Chester Land Trust

Clinton Land Conservation Trust

Connecticut River Land Trust

Deep River Land Trust

East Haddam Land Trust

Essex Land Trust

Haddam Land Trust

Lyme Land Conservation Trust

Lynde Point Land Trust

Middlesex Land Trust

Old Lyme Land Trust

Old Saybrook Land Trust

Salem Land Trust

Westbrook Land Conservation Trust

CT DEEP Forestry

CT DEEP Inland Fisheries

Natural Resource Conservation Service

National Park Service

UConn Extension Forestry

US Fish and Wildlife Service

Lower Connecticut River Valley Council of Governments

The Lower CT River and Coastal Region Land Trust Exchange Natural Resource Based Strategic Conservation Plan

A GIS Overlay Analysis

Mission Statement

To develop a plan that will enable effective collaboration towards the creation of large connected natural areas to provide wildlife habitat, to protect water quality and quantity, and to protect working and scenic lands.

Margot Burns
Environmental Planner

Technical Assistance Provided by:
National Park Service

Rivers, Trails and Conservation Assistance Program (RTCA)

Abstract

The globally significant lower Connecticut River and coastal region has a long lived and hardworking conservation community that has come together to create an agreed upon large landscape scale prioritized strategic conservation plan that allows for separate municipal based conservation organizations to work across municipal boundaries toward common regional conservation goals. To this end the Lower Connecticut River and Coastal Region Land Trust Exchange (LTE), a program of the Lower CT River Valley Council of Governments (RiverCOG, the Region), has included among its priorities to develop a natural resource-based geographic information system (GIS) overlay analysis strategic conservation plan. This plan is meant to enable effective collaboration in a regional manner, towards the creation of large connected natural areas to provide wildlife habitat, protect water quality and quantity, and protect working and scenic lands in conjunction with the Natural Resource Conservation Service (NRCS), US Fish and Wildlife Service, State of CT Department of Energy and Environmental Protection (DEEP) Forestry and Inland Fisheries divisions, University of Connecticut (UConn) Extension Forestry, with technical assistance provided by the National Park Service (NPS) Rivers, Trails and Conservation Assistance Program (RTCA).

Overlay analysis, a type of suitability modeling, weights locations relative to each other based on specific criteria. They can be used to help find locations that are best suited for most anything. Good examples include shopping malls and schools, or locations that provide the most favorable habitat for a particular species of bird. For this analysis a subcommittee (the Committee) of 9 of the 14 member land trusts of the LTE and representatives of their partnering organizations determined where they felt the RiverCOG region's most important land based natural resources are located within the constraints of available regional GIS data sets.

The Committee met through four meetings during the winter and spring of 2014 and developed this GIS overlay analysis at both the local and regional scale to first identify where important RiverCOG Region natural resources occur alone and together within large natural areas (LNAs) and then classify and prioritize the existing LNAs by size, percentage of core forest, and buffered surface hydrology.

The 86 LNAs with resource index scores of 4, 5, and 6 account for 68% of the total LNA acreage, 81% of core forest area, and 69% of buffered surface hydrology. Because of their size and resource value the Committee chose these LNAs as primary regional wildlife habitat corridors, and the LNAs with the resource index score of 7 (which account for an additional 63 LNAs), 11% of LNA acreage, 10% of core forest area, and 11% of buffered surface hydrology, as connecting habitat corridors. The local model data allows for identification of areas where the important natural resources coexist in the greatest densities within these primary and connecting corridors.

For RiverCOG regional purposes the models and maps identify where the vast majority of important natural resources exist within and bordering the Region for the purposes of creating large connected natural areas to provide wildlife habitat, protect water quality and quantity, and to protect the Region's working and scenic lands. The primary and connecting corridors, as well as other critical habitats and endangered species locations, should be considered as primary strategic areas for public outreach and education concerning natural resource protection, best management practices, and permanent land conservation. At the local level these models could be applied to subsets of the existing data at the

municipal or smaller region scale to identify where other smaller and less resource rich, but still very important local connecting corridors exist within those boundaries.

The next step in the planning process is to use this completed natural resource based model as a foundation to build the yet undetermined remaining conservation index criteria for each LNA. Updates will be added when RiverCOG's region wide seamless GIS municipal parcel data set is completed. Some examples of further index criteria that could be considered for each LNA include: The percent of each LNA in permanent conservation; is the LNA within a State designated greenway; how many parcels of the LNA are vacant and still in a natural condition; and how connected is each LNA to the other. This plan will allow for further strategic and proactive conservation on the part of RiverCOG's land trusts and conservation organizations, thus leading to enhancement of our forests and wetlands that protect our water quality and quantity; provide wildlife corridors and agricultural products; and maintain the lower Connecticut River and coastal region's economy, beauty, and quality of life.

Acknowledgements

A sincere and heart felt thank you to all the Committee members who took time out of their very busy schedules to participate in the process and creation of this plan. They include:

- **David Brown – Middlesex Land Trust**
- **Christine Clayton – Old Lyme Land Trust**
- **Tom Elliott – Westbrook Land Conservation Trust**
- **Dick Harrall – Chester Land Trust**
- **Lisa Niccolai – Lyme Land Conservation Trust, CT River Land Trust**
- **Nancy Rambeau – Essex Land Trust**
- **Gail Reynolds – Haddam Land Trust**
- **Rob Smith – East Haddam Land Trust**
- **Javier Cruz, NRCS District Conservationist, Norwich**
- **Rick Potvin, Refuge Manager, Stewart B. McKinney National Wildlife Refuge, US Fish and Wildlife**
- **Steve Gephard, Supervising Fisheries Biologist, CT DEEP Inland Fisheries Division**
- **Emery Gluck, Cockaponset State Forester, CT DEEP Division of Forestry**
- **Tom Worthley, UConn Dept. of Extension, Forestry.**

They all live and/or work and volunteer in the RiverCOG Region and share this Agency's love of, and passion for, maintaining our region's beautiful landscape and wonderful quality of life that it provides for both its people and its wildlife .

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Introduction

As in most of New England, much of the work being done to preserve open space in the region of the Lower Connecticut River Valley Council of Governments (RiverCOG, the Region), and Connecticut, is through the efforts of small land trusts organized and incorporated at the town level. Experience has shown that those towns in Connecticut with the most open space under preservation have the strongest grassroots support, which is the result of a sustained community communication and education effort by the local land trust. This work at the community level is critical to the sustainability of local organizations. For effective preservation of biodiversity, wildlife habitat, and ecosystem maintenance it is also critical to involve a wider audience; to work beyond local boundaries for land use planning purposes, funding, and technical support; and stress the importance of regional, and even global connections and conservation goals; and relate those goals back to the local level through community outreach and land use planning commission processes.

To this end the Lower Connecticut River and Coastal Region Land Trust Exchange (LTE) has been meeting on a regular basis for the past 5 years and chose to develop this natural resource based strategic conservation plan for the lower Connecticut River and coastal region to enable effective collaboration in a regional manner, towards the creation of large connected natural areas to provide wildlife habitat, to protect water quality and quantity, and to protect working and scenic lands. This geographic information system (GIS) overlay analysis includes the land area of the RiverCOG Region towns of Clinton, Chester, Cromwell, Deep River, Durham, East Haddam, East Hampton, Essex, Haddam, Killingworth, Lyme, Middlefield, Middletown, Old Lyme, Old Saybrook, Portland, and Westbrook. The town of Salem, although not a RiverCOG member, is included because 64% of its land area is included in the Eightmile Wild and Scenic River watershed, an important RiverCOG environmental asset.

The member land trusts of the LTE have charged themselves with protecting the natural assets of the RiverCOG Region, an invaluable environmental and recreational area of global significance that surrounds the lower 36 miles of the Connecticut River from the river's mouth at Long Island Sound to the northern borders of the municipalities of Cromwell and Portland and over 20 miles of Long Island Sound coast line from the western border of the town of Clinton, to the eastern border of the town of Old Lyme. It is home to many of the State's parks and forests and portions of two Refuges, the Menunketesuck/Duck Island complex and the Salt Meadow Unit of the Stewart B. McKinney National Wildlife Refuge and the southernmost 354 sq. miles of the Connecticut River watershed based Silvio O. Conte National Fish and Wildlife Refuge. This area of the Conte Refuge is now home to the Roger Tory Peterson Division, the Salmon River Division, and the Whalebone Cove Division; the Wild and Scenic Eightmile River; five Connecticut State designated greenways – the Menunketesuck – Cockaponset Regional Greenway, the Connecticut River Gateway Zone Greenway, the Eight Mile River Greenway, the Old Lyme Greenway, and parts of the Blue Blazed Trail System Greenway. The estuary of the lower river was designated as a Ramsar Estuary of Global Importance (1994), has been proclaimed by The Nature Conservancy to be one of the World's Last Great Places, and is listed as a Long Island Sound Stewardship Site (2005) by the Long Island Sound Stewardship Initiative. In 1998 the Connecticut was designated as an American Heritage River, one of 14 in the country. Running through the Region is part of the Metacomet, Monadnock, Mattabesett Trail System designated in 2009 as the New England National Scenic Trail that strives to extend over 200 miles from Massachusetts to Long Island Sound; the Region also surrounds the Connecticut River Gateway Conservation Zone, a 30,000 acre area surrounding the lower 30 miles of the Connecticut River, from the nearest ridge top to nearest ridge top across the length of the lower river. Since 1974, the Connecticut River Gateway Commission has been charged with protecting the scenic and ecological properties of this unique landscape. Most recently the lower

Connecticut River region was identified by The Nature Conservancy as a focal area in their report entitled *Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region* and the Connecticut River watershed was named the Nation's first National Blueway as part of the Dept. of the Interior's Americas Great Outdoors Initiative.

The LTE, a program of RiverCOG, is an informal collaboration of 14 land trusts representing the 17 communities of its coordinating organization, RiverCOG, formerly the Connecticut River Estuary Regional Planning Agency (CRERPA) and Mid State Regional Planning Agency, consecutive Connecticut River centered regional planning organizations recently merged in large part to conserve and protect the unique character and environment of the communities of the lower Connecticut River and coastal region, and the town of Salem. The creation of the LTE was an outcome of the 2006 Tidewater Institute and CRERPA National Fish and Wildlife Foundation funded *Lower Connecticut River Ground-Truthing Project*.

That project sought to engage citizens in eight towns of the lower Connecticut River watershed to develop maps and plans designed to protect open space across town boundaries through creation of greenways, and to engage citizens in the lower Connecticut River watershed in a collaborative effort to identify and act on opportunities to protect open space across town boundaries. The project built on an existing long lived conservation ethic in the lower River region, and engaged individuals in a more encompassing regional vision of pride and protection of its extraordinary natural assets.

The mission of RiverCOG in regards to the LTE is to create a stronger connection between the local, regional conservation community, and the Regional, State, and Federal land use planning process; further their ability to provide an educational and planning opportunity for environmental and landscape protection for members of the Region's land trusts and conservation commissions to promote landscape linkages, tool creation, data acquisition, and sharing to enable effective collaboration and cooperation, in a regional manner, towards the creation of trails and greenways, and protection of existing habitat, water quality, and scenic and cultural landscape corridors; and identify possible collaboration mechanisms and business structures that will not take away from an individual land trust's unique and important relationship and place in its own community, but enable them to practice best management and business principles. This will allow each to operate to its greatest potential concerning long term planning goals, future land acquisition, and the sustainable stewardship of their already existing protected open space.

Since its first meeting in September 2009, the LTE has worked internally, locally, regionally, State, and New England wide to promote this Region, a region that has fostered a landscape scale conservation ethic for many decades, for both wild and working lands and for habitat and wildlife protection through working with private landowners, State land managers, educators, US Fish and Wildlife, the nonprofit community, and through the municipal, Regional, and State land use planning process. It has been a tenet of CRERPA, and now RiverCOG, since the inception of the LTE, with strong support and funding from Eastern Connecticut Resource, Conservation, and Development (RC&D), that only through community outreach and the practice of strong business and planning principals by each of the member land trust will we be able to maintain and increase the pace of conservation and stewardship of our undeveloped and working lands to benefit both wildlife and people. This *Natural Resource Based Regional Strategic Conservation Plan* will provide a strong base for this work to be built upon.

Methodology

This planning document was created through a series of 4 planning workshops during the winter and spring of 2014 with technical assistance provided by John Monroe of the National Park Service Rivers, Trails and Conservation Assistance Program (RTCA). Committee members included Sub Committee A of the LTE:

- David Brown – Middlesex Land Trust;
- Christine Clayton – Old Lyme Land Trust;
- Tom Elliott – Westbrook Land Conservation Trust;
- Dick Harrall – Chester Land Trust;
- Lisa Niccolai – Lyme Land Conservation Trust, CT River Land Trust;
- Nancy Rambeau – Essex Land Trust;
- Gail Reynolds – Haddam Land Trust; and
- Rob Smith – East Haddam Land Trust;

and representatives of partnering organizations:

- Javier Cruz, NRCS District Conservationist, Norwich;
- Rick Potvin, Refuge Manager, Stewart B. McKinney National Wildlife Refuge, US Fish and Wildlife;
- Steve Gephard, Supervising Fisheries Biologist, CT DEEP Inland Fisheries Division;
- Emery Gluck, Cockaponset State Forester, CT DEEP Division of Forestry; and
- Tom Worthley, UConn Dept. of Extension, Forestry.

Workbooks created for each of the first three workshops are provided as Appendices I, II, and III at the end of this document.

Overlay analysis, a type of suitability modeling, weights locations relative to each other based on given criteria. They can be used to help find locations that are best suited for most anything. Good examples include shopping malls and schools, or locations that provide the most favorable habitat for a particular species of bird. In the case of this analysis the Committee located where they felt the Region's most important land based natural resources are within the constraints of available regional GIS data sets.

In a GIS information is most often displayed in the form of a map made up of data layers. A data layer is a data table of information arranged in rows and columns and the associated map features they represent. Each row represents a feature and each column represents the same kind of data about each of the features. This feature could be anything that can be located. In our case that location is the surface of the earth, and more specifically the area that represents the RiverCOG Region. This location data, which are stored in the data table, are what makes GIS data different from other kinds of data, why it is called geographic or spatial information data, and why we can map the data and show how it relates in space or in our case, across the surface of the earth.

The features can be anything: A road or stream, a linear feature; a house or pond, a feature that represents area; or the location of a rabbit hole or fox's den, a feature that might be represented by a discrete point. On a map linear features are represented by lines when it is not practical to represent them as polygons, like a river or a road on a map of the State of Connecticut. Features that represent areas, when it is practical to do so, are represented by polygons, and a point can represent things that are not practical to represent as polygons on a map, like a city on a map of the United States or a den location in the forest. In a GIS this type of point, line, and polygon data is called vector data.

At a minimum each row in a data table has to contain this geographic information, but a row of information about a feature can contain all kinds of data. If a feature is a house the row might contain information about how tall it is, what year it was built, or how many bedrooms it has. If the feature is a pond it might contain the name of the pond, how many acres it covers, and if it's a public water supply. This data are called attribute data. GIS allows us to ask questions and analyze this attribute or tabular data and visualize the results in the form of a map. As an example, from this data we could map houses built before 1900 near ponds greater than 10 acres.

A second type of GIS data is called raster data. Raster data sets differ from vector data sets in that they divide the world into discrete square or rectangular cells laid out in a grid, like a digital picture, each grid cell is a feature and is represented by a row in the layer's associated data table. Each cell has locational data associated with it just like vector data. Overlay analysis ultimately is accomplished with raster data sets.

Overlay analysis works much like a layer cake. Some cakes or overlay analyses / models have only two layers both of which represent the same kind of information or data, they are both vanilla. Other cakes or overlay analyses / models have many different kinds of layers which represent different kinds of information or data; they can be vanilla, chocolate, cream, or strawberries. The trick is to get each of the data layers to taste and look like the same flavor. This is done through changing vector data (point, lines, and polygons) into raster data and reclassifying the relevant information in each data layer's data table into whole numbers. In this way every grid cell of the raster data set has a whole number associated with it that represents the information about that cell that has been chosen to be used in the analysis.

In the final step of the analysis each of the data layers is in a raster format, each layer represents what has been chosen as one of the criteria to be used in the analysis, and each of the grid cells of the layer is represented by a number. Just like the layers of a cake which are decorated with a checkered board pattern and stacked on top of each other, the data layers are stacked on top of each other, and each of the cells that lay on top of each other can be added together in a vertical manner to create the top most layer of the cake. This top most layer represents the sum of each of the stacks of cells or checkered board squares and the results of the analysis.

The method used to create this overlay analysis or model followed Environmental Systems Research Institute's (ESRI) outline for overlay analysis described in their primer at http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/Understanding_overlay_analysis/009z000000rs000000/. ESRI is an industry leader in the research and development of GIS software and the developer of the ArcGIS 10.2.1 software and its Spatial Analyst extension used in this model. The following lists the general steps described by ESRI to perform overlay analysis:

1. Define the problem and determine the goal;
2. Break the problem into submodels;
3. Determine significant geospatial layers;
4. Reclassify or transform the data within a layer (so that all the data layers are represented by the same data format).

5. Weight the input layers.
6. Add or combine the layers.
7. Analyze.

Currently the problem for the LTE is there is no large landscape scale prioritized strategic conservation plan for the lower Connecticut River and coastal region that allows for separate municipal based conservation organizations to work across municipal boundaries towards common regional conservation goals. The goal of this overlay analysis is to create an agreed upon natural resource based map of classified connected important regional natural resource areas to provide wildlife habitat, to protect water quality and quantity, and to protect working and scenic lands.

The committee chose to break the model into two submodels both consisting of readily available GIS data layers representing the natural resources of the RiverCOG Region; one at the local scale to identify where resources occur alone and together within large natural areas (LNAs), and one at the regional scale to classify and prioritize those same LNAs.

Base rules for data layer determination were set at the beginning of the selection process to include:

- The layer must be a raster layer or a layer that can be turned into a raster by buffering or other operation to turn line or point vector data into polygon vector data that can then be rasterized.

- The layer must possess Federal Geographic Data Committee (FGDC) compliant metadata (data about the data, http://www.fgdc.gov/metadata). All the data provided by the Connecticut Department of Energy and Environmental Protection (CT DEEP) GIS website and University of Connecticut's (UConn) Center for Land Use Education and Research (CLEAR) CT Eco site, as well as any publically accessible Federal data are FGDC compliant.

- The layer must cover the whole RiverCOG Region. Lyme, Old Lyme, East Haddam, Salem, Haddam, Portland, East Hampton, Middletown, Middlefield, Durham, Killingworth, Chester, Deep River, Essex, Old Saybrook, Westbrook, Clinton, and Cromwell. (Note: Salem is not part of the RiverCog Region but is a bordering town, part of the Eightmile Wild and Scenic River watershed and an integral part of the natural resource base of the lower Connecticut River and coastal region).

Through three workshops participants explored data sets available from the CT DEEP GIS website and discussed other data sets relevant to their own work that might fit the above listed criteria (Appendices I, II, & III). Final data sets were selected, transformed, and reclassified to meet the needs of both the local and regional analysis. Primary final data sets included:

- Center for Land Use Education and Research Land Cover 2010 –

> … a view of general land cover for the greater Connecticut, Westchester County and northern Long Island areas circa 2010. The data are for general information purposes only and is not suitable for site-specific studies or litigation. The classification is intended for use in general,

area-wide analysis that can tolerate the errors and inaccuracies within the data.

The classification depicts 12 land cover categories. These are: 1. Developed, 2. Turf & Grass, 3. Other Grasses, 4. Agricultural Fields, 5. Deciduous Forest, 6. Coniferous Forest, 7. Water, 8. Non-forested Wetland, 9. Forested Wetland, 10. Tidal Wetland, 11. Barren Land, and 12. Utility Corridors. Source Landsat TM image data were from October 8, 2010 and September 22, 2010. The classification was compiled using ERDAS Imagine 2011 by the Center for Land use Education and Research (CLEAR) in the College of Agriculture and Natural Resources at the University of Connecticut.
http://clear.uconn.edu/projects/landscapeLIS/landcover.htm

- Inland Wetland Soils:

Inland Wetland Soils provide the general location of soil map units in Connecticut that are defined as Inland Wetlands and may be subject to regulation. The Connecticut Inland Wetlands and Watercourses Act, Connecticut General Statutes Section 22a-38, defines wetland soils to include, "Any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soil Survey, as may be amended from time to time, of the Natural Resources Conservation Service of the United States Department of Agriculture". For additional documentation including a description of the map legend for Inland Wetland Soils, refer to the CT ECO Complete Resource Guide for Inland Wetland Soils. All soil information included in the CT ECO maps and map viewers is from the Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS), which is based on information originally published on the set of Soil Survey quarter quadrangle maps that cover Connecticut.
http://cteco.uconn.edu/guides/Soils_Inland_Wetland.htm

http://www.cteco.uconn.edu/metadata/dep/document/SOILS_POLY_DATA_FGDC_Plus.htm

- Hydrography lines and water bodies:

Connecticut Hydrography Polygon includes the polygon features of a layer named Hydrography. Hydrography is a 1:24,000-scale, polygon and line feature-based layer that includes all hydrography features depicted on the U.S. Geological Survey (USGS) 7.5 minute topographic quadrangle maps for the State of Connecticut. This layer only includes features located in Connecticut. These hydrography features include waterbodies, inundation areas, marshes, dams, aqueducts, canals, ditches, shorelines, tidal flats, shoals, rocks, channels, and islands. Hydrography is comprised of polygon and line features. Polygon features represent areas of water for rivers, streams, brooks, reservoirs, lakes, ponds, bays, coves, and harbors. Polygon features also depict inundation areas, marshes, dams, aqueducts, canals, tidal flats, shoals, rocks, channels, and islands shown on the USGS 7.5 minute topographic quadrangle maps. Line features represent single-line rivers and streams, aqueducts, canals, and ditches. Line features also enclose all polygon features in the form of natural shorelines, manmade shorelines, dams, closure lines separating adjacent water bodies, and the apparent limits for tidal flats, rocks, and areas of marsh. The layer is based on information from USGS topographic quadrangle maps published between 1969 and 1984 so it does not depict conditions at any one particular point in time. Also, the layer does not reflect recent changes with the course of streams or location of shorelines impacted by natural events or changes in development since the time the USGS 7.5 minute topographic quadrangle maps were published. Attribute information is comprised of codes to identify hydrography features by type, cartographically represent (symbolize) hydrography features on a map, select water bodies appropriate to display at different map scales, identify individual water bodies on a map by name, and describe feature area and length. The names assigned to individual water bodies are based on information published on the USGS 7.5 minute topographic quadrangle maps or other state and local maps. The layer does not include bathymetric, stream gradient, water flow, water quality, or biological habitat information. This layer was originally published in 1994. The 2005 edition includes the same water features published in 1994, however some attribute information has been slightly modified and made easier to use. Also, the 2005 edition corrects previously undetected attribute coding errors.

http://www.cteco.uconn.edu/metadata/dep/**document**/HYDROGRAPHY_POLY_FGDC_Plus.htm

- Critical Habitats:

Connecticut Critical Habitats depicts the classification and distribution of twenty-five rare and specialized wildlife habitats in the State. It represents a compilation of ecological information collected over many years by State agencies, conservation organizations and many individuals. Examples of critical habitats include Acidic Atlantic White

Cedar Swamps, Sand Barrens, Dry Subacidic Forests and Intertidal Marshes. Connecticut Critical Habitats is the result of a project which took place from 2007-2009, to create habitat maps to be used in land use planning and natural resource protection. Critical habitats range in size from areas less than 1 acre to areas that are 10's of acres in extent. Connecticut Critical Habitats is best represented when viewed with high resolution imagery at scales between 1:2,000 and 1:12,000. (http://cteco.uconn.edu/guides/Critical_Habitat.htm)

- Natural Diversity Database Areas :

  Natural Diversity Data Base Areas represent known locations, both historic and extant, of state listed species and significant natural communities. State listed species are those listed as endangered, Threatened or Special Concern under the Connecticut Endangered Species Act (Connecticut General Statutes, Section 26-303). Some examples of significant natural communities in Connecticut include Acidic Atlantic White Cedar Swamps, Sand Barrens and Poor fens. This dataset represents over 100 years worth of field observations, scientific collections, and publications. The data have been compiled from a variety of sources and in most cases do not represent a comprehensive or state-wide survey. Sources include state biologists, university students and professors, conservation organizations and private landowners.
  http://cteco.uconn.edu/guides/Natural_Diversity_Database.htm

Of these five primary data sets, Critical Habitats and the Natural Diversity Database Areas were left to stand on their own and the 2010 CLEAR Land Cover, Inland Wetland Soils, and Hydrography Lines and Water Bodies were manipulated to create specialized land cover and hydrology data sets.

The 2010 Land Cover raster data set was analyzed to produce the Large Natural Areas (LNAs) data set; the Core Forest Areas data set; and the Early Successional Habitat Areas data set. The 2010 Land Cover raster data set land classification attributes include (CLEAR):

Developed

High-density built-up areas typically associated with commercial, industrial and residential activities and transportation routes. These areas can be expected to contain a significant amount of impervious surfaces, roofs, roads, and other concrete and asphalt surfaces.

Turf & Grass

A compound category of undifferentiated maintained grasses associated mostly with developed areas. This class contains cultivated lawns typical of residential neighborhoods, parks, cemeteries, golf courses, turf farms, and other maintained grassy areas. Also includes some agricultural fields due to similar spectral reflectance properties.

Other Grasses

Includes non-maintained grassy areas commonly found along transportation routes and other developed areas, and within and surrounding airport properties. Also likely to include forested clear-cut areas, and some abandoned agricultural areas that appear to be undergoing conversion to woody scrub and shrub cover.

Agricultural Field

Includes areas that are under agricultural uses such as crop production and/or active pasture. Also likely to include some abandoned agricultural areas that have not undergone conversion to woody vegetation.

Deciduous Forest

includes southern New England mixed hardwood forests. Also includes scrub areas characterized by patches of dense woody vegetation. May include isolated low density residential areas.

Coniferous Forest

Includes southern New England mixed softwood forests. May include isolated low density residential areas.

Water

Open water bodies and watercourses with relatively deep water.

Non-forested Wetland

Includes areas that predominately are wet throughout most of the year and that have a detectable vegetative cover (therefore not open water). Also includes some small water courses due to spectral characteristics of mixed pixels that include both water and vegetation.

Forested Wetland

Includes areas depicted as wetland, but with forested cover. Also includes some small water courses due to spectral characteristics of mixed pixels that include both water and vegetation.

Tidal Wetland

Emergent wetlands, wet throughout most of the year, with distinctive marsh vegetation and located in areas influenced by tidal change.

Barren

Mostly non-agricultural areas free from vegetation, such as sand, sand and gravel operations, bare exposed rock, mines, and quarries. Also includes some urban areas where the composition of construction materials spectrally resembles more natural materials. Also includes some bare soil agricultural fields.

Utility Rights-of-way (Forest)

Includes utility rights-of-way. This category was manually digitized on-screen from rights-of-way visible in the Landsat satellite imagery. The class was digitized within the deciduous and coniferous categories only.

The specialized land cover dependent data sets were created in the following ways.

- *Large Natural Areas* (LNAs) excluded attributes from the 2010 CLEAR Land Cover data that are characteristic of developed landscape features. These attributes included developed, turf & grass, agriculture, and barren land. The committee chose to remove agriculture from the land cover data because of their desire to isolate the region's large natural areas and the agricultural data primarily included active crop production and/or active pasture. During any implementation of this plan's findings, and during any ground truthing activities and final analysis this data should be refined to include abandoned fields that are returning to a natural state and are connected to existing LNAs. The remaining attributes were aggregated into single polygons greater than 5 acres. LNAs cover 73.2% of the region's area.

- *Core Forest Areas* was developed using CLEAR's forest fragmentation model available at http://clear.uconn.edu/%5C/tools/lft/lft2/index.htm and the 2010 CLEAR land cover data. For the purpose of this analysis core forest is any point in the forest that is 300 feet from any type of development features. The data set was chosen because the region's LNAs are 81.7% forested, because of the State's emphasis on the detrimental effects of fragmentation of the forest resource in the Connecticut Department of Energy and Environmental Protection's planning document *Connecticut's Forest Resource Assessment and Strategy 2010* (Hochholzer, 2010) ((http://www.ct.gov/deep/cwp/view.asp?a=2697&q=454164&deepNav_GID=1631), and because of the work the Region has been doing with UConn Extension and CT DEEP concerning forest landowner outreach and the Lower Connecticut River and Coastal Region Forest Stewardship Initiative (http://www.ctforestry.uconn.edu/LCRCR.html).

- *Early Successional Habitat Areas* was developed using CLEAR's 2010 Land Cover Data and only includes attributes that are indicative of this habitat type. They include other grasses and utility corridors. They were chosen by the Committee because of the lack of this habitat type in the region and because of Connecticut Department of Energy and Environmental Protection's *Connecticut's Comprehensive Wildlife Conservation Strategy* (CT DEEP, 2005) emphasis on the importance of the habitat type to the threatened and endangered species of the State. http://www.ct.gov/deep/cwp/view.asp?a=2723&q=325886&deepNav_GID=1719

Other specialized data sets included:

- *Surface Hydrology* – The committee chose to take the approach of unifying the region's surface hydrology into one unified data set that had a buffer of 300' applied excluding developed CLEAR 2010 Land Cover data. This data set included wetland soils, water bodies, streams, and intermittent streams. These data sets were buffered by 300' and unified to create one data layer. The CLEAR 2010 Land Cover data developed areas (developed, turf grass, and barren land) were removed from the unified data set so that only intact riparian areas and stream side buffers were represented. This data set was chosen because of the importance of wetlands of all types in maintaining the region's biodiversity (CWCS). 300' was chosen as a buffer width because it is a generally accepted minimum width for maintenance of wildlife corridors (Wenger, 1999); and

- *Critical Habitat Areas* was buffered by 300' for the same reason previously mentioned.

The final data sets chosen for the local model consist of:

- LNAs;
- Core Forest Areas;
- Early Successional Habitat Areas;
- Surface Hydrology;
- Critical Habitats; and
- Natural Diversity Database Areas.

The final data sets used in the regional model consist of:

- LNAs;
- Percent Core Forest in LNAs;
- Percent Surface Hydrology in LNAs;
- Critical Habitat;
- Natural Diversity Database Areas.

The local model weighted core forest areas, surface hydrology, and critical habitat data sets as twice as important as the LNAs, early successional habitat and natural diversity database data sets. Natural diversity database areas were not weighted more heavily because of the inconsistent data collection methods used within the data set. The committee determined that because of the very small amount of early successional habitat in the RiverCOG Region, its relative short lived nature unless stewarded, and the ability to manage for its introduction and maintenance in the future that core forest and surface hydrology, the RiverCOG Region's primary natural resources, and critical habitats - rare and specialized wildlife habitats identified in the Connecticut Comprehensive Wildlife Conservation Strategy (CT DEEP, 2005), should be weighted more heavily within the analysis. The committee also felt it was important to emphasize within this plan the important functions this habitat plays within the landscape of the region and the state, and emphasize the need to work with private land owners to create and maintain this habitat type. The following is from the State of Connecticut Department of Energy and Environmental Protection Wildlife Division's Young Forest and Shrubland Initiative web site (http://www.ct.gov/deep/cwp/view.asp?a=2723&q=514596&deepNav_GID=1655):

> Young forests and shrub lands, also referred to as early successional habitats, provide habitat for a variety of wildlife species. In the past, early successional habitat was created and maintained through natural disturbances such as fire, flooding, beaver activity, and blow downs from wind. It also was created and maintained through human disturbances such as agricultural and timber harvesting. Historically, early successional habitat in New England would have been most common in southern New England. Today, Connecticut has become very developed and opportunities for natural disturbance have been controlled. Fire and flooding is controlled, agriculture is declining, and clear-cut timber harvesting has decreased in size and frequency throughout the State as well. Early successional habitat is found in Connecticut today primarily along utility right-of-ways, in wildlife management areas owned by the State or other private organizations, and in forests where timber harvest has been conducted.
>
> Because the amount of early successional habitat is declining in Connecticut, so are the wildlife species that depend on these habitats. Connecticut's Wildlife Action Plan has identified 47 wildlife species of Greatest Conservation Need (GCN) as being associated with these habitats and in need of active management. These species include the American woodcock, eastern towhee, New England cottontail, prairie warbler, brown thrasher, and field sparrow. The Wildlife Division in cooperation with other partners has initiated the Young Forest and Shrubland Initiative to help restore these important habitats. Projects associated with this initiative include: 1) New England cottontail restoration, 2) upland shrub land bird monitoring, and 3) American woodcock habitat use and survival.

Grid analysis was done at a 30 meter resolution using the reclassification and weighted sum tools available within the Spatial Analyst extension for the ArcGIS 10.2.1 software. Core forest areas, surface hydrology, and critical habitat areas were weighted with a value of 2, while LNA's, natural diversity database areas, and early successional habitats were weighted with a value of 1. This allowed for a minimum weight or resource index of 1, and a maximum weight or resource index of 9 for each 30 meter grid cell (Figure 1). High resource index areas on the map indicate grid cells where a greater number or more heavily weighted agreed on natural resources are located and prioritize where conservation work should be applied.

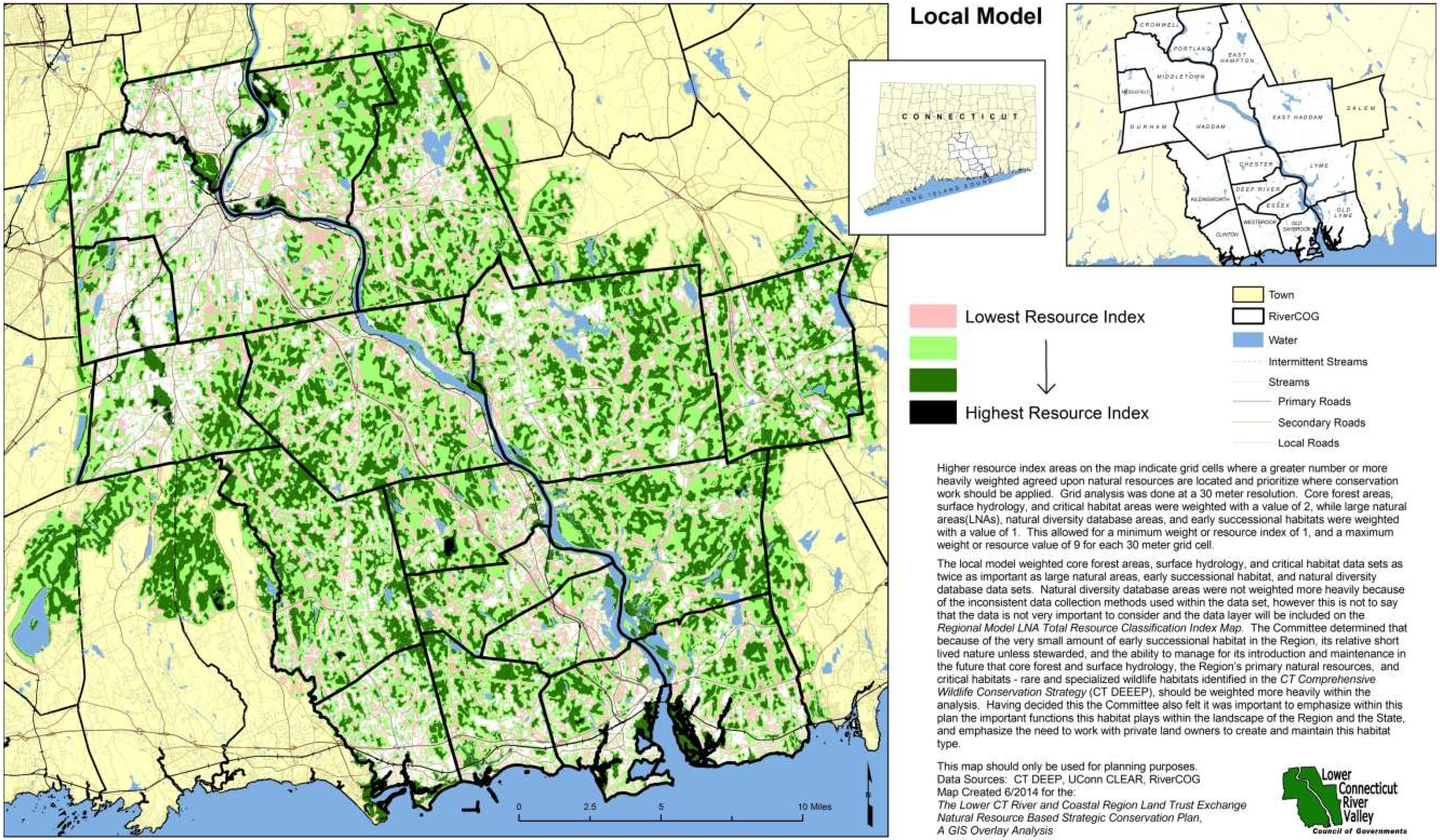


Figure 1 – Local Model.

