

## **Appendix E:**

### **Technical Documentation for the Biodiversity/Wildlife Habitat Assessment**

All GIS data for the Biodiversity/Wildlife Habitat Assessment were processed using ESRI's ArcGIS 9.3 ArcMap software, including the Spatial Analyst extension.

Due to the large number of data layers and 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 (see below). The cell size of the GRID (30m) represents the overall spatial precision of the combined data layers.

For more information on these data and the conservation values (CPT Ratings) assigned to each layer, see Chapter 4 (Biodiversity and Wildlife Habitat Assessment). Individual layers are organized below by the Categories shown in the table in Chapter 4.

#### **Individual Layer Processing**

All layers were projected in NC Stateplane, NAD83, meters and have the following extent and cell size:

##### ***Extent***

<b>North</b>	<b>322678.5877</b>
<b>South</b>	<b>-40351.413</b>
<b>East</b>	<b>978249.376</b>
<b>West</b>	<b>119769.376</b>

***Cell Size***     **30m**

Buffers on individual layers 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 represent their relative conservation values (CPT Rating), and NoData values were replaced with zeros.

#### **Natural Heritage Program - NHP**

**Significant Natural Heritage Areas (SNHA)** – NHP provided snha.shp (March 2011). All records with SITENAME not ending in 'Aquatic Habitat' were selected, and the result converted to GRID preserving the 'Sig' field. Reclassified GRID to CPT Ratings 'Sig' A or B = 10, C = 8, D = 6.

**Aquatic Significant Natural Heritage Areas (ASNHA)** – NHP provided snha.shp (March 2011). All records with SITENAME including ‘Aquatic Habitat’ were selected. Polygons were buffered by 300 feet using the ArcToolbox Buffer tool, and the result was converted to GRID, preserving the ‘Sig’ field. Reclassified to CPT Ratings ‘Sig’ A or B = 10, C = 8.

**Element Occurrences (EO)** – NHP provided nheo.shp, filtered to include only CPT-qualifying EOs (January 2011); EOs with EO\_RANK of X, F, H, or D, last observed (LAST\_OBS) >30 years ago, and those with EST\_ACCR (estimated accuracy) of very low or low are excluded. To create data for “EOs – High Ranking”, all polygons were intersected (using the Biogeography Overlapping Polygon tool) to find overlaps of EOs and the result was converted to GRID; the overlapping EOs GRID was reclassified to a CPT Rating = 5. Polygons with GRANK beginning with G1 or G2; SRANK beginning with S1; or EORANK beginning with A or B were assigned a CPT Rating = 5 in a temp field. All other EOs (“EOs – Other”) were assigned a CPT Rating = 4. Polygons were converted to GRID, preserving the temp field.

## GUILDS

**Core Guild Areas** - NHP provided a shapefile of Landscape Habitat Indicator (LHI) Guild core areas (January 2011). The original Score field provided by NHP was used to add scores together where guilds overlapped; the total score was divided into CPT Ratings of 1 to 10 (below).

CPT Rating	Guild Score Total
10	10000
9	7812
8	5623
7	4393
6	3162
5	2470
4	1778
3	1389
2	1000
1	800

A SCOREINT field was created for further processing. SCOREINT is a long integer derived from the Guild Score Total \*100. The shapefile was then run through a Python script to process each guild into a GRID layer. For each guild, the polygon features are selected from the original shapefile, converted to GRID on the SCOREINT field, and reclassified to replace NoData values with 0. All the resulting GRIDs were added together using the “max” command in Raster Calculator and classified as above.

