# Appendix E:
## Technical Documentation for Biodiversity/Wildlife Habitat Assessment

**Processing of the GIS data**

All data was processed using ESRI's ArcGIS 9.1 ArcMap software including the Spatial Analyst extension.

Due to the large number of data layers and the large numbers of features in some layers, a raster based data model was used to store and process the layers. All conversions to ESRI GRID format used the same extent and cell size. The cell size of the GRID is also a good representation of the overall spatial precision of the combined data layers.

**Individual Layer Processing**

**General notes –** Buffers were created as vectors using the ArcToolbox Buffer tool except where otherwise noted. Conversion to raster was performed using the same template to keep the extent and cell size consistent. All GRIDS were reclassified to replace NoData values with zeros.

NC Stateplane, NAD83, meters
North = 322678.587
South = -40351.413
East = 978249.376
West = 119769.376
Cell Size = 30m

**Significant Natural Heritage Areas (SNHA) –** snha.shp (July 2007) shapefile from the NCNHP, select only primary boundaries of non-aquatic sites (type <> 'Secondary', sitename not ending 'Aquatic Habitat'), convert features to GRID preserving the Sig field, Reclassify to SCP rating, Sig. A or B = 10, C = 8, D = 6.

**Aquatic Significant Natural Heritage Areas** - snha.shp (July 2007) shapefile from the NCNHP, select only aquatic SNHAs (sitename ending 'Aquatic Habitat'), buffer the polygons by 300 feet using the Buffer Toolbox, convert features to GRID preserving the Sig field, Reclassify to SCP rating, Sig. A or B = 10, C = 8.

**Element Occurrences (EO) –** NCNHP provided a shapefile (March 2007) of the qualifying EOs to be included. All polygons were intersected to find overlaps and result was converted to GRID. Overlapping EOs GRID was reclassified to SCP Rating 5. Other polygons with GRANK beginning with G1 or G2; SRANK beginning with S1; or EORANK beginning with A or B were assigned an SCP Rating of 5 in a temp field. All other records are assigned 4. Convert polygons to GRID preserving the temp field.

**Native Trout –** WRC provided an Access table of native trout stream locations with coordinates and stream names. These points were displayed and 1:24,000 stream segments were selected manually by NCNHP with guidance by WRC. The segments were then buffered by 100 ft and converted to GRID and reclassified to 9.

**Core Guild Areas** - NCNHP provided a shapefile (March 2007). Polygons for each type of guild were selected and the features converted to GRID preserving the 'Score'. The GRIDS were then combined and the 'Score' values for each pixel added. The GRID was reclassified to SCP Ratings as shown in the table below.

| SCP Rating | S-RANK | Score Total |
|---|---|---|
| 10 | 1 | 100 |
| 9 | 1.5 | 78.12 |
| 8 | 2 | 56.23 |
| 7 | 2.5 | 43.93 |
| 6 | 3 | 31.62 |
| 5 | 3.5 | 24.7 |
| 4 | 4 | 17.78 |
| 3 | 4.5 | 13.89 |
| 2 | 5 | 10 |
| 1 | 5.5 | 8.02 |

**All Streams** – DWQ provided 24khydro.shp. Non Hydrology lines (minor1 <> -99999 basin boundaries, intercoastal waterway, etc; minor1 <> 202 closure lines; minor1 <> 205 carolina bays outline) were removed, buffered 100 ft, converted to GRID (done in 4 parts due to memory limits)and reclassified to SCP Rating 1

**Wetlands** – DCM provided shapefiles from their website of NC CREWS wetland ratings. Merged county shapefiles into a single shapefile, converted to GRID preserving the OWR1 attribute, reclassified to SCP Ratings 3=7, 2=6, 1=2 National Wetlands Inventory (USFWS) – selected polygons in the counties not covered by the CREWS data, removed diked or impounded areas (nwi_name ending "h" or "HH") , converted to GRID, reclassified to SCP Rating 5.

**DWQ Bioclass Benthic** – Files supplied by DWQ, nc24kAUonly.shp (1:24,000 hydrography with DWQ assessment unit codes), benthos20070420.xls and benthosmostrecent.xls. The 2 .xls files were converted to delimited text and joined to the shapefile using the AUNUM field. The records that with good, excellent, or natural bioclass, a survey date after 2000, and the most recent records were selected. These stream segments were then buffered by 100 ft. The polygons were converted to GRID preserving the Bioclass field, Reclassify to SCP rating, Excellent or Natural = 9, Good = 7.

**DWQ Bioclass Fish** – Files supplied by DWQ, nc24kAUonly.shp (1:24,000 hydrography with DWQ assessment unit codes) and 04_07FishCom.shp. The 2 shapefiles were joined using the AUNUM field. The records that with good or excellent bioclass, and a survey date after 2000 were selected. These stream segments were then buffered by 100 ft. The polygons were converted to GRID preserving the Bioclass field, Reclassify to SCP rating, Excellent or Natural = 9, Good = 7.

**Important Bird Areas (IBA) –** NC_IBA83.shp (2004) supplied by Audubon. Converted to GRID and reclassified to SCP Rating 6.

**Outstanding Resource Waters / High Quality Waters (ORW/HQW) –** Files supplied by DWQ, nc24kAUonly.shp (1:24,000 hydrography with DWQ assessment unit codes) and Q_Assessment_Units_Classifications for NHP.txt. The shapefile and text file were joined using the AUNUM field. The records that with ORW or HWQ, and not classed as SA, WS-I, or WS-II were selected. These stream segments were then buffered by 200 ft. The polygons were converted to GRID preserving the BIMS_classification field, reclassify to SCP rating, ORW = 10, HQW = 8.

**Stream Buffers on T&E Streams –** NCNHP provided fedhucs.shp and DWQ provided 24khydro.shp. The stream segments that intersected the fedhucs watersheds were buffered by 200 ft. The polygons were then converted to GRID and reclassified to the SCP Rating of 7.

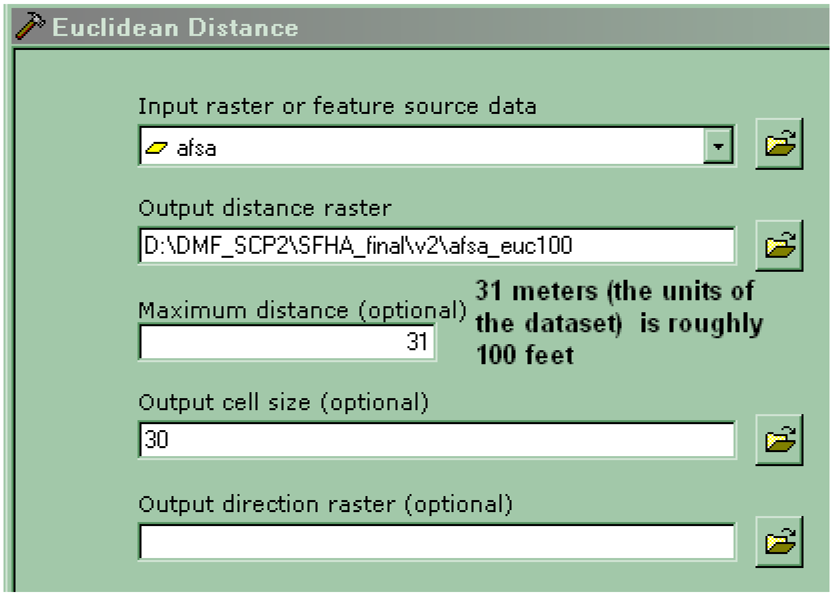
**Priority Watersheds –** WRC provided ncwrc_addnl_cons_areas.shp and tnc_cons_areas.shp. NCNHP provided NHP priority sheds_rev1.shp. . These 3 shapefiles were converted to GRIDs. The nc24kAUonly.shp (from DWQ) was buffered by 100 ft, converted to GRID and reclassified to 1. Each watershed GRID was multiplied by the stream GRID filtering the watershed to only 100 ft within selected watersheds. The resulting GRIDs were then combined and reclassified to a SCP Rating of 3.