The regional model reflects the local model but looks at LNAs in their entirety. The committee chose to focus and classify the resource layers in three ways [Table 1]: Size of the LNAs in acres (Figure 2); percentage of core forest of each LNA (Figure 3); and percentage of surface hydrology of each LNA (Figure 4). Each of the three classification criteria was given a classification index from 1 to 4 for each LNA.

The LNAs were first classified by size into tiers.

- Tier 1 LNAs are greater than 1000 acres (Tier 1 > 1000 Acres).
- Tier 2 LNAs are greater than 500 acres but less than 1000 acres (Tier 2 > 500 < 1000 Acres).
- Tier 3 LNAs are greater than 100 acres but less than 500 acres (Tier 3 > 100 < 500 Acres).
- Tier 4 LNAs less than 100 acres (Tier 4 < 100 Acres).

Each tier was then classified into four classes for both percentage of core forest and percentage of surface hydrology.

- Class 1 in each tier were LNAs that contained 75% - 100% of either core forest or surface hydrology.
- Class 2 in each tier were LNAs that contained 50% - 74% of either core forest or surface hydrology.
- Classes 3 in each tier were LNAs that contained 25% - 49% core forest or surface hydrology.
- Classes 4 in each tier were LNAs that contained 0 % - 24% core forest or surface hydrology.

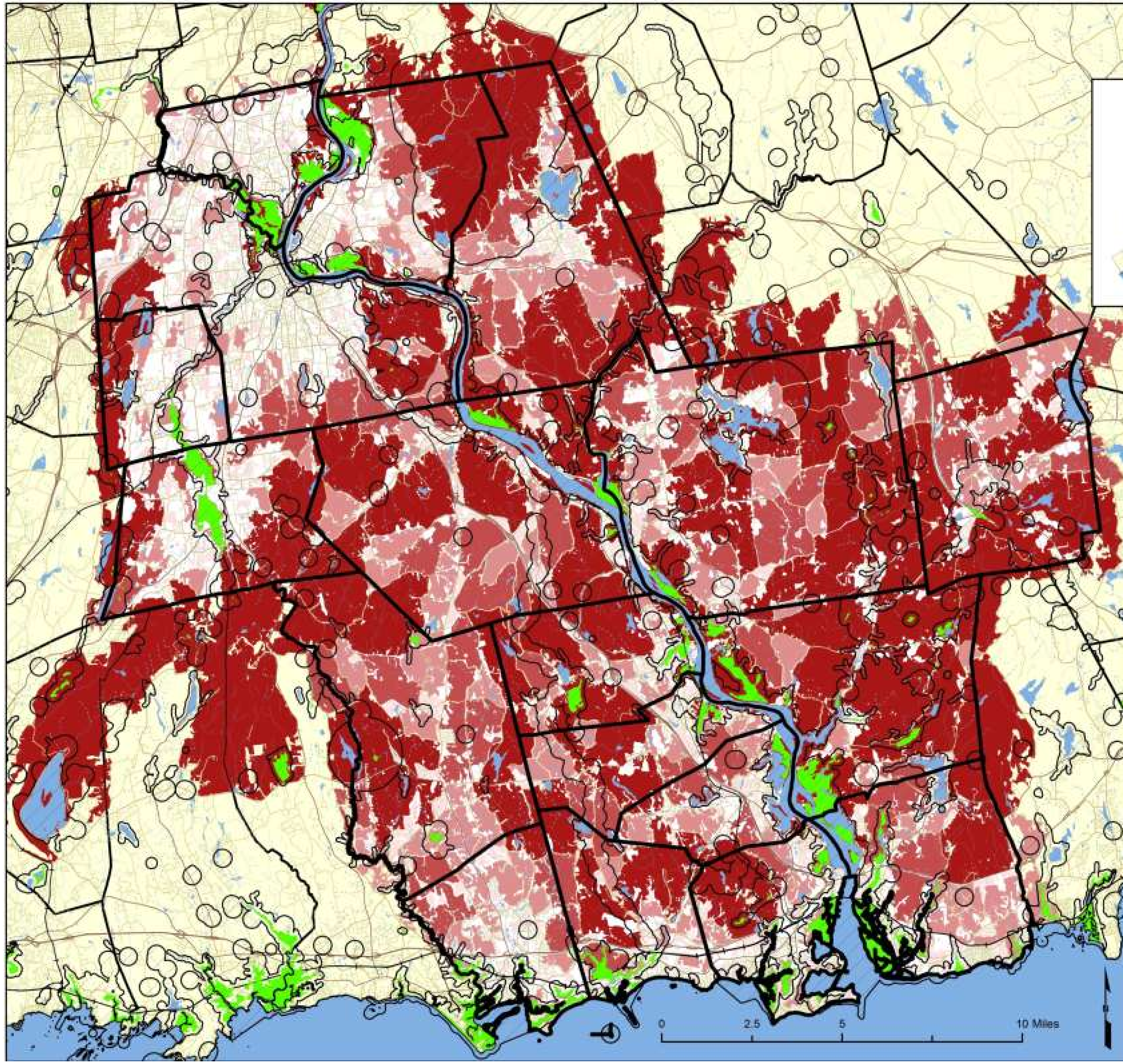
These classification indices were then added together to create the LNA total resource index score in the same manner as the local model, except LNA polygons replaced 30 meter grid cells (Figure 5). **In this analysis, the lower the resource classification score the higher its value**. The LNAs with the lowest score are the LNAs that are the largest or have the greatest percentages of core forest and/or surface hydrology, the LNAs with the lowest score are those that are the smallest or have low percentages of core forest and/or surface hydrology. **Total resource index scores for the LNAs ranged from 4 to 12, 4 being the highest score and 12 being the lowest score**.

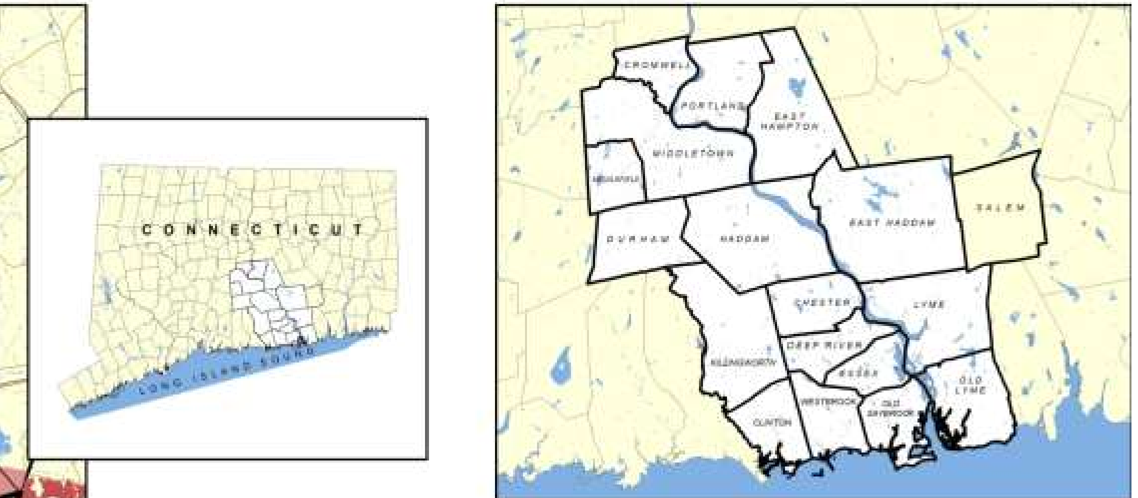
To retain the importance of the locations of Critical Habitats and Natural Diversity Database Areas they are included as separate data layers on the regional model maps. The local and regional models include those LNAs that extend beyond the boundary of the Region to enable planning across regional and municipal boundaries.

Regional Model				
Acreage Large Natural Area				
Tier 1 ≥ 1000 Acres		**% Core Forest**		**% Hydrography**
	Class 1	**75 -100**	**Class 1**	**75 - 100**
	Class 2	**50 - 74**	**Class 2**	**50 - 74**
	Class 3	**25 - 49**	**Class 3**	**25 - 49**
	Class 4	**0 -24**	**Class 4**	**0 -24**
Tier 2 ≥ 500 < 1000 Acres				
	Class 1	**75 - 100**	**Class 1**	**75 - 100**
	Class 2	**50 - 74**	**Class 2**	**50 - 74**
	Class 3	**25 - 49**	**Class 3**	**25 - 49**
	Class 4	**0 - 24**	**Class 4**	**0 -24**
Tier 3 ≥ 100 < 500 Acres				
	Class 1	**75 - 100**	**Class 1**	**75 - 100**
	Class 2	**50 - 74**	**Class 2**	**50 - 74**
	Class 3	**25 - 49**	**Class 3**	**25 - 49**
	Class 4	**0 - 24**	**Class 4**	**0 - 24**
Tier 4 < 100 Acres				
	Class 1	**75 - 100**	**Class 1**	**75 - 100**
	Class 2	**50 - 74**	**Class 2**	**50 - 74**
	Class 3	**25 - 49**	**Class 3**	**25 - 49**
	Class 4	**0 - 24**	**Class 4**	**0 - 24**

Table 1 – LNA Classification Index.

Regional Model, Large Natural Areas, Total Acres Classification Index





Total Acres Index

- 1 - > 1000
- 2 - > 500 < 1000
- 3 - > 100 < 500
- 4 - < 100
- Natural Diversity Database
- Critical Habitats
- Town
- RiverCOG
- Water
- Intermittent Streams
- Streams
- Railroad
- Primary Roads
- Secondary Roads
- Local Roads

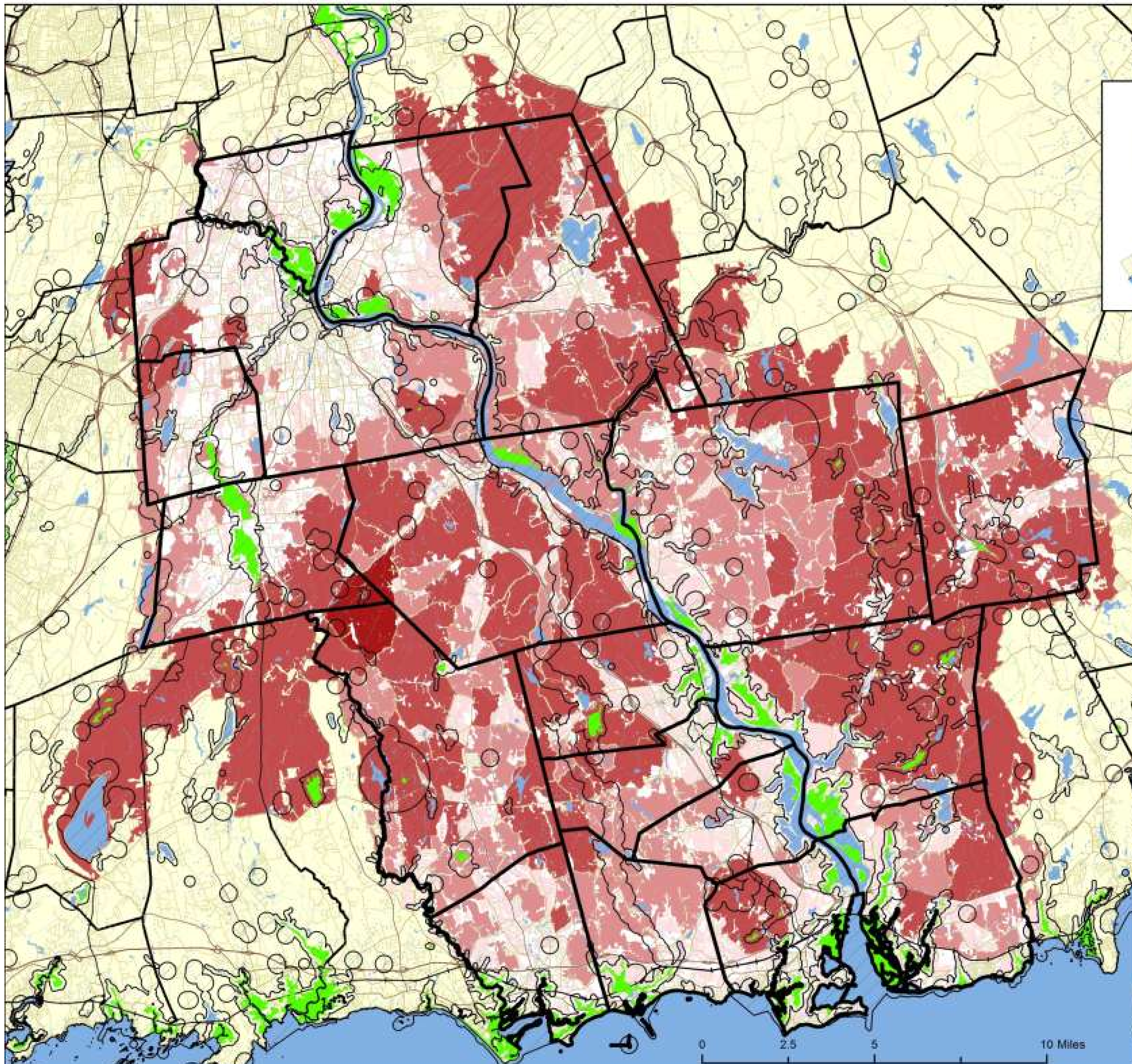
Large Natural Areas (LNAs)excluded attributes from the 2010 CLEAR Land Cover data that are characteristic of developed landscape features. These attributes included developed, turf & grass, agriculture, and barren land. The committee chose to remove agriculture from the land cover data because of their desire to isolate the Region's large natural areas and the agricultural data primarily included active crop production and/or active pasture. During any implementation of this plan's findings, and during any ground truthing activities and final analysis this data should be refined to include abandoned fields that are returning to a natural state and are connected to existing LNAs. The remaining attributes were aggregated into single polygons greater than 5 acres. LNAs cover 73.2% of the Region's area.

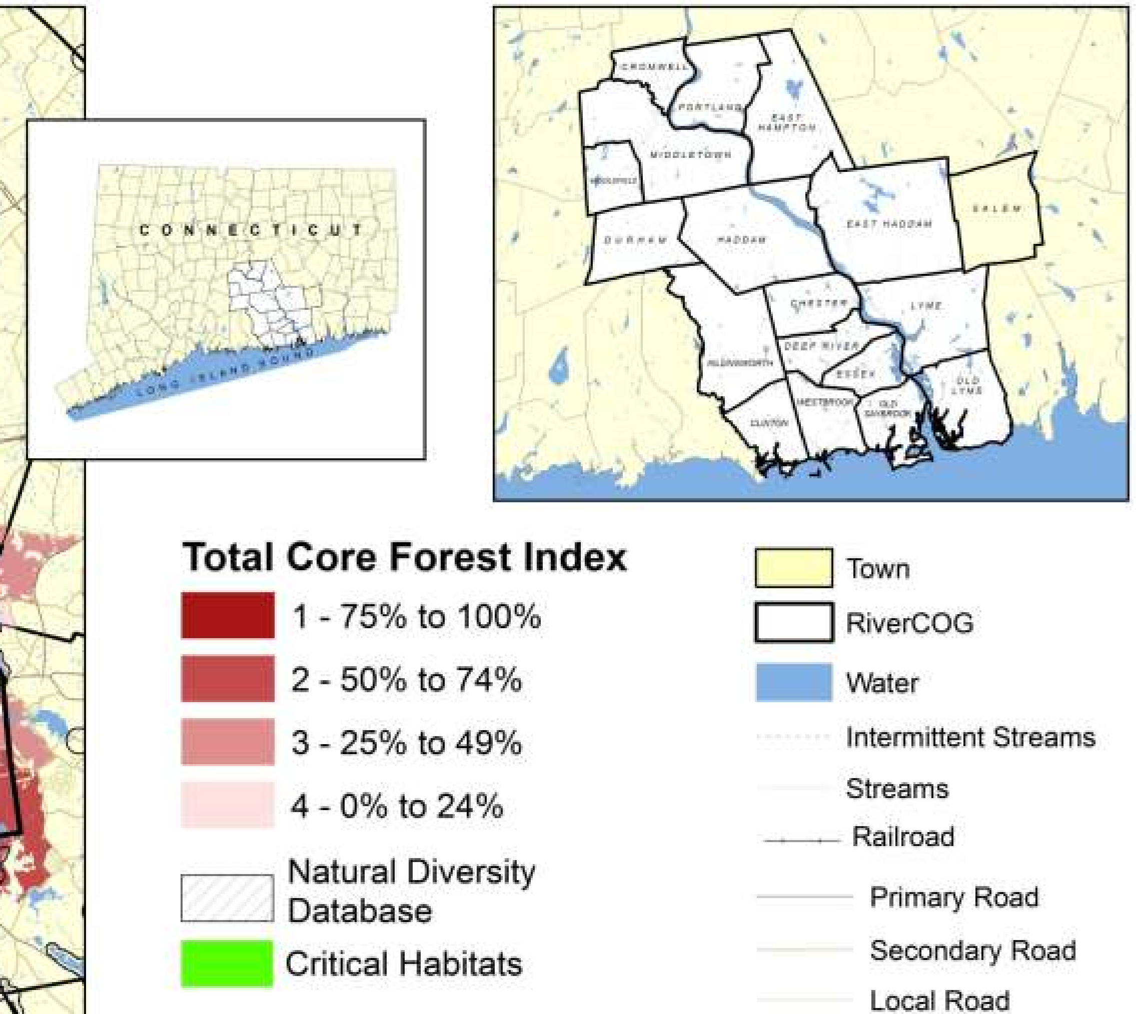
This map should only be used for planning purposes.
Data Sources: CT DEEP, UConn CLEAR, RiverCOG
Map Created 6/2014 for the:
The Lower CT River and Coastal Region Land Trust Exchange
Natural Resource Based Strategic Conservation Plan,
A GIS Overlay Analysis

Lower Connecticut River Valley Council of Governments

Figure 2 – LNA Total Acres Classification Index.

Regional Model, Large Natural Areas, Core Forest Classification Index





Core Forest Areas was developed using CLEAR's forest fragmentation model available at http://clear.uconn.edu/%5C/tools/lft/lft2/index.htm and the 2010 CLEAR land cover data. For the purpose of this analysis core forest is any point in the forest that is 300 feet from any type of development features. The data set was chosen because the Region's LNAs are 81.7% forested, because of the State's emphasis on the detrimental effects of fragmentation of the forest resource in the CT DEEP planning document *Connecticut's Forest Resource Assessment and Strategy 2010 – 2015* (http://www.ct.gov/deep/cwp/view.asp?a=2697&q=454164&deepNav_GID=1631), and because of the work the Region has been doing with UConn Extension and CT DEEP concerning forest landowner outreach and the Lower CT River and Coastal Region Forest Stewardship Initiative (http://www.ctforestry.uconn.edu/LCRCR.html).

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Data Sources: CT DEEP, UConn CLEAR, RiverCOG
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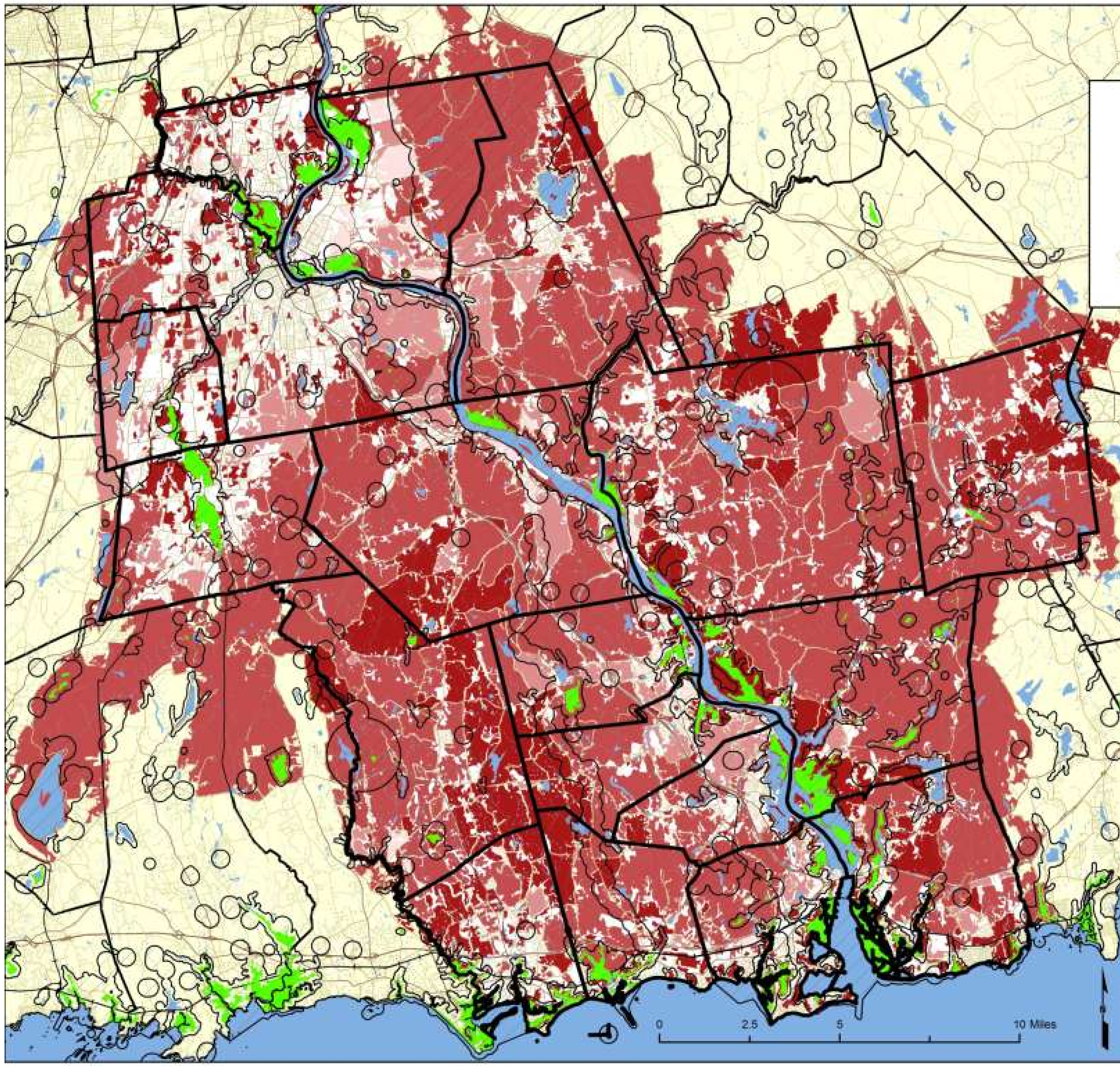
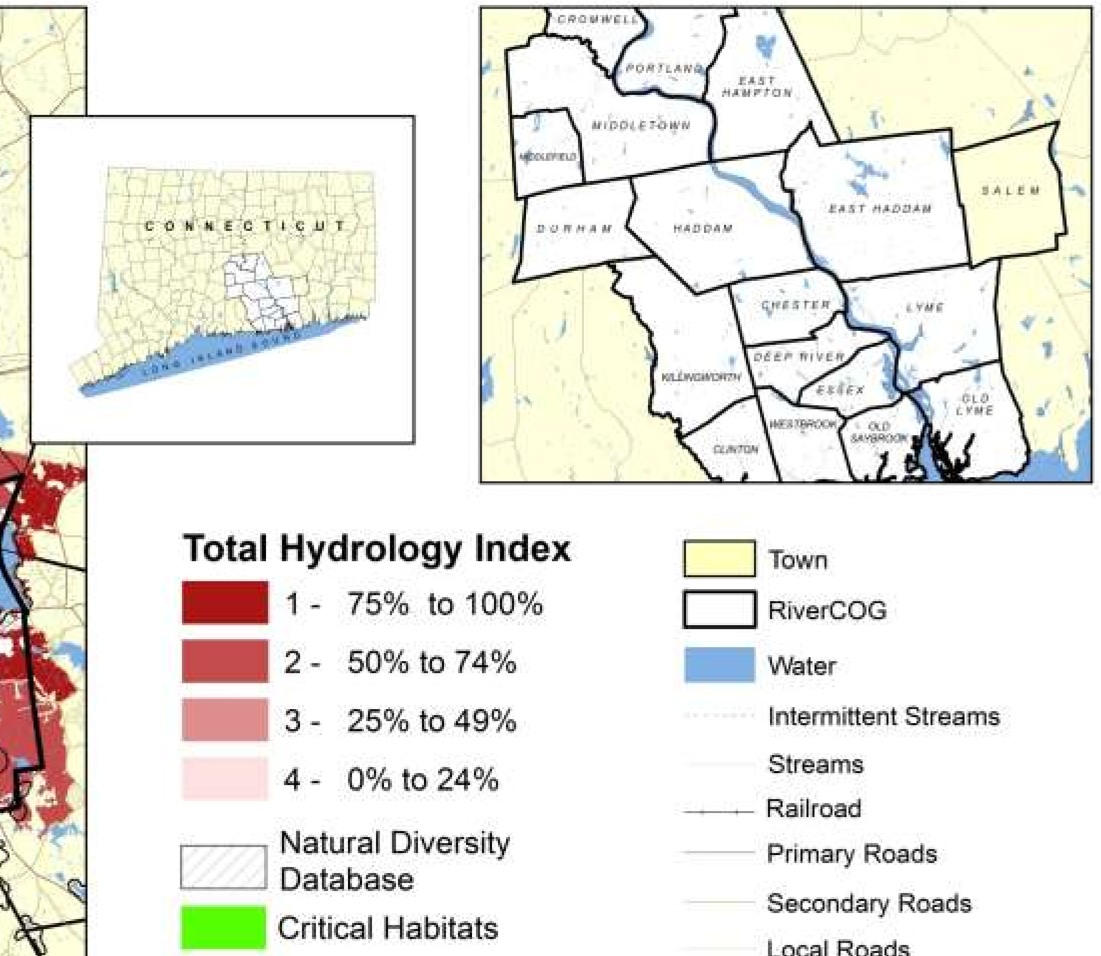
gure 3 – LNA Core Forest Index.

Regional Model, Large Natural Areas, Hydrology Classification Index





Surface Hydrology – The committee chose to take the approach of unifying the Region's surface hydrology into one unified data set that had a buffer of 300' applied excluding developed CLEAR 2010 Land Cover data. This data set included wetland soils, water bodies, streams, and intermittent streams. These data sets were buffered by 300' and unified to create one data layer. The CLEAR 2010 Land Cover data developed areas (developed, turf grass, and barren land) were removed from the unified data set so that only intact riparian areas and stream side buffers were represented. This data set was chosen because of the importance of wetlands of all types in maintaining the Region's biodiversity (CWCS). 300' was chosen as a buffer width because it is a generally excepted minimum width for maintenance of wildlife corridors (Wenger, 1999).

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Data Sources: CT DEEP, UConn CLEAR, RiverCOG
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Figure 4 – LNA Hydrology Classification Index.

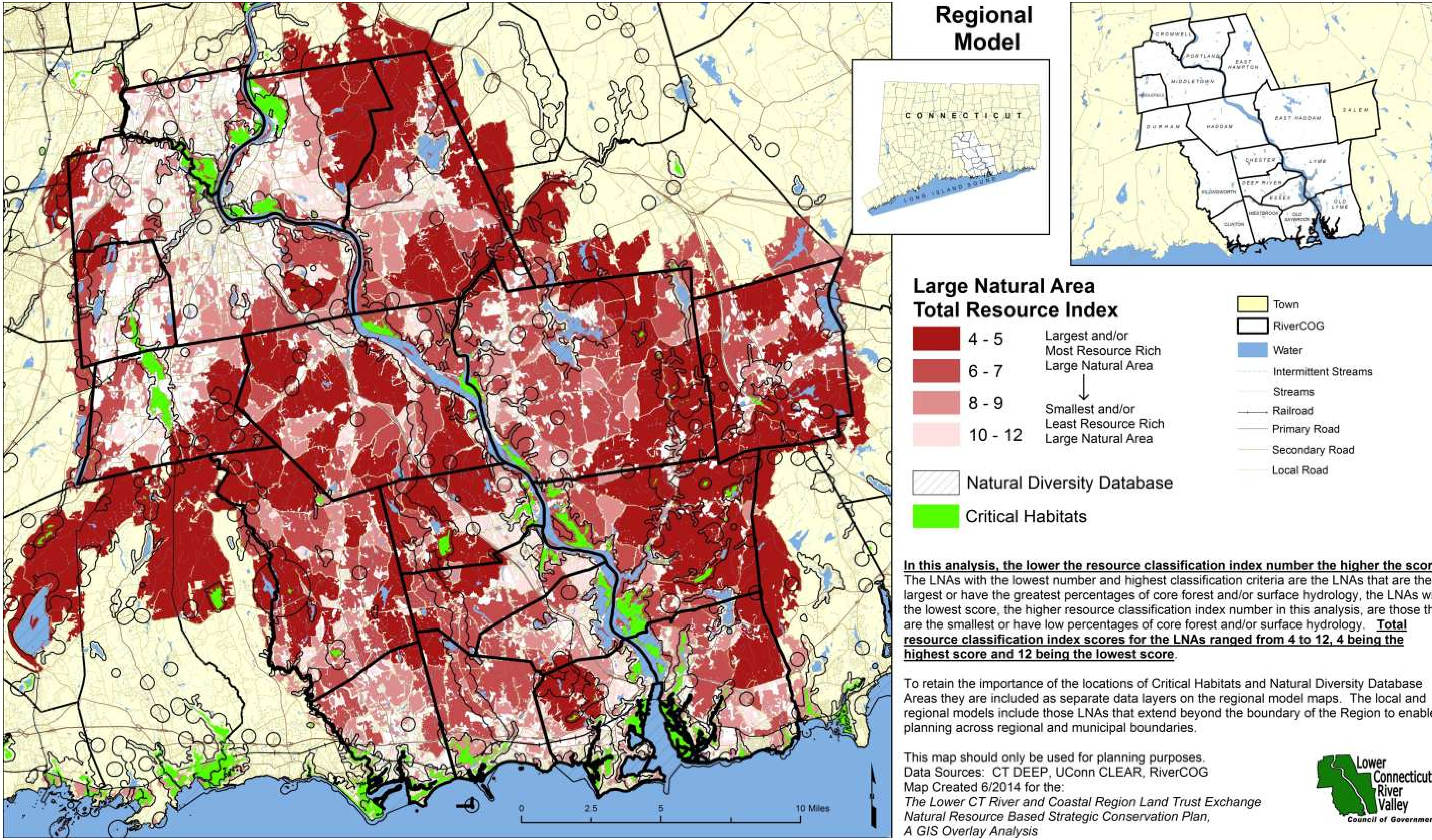


Figure 5 - LNA Total Resource Classification Index.

Results and Value of Analysis

The results will allow those working in the RiverCOG Region to identify, in a strategic manner, the most suitable areas to apply limited financial and human resources towards their work with private land owners to promote best natural resource management principals and/or towards the permanent protection of the identified natural resource areas and habitat corridors.

It should be kept in mind when using the data associated with the regional model that discussion has occurred as to how connected forest blocks are across dirt and little used paved forest roads where tree canopy is unbroken, and there are instances within the original land cover data set and within the subsequent analysis where it could be argued either way as to whether an LNA should or should not be connected across one of these features. It should also be kept in mind that the LNAs include water bodies. This is most prominently expressed in the LNAs associated with the Connecticut River that account for some of the higher acreage LNA areas. The Connecticut River habitat corridor is divided into three LNAs. The most southerly from the I-95 bridge between Old Saybrook and Old Lyme to the Rt. 82 Haddam bridge between Haddam and East Haddam. The second from the Haddam bridge to the bridge between Middletown and Portland, and the most northerly from the Middletown / Portland bridge to the Rt. 3 bridge between Wethersfield and Glastonbury. These LNAs are some of the Region's most recognized and biologically diverse.

The analysis of the CLEAR land cover dataset revealed that there are 1004 LNAs greater than five acres associated with the region covering a land area of 267,888 acres with an average size of approximately 266 acres. Tier 1 and Tier 2 LNAs account for 78% of the land area of all LNAs combined (Figure 6).

- 64 Tier 1 LNAs are 1000 acres or greater, and cover 170,145 acres.
- 55 Tier 2 LNAs are 500 acres to 999 acres, and cover 37,874 acres.
- 178 Tier 3 LNAs are 100 acres to 499 acres, and cover 42,722 acres.
- 703 Tier 4 LNAs are < then 100 acres and cover 17,147 acres.

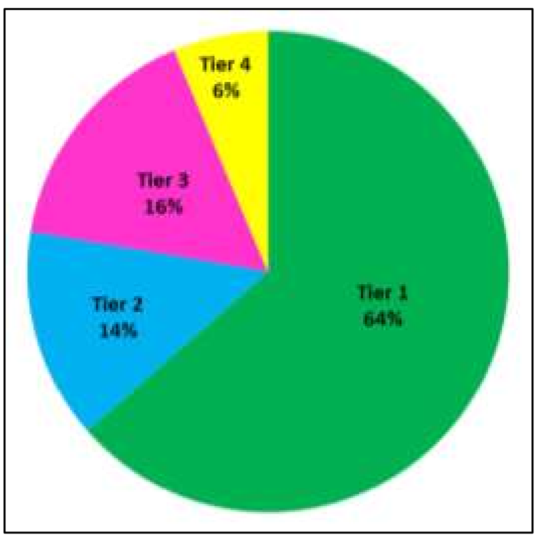


Figure 6 – Percent LNA Acreage by Tier.

46% of the land area of the LNAs is covered by core forest and 64% by intact buffered surface hydrology, 123,522 acres and 171,472 acres respectively.

The analysis of the LNAs in terms of their total resource index scores shows that there are (Figure 7):

- **53 LNAs with the highest value scores of 4 or 5** covering 129,395 acres, these are the largest and or most resource rich LNAs, their median size is 2,441 acres **and account for 48% of the land area of all LNAs combined**;

- **96 LNAs with the next lower value scores of 6 or 7** covering 84,060 acres and a median size of 876 acres **and account for 31% of the land area of all LNAs combined**;

- 482 LNAs with scores of 8 or 9 covering 42,149 acres and a median size of 87 acres and account for 16% of the land area of all LNAs combined; and

- 373 LNAs with the lowest value scores of 10, 11, or 12 covering 12,284 acres, these are the smallest and or least resource rich, their median size is 33 acres and account for 5% of all LNAs combined.