The Python script for Guild processing is (guildproc.0111.py):

```

# Import system modules
import sys, string, os, arcgisscripting

# Create the Geoprocessor object
gp = arcgisscripting.create()

# Check out any necessary licenses
gp.CheckOutExtension("spatial")

# Load required toolboxes...
gp.AddToolbox("C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Spatial Analyst Tools.tbx")
gp.AddToolbox("C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Conversion Tools.tbx")
gp.AddToolbox("C:/Program Files/ArcGIS/ArcToolbox/Toolboxes/Analysis Tools.tbx")

# Set the Geoprocessing environment...
gp.extent = "119769.376 -40351.413 978249.376 322678.587"
gp.cellSize = "30"

# Local variables...
Input_true_raster_or_constant_value = "0"
core_areas = "core_areas.shp"

# List of values for loop (check list for completeness, all guilds must be included)
guild_abbrs =
['awcf', 'blhf', 'cgs', 'dhhmf', 'dwhmf', 'dxhmf', 'dxmfst', 'dxmfwb', 'fc', 'ff', 'ffnrwf', 'fm', 'gm', 'gmdmhmf', 'g
mwmhmf', 'hemmhmf', 'hpppm', 'lemwmhmf', 'mdmbhf', 'mfhmf', 'mhf', 'mom', 'pdwbhf', 'pdwhmf', 'pfm', 'p
hb', 'pom', 'ppmgwhs', 'psng', 'pwhf', 'pwmhf', 'rbbmf', 'sawcf', 'sff', 'sim', 'sm', 'sng', 'ssm', 'ssmh', 'sssp', 'ssw
shs', 'swshs', 'was', 'whf', 'wmhf', 'wmhmf', 'wmpw', 'wxlpwep', 'wxlww', 'xmlpmow', 'xmmmhg']

# Loop on Guild Type
for x in guild_abbrs:

    # Local variables in loop
    guildras = "out\\" + x + "ras"
    guild_shp = "out\\" + x + ".shp"
    guildnull = "out\\" + x + "null"
    guildcon = "out\\" + x + "con"

    # Process: Select...
    gp.Select_analysis(core_areas, guild_shp, "\"acronym\" = \""+x+"\"")

    # Process: Feature to Raster...
    gp.FeatureToRaster_conversion(guild_shp, "scoreInt", guildras, "30")

    # Process: Is Null...
    gp.IsNull_sa(guildras, guildnull)

    # Process: Con...
    gp.Con_sa(guildnull, Input_true_raster_or_constant_value, guildcon, guildras, "")

print x

```

## FISH HABITAT

**Wild Brook Trout** – Wildlife Resources Commission provided wild brook trout population data that included coordinates and stream names (NCWRC\_Trout\_Distribution\_2011\_Mar7.xls). Coordinates were used to create a point shapefile in the correct projection; these points were then displayed with high resolution (1:24,000) stream segments from the NHD (National Hydrography Dataset) data to select stream segments manually (resulting in BKT\_Flowline\_June2011.shp). Stream segments were selected manually by NHP, with guidance from WRC. The segments were then buffered by 100 ft, converted to GRID, and reclassified to a CPT Rating = 9.

**Anadromous Fish Spawning Areas (AFSA)** – Division of Marine Fisheries provided polygon data in afsa.shp (data from 2009). Filtered on the SURFACE attribute to remove land areas (and include only water); the result was buffered by 100 feet, converted to GRID, and reclassified to a CPT Rating = 8.

**Fish Nursery Areas (FNA)** – DMF provided fna\_dist.shp (data from 2008). The data were filtered by FNA designations in the RULE\_ID attribute to select only those areas that serve as Primary Nursery Areas or Secondary Nursery Areas ("RULE\_ID" = '15A NCAC 03R .0103' OR "RULE\_ID" = '15A NCAC 03R .0104'); other rule designations were not included. The result was buffered by 100 ft, converted to GRID, and reclassified to a CPT Rating = 8.

## Division of Water Quality - DWQ

**Outstanding Resource Waters / High Quality Waters (ORW/HQW)** – DWQ provided DWQ\_classifications\_20110208.shp (2011). Records with a CLASS attribute that included ORW or HQW were selected. Those streams designated HQW were filtered to remove streams that also have a CLASS of SA, WS-I, or WS-II. The resultant ORW and HQW stream segments were then buffered by 100 ft to create polygons. The polygons were converted to GRID, and reclassified to CPT Ratings ORW = 10, HQW = 8.