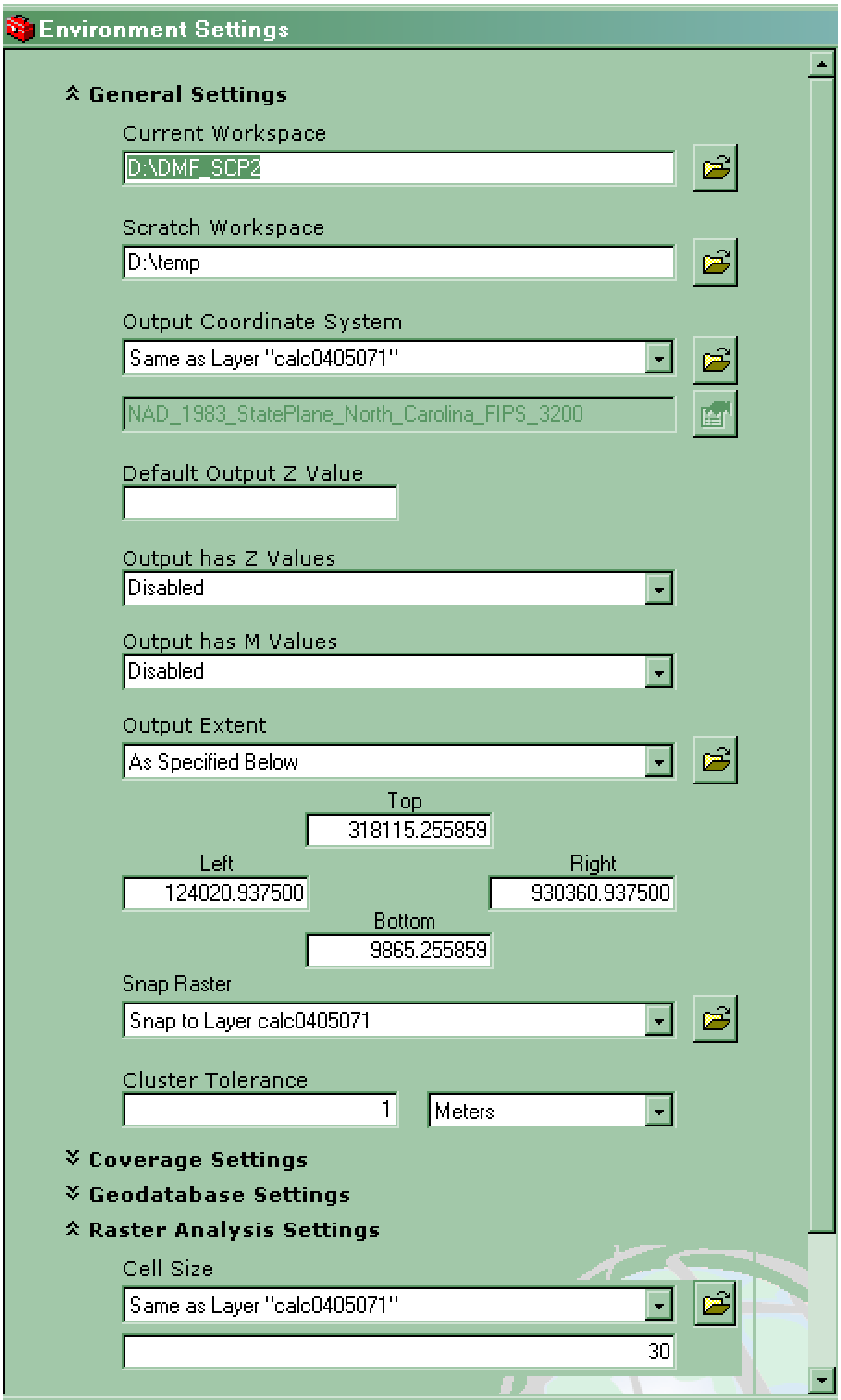
**Impervious Surface –** Land cover was provided by the EPA's Multi-Resolution Land Characteristics Consortium. This data was already a GRID. It was reclassified to >20% impervious surface = 0 and all other values = 1.

**Anadromous Fish Spawning Areas - Processing Notes (July 2007)**

***Note***: Marine Fisheries was only willing to supply the existing 1998 version of the Anadromous Fish Spawning Areas **(**AFSA) dataset. They claim they are *still* working on updating a more current version and did not want to release an unapproved draft for use in the June 2007 edition of the State Conservation Plan data model.

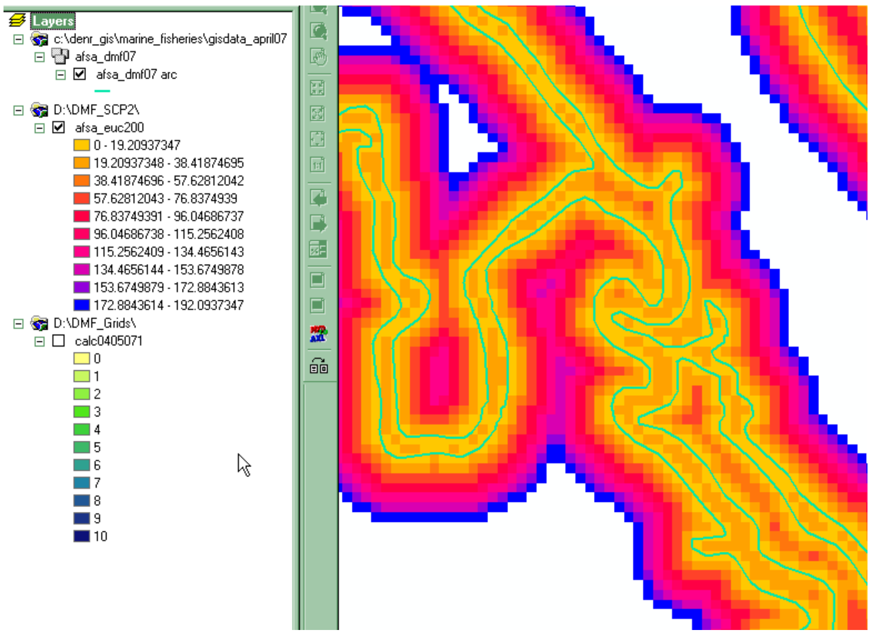
**Step 1**: Use the Spatial Analyst ArcToolbox ***Euclidean Distance function*** to create a straight line distance buffer of **100** (formerly 200) feet from each cell to the closest vector AFSA linework. Note: Set your extent and cell size to match the existing SCP working grid in your Environment Settings. Don't create a direction raster.


Euclidean Distance
Input raster or feature source data
afsa
Output distance raster
D:\DMF_SCP2\SFHA_final\v2\afsa_euc100
Maximum distance (optional)
31
31 meters (the units of the dataset) is roughly 100 feet
Output cell size (optional)
30
Output direction raster (optional)

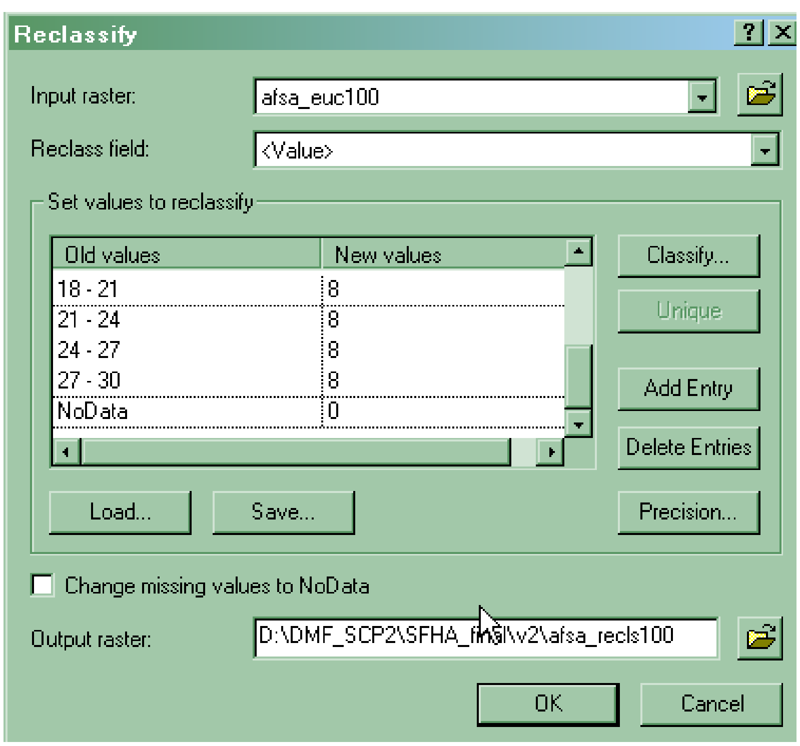

Environment Settings
General Settings
Current Workspace
D:\DMF_SCP2
Scratch Workspace
D:\temp
Output Coordinate System
Same as Layer "calc0405071"
NAD_1983_StatePlane_North_Carolina_FIPS_3200
Default Output Z Value
Output has Z Values
Disabled
Output has M Values
Disabled
Output Extent
As Specified Below
Top
318115.255859
Left
124020.937500
Right
930360.937500
Bottom
9865.255859
Snap Raster
Snap to Layer calc0405071
Cluster Tolerance
1
Meters
Coverage Settings
Geodatabase Settings
Raster Analysis Settings
Cell Size
Same as Layer "calc0405071"
30

**Step 2:**

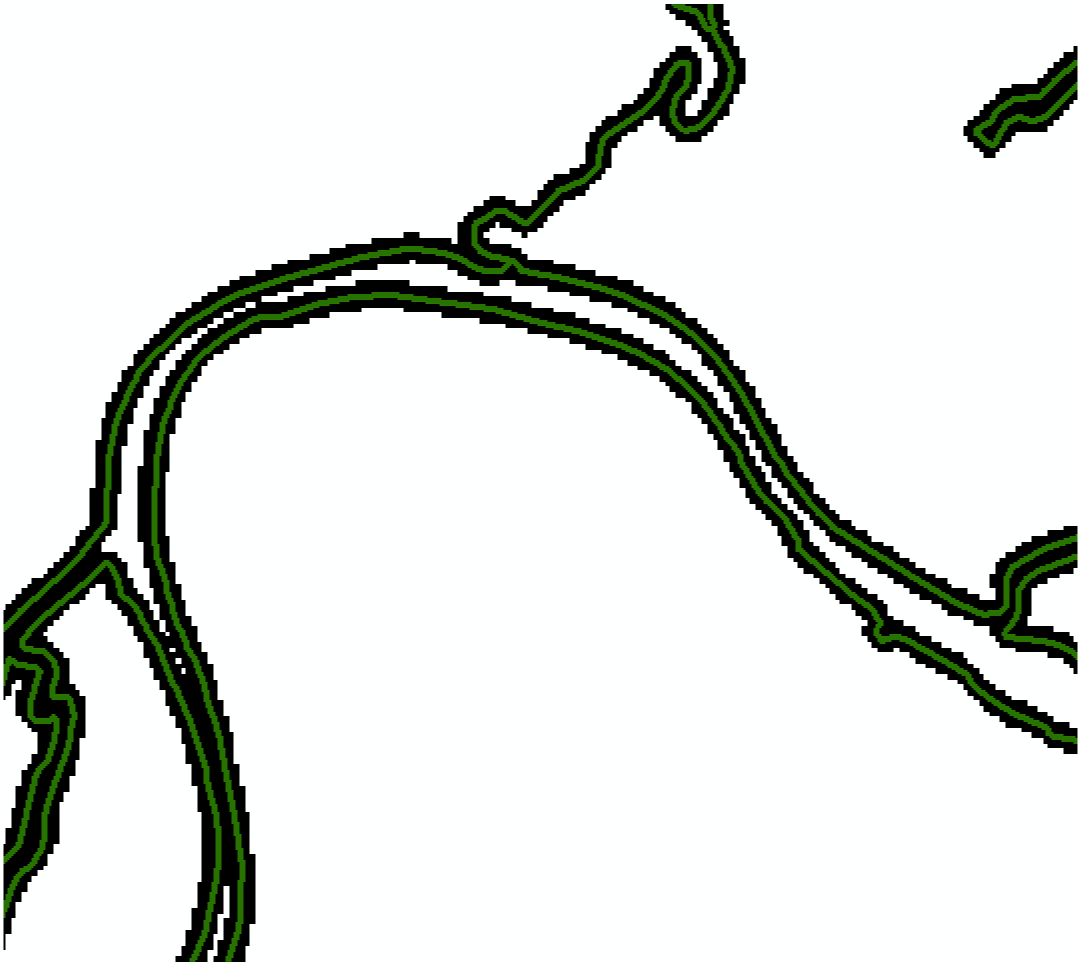
The output looks like this, but cell "Value" field varies based on distance from the vector AFSA lines, so we have to reclassify everything except NODATA cells to have a value of 8, which is the rating for the AFSA 100 foot buffers in the SCP.




