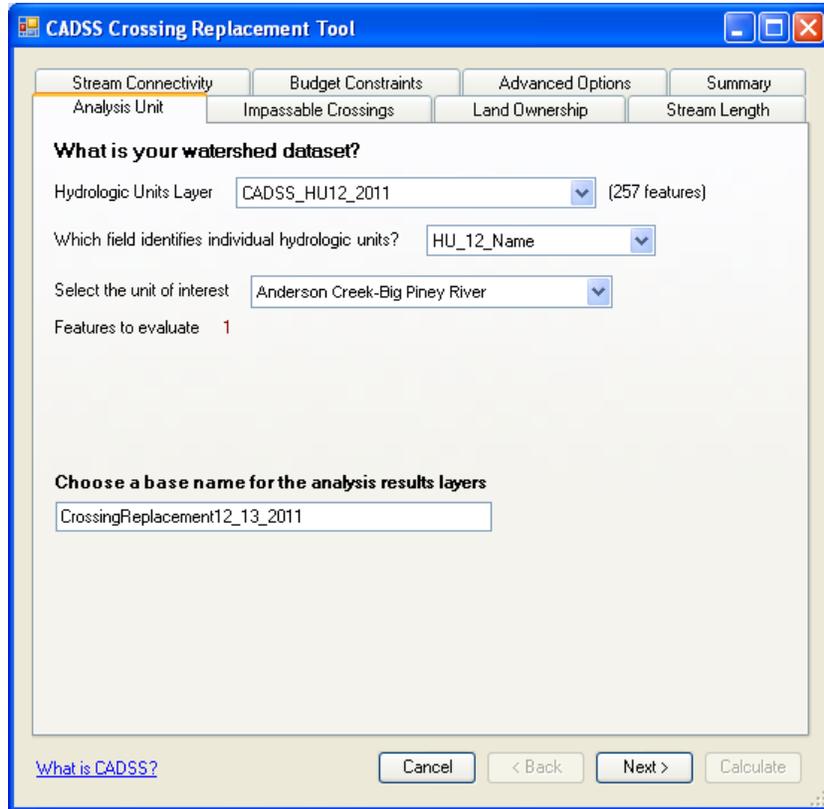


Analysis Unit

The Analysis Unit form allows you to designate your hydrologic units layer and select a single analysis unit by name, number, or other designation.

CADSS comes with a default layer, but you may select others, if needed.

Select the field that contains the list of hydrologic units, then select the unit of interest. In the example below we are selecting the Anderson Creek-Big Piney River unit from the HU_12_Name field in the CADSS_HU12_2011 layer.



The screenshot shows the 'CADSS Crossing Replacement Tool' window with the 'Analysis Unit' tab selected. The form is titled 'What is your watershed dataset?' and contains the following fields:

- Hydrologic Units Layer:** A dropdown menu set to 'CADSS_HU12_2011' with '(257 features)' next to it.
- Which field identifies individual hydrologic units?:** A dropdown menu set to 'HU_12_Name'.
- Select the unit of interest:** A dropdown menu set to 'Anderson Creek-Big Piney River'.
- Features to evaluate:** A red '1' next to the text.

Below these fields is a section titled 'Choose a base name for the analysis results layers' with a text input field containing 'CrossingReplacement12_13_2011'.

At the bottom of the form, there are four buttons: 'Cancel', '< Back', 'Next >', and 'Calculate'. A link for 'What is CADSS?' is also present at the bottom left.

Don't forget to **input a unique name** for your output feature class at the bottom of the form.

Click the **Next** button at the bottom of the form to move to the next form.

Note that unit names are not necessarily unique. Selecting a name that is a duplicate will cause CADSS to generate a warning.



If your intention is to run the analysis within a single unit you must re-select using a unique identifier.

For example, if you select a HUC named Brushy Creek and the above warning is generated you could re-select by HUC number to run the analysis on a single HUC.

Impassable Crossings

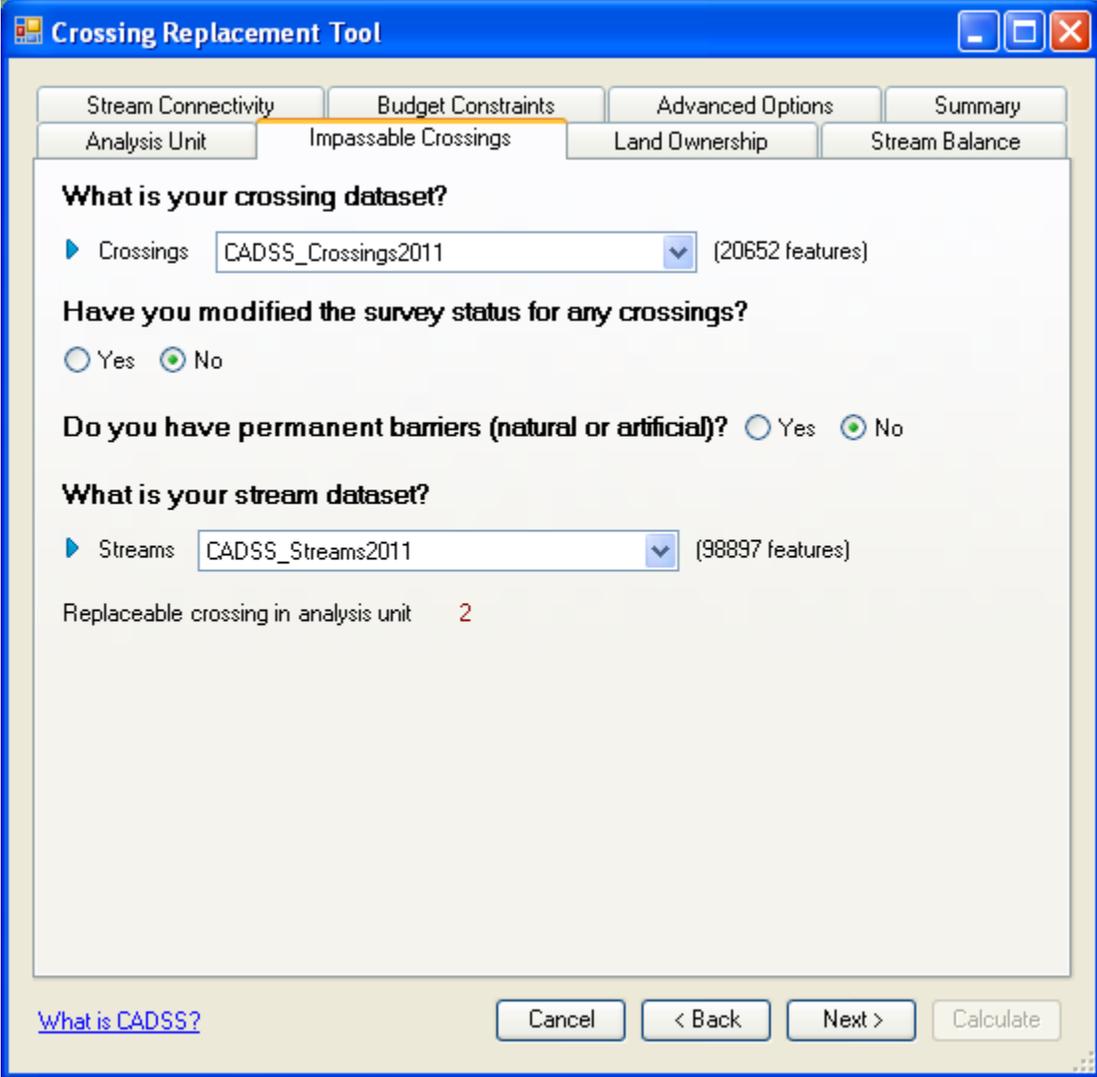
The Impassable Crossings form allows you to designate crossings and streams layers.