**Stream Bioclassification (Benthic)** – DWQ provided the following shapefile - nc\_2010\_IR\_Asmnt\_20100928.shp (2011). All “benthos” records were selected (POI\_LONG attribute), and the data were further filtered to include only those records with a bioclassification of “good”, “excellent”, or “natural” (RFR\_LONG attribute), and a collection date after 2000 (within the last 10 years). These stream segments were then buffered by 100 ft. The polygons were converted to GRID, preserving the BIOCLASS field, and reclassified to CPT Ratings of (BIOCLASS) Excellent or Natural = 9, Good = 7.

**Stream Bioclassification (Fish)** – DWQ provided the following shapefile - nc\_2010\_IR\_Asmnt\_20100928.shp (2011). All “FishCom” records were selected

(POI\_LONG attribute), and the data further filtered to include only those records with a bioclassification of “good” or “excellent” (RFR\_LONG attribute), and a collection date after 2000 (within the last 10 years). These stream segments were then buffered by 100 ft. The polygons were converted to GRID preserving the BIOCLASS field, and reclassified to CPT Ratings of (BIOCLASS) Excellent = 9, Good = 7.

**Streams** – DWQ provided 24khydro.shp (2007), representing all USGS streams statewide. Non-hydrology lines were removed (minor1 <> -99999 basin boundaries, intercoastal waterway, etc.; minor1 <> 202 closure lines; and minor1 <> 205 carolina bays outline); the result was buffered by 100 ft, converted to GRID (done in 4 parts due to memory limits), and reclassified to a CPT Rating = 1.

## WETLANDS

**NC-CREWS Wetlands** – Division of Coastal Management provided shapefiles from their website (see <http://dcm2.enr.state.nc.us/wetlands/download.htm>) for NC-CREWS data that include overall wetland ratings. All individual county shapefiles were merged into a single shapefile; the result was converted to GRID, preserving the OWR1 attribute, and the wetlands ratings were used to reclassify to CPT Ratings (ORW1) 3=7, 2=6, 1=2.

**NWI Wetlands** – U.S. Fish and Wildlife Service provided a shapefile for the National Wetlands Inventory (NWI). Polygons in the counties not covered by the CREWS data were selected, and those considered diked or impounded areas (NWI\_NAME ending in “h” or “HH”) were removed. The result was converted to GRID, and reclassified to a CPT Rating = 5.

## IBAs

**Important Bird Areas (IBAs)** – The NC Chapter of the Audubon Society provided NC\_IBA83.shp (2010). The shapefile was converted to GRID and reclassified to CPT Rating = 5.

## WATERSHEDS

**Watersheds with Federally-listed Species (T&E Streams)** – NHP provided Fed\_hucs\_201107\_final.shp and DWQ provided hydro24k\_arc.shp (2011). The stream segments that intersected the Fed\_huc watersheds were buffered by 200 ft; the polygons were then converted to GRID, and reclassified to a CPT Rating = 7.

**Priority Watersheds** – NHP provided nhp\_priority\_hucs\_201101.shp (January 2011), and WRC provided ncwrc\_addnl\_cons\_areas.shp and

tnc\_cons\_areas.shp (March 2007) (these shapefiles have not been updated since 2007); these 3 shapefiles were converted to GRIDs. Each watershed GRID was multiplied by the stream GRID (see above) to filter the watershed to only include streams buffered by 100 ft within the selected watersheds. The resulting GRIDs were then combined using the “max” command and reclassified to a CPT Rating = 3.

## IMPERVIOUS SURFACE

**Impervious Surface** – DENR GIS provided a statewide GRID of 2006 National Land Cover Dataset (NLCD) Percent Developed Imperviousness data (nc2006\_imperv - July 2011). The statewide GRID was reclassified to a CPT Rating of 21% or greater = 99, <21% = 0. The final value for impervious surface was set to -1 after input layers for the BWA were calculated (see Final BWA Layer Processing below).

## MARINE

**Oyster Sanctuaries** - DMF provided os\_polys (2011) representing oyster sanctuaries. Polygons were buffered by 100 feet, converted to GRID, and reclassified to a CPT Rating = 8.