**Note:** Make the NoData cells 0 , because when we use the Max function later to combine with the hydro polygon fill grid, we don't want the NoData areas in each grid to take precedence.

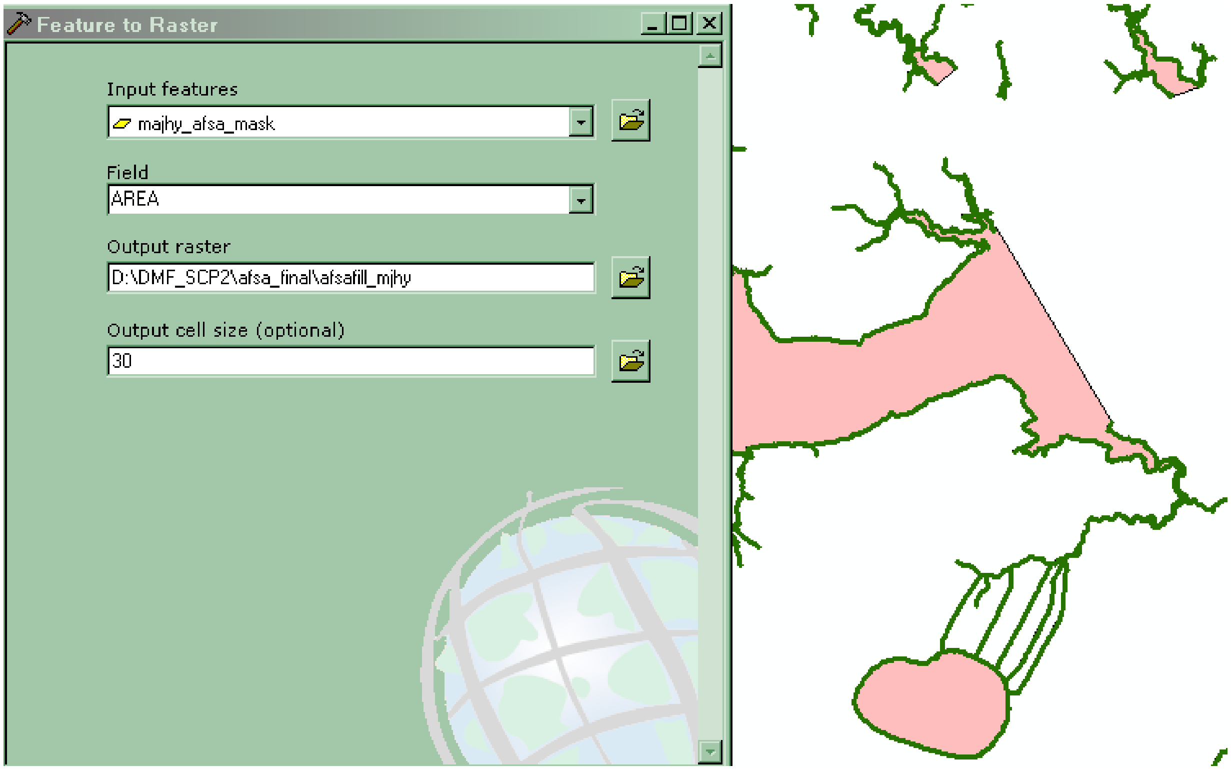


**Step 3:** There are still some places (generally where the mouths of rivers meet the sound) where the double-line streams are much wider than the 100ft buffer, and some of the interior portions of the AFSA in those sections is not included in the resulting raster layer. See illustration below:

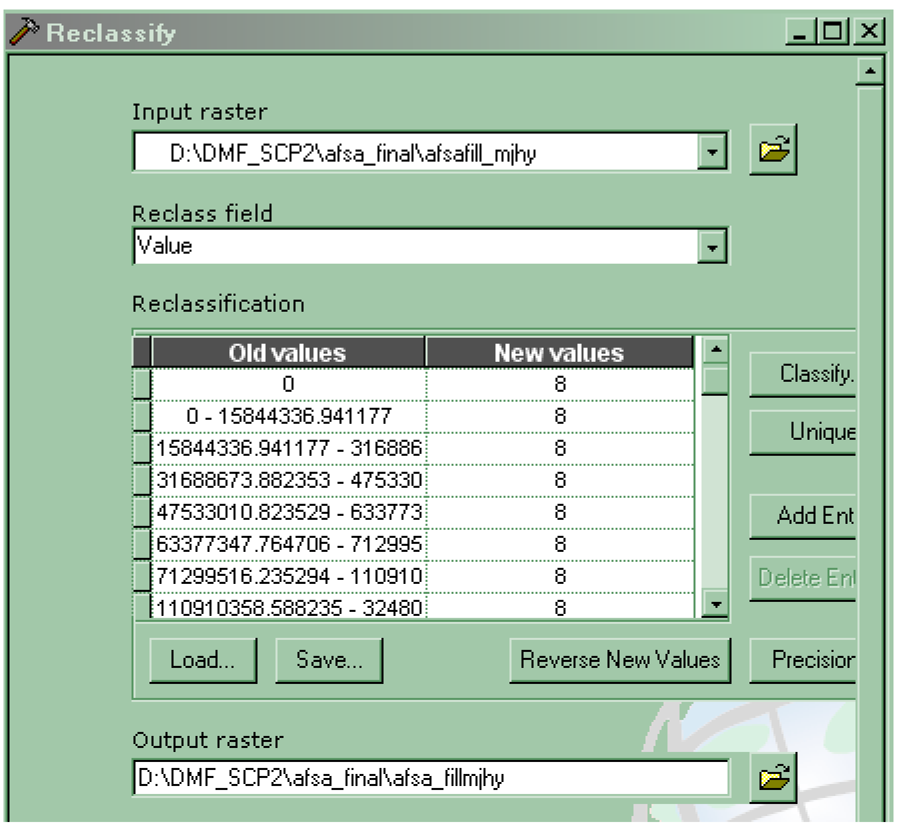


In order to compensate for this, the “Major Hydro” Polygon layer was used. We select out only those bodies of water that are affected and use them to create a filling layer. This did entail some manual splitting of large polygons so as to be able to select only the areas outlined by the AFSA dataset. This fill shapefile has been saved for use in future iterations of the model. Should DMF provide an updated AFSA dataset in the future, this fill layer will likely need to be modified.

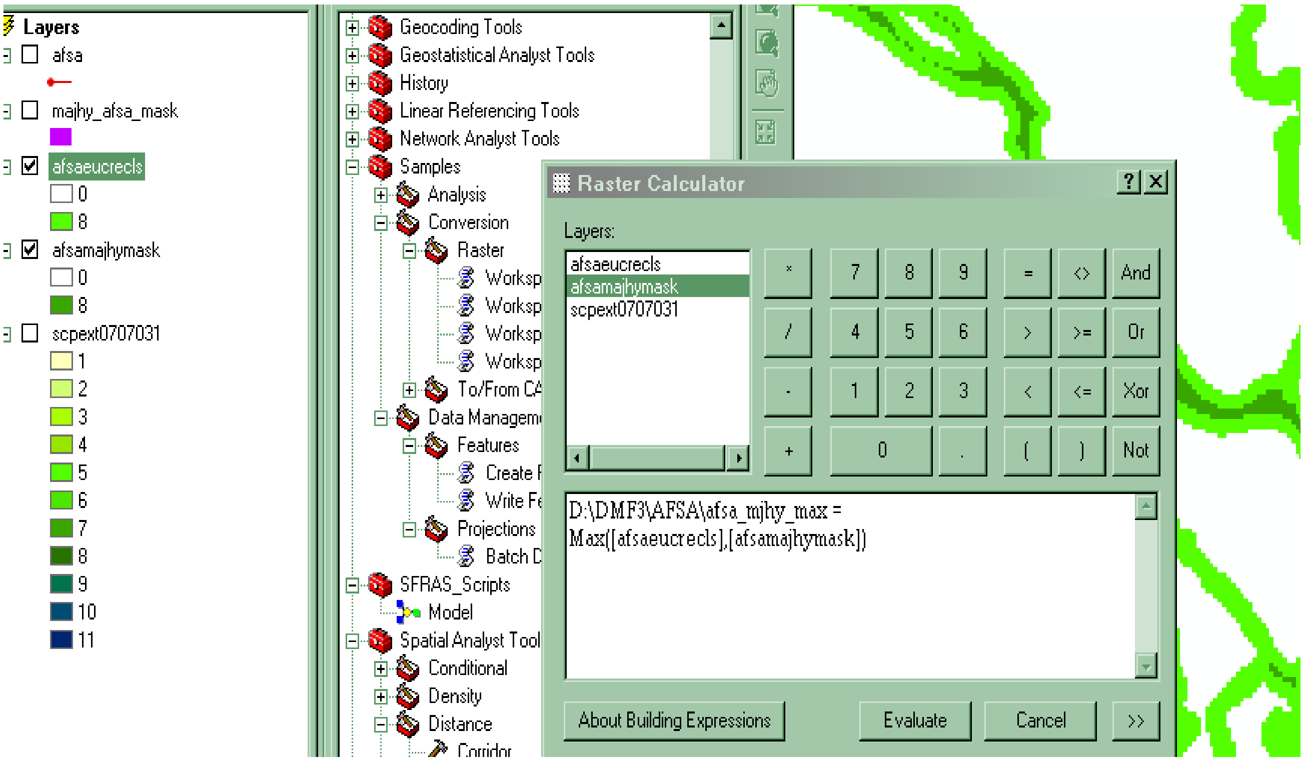
**Step 4:** Convert the vector polygon layer to a raster layer




**Step 5:** Reclassify all cell values to 8, except NoData, which should be 0.



**Step 6:** Combine the 100ft Euclidean distance raster buffer and the major hydro fill layer into a single grid, using the raster calculator, using the MAX function.