CADSS comes with default layers, but you may select others, if needed.

The form also asks if you have modified the survey status for any crossings. If you have updated passage status, or if you are uncertain of what passage status field is being applied (e.g. Filter A, Filter B, or Filter C) to your analysis you should click Yes.

It is **very important** to know the correct passage status field is selected and that values have been applied to the network weight field. CADSS uses values in the network weight field when running the CRT. The only way to be certain is to check yes and then run an update (see next page for details), or to use the Crossing Weight Editing Tool (see Data Editing Tools section).

The form also asks if you have permanent barriers you would like to include in the analysis. Select Yes to include a barrier dataset (see page 28 for details).



The screenshot shows the 'Crossing Replacement Tool' dialog box with the 'Impassable Crossings' tab selected. The dialog has a blue title bar and a light beige background. At the top, there are four tabs: 'Stream Connectivity', 'Budget Constraints', 'Advanced Options', and 'Summary'. Below these are four sub-tabs: 'Analysis Unit', 'Impassable Crossings', 'Land Ownership', and 'Stream Balance'. The main content area contains the following questions and options:

- What is your crossing dataset?**
Crossings: CADSS_Crossings2011 (20652 features)
- Have you modified the survey status for any crossings?**
 Yes No
- Do you have permanent barriers (natural or artificial)?** Yes No
- What is your stream dataset?**
Streams: CADSS_Streams2011 (98897 features)

At the bottom, it shows 'Replaceable crossing in analysis unit' with the value '2'. There are four buttons at the bottom: 'Cancel', '< Back', 'Next >', and 'Calculate'. A link 'What is CADSS?' is located at the bottom left.

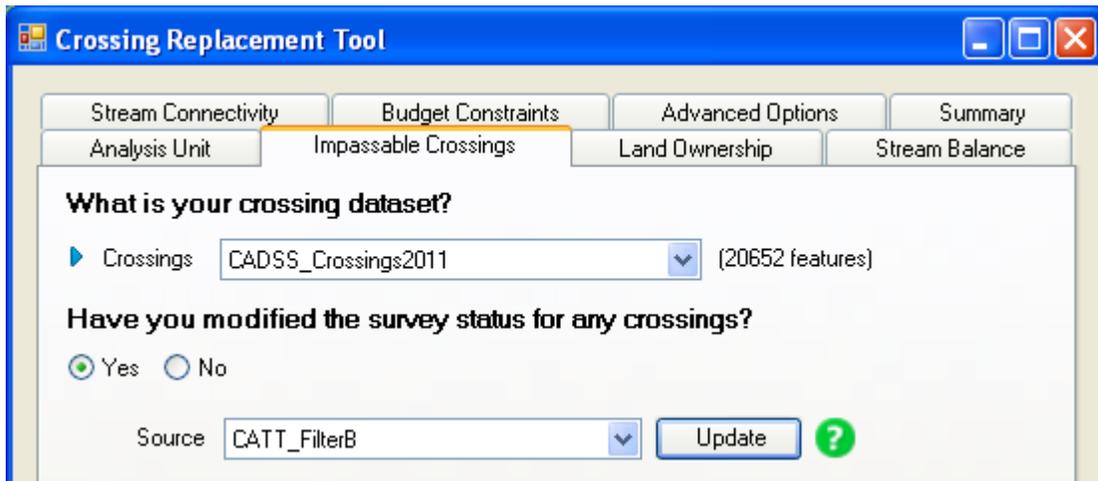
Updating survey status

There are four primary reasons you may need to update survey status:

- 1) You are running CADSS for the first time
- 2) You do not know what source field (e.g. FilterA vs. FilterB) is currently loaded
- 3) You would like to change the source field (e.g. switch from FilterA to FilterB)
- 4) You have changed the passage status of a crossing since last running CADSS

In any of these cases you should select **Yes, select the appropriate source data**, then click **Update**.

In the example below we are updating survey status using the values in the CATT_FilterB field.



Be patient, the conversion may take a couple of minutes. CADSS provides confirmation of the update as shown below.



Adding barriers

If you wish to include natural barriers or dams in the analysis, then you must answer YES to the question 'Do you have permanent barriers (natural or artificial)?'

Answering yes will allow you to designate a feature class containing barriers. There is a default layer loaded, and you may add features to this layer either manually or with the **Barrier Editing Tool** in the CADSS dropdown menu.



The screenshot shows a software interface for configuring barriers. At the top, it asks "Do you have permanent barriers (natural or artificial)?" with two radio buttons: "Yes" (which is selected) and "No". Below this, there is a section labeled "Barriers" with a dropdown menu currently set to "CADSS_Barriers2011" and a count of "(0 features)". At the bottom of the panel, it displays "Barriers in analysis unit" followed by a red "0".

Land Ownership

The Land Ownership form asks how important it is to consider Forest Service management status when prioritizing replacements.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

CADSS comes with a default layer, but you may select other layers as needed.

You may choose to designate ownership based on a field value (default), or to include all areas as FS managed.

If you wish to choose ownership using a field value then you must indicate which field contains the values, and then what values should be considered FS owned. These fields are pre-populated if you use the default layers.

In the example below we are selecting lands listed as USDA FOREST SERVICE from the ORGANIZATI field in the Twain_Ownership layer.

The screenshot shows the 'Crossing Replacement Tool' window with the 'Land Ownership' tab selected. The interface includes several sections:

- How important is Forest Service management?**: Radio buttons for 'Extremely', 'Somewhat', 'No opinion' (selected), and 'Not at all'. A red text label 'Category weight 25.00%' with a question mark icon is displayed.
- What is your Forest Service ownership dataset?**: A dropdown menu for 'Ownership Layer' is set to 'Twain_Ownership' (10394 features). Radio buttons for 'All areas are Forest Service managed/owned' and 'Choose management/ownership areas using field values' (selected) are present.
- Which field identifies land ownership?**: A dropdown menu is set to 'ORGANIZATI'.
- Choose one or more values to select areas of interest**: A list box contains 'Private' and 'USDA FOREST SERVICE' (highlighted).
- Forest Service ownership areas in analysis unit**: A red text label shows the value '55'.

At the bottom, there are buttons for 'Cancel', '< Back', 'Next >', and 'Calculate', along with a link for 'What is CADSS?'.