**Submerged Aquatic Vegetation (SAV)** – DMF provided a mosaic dataset of SAV mapped over time (sav\_mosaic\_1981\_may2009.shp) (2009). This shapefile was converted to GRID and reclassified to a CPT Rating = 7.

## HARDBOTTOM

**Hard Bottom** (SEAMAP and Moses and Taylor) - DMF provided 4 shapefiles to determine hardbottom substrate (shellfish habitat):

seamap\_hard\_bottom\_points.shp  
moser\_taylor\_seamap\_hard\_bottom\_lines.shp  
moser\_taylor\_hard\_bottom\_pts.shp  
moser\_taylor\_hard\_bottom\_polys.shp

These shapefiles were processed as follows.

**seamap\_hard\_bottom\_points.shp** (data from 1995-2001) - Filtered data to exclude include only BTM\_TYPE = HB [eliminated NH (not hard bottom), PH (possible hard bottom), and AR (artificial reef)]. Buffered each point by 400 feet, converted to GRID, and reclassified to a CPT Rating = 7.

**moser\_taylor\_seamap\_hard\_bottom\_lines.shp** - Filtered data to select only those with BTM\_TYP = HB and RELIEF = H or M (data didn't contain any RELIEF = L). Buffered lines by 400 feet, converted to GRID, and reclassified to CPT Rating = 7.

**moser\_taylor\_hard\_bottom\_pts.shp** – Filtered data to select only those with RELIEF = H or M (eliminating those with L or no value). Buffered points by 400 feet, converted to GRID, and reclassified to CPT = 7.

**moser\_taylor\_hard\_bottom\_polys.shp** - Filtered data to select only those with RELIEF = H or M (eliminating those with L or no value). Buffered polygons by 400 feet, converted to GRID, and reclassified to CPT = 7.

The “max” function in Raster Calculator was used to combine all buffered points into raster named mt\_hb\_pt400rc, and combined all buffered lines into mt\_hb\_ln400rc. The buffered polygon was reclassified to mt\_hb\_ply400r. These three rasters were then combined using the “max” function in Raster Calculator to create hbtm\_all.

**Shellfish Habitat / Shell Bottom** – DMF provided Shellfish Bottom Mapping Areas (MSA\_I1\_20110510.shp and MSA\_I2\_20110510.shp – May 2011), and Shellfish Growing Areas (sga.shp) were downloaded from the NC OneMap website (May 2011).

DENR has, in consultation with experts in DMF, determined that because the Shellfish Growing Areas (SGAs) are artificial jurisdictional boundaries which encompass our entire intra-coastal waterway and estuarine areas, rather than documented shellfish habitat areas, those SGAs considered open will be considered along with those areas with documented shell bottom to rate the most important shellfish habitat. Closed SGAs with documented shell bottom are also considered important, but less important than open SGAs with shell bottom. NOTE: Although shellbottom mapping has not been completed in Brunswick County, an abundance of shell bottom habitat is known to occur, and DMF rates the open shellfish waters in Brunswick County as if they had shell bottom present.

The SGA data was ultimately intersected with the MSA dataset and only the intersected polygons received a rating in the CPT as follows:

A) Open SGAs that also have documented evidence of shell bottom present get a CPT Rating = 8. The only exception to this is that all open SGAs in Brunswick County get a CPT Rating = 8, regardless of shell bottom presence.

B) Open SGAs (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 (CPT Rating = 0).

C) Closed SGAs that have documented presence of shell bottom present get a slightly lower rating than the documented shell bottom areas in open SGAs (CPT Rating = 5).

D) Closed SGAs 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 (CPT Rating = 0).

<b>Shellfish Habitat/Shell Bottom status based on SGA and MSA data</b>	<b>CPT Rating</b>
Open SGA and shellbottom present	8
Open SGA in Brunswick County and either shellbottom present or no shellbottom present	8
Open SGA (outside Brunswick County) with no shellbottom present	0
Closed SGA and shellbottom present	5
Closed SGA and no shellbottom present	0

Processing of the SGA and MSA data, and the intersection of those data, are described in detail below.