"Afsa_Mjhy_Max" is the final AFSA grid for the initial version of the SCP data model. This methodology may change in subsequent iterations of the dataset development.

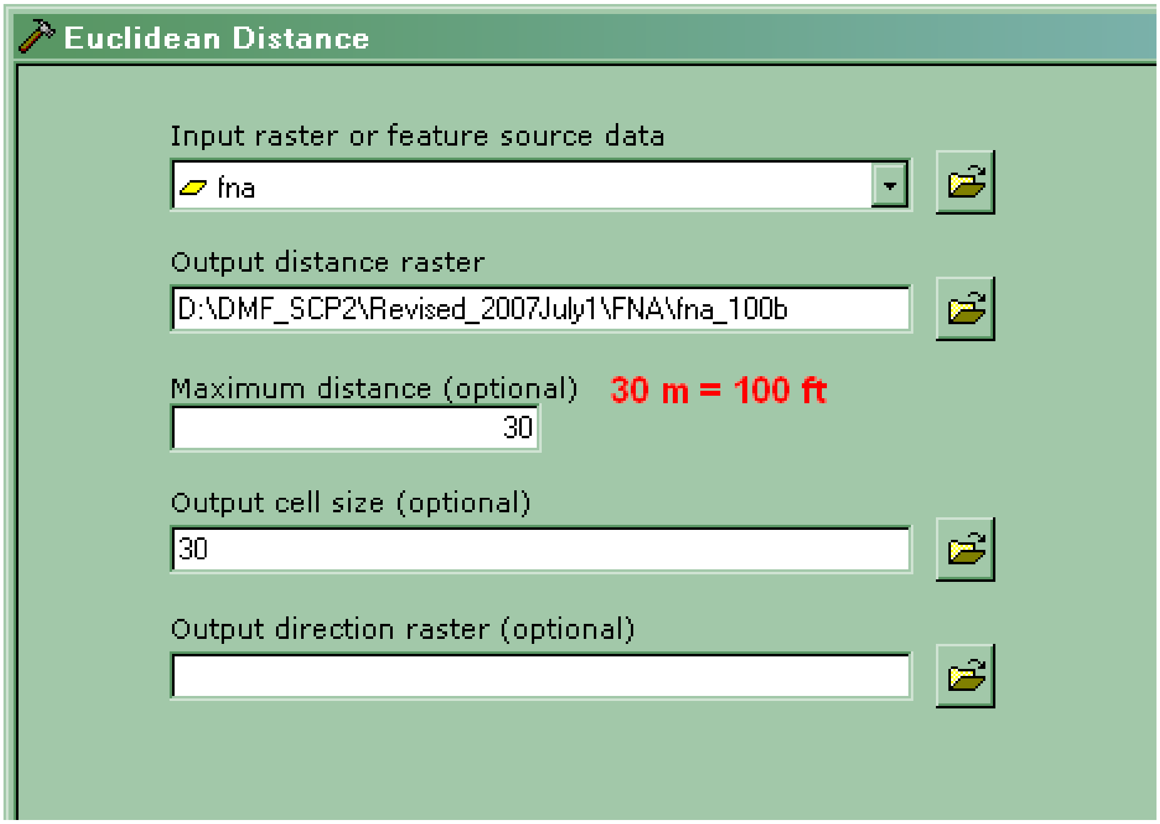
**Fish Nursery Areas - Data Processing Notes (June 7, 2007)**

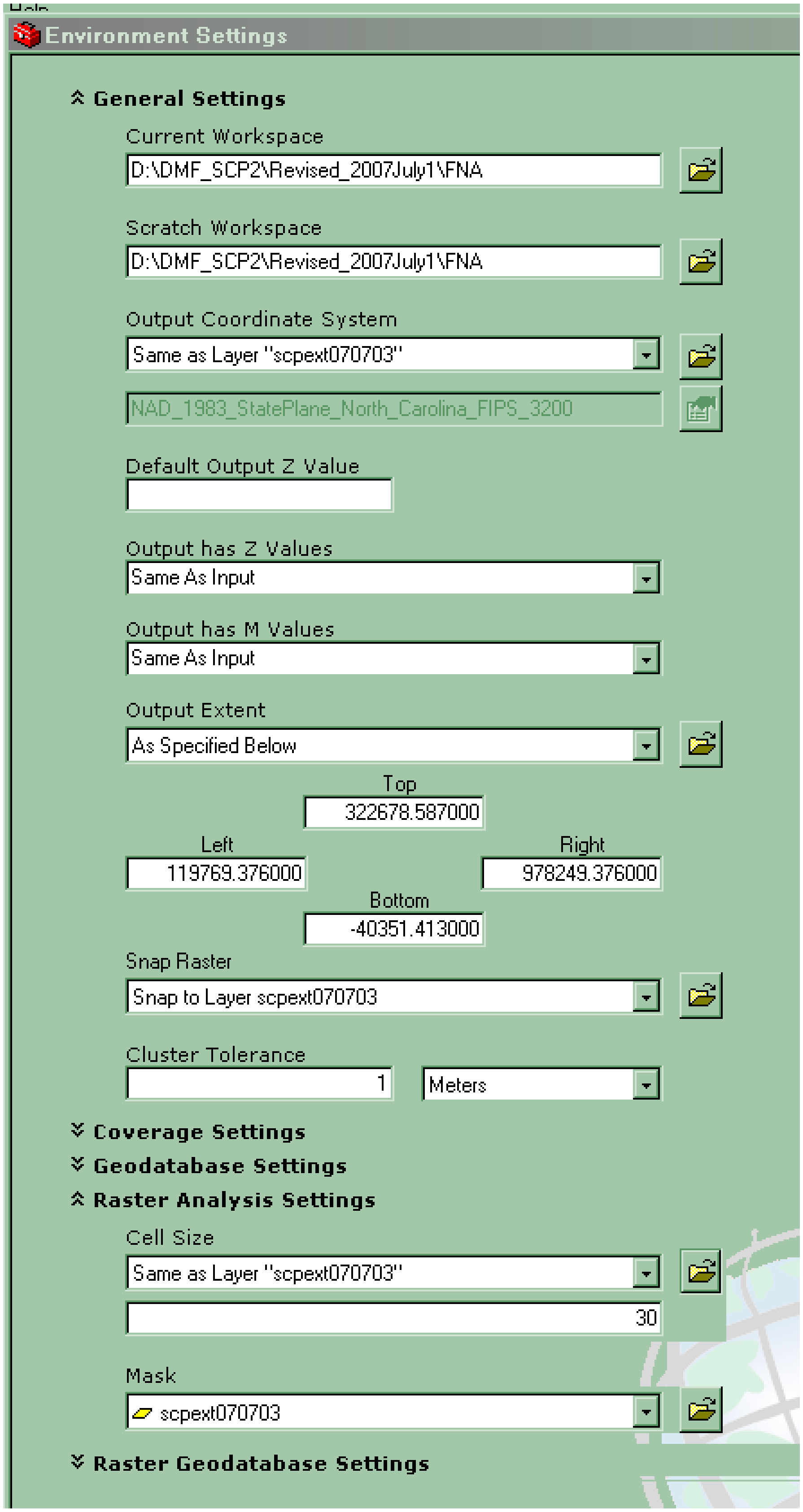
Dataset used was obtained in 2006 and is suspected of being 2005 vintage. No metadata exists. Marine Fisheries was also not willing to release anything more current in draft form.

**Step 1**: Set a Definition Query on the layer using this SQL to eliminate hole areas that are not part of the FNA jurisdictions and the "special secondary" nursery areas.