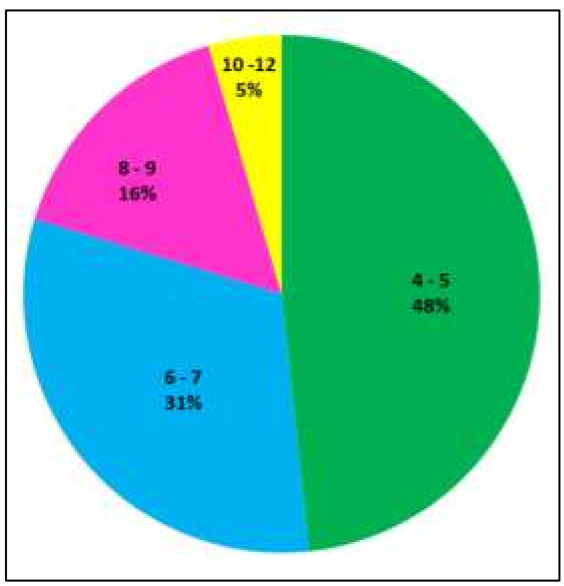


Figure 7 – Percent LNAs by Total Resource Index Score.

The 149 LNAs with high resource index scores ranging from 4 to 7 account for 79% of the total area of all LNAs and contain 90% of the core forest areas and 80% of intact riparian and surface hydrology of all LNAs combined (Figure 8).

- There are 7 LNAs with the highest resource index score of 4. They account for 8% of the core forest area and 6% of the buffered surface hydrology. Their average size is 2,051 acres and account for 5% of all LNA acreage.

- 46 LNAs with the next lower resource index score of 5. They account for 46% of the core forest area and 39% of the buffered surface hydrology. Their average size is 2,500 acres and account for 43% of all LNA acreage.

- 33 LNAs resource index score equaled 6. They account for 14% of the core forest area and 24% of the buffered surface hydrology. There average size is 1,628 acres and account for 20% of all LNA acreage.

- 63 LNAs resource index score equaled 7. They account for 10% of the core forest area and 11% of the buffered surface hydrology. There average size is 481 acres and account for 11% of all LNA acreage.

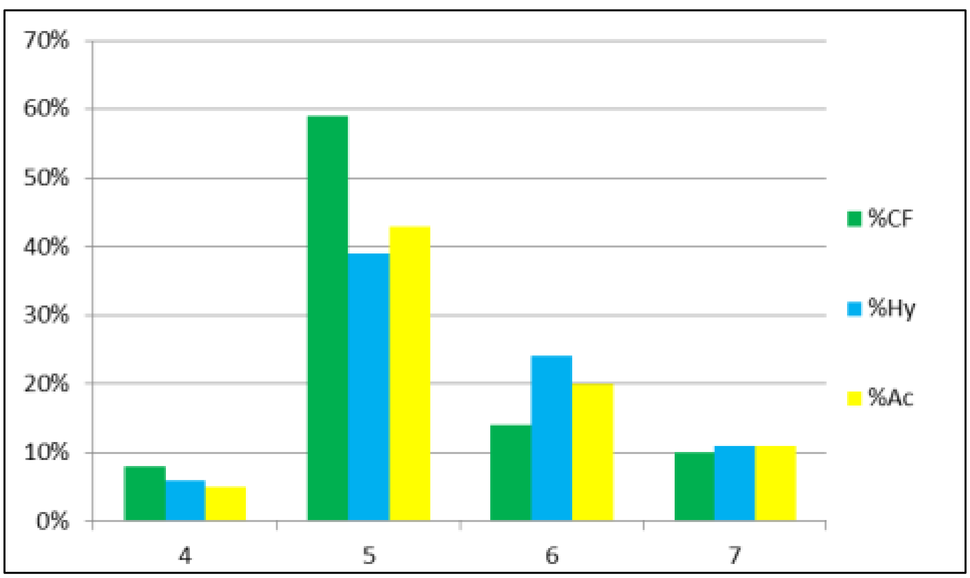


Figure 8 – Percent Core Forest (CF), Surface Hydrology (Hy), and Acreage of Highest Total Resource (Ac) Index Scoring LNAs.

The 86 LNAs with resource index scores of 4, 5, and 6 account for 68% of the total LNA acreage, 81% of core forest area, and 69% of buffered surface hydrology. Because of their size and resource value the Committee chose these LNAs as primary regional wildlife habitat corridors, and the LNAs with the resource index score of 7 which account for an additional 63 LNAs, 11% of LNA acreage, 10% of core forest area, and 11% of buffered surface hydrology, as connecting habitat corridors (Figure 9).

The local model data allows for identification of areas where the identified natural resources coexist in the greatest densities within these primary and connecting corridors (Figure 10 and Figure 11).

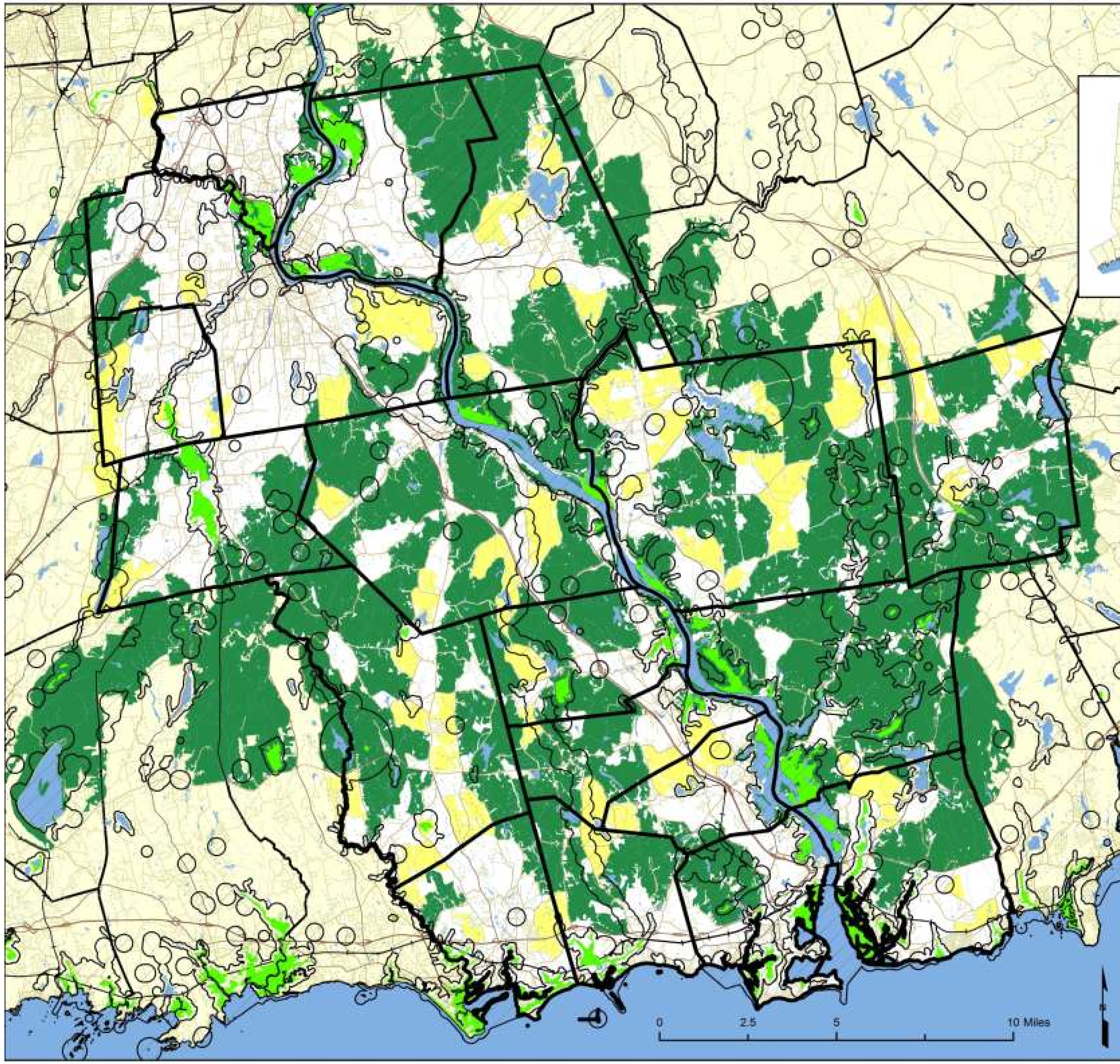
How to Use the Results for Your Strategic Planning Purposes

For regional purposes the models and maps identify where the vast majority of agreed upon important natural resources exist within and bordering the RiverCOG Region for the purposes of creating large connected natural areas to provide wildlife habitat, to protect water quality and quantity, and to protect the region's working and scenic lands. The primary and connecting corridors should be considered as primary strategic areas, as well as critical habitat and endangered species locations, for public outreach and education concerning natural resource protection, best management practices, and permanent land conservation. At the local level these models could be applied to subsets of the existing data at the municipal or smaller region scale to identify where other locally important connecting corridors exist within those boundaries.

Next Steps

The next step in the planning process is to use this completed natural resource based model as a foundation to build the yet undetermined remaining conservation index criteria for each LNA. Updates will be added when RiverCOG's Region wide seamless GIS municipal parcel data set is completed. Some examples of further index criteria that could be considered for each LNA include: The percent of each LNA in permanent conservation; is the LNA within a State designated greenway; how many parcels of the LNA are vacant and still in a natural condition; and how connected is each LNA to the other. This plan will allow for further strategic and proactive conservation on the part of RiverCOG's land trusts and conservation organizations, thus leading to enhancement of our forests and wetlands that protect our water quality and quantity; provide wildlife corridors and agricultural products; and maintain the lower Connecticut River and coastal region's economy, beauty, and quality of life.

Large Natural Areas Primary and Connecting Corridors



The 86 LNAs with resource index scores of 4, 5, and 6 account for 68% of the total LNA acreage, 81% of core forest area, and 69% of buffered surface hydrology. Because of their size and resource value the Committee chose these LNAs as *primary regional wildlife habitat and natural resource protection corridors*, and the LNAs with the resource index score of 7 which account for an additional 63 LNAs, 11% of LNA acreage, 10% of core forest area, and 11% of buffered surface hydrology, as *connecting regional wildlife habitat and natural resource protection corridors.*

To retain the importance of the locations of Critical Habitats and Natural Diversity Database Areas they are included as separate data layers on the regional model maps. The local and regional models include those LNAs that extend beyond the boundary of the Region to enable planning across regional and municipal boundaries.

This map should only be used for planning purposes.
Data Sources: CT DEEP, UConn CLEAR, RiverCOG
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Figure 9 – LNAs Primary and Connecting Corridors

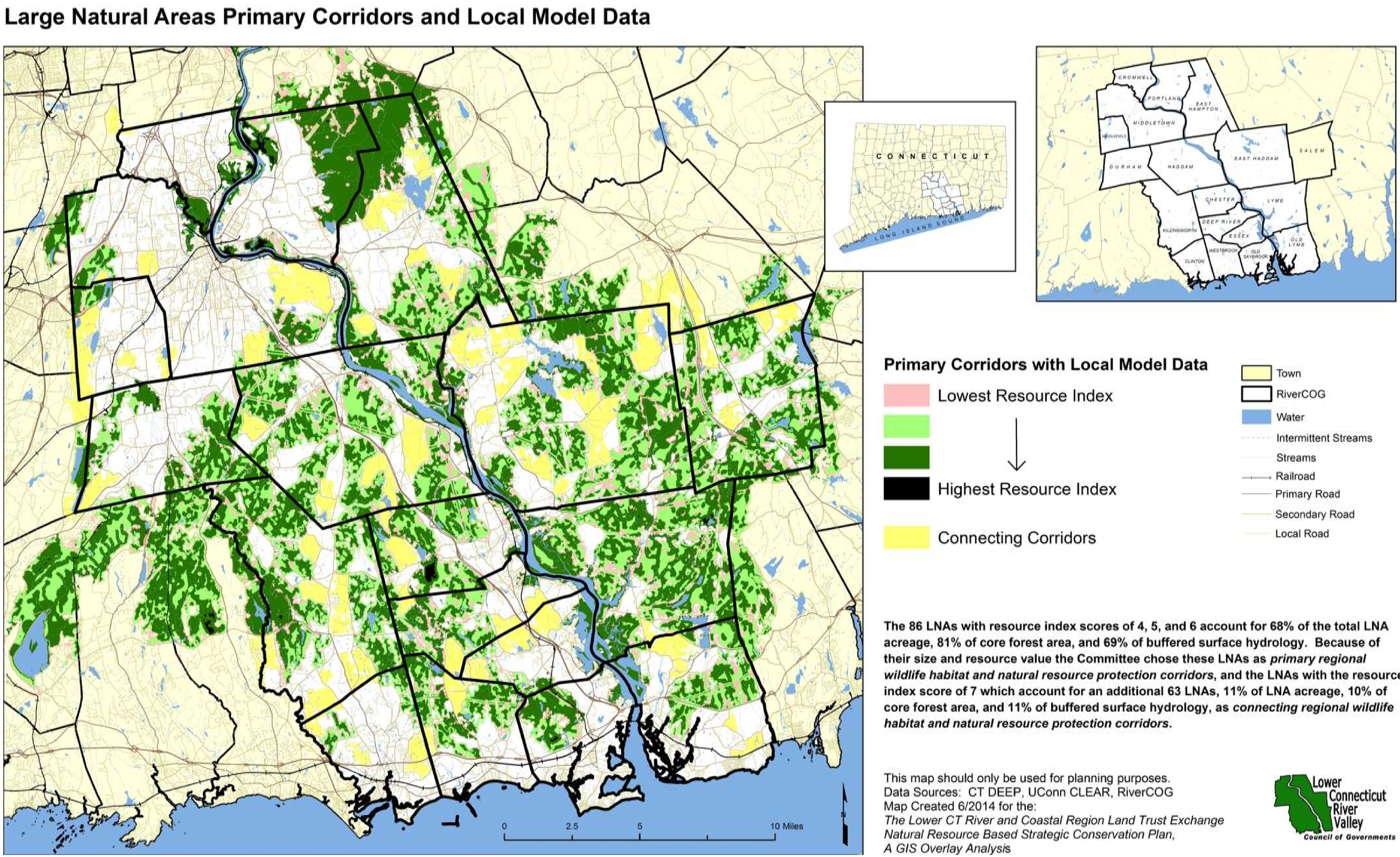


Figure 10 – Large Natural Areas Primary Corridors and Local Model Data

Large Natural Areas Primary and Connecting Corridors and Local Model Data

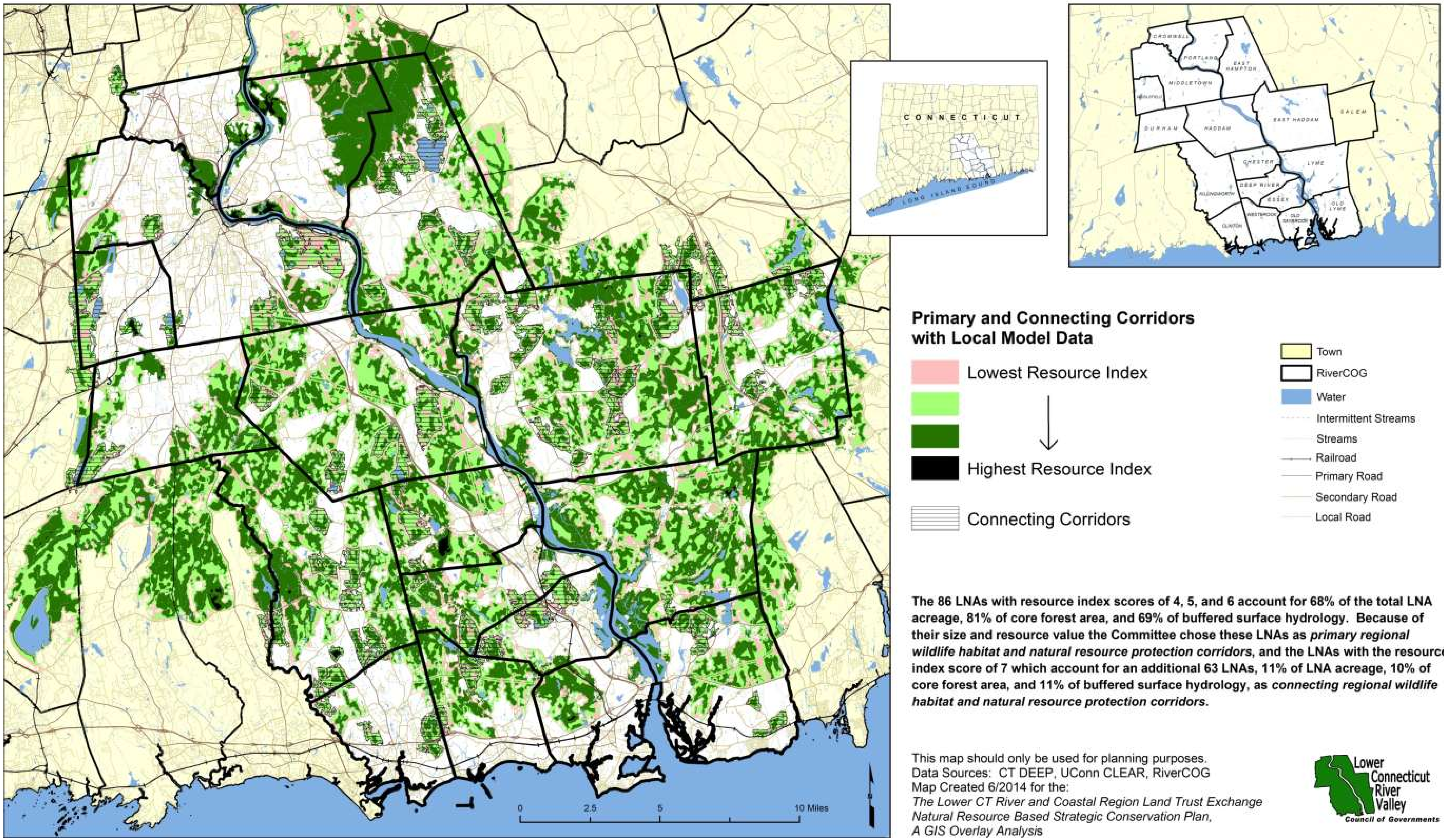


Figure 11 – Large Natural Areas Primary and Connecting Corridors and Local Model Data

Appendix I

Getting Started, Educational Material for 1st Workshop

The Lower CT River and Coastal Region Land Trust Exchange
Natural Resource Based Strategic Conservation Plan
A GIS Overlay Analysis

To Enable Effective Collaboration and Cooperation, in a Regional Manner, Towards the Creation of Landscape Scale Greenway Corridors to Protect Existing Wildlife Habitat, Water Quality, Working and Scenic Lands

Getting Started

Educational Material for 1st Workshop

Chester Land Trust
Clinton Land Conservation Trust
Connecticut River Land Trust
Deep River Land Trust
East Haddam Land Trust
Essex Land Trust
Haddam Land Trust
Lyme Land Conservation Trust
Lynde Point Land Trust
Middlesex Land Trust
Old Lyme Land Trust
Old Saybrook Land Trust
Salem Land Trust
Westbrook Land Conservation Trust
CT DEEP Forestry
CT DEEP Fisheries
Natural Resource Conservation Service
National Park Service
UConn Extension Forestry
US Fish and Wildlife Service

Lower Connecticut River Valley
Council of Governments

Technical Assistance Provided by:
National Park Service Rivers, Trails and Conservation Assistance Program (RTCA)

Table of Contents

Introduction

As in most of New England much of the work being done to preserve open space in the Region, and Connecticut, is through the efforts of small land trusts organized and incorporated at the town level. Experience has shown that those towns in Connecticut with the most open space under preservation have the strongest grassroots support, which is the result of a sustained community communication and education effort by the local land trust. Although working at the community level is critical to the sustainability of local organizations it is also important for the preservation of wildlife habitat and ecosystem maintenance, as well as outreach to a wider audience for funding and technical support, to work beyond local boundaries and include in local perceptions of conservation the importance of regional, large landscape, and even global connections and conservation goals and relate them back to the local level.

To this end the Lower CT River and Coastal Region Land Trust Exchange (LTE) has been meeting on a regular basis for the past 4 years and has now chosen to create a natural resource based strategic conservation plan for the lower CT River and Coastal Region to enable effective collaboration and cooperation, in a Regional manner, towards the creation of landscape scale greenway corridors to protect existing wildlife habitat, water quality, and working and scenic lands. The analysis will include the land area of the towns of Clinton, Chester, Cromwell, Deep River, Durham, East Haddam, East Hampton, Essex, Haddam, Killingworth, Lyme, Middlefield, Middletown, Old Lyme, Old Saybrook, Portland, Salem, and Westbrook.

The member land trusts of the LTE have charged themselves with protecting the natural assets of an invaluable environmental and recreational Region of global significance that surrounds the lower 36 miles of the CT River from the River's mouth at Long Island Sound to the northern borders of the municipalities of Cromwell and Portland and over 20 miles of Long Island Sound coast line from the western border of the Town of Clinton, to the eastern border of the Town of Old Lyme. It is home to many of the State's Parks and Forests and portions of 2 Refuges, the Menunketesuck/Duck Island complex and the Salt Meadow Unit of the Stewart B. McKinney National Wildlife Refuge and the southernmost 354 sq. miles of the CT River watershed based Silvio O. Conte National Fish and Wildlife Refuge. This area of the CT River watershed based Conte Refuge is now home to the Roger Tory Peterson Division, the Salmon River Division, and the Whalebone Cove Division; the Wild and Scenic Eightmile River; 5 Ct State designated greenways – the Menunketesuck – Cockaponset Regional Greenway, the Connecticut River Gateway Zone Greenway, the Eight Mile River Greenway, the Old Lyme Greenway, and parts of the Blue Blazed Trail System Greenway. The estuary of the lower River was designated as a Ramsar Estuary of Global Importance (1994), has been proclaimed by The Nature Conservancy to be one of the World's Last Great Places, and is listed as a Long Island Sound Stewardship Site (2005) by the Long Island Sound Stewardship Initiative. In 1998 the Connecticut was designated as an American Heritage River, one of 14 in the Country. Running through the region is part of the Metacomet, Monadnock, Mattabesett Trail System designated in 2009 as the New England National Scenic Trail that strives to extend over 200 miles from Massachusetts to Long Island Sound; the region also surrounds the Connecticut River Gateway Conservation Zone, a 30,000 acre area surrounding the lower 30 miles of the Connecticut River, from the nearest ridge top to nearest ridge top across the length of the lower River. Since 1974 the Connecticut River Gateway Commission has been charged with protecting the scenic and ecological properties of this unique landscape. Most recently the lower River Region was identified by the Nature Conservancy as a focal area in their report entitled *Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region* and the CT River Watershed was named the Nation's first National Blueway as part of the Dept. of the Interior's Americas Great Outdoors Initiative.

The LTE is an informal collaboration of 14 land trusts representing the 17 communities of its coordinating organization the Lower CT River Valley Council of Governments (LCRVCOG), formerly the CT River Estuary Regional Planning Agency and Mid State Regional Planning Agency, consecutive CT River centered regional planning organizations recently merged in large part to conserve and protect the unique character and environment of the communities of the lower CT River and Coastal Region, and the town of Salem. The creation of the LTE was an outcome of the National Fish and Wildlife Foundation, 2006 funded Lower CT River Ground-Truthing Project.

That project sought to engage citizens in eight towns of the Lower Connecticut River Watershed to develop maps and plans designed to protect open space across town boundaries through creation of greenways, and to engage citizens in the lower Connecticut River watershed in a collaborative effort to identify and act on opportunities to protect open space across town boundaries. The project built on an existing long lived conservation ethic in the lower River Region, and engaged individuals in a more encompassing regional vision of pride and protection of its extraordinary natural assets.

The mission of the LCRVCOG in regards to the LTE is to create a stronger connection between the local, regional conservation community, and the Regional, State, and Federal land use planning process; further their ability to provide an educational and planning opportunity for environmental and landscape protection for members of their region's land trusts and conservation commissions to promote landscape linkages, tool creation, data acquisition, and sharing to enable effective collaboration and cooperation, in a regional manner, towards the creation of trails and greenways, and protection of existing habitat, water quality, and scenic and cultural landscape corridors; and identify possible collaboration mechanisms and business structures that will not take away from an individual land trust's unique and important relationship and place in its own community, but enable them to practice best management and business principles. This will allow each to operate to its greatest potential concerning long term planning goals, future land acquisition, and the sustainable stewardship of their already existing protected open space.

Since its first meeting in Sept. 2009, the LTE has worked internally, locally, regionally, State, and New England wide to promote landscape scale conservation for both wild and working lands and for habitat and wildlife protection through working with private landowners, State land managers, educators, US Fish and Wildlife, the nonprofit community, and through the municipal, regional, and State land use planning process. It has been a tenet of the Regional Planning Organization since the inception of the LTE, with strong support and funding from Eastern CT Resource, Conservation, and Development (RC&D), that only through community outreach and the practice of strong business and planning principals by each of the member land trust will we be able to maintain and increase the pace of conservation and stewardship of our undeveloped and working lands to benefit both wildlife and people. This Natural Resource Based Regional Strategic Conservation Plan will provide a strong base for this work to be built upon.

Getting Started

To get us started I have included:

- A primer from the Environmental Systems Research Institute (ESRI) and ArcMap Software on understanding overlay analysis,
- An example of an overlay analysis for the Region using non natural resource based data, and
- Suggested data layers we should be looking at for the first workshop.

Links to information and metadata for each layer are provided. Please review these for the first workshop. A hardcopy of these and this document will be provided for you at the first meeting.

As you review the suggested data layers please send along any others you think should go on the list.

A Short Primer on Overlay Analysis from the Environmental Systems Research Institute (ESRI) and ArcMap Software

Understanding overlay analysis.
ArcGIS 10.1

Overlay analysis is a group of methodologies applied in optimal site selection or suitability modeling. It is a technique for applying a common scale of values to diverse and dissimilar inputs to create an integrated analysis.

Suitability models identify the best or most preferred locations for a specific phenomenon. Types of problems addressed by suitability analysis include:

- Where to site a new housing development
- Which sites are better for deer habitat
- Where economic growth is most likely to occur
- Where the locations are that are most susceptible to mud slides

Overlay analysis often requires the analysis of many different factors. For instance, choosing the site for a new housing development means assessing such things as land cost, proximity to existing services, slope, and flood frequency. This information exists in different rasters with different value scales: dollars, distances, degrees, and so on. You cannot add a raster of land cost (dollars) to a raster of distance to utilities (meters) and obtain a meaningful result.
Additionally, the factors in your analysis may not be equally important. It may be that the cost of land is more important in choosing a site than the distance to utility lines. How much more important is for you to decide.

Even within a single raster, you must prioritize values. Some values in a particular raster may be ideal for your purposes (for example, slopes of 0 to 5 degrees), while others may be good, others bad, and still others unacceptable.

The following lists the general steps to perform overlay analysis:

8. Define the problem.
9. Break the problem into submodels.
10. Determine significant layers.
11. Reclassify or transform the data within a layer.
12. Weight the input layers.
13. Add or combine the layers.
14. Analyze.

Steps 1–3 are common steps for nearly all spatial problem solving and are particularly important in overlay analysis.

1. Define the problem

Defining the problem is one of the most difficult aspects of the modeling process. The overall objective must be identified. All aspects of the remaining steps of the overlay modeling process must contribute to this overall objective.

The components relating to the objective must be defined. Some of the components may be complimentary, and others competitive. However, a clear definition of each component and how they interact must be established.

Not only is it important to identify what the problem is, a clear understanding needs to be developed to define when the problem is solved, or when the phenomenon is satisfied. In the problem definition, specific measures should be established to identify the success of the outcome from the model.
For example, when identifying the best location for a ski resort, the overall goal may be to make money. All factors that are identified in the model should help the ski area be profitable.

2. Break the problem into submodels

Most overlay problems are complex, and it is recommended that you break them down into submodels for clarity, to organize your thoughts, and to more effectively solve the overlay problem.

For example, a suitability model for identifying the best location for a ski resort can be broken into a series of submodels that all help the ski area be profitable. The first submodel can be a terrain submodel identifying locations that have a wide variety of favorable terrain for skiers and snowboarders.

Making sure people can reach the ski area can be captured in an accessibility submodel. Included in the submodel can be access from major cities as well as local road access.

A cost submodel can identify the locations that would be optimal to build on. This submodel may identify flatter slopes as well as those close to power and water as being favorable.

Certain attributes or layers can be in multiple submodels. For example, steep slopes might be favorable in the terrain submodel but detrimental for the cost for building submodel.

3. Determine significant layers

The attributes or layers that affect each submodel need to be identified. Each factor captures and describes a component of the phenomena the submodel is defining. Each factor contributes to the goals of the submodel, and each submodel contributes to the overall goal of the overlay model. All and only factors that contribute to defining the phenomenon should be included in the overlay model.

For certain factors, the layers may need to be created. For example, it may be more desirable to be closer to a major road. To identify the distance each cell is from a road, Euclidean Distance may be run to create the distance raster.

4. Reclassification/transformation

Different number systems cannot be directly combined effectively. For example, adding slope to land use would produce meaningless results. The four main numbering systems are:

- Ratio—The ratio scale has a reference point, usually zero, and the numbers within the scale are comparable. For example, elevation values are ratio numbers, and an elevation of 50 meters is half as high as 100 meters.

- Interval—The values in an interval scale are relative to one another; however, there is not a common reference point. For example, a pH scale is of type interval, where the higher the value is above the neutral value of 7, the more alkaline it is, and the lower the value is below 7, the more acidic it is. However, the values are not fully comparable. For example, a pH of 2 is not twice as acidic as a pH of 4.

- Ordinal—An ordinal scale establishes order such as who came in first, second, and third in a race. Order is established, but the assigned order values cannot be directly compared. For example, the person who came in first was not necessarily twice as fast as the person who came in second.

- Nominal—There is no relationship between the assigned values in the nominal scale. For example, land-use values, which are nominal values, cannot be compared to one another. A land use of 8 is probably not twice as much as a land use of 4.

Because of the potential different ranges of values and the different types of numbering systems each input layer may have, before the multiple factors can be combined for analysis, each must be reclassified or transformed to a common ratio scale.

Common scales can be predetermined, such as a 1 to 9 or a 1 to 10 scale, with the higher value being more favorable, or the scale can be on a 0 to 1 scale, defining the possibility of belonging to a specific set.

5. Weight

Certain factors may be more important to the overall goal than others. If this is the case, before the factors are combined, the factors can be weighted based on their importance. For example, in the building submodel for siting the ski resort, the slope criteria may be twice as important to the cost of construction as the distance from a road. Therefore, before combining the two layers, the slope criteria should be multiplied twice as much as distance to roads.

6. Add/Combine

In overlay analysis, it is desirable to establish the relationship of all the input factors together to identify the desirable locations that meet the goals of the model. For example, the input layers, once weighted appropriately, can be added together in an additive weighted overlay model. In this combination approach, it is assumed that the more favorable the factors, the more desirable the location will be. Thus, the higher the value on the resulting output raster, the more desirable the location will be.

Other combining approaches can be applied. For example, in a fuzzy logic overlay analysis, the combination approaches explore the possibility of membership of a location to multiple sets.

7. Analyze

The final step in the modeling process is for you to analyze the results. Do the potential ideal locations sensibly meet the criteria? It may be beneficial not only to explore the best locations identified by the model but to also investigate the second and third most favorable sites.

The identified locations should be visited. You need to validate what you think is there is actually there. Things could have changed since the data for the model was created. For example, views may be one of the input criteria to the model; the better the view, the more preferred the location will be. From the input elevation data, the model identified the locations with the best views; however, when one of the favorable sites is visited, it is discovered that a building has been constructed in front of the location, obstructing the view.

Taking the input from all of the steps above, a location is selected.

<u>An Overlay Model Example for the Region Using Non Natural Resource Based Data.</u>

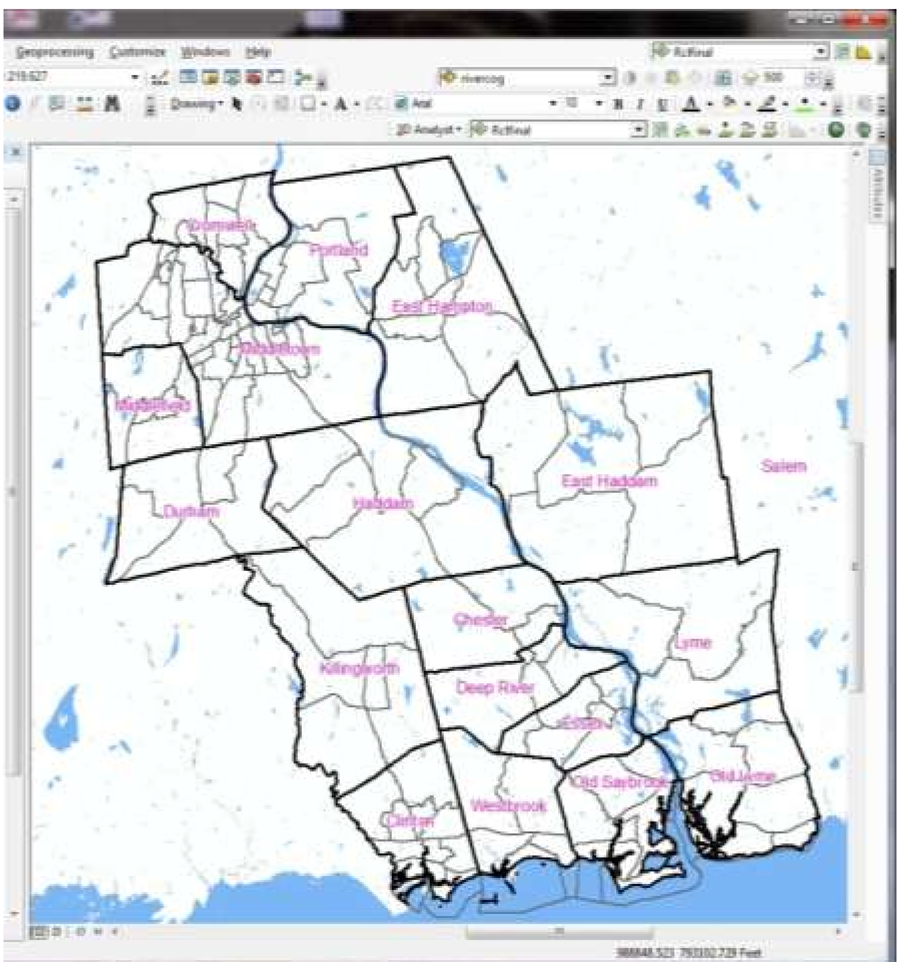
Define the Problem:

The Region's private forestland owners are ageing and ready to pass on or sell the land they currently own. This will lead to further fragmentation and development of the Region's forested landscape.

The goal of this overlay analysis is to determine using 2010 census data where in the Region land is most likely to be sold due to the ageing of CT's private forest land owners. This will enable the Region's land trusts to strategically outreach to landowners.

The geography used for this analysis is the 2010 Census Block Group.