*Shellfish Growing Areas* - Shellfish Growing Areas (sga.shp) were filtered to only include SURFACE = canal, mhw, or water, and all records with HA\_CLASS = ‘ ‘ were deleted (these features include Lake Matamuskeet, and various small polygons that appear to be boat slips at marinas), resulting in sga\_initial.shp. All polygons with HA\_CLASS = Open, Conditionally Approved – Open, and Conditionally Approved – Closed are considered “open” (Conditionally Approved – Closed is included in the “open” category because these areas may sometimes be open, sometimes closed – depending on local conditions). Those polygons with an HA\_CLASS = CSHA-Prohibited are considered permanently closed.

Records with open status were selected from sga\_initial.shp and exported to sga\_open.shp. Those records with closed status (HA\_CLASS = CSHA – Prohibited) were selected from sga\_initial and exported to sga\_closed.shp. Both sga\_open.shp and sga\_closed.shp were converted to GRID preserving the HA\_CLASS field; these individual GRIDS were then each reclassified so that open areas received a CPT Rating = 8 and closed areas received a CPT Rating = 5. The reclassified GRIDS were then combined using the “max” function in Raster Calculator to create sga\_op\_cl.

*Shellfish Bottom Mapping Areas* - The MSA data from DMF contains locations of known shellfish-producing areas and productive benthic shellfish habitats by

strata or habitat bottom types. The most important of these bottom types is shell bottom. The MSA data are comprised of records from 1988 to 2011.

MSA\_I2\_20110510.shp (MSA I2) was used for all areas where its coverage exists; this data set represents areas that have been remapped since the MSA I1 data set. In areas where MSA I2 coverage does not exist, MSA I1 data were used. The MSA I1 data set ranges from 1988-2011, and the MSA I2 data set ranges from 2005-2011. The I1 data set is not complete. Areas remain unmapped in some parts of Brunswick County and Hyde County.

The following STRATA were selected from each shapefile (MSA\_I1\_20110510.shp and MSA\_I2\_20110510.shp):

"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"

The selected records in MSA\_I1\_201105 and MSA\_I2\_201105 were then each converted to GRID and reclassified to a CPT Rating = 1 (so that areas with mapped shellbottom receive a CPT Rating = 1, and areas with no shellbottom receive a CPT Rating = 0). The "max" function in Raster Calculator was used to combine the two GRIDs to create msa12shell.

A shapefile of Brunswick County was created from cb100\_poly, resulting in cb100\_poly\_BRUNSWICK. This shapefile was converted to GRID, and reclassified to a CPT Rating = 8. The reclassified GRID was combined with msa12shell using the "max" function in Raster Calculator to create shellbtm (which shows all of Brunswick County as having shellbottom). The shellbtm GRID was then reclassified to CPT Rating = 1.

*Intersection of Shellfish Growing Areas (SGAs) and Shellbottom (MSA) data -*  
The sga\_op\_cl and shellbtm GRIDS were multiplied (\*) using Raster Calculator to result in shellbtm\_all, so that all open areas with shellbottom receive a CPT

Rating = 8, closed areas with shellbottom receive a CPT Rating = 5, closed areas with no shellbottom receive a CPT Rating = 0, and all open areas in Brunswick County receive a CPT Rating = 8.

To create the final Hardbottom GRID, shellbtm\_all was combined with hdbtm\_all using the “max” function in Raster Calculator to create hardbottom.

### **Final BWAH Layer (GRID) Processing**

The final Biodiversity/Wildlife Habitat GRID shows the maximum value for all data layers relative to individual cells (30m pixels). Individual layers were combined into Category layers following the naming scheme included in the table in Chapter 4. Impervious surface (20% or more) was given a value of 99 when processing the final layer to remove those cells; the final GRID was then reclassified for impervious surface to change its value from 99 to -1.

The “max” function in Raster Calculator was used to assemble Category layers into the Final layer.

A Value Attribute Table (VAT) was created to show relative values for each individual Category layer in an attribute table using the “combine” command in Raster Calculator.