**"RULE_ID" = '15A NCAC 03R .0103' OR "RULE_ID" = '15A NCAC 03R .0104'**

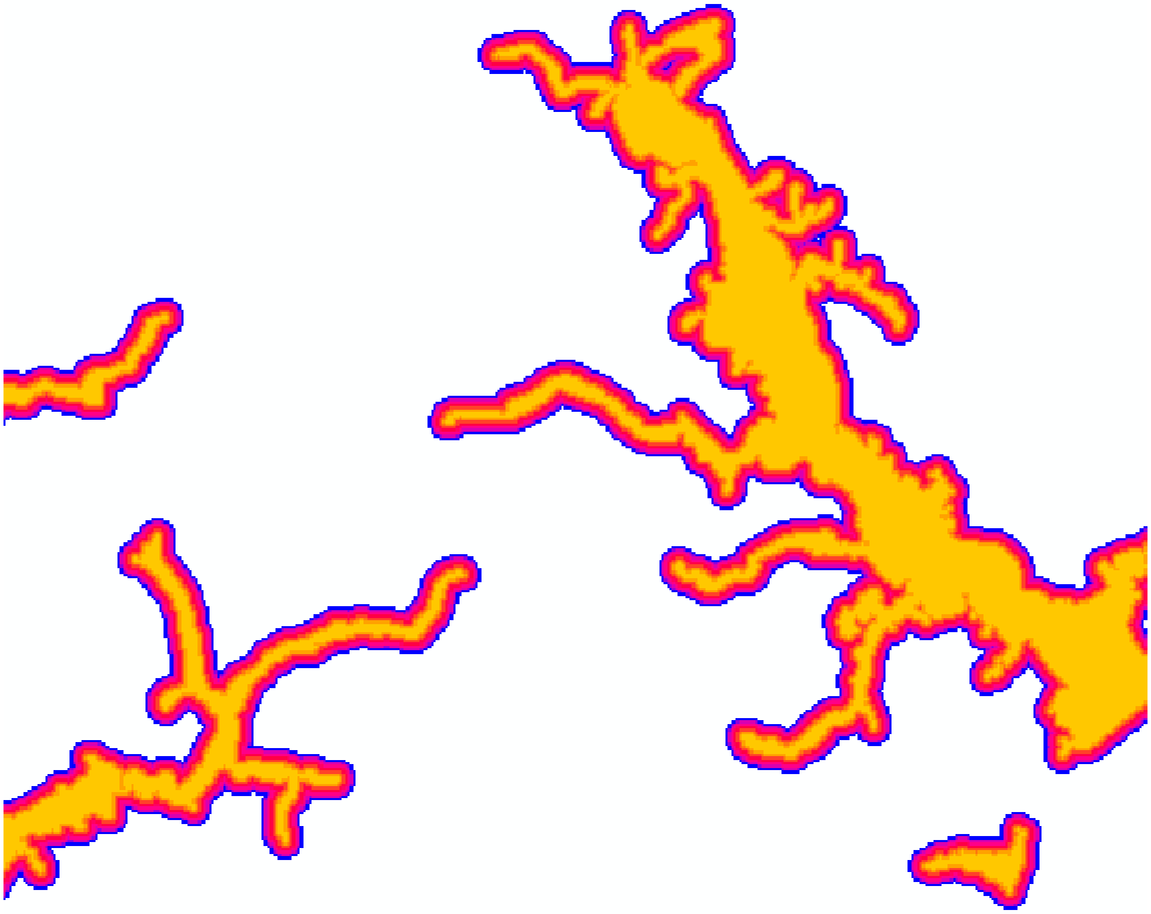
**Step 2:** Use the Spatial Analyst ArcToolbox ***Euclidean Distance function*** to create a straight line distance buffer of 100 feet from each cell to the closest vector FNA polygon. Note: Set your extent and cell size to match the existing SCP working grid in your Environment Settings. Don't create a direction raster.

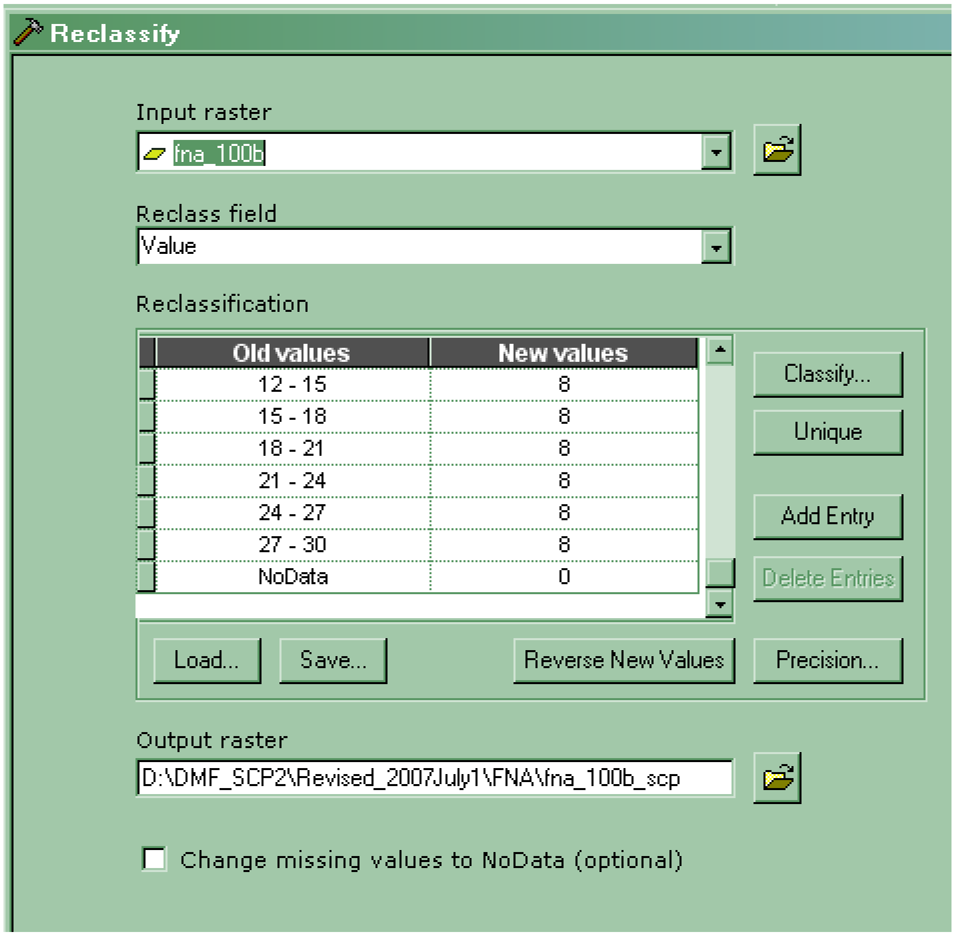

Euclidean Distance
Input raster or feature source data
fna
Output distance raster
D:\DMF_SCP2\Revised_2007July1\FNA\fna_100b
Maximum distance (optional)
30 m = 100 ft
30
Output cell size (optional)
30
Output direction raster (optional)


Environment Settings
General Settings
Current Workspace
D:\DMF_SCP2\Revised_2007July1\FNA
Scratch Workspace
D:\DMF_SCP2\Revised_2007July1\FNA
Output Coordinate System
Same as Layer "scpext070703"
NAD_1983_StatePlane_North_Carolina_FIPS_3200
Default Output Z Value
Output has Z Values
Same As Input
Output has M Values
Same As Input
Output Extent
As Specified Below
Top
322678.587000
Left
119769.376000
Right
978249.376000
Bottom
-40351.413000
Snap Raster
Snap to Layer scpext070703
Cluster Tolerance
1
Meters
Coverage Settings
Geodatabase Settings
Raster Analysis Settings
Cell Size
Same as Layer "scpext070703"
30
Mask
scpext070703
Raster Geodatabase Settings

**Step 3:**

The output looks like this, but cell “Value” field varies based on distance from the vector FNA polygons, so we have to reclassify all cells except NODATA cells to have a value of 8, which is the rating for the FNA 100 foot buffers in the SCP. NoData cells will become 0.






**Hard Bottom Data - Processing Notes (July 2007)**

**Multiple datasets from DMF – (no metadata, only this info from staff)**

**Hardbottom (Moser and Taylor) -**
This dataset comes from a report entitled "Hard bottom habitat in NC state waters: a survey of available data" , Moser and Taylor 1995. The report was completed for the DCM Ocean Resources Taskforce. GPS coordinates from the report were pulled into DMF (A. Deaton, M. Voss). Points represent known hard bottom from surveying researchers, fishermen, and divers. These data were more inclusive in state waters then the GIS data in SEAMAP. Attribute data includes relief: low relief = <0.5m, moderate relief = 0.5-2.0 m, high relief = >2m. All should be a priority, but moderate - high relief hardbottom sites represent areas probably having greater habitat diversity and complexity.

Files are:

hbline2spm (point) * Note – use only Medium & High Relief elements from
hbline2bspm (arc) these 3 datasets w/ rating of 7
hbpoly2spm (poly)

**Hardbottom (SEAMAP) –**

Federal project that compiled hardbottom reef data from Fl - NC in state and federal waters. Point and line data can be used to represent known hard bottom. Could exclude possible hardbottom since questionable, as well as the wrecks and artificial reefs since not natural.

**Files are:**

Php point and Phl arc
Hbp point and Hbl arc

**Step 1:** Process Moser Hard Bottom files

Set a definition query on the layer to filter out low relief and unclassified sites.