2010 Census Block Group Level Geography

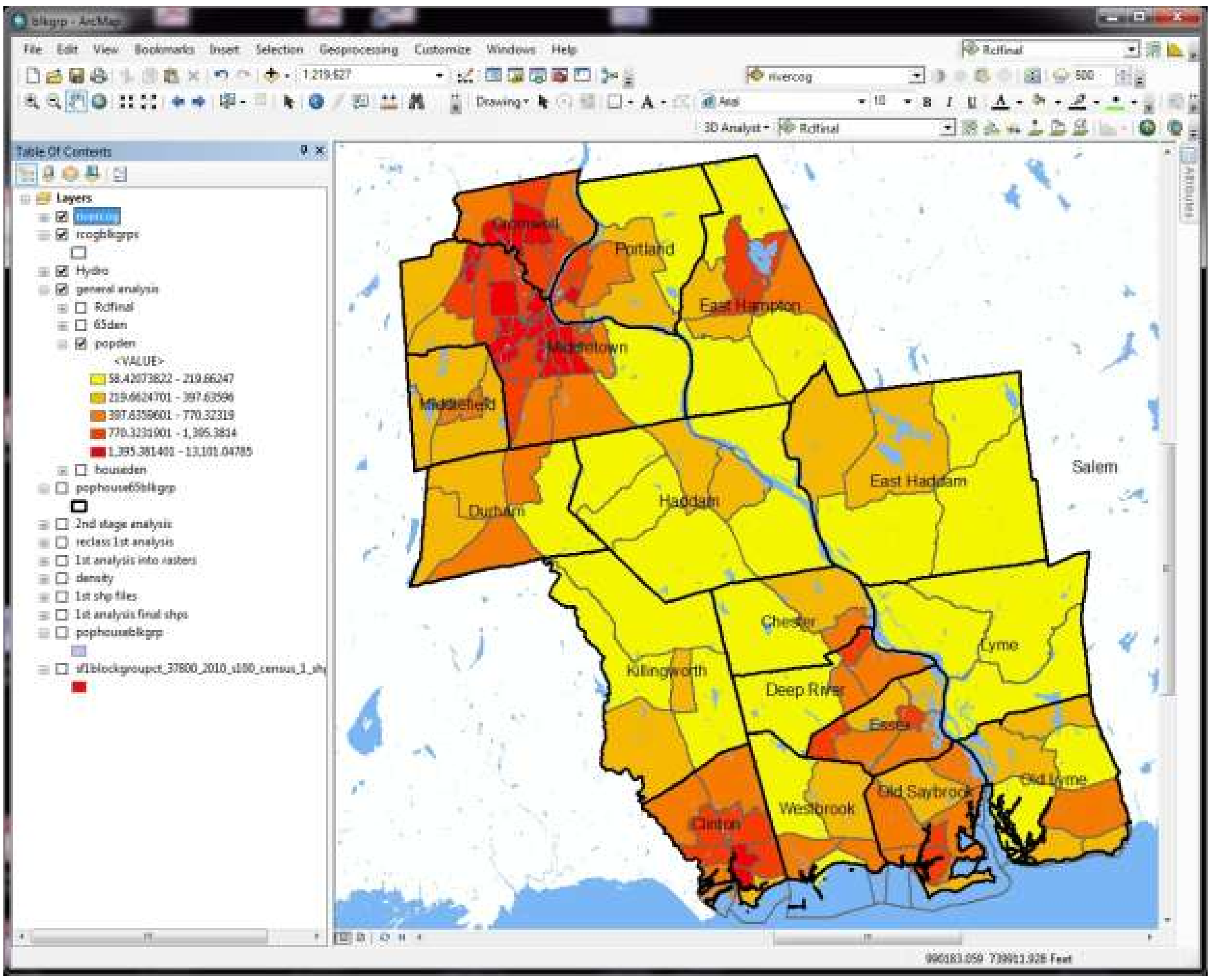


[Density of population, housing units, and head of household 65 and older data was determined by dividing each block group total by its sq. miles.]

Submodel 1 – Population Density Per Sq. Mile

2010 Census Total Population by block group – Table P1 Total Population by block group – used to determine population density and symbolized into 5 quintiles (in statistics, one of the values that divide a frequency distribution into five parts, each containing a fifth of the sample population). The 20% of block groups with the lowest population density are symbolized in yellow up to the 20% of block groups with the greatest population density in red. Be careful when looking at coastal block groups in some areas as their areas include parts of Long Island Sound and are seasonal in nature.

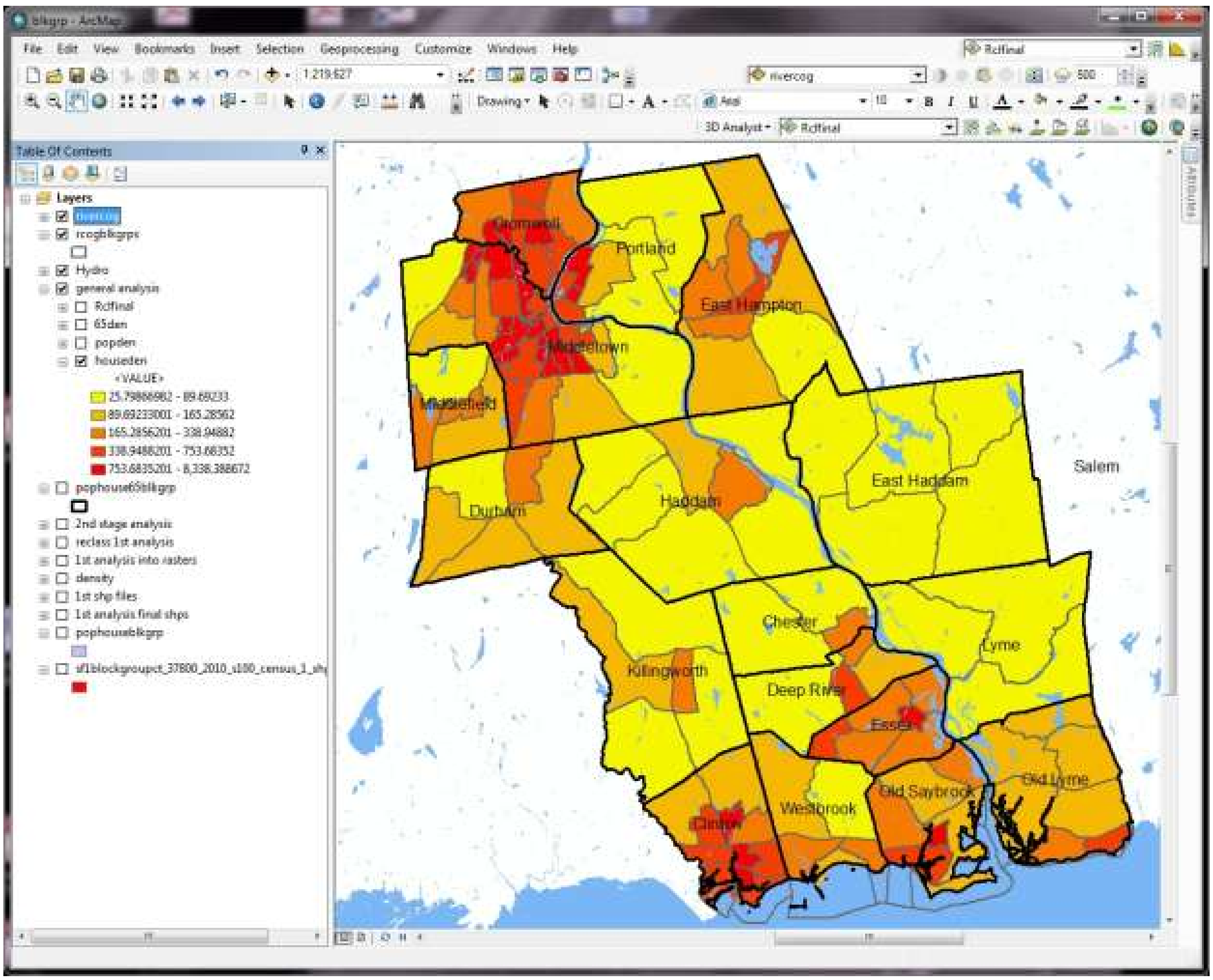
Population Density Per Sq. Mile



Submodel 2 – Housing Unit Density Per Sq. Mile

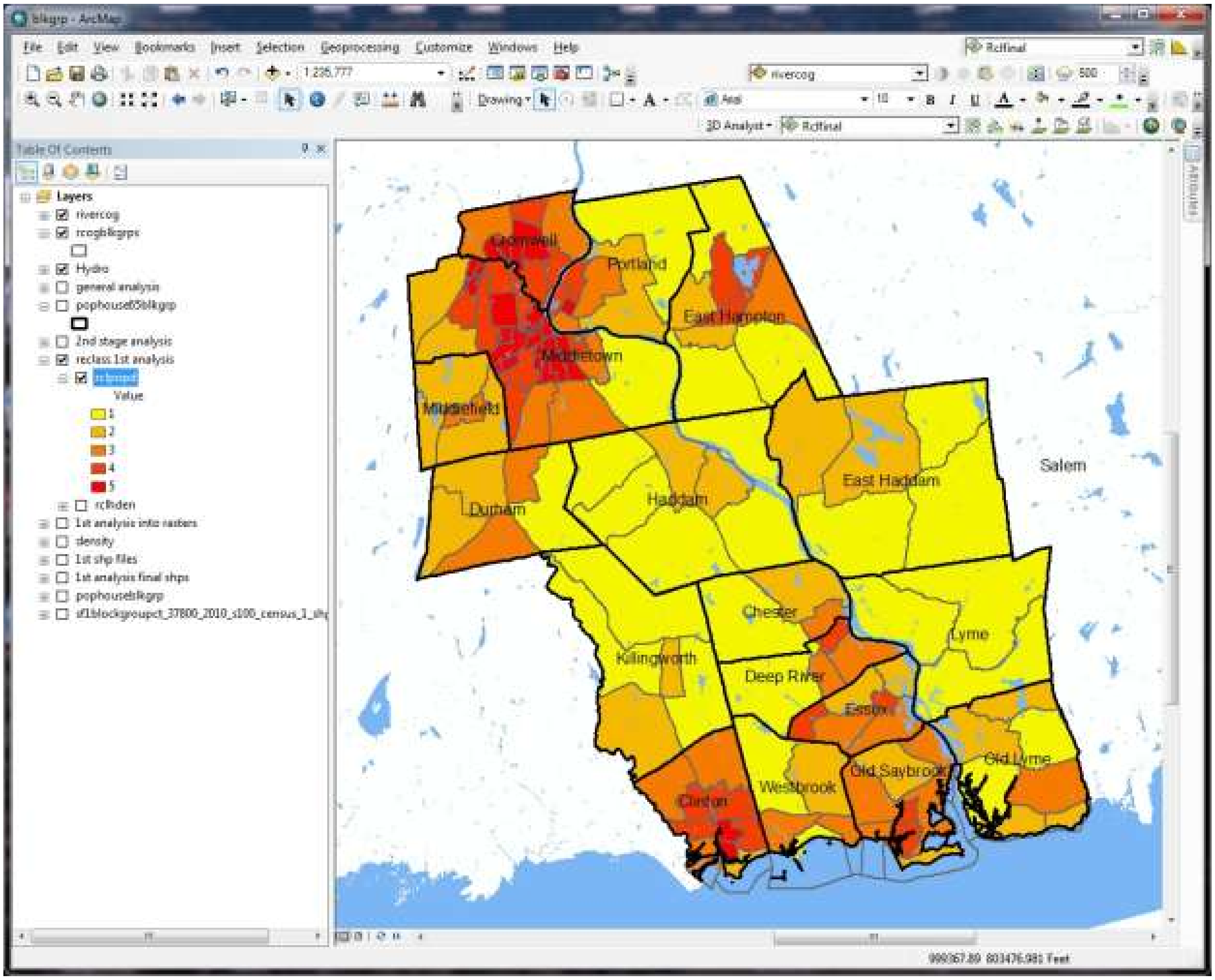
2010 Census Total Housing Units by block group – Table H1 Housing Units – used to determine housing unit density and symbolized into 5 quintiles (in statistics, one of the values that divide a frequency distribution into five parts, each containing a fifth of the sample population). The 20% of block groups with the lowest housing unit density are symbolized in yellow up to the 20% of block groups with the greatest housing unit density in red. Be careful when looking at coastal block groups in some areas as their areas include parts of Long Island Sound.

Housing Unit Density Per Sq. Mile

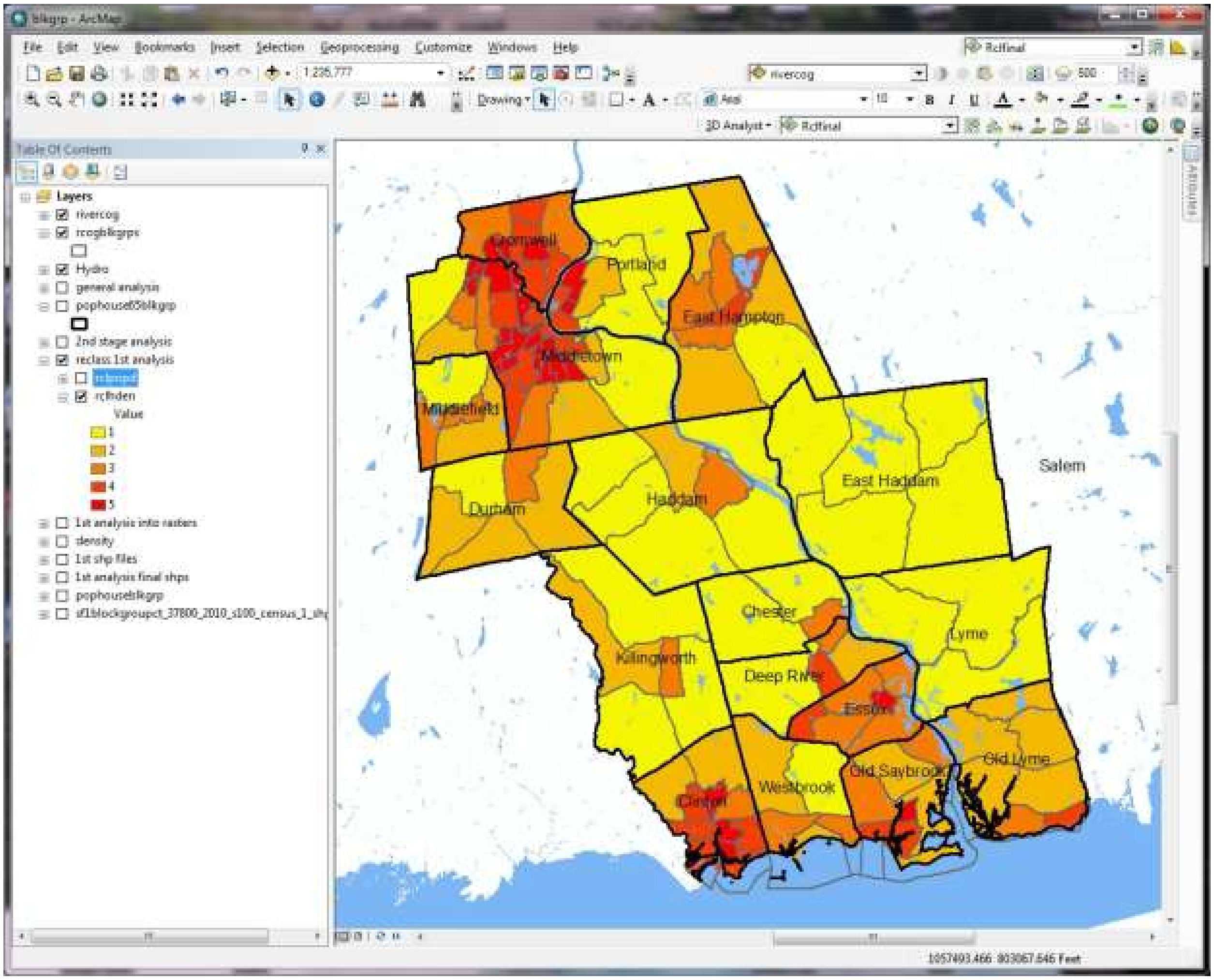


Both of these data layers were reclassified 1 to 5 so that the lowest quintile, or lowest 20% of block groups, equaled 1 up to the highest quintile, or highest 20%, valued at 5.

Population Density Reclassified 1 – 5



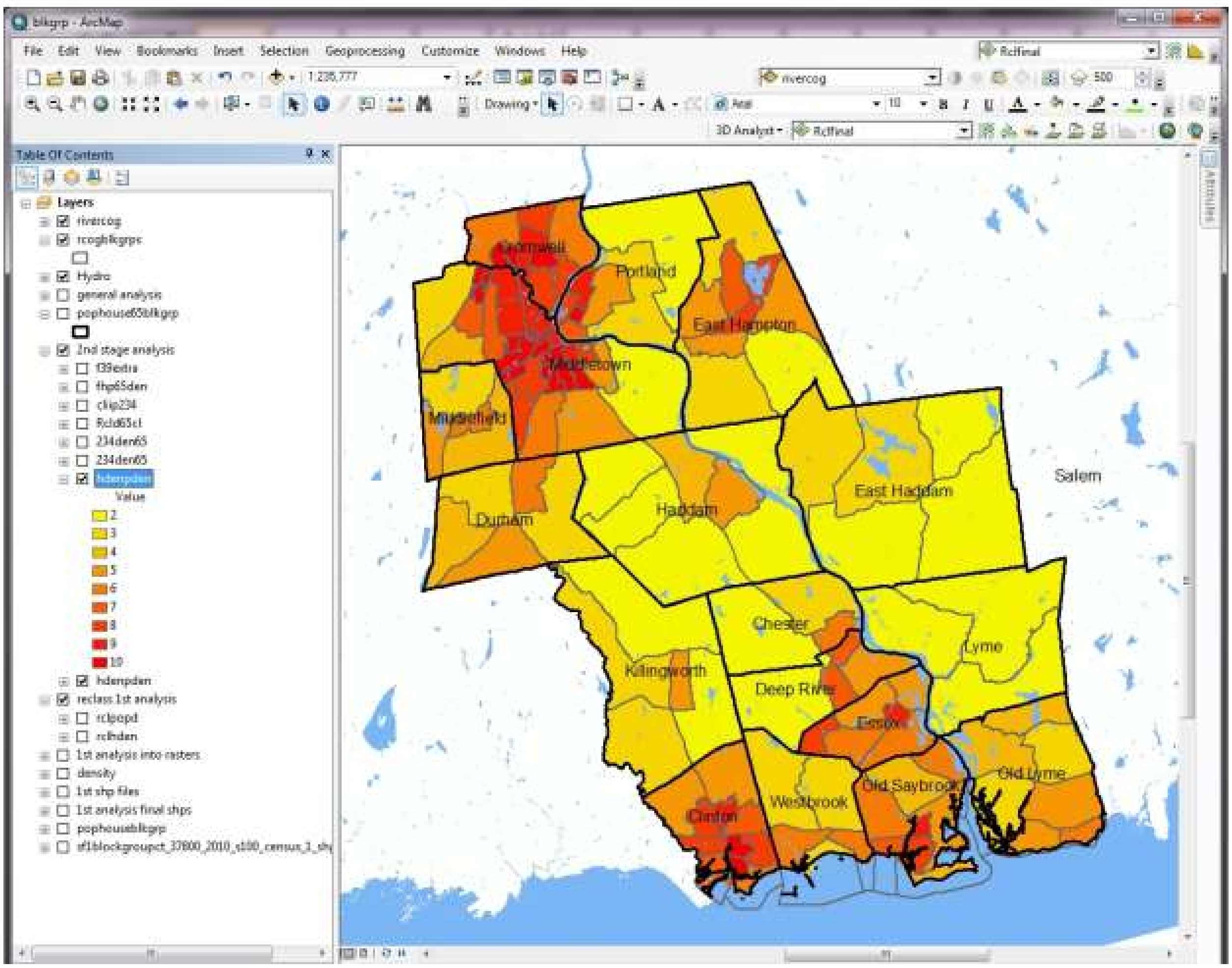
Housing Unit Density Reclassified 1 - 5



Submodel 3 – Combined Population Density and Housing Unit Density – Lowest 40% of Block Groups

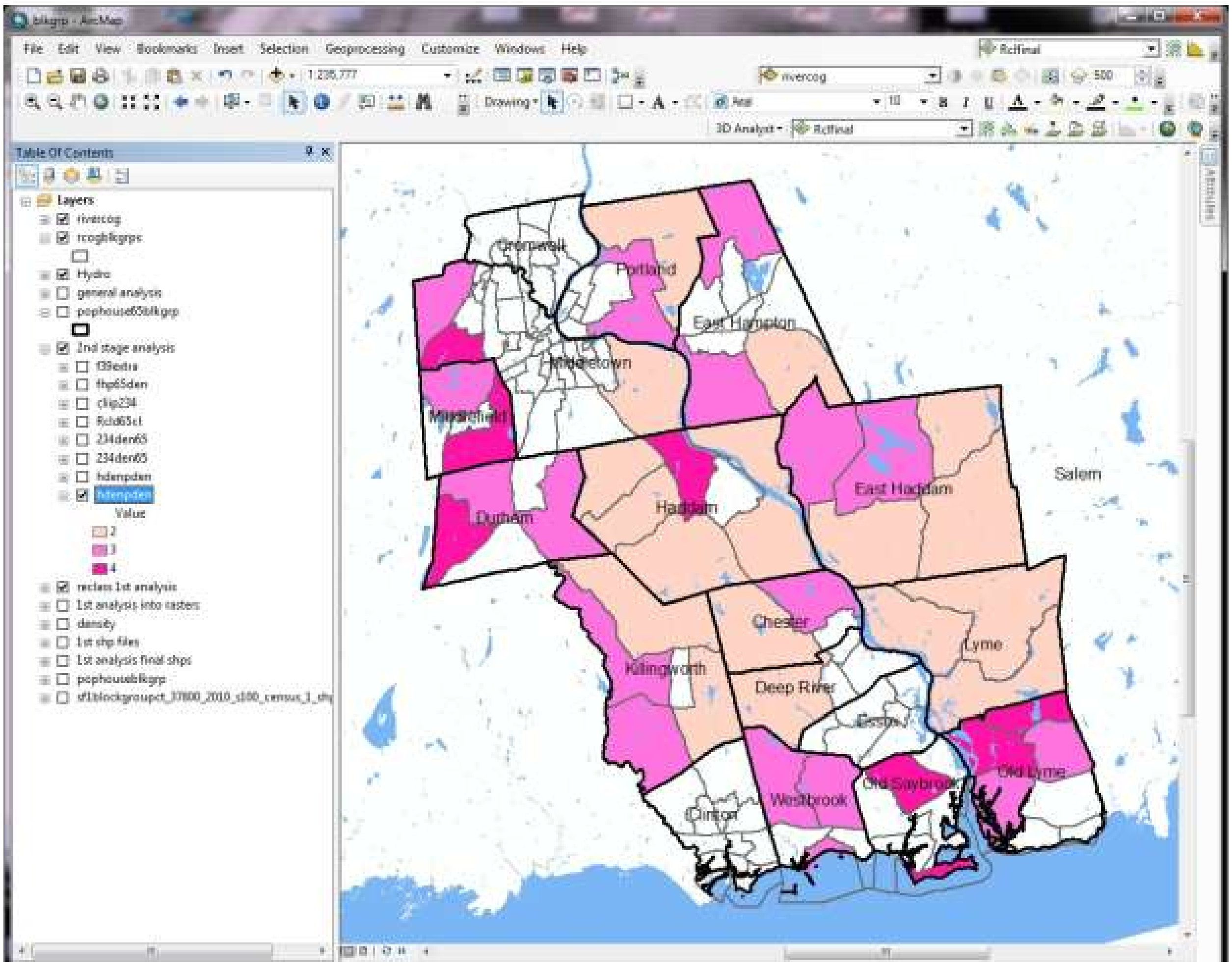
These 2 reclassified data layers were then added together using the ArcMAP raster calculator tool, they were both of equal value and weighted equally. Each block group value from 1 – 5 for population density was added to its corresponding 1 – 5 value for that block group in the housing density data layer. Values for the new data layer could range from 2 – 10. Because we are looking for the block groups with the most land available to conserve we are trying to identify the block groups with the lowest population density and the lowest housing unit density combined. The lower the added together data values the lower the combined population density and housing unit density.

Combined Population Density and Housing Unit Density



Because I was looking for the least densely populated and least densely built block groups for this analysis I chose to work with the lowest 40% of the block groups. This group is valued at 1 or 2 for both the population density data layer and the housing unit density data layer. The lowest combined value that could be calculated is 2 and the highest combined value for these two percentage groups is 4.

Lowest 40% of Block Groups of Combined Population Density and Housing Unit Density Layer



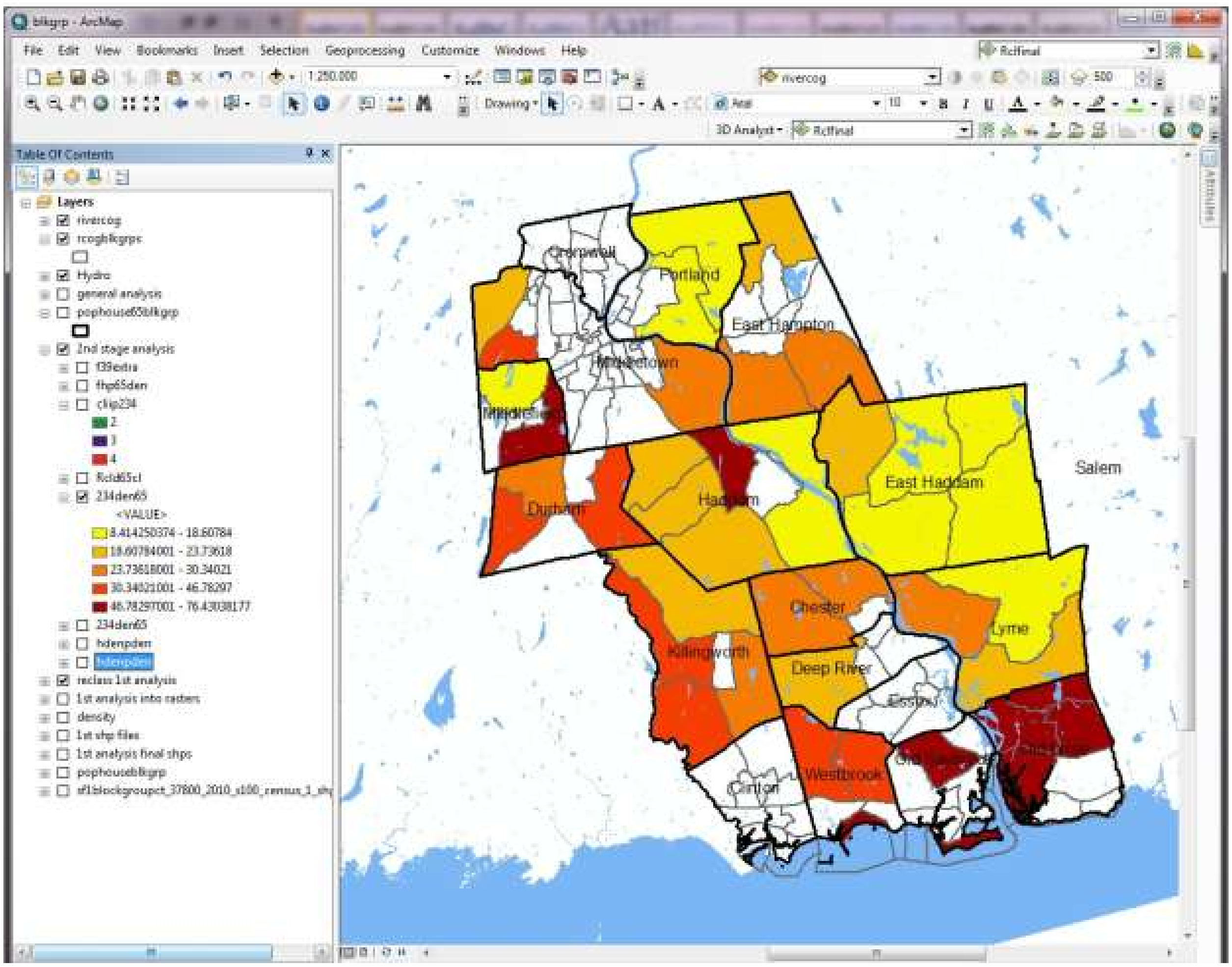
The lowest 20% of block groups for combined population density and housing unit density are shown in lightest pink. This is where (at least using these data sets) there should be the most amount of open land.

The second part of the analysis, now that we know where our block groups are that are the least densely developed and probably contain the most open land is to determine which of them have the most property owners that have reached retirement age and are likely to be getting ready to sell or pass along their land to someone else. For the head of household over 65 data we only need to use that part of the data set that corresponds to the previous data set of the combined population density and housing unit density lowest 40% with values that equal 2 – 4.

Submodel 4 – Head of Household 65 Years or Older Density Per Sq. Mile

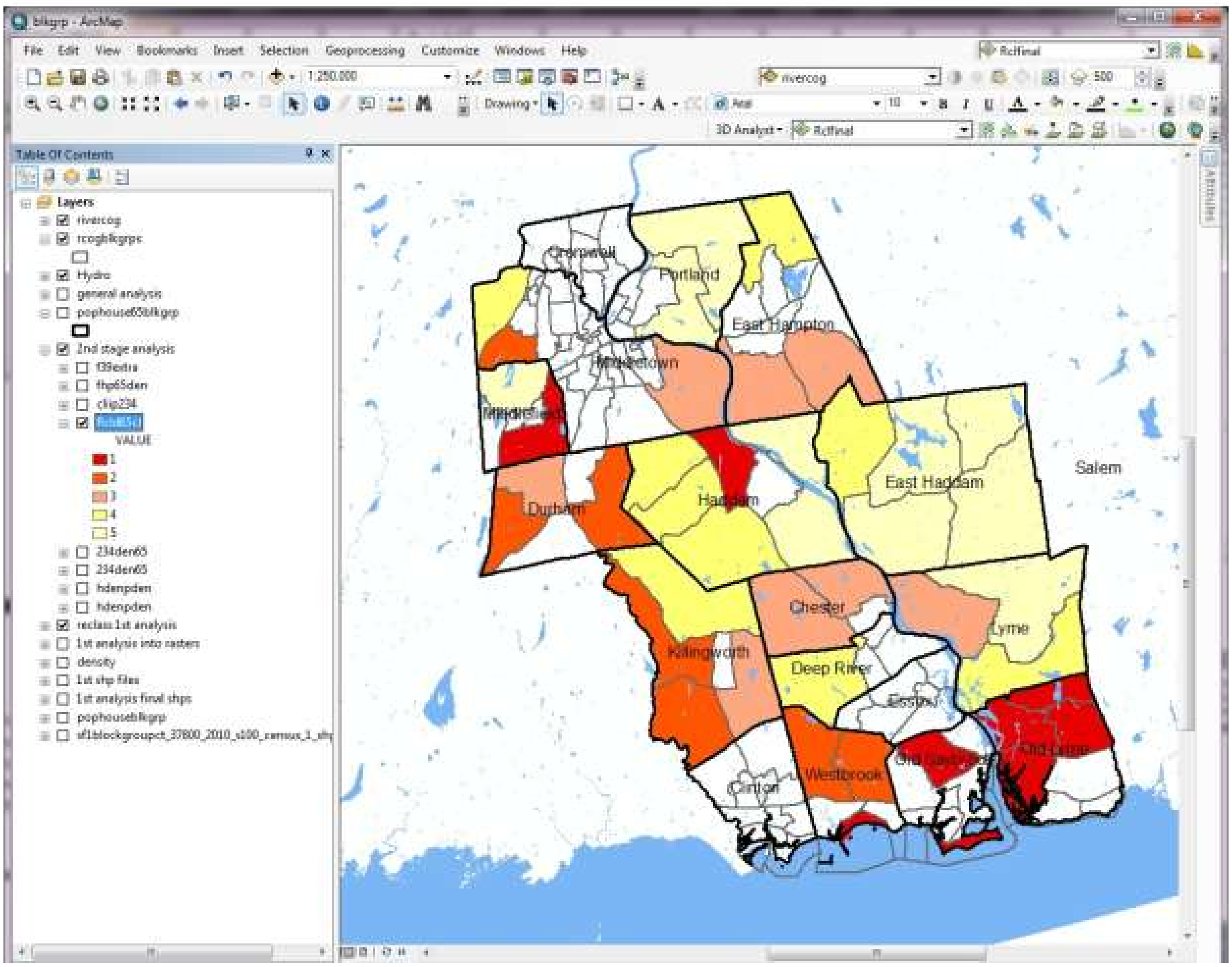
2010 Census data *table P34 Household Type by Relationship for the Population 65 years* was calculated by total for each block group (that corresponds to submodel 3 results) and divided by the sq. miles of each block group to obtain the density of head of households 65 and over for each and symbolized as the previous data layers into 5 quintiles

Head of Household 65 Years or Older Density Per Sq. Mile



This data layer was then reclassified, like the previous data layers, from 1 – 5. However, the relationship was inversed so that 1 represented the 20% of block groups with the greatest density of head of households, and 5 represented the lowest density 20% of block groups because we are looking for the least densely developed block groups with the greatest number of head of households over the age of 65.

Reclassified Head of Household 65 Years or Older Density Per Sq. Mile

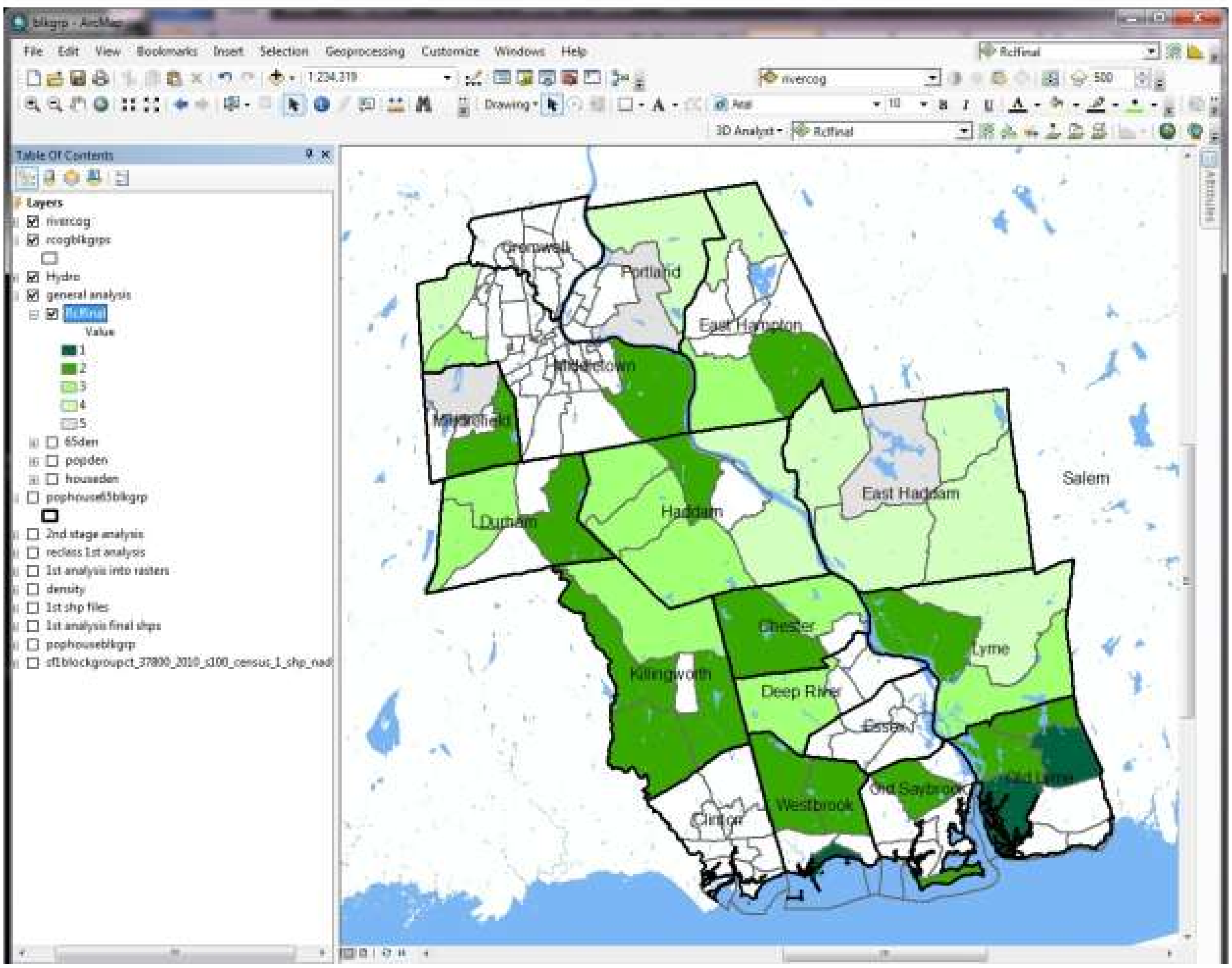


Final Overlay Model - Block Groups with the Lowest Population and Housing Unit Density and Highest Density of Head of Households Age 65 or More.