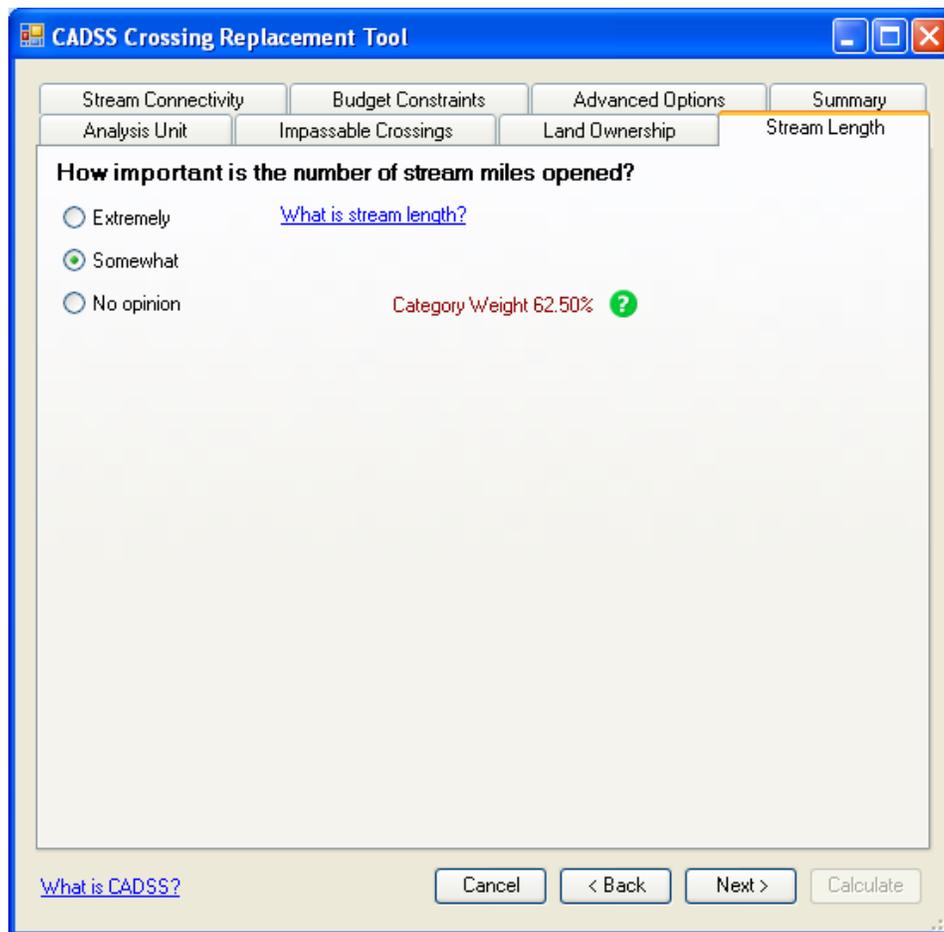
Stream Length

The Stream Length form asks how important it is to consider the length of stream miles opened when prioritizing replacements.

Options range from 'Extremely' important to 'No opinion'. Stream length must be included in the analysis, so 'Not at all' is not available as an option. The category weight (red numbers in upper right) will change as you select different values.

The hyperlink on the page takes you to a help document that explains how we calculate the stream length metric. In short, CADSS calculates not the total length of the newly connected reach, but how similar in length the two connected reaches are. CADSS gives the highest score to reaches that are similar and length and have high total miles connected. The table below is a simplified example:

| Upstream reach (miles) | Downstream reach (miles) | Total reach | Rank |
|------------------------|--------------------------|-------------|------|
| 50 | 50 | 100 | 1 |
| 25 | 25 | 50 | 2 |
| 10 | 90 | 100 | 3 |
| 99 | 1 | 100 | 4 |



Stream Connectivity

The Stream Connectivity form asks how important it is to maximize contiguous stream miles when prioritizing replacements.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

Connectivity comes into play only when replacing multiple crossings. Would you prefer to open stream reaches within the analysis unit that are connected to one another, or do you just want to open the maximum number of stream miles in the unit regardless of whether they are connected?

The screenshot shows a software window titled "Crossing Replacement Tool" with a blue title bar. The window contains several tabs: "Analysis Unit", "Impassable Crossings", "Land Ownership", "Stream Balance", "Stream Connectivity", "Budget Constraints", "Advanced Options", and "Summary". The "Stream Connectivity" tab is active. The main content area has the heading "How important are contiguous stream miles?" and four radio button options: "Extremely", "Somewhat", "No opinion", and "Not at all". The "Somewhat" option is selected. To the right of the options is a blue hyperlink "What is connectivity?". Below the options, the text "Category Weight 41.67%" is displayed in red, followed by a green question mark icon. At the bottom left, there is a blue hyperlink "What is CADSS?". At the bottom right, there are four buttons: "Cancel", "< Back", "Next >", and "Calculate".

Budget Constraints

The Budget Constraints form asks how important it is to consider total costs when prioritizing replacements.

Options range from 'Extremely' important to 'Not at all'. Selecting 'Not at all' will set the category weight (red numbers in upper right) to zero and remove this category from the analysis.

Budget constraints come into play only when replacing multiple crossings. CADSS assumes that all replacements cost the same amount and thus expenses increase as the number of replacements increases. As such, CADSS will always score options with the fewest replacements the highest.

Crossing Replacement Tool

Analysis Unit | Impassable Crossings | Land Ownership | Stream Balance
 Stream Connectivity | **Budget Constraints** | Advanced Options | Summary

How important is the total replacement cost?

Extremely [How is cost calculated?](#)
 Somewhat
 No opinion
 Not at all

Category Weight 0.00% ?

[What is CADSS?](#) Cancel < Back Next > Calculate

Advanced Options

The Advanced Options form allows you to change several settings, the most important being the number of crossings you want to replace. Processing time increases exponentially as the number of crossings considered increases.

Note the **ESTIMATE PROCESSING TIME** link – a useful tool for comparing processing time prior to running the analysis.

Ways to decrease processing time:

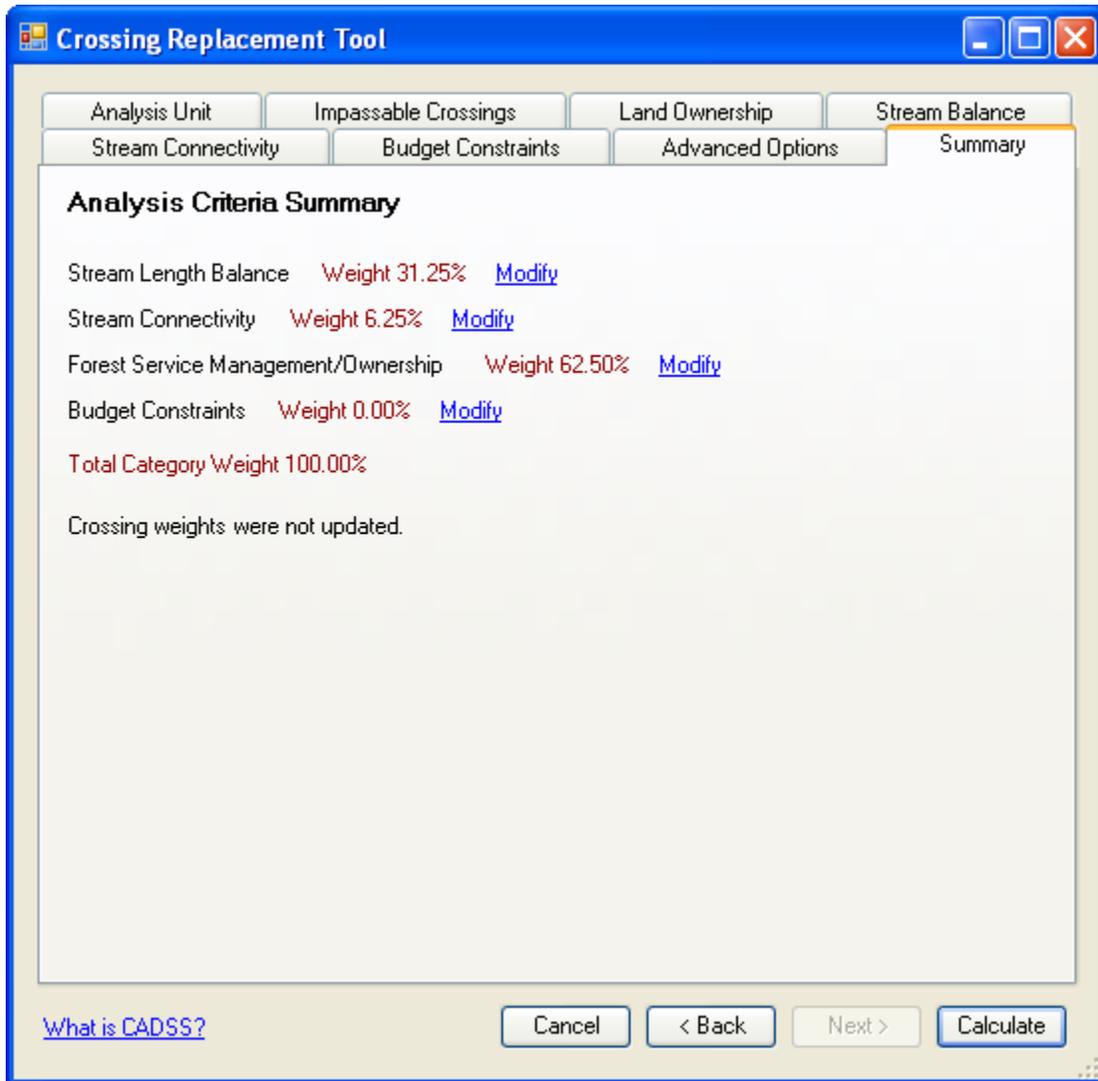
- Use the short-hand method
 - The short-hand method is explained in the help link, but note that we have not tested this function thoroughly yet, so use it with caution
- Designate crossings that must be contained in the results
 - Particularly useful if you know you must replace a particular culvert, but have enough funds to replace multiple culverts simultaneously

Note that all results are stored in a feature class, so you will not need to re-run lengthy analyses.

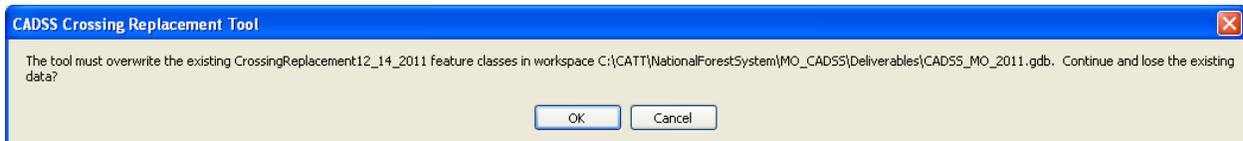
The screenshot shows the 'Advanced Options' tab of the 'CADSS Crossing Replacement Tool' dialog box. The 'Analysis Unit' tab is selected. The 'How many crossings do you want to replace?' section has 'Exactly' selected in the dropdown and '1' in the input field, with a note '(maximum of 5)'. The 'Choose method to combine replacements' section has '10' in the dropdown. Three radio buttons are present: 'Evaluate all possible combinations' (selected), 'Evaluate combinations using the short-hand method' (with a green question mark), and 'Evaluate combinations that contain the following crossings' (with a green question mark). Below this, it says 'Replacement combinations to analyze 2' and includes a blue link 'Estimate processing time'. At the bottom, there are buttons for 'Cancel', '< Back', 'Next >', and 'Calculate', along with a link 'What is CADSS?'.

Summary

The Summary form allows you to review and modify your selections. To accept your settings and run the analysis, click the **Calculate** button.

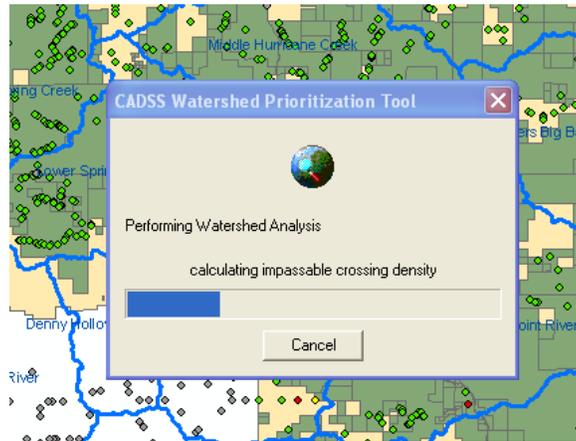


If you get this warning message then you must change your output layer name or CADSS will overwrite existing output files. Click **'Cancel'** to change your output file name.

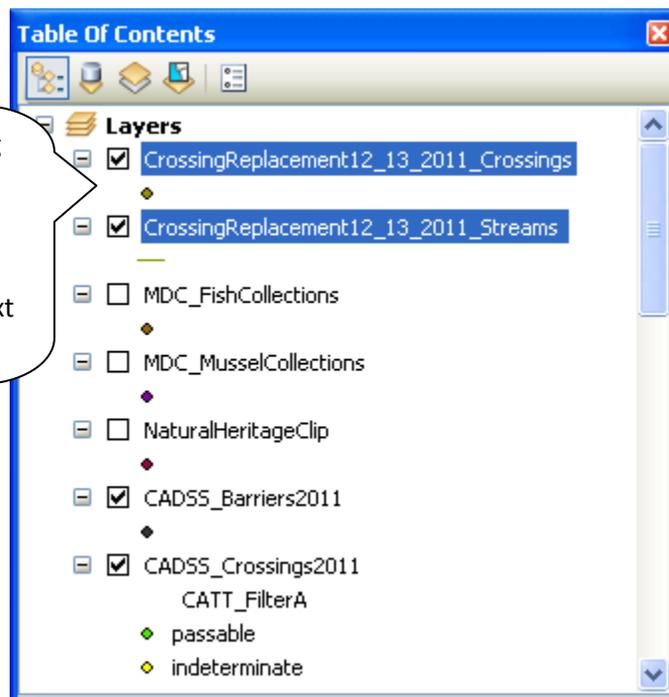
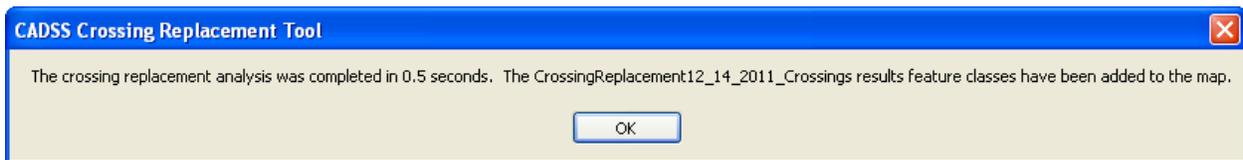


CRT Output

Be patient while CADSS calculates... it may take several minutes depending on analysis area size.



CADSS will alert you when the analysis is complete, click 'OK' to view a table of top results. Note the **addition of two feature classes to the map**.



Two feature classes containing results are added to the table of contents. These are available even after the top 10 priority table is closed (see next page).

The table in the pop-up window shows the top 10 priority replacements, or replacement combinations based on your input. The 'Sum of Weighted Scores' column is what CADSS uses to rank replacements. Hover your mouse-pointer over a field in the 'Sum of Weighted Scores' column to see how the score is calculated (shown in red at top of table). Raw, scaled, and weighted scores are also available in the table, just scroll to the right.

Click on a record in the table to select it on the map. Use the **Zoom** button to zoom to the crossing features. Use the **Stream** button to view the streams associated with the crossing replacements.

This table is no longer available for viewing once closed, but ranks and scores are all saved for future reference in the geodatabase associated with CADSS (see next page).

CADSS Crossing Replacement Tool

Top 10 Crossing Replacement Combinations (Bee Fork)

Sum of Weighted Scores: sum of weighted scores for all criteria

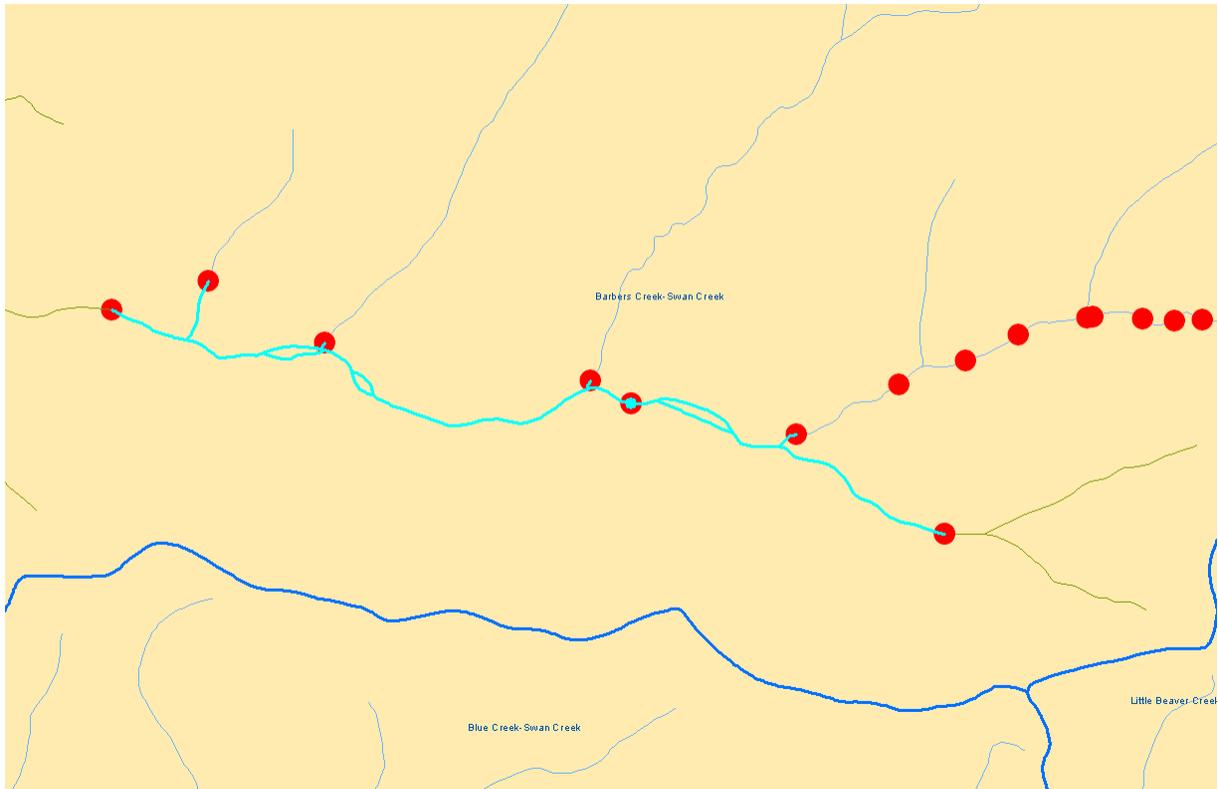
Weighted score 88.586 = stream length 60.126 + stream connectivity 11.105 + land ownership 6.250 + budget constraints 6.250

| | Priority Rank | Combination ID | Crossings Replaced | Crossing ObjectIDs | Field Survey IDs | Sum of Weighted Scores |
|---|---------------|----------------|--------------------|--------------------|------------------|------------------------|
| ▶ | 1 | 53 | 2 | 16892, 16911 | 0, 0 | 88.586 |
| | 2 | 61 | 2 | 16896, 16911 | 0, 0 | 84.710 |
| | 3 | 47 | 2 | 16892, 16896 | 0, 0 | 77.752 |
| | 4 | 37 | 2 | 16891, 16892 | 0, 0 | 69.648 |
| | 5 | 38 | 2 | 16891, 16896 | 0, 0 | 65.769 |
| | 6 | 49 | 2 | 16892, 16906 | 0, 0 | 62.427 |
| | 7 | 79 | 2 | 16908, 16911 | 0, 0 | 61.239 |
| | 8 | 44 | 2 | 16891, 16911 | 0, 0 | 60.744 |
| | 9 | 57 | 2 | 16896, 16906 | 0, 0 | 58.550 |
| | 10 | 34 | 2 | 16883, 16911 | 0, 0 | 54.958 |

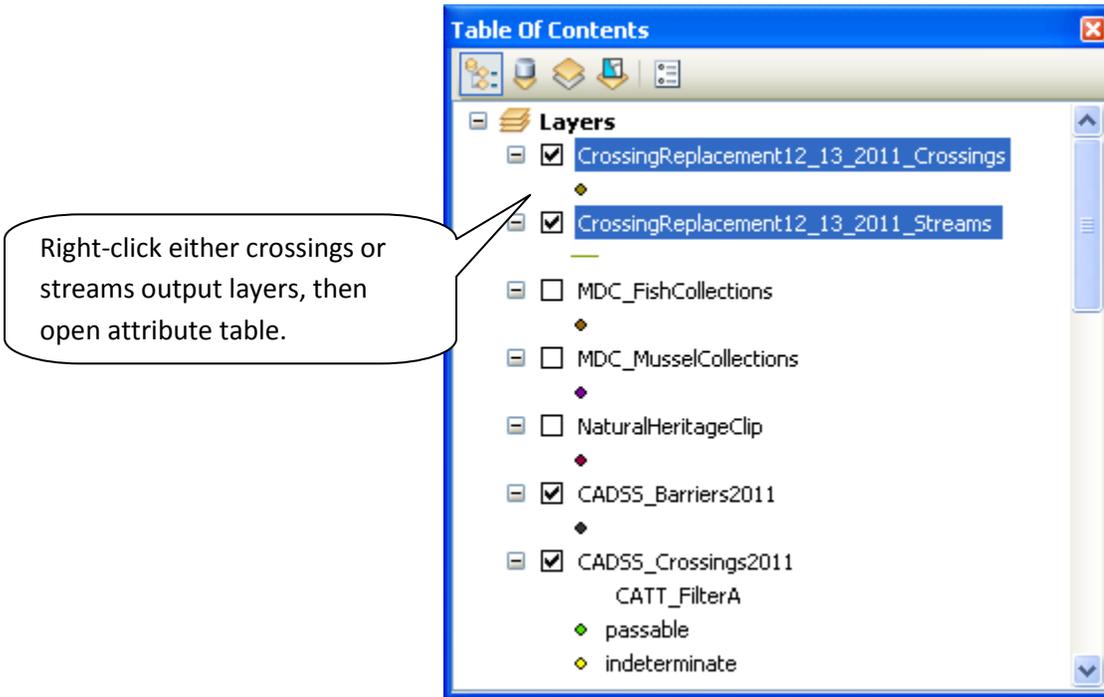
Streams Zoom Close

Selecting rows in the table will highlight the crossings contained. Click the Streams button to display connected stream reaches.

Use the **Zoom** and **Stream** buttons on the top 10 table to see stream segments connected by removal of impassable crossings. In the example below, two stream segments are connected by the removal of a single impassable crossing near the center of the highlighted reach.



To view results after the top 10 table is closed, right click on your output feature class in the table of contents window, then open the attribute table.



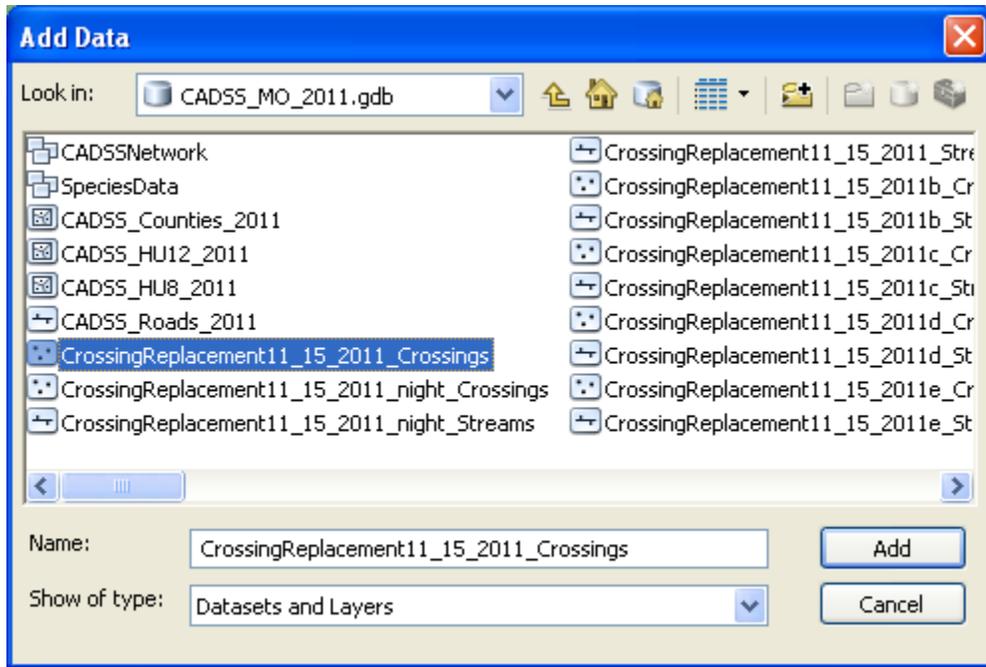
The attribute table contains the scores and the final rankings for the top 10 options. The sum of weighted scores and priority rank fields are near front of the table.

| OBJECTID | Shape | Priority Rank | Combination ID | Crossings Replaced | Crossing ObjectIDs |
|----------|----------|---------------|----------------|--------------------|--------------------|
| 1 | Polyline | 1 | 53 | 2 | 16892, 16911 |
| 2 | Polyline | 2 | 61 | 2 | 16896, 16911 |
| 3 | Polyline | 3 | 47 | 2 | 16892, 16896 |
| 4 | Polyline | 4 | 37 | 2 | 16891, 16892 |
| 5 | Polyline | 5 | 38 | 2 | 16891, 16896 |
| 6 | Polyline | 6 | 49 | 2 | 16892, 16906 |
| 7 | Polyline | 7 | 79 | 2 | 16908, 16911 |
| 8 | Polyline | 8 | 44 | 2 | 16891, 16911 |
| 9 | Polyline | 9 | 57 | 2 | 16896, 16906 |
| 10 | Polyline | 10 | 24 | 2 | 16892, 16911 |

(1 out of 10 Selected)

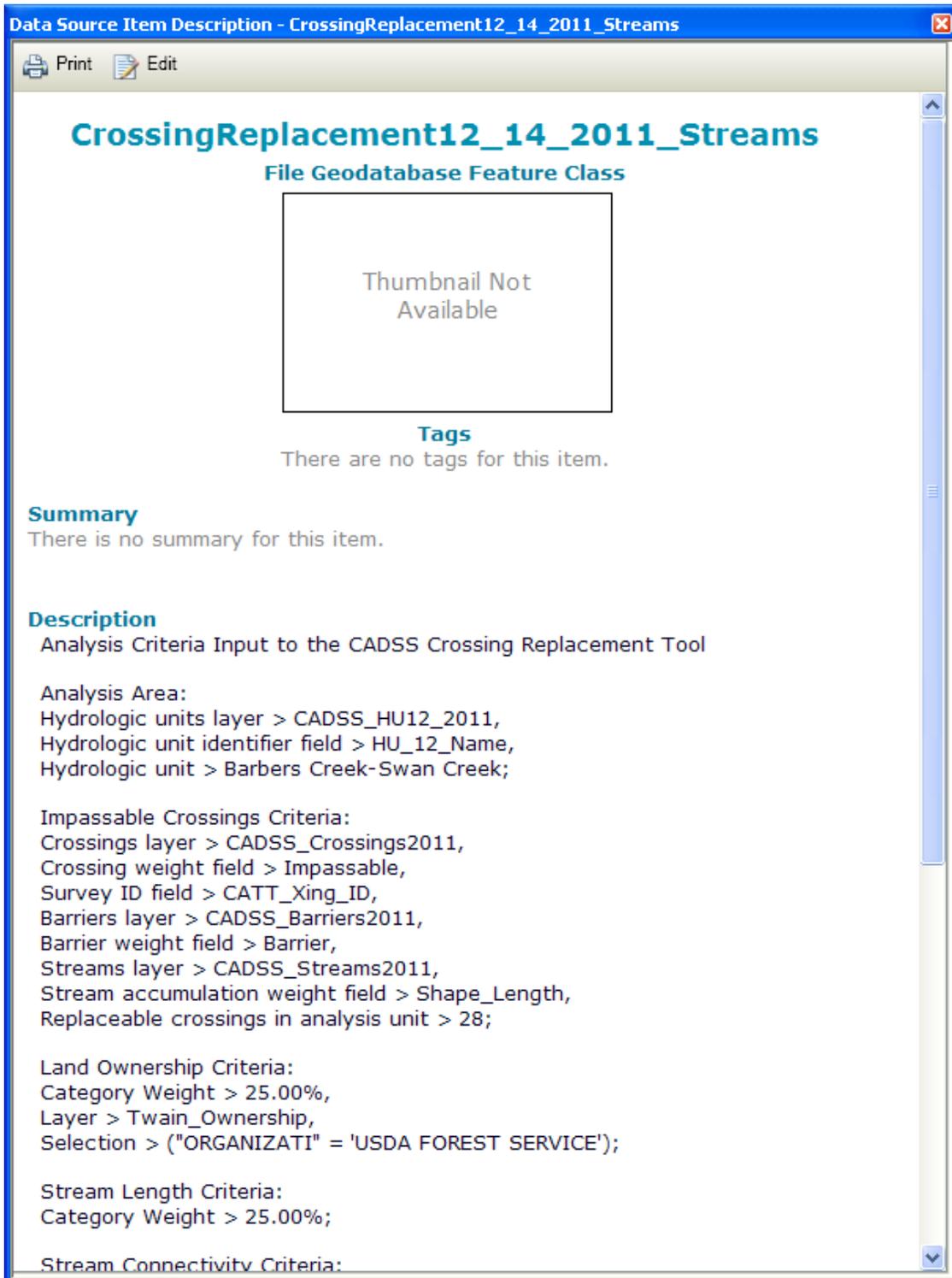
If the feature class is not available in the table of contents, click the Add Data button and browse to the geodatabase associated with CADSS, then select your feature class (see next page).

Your output feature classes are saved in the **CADSS_MO_2011.gdb** geodatabase, and are available for future use, unless you overwrite or delete them. To add a feature class from a previous CADSS run, simply click the add data button and browse to the feature class within the geodatabase.



It is easy to forget what settings you selected within CADSS. The selections you made to generate a particular output file can be viewed within the metadata:

Right-click on your output file in the table of contents, then select **Data > View Item Description**. All CADSS settings are listed in the Description section.



Data Editing Tools

CADSS tools are available for several common data editing tasks:

| Task | Tool(s) required |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Update the passage status of a crossing, for example, change status from unknown to passable. | Survey Status Editing Tool, then Crossing Weight Editing Tool |
| Re-load an updated crossing status field for analysis. For example, you have updated passage status for several crossings, and want to use the updated status next time you run a prioritization tool. | Crossing Weight Editing Tool |
| Add or remove a permanent barrier (e.g. dam, waterfall, etc.) to the stream network. | Network Barrier Editing Tool, then Network Flow Editing Tool |
| Initialize flow within your stream network (required for using the CRT). | Network Flow Editing Tool |

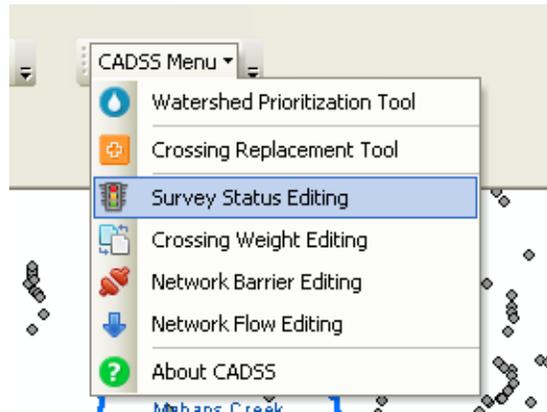
See following pages for detailed instruction on the use of each data editing tool.

Survey Status Editing

The Survey Status Editing Tool is used to change the passage status of crossings.

This tool makes changes to the underlying data that cannot be undone. Be sure to make a backup copy of the **CADSS_MO_2011.gdb** geodatabase before using this tool.

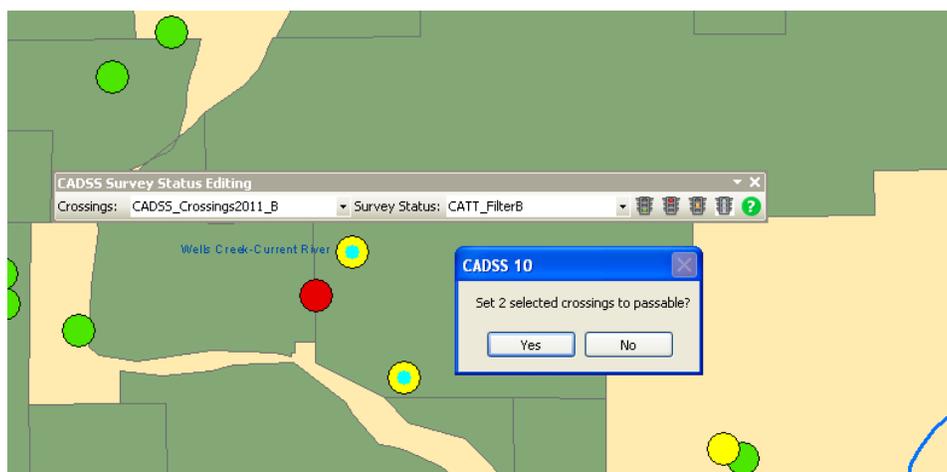
Access the tool through the CADSS dropdown menu.



Once the tool opens you can select a crossing layer and a survey status field to edit.



Zoom to the crossing(s) you would like to update, select the crossing(s) with the Arcmap10 selection tool, then click a stoplight icon (hover over icons to view description) on the right of the toolbar to update the crossing status. CADSS will prompt you to confirm the update.



To apply the updates to your next analysis you must run the Crossing Weight Editing Tool (see next page).

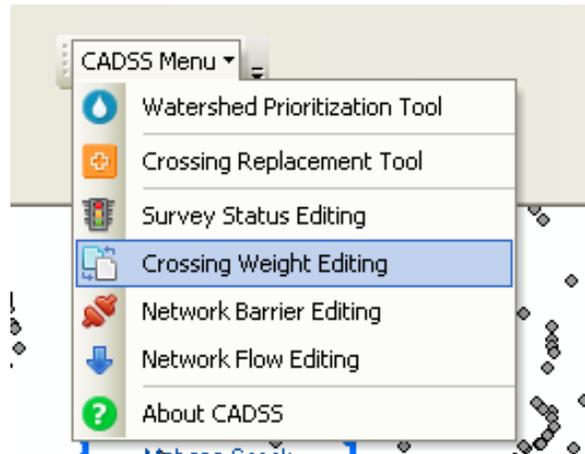
Crossing Weight Editing

The Crossing Weight Editing Tool is used to apply the correct passage status field to the network weight field. There are four primary reasons you may need to run this tool:

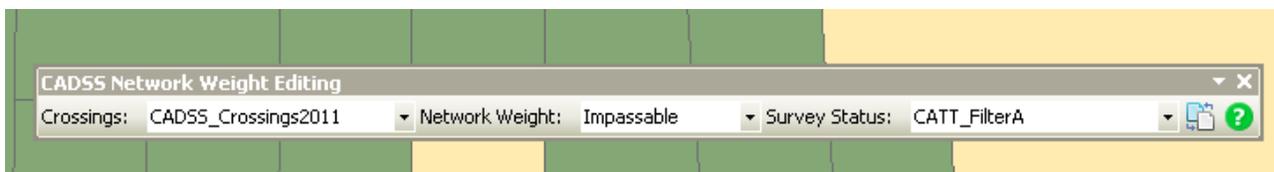
- 1) You are running CADSS for the first time
- 2) You do not know what source field (e.g. FilterA vs. FilterB) is currently loaded
- 3) You would like to change the source field (e.g. switch from FilterA to FilterB)
- 4) You have changed the passage status of a crossing since last running CADSS

It is **very important** to know the correct passage status field is selected and that values have been applied to the network weight field. CADSS uses values in the network weight field when running the CRT. The only way to be certain that the correct values are being applied is to run this tool, or to use the Update button on the Impassable Crossings tab in the CRT (see page 28)

Access the tool through the CADSS dropdown menu.



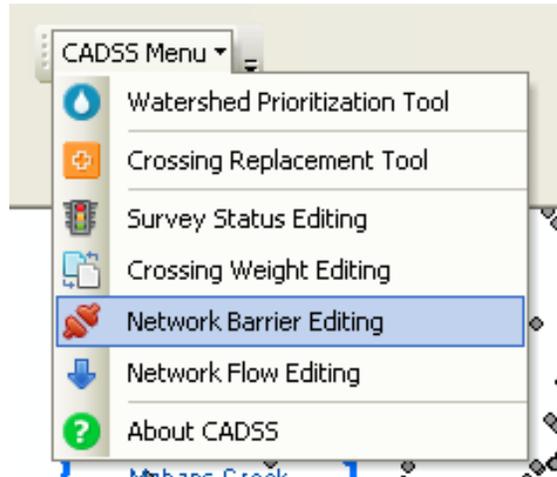
Select the crossing dataset and the network weight field, then select which survey status field to apply to the network weight field. Click the icon to the right of the survey status dropdown to run the tool. In the example below we are assigning network weights to the text values in CATT_FilterA and storing them in the Impassable field of the CADSS_Crossings2011 dataset. The values stored in the Impassable field will be used by CADSS when the CRT field is run.



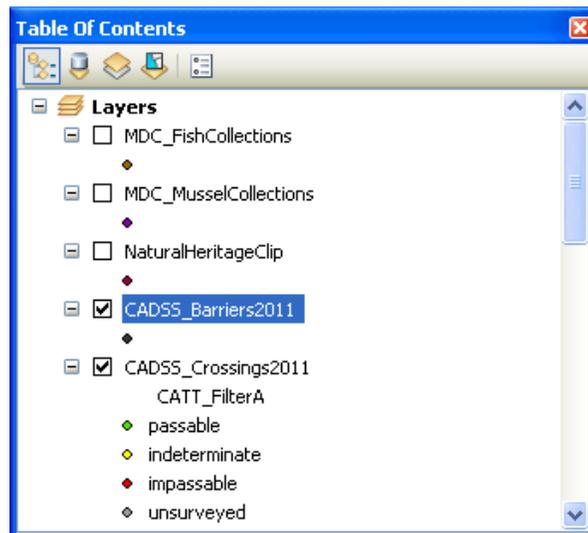
Network Barrier Editing

The Network Barrier Editing Tool is used to edit natural (e.g. waterfalls) or manmade (e.g. dams) barriers in a barrier data layer.

Access the tool through the CADSS dropdown menu.

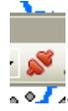


CADSS comes with a default barrier layer, **CADSS_Barriers2011**, as shown below.

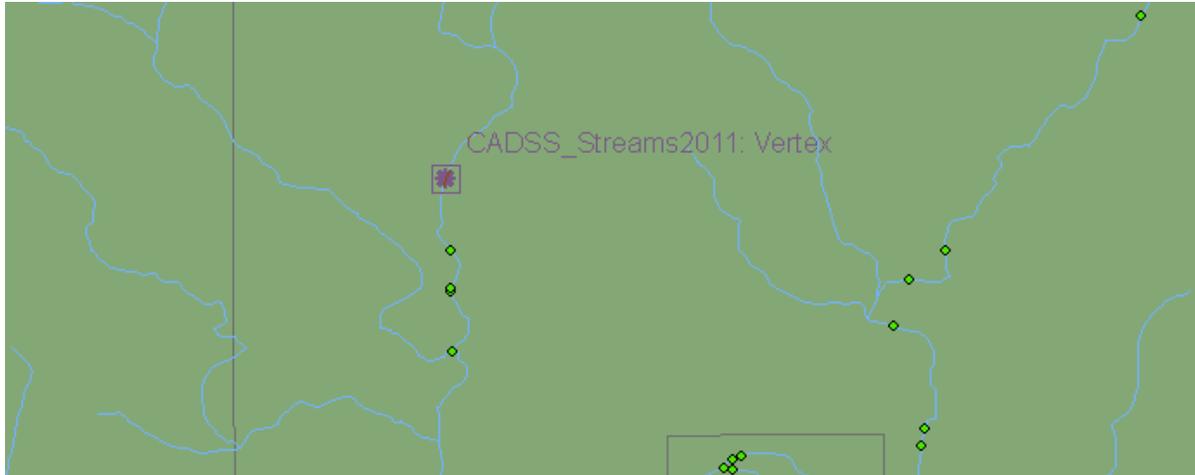


Select a target barrier layer, a network weight field, and a streams layer to edit. In the example below we are editing a barrier on the CADSS_Streams2011 layer.

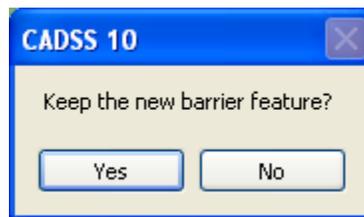




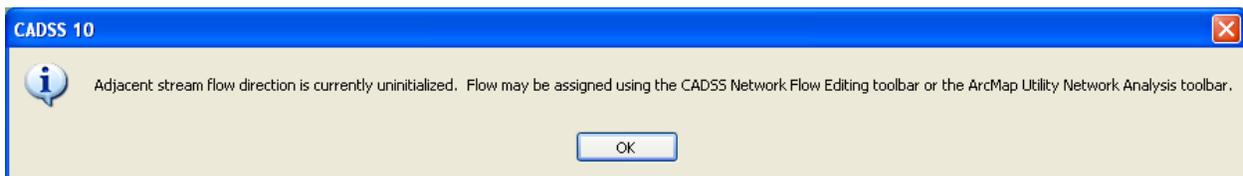
To **add a barrier**, click the red button . Crosshairs will appear that snap a point to the nearest stream. Move the crosshairs to the desired barrier location and click.



Click Yes to keep the new barrier.



CADSS warns you to **run the Flow Editing tool after editing a barrier**. CADSS will not be able to run the CRT without first running the Flow Editing tool. You can run the flow editing tool at any time following barrier editing (see next page).



All barriers are added to the network as fully impassable. You may need to run the Network Flow Editing Tool on the streams layer after editing (see next page).

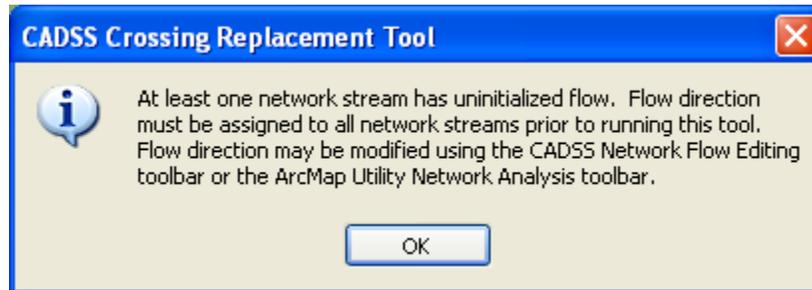


To **remove a barrier**, use the select tool to select the barrier, then click the green button .

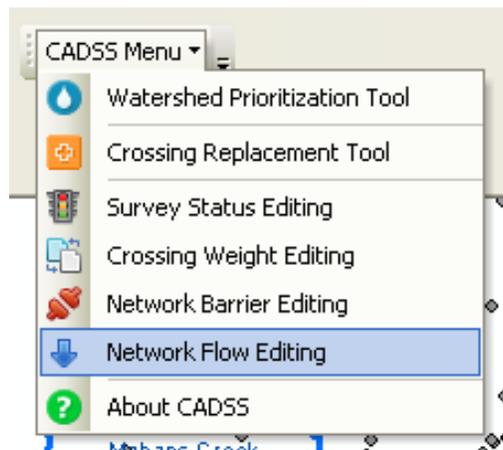
Network Flow Editing

The Network Flow Editing Tool is used to initialize flow in a stream network. Flow must be initialized for all streams in a network prior to running the Crossing Replacement Tool (CRT).

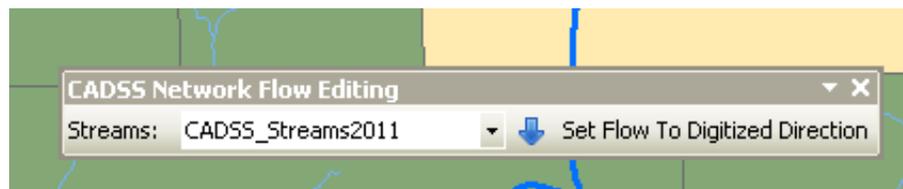
If flow is not initialized you will receive the following error after clicking the Calculate button in the CRT.



Access the tool through the CADSS dropdown menu.



Select your target stream network, then click the Set Flow to Digitized Direction button.



Click Yes to accept the changes. The CRT will now be able to run.