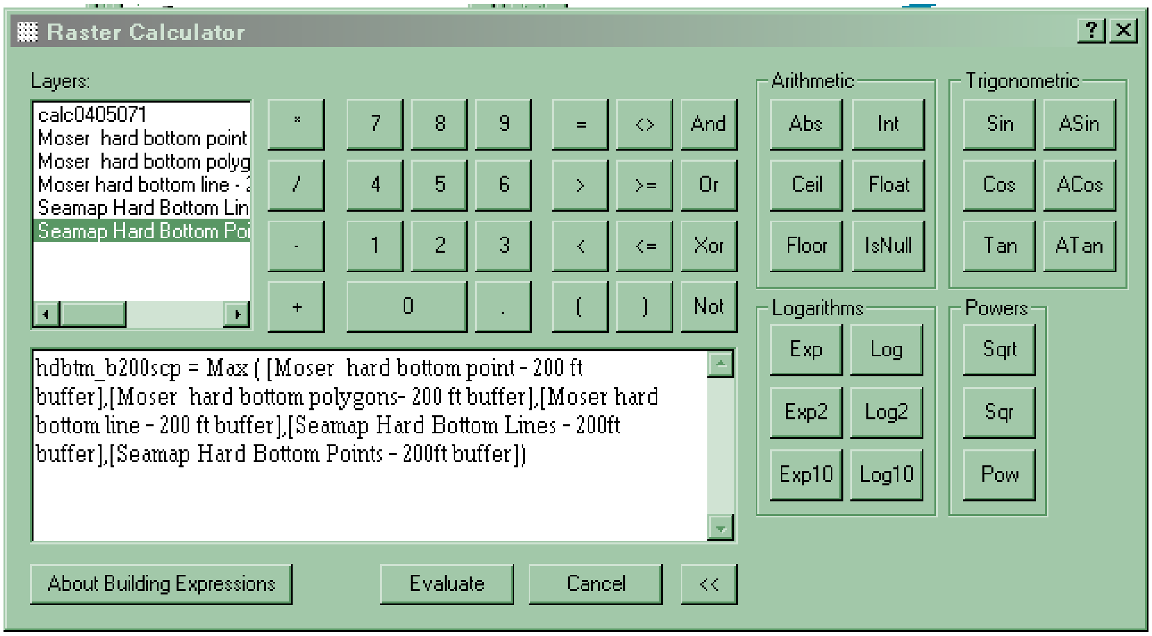
Then Buffer each one by 400 feet (122 meters)

Do the same for the Seamap data, but it doesn't have any relief information

**Step 2:** Combine all 5 hardbottom shapefiles that have been buffered by 400 feet into a single shapefile.

**Step 3:** Convert to a GRID, using the master extent grid to snap to for proper cell alignment

**Step 4:** Relcass so that all instances of hardbottom get a rating of 7 and all NoData cells become 0's

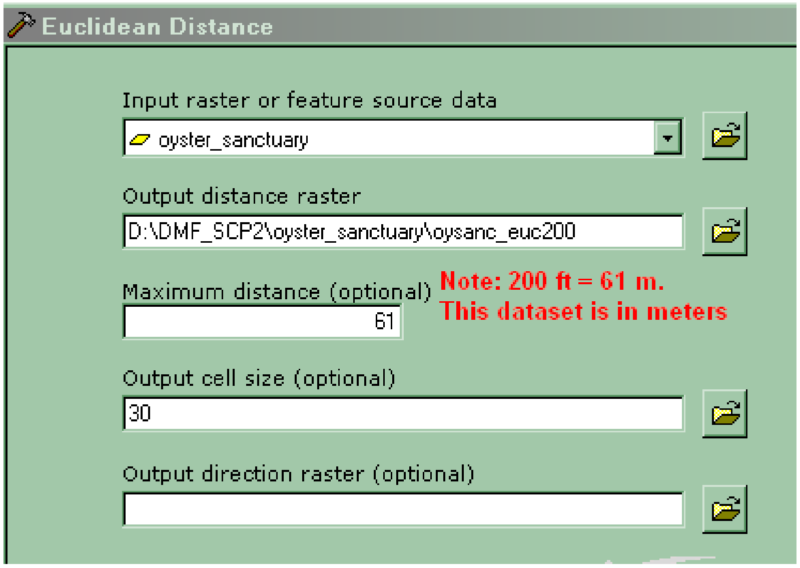



**Step 7:** Reclassify the combined, final grid “hdbm_b200_scp” so that all the NoData’s zeros and the hardbottom occurrence sites are 7’s

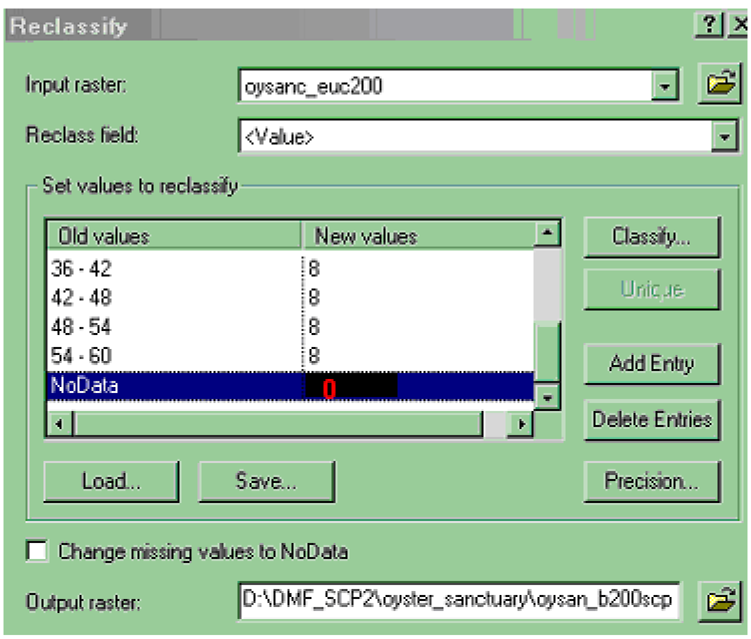
**Oyster Sanctuaries - Data Processing Notes (June 2007)**

Dataset used was obtained in 2006 and is of unknown vintage. There are only 9 very tiny polygons in this dataset. No metadata was provided..

**Step 1:** Use the Spatial Analyst ArcToolbox ***Euclidean Distance function*** to create a straight line distance buffer of 100 feet from each cell to the closest vector Oyster Sanctuary polygon. Note: Set your extent and cell size to match the existing SCP working grid in your Environment Settings. Don’t create a direction raster. Note: graphic is older, reduce the max distance to 31 feet for the 100 ft buffer




**Step 3:** Reclassify all cells except NODATA cells to have a value of 8, which is the rating for the Oyster Sanctuary 100 foot buffers in the SCP. NoData cells will have a value of 0.




**Submerged Aquatic Vegetation (SAV) - (July 2007)**

Dataset used was obtained from DMF in May 2007. Source was described by DMF as:

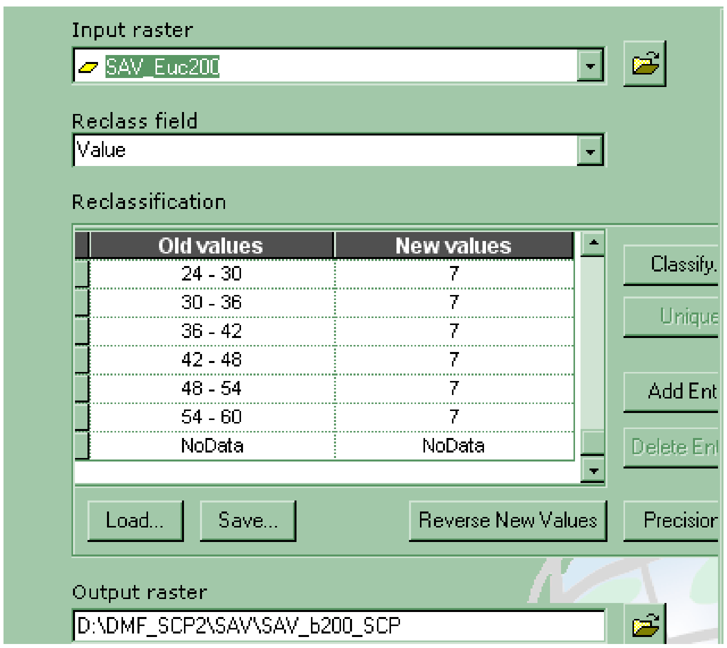
- Carroway, R.J., and L.J. Priddy. 1983. Mapping of submerged grass beds in Core and Bogue Sounds, Cartaret County, North Carolina, by conventional aerial photography. CEIP Report No. 20, 88p. *Photo interpretation from true color images dated 1983*

- Ferguson, R. L. and L.L. Wood. 1994. Rooted vascular aquatic beds in the Albemarle-Pamlico estuarine system. NMFS, NOAA, Beaufort, NC, Project No. 94-02, 103 p. *Photo interpretation from true color images ranging in date from 1988 to 1990*
- DWQ. 1998. Neuse River estuary SAV ground-truthing study. DWQ, Unpub. Rep. 11p.
- DMF bottom mapping - subtidal vegetated strata (you already have metadata for this)

Metadata did accompany the shapefile, from Scott Chappell

**Step 1:** Convert the SAV Mosaic shapefile to a GRID, snapping to the main extents grid, without any buffering

**Step 2:** Reclassify all SAV cells to 7 and all 0 & NODATA cells to have a value of 0.




**Shellfish Harvesting Areas / Shell Bottom - (July 2007)**

The Shellfish Harvesting Areas layer from DEH/Shellfish Sanitation is Feb 2007. The Shell Bottom/ mapped shellfish areas layer from DMF is composed of records from the mid 1990's to 2006.

DENR has, in consultation with experts in Division of Marine Fisheries, determined that because the shellfish harvesting areas are artificial jurisdictional boundaries which encompass our entire intra-coastal waterway and estuarine areas, rather than documented shellfish habitat areas, we will do two things to help focus the ratings on areas that are the most important.

**Analysis Constraint #1:** We separate the shellfish harvesting areas into those considered "open" and those considered "closed". For this analysis, we will consider all polygons with these HA_CLASS codes to be open. The reason we include Conditionally Approved – Closed in this category is because these areas may sometimes be open, sometimes closed – depending on local conditions.

Open
Conditionally Approved - Open
Conditionally Approved - Closed

Those polygons that have an HA_CLASS attribute set to "CSHA-Prohibited" are considered permanently closed.

**Analysis Constraint #2:** We will intersect the SFHA layer with the "Shell Bottom" dataset, which contains mapped areas of known shell bottom and only the intersection polygons will receive a final rating for the SCP.