This data set was then added to the previously calculated *Lowest 40% of Block Groups of Combined Population Density and Housing Unit Density Layer* using the raster calculator tool, they were equally weighted layers. When these two data sets were added together values ranged from 4 – 8. The lowest values representing the block groups with the lowest population and housing density that have the greatest density of heads of households over the age of 65, and the higher values representing higher population and housing density with lesser amounts of heads of households over the age of 65.

This data layer was then reclassified so that the values 4 – 8 were represented by the values 1 – 5 just for representative purposes.

Block Groups with the Lowest Population and Housing Unit Density and Highest Density of Head of Households Age 65 or More.



Analyze

Although all of the block groups depicted on the last map are probably areas where proactive conservation of open space should take place, if an important part of your organization's land protection plan is outreach to land owners that are ready to sell or turn over their land due to age, this model could help direct your efforts. If your land trust had to prioritize where resources would be focused for this purpose you would look to begin your outreach in the darker green block groups first.

Data for LTE Natural Resource Based Strategic Conservation Plan Overlay Analysis

Currently there is no large landscape scale agreed upon prioritized strategic conservation plan for the lower CT River and Coastal Region that allows for separate municipal based conservation organizations to work across municipal boundaries towards common Regional conservation goals.

The Goal of this overlay analysis is to create a large landscape scale natural resource based map of Regional prioritized conservation areas to enable effective collaboration and cooperation, in a Regional manner, towards the creation of landscape scale greenway corridors to protect existing wildlife habitat, water quality, and working and scenic lands.

Layer requirements for LTE Strategic Conservation Plan:

- The layer must be **a raster layer or a layer that can be turned into a raster by buffering or other operation to turn line or point data into polygons** that can then be rasterized. Raster datasets represent geographic features by dividing the world into discrete square or rectangular cells laid out in a grid. Each cell has a value that is used to represent some characteristic of that location.

  Raster datasets are commonly used for representing and managing imagery, digital elevation models, and numerous other phenomena. Often rasters are used as a way to represent point, line, and polygon features. In the example below, you can see how a series of polygons would be represented as a raster dataset.

  Rasters are interesting for at least two reasons: one, they can be used to represent all geographic information (features, images, and surfaces) and two, they have a rich set of analytic geoprocessing operators. Therefore, in addition to being a universal data type for holding imagery in GIS, rasters are also heavily used to represent features enabling all geographic objects to be used in raster-based modeling and analysis.

- The layer **must possess Federal Geographic Data Committee (FGDC) compliant metadata** (data about the data, http://www.fgdc.gov/metadata). All the data provided by the CT DEEP GIS website and UConn's CLEAR CT Eco site, as well as any publically accessible Federal data are FGDC compliant.

- The layer **must cover the whole Region**

  Lyme, Old Lyme, East Haddam, Salem, Haddam, Portland, East Hampton, Middletown, Middlefield, Durham, Killingworth, Chester, Deep River, Essex, Old Saybrook, Westbrook, Clinton, and Cromwell. (Note: Salem is not part of the RiverCog Region but is a bordering town, part of the eight mile wild and scenic watershed, and an integral part of the LTE)

Data Sets for Us to Consider

Following is a suggested list of data layers to begin looking at. Links to data guides and metadata for each layer is included. Please send along information regarding any data layers you think should be added.

Land Cover 2010 Center for Land Use Education and Research (CLEAR)
http://clear.uconn.edu/projects/landscapeLIS/landcover.htm

Forest Fragmentation Data
http://clear.uconn.edu/projects/landscape/forestfrag/index.htm

Riparian Buffer Analysis
http://clear.uconn.edu/projects/landscapeLIS/riparian.htm

Natural Diversity Database Areas
http://cteco.uconn.edu/guides/Natural_Diversity_Database.htm
http://www.cteco.uconn.edu/metadata/dep/document/NATURAL_DIVERSITY_DATABASE_FGDC_Plus.htm

Critical Habitats
http://cteco.uconn.edu/guides/Critical_Habitat.htm
http://www.cteco.uconn.edu/metadata/dep/document/NATURAL_DIVERSITY_DATABASE_FGDC_Plus.htm

Soil Survey Geographic (SSURGO) database for the State of Connecticut - Map Unit Boundary Polygons
http://cteco.uconn.edu/guides/Soils.htm
http://www.cteco.uconn.edu/metadata/dep/document/SOILS_POLY_FGDC_Plus.htm

Farmland soils
http://cteco.uconn.edu/guides/Soils_Farmland.htm
http://www.cteco.uconn.edu/metadata/dep/document/SOILS_FARMLAND_POLY_FGDC_Plus.htm

Inland Wetland Soils
http://cteco.uconn.edu/guides/Soils_Inland_Wetland.htm
http://www.cteco.uconn.edu/metadata/dep/document/SOILS_POLY_DATA_FGDC_Plus.htm

Ct Terrain Dataset – Version 2 CT DEEP, elevation and aspect
http://cteco.uconn.edu/guides/user/terrain%20dataset%20user%20guide.pdf
http://www.cteco.uconn.edu/metadata/dep/document/CT_terrain_v2_fgdc_plus.htm

Hydrography lines and water bodies

http://www.cteco.uconn.edu/metadata/dep/document/HYDROGRAPHY_POLY_FGDC_Plus.htm

Ground water quality classification polygon
http://cteco.uconn.edu/guides/Water_Quality_Class.htm
http://www.cteco.uconn.edu/guides/aquifer_protection_area.htm

Surface water quality classification polygon
http://cteco.uconn.edu/metadata/dep/document/waterqualityclass_surface_poly_fgdc_plus.htm
http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325620&depNav_GID=1654

Aquifer Protection Areas
http://www.cteco.uconn.edu/metadata/dep/document/AQUIFER_PROTECTION_AREA_FGDC_Plus.htm
http://www.cteco.uconn.edu/guides/aquifer_protection_area.htm

CT DEEP Fisheries Management Area Polygon Features
http://www.cteco.uconn.edu/metadata/dep/document/fisheries_management_area_poly_fgdc_plus.htm

The National Hydrography Dataset
http://pubs.usgs.gov/fs/2009/3054/

Regional Parcel Data
http://www.rivercog.org/Documents/RPIPMunicipalStaffInfo102313.pdf

Appendix II

Workshop 2 – Layer Information and Possible Operations for Modeling

Workshop 2 – Layer Information and Possible Operations for Modeling

Lower Connecticut River Valley Council of Governments

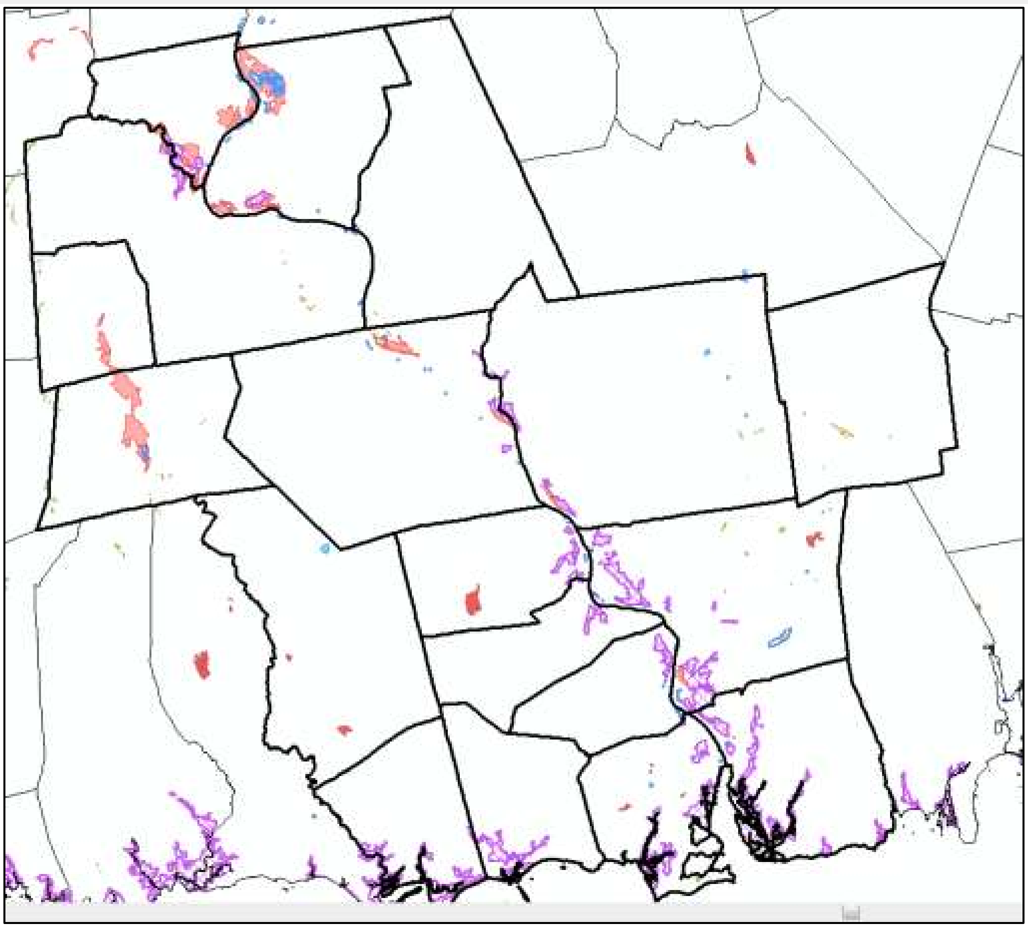
Technical Assistance Provided by:
National Park Service Rivers, Trails and Conservation Assistance Program (RTCA)

Workshop 2 – Layer Information and Possible Operations for Modeling

Critical Habitat

Simple In or Out
Buffer
Weight (percent of State Total)

COMMTYPE	COGacres	COMMTYPE_1	Stateacre	percent
Subacidic Cold Talus Forest/Woodland	7.102	Subacidic Cold Talus Forest/Woodland	9.589	74.06
Freshwater Aquatic	74.83	Freshwater Aquatic	124.15	60.27
Intertidal Marsh	5191.002	Intertidal Marsh	11622.33	44.66
Medium Fen	53.939	Medium Fen	160.145	33.68
Floodplain Forest	2630.749	Floodplain Forest	15201.658	17.31
Alluvial Grassland/Outcrop	35.807	Alluvial Grassland/Outcrop	224.881	15.92
Dry Subacidic Forest	46.572	Dry Subacidic Forest	433.296	10.75
Beachshore	70.499	Beachshore	683.798	10.31
Sand Barren	37.561	Sand Barren	367.163	10.23
Coastal Woodland/Shrubland	15.098	Coastal Woodland/Shrubland	160.866	9.39
Acidic Atlantic White Cedar Swamp	268.86	Acidic Atlantic White Cedar Swamp	4076.072	6.6
Coastal Bluffs and Headlands	0.947	Coastal Bluffs and Headlands	14.838	6.38
Coastal Grassland	2.664	Coastal Grassland	56.807	4.69
Subacidic Rocky Summit Outcrop	4.482	Subacidic Rocky Summit Outcrop	132.821	3.37
Acidic Rocky Summit Outcrop	19.852	Acidic Rocky Summit Outcrop	696.007	2.85
Poor Fen	15.02	Poor Fen	839.223	1.79



ESTUARINE
- Estuarine, Beachshore, B
- Estuarine, Intertidal Marsh, IM

PALUSTRINE FORESTED
- Palustrine Forested, Acidic Atlantic White Cedar Swamp, AAWCS
- Palustrine Forested, Acidic Red/Black Spruce Basin Swamp, AcR/BSS
- Palustrine Forested, Circumneutral Northern White Cedar Swamp, CirNWCS
- Palustrine Forested, Floodplain Forest, FF

PALUSTRINE NON-FORESTED
- Palustrine Non-forested, Beachshore, B
- Palustrine Non-forested, Circumneutral Spring Fen, CirSF
- Palustrine Non-forested, Floodplain Forest, FF
- Palustrine Non-forested, Freshwater Aquatic, FA
- Palustrine Non-forested, Medium Fen, MF
- Palustrine Non-forested, Poor Fen, PF
- Palustrine Non-forested, Rich Fen, RF
- Palustrine Non-forested, Sea Level Fen, SLF

TERRESTRIAL FORESTED
- Terrestrial Forested, Coastal Woodland/Shrubland, CWS
- Terrestrial Forested, Dry Acidic Forest, DAF
- Terrestrial Forested, Dry Circumneutral Forest, DCF
- Terrestrial Forested, Dry Subacidic Forest, DSF
- Terrestrial Forested, Old Growth Forest, OGF
- Terrestrial Forested, Subacidic Cold Talus Forest/Woodland, SubCTFW

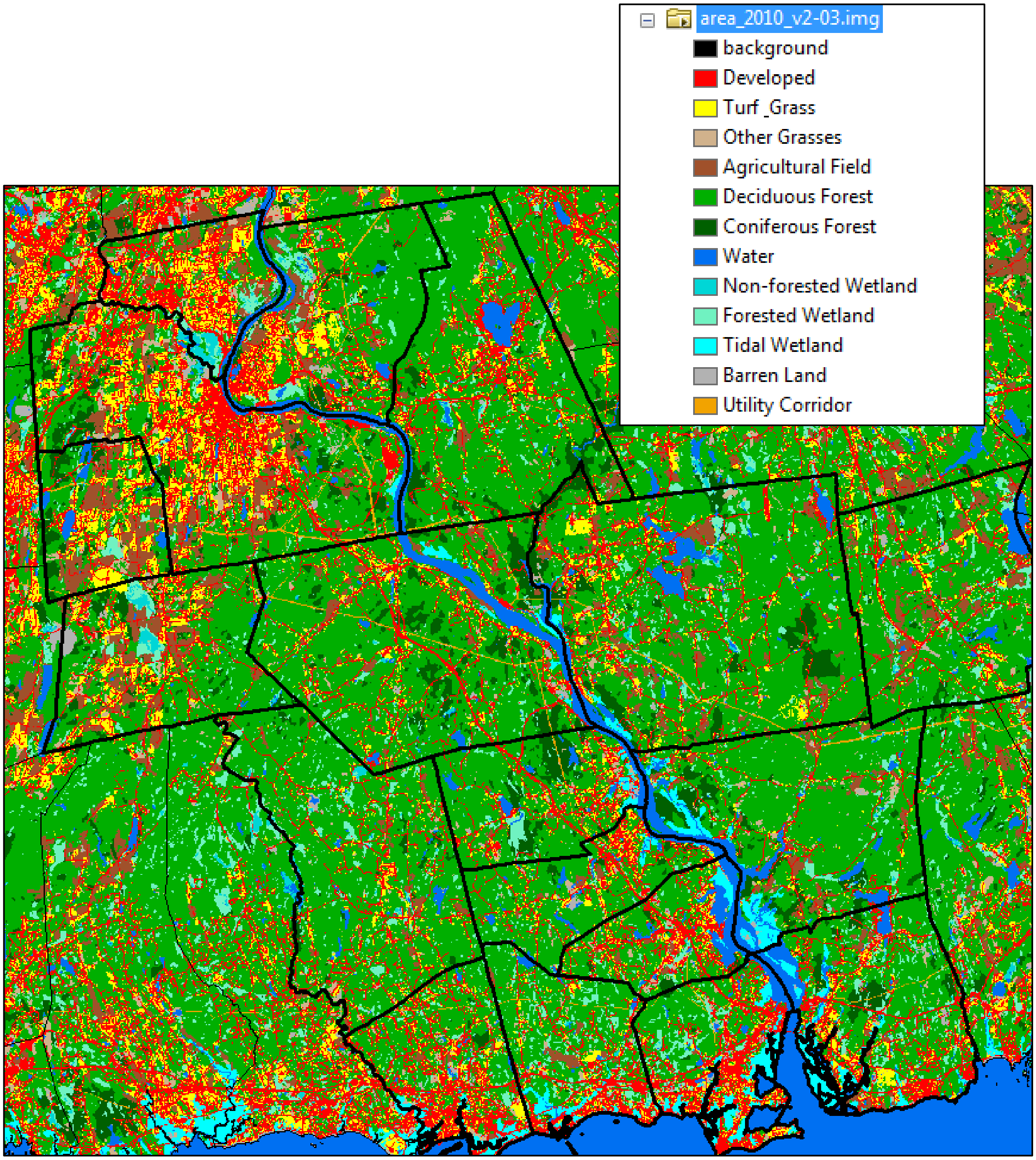
TERRESTRIAL NON-FORESTED
- Terrestrial Non-forested, Acidic Rocky Summit Outcrop, AcRSO
- Terrestrial Non-forested, Alluvial Grassland/Outcrop, AllG/O
- Terrestrial Non-forested, Circumneutral Rocky Summit Outcrop, CirRSO
- Terrestrial Non-forested, Coastal Bluffs and Headlands, CBH
- Terrestrial Non-forested, Coastal Grassland, CG
- Terrestrial Non-forested, Sand Barren, SB
- Terrestrial Non-forested, Subacidic Rocky Summit Outcrop, SubRSO

Land Cover

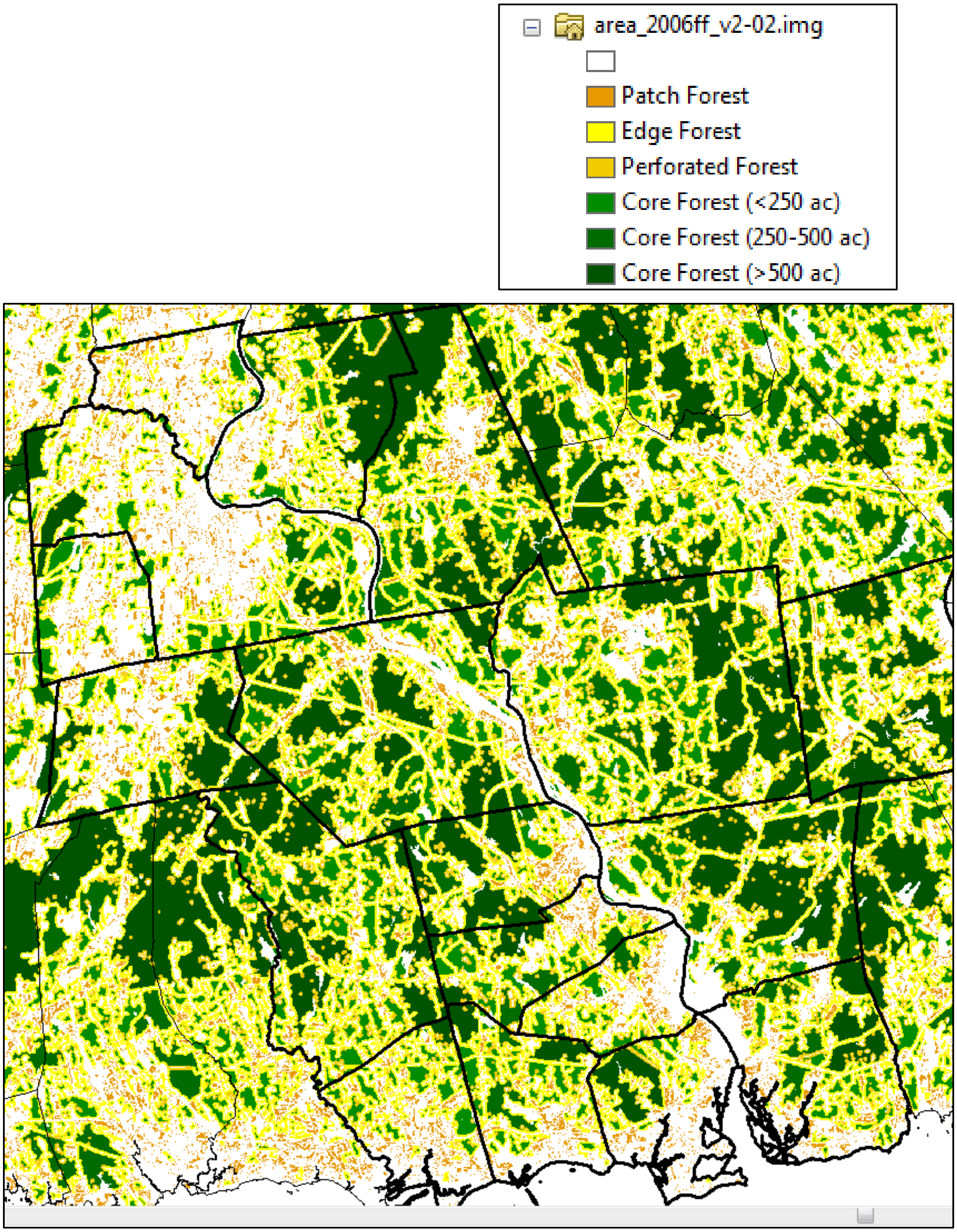
Simple In or Out

Buffer

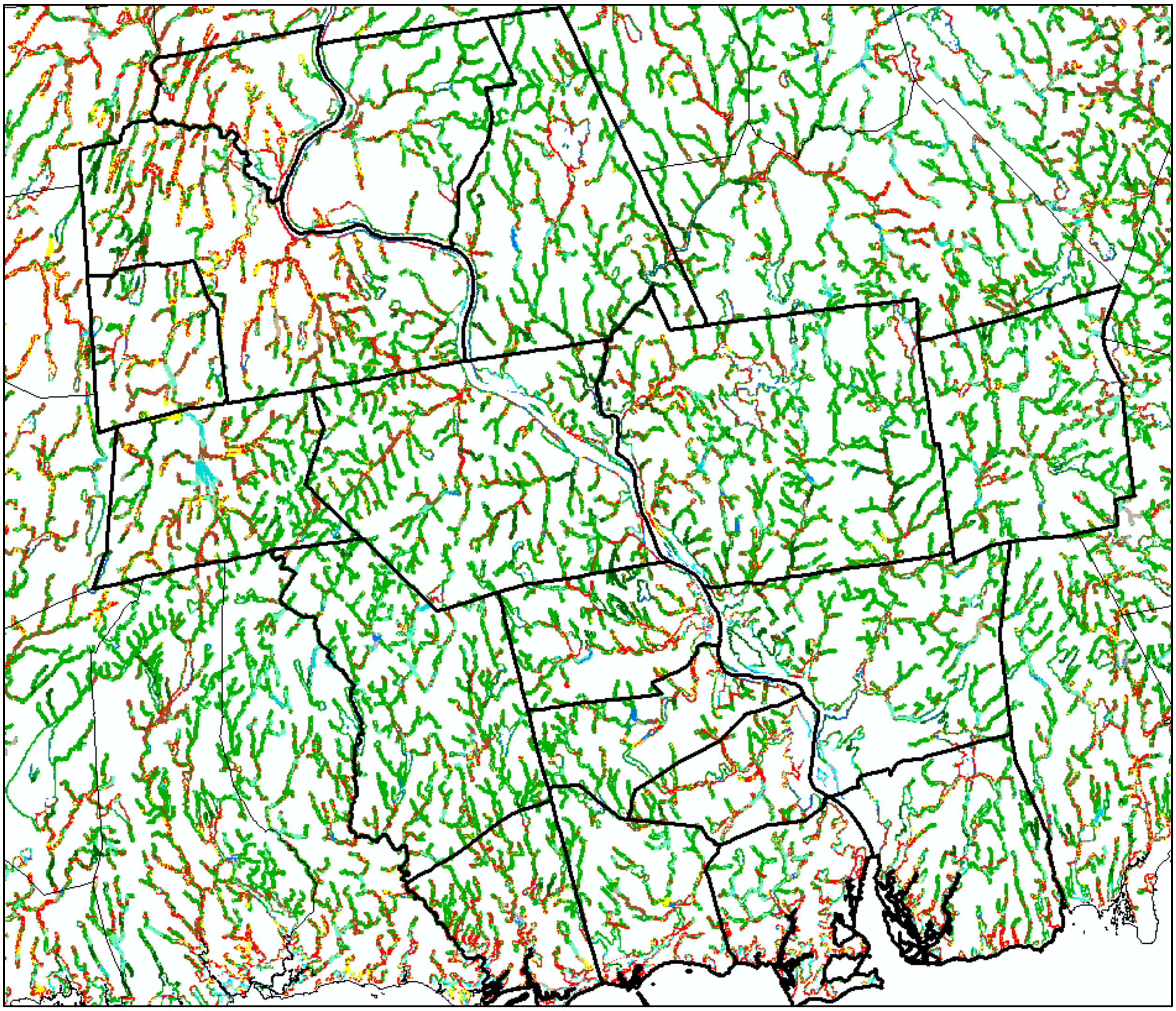
Do we edit data sets where roads cut through State Forest areas



Core forest areas as its own layer
In Out

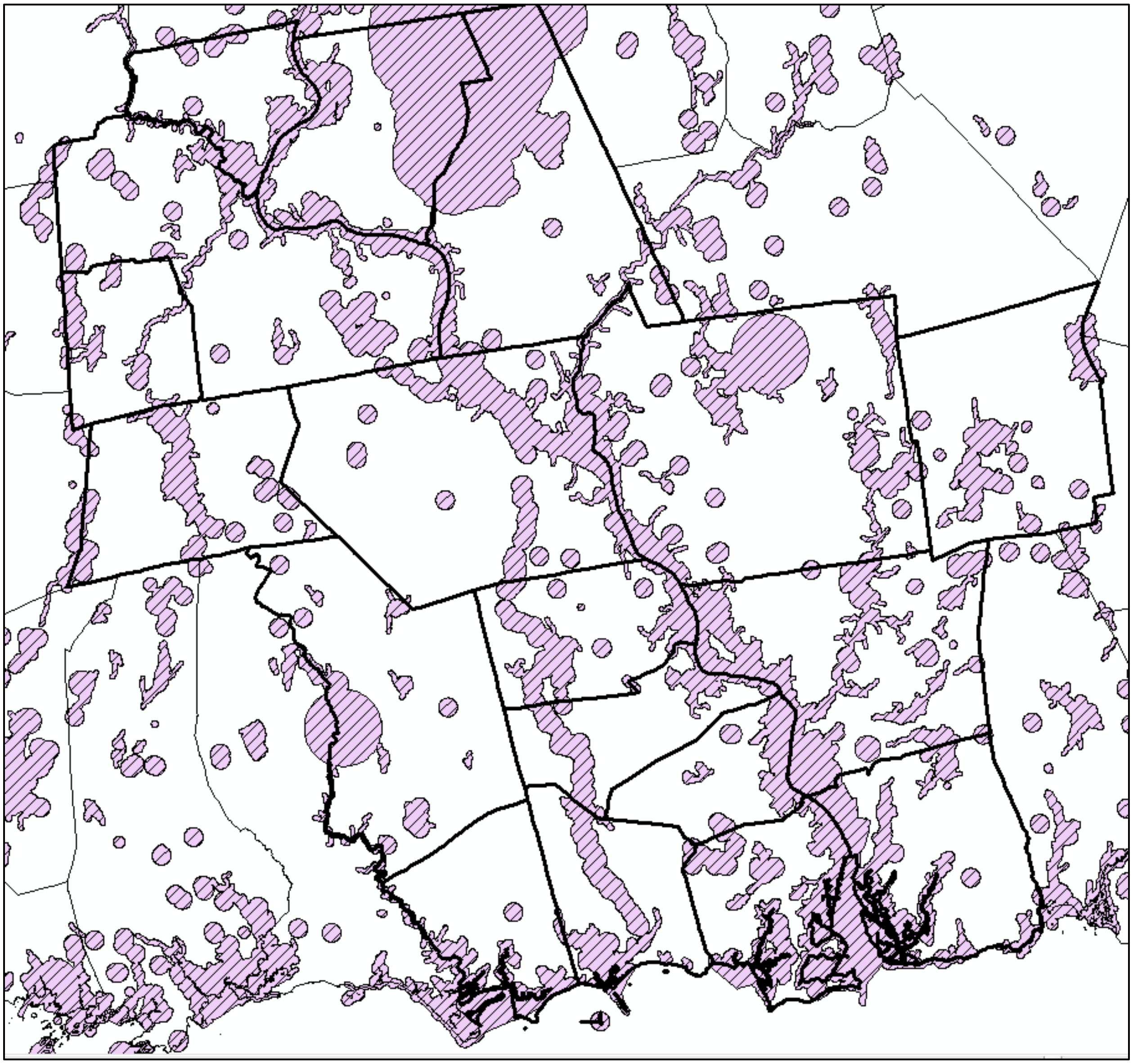


Riparian Buffers



Natural Diversity Database

In or Out



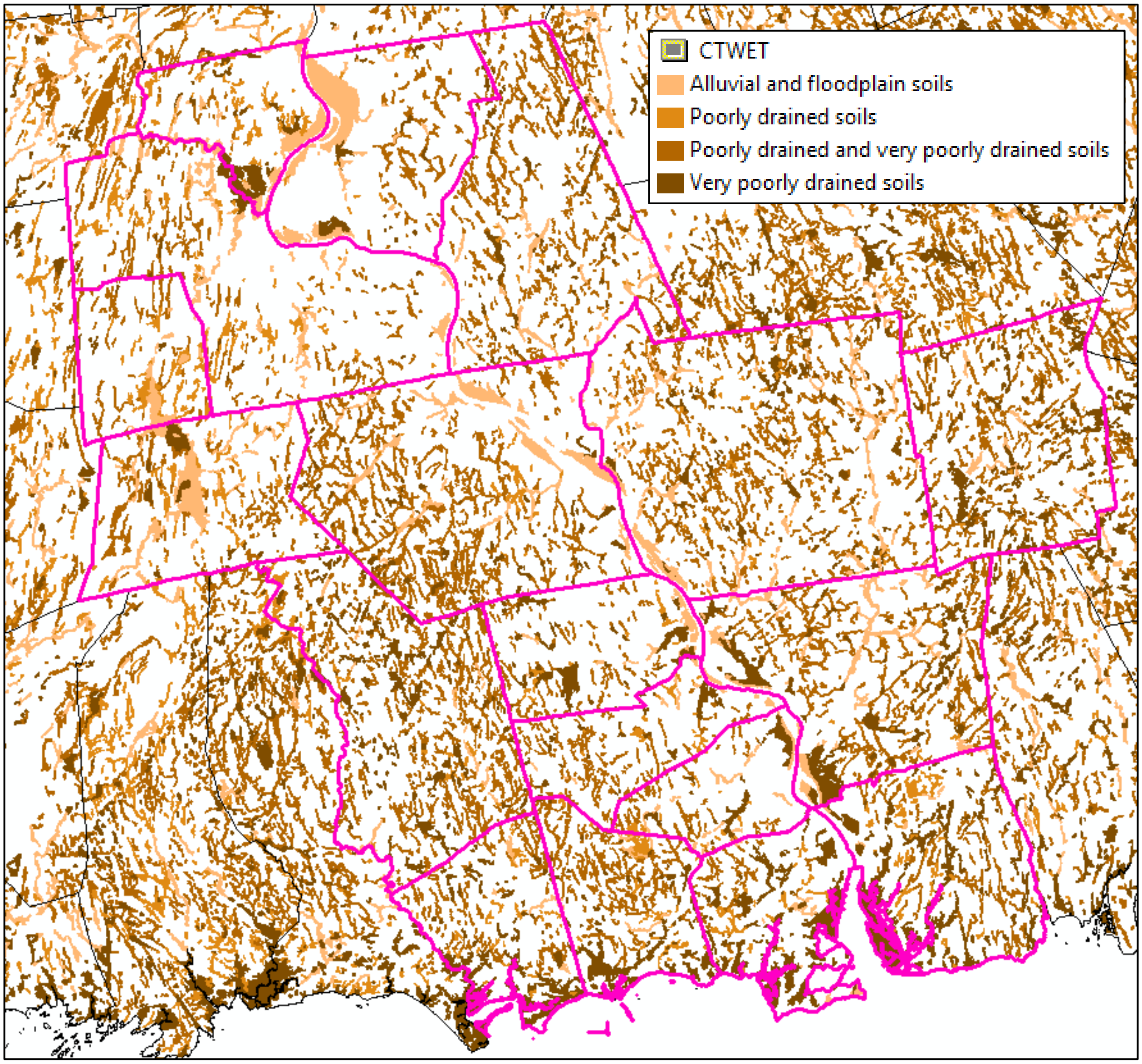
Soil

Wetand Soils

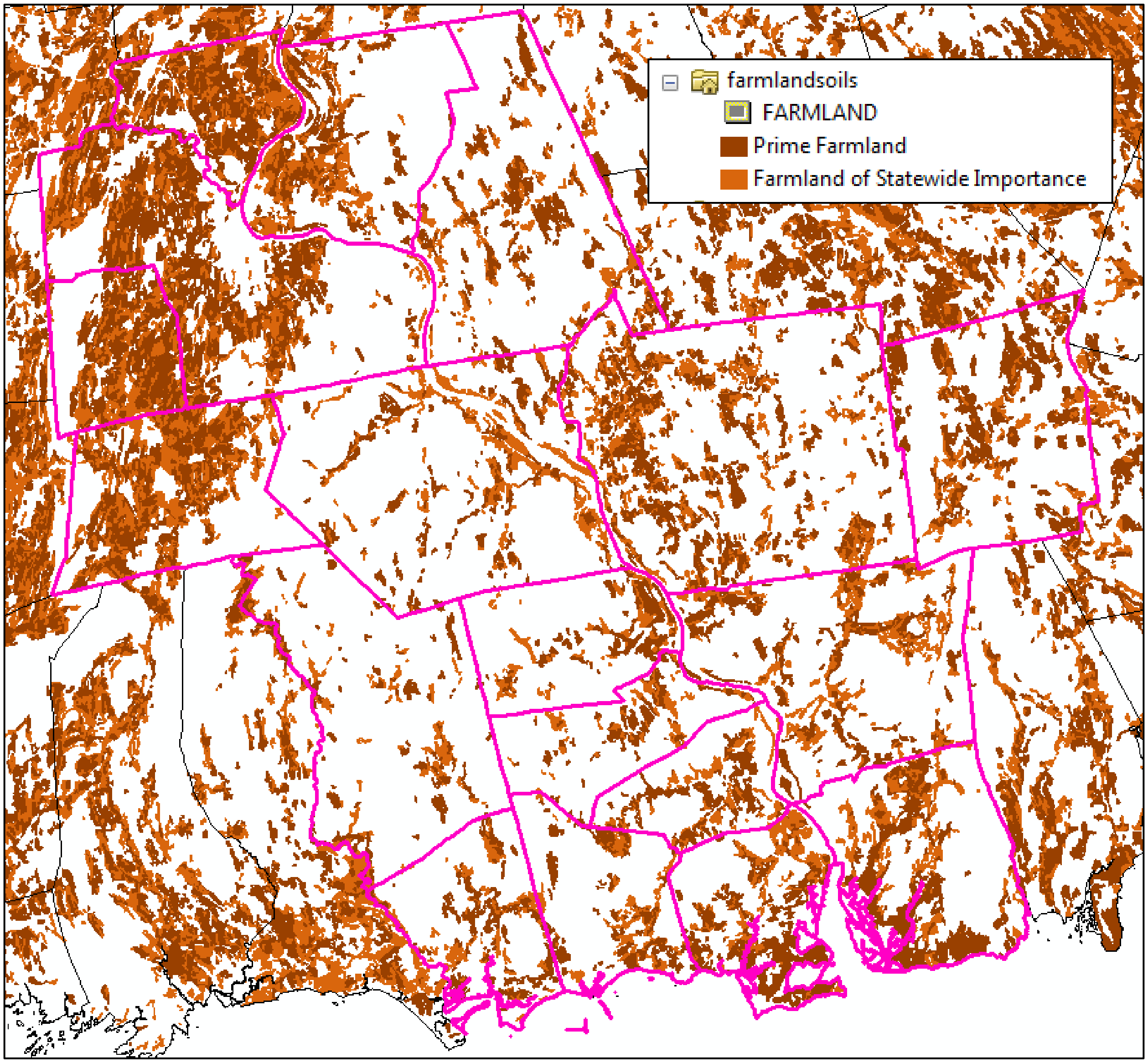
In Out

Buffer

Connections to Hydrography

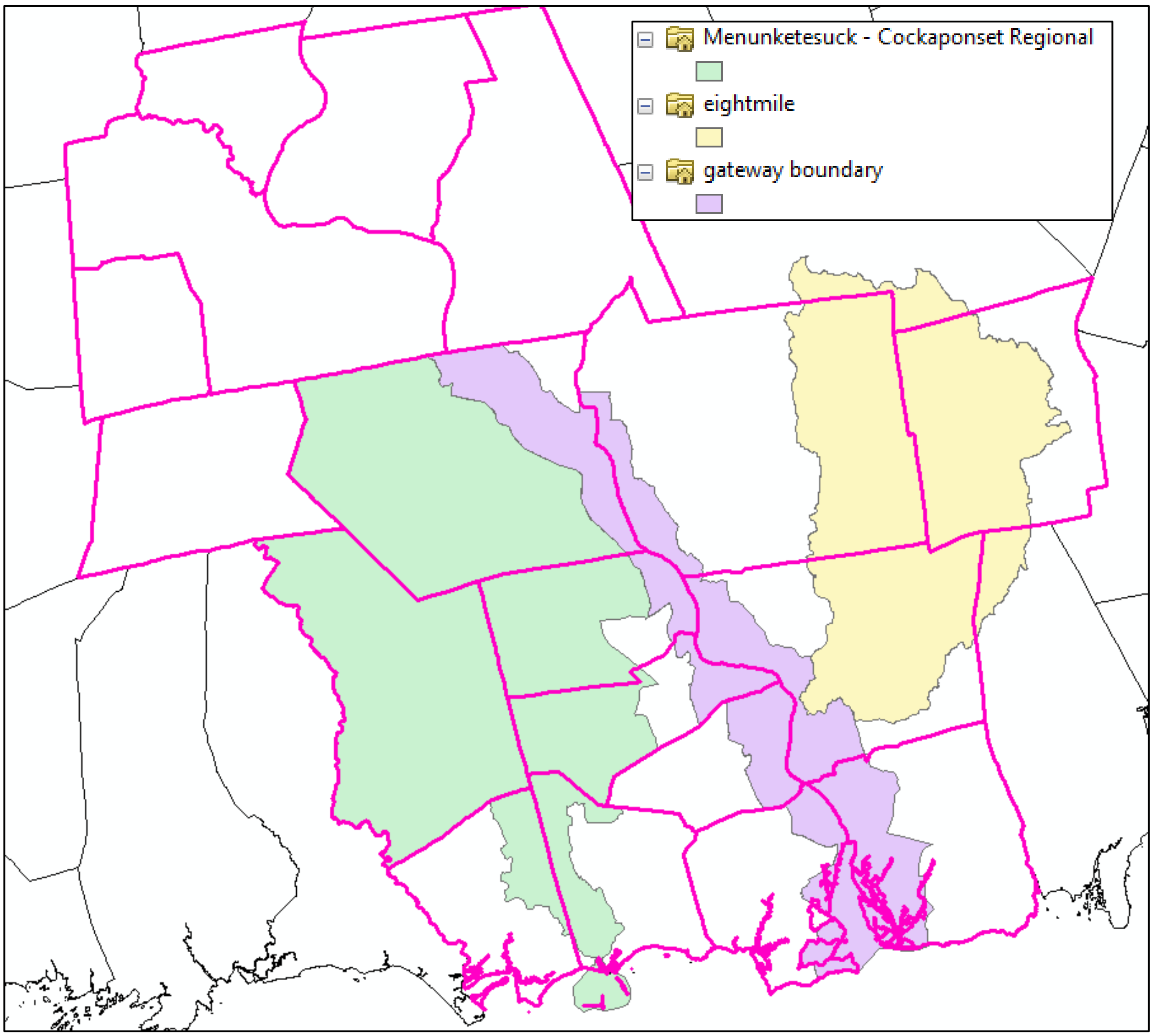


Farmland Soils
In or Out



Greenways

In or Out



Hydrography

Ground Water Quality Classifications

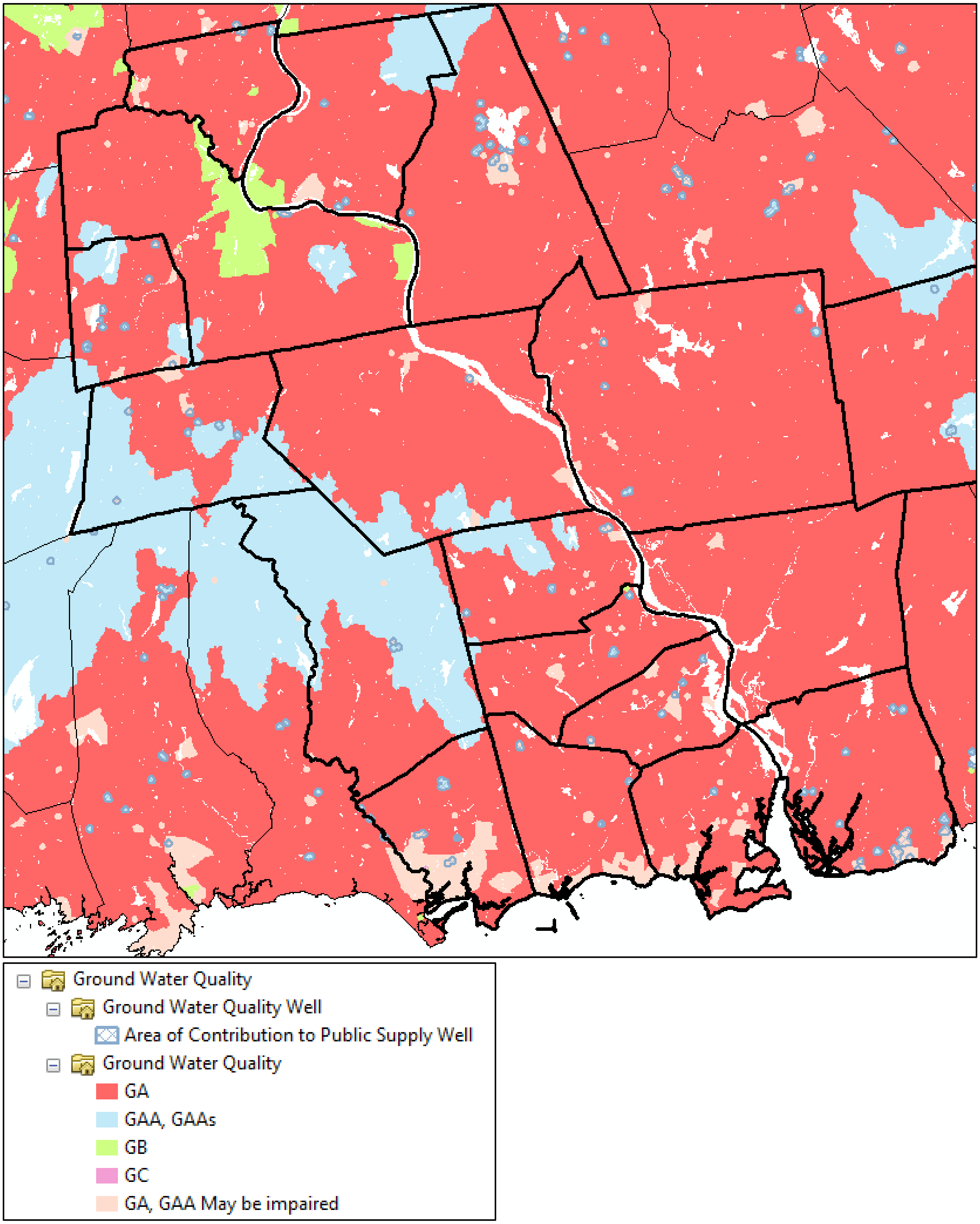
Class GAA
Designated uses: existing or potential public supply of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.
Discharges limited to: treated domestic sewage, certain agricultural wastes, certain water treatment wastewaters.

Class GA
Designated uses: existing private and potential public or private supplies of water suitable for drinking without treatment; baseflow for hydraulically connected surface water bodies.
Discharges restricted to: as for GAA and discharge from septage treatment facilities subject to stringent treatment and discharge requirements, and other wastes of natural origin that easily biodegrade and present no threat to groundwater.

Class GB
Designated uses: industrial process water and cooling waters; baseflow for hydraulically connected surface water bodies; presumed not suitable for human consumption without treatment.
Discharges restricted to: same as for A (Note; same treatment standards apply), certain other biodegradable wastewaters subject to soil attenuation.

Class GC
Designated uses: assimilation of discharge authorized by the Commissioner pursuant to Section 22a-430 of the General Statutes. As an example a lined landfill for disposal of ash residue from a resource recovery facility. The GC hydrogeology and hydrologic setting provides the best safeguard to adjacent resources.
Discharges restricted to: potential discharges from certain waste facilities subject to specific permitting requirements.

Simple In or Out


Ground Water Quality
Ground Water Quality Well
Area of Contribution to Public Supply Well
Ground Water Quality
GA
GAA, GAAs
GB
GC
GA, GAA May be impaired

Surface Water Quality Classifications

Inland Surface Water Classifications

Class AA
Designated uses: existing or proposed drinking water supply, fish and wildlife habitat, recreational use (may be restricted,) agricultural and industrial supply.
Discharges restricted to: discharges from public or private drinking water treatment systems, dredging and dewatering, emergency and clean water discharges.

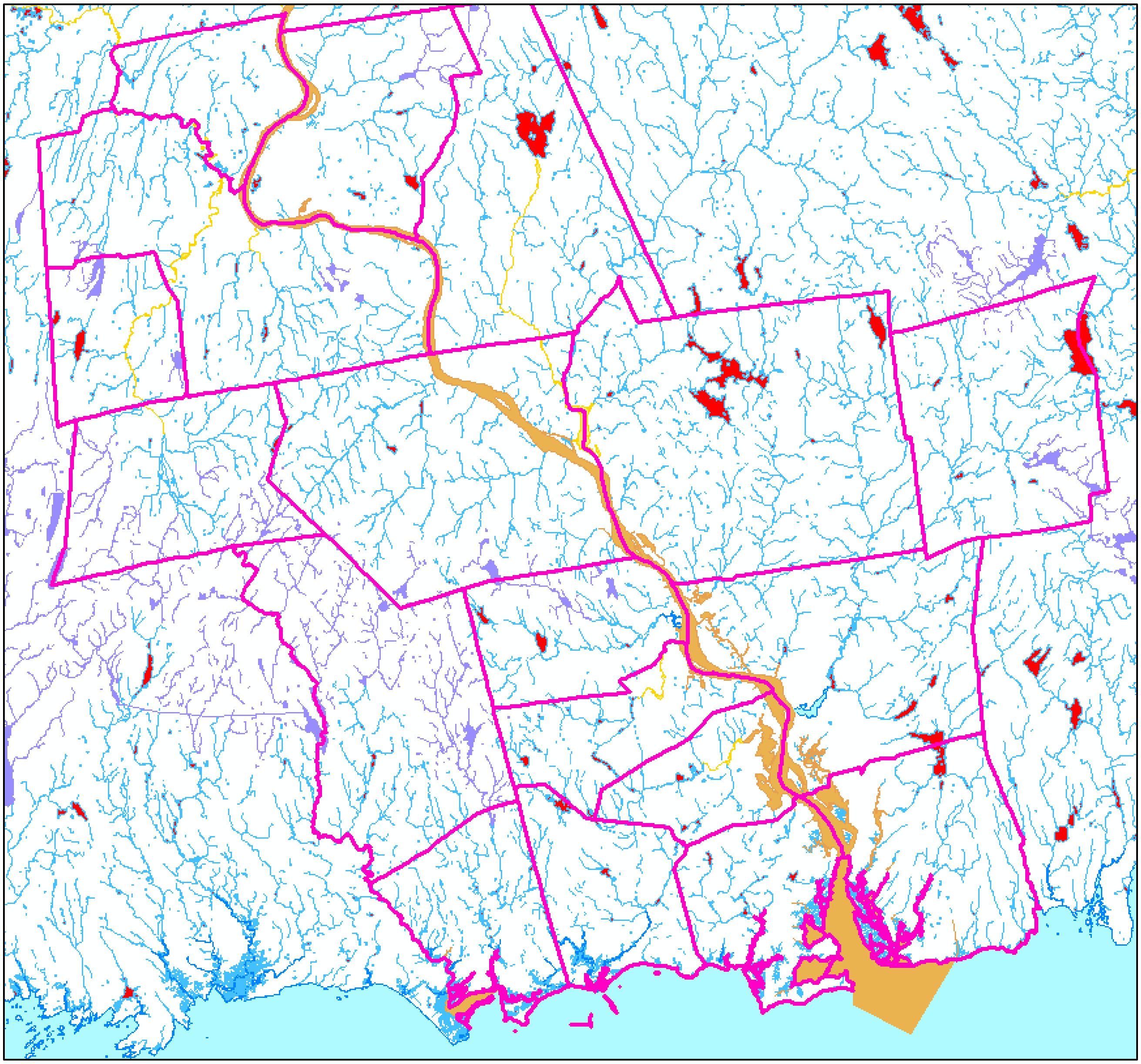
Class A
Designated uses: potential drinking water supply; fish and wildlife habitat; recreational use; agricultural and industrial supply and other legitimate uses including navigation.
Discharges restricted to: same as allowed in AA.

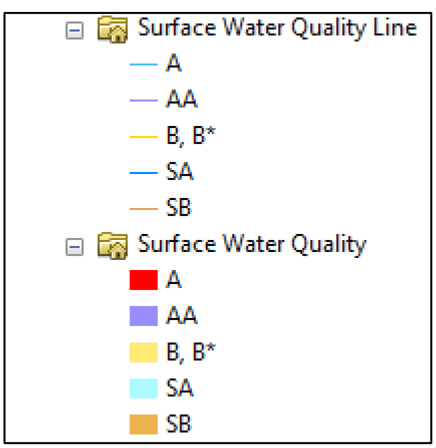
Class B
Designated uses: recreational use: fish and wildlife habitat; agricultural and industrial supply and other legitimate uses including navigation.
Discharges restricted to: same as allowed in A and cooling waters, discharges from industrial and municipal wastewater treatment facilities (providing Best Available Treatment and Best Management Practices are applied), and other discharges subject to the provisions of section 22a-430 CGS.

Coastal and Marine Surface Waters

Class SA
Designated uses: marine fish, shellfish and wildlife habitat, shell fish harvesting for direct human consumption, recreation and all other legitimate uses including navigation.
Discharges restricted to: same as for AA or A surface waters.

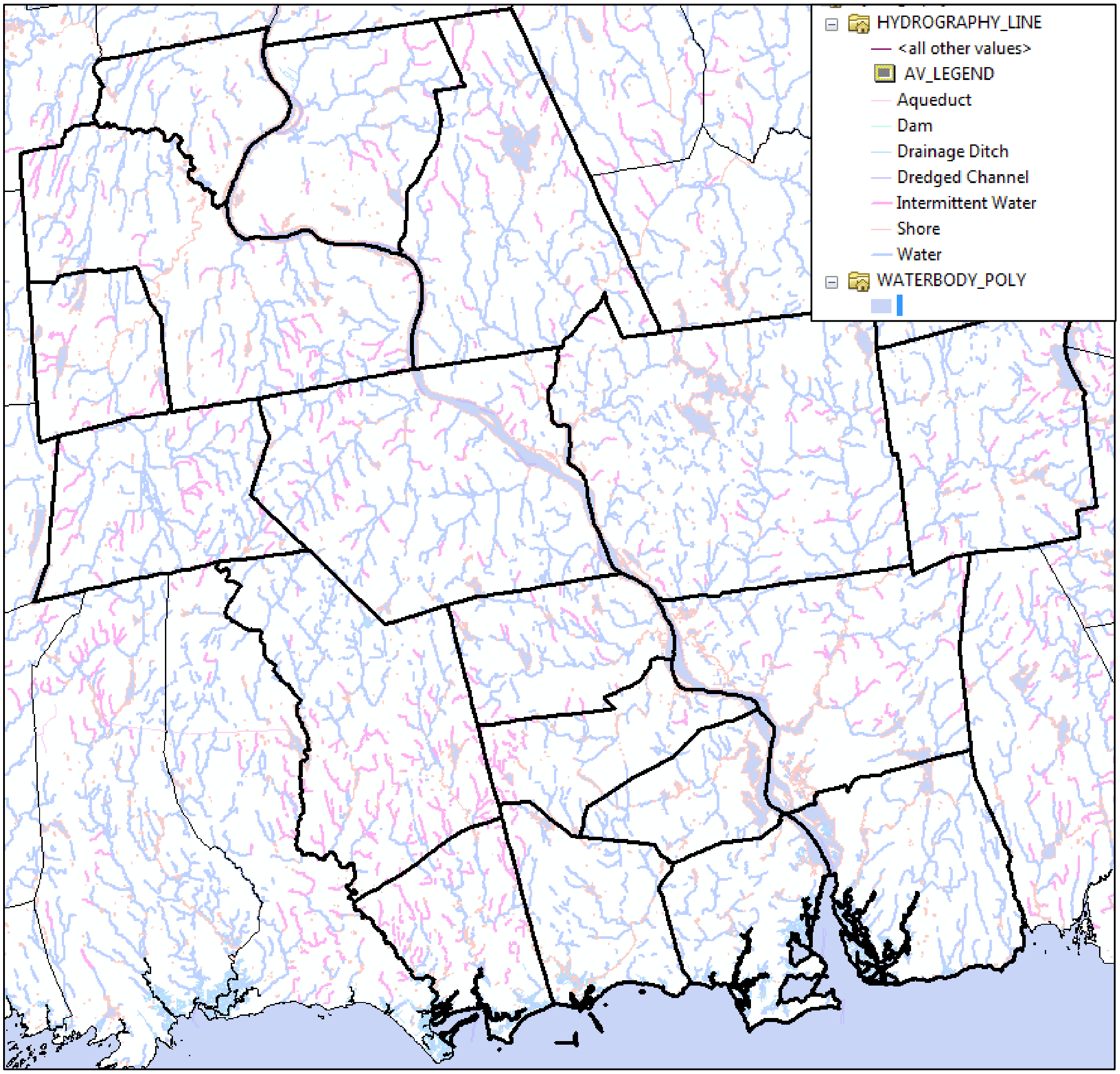
Class SB
Designated uses: marine fish, shellfish and wildlife habitat, shellfish harvesting for transfer to approved areas for purification prior to human consumption, recreation, industrial and other legitimate uses including navigation.
Discharges restricted to: same as for B surface waters.



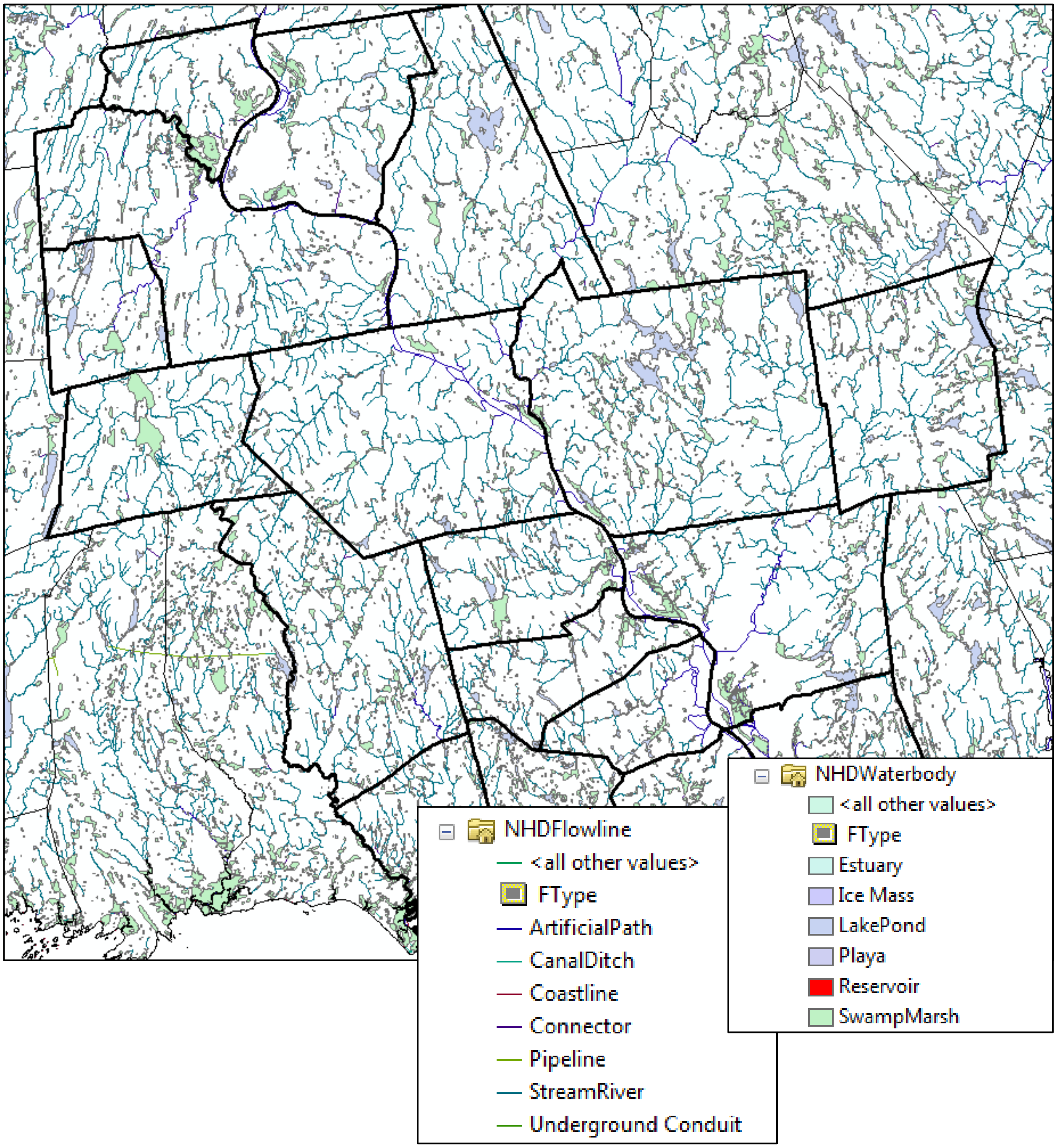


Buffer width
In or Out

Streams and Water Bodies – CT DEEP Data



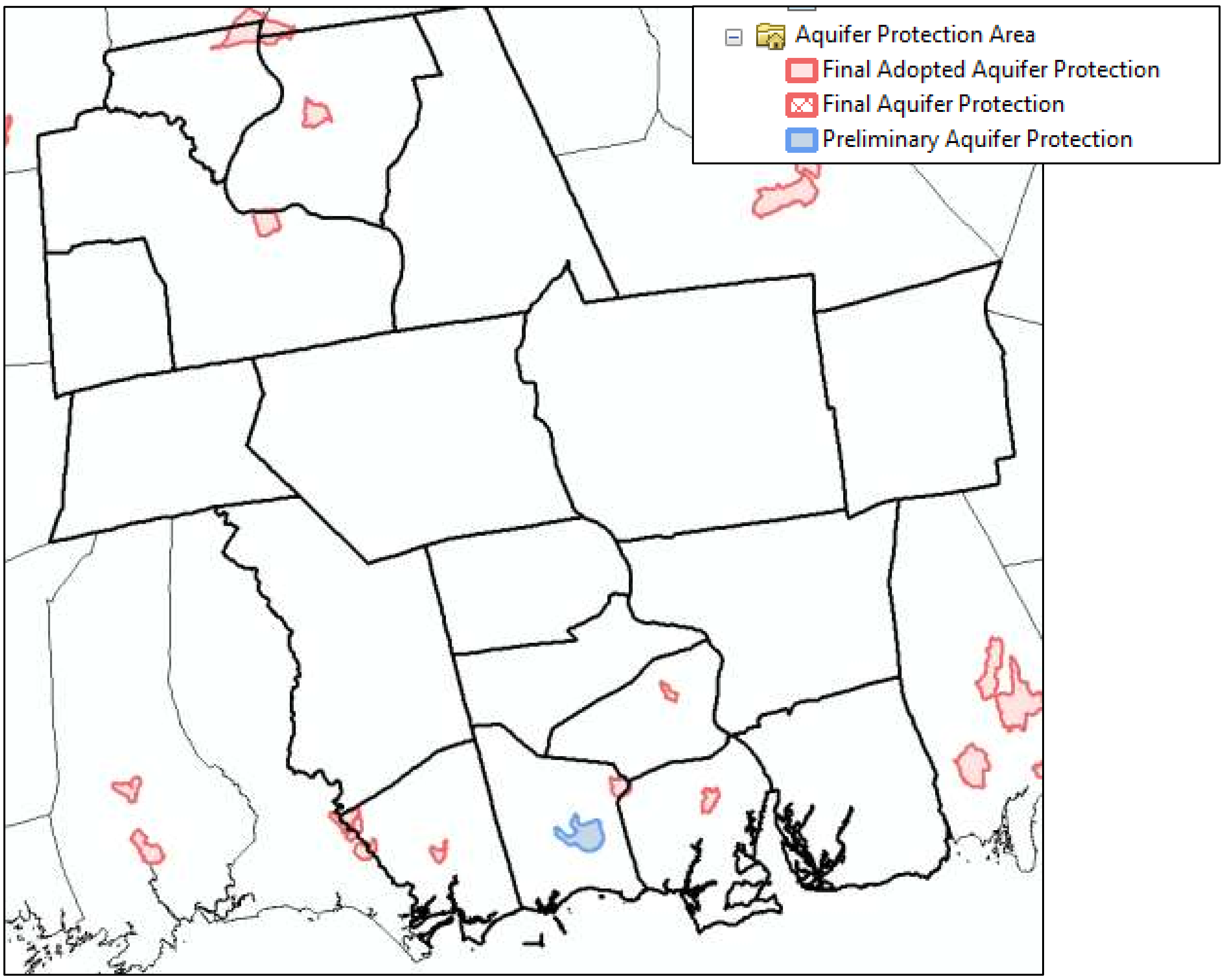
NHD


NHDFlowline
<all other values>
FType
ArtificialPath
CanalDitch
Coastline
Connector
Pipeline
StreamRiver
Underground Conduit
NHDWaterbody
<all other values>
FType
Estuary
Ice Mass
LakePond
Playa
Reservoir
SwampMarsh

Aquifer Protection Areas

Purpose

Administered by the Connecticut Department of Energy and Environmental Protection, the Aquifer Protection Program provides primary protection for Connecticut's high-yield public water supply well fields. The intent of this program is to protect the water supplies by identifying the land areas contributing ground water to the wells through detailed field work and ground-water flow modeling, and then by regulating land use within those areas. Municipalities adopt land use regulations for final aquifer protection areas. For example, land use involving hazardous materials within a designated aquifer protection area is strictly monitored and regulated.

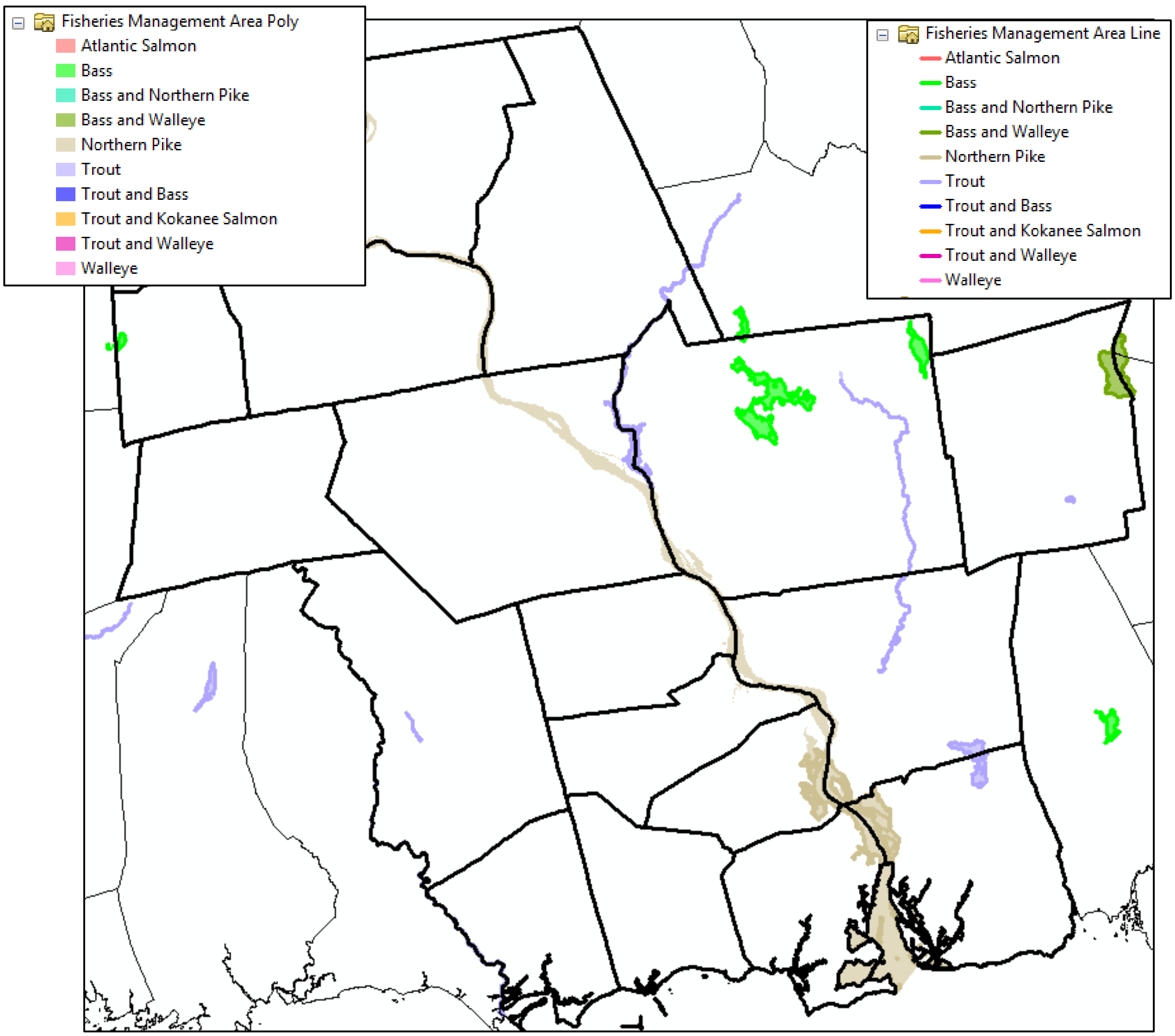


In
Buffer width

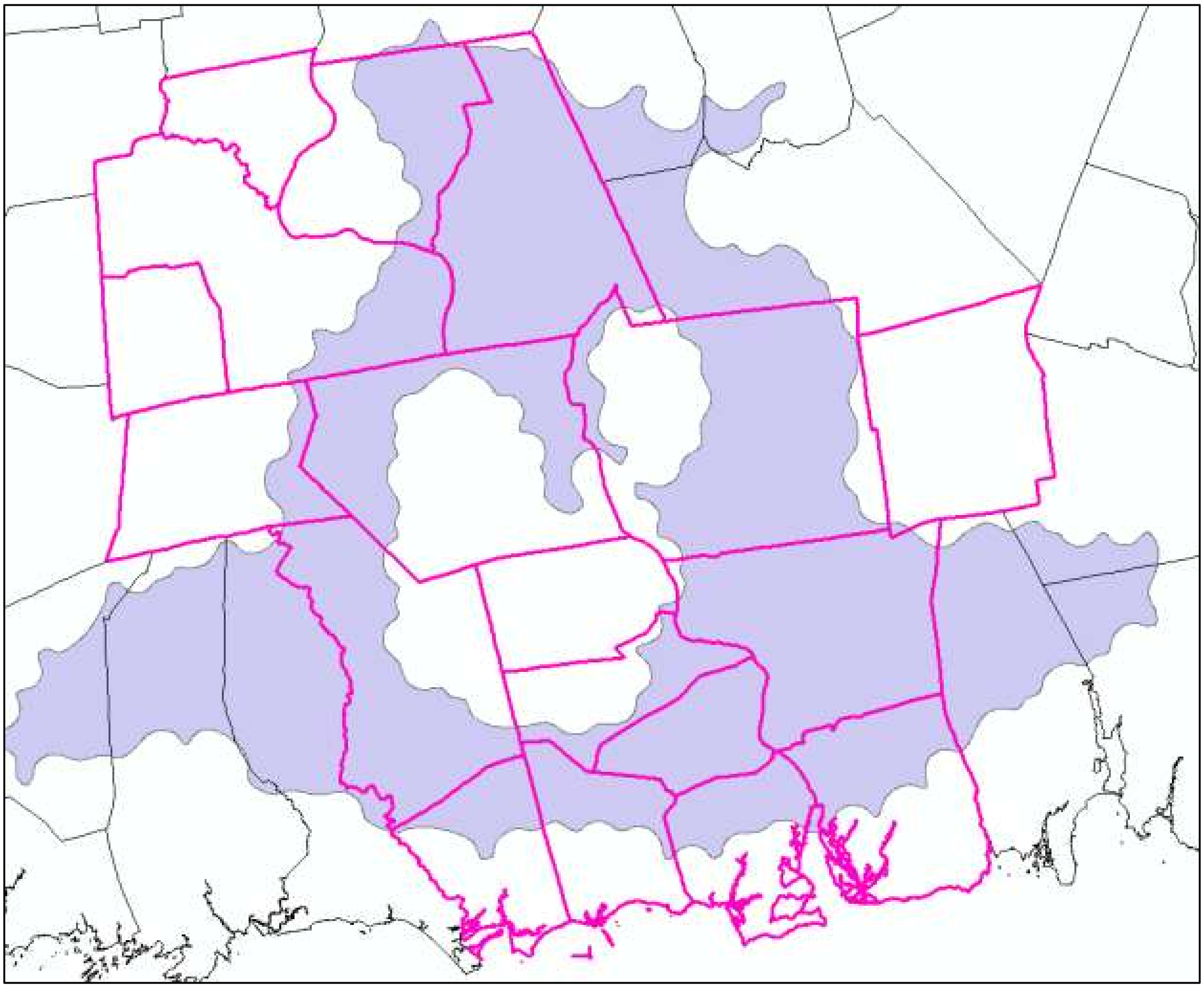
Stream Temperature – LYONS Classification System 1 – 4.

Steve Gephard:
Found a database based upon actual water temperatures taken in streams. The Excel sheet then ranks the streams 1 – 4 using a LYONS classification system. Rank 1 is cold, rank 2 is cool towards cold. You should be able to sort this Excel sheet first by town so you get just the towns in the Lower River Valley, then sort it by LYON ranks to get just streams ranked 1 and 2. This should give you all the cold and cool water streams in the area. This could be used in conjunction with other parameters to indicate high quality streams valuable for fish and aquatic resources and perhaps important in light of climate change.

CT DEEP Fisheries Management Area

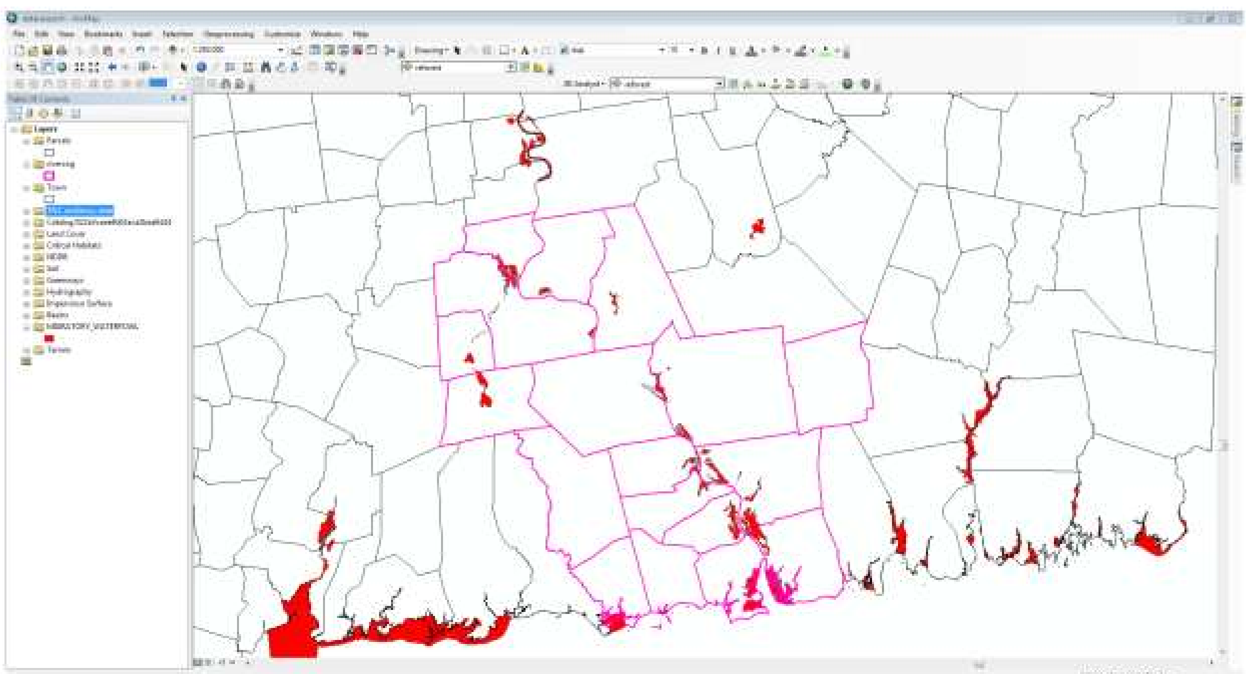


TNC Landscape Resiliency Data



Migratory Waterfowl Sites

Migratory Waterfowl is a 1:24,000-scale, polygon feature-based layer that depicts the concentration areas of migratory waterfowl at specific locations within Connecticut. Paul Merola, former DEP Wildlife Biologist, and Greg Chasko, DEP Wildlife Biologist, identified the migratory waterfowl concentration areas based on the Northeast Coastal Areas Study, Joseph Dowhan, 1991 (see Supplemental Information) as well as by using midwinter surveys, breeding surveys and personal observations. The concentration areas are primarily found along the shoreline and the lower tributaries and wetlands of major Connecticut rivers. In addition to depicting the concentration areas, the potential waterfowl species associated with each polygon have been identified and are listed in the attribute table as boolean values indicating their presence or absence. The intent of this datalayer is to assist in the identification of migratory waterfowl resource areas in the event of an oil spill or other condition that might be a threat to waterfowl species. This layer identifies conditions at a particular point in time. It is not updated and it is not a complete representation of all areas of migratory waterfowl in Connecticut.



Appendix III

Possible Weighting Schema

Workshop 3 – Possible Weighting Schema

Pg.

Technical Assistance Provided by:
National Park Service Rivers, Trails and Conservation Assistance Program (RTCA)

Workshop 3 – Possible Weighting Schemes

Mission Statement

To develop a plan that will enable effective collaboration towards the creation of large connected natural areas to provide wildlife habitat, to protect water quality and quantity, and to protect working and scenic lands.

Introduction

I've approached the weighting and modeling in two different ways. The first in the way we have discussed in meetings 1 and 2, each grid of 100' cells being added together to create one grid where locations can be identified that contain the highest to lowest numbers of accumulated resources on a cell by cell basis. For the second and third model I chose to focus on the language of the generally agreed upon mission statement and its emphasis on connected large natural areas and assessed them on the basis of how much of each resource is contained within each large natural area in the Region.

I have looked at the data sets that we've been looking at and drawn from my own experience of working with you and other natural resource specialist within the region to narrow the data down to what I think are the most important data sets to consider on a regional scale. For the next meeting all of you need to do the same so that we are able to discuss the two approaches and make a decision on which approach or combination of approaches to use.

List of data layers from the end of the last meeting:

Land Cover
- Riparian Buffer
- Forest Fragmentation

NDDB
Critical Habitats
Soils
- Wetland Soils
- Farmland Soils

Greenways
Surface Water Quality
Streams and Water Bodies CT DEEP
Stream Temperatures
Fisheries Management Areas CT DEEP
TNC Resiliency Data Set
Migratory Waterfowl Sites
Terrain

List of Data Layers I have chosen to work with:

Land Cover – excluding developed, turf grass, agriculture, and barren land.

> I chose to remove agriculture from the land cover data because I wanted to isolate our large natural areas (LNA's) and the agricultural data primarily included active crop production and/or active pasture. In the final analysis this data could be refined so that any abandoned fields that are returning to a natural state could be included.

Core Forest – developed using CLEAR's forest fragmentation model and 2010 land cover data – 300'.

> Chosen because of the State's emphasis on the fragmentation of the resource (http://www.ct.gov/deep/cwp/view.asp?a=2697&q=454164&deepNav_GID=1631) and because of the work we have been doing with UConn Extension concerning forest landowner outreach and the Lower CT River and Coastal Region Forest Stewardship Initiative (http://www.ctforestry.uconn.edu/LCRCR.html).

Early Successional – other grasses and utility corridors from Land Cover data (some of agriculture could be included)

> Chosen because of the lack of this habitat type in the Region. Ct's Comprehensive Wildlife Conservation Strategy (CWCS) (2005) its importance to the threatened and endangered species of the State. http://www.ct.gov/deep/cwp/view.asp?a=2723&q=325886&deepNav_GID=1719

Hydrology – I have taken the approach of unifying the region's surface hydrology into one unified data set. I buffered wetland soils, water bodies, streams, and intermittent streams by 300' and unified them together to create one data layer and took away developed areas.

> (Minimum width in reference material for wildlife corridors and land animals*, A REVIEW OF THE SCIENTIFIC LITERATUREON RIPARIAN BUFFER WIDTH, EXTENT AND VEGETATION*., Seth Wenger for the (Office of Public Service & Outreach Institute of Ecology University of Georgia, 1999. http://www.rivercenter.uga.edu/publications/pdf/luc_buffer_fact_sheet.pdf) and importance of wetlands of all types in maintaining biodiversity (CWCS).

NDDB - Almost always a priority (this has to do with how the data is presented)

Critical Habitats buffered by 300' – always a priority. Should they be buffered by more?

List of Data Layers I have chosen not to include in weighting models:

Greenways – always a priority area.

Surface Water Quality – We have good water quality throughout the Region except in our most developed areas which I think are primarily improved with Non Point Source education and solutions.

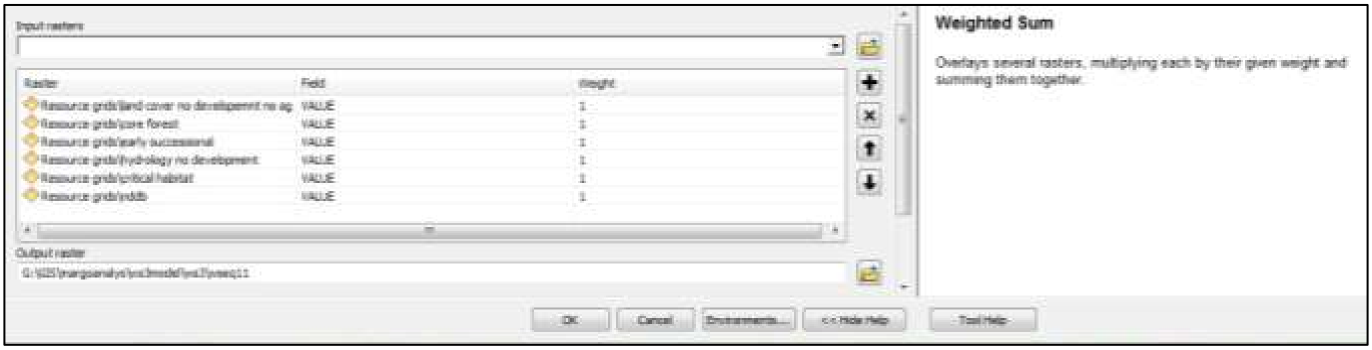
Fisheries Management Areas – undecided due to lack of information.

TNC Resiliency Data – undecided as to how useful the data is at this scale as it covers most of the area we are working in

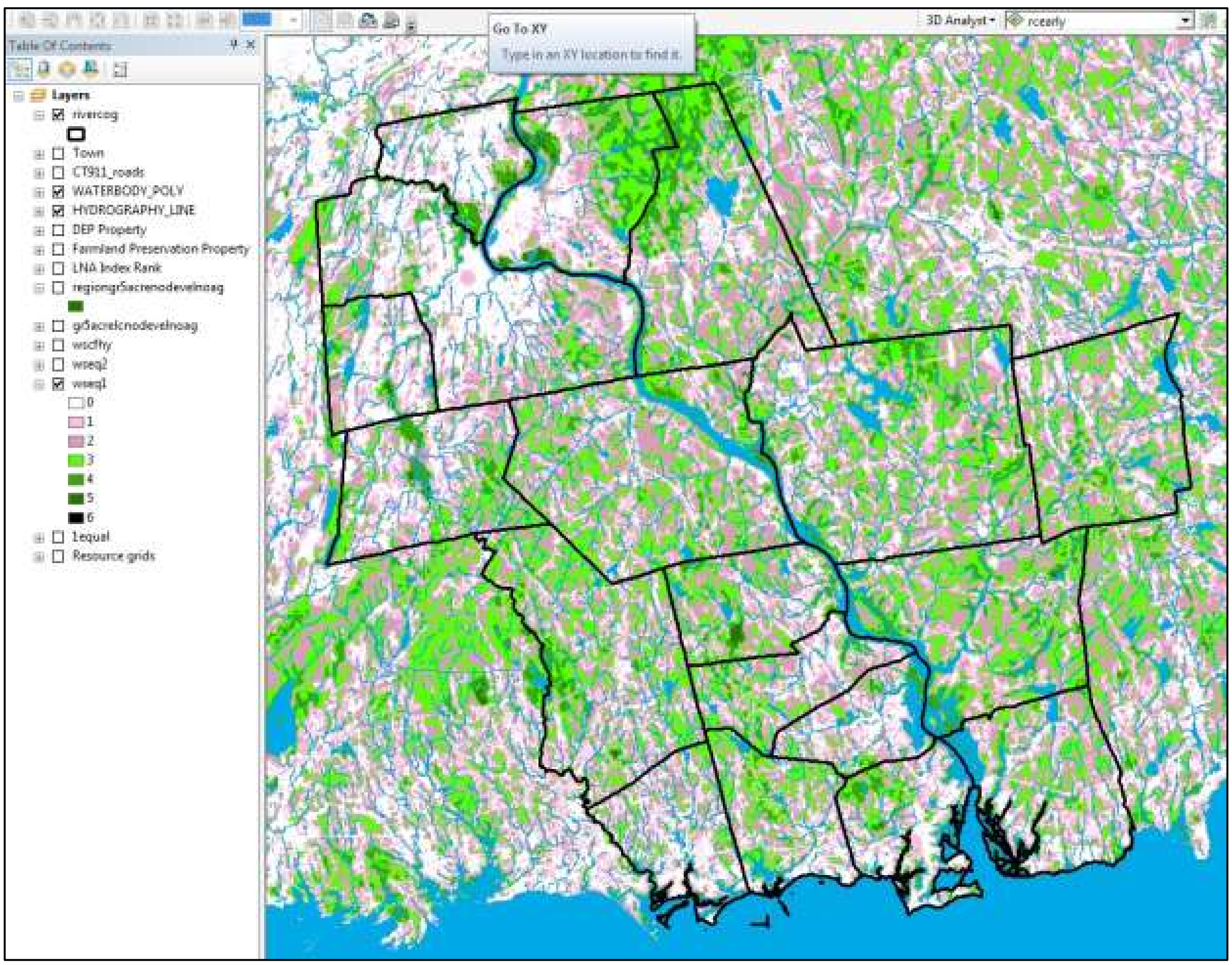
Migratory Waterfowl Sites – I believe these areas are included in the critical habitat layer which will always be a priority.

Terrain – undecided as to its use at this scale and in our Region. We do not have large elevation changes and our trap rock ridges are included in the critical habitat layer. I thought of using the data to determine head water areas.

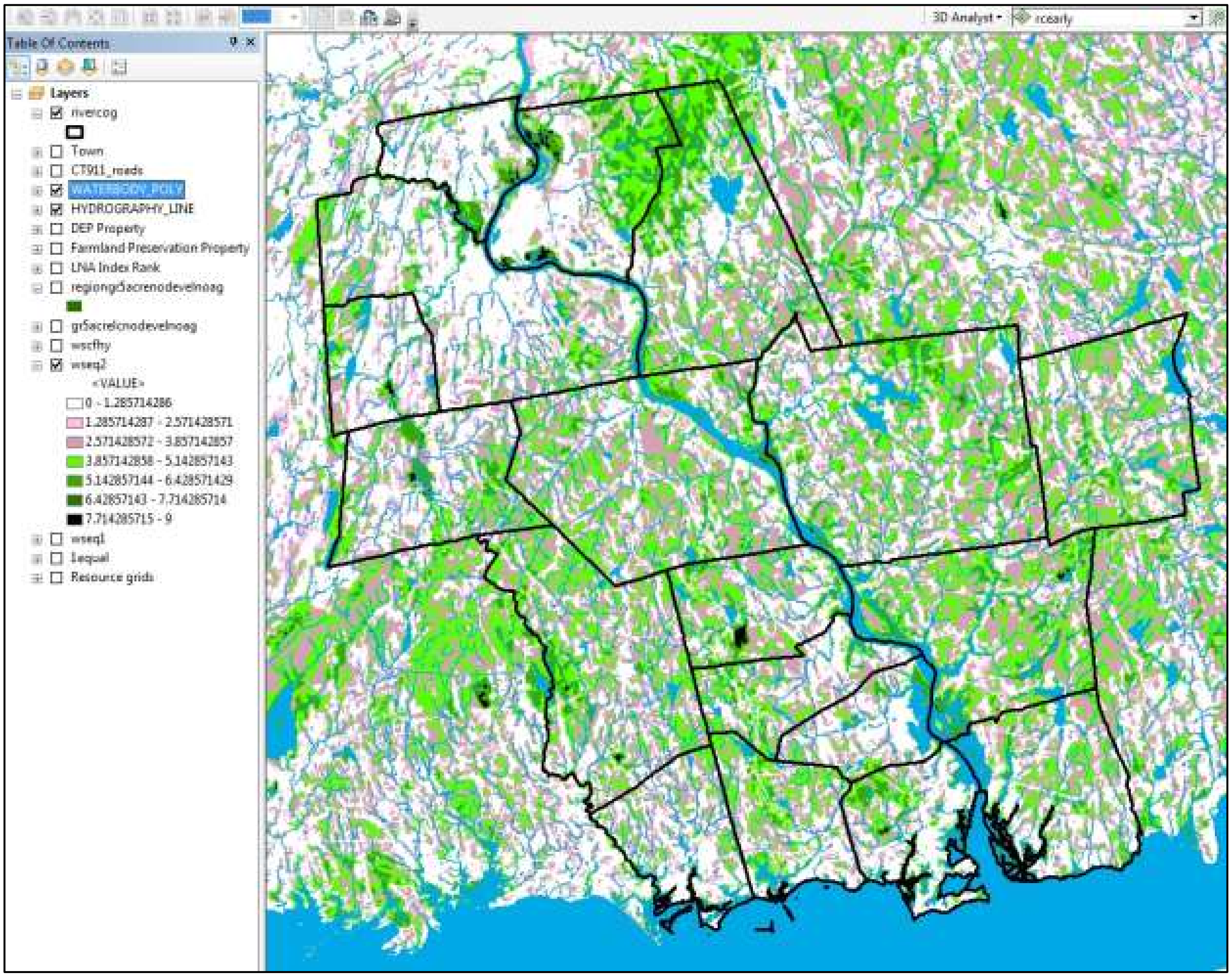
Model 1 – Examples Using Weighted Sum Tool



For the first run of the model I ran all data layers as having equal weight. Pink areas are the lower values and green areas are the highest.



For the second run I had core forest, hydrology, and critical habitats as being twice as important as general natural land cover, early successional, and nddb. Not to much different, but some areas do pop out.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rcearly
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Farmland Preservation Property
LNA Index Rank
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gr5acrelcnodevelnoag
wscfhy
wseq2
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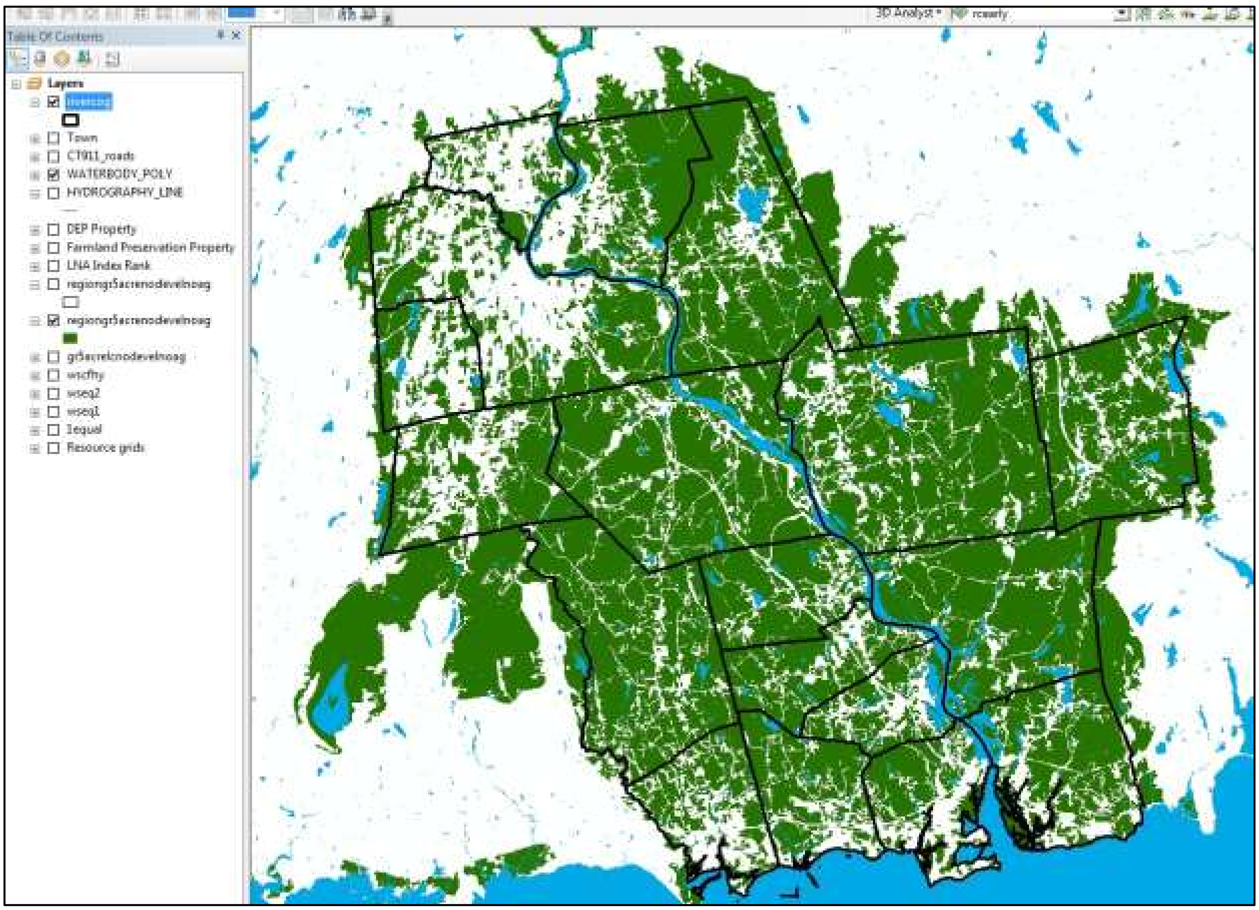
1.285714287 - 2.571428571
2.571428572 - 3.857142857
3.857142858 - 5.142857143
5.142857144 - 6.428571429
6.42857143 - 7.714285714
7.714285715 - 9
wseq1
1equal
Resource grids

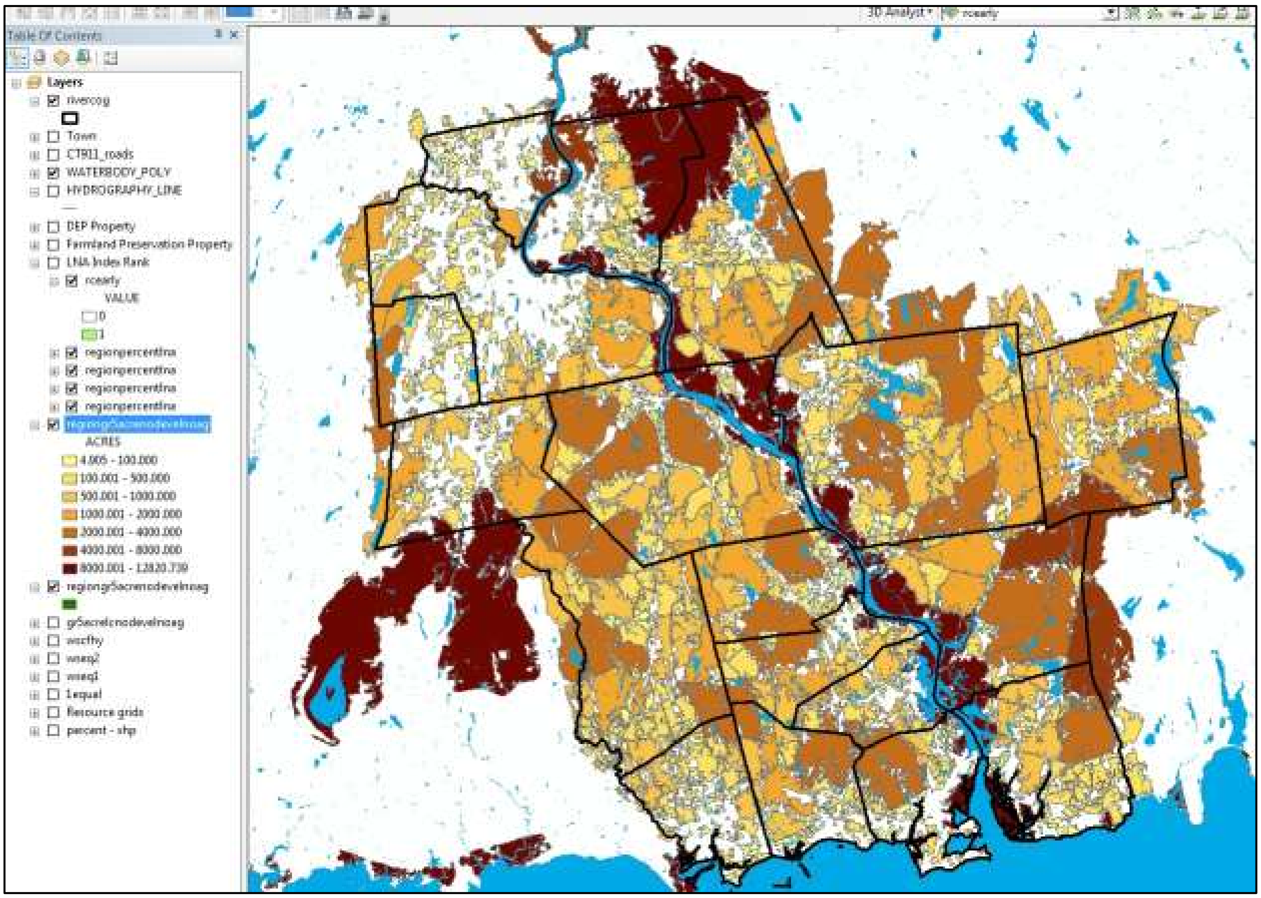
Model 2 – Large Natural Areas

I determined where the Region's contiguous natural areas are by using my land cover data set with developed, turf grass, and agriculture removed. Mapped are large natural areas (LNA) greater than 5 acres.

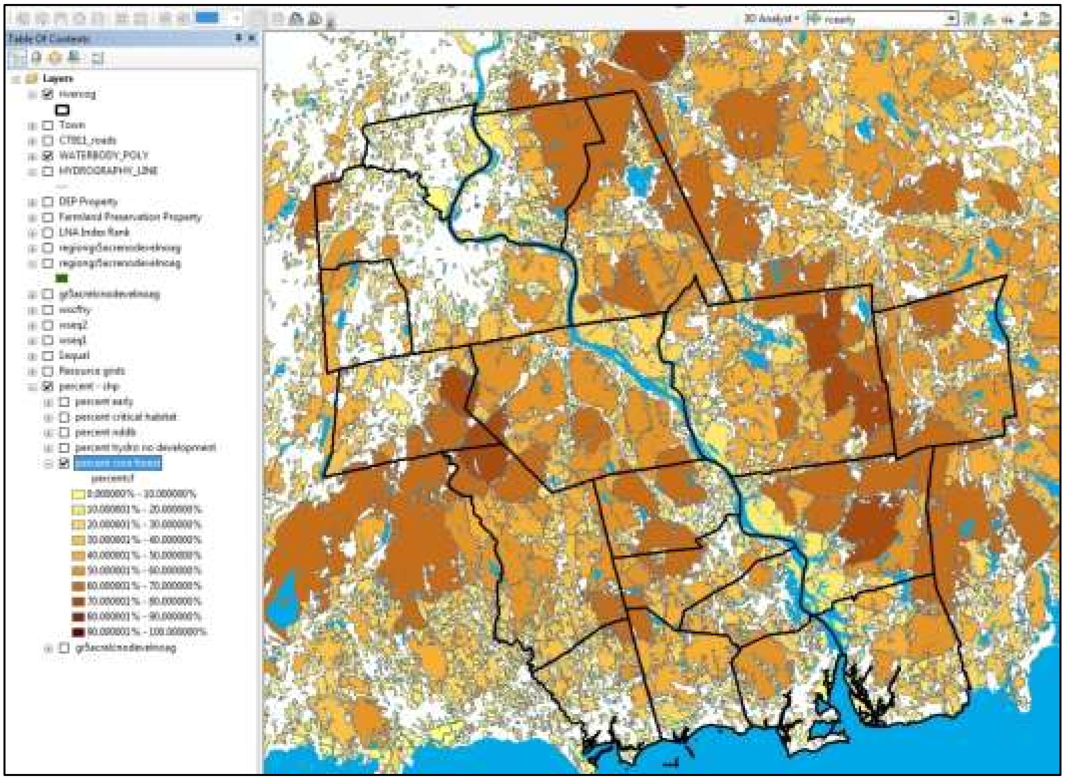


I determined for each area what its acreage is and its percentage of core forest, early successional, nddb, and hydrology, and critical habitats. When looking at the maps be aware that there is a coastal polygon that stretches the length of the CT shore that includes Great Island and Ragged Rock. This group of polygons for an unknown reason is being treated as one in my analysis. If we decide to go this route I will sort out why and fix it when I work on the final product. Also, the lower River and estuary is split into two polygons by the Haddam and I-95 bridges.

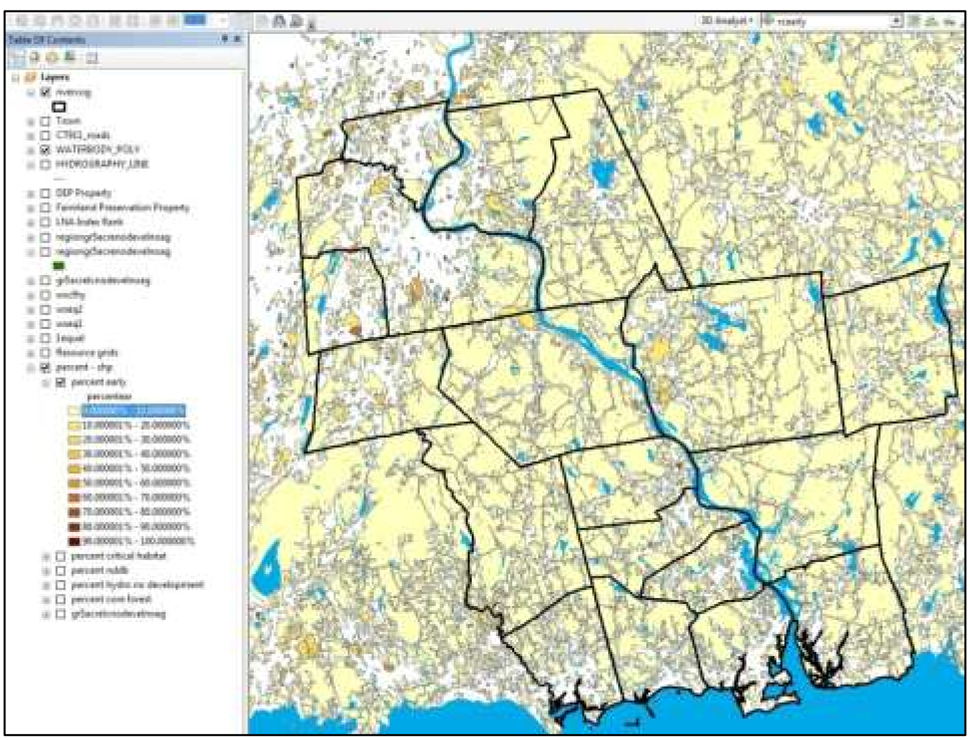
LNA Acreage



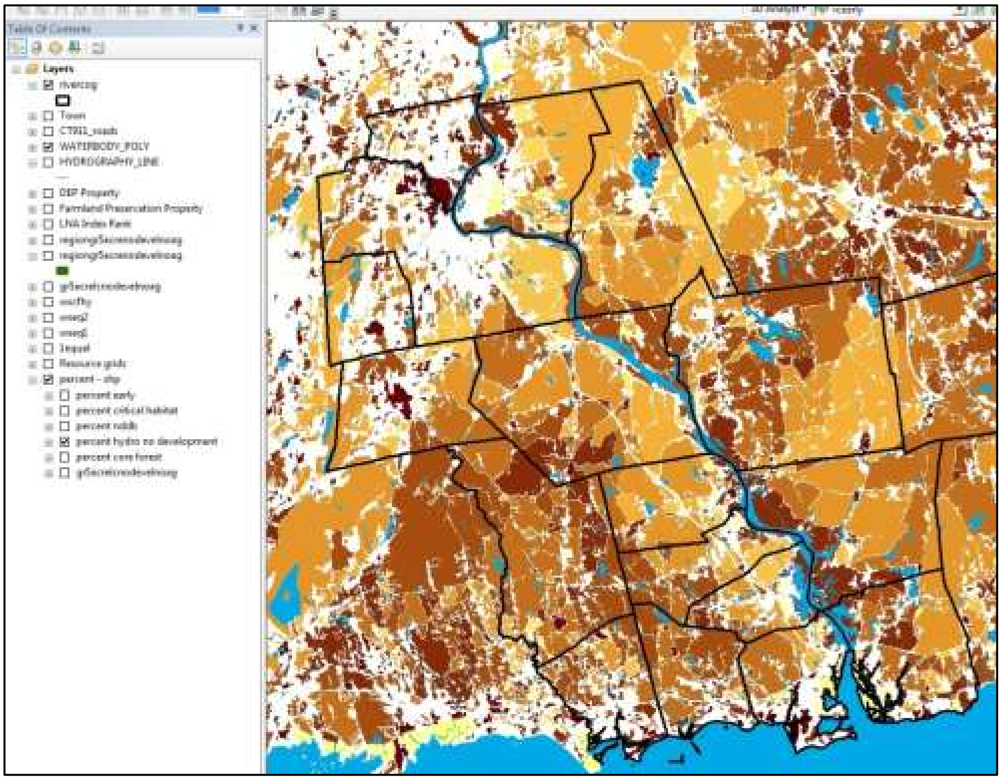
LNA Percent Core Forest



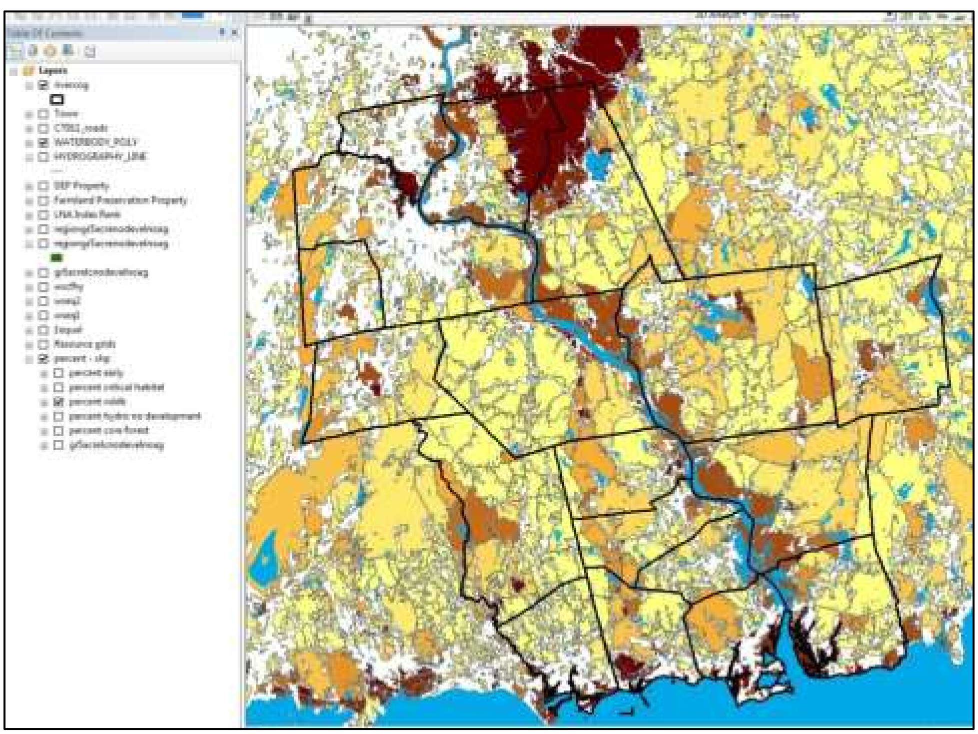
LNA Percent Early Successional



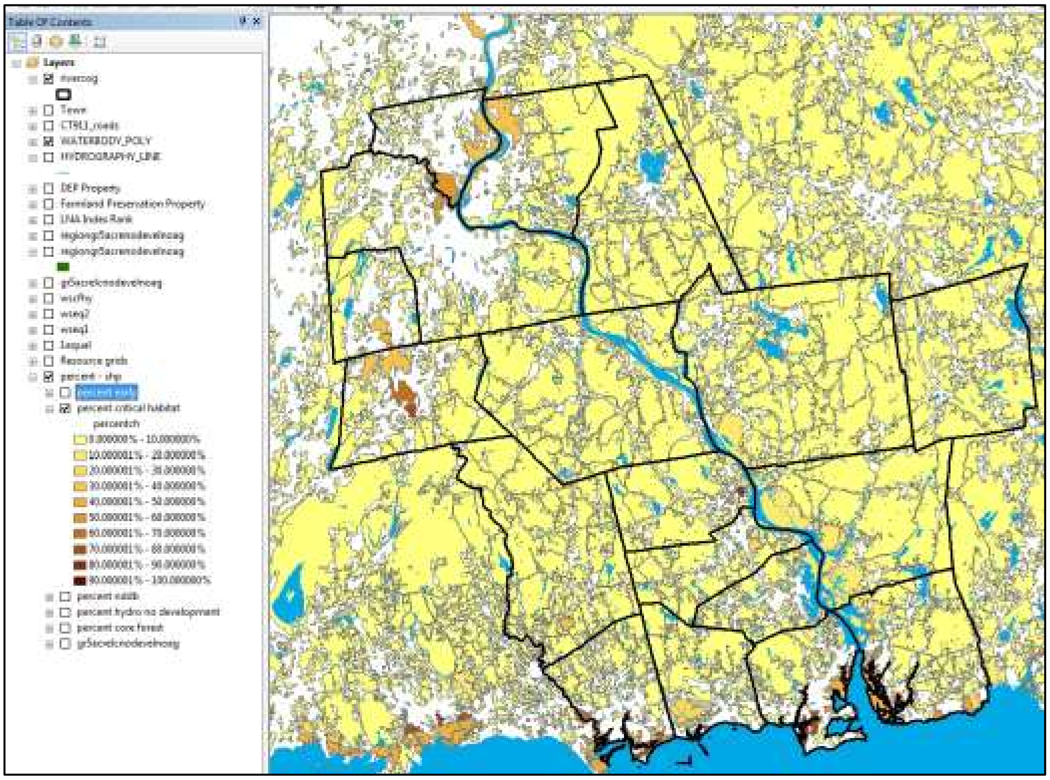
LNA Percent NDDB



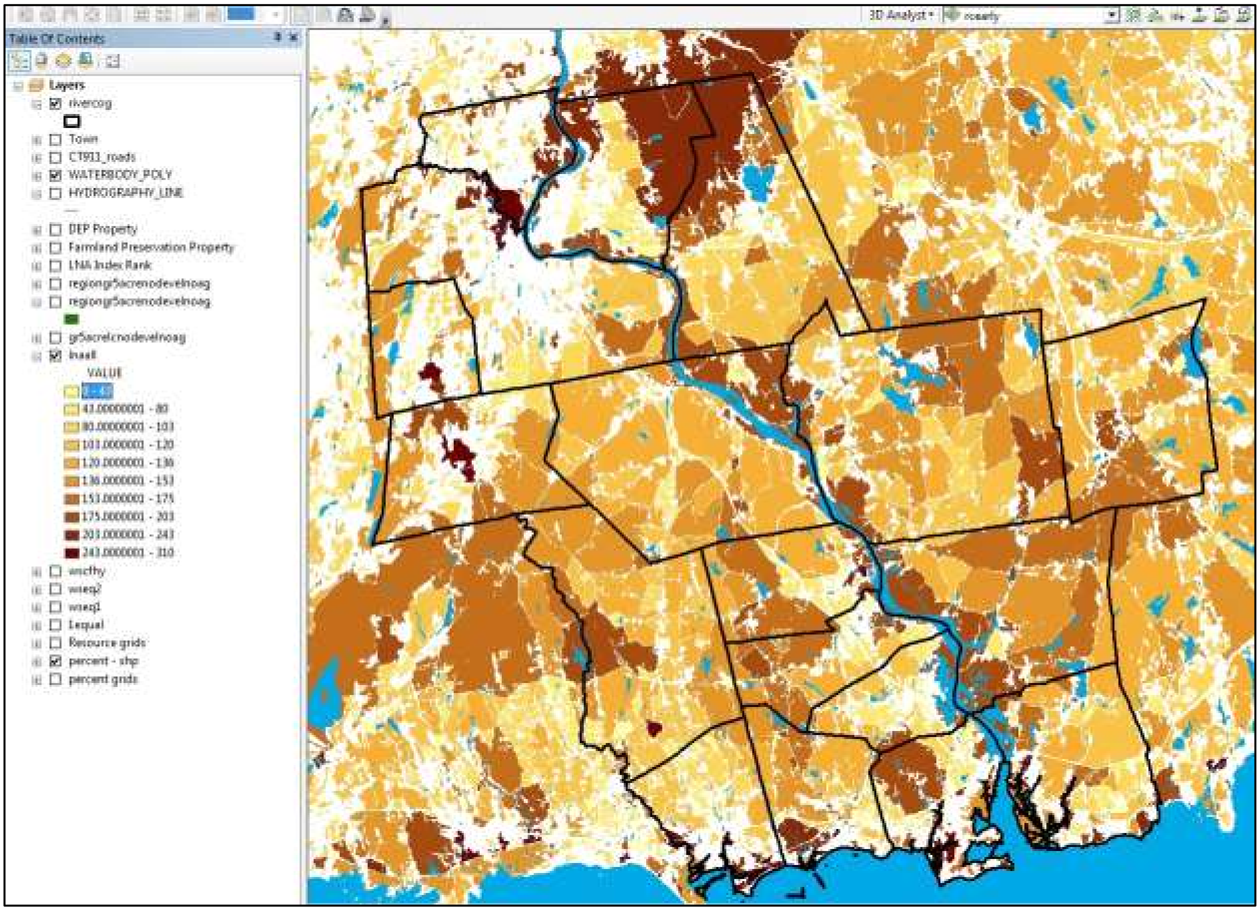
LNA Percent Hydrology



LNA Percent Critical Habitats

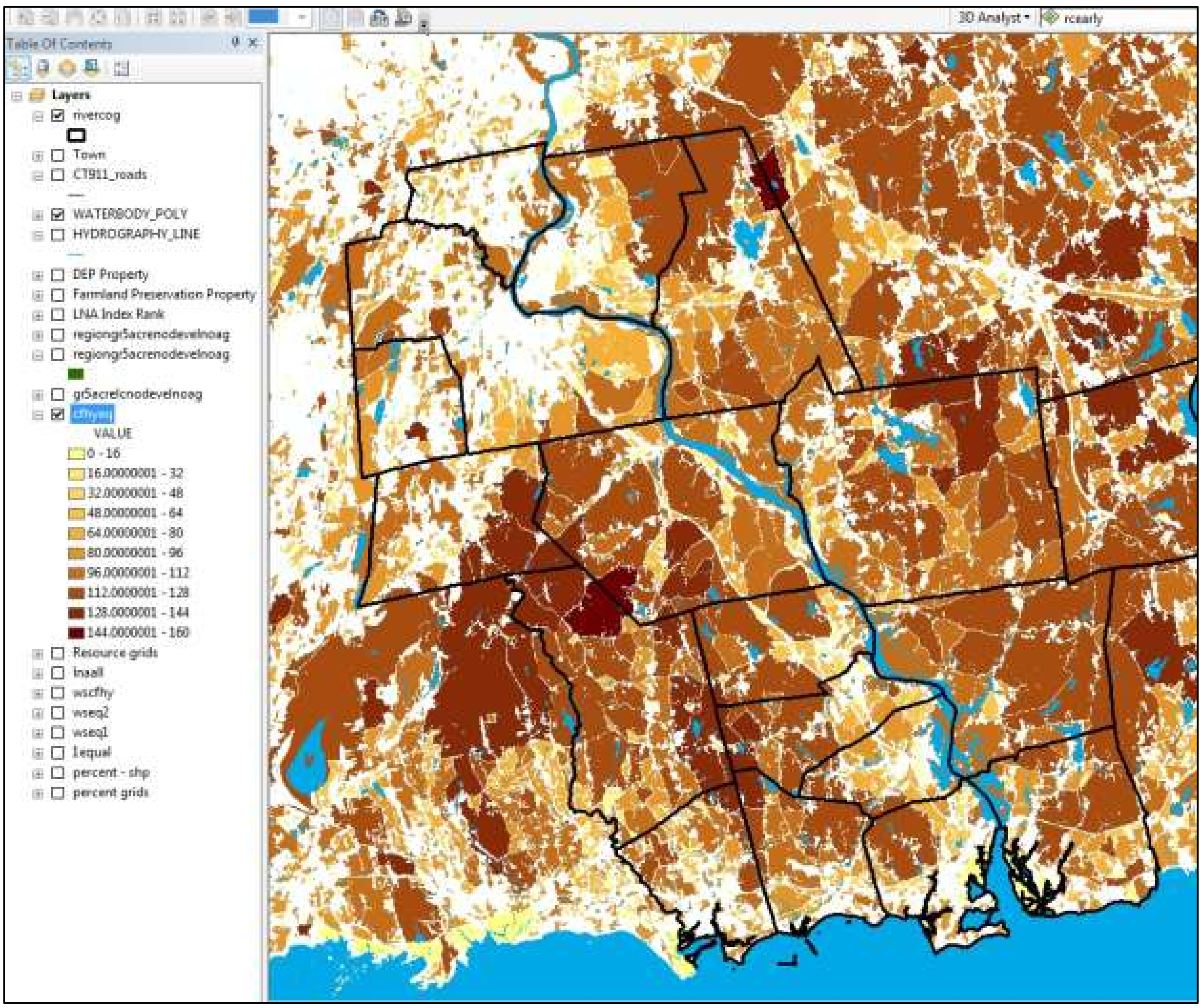


All LNA Percent Data Sets Added Together with Equal Weight



My thought process as I have gone through this exercise is to think about what resources on a regional scale do we need to conserve in order to maintain meaningful wildlife habitat and corridors and maintain water quality. Out of the data sets we have looked at I chose wetland areas with intact buffers and core forest areas as the best indicators of where corridors should be located and as the primary protectors of the Region's water quality while remembering that critical habitats should always be a priority conservation area and NDDB areas should almost always be priority conservation areas.

LNA Percent Data Sets Core Forest and Hydrology Added Together with Equal Weight



Model 3 – LNA Classification

I have chosen a tiered 3 number classification system of the LNA based on their size, percent of core forest, and percent of hydrology to graphically represent these qualities across the landscape.

The first number in the classification system represents the LNA corresponding tier and amount of acreage:

- Tier 1. 1 is = or > then 1000 acres, **represented by the color green**
- Tier 2. 2 is = or > 500 and < 1000 acres, **represented by the color brown**
- Tier 3. 3 is = or > 100 and < 500 acres, **represented by the color purple**
- Tier 4. 4 is < 100 acres, **represented by the color yellow**.

The second number represents the LNA percentage of core forest:

- 1 = 75% - 100%
- 2 = 50% - 75%
- 3 = 25% - 49%
- 4 = 0 – 24%.

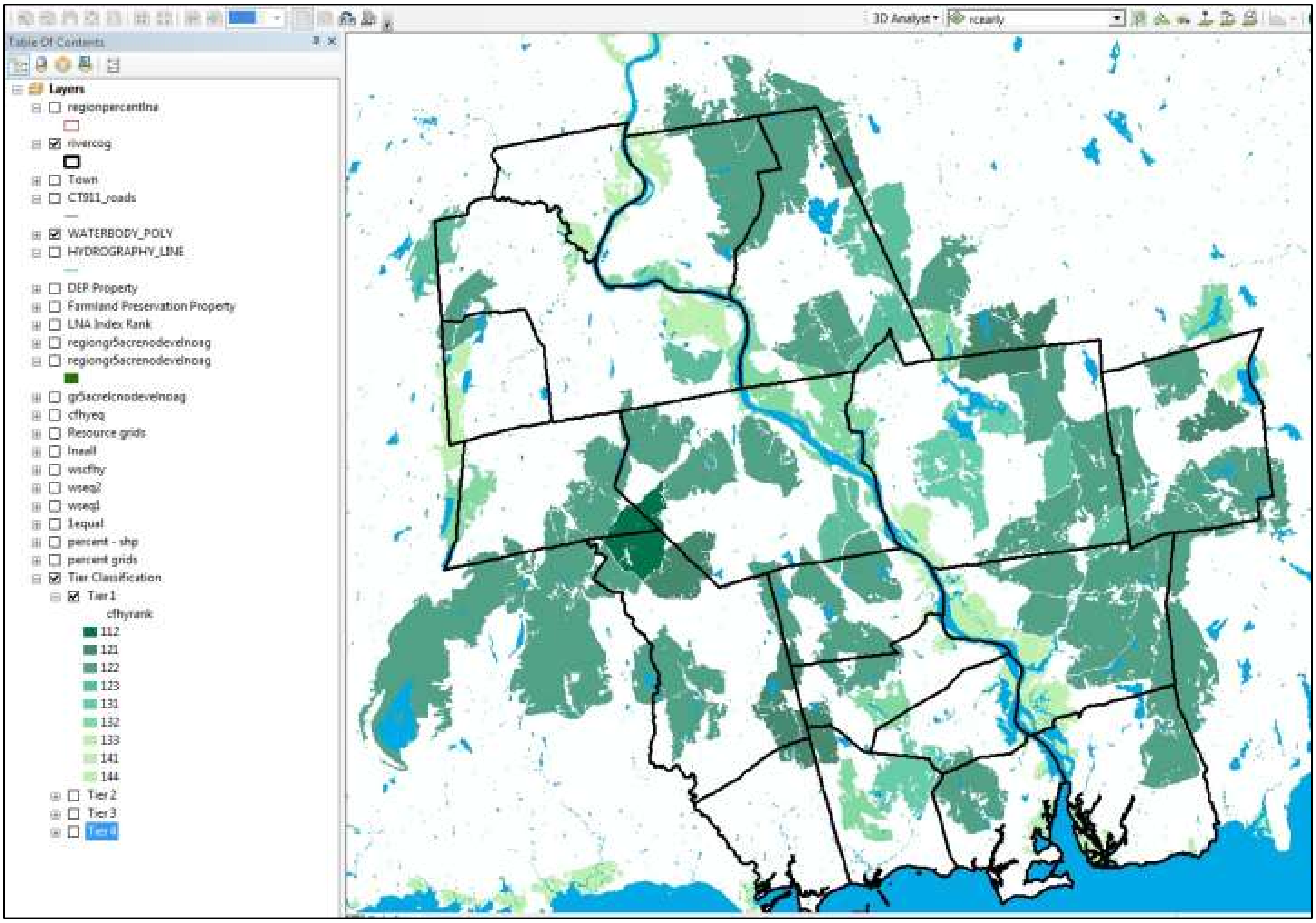
The Third number represents the LNA percentage of hydrology:

- 1 = 75% - 100%
- 2 = 50% - 75%
- 3 = 25% - 49%
- 4 = 0 – 24%.

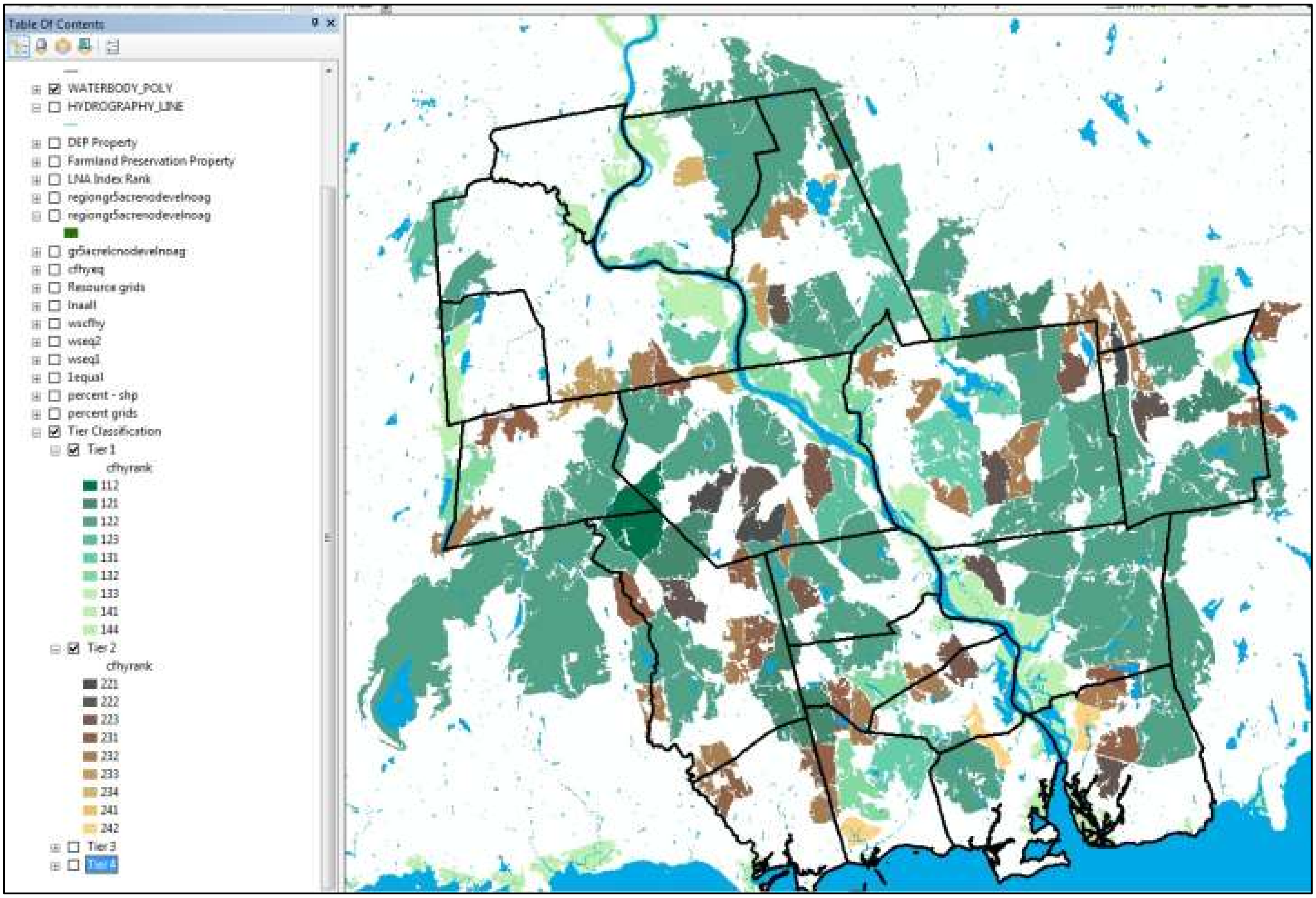
The lighter the color the smaller the percentage of core forest and to some extent the smaller the amount of hydrology although this aspect starts to break down within this symbology once you reach the third number of the classification system.

Classification of LNA

Tier 1



Tier 1 and 2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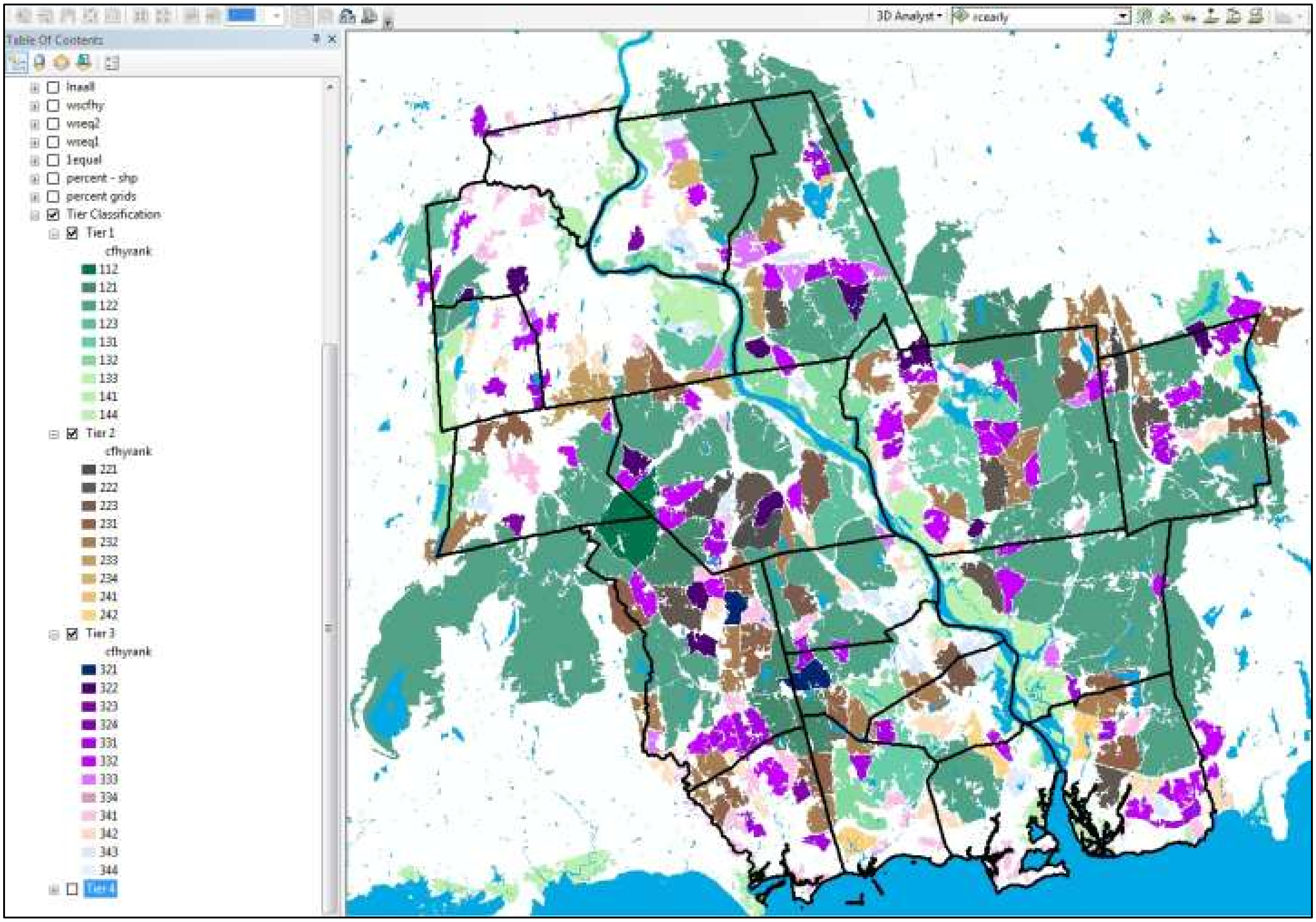
241
242
Tier 3
Tier 4

Tier 1, 2, and 3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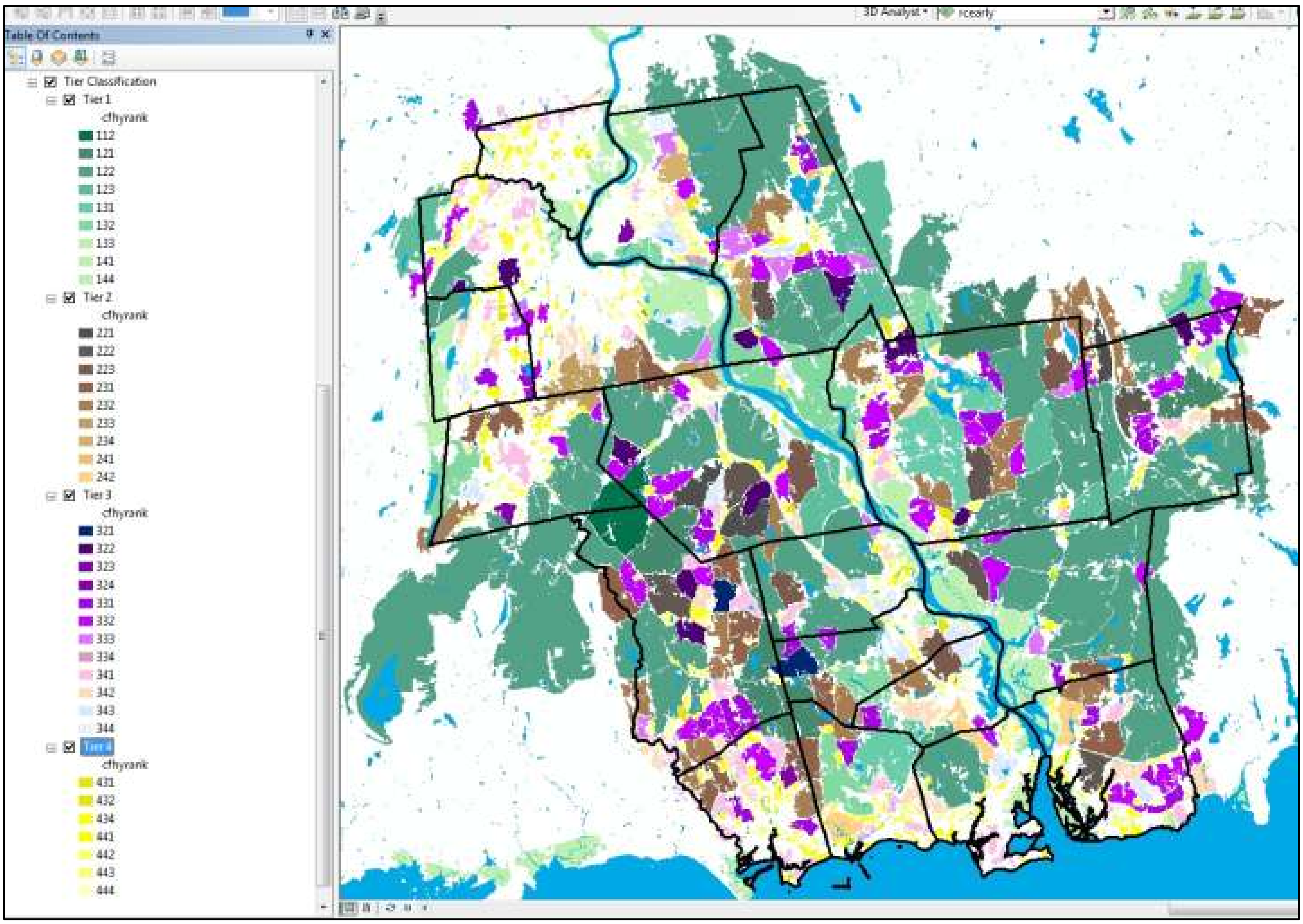
Tier 4

Tier 1, 2, 3, and 4

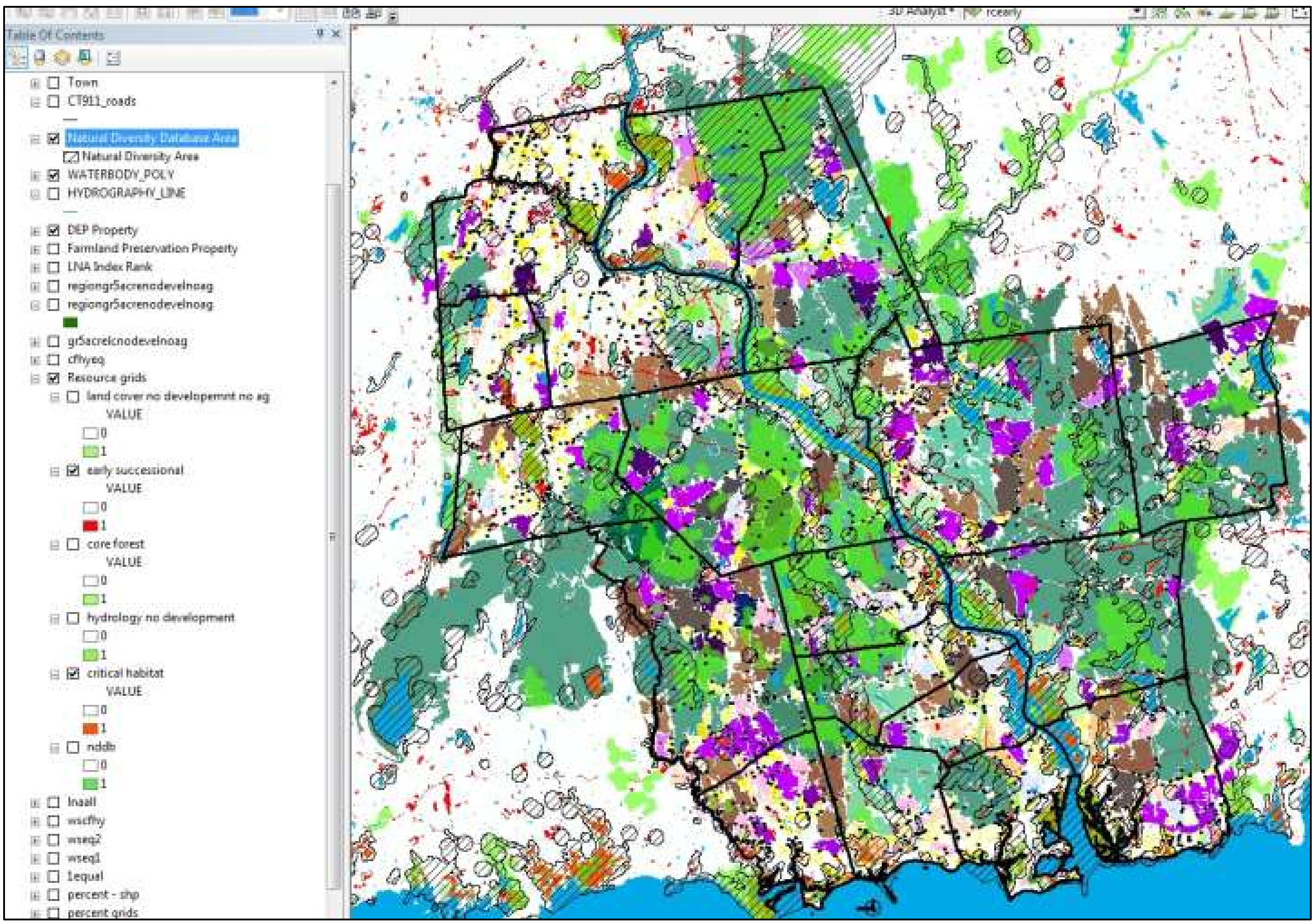


Improving Connectivity

Although we are focused on where natural resources are an example of a map that begins to look at how connected our LNA are (includes where critical habitats, nddb areas, and early successional areas are including the electrical utility corridors which are thought by some to be wildlife corridors) includes DEEP lands (other conserved opens space to be added) and, stream and road intersections (road kill location areas would be another useful data set).

https://www.fhwa.dot.gov/environment/critter_crossings/overview.cfm

http://www.cflhd.gov/programs/techDevelopment/wildlife/documents/01_Wildlife_Crossing_Structures_Handbook.pdf



http://www.peopleswaywildlifecrossings.org/images/crossingstructures/documents/Habitat-corridors-and-landscape-connectivity.pdf

http://www.peopleswaywildlifecrossings.org/howdoroadsimpactwildlife.html

Conservation Index/Ranking Schema

As I know you know, there are many things to consider beyond resource richness when an area is looked at for its conservation potential, and conservation efforts in the Region run the gamut from landowner and community outreach and education to the purchase of conservation easements and in fee open space purchases. I have started work on a conservation index/ranking schema for our resource rich areas that will try and look at the very big picture as we begin work on our Regional Plan of Conservation and Development. I am hoping that we are able to keep a dialogue going concerning its development even after we are finished with this portion of the project. For now it reflects what I have been working on for workshop 3 and large natural areas.

	Acerage Large Natural Area	% Core Forest	% Hydrography	NDDB yes or no	% Acres Early Successional	Critical Habitats	% Protected	% Vacant in Natural State	Average Vacant Parcel Size	# Non - Conservation Owners	Proximity to other LNA's	Connectedness of LNA's?	Within a Regional Greenway	% Class I & II water Co. lands	Bridges & Culverts	Municipal POCD Open Space Areas	Zoning
Tier 1 - > 1000 Acres				all most always a priority		all + buffer always a priority											
Tier 1		75 -100	75 - 100														
Tier 2		50 - 74	50 - 74														
Tier 3		25 - 49	25 - 49														
Tier 4		0 - 24	0 - 24														
Tier 2 - > 500 < 1000																	
Tier 1		75 - 100	75 - 100														
Tier 2		50 - 74	50 - 74														
Tier 3		25 - 49	25 - 49														
Tier 4		0 - 24	0 - 24														
Tier 3 - > 100 Acres < 500																	
Tier 1		75 - 100	75 - 100														
Tier 2		50 - 74	50 - 74														
Tier 3		25 - 49	25 - 49														
Tier 4		0 - 24	0 - 24														
Tier 4 - < 100																	
Tier 1		75 - 100	75 - 100														
Tier 2		50 - 74	50 - 74														
Tier 3		25 - 49	25 - 49														
Tier 4		0 - 24	0 - 24														

References

Connecticut Department of Energy and Environmental Protection Bureau of Natural Resources. 2005. *Connecticut's Comprehensive Wildlife Conservation Strategy*. Pgs. 2-18, 3-2, 4-14, 4-19, 4-21.

Hochholzer, Helene. 2010. *Connecticut's Forest Resource Assessment and Strategy 2010*. CT DEEP. Pgs. 18, 22, 94, 107, 114, 134, 135, 150, 152, 154, 164.

Wenger, Seth. 1999. *A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*. Office of Public Service and Outreach, University of Georgia. Revised March 5, 1999. Pgs. 4, 40, 47.


Little Bluet – Ellen Pehek, NY Natural Heritage Program


Eastern Wild Turkey - NWTF

Lower Connecticut River Valley
Council of Governments