A) Open shellfish harvesting waters that also have documented evidence of shell bottom present get a rating of 8. The only exception to this is that open shellfish harvesting waters in Brunswick county, although "officially un-surveyed" at present, are known to have an abundance of shell bottom habitat. DMF would like to rate the open shellfish harvesting waters in Brunswick County as if they had shell bottom present.

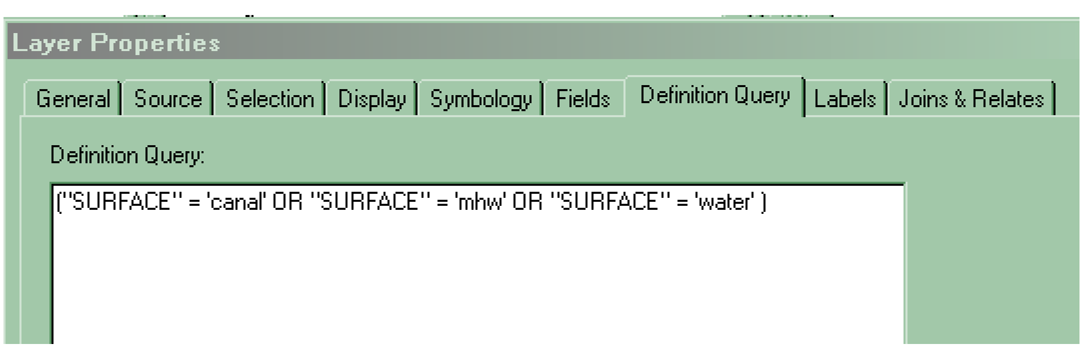
B) Open shellfish harvesting waters outside of Brunswick County where either there is no shell bottom survey data or the survey data indicates no shell bottom is present do not get a rating at all.

C) Closed shellfish harvesting waters that have documented evidence of having shell bottom present get a slightly lower rating than the documented shell bottom areas in open harvesting waters - a 5 (was 6 in previous rating scales).

D) Closed shellfish harvesting waters where either there is no shell bottom survey data or the survey data indicates no shell bottom is present do not get a rating at all.

**Step 1:** Add a definition query to the original shellfish harvesting areas shapefile from DEH (SGASHAPE022007.shp) – to get rid of all the land areas.

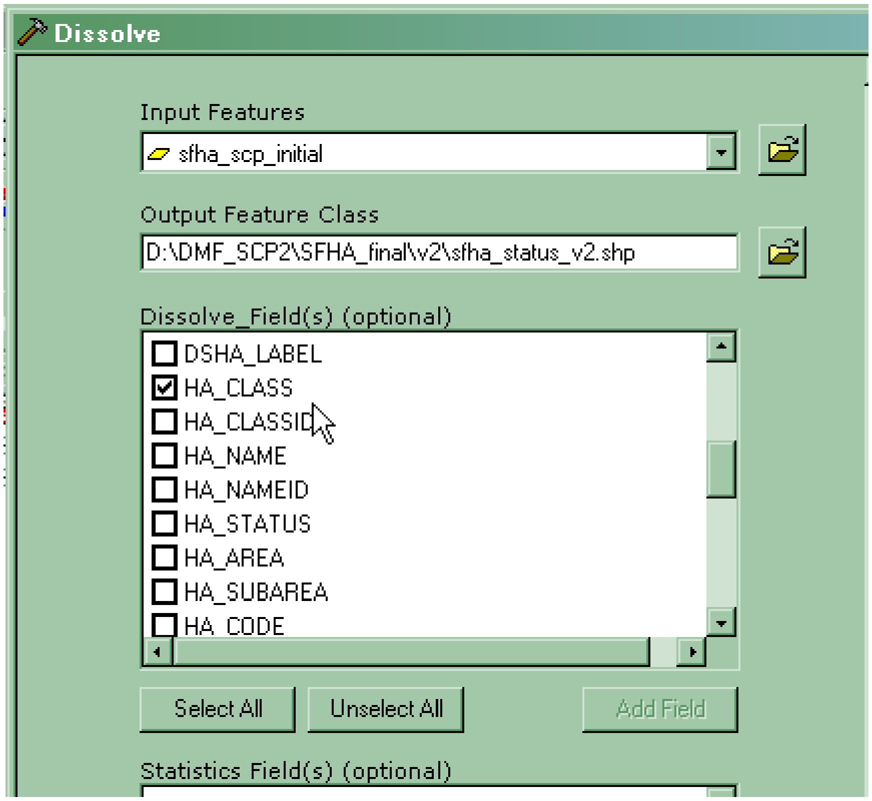
("SURFACE" = 'canal' OR "SURFACE" = 'mhw' OR "SURFACE" = 'water' )



**Step 2:** Save selected subset of records to a new shapefile "***sfha_initial_scp.shp***", and then delete the records that satisfy this query**: "HA_CLASS" = ' '**

These 31 features include Lake Matamuskeet, and various small polygons that appear to be boat slips at marinas, etc.

**Step 3**: Dissolve the ***"sfha _initial_scp.shp***" shapefile on the **County** & **HA_CLASS** fields to create "***sfha_status.shp***".



**Step 4:** Add a new text (10) field called SCP_Status to the **"sfha_status.shp",** and calculate the value of all records where **"CSHA – Prohibited"** = Closed and everything else = Open

**Step 5:** Add a new integer field called **"Val"** to the **"sfha_status.shp",** and calculate the value of all Brunswick County records according to this rating scheme:

If ( County = 'Brunswick' ) AND ( SCP_Status = 'Open') calculate **Val = 8**
If ( County <> 'Brunswick' ) calculate ( SCP_Status = 'Closed ) calculate **Val = 5**

The rest of the shellfish areas in other counties will depend on whether they intersect shell bottom areas in order to get a rating.

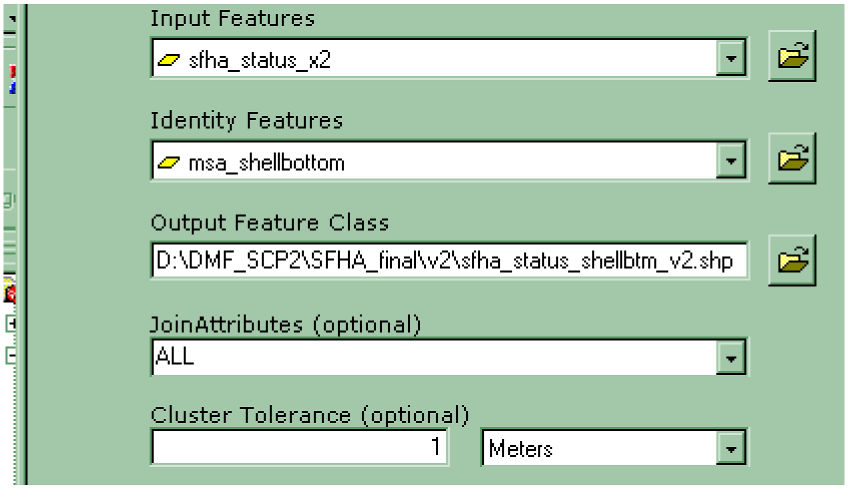
**Step 6:** In the MSA04192007.shp "mapped shellfish areas" (aka strata/shell bottom) shapefile, add this definition query to select out only the mapped areas with a shell bottom. These will be the areas we combine with the Shellfish Harvesting Areas.

"STRATA" = 'A' OR "STRATA" = 'C' OR "STRATA" = 'E' OR "STRATA" = 'G' OR "STRATA" = 'I' OR "STRATA" = 'K' OR "STRATA" = 'M' OR "STRATA" = 'Q' OR "STRATA" = 'O' OR "STRATA" = 'S' OR "STRATA" = 'W' OR "STRATA" = 'U'

"A - Subtidal Soft Vegetated Shell"
"C - Subtidal Soft Non-vegetated Shell"
"E - Subtidal Firm Vegetated Shell"
"G - Subtidal Firm Non-vegetated Shell"
"I - Subtidal Hard Vegetated Shell"
"K - Subtidal Hard Non-vegetated Shell"
"M - Intertidal Soft Vegetated Shell"
"O - Intertidal Soft Non-vegetated Shell"
"Q - Intertidal Firm Vegetated Shell"
"S - Intertidal Firm Non-vegetated Shell"
"U - Intertidal Hard Vegetated Shell"
"W - Intertidal Hard Non-vegetated Shell"

**Step 6:** Export the subset you've defined in the MSA layer to a new shapefile named "msa_shellbottom.shp". Drop all the attribute fields except "FIS", "Shape" & "Strata".

**Step 7:** Run an Identity operation on the "**msa_shellbottom.shp**" & "**sfha_status.shp**" shapefiles with a resulting dataset of : **"sfha_status_shellbtm.shp**"




**Step 8:** Open the attribute table of "sfha_status_shellbtm.shp" and select using this critieria:

"COUNTY" <> 'Brunswick' AND "STRATA" <> ' ' AND "SCP_Status" = 'Open'

This will select all polygons that *do* have shellbottom present in an *open* shellfish harvesting area in all counties except Brunswick. Calculate the "Val" field to be **8** on these records

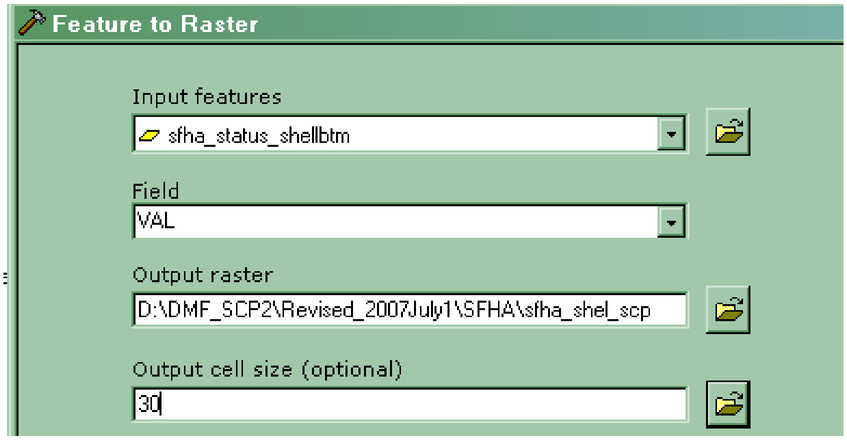
**Step 9:** Clear your selection set and make another selection based upon this criteria:

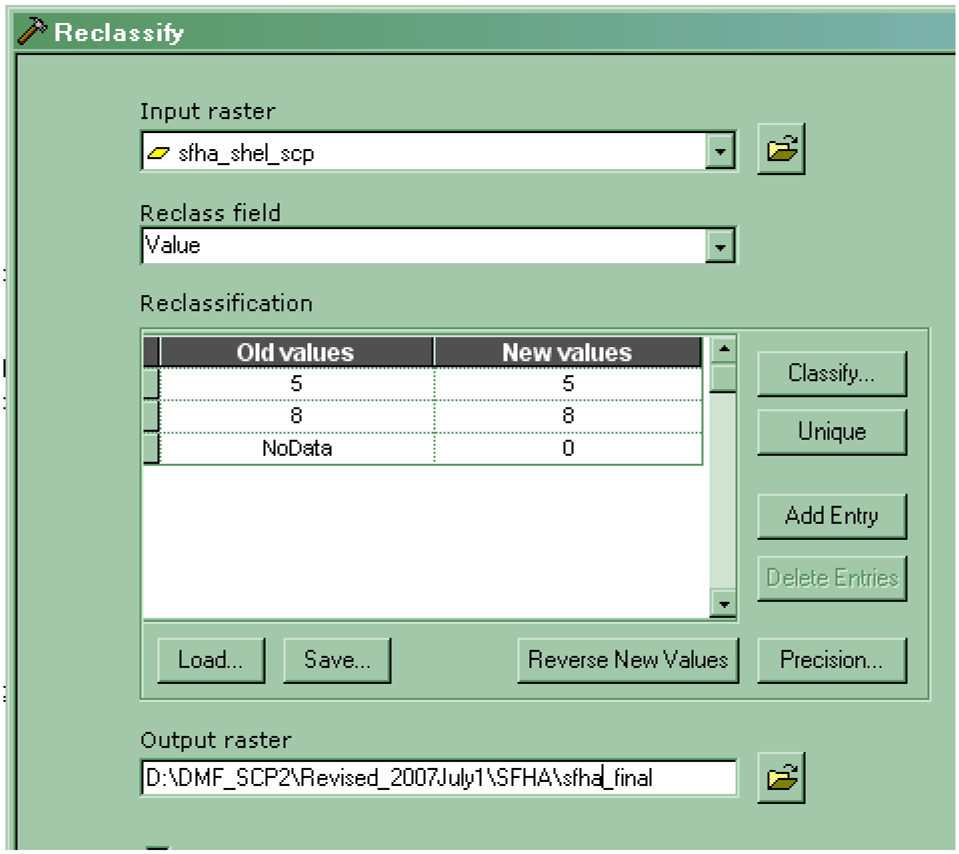
"COUNTY" <> 'Brunswick' AND "STRATA" <> ' ' AND "SCP_Status" = 'Closed'

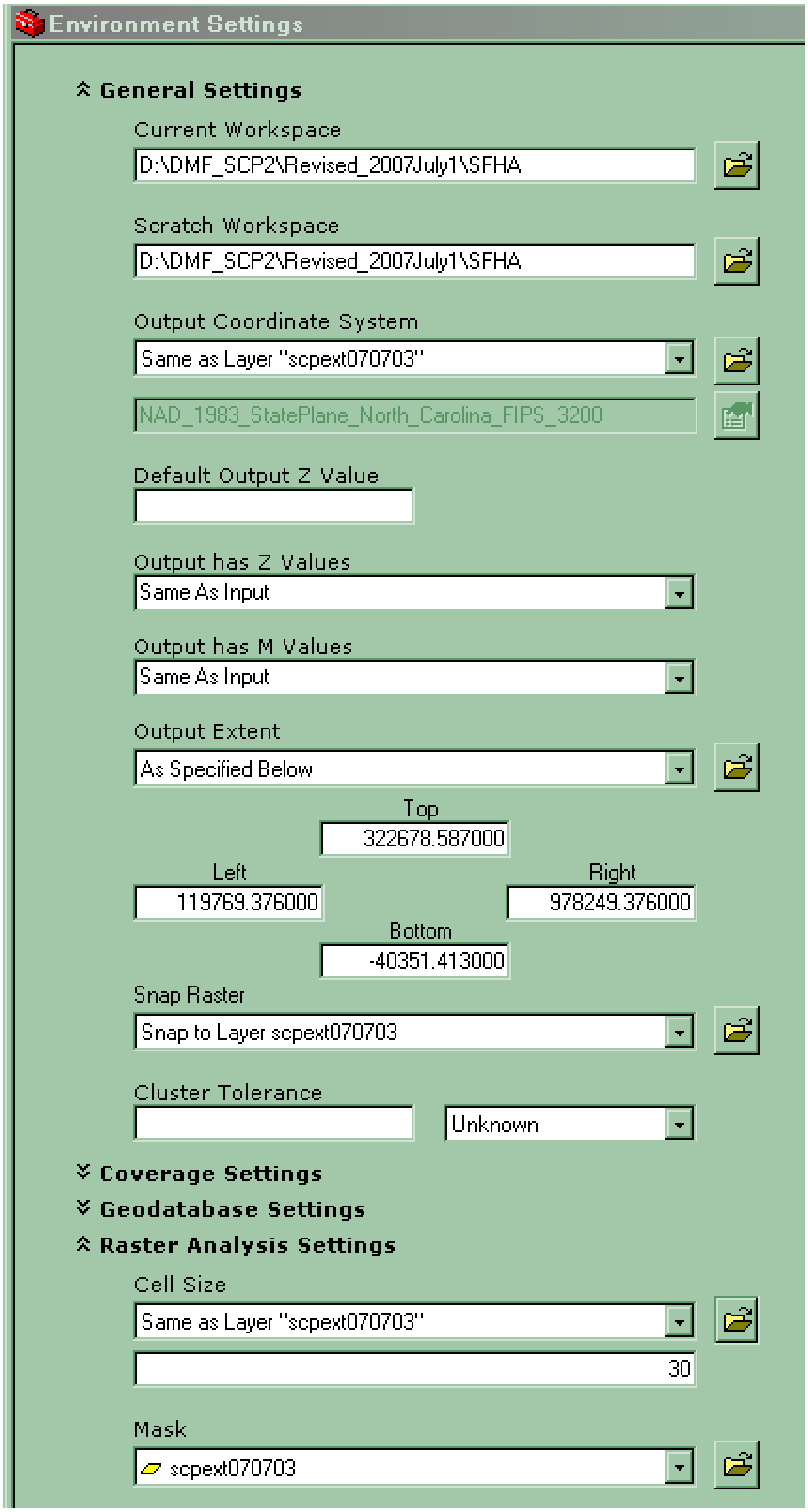
This will select all polygons that *do* have shellbottom present in *closed* shellfish harvesting areas in all counties except Brunswick. Calculate the "Val" field to be **5** on these records.

**Step 10:** In order to reduce the size of the output grid and time it takes to generate it, select only the polygons from sfha_status_shellbtm.shp and export them to a new shapefile, called "sfha_shellbtm_final.shp.

**Step 11**: Convert the final polygon shapefile to a Raster GRID, using the new 'VAL' field to represent grid cell values. The grid name is: **sfha_shel_scp.** Be sure to set your raster env settings to snap to the main SCP grid and copy its extents & cell size. All non data cells in the final grid should have a value of 0 instead of NoData. This will necessitate a reclassify operation.


Feature to Raster
Input features
sfha_status_shellbtm
Field
VAL
Output raster
D:\DMF_SCP2\Revised_2007July1\SFHA\sfha_shel_scp
Output cell size (optional)
30


Reclassify
Input raster
sfha_shel_scp
Reclass field
Value
Reclassification
Old values
New values
5
5
8
8
NoData
0
Classify...
Unique
Add Entry
Delete Entries
Load...
Save...
Reverse New Values
Precision...
Output raster
D:\DMF_SCP2\Revised_2007July1\SFHA\sfha_final


Environment Settings
General Settings
Current Workspace
D:\DMF_SCP2\Revised_2007July1\SFHA
Scratch Workspace
D:\DMF_SCP2\Revised_2007July1\SFHA
Output Coordinate System
Same as Layer "scpext070703"
NAD_1983_StatePlane_North_Carolina_FIPS_3200
Default Output Z Value
Output has Z Values
Same As Input
Output has M Values
Same As Input
Output Extent
As Specified Below
Top
322678.587000
Left
119769.376000
Right
978249.376000
Bottom
-40351.413000
Snap Raster
Snap to Layer scpext070703
Cluster Tolerance
Unknown
Coverage Settings
Geodatabase Settings
Raster Analysis Settings
Cell Size
Same as Layer "scpext070703"
30
Mask
scpext070703

**Final Assembly of Rankings**

The algorithm for the final scoring was to take the maximum value from all the GRIDs for any given pixel location except for pixels with more than 20% impervious surface.

Max(grid1,grid2,grid3…)

The impervious surface was multiplied by that maximum GRID result which zeroed out impervious areas.

*(This process step is not complete. We think the problem may be a lack RAM or a software issue.)*

*A combine step was added to make determining the data layer that contributed to the final rating. This step created a Value Attribute Table with each layer and the final SCP Rating having an attribute field. Combine (grid1,grid2,grid3…